

Asset Integrity Operational Standard: Pipeline Operating & Maintenance Manual

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Verb forms "shall" and "will" are mandatory. "May" and "can" are associated with optional approaches.

Revision Date	Overview of Revisions Made to Document
September 2018	Reformat and change to remove items that are now in separate documents and update manual to AIMS format
January 2019	Added to section Non-Routine Pipeline Operation Tasks: Inspection, Repair or Alteration of ARC Pipelines in regard to referencing AIMS Ground Disturbance Standard – Inspections for consistency in process to ensure compliance with NEB regulations
January 2019	Revised Roles and Responsibilities to ensure consistency with Inspection requirements for federally regulated pipelines.



PURPOSE

The purpose of this Pipeline Operating and Maintenance Manual (POMM) is to provide direction and understanding of responsibility to operations staff regarding pipeline operation and maintenance. The manual will also assist in ensuring the long-term integrity of pipelines operated by ARC Resources Ltd. (ARC) by describing the minimum requirements, guidelines and procedures necessary to control operating risks.

INTENT IS OF THIS STANDARD AND WHAT IS INCLUDED



This manual ensures that ARC Resources is compliant with requirements that pertain to the operation and maintenance of pipelines the fall within the jurisdictional regulatory authorities of Alberta, British Columbia and the National Energy Board (NEB).

The processes in this POMM are designed to meet the requirements of the Provincial and Federal regulators as a minimum standard. Where it is appropriate, the specific requirements for other jurisdictions are cited within this POMM.

PIPELINES APPLICABLE TO THIS MANUAL

This POMM is applicable for all ARC licensed pipelines. Licensed pipelines include all active operational pipelines as well as discontinued, inactive and abandoned pipelines.

<u>Substance</u>	Definition
Natural Gas	Alberta - Natural Gas with an H₂S Partial Pressure ≤0.30-kPa.
	BC – Natural Gas containing no measurable H ₂ S
Sour Service Natural Gas	Natural Gas with an H_2S Partial Pressure >0.30-kPa.
Sour Natural Gas	Alberta - Natural Gas with an H_2S content $\geq 1\%$ (10,000-ppm or 10.0 mol/kmol)
	BC – Natural Gas that contains measurable amounts of H ₂ S
Sweet Multiphase (Oil Emulsion)	Alberta - Multiphase with an Effective H_2S Partial Pressure \leq 70.0-kPa BC - Multiphase with an Effective H_2S Partial Pressure \leq 0.30-kPa
Sour Service Multiphase	Alberta - Multiphase with an Effective H ₂ S Partial Pressure >70.0-kPa BC - Multiphase with an Effective H ₂ S Partial Pressure >0.30-kPa
Sour Multiphase	Multiphase with an H₂S content ≥1% (10,000-ppm or 10.0 mol/kmol)
Multi-Fluid	A pipeline that is licensed to convey multiple substances at any one time
Crude Oil	Spec Sales Oil
High Vapour Product (HVP)	E.g Butane, Propane, Ethane, Etc.

The substances transported through ARC licensed pipelines include:



Fuel Gas	Processed sweet natural gas used for consumption	
Produced Water	Water separated from produced emulsions or natural gas streams containing elevated levels of chlorides	
Oilfield Water	Fresh or produced water used for the purpose of water injection disposal or transporting to or between production facilities	
Fresh Water	Waters containing low salinity typically from rivers or fresh water aquifers.	

PIPELINE DEFINITION AND REGULATORY JURISDICTIONAL BOUNDARIES

Pipeline Boundary Definition

- ARC defines the boundary of a pipeline as follows:
 - o The first isolation valve upstream before the pipeline enters the ground and the first valve downstream as the pipeline exits the ground

JURISDICTIONAL BOUNDARIES

□ The jurisdictional boundaries between Pipelines (scope of this manual), Facilities (Pressure Systems – See ARC's Pressure Equipment Integrity Manual) and Wells are as follows:

Figure 1: Typical Gas Gathering System







Figure 2: Typical Oil Emulsion Gathering System

SCOPE OF GUIDELINES AND REQUIREMENTS WITHIN MANUAL

Included

□ This POMM does include ARC requirements for routine and non-routine pipeline operation. A listing of the routine and non-routine operating and maintenance tasks and the guidelines included in this manual are listed below although some of the tasks are described in detail within the supporting documents listed in Support Documents section:

Routine Operating Tasks Included

- □ Internal Corrosion Control Requirements
- External Corrosion Control Requirements
 - o Cathodic Protection Requirements
 - o External Coating Maintenance
- □ Pipeline Marker Sign Maintenance
- □ Right of Way Patrolling
- □ Pipeline Crossing Inspections
- □ Watercourse Crossing Inspections
- □ Right of Way Vegetation Inspection
- Over Pressure Protection Device Maintenance
- Emergency Shutdown / Isolation Device Maintenance
- □ Leak Detection Requirements



- PE Tight Liner Vent Maintenance
- □ Non-Metallic Pipelines
- □ Internally Coated Pipelines

Non-Routine Operating Tasks Included

- □ Management of Change
- □ Pipeline Incident Reporting
- D Pipeline Commissioning Requirements
- □ Requirements for Inactive Pipelines
- □ Requirements for Discontinuing or Abandoning a Pipeline
- Dipeline Hydrostatic Testing Requirements (Pressure Testing)
- D Pipeline Inspection and Repair Requirements

Regulatory Regulations Included

- □ The operational tasks outlined in this POMM were developed to meet the minimum requirements of all the following applicable government regulations and industry codes. The provincial regulations or rules will meet or exceed those noted in CSA Z662
- □ Always refer to the current Provincial regulations or rules first to determine if current CSA Z662 code meets minimum requirements:
 - o Alberta Energy Regulator (AER)
 - Alberta Pipeline Act, RSA 2000 Chapter P-15
 - Alberta Pipeline Regulation (91/2005) Pipeline Rules (Amended 4/2015)
 - Directive 056 Energy Development Applications and Schedules
 - Manual 005 Pipeline Inspection. (Replaced Directive 066 Requirements and Procedures for Pipelines October 6, 2013)
 - Directive 077: Pipelines Requirements and Reference Tools
 - Web Site: <u>http://www.aer.ca/</u>
 - o British Columbia Oil & Gas Commission (BC-OGC)
 - Pipeline Act [RSBC 1996] Chapter 364
 - Pipeline Regulation, BC Reg 360/98
 - Sour Pipeline Regulation, BC Reg 359/98
 - Pipeline and Liquefied Natural Gas Facility Regulation, BC Reg 281/2010
 - Web Site: <u>www.bcogc.ca/</u>
 - o National Energy Board (NEB)
 - Onshore Pipeline Regulations SOR/99-294
 - Pipeline Damage Prevention Regulations Authorizations (SOR/2016-124)
 - Pipeline Damage Prevention Regulations Obligations for Pipeline Companies (SOR/2016-133)
 - Web Site: <u>www.neb.gc.ca/</u>
 - o Canadian Standards Association (CSA)
 - Oil and Gas Pipeline Systems CSA Z662
 - Web Site: <u>www.csa.ca</u>

Not Included

- □ This POMM **does not** include procedures relating to:
 - o Specific Safety or Emergency Response Procedures
 - o Design and construction of pipelines or cathodic protection systems,



- Specific pipeline integrity inspections, such as In-Line Inspections (Smart Pigging), Radiographic Inspections (X-Ray), Ultrasonic Inspections (UT) and Magnetic Particle Inspections (MPI). Such inspections shall be handled under separate procedures and in conjunction with the Calgary Asset Integrity Group.
- o Site specific welding procedures. Welding procedures will be supplied by the contractor conducting the construction or repair work and ARC will accept and periodically review these procedures.

