Comparison of Air Emission Standards for the Oil & Gas Industry

(Well Pad Operations, Natural Gas Compressor Stations, and Natural Gas Processing Facilities)

The Pennsylvania Department of Environmental Protection issued a General Permit, General Plan Approval and/or General Operating Permit (BAQ-GPA/GP-5) to authorize the construction, modification, and/or operation of natural gas compression and/or natural gas processing facilities. Plan Approval and Operating Permit Exemption Category #38 (Well Pad Operations) was amended on August 10, 2013.

The Center for Sustainable Shale Development (CSSD) is an independent nonprofit organization based in Pittsburgh, Pennsylvania. The Center provides a forum for a diverse group of stakeholders to share expertise with the common objective of developing solutions and serving as a center of excellence for shale gas development. CSSD's mission is to support continuous improvement and innovative practices through performance standards and third-party certification. CSSD has developed initial performance standards for operators engaged in unconventional exploration, development, and gathering activities including site construction, drilling, hydraulic fracturing and production in the Appalachian Basin. These standards represent consensus on what is achievable and protective of human health and the environment.

Colorado Department of Public Health and Environment, Air Quality Control Commission has promulgated air emissions regulations 3, 6, & 7 (adopted 23-Feb-2014) impacting oil and gas (O&G) exploration and production (E&P) activities in Colorado.

EPA has promulgated New Source Performance Standards at 40 CFR Part 60, Subpart OOOO (Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution).

West Virginia and **Ohio** have issued General Air Permits for Natural Gas Production facilities.

This document provides a comparison of the requirements in these air standards. The information highlighted in blue was compiled by CSSD.

Pennsylvania Department of Environmental Protection, Bureau of Air Quality

5/23/2014

Item	Pennsylvania	CSSD Performance Standard	Federal	Colorado	Ohio	West Virginia
Well Site	Exemption Category No. 38[1] • Requires compliance with NSPS requirements in 40 CFR Part 60, Subpart OOOO. • Beginning 10/15/12 - No venting allowed – must capture and direct flowback emissions to a completion combustion device, except in conditions that may result in a fire hazard or explosion. • Beginning on 1/1/15 – direct all pipeline-quality gas during completion of development wells and re-completion or workover of any well into a pipeline for sales. • Open Flaring is only allowed under the following circumstances: ○ used at exploration wells to determine whether oil and/or gas exists in geological formations or to appraise the physical extent, reserves and likely production rate of an oil or gas field. ○ Flaring used for repair, maintenance, emergency or safety purposes. ○ Flaring used for other operations at a wellhead or facility to comply with 40 CFR	Performance Standard No. 9 • Beginning on 1/1/14 – direct all pipeline-quality gas during completion of development wells and re-completion or workover of any well into a pipeline for sales. • No venting allowed – must be flared in accordance with CSSD Performance Standard No. 10. • Acceptable reasons for flaring – low content of flammable gas and safety reasons. • Unacceptable reasons for flaring – i) lack of pipeline connection except for exploratory or extension wells; ii) inadequate water disposal capacity; iii) inadequate or lack of flowback equipment or operating personnel.	NSPS Subpart OOOO • Beginning 10/15/12: ○ Must capture and direct flowback emissions to a completion combustion device, except in conditions that may result in a fire hazard or explosion.[2] • Beginning 1/1/15: ○ REC equipment required for all wells besides those classified as wildcat, delineation or low pressure.[3] ○ Salable quality gas must be routed to the gas flow line "as soon as practicable."[4] ○ Emissions that cannot be directed to the gas flow must be directed to a completion combustion device (*e.g.*, flare) with a continuous ignition source except in conditions that may result in a fire hazard or explosion.[5] ○ General duty to safely maximize resource recovery and minimize releases to the atmosphere during flowback and subsequent recovery.[6]	Regulation Nos. 6 & 7: • Requires compliance with NSPS requirements in 40 CFR Part 60, Subpart OOOO. • If a combustion device is used to control emissions of VOCs and other hydrocarbons, it shall be enclosed. • Alternative emissions control equipment shall qualify as air pollution control equipment, and may be used if the Division approves the equipment, device or process.	Current • No state-specific REC requirements in addition to NSPS Subpart OOOO. • Flaring required except for gas releases by a properly functioning relief device and gas released by controlled venting for testing, blowing down and cleaning out wells.[7] Proposed • Natural Gas Completion Permit-by-Rule[8] – requires compliance with NSPS Subpart OOOO.	• No state-specific REC requirements in addition to NSPS Subpart OOOO • Compliance with NSPS Subpart OOOO requirements is required by General Permit G70-A9; (however, permit is not required to be obtained prior to well completion activities.)[10]

[1] "Pennsylvania's Air Quality Permit Exemptions
[2] 40 C.F.R. § 60.5375(a)
[3] 40 C.F.R. § 60.5375(a)
[4] 40 C.F.R. § 60.5375(a)(2)
[5] 40 C.F.R. § 60.5375(a)(3)
[6] 40 C.F.R. § 60.5375(a)(4)
[7] Ohio Admin. Code § 1501:9-9-05(B)
[8] Ohio's Draft Natural Gas Completion Draft Permit-by-Rule

Item	Pennsylvania	CSSD Performance Standard	Federal	Colorado	Ohio	West Virginia
	Part 60, Subpart OOOO requirements. • Enclosed combustion device including enclosed flare must be used for all permanent flaring operations at a wellhead or facility. These flaring operations will be designed and operated in accordance with the requirements of 40 CFR § 60.18.					
Flaring	Exemption Category No. 38 [11] • Flaring during completions as allowed by NSPS Subpart OOOO. Post Completion Requirements: • Enclosed flare (Raised/elevated flares or engineered combustion device) must be used for permanent installations. • All permanent enclosed flaring operations must be designed and operated in accordance with 40 CFR § 60.18.	Performance Standard No. 10 • Raised/elevated flares or engineered combustion device with a reliable continuous ignition source. • 98% destruction efficiency. • Development well: flaring no more than 14-days (for life of well). • Exploratory/Extension wells: Flaring no more than 30-days (for life of well). • No visible emissions from flares except	NSPS Subpart OOOO • Completion combustion devices (*e.g.* flares) are required to have a continuous ignition source.[12]	Regulation No. 7: • If a combustion device is used to control emissions of VOCs and other hydrocarbons, it shall be enclosed. • Have no visible emissions during normal operations • Be designed so than that an observer can determine whether it is operating properly. • Auto-igniters: All combustion devices used to control emissions of hydrocarbons must be equipped with and operate an auto-	Current • Requires "properly functioning relief device"[13] Proposed Natural Gas Completion Permit-by-Rule[14] • Emissions limitations for completion operations: ○ 34 tons/yr VOCs. ○ 1.7 tons/yr NOx. ○ 9.3 tons/yr CO. ○ 0.82 tons/yr HAP.	• "Temporary" flaring allowed for 30-days before a permit is required.[15] ○ 20% opacity limitation and PM emissions limit set according to a formula[16] • General Permit G70A: 20% opacity limitation

[9] WVDEP General Permit G70-A, Section 5.1
[10] WVDEP Response to Public Comment #33 on General Permit G70-A
[11] Pennsylvania's Air Quality Permit Exemptions
[12] 40 C.F.R § 60.5375(a)(3)
[13] Ohio Admin. Code § 1501:9-9-05(B)
[14] Ohio's Proposed Natural Gas Completion Permit-by-Rule
[15] W. Va. Code R. § 45-6-6.1a
[16] W. Va. Code R. § 45-6-4.1, 4.3

