



Compliance Strategy Guide

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Understanding Industrial Boiler MACT: What it Means for Plants Burning Fossil Fuels and Biomass

1. Overview

1.1 Summary

This guide is designed to help make sense of the U.S. Environmental Protection Agency's proposed Maximum Achievable Control Technology (MACT) rules to further reduce emission of hazardous air pollutants (HAPs) from industrial and institutional boilers burning fossil fuels (coal and oil) or biomass (wood and wood products) to produce electricity for indirect process steam and/or for sale to the grid.

The new rules will apply differently depending on fuel burned and type of equipment used for hazardous air pollutant collection. This guide first explains which rule (if any) applies to a given boiler. The remaining sections discuss impact on all affected sources, impact only on Major Sources, and impact only on Area Sources. Finally, [a summary](#) outlines the best strategy for creating a compliance plan.

The discussion here involves just two of the EPA's proposed MACT rules; boilers in other industries, such as cement, are regulated separately. The EPA is also working in a new proposed MACT rule for utility boilers; a draft is expected out next spring.

1.2 When Do the New Rules Go Into Effect?

The public comment period for proposed industrial and institutional boiler **Major Source** and **Area Source** MACT rules closed August 23, 2010. The EPA will probably finish reviewing comments and publish a final version of the rules in the Federal Register by end of 2010. After that, existing sources will have three years to comply and new sources will have to comply immediately.

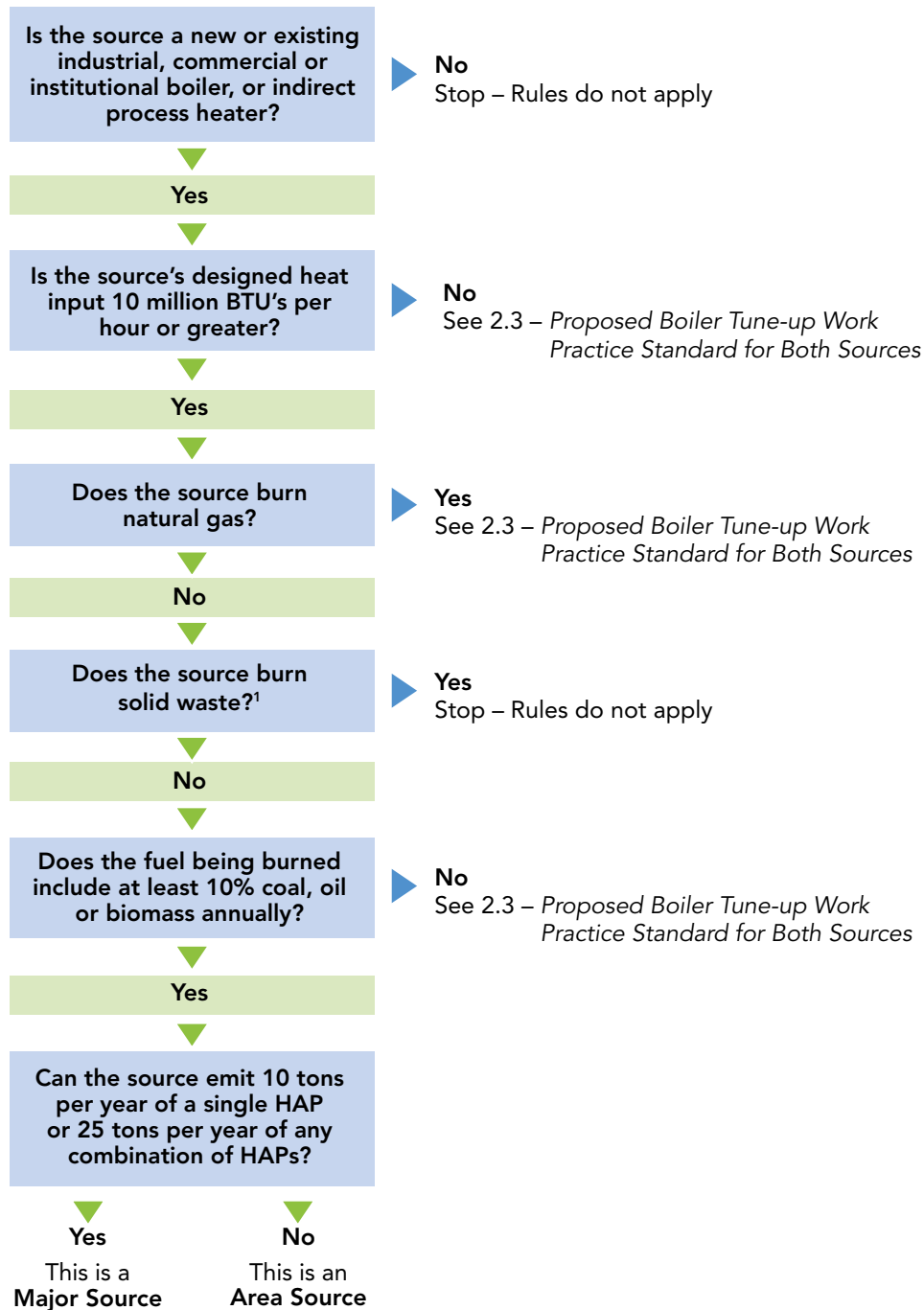
1.3 Does This Apply to Me?

