Line 6B

Pipeline Repair Workplan

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Index

Pipeline Repair Workplan

The Pipeline Repair Workplan (PRW) details the technical aspects, activities and associated procedures that will be implemented during the pipeline repair. Enbridge pipeline repair procedures are governed and under the direct jurisdiction of the Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA). This plan addresses the technical aspects under the jurisdiction of PHMSA, and the National Transportation Safety Board (NTSB), as well as the United States Environmental Protection Agency's (EPA) directional authority over the coincident environmental mitigation and controls related to pipeline repair activities, due to the release. As such, plan approval is required from each agency.

Health and safety procedures specific to the pipeline removal are attached as an Appendix. The Health and Safety Plan addresses comprehensive health and safety procedures applicable to the release. Details of environmental remediation activities associated with the pipeline repair are included in the "Source Release Area Remediation Plan".

The scope and purpose of the PRW is to provide clear and comprehensive information relative to the design, planning and execution of the intended pipeline repair and potential contingencies. The PRW documents Enbridge's procedures to be employed during repair operations as well the specific application and documentation requirements for the MP 608 pipe replacement repair in a manner that is designed to minimize the risk of injury to workers, the public, and potential impacts to the environment.

The major work tasks associated with the pipe replacement are as follows:

1. Preliminary clean-up, access and preparation of the site,
2. Installation of shoring to provide a safe excavation
3. Bonding/Venting
4. Pipe Removal and custody transfer
5. Installation of Mud Plugs
6. Pipe Replacement
7. Welding and Non-Destructive Testing

Procedures associated with the specific work tasks are imbedded within each work task description. Safety procedures specific to the pipeline repair are included in the Appendix.

Enbridge incorporates the above defined tasks as well as detailed procedures for restarting the line in a "Pipeline Repair/Modification Work Job Planning Template" (PRMW/JPT) which is required whenever Enbridge conducts hot work on an open system. The template provides the basis for planning, documenting, communicating and managing changes during the course of planned hot work events on mainline piping.

PHMSA has issued a "Corrective Action Order" (CAO) dated July 28th, 2010 which identified preliminary findings relative to the incident as well as required corrective actions which Enbridge must take prior to and during the start-up of the pipeline, including approval of a return to service plan defining the conditions and restrictions Enbridge is required to adhere to during start-up and future operation of the Line 6B.

Enbridge's PRM/WJPT incorporates the safety, environmental and technical planning currently defined for the anticipated repair for MP 608, as well as the immediate actions required by PHMSA during the return to service phase. The Plan also as well as defines additional safety requirements to assess and analyze the pipe and accident investigation, and based on the results, implement corrective measures accordingly.

Work tasks such as excavation and shoring involve water and soil management issues which are detailed in the "Source Release Area Remediation Plan" section of the response to this Order and referenced where applicable in the PRW.

The NTSB is overseeing and approving the identification and removal of the effected pipe joint to preserve and take custody of pipe for further investigation and analysis, with Enbridge and PHMSA as additional parties providing input into the analysis.

The repair work will be completed in compliance with Code of Federal Regulations (CFR), Title 49 – Transportation:

- Part 195, Transportation of Hazardous Liquids by Pipeline, Subparts A-H.

The PRW defines the Scope of work, Regulatory Requirements and Company Standards for each work task.

Pipeline Repair Activities Completed:

- Access to the leak site utilizing timber mats and gravel road
- Excavation to locate and install (2) 2-inch fittings for drain-up of pipe segment
- Establish adequate work space for oil/water removal and
- Installation of matting adjacent to proposed trenchline

- Installation of 340 feet of sheet piling for excavation and containment area
- The containment area will have a length of 170 feet and width of 20 feed and the pipeline repair work will occur between those two rows of sheet piling.
- Sheet piling will also serve to stabilize the trench and the adjacent gas pipeline. Additionally, the gas pipeline will be stabilized and protected by sheet piling and mats.
- Staging of resources, including vacuum trucks, skimmers and frac tanks to recover water/ oil mixture.

A Line 6B repair drawing follows and depicts the site configuration as defined above.

Pipeline Repair/Modification Work
Job Planning Template

The purpose of the Job Planning Template is to provide a tool that will promote consistency amongst the operating districts with respect to job planning, hazard identification and documentation requirements for Pipe Repair & Modification Work. It should be used as a planning supplement to the specific procedures defined in Book 3 Section 06 – Pipe Repair & Modification, overall hazard assessment and completion of any required Enbridge permits (i.e., Safe Work and Confined Space Entry Permit). It must be completed for all Pipe Repair and Modification work involving an open system and hot work (i.e., cutting pipe, grinding, welding). Examples include major tie-in work, and/or installation of valves where welding is involved, cut-out and replacement of a section of pipe where welding is involved, etc..

Examples that would not require the completion of the template include situations where drain-up was not required (i.e., integrity dig sleeving work, installation of Plidco sleeves or other approved repair methods such as ClockSprings where a leak has not occurred. Other examples include pump / motor replacements, screen-pot inspection clean-out / re-placement, small valve replacement or valve replacement where welding is not involved.

Note: Control Center Manager or designate approval must be obtained after a Pipeline Repair Job as defined above (involves open system and hot work) has been completed and the Control Center will actively participate in the line-fill and start-up section of pipe (terminal or facilities). The Control Center must be given a minimum of 5 days advance notice for review & approval purposes. The Control Center must review and approve the line-fill and start-up section of the Job Plan a minimum of 2 days prior to the date the work is scheduled to be completed.

The following positions must be involved with planning for and/or reviewing the job plan:

1) **PLM Coordinator, PLM or Area Supervisor, or designate**
2) **PLM Work Crew, Operators or Operation Technicians**
3) **Safety Coordinators or a Qualified Safety Representative (A Qualified Safety Representative is an employee or contactor who has completed the Enbridge Inspector Qualification Training Program).**

One of the following positions must review and sign-off on the final Job Plan (prior to being provided to the Regional General Manager for final sign-off):

1) **PLM Service Manager, PLM Services Supervisor, Area Supervisor, Manager Pipeline Services, Operations Manager, Operations Supervisor or designate**
2) **Regional Services and Development Manager or Operations Engineering Manager or designate**

Final sign off is required by the Regional General Manager or an assigned designate.

A hard copy of the Job Plan must be maintained (with the appropriate signatures and supporting documentation) by the functional group performing the work for a period of 2 years (for audit purposes).

Pipeline Repair/Modification Work
Job Planning Template

ENBRIDGE

JOB PLAN:		☒ New Plan	☐ Revised Plan
Asset/Location (MP):	Line 6B MP 608 Pipe Cut Out --- Butt Weld Repair		
Prepared by:	John Pechin & Bill Palmer	**Date Prepared:**	08/05/10
AFE Number:	91153SC10124		
Est. Start Date:	7/30/10	**Est. Completion Date:**	8/08/10
Job Objective:	Repair section of pipe on Line 6B that ruptured.		
Job Scope:	Drain up line 6 section, cut and remove 30" pipe section, weld in new 30" pipe		

MANPOWER LISTING AND CONTACT INFORMATION: (*Identify affected personnel and ensure necessary communications are complete prior to starting job)*			
	Contact Name	**Contact Phone #**	**N/A**
Regional Manager or designate	Garry Worone	832-331-6652	☐
PLM Services Manager, Manager Pipeline Services, Operations Manager or designate	David Hodgins (Day) Adam Erickson (Night)	918-285-1132 218-393-6405	☐
Regional Services & Development Manager, Operations Engineering Manager or designate	Dean Rawson	219-381-5350	☐
PLM Supervisor, Operations or Area Supervisor or designate	Steve Sleaver / (Days) Ryan Anderson (Nights)	920-723-8824 920-988-7931	☐
PLM Coordinator, Project Coordinator, Operations Coordinator or designate	Tony Hommerding(Days)	218-393-1308	☒
Regional Engineer, Operations Engineer or designate	John Pechin(Nights) Bill Palmer (Days)	218-393-3180 218-390-7901	☐
Safety Coordinator or Qualified Safety Representative	Jason Palmer (Day) Lamar Kelley (Night)	918-285-6297 218-391-5341	☐
Pipeline Control Contact	Control Center Line 6B Richard Folkema	**800-379-4781 Extension 8896** 780-420-8285	☐
Contractors:			
1.Roberts, Support labor as needed	Kris Kemper (Day) Greg Fisher (Night)	765-524-5253 765-620-0301	☐
2.MN Limited, General Contractor, Welders, Labor and support materials and services and equipment	Mike Hyke (Day) Dave Voeltz (Night)	612-810-5714 763-478-1245	☐
3. Code Red, Confined Space Rescue	Mike Accroman (Day) Alfredo Sida (Night)	219-506-3523 219-588-0874	☐
			☐
			☐
Other: (First Responders)			
1. Police	911		☐
2. Fire	911		☐
3. Ambulance	911		☐
4. Hospital (include directions to nearest hospital).	**East on Division Dr.. North on Old 27 East on 94-BR North on Madason**.	269-781-4271	☐

Pipeline Repair/Modification Work
Job Planning Template

	Planning Items / Considerations - General	Yes	No	N/A
1.	Has the availability of the General Manager or designate been confirmed for the dates of the planned work?	☒	☐	☐
2.	Has the availability of the Safety Coordinator or Qualified Safety Representative for the dates of the planned work been confirmed?	☒	☐	☐
3.	If a Qualified Safety Representative has been assigned, has he or she received the Enbridge Inspector Qualification training?	☒	☐	☐
4.	Have the members of the Job Planning Team been identified (see above for planning team members)?	☒	☐	☐
5.	Have all applicable O&M Procedures been identified and reviewed by the planning team?	☒	☐	☐
6.	Does the required work require engineering analysis or other department technical support (i.e., Pipeline / Facilities Integrity)? If so, has the support been arranged for?	☒	☐	☐
7.	If any conditions in the O&M Procedures cannot be met has a variance been granted / approved by the Regional Manager or designate?	☐	☐	☒
8.	Have all necessary regulatory permitting requirements been arranged for / obtained?	☐	☐	☒
9.	If applicable, have any necessary landowner arrangements been arranged for by the ROW Agent?	☒	☐	☐
10.	Have the necessary materials and replacement components been identified and availability confirmed, as listed in the Job Safety Analysis?	☒	☐	☐
11.	Have the members of the work crew been actively involved with planning for the work activity including identifying hazards and risk mitigation strategies (should be included in performing what-if scenario analysis)?	☒	☐	☐
12.	Have Employees performing pipeline safety related/OQ /PBT tasks met training and OQ/PBT requirements for each of the tasks they will be involved in (including appropriate documentation)?	☒	☐	☐
13.	Have Contractors performing pipeline safety related/OQ /PBT tasks met training and OQ/PBT requirements for each of the tasks they will be involved in (including appropriate documentation)?	☒	☐	☐
14.	Are appropriate procedures in place for those employees/contractors who are not fully qualified but will be involved and/or participate in the completion of a pipeline safety related/OQ/PBT task(s) as follows? <u>Use of Non-Qualified Individuals</u> To facilitate pipeline repair work, non-qualified individuals may perform pipeline safety related/OQ/PBT tasks when directed and observed by an OQ/PBT qualified individual who will ensure immediate corrective action is taken when necessary. Qualified individuals overseeing non-qualified workers are responsible for the correct and safe performance of the covered task(s). <u>Span of Control Ratio</u> Non-qualified workers may be used with the ratio not to exceed two non-qualified workers to one qualified worker. Factors that may reduce this ratio, and should be considered by the qualified individual(s), are interferences such as noise, visual obstructions, weather or job site conditions that make it more difficult for an individual to observe others.	☒	☐	☐
15.	Do all replacement components (pipe, motors, pumps, etc.) meet or exceed the design maximum operating pressure (see Book 3 Section 06-02-01) and / or regulatory requirements?	☒	☐	☐
16.	If used pipeline equipment and components are being utilized, has it been confirmed they have been properly relieved of any trapped pressure and/or hazardous materials and are in proper working condition?	☐	☐	☒
17.	If a Plidco Sleeve or Weld Plus Ends are going to be used, has the overall condition including the quality of the seals been verified?	☒	☐	☐
18.	Has all Enbridge equipment that will be used to carry-out the work been identified and checked to ensure it is in proper working order (i.e., stopple equipment, pipe saws, etc.)?	☒	☐	☐
19.	Has all 3rd party equipment that will be used on the job been checked to verify it is in compliance with regulatory standards/requirements (i.e., cranes, booms, etc)? (As Used.)	☒	☐	☐
20.	Has any necessary 3rd party equipment been properly arranged for?	☒	☐	☐
21.	Has all necessary PPE been identified including any special PPE requirements (i.e., gas monitoring equipment, respirators, gloves, etc.)?	☒	☐	☐
22.	Has the PPE been verified to be in good working condition?	☒	☐	☐

23.	Has a communication plan been developed for on-site work activity (i.e., work crew)?	☒	☐	☐
24.	Have the proper Provincial/State One Call regulatory requirements been identified and properly planned for?	☒	☐	☐
25.	Have pipeline facility/row drawings been obtained and reviewed for accuracy and potential hazards?	☒	☐	☐
26.	Have all underground facilities/piping been identified	☒	☐	☐
27.	If magnetism is an issue in the area, has it been properly planned for?	☒	☐	☐
28.	Has a properly trained Enbridge representative been identified and assigned responsibility for locating and marking underground facilities/piping?	☒	☐	☐
29.	Have work-site hazards been identified with risk mitigation strategies implemented (i.e., overhead power lines, muddy work area, congested work area, etc.)?	☒	☐	☐
30.	Has the nearest hospital/medical facility been identified (including phone numbers & direction to the facility)?	☒	☐	☐
31.	Has the excavator operator been identified and qualifications to perform this activity verified?	☒	☐	☐
32.	Has a properly trained Enbridge representative been identified and assigned responsibility for being on-site and inspecting while actual excavation occurs?	☒	☐	☐
33.	Have contingency plans been developed in the event current plans are not effective?	☒	☐	☐
34.	Is there a procedure in place to ensure that the current job plan is re-evaluated as to it adequacy in the event there are any significant changes to the major assumptions under which the Job Plan was initially prepared (i.e., repair method changes from butt weld to Plidco sleeve, weather change ,etc.)	☒	☐	☐
Drain-up Planning Considerations		**Yes**	**No**	**N/A**
1.	Has a pipeline drain-up procedure been developed?	☒	☐	☐
2.	Has the Pressure Piping Isolation / Re-Pressurizing Valve Position Tracking Form been properly prepared / filled out for all valves involved (including drain(s) / vent(s))?	☒	☐	☐
3.	Has the Pressure Piping Isolation /Re-Pressurizing Valve Position Tracking Form been reviewed by a Supervisor to ensure it has been properly filled out?	☒	☐	☐
4.	Has responsibility been assigned for opening and closing all valves identified in the Pressure Piping Isolation /Re-Pressurizing Valve Position Tracking Form?	☒	☐	☐
5.	Has a secondary walk through been performed to verify all valves are in the correct position as per the Pressure Piping Isolation /Re-Pressurizing Valve Position Tracking Form?	☒	☐	☐
6.	Are you able to achieve double block & bleed with the valve/piping configuration?	☐	☒	☐
7.	If double block and bleed is not achievable have other risk mitigation strategies been developed to reduce the risk to an acceptable level (i.e., line shut-down, ignition sources turned off or removed from work area when not needed, wind direction monitored, continuous gas monitoring, etc.)?	☒	☐	☐
Repair Procedure Considerations (i.e., butt weld, weld plus ends, plidco sleeves, stopple job)		**Yes**	**No**	**N/A**
1.	Have the applicable procedures in OM&P Book 3 been reviewed by the Project Team Members?	☒	☐	☐
2.	Have the manufacturers' instructions for the repair method selected been reviewed by the Project Team / PLM Work Crew Members?	☒	☐	☐
3.	Has the pipe being repaired been properly checked / inspected (i.e., oval, lan scan performed, properly anchored, properly supported, coating removed, wall thickness, grade)?	☐	☐	☐
4.	If a butt weld(s) is to be performed and pipe alignment/fitting is required, has enough pipe been exposed to avoid undue stress on the pipeline?	☒	☐	☐
5.	If a mud plug is required, has a confined space permit been issued and a rescue plan developed?	☒	☐	☐
6.	Has the replacement pipe been inspected to ensure it is the same grade, wall thickness, proper length, etc)?	☒	☐	☐
Line-Fill & Start-up Planning Considerations		**Yes**	**No**	**N/A**
1.	Has a communication plan been developed for on-going communication with the Control Center throughout the line-fill re-pressurization process (Field personnel will remain in constant contact with the Control Center until such time that line filling and venting is achieved and the predetermined pressure is reached and the line is stabilized)?	☐	☐	☐

2.	Has the communication equipment been verified to be in good working order?	☐	☐	☐
3.	Has a line-fill re-pressurization procedure been developed by the Project Sponsor with maximum allowable pressures identified using the proper O&M procedure(s) (Note – The maximum operating pressure (including any pressure restrictions) must be identified and documented on Page 8 – Line-fill & Start-up Procedure prior to the Job Plan being submitted to the Control Center Manager or designate for approval)?	☒	☐	☐
4.	Has the line-fill procedure been agreed to by the Regional General Manager and Control Center Manager (or there designates)? Note: A minimum of 5 days notice should be given to the Control Center for review & approval purposes.	☒	☐	☐
5.	Has an employee been assigned responsibility for closing and re-opening the required valve(s) (including drain /vents) identified on the Pressure Piping Isolation / Re-Pressurizing Valve Position Tracking form (including completion of the form)?	☐	☐	☐
6.	Has a secondary walk through been performed to verify all valves are in the correct position prior to the line being re-filled / pressurized?	☐	☐	☐
7.	Have all unnecessary ignition sources within the safe zone been turned off (i.e., vehicles, heaters, etc.) and all unnecessary personnel left the safe zone work area?	☐	☐	☐
Post Job Considerations / Notes		Yes	No	N/A
1.	Has a Post-Job Meeting been scheduled with learning's identified and action plans to correct assigned?	☐	☐	☐
2.	Have the learning's been circulated to other relevant operating/service departments for their benefit?	☐	☐	☐
3.	Has all work equipment been cleaned and inspected for storage & reuse?	☐	☐	☐
4.	Have any materials or equipment that was removed been properly inspected, cleaned/relieved of pressure?	☐	☐	☐
5.	Has the work-site been properly back-filled and site clean-up completed?	☐	☐	☐
6.	If applicable, has the ROW Agent been advised the work is complete so that any remaining landowner issues can be finalized?	☐	☐	☐
7.	Have any necessary regulatory notices of completion of work been completed?	☐	☐	☐
8.	Has all the necessary documentation been completed and sent to the proper custodian for filing purposes?	☐	☐	☐

	Pre-Planning – Additional Items/Notes (Specify relevant OM&P sections – mandatory)
1.	Drain is currently in progress due to the rupture. Site cleanup and preparation is ongoing.
2.	**Notify Pipeline Integrity, NTSB, PHSMA and EPA 1 hour prior to commencement of excavation.** **Notify Tom Zimmerman (780-660-1916) to notify Michigan DNRE onsite officer Bill Ford 1 hour prior to commencement of cutting of pipe.**
3.	Repair will entail removal of existing ruptured joint of pipe and installation of approximately 46' feet of new pipe. (30" diameter, 0.375" wall thickness, 5L-X70). The replacement pipe is joining to API-5L X-52 pipe and the thicker replacement pipe will require appropriate transitioning by grinding. New pipe will be installed using Enbridge butt weld procedures UB-75.
4.	After new pipe section is installed the bottom of the pipe shall be adequately backfilled (prior to line fill) to prevent movement / settlement per Book 3, 04-02-03 requirements.
5.	Line fill will be completed using crude available upstream of leak site **via** mainline pump GT-U-3 at Griffith. Fill valve to be 607.66-6-V.
6.	Venting of air for linefill will be done via multiple 2" fitting installations located on the new pipe section and existing pipe ends. In addition an existing high point 2" fitting located upstream of the rupture location can be used. Vent points will be connected to a vacuum truck during the venting process.
7.	Only essential personnel shall be within the 100' hot zone in venting location. All ignition sources will be shut off in the 100' hot zone.
8.	Updates with CCO will be provided every 2 hours or as needed. GM or designate onsite will be responsible for providing the updates.
9.	Primary Isolation Valves 607.66-6-V and 610.61-6-V are to be bleed prior to cutting to ensure valve seats are holding. Bleeding is to be done periodically throughout repair process following cuts to tie in. **Isolation Points Upstream to Downstream in Order:** 599.43-6-V 607.63-6-V 6-SSV-1 6-SDV-1 607.66-6-V Rupture 610.61-6-V 611.00-6-V 620.66-6-V **Double Block and Bleed Upstream of rupture:** Continuous monitoring of isolated section upstream of valve 607.66-6-V will be achieved via pressure transmitter PT-2D located at Marshall Station. **Double Block and Bleed Downstream of rupture:** Double Block and Bleed downstream of the rupture location cannot be achieved. To mitigate risk of valve leakage at 610.61-6-V an additional 2" TDW vent fitting is required for monitoring liquid.
10.	**Relevant OM&P sections:** Book 2: 02-02-02, 02-02-04, 03-02-01, 03-02-02, 04-02-01, 05-02-02, 06-03-01 & 02, Tab 7, Tab 9, 11-02-01 through 03 & 07, Tab 12, 13-02-01 through 10, 14-02-01 through 04 Book 3: 04-02-02, 06-03-02 through 05, 06-03-10, 06-03-17, 06-03-21
11.	**Contingency Planning** Materials & Equipment– 120' of 30" X 0.375" W.T. API 5L X 70 (Marshall PLM stock Onsite) 120' of 30" X 0.375" W.T. API 5L X 70 (Bay City PLM Stock Onsite) 120' of 30" X 0.375" W.T. API 5L X 70 (Bay City PLM Stock – Available from Bay City) Two 30" PLIDCO Weld Plus End Couplings (Marshall PLM) Two 30" PLIDCO Split Sleeves (Marshall PLM) Field Bend Machine Hydro testing Equipment Manpower & Resources – The job schedule will be evaluated periodically. Currently the location will be staffed 24 hours, 12 hour shifts from 7 am to 7pm.
12.	**Line Up Concerns** – It is preferred to perform a butt weld on both ends of the new pipe section to be installed. If lineup is not acceptable an alternative method of joining the pipe will be completed (either weld plus end will be installed per Enbridge O&MP 06-03-13 Installing Plidco Weld Plus Ends Couplings or split repair sleeve).

	Pipe Investigation Process
1.	No excavation, pipe removal or inspection can occur unless NTSB, EPA, MDNRE and PHMSA representatives have been notified.
2.	This Investigation Process Procedure has been developed in concert with the NTSB, PHMSA and Enbridge Pipeline Integrity Representatives.
3.	Follow all aspects of Book 3, 06-03-22 – Removing Pipe for Investigation – Review in detail at start of each shift. During excavation and dewatering, ensure that drains and hoses do not contact the rupture surfaces.
4.	Enbridge representatives will document the excavation, pipe examination, pipe removal and pipe installation.
5.	Expose and excavate approximately 180 ft of pipe in accordance with Enbridge O&MP Manual Book 3 04-03-01. The excavation will extend from upstream of girth weld 217710 to downstream of girth weld 217740.
5.	Prepare ditch for safe access by repair and inspection personnel. Ensure cribbing supports pipe every 20' per the O&MP 04-02-03.
6.	Enbridge Pipeline Integrity locates and verifies girth welds 217720 and 217730. See Figure 1 for details.
7.	Conduct an elevation profile survey of the top of the exposed pipe by taking elevation readings at a maximum interval of 5 feet.
8.	The first cut will be at least 4 feet downstream of girth weld 217730 or 3 feet from the end of the rupture, whichever is longer. Actual position of cold cut location will be approved by the NTSB prior to starting cutting operations.
9.	The drain up will be completed out of this cut per Enbridge procedures. A Wachs saw will be used to cut into the pipe from the top to allow a controlled liquid flow into a trough. As the liquid level drops, the saw will cut deeper until it is all the way through. The liquid in the trough will be transferred into a vacuum truck for disposal off site.
10.	Any pipe movement after this cut has been completed will be measured by onsite surveyors, photographed and documented by Enbridge Pipeline Integrity.
11.	Prior to removal, visually inspect and photograph the pipe rupture by Enbridge Pipeline Integrity. The photos will be labeled as follows: Enbridge Line 6B MP 608.375 Flow Direction 12:00 Position
12.	Onsite surveyors will measure and record GPS coordinates of beginning and end of failure location in Latitude, Longitude, six decimal place accuracy Measure distance from U/S 2" TOR fitting to upstream end of rupture.
13.	Cut the pipe at least 4 feet upstream of girth weld 217720. Actual position of cold cut location will be approved by the NTSB prior to starting cutting operations.
14.	Remove the cut out pipe section and place in a safe location on site. During pipe removal attempt to keep all evidence (pipe material, coating etc.) in as-found condition as much as reasonably possible
15.	The NTSB Pipe Specimen will made up by cutting the removed pipe section as follows: a. Cut the pipe joint 19 feet downstream of girth weld 217720 where there are no ILI indications. Actual position of cold cut location will be approved by the NTSB prior to starting cutting operations. b. Trim the ends as required by NTSB.
16.	The NTSB Pipe Specimen shall be marked as follows: Enbridge Line 6B MP 608.375 Each segment will have a unique identifier Label Flow Direction Label 12:00 Position Label long seam orientation Label pipeline station footage Label GPS coordinate of failure location in Latitude, Longitude, six decimal place accuracy Label distance from U/S 2" TOR fitting to failure location. Label upstream and downstream girth welds (217720 and 217730) MDNRE and NTSB will also add their own unique markings.

17.	After removal any free product located in or on the pipe shall be removed using non aggressive cleaning methods (hand cleaning with absorbent material). No cleaning solutions will be used. The pipe must be suitably cleaned for over the road transport.
18.	Coat rupture surfaces completely with Vaseline or other protective grease. Place split rubber hose on the rupture surfaces.
19.	Wrap both pipe sections in plastic, cap pipe ends and pack in separate shipping crates. Seal the crates and load them into a transport truck.
20.	The pipeline integrity department will complete chain of custody documentation for delivery to the failure analysis location.
21.	Transfer custody of NTSB Pipe Specimen to NTSB representative on site.
22.	Any other pipe that is removed from the ditch will be marked and retained for possible future inspection.
23.	A minimum of 50 ft of pipe, upstream and downstream of the failed joint will be blast clean and inspected for a indication of dents, corrosion (internal and external), long seam cracking and SCC. This inspection will be conducted according to the O&MP Book 3 06-02-02 Defect Evaluation- Repair Methods.

Pipeline Repair/Modification Work
Job Planning Template

	Drain-up Procedure	Potential Hazards	Hazard Controls
1.	Maintain communication with Edmonton Control Center (1-800-379-4781 Extension 8896) to periodically communicate progress.		
2.	Upstream Valves LOTO 599.43-6-V, 607.66-6-V, 6-SDV-1, 6-SSV-1, 607.63-6-V	Missed Energy Source.	Complete the Pressure piping isolation/Re-pressurization Valve Position Tracking Form Book 2 tab 6 Section 06-02-01 & 06-03-01, Isolate and Lockout Electrical sources to Valves, Chain and Lock hand wheels on Valves.
3.	Downstream valves: LOTO 610.61-6-V, 611.00-6-V, 620.66-6-V	Missed Energy Source.	Complete the Pressure piping isolation/Re-pressurization Valve Position Tracking Form Book 2 tab 6 Section 06-02-01 & 06-03-01, Isolate and Lockout Electrical sources to Valves, Chain and Lock hand wheels on Valves.
4.	Venting during drain up will done via high point 2" fittings. Fittings are located approximately 125' upstream of the rupture location. Only essential personnel shall be within the 100' hot zone in venting location. All ignition sources will be shut off in the 100' hot zone.	Flammable Vapors, Breathing hazards, Line of fire, Falls, Falling Objects, Working at heights, confined space.	PPE per O&MP Book 2 Tab 13-02-01 through 13-02-10, Gas Monitors; fire Guns, Control Ignition sources
5.	Drain up pipe (refer to Pipe Investigation Section and applicable portion of Book 3, 06-03-03). Once the oil level in the section is at a manageable level, the pipe section is to be partially cut and drained in to tubs.	Flammable Vapors, Breathing hazards, Line of fire, Falls, Falling Objects, Working at heights	PPE per O&MP Book 2 Tab 13-02-01 through 13-02-10, Gas Monitors; fire Guns, Control Ignition sources, Grounding Equipment, Secure hose couplings. Book 2 Tab 14 section 14-02-02
6.	Upstream periodic monitoring double block and bleed pressure monitoring will be performed at Marshall Station pressure transmitter PT-2D. Pressure will be checked and logged every 15 minutes. This task will be performed for the duration of the repair.	Flammable Vapors, Breathing hazards, Line of fire,	PPE per O&MP Book 2 Tab 13-02-01 through 13-02-10, Gas Monitors; Control Ignition sources
7.	Downstream periodic Monitoring for liquid will be performed through a 2" fitting located downstream of the downstream mud plug. Periodic monitoring will be performed every 15 minutes. If oil is present a vac truck with wand will be placed in 2" fitting to remove oil. Additional vents will be installed as required. This task will be performed for the duration of the repair.	Flammable Vapors, Breathing hazards, Line of fire,	PPE per O&MP Book 2 Tab 13-02-01 through 13-02-10, Gas Monitors; Control Ignition sources

JOB SAFETY ANALYSIS: *(Define the job steps. Identify and control the potential hazards for each)*

Job Steps by Major Category

Job Safety Analysis		**Potential Hazards**	**Hazard Controls**
1.	Prior to performing cuts to pipeline, NTSB evaluation will be performed. Exact location of cuts will be approved by Enbridge Pipeline Integrity in consultation with the NTSB and PHMSA. (See Pipe Investigation Process Section)		
2.	Cold cut pipe section to be removed. (see Book 3 Tab 06-03-02). Cuts will be made per approved Cut Out Diagram as attached.	Hazardous Vapors, line of fire, flammable vapors, breathing hazards, Air operated equipment, pinch points, Eye hazards	Gas monitors, fire guns, Control Ignition sources, Fire Watch, clips on air lines, ensure fingers are kept out of pinch points, eye protection, respirators, Only vehicles and equipment that are required to perform the work are allowed in the immediate work area. Book 2 tab 14 section 14-02-02, tab 6 section 06-03-21, tab 13
3.	Prior to removal of damaged pipe section, ensure residual product is contained. Pipe will be placed in two separate crates per Enbridge Pipeline Integrity and NTSB.		
4.	Pipe will be removed per the approved contractor Critical Lift Plan with Enbridge Oversight.	Lifting	Mark swing radius. Ensure qualified operators. Use tag lines on all objects being lifted.
5..	Remove pipe section (see Book 3, 06-03-21, Grounding Pipe for Static Electricity) and place on approved supports (see Book 3, 06-03-22 Removing Pipe for Investigation).	Pinch Points, Lifting Equipment, Hazardous Vapors	Mark swing radius. Ensure no one places hands/fingers between pipe. Ensure crane operator qualified. Use tag lines on all objects being lifted. Ensure grounding clamps installed on all pieces of pipe. Gas monitors, fire guns, Control Ignition sources, Fire Watch, clips on air lines. Book 2 tab 13, Book 2 tab 12 12-02-01 thru 12-02-03, Book 3 tab 6 06-03-17, tab 6 06-03-21
6.	Clean inside of pipe at sealing points for foreman plug. (see Book 3, 06-03-05, Installing Vapor Plugs)	Hazardous Vapors, flammable vapors, breathing hazards, Eye hazards	Gas monitors, fire guns, Control Ignition sources, Fire Watch, eye protection, respirators, Only vehicles and equipment that are required to perform the work are allowed in the immediate work area. Book 2 tab 14 section 14-02-02, tab 6 section 06-03-21, tab 13
7.	Install foreman's plug in each existing pipe end to facilitate. Vent foreman's plug with hose. Hose should run up the bank, away and down wind. (see Book 3, 06-03-05, installing vapor plugs).	Confined Space, Hazardous Vapors, flammable vapors, breathing hazards, Air operated equipment, pinch points, Eye hazards	Confined Space permit, Confined Space Rescue Plan, Gas monitors, fire guns, Control Ignition sources, Fire Watch, clips on air lines, ensure fingers are kept out of pinch points, eye protection, respirators, Only vehicles and equipment that are required to perform the work are allowed in the immediate work area. Book 2 tab 14 section 14-02-02, tab 6 section 06-03-21, tab 13
8.	Prepare piping 50' upstream of girth weld GWD217720 and 50' downstream of girth weld GWD217730. This will be done by abrasive blasting.	Confined Space, Hazardous Vapors, flammable vapors, breathing hazards, Air operated equipment, pinch points, Eye hazards	Confined Space permit, Confined Space Rescue Plan, Gas monitors, fire guns, Control Ignition sources, Fire Watch, clips on air lines, ensure fingers are kept out of pinch points, eye protection, respirators, Only vehicles and equipment that are required to perform the work are allowed in the immediate work area. Book 2 tab 14 section 14-02-02, tab 6 section 06-03-21, tab 13

9.	Install foreman's plug in each existing pipe end to facilitate. Vent foreman's plug with hose. Hose should run up the bank, away and down wind. (see Book 3, 06-03-05, installing vapor plugs). Note: Ensure face of foreman plugs are installed a minimum of 10' feet from pipe edge.	Confined Space, Hazardous Vapors, flammable vapors, breathing hazards, Air operated equipment, pinch points, Eye hazards	Confined Space permit, Confined Space Rescue Plan, Gas monitors, fire guns, Control Ignition sources, Fire Watch, clips on air lines, ensure fingers are kept out of pinch points, eye protection, respirators, Only vehicles and equipment that are required to perform the work are allowed in the immediate work area. Book 2 tab 14 section 14-02-02, tab 6 section 06-03-21, tab 13
10.	Weld 2" TDW fitting on both pipe ends between pipe ends and foreman plug for venting. Use weld procedure UN-30. Maintain 12" of separation between foreman plug and 2" TDW. Monitor heat while welding next to foreman plug. Ensure surface temperature of pipe next to foreman plug is less than 250 degrees F at 6" away from foreman plug. Downstream pipe end will require 2-2" TDW fittings to be welded and tapped. Upstream pipe end will require 1-2" TDW fitting to be welded and tapped. Optionally an additional 2" vent can be installed on the upstream end if there is pressure monitoring concerns. Remove Foreman plug. Perform NDT on welds. Check mainline pipe with UT for laminations prior to welding.	Fire, Hazardous vapors, confined space	A minimum of two fire watch with #30 fire guns, positioned on both sides of the pipe. Ensure grounding clamps installed on all pieces of pipe. Book 2 tab 13, Book 2 tab 12 12-02-01 thru 12-02-03, Book 3 tab 6 06-03-17, Book 3 tab 6 06-03-21
11.	Clean the inside of the pipe and install mud plugs between newly installed 2" vents and pipe ends. (see Book 3 Tab 06-03-04)	Hazardous vapors, confined space	Confined space permit & written rescue procedure. Gas monitors, check seal with gas monitors, fire guns, safety watch. Book 2 tab 6 06-03-21, tab 14 14-02-02, tab 6 06-03-04
12.	Bevel the existing pipe to length and touch up with a grinder in preparation for new pipe joint installation.	Fire, Mud Plug shifting	PPE per O&MP Book 2 Tab 13-02-01 through 13-02-10, A minimum of 2 fire watch, positioned on both sides of the pipe. Check seal integrity with gas monitor, grounding/bonding cables on all pieces. Book 2 tab 13, Book 3 tab 6 06-03-21
13.	Install line-up clamps.	Pinch Points, Lifting Equipment, static	Mark swing radius. Ensure no one places hands/fingers between pipes. Ensure crane operator qualified. Use tag lines on all objects being lifted. Ensure grounding clamps installed on all pieces of pipe. Book 2 tab 13, Book 2 tab 12 12-02-01 thru 12-02-03, Book 3 tab 6 06-03-17, tab 6 06-03-21
14.	Lower pipe into place (following approved contractor Critical Lift Plan with Enbridge Oversight) and line-up for welding. Prior to placing new pipe, weld 2" TDW per UN-68. Perform NDT on welds.	Pinch Points, Lifting Equipment, Hazardous Vapors	Mark swing radius. Ensure no one places hands/fingers between pipe. Ensure crane operator qualified. Use tag lines on all objects being lifted. Ensure grounding clamps installed on all pieces of pipe. Gas monitors, fire guns, Control Ignition sources, Fire Watch, clips on air lines. Book 2 tab 13, Book 2 tab 12 12-02-01 thru 12-02-03, Book 3 tab 6 06-03-17, tab 6 06-03-21

15.	If lineup is acceptable, make the butt welds using UB-75. Perform immediate NDT on welds. A 12 hour delay NDT is required as well.	Fire	A minimum of two fire watch with #30 fire guns, positioned on both sides of the pipe. Ensure grounding clamps installed on all pieces of pipe. Book 2 tab 13, Book 2 tab 12 12-02-01 thru 12-02-03, Book 3 tab 6 06-03-17, Book 3 tab 6 06-03-21
16.	If weld(s) fail NDT, attempt single repair per UB-75R. If weld repair(s) fail, install approved alternative. - Cut out failed weld section, replace with new spool piece. Minimum length 4'. - Install Plidco Split Sleeve per Book 3, 06-03-12 using weld procedure UF-49. The weld plus ends will be considered un-anchored. An anchor design needs to be completed and installed prior to line fill. - Install Split sleeve per Book 3, 06-02-06 repair sleeve using UF-49. Perform NDT on welds. Chosen alternative must be approved in writing by the Enbridge Pipeline Integrity department.	Fire	A minimum of two fire watch with #30 fire guns, positioned on both sides of the pipe. Ensure grounding clamps installed on all pieces of pipe. Book 2 tab 13, Book 2 tab 12 12-02-01 thru 12-02-03, Book 3 tab 6 06-03-17, Book 3 tab 6 06-03-21, Book 3, 06-03-12, 06-02-06
17.	Ensure replacement pipe is adequately supported prior to line fill (see Book 3, 04-02-03).Place pipe on approved pipe supports with 20 foot maximum spacing.	Pipe stress related damage	
18.	Ensure all 2" fitting not used for linefill venting are plugged and blinded or capped.		
19.	Following linefill and start up coating of pipe will be performed per the following Enbridge Specification: C-210 – Coating of Buried Steel with Rollable or Brushable Coatings – We intend to use this standard to apply SPC 2888 product over the fusion bond epoxy to fusion bond epoxy weld joint. This coating standard will also be used to repair coating for any holiday areas detected. C-410 – Coating of Buried Pipe With Bituminous Tape (refer to section 1.1.1) – We intend to this standard to apply Densotherm hot applied tape to transition between fusion bond epoxy and the historic tape wrap.		

Line-fill & Start-up Procedures		Potential Hazards	Hazard Controls
	(SUBJECT TO PHMSA APPROVAL)		

Pipeline Repair/Modification Work
Job Planning Template

ENBRIDGE

Drawings / P&IDs: *(list the drawings associated with this work and attach to the Job Plan)*		
Number	**Title**	**Date**
Line 6B Alignment Sheets	D-5.92-10279-15-573	
Linefill Sketch-001	LOTO and Valve Closure Sketch	08/04/2010
Sketches	6B- Repair install detail sketch 6B- Repair linefill venting detail Figure 1. Cut locations- Line 6B	08/05/2010

Equipment/Tools: (Optional)			
Type	**Quantity**	**Source**	**Contact**
Material (Optional)			
	Quantity	**Source**	**Contact**
Permits Required: *(lists all that are required)*			
Type	**Required (yes/no)**	**Description (#)**	**Person Responsible**
Safe Work Permit	Yes		PLM Supervisors
Confined Space Permit	Yes		PLM Supervisors
Environmental Permits	EPA		
Other	NTSB		
Procedures: *(list all that apply)*			
Type	**Required (yes/no)**	**Description**	**Person Responsible**
Lock-out/Tag-out-Valves (see Attachment I)	Yes		PLM Supervisors
Other:			
Personal Protective Equipment (PPE): Required			

Typical routine PPE (FR clothing, Hard Hat, Steel Toe Boots, Safety Glasses) plus appropriate half mask or full face respiratory protection and/or fall protection, where required. Additional requirements as noted in Safe Work Permit and Confined Space Entry Permit, as applicable.

Job Plan Review: *(to be performed prior to beginning work)*			
Job Plan reviewed by: **(one of the following must sign-off:** PLM Services Manager, Manager Pipeline Services, Operations Manager, Manager Regional Services & Development, Regional Services Manager, Operations Eng. Manager, Operations Manager.	David Holy	**Review Date:**	AUG.6/2010 11:00 am
Final Job Plan Approved By: Regional General Manager or designate	[signature]	**Review Date:**	AUG 6/10
Notes:			

Pipeline Repair/Modification Work
Job Planning Template

Date:		**Assigned to/Date:**
Post Job Notes:		
1.		
2.		
3.		

Pipeline Repair/Modification Work
Job Planning Template

ENBRIDGE

ATTACHMENT I
PRESSURE PIPING ISOLATION/RE-PRESSURIZING
Valve Position Tracking Form

Purpose - The purpose of this form is to document the correct positioning of valves to ensure all are in the appropriate position prior to de-pressurizing and re-pressurizing the piping system.

Scope - This form is intended to be utilized when the pipeline system is being pressurized or de-pressurized in the following situations:

- Operation of scraper traps
- Isolation of piping to complete piping tie-ins
- Any operation that might result in an oil leak if valves are left in an incorrect position (i.e., small bore piping modifications / sump work / strainers and filters, etc.)
-

Note: this is not intended to be used in situations such as Pressure Transmitter calibrations etc.

How to use this form

This form will provide a record of the operation of each valve involved in the work. A list of the valves to be operated and their order of operation will be placed in the "Isolation Procedure Steps" section. After each valve or group of valves is operated, the worker will indicate the time the action was completed and initial that the valve was opened or closed. Prior to operating the final valve to either vent or re-pressurize, this form will be reviewed with the Assigned Person in Charge of the Work to confirm that all valves are in the proper position.

Station:		**Date:**	
Description of piping being isolated (i.e. Line 4 receiving trap)	Drain up line from mainline valve 607.66-6-V to approximately MP 610.61-6-V, cut and remove ruptured 30" pipe section, weld in new 30" pipe		
Nature of Work and Reason:	Mainline repair		

Assigned person in charge of work:		
Tony Hummerding (Day) Ryan Anderson (Night)		11AM EDT 8:45pm EDT
Name	**Signature**	**Time**

Workers		
Person(s) Working on Facilities	**Signature**	**Time**
See site sign in.		

Pipeline Repair/Modification Work
Job Planning Template

Seq #	**Isolation Procedure Steps** Make a list of all valves that will be operated and in what order they will be turned (include vent and drainage valves). Attach piping schematics if available. Confirmation of valve position as described in this list shall be the final step before operating the last valve.	Lock #	Initial Valve Status O / C	Shutdown Valve Status O / C	Time	Initials	Locked at MCC	Locked at Equip	Re-Pressurize Status O / C	Time	Initials
Example	**Trap isolation valve (R2.1) to be closed**		**C**								
	Upstream										
	599.43-6-V										
	607.63-6-V (M)		C								
	6-SDV-1		C								
	6-SSV-1		C								
	607.66-6-V		C								
	Down Stream										
	610.61-6-V		C								
	611.00-6-V (M)		C								
	620.66-6-V		C								
	Rectifiers										

Appropriate PPE & Equipment?	☐	YES
Isolation Procedure Steps Reviewed & Approved?	☐	YES
FINAL CHECK BEFORE DE-PRESSURIZING		
Are all sealing devices (valves) in proper position?	☐	YES
Assigned Person in Charge of work	Signed:	
FINAL CHECK BEFORE RE-PRESSURIZING		

Are all sealing devices (valves) in proper position?	☐	YES

Assigned Person in Charge of work	Signed:	

Plan	➔	Isolate	➔	Depressurize	➔	Test for LEL's Vapors etc	➔	Start Work
		Re-pressurize	🡐	Confirm Sealing Device Positions	🡐	Check for Tools & Personnel	🡐	Work Complete

VALVE POSITIONING - LOCK OUT TAG OUT FORM (LOTO) – Alternate Version

ENBRIDGE

Valve #	Lock #	Initial Status O / C	Shut-down Status O / C	Time	Initial	Locked at Equip	Locked at MCC	Re-Pressurize Status – O / C	Time	Initial	Comments
Upstream											
599.43-6-V											
607.63-6-V (M)		C									
6-SDV-1		C									
6-SSV-1		C									
607.66-6-V		C									
Down Stream											
610.61-6-V		C									
611.00-6-V (M)		C									
620.66-6-V		C									
Rectifiers											

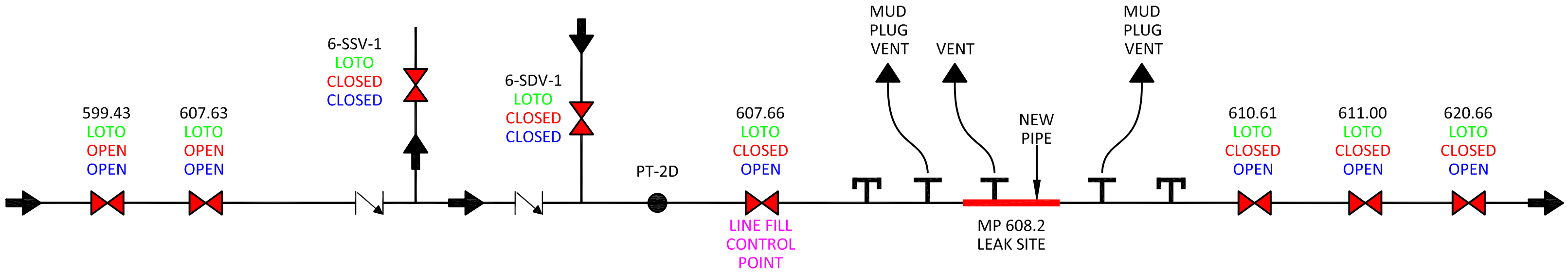
FINAL CHECK BEFORE DE-PRESSURIZING			
Are all sealing devices (valves) in proper position?		☐	YES
Person in Charge of work	Signed:		
FINAL CHECK BEFORE RE-PRESSURIZING			
Are all sealing devices (valves) in proper position?		☐	YES
Person in Charge of work	Signed:		

Plan ➔	Isolate ➔	Depressurize ➔	Test for LEL's Vapors etc ➔	Start Work
	Re-pressure 🡐	Confirm Sealing Device Positions 🡐	Check for Tools & Personnel 🡐	Work Complete

VENT SITE PLM SUPERVISORS
Steve Sleaver (Days) 920-723-8824
Mike Paradise (Nights) 906-630-5314
LINEFILL COORDINATOR:
Bill Palmer 218-390-7901
MARSHALL COORDINATOR:
John Pechin 218-393-3180
EDMONTON SHIFT LEAD:
800-379-4781 ext. 8899
EDMONTON LINE OPERATOR:
800-379-4781 ext. 8896
MARSHALL TECHNICIANS:
Brian Whittaker 269-986-5743
Andrea Laforrest 517-851-2215
GRIFFITH TERMINAL TECHNICIANS:
Mike Smiley 219-218-7360
Tim Toper 219-369-3797
GRIFFITH GAUGER:
219-616-2684
STOCKBRIDGE TECHNICIANS:
Dennis Esterline 517-260-0735

LEGEND

VALVE STAYS OPEN
PRE-FILL VALVE STATUS
LINEFILL VALVE STATUS
FINAL VALVE STATUS
TOR- PLUGGED & FLANGED PRIOR TO START



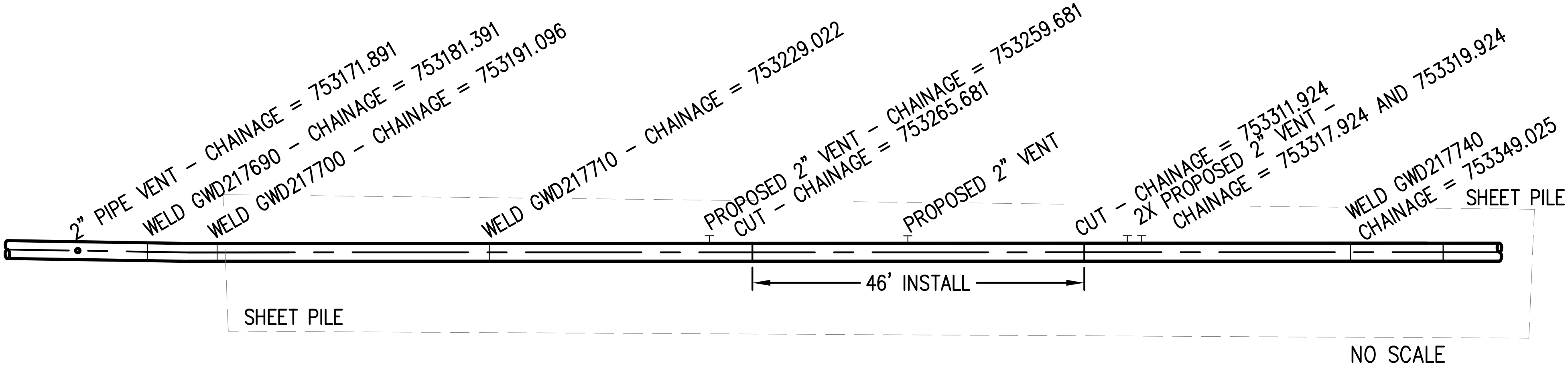
- 2 HOURS
- WELDING COMPLETE
- MANAGEMENT NOTIFICATIONS
- CALL IN VALVE CREWS
- NOTIFY CCO

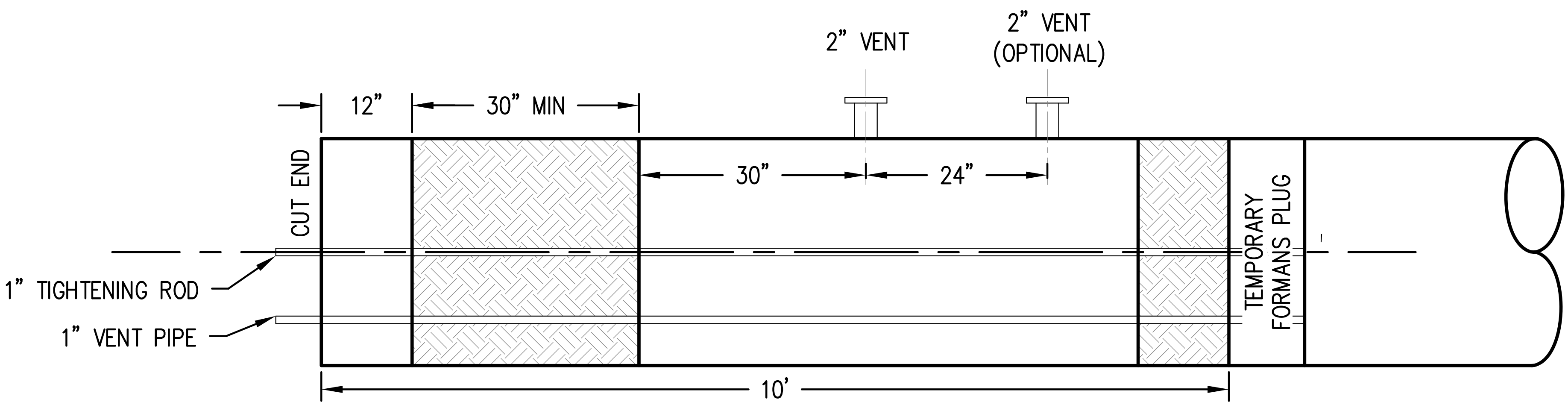
- 1 HOUR
- X-RAY COMPLETE
- NOTIFY MANAGEMENT
- NOTIFY CCO
- JOHN PECHIN AND TECHNICIANS GO TO MARSHAL WITH KEYS

0
- EXECUTE LINEFILL

...DAYTIME
- AERIAL PATROL
- PLUG 2" FITTINGS
- INSPECT FOR LEAKS

DRAWING NUMBER: LINEFILL SKETCH-001
DRAWING NAME: LOTO AND VALVE CLOSURE SKETCH
DATE: 08/04/2010





PLUG AND VENT DETAIL

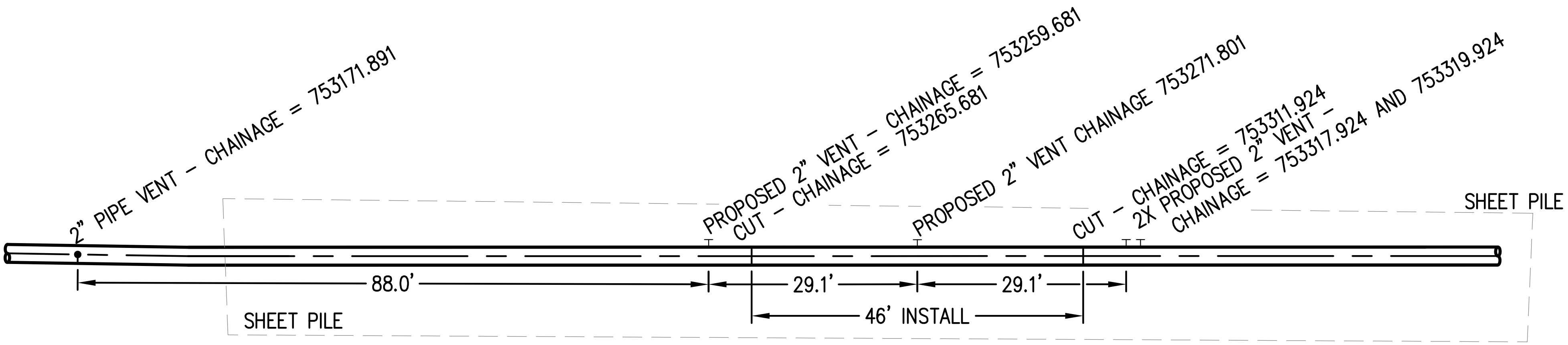
NO SCALE

NO.	REVISION DESCRIPTION	DATE	BY	APP'D
1.	ISSUED	8/04/10	ND	BP
2.	ADD VENTS	8/06/10	ND	BP

ENBRIDGE™

6B REPAIR

INSTALL DETAIL



NO SCALE

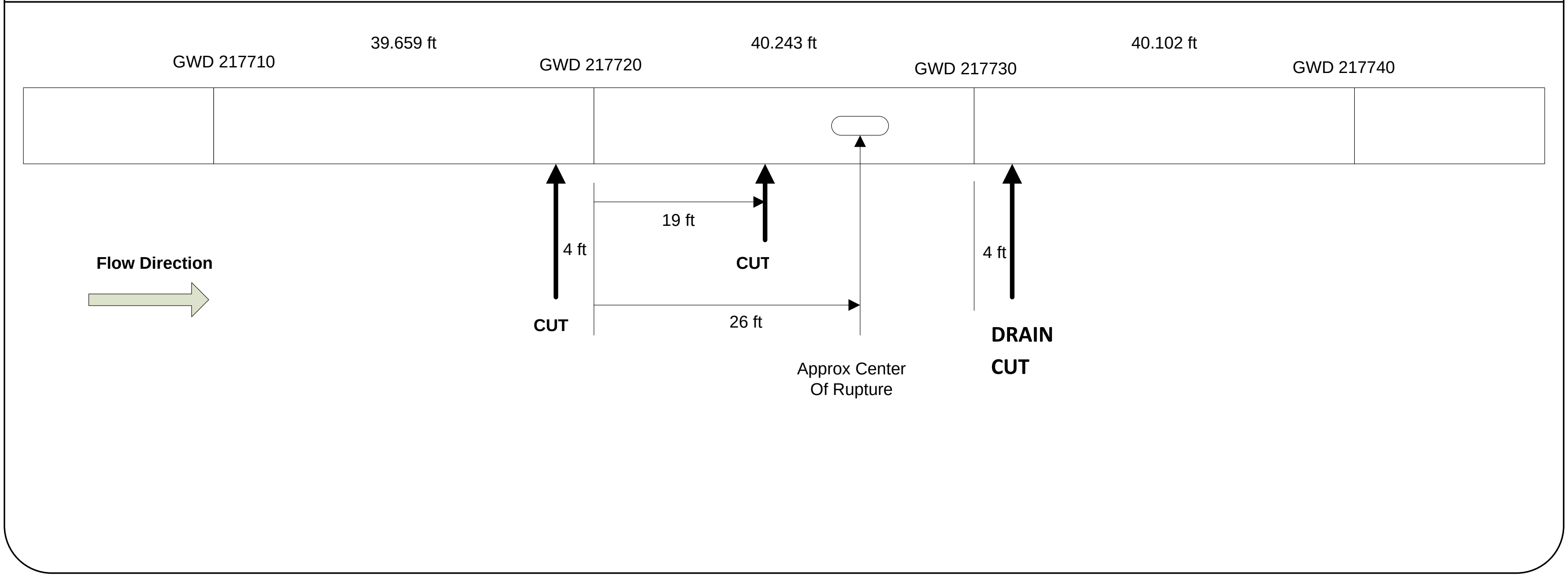
NO.	REVISION DESCRIPTION	DATE	BY	APP'D
1.	ISSUED	8/04/10	ND	BP
2.	ADD VENT	8/06/10	ND	BP

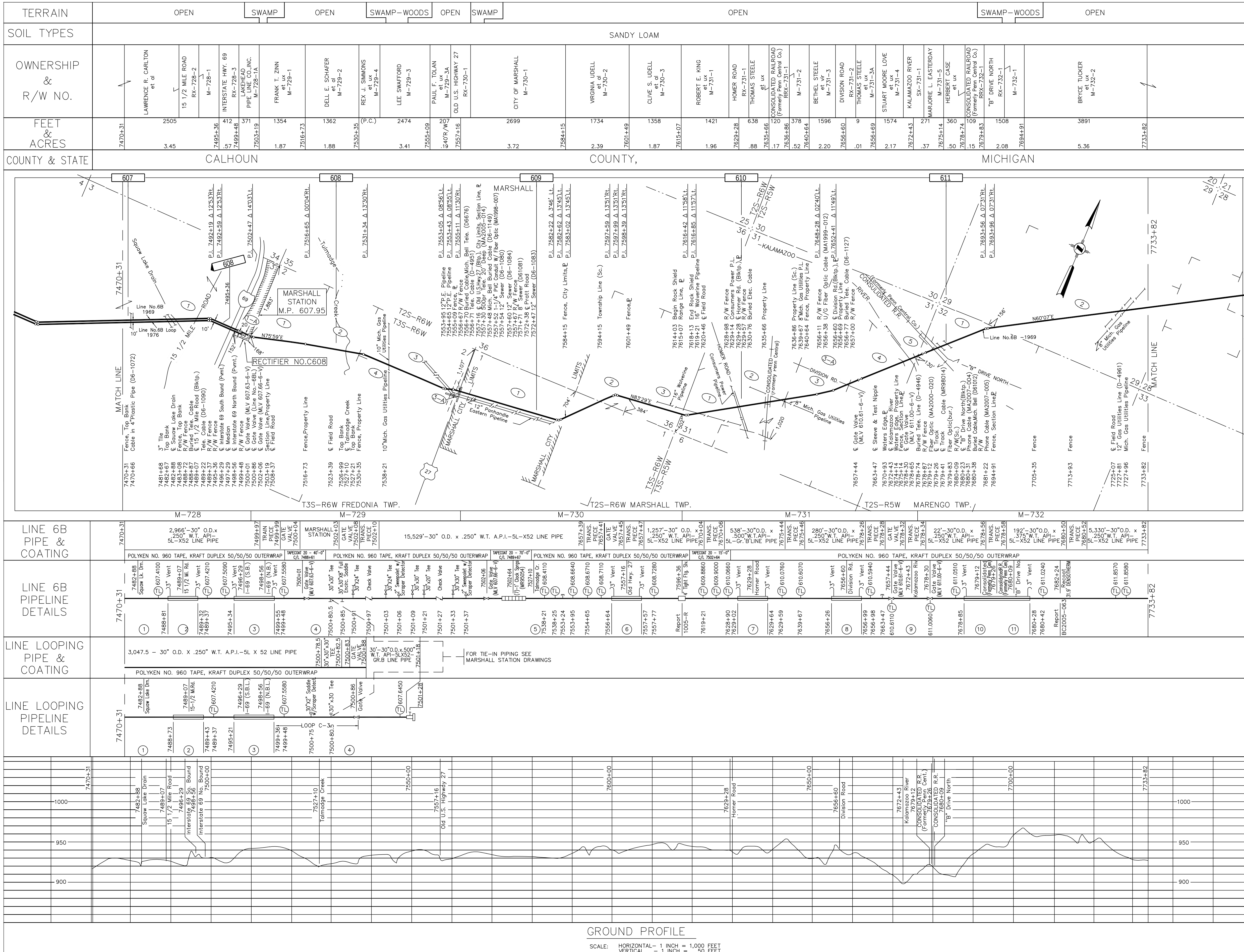
ENBRIDGE™

6B REPAIR

LINE FILL VENTING DETAIL

Figure 1. Cut Locations Line 6B





LINE 6B REFERENCE DRAWINGS & SURVEY NOTES

Detail No.	Description	Drawing No.	Book	Pages
	Alignment Notes		AR–11	29–30
	Alignment Notes		AR–12	2–17
1	Squaw Lake Drain	B–5.84–10443	AP–6	29
2	15/12 Mile Road	B–1.02–1129	AP–6	30
3	Interstate Highway 69	B–5.81–10346	AP–7	2
4	Marshall Station	D–3.2–3611	AR–12	2–4
5	Talmadge Creek	B–5.84–10444	AP–7	4
6	Old U.S. Highway 27	B–1.02–1129	AP–7	5
7	Homer Road	B–1.02–1129	AP–7	6
8	Division Road	B–1.02–1129	AP–7	7
9	Kalamazoo River	C–5.84–10445	AP–7	8–9
10	Consoildated R.R.(Formerly Penn Central Co.)	B–5.82–10383	AP–7	10–11
11	'B' Drive North	B–1.02–1129	AP–7	10–11

LINE LOOPING REFERENCE DRAWINGS & SURVEY NOTES

Detail No.	Description	Drawing No.	Book	Pages
1	Squaw Lake Drain	B–5.84–11225–573	L–7478–1	7
2	15–1/2 Mile Road	B–5081–11222–573	1	3
3	Interstate Highway 69	B–5.81–11223–573	1	2
4	Marshall Station			

POLYKEN 960 TAPE 273 Sq's.
KRAFT OUTERWRAP 265 Sq's.

LEGEND

- 12 — U.S. Highway
- 10 — Interstate Highway
- 7 — State Highway
- XXX — Mile Post, Miles From Superior
- XXX — Aerial Marker
- TL — Test Lead
- T — Air Vent Installation

Note: All R/W is 60' width unless noted.

NO.	REVISIONS	DATE	APPR.	MICRO.
15	Added Test Lead Milepost Numbers	9/18/09 JT	SD	
14	Revised Per PLM Reports	6/7/07 MKS	KWS	
13	Revised Per PLM Reports	5/11/06 MKS	KWS	
12	Revised Per PLM Reports	2/28/05 JT	GMF	

SCALE: 1"=1,000' | DATE 11–10–69 | DRAWN JOHNSON | CHECK n.k. Seay | APPR. J.E. PETERSON

ENBRIDGE

GRIFFITH, IND. TO SARNIA, ONTARIO

30 INCH EXTENSION

M.P. 607.06 to M.P. 612.05

DRAWING NUMBER: E–5.92–10279–15–573

ROUTE INDEX: C–404

U.S. Department
of Transportation

Pipeline and Hazardous Materials
Safety Administration

JUL 2 8 2010

1200 New Jersey Ave., SE
Washington, DC 20590

VIA CERTIFIED MAIL [7009 1410 0000 2472 2704] AND FAX TO: (713) 653-6711

Mr. Terry McGill
President
Enbridge Energy Partners, Ltd
1100 Louisiana, Suite 3300
Houston, TX 77002

Re: CPF No. 3-2010-5008H

Dear Mr. McGill:

Enclosed is a Corrective Action Order issued by the Associate Administrator for Pipeline Safety in the above-referenced case. It requires you to take certain corrective actions with respect to your hazardous liquid pipeline designated as Line 6B in connection with the July 26, 2010 failure near Marshall, Michigan. Service is being made by certified mail and facsimile. Your receipt of this Corrective Action Order constitutes service of that document under 49 C.F.R. § 190.5. The terms and conditions of this Order are effective upon receipt.

Sincerely,

for: Jeffrey D. Wiese
Associate Administrator
for Pipeline Safety

Enclosure

cc: Mr. David Barrett
Director, Central Region, PHMSA

U.S. DEPARTMENT OF TRANSPORTATION
PIPELINE AND HAZARDOUS MATERIALS SAFETY ADMINISTRATION
OFFICE OF PIPELINE SAFETY
WASHINGTON, D.C. 20590

In the Matter of	)	
	)	
Enbridge Energy Partners, Ltd.,	)	**CPF No. 3-2010-5008H**
	)	
Respondent.	)	

CORRECTIVE ACTION ORDER

Purpose and Background

This Corrective Action Order is being issued, under authority of 49 U.S.C. § 60112, to require Enbridge Energy Partners, Ltd. (Enbridge or Respondent), to take the necessary corrective action to protect the public, property, and the environment from potential hazards associated with a failure involving Respondent's 30-inch diameter Line 6B hazardous liquid pipeline.

On July 26, 2010, a failure occurred on the Line 6B pipeline approximately one mile south of Marshall, Michigan, resulting in the release of crude oil. The cause of the failure has not yet been determined. Pursuant to 49 U.S.C. § 60117, the Pipeline and Hazardous Materials Safety Administration (PHMSA), Office of Pipeline Safety (OPS), initiated an investigation of the incident and the National Transportation Safety Board (NTSB) launched a failure investigation team to the incident location.

Preliminary Findings

- At approximately 9:45 a.m. CDT on July 26, 2010, Respondent discovered that a rupture occurred on its Line 6B hazardous liquid pipeline, resulting in the release of an estimated 19,500 barrels of crude oil. The failure occurred at Mile Post (MP) 608, approximately one mile south of the town of Marshall, Michigan. Marshall is located approximately half-way between the cities of Kalamazoo and Jackson, Michigan. The incident was reported to the National Response Center (NRC Report No. 948903).

- Spilled oil from Respondent's pipeline entered the Talmadge Creek and the Kalamazoo River. Emergency responders closed two nearby county roads. Various state and federal agencies including the Environmental Protection Agency, U.S. Coast Guard, and the Michigan Department of Environmental Quality are deploying boom and taking other response and collection measures. Spilled oil has migrated as far downriver as Augusta, Michigan.

- After discovering the failure, Respondent's personnel initiated an emergency shut-down of the pipeline. Respondent's personnel then isolated the line by closing the nearest upstream and nearest downstream block valves.

- The cause of the failure is unknown and the investigation is ongoing. The NTSB will take custody of the failed pipe section once it is excavated and transport it to a metallurgist for examination and failure analysis.

- The pipe in the affected segment was manufactured by Siderius in 1969 and is constructed of 30-inch x 0.250-inch wall thickness, grade X-52 submerged arc weld pipe. It has a Polyken tape coating and an impressed current cathodic protection system.

- At the time of the incident, the estimated operating pressure at the failure site was 425 psig. The maximum operating pressure (MOP) of this line segment is 624 psig and the Marshall Station discharge set point was 523 psig.

- Respondent's Line 6B originates in Griffith, Indiana and runs eastward to Sarnia, Ontario. The U.S. portion is approximately 286 miles in length. Portions of the pipeline are located in High Consequence Areas (HCAs). The line crosses numerous state and local highways.

- Line 6B was last re-assessed for corrosion in June, 2009 with Ultrasonic Technology and prior to that in October, 2007 with Magnetic Flux Leakage technology. On July 15, 2010 Respondent notified PHMSA of an alternative remediation plan for metal loss anomalies found in this survey to consider pipe replacement instead of repair. Enbridge further notified PHMSA that the alternative remediation method would result in exceeding the allowable timeframe to complete remediation.

Determination of Necessity for Corrective Action Order and Right to Hearing

Section 60112 of Title 49, United States Code, provides for the issuance of a Corrective Action Order, after reasonable notice and the opportunity for a hearing, requiring corrective action, which may include the suspended or restricted use of a pipeline facility, physical inspection, testing, repair, replacement, or other action as appropriate. The basis for making the determination that a pipeline facility is hazardous, requiring corrective action, is set forth both in the above referenced statute and 49 C.F.R. §190.233, a copy of which is enclosed.

Section 60112, and the regulations promulgated thereunder, provide for the issuance of a Corrective Action Order without prior opportunity for notice and hearing upon a finding that failure to issue the Order expeditiously will result in likely serious harm to life, property or the environment. In such cases, an opportunity for a hearing will be provided as soon as practicable after the issuance of the Order.

After evaluating the foregoing preliminary findings of fact, I find that the continued operation of the Respondent's Line 6B pipeline without corrective measures would be hazardous to life, property and the environment. Additionally, after considering the age of the pipe, circumstances surrounding this failure, the proximity of the pipeline to populated areas, public roadways and high consequence areas, the hazardous nature of the product the pipeline transports, the pressure required for transporting the material, the uncertainties as to the cause of the failure, and the ongoing investigation to determine the cause of the failure, I find that a failure to issue this Order expeditiously to require immediate corrective action would result in likely serious harm to life, property, and the environment. Accordingly, this Corrective Action Order mandating immediate corrective action is issued without prior notice and opportunity for a hearing. The terms and conditions of this Order are effective upon receipt.

Within 10 days of receipt of this Order, Respondent may request a hearing, to be held as soon as practicable, by notifying the Associate Administrator for Pipeline Safety in writing, delivered personally, by mail or by telecopy at (202) 366-4566. The hearing will be held in Kansas City, Missouri or Washington, D.C. on a date that is mutually convenient to PHMSA and Respondent.

After receiving and analyzing additional data in the course of this investigation, PHMSA may identify other corrective measures that need to be taken. Respondent will be notified of any additional measures required and amendment of this Order will be considered. To the extent consistent with safety, Respondent will be afforded notice and an opportunity for a hearing prior to the imposition of any additional corrective measures.

Required Corrective Action

Pursuant to 49 U.S.C. § 60112, I hereby order Enbridge Energy Partners, Ltd. to immediately take the following corrective actions with respect to Line 6B:

1. Prior to resuming operation of the section of Line 6B pipeline segment running from the Marshall Station to the Stockbridge Station, develop and submit a written restart plan for prior approval of the Director, Central Region, OPS, Pipeline and Hazardous Materials Safety Administration, 901 Locust Street, Suite 462, Kansas City, MO 64106-2641.

2. The restart plan must provide for adequate patrolling of the pipeline segment during the restart process and must include:

    A. Exposure of the pipeline extending 50 feet on either side of the failed pipe joint to examine for corrosion, coating condition, or other issues. Expose further pipe as needed. Repair or replace pipe or coating as necessary in accordance with 49 C.F.R. Part 195. Upon completion of pipe replacement and repairs, ensure proper backfill and protection from stones and rocks;

    B. Verify adequate cathodic protection for the area where the failure occurred. Once backfill and land settling has occurred, ensure pipe-to-soil readings are within applicable criteria; and

    C. Perform incremental start-up in 25% pressure increments with each increment to be held for at least one hour. Include sufficient surveillance on each increment to ensure that no leaks are present when operation of the line is resumed.

   The restart plan must specify a daylight restart and detail advance communications with local emergency response officials. Obtain written approval to resume operation of the line from the Regional Director prior to resuming operation.

3. After receiving approval from the Regional Director to restart the pipeline, maintain a twenty percent (20%) pressure reduction in the operating pressure of Line 6B. The operating pressure of Line 6B is not to exceed eighty percent (80%) of the operating pressure in effect immediately prior to the failure. Specifically, the pressure in the Marshall Station discharge segment is not to exceed 340 psig. Enbridge must reset the station discharge set points for all other stations on Line 6B not to exceed 80% of the discharge pressures in effect at the time of the failure. This pressure restriction will remain in effect until written approval to increase the pressure or return the pipeline to its pre-failure operating pressure is obtained from the Regional Director pursuant to Item 11.

4. Transfer custody of the failed pipe to the NTSB for mechanical and metallurgical testing and failure analysis, including analysis of soil samples and any foreign materials. The mechanical and metallurgical testing protocols shall be determined by the NTSB in consultation with PHMSA.

5. Within 60 days following receipt of this order, submit an integrity verification and remedial work plan to the Regional Director for approval. The plan must provide for the verification of the integrity of the pipeline and must address all factors known or suspected in the July 26, 2010 failure. The plan must include:

   A. Integrate the results of the metallurgical analysis performed pursuant to Item 4 with all relevant operating data in analyzing the July 26, 2010 failure;

   B. Review the failure history of the entire U.S. portion of Line 6B over the past 20 years and develop a written report containing all available information on the locations of failures, dates of failures, and cause of failures and describing your plans to confirm that the remainder of the line is not susceptible to more such failures. Make the report available to the Regional Director.

   C. Evaluate the remainder of Line 6B to determine whether the condition(s) involved in the July 26, 2010 failure, or any other integrity threatening condition(s), are present. The evaluation methods used must be technologically appropriate for assessing the pipeline based on the type of failure that occurred on July 26, 2010 and should include consideration of pressure testing and/or additional in-line inspections supplemented by complimentary direct assessment as appropriate;

   D. Include a detailed description of the inspection and repair criteria to be used in the field evaluation of any anomalies that are excavated. This is to include a description of how any defects are to be graded and the schedule for repairs or replacement;

   E. Include provisions for continuing long-term periodic testing and integrity verification measures to ensure the ongoing safe operation of the affected segment considering the results of the analyses, inspections, and corrective measures undertaken pursuant to this Order;

   F. Include a proposed schedule for completion of the actions required by paragraphs A-E of this Item.

6. Upon approval by the Regional Director, the integrity verification and remedial work plan becomes incorporated into this Order and shall be revised as necessary to incorporate the results of actions undertaken pursuant to this Order and whenever necessary to incorporate new information obtained during the failure investigation and remedial activities. Submit any such plan revisions to the Regional Director for prior approval. The Regional Director may approve plan elements incrementally.

7. Implement the work plan as it is approved by the Regional Director, including any revisions to the plan.

8. Submit quarterly reports to the Regional Director that: (1) include all available data and results of the testing and evaluations required by this Order; and (2) describe the progress of the repairs or other remedial actions being undertaken. The first quarterly report for the period from July 26, 2010 through October 31, 2010 shall be due by November 30, 2010.

9. Maintain documentation of the costs associated with implementation of this Corrective Action Order. Include in each monthly report submitted, the to-date total costs associated with: (1) preparation and revision of procedures, studies and analyses; (2) physical changes to pipeline infrastructure, including repairs, replacements and other modifications; and (3) environmental remediation, if applicable.

10. With respect to each submission that under this Order requires the approval of the Regional Director, the Director may: (a) approve, in whole or part, the submission; (b) approve the submission on specified conditions; (c) modify the submission to cure any deficiencies; (d) disapprove in whole or in part, the submission, directing that Respondent modify the submission, or (e) any combination of the above. In the event of approval, approval upon conditions, or modification by the Regional Director, Respondent shall proceed to take all action required by the submission as approved or modified by the Director. If the Regional Director disapproves all or any portion of the submission, Respondent shall correct all deficiencies within the time specified by the Regional Director, and resubmit it for approval.

11. The Regional Director may allow the removal or modification of the pressure restriction set forth in Item 3 upon a written request from Respondent demonstrating that the hazard has been abated and that restoring the pipeline to its pre-failure operating pressure or established MOP is justified based on a reliable engineering analysis showing that the pressure increase is safe considering all known defects, anomalies and operating parameters of the pipeline.

The Regional Director may grant an extension of time for compliance with any of the terms of this Order upon a written request timely submitted demonstrating good cause for an extension.

The actions required by this Corrective Action Order are in addition to and do not waive any requirements that apply to Respondent's pipeline system under 49 C.F.R. Part 195, under any other order issued to Respondent under authority of 49 U.S.C. § 60101 et seq., or under any other provision of Federal or State law.

Respondent may appeal any decision of the Regional Director to the Associate Administrator for Pipeline Safety. Decisions of the Associate Administrator shall be final.

Failure to comply with this Order may result in the assessment of civil penalties and in referral to the Attorney General for appropriate relief in United States District Court pursuant to 49 U.S.C. § 60120.

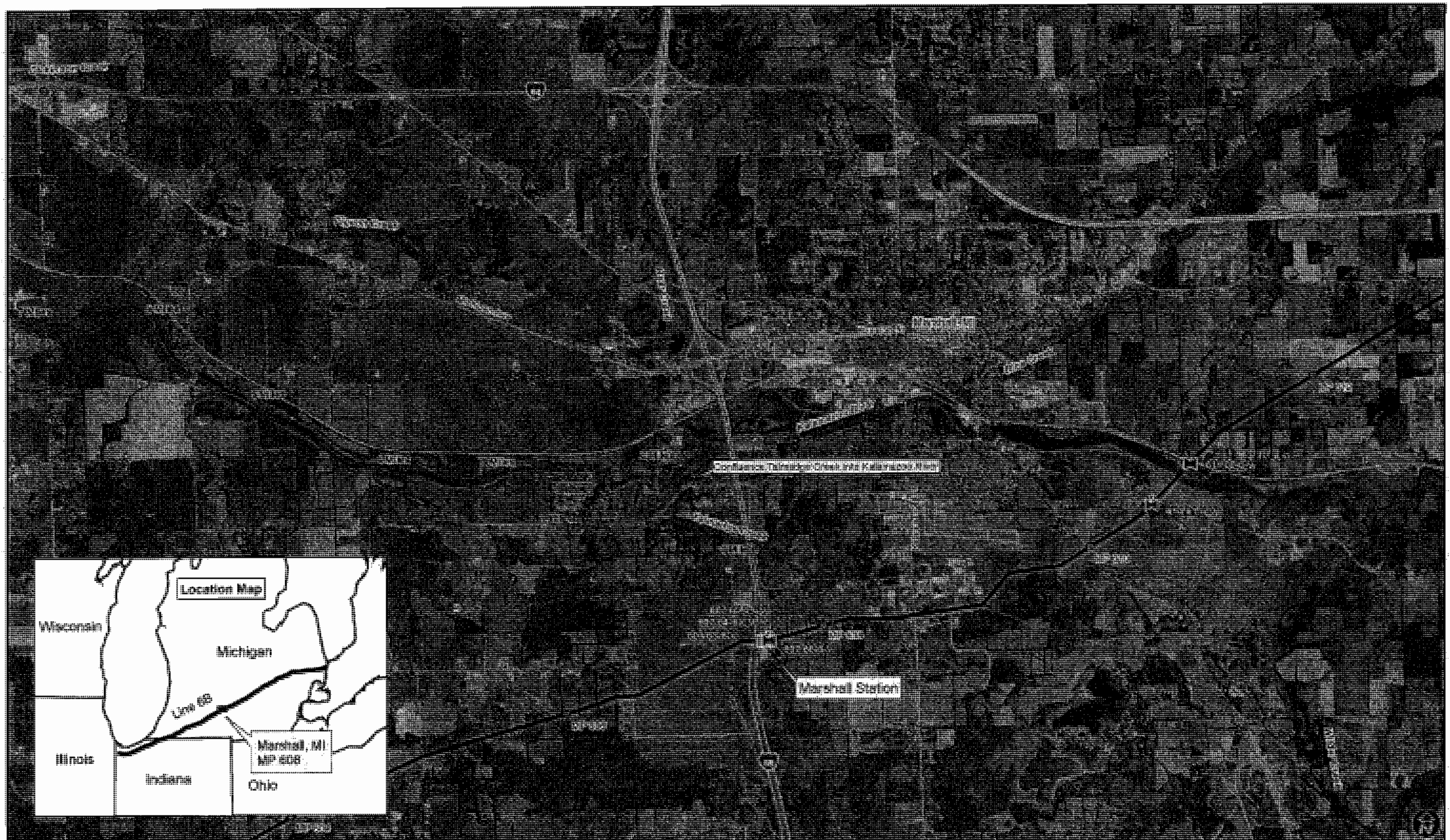
The terms and conditions of this Corrective Action Order are effective upon receipt.

JWiese

Jeffrey D. Wiese
Associate Administrator
for Pipeline Safety

JUL 28 2010

Date Issued



ENBRIDGE

Legend

- Pipeline
- Station
- Approximate Milepost
- Miles Downstream
- River Course
- Gate Valve (Hand)
- Gate Valve (Motorized)
- Gate Valve (Remote)

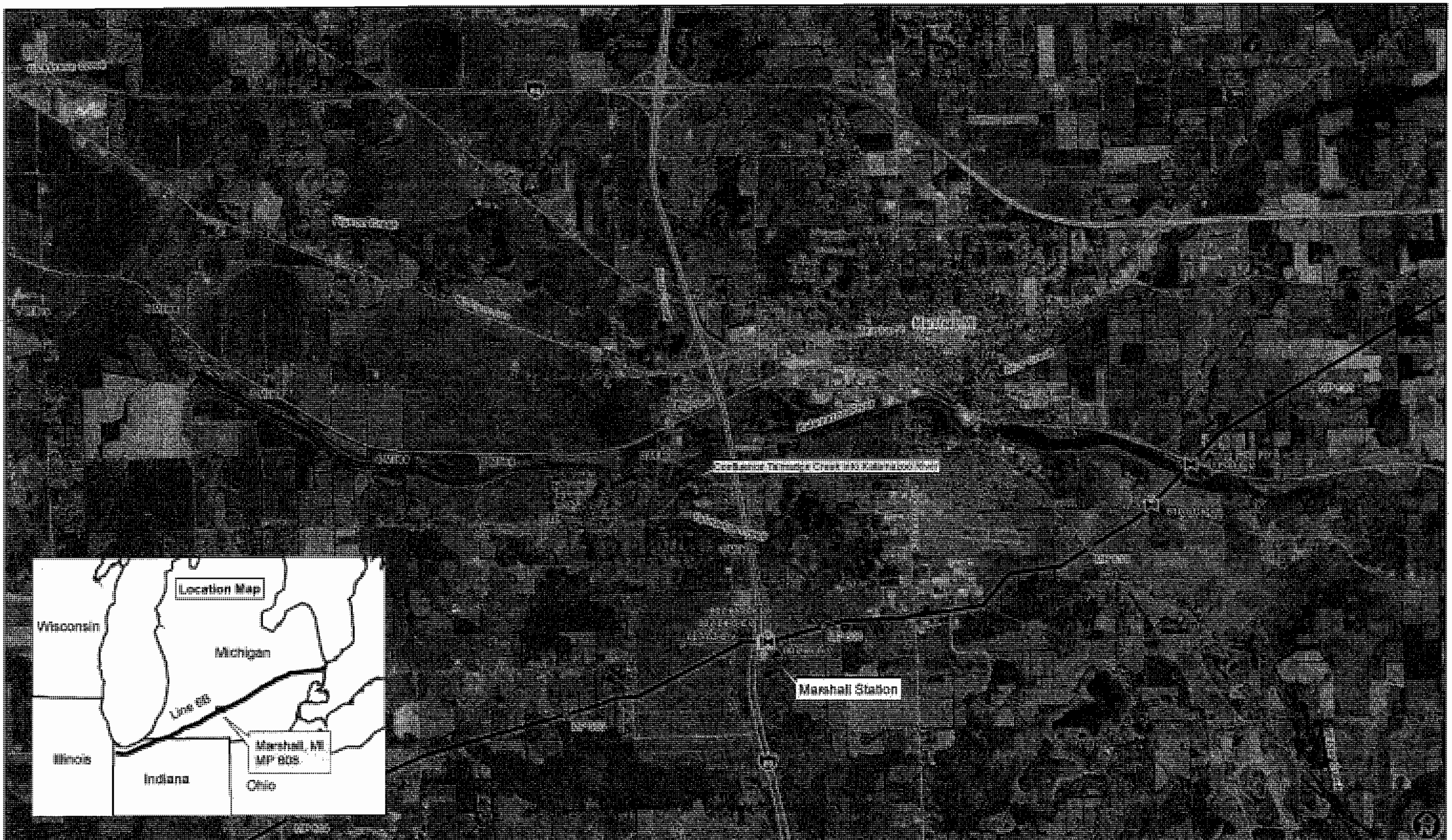
Enbridge Energy, Limited Partnership

Figure 1: Overview Map Line 6B (30") MP 608 Crude Oil

0 0.5 1 1.5 2 Miles

DATE ISSUED: 8/1/2010
DATE REVISED:
SCALE: 1:40,000
DRAWN BY: JAI
SERIES: Line 6B MP 608

Natural Resources Engineering Co.