DIGITAL ACCESS TO POMM

- □ The digital copy of the POMM located in the AIMS platform and will be the "Controlled" version and any printed copies will be deemed "Uncontrolled"
- □ The latest revision of each POMM section (including all forms) can be found on the AIMS platform

THE REASON FOR THIS MANUAL

WHY

This manual is an integral component of ARC's overall Pipeline Integrity Management System (PLIMS). ARC's PLIMS was developed for the purposes of assuring the safe, reliable, environmentally responsible and predictable operation of ARC pipelines.

This POMM is intended to support ARC's corporate Operations & Asset Integrity Management Policy (see AIMS Element - Engagement, Commitment & Accountability).

This POMM is to be used in conjunction with the most recent version of ARC's Integrated Management System (AIMS) which includes but is not limited to HS standards, Corporate Emergency Response (management and plans) and Environmental Guidelines. Emergency contact lists are maintained in the field specific Emergency Response Plan.

TIMELINES

This Standard is to be followed at all times by competent personnel as a guide for the safe and efficient operating and maintenance activities of ARC's pipelines. This standard is not an alternative to thorough training and should not be relied upon as a sole source of guidance. All personnel involved in the operating and maintenance activities involving pipeline systems must be experienced and deemed competent.

In addition, this standard must be referenced with developing site-specific operating procedures (SSOP's) and a Job Safety Analysis (JSA) that addresses hazards and controls associated with the operation and maintenance activities of pipeline systems. Procedures and JSA's must be reviewed annually at a minimum.

ROLES & RESPONSIBILITIES



□ The success of achieving the goals of this POMM largely rest with ARC's field-based Operations Groups. Field Operations consists of the following Districts:

- o Pembina/SEAB (Drayton Valley Office)
- o Northern Alberta (Grande Prairie Office)
- o Northeast British Columbia (Dawson Creek Office)

FIELD OPERATORS

- Ensuring the requirements outlined in this manual are followed
- □ Reporting any peculiarities or problems observed in the operation and maintenance of the pipelines to the Production Foreman for follow-up



- □ Recording Current Pigging Schedules
- □ Complete Pipeline/Utility Crossing Form as required
- □ Ensure visual coating inspections are conducted. When the opportunity exists, ensure the following is noted:
 - o Is the coating completely bonded to the pipe?
 - o Are there any jeeps/holidays (holes) in the coating and pipeline steel exposed to earth?
- □ Ensure External Coating Repairs are completed when required
- □ When pipeline RoW patrols are completed and/or when an opportunity exists, inspect marker signs for the following:
 - o Marker Signs are Located Correctly
 - o The Correct Information is Included on the Marker Sign
 - o Condition of Marker Signs are Adequate
- □ Replace marker signs that are in poor condition (defaced, illegible, etc.) or have been removed
- □ Change Signage when Pipelines are acquired
- □ Complete RoW Patrol Form
- Complete Pipeline/Backfill Inspection forms as required for federally regulated/non-regulated lines
- Ensure Over-pressure shut-down devices are:
 - o Calibrated Annually
 - o Function Tested
 - Annually (BC ONLY)
 - Monthly (AB ONLY)
- Ensure the Pressure Switch Function Test Checklist is completed
 - In the event where the over-pressure protection device functions to a higher than the licensed MOP of the pipeline that it is protecting or its noted set pressure, note in the comment section and notify the Asset Integrity Group to complete non-conformance report (NCR), review and rectify
- Ensure that all ESD and Isolation Devices are function tested annually
- □ Ensure that the Emergency Shutdown Valve Checklist is completed

LEAD OPERATOR/ FIELD FOREMAN

- □ Ensure pipeline operations are conducted in accordance with this manual
- Ensure the applicable sections of this manual are updated when revisions are issued
- Ensure Pipeline/Utility Crossing Forms are completed as required
- □ Ensure RoW Patrol Forms are completed where required
- □ Ensure Pipeline/Backfill Inspection forms are completed as required for federally regulated/non-regulated lines
- □ Notify the Asset Integrity Group when the requirements outlined in this manual are no longer effective so that a revision can be issued
- □ Ensure that the revisions are incorporated into the applicable uncontrolled POMM and the Operators are made aware of the changes
- □ Completing Chemical Program Description
- Ensure the chemical vendors' description includes the following:
 - o Chemical Batching Schedule (for each applicable Pipeline)
 - o Continuous Chemical Injection Locations/Pipelines
 - o Person (or Parties) Responsible for Completion of Program
 - o Method of Reporting Compliance with Program



- □ Ensure visual coating inspections are conducted. When the opportunity exists, ensure the following is noted:
 - o Is the coating completely bonded to the pipe?
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- □ Ensure the Pressure Switch Function Test Checklist is completed as required
 - In the event where the over-pressure protection device functions to a higher than the licensed MOP of the pipeline that it is protecting or its noted set pressure, note in the comment section and notify the Asset Integrity Group to complete non-conformance report (NCR), review and rectify
- Ensure that all ESD and Isolation Devices are function tested annually
- Ensure that the Emergency Shutdown Valve Checklist is completed

AREA MANAGER

- □ Ensure that a filing system is set up and the requirements for record keeping (outlined in the body of this manual) are met
- □ Ensure pipeline operations are conducted in accordance with this manual

ASSET INTEGRITY

- Ensure manual is reviewed and updates are completed when changes to codes and regulations occur
- Developing practical requirements, guidelines and procedures, in conjunction with local ARC operations, that ensure the integrity of ARC pipelines and comply with applicable regulatory requirements
- □ Supporting ARC Field Operations Group with respect to this manual
- Ensuring that the ARC Field Operations Group are trained with respect of this manual
- □ Controlling manual updates and distribution
- □ Monitor Pipeline/Backfill Inspections of federally regulated pipelines
- Other specific responsibilities as outlined in the body of this manual
- □ Ensure visual coating inspections are conducted. When the opportunity exists, ensure the following is noted:
 - o Is the coating completely bonded to the pipe?
 - o Are there any jeeps/holidays (holes) in the coating and pipeline steel exposed to earth?
- Ensure External Coating Repairs are completed when required

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- □ Ensure visual coating inspections are conducted. When the opportunity exists, ensure the following is noted:
 - o Is the coating completely bonded to the pipe?
 - o Are there any jeeps/holidays (holes) in the coating and pipeline steel exposed to earth?
- □ Ensure External Coating Repairs are completed when required
- Complete Pipeline/Backfill Inspection forms as required for federally regulated/non-regulated lines

ARC RESOURCES LTD.