The two proposed rules have similar titles, and similar content, but differ in some important ways. In general, the Major Source rule affects facilities with larger boilers and is more stringent than the Area Source rule. Both rules affect boilers with heat input capacity of 10 million BTUs per hour or greater (equivalent to burning about a half-ton of coal every 60 minutes).

A **Major Source** is any affected boiler that emits, or has the potential to emit, *10 tons per year (TPY) or more of a single HAP or 25 TPY of any combination of HAPs.*

An **Area Source** is any affected boiler that is not a Major Source.

The flowchart below spells out more specifically how to categorize a specific boiler.



1. For the EPA's definition of solid waste, see <http://www.epa.gov/epawaste/nonhaz/define/index.htm>.

2. Impact on Both Sources

2.1 Summary for Both Sources

Here are some general points to keep in mind about the proposed MACT rules, applying to **Major Sources** and **Area Sources**.

1. There is no allowance for startup, shutdown and malfunction (SSM); sources are expected to comply at all times, based on averaged daily or monthly emission levels. When malfunctions occur, the EPA will base its response in part on good faith preventative efforts and corrective actions.
2. Baseline testing is required to establish compliance with specified pollutant limits (particulate matter, mercury, carbon monoxide), and also to establish site-specific operating parameters (e.g. electrostatic precipitator voltage and current levels, wet scrubber flow rate) for equipment associated with proof of compliance.
3. Annual emission testing is required to demonstrate continued compliance with particulate matter (PM), mercury and carbon monoxide (CO) limits.
4. All sources affected by these rules must maintain daily records showing that no solid waste is burned.

Table 1 outlines a few other requirements for sources with particular characteristics.

Table 1 – Other Requirements for Major Sources and Area Sources

Description	Requirement(s)
<ul style="list-style-type: none"> • Source with heat input capacity greater than 100 million BTUs per hour 	Continuously monitor CO; maintain levels at or below applicable limit. (<i>Major Sources: See Table 4, page 8. Area Sources: see Table 5, page 10.</i>)
<ul style="list-style-type: none"> • Source with electrostatic precipitator (ESP) but no wet scrubber 	Maintain opacity at or below 10%, based on daily averages
<ul style="list-style-type: none"> • Source with wet scrubber 	Monitor differential pressure drop, liquid flow rate and pH; maintain daily block averages at or above standards established during baseline testing
<ul style="list-style-type: none"> • Source with baghouse and wet scrubber, but no continuous emission monitoring system (CEMS) 	Ensure that bag leak detection alarm does not sound more than 5% of the time during any 6-month period

2.2 One-Time Energy Assessment for Both Sources

Most existing Major and Area Sources are required to do a one-time, plant-wide energy assessment. The goal is to identify cost-effective energy conservation measures that can be taken to run a more efficient facility. The assessment must be done by professionals or engineers who are experts about all types of energy-using system processes and equipment.

The EPA's proposed rules do, however, include a "Work Practice Standard" for sources with heat input capacity less than 10 million BTUs per hour, allowing them to bypass the new emission limit and energy assessment requirements and instead do a boiler tune-up.

See 2.3 - *Proposed Boiler Tune-Up Work Practice Standard for Both Sources*.

