MICHIGAN HAZARD ALERT

MICHIGAN STATE UNIVERSITY: Prevention of work-related deaths through research & investigation

WORKERS FATALLY STRUCK BY VICTAULIC END CAPS DURING PRESSURE TESTING

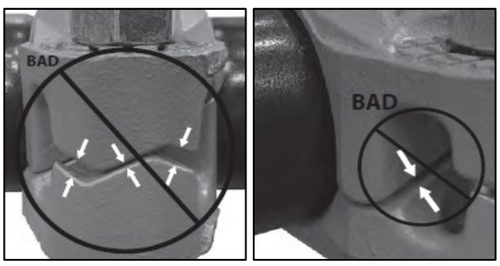
Collar Style Coupling. Arrows show mating surfaces with no gaps. Source: Victaulic

Victaulic manufactures piping systems for multiple commercial and industrial applications. One system of assembly* relies on a properly tightened collar style coupling (see photo at left) to secure pipe sections and end caps in place. Victaulic product guidance clearly indicates it is critical that the two coupling collar bolts be tightened to a specified torque setting, and most importantly that the mating surfaces (pads) be visually inspected and confirmed to be completely together with no gap (see arrows at left). Victaulic provides photo guidance to show correctly and incorrectly tightened couplings (see photos at right with white arrows).

Properly assembled coupling with no gaps. Source: Victaulic

The end of each pipe run is fitted with an end cap the same color as the coupling. The end cap is secured to the pipe using the same type coupling. **Victaulic warns that gapped pads or loosening of the coupling bolts under pressure may result in fatal injury.**

T-60 Testing End Cap. Source: Victaulic



Improper (gapped) coupling assemblies. Source: Victaulic.

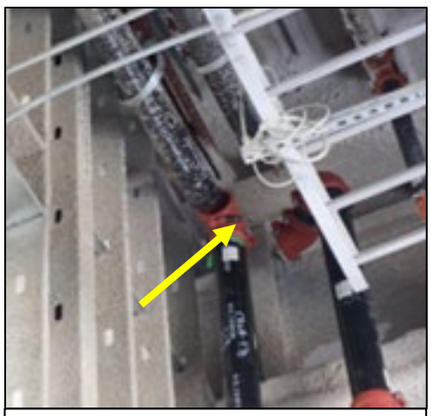
During installation, system testing is normally done using liquid (hydrostatic) or air (pneumatic) pressure. Recently, two Michigan workers died within a 7-month period when the end caps in the Victaulic piping systems dislodged explosively during pressure testing, striking the workers in the head. An additional two fatalities occurred in Michigan prior to 2023. In all cases, air testing was used, and loosening of the coupling under pressure resulted in fatal injury. Victaulic prescribes using a high visibility yellow T-60 end cap pressure testing kit (shown at left) with built in depressurization valve and a warning tag. **In both recent fatalities, a red end cap intended for final installation was used instead, giving no visible indication that the system was pressurized and under test conditions.**

CASE NARRATIVES

Case 23MI139: On September 15, 2023, a 41-year-old pipefitter working from a scissor lift was fatally struck in the head by a Victaulic end cap from a 150-psi (air) pressurized pipe. The pipefitter was attempting to depressurize a line after completing air testing by loosening the coupling bolts holding the 6-inch metal end cap in place. The end cap exploded from the coupling after loosening it, striking the pipefitter in the hard hat. The end cap penetrated the hard hat and continued for approximately 110 feet from point of impact. The socket being used with a socket wrench was still attached to the coupling bolt. This method of loosening the coupling bolts to depressurize was used throughout the week leading up to the incident. The pressure test procedures and training were generic and did not include the specific Victaulic warnings to never loosen the coupling under pressure. The cause of death was listed as craniocerebral trauma.

View of collar style coupler and end cap at site taken by MIOSHA. Yellow arrow indicates warning not to remove the cap under pressure. Case 23MI139.

