



COLORADO

Oil & Gas Conservation
Commission

Department of Natural Resources

COGCC OPERATOR INSTRUCTIONS

BRADENHEAD TESTING AND REPORTING

Document Control:

Created Date:	November 29, 2016
Last Updated Date:	October 18, 2018
Last Updated By:	Stuart Ellsworth
Review Cycle:	Yearly Review
Systems Used:	None
Document Owner:	Stuart Ellsworth
Work Units:	Engineering, Field Inspection

Background

Purpose/ Applicability:

The purpose of this document is to explain a suggested procedure to perform and report a bradenhead test. Reporting a bradenhead test through a Form 17, Bradenhead Test Report, may be required by a Commission Field Order or otherwise requested by COGCC staff.

This document describes bradenhead testing and reporting procedures, but it does not describe procedures for monitoring during stimulation (Rule 341) or reporting high pressures during stimulation (Rule 316.C.1.). High bradenhead pressure during stimulation is evaluated on a well-by-well basis. Bradenhead monitoring of offset wells during stimulation may also be required by permit conditions. Operators should consult COGCC engineering staff to discuss specific situations related to high bradenhead pressures during stimulation.

Pre-test well evaluation and Set-up:

To ensure the bradenhead test is performed in a safe and efficient manner, operators and others on location are encouraged to:

- Review existing wellbore construction, including casing and cement configuration, prior to performing a bradenhead test,

BRADENHEAD TESTING AND REPORTING INSTRUCTIONS

- Be aware of the location of valves and potential pressures prior to opening valves, and
- Compare the document wellbore configuration to the wellbore configuration observed in the field to determine if any valves, including the bradenhead valve, are buried or plumbed outside of the well cellar.

Wellbore Diagram

Bradenhead tests are intended to evaluate shut-in pressures and blowdown characteristics of all annular spaces in a well. A wellbore diagram is useful during a test to provide a visual representation of the cement, casing, perforations, completed formation(s), and location of any packer(s) or bridge plug(s) in the well. The operator may want to create a current diagram or check COGCC's well files for any existing wellbore diagrams prior to performing a bradenhead test. If not otherwise required, a current wellbore diagram can be attached to a Form 4, Sundry Notice, if an operator wishes to update COGCC's well files to reflect the current wellbore configuration.

Guidance on creating a wellbore diagram may be found on the COGCC website at:

Regulation\Forms\Form 17, Bradenhead Test Report\Instructions:

- Form Instructions\Casing and Cement Nomenclature Guidelines
- Attachment Guidance\Suggested Wellbore Diagram Guidance

Wellheads

To facilitate regular bradenhead testing, Operators should ensure that:

- All bradenhead and intermediate casing taps are plumbed to surface or above ground level.
- All access to plumbing, fittings and valves below ground level are exposed to allow for easy access.
- All valves below ground level are housed and enclosed with an easy-opening lid.

Testing Preparation

To ensure consistent and informative tests, Operators are encouraged to do the following:

- The bradenhead and any intermediate valves should be shut in 7 to 14 days prior to testing. This allows time for pressures to stabilize.
- If a Form 17 is to be used to report test results, the well name, API number, location, mineral type, well status, number of casing strings, and completed

BRADENHEAD TESTING AND REPORTING INSTRUCTIONS

formations should be entered prior to observing pressures and flow characteristic,

- All initial pressures should be measured with a deadweight tester, calibrated mechanical or digital test gauge with maximum 2 psig increments (a 5 psig increment gauge is acceptable only if pressures exceed 600 psig, necessitating a gauge with greater range).

Test Equipment to be provided by Operator

Operators are also encouraged to ensure there is:

- Sufficient containment for any liquid discharge (see Step 5 of Flowing Test Procedure below).
- A sufficient number of pressure gauges to simultaneously monitor tubing string(s), production casing, intermediate casing(s), and surface casing (bradenhead) pressures.
- A sufficient number of liquid sample containers and gas canisters to sample all annular spaces and production gas if required, as specified in Appendix A.
- A stopwatch to measure blowdown times.

