



ECMC OPERATOR GUIDANCE

BRADENHEAD PRESSURE MONITORING, TESTING, MANAGEMENT, MITIGATION, AND REPORTING

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Section 1.0: Purpose

This Operator guidance is intended to clarify the overall process for Rule 419 bradenhead pressure monitoring, annual testing, diagnostic testing, and related plan approval and reporting requirements in light of changes to ECMC wellbore integrity rules, effective November 2, 2020. This guidance also describes how Rule 419 requirements relate to other standards for existing bradenhead test areas and bradenhead monitoring areas previously established by Commission orders. Rule 419 applies to all wells that are not permanently plugged.

For coalbed methane wells only, Rule 614.e provides for ceasing bradenhead testing requirements when the Operator demonstrates all of the following:

1. adequate isolation of all potential flow zones (hydrocarbon, groundwater, and, subsurface hazards);
2. cement coverage in the wellbore that extends up a minimum of 50 feet into the surface casing and above the surface casing shoe; and
3. two consecutive bradenhead tests at least 12 months apart.

Apart from this provision, coalbed methane wells follow the same Rule 419 requirements described in this guidance, including testing the well annually. A coalbed methane well Operator may submit the information required by Rule 614.e on a Form 4.

For wells in areas governed by existing Commission orders for bradenhead monitoring or bradenhead testing, the Operator will comply with the bradenhead pressure action thresholds and testing frequency of the Commission order, if they are more stringent than the requirements of Rule 419. Section 3.0 describes special requirements for existing bradenhead test areas in D-J Basin, Piceance Basin, and San Juan Basin.

Section 2.0: Rule 419 Guidance

Rule 419 outlines monitoring and testing requirements for different stages of a well's life cycle to assist the Operator and Commission staff with evaluating wellbore integrity.

2.1 Bradenhead Access for Pressure Measurements

Rule 419 requires the Operator to equip bradenhead access on all wells as of November 2, 2020 to allow ECMC staff to visually inspect the bradenhead access at all times. The Operator will retrofit existing wells that do not have an accessible bradenhead valve to accommodate periodic monitoring and testing.

2.2 Bradenhead Pressure Action Threshold

All wells have a well-specific bradenhead pressure "action threshold." The statewide action threshold is 30% of the true vertical depth (TVD) of the surface casing shoe, expressed in psig.

For example, if the surface casing TVD is 1,000 feet below ground level:

$$0.30 \text{ psig/foot} * 1,000 \text{ feet} = 300 \text{ psig monitoring threshold}$$

Commission orders may require a more stringent action threshold than the statewide requirement in Bradenhead Test Areas (refer to Section 3.0).

For wells that have a Pressure Management Plan (PMP) approved by the Director, the Operator will comply with pressure action thresholds specified by the PMP.