ENBRIDGE

Legend

Pipeline
Station
Approximate Milepost
Miles Downstream
River Course
Gate Valve (Hand)
Gate Valve (Motorized)
Gate Valve (Remote)

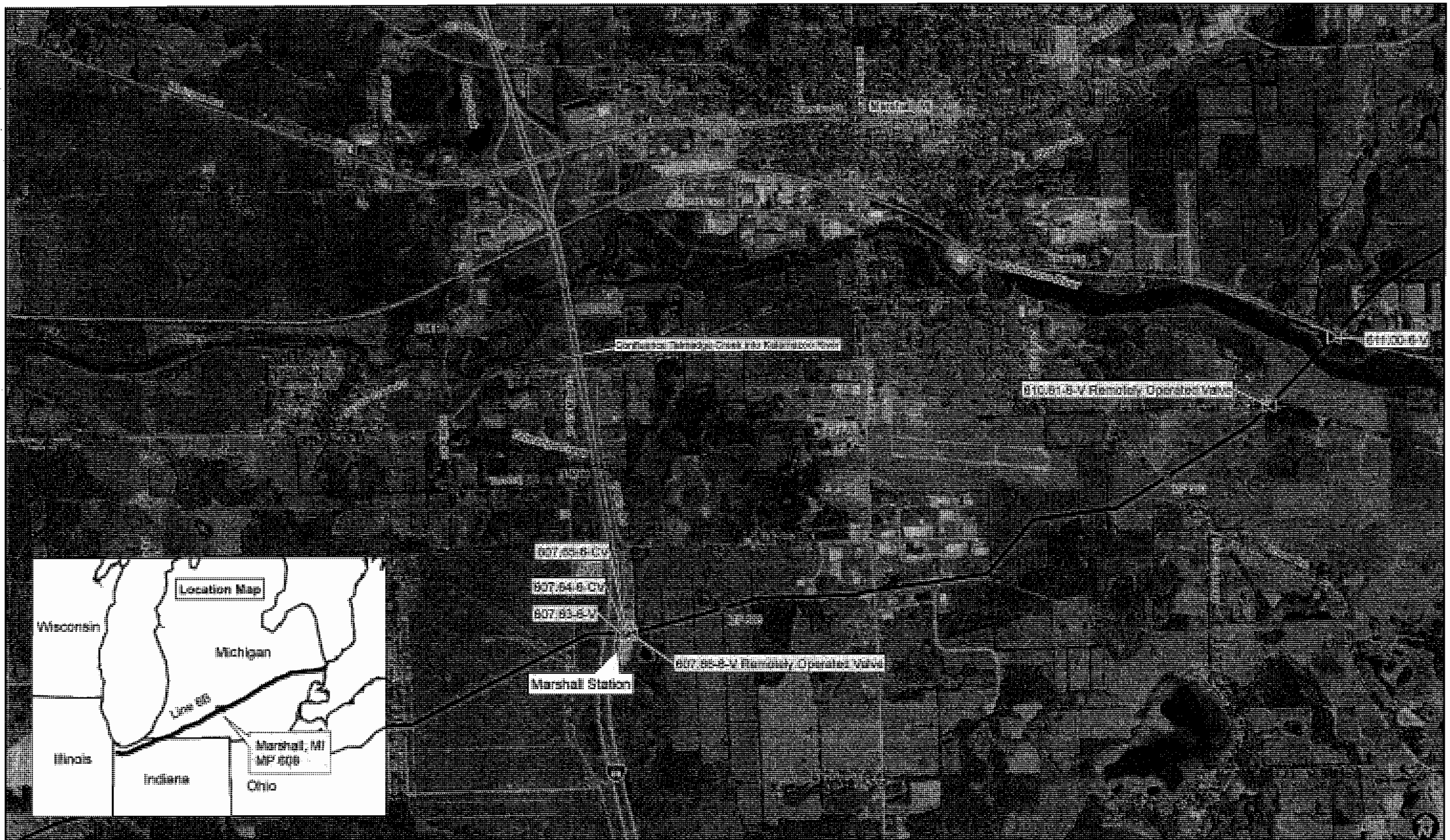
Enbridge Energy, Limited Partnership

Figure 1: Overview Map Line 6B (30") MP 608
Crude Oil

0 0.5 1 1.5 2 Miles

DATE ISSUED: 8/1/2010
DATE REVISED:
SCALE: 1:40,000
DRAWN BY: JAI
SERIES: Line 6B MP 608

Natural Resources Engineering Co.
715-395-5080



ENBRIDGE

Legend
Pipeline
Station
Approximate Milepost
Miles Downstream
River Course
Gate Valve (Hand)
Gate Valve (Motorized)
Gate Valve (Remote)

Enbridge Energy, Limited Partnership

Figure 2: Valve Map Line 6B (30") MP 608
Crude Oil

0 0.25 0.5 0.75 1 Miles

DATE ISSUED: 8/1/2010
DATE REVISED:
SCALE: 1:24,000
DRAWN BY: JAI
SERIES: Line 6B MP 608

Natural Resources Engineering Co.
715-395-5860

Line 6B MP608 - Isolation Valve Locations

Enbridge Pipelines (Lakehead), Inc.

Isolation Valve	Stationing (feet)	Type	Operation	Approximate Surface Elevation (feet MSL)
MLV 607.66-6-v	7502+06	Gate	Remote	922.8
MLV 610.61-6-v	7657+44	Gate	Remote	930.5

Section Length =	15,538	(feet)
Section Volume =	13,134	(bbls)

L6BMP608Valves

Natural Resources Engineering Company does not guarantee the accuracy of the material herein contained and is not responsible for any misuse or misrepresentation of the information.

Natural Resources Engineering Co.
715-395-5680

Map created on Aug 1, 2010 10:11. This information is to be used for reference purposes only.
Natural Resource Engineering Company at http://www.nrecompany.com/

L6BMP608Valves

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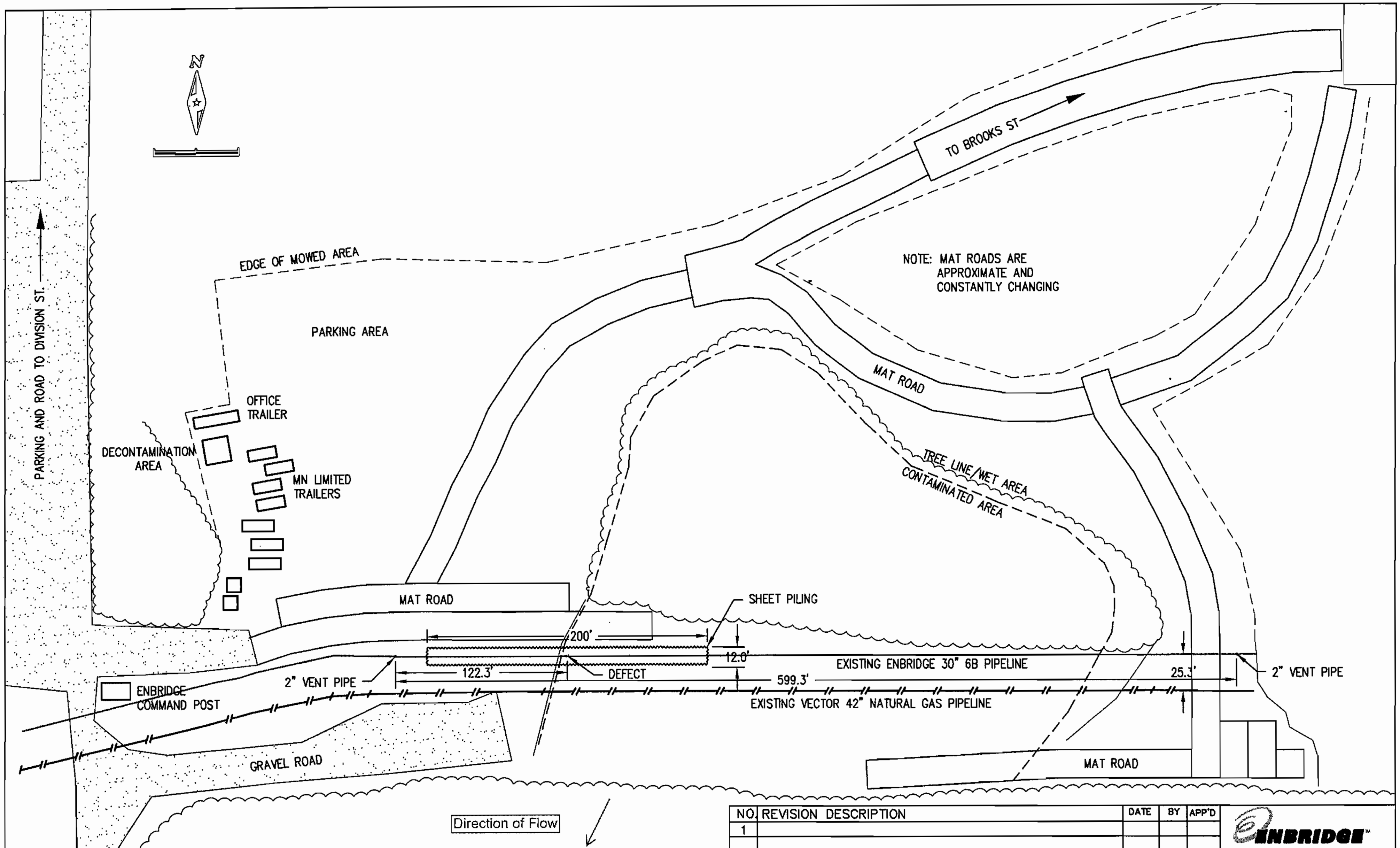
Natural Resources Engineering Co.
715-395-5680



ISSUED 8/01/10 9:30am

NO.	REVISION DESCRIPTION	DATE	BY	APP'D
1				

ENBRIDGE

LINE 6B
SITE PLAN

EXCAVATION and SHORING

Scope of work

Incidents involving pipelines often result from unsafe excavation practices that can damage the pipeline and result in injury or fatality to workers and the public.

The scope of this section includes the requirements that will reduce the likelihood of damage to underground facilities and ensure excavating activities are completed in a safe and environmentally efficient manner. Additionally, the adjacent pipeline has been stabilized and protected by sheet piling and mats. Such measures have been verified and approved by the gas pipeline operator Vector Pipeline Company.

Regulatory Requirements

Code of Federal Regulations (CFR):

- Title 29, Part 1926—Safety and Health Regulations for Construction, Subpart P—Excavations
- Title 49 , Part 195—Transportation of Hazardous Liquids by Pipeline, Part F—Operation and Maintenance
- Title 49, Part 192 - Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

Area contingency plan/regional contingency plan

Federal and state natural resource agencies

Federal, state and local environmental agency regulations

State occupational health and safety regulations

Company Standards

Book 3 02-02-02 Erosion Control

Book 3 02-02-05 Stormwater Management

Book 3 04-02-01 Safeguarding Workers and Public

Book 3 04-02-01 Damage Prevention

Book 3 04-02-01 Pipe Support and Backfill

Exceptions to standards or specific site requirements- None

Related Standards

Company

Book 2: Safety

- *11-02-07 Heavy Equipment*

Book 3: Pipeline Facilities

- *04-02-01 Safeguarding Workers and Public*
- *04-02-02 Damage Prevention*

Responsibilities

Equipment Operators

Before operating equipment in the work area, operators are responsible for:

- verifying the location of above and below ground pipes, cables and conduits in the work area
- discussing and agreeing on hand signals with the designated spotter
- ensuring spotters understand their responsibilities

Qualifications

Operators of excavating equipment must be qualified (i.e., Ground Disturbance Level II [CAN], OQ [USA]) on the type of equipment used, and working around below grade facilities and within congested areas (i.e., previous industrial/plant experience).

Personnel performing damage prevention and excavation activities in the U.S. need to have completed operator qualification (OQ) documentation or be working with a qualified person under the appropriate span of control ratio per the company OQ Plan.

Spotters

CAN — Spotters must be qualified (Ground Disturbance Level II)

Spotters are responsible for:

- checking the location of above and below ground pipes, cables, and conduits in the work area using agreed-on hand signals to assist the operator in maintaining required clearances and depth of cuts
- observing progress and using hand signals and/or verbal communication to alert the operator to potential dangers
- where the operator loses sight of a facility, probing to locate the facility
- manually removing soil within 0.3 m (1 ft) of a facility
- stopping the work if unmanaged or unexpected hazards arise (e.g., unidentified facilities, contact between the excavation equipment and a facility)

NOTE: Unreported contact between excavating equipment and a facility will result in disciplinary action.

Requirements

Excavating must always be done by two workers, the equipment operator and a spotter.

Operator Qualification (OQ) is required if performing damage prevention during excavation activities in the U.S.

Equipment

Gradalls, backhoes, or excavators may be used as excavation equipment.

Buckets with teeth may be used where conditions allow (e.g., frozen ground, rock, demolition of abrasive materials such as concrete or asphalt, areas with no below grade facilities), on approval by the company representative and the site supervisor.

Procedure

Excavating the Worksite

⚠ **CAUTION**: Use extreme caution when machine excavating in high-risk areas containing buried facilities. Vacuum excavation or manual excavation are required when possible in congested areas.

1. Request locates of foreign facilities.

2. Arrange to have landowners/tenants contacted for access, if applicable.

3. Determine storage requirements for topsoil and spoil piles.

4. Make/receive One-Call notification:
    a) Print a copy of the One-Call notification when it is received. Establish if notification is routine or an emergency.
    b) Determine if company pipelines are within the excavation site. If the location of excavation is unclear, call submitter of One-Call. If necessary, meet in field at proposed excavation site to confirm.
    c) If the excavation location is verified as 'no conflict' with company pipelines, notify the One-Call submitter as required by state One-Call laws.
    d) If the excavation site is verified as 'conflict' with the company pipelines, call the One-Call submitter and arrange a meeting at the excavation site, if necessary, to discuss the excavation procedures.

5. Determine the width of the right-of-way (ROW) and temporary workspace.

6. Locate and stake company facilities.
7. Positively identify and mark potential hazards.
8. Take photographs for restoration reference.
9. Notify the control center of beginning and end of work day excavation.
10. Erect wind sock.
11. Obtain a Safe Work Permit.
12. Arrange to have vegetation cleared from the worksite.
13. Discuss the excavation procedure with the equipment operator.
14. Set up safety equipment.
15. Secure area by posting signs and erecting barricades or fences.
16. Notify the control center.
17. Gather the required equipment, including the proper personal protective equipment.
18. Strip topsoil from the worksite and access road, if necessary.
19. Excavate the site and install pipe supports in accordance with company procedures that reference slope, step, shore, clearance distance, etc.
20. Inspect exposed pipe and monitor excavation activities.
21. Complete project activities.
22. Backfill and restoration in accordance with company procedures.
23. Get approval from landowner through Lands & Right-of-Way, if applicable.

Purpose

To protect pipelines and facilities when operating mechanized equipment or other below grade activity with the potential for damage takes place near company facilities.

Scope

This applies for both company facilities and foreign crossings.

Requirements

One-Call System

Notify the One-Call Center at least 2 or 3 working days before starting any below grade activity (see state and provincial specific Once-Call regulations).

NOTE: The One-Call Center will notify facility owners and request that all buried facilities in the area of the proposed activity are located and staked.

USA

NOTE: The Information Retrieval Ticket Handling (IRTH) system receives notification from the One-Call Center and assigns One-Call tickets to the appropriate service area. For emergency work during normal working hours and as backup to the IRTH system, the One-Call Center or the region (depending on the service area) will notify the locator directly. For emergency work after hours, the respective control centre or the region (depending on the service area) will notify the location directly

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CAN

Facility owners within 30 m (100 ft) of the proposed below grade activity that are not members of the One-Call system must be contacted directly.

Facility Locates

Refer notifications of planned excavations to the One-Call Center.

When notification of a planned excavation is received and before any potentially destructive below grade activity begins, within 2 or 3 working days or a mutually agreed timeframe, depending on location, regions are responsible for:

- recording the information on the Facility Locate Request/Safety Zone Excavation Request form (CAN) as applicable, or on the One-Call ticket where positive response is required (USA)
- identifying and marking all facilities if necessary
- ensuring the applicant is advised when locating and staking is complete, and that the applicant understands the scope of work and the markings

Facility owners may conduct emergency work without advance notification provided the facility owner notifies the region.

Unauthorized Crossings

CAN

Use the Unauthorized Crossing Information report to immediately report any unauthorized ground disturbance on the right-of-way (ROW) or within 30 m of the ROW of a non company utility or road to Lands & Right-of-Way.

USA

Use the One-Call Violations form to immediately report any unauthorized ground disturbance on the ROW to the regional office. Regions are responsible for:

- providing One-Call Center information to the offending worker and/or the company
- ensuring one-call violators are included in the list of excavators
- for subsequent violations, notifying state or federal regulators as necessary

Surface Locating

Before beginning mechanical excavation/trenching or other potentially destructive below grade activity, all facilities (a) within the perimeter of the excavation and (b) extending 3 m (10 ft) outside the perimeter of the excavation, or for ENB (Athabasca) extending 5 m (16.5 ft) outside the perimeter of the excavation, must be surface located.

NOTE: To identify the location of facilities in the work area, refer to as built drawings, mainline route/alignment sheets, station piping, instrumentation and cathodic protection drawings, electrical drawings, and/or station photographs. In addition, consult with field employees familiar with the site to identify any other below grade facilities that may not be recorded.

Use a line locator to identify all below grade facilities within the work area.

Use flags, stakes, or paint in accordance with the universal color codes to mark (a) the centerline of facilities, and (b) any changes in direction or elevation.

Space markers (a) no more than 3 m (10 ft) apart directly over the centerline of the facility, or (b) at appropriate intervals on the ROW.

For foreign crossings, identify stakes with:

- company name
- ℄ to denote facility centerline
- size and type of facility (e.g., 20-in. Line 1, conduit, high voltage)
- depth below grade, if required

NOTE: Identify the depth below grade before excavating to prevent an excavator from crossing without approval or notification.

Staking of company facilities is not required when the proposed activity is outside the ROW for a specified work period. However, the ROW boundary must be clearly identified using stakes with pink marking at the top (e.g., tape, paint) or pink flags, and writing in permanent marker (a) on one side, "Restricted Area", and (b) on the other side, the limit represented (e.g., "Enbridge P/L ROW").

Where the proposed activity is separated from the company facility (or ROW) by an existing boundary (e.g., fence, hedge, noise barrier) it is not necessary to mark the ROW boundary.

All facilities within station property that are less than 1 m (3 ft) above grade or that are protected by less than 0.3 m (1 ft) of cover should be (a) permanently marked with stakes that extend a minimum of 1 m (3 ft) above grade and (b) flagged, if necessary, to ensure visibility.

NOTE: In roadways and driveways, permanent marking is not feasible. Each side of these areas should be marked to indicate the pipeline alignment.

Confirm the number, locations, and dimensions of facilities with as-built drawings and other field records to ensure all facilities are located.

Markers

There must be a clear line of vision between markers identifying a particular facility location.

All markers must be highly visible to equipment operators despite local conditions (e.g., wind, snow).

Markers must remain in place for the duration of the work activities. If any markers become dislodged, notify the site inspector.

Before resuming activities previously initiated by other workers, review the location and identification of facilities.

Positive Confirmation

Once the location of below grade facilities are surface located, before beginning mechanical excavation or any other potentially destructive below grade activity, the location, depth, and size of below grade facilities within the perimeter of the excavation must be positively confirmed by hand digging, water washing, or repeated probing to ensure clearances.

NOTE: Positively confirm any changes in pipe alignment, elevation, or any appurtenances (e.g., plugs, O-lets and other fittings, flanges, branch piping).

⚠ **WARNING**: Cover any hand dug or water washed holes with plywood or erect suitable barricades.

Clearances

Mechanized equipment must remain at least 0.6 m (2 ft) from any below grade facility (based on drawings, instrument readings, and/or probing) until the facility is exposed (i.e., daylighted) by hand digging or water washing to the view of the equipment operator or spotter.

NOTE: Where safe to do so, probe while excavating to ensure minimum clearances are maintained until the below grade facility is exposed to view.

With the facility exposed and in view of the equipment operator or spotter, the cutting edge of mechanized equipment must remain clear of below facilities by at least 0.3 m (12 in.). Final exposure of underground facilities must be done by hand.

Foreign Crossings

Before mechanical excavation or other potentially destructive below grade activity begins for a foreign crossing on the ROW or within 3 m (10 ft) of the company's pipeline, the location, depth, and size of the company's pipeline must be positively confirmed as follows:

- Where the foreign facility will cross the company's pipeline(s), each pipe must be exposed (i.e., daylighted) at the point of crossing by hand digging or water washing. However, if (a) the top of the pipe on drawings and instrument readings is more than 0.6 m (2 ft) below the proposed excavation/underground activity at the point of crossing, or (b) ground conditions or the depth of the pipe make exposure by hand digging or water washing impractical, the excavation may proceed under direct supervision of the company representative to no closer than 0.6 m (2 ft) from the pipe, confirmed by repeated probing as the excavation progresses. Final exposure must be done by hand.

- Where the foreign facility will be constructed adjacent or parallel to a company pipeline outside the ROW, the pipe must be located at sufficient intervals to confirm its position or direction by hand digging, water washing, or probing under the direct supervision of the site inspector.

Boring

When a boring device is used to install a facility across one or more pipelines, the location of the boring device must be positively confirmed by excavating a test hole before and between each facility.

Pilings

Before installing pilings within stations, the location of below grade facilities must be positively confirmed and piling holes water washed, 0.3 to 0.6 m (1 to 2 ft) below the intended depth of the pilings.

Temporary Crossing Ramps

Use temporary crossing ramps (see Figure 1) when vehicles pass over existing pipelines where:

- ruts are likely to develop at the crossing
- depth of cover (i.e., top of pipe to ground) is less than 1.3 m (52 in.)
- vehicle single axle loading exceeds 12,000 kg (25,000 lb)
- vehicles will be continually crossing (e.g., logging trucks)
- the pipeline to be crossed has been installed for under a year
- the crossing lies in a wet area (e.g., marsh, swamp, peat bog)

NOTE: Vehicle crossings in normally wet areas are prohibited unless winter conditions exist and frost depth is 0.3 m (1 ft) or greater.

Temporary crossing ramps may not be required where:

- the vehicles crossing the pipeline are low ground pressure (LGP) tracked equipment exerting 5.80 psi or less ground pressure, the depth of cover is no less than 0.9 m (36 in.) of consolidated clay soil, and repeated crossings are not required (e.g., a crossing by a D6 with 30 in. or larger track width, or a D5 with 24 in. or larger track width)

- the depth of cover is, or is increased to, 1.3 m (52 in.) or greater, the vehicle axle loading is highway legal, conditions are dry, and a company representative is onsite when vehicles are crossing the pipeline

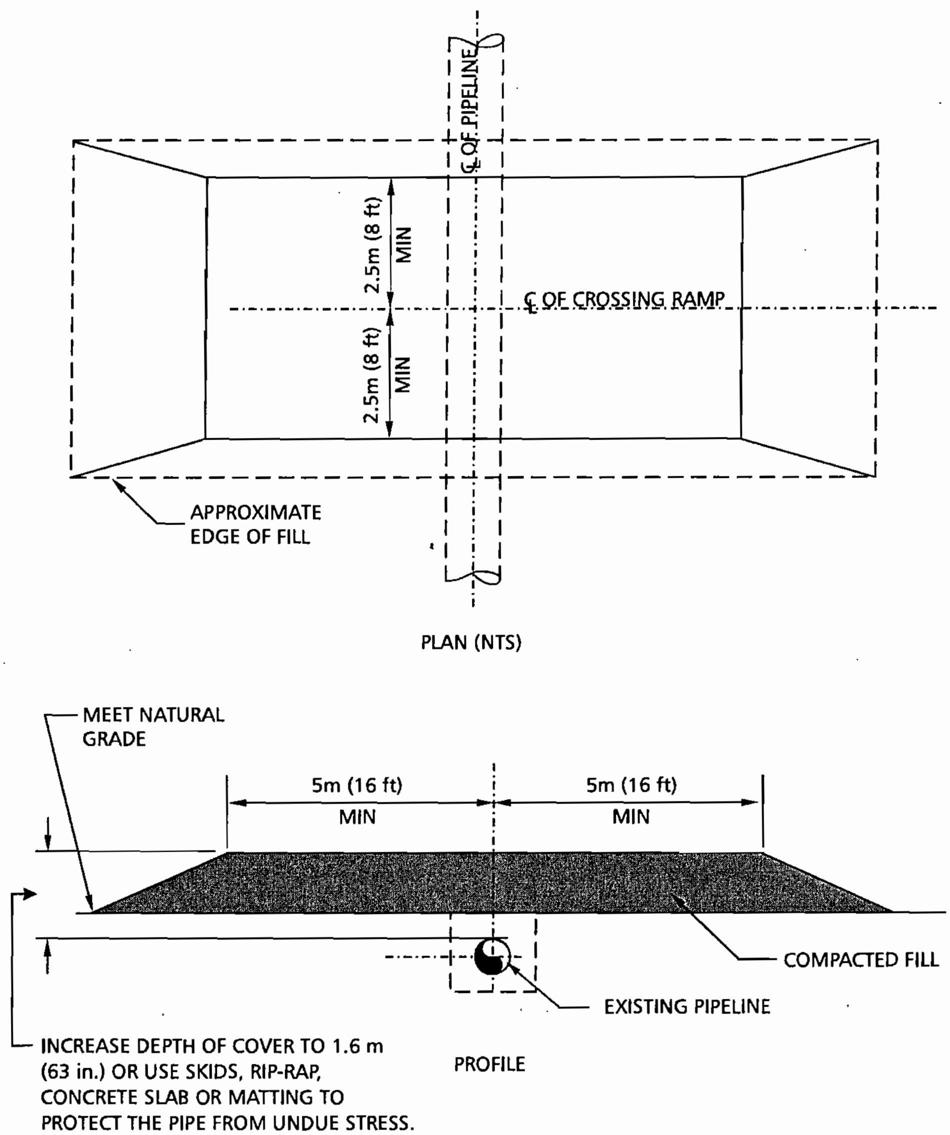
Construct temporary crossing ramps to provide 1.6 m (63 in.) of cover over the pipeline (see Figure 1). Contact Lands & Right-of-Way if situations do not fit the listed conditions, before relaxing the standard, or if soil conditions are questionable.

Before constructing temporary crossing ramps, contact the regional engineer (USA) or Lands & Right-of-Way (CAN).

Remove temporary access ramps upon completion of the work.

Records **One-Call Violation Form**

USA ········ Retain One-Call Violation forms at the region for 3 years.



NOTES

- In rock terrain, expose pipes and backfill the ditch with compacted sand or selected fill.
- When crossing multiple pipelines, construct one continuous ramp across such lines.
- Ramp length varies in accordance with the crossing angle.
- On project completion, remove the entire ramp and restore the area.
- During winter, snow and water can be used to make an ice bridge of equal proportions.

Figure 1
Temporary Ramp

Purpose

To protect the safety of workers and the public when operating mechanized excavation equipment, or other below grade activity with the potential for damage, takes place near company facilities.

Scope

This applies to activities supervised by company employees. This does not apply where contractors or contractor personnel supervise the work.

Related Standards

Company

Book 2: Safety

- *03-02-01 Safe Work Permit – Hazard Assessment*

Book 3: Pipeline Facilities

- *04-02-02 Damage Prevention*

Responsibilities

Company Representative

> **WARNING**: A company representative must remain onsite to continually monitor any mechanized excavation, or other activity with the potential for damage, that takes place within 3 m (10 ft) of a company facility, or for ENB (Athabasca) within 5 m (16.5 ft) of a company facility, whether located above or below grade.

The company representative, who must be a competent worker, is responsible for ensuring:

- activities involving mechanized equipment are adequately supervised
- company facilities in the work area are surface located
- necessary safety precautions are taken considering the unique aspects of the work
- workers and facilities are adequately protected in accordance with this standard
- work stops if there is a concern for safety, pipeline integrity, or damage to company equipment or facilities
- exposed pipes, conduits, and cables are not damaged, confirmed by visual inspection in the ditch/excavation before backfilling

Requirements

A hazard assessment must be completed by company employees any time activity takes place near company facilities.

Inspections

A competent worker must conduct daily inspections of excavations, adjacent areas, and protective equipment:

- before starting work

- as needed throughout the shift
- after rainstorms or other occurrence that could create a hazard

Inspections must look for:
- situations that could result in cave-ins
- indications of failure of protective systems
- hazardous atmospheres or other hazardous condition

NOTE: When a hazardous atmosphere may be expected, emergency rescue equipment, including breathing apparatus and rescue harness and line, must be available.

Excavation Size and Shape
Excavations must be large enough in all dimensions for safe and easy working conditions.

Scrape all loose materials from the sides of an excavation and from walking and working areas where workers will be present.

Spoil Piles, Materials, Tools, and Equipment
Store spoil piles, materials, tools, vehicles, and equipment at least 1 m (3 ft) (CAN) or at least 0.6 m (2 ft) (USA) from the edge of an excavation, trench, or borehole.

CAUTION: Mechanized equipment must not operate closer than 1 m (CAN) or 2 ft (USA) from the edge of an excavation.

Slope spoil piles next to excavations, trenches, or boreholes at an angle not less than 45° to the vertical.

Thoroughly remove all lumps and stones from walking and working surfaces, and from excavated spoil.

Entrances/Exits
CAN: For excavations greater than 1.2 m (4 ft) deep, provide at least 2 entrances/exits.

WARNING: Where a portion of an excavation greater than 4 ft (1.2 m) deep is constructed with vertical walls, use warning signs attached to barricades or ropes, or other appropriate methods to prevent workers from entering that portion of the excavation.

USA: If workers are required to work on either side of the pipe, provide an exit on each side of the pipe.

Locate entrances/exits so that no worker travels more than 8 m (25 ft) in either direction to exit the trench.

Entrances/exits must be ladders, steps, or sloped walkways of not more than 1:3 slope.

Side rails of ladders must extend 1 m (3 ft) out of the trench or excavation.

Water Accumulation

Keep all excavations, trenches, and boreholes free of accumulations of water where workers are present.

A competent worker must monitor water removal equipment.

Water pumped from an excavation should be discharged into an energy dissipation or erosion control device located in adjacent upland areas or other well-vegetated areas.

NOTE: A permit may be required depending on the amount of water pumped from the excavation. For more information, contact Safety & Environment.

Sloping

Slope the walls of the excavation when (a) the excavation is greater than 1.2 m (4 ft) deep, and (b) shoring or a trench box is not used.

If a worker must lie down or kneel in a trench without an approved temporary protective structure, slope the trench wall from the bottom of the excavation in the area where the work will occur.

Soil Analysis

CAN

A competent worker must examine the type of soil in an excavation or trench to ensure the stability of sloping used for excavations and trenches. The angle of sloping must not be less than required by provincial regulations.

Treat frozen soil conditions the same as unfrozen soil conditions.

NOTE: Stable rock is comprised of solid mineral matter and does not require sloping.

USA

Classification of Soil and Rock

A competent worker must classify each soil and rock deposit before and during excavation as one of the following soil types:

- Type A—clay and cemented soils
- Type B—angular gravel, silt loam, crushed rock, etc.
- Type C—gravel, sand, submerged soil, etc.

NOTE: Whenever excavation work is inside the fenced area of a pump station or right-of-way (ROW), the soil should be treated as Type C, since there is a good chance it was previously disturbed. A competent worker must approve any exemptions.

USA

A competent worker must classify soil types using the following tests:

- visual test to determine:
  - qualitative information regarding the excavation site in general
  - soil properties next to the excavation
  - soil properties forming the sides of the opening excavation
  - soil properties taken as samples from excavated material
- manual test to determine quantitative as well as qualitative properties of soil, and to provide more information for classifying soil property. Manual tests include:
  - plasticity test
  - dry strength
  - thumb penetration
  - other strength tests (e.g., pocket penetrometer or hand-operated shearvane)

Sloping and Benching Systems

USA

Use one of the following options when designing slopes and benching systems of excavations under the direction of a competent worker:

Option 1: Slope or bench the excavation at an angle not steeper than one and one-half horizontal to one vertical (34° measured from the horizontal).

Option 2: Have a competent worker classify the soil using manual and visual tests, and a slope a maximum of:

- Type A: ¾:1 (53°)
- Type B: 1:1 (45°)
- Type C: 1½:1 (34°)

NOTE: For a sample bench system for Type B soil, see Figure 1.

Option 3: Install shoring or use a trench box.

Option 4: Have a registered professional engineer design a support system for the excavation.

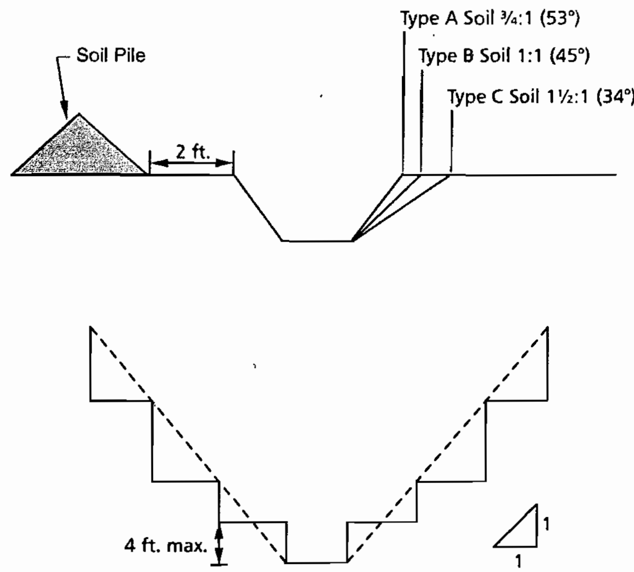


Figure 1
Sample Bench System for Type B Soil

Fences and Barricades

Within Fenced Areas

Barricade or fence off unattended excavations, trenches, and boreholes within fenced areas (e.g., stations, valve sites) as appropriate depending on:

- location of the excavation
- worker/public access or exposure to the excavation
- size of the excavation (e.g., depth, length)
- potential for workers or the public falling into the excavation
- potential for drowning
- number of exits, if any
- condition of the excavation (e.g., wet, muddy)
- length of time the excavation will be unattended

Barricades must be:

- manufactured type (wood, plastic, or metal construction)
- approximately 1 m (3 ft) high
- secured in place

In addition to barricades/fences, use suitable warning devices (e.g., reflective signs or flashing light) to provide advance warning of excavations, trenches, or boreholes that may present a hazard to night traffic.

Along the ROW
Guard unattended excavations on the ROW from unintentional entry using highly visible material (e.g., orange snow fencing). In addition, use barbed wire where livestock are present.

Support the fencing at a spacing of approximately 3 m (10 ft), and secure the fencing to each support (e.g., using wire or rope).

Erect barricades or fences approximately 1 m (3 ft) from the excavation to maintain an adequate walkway around the excavation.

Temporary Protective Structures

Consult a registered professional engineer to review the stability of any structure or foundation that may be affected by an excavation or trench. If required, design, construct, and install a temporary protective structure to support the structure or foundation in accordance with the specifications of a registered professional engineer.

Shoring
Timber shoring used in trenches and excavations must be in accordance with Table 1.

Assemble and install hydraulic shoring in accordance with the manufacturer's instructions.

When installing stringer and brace components in a shoring system, work downward from the surface using a ladder to install each brace in descending order. Use the reverse order to remove components, unless conditions make it unsafe for workers to enter the excavation. In such cases, use an alternate method of removal that protects workers from injury.

Shoring must extend a minimum of 600 mm (2 ft) above the surface of the ground or vertical trench walls.

A professional engineer must design any support system used in an excavation greater than 6 m (20 ft) deep.

Trench Boxes
Install trench boxes in excavations before workers enter, and place egress ladders inside the trench box.

Trench boxes must be (a) designed by a professional engineer, and (b) constructed, inspected, and maintained in accordance with the engineering or manufacturer's specifications.

Before installing a trench box, a copy of the Engineering Certificate or a stamped Engineering Drawing must be provided.

Trench boxes stacked in deep excavations must be adequately secured to one another.

Trench boxes must have continuous sides and must extend a minimum of 600 mm (24 in.) above the vertical wall of the excavation.

A professional engineer must design and approve hoisting hook-up and drag points. Where a trench box will be dragged forward, protect workers in the box against rigging failure by suitable protective screening or other means.

Workers must remain inside the box as long as they are in the trench, and must leave if the trench box will be lifted to be moved.

Excavation must be done to minimize the space between the trench box and the excavation wall in order to allow closer access to the top of the box and to limit soil movement in case of cave-ins:

- Low ground pressure (LGP) tracked equipment exerting 5.80 psi or less ground pressure, the depth of cover is no less than 0.9 m (36 in.) of consolidated clay soil, and repeated crossings are not required (e.g., a crossing by a D6 with 30 in. or larger track width, or a D5 with 24 in. or larger track width).
- The depth of cover is, or is increased to, 1.3 m (52 in.) or greater, the vehicle axle loading is highway legal, conditions are dry, and a company representative is onsite when vehicles are crossing the pipeline.

Table 1
Shoring Trenches

Soil Condition	Depth of Trench		Uprights				Stringers				Cross Braces							
			Dimensions		Horizontal Spacing		Dimensions		Vertical Spacing		Trenches to 6 ft wide Dimensions		Trenches 6-12 ft wide Dimensions		Horizontal Spacing		Vertical Spacing	
	m	ft	mm	in	m	ft	mm	in	m	ft	mm	in	mm	in	m	ft	m	ft
Hard compact ground	1.2 to 3	3 to 10	50 x 250	2 x 10	1.8	6	100 x 150	4 x 6	1.2	3	100 x 100	4 x 4	150 x 150	6 x 6	1.8	6	1.2	3
	3 to 4.6	10 to 15	50 x 250	2 x 10	1.2	3	100 x 150	4 x 6	1.2	3	100 x 150	4 x 6	150 x 200	6 x 8	1.8	6	1.2	3
	4.6 to 6	15 to 20	50 x 250	2 x 10	close	close	150 x 150	6 x 6	1.2	3	150 x 200	6 x 8	200 x 250	8 x 10	1.8	6	1.2	3
Soils likely to crack or crumble	1.2 to 3	3 to 10	50 x 250	2 x 10	1.2	3	100 x 150	4 x 6	1.2	3	100 x 150	4 x 6	150 x 150	6 x 6	1.8	6	1.2	3
	3 to 4.6	10 to 15	50 x 250	2 x 10	.6	2	150 x 150	6 x 6	1.2	3	150 x 150	6 x 6	150 x 200	6 x 8	1.8	6	1.2	3
	4.6 to 6	15 to 20	50 x 250	2 x 10	close	close	150 x 200	6 x 8	1.2	3	150 x 200	6 x 8	200 x 250	8 x 10	1.8	6	1.2	3
Loose or free running soil	1.2 to 3	3 to 10	50 x 250	2 x 10	close	close	150 x 150	6 x 6	1.2	3	150 x 150	6 x 6	150 x 200	6 x 8	1.8	6	1.2	3
	2 to 4.6	6.5 to 15	50 x 250	2 x 10	close	close	150 x 200	6 x 8	1.2	3	150 x 200	6 x 8	200 x 200	8 x 8	1.8	6	1.2	3
	4.6 to 6	15 to 20	50 x 250	2 x 10	close	close	200 x 200	8 x 8	1.2	3	150 x 200	6 x 8	200 x 250	8 x 10	1.8	6	1.2	3

Waste Management - Liquids

Scope of work

The scope of this section is to ensure that the liquids potentially generated in association with the repair of the pipeline are handled and disposed of with proper procedures as set forth in the various relevant Enbridge documents and plans as referenced below.

The potential liquid waste streams associated with the repair include crude oil impacted water associated with dewatering the repair excavation and stormwater run-off associated with disturbed soils. The outfall of the dewatering discharge stream will be to on site fractionation tanks for short term storage and future disposal as coordinated by Enbridge's Environment Department. The potential stormwater run-off will be mitigated via the best management practices set forth on the attached figures.

Regulatory Requirements

The relevant Enbridge plans and procedures currently in effect to handle liquid waste streams were created to be compliant with the Clean Water Act as promulgated in 40CFR Protection of the Environment and adopted by Michigan's Department of Natural Resources and Environment. Attached are the relevant portions of Enbridge's Operations and Maintenance Plan, and supporting documentation specific to the repair associated with Line 6B.

Company Standards (see attached)

Book 3 02-01-01 – Overview of Environmental Protection
Book 3 02-02-01 – Environmental Permits/Licenses/Approvals
Book 3 02-02-02 – Erosion Control
Book 3 02-02-05 – Stormwater Management
Book 3 02-02-08 – Environmental Records
Book 3 02-02-09 – Refueling Tanks, Equipment and Containers

Exceptions to standards or specific site requirements- None

Purpose

Containment structures (e.g., berms, retention ponds) are designed to contain product and to minimize impacts offsite in the event of a release at a facility. This standard includes the requirements for managing and discharging stormwater accumulated in containment structures in a manner that does not adversely affect the environment by releasing pollutants or by causing erosion to receiving lands.

Responsibilities

Regions are responsible for managing stormwater, including: inspecting, discharging, sampling (if required), and maintaining records.

NOTE: If stormwater is contaminated, contact Environment for assistance with sampling, testing, and analyzing test results.

Requirements

Prevention

To minimize the risk of surface water contamination:

- keep the site clean and orderly
- store hazardous materials in accordance with the Waste Management Plan
- clean up spills immediately and store wastes in appropriate containers in accordance with the Waste Management Plan

Discharging

Discharge stormwater accumulated in containment structures after significant rainfalls or as often as practical to maximize containment capacity in the event of a release at the facility.

Facility stormwater drain valves should be closed at all times, except when actively discharging stormwater.

Permits

Where facilities have existing permits that regulate discharging stormwater offsite, follow all conditions in the permit.

Visual Inspection

Before discharging accumulated stormwater within a containment structure, visually inspect for (a) an oily sheen, or (b) suspended solids and/or foam.

If visual inspection indicates no evidence of contaminated stormwater (i.e., only precipitation is present), (a) follow the conditions specified in the permit/license, where required, to discharge stormwater offsite; otherwise, (b) open the valves to discharge stormwater offsite, ensuring:

- discharge is conducted in a controlled manner using a slow flow rate to prevent soil erosion and damage to streambanks and streambeds of waterbodies
- the discharge valve is closed after the discharge is complete

For containment structures that automatically discharge stormwater, visually inspect the accumulated stormwater weekly.

Sampling

If visual inspection indicates that stormwater may be contaminated, contact Environment for sampling requirements, including: laboratory contacts, sample bottles, custody transfer forms, and sampling procedures.

Records

CAN

Stormwater Logs

Stormwater logs must be retained at the facility for 5 years.

For stormwater discharged offsite, record the date, time, estimated amount of water discharged, and confirmation of water.

If laboratory analysis is required before discharging stormwater, record the sample date and laboratory test results.

For contaminated stormwater, record the date, remediation techniques, and observations.

Purpose

Erosion control is necessary to:

- contain excavated soil onsite
- prevent sediment from entering wetlands or waterbodies
- prevent pipe exposure

Responsibilities

Operations

Operations must notify Environment when work is to be conducted in or around a wetland, waterbody or other environmentally sensitive area.

Environment

Environment must coordinate the necessary environmental work and obtain the appropriate permits to conduct the proposed work.

Requirements

Soil Erosion

By Wind

To minimize drifting soils and loss of topsoil by wind, in areas prone to wind erosion:

- limit the time between topsoil stripping and final cleanup
- suspend topsoil stripping and backfill operations during high winds
- apply a tackifier to the topsoil pile
- install wind barriers (e.g., slat fences, snow fences)
- spread wood chips or straw crimping
- sow a fast growing ground cover
- walk down tree and shrub debris over exposed soils

By Water

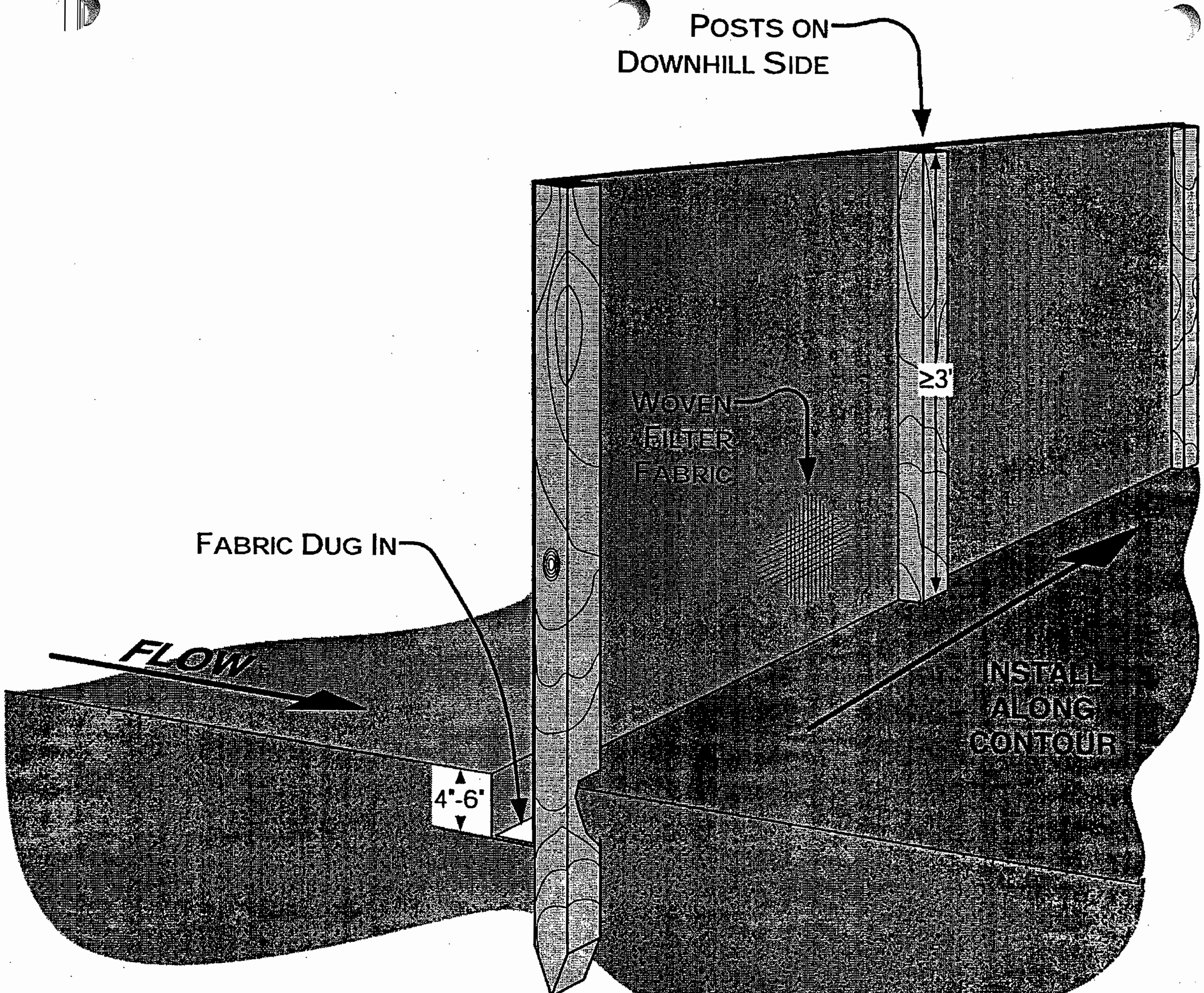
Use temporary erosion control measures (e.g., sandbags, logs or straw bales) on undisturbed pasture or well-sodded right-of-way (ROW) during cleanup.

Use permanent erosion control measures on disturbed steep slopes during restoration, especially if heavy runoff, spring breakup or heavy storms are likely and there is a risk of significant soil erosion:

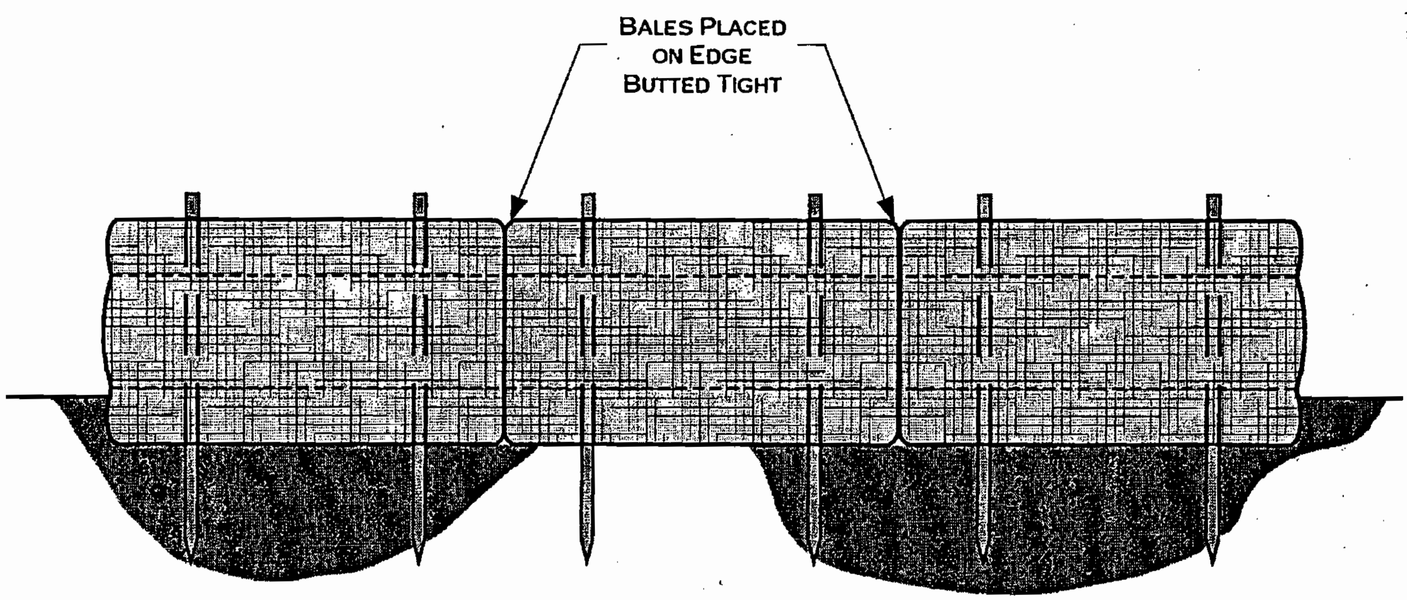
- construct trench breakers
- install cross ditches and diversion berms
- walk down tree and shrub debris over exposed soils
- armor berms and ditches with logs, polyethylene or sandbags
- install netting or filter cloth
- apply tackifier
- install and stake sod
- hydromulch

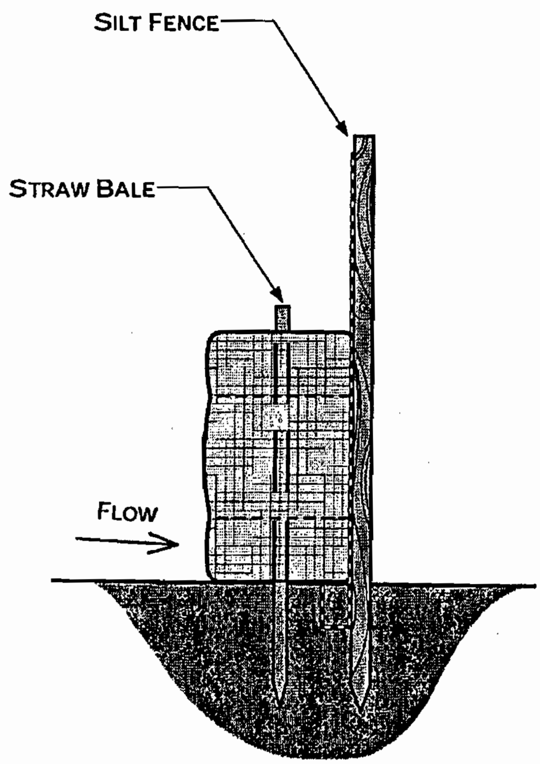
- hydroseed, spread straw and crimp
- seed an annual crop of barley, fall rye, or oats
- plant native shrubs or willow cuttings

NOTE: For information on installing berms and ditches and stream bank protection, see the Environmental Guidelines for Construction.

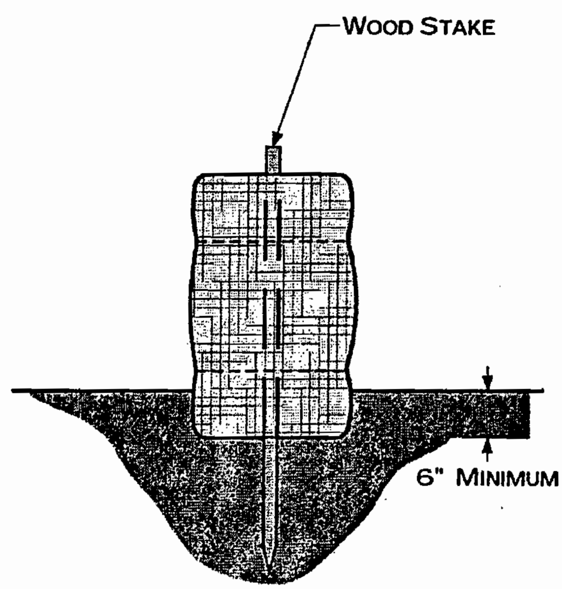


POSTS ON
DOWNHILL SIDE
WOVEN
FILTER
FABRIC
≥3'
FABRIC DUG IN
FLOW
4"-6"
INSTALL
ALONG
CONTOUR





Straw/Hay Bales &
Silt Fence



Straw/Hay Bales Only

Scope of work – Bonding and venting

The scope of this section is to ensure static electricity is minimized while pipe is separated from line and to install vents to ensure vapours are segregated from work site.

Static electricity is generated when handling or storing flammable or combustible liquids. An electric charge is created when such liquids flow through a pipe or hose, or fall through the air in drops or as a spray. The static charge in the pipeline system is strong enough to create a spark when any separation is made. Furthermore, a spark could be created when a product within the pipeline system is transferred into a container or tank of a different potential. This is particularly hazardous in explosive atmospheres.

Regulatory Requirements

195.402 (c) The paragraph required by paragraph (a) of this section must include procedures for the following to provide safety during maintenance and normal operations

(11) Minimimizing the likelihood of accidental ignition of vapours in areas and facilities identified iunder paragraph c (4) of this section where the potential exists for the presence of flammable liquids and gases

195.422 (a) Each operator shall, in repaiting its pipeline systems, insure that the repairs are made in a safe manner and are made so as to prevent damage to persons or property.

Company Standards

Book 3 06-03-21 Bonding for static Electricity – See attached

Book 3 06-03-21 Installing threadolets, Sockolets and thread-O -Rings

Exceptions to standards or specific site requirements-

For details regarding the cutout procedure drainup and specific steps to remove and reinstall pipe refer to Pipeline/Repair/Modification Job Planning Template.

Purpose

Static electricity is generated when handling or storing flammable or combustible liquids. An electric charge is created when such liquids flow through a pipe or hose, or fall through the air in drops or as a spray.

The static charge in the pipeline system is strong enough to create a spark when any separation is made. Furthermore, a spark could be created when a product within the pipeline system is transferred into a container or tank of a different potential. This is particularly hazardous in explosive atmospheres.

Scope

To prevent sparking, bonding is used when workers:

- remove an accessory attachment from a fixed facility (e.g., a mixer from a tank)
- cut and separate a pipeline
- separate flanges
- draw samples from the pipeline
- drain oil from the pipeline into a pan
- load or offload at sump tank locations
- dispense from bulk drums into a secondary container

NOTE: In some cases, such as where piping forms an electrical bond, it may not be necessary to install bonding cables.

Requirements

Equipment

When drawing oil or products samples from the line, or when loading or offloading at sump tank locations, use an uncovered braided copper wire with an alligator clip brazed to each end, or other suitable bonding cable.

Each pipeline crew must have at least two prefabricated bonding cables made of #4 AWG stranded copper wire with a spade connector brazed on each end (see Figure 1).

Each pipeline crew must have at least two grounding clamps for attaching the bonding cable to the pipe (see Figure 2).

Safety Precautions

Once a bonding cable is in place, take care to avoid breaking, cutting, or detaching it as long as a fire hazard exists

Procedure

Removing Accessory Attachments or Separating Flanges

1. Select a bonding cable long enough to clear the hazardous area when removing attachments, or long enough to span the work area when separating flanges.

2. Securely attach the cable to clean bare metal on the accessory attachment and to the fixed facility when removing attachments, or to each flange when separating flanges.

NOTE: This equalizes the potential.

3. Proceed with removal or separation.

4. Once the equipment is removed to a safe area or the work is complete, disconnect the cable.

Procedure

Cutting and Separating a Pipeline

1. Install grounding clamps (see Figure 2) on either side of a separation and on the pipe section to be removed (see Figure 3). Ensure the clamps make contact with clean bare metal.

2. Select one prefabricated bonding cable long enough to span the work area, and securely attach each end to the grounding clamps located on either side of the separation.

3. Select a second prefabricated bonding cable long enough to clear the hazardous area when removing a pipe section.
   a) Securely attach one end of the cable to one of the grounding clamps located at either side of the separation.
   b) Attach the other end of the cable to the grounding clamp on the pipe section to be removed.

4. Remove the section of pipe to a safe area.

5. Disconnect the cables and remove the grounding clamps.

Procedure

Drawing Samples From the Pipeline

1. Attach one alligator clip on the bonding cable (unbraided copper wire) to the sample point on the pipeline (pipe, valve, etc.) and the other clip to the metal sample container.

   - If the sample container is glass or plastic, insert the free end of the bonding cable into the sample container.

2. Draw the sample.

WARNING: Ensure the bonding cable remains in contact with the liquid in a plastic or glass container at all times.

3. Disconnect the bonding cable when sampling is complete.

Procedure

Draining Oil From the Pipeline

1. Securely attach one end of the bonding cable to the pipe and the second end to the metal drain tray.
   - If the drain tray is plastic, ensure the second end of the bonding cable remains in contact at all times with the liquid being drained into the tray.

NOTE: This can be achieved by attaching the cable to a metal grid insert which lays on the bottom of the tray.

2. Proceed with drainup.

3. Disconnect the bonding cable when drainup is complete.

Procedure

Loading/Offloading at Sump Tanks

1. Securely attach one end of the bonding cable to the object being loaded/offloaded (e.g., tank/vacuum truck, portable tank), and attach the other end to the sump tank or the piping connection at the loading/offloading facility.
   - Where fiberglass sump tanks are used, attach the second end to the specified bonding point.

2. Transfer the load.

3. Disconnect the bonding cable when load transfer is complete.

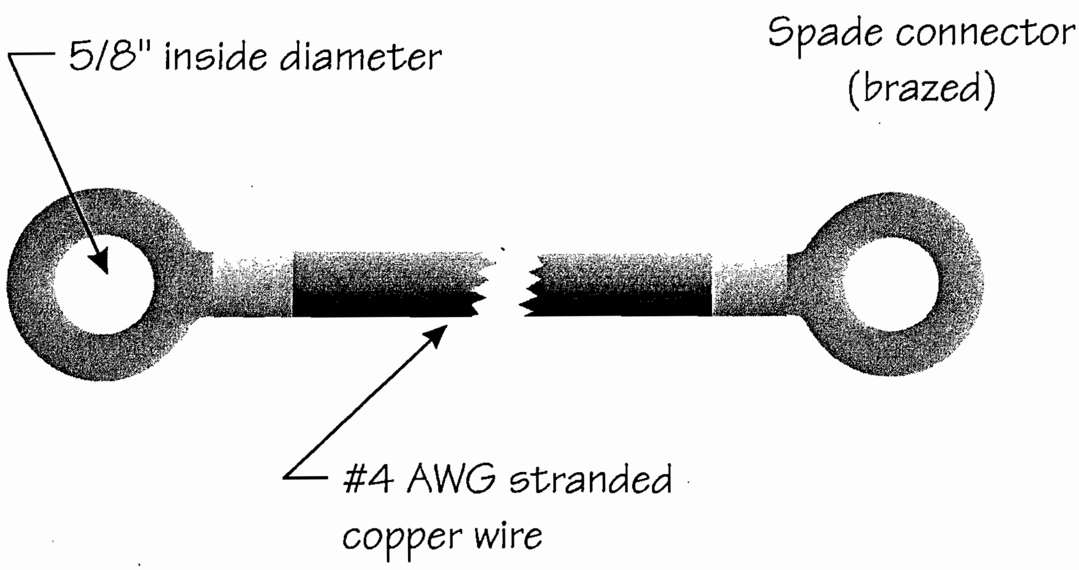
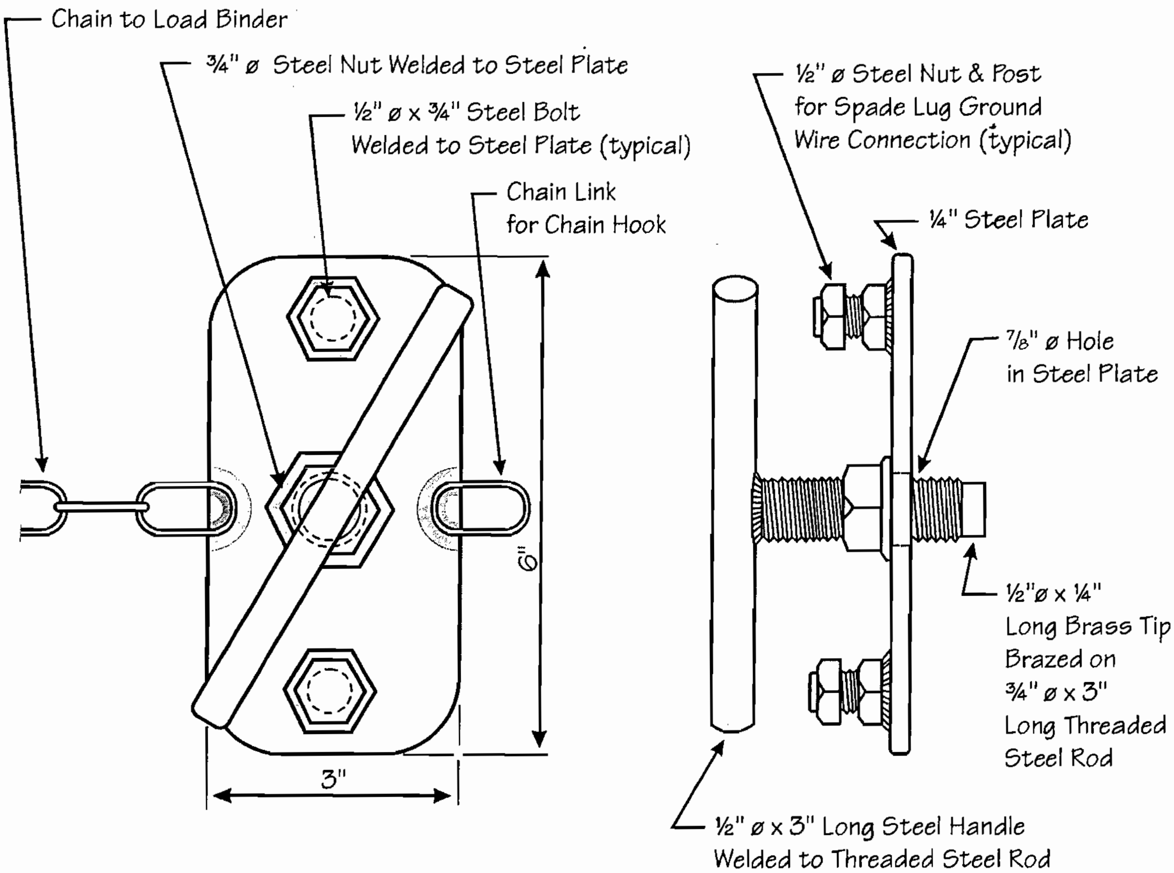
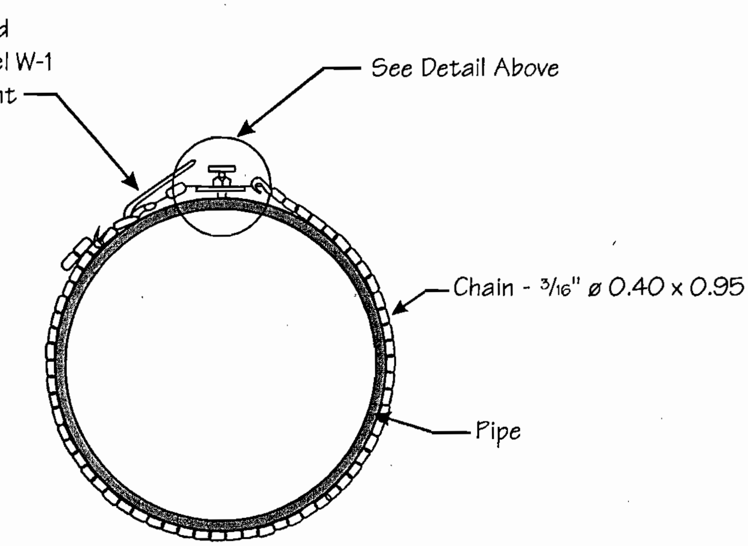


Figure 1
Typical Bonding Cable





Notes:

1. This grounding clamp is to be used wherever bonding or grounding wire is to be attached to pipeline.
2. *Grounding wire to be #4 AWG welding cable.*
3. *Driven ground rod to be 1½" ø x 48" long clean galvanized conduit with clamp.*

Figure 2
Grounding Clamp

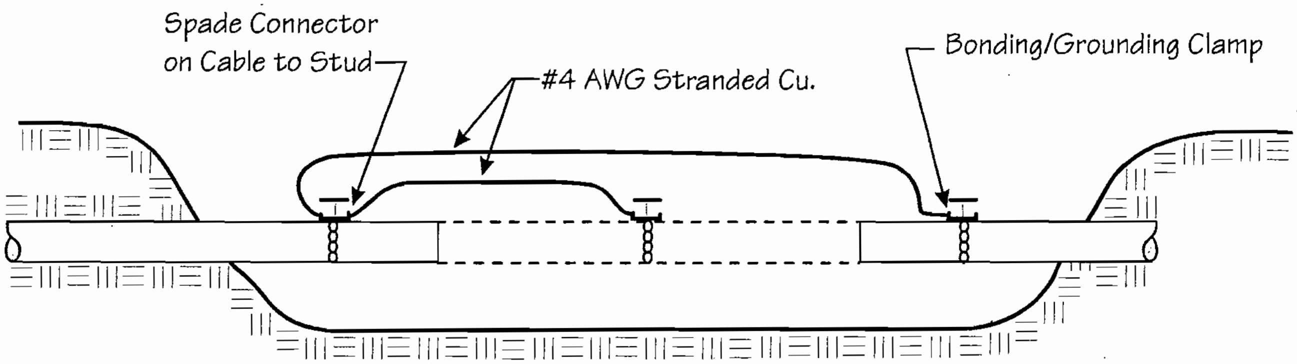


Figure 3
Cutting and Separating Pipe

Purpose

Thredolets®, Sockolets® and Thread-O-ring™ fittings are the type of branch connections used for small diameter pipe (i.e., NPS 2 and smaller).

NOTE: For minimum branch connection requirements, see Engineering Design Standard D06-102.

Related Standards

Company

Book 4: Welding:

- *01-04-01 Welding Procedure Specification Data Sheets*
- *02-02-06 Inspection*

Engineering Design Standards:

- D06-102 Piping Design – Station and Terminal

Requirements

All branch connections NPS 1 ½ and smaller must be made with extra strong Sockolets® or 3000# Thredolets® or equal, without special reinforcing.

Do not use couplings or half couplings.

Sockolets®, or equivalent, must be used below ground.

Install Thread-O-ring™ fittings at the 12 o'clock position, unless the connection is for a densitometer, which must be at the 3 o'clock position.

Procedure

Installing Thredolets®, Sockolets® and Thread-O-rings™

NOTE: Refer to Figure 1.

1. Remove the pipe coating.
2. Clean the pipe surface where the connection will be installed.
3. Use ultrasonic techniques to inspect the pipe in the area where the fitting will be welded.
4. Prepare the fitting and pipe for welding:
   a) Prepare the land and beveled surface of the fitting.
   b) Center punch the pipe where the center of the connection is desired.

5. Level the fitting or set to the desired angle, and tack weld in place using the appropriate welding procedure specification (WPS) (see *Book 4: Welding, 01-04-01 Welding Procedure Specification Data Sheets*).

6. Preheat the pipe.

7. Protect Thredolets® and Thread-O-ring™ threads from spatter:
   a) Coat threads with copper coat.
   b) Hand-tighten a nipple or plug into the fitting.

8. Complete welds using the appropriate WPS (see *Book 4: Welding, 01-04-01 Welding Procedure Specification Data Sheets*).

9. Run a thread tap into Thredolets® to remove spatter if necessary.

10. Inspect all welds (see *Book 4: Welding, 02-02-06 Inspection*).

11. Complete the connection by hot tapping the pipe.

12. Complete an as-built drawing showing the new installation.

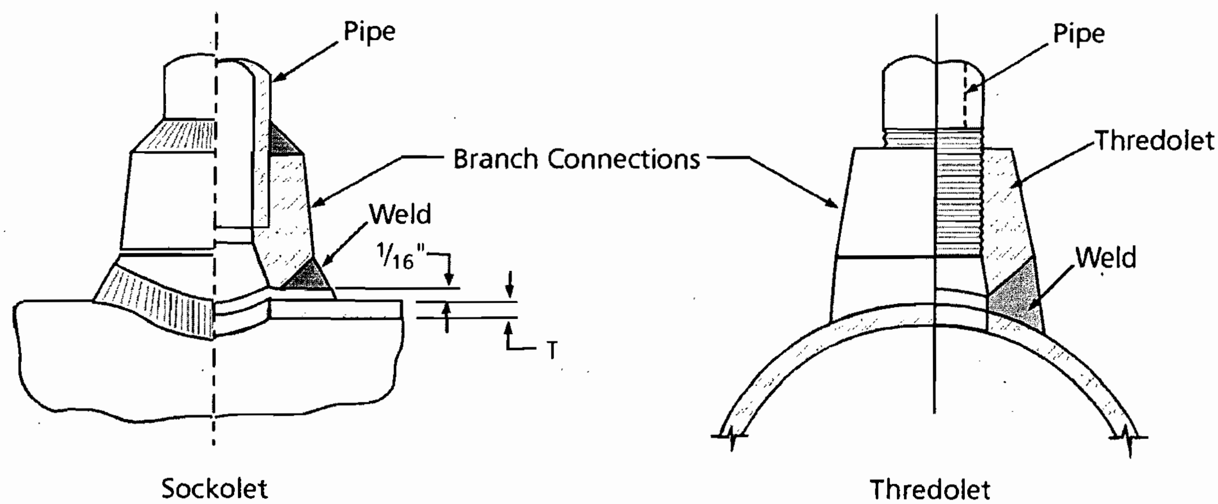


Figure 1
Typical Vent Connections

Scope of work – Pipe Removal and Custody Transfer

The scope of this section is to transfer custody of the pipe sample including soil samples and any foreign materials to the NTSB for mechanical and metallurgical testing. The mechanical and metallurgical testing protocols shall be determined by the NTSB in consultation with PHMSA and are outside the scope of this document. The attached document details how to Preserve major pipeline components removed due to failure until it is determined if an analytical investigation is required. In this case the National Transportation Safety Board will investigate or have investigated and establish the facts, circumstances, and cause or probable cause of the pipeline accident in which there is a fatality, substantial property damage, or significant injury to the environment.

Regulatory Requirements

Title 49. Transportation -Subtitle II. Other Government Agencies -Chapter 11. National Transportation Safety Board -Subchapter I. General

Company Standards

BOOK 1: 02-02-04 Investigating Piping Failures
BOOK 3: 06-03-22 Removing Pipe for Investigation

Specific requirements

Prior to cut out, we will survey the profile of the pipe and visually inspect the pipeline.
Cold Cuts will identify approximately 140 ft for removal. The total 140 ft will be cut into 3 sections. One that is sent to NTSB laboratories and the other 2 will be evaluated as per Enbridge policy and PHMSA direction.

For the Segment destined for NTSB Pipeline integrity in conjunction with the NTSB will identify the ends of the cut for Pipe removal and sending to NTSB laboratories. It is anticipated that this section will be approximately 20 feet in length. Remove this pipe section for documentation, cleaning and preparation for shipping. The cleaning will be done with absorbent material to mop up free liquid inside and outside of the pipe. There will be no blasting of this section.
It is planned to ship in a 30 foot crate and the pipe needs to be supported every 6 feet.

The 2 remaining cut out sections that will not be sent to NTSB will be cleaned to expose the long seam and girth welds. These sections can be blasted as per Enbridge procedures. The need for additional cleaning of these pipe sections further will be dictated by what we find when they are exposed. NDE will be conducted on the long seam and girth welds.

Pipe destined for Washington can be transported in sections not exceeding 20 ft
The Pipe containing the failure location needs to be a minimum of XX ft on each side of the failure
Each section needs to be housed in a separate crate.
Crates will be delivered to NTSB facilities in Washington.
Records show that the rupture is on GWD 217720.

Subject
Removing Pipe for Investigation

Purpose

To cut out pipe for investigation following a failure.

Related Standards

Company
Book 1: General Reference
- *02-02-04 Investigating Piping Failures*

Responsibilities

Regions are responsible to determine the type of repair at a failure site after considering several factors (e.g., location, drainup, safety).

Requirements

Preserve major pipeline components removed due to failure until it is determined if an analytical investigation is required. Only Authorized Personnel will be permitted to inspect the failed component at site. Management approval is required before releasing the failed component to any other person or authority.

Procedure

Removing Pipe

1. Before removing pipe components, obtain approval from regional management.

NOTE: For some incidents, legislation requires that site conditions are not disturbed until government agencies complete their investigation.

2. Insert hoses into the pipe to drain up liquids and loosen residuals.
   - If the rupture opening is not wide enough to accommodate the hoses (a) contact Pipeline Integrity to confirm where to cut the pipe, or (b) cut the pipe at least 30 cm (12 in.) from the rupture opening to ensure the fracture surfaces are not damaged.

NOTE: The point where the failure initiated must not be damaged. This usually coincides with the widest point of a rupture.

3. Cover fracture surfaces with a split rubber hose to prevent damage and to preserve features for examination during the failure investigation.

4. Before removing major pipeline components:
   - leave the pipe coating intact
   - identify or sketch detailed as-builts
   - complete the Pipeline Failure Field Notes
   - mark or record the upstream end and the 12:00 o'clock position on the pipe

- mark the long seam o'clock position (looking downstream) on the pipe
- mark the chainage and failure/leak date on the pipe

5. After removing damaged pipeline components:
   - protect fracture surfaces using grease
   - cover and move the components to a safe storage area for protection from weathering

Records

Pipeline Failure Field Notes

Record 'as found' conditions during all stages of failure investigation. Include digital pictures, descriptions, sketches of the damaged equipment and exact location of the damage.

Retain Pipeline Failure Field Notes in Pipeline Integrity permanently.

Installation of Mud Plugs

Scope of work

The scope of this section is to ensure gas vapors are minimized while pipe is separated from line.

Vapor plugs seal off gas vapors in preparation for replacing pipe sections and welding the pipe.

Regulatory Requirements

195.402 (c) The paragraph required by paragraph (a) of this section must include procedures for the following to provide safety during maintenance and normal operations

(11) Minimizing the likelihood of accidental ignition of vapors in areas and facilities identified under paragraph c (4) of this section where the potential exists for the presence of flammable liquids and gases

195.422 (a) Each operator shall, in repairing its pipeline systems, insure that the repairs are made in a safe manner and are made so as to prevent damage to persons or property.

Company Standards

Book 3 06-03-04-Installing Mud Plugs– See attached

Exceptions to standards or specific site requirements- None

Purpose

To seal off gas vapors in preparation for replacing pipe or installing valves and fittings.

Related Standards

Company
Book 2: Safety

- *13-02-07 Respiratory Protection*
- *04-02-01 Confined Space Entry Permit – Hazard Assessment*

Waste Management Plan

Requirements

Venting
To prevent pressure from building up and moving the plug, install vents to atmosphere behind each mud plug by (a) installing and tapping a small connection, using an existing connection, or (b) inserting a hose through the mud plug.

Mixing Mud
Mix the mud to a smooth but sticky texture. If the temperature is below 0°C (32°F), mix mud with an antifreeze/water mixture.

NOTE: The amount of antifreeze depends on the ambient temperature.

Packing Mud Plugs
Insert mud in the open end of the pipeline as soon as possible after drainup.

After installation, do not disturb mud plugs as much as practicable (e.g., hammer on the pipe).

Replace mud plugs if they dry out.

Procedure

Installing Mud Plugs

⚠ **WARNING**: Petroleum vapors or other hazardous materials may be present.

1. Check pipe ends for excessive vapor using a gas detector at the open end of the pipe (see *Book 2: Safety, 13-02-07 Respiratory Protection* and *04-02-01 Confined Space Entry Permit – Hazard Assessment*).

2. File sharp edges of the pipe or cover with a split rubber hose to prevent lacerations.

WARNING: Be careful not to create a spark. If combustible gas vapors are present, a spark could cause an explosion.

3. Clean the inside of the pipe as far as can be reached with rags or a long-handled scrub brush; use solvents to remove wax or residuals.

   - If required to temporarily stop product from seeping into the cleaned area, place a pile of dry mud as far as possible into the pipe.

WARNING: When cleaning pipe, be careful of the razor-sharp edge of the pipe left by the cutter.

NOTE: Discard rags in accordance with the Waste Management Plan.

4. Coat the pipe wall with a thin layer of dry mud and then wet mud to ensure the mud adheres to the pipe.

5. Pack the mud to form a plug to a minimum thickness of 1 × the pipe diameter.

NOTE: The end of the completed plug should be at least 150 mm (6 in.) back from the open pipe end (see Figure 1).

6. Vent the space behind the mud plug to prevent pressure from building up and moving the plug..

   - If venting through a fitting behind the plug, ensure there are no obstructions between the fitting and the mud plug, and connect a vent hose to the fitting.

   - If venting through the plug, place the air hose in the bottom third of the plug.

NOTE: Run vent hose downwind from worksite to direct gases away from area.

7. Check the inside of the open pipe end with a combustible gas detector to verify that the mud plug is holding.

NOTE: Monitor continuously during repair work, both visually for the condition of the plug and with a combustible gas detector.

8. Begin tie-in activities.

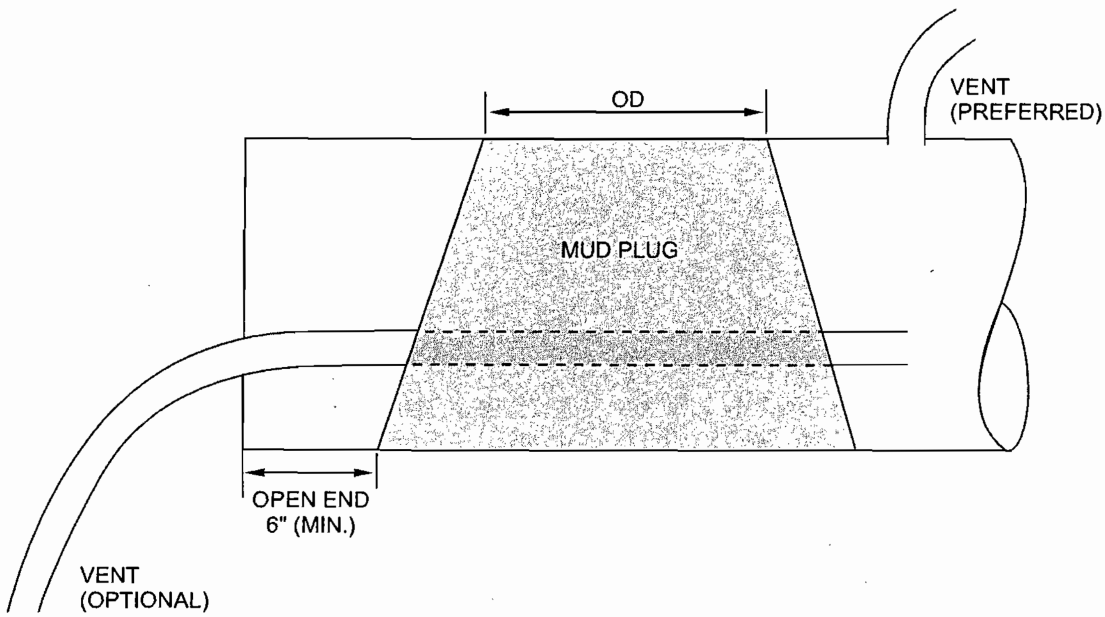


Figure 1
Positioning of Mud Plug

06-Pipe Repair & Modification

Purpose

To rejoin pipe when suitable conditions for butt welding cannot be achieved or are difficult to achieve. It is not intended to be a substitute for butt welding under normal conditions.

Related Standards

Company

Book 3: Pipeline Facilities

- *06-03-03 Drainup/Linefill*

Book 4: Welding

- *01-04-01 Welding Procedure Specification Data Sheets*
- *02-02-06 Inspection*

Requirements

Maximum Pressure Rating

The maximum pressure rating of the Weld+Ends coupling (shown on the coupling label) must be greater than or equal to (≥) the maximum design ultimate pressure capacity of the connected pipes (at 100% SMYS 80% SYMS [CAN] and 72% SMYS [USA]).

Anchored Pipe Installation

A joint between two pipes can be subjected to forces caused by internal pressure, thermal expansion and contraction, external loads, or any combination thereof. A coupling installation is considered to be anchored only if sufficient external restraint is provided, by the surrounding soil or an external mechanical restraining device, to safely resist such forces.

Prior to welding and inspection, a coupling installation may only be classified as anchored if:

- an engineering assessment by a suitably qualified individual determines that there is sufficient external restraint provided by the surrounding soil to resist the applied forces; or

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NOTE: The engineering assessment should consider: the length of exposed pipe; deviations from a straight alignment; soil stiffness and strength; pipe and coupling stiffness and strength; locked-in pipe bending stresses required to facilitate fit-up; and the effects of restrained thermal expansion or contraction. The individual conducting the assessment may be a staff engineer or external engineering consultant, but must have relevant knowledge and experience related to pipe-soil interaction analysis. Contact Pipeline Integrity or Engineering for additional information.

- external forces are restrained by a PLIDCO® Clamp+Ring or other approved external restraining device.

Unanchored Pipe Installation

A coupling installation is considered to be unanchored if there is insufficient external restraint provided to safely resist the forces to which it is subjected.

> ⚠ **CAUTION**: Any installation that does not meet the anchored pipe installation criteria given above must be considered unanchored and is subject to the unanchored pressure limits specified in this subject.

Storage

Store couplings in a cool, dark and dry environment at temperatures not exceeding 49°C (120°F). Cover with dark polyethylene to keep direct sunlight from the seals. Avoid contaminants, light, ozone and radiation.

Procedure

Coupling and Pipe Preparation (see Figures 1 and 2)

1. Read and be familiar with the installation instructions provided by the manufacturer.

2. Check the condition of the sealing elements to ensure they have not dried out and that they are not past the expiry date provided by the manufacturer.

3. Clean the sealing elements and coat exposed seal surfaces with a petroleum, silicone or glycerin-based lubricant recommended by the manufacturer to prevent seal abrasion.

4. Use only the clamp and thrust screws supplied by the manufacturer with the coupling and ensure they are clean and free of rust.

5. Prepare pipe ends where the coupling will be installed so the pipe ends have:
   - no rust or coatings
   - the longitudinal weld seams and any protruding surface features, ground or filed smooth, including the area where the coupling will be slipped back while the replacement pipe is positioned
   - pilot bevels ground with tapers, as required, to reduce the risk of damage to the seals when installing the coupling.

6. Clean all surfaces to be welded so that they are free of lubricants and other contaminants.

Procedure

Coupling Installation

1. Measure the gap from the removed pipe section to determine the required length of replacement pipe, allowing for a 1/2 in. gap at each coupling location (see Figure 1).

2. Mark reference points on each end of the existing and replacement pipes in order to ensure that the coupling can be centered on the pipe joint (measure one-half of the coupling length and mark on pipes from center of gap).

3. Slide the coupling completely over one end of the existing pipe.

4. Position the replacement pipe and slide the coupling over both pipes to the predetermined reference marks. For pipe lengths greater than 6 m (20 ft), ensure that the pipe is supported with cribbing or pipe supports prior to step 5.

> ⚠ **CAUTION**: Slide the coupling carefully to ensure sealing elements are not damaged.

5. Snug all the clamp screws evenly, maintaining an equal space between the pipe and the coupling, then tighten the clamp screws to the appropriate torque value shown in Table 1.

> ⚠ **CAUTION**: Do not over-tighten clamping screws (see tolerance limits in Table 1) as doing so may deform the pipe ends and prevent proper sealing.

6. Double-check all clamp screws using a calibrated torque wrench to ensure that each screw has received the specified torque.

7. Tighten thrust screws gradually and uniformly around the pipe circumference to activate the seal.
   - Snug all screws firmly and then advance each thrust screw 1/8 of a turn before proceeding to the next screw.
   - Make several circuits to evenly tighten the sealing unit, tightening the screws to the appropriate torque value shown in Table 2.

8. If not already supported (in step 4), support the new section of pipe with cribbing or pipe supports to ensure it does not shift during filling, as this could compromise the sealing elements.

Procedure

Preparation for Welding

There are 2 options for refilling and pressurizing the pipeline in preparation for welding:

- Option #1 - Refilled, not flowing
- Option #2 - Refilled, pressurized and flowing

NOTE: The coupling may also be welded without refilling the drained pipeline section, provided that the presence of explosive air mixtures is avoided using mud plugs or vapor plugs (see *06-03-04 Installing Mud Plugs* or *06-03-05 Installing Vapor Plugs*)

For Options #1 and #2 (except as noted), the following requirements apply:

1. Linefill must be conducted in accordance with *06-03-03 Drainup/Linefill*. This includes adherence to the safe work zone requirements.
2. For Option #1 (refilled, not flowing), prior to linefill, the drained pipe section must be purged with nitrogen until the percentage of oxygen at the vent is below 5%.
3. All personnel, except those required to perform specialized tasks (e.g., checking vents or checking for slippage or leaks) must remain in the safe work zone:
   - during linefill;
   - until the control center confirms that the mainline pressure is stable and that no surges have occurred; and
   - until the coupling has been checked for leaks and slippage, using the reference points marked on the pipe.
4. Measures must be taken to ensure that the maximum allowable operation pressure (MAOP) prior to completion of welding (as defined below) is not exceeded during linefill, or at any time prior to or during welding.

> ⚠ **CAUTION**: It is essential that pressure limits are based on the appropriate anchorage conditions.

5. Prior to welding, measures must be taken to ensure that no pockets of air exist that could contain an explosive air mixture (as specified in *06-03-03 Drainup/Linefill*), and if the line has been purged with nitrogen, that nitrogen has been removed as completely as possible.

Maximum Allowable Operating Pressure (MAOP) Prior to Completion of Welding

The MAOP prior to completion of welding the coupling is the lesser of the following values:

- 50% of the maximum operating pressure (MOP) of the pipeline at that location (as determined by the control center, normally governed by pipe yield, hydrostatic test pressure or pressure restriction); or
- The maximum rating of the coupling, as defined below, for the applicable pipeline anchorage conditions.

The maximum rating of the coupling is:

- Unanchored conditions – the capacity given in Table 3
- Anchored conditions – 50% of the anchored rating shown on the label attached to the coupling.

Procedure

Welding

1. To prevent damage to seals, monitor the heat generated during cutting, preheating and welding at locations A and B shown in Figure 2 using temperature crayons or probe thermometers to ensure that surface temperatures on both sides of the welds do not exceed 107°C (225°F) for Buna-N seals and 121°C (250°F) for Viton seals.

NOTE: Heat dissipates more slowly under no flow conditions. Sequence welding so that heat is not concentrated in one area.

2. Double-check all thrust screws, after pre-heat, using a calibrated torque wrench to ensure each screw has received the specified torque.

