


Comparison of Pennsylvania Requirements,
EPA Rules, and CSSD Requirements for
Methane & VOC Emission Reduction for the Oil & Gas Industry
Effective August 8, 2018


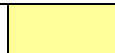

Well Pad Operations				
Pennsylvania's Air Quality Permit Exemption Criteria Category No. 38	Pennsylvania's Air Quality Permit Exemption Criteria Category No. 38(c)	Pennsylvania's GP-5A for Sources at Unconventional Natural Gas Well Sites	Center for Responsible Shale Development (CRSD) Performance Standards	EPA's Final NSPS Subpart OOOOa
Air Quality Permit Category No 38 Exemption Criteria 25 Pa. Code 127.14 (d) No 38(a) Applicable to authorized sources operating before August 10, 2013 No 38(b) Applicable to new or modified source operating after August 10, 2013 and prior to August 8, 2018.	Applicable to new or modified source operating after August 8, 2018.	✓ Streamlined General Permit which incorporates federal requirements and state BAT requirements into a single permit for these sources. GP-5A covers more sources than federally regulated sources. Wherever technically and economically feasible, more stringent limits than the federal requirements. Effective August 8, 2018.	Performance standards apply to unconventional exploration, development, and gathering activities including site construction, drilling, hydraulic fracturing and production in the Appalachian Basin. Amended December 8, 2017.	NSPS Subpart OOOOa finalized on June 3, 2016 and effective August 2, 2106. Applicable to all new hydraulically fractured wells. Hydraulically refracturing a well results in the entire facility being counted as modified for purposes of LDAR.
LDAR: LDAR Program applies to Methane and Volatile Organic Compounds (VOC).	LDAR: LDAR Program applies to Methane and Volatile Organic Compounds (VOC).	LDAR: LDAR Program applies to Methane and VOC.	Directed Inspection & Maintenance (DI&M) program for equipment leaks is not compound specific.	LDAR: LDAR Program applies to Methane and VOC emissions.
Define a leak is any gaseous hydrocarbons that can be detected by an optical gas imaging camera such as a FLIR camera or any other approved gas leak detection device that detects a concentration of 2.5% methane and 500 ppm VOC or more.	✓ Define a leak as any positive indication during an Auditory, Visual, and Olfactory (AVO) inspection, any visible image detected by OGI camera, or concentration of 500 ppm or greater detected by an FID or similar instrument.	✓ Define a leak as any positive indication during an Auditory, Visual, and Olfactory (AVO) inspection, any visible image detected by OGI camera, or concentration of 500 ppm or greater detected by an FID or similar instrument.	DI&M defines a leak as, fugitive emissions without quantifying the concentration or rate.	LDAR Program for well production facilities with leak definition of 500 ppm for methane and VOC using FID or any visible image with OGI.
Initial Inspection using Forward Looking Infra-Red (FLIR) Camera or approved device - within 60 days after the well is put into production.	Initial Inspection using Forward Looking Infra-Red (FLIR) Camera or approved device - within 60 days after the well is put into production.	✓ AVO inspection within 30 days of emission source commencing operation. OGI camera or gas detection instrument inspection within 60 days of the well starts production.	DI&M requires an AVO inspection for initial certification. No specific requirement for a FLIR Camera	Inspection using OGI Camera or gas leak detection instrument – no later than 60 days after the well starts production.
After the initial inspection LDAR must be conducted annually.	After the initial inspection LDAR must be conducted semi-annual LDAR as per Subpart OOOOa.	✓ Quarterly LDAR inspections using OGI camera or gas leak detection device. Semiannual if percentage leaking components is less than 2% of components for two consecutive quarters. Quarterly LDAR resumes if leaking components are greater than 2% total components.	DI&M require an AVO inspection on a weekly basis with a yearly mechanical or instrument check to detect leaks. No specific requirement for a FLIR Camera.	After the initial inspection LDAR must be conducted semi-annually.
No AVO inspections required beyond those required by Subpart OOOO or Subpart OOOOa.	No AVO inspections required beyond those required by Subpart OOOO or Subpart OOOOa.	Monthly AVO inspections required.	✓ DI&M require a visual, auditory and olfactory inspection and on a weekly basis.	AVO inspections required only for, covers, closed vent systems, and control devices on a monthly basis.

