

1.0 ACTIVITY DESCRIPTION

- 1.1. This document provides basic guidelines to manage the safety of all personnel and the general public during pressure (e.g., hydrostatic, pneumatic) testing operations.
- 1.2. These guidelines are to assist with the planning and execution of a pressure testing event to manage the risk to life, property and the environment through:
 - Elimination of the risk
 - Changing the workspace to control the risk
 - Developing and following work practices and procedure to manage the risk
 - Employing personal protective equipment (PPE) to protect workers from the risk
- 1.3. All pressure tests must be conducted with due regard for the safety of life and property.
- 1.4. All personnel have, and should use, "Stop Work" authority whenever there is concern for safety during pressure testing operations.
- 1.5. This document is not meant to supersede or replace regulatory requirements, nor is it intended to be all inclusive of the applicable regulatory requirements. It is intended to be supportive and complimentary to such requirements.

2.0 HAZARD ASSESSMENT AND CONTROL

- 2.1. When developing the test procedure, assess all procedure-specific hazards which may harm life, property or the environment and employ the National Institute for Occupational Safety and Health's Hierarchy of Controls to eliminate or manage each hazard, as shown below in Figure 1.

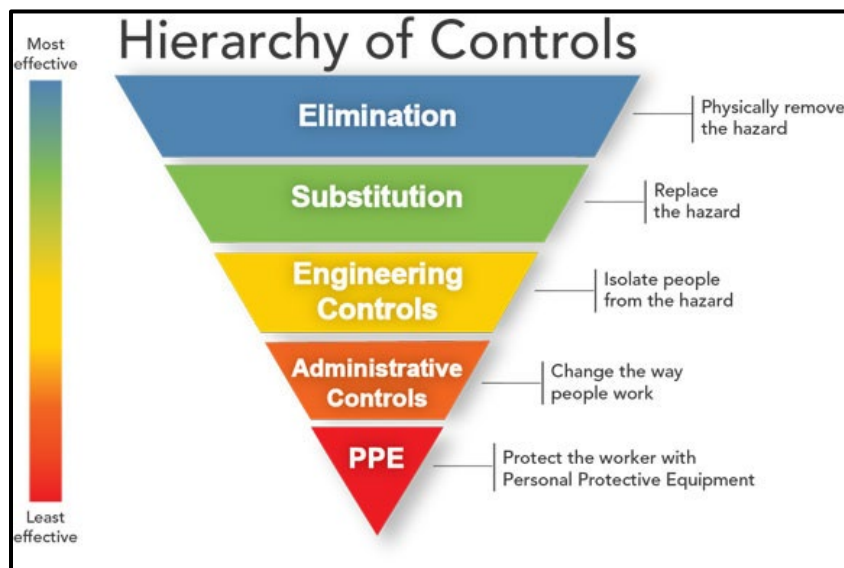


Figure 1: NIOSH's Hierarchy of Controls (from: <https://www.cdc.gov/niosh/topics/hierarchy/>)



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- 2.2. If the detailed test procedures are still being developed, use the assessment to first determine which hazardous elements of the test may be eliminated or substituted.
- 2.3. Once each avoidable hazard is eliminated or substituted, employ engineering controls to neutralize each unavoidable hazard at the source, before the worker may be exposed to it.
- 2.4. Provide written procedures to manage the remaining hazards and be prepared to train all workers associated with pressure testing to be familiar with those procedures.
- 2.5. A detailed pressure testing section should be in the Site-Specific Safety Plan (SSSP) for every project involving any pressure testing. This section should specifically include a detailed piping and equipment layout, dimensions and locations of all pressure testing equipment, valving, instrumentation, anchors, supports, expansion joints, frac tanks, launchers and receivers, supply and discharge lines, and all key components of the temporary piping systems associated with strength test activities. Safety barriers, fences, signage, and safety zones should also be outlined prior to testing.
- 2.6. All hazards and associated control measures should be identified as part of the SSSP. The SSSP should not be generic, but rather very specific for the project site and pipeline segment being tested. The layout and design of temporary systems and controls used for testing should not be strictly left up to construction personnel, but should be reviewed, preferably by an experienced professional engineer, and/or by a safety professional, who are intimately knowledgeable in calculating piping stresses, dynamic forces, and implementing safety measures to keep both, workers and the public safe.
- 2.7. SSSP should be reviewed and evaluated by personnel responsible for safety (Safety Professionals, Superintendents, Supervisors, testing leads, engineers, etc.) and built to specifications by the construction personnel.
- 2.8. A test plan, outlining a step by step sequence of operation, is prepared prior to conducting pressure testing.
- 2.9. A Job Safety Analysis (JSA) will be prepared and on-site safety briefings (tailgates) will be conducted at the beginning of each shift with all affected and involved personnel in pressure test outlining all specific activities to be performed during the shift, associated hazards and hazard control measures. Specific tasks, roles and responsibilities for each involved crew member and leader will be reviewed and understood by all. Three-way communication will be leveraged to ensure understanding by each crew member during the on-site safety briefings.
- 2.10. Review and update hazard assessments when:
 - Each new task is begun.
 - There is a change in how a task is performed.
 - Changes in site or environmental conditions occur.
 - A specific need or concern is identified (i.e., as needed to ensure the safety of personnel or property).
 - Changes in personnel