FACILITY ENGINEERING, HEALTH & SAFETY, REGULATORY & ENVIRONMENTAL GROUPS

- ARC's Facility Engineering, Health & Safety and Regulatory & Environmental Groups are a resource for all ARC Field Operations Groups with respect to pipeline integrity issues and pipeline regulatory requirements. Their role is largely to develop and issue ARC's requirement for longterm pipeline integrity. These Groups consists of the following managers:
 - o Manager Facility Engineering & Manager HSE and Regulatory
- □ Ensure requirements for inspections of federally regulated/non-regulated pipelines are communicated to ARC representatives and followed as required
- □ Specifically, the Facility Engineering, HSE & Regulatory Groups are responsible for:
 - o Developing practical requirements, guidelines and procedures, in conjunction with local ARC operations, that ensure the integrity of ARC pipelines and comply with applicable regulatory requirements
 - o Supporting ARC Field Operations Group with respect to this manual
 - o Ensuring that the ARC Field Operations Group are trained with respect of this manual
 - o Controlling manual updates and distribution
 - o Other specific responsibilities as outlined in the body of this manual

RULES & REQUIREMENTS

PIPELII Pipelin

PIPELINE INVENTORY & SYSTEM MAPS

Pipeline Inventory

- A complete inventory listing (Master Pipeline List) of all pipelines shall be maintained for each operating area. For each pipeline in the inventory, the records shall show:
 - o Unique identifiers (e.g. License #, line #, etc.)
 - o Location data, (from-to, end facility type)
 - o Materials data, (diameter, wall thickness, length, grade, coatings)
 - o Design data, (service, MOP, type)
 - o Operational data, (construction date, operational status, service, etc.)

Pipeline Field Maps

- A map of the operating prospect/field shall be maintained illustrating the connectivity of the pipelines. Maps shall include the following information:
 - o Location of ARC pipelines, facilities and wells,
 - o Watercourse crossings
 - o Location of towns, cities, etc.
 - o Access roads
- □ The latest version of most ARC gathering field system maps can be found on the Pipeline Risk Assessment Program database

ROUTINE PIPELINE OPERATION MAINTENANCE TASKS

- □ Routine operating tasks include the day-to-day maintenance requirements necessary to ensure reliable long-term operation of an operating ARC pipeline. Routine operating tasks include:
 - o Internal Corrosion Control Requirements
 - o External Corrosion Control Requirements
 - Cathodic Protection Maintenance
 - External Coating Inspection
 - o Pipeline Marker Sign Requirements
 - o Right-of-Way Patrolling Requirements
 - o Pipeline/Utility Crossing Inspection



- o Watercourse Crossing Inspection
- o Right-of-Way Vegetation Inspection
- o Over-Pressure Shut Down Device Maintenance
- o Emergency Shut Down / Isolation Valve Maintenance
- o Leak Detection Requirements
- o PE (Tight) Liner Vent Maintenance
- o Non-Metallic Pipelines

Internal Corrosion Control Requirements

- Pipeline regulations require that internal corrosion mitigation evaluations be completed annually and prior to the commencement of operation of a new pipeline and prior to the resumption of operation of a discontinued or abandoned pipeline.
- □ The evaluation shall be documented and include a review of production records, monitoring, mitigation, and inspection records.
- Regulations also require that all sour service pipelines have monitoring and mitigation programs.
 Refer to CSA Z662 Clause 16.7 Corrosion and Corrosion Control
- □ The intent of the requirements is to prevent internal corrosion through effective mitigating and monitoring strategies. Internal corrosion control measures may include one or all of the following:
 - o Chemical Inhibition & Pigging Programs
 - o Coupon Monitoring, Non-Destructive Testing
 - o Visual Inspection (I.e. Cut-Outs)
- □ All chemical suppliers are expected to comply with ARC's Corrosion Chemicals Best Practice. Highlights of these components include:
 - o Chemical Monitoring Programs
 - o Monitoring of Corrosion Activity and Corrosivity of Produced Fluids
 - o Consumed Chemical Volumes
 - o Documentation and Reporting
- □ For ARC Fields that have pipelines which are pigged, a pigging record shall be kept. A Pipeline Pigging Form can be found in Forms and Checklists. Alternate forms may be used if they capture the specified information. The intent of the form is to document that pipeline pigging occurs.
- □ For ARC Fields that have corrosion chemical programs in place for pipelines, such as chemical inhibition or biocide injection, a copy of the chemical vendor's program description shall be maintained in ARC's Pipeline Risk Assessment Database.
- □ If changes are required to a current corrosion inhibition program, an MOC (Management of Change) must be completed and approved

External Corrosion Control Requirements

- External corrosion control is used to maintain the external integrity of steel risers and pipelines.
 The two primary measures used to control external corrosion are:
 - o Cathodic Protection
 - o External Coatings

Cathodic Protection

- Cathodic protection (CP) can prevent external corrosion where pipeline steel is exposed to earth
- □ All ARC steel pipelines will have either an Impressed Current, or Sacrificial Anode CP system to help mitigate external corrosion
- □ A stand-alone reference document has been developed to cover all aspects of operating and maintaining a CP system to remain compliant. Refer to the Cathodic Protection Best Practice



External Coatings Maintenance Requirements

- External coatings provide the primary protection against external corrosion for ARC pipelines. A common instance when the external coating can be examined is during a pipeline or utility crossing inspections
- Maintenance on external coatings is mostly limited to visual inspections when an ARC pipeline becomes exposed
- Depending on the visual inspection results, an external coating repair may be required
- □ All repairs shall be in accordance CSA Z662 Clause 9

*Note: CP must be maintained on all inactive and discontinued pipelines. See "Required On-Going Operational Maintenance for Discontinued Pipelines" section of this manual.

Pipeline Marker Sign Maintenance

- Pipeline Marker Signs are installed and maintained to identify the presence of a pipeline or pipelines to reduce the possibility of damage to the public and the pipeline
- □ They also provide information on the product transported, licensee or operator, and emergency contact information in the event of an emergency. As such, they can only be effective if well maintained

Required Information on Marker Signs

- Pipeline marker signs must include the following information as a minimum:
- o Name of Operator: "ARC Resources Ltd."
- Emergency Telephone Number (See Emergency Response Plan) 0
- The following additional information (in this order):
 - "High-Pressure"
 - Classification of substance transported: "Oil", "Gas", "Water" or "Flammable Liquids" and then "Pipeline"
- High Vapor Pressure (HVP) pipelines must:
- o have the same information as above.
- o clearly indicate the name of highest vapour pressure substance being transported through the pipeline (i.e. "Propane", "Butane", etc.) on the marker sign

Figure 3: Typical Pipeline Warning Signs





150

100

Black lettering on white

Black lettering on white

25 x 6 mm (m

13 mm (minimum) font



Required Locations of Marker Signs

□ Pipeline marker signs are required at the following locations:

- o Facility Entry and Exit Points
 - Marker signs are required at entry and exit points of a facility lease boundary (including Block Valve Risers along the Right of Way (RoW).
 - Marker signs should be placed on the facility fence if possible
- o Highway or Road Crossings
 - Where an ARC pipeline crosses a highway or road crossing, marker signs are required on both sides of the road crossing RoW.
 - Marker signs must face and be visible from the road crossing.
- o Watercourse Crossings (a watercourse is defined as a stream, creek, river, pond or lake)
 - Where an ARC pipeline crosses a watercourse, marker signs are required on each side of watercourse crossing
 - Marker signs must face and be visible from the watercourse and bank side looking towards the water crossing
- o Railway Crossings
 - Where an ARC pipeline crosses a railway, marker signs are required on both sides of the railway RoW.
 - Marker signs must face and be visible from the railway RoW
- o Irrigation Systems
 - Where an ARC pipeline crosses a defined irrigation system, marker signs are required on both sides of the irrigation system RoW
 - Marker signs must face and be visible from the irrigation system
- o Urban Areas
 - Where an ARC pipeline traverses through heavily developed urban areas, signs shall not be required where the placing of signs is impractical or where they would not serve their intended purpose. In such areas, alternative identification methods shall be considered
- o Surface Pipelines
 - Where an ARC surface pipeline is buried under a road or trail crossing, pipeline signs shall be installed at the point of entry and exit of each crossing
 - Precautions shall also be taken by adding extra pipeline signage to indicate the presence of a surface pipeline, when:
 - Equipment may be working in the vicinity of the pipeline,
 - Off-road vehicular traffic may endanger the pipeline, or
 - Any conditions may obscure or endanger the pipeline.

Required Placement of Marker Signs within Right-of-Way

- □ Proximity to Pipeline
 - o Locate marker signs as close to (within 1-metre) of the intended ARC pipeline. Ensure that the marker sign does not contact the pipeline.
- □ Marker Sign at Fence Line Requirements
 - Where a fence line indicates a property line, place the marker sign within 30-cm of the fence line. Pipeline signs cannot be attached to fences or property not owned by ARC.
- □ Sign Post Requirements
 - o Marker signs are required to be on their own posts, except where signage is noted on a facility boundary fence



Newly Acquired Pipelines

- □ Marker signs are required to have applicable information changed within 60-days of the acquisition date or commissioning of pipeline(s)
- □ If signage cannot be updated within the above allotted days, an agreement shall be made to have the 1-800 number forwarded to ARC's 1-403-292-0434 Calgary 24hr number

New Pipelines

□ Marker signs are required to be installed as per these requirements prior to commissioning or recommissioning of ARC pipeline(s)

Discontinued and Abandoned Pipelines

- □ Marker signs for discontinued and abandoned pipelines must:
 - o Be maintained as if operational
 - o Not indicate that a pipeline is "discontinued" or "abandoned"

Non-Metallic, Polyethylene, and Thermoplastic Pipeline Signage

□ ARC must ensure that the maximum temperature during pressure testing and operation does not exceed the pipeline design or manufacturer's temperature rating. Signs may be installed at the end points of non-metallic pipelines indicating the maximum operating temperature and pressure

Right-of-Way Patrolling

- □ The purpose of Right-of-Way (RoW) Patrolling is to inspect the general condition of the RoW and to identify any unauthorized third-party activities, encroachment, geotechnical or hydrotechnical hazards that may affect the integrity of the pipeline(s)
- □ The requirements and methods of execution are described in the RoW Inspection Best Practice

Over-Pressure Shut Down Device Maintenance

- Over-pressure shutdown devices are required to ensure that the pipeline does not mistakenly experience pressures over the licensed Maximum Operating Pressure (MOP). Such devices shall be inspected and maintained to ensure that they are:
 - o Properly installed
 - o Protected from contamination
 - o Suitable for their intended service
 - o In good operating condition
 - o Set to function at the correct pressure
 - o If isolation valve is present, ensuring that it is in the open and locked in position
- □ Calibrations:
 - o Once per year with a maximum interval of 18 months, a qualified technician must calibrate and inspect each pipeline over-pressure protection switch to ensure it is functioning correctly and calibrated to the correct pressure
 - o The device must have a tag indicating pressure at which it is set at and last date calibrated
- □ Function Tests:
 - o **BC:** Once per year with a maximum interval of 18 months, each pipeline over-pressure protection switch must be tested to ensure it is functioning correctly and calibrated to the correct pressure
 - o **AB:** Each pipeline over-pressure protection switch must be tested monthly to ensure it is functioning to the correct pressure



Emergency Shutdown (ESD) / Isolation Valve Maintenance

- □ The purpose of ESD and isolation valves is to isolate a pipeline or sections of a pipeline from the remainder of the pipeline system in the event of an emergency
- Preventative maintenance is required to ensure these valves operate and function effectively in emergency situations
- □ To ensure effective operation of all ESD and isolation valves, the valves must be cycled completely at least once per year, with a maximum interval of 18 months between such inspections (i.e. fully open to fully closed)
- All ARC ESD valves should have the 'Fully Open' and 'Fully Close' positions clearly marked on the valves

Leak Detection System

- A leak detection system is any method used to determine the existence of a pipeline leak.
- Detecting leaks along ARC pipelines is achieved through several methods. Leak detection activities are also covered in the RoW Inspection Best Practice

PE Lined Pipelines

ARC operates and maintains a number of pipelines that contain tight fit polyethylene liners. Refer to PE Lined Pipelines Best Practice Document

NON-ROUTINE PIPELINE OPERATION TASKS

- Non-routine operational tasks are typically managed by local operations. This POMM includes ARC requirements, guidelines and includes or references the procedures necessary for the completion of those tasks
- □ Site specific maintenance procedures and tasks for non-routine activities may have to be developed and documentation of those non-routine procedures or maintenance tasks will be maintained under the AIMS platform

Management of Change (MOC)

MOC is a process intended to involve technical scrutiny when there is either an addition or deletion from a process and the effects of that change could have an impact to part of the process or the process. Refer to AIMS Element - Management of Change for a complete description of the process

Pipeline Incident Reporting

- □ When an incident involving an ARC licensed pipeline occurs, it must be reported through ARC's field incident reporting system (FITS).
- An incident can be but not limited to the following:
 - o Loss of containment (leak or spill)
 - o Damage to pressure containment boundary (external contact)
 - o Over pressure event (exceeding licensed maximum operating pressure)
- □ The FITS report should be reviewed by the Asset Integrity group prior to the pipeline incident investigation. Any findings that may affect other pipelines in the company should be communicated through an Asset Integrity Information Bulletin

Requirements When a Reportable Incident Occurs

The following is not intended to supersede any emergency requirements outlined in AIMS Incident and Emergency Management Element or as identified in the specific Emergency Response Plan. It is intended to give guidance regarding regulatory reporting as well as any learning's that can be made as a result of an incident



Failure Investigations

- □ Failure Investigations may be part of an incident investigation (Incident Investigation Procedure) which will be the governing protocol. Preserving the incident scene may be a requirement prior to beginning failure investigation
- Once the incident investigation requirements have been met, the failure may need to be analyzed by third party experts in order to determine the cause and to determine if the current control mechanisms are effective
- □ The results of the failure investigation may necessitate the need for changes to existing strategies. Refer to the Failure Preservation Form in Forms and Checklists
- □ Contact the Asset Integrity Group for the steps required to complete the failure analysis