✓	Indicates most stringent requirements.		Less stringent than the Federal requirements.		More stringent than the Federal requirements.
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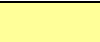

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<p>✓ Leaks are to be repaired no later than fifteen (15) calendar days after leak detections unless facility shutdowns or ordering of replacement parts are necessary for repair of the leaks.</p>	<p>✓ Leaks are to be repaired no later than fifteen (15) calendar days after leak detections unless facility shutdowns or ordering of replacement parts are necessary for repair of the leaks.</p>	<p>✓ Require the first attempt at leak repair within five calendar days after detecting a leak. Leak must be repaired no later than 15 days unless the purchase of parts is necessary, in which case the leak must be repaired within 10 calendar days after receipt of the parts, or the repair requires a venting, blowdown, shut-in, or shutdown to accomplish, in which case the repair must be done at the next shutdown or within 2 years.</p>	<p>Once significant leaks are detected they are required to be repaired in a timely manner.</p>	<p>Leaks are to be repaired as expeditiously as practicable, but no later than 30 calendar days after leak detection unless facility shutdowns or ordering of replacement parts are necessary for repair of the leaks.</p>
<p>Reporting: Compliance Demonstration Reports including LDAR must be submitted to DEP within 180 calendar days after the well completion or installation of a new source. In addition, by March 1st of each year, source reports for all air emissions for the preceding year, including methane emissions, from all unconventional natural gas well sites, must be submitted for the annual emission inventory.</p>	<p>Compliance Demonstration through annual report. In addition, by March 1st of each year, source reports for all air emissions for the preceding year, including methane emissions, from all unconventional natural gas well sites, must be submitted for the annual emission inventory.</p>	<p>✓ Reports including LDAR inspection results must be submitted to DEP. By March 1st each year, Chapter 135 source reports must be submitted to DEP for the annual emission inventory. The reports must include all emissions during the preceding year, including methane emissions, from all unconventional natural gas well sites.</p>	<p>Performance Standards have no air specific requirement for reporting by the operator.</p>	<p>The owner or operator of each affected facility must submit an annual report to include results of leak monitoring survey for fugitive emissions and information related to repair of detected component leaks. Initial reports are due no later than 90 days of initial compliance period ends. Subsequent reports are due no later than the same date each year as the initial report.</p>
<p>Storage Tanks Storage vessels/ Storage Tanks that are equipped with VOC emission controls that reduce VOC emissions by 95% or greater.</p>	<p>Reduce VOC emissions by 95% with the potential to emit 2.7 tpy or greater. Methane emissions must be less than 200 tpy.</p>	<p>✓ Reduce emissions by 95% for tanks with a methane emission rate of 200 tpy or greater, total VOC emissions of 2.7 tpy or greater, an single HAP emission rate of 0.5 tpy or greater, or total HAP emissions of 1 tpy or greater shall route all vapor through a closed vent system to a control device with at least 95% reduction of emissions.</p>	<p>Individual storage vessels with VOC emissions equal to or greater than 6 tpy must install controls to achieve at least 95% reduction in VOC emissions</p>	<p>Reduce VOC emissions by 95% with the potential to emit 6 tpy or greater. Can remove device if actual emissions are 4 tpy or lower.</p>
<p>Reciprocating Compressors: No specific requirements beyond those required by Subpart OOOO or Subpart OOOOa.</p>	<p>No specific requirements beyond those required by Subpart OOOO or Subpart OOOOa.</p>	<p>✓ Replace reciprocating compressor rod packing every 26,000 hours or every 36 months or route emissions to a process under negative pressure (Reciprocating compressors). Reduce VOC emissions from each centrifugal compressor wet seal fluid gassing system by 95 percent or greater.</p>	<p>✓ Change rod packing at all reciprocating compressors (both existing and new), including those at the wellhead, either every 26,000 hours of operation or after 36 months.</p>	<p>Reciprocating compressors at well sites are exempt from requirements.</p>
<p>Pneumatic controllers: No state specific requirements beyond those required by Subpart OOOO or Subpart OOOOa.</p>	<p>No state specific requirements beyond those required by Subpart OOOO or Subpart OOOOa.</p>	<p>No state specific requirements beyond those required by Subpart OOOO or Subpart OOOOa.</p>	<p>✓ Must be low—bleed with a natural gas bleed of 6 scfh or less. Requires zero bleed when electricity (3-phase electrical power) is on—site.</p>	<p>Natural gas bleed rate no more than 6 scfh.</p>