3.0 ROLES AND RESPONSIBILITIES

3.1. Establish emergency contacts:

- Police Department
- Fire Department
- Nearest Hospital
- Operator Gas Control Center
- Local Jurisdiction Contact

3.2. Establish Test Lead Contacts:

- Incident Commander
- Emergency Spill Responders
- Patrol Lead
- Test Supervisor
- Construction Manager/Supervisor
- Lead Inspector

3.2.1. Test Personnel Contacts:

- Contractor/Construction Foreman
- Pipeline Cleaning Specialist
- Test Contractor
- Surveying Contractor
- Public Outreach/Local Jurisdiction Outreach
- Environmental Inspector
- Water Specialist
- Haz-Mat Subject Matter Expert
- Environmental Field Specialist
- Waste Water Handling Contractor
- Water Filter Coordination
- Pigging and Cleaning Subject Matter Expert
- Clearance Supervisor
- Responsible/Professional Engineer
- Project Manager

3.3. Establish clear roles and responsibilities.

3.4. Health and Safety (HS) Responsibilities

- 3.4.1. A Health and Safety Professional is involved with performing the hazard assessment.
- 3.4.2. Provide technical support for interpretation of pressure testing safety guidelines.
- 3.4.3. Evaluate the effectiveness of the job-specific safety plan (or equivalent).
- 3.4.4. Immediately stop and correct any safety related non-compliant activities.



3.5. Employee Responsibilities

- 3.5.1. Do not enter or otherwise be present at a pressure-testing event unless you are part of the testing team.
- 3.5.2. Personnel performing the test should approach the pressured line only in the performance of their duties. Where possible, personnel should use safety barriers for protection from the pressurized line and position the testing equipment in such a manner to minimize potential hazards.
- 3.5.3. Review safety requirements of the site-specific test plan (see Section 6.1).
- 3.5.4. Do not work over or near where pressure testing is being conducted.
- 3.5.5. Wear the PPE as appropriate for the task being performed. Wear hearing protection (which may include double hearing protection) that is adequate to reduce the noise below 80 decibels.
- 3.5.6. Attend required training before working on the task.
- 3.5.7. Report any non-compliant HS activities to a Supervisor. If you are unsure of the safety at the site, do not enter or otherwise be present at a pressure testing event and report it to the Supervisor.

4.0 GENERAL WORKSITE SAFETY

- 4.1. Incorporate general worksite safety precautions and procedures, as applicable.
- 4.2. The following are examples of general worksite safety precautions and procedures which may be incorporated into the SSSP.
 - Adequate lighting should be available throughout testing operations.
 - Safety equipment and supplies should be readily available and should include, but are not limited to:
 - Emergency spill kit.
 - Fire extinguisher.
 - Ladders.
 - Mobile light plants.
 - Whip checks.
- 4.3. Install mats or utilize secured ladders for access to test header valves. If using mat bridges across the excavation, handrails must be installed if elevated 6' above a lower level.
- 4.4. Provide for and require the installation of devices that mark the limits of the exclusion zone.
- 4.5. Keep unauthorized personnel out of the test area.
- 4.6. Inform all affected site and community personnel of the planned test.
- 4.7. Provide for and require that equipment and materials are arranged to give unobstructed access/egress during testing and in the event of an emergency.



