

**NEW MEXICO AIR QUALITY BUREAU
NSR & TV: IC ENGINES MONITORING PROTOCOL –
PERMIT TEMPLATE LANGUAGE
Version: May 23, 2016**

Purpose. These guidelines are intended to help permit specialists include adequate monitoring conditions into construction or operating permits in accordance with 20.2.72.210 NMAC or 20.2.70.302 NMAC. These guidelines also help ensure consistency in monitoring conditions for all permits regardless of which permit specialist is assigned the permit.

All IC engines are combustion devices subject to 20.2.61 NMAC and opacity monitoring, unless they qualify for the exemption under 20.2.61.109 NMAC (see permit template for opacity language).

NOTE: If the affected unit is subject to 40 CFR 64, CAM Rule, the AQB standard conditions may not apply.

[NOTE: Each permit writer shall review, select, and adjust the requirements below according to the specific facility circumstances.]

NOTE: EXTERRAN – Engine Integrated Control System (EICS): It is important that the permit identify that this particular control device is installed on an engine so that an enforcement inspector knows to check if the control device is installed. This is an engine emissions control device that will automatically shut down an engine if emission limits are exceeded. The department has determined that this control device is part of the engine’s “physical and operational design” with regard to the definitions of PER and PTE as applied to permitting, not as applied to NSPS/NESHAP. We may adjust the monitoring requirements for engines with this control device once we have experience in verifying that the control system performs as represented. For more information, see the presentation in aurora at: P:\AQB-Permits-Section\NSR-TV-Common\Permitting-Guidance-Documents\Engines\Exterran Engine Integrated Control System.

Engines

A. Maintenance and Repair Monitoring (Unit(s) **X, Y, and Z**)

Requirement: Compliance with the allowable emission limits in Table 106.A shall be demonstrated by properly maintaining and repairing the units.

Monitoring: Maintenance and repair shall meet the minimum manufacturer's or permittee's recommended maintenance schedule. Activities that involve maintenance, adjustment, replacement, or repair of functional components with the potential to affect the operation of an emission unit shall be documented as they occur for the following events:

- (1) Routine maintenance that takes a unit out of service for more than two hours during any twenty-four hour period.
- (2) Unscheduled repairs that require a unit to be taken out of service for more than two hours in any twenty-four hour period.

Recordkeeping: The permittee shall maintain records in accordance with Section B109,

including records of maintenance and repairs activities and a copy of the manufacturer's or permittee's recommended maintenance schedule.

Reporting: The permittee shall report in accordance with Section B110.

[Periodic Testing: Condition may be used for multiple scenarios; adjust as necessary and refer to flow diagram. For example, quarterly testing is required for units with controls and annual testing is required for uncontrolled units with total facility emissions ≥ 95 tpy for any pollutant.]

B. Periodic Emissions Testing (Unit(s) X, Y, and Z)

Requirement: Compliance with the allowable emission limits in Table 106.A shall be demonstrated by completing periodic emission tests during the monitoring period. **For TV Permits add** (NSR XXXX-MX, Condition AXXX.B **and revised**)

Monitoring: The permittee shall test using a portable analyzer or EPA Reference Methods subject to the requirements and limitations of Section B108, General Monitoring Requirements. Emission testing is required for NO_x and CO **[change reference to pollutants as necessary]** and shall be carried out as described below.

[If the unit has VOC emission limits, include the following.]

Test results that demonstrate compliance with the CO emission limits shall also be considered to demonstrate compliance with the VOC emission limits.

For units with g/hp-hr emission limits, in addition to the requirements stated in Section B108, the engine load shall be calculated by using the following equation:

$$\text{Load(Hp)} = \frac{\text{Fuel consumption (scfh)} \times \text{Measured fuel heating value (LHV btu/scf)}}{\text{Manufacturer's rated BSFC (btu/bhp-hr) at 100\% load or best efficiency}}$$

(1) The testing shall be conducted as follows:

- a. Testing frequency shall be **once per [quarter or year]**
- b. The monitoring period is defined as **[a calendar quarter, a calendar year], or [a custom schedule requested by the permittee].**

(2) The first test shall occur within the first monitoring period occurring after permit issuance. **[or if testing was already required by the previous permit, use this instead:]** The tests shall continue based on the existing testing schedule.

