San Joaquin Valley
Unified Air Pollution Control District

Best Available Control Technology (BACT) Guideline 8.3.11*

Emissions Unit: Laser or Plasma Metal Cutting System **Industry Type:** Multiple
Equipment Rating: All **Last Update:** May 20, 2024

Pollutant	Achieved in Practice or contained in SIP	Technologically Feasible	Alternate Basic Equipment
PM10	>99.9% Control Efficiency (Fume or dust collector with HEPA after-filter, HEPA Dust Collector, Fabric Filter Baghouse with Minimum Efficiency Reporting Value (MERV) 17, or Equiv.)		

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

***This is a Summary Page for this Class of Source**

Proactive Best Available Control Technology Analysis

District BACT Guideline 8.3.11

Laser or Plasma Metal Cutting System

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I. Introduction

The objective of this project is to proactively update the Best Available Control Technology (BACT) guideline 8.3.11, which covers laser cutting system operations. This guideline was last updated on November 13, 2008, and was rescinded August 16, 2023.

This proactive update is necessary to incorporate the most stringent emission control standards that have been achieved in practice. Furthermore, the proactive update to this BACT guideline will bring consistency in implementing the BACT standard throughout the regional offices of the District for new and modified laser cutting system operations triggering BACT. The discussion in this document will be limited to the following items:

- Source of emissions
- Top-Down BACT Analysis for each pollutant
- Recommendation

II. Source of emissions

In laser cutting, a beam of light is used as a heat source to both melt and vaporize material in its path. Assist gases are also used to aid in additional heat generation and material removal. The assist gases are supplied at various pressures, depending upon the process. The normal operating range is usually 50 to 100 psig. As a result, a very narrow and consistent path or “kerf” is created.

The metal fumes (small particulates) will be generated from the cutting operations and all of the vapors will be classified as PM10 (particulate matter with a mean aerodynamic diameter of 10 microns or less). A large percentage of the metal removed by the laser cutter will be collected below the cutting table. This waste metal is known as “slag” or “dross” and is not particulate matter.

This proactive BACT determination will focus exclusively on PM10 emissions from the laser metal cutting operation.

III. Top-Down BACT Analysis

BACT analysis for PM10 Emissions

As explained earlier, PM10 is emitted as fumes generated from laser metal cutting operations.

<u>Step 1 - Identify All Possible Control Technologies</u>

The following BACT clearinghouse references were reviewed to determine whether any laser metal cutting operations have been required to employ PM10 controls:

– EPA RACT/BACT/LAER clearinghouse
– CARB BACT clearinghouse
– South Coast AQMD (SCAQMD) BACT clearinghouse
– Bay Area AQMD (BAAQMD) BACT clearinghouse
– Sacramento Metro AQMD (SMAQMD) BACT clearinghouse
– San Diego AQMD (SDAQMD) BACT clearinghouse
– San Joaquin Valley APCD (SJVAPCD) BACT clearinghouse

Also, Rules and Regulations of the above references were reviewed to identify any emission limits that could be considered more stringent than the current District BACT requirements for laser cutting system operations. The following is a summary of the findings:

A. Survey of BACT Guidelines:

The EPA RACT/BACT/LAER clearinghouse does not include general guidelines. No results were found for laser cutting operations.

The CARB BACT clearinghouse does not include general guidelines, only individual determinations made by individual air districts. The relevant data is shown in the table below:

Application/ Permit No.	**Air District**	**Control Method & Control Efficiency (CE)**	**PM10 Limit**
24729	SMAQMD	HD Plasma Cutter CE – 99.9%	Not specified

The SCAQMD BACT clearinghouse does not include any BACT requirements for the source category and class.

The BAAQMD BACT clearinghouse does not include any BACT requirements for the source category and class.

The SDAQMD clearinghouse does not include any BACT requirements for the source category and class.

The SJVAPCD clearinghouse contains currently rescinded BACT guideline. Previous BACT requirements were >99.9% Control Efficiency (HEPA Dust Collector, Fabric Filter Baghouse, or Equivalent).

Summary of BACT Guidelines:

Based on the above information, the current most stringent BACT emissions limitation for laser cutting system operations would be:

- >99.9% Control Efficiency (Fume or dust collector with HEPA after-filter, HEPA Dust Collector, Fabric Filter Baghouse with Minimum Efficiency Reporting Value (MERV) 17, or Equiv.)

What are MERV Ratings?