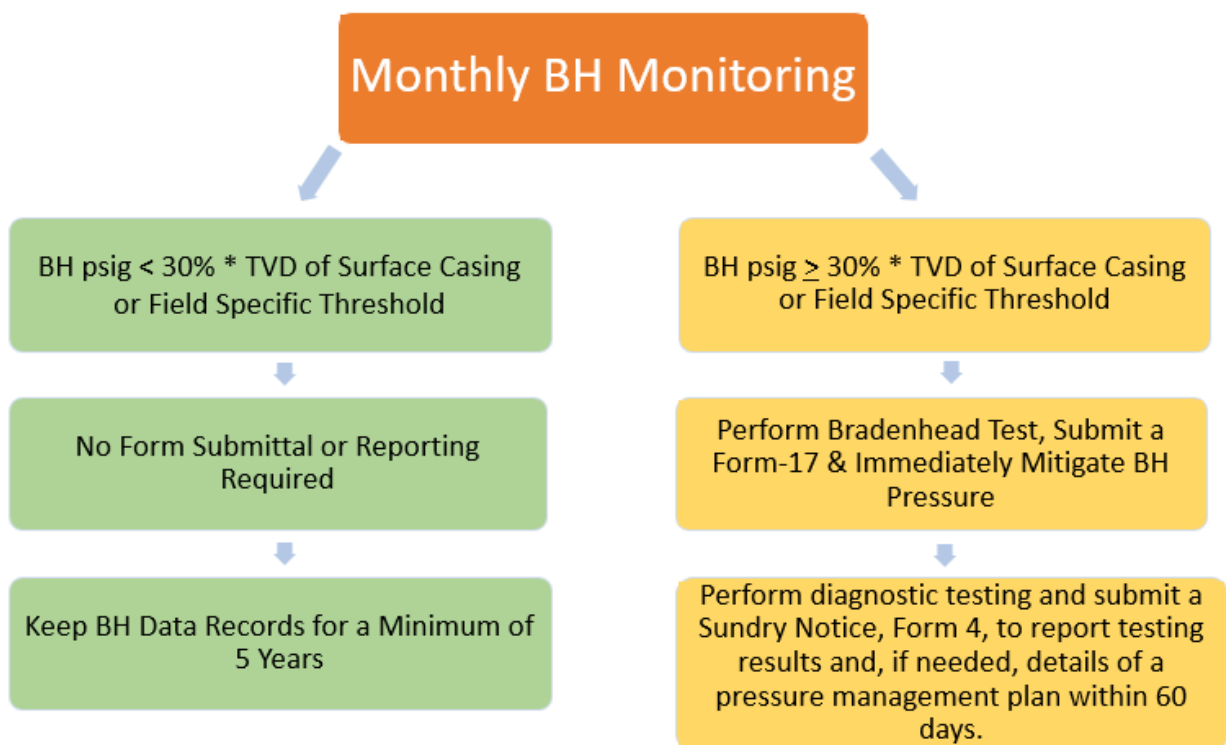
2.3 Monthly Monitoring

The Operator will perform monthly bradenhead pressure monitoring. Bradenhead monitoring consists of checking the bradenhead annulus pressure without performing a flowing test. The pressure is measured by opening the bradenhead valve with a pressure gauge installed to check the annulus pressure (a similar procedure is performed with a gauge on the intermediate casing valve, if the well has intermediate casing). Gauge(s) do not need to remain on the well when not in use by the Operator to measure pressure. The Operator will maintain all bradenhead pressure monitoring

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records for a minimum period of 5 years, and the Operator will make the records available for inspection by the Director upon request.

The monthly monitoring requirement applies to all wells that have a bradenhead annulus, including wells with a Suspended Operation or Waiting On Completion status. For Waiting on Completion wells with a bradenhead pressure that exceeds the action threshold, the Operator will seek Director approval by contacting the Engineering Supervisor before proceeding with stimulation to determine whether mitigation or other measures are necessary to ensure wellbore isolation consistent with the Commission's Rules.



For wells with bradenhead pressure that exceeds the action threshold during monthly monitoring, the Operator will:

- 1) perform a bradenhead test and submit Form 17 within 10 days
- 2) mitigate the pressure
- 3) perform diagnostic testing to determine if the annular casing pressure is sustained
- 4) submit Form 4 within 60 days

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The Form 4 will describe the Operator's discovery of the pressure above the action threshold and actions taken to mitigate the pressure. For sustained casing pressure, the Form 4 will include a PMP.

For wells that are included in a Commission order or a Director-approved PMP and the monitoring frequency is more stringent than monthly, the Operator will comply with the monitoring frequency specified by the Commission order or PMP.

2.4 Bradenhead Test Timing

The Operator will perform annual bradenhead tests once per calendar year, no later than December 31. Tests should be completed within 9 to 12 months of the previous year's test. More frequent tests may be necessary for special situations (e.g., pressure mitigation, diagnostic testing, post-repair confirmation), or as required by a Commission order, Condition of Approval, or PMP.

For a well where the rig was released before November 1, the Operator will perform the initial bradenhead test on or before December 31 and prior to hydraulic fracture treatment.

2.5 Bradenhead Test Reporting

The Operator will report:

1. results of bradenhead tests on a Form 17 within 10 days of the test, or
2. test results for multiple wells in a bulk data upload by the 15th of the month following the month in which the tests were done (e.g., any tests performed in November that qualify for bulk upload will be reported by December 15), and
3. laboratory analytical results with Form 43, if fluid samples are collected for laboratory analysis.