(3) All subsequent monitoring shall occur in each succeeding monitoring period. No two monitoring events shall occur closer together in time than 25% of a monitoring period.

(4) The permittee shall follow the General Testing Procedures of Section B111. **[add #5 if subject to testing in NSPS JJJJ/IIII or NESHAP ZZZZ]** (5) Performance testing required by 40 CFR 60, Subpart JJJJ or IIII or 40 CFR 63, Subpart ZZZZ may be used to satisfy these periodic testing requirements if they meet the requirements of this condition and are completed during the specified monitoring period.

Recordkeeping: The permittee shall maintain records in accordance with Section B109, B110, and B111.

Reporting: The permittee shall report in accordance with Section B109, B110, and B111.

[If C&E has approved an exemption for 30-day notification then replace (4) above with this:]

(4) Follow the General Testing Procedures of Section B111. Due to the unique operation of this facility as a “peaking station”, the Department exempts the permittee from the 30-day notification stated in General Condition B111.D(1). The permittee shall notify the department as soon as possible prior to the test.] **This was done in Permits P151R2, P155R2, P153R2M1, P154R3 for TWP.**

[Initial Compliance Test: TV permits shall determine if the required test has been completed or if the requirement must be brought forward.]

C. Initial Compliance Test (Unit(s) **X, Y, and Z**)

Requirement: Compliance with the allowable emission limits in Table 106.A shall be demonstrated by performing an initial compliance test.

Monitoring: The permittee shall perform an initial compliance test in accordance with the General Testing Requirements of Section B111. Emission testing is required for NO_x and CO.

[change reference to pollutants as necessary].

[If the unit has VOC emission limits, include the following.] Test results that demonstrate compliance with the CO emission limits shall also be considered to demonstrate compliance with the VOC emission limits.

The monitoring exemptions of Section B108 do not apply to this requirement. **[TV: Add additional requirements from NSR Permit such as timeframe]**

For units with g/hp-hr emission limits, the engine load shall be calculated by using the following equation:

$$\text{Load(Hp)} = \frac{\text{Fuel consumption (scfh)} \times \text{Measured fuel heating value (LHV btu/scf)}}{\text{Manufacturer's rated BSFC (btu/bhp-hr) at 100\% load or best efficiency}}$$

Recordkeeping: The permittee shall maintain records in accordance with the applicable Sections in B109, B110, and B111.

Reporting: The permittee shall report in accordance with the applicable Sections in B109, B110, and B111.

[If the engine has a control device, include an operational requirement. Examples are provided below. Adjust as necessary for your particular situation. Do not list control device efficiencies in the requirement.]

D. Catalytic Converter Operation (Unit(s) **X, Y, and Z**)

Requirement: **[Include and revise requirement(s) as necessary].**

(1) The unit(s) shall be equipped and operated with an oxidation catalytic converter to control **CO, VOC, and HAP** emissions. Engines equipped with oxidation catalysts are not required to operate with an AFR. **(Note, this last sentence should not be included if there is an add-on AFR.)**

(2) The unit(s) shall be equipped and operated with a non-selective catalytic converter to control **NO_x, CO, and VOC** emissions. These units shall also be equipped with an AFR controlling

device, or similar device that performs the same function of maintaining an appropriate air-fuel ratio.

The permittee shall maintain the units according to manufacturer's or supplier's recommended maintenance, including replacement of oxygen sensor as necessary for oxygen-based controllers.

Monitoring: The unit(s) shall be operated with the catalytic converter, which includes catalyst maintenance periods. During periods of catalyst maintenance, the permittee shall either (1) shut down the engine(s); or (2) replace the catalyst with a functionally equivalent spare to allow the engine to remain in operation.

Recordkeeping: The permittee shall maintain records in accordance with Section B109.

Reporting: The permittee shall report in accordance with Section B110.

E. Air Fuel Ratio Operation (Unit(s) X, Y, and Z) [AFR only - add on device, not integral to unit]

Requirement: [Include and revise requirement(s) as necessary].

The unit(s) shall be equipped and operated with an AFR controlling device, or similar device that performs the same function of maintaining an appropriate air-fuel ratio. The permittee shall demonstrate that the manufacturer's or supplier's recommended maintenance is performed, including replacement of oxygen sensor as necessary for oxygen-based controllers.

