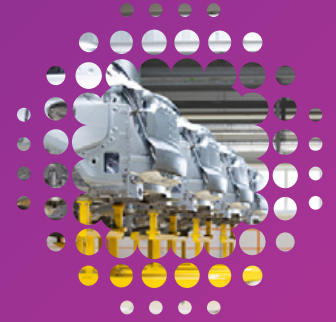
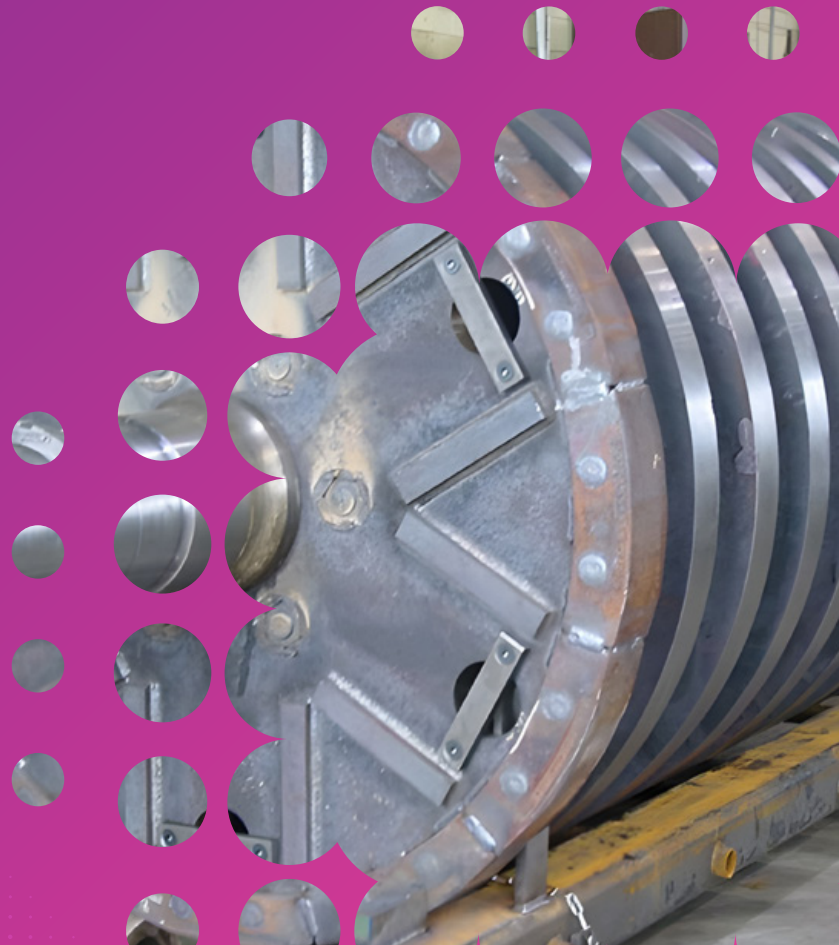
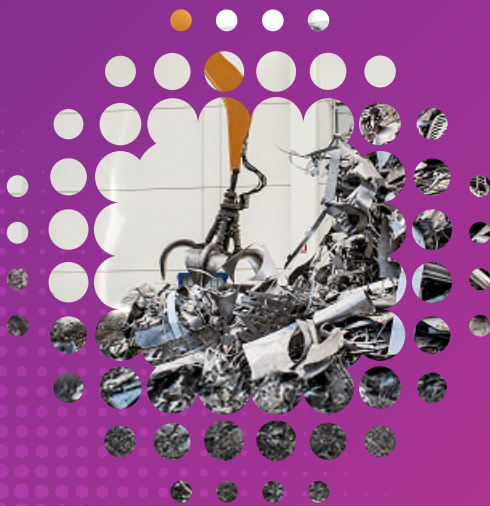


ReMA GUIDE



VOC EMISSIONS GUIDANCE FOR METAL SHREDDERS



Recycled Materials
Association

Sustainable. Resilient. Essential.

Updated December 2023

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SECTION 1

Introduction

This document was prepared under the authorization of ReMA to provide technical guidance to member facilities regarding the calculation, permitting, and measurement of volatile organic compound (VOC) emissions from metal shredder operations. This document replaces guidance provided in the 1996 Versar Title V Applicability Workbook (Versar Report)¹ regarding metal shredder VOC emissions and potential air permitting implications. The Versar Report reflected the industry's understanding at the time of its publication that shredder VOC emissions² were negligible. The guidance regarding metal shredder VOC emissions factors provided in the Versar Report is no longer supported by ReMA.

1.1 PURPOSE

The primary purpose of this document is to provide general guidance to operators when calculating VOC emissions from metal shredders. Secondly, this document provides an overview of Clean Air Act (CAA) air permitting requirements associated with VOC emissions and includes a discussion of VOC stack testing methods. The document is targeted to the shredder community, particularly company and facility resources that are responsible for compliance with federal, state, and local air quality regulations. Site-specific practices and conditions at shredder operations can vary, and differences in operating practices may influence how VOC emissions are calculated for individual facilities. ReMA recommends that shredder operators consult with qualified environmental professionals (e.g. lawyers and/or consultants) that are familiar with state and local VOC air permitting requirements for specific shredder locations to address shredder emissions permitting and testing considerations.

¹ Versar, Inc., Title V Applicability Workbook, prepared for ReMA, dated 1996.

² The published metal shredder VOC emissions factor listed in Table D-11.F of the Versar Report is being replaced through this document.



1.2 ORGANIZATION

The document includes the following sections:

- ☒ **SECTION 1: Introduction** — Discusses the purpose and content of this document.
- ☒ **SECTION 2: Volatile Organic Compounds** — Describes background information on VOC emissions from metal shredders and how VOC emissions are regulated.
- ☒ **SECTION 3: Shredder Potential to Emit** — Provides an overview of the potential to emit (PTE) of VOC emissions for shredders and describes approaches for shredder operators to establish enforceable VOC emissions limitations.
- ☒ **SECTION 4: VOC Permitting Requirements** — Provides an overview of air permit programs, possible air permit obligations, and available air permitting options for facilities.
- ☒ **SECTION 5: Potential Source Control for VOC Emissions** — Provides an overview of source control as a means to potentially minimize VOC emissions from metal shredders.
- ☒ **SECTION 6: Source Sampling for Shredder VOC Emissions** — Provides a general overview of VOC stack sampling methods and guidance for identifying appropriate VOC sampling methodology for shredder operations.
- ☒ **APPENDIX A: Development of VOC Emissions Factors for Metal Shredders** — Provides a report entitled “Development of Volatile Organic Compounds (VOC) Emissions Factors for Metal Shredders,” which describes how the authors evaluated available metal shredder VOC emissions test results and used those results to develop general VOC emissions factors for metal shredders processing typical feed materials.
- ☒ **APPENDIX B: Stack Test Method Descriptions** — Provides a general description of VOC stack testing methods that can be utilized to measure VOC emissions from a metal shredder, if it is determined that stack testing is appropriate.



SECTION 2

Volatile Organic Compounds

As generally defined, VOCs are organic compounds exhibiting a high vapor pressure and low water solubility.³ Examples of substances that typically include VOC in their formulation include petroleum-based fuels, lubricants, industrial solvents, and surface coatings. VOCs are typically emitted from many industrial processes as vapors but in certain processes can also be emitted as aerosol mist. This section provides a discussion of the regulatory definition of VOC, possible sources of VOC emissions from shredders, VOC calculation methods, and VOC air quality regulatory considerations.

2.1 VOLATILE ORGANIC COMPOUND DEFINITION

The Federal regulatory definition of VOC found at 40 Code of Federal Regulations (C.F.R.) § 51.100(s) is:

Volatile organic compounds (VOC) means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions.