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Pneumatic pumps driven by compressed natural gas: No state specific requirements beyond those required by Subpart OOOO or Subpart OOOOa.	No state specific requirements beyond those required by Subpart OOOO or Subpart OOOOa.	 Reduce emissions by 95% for tanks with a methane emission rate of 200 tpy or greater, total VOC emissions of 2.7 tpy or greater, a single HAP emission rate of 0.5 tpy or greater, or total HAP emissions of 1 tpy or greater, shall route all vapor through a closed vent system to a control device with at least 95% reduction of emissions.	 Pneumatic pumps require dry seals with no additional specific requirements	If there is an existing control device at the location of the pneumatic pump, reduce VOC emissions from each gas-driven diaphragm pump at the location by 95 percent or greater.
Pigging Venting: No state specific requirements.	Require the use of best management practices (BMP) to minimize the emission of methane and other hydrocarbons into the atmosphere. Exemption Criteria limits the VOC emissions to 2.7 tpy and methane emissions to 200 tpy.	 Require the use of BMP to minimize the emission of methane and other hydrocarbons into the atmosphere. Reduce emissions by 95% for pig operations which, after BMP, with methane emission of 200 tpy or greater, total VOC emissions of 2.7 tpy or greater, a single HAP emission rate of 0.5 tpy or greater, or total HAP emissions of 1 tpy or greater.	No specific requirements.	No specific requirements.
Wellbore Liquid Unloading: No state specific requirements.	Exemption Criteria limits the VOC emissions to 2.7 tpy and methane emissions to 200 tpy.	 Wellbore Liquid Unloading requires BMP such as an automatic plunger lift system to minimize hydrocarbon and methane emissions during liquids unloading. Where technically feasible and safe, shall direct the gas to existing separator, storage vessel, or control device.	Operator must direct all pipeline—quality gas into a pipeline for sales. Any gas not captured and put into the sales pipeline may not be vented and must be flared in accordance with Performance Standard 10	No specific requirements.
Records: must be maintained for five years and made available to the DEP upon request.	Records must be maintained for five years and made available to the DEP upon request.	Records must be maintained for five years and made available to the Department upon request.	No specific requirement for the retention of records by the operator.	Records must be maintained for five years.
Records: Initial compliance certification within 180 days and submit an annual emission inventory. No compliance certification is required beyond those required by Subpart OOOO or Subpart OOOOa.	No compliance certification is required beyond those required by Subpart OOOO or Subpart OOOOa.	Annual Compliance certification must be submitted to the DEP by the responsible official.	Initial compliance certification with a full recertification audit every two years	Annual compliance certification must be submitted by the certified official.
Internal combustion engines (production engines only): Internal combustion engines with combined NO _x emissions less than 100 lbs/hr, 1000 lbs/day, 2.75 tons per ozone season, and 6.6 tons per year on a 12 month-rolling basis.	Internal combustion engines (production engines only): Internal combustion engines with combined NO _x emissions less than 100 lbs/hr, 1000 lbs/day, 2.75 tons per ozone season, and 6.6 tons per year on a 12 month-rolling basis.	 Specific BAT requirements for stationary lean-burn and rich-burn engines based on rated bhp.	No Specific additional requirement for stationary engines.	Federal emission standards for internal combustion engines NSPS Subpart JJJJ NSPS Subpart IIII NESHAP Subpart ZZZZ





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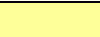