*Similar systems are produced by other companies – always follow the manufacturer's instructions. See resource section.



View of elbow (red) where end cap dislodged under pressure.
Case 23MI139.

Case 24MI035: On March 27, 2024, a 21-year-old apprentice pipefitter working on a ladder was struck in the face and hard hat by a Victaulic end cap from a 100-psi (air) pressurized pipe. The pipe had been pressurized for testing two days earlier, awaiting availability of an inspector. One Victaulic coupler nut was found partially loosened, with a visible gap between the upper and lower couplings on one side. A cordless driver with socket size matching the bolt was found on the floor beneath the coupling. The end cap penetrated the cranium and was found on the ground near the pipefitter. The substantial explosive projectile force displaced the permanently deformed hardhat and caused severe cranial damage resulting in 50% loss of brain matter into the work area. Cause of death was listed as multiple injuries.

View of grooved pipe end separated to insert end cap into elbow to isolate for pressure testing. The socket remained on the coupling bolt being loosened (yellow arrow). The end cap ejected under 150 psi compressed air pressure.
Case 23MI139

Additionally, a search of historical FACE cases revealed two prior fatal injuries from end caps under pressure, both in Michigan. In Hazard Alert 02MI090, a 49 year old journeyman pipefitter was struck in the head by a 6 inch end cap under 100 psi air pressure. In MIFACE investigation 06MI201, a 41 year old plumber/pipefitter was struck in the upper chest and neck by a 25 pound, 8 inch Victaulic end cap under 80 psi air pressure. Links are provided in the Resources section at the end of this report.

MANUFACTURER'S WRITTEN WARNINGS AND TESTING GUIDANCE

Victaulic® No. T-60 Test Cap Kit Information Sheet: Victaulic states that end caps installed for system pressure testing shall be equipped with a ball valve that can be opened to verify depressurization. It recommends the Victaulic No. T-60 Test Cap be used whenever possible for purposes of system pressure testing. In the event a Victaulic No. T-60 Test Cap is not available in the applicable size, contact Victaulic so a tapped end cap can be provided to fit with an appropriately rated ball valve for the system conditions. Victaulic warns "**Under no circumstances should coupling hardware or any other system component be loosened to check if the system is pressurized or to depressurize the system.**"

View of the T-60 test end cap tag warning pictogram.

End Cap Safety Information Sheet: Victaulic emphasizes to:

- Always re-inspect joints before and after the field test to identify points of improper installation.
- Look for gaps at the bolt pads and/or keys that ride up on the shoulders. If any of these conditions exist, depressurize the system, and replace any questionable joints.

System Walk Down: Victaulilc stresses that every joint on the collar style couplet must be inspected and any improper assembly corrected before the system is placed in service or tested.

RECOMMENDATIONS FOR PRESSURE TESTING INJURY PREVENTION

To help prevent similar occurrences, MIFACE recommends employers should:

- Always read and follow all the manufacturer's instructions for installation or testing including couplings, end caps, and proper torquing of bolts. See the links provided in the resource section below.
- Implement an accident prevention program to identify, eliminate or safeguard employees from site hazards, and instruct employees on procedures required. (See MIOSHA regulations in Resources section.)
- **Under no circumstances should coupling hardware or any other system component be loosened to check if the system is pressurized or to depressurize the system.**
- Use hydrostatic (water) testing instead of pneumatic (air) testing whenever possible.
- With Victaulic systems, use the highly visible Victaulic Yellow No. T-60 Testing End Cap with warning tag, tapped with a properly sized ball valve or contact Victaulic if a custom size is needed.
- Follow the testing procedures recommended by technical experts, such as those found in the "Guide to Pressure Testing Safety" published by the Mechanical Contractors Association of America, Inc. (MCAA) and

by the ANSI/ASSP standard A10.35-2020, Safety Requirements for Pressure Testing Steel and Copper Piping Systems. See the resources section below for links to these standards.