(1) This includes any such organic compound other than the following, which have been determined to have negligible photochemical reactivity: Methane; ethane; methylene chloride (dichloromethane); 1, 1, 1-trichloroethane (methyl chloroform); 1, 1, 2-trichloro-1, 2, 2-trifluoroethane (CFC- 113); trichlorofluoromethane (CFC- 11); dichlorodifluoromethane (CFC- 12); chlorodifluoromethane (HCFC-22); trifluoromethane (HFC-23); 1,2-dichloro 1, 1, 2, 2-tetrafluoroethane (CFC- 114); chloropentafluoroethane (CFC- 115); 1, 1, 1-trifluoro 2, 2-dichloroethane (HCFC- 123); 1, 1, 1, 2-tetrafluoroethane (HFC- 134a); 1, 1-dichloro 1-fluoroethane (HCFC- 141b); 1-chloro 1, 1-difluoroethane (HCFC- 142b); 2-chloro- 1, 1, 1, 2-tetrafluoroethane (HCFC- 124); pentafluoroethane (HFC- 125); 1, 1, 2, 2-tetrafluoroethane (HFC- 134); 1, 1, 1-trifluoroethane (HFC- 143a); 1, 1-difluoroethane (HFC- 152a); parachlorobenzotrifluoride (PCBTF); cyclic, branched, or linear completely methylated siloxanes; acetone; perchloroethylene (tetrachloroethylene); 3, 3-dichloro- 1, 1, 1, 2, 2-pentafluoropropane (HCFC-225ca); 1, 3-dichloro- 1, 1, 2, 2, 3-pentafluoropropane (HCFC-225cb); 1, 1, 1, 2, 3, 4, 4, 5, 5, 5-decafluoropentane (HFC 43- 10mee); difluoromethane (HFC-32); ethylfluoride (HFC- 161); 1, 1, 1, 3, 3, 3-hexafluoropropane (HFC-236fa); 1, 1, 2, 2, 3-pentafluoropropane (HFC-245ca); 1, 1, 2, 3, 3-pentafluoropropane (HFC-245ea); 1, 1, 1, 2, 3-pentafluoropropane (HFC-245eb); 1, 1, 1, 3, 3-pentafluoropropane (HFC-245fa); 1, 1, 1, 2, 3, 3-hexafluoropropane (HFC-236ea); 1, 1, 1, 3, 3-pentafluorobutane (HFC-365mfc); chlorofluoromethane (HCFC- 31); 1 chloro- 1-fluoroethane (HCFC- 151a); 1, 2-dichloro- 1, 1, 2-trifluoroethane (HCFC- 123a); 1, 1, 1, 2, 2, 3, 3, 4, 4-nonafluoro-4-methoxy-butane ($C_4F_9OCH_3$ or HFE-7100); 2-(difluoromethoxymethyl)- 1, 1, 1, 2, 3, 3, 3-heptafluoropropane ($(CF_3)_2CF_2OCH_3$); 1-ethoxy- 1, 1, 2, 2, 3, 3, 4, 4, 4-nonafluorobutane ($C_4F_9OC_2H_5$ or HFE-7200); 2-(ethoxydifluoromethyl)- 1, 1, 1, 2, 3, 3, 3-heptafluoropropane ($(CF_3)_2CF_2OC_2H_5$); methyl acetate; 1, 1, 1, 2, 2, 3, 3-heptafluoro-3-methoxy-propane ($n-C_3F_7OCH_3$, HFE-7000); 3-ethoxy- 1, 1, 1, 2, 3, 4, 4, 5, 5, 6, 6, 6-dodecafluoro-2-trifluoromethyl) hexane (HFE-7500); 1, 1, 1, 2, 3, 3, 3-heptafluoropropane (HFC 227ea); methyl formate ($HCOOCH_3$); 1, 1, 1, 2, 2, 3, 4, 5, 5, 5-decafluoro-3-methoxy-4-trifluoromethyl-pentane (HFE-7300); propylene carbonate;

³ See: U.S. EPA Indoor Air Quality, <https://www.epa.gov/indoor-air-quality-iaq/what-are-volatile-organic-compounds-vocs>



dimethyl carbonate; trans-1,3,3,3-tetrafluoropropene; HCF₂OCF₂H (HFE-134); HCF₂OCF₂OCF₂H (HFE-236cal2); HCF₂OCF₂CF₂OCF₂H (HFE-338pcc 13); HCF₂OCF₂OCF₂CF₂OCF₂H (H-Galden 1040x or H-Galden ZT 130 (or 150 or 180)); trans 1-chloro-3,3,3-trifluoroprop-1-ene; 2,3,3,3-tetrafluoropropene; 2-amino-2-methyl-1-propanol; t-butyl acetate; 1,1,2,2-Tetrafluoro-1-(2,2,2-trifluoroethoxy) ethane; cis-1,1,1,4,4,4-hexafluorobut-2-ene (HFO-1336mzz-Z); and perfluorocarbon compounds which fall into these classes:

- (i) Cyclic, branched, or linear, completely fluorinated alkanes;*
- (ii) Cyclic, branched, or linear, completely fluorinated ethers with no unsaturations;*
- (iii) Cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations; and*
- (iv) Sulfur containing perfluorocarbons with no unsaturations and with sulfur bonds only to carbon and fluorine.*

The definition of VOC in 40 C.F.R. § 51.100(s) is clearly limited to species that “participate[s] in atmospheric photochemical reactions.” As referenced herein, if a shredder uses stack testing to determine potential VOC emissions, there may be organic materials present in the shredder feed material that, if emitted, could be collected and quantified as VOC by the stack test method even though that specific organic material is not photochemically reactive, and therefore not a VOC by regulatory definition. Total VOC measurements that generally include all hydrocarbons present in an exhaust stream may incorrectly overstate regulated VOC emissions by including compounds that are VOC exempt and/or non-photochemically reactive in the measured VOC concentration. ReMA recommends consulting with a qualified environmental professional to assist in correcting the level of VOC emissions that may be incorrectly overstated based on stack testing results.

2.2 VOLATILE ORGANIC COMPOUNDS EMITTED FROM METAL SHREDDING OPERATIONS

VOC emissions from metal shredders are presumably related to residual organic materials that may be present in shredder feed materials. Residual organic liquids that may be present in end-of-life vehicle (ELV) shredder feed materials can include lubricants (e.g., motor oil, etc.), hydraulic fluids (e.g., brake fluid, etc.), and fuel (e.g., gasoline, etc.). These organic liquids can have varying degrees of VOC content, from refined oils with limited levels of VOC to gasoline, which is comprised of a broad mixture of hydrocarbons that meet the regulatory VOC definition.

Source control⁴ methods used by facilities and raw material providers to substantially reduce the level of fluids in feed material prior to shredding can substantially reduce, but are unlikely to completely eliminate VOC emissions from metal shredders. Certain organic fluids (e.g., gasoline), if residually present, can evaporate and emit VOC during the metal shredding process. The fate of other organic fluids (e.g., motor oil) are not well understood with various fractions potentially

⁴ “Source control” is a term used by the industry to generally describe pollution prevention measures to remove materials (e.g., lubricants, fuel, fluids, etc.) from shredder feed materials prior to processing in the shredder.



carried out of the shredder with product or auto shredder residue, emitted as VOC, or emitted as aerosol mist, depending upon shredder operating conditions. The use of water and/or other material addition to the shredder box, commonly used as a method to moderate shredder box temperature, may also act to reduce the release of VOC from residual organic liquids in the feed and to reduce the release of particulate matter (PM) emissions by keeping the feed material wet.

2.3 VOC AIR QUALITY REGULATIONS

The following sections present a brief overview of air quality regulations associated with VOC emissions.

2.3.1 National Ambient Air Quality Standards

VOC emissions from stationary sources may be regulated at the federal, state, and local level. While VOC emissions are not regulated as a “criteria” air pollutant under the CAA, both VOC and nitrogen oxides (NOX) are regulated as precursors to the formation of ground level ozone, which is a criteria pollutant. As precursors to ozone formation, VOC and NOX can participate in complex photochemical reactions in the atmosphere in the presence of sunlight to form ozone.⁵ U.S. EPA has established national ambient air quality standards (NAAQS) for six criteria pollutants,⁶ including ozone.⁷

U.S. EPA establishes whether areas are attaining the NAAQS and the degree of NAAQS nonattainment primarily through regional ambient air quality monitoring stations. The ozone attainment status and the degree of ozone nonattainment of an area are key factors that can impact how new and modified metal shredders are permitted and the method of VOC emission reduction that may be required for new or modified facilities. The U.S. EPA Greenbook⁸ identifies current areas that are not attaining the ozone NAAQS and their respective degree of nonattainment.

⁵ Final Ozone NAAQS Regulatory Impact Analysis, Chapter 2: Characterizing Ozone and Modeling Tools Used in This Analysis. Pg. 2-1; https://www.epa.gov/sites/default/files/2020-07/documents/naaqs-o3_ria_final_2008-03.pdf

⁶ The six criteria pollutants are particulate matter, ground-level ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead, <https://www.epa.gov/criteria-air-pollutants>

⁷ The current (2015) ozone NAAQS is 70 parts per billion (ppb) based on an 8-hour averaging period. The U.S. EPA is obligated to review each NAAQS every five years. A reduced ozone NAAQS could result in newly designated ozone nonattainment areas and more restrictive levels of nonattainment in current ozone nonattainment areas, which would result in more stringent VOC permitting requirements in those affected areas.