Item	Pennsylvania	CSSD Performance Standard	Federal	Colorado	Ohio	West Virginia
	• Open Flaring is only allowed under the following circumstances: ○ Flaring used at exploration wells to determine whether oil and/or gas exists in geological formations or to appraise the physical extent, reserves and likely production rate of an oil or gas field. ○ Flaring used for repair, maintenance, emergency or safety purposes. ○ Flaring used for other operations at a wellhead or facility to comply with 40 CFR Part 60, Subpart OOOO requirements. • Opacity is limited to 20% or greater for an aggregated 3 min period in any 1 hour, but cannot be equal to or greater than 60% opacity at any time.	for periods not to exceed a total of five minutes during any two consecutive hours.		igniter as follows: ○ All combustion devices installed on or after May 1, 2014, must be equipped with an operational auto-igniter upon installation of the combustion device. ○ All combustion devices installed before May 1, 2014, must be equipped with an operational auto-igniter by or before May 1, 2016, or after the next combustion device planned shutdown, whichever comes first. • Alternative emissions control equipment shall qualify as air pollution control equipment, and may be used if the Division approves the equipment, device or process.	GP-12.1[19] Enclosed or Open Flare(s)/Combustion Device(s) with a maximum combined capacity heat input of no more than 250 MMBtu/hr and operated at no more than 10 MMBtu per hour combined heat input from all the sources vented to the combustion device(s), except during an emergency. ○ For VOC and where applicable, compliance with the applicable control requirements of 40 CFR Part 60, Subpart OOOO, by having a designed minimum control efficiency of 95% for an enclosed flare/combustor. ○ Carbon monoxide (CO) emissions shall not exceed 1.35 tons per month averaged over a 12-month rolling period. ○ Nitrogen Oxide (NOx) emissions shall not exceed 0.25 ton per month averaged over a 12-month rolling period. ○ Sulfur Dioxide (SO2) emissions shall not exceed 0.15 ton per month averaged over a 12-month rolling period. GP-12.2[20] Enclosed or Open Flare(s)/Combustion Device(s) with a maximum combined capacity heat input of no more than 250 MMBtu/hr and operated at no more than 32 MMBtu per hour combined heat input from all the sources vented to the combustion device(s), except during an emergency.	and PM emissions limit set according to a formula.[17] • However, permit is not required to be obtained prior to well completion activities.[18]

[19] Ohio General Permit 12.1, Condition 4
[20] Ohio General Permit 12.2, Condition 4
[17] WVDEP General Permit G70-A, Section 5.1.5
[18] WVDEP Response to Public Comment #33 on General Permit G70-A

Item	Pennsylvania	CSSD Performance Standard	Federal	Colorado	Ohio	West Virginia
					○ For VOC and where applicable, compliance with the applicable control requirements of 40 CFR Part 60, Subpart OOOO, by having a designed minimum control efficiency of 95% for an enclosed flare/combustor. ○ Carbon monoxide (CO) emissions shall not exceed 4.32 tons per month averaged over a 12-month rolling period. ○ Nitrogen Oxide (NOx) emissions shall not exceed 0.79 ton per month averaged over a 12-month rolling period. ○ Sulfur Dioxide (SO2) emissions shall not exceed 0.48 ton per month averaged over a 12-month rolling period.	
Diesel Nonroad Drilling Rig Engines	• States including Pennsylvania are precluded from establishing any emissions limitations other than those required by 40 CFR Part 89. • Non-road engines are exempt from permitting requirements under Exemption Category No. 38.[21] • All non-road engines must comply with federal emission standards found in 40 CFR Part 89, Subpart B or 40 CFR Part 1039, Subpart B, based upon the engine's model year. • Only ultra-low sulfur diesel fuel will be available.	Performance Standard No. 11 • Meet EPA Tier 2 standards by March 20, 2013. • 25% of owner/operator engine utilization (hp) meeting EPA Tier 4 standards for PM by March 20, 2015. • 75% of owner/operator engine utilization (hp) meeting EPA Tier 4 standards for PM by September 24, 2015. • 95% of owner/operator engine utilization meeting EPA Tier 4 standards for PM by September 24, 2016. • Use ultra-low sulfur diesel (15ppm of	• U.S. EPA regulates emissions from non-road diesel engines according to varying "tiered" levels based on the engine's manufacturing date.[22] • Starting in 2010, diesel produced for use in non-road engines required to meet ultra-low sulfur (15 ppm of sulfur) requirement.[23]	• States are precluded from establishing any emissions limitations other than those required by 40 CFR Part 89.	• States are precluded from establishing any emissions limitations other than those required by 40 CFR Part 89.	• States are precluded from establishing any emissions limitations other than those required by 40 CFR Part 89.

[21] Pennsylvania's Air Quality Permit Exemptions
[22] 40 C.F.R. Part 89; 40 C.F.R. Part 1039
[23] 40 C.F.R. Part 80

Item	Pennsylvania	CSSD Performance Standard	Federal	Colorado	Ohio	West Virginia
		sulfur) at all times.				
Diesel Nonroad Fracturing Pump Engines	• States including Pennsylvania are precluded from establishing any emissions limitations other than those required by 40 CFR Part 89. • Non-road engines are exempt from permitting requirements under Exemption Category No. 38. • All non-road engines must comply with federal emission standards found in 40 CFR Part 89, Subpart B or 40 CFR Part 1039, Subpart B based upon the engine's model year. • Only ultra-low sulfur diesel fuel will be available.	Performance Standard No. 11.1 • Meet EPA Tier 2 standards by March 20, 2014. • 25% of owner/operator engine utilization (hp) meeting EPA Tier 4 standards for PM by September 24, 2015/ March 20, 2016. • 75% of owner/operator engine utilization (hp) meeting EPA Tier 4 standards for PM by September 24, 2016. • 95% of owner/operator engine utilization meeting EPA Tier 4 standards for PM by September 24, 2017. • Use ultra-low sulfur diesel (15ppm of sulfur) at all times.	• U.S. EPA regulates emissions from non-road diesel engines according to varying "tiered" levels based on the engine's manufacturing date[24] • Starting in 2010, diesel produced for use in non-road engines required to meet ultra-low sulfur (15 ppm of sulfur) requirement.[25]	• States are precluded from establishing any emissions limitations other than those required by 40 CFR Part 89.	• States are precluded from establishing any emissions limitations other than those required by 40 CFR Part 89.	• States are precluded from establishing any emissions limitations other than those required by 40 CFR Part 89.
Diesel Heavy-Duty Vehicle Fracturing Pump Engines	• States including Pennsylvania are precluded from establishing any emissions limitations other than those required by 40 CFR Part 86. • Heavy duty vehicle engines are exempt from permitting requirements under Exemption Category No. 38. • All Heavy Duty vehicle engines must comply with federal emission standards found in 40 CFR Part 86. • Only ultra-low sulfur diesel fuel will be available.	Performance Standard No. 11.2 • 50% of engines meeting EPA 2007 and Later Model Year Highway Heavy-Duty Vehicles and Engines emissions standards for PM by September24, 2017. • 80% of engines meeting EPA 2007 and Later Model Year Highway Heavy-Duty Vehicles and Engines emissions standards for PM by September 24, 2014. • Use ultra-low sulfur diesel (15ppm of sulfur) at all times.	• U.S. EPA regulates engine emissions from highway heavy-duty vehicles based on the vehicle's model year. • Starting in 2006, highway diesel fuel required to meet ultra-low sulfur (15 ppm of sulfur) requirement.	• States are precluded from establishing any emissions limitations other than those required by 40 CFR Part 89.	• States are precluded from establishing any emissions limitations other than those required by 40 CFR Part 89.	• States are precluded from establishing any emissions limitations other than those required by 40 CFR Part 89.