For bulk uploads of bradenhead test data related to wells that are below the action threshold, do not have sustained casing pressure, and do not flow liquids during the test, the Director has approved a bulk upload process through a third-party vendor, EHS Data Monster. The process allows companies to enter thousands of tests into a single Excel template, and deliver those test results to the ECMC database via email. For Operators that are interested in utilizing this streamlined process, please contact EHS Datamonster for pricing and additional information:

Rockwood LLC/EHS Data Monster

info@rockwood-llc.com

www.rockwood-llc.com

2.6 Bradenhead Test Procedures

Bradenhead test field procedures are discussed in a separate guidance document, [Operator Instructions: Bradenhead Testing and Reporting](#).

2.7 Diagnostic Testing

The objective of diagnostic testing is to determine:

1. if the bradenhead pressure is sustained
2. proper wellbore isolation
3. the source of fluids in the annulus
4. mitigation options
5. remediation options

The Operator is encouraged to perform tests that demonstrate conclusive results with a single test or multiple lines of evidence to support a conclusion using more than one test. Tests include but are not limited to:

1. Pressure bleed down tests, followed by pressure buildup tests
2. For wells with no existing cement bond log (CBL) run across a cemented portion of the well, a new CBL
3. For wells in which the original CBL was not run at a proper line speed per tool manufacturer specifications, a new CBL
4. For wells with existing CBLs run under pressure, a CBL run with no pressure applied to the casing
5. A cement evaluation log
6. A casing evaluation log
7. A noise log
8. A temperature log
9. Echometer depth measurements to determine the distance to the liquid level in the annulus
10. An auditory, visual, and olfactory (AVO) inspection of the mechanical condition of the wellhead valves and seals
11. A function check and other troubleshooting for faulty gauges or automation equipment

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12. For liquid flow from the annular space other than a mist, liquid sampling and analysis of the parameters specified in [Operator Instructions: Bradenhead Testing and Reporting](#), Appendix A
13. For gas flow from the annular space, gas sampling and analysis, including gas analysis for hydrogen sulfide, if required by Rule 903.d
14. Gas composition and isotopic analysis for comparison with production gas analyses

2.8 Sustained Casing Pressure and Pressure Management Plans

For the purpose of this guidance document, **SUSTAINED CASING PRESSURE** means an annulus pressure that will not blow down to zero or builds up after being bled down, and the pressure is determined to be the result of a cause other than temperature effects in the well or an applied pressure in the well.

Sustained casing pressure may be measured in the bradenhead annulus, or the intermediate casing annulus, if the well is equipped with intermediate casing. For any pressure greater than zero psi observed in the intermediate casing annulus, the Operator will contact the Area Engineer.

For wells that have sustained casing pressure or for wells that flow liquid, as determined through diagnostic testing, the Operator will provide a PMP with the Form 4, including a description of the Operator's future plans for more frequent monitoring or testing, pressure mitigation, or remedial well work. PMP mitigation and reporting options will vary based on pressure and flow characteristics and the existing casing and cement configuration in the well. Engineering Staff will consider the following potential mitigation measures when evaluating the Operator's plan:

1. Bradenhead testing and bleed off strategy that is compliant with ECMC and CDPHE regulations
2. Bradenhead pressure abatement system that combusts bradenhead gas, or that routes bradenhead gas to sales with check valve(s) to prevent backflow
3. Remediation strategies intended to eliminate or reduce the bradenhead pressure by means of a downhole intervention (i.e., cement squeeze or other isolation technology)
4. Plug and Abandon the well

When approving a PMP, the Director may require bradenhead monitoring or testing frequencies that are more stringent than the monthly monitoring and annual bradenhead testing required by Rule 419, as reasonable and necessary to protect public

health, safety, welfare, the environment and wildlife resources. Venting from the bradenhead is not permitted, other than venting while the valve is open during a bradenhead test or during diagnostic testing.

The Operator will submit a Form 4 for requested changes to an approved PMP. Subject to the requirements of any Conditions of Approval on a PMP, the Operator may submit a Form 4 for a request to discontinue a PMP at a well when:

1. pressure no longer exceeds the well's bradenhead pressure threshold, and
2. there is no sustained casing pressure, and
3. there is no liquid flow

2.9 Monitoring During Hydraulic Fracturing Treatment

During hydraulic fracturing treatment operations, the Operator will perform continuous bradenhead pressure monitoring on the well(s) being treated, and the Operator will also monitor bradenhead pressure in all wells within 300' (in three dimensions) of the wellbore(s) being treated. The Operator conducting the hydraulic fracturing treatment is responsible to ensure all monitoring is occurring as required by rule and maintaining all monitoring records for five years. As with monthly bradenhead monitoring, monitoring during hydraulic fracturing treatment will consist of the Operator measuring and recording bradenhead pressure with the bradenhead valve open to the annulus and closed to the atmosphere with pressure gauges installed. The operator will perform similar monitoring on the intermediate casing valve, if the well has intermediate casing.