3. Complete fillet welds using the appropriate welding procedure specification (WPS) (see *Book 4: Welding, 01-04-01 Welding Procedure Specification Data Sheets*), cutting off thrust screws as welding progresses.
    - Circumferential fillet weld to be completed on one side of the coupling before welding the other side.
    - For two welders working on the same circumferential fillet weld, sequence welding so that welders work in opposite quadrants (e.g., 6 o'clock to 9 o'clock and 3 o'clock to 12 o'clock).
    - Do not cut off thrust screws too far ahead of the fillet weld (i.e., not more than two or three) as they may require tightening if leakage occurs.

4. After the circumferential fillet welds are complete, remove one clamp screw from each side on top of the coupling to vent gas pressure within the coupling during clamp screw welding.

5. Cut or burn off clamp screws approximately 5 mm (3/16 in.) above the coupling and seal weld using the appropriate WPS (see *Book 4: Welding, 01-04-01 Welding Procedure Specification Data Sheets*) starting with the bottom screws and ending with the top screws. The screws previously removed for venting must be reinstalled, cut off and seal welded.

NOTE: Cutting clamp screws off flush is not allowed.

NOTE: Contaminants on clamp screws should be removed prior to seal welding.

6. Inspect welds as required (see *Book 4: Welding, 02-02-06 Inspection*).

NOTE: After completion of welding and inspection, the Weld+Ends coupling installation is considered to have strength equivalent to that of the surrounding pipe.

7. If used, remove the PLIDCO® Clamp+Ring (or other approved external restraining device) after the welds pass inspection.

8. Advise the control center that the repair is complete and that normal operations may resume.

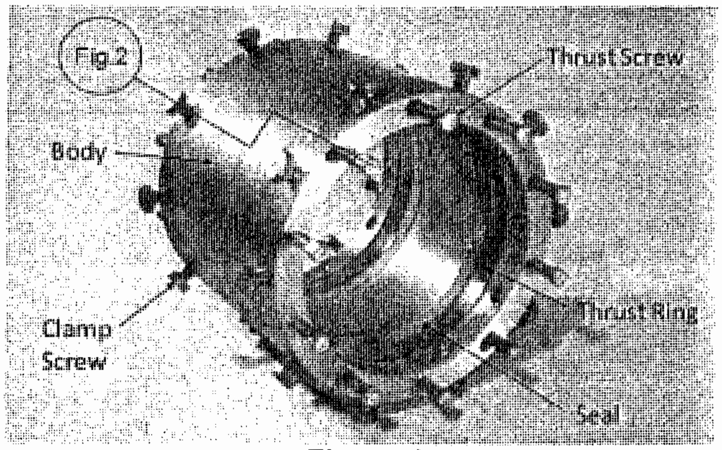
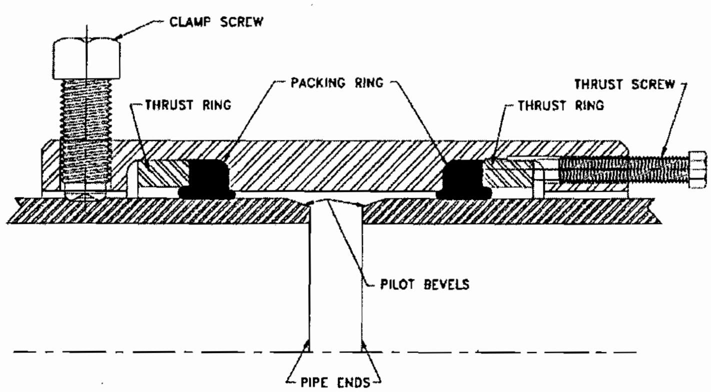
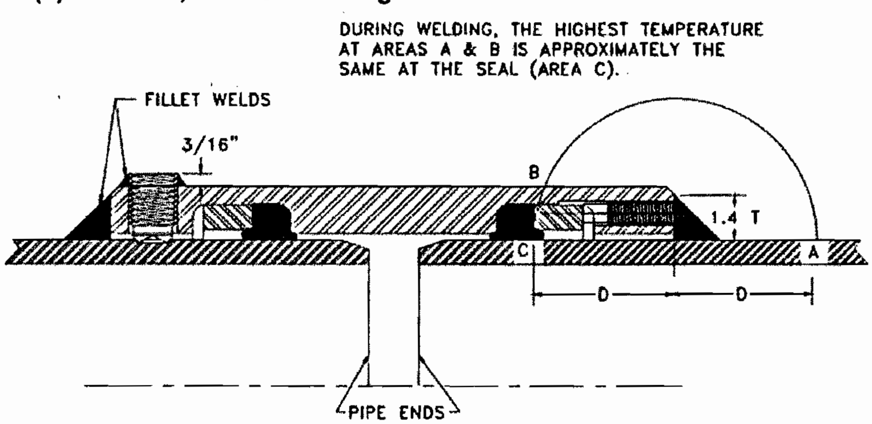


Figure 1
PLIDCO Weld+Ends Coupling
(8 in. coupling shown, courtesy of PLIDCO)



(a) Installed, Prior to Welding



(b) After Welding

Figure 2
Sections Through PLIDCO Weld+Ends Coupling
(courtesy of PLIDCO)

Table 1
Required Clamp Screw Torque*

Pipe Diameter (in)	Required Clamp Screw Torque (ft-lbs)										
	Pipe Wall Thickness (in)										
	0.250	0.281	0.312	0.344	0.354	0.375	0.386	0.406	0.425	0.469	0.500
16	40	47	55	63	65	70	73	77	82	93	100
18	50	62	75	88	92	100	104	112	120	138	150
20	90	97	105	113	115	120	123	127	132	143	150
24	50	62	75	88	92	100	104	112	120	138	150
26	100	106	112	119	121	125	127	131	135	144	150
30	75	84	94	103	106	113	116	122	128	141	150
34	50	62	75	88	92	100	104	112	120	138	150
36			40	59	65	77	83	95	106	132	150
42			35	55	61	74	80	93	104	131	150
48						125	127	131	135	144	150

* tolerance: -0 ft-lbs, +5 ft-lbs

Table 2
Required Thrust Screw Torque Range

Pipe Diameter (in)	Thrust Screw Size and Thread	Torque Range (ft-lbs)
16	1/2-13	30 - 40
18 - 48	5/8-11	70 - 80

Table 3
Unanchored Pressure Rating

Pipe Diameter (in)	Unanchored Pressure Rating (psi)										
	Pipe Wall Thickness (in)										
	0.250	0.281	0.312	0.344	0.354	0.375	0.386	0.406	0.425	0.469	0.500
16	57	79	102	125	132	148	155	170	184	216	238
18	42	68	94	121	129	147	156	172	188	225	251
20	75	91	107	123	128	139	145	155	165	187	203
24	40	61	83	105	112	126	134	147	160	191	212
26	40	57	75	93	98	110	116	127	138	163	180
30	30	43	56	69	74	83	87	96	104	122	135
34	35	48	61	74	79	88	92	101	109	127	140
36			32	48	53	63	69	79	88	110	125
42			15	30	35	44	50	59	68	88	103
48						50	54	60	67	82	92

Related Standards

Canada

Canadian Standards Association (CSA):

- CSA Z662 – Oil and Gas Pipeline Systems

Canadian General Standards Board (CGSB):

- CAN/CGSB 48.9712 - Nondestructive Testing; Qualification and Certification of Personnel

United States

American Petroleum Institute (API):

- ANSI/API Std 1104 – Welding of Pipelines and Related Facilities, Section 9

American Society for Non-destructive Testing (ASNT)

- ASNT SNT-TC-1A – Nondestructive Testing

Requirements

All welds must be nondestructively inspected in accordance with CSA Z662 (CAN), or API Std 1104, Section 9 (USA).

Workers must be aware of company policies concerning weld inspection to ensure standards are met.

Use contractors for:

- magnetic particle inspection (MPI)
- ultrasonic inspection (except to determine wall thickness)
- radiographic inspection

CAN — Contractors who are retained to perform nondestructive examination (NDE) must be hired directly by the company and must not be subcontracted through a second or third party.

Contractors must submit a written procedure describing the nondestructive testing method that includes as a minimum:

- equipment used
- calibration of the equipment
- how to use the equipment

Qualification

CAN — Contractor personnel establishing inspection procedures or techniques, scanning weldments, or interpreting results must be qualified to Level II or Level III in accordance with CAN/CGSB 48.9712-2000.

USA — Contractor personnel establishing inspection procedures or techniques, scanning weldments or interpreting results must be qualified to Level II or Level III in accordance with ASNT RP SNT-TC-1A.

Visual Inspection

Observe the welding process to ensure the weld is completed according to the qualified procedure.

Fillet Welds

For all welding on in-service pipe, inspect the weld for defects using MPI (a) immediately after completing the weld, and (b) at least 12 hrs after completing the weld. If MPI identifies crack indications, complete ultrasonic inspection on all suspected areas.

Any undercut must be blended out and the area re-examined. Cracks, regardless of length, are defects that must be repaired (see *Book 3: Pipeline Facilities, Tab 06 Pipe Repair and Modification*).

NOTE: Exceptions to the 12-hr wait for branch connections reinforced with a saddle or split tee (see below) and in special circumstances must be approved by regional management.

When adding a branch connection that will be reinforced with a saddle or split tee, the weld between the branch and the mainline can be inspected immediately after welding. The 12-hr waiting period must be observed before nondestructive examination of the fillet welds between the branch and the reinforcement and between the run pipe and the reinforcement.

Magnetic Particle Inspection

Use magnetic particle inspection to check:

- fillet welds
- nozzle welds
- sleeve long-seam welds
- longitudinal welds on pipe (manufacturers' welds)

NOTE: For more information, see *02-03-03 Magnetic Particle Inspection of Fillet Welds.*

Ultrasonic Inspection

Use ultrasonic inspection to:

- evaluate pipe wall thickness
- evaluate internal corrosion
- examine fillet welds
- examine nozzle welds
- examine longitudinal welds on pipe (manufacturers' welds)

NOTE: For more information, see *02-03-04 Ultrasonic Inspection of Fillet Welds.*

Radiographic Inspection (X-Ray)

Use radiographic inspection (or x-ray) to examine:

- butt welds

NOTE: For more information, see CSA Z662 (CAN) and ANSI/API Std 1104 (USA).

NOTE: In Canada, ultrasonic inspection may be used as an alternative to radiographic inspection at the company's discretion.

Defects

Welds that exceed the defect acceptance criteria of CSA Z662 (CAN) or ANSI/API Std 1104 (USA) must be repaired or removed (see *02-02-04 Defect Repair*).

Records

Nondestructive Testing Report

Record the results of ultrasonic and magnetic particle inspections of fillet welds using the Nondestructive Testing Report.

USA — Retain all Nondestructive Testing Reports permanently in the PLM Activity Reporting database.

X-Ray Inspection of Girth Welds Form

Record the results of radiographic inspection of butt welds using the X-Ray Inspection of Girth Welds form.

USA — Retain all X-Ray Inspection of Girth Welds forms permanently in the PLM Activity Reporting database.

Welding

1. Scope of Work

The scope of this section is to ensure the required Welding Procedure Qualification and Welding Procedure Specification (WPS) are met and the necessary Welder Performance Qualifications are adequate and current. All regulatory requirements are noted below in Section 2. Enbridge O&MP Book 4 – Welding is the primary standard and includes incorporation of other regulatory requirements.

The pipe replacement section will be welded into the existing pipeline using pre-approved Company WPS. Welders currently qualified to the WPS will perform the welding required. Two WPS's will be used as part of the welding repair process. Enbridge procedure **to be determined** will be used as the WPS for welding 2" branch connections on the existing line to allow thorough drain-up of any remaining product in the line and venting during the welding process. Enbridge procedure UB-75 will be used as the WPS for butt weld tie-ins of replacement pipe to the existing pipeline. Both procedures are manual, shielded metal arc weld (SMAW) welding procedures. The SMAW process uses consumable electrodes coated in flux to lay the weld. The WPS's are included as attachments to this section of the work plan.

At the completion of the respective replacement pipe segment installation welding processes, the integrity of all welds will be verified by a non-destructive testing (NDT). The 2" drain connections will be tested by Magnetic Particle Inspection (MPI). The requirements for the MPI process are addressed in Enbridge O&MP Book 4, Section 02-02-06 Inspection and Section 02-03-03 Performing Magnetic Particle Inspection of Fillet Welds. The butt welds will be inspected by radiography. The radiographic process is addressed in Enbridge O&MP Book 4, Section 02-02-06 Inspection. All NDT will be performed by independent, third party Contractors who have the required, qualified NDT procedures and technical personnel to perform the respective NDT process.

2. Regulatory Requirements

API 1104 Welding of Pipelines and Related Facilities, 19th Edition

ASME Section IX of the Boiler and Pressure Vessel Code

CFR Title 49, Part 195:

§ 195.202 Compliance with specifications or standards.

Each pipeline system must be constructed in accordance with comprehensive written specifications or standards that are consistent with the requirements of this part.

§ 195.206 Material inspection.

No pipe or other component may be installed in a pipeline system unless it has been visually inspected at the site of installation to ensure that it is not damaged in a manner that could impair its strength or reduce its serviceability.

195.214 Welding procedures.

(a) Welding must be performed by a qualified welder in accordance with welding procedures qualified under Section 5 of API 1104 or Section IX of the ASME Boiler and Pressure Vessel Code (incorporated by reference, *see* §195.3) . The quality of the test welds used to qualify the welding procedure shall be determined by destructive testing.

(b) Each welding procedure must be recorded in detail, including the results of the qualifying tests. This record must be retained and followed whenever the procedure is used.

§ 195.222 Welders: Qualification of welders.

(a) Each welder must be qualified in accordance with section 6 of API 1104 (incorporated by reference, *see* §195.3) or section IX of the ASME Boiler and Pressure Vessel Code, (incorporated by reference, *see* §195.3) except that a welder qualified under an earlier edition than listed in §195.3 may weld but may not re-qualify under that earlier edition.

(b) No welder may weld with a welding process unless, within the preceding 6 calendar months, the welder has—

(1) Engaged in welding with that process; and

(2) Had one welded tested and found acceptable under section 9 of API 1104 (incorporated by reference, *see* §195.3).

§ 195.224 Welding: Weather.

Welding must be protected from weather conditions that would impair the quality of the completed weld.

§ 195.226 Welding: Arc burns.

(a) Each arc burn must be repaired.

(b) An arc burn may be repaired by completely removing the notch by grinding, if the grinding does not reduce the remaining wall thickness to less than the minimum thickness required by the tolerances in the specification to which the pipe is manufactured. If a notch is not repairable by grinding, a cylinder of the pipe containing the entire notch must be removed.

(c) A ground may not be welded to the pipe or fitting that is being welded.

§ 195.228 Welds and welding inspection: Standards of acceptability.

(a) Each weld and welding must be inspected to insure compliance with the requirements of this subpart. Visual inspection must be supplemented by nondestructive testing.

(b) The acceptability of a weld is determined according to the standards in Section 9 of API 1104. However, if a girth weld is unacceptable under those standards for a reason other than a crack, and if Appendix A to API 1104 (incorporated by reference, *see* §195.3) applies to the weld, the acceptability of the weld may be determined under that appendix.

§ 195.230 Welds: Repair or removal of defects.

(a) Each weld that is unacceptable under §195.228 must be removed or repaired. Except for welds on an offshore pipeline being installed from a pipelay vessel, a weld must be removed if it has a crack that is more than 8 percent of the weld length.

(b) Each weld that is repaired must have the defect removed down to sound metal and the segment to be repaired must be preheated if conditions exist which would adversely affect the quality of the weld repair. After repair, the segment of the weld that was repaired must be inspected to ensure its acceptability.

(c) Repair of a crack, or of any defect in a previously repaired area must be in accordance with written weld repair procedures that have been qualified under §195.214. Repair procedures must provide that the minimum mechanical properties specified for the welding procedure used to make the original weld are met upon completion of the final weld repair.

§ 195.234 Welds: Nondestructive testing.

(a) A weld may be nondestructively tested by any process that will clearly indicate any defects that may affect the integrity of the weld.

(b) Any nondestructive testing of welds must be performed—

(1) In accordance with a written set of procedures for nondestructive testing; and

(2) With personnel that have been trained in the established procedures and in the use of the equipment employed in the testing.

(c) Procedures for the proper interpretation of each weld inspection must be established to ensure the acceptability of the weld under §195.228.

(d) During construction, at least 10 percent of the girth welds made by each welder during each welding day must be nondestructively tested over the entire circumference of the weld.

(e) All girth welds installed each day in the following locations must be nondestructively tested over their entire circumference, except that when nondestructive testing is impracticable for a girth weld, it need not be tested if the number of girth welds for which testing is impracticable does not exceed 10 percent of the girth welds installed that day:

(1) At any onshore location where a loss of hazardous liquid could reasonably be expected to pollute any stream, river, lake, reservoir, or other body of water, and any offshore area;

(2) Within railroad or public road rights-of-way;

(3) At overhead road crossings and within tunnels;

(4) Within the limits of any incorporated subdivision of a State government; and

(5) Within populated areas, including, but not limited to, residential subdivisions, shopping centers, schools, designated commercial areas, industrial facilities, public institutions, and places of public assembly.

(f) When installing used pipe, 100 percent of the old girth welds must be nondestructively tested.

(g) At pipeline tie-ins, including tie-ins of replacement sections, 100 percent of the girth welds must be nondestructively tested.

3. Company Standards

O&MP Book 4 – Welding

4. Exceptions to standards or specific site requirements - None

ENBRIDGE

Welding Procedure Specification Datasheet

Application: Butt weld for maintenance welding of non-in-service pipe or fittings with and without notch toughness requirement to -46°C (-50°F) **Codes:** ASME Section IX, Compliant to CSA Z662, CFR 49 Parts 192 and 195 **Inspection Standards:** CAN: ASME B31.3; USA: API 1104	**Datasheet No.:** UB-75 Rev.: 0 **WPS No.:** UB-75 (rev 0)

Material Qualified
≤API 5L Gr.X70; ≤CSA Z245 Gr.483, ASME IX P1(S1) Group 1/2/3
CE: ≤ 0.50
(typical P1 materials include SA106, SA333, SA516-70, SA537CL2) – contact Pipeline Integrity for other material substitutions

Diameter Range All	**Welding Process** SMAW, Manual	**Polarity** DCRP (Electrode Positive)
Wall Thickness Range 3.2 – 25.4 mm (0.125 – 1 in.)	**Welding Position** All	**Filler Metal** E6010 and E8018-C3
Preheat Temperature ≥120°C (250°F)	**Interpass Temperature** ≥120°C (250°F) and ≤232°C (450°F)	**Postweld Heat Treatment** N/A

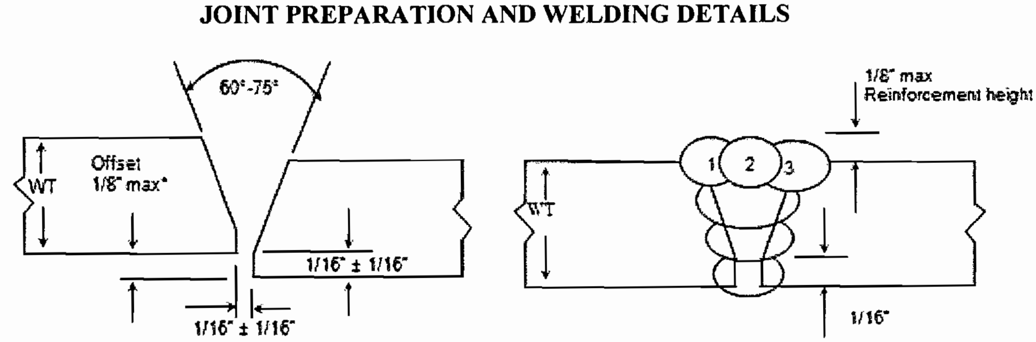
- Preheat must be applied to an area of at least 2" on each side of the weld joint for the entire circumference prior to welding.
- Preheating may be applied by oxy-fuel torch, propane torch, electrical induction coils or other method approved by Enbridge.
- Preheat temperature must be checked using temperature indicating crayons, thermocouple pyrometers or other suitable method approved by Enbridge to determine that the required preheat temperature is obtained prior to, and maintained during the welding operation.

Line Up Clamp Removal Internal Clamp: 100% of root complete prior to removal. External Clamp: 50% of root complete and uniformly spaced prior to removal.	**Maximum Time Interval Between Passes** Root / Hot: 5 Minutes To Completion: 72 Hours (Unless otherwise Authorized by Enbridge Assigned Designate)

Welding Technique Root Pass: String Hot / Fill / Cap: String or Weave	**Minimum No. of Welders** One for OD <=12" Two for OD >12"	**Interpass Cleaning** Brush, chip and/or grind as required

Bead Number	Electrode Size mm (in.)	Electrode AWS Class	Welding Progression	Amperage Range amperes	Voltage Range volts	Travel Speed mm/min (in./min)	Heat Input kJ/mm (kJ/in.)
Root/hot	2.4 (3/32)	E6010 5P+	Root: up/down Hot: down	50 – 70	19 – 30	50 - 300 (2.0 - 12.0)	≤0.69 (17.5) for wt ≤12.7mm (0.5") ≤1.13 (28.8) for wt >12.7mm (0.5")
	3.2 (1/8)			75 – 130		75 - 350 (3.0 - 14.0)	
	4.0 (5/32)			90 – 160		100 - 400 (4.0 - 16.0)	
Remaining	2.4 (3/32)	E8018-C3	Uphill	80 – 110	18 – 28	50 - 250 (2.0 - 10.0)	≤1.06 (27.0) for wt ≤12.7mm (0.5") ≤1.42 (36.2) for wt >12.7mm (0.5")
	3.2 (1/8)			100 – 150		100 - 300 (4.0 - 12.0)	
	4.0 (5/32)			130 – 180		125 - 350 (5.0 - 14.0)	

JOINT PREPARATION AND WELDING DETAILS



Enbridge Engineering Approval: Date: June 30, 2010   Page 1 of 1

ENBRIDGE

WELDING PROCEDURE SPECIFICATION No. UB-75 (Rev. 0) Date: 20 May 2010

Company: Enbridge Pipelines Inc., PO Box 398, 10201 Jasper Avenue, Edmonton, AB T5J 2J9
Supporting PQR(s): UB-70-1, UB-70-2, EPI-08-WP9-1
Intended Application: Above and below ground piping and repair welding
Base Metals: P1 Groups 1, 2 &3 to P1 Groups 1, 2 &3
Carbon Equivalent: 0.5 max.
Welding Process: SMAW **Type:** Manual **Weld Types:** Groove and Fillet
Minimum No. of Root Bead and Hot Pass Welders: Two for NPS 12 and greater
Position: All positions **Diameters:** All
Filler Metals: E6010 5P+, E8018-C3
Thickness Qualified: 3.2 mm to 25.4 mm (0.125 to 1.000 in.) inclusive
Notch Toughness: -46°C as-welded condition

JOINTS (QW-402)
Type: All groove and fillet weld joints **Backing:** with or without
Root Opening: 1.6 to 4.0 mm (1/16 to 5/32 in.) **Retainers:** not required

BASE METALS (QW-403)
P-Number: P1 Groups 1, 2&3 **To P-Number :** P1 Groups 1, 2&3
Thickness Range: **Groove:** 3.2 to 25.4 mm (0.125 to 1.000 in.) inclusive
Fillet: All base metal thicknesses
Pipe Diameter Ranges: **Groove:** all **Fillet:** all
Max. Deposited Weld Metal (Per Pass): 12.7 mm (0.50 in.)

FILLER METALS (QW - 404)

	SMAW	SMAW
Specification No. (SFA)	5.1	5.5
AWS No. (Class)	E6010 5P+	E8018-C3
F-No.	F3	F4
A-No.	A1	A1
Diameter, mm (in.)	2.4, 3.2 & 4 (3/32, 1/8 & 5/32)	2.4 to 6.4 (3/32 to 1/4)
Deposited Metal Thickness Range		
Groove Fillet	6.4 mm (0.250) max. All fillet sizes	19.05 mm (0.750) max. All fillet sizes

POSITION (QW - 405)
Position of Groove: All positions **Position of Fillet:** All positions
Weld Progression: F3: vertical up or down; F4: vertical up

PREHEAT (QW - 406)
Preheat Temperature: 120°C **Maximum Interpass Temperature:** 232°C
Preheat Maintenance: 120°C prior to welding. Preheat maintenance is not required if welding is interrupted or after the completion of welding unless required by the code of construction.

POSTWELD HEAT TREATMENT (QW - 407)
Temperature: None **Time:** Not applicable

ENBRIDGE

ELECTRICAL CHARACTERISTICS (QW - 409)

Current: Direct **Polarity:** Reverse, electrode positive

Amps: see summary **Volts:** see summary

Maximum Heat Input:

Base Metal Thickness Range	E6010 Electrode	E8018-C3 Electrode
3.2 to 12.7 mm (0.125 to 0.500 in.)	690 J/mm 17 486 J/in.	1060 J/mm 27 000 J/in.
12.7 to 25.4 mm (0.500 to 1.000 in.)	1130 J/mm 28 800 J/in.	1420 J/mm 36 225 J/in.

TECHNIQUE (QW - 410)

String or Weave: Root – String, Fill & Cap - Either **Travel Speed:** see summary

Initial & Interpass Cleaning: Brushing, chipping, or grinding as required

Method of Back Gouging: Air carbon arc, back-grind as required

Multiple or Single Pass Per Side: Multiple **Multiple or Single Electrodes:** Single

Peening: Not required

REPAIR WELDING

Welding Technique: Welding shall be performed using the details listed in this specification, in addition to the details listed below.

Defect Removal: Defects shall be removed by grinding and may extend through the complete wall thickness when approved by the Company representative.

Length of Repair: The minimum repair length shall be 50 mm.

Preheat: The area to be rewelded shall be preheated to 120ºC.

Reexamination: The area shall be reexamined using the same method(s) originally used to identify the defect.

SUMMARY OF WELDING PARAMETERS

Process	Filler Metal	Diameter mm (in)	Current & Polarity	Amperage Range	Voltage Range	Travel Speed mm/min (in/min.)
Root	E6010 5P+	2.4 (3/32)	DCRP	50-70	19-30	50-300 (2.0-12.0)
Root	E6010 5P+	3.2 (1/8)	DCRP	75-130	19-30	75-350 (3.0-14.0)
Root	E6010 5P+	4.0 (5/32)	DCRP	90-160	19-30	100-400 (4.0-16.0)
Bal.	E8018-C3	2.4 (3/32)	DCRP	80-110	18-28	50-250 (2.0-10.0)
Bal.	E8018-C3	3.2 (1/8)	DCRP	100-150	18-28	100-300 (4.0-12.0)
Bal.	E8018-C3	4.0 (5/32)	DCRP	130-180	18-28	125-350 (5.0-14.0)
Bal.	E8018-C3	5.0 (3/16)	DCRP	150-270	18-28	150-400 (6.0-16.0)
Bal.	E8018-C3	6.4 (1/4)	DCRP	270-360	18-28	200-400 (8.0-16.0)
Note: Welding parameters shall be adjusted to ensure that the maximum heat input value specified in QW-409 above is not exceeded.						

Date: 20 May 2010 Signed: Jimfanfun

PROCEDURE QUALIFICATION TEST REPORT

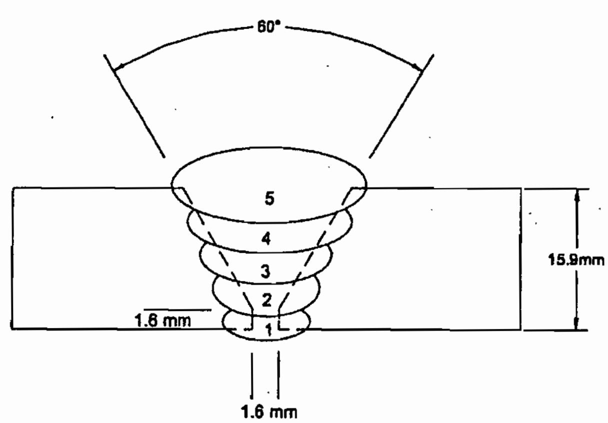
PQR No.	EPI-08-WP9-1	Date	March 19, 2008
Welder (a)	Brad Whitworth	Welder (b)	Shannon Whitworth
Base Material	CSA Z245.1	Grade	483
Heat Number	591747	Carbon Equivalent	0.23
Size	914 mm (36.0 in.) O.D.	Wall Thickness	15.9 mm (0.625 in.)
Preheat & Min. Interpass	120°C (250°F)	Max. Interpass	160°C (320°F)
Technique	Root & hot pass - string, Fill & Cap - weave	Thermal Condition	As welded
Welding Progression	Root & Hot: Down Remaining: Up	Welding Position	Horizontal - fixed (5G)
Time Delay:	N/A	Test No.:	25RD

Electrode Trade Name: E6010 (Lincoln Fleetweld 5P+), E8010-P1 (Lincoln Pipeliner 8P+)
E8018-C3 (Air Liquide LA 8018-C3)

WELDING PARAMETERS

	ELECTRODE		CURRENT				
Pass	Class	Size	Type & Polarity	Amperage	Voltage	Arc Speed mm / min. (i.p.m.)	Heat Input kJ / mm (J / inch)
1a	E6010	1/8	DCRP	100	23.5	203 (8.0)	0.69 (17,625)
1b	E6010	1/8	DCRP	95	25.5	319 (12.5)	0.46 (11,628)
2a	E8010-P1	5/32	DCRP	160	27.5	274 (10.8)	0.96 (24,444)
2b	E8010-P1	5/32	DCRP	160	29.5	290 (11.4)	0.98 (24,842)
3a	E8018-C3	3/32	DCRP	115	25.5	90 (3.5)	1.96 (50,271)
3b	E8018-C3	3/32	DCRP	95	24	66 (2.6)	2.07 (52,615)
4a	E8018-C3	1/8	DCRP	155	25	82 (3.2)	2.84 (72,656)
4b	E8018-C3	1/8	DCRP	125	25	39 (1.5)	4.81 (125,000)
5a	E8018-C3	1/8	DCRP	160	25	80 (3.2)	3.00 (75,000)
5b	E8018-C3	1/8	DCRP	120	24	45 (1.8)	3.84 (96,000)
*6a	E8018-C3	1/8	DCRP	155	23	89 (3.5)	2.40 (61,114)

* Brad Completed the weld using six passes, Shannon used five.



LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER:	**Enbridge Pipelines Inc.** 10201 Jasper Avenue Edmonton, AB T5J 2J9	**Laboratory Test No.:**	E08-213.18
		Date:	April 11, 2008
Attention:	Bob Hogg		

PQR No.:	EPI-08-WP9-1	**Heat No.:**	591747
Material:	CSA Z245.1 Gr. 483	**Weld Test No.:**	25rd
Size:	914 mm (36.0 in.) O.D. x 15.9 mm (0.626 in.) w.t.		
Thermal Condition:	As Welded		

TENSILE TEST

SAMPLE NUMBER	T1		T2	
WIDTH mm (in.)	25.5	(1.00)	25.3	(0.996)
THICKNESS mm (in.)	15.8	(0.624)	15.7	(0.618)
AREA sq. mm (sq. in.)	404	(0.626)	397	(0.616)
ULTIMATE LOAD N (lbs)	249 819	(56,200)	251 183	(56,500)
UTS MPa (psi)	618	(89,600)	632	(91,700)
FRACTURE TYPE	Partial Cup & Cone		Partial Cup & Cone	
FRACTURE LOCATION	Parent Metal		Parent Metal	

GUIDED-BEND TEST

SAMPLE WIDTH: 12.7 mm (0.500 in.) SAMPLE THICKNESS: 15.9 mm (0.626 in.)
PLUNGER SIZE: 88.9 mm (3.50 in.) YOKE SIZE: 120 mm (4.72 in.)

SAMPLE TYPE	Side Bend	Side Bend	Side Bend	Side Bend
SAMPLE NUMBER(S)	S1	S2	S3	S4
RESULTS	Pass	Pass	Pass	Pass

NICK BREAK TEST

SAMPLE NUMBER(S)	N1	N2
REMARKS	Pass	Pass

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of CSA Z662 - 07. Material information has been provided by the Customer whose name appears on this report.

Samples associated with this report will be discarded in 30 days.

Laboratory Test Conducted By: ______________________

Natashua Collier, C.E.T.

LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER:	**Enbridge Pipelines Inc.** 10201 Jasper Avenue Edmonton, AB T5J 2J9	**Laboratory Test No.:**	E08-213.18
		Date:	April 11, 2008
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Material:	CSA Z245.1 Gr. 483	**Weld Test No.:**	25rd
Size:	914 mm (36.0 in.) O.D. x 15.9 mm (0.626 in.) w.t.		
Thermal Condition:	As Welded		

NOTCH-TOUGHNESS TEST

TYPE OF TEST:	Charpy V-Notch	ORIENTATION:	Transverse
TEST TEMPERATURE:	-5°C (23°F)	SPECIMEN SIZE:	10 x 10 mm

Specimen Number	Notch Location	Impact Values Joules	(ft.lbs)
J2.1	Weld Metal within 1/16" of root	152	(112)
J2.2	Weld Metal within 1/16" of root	130	(96.2)
J2.3	Weld Metal within 1/16" of root	>163	(>120)
J3.1	HAZ	>163	(>120)
J3.2	HAZ	>163	(>120)
J3.3	HAZ	>163	(>120)

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASME Section VIII, Div. I, UG-84 - 2007 *edition and latest addenda. Material information has been provided by the Customer whose name appears on this report.*

Samples associated with this report will be discarded in 30 days.

Laboratory Test Conducted By:____________________

Natashua Collier, C.E.T.

4027 - 14 Street, S.E., CALGARY, ALBERTA T2G 3K6 PHONE: (403) 262-7072 FAX: (403) 266-3169

7925 Davies Road, EDMONTON, ALBERTA T6E 4N1 PHONE: (780) 468-3030 FAX: (780) 468-3032

LUDWIG ASSOCIATES LTD.

Materials and Welding Consulting

LABORATORY TEST REPORT

CUSTOMER: **Enbridge Pipelines Inc.**
10201 Jasper Avenue
Edmonton, AB
T5J 2J9

Laboratory Test No.: E08-213.18
Date: April 11, 2008

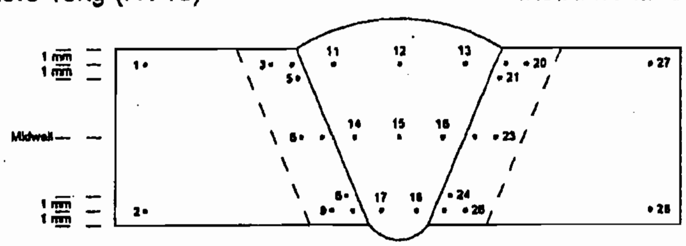
Attention: Bob Hogg

PQR No.:	EPI-08-WP9-1	**Heat No.:**	591747
Material:	CSA Z245.1 Gr. 483	**Weld Test No.:**	25rd
Size:	914 mm (36.0 in.) O.D. x 15.9 mm (0.626 in.) w.t.		
Thermal Condition:	As Welded		

HARDNESS TEST

Type of Test: Vickers 10kg (HV10)

Instrument: Leco V-100-C1



Parent Metal		HAZ		Weld Metal		HAZ		Parent Metal	
1	230	3	203	11	200	19	208	27	230
2	227	4	210	12	202	20	202	28	231
		5	208	13	203	21	209		
		6	208	14	203	22	214		
		7	224	15	202	23	201		
		8	186	16	197	24	187		
		9	175	17	166	25	184		
		10	182	18	166	26	174		

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E92-82 (Reapproved 2003). *Material information has been provided by the Customer whose name appears on this report.*

Samples associated with this report will be discarded in 30 days

Laboratory Test Conducted By: ______________________
Natashua Collier, C.E.T.

4027 - 14 Street, S.E., CALGARY, ALBERTA T2G 3K6 PHONE: (403) 262-7072 FAX: (403) 266-3169
7925 Davies Road, EDMONTON, ALBERTA T6E 4N1 PHONE: (780) 468-3030 FAX: (780) 468-3032

IPSCO

MILL CERTIFICATE
Chemistry

Certificate Package ID:	4454
Certificate Form Number:	L 2422

Customer: ENBRIDGE PIPELINES INC. Specification: API 5L 43RD ED / ENBRIDGE EES103-2006 REV 0 8/4/06	Customer Order No: P4000-4722 Mill Order No: 70008861	Date: 03/04/2008 Time: 13:05:41	Size: 36.000 in Wall: 0.625 in Grade: X70 PSL 2

Coil	Pipe	Type	C	Mn	S	P	Si	Cu	Ni	Cr	V	Cb	Sn	Mo	Al	Ca	B	Ti	N	Ce	CEpcm	SoAl
Heat 591747																						
		HEAT	0.03	1.54	0.001	0.007	0.25	0.21	0.38	0.06	0.001	0.070	0.047	0.190	0.038	0.0028	0.0001	0.016	0.008	0.000	0.15	0.030
C52	3170	PRODUCT	0.03	1.57	0.002	0.008	0.25	0.22	0.39	0.07	0.002	0.070	0.038	0.191	0.037	0.0032	0.0002	0.015	0.008	0.000	0.16	0.031
C53	3173	PRODUCT	0.03	1.54	0.002	0.008	0.25	0.21	0.38	0.07	0.003	0.072	0.043	0.195	0.039	0.0030	0.0002	0.015	0.008	0.000	0.16	0.033

Deoxidization Practice: Aluminum Fully Killed
Furnace: ELECTRIC ARC Casting: CONTINUOUS SLAB Rolling Mill: STECKEL

WE HEREBY CERTIFY THAT THE PRODUCT DESCRIBED ABOVE HAS PASSED ALL THE TESTS REQUIRED BY THE SPECIFICATIONS.

Brent Dalrymple

Quality Assurance

Form: Cipr787F

RTD

RTD Quality Services Inc.
1431 – 70 Avenue
Edmonton, Alberta T6P 1N5
Tel: (780) 440-6600
Fax: (780) 440-2538

Date m/d/y: Mar-24-08
Time:
Page: 1 of 1
Report #: 12522

RADIOGRAPHIC TESTING REPORT

Client/Contractor: Enbridge
RTD Job #: 00941
Project: Alberta Clipper Procedures
RTD Procedure: RT-001 Rev. #:
Location: Nisku AB (RMS)
Code/Specification: CSA-Z662.07
Client Job #/P.O.#:
Item(s) Inspected: 36" Pipe Weld

Material: Type: Carbon Steel Thickness: Weld Reinforcement: 3.5mm
Exposure: ☑ Single Wall ☐ Double Wall Viewing: ☑ Single Wall ☐ Double Wall RTD Technique: A

Film	Type	Size	Qty/Cassette	Total # of Film
AGFA	D-5	70mm X 300mm	1	1- Roll Pac

Source: ☑ X-Ray ☐ Gamma Type: ☐ Iridium 192 ☐ Cobalt 60 ☑ Tube ☐ Other Source Size: Focal Spot Size:
Screens: 0.005" ☐ Front ☐ Back 0.010" ☐ Front ☐ Back
SOD: Processing: ☑ Manual ☐ Automatic Screen Type: Pb .027mm
OFD:
Note: The OFD (Object to Film Distance) shall be measured from the maximum distance from the source side of the object to the film.

IP	Incomplete Penetration	CK	Crack	EP	Excess Penetration	LC	Low Cover
LF	Lack of Fusion	S	Slag	IC	Internal Concavity	HB	Hollow Bead
BT	Burn Through	P	Porosity	IU	Internal Undercut	EU	External Undercut
WS	Welder Symbol	T	Technique	A	Acceptable	R	Rejectable

#	Weld / Film ID	Size/Sch	WS / IP / LF / CK / P / S / BT / EP / IC / LC / HB / IU / EU / T / Comments	A	R
1	Test25RD	36" X 15.9mm		✓	
2	48hr	@ 0-50cm	(upper Quadrant) Thru WALL		
3					
4	Test25RD	36" X 15.9mm		✓	
5	48hr @	175-210cm	(lower Quadrant Thru Wall)		
6					
7					
8	Test26RD	36" X 15.9mm			
9	48hr	@125-140	(lower Quadrant BackWeld)	✓	
10					
11	Test26RD	36" X 15.9mm			
12	48hr	@ 270-290cm	(upper Quadrant BackWeld)	✓	
13					
14					
15	Notes ①	the above weld test appear on 1 piece of film			
16	②	above welds where performed on Test Weld 22D			
17					
18					
19					
20					

Rick OSTROM
Client Name
Client Signature
Date:

Start Time: 0700
End Time: 1700
Total Hours: 10hr
Kilometres:
Consumables: ☐ Yes ☐ No

Tech. Name: GARY HELLEVANG Cert #: 2309
Tech. Signature: Gary Hellevang
☑ CGSB ☐ ASNT ☐ SNT Level: II Disc.: RT
Assistant Name: Don GRIMARD Cert #:
☐ CGSB ☐ ASNT ☐ SNT ☐ Level I ☐ QO ☐ CEDO ☑ Trainee

*Results are an interpretation of the inspection method, not a guarantee. Client signature indicates acceptance of report, results and applicable charges.
White – Client Green – Client Yellow – Office Pink – Invoice Golden Rod - Technician

RTD QUALITY SERVICES INC.
1431 – 70 AVENUE, EDMONTON,
ALBERTA, CANADA T6P 1N5
TEL: (780) 440-6600 FAX: (780) 440-2538

NDE REPORT # 2585

Date m/d/y: Mar-24-08 Page 1 of 1
RTD Job #: 00941
RTD Dep. #: PS

Client: Enbridge
Address:
PO/WO:

Job location: Nisku AB
Procedure(s): MT-005
Code(s): CSA-Z662.07
Client Rep.:

Part (s) Examined: 36" Pipe Weld internal side, root only
Calibration Standard:

Surface Condition: ☑ Weldment ☐ Ground ☐ Machined ☐ Sandblasted ☐ Painted ☐ Other

Method: ☑ MT ☐ PT ☐ VT ☐ Other

Surface Temp (C°): ☐ < 5 >5 ☑ < 60 ☐ > 60

Equipment

Type	RTD Asset #	Calibration Date
☑ Yoke	10722	Mar-01-08
☐ Perm. Magnet		
☐ Coil		
☐ Blacklight		
☐ Alloy Analyzer		
☐ Hardness Tester		
☐ Other		

Test Medium

☐ Wet Fluorescent
☐ Dry Powder
☑ Black and White
☐ Fluorescent
☐ Visible Dye
☐ Other

Technique

MPI
☑ AC
☐ DC
☐ Continuous
☐ Residual
☐ Other

LPI
☐ Water Washable
☐ Post Emulsified
☐ Solvent Removable

Dwell Time:
Developer Time:

INSPECTION DETAILS

Scope: Do Black on White color contrast MPI inspection on internal side of pipe on root only

WELD #	WALL THICKNESS & SIZE	Comments	Results
Test 21 D	36" x 15.9 mm	No relevant indications found at time of inspection	Accept
Test 23 D	36" x 15.9 mm		Accept
Test 24 C	36" x 10.3 mm		Accept
Test 25 RD-Upper	36" x 15.9 mm		Accept
Test 25 RD-Lwr	36" x 15.9 mm		Accept
Test 26 RD-Upper	36" x 15.9 mm		Accept
Test 26 RD-Lwr	36" x 15.9 mm		Accept

Assistant: DON GRIMARD
☐ CGSB ☐ ASNT ☐ SNT Level: ☐ I ☐ II
Discipline: ☐ UT ☐ MT ☐ PT ☐ ET ☐ RT ☐ VT

Technician: GARY HELLEVANG
7309 ☑ CGSB ☐ ASNT ☐ SNT Level: ☐ I ☑ II
Discipline: ☐ UT ☑ MT ☐ PT ☐ ET ☑ RT ☐ VT
Signature: Gary Hellevang

Unit: Km: Travel Time:
Start Time: Stop Time: Work hrs:
☐ OT Meal ☐ Subsistence required Total hrs:
Consumables:

Client Name: RICK OSTROM
Client Signature:

T094, Rev. 2
Apr. 28, 03

*Results are an interpretation of the inspection method, not a guarantee. Client signature indicates acceptance of report, results and applicable charges.

White – Client Yellow – Office Pink – Invoice Golden Rod - Technician

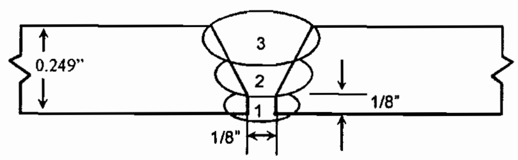
ENBRIDGE

PROCEDURE QUALIFICATION RECORD (PQR)

Procedure Qualification No: UB-70-1

Welding Procedure Specification No: UB - 70

JOINTS



BASE METALS

Material Spec:	SA 516	To:	SA 537
Type or Grade:	60/70	To:	CL 2
P No:	1 Group No.: 1&2	To:	P No: 1 Group No.: 3
Heat Number:		To:	
ASME Carbon Equivalent:	0.4	To:	0.45
CSA Carbon Equivalent:		To:	
Coupon Thickness:	Machined to 0.249"	To	Machined to 0.249"
Coupon Diameter:	Plate	To	Plate

FILLER METALS

Process:	SMAW	SMAW	
Number of Layers:	1	2	
SFA Spec. No.:	5.1	5.5	
AWS Class No.:	E6010 5P+	E8018-C3	
F-No.:	F3	F4	
A-No.:	A1	A10	
Size of Filler Metal:	1/8"	3/32"	
Manufacturer:	Lincoln	Air Liquide	
Trade Name:	Fleetweld 5P+	LA8018-C3	
Heat/Lot No.:			
Weld Metal Thickness:	0.100"	0.149"	
Flux Type:	NA	NA	
Flux Trade Name:	NA	NA	
Other:	Covered Electrode	Covered Electrode	

POSITIONS

Process:	SMAW	SMAW	
Position of Groove:	3G	3G	
Welding Progression:	Uphill	Uphill	

ENBRIDGE

PROCEDURE QUALIFICATION RECORD (PQR)

PREHEAT

Preheat Temp: 50° F

Interpass Temp: 550° F

Other: Temperature monitored using templesticks

POST WELD HEAT TREATMENT

Temperature: NA

Time:

Heating:

Cooling:

GAS

	SFA	Composition	Flow Rate (CFH)		
Shielding:	NA				
Backing:	NA				

ELECTRICAL CHARACTERISTICS

Process:	SMAW- F3	SMAW -F4	
Current Type:	Direct (DC)	Direct (DC)	
Polarity:	Reverse (EP)	Reverse (EP)	
Amps:	82-87	72-92	
Volts:	22-26	18-22	
Maximum Heat Input (Joules/Inch):	17,486	27,000	
Tungsten Electrode Size & Type:	NA		
Mode of Metal Transfer for GMAW:	NA		
Electrode Wire Feed Speed:	NA		
Electrode Stick Out:	NA		

Process	Filler Metal	Diameter	Amps	Volts	Travel (IPM)	
SMAW	E6010 5P+	1/8"	85	24	7	
SMAW	E8018-C3	3/32"	90	20	4	
SMAW	E8018-C3	3/32"	80	21	4	

TECHNIQUE

	F3	F4	
String or Weave Bead:	String	String & Weave	
Multiple or Single Pass (Per Side):	Multiple Passes from One Side		
Multiple or Single Electrodes:	single	single	
Gas Cup Size:	NA		
Oscillation:	NA		
Other:	NA		

ENBRIDGE

PROCEDURE QUALIFICATION RECORD (PQR)

TENSILE TEST

Specimen No.	Width (in.)	Thickness (in.)	Area (in^2)	Ultimate Total Load (lb.)	Ultimate Unit Stress (psi)	Type of Failure & Location	

GUIDED BEND TEST

Specimen No.	Type	Figure No.	Result	

TOUGHNESS TEST

Specimen No.	Notch Location	Notch Type	Qualification Temperature	Impact Values ft-lbs	% Shear	Lateral Expansion (inches)	
1	SA 516 HAZ	V-notch	-50°F	34		NA	
2	SA516 HAZ	V-notch	-50°F	35			
3	SA516 HAZ	V-notch	-50°F	38			
4	Weld Zone	V-notch	-50°F	26			
5	Weld Zone	V-notch	-50°F	25			
6	Weld Zone	V-notch	-50°F	26			
7	SA-537 HAZ	V-notch	-50°F	58			
8	SA-537 HAZ	V-notch	-50°F	45			
9	SA-537 HAZ	V-notch	-50°F	61			

OTHER TESTS

Hardness:

Ferrite:

Chemical Analysis:

Liquid Penetrant:

PMI:

Welder's Name: Greg McKecheran **File No.:** **ID No.:**

Test Conducted By: Alfor Metallurgical Company Ltd. **Lab. Test No.:** 09-363

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer: Enbridge Pipelines Ltd.

Date: 5-Jul-09

Signed:

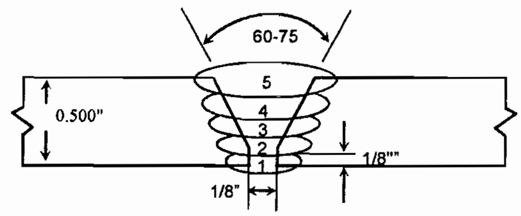
PROCEDURE QUALIFICATION RECORD (PQR)

ENBRIDGE

Procedure Qualification No: UB-70-2

Welding Procedure Specification No: UB - 70

JOINTS



BASE METALS

Material Spec:	SA 516	**To:**	SA 537
Type or Grade:	60/70	**To:**	CL 2
P No:	1 Group No.: 1&2	**To:**	P No 1 Group No.: 3
Heat Number:		**To:**	
ASME Carbon Equivalent:	0.42	**To:**	0.47
CSA Carbon Equivalent:		**To:**	
Coupon Thickness:	Machined to 0.500"	To:	Machined to 0.500"
Coupon Diameter:	Plate	**To**	Plate

FILLER METALS

Process:	SMAW	SMAW	
Number of Layers:	1	2	
SFA Spec. No.:	5.1	5.5	
AWS Class No.:	E6010 5P+	E8018-C3	
F-No.:	F3	F4	
A-No.:	A1	A10	
Size of Filler Metal:	1/8"	3/32"	
Manufacturer:	Lincoln	Air Liquide	
Trade Name:	Fleetweld 5P+	LA8018-C3	
Heat/Lot No.:			
Weld Metal Thickness:	0.125"	0.375"	
Flux Type:	NA	NA	
Flux Trade Name:	NA	NA	
Other:	Covered Electrode	Covered Electrode	

POSITIONS

Process:	SMAW	SMAW	
Position of Groove:	3G	3G	
Welding Progression:	Uphill	Uphill	

ENBRIDGE

PROCEDURE QUALIFICATION RECORD (PQR)

PREHEAT

Preheat Temp: 50° F

Interpass Temp: 550° F

Other: Temperature monitored using templesticks

POST WELD HEAT TREATMENT

Temperature: NA

Time:

Heating:

Cooling:

GAS

	SFA	Composition	Flow Rate (CFH)		
Shielding:	NA				
Backing:	NA				

ELECTRICAL CHARACTERISTICS

Process:	SMAW- F3	SMAW -F4	
Current Type:	Direct (DC)	Direct (DC)	
Polarity:	Reverse (EP)	Reverse (EP)	
Amps:	80-90	100-115	
Volts:	23-24	21-22	
Maximum Heat Input (Joules/Inch):	28,800	36,225	
Tungsten Electrode Size & Type:	NA		
Mode of Metal Transfer for GMAW:	NA		
Electrode Wire Feed Speed:	NA		
Electrode Stick Out:	NA		

Process	Filler Metal	Diameter	Amps	Volts	Travel (IPM)
SMAW	E6010 5P+	1/8"	90	23/24	4.5
SMAW	E8018-C3	3/32"	100	21	5
SMAW	E8018-C3	3/32"	105	22	4
SMAW	E8018-C3	3/32"	102	22	4
SMAW	E8018-C3	1/8"	115	21	4

TECHNIQUE

	F3	F4	
String or Weave Bead:	String	String & Weave	
Multiple or Single Pass (Per Side):	Multiple Passes fron One Side		
Multiple or Single Electrodes:	single	single	
Gas Cup Size:	NA		
Oscillation:	NA		
Other:	NA		

ENBRIDGE

PROCEDURE QUALIFICATION RECORD (PQR)

TENSILE TEST

Specimen No.	Width (in.)	Thickness (in.)	Area (in^2)	Ultimate Total Load (lb.)	Ultimate Unit Stress (psi)	Type of Failure & Location
1	0.749	0.488	0.366	29,000	79,300	Ductile/Weld
2	0.753	0.476	0.358	28,500	79,700	Ductile/Weld

GUIDED BEND TEST

Specimen No.	Type	Figure No.	Result
1	Side Bend	QW-462.2	Pass
2	Side Bend	QW-462.2	Pass
3	Side Bend	QW-462.2	Pass
4	Side Bend	QW-462.2	Pass

TOUGHNESS TEST

Specimen No.	Notch Location	Notch Type	Qualification Temperature	Impact Values ft-lbs	% Shear	Lateral Expansion (inches)
1	SA 516 HAZ	V-notch	-50°F	132		NA
2	SA516 HAZ	V-notch	-50°F	125		
3	SA516 HAZ	V-notch	-50°F	121		
4	Weld Zone	V-notch	-50°F	75		
5	Weld Zone	V-notch	-50°F	59		
6	Weld Zone	V-notch	-50°F	62		
7	SA-537 HAZ	V-notch	-50°F	146		
8	SA-537 HAZ	V-notch	-50°F	162		
9	SA-537 HAZ	V-notch	-50°F	149		

OTHER TESTS

Hardness: see attached report

Ferrite:

Chemical Analysis:

Liquid Penetrant:

PMI:

Nick Break see attached report

Welder's Name: Greg McKecheran File No.: ID No.:

Test Conducted By: Alfor Metallurgical Company Ltd. Lab. Test No.: 09-363

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer: Enbridge Pipelines Ltd.

Date: 5-Jul-09

Signed:

ENBRIDGE™

Enbridge Energy Company, Inc.

STOCK PIPE PRESSURE TEST RECORD

Test Report Number:	999-08-803
Pipe Size:	30
Wall Thickness:	.375
Date of Test:	09/18/2008
Min Test Pressure:	1755
Test Medium:	Water
Yield Strength:	
Description:	Stock Pipe - Griffith Region 3 40' sections of ERW longseam X70

Enbridge (U.S.)
HYDROSTATIC PRESSURE TEST REPORT

PRE-TEST INFO

PROJECT DESCRIPTION/AFE
TEST REPORT NO. 949-08-803 **TEST DATE:** 9-18-08
GENERAL CONTRACTOR Enbridge
TESTING COMPANY MAP **COMPANY REPRESENTATIVE** mike McCamey

DESCRIPTION OF FACILITY

MAINLINE LINE NO. ________ FROM STA ________ TO STA ________
STATION OR FACILITY LOCATION ________
ATTACHED DRAWING NO. ________
✓ STOCK PIPE

PIPE DATA

OD	WT	GRADE	LENGTH	MANUFACTURER	SEAM TYPE
.30	.375	X 70	362.5	JFE	DSAW

TEST DATA

TEST MEDIUM: water FILL VOLUME: 12 654 U.S. gal SQUEEZE VOLUME: 106 gal

MAINLINE USE ONLY

Deadweight/Recorder Elev.		Stationing	Pressure psig
High Point Elevation		Stationing	Pressure psig
Low Point Elevation		Stationing	Pressure psig

TEST EQUIPMENT

	Deadweight Tester	Pressure Recorder	Pressure Gauge	Line Temperature Recorder
Make	Vaetrix 6-3	PMC	Oilwer	PMC
Range	0- 7000	0-3000	0-5000	0-150°
Serial No.	25323-1	071108-3	070708/01	071108-5
Cert. Date	6-20-08	7-11-08	7-7-08	7-11-08

TEST DATA

TEST DATA

TEST	Actual Minimum PSI	Actual Maximum PSI	Duration
STRENGTH	1755 psi	1802	4.5 hr.
LEAK			

EQUIPMENT VALIDATION

	Calibration During Pressurization				Calibration During Depressurization			
	Zero	Approx 25%	Approx 50%	Approx 100%	Full Scale	1/2 Scale	1/4 Scale	Zero
Deadweight	0	429	878	1752	1802	874	432	-0-
Pressure Recorder	0	437	880	1755	1800	880	430	-0-
Pressure Gauge	0	440	878	1742	1794	873	435	-0-

Test Supervisor Scott Friesen
Signature Scott Friesen
Company MAP Mech

Enbridge Approval Mike McCamey
Signature M McCamey

Enbridge (U.S.)

HYDROSTATIC TEST DATA SHEET

TEST DATE: 9-18-08
PROJECT DESCRIPTION/AFE :
TEST REPORT NUMBER: 999-08-803
TARGET PRESSURE 1750
TEST MINIMUM PSI 1663
TEST MAXIMUM PSI 1837

Time Record 15 min. Intervals	Chart Recorder	Deadweight Pressure	Temperature (°F) Ambient Thermometer	Line (Recorder)	REMARKS (Weather, Volumes Added/Bled Off)
8:30 AM	0	0	50	60	Install Chart
8:45	0	0	50	61	Start press to 25%
8:57	437	439	50	64	END Press to 25%
9:45	432	434	52	65	Start press to 50%
9:30	880	878	54	65	END press to 50%
9:50	881	879	55	65	Start Press to 100%
10:20	1755	1752	57	66	END press to 100%
10:21	1756	1753	57	66	Stabilizing p
10:30	1757	1754	57	66	Start test
10:46	1755	1755	59	66	Sunny Cool Breeze
11:03	1758	1758	59	66	Sunny cool Breeze
11:17	1761	1761	59	66	Sunny cool Breeze
11:31	1763	1763	59	67	Sunny Cool Breeze
11:46	1765	1765	61	67	Sunny warmer Breeze
12:02 PM	1770	1763	62	67	Sunny warm
12:16	1770	1768	64	67	Sunny warm
12:30	1775	1771	63	67	Sunny warm
12:45	1776	1776	61	67	sunny warm
1:00	1777	1778	61	67	Sunny warm
1:15	1777	1781	61	67	Sun warm
1:30	1780	1783	61	68	Sun warm
1:45	1781	1786	61	68	Sun warm
2:00	1783	1790	61	68	Sun warm
2:15	1788	1792	61	68	
2:30	1791	1796	61	68	
2:45	1795	1798	61	68	
3:00	1800	1802	61	68	END TEST Bleed to 50%
3:28	880	874	63	68	@ 50%
3:45	880	878	63	68	Start Bleed to 25%
3:57	430	432	63	68	END Bleed to 25%
4:12	430	432	63	67	Start Bleed to 0
4:35	-0-	-0-	63	67	Remove Chart

Test Supervisor Signature: Scott Frieser
Company: MAP Mech.

Enbridge Approval Signature: Mike McCamey

30" CHICAGO REGION EMERGENCY PIPE
TEST # 999-08-803

検査証明書
INSPECTION CERTIFICATE

JFE JFEスチール株式会社 東日本製鉄所(千葉) JFE Steel Corporation East Japan Works(Chiba)
〒260-0835 千葉市中央区川崎町1番地 1, KAWASAKI-CHO, CHUO-KU, CHIBA, JAPAN

注文番号 ORDER No :7A90692-002 (FJ2FJ218958)
注文者 SHIPPER :JFE SHOJI TRADE CORPORATION
需要家 CUSTOMER :EDGEN CARBON PRODUCTS GROUP, L.L.C.
品名 COMMODITY :SAW STEEL PIPE
規格 SPECIFICATION :API 5L GRADE X70 PSL2 43 EDITION MARCH 2004
寸法 SIZE :OD30"X0.375"X40'
日付 DATE :2007-10-03
数量 QUANTITY: 100 PIECES 4,000.0 FEET 215,500KG
証明書番号 CERTIFICATION No :7X0302
船番 SHIP No
工事番号 CONSTRUCTION No :
需要家管理番号 CUSTOMER'S CONTROL No :PO NO.64053
物件名 PROJECT NAME .

製鋼番号 HEAT No	試験パイプ番号 TEST PIPE No (連続番号 SEQUENCE No)	LOT No		耐力 YIELD STRENGTH KSI	引張強さ TENSILE STRENGTH KSI	伸び% ELONGATION ≒ 2"	降伏比 YIELD RATIO %	曲げ試験 GUIDED BEND TEST F	R	衝撃試験 IMPACT TEST FT-LBS						落重試験 DROP WEIGHT TEAR TEST S.A.(%) EACH	AVE.	HARDNESS
			BT	70.0-90.0	82.0 110.0	21.0 W=1.5" MIN.	93 MAX.			1 BT +32°F 2V 10X10 / 2 BT -4°F 2V 10X10				EACH 15.0 / 23.0 MIN.	AVE. 20.0 / 30.0 MIN.	MIN.	MIN.	HV(10) B W H MAX.
			WT		82.0 110.0													
51-2253	PKT56139 (77)		BT	81.7	98.1	28.3	83	G	G	1	97.4 85%	122.6 87%	122.6 87%	114.2 86%				B 217 W 213 H 237
			WT		96.5					2	99.8 78%	119.4 81%	101.0 78%	106.7 79%				F.G 11.3
51-2253	PKT56403 (60)																	
51-1542	PKT57060 (23)																	
51-1542	PKT57082 (35)		BT	85.4	101.7	23.4	84	G	G	1	99.8 78%	128.0 85%	108.5 80%	112.1 81%				B 229 W 213 H 239
			WT		94.7					2	106.4 80%	96.6 70%	93.3 69%	98.7 73%				F.G 11.0

化学成分 CHEMICAL COMPOSITION(%)
HA--HEAT 取鍋分析 *1..V +NB+TI
PA--PRODUCT 製品分析 PCM(X100)

	C (×100)	Si (×100)	Mn (×100)	P (×1000)	S (×1000)	Mo (×1000)	V (×1000)	Nb (×1000)	Al (×1000)	Ti (×1000)	*1 (×1000)	PCM (×1000)	Cu (×100)	Ni (×100)	Cr (×100)	B (×10000)	N (×10000)	Ceq (×100)
HA	15 MA		200 MAX	25 MA	15 MA					60 MA	150 MAX	25 MAX		99 MA				43 MA
PA	15 MA		200 MAX	25 MA	15 MA					60 MA	150 MAX	25 MAX		99 MA				43 MA
HA	7	24	161	12	1	180	3	29	25	10	42	17	2	1	1	1		38
PA	6	24	161	13	2	181	4	29	24	11	44	16	2	1	2	1		37
HA	7	24	161	12	1	180	3	29	25	10	42	17	2	1	1	1		38
PA	6	24	161	12	2	180	4	29	23	11	44	16	2	1	2	1		37
HA	7	25	161	7	1	200	2	30	28	9	41	17	2	1	1	1		38
PA	7	25	158	8	2	191	3	27	29	10	40	17	2	1	1	1		38
HA	7	25	161	7	1	200	2	30	28	9	41	17	2	1	1	1		38
PA	7	24	159	8	2	191	3	28	27	10	41	17	2	1	1	1		38

IMPACT TEST WERE CONDUCTED BY USING SUB-SIZE SPECIMENS(10X6.7), AND THESE ABSORBED ENERGY WERE CONVERTED TO FULL-SIZE EQUIVALENT VALUES IN ACCORDANCE WITH API 5L PARA.9.10.4.

NDT REFERENCE STANDARD
UT(LONGI.):3.2MM AND 1.6MM DIA. DRILLED HOLE
RT:ISO WIRE TYPE PENETRAMETER

* DETAILS AS PER PACKING LIST *

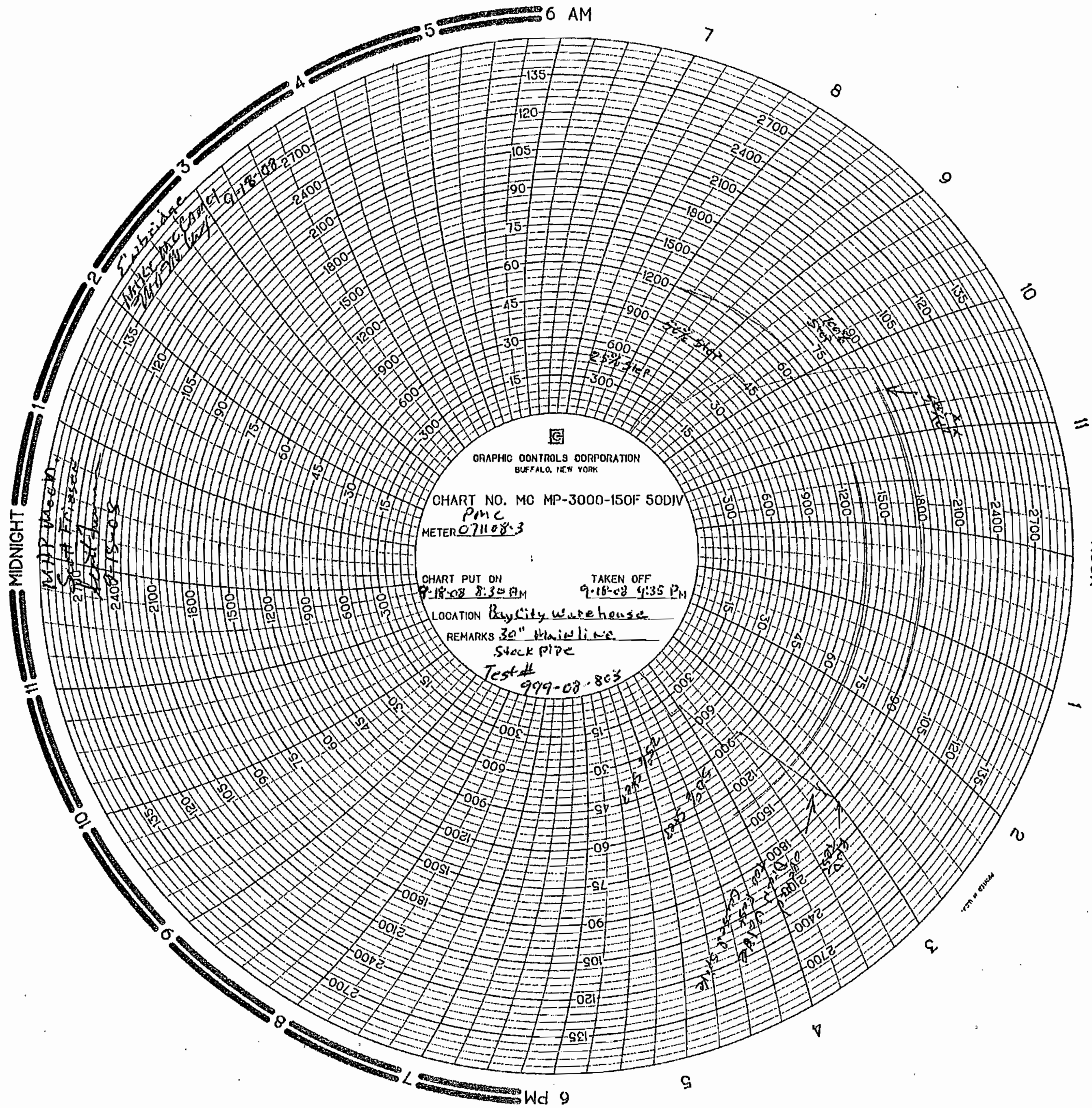
MILL CERT API 5L-SR15. CER MAX.0.43% BASED ON SR18
STRAIGHTNESS AND ROUNDNESS AS PER API2B.
ALL STEEL MADE BY FINE GRAIN FULLY KILLED PRACTICE.
WE CONFIRM COMPLYING WITH NI CONTENT REQUIREMENT (MAX.1.0%)WHICH ARE REQUIRED IN NACE MR0175.

水圧試験 HYDROSTATIC TEST	超音波探傷検査 ULTRASONIC INSPECTION	放射線検査 RADIOGRAPHIC INSPECTION	外観・寸法検査 VISUAL & DIMENSION INSPECTION
GOOD (1580 PSI 10 SEC.)	GOOD	GOOD	GOOD

上記鋼材は規定の検査を行ないこれに合格したことを証明する。
WE HEREBY CERTIFY THAT THE MATERIAL DESCRIBED HEREIN HAS BEEN SATISFACTORILY TESTED IN ACCORDANCE WITH THE SPECIFICATION.

A. Umetsu
東日本製鉄所 品質保証室
Quality Assurance Section
East Japan Works

BT--BASE METAL, WT--WELD METAL, H--HEAT AFFECTED ZONE, T--TRANSVERSE, L--LONGITUDINAL, G--GOOD, S.A.--SHEAR AREA(%)


GRAPHIC CONTROLS CORPORATION
BUFFALO, NEW YORK
CHART NO. MC MP-3000-150F 50DIV
PMC
METER 071108-3
CHART PUT ON
9-18-08 8:30 AM
TAKEN OFF
9-18-08 4:35 PM
LOCATION Bay City warehouse
REMARKS 30" Mainline
Stock Pipe
Test #
999-08-803
MIDNIGHT
6 AM
6 PM
25% Step

TAYLOR VALVE TECHNOLOGY INC.

8300 S.W. 8th Street
Oklahoma City,Oklahoma 73128
1-405-787-0145

Customer Name:	Mechanical Contractors Inc.	Gauge Serial No :	25323-1
Mailing Address :	2000 Austin Street	Tester No :	1336A
City / State:	Midland Michigan 48642	Sales Order No :	41956
Shipped :	24- Jun-08	Certificate No :	535578

Calibration Date: **20 June 2008**

CALIBRATION CONDITIONS

All calibrations are performed by the Taylor Valve Metrology Laboratory in a controlled environment by qualified personnel using instrumentation and methods which guarantee that the specifications claimed are reliable.

The laboratory reference standards for Mass and Effective Area are traceable to:

NIST-United States,through reference piston-cylinders 202 and 26 and reference mass set R100 bearing test report numbers M4212, TN-251820-93 and 822/255136-95 respectively. The traceability to NIST of standards for secondary measurement is established through laboratories approved by the DH Instruments Quality Assurance Program.

THIS CERTIFICATE EXPIRES ONE YEAR FROM THE ABOVE CALIBRTATED DATE

Vaetrix Test Analysis

Customer Name : Mechanical Contractors Inc.
Mailing Address : 2000 Austin Street
City / State : Midland Michigan 48642
Sales Order No : 41956
Certificate No. : 535578
Gauge Serial No. : 25323-1

Piston/Cylinder No : 1336A
Mass Set Identity : 1220
Full Scale Output : 7000 PSI
Linearity (% F.S.O.) : 0.033% PASS
Hysteresis: (% F.S.O.) : 0.023% PASS
Calibartion Date : **20 June 2008**

First Increasing Run

PSI	APPLIED	I. R.	
0	0.000	0	
1400	1397.412	1397.1	PASS
2800	2795.510	2794.8	PASS
4200	4193.614	4194.4	PASS
5600	5591.718	5593	PASS
7000	6989.814	6992	PASS

First Decreasing Run

PSI	APPLIED	I. R.	
0	0.000	0	PASS
1400	1397.412	1398.1	PASS
2800	2795.510	2796.3	PASS
4200	4193.614	4195.7	PASS
5600	5591.718	5594	PASS
7000	6989.814		

Second Increasing Run

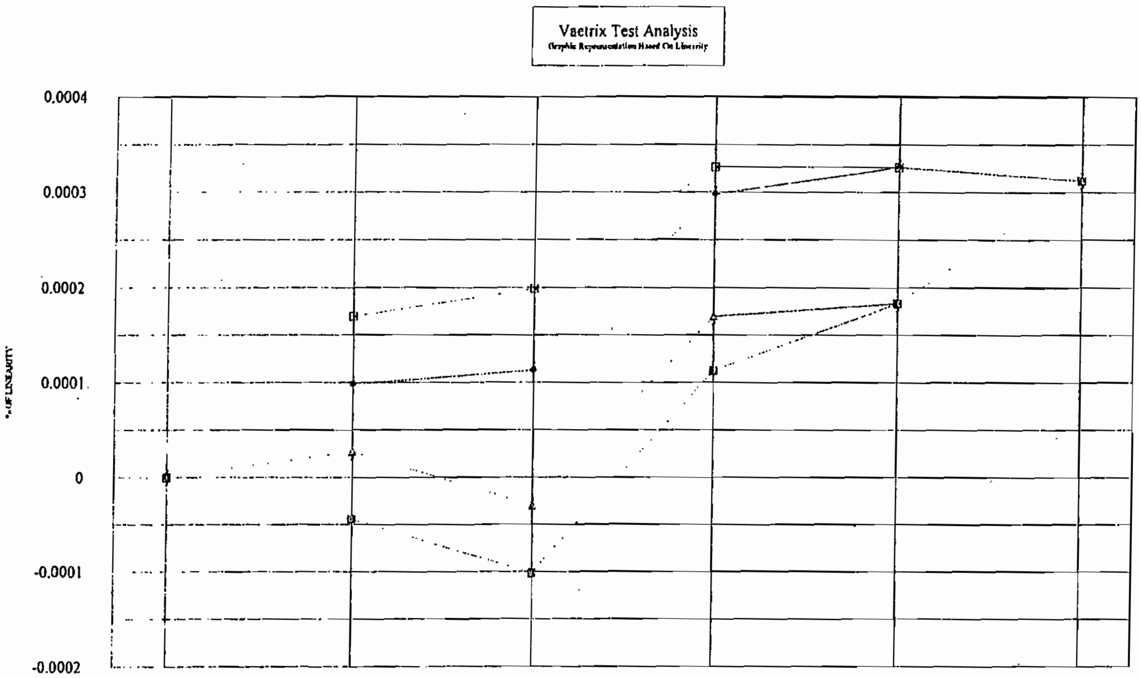
PSI	APPLIED	I. R.	
0	0.000	0	
1400	1397.412	1397.6	PASS
2800	2795.510	2795.3	PASS
4200	4193.614	4194.8	PASS
5600	5591.718	5593	PASS
7000	6989.814	6992	PASS

Second Decreasing Run

PSI	APPLIED	I. R.	
0	0.000	0	PASS
1400	1397.412	1398.6	PASS
2800	2795.510	2796.9	PASS
4200	4193.614	4195.9	PASS
5600	5591.718	5594	PASS
7000	6989.814		

Test Performed By :

Quality Assurance :



	0.000	1397.412	2795.510	4193.614	5591.718	6989.814
□ 1	0	-4.46072497179E-5	-0.000101434339338	0.000112268358611	0.000183192378896	0.000312222239158
◆ 2	0	9.82498931392E-5	0.000112851374947	0.000297982644325	0.000326049521817	0.000312222239158
△ 3	0	2.68213217106E-5	-3.00057679098E-5	0.000169411215753	0.000183192378896	0.000312222239158
□ 4	0	0.000169678464568	0.000198565660662	0.000326554072896	0.000326049521817	0.000312222239158

Vaetrix Test Analysis

	Temperature (+/- 1) Deg C			
	+/- 0	25	50	
Zero Drift :	0	+/- 0	0	: Zero Reading
Full Scale Drift :	6990	6989.814	6990	: Full Scale Reading

Calculated Values

Thermal Zero Drift (% F.S.O.) : ************** **PASS**
Thermal Span Drift (% F.S.O.) : ************** **PASS**

Specified Values

Thermal Zero Drift (% F.S.O.) : **.030 %FS / Deg Celcius**
Thermal Span Drift (%F.S.O.) : **.005 %FS / Deg Celcius**

GALLOUP
J.O. Galloup Company
SMITH INSTRUMENT | MERLO ENERGY

Certified Calibration Chart

CORPORATE OFFICE

130 North Helmer Road

Battle Creek, MI 49015

T 269.965.2303

F 269.965.2393

J.O. GALLOUP COMPANY

Adrian 517.263.3190

Ann Arbor 734.668.1612

Battle Creek 269.965.4005

Grand Rapids 616.452.3251

Holland 616.392.4030

Jackson 517.787.6650

Kalamazoo 269.382.1190

Lansing 517.482.6170

Manistee 231.723.2506

Muskegon 231.739.3100

Toledo 419.867.0893

Warren 586.755.3110

www.galloup.com

SMITH INSTRUMENT
MERLO ENERGY

Grand Rapids 616.245.1195

Midland 989.496.9250

Warren 586.755.3110

www.smithinstrument.com

Customer: MAP Mechanical
Customer Order Number: M08100 Date 7/11/2008

Manufacture: PMC Pressure/Temperature Recorder
Model: 11415
Range: 3,000 **PSIG ACCURACY 1.0%**
I.D. Number: 071108-03
Smith Shipper Number: 767110-00

Test Gauge PSIG	Pressure Reading PSIG	% Error
0	0	0.00%
300	300	0.00%
600	600	0.00%
900	900	0.00%
1200	1200	0.00%
1500	1500	0.00%
1800	1800	0.00%
2100	2100	0.00%
2400	2400	0.00%
2700	2700	0.00%
3000	3000	0.00%

Calibration Standard: Druck Model M2200/3 S/N 3936-B5 (0.03% of Reading)
***The above is traceable to N.I.S.T. and certified by Smith Instrument Inc.

TESTED BY: Cindy Myer

Signature Cindy Myer

GALLOUP
J.O. Galloup Company
SMITH INSTRUMENT | MERLO ENERGY

Certified Calibration Chart

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Toledo 419.867.0893
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SMITH INSTRUMENT
MERLO ENERGY

Grand Rapids 616.245.1195
Midland 989.496.9250
Warren 586.755.3110
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Customer: MAP Mechanical
Customer Order Number: M08200 Date 7/7/2008

Manufacture: Dywer
Model: DPG-111
Range: 5,000 **PSIG ACCURACY 1.0%**
I.D. Number: 070708/01
Smith Shipper Number: 763852-00

Test Gauge PSIG	Pressure Reading PSIG	% Error
0	0	0.00%
500	500	0.00%
1000	999	-0.02%
1500	1496	-0.08%
2000	1990	-0.20%
2500	2483	-0.34%
3000	2985	-0.30%
3500	3485	-0.30%
4000	3986	-0.28%
4500	4485	-0.30%
5000	4980	-0.40%

Calibration Standard: Druck Model M2200/3 S/N 3936-B5 (0.03% of Reading)
***The above is traceable to N.I.S.T. and certified by Smith Instrument Inc.

TESTED BY: Cindy Myer

Signature Cindy Myer

GALLOUP
J.O. Galloup Company
SMITH INSTRUMENT | MERLO ENERGY

CALIBRATION CERTIFICATE

CORPORATE OFFICE

130 North Helmer Road

Battle Creek, MI 49015

T 269.965.2303

F 269.965.2393

We certify the instrument identified below has been tested using precision standards traceable to NIST and the accuracy found is attested to below:

Customer:	MAP Mechanical
Customer Order #:	M08100
Date:	7/11/2008
Type:	PMC Pressure/Temperature Recorder
Serial #:	11415
Range:	0-150°F
Smith Shipper #:	767110-00

Chart Recorder 2312-2	P3
33°F	33.08°F
75°F	75.21°F
150°F	150.02°F

Calibration Standard: Veatrix Pressure Indicator Serial Number 25323-1.