⁸ <https://www.epa.gov/green-book>

2.3.2 State Implementation Plans

Individual states⁹ are required to develop and implement state implementation plans (SIPs), subject to U.S. EPA approval, to implement, maintain, and enforce the NAAQS. SIPs¹⁰ in general, must address specific provisions that include emissions limitations, control measures, ambient monitoring programs, enforcement provisions, and permitting requirements. U.S. EPA develops Control Techniques Guidelines (CTGs) and Alternative Control Techniques documents¹¹ that form the basis for many states' air quality regulations for VOC. Certain states include "generic" VOC rules in their SIPs that may apply to non-CTG sources. Some states may also regulate certain VOC species as volatile hazardous air pollutants (HAP) or toxic air pollutants that could require air quality modeling depending on their estimated concentration or level in regulated emissions. Each state air pollution control agency's website identifies and provides access to relevant rules and guidance documents that can help determine what VOC air quality regulations may apply. ReMA recommends that shredder operators retain qualified environmental professionals to assist them in evaluating possible air regulations and air permit requirements related to potential VOC emissions.

⁹ The use of the term "state" or "states" herein includes state, local, and tribal air quality regulatory authorities.

¹⁰ SIPs may include VOC-specific regulations that apply to certain industrial source types or operations and may include emissions limits, work practices, and/or control technology requirements.

¹¹ <https://www.epa.gov/ground-level-ozone-pollution/control-techniques-guidelines-and-alternative-control-techniques>



SECTION 3

Shredder Potential to Emit

A facility's PTE for VOC is a key factor when evaluating possible construction and operating air permitting requirements. Under programs such as New Source Review (NSR) and Title V, any regulated VOC emissions that could reasonably be collected (referred to as non-fugitive emissions) should be counted towards total VOC emissions even if the operation is not currently enclosed and/or the emissions are not currently collected. Under these air permit programs; fugitive emissions may not need to be included when evaluating air permitting applicability. There are many relevant factors in determining whether emissions can be reasonably collected, and such determinations are made on a case-by-case basis. Under certain other air program requirements (including state minor source programs), fugitive emissions may need to be accounted for in the air permitting process. Therefore, the characterization of VOC emissions as fugitive or non-fugitive must be considered when determining PTE for VOC for a facility. This section addresses how PTE is defined, establishing VOC PTE for metal shredders, whether a facility is considered a major¹² source of VOC, and common approaches to restrict the VOC PTE for metal shredders.

3.1 REGULATORY DEFINITION OF PTE

PTE is the ability of a facility to emit regulated air pollutants (in this case, VOC) under its maximum capacity and physical and operational design. U.S. EPA has defined PTE¹³ under 40 C.F.R. Part 70 State Operating Permit Programs (40 C.F.R. §70.2) as follows:¹⁴

Potential to emit means the maximum capacity of a stationary source to emit any air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of a source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation is enforceable by the Administrator.¹⁵ This term does not alter or affect the use of this term for any other purposes under the Act, or the term "capacity factor" as used in title IV of the Act or the regulations promulgated thereunder.

¹² A major source has actual or potential emissions at or above the major source threshold for any "air pollutant." Refer to Section 4.1 for more information.

¹³ Individual SIP PTE definitions may differ from the federal definition. ReMA recommends that metal shredder facilities consult with qualified environmental professionals to assist in determining the appropriate determination of PTE.

¹⁴ Functionally equivalent definitions of PTE are also found under 40 C.F.R. §52.21(b)(4), 40 C.F.R. §51.165(a)(1)(iii), 40 C.F.R. §51.166(b)(4), 40 C.F.R. 51.301 "Potential to emit," §40 C.F.R. Appendix-S-to-Part-51 II.A.3, and Appendix Y to Part 51— Guidelines for BART Determinations Under the Regional Haze Rule.

¹⁵ The cases of *National Mining Association vs. EPA* and *Chemical Manufacturers Association vs EPA* eliminated the requirement that federal enforceability be required to limit PTE.



U.S. EPA has also issued guidance on how to calculate PTE both generically and for specific types of sources or industries. In some instances, U.S. EPA's guidance indicates that it is not realistic to use 8,760 hours of operation annually to calculate PTE. For example, 500 hours per year may be used for emergency engines.¹⁶ U.S. EPA has also acknowledged that there may be inherent physical limitations to operating 8,760 hours per year for certain types of operations, like small auto body shops.¹⁷ There are many industries, including metal shredder operations, where it is physically or operationally impossible to operate every hour per year (i.e., 8,760 hours). Physical or operational constraints are inherent for metal shredders due to maintenance and upkeep requirements and generally require at least one hour of preventative maintenance for every hour of operation.

3.2 FACTORS THAT CAN INFLUENCE PTE

Regulatory agencies may initially default to a PTE calculation based on operation of 8,760 hours per year.¹⁸ However, in addition to the allowed limitation for physical and operational constraints, a facility may take emissions controls, emissions limits, and operational limitations into account when establishing its VOC PTE as long as such limitations are enforceable as permit limits (e.g., annual operating hour limits, annual throughput limits, required operation of a control device, etc.) See Section 3.3 for more information regarding the use of enforceable limits.

To determine PTE, a facility operator needs to assume that each operation emits at its maximum operating capacity for the maximum number of hours¹⁹ the unit is able to operate in a year. While the maximum number of hours in a year is 8,760, a facility may reduce the number of operating hours from that maximum based on inherent limitations resulting from physical and operational design limitations. For example, a core industry practice is to require at least one hour of scheduled maintenance for each hour of operation, which is an inherent operational design limitation. Considering this inherent limitation, the maximum number of hours that a typical metal shredder can operate in a year is 4,380 hours. Regulatory agencies may review, question and even challenge the reasonability of the basis claimed for inherent restrictions when claiming limits on PTE for VOCs. There may be additional physical, operational, or legal limitations (e.g., noise ordinances or inability to operate at night due to lack of lighting) that apply to a metal shredder that can further reduce the maximum number of hours that a shredder can operate in a year.

¹⁶ <https://www.epa.gov/sites/default/files/2015-08/documents/emgen.pdf>

¹⁷ <https://www.epa.gov/sites/default/files/2015-07/documents/ptememo.pdf>

¹⁸ It is not possible for metal shredders to operate 8,760 hours per year. In fact, the 1:1 ratio of operating hours to maintenance hours demonstrates, that a plausible maximum annual hours of operation for a metal shredder is 4,380 hours (assuming hours or material throughput is not further limited within an existing air permit).

¹⁹ It is important to clarify that while hours are discussed as a means of limiting shredder PTE, it is most often a limitation on the total annual shredder infeed (in a permit) that is used to demonstrate PTE. The variability of an hourly feed rate makes the use of a limitation on hours disadvantageous and overly restrictive.



Rather than limit operating hours to restrict VOC emissions, facilities can accept enforceable limitations on shredder input or production to preserve operational flexibility. Such material throughput or production limits would restrict shredder feedstock input or production output on a rolling 12-month basis to ensure compliance with a mass VOC emissions limit (i.e., tons of VOC/ per rolling 12-month period).

In most instances, all non-fugitive regulatory VOC emissions need to be included when calculating PTE from a metal shredding facility. If the facility is an existing major²⁰ source under certain air permitting programs, fugitive VOC emissions may need to be included when establishing VOC emissions increases associated with facility modifications (See Section 4). Fugitive emissions may also need to be included in a source's PTE under certain state minor NSR permit programs. Facilities may also need to consider historic U.S. EPA policy for determining whether certain emissions are fugitive or non-fugitive and according to

U.S. EPA, such a determination is "...inherently a fact-finding inquiry."²¹ U.S. EPA's current approach when determining whether emissions could reasonably pass through a stack, chimney, vent, or other functionally equivalent opening is based on various criteria including:

- Whether similar facilities collect or capture emissions.
- Whether U.S. EPA has established a national emissions standard or regulation that requires some sources in the source category to capture or collect emissions.
- Whether it is technically and economically feasible to capture, collect, or control emissions.²²
- "Various criteria guide this case-by-case analysis, and no single criterion should be considered determinative."²³

ReMA recommends that metal shredder facilities consult with qualified environmental professionals to assist them in determining whether or not emissions should be considered fugitive or non-fugitive. Determinations may need to be reviewed with the relevant permitting authority responsible for the facility.

3.3 USING ENFORCEABLE LIMITS TO RESTRICT VOC EMISSIONS

Facilities can accept limits on their VOC PTE to avoid major source permitting programs or regulations that apply to major sources of VOC emissions. Any limitations must be practically enforceable. Enforceable is defined under 40 C.F.R. §52.21(b)(17) as:

"...all limitations and conditions which are enforceable by the Administrator, including those requirements developed pursuant to 40 CFR parts 60 and 61, requirements within any applicable State implementation plan, any permit requirements established pursuant to 40 CFR 52.21 or under regulations approved pursuant to 40 CFR part 51, subpart I, including operating permits issued under an EPA-approved program that is incorporated into the State implementation plan and expressly requires adherence to any permit issued under such program."

²⁰ A major source has actual or potential emissions at or above the major source threshold for any "air pollutant." Refer to Section 4.1 for more information.

²¹ 87 Fed Reg. 62335 (Oct. 14, 2022).