Monitoring: The unit(s) shall be operated with the AFR, which includes maintenance periods. During periods of AFR maintenance, the permittee shall either (1) shut down the engine(s); or (2) replace the AFR with a functionally equivalent spare to allow the engine to remain in operation.

Recordkeeping: The permittee shall maintain records in accordance with Section B109, including a records of maintenance performed on AFR controllers and the manufacturer's or suppliers' recommended maintenance schedules for AFR Controllers.

Reporting: The permittee shall report in accordance with Section B110.

[Not applicable if engine is authorized to operate continuously – 8760 hours per year]

F. Hours of Operation (Unit(s) X, Y, and Z)

Requirement: To ensure compliance with allowable emission limits in Table 106.A, [insert requirement, for example only two of the three engines shall be operated at any one time].

Monitoring: The permittee shall monitor the dates and hours of operation for the units.

Recordkeeping: The permittee shall record the hours of operation daily, shall calculate and record the rolling 12-month total hours of operation, and shall meet the recordkeeping requirements in Section B109.

Reporting: The permittee shall report in accordance with Section B110.

G. Engine RPM (Unit(s) X, Y, and Z)

Requirement: [Insert operational requirement, for example] The unit shall be attached to a

[insert make/model] compressor that physically limits the engine speed to XXX RPM.
Monitoring: Once each 12 months, the permittee shall verify that the unit is attached to the make and model of the compressor specified above.
Recordkeeping: The permittee shall maintain records of the annual monitoring and maintain manufacturer's documentation on file that shows the make, model, and maximum design speed of the compressor attached to the unit. The permittee shall maintain records in accordance with Section B109.
Reporting: The permittee shall report in accordance with Section B110.

H. RPM governor or RPM limit switch (Unit(s) **X, Y, and Z**)

Requirement: The permittee shall install and operate an RPM governor or RPM limit switch, each with a tamper resistant seal.
Monitoring: The permittee shall check the proper function of the governor or limit switch every 12 months.
Recordkeeping: The permittee shall maintain records of the annual monitoring and documentation of the RPM governor or limit switch with seal. The permittee shall maintain records in accordance with Section B109.
Reporting: The permittee shall report in accordance with Section B110.

I. Fuel Flow Rate (Unit(s) **X, Y, and Z**)

Requirement: [Add Operational Req.]
Monitoring: The permittee shall record the fuel flow/consumption for each unit (or for group of units if not available for each unit) once every 24 hours.
Recordkeeping: Each month, the permittee shall calculate and record the average fuel flow rate. The permittee shall maintain records in accordance with Section B109.
Reporting: The permittee shall report in accordance with Section B110.

[Fuel analysis is not required for facilities that certify the use of natural gas in the permit application unless HAPs are an issue. Fuel Analysis may be required for facilities that use field natural gas.]

J. Fuel Content (Unit(s) **X, Y, and Z**)

Requirement: The permittee shall perform a fuel analysis at least every six months by methods acceptable to NMED.
Monitoring: At a minimum, this analysis or test method shall include H ₂ S, moisture, VOC, and a thermal heating value in BTU for the fuel.
Recordkeeping: The permittee shall maintain records in accordance with Section B109.
Reporting: The permittee shall report in accordance with Section B110.

- K. 40 CFR 60, Subpart JJJJ (Unit(s) X, Y, and Z) **[already installed units or when applicability is known]** **[Note for SoB: Engines with Exterranean EICS are considered non-certified engines (see 40 CFR 60.4243)]**

Requirement: The unit(s) is/are subject to 40 CFR 60, Subparts A and JJJJ and shall comply with the notification requirements in Subpart A and the specific requirements of Subpart JJJJ.
Monitoring: The permittee shall comply with all applicable monitoring requirements in 40 CFR 60, Subpart A and Subpart JJJJ, including but not limited to 60.4243.
Recordkeeping: The permittee shall comply with all applicable recordkeeping requirements in 40 CFR 60, Subpart A and Subpart JJJJ, including but not limited to 60.4245.
Reporting: The permittee shall comply with all applicable reporting requirements in 40 CFR 60, Subpart A and Subpart JJJJ, including but not limited to 60.4245.

