

12-E Repair of Plastic and Steel Pipelines

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[1.0 SCOPE](#)

[2.0 REGULATORY REFERENCES](#)

[3.0 PROCEDURE](#)

[4.0 TRAINING/QUALIFICATIONS](#)

[5.0 DOCUMENTATION/FORMS](#)

[6.0 RELATED DOCUMENTS](#)

[7.0 APPENDICES](#)

1.0 SCOPE

This chapter describes the procedures for repair of plastic and steel pipelines.

2.0 REGULATORY REFERENCES

49 CFR Part 192 §§ [192.53](#), [192.55](#), [192.67](#), [192.103](#), [192.105](#), [192.127](#), [192.150](#), [192.205](#), [192.311](#), [192.517](#), [192.607](#), [192.619](#), [192.624](#), [192.709](#), [192.711](#), [192.713](#), [192.715](#), [192.717](#), [192.719](#)

29 CFR 1926.650 – 652 (OSHA)

3.0 PROCEDURE

[3.1 General](#)

[3.2 Squeezing Off Pipelines](#)

[3.3 Repairs to Plastic Pipe \[192.311\]](#)

[3.4 Repair of Steel Pipelines](#)

[3.5 Fittings and Other Materials Used to Make Repairs](#)

3.1 General

[3.1.1 Tested Pipe Used for Repairs \[192.719\]](#)

[3.1.2 Inspection and Testing \[192.719\]](#)

3.1.1 Tested Pipe Used for Repairs [192.719]

- (a) *Pipe* and fabricated components made with pipe that are used to repair an operating pipeline system *shall* be tested and maintained in accordance with section (b) of this procedure. Generally, such pipe will be maintained for use in an unplanned repair situation but *may* be used in any application. For each size of pipeline in a system, at least 20 feet of pre-tested pipe *should* be maintained for repair and readily available.
- (b) Procedure
 - (1) Repair pipe shall be tested in accordance with [Chapter 9 - Pressure Test Requirements](#) and maintained as necessary in accordance with this procedure.
 - (2) Storage and Marking
 - (i) Tested pipe in storage should be segregated from untested pipe. Pipe that has been in storage for an extended period of time should be periodically inspected, not to exceed annually, to ensure compliance with the marking requirements as listed below.
 - (ii) Each section of pre-tested pipe shall be marked / labeled as appropriate to verify test record. As portions of pipe are used, the marking shall be visible or moved for the remaining sections of pipe.

3.1.2 Inspection and Testing [192.719]

All repairs should be visually inspected and *leak* tested at pipeline operating pressure. Leak testing may be conducted with a non-corrosive soap or a *gas* detector.

3.2 Squeezing Off Pipelines

All squeeze tools shall be in proper operating condition and operated in accordance with the manufacturer's operating procedures. Defective or worn tools *shall* be discarded or removed from service until returned to proper operating condition.

3.2.1 Squeezing Plastic Pipe

- (a) Employees performing the squeeze and those in the immediate vicinity *must* don the appropriate PPE.
- (b) Verify that the squeeze-off tool is sized appropriately for the diameter and DR of pipe to be squeezed off.
 - (1) Ensure the tool meets the requirements of *ASTM* F1563.
 - (2) The squeeze-off tool shall contain stops that limit the squeeze as to not over stress the pipe. Make sure the correct stops are installed in the tool before starting.
- (c) Wet plastic pipeline with a soapy-water solution.
 - (1) Place non synthetic soapy rags on both sides of the plastic pipe squeeze point.
 - (2) The squeeze tool must be grounded before being placed on a steel or plastic pipeline.