²² 73 Fed. Reg. 77881, 77893 (Dec. 19, 2008).

²³ 87 Fed. Reg. at 62,335



U.S. EPA has provided historical guidance²⁴ on practical enforceability, which suggests that permit limits on PTE include operational limits (e.g., rolling 12-month process throughput restriction, rolling 12-month operating hour restriction, etc.), emissions limitations (e.g., monthly VOC emission restriction, rolling 12-month VOC emission restriction), and recordkeeping requirements (e.g., monthly record of material throughput, monthly record of VOC emissions, monthly calculation of rolling 12-month VOC emissions). While U.S. EPA may prefer operational and emissions restrictions on as short of a time period as possible, rolling 12-month throughput limits have been accepted in multiple metal shredder air permits as an enforceable means to limit PTE. ReMA notes that determinations of practical enforceability can vary on a case-by-case basis and suggests that shredder operators consult with qualified environmental professionals when establishing limits on PTE for VOC.

U.S. EPA guidance also suggests that to ensure practical enforceability²⁵, permits may include other requirements on the facility. In simple terms, the permit should reflect clear, enforceable means to demonstrate compliance with throughput and emissions limitations.

3.4 HOW TO ESTABLISH VOC POTENTIAL TO EMIT

The following discussion reflects a simplified “base-case” approach on how to establish a shredder’s PTE for VOC. Establishing the VOC PTE for a shredder can be a complex undertaking, reflecting site-specific conditions, and typically should be performed with the assistance of a qualified environmental professional. Methods and calculations used to establish VOC emissions are included in the sections below.

3.4.1 Identify Operational Limitations

To establish the VOC PTE for a metal shredder, operators will need to first establish the maximum hourly throughput capacity of their shredders in terms of tons of feed per hour of operation (for this purpose tons refer to “net tons” or 2,000 lb per ton) and maximum operating hours per year. Operators may choose to base short term shredder capacity on practical experience with their shredder (i.e., historical maximum sustained throughput) or on the manufacturer’s rated capacity of the unit. The shredder’s maximum annual operating hours should account for all known shredder downtime (e.g., maintenance, upkeep, seasonal operating variations, holidays, vacations, and ordinances, as well as infeed limitations based on the size of the sourcing “catchment” area). Periodic shredder shutdown and maintenance are typically required to ensure continued proper operation of machinery. Facilities may also be impacted by local noise or other time-of-day ordinances that limit operations to certain hours of the day. Availability of shredder feed material can also limit metal shredder operations. As indicated, fugitive emissions do not need to

²⁴ See: Guidance on Limiting Potential to Emit in New Source Permitting, June 13, 1989
https://www3.epa.gov/airtoxics/pte/june13_89.pdf

²⁵ See: Guidance on Enforceability Requirements for Limiting Potential to Emit through SIP and §112 Rules and General Permits, January 25, 1995 <https://www.epa.gov/sites/default/files/2015-07/documents/potoem.pdf>



be considered in permitting determinations for certain air programs (i.e., Title V and attainment NSR permitting). Regulatory agencies may accept these limitations on PTE as inherent limitations, without an associated permit condition. This position may need to be confirmed with the regulatory authority, as some states have incorrectly sought to require that inherent operational limits be included as permit restrictions.

3.4.2 Calculating VOC PTE

PTE for VOC is established by multiplying the shredder's maximum annual shredder throughput capacity (tpy) by a VOC emissions factor that represents the typical operation of the shredder (i.e., its typical feed material mix). Facilities should prioritize the use of valid, existing site specific (or company-specific) VOC emissions test data and/or associated VOC emissions factors (i.e., pound of VOC/ton throughput), if available, when calculating PTE for VOC.²⁶ Determining shredder VOC emissions factors based on VOC stack testing of the specific shredder is typically not practical, appropriate and/or reasonable in part due to the substantial expenditure of time and cost needed to design and install a temporary total enclosure (TTE) for use in such tests.

In the absence of representative VOC emissions test data from specific shredders, VOC emissions factors derived from VOC emissions testing at other similarly-situated metal shredders may be considered (See Appendix A²⁷) to establish VOC PTE. Use of other methods or analysis, which account for site-specific conditions, may also be appropriate. Several PTE calculation examples are provided below that use the referenced VOC emissions factors in Appendix A. For simplicity, all shredder VOC emissions in the examples are assumed to be non-fugitive. Note the examples below show the calculation of PTE for NSR and Title V permitting purposes. Calculation of PTE for HAP is not included in these examples.

²⁶ ReMA recognizes that planning and executing an emissions testing program to measure representative VOC emissions from industrial shredders, especially those facilities that do not have a robust shredder emissions capture system, can take months for preparation and approval and can cost hundreds of thousands of dollars.

²⁷ The emissions factors provided in Appendix A were derived using U.S. EPA recommended methods and are based on the average results of representative VOC emission tests conducted at representative metal shredder operations. As average emissions factors, the data used to establish the emissions factors reflect measured emissions that are both higher and lower than the average. Facilities should consult with qualified environmental professionals regarding any potential adjustments to the average emissions factors to reflect their intended use (e.g., establishing PTE, reporting annual actual emissions, establishing baseline actual emissions, calculating emissions fees, etc.).



PTE EXAMPLE 1

Company A is located in an area that is attaining the ozone NAAQS and operates a metal shredder with no add-on VOC emissions controls. The metal shredder has a maximum hourly shredder feed throughput capacity of 150 net tph. The facility typically processes an ELV and Light Iron blend and has site-specific VOC emissions performance test data that is representative of its typical operations (i.e., while processing an ELV and Light Iron Blend), from which it was determined that the emissions factor is 0.15 lb VOC/net ton feed material. Due to material availability, the maximum amount of net tons processed in any 12-month rolling period is 450,000 net tons. For simplicity, the facility is not claiming that any of its emissions are fugitive emissions.

Given:

- Site specific VOC emissions factor for ELV and Light Iron Blend is 0.15 lbs VOC/net ton feed
- Maximum hourly feed material throughput capacity = 150 net tons/hr combined feeds
- Maximum annual material throughput = 450,000 net tons/yr (if recognized as an inherent limit or included in a practically enforceable permit condition)
- Title V major source threshold for VOC emissions = 100 tons VOC/year
- Prevention of Significant Deterioration (PSD) major source threshold for VOC = 250 tons VOC/year

Annual Potential Emissions of VOC:

$(450,000 \text{ net tons feed/yr}) \times (0.15 \text{ lbs of VOC/net ton feed}) \times (1 \text{ ton}/2,000 \text{ lbs}) = 33.75 \text{ tons of VOC/yr.}$

The facility is a minor source of VOC emissions. (Title V and PSD)

PTE EXAMPLE 2

Company B is located in an area that is attaining the ozone NAAQS and operates a metal shredder with no add-on VOC emissions controls. The metal shredder has a maximum hourly feed material throughput capacity of 300 net tph. The facility typically processes an ELV and Light Iron Blend. The facility does not have site-specific VOC performance test data. Due to material availability, the maximum amount of net tons processed in any 12-month rolling period is 900,000 net tons/year. In the absence of site-specific VOC emissions test data, the facility has elected to use a VOC emissions factor derived from industry data that is representative of its typical annual feed mix (i.e., an ELV and Light Iron Blend), which is 0.21 lb VOC/net ton feed material. For simplicity, the facility is not claiming that any of its emissions are fugitive emissions.

Given:

- VOC emissions factor derived from industry data for an ELV and Light Iron Blend: 0.21 lbs VOC/net tons feed
- Maximum hourly feed material throughput capacity = 300 net tons/hr
- Maximum annual material throughput = 900,000 net tons/yr (if recognized as an inherent limit or included in a practically enforceable permit condition)
- Title V major source threshold for VOC emissions = 100 tons VOC/year
- PSD major source threshold for VOC emissions = 250 tons VOC/year

Annual Potential Emissions of VOC

$(900,000 \text{ tons feed/yr}) \times (0.21 \text{ lbs of VOC/tons feed}) \times (1 \text{ ton}/2,000 \text{ lbs}) = 94.5 \text{ tons of VOC/yr}$

The facility is a minor source of VOC emissions. (Title V and PSD)



PTE EXAMPLE 3

Company C is located in an area that is designated as serious nonattainment with the ozone NAAQS and operates a metal shredder with no add-on VOC emissions controls. The metal shredder has a maximum hourly feed material throughput capacity of 150 net tph. The facility typically processes 100% ELV. The facility does not have site-specific VOC performance test data. Due to material availability, the maximum amount of net tons processed in any 12-month rolling period is 450,000 net tons/year. In the absence of site-specific VOC emissions test data, the facility has elected to use a VOC emissions factor derived from industry data that is representative of its typical annual feed mix (i.e., 100% ELV) which is 0.31 lb VOC/net ton feed material. Because this source is located in an ozone non-attainment area, unique state nonattainment new source review requirements may require consideration of fugitive emissions.