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<p>Well Pad Completions: No state specific requirements beyond those required by Subpart OOOO or Subpart OOOOa.</p>	<p>No state specific requirements beyond those required by Subpart OOOO or Subpart OOOOa.</p>	<p>No state specific requirements beyond those required by Subpart OOOO or Subpart OOOOa.</p>	<p>Operator must direct all pipeline-quality gas during well completion of development wells⁴, and re-completion or workover of any well into a pipeline for sales.</p> <p>Any gas not captured and put in the sales pipeline may not be vented⁵ and must be flared</p> <p>Acceptable reasons for sending gas to a flare and not directing gas into the sales line include:</p> <ul style="list-style-type: none"> a) Low content of flammable gas. Such low-flammability gas must be directed through a flare, past a continuous flame, to insure combustion begins when gas composition becomes flammable; b) For safety reasons. <p>Circumstances unacceptable for sending gas to flare, instead of directing it into a sales line, are:</p> <ul style="list-style-type: none"> a) Beginning on January 1, 2014, a lack of a pipeline connection except for wells that are designated as either exploratory or extension wells using SEC definitions (however, companies should minimize flaring and maximize the use of reduced emissions completions on exploratory or extension wells, where possible); b) Inadequate water disposal capacity; c) Undersized flow back equipment, lack of flow back equipment or lack of equipment operating personnel. 	<p>The owner or operator of any unconventional natural gas well must have a separator onsite during the entirety of the flowback period unless the well was not hydraulically fractured or refractured; or does not generate condensate, intermediate hydrocarbons, or produced water such that there is no liquid collection system present at the site.</p> <p>If it is technically infeasible for a separator to function as required, the flowback must be routed to one or more well completion vessels or storage vessels. There are no requirements to control the gas present in the flowback if the separator cannot function as required.</p> <p>When a separator is functioning as required, the owner or operator must route all recovered liquids from the separator to one or more well completion vessels or storage vessels; re-inject all recovered liquids into the well or another well; or route all recovered liquids to a liquids collection system; and route all recovered gas to the gas flow line or collection system; re-inject all recovered gas into the well or another well; use the recovered gas onsite as a fuel source; or use the recovered gas for another useful purpose that a purchased fuel or raw material would serve; unless it is technically infeasible to use the gas in one of the above ways.</p> <p>In such cases, the owner or operator must capture and direct the recovered gas to a completion combustion device that is equipped with a reliable continuous pilot flame unless doing so may result in a fire hazard or explosion; or where high heat emissions may negatively impact tundra, permafrost, or waterways.</p> <p>The owner or operator has a general duty to safely maximize resource recovery and minimize releases to the atmosphere during flowback and subsequent recovery.</p> <p>To demonstrate compliance, the owner or operator must submit the required notifications and reports and maintain the required records.</p>



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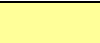

Natural Gas Compressor Stations			
Pennsylvania's Prior GP-5	Pennsylvania's GP-5 for Sources at Natural Gas Compression Stations, Processing Plants, and Transmission Stations	Center for Responsible Shale Development (CRSD) Performance Standards	EPA's Final NSPS Subpart OOOOa
Air Quality General Plan Approval and/or General Operating Permit (BAQ-GPA/GP-5) 25 Pa. Code Chapter 127, Subchapter H Applicable to Natural Gas Compression and/or Processing Plants.	Expanded GP-5 applicability to include Natural Gas Transmission Stations.	No Performance Standards for midstream gas compressor stations.	NSPS Subpart OOOOa finalized on June 3, 2016 and effective August 2, 2016. Applicable to all new gathering and boosting compressor stations, natural gas processing plants, and transmission compressor stations constructed on or after September 18, 2015. Adding a new compressor results in the entire facility being counted as modified for purposes of LDAR
Leaks: Considers a "leak" as any release of gaseous hydrocarbons including methane that is determined by AVO inspection, a FLIR camera or any gas leak detection device approved by DEP that detects a concentration of 2.5% methane and 500 ppm VOC or more.	Considers a "leak" as any release of gaseous hydrocarbons including methane that is determined by AVO inspection, an OGI camera, a gas leak detection device, or other methods approved by DEP.	No Performance Standards for midstream gas compressor stations.	LDAR Program for natural gas compressor stations with leak definition of 500 ppm using FID or any visible image with OGI.
LDAR: Monthly AVO inspections are required for entire site. Within 180 days of initial startup and quarterly thereafter, LDAR is required using FLIR camera or other approved device. GP-5 applies only to non-major facilities.	✓ Require monthly AVO inspections for entire site. Within 60 days of initial startup and quarterly thereafter, require a LDAR program using an OGI camera, gas leak detection device, or other DEP-approved method. GP-5 applies only to non-major facilities.	No Performance Standards for midstream gas compressor stations.	LDAR: AVO inspections required only for covers, closed vent systems, and control devices on a monthly basis. After the initial inspection LDAR must be conducted using optical imaging camera or gas leak detection instrument on a quarterly basis. Provisions to skip one quarterly inspection if outdoor temperatures fall below 0°F for two to three months of the quarter, with only one quarter being allowed to be skipped.
Repair: Leaks are to be repaired as expeditiously as practicable , but no later than 15 calendar days after leak detections unless facility shutdowns or ordering of replacement parts are necessary for repair of the leaks.	✓ Require the first attempt at leak repair within five calendar days after detecting a leak. Leak must be repaired no later than 15 days unless the purchase of parts is necessary, in which case the leak must be repaired within 10 calendar days after receipt of the parts, or the repair requires a venting, blowdown, shut-in, or shutdown to accomplish, in which case the repair must be done at the next shutdown or within 2 years.	No Performance Standards for midstream gas compressor stations.	Leaks are to be repaired as expeditiously as practicable, but no later than 30 calendar days after leak detection unless facility shutdowns or ordering of replacement parts are necessary for repair of the leaks.
Reciprocating compressor rod packing: No state specific requirements beyond those required by Subpart OOOO or Subpart OOOOa	No state specific requirements beyond those required by Subpart OOOO or Subpart OOOOa	No Performance Standards for midstream gas compressor stations.	Replace reciprocating compressor rod packing every 26,000 hours or every 36 months or route emissions to a process under negative pressure (Reciprocating compressors). Reduce VOC emissions from each centrifugal compressor wet seal fluid gassing system by 95 percent or greater.

