

O_{2d} = Dry-basis hourly average oxygen concentration, percent O₂

O_{2w} = Wet-basis hourly average oxygen concentration, percent O₂

[58 FR 3701, Jan. 11, 1993; Redesignated and amended at 60 FR 26553, 26571, May 17, 1995; 61 FR 25585, May 22, 1996; 61 FR 59166, Nov. 20, 1996; 63 FR 57513, Oct. 27, 1998; 64 FR 28666–28671, May 26, 1999; 64 FR 37582, July 12, 1999; 67 FR 40474, 40475, June 12, 2002; 67 FR 53505, Aug. 16, 2002; 70 FR 28695, May 18, 2005; 73 FR 4372, Jan. 24, 2008; 76 FR 17325, Mar. 28, 2011; 77 FR 2460, Jan. 18, 2012]

APPENDIX G TO PART 75— DETERMINATION OF CO₂ EMISSIONS

1. APPLICABILITY

The procedures in this appendix may be used to estimate CO₂ mass emissions discharged to the atmosphere (in tons/day) as the sum of CO₂ emissions from combustion and, if applicable, CO₂ emissions from sorbent used in a wet flue gas desulfurization control system, fluidized bed boiler, or other emission controls.

2. PROCEDURES FOR ESTIMATING CO₂ EMISSIONS FROM COMBUSTION

Use the following procedures to estimate daily CO₂ mass emissions from the combustion of fossil fuels. The optional procedure in section 2.3 of this appendix may also be used for an affected gas-fired unit. For an affected unit that combusts any nonfossil fuels (e.g., bark, wood, residue, or refuse), either use a CO₂ continuous emission monitoring system or apply to the Administrator for approval of a unit-specific method for determining CO₂ emissions.

2.1 Use the following equation to calculate daily CO₂ mass emissions (in tons/day) from the combustion of fossil fuels. Where fuel flow is measured in a common pipe header (i.e., a pipe carrying fuel for multiple units), the owner or operator may use the procedures in section 2.1.2 of appendix D of this part for combining or apportioning emissions, except that the term “SO₂ mass emissions” is replaced with the term “CO₂ mass emissions.”

$$W_{CO_2} = \frac{(MW_C + MW_{O_2}) \times W_C}{2,000 MW_C} \text{ (Eq. G-1)}$$

Where:

W_{CO2} = CO₂ emitted from combustion, tons/day.

MW_C = Molecular weight of carbon (12.0).

MW_{O2} = Molecular weight of oxygen (32.0)

W_C = Carbon burned, lb/day, determined using fuel sampling and analysis and fuel feed rates.

2.1.1 Collect at least one fuel sample during each week that the unit combusts coal, one sample per each shipment or delivery for oil and diesel fuel, one fuel sample for each delivery for gaseous fuel in lots, one sample per day or per hour (as applicable) for each gaseous fuel that is required to be sampled daily or hourly for gross calorific value under section 2.3.5.6 of appendix D to this part, and one sample per month for each gaseous fuel that is required to be sampled monthly for gross calorific value under section 2.3.4.1 or 2.3.4.2 of appendix D to this part. Collect coal samples from a location in the fuel handling system that provides a sample representative of the fuel bunkered or consumed during the week.

2.1.2 Determine the carbon content of each fuel sample using one of the following methods: ASTM D3178–89 (Reapproved 2002) or ASTM D5373–02 (Reapproved 2007) for coal; ASTM D5291–02, Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants, ultimate analysis of oil, or computations based upon ASTM D3238–95 (Reapproved 2000) and either ASTM D2502–92 (Reapproved 1996) or ASTM D2503–92 (Reapproved 1997) for oil; and computations based on ASTM D1945–96 (Reapproved 2001) or ASTM D1946–90 (Reapproved 2006) for gas (all incorporated by reference under §75.6 of this part).

2.1.3 Use daily fuel feed rates from company records for all fuels and the carbon content of the most recent fuel sample under this section to determine tons of carbon per day from combustion of each fuel. (All ASTM methods are incorporated by reference under §75.6.) Where more than one fuel is combusted during a calendar day, calculate total tons of carbon for the day from all fuels.

2.2 For an affected coal-fired unit, the estimate of daily CO₂ mass emissions given by equation G–1 may be adjusted to account for carbon retained in the ash using the procedures in either section 2.2.1 through 2.2.3 or section 2.2.4 of this appendix.

2.2.1 Determine the ash content of the weekly sample of coal using ASTM D3174–00, “Standard Test Method for Ash in the Analysis Sample of Coal and Coke from Coal” (incorporated by reference under §75.6 of this part).

2.2.2 Sample and analyze the carbon content of the fly-ash according to ASTM D5373–02 (Reapproved 2007), Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal and Coke” (incorporated by reference under §75.6 of this part).