The Operator will safely and quickly suspend the operation and relieve the annular pressure if any of the following occur during hydraulic fracturing treatment operations:

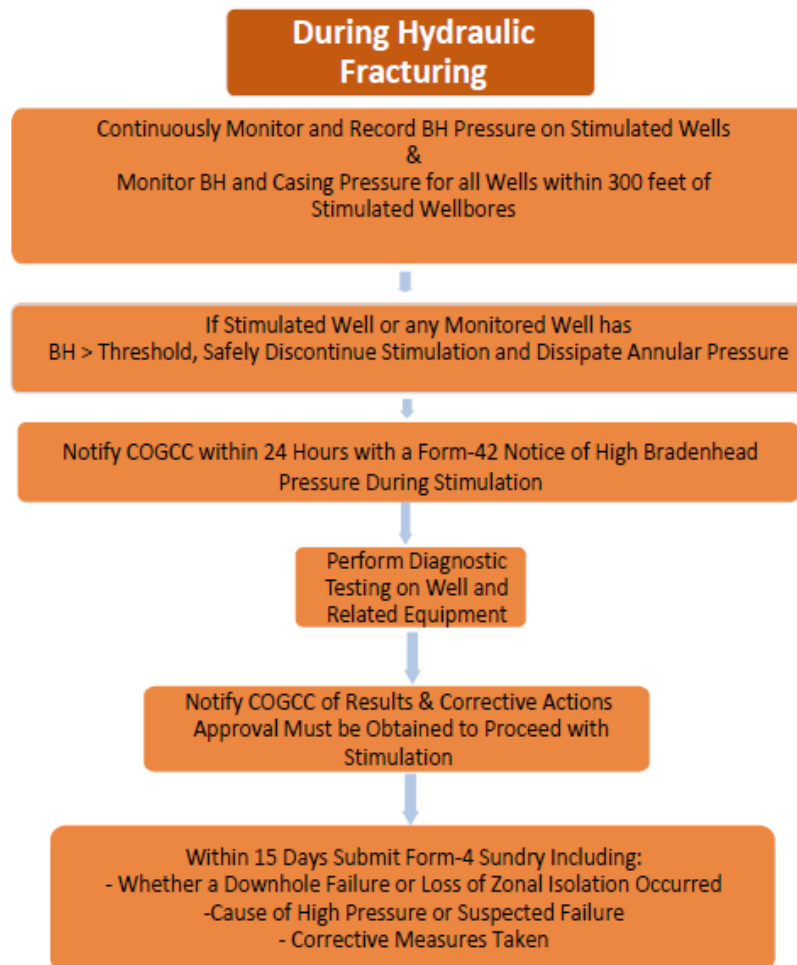
1. The bradenhead pressure exceeds the action threshold in the well(s) being treated;
2. There is an indication of a wellbore integrity failure in the well(s) being treated;
3. The bradenhead pressure exceeds the action threshold in the offset well(s) being monitored;
4. There is an indication of communication with the bradenhead annulus of offset well(s); or,
5. Fluids communicate to the ground surface.

The Operator will submit a Form 42, Field Operations Notice, Notice of High Bradenhead Pressure During Stimulation within 24 hours of the pressure event. The Operator will diagnose the problem that led to the elevated annular pressure and

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consult with the Director by first contacting the Area Engineer and, upon request, provide and implement a corrective plan prior to continuing any further stimulation operations on the well and any additional well on the Oil and Gas Location. The Operator will submit a Form 4, Sundry Notice within 15 days of the pressure event that describes the cause of the pressure event and corrective measures taken.

The Operator may continue stimulation activities without waiting for Director approval if the pressure event was caused by equipment problems that do not present a threat to workers at the location or public health, safety, welfare, the environment and wildlife resources, provided that the problem is quickly diagnosed and corrected, such as a faulty gauge reporting an incorrect pressure. In this case, the Operator will submit a Form 4 documenting the pressure event within 15 days.