Regulatory Response Letter

- □ If the Regulatory Body submits a letter requiring a response on the reported incident, the letter must be forwarded to the Environment and Regulatory Group
- The Asset Integrity Group will review the letter and gather all pertinent information to formulate a response
- Prior to submitting response letter, it will be reviewed with the District Area Manager, Area Foreman and any other personnel that may be involved with the incident
- □ If changes are required to the Pipeline Operating and Maintenance Manual based on the results of the incident, the Asset Integrity Group will issue an Asset Integrity Information Bulletin that outlines the changes and will be implemented in the next update of the manual
- □ Records of all incidents must be maintained for the life of the pipeline and be made available to the governing regulatory authority upon request

Requirements for Commissioning a Pipeline

- Commissioning a pipeline refers to the necessary work required to put the pipeline into routine operation
- Commissioning takes place for newly constructed pipelines and discontinued or inactive pipelines
- □ For details related to the execution of commissioning or recommissioning, please refer to the Pipeline Commissioning Best Practice

Requirements for When a Pipeline Becomes Inactive

- A pipeline that is not in active flowing service for longer than 1 month is inactive
- □ A review will be conducted by the Field Foreman to determine if the pipeline will become active or will remain inactive beyond this period. The Field Foreman and Asset Integrity group will determine the future integrity plan of the pipeline if it remains inactive

Maximum Duration of Pipeline Inactivity

- □ The maximum duration a pipeline can remain inactive is 12 consecutive months (18 months BC). Prior to this time, the pipeline must be either:
 - o Returned to operation
 - o Deemed an Operating Deadleg (pipeline cannot be isolated from a pressurized system and has no flow)
 - o Formally Discontinued as per "Requirements for Discontinuing a Pipeline" of this manual
 - o Formally Abandoned as per "Required On-Going Operational Maintenance for Discontinued Pipelines" of this manual
- □ In Alberta, if a pipeline is inactive for longer than 12-months, a non-routine application must be made to the AER to resume operation.



Corrosion Effects on Inactive Pipelines

- □ An inactive pipeline may have an increased internal corrosion risk since any water within production fluids will likely settle on the bottom portions of the pipeline. This water can result in corrosion and reduce the useful life of the pipeline
- □ Consideration should strongly be given to cleaning the pipeline as soon as reasonably possible after it is understood that the pipeline will become inactive, since the internal corrosion risk may increase
- □ Cleaning should be completed by purging production fluids from the pipeline with properly sized pipeline pigs

Operational Tasks

- □ To be completed by field operations in conjunction with Asset Integrity
 - o Review Internal Corrosion Control Plans
 - o If a pipeline is inactive, a review of the internal corrosion risk should be considered. (Contact the Asset Integrity Group for Assistance).
 - o If the pipeline is deemed an Operating Deadleg, the pipeline must be maintained as an operating pipeline and its integrity must be taken into account.

Required On-Going Routine Operational Tasks

- □ To be completed by field operations in conjunction with Asset Integrity
 - o Inactive pipelines must be maintained as if they were operating because they can be reactivated at any time provided the integrity has been maintained.
 - o Internal Corrosion Control activities and requirements must be adequate.
 - o External corrosion mitigation practices must be maintained as if the pipeline is operating. This includes routine monthly CP Rectifier readings and performing CP Annual Surveys.
 - o Pipeline marker signs will be maintained the same as operating pipelines
 - o Right of Way Patrolling will be maintained the same as operating pipelines
 - o Pipeline/Utility crossings will be maintained the same as operating pipelines
 - o Watercourse Crossings will be maintained the same as operating pipelines
 - o Right of Way vegetation control will be maintained the same as operating pipelines
 - o Pipeline isolation & over protection device maintenance will be performed the same as operating pipelines
 - o Leak detection efforts will be performed the same as operating pipelines

***NOTE:** Pipelines that are inactive are considered as "operating" by the regulatory bodies and must follow all of the regulations for an operating pipeline.

Requirements for Discontinuing a Pipeline

- Discontinuing a pipeline refers to the planned deactivation of a pipeline from operation (purged of all contents, isolated and left in a safe state) for an indefinite period although the pipeline will be maintained for possible future operation
- There is no limit on how long a pipeline can remain discontinued
- Pipelines must be discontinued, abandoned or returned to active flowing service after one year of inactivity
- □ If a pipeline cannot be isolated from an active flowing pipeline without physical modifications of the facilities, it may be left as operational and an internal corrosion mitigation program must be appropriate for stagnant conditions (operating deadleg)

ARC Pipeline Discontinuation Procedure

Additional information related to the field procedure for proper discontinuation of ARC pipelines can be found in the Pipeline Discontinuation Best Practice



MOC Process

Ensure that a Management of Change form is completed when discontinuing a pipeline

Regulatory Notification and Approvals

- □ Regulatory approval is required when discontinuing any ARC pipeline. The applicable regulator will formally change the operating status from 'Operating' to 'Discontinued'
- □ The timing of when to apply for Discontinuation status is as follows:
 - For pipelines located in Alberta or BC, pipeline discontinuation work may take place before the discontinuation application is submitted for approval. However, the discontinuation application must be provided to the AER or BCOGC within 90-days of the completion of the discontinuation work
- □ It is also important to ensure that the regulatory status is correct since the amount of municipal tax paid on the pipeline is typically linked to the regulatory operating status.

ARC Pipeline Status Change Process

- □ The following process is required to ensure the regulatory status is changed when a pipeline is discontinued:
 - o A copy of the completed ARC Pipeline Discontinuation Form is forwarded to the Regulatory Coordinator
 - The Regulatory Coordinator will formally apply to applicable regulatory board for change in pipeline status. All records will be stored in the pipeline license files located on ARC's internal W Drive

Required On-Going Operational Maintenance for Discontinued Pipelines

- Discontinued pipelines may be returned to service at some point in the future. As a result, all external corrosion control strategies are required on the pipeline, the same as if operating. This includes all CP monthly rectifier checks, annual surveys and completion of all annual survey deficiencies noted.
- □ Since at this point, the pipeline's interior is clean, and the pipeline has been isolated (and possibly had a corrosion inhibitor applied), all internal corrosion control practices may be stopped
- □ For non-metallic pipelines containing a polyethylene liner, a significant amount of gas or fluid can be absorbed during operation. Once pressure is reduced to zero, these absorbed gases or fluids could evolve over time, potentially leading to unexpected contamination of surrounding soils. An assessment of potential hazards from gases that can evolve from the pipeline material shall be considered.
- Other routine operating requirements, such as the following, are required as if the pipeline is operating:
 - o Pipeline Marker Sign Maintenance,
 - o Right-Of-Way Patrolling
 - o Pipeline/Utility Crossings Inspection
 - o Watercourse Crossing Inspection and
 - o Right-Of-Way Vegetation Inspection

Requirements for Abandoning a Pipeline

- Abandoning a pipeline refers to the planned permanent shutdown of a pipeline from operation.
 The abandoned pipelines integrity is no longer maintained and eventually will corrode through or collapse
- □ It is the intent of ARC to abandoned pipelines in a manner that does not pose any future environmental risks

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- □ The decision to abandon a section of pipeline, whether in place or through removal shall be made on the basis of a documented plan that includes the rational for the abandonment, landowner consultation, effects on terrain and water, road, railway crossings as well as current and potential land use
- □ The plan shall consider the potential for safety hazards and environmental damage that could be created by ground subsidence, soil admixing or contamination, ground water contamination, erosion, and the creation of water conduits. The basis for abandonment will be documented in the MOC
- Abandon segments of pipelines may be used as a "conduit" for installing "free standing liners".