Bradenhead Testing Procedure

Initial Pressure Measurements

Initial pressures are measured while the bradenhead valve (and any intermediate casing valve) is closed to the atmosphere with pressure gauges installed. Prior to opening the bradenhead valve and performing the Flowing Test Procedure shown below, measure and record initial pressures on the tubing string(s) (flowing or shut in), production casing (flowing or shut in), intermediate casing(s) (shut in), and surface casing (bradenhead, shut in).

When reporting by Form 17, choose the producing formation from the dropdown list; otherwise note the producing formation on the paper form.

Flowing Test Procedure

The flowing stage of the test is performed while the bradenhead valve (and intermediate valve for the intermediate annulus test) is open to the atmosphere. The open-flow blowdown tests are performed consecutively on each annular space, starting with the bradenhead annulus and ending with the innermost annulus.

1. Keep all pressure gauges installed on the tubing, production casing, and

BRADENHEAD TESTING AND REPORTING INSTRUCTIONS

intermediate casing(s) throughout the flowing bradenhead test. The intermediate casing annulus pressure gauge should only be removed during the intermediate annulus flow test (to be performed after the bradenhead flow test).

2. Remove the bradenhead annulus gauge (and intermediate gauge for the intermediate annulus flow test), if necessary, then open the valve to vent the annulus to atmosphere.
3. If a liquid or gas sample is to be taken, collect a sample per Appendix A: Liquid and Gas Sampling.
4. After collecting the sample, close the valve to assure sample canisters fittings or lids are properly sealed. Re-open the valve after sampling, and proceed with the next step.
5. Any liquids that discharge from the bradenhead are exploration and production waste and shall be handled in accordance with COGCC's 900-Series rules.
6. Monitor the tubing string(s), production casing, and intermediate casing(s) pressures. If a Form 17 is used to report the observed pressure readings and flow characteristics, refer to steps 8 and 9 below.
7. When possible, allow the annulus to blowdown to as low a flow as possible (whisper or zero). Do not close the bradenhead valve (or the intermediate valve for the intermediate annulus flow test), unless: gas or liquids begin to continuously discharge through the valve, and one or more of the following apply:
 - i. the flow is indicative of a high-pressure casing leak;
 - ii. the flow has the potential to create a safety hazard for personnel on the location;
 - iii. the flow has the potential to cut-out the valve because of abrasive particulates in the flow; or
 - iv. Another observed reason based on the current field conditions.
8. If reporting the test results by Form 17, record pressure observations at 5 minute intervals for 30 minutes on the Form 17 or as required by Field Order. The bradenhead valve (and intermediate valve for the intermediate annulus flow test) should remain open and flowing during the 30-minute test, except as noted above.
9. If reporting by Form 17, describe characteristics of the fluid(s) discharging from the valve in the last column on Form 17 or alternate format if required by Field Order, and add comments to describe the discharge.
 - a. **Flow Type:** The first single-character data-field represents the flow type: C = Continuous flow, S = Surge flow, W = Whisper (very low flow),

BRADENHEAD TESTING AND REPORTING INSTRUCTIONS

D = Down to Zero, or O = No flow.

- b. **Fluid Type:** The second single-character data field represents the fluid type: G=Gas, V=Vapor, H=Water, or M = Mud.
10. If reporting by Form 17, document the visual or odor characteristics of the fluid with standard Form 17 descriptions (sulfur smell, salty, black, clear, fresh, or other) and additional comment(s) on Form 17 or as required by Field Order.
11. At the end of the 30-minute blowdown, shut in the bradenhead valve. Measure the instantaneous shut-in pressure on the bradenhead at the conclusion of the test. If the shut in pressure is greater than zero but Too Small to Measure, report TSTM.
12. If a liquid or gas sample is to be taken at the end of the test, collect a sample per Appendix A: Liquid and Gas Sampling.
13. Keep the bradenhead open while conducting the intermediate casing blowdown test(s) (if intermediate casing is present), and repeat the procedure described above for intermediate casing(s) from outermost annulus to innermost annulus.
14. Secure the wellhead and close all valves as necessary at the end of the test.
15. If reporting test results via an eForm 17, sign and date the field Form 17 and append the hardcopy to the eForm 17 as an attachment.