Section 3.0: Bradenhead Test Areas Specified by Commission Order

This section describes special requirements for existing bradenhead test areas in D-J Basin, Piceance Basin, and San Juan Basin.

3.1 D-J Basin Bradenhead Monitoring Area

Commission Order 1-232, effective January 1, 2019, established a Bradenhead Monitoring Area in Adams, Arapahoe, Boulder, Broomfield, Denver, Jefferson, Larimer, and Weld counties. For wells that receive a Hydraulic Fracture Treatment, bradenhead testing requirements in the order are more stringent than Rule 419. In addition to the annual bradenhead test required by Rule 419, the Operator will perform bradenhead tests (not just monitoring, as required by rule) according to the following schedule and submit a Form 17 within 10 days of each test:

Order 1-232 Pre-Treatment Bradenhead Test

1. The Operator will perform an initial bradenhead test within 60 days of rig release and prior to Hydraulic Fracture Treatment, and
2. For a Waiting On Completion well with a delayed completion, the Operator will perform an additional bradenhead test at least 6 months after rig release but prior to Hydraulic Fracture Treatment

For wells with any instance of measured pressure greater than or equal to 200 psig during a pre-treatment test, the Operator will contact the ECMC Area Engineer for approval prior to commencing Hydraulic Fracturing Treatment. A pre-treatment mitigation plan is specifically required by Order 1-232, and it is not the same as a sustained casing pressure PMP.

Order 1-232 Post-Treatment Bradenhead Test COA

The Operator will perform a post-production test within 60 days after first sales, as reported on the Form 10, Certificate of Clearance

Bradenhead tests conducted as required by Order 1-232 will count as the annual bradenhead test required by Rule 419.

Order 1-232 bradenhead pressure action thresholds are more stringent than Rule 419's statewide requirement.

Order 1-232 Bradenhead Pressure Action Thresholds

- For wells in the Bradenhead Monitoring Area that do not have surface casing isolation of known groundwater, the action threshold is any pressure greater than 0 psig.
- For wells in the Bradenhead Monitoring Area with surface casing shallower than 455 feet deep that have full isolation of Groundwater, the monthly

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monitoring action threshold is calculated using the surface casing setting depth times 0.11 psig/foot

Example well-specific action threshold:

setting depth of 380 feet * 0.11 psig/foot = 42 psig

- For all other wells in the Bradenhead Monitoring Area, the action threshold is 50 psig.