Here's what the energy assessment involves:

- Visually inspect the boiler system.
- Establish unit characteristics – energy system specifications, operating/maintenance procedures, unusual operating constraints.
- Identify major energy consuming systems.
- Review architectural/engineering plans, operation/maintenance procedures and logs, fuel usage.
- Identify major energy conservation measures.
- Determine potential for energy savings.
- Prepare report detailing how efficiency can be improved, what it will cost, what benefits are for improvements, and timeframe for return on investment.

2.3 Proposed Boiler Tune-Up Work Practice Standard for Both Sources

A grandfather clause (the so-called Work Practice Standard) in the EPA's proposed rules provides some leniency for facilities with very small boilers (heat input capacity less than 10 million BTUs per hour).

For existing sources in this category that burn fossil fuels or biomass, neither the new emission standards nor the energy assessment apply; instead, these units can continue using generally available control technology (GACT) but must also do a boiler tune-up every two years and submit a report afterward detailing what was fixed, and how much/what type of fuel was burned during the previous 12 months. In most cases, this provision will apply only to Area Sources.

The Work Practice Standard also applies to natural/refinery gas-fired sources, but in that category an annual boiler tune-up is required.

Here's what the boiler tune-up involves:

- Inspect burners and clean/replace as needed.
- Inspect flame pattern and make adjustments needed to optimize, based on manufacturer specifications.
- Inspect air-to-fuel ratio system and calibrate as needed.
- Minimize CO emissions based on manufacturer specifications.
- Measure CO (parts per million by dry volume) and O₂ (percent dry) in the effluent stream before and after boiler adjustments.

For more about how GACT applies to Area Sources, see 4.3 – *Continuous Emission Monitoring for Area Sources*.

2.4 Emission Testing and Fuel Changes for Both Sources

Every year, and/or after any fuel change, sources must prove compliance either through fuel analysis or stack test. A “new fuel” is defined as either a different type of fuel, a new fuel mixture, or the same fuel from a different source.

As long as fuel is not changed after baseline emission testing, continued compliance may be proved by maintaining monthly fuel analysis records and submitting these annually to the EPA. Each new fuel must be analyzed to prove it will comply with limits established during the most recent stack test. If fuel analysis indicates that limits are exceeded, a new stack test is necessary.

3. Impact on Major Sources

3.1 Pollutant Categories for Major Sources

The MACT rule for Major Sources focuses on controlling emission not only of particulate matter (PM), mercury (Hg) and carbon monoxide (CO), but also hydrogen chloride (HCl) and dioxins/furans. This means that fuel analysis results for Major Sources must include details about chlorine (to comply with HCl requirement) in addition to mercury.

CEMS is required for some Major Sources to monitor pollutants. See 3.3 – *Continuous Emission Monitoring for Major Sources*.

Table 4 on page 8 spells out specific Major Source limits for each hazardous air pollutant category, depending on what type of fuel is burned.

3.2 Equipment Parameters and Baseline Emission Testing for Major Sources

As described in Section 2.1 – *Summary for Both Sources*, Major Sources must do baseline emission testing to demonstrate compliance with specified HAP limits (PM, mercury, CO, plus HCl and dioxins/furans). During this testing, pollution control equipment (e.g. ESP, wet scrubber) must be monitored to determine site-specific operating parameters (e.g. current and voltage levels, flow rate) associated with compliance.

Table 2 outlines what parameters must be recorded, depending on the type of pollution control equipment used.

Table 2 – Equipment Parameters to Record During Baseline Emission Testing for Major Source Boilers

Description	Requirement(s)
<ul style="list-style-type: none"> Source with baghouse and wet scrubber 	Measure pH (levels in effluent stream), pressure drop and liquid flow rate; average from three test runs establishes site-specific operating parameters for the wet scrubber
<ul style="list-style-type: none"> Source with ESP and wet scrubber 	Measure pH (levels in effluent stream), pressure drop and liquid flow rate of wet scrubber during HCl test; average from three test runs establishes site-specific operating parameters Measure ESP voltage and current during mercury and PM tests; average from three test runs establishes site-specific operating parameters
<ul style="list-style-type: none"> Source with dry scrubber or sorbent injection 	Measure injection rate of each sorbent during HCl, mercury and dioxins/furans tests; average from three test runs establishes site-specific minimum injection rate

3.3 Continuous Emission Monitoring for Major Sources

Because of the potential to be very significant pollutants, all Major Sources have some type of responsibility to monitor hazardous air pollutants continuously. Exactly what must be monitored, and how, varies depending on the capacity of the source boiler and what type of pollution control equipment is used. Specifics are summarized in Table 3.