Landowner Notifications

□ Landowners along the pipeline right of way, within the calculated setback distances must be notified of the pipeline abandonment prior to the abandonment application being made

Removal of a Pipeline

- □ If all or a portion of the pipeline is to be removed, the approved and amended pipeline license indicating approval of pipeline abandonment must be obtained prior to removing the pipeline or portions of pipeline.
- □ ARC's Surface Land Department must be contacted regarding all pipeline abandonments. In certain cases, the original pipeline easement may dictate the requirements of pipeline abandonment

Pipeline Abandonment Work

Dipeline Abandonment activities will adhere to the Pipeline Abandonment Best Practice

Pipeline Hydrostatic Testing Requirements

Pipeline pressure testing is required prior to commissioning a new or discontinued pipeline or increasing the MOP of a pipeline. For further guidance and information, please refer to the Pipeline Pressure Testing Criteria in Appendix A (can also be found in Forms and Checklists)

Inspection, Repair or Alteration of ARC Pipelines

- □ There are specific inspection requirements for federally (NEB) regulated pipelines in regard to types of inspections when ground disturbance activities are conducted and when they need to be completed. Refer to AIMS H&S Standard: Ground Disturbance Inspections for these requirements
- Pipelines repairs may be required but are not limited to, the following circumstances:
 - o Corrosion (External or Internal)
 - o Dents
 - o Cracking
 - o Leaks
 - o Third party/ Construction Damage
 - o Maintenance activities

High Vapour Pressure (HVP) and Sour Gas Pipeline Regulatory Requirements

- □ For pipelines transporting HVP or Sour Gas (>10 mol/kmol (1.0%) H2S), the AER must be notified via the DDS a minimum of 48-hrs prior to the commencement of the following:
 - o Replacement of short sections (< 100-m) of pipeline
 - o Smart-tool inspection of the pipeline
 - o Welding on in-service pipeline
- □ The above conditions are exempt if an emergency situation arises but must be reported



PIPELINE DEFECTS

Pipeline Defect Definitions

- □ Dents
 - o A depression caused by mechanical damage that produces a visible disturbance in the curvature of the wall of the pipe or component without reducing the wall thickness
 - o Dents may contain cracking
- □ Gouges / Scratches
 - o A surface imperfection caused by mechanical removal or displacement of metal that reduces the wall thickness or a pipe or component
 - o Gouges may contain cracking
- □ Buckle
 - o A diamond-shaped inward and outward deformation of a pipe wall caused by any combination of bending, axial, and torsional loads.
 - o Buckles may contain cracking

Metallic Pipelines

Defect Evaluation

- □ In order to determine if a repair is required, the pipeline imperfection must be evaluated to determine if it is a defect
- □ Consider proceeding directly to pipeline repair, as it may be more economical to repair the pipeline than to evaluate the imperfection for repair.

Corrosion Defect Evaluation

- Corrosion defects are evaluated to determine the safe operating pressure of the corroded area. Since corrosion involves the loss of metal, the local corroded area has a reduced strength. To ensure that the pipeline can continue to operate safely, the corrosion imperfection must be evaluated in terms of remaining strength
- □ Contact the Asset Integrity group to complete the remaining strength calculation

Dents

Dents are evaluated in terms of their depth and whether any cracking has occurred. Cracking may not be visible to the naked eye. To evaluate a dent, refer to Figure 10.2 Dents in Pipe in CSA Z662.

Cracking (Including Stress Corrosion Cracking)

- □ Cracking is evaluated by determining if it exists or not. MPI is required to determine if cracking exists. Generally, cracking is evaluated as part of the evaluation of other defects.
- □ Proceed directly to pipeline repair for all cracking

Gouging (Damage by Mechanical Equipment)

- □ If the pipeline has been gouged by mechanical equipment it has reduced strength in the local area of gouge because metal has been removed. Also, it may have developed cracks not visible to the naked eye.
- □ Proceed directly to pipeline repair for all gouges

Buckle(s)

- □ Visually inspect the pipeline to determine if a buckle exists. Generally, if the pipeline axis is altered in an otherwise straight section of pipeline, a buckle exists
- □ Refer to CSA Z662 Clause 10.10.8



Acceptable Defect Repair Methods

- □ Engineering assessments are required for all temporary and permanent pipeline repairs. Contact the Asset Integrity group. Acceptable repair methods are outlined in Table 10.1 of the CSA Z662 code. Refer to this table and ensure legend and all notes are addressed.
- □ Coating Repair: For field applied coating repairs, refer to CSA Z245.30

Pipeline Section Replacement Requirements

- □ The following are the non-destructing testing requirements associated with pipeline section replacements:
 - o Hydrostatic Testing (Pressure Test)
 - All pipeline sections to be installed as part of any existing pipeline must be pressure tested.
 See Pipeline Pressure Testing Criteria in Appendix A and in Forms and Checklists
 - o X-Ray Inspection of Tie-In Welds
 - All tie-in welds completed as part of a pipeline section replacement must pass an x-ray inspection.

Non-Metallic Pipelines

□ Where a defect or imperfection is found, consult with the Asset Integrity group and manufacture to determine its acceptability. Repairs should only be performed by a manufacturer's approved company

Operational Requirements

□ Evaluate defect through an engineering assessment or Proceed directly to repair

CONTROL, REVIEW AND REVISION OF MANUAL

Record Keeping Management

- □ A copy of all records and forms produced from meeting the requirements of this manual will be kept in the applicable District "W Drive" on ARC's LAN. The structure of the District Office filing system will be the responsibility of the District Field Managers.
- □ These records shall be kept for the life of the pipeline.
- □ The records outlined in this POMM may be subject to regulatory audit.