[24] 40 C.F.R. Part 89; 40 C.F.R. Part 1039

[25] 40 C.F.R. Part 80

Item	Pennsylvania	CSSD Performance Standard	Federal	Colorado	Ohio	West Virginia
Existing Compressor Engines	Previous Exemption Category No. 38 • Existing compressor engines (those installed prior to August 10, 2013) – exempt from any permitting or emission limitation requirements if less than 100 hp. Previous GP-5 • Prior to February 2013 - existing compressor engines greater than or equal to 100 hp and less than 1500 hp were subject to the previous GP-5 emissions limitations: ○ 2.0 g/hp-hr NOx. ○ 2.0 g/hp-hr CO. ○ 2.0 g/hp-hr VOCs. • **Emission test results** indicate that the existing compressor engines authorized under the previous GP-5 are generally meeting the CCSD performance standard of 1.5 g/bhp-hr of NOx.	Performance Standard No. 12 • By March 20, 2014 – 1.5 g/hphr NOx emission limitation for existing compressor engines greater than 100 hp. ○ CO – None ○ VOC – None	NSPS Subpart JJJJ (Standards of Performance for Stationary Spark Ignition Internal Combustion Engines) • Applies to constructed, reconstructed, and modified engines after June 12, 2006.[26] • Emissions limitations for engines manufactured between 2007/2008 and 2010/2011 greater than 100 hp:[27] ○ 2.0 g/hp-hr for NOx. ○ 4.0 g/hp-hr for CO. ○ 1.0 g/hp-hr for VOCs. • Compressor engines are also subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Stationary Reciprocating Internal Combustion Engines (RICE) at 40 C.F.R. 63, Subpart ZZZZ (*i.e.,* the "RICE MACT")[28]	Existing Natural Gas Fired Reciprocating Internal Combustion Engines: Rich Burn Reciprocating Internal Combustion Engines: • Rich Burn Engines greater than 500 horsepower, constructed or modified before February 1, 2009 - shall install NSCR and an air fuel controller by July 1, 2010. • Any rich burn reciprocating internal combustion engine constructed or modified before February 1, 2009, for which the owner or operator demonstrates to the Division that retrofit technology cannot be installed at a cost of less than $ 5,000 per ton of combined volatile organic compound and nitrogen oxides emission reductions (this value shall be adjusted for future applications according to the current day consumer price index) is exempt complying with Section XVII.E.3.a. Lean Burn Reciprocating Internal Combustion Engines: • All lean burn reciprocating internal combustion engines rated greater than 500 horsepower - install and operate an oxidation catalyst by July 1, 2010. • Any lean burn reciprocating internal combustion engine constructed or modified before February 1, 2009, for which the owner or operator demonstrates to the Division that retrofit technology cannot be installed at a cost of less than $ 5,000 per ton of volatile organic compound emission reduction (this value shall be adjusted for future applications according to the current		Natural Gas Compressor Station General Permit Number G33-A[29] Engines over 100 HP - compliance with NSPS Subpart JJJJ.

[26] 40 C.F.R. § 60.4230
[27] 40 C.F.R. Part 60, Subpart JJJJ, Table 1
[28] 40 C.F.R. Part 63, Subpart ZZZZ
[29] WVDEP General Permit G33-A, Section 6.0

<table>
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<tr><td></td><td></td><td></td><td></td><td>day consumer price index) is exempt from complying with the requirement to install an oxidation catalyst.</td><td></td><td></td></tr>
<tr><td>“New” Lean-Burn Compressor Engines</td><td><u>Exemption Category No. 38 (Compressor Engines at the Wellpad)</u>[30]
Lean-Burn compressor engines at the wellpad (those installed on or after August 10, 2013) are exempt from permitting requirements provided that:
NOx emissions from stationary internal combustion engines at the wells, and wellheads are less than 100 lbs/hr, 1000 lbs/day, 2.75 tons per ozone season (May 1 to September 30); and 6.6. tons per year on a 12-month rolling basis.
VOC emissions from facility is less than 2.7 tpy, VOC from facility is exempted. If the VOCs include HAPs, the HAP exemption criteria in this paragraph will be met. Combined HAP emissions at the facility less than 1000 lbs of a single HAP or one ton of a combination of HAPs in any consecutive 12-month period.
If the exemption criteria cannot be met, then a case-by-case plan approval is required.
<u>GP-5 (Compressor Engines at Natural Gas Compression and/or Processing Facilities) (Feb. 2013)</u>
The facility emissions are limited to non-major emission thresholds. (Synthetic Minor)</td><td><u>Performance Standard No. 12.1</u>
Emissions limitations for new, purchased, replacement, reconstructed, or relocated lean-burn engines greater than 100 hp:
0.5 g/hp-hr NOx.
2.0 g/hp-hr CO.
0.7 g/hp-hr VOCs.
Formaldehyde – None
HAPS – No facility wide limit</td><td><u>NSPS Subpart JJJJ (Standards of Performance for Stationary Spark Ignition Internal Combustion Engines)</u>
Emissions limitations for engines manufactured on or after 2010/2011 greater than 100 hp engine models (depending on engine size)[31]:
1.0 g/hp-hr for NOx.
2.0 g/hp-hr for CO.
0.7 g/hp-hr for VOCs.
Compressor engines are also subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Stationary Reciprocating Internal Combustion Engines (RICE) at 40 C.F.R. 63, Subpart ZZZZ (i.e., the “RICE MACT”)[32]</td><td>No emission standards for engines rated less than 100 HP
<u>Regulation No. 7:</u>
Actual emissions from natural gas fired reciprocating internal combustion engines shall not exceed the emission performance standards in table below as expressed in units of grams per horsepower-hour (g/hp-hr)
<table>
<tr><td>Maximum Engine HP</td><td>Construction or Relocation Date</td><td colspan="3">Emission Standards is g/hp-hr</td></tr>
<tr><td></td><td></td><td>NOx</td><td>CO</td><td>VOC</td></tr>
<tr><td>< 100 HP</td><td>Any</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>≥100 HP and < 500 HP</td><td>On or after January 1, 2008</td><td>2.0</td><td>4.0</td><td>1.0</td></tr>
<tr><td></td><td>On or after January 1, 2011</td><td>1.0</td><td>2.0</td><td>0.7</td></tr>
<tr><td>≥500 Hp</td><td>On or after July 1, 2007</td><td>2.0</td><td>4.0</td><td>1.0</td></tr>
<tr><td></td><td>On or after July 1, 2010</td><td>1.0</td><td>2.0</td><td>0.7</td></tr>
</table>
Formaldehyde – None</td><td><u>Oil and Gas Well-Site Production Operations, General Permit 12</u>
Engines must comply with NSPS Subpart JJJJ standards.
Specific emissions limitations:
20% opacity, 6-min average.
Particulate Emissions (PE):
0.310 lb/MMBtu for engines ≤ 600 hp.
0.062 lb/MMBtu for engines > 600 hp.
2.6 tons of SO2/year.
Total combined engine power less than or equal to 1,300 hp:
2.0 g/hp-hr NOx or 160 ppmvd at 15% O2 for engines ≥ 100 hp.
4.0 g/hp-hr CO or 540 ppmvd at 15% O2 for engines ≥ 100 hp.
1.0 g/hp-hr VOCs or 86 ppmvd at 15% O2 for engines ≥ 100 hp.
Total combined engine power greater than 1,300 hp:
1.0 g/hp-hr NOx /or 82 ppmvd at 15% O2 for engines ≥ 100 hp.
2.0 g/hp-hr CO/or 270 ppmvd at 15% O2 for engines ≥ 100 hp.</td><td><u>Natural Gas Production Facility Class II General Permit G70-A</u>
Requires compliance with NSPS Subpart JJJJ.[33]</td></tr>
</table>

[30] Pennsylvania’s Air Quality Permit Exemptions
[31] 40 C.F.R. Part 60, Subpart JJJJ, Table 1
[32] 40 C.F.R. Part 63, Subpart ZZZZ
[33] WVDEP General Permit G70-A, Section 13

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<tr><td></td><td>• Natural gas fired lean burn less than 100 hp
○ 2.0 g/hp-hr for NOx.
○ 2.0 g/hp-hr for CO.

• Natural gas lean burn greater than 100 hp and less than or equal to 500 hp
○ 1.0 g/hp-hr for NOx.
○ 2.0 g/hp-hr for CO.
○ 0.7 g/hp-hr for non-methane/non-ethane hydrocarbons (except formaldehyde).

• Natural gas lean burn greater than 500 hp
○ 0.5 g/hp-hr for NOx.
○ 93% reduction for CO or 47ppm@15% oxygen.
○ 0.25 g/hp-hr for non-methane/non-ethane hydrocarbons (except formaldehyde).
○ 0.05 g/hp-hr for formaldehyde.</td><td></td><td></td><td></td><td>○ 0.7 g/hp-hr VOCs or 60 ppmvd at 15% O2 for engines ≥ 100 hp.</td><td></td></tr>
<tr><td>“New” Rich-Burn Compressor Engines</td><td><u>Exemption Category No. 38 (Compressor Engines at the Wellpad)</u>[34]

• Rich Burn compressor engines at the wellpad (those installed on or after August 10, 2013) exempt from permitting where:

○ NO_X emissions from stationary internal combustion engines at the wells, and wellheads are less than 100 lbs/hr, 1000 lbs/day, 2.75 tons per ozone season (May 1 to September 30); and 6.6 tons per year on a 12-month rolling basis.