- L. 40 CFR 60, Subpart JJJJ (Unit(s) X, Y, and Z) **[To be installed units]** **[Note for SoB: Engines with Exterranean EICS are considered non-certified engines (see 40 CFR 60.4243)]**

Requirement: The unit(s) will be subject to 40 CFR 60, Subparts A and JJJJ if the unit is constructed (ordered) and manufactured after the applicability dates in 40 CFR 60.4230 and the permittee shall comply with the notification requirements in Subpart A and the specific requirements of Subpart JJJJ.
Monitoring: The permittee shall comply with all applicable monitoring requirements in 40 CFR 60, Subpart A and Subpart JJJJ, including but not limited to 60.4243.
Recordkeeping: The permittee shall comply with all applicable recordkeeping requirements in 40 CFR 60, Subpart A and Subpart JJJJ, including but not limited to 60.4245.
Reporting: The permittee shall comply with all applicable reporting requirements in 40 CFR 60, Subpart A and Subpart JJJJ, including but not limited to 60.4245.

Note Regarding 40 CFR 63, Subpart ZZZZ, engines with no applicable requirements.

For an engine that is subject to 40 CFR 63, Subpart ZZZZ at §§63.6585 and 6590(a), but does not have to meet the requirements of this subpart and of subpart A of this part, including initial notification (see §63.6590(b)(3)), and there are no applicable requirements in the NSR permit (e.g. the unit is an emergency standby generator and NSR exempt per 20.2.72.202.B(3) NMAC or a fire pump engine and NSR exempt per 20.2.72.202.A(4) NMAC), be sure to include its NESHAP applicability determination in the Statement of Basis, but do not list the unit in Table 103-Applicable Regulations, do not include the generic Quad Z condition, and do not include any other Quad Z requirements in the permit. Initial notification as required in 63.6590(b)(1) and (b)(2) is considered an applicable requirement and therefore the unit should be included in the permit. Also, if the unit is meeting the requirements of Quad Z by meeting NSPS IIII or JJJJ (see §63.6590(c)), then the permit should list the unit in Table 103 and include the generic Quad Z condition.

Engines with no applicable requirements are Title V insignificant.

This guidance is based on the regulations as of March 25, 2013. (Note revised 2-03-15).

“40 CFR, 63.6585 You are subject to this subpart if you own or operate a stationary RICE at a major or area source of HAP emissions, except if the stationary RICE is being tested at a stationary RICE test cell/stand.”

“§ 63.6590 What parts of my plant does this subpart cover?

(b) Stationary RICE subject to limited requirements.

(3) The following stationary RICE do not have to meet the requirements of this subpart and of subpart A of this part, including initial notification requirements:”

M. 40 CFR 63, Subpart ZZZZ (Unit(s) X, Y, and Z) [already installed units or when applicability is known]

Requirement: The unit(s) is/are subject to 40 CFR 63, Subpart ZZZZ and the permittee shall comply with all applicable requirements of Subpart A and Subpart ZZZZ.

Monitoring: The permittee shall comply with all applicable monitoring requirements of 40 CFR 63, Subpart A and Subpart ZZZZ.

Recordkeeping: The permittee shall comply with all applicable recordkeeping requirements of 40 CFR 63, Subpart A and Subpart ZZZZ, including but not limited to 63.6655 and 63.10.

Reporting: The permittee shall comply with all applicable reporting requirements of 40 CFR 63, Subpart A and ZZZZ, including but not limited to 63.6645, 63.6650, 63.9, and 63.10.

N. 40 CFR 63, Subpart ZZZZ (Unit(s) X, Y, and Z) [To be installed units]

Requirement: The unit(s) will be subject to 40 CFR 63, Subparts A and ZZZZ if they meet the applicability criteria in 40 CFR 63.6590. The permittee shall comply with any applicable notification requirements in Subpart A and any specific requirements of Subpart ZZZZ.

Monitoring: The permittee shall comply with all applicable monitoring requirements of 40 CFR 63, Subpart A and Subpart ZZZZ.

Recordkeeping: The permittee shall comply with all applicable recordkeeping requirements of 40 CFR 63, Subpart A and Subpart ZZZZ, including but not limited to 63.6655 and 63.10.

Reporting: The permittee shall comply with all applicable reporting requirements of 40 CFR 63, Subpart A and ZZZZ, including but not limited to 63.6645, 63.6650, 63.9, and 63.10.