Revision Process

- Revisions to this manual will be managed in a manner that is compliant with the AIMS Element -Document Control. Notifications will be made to Field Managers, Operations and other stakeholders who will make sure that all printed (uncontrolled) POMM manuals and procedures are replaced with the most current version
- D POMM revisions will be required when:
 - o The next annual update is scheduled
 - o Updated guidelines or procedures are developed as a result of a change in ARC requirements
 - o Changes/updates occur to regulations or codes
 - o Pipelines are acquired and need to be incorporated into an existing POMM
 - o Existing pipelines are divested and need to be removed from the existing POMM

Support Documents

- □ There **are** several supporting documents that are referred to within this manual. These documents are controlled and will be managed as per the AIMS Document Control Element. These support documents are AIMS elements, procedures or best practices that contain more detail to aid in completion of critical tasks. The documents that are referenced and support this POMM are:
 - o AIMS Element Document Control



- o AIMS Element Management of Change
- o AIMS Element Training and Competency
- o AIMS Element Incident & Emergency Management (includes Corporate Emergency Response Plan)
- o Cathodic Protection Best Practice
- o Right of Way Inspections Best Practice
- o Non-Metallic Pipelines Best Practice
- o Pipeline Commissioning Best Practice
- o Pipeline Abandonment Best Practice
- o Pipeline Discontinuation Best Practice
- o Pipeline Pressure Testing Criteria
- o Corrosion Chemicals Best Practice
- o Corporate Emergency Response Plan
- o Environmental Standards

MEASURES OF EFFECTIVENESS

Tri-Annually: One pipeline system audit to be completed

- To measure the effectiveness of this manual at meeting the goals outlined, ARC will perform a thorough comprehensive program system review in conjunction with a compliance review as referenced in Section 15 of the PLIMS every 3 years. Reviews will include a complete field review of all requirements outlined in this manual
- o Results will include a summary of requirements that are being met and those that are not.
- Results will be communicated through an Asset Integrity Bulletin with Field Managers,
 Foreman and Lead Operators in efforts to identify any similar instances of non-compliance
 and/or incorporate any lessons learned



Appendix A: Pipeline Pressure Testing Criteria

PIPELINE MINIMUM TEST PRESSURES AND DURATIONS

Edit Date: April 10, 2017

Current CSA Edition: Z662-15

Current Pipeline Regulation: 91 / 2005

IMPORTANT NOTE:

In this document, "LVP" includes all the AER substances OE, SW, FW, CO, and LVP

MATERIAL	PRODUCT	MEDIA	PROCEDURE
	LVP (all Class locations), NATURAL GAS (Class 1 and 2 locations), HVP or CO ₂ (Class 1 locations)	LIQUID	$1.25 \times MOP$ for 4 hrs plus $1.1 \times MOP$ (min.) for 4 hrs (Clause 8.7.1, Table 8.1, Cl. 8.7.5)
		AIR	$1.25 \times MOP$ for 4 hrs plus $1.1 \times MOP$ (min.) for 24 hrs OR $1.25 \times MOP$ for 24 hr concurrently (CI 8.7.5.4)
	SOUR GAS (>10 mol/kmol H ₂ S),	LIQUID	1.4 × MOP for 4 hrs plus 1.1 × MOP (min.) for 4 hrs (Clause 8.7.1, Reg S. 34)
	NATURAL GAS (Class 3 and 4 locations)	AIR	$1.4 \times MOP$ for 4 hrs plus $1.1 \times MOP$ (min.) for 24 hrs or 1.4 x MOP for 24 hr concurrently (Cl. 8.7.5.4), Reg S.34)
	HVP or CO ₂ (Class 2, 3, and 4 locations)	LIQUID	$1.5 \times MOP$ for 4 hrs plus $1.1 \times MOP$ (min.) for 4 hrs or 1.5 x MOP for 24 hrs concurrently (Cl. 8.7.1, 8.7.5.4)
STEEL PIPE		AIR	$1.5 \times MOP$ for 4 hrs plus $1.1 \times MOP$ (min.) for 24 hrs or 1.5 x MOP for 24 hrs concurrently (Cl 8.7.1, 8.7.5.4)
	DISTRIBUTION GAS SERVICE Pipeline must be used in natural gas distribution service and operate at less than 30% SMYS. Natural gas may be used as test media only where the test pressure does not exceed 30% stress level. For Class 3 or 4 locations, test to 1.4 x MOP.	LIQUID	1.25 x MOP for 4 hrs plus 1.1 x MOP (min.) for 4 hrs OR 1.25 x MOP for not less than 4 hrs (concurrent strength and leak test) provided a suitable leak detection method is used (CI 12.8.1.3). Testing periods less than the 4 hrs may be possible if leak detection method is appropriate for a shorter duration. (Clause 12.8.1.4, Table 8.1)
		AIR or NG	$1.25 \times MOP$ for 4 hrs plus $1.1 \times MOP$ (min.) for 24 hrs OR 1.25 x MOP for 24 hr concurrently (Cl 8.7.5.4. Table 8.1) Pressure testing of distribution gas pipelines using NG as test media may not exceed a stress level of 30% SMYS during testing (Clause 12.8.1.1) but also is only permissible in CSA Class 1 areas. (Reg S. 37)

Applicability of Clause 12 Distribution Service: Some requirements of Clause 12 can be applied to piping systems other than gas distribution, PROVIDED that it is so stated in the applicable clause of the Standard and that any such pipeline will operate at stress less than 30% SMYS. An example is contained in Clause 7.1.2, where it is stated that it may be permissible to join piping following the requirements given in Clause 12.7 (instead of the usual Clause 7.1.2), subject to additional limitations stated in Clause 7.1.2.



ARC INTEGRATED MANAGEMENT SYSTEM

MATERIAL	PRODUCT	MEDIA	PROCEDURE
RIGID (STICK) FIBREGLASS, AND CONTINUOUS FIBRE- REINFORCED COMPOSITE PIPE	LVP or NATURAL GAS or SOUR GAS* (see notes)	LIQUID	 1.25 × MOP for 8 hrs after stabilization (Cl.13.1.8.4) If H2S exceeds 10 mole/kmole, 1.4 x MOP. Same testing requirements apply whether used as pipe or freestanding liner. Pipe leaking at initial installation must be retested like new pipe. (Cl. 13.1.8.6) Repaired pipe (after service) may be left exposed for a 4hr visual leak test at best available working pressure (Cl. 13.1.10.2) Following tie-in with flanges or mechanical couplers a one hour visual test shall be done using best available pipeline pressure (Clause 13.1.8.7)
RIGID (STICK) FIBREGLASS, AND CONTINUOUS FIBRE- REINFORCED COMPOSITE PIPE	LVP or NATURAL GAS or SOUR GAS* (see notes)	AIR	Maximum test pressure with air not to exceed 2900 kPa. (13.1.8.2) 1.25 x MOP for 24 hrs after stabilization (Cl.13.1.8.5) If H2S exceeds 10 mole/kmole, 1.4 x MOP. Same testing requirements apply whether used as pipe or freestanding liner. Pipe leaking at installation must be retested like new pipe. (Cl. 13.1.8.6) Repaired pipe may be left exposed for a 4hr visual leak test at best available working pressure (Cl. 13.1.10.2) Following tie-in with flanges or mechanical couplers a one hour visual test shall be done using best available pipeline pressure (Clause 13.1.8.7)

MATERIAL	REQUIRED TASK	MEDIA	PROCEDURE	
THERMOPLASTIC LINERS (EXPANDED or TIGHTLY FIT)	QUALIFY NEW STEEL PIPELINE	LIQUID or AIR	Pressure test as for new steel in the same service. If SG then test must be 1.4 x MOP. (Clause 13.2.2.10)	
	QUALIFY EXISTING STEEL PIPELINE	LIQUID	Repair any leaks as per Cl. 10.11. Evaluate any defects as per Cl. 10.10 or by pressure test per Cl. 13.2.2.12.; which allows integrity test at 1.0 X design pressure for 4 hrs, OR conduct an engineering assessment to verify integrity as per Cl. 10.10. (Clause 13.2.2.11 and .12)	
	LINER LEAK TEST FOLLOWING INSTALLATION	LIQUID or AIR*	Test completed lined sections at 1.0 X MOP for 4hrs and if test pressure >2 MPa, add an additional 4 hr leak test after pressure is lowered to 2 MPa. (Reducing the pressure is to allow trapped gas bubbles to move to the vents.) Annulus vents must be periodically monitored during test. (*)Liners installed in NEW pipelines may be leak tested with air. (Clause 13.2.7)	
	NOTE: THERMOPLASTIC LINERS ARE TESTED THE SAME WAY FOR ALL SUBSTANCES			