○ VOC emissions less than 2.7 tpy, VOCs from facility are exempted. If the VOCs include HAPs, the HAP exemption criteria in this paragraph will be</td><td><u>Performance Standard No. 12.2</u>

• Emissions limitations for new, purchased, replacement, reconstructed, or relocated rich-burn engines greater than 100 hp:

○ 0.3 g/hp-hr NOx.

○ 2.0 g/hp-hr CO.

○ 0.7 g/hp-hr VOCSs.

○ Formaldehyde - None</td><td><u>NSPS Subpart JJJJ (Standards of Performance for Stationary Spark Ignition Internal Combustion Engines)</u>

• Emissions limitations for engines manufactured on or after 2010/2011 greater than 100 hp engine models (depending on engine size):[35]

○ 1.0 g/hp-hr for NOx.

○ 2.0 g/hp-hr for CO.

○ 0.7 g/hp-hr for VOCs.

Compressor engines are also subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Stationary Reciprocating Internal Combustion Engines (RICE) at 40 C.F.R. 63, Subpart ZZZZ (i.e., the “RICE</td><td><u>Regulation No. 7:</u>

• Actual emissions from natural gas fired reciprocating internal combustion engines shall not exceed the emission performance standards in table below as expressed in units of grams per horsepower-hour (g/hp-hr)

<table><tr><td>Maximum Engine HP</td><td>Construction or Relocation Date</td><td colspan="3">Emission Standards is g/hp-hr</td></tr><tr><td></td><td></td><td>NOx</td><td>CO</td><td>VOC</td></tr><tr><td>< 100 HP</td><td>Any</td><td>NA</td><td>NA</td><td>NA</td></tr><tr><td>≥100 HP and < 500 HP</td><td>On or after January 1, 2008</td><td>2.0</td><td>4.0</td><td>1.0</td></tr></table></td><td><u>Oil and Gas Well-Site Production Operations, General Permit 12</u>

Engines must comply with NSPS Subpart JJJJ standards.[37]

• Specific emissions limitations:[38]
○ 20% opacity, 6-min average.
○ Particulate Emissions (PE):
▪ 0.310 lb/MMBtu for engines ≤ 600 hp.
▪ 0.062 lb/MMBtu for engines > 600 hp.
○ 2.6 tons of SO_2/year.
○ Total engine power less than or equal to 1,300 hp:</td><td><u>Natural Gas Production Facility Class II General Permit G70-A</u>

Compliance with NSPS Subpart JJJJ.[40]</td></tr>
</table>

[34] Pennsylvania’s Air Quality Permit Exemptions

[35] 40 C.F.R. Part 60, Subpart JJJJ, Table 1

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met. Combined HAP emissions at the facility less than 1000 lbs of a single HAP or one ton of a combination of HAPs in any consecutive 12-month period.

○ If the exemption criteria cannot be met, then a case-by-case plan approval is required.

<u>Coverage under GP-5 (Rich-Burn Compressor Engines at Natural Gas Compression and/or Processing Facilities) (Feb. 2013)</u>

• The facility emissions are limited to non-major emission thresholds. (Synthetic Minor)

• Natural gas fired rich burn engines less than or equal to 100 hp:
• 2.0 g/hp-hr NOx.
• 2.0 g/hp-hr CO.

• Natural gas rich burn engines greater than 100 hp and less than or equal to 500 hp:
• 0.25 g/hp-hr NOx.
• 0.30 g/hp-hr CO;
• 0.2 g/hp-hr for non-methane/non-ethane hydrocarbons (except formaldehyde).

• Natural gas rich burn engines greater than 500 hp:
• 0.20 g/hp-hr NOx.
• 0.30 g/hp-hr CO.
• 0.20 g/hp-hr for non-methane/non-ethane hydrocarbons (except formaldehyde).
• 76% reduction for formaldehyde or 2.7 ppmvd @ 15% oxygen
</td>
<td></td>
<td>MACT")[36]</td>
<td>
<table>
<tr><td></td><td>On or after January 1, 2011</td><td>1.0</td><td>2.0</td><td>0.7</td></tr>
<tr><td>≥500 Hp</td><td>On or after July 1, 2007</td><td>2.0</td><td>4.0</td><td>1.0</td></tr>
<tr><td></td><td>On or after July 1, 2010</td><td>1.0</td><td>2.0</td><td>0.7</td></tr>
</table>
○ Formaldehyde - None
</td>
<td>
▪ 2.0 g/hp-hr NOx or 160 ppmvd at 15% O_2 for engines ≥ 100 hp.

▪ 4.0 g/hp-hr CO or 540 ppmvd at 15% O_2 for engines ≥ 100 hp.

▪ 1.0 g/hp-hr VOCs or 86 ppmvd at 15% O_2 for engines ≥ 100 hp.

○ Total engine power greater than 1,300 hp:[39]

• 1.0 g/hp-hr NOx /or 82 ppmvd at 15% O_2 for engines ≥ 100 hp.

• 2.0 g/hp-hr CO/or 270 ppmvd at 15% O_2 for engines ≥ 100 hp.

• 0.7 g/hp-hr VOCs or 60 ppmvd at 15% O_2 for engines ≥ 100 hp.
</td>
<td></td>
</tr>
</table>

[37] Ohio GP-12, at pp. 12-14

[38] Ohio GP-12, at pp. 12-14

[40] WVDEP General Permit G70-A, Section 13

[36] 40 C.F.R. Part 63, Subpart ZZZZ

[39] The total combined total engine horsepower must also be no more than 1,800 hp for the site in order to qualify for Ohio's GP-12. *See* Ohio GP-12, at pp. 12. Additionally, where the total combined engine power exceeds 1,300 hp the engines must have a manufacturing date of no earlier than January 1, 2011 for engines less than 500 HP or no earlier than July 1, 2010 for engines 500 hp or greater. *Id*.

Item	Pennsylvania	CSSD Performance Standard	Federal	Colorado	Ohio	West Virginia
Storage Vessels	Exemption Category No. 38[41]: • Storage vessels/storage tanks at the well pad are exempt from permit requirements if they are equipped with VOC emission controls achieving emission reduction of 95% or greater. • Storage tanks at the well pad can qualify for the exemption if combined VOC emissions from all the sources at the facility are less than 2.7 tons on a 12-month rolling basis. Combined HAP emissions at the facility must be less than 1000 lbs of a single HAP or one ton of a combination of HAPs in any consecutive 12-month period in order to qualify for the exemption. If the VOCs emissions include HAPs, this HAP exemption criteria is met. • No de minimis emission threshold per tank as allowed in NSPS Subpart OOOO (i.e., must reduce storage tank/storage vessel VOC emissions by 95% if combined VOC emissions from storage vessels/storage tanks are above 2.7 tpy in order to qualify for exemption). • Compliance with above criteria ensures compliance with NSPS Subpart OOOO. GP-5 • The owner or operator of each storage vessel / storage tank shall also comply with the applicable requirements specified in 40 CFR Part 60, Subparts Kb and OOOO and 40 CFR Part 63, Subpart HH (relating to national emission standards	Performance Standard No. 13 • By October 15, 2013 – all existing or new individual storage vessels at the wellpad with VOC emissions equal to or greater than 6 tpy must install controls to achieve at least a 95% reduction in VOC emissions.	NSPS Subpart OOOO • "New" Group 1 storage vessels (constructed, modified, or reconstructed after August 23, 2011 and before April 12, 2013) that have potential VOC emissions equal to or greater than 6 tons per year (tpy) - at least a 95% reduction in VOC emissions by April 15, 2015.[42] • "New" Group 2 storage vessels (constructed, modified, or reconstructed after April 12, 2013) that have potential VOC emissions equal to or greater than 6 tons per year (tpy) - at least a 95% reduction in VOC emissions by April 15, 2014 or within 60-days of startup (whichever is later).[43] • 6 tpy VOC determination may take into account enforceable limits in an operating permit or other requirement established under a Federal, State, local or tribal authority.[44] • Emissions from a storage vessel that are recovered and routed to a process through a vapor recovery unit (VRU) can be excluded from the 6 tpy VOC determination provided certain requirements are met.[45] • Control devices (installed to achieve the 95% reduction in VOC emissions discussed above) may be removed if emissions from the storage vessel have been below 4 tpy on an uncontrolled basis for 12	Regulation No. 7: • Construction permits are now required for all crude oil storage tanks (previously, tanks with capacity < 40,000 gallons were exempt) • Operating permits are now required for all crude oil storage tanks (previously, tanks with capacity < 40,000 gallons were exempt) • For tanks projected to have > 1.5 tons VOC emissions in first 90 days of operation o Emissions controls must be installed at date of first operation and must have 95% (98% if combustion device used) efficiency o Controls can be removed after 90 days if VOC emissions are projected to be <6 tons per year • Storage tank controls after 90 days: • For tanks with VOC emissions less than 20 TPY and equal to or greater than 6 TPY – 95% control efficiency (98% if a combustion device is used). • For tanks with VOC emissions greater than 20 TPY – 95% control efficiency. • AVO inspections of tanks and associated equipment as frequent as every 7 days and at least every 31 days.	Oil and Gas Well-Site Production Operations, General Permit 12 • Total VOC emissions from all tanks combined at the site (including breathing losses, tank working losses, flash losses and truck loading losses) may not exceed 51.3 tons per rolling 12-month period.[48]	Natural Gas Production Facility Class II General Permit G70-A • Requires compliance with NSPS Subpart OOOO[49]