TESTED BY: Cindy Myer

Signature Cindy Myer

J.O. GALLOUP COMPANY

Adrian	517.263.3190
Ann Arbor	734.668.1612
Battle Creek	269.965.4005
Grand Rapids	616.452.3251
Holland	616.392.4030
Jackson	517.787.6650
Kalamazoo	269.382.1190
Lansing	517.482.6170
Manistee	231.723.2506
Muskegon	231.739.3100
Toledo	419.867.0893
Warren	586.755.3110

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SMITH INSTRUMENT
MERLO ENERGY

Grand Rapids	616.245.1195
Midland	989.496.9250
Warren	586.755.3110

www.smithinstrument.com

M.A.P. Mechanical

CustomerEnbridge Bay City

Project 30" Stock Pipe

TEST # 999-08-803

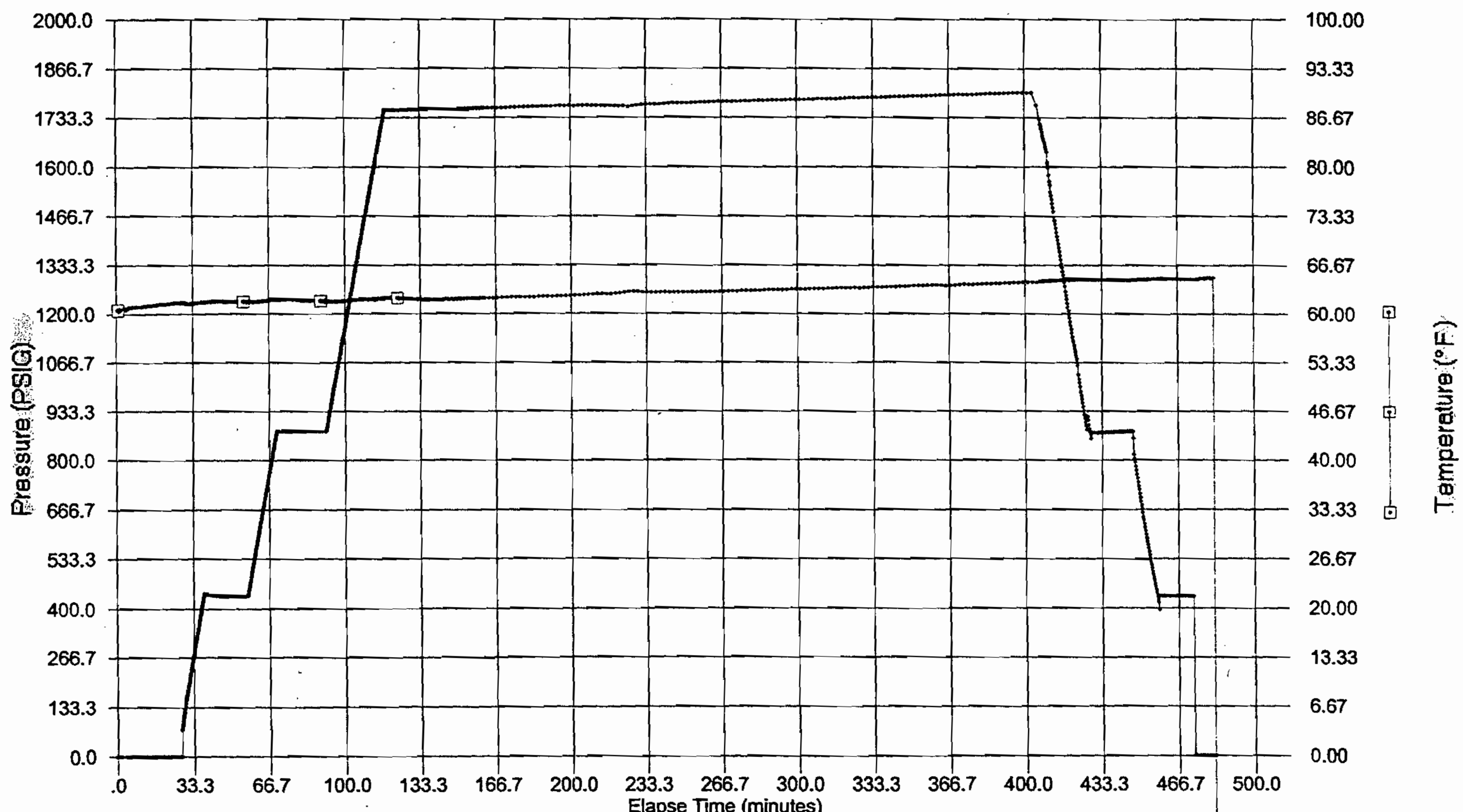
Pressure Gauge Taylor Gauge 3 7000 PSIG

Serial No. 25323-1

Calibration Date 20 JUN 08

Customer : Enbridge Bay City **Project : 30" Stock Pipe**

Taylor Gauge 3 7000 PSIG **Serial No. 25323-1** **Last Calibration Date 20 JUN 08**



Start Log Date Time 9/18/08 08:17:28
Pressure 0
Temperature 60.48

Date Time 9/18/2008 4:37:28 PM **Stop**
Pressure 0
Temperature -999

Customer : Enbridge Project : Stock Pipe

Taylor Gauge 3 7000 PSIG Serial No. 25323-1 Last Calibration Date 20 JUN 08

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 08:17:28	0.0	60.46	29.7	54.0
09/18/08 08:18:27	0.0	60.48	29.7	54.0
09/18/08 08:18:30	0.0	60.41	29.7	54.0
09/18/08 08:18:33	0.0	60.47	29.7	54.0
09/18/08 08:18:36	0.0	60.55	29.7	54.0
09/18/08 08:18:39	0.0	60.48	29.7	54.0
09/18/08 08:18:42	0.0	60.55	29.7	54.0
09/18/08 08:18:45	0.0	60.51	29.7	54.0
09/18/08 08:18:48	0.0	60.5	29.7	54.0
09/18/08 08:18:51	0.0	60.45	29.7	54.0
09/18/08 08:18:54	0.0	60.39	29.7	54.0
09/18/08 08:18:57	0.0	60.39	29.7	54.0
09/18/08 08:19:00	0.0	60.48	29.7	54.0
09/18/08 08:19:03	0.0	60.51	29.7	54.0
09/18/08 08:19:06	0.0	60.58	29.7	54.0
09/18/08 08:19:09	0.0	60.55	29.7	54.0
09/18/08 08:19:12	0.0	60.58	29.7	54.0
09/18/08 08:19:15	0.0	60.57	29.7	54.0
09/18/08 08:19:18	0.0	60.53	29.7	54.0
09/18/08 08:19:21	0.0	60.54	29.7	54.0
09/18/08 08:19:24	0.0	60.5	29.7	54.0
09/18/08 08:19:27	0.0	60.46	29.7	54.0
09/18/08 08:19:30	0.0	60.51	29.7	54.0
09/18/08 08:19:33	0.0	60.54	29.7	54.0
09/18/08 08:21:28	0.0	60.63	29.7	52.0
09/18/08 08:21:30	0.0	60.63	29.7	52.0
09/18/08 08:21:32	0.0	60.63	29.7	52.0
09/18/08 08:21:34	0.0	60.63	29.7	52.0
09/18/08 08:21:36	0.0	60.63	29.7	52.0
09/18/08 08:21:39	0.0	60.65	29.7	52.0
09/18/08 08:21:42	0.0	60.64	29.7	52.0
09/18/08 08:21:45	0.0	60.64	29.7	52.0
09/18/08 08:21:48	0.0	60.67	29.7	52.0
09/18/08 08:21:51	0.0	60.63	29.7	52.0
09/18/08 08:21:54	0.0	60.6	29.7	52.0
09/18/08 08:21:57	0.0	60.61	29.7	52.0
09/18/08 08:22:00	0.0	60.62	29.7	52.0
09/18/08 08:22:03	0.0	60.59	29.7	52.0
09/18/08 08:22:06	0.0	60.59	29.7	52.0
09/18/08 08:22:09	0.0	60.62	29.7	52.0
09/18/08 08:22:12	0.0	60.65	29.7	52.0
09/18/08 08:22:15	0.0	60.65	29.7	52.0
09/18/08 08:22:18	0.0	60.64	29.7	52.0
09/18/08 08:22:21	0.0	60.65	29.7	52.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 08:22:24	0.0	60.62	29.7	52.0
09/18/08 08:22:28	0.0	60.61	29.7	52.0
09/18/08 08:22:38	0.0	60.62	29.7	52.0
09/18/08 08:23:08	0.0	60.8	29.7	52.0
09/18/08 08:23:38	0.0	60.75	29.7	52.0
09/18/08 08:24:08	0.0	60.76	29.7	52.0
09/18/08 08:24:38	0.0	60.84	29.7	52.0
09/18/08 08:25:08	0.0	60.82	29.7	52.0
09/18/08 08:25:38	0.0	60.85	29.7	52.0
09/18/08 08:26:08	0.0	60.84	29.7	52.0
09/18/08 08:26:38	0.0	60.89	29.7	52.0
09/18/08 08:27:08	0.0	60.91	29.7	52.0
09/18/08 08:27:38	0.0	60.88	29.7	52.0
09/18/08 08:28:08	0.0	60.86	29.7	52.0
09/18/08 08:28:38	0.0	60.94	29.7	52.0
09/18/08 08:29:08	0.0	60.89	29.7	52.0
09/18/08 08:29:38	0.0	60.96	29.7	52.0
09/18/08 08:30:08	0.0	61.01	29.7	52.0
09/18/08 08:30:38	0.0	61.0	29.7	52.0
09/18/08 08:31:08	0.0	61.02	29.7	52.0
09/18/08 08:31:38	0.0	61.05	29.7	52.0
09/18/08 08:32:08	0.0	61.04	29.7	52.0
09/18/08 08:32:38	0.0	61.11	29.7	52.0
09/18/08 08:33:08	0.0	61.11	29.7	52.0
09/18/08 08:33:38	0.0	61.1	29.7	50.0
09/18/08 08:34:08	0.0	61.12	29.7	50.0
09/18/08 08:34:38	0.0	61.13	29.7	50.0
09/18/08 08:35:08	0.0	61.18	29.7	50.0
09/18/08 08:35:38	0.0	61.18	29.7	50.0
09/18/08 08:36:08	0.0	61.21	29.7	50.0
09/18/08 08:36:38	0.0	61.25	29.7	50.0
09/18/08 08:37:08	0.0	61.25	29.7	50.0
09/18/08 08:37:38	0.0	61.27	29.7	50.0
09/18/08 08:38:08	0.0	61.27	29.7	50.0
09/18/08 08:38:38	0.0	61.3	29.7	50.0
09/18/08 08:39:08	0.0	61.28	29.7	50.0
09/18/08 08:39:38	0.0	61.32	29.7	50.0
09/18/08 08:40:08	0.0	61.33	29.7	50.0
09/18/08 08:40:38	0.0	61.34	29.7	50.0
09/18/08 08:41:08	0.0	61.32	29.7	50.0
09/18/08 08:41:38	0.0	61.36	29.7	50.0
09/18/08 08:42:08	0.0	61.38	29.7	50.0
09/18/08 08:42:38	0.0	61.41	29.7	50.0
09/18/08 08:43:08	0.0	61.43	29.7	50.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 08:43:38	0.0	61.42	29.7	50.0
09/18/08 08:44:08	0.0	61.46	29.7	50.0
09/18/08 08:44:38	0.0	61.44	29.7	50.0
09/18/08 08:45:08	0.0	61.45	29.7	50.0
09/18/08 08:45:38	0.0	61.45	29.7	50.0
09/18/08 08:45:43	0.0	61.46	29.7	50.0
09/18/08 08:45:47	71.9	61.47	29.7	50.0
09/18/08 08:45:51	75.41	61.45	29.7	50.0
09/18/08 08:45:55	78.11	61.44	29.7	50.0
09/18/08 08:45:59	80.91	61.43	29.7	50.0
09/18/08 08:46:03	84.16	61.43	29.7	50.0
09/18/08 08:46:07	86.71	61.42	29.7	50.0
09/18/08 08:46:11	89.85	61.44	29.7	50.0
09/18/08 08:46:15	92.55	61.45	29.7	50.0
09/18/08 08:46:19	95.89	61.43	29.7	50.0
09/18/08 08:46:23	98.54	61.48	29.7	50.0
09/18/08 08:46:27	101.24	61.44	29.7	50.0
09/18/08 08:46:31	104.4	61.44	29.7	50.0
09/18/08 08:46:35	107.44	61.47	29.7	50.0
09/18/08 08:46:39	109.91	61.48	29.7	50.0
09/18/08 08:46:43	113.07	61.48	29.7	50.0
09/18/08 08:46:47	115.47	61.43	29.7	50.0
09/18/08 08:46:51	118.62	61.45	29.7	50.0
09/18/08 08:46:55	121.16	61.42	29.7	50.0
09/18/08 08:46:59	124.04	61.45	29.7	50.0
09/18/08 08:47:03	126.84	61.43	29.7	50.0
09/18/08 08:47:07	129.41	61.45	29.7	50.0
09/18/08 08:47:11	132.52	61.46	29.7	50.0
09/18/08 08:47:15	135.47	61.45	29.7	50.0
09/18/08 08:47:19	137.48	61.44	29.7	50.0
09/18/08 08:47:23	140.5	61.45	29.7	50.0
09/18/08 08:47:27	142.9	61.46	29.7	50.0
09/18/08 08:47:31	145.39	61.44	29.7	50.0
09/18/08 08:47:35	148.18	61.45	29.7	50.0
09/18/08 08:47:39	150.75	61.44	29.7	50.0
09/18/08 08:47:43	153.69	61.4	29.7	50.0
09/18/08 08:47:47	155.62	61.44	29.7	50.0
09/18/08 08:47:51	158.21	61.42	29.7	50.0
09/18/08 08:47:55	160.81	61.42	29.7	50.0
09/18/08 08:47:59	163.07	61.42	29.7	50.0
09/18/08 08:48:03	165.55	61.39	29.7	50.0
09/18/08 08:48:07	168.11	61.4	29.7	50.0
09/18/08 08:48:11	170.73	61.41	29.7	50.0
09/18/08 08:48:15	173.18	61.39	29.7	50.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 08:48:19	175.64	61.39	29.7	50.0
09/18/08 08:48:23	177.47	61.4	29.7	50.0
09/18/08 08:48:27	180.49	61.44	29.7	50.0
09/18/08 08:48:31	182.41	61.38	29.7	50.0
09/18/08 08:48:35	184.96	61.41	29.7	50.0
09/18/08 08:48:39	187.33	61.38	29.7	50.0
09/18/08 08:48:43	189.93	61.37	29.7	50.0
09/18/08 08:48:47	191.92	61.4	29.7	50.0
09/18/08 08:48:51	194.71	61.37	29.7	50.0
09/18/08 08:48:55	196.92	61.4	29.7	50.0
09/18/08 08:48:59	199.49	61.39	29.7	50.0
09/18/08 08:49:03	201.95	61.36	29.7	50.0
09/18/08 08:49:07	204.06	61.37	29.7	50.0
09/18/08 08:49:11	206.62	61.37	29.7	50.0
09/18/08 08:49:15	209.1	61.38	29.7	50.0
09/18/08 08:49:19	211.46	61.35	29.7	50.0
09/18/08 08:49:23	213.7	61.4	29.7	50.0
09/18/08 08:49:27	216.19	61.37	29.7	50.0
09/18/08 08:49:31	218.2	61.36	29.7	50.0
09/18/08 08:49:35	220.54	61.34	29.7	50.0
09/18/08 08:49:39	223.47	61.34	29.7	50.0
09/18/08 08:49:43	225.67	61.39	29.7	50.0
09/18/08 08:49:47	228.04	61.39	29.7	50.0
09/18/08 08:49:51	230.63	61.38	29.7	50.0
09/18/08 08:49:55	232.84	61.36	29.7	50.0
09/18/08 08:49:59	235.4	61.39	29.7	50.0
09/18/08 08:50:03	237.73	61.36	29.7	50.0
09/18/08 08:50:07	240.05	61.36	29.7	50.0
09/18/08 08:50:11	242.4	61.39	29.7	50.0
09/18/08 08:50:15	244.81	61.33	29.7	50.0
09/18/08 08:50:19	247.37	61.39	29.7	50.0
09/18/08 08:50:23	249.57	61.35	29.7	50.0
09/18/08 08:50:27	252.19	61.37	29.7	50.0
09/18/08 08:50:31	254.58	61.38	29.7	50.0
09/18/08 08:50:35	256.64	61.39	29.7	50.0
09/18/08 08:50:39	259.29	61.4	29.7	50.0
09/18/08 08:50:43	262.14	61.41	29.7	50.0
09/18/08 08:50:47	264.26	61.4	29.7	50.0
09/18/08 08:50:51	266.52	61.37	29.7	50.0
09/18/08 08:50:55	268.94	61.38	29.7	50.0
09/18/08 08:50:59	271.11	61.39	29.7	50.0
09/18/08 08:51:03	273.84	61.41	29.7	50.0
09/18/08 08:51:07	276.33	61.41	29.7	50.0
09/18/08 08:51:11	278.61	61.36	29.7	50.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 08:51:15	280.63	61.39	29.7	50.0
09/18/08 08:51:19	283.06	61.39	29.7	50.0
09/18/08 08:51:23	285.51	61.41	29.7	50.0
09/18/08 08:51:27	288.58	61.41	29.7	50.0
09/18/08 08:51:31	290.35	61.42	29.7	50.0
09/18/08 08:51:35	292.62	61.41	29.7	50.0
09/18/08 08:51:39	295.28	61.43	29.7	50.0
09/18/08 08:51:43	297.62	61.43	29.7	50.0
09/18/08 08:51:47	300.44	61.39	29.7	50.0
09/18/08 08:51:51	302.03	61.4	29.7	50.0
09/18/08 08:51:55	304.73	61.41	29.7	50.0
09/18/08 08:51:59	307.28	61.45	29.7	50.0
09/18/08 08:52:03	309.44	61.45	29.7	50.0
09/18/08 08:52:07	311.91	61.43	29.7	50.0
09/18/08 08:52:11	314.82	61.43	29.7	50.0
09/18/08 08:52:15	316.55	61.42	29.7	50.0
09/18/08 08:52:19	318.99	61.46	29.7	50.0
09/18/08 08:52:23	321.41	61.42	29.7	50.0
09/18/08 08:52:27	323.99	61.43	29.7	50.0
09/18/08 08:52:31	326.21	61.41	29.7	50.0
09/18/08 08:52:35	328.55	61.45	29.7	50.0
09/18/08 08:52:39	330.63	61.4	29.7	50.0
09/18/08 08:52:43	333.28	61.41	29.7	50.0
09/18/08 08:52:47	336.05	61.44	29.7	50.0
09/18/08 08:52:51	338.67	61.45	29.7	50.0
09/18/08 08:52:55	340.72	61.46	29.7	50.0
09/18/08 08:52:59	343.01	61.48	29.7	50.0
09/18/08 08:53:03	345.22	61.44	29.7	50.0
09/18/08 08:53:07	347.83	61.46	29.7	50.0
09/18/08 08:53:11	350.12	61.45	29.7	50.0
09/18/08 08:53:15	352.28	61.46	29.7	50.0
09/18/08 08:53:19	354.9	61.45	29.7	50.0
09/18/08 08:53:23	357.57	61.46	29.7	50.0
09/18/08 08:53:27	360.5	61.46	29.7	50.0
09/18/08 08:53:31	362.46	61.47	29.7	50.0
09/18/08 08:53:35	364.46	61.48	29.7	50.0
09/18/08 08:53:39	366.83	61.48	29.7	50.0
09/18/08 08:53:43	369.66	61.5	29.7	50.0
09/18/08 08:53:47	371.75	61.49	29.7	50.0
09/18/08 08:53:51	373.74	61.52	29.7	50.0
09/18/08 08:53:55	376.6	61.48	29.7	50.0
09/18/08 08:53:59	379.6	61.46	29.7	50.0
09/18/08 08:54:03	381.37	61.52	29.7	50.0
09/18/08 08:54:07	383.58	61.5	29.7	50.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 08:54:11	386.21	61.48	29.7	50.0
09/18/08 08:54:15	388.37	61.48	29.7	50.0
09/18/08 08:54:19	390.92	61.48	29.7	50.0
09/18/08 08:54:23	392.87	61.47	29.7	50.0
09/18/08 08:54:27	395.92	61.49	29.7	50.0
09/18/08 08:54:31	398.42	61.46	29.7	50.0
09/18/08 08:54:35	400.7	61.48	29.7	50.0
09/18/08 08:54:39	402.84	61.49	29.7	50.0
09/18/08 08:54:43	405.24	61.48	29.7	50.0
09/18/08 08:54:47	407.75	61.5	29.7	50.0
09/18/08 08:54:51	410.31	61.54	29.7	50.0
09/18/08 08:54:55	412.17	61.52	29.7	50.0
09/18/08 08:54:59	414.79	61.5	29.7	50.0
09/18/08 08:55:03	417.18	61.5	29.7	50.0
09/18/08 08:55:07	419.42	61.51	29.7	50.0
09/18/08 08:55:11	422.05	61.52	29.7	50.0
09/18/08 08:55:15	424.56	61.51	29.7	50.0
09/18/08 08:55:19	426.88	61.51	29.7	50.0
09/18/08 08:55:23	428.88	61.55	29.7	50.0
09/18/08 08:55:27	431.86	61.5	29.7	50.0
09/18/08 08:55:31	433.92	61.5	29.7	50.0
09/18/08 08:55:35	436.11	61.49	29.7	50.0
09/18/08 08:55:39	438.92	61.49	29.7	50.0
09/18/08 08:55:43	440.95	61.5	29.7	50.0
09/18/08 08:55:47	441.37	61.52	29.7	50.0
09/18/08 08:55:51	441.13	61.51	29.7	50.0
09/18/08 08:55:55	441.24	61.52	29.7	50.0
09/18/08 08:55:59	440.71	61.5	29.7	50.0
09/18/08 08:56:03	441.18	61.53	29.7	50.0
09/18/08 08:56:07	441.15	61.54	29.7	50.0
09/18/08 08:56:11	440.86	61.51	29.7	50.0
09/18/08 08:56:15	440.86	61.55	29.7	50.0
09/18/08 08:56:19	440.48	61.53	29.7	50.0
09/18/08 08:56:23	440.6	61.54	29.7	50.0
09/18/08 08:56:27	440.05	61.52	29.7	50.0
09/18/08 08:56:31	440.39	61.51	29.7	50.0
09/18/08 08:56:35	440.55	61.55	29.7	50.0
09/18/08 08:56:39	440.21	61.56	29.7	50.0
09/18/08 08:56:43	439.99	61.57	29.7	50.0
09/18/08 08:56:47	439.81	61.57	29.7	50.0
09/18/08 08:56:51	439.93	61.58	29.7	50.0
09/18/08 08:56:55	439.57	61.56	29.7	50.0
09/18/08 08:56:59	439.8	61.57	29.7	50.0
09/18/08 08:57:03	440.24	61.55	29.7	50.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 08:57:07	439.39	61.56	29.7	50.0
09/18/08 08:57:11	439.42	61.57	29.7	50.0
09/18/08 08:57:15	439.3	61.58	29.7	50.0
09/18/08 08:57:19	439.16	61.58	29.7	50.0
09/18/08 08:57:23	439.25	61.58	29.7	50.0
09/18/08 08:57:27	439.08	61.55	29.7	50.0
09/18/08 08:57:31	439.12	61.59	29.7	50.0
09/18/08 08:57:35	439.32	61.57	29.7	50.0
09/18/08 08:57:39	439.45	61.6	29.7	50.0
09/18/08 08:57:43	439.21	61.59	29.7	50.0
09/18/08 08:57:47	438.97	61.58	29.7	50.0
09/18/08 08:57:51	438.86	61.6	29.7	50.0
09/18/08 08:57:55	439.14	61.6	29.7	50.0
09/18/08 08:57:59	438.97	61.6	29.7	50.0
09/18/08 08:58:03	438.5	61.64	29.7	50.0
09/18/08 08:58:07	438.82	61.63	29.7	50.0
09/18/08 08:58:11	438.68	61.59	29.7	50.0
09/18/08 08:58:15	438.18	61.61	29.7	50.0
09/18/08 08:58:19	438.33	61.61	29.7	50.0
09/18/08 08:58:23	438.56	61.6	29.7	50.0
09/18/08 08:58:27	438.29	61.59	29.7	50.0
09/18/08 08:58:31	438.29	61.59	29.7	50.0
09/18/08 08:58:35	437.96	61.62	29.7	50.0
09/18/08 08:58:39	438.0	61.57	29.7	50.0
09/18/08 08:58:43	438.0	61.6	29.7	50.0
09/18/08 08:58:47	438.02	61.57	29.7	50.0
09/18/08 08:58:51	437.94	61.57	29.7	50.0
09/18/08 08:58:55	437.86	61.63	29.7	50.0
09/18/08 08:58:59	438.01	61.65	29.7	50.0
09/18/08 08:59:03	437.53	61.64	29.7	50.0
09/18/08 08:59:07	438.01	61.64	29.7	50.0
09/18/08 08:59:11	437.58	61.66	29.7	50.0
09/18/08 08:59:15	437.82	61.58	29.7	50.0
09/18/08 08:59:19	437.49	61.65	29.7	50.0
09/18/08 08:59:23	437.37	61.65	29.7	50.0
09/18/08 08:59:27	437.74	61.66	29.7	50.0
09/18/08 08:59:31	437.6	61.67	29.7	50.0
09/18/08 08:59:35	437.28	61.64	29.7	50.0
09/18/08 08:59:39	437.27	61.66	29.7	50.0
09/18/08 08:59:43	437.31	61.68	29.7	50.0
09/18/08 08:59:47	437.27	61.63	29.7	50.0
09/18/08 08:59:51	437.14	61.68	29.7	50.0
09/18/08 08:59:55	436.94	61.64	29.7	50.0
09/18/08 08:59:59	436.78	61.64	29.7	50.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:00:03	436.89	61.64	29.7	50.0
09/18/08 09:00:07	436.91	61.65	29.7	50.0
09/18/08 09:00:11	436.75	61.66	29.7	50.0
09/18/08 09:00:15	436.67	61.64	29.7	50.0
09/18/08 09:00:19	436.46	61.66	29.7	50.0
09/18/08 09:00:23	436.91	61.64	29.7	50.0
09/18/08 09:00:27	436.5	61.67	29.7	50.0
09/18/08 09:00:31	436.82	61.66	29.7	50.0
09/18/08 09:00:35	436.65	61.67	29.7	50.0
09/18/08 09:00:39	436.53	61.66	29.7	50.0
09/18/08 09:00:43	436.44	61.66	29.7	50.0
09/18/08 09:00:47	436.12	61.68	29.7	50.0
09/18/08 09:00:51	436.24	61.62	29.7	50.0
09/18/08 09:00:55	436.16	61.66	29.7	50.0
09/18/08 09:00:59	436.14	61.68	29.7	50.0
09/18/08 09:01:03	435.85	61.67	29.7	50.0
09/18/08 09:01:07	435.9	61.65	29.7	50.0
09/18/08 09:01:11	435.72	61.66	29.7	50.0
09/18/08 09:01:15	435.88	61.68	29.7	50.0
09/18/08 09:01:19	435.52	61.67	29.7	50.0
09/18/08 09:01:23	435.63	61.65	29.7	50.0
09/18/08 09:01:27	435.68	61.69	29.7	50.0
09/18/08 09:01:31	435.56	61.69	29.7	50.0
09/18/08 09:01:35	435.37	61.67	29.7	50.0
09/18/08 09:01:39	435.68	61.67	29.7	50.0
09/18/08 09:01:43	435.63	61.69	29.7	50.0
09/18/08 09:01:47	435.73	61.7	29.7	50.0
09/18/08 09:01:51	435.13	61.69	29.7	50.0
09/18/08 09:01:55	435.53	61.71	29.7	50.0
09/18/08 09:01:59	435.54	61.69	29.7	50.0
09/18/08 09:02:03	435.25	61.71	29.7	50.0
09/18/08 09:02:07	435.09	61.72	29.7	50.0
09/18/08 09:02:11	435.05	61.69	29.7	50.0
09/18/08 09:02:15	435.38	61.68	29.7	50.0
09/18/08 09:02:19	434.85	61.68	29.7	50.0
09/18/08 09:02:23	435.03	61.7	29.7	50.0
09/18/08 09:02:27	435.18	61.7	29.7	50.0
09/18/08 09:02:31	435.08	61.71	29.7	50.0
09/18/08 09:02:35	434.76	61.71	29.7	50.0
09/18/08 09:02:39	434.9	61.7	29.7	50.0
09/18/08 09:02:43	435.14	61.68	29.7	50.0
09/18/08 09:02:47	434.71	61.69	29.7	50.0
09/18/08 09:02:51	435.05	61.73	29.7	50.0
09/18/08 09:02:55	435.14	61.71	29.7	50.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:02:59	434.69	61.7	29.7	50.0
09/18/08 09:03:03	434.89	61.72	29.7	50.0
09/18/08 09:03:07	434.81	61.7	29.7	50.0
09/18/08 09:03:11	434.7	61.69	29.7	50.0
09/18/08 09:03:15	434.87	61.68	29.7	50.0
09/18/08 09:03:19	434.71	61.72	29.7	50.0
09/18/08 09:03:23	435.1	61.69	29.7	50.0
09/18/08 09:03:27	435.15	61.67	29.7	50.0
09/18/08 09:03:31	434.64	61.68	29.7	50.0
09/18/08 09:03:35	434.78	61.66	29.7	50.0
09/18/08 09:03:39	434.96	61.69	29.7	50.0
09/18/08 09:03:43	434.79	61.63	29.7	50.0
09/18/08 09:03:47	434.94	61.68	29.7	50.0
09/18/08 09:03:51	434.96	61.69	29.7	50.0
09/18/08 09:03:55	434.9	61.69	29.7	50.0
09/18/08 09:03:59	434.78	61.69	29.7	50.0
09/18/08 09:04:03	434.31	61.67	29.7	52.0
09/18/08 09:04:07	434.51	61.68	29.7	52.0
09/18/08 09:04:11	434.39	61.67	29.7	52.0
09/18/08 09:04:15	434.66	61.67	29.7	52.0
09/18/08 09:04:19	434.45	61.7	29.7	52.0
09/18/08 09:04:23	434.64	61.69	29.7	52.0
09/18/08 09:04:27	434.82	61.69	29.7	52.0
09/18/08 09:04:31	434.76	61.7	29.7	52.0
09/18/08 09:04:35	434.57	61.67	29.7	52.0
09/18/08 09:04:39	434.52	61.66	29.7	52.0
09/18/08 09:04:43	434.56	61.71	29.7	52.0
09/18/08 09:04:47	434.13	61.7	29.7	52.0
09/18/08 09:04:51	434.65	61.69	29.7	52.0
09/18/08 09:04:55	434.58	61.69	29.7	52.0
09/18/08 09:04:59	434.46	61.68	29.7	52.0
09/18/08 09:05:03	434.21	61.67	29.7	52.0
09/18/08 09:05:07	434.19	61.65	29.7	52.0
09/18/08 09:05:11	434.72	61.62	29.7	52.0
09/18/08 09:05:15	433.99	61.65	29.7	52.0
09/18/08 09:05:19	434.83	61.56	29.7	52.0
09/18/08 09:05:23	434.26	61.63	29.7	52.0
09/18/08 09:05:27	434.46	61.63	29.7	52.0
09/18/08 09:05:31	434.58	61.67	29.7	52.0
09/18/08 09:05:35	434.51	61.64	29.7	52.0
09/18/08 09:05:39	434.41	61.65	29.7	52.0
09/18/08 09:05:43	434.34	61.65	29.7	52.0
09/18/08 09:05:47	434.51	61.66	29.7	52.0
09/18/08 09:05:51	434.79	61.7	29.7	52.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:05:55	434.87	61.67	29.7	52.0
09/18/08 09:05:59	434.55	61.66	29.7	52.0
09/18/08 09:06:03	434.66	61.7	29.7	52.0
09/18/08 09:06:07	434.33	61.62	29.7	52.0
09/18/08 09:06:11	434.68	61.68	29.7	52.0
09/18/08 09:06:15	434.46	61.66	29.7	52.0
09/18/08 09:06:19	434.93	61.68	29.7	52.0
09/18/08 09:06:23	434.8	61.67	29.7	52.0
09/18/08 09:06:27	434.89	61.67	29.7	52.0
09/18/08 09:06:31	434.32	61.66	29.7	52.0
09/18/08 09:06:35	434.46	61.66	29.7	52.0
09/18/08 09:06:39	434.38	61.65	29.7	52.0
09/18/08 09:06:43	434.28	61.66	29.7	52.0
09/18/08 09:06:47	435.0	61.64	29.7	52.0
09/18/08 09:06:51	434.42	61.64	29.7	52.0
09/18/08 09:06:55	434.65	61.62	29.7	52.0
09/18/08 09:06:59	434.05	61.63	29.7	52.0
09/18/08 09:07:03	434.5	61.63	29.7	52.0
09/18/08 09:07:07	434.9	61.64	29.7	52.0
09/18/08 09:07:11	434.16	61.61	29.7	52.0
09/18/08 09:07:15	434.37	61.61	29.7	52.0
09/18/08 09:07:19	434.56	61.66	29.7	52.0
09/18/08 09:07:23	434.71	61.65	29.7	52.0
09/18/08 09:07:27	434.61	61.64	29.7	52.0
09/18/08 09:07:31	434.71	61.62	29.7	52.0
09/18/08 09:07:35	434.56	61.63	29.7	52.0
09/18/08 09:07:39	434.67	61.62	29.7	52.0
09/18/08 09:07:43	434.8	61.63	29.7	52.0
09/18/08 09:07:47	434.78	61.62	29.7	52.0
09/18/08 09:07:51	434.71	61.63	29.7	52.0
09/18/08 09:07:55	434.63	61.64	29.7	52.0
09/18/08 09:07:59	434.43	61.6	29.7	52.0
09/18/08 09:08:03	434.46	61.59	29.7	52.0
09/18/08 09:08:07	434.42	61.62	29.7	52.0
09/18/08 09:08:11	434.2	61.68	29.7	52.0
09/18/08 09:08:15	434.56	61.65	29.7	52.0
09/18/08 09:08:19	434.47	61.63	29.7	52.0
09/18/08 09:08:23	434.32	61.64	29.7	52.0
09/18/08 09:08:27	434.21	61.6	29.7	52.0
09/18/08 09:08:31	434.31	61.63	29.7	52.0
09/18/08 09:08:35	434.08	61.63	29.7	52.0
09/18/08 09:08:39	434.66	61.63	29.7	52.0
09/18/08 09:08:43	434.21	61.62	29.7	52.0
09/18/08 09:08:47	434.44	61.63	29.7	52.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:08:51	434.3	61.62	29.7	52.0
09/18/08 09:08:55	434.83	61.63	29.7	52.0
09/18/08 09:08:59	434.75	61.64	29.7	52.0
09/18/08 09:09:03	434.41	61.62	29.7	52.0
09/18/08 09:09:07	434.78	61.61	29.7	52.0
09/18/08 09:09:11	434.41	61.6	29.7	52.0
09/18/08 09:09:15	434.28	61.62	29.7	52.0
09/18/08 09:09:19	434.5	61.62	29.7	52.0
09/18/08 09:09:23	434.63	61.63	29.7	52.0
09/18/08 09:09:27	434.47	61.66	29.7	52.0
09/18/08 09:09:31	434.52	61.63	29.7	52.0
09/18/08 09:09:35	434.6	61.6	29.7	52.0
09/18/08 09:09:39	434.56	61.64	29.7	52.0
09/18/08 09:09:43	434.49	61.62	29.7	52.0
09/18/08 09:09:47	434.56	61.63	29.7	52.0
09/18/08 09:09:51	434.6	61.62	29.7	52.0
09/18/08 09:09:55	434.21	61.6	29.7	52.0
09/18/08 09:09:59	434.68	61.61	29.7	52.0
09/18/08 09:10:03	434.96	61.62	29.7	52.0
09/18/08 09:10:07	434.98	61.6	29.7	52.0
09/18/08 09:10:11	434.54	61.61	29.7	52.0
09/18/08 09:10:15	434.6	61.63	29.7	52.0
09/18/08 09:10:19	434.59	61.67	29.7	52.0
09/18/08 09:10:23	434.42	61.62	29.7	52.0
09/18/08 09:10:27	434.24	61.63	29.7	52.0
09/18/08 09:10:31	434.37	61.65	29.7	52.0
09/18/08 09:10:35	434.67	61.63	29.7	52.0
09/18/08 09:10:39	434.04	61.65	29.7	52.0
09/18/08 09:10:43	434.27	61.59	29.7	52.0
09/18/08 09:10:47	434.44	61.62	29.7	52.0
09/18/08 09:10:51	434.38	61.65	29.7	52.0
09/18/08 09:10:55	434.31	61.62	29.7	52.0
09/18/08 09:10:59	434.51	61.65	29.7	52.0
09/18/08 09:11:03	434.54	61.62	29.7	52.0
09/18/08 09:11:07	434.2	61.62	29.7	52.0
09/18/08 09:11:11	434.18	61.65	29.7	52.0
09/18/08 09:11:15	434.4	61.64	29.7	52.0
09/18/08 09:11:19	434.29	61.65	29.7	52.0
09/18/08 09:11:23	434.31	61.61	29.7	52.0
09/18/08 09:11:27	434.7	61.62	29.7	52.0
09/18/08 09:11:31	434.14	61.61	29.7	52.0
09/18/08 09:11:35	434.58	61.66	29.7	52.0
09/18/08 09:11:39	434.77	61.64	29.7	52.0
09/18/08 09:11:43	434.35	61.63	29.7	52.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:11:47	434.49	61.64	29.7	52.0
09/18/08 09:11:51	434.12	61.64	29.7	52.0
09/18/08 09:11:55	434.36	61.64	29.7	52.0
09/18/08 09:11:59	434.62	61.61	29.7	52.0
09/18/08 09:12:03	434.06	61.64	29.7	52.0
09/18/08 09:12:07	434.49	61.68	29.7	52.0
09/18/08 09:12:11	434.98	61.64	29.7	52.0
09/18/08 09:12:15	434.54	61.6	29.7	52.0
09/18/08 09:12:19	434.51	61.63	29.7	52.0
09/18/08 09:12:23	434.5	61.65	29.7	52.0
09/18/08 09:12:27	434.41	61.67	29.7	52.0
09/18/08 09:12:31	434.54	61.66	29.7	52.0
09/18/08 09:12:35	434.4	61.66	29.7	52.0
09/18/08 09:12:39	434.42	61.64	29.7	52.0
09/18/08 09:12:43	434.23	61.63	29.7	52.0
09/18/08 09:12:47	434.72	61.65	29.7	52.0
09/18/08 09:12:51	434.33	61.68	29.7	52.0
09/18/08 09:12:55	434.43	61.65	29.7	52.0
09/18/08 09:12:59	434.39	61.66	29.7	52.0
09/18/08 09:13:03	434.15	61.65	29.7	52.0
09/18/08 09:13:07	434.55	61.6	29.7	52.0
09/18/08 09:13:11	434.56	61.65	29.7	52.0
09/18/08 09:13:15	434.37	61.66	29.7	52.0
09/18/08 09:13:19	434.51	61.65	29.7	52.0
09/18/08 09:13:23	434.71	61.69	29.7	52.0
09/18/08 09:13:27	434.32	61.63	29.7	52.0
09/18/08 09:13:31	434.56	61.69	29.7	52.0
09/18/08 09:13:35	434.41	61.65	29.7	52.0
09/18/08 09:13:39	434.52	61.67	29.7	52.0
09/18/08 09:13:43	434.5	61.67	29.7	52.0
09/18/08 09:13:47	434.21	61.64	29.7	52.0
09/18/08 09:13:51	434.32	61.65	29.7	52.0
09/18/08 09:13:55	435.02	61.64	29.7	52.0
09/18/08 09:13:59	434.93	61.65	29.7	52.0
09/18/08 09:14:03	434.48	61.66	29.7	52.0
09/18/08 09:14:07	434.65	61.67	29.7	52.0
09/18/08 09:14:11	434.67	61.67	29.7	52.0
09/18/08 09:14:15	434.69	61.67	29.7	52.0
09/18/08 09:14:19	435.26	61.63	29.7	52.0
09/18/08 09:14:23	435.35	61.65	29.7	52.0
09/18/08 09:14:27	435.26	61.57	29.7	52.0
09/18/08 09:14:31	435.33	61.58	29.7	52.0
09/18/08 09:14:35	435.5	61.61	29.7	52.0
09/18/08 09:14:39	435.57	61.59	29.7	52.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:14:43	435.28	61.6	29.7	52.0
09/18/08 09:14:47	435.06	61.62	29.7	52.0
09/18/08 09:14:51	434.92	61.63	29.7	52.0
09/18/08 09:14:55	435.23	61.61	29.7	52.0
09/18/08 09:14:59	437.37	61.61	29.7	52.0
09/18/08 09:15:03	439.6	61.6	29.7	52.0
09/18/08 09:15:07	441.59	61.56	29.7	52.0
09/18/08 09:15:11	444.08	61.62	29.7	52.0
09/18/08 09:15:15	446.55	61.6	29.7	52.0
09/18/08 09:15:19	449.33	61.66	29.7	52.0
09/18/08 09:15:23	450.9	61.59	29.7	54.0
09/18/08 09:15:27	453.2	61.66	29.7	54.0
09/18/08 09:15:31	455.44	61.61	29.7	54.0
09/18/08 09:15:35	457.77	61.63	29.7	54.0
09/18/08 09:15:39	460.34	61.62	29.7	54.0
09/18/08 09:15:43	462.29	61.65	29.7	54.0
09/18/08 09:15:47	464.97	61.63	29.7	54.0
09/18/08 09:15:51	467.29	61.61	29.7	54.0
09/18/08 09:15:55	469.46	61.63	29.7	54.0
09/18/08 09:15:59	471.5	61.63	29.7	54.0
09/18/08 09:16:03	473.88	61.62	29.7	54.0
09/18/08 09:16:07	476.49	61.62	29.7	54.0
09/18/08 09:16:11	478.62	61.61	29.7	54.0
09/18/08 09:16:15	481.44	61.61	29.7	54.0
09/18/08 09:16:19	482.86	61.64	29.7	54.0
09/18/08 09:16:23	485.74	61.63	29.7	54.0
09/18/08 09:16:27	488.07	61.62	29.7	54.0
09/18/08 09:16:31	490.26	61.65	29.7	54.0
09/18/08 09:16:35	492.48	61.64	29.7	54.0
09/18/08 09:16:39	494.89	61.63	29.7	54.0
09/18/08 09:16:43	497.32	61.63	29.7	54.0
09/18/08 09:16:47	499.85	61.66	29.7	54.0
09/18/08 09:16:51	502.0	61.65	29.7	54.0
09/18/08 09:16:55	504.8	61.65	29.7	54.0
09/18/08 09:16:59	506.5	61.63	29.7	54.0
09/18/08 09:17:03	508.8	61.61	29.7	54.0
09/18/08 09:17:07	511.4	61.65	29.7	54.0
09/18/08 09:17:11	513.8	61.64	29.7	54.0
09/18/08 09:17:15	516.0	61.62	29.7	54.0
09/18/08 09:17:19	518.5	61.63	29.7	54.0
09/18/08 09:17:23	521.0	61.64	29.7	54.0
09/18/08 09:17:27	522.9	61.58	29.7	54.0
09/18/08 09:17:31	525.1	61.61	29.7	54.0
09/18/08 09:17:35	528.0	61.61	29.7	54.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:17:39	530.1	61.63	29.7	54.0
09/18/08 09:17:43	532.2	61.62	29.7	54.0
09/18/08 09:17:47	534.4	61.64	29.7	54.0
09/18/08 09:17:51	537.3	61.6	29.7	54.0
09/18/08 09:17:55	539.1	61.57	29.7	54.0
09/18/08 09:17:59	541.7	61.64	29.7	54.0
09/18/08 09:18:03	544.2	61.61	29.7	54.0
09/18/08 09:18:07	546.3	61.64	29.7	54.0
09/18/08 09:18:11	548.8	61.6	29.7	54.0
09/18/08 09:18:15	551.1	61.58	29.7	54.0
09/18/08 09:18:19	553.1	61.61	29.7	54.0
09/18/08 09:18:23	555.6	61.59	29.7	54.0
09/18/08 09:18:27	558.2	61.58	29.7	54.0
09/18/08 09:18:31	560.2	61.61	29.7	54.0
09/18/08 09:18:35	562.6	61.61	29.7	54.0
09/18/08 09:18:39	565.1	61.63	29.7	54.0
09/18/08 09:18:43	567.3	61.61	29.7	54.0
09/18/08 09:18:47	569.4	61.61	29.7	54.0
09/18/08 09:18:51	571.8	61.59	29.7	54.0
09/18/08 09:18:55	574.1	61.64	29.7	54.0
09/18/08 09:18:59	576.5	61.63	29.7	54.0
09/18/08 09:19:03	579.4	61.66	29.7	52.0
09/18/08 09:19:07	581.6	61.66	29.7	52.0
09/18/08 09:19:11	583.9	61.65	29.7	52.0
09/18/08 09:19:15	586.2	61.63	29.7	52.0
09/18/08 09:19:19	588.3	61.62	29.7	52.0
09/18/08 09:19:23	590.6	61.66	29.7	52.0
09/18/08 09:19:27	592.9	61.65	29.7	52.0
09/18/08 09:19:31	595.3	61.6	29.7	52.0
09/18/08 09:19:35	597.7	61.65	29.7	52.0
09/18/08 09:19:39	599.9	61.62	29.7	52.0
09/18/08 09:19:43	602.5	61.62	29.7	52.0
09/18/08 09:19:47	604.8	61.63	29.7	52.0
09/18/08 09:19:51	607.2	61.65	29.7	52.0
09/18/08 09:19:55	609.9	61.64	29.7	52.0
09/18/08 09:19:59	611.8	61.65	29.7	52.0
09/18/08 09:20:03	613.9	61.65	29.7	52.0
09/18/08 09:20:07	616.7	61.7	29.7	52.0
09/18/08 09:20:11	618.8	61.66	29.7	52.0
09/18/08 09:20:15	620.7	61.63	29.7	52.0
09/18/08 09:20:19	623.5	61.66	29.7	52.0
09/18/08 09:20:23	625.7	61.67	29.7	52.0
09/18/08 09:20:27	628.0	61.68	29.7	52.0
09/18/08 09:20:31	630.5	61.68	29.7	52.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:20:35	632.7	61.66	29.7	52.0
09/18/08 09:20:39	635.1	61.67	29.7	52.0
09/18/08 09:20:43	637.1	61.68	29.7	52.0
09/18/08 09:20:47	639.7	61.66	29.7	52.0
09/18/08 09:20:51	642.0	61.66	29.7	52.0
09/18/08 09:20:55	644.7	61.64	29.7	52.0
09/18/08 09:20:59	646.6	61.68	29.7	52.0
09/18/08 09:21:03	648.8	61.67	29.7	52.0
09/18/08 09:21:07	651.4	61.67	29.7	52.0
09/18/08 09:21:11	653.4	61.63	29.7	52.0
09/18/08 09:21:15	655.9	61.69	29.7	52.0
09/18/08 09:21:19	658.2	61.72	29.7	52.0
09/18/08 09:21:23	660.5	61.71	29.7	52.0
09/18/08 09:21:27	662.5	61.72	29.7	52.0
09/18/08 09:21:31	665.2	61.7	29.7	52.0
09/18/08 09:21:35	667.4	61.71	29.7	52.0
09/18/08 09:21:39	669.8	61.72	29.7	52.0
09/18/08 09:21:43	672.0	61.72	29.7	52.0
09/18/08 09:21:47	674.4	61.69	29.7	52.0
09/18/08 09:21:51	676.4	61.75	29.7	52.0
09/18/08 09:21:55	678.6	61.73	29.7	52.0
09/18/08 09:21:59	681.4	61.71	29.7	52.0
09/18/08 09:22:03	683.6	61.71	29.7	52.0
09/18/08 09:22:07	685.9	61.71	29.7	52.0
09/18/08 09:22:11	688.1	61.72	29.7	52.0
09/18/08 09:22:15	690.8	61.71	29.7	52.0
09/18/08 09:22:19	692.7	61.73	29.7	52.0
09/18/08 09:22:23	695.0	61.73	29.7	52.0
09/18/08 09:22:27	697.5	61.74	29.7	52.0
09/18/08 09:22:31	699.9	61.71	29.7	52.0
09/18/08 09:22:35	701.9	61.75	29.7	52.0
09/18/08 09:22:39	704.7	61.76	29.7	52.0
09/18/08 09:22:43	706.7	61.78	29.7	52.0
09/18/08 09:22:47	708.7	61.77	29.7	52.0
09/18/08 09:22:51	711.2	61.75	29.7	52.0
09/18/08 09:22:55	713.5	61.78	29.7	52.0
09/18/08 09:22:59	716.0	61.77	29.7	52.0
09/18/08 09:23:03	718.0	61.77	29.7	52.0
09/18/08 09:23:07	720.3	61.78	29.7	52.0
09/18/08 09:23:11	722.6	61.78	29.7	52.0
09/18/08 09:23:15	725.0	61.77	29.7	52.0
09/18/08 09:23:19	727.3	61.72	29.7	52.0
09/18/08 09:23:23	729.8	61.78	29.7	52.0
09/18/08 09:23:27	732.2	61.78	29.7	52.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:23:31	734.5	61.76	29.7	52.0
09/18/08 09:23:35	736.1	61.76	29.7	52.0
09/18/08 09:23:39	738.9	61.76	29.7	52.0
09/18/08 09:23:43	741.0	61.79	29.7	52.0
09/18/08 09:23:47	742.9	61.79	29.7	52.0
09/18/08 09:23:51	745.8	61.79	29.7	52.0
09/18/08 09:23:55	748.0	61.75	29.7	52.0
09/18/08 09:23:59	750.0	61.77	29.7	52.0
09/18/08 09:24:03	752.0	61.8	29.7	54.0
09/18/08 09:24:07	754.8	61.78	29.7	54.0
09/18/08 09:24:11	756.6	61.77	29.7	54.0
09/18/08 09:24:15	758.7	61.78	29.7	54.0
09/18/08 09:24:19	761.4	61.75	29.7	54.0
09/18/08 09:24:23	763.8	61.8	29.7	54.0
09/18/08 09:24:27	765.9	61.8	29.7	54.0
09/18/08 09:24:31	767.7	61.77	29.7	54.0
09/18/08 09:24:35	770.6	61.83	29.7	54.0
09/18/08 09:24:39	772.9	61.82	29.7	54.0
09/18/08 09:24:43	774.8	61.78	29.7	54.0
09/18/08 09:24:47	777.6	61.82	29.7	54.0
09/18/08 09:24:51	779.5	61.82	29.7	54.0
09/18/08 09:24:55	782.2	61.81	29.7	54.0
09/18/08 09:24:59	784.1	61.84	29.7	54.0
09/18/08 09:25:03	786.2	61.83	29.7	54.0
09/18/08 09:25:07	788.9	61.85	29.7	54.0
09/18/08 09:25:11	790.7	61.83	29.7	54.0
09/18/08 09:25:15	793.4	61.86	29.7	54.0
09/18/08 09:25:19	795.8	61.83	29.7	54.0
09/18/08 09:25:23	798.0	61.86	29.7	54.0
09/18/08 09:25:27	800.1	61.87	29.7	54.0
09/18/08 09:25:31	802.4	61.84	29.7	54.0
09/18/08 09:25:35	804.7	61.85	29.7	54.0
09/18/08 09:25:39	806.9	61.83	29.7	54.0
09/18/08 09:25:43	809.4	61.88	29.7	54.0
09/18/08 09:25:47	811.7	61.88	29.7	54.0
09/18/08 09:25:51	813.7	61.88	29.7	54.0
09/18/08 09:25:55	816.3	61.89	29.7	54.0
09/18/08 09:25:59	818.7	61.86	29.7	54.0
09/18/08 09:26:03	820.9	61.87	29.7	54.0
09/18/08 09:26:07	823.3	61.87	29.7	54.0
09/18/08 09:26:11	824.9	61.87	29.7	54.0
09/18/08 09:26:15	827.6	61.89	29.7	54.0
09/18/08 09:26:19	829.6	61.89	29.7	54.0
09/18/08 09:26:23	832.0	61.87	29.7	54.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:26:27	834.2	61.85	29.7	54.0
09/18/08 09:26:31	837.0	61.9	29.7	54.0
09/18/08 09:26:35	839.4	61.88	29.7	54.0
09/18/08 09:26:39	841.6	61.84	29.7	54.0
09/18/08 09:26:43	843.7	61.89	29.7	54.0
09/18/08 09:26:47	846.0	61.91	29.7	54.0
09/18/08 09:26:51	847.8	61.9	29.7	54.0
09/18/08 09:26:55	850.3	61.93	29.7	54.0
09/18/08 09:26:59	852.5	61.92	29.7	54.0
09/18/08 09:27:03	854.9	61.9	29.7	54.0
09/18/08 09:27:07	857.1	61.89	29.7	54.0
09/18/08 09:27:11	859.7	61.91	29.7	54.0
09/18/08 09:27:15	861.7	61.92	29.7	54.0
09/18/08 09:27:19	864.3	61.92	29.7	54.0
09/18/08 09:27:23	866.2	61.92	29.7	54.0
09/18/08 09:27:27	868.6	61.92	29.7	54.0
09/18/08 09:27:31	870.9	61.89	29.7	54.0
09/18/08 09:27:35	872.9	61.91	29.7	54.0
09/18/08 09:27:39	875.5	61.91	29.7	54.0
09/18/08 09:27:43	877.8	61.88	29.7	54.0
09/18/08 09:27:47	878.8	61.88	29.7	54.0
09/18/08 09:27:51	878.8	61.89	29.7	54.0
09/18/08 09:27:55	878.7	61.89	29.7	54.0
09/18/08 09:27:59	878.6	61.85	29.7	54.0
09/18/08 09:28:03	878.4	61.86	29.7	54.0
09/18/08 09:28:07	878.2	61.88	29.7	54.0
09/18/08 09:28:11	878.6	61.9	29.7	54.0
09/18/08 09:28:15	878.0	61.91	29.7	54.0
09/18/08 09:28:19	877.9	61.89	29.7	54.0
09/18/08 09:28:23	878.3	61.9	29.7	54.0
09/18/08 09:28:27	877.7	61.9	29.7	54.0
09/18/08 09:28:31	877.5	61.88	29.7	54.0
09/18/08 09:28:35	878.1	61.89	29.7	54.0
09/18/08 09:28:39	878.1	61.88	29.7	54.0
09/18/08 09:28:43	878.2	61.87	29.7	54.0
09/18/08 09:28:47	877.8	61.84	29.7	54.0
09/18/08 09:28:51	877.8	61.9	29.7	54.0
09/18/08 09:28:55	878.1	61.9	29.7	54.0
09/18/08 09:28:59	877.9	61.92	29.7	54.0
09/18/08 09:29:03	877.9	61.96	29.7	54.0
09/18/08 09:29:07	877.8	61.93	29.7	54.0
09/18/08 09:29:11	877.6	61.95	29.7	54.0
09/18/08 09:29:15	877.9	61.91	29.7	54.0
09/18/08 09:29:19	877.6	61.93	29.7	54.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:29:23	877.8	61.93	29.7	54.0
09/18/08 09:29:27	878.1	61.92	29.7	54.0
09/18/08 09:29:31	878.2	61.9	29.7	54.0
09/18/08 09:29:35	878.3	61.92	29.7	54.0
09/18/08 09:29:39	877.9	61.94	29.7	54.0
09/18/08 09:29:43	878.5	61.93	29.7	54.0
09/18/08 09:29:47	878.4	61.94	29.7	54.0
09/18/08 09:29:51	878.2	61.94	29.7	54.0
09/18/08 09:29:55	877.9	61.9	29.7	54.0
09/18/08 09:29:59	878.4	61.93	29.7	54.0
09/18/08 09:30:03	878.3	61.97	29.7	54.0
09/18/08 09:30:07	878.3	61.95	29.7	54.0
09/18/08 09:30:11	878.1	61.95	29.7	54.0
09/18/08 09:30:15	878.5	61.95	29.7	54.0
09/18/08 09:30:19	878.0	61.93	29.7	54.0
09/18/08 09:30:23	877.6	61.93	29.7	54.0
09/18/08 09:30:27	878.0	61.92	29.7	54.0
09/18/08 09:30:31	878.4	61.91	29.7	54.0
09/18/08 09:30:35	878.2	61.9	29.7	54.0
09/18/08 09:30:39	877.9	61.94	29.7	54.0
09/18/08 09:30:43	877.9	61.93	29.7	54.0
09/18/08 09:30:47	878.1	61.94	29.7	54.0
09/18/08 09:30:51	878.0	61.94	29.7	54.0
09/18/08 09:30:55	878.1	61.95	29.7	54.0
09/18/08 09:30:59	877.6	61.94	29.7	54.0
09/18/08 09:31:03	878.1	61.96	29.7	54.0
09/18/08 09:31:07	877.9	61.96	29.7	54.0
09/18/08 09:31:11	877.9	61.98	29.7	54.0
09/18/08 09:31:15	877.9	61.95	29.7	54.0
09/18/08 09:31:19	878.1	61.96	29.7	54.0
09/18/08 09:31:23	877.9	61.99	29.7	54.0
09/18/08 09:31:27	878.1	61.99	29.7	54.0
09/18/08 09:31:31	878.0	61.97	29.7	54.0
09/18/08 09:31:35	878.1	61.97	29.7	54.0
09/18/08 09:31:39	878.0	61.98	29.7	54.0
09/18/08 09:31:43	878.1	61.98	29.7	54.0
09/18/08 09:31:47	878.1	61.99	29.7	54.0
09/18/08 09:31:51	878.1	61.96	29.7	54.0
09/18/08 09:31:55	878.1	61.95	29.7	54.0
09/18/08 09:31:59	878.0	61.94	29.7	54.0
09/18/08 09:32:03	877.5	61.95	29.7	54.0
09/18/08 09:32:07	878.6	61.94	29.7	54.0
09/18/08 09:32:11	877.9	61.97	29.7	54.0
09/18/08 09:32:15	877.9	61.98	29.7	54.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:32:19	878.2	61.98	29.7	54.0
09/18/08 09:32:23	878.0	61.96	29.7	54.0
09/18/08 09:32:27	877.8	61.95	29.7	54.0
09/18/08 09:32:31	878.6	61.96	29.7	54.0
09/18/08 09:32:35	878.2	61.96	29.7	54.0
09/18/08 09:32:39	878.0	61.97	29.7	54.0
09/18/08 09:32:43	878.0	61.96	29.7	54.0
09/18/08 09:32:47	878.2	61.98	29.7	54.0
09/18/08 09:32:51	877.9	61.95	29.7	54.0
09/18/08 09:32:55	878.5	61.97	29.7	54.0
09/18/08 09:32:59	878.1	61.98	29.7	54.0
09/18/08 09:33:03	878.1	62.0	29.7	54.0
09/18/08 09:33:07	878.1	61.97	29.7	54.0
09/18/08 09:33:11	878.0	62.0	29.7	54.0
09/18/08 09:33:15	878.1	61.99	29.7	54.0
09/18/08 09:33:19	877.9	61.98	29.7	54.0
09/18/08 09:33:23	878.8	62.01	29.7	54.0
09/18/08 09:33:27	878.2	61.96	29.7	54.0
09/18/08 09:33:31	878.1	61.97	29.7	54.0
09/18/08 09:33:35	878.1	62.01	29.7	54.0
09/18/08 09:33:39	878.1	61.97	29.7	54.0
09/18/08 09:33:43	878.3	61.97	29.7	54.0
09/18/08 09:33:47	878.2	61.97	29.7	54.0
09/18/08 09:33:51	878.2	61.98	29.7	54.0
09/18/08 09:33:55	878.0	61.97	29.7	54.0
09/18/08 09:33:59	878.4	61.97	29.7	54.0
09/18/08 09:34:03	878.4	61.97	29.7	54.0
09/18/08 09:34:07	878.2	61.99	29.7	54.0
09/18/08 09:34:11	878.3	61.95	29.7	54.0
09/18/08 09:34:15	878.2	61.96	29.7	54.0
09/18/08 09:34:19	878.2	61.96	29.7	54.0
09/18/08 09:34:23	878.5	61.95	29.7	54.0
09/18/08 09:34:27	878.2	61.98	29.7	54.0
09/18/08 09:34:31	878.2	61.98	29.7	54.0
09/18/08 09:34:35	878.0	61.96	29.7	54.0
09/18/08 09:34:39	878.2	61.95	29.7	54.0
09/18/08 09:34:43	878.2	61.98	29.7	54.0
09/18/08 09:34:47	877.8	61.99	29.7	54.0
09/18/08 09:34:51	878.1	61.98	29.7	54.0
09/18/08 09:34:55	878.0	61.98	29.7	54.0
09/18/08 09:34:59	878.4	61.95	29.7	54.0
09/18/08 09:35:03	878.0	61.93	29.7	54.0
09/18/08 09:35:07	878.5	61.95	29.7	54.0
09/18/08 09:35:11	878.2	61.98	29.7	54.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:35:15	878.0	61.96	29.7	54.0
09/18/08 09:35:19	878.2	61.97	29.7	54.0
09/18/08 09:35:23	878.6	61.97	29.7	54.0
09/18/08 09:35:27	878.6	61.96	29.7	54.0
09/18/08 09:35:31	878.6	61.93	29.7	54.0
09/18/08 09:35:35	878.3	61.92	29.7	54.0
09/18/08 09:35:39	878.5	61.91	29.7	54.0
09/18/08 09:35:43	878.2	61.92	29.7	54.0
09/18/08 09:35:47	878.2	61.95	29.7	54.0
09/18/08 09:35:51	878.3	61.92	29.7	54.0
09/18/08 09:35:55	878.4	61.94	29.7	54.0
09/18/08 09:35:59	878.3	61.93	29.7	54.0
09/18/08 09:36:03	878.0	61.88	29.7	54.0
09/18/08 09:36:07	878.0	61.9	29.7	54.0
09/18/08 09:36:11	878.6	61.91	29.7	54.0
09/18/08 09:36:15	877.9	61.9	29.7	54.0
09/18/08 09:36:19	878.8	61.91	29.7	54.0
09/18/08 09:36:23	878.5	61.9	29.7	54.0
09/18/08 09:36:27	878.7	61.93	29.7	54.0
09/18/08 09:36:31	878.3	61.9	29.7	54.0
09/18/08 09:36:35	878.4	61.92	29.7	54.0
09/18/08 09:36:39	878.4	61.9	29.7	54.0
09/18/08 09:36:43	878.4	61.91	29.7	54.0
09/18/08 09:36:47	878.5	61.89	29.7	54.0
09/18/08 09:36:51	878.8	61.89	29.7	54.0
09/18/08 09:36:55	878.3	61.87	29.7	54.0
09/18/08 09:36:59	878.3	61.88	29.7	54.0
09/18/08 09:37:03	878.6	61.92	29.7	54.0
09/18/08 09:37:07	878.2	61.89	29.7	54.0
09/18/08 09:37:11	878.6	61.88	29.7	54.0
09/18/08 09:37:15	878.3	61.88	29.7	54.0
09/18/08 09:37:19	878.5	61.87	29.7	54.0
09/18/08 09:37:23	878.6	61.9	29.7	54.0
09/18/08 09:37:27	877.9	61.86	29.7	54.0
09/18/08 09:37:31	878.0	61.88	29.7	54.0
09/18/08 09:37:35	878.4	61.87	29.7	54.0
09/18/08 09:37:39	878.4	61.9	29.7	54.0
09/18/08 09:37:43	878.3	61.89	29.7	54.0
09/18/08 09:37:47	878.4	61.89	29.7	54.0
09/18/08 09:37:51	878.3	61.89	29.7	54.0
09/18/08 09:37:55	878.3	61.87	29.7	54.0
09/18/08 09:37:59	878.5	61.86	29.7	54.0
09/18/08 09:38:03	878.1	61.89	29.7	54.0
09/18/08 09:38:07	878.4	61.87	29.7	54.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:38:11	878.3	61.86	29.7	54.0
09/18/08 09:38:15	878.3	61.85	29.7	54.0
09/18/08 09:38:19	878.5	61.84	29.7	54.0
09/18/08 09:38:23	878.3	61.8	29.7	54.0
09/18/08 09:38:27	878.1	61.82	29.7	54.0
09/18/08 09:38:31	878.8	61.83	29.7	54.0
09/18/08 09:38:35	878.4	61.83	29.7	54.0
09/18/08 09:38:39	878.0	61.84	29.7	54.0
09/18/08 09:38:43	878.5	61.87	29.7	54.0
09/18/08 09:38:47	878.4	61.82	29.7	54.0
09/18/08 09:38:51	878.7	61.81	29.7	54.0
09/18/08 09:38:55	878.5	61.83	29.7	54.0
09/18/08 09:38:59	878.7	61.84	29.7	54.0
09/18/08 09:39:03	878.9	61.84	29.7	54.0
09/18/08 09:39:07	878.7	61.8	29.7	54.0
09/18/08 09:39:11	879.0	61.83	29.7	54.0
09/18/08 09:39:15	878.4	61.83	29.7	54.0
09/18/08 09:39:19	878.6	61.84	29.7	54.0
09/18/08 09:39:23	878.9	61.8	29.7	54.0
09/18/08 09:39:27	878.8	61.83	29.7	54.0
09/18/08 09:39:31	878.7	61.81	29.7	54.0
09/18/08 09:39:35	878.7	61.81	29.7	54.0
09/18/08 09:39:39	878.2	61.81	29.7	54.0
09/18/08 09:39:43	878.7	61.78	29.7	54.0
09/18/08 09:39:47	878.3	61.8	29.7	54.0
09/18/08 09:39:51	878.8	61.79	29.7	54.0
09/18/08 09:39:55	879.1	61.82	29.7	54.0
09/18/08 09:39:59	878.6	61.8	29.7	54.0
09/18/08 09:40:03	878.6	61.79	29.7	54.0
09/18/08 09:40:07	879.0	61.84	29.7	54.0
09/18/08 09:40:11	878.8	61.8	29.7	54.0
09/18/08 09:40:15	878.7	61.8	29.7	54.0
09/18/08 09:40:19	878.3	61.83	29.7	54.0
09/18/08 09:40:23	878.4	61.83	29.7	54.0
09/18/08 09:40:27	878.3	61.8	29.7	54.0
09/18/08 09:40:31	878.8	61.81	29.7	54.0
09/18/08 09:40:35	878.6	61.82	29.7	54.0
09/18/08 09:40:39	878.6	61.81	29.7	54.0
09/18/08 09:40:43	878.4	61.81	29.7	54.0
09/18/08 09:40:47	878.9	61.81	29.7	54.0
09/18/08 09:40:51	878.8	61.8	29.7	54.0
09/18/08 09:40:55	878.1	61.78	29.7	54.0
09/18/08 09:40:59	878.9	61.81	29.7	54.0
09/18/08 09:41:03	878.7	61.78	29.7	54.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:41:07	878.8	61.8	29.7	54.0
09/18/08 09:41:11	878.8	61.83	29.7	54.0
09/18/08 09:41:15	878.6	61.78	29.7	54.0
09/18/08 09:41:19	879.0	61.78	29.7	54.0
09/18/08 09:41:23	879.0	61.79	29.7	54.0
09/18/08 09:41:27	878.8	61.77	29.7	54.0
09/18/08 09:41:31	878.8	61.76	29.7	54.0
09/18/08 09:41:35	879.0	61.78	29.7	54.0
09/18/08 09:41:39	879.1	61.79	29.7	54.0
09/18/08 09:41:43	878.7	61.79	29.7	54.0
09/18/08 09:41:47	878.6	61.82	29.7	54.0
09/18/08 09:41:51	878.7	61.77	29.7	54.0
09/18/08 09:41:55	879.0	61.79	29.7	54.0
09/18/08 09:41:59	879.3	61.79	29.7	54.0
09/18/08 09:42:03	878.5	61.79	29.7	54.0
09/18/08 09:42:07	879.3	61.78	29.7	54.0
09/18/08 09:42:11	878.8	61.82	29.7	54.0
09/18/08 09:42:15	878.8	61.78	29.7	54.0
09/18/08 09:42:19	878.9	61.79	29.7	54.0
09/18/08 09:42:23	878.8	61.78	29.7	54.0
09/18/08 09:42:27	878.9	61.78	29.7	54.0
09/18/08 09:42:31	879.1	61.76	29.7	54.0
09/18/08 09:42:35	879.0	61.82	29.7	54.0
09/18/08 09:42:39	879.2	61.78	29.7	54.0
09/18/08 09:42:43	878.5	61.86	29.7	54.0
09/18/08 09:42:47	879.1	61.85	29.7	54.0
09/18/08 09:42:51	879.3	61.84	29.7	54.0
09/18/08 09:42:55	878.8	61.77	29.7	54.0
09/18/08 09:42:59	878.7	61.81	29.7	54.0
09/18/08 09:43:03	879.0	61.79	29.7	54.0
09/18/08 09:43:07	879.2	61.83	29.7	54.0
09/18/08 09:43:11	878.7	61.83	29.7	54.0
09/18/08 09:43:15	879.2	61.77	29.7	54.0
09/18/08 09:43:19	878.4	61.77	29.7	54.0
09/18/08 09:43:23	879.0	61.79	29.7	54.0
09/18/08 09:43:27	879.3	61.8	29.7	54.0
09/18/08 09:43:31	879.2	61.79	29.7	54.0
09/18/08 09:43:35	879.1	61.77	29.7	54.0
09/18/08 09:43:39	879.2	61.76	29.7	54.0
09/18/08 09:43:43	879.0	61.77	29.7	54.0
09/18/08 09:43:47	878.5	61.76	29.7	54.0
09/18/08 09:43:51	878.8	61.74	29.7	54.0
09/18/08 09:43:55	878.9	61.76	29.7	54.0
09/18/08 09:43:59	879.2	61.75	29.7	54.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:44:03	879.2	61.77	29.7	54.0
09/18/08 09:44:07	879.1	61.76	29.7	54.0
09/18/08 09:44:11	879.2	61.77	29.7	54.0
09/18/08 09:44:15	879.2	61.77	29.7	54.0
09/18/08 09:44:19	879.3	61.76	29.7	54.0
09/18/08 09:44:23	878.9	61.74	29.7	54.0
09/18/08 09:44:27	879.5	61.75	29.7	54.0
09/18/08 09:44:31	878.9	61.74	29.7	54.0
09/18/08 09:44:35	878.9	61.73	29.7	54.0
09/18/08 09:44:39	879.3	61.75	29.7	54.0
09/18/08 09:44:43	878.9	61.74	29.7	54.0
09/18/08 09:44:47	878.9	61.77	29.7	54.0
09/18/08 09:44:51	879.1	61.74	29.7	54.0
09/18/08 09:44:55	879.1	61.75	29.7	54.0
09/18/08 09:44:59	879.5	61.75	29.7	54.0
09/18/08 09:45:03	879.0	61.77	29.7	54.0
09/18/08 09:45:07	879.2	61.74	29.7	54.0
09/18/08 09:45:11	879.2	61.74	29.7	54.0
09/18/08 09:45:15	879.2	61.75	29.7	54.0
09/18/08 09:45:19	879.0	61.74	29.7	54.0
09/18/08 09:45:23	879.0	61.77	29.7	54.0
09/18/08 09:45:27	879.4	61.74	29.7	54.0
09/18/08 09:45:31	879.1	61.75	29.7	54.0
09/18/08 09:45:35	879.1	61.73	29.7	54.0
09/18/08 09:45:39	879.0	61.71	29.7	54.0
09/18/08 09:45:43	879.2	61.76	29.7	54.0
09/18/08 09:45:47	879.6	61.74	29.7	54.0
09/18/08 09:45:51	879.2	61.74	29.7	54.0
09/18/08 09:45:55	879.4	61.71	29.7	54.0
09/18/08 09:45:59	878.9	61.72	29.7	54.0
09/18/08 09:46:03	879.1	61.74	29.7	54.0
09/18/08 09:46:07	879.2	61.71	29.7	54.0
09/18/08 09:46:11	879.0	61.72	29.7	54.0
09/18/08 09:46:15	879.8	61.75	29.7	54.0
09/18/08 09:46:19	879.1	61.74	29.7	54.0
09/18/08 09:46:23	879.5	61.73	29.7	54.0
09/18/08 09:46:27	879.4	61.74	29.7	54.0
09/18/08 09:46:31	878.9	61.73	29.7	54.0
09/18/08 09:46:35	879.3	61.71	29.7	54.0
09/18/08 09:46:39	879.4	61.76	29.7	54.0
09/18/08 09:46:43	879.2	61.73	29.7	54.0
09/18/08 09:46:47	879.4	61.73	29.7	54.0
09/18/08 09:46:51	879.2	61.73	29.7	54.0
09/18/08 09:46:55	879.3	61.7	29.7	54.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:46:59	879.4	61.73	29.7	54.0
09/18/08 09:47:03	879.2	61.73	29.7	54.0
09/18/08 09:47:07	879.0	61.73	29.7	54.0
09/18/08 09:47:11	879.0	61.71	29.7	54.0
09/18/08 09:47:15	879.5	61.7	29.7	54.0
09/18/08 09:47:19	879.3	61.74	29.7	54.0
09/18/08 09:47:23	879.6	61.72	29.7	54.0
09/18/08 09:47:27	879.5	61.73	29.7	54.0
09/18/08 09:47:31	879.2	61.69	29.7	54.0
09/18/08 09:47:35	879.6	61.68	29.7	54.0
09/18/08 09:47:39	879.4	61.69	29.7	54.0
09/18/08 09:47:43	879.7	61.7	29.7	54.0
09/18/08 09:47:47	879.5	61.7	29.7	54.0
09/18/08 09:47:51	879.7	61.67	29.7	54.0
09/18/08 09:47:55	879.1	61.72	29.7	54.0
09/18/08 09:47:59	879.6	61.69	29.7	54.0
09/18/08 09:48:03	879.5	61.72	29.7	54.0
09/18/08 09:48:07	879.5	61.68	29.7	54.0
09/18/08 09:48:11	879.5	61.69	29.7	54.0
09/18/08 09:48:15	879.4	61.67	29.7	54.0
09/18/08 09:48:19	879.3	61.7	29.7	54.0
09/18/08 09:48:23	879.8	61.69	29.7	54.0
09/18/08 09:48:27	879.8	61.71	29.7	54.0
09/18/08 09:48:31	879.4	61.72	29.7	54.0
09/18/08 09:48:35	879.7	61.7	29.7	54.0
09/18/08 09:48:39	879.7	61.68	29.7	54.0
09/18/08 09:48:43	879.5	61.69	29.7	54.0
09/18/08 09:48:47	880.0	61.69	29.7	54.0
09/18/08 09:48:51	879.8	61.68	29.7	54.0
09/18/08 09:48:55	879.7	61.69	29.7	54.0
09/18/08 09:48:59	879.5	61.73	29.7	54.0
09/18/08 09:49:03	879.4	61.74	29.7	54.0
09/18/08 09:49:07	879.3	61.75	29.7	54.0
09/18/08 09:49:11	879.6	61.73	29.7	54.0
09/18/08 09:49:15	879.4	61.79	29.7	54.0
09/18/08 09:49:19	878.5	61.78	29.7	54.0
09/18/08 09:49:23	880.8	61.77	29.7	54.0
09/18/08 09:49:27	882.2	61.57	29.7	54.0
09/18/08 09:49:31	885.4	61.54	29.7	54.0
09/18/08 09:49:35	888.7	61.57	29.7	54.0
09/18/08 09:49:39	891.2	61.58	29.7	54.0
09/18/08 09:49:43	893.4	61.58	29.7	54.0
09/18/08 09:49:47	895.7	61.58	29.7	54.0
09/18/08 09:49:51	898.1	61.57	29.7	54.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:49:55	900.0	61.61	29.7	54.0
09/18/08 09:49:59	902.3	61.63	29.7	54.0
09/18/08 09:50:03	903.1	61.62	29.7	55.0
09/18/08 09:50:07	905.7	61.62	29.7	55.0
09/18/08 09:50:11	907.7	61.65	29.7	55.0
09/18/08 09:50:15	910.2	61.61	29.7	55.0
09/18/08 09:50:19	912.2	61.62	29.7	55.0
09/18/08 09:50:23	915.1	61.63	29.7	55.0
09/18/08 09:50:27	917.0	61.61	29.7	55.0
09/18/08 09:50:31	919.5	61.65	29.7	55.0
09/18/08 09:50:35	921.5	61.67	29.7	55.0
09/18/08 09:50:39	924.0	61.66	29.7	55.0
09/18/08 09:50:43	926.2	61.65	29.7	55.0
09/18/08 09:50:47	928.1	61.66	29.7	55.0
09/18/08 09:50:51	930.7	61.63	29.7	55.0
09/18/08 09:50:55	933.1	61.67	29.7	55.0
09/18/08 09:50:59	935.2	61.66	29.7	55.0
09/18/08 09:51:03	937.7	61.65	29.7	55.0
09/18/08 09:51:07	940.1	61.66	29.7	55.0
09/18/08 09:51:11	942.0	61.64	29.7	55.0
09/18/08 09:51:15	944.3	61.67	29.7	55.0
09/18/08 09:51:19	946.6	61.68	29.7	55.0
09/18/08 09:51:23	949.3	61.66	29.7	55.0
09/18/08 09:51:27	951.5	61.67	29.7	55.0
09/18/08 09:51:31	953.5	61.69	29.7	55.0
09/18/08 09:51:35	955.9	61.68	29.7	55.0
09/18/08 09:51:39	958.0	61.63	29.7	55.0
09/18/08 09:51:43	960.1	61.64	29.7	55.0
09/18/08 09:51:47	962.6	61.64	29.7	55.0
09/18/08 09:51:51	964.9	61.66	29.7	55.0
09/18/08 09:51:55	967.4	61.62	29.7	55.0
09/18/08 09:51:59	969.6	61.62	29.7	55.0
09/18/08 09:52:03	971.5	61.64	29.7	55.0
09/18/08 09:52:07	974.2	61.65	29.7	55.0
09/18/08 09:52:11	976.3	61.63	29.7	55.0
09/18/08 09:52:15	978.6	61.64	29.7	55.0
09/18/08 09:52:19	980.8	61.65	29.7	55.0
09/18/08 09:52:23	983.2	61.66	29.7	55.0
09/18/08 09:52:27	985.3	61.63	29.7	55.0
09/18/08 09:52:31	987.5	61.63	29.7	55.0
09/18/08 09:52:35	989.9	61.64	29.7	55.0
09/18/08 09:52:39	992.1	61.64	29.7	55.0
09/18/08 09:52:43	994.5	61.64	29.7	55.0
09/18/08 09:52:47	996.9	61.65	29.7	55.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:52:51	999.3	61.64	29.7	55.0
09/18/08 09:52:55	1001.2	61.66	29.7	55.0
09/18/08 09:52:59	1004.1	61.66	29.7	55.0
09/18/08 09:53:03	1005.8	61.63	29.7	55.0
09/18/08 09:53:07	1008.2	61.66	29.7	55.0
09/18/08 09:53:11	1010.6	61.65	29.7	55.0
09/18/08 09:53:15	1012.7	61.65	29.7	55.0
09/18/08 09:53:19	1015.0	61.67	29.7	55.0
09/18/08 09:53:23	1017.7	61.65	29.7	55.0
09/18/08 09:53:27	1019.5	61.63	29.7	55.0
09/18/08 09:53:31	1022.1	61.67	29.7	55.0
09/18/08 09:53:35	1024.0	61.65	29.7	55.0
09/18/08 09:53:39	1026.4	61.63	29.7	55.0
09/18/08 09:53:43	1028.6	61.67	29.7	55.0
09/18/08 09:53:47	1030.9	61.64	29.7	55.0
09/18/08 09:53:51	1033.4	61.63	29.7	55.0
09/18/08 09:53:55	1034.7	61.62	29.7	55.0
09/18/08 09:53:59	1037.5	61.62	29.7	55.0
09/18/08 09:54:03	1040.0	61.63	29.7	55.0
09/18/08 09:54:07	1042.2	61.64	29.7	55.0
09/18/08 09:54:11	1044.2	61.65	29.7	55.0
09/18/08 09:54:15	1046.2	61.63	29.7	55.0
09/18/08 09:54:19	1048.9	61.64	29.7	55.0
09/18/08 09:54:23	1051.4	61.62	29.7	55.0
09/18/08 09:54:27	1053.3	61.64	29.7	55.0
09/18/08 09:54:31	1055.6	61.66	29.7	55.0
09/18/08 09:54:35	1057.7	61.63	29.7	55.0
09/18/08 09:54:39	1060.0	61.62	29.7	55.0
09/18/08 09:54:43	1062.7	61.65	29.7	55.0
09/18/08 09:54:47	1064.9	61.65	29.7	55.0
09/18/08 09:54:51	1067.0	61.66	29.7	55.0
09/18/08 09:54:55	1069.5	61.66	29.7	55.0
09/18/08 09:54:59	1071.5	61.65	29.7	55.0
09/18/08 09:55:03	1073.7	61.66	29.7	55.0
09/18/08 09:55:07	1076.3	61.65	29.7	55.0
09/18/08 09:55:11	1078.4	61.67	29.7	55.0
09/18/08 09:55:15	1080.6	61.66	29.7	55.0
09/18/08 09:55:19	1082.8	61.66	29.7	55.0
09/18/08 09:55:23	1085.2	61.64	29.7	55.0
09/18/08 09:55:27	1087.4	61.68	29.7	55.0
09/18/08 09:55:31	1089.9	61.67	29.7	55.0
09/18/08 09:55:35	1092.3	61.66	29.7	55.0
09/18/08 09:55:39	1094.0	61.67	29.7	55.0
09/18/08 09:55:43	1096.4	61.66	29.7	55.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:55:47	1098.8	61.7	29.7	55.0
09/18/08 09:55:51	1101.0	61.66	29.7	55.0
09/18/08 09:55:55	1103.6	61.66	29.7	55.0
09/18/08 09:55:59	1105.8	61.68	29.7	55.0
09/18/08 09:56:03	1108.0	61.66	29.7	55.0
09/18/08 09:56:07	1110.2	61.67	29.7	55.0
09/18/08 09:56:11	1112.3	61.67	29.7	55.0
09/18/08 09:56:15	1114.6	61.69	29.7	55.0
09/18/08 09:56:19	1117.4	61.71	29.7	55.0
09/18/08 09:56:23	1118.8	61.71	29.7	55.0
09/18/08 09:56:27	1121.7	61.72	29.7	55.0
09/18/08 09:56:31	1123.6	61.7	29.7	55.0
09/18/08 09:56:35	1126.4	61.67	29.7	55.0
09/18/08 09:56:39	1128.3	61.72	29.7	55.0
09/18/08 09:56:43	1130.1	61.73	29.7	55.0
09/18/08 09:56:47	1132.9	61.69	29.7	55.0
09/18/08 09:56:51	1135.1	61.71	29.7	55.0
09/18/08 09:56:55	1137.4	61.72	29.7	55.0
09/18/08 09:56:59	1139.4	61.72	29.7	55.0
09/18/08 09:57:03	1141.6	61.72	29.7	55.0
09/18/08 09:57:07	1143.9	61.7	29.7	55.0
09/18/08 09:57:11	1146.1	61.68	29.7	55.0
09/18/08 09:57:15	1148.2	61.72	29.7	55.0
09/18/08 09:57:19	1150.4	61.74	29.7	55.0
09/18/08 09:57:23	1153.3	61.72	29.7	55.0
09/18/08 09:57:27	1155.3	61.71	29.7	55.0
09/18/08 09:57:31	1157.2	61.7	29.7	55.0
09/18/08 09:57:35	1160.2	61.71	29.7	55.0
09/18/08 09:57:39	1162.0	61.75	29.7	55.0
09/18/08 09:57:43	1164.2	61.74	29.7	55.0
09/18/08 09:57:47	1166.5	61.77	29.7	55.0
09/18/08 09:57:51	1168.4	61.74	29.7	55.0
09/18/08 09:57:55	1170.9	61.76	29.7	55.0
09/18/08 09:57:59	1173.1	61.75	29.7	55.0
09/18/08 09:58:03	1175.6	61.73	29.7	55.0
09/18/08 09:58:07	1177.6	61.75	29.7	55.0
09/18/08 09:58:11	1179.6	61.75	29.7	55.0
09/18/08 09:58:15	1182.1	61.78	29.7	55.0
09/18/08 09:58:19	1184.3	61.76	29.7	55.0
09/18/08 09:58:23	1187.0	61.76	29.7	55.0
09/18/08 09:58:27	1188.9	61.75	29.7	55.0
09/18/08 09:58:31	1191.3	61.78	29.7	55.0
09/18/08 09:58:35	1193.5	61.78	29.7	55.0
09/18/08 09:58:39	1195.7	61.76	29.7	55.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 09:58:43	1197.9	61.78	29.7	55.0
09/18/08 09:58:47	1200.2	61.77	29.7	55.0
09/18/08 09:58:51	1202.5	61.78	29.7	55.0
09/18/08 09:58:55	1204.7	61.79	29.7	55.0
09/18/08 09:58:59	1206.9	61.78	29.7	55.0
09/18/08 09:59:03	1209.4	61.77	29.7	55.0
09/18/08 09:59:07	1211.6	61.78	29.7	55.0
09/18/08 09:59:11	1214.0	61.78	29.7	55.0
09/18/08 09:59:15	1216.2	61.79	29.7	55.0
09/18/08 09:59:19	1218.0	61.78	29.7	55.0
09/18/08 09:59:23	1220.5	61.79	29.7	55.0
09/18/08 09:59:27	1222.5	61.82	29.7	55.0
09/18/08 09:59:31	1225.2	61.79	29.7	55.0
09/18/08 09:59:35	1226.7	61.8	29.7	55.0
09/18/08 09:59:39	1229.5	61.78	29.7	55.0
09/18/08 09:59:43	1232.2	61.79	29.7	55.0
09/18/08 09:59:47	1234.0	61.78	29.7	55.0
09/18/08 09:59:51	1236.3	61.8	29.7	55.0
09/18/08 09:59:55	1238.2	61.82	29.7	55.0
09/18/08 09:59:59	1241.0	61.79	29.7	55.0
09/18/08 10:00:03	1242.8	61.82	29.7	55.0
09/18/08 10:00:07	1245.2	61.82	29.7	55.0
09/18/08 10:00:11	1247.6	61.79	29.7	55.0
09/18/08 10:00:15	1249.9	61.81	29.7	55.0
09/18/08 10:00:19	1251.8	61.82	29.7	55.0
09/18/08 10:00:23	1254.8	61.82	29.7	55.0
09/18/08 10:00:27	1256.8	61.82	29.7	55.0
09/18/08 10:00:31	1258.7	61.79	29.7	55.0
09/18/08 10:00:35	1260.9	61.82	29.7	55.0
09/18/08 10:00:39	1263.7	61.8	29.7	55.0
09/18/08 10:00:43	1265.5	61.81	29.7	55.0
09/18/08 10:00:47	1268.2	61.85	29.7	55.0
09/18/08 10:00:51	1269.7	61.83	29.7	55.0
09/18/08 10:00:55	1272.4	61.81	29.7	55.0
09/18/08 10:00:59	1274.7	61.84	29.7	55.0
09/18/08 10:01:03	1277.1	61.84	29.7	55.0
09/18/08 10:01:07	1278.9	61.84	29.7	55.0
09/18/08 10:01:11	1281.6	61.82	29.7	55.0
09/18/08 10:01:15	1283.4	61.85	29.7	55.0
09/18/08 10:01:19	1286.0	61.84	29.7	55.0
09/18/08 10:01:23	1288.4	61.84	29.7	55.0
09/18/08 10:01:27	1290.4	61.85	29.7	55.0
09/18/08 10:01:31	1292.7	61.88	29.7	55.0
09/18/08 10:01:35	1295.0	61.86	29.7	55.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 10:01:39	1296.8	61.77	29.7	55.0
09/18/08 10:01:43	1299.7	61.82	29.7	55.0
09/18/08 10:01:47	1301.3	61.86	29.7	55.0
09/18/08 10:01:51	1303.9	61.85	29.7	55.0
09/18/08 10:01:55	1306.3	61.78	29.7	55.0
09/18/08 10:01:59	1308.3	61.81	29.7	55.0
09/18/08 10:02:03	1310.7	61.82	29.7	55.0
09/18/08 10:02:07	1312.6	61.8	29.7	55.0
09/18/08 10:02:11	1315.1	61.81	29.7	55.0
09/18/08 10:02:15	1316.9	61.84	29.7	55.0
09/18/08 10:02:19	1319.4	61.86	29.7	55.0
09/18/08 10:02:23	1321.9	61.83	29.7	55.0
09/18/08 10:02:27	1324.3	61.83	29.7	55.0
09/18/08 10:02:31	1326.3	61.85	29.7	55.0
09/18/08 10:02:35	1328.6	61.83	29.7	55.0
09/18/08 10:02:39	1330.6	61.86	29.7	55.0
09/18/08 10:02:43	1332.3	61.87	29.7	55.0
09/18/08 10:02:47	1335.6	61.88	29.7	55.0
09/18/08 10:02:51	1336.8	61.88	29.7	55.0
09/18/08 10:02:55	1339.4	61.86	29.7	55.0
09/18/08 10:02:59	1341.7	61.86	29.7	55.0
09/18/08 10:03:03	1343.9	61.88	29.7	55.0
09/18/08 10:03:07	1346.1	61.89	29.7	55.0
09/18/08 10:03:11	1347.8	61.91	29.7	55.0
09/18/08 10:03:15	1350.4	61.89	29.7	55.0
09/18/08 10:03:19	1352.5	61.87	29.7	55.0
09/18/08 10:03:23	1354.8	61.9	29.7	55.0
09/18/08 10:03:27	1357.5	61.89	29.7	55.0
09/18/08 10:03:31	1359.4	61.89	29.7	55.0
09/18/08 10:03:35	1361.4	61.91	29.7	55.0
09/18/08 10:03:39	1363.8	61.88	29.7	55.0
09/18/08 10:03:43	1366.1	61.92	29.7	55.0
09/18/08 10:03:47	1368.4	61.9	29.7	55.0
09/18/08 10:03:51	1370.4	61.92	29.7	55.0
09/18/08 10:03:55	1372.9	61.91	29.7	55.0
09/18/08 10:03:59	1375.4	61.93	29.7	55.0
09/18/08 10:04:03	1377.5	61.93	29.7	55.0
09/18/08 10:04:07	1379.5	61.94	29.7	55.0
09/18/08 10:04:11	1381.8	61.92	29.7	55.0
09/18/08 10:04:15	1384.1	61.93	29.7	55.0
09/18/08 10:04:19	1386.5	61.95	29.7	55.0
09/18/08 10:04:23	1388.6	61.94	29.7	55.0
09/18/08 10:04:27	1390.9	61.97	29.7	55.0
09/18/08 10:04:31	1392.5	61.94	29.7	55.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 10:04:35	1395.0	61.95	29.7	55.0
09/18/08 10:04:39	1397.7	61.96	29.7	55.0
09/18/08 10:04:43	1400.0	61.94	29.7	55.0
09/18/08 10:04:47	1401.7	61.92	29.7	55.0
09/18/08 10:04:51	1403.9	61.94	29.7	55.0
09/18/08 10:04:55	1406.4	61.92	29.7	55.0
09/18/08 10:04:59	1408.9	61.92	29.7	55.0
09/18/08 10:05:03	1410.5	61.93	29.7	55.0
09/18/08 10:05:07	1413.1	61.94	29.7	55.0
09/18/08 10:05:11	1415.4	61.98	29.7	55.0
09/18/08 10:05:15	1417.3	61.97	29.7	55.0
09/18/08 10:05:19	1420.3	61.95	29.7	55.0
09/18/08 10:05:23	1422.1	61.99	29.7	55.0
09/18/08 10:05:27	1424.5	61.95	29.7	55.0
09/18/08 10:05:31	1426.8	61.95	29.7	55.0
09/18/08 10:05:35	1429.1	61.94	29.7	55.0
09/18/08 10:05:39	1431.3	61.93	29.7	55.0
09/18/08 10:05:43	1433.3	61.96	29.7	55.0
09/18/08 10:05:47	1435.2	61.95	29.7	55.0
09/18/08 10:05:51	1437.3	61.91	29.7	55.0
09/18/08 10:05:55	1439.6	61.96	29.7	55.0
09/18/08 10:05:59	1442.1	61.97	29.7	55.0
09/18/08 10:06:03	1444.1	61.96	29.7	55.0
09/18/08 10:06:07	1446.4	61.97	29.7	55.0
09/18/08 10:06:11	1449.2	61.92	29.7	55.0
09/18/08 10:06:15	1450.8	61.98	29.7	55.0
09/18/08 10:06:19	1453.5	61.96	29.7	55.0
09/18/08 10:06:23	1455.0	61.92	29.7	55.0
09/18/08 10:06:27	1457.7	61.96	29.7	55.0
09/18/08 10:06:31	1459.9	61.95	29.7	55.0
09/18/08 10:06:35	1462.3	61.95	29.7	55.0
09/18/08 10:06:39	1464.2	61.91	29.7	55.0
09/18/08 10:06:43	1466.5	61.94	29.7	55.0
09/18/08 10:06:47	1468.8	61.96	29.7	55.0
09/18/08 10:06:51	1471.0	61.92	29.7	55.0
09/18/08 10:06:55	1473.2	61.93	29.7	55.0
09/18/08 10:06:59	1475.1	61.93	29.7	55.0
09/18/08 10:07:03	1477.1	61.94	29.7	55.0
09/18/08 10:07:07	1480.0	61.92	29.7	55.0
09/18/08 10:07:11	1482.2	61.93	29.7	55.0
09/18/08 10:07:15	1484.6	61.95	29.7	55.0
09/18/08 10:07:19	1486.5	61.95	29.7	55.0
09/18/08 10:07:23	1488.6	61.94	29.7	55.0
09/18/08 10:07:27	1490.6	61.96	29.7	55.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 10:07:31	1493.3	61.93	29.7	55.0
09/18/08 10:07:35	1495.4	61.94	29.7	55.0
09/18/08 10:07:39	1497.4	61.97	29.7	55.0
09/18/08 10:07:43	1499.6	61.93	29.7	55.0
09/18/08 10:07:47	1502.2	61.95	29.7	55.0
09/18/08 10:07:51	1504.2	61.94	29.7	55.0
09/18/08 10:07:55	1506.3	61.96	29.7	55.0
09/18/08 10:07:59	1509.0	61.95	29.7	55.0
09/18/08 10:08:03	1510.6	61.93	29.7	55.0
09/18/08 10:08:07	1512.7	61.89	29.7	55.0
09/18/08 10:08:11	1515.4	61.9	29.7	55.0
09/18/08 10:08:15	1517.5	61.93	29.7	55.0
09/18/08 10:08:19	1519.5	61.91	29.7	55.0
09/18/08 10:08:23	1521.0	61.95	29.7	57.0
09/18/08 10:08:27	1523.3	61.93	29.7	57.0
09/18/08 10:08:31	1525.5	61.94	29.7	57.0
09/18/08 10:08:35	1527.8	61.94	29.7	57.0
09/18/08 10:08:39	1529.7	61.96	29.7	57.0
09/18/08 10:08:43	1532.3	61.93	29.7	57.0
09/18/08 10:08:47	1533.8	61.94	29.7	57.0
09/18/08 10:08:51	1536.8	61.95	29.7	57.0
09/18/08 10:08:55	1538.6	61.97	29.7	57.0
09/18/08 10:08:59	1540.9	61.95	29.7	57.0
09/18/08 10:09:03	1543.4	61.96	29.7	57.0
09/18/08 10:09:07	1545.2	61.91	29.7	57.0
09/18/08 10:09:11	1547.3	61.91	29.7	57.0
09/18/08 10:09:15	1549.7	61.97	29.7	57.0
09/18/08 10:09:19	1552.3	61.91	29.7	57.0
09/18/08 10:09:23	1554.0	61.94	29.7	57.0
09/18/08 10:09:27	1556.2	61.96	29.7	57.0
09/18/08 10:09:31	1558.9	61.96	29.7	57.0
09/18/08 10:09:35	1560.5	61.99	29.7	57.0
09/18/08 10:09:39	1562.8	61.95	29.7	57.0
09/18/08 10:09:43	1565.3	61.97	29.7	57.0
09/18/08 10:09:47	1567.3	61.91	29.7	57.0
09/18/08 10:09:51	1568.8	61.89	29.7	57.0
09/18/08 10:09:55	1571.7	61.91	29.7	57.0
09/18/08 10:09:59	1574.0	61.91	29.7	57.0
09/18/08 10:10:03	1576.2	61.9	29.7	57.0
09/18/08 10:10:07	1578.2	61.92	29.7	57.0
09/18/08 10:10:11	1580.3	61.88	29.7	57.0
09/18/08 10:10:15	1582.9	61.96	29.7	57.0
09/18/08 10:10:19	1584.9	61.9	29.7	57.0
09/18/08 10:10:23	1587.3	61.9	29.7	57.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 10:10:27	1589.3	61.91	29.7	57.0
09/18/08 10:10:31	1591.4	61.92	29.7	57.0
09/18/08 10:10:35	1593.8	61.91	29.7	57.0
09/18/08 10:10:39	1596.0	61.92	29.7	57.0
09/18/08 10:10:43	1598.1	61.93	29.7	57.0
09/18/08 10:10:47	1600.9	61.92	29.7	57.0
09/18/08 10:10:51	1602.5	61.94	29.7	57.0
09/18/08 10:10:55	1604.9	61.93	29.7	57.0
09/18/08 10:10:59	1606.6	61.94	29.7	57.0
09/18/08 10:11:03	1609.3	61.91	29.7	57.0
09/18/08 10:11:07	1611.2	61.89	29.7	57.0
09/18/08 10:11:11	1613.3	61.94	29.7	57.0
09/18/08 10:11:15	1615.8	61.96	29.7	57.0
09/18/08 10:11:19	1617.8	61.95	29.7	57.0
09/18/08 10:11:23	1620.4	61.97	29.7	57.0
09/18/08 10:11:27	1622.6	61.94	29.7	57.0
09/18/08 10:11:31	1624.5	61.93	29.7	57.0
09/18/08 10:11:35	1626.8	61.94	29.7	57.0
09/18/08 10:11:39	1629.0	61.93	29.7	57.0
09/18/08 10:11:43	1631.0	61.99	29.7	57.0
09/18/08 10:11:47	1633.5	62.02	29.7	57.0
09/18/08 10:11:51	1635.7	61.99	29.7	57.0
09/18/08 10:11:55	1638.0	61.99	29.7	57.0
09/18/08 10:11:59	1639.6	61.94	29.7	57.0
09/18/08 10:12:03	1641.9	61.99	29.7	57.0
09/18/08 10:12:07	1644.4	61.96	29.7	57.0
09/18/08 10:12:11	1646.7	61.98	29.7	57.0
09/18/08 10:12:15	1649.1	61.97	29.7	57.0
09/18/08 10:12:19	1650.6	61.99	29.7	57.0
09/18/08 10:12:23	1652.8	61.99	29.7	57.0
09/18/08 10:12:27	1655.5	62.0	29.7	57.0
09/18/08 10:12:31	1657.4	61.98	29.7	57.0
09/18/08 10:12:35	1659.7	61.99	29.7	57.0
09/18/08 10:12:39	1661.8	62.0	29.7	57.0
09/18/08 10:12:43	1664.1	61.99	29.7	57.0
09/18/08 10:12:47	1666.4	61.99	29.7	57.0
09/18/08 10:12:51	1668.1	61.99	29.7	57.0
09/18/08 10:12:55	1670.3	62.03	29.7	57.0
09/18/08 10:12:59	1672.4	61.99	29.7	57.0
09/18/08 10:13:03	1674.6	61.99	29.7	57.0
09/18/08 10:13:07	1676.9	62.04	29.7	57.0
09/18/08 10:13:11	1679.0	62.01	29.7	57.0
09/18/08 10:13:15	1681.2	62.03	29.7	57.0
09/18/08 10:13:19	1683.3	62.03	29.7	57.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 10:13:23	1685.5	62.0	29.7	57.0
09/18/08 10:13:27	1687.8	62.0	29.7	57.0
09/18/08 10:13:31	1689.5	62.0	29.7	57.0
09/18/08 10:13:35	1692.1	62.02	29.7	57.0
09/18/08 10:13:39	1694.2	62.01	29.7	57.0
09/18/08 10:13:43	1696.6	62.04	29.7	57.0
09/18/08 10:13:47	1698.7	62.0	29.7	57.0
09/18/08 10:13:51	1700.5	62.03	29.7	57.0
09/18/08 10:13:55	1703.3	62.03	29.7	57.0
09/18/08 10:13:59	1705.4	62.03	29.7	57.0
09/18/08 10:14:03	1707.6	62.02	29.7	57.0
09/18/08 10:14:07	1709.6	62.06	29.7	57.0
09/18/08 10:14:11	1712.0	62.06	29.7	57.0
09/18/08 10:14:15	1714.5	62.03	29.7	57.0
09/18/08 10:14:19	1716.1	62.05	29.7	57.0
09/18/08 10:14:23	1718.9	62.04	29.7	57.0
09/18/08 10:14:27	1720.6	62.05	29.7	57.0
09/18/08 10:14:31	1722.8	62.07	29.7	57.0
09/18/08 10:14:35	1725.1	62.07	29.7	57.0
09/18/08 10:14;39	1727.4	62.04	29.7	57.0
09/18/08 10:14:43	1729.4	62.04	29.7	57.0
09/18/08 10:14:47	1731.8	62.05	29.7	57.0
09/18/08 10:14:51	1734.1	62.04	29.7	57.0
09/18/08 10:14:55	1736.1	62.02	29.7	57.0
09/18/08 10:14:59	1738.6	62.05	29.7	57.0
09/18/08 10:15:03	1740.4	62.01	29.7	57.0
09/18/08 10:15:07	1742.5	62.07	29.7	57.0
09/18/08 10:15:11	1744.7	62.06	29.7	57.0
09/18/08 10:15:15	1747.1	62.04	29.7	57.0
09/18/08 10:15:19	1749.2	62.07	29.7	57.0
09/18/08 10:15:23	1751.3	62.05	29.7	57.0
09/18/08 10:15:27	1753.1	62.11	29.7	57.0
09/18/08 10:15:31	1753.0	62.1	29.7	57.0
09/18/08 10:15:35	1752.9	62.08	29.7	57.0
09/18/08 10:15:39	1753.1	62.15	29.7	57.0
09/18/08 10:15:43	1752.7	62.16	29.7	57.0
09/18/08 10:15:47	1752.8	62.17	29.7	57.0
09/18/08 10:15:51	1752.7	62.16	29.7	57.0
09/18/08 10:15:55	1752.6	62.16	29.7	57.0
09/18/08 10:15:59	1752.5	62.17	29.7	57.0
09/18/08 10:16:03	1752.5	62.17	29.7	57.0
09/18/08 10:16:07	1752.5	62.13	29.7	57.0
09/18/08 10:16:11	1752.6	62.14	29.7	57.0
09/18/08 10:16:15	1752.2	62.13	29.7	57.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 10:16:19	1752.6	62.15	29.7	57.0
09/18/08 10:16:23	1752.5	62.16	29.7	57.0
09/18/08 10:16:27	1752.5	62.14	29.7	57.0
09/18/08 10:16:31	1752.2	62.16	29.7	57.0
09/18/08 10:16:35	1752.8	62.15	29.7	57.0
09/18/08 10:16:39	1752.1	62.15	29.7	57.0
09/18/08 10:16:43	1752.5	62.12	29.7	57.0
09/18/08 10:16:47	1752.6	62.16	29.7	57.0
09/18/08 10:16:51	1752.8	62.17	29.7	57.0
09/18/08 10:16:55	1752.6	62.15	29.7	57.0
09/18/08 10:16:59	1752.1	62.15	29.7	57.0
09/18/08 10:17:03	1752.4	62.14	29.7	57.0
09/18/08 10:17:07	1752.2	62.17	29.7	57.0
09/18/08 10:17:11	1752.7	62.18	29.7	57.0
09/18/08 10:17:15	1752.6	62.15	29.7	57.0
09/18/08 10:17:19	1752.4	62.15	29.7	57.0
09/18/08 10:17:23	1752.6	62.14	29.7	57.0
09/18/08 10:17:27	1752.7	62.15	29.7	57.0
09/18/08 10:17:31	1752.7	62.17	29.7	57.0
09/18/08 10:17:35	1752.5	62.17	29.7	57.0
09/18/08 10:17:39	1752.6	62.15	29.7	57.0
09/18/08 10:17:43	1752.8	62.13	29.7	57.0
09/18/08 10:17:47	1752.4	62.17	29.7	57.0
09/18/08 10:17:51	1752.5	62.14	29.7	57.0
09/18/08 10:17:55	1752.9	62.15	29.7	57.0
09/18/08 10:17:59	1752.6	62.14	29.7	57.0
09/18/08 10:18:03	1753.0	62.16	29.7	57.0
09/18/08 10:18:07	1752.7	62.17	29.7	57.0
09/18/08 10:18:11	1752.4	62.15	29.7	57.0
09/18/08 10:18:15	1752.5	62.21	29.7	57.0
09/18/08 10:18:19	1752.8	62.22	29.7	57.0
09/18/08 10:18:23	1752.3	62.23	29.7	57.0
09/18/08 10:18:27	1752.8	62.24	29.7	57.0
09/18/08 10:18:31	1752.8	62.22	29.7	57.0
09/18/08 10:18:35	1752.9	62.23	29.7	57.0
09/18/08 10:18:39	1752.7	62.15	29.7	57.0
09/18/08 10:18:43	1752.7	62.14	29.7	57.0
09/18/08 10:18:47	1752.9	62.16	29.7	57.0
09/18/08 10:18:51	1752.8	62.16	29.7	57.0
09/18/08 10:18:55	1752.9	62.14	29.7	57.0
09/18/08 10:18:59	1752.8	62.17	29.7	57.0
09/18/08 10:19:03	1752.8	62.14	29.7	57.0
09/18/08 10:19:07	1752.7	62.15	29.7	57.0
09/18/08 10:19:11	1753.1	62.15	29.7	57.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 10:19:15	1753.2	62.14	29.7	57.0
09/18/08 10:19:19	1753.3	62.15	29.7	57.0
09/18/08 10:19:23	1753.1	62.15	29.7	57.0
09/18/08 10:19:27	1752.9	62.17	29.7	57.0
09/18/08 10:19:31	1752.7	62.15	29.7	57.0
09/18/08 10:19:35	1753.1	62.13	29.7	57.0
09/18/08 10:19:39	1753.2	62.16	29.7	57.0
09/18/08 10:19:43	1753.0	62.17	29.7	57.0
09/18/08 10:19:47	1752.9	62.14	29.7	57.0
09/18/08 10:19:51	1753.2	62.13	29.7	57.0
09/18/08 10:19:55	1752.6	62.14	29.7	57.0
09/18/08 10:19:59	1752.8	62.12	29.7	57.0
09/18/08 10:20:03	1752.7	62.13	29.7	57.0
09/18/08 10:20:07	1753.2	62.14	29.7	57.0
09/18/08 10:20:11	1752.9	62.16	29.7	57.0
09/18/08 10:20:15	1753.1	62.14	29.7	57.0
09/18/08 10:20:19	1753.0	62.12	29.7	57.0
09/18/08 10:20:23	1752.8	62.12	29.7	57.0
09/18/08 10:20:27	1753.1	62.14	29.7	57.0
09/18/08 10:20:31	1753.0	62.12	29.7	57.0
09/18/08 10:20:35	1752.7	62.13	29.7	57.0
09/18/08 10:20:39	1753.1	62.15	29.7	57.0
09/18/08 10:20:43	1752.9	62.12	29.7	57.0
09/18/08 10:20:47	1753.5	62.14	29.7	57.0
09/18/08 10:20:51	1752.6	62.12	29.7	57.0
09/18/08 10:20:55	1753.0	62.12	29.7	57.0
09/18/08 10:20:59	1753.3	62.09	29.7	57.0
09/18/08 10:21:03	1753.3	62.1	29.7	57.0
09/18/08 10:21:07	1752.8	62.11	29.7	57.0
09/18/08 10:21:11	1753.4	62.09	29.7	57.0
09/18/08 10:21:15	1753.3	62.08	29.7	57.0
09/18/08 10:21:19	1753.1	62.11	29.7	57.0
09/18/08 10:21:23	1753.2	62.09	29.7	57.0
09/18/08 10:21:27	1753.1	62.09	29.7	57.0
09/18/08 10:21:32	1752.9	62.06	29.7	57.0
09/18/08 10:21:43	1753.0	62.02	29.7	57.0
09/18/08 10:22:14	1753.4	62.05	29.7	57.0
09/18/08 10:22:44	1753.3	62.05	29.7	57.0
09/18/08 10:23:14	1753.4	62.05	29.7	57.0
09/18/08 10:23:44	1753.8	62.04	29.7	57.0
09/18/08 10:24:14	1753.5	62.03	29.7	57.0
09/18/08 10:24:44	1753.6	62.0	29.7	57.0
09/18/08 10:25:14	1753.9	61.99	29.7	57.0
09/18/08 10:25:44	1753.7	61.99	29.7	57.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 10:26:14	1754.0	62.01	29.7	57.0
09/18/08 10:26:44	1754.2	61.99	29.7	57.0
09/18/08 10:27:14	1754.2	61.96	29.7	57.0
09/18/08 10:27:44	1753.8	61.95	29.7	57.0
09/18/08 10:28:14	1754.3	61.93	29.7	57.0
09/18/08 10:28:44	1754.1	61.92	29.7	57.0
09/18/08 10:29:14	1754.4	61.95	29.7	57.0
09/18/08 10:29:44	1754.5	61.9	29.7	57.0
09/18/08 10:30:14	1754.4	61.94	29.7	57.0
09/18/08 10:30:45	1754.2	61.93	29.7	57.0
09/18/08 10:31:15	1754.9	61.91	29.7	57.0
09/18/08 10:31:45	1754.5	61.89	29.7	57.0
09/18/08 10:32:15	1754.7	61.9	29.7	57.0
09/18/08 10:32:45	1755.1	61.87	29.7	57.0
09/18/08 10:33:15	1754.9	61.86	29.7	57.0
09/18/08 10:33:45	1755.0	61.83	29.7	57.0
09/18/08 10:34:15	1755.3	61.87	29.7	57.0
09/18/08 10:34:46	1754.9	61.84	29.7	57.0
09/18/08 10:35:16	1755.2	61.86	29.7	57.0
09/18/08 10:35:46	1755.3	61.87	29.7	57.0
09/18/08 10:36:16	1755.5	61.87	29.7	57.0
09/18/08 10:36:46	1755.8	61.86	29.7	57.0
09/18/08 10:37:16	1755.7	61.88	29.7	57.0
09/18/08 10:37:46	1756.1	61.9	29.7	57.0
09/18/08 10:38:16	1756.1	61.9	29.7	57.0
09/18/08 10:38:46	1756.3	61.89	29.7	57.0
09/18/08 10:39:16	1756.4	61.88	29.7	57.0
09/18/08 10:39:46	1756.1	61.91	29.7	57.0
09/18/08 10:40:16	1756.1	61.92	29.7	57.0
09/18/08 10:40:46	1755.1	61.92	29.7	59.0
09/18/08 10:41:16	1754.8	61.91	29.7	59.0
09/18/08 10:41:46	1755.4	61.97	29.7	59.0
09/18/08 10:42:16	1755.4	61.99	29.7	59.0
09/18/08 10:42:46	1755.5	62.01	29.7	59.0
09/18/08 10:43:17	1755.6	61.98	29.7	59.0
09/18/08 10:43:47	1755.3	61.95	29.7	59.0
09/18/08 10:44:17	1755.5	61.99	29.7	59.0
09/18/08 10:44:47	1755.9	61.98	29.7	59.0
09/18/08 10:45:17	1755.8	61.94	29.7	59.0
09/18/08 10:45:47	1755.8	61.97	29.7	59.0
09/18/08 10:46:17	1755.8	61.96	29.7	59.0
09/18/08 10:46:47	1755.8	61.99	29.7	59.0
09/18/08 10:47:18	1756.1	61.98	29.7	59.0
09/18/08 10:47:48	1756.2	62.0	29.7	59.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 10:48:18	1756.3	61.99	29.7	59.0
09/18/08 10:48:48	1756.5	61.98	29.7	59.0
09/18/08 10:49:18	1756.6	62.0	29.7	59.0
09/18/08 10:49:48	1756.3	62.01	29.7	59.0
09/18/08 10:50:18	1756.8	62.02	29.7	59.0
09/18/08 10:50:48	1756.9	62.04	29.7	59.0
09/18/08 10:51:19	1756.8	62.04	29.7	59.0
09/18/08 10:51:49	1757.2	62.02	29.7	59.0
09/18/08 10:52:19	1757.1	62.02	29.7	59.0
09/18/08 10:52:49	1757.7	62.06	29.7	59.0
09/18/08 10:53:19	1757.2	62.04	29.7	59.0
09/18/08 10:53:49	1757.5	62.05	29.7	59.0
09/18/08 10:54:19	1757.6	62.05	29.7	59.0
09/18/08 10:54:49	1757.3	62.07	29.7	59.0
09/18/08 10:55:19	1757.7	62.06	29.7	59.0
09/18/08 10:55:49	1757.7	62.06	29.7	59.0
09/18/08 10:56:19	1758.0	62.08	29.7	59.0
09/18/08 10:56:49	1758.1	62.07	29.7	59.0
09/18/08 10:57:19	1757.8	62.1	29.7	59.0
09/18/08 10:57:49	1758.1	62.08	29.7	59.0
09/18/08 10:58:19	1758.1	62.07	29.7	59.0
09/18/08 10:58:49	1758.3	62.08	29.7	59.0
09/18/08 10:59:19	1758.2	62.1	29.7	59.0
09/18/08 11:01:06	1758.7	62.1	29.7	59.0
09/18/08 11:03:06	1758.6	62.12	29.7	59.0
09/18/08 11:05:06	1759.2	62.14	29.7	59.0
09/18/08 11:07:06	1759.4	62.21	29.7	59.0
09/18/08 11:09:06	1760.0	62.21	29.7	59.0
09/18/08 11:11:06	1760.4	62.26	29.7	59.0
09/18/08 11:13:06	1760.2	62.26	29.7	59.0
09/18/08 11:15:06	1761.5	62.27	29.7	59.0
09/18/08 11:17:06	1761.6	62.27	29.7	59.0
09/18/08 11:19:06	1761.2	62.27	29.7	59.0
09/18/08 11:21:06	1762.1	62.29	29.7	59.0
09/18/08 11:23:06	1762.1	62.33	29.7	59.0
09/18/08 11:25:06	1762.5	62.35	29.7	59.0
09/18/08 11:27:06	1763.3	62.39	29.7	59.0
09/18/08 11:29:06	1763.4	62.37	29.7	59.0
09/18/08 11:31:06	1764.1	62.38	29.7	59.0
09/18/08 11:33:06	1764.4	62.41	29.7	59.0
09/18/08 11:35:06	1763.9	62.42	29.7	59.0
09/18/08 11:37:06	1764.4	62.47	29.7	59.0
09/18/08 11:39:06	1763.9	62.5	29.7	61.0
09/18/08 11:41:06	1764.6	62.51	29.7	61.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 11:43:06	1764.7	62.56	29.7	61.0
09/18/08 11:45:06	1765.2	62.6	29.7	61.0
09/18/08 11:47:06	1764.6	62.61	29.7	63.0
09/18/08 11:49:06	1764.4	62.65	29.7	63.0
09/18/08 11:51:06	1764.7	62.66	29.7	64.0
09/18/08 11:53:06	1764.6	62.69	29.7	64.0
09/18/08 11:55:06	1764.7	62.68	29.8	64.0
09/18/08 11:57:06	1763.6	62.75	29.8	66.0
09/18/08 11:59:06	1763.3	62.78	29.8	68.0
09/18/08 12:01:06	1763.6	62.89	29.8	68.0
09/18/08 12:03:06	1761.8	62.98	29.8	70.0
09/18/08 12:05:06	1763.9	63.01	29.8	68.0
09/18/08 12:07:06	1765.2	63.01	29.8	68.0
09/18/08 12:09:06	1766.9	62.97	29.8	66.0
09/18/08 12:11:06	1767.5	62.92	29.8	66.0
09/18/08 12:13:06	1768.4	62.9	29.8	64.0
09/18/08 12:15:06	1768.1	62.89	29.8	64.0
09/18/08 12:17:06	1768.5	62.93	29.8	64.0
09/18/08 12:19:06	1769.9	62.95	29.8	63.0
09/18/08 12:21:06	1771.3	62.91	29.8	63.0
09/18/08 12:23:06	1772.9	62.91	29.7	63.0
09/18/08 12:25:06	1772.0	62.89	29.7	63.0
09/18/08 12:27:06	1772.0	62.91	29.7	63.0
09/18/08 12:29:06	1771.7	62.9	29.7	63.0
09/18/08 12:31:06	1772.6	62.93	29.7	63.0
09/18/08 12:33:06	1773.1	62.92	29.7	61.0
09/18/08 12:35:06	1773.8	62.96	29.7	61.0
09/18/08 12:37:06	1774.0	62.96	29.7	61.0
09/18/08 12:39:06	1774.5	63.0	29.7	61.0
09/18/08 12:41:06	1775.0	63.0	29.7	61.0
09/18/08 12:43:06	1776.1	63.01	29.7	61.0
09/18/08 12:45:06	1775.9	63.03	29.7	61.0
09/18/08 12:47:06	1776.4	63.07	29.7	61.0
09/18/08 12:49:06	1776.6	63.08	29.7	61.0
09/18/08 12:51:06	1776.9	63.08	29.7	61.0
09/18/08 12:53:06	1777.1	63.12	29.7	61.0
09/18/08 12:55:06	1778.0	63.14	29.7	61.0
09/18/08 12:57:06	1777.6	63.16	29.7	61.0
09/18/08 12:59:06	1778.3	63.16	29.7	61.0
09/18/08 13:01:06	1778.5	63.19	29.7	61.0
09/18/08 13:03:06	1778.8	63.21	29.7	61.0
09/18/08 13:05:06	1779.9	63.25	29.7	61.0
09/18/08 13:07:06	1780.4	63.27	29.7	61.0
09/18/08 13:09:06	1780.0	63.25	29.7	61.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 13:11:06	1780.7	63.28	29.7	61.0
09/18/08 13:13:06	1781.5	63.26	29.7	61.0
09/18/08 13:15:06	1781.8	63.32	29.7	61.0
09/18/08 13:17:06	1781.8	63.34	29.7	61.0
09/18/08 13:19:06	1782.0	63.36	29.7	61.0
09/18/08 13:21:06	1782.2	63.36	29.7	61.0
09/18/08 13:23:06	1782.5	63.38	29.7	61.0
09/18/08 13:25:06	1783.1	63.41	29.7	61.0
09/18/08 13:27:06	1784.0	63.43	29.7	61.0
09/18/08 13:29:06	1783.9	63.43	29.7	61.0
09/18/08 13:31:06	1784.2	63.45	29.7	61.0
09/18/08 13:33:06	1784.4	63.47	29.7	61.0
09/18/08 13:35:06	1784.8	63.51	29.7	61.0
09/18/08 13:37:06	1785.5	63.52	29.7	61.0
09/18/08 13:39:06	1785.7	63.54	29.7	61.0
09/18/08 13:41:06	1786.2	63.55	29.7	61.0
09/18/08 13:43:06	1786.6	63.59	29.7	61.0
09/18/08 13:45:06	1786.8	63.56	29.7	61.0
09/18/08 13:47:06	1787.5	63.59	29.7	61.0
09/18/08 13:49:06	1788.2	63.58	29.7	61.0
09/18/08 13:51:06	1788.3	63.62	29.7	61.0
09/18/08 13:53:06	1788.8	63.66	29.7	61.0
09/18/08 13:55:06	1789.3	63.67	29.7	61.0
09/18/08 13:57:06	1789.3	63.67	29.7	61.0
09/18/08 13:59:06	1790.0	63.69	29.7	61.0
09/18/08 14:01:06	1790.3	63.7	29.7	61.0
09/18/08 14:03:06	1790.7	63.77	29.7	61.0
09/18/08 14:05:06	1790.6	63.79	29.7	61.0
09/18/08 14:07:06	1791.3	63.81	29.7	61.0
09/18/08 14:09:06	1791.8	63.83	29.7	61.0
09/18/08 14:11:06	1792.1	63.87	29.7	61.0
09/18/08 14:13:06	1792.4	63.86	29.7	61.0
09/18/08 14:15:06	1793.0	63.88	29.7	61.0
09/18/08 14:17:06	1793.2	63.91	29.7	61.0
09/18/08 14:19:06	1793.6	63.93	29.7	61.0
09/18/08 14:21:06	1794.1	63.91	29.7	61.0
09/18/08 14:23:06	1794.5	63.85	29.7	61.0
09/18/08 14:25:06	1794.7	63.9	29.7	61.0
09/18/08 14:27:06	1795.2	63.95	29.7	61.0
09/18/08 14:29:06	1796.1	63.98	29.7	61.0
09/18/08 14:31:06	1796.1	64.03	29.7	61.0
09/18/08 14:33:06	1796.3	64.02	29.7	61.0
09/18/08 14:35:06	1796.6	64.02	29.7	61.0
09/18/08 14:37:06	1797.0	64.06	29.7	61.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 14:39:06	1797.5	64.1	29.7	61.0
09/18/08 14:41:06	1798.1	64.12	29.7	61.0
09/18/08 14:43:06	1798.5	64.11	29.7	61.0
09/18/08 14:45:06	1798.7	64.16	29.7	61.0
09/18/08 14:47:06	1799.5	64.18	29.7	61.0
09/18/08 14:49:06	1799.9	64.21	29.7	61.0
09/18/08 14:51:06	1800.3	64.19	29.7	61.0
09/18/08 14:53:06	1800.7	64.25	29.7	61.0
09/18/08 14:55:06	1801.0	64.26	29.7	61.0
09/18/08 14:57:06	1801.3	64.28	29.7	61.0
09/18/08 14:59:06	1800.7	64.35	29.7	63.0
09/18/08 15:01:06	1801.0	64.33	29.7	63.0
09/18/08 15:03:07	1766.6	64.29	29.7	63.0
09/18/08 15:04:35	1727.7	64.42	29.7	63.0
09/18/08 15:04:50	1716.0	64.41	29.7	63.0
09/18/08 15:05:05	1709.3	64.4	29.7	63.0
09/18/08 15:05:20	1701.1	64.4	29.7	63.0
09/18/08 15:05:35	1694.3	64.38	29.7	63.0
09/18/08 15:05:50	1685.0	64.43	29.7	63.0
09/18/08 15:06:05	1679.3	64.39	29.7	63.0
09/18/08 15:06:20	1673.3	64.47	29.7	63.0
09/18/08 15:06:35	1667.1	64.45	29.7	63.0
09/18/08 15:06:50	1660.5	64.47	29.7	63.0
09/18/08 15:07:05	1653.7	64.46	29.7	63.0
09/18/08 15:07:20	1646.6	64.47	29.7	63.0
09/18/08 15:07:35	1639.7	64.49	29.7	63.0
09/18/08 15:07:50	1611.3	64.49	29.7	63.0
09/18/08 15:08:05	1605.4	64.49	29.7	63.0
09/18/08 15:08:20	1596.0	64.48	29.7	63.0
09/18/08 15:08:35	1578.1	64.48	29.7	63.0
09/18/08 15:08:50	1561.2	64.47	29.7	63.0
09/18/08 15:09:05	1551.7	64.51	29.7	63.0
09/18/08 15:09:20	1531.5	64.49	29.7	63.0
09/18/08 15:09:35	1522.1	64.51	29.7	63.0
09/18/08 15:09:50	1511.6	64.53	29.7	63.0
09/18/08 15:10:05	1500.2	64.52	29.7	63.0
09/18/08 15:10:20	1488.6	64.5	29.7	63.0
09/18/08 15:10:35	1478.1	64.5	29.7	63.0
09/18/08 15:10:50	1466.0	64.54	29.7	63.0
09/18/08 15:11:05	1455.4	64.52	29.7	63.0
09/18/08 15:11:20	1444.4	64.54	29.7	63.0
09/18/08 15:11:35	1433.9	64.56	29.7	63.0
09/18/08 15:11:50	1422.7	64.56	29.7	63.0
09/18/08 15:12:05	1411.5	64.55	29.7	63.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 15:12:20	1401.4	64.58	29.7	63.0
09/18/08 15:12:35	1390.1	64.55	29.7	63.0
09/18/08 15:12:50	1379.8	64.58	29.7	63.0
09/18/08 15:13:05	1369.1	64.58	29.7	63.0
09/18/08 15:13:20	1358.7	64.55	29.7	63.0
09/18/08 15:13:35	1347.9	64.61	29.7	63.0
09/18/08 15:13:50	1336.7	64.6	29.7	63.0
09/18/08 15:14:05	1326.7	64.6	29.7	63.0
09/18/08 15:14:20	1316.0	64.62	29.7	63.0
09/18/08 15:14:35	1305.9	64.6	29.7	63.0
09/18/08 15:14:50	1295.7	64.59	29.7	63.0
09/18/08 15:15:05	1285.3	64.63	29.7	63.0
09/18/08 15:15:20	1274.5	64.63	29.7	63.0
09/18/08 15:15:35	1260.2	64.61	29.7	63.0
09/18/08 15:15:50	1250.0	64.62	29.7	63.0
09/18/08 15:16:05	1239.8	64.64	29.7	63.0
09/18/08 15:16:20	1228.9	64.64	29.7	63.0
09/18/08 15:16:35	1218.2	64.65	29.7	63.0
09/18/08 15:16:50	1208.4	64.63	29.7	63.0
09/18/08 15:17:05	1197.4	64.65	29.7	63.0
09/18/08 15:17:20	1187.2	64.65	29.7	63.0
09/18/08 15:17:35	1177.1	64.6	29.7	63.0
09/18/08 15:17:50	1166.6	64.65	29.7	63.0
09/18/08 15:18:05	1156.2	64.64	29.7	63.0
09/18/08 15:18:20	1145.7	64.66	29.7	63.0
09/18/08 15:18:35	1135.6	64.67	29.7	63.0
09/18/08 15:18:50	1125.9	64.65	29.7	63.0
09/18/08 15:19:05	1121.9	64.66	29.7	63.0
09/18/08 15:19:20	1112.7	64.66	29.7	63.0
09/18/08 15:19:35	1103.3	64.64	29.7	63.0
09/18/08 15:19:50	1094.2	64.66	29.7	63.0
09/18/08 15:20:05	1085.1	64.66	29.7	63.0
09/18/08 15:20:20	1076.1	64.64	29.7	63.0
09/18/08 15:20:35	1066.5	64.65	29.7	63.0
09/18/08 15:20:50	1058.2	64.66	29.7	63.0
09/18/08 15:21:05	1033.0	64.68	29.7	63.0
09/18/08 15:21:20	1021.1	64.67	29.7	63.0
09/18/08 15:21:35	1011.2	64.65	29.7	63.0
09/18/08 15:21:50	1000.3	64.68	29.7	63.0
09/18/08 15:22:05	987.1	64.67	29.7	63.0
09/18/08 15:22:20	976.7	64.67	29.7	63.0
09/18/08 15:22:35	966.1	64.67	29.7	63.0
09/18/08 15:22:50	955.3	64.67	29.7	63.0
09/18/08 15:23:05	944.9	64.67	29.7	63.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 15:23:20	934.6	64.68	29.7	63.0
09/18/08 15:23:35	924.2	64.63	29.7	63.0
09/18/08 15:23:50	913.7	64.65	29.7	63.0
09/18/08 15:24:05	903.5	64.66	29.7	63.0
09/18/08 15:24:20	893.1	64.67	29.7	63.0
09/18/08 15:24:35	882.6	64.71	29.7	63.0
09/18/08 15:24:50	919.1	64.69	29.7	63.0
09/18/08 15:25:05	918.6	64.68	29.7	63.0
09/18/08 15:25:20	908.5	64.65	29.7	63.0
09/18/08 15:25:35	894.4	64.68	29.7	63.0
09/18/08 15:25:50	883.3	64.67	29.7	63.0
09/18/08 15:26:05	876.4	64.71	29.7	63.0
09/18/08 15:26:20	869.0	64.7	29.7	63.0
09/18/08 15:26:35	858.2	64.69	29.7	63.0
09/18/08 15:26:50	874.6	64.7	29.7	63.0
09/18/08 15:27:05	874.7	64.69	29.7	63.0
09/18/08 15:27:20	874.6	64.7	29.7	63.0
09/18/08 15:27:35	874.9	64.68	29.7	63.0
09/18/08 15:27:50	874.7	64.67	29.7	63.0
09/18/08 15:28:05	874.5	64.68	29.7	63.0
09/18/08 15:28:20	874.8	64.68	29.7	63.0
09/18/08 15:28:35	874.6	64.63	29.7	63.0
09/18/08 15:28:50	874.5	64.66	29.7	63.0
09/18/08 15:29:05	874.3	64.66	29.7	63.0
09/18/08 15:29:20	874.9	64.66	29.7	63.0
09/18/08 15:29:35	874.5	64.67	29.7	63.0
09/18/08 15:29:50	875.0	64.67	29.7	63.0
09/18/08 15:30:05	874.5	64.66	29.7	63.0
09/18/08 15:30:20	874.7	64.65	29.7	63.0
09/18/08 15:30:35	875.1	64.62	29.7	63.0
09/18/08 15:30:50	875.2	64.63	29.7	63.0
09/18/08 15:31:05	875.4	64.63	29.7	63.0
09/18/08 15:31:20	875.1	64.65	29.7	63.0
09/18/08 15:31:35	875.4	64.63	29.7	63.0
09/18/08 15:31:50	875.7	64.66	29.7	63.0
09/18/08 15:32:05	875.9	64.63	29.7	63.0
09/18/08 15:32:20	875.7	64.6	29.7	63.0
09/18/08 15:32:35	875.3	64.66	29.7	63.0
09/18/08 15:32:50	875.7	64.64	29.7	63.0
09/18/08 15:33:05	875.9	64.65	29.7	63.0
09/18/08 15:33:20	875.8	64.65	29.7	63.0
09/18/08 15:33:35	876.0	64.65	29.7	63.0
09/18/08 15:33:50	876.0	64.64	29.7	63.0
09/18/08 15:34:05	876.0	64.63	29.7	63.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 15:34:20	876.0	64.66	29.7	63.0
09/18/08 15:34:35	876.2	64.64	29.7	63.0
09/18/08 15:34:50	876.0	64.64	29.7	63.0
09/18/08 15:35:05	876.0	64.64	29.7	63.0
09/18/08 15:35:20	876.1	64.66	29.7	63.0
09/18/08 15:35:35	876.6	64.63	29.7	63.0
09/18/08 15:35:50	876.2	64.64	29.7	63.0
09/18/08 15:36:05	876.5	64.64	29.7	63.0
09/18/08 15:36:20	876.1	64.64	29.7	63.0
09/18/08 15:36:35	876.6	64.61	29.7	63.0
09/18/08 15:36:50	876.8	64.64	29.7	63.0
09/18/08 15:37:05	876.9	64.62	29.7	63.0
09/18/08 15:37:20	876.6	64.65	29.7	63.0
09/18/08 15:37:35	876.8	64.62	29.7	63.0
09/18/08 15:37:50	876.6	64.63	29.7	63.0
09/18/08 15:38:05	877.0	64.63	29.7	63.0
09/18/08 15:38:20	876.9	64.62	29.7	63.0
09/18/08 15:38:35	877.0	64.62	29.7	63.0
09/18/08 15:38:50	877.2	64.63	29.7	63.0
09/18/08 15:39:05	877.4	64.64	29.7	63.0
09/18/08 15:39:20	877.1	64.61	29.7	63.0
09/18/08 15:39:35	877.0	64.64	29.7	63.0
09/18/08 15:39:50	877.3	64.61	29.7	63.0
09/18/08 15:40:05	877.6	64.65	29.7	63.0
09/18/08 15:40:20	877.3	64.65	29.7	63.0
09/18/08 15:40:35	877.4	64.62	29.7	63.0
09/18/08 15:40:50	877.5	64.61	29.7	63.0
09/18/08 15:41:05	877.5	64.65	29.7	63.0
09/18/08 15:41:20	877.3	64.64	29.7	63.0
09/18/08 15:41:35	878.0	64.64	29.7	63.0
09/18/08 15:41:50	877.7	64.64	29.7	63.0
09/18/08 15:42:05	877.6	64.65	29.7	63.0
09/18/08 15:42:20	878.0	64.65	29.7	63.0
09/18/08 15:42:35	878.1	64.64	29.7	63.0
09/18/08 15:42:50	877.8	64.65	29.7	63.0
09/18/08 15:43:05	877.9	64.66	29.7	63.0
09/18/08 15:43:20	878.4	64.64	29.7	63.0
09/18/08 15:43:35	878.1	64.64	29.7	63.0
09/18/08 15:43:50	878.2	64.65	29.7	63.0
09/18/08 15:44:05	878.3	64.65	29.7	63.0
09/18/08 15:44:20	878.4	64.65	29.7	63.0
09/18/08 15:44:35	878.3	64.65	29.7	63.0
09/18/08 15:44:50	878.4	64.64	29.7	63.0
09/18/08 15:45:05	859.6	64.66	29.7	63.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 15:45:20	815.7	64.65	29.7	63.0
09/18/08 15:45:35	804.5	64.67	29.7	63.0
09/18/08 15:45:50	794.1	64.65	29.7	63.0
09/18/08 15:46:05	782.8	64.67	29.7	63.0
09/18/08 15:46:20	772.1	64.66	29.7	63.0
09/18/08 15:46:35	761.3	64.67	29.7	63.0
09/18/08 15:46:50	750.8	64.67	29.7	63.0
09/18/08 15:47:05	740.2	64.67	29.7	63.0
09/18/08 15:47:20	730.0	64.69	29.7	63.0
09/18/08 15:47:35	719.7	64.68	29.7	63.0
09/18/08 15:47:50	708.6	64.7	29.7	63.0
09/18/08 15:48:05	698.4	64.67	29.7	63.0
09/18/08 15:48:20	687.8	64.69	29.7	63.0
09/18/08 15:48:35	677.6	64.68	29.7	63.0
09/18/08 15:48:50	667.7	64.71	29.7	63.0
09/18/08 15:49:05	657.9	64.72	29.7	63.0
09/18/08 15:49:20	647.4	64.72	29.7	63.0
09/18/08 15:49:35	638.2	64.73	29.7	63.0
09/18/08 15:49:50	628.1	64.69	29.7	63.0
09/18/08 15:50:05	618.5	64.73	29.7	63.0
09/18/08 15:50:20	609.1	64.71	29.7	63.0
09/18/08 15:50:35	599.3	64.72	29.7	63.0
09/18/08 15:50:50	589.9	64.72	29.7	63.0
09/18/08 15:51:05	580.4	64.75	29.7	63.0
09/18/08 15:51:20	570.8	64.72	29.7	63.0
09/18/08 15:51:35	561.7	64.76	29.7	63.0
09/18/08 15:51:50	552.8	64.73	29.7	63.0
09/18/08 15:52:05	543.5	64.75	29.7	63.0
09/18/08 15:52:20	534.5	64.75	29.7	63.0
09/18/08 15:52:35	525.6	64.74	29.7	63.0
09/18/08 15:52:50	516.8	64.76	29.7	63.0
09/18/08 15:53:05	508.1	64.76	29.7	63.0
09/18/08 15:53:20	499.14	64.75	29.7	63.0
09/18/08 15:53:35	490.44	64.76	29.7	63.0
09/18/08 15:53:50	482.13	64.78	29.7	63.0
09/18/08 15:54:05	474.04	64.79	29.7	63.0
09/18/08 15:54:20	465.52	64.75	29.7	63.0
09/18/08 15:54:35	457.01	64.78	29.7	63.0
09/18/08 15:54:50	448.67	64.75	29.7	63.0
09/18/08 15:55:05	440.92	64.78	29.7	63.0
09/18/08 15:55:20	432.6	64.76	29.7	63.0
09/18/08 15:55:35	424.52	64.79	29.7	63.0
09/18/08 15:55:50	416.52	64.79	29.7	63.0
09/18/08 15:56:05	394.64	64.81	29.7	63.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 15:56:20	432.58	64.8	29.7	63.0
09/18/08 15:56:35	432.4	64.77	29.7	63.0
09/18/08 15:56:50	432.31	64.77	29.7	63.0
09/18/08 15:57:05	432.51	64.79	29.7	63.0
09/18/08 15:57:20	432.6	64.79	29.7	63.0
09/18/08 15:57:35	432.29	64.81	29.7	63.0
09/18/08 15:57:50	432.54	64.77	29.7	63.0
09/18/08 15:58:05	432.65	64.8	29.7	63.0
09/18/08 15:58:20	432.42	64.78	29.7	63.0
09/18/08 15:58:35	432.2	64.8	29.7	63.0
09/18/08 15:58:50	432.32	64.81	29.7	63.0
09/18/08 15:59:05	432.42	64.78	29.7	63.0
09/18/08 15:59:20	432.55	64.78	29.7	63.0
09/18/08 15:59:35	432.68	64.79	29.7	63.0
09/18/08 15:59:50	432.56	64.77	29.7	63.0
09/18/08 16:00:05	432.41	64.77	29.7	63.0
09/18/08 16:00:20	432.25	64.78	29.7	63.0
09/18/08 16:00:35	432.63	64.79	29.7	63.0
09/18/08 16:00:50	432.55	64.78	29.7	63.0
09/18/08 16:01:05	431.98	64.78	29.7	63.0
09/18/08 16:01:20	432.15	64.77	29.7	63.0
09/18/08 16:01:35	432.47	64.79	29.7	63.0
09/18/08 16:01:50	432.28	64.76	29.7	63.0
09/18/08 16:02:05	432.46	64.76	29.7	63.0
09/18/08 16:02:20	432.25	64.77	29.7	63.0
09/18/08 16:02:35	432.74	64.76	29.7	63.0
09/18/08 16:02:50	432.31	64.77	29.7	63.0
09/18/08 16:03:05	431.95	64.75	29.7	63.0
09/18/08 16:03:20	432.56	64.78	29.7	63.0
09/18/08 16:03:35	432.44	64.76	29.7	63.0
09/18/08 16:03:50	432.52	64.76	29.7	63.0
09/18/08 16:04:05	432.11	64.76	29.7	63.0
09/18/08 16:04:20	432.17	64.75	29.7	63.0
09/18/08 16:04:35	432.34	64.76	29.7	63.0
09/18/08 16:04:50	432.27	64.75	29.7	63.0
09/18/08 16:05:05	432.44	64.76	29.7	63.0
09/18/08 16:05:20	432.2	64.75	29.7	63.0
09/18/08 16:05:35	432.3	64.76	29.7	63.0
09/18/08 16:05:52	432.15	64.75	29.7	63.0
09/18/08 16:06:09	432.44	64.75	29.7	63.0
09/18/08 16:06:26	432.48	64.75	29.7	63.0
09/18/08 16:06:43	432.43	64.75	29.7	63.0
09/18/08 16:07:00	432.31	64.76	29.7	63.0
09/18/08 16:07:17	432.41	64.76	29.7	63.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 16:07:34	432.11	64.75	29.7	63.0
09/18/08 16:07:51	432.49	64.76	29.7	63.0
09/18/08 16:08:08	432.55	64.74	29.7	63.0
09/18/08 16:08:25	432.33	64.74	29.7	63.0
09/18/08 16:08:42	432.43	64.76	29.7	63.0
09/18/08 16:08:59	432.29	64.75	29.7	63.0
09/18/08 16:09:16	432.03	64.77	29.7	63.0
09/18/08 16:09:33	432.72	64.75	29.7	63.0
09/18/08 16:09:50	432.6	64.77	29.7	63.0
09/18/08 16:10:07	432.32	64.78	29.7	63.0
09/18/08 16:10:24	432.28	64.76	29.7	63.0
09/18/08 16:10:41	431.78	64.77	29.7	63.0
09/18/08 16:10:58	432.67	64.76	29.7	63.0
09/18/08 16:11:15	432.06	64.77	29.7	63.0
09/18/08 16:11:32	0.0	64.78	29.7	63.0
09/18/08 16:11:49	0.0	64.73	29.7	63.0
09/18/08 16:12:06	0.0	64.71	29.7	63.0
09/18/08 16:12:23	0.0	64.71	29.7	63.0
09/18/08 16:12:40	0.0	64.71	29.7	63.0
09/18/08 16:12:57	0.0	64.73	29.7	63.0
09/18/08 16:13:14	0.0	64.75	29.7	63.0
09/18/08 16:13:31	0.0	64.74	29.7	63.0
09/18/08 16:13:48	0.0	64.74	29.7	63.0
09/18/08 16:14:05	0.0	64.76	29.7	63.0
09/18/08 16:14:22	0.0	64.79	29.7	63.0
09/18/08 16:14:39	0.0	64.82	29.7	63.0
09/18/08 16:14:56	0.0	64.83	29.7	63.0
09/18/08 16:15:13	0.0	64.84	29.7	63.0
09/18/08 16:15:30	0.0	64.85	29.7	63.0
09/18/08 16:15:47	0.0	64.86	29.7	63.0
09/18/08 16:16:04	0.0	64.86	29.7	63.0
09/18/08 16:16:21	0.0	64.87	29.7	63.0
09/18/08 16:16:38	0.0	64.78	29.7	63.0
09/18/08 16:16:55	0.0	64.87	29.7	63.0
09/18/08 16:17:12	0.0	64.9	29.7	63.0
09/18/08 16:17:29	0.0	64.9	29.7	63.0
09/18/08 16:17:46	0.0	64.9	29.7	63.0
09/18/08 16:18:03	0.0	64.89	29.7	63.0
09/18/08 16:18:20	0.0	64.89	29.7	63.0
09/18/08 16:18:37	0.0	64.9	29.7	63.0
09/18/08 16:18:54	0.0	64.91	29.7	63.0
09/18/08 16:19:11	0.0	64.88	29.7	63.0
09/18/08 16:19:28	0.0	64.88	29.7	63.0
09/18/08 16:19:45	0.0	64.87	29.7	63.0