Table 3 – Continuous Emission Monitoring for Major Source Boilers

Description	Requirement(s)
<ul style="list-style-type: none"> Heat input capacity = less than 250 million BTUs per hour Uses ESP but no wet scrubber 	Maintain daily average opacity below 10% Use 12-hour block averages (mercury or PM tests) to show compliance with ESP current and voltage limits
<ul style="list-style-type: none"> Heat input capacity = less than 250 million BTUs per hour Uses ESP and wet scrubber 	Maintain records in 12-hour block averages (pH, pressure drop, liquid flow rate) to show compliance with HCl limits Use 12-hour block averages (mercury or PM tests) to show compliance with ESP current and voltage limits
<ul style="list-style-type: none"> Heat input capacity = 250 million BTUs per hour or greater 	Use CEMS to prove compliance

3.4 Emission Limits by Pollutant Type for Major Sources

In Table 4, which spells out Major Source emission limits for specific hazardous air pollutant categories, the EPA divides Major Sources into the following subcategories.

- **Coal**

Source that burns at least 10% coal annually.

- **Biomass**

Source that burns at least 10% biomass annually, and less than 10% coal annually.

- **Liquid**

Source that burns at least 10% liquid fuel (e.g. distillate oil, residual oil) annually, and less than 10% solid fuel annually.

- **Gas**

Source that that burn gaseous fuel and less than 10% liquid or solid fuel annually.

Table 4 – Emission Limits by Pollutant Type for Major Sources

Subcategory	Particulate Matter (PM) ¹ Lbs/MM BTU	Hydrogen Chloride (HCL) ² Lbs/MM BTU	Mercury Lbs/MM BTU	Carbon Monoxide (CO) ³ PPM @ 3% O ₂	Dioxins/Furans Toxic equivalents (TEQ), NG/DSCM
Existing Coal Stoker	0.02	0.02	0.000003	50	0.003
Existing Coal Fluidized Bed	0.02	0.02	0.000003	30	0.002
Existing Pulverized Coal	0.02	0.02	0.000003	90	0.004
Existing Biomass Stoker	0.02	0.006	0.0000009	250	0.02
Existing Biomass Fluidized Bed	0.02	0.006	0.0000009	250	0.02
Existing Biomass Suspension Burner / Dutch Oven	0.02	0.006	0.0000009	1010	0.03
Existing Biomass Fuel Cells	0.02	0.006	0.0000009	270	0.02
Existing Liquid	0.004	0.0009	0.000004	1	0.002
Existing Gas (Other Process Gases)	0.05	0.000003	0.0000002	1	0.009
New Coal Stoker	0.001	0.00006	0.000002	7	0.003
New Coal Fluidized Bed	0.001	0.00006	0.000002	30	0.00003

Source: “National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers; Proposed Rule,” docket number EPA-HQ-OAR-2002-0058, published June 4, 2010.

Notes

1. PM is substituted for non-mercury metals, because these metals tend to appear in particulate form.
2. HCl is substituted for hydrochloric acid, hexachlorobenzene, and polychlorinated byphenyls.
3. CO is substituted for polycyclic organic matter (POM), because CO is an indication of poor or incomplete combustion, which results in emission of hydrocarbons.

4. Impact on Area Sources

4.1 Pollutant Categories for Area Sources

The MACT rule for Area Sources focuses on controlling emission of particulate matter (PM), mercury (Hg) and carbon monoxide (CO).

Table 5 on page 10 spells out specific Area Source limits for each hazardous air pollutant category, depending on what type of fuel is burned.

4.2 Emission Testing Requirements and Fuel Changes for Area Sources

As explained in Section 2.4 – *Emission Testing and Fuel Changes for Both Sources*, Area Sources must control and report on specific pollutants (see Table 5 on page 10) annually and/or after fuel changes.