Given:

- VOC emissions factor derived from industry data for 100% ELV: 0.31 lbs VOC/net tons feed
- Maximum hourly capacity = 150 net tons/hr
- Maximum annual material throughput = 450,000 net tons/yr (if recognized as an inherent limit or included in a practically enforceable permit condition)
- Title V Major source threshold for VOC emissions = 50 tons VOC/year
- Nonattainment New Source Review (NNSR) major source threshold for VOC emissions = 50 tons VOC/year

Annual Potential Emissions of VOC:

$(450,000 \text{ tons feed/yr}) \times (0.31 \text{ lbs of VOC/tons feed}) \times (1 \text{ ton}/2,000 \text{ lbs}) = 69.75 \text{ tons of VOC/yr}$

The facility is a major source of VOC emissions. (Title V)

The facility is a major source of VOC emissions (NNSR)



PTE EXAMPLE 4

Company D is located in an area that is attaining the ozone NAAQS and operates a metal shredder with no add-on VOC emissions controls. The metal shredder has a maximum hourly net feed material throughput capacity of 250 net tph. The facility typically processes an ELV and Light Iron Blend. The facility does not have site-specific VOC performance test data. Due to material availability, the maximum amount of net tons processed in any 12-month rolling period is 1,095,000 tons/year. In the absence of site-specific VOC emissions test data, the facility has elected to use a VOC emissions factor derived from industry data that is representative of its typical annual feed mix (i.e., an ELV and Light Iron Blend), which is 0.21 lb VOC/net ton feed material. For simplicity, the facility is not claiming that any of its emissions are fugitive emissions.

Given:

- VOC emissions factor derived from industry data for an ELV and Light Iron Blend: 0.21 lbs VOC/net tons feed
- Maximum hourly capacity = 250 net tons/hr
- Maximum annual material throughput = 1,095,000 net tons/yr (if recognized as an inherent limit or included in a practically enforceable permit condition)
- Title V Major source threshold for VOC emissions = 100 tons VOC/year
- PSD Major source threshold for VOC emissions = 250 tons VOC/year

Annual Potential Emissions of VOC

$(1,095,000 \text{ tons feed/yr}) \times (0.21 \text{ lbs of VOC/tons feed}) \times (1 \text{ ton}/2,000 \text{ lbs}) = 115.0 \text{ tons of VOC/yr}$

The facility is a major source of VOC emissions (Title V)

The facility is a minor source of VOC emissions (PSD)



SECTION 4

VOC Permitting Requirements

The applicability of various VOC air permitting programs is based on a facility's PTE for VOC. Once a facility's PTE is established, its status with respect to various air quality permitting requirements can be determined. This section provides an overview of the air permitting programs that could apply to a metal shredder based on its PTE for VOC. This is a general discussion and should not be viewed as a substitute for individual facility review with a qualified environmental professional. Air permitting requirements and the interpretation of requirements for each of the programs addressed herein may vary on state-by-state and local basis.

4.1 OPERATING PERMITS

Title V of the 1990 Clean Air Act Amendments (Title V) requires that states adopt and implement an air pollution operating permit program covering all federally-defined major and certain other federally-regulated stationary sources of air pollution. Title V operating permit regulations under 40 C.F.R. Part 70 define "major source"²⁸ for purposes of operating permits. Title V applicability thresholds for VOC vary based on the attainment status of the ozone NAAQS in a given region, which will influence whether a facility is a major source under Title V, as described below:

- If a facility is located in an area that is classified as **attainment with the ozone NAAQS**, and the facility's PTE for VOC is 100 tpy or more, U.S. EPA would deem the facility to be a "major source" of VOC, subject to the major source operating requirements under Title V.
- If a facility is located in an area that is classified as **moderate or marginal nonattainment**²⁹ **with the ozone NAAQS** and the facility's PTE for VOC is 100 tpy or more, U.S. EPA would deem the facility to be a "major source" of VOC, subject to the major source operating requirements under Title V.
- If a facility is located in an area that is classified as **serious nonattainment**³⁰ **with the ozone NAAQS** or in the **northeast ozone transport region (OTR)**³¹, and the facility's PTE for VOC is greater than 50 tpy, U.S. EPA would deem the facility to be a major source of VOC, subject to the major source operating permit requirements under Title V.

²⁸ See: 40 C.F.R. § 70.2.

²⁹ Ozone nonattainment areas may be subject to "anti-backsliding" provisions, which could impact the major source threshold for VOC emissions in such areas. "Anti-backsliding" under the CAA has been stated by U.S. EPA to mean that if U.S. EPA relaxes a national primary ambient air quality standard, it must ensure that any area that had not met the old standard remains subject to "controls which are not less stringent" than the old requirements. Under this position, the term "controls" could be interpreted to include reduced major source thresholds.

³⁰ Ibid.

³¹ As of March 14, 2022, the boundary for the OTR consists of the entire states of Connecticut, Delaware, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; portions of Maine identified in this section under Table 1; and the Consolidated Metropolitan Statistical Area that includes the District of Columbia and the following counties and cities in Virginia: Arlington County, Fairfax County, Loudoun County, Prince William County, Stafford County, Alexandria City, Fairfax City, Falls Church City, Manassas City, and Manassas Park City.



- If a facility is located in an area that is classified as **severe nonattainment**³² **with the ozone NAAQS** and the facility's PTE for VOC is greater than 25 tpy, U.S. EPA would deem the facility to be a major source of VOC, subject to the major source operating permit requirements under Title V.
- If a facility is located in an area that is classified as **extreme nonattainment with the ozone NAAQS** and the facility's PTE for VOC is greater than 10 tpy, U.S. EPA would deem the facility to be a major source of VOC, subject to the major source operating permit requirements under Title V.

To simplify the discussion provided herein, all shredder VOC emissions are assumed in this section to be non-fugitive emissions. This assumption is important because fugitive VOC emissions are not considered in determining whether a facility is a major source under Title V unless the facility is one of the source categories listed at 40 C.F.R. § 70.2. There are many relevant factors in determining whether emissions from a shredder can be reasonably collected, and those determinations are typically made on a case-by-case basis by state and local regulators in accordance with their SIPs. ReMA recommends that shredder operators consult with qualified environmental professionals when evaluating the status of shredder VOC emissions as fugitive or non-fugitive.

Facilities may propose enforceable permit conditions to restrict VOC emissions to less than applicable major source thresholds to be classified as a "synthetic minor" source. For example, for a facility located in an ozone attainment area, if a facility's PTE for VOC is determined to be greater than 100 tpy, but the facility has determined that actual facility VOC emissions will never exceed 100 tpy based on site-specific factors or on a desire to be regulated as a minor source of VOC emissions, then the facility can propose enforceable permit conditions to restrict VOC emissions to less than 100 tpy to become a synthetic minor Title V source. Many SIPs require "state-only" operating permits for synthetic minor sources because public notice is required for enforceable air permit conditions. As applicable, consult your regulatory authority's air permitting rules to determine the requirements associated with operating permits for synthetic minor sources.

Facilities may also be classified as "natural minor" sources of VOC. For example, if a facility is located in an ozone attainment area and its PTE, without consideration of enforceable emissions limits for VOC or operational limits is less than 100 tpy, then the facility is considered a natural minor source (or in some states, a small source). Many SIPs require state-only operating permits for minor sources. As applicable, consult your regulatory authority's air permitting rules to determine the requirements associated with operating permits for natural minor sources.

Each regulatory authority has specific regulations to implement the federal Title V operating permit program. As applicable, consult your regulatory authority's air permitting rules to determine the requirements associated with preparing an application for a Title V operating permit. Minimum content requirements for initial Title V operating permit applications are specified under 40 C.F.R. 70.5(c) and include identifying company information; descriptions of

³² Ibid p. 31

the source's processes and products; descriptions of emissions of regulated air pollutants and emissions units; identification and description of all points of emissions; emissions rates in tpy for all pollutants; descriptions of fuels, fuel use, raw materials, production rates, and operating schedules; descriptions of air pollution control equipment; limitations on source operation; emissions calculations; citations for all applicable air quality requirements, and certification by a responsible official of compliance with applicable air quality requirements.

Initial Title V operating permit applications require time and resources to complete. Once submitted, the permitting agency reviews the application for completeness, issues a notice of completeness to the applicant, and then conducts their technical evaluation. The technical evaluation period varies depending upon the jurisdiction but can take a year or more in certain areas. Following completion of the agency's technical evaluation, a draft operating permit is published for public and U.S. EPA comment. A final operating permit is issued to the applicant after any public and U.S. EPA comments have been addressed. The entire application process can take up to 18 months or more.