[41] Pennsylvania's Air Quality Permit Exemptions
[42] 40 C.F.R. § 60.5395(b)
[43] 40 C.F.R. § 60.5395(c)
[44] 40 C.F.R. § 60.5365(e)
[45] 40 C.F.R. § 60.5365(e)

<table>
<tr><th>Item</th><th>Pennsylvania</th><th>CSSD Performance Standard</th><th>Federal</th><th>Colorado</th><th>Ohio</th><th>West Virginia</th></tr>
<tr><td></td><td>for hazardous Air pollutants from oil and natural gas production facilities).

• In accordance with 25 Pa. Code §§ 127.1 and 127.12(a)(5), the owner or operator of each storage tank with a capacity greater than 40,000 gallons shall also comply with the requirements specified in 25 Pa. Code § 129.56. These storage tanks shall be equipped with of the following vapor loss control devices:
o An external or internal floating roof
o A vapor recovery system

• In accordance with 25 Pa. Code §§ 127.1 and 127.12(a) (5), the owner or operator of each storage tank with a capacity less than or equal to 40,000 gallons shall also comply with the requirements in 25 Pa. Code § 129.57.

• These storage tanks shall be equipped with pressure relief valves.</td><td></td><td>consecutive months.[46]

• Control device must be reinstalled: (1) if a well feeding the storage vessel undergoes fracturing or refracturing; or (2) the monthly emissions from the uncontrolled storage vessel increase to 4 tpy or greater.[47]</td><td>• Storage Tank Emission Management (STEM) plan and inspections for tanks with non-stabilized liquids as follows:

<table><tr><td>Uncontrolled VOC Emissions (tpy)</td><td>AIMM (Approved Instrument Monitoring Method) Inspection Frequency</td></tr><tr><td>>6 and <12</td><td>Annually</td></tr><tr><td>>12 and <50</td><td>Quarterly</td></tr><tr><td>> 50</td><td>Monthly</td></tr></table></td><td></td><td></td></tr>
<tr><td>Reciprocating Compressors</td><td>GP-5/ NSPS Subpart OOOO

• “New reciprocating compressors (those installed after August 23, 2011) – change rod packing either every 26,000 hours of operation or every 36 months as well as new reciprocating compressors. [50]

• Reciprocating compressors located at a well site or an adjacent well site and</td><td>Performance Standard No. 14.1

• 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.</td><td>NSPS Subpart OOOO

• “New” reciprocating compressors (those installed after August 23, 2011) – change rod packing either every 26,000 hours of operation or every 36 months as well as new reciprocating compressors.[52]
• Reciprocating compressors located at a well site or an adjacent well site</td><td>Regulation 6:

• Federal Register regulations adopted by reference: Subpart OOOO, Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution (40 CFR Part 60, Subpart OOOOO, 01-Jul-2012 as amended by 78 Fed. Reg. 58416 on 23-Sep-2013).

• NSPS OOOO applies to NG wells, storage</td><td>• No state-specific requirements.</td><td>• No state-specific requirements.</td></tr>
</table>

[48] Ohio GP-12, at p. 41
[49] WVDEP General Permit G70-A, Section 12.1
[46] 40 C.F.R. § 60.5395(d)(2)
[47] 40 C.F.R. § 60.5395(d)(2)
[50] 40 C.F.R. §60.5385(a)

Item	Pennsylvania	CSSD Performance Standard	Federal	Colorado	Ohio	West Virginia
	servicing more than one well site are excluded from this requirement. [51]		and servicing more than one well site are excluded from this requirement.[53]	vessels, centrifugal compressors with wet seals, reciprocating compressors, pneumatic controllers, leaks and leaking components at gas plants, sweetening units, and NG well green completion provisions. • Affects all facilities regardless of emissions levels.		
Pneumatic Controllers	GP-5/ NSPS Subpart OOOO • "New" pneumatic controllers (those constructed (installed), modified or reconstructed on or after October 15, 2013) located between the wellhead and a natural gas processing plant: bleed rate of 6.0 scfh or less.[54] • Exception to 6.0 scfh bleed rate – where use of a greater bleed rate is required based on functional needs, including response time, safety and positive actuation. [55] • The owner or operator of pneumatic controllers shall also comply with the applicable requirements specified in 40 CFR Part 60, Subpart OOOO.	Performance Standard No. 14.2 • By October 15, 2013, pneumatic controllers (both existing and new): ○ Low – bleed, with a natural gas bleed rate limit of 6.0 scfh or less. ○ Zero bleed when electricity (3-phase electrical power) is on-site.	NSPS Subpart OOOO • "New" pneumatic controllers (those constructed (installed), modified or reconstructed on or after October 15, 2013) located between the wellhead and a natural gas processing plant: bleed rate of 6.0 scfh or less.56 • Exception to 6.0 scfh bleed rate – where use of a greater bleed rate is required based on functional needs, including response time, safety and positive actuation.[57]	Regulation No. 7: • Controllers placed in service on or after 01-May-2014 must ○ Emit in an amount less than or equal to a low-bleed controller. ○ Utilize no-bleed controller where on-site electrical grid power is accessible. • High-bleed controllers in service prior to 01-May-2014 must be replaced or retrofitted such that emissions are less than or equal to a low-bleed controller. • All high-bleed controllers that must remain in service must obtain State approval. • Beginning 01-May-2015 ○ High-bleed controllers must be tagged, and ○ Must be inspected monthly with attendant maintenance to minimize emissions	• No state-specific requirements. • Proposed revisions to Ohio's Oil and Gas Well-Site Production Operations, General Permit 12 require compliance with Subpart OOOO requirements for pneumatic controllers.	Natural Gas Production Facility Class II General Permit G70-A • Requires compliance with NSPS Subpart OOOO requirements for pneumatic controllers.[58]

[52] 40 C.F.R. § 60.5385(a)
[51] 40 C.F.R. §60.5365(c)
[53] 40 C.F.R. § 60.5365(c)
[54] 40 C.F.R. §60.5390(c)(1)
[55] 40 C.F.R. § 60.5390(a)
[56] 40 C.F.R. § 60.5390(c)(1)
[57] 40 C.F.R. § 60.5390(a)
[58] WVDEP General Permit G70-A, Section 8