4.3 Continuous Emission Monitoring for Area Sources

Area Sources with heat input capacity of more than 100 million BTUs per hour (roughly five tons of coal burned every 60 minutes) must monitor CO continuously and maintain acceptable levels based on daily averages. (For Area Sources with smaller boilers, annual testing for CO emission is acceptable.)

The EPA *might* modify its proposed Area Source MACT rule and allow sources with small boilers (heat input capacity less than 10 million BTUs per hour) with 12-inch or smaller stack diameters to use generally available control technologies (GACT) instead of CEMS, in cases where CEMS would otherwise be required. (On such small stacks, it's difficult or impossible to use CEMs.) Instead, results from fuel analysis would be used to demonstrate compliance.

It's not certain the EPA will include this provision, though, so Area Sources should go ahead with plans to comply with CEMS requirements in the rule now under review.

4.4 Emission Limits by Pollutant Category for Area Sources

In Table 5, which spells out Area Source emission limits for specific hazardous air pollutant categories, the EPA divides Area Sources into the following subcategories.

- **Coal**

Source that burns at least 10% coal annually

- **Biomass**

Source that burns biomass alone or in combination with a liquid or gaseous fuel

- **Oil**

Source that burns oil alone or in combination with a gaseous fuel

Table 5 – Emission Limits by Pollutant Type for Large¹ Area Sources

Source	Subcategory	Particulate Matter (PM) ² Lbs/MM BTU	Mercury Lbs/MM BTU	Carbon Monoxide (CO) ³ PPM
New Boiler	Coal	0.03	3.0E-06	310 (at 7% oxygen)
	Biomass	0.03	N/A	100 (at 7% oxygen)
	Oil	0.03	N/A	1 (at 3% oxygen)
Existing Boiler	Coal	N/A	3.0E-06	310 (at 7% oxygen)
	Biomass	N/A	N/A	160 (at 7% oxygen)
	Oil	N/A	N/A	2 (at 3% oxygen)

Source: “National Emission Standards for Hazardous Air Pollutants for Area Sources: Industrial, Commercial, and Institutional Boilers; Proposed Rule,” docket number EPA-HQ-OAR-2006-0790, published June 4, 2010.

Notes

1. Large Area Source Boiler: heat input capacity of 10 million BTUs per hour or greater.
2. PM is substituted for non-mercury metals, because these metals tend to appear in particulate form.
3. CO is substituted for polycyclic organic matter (POM), because CO is an indication of poor or incomplete combustion, which results in emission of hydrocarbons.

Summary

A holistic, scenario planning-based approach is best for complying with new MACT rules. To make smart, educated decisions, it’s necessary to understand *all* variables that impact compliance—from the fuel to the stack. The performance of front-end equipment like coal mills and air heaters can have a significant impact on back-end emission control equipment and, ultimately, pollutant levels exiting the stack. Only with an understanding of these connections, based on representative and comparative data, is it possible to define achievable goals and choose the highest performance, lowest-cost, most flexible options.

The first step is baseline testing which, if well-planned and executed, creates linked combustion and efficiency data that can be used in effective compliance scenario planning. This requires data collection beyond the requirements outlined above.

Such an approach requires multiple steps which, if followed completely and in order, result in a clear picture of existing conditions, necessary conditions, and how to get there. This process has five phases:

1. Collect representative data about baseline conditions
2. Analyze and compare the meaning of baseline data sets
3. Accurately model the effects of different options
4. Assess the costs and benefits of available options
5. Formulate and execute a plan of action for compliance

The timeframe for compliance is short, and the stakes are high. Good planning and execution during the data collection and analysis phase enables accurate modeling and scenario planning, revealing the most cost-effective compliance strategy.

Comments

We invite you to share your thoughts about boiler MACT in general and this guide in particular. Please send comments to Mae Kowalke, MaeK@neundorfer.com.

About the authors

Marlin Anderson, Senior Environmental Consultant, joined Neundorfer in 2007 and has more than 30 years experience in the air pollution control industry. His areas of specialty include gas flow modeling, troubleshooting electrostatic precipitator performance, in situ testing of gas flow distribution, ash resistivity lab testing and process evaluation. He has authored or co-authored papers and reports on the evaluation of new technologies and particulate control devices. Marlin holds a B.A. in physics and mathematics from Huntingdon College and a Ph.D. in physics from Auburn University.

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