

Informational Letter

IL 2002-02

June 18, 2002

TO: Pipeline Operators
Pipeline Engineering Consultants
Pipeline Contractors

STRENGTH AND LEAK PRESSURE TESTING OF PIPELINES USING GASEOUS TEST MEDIA

The Alberta Energy and Utilities Board (EUB) receives requests for clarification of the requirements governing gaseous media pressure testing of pipelines. Gaseous media pressure testing is allowable in some instances **provided** that operators comply with the requirements detailed in the Alberta Pipeline Regulation and *CSA Standard Z662-99, Oil and Gas Pipeline Systems (CSA Z662)*.

As a general policy, the EUB prefers that water be used as the pressure test medium in order to achieve the highest level of safety during the process and obtain reliable leak test data. This is also in keeping with the *CSA Z662* standard. However, there may be circumstances where gaseous media testing can be justified and can be safely and effectively performed.

The EUB believes that gaseous media testing is suitable primarily for the testing of newly constructed smaller diameter pipelines and that gaseous media testing is inappropriate for high-pressure pipelines located in densely populated areas. The EUB further believes that, except in rare circumstances where an engineering assessment or additional data provide satisfactory integrity information, gaseous media pressure testing is inappropriate for requalification of in-service or out-of-service pipelines.

Explanation of how the EUB applies the requirements of the Pipeline Regulation and *CSA Z662* for the specific requirements relating to gaseous media pressure testing is provided below. **Note that the referenced documents and the pertinent sections of *CSA Z662* must be reviewed in their entirety** before planning or conducting gaseous media pressure testing.

1 APPLICABLE REGULATIONS AND STANDARDS

- Alberta Pipeline Act and Pipeline Regulation
- *CSA Z662-99*, Clause 8, Pressure Testing (pipelines operating at over 700 kilopascals [kPa])
- *CSA Z662-99*, Clause 10.11.5, Pressure Testing Existing Piping
- *CSA Z662-99*, Clause 10.11.6, Engineering Assessments

2 EUB FIELD CENTRE NOTIFICATION AND RESPONSIBILITY

The appropriate EUB Field Centre must be notified at least 48 hours prior to the commencement of any pressure test. If in any situation an EUB Field Centre inspector believes that a gaseous media pressure test might be inappropriate or constitute a safety hazard to personnel or community, the inspector may prohibit the test until any concerns have been alleviated.

3 INTEGRITY REQUIREMENTS FOR EXISTING PIPELINES

If a pipeline

- has been discontinued,
- has been abandoned,
- has otherwise been out of operation for longer than one year, or
- is being requalified,

the EUB expects its integrity to be confirmed prior to resuming operation, either by pressure testing or other evaluative means.

In these instances the condition of the pipeline may be uncertain; therefore, the EUB requires that pressure testing **be conducted hydrostatically**. In situations where hydrostatic testing may not be feasible or additional pipeline integrity information and an engineering assessment indicate that gaseous media pressure testing may be possible, a detailed proposal and testing procedure must be submitted to the EUB for approval prior to the test, regardless of pipeline volume. The EUB expects the pipeline operator to assess whether the pipeline may have **any condition**, such as metal loss, defect, or manufacturing characteristic that could result in a rupture during pressure test.

4 CRITERIA FOR USING GASEOUS MEDIA FOR PRESSURE TESTING

Water is the preferred pressure-test medium, followed by water with freezing-point depressant, followed by gaseous test media. The CSA standard states that pressure testing with gaseous media may be permissible if one of the following conditions exists:

- The testing temperature is expected to be below freezing.
- An appropriate liquid medium of sufficient quality and quantity is not available.
- Piping configuration prevents liquid removal.
- The elevation profile of the line would result in an excessive number of test sections.

In these instances, gaseous media testing may be conducted. The test pressure must not produce hoop stresses in excess of 95 per cent of the material's specified minimum yield strength (SMYS), and the maximum operating pressure (MOP) is limited to that calculated from a pressure corresponding to a maximum of 90 per cent of SMYS. Thus the maximum hoop stress allowable at MOP is 72 per cent SMYS ($90/1.25=72$) for pipeline requiring a pressure test to 125 per cent of MOP.

If none of the four qualifying conditions described above exists, gaseous media testing may be conducted, but only to a pressure that will not produce hoop stresses in excess of 80 per cent of the material's SMYS. For a visual representation of this selection process, see the attachment.