Date/Time	Pressure (PSIG)	Temperature (°F)	Baro (IN HG)	Ambient Temp. (F)
09/18/08 16:20:02	0.0	64.89	29.7	63.0
09/18/08 16:20:19	0.0	64.91	29.7	63.0
09/18/08 16:20:36	0.0	-999.0	29.7	63.0

Gail M Follis/LPL
08/12/2008 04:15 PM

To Vince P Kolbuck/LPL@LPL
cc Bill Burdeau/US/Enbridge@LPL, Mick J Collier/LPL@LPL
bcc
Subject Re: Request Hydrotest Number - 30" Emergency Pipe Stock

test number 999-08-803

Gail Follis
Technical Records Coordinator
Engineering Services
Enbridge Energy
Office (715) 398-4561
Fax (713) 821-9917
Cellular (218) 391-1052
e-mail: Gail.Follis@enbridge.com
Vince P Kolbuck/LPL

Vince P Kolbuck/LPL
07/02/2008 10:53 AM

To Gail M Follis/LPL@LPL
cc Mick J Collier/LPL@LPL, Bill Burdeau/US/Enbridge@LPL
Subject Request Hydrotest Number - 30" Emergency Pipe Stock

Gail,

We have purchased three (3) 40' sections of 30" diameter 0.375" wt ERW longseam API-5L-X70 Line pipe to be used for emergency pipe. The pipe was purchased under Enbridge purchase order P91002-13363-07 dated February 12, 2008.

MAP Mechanical Contractors will be responsible for all aspects of the pressure test.

We will test the pipe to 100% SMYS per book 3 requirements. The **Target Test Pressure is 1750 psi**. The strength test duration will be four hours. **Note:** This time does not include stabilization time and times to ramp the test up and down . The test pressure will be raised to 25% of target and held for 15 minutes, then raised again to 50% of target and held for 15 minutes and finally the pressure will be raised to target pressure and let stabilize before starting the test. Water will be bled from or added to the system in measured amounts to achieve +/- 5% of the target test pressure.

MAP will provide Deadweight, Pressure Recorder, Pressure Gage and Temperature recorder certifications prior to commencing the pressure test. All location information, weather conditions etc. will be documented and attached to the pressure log. NOTE: A digital deadweight will be used which is acceptable practice.

The hydrotest number you assign for this work will be marked on the actual test pressure chart.

Following the test we will submit an as-built drawing showing stationing, weld locations, weld test results, material properties (MTR's) for each pipe joint and the associated pressure test chart and data sheets from the hydrotest. Attached is my worksheet showing all values and calculations. Thanks for your prompt and continued support.

Hydrotest Calculations - 30 Inch Emergency Pipe Grade X70.xls

Vince Kolbuck
Supervisor, Regional Engineering
Enbridge (U.S.) Inc.
1500 West Main St, Griffith, IN, 46319
Office Phone: (219) 922-7004
Office Fax: (219) 922-3128
e-mail: vince.kolbuck@enbridge.com

Hydrotest Pressures

Fresh Water

Date ....July 2, 2008...:
Station (if applicable) ...30" Emergency Pipe...:
Line Number ....:
From Mile Post ....:
To Mile Post ....:
Hydrotest Number ....:

Note: Fill in all black text fields. If second, third & fourth pipe data is not needed, copy same data used for the first pipe. **Exception:** Elevation data is required only when elevation changes are encountered.

Black = Information Entry Required
Blue indicates formulas are present - Do Not Enter Information

Enter Information

	First Pipe	Second Pipe	Third Pipe	Fourth Pipe	
Specified Minimum Yield Strength (SMYS)	70000	70000	70000	70000	PSI
Outside Diameter	30	30	30	30	In.
Nominal Wall Thickness	0.375	0.375	0.375	0.375	In.
Weld Joint Factor	1.00	1.00	1.00	1.00	
Design Safety Factor	60%	60%	60%	60%	%
System ANSI Pressure Rating (flanges, valves)........................	3000	3000	3000	3000	PSI
Hydrotest Pressure to Desired % of SMYS	100%	100%	100%	100%	
Test Point Elevation	685	....			Ft.
High Point Elevation	685	....			Ft.
Low Point Elevation	685	....			Ft.

Formula Calculations - Do Not Enter Information

Pipe (only) Design Pressure- (X Safety Factor)	=	1050	1050	1050	1050	PSI
Pipe Allowable Hydrotest Pressure - (maximum)	=	1750	1750	1750	1750	PSI
ANSI Allowable Hydrotest Pressure - (flanges, valves)	=	4500	4500	4500	4500	PSI
Hydrotest Pressure at Desired % SMYS or Actual Test PSI	=	1750	1750	1750	1750	PSI
Component MAOP Lowest value - ANSI rating PSI, pipe design PSI, 80% hydrotest PSI	=	1050	1050	1050	1050	PSI

Pressure Data

				ANSI % SMYS	Pipe % SMYS
Hydrotest Pressure - (strength test maximum)	=	1750	PSI		
Hydrotest Pressure - (leak test minimum)	=	1155	PSI		
System MAOP (by design) Lowest value - 80% hydro, allowable operating PSI, ANSI rating	=	1050	PSI		
Test Point Pressure	=	1750	PSI	39%	100%
High Point Pressure	=	1750	PSI	39%	100%
Low Point Pressure	=	1750	PSI	39%	100%

Enter actual test PSI here if .... [ ] different from calculated PSI at left

ENBRIDGE™

HYDROSTATIC (PRESSURE) TEST RECORD REQUIREMENT CHECKLIST

In compliance with 49 CFR 192.517 and 195.310 and the Enbridge O&MP Manual Book 3, Tab 7 "Pressure Testing," the following documentation is required for each pressure test, and shall be maintained as a permanent record for the life of the facility:

✓ Enbridge Hydrostatic Pressure Test Report Form
✓ Enbridge Hydrostatic Test Data Sheet
✓ Pressure and Temperature Recording Chart(s)
✓ Explanation of any pressure discontinuities, including test failures that appear on the chart
✓ Test Instrument Calibration Data

- Ensure that the following calibration intervals and accuracy requirements are met:

Instrument	Calibration Intervals	Accuracy	
Deadweight Tester *	12 Months	0.1% Indicated Pressure	6-20-08
Pressure Gauge	12 Months	± 0.5% Full Scale Reading	7-7-08
Pressure Recorder	12 Months	± 1% Full Scale Reading	7-11-08
Temperature Recorder	12 Months	± 2% Full Scale Reading	7-11-08
Liquid-In-Glass Thermometer (if used)	Lifetime	± 1% Full Scale Reading	
All Other Test Instruments (e.g. Flow Meter)	12 Months	± 1% Full Scale Reading	
*Deadweight Tester must be calibrated by a certified technician external to the company.			

✓ Names of:
  ✓ Operator
  ✓ Person responsible for making test (Enbridge Personnel)
  ✓ Test Company used
✓ Date and Time of Test 9-18-08
✓ Minimum Test Pressure 1755psi
✓ Test Medium WATER
✓ Temperature
✓ Description of Facility Tested and Test Apparatus:
  ✓ Test Summary with weather conditions, test narrative, problems
  ✓ Test Section Drawing with following information:
  - Type, grade, size, and rating of pipe, fittings, and valves
  - Where system will be isolated or blind flanged

N/A Profile of Pipeline with test sites shown if elevation change is greater than 100'
NONE Summary of Failures and Causes encountered during testing (if not in narrative)

Test Number 999-08-803
AFE

Description STOCK PIPE - GRIFFITH REG. - 3EA 40'x30 X70, 0.375 W.T. PIPE

Project Manager / Designate

Technical Records Coordinator / Designate

6/14/07

cmf

30" CHICAGO REGION EMERGENCY PIPE
TEST # 999-08-803

検査証明書
INSPECTION CERTIFICATE

JFE スチール株式会社
東日本製鉄所(千葉)
JFE Steel Corporation
East Japan Works(Chiba)
〒260-0835 千葉市中央区川崎町1番地
1, KAWASAKI-CHO, CHUO-KU, CHIBA, JAPAN

注文番号 ORDER No :7A90692-002 (FJ2FJ218958)
注文者 SHIPPER :JFE SHOJI TRADE CORPORATION
日付 DATE :2007-10-03
需要家 CUSTOMER :EDGEN CARBON PRODUCTS GROUP, L.L.C.
品名 COMMODITY :SAW STEEL PIPE
規格 SPECIFICATION :API 5L GRADE X70 PSL2 43 EDITION MARCH 2004
寸法 SIZE :OD30"X0.375"X40'
数量 QUANTITY: 100 PIECES 4,000.0 FEET 215,500KG

証明書番号 CERTIFICATION No :7X0302
船番 SHIP No
工事番号 CONSTRUCTION No :
需要家管理番号 CUSTOMER'S CONTROL No :PO NO.64053
物件名 PROJECT NAME

製鋼番号 HEAT No	試験パイプ番号 TEST PIPE No (連続番号 SEQUENCE No)	LOT No		引張試験 TENSILE TEST 耐力 YIELD STRENGTH KSI	引張強さ TENSILE STRENGTH KSI	伸び% ELONGATION GL 2"	降伏比 YIELD RATIO %	曲げ試験 GUIDED BEND TEST F	R	衝撃試験 IMPACT TEST	FT-LBS				落重試験 DROP WEIGHT TEAR TEST S.A.(%) EACH	AVE.	HARDNESS HV(10) B W H
			BT	70.0-90.0	82.0-110.0	21.0 W=1.5" MIN.	93 MAX.			1 BT +32°F 2V 10X10			EACH 15.0 MIN.	AVE. 20.0 MIN.	MIN.	MIN.	MAX.
			WT		82.0-110.0					2 BT -4°F 2V 10X10			EACH 23.0 MIN.	AVE. 30.0 MIN.			
51-2253	PKT56139 (77)		BT	81.7	98.1	28.3	83	G	G	1	97.4 85%	122.6 87%	122.6 87%	114.2 86%			B 217
			WT		96.5					2	99.8 78%	119.4 81%	101.0 78%	106.7 79%			W 213 H 237 F.G 11.3
51-2253	PKT56403 (60)																
51-1542	PKT57060 (23)																
51-1542	PKT57082 (35)		BT	85.4	101.7	23.4	84	G	G	1	99.8 78%	128.0 85%	108.5 80%	112.1 81%			B 229
			WT		94.7					2	106.4 80%	96.6 70%	93.3 69%	98.7 73%			W 213 H 239 F.G 11.0

化学成分 CHEMICAL COMPOSITION(%)
HA--HEAT 取鍋分析 *1..V +NB+TI
PA--PRODUCT 製品分析 PCM(X100)

	C (×100)	Si (×100)	Mn (×100)	P (×1000)	S (×1000)	Mo (×1000)	V (×1000)	Nb (×1000)	Al (×1000)	Ti (×1000)	*1 (×1000)	PCM (×1000)	Cu (×100)	Ni (×100)	Cr (×100)	B (×10000)	N	Ceq
HA	15 MA		200 MAX	25 MA	15 MA					60 MA	150 MAX	25 MAX		99 MA				43 MA
PA	15 MA		200 MAX	25 MA	15 MA					60 MA	150 MAX	25 MAX		99 MA				43 MA
HA	7	24	161	12	1	180	3	29	25	10	42	17	2	1	1	1		38
PA	6	24	161	13	2	181	4	29	24	11	44	16	2	1	2	1		37
HA	7	24	161	12	1	180	3	29	25	10	42	17	2	1	1	1		38
PA	6	24	161	12	2	180	4	29	23	11	44	16	2	1	2	1		37
HA	7	25	161	7	1	200	2	30	28	9	41	17	2	1	1	1		38
PA	7	25	158	8	2	191	3	27	29	10	40	17	2	1	1	1		38
HA	7	25	161	7	1	200	2	30	28	9	41	17	2	1	1	1		38
PA	7	24	159	8	2	191	3	28	27	10	41	17	2	1	1	1		38

IMPACT TEST WERE CONDUCTED BY USING SUB-SIZE SPECIMENS(10X6.7), AND THESE ABSORBED ENERGY WERE CONVERTED TO FULL-SIZE EQUIVALENT VALUES IN ACCORDANCE WITH API 5L PARA.9.10.4.

NDT REFERENCE STANDARD
UT(LONGI.):3.2MM AND 1.6MM DIA. DRILLED HOLE
RT:ISO WIRE TYPE PENETRAMETER

* DETAILS AS PER PACKING LIST *

MILL CERT API 5L-SR15. CER MAX.0.43% BASED ON SR18
STRAIGHTNESS AND ROUNDNESS AS PER API2B.
ALL STEEL MADE BY FINE GRAIN FULLY KILLED PRACTICE.
WE CONFIRM COMPLYING WITH NI CONTENT REQUIREMENT
(MAX.1.0%)WHICH ARE REQUIRED IN NACE MR0175.

水圧試験 HYDROSTATIC TEST	超音波探傷検査 ULTRASONIC INSPECTION	放射線検査 RADIOGRAPHIC INSPECTION	外観・寸法検査 VISUAL & DIMENSION INSPECTION
GOOD (1580 PSI 10 SEC.)	GOOD	GOOD	GOOD

上記鋼材は規定の検査を行ないこれに合格したことを証明する。
WE HEREBY CERTIFY THAT THE MATERIAL DESCRIBED HEREIN HAS BEEN SATISFACTORILY TESTED IN ACCORDANCE WITH THE SPECIFICATION.

A. Umetsu
東日本製鉄所 品質保証室
Quality Assurance Section
East Japan Works

Legislation

Canada
Canada Labour Code, Part II:
- Canadian Occupational Safety and Health (COSH) regulations

Provincial/territorial occupational health and safety regulations

United States
Occupational Safety and Health Administration (OSHA) regulations

State occupational health and safety regulations

Related Standards

Industry
USA — Code of Federal Regulations (CFR), Title 29 – Labor:
- Part 1910.26—Portable Metal Ladders
- Part 1910.27—Fixed Ladders
- Part 1926.1053—Ladders

Responsibilities

Workers
Workers have the right and responsibility to refuse any work where there are reasonable grounds to believe it is dangerous to the health and safety of themselves or any person on the worksite. In addition, workers are responsible to stop any work that they believe places workers in imminent danger.

Requirements

If a load is too heavy for one worker to lift, get help or use mechanical lifting equipment.

NOTE: For information on mechanical lifting, see *Tab 12 Material Handling*.

Follow the "eight commandments" of safe lifting:

1. *Plan your lift and test the load.* Before lifting, think about the item you are going to move and ask: "Can I do this alone?" "Is it too awkward for one person?" "Is the path clear?" Also, test the load to see approximately how heavy it is before lifting.

2. *Ask for help.* If the load is too heavy or awkward to lift, ask for assistance.

3. *Get a firm footing.* Keep your feet apart for a stable base and point your toes out.

4. *Bend your knees.* Do not bend at the waist. Keep the principles of leverage in mind at all times.

5. *Tighten your stomach muscles.* Use intra-abdominal pressure to support your spine when you lift, offsetting the force of the load. Train your muscles to work together.

6. *Lift with your legs.* Let your leg muscles do the work of lifting. Do not rely on your weaker back muscles.

7. *Keep the load close.* Do not hold the load away from your body. The closer it is to your spine, the less force it exerts on your back.

8. *Keep your back upright.* Whether lifting or putting down the load, do not add the weight of your body to the load. Avoid twisting.

Subject
Fatigue Management

Purpose

To reduce the effects of fatigue that may produce physical and mental decrements in alertness, vigilance, and decision-making that can increase the risk of human error and result in injuries.

Scope

This applies to field employees.

This does not apply to field office employees or employees traveling commercially (e.g. airlines). This does not supersede Commercial Vehicle Drivers Hours of Service Regulations.

Related Standards

Company
Book 2: Safety:
- 09-02-01 Drivers

Responsibilities

Supervisors or On-call management must approve any work activities including commuting more than 30 minutes that will result in exceeding a 16 hour work day. The decision making process will include considering all operational fatigue risk factors.

Requirements

16 Hour Work Day

Field employees shall not work more than 16 consecutive hours in a 24 hour day unless deemed an emergency by their immediate supervisor.

Responding to Emergencies

Field employees responding to an initial emergency (including callouts) are exempt to allow sufficient staffing to safely sustain an effective response. During this period supervisors will use sound judgment and maintain a watchful eye on the workers' behavior.

Operations Fatigue Risk Factors

Supervisor's/On-call Management's decision making process will be based on considering the following common operational fatigue risk factors:
- Extended Work (including Commuting to/from base/home)
- Equipment Operations (ie. Vehicles)
- Split-Shift Work Schedules
- Sleep Disruption
- Inadequate Exercise Opportunities

- Environmental Stressors (heat, humidity, cold, altitude, vibration, and noise)

Notification Process

In absence of direct supervision, employees must notify their supervisor at the 14th consecutive working hour on the status of their tasks.

Safe Work Permit – Hazard Assessment

Purpose

To ensure compliance with legislative requirements and to protect the health and safety of workers by reducing illnesses and injuries in the workplace.

Scope

This applies before beginning work activities at facilities and on the right-of-way (ROW).

This does not apply for work activities involving entry or work within confined spaces.

Legislation

Canada
Canada Labour Code:

- Part II: Occupational Health and Safety

APLI

Alberta Occupational Health and Safety Act:

- Occupational Health and Safety Code
  - Part 2: Hazard Assessment, Elimination and Control

Provincial/territorial occupational health and safety regulations

United States
Code of Federal Regulations (CFR), Title 29 – Labor:

- Part 1910: Occupational Safety and Health Standards
  - Subpart I: Personal Protective Equipment

Related Standards

Company
Book 2: Safety:

- 04-02-01 Confined Space Entry Permit – Hazard Assessment
- 15-02-01 Safety Training Matrix

Definitions

hazard— a condition or practice with the potential for accidental loss.

hazard assessment— involves identifying hazards, assessing associated risks, and determining appropriate controls to mitigate the hazard.

There are four categories of hazards:

- chemical—hazardous materials or substances with a toxic effect (e.g., H_2S, asbestos, welding fumes)
- physical—hazards with the potential for physical injuries or adverse health effects (e.g., noise, extreme temperatures, falling objects, slips and trips)

- biological—hazards associated with exposure to, for example, animals, plants, bacteria, that may cause adverse health effects such as infections or allergic reactions (e.g., insects, hanta virus, poison ivy)
- ergonomic—hazards resulting from the work environment that may lead to undue physical or mental stress (e.g., improper lifting, equipment, workstations, poorly designed tools)

Methods of control include:

- engineering—changing the design of the workplace, processes, or equipment (e.g., installing relief valves, additional lighting, automatic shutdown devices)
- administrative—controlling exposure to hazards through awareness, communication, training, or preventative maintenance (e.g., incident bulletins, safety standards and procedures, work scheduling)
- personal protective equipment (PPE)—used when other control methods do not eliminate the hazard, and when there are no other practical means to effectively control the hazards (e.g., hearing protection, gloves, hard hats, respirators)

high risk work activity—a work activity with a risk rating from 4 to 16, including but not limited to:

- all work on electrical equipment and circuits with voltages greater than 750 V (CAN) or 600 V (USA)
- all work upstream of the 480 V main breaker

low risk work activity—a work activity with a risk rating from 1 to 3.

permit approver—the site supervisor or regional manager depending on the work.

permit issuer—a worker trained in hazard identification and assessment.

permit receiver—the employee in charge of the work or, when working alone, the employee doing the work.

Responsibilities

Regions

Before work begins, regions are responsible for:

- ensuring affected workers are trained in (a) hazard identification and assessment, and (b) selection and use of personal protective equipment (PPE) (see *15-02-01 Safety Training Matrix*)
- conducting a risk assessment for the work activity
- where reasonably practicable, involving all workers associated with the work activity in the risk assessment

In addition, for all high risk work activities, before work begins regions are responsible for:

- assessing and identifying existing and potential hazards specific to the work activity and related job tasks
- where reasonably practicable, involving all workers associated with the work in the hazard assessment
- communicating the results of the hazard assessment to all affected workers
- eliminating or controlling existing or potential hazards specific to the work activity and related job tasks
- documenting the hazard assessment as verification

> ⚠WARNING: Hazard assessments must be documented for all high risk work activities; exemptions must be approved by the regional manager at their discretion.

At least every 3 yrs, or more often if hazard conditions change or new hazard information is available, regions are responsible for evaluating (a) the effectiveness of the hazard assessment process and (b) the suitability of controls based on, but not limited to:

- changes in workplace conditions or work activities
- workplace inspection reports
- injury statistics
- incident investigations

Requirements

Approvals and Signing Authorities

A Safe Work Permit must be (a) approved by the regional manager for hot work on a tank shell that has not been gas freed, or the site supervisor for all other work, and (b) signed by both the permit issuer and the permit receiver.

> ⚠WARNING: The Safe Work Permit is verification that a hazard assessment has been completed. Do not approve or issue any Safe Work Permit until:

- the scope of work has been (a) defined in sufficient detail to ensure all hazards are identified and controlled, and (b) reviewed with the permit issuer for accuracy
- all potential hazards and controls have been identified

If the permit receiver or permit issuer changes while the work is in progress, the new permit receiver or permit issuer must read and sign the Safe Work Permit to acknowledge the conditions under which the permit was issued.

NOTE: Copies of the original Safe Work Permit may be marked up to identify changes.

Permit Approver

The permit approver is responsible for:

- acknowledging the work
- reviewing hazards and controls with the permit issuer
- ensuring the permit issuer is aware of site-specific information

Permit Issuer

The permit issuer is responsible for:

- reviewing hazards and controls with the permit receiver
- verifying compliance with the requirements on the permit
- verifying that appropriate controls are in place
- ensuring atmospheric testing is complete
- determining the need for a safety watch(es)

Permit Receiver

The permit receiver is responsible for:

- providing the permit issuer with adequate notice and a sufficient description of the scope of work
- reviewing hazards and controls with affected workers
- ensuring requirements on the permit are followed

Permit Limitations

A Safe Work Permit is valid for a maximum of 24 hrs, and only for the conditions under which it is issued.

A new Safe Work Permit must be issued (a) for each 24-hr period that the work continues, and (b) if the scope of work or conditions change from the original permit.

All work must cease by the proposed completion time, unless (a) a new permit is issued or (b) the permit issuer extends the existing permit.

Procedure

NOTE: For a flowchart of the hazard assessment process, see Figure 1.

⚠WARNING: A documented hazard assessment must be completed for all activities that are predetermined as high risk.

Risk Assessment

1. Rate the probability of an incident occurring that would typically result from how frequent the work activity is performed (see Figure 2).

2. Rate the severity of consequence that would typically result from an incident involving the work activity.

3. Determine the risk based on the intersection of the probability and consequence ratings.

4. Take action corresponding with the risk:
   - For a high risk work activity, complete a hazard assessment.
   - For a low risk work activity, no further action is required.

Hazard Assessment

1. Identify existing and potential sources of hazards for the work activity and related job tasks (e.g., walk-through of the work area).

2. Record the information gathered on the Safe Work Permit.

3. For each hazard, identify and implement controls.

Records

Safe Work Permit

For all high risk work activities, record the hazard assessment on the Safe Work Permit.

NOTE: A generic hazard assessment may be used to supplement hazards and controls specific to the work activity that are identified on the permit.

Retain the Safe Work Permit as follows:

- white copy to the permit receiver
- pink copy retained by the permit issuer

When work is complete each day, give the white copy to the permit issuer. The permit issuer keeps the pink copy onsite.

Retain pink copies of Safe Work Permits onsite for at least 2 yrs.

Hazard Assessment Evaluation

At least every 3 yrs, regions must prepare a summary report that evaluates the effectiveness of the hazard assessment process and the suitability of controls.

Regions must ensure summary evaluation reports are readily available and retained for 6 yrs after the date of the report.

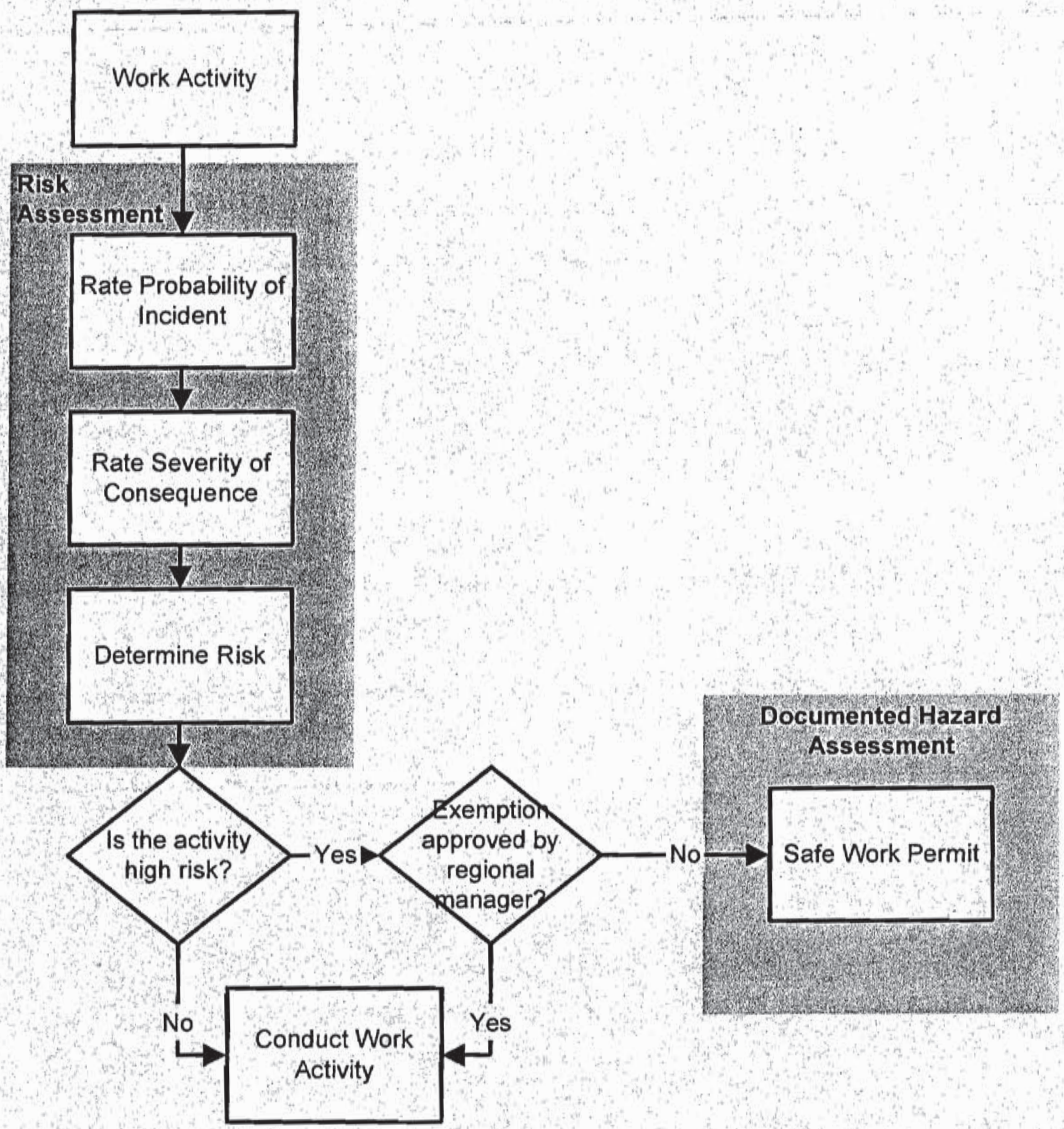


Figure 1
Hazard Assessment Process

Probability of Incident

Probability	Frequency Work Activity Performed			
	Never	Rarely (few times per year)	Occasionally (weekly/ monthly)	Frequently (hourly/daily)
High – likely to occur	4	4	4	4
Medium – could occur	3	2	2	1
Low – unlikely to occur	2	1	1	1

Severity of Consequence

Severity	Health	Cost
4	Fatality	Extensive damage, extended downtime for site
3	Serious injury (days away)	Major damage or downtime for site
2	Medical Aid injury	Minor damage or downtime for equipment or process
1	First Aid injury	Minor damage, no down time

Risk Rating

Probability					
	4	4	8	12	16
	3	3	6	9	12
	2	2	4	6	8
	1	1	2	3	4
		1	2	3	4
		Consequences			

NOTES
High Risk (score from 4 to 16)
Low Risk (score from 1 to 3)

Figure 2
Risk Assessment

Purpose

To classify hazardous and restricted areas in order to complete hazard assessments and Safe Work Permits.

Legislation

Canada

Canada Labour Code, Part II:

- Canadian Occupational Safety and Health (COSH) regulations

Provincial/territorial occupational health and safety regulations

United States

Code of Federal Regulations (CFR), Title 29 – Labor:

- Part 1910 Subpart I App B—Non-mandatory Compliance Guidelines for Hazard Assessment and Personal Protective Equipment Selection

Definitions

hazard— a condition or practice with the potential for accidental loss.

hazard assessment— involves identifying hazards, assessing associated risks, and determining appropriate controls to mitigate the hazard.

There are four categories of hazards:

- chemical—hazardous materials or substances with a toxic effect (e.g., H_2S, asbestos, welding fumes)
- physical—hazards with the potential for physical injuries or adverse health effects (e.g., noise, extreme temperatures, falling objects, slips and trips)
- biological—hazards associated with exposure to, for example, animals, plants, bacteria, that may cause adverse health effects such as infections or allergic reactions (e.g., insects, hanta virus, poison ivy)
- ergonomic—hazards resulting from the work environment that may lead to undue physical or mental stress (e.g., improper lifting, equipment, workstations, poorly designed tools)

Methods of control include:

- engineering—changing the design of the workplace, processes, or equipment (e.g., installing relief valves, additional lighting, automatic shutdown devices)
- administrative—controlling exposure to hazards through awareness, communication, training, or preventative maintenance (e.g., incident bulletins, safety standards and procedures, work scheduling)
- personal protective equipment (PPE)—used when other control methods do not eliminate the hazard, and when there are no other practical means to effectively control the hazards (e.g., hearing protection, gloves, hard hats, respirators)

hazardous area—an area in which there is significant potential for a flammable or toxic atmosphere to develop, including, but not limited to the areas around:

- mainline pump, engine and booster pump shelters/rooms
- sump tanks and vents
- tank truck hatches and vents
- crude oil or product storage tanks and lots
- meter and valve manifold shelters/rooms
- densitometer, sampler and instrument shelters
- below-grade access culverts
- NGL storage vessels
- leak sites
- any open system
- hazardous waste/material storage buildings
- ENB (NW) ········ mainline valve sites

restricted area—an area in which there is limited potential for a flammable or toxic atmosphere to develop.

Requirements

Hazardous Areas

Observe Safe Work Permit requirements for work in hazardous areas and near hazardous areas, including:

- investigating facilities for known or suspected anomalies
- repairing facilities with leaks, defects or corrosion pits/clusters where the calculated rupture pressure ratio is less than one
- welding directly on mainline or station piping
- welding on a pressurized split tee with longitudinal fillet-welded checkstraps/backing straps
- welding on a pressurized Morrison sleeve

For information regarding hazardous areas in relation to specified facilities at typical stations and mainline locations, see Figures 1–10.

Restricted Areas

Observe Safe Work Permit requirements for work done in restricted areas.

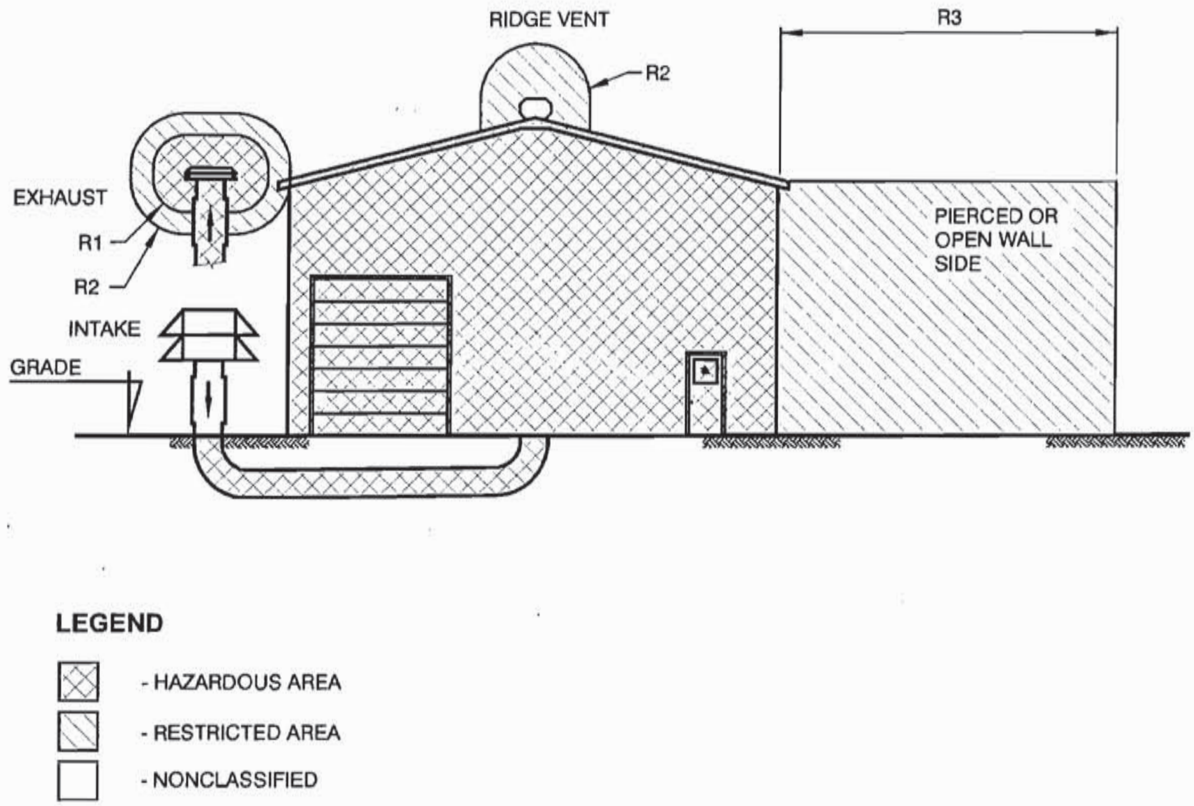
For information regarding the proximity of restricted areas in relation to specified facilities at typical stations and mainline locations, see Figures 1–10.

Site Safety Plot Plans

Hazardous and restricted areas should be reflected on site safety plot plans (posted at all station sites).

When changes to facilities affect site safety plot plans, the site supervisor must:

- note and describe the additions and/or deletions in a memo and on the existing site safety plot plan
- forward the information to the regional office, where it is reviewed and sent to Engineering; Engineering then issues a revised site safety plot plan



COMMODITY	DISTANCE R1	R2	R3
LIQUID PETROLEUM	0.9 m (3'-0")	1.5 m (5'-0")	15 m (50'-0")
NGL	1.5 m (5'-0")	4.5 m (15'-0")	30 m (100'-0")

NOTES

A wall that contains a door, window, air vent, etc., or has a pipe, conduit or cable passing through it is defined as a pierced wall. In practice, this means the distance R3 will usually surround a building.