ARC INTEGRATED MANAGEMENT SYSTEM

MATERIAL	PRODUCT	MEDIA	PROCEDURE
		LIQUID	Use standard Table 8.1 procedures.
ALUMINUM PIPE	ALL PRODUCTS	AIR or NG*	Allowable with following limitations: Pipe must be new pipe, 4" or smaller, and testing pressure stress level must not exceed 95% SMYS, or 75% SMYS in above ground installations or where non-standard ground cover exists. Additionally, pressure testing of aluminum gas pipelines using NG as test media is only permissible in CSA Class 1 areas. (Reg S. 37) (Cl. 15.7)

MATERIAL	PRODUCT	MEDIA	PROCEDURE
POLYETHYLENE PIPE, OR FREE-STANDING POLYETHYLENE LINER	LVP or NATURAL GAS or SOUR GAS* (see note) (gathering pipeline)	LIQUID	Maintain pipe test pressure for 3 - 4 hours to allow expansion/stabilization. Test 1.25 x MOP for 3 hrs after stabilization (1.4 x MOP if H2S exceeds 10 mol/kmol). Measure additional fluid volume needed to maintain test pressure and compare to Table 13.5. (Cl. 13.3.8.1). Following tie in of tested sections, conduct 1 hr leak test at best available pipeline pressure. For gas lines, do flame ionization of tie-in after backfilling, no sooner than a minimum of 48 hours and no later than a maximum of one month after service begins. (Clause 13.3.8.2.) Use same process following a repair. (Cl 13.3.8.5)
		AIR	If using air, follow same process as above. Note however that compressor air temperature must be controlled to be below pipeline design temperature, and that temperature stabilization must occur before testing. (Cl. 13.3.8.1)
	DISTRIBUTION GAS SERVICE Pipelines less than 30% SMYS. Pressure testing must be done at material temperatures below 60°C. (Clause 12.8.3.3) Pressure testing of distribution gas pipelines using NG as test media may not exceed a stress level of 30% SMYS during testing. (Cl. 12.8.1.1)	LIQUID	1.4 X MOP (CI. 12.8.3.5) for 4 hrs plus 1.1 x MOP (min.) for 4 hrs OR 1.4 x MOP for not less than 4 hrs (12.8.1.3) (concurrent strength and leak test) provided a suitable leak detection method is used. (CI. 12.8.1.3) Testing periods less than the 4 hrs may be possible provided the leak detection method is appropriate for that shorter duration. (CI. 12.8.1.4) Tie-in joints or tie-in sections shall be tested for leaks (CI 12.8.3.2)
		AIR or NG	1.4 x MOP for 4 hrs plus 1.1 x MOP (min.) for 24 hrs (8.7.5.3) OR 1.4 x MOP for > 24 hrs (Cl 8.7.5.4) (concurrent strength and leak test) Tie-in joints or tie-in sections shall be tested for leaks (Cl 12.8.3.1)



Additional Notes:

- It is not a requirement to reduce pressure to zero between the strength test and leak test. Pressure may be reduced to 1.1x MOP for the leak test but this is not mandatory.
- Clause 13.1.1.4 and 13.3.1.2 allow composite pipes and polyethylene pipes in service containing H2S greater than 10 moles/kmole, thus requiring those pipelines to be tested at 1.4 x MOP. Note however that there are also partial pressure limitations imposed that will result in very low MOPs.
- When testing HDPE pipe, exposed pipe sections will be affected by solar heating and may require shading to ensure pipe remains below the design temperature. If not followed, premature failures can result.
- Any steel pressure test resulting in stresses exceeding 100% SMYS requires a yield plot. (Regulation S.32)
- Piping or fabricated items fully exposed at the time of pressure testing may have a concurrent strength test and leak test of only 1 hour, (8.7.1.2, 8.7.5.2) provided a visual inspection for leaks at a pressure of at least 1.1 x MOP (but that does not exceed 100% SMYS) (8.7.1.3) is conducted immediately following the 1 hr test. (Clause 8.7.1.2.) Further, a 1-hour pressure test is acceptable for all piping that is above ground, or any pipeline less than 75m in length. (Pipeline Regulation S.40(1)) Either liquid or air media may be used, subject to the normal restrictions for that media.
- Gaseous media testing is intended to be only for new pipeline and is only permissible for testing used pipelines by special approval. While Gaseous Media Pressure Testing is allowable by CSA Z662 for many situations, pipeline volumes greater than 125 m3 may require non-standard testing durations or procedures, and other factors mean that extra consideration is required before doing gas tests. Any pipeline being tested with gaseous media is restricted to a maximum stress level of 80% SMYS at any road or railway crossing, unless the crossing is closed to traffic during the test. (Clause 8.7.1.4.) Further guidance is contained in Directive 077: Pipelines Requirements and Reference Tools. If further interpretation is required please contact the Pipeline Section.
- For testing using non-fresh-water test media, (example: water/methanol) refer to Directive 077 which explains when additional radiography, and preparing contingency plans for managing spills, is required.
- It is permissible to use sweet natural gas as a gaseous test media in CSA Class 1 locations (Pipeline Regulation, S.37) for any type of pipeline where gaseous testing is otherwise permissible. Low pressure gas distribution pipelines are frequently tested using natural gas. (Hard to get water out of the system.) Note however that for pipelines designed to Clause 12 (Distribution), such natural gas testing is limited to pressures that do not cause stresses exceeding 30% SMYS during the test.
- Steam Distribution Pipelines: (Pressure >103 kPa, AND Temperature >120°C as per CSA Z662 Clause 14) Steam and produced fluid lines will be licensed by the ERCB, but the design, construction and testing approvals are handled by ABSA (Alberta Boilers Safety Association).
- For ALL PIPELINES, including DISTRIBUTION GAS when 30% stress level and over, full circumference radiography is required for all welds within the limits of uncased road and railway crossings; within the limits of water crossings; or that will not be pressure tested in place; plus, a minimum of 15% of all field welds done each day. (Clause 7.10.3.1) For DISTRIBUTION GAS pipelines (under 30% stress level) – It is permissible to use visual inspection only. (Clause 12.7.4)
- For CO2 SERVICE and for SOUR SERVICE (as determined by the CSA methods using partial pressure of H2S)–full circumference radiography is required for ALL WELDS. This is applicable to any substance that requires sour service spec material and construction as per the CSA partial pressure definitions.

***Note:** The Requirements in this Document are Applicable to CSA Z662-15 and Pipeline Regulation Version 91/2005.