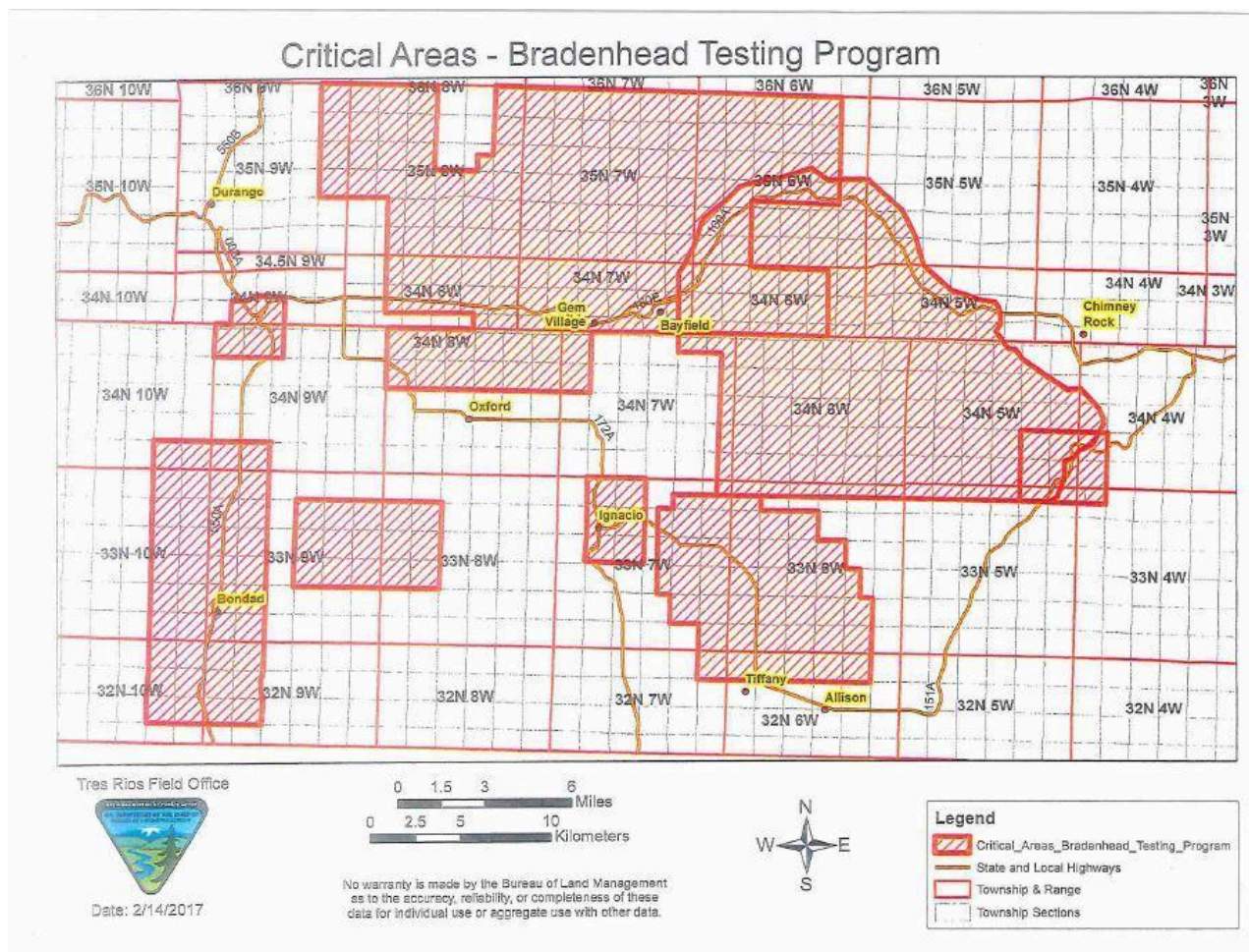
Additionally, if any well in this Bradenhead Monitoring Area has a sustained fluid flow at the end of the 30 minute Bradenhead Test action is required. The Operator should conduct diagnostic testing and submit a Form 4.

3.2 Ignacio Blanco Field

Operators will perform their operations in accordance with Rule 419, except for the provisions of Rule 614.e. for coalbed methane wells. ECMC Rules are now more stringent than Commission Order 112-85 and require annual tests rather than biennial tests.

BLM's Notice to Lessees NTL-MDO-91-1 uses bradenhead pressure action thresholds of 5 psi in critical areas and 25 psi in other areas as shown on the map below. The Operator will submit a Pressure Management Plan for wells:

1. In the Critical Areas when the bradenhead pressure is greater than 5 psi, and,
2. Outside of the Critical Areas when the bradenhead pressure is greater than 25 psi.



3.3 Buzzard, Mamm Creek, and Rulison Fields

ECMC's Rules are now as stringent or more stringent than Commission Orders 1-107, 139-56, 191-22, and 369-2, except for the bradenhead pressure action threshold in areas subject to the Commission orders:

1. For wells with surface casing vertical setting depths greater than 500 feet, the bradenhead pressure action threshold is 150 psi
2. For wells with surface casing vertical setting depths less than or equal to 500 feet, the Operator will calculate a bradenhead action threshold in accordance with the Rule 419 statewide standard

Related documents:

[Commission Orders](#) related to bradenhead testing: [1-107](#), [1-232](#), [112-85](#), [139-56](#), [191-22](#), and [369-2](#)
[Operator Instructions: Bradenhead Testing and Reporting](#)

Obsolete Guidance and Policies:

- COGCC Policy for Bradenhead Monitoring During Hydraulic Fracturing Treatments in the Greater Wattenberg Area
- Notice to Operators (NTO) Drilling Wells in the Buzzard, Mamm Creek, and Rulison Fields, Garfield County and Mesa County
- Operator Guidance for Order No. 1-232, Bradenhead Pressure Monitoring and Reporting

Document Change Log

Change Date	Description of Changes
January 15, 2021	Document Created and Finalized
April 12, 2022	Substantial reorganization and content changes
June 8, 2022	Clarification on timing for annual tests
September 26, 2023	Clarification on timing for annual tests in section 2.4
April 29, 2025	Clarification that isotopic and composition analysis are expected when collecting bradenhead samples

Appendix A: Rule Citations

100 Series Definitions

ANNULAR OVER-PRESSURIZATION means a wellbore condition that occurs when fluids in the annulus between the surface casing and the intermediate or production casings are pressurized to a degree that may cause migration of confined fluids or gases out of the annular space.