Figure 1
Mainline Pump/Booster Pump Shelters/Rooms
(includes Engine Rooms in ENB [NW])

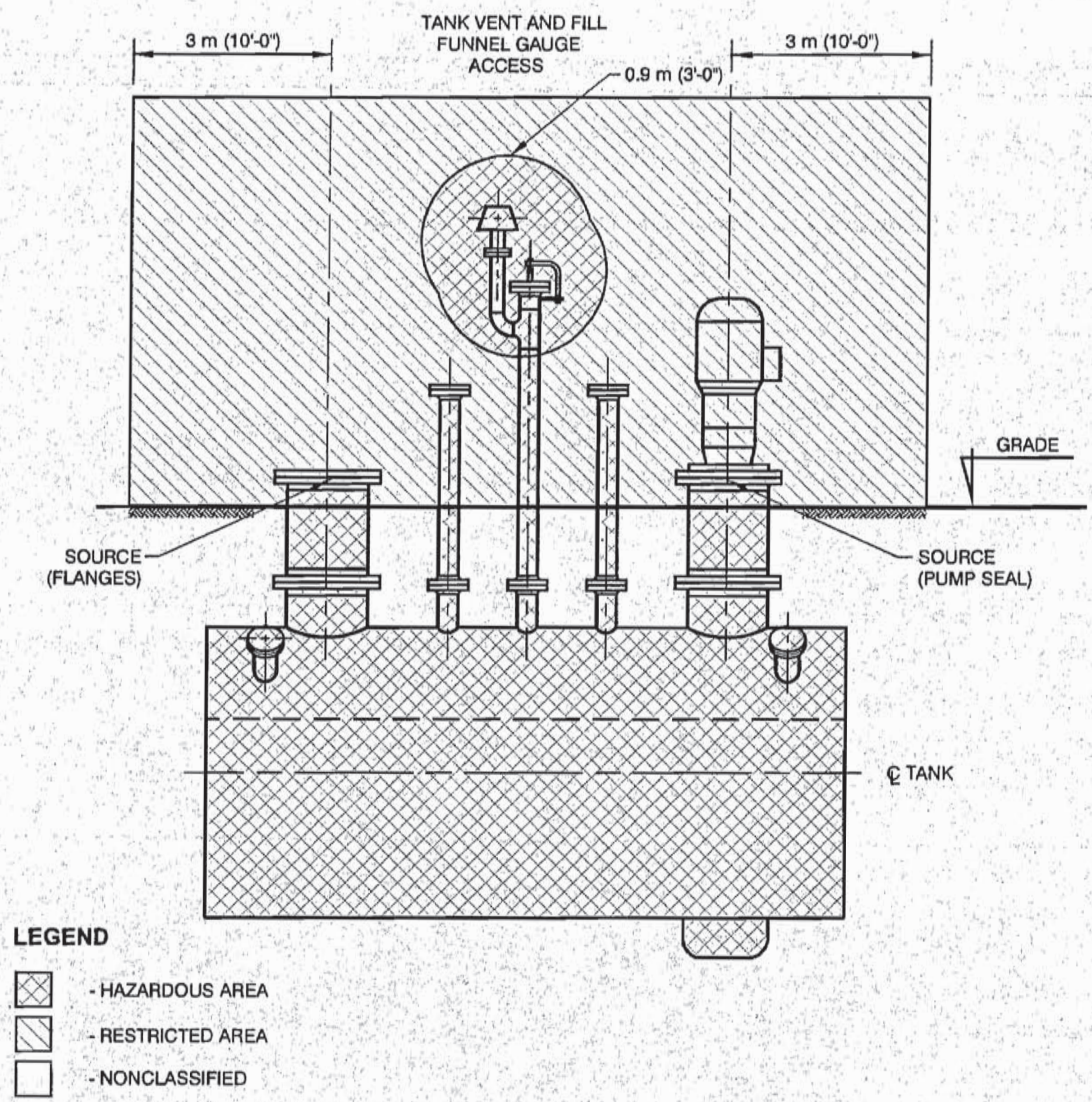
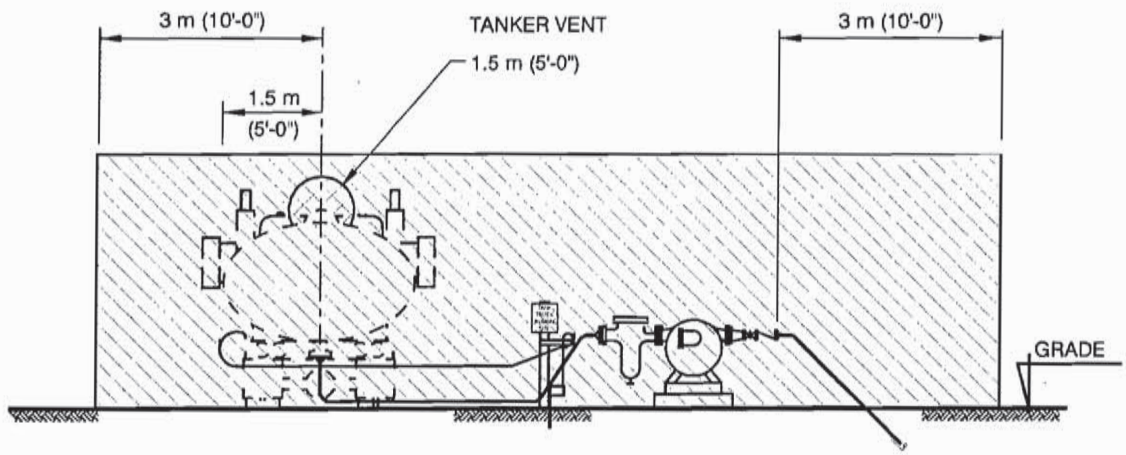


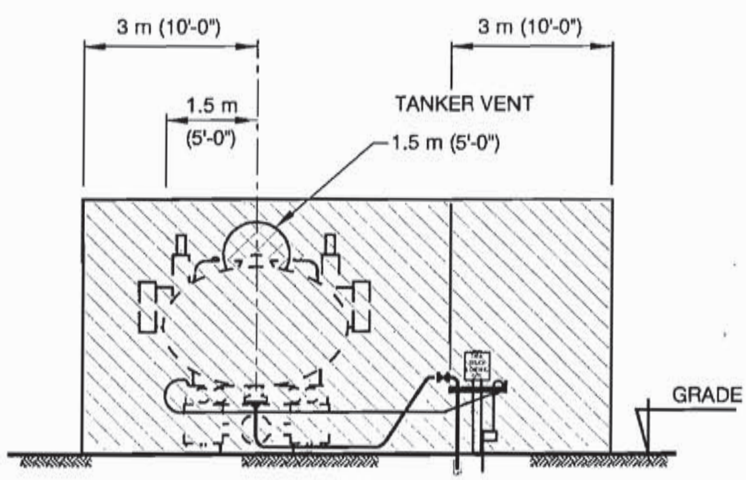
Figure 2
Sump Tank and Vents



LEGEND

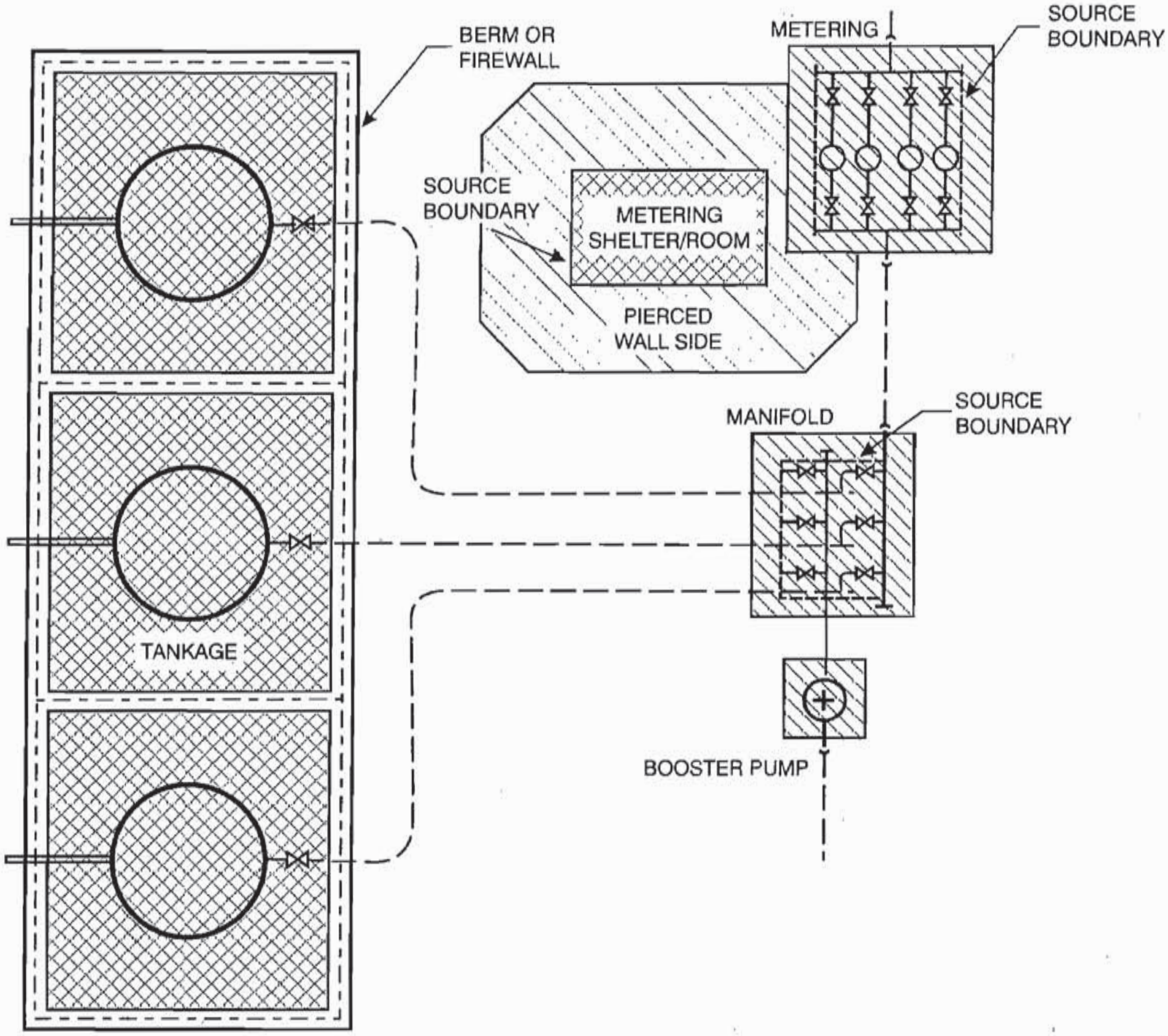
TYPICAL TANK TRUCK UNLOADING FACILITY

- HAZARDOUS AREA
- RESTRICTED AREA
- NONCLASSIFIED



TYPICAL TANK TRUCK LOADING STATION

Figure 3
Tank Truck Facilities



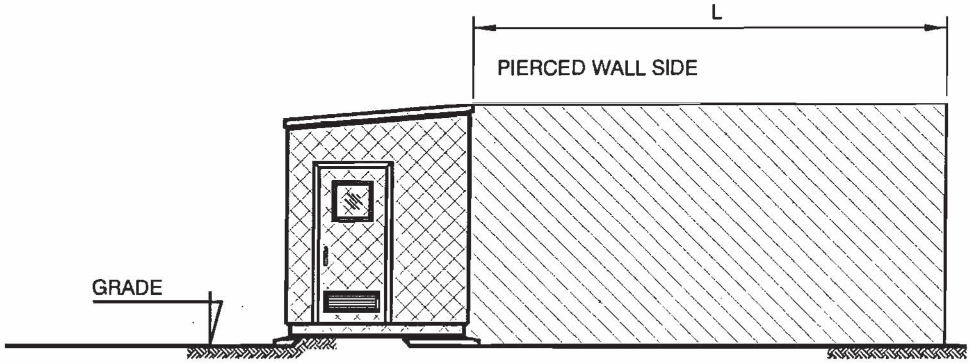
LEGEND

- HAZARDOUS AREA
- RESTRICTED AREA
- NON-CLASSIFIED

FACILITY	DISTANCE LIQUID PETROLEUM	DISTANCE NGL
OUTDOOR MANIFOLD*	3 m (10'-0")	6 m (20'-0")
METERING SHELTER*	3 m (10'-0")	6 m (20'-0")
OUTDOOR METERING*	3 m (10'-0")	6 m (20'-0")
OUTDOOR BOOSTER PUMP**	15 m (50'-0")	30 m (100'-0")

*DISTANCE FROM SOURCE BOUNDARY
**DISTANCE FROM CENTER OF PUMP

Figure 4
Metering Shelters/Rooms and Areas,
Manifold Areas, Booster Pumps and Tankage Areas



LEGEND

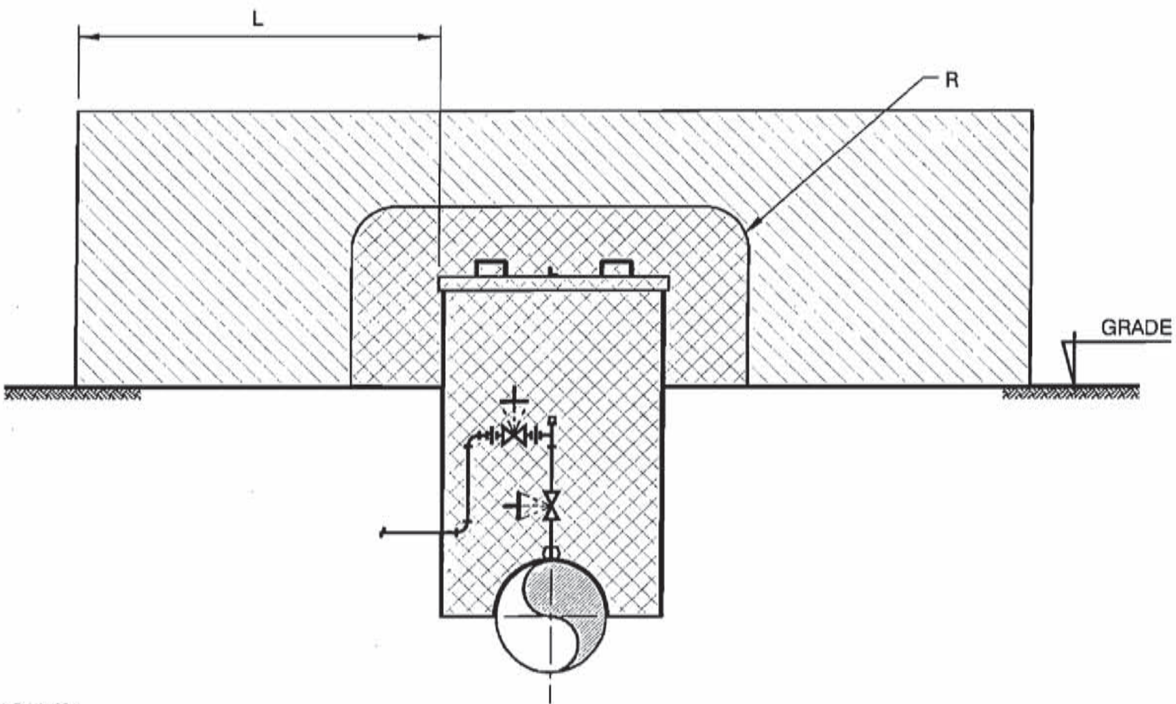
- HAZARDOUS AREA
- RESTRICTED AREA
- NONCLASSIFIED

COMMODITY	DISTANCE L
LIQUID PETROLEUM	3 m (10'-0")
NGL	6 m (20'-0")

NOTES

A wall that contains a door, window, air vent, etc., or has a pipe, conduit or cable passing through it is defined as a pierced wall. In practice, this means the distance R3 will usually surround a building.

Figure 5
Densitometer, Sampler and Instrument Shelters

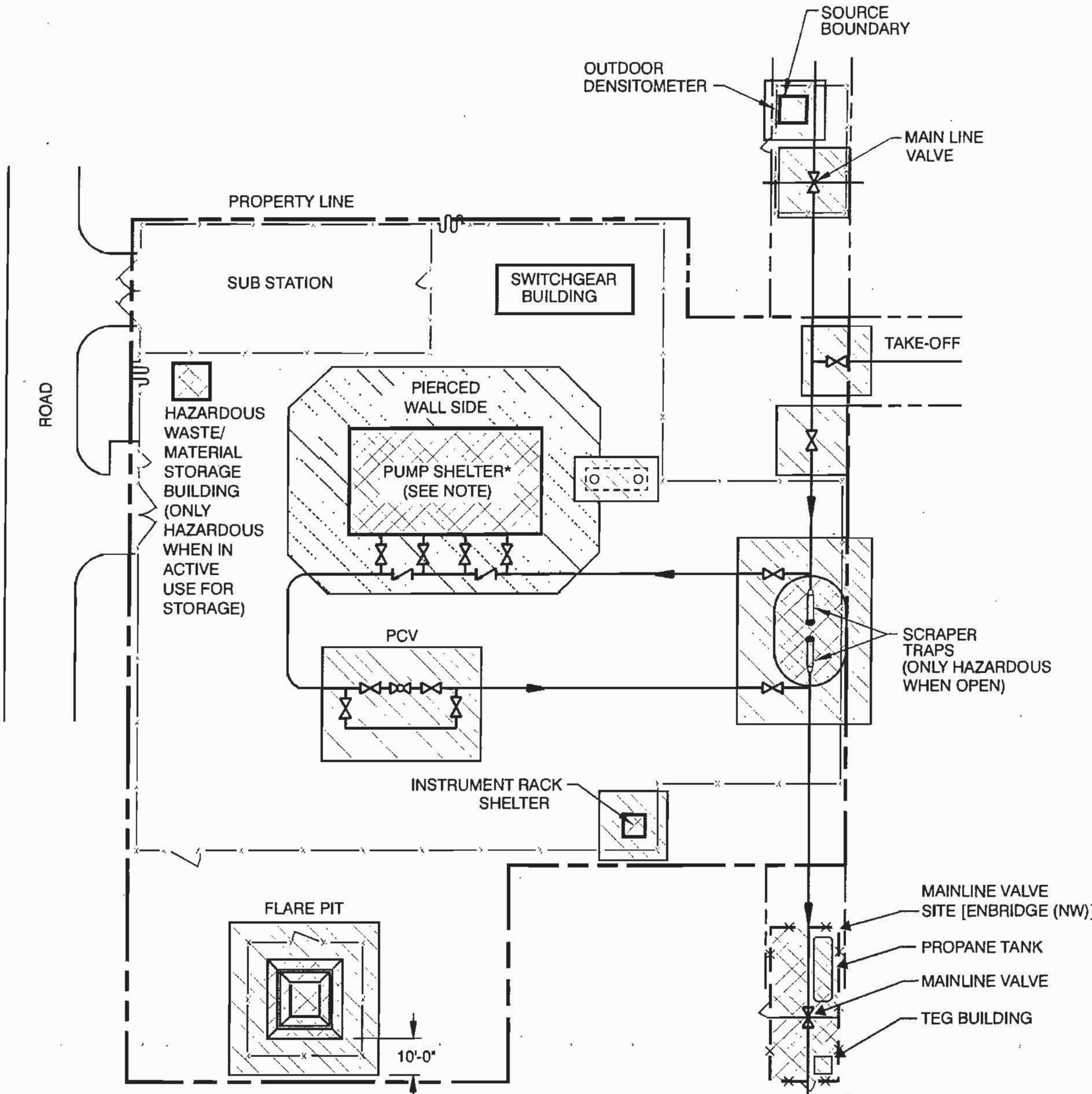


LEGEND

- HAZARDOUS AREA
- RESTRICTED AREA
- NONCLASSIFIED

COMMODITY	DISTANCE L	DISTANCE R
LIQUID PETROLEUM	3 m (10'-0")	1.5 m (5'-0")
NGL	6 m (20'-0")	1.5 m (5'-0")

Figure 6
Below-Grade Access Culverts



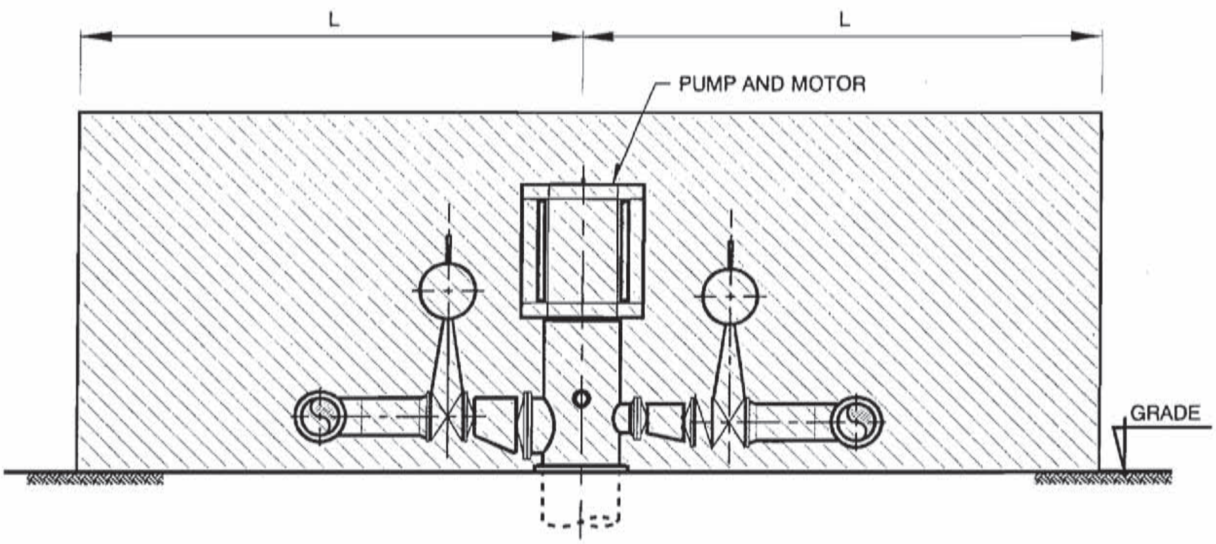
LEGEND

- HAZARDOUS AREA
- RESTRICTED AREA
- NONCLASSIFIED

FACILITY	DISTANCE	
	LIQUID PETROLEUM	NGL
OUTDOOR DENSITOMETER	3 m (10'-0")	6 m (20'-0")
VALVES	3 m (10'-0")	6 m (20'-0")

* NOTE: INCLUDES PUMP & ENGINE ROOMS IN ENBRIDGE (NW)

Figure 7
Typical Stations and Mainline Area Classification

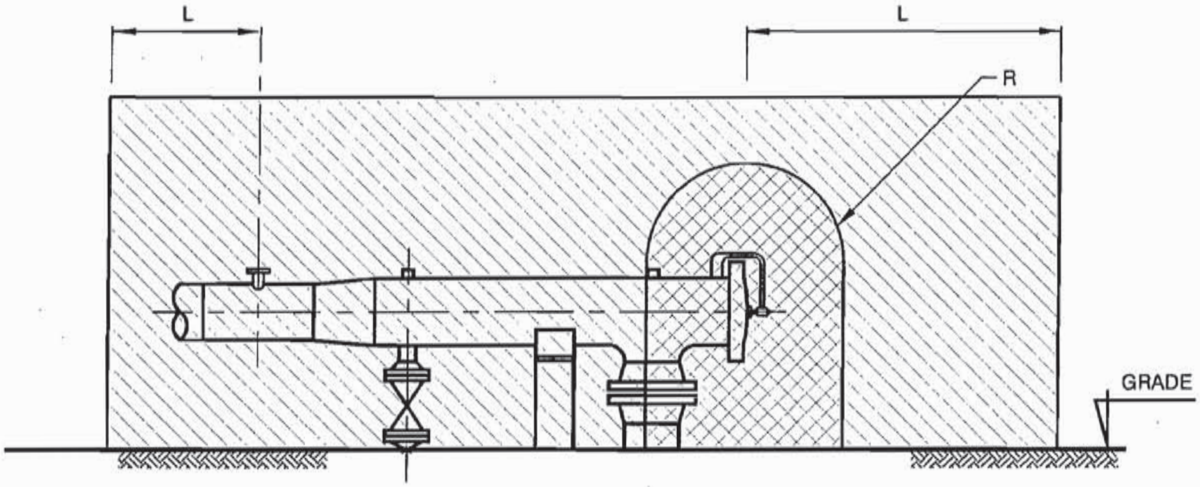


LEGEND

- HAZARDOUS AREA
- RESTRICTED AREA
- NONCLASSIFIED

COMMODITY	DISTANCE FROM CENTRE OF PUMP L
LIQUID PETROLEUM	15 m (50'-0")
NGL	30 m (100'-0")

Figure 8
Outdoor Pumps



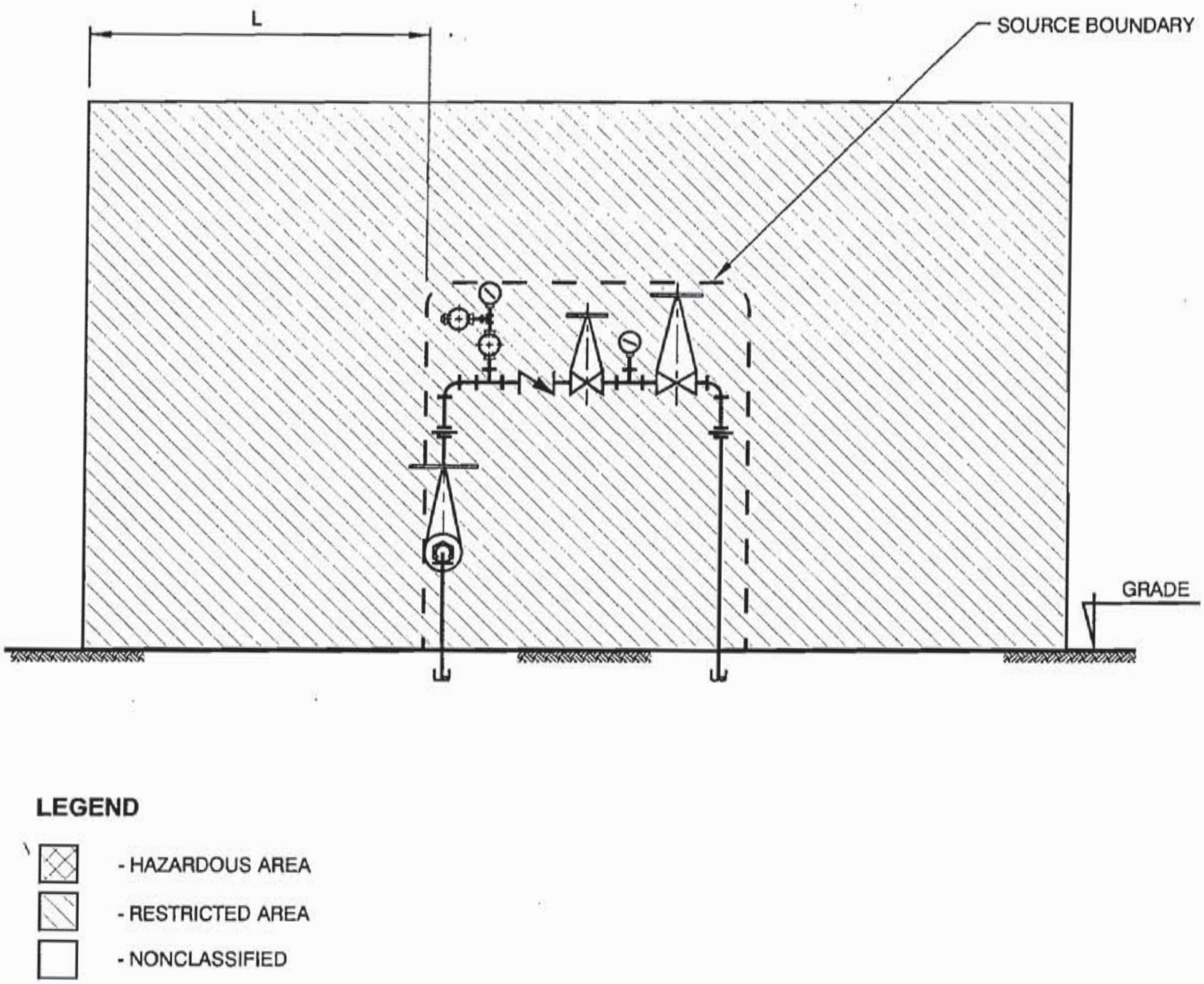
LEGEND

- HAZARDOUS AREA (ONLY WHEN OPEN)
- RESTRICTED AREA
- NONCLASSIFIED

COMMODITY	DISTANCE FROM TRAPS / PROVERS* L	R - (ONLY WHEN OPEN)
LIQUID PETROLEUM	3 m (10'-0")	1.5 m (5'-0")
NGL	6 m (20'-0")	1.5 m (5'-0")

*FOR PROVERS, L IS MEASURED FROM PERIMETER OF PROVER AND R IS FROM PROVER OPENINGS.

Figure 9
Provers and Scraper Traps



COMMODITY	DISTANCE L
LIQUID PETROLEUM	3 m (10'-0")
NGL	6 m (20'-0")

Figure 10
Valves and Instrumentation

Purpose

To protect the health and safety of workers from exposure to hazards in confined spaces, and to regulate entry into confined spaces.

Scope

This applies for entry or work within confined spaces.

This does not apply for entry or work within excavations or enclosed spaces (e.g., dyked areas, areas within firewalls, pump shelters, and densitometer, instrument, and sample buildings).

Legislation

Canada

Canada Occupational Health and Safety Regulations:

- Part XI—Confined Spaces

Alberta Occupational Health and Safety Act:

- Occupational Health and Safety Code
  - Part 5—Confined Spaces

Ontario Occupational Health and Safety Act:

- Ontario Regulation 632/05
  - Confined Spaces

Saskatchewan Occupational Health and Safety Regulations:

- Part XVIII—Confined Space Entry

United States

Code of Federal Regulations (CFR), Title 29—Labor:

- Part 1910.146—Permit-Required Confined Spaces

Minnesota Department of Labor and Industry:

- Occupational Safety and Health Rules:
  - 5207.0304—Entry Into and Work Within Confined Spaces

Michigan Occupational Safety and Health (MIOSHA) Standards:

- Section A, Part 90—Confined Space Entry
- Section A, Part 490—Permit-Required Confined Spaces

Related Standards

Industry

American Petroleum Institute (API):

- API 2026—Safe Access/Egress Involving Floating Roofs of Storage Tanks in Petroleum Service
- API 2015—Safe Entry and Cleaning of Petroleum Storage Tanks, Planning and Managing Tank Entry From Decommissioning Through Re-commissioning

Company

Book 2: Safety:

- 03-02-01 Safe Work Permit – Hazard Assessment
- 13-02-07 Respiratory Protection
- 13-02-08 Fall Protection and Work Restraint
- Tab 15 Training and Qualification

Book 3: Pipeline Facilities:

- 01-02-01 Pre-Job Meeting
- Tab 04 Trenching and Excavations

Definitions

confined space—an enclosed or partially enclosed area that meets all of the following:

- is not designed or intended for continuous worker occupancy (e.g., tanks, pipes)
- has restricted means of entry and exit that may compromise the provision of first aid, evacuation, rescue, or other emergency response (e.g., manholes, electrical vaults, boreholes, pits, sump tanks, vertical and horizontal culverts)
- is large enough so that a worker can bodily enter to perform work

confined space entry—occurs when any part of the worker's body enters into a confined space.

permit approver—the site supervisor or regional manager, depending on the work.

permit issuer—a worker trained in hazard identification and assessment.

permit receiver—the employee in charge of the work or, when working alone, the employee doing the work.

permit required confined space—a confined space that is hazardous or that may become hazardous due to one or more of the following:

- work activity would cause adverse health effects (e.g., fiberglassing, abrasive blasting, welding)
- contains or has the potential to contain a hazardous atmosphere (e.g., H_2S, LEL, O_2)
- contains a material that has the potential for drowning or suffocating a worker (e.g., liquid)
- has an internal configuration such that a worker could become trapped or asphyxiated
- contains any other safety or health hazard which is recognized as immediately dangerous to life and health (IDLH) (e.g., energy sources, visibility)

nonpermit required confined space—a confined space that does not contain a hazardous atmospheric or have the potential to contain any hazardous condition that may cause death or serious physical harm.

Responsibilities

Confined space entry supervisors are responsible for:

- ensuring written entry procedures and rescue plan are readily available
- ensuring only trained workers enter a confined space
- verifying lockout/tagout of equipment
- supporting the safety watch in controlling access to the confined space
- reviewing hazards and controls with affected workers
- ensuring emergency rescue services are readily available

Workers entering a confined space are responsible for:

- conducting work in accordance with the requirements on the permit
- maintaining communication with the safety watch
- exiting the confined space when alerted by the safety watch
- wearing appropriate PPE

Requirements

Training and Qualification

Before entry or work within confined spaces, regions are responsible for ensuring affected workers are trained and qualified in:

- hazard identification and assessment
- selection and use of personal protective equipment (PPE)
- confined space entry

In addition, regions are responsible for ensuring affected workers have the knowledge, training, and experience necessary to safely perform the following duties:

- air testing and monitoring
- safety watch
- emergency rescue

NOTE: For more information, see *Tab 15 Training and Qualification.*

Confined Space Classes

⚠WARNING: All confined spaces are Class 3 until verified by initial air testing.

Class 1 (Low Hazard)

Class 1 confined spaces are those where airborne concentrations within the following limits are verified by initial testing and are unlikely to develop:

- oxygen: 19.5 to 23.5%
- lower explosive limit (LEL): less than (<) 4%
- hydrogen sulfide (H_2S): less than or equal to (≤) 10 ppm
- other toxic contaminants: less than or equal to (≤) permissible exposure limits (PEL)

Class 2 (Moderate Hazard)

Class 2 confined spaces are those where airborne concentrations within the following limits are verified by initial testing, or have the potential to develop due to atmospheric change, temperature change, type of work:

- oxygen: 19.5 to 23.5%
- lower explosive limit (LEL): 4 to 10 %
- hydrogen sulfide (H_2S): less than or equal to (≤) 10 ppm
- other toxic contaminants: greater than (>) permissible exposure limits (PEL)

Class 3 (High Hazard)

Class 3 confined spaces are those where airborne concentrations within the following limits are verified by initial testing, or are likely to develop, or when atmospheric concentrations can't be verified:

- oxygen: less than (<)19.5 or greater than (>) 23.5%
- lower explosive limit (LEL): 10 to 20%
- hydrogen sulfide (H_2S): greater than (>) 10ppm
- other toxic contaminants: greater than (>) permissible exposure limits requiring supplied air respirator (SAR)or self-contained breathing apparatus (SCBA) (see *13-02-07 Respiratory Equipment*)

Hazard Assessment

Before entry or work within confined spaces, regions are responsible for:

- assessing and identifying existing and potential hazards specific to the work activity and related job tasks
- where reasonably practicable, involving all workers associated with the work in the hazard assessment
- communicating the results of the hazard assessment to all affected workers
- eliminating or controlling existing or potential hazards specific to the work activity and related job tasks
- documenting the hazard assessment on the Confined Space Permit as verification

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NOTE: For a flowchart of the hazard assessment process, see Figure 1. For an example of potential sources of hazards and controls for the classes of confined space, see Table 1. For minimum hazard controls for confined spaces, see Table 2.

At least every 3 yrs, or more often if hazard conditions change or new hazard information is available, regions are responsible for evaluating (a) the effectiveness of the hazard assessment process and (b) the suitability of controls based on, but not limited to:

- changes in workplace conditions or work activities
- workplace inspection reports
- injury statistics
- incident investigations

Signage

Confined spaces that are permanent or that are frequently accessed must be identified by signs in accordance with *Book 3: Pipeline Facilities, 03-02-03 Facility Signs and Markers*.

Air Testing and Monitoring

Air testing for atmospheric hazards must be conducted in the following order:

- oxygen deficiency (% O_2)
- flammable gases/vapors (% LEL)
- toxic air contaminants (e.g., H_2S)
- other toxic contaminants associated with the work activity and related job tasks (e.g., CO)

NOTE: Remote gas detector accessories (e.g., sample draw pumps) may be needed for air testing at various locations or elevations.

Initial Air Testing

Before entry into a confined space, conduct initial air testing through openings from outside the confined space where possible using a calibrated direct-reading and/or grab sample instrument.

If testing from outside the confined space is not possible, conduct initial air testing from inside the confined space using PPE in accordance with *13-02-07 Respiratory Protection.*

Air Retesting

Retest air as often as necessary to ensure the health and safety of workers in the confined space (see Table 2).

Safety Watch

Safety watches must be provided with:

- an emergency warning device (e.g., air horn)
- for hot work, a fire extinguisher
- PPE in accordance with *13-02-07 Respiratory Protection*, and *13-02-08 Fall Protection and Work Restraint*

Safety watches are responsible for:

- ensuring initial and ongoing air testing, and recording test results
- ensuring requirements on the permit are followed
- controlling access to the confined space
- recording workers entering and exiting the confined space
- maintaining communication with workers in the confined space
- assessing hazards and implementing appropriate controls
- contacting emergency rescue services as required

Safety watches may perform additional duties provided they do not distract from effectively performing safety watch duties.

Prejob Meeting

Before starting work, conduct a prejob meeting to review, for example, but not limited to:

- the Confined Space Entry Permit
- air testing
- entering and exiting the confined space
- communication system
- isolation of energy sources and control of materials movement
- securing the confined space from unauthorized entry
- written rescue procedure and equipment

NOTE: For more information, see *Book 3: Pipeline Facilities, 01-02-01 Prejob Meeting*.

Communication System

Before entry into a confined space, a method of communication must be established (e.g., voice, visual, signal line) between (a) workers and the safety watch, and (b) the safety watch and any backup workers or rescue personnel.

The communication system must be maintained as long as workers are in the confined space.

Onsite Rescue

Rescue personnel must be provided with PPE in accordance with *13-02-07 Respiratory Protection* and *13-02-08 Fall Protection and Work Restraint*.

Before entry into a confined space, written rescue procedures must be readily available and include:

- names of safety watch(es)
- names and number of rescue personnel
- communication system
- evacuation method
- rescue equipment

Retain rescue procedures with the Confined Space Entry Permit.

Permit Approvals and Signing Authorities

A Confined Space Entry Permit must be (a) approved by the regional manager for work within Class 3 confined spaces, or the site supervisor, for all other work, and (b) signed by both the permit issuer and the permit receiver.

⚠WARNING: The Confined Space Entry Permit is verification that a hazard assessment has been completed. Do not approve or issue any Confined Space Entry until:

- the scope of work has been (a) defined in sufficient detail to ensure all hazards are identified and controlled, and (b) reviewed with the permit issuer for accuracy
- all potential hazards and controls have been identified

If the permit receiver or permit issuer changes while the work is in progress, the new permit receiver or permit issuer must read and sign the Confined Space Entry Permit to acknowledge the conditions under which the permit was issued.

NOTE: Copies of the original Confined Space Entry Permit may be marked up to identify changes.

Permit Approver
The permit approver is responsible for:

- acknowledging the work
- reviewing hazards and controls with the permit issuer
- ensuring the permit issuer is aware of site-specific information

Permit Issuer
The permit issuer is responsible for:

- reviewing hazards and controls with the permit receiver
- verifying compliance with the requirements on the permit
- verifying that appropriate controls are in place
- ensuring atmospheric testing is complete
- determining the need for a safety watch(es)

Permit Receiver
The permit receiver is responsible for:

- providing the permit issuer with adequate notice and a sufficient description of the scope of work
- reviewing hazards and controls with affected workers
- ensuring requirements on the permit are followed

Permit Limitations

A Confined Space Entry Permit is valid for a maximum of 24 hrs, and only for the conditions under which it is issued.

A new Confined Space Entry Permit must be issued (a) for each 24-hr period that the work continues, and (b) if the scope of work or conditions change from the original permit.

All work must cease by the proposed completion time, unless (a) a new permit is issued or (b) the permit issuer extends the existing permit.

Records

Confined Space Entry Permit

For all entry or work within confined spaces, record the hazard assessment on the Confined Space Entry Permit.

Retain the Confined Space Entry Permit as follows:

- white copy to permit receiver
- pink copy retained by the permit issuer

When work is complete each day, give the white copy to the permit issuer. The permit issuer keeps the pink copy onsite.

Retain pink copies of Confined Space Entry Permits onsite for at least 10 yrs.

Hazard Assessment Evaluation

At least every 3 yrs, regions must prepare a summary report that evaluates the effectiveness of the hazard assessment process and the suitability of controls.

Regions must ensure summary evaluation reports are readily available and retained for 6 yrs after the date of the report.

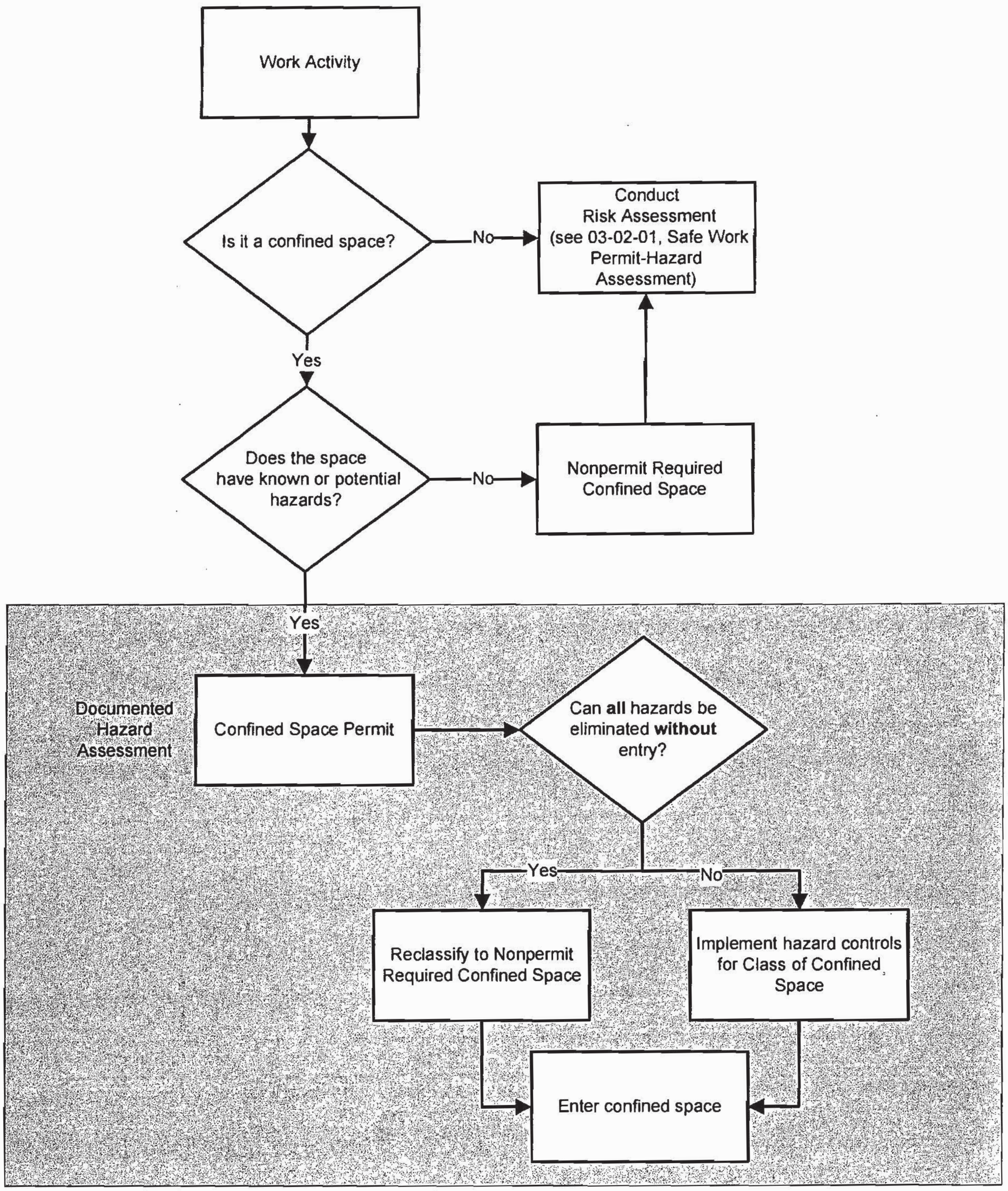


Figure 1
Hazard Assessment Process

Table 1
Example of Confined Space Hazard Assessment

Type of Confined Space	Potential Hazards	Potential Controls
CLASS 3 (High Hazard)		
Geodesic Dome Tank – Floating Roof	• restricted access and egress • tank height and size may make rescue difficult • flammable atmosphere • roof instability • breathing hazard	• for respiratory protection, see *13-02-07 Respiratory Protection* • written rescue procedure • safety watch(es) • continuous gas monitoring • continuous mechanical ventilation • communication system
Open Tank – Floating Roof • initial tank entry	• tank height and size may make rescue difficult • flammable atmosphere • roof instability • breathing hazard	
Cone Tank Roof Holding Tank • initial entry	• explosive/flammable atmosphere • toxic atmosphere • oxygen deficiency • breathing hazard	
Mainline Sump	• explosive/flammable atmosphere • substance/residue adhering to walls • falling when entering and exiting • restricted movement • breathing hazard	
CLASS 2 (Moderate Hazard)		
Open Tank – Floating Roof • initial tank roof access	• difficult rescue due to tank height and size • flammable atmosphere	• escape pak if remote accessories not used • continuous gas monitoring • communications system • written rescue procedure
Pipe, Horizontal Culvert, Vertical Culvert, Electrical Vault	• product release • oxygen deficiency	

Table 1
Example of Confined Space Hazard Assessment

Type of Confined Space	Potential Hazards	Potential Controls
CLASS 1 (Low Hazard)		
Below Floor Grating – Pump Room	• restricted egress • hazardous atmosphere • oxygen deficiency • noise	• supporting structures • lighting • housekeeping • fall protection • continuous gas monitoring • maintain three-point contact • written rescue procedure
Open Tank – Floating Roof • roof inspection	• potential hazards can be controlled • slips, trips, falls	

Table 2
Hazard Controls for Confined Spaces

Requirement	Class 3 (High Hazard)	Class 2 (Moderate Hazard)	Class 1 (Low Hazard)
Confined Space Permit/Hazard Assessment	required	required	required
pre-job meeting	required	required	required
initial air testing	required	required	required
air retesting	required if space is vacated for longer than 20 min.	required if space is vacated for longer than 20 min.	required if space is vacated for longer than 20 min.
continuous air monitoring	required when space is occupied	required when space is occupied	required when space is occupied
written job procedure	required	required	required
written rescue procedure	required	required	required
ventilation	required	determined by air monitoring	determined by air monitoring
safety watch	required at entrance	required at entrance	required at entrance
rescue equipment	required at entrance	required within reasonable distance of worksite	required within reasonable distance of worksite
rescue personnel	required onsite	2 rescuers required for floating tank roof	determined by hazard assessment
lockout and isolation	determined by hazard assessment	determined by hazard assessment	determined by hazard assessment
fall arrest	determined by hazard assessment	determined by hazard assessment	determined by hazard assessment

Purpose

Erosion control is necessary to:

- contain excavated soil onsite
- prevent sediment from entering wetlands or waterbodies
- prevent pipe exposure

Responsibilities

Operations

Operations must notify Environment when work is to be conducted in or around a wetland, waterbody or other environmentally sensitive area.

Environment

Environment must coordinate the necessary environmental work and obtain the appropriate permits to conduct the proposed work.

Requirements

Soil Erosion

By Wind

To minimize drifting soils and loss of topsoil by wind, in areas prone to wind erosion:

- limit the time between topsoil stripping and final cleanup
- suspend topsoil stripping and backfill operations during high winds
- apply a tackifier to the topsoil pile
- install wind barriers (e.g., slat fences, snow fences)
- spread wood chips or straw crimping
- sow a fast growing ground cover
- walk down tree and shrub debris over exposed soils

By Water

Use temporary erosion control measures (e.g., sandbags, logs or straw bales) on undisturbed pasture or well-sodded right-of-way (ROW) during cleanup.

Use permanent erosion control measures on disturbed steep slopes during restoration, especially if heavy runoff, spring breakup or heavy storms are likely and there is a risk of significant soil erosion:

- construct trench breakers
- install cross ditches and diversion berms
- walk down tree and shrub debris over exposed soils
- armor berms and ditches with logs, polyethylene or sandbags
- install netting or filter cloth
- apply tackifier
- install and stake sod
- hydromulch

- hydroseed, spread straw and crimp
- seed an annual crop of barley, fall rye, or oats
- plant native shrubs or willow cuttings

NOTE: For information on installing berms and ditches and stream bank protection, see the Environmental Guidelines for Construction.

Purpose

Containment structures (e.g., berms, retention ponds) are designed to contain product and to minimize impacts offsite in the event of a release at a facility. This standard includes the requirements for managing and discharging stormwater accumulated in containment structures in a manner that does not adversely affect the environment by releasing pollutants or by causing erosion to receiving lands.

Responsibilities

Regions are responsible for managing stormwater, including: inspecting, discharging, sampling (if required), and maintaining records.

NOTE: If stormwater is contaminated, contact Environment for assistance with sampling, testing, and analyzing test results.

Requirements

Prevention

To minimize the risk of surface water contamination:

- keep the site clean and orderly
- store hazardous materials in accordance with the Waste Management Plan
- clean up spills immediately and store wastes in appropriate containers in accordance with the Waste Management Plan

Discharging

Discharge stormwater accumulated in containment structures after significant rainfalls or as often as practical to maximize containment capacity in the event of a release at the facility.

Facility stormwater drain valves should be closed at all times, except when actively discharging stormwater.

Permits

Where facilities have existing permits that regulate discharging stormwater offsite, follow all conditions in the permit.

Visual Inspection

Before discharging accumulated stormwater within a containment structure, visually inspect for (a) an oily sheen, or (b) suspended solids and/or foam.

If visual inspection indicates no evidence of contaminated stormwater (i.e., only precipitation is present), (a) follow the conditions specified in the permit/license, where required, to discharge stormwater offsite; otherwise, (b) open the valves to discharge stormwater offsite, ensuring:

- discharge is conducted in a controlled manner using a slow flow rate to prevent soil erosion and damage to streambanks and streambeds of waterbodies
- the discharge valve is closed after the discharge is complete

For containment structures that automatically discharge stormwater, visually inspect the accumulated stormwater weekly.

Sampling

If visual inspection indicates that stormwater may be contaminated, contact Environment for sampling requirements, including: laboratory contacts, sample bottles, custody transfer forms, and sampling procedures.

Records

CAN

Stormwater Logs

Stormwater logs must be retained at the facility for 5 years.

For stormwater discharged offsite, record the date, time, estimated amount of water discharged, and confirmation of water.

If laboratory analysis is required before discharging stormwater, record the sample date and laboratory test results.

For contaminated stormwater, record the date, remediation techniques, and observations.

Purpose

To protect the safety of workers and the public when operating mechanized excavation equipment, or other below grade activity with the potential for damage, takes place near company facilities.

Scope

This applies to activities supervised by company employees. This does not apply where contractors or contractor personnel supervise the work.

Related Standards

Company

Book 2: Safety

- *03-02-01 Safe Work Permit – Hazard Assessment*

Book 3: Pipeline Facilities

- *04-02-02 Damage Prevention*

Responsibilities

Company Representative

> **WARNING**: A company representative must remain onsite to continually monitor any mechanized excavation, or other activity with the potential for damage, that takes place within 3 m (10 ft) of a company facility, or for ENB (Athabasca) within 5 m (16.5 ft) of a company facility, whether located above or below grade.

The company representative, who must be a competent worker, is responsible for ensuring:

- activities involving mechanized equipment are adequately supervised
- company facilities in the work area are surface located
- necessary safety precautions are taken considering the unique aspects of the work
- workers and facilities are adequately protected in accordance with this standard
- work stops if there is a concern for safety, pipeline integrity, or damage to company equipment or facilities
- exposed pipes, conduits, and cables are not damaged, confirmed by visual inspection in the ditch/excavation before backfilling

Requirements

A hazard assessment must be completed by company employees any time activity takes place near company facilities.

Inspections

A competent worker must conduct daily inspections of excavations, adjacent areas, and protective equipment:

- before starting work

- as needed throughout the shift
- after rainstorms or other occurrence that could create a hazard

Inspections must look for:
- situations that could result in cave-ins
- indications of failure of protective systems
- hazardous atmospheres or other hazardous condition

NOTE: When a hazardous atmosphere may be expected, emergency rescue equipment, including breathing apparatus and rescue harness and line, must be available.

Excavation Size and Shape
Excavations must be large enough in all dimensions for safe and easy working conditions.

Scrape all loose materials from the sides of an excavation and from walking and working areas where workers will be present.

Spoil Piles, Materials, Tools, and Equipment
Store spoil piles, materials, tools, vehicles, and equipment at least 1 m (3 ft) (CAN) or at least 0.6 m (2 ft) (USA) from the edge of an excavation, trench, or borehole.

CAUTION: Mechanized equipment must not operate closer than 1 m (CAN) or 2 ft (USA) from the edge of an excavation.

Slope spoil piles next to excavations, trenches, or boreholes at an angle not less than 45° to the vertical.

Thoroughly remove all lumps and stones from walking and working surfaces, and from excavated spoil.

Entrances/Exits
CAN: For excavations greater than 1.2 m (4 ft) deep, provide at least 2 entrances/exits.

WARNING: Where a portion of an excavation greater than 4 ft (1.2 m) deep is constructed with vertical walls, use warning signs attached to barricades or ropes, or other appropriate methods to prevent workers from entering that portion of the excavation.

USA: If workers are required to work on either side of the pipe, provide an exit on each side of the pipe.

Locate entrances/exits so that no worker travels more than 8 m (25 ft) in either direction to exit the trench.

Entrances/exits must be ladders, steps, or sloped walkways of not more than 1:3 slope.

Side rails of ladders must extend 1 m (3 ft) out of the trench or excavation.

Water Accumulation

Keep all excavations, trenches, and boreholes free of accumulations of water where workers are present.

A competent worker must monitor water removal equipment.

Water pumped from an excavation should be discharged into an energy dissipation or erosion control device located in adjacent upland areas or other well-vegetated areas.

NOTE: A permit may be required depending on the amount of water pumped from the excavation. For more information, contact Safety & Environment.

Sloping

Slope the walls of the excavation when (a) the excavation is greater than 1.2 m (4 ft) deep, and (b) shoring or a trench box is not used.

If a worker must lie down or kneel in a trench without an approved temporary protective structure, slope the trench wall from the bottom of the excavation in the area where the work will occur.

Soil Analysis

CAN

A competent worker must examine the type of soil in an excavation or trench to ensure the stability of sloping used for excavations and trenches. The angle of sloping must not be less than required by provincial regulations.

Treat frozen soil conditions the same as unfrozen soil conditions.

NOTE: Stable rock is comprised of solid mineral matter and does not require sloping.

USA

Classification of Soil and Rock

A competent worker must classify each soil and rock deposit before and during excavation as one of the following soil types:

- Type A—clay and cemented soils
- Type B—angular gravel, silt loam, crushed rock, etc.
- Type C—gravel, sand, submerged soil, etc.

NOTE: Whenever excavation work is inside the fenced area of a pump station or right-of-way (ROW), the soil should be treated as Type C, since there is a good chance it was previously disturbed. A competent worker must approve any exemptions.

USA

A competent worker must classify soil types using the following tests:

- visual test to determine:
  - qualitative information regarding the excavation site in general
  - soil properties next to the excavation
  - soil properties forming the sides of the opening excavation
  - soil properties taken as samples from excavated material
- manual test to determine quantitative as well as qualitative properties of soil, and to provide more information for classifying soil property. Manual tests include:
  - plasticity test
  - dry strength
  - thumb penetration
  - other strength tests (e.g., pocket penetrometer or hand-operated shearvane)

USA

Sloping and Benching Systems

Use one of the following options when designing slopes and benching systems of excavations under the direction of a competent worker:

Option 1: Slope or bench the excavation at an angle not steeper than one and one-half horizontal to one vertical (34° measured from the horizontal).

Option 2: Have a competent worker classify the soil using manual and visual tests, and a slope a maximum of:

- Type A: ¾:1 (53°)
- Type B: 1:1 (45°)
- Type C: 1½:1 (34°)

NOTE: For a sample bench system for Type B soil, see Figure 1.

Option 3: Install shoring or use a trench box.

Option 4: Have a registered professional engineer design a support system for the excavation.

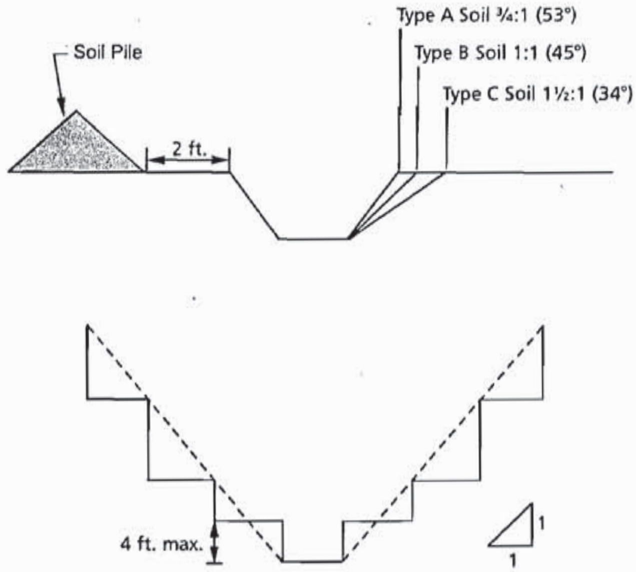


Figure 1
Sample Bench System for Type B Soil

Fences and Barricades

Within Fenced Areas

Barricade or fence off unattended excavations, trenches, and boreholes within fenced areas (e.g., stations, valve sites) as appropriate depending on:

- location of the excavation
- worker/public access or exposure to the excavation
- size of the excavation (e.g., depth, length)
- potential for workers or the public falling into the excavation
- potential for drowning
- number of exits, if any
- condition of the excavation (e.g., wet, muddy)
- length of time the excavation will be unattended

Barricades must be:

- manufactured type (wood, plastic, or metal construction)
- approximately 1 m (3 ft) high
- secured in place

In addition to barricades/fences, use suitable warning devices (e.g., reflective signs or flashing light) to provide advance warning of excavations, trenches, or boreholes that may present a hazard to night traffic.

Along the ROW

Guard unattended excavations on the ROW from unintentional entry using highly visible material (e.g., orange snow fencing). In addition, use barbed wire where livestock are present.

Support the fencing at a spacing of approximately 3 m (10 ft), and secure the fencing to each support (e.g., using wire or rope).

Erect barricades or fences approximately 1 m (3 ft) from the excavation to maintain an adequate walkway around the excavation.

Temporary Protective Structures

Consult a registered professional engineer to review the stability of any structure or foundation that may be affected by an excavation or trench. If required, design, construct, and install a temporary protective structure to support the structure or foundation in accordance with the specifications of a registered professional engineer.

Shoring

Timber shoring used in trenches and excavations must be in accordance with Table 1.

Assemble and install hydraulic shoring in accordance with the manufacturer's instructions.

When installing stringer and brace components in a shoring system, work downward from the surface using a ladder to install each brace in descending order. Use the reverse order to remove components, unless conditions make it unsafe for workers to enter the excavation. In such cases, use an alternate method of removal that protects workers from injury.

Shoring must extend a minimum of 600 mm (2 ft) above the surface of the ground or vertical trench walls.

A professional engineer must design any support system used in an excavation greater than 6 m (20 ft) deep.

Trench Boxes

Install trench boxes in excavations before workers enter, and place egress ladders inside the trench box.

Trench boxes must be (a) designed by a professional engineer, and (b) constructed, inspected, and maintained in accordance with the engineering or manufacturer's specifications.

Before installing a trench box, a copy of the Engineering Certificate or a stamped Engineering Drawing must be provided.

Trench boxes stacked in deep excavations must be adequately secured to one another.

Trench boxes must have continuous sides and must extend a minimum of 600 mm (24 in.) above the vertical wall of the excavation.

A professional engineer must design and approve hoisting hook-up and drag points. Where a trench box will be dragged forward, protect workers in the box against rigging failure by suitable protective screening or other means.

Workers must remain inside the box as long as they are in the trench, and must leave if the trench box will be lifted to be moved.

Excavation must be done to minimize the space between the trench box and the excavation wall in order to allow closer access to the top of the box and to limit soil movement in case of cave-ins:

- Low ground pressure (LGP) tracked equipment exerting 5.80 psi or less ground pressure, the depth of cover is no less than 0.9 m (36 in.) of consolidated clay soil, and repeated crossings are not required (e.g., a crossing by a D6 with 30 in. or larger track width, or a D5 with 24 in. or larger track width).
- The depth of cover is, or is increased to, 1.3 m (52 in.) or greater, the vehicle axle loading is highway legal, conditions are dry, and a company representative is onsite when vehicles are crossing the pipeline.

Table 1
Shoring Trenches

Soil Condition	Depth of Trench		Uprights				Stringers				Cross Braces							
			Dimensions		Horizontal Spacing		Dimensions		Vertical Spacing		Trenches to 6 ft wide Dimensions		Trenches 6-12 ft wide Dimensions		Horizontal Spacing		Vertical Spacing	
	m	ft	mm	in	m	ft	mm	in	m	ft	mm	in	mm	in	m	ft	m	ft
Hard	1.2 to 3	3 to 10	50 x 250	2 x 10	1.8	6	100 x 150	4 x 6	1.2	3	100 x 100	4 x 4	150 x 150	6 x 6	1.8	6	1.2	3
compact	3 to 4.6	10 to 15	50 x 250	2 x 10	1.2	3	100 x 150	4 x 6	1.2	3	100 x 150	4 x 6	150 x 200	6 x 8	1.8	6	1.2	3
ground	4.6 to 6	15 to 20	50 x 250	2 x 10	close	close	150 x 150	6 x 6	1.2	3	150 x 200	6 x 8	200 x 250	8 x 10	1.8	6	1.2	3
Soils likely to	1.2 to 3	3 to 10	50 x 250	2 x 10	1.2	3	100 x 150	4 x 6	1.2	3	100 x 150	4 x 6	150 x 150	6 x 6	1.8	6	1.2	3
crack or	3 to 4.6	10 to 15	50 x 250	2 x 10	.6	2	150 x 150	6 x 6	1.2	3	150 x 150	6 x 6	150 x 200	6 x 8	1.8	6	1.2	3
crumble	4.6 to 6	15 to 20	50 x 250	2 x 10	close	close	150 x 200	6 x 8	1.2	3	150 x 200	6 x 8	200 x 250	8 x 10	1.8	6	1.2	3
Loose	1.2 to 3	3 to 10	50 x 250	2 x 10	close	close	150 x 150	6 x 6	1.2	3	150 x 150	6 x 6	150 x 200	6 x 8	1.8	6	1.2	3
or free	2 to 4.6	6.5 to 15	50 x 250	2 x 10	close	close	150 x 200	6 x 8	1.2	3	150 x 200	6 x 8	200 x 200	8 x 8	1.8	6	1.2	3
running soil	4.6 to 6	15 to 20	50 x 250	2 x 10	close	close	200 x 200	8 x 8	1.2	3	150 x 200	6 x 8	200 x 250	8 x 10	1.8	6	1.2	3

Purpose

To protect pipelines and facilities when operating mechanized equipment or other below grade activity with the potential for damage takes place near company facilities.

Scope

This applies for both company facilities and foreign crossings.

Requirements

One-Call System

Notify the One-Call Center at least 2 or 3 working days before starting any below grade activity (see state and provincial specific Once-Call regulations).

NOTE: The One-Call Center will notify facility owners and request that all buried facilities in the area of the proposed activity are located and staked.

USA

NOTE: The Information Retrieval Ticket Handling (IRTH) system receives notification from the One-Call Center and assigns One-Call tickets to the appropriate service area. For emergency work during normal working hours and as backup to the IRTH system, the One-Call Center or the region (depending on the service area) will notify the locator directly. For emergency work after hours, the respective control centre or the region (depending on the service area) will notify the location directly

CAN

Facility owners within 30 m (100 ft) of the proposed below grade activity that are not members of the One-Call system must be contacted directly.

Facility Locates

Refer notifications of planned excavations to the One-Call Center.

When notification of a planned excavation is received and before any potentially destructive below grade activity begins, within 2 or 3 working days or a mutually agreed timeframe, depending on location, regions are responsible for:

- recording the information on the Facility Locate Request/Safety Zone Excavation Request form (CAN) as applicable, or on the One-Call ticket where positive response is required (USA)
- identifying and marking all facilities if necessary
- ensuring the applicant is advised when locating and staking is complete, and that the applicant understands the scope of work and the markings

Facility owners may conduct emergency work without advance notification provided the facility owner notifies the region.

Unauthorized Crossings

CAN

Use the Unauthorized Crossing Information report to immediately report any unauthorized ground disturbance on the right-of-way (ROW) or within 30 m of the ROW of a non company utility or road to Lands & Right-of-Way.

USA

Use the One-Call Violations form to immediately report any unauthorized ground disturbance on the ROW to the regional office. Regions are responsible for:

- providing One-Call Center information to the offending worker and/or the company
- ensuring one-call violators are included in the list of excavators
- for subsequent violations, notifying state or federal regulators as necessary

Surface Locating

Before beginning mechanical excavation/trenching or other potentially destructive below grade activity, all facilities (a) within the perimeter of the excavation and (b) extending 3 m (10 ft) outside the perimeter of the excavation, or for ENB (Athabasca) extending 5 m (16.5 ft) outside the perimeter of the excavation, must be surface located.

NOTE: To identify the location of facilities in the work area, refer to as built drawings, mainline route/alignment sheets, station piping, instrumentation and cathodic protection drawings, electrical drawings, and/or station photographs. In addition, consult with field employees familiar with the site to identify any other below grade facilities that may not be recorded.

Use a line locator to identify all below grade facilities within the work area.

Use flags, stakes, or paint in accordance with the universal color codes to mark (a) the centerline of facilities, and (b) any changes in direction or elevation.

Space markers (a) no more than 3 m (10 ft) apart directly over the centerline of the facility, or (b) at appropriate intervals on the ROW.

For foreign crossings, identify stakes with:

- company name
- ℄ to denote facility centerline
- size and type of facility (e.g., 20-in. Line 1, conduit, high voltage)
- depth below grade, if required

NOTE: Identify the depth below grade before excavating to prevent an excavator from crossing without approval or notification.

Staking of company facilities is not required when the proposed activity is outside the ROW for a specified work period. However, the ROW boundary must be clearly identified using stakes with pink marking at the top (e.g., tape, paint) or pink flags, and writing in permanent marker (a) on one side, "Restricted Area", and (b) on the other side, the limit represented (e.g., "Enbridge P/L ROW").

Where the proposed activity is separated from the company facility (or ROW) by an existing boundary (e.g., fence, hedge, noise barrier) it is not necessary to mark the ROW boundary.

All facilities within station property that are less than 1 m (3 ft) above grade or that are protected by less than 0.3 m (1 ft) of cover should be (a) permanently marked with stakes that extend a minimum of 1 m (3 ft) above grade and (b) flagged, if necessary, to ensure visibility.

NOTE: In roadways and driveways, permanent marking is not feasible. Each side of these areas should be marked to indicate the pipeline alignment.

Confirm the number, locations, and dimensions of facilities with as-built drawings and other field records to ensure all facilities are located.

Markers

There must be a clear line of vision between markers identifying a particular facility location.

All markers must be highly visible to equipment operators despite local conditions (e.g., wind, snow).

Markers must remain in place for the duration of the work activities. If any markers become dislodged, notify the site inspector.

Before resuming activities previously initiated by other workers, review the location and identification of facilities.

Positive Confirmation

Once the location of below grade facilities are surface located, before beginning mechanical excavation or any other potentially destructive below grade activity, the location, depth, and size of below grade facilities within the perimeter of the excavation must be positively confirmed by hand digging, water washing, or repeated probing to ensure clearances.

NOTE: Positively confirm any changes in pipe alignment, elevation, or any appurtenances (e.g., plugs, O-lets and other fittings, flanges, branch piping).

WARNING: Cover any hand dug or water washed holes with plywood or erect suitable barricades.

Clearances

Mechanized equipment must remain at least 0.6 m (2 ft) from any below grade facility (based on drawings, instrument readings, and/or probing) until the facility is exposed (i.e., daylighted) by hand digging or water washing to the view of the equipment operator or spotter.

NOTE: Where safe to do so, probe while excavating to ensure minimum clearances are maintained until the below grade facility is exposed to view.

With the facility exposed and in view of the equipment operator or spotter, the cutting edge of mechanized equipment must remain clear of below facilities by at least 0.3 m (12 in.). Final exposure of underground facilities must be done by hand.

Foreign Crossings

Before mechanical excavation or other potentially destructive below grade activity begins for a foreign crossing on the ROW or within 3 m (10 ft) of the company's pipeline, the location, depth, and size of the company's pipeline must be positively confirmed as follows:

- Where the foreign facility will cross the company's pipeline(s), each pipe must be exposed (i.e., daylighted) at the point of crossing by hand digging or water washing. However, if (a) the top of the pipe on drawings and instrument readings is more than 0.6 m (2 ft) below the proposed excavation/underground activity at the point of crossing, or (b) ground conditions or the depth of the pipe make exposure by hand digging or water washing impractical, the excavation may proceed under direct supervision of the company representative to no closer than 0.6 m (2 ft) from the pipe, confirmed by repeated probing as the excavation progresses. Final exposure must be done by hand.

- Where the foreign facility will be constructed adjacent or parallel to a company pipeline outside the ROW, the pipe must be located at sufficient intervals to confirm its position or direction by hand digging, water washing, or probing under the direct supervision of the site inspector.

Boring

When a boring device is used to install a facility across one or more pipelines, the location of the boring device must be positively confirmed by excavating a test hole before and between each facility.

Pilings

Before installing pilings within stations, the location of below grade facilities must be positively confirmed and piling holes water washed, 0.3 to 0.6 m (1 to 2 ft) below the intended depth of the pilings.

Temporary Crossing Ramps

Use temporary crossing ramps (see Figure 1) when vehicles pass over existing pipelines where:

- ruts are likely to develop at the crossing
- depth of cover (i.e., top of pipe to ground) is less than 1.3 m (52 in.)
- vehicle single axle loading exceeds 12,000 kg (25,000 lb)
- vehicles will be continually crossing (e.g., logging trucks)
- the pipeline to be crossed has been installed for under a year
- the crossing lies in a wet area (e.g., marsh, swamp, peat bog)

NOTE: Vehicle crossings in normally wet areas are prohibited unless winter conditions exist and frost depth is 0.3 m (1 ft) or greater.

Temporary crossing ramps may not be required where:

- the vehicles crossing the pipeline are low ground pressure (LGP) tracked equipment exerting 5.80 psi or less ground pressure, the depth of cover is no less than 0.9 m (36 in.) of consolidated clay soil, and repeated crossings are not required (e.g., a crossing by a D6 with 30 in. or larger track width, or a D5 with 24 in. or larger track width)

- the depth of cover is, or is increased to, 1.3 m (52 in.) or greater, the vehicle axle loading is highway legal, conditions are dry, and a company representative is onsite when vehicles are crossing the pipeline

Construct temporary crossing ramps to provide 1.6 m (63 in.) of cover over the pipeline (see Figure 1). Contact Lands & Right-of-Way if situations do not fit the listed conditions, before relaxing the standard, or if soil conditions are questionable.

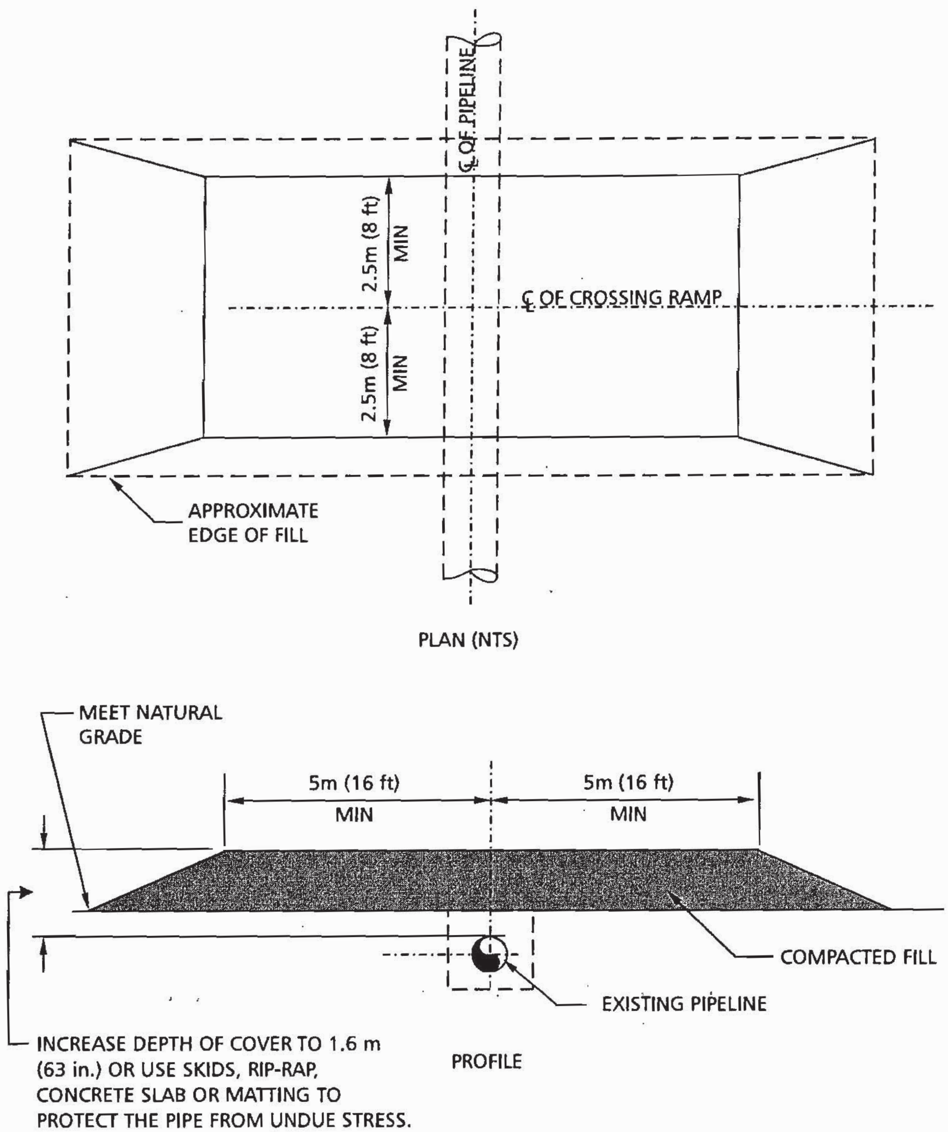
Before constructing temporary crossing ramps, contact the regional engineer (USA) or Lands & Right-of-Way (CAN).

Remove temporary access ramps upon completion of the work.

Records

One-Call Violation Form

USA — Retain One-Call Violation forms at the region for 3 years.



NOTES

- In rock terrain, expose pipes and backfill the ditch with compacted sand or selected fill.
- When crossing multiple pipelines, construct one continuous ramp across such lines.
- Ramp length varies in accordance with the crossing angle.
- On project completion, remove the entire ramp and restore the area.
- During winter, snow and water can be used to make an ice bridge of equal proportions.

Figure 1
Temporary Ramp

Related Standards

Company

Book 2: Safety

- *11-02-07 Heavy Equipment*

Book 3: Pipeline Facilities

- *04-02-01 Safeguarding Workers and Public*
- *04-02-02 Damage Prevention*

Responsibilities

Equipment Operators

Before operating equipment in the work area, operators are responsible for:

- verifying the location of above and below ground pipes, cables and conduits in the work area
- discussing and agreeing on hand signals with the designated spotter
- ensuring spotters understand their responsibilities

Qualifications

Operators of excavating equipment must be qualified (i.e., Ground Disturbance Level II [CAN], OQ [USA]) on the type of equipment used, and working around below grade facilities and within congested areas (i.e., previous industrial/plant experience).

Personnel performing damage prevention and excavation activities in the U.S. need to have completed operator qualification (OQ) documentation or be working with a qualified person under the appropriate span of control ratio per the company OQ Plan.

Spotters

CAN — Spotters must be qualified (Ground Disturbance Level II)

Spotters are responsible for:

- checking the location of above and below ground pipes, cables, and conduits in the work area using agreed-on hand signals to assist the operator in maintaining required clearances and depth of cuts
- observing progress and using hand signals and/or verbal communication to alert the operator to potential dangers
- where the operator loses sight of a facility, probing to locate the facility
- manually removing soil within 0.3 m (1 ft) of a facility
- stopping the work if unmanaged or unexpected hazards arise (e.g., unidentified facilities, contact between the excavation equipment and a facility)

NOTE: Unreported contact between excavating equipment and a facility will result in disciplinary action.

Requirements

Excavating must always be done by two workers, the equipment operator and a spotter.

Operator Qualification (OQ) is required if performing damage prevention during excavation activities in the U.S.

Equipment

Gradalls, backhoes, or excavators may be used as excavation equipment.

Buckets with teeth may be used where conditions allow (e.g., frozen ground, rock, demolition of abrasive materials such as concrete or asphalt, areas with no below grade facilities), on approval by the company representative and the site supervisor.

Procedure

Excavating the Worksite

⚠ **CAUTION:** Use extreme caution when machine excavating in high-risk areas containing buried facilities. Vacuum excavation or manual excavation are required when possible in congested areas.

1. Request locates of foreign facilities.

2. Arrange to have landowners/tenants contacted for access, if applicable.

3. Determine storage requirements for topsoil and spoil piles.

4. Make/receive One-Call notification:
   a) Print a copy of the One-Call notification when it is received. Establish if notification is routine or an emergency.
   b) Determine if company pipelines are within the excavation site. If the location of excavation is unclear, call submitter of One-Call. If necessary, meet in field at proposed excavation site to confirm.
   c) If the excavation location is verified as 'no conflict' with company pipelines, notify the One-Call submitter as required by state One-Call laws.
   d) If the excavation site is verified as 'conflict' with the company pipelines, call the One-Call submitter and arrange a meeting at the excavation site, if necessary, to discuss the excavation procedures.

5. Determine the width of the right-of-way (ROW) and temporary workspace.

6. Locate and stake company facilities.
7. Positively identify and mark potential hazards.
8. Take photographs for restoration reference.
9. Notify the control center of beginning and end of work day excavation.
10. Erect wind sock.
11. Obtain a Safe Work Permit.
12. Arrange to have vegetation cleared from the worksite.
13. Discuss the excavation procedure with the equipment operator.
14. Set up safety equipment.
15. Secure area by posting signs and erecting barricades or fences.
16. Notify the control center.
17. Gather the required equipment, including the proper personal protective equipment.
18. Strip topsoil from the worksite and access road, if necessary.
19. Excavate the site and install pipe supports in accordance with company procedures that reference slope, step, shore, clearance distance, etc.
20. Inspect exposed pipe and monitor excavation activities.
21. Complete project activities.
22. Backfill and restoration in accordance with company procedures.
23. Get approval from landowner through Lands & Right-of-Way, if applicable.

Legislation

Canada

Canada Labour Code, Part II:

- Canadian Occupational Safety and Health (COSH) regulations

Provincial/territorial occupational health and safety regulations

Requirements

Vehicles

NOTE: Internal combustion engines—gasoline and diesel—on mobile and stationary equipment, if improperly equipped or operated, provide several sources of ignition, not least of which are sparks from starting and ignition systems.

Vehicles left unattended in a restricted or hazardous area must be shut off and not restarted until air monitoring confirms the absence of hazardous vapors.

Diesel-fueled equipment used in hazardous or restricted areas must have the exhaust system fitted with a functional spark arrester, excluding turbocharged equipment.

Spark arresters must be fully functional before working in hazardous or restricted areas. To remain effective, spark arresters must be periodically blown clean with compressed air through the cleanout plug.

Diesel-fueled equipment used in hazardous or restricted areas should have the air intake system fitted with a positive air shut-off. If not equipped, constant air monitoring is required when diesel-driven equipment is used in hazardous or restricted areas.

Do not stop vehicles in areas where there is combustible ground cover like dry grass or straw.

Matches and Lighters

Safety matches (i.e., those ignited on the box or folder) and lighters with enclosed mechanisms (i.e., flip-top type) may be carried by workers at the work site. Strike-anywhere matches and lighters with open mechanisms, including disposable lighters, must be left in designated areas (e.g., vehicles).

> ⚠**WARNING**: Disposable butane lighters are added hazards around any hot work. Sparks or hot slag can melt the plastic container and ignite the butane, causing serious injury.

Electric Sparks

NOTE: Vehicles, electric hand tools and other electrically powered equipment not certified for use in hazardous areas, usually produce electric sparks.

Use only explosion-proof electrical installations and explosion-proof electrical equipment in hazardous areas.

Use only intrinsically safe electronic devices (e.g., cell phones, pagers, radios, cameras) in hazardous and restricted areas, unless the air (a) is initially tested and verified as non combustible and (b) is continuously monitored for combustible/flammable vapors.

Do not position airfield floodlights and power units near combustible or flammable material (where they could become ignition sources).

Static Electricity

NOTE: Static electricity is a source of ignition in refined petroleum product fires. Static electricity builds up through the flow of a liquid, and can accumulate on containers with different potential unless there is an electrical bond between the two containers. Failure to bond containers can result in a static spark and, in the presence of oxygen, cause an explosion in a tank, pipe or other container.

When flammable liquids flow from one container to another (e.g., when taking a gasoline sample off the line into a container), ground or electrically bond the containers to each another (for detailed procedures, see *Book 3: Pipeline Facilities, Tab 06 Pipe Repair and Modification*).

Hot Surfaces

NOTE: Any hot surface with enough heat to vaporize a combustible material is a source of ignition (e.g., catalytic converter of an automobile in dry grass).

Avoid drilling metals without sufficient lubrication or mechanically cutting pipe at speeds that produce excessive heat.

Inspect and maintain equipment; friction in a defective or under-lubricated equipment bearing can overheat the bearing and cause a fire by vaporizing and igniting lubricating oil.

Oily Rags

Store and dispose of oily rags in approved containers.

Pyrophoric Deposits

NOTE: Pyrophoric iron sulfide is a black deposit that can build up in locations such as storage tanks, seal pots, piping and metal sumps. It develops through hydrogen sulfide in contact with iron. When the deposit dries, it can ignite spontaneously.

NOTE: For more information on pyrophoric iron sulfide in storage tanks, see *Book 3: Pipeline Facilities, Tab 09 Tank Maintenance*.

06-Pipe Repair & Modification

Subject

Locking Out Equipment—Standard Procedure

Purpose

To ensure:

- equipment or motors do not start up unexpectedly during maintenance
- line flow, pressure and secondary energy sources are isolated
- electrical shorts or arcs are prevented
- workers are protected against the unexpected release of stored electrical, mechanical, pneumatic or hydraulic energy

Legislation

Canada

Canada Labour Code, Part II:

- Canadian Occupational Safety and Health (COSH) regulations

Provincial/territorial occupational health and safety regulations

United States

Code of Federal Regulations (CFR), Title 29 Labor:

- Part 1910.147—Control of Hazardous Energy (Lockout/Tagout)

Definitions

energy-isolating device—a mechanical device that physically prevents the transmission of released energy.

Hazards

- energized electrical equipment
- rotating equipment (e.g., pump shafts)
- liquids under pressure
- flammable fluids

Responsibilities

Management

Operations managers and site supervisors must ensure:

- correct lockout procedures are followed
- workers are appropriately trained in lockout procedures
- lockout devices are provided at each location

Field Inspections

Operations management must inspect lockout procedures as part of field inspections. In addition, supervisors must conduct routine inspections to ensure appropriate lockout procedures have been established and are being followed.

Requirements

Workers have the authority to and are responsible for stopping and/or correcting work if lockout procedures are not being followed.

If vapor sensors will be disarmed, deactivate only the sensors being worked on.

Procedure

1. Identify and locate all potential energy sources to be isolated:

   a. Review the scope of work

   b. Review drawings if applicable

   c. Visually inspect the equipment components being worked on to verify drawings

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NOTE: It may be necessary to access equipment compartments to verify potential energy sources.

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2. Notify affected workers that a lockout will be in effect and explain the reason for the lockout.

3. Shut down operating equipment.

4. Isolate equipment from its energy source by operating the switch, valve or other energy-isolating device.

NOTE: For information on isolating specific types of high-voltage electrical equipment, see *07-03-01 De-energizing or Switching High-Voltage Equipment*.

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5. Relieve, disconnect or restrain potentially hazardous stored or residual energy.

   - For electrical energy, locate and open the correct electrical disconnect switch or other similar device (see *07-03-01 De-energizing or Switching High-Voltage Equipment*).

   - For mechanical energy (e.g., rotating couplings or elevated equipment parts), disconnect or block equipment.

   - For thermal, chemical, flammable, pneumatic or hydraulic energy in lines or piping:

     a. Close valves.

     b. Disconnect, and drain, and purge and/or vent lines.

     c. Install isolating blanks or blinds.

6. Lock and tag the equipment.

NOTE: Do not use tags without locks unless equipment is physically incapable of being locked out.

7. Verify the lockout by confirming that energy sources have been isolated and locked out. (Operate the pushbutton or other normal operating control to ensure equipment will not operate.)

8. Proceed with maintenance.

NOTE: For restoration procedures, see *06-03-02 Restoring Locked Out Equipment*.

NOTE: For information on returning high-voltage equipment to service, see *07-03-04 Re-energizing High-Voltage Equipment*.

Records

Electrical Equipment Isolation/Clearance Form

If the lockout involves electrical equipment, use the Electrical Equipment Isolation/Clearance Form where required and retain onsite for a minimum of 2 years. (see *07-03-01 De-energizing or Switching High-Voltage Equipment*).

Equipment Lockout Checklist

Lockout checklists specific to site equipment must be developed and retained onsite.

Purpose

To cut hot pipelines for repair or modification using a Wachs or Fein saw.

Related Standards

Company

Book 2: Safety

- *03-02-01 Safe Work Permit – Hazard Assessment*
- *11-02-01 Tool Operation*
- *Tab 13 Personal Protective Equipment*
- *14-02-04 Firefighting Equipment*

Book 3: Pipeline Facilities

- *Tab 04 Trenching and Excavations*
- *06-03-01 Grounding Pipe for Induced Voltage*
- *06-03-03 Drainup/Linefill*
- *06-03-06 Purging the Pipeline with Nitrogen*
- *06-03-21 Bonding for Static Electricity*

Requirements

Prerequisite

Before using pipe saws, check:

- for loose, missing or broken parts
- the condition and operation of the cutter wheel and guide wheels or rollers
- that the cutter has all the parts, spare parts, and accessories needed for the cut

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NOTE: In cold conditions, consider using synthetic oil or ensure the oil in the power units has been circulated prior to cutting.

Procedure

Cutting the Pipe

1. Excavate the site and install pipe supports.

2. Attach slings to control swing of the pipe.

3. Evacuate the line as per *06-03-03 Drainup/Linefill* and *06-03-06 Purging the Pipeline with Nitrogen.*

4. Prepare to make the cut:
   a) NDT should be considered before making a cut.
   b) Determine where the cold cut will be made on the pipe, allowing extra pipe for hot cuts and fit-up.
   c) Remove the pipeline coating and clean the immediate area.

d) Install bonding cables (see *06-03-01 Grounding Pipe for Induced Voltage*) between the upstream and downstream pipe sections, and to the pipe section.

e) Check the pipe for induced voltage.

f) Mount the cutter on the pipeline. If using the Fein Saw, ensure it is on the section of pipe to be removed.

g) Attach guide chains and turnbuckle segments.

h) Position saw with all wheels touching and in line with the proposed cut.

i) Tighten turnbuckle to tension chain.

j) Connect power pack.

k) Adjust cutter to track straight, set and adjust tension nut while rotating cutter and ensure proper direction.

NOTE: Ensure fire extinguishers are ready and the fire watch is on alert (see *Book 2: Safety, 14-02-04 Firefighting Equipment*). Two 30# dry chemical extinguishers must be onsite.

⚠ WARNING: The pipe may spring suddenly as the cut completes. Watch both sections of pipe for movement or binding, and add or change supports as necessary.

⚠ CAUTION: Do not use air or hand-operated saws at speeds that create pipe surface temperatures over 121°C (250°F).

5. Cold cut the pipe.
   a) Turn on saw and engage lubrication.
   b) Advance cutter wheel into pipe until pipe is cut into.
   c) Monitor both sections of pipe during cutting for signs of movement or binding. Wedge open as necessary to prevent binding of cutter wheel.
   d) Add or change pipe supports as necessary to keep pipe from moving.

⚠ CAUTION: As the cut nears completion, the pipe may twist or demonstrate stress that could cause the pipe to tear and possibly damage the saw. Consider raising the blade and moving the saw into the center of the remaining uncut section. Lower the blade and finish the cut.

6. Complete the cut.

NOTE: If the mainline pipe is subject to compressive forces, the section may continue to be securely bound through frictional forces with the mainline pipe. Additional cuts may be necessary to obtain the necessary clearance for removal.

7. Remove cutter.
   a) Ensure pipe is cut completely through and all the way around.
   b) Take saw out of gear.
   c) Retract cutter wheel with handle.
   d) Turn off cutter wheel lubrication.
   e) Shut off and disconnect saw power supply.
   f) Remove chain sections.
   g) Lift saw from top of pipe, watching for pipe movement as cutter is being removed.

8. Complete drainup if there is any product remaining in the pipe.

WARNING: Use caution when rolling pipe out of position as compression forces between the cut section and the original line can cause extreme heat from friction. More cold cuts may be necessary to relieve this situation.