Item	Pennsylvania	CSSD Performance Standard	Federal	Colorado	Ohio	West Virginia
Centrifugal Compressors	GP-5 -Natural Gas Compression and/or Processing Facilities • Compliance with NSPS Subpart OOOO requirements for centrifugal compressors.[59] ○ Reduce VOC emissions from each centrifugal compressor wet seal fluid degassing system by 95.0 percent or greater. • If a control device is used to reduce emissions, you must equip the wet seal fluid degassing system with a cover that meets the requirements of §60.5411(b), that is connected through a closed vent system that meets the requirements of §60.5411(a) and routed to a control device that meets the conditions specified in §60.5412(a), (b) and (c). As an alternative to routing the closed vent system to a control device, you may route the closed vent system to a process.	Performance Standard No. 14.3 • New centrifugal compressors may not contain wet oil seals. • Replace worn out wet seals on existing centrifugal compressors with dry seals.	NSPS Subpart OOOO • For centrifugal compressors installed after August 23, 2011 - must reduce VOC emissions from each centrifugal compressor wet seal fluid degassing system by 95 % or greater.[60] ○ If a control device is used to reduce emissions, must equip the wet seal fluid degassing system with a cover that meets the requirements of 40 CFR §60.5411(b), that is connected through a closed vent system that meets the requirements of 40 CFR §60.5411(a) and routed to a control device that meets the conditions specified in 40 CFR §60.5412(a), (b) and (c). As an alternative to routing the closed vent system to a control device, may route the closed vent system to a process. • Not applicable to centrifugal compressors located at a well site or at an adjacent well site and servicing more than one well site.[61]	Regulation 6: • NSPS OOOO applies to NG wells, storage vessels, centrifugal compressors with wet seals, reciprocating compressors, pneumatic controllers, leaks and leaking components at gas plants, sweetening units, and NG well green completion provisions.	• No state-specific requirements.	• No state-specific requirements.
LDAR	Exemption Category No. 38[62] • Perform a leak detection and repair (LDAR) program within 60 days after the well is put into production and annually thereafter. ○ Use of optical gas imaging	Performance Standard No. 14.4 • By March 20, 2014 – implement a directed inspection and maintenance program (DI&M) for equipment leaks from all existing and new valves, pump seals, flanges, compressor seals,	NSPS Subpart OOOO • Cover and closed vent inspections for “new” storage vessels with potential to emit VOC emissions equal to or greater than 6 tpy.[63] ○ Monthly olfactory, visual and	Well Production Facilities: • AIMM (Approved Instrument Monitoring Method) inspection must be initiated 15 to 30 days after unit commences operation for units constructed on or after 15-Oct-2014	Oil and Gas Well-Site Production Operations, General Permit 12.1 & 12.2 • Leaks shall be detected by the use of either a “Forward Looking Infra Red” (FLIR) camera or an analyzer meeting U.S. EPA Method 2164.	G70-A • Compliance with NSPS Subpart OOOO inspection requirements for storage vessels.[65]

[59] Pennsylvania’s GP-5 -Natural Gas Compression and/or Processing Facilities, Section D
[60] 40 C.F.R. § 60.5380(a)
[61] 40 C.F.R. § 60.5365(b)
[62] Pennsylvania’s Air Quality Permit Exemptions
[63] 40 C.F.R. § 60.5416(c)
[64] Ohio GP-12.1 & 12.2

<table>
<tr><th>Item</th><th>Pennsylvania</th><th>CSSD Performance Standard</th><th>Federal</th><th>Colorado</th><th>Ohio</th><th>West Virginia</th></tr>
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<td>camera (such as FLIR) or gas leak detector.

○ Conduct on valves, flanges, connectors, storage vessels/storage tanks, and compressor seals.

○ If leak is discovered – repair within in 15 days unless facility shutdown is required or ordering replacement parts are necessary for the repair.

• Upon written request documenting justification – DEP may grant extension for leak detection deadlines or repairs.

• A leak is considered repaired if one of the following can be demonstrated:

○ No detectable emissions consistent with EPA Method 21 specified in 40 CFR Part 60, Appendix A

○ A concentration of 2.5% methane or less using a gas leak detector and a VOC concentration of 500 ppm or less

○ No visible leak image when using an optical gas imaging camera

○ No bubbling at leak interface using a soap solution bubble test specified in EPA Method 21

○ Any other method approved in writing by the Department</td>
<td>pressure relief valves, open-ended lines, tanks and other process and operation components that result in fugitive emissions.

○ Monitored by a weekly visual, auditory, and olfactory check.

○ Yearly mechanical or instrument check to detect leaks.

○ Repair detected significant leaks in a timely manner.

○ No leak repair quantification

○ No FLIR or gas detector</td>
<td>auditory inspections for defects that could result in air emissions.

○ If leak detected:

▪ Within 5 days – make first repair attempt.

▪ Complete repair within 30 days.

▪ Apply grease to deteriorating or cracked gaskets to improve the seal while awaiting repair.

Delay permissible if repair requires shutdown or if emissions during repair would be greater than delay of repair until shutdown.</td>
<td>• AIMM inspection must be initiated by the phase-in schedule for units constructed before 15-Oct-2014

• AIMM inspections will continue as follows based on uncontrolled VOC emissions from the highest emitting storage tank or controlled VOC emissions from all permanent equipment:

<u>Well Production Facilities without Storage Tanks:</u>

<table>
<tr><th>Well Production Facilities WITHOUT Storage Tanks (tpy)</th><th>AIMM Inspection Frequency</th><th>AVO Inspection Frequency</th></tr>
<tr><td>0 < x < 6</td><td>One time</td><td>Monthly</td></tr>
<tr><td>6 < x < 12</td><td>Annually</td><td>Monthly</td></tr>
<tr><td>12 < x < 20</td><td>Quarterly</td><td>Monthly</td></tr>
<tr><td>x > 20</td><td>Monthly</td><td>Monthly</td></tr>
</table>

<u>Well Production Facilities with Storage Tanks:</u>

<table>
<tr><th>Well Production Facilities WITH Storage Tanks (tpy)</th><th>AIMM Inspection Frequency</th><th>AVO Inspection Frequency</th></tr>
<tr><td>0 < x < 6</td><td>One time</td><td>Monthly</td></tr>
<tr><td>6 < x < 12</td><td>Annually</td><td>Monthly</td></tr>
<tr><td>12 < x < 50</td><td>Quarterly</td><td>Monthly</td></tr>
<tr><td>x > 50</td><td>Monthly</td><td>Monthly</td></tr>
</table>

<u>Natural Gas Compressor Stations:</u>

• AIMM inspections schedule for units constructed on or after 01-Jan-2015
○ With fugitive VOC emissions < 50 tons, must begin < 90 days
○ With fugitive VOC emissions ></td>
<td>• 2Initial monitoring within 90 days of startup and quarterly thereafter for a period of four consecutive quarters (1 year).

• If following the initial four consecutive quarters, less than or equal to 2.0% of the ancillary equipment are determined to be leaking during the most recent quarterly monitoring event, then the frequency of monitoring can be reduced to semi-annual.

• If following two consecutive semi-annual periods, less than 2.0% of the ancillary equipment are determined to be leaking during the most recent semi-annual monitoring event, then the frequency of the monitoring can be reduced to annual.

• If more than or equal to 2.0% of the ancillary equipment are determined to be leaking during any one of the semi-annual or annual monitoring events, then the frequency of monitoring shall be returned to quarterly.

• The program shall require the first attempt at repair within five (5) calendar days of determining a leak.

• The program shall require that the leaking component is repaired within 30 calendar days after the leak is detected.

• Leaks shall be measured by utilizing U.S. EPA Method 21 (40 CFR Part 60, Appendix A). All potential leak interfaces shall be traversed as close to the interface</td>
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[65] WVDEP General Permit G70-A, Section 12

<table>
<tr><th>Item</th><th>Pennsylvania</th><th>CSSD Performance Standard</th><th>Federal</th><th>Colorado</th><th>Ohio</th><th>West Virginia</th></tr>
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<td></td>
<td>
<u>GP-5 LDAR Program</u>

• At a minimum, on a monthly basis perform a leak detection and repair program that includes audible, visual, and olfactory (“AVO”) inspections.

• Within 180 days after initial startup and at a minimum on a quarterly basis, use forward looking infrared (“FLIR”) cameras or other leak detection monitoring devices approved by the Department for the detection of fugitive leaks. The Department may grant an extension for the use of FLIR camera upon receiving a written request that documents the justification.

• Repair detected leaks as soon as possible but no later than 15 days after the leak is detected.

• Records must be kept for a period of 5 years.