- [Performance Pipe Technical Note PP 801-TN](#) (PDF file)
- [Info Brief #8, Duraline, Proper Squeeze-Off Procedure](#) (PDF file)

1. A thorough inspection of the pipe for cuts, scrapes, gouges or anomalies should be made before placing of the squeeze off tool. Do not squeeze on pipe sections containing deep scratches (>10% of pipe wall thickness).
 2. Ensure the squeeze tool is square to the pipe with the squeeze plates parallel to each other. This will allow the pipe to flatten freely without coming in contact with the tool frame or abutments.
 3. Locate the squeeze-off tool a minimum of 3x the pipe diameter, or 12 inches, whichever is greater, from any fusion *joint*, mechanical connection, prior squeeze-off point, or second squeeze-off tool.
 4. Compress the pipe at a slow rate to allow stress relaxation in the pipe. ASTM F1041 recommends a maximum compression rate of 2 inches per minute. For example, it should take no less than 2.25 minutes to fully compress 4" *IPS* pipe (4.5inch/2ipm).
 5. Squeeze the pipe until the flow of gas ceases or the mechanical stops built into the machine are contacted, whichever comes first.
 6. Do not over-squeeze the pipe. The squeeze-off tool should contain stops that limit the squeeze to 70% of twice the maximum wall thickness as described in ASTM F1563.
- (e) When removing the squeeze-off tool it is critical to release the squeeze very slowly and in a controlled manner. ASTM F1041 recommends that the release rate not exceed 0.5 inches per minute. For example, it should take no less than 9 minutes to fully release 4" IPS pipe (4.5inch/0.5ipm).
- (1) Cold weather increases the pipe's susceptibility to damage. Compression and release times should increase in cold weather. Cold weather increases the pipe's susceptibility to damage. Compression and release times should increase by double in cold weather (32°F and below).
 - (2) Before and after the squeeze-off tool has been removed, the pipe should be closely inspected for any signs of damage. Any pipe suspected of damage during a squeeze-off should be replaced or removed from service. Whitening of the pipe, and cracking of the pipe surface is evidence of pipe damage.
- (f) Plastic pipe should be re-rounded after squeeze-off whenever practical. This means that re-rounding of pipe should be performed if minimal excavation is needed to accommodate 90 degree squeeze tool rotation and it is safe to enter the excavation to operate the tool in the horizontal position.
- (g) Pipe should be allowed to return to shape from the restored internal gas pressure for as long as practical (but at least 15 minutes) prior to backfill of the excavation. This is particularly important if re-rounding with the tool is not practical.
- (h) Do not squeeze in the same place more than once (even if only partially releasing tool).
- (i) Mark the squeeze point with several wraps of black electrical tape immediately after the squeeze tool has been removed.
- (j) If the installer or operator does not follow the approved procedure during a squeeze-off, such as what might occur in an *emergency*, presume the pipe damaged and replace or remove from service. Secondary squeeze point should be in place before removing the original squeeze tool.

State Specific: South Carolina

Any squeeze points on 4" and larger plastic pipe should have an Electrofusion Clamp installed to reinforce the pipe at the squeeze points. If an Electrofusion Clamp cannot be used, squeeze points on plastic pipe larger than 4" should be planned for removal.

See [Training Document for installing Electrofusion Clamp](#) (PDF file).

Alternatives to Squeezing Plastic Pipe – An electrofusion SHORTSTOPP PE Bottom Branch *Outlet* fitting from TD Williamson is one of the preferred methods for branch connections. The SHORTSTOPP PE Bottom Branch Outlet fitting may also be used to stop off plastic pipe in lieu of squeezing by tapping only the top of the fitting and pipe. The SHORTSTOPPE PE Bottom Outlet fitting (with only the top tapped out for use as a line stopper) is a method for extending plastic mains 4" and larger.

3.3 Repairs to Plastic Pipe [[192.311](#)]

(a) Damage Requiring Repair

Any permanent deformation or damage that could impair the integrity of the plastic pipe must be permanently repaired or removed including but not limited to the following:

- (1) Scratches and gouges deeper than 10% of the wall thickness.
- (2) Wrinkle bends.
- (3) Stretched pipe caused by excessive tensile forces.
- (4) Over squeezed, rapidly squeezed or rapidly released "squeezed-off" segments of plastic pipe.

(b) Approved Repair Methods

(1) The following methods of joining plastic pipe may be used when making repairs:

- (i) Butt
- (ii) Electro-fusion
- (iii) Mechanical Fittings

(2) Only materials approved by DENC and DESC shall be used to repair the pipeline.

(3) The primary method of repair shall be to cut out the damaged portion of plastic pipe and replace with new plastic pipe. Scratches or gouges may not be in the joint area. Replacement pipe shall be pre-tested in accordance with [Chapter 9 - Pressure Test Requirements](#).