4.2 PERMITS TO CONSTRUCT

If a new shredder facility is being built or an existing shredder facility is expanding or being modified, an air quality permit to construct may be required prior to beginning actual construction. Construction permits are typically issued under the NSR program, which is comprised of a minor NSR program and two distinct major NSR permitting programs: Prevention of Significant Deterioration (PSD) and Nonattainment New Source Review (NNSR). For construction permitting, there are additional definitions of major source, which depends on the NAAQS attainment status of an area and type of facility. Potentially applicable permitting programs are summarized in the following sections. Many states also have regulations or policies related to environmental justice,³³ which can require additional steps by facilities during an air permitting event. ReMA recommends that facilities consult with qualified environmental professionals that are familiar with state and local VOC air permitting requirements to address air permitting considerations.

There may be instances where an existing shredder facility becomes aware³⁴ that their shredder VOC emissions may be greater than applicable VOC permitting thresholds (e.g., Title V or state-only operating permit VOC emission thresholds). Should a facility become aware that they may be subject to an operating permit requirement (because of possible VOC emissions levels or otherwise), ReMA recommends that the facility consult with management, legal counsel, and qualified environmental professionals to raise awareness, confirm (or refute) the validity of the VOC emissions calculations, and if confirmed, develop a plan to bring the facility into compliance

³³ See: <https://www.epa.gov/environmentaljustice>

³⁴ Events that could lead to a facility becoming aware that they are subject to an operating permit requirement include VOC source testing results at the facility, VOC source testing results from a similar facility, or publication of a relevant VOC emissions factor.

with applicable air operating permitting requirements. For permitting actions that seek to include VOC emissions under an existing air permit (e.g., based on the availability of new and/or improved emissions data) with no associated physical or operational change, it is ReMA's position that such changes in and of themselves, are not modifications under NSR.

4.2.1 Prevention of Significant Deterioration

State and local regulatory agencies can prepare and submit PSD rules to U.S. EPA for approval into their SIPs or U.S. EPA may delegate the authority to implement the federal PSD rules to regulatory agencies. The minimum SIP requirements for states to develop their own PSD regulations are codified at 40 C.F.R. § 51.166. If a state declines to develop PSD regulations, they can utilize 40 C.F.R. § 52.21. State PSD programs may include requirements that are more stringent than the underlying federal regulations.

The PSD regulations apply to the construction or modification of major stationary sources and are designed to ensure that the air quality in areas attaining the NAAQS does not significantly deteriorate. The PSD program regulates VOC emissions as precursors to the formation of ground level ozone and applies to major stationary sources that are located in areas designated as in attainment with the ozone NAAQS.

The term "major stationary source" is defined under the PSD regulations in two ways:

- For the 28 "listed"³⁵ stationary sources, major stationary source means "[a]ny...stationary source of air pollutants which emits, or has the potential to emit, 100 tons per year or more of any regulated NSR pollutant..." [40 C.F.R. § 52.21(b)(1)(i)(a)]. Metal shredders are not one of the listed sources under 40 C.F.R. § 52.21(b)(1)(i)(a).
- For non-listed sources, major stationary source means "...any stationary source which emits, or has the potential to emit, 250 tons per year or more of a regulated NSR pollutant..." 40 C.F.R. § 52.21(b)(1)(i)(b).

For a metal shredder facility to be a major stationary source under PSD, 40 C.F.R. § 52.21(b)(1)(i)(b), its potential to emit an NSR regulated pollutant,³⁶ which includes VOC, needs to be greater than 250 tons per year.

³⁵ Under 40 C.F.R. § 52.21(b)(1)(i)(a), "listed" stationary sources are: Fossil fuel-fired steam electric plants of more than 250 million British thermal units per hour heat input, coal cleaning plants (with thermal dryers), kraft pulp mills, Portland cement plants, primary zinc smelters, iron and steel mill plants, primary aluminum ore reduction plants (with thermal dryers), primary copper smelters, municipal incinerators capable of charging more than 50 tons of refuse per day, hydrofluoric, sulfuric, and nitric acid plants, petroleum refineries, lime plants, phosphate rock processing plants, coke oven batteries, sulfur recovery plants, carbon black plants (furnace process), primary lead smelters, fuel conversion plants, sintering plants, secondary metal production plants, chemical process plants (which does not include ethanol production facilities that produce ethanol by natural fermentation included in NAICS codes 325193 or 312140), fossil-fuel boilers (or combinations thereof) totaling more than 250 million British thermal units per hour heat input, petroleum storage and transfer units with a total storage capacity exceeding 300,000 barrels, taconite ore processing plants, glass fiber processing plants, and charcoal production plants.

³⁶ See: 40 C.F.R. §52.21(b)(50)



Under 40 C.F.R. § 52.21(b)(1)(iii), fugitive emissions are not included in determining whether a non-listed source is a major stationary source. Fugitive emissions are defined under 40 C.F.R. § 52.21(b)(20) as “...those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening.” As mentioned above, the determination of what emissions are fugitive is a case-by-case determination. States have provided inconsistent determinations regarding the status of VOC emissions from specific metal shredders as fugitive or non-fugitive emissions, and thus whether they must be included when determining if a facility is a major stationary source. ReMA recommends that shredder operators consult with qualified environmental professionals when evaluating the status of shredder VOC emissions as fugitive or non-fugitive. This determination should also be reviewed with the relevant permitting authority, where appropriate. To simplify the discussion provided herein, all shredder VOC emissions are assumed to be non-fugitive emissions.

If a facility is major for one NSR regulated pollutant (e.g., VOC), it is considered as an existing major stationary source under the PSD regulations. For existing major stationary sources, the PSD regulations may be triggered by a modification (e.g., a physical change or change in the method of operation) that results in a significant increase of a regulated NSR pollutant. Significant emissions increases at existing major stationary sources under PSD are 40 tpy³⁷ for VOC, NO_x, and sulfur dioxide (SO₂), 15 tpy for particulate matter less than 10 microns (PM₁₀), 10 tpy for particulate matter less than 2.5 microns (PM_{2.5}), 100 tpy for carbon monoxide (CO), and 0.6 tpy for lead. The PSD rules do not explicitly define the terms “physical change or change in the method of operation,” however, they do include some exclusions from what is considered to be a modification:

- Change in ownership;
- Routine maintenance, repair, and replacement (RMRR);
- Increases in production rate, so long as those increases do not exceed capacity and are not prohibited by a permit condition; or
- Increases in hours of operation, so long as the increase is not prohibited by a permit condition.

While U.S. EPA has provided guidance on what constitutes RMRR, determining whether an activity is RMRR is not always a straightforward evaluation and is a case-by-case determination. The RMRR provision under PSD is important for metal shredder operators that are major sources under the PSD program. Certain components of metal shredders are routinely repaired or replaced to ensure the continued effective operation of the shredder.

To determine if a modification is major at an existing major PSD source, one of several applicability tests³⁸ under 40 C.F.R. § 52.21(a)(2) is used to determine if an emissions increase that could occur as a result of a modification is significant. The first step is to determine if the

³⁷ See: 40 CFR §52.21(b)(23)(i)

³⁸ See: 40 C.F.R. § 52.21(a)(2).

proposed project³⁹ would result in a “significant emissions increase” of a regulated NSR pollutant (Step 1). If the proposed project is determined to result in such an increase, the second step is to determine if the project would also result in a “significant net emissions increase” of that pollutant from the source (Step 2). A project that results in a significant emissions increase in Step 1 and a significant net emissions increase in Step 2 of the NSR major modification applicability test is a major modification that requires a major NSR permit.⁴⁰

Constructing a new major stationary source or conducting a major modification at an existing major stationary source in a NAAQS attainment area triggers the PSD permitting regulations. The basic requirements under PSD are extensive and can include:

- Demonstration that emissions are controlled using best available control technology (BACT). Technical or economic feasibility may need to be evaluated.
- An air quality impacts analysis using air quality dispersion modeling, which increases in criteria pollutant emissions (except VOC) will not cause or contribute to a violation of a NAAQS standard or PSD increment. PSD increments reflect the maximum allowable increase in ambient air concentrations above a baseline concentration. VOC emissions are typically not modeled under PSD but are quantitatively evaluated using modeled emissions rates for precursors (MERPs), which are used to calculate concentrations of ozone.
- An additional impacts analysis to assess a project’s impact on soil, vegetation, and visibility related to its emissions increases and an evaluation of secondary emissions that may occur as a result of the project due to growth.
- A Class I area impacts analysis, as applicable. Class I areas include national parks and national wilderness areas, typically managed by the National Park Service (NPS), the Forest Service (FS), or the Fish and Wildlife Service (FWS). The Class I area impacts analysis can include air quality modeling for reduced Class I PSD increments, visibility, and deposition, and a demonstration of protection of air quality related values (AQRV) such as flora and fauna, water, visibility, cultural and paleontological, and odor. A Class I impacts analysis includes participation by the Federal Land Manager (FLM) for the impacted site(s).