• Operators are required to submit annual reports to the DEP.
</td>
<td></td>
<td></td>
<td>
50 tons, must begin < 30 days

• AIMM inspections will continue as follows:
<table>
<tr><th>Fugitive VOC Emissions (tpy)</th><th>Inspection Frequency</th></tr>
<tr><td>>0 and < 12</td><td>Annually</td></tr>
<tr><td>> 12 and < 50</td><td>Quarterly</td></tr>
<tr><td>> 50</td><td>Monthly</td></tr>
</table>
<u>Repairing Leaks:</u>

• Quantitative AIMM (EPA Method 21 or other Division approved method)
○ Units constructed on or after 01-May-2014, a leak is anything > 500 ppm
○ Units constructed before 01-May-2014, a leak is anything > 2,000 ppm

• For infra-red camera or AVO, a leak is any detectable emission not associated with normal operation.

• Leaks must be repaired within
○ 5 days after discovery unless parts are unavailable, equipment requires shutdown, or other good cause
○ 15 days if parts need to be ordered
○ If shutdown required, leak must be repaired at next scheduled shutdown
○ If other good cause, leak must be repaired within 15 days good
</td>
<td>
as possible. The arithmetic difference between the maximum concentration indicated by the instrument and the background level is compared with 500 ppm or 10,000 ppm (as applicable) for determining compliance.

• A component is considered to be leaking if the instrument reading is equal to or greater than 500 ppm or 10,000 ppm depending on the component.
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Item	Pennsylvania	CSSD Performance Standard	Federal	Colorado	Ohio	West Virginia
				cause ceases ○ Equipment must be re-monitored within 15 days of repair ○ Records must be kept for a period of 2 years ○ Operators are required to submit annual reports to the State.		
Well-bore freeze-up emissions	• Facility VOC emissions exceeding 2.7 tpy may require Plan Approval (case-by-case BAT).	Performance Standard No. 14.5 • Eliminate VOC emissions associated with the prevention of well-bore freeze-up (only de minimis emissions are permitted).	• None.		• None.	• None.
Blowdown emissions	• Facility VOC emissions exceeding 2.7 tpy may require Plan Approval (case-by-case BAT).	Performance Standard No. 14.6 • Existing and new compressors are required to be pressurized when they are off-line for operational reasons in order to reduce blowdown emissions.	• None.		• None.	• None.
Truck Emission Requirements	• States including Pennsylvania are precluded from establishing any emissions limitations other than those required by 40 CFR Part 86. • Heavy duty vehicle engines are exempt from permitting requirements under Exemption Category No. 38. • All non-road engines must comply with federal emission standards found in 40 CFR Part 86. • Only ultra-low sulfur diesel fuel will be available.	Performance Standard No. 15.1 and 15.2 • By March 20, 2014 -80% of all trucks used to transport fresh water or well flowback water must meet U.S. EPA's Final Emission Standards for 2007 and Later Model Year Highway Heavy-Duty Vehicles and Engines for particulate matter (PM) emissions. • By September 24, 2015 -95% of all trucks used to transport fresh water or well flowback water must meet U.S. EPA's Final Emission Standards for 2007 and Later Model Year Highway Heavy-Duty Vehicles and Engines for particulate matter (PM) emissions.	• U.S. EPA regulates engine emissions from highway heavy-duty vehicles based on the vehicle's model year.[66]	• States including Pennsylvania are precluded from establishing any emissions limitations other than those required by 40 CFR Part 86.	• States including Pennsylvania are precluded from establishing any emissions limitations other than those required by 40 CFR Part 86.	• States including Pennsylvania are precluded from establishing any emissions limitations other than those required by 40 CFR Part 86.

[66] 40 C.F.R. Part 86

Item	Pennsylvania	CSSD Performance Standard	Federal	Colorado	Ohio	West Virginia
Truck Load-out Emissions	Exemption Category No. 38[67] • Exemption Category No. 38 requires compliance with 95% VOC reduction requirements of other equipment such as tanker truck load-outs, consistent with § 60.5413 or alternate test methods as approved by the Department.	• None		Regulation No. 3: • The following sources are exempt because by themselves, or cumulatively as a category, they are deemed to have a negligible impact on air quality: ○ Crude oil truck loading equipment at exploration and production sites where the loading rate does not exceed 10,000 gallons of crude oil per day averaged on an annual basis. • Condensate truck loading equipment at exploration and production sites that splash fill less than 6750 barrels of condensate per year or that submerge fill less than 16308 barrels of condensate per year.		Natural Gas Production Facility Class II General Permit G70-A *Regulated Pollutant Limitation.* The registrant shall not cause, suffer, allow or permit emissions from any registered Tank Truck Loading Facility of any regulated pollutant listed in the General Permit Registration to exceed the potential to emit (pounds per hour and tons per year) recorded with the registrant's General Permit Registration without effecting a modification or administrative update. To demonstrate compliance with the tank truck loading emissions in section 11.1.1, the registrant shall not exceed the maximum throughput limit that was recorded with registrant's General Permit Registration without effecting a modification or administrative update. Compliance with the Maximum Annual Throughput Limitation shall be determined using a twelve month rolling total.

Glycol Dehydrators	GP-5
	
	• The owner or operator of each glycol dehydrator located at natural gas compression and/or processing facility shall comply with the applicable requirements established in 40 CFR Part 63, Subpart HH.
	
	• The VOC emissions from the glycol
		• None	• The owner or operator of each glycol dehydrator located at natural gas compression and/or processing facility shall comply with the applicable requirements established in 40 CFR Part 63, Subpart HH.	• For still vents and vents from any flash separator or flash tank, shall reduce hydrocarbon emissions by 95% (98% if combustion device used) except where
				  ○ Combustion device was permitted prior to 01-May-2014, and
				
				  ○ Dehydrator is not within 1,320 feet of a building unit or
					GP12.1 and GP 12.2
					
					• For Total Organic Compounds (TOC), total hazardous air pollutants (total HAP), or benzene, compliance with the applicable control requirements of 40 CFR Part 63, Subpart HH.
					
					• Emissions from a flare used to
						Natural Gas Production Facility Class II General Permit G70-A
						
						• In addition to the minimum requirements in this section, area source TEG units may also be subject to 40

[67] Pennsylvania's Air Quality Permit Exemptions

Item	Pennsylvania	CSSD Performance Standard	Federal	Colorado	Ohio	West Virginia
	dehydrator still vent stream, which has a total uncontrolled potential emission rate of VOC in excess of ten (10) tons per year, shall be controlled either by at least 85% with a condenser, a flare or other air cleaning device, or any alternative methods as approved by the Department. ○ A glycol dehydrator using a condenser as an air cleaning device shall daily achieve an average final exhaust temperature of less than 110 degrees Fahrenheit (110 ºF). ○ (c) A glycol dehydrator using a flare as an air cleaning device shall ensure destruction of VOC emissions to the flare stack by maintaining the heat content of the flare gas above 300 Btu/scf. • Visible emissions from a glycol dehydrator using a flare shall not exceed either of the following limitations: ○ Equal to or greater than 10% for a period or periods aggregating more than 3 minutes in any one hour. ○ Equal to or greater than 30% at any time. • A glycol dehydrator shall not emit malodorous air contaminants in such a manner that the malodors are detectable outside the facility property. • If a flare is used as an air cleaning device for the glycol dehydrator, the owner or operator shall maintain a record of daily visual observations of the continuous presence of a flame or a record of the continuous recorder that indicates the			designated activity area • Applies to units ○ Constructed on or after 01-May-2015 with uncontrolled VOC emissions > 2 tons per year ○ Constructed before 01-May-2015 with uncontrolled VOC emissions > 6 tons per year ○ Constructed before 01-may-2015 with uncontrolled VOC emissions > 2 tons per year if unit is within 1,320 feet of a building unit or designated activity area.	control emissions from the glycol dehydration unit shall not exceed:[68] ○ 0.25 ton Nitrogen Oxides (NOx) per month averaged over a 12-month rolling period; ○ 0.23 ton VOC per month averaged over a 12-month rolling period; and ○ 0.15 ton Sulfur dioxide (SO2) per month averaged over a 12-month rolling period. ○ Carbon Monoxide (CO) emissions from a flare used as a control device for the dehydrator shall not exceed 1.35 tons CO per month averaged over a 12-month rolling period. ○ Emissions of Volatile Organic Compounds (VOC) (excludes methane and ethane) shall not exceed 5.0 tons/year. • If a flare is used to control emissions from the dehydrator: ○ The flare shall be operated with a flame present at all times when gases are vented to it. ○ An automatic flame ignition system shall be installed. ○ If the permittee is using a pilot flame ignition	CFR 63, Subpart HH. • *Maximum Throughput Limitation.* The maximum wet natural gas throughput to the glycol dehydration units/ still columns shall not exceed the throughput limit listed in the registrant's G70-A general permit registration. Compliance with the Maximum Throughput Limitation shall be determined using a twelve month rolling total. • *Emission Limits.* The registrant shall not cause, suffer, allow or permit emissions of hazardous air pollutants (HAPs) and Volatile Organic Compounds (VOCs) to exceed the emission limits listed in the registrant's G70-A general permit registration. • *Control Devices.* The following control devices may be used: Flares Enclosed