(4) Gouges or cuts that are not leaking may be repaired using an electrofusion repair saddle. The saddle must cover the damaged area and must be installed in accordance with manufacturers' procedures and the guidelines.

(5) Approved mechanical couplings up to 4" in size may be used for permanent repairs. A rigid internal stiffener must be used with any compression type mechanical fitting.

(6) Mechanical leak repair clamps shall not be used as a permanent repair.

(c) Measures to eliminate or prevent static electricity must be followed. This includes placing wet soapy rags over the pipe and in contact with the ground,

3.4 Repair of Steel Pipelines

[3.4.1 General \[192.711\]](#)

[3.4.2 Transmission Pipelines \[192.150\]](#)

[3.4.3 Reduction of Pressure](#)

[3.4.4 Permanent Repair of Damages Resulting in the Loss of Wall Thickness \[192.717\]](#)

[3.4.5 Permanent Repair of Dents \[192.713\]](#)

[3.4.6 Permanent Repair of Leaks \[192.717\]](#)

[3.4.7 Permanent Repair of Imperfections and Damages](#)

[3.4.8 Permanent Repair of Welds \[192.715\]](#)

[3.4.9 Unacceptable Repairs](#)

[3.4.10 Temporary Repairs](#)

[3.4.11 Squeezing Steel Pipelines](#)

3.4.1 General [192.711]

All damages or defects that effectively reduce the maximum allowable operating pressure (*MAOP*) of the pipeline shall be replaced or repaired. Pipelines must be repaired in accordance with these minimum guidelines but may be repaired at any time as long as the repair methods meet the criteria set forth in this procedure.

3.4.2 Transmission Pipelines [192.150]

- (a) The approval of any work performed on transmission shall be coordinated with and be approved by the Director or their designees. Strength calculations to determine if the *MOP* must be reduced in response to a loss of pipe wall due to damage or corrosion shall be performed. Pipeline Integrity shall also receive notification of any damage or potential damage to these pipelines.
- (b) Any new attachments to a transmission pipeline or abandonments of existing facilities (including pipe sections, farm taps, M&R stations, high pressure services or any other attachment to these pipelines) shall be designed by *engineering* and approved by the Director.
- (c) All replacements of transmission pipe, valves, fittings, or other components shall be designed and constructed to accommodate ILI devices in accordance with NACE SP0102, section 7. (Exceptions apply in accordance with [192.150\(b\)](#), (c))

3.4.3 Reduction of Pressure

If a segment of pipe to be repaired is not taken out of service, the operating pressure shall be regulated to a safe level. When repairing a weld on a pipeline in service, the operating pressure of the pipe shall not produce a hoop stress of more than 20% *SMYS*.

3.4.4 Permanent Repair of Damages Resulting in the Loss of Wall Thickness [192.717]

The MAOP of a pipeline may need to be adjusted if damage resulting in the reduction of wall thickness is not repaired. Loss in pipe wall thickness should be determined through the use of a depth gauge or other suitable measurement device.

- (a) If it is feasible to take the segment (cylinder) out of service, repair the damaged section by replacing the damaged section with new pipe. The new pipe shall have a design pressure equal to or greater than the MAOP. All pipelines shall be installed in accordance with the applicable sections of DENC and DESC's Construction Standards.
- (b) If taking the segment (cylinder) of damaged pipe out of service is not feasible, repair the damaged section by installing a full encirclement repair clamp rated at least to the MAOP of the line. If the pipeline being repaired operates at or more than 20% SMYS, the full encirclement clamp shall also be welded unless approved by Engineering. When installing repair clamp, manufacturer's instructions shall be followed.
- (c) A pipeline may be repaired by a method that reliable engineering tests and analysis show can permanently restore the serviceability of the pipe.
- (d) A composite repair system designed and approved by Engineering (such as Syntho Glass, etc.) may be used for non-leaking repairs with no more than 80% wall loss; or other methods as approved by the Director or his designee.
- (e) The MAOP of the pipeline may be reduced to the pressure commensurate with the pipe wall thickness. The Director of Engineering and Construction shall approve MAOP reduction and ensure that pipeline MAOP records are revised with the new MAOP.