9. Roll the pipe sideways out of position.

10. Remove bonding cables.

11. Lift the pipe section from the ditch.

12. Place the pipe in a safe location on the right-of-way (ROW) away from the worksite.

13. Tag the pipe.

14. File sharp edges of the pipe or cover with a split rubber hose to prevent lacerations.

15. Inspect the inside of cut out pipe for internal corrosion.

16. Contact Pipeline Integrity to determine if further analysis is required.

Related Standards

Canada

Canadian Standards Association (CSA):

- CSA Z662 – Oil and Gas Pipeline Systems

Canadian General Standards Board (CGSB):

- CAN/CGSB 48.9712 - Nondestructive Testing; Qualification and Certification of Personnel

United States

American Petroleum Institute (API):

- ANSI/API Std 1104 – Welding of Pipelines and Related Facilities, Section 9

American Society for Non-destructive Testing (ASNT)

- ASNT SNT-TC-1A – Nondestructive Testing

Requirements

All welds must be nondestructively inspected in accordance with CSA Z662 (CAN), or API Std 1104, Section 9 (USA).

Workers must be aware of company policies concerning weld inspection to ensure standards are met.

Use contractors for:

- magnetic particle inspection (MPI)
- ultrasonic inspection (except to determine wall thickness)
- radiographic inspection

CAN — Contractors who are retained to perform nondestructive examination (NDE) must be hired directly by the company and must not be subcontracted through a second or third party.

Contractors must submit a written procedure describing the nondestructive testing method that includes as a minimum:

- equipment used
- calibration of the equipment
- how to use the equipment

Qualification

CAN — Contractor personnel establishing inspection procedures or techniques, scanning weldments, or interpreting results must be qualified to Level II or Level III in accordance with CAN/CGSB 48.9712-2000.

USA — Contractor personnel establishing inspection procedures or techniques, scanning weldments or interpreting results must be qualified to Level II or Level III in accordance with ASNT RP SNT-TC-1A.

Visual Inspection

Observe the welding process to ensure the weld is completed according to the qualified procedure.

Fillet Welds

For all welding on in-service pipe, inspect the weld for defects using MPI (a) immediately after completing the weld, and (b) at least 12 hrs after completing the weld. If MPI identifies crack indications, complete ultrasonic inspection on all suspected areas.

Any undercut must be blended out and the area re-examined. Cracks, regardless of length, are defects that must be repaired (see *Book 3: Pipeline Facilities, Tab 06 Pipe Repair and Modification*).

NOTE: Exceptions to the 12-hr wait for branch connections reinforced with a saddle or split tee (see below) and in special circumstances must be approved by regional management.

When adding a branch connection that will be reinforced with a saddle or split tee, the weld between the branch and the mainline can be inspected immediately after welding. The 12-hr waiting period must be observed before nondestructive examination of the fillet welds between the branch and the reinforcement and between the run pipe and the reinforcement.

Magnetic Particle Inspection

Use magnetic particle inspection to check:

- fillet welds
- nozzle welds
- sleeve long-seam welds
- longitudinal welds on pipe (manufacturers' welds)

NOTE: For more information, see *02-03-03 Magnetic Particle Inspection of Fillet Welds*.

Ultrasonic Inspection

Use ultrasonic inspection to:

- evaluate pipe wall thickness
- evaluate internal corrosion
- examine fillet welds
- examine nozzle welds
- examine longitudinal welds on pipe (manufacturers' welds)

NOTE: For more information, see *02-03-04 Ultrasonic Inspection of Fillet Welds*.

Radiographic Inspection (X-Ray)

Use radiographic inspection (or x-ray) to examine:

- butt welds

NOTE: For more information, see CSA Z662 (CAN) and ANSI/API Std 1104 (USA).

NOTE: In Canada, ultrasonic inspection may be used as an alternative to radiographic inspection at the company's discretion.

Defects

Welds that exceed the defect acceptance criteria of CSA Z662 (CAN) or ANSI/API Std 1104 (USA) must be repaired or removed (see *02-02-04 Defect Repair*).

Records

Nondestructive Testing Report

Record the results of ultrasonic and magnetic particle inspections of fillet welds using the Nondestructive Testing Report.

USA .... Retain all Nondestructive Testing Reports permanently in the PLM Activity Reporting database.

X-Ray Inspection of Girth Welds Form

Record the results of radiographic inspection of butt welds using the X-Ray Inspection of Girth Welds form.

USA .... Retain all X-Ray Inspection of Girth Welds forms permanently in the PLM Activity Reporting database.

NOTE: When restoring a protective device lockout of units and booster pumps, follow the procedure in *07-03-04 Re-energizing High-Voltage Equipment*.

Legislation

Canada

Canada Labour Code, Part II:

- Canadian Occupational Safety and Health (COSH) regulations

Provincial/territorial occupational health and safety regulations

United States

Code of Federal Regulations (CFR), Title 29 Labor:

- Part 1910.147—Control of Hazardous Energy (Lockout/Tagout)

Hazards

- energized electrical equipment
- rotating equipment (e.g., pump shafts)
- liquids under pressure
- flammable fluids

Requirements

Workers must remove only the lockout devices that they installed, unless following emergency lock removal procedures.

Procedure

Standard Lock Removal

1. Obtain clearance from individuals with applied locks.
2. Notify affected workers in the startup area that the equipment will be re-energized.
3. Replace equipment guards if previously removed.
4. Remove tools and equipment used for repairs.
5. Remove the lock and tag.
6. Restore isolating devices (e.g., switch, valve) to their original operating position.
7. Notify operators that the equipment is back in service.

Emergency Lock Removal

NOTE: An emergency may require the removal of personal locks by someone other than the installer.

1. Contact the person who installed the lock to determine the status of the equipment.
   - If the installer is unavailable, arrange for the supervisor or designate to review the work order (where contractors' locks are involved), and inspect the equipment to determine if the repair has been completed.
2. Notify affected workers in the startup area that the equipment will be re-energized.
3. Replace equipment guards if previously removed.
4. Remove tools and equipment used for repairs.
5. Remove the lock and tag.
6. Restore isolating devices (e.g., switches, valves) to their original operating position.
7. Notify operators that the equipment is back in service.
8. Immediately, or as soon as possible, inform the person who installed the lock that the lock has been removed.

Purpose

To drainup before replacing a section of mainline pipe during planned and emergency repairs.

Related Standards

Company

Book 2: Safety

- *Tab 03 Hazard Assessment*
- *05-02-02 Ignition Sources*
- *06-02-01 Lockout Equipment*
- *Tab 08 Hazardous Materials*

Book 3: Pipeline Facilities

- *01-02-03 Field Work Request*
- *06-03-17 Tightening and Torquing Flanges*
- *06-03-21 Bonding for Static Electricity*

Engineering Design Standards:

- D06-106 Piping Design and Construction, Auxiliary

Pipeline Repair Job Planning Template

Requirements

Maintenance Scheduling

The pipeline must be shut down when drainup is involved, except when a bypass has been installed. If a line shutdown is required, obtain approval from the control center (see *01-02-03 Field Work Request*).

Ensure a proper outage is requested from the control center.

Recovery

Ensure a plan is established for recovery of product during drainup (e.g., tanker truck, vacuum truck, portable tanks).

Take drainup directly into tanker trucks or a fabricated storage device.

> **WARNING**: Petroleum vapors or other hazardous materials may be released during drainup/linefill. For precautions, see *Book 2: Safety, Tab 08 Hazardous Materials*.

Inject oil back into the pipeline system when work is complete.

Estimating Drainup Volumes
Example

USA **NOTE:** Use barrel conversions for calculating drainup/linefill.

Estimate the drainup volume for a worksite at KP 2.5 on Line 1 (see Figure 1 and Figure 2).

- The mainline valves at KP 0 and KP 2.75 are closed.
- Between these valves, Line 1 pipe has an outside diameter of 508 mm and wall thickness of 11.9 mm.

1. Find the volume per kilometer for the size(s) of pipe in the drainup section (see Table 1).

   As Table 1 does not list the 11.9 mm wall thickness shown in the example, use the following calculations:

   Inside diameter $= \textit{outside diameter} - (2 \times \textit{wall thickness})$
   $= 508\ mm - (2 \times 11.9\ mm)$
   $= 484.2\ mm$

   Radius $= \textit{internal diameter} \div 2$
   $= 484.2\ mm \div 2$
   $= 242.1\ mm$

   Area $= Pi \times Radius^2$
   $= 3.14 \times 242.1^2$
   $= 184{,}043\ mm2$
   $= 0.184\ m2$

   Volume/km $= 0.184\ m^2 \times 1000\ m/km$
   $= 184\ m3/km$

2. Use the elevation profile to determine each length of downstream pipe that slopes down to the worksite, and calculate the drainup volume of each slope.

   e.g.,

   a. *Follow the elevation profile downstream of KP 2.5 until the first high point is reached (point A).*

NOTE: This section will drain to the worksite because it is higher and slopes continuously down to the worksite.

   b. *Scale off the distance from KP 2.5 to point A.*

   Distance, KP 2.5 to point A $= 2.55 - 2.50 = 0.05\ km$

   c. *Find the volume between KP 2.5 and point A (V1):*

   Drainup $= \textit{distance} \times \textit{volume/km}$
   $= 0.05\ km \times 184\ m^3/km$
   $= 9.2\ m3\ (V1)$

d. *Draw a horizontal line from point A downstream to where it intersects the elevation profile (point B).*

NOTE: The volume between point A and point B will not drain because it is in a dip.

e. *Follow the elevation profile downstream of point B until the next high point is reached (point C).*

NOTE: This section will drain to the worksite because it is higher and slopes continuously down to the worksite.

f. *Scale off the distance between Point B and Point C.*

Distance, point B to point C = 2.62 – 2.59 = 0.03 km

g. *Find the volume between point B and point C (V2):*

Drainup $= \text{length} \times \text{volume/km}$
$= 0.03 \text{ km} \times 184 \text{ m}^3\text{/km}$
$= 5.5 \text{ m3 (V2)}$

h. *Draw a horizontal line from point C downstream to where it intersects the elevation profile (point D).*

NOTE: The volume between point C and point D will not drain because it is in a dip.

i. *Follow the elevation profile downstream of point D until the sectionalizing valve at KM 2.75 is reached.*

NOTE: This section will drain to the worksite because it is higher and slopes continuously down to the worksite.

j. *Scale off the distance between point D and the valve.*

Distance, point D to the valve = 2.75 – 2.74 = 0.01 km

k. *Find the volume between point D and the valve (V3):*

Drainup = *length x volume/km*
= *0.01 km x 184 m3/km*
= *1.8 m3 (V3)*

3. Calculate the total drainup volume from downstream of the worksite.

e.g., Total downstream drainup = V1 + V2 + V3
= 9.2 m3 + 5.5 m3 + 1.8 m3
= 16.5 m3 (V4)

4. Use the elevation profile to determine each length of upstream pipe that slopes down to the worksite, and calculate the drainup volume of each slope.

   e.g.,

   a. *Draw a horizontal line from KP 2.5 upstream to where it intersects the elevation profile (point E).*

NOTE: The volume between KP 2.5 and point E will not drain because it is in a dip.

   b. *Follow the elevation profile upstream of point E until the next high point is reached (point F).*

NOTE: This section will drain to the worksite because it is higher and slopes continuously down to the worksite.

   c. *Scale off the distance between point E and point F.*

      Distance, point E to point F = 2.06 – 1.96 = 0.10 km

   d. *Find the volume between point E to point F (V5):*

      Drainup = length x volume/km
      = 0.10 km x 184 m3/km
      = 18.4 m3(V5)

   e. *Draw a horizontal line from point F upstream to where it intersects the elevation profile (point G).*

NOTE: The volume between Point F and Point G will not drain because it is in a dip.

   f. *Follow the elevation profile upstream of point G until the next high point is reached (point H).*

NOTE: This section will drain to the worksite because it is higher and slopes continuously down to the worksite.

   g. *Scale off the distance between point G and point H.*

      Distance, point G and point H = 1.78 – 1.76 = 0.02 km

   h. *Find the volume between point G and point H (V6):*

      Drainup = length x volume/km
      = 0.02 km x 184 m3/km
      = 3.7 m3(V6)

NOTE: A horizontal line drawn from Point H does not intersect the elevation profile between KP 0 and Point H. Therefore, this section will not drain.

5. Calculate the total upstream drainup volume.

   e.g., Total upstream drainup volume $= V5 + V6$
   $= 18.4\ m3 + 3.7\ m3$
   $= 22.1\ m3\ (V7)$

6. Calculate the total drainup volume.

   e.g., total drainup $=$ *downstream (V4) + upstream (V7)*
   $= 16.5\ m3 + 22.1\ m3$
   $= 38.6\ m3$

NOTE: Be prepared for greater than calculated estimates in case of incorrect calculations, errors in the elevation profiles, or malfunctioning shutoff valves.

Procedure

Drainup

WARNING: During drainup, continuously monitor petroleum vapor with a gas detector.

WARNING: Verify benzene levels prior to commencing work.

1. Notify the control center to verify outage. Reference the isolation procedure in the Pipeline Repair Job Planning Template.

2. Isolate the section of pipe to be drained by closing and locking out upstream and downstream valves, by using Stopples, or by using a pipeline isolation tool.

3. Configure the drain connection (see Figure 3):
   a) Install a flanged fitting.

NOTE: For more information, see Engineering Design Standard D06-106.

   b) Install a full bore tapping valve.
   c) Mount a tapping machine and drill a hole through the open valve to tap the pipe.
   d) Install a bonding cable between the flanged fitting and Stopple machine (see Figure 3).
   e) Install a tee with a pressure gauge on the branch.
   f) Install a drain valve.

4. Connect bonding cable(s) between the pipe and the drain tray or vacuum truck (see *06-03-21 Bonding for Static Electricity*).

5. Slowly open the tapping valve and the drain valve, and proceed with drainup.

> ⚠ **WARNING**: Ensure a fire watch is standing by during draining.

6. Stop the drainup, close the drain valve, and monitor the pressure gauge:
   - If pressure increases, confirm that all mainline valves are closed and locked out (see the Pipeline Repair Job Planning Template).
   - If there is no pressure increase, continue drainup.

NOTE: When no more product can be drawn from the connection, open any available vent valves. Insert a small hose or stand pipe through the drainup nozzle to suck out the remaining product.

7. When drainup is complete:
   a) Dip the pipe to ensure it is empty
   b) Disconnect the drain hoses/piping
   c) Disconnect the bonding cable(s)

NOTE: Long lengths of exposed pipe may continue to drain due to liquid expansion from solar heat or higher ambient temperature.

Procedure

Linefill

NOTE: Before work begins, the startup line procedure and maximum allowable pressure must be determined and agreed to, in writing, by the regional manager (or their designate) and the control center manager (or their designate) using the Pipeline Repair/ Modification Work Job Planning Template.

Field personnel must remain in close contact with the control center until such time that linefilling and venting is achieved, the predetermined pressure is reached and the line is stabilized.

Safe Work Zone
Workers and ignition sources (including vehicles and heaters) must be positioned in the safe work zone (17 m/56 ft) upwind of the excavation until such time that linefilling and venting is achieved, the predetermined pressure is reached and the line is stabilized.

NOTE: The safe work zone distance is based on mild wind conditions for medium crude and a 60 psi release potential. See Table 2 and Table 3 for safe work zone determination during hazard assessment. Fixed facilities where ignition sources may be present must be considered when determining safe work zone.

Only essential personnel are permitted to enter the hazardous area to perform specialized tasks (i.e., checking vents) with a clear means of egress established upwind. Nonessential personnel must not be positioned downwind nor enter the hazardous area.

1. Ensure the sealing integrity of the system:
   a) Torque flanges in accordance with *06-03-17 Tightening and Torquing Flanges.*
   b) Close the drain valves and any vent valves
2. Remove isolation/lockout device as per the lockout/isolation procedure.
3. One at a time, open the mainline valves slowly to refill the pipe. Ensure pressure equalization of the first valve prior to opening the second valve.

> **WARNING**: Avoid sudden pressure buildup and ensure a fire watch is standing by during linefill.

4. Verify there are no leaks as the section is flooded.
5. Connect high point vent valve(s) into a large container or tank truck. Ensure connections are adequately secured to avoid becoming loose during venting activity.
6. Connect bonding cable(s) between the pipe and the container or the tank truck (see *06-03-21 Bonding for Static Electricity*).
7. Slowly open the vent valves and vent air into the container or tank truck.

> **CAUTION**: Vent air as carefully and completely as possible. Trapped air can cause operational problems such as column separation.

NOTE: It may be necessary to stop and start a few times to ensure all air is vented.

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8. When all air is vented:
   a) close the vent valves
   b) disconnect the piping
   c) plug the vent valves
9. Remove all lockouts and return isolation valves to the original positions.
10. Watch for leaks as the line is started and pressure builds up.

Table 1
Linefill Volume by Pipe Size

Pipe Dimensions					Linefill Volumes					
Nominal Diameter		Wall Thickness			USC		Metric			
in.	mm	decimal	fraction	mm	bbl/ft	bbl/mi	m^3/ft	m^3/mi	m^3/m	m^3/km
12	324	.250	1/4	6.35	.145775	769.69	.023177	122.37	.076040	76.040
		.281	9/32	7.14	.144291	761.86	.022940	121.13	.075262	75.262
		.312	5/16	7.92	.142815	754.06	.022706	119.89	.074495	74.495
		.343	11/32	8.73	.141346	746.31	.022473	118.66	.073730	73.730
		.375	3/8	9.53	.139885	738.60	.022240	117.43	.072966	72.966
		.500	1/2	12.70	.134118	708.14	.021323	112.59	.069957	69.957
16	406.4	.281	9/32	7.14	.231507	1222.36	.036807	194.34	.120758	120.758
		.312	5/16	7.92	.229637	1212.48	.036510	192.77	.119783	119.783
		.343	11/32	8.73	.227774	1202.64	.036510	191.21	.118812	118.812
		.375	3/8	9.53	.225918	1192.84	.035919	189.65	.117844	117.844
		.500	1/2	12.70	.218572	1154.05	.034751	183.48	.114012	114.012
18	457	.281	9/32	7.14	.295379	1559.59	.046962	247.96	.154075	154.075
		.312	5/16	7.92	.293266	1548.44	.046626	246.19	.152972	152.972
		.343	11/32	8.73	.291160	1537.32	.046292	244.42	.151877	151.877
		.375	3/8	9.53	.289061	1526.24	.045958	242.66	.150781	150.781
		.500	1/2	12.70	.280743	1482.32	.044635	235.67	.146440	146.440
20	508	.281	9/32	7.14	.367022	1937.87	.058353	308.10	.191447	191.447
		.312	5/16	7.92	.364666	1925.43	.057978	306.12	.190217	190.217
		.343	11/32	8.73	.362317	1913.03	.057605	304.15	.188993	188.993
		.375	3/8	9.53	.359975	1900.67	.057232	302.19	.187769	187.769
		.500	1/2	12.70	.350686	1851.62	.055756	294.39	.182927	182.927
24	610	.281	9/32	7.14	.533622	2817.52	.084841	447.96	.278350	278.350
		.312	5/16	7.92	.530780	2802.51	.084389	445.57	.276867	276.867
		.343	11/32	8.73	.527947	2787.54	.083938	443.19	.275387	275.387
		.375	3/8	9.53	.525117	2772.62	.083488	440.82	.273911	273.911
		.500	1/2	12.70	.513886	2713.31	.081703	431.39	.268054	268.054
26	660	.281	9/32	7.14	.628580	3318.89	.099938	527.57	.327881	327.881
		.312	5/16	7.92	.625495	3302.60	.099448	525.08	.326273	326.273
		.343	11/32	8.73	.622417	3286.35	.098958	522.50	.324665	324.665
		.375	3/8	9.53	.619347	3270.14	.098470	519.92	.323064	323.064
		.500	1/2	12.70	.607144	3205.71	.096530	509.68	.316699	316.699
30	762	.281	9/32	7.14	.841808	4444.75	.133839	706.67	.439104	439.104
		.312	5/16	7.92	.838238	4425.88	.133272	703.67	.437244	437.244
		.343	11/32	8.73	.834675	4407.06	.132705	700.68	.435384	435.384
		.375	3/8	9.53	.831119	4388.29	.132140	697.69	.433530	433.530
		.500	1/2	12.70	.816973	4313.60	.129891	685.82	.426152	426.152
34	864	.281	9/32	7.14	1.086123	5734.71	.172684	911.76	.566545	566.545
		.312	5/16	7.92	1.082066	5713.29	.172038	908.36	.564429	564.429
		.343	11/32	8.73	1.078017	5691.91	.171394	904.96	.562316	562.316
		.375	3/8	9.53	1.073974	5670.56	.170751	901.56	.560207	560.207
		.500	1/2	12.70	1.057887	5585.62	.168194	888.06	.551818	551.818
36	914	.312	5/16	7.92	1.215638	6418.54	.193274	1020.48	.634101	634.101
		.343	11/32	8.73	1.211344	6395.87	.192592	1016.88	.631864	631.864
		.375	3/8	9.53	1.207060	6373.25	.191911	1013.28	.629629	629.629
		.500	1/2	12.70	1.190001	6283.18	.189198	998.96	.620728	620.728
40	1016	.312	5/16	7.92	1.506095	7952.15	.239454	1264.31	.785610	785.610
		.343	11/32	8.73	1.501316	7926.92	.238694	1260.30	.783117	783.117
		.375	3/8	9.53	1.496546	7901.73	.237936	1256.30	.780630	780.630
		.500	1/2	12.70	1.477545	7801.41	.234915	1240.35	.770719	770.719
42	1067	.312	5/16	7.92	1.661981	8780.51	.264239	1396.01	.866926	866.926
		.343	11/32	8.73	1.657959	8753.99	.263599	1391.80	.864826	864.826
		.375	3/8	9.53	1.652946	8727.52	.262802	1387.59	.862211	862.211
		.500	1/2	12.70	1.632974	8622.07	.259627	1370.82	.851795	851.795
48	1219	.312	5/16	7.92	2.180268	11511.77	.346641	1830.26	1.137274	1137.274
		.343	11/32	8.73	2.174517	11481.40	.345727	1825.43	1.134275	1134.275
		.375	3/8	9.53	2.168776	11451.40	.344814	1820.61	1.131280	1131.280
		.406	–	10.31	2.163090	11421.07	.343904	1815.84	1.128294	1128.294
		.500	1/2	12.70	2.145889	11330.25	.341175	1801.40	1.119341	1119.341

NOTES

- bbl/foot $= ID^2 \times 0.00097143$
- $m^3/foot = \dfrac{bbl/foot}{6.2898}$
- bbl/mile $= ID^2 \times 5.12913$
- $m^3/mile = \dfrac{bbl/mile}{6.2898}$

Table 2
Lateral Dispersion Model
Distance for Various Crudes and Wind Velocities

Wind Velocity		Dispersion Direction	Footprint					
			light		medium		heavy	
m/s	mph		m	ft	m	ft	m	ft
1-3	2-6	lateral	22-52	72-171	7-17	23-56	5-10	16-33
4-5	7-10	lateral	16-30	53-98	7-16	23-53	5-8	16-26
6-7	11-16	lateral	12-28	39-92	6-11	20-36	3-7	10-23

Table 3
Release Model
Potential Results under 60 psi

Wind Velocity		Dispersion Direction	Rainout Distance	
m/s	mph		m	ft
0	0	radius	17	56
2	5	upwind - downwind	15-20	49-66
4	9	upwind - downwind	12-22	39-72
7	16	upwind - downwind	8-26	26-85

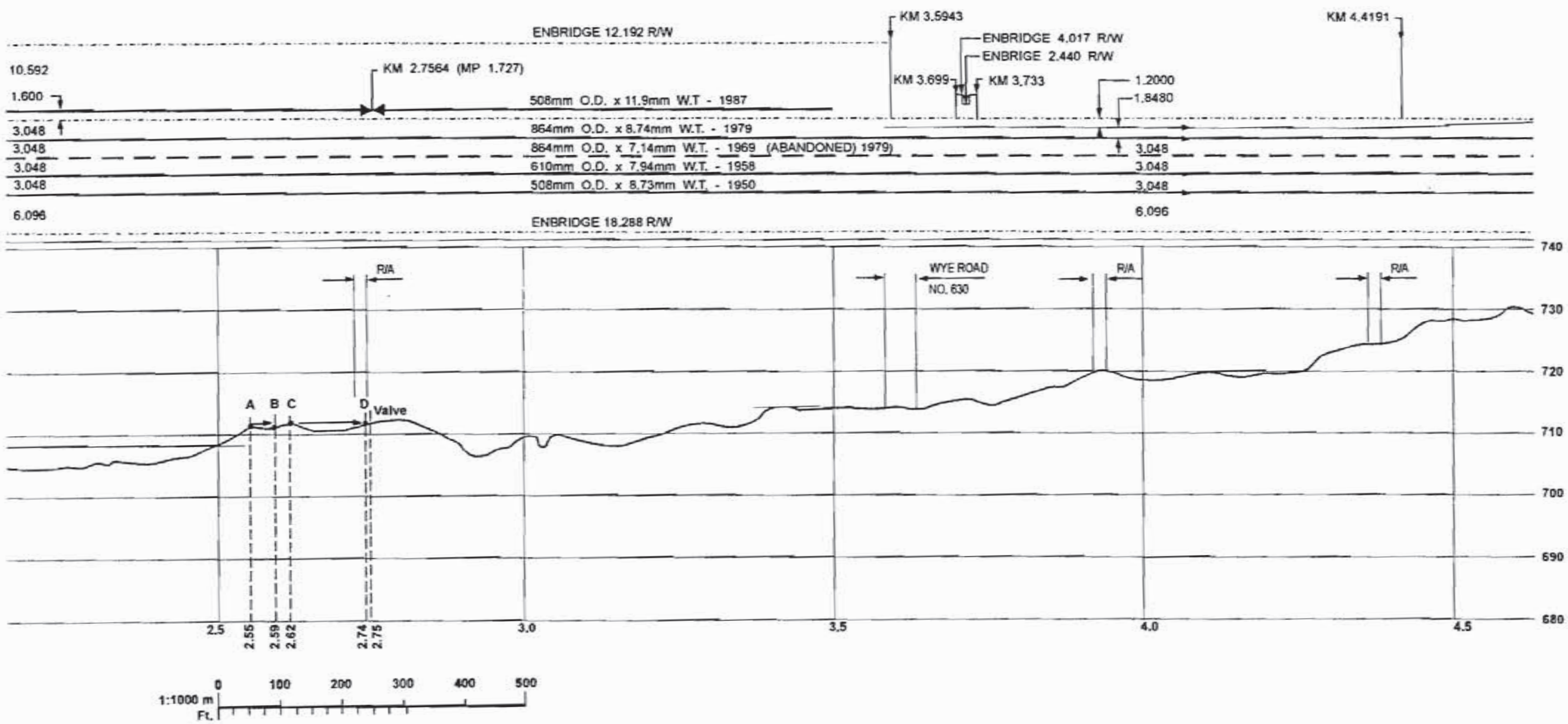

Figure 1
Downstream Elevation Profile

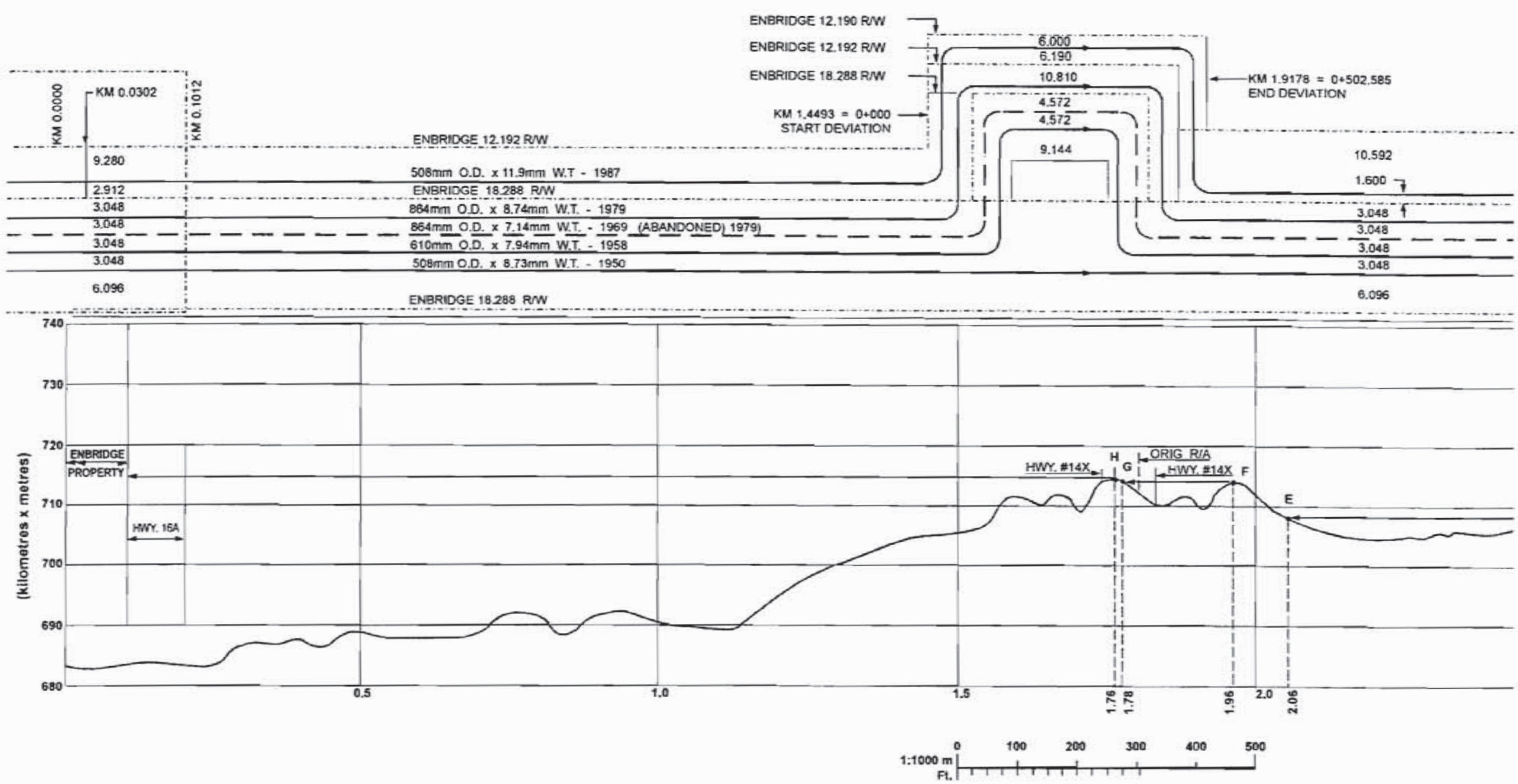

Figure 2
Upstream Elevation Profile

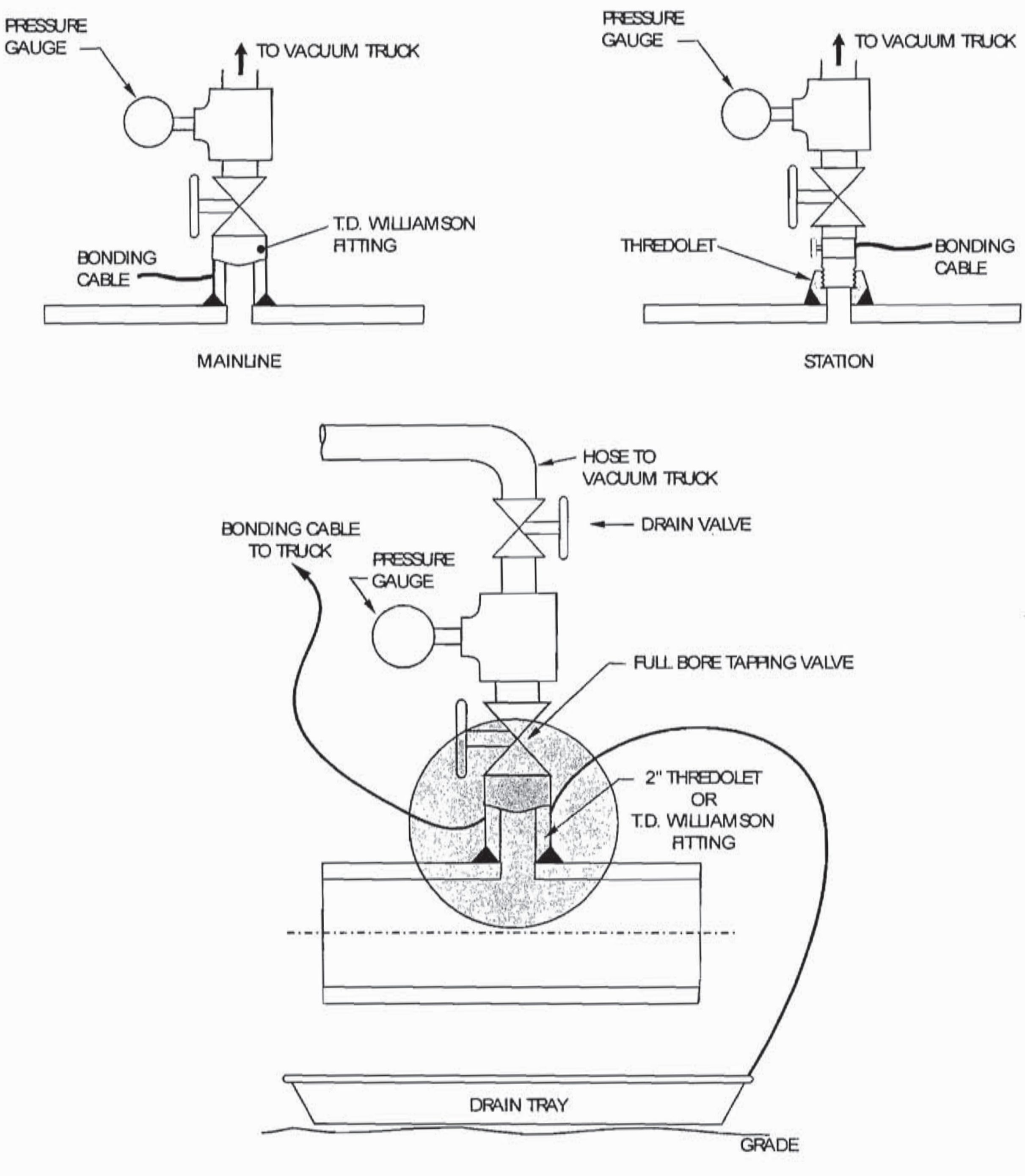

Figure 3
Drain Connection Configuration

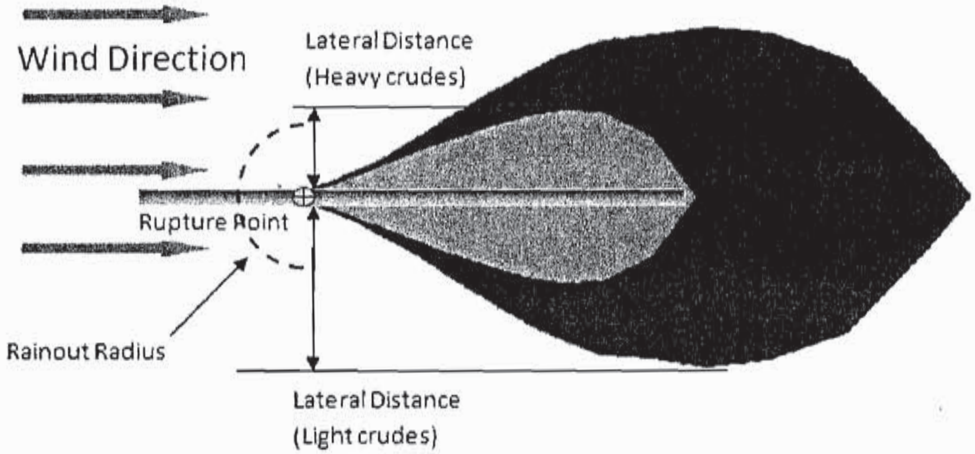

Figure 4
Lateral and Downwind Model

Purpose

To seal off gas vapors in preparation for replacing pipe or installing valves and fittings.

Related Standards

Company
Book 2: Safety
- *13-02-07 Respiratory Protection*
- *04-02-01 Confined Space Entry Permit – Hazard Assessment*

Waste Management Plan

Requirements

Venting
To prevent pressure from building up and moving the plug, install vents to atmosphere behind each mud plug by (a) installing and tapping a small connection, using an existing connection, or (b) inserting a hose through the mud plug.

Mixing Mud
Mix the mud to a smooth but sticky texture. If the temperature is below 0°C (32°F), mix mud with an antifreeze/water mixture.

NOTE: The amount of antifreeze depends on the ambient temperature.

Packing Mud Plugs
Insert mud in the open end of the pipeline as soon as possible after drainup.

After installation, do not disturb mud plugs as much as practicable (e.g., hammer on the pipe).

Replace mud plugs if they dry out.

Procedure

Installing Mud Plugs

WARNING: Petroleum vapors or other hazardous materials may be present.

1. Check pipe ends for excessive vapor using a gas detector at the open end of the pipe (see *Book 2: Safety, 13-02-07 Respiratory Protection* and *04-02-01 Confined Space Entry Permit – Hazard Assessment*).

2. File sharp edges of the pipe or cover with a split rubber hose to prevent lacerations.

WARNING: Be careful not to create a spark. If combustible gas vapors are present, a spark could cause an explosion.

3. Clean the inside of the pipe as far as can be reached with rags or a long-handled scrub brush; use solvents to remove wax or residuals.
   - If required to temporarily stop product from seeping into the cleaned area, place a pile of dry mud as far as possible into the pipe.

WARNING: When cleaning pipe, be careful of the razor-sharp edge of the pipe left by the cutter.

NOTE: Discard rags in accordance with the Waste Management Plan.

4. Coat the pipe wall with a thin layer of dry mud and then wet mud to ensure the mud adheres to the pipe.
5. Pack the mud to form a plug to a minimum thickness of 1 × the pipe diameter.

NOTE: The end of the completed plug should be at least 150 mm (6 in.) back from the open pipe end (see Figure 1).

6. Vent the space behind the mud plug to prevent pressure from building up and moving the plug..
   - If venting through a fitting behind the plug, ensure there are no obstructions between the fitting and the mud plug, and connect a vent hose to the fitting.
   - If venting through the plug, place the air hose in the bottom third of the plug.

NOTE: Run vent hose downwind from worksite to direct gases away from area.

7. Check the inside of the open pipe end with a combustible gas detector to verify that the mud plug is holding.

NOTE: Monitor continuously during repair work, both visually for the condition of the plug and with a combustible gas detector.

8. Begin tie-in activities.

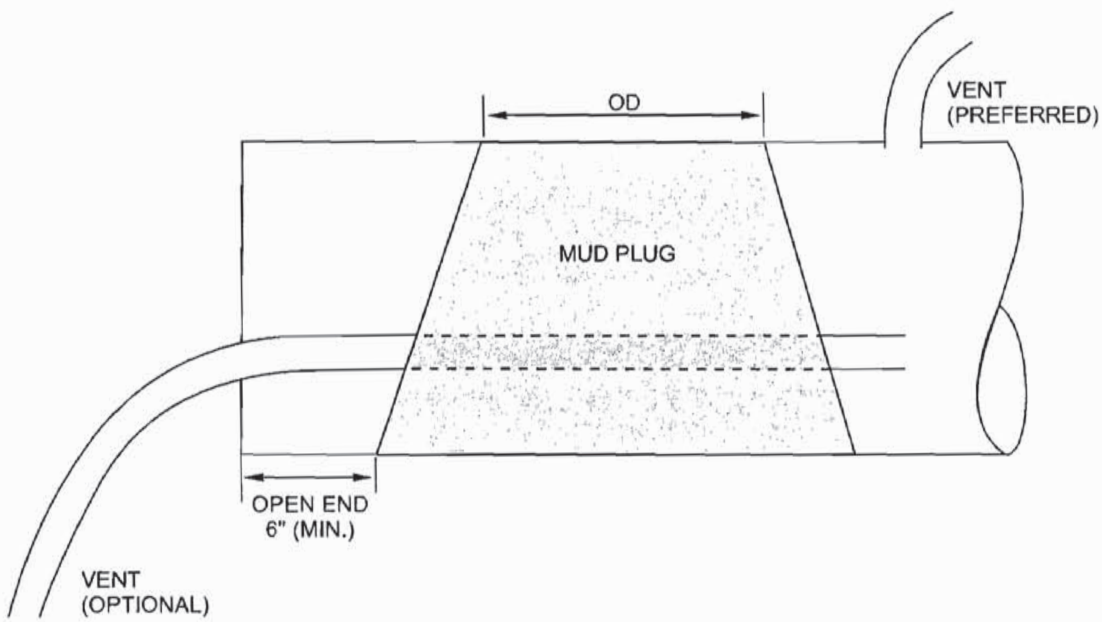

Figure 1
Positioning of Mud Plug

Subject
Installing Vapor Plugs

Purpose

To seal off gas vapors before purging pipe ends in preparation for replacing pipe sections and welding the pipe.

Scope

This applies to the following types of vapor plugs:

- mechanical plug (e.g., V tool)
- inflatable air plug (e.g., Vetter, Landis bag)
- plumber's plug

For additional information on the operation and maintenance of all vapor plugs, see the manufacturer's instructions.

Requirements

Use vapor plugs whenever practicable.

To use vapor plugs, there must be an adequate opening for inserting the plugs. In addition, to use a mechanical vapor plug, the downstream piping must allow the plug unobstructed travel to a receiving trap, except where the plug is removed at the site.

Venting

To prevent pressure from building up and moving the plug, install vents to atmosphere on the isolated side of each vapor plug by (a) installing and tapping a 2-in. fitting, (b) using an existing connection, or (c) connecting a hose through the vapor plug.

Check vent hoses before use and frequently throughout the job to ensure hoses are unobstructed.

Extend vents to ground level and downwind from the worksite to direct vapors away from the area.

Determine the size of vents and the need for vent valves on a job-by-job basis.

Procedure

Pre-Installation

- Confirm that the vapor plug is in good working condition:
  - Check the sealing element or sealing surface of the plug for wear or cuts. If damaged, replace the sealing element if applicable, or remove the plug from service until repaired.
  - Check condition of carrying rubbers (V tool only).
  - Inflate, activate or tighten the plug to ensure proper operation.

- Clearly identify vent hoses from air supply hoses.

Procedure

Installation

1. Using a gas detector at the open end of the pipe, check pipe ends for excessive vapor.

> **WARNING**: When cleaning pipe, be careful of the razor-sharp edge of the pipe left by the cutter. To prevent lacerations, file sharp edges of the pipe or cover with a split rubber hose.

2. Use solvents to clean the inside of the pipe as far as can be reached with rags or a long-handled scrub brush.

3. Insert the vapor plug with the operating mechanism facing the open end of the pipe, ensuring the plug does not interfere with vent connection.
   - Position the front edge of the plug inside the pipe approximately 300 to 450 mm (12 to 18 in.) from the open pipe end.

4. Connect the vent line to the plug or pipeline (depending on venting setup) and vent a safe distance from the worksite at ground level.

5. Connect the hydraulic or air lines to the vapor plug, if applicable.

NOTE: If required for mainline applications, install a tracking transmitter.

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6. Pressurize or tighten the plug in accordance with the manufacturer's instructions.

> **WARNING**: Minimize work in front of any open-ended pipe. Injury could result if a vapor plug releases from the pipe.

7. Check that the plug sealing element is fully expanded and even all the way around.

8. For a hydraulic and air operated mechanical vapor plugs, ensure the pressure is released before disconnecting hoses.
   a) Disconnect the hydraulic or air lines, starting with the 'out' hose.

   b) Install protective caps over the connections.

> **WARNING**: Do not stand directly in front of the pipe.

9. Pull on the plug to ensure it is holding.

10. Install a small seal of wet mud around the sealing element and the face of the plug to prevent heat damage and act as a secondary seal.

11. Test the sealing integrity of the vapor plug using a gas detector positioned as close as possible to the sealing element.

12. Complete work activity.

WARNING: Monitor continuously for combustible gas until final fitup.

WARNING: If releasing the vapor plug manually, ensure (a) the vent line behind the vapor plug is open, and (b) there is no pressure or liquid behind the vapor plug.

NOTE: If the plug is released hydraulically, the plug must be tracked to the downstream receiving trap.

13. When welding/tie-in is complete, release the vapor plug:
    - manually, if the pipe end is open
    - hydraulically, if using the mechanical vapor plug, by injecting liquid back into the pipe at the pressure release plunger end of the vapor plug.

14. Remove the plug from the pipe.

15. Disassemble and clean the vapor plug.
    - Check the condition of the vapor plug for wear or damaged parts, and repair or replace as necessary.

16. Reassemble the vapor plug and return to storage.

Purpose

To repair gouges, grooves, arc burns, and some external cracks under certain conditions.

Related Standards

Company

Book 3: Pipeline Facilities

- *06-03-09 Assessing Limits of Corrosion*
- *06-03-24 Inspecting Crack-Like Indications*
- *06-04-01 Maximum Pressures for Maintenance Activities*

Book 4: Welding

- *Tab 02 Maintenance and Repair Welding*

Requirements

Equipment

- pencil grinder with a sanding disk

Grinding

Grinding is allowed to a maximum depth of 40% of the nominal wall thickness (WT), provided the longitudinal length does not exceed L in the following formula:

$$L = 1.12\, B_1 \sqrt{Dt}$$

Where:

L	=	maximum allowable longitudinal length of the ground out area, mm (in.)
D	=	nominal outside diameter of the pipe, mm (in.)
t	=	nominal wall thickness of the pipe, mm (in.)
B_1	=	a value equal to 4.0 for depths up to and including 13% of the nominal WT
	=	a value determined from the following formula for depths greater than 13% up to and including 40% of the nominal WT

$$B_1 = \sqrt{\left(\frac{c/t}{1.1c/t - 0.11}\right)^2 - 1}$$

Where:

c	=	maximum depth of the ground area, mm (in.)

NOTE: The relationship between B1 and c/t is also shown in Figure 1.

Pipe with ground-out areas that do not exceed the longitudinal length calculated above are allowed for continued service.

For pipe with ground-out areas that exceed the longitudinal length calculated above, use a reinforcement sleeve.

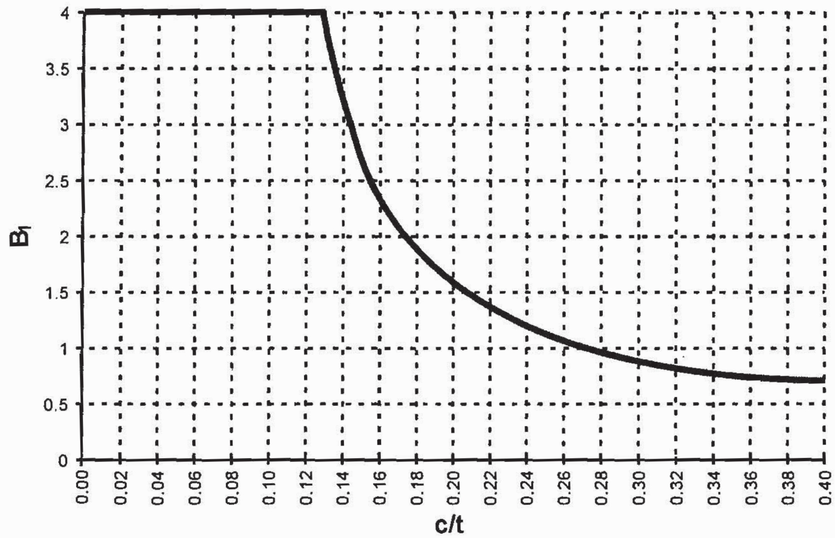


Figure 1
Relationship Between B1 and c/t

If grinding depth exceeds 40% of the nominal WT, use a pressure containment sleeve.

NOTE: For information on removing arc burns, see *Book 4: Welding, Tab 02 Maintenance and Repair Welding.*

When grinding a crack, ensure the crack opening is not smeared or covered with metal, concealing the crack. Stop grinding occasionally to see if the crack is shortened.

Procedure

Grinding Repairs

WARNING: Do not grind when there is NGL in the line.

1. Determine the depth of grinding required, using an ultrasonic inspection technique.
2. Determine operating pressure permitted during grinding (see *06-04-01 Maximum Pressures for Maintenance Activities*).
3. Contact the control center for the operating pressure.
4. Remove the pipe coating.
5. Clean the repair area thoroughly.

6. Grind lightly until the defect is removed, or up to 40% nominal WT.

7. Contour the ground-out area to make a smooth transition with the surrounding pipe surface.

8. Confirm the defect has been removed.
   - For arc burns and gouging, etch the ground area with ammonium persulfate (10% solution in CAN, 20% in USA), or a 5% solution of nital.
   - For cracks at welds and for body cracks, use magnetic particle inspection (MPI) (see *06-03-24 Inspecting Crack-Like Indications*).

9. Confirm the remaining wall thickness using mechanical or ultrasonic methods (see *06-03-24 Inspecting Crack-Like Indications*).
   - Ensure the length of the cavity does not exceed the equivalent corrosion length (see *06-03-09 Assessing Limits of Corrosion*).

10. Install an appropriate sleeve if required.

11. Contact the regional corrosion technician or Pipeline Integrity for the appropriate coating repair.

Purpose

To rejoin pipe when suitable conditions for butt welding cannot be achieved or are difficult to achieve. It is not intended to be a substitute for butt welding under normal conditions.

Related Standards

Company

Book 3: Pipeline Facilities

- *06-03-03 Drainup/Linefill*

Book 4: Welding

- *01-04-01 Welding Procedure Specification Data Sheets*
- *02-02-06 Inspection*

Requirements

Maximum Pressure Rating

The maximum pressure rating of the Weld+Ends coupling (shown on the coupling label) must be greater than or equal to (≥) the maximum design ultimate pressure capacity of the connected pipes (at 100% SMYS 80% SYMS [CAN] and 72% SMYS [USA]).

Anchored Pipe Installation

A joint between two pipes can be subjected to forces caused by internal pressure, thermal expansion and contraction, external loads, or any combination thereof. A coupling installation is considered to be anchored only if sufficient external restraint is provided, by the surrounding soil or an external mechanical restraining device, to safely resist such forces.

Prior to welding and inspection, a coupling installation may only be classified as anchored if:

- an engineering assessment by a suitably qualified individual determines that there is sufficient external restraint provided by the surrounding soil to resist the applied forces; or

NOTE: The engineering assessment should consider: the length of exposed pipe; deviations from a straight alignment; soil stiffness and strength; pipe and coupling stiffness and strength; locked-in pipe bending stresses required to facilitate fit-up; and the effects of restrained thermal expansion or contraction. The individual conducting the assessment may be a staff engineer or external engineering consultant, but must have relevant knowledge and experience related to pipe-soil interaction analysis. Contact Pipeline Integrity or Engineering for additional information.

- external forces are restrained by a PLIDCO® Clamp+Ring or other approved external restraining device.

Unanchored Pipe Installation

A coupling installation is considered to be unanchored if there is insufficient external restraint provided to safely resist the forces to which it is subjected.

> ⚠ **CAUTION**: Any installation that does not meet the anchored pipe installation criteria given above must be considered unanchored and is subject to the unanchored pressure limits specified in this subject.

Storage

Store couplings in a cool, dark and dry environment at temperatures not exceeding 49°C (120°F). Cover with dark polyethylene to keep direct sunlight from the seals. Avoid contaminants, light, ozone and radiation.

Procedure

Coupling and Pipe Preparation (see Figures 1 and 2)

1. Read and be familiar with the installation instructions provided by the manufacturer.

2. Check the condition of the sealing elements to ensure they have not dried out and that they are not past the expiry date provided by the manufacturer.

3. Clean the sealing elements and coat exposed seal surfaces with a petroleum, silicone or glycerin-based lubricant recommended by the manufacturer to prevent seal abrasion.

4. Use only the clamp and thrust screws supplied by the manufacturer with the coupling and ensure they are clean and free of rust.

5. Prepare pipe ends where the coupling will be installed so the pipe ends have:
   - no rust or coatings
   - the longitudinal weld seams and any protruding surface features, ground or filed smooth, including the area where the coupling will be slipped back while the replacement pipe is positioned
   - pilot bevels ground with tapers, as required, to reduce the risk of damage to the seals when installing the coupling.

6. Clean all surfaces to be welded so that they are free of lubricants and other contaminants.

Procedure

Coupling Installation

1. Measure the gap from the removed pipe section to determine the required length of replacement pipe, allowing for a 1/2 in. gap at each coupling location (see Figure 1).

2. Mark reference points on each end of the existing and replacement pipes in order to ensure that the coupling can be centered on the pipe joint (measure one-half of the coupling length and mark on pipes from center of gap).

3. Slide the coupling completely over one end of the existing pipe.

4. Position the replacement pipe and slide the coupling over both pipes to the predetermined reference marks. For pipe lengths greater than 6 m (20 ft), ensure that the pipe is supported with cribbing or pipe supports prior to step 5.

> ⚠ **CAUTION**: Slide the coupling carefully to ensure sealing elements are not damaged.

5. Snug all the clamp screws evenly, maintaining an equal space between the pipe and the coupling, then tighten the clamp screws to the appropriate torque value shown in Table 1.

> ⚠ **CAUTION**: Do not over-tighten clamping screws (see tolerance limits in Table 1) as doing so may deform the pipe ends and prevent proper sealing.

6. Double-check all clamp screws using a calibrated torque wrench to ensure that each screw has received the specified torque.

7. Tighten thrust screws gradually and uniformly around the pipe circumference to activate the seal.
   - Snug all screws firmly and then advance each thrust screw 1/8 of a turn before proceeding to the next screw.
   - Make several circuits to evenly tighten the sealing unit, tightening the screws to the appropriate torque value shown in Table 2.

8. If not already supported (in step 4), support the new section of pipe with cribbing or pipe supports to ensure it does not shift during filling, as this could compromise the sealing elements.

Procedure

Preparation for Welding

There are 2 options for refilling and pressurizing the pipeline in preparation for welding:

- Option #1 - Refilled, not flowing
- Option #2 - Refilled, pressurized and flowing

NOTE: The coupling may also be welded without refilling the drained pipeline section, provided that the presence of explosive air mixtures is avoided using mud plugs or vapor plugs (see *06-03-04 Installing Mud Plugs* or *06-03-05 Installing Vapor Plugs*)

For Options #1 and #2 (except as noted), the following requirements apply:

1. Linefill must be conducted in accordance with *06-03-03 Drainup/Linefill*. This includes adherence to the safe work zone requirements.

2. For Option #1 (refilled, not flowing), prior to linefill, the drained pipe section must be purged with nitrogen until the percentage of oxygen at the vent is below 5%.

3. All personnel, except those required to perform specialized tasks (e.g., checking vents or checking for slippage or leaks) must remain in the safe work zone:
   - during linefill;
   - until the control center confirms that the mainline pressure is stable and that no surges have occurred; and
   - until the coupling has been checked for leaks and slippage, using the reference points marked on the pipe.

4. Measures must be taken to ensure that the maximum allowable operation pressure (MAOP) prior to completion of welding (as defined below) is not exceeded during linefill, or at any time prior to or during welding.

> ⚠ **CAUTION**: It is essential that pressure limits are based on the appropriate anchorage conditions.

5. Prior to welding, measures must be taken to ensure that no pockets of air exist that could contain an explosive air mixture (as specified in *06-03-03 Drainup/Linefill*), and if the line has been purged with nitrogen, that nitrogen has been removed as completely as possible.

Maximum Allowable Operating Pressure (MAOP) Prior to Completion of Welding

The MAOP prior to completion of welding the coupling is the lesser of the following values:

- 50% of the maximum operating pressure (MOP) of the pipeline at that location (as determined by the control center, normally governed by pipe yield, hydrostatic test pressure or pressure restriction); or
- The maximum rating of the coupling, as defined below, for the applicable pipeline anchorage conditions.

The maximum rating of the coupling is:

- Unanchored conditions – the capacity given in Table 3
- Anchored conditions – 50% of the anchored rating shown on the label attached to the coupling.

Procedure

Welding

1. To prevent damage to seals, monitor the heat generated during cutting, preheating and welding at locations A and B shown in Figure 2 using temperature crayons or probe thermometers to ensure that surface temperatures on both sides of the welds do not exceed 107°C (225°F) for Buna-N seals and 121°C (250°F) for Viton seals.

NOTE: Heat dissipates more slowly under no flow conditions. Sequence welding so that heat is not concentrated in one area.

2. Double-check all thrust screws, after pre-heat, using a calibrated torque wrench to ensure each screw has received the specified torque.

3. Complete fillet welds using the appropriate welding procedure specification (WPS) (see *Book 4: Welding, 01-04-01 Welding Procedure Specification Data Sheets*), cutting off thrust screws as welding progresses.
    - Circumferential fillet weld to be completed on one side of the coupling before welding the other side.
    - For two welders working on the same circumferential fillet weld, sequence welding so that welders work in opposite quadrants (e.g., 6 o'clock to 9 o'clock and 3 o'clock to 12 o'clock).
    - Do not cut off thrust screws too far ahead of the fillet weld (i.e., not more than two or three) as they may require tightening if leakage occurs.

4. After the circumferential fillet welds are complete, remove one clamp screw from each side on top of the coupling to vent gas pressure within the coupling during clamp screw welding.

5. Cut or burn off clamp screws approximately 5 mm (3/16 in.) above the coupling and seal weld using the appropriate WPS (see *Book 4: Welding, 01-04-01 Welding Procedure Specification Data Sheets*) starting with the bottom screws and ending with the top screws. The screws previously removed for venting must be reinstalled, cut off and seal welded.

NOTE: Cutting clamp screws off flush is not allowed.

NOTE: Contaminants on clamp screws should be removed prior to seal welding.

6. Inspect welds as required (see *Book 4: Welding, 02-02-06 Inspection*).

NOTE: After completion of welding and inspection, the Weld+Ends coupling installation is considered to have strength equivalent to that of the surrounding pipe.

7. If used, remove the PLIDCO® Clamp+Ring (or other approved external restraining device) after the welds pass inspection.

8. Advise the control center that the repair is complete and that normal operations may resume.

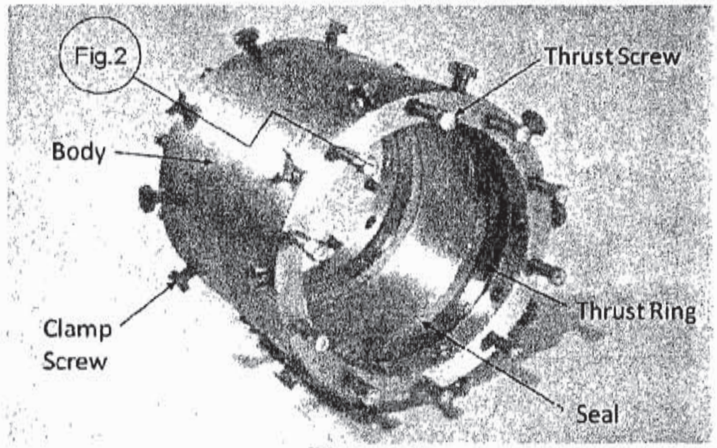
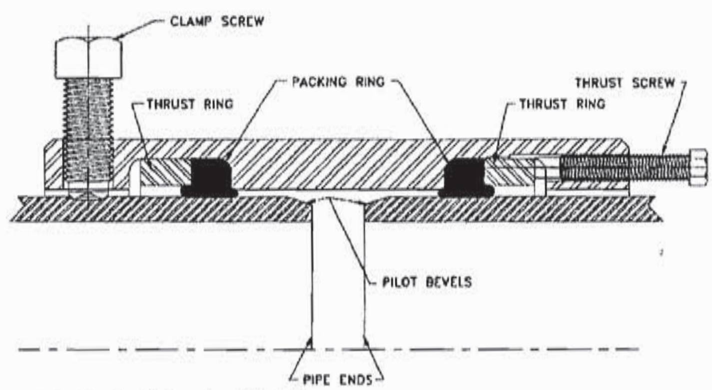
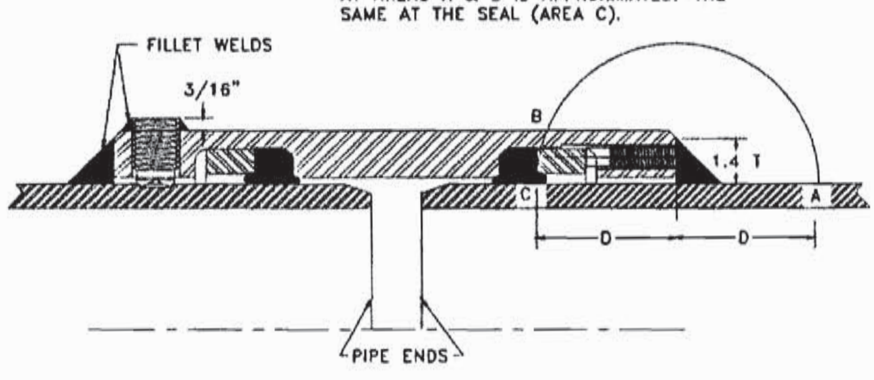


Figure 1
PLIDCO Weld+Ends Coupling
(8 in. coupling shown, courtesy of PLIDCO)



(a) Installed, Prior to Welding



(b) After Welding

Figure 2
Sections Through PLIDCO Weld+Ends Coupling
(courtesy of PLIDCO)

Table 1
Required Clamp Screw Torque*

Pipe Diameter (in)	Required Clamp Screw Torque (ft-lbs)										
	Pipe Wall Thickness (in)										
	0.250	0.281	0.312	0.344	0.354	0.375	0.386	0.406	0.425	0.469	0.500
16	40	47	55	63	65	70	73	77	82	93	100
18	50	62	75	88	92	100	104	112	120	138	150
20	90	97	105	113	115	120	123	127	132	143	150
24	50	62	75	88	92	100	104	112	120	138	150
26	100	106	112	119	121	125	127	131	135	144	150
30	75	84	94	103	106	113	116	122	128	141	150
34	50	62	75	88	92	100	104	112	120	138	150
36			40	59	65	77	83	95	106	132	150
42			35	55	61	74	80	93	104	131	150
48						125	127	131	135	144	150

* tolerance: -0 ft-lbs, +5 ft-lbs

Table 2
Required Thrust Screw Torque Range

Pipe Diameter (in)	Thrust Screw Size and Thread	Torque Range (ft-lbs)
16	1/2-13	30 - 40
18 - 48	5/8-11	70 - 80

Table 3
Unanchored Pressure Rating

Pipe Diameter (in)	Unanchored Pressure Rating (psi)										
	Pipe Wall Thickness (in)										
	0.250	0.281	0.312	0.344	0.354	0.375	0.386	0.406	0.425	0.469	0.500
16	57	79	102	125	132	148	155	170	184	216	238
18	42	68	94	121	129	147	156	172	188	225	251
20	75	91	107	123	128	139	145	155	165	187	203
24	40	61	83	105	112	126	134	147	160	191	212
26	40	57	75	93	98	110	116	127	138	163	180
30	30	43	56	69	74	83	87	96	104	122	135
34	35	48	61	74	79	88	92	101	109	127	140
36			32	48	53	63	69	79	88	110	125
42			15	30	35	44	50	59	68	88	103
48						50	54	60	67	82	92

Purpose

Thredolets®, Sockolets® and Thread-O-ring™ fittings are the type of branch connections used for small diameter pipe (i.e., NPS 2 and smaller).

NOTE: For minimum branch connection requirements, see Engineering Design Standard D06-102.

Related Standards

Company

Book 4: Welding:

- *01-04-01 Welding Procedure Specification Data Sheets*
- *02-02-06 Inspection*

Engineering Design Standards:

- D06-102 Piping Design – Station and Terminal

Requirements

All branch connections NPS 1 ½ and smaller must be made with extra strong Sockolets® or 3000# Thredolets® or equal, without special reinforcing.

Do not use couplings or half couplings.

Sockolets®, or equivalent, must be used below ground.

Install Thread-O-ring™ fittings at the 12 o'clock position, unless the connection is for a densitometer, which must be at the 3 o'clock position.

Procedure

Installing Thredolets®, Sockolets® and Thread-O-rings™

NOTE: Refer to Figure 1.

1. Remove the pipe coating.
2. Clean the pipe surface where the connection will be installed.
3. Use ultrasonic techniques to inspect the pipe in the area where the fitting will be welded.
4. Prepare the fitting and pipe for welding:
   a) Prepare the land and beveled surface of the fitting.
   b) Center punch the pipe where the center of the connection is desired.

5. Level the fitting or set to the desired angle, and tack weld in place using the appropriate welding procedure specification (WPS) (see *Book 4: Welding, 01-04-01 Welding Procedure Specification Data Sheets*).

6. Preheat the pipe.

7. Protect Thredolets® and Thread-O-ring™ threads from spatter:
   a) Coat threads with copper coat.
   b) Hand-tighten a nipple or plug into the fitting.

8. Complete welds using the appropriate WPS (see *Book 4: Welding, 01-04-01 Welding Procedure Specification Data Sheets*).

9. Run a thread tap into Thredolets® to remove spatter if necessary.

10. Inspect all welds (see *Book 4: Welding, 02-02-06 Inspection*).

11. Complete the connection by hot tapping the pipe.

12. Complete an as-built drawing showing the new installation.

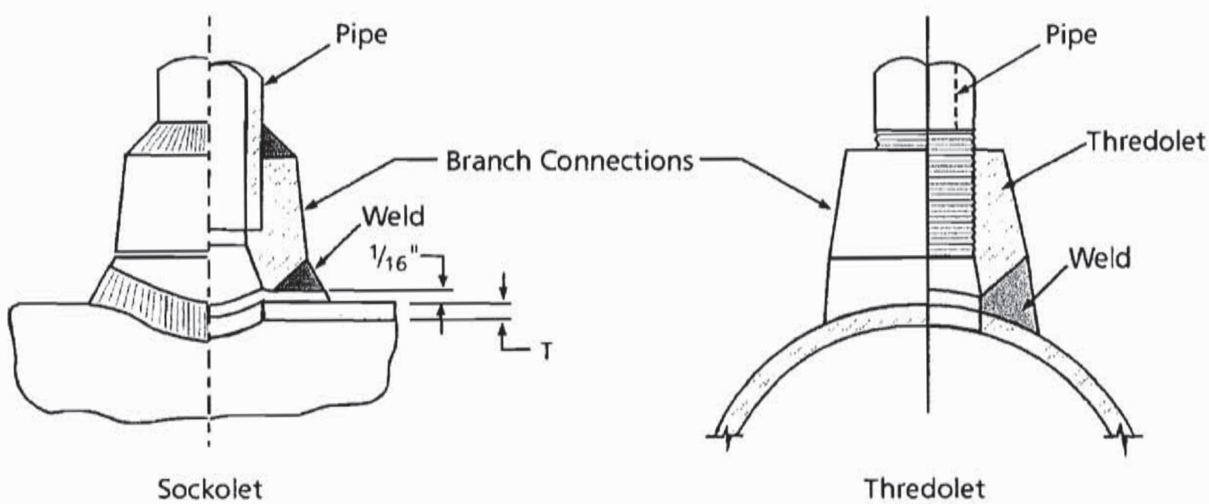


Figure 1
Typical Vent Connections

Purpose

To ensure the quality and long-term integrity of bolted flange connections.

Scope

This includes the requirements for gaskets and torquing, and the procedure for installing and torquing a flange assembly when the pipeline is not under pressure.

NOTE: Before torquing while the pipeline is under pressure, contact Facilities Integrity.

> ⚠ **WARNING**: If the pipeline contains NGL or gas, do not torque while the pipeline is under pressure.

Equipment

Torquing Tools

Use a calibrated hand, hydraulic, or pneumatic torque wrench for tightening flanges.

For tightening critical flanges (e.g., pumps, below grade flanges), a hydraulic bolt tensioning system may be used as it provides the most accurate method of applying bolt stress.

If using a hydraulic bolt tensioning tool, the studs must have sufficient length so that the threads extend at least 1-½ times the bolt diameter past the nut face on the side the tensioning tool is mounted. For example, a stud 51 mm (2 in.) in diameter requires at least 76 mm (3 in.) of threads extending past the nut face.

NOTE: For bolt tensioning target stress values, contact Facilities Integrity.

Flange Facing

An impact wrench may be used to face-up a flange (see step 6), but must not be used to tighten the studs (see steps 9 to 12). To ensure adequate bolt tension, when the nuts are hand-tight, tighten flange connections using a torquing tool that is accurate to within 5%.

Requirements

Preparation

Visually inspect piping to ensure it is free of foreign materials and construction debris.

Studs and Nuts

Ensure studs are the correct size and material specification, and visually inspect for mechanical damage (e.g., burrs, nicks, rust).

Stud bolt specifications must be in accordance with ASTM A193, Gr B7, threaded for the full length. Nut specifications must be in accordance with ASTM A194, Gr 2H.

Gaskets

For approved gaskets types, see Table 1.

Match the pressure rating and size of the gasket to the flange.

Do not use asbestos and asbestos compounds.

Procedure

Tightening and Torquing Flanges

1. Clean flange faces using a steel scraper or wire brush. Ensure studs, nuts, flange faces and gaskets are free of dirt and rust.

2. Wipe flange faces with a clean rag and visually inspect for surface damage, trueness (i.e., not warped or wavy), and misalignment.

NOTE: If there is any significant pitting or corrosion on flange faces, contact Facilities Integrity.

3. Lubricate the threads of studs, faces of nuts, and contact area of flanges using a lubricant with a coefficient of friction (COF) less than 0.08 (e.g., molybdenum-disulfide-based lubricant).

4. Align flanges using at least two line-up pins sized 2 mm (0.08 in.) smaller than the diameter of the bolt holes.

> ⚠ **CAUTION**: To prevent damaging the gasket, ensure the outside edges of the flange raised faces are aligned. Flanges that are misaligned must be corrected (e.g., increased excavation, cut out).

> ⚠ **CAUTION**: To prevent pump nozzle loads, do not use line-up pins on pump flanges. Pipe to pump flange faces must be concentric to within 0.06 in., and parallel to within 0.02 in./ft in the vertical and axial directions.

5. Insert a new gasket, and install studs and nuts, except where the line-up pins prevent this.

> ⚠ **CAUTION**: Never install a used gasket as it may not seal properly, resulting in a flange leak.

NOTE: If the pipe run is horizontal, install the bottom studs first to retain the gasket. Ensure the gasket does not sit in the stud thread.

6. Tighten all nuts hand tight, ensuring the bolts or studs extend completely through the nuts.

    - Tighten four studs at 90° to each other until there is no visible gap at the gasket.

NOTE: To eliminate the gap, it may be necessary to tighten more than four studs.

NOTE: The flange must be aligned to ensure adequate clamping stress for seating the gasket. If the nuts cannot be snugged up with a hand torque wrench, the flange is misaligned (see step 4).

7. Measure the distance from face-to-face at the flange outside diameter, moving around the flange circumference to ensure there is no more than 2 mm (0.08 in.) variance.

NOTE: The flange is now faced. For remaining work, use only torquing or tensioning tools.

8. Number the studs (see Figure 1).

9. Tighten the studs in numbered sequence (diametrically opposite) to approximately 30% of the final torque value (see Tables 2 – 7).

NOTE: For insulating gaskets and Stopple® equipment, use torque values in accordance with the manufacturer's specifications.

NOTE: Skip the line-up pins to ensure flange alignment.

NOTE: If tightening pump flanges, some variation in sequence may be necessary to avoid excessive pump shaft deflection.

10. Remove the line-up pins, and install studs and nuts.

11. Tighten studs in numbered sequence (diametrically opposite) to approximately 60% of the final torque value (see Tables 2 7).

12. Tighten studs in numbered sequence (diametrically opposite) to 100% of the final torque value (see Tables 2 – 7).

    - For flanges with studs greater or equal to (≥) 32 mm (1 ¼ in.) in diameter, tighten to 110% of the final torque value.

    - If installing two gaskets for Spacer Ring or Wafer-Style check valve applications, increase torque values by an additional 10% (i.e., increase the 30%, 60%, 100% and 110% torque values by 10%); based on stud diameter criteria above.

13. Check the torque of each nut at 100% of the final torque value; moving around the flange in clockwise rotational sequence (i.e., adjacent nuts), using one or more passes to ensure studs are evenly tightened.

14. Slowly pressurize the facility to working pressure and visually inspect for leaks.
    - If there is a leak, check the stud tension; and, if necessary, tighten all studs to 100% of the final torque value.
    - If the studs do not retain the applied tension and the flange continues to leak:
        a) relieve pressure
        b) remove the studs and the gasket
        c) check for flange face defects and gasket defects; repair or replace if necessary
        d) repeat the installation procedure

NOTE: If the flange assembly is in a high pressure or high temperature application, re-torquing may be necessary after startup to compensate for any relaxation or creep in the assembly.

15. Record the installation using the Flange Installation Quality Control Form.

Records

Flange Installation Quality Control Form

Record the installation of all flanges using the Flange Installation Quality Control form and retain for 6 years as follows:

- white copy onsite
- yellow copy in the Engineering project file, if applicable
- pink copy in Facilities Integrity

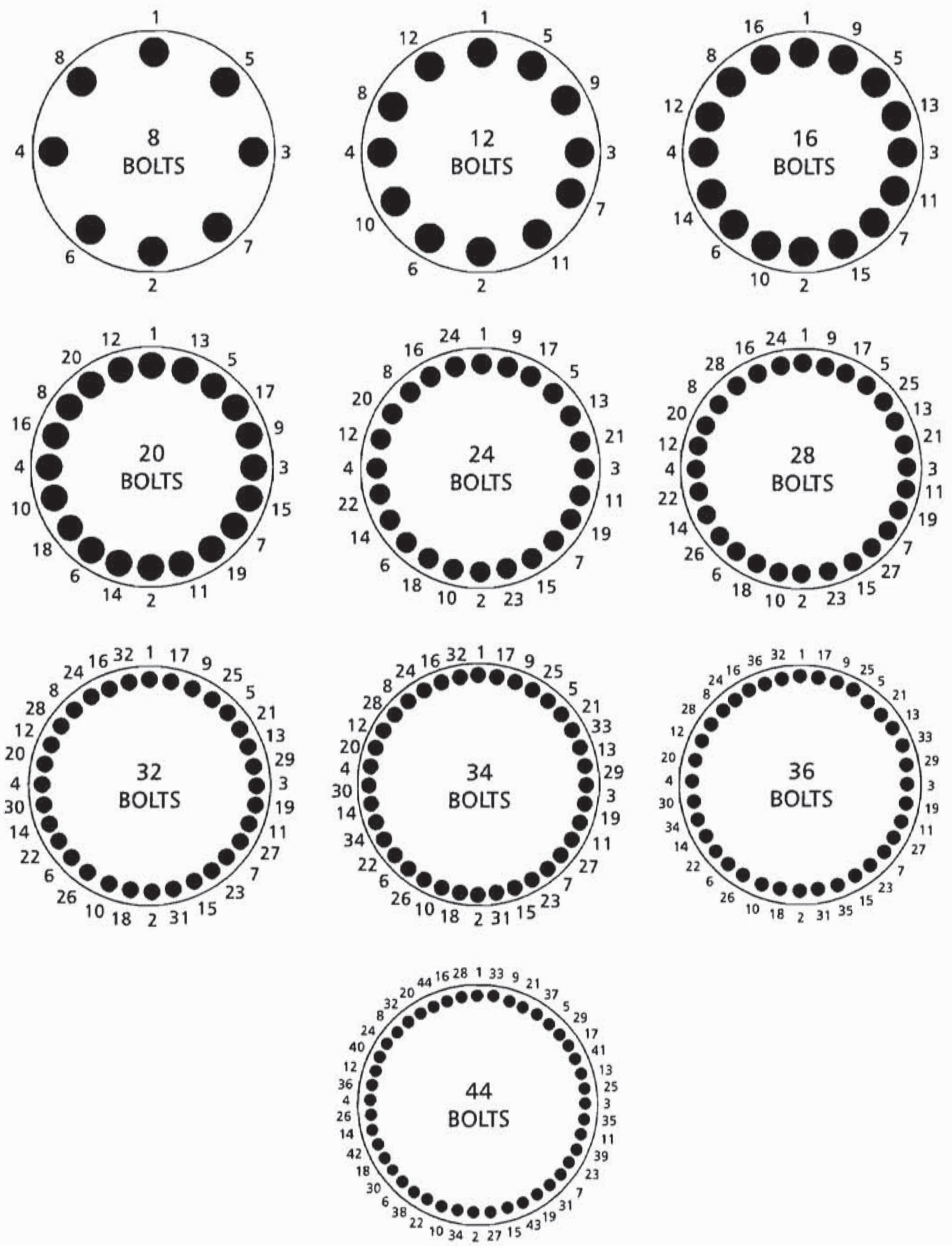


Figure 1
Detailed Numbering and Torquing Sequence

Table 1
Gasket Specifications

Application [1]		Gasket Type				
		Corrugated Metal Gasket [2, 3, 4, 9]	Spiral Wound with Inner Ring [5, 6, 7, 9]	Nonasbestos Fiber Gasket [8]	Insulating Gasket [10]	Kammprofile Gasket [11]
ANSI 150	NPS ≤ 24	√				
	NPS ≥ 26 or NGL service (any size)		√			
ANSI 300	NPS ≤ 24	√	√			
	NPS ≥ 26 or NGL service (any size)		√			
ANSI 400			√			
ANSI 600			√			
ANSI 900			√			
API Tank Flange	manway			√		
	flush-type cleanout					
Insulating Flange					√	
All Densitometers						√

NOTES

√ acceptable gasket type

1 For other gasket types to be used in special applications, contact Facilities Integrity for Gasket Requirement Changes and Approval forms as required.

2 Do not use corrugated metal gaskets for Natural Gas Liquids (NGL) lines regardless of the flange rating.

3 Corrugated metal gaskets must be 1/16 in. or 1/8 in. with flexible graphite sealing element and a 304 SS (or higher grade) metal core.

4 Types of corrugated metal gaskets include the Elastagraph, Graphonic, and MetalBest 905. The Elastagraph is recommended for temperature applications greater than (>) 90° C.

5 All spiral wound gaskets must be in accordance with ASME B16.20 specifications. In addition, spiral wound gaskets less than or equal to (≤) NPS 24 must be in accordance with ASME B16.5 specifications. Spiral wound gaskets greater than or equal to (≥) NPS 26 must be in accordance with ASME B16.47 Series A. Spiral wound gaskets must have carbon steel outer rings, 3.2 mm (1/8 in.) 304 SS (or higher grade) windings with flexible graphite filler, and inner rings of the same material as the windings.

6 The 304 SS gasket is identified by a solid yellow color around the outside edge of the gasket; the flexible graphite filler is identified by grey stripes at equal intervals around the outside edge of the gasket.

7 Spiral wound gaskets complete with inner rings include, for example, Flexitallic CGI, Teadit 913-M, Garlock RWI.

8 Nonasbestos fiber gaskets must be fire resistant 3.2 mm (1/8 in.) material with a nitrile binder (NBR) (e.g., Garlock IFG-5550, Teadit NA-1090).

9 For sour service applications, use 316 SS CMG metal core, spiral windings, and inner rings.

10 G-10 fiberglass carrier with a Viton or Teflon sealing element (Teflon preferred for high H_2S applications).

11 All densitometers require Kammprofile gaskets.

Table 2
API Tank Flange Torque Values

Bolt Size (in)	30% Final Torque (ft lbs)	60% Final Torque (ft lbs)	100% Final Torque (ft lbs)
5/8	20	30	**50**
3/4	30	60	**100**
1	70	140	**225**

Torque values are for fiber gaskets.

Table 3
ANSI 150 Torque Values

NPS	Bolt Size (in)	30% Final Torque (ft lbs)	60% Final Torque (ft lbs)	100% Final Torque (ft lbs)	110% Final Torque (ft lbs)
1/2	1/2	10	20	**40**	—
3/4	1/2	20	30	**50**	—
1	1/2	20	40	**60**	—
1-1/4	1/2	20	40	**60**	—
1-1/2	1/2	20	40	**60**	—
2	5/8	30	50	**90**	—
2-1/2	5/8	40	80	**130**	—
3	5/8	40	70	**120**	—
3-1/2	5/8	30	60	**100**	—
4	5/8	30	70	**110**	—
5	3/4	50	100	**160**	—
6	3/4	70	130	**220**	—
8	3/4	70	140	**230**	—
10	7/8	90	180	**300**	—
12	7/8	110	220	**360**	—
14	1	140	270	**450**	—
16	1	120	230	**390**	—
18	1-1/8	230	460	**760**	—
20	1-1/8	210	420	**700**	—
22	1-1/4	210	420	**700**	770
24	1-1/4	300	590	**990**	1090
26	1-1/4	200	400	**670**	740
30	1-1/4	200	400	**660**	730
34	1-1/2	360	720	**1200**	1320
36	1-1/2	360	720	**1200**	1320
42	1-1/2	360	720	**1200**	1320
48	1-1/2	360	720	**1200**	1320

NOTES

Torque values are for corrugated metal and spiral wound gaskets.

If a flange assembly includes 2 gaskets, increase torque values by an additional 10% to compensate for additional compression of the gasket material. For 3 or more gaskets, contact Facilities Integrity.

Torque values and the gauge reading on the torque machine may vary depending on the manufacturer. For conversion charts or more information, see the manufacturer's instructions.

Table 4
ANSI 300 Torque Values

NPS	Bolt Size (in)	30% Final Torque (ft Lbs)	60% Final Torque (ft lbs)	100% Final Torque (ft lbs)	110% Final Torque (ft lbs)
1/2	1/2	10	20	**40**	—
3/4	5/8	20	40	**70**	—
1	5/8	20	40	**70**	—
1-1/4	5/8	20	50	**80**	—
1-1/2	3/4	40	80	**130**	—
2	5/8	20	40	**70**	—
2-1/2	3/4	40	80	**130**	—
3	3/4	50	90	**150**	—
3-1/2	3/4	50	100	**160**	—
4	3/4	70	130	**220**	—
5	3/4	70	130	**220**	—
6	3/4	70	130	**220**	—
8	7/8	110	210	**350**	—
10	1	160	320	**530**	—
12	1-1/8	220	440	**730**	—
14	1-1/8	160	320	**540**	—
16	1-1/4	230	460	**760**	840
18	1-1/4	240	470	**790**	870
20	1-1/4	290	570	**950**	1050
22	1-1/2	380	770	**1280**	1410
24	1-1/2	450	900	**1500**	1650
26	1-5/8	510	1020	**1700**	1870
30	1-3/4	660	1320	**2200**	2420
34	1-7/8	960	1920	**3200**	3520
36	2	960	1920	**3200**	3520
48	1-7/8	1140	2280	**3800**	4180
IPL 48	2-1/4	1260	2520	**4200**	4620

NOTES
Torque values are for corrugated metal and spiral wound gaskets.
If a flange assembly includes 2 gaskets, increase torque values by an additional 10% to compensate for additional compression of the gasket material. For 3 or more gaskets, contact Facilities Integrity.
Torque values and the gauge reading on the torque machine may vary depending on the manufacturer. For conversion charts or more information, see the manufacturer's instructions.

Table 5
ANSI 400 Torque Values

NPS	Bolt Size (in)	30% Final Torque (ft lbs)	60% Final Torque (ft lbs)	100% Final Torque (ft lbs)	110% Final Torque (ft lbs)
1/2	1/2	10	20	**40**	—
3/4	5/8	20	40	**70**	—
1	5/8	20	40	**70**	—
1-1/4	5/8	30	50	**90**	—
1-1/2	3/4	40	80	**140**	—
2	5/8	20	50	**80**	—
2-1/2	3/4	40	80	**130**	—
3	3/4	50	110	**180**	—
3-1/2	7/8	100	200	**330**	—
4	7/8	110	220	**360**	—
5	7/8	110	220	**360**	—
6	7/8	110	220	**360**	—
8	1	160	320	**540**	—
10	1-1/8	230	470	**780**	—
12	1-1/4	310	620	**1030**	1130
14	1-1/4	250	500	**830**	910
16	1-3/8	330	660	**1100**	1210
18	1-3/8	360	720	**1200**	1320
20	1-1/2	420	840	**1400**	1540
24	1-3/4	600	1200	**2000**	2200
26	1-3/4	660	1320	**2200**	2420
30	2	900	1800	**3000**	3300
34	2	1020	2040	**3400**	3740
36	2	960	1920	**3200**	3520
48	2-1/4	1590	3180	**5300**	5830
IPL 48	2-3/4	2280	4560	**7600**	8360

NOTES

Torque values are for corrugated metal and spiral wound gaskets.
If a flange assembly includes 2 gaskets, increase torque values by an additional 10% to compensate for additional compression of the gasket material. For 3 or more gaskets, contact Facilities Integrity.
Torque values and the gauge reading on the torque machine may vary depending on the manufacturer. For conversion charts or more information, see the manufacturer's instructions.

Table 6
ANSI 600 Torque Values

NPS	Bolt Size (in)	30% Final Torque (ft lbs)	60% Final Torque (ft lbs)	100% Final Torque (ft lbs)	110% Final Torque (ft lbs)
1/2	1/2	10	20	**40**	—
3/4	5/8	20	40	**70**	—
1	5/8	20	50	**80**	—
1-1/4	5/8	30	50	**90**	—
1-1/2	3/4	50	100	**160**	—
2	5/8	20	50	**80**	—
2-1/2	3/4	40	80	**130**	—
3	3/4	50	110	**180**	—
3-1/2	7/8	100	190	**320**	—
4	7/8	110	210	**350**	—
5	1	160	320	**530**	—
6	1	150	290	**490**	—
8	1-1/8	240	480	**800**	—
10	1-1/4	260	530	**880**	970
12	1-1/4	210	430	**710**	780
14	1-3/8	360	710	**1190**	1310
16	1-1/2	510	1020	**1700**	1870
18	1-5/8	720	1440	**2400**	2640
20	1-5/8	660	1320	**2200**	2420
22	1-3/4	630	1260	**2100**	2310
24	1-7/8	900	1800	**3000**	3300
26	1-7/8	750	1500	**2500**	2750
30	2	900	1800	**3000**	3300
34	2-1/4	1260	2520	**4200**	4620
36	2-1/2	1770	3540	**5900**	6490
42	2-1/2	1770	3540	**5900**	6490
46	2-1/2	1770	3540	**5900**	6490
48	2-3/4	2310	4620	**7700**	8470

NOTES

Torque values are for corrugated metal and spiral wound gaskets.

If a flange assembly includes 2 gaskets, increase torque values by an additional 10% to compensate for additional compression of the gasket material. For 3 or more gaskets, contact Facilities Integrity.