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- 4.8. Establish lines of communication between the Owner/Facility, Contractor, and local authorities.
- 4.9. Provide for and require the use of reliable transportation and communication systems during all aspects of the testing event.

5.0 EXCLUSION ZONE

- 5.1. Precautions should be taken to see that people not directly engaged in the testing operations remain out of the test area during the test period.
- 5.2. Provide for and require that signs, barricades or other protective barriers are placed in a manner and at a distance sufficient to demarcate a safe zone to protect personnel and the public from unanticipated pressure release or equipment failure.
- 5.3. For hydrotesting only, a minimum distance of 50 feet should be maintained between facilities that are being tested and any person, whether it be the public or the personnel conducting the test. The safe distance may be increased, and the temperature probe, manifold and recorders may have to be set back further than 50 feet due to potential projectiles or extreme volume/pressure.
- 5.4. For pneumatic testing, the exclusion zones are significantly larger than for hydrotesting by orders of magnitude. The exclusion zones must be established on a case by case basis by the responsible engineer. Factors such as pipe size, test pressure, total test footage and surrounding structures affect the size of the exclusion zone and must be considered by the engineer to establish the appropriate exclusion zone for each pneumatic test.
- 5.5. In locations where space is limited (urban areas), install K-rail or other appropriate physical barriers (i.e. steel box) around the exposed pipe to protect the public. If K-rail or other appropriate physical barriers are used in lieu of the established safety perimeter, all facilities within line of site must be properly protected. Example 1: The highest point of the test head should not be above the top of the physical barrier. Example 2: The facility being tested is located inside an excavation and is visible to passing pedestrians or vehicle. All facilities within line of site without the established safety perimeter must be protected.
- 5.6. Restrict access to the immediate area involving the pressure test (i.e., test shelter, manifolds, pressure pumps, instruments, etc.) to only those persons actively engaged in the testing operation.
- 5.7. Set up test equipment outside of the safety zone and use caution ribbon to restrict access around the test equipment.
- 5.8. During pressure testing events, distinct warning signs, such as DANGER – HIGH PRESSURE TESTING IN PROGRESS must be posted at the test site and additional locations identified in the job specific safety plan.
- 5.9. When testing in a populated area, an extensive public relations campaign (e.g., warning signs, barricade tape, strobe lights, and/or security guards) may be required to inform and protect the public from hazards associated with testing activities.



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5.10. Notification

- 5.10.1. Residents within close proximity of the facility being tested, and state and local enforcement agencies, if applicable, should be advised by the Owner/Operator of the testing program and kept informed of the progress, as necessary.
- 5.10.2. When testing at or above 100% SMYS, consider clearing the safety zone for the entire length of pipe being tested.

6.0 HYDROTEST REQUIREMENTS

6.1. Safety Planning / Site-Specific Test Plan

- 6.1.1. Develop and deploy a site-specific test plan including descriptions of safety procedures and requirements.
- 6.1.2. Before attempting any test, the Testing Supervisor will review the test specifications and procedures with the Test Inspector, Chief Inspector, and any other relevant personnel to be certain that all equipment is adequate, and duties are organized and understood.
- 6.1.3. Suspend a test when the testing personnel (including but not limited to: contractor, contractor's agents) or equipment are not working in a safe manner.
- 6.1.4. Inform all personnel of assignments, responsibilities, and test requirements.
- 6.1.5. Precautions associated with potential weather extremes should be considered and addressed in the site-specific test plan.

6.2. The design guidelines should be followed when setting up temporary piping:

- 6.2.1. Before fabricating and installing the temporary piping (filling, de-watering and cleaning piping) system, review the piping setup plan with the field engineer/lead inspector for consensus. Identify the water pressure and estimate the level of dynamic force. Special consideration should be given to protect the piping from possible water hammer at elbows, tees, reducers, valves or the end of discharge piping.
- 6.2.2. Temporary piping specifications (OD, wall thickness, grade, and seam), valve ratings, and ratings of fittings being used to be verified and reviewed by engineer/test lead.
- 6.2.3. No flex hoses should be used for temporary piping unless application has been reviewed and approved by engineer or competent test lead.
- 6.2.4. Appropriate valve types (e.g. Needle) should be identified and assigned for controlling any 'bleed' activities during test execution and dewatering.
- 6.2.5. Butterfly valves should not be installed along the alignment of the flow for discharge.
- 6.2.6. All temporary piping should be connected with welded/flanged/threaded joints.
- 6.2.7. All couplings and parts of the de-watering system need to be properly selected for their application. The associated piping, which the couplings connect, is a significant variable in the entire mechanical piping system. The couplings are manufactured in a controlled



environment, and variations in the quality of the couplings should be limited. Ensure that couplings are within manufacturer's tolerances and free of damage that may result in connection failure.

