NESHAP 5D Annual Heat Input Calculation & Subcategory Selection Guide

How do I determine the percentage of fuel use on an annual heat input basis to select my boiler or process heater's NESHAP 5D subcategory?

Under NESHAP 5D, a boiler or process heater's fuel subcategory is determined, in part, based on the percentage of fuel consumed by the unit in the 12 month period preceding the required compliance demonstration (e.g. the required tune-up or performance test). The fuel use must be evaluated on an **annual heat input basis**. This guide details how to calculate your annual heat input basis and determine the fuel type, fuel classification, and unit subcategory under NESHAP 5D.

If the boiler or process heater is new or modified to switch fuels, then the fuel consumption is calculated using the maximum fuel use as authorized by:

- a permit by rule (permit exemption) fuel limitation found in Rule 282 of the Part 55 Air Pollution Control Rules) and the equipment maximum operating capacity; or
- the fuel and capacity limitations in a federally enforceable air use permit to install or renewable operating permit.

Follow the steps below to calculate your annual heat input basis and select a subcategory.

Step 1: Determine the High Heat Value (HHV) for Each Fuel
The rule provides several options to estimate HHV. You may obtain the data from your fuel supplier, use the calculation methodologies in the EPA greenhouse gas (GHG) reporting program (40 CFR part 98, subpart C), or from a site-specific performance test.

Step 2: Determine the Annual Fuel Consumption of Each Fuel
Add the total amount of each fuel consumed in the 12 months preceding the compliance demonstration (tune up or performance test). This step may not be needed if the unit is new or is modifying fuels. Contact an AQD permit engineer if you have a new source.

Step 3: Calculate the Annual Heat Input of Each Fuel
Multiply the total annual consumption by the HHV of each fuel to determine the annual heat input of each fuel.

Step 4: Total the Annual Heat Input from all Fuel Types
Add the calculated annual heat input for all fuel types.

Step 5: Total the Annual Heat Input from Each Fuel Classification
Identify the classification for each fuel according to definitions under 40 CFR 63.7575. Find the total annual heat input from each fuel classification by adding together the calculated annual heat input of each fuel with the same fuel classification.

Step 6: Determine the Percent Annual Heat Input of Each Fuel Classification
Divide the total annual heat input from each fuel classification by the total annual heat input from all fuel types, then multiply by 100%.

Step 7: Determine the Boiler or Heater's Fuel Subcategories
Compare the percentage of each fuel classification on an annual heat input basis to the fuel subcategories according to definitions under 40 CFR 63.7575.

When calculating the annual heat input value, it is important to select the correct 12 month period. The 12 month period will vary from affected source to affected source as it is the 12 month period preceding the last compliance demonstration (e.g. the later of any required tune-up or performance test for the affected source). The following are a few compliance demonstration scenarios:

- **Existing 5D source without emission limits** – The annual heat input period would be driven by the date that the required tune up was performed. If the source completed the tune up on the final compliance demonstration date or on January 1, 2016, the time period to be used for calculating the annual heat input would be from January 1, 2015, through December 31, 2015.

- **Existing 5D source with emission limits** – The annual heat input period would be driven by the later of the dates the sources completes the performance test or tune up. If the source completed the performance test last and it was performed on the very last day it could be performed or on 7/31/16, the time period to be used for calculating the annual heat input would be from July 31, 2015, through July 30, 2016.

- **New or modified source with a fuel change** – In light of the fact that there would be no preceding fuel use, the subcategory would be calculated using the limits provided in the rule or permit authorizing the construction, installation, or modification.

As a practical matter, a source with an affected unit would need to perform a preliminary annual heat input calculation using the most recent twelve months fuel use to identify the preliminary subcategory and expected compliance demonstration deadlines under NESHAP 5D. Following the last compliance demonstration date, the source would verify the subcategory determination with a calculation meeting the definition of annual heat input. Monthly, the source should continue to calculate the annual heat input to verify the subcategory determination and prevent any unrecognized fuel switching resulting in a subcategory change and prompting additional requirements. 5D sources that switch categories are required to provide notice to EPA via CEDRI within 30 days of the switch per 40 CFR 63.7545(h) and physical compliance is generally required within 180 days per 40 CFR 63.7510 if it is not the result of a change in NESHAP (e.g. a switch to 5D from CISWI or from EGU).