Torque values and the gauge reading on the torque machine may vary depending on the manufacturer. For conversion charts or more information, see the manufacturer's instructions.

Table 7
ANSI 900 Torque Values

NPS	Bolt Size in)	30% Final Torque (ft lbs)	60% Final Torque (ft lbs)	100% Final Torque (ft lbs)	110% Final Torque (ft lbs)
1/2	3/4	30	60	**100**	–
3/4	3/4	30	60	**100**	–
1	7/8	50	100	**160**	–
1-1/4	7/8	60	120	**200**	–
1-1/2	1	90	180	**300**	–
2	7/8	60	110	**190**	–
2-1/2	1	80	160	**270**	–
3	7/8	80	170	**280**	–
4	1-1/8	160	310	**520**	–
5	1-1/4	220	440	**740**	–
6	1-1/8	180	370	**610**	–
8	1-3/8	280	560	**930**	–
10	1-3/8	260	520	**870**	–
12	1-3/8	330	660	**1100**	–
14	1-1/2	390	780	**1300**	–
16	1-5/8	480	960	**1600**	–
18	1-7/8	810	1620	**2700**	–
20	2	870	1740	**2900**	–
24	2-1/2	1770	3540	**5900**	–
26	2-3/4	2370	4740	**7900**	–
30	3	3090	6180	**10300**	–
34	3-1/2	4950	9900	**16500**	–
36	3-1/2	4980	9960	**16600**	–

NOTES
Torque values are for corrugated metal and spiral wound gaskets.
If a flange assembly includes 2 gaskets, increase torque values by an additional 10% to compensate for additional compression of the gasket material. For 3 or more gaskets, contact Facilities Integrity.
Torque values and the gauge reading on the torque machine may vary depending on the manufacturer. For conversion charts or more information, see the manufacturer's instructions.

Purpose

Static electricity is generated when handling or storing flammable or combustible liquids. An electric charge is created when such liquids flow through a pipe or hose, or fall through the air in drops or as a spray.

The static charge in the pipeline system is strong enough to create a spark when any separation is made. Furthermore, a spark could be created when a product within the pipeline system is transferred into a container or tank of a different potential. This is particularly hazardous in explosive atmospheres.

Scope

To prevent sparking, bonding is used when workers:

- remove an accessory attachment from a fixed facility (e.g., a mixer from a tank)
- cut and separate a pipeline
- separate flanges
- draw samples from the pipeline
- drain oil from the pipeline into a pan
- load or offload at sump tank locations
- dispense from bulk drums into a secondary container

NOTE: In some cases, such as where piping forms an electrical bond, it may not be necessary to install bonding cables.

Requirements

Equipment

When drawing oil or products samples from the line, or when loading or offloading at sump tank locations, use an uncovered braided copper wire with an alligator clip brazed to each end, or other suitable bonding cable.

Each pipeline crew must have at least two prefabricated bonding cables made of #4 AWG stranded copper wire with a spade connector brazed on each end (see Figure 1).

Each pipeline crew must have at least two grounding clamps for attaching the bonding cable to the pipe (see Figure 2).

Safety Precautions

Once a bonding cable is in place, take care to avoid breaking, cutting, or detaching it as long as a fire hazard exists

Procedure

Removing Accessory Attachments or Separating Flanges

1. Select a bonding cable long enough to clear the hazardous area when removing attachments, or long enough to span the work area when separating flanges.

2. Securely attach the cable to clean bare metal on the accessory attachment and to the fixed facility when removing attachments, or to each flange when separating flanges.

NOTE: This equalizes the potential.

3. Proceed with removal or separation.

4. Once the equipment is removed to a safe area or the work is complete, disconnect the cable.

Procedure

Cutting and Separating a Pipeline

1. Install grounding clamps (see Figure 2) on either side of a separation and on the pipe section to be removed (see Figure 3). Ensure the clamps make contact with clean bare metal.

2. Select one prefabricated bonding cable long enough to span the work area, and securely attach each end to the grounding clamps located on either side of the separation.

3. Select a second prefabricated bonding cable long enough to clear the hazardous area when removing a pipe section.
   a) Securely attach one end of the cable to one of the grounding clamps located at either side of the separation.
   b) Attach the other end of the cable to the grounding clamp on the pipe section to be removed.

4. Remove the section of pipe to a safe area.

5. Disconnect the cables and remove the grounding clamps.

Procedure

Drawing Samples From the Pipeline

1. Attach one alligator clip on the bonding cable (unbraided copper wire) to the sample point on the pipeline (pipe, valve, etc.) and the other clip to the metal sample container.

   - If the sample container is glass or plastic, insert the free end of the bonding cable into the sample container.

2. Draw the sample.

> **WARNING**: Ensure the bonding cable remains in contact with the liquid in a plastic or glass container at all times.

3. Disconnect the bonding cable when sampling is complete.

Procedure

Draining Oil From the Pipeline

1. Securely attach one end of the bonding cable to the pipe and the second end to the metal drain tray.
   - If the drain tray is plastic, ensure the second end of the bonding cable remains in contact at all times with the liquid being drained into the tray.

NOTE: This can be achieved by attaching the cable to a metal grid insert which lays on the bottom of the tray.

2. Proceed with drainup.
3. Disconnect the bonding cable when drainup is complete.

Procedure

Loading/Offloading at Sump Tanks

1. Securely attach one end of the bonding cable to the object being loaded/offloaded (e.g., tank/vacuum truck, portable tank), and attach the other end to the sump tank or the piping connection at the loading/offloading facility.
   - Where fiberglass sump tanks are used, attach the second end to the specified bonding point.
2. Transfer the load.
3. Disconnect the bonding cable when load transfer is complete.

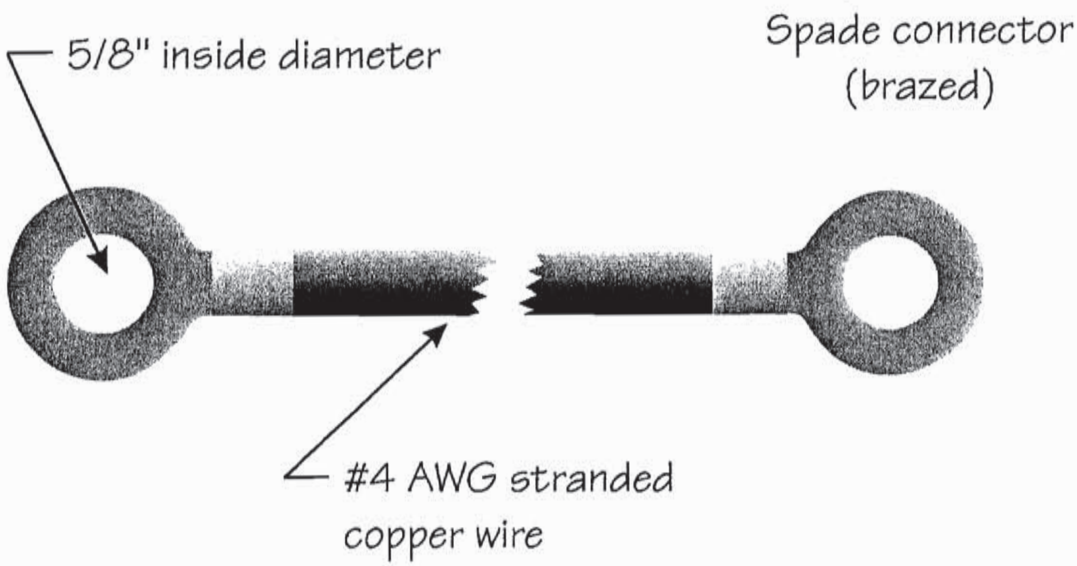
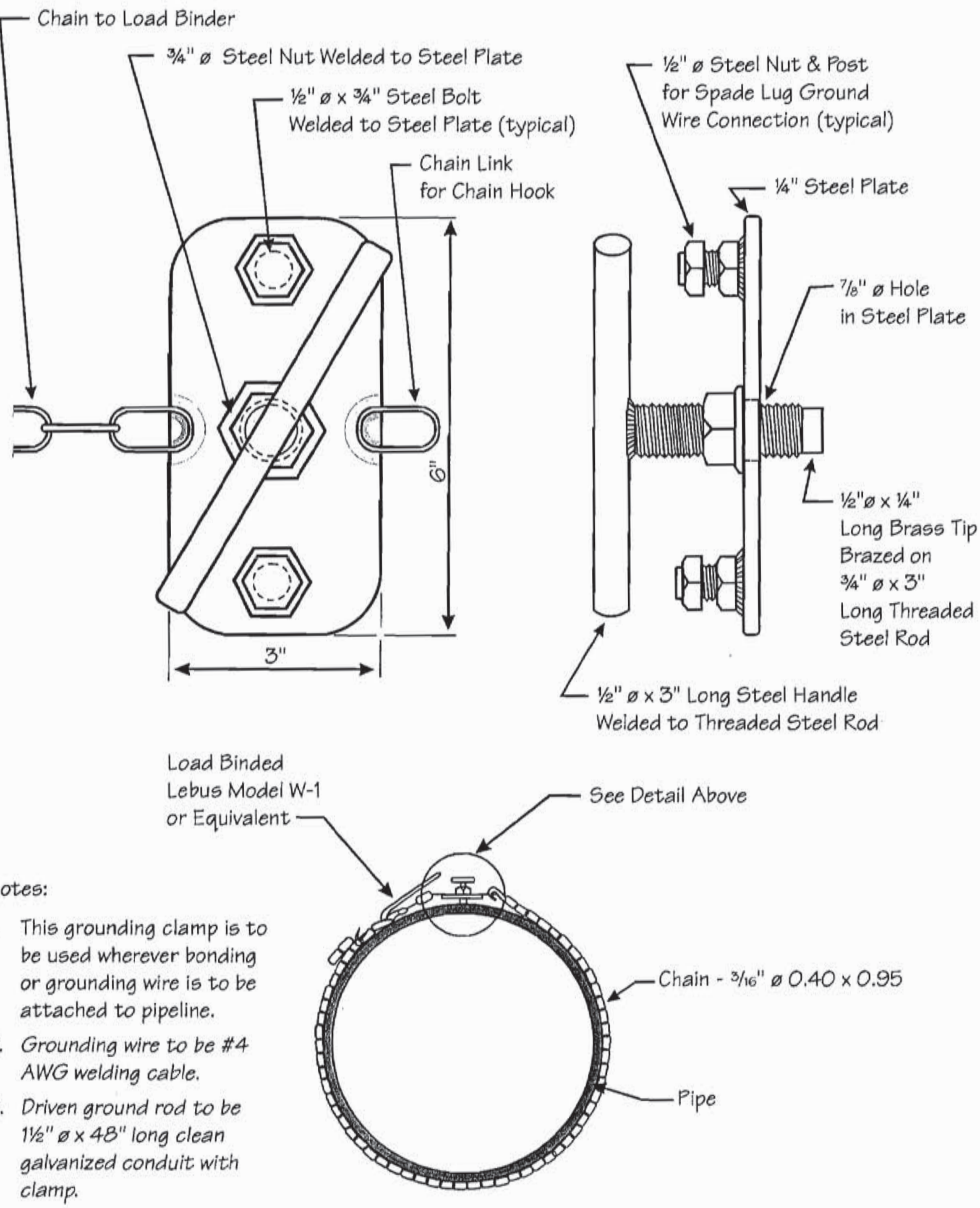


Figure 1
Typical Bonding Cable



Notes:

1. This grounding clamp is to be used wherever bonding or grounding wire is to be attached to pipeline.
2. *Grounding wire to be #4 AWG welding cable.*
3. *Driven ground rod to be 1½" ø x 48" long clean galvanized conduit with clamp.*

Figure 2
Grounding Clamp

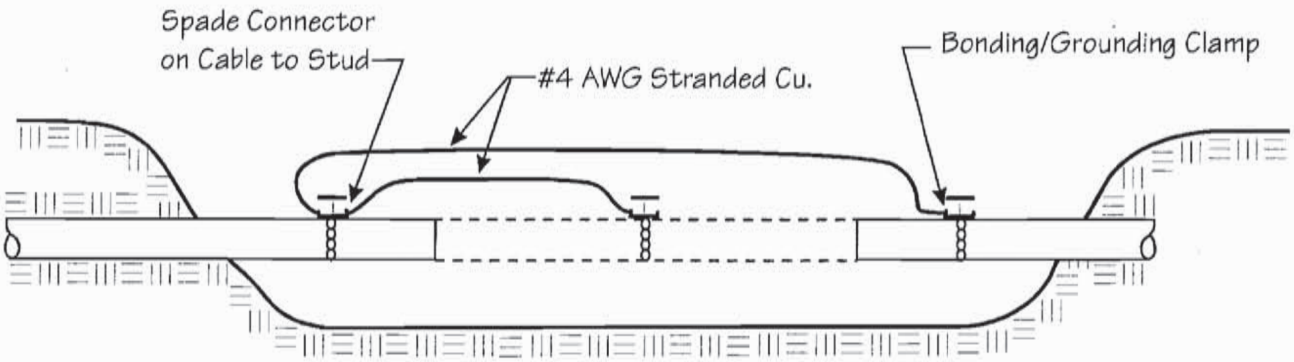


Figure 3
Cutting and Separating Pipe

Removing Pipe for Investigation

Purpose

To cut out pipe for investigation following a failure.

Related Standards

Company

Book 1: General Reference

- *02-02-04 Investigating Piping Failures*

Responsibilities

Regions are responsible to determine the type of repair at a failure site after considering several factors (e.g., location, drainup, safety).

Requirements

Preserve major pipeline components removed due to failure until it is determined if an analytical investigation is required. Only Authorized Personnel will be permitted to inspect the failed component at site. Management approval is required before releasing the failed component to any other person or authority.

Procedure

Removing Pipe

1. Before removing pipe components, obtain approval from regional management.

NOTE: For some incidents, legislation requires that site conditions are not disturbed until government agencies complete their investigation.

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2. Insert hoses into the pipe to drain up liquids and loosen residuals.
   - If the rupture opening is not wide enough to accommodate the hoses (a) contact Pipeline Integrity to confirm where to cut the pipe, or (b) cut the pipe at least 30 cm (12 in.) from the rupture opening to ensure the fracture surfaces are not damaged.

NOTE: The point where the failure initiated must not be damaged. This usually coincides with the widest point of a rupture.

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3. Cover fracture surfaces with a split rubber hose to prevent damage and to preserve features for examination during the failure investigation.

4. Before removing major pipeline components:
   - leave the pipe coating intact
   - identify or sketch detailed as-builts
   - complete the Pipeline Failure Field Notes
   - mark or record the upstream end and the 12:00 o'clock position on the pipe

- mark the long seam o'clock position (looking downstream) on the pipe
- mark the chainage and failure/leak date on the pipe

5. After removing damaged pipeline components:
   - protect fracture surfaces using grease
   - cover and move the components to a safe storage area for protection from weathering

Records

Pipeline Failure Field Notes

Record 'as found' conditions during all stages of failure investigation. Include digital pictures, descriptions, sketches of the damaged equipment and exact location of the damage.

Retain Pipeline Failure Field Notes in Pipeline Integrity permanently.

Requirements

Operating Condition

Maintain tools in good operating condition. Before each use, inspect tools for defects and hazards. Remove defective tools from service and have them repaired or replaced.

Snowblowers and Mowers

Before reaching under mowers or into snowblowers with hands, remove the ignition wire from the spark plug.

Properly guard moving parts (e.g., fans, belts).

NOTE: Hidden stones and other pieces of debris can become projectiles if struck during mowing or snowblowing.

Legislation

Canada

Canada Labor Code, Part II:

- Canadian Occupational Safety and Health (COSH) regulations, Section 12.6

Provincial/territorial occupational health and safety regulations

United States

Code of Federal Regulations (CFR), Title 29 – Labor:

- Part 1910.132 - General Requirements
- Part 1910.133 - Eye and Face Protection

Related Standards

Canada

Canadian Standards Association (CSA):

- CAN/CSA Z94.3—Eye and Face Protectors

United States

American Society of Safety Engineers (ASSE):

- ASSE Z87.1 - Occupational and Educational Personal Eye and Face Protection Devices

Industry

National Fire Protection Association (NFPA):

- NFPA 70E (2009) – Electrical Safety in the Workplace

Responsibilities

Site Supervisors

Site supervisors are responsible for ensuring eye and face protection is:

- available
- maintained in good condition
- replaced as necessary

Requirements

Table 1 identifies appropriate eye and face protection for job tasks that may be hazardous to the eyes and face.

Anti-Fogging Solution

Anti-fogging solution should be considered at work location where fogging hazards may exist with safety glasses, prescription safety glasses, and face shields.

Table 1
Summary of Minimum Eye and Face Protection

Task	Eye and Face Protection
abrasive blasting	• blasting hood
chipping, hammering metal, sledge hammering, jack hammering, using compressed air, operating electric and/or hand saws, concrete work	• safety glasses c/w side shields, or • impact goggles
electrical work with Hazard/Risk Category HRC 0	• safety glasses
electrical work with HRC 1, 2	• safety glasses or goggles • face shield (with a minimum arc rating of 8) with wrap-around guarding, or flash suit hood[1]
Electrical work with HRC 2*	• safety glasses or goggles • face shield (with a minimum arc rating of 8) with wrap-around guarding and balaclava, or arc rated flash suit hood[1]
electrical work with HRC 3, 4	• safety glasses or goggles • arc rated flash suit hood[1]
removing asbestos materials	• full face shield and safety glasses c/w side shields, *or* • goggles
handling liquid hazardous substances (e.g., toluene, NGL, wet cell batteries)	• chemical splash goggles, and any additional protective equipment indicated on container labels or MSDSs • face shield when handling large quantities, exposed to liquid spray, or transferring liquids • protective cream[2]
handling PCBs	• full face shield and safety glasses c/w side shields, or • chemical-resistant goggles
operating chainsaws, using weed trimmers	• full face shield and safety glasses c/w side shields or • impact goggles (mesh face shields are recommended when operating chainsaws)
welding—arc welding or arc gouging	• welder—welding helmet, safety glasses c/w side shields under helmet, and protective cream[2] • helper—as above, or full face shield and shaded[3] safety glasses c/w side shield, or full face shield and shaded[3] welder/cutter goggles
welding—oxy-acetylene welding or cutting, brazing or soldering	• welder— protective cream[2] and welder/cutter goggles (eye-cup or monoframe), or shaded[3] safety glasses c/w side shields and face shield[4] • helper—same as welder
wire brushing, buffing, grinding (electric and pneumatic, including cut-off saws and concrete saws)	• welding helmet and safety glasses c/w side shields under helmet, or • full face shield and safety glasses c/w side shields, or • full face shield and impact goggles

NOTES

1 See NFPA 70E, Table 130.7 (c)(10)
2 Protective cream may be considered for protection against skin irritation, burns, or dermatitis.
3 Minimum shade of three.
4 A welding helmet with a flip-up lens can substitute a face shield.

Legislation

Canada

Canada Labor Code, Part II:

- Canadian Occupational Safety and Health (COSH) regulations Section 12.6

Provincial/territorial occupational health and safety regulations

United States

Occupational Safety and Health Administration (OSHA):

- 29CFR1910.132 - General Requirements
- 29CFR1910.135 - Head Protection

Related Standards

Industry

International Safety Equipment Association (ISEA):

- ANSI/ISEA Z89.1 - Personal Protection–Protective Headwear for Industrial Workers

Requirements

Hard Hats

Wear approved industrial head protection (hard hats) at all times while in the field, except when:

- actively engaged in welding and overhead hazards have been eliminated

EPSI

NOTE: Wear hard hats at all times while welding.

- sheltered in vehicles or equipment with enclosed cabs
- getting in, out, or working around helicopters under full throttle, unless the helicopter is involved in slinging operations
- visiting landowners
- working in water or at water's edge as determined by the Incident Commander

Electrical Equipment

There are 3 classes of hard hats that indicate electrical insulation rating:

- Class E (electrical) – tested to withstand 20,000 volts
- Class G (general) – tested to 2,200 volts
- Class C (conductive) – provide no electrical protection

When working on electrical equipment, wear a Class E hard hat. When working on electrical equipment with a Hazard/Risk Category (HRC) of 3 or 4, a fire retardant (FR) hard hat liner is recommended.

Inspection and Maintenance
Before use, visually inspect hard hats for cracks, weaknesses, or damage to the shell or suspension system. Replace hard hats immediately at the first indication of any of these conditions.

Limit use of stickers on hard hats. Do not cover cracks in hard hat shells with paint or stickers.

Do not place hard hats on or near heat sources (e.g., radiator) or where heat from the sun may be intensified (e.g., vehicle dashboard).

NOTE: Exposure to temperatures over 50°C (122°F) degrades the hard hat shell over time, significantly reducing its useful life and possibly causing the shell to fail when hit.

Do not clean hard hats with solvents. Clean and replace hard hats in accordance with the manufacturer's recommendations.

Helmets
Wear motorcycle or snowmobile helmets while operating snowmobiles or all-terrain vehicles.

NOTE: Motorcycle and snowmobile helmets are not approved industrial head protection and are not acceptable as substitute protection. Consequently, workers required to enter work areas or perform work activities where they are exposed to head contact hazards must remove such helmets and wear approved hard hats, unless actively operating a snowmobile or all-terrain vehicle.

Purpose

This standard ensures workers who are or who may be exposed to workplace noise hazards are protected in compliance with government regulations.

Responsibilities

Regions

Regions are responsible for:

- coordinating hearing conservation training as required
- arranging initial and ongoing audiometric testing with the testing agency
- CAN: one month before scheduled audiometric testing, submitting a list of employees to be tested to Safety & Environment
- CAN: providing employees with forms and information needed for audiometric testing, including any follow-up testing or further evaluation necessary

USA: **NOTE:** The testing agency provides employees with forms and information needed.

- arranging follow-up tests or evaluation with the testing agency if required
- participating in reviewing abnormal test results as necessary

Employees

Employees are responsible for:

- attending audiometric testing as required

NOTE: The company pays for all audiometric tests and allows time off during normal working hours for appointments.

- following up abnormal test results from the testing agency with their personal physician
- attending follow-up tests or other medical evaluation if required by the testing agency, medical director, or personal physician

Safety & Environment

Safety & Environment is responsible for:

- ensuring employee audiometric test result records are provided to the testing agency for ongoing testing

- liaising with the company's medical director, testing agency, regional safety coordinator, and employee regarding test result records, including safety concerns and any follow-up testing or further evaluation required
- reviewing abnormal test results where there is a safety concern
- CAN: maintaining summaries of audiometric test results for employees

USA: **NOTE:** Human Resources maintains summaries of employee audiometric test results.

Requirements

Hearing Protection

Wear approved hearing protection in the field:

- in posted areas when equipment is operating
- when operating any piece of equipment where the noise level greater than (>) 85 dBA

When working on electrical equipment with a Hazard/Risk Category (HRC) of 2, 3 or 4, wear ear canal inserts.

NOTE: The company provides approved hearing protection at all locations.

Audiometric Tests

All new employees who may be exposed to noise hazards must receive an initial audiometric test.

In addition to initial testing, employees must receive ongoing audiometric testing:

- CAN: every 5 yrs
- EPSI: every 2 yrs for field employees, and every 4 yrs for office employees
- USA: annually for employees who continue to be exposed to noise hazards
- APLI: every 2 yrs
- as requested by the medical director (retained by the company), the testing agency or the employee's physician

Records

Audiometric Test Results

Safety & Environment (CAN) or the testing agency (USA), under direction of the medical director, retains original audiometric test results of employees permanently.

NOTE: Audiometric test results are confidential, accessible only to Safety & Environment and the medical director, and released only upon authorization from the employee or where there is a safety concern.

Purpose

To ensure appropriate hand protection where there is a risk of hand injury (see Table 1).

Related Standards

Company

Maximo Job Plans:

- EP2061R, Hot Gloves

Requirements

Rubber Glove Testing – Electrical

Test rubber gloves for:

- air leaks before each use
- specified voltage by an authorized testing company at least twice a year (time between tests not to exceed 6 months)

Discard rubber gloves that fail the air-leak test.

NOTE: The testing company marks and mutilates rubber gloves that fail the specified voltage test before being returned to ensure they are not used inadvertently.

Mark rubber gloves tested for voltage with the date of the test and the test voltage.

Table 1
Summary of Hand Protection

Task	Hand Protection
abrasive blasting	• leather gloves
electrical work with Hazard/Risk Category (HRC) 1, 2, 3, 4	• voltage-rated ANSI/ASTM-approved rubber gloves with protective leather gauntlet gloves
handling acids or caustics (including acid batteries)	• neoprene or nitrile gloves
handling NGL (risk of spray)	• gloves and protective sleeves
handling PCBs	• nitrile gloves
handling pipe, valves and casing, and measuring equipment where exposed to induced voltage	• ANSI/ASTM-approved low voltage lineman's rubber gloves and protective leather gauntlets
handling toluene	• nitrile gloves
operating chainsaws	• leather gloves
removing asbestos materials	• neoprene gloves when removing coal tar wrap; otherwise, rubber gloves
washing walls and ceilings	• rubber gloves
welding and associated activities	• leather gauntlet-type gloves (with seams on the inside to prevent stitches from burning and hot metal particles from becoming trapped)

NOTES
The company provides ANSI/ASTM-approved rubber gloves and protective leather gauntlet gloves.

Requirements

Employees performing jobs requiring foot protection must wear safety footwear, except when in:

- control rooms
- lunchrooms
- offices

Safety footwear must:

- have a minimum CSA Grade 1 (CAN) or ANSI Class 75 (all companies) rating
- provide sufficient protection against injury to the feet and ankles, considering the employee's work environment
- have a minimum 15 cm (6 in.) ankle support

The company supplies appropriate protective footwear for any job where additional foot or leg protection is necessary (see *13-02-06 Protective Clothing*).

Exemptions

Employees working in areas requiring safety footwear whose job does not have the potential for ankle injuries may be exempt from the requirement for minimum 15 cm (6 in.) ankle support.

Workers and visitors on a supervised or controlled tour of a facility, or whose occasional visits are administrative may be exempt from the requirement for safety footwear only if they are not exposed to any hazard.

CSA Symbols

CAN

Approved safety footwear must have a green triangle to indicate a Grade 1 safety toe, as well as a puncture-resistant sole

Electrical Work

All workers performing electrical work or any worker entering a substation must wear safety footwear marked with the omega symbol (Ω) (CAN) or Electrical Hazard (EH) (USA).

Subsidies

For safety footwear subsidies, contact the regional safety coordinator.

Requirements

Workers must wear appropriate clothing for body protection when performing job tasks that may be hazardous (see Table 1).

Table 1
Summary of Protective Clothing

Task	Body Protection
handling NGL (risk of spray)	• neoprene apron
handling PCBs	• nitrile apron • disposable coveralls • rubber boots
removing asbestos materials	• disposable hooded coveralls (preferably Tyvek brand) with elastic fittings • rubber boots or disposable boots (preferably Tyvek brand) • elasticized shoe covers • nitrile apron
handling acids or caustics (large quantities)	• neoprene or nitrile apron
operating chainsaws	• approved leg chaps or pants
abrasive blasting	• heavy pants and long-sleeve jacket or shirt • for coal slag, disposable coveralls recommended
designated signaler or spotter	high-visibility apparel[1] (e.g., vest, coveralls) that includes all of the following: • symmetrical "X" on the back extending from the shoulders to the waist (CAN) • two vertical stripes on the front extending from the shoulders to the waist • horizontal stripe extending around the entire waist
working on or adjacent to roadways	as above
working near mobile earth-moving equipment	recommended as above or as required by regulations
electrical work with Hazard/Risk Category (HRC) -1, 0, 1, 2	• approved fire retardant (FR) clothing
electrical work with HRC 3	• approved FR clothing
electrical work with HRC 4	• approved FR clothing
welding and cutting	• leather shoulder and sleeve covers

NOTES

1 Apparel must meet or exceed Class 2 standard specified in CSA Z96, High-Visibility Safety Apparel (CAN), or ANSI/ISEA 107, High-Visibility Safety Apparel (USA).

Electrical Work

While performing electrical work, keep sleeves down and do not wear metal articles (e.g., rings, watches, key chains) unless made nonconductive by taping.

Purpose

To protect workers where (a) air testing or monitoring, or a hazard assessment identifies an existing or potential breathing hazard, or where (b) respiratory or eye irritation or discomfort occurs due to airborne contaminants.

Scope

This includes selecting, using, and maintaining respiratory protection equipment.

Legislation

United States

Code of Federal Regulations (CFR), Title 29—Labor:

- Part 1910.134—Respiratory Protection

Related Standards

Canada

Canadian Standards Association (CSA):

- CSA Z94.4—Selection, Use, and Care of Respirators
- CSA Z180.1—Compressed Breathing Air and Systems
  - Table 1: Allowable Concentrations and Components for Compressed Breathing Air

Company

Book 2: Safety:

- 13-03-01 Filling Air Cylinders with the Cascade System
- 14-02-02 Portable Gas Detectors

Definitions

air-purifying respirator (APR)—passes contaminated air through an element which removes the contaminants and supplies purified air to a respirator inlet covering.

powered air-purifying respirator (PAPR)—uses a blower to pass contaminated air through an element that removes the contaminants and supplies the purified air to a respirator inlet covering.

self-contained breathing apparatus (SCBA)—allows the wearer to move about freely without the need to be connected to a stationary breathing air source.

supplied-air respirator (SAR)—provides air from a source other than the surrounding atmosphere (e.g., full-face respirator with hoseline).

tight-fitting respirator—includes half-mask APR, full-face APR, PAPR, SAR (excluding types with hoods), and SCBA.

Responsibilities

Regions

Regions are responsible for:

- coordinating respiratory protection training as required (see *15-02-01 Safety Training Matrix*)
- ensuring respirators are available, properly used and maintained, and cartridges are replaced as necessary
- arranging fit testing, and initial and ongoing medical evaluations with testing agency (i.e., pulmonary function test, spirometry examination)
- CAN — one month before scheduled medical evaluations, submitting a list of employees to be tested to Safety & Environment
- arranging follow-up tests or medical evaluations with testing agency as necessary
- participating in reviewing abnormal test results as necessary

Safety & Environment

Safety & Environment is responsible for:

- ensuring employee initial test result records are provided to the testing agency for ongoing testing
- liaising with the company's medical director, testing agency, regional safety coordinators, and employees regarding test result records, including safety concerns and any follow-up tests or medical evaluations required
- reviewing abnormal test results where there is a safety concern
- CAN — maintaining summaries of employee medical evaluation results

USA — **NOTE:** Human Resources maintains summaries of employee medical evaluation results.

Employees

Employees are responsible for:

- attending fit testing and medical evaluations
- following up abnormal test results
- attending follow-up tests or other medical evaluation required

Requirements

Medical Evaluations

All new field employees who may be required to wear a tight-fitting respirator must have an initial medical evaluation that is reviewed by a physician (i.e., baseline pulmonary function test or spirometry examination).

For new and transferred field office employees, summer and co-op students, and temporary employees, regional managers will determine initial medical evaluations at their discretion.

In addition to initial evaluations, ongoing medical evaluations are recommended for employees every 5 yrs (CAN), 2 yrs (APLI), or annually (USA).

Respirator Fit

Physical conditions (e.g., facial hair or temple pieces on glasses) must allow an effective facial seal with the respirator.

NOTE: Prescription eyeglasses with rubber strap temple arms or a spectacle kit, or alternatively contact lenses, may be worn with SCBA.

All workers, including field and office employees, who may be required to wear respiratory protection that depends on an effective seal must be clean-shaven where the facepiece contacts the skin; this may require trimming or removing mustaches.

Fit-Testing

Before wearing a respirator, employees must be fit-tested for the brand and model used.

Before each use of a respirator, perform a positive and negative pressure field fit-test to check the seal of the face mask.

Inspection and Maintenance

Inspect and maintain respiratory equipment in accordance with the manufacturer's specifications.

Visually inspect all respirators before and after each use.

For shared respiratory equipment, disinfect after each use and clean as necessary. For all other respirators, sanitize after each use and clean as necessary.

Workers may perform minor maintenance on hoseline breathing equipment (e.g., replace headbands, valves, gaskets, hoses, and clamps). Major maintenance and repairs must be performed by (a) a qualified worker (i.e., trained in cleaning, inspecting, and maintaining respirators), or (b) a certified technician from the supplier or manufacturer.

SCBA/Emergency Escape Paks

Visually inspect SCBA and emergency escape paks monthly.

CAN — Replace the breathing air in SCBA, emergency escape pak, and cascade system cylinders every 12 months.

Steel and aluminum SCBA cylinders and emergency escape pak cylinders must be hydrostatically tested every 5 yrs by a qualified service supplier. All other cylinders (e.g., carbon, fiberglass) must be hydrostatically tested every 3 yrs by a qualified service supplier.

NOTE: The most recent hydrostatic test date is stamped on the neck of the cylinder.

Each SCBA must be functionally tested in accordance with the manufacturer's specifications.

Cascade System
Cylinders used in a cascade system (or for hoseline equipment) must be hydrostatically tested by a qualified service supplier every 5 or 10 yrs.

NOTE: The most recent hydrostatic test date is stamped on the neck of the cylinder. The date format identifies the test interval:

- date alone or date followed by a plus sign (e.g., 4/89 or 4/89+) indicates a 5-year test interval
- date followed by an asterisk (e.g., 4/89*) indicates a 10-year test interval

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CAN — Cylinders used in a cascade system should be returned to the supplier with at least 10 psi of air pressure remaining.

Upon receiving a cylinder from a supplier, ensure:
- cylinder identifies supplier/company name
- label identifies the contents and expiration date
- cylinder is painted yellow if used in the cascade system

Cartridges
Replace organic vapor (OV) cartridges and organic vapor/acid gas (OV/AG) cartridges after a total of 10-hrs use or 30 days, whichever comes first.

Immediately replace OV/AG cartridges if:
- used for escape from H_2S concentrations >10 ppm
- damaged
- there is odor breakthrough

Replace filters when plugged, damaged, or soiled, or when breathing is difficult. If used in environments containing oil aerosols, replace oil-resistant filters after a total of 40-hrs use or 30 days, whichever comes first.

CAN

Compressor Systems for Breathing Air
Collect and test a sample of the breathing air from a compressor system:

- at least once every 6 months
- after major overhauls, modifications, or extensive repairs to the compressor system
- whenever contamination of the compressor system is suspected

NOTE: Obtain sampling instructions from the laboratory conducting the testing. The lab will provide test results of the breathing air sample.

The quality of breathing air from a compressor must be in accordance with CAN/CSA Z180.1-Table 1. If breathing air cylinders are filled by a supplier, records must be provided to verify compliance with Table 1.

Storage

Store respirators in clean plastic bags in a manner that prevents contamination and damage to the equipment.

Respirator Selection and Use

All respirators used must be approved by the National Institute for Occupational Safety and Health (NIOSH) or the Canadian Standards Association (CSA).

For work activities that are hazardous or potentially hazardous, see Table 1 and Table 2 for respiratory protection.

For any work activity where there is respiratory or eye irritation or discomfort, use a full-face APR.

If the concentration of the contaminant is unknown or there is a potential for a hazardous atmosphere (e.g., work around open systems), assume the atmosphere is hazardous, perform exposure assessments, and use respiratory protection in accordance with *Table 1* and *Table 2*.

Self-Contained Breathing Apparatus (SCBA)

> ⚠ WARNING: Workers using SCBA must leave the danger area when the alarm sounds, or when 20–25% of the operating time remains. Never remove the face mask while in the danger area.

Hoseline Breathing Equipment

Hoselines for breathing equipment must be less than 76 m (250 ft) in length.

Cylinders for hoseline breathing equipment must be equipped with a pressure-reducing regulator to control hoseline pressure below 1380 kPa (200 psi).

Breathing Hazards

Hydrogen Sulfide (H_2S)

NOTE: The low level alarm set point corresponds with the threshold limit value (TLV) for H_2S exposure; the high level alarm set point corresponds with the immediately dangerous to life and health (IDLH) for H_2S.

Hazardous levels of H_2S at company facilities are usually limited to confined spaces. Since H_2S is heavier than air, it can also accumulate in low areas, inside firewalls, and in ditches. Although the air in a sump or tank may test very low for H_2S, hazardous levels of H_2S may release into the air when the contents in the sump or tank bottoms is stirred.

Asbestos

Asbestos fibers inhaled into the lungs can lead to lung cancer, asbestosis, or mesothelioma.

The following materials are known or presumed to contain asbestos:

- insulation on abandoned waste heat boilers and piping
- plain and perforated asbestos board panels on interior walls and ceilings in some station buildings
- insulation on standby generator exhaust piping
- some floor tiles
- gasket material on pumping units and flanges on piping
- some pipe coating
- underground concrete electrical duct banks at terminal sites

Oxygen Deficiency
Normal air contains approximately 21% oxygen and 79% nitrogen. Less oxygen causes deep and rapid breathing. This progresses to dizziness, rapid heartbeat, headache, and a possible inability to move as the percentage of oxygen decreases to 16%. At 14% and lower, humans cannot survive.

Oxygen deficiency can develop in enclosed spaces, even in the absence of petroleum vapor. For example, in a sealed, cleaned tank, some oxygen is used up as the interior walls of the tank rust. As well, CO_2 and Halon fire extinguishing systems displace oxygen to put out a fire.

Abrasive Dusts
Abrasive blasting is commonly used to prepare surfaces before painting, coating, or lining. Abrasive blasting operations may create a breathing hazard from the blasting agent or from dusts generated during surface preparation.

Crystalline Silica (Refractory Materials)
Crystalline silica is found in the insulating materials commonly used to insulate crude oil heaters, including:
- Insulating Firebrick and Insulating Castable, which break down through the normal cycling of the heater and the turbulent flue gas, creating dusts that are disturbed on entry.
- Kaowool Blanket Products, which may contain crystalline silica after being exposed to temperatures above 1800°F.

Such temperatures are not unusual during normal operation of the crude oil heaters.

NOTE: For information on entry procedures and product MSDS, see the Crude Oil Heater Operations and Maintenance Manual onsite.

Records

SCBA/Emergency Escape Paks Monthly Inspections and Labels
Record monthly inspections of SCBA and emergency escape paks and retain onsite for 1 yr.

For emergency escape paks and SCBA not used routinely, label each respirator or storage bag with:
- inspection date
- name of worker completing the inspection
- findings, including remedial action required
- serial number or other identification

Air-Purifying Respirator Labels

Label APR storage bags with the (a) dates of inspection, cleaning, and maintenance, and (b) cartridge replacement schedule.

NOTE: Time logs are recommended for tracking cartridge use.

Pulmonary Function Test Results

Safety & Environment (CAN) or the testing agency (USA), under direction of the medical director, retains original Pulmonary Function Test results of employees permanently.

NOTE: Pulmonary Function Test results are confidential, accessible only to Safety & Environment and the medical director, and released only upon authorization from the employee or where there is a safety concern.

Quantitative/Qualitative Fit Test Results

Record Quantitative/Qualitative Fit Test results for each employee and retain until the next test.

Table 1
Summary of Respiratory Protection

Activity	Breathing Hazard	Respiratory Protection	Model Numbers	Comments
abrasive blasting	nonsilica silica dust, metals, recycled glass/glass-based dust	blaster: supplied-air hood or helmet with apron operated in continuous flow mode	Type CE	If using a self-contained system (e.g., Blastrac), half-mask APR with P100 dust filter may be used.
		helpers and workers in the blast area (within 100 ft downwind, 50 ft upwind, 70 ft if no wind): disposable dust mask or half-mask APR with P100 filter	3M 8210 or 3M 6000 with 2091 filter	
		helpers and workers in a confined space or in the immediate vicinity of blasting (within 50 ft downwind, 25 ft upwind, 30 ft if no wind): same as blaster		
	lead from lead-based paint	blaster: SAR with tight-fitting full-face mask in positive pressure mode		
		helpers and workers in the blast area (within 100 ft downwind, 50 ft upwind, 70 ft if no wind): disposable dust mask or half-mask APR with P100 filter	3M 8293 or 3M 6000 with 2091 filter	
		helpers and workers in a confined space or in the immediate vicinity of blasting (within 50 ft downwind, 25 ft upwind, 30 ft if no wind): same as blaster		
collecting spent abrasive blasting agent in confined spaces	very dusty air	0 to 0.5 hrs after abrasive blasting: supplied-air hood or helmet with apron operated in continuous flow mode	Type CE	
		more than 0.5 hrs after abrasive blasting: P100 filter	3M 8293 or 3M 6000 with 2091 filter	
	moderate dusty air	P100 filter		
	no visible dust	0 to 2 hrs after abrasive blasting: P100 filter		
		more than 2 hrs after abrasive blasting: none		

Table 1 - *continued*
Summary of Respiratory Protection

Activity	Breathing Hazard	Respiratory Protection	Model Numbers	Comments
collecting spent abrasive blasting agent in open spaces	very dusty air	0 to 0.5 hrs after abrasive blasting: supplied-air hood or helmet with apron operated in continuous flow mode	Type CE	
		more than 0.5 hrs after abrasive blasting: P100 filter	3M 8293 or 3M 6000 with 2091 filter	
	moderate dusty air	P100 filter		
	no visible dust	0 to 0.5 hrs after abrasive blasting: P100 filter		
		more than 0.5 hrs after abrasive blasting: none		
handling acids/caustics	corrosive mist, vapors, gas (e.g., hydrochloric acid, sulfuric acid, sodium hydroxide, chlorine)	half-mask APR with OV/AG cartridge with P100 filter	3M 6000 with 60923 cartridge	
removing asbestos materials	asbestos fibers	half-mask APR with P100 filter	3M 6000 with 2091 filter	
buffing, cutting, grinding	dusts and fumes	disposable dust mask or half-mask APR with P100 filter	3M 8293 or 3M 6000 with 2091 filter	
confined space entry	oxygen deficiency, mists, fumes, dusts, toxic vapors, gases	initial air testing from inside the confined space: SCBA	Scott Air-Pak	
		ongoing work: see Table 2		
drainup, work around open systems or exposed products	toxic organic vapors, hydrogen sulfide	initial exposure: half-mask APR with OV/AV cartridge	3M 6000 with 6003 cartridge	
		ongoing work: see Table 2		
applying herbicides and pesticides	toxic organic vapors or mists	half-mask APR with OV cartridge with dust/mist prefilter	3M 6000 with 60923 cartridge	

Table 1 - *continued*
Summary of Respiratory Protection

Activity	Breathing Hazard	Respiratory Protection	Model Numbers	Comments
lab operations	toxic organic vapors	normal operations: none		
		small spills: half-mask APR with OV/AV cartridge	3M 6000 with 6003 cartridge	
entering line heater	crystalline silica, refractory ceramic fibers	half-mask APR with P100 filter	3M 6000 with 2091 filter	
removing moldy ceiling tiles, bricks and various boards; mold remediation	biological aerosols	moldy area less than (<) 10 ft^2: N95	3M 8210	
		moldy area less than (<) 100 ft^2: half-mask APR with P100 filter	3M 6000 with 2091 filter	
		moldy area greater than (>) 100 ft^2: full-face APR with P100 filter	3M 6000 or 7000 full-face with 2091 filter	
painting and coating in enclosed and confined spaces with poor ventilation (n/a to water-based coating)	spraying: toxic organic mists	spraying: half-mask APR with OV/AG cartridge with P100 filter	3M 6000 with 60923 cartridge	
	spraying and brush/roller application: toxic organic vapors	brush/roller application: half-mask APR with OV cartridge	3M 6000 with 6001 cartridge	
	isocyanate (two-part coatings containing isocyanate)	spraying: SCBA or full-face SAR	Scott Air-Pak or 3M 6000 with 6001 cartridge	
		brush/roller application: half-mask APR with OV cartridge	3M 6000 with 6001 cartridge	

Table 1 - *continued*
Summary of Respiratory Protection

Activity	Breathing Hazard	Respiratory Protection	Model Numbers	Comments
pipe coating	hot tapecoat application: coal tar fumes (carcinogen)	tapecoat application: half-mask APR with OV/AG with P100 filter	3M 6000 with 60293 cartridge	
	coal tar felt wrap: asbestos fibers	hand removal: none (half-mask APR with P100 filter may be used)		
		mechanical removal: half-mask APR with P100 filter	3M 6000 with 2091 filter	
spill response	toxic organic vapors (e.g., benzene, petroleum vapors, toluene), hydrogen sulfide	first responder: half-mask APR with OV/AG cartridge	3M 6000 with 6003 cartridge	For respiratory protection in hot zones, see spill site safety plot plan.
		ongoing work: see Table 2		
tank cleaning	oxygen deficiency, toxic organic vapors, hydrogen sulfide	initial entry: SCBA or SAR with escape pak	Scott Air-Pak	
		ongoing work: see Table 2		
welding inside tanks or in areas with poor ventilation	toxic dusts and fumes	half-mask APR with P100 filter	3M 8293, or 3M 6000 with 2091 filter	

NOTES

- Equivalent disposable equipment in the 3M 5000 series may be used for 3M 6000 series equipment.
- In Canada, equivalent NIOSH-approved equipment may be used for 3M series equipment.
- 6003 OV/AG cartridges may be used for 6001 OV cartridges
- 3M 8293 respirators may be used for 3M 8210 respirators.

Table 2
Respiratory Protection for Exposure Concentrations

Breathing Hazard	Exposure Concentration	Respiratory Protection	Model
benzene	0 to 0.5 ppm	none	
	0.6 to 5 ppm	half-mask APR with OV cartridge	3M 6000 with 6003 cartridge
	6 to 25 ppm	full-face APR[1] with OV cartridge or SAR	3M 6000 or 7000 full-face with 6003 cartridge
	greater than (>) 25 ppm	SCBA or SAR	Scott Air-Pak
	greater than (>) 500 ppm (IDLH)[2]	planned work is not permitted[3]	
carbon monoxide	25 ppm to 500 ppm	SCBA or SAR	Scott Air-Pak
	greater than (>) 500 ppm	planned work is not permitted[3]	
hydrogen sulfide (H_2S)[4]	0 to 10 ppm	none	
	11 to 99 ppm[5]	SAR	Type C supplied-air respirator
	100 to 300 ppm	SCBA or SAR with escape pak[6]	Scott Air-Pak
	greater than (>) 300 ppm (IDLH)	planned work is not permitted[3]	
mercaptan	0 to 0.5 ppm	none	
	0.6 to 5 ppm	half-mask APR with OV cartridge	3M 6000 with 6003 cartridge
	6 to 25 ppm	full-face APR[1] with OV cartridge or SAR	Scott Air-Pak
	greater than (>) 25 ppm	SCBA or SAR	Scott Air-Pak
	greater than (>) 500 ppm (IDLH)[2]	planned work is not permitted	
natural gas	0 to 10% LEL	none	
	11 to 20% LEL	SCBA for cold work; hot work is not permitted[7]	Scott Air-Pak
	greater than (>) 20%	planned work is not permitted[3]	
oxygen deficiency	less than (<) 19.5%	SCBA	Scott Air Pak

Table 2 - *continued*
Respiratory Protection for Exposure Concentrations

Breathing Hazard	Exposure Concentration	Respiratory Protection	Model
petroleum vapors	less than (>) 3% LEL	none	
	greater than or equal to (≥) 3% LEL to less than (<) 10% LEL	half-mask APR with OV cartridge	3M 6000 with 6003 cartridge
	greater than or equal to (≥) 10% LEL to less than (<) 20% LEL	SCBA (or equivalent) for cold work; hot work is not permitted	Scott Air-Pak
	greater than or equal to (≥) 20% LEL	planned work is not permitted[3]	

NOTES

1 If quantitative fit test performed.
2 Immediately dangerous to life and health.
3 Emergency work is allowed if SCBA or SAR with escape pak is used and all ignition sources are eliminated.
4 If the concentration exceeds the maximum detection limit of the H_2S detector, planned work is not permitted until the concentration has been verified.
5 Where possible, reset gas detectors monitoring H_2S to alarm at 10 ppm (low level) and 100 ppm (high level).
6 A safety watch with SCBA or SAR must be present.
7 Natural gas is composed of 95% methane. Methane is a simple asphyxiate; therefore does not have an allowable exposure limit. Methane displaces oxygen in the atmosphere; therefore, entry into areas where oxygen levels are greater than (>) 19.5% require SCBA.

NOTE: For information on ladders, fixed platforms, swingstages, work cages, and powered mobile elevating work platforms, see *02-02-03 Working at Elevations.*

Requirements

Provide two independent means of support for each worker using the equipment:

- the work platform itself
- a fall protection system consisting of a lifeline, rope-grabbing device, lanyard and shock-absorber, and full body harness

Tie back or otherwise secure a thrustout or parapet hook to a solid part of the structure to prevent movement or dislodgement.

When working from a windgirder without handrails to install, adjust or remove anchorage points, use a fall prevention system.

Safety Harnesses

Fall Protection

Workers must wear ANSI-approved (USA) or CSA-approved (CAN) fall-arresting full body harnesses (with lanyard) when they could fall a vertical distance greater than 2.4 m (8 ft) for Canada or 1.8 m (6 ft) for the USA, and (a) it is impractical to provide adequate work platforms, scaffolds, staging and guard rails, or (b) workers require both hands to work

Use a full body harness for all applications involving swingstages and work cages.

NOTE: There are no exceptions to fall protection requirements.

Workers working at heights (e.g., changing lights or bulbs on light standards in the station yard or communication tower) should fasten their harnesses around the light standard or tower, even if it is equipped with steps or if a ladder is being used.

Work Restraint

Workers must wear ANSI-approved (USA) or CSA-approved (CAN) safety harnesses (with lanyard) when they approach within 1.5 m (5 ft) of a roof edge.

Lanyards

Fall Protection

Where used for fall protection, use ANSI-approved (USA) or CSA-approved (CAN) lanyards to secure workers wearing a full body harness to an approved drop line, lifeline or fixed anchorage point.

NOTE: Use shock-absorbing lanyards with wire rope lifelines to keep fall-arrest loads below accepted limits.

Where used for fall protection, lanyards must not permit a worker to fall more than 1.2 m (4 ft) vertically.

Provide one lifeline for each worker on swingstages and work cages. Securely anchor each lifeline to an independent support so that failure of the equipment will not cause failure of the lifeline.

Inspect lifelines before using for damage from abrasion and chafing. When in use, protect lifelines from such damage.

Lifelines must be ⅝-in. polypropylene rope or other fibers of equivalent durability, impact strength and elasticity. Each individual lifeline must be long enough to reach the ground.

Work Restraint

Where lanyards are used for horizontal work restraint, suitably anchor lanyards to prevent wearers from slipping over a roof edge.

Safety Belts

Work Restraint

ANSI-approved (USA) or CSA-approved (CAN) waist-type safety belts, with safety lines, can be used only for horizontal work restraint (e.g., oil spill cleanup at water's edge).

⚠WARNING: Do not use safety belts for fall protection.

Safety Lines

Fall Protection and Work Restraint

ANSI-approved (USA) or CSA-approved (CAN) safety lines (e.g., lifelines), safety straps, may be used for horizontal work restraint or fall protection.

Independently secure safety lines to approved structures of adequate strength.

Use softeners where lines attach to structures and elsewhere as necessary to protect against chafing or abrasion from contact with sharp edges.

Purpose

To identify the coverage available to eligible employees for reimbursement of prescription safety glasses.

NOTE: For a list of optometrists participating in company occupational vision care (OVC) and additional reimbursement details, contact the regional safety coordinator.

Scope

This applies to:

- field employees, including temporary employees and summer and co-op students
- office employees who work in or frequently visit the field where eye protection is required

NOTE: Where there is uncertainty, the employee's manager or supervisor and Safety & Environment will determine eligibility.

Related Standards

Industry

American Society of Safety Engineers (ASSE):

- ASSE Z87.1—Occupational and Educational Personal Eye and Face Protection Devices

Canadian Standards Association (CSA):

- CAN/CSA Z94.3—Eye and Face Protectors

Requirements

NOTE: Safety & Environment must approve exceptions to the following requirements.

Frames

Frames are covered if they (a) have detachable or fixed sideshields and (b) meet the requirements in CAN/CSA Z94.3 or ASSE Z87.1.

CAN — Special frame materials (e.g., titanium) are not covered unless clinically required or necessary for work duties, and authorized (e.g., hypoallergenic, thickness/weight of lens).

CAN

Lenses

Lenses must be either plastic or polycarbonate. Glass lenses are not covered.

All lenses must have scratch resistant coating.

High index lenses are covered if:

- sphere and cylinder together are more than 6 dioptres
- currently worn in dress glasses
- more than 3 mm thick in the center

Anti-reflective coating and ultraviolet coatings are permitted options for lenses.

The following lens treatments are not covered unless clinically required or necessary for work duties, and authorized:

- planos
- photochromatics (e.g., transitions, colormatics)
- tints to a maximum of 30%
- progressive bifocals, if currently worn in dress glasses or in previous safety glasses

USA

Lenses

Polycarbonate, plastic, and glass lenses must be marked in accordance with ASSE Z87.1.

NOTE: Polycarbonate lenses have the highest resistance to impact, and are preferred by vendors and the company. Glass is least preferred due to potential shattering on impact.

Scratch resistant coating, anti-reflective coating, and ultraviolet coating are permitted options for lenses.

Tinting is a permitted option, subject to the following restriction:

- Only a #1 lens tint is acceptable for indoor use; #2 and #3 tints are acceptable only for outdoor use.

Video display terminal (VDT) option packages, which usually include ultraviolet coating, slight tint and anti-reflective coating, are not recommended for field employees, since they are often susceptible to scratching.

Photochromic lenses are not covered unless pre-authorized. Photochromic transition-plus lenses are available in plastic, while photogrey and photobrown are available in glass.

NOTE: OSHA prohibits the use of tinted or variable tinted lenses when a worker must pass from a brightly lit area to an area with low illumination, e.g., a forklift operator passing from outdoors to indoors.

Bifocal lenses are a permitted option, subject to the following qualifications:

- Full-field multifocals are generally not recommended; if recommended by the doctor or eyeglass dispenser, polycarbonate lenses should be obtained.
- Progressive power lenses (no-line bifocals) should be used with caution by uninitiated employees, who may have problems with depth perception.

Second Pair

Under special circumstances (e.g., remote locations), a second pair of prescription safety glasses may be purchased with approval from the regional manager.

A second pair of prescription safety glasses with tinting greater than 30% may be purchased for use only during welding-related activities that require additional levels of tinting.

A second pair of prescription lenses may be purchased for use with a spectacle kit if clinically required or necessary for work activities (i.e., wearing full facepiece respirator or SCBA).

Accessories

Accessories (e.g., sunclips, carrying cases, cleaning products, neck cords) are not covered unless clinically required or necessary for work duties, and authorized.

Replacements

Prescription safety glasses may be replaced (a) if the lenses or frames become lost or damaged to the point where vision is impaired or (b) when a prescription changes.

Eye Examinations

Eye exams are covered by most provincial health care plans (CAN) and can be supplemented by the company's extended health care benefits.

Subsidies

For prescription safety glasses subsidies, contact Safety & Environment.

Records

Occupational Vision Care (OVC) Authorization Form

Before purchasing prescription safety glasses, employees must (a) complete the first part of the OVC Authorization Form, and (b) have the form signed by their supervisor.

When purchasing prescription safety glasses, provide the appropriate completed OVC Authorization Form with a copy of 13-02-09, Prescription Safety Glasses (CAN), to a provincial optometrist participating in OVC, or to an optical dispensing outlet of the employee's choice (with the prescription).

Purpose

To protect workers from flash fire or electrical arc flash hazards.

Legislation

Canada

Canada Labour Code:

- Part II: Occupational Health and Safety
  - Section 124—Duties of Employers
  - Section 126—Duties of Employees

Canadian Occupational Health and Safety Regulations:

- Part XII—Safety Materials, Equipment , Devices and Clothing

Alberta Occupational Health and Safety Code:

- Part XII—Safety Materials, Equipment, Devices and Clothing

Saskatchewan Occupational Health and Safety Act:

- Part II—Duties

Saskatchewan Occupational Health and Safety Regulations:

- Part VII—Personal Protective Equipment

United States

Code of Federal Regulations (CFR), Title 29—Labor:

- Part 1910, Subpart I—Personal Protective Equipment
- Part 1910.335—Safeguards for Personal Protection

Related Standards

Canada

Canadian General Standards Board (CGSB):

- CAN/CGSB 155.20—Workwear for Protection Against Hydrocarbon Flash Fire
- CAN/CGSB 155.21—Provision and Use of Workwear for Protection Against Hydrocarbon Flash Fire

United States

National Fire Prevention Association (NFPA):

- NFPA 2112—Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire
- NFPA 2113—Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire
- NFPA 70E—Standard for Electrical Safety in the Workplace

Definitions

approved fire retardant clothing—meets the requirements of CAN/CGSB 155.20 or NFPA 2112, and has a minimum arc thermal protection value (ATPV) of 8 cal/cm2.

Requirements

Work Wear

Field employees must wear approved fire retardant (FR) clothing as daily work wear when issued by the regional manager at their discretion.

All other company employees, summer and co-op students, and visitors (i.e., non-company employees) must wear approved FR clothing (a) inside fenced or operating facilities, or (b) wherever hot work is being performed. Exceptions include:

- low-risk areas, including office buildings, PLM shops, and areas on the right-of-way (ROW) identified by the site supervisor
- Edmonton Control Center (ECC) employees at the backup control center (i.e., Site 2)
- controlled vehicle or escorted tours where risks are eliminated by a company representative

Shirts

> ⚠WARNING: Do not remove sleeves on long sleeve FR shirts.

Short sleeve t-shirts may be worn at the discretion of the site supervisor during job tasks in restricted or nonclassified areas, for example:

- washing or inspecting vehicles
- mowing grass
- indoor housekeeping duties where there is no exposure to high voltage (e.g., mopping, sweeping)
- painting with rollers or brushes

Outerwear

Only approved FR outerwear, including rainwear, must be worn as the outer garment and must fully cover any unapproved FR clothing worn.

If other safety concerns exceed the fire hazard (e.g., protection from asbestos, drowning or corrosive materials, contact by heavy equipment/vehicles), outerwear that is not approved FR clothing may be worn over approved FR clothing.

Undergarments

Workers should wear only 100% cotton, wool, or approved FR undergarments.

Multiple Layers

Multiple layers of FR clothing are recommended as additional protection during high risk work activities, including, for example, but not limited to:

- open systems
- high voltage work (see 13-02-06, Protective Clothing)
- pumps and components that are open and isolated

Maintenance

Follow the laundering instructions and temperature limits for FR clothing identified on the garment care tag.

> ▲CAUTION: Do not use chlorine bleach when laundering FR clothing as it may weaken the fabric and result in color loss over time.

Keep FR clothing reasonably free from grease and oil.

Subject
Standard Safety Equipment

Legislation

Canada
Transport Canada:
- Canada Shipping Regulations

United States
United States Coast Guard (USCG):
- Federal Requirements and Safety Tips for Recreational Boats

Requirements

Company Locations
Table 1 identifies the standard safety equipment recommended at company locations.

NOTE: Where location requirements apply, personal protective equipment (PPE) is also identified.

Locate wind socks:
- away from wind currents caused by tanks or buildings
- high enough to avoid influence from equipment (however, if located too high, an accurate indication of wind movement at ground level may not be possible
- in an area illuminated at night

Boats
Boats must be equipped with safety equipment according to the Canada Shipping Regulations (CAN), or the Federal Requirements and Safety Tips for Recreational Boats (USA).

Table 2 (CAN) or Table 3 (USA) identifies the standard safety equipment for boats.

USA

In addition to the standard boat safety equipment, the following equipment is recommended depending on the size, location, and use of boat:
- VHF radio
- anchor/spare anchor
- heaving line
- first aid kit
- ring buoy
- oars or paddles
- tool kit

Vehicles

Table 4 identifies the standard safety accessories recommended for company-owned and leased vehicles.

NOTE: Where vehicle requirements apply, PPE is also identified.

Vehicle Recovery Straps

Whenever practicable, use a certified towing agency to recover vehicles; otherwise (a) recovery straps must be nylon with sewn loops at each end and at least 6 m (20 ft) in length, and (b) follow the pulling strength limits of the vehicle recovery equipment in accordance with the manufacturer's specifications.

⚠**WARNING**: Do not use lifting slings, snatch straps, chains, or recovery straps manufactured with chain and hook attachments to recover vehicles.

Table 1
Summary of Safety Equipment at Company Locations

Equipment	Tank Station (CAN) (USA)	Delivery/ Injection Location	Pump Station	Location with PLM Crew	Location with Mechanical Dept	Location with Electrical Dept
air mover	as required					
bonding and grounding cable and connections	—	—	—	2	—	—
cascade system (for refilling air cylinders)	as required					
fire blanket in suitable case	1	1	1	1	1	1
fire extinguisher and equipment	as required					
first aid kit	as required					
flashlight[1] (explosion-proof) and extra batteries	as required[2]					
floodlight (portable, explosion-proof)	—	—	—	2	—	—
ground mat	as required					
grounding cable: electrical cubicles (CAN) (USA) electrical dept (ENB [NW])	1	—	1	—	—	—
hoseline with egress bottle	—	—	—	as required	—	—
hydrogen sulfide detector	1	2	—	1	—	—
lineman's belt	as required					
life buoy and rope	as required					
locks and tags for lockout	as required					
NGL flare pistol and 4 min/10 max signal flare cartridges	1	1	1 set per NGL facility	—	—	—
NGL personal protective equipment (required for Lines 1 and 5 service)	1 set	1 set	1 set per NGL facility	3 sets	—	—
portable gas detector	1 per worker + additional as required					
rubber gloves (electrician) and leather gauntlets	1 pair	—	1 pair	as required	—	2 pairs
safety harness and lanyard	2	—	2	4 (CAN) (USA) 1 (ENB [NW])	—	—

Table 1
Summary of Safety Equipment at Company Locations

Equipment	Tank Station (CAN) (USA)	Delivery/ Injection Location	Pump Station	Location with PLM Crew	Location with Mechanical Dept	Location with Electrical Dept
Scott Air-Pak	3	1 (ENB [NW])	2 (ENB [NW])	4 [3] (CAN) (USA) 2 (ENB [NW])	—	—
warning signs	as required					
wind sock	1	1	1	2 (portable)	as required	

NOTES

as required—determined by site supervisor

1 Flashlights must carry the Underwriters Laboratories label "approved for use in explosive atmospheres."
2 When working in areas without emergency lighting facilities, approved flashlights must be available for immediate use.
3 Crews may store Scott Air Pak at their work location or unattended locations under their control provided the equipment is readily available.

Table 2
Boat Safety Equipment—CAN

Boat Size	Standard Equipment
<5.5 m (18 ft)	• 1 CGSB[1]-approved life jacket per occupant • 2 oars and rowlock, or 2 paddles • 1 bailer[2] or 1 manual pump • 1 Class BI fire extinguisher (minimum 5-lb extinguisher rated for Class B fires) • buoyant heaving line >15 m (50 ft) long, or an approved[2] 610 mm (2 ft) or 762 mm (2 ½ ft) lifebuoy
>5.5 m (18 ft) to <8m (26 ft)	• 1 CGSB[1]-approved life jacket per occupant • 2 oars and rowlock, or 2 paddles • 1 bailer[2] or 1 manual pump • 1 Class BI fire extinguisher (minimum 5-lb extinguisher rated for Class B fires) • 6 approved[2] pyrotechnic distress signals (at least 3 Type A, B or C) • buoyant heaving line >15 m (50 ft) long, or an approved[2] 610 mm (2 ft) or 762 mm (2 ½ ft) lifebuoy • permanently fitted navigational lights[3]
>8m (26 ft) to <12 m (39 ft)	• 1 CGSB[1]-approved life jacket per occupant • 1 approved[2] 762 mm (2 ½ ft) lifebuoy with at least 9 m (30 ft) of rope attached • 1 bailer and one manual or power-driven bilge pump • 1 Class BI fire extinguisher (minimum 5-lb extinguisher rated for Class B fires) • if equipped with a heating or cooking appliance, an additional Class BI fire extinguisher • 6 approved[2] pyrotechnic distress signals of any type, and 6 pyrotechnic Type A, B or C signals • 1 fire bucket • 1 anchor with not less than 15 m (49 ft) of cable, rope or chain • permanently fitted navigational lights[3] • sound signaling device[3]

NOTES

1 Canadian General Standards Board
2 In accordance with Transport Canada, Canada Shipping Act, Small Vessel Regulations, Schedule III, Equipment Standard
3 In accordance with Transport Canada, Canada Shipping Act, Collision Regulations

Table 3
Boat Safety Equipment—USA

Boat Size	Standard Equipment
<16 ft	• 1 USCG[1]-approved life jacket per occupant • 1 electric distress light or, if operating between sunset and sunrise, 3 combination (for both day/night use) red flares • 1 Class BI fire extinguisher • sound signaling device audible for ½ mi/4 to 6 sec • red and green navigational sidelights lights visible from at least 1 mi • an all-round white light, or a masthead light and a sternlight; all visible from at least 2 mi
>16 ft to <26 ft	• 1 USCG[1]-approved life jacket per occupant and 1 Type IV personal flotation device • 1 orange distress flag or electric distress light, or 3 handheld or floating orange smoke signals and 1 electric distress light, or 3 handheld, meteor or parachute type combination (for both day/night use) red flares • 1 Class BI fire extinguisher • sound signaling device audible for ½ mi/4 to 6 sec • red and green navigational sidelights lights visible from at least 1 mi • an all-round white light, or a masthead light and a sternlight; all visible from at least 2 mi

NOTES
1 United States Coast Guard

In addition, vessels operating in the State of New York also must be equipped with an anchor and line of sufficient strength to provide the vessel with safe anchorage.

Table 4
Summary of Safety Accessories for Vehicles

Equipment	Tank Station Vehicle (CAN) (USA)	Delivery Injection Vehicle	Regional Office Vehicle	PLM Vehicle	Mechanic Vehicle	Electrician Vehicle	Office Supervisor Vehicle (EPSI)	Field Vehicle (EPSI)	Emergency Response Vehicle (EPSI)	Leased Vehicle
area maps	—	—	as required							
booster cable	—	—	—	1	1	1	1	1	1	—
chain, rope and booster to secure loads (ENB [NW])	—	—	—	1 set	—	—	—	—	—	—
portable gas detector	as required									
disposable camera	as required									
fire blanket in suitable case	—	—	—	1	—	—	—	—	—	—
fire extinguisher–2 ½lb dry chemical extinguisher	—	—	1	—	—	—	—	—	—	—
fire extinguisher–5 or 10lb dry chemical extinguisher	1 (USA) (CAN)	1 (USA) (CAN)	—	1 10 lb if suburban (ENB[NW])	1	1	—	1 (USA) (CAN)	—	—
fire extinguisher–30 lb dry chemical extinguisher	—	1	—	1 (2 if≥1 ton)	—	—	—	1	—	—
first aid kit	1	1	1	1	1	1	1	1	1	1
flags/red cloth	—	—	—	2	—	—	—	—	—	—
flashing amber light	—	—	—	1	1	1	—	—	1	—
flashlight	as required									

Table 4
Summary of Safety Accessories for Vehicles

Equipment	Tank Station Vehicle (CAN) (USA)	Delivery Injection Vehicle	Regional Office Vehicle	PLM Vehicle	Mechanic Vehicle	Electrician Vehicle	Office Supervisor Vehicle (EPSI)	Field Vehicle (EPSI)	Emergency Response Vehicle (EPSI)	Leased Vehicle
NGL flare pistol and 4 min/10 max signal flare cartridges	—	—	as required	1	1	1	—	—	1	—
shovel	—	—	as required	1	1	1	1	1	1	—
snow brush	1	1	1	1	1	1	1	1	1	1
spare tire	1	1	1	1 if <1 ton as required if ≥1 ton (CAN) (USA)	1	1	1	1	1	—
standard tool kit	—	—	—	1	1	1	—	1	—	—
tire pressure gauge	1	1	1	1	1	1	1	1	1	1
tire inflator sealer	As required									
tire jack	1	1	1	1	1	1	1	1	1	1
vehicle recovery strap	as required						1	1	1	as required
warning reflector / road hazard triangles	—	—	3	3	3	3	1	1	1	1
winter survival kit (ENB [NW])	—	—	—	as required			—	—	—	—

NOTES
as required—determined by site supervisor

Purpose

To provide guidance on the use of portable gas detectors.

Scope

This applies to:

- multi-head gas detectors
- personal air sampling
- grab sampling equipment (e.g., Drager Chip Measurement System [CMS])

Related Standards

Company
Book 2: Safety

- 14-02-01 Standard Safety Equipment

Responsibilities

Regions are responsible for ensuring workers are familiar with (a) operation and maintenance for the type of portable gas detector used at the location, and with (b) manufacturer's instructions regarding operation, servicing and bump testing calibration.

Requirements

Selection and Use

Portable gas detectors must be used where there is potential for exposure to atmospheric hazards including, but not limited to:

- confined spaces
- open systems
- venting systems
- leak sites

Where possible, use portable gas detectors equipped with a visual alarm (i.e., red indicator that lights when alarm levels are reached) in addition to an audible alarm.

NOTE: Combustible gas detectors do not provide accurate readings in an oxygen-deficient atmosphere.

Passive detectors assess the atmosphere without the use of a pump. Active detectors have internal pumps that draw air samples from the immediate area or from a distance (e.g., inside a pipe, sump, booster pit).

Multi-Head Gas Detectors
Position multi-head continuous gas detectors within a few feet of the work area in order not to interfere with the task, including:

- at the source of the gas or vapor
- low areas (for petroleum vapors and hydrogen sulfide)
- the most representative location for workers at the site
- areas with the highest potential for exposure

Personal Air Monitoring
Personal detectors monitor breathing hazards and provide information when working on open systems and at leak sites and include:

- continuous monitors personal detectors (e.g., single or multi-head detectors)
- passive badges/tubes
- personal sampling pumps

Conduct passive badge and personal sampling pump testing as determined by the regional safety coordinator.

To obtain a representative exposure sample, position the personal detector in the breathing zone (approximately 6 10 in. from the nose) of a worker with the highest potential for exposure. Communicate results with all exposed workers.

Grab Sampling Equipment
Detector tubes (i.e., Drager CMS) and photo ionization detectors (i.e., UltraRae) are screening tools that provide information on air contaminants at a specific instant. When using detector tubes (i.e., Drager CMS) and photo ionization detectors (i.e., UltraRae) to obtain representative exposure information, multiple grab samples are needed.

Inspection and Maintenance

Functional Bump Testing
Perform a functional "bump" test in accordance with the manufacturer's specifications before each day's use.

NOTE: A functional test is a brief exposure of the monitor to a concentration of gas(es), in excess of the lowest alarm set-point for each sensor. This test verifies sensor and alarm operation.

Calibration
Calibrate portable gas detectors in accordance with the manufacturer's recommendations for frequency and calibration gas.

Records

Gas Detector Inspection Tag

Attach a gas detector inspection tag to each gas detector that includes (a) calibration date and (b) initials of the worker who calibrated the detector.

Gas Detection Instrument Service Log

Record calibration results in the Gas Detection Instrument Service Log and retain onsite for 2 yrs.

Requirements

First Aid Kits

At company locations, install first aid kits in a conspicuous place. At attended locations, identify the location on building entrances; at unattended locations, identify the location on cubicle doors. Identification must include the words FIRST AID or the first aid symbol.

Eyewashes

Portable Eyewashes

Portable eyewashes must be clearly identified and conveniently located at various locations in each station.

At isolated or remote work areas, at least one eyewash squeeze bottle must be available anywhere there is potential hazard from chemicals. Locate squeeze bottles close to the chemical hazard and protected from the elements (e.g., freezing).

Eyewash Stations

Remote stations without a constant water supply must have an emergency eyewash station capable of providing approximately 15 min of continuous flushing.

ENB (NW) — Use appropriate personal protective equipment (PPE) at remote locations where portable eyewashes and eyewash stations are impractical due to extreme weather conditions.

Inspection and Maintenance

First Aid Supplies

A list of required first aid supplies must be included inside each first aid kit. Obtain lists from the regional safety coordinator.

Inspect first aid kits quarterly. Open the kit and verify its contents with the list of first aid supplies inside the kit. Re-stock as necessary.

Eyewash Equipment
Inspect plumbed, self-contained, and portable eyewash equipment monthly.

For plumbed eyewash stations, (a) flush the line and (b) verify proper operation.

For self-contained eyewash stations and portable eyewashes, ensure (a) the equipment is clean and in the designated location, and (b) sufficient eyewash fluid is available. In addition, for portable eyewashes, check the seal and expiry date and replace if necessary.

For self-contained eyewash stations and unsealed portable eyewashes, change the flushing fluids quarterly or as specified by the manufacturer, and if using water, add a preservative to maintain freshness.

Legislation

Canada

Canada Labor Code, Part II:

- Canadian Occupational Safety and Health (COSH) regulations

National Fire Code of Canada, Parts 6 and 7

APLI .... Alberta Fire Code

United States

Code of Federal Regulations (CFR), Title 29 - Labor:

- Part 1910.120 Hazardous Waste Operations and Emergency Response
- Part 1910.151—Medical Services First Aid
- Part 1926.150—Fire Protection
- Part 1910.157—Portable Fire Extinguishers

Related Standards

Industry

National Fire Prevention Association (NFPA):

- 10, Standards on Portable Fire Extinguishers
- 11C, Mobile Foam Apparatus
- 1962, Inspection, Care and Use of Fire Hose, Couplings and Nozzles; and the Service Testing of Fire Hose

Definitions

aqueous film-forming foam (AFFF) concentrates—substances that are based on fluorinated foam surfactants plus foam stabilizers and usually diluted with water to a 3% or 6% foam solution. The foam solution acts as a barrier, excluding air or oxygen and developing an aqueous film on the fuel surface capable of suppressing the evolution of fuel vapors. The foam solution is suitable for combined use with dry chemicals.

extinguishing agent—the substance (e.g., dry chemical powder, foam) that interrupts the chemical chain reaction that produces fire by removing heat, removing fuel, and removing or diluting oxygen.

film-forming fluoroprotein (FFFP) foam concentrates—substances that use fluorinated surfactants plus a protein base and stabilizing additives and inhibitors to produce an aqueous film for suppressing hydrocarbon fuel vapors and fighting fires. Concentrates are usually diluted with water to a 3% or 6% solution.

fluoroprotein (FP) foam concentrates—substances consisting of an agent mixed with fluorocarbon surfactants, most commonly used against nonplolar oil fires. They can be used in conjunction with dry chemical extinguishers with no loss of effectiveness. The shelf-life of FP foam concentrates is 10 yrs-plus in ideal conditions.

foam system—equipment and piping that distributes fluoroprotein (FP) foam to suppress tank fires. A semi-fixed system uses a mobile foam unit that is moved to the fire location and temporarily connected to fixed piping laterals. With a fixed system, the foam unit is housed in a building and permanently connected to lateral piping.

foam trailer—a mobile proportioning unit connected to a hydrant.

stored pressure extinguisher—an extinguisher with both the extinguishing material and expellant gas kept in a single container.

Requirements

NOTE: For the location of firefighting equipment, see the Site Safety Plot Plan.

Portable Fire Extinguishers

Select and install portable fire extinguishers in accordance with the appropriate legislation. Provide appropriate fire protection taking into consideration building structure (e.g. metal or wooden studs, ceiling tiles), potential fuel sources (e.g. parts cleaner, wooden cabinets, plywood walls, electrical panels), and occupancy hazards (e.g., lunchrooms).

Unless specific instructions indicate otherwise, locate hand-held fire extinguishers so that travel distance is:

- ≤23 m (75 ft) for Class A fires (e.g., wood, paper)
- ≤15 m (50 ft) for Class B fires (flammable/combustible liquids)

NOTE: Distances for Class C fires (electrical) is based on the surrounding fire hazards (Class A or Class B).

Storage

Store hand-held extinguishers off the floor or ground to prevent condensation and subsequent corrosion on extinguisher bases.

Use a cover to protect extinguishers stored outside.

When stored on vehicles or equipment, or where otherwise subjected to shock and vibration, mount portable dry chemical extinguishers on their sides with the elbow and hose facing upwards.

Pump Stations and Compressor Buildings

- one 30-lb dry chemical extinguisher immediately inside each compressor building or pump room/shelter
- minimum of one 20-lb or 30-lb dry chemical extinguisher in each manifold area
- one 15-lb carbon dioxide (CO2) or 7-lb Halon extinguisher inside each control room door and in the hallway outside the switchgear cubicle door
- one wheeled extinguisher immediately inside or outside the most used doorway of pump rooms/shelters

---

NOTE: If two shelters are less than 15 m (50 ft) apart, one wheeled extinguisher may be placed between the two shelters.

- one 30-lb dry chemical extinguisher in an pump room so that the travel distance from anywhere in the pump room to an extinguisher is no more than 9 m (30 ft)

Pipeline Maintenance (PLM)

- two 30-lb dry chemical extinguishers to be taken to pipeline repair jobs
- additional 20-lb or 30-lb dry chemical extinguishers strategically located in PLM and welding shops
- ENB (NW) one 30-lb Foray dry chemical extinguisher at each door and strategically located in work and welding shops

ENB (NW) ***Remote Maintenance Bases***

- four 30-lb dry chemical extinguishers to be taken to work sites as needed and hazards dictate

ENB (NW) ***Regional Office***

- one 10-lb CO_2 extinguisher inside each entrance door
- one 20-lb CO_2 extinguisher in the computer room and the measurement room
- one 10-lb CO_2 extinguisher in the boiler room
- one 20-lb CO_2 extinguisher in the UPS room

Hydrant Systems

Pump Stations

- firefighting water mains, hydrants and hose in station yard and tank farm
- water tank or reservoir according to design specifications
- pump and engine for creating adequate firefighting pressures in fire mains
- fire hose as specified on the Foam Trailer Check Sheets
- fire hose nozzles as required
- adequate supply of gaskets for hose and hose wrenches

CO_2 and Halon Fixed Systems

For information on CO2 and Halon systems, see *Book 7: Emergency Response, 03-03-02 Fires and Explosions.*

Foam Systems

For information on Foam systems, see *Book 7: Emergency Response, 03-03-02 Fires and Explosions.*

Inspection Frequency

Inspect firefighting equipment at the frequencies indicated in Table 1.

NOTE: Use the trailer without the semi-fixed system to establish the water pressure and water pressure range at the monitors. For operating and maintenance instructions, see the manufacturer's manual.

Maintenance

Maintain firefighting equipment in accordance with the (a) Fire Inspection and Maintenance Check Sheet, and (b) manufacturer's instructions.

Portable Extinguishers

Maintain and test extinguishers and cartridges/cylinders at frequencies identified in Table 2 and Table 3.

A qualified service contractor must perform hydrostatic testing.

▲CAUTION: Do not mix a bicarbonate-based dry chemical agent with a phosphate-based agent, and do not use either in an extinguisher designed for use with the other. Do not convert an extinguisher for use with a different type of extinguishing agent unless for training purposes. To recharge an extinguisher, use only the types of extinguishing agent specified on the extinguisher nameplate (equivalent brands may be substituted). Do not combine FFFP with AFFF; the mixture will block the foam system piping.

CO_2 and Halon Systems
Lock out or bypass fixed systems before maintenance.

Hydrant Systems
Winterize hydrant systems as the climate requires.

NOTE: Propylene glycol, considered nontoxic, is preferable as antifreeze to ethylene glycol, which is a poisonous substance.

Fire Extinguisher Supplies
Amounts of fire extinguisher supplies for company locations should be maintained as identified in Table 4.

NOTE: If recommended amounts are not maintained, keep a current list of supplies on file.

Locations with ABC-rated fire extinguishers must establish access to a supply of ABC dry chemical extinguishing agent.

Dry chemical extinguishers stored or used outside during winter conditions should be equipped with nitrogen gas cartridges rather than carbon dioxide gas cartridges.

Table 1
Inspection Frequency for Firefighting Equipment

Type of Equipment	Inspection Frequency
portable fire extinguishers (hand-held)	• monthly • when placed in service • after repairs and use
portable fire extinguishers (wheeled)	• monthly • when placed in service • after repairs and use
fixed systems (hydrant systems)	• annually • when placed in service • after repairs and use
fixed systems (CO_2 and Halon systems)	• annually (minimum)[1] • monthly (visual inspections)[2] • semiannually (for high-pressure cylinders)[3] • when placed in service • after repairs and use
foam trailers	• monthly[4] • when placed in service • after repairs and use

NOTES

1 A qualified service contractor must inspect and test systems annually.
2 A site supervisor must visually inspect systems monthly.
3 A qualified service contractor must inspect high-pressure cylinders semiannually. During the inspection, cylinders must be weighed and the date of the last hydrostatic test noted. Any container that shows a loss in net content of more than 10% must be refilled or replaced.
4 Each department must assign a qualified employee to inspect foam trailers.

Table 2
Maintenance Frequency for Portable Fire Extinguishers

Extinguisher	Maintenance Frequency	Hydrostatic Test Frequency
cartridge-type dry chemical extinguishers stored on vehicles	• annually • if evidence of corrosion or mechanical damage	every 12 years
cartridge-type dry chemical extinguishers stored in buildings or outdoors	• annually, not to exceed 356 days • if evidence of corrosion or mechanical damage	every 12 years
CO_2 stored pressure extinguishers	• if evidence of corrosion or mechanical damage	every 5 years
Halon stored pressure extinguishers	• if evidence of corrosion or mechanical damage	every 12 years
liquid-charged AFFF foam extinguishers	• every 3 years • if evidence of corrosion or mechanical damage	every 5 years
wheeled fire extinguishers	• annually • if evidence of corrosion or mechanical damage	every 12 years

Table 3
Hydrostatic Test Frequency for Cartridges and Cylinders

Cartridge/Cylinder	Hydrostatic Test Frequency
nitrogen cartridges on hand-held extinguishers	exempt (CAN), every 10 yrs (US)
Ansul CO_2 cartridges on hand-held extinguishers	exempt
nitrogen cylinders on wheeled fire extinguishers	every 5 years

Table 4
Stock Amounts—Fire Extinguisher Supplies

Location	Supplies	Minimum Quantity[1]
attended pump station	Purple K	500 lb
pump station—ENB (NW)	Foray, Plus 50 or Purple K	500 lb
delivery location and electric station with 150-lb extinguisher(s)	Purple K	200 lb
PLM shop	Purple K	500 lb
remote maintenance base—ENB (NW)	Foray, Plus 50 or Purple K	200 lb
location with 350-lb nitrogen extinguisher(s)	nitrogen cylinders/cartridges	1
location with 150-lb nitrogen extinguisher(s)	nitrogen cylinders/cartridges	1
location with 20-lb or 30-lb nitrogen extinguisher(s)	nitrogen cylinders/cartridges	half as many as extinguishers in outdoor use (2 minimum)
location with 4-lb, 10-lb, 20-lb, or 30-lb CO_2 extinguisher(s)	CO_2 cartridges	half as many as extinguishers in indoor use

NOTES
1 or as determined by the site supervisor at their discretion

Procedures

Portable Extinguisher Monthly Inspection

1. Ensure extinguishers are located in their designated places.
2. Ensure equipment is accessible and visible (i.e., not obstructed in any way).
3. Ensure operating instructions on equipment nameplates are legible and facing outward.
4. Check seals and tamper indicators to ensure they are not broken or missing.
    a. If seals are broken or missing, the extinguisher must be completely inspected.
5. Estimate fullness of extinguishers by lifting them and judging their weight.

NOTE: Extinguishers that are not full must be recharged or replaced.

6. Check extinguishers for:
   a. physical damage

   b. corrosion

   c. leaks

   d. clogged nozzle

7. Ensure the pressure gauge reading or indicator for stored pressure extinguishers is in the operable range or position.

8. Complete the inspection tag.

9. Ensure minimum quantities of dry chemical, cylinders and cartridges are available (see Table 4).

Hydrant System Annual Inspection

1. Pressurize the hydrant with water.

2. Check that the hydrant was winterized if required.

3. Ensure all hydrant handles and nozzles are in place.

4. Check the contents of hose houses and pressurize all hoses and connections with water.

NOTE: Several lengths of hose may be connected and tested together.

> ⚠WARNING: Ensure workers are out of range of any whiplash that may occur from a hose bursting during the test.

   a. Lay the hose on a flat surface. Ensure the hose has no kinks or twists.

   b. Attach a fitting that can be used as an air vent at the outlet end of the hose.

   c. Mark the hose at the couplings to indicate any coupling rotation on the hose during the test.

   d. Open the air vent.

   e. Using a pump, gradually fill the hose with water until all the air is replaced.

   f. After the hose has been filled, close the air vent.

g. Apply full test pressure for five minutes and then release.

NOTE: Test double-jacket hoses to 1724 kPa (250 psi) and single-jacket hoses to 1034 kPa (150 psi).

h. Remove any burst or leaking hoses out of service.

i. Replace any coupling that:

- has rotated on the hose
- is defective
- has damaged threads

j. Replace gaskets if:

- worn or cracked
- coupling leaks after tightening

5. Check all water tank, pump house and underground line valves for open or shut position, and operate them without pressure on the system.

NOTE: Record whether valves are serviceable in both open and shut positions.

6. Test pumper connects at applicable locations.

7. Complete the Fire Inspection and Maintenance Checksheet.

Records

Foam Trailer Checksheet / Fire Inspection and Maintenance Checksheet

Record inspections and maintenance of firefighting equipment (i.e., foam trailers, fixed systems, fire extinguishers) on the appropriate Foam Trailer Checksheet or the Fire Inspection and Maintenance Checksheet, or in Maximo, or on a detailed spreadsheet (e.g., MS Excel). Retain the original onsite for 2 yrs (USA) or permanently (CAN).

Witness Safety Program

This plan outlines the requirements to ensure the safety of the witnesses of the pipe removal operation. In addition to this plan all witnesses will be required to attend a site specific orientation.

All visitors shall report to site security prior to accessing the site. During the witnessing of this operation all witnesses will be accompanied by and Enbridge representative to ensure the safety of the witnesses. The witnesses will be restricted to the warm and cold zones as identified and marked at the site based atmospheric testing results. This access restriction is to ensure that witnesses are not exposed to hazardous vapors and/or potentially explosive atmospheres and heavy equipment.

Electronic devices such as cameras and cellular telephones will **ONLY** be allowed when the witness is in the immediate vicinity of the Enbridge representative who is continually monitoring the atmosphere for combustible vapors.

Witnesses are required to wear the following personal protective equipment:

- Fire retardant clothing
- Hard Hats
- Safety Glasses
- Reflective Vests
- Steel toed boots are preferred, as a minimum closed toed shoes are required