- 6.2.8. Flexible connectors may be allowed in the cleaning piping. If used, it should be restrained at both sides with adequate anchoring devices. Safety zone along the flexible connector should be established with the radius same or larger than the length of flexible connector.
- 6.2.9. Discharge piping should be equal to or greater than the diameter of the fill port.
- 6.2.10. Temporary piping should be routed as low to the ground level as possible and aligned as straight as feasible from the test head outlet to the receiving storage tanks.
- 6.2.11. Securely support the temporary piping with reasonable spacing and the proper supporting device to prevent the piping from sagging. Refer to the table below with suggested support spacing for each pipe OD.

Table 121.5 Suggested Pipe Support Spacing

Nominal Pipe Size, NPS	Suggested Maximum Span			
	Water Service		Steam, Gas, or Air Service	
	ft	m	ft	m
1	7	2.1	9	2.7
2	10	3.0	13	4.0
3	12	3.7	15	4.6
4	14	4.3	17	5.2
6	17	5.2	21	6.4
8	19	5.8	24	7.3
12	23	7.0	30	9.1
16	27	8.2	35	10.7
20	30	9.1	39	11.9
24	32	9.8	42	12.8

- 6.2.12. Adequately anchor temporary piping to prevent movement and separation of the piping:
 - Anchors should be used on straight runs of pipe for every 300 ft or less.
 - Anchors should be used upstream and downstream of all fittings (elbows, tees, etc.). The anchors should be placed at a distance of 5 to 10 times the pipe's OD from the center of fitting.
- 6.2.13. Consideration should be given to establish a 5 to 10-foot safety radius around temporary piping.
- 6.2.14. Securely support and tie down de-watering lines at its discharge end connecting to the frac tank to prevent uncontrolled movement during de-watering. Highly recommended to use rated flanges as the connection.



6.2.15. If one frac tank is used, it is recommended to fill to a maximum of 50-75% of full capacity during discharge to prevent uncontrolled splashing outside of the tank.

6.2.16. Every frac tank should be equipped with full scale level gauge. The level gauge should be inspected and ensured it is functioning properly prior to connecting the fill/dewatering piping.

6.3. Pre-Fill Activities

6.3.1. Verify pressure rating of facility being tested.

6.3.2. Verify that test equipment and material are rated to withstand the test pressures.

- Verify that all supply lines and hose connections are secure with retaining devices before and during the test.
- Visually inspect and ensure soundness and proper installation and valve positioning of all equipment used.
- Verify the pressure ratings of hoses, fittings, gaskets, and other manifold materials. Ensure components are assessed for continued use.
- Take steps to ensure the integrity of all mechanical connections and components.

6.3.3. Create a checklist of all upgrades that need to be made prior to test and have the Lead Inspector and Construction Foreman walk the line to ensure all upgrades have been completed.

6.3.4. For all pipeline valves that will be subjected to test pressure, place all main line valves in 100% open position and all other valves in 100% closed position for the pre-fill activities. Lead Inspector and Construction Foreman to confirm all valve positioning.

6.3.5. Flexible hose assembly must be restrained or shielded to restrict whiplash hazard in the event of a failure/rupture. Restraint may be achieved using whip checks or whipsnocks.

6.3.6. Avoid using ferrule type connectors. Ferrule type connectors with compression olives present an increased risk from incorrect assembly.

6.3.7. Full port valves should be installed at both launchers and receivers to ensure faster cycling of pigs and to isolate the system in case of an emergency.

6.3.8. Appropriately rated flanged expansion joints should be installed at the supply and discharge valves on launchers and receivers as well on all rotating equipment (e.g. high and low head pumps, etc.).

6.3.9. No threaded connections should be used on the supply or discharge lines to the launcher and receiver.

6.3.10. Appropriately rated hard piping should be utilized between receiving test header and any containment structure(s).