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Natural Gas Compressor Stations			
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Storage Tanks Reduce VOC emissions by 95% with the potential to emit 6 tpy or greater. No detectable emissions consistent with the EPA Method 21 referenced in EPA's New Source Performance Standard (NSPS) for the Oil & Gas Sector (40 CFR Part 60, Subpart OOOO).	 Reduce emissions by 95% for tanks with methane emissions of 200 tpy or greater, total VOC emissions of 2.7 tpy or greater, a single HAP emission rate of 0.5 tpy or greater, or total HAP emissions of 1 tpy or greater, shall equip the storage vessel with a cover and route all vapor to a control device.	No Performance Standards for midstream gas compressor stations.	Reduce VOC emissions by 95% with the potential to emit 6 tpy or greater. No detectable emissions consistent with the EPA Method 21 referenced in EPA's New Source Performance Standard (NSPS) for the Oil & Gas Sector (40 CFR Part 60, Subpart OOOOa).
Pigging Venting: No state specific requirements.	 Require the use of BMP to minimize the emission of methane and other hydrocarbons into the atmosphere. Reduce emissions by 95% for pig operations which, after BMP, with methane emission of 200 tpy or greater, total VOC emissions of 2.7 tpy or greater, a single HAP emission rate of 0.5 tpy or greater, or total HAP emissions of 1 tpy or greater.	No Performance Standards for midstream gas compressor stations.	No specific requirements.
Pneumatic pumps driven by compressed natural gas: No state specific requirements beyond those required by Subpart OOOOa.	 Pumps with potential methane emissions of 200 tpy or greater, total VOC emissions of 2.7 tpy or greater, a single HAP emission rate of 0.5 tpy or greater, or total HAP emissions of 1 tpy or greater by routing through a closed vent system to a control device with at 95% reduction efficiency.	No Performance Standards for midstream gas compressor stations.	If there is an existing control device at the location of the natural gas driven pneumatic diaphragm pump, reduce VOC emissions from each pump at the location by 95 percent or greater.
Reporting: The owner or operator of the facility must submit to the DEP a compliance certification for GP-5 including LDAR requirements by March 1st of each year. In addition, by March 1st each year, Chapter 135 source reports for all air emissions for the preceding year, including methane emissions , from all natural gas operations including compressor stations, must be submitted for the annual emission inventory.	The owner or operator of the facility must submit to the DEP a compliance certification for GP-5 including LDAR requirements each year. In addition, by March 1st each year, source reports for all air emissions for the preceding year, including methane emissions , from all natural gas operations including compressor stations, must be submitted for the annual emission inventory.	No Performance Standards for midstream gas compressor stations.	The owner or operator of each facility must submit an annual report.
Pneumatic controllers: No state specific requirements beyond those required by Subpart OOOO.	No state specific requirements beyond those required by Subpart OOOO..	No Performance Standards for midstream gas compressor stations.	Natural gas continuous bleed rate no more than 6 scfh
Glycol Dehydrators: Units with potential emission rate of VOC in excess of five tons per year shall be controlled either by at least 95% with a condenser, a flare or other air cleaning device, or any alternative methods as approved by the Department.	 Dehydrators with methane emissions of 200 tpy or greater, total VOC emissions of 2.7 tpy or greater, a single HAP emission rate of 0.5 tpy or greater, or total HAP emissions of 1 tpy or greater must control emissions by 95% for dehydrators. Authorized to operate under a previous GP5 must control emissions as authorized under that GP5.	No Performance Standards for midstream gas compressor stations.	Triethylene Glycol (TEG) units at an area source of HAP in Urban areas: Reduce HAP emissions by 95% (40 CFR § 63.764) TEG units located at an area source of HAP outside of an Urban area: Minimize HAP emissions through work practice to maximize glycol circulation rate efficiency (40 CFR § 63.764)
Annual Compliance certification must be submitted by the responsible official.	Annual Compliance certification must be submitted by the responsible official.	No Performance Standards for midstream gas compressor stations.	Annual compliance certification must be submitted by the certified official.