Definitions

To select the correct subcategory, you not only need to know the fuel use on an annual heat input basis, but also the equipment design, fuel type, and fuel classification. This section is intended to clarify the various terms and definitions in NESHAP 5D that relate to selecting the appropriate subcategory. In order to select the correct subcategory, you must refer to the definitions within 40 CFR 63.7575 and the subcategory descriptions in 40 CFR 63.7499. Be sure to also confirm the definitions for the equipment design or use limitations for the selected subcategory as they are specifically defined in NESHAP 5D as well. For example, there are specific definition for dutch oven, fluidized bed boiler, fluidized bed boiler with an integrated fluidized bed heat exchanger, fluidized bed combustion, fuel cell, limited-use boiler, hybrid suspension grate boiler, metal process furnace, other combustor, oxygen trim system, pile burner, pulverized coal boiler, sloped grate, stoker, suspension burner, stoker/sloped grate/other unit designed to burn kiln dried biomass, unit designed to burn coal/solid fossil fuel subcategory, etc.).

Fuel means fuel type as defined in 63.7575.

Fuel type as defined in 63.7575 means a category of fuel or fuel types that share a common name or classification. Examples of fuel types include, but are not limited to bituminous coal, sub-bituminous coal, lignite, anthracite, coal refuse, petroleum coke, coke, tire derived fuel, distillate oil, biodiesel, vegetable oil, residual oil, used oil, biodiesel, biomass, natural gas, refinery gas, biogas, landfill gas, process gas, coal derived gas, regulated gas stream, other gas, etc.

Fuel classification itself is not defined in 63.7575; however, specific fuel classifications are defined in 63.7575. Examples of defined fuel classifications include, but are not limited to, biomass or bio-based solid fuel, heavy liquid, light liquid, solid fossil fuel, solid fuel, gas 1 and gas 2. Note too that a specific fuel or fuel type may fit into more than one fuel classification. For example, bituminous coal fits into the coal, solid fossil fuel, and solid fuel classifications.

Subcategory itself is not defined in 63.7575; however, the NESHAP subcategories are identified in in 40 CFR 63.7499 and tied to numerous specific definitions in 63.7575. There are 2 subcategories based on use limitations (limited use boilers and metal process furnaces) and 19 subcategories based on fuel use and equipment design which include:

1. Pulverized coal/solid fossil fuel units.
2. Stokers designed to burn coal/solid fossil fuel.
3. Fluidized bed units designed to burn coal/solid fossil fuel.
4. Stokers/sloped grate/other units designed to burn kiln dried biomass/bio-based solid.
5. Fluidized bed units designed to burn biomass/bio-based solid.
6. Suspension burners designed to burn biomass/bio-based solid.
7. Fuel cells designed to burn biomass/bio-based solid.
8. Hybrid suspension/grate burners designed to burn wet biomass/bio-based solid.
9. Stokers/sloped grate/other units designed to burn wet biomass/bio-based solid.
10. Dutch ovens/pile burners designed to burn biomass/bio-based solid.
11. Units designed to burn liquid fuel that are non-continental units.
12. Units designed to burn gas 1 fuels.
13. Units designed to burn gas 2 (other) gases.
14. Units designed to burn solid fuel.
15. Units designed to burn liquid fuel.
16. Units designed to burn coal/solid fossil fuel.
17. Fluidized bed units with an integrated fluidized bed heat exchanger designed to burn coal/solid fossil fuel.
18. Units designed to burn heavy liquid fuel.
19. Units designed to burn light liquid fuel.

Example Calculation

An existing boiler burns a coal blend fuel (35% bituminous and 65% sub-bituminous), wood chips (30% moisture), tire derived fuel and No. 2 fuel oil. There are no plans to change the fuel consumption of the boiler. Find the percentage of each fuel type on an annual heat input basis and determine the correlating fuel subcategory.

Step 1: Determine High Heat Value (HHV) for Each Fuel

In this case, there is no information from the fuel provider. The following high heat values can be obtained from 40 CFR part 98, subpart C:

Fuel type	Default High Heat Value
Bituminous coal	24.93 MM Btu/short ton
Subbituminous coal	17.25 MM Btu/short ton
Wood (dry basis)*	17.48 MM Btu/short ton
Tire derived fuel (tires)	28.00 MM Btu/short ton
No. 2 fuel oil	0.138 MM Btu/gallon

Use the following formula to calculate a wet basis HHV for use in Equation C-1: HHVw = ((100 − M)/100)*HHVd where HHVw = wet basis HHV, M = moisture content (percent) and HHVd = dry basis HHV.

The wood chips for this example have 30% moisture content. Therefore, the default high heat value of the wood on a dry basis must be adjusted using the specified formula.

High heat value of wood on wet basis= $\frac{100-30}{100} * 17.48$ MM Btu/short ton = 12.24 MM Btu/short ton.