2.2.3 Discount the estimate of daily CO₂ mass emissions from the combustion of coal given by equation G–1 by the percent carbon retained in the ash using the following equation:

$$W_{\text{NCO}_2} = W_{\text{CO}_2} - \left(\frac{MW_{\text{CO}_2}}{MW_c} \right) \left(\frac{A\%}{100} \right) \left(\frac{C\%}{100} \right) W_{\text{COAL}}$$

(Eq. G-2)

where,

W_{NCO_2} = Net CO₂ mass emissions discharged to the atmosphere, tons/day.

W_{CO_2} = Daily CO₂ mass emissions calculated by equation G-1, tons/day.

MW_{CO_2} = Molecular weight of carbon dioxide (44.0).

MW_c = Molecular weight of carbon (12.0).

A% = Ash content of the coal sample, percent by weight.

C% = Carbon content of ash, percent by weight.

W_{COAL} = Feed rate of coal from company records, tons/day.

2.2.4 The daily CO₂ mass emissions from combusting coal may be adjusted to account

for carbon retained in the ash using the following equation:

$$W_{\text{NCO}_2} = .99 W_{\text{CO}_2}$$

(Eq. G-3)

where,

W_{NCO_2} = Net CO₂ mass emissions from the combustion of coal discharged to the atmosphere, tons/day.

.99 = Average fraction of coal converted into CO₂ upon combustion.

W_{CO_2} = Daily CO₂ mass emissions from the combustion of coal calculated by equation G-1, tons/day.

2.3 In lieu of using the procedures, methods, and equations in section 2.1 of this appendix, the owner or operator of an affected gas-fired or oil-fired unit (as defined under §72.2 of this chapter) may use the following equation and records of hourly heat input to estimate hourly CO₂ mass emissions (in tons).

$$W_{\text{CO}_2} = \left(\frac{F_c \times H \times U_f \times MW_{\text{CO}_2}}{2000} \right) \quad (\text{Eq. G-4})$$

(Eq. G-4)

Where:

W_{CO_2} = CO₂ emitted from combustion, tons/hr.

MW_{CO_2} = Molecular weight of carbon dioxide, 44.0 lb/lb-mole.

F_c = Carbon based F-factor, 1040 scf/mmBtu for natural gas; 1,420 scf/mmBtu for crude, residual, or distillate oil; and calculated according to the procedures in section 3.3.5 of appendix F to this part for other gaseous fuels.

H = Hourly heat input in mmBtu, as calculated using the procedures in section 5 of appendix F of this part.

U_f = 1/385 scf CO₂/lb-mole at 14.7 psia and 68 °F.

3. PROCEDURES FOR ESTIMATING CO₂ EMISSIONS FROM SORBENT

When the affected unit has a wet flue gas desulfurization system, is a fluidized bed boiler, or uses other emission controls with sorbent injection, use either a CO₂ continuous emission monitoring system or an O₂ monitor and a flow monitor, or use the procedures, methods, and equations in sections 3.1 through 3.2 of this appendix to determine daily CO₂ mass emissions from the sorbent (in tons).

3.1 When limestone is the sorbent material, use the equations and procedures in either section 3.1.1 or 3.1.2 of this appendix.

3.1.1 Use the following equation to estimate daily CO₂ mass emissions from sorbent (in tons).

$$SE_{\text{CO}_2} = W_{\text{CaCO}_3} F_u \frac{MW_{\text{CO}_2}}{MW_{\text{CaCO}_3}}$$

(Eq. G-5)

where,

SE_{CO_2} = CO₂ emitted from sorbent, tons/day.

W_{CaCO_3} = CaCO₃ used, tons/day.

F_u = 1.00, the calcium to sulfur stoichiometric ratio.

MW_{CO_2} = Molecular weight of carbon dioxide (44).

MW_{CaCO_3} = Molecular weight of calcium carbonate (100).

3.1.2 In lieu of using Equation G-5, any owner or operator who operates and maintains a certified SO₂-diluent continuous emission monitoring system (consisting of an SO₂ pollutant concentration monitor and an O₂ or CO₂ diluent gas monitor), for measuring and recording SO₂ emission rate (in lb/mmBtu) at the outlet to the emission controls and who uses the applicable procedures, methods, and equations such as those in EPA Method 19 in appendix A to part 60 of this chapter to estimate the SO₂ emissions removal efficiency of the emission controls, may use the following equations to estimate

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daily CO₂ mass emissions from sorbent (in tons).

$$SE_{CO_2} = F_u \frac{W_{SO_2}}{2000} \frac{MW_{CO_2}}{MW_{SO_2}}$$

(Eq. G-6)

where,

SE_{CO₂}=CO₂ emitted from sorbent, tons/day.

MW_{CO₂}=Molecular weight of carbon dioxide (44).

MW_{SO₂}=Molecular weight of sulfur dioxide (64).

W_{SO₂}=Sulfur dioxide removed, lb/day, as calculated below using Eq. G-7.