3.4.5 Permanent Repair of Dents [192.713]

- (a) Each of the following dents must be removed from steel pipe to be operated at a pressure that produces a hoop stress of 20% or more, of SMYS unless the dent is repaired by a method that reliable engineering tests and analyses show can permanently restore the serviceability of the pipe:
 - (1) Dent containing a stress concentrator such as a scratch, gouge, groove, or arc burn.
 - (2) A dent that affects the longitudinal weld (pipe seam) or a circumferential (butt) weld.
 - (3) In pipe to be operated at a pressure that produces a hoop stress of 40% or more of SMYS, a dent that has a depth of:
 - (i) More than one-quarter inch in pipe 12-3/4 inches or less in outer diameter; or
 - (ii) More than 2% of the nominal pipe diameter in pipe over 12-3/4 inches in outer diameter.
- (b) For the purpose of this section a "dent" is a depression that produces a gross disturbance in the curvature of the pipe wall without reducing the pipe-wall thickness. The depth of a dent is measured as the gap between the lowest point of the dent and a prolongation of the original contour of the pipe.

3.4.6 Permanent Repair of Leaks [192.717]

- (a) For repair of leaks, an action listed in [3.4.4\(a\)](#) or [3.4.4\(b\)](#) shall be taken. If feasible, corrosion scale should be removed from the pipe and the surface cleaned to a smooth finish before installing full encirclement clamps.
- (b) Stainless steel band clamps or compression couplings are typically temporary repairs but may be used as a permanent repair on horizontal piping below ground with approval from Director. In no case shall these clamps be installed as a permanent repair on mains with an MAOP greater than 60 psig. If used as a permanent repair, the clamp must be bonded to the cathodically protected *main*.

- (c) If the corrosion or damage to a riser is severe and affects the structural integrity, the riser shall be replaced at the time of *discovery*.

3.4.7 Permanent Repair of Imperfections and Damages

Each imperfection or damage that impairs the serviceability of pipe in a steel *transmission line* operating at or above 40 percent of SMYS must be removed by cutting out and replacing a cylindrical piece of pipe repaired by a method that can permanently restore the serviceability of the pipe.

3.4.8 Permanent Repair of Welds [192.715]

- (a) Each arc burn on steel pipe to be operated at a pressure that produces a hoop stress of 40% or more, of SMYS must be repaired or removed. If it is feasible to take the segment out of service, damaged or defective welds shall be replaced or repaired.
- (b) If it is not feasible to take the segment out of service, the weld may be repaired in accordance with applicable section of the DENC and DESC Welding Manual (see [Chapter 4 - Welding of Steel in Pipelines](#)), while the pipe is in service if:
- (1) The weld is not leaking.
 - (2) The operating pressure does not exceed 20 % SMYS.
 - (3) Grinding of the defective area can be limited so that at least 1/8 inch wall thickness in the pipe remains.
- (c) Weld repairs shall be tested in accordance with the applicable sections of the DENC and DESC Welding Manual (see [Chapter 4 - Welding of Steel in Pipelines](#)).

3.4.9 Unacceptable Repairs

Damage or a defect may not be repaired by pounding out.

3.4.10 Temporary Repairs

If it is not feasible to make a permanent repair at the time of discovery or if a leak, imperfection, or damage that impairs its serviceability is found in a segment of steel *transmission line* operating at or above 40 percent of the *SMYS*, one shall take immediate measures to protect the public. These measures may include restricting access, erecting barricades and/or installation of a temporary repair fitting. Stainless steel band clamps or compression couplings on vertical piping above or below ground including risers are temporary repairs and shall be replaced within 10 working days unless approved by Engineering.

3.4.11 Squeezing Steel Pipelines

Steel pipelines may be squeezed off using approved hydraulic steel squeeze tools in accordance with manufacturer's operating procedures. Steel squeeze locations should not be within 12" of a fitting or welded joint on the pipeline. To mitigate the possibility of the squeeze point failing (cracking), steel squeeze points shall be removed from the pipeline system within 6 months of the squeeze off.