Step 2: Determine the Annual Fuel Consumption of Each Fuel

There are no plans to change the fuel consumption for the boiler, so the fuel usage records for the previous 12 months should be referenced. For this example, the current month is May 2014 and the calculation is a preliminary calculation to preliminarily establish the subcategory and expected compliance demonstration dates. The fuel records in this example are as follows:

Month	Blended Coal (short tons)	Wood Chips (short tons)	Tire Derived Fuel (short tons)	No. 2 Fuel Oil (gallons)
April 2014	575	1,203	162	5,396
March 2014	420	996	207	12,579
February 2014	604	875	321	3,241
January 2014	843	0	305	21,354
December 2013	901	0	284	36,486
November 2013	793	0	185	37,985
October 2013	221	1,354	115	41,952
September 2013	444	1,250	234	4,381
August 2013	105	756	247	9,584
July 2013	0	798	192	22,437
June 2013	0	0	311	9,734
May 2013	302	1,450	204	8,210
Total:	**5,208**	**8,682**	**2,767**	**213,339**

The records show the total blended coal burned, but the annual consumption of each coal type must be determined. In this case, the coal blend was 35% bituminous and 65% sub-bituminous

for the entire year. Therefore, the following equation may be used to determine the annual consumption of each coal type. If the blend changed from month to month, then the percentage would have to be applied on a monthly basis.

Total of type X coal burned = Total coal burned * $\frac{percent\ of\ type\ X}{100\%}$

Total bituminous coal burned = 5,208 short tons * $\frac{35\%}{100\%}$ = 1,823 short tons

Total sub-bituminous coal burned = 5,208 short tons * $\frac{65\%}{100\%}$ = 3,385 short tons

Step 3: Calculate the Annual Heat Input of Each Fuel

Multiply the total annual consumption by the high heat value of each fuel to determine the annual heat input of each fuel.

Fuel Type	Total Annual Consumption (TAC)	High Heat Value (HHV)	Annual Heat Input =TAC * HHV
Bituminous coal	1,823 tons	24.93 MM Btu/short ton	45447.4 MM Btu
Subbituminous coal	3,385 tons	17.25 MM Btu/short ton	58391.3 MM Btu
Wood chips	8,682 tons	12.24 MM Btu/short ton	106267.7 MM Btu
Tire derived fuel	2,767 tons	28.00 MM Btu/short ton	77476 MM Btu
No. 2 fuel oil	213,339 gallons	0.138 MM Btu/gallon	29440.8 MM Btu

Step 4: Total the Annual Heat Input from all Fuel Types

Add the calculated Annual Heat Input from all fuel types.

(45,447.4 + 58,391.3 + 106,267.7 + 77,476 + 29,440.8) MM Btu = 317,023.1 MM Btu

Step 5: Total the Annual Heat Input from Each Fuel Classification

Identify the classification for each fuel according to the definitions found in 40 CFR 63.7575. For this example, the following definitions apply:

Biomass or bio-based solid fuel *means any biomass-based solid fuel that is not a solid waste. This includes, but is not limited to, wood residue; wood products (e.g., trees, tree stumps, tree limbs, bark, lumber, sawdust, sander dust, chips, scraps, slabs, millings, and shavings); animal manure, including litter and other bedding materials; vegetative agricultural and silvicultural materials, such as logging residues (slash), nut and grain hulls and chaff (e.g., almond, walnut, peanut, rice, and wheat), bagasse, orchard prunings, corn stalks, coffee bean hulls and grounds. This definition of biomass is not intended to suggest that these materials are or are not solid waste.*

Coal *means all solid fuels classifiable as anthracite, bituminous, sub-bituminous, or lignite by ASTM D388 (incorporated by reference, see §63.14), coal refuse, and petroleum coke. For the purposes of this subpart, this definition of "coal" includes synthetic fuels derived from coal, including but not limited to, solvent-refined coal, coal-oil mixtures, and coal-water mixtures. Coal derived gases are excluded from this definition.*

Distillate oil *means fuel oils that contain 0.05 weight percent nitrogen or less and comply with the specifications for fuel oil numbers 1 and 2, as defined by the American Society of Testing and Materials in ASTM D396 (incorporated by reference, see §63.14) or diesel fuel oil numbers 1 and 2, as defined by the American Society for Testing and Materials in ASTM D975 (incorporated by reference, see §63.14), kerosene, and biodiesel as defined by the American Society of Testing and Materials in ASTM D6751-11b (incorporated by reference, see §60.14).*