A step-by-step approach for determining if a PSD permit is required and if required, completing a PSD permit application, is beyond the scope of this guidance document. Evaluating PSD applicability and applying for a PSD permit can be complex tasks and are typically performed with the assistance of a qualified environmental professional. Consult with qualified environmental professionals that are familiar with state and local PSD air permitting requirements to address air permitting considerations.

³⁹ The “project” is defined as physical change or change in the method of operation and these changes are evaluated to determine if they qualify as a major modification

⁴⁰ 85 FR 74890

4.2.2 Nonattainment New Source Review

The NNSR regulations apply to the construction or modification of major stationary sources in areas that are designated as nonattainment with one or more NAAQS. The NNSR rules are designed to ensure that ambient air quality does not deteriorate further within nonattainment areas, which is achieved by decreases in criteria pollutant or precursor emissions (i.e., emissions offsets) and through the imposition of lowest achievable emission rate (LAER) for new major stationary sources or major modifications to existing major stationary sources in a nonattainment areas.

There are five degrees of nonattainment classifications for ozone: marginal, moderate, serious, severe, and extreme. As the degree of nonattainment in an area increases, the major air permitting thresholds for VOC emissions decrease as shown in Table 4-1. Understanding the ozone attainment status, degree of nonattainment, and the potential to emit VOC from a metal shredding facility is important because air quality permitting for VOC becomes more challenging from a schedule and budgeting perspective for new major sources of VOC and for major modifications at existing major VOC sources. The attainment status of a facility's location with regards to the ozone NAAQS can be found in the U.S. EPA "Green Book."⁴¹

Table 4-1 Major VOC Source and Significant Emissions Rate by Nonattainment Classification

Nonattainment Classification	Major VOC Source Definition (tpy)	VOC Significant Emissions Increase (tpy)
Marginal	100	40
Moderate	100	40
Serious	50	25
Severe	25	25
Ozone Transport Region	50	40
Extreme	10	Any increase

⁴¹ U.S. EPA, *Nonattainment Areas for Criteria Pollutants*, available at <https://www.epa.gov/green-book>.

Requirements for NNSR permitting differ somewhat from PSD permitting, including a requirement for a LAER analysis instead of BACT analysis; an alternative sites analysis; and emissions offsets [i.e., increases in VOC emissions in the nonattainment area (NAA) must be offset by the purchase or use of emissions decreases at a ratio that depends on the severity of the NAA].

Some states develop and implement state-specific NNSR permitting regulations to address ozone non-attainment and target ozone precursor emissions (i.e., VOC and NOX). State-specific NNSR rules must be equivalent to, or more stringent than, the applicable federal NNSR requirements for state programs. Facilities should pay particular attention to state-specific NNSR regulations because state-specific NNSR rules can be nuanced and more stringent than the equivalent federal rules. For example, some state NNSR programs make no distinction between fugitive and non-fugitive emissions of a nonattainment pollutant or precursor when determining a facility's initial major source status under NNSR. ReMA recommends that facilities consult with a qualified environmental professional when determining the applicability of state-specific NNSR regulations to facility modifications.

4.2.3 Minor Source Air Permit Programs

The air permitting program for stationary sources that do not require PSD or NNSR permits is known as the minor NSR program. CAA section 110(a)(2)(C) requires states to develop a program to regulate the construction and modification of any stationary source to ensure that the NAAQS are achieved. If a facility's emissions are less than the PSD/NNSR major source thresholds for VOC and a project is not a major new stationary source by itself, then the facility would be subject to minor NSR construction permitting. Each state (or local jurisdiction) has its own regulations to implement their minor NSR construction permit program.

As applicable, a facility should review their state's air permitting regulations to determine the requirements associated with preparing an application for a permit to construct. The state-specific requirements for minor NSR permitting are typically less rigorous than for PSD/NNSR permitting. However, some states require air dispersion modeling, control technology analyses, air toxic compound (ATC) emissions analyses, and exposure modeling for minor NSR permitting actions. Note that many common VOC species are also often subject to state's ATC rules or policies. Public notice of permit actions may also be required under a state's minor NSR air permitting programs.

SECTION 5

Potential Source Control for VOC Emissions

Practices available to metal shredder facilities to reduce VOC emissions from metal shredder operations include effective use of source control practices (source control). The term “source control” is a term used by the metal shredder industry to describe measures that require shredder feed suppliers to remove materials (e.g., lubricants, hydraulic fluids, fuel, etc.) from shredder feed materials prior to processing in a shredder. Source control can include direct measures for removal of materials or providing requirements to suppliers of shredder feed material that may then be inspected for conformance by the shredder operation.

Common source control practices used by the metal recycling industry, could include but are not limited to:

- Agreements requiring that suppliers of metal infeed materials remove unacceptable materials prior to delivery to the metal recycling facility and certifications to that effect;
- Signage at facility entrances stating or showing types of materials not accepted at the recycling facility (e.g. petroleum products);
- Shredder site inspectors trained to inspect inbound materials for unacceptable materials and to reject those materials (or the load in which such materials were found);
- Periodic training for applicable facility personnel regarding source control and metal shredder infeed material inspection programs; and
- Removal of refrigerants⁴² and other materials (e.g., petroleum products) from ELVs and appliances by the supplier, or the entity operating the shredder, prior to shredding.

Because the use of source control methods effectively reduces shredder VOC input and therefore shredder VOC emissions, the consistent use of these or similar measures with ongoing verification (inspection) may reflect an effective means to minimize VOC emissions from metal shredder operations.

⁴² Per 40 C.F.R. § 82.155 — see ReMA Guidance titled “Compliance Guideline: Refrigerant Recycling Requirements under the Clean Air Act”, March 1999” and associated ReMA Guidance titled: “Issue Update: Revised Recommended Language for Verification Contracts and Statements for Recycling Appliances and Vehicles”

SECTION 6

Source Sampling for Shredder VOC Emissions

This section provides general guidance for measuring VOC emissions from metal shredder operations. When conducting source sampling for VOC emissions from a metal shredder, it is recommended that all methods, sampling times, and operating conditions for the purposes of quantifying VOC emissions be clearly outlined in a source sampling plan or test protocol and that the plan or protocol be reviewed and approved by the regulatory authority, as required or as may otherwise be appropriate. ReMA recommends that facilities consult with a qualified environmental professional to assist with the development of VOC source testing plans or protocols when considering source testing options.

6.1 SHREDDER STACK TESTING DIFFICULTIES AND LIMITATIONS

Designing, gaining approval, planning, and executing a stack test program to evaluate VOC emissions from an industrial metal shredding operation is a challenging, time consuming and expensive endeavor. Complications with such emissions testing programs include, but are not limited to, the following:

- The design and construction of an effective (temporary) emissions capture system that ensures shredder emissions are effectively captured, to enable measurement provided that an emissions capture system (e.g., hood or enclosure) does not already exist.
- Accumulating sufficient feed materials of a consistent quantity to support emissions testing over a several-hour or several-day period.
- Selection of VOC emissions test methods, or conducting simultaneous tests to accurately quantify regulated VOC emissions and exclude exempt or unregulated emissions from the VOC sample trains.

VOC emissions test programs conducted on metal shredders without permanent emission capture systems are costly (e.g., hundreds of thousands of dollars), disruptive to operations, time consuming, subject to potentially intense regulatory scrutiny, and are only reflective of the nature of the feed materials that are processed during the test program. ReMA notes that several State regulatory agencies and U.S. EPA have questioned the results of multiple shredder VOC emission tests that were performed using TTEs.

6.2 CAPTURE EFFICIENCY

To accurately measure VOC emissions during stack testing, the VOC emissions from the source must be captured and delivered to the sampling location. The percentage (or fraction) of VOC emissions from the source that are captured and vented to the stack or control device reflects the capture efficiency (CE). Qualitative and quantitative methods that can be used during VOC emission test programs include U.S. EPA Method-204,⁴³ visible emissions observations, tracer tests, and FLIR camera imaging. Non-Method 204 CE demonstrations are largely qualitative and do not include established protocols and are often subjective in nature, especially with respect to metal shredder emissions due to the specific operating conditions of metal shredders. The determination of CE should be addressed up-front when considering source testing of a metal shredder for VOC emissions. Addressing CE should be carefully reviewed with a qualified environmental professional assisting in the conducting of any source testing.

Few shredders have been constructed with permanent total enclosures around them and retrofitting total enclosure structures for purposes of emission testing is challenging from a safety, engineering and cost perspective. One of the primary challenges to construction of enclosures around industrial metal shredders is their sheer size and the energy associated with the shredding process. Due to the lack of permanent total enclosures, the generation of steam and the turbulent dynamics within the shredder mill, the determination of CE can be complex and challenging at existing shredding operations. Other than U.S. EPA Method-204 for shredders with existing permanent total enclosures, no protocols or validation criteria have been established for use of visible observations, tracer tests or FLIR camera imaging for determining CE for VOC emissions at metal shredders.