F_u=1.0, the calcium to sulfur stoichiometric ratio.

and

$$W_{SO_2} = SO_{20} \frac{\%R}{(100 - \%R)} \quad (\text{Eq. G-7})$$

(Eq. G-7)

where:

W_{SO₂} = Weight of sulfur dioxide removed, lb/day.

SO₂₀ = SO₂ mass emissions monitored at the outlet, lb/day, as calculated using the equations and procedures in section 2 of appendix F of this part.

%R = Overall percentage SO₂ emissions removal efficiency, calculated using equations such as those in EPA Method 19 in appendix A to part 60 of this chapter, and using daily instead of annual average emission rates.

3.2 When a sorbent material other than limestone is used, modify the equations, methods, and procedures in section 3.1 of this appendix as follows to estimate daily CO₂ mass emissions from sorbent (in tons).

3.2.1 Determine a site-specific value for F_u, defined as the ratio of the number of moles of CO₂ released upon capture of one mole of SO₂, using methods and procedures satisfactory to the Administrator. Use this value of F_u (instead of 1.0) in either equation G-5 or equation G-6.

3.2.2 When using equation G-5, replace MW_{CaCO₃}, the molecular weight of calcium carbonate, with the molecular weight of the

sorbent material that participates in the reaction to capture SO₂ and that releases CO₂, and replace W_{CaCO₃}, the amount of calcium carbonate used (in tons/day), with the amount of sorbent material used (in tons/day).

4. PROCEDURES FOR ESTIMATING TOTAL CO₂ EMISSIONS

When the affected unit has a wet flue gas desulfurization system, is a fluidized bed boiler, or uses other emission controls with sorbent injection, use the following equation to obtain total daily CO₂ mass emissions (in tons) as the sum of combustion-related emissions and sorbent-related emissions.

$$W_t = W_{CO_2} + SE_{CO_2}$$

(Eq. G-8)

where,

W_t = Estimated total CO₂ mass emissions, tons/day.

W_{CO₂} = CO₂ emitted from fuel combustion, tons/day.

SE_{CO₂} = CO₂ emitted from sorbent, tons/day.

5. MISSING DATA SUBSTITUTION PROCEDURES FOR FUEL ANALYTICAL DATA

Use the following procedures to substitute for missing fuel analytical data used to calculate CO₂ mass emissions under this appendix.

5.1-5.1.2 [Reserved]

5.2 Missing Carbon Content Data

Use the following procedures to substitute for missing carbon content data.

5.2.1 In all cases (i.e., for weekly coal samples or composite oil samples from continuous sampling, for oil samples taken from the storage tank after transfer of a new delivery of fuel, for as-delivered samples of oil, diesel fuel, or gaseous fuel delivered in lots, and for gaseous fuel that is supplied by a pipeline and sampled monthly, daily or hourly for gross calorific value) when carbon content data is missing, report the appropriate default value from Table G-1.

5.2.2 The missing data values in Table G-1 shall be reported whenever the results of a required sample of fuel carbon content are either missing or invalid. The substitute data value shall be used until the next valid carbon content sample is obtained.

TABLE G-1. -- MISSING DATA SUBSTITUTION PROCEDURES FOR MISSING CARBON CONTENT DATA

Parameter	Missing data value
Oil and coal carbon content	Most recent, previous carbon content value available for that type of coal, grade of oil, or default value, in this table
Gas carbon content	Most recent, previous carbon content value available for that type of gaseous fuel, or default value, in this table
Default coal carbon content	Anthracite: 90.0 percent
	Bituminous: 85.0 percent
	Subbituminous/Lignite: 75.0 percent
Default oil carbon content	90.0 percent
Default gas carbon content	Natural gas: 75.0 percent
	Other gaseous fuels: 90.0 percent

5.3 Gross Calorific Value Data

For a gas-fired unit using the procedures of section 2.3 of this appendix to determine CO₂ emissions, substitute for missing gross calorific value data used to calculate heat input by following the missing data procedures for gross calorific value in section 2.4 of appendix D to this part.

[58 FR 3701, Jan. 11, 1993, as amended at 60 FR 26556-26557, May 17, 1995; 61 FR 25585, May 22, 1996; 64 FR 28671, May 26, 1999; 67 FR 40475, June 12, 2002; 67 FR 57274, Sept. 9, 2002; 73 FR 4376, Jan. 24, 2008]

APPENDIX H TO PART 75—REVISED TRACEABILITY PROTOCOL NO. 1 [RESERVED]

APPENDIX I TO PART 75—OPTIONAL FACTOR/FUEL FLOW METHOD [RESERVED]

APPENDIX J TO PART 75—COMPLIANCE DATES FOR REVISED RECORDKEEPING REQUIREMENTS AND MISSING DATA PROCEDURES [RESERVED]

PART 76—ACID RAIN NITROGEN OXIDES EMISSION REDUCTION PROGRAM

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- 76.7 Revised NO_x emission limitations for Group 1, Phase II boilers.
- 76.8 Early election for Group 1, Phase II boilers.
- 76.9 Permit application and compliance plans.