Potential Concerns related to Bradenhead Testing Results

If any of the conditions noted below are observed, which may indicate a casing leak, operators are encouraged to consult with COGCC engineering staff to discuss specific situations:

- A prolonged or continuous liquid discharge from the bradenhead or intermediate annulus;
- A sustained gas flow from the bradenhead or intermediate annulus; or
- Pressure drops observed in other casings when venting the bradenhead or intermediate annulus.

Guidance Disclaimer

This is a guidance document, not a formal rule. The purpose of this guidance document is to inform all interested stakeholders of the Commission's interpretation of, and expectations concerning, the formal Commission Rules, Field Orders or policies discussed herein. Interpretative rules or general statements of policy, such as

BRADENHEAD TESTING AND REPORTING INSTRUCTIONS

this guidance document, are not meant to be binding as rules under the Administrative Procedures Act. § 24-4-103(1), C.R.S.

Document Change Log

Change Date	Description of Changes
November 29, 2016	Initial Draft Document
March 22, 2017	Initial Release
October 18, 2018	Revised Appendix A for using COGCC Form 43 to submit bradenhead gas or liquid sample data

BRADENHEAD TESTING AND REPORTING INSTRUCTIONS

Appendix A: Liquid and Gas Sampling

As indicated in the Bradenhead Test Procedure:

- Initial pressures should be documented prior to opening valves and prior to collecting sample(s).
- It is suggested that operators should be prepared to collect liquid and gas samples when conducting their Bradenhead tests.

All final laboratory analytical results shall be submitted to the COGCC via an approved Electronic Data Deliverable (EDD) format using the Form 43 - Analytical Sample Data Submittal Form (Instruction on uploading analytical data through the Form 43 can be found at the following link (http://cogcc.state.co.us/reg.html#/forms/form43_new). PDF copies of laboratory reports should be attached to the Form 43.

Liquid Sampling

- Operators are encouraged to collect a “first-draw” sample when the valve is opened (in the event that liquid discharge ceases during the test) and a flowing liquid sample at the end of the test (if liquid continues to flow during a partial test or a full test).
- When liquids discharge from the annulus in quantities sufficient to allow for sampling, (meaning the flow is greater than a mist) Operators are encouraged to submit the liquids for laboratory analysis:
 - If free-phase oil is present organic liquids should be analyzed for “whole oil analysis” with biomarkers (phytane and pristane).
 - Analyze aqueous samples for major anions (chloride, carbonate, bicarbonate, and sulfate), major cations (sodium, potassium, calcium, and magnesium) total dissolved solids (TDS), benzene, toluene, ethylbenzene, and total xylenes (BTEX), diesel-range organics (DRO), and gasoline-range organics (GRO) and dissolved gasses (RSK 175).
 - If there is a limited amount of aqueous liquid available with the discharge, then BTEX, anions, and cations should be given a higher priority.
- If liquids are discharged as a mist or spray, but do not “flow,” then COGCC does not expect liquid samples to be collected.
 - A mist or spray in this context will be used as fluid particles floating or falling out of the bradenhead into the atmosphere, which are in an amount too small to be reasonably collected.

BRADENHEAD TESTING AND REPORTING INSTRUCTIONS

- The operator should consult with COGCC environmental staff in situations when oil and aqueous samples are collected to determine which sample(s) will be submitted for laboratory analysis.

Gas Sampling

- Operators are encouraged to submit Bradenhead, intermediate annulus (if present), and production gas samples for laboratory analyses when gas samples are collected. Gas samples should be analyzed for gas composition and stable isotopes:
 - The compositional analysis should include hydrogen, argon, oxygen, carbon dioxide, nitrogen, methane (C1), ethane (C2), ethene, propane (nC3), isobutane (iC4), butane (nC4), isopentane (iC5), pentane (nC5), hexanes +, specific gravity and British Thermal Units (BTU).
 - Stable isotope analyses should include delta DC1, delta 13C1, delta 13C2, delta 13C3, delta 13iC4, delta 13nC4, delta 13iC5 (if possible), delta 13nC5 (if possible), and delta 13C of CO2 if possible.
 - Gas sample containers should be filled in accordance with container manufacturer or laboratory recommendations; purging multiple container volumes may not be feasible due to limited gas volumes.

Reference

BLM gas sampling: [NTL-MDO-91-1 - Bradenhead Testing in Ignacio-Blanco Field, Southern Colorado](#) .