3.5 Fittings and Other Materials Used to Make Repairs

- (a) Pipe and fittings used in the repair of pipeline damage shall be obtained through DENC and DESC's Purchasing Department or as approved by

- (b) See the [Repair Clamp List](#) (Excel file) for approved repair clamps and fittings and rated pressures. This list is not intended to be all-inclusive however; any deviation from the list below requires Engineering approval. All repair clamps and fittings shall be installed in accordance with manufacturer's instructions. See [Chapter 2 – Materials](#) for further information on approved materials.

State Specific: South Carolina

The Mueller Tapered Screw Plug is a repair option that typically involves working in an excavation with escaping gas. It should be considered after a shut-down analysis and various safety aspects have been explored. See [Procedure for the Installation of Mueller Screw Plug under Pressure \(up to 150 psig\)](#) (PDF file).

4.0 TRAINING/QUALIFICATIONS

See the appropriate system Operator Qualification Program.

5.0 DOCUMENTATION / FORMS

System specific forms should be used where applicable.

Test documentation shall be entered into the LDF system.

State Specific: South Carolina

- [Add/Remove Fitting Record for Mains \(DESC\)](#) (PDF file)
- [Add/Modify Pipe Record](#) (PDF file)
- [Transmission System - Add/Modify/Verify Pipe Record](#) (PDF file)
- [Transmission System - Add/Modify/Verify Fitting Record](#) (PDF file)

[5.1 Records Requirements for Steel Pipeline Systems Operating as Transmission \[192.67\] \[192.103\] \[192.105\] \[192.127\] \[192.205\] \[192.607\] \[192.709\]](#)

[5.2 MAOP Reconfirmation \[192.67\] \[192.517\] \[192.619\] \[192.624\]](#)

5.1 Records Requirements for Steel Pipeline Systems Operating as Transmission [192.67] [192.103] [192.105] [192.127] [192.205] [192.607] [192.709]

As long as a line remains in service, the transmission records documenting the date, location, and description of each repair shall be maintained.

For Steel Transmission pipelines, pipe and components installed on or before July 1, 2020, existing documentation and records regarding the following items, must be retained for the life of the pipeline:

- (a) Design Documentation:

If DESC has pipe design and the *determination* of design pressure in accordance with [192.103](#) and [192.105](#), these records must be retained for the life of the pipeline

(b) Pipe documentation:

Tests, inspections, and attributes required by manufacturing specifications applicable at the time the pipe was manufactured or installed including:

- Diameter
- Yield Strength
- Ultimate Tensile Strength
- Wall Thickness
- Seam Type
- Chemical composition (in accordance with §[192.53](#) and §[192.55](#))

(c) Component Documentation:

Manufacturing standard and pressure rating of:

- Valves
- Flanges
- Fittings
- Branch connections
- Extruded outlets
- Anchor forgings
- Other components with strength grades of 42,000 psi (X42) or greater with nominal diameters greater than 2".

5.2 MAOP Reconfirmation [[192.67](#)] [[192.517](#)] [[192.619](#)] [[192.624](#)]

Effective July 1, 2020, for pipelines that do not have *TVC* records for documenting the design of the pipe, MAOP reconfirmation shall be performed in accordance with [192.624](#), per GD-OM-L-060-001, [MAOP Reconfirmation](#).

Other repairs made to parts of the system other than pipe must be retained for a minimum of five (5) years.

These are minimum requirements. Periodically, required, life of pipeline records as listed above or copies of such shall be forwarded to Engineering for permanent filing. Once placed in the permanent file, these records shall be kept for the life of the pipeline. Permanent files may be kept in a variety of media including but not limited to paper, micrographic or electronic. Engineering is responsible for designating records to be placed into the permanent file and maintenance of such. No permanent records may be destroyed or disposed of without prior approval from the Director of Engineering & Construction.

6.0 RELATED DOCUMENTS

- [Performance Pipe Technical Note PP 801-TN](#) (PDF file)
- [Info Brief #8, Duraline, Proper Squeeze-Off Procedure](#) (PDF file)

7.0 APPENDICES

- [Repair Clamp List](#) (Excel file)

State Specific: South Carolina

- [2.05.400 - Pipe Repair Clamp – Cathodic Protection](#) (PDF file)
- [Procedure for the Installation of Mueller Screw Plug under Pressure \(up to 150 psig\)](#) (PDF file)
- [Training Document for installing Electrofusion Clamp](#) (PDF file)

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