O. 40 CFR 64, CAM (Unit(s) X, Y, and Z) [TV permits only. When an IC Engine uses a control device and uncontrolled emissions are greater than 100 tpy]

Requirement: Compliance Assurance Monitoring (CAM) contained in 40 CFR 64 applies to this facility, and the permittee shall meet the requirements of the provisions contained in Subpart 3, 7, 9(a), and 9(b).

Monitoring: The permittee shall monitor exhaust gas temperature and percent oxygen [update to match parameters listed in the CAM Plan] concentration of the gas at the catalyst inlet pursuant to 40 CFR 64.3, and continue the monitoring operation pursuant to 40 CFR 64.7. The

frequency of data collection shall be at least once every 24 hours per 40 CFR 64.3(b)(4)(iii).
Recordkeeping: The permittee shall comply with the recordkeeping requirements of 40 CFR 64.9(b).
Reporting: The permittee shall submit monitoring reports to the Department per 40 CFR 64.9(a).

P. 40 CFR 60, Subpart IIII (Unit(s) **X, Y, and Z**) **[diesel engines]**

Requirement: The unit is subject to 40 CFR 60, Subparts A and IIII and shall comply with the notification requirements in Subpart A and the specific requirements of Subpart IIII.
Monitoring: The permittee shall comply with all applicable monitoring requirements in 40 CFR 60, Subpart A and Subpart IIII, including but not limited to 60.4211.
Recordkeeping: The permittee shall comply with all applicable recordkeeping requirements in 40 CFR 60, Subpart A and Subpart IIII, including but not limited to 60.4214.
Reporting: The permittee shall comply with all applicable reporting requirements in 40 CFR 60, Subpart A and Subpart IIII, including but not limited to 60.4214.

BACKGROUND INFORMATION

(Not for inclusion in permit)

NOTES

Note 1: We will not apply monitoring to IC engines that qualify for an exemption under 20.2.72.202 NMAC or 20.2.70 NMAC List of Insignificant Activities.

Note 2: For any monitoring, an emission limit or standard must be identified somewhere in the permit. For example, fuel usage should be compared to the appropriate calculated maximum; rpm should be compared to the value that limits horsepower.

Note 3: Periodic Emissions Testing: "Test results that demonstrate compliance with the CO emission limits shall also be considered to demonstrate compliance with the VOC emission limits." The rationale for this statement is that the portable analyzers do not speciate VOC compounds and the cost of a separate EPA method test is significant; therefore, AQB relies on CO monitoring to demonstrate compliance with VOC limits. Taking into account that the manufacturer tests the equipment and specifies the expected NO_x, CO, and VOC emissions for a unit operating properly, as well as basic principles of combustion chemistry, if an engine test demonstrates that CO concentration fall within the emission limits, then VOC also falls within the emission limits, and the engine is performing as represented in the application.

MONITORING GUIDANCE

1. Opacity must be measured for each engine to show compliance with 20.2.61 NMAC. Use of natural gas will constitute compliance without measurements if such fuel is identified in the application. Engines subject to 20.2.37 NMAC particulate matter requirements are exempt from 20.2.61 NMAC.
2. Annual Emissions Testing by portable analyzer is required for uncontrolled IC engines with emissions greater than 1 tpy and facility allowable emission limits greater than 95 tons per year.
3. Quarterly Emissions Testing by portable analyzer is required for IC engines which have control equipment (AFR, catalytic converter, etc.) installed for the purpose of limiting emission rates or for IC engines operated at crossover (equal NO_x and CO emissions) with an AFR.
4. Fuel Usage Recordkeeping used to be required in the 2001 Engine monitoring protocol and Supplemental Guidance to demonstrate compliance with a physical constraint (e.g. RPM limiting device) on an engine's capacity. Currently, the AQB only requires an RPM limiting device or the use of Governor with Seals to demonstrate that emissions are limited using deration schemes. We no longer use the 2001 Supplemental Guidance but this document can still be found in the monitoring protocol archives.
5. Fuel Analysis is required when HAPs are an issue for any IC engine, or for fugitive emission sources. Fuel Analysis may also be required for facilities that use field natural gas.