5 SAFETY AND ENVIRONMENTAL CONCERNS

Although gaseous media pressure tests may be advantageous in certain situations due to not having to procure and dispose of liquid media, there are a number of safety and environmental considerations contained in the Pipeline Regulation, other EUB documents, and *CSA Z662* that must be carefully evaluated before conducting gaseous media testing:

- Gaseous media used for pressure testing must be air or other nontoxic gaseous media. Natural gas that does not contain any hydrogen sulphide (H₂S) qualifies as nontoxic gaseous media and may be used for pressure testing of **distribution** pipelines, as they are defined in *CSA Z662*. For other pipelines, natural gas is allowable for pressure testing within *CSA Z662* Class 1 areas **only**.
- All pressure tests must be conducted in a manner that will ensure the protection of people and property in the vicinity of the pipeline. Extra consideration must be made in regard to public notification of any parties that might be influenced by activities occurring within the test area. People not involved in the testing process must be restricted from the area during the testing process.
- As gaseous media are much more compressible than liquid media and the potential consequences of a test failure are greater, additional planning and measures for safety of the public and workers is necessary.
- When gaseous media are being used, consideration should be given to operating the test head assemblies at lower stress levels than would normally be used in hydrostatic testing.
- Piping located under railway or road crossings must be pretested separately or must not be tested with gaseous media to stresses exceeding 80 per cent of SMYS without closing the crossing to traffic.
- Gaseous media pressure testing should only be performed on pipelines that are satisfactorily cleaned. The operator must evaluate and mitigate the formation of an explosive mixture within the pipeline that could result in internal combustion during the test.
- After test completion, the pressure must be released under controlled conditions. EUB *Interim Directive (ID) 99-8: Noise Control Directive* and *Guide 38: Noise Control Directive User Guide* specify the requirements for abatement of noise that may result from venting operations.
- EUB *Guide 60: Upstream Petroleum Industry Flaring Guide* places restrictions on the amount of gas to be flared or vented and imposes public notification guidelines for flaring of gas if it is used as a test medium.

6 MATERIAL LIMITATIONS

There may be restrictions placed upon gaseous media pressure testing due to the type and nature of pipeline materials:

- Steel pipe must be girth welded and must meet requirements for fracture initiation and propagation (*CSA Z662*, Clauses 8.2.2.1.3 and 5.2). Used (salvaged) pipe may not be tested with gaseous media.
- Fibreglass and flexible composite pipe may not be tested with gaseous media.
- Plastic liners may be leak tested with gaseous media after installation. Polyethylene gathering- system pipe operating at hoop stresses of 40 per cent or less of the specified hydrostatic design basis (HDB) may be tested with gaseous media for 24 hours after pressure stabilization.
- Caution must be exercised when using gaseous media for the testing of plastic pipes, since a static charge could be generated from the passage of the gas through the plastic pipe. For this reason, the pipe must be buried and grounded in order to prevent electrical discharge.
- Buried aluminum pipe up to and including 114.3 millimetres (mm) outside diameter may be tested with gaseous media up to a hoop stress of 95 per cent of SMYS, subject to further conditions described in *CSA Z662-99*, Clause 15.8.

7 TEST SECTION VOLUME LIMITS AND DURATION OF TESTING

Pipelines must be pressure tested in place under the same conditions that will prevail during operation. This means that buried pipelines must be backfilled before testing. Pipeline sections less than 75 m in length may be strength and leak tested concurrently with gaseous media for a minimum of one hour. Pipeline sections exceeding 75 m in length may be strength and leak tested concurrently for a minimum duration of 24 hours.

In situations that involve large test volumes, *CSA Z662* requires that the effect of gas compressibility must be considered when determining the length of the test section and the duration of the test in order to detect small leaks. In order to simplify this process, the EUB has determined that test segment volumes of 125 m³ or less are sufficiently sensitive to minor gas leaks so as to enable leak detection when tested over a 24-hour period. The EUB therefore allows that testing of test sections 125 m³ or less shall not require an engineering evaluation of leak detection sensitivity to be submitted. Larger test volumes will require a fully supported engineering evaluation be submitted to the EUB Pipeline Section for approval, demonstrating that the alternative testing procedures are safe and also effective in detecting leaks in segments with test volumes greater than 125 m³.

Consideration of the condition of the pipeline must still be made regardless of pipeline volume, and therefore the requirements outlined in Section 3 of this document also apply.

The 125 m³ limitation results in approximate test segment lengths, as given in the following table:

Pipeline diameter (nominal) (mm)	60.3	88.9	114.3	168.3	219.1	273.1	323.9
Test section length (km)	57.8	23.4	14.1	6.3	3.7	2.3	1.7

In order to make valid conclusions regarding test pressure loss, high-resolution (better than 1 per cent) pressure instruments may be required. The pipeline must be allowed to fully stabilize after pressurization **before** beginning the 24-hour test period. Ambient temperature and internal test section temperature must be monitored during the test and reconciled with pressure changes. The operator should also consider alternative techniques to assist in leak detection, such as the use of odorant, gas detectors, ultrasonic leak detectors, thermography, and trained animal detectors.

8 PRESSURE TESTING ABOVEGROUND PIPING

Piping that is aboveground and fabricated items that are fully exposed may be tested with gaseous media for a duration of one hour. Open trench pipeline is **not** considered to be aboveground piping.

For further clarification, direct questions to the EUB Operations and Compliance Branch, Pipeline Section, at (403) 297-8432, (403) 297-8967, or (403) 297-8148.

<Original signed by>

J. D. Dilay, P.Eng.
Board Member

Attachment

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SELECTION PROCESS FOR GASEOUS MEDIA PRESSURE TESTS