- Identify and isolate any equipment to be pressurized in the workplace including branch lines and sections of pipe isolated by valves or closures. Keep workers out of the pressure testing area. Prevent any work on pressurized components.
- Shield workers in areas that can't be adequately isolated from any projectiles from a failed test. **American National Standards Institute & American Society of Safety Professionals (ANSI/ASSP) A10.35.2020 Appendix G provides guidance for calculating safe distances from pressurized components.**
- Develop a pre-test safety plan including a job hazard analysis to identify and document the potential hazards and required measures to be used to protect workers. The MCAA guide provides an example in Appendix A. Include all affected workers and companies in the process.
- Use a checklist to document steps for pressurizing and depressurizing. The MCAA guide provides an example checklist for pneumatic testing in Appendix C. Sample checklists are also provided in Appendix E and F of ANSI/ASSP standard A10.35.
- Use the hazard analysis and checklist to train all supervisors and employees involved.
- Conduct a pre-test walk down. Use the checklist and ensure system components and test end points are correctly identified and installed. Verify system components being pressurized are visibly identified and the area barricaded as needed to prevent accidental exposure to or work on components under pressure.
- Use a permit that requires a supervisor to sign and approve the start and completion of the pressure test.
- Hold a pre-test safety briefing. Review the plan, protective measures and ensure all equipment needed is available. Ensure all those involved understand the pressurization and depressurization steps and hazards. Review the two-way communication system to be used, emergency procedures and provide contact information for emergency notification.
- Conduct the test applying gradual increases in pressure in accordance with Victaulic recommendations, the American Standard for Mechanical Engineering (ASME) piping standard, and the local site and code requirements. Document pressurization steps in the test checklist.
- Develop and use post test procedures for depressurization following Victaulic, MCAA, and ANSI/ASSP guidelines.
- Always properly depressurize the system immediately after completing a test.
- Use the above process for each test individually.

RESOURCES

Always follow the manufacturer's instructions for the system being used

1. "Guide to Pressure Testing Safety" published by the Mechanical Contractors Association of America, Inc. (MCAA), 2013, free download at MCAA Guide to Pressure Testing Safety (https://www.mcaa.org/pca/wp-content/uploads/sites/3/2016/03/SE86PDF.pdf).
2. Victaulic Field Installation Handbook, I-100, Revision H 03/2023 (https://assets.victaulic.com/assets/uploads/literature/I-100.pdf).
3. Victaulic End Caps Installation Safety Instructions Sheet, I-Endcap 11978 Rev A 07/2018 (https://assets.victaulic.com/assets/uploads/literature/I-ENDCAP.pdf).
4. American Society of Mechanical Engineers (ASME) B31.1 Power Piping, B31.3 Process Piping, B31.5 Refrigeration Piping and Heat Transfer Components, and B31.9 Building Services Piping, available for a cost at List of all Codes and Standards - ASME or ASME B31.9-2020 - Building Services Piping.
5. Safety Requirements for Pressure Testing Steel and Copper Piping Systems, ANSI/ASSP A10.35-2020, American National Standards Institute and American Association of Safety Professionals, October 2020, available at a cost via https://webstore.ansi.org/preview-pages/ASSE/preview_ANSI+ASSP+A10.35-2020.pdf.
6. MIOSHA Construction Part 1 General Rules, R 408.40114 Employer responsibilities; accident prevention program, CS 1.
7. MIFACE Investigation #06MI201, Journeyman Pipefitter Dies When Struck in Chest While Removing Vic Fitting End Cap from a Pressurized Pipe (https://oem.msu.edu/images/MiFACE/06MI201.pdf).
8. MIFACE Hazard Alert #02MI090 Journeyman Pipefitter Killed When Struck in Head by Grooved End Cap under Pressure, October 2002 (https://www.cdc.gov/niosh/face/stateface/mi/02mi090.html).