6.3.11. All discharge piping should direct flow into the top of the storage tank at a 45-degree angle, this end should not be welded to the tank, but should be restrained to prevent vertical movement.



- 6.3.12. Calculate back pressure for injecting water/running pigs by considering the static head and comparing it to MAOP.
- 6.3.13. Use appropriately sized fill pump and compressor. All pumps should include a device to detect and prevent pump cavitation.
- 6.3.14. The input supply pressure should be kept below 150 psig.
- 6.3.15. Throttle valve on receiving end to maintain the initial pack pressure at the Receiver. Maintain pig speed of approximately 4-8 feet per second.
- 6.3.16. Monitor pig location and verify pig speed along the length of the test by use of pig tracking device, geophones, or above ground markers.
- 6.3.17. Move all pigs past the isolation valve, into the oversized barrel. Close the isolation valve and relieve pressure from the Receiver barrel. Check liquid level prior to removing receiver door.

6.4. Sequence

- 6.4.1. Test Supervisor and /or Contractor should inspect test heads to confirm all components are in good condition and meet working pressure requirements.
- 6.4.2.  Temporary test heads or test caps are fabricated for the job, record each use and review the history before each use to determine how many times they have been subjected to a pressure greater than 72% of yield strength. Prior to use, historical records should be reviewed and steps taken to ensure component integrity.
- 6.4.3. Inspect all temporary welds on test headers subject to test pressures.
- 6.4.4. Test Manifold Construction
 - A welded connection is recommended as the first connection to the test manifold.
 - Prior to commencing hydrostatic testing operations, the Company Representative and /or Contractor should inspect test heads to confirm all components are in good condition and meet working pressure requirements. This will include an inspection and test of heads / manifolds to ensure that no components (e.g., gaskets, O-rings, fittings, valves) will leak or cause loss of test water and that the components conform to specified safety requirements.
 - If the first connection to the manifold is threaded, the following should be performed after each test:
 - Break apart the test tree equipment.
 - Reassemble the test tree after ensuring its integrity or replacing it with new equipment.
 - Inspect/test the equipment to confirm all pieces are structurally sound and functioning properly.
 - High-pressure pipe and fittings should be used for connection of the pressure pump, manifolds, and test equipment.
 - If the testing manifold contains a longitudinal seam, the test equipment should be located on the side opposite the seam, if possible.



- Inspect the make-up of all screwed connections.
- Material certifications should be confirmed as appropriate for use in pressure testing operations.
- Vent valves should be installed and opened at the appropriate time when stored energy can be isolated and/or trapped between two points such as valves, skilllets, etc.
- When using a pressure relief valve (pop-off valve), it should be set to a pressure just above maximum test pressure. This will ensure that the pipeline and testing equipment will not exceed its maximum pressure ratings.

6.4.5. Connect the test head on the receiving end to a steel storage tank with appropriately rated hard piping to collect bypass and purge water during the filling operation.

6.4.6. Adequate methods for verification of pig position in the manifolds are in use. The exact location of the pig(s) should be measured when loaded in the test header. The position, type, and direction of the pig(s) should be indicated.

6.4.7. Ensure that there are no unrestrained couplings (Dresser®, Victaulic™, threaded, or equivalent connections).

6.4.8. Fill lines are able to contain initial water pack pressure.

6.4.9. Fill the line at a slow and steady rate in order to not create air pockets within the test segment.

6.4.10. Propel the pig to the receiving end by filling the test segment with water. Maintain back pressure by throttling the valve on the test head at the receiving end. Increase back pressure ahead of the pigs as the water column makes downhill runs. Monitor the pig location by use of the tracking device.

6.4.11. Bleed off air from the test heads and as practical at high points, tap stubs, and valves that will be subjected to test pressure.

6.4.12. Victaulic type connectors should not be used on any portions of the testing system that will see any pressure greater than the static vertical head in frac tanks. Further, Victaulic type connectors should be used only in the suction piping of low pressure pumps and connected to the frac tanks and at no other locations of the testing system.