[68] OAC (Ohio Adminstrative Code) rule 3745-31-05(A)(3), as effective 11/30/01

Item	Pennsylvania	CSSD Performance Standard	Federal	Colorado	Ohio	West Virginia
	continuous ignition of the pilot flame. • The owner or operator of a new glycol dehydrator, which is not subject to the requirements established in 40 CFR Part 63, Subpart HH and has a total uncontrolled potential emission rate of VOC in excess of five (5) 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. <u>Exemption Category No. 38</u> • Combined VOC emissions from all the sources at the facility less than 2.7 tons on a 12-month rolling basis. If the VOCs include HAPs, the HAP exemption criteria in this paragraph will be met. Compliance with this criterion is to be determined using any generally accepted model or calculation methodology. • If the exemption criteria cannot be met, then a case-by-case plan approval is required.				system, the presence of a pilot flame shall be monitored using a thermocouple or other equivalent device to detect the presence of a flame. A pilot flame shall be maintained at all times in the flare's pilot light burner. If the pilot flame goes out and does not relight, then an alarm shall sound. ○ If the permittee is using an electric arc ignition system, the arcing of the electric arc ignition system shall pulse continually and a device shall be installed and used to continuously monitor the electric arc ignition system. ○ Any flare, auto ignition system, and recorder shall be installed, calibrated, operated, and maintained in accordance with the manufacturer's recommendations, instructions, and operating manuals. • If a condenser (or BTEX elimination system) is used to control emissions from the dehydrator: ○ The condenser shall be operated at all times when gases are vented to it. ○ The condenser must be equipped with a continuous temperature monitoring device that continuously monitors and records the dehydration still vent	Combustion Devices Closed Vent System Carbon Adsorption Systems Condensers • The registrant shall comply with all applicable control device requirements. *Glycol Dehydration Units Recycling Back to Flame Zone of the Reboiler:* • If the registrant is reducing emissions by recycling the glycol dehydration unit back to the flame zone of the reboiler, it shall be designed and operated in accordance with the following: a. The vapors/overheads from the still column shall be routed through a condenser at all times when there is a potential that vapors (emissions) can be generated from the still column. b. The reboiler shall only be fired with vapors from the still column and flash tank, and natural gas may be used as a supplemental fuel.

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					temperature. ○ The condenser, temperature monitoring device and recorder shall be installed, calibrated, operated, and maintained in accordance with the manufacturer's recommendations, instructions, and operating manuals. • Emission Limitation from a flare used to control the dehydrator: ○ 1.35 tons of CO per month averaged over a 12-month rolling period. ○ 0.23 ton of VOC per month averaged over a 12-month rolling period. ○ 0.25 ton of NOx per month averaged over a 12-month rolling period. ○ 0.15 ton of SO2 per month averaged over a 12-month rolling period.	c. The vapors/overheads from the still column shall be introduced into the flame zone of the reboiler as the primary fuel or with the primary fuel before the combustion chamber. To demonstrate compliance with the registrant shall monitor the throughput of wet natural gas fed to the dehydration system on a monthly basis for each glycol dehydration unit. Representative gas sample collection and analysis frequency for dehydration units shall be determined based on the level of HAP emissions from the glycol dehydration unit of the facility as set forth below: *Each dehydration unit exempt from § 63.764(d) requirements and with federally enforceable controls* - Upon request by the Director. *Each dehydration*

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						unit exempt from § 63.764(d) requirements and without federally enforceable control - (a) An initial compliance test within 180 days of permit issuance or within 180 days of start-up of the dehydration unit, whichever is later. (b) Monitor and record bi-monthly the actual input parameters for GRI GLYCalc V3 or higher. *Every dehydration unit at or above 95% of HAPs major source levels exempt from § 63.764(d) requirements and without federally enforceable controls* - The registrant shall sample and perform a wet gas analysis at least once each year.
Natural Gas Processing Plants	• In accordance with 25 Pa. Code §§ 127.11 and 127.12(a)(5), the owner or operator of a fractionation unit located at an onshore natural gas processing plant shall comply with 40 CFR Part 60, Subpart KKK – Standards of Performance for Equipment Leaks of VOCs from Onshore Natural Gas Processing Plants.	• None	• The owner or operator of a fractionation unit located at an onshore natural gas processing plant shall comply with 40 CFR Part 60, Subpart KKK – Standards of Performance for Equipment Leaks of VOCs from Onshore Natural Gas Processing Plants.	• Not Covered by Regulations 3, 6 and 7.	• Not Covered by GP12.1 and GP12.2.	• Not covered by General Permit G-30D, G-35A, or G70-A. .

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<tr><td>Turbines</td><td><u>Exemption Category No. 38:</u>
Combustion turbines rated at less than 1,000 horsepower or 10.7 gigajoules per hour.
GP-5
The owner or operator of a new or reconstructed turbine with a rated capacity equal to or greater than 1000 bhp or 10.7 gigajoules per hour (10 MMBtu/ per hour), based on the higher heating value (HHV) of the fuel that commenced construction, modification, or reconstruction after February 18, 2005, shall comply with applicable requirements specified in 40 CFR Part 60, Subpart KKKK.
In accordance with 25 Pa. Code §§ 127.1 and 127.12(a)(5), the owner or operator of a new or reconstructed turbine shall not exceed the following emissions standards:
Turbine Size ≥1,000 BHP and <5,000 BHP<table><tr><td>NOx ppmvd corrected at 15% O2</td><td>CO ppmvd corrected at 15% O2</td><td>NMNEHC (as Propane) ppmvd corrected at 15% O2</td><td>Total Particulate Matter Lbs/MMBtu</td></tr><tr><td>25</td><td>25</td><td>9</td><td>0.03</td></tr></table></td><td>None</td><td>The owner or operator of a Turbine shall comply with emissions standards specified in 40 CFR Part 60, Subpart KKKK.</td><td>Not covered by Regulations 3, 6 and 7.</td><td>Micro turbines less than 200 kW are exempt.
Not Covered by GP12.1 and GP12.2.</td><td>Not covered by General Permit G-30D, G-35A, or G70-A</td></tr>
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Turbine Size ≥5,000 BHP and <15,000 BHP

<table>
<tr><th>NOx ppmvd corrected at 15% O2</th><th>CO ppmvd corrected at 15% O2</th><th>NMNEHC (as Propane) ppmvd corrected at 15% O2</th><th>Total Particulate Matter Lbs/MMBtu</th></tr>
<tr><td>15</td><td>25</td><td>9</td><td>0.03</td></tr>
</table>

Turbine Size ≥15,000 BHP

<table>
<tr><th>NOx ppmvd corrected at 15% O2</th><th>CO ppmvd corrected at 15% O2</th><th>NMNEHC (as Propane) ppmvd corrected at 15% O2</th><th>Total Particulate Matter Lbs/MMBtu</th></tr>
<tr><td>15</td><td>10 ppm or 93% reduction</td><td>5 ppm or 50% reduction</td><td>0.03</td></tr>
</table>

- Compliance with the emissions standards in this section shall be considered compliance with the NSPS emissions standards specified in 40 CFR Part 60, Subpart KKKK and 25 Pa. Code Chapter 122 (relating to national standards of performance for new stationary sources).

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