



Engineering Guide #18: SO₂ Compliance Determination Methods for Boilers

Question:

Do the sulfur dioxide emission limits for boilers in the presently effective Ohio SO₂ State Implementation Plan apply to each fuel burned in a boiler, or to an average of the fuels burned in the boiler? If an average applies, what is the applicable averaging period?

Answer:

Compliance methods for Ohio EPA sulfur dioxide (SO₂) rules depend on a number of factors include the underlying rule, the compliance options available in the rule, the type of fuel used, and the size and type of boiler. In general, compliance needs to be determined based on the worse-case fuel from an SO₂ emission rate standpoint. However, it is important to look closely at the underlying rule to determine the compliance methods available and the specifics concerning how the applicable compliance method works.

The guidance below is intended to only apply to the SO₂ compliance methods specified in OAC rule 3745-18-04(D) and (E).

There are three basic methods for determining compliance specified in OAC rule 3745-18-04(D) and (E).

The first method, stack testing (OAC rule 3745-18-04 (D)(1) and (E)(1)), should be used with the boilers operating under their worst emission scenario, e.g., if the boiler burns several fuels, it should be tested while burning the highest sulfur content fuel or combination of fuels that it is capable of burning.

The second compliance method involves the use of continuous emission monitors (OAC rule 3745-18-04(D)(2) and (E)(2)). With this method, a rolling, thirty-day average emission rate is calculated from daily average emission rates. Please note, however, that the thirty-day average shall be weighted based on either the amount of coal burned or the steam output for each day.

The third compliance determination method is fuel sampling either onsite or, sampling by the fuel supplier prior to delivery to the facility (OAC rule 3745-18-04(D)(3) and (E)(3)). The type and frequency of sampling is determined by the maximum combined firing rate at the facility and the type of fuel burned. The averaging period for the samples is determined based on the fuel burned and maximum combined firing rate at the facility as discussed below.

Burning coal with > 1,000 mmBtu/hr heat input

OAC rule 3745-18-04(D)(3)(a) requires daily as-fired fuel sampling and compliance is based on the weighted arithmetic average of the preceding thirty consecutive daily sample analyses (30-day rolling average).

Burning coal with > 100 mmBtu/hr heat input and ≤ 1,000 mmBtu/hr heat input

OAC rule 3745-18-04(D)(3)(b) requires monthly composite sampling consisting of:

1. periodic as-fired samples (e.g., daily or weekly); or

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2. as received samples with a minimum of 1 sample per truckload or carload. The purpose of this option is to provide a compliance determination method for those sources which do not have the facilities or resources to do their own coal sampling. Electric utilities cannot use option 2. and must use option 1. above.

Burning coal with > 10 mmBtu/hr heat input and ≤ 100 mmBtu/hr heat input

OAC rule 3745-18-04(D)(3)(c) requires:

1. monthly composite sampling according to OAC rule 3745-18-04(D)(3)(b) above; or
2. the weighted arithmetic average of all fuel supplier analyses for each shipment received during the calendar month.

Burning fuels other than coal

OAC rule 3745-18-04(E)(3) requires:

1. onsite sampling at a minimum frequency such that the sulfur dioxide emission rate representative of the 30-day average sulfur dioxide emission rate can be determined; or
2. fuel supplier analysis for each shipment.

Per OAC rule 3745-18-06(A), note that emissions units are exempt from the OAC rule 3745-18-06(D) and 3745-18-07 to 3745-18-94 limits during any calendar day in which only natural gas is burned.

(Note: OAC rule 3745-18-04(D) and (E) also contains additional measurement methods and procedures for specific facilities and counties that should be followed when applicable. The county and facility-specific requirements specified in OAC rule 3745-18-04(D) and (E) begin at paragraphs (D)(4) and (E)(4) of the rule.)

How to calculate the monthly weighted average emission rate

As an example of how to calculate a rolling, weighted average, consider a source which takes one coal sample every week. The last six analyses are as follows:

Week 1	2.9%S	11,300 Btu/lb	4.9 lbSO ₂ /mmBtu
Week 2	2.7%S	11,500 Btu/lb	4.5 lbSO ₂ /mmBtu
Week 3	3.2%S	10,800 Btu/lb	5.6 lbSO ₂ /mmBtu
Week 4	2.4%S	11,200 Btu/lb	4.1 lbSO ₂ /mmBtu
Week 5	2.5%S	10,900 Btu/lb	4.4 lbSO ₂ /mmBtu
Week 6	3.1%S	11,400 Btu/lb	5.2 lbSO ₂ /mmBtu

Since there are four samples available for each 30-day period, the most recent four analyses should be included in each rolling average. The emission rates should be weighted based on the amount of fuel burned each week.

	<u>Coal Burned</u>	<u>Emission Rate</u>	<u>30-day Rolling, Weighted Average</u>
Week 1	25 tons	4.9 lb/mmBtu	
Week 2	37 tons	4.5 lb/mmBtu	

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Week 3	52 tons	5.6 lb/mmBtu	
Week 4	30 tons	4.1 lb/mmBtu	4.9 lb/mmBtu (see below calculation)
Week 5	19 tons	4.4 lb/mmBtu	4.8 lb/mmBtu
Week 6	42 tons	5.2 lb/mmBtu	5.0 lb/mmBtu

To calculate the 30-day rolling, weighted average, begin by calculating the heat input during the time period which is represented by each fuel sample:

Week 1 25 tons (11,300 Btu/lb) (2000 lb/ton) = 565 mmBtu

Week 2 37 tons (11,500 Btu/lb) (2000 lb/ton) = 851 mmBtu

Week 3 52 tons (10,800 Btu/lb) (2000 lb/ton) = 1,123 mmBtu

Week 4 30 tons (11,200 Btu/lb) (2000 lb/ton) = 672 mmBtu

Next, calculate the 30-day rolling, weighted average emission rate by adding the product of the heat input multiplied by the emission rate of each sample and dividing by the total heat input for the 30-day period.

Week 4 weighted 30-day rolling average emission rate

$[565 \text{ mmBtu/hr} (4.9 \text{ lb/mmBtu}) + 851 \text{ mmBtu/hr} (4.5 \text{ lb/mmBtu}) +$

$1,123 \text{ mmBtu/hr} (5.6 \text{ lb/mmBtu}) + 672 \text{ mmBtu/hr} (4.1 \text{ lb/mmBtu})] / (565+851+1,123+672)\text{mmBtu} =$
4.9 lb/mmBtu