Solid fossil fuel *includes, but is not limited to, coal, coke, petroleum coke, and tire derived fuel.*

Solid fuel *means any solid fossil fuel or biomass or bio-based solid fuel*

Light liquid *includes distillate oil, biodiesel, or vegetable oil.*

Liquid fuel *includes, but is not limited to, light liquid, heavy liquid, any form of liquid fuel derived from petroleum, used oil, liquid biofuels, biodiesel, vegetable oil, and comparable fuels as defined under 40 CFR 261.38.*

The fuels for this example placed in each classification:

Classification	**Fuel Types**
Solid fuel	Bituminous coal, sub-bituminous coal, wood chips, & tire derived fuel
Solid fossil fuel	Bituminous coal, sub-bituminous coal, and tire derived fuel
Coal	Bituminous coal & sub-bituminous coal
Biomass	Wood chips
Liquid fuel	No. 2 fuel oil
Light liquid	No. 2 fuel oil
Distillate oil	No. 2 fuel oil

Find the total annual heat input from each fuel classification by adding together the calculated annual heat input of each fuel with the same fuel classification. The classifications for this example are Solid Fuel, Solid Fossil Fuel, Coal, Biomass, Liquid Fuel, Light Liquid, and Distillate oil. The Annual Heat Input for each fuel was found in Step 3.

The following table shows the annual heat input of the fuels in each classification. A fuel which

does not fall under the classification is designated with an “X”.

Classification	Bituminous Coal	Subbituminous Coal	Wood Chips	Tire Derived Fuel	No. 2 Fuel Oil	Total (MM Btu)
	Annual Heat Input (MM Btu)					
Solid fuel	45447.4	58391.3	106267.7	77476	X	**287,582.4**
Solid fossil fuel	45447.4	58391.3	X	77476	X	**181,314.7**
Coal	45447.4	58391.3	X	X	X	**103,838.7**
Biomass	X	X	106267.7	X	X	**106,267.7**
Liquid fuel	X	X	X	X	29440.8	**29,440.8**
Light liquid	X	X	X	X	29440.8	**29,440.8**
Distillate oil	X	X	X	X	29440.8	**29,440.8**

Step 6: Determine the Percent Annual Heat Input of Each Fuel Classification

Divide the total annual heat input from each fuel classification by the total annual heat input from all fuel types, then multiply by 100%

Solid Fuels on an Annual Heat Basis = $\frac{287{,}582.4\ MM\ Btu}{317{,}023.1\ MM\ Btu} * 100\%$ = 90.7%

Solid Fossil Fuels on an Annual Heat Basis = $\frac{181{,}314.7\ MM\ Btu}{317{,}023.1\ MM\ Btu} * 100\%$ = 57.2%

Coal on an Annual Heat Basis = $\frac{103{,}838.7\ MM\ Btu}{317{,}023.1\ MM\ Btu} * 100\%$ = 32.8%

Biomass on an Annual Heat Basis = $\frac{106{,}267.7\ MM\ Btu}{317{,}023.1\ MM\ Btu} * 100\%$ = 33.5%

Liquid Fuel on an Annual Heat Basis = $\frac{29{,}440.8\ MM\ Btu}{317{,}023.1\ MM\ Btu} * 100\%$ = 9.3%

Light Liquid on an Annual Heat Basis = $\frac{29{,}440.8\ MM\ Btu}{317{,}023.1\ MM\ Btu} * 100\%$ = 9.3%

Distillate Oil on an Annual Heat Basis = $\frac{29{,}440.8\ MM\ Btu}{317{,}023.1\ MM\ Btu} * 100\%$ = 9.3%

Step 7: Determine the Boiler or Process Heater's Fuel Subcategories

Compare the percentage of each fuel classification on an annual heat input basis to the fuel subcategories identified in 40 CFR 63.7575 to limit the subcategory fuel classification that applies to this source.

Does this unit fall under the "designed to burn biomass/bio-based solid subcategory"?
Unit designed to burn biomass/bio-based solid subcategory includes any boiler or process heater that burns at least 10 percent biomass or bio-based solids on an annual heat input basis in combination with solid fossil fuels, liquid fuels, or gaseous fuels.

Answer: Yes. The unit burns 33.5% biomass on an annual heat input basis.