ANNULUS means the space between the borehole and a casing string or between two casing strings in a well.

BRADENHEAD shall mean the annular space between the surface casing and the next smaller diameter casing string that extends up to the wellhead.

BRADENHEAD TEST AREA shall mean any area designated as a bradenhead test area by the Commission under Rule 207.b.

WAITING ON COMPLETION WELL shall mean a well which has been drilled, cased, and cemented but the objective hydrocarbon formation has not yet been completed or stimulated using an open-hole, a liner, or a perforated casing completion.

WELL when used alone in these Rules and Regulations, shall mean an oil or gas well, a hole drilled for the purpose of producing oil or gas, a well into which fluids are injected, a stratigraphic well, a gas storage well, or a well used for the purpose of monitoring or observing a reservoir.

419.a. Equipment Requirements.

- (1) The Operator will equip bradenhead access on all Wells to the annulus between the production and surface casing as well as any intermediate casing with appropriate fittings to allow safe and convenient determination of pressure and fluid flow.
- (2) To allow for Commission visual inspection at all times, all valves used for annular pressure monitoring will remain exposed and will not be buried. An Operator may use a rigid housing to protect the valves so long as the housing can be easily opened or removed by the Operator upon request.
- (3) These equipment requirements apply to all Wells, regardless of function.

419.b. Bradenhead Monitoring. The Operator will monitor all Wells at a Director-indicated frequency for aspects of well integrity necessary to protect public health, safety, welfare, the environment, including groundwater, potential flow zones, and formations, and wildlife resources and in accordance with this Rule 419.

- (1) **After Rig Release, Prior to Stimulation.** An Operator will monitor all annular casing pressures on a monthly basis. If at any point the bradenhead monitoring pressure is greater than 30% of the true vertical depth (TVD) in feet of the surface casing shoe expressed in psig, the Operator will contact the Director before proceeding with stimulation to determine whether mitigation or other measures are necessary to ensure isolation consistent with the Commission's Rules.

(2) During Hydraulic Fracturing Treatment.

- A. An Operator will confine the placement of all stimulation fluids to the objective formations during hydraulic fracturing treatment to the extent practicable.
- B. During hydraulic fracturing treatment operations, an Operator will continuously monitor and record bradenhead annulus pressure on all wells being stimulated.
- C. If intermediate casing has been set on the well stimulated by hydraulic fracturing treatment, an Operator will monitor and record the pressure in the annulus between the intermediate casing and the production casing during stimulation operations.
- D. During hydraulic fracturing treatment operations, an Operator will monitor the bradenhead annulus and casing pressures for all wells within 300 feet of the wellbore being stimulated.

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- E. If at any time during hydraulic fracturing treatment operations, the bradenhead annulus pressure in psig in the well being stimulated or any well being monitored has a bradenhead pressure exceeding 30% of the true vertical depth (TVD) in feet of the surface casing shoe expressed in psig, or the Operator has reason to suspect any potential failure of the production casing or stimulation string, the operator will:
 - i. Safely and quickly discontinue the stimulation and dissipate the annular pressure.
 - ii. Notify the Director as soon as practicable but no later than 24 hours following the occurrence with a Form 42, Field Operations Notice, Notice of High Bradenhead Pressure During Stimulation.
 - iii. Perform diagnostic testing on the well and related equipment as is necessary to determine: (i) whether such a failure has actually occurred; (ii) if the pressure observations can be accounted for due to thermal expansion or pressure “ballooning” of the casing; or (iii) the presence or absence of a downhole failure or whether a migration pathway has actually occurred. The Operator will perform diagnostic testing as soon as is reasonably practical after Operator has reasonable cause to know of or suspect any such failure.
 - I. If the Operator does not identify a downhole failure or a migration pathway, the Operator will notify the Director of the results. The Director will timely grant approval to proceed with stimulation and may do so orally.
 - II. If the Operator identifies a downhole failure or migration pathway, the Operator will consult with the Director and, upon request, provide and implement a corrective plan prior to continuing any further stimulation operations on the Well and any additional Well on the Oil and Gas Location.
 - iv. Submit a Sundry Notice, Form 4, providing all details, including whether a downhole failure or migration pathway occurred, cause of the high pressure or suspected failure, and corrective measures taken within 15 days after the occurrence.
- (3) **Thirty Days After Hydraulic Fracturing Treatment.** For the first 30 days after hydraulic fracturing treatment or completion, an Operator will monitor and record production casing pressure and all annular casing pressures for a well on a daily basis, at a minimum.
- (4) **Through the Remaining Life of the Well.** For all Wells in the state, an Operator will monitor and record production casing pressure and all annular casing pressures on a monthly basis or at a Director-approved frequency. If a