For shredders that are not enclosed within a permanent structure, temporary enclosures or hood-type structures may be built at openings of the metal shredder, coupled with the use of a large fan, to capture emissions for purposes of testing. In these instances, the only valid quantitative method for estimating CE is tied to the use of U.S. EPA Method 204, or the functional equivalent to that method. While visible emission observations, FLIR cameras, and tracer testing have been attempted, little meaningful or measurable validity has been demonstrated for such methods in determining CE for metal shredders. Demonstrating CE through these alternative measures can be further challenged by ambient conditions at the time of testing, including both wind speed, wind direction, precipitation, temperature and dew point. The effects of wind and the vast expansive properties of steam often require significant up-sizing of temporary capture systems. ReMA members are strongly advised to avoid any attempts to quantify CE through tracer gas releases or similar studies that are difficult to conduct in general and nearly impossible to conduct in the extremely volatile shredder environment. As a result of these challenges, ReMA believes that the use of emissions factors, as developed and provided in Appendix A, provides significant utility.

⁴³ See: https://www.epa.gov/sites/default/files/2019-06/documents/method_204_0.pdf



6.3 STACK TESTING METHODS

There are a number of stack testing methods that can be considered when evaluating VOC emissions from a metal shredder if it is determined that stack testing is appropriate. Methods that have been used in evaluating VOC emissions from shredder operations include, but may not be limited to, Method 25A, Method 25 and similar variants, Method 25C, South Coast Air Quality Management District 25.3, Method 18, TO-12, TO-15, and SW-846 Methods [Volatile Organic Sampling Train (VOST) and Semi-VOST]. There may be reasons for selecting individual test methods that should be considered with an environmental professional as well as potentially in consultation with the appropriate regulatory authority, as required or otherwise appropriate. A summary of VOC stack testing methods is provided in Appendix B for information only. Consult with a qualified environmental professional who is familiar with local regulatory agency requirements and VOC stack sampling methods when considering appropriate VOC stack testing methods for use in a VOC sampling program.

6.4 CONDENSABLE PM COMPARED TO VOC

VOC and PM are analytes defined by the methods that are used to measure them. They are not individual chemical species but rather are classes and groups of species which can have similar behavior and are combined into a class by the measurement method used. A subset of PM is condensable PM (CPM); its defining quality is that it is not filtered out of the gas stream by the methods referenced in Section 6.3 but is condensed and captured after a filter. A subset of CPM is organic in nature, being recovered from the condensed material by organic extraction.

It is possible that the same components could be contributing to both CPM and VOC. The CPM and VOC split depends on a number of factors, all having to do with the various sampling parameters. From the CPM side, a species which is volatile enough to pass through a filter in a sampling train must not be volatile enough to pass the condenser. The same species must be volatile enough to pass through the full heated sample line and sampling system to the VOC measurement system.

It is possible that CPM and VOC on the same source may result in “double-counting” of VOC emissions when measured by the same sampling train because the same components could be contributing to each. The sampling and analysis procedures that are used to collect and measure VOC emissions could also collect and measure an unknown fraction of organic CPM and thereby contribute to a positive bias on VOC test results. Test methods that measure and report the aggregate of organic compound emissions in a gas stream (e.g., Method 25A) could be affected by this phenomenon.

6.5 DESIGNING AN EFFECTIVE VOC STACK TEST PROGRAM

ReMA suggests that facilities considering stack testing to measure VOC emissions from a metal shredder consult with a qualified environmental professional that is familiar with local regulatory agency requirements and VOC stack sampling methods to prepare a test protocol and to design an effective testing program that will collect representative VOC data and meet regulatory scrutiny. Recommended minimum VOC test protocol contents are provided in Table 6-1.

Table 6-1 Example Test Protocol Content

Topic	Description
Introduction	Describe what is being testing and why. Define the facility, the test organization, and any appropriate regulatory agency or permit condition requiring the emissions testing. Specify, in a broad sense, how many conditions will be tested, how many replicates at each condition, and what each condition represents.
Facility and Process Description	Describe the facility and any shredder(s) within. If testing just one unit to be applicable to the others, explain why that is appropriate. Describe the selected shredder in greater detail, along with issues of port configuration, access, and any safety issues. Describe and define the major operational parameters (e.g., feed rate, temperature) and pollution control system parameters (e.g., differential pressure, temperature, liquid to gas ratio).
Test Approach and Conditions	Describe the testing to be conducted in some detail. The overall test program, and each test condition, should have a clear demonstration objective, both in terms of process condition and in terms of emissions measurement. Note that one of these tests might be a test related to capture efficiency. This section will likely be enhanced by a series of tables presenting, for example, lists of operating parameters and target ranges, and target analytes (and possibly regulatory limits) for the measurement activities.
Sampling, Analysis, and Quality Control	Provide further detail on the methods to be used to collect samples and then to analyze the collected samples. This includes method references, discussions of any deviations or modifications necessary for testing at this facility and unit. Identify the test organization and the selected laboratories. This section will likely be enhanced by a series of tables presenting method references, method configurational specifications (e.g., duration and volume), and any method deviations.
Reporting	Describe the report to be prepared. Identify who the recipients of the report will be, and what is the intended use the resulting data and operational assessment.

Appendix A

Development of VOC Emissions Factors for
Metal Shredders

APPENDIX A

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SECTION 1

Introduction

ALL4 LLC (ALL4) evaluated available volatile organic compound (VOC) emissions test results for metal shredders to develop VOC emissions factors for use in quantifying VOC emissions from metal shredders processing typical feed materials.

ALL4 obtained available emissions test reports for metal shredders from the United States Environmental Protection Agency (U.S. EPA), state regulatory agencies, and members of ReMA. ALL4 compiled the VOC emissions data from the VOC emissions test reports into a consistent format suitable for a statistical evaluation. ALL4 conducted additional research to gather supplemental technical information regarding shredder operating conditions during the various VOC emissions test programs represented in the dataset. ALL4 then reviewed the emissions test reports, emissions test protocols, facility permits, and supplemental information to evaluate the VOC test methods used during the test programs and understand the operating conditions of the shredder during emissions testing. This review also served as an initial screening step to determine whether certain VOC emission test results should be excluded from the dataset used in the statistical evaluation presented herein. VOC emissions test results were converted to a common propane basis for the statistical evaluation, consistent with how U.S. EPA has evaluated similar VOC emissions data for metal shredders.

This report describes how the metal shredder VOC emissions factors were developed including the statistical evaluation (data collection and analyses, data screening, and identification of outliers), the basis for the emissions factors (approach, suggested emissions factors, and data quality), the review and evaluation of VOC emissions tests (VOC emissions test methods and test conditions), and possible process influences on metal shredder VOC emissions factors. The shredder VOC emissions factors presented herein reflect three feed composition scenarios: 100% end-of-life vehicles (ELV), 100% light iron, and a blend of ELV and light iron. The emission factors are presented on a pound of VOC (lb VOC) per net ton feed basis.

The metal shredder VOC emissions factors provided herein reflect a current and comprehensive review of available metal shredder VOC emissions data and therefore replace the metal shredder VOC emissions factors included in the 1996 Versar Title V Applicability Workbook (Versar Workbook).¹ Notwithstanding the importance of this evaluation to the metal recycling industry, each facility and company with site- or company-specific VOC emissions testing data should consider prioritizing such data for use when quantifying metal shredder VOC emissions when appropriate.

¹ Versar, Inc., Title V Applicability Workbook, prepared for ReMA, dated 1996

SECTION 2

Statistical Evaluation

ALL4 used a comprehensive framework to derive VOC emissions factors from a population of metal shredder operations for which VOC emissions test information was available. The framework is based on U.S. EPA's *Recommended Procedures for Development of Emissions Factors*.² U.S. EPA uses this framework to develop emissions factors for its online emissions factor repository, retrieval, and development tool (i.e., WebFIRE). ALL4 followed U.S. EPA's recommended statistical methods and procedures, which are typically recommended for larger datasets, to the extent practicable. The following sections describe how ALL4 developed the metal shredder VOC emissions factors.

2.1 DATA COLLECTION AND ANALYSIS

The emissions test dataset collected consists of VOC emissions test results from 21 VOC emissions test programs at 15 different metal shredding facilities located across multiple geographic regions of the continental United States. Each test program may include multiple VOC test results for differing feed types. To maintain anonymity for each VOC emissions test program, ALL4 assigned a unique identification number to each VOC emissions test report. The dataset includes test programs with metal shredder VOC emissions that reflect various feed types and varying feed rates, and that were measured using U.S. EPA or State Agency VOC emission test methods. ALL4 reviewed each test report