Does this unit fall under the "designed to burn liquid subcategory?
Unit designed to burn liquid subcategory includes any boiler or process heater that burns any liquid fuel, but less than 10 percent coal/solid fossil fuel and less than 10 percent biomass/bio-based solid fuel on an annual heat input basis, either alone or in combination with gaseous fuels. Units in the unit design to burn gas 1 or unit designed to burn gas 2 (other) subcategories that burn liquid fuel for periodic testing of liquid fuel, maintenance, or operator training, not to exceed a combined total of 48 hours during any calendar year are not included in this definition. Units in the unit design to burn gas 1 or unit designed to burn gas 2 (other) subcategories during periods of gas curtailment or gas supply interruption of any duration are also not included in this definition.

Answer: No. The unit burns 57.2% solid fossil fuels (32.8% coal) and 33.5% Biomass

Does this unit fall under the "designed to burn heavy liquid subcategory"?
Unit designed to burn heavy liquid subcategory means a unit in the unit designed to burn liquid subcategory where at least 10 percent of the heat input from liquid fuels on an annual heat input basis comes from heavy liquids.

Answer: No. The unit does not fall under the "designed to burn liquid subcategory" so it cannot fall under this category.

Note: If the unit did fall under the "designed to burn liquid subcategory", the unit does not burn any heavy liquid fuels (No. 2 Fuel oil is a light fuel) so it would still not fall under this category.

Does this unit fall under the "designed to burn light liquid subcategory"?
Unit designed to burn light liquid subcategory means a unit in the unit designed to burn liquid subcategory that is not part of the unit designed to burn heavy liquid subcategory.

Answer: No. The unit does not fall under the "designed to burn liquid subcategory" so it cannot fall under this category.

Note: If the unit did fall under the "designed to burn liquid subcategory", the unit would fall under this category because it did not fall under the unit designed to burn heavy liquid subcategory.

Does this unit fall under the "designed to burn gas 1 subcategory"?
Unit designed to burn gas 1 subcategory includes any boiler or process heater that burns only natural gas, refinery gas, and/or other gas 1 fuels. Gaseous fuel boilers and process heaters that burn liquid fuel for periodic testing of liquid fuel, maintenance, or operator training, not to exceed a combined total of 48 hours during any calendar year, are included in this definition.

Gaseous fuel boilers and process heaters that burn liquid fuel during periods of gas curtailment or gas supply interruptions of any duration are also included in this definition.

Note: Other gas 1 fuel means a gaseous fuel that is not natural gas or refinery gas and does not exceed a maximum concentration of 40 micrograms/cubic meters of mercury.

Answer: No. The unit does not burn natural gas, refinery gas, and/or other gas 1 fuels.

Does this unit fall under the "designed to burn gas 2 subcategory"?
Unit designed to burn gas 2 (other) subcategory includes any boiler or process heater that is not in the unit designed to burn gas 1 subcategory and burns any gaseous fuels either alone or in combination with less than 10 percent coal/solid fossil fuel, and less than 10 percent biomass/bio-based solid fuel on an annual heat input basis, and no liquid fuels. Gaseous fuel boilers and process heaters that are not in the unit designed to burn gas 1 subcategory and that burn liquid fuel for periodic testing of liquid fuel, maintenance, or operator training, not to exceed a combined total of 48 hours during any calendar year, are included in this definition. Gaseous fuel boilers and process heaters that are not in the unit designed to burn gas 1 subcategory and that burn liquid fuel during periods of gas curtailment or gas supply interruption of any duration are also included in this definition.

Answer: No. The unit does not burn gaseous fuels, burns 57.2% solid fossil fuels, and 33.5% biomass on an annual heat input basis. The boiler also burns liquid fuels.

Does this unit fall under the "designed to burn solid fuel subcategory"?
Unit designed to burn solid fuel subcategory means any boiler or process heater that burns only solid fuels or at least 10 percent solid fuel on an annual heat input basis in combination with liquid fuels or gaseous fuels.

Answer: Yes. The unit burns 90.7% solid fuels on an annual heat input basis.

The annual heat input review has resulted in this unit being in the designed to burn biomass bio-based solid fuel classification. Now review fuel subcategories identified in 40 CFR 63.7499 that include the equipment design to determine the specific subcategory that applies to this source. The following subcategories exist for biomass bio-based solid fuel units:

1. Stokers/sloped grate/other units designed to burn kiln dried biomass/bio-based solid
2. Fluidized bed units designed to burn biomass/bio-based solid
3. Suspension burners designed to burn biomass/bio-based solid
4. Fuel cells designed to burn biomass/bio-based solid
5. Hybrid suspension/grate burners designed to burn wet biomass/bio-based solid
6. Stokers/sloped grate/other units designed to burn wet biomass/bio-based solid
7. Dutch ovens/pile burners designed to burn biomass/bio-based solid