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Natural Gas Processing Plants			
Pennsylvania's Prior GP-5	Pennsylvania's GP-5 for Sources at Natural Gas Compression Stations, Processing Plants, and Transmission Stations	Center for Responsible Shale Development (CRSD) Performance Standards	EPA's Final NSPS Subpart OOOOa
Air Quality General Plan Approval and/or General Operating Permit (BAQ-GPA/GP-5). 25 Pa. Code Chapter 127, Subchapter H Applicable to Natural Gas Compression and/or Processing Plants.	Air Quality General Plan Approval and/or General Operating Permit (BAQ-GPA/GP-5). 25 Pa. Code Chapter 127, Subchapter H Applicability extended to Transmission Stations.	No Performance Standards for gas processing	NSPS Subpart OOOOa finalized on June 3, 2016 and effective August 2, 2016. Applicable to all new natural gas processing plant.
Pneumatic controllers: No state specific requirements beyond those required by Subpart OOOO or Subpart OOOOa.	All pneumatic controllers must be zero bleed controllers, unless a higher rate is operationally necessary.	No Performance Standards for gas processing	Natural gas bleed rate zero scfh unless there are functional needs.
Pigging Venting: No state specific requirements.	 Require the use of BMP to minimize the emission of methane and other hydrocarbons into the atmosphere. Reduce emissions by 95% for pig operations which, after BMP, with methane emission of 200 tpy or greater, total VOC emissions of 2.7 tpy or greater, a single HAP emission rate of 0.5 tpy or greater, or total HAP emissions of 1 tpy or greater.	No Performance Standards for gas processing	No specific requirements.
Pneumatic pumps driven by compressed natural gas: No state specific requirements beyond those required by Subpart OOOO or Subpart OOOOa.	No state specific requirements beyond those required by Subpart OOOO or Subpart OOOOa.	No Performance Standards for gas processing	Zero natural gas emissions.
LDAR: Monthly AVO inspections are required for entire facility. Within 180 days of initial startup and quarterly thereafter, LDAR is required using FLIR camera or other approved device that detects a concentration of 2.5% methane and 500 ppm VOC or more. GP-5 applies only to non-major sources.	 Require monthly AVO inspections for entire site. Within 60 days of initial startup and quarterly thereafter, require a LDAR program using an OGI camera, gas leak detection device, or other DEP-approved method. GP-5 applies only to non-major sources. Reporting: Compliance certifications, including LDAR inspection results, must be submitted to DEP by March 1st each year. Chapter 135 source reports must also be submitted to DEP for all air emissions including methane for the preceding year.	No Performance Standards for gas processing	LDAR: Follows the requirements of 40 CFR Part 60 Subpart VVa for inspection intervals and types. Generally, Method 21 is required for all sources. OGI is an approved method in Method 21 in accordance with 40 CFR Part 65. All equipment is to be considered in VOC or wet gas service. Valves in gas/vapor service are required to have monthly Method 21 inspection, with frequency decreasing to quarterly with two successive months of no leak. Connectors in gas/vapor service are required to have annual Method 21 inspection.

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