MERV stands for “Minimum Efficiency Reporting Value”[1]. This system of rating air filters was created by the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE). MERV ratings range from 1 to 20 and report a filter's ability to capture particles between 0.3 and 10 microns (µm). MERV rating is helpful in comparing the performance of different filters. The higher the MERV rating, the more particles a filter will catch.

The standard baghouse filters have MERV ratings between 1 and 16, whereas HEPA filters have MERV ratings between 17 and 20.

What are HEPA Filters?

HEPA is a type of pleated mechanical air filter. It is an acronym for "High Efficiency Particulate Air" or "High Efficiency Particulate Arrestance". This acronym refers to a filter that is manufactured, tested, certified, and labeled in accordance with current HEPA filter standards set by ASHRAE and the US Department of Energy[2] (DOE).

Air filters must satisfy certain standards of efficiency – most commonly those developed by the US Department of Energy (DOE) – in order to qualify as a HEPA filter. The US standard (DOE-STD-3020-2015[3]) requires that a HEPA filter be capable of removing 99.97% of contaminant particles 0.3 µm in diameter. Most standards also specify that HEPA filters must feature minimal pressure drop and maximum airflow when in operation.

Particle Size and Filtration Method[4]

While the US HEPA standard usage of 0.3 micrometer particles to describe efficiency may seem arbitrary, particles of this size are actually the most difficult to

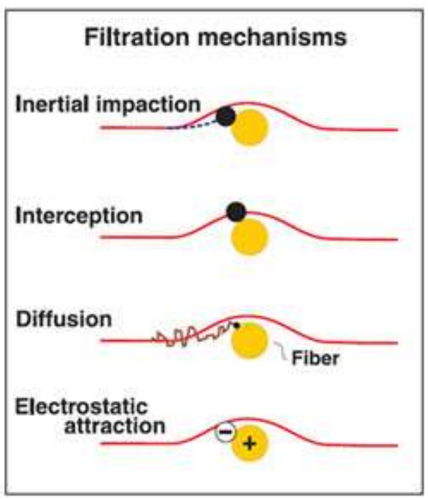
[1] https://www.epa.gov/indoor-air-quality-iaq/what-merv-rating-1
[2] https://www.standards.doe.gov/standards-documents/3000/3020-astd-2015
[3] https://www.standards.doe.gov/standards-documents/3000/3020-astd-2015/@@images/file
[4] https://www.globalspec.com/learnmore/manufacturing_process_equipment/filtration_separation_products/hepa_filters_ulpa_filters

filter, rendering them a kind of "worst-case scenario" reference particle. The reasons for this difficulty in filtration are described below.

HEPA filter media is made up of countless randomly-arranged fibers which together form a dense mat; when air flows through the filter, the media captures and contains contaminant particles throughout its depth. The ultra-fine, glass-fiber medium captures microscopic particles that can easily pass through the standard filters by a combination of interception, inertial impaction, and diffusion as described below:

- **Interception** takes place when a contaminant particle passes within the distance equal to one particle's radius of a filter fiber, resulting in it touching the fiber and being removed from the airflow. Particles further than one particle radius from a fiber will not be trapped.
- **Inertial impaction** occurs when a large particle, unable to adjust to the change in air direction near a filter fiber, becomes trapped on the fiber. The particle's inertia ensures that it continues along its original path instead of circumventing the fiber, resulting in its capture.
- **Diffusion** relies on the Brownian motion of gas particles. Small particles (typically 0.1 µm or less) tend to travel on a streamline in an erratic fashion, making random motions as they interact with gas molecules. This erratic motion causes the contaminant particles to become stuck to filter fibers.

These filtration mechanisms are illustrated below:



The diameter specification of 0.3 microns responds very closely with the worst case, i.e., the most penetrating particle size (MPPS). Particles that are larger or smaller are trapped with even higher efficiency. Particles less than 0.1 micrometers are easily trapped due to diffusion while particles larger than 0.4 micrometers are trapped by inertial impaction. Particles between 0.1 and 0.4 µm are therefore too large for effective diffusion and too small for inertial impaction and efficient interception, so that the filter's efficiency drops within this range. By specifying a HEPA filter's efficiency at 0.3 µm, standards bodies are really describing a variant of the filter's *minimum efficiency*, as illustrated below:

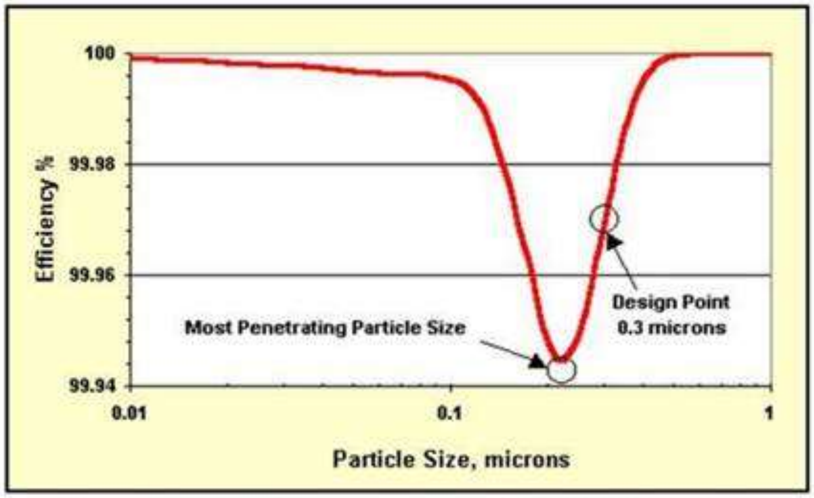


Figure 1: *Typical Performance of a HEPA 99.97% Filter.*

As illustrated above, if a filter can achieve a minimum 99.97% efficiency of particulate matter ≥0.3 microns (PM0.3), its efficiency for PM10 must be much higher. However, a minimum control efficiency of 99.97% will be assumed for PM10 emissions as a worst case.

Since HEPA filters cost more than standard filters, a typically configuration is to use a standard baghouse discharging into a HEPA after filter. Therefore, updated BACT will reflect 'HEPA filtration system'.

Additionally, there may be equivalent filtration classification, e.g., Ultra-Low Particulate (or sometimes "penetration") Air (ULPA) filters are closely related to HEPA filters but are even more efficient. ULPA filters are specified to remove 99.999% of contaminants 0.12 micron or larger in diameter[5]. An H13 rated filter can achieve a minimum 99.95% efficiency at 0.2 microns, or MPPS. An H14 rated filter can achieve a minimum 99.995% efficiency at 0.2 microns, or MPPS.

B. Survey of Applicable Rules and Regulations:

None of the rules surveyed contained any requirements that could be considered more stringent than the BACT requirement identified in Section III above.

[5] https://www.globalspec.com/learnmore/manufacturing_process_equipment/filtration_separation_products/hepa_filters_ulpa_filters

Step 2 - Eliminate Technologically Infeasible Options

There are no technologically infeasible options listed in Step 1. The only emission control option under consideration is based on the current BACT requirements. Therefore, no further discussion is required.

Step 3 - Rank Remaining Control Technologies by Control effectiveness

The only PM10 emission control technology option under consideration is also achieved in practice. Therefore, ranking is not necessary.

Step 4 - Cost Effectiveness Analysis

The only PM10 emission control technology option under consideration is also achieved in practice. Therefore, a cost effectiveness analysis is not necessary.

Step 5 - Select BACT

This is a proactive determination that is not part of a specific permitting action. Therefore, selecting BACT is not necessary. However, the following PM10 emission control option has been determined to be achieved in practice and is therefore determined to be BACT for laser cutting operations:

- >99.9% Control Efficiency (Fume or dust collector with HEPA after-filter, HEPA Dust Collector, Fabric Filter Baghouse with Minimum Efficiency Reporting Value (MERV) 17, or Equiv.)

IV. Recommendation

Therefore, it is recommended to adopt the BACT requirements for PM10 as identified above.

Appendix
Appendix A: Draft BACT Guideline
Appendix B: Current BACT Guideline 8.3.11

Appendix A
Draft BACT Guideline

San Joaquin Valley
Unified Air Pollution Control District

Best Available Control Technology (BACT) Guideline 8.3.11*

Emissions Unit: Laser or Plasma Metal Cutting System
Industry Type: Multiple
Equipment Rating: All
Last Update: TBD

Pollutant	Achieved in Practice or contained in SIP	Technologically Feasible	Alternate Basic Equipment
PM10	>99.9% Control Efficiency (Fume or dust collector with HEPA after-filter, HEPA Dust Collector, Fabric Filter Baghouse with Minimum Efficiency Reporting Value (MERV) 17, or Equiv.)		

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Appendix B
Rescinded BACT Guideline 8.3.11

San Joaquin Valley
Unified Air Pollution Control District

Best Available Control Technology (BACT) Guideline 8.3.11*

Last Update: 8/16/2023

Laser Cutting System *RESCINDED*

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

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