6.5. Test Sequence

6.5.1. Prior to testing, system temperature stabilization should be confirmed.

6.5.2. Test Supervisor to establish the target test pressures.

6.5.3. Confirm barriers and related signage are placed along the test section.

6.5.4. Assign designated personnel to patrol areas to keep people away from exposed pipe during the test.

6.5.5. Establish communication between patrolmen and test supervisor prior to beginning pipeline pressurization.



- 6.5.6. Place all ball valves in 50% open position for the test and leave all plug and gate valves in the 100% open position, or at the position specified by the manufacturer.
- 6.5.7. Ensure methods of isolating facilities being tested from test equipment and pumps are adequate. Provide a double block between the pump and test head.
- 6.5.8. Raise the pressure in the pipeline slowly and smoothly to MAOP and hold for thirty minutes. Check all accessible visible connections for leaks and allow the pressure to stabilize.
- 6.5.9.  Raise the pressure in the pipeline slowly and smoothly to 75% of the minimum of the minimum hydrostatic test pressure at the test point and hold for thirty minutes, accounting for company specific procedures related to pressure holds and duration. Allow pressure to stabilize and verify there are no signs of a leak.
- 6.5.10. Upon Test Supervisor approval, pressurization should continue at a uniform rate not to exceed 10 psi/minute to desired test pressure.
- 6.5.11. Upon completion of test, use caution when releasing water at test pressure. When opening any valves or appurtenances, watch body position and stand clear of line of fire. The test pressure should be relieved by partially opening a small tap valve before initiating the de-watering process.

6.6. Leak or Rupture Response

- 6.6.1. Never tighten connections that are under pressure. If a leak develops, you must depressurize to a safe level and then re-tighten.
- 6.6.2. Spill Response Equipment
- One vacuum truck
 - Sand bags
 - Straw wattle
 - Straw bales
- 6.6.3. Have a written leak contingency plan that outlines how to isolate and locate the leak, as well as how to contain and clean up any discharge.

6.7. Dewatering

- 6.7.1. Place all valves in the test segment in 100% full open position.
- 6.7.2. Insert dewatering pigs, if required.
- 6.7.3. Connect compressor(s) to the test head at the receiving end.
- 6.7.4. Establish de-watering safety zones of 50 feet from all discharge piping at the test head.
- 6.7.5. Access into safety zone is limited to only personnel necessary to perform the work.
- 6.7.6. Verify the integrity of each connecting joint (welded/flange/threaded) prior to depressurizing.
- 6.7.7. Notify all personnel that the area is all clear.



- 6.7.8. **Fusing** launchers and receivers for cleaning, filling, and drying runs, confirm there is no pressure against pig trap doors each time before opening.
- 6.7.9. Be aware of the potential for water hammer, variable system pressures, changes in pig velocities, potential for leakage on isolation valves, and other site-specific conditions.
- 6.7.10. Confirm that the diversion of water and/or gas will follow a safe pathway (e.g., use of 90° or 45° angles).
- 6.7.11. Always verify that complete depressurization has occurred by monitoring pressure gauges before attempting to disconnect components

6.8. Drying Sequence

- 6.8.1. Insert poly or disc pig and connect the compressor to the launching pig trap, opposite the receiving storage tanks.
- 6.8.2. Send the pig to the receiving pig trap to remove residual water from the pipeline. Maintain pig speed of 6-12 feet per second.
- 6.8.3. Continue to propel drying pigs until the desired dewatering is achieved. Additional techniques may need to be employed to lower the dew point to a specified level, (e.g. methanol slugs, desiccant air dryers, refrigerant air dryers.)
- 6.8.4. Clear water from all taps and valves. Test Supervisor should confirm all taps and valve locations achieved desired dew point.

6.9. Personnel, Qualifications and Training

- 6.9.1. Only experienced and trained supervision and personnel will be utilized in monitoring and operating all systems and equipment used in pressure testing. The responsible project manager, superintendent and responsible engineer will review qualifications of the supervision and personnel assigned to testing activities and will ensure that only adequately trained and experienced personnel are monitoring and operating the test equipment (compressors, valves, pumps, launchers and receivers, etc.).
- 6.9.2. In addition, the responsible project manager, superintendent and responsible engineer will review the proposed staffing plan for the testing activities and will ensure that sufficient competent personnel are assigned to the activities to safely and efficiently operate the test systems and to adequately operate all key activities for the full duration of the test. This specifically includes, but is not limited to, monitoring water level in frac tanks, monitoring all pumps, compressors, gauges, supply and discharge piping to prevent abnormal operating conditions.
- 6.9.3. Additional personnel to be assigned to monitor safety/ exclusion zones to specifically prevent any members of the public or workers from entering the exclusion zone while the test is on.
- 6.9.4. Employee training should highlight the hazards of hydrostatic testing, dewatering facility designs and techniques, piping coupling and anchoring methods, hazard identification and control.