TESTING GUIDANCE

See EPA's Memorandum titled Issuance of the Clean Air Act National Stack Testing Guidance

dated February 2, 2004 for additional guidance.

For initial compliance testing:

1. All emission units (100%) above 180 hp shall be tested.
2. All emission units shall be tested by EPA Method if located within a sensitive area. Sensitive areas are defined as 1) within a non-attainment area, 2) within Areas Where Streamlined Permits Are Prohibited, or 3) a source for which the emissions exceed 80% of the NAAQS, not including background concentrations from other facilities. See Modeling Guidelines Document for these areas available at <http://www.nmenv.state.nm.us/aqb/modeling/modelingpubs.html>.
3. All emission units shall be tested unless the units are (1) identical; (2) located at the same facility; (3) operated and maintained in a similar manner; (4) the permit writer is satisfied that emissions from a representative sample of identical units at the facility are less than or equal to 50% of the applicable standard; and (5) the facility can demonstrate the ability to comply with this margin of compliance on an on-going basis.
4. For engines that meet the requirements in 3 above, only 50% of the engines are required to have an initial compliance test. Inconsistent test results may cause the remaining units to be tested.
5. All engines regardless of the type of turbocharging used (low or high) shall conduct initial compliance testing. The use of low speed or high speed turbochargers does not change the above initial test requirements.

Note: Purpose of adding in April 2015, to the engine monitoring protocol, the engine load calculation for stack testing. These statements are taken from a 2013 memo regarding an Area of Concern that was revealed during an inspection at a compressor station.

“A review of emissions data during a current permit revision review process reveals a potential issue with the facility’s determination of engine horsepower, load percent or fuel flow.

The test data in question is from the November 17, 2010 and February 7, 2012 periodic testing of Emissions Unit 1a at the facility. This unit is a Superior, Model# 16SGTB, natural gas fired reciprocating engine.

The test results from 2010 and 2012 report that the engine was operating at 39.7 and 40.0 percent (respectively) of full load which equates to 1053 and 1060 horsepower. The measured average fuel usage rate, of Unit 1a, during the three runs in 2010 was 3560 scf/hr and in 2012 was 4055 scf/hr. The measured fuel heating value of the natural gas was 1068 Btu/ft³ in 2010 and 1019 in 2012 which means the engine’s average fuel input was approximately 3.8 MMBtu/hr in 2010 and 4.13 MMBtu/hr in 2012. If the engine was actually operating at 1053 and 1060 horsepower, while burning 3.8 and 4.13 MMBtu/hr respectively, the Brake Specific Fuel Consumption (BSFC) would be:

$$\text{BSFC}(2010) = \frac{\text{Fuel usage}}{\text{Horsepower}} = \frac{3,800,000 \text{ Btu/hr}}{1053 \text{ Hp}} = 3609 \text{ Btu/Hp-hr}$$

and

$$\text{BSFC}(2012) = \frac{\text{Fuel usage}}{\text{Horsepower}} = \frac{4,130,000 \text{ Btu/hr}}{1060 \text{ Hp}} = 3896 \text{ Btu/Hp-hr}$$

BSFC is basically a measure of the efficiency of an engine, the lower the number the more efficient the engine. Published data from Superior lists maximum engine efficiency (lowest potential BSFC) for this engine model at 7100 Btu/Hp-hr at 100 percent load. The BSFC increases to 7150 at 83 percent load and 7680 at 66 percent load. Therefore, the reported BSFC cannot be accurate. Either the estimated load percent and horsepower or the measured fuel usage rate is in error.

Why is this important?

In this situation, the source is only limited to numerical mass emission rates (lbs/hr) that are not directly linked to engine output horsepower. Therefore, the potential error in the calculated load and horsepower is secondary to determining compliance with the permitted emissions limit.

However, if we assume the fuel usage measurement is incorrect, the calculated mass emission rates would also be inaccurate given the source used the Method 19 F-factor and the measured emission concentrations to determine mass emission rates. In order to determine accurately the mass emission rate from only a pollutant concentration and the Method 19 F-factor, an accurate measurement of the fuel flow rate and heat content (Btu/scf) is critical. Given the reported fuel efficiency (i.e. BSFC) is approximately one-half the minimum achievable for this engine (3600 vs. 7100), it is reasonable to assume the mass emission rates are also underestimated by approximately 50 percent.”