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Well's bradenhead pressure is greater than 30% of the true vertical depth (TVD) in feet of the surface casing shoe expressed in psig, or a lower threshold set by a Commission Order, or if a Well flows liquids or continuous gas from the bradenhead annulus, an operator will

- A. Report the bradenhead pressure to the Director on a Form 17, Bradenhead Test;
 - B. Take immediate action to remedy such an annular pressure; and
 - C. Perform diagnostic testing to determine if the annular casing pressure is sustained. An Operator will report diagnostic testing results to the Director on a Sundry Notice, Form 4, within 60 days of submitting a Form 17 pursuant to Rule 419.b.(4)A. If the diagnostic testing confirms sustained casing pressure, an Operator will develop and implement a pressure management plan and provide the plan with the Sundry Notice.
- (5) **Records.** An Operator will keep bradenhead monitoring records required by Rule 419.b. available for inspection by the Director for a minimum of 5 years after the monitoring was performed.

419.c. Annual Bradenhead Testing and Reporting. For all Wells other than coalbed methane wells, an operator will perform an annual bradenhead test and submit the data to the Director on a Form 17 or other Director-approved method. For coalbed methane wells, an Operator will perform bradenhead testing in accordance with Rule 614.e.

419.d. Bradenhead Test Observations.

- (1) If an Operator observes a deficiency, the Operator will immediately take action to address the deficiency. Actions taken may include the Operator performing diagnostic testing on the Well to determine whether a deficiency does exist and the best method of repair or if a pressure management plan is needed.
- (2) The Director may impose a remediation plan if a deficiency exists, and if imposed, the Operator will implement an approved remediation plan or pressure management plan and report results within 30 days or as required by the approved plan.
- (3) If the Operator is not able to effectively address the deficiency or implement a pressure management plan, the Operator will plug and abandon the well within 6 months of discovering the deficiency.

614.e. Bradenhead Testing. An Operator of a coalbed methane well will comply with Rule 419, except as modified by this Rule. The appropriate regulatory agency will determine remedial requirements. The bradenhead testing requirement will not

apply if the operator demonstrates to the satisfaction of the Director annular cement coverage greater than 50 feet above the base of surface casing and zonal isolation is confirmed by reliable evidence such as a cement bond log or cementing ticket indicating that the height of cement coverage is 50 feet above the base of the surface casing, and zonal isolation is confirmed by two consecutive bradenhead tests that the Operator conducts at least 12 months apart. Before beginning a bradenhead test, the Operator will shut-in the bradenhead annulus for a minimum shut-in period of 7 days.

Appendix B: Related Rule Citations

209.c. Bradenhead test areas.

- (1) The Commission may approve specific fields or portions of fields as bradenhead test areas.
 - A. The Director may propose specific fields or portions of fields as bradenhead test areas by notice to all operators on record within the area and by publication.
 - B. The proposed designation, if no protests are timely filed, will be placed upon the Commission consent agenda for the next regular meeting of the Commission following the month in which such notice was given. The Commission will hear the proposed designation in accordance with Rule 531.
 - C. If a protest is timely filed, the Commission will hear the proposed designation in accordance with the 500 Series Rules.
- (2) The Commission order will describe the bradenhead testing or monitoring required and become effective upon approval by the Commission unless the Commission orders otherwise.

420. Form 17. BRADENHEAD TEST REPORT

The Operator will submit results of bradenhead tests to the Director within 10 days of completing the test either by filing a Form 17 or by another method approved by the Director or Commission. The Operator will include a wellbore diagram if not previously submitted or if the wellbore configuration has changed. The Director may request that the Operator collect samples for analysis of the bradenhead gas and liquid along with production gas. The Operator will submit the results of any gas and liquid analysis collected using a Form 43.