- 6.9.5. For individuals involved with de-watering activities, provide adequate employee training on de-watering installation designs and techniques, including proper coupling and anchoring methods. Ensure that personnel understand the potential hazards of improperly installed de-watering systems. Provide personnel a means of determining whether the pipe groove meets manufacturer's tolerances, and the procedures they should implement to protect themselves and others working around them.

7.0 PNEUMATIC TEST REQUIREMENTS

- 7.1. Pneumatic strength tests present different hazards, with the most significant being the stored energy. The explosive decompression generates a blast wave and launches projectiles.
- 7.2. For above ground ruptures, the shock wave carries the most significant risk. The shock wave could impact surrounding equipment, buildings, and people.
- 7.3. For below ground ruptures, the energy released is translated to the soil surrounding the pipeline, creating a crater (ejecting material). The safety radius should take into consideration damages caused by projectiles by calculating the maximum distance a projectile can be thrown.
- 7.4. In addition to the requirements outlined for hydrotests, the following are supplemental requirements for pneumatic tests.
- 7.5. When critical equipment/piping is nearby the system being tested, the equipment/piping being tested must be properly anchored/restrained. Anchors are intended to be used in conjunction with restraint systems. Common designs include deadmen anchors, clamped-stakes anchor, concrete blocks, and helical anchors. They should be installed and placed based on spacing from engineering calculations or guidelines for the expected forces to be encountered.
- 7.5.1. Hard piping should be used between the source of gas and injection location. Hard piping should be pretested to a minimum of 1.5 times the minimum test pressure. If using flex hoses, do not exceed the maximum velocity per the manufacturer recommendation and verify the condition and pressure rating of the hose.
- 7.5.2. Pressurize at a steady rate. Ensure the sound of gas flowing or equalizing can no longer be heard before continuing to next step. Note that larger volume systems or higher test pressures will require longer pressure equalization times. Shorter simple systems will require less time.
- 7.5.3. Soap test all pressurized fittings at 100 psig. Hold leak test pressure for fifteen minutes. Test Supervisor to confirm all soap test locations.
- 7.5.4. Ensure there is overpressure protection. The set pressure of a pressure relief device should not be more than the greater of (1) the test pressure plus 10 psi, or (2) 105% of the maximum test pressure. The device must be tested prior to each strength test to ensure it is fit for service.

- 7.5.5. Above ground equipment (temporary equipment, temporary piping, etc.) must be physically shielded, wherever possible, to contain any projected missiles. This can be achieved by use of temporary barriers/shielding, including protection between the test controls and the assembly under pressure.
- 7.5.6. When performing pneumatic tests, the piping should be inspected to determine if the inside surfaces are contaminated with a combustible or flammable material (e.g., iron sulfide, condensate). If found, remove such materials prior to air testing.
- 7.6. Perform leak survey prior to pneumatic test to identify areas that need repair.
- 7.7. Have a written safety plan on securing the exclusion zone for the duration of the test. Establish roles and responsibilities and make sure communication is established between all patrols and incident commander.
- 7.8. Have a written pressurization and depressurization plan. Monitor pressure and temperature at nozzle and on the mainline.
- 7.9. When using nitrogen, ensure that the nitrogen supplier has a functional low temperature shutdown.
- 7.10. Have a written leak and rupture plan.
- 7.11. Create communication plan to inform the surrounding public of the planned test.
- 7.12. Consider the possibility of crack propagation from a rupture. Perform destructive testing, if possible, to validate the material properties, (i.e. fracture toughness) of the system being tested.
- 7.13. If appropriate, establish an emergency command center prior to the test.

8.0 REFERENCES

Current versions of the reference automatically supersede the reference listed below.

Occupational Safety and Health Administration (OSHA)

- *Hazards Associated with De-Watering Pipe Lines*, Safety and Health Bulletin SH 1B 06-21-2004 / Advisory Bulletin ADB-04-01

9.0 HISTORY OF REVISIONS

Revision	Date	Description
0	September 2012	Initial publication of this INGAA Foundation Construction Safety Consensus Guidelines document.
1	December 2018	General Revision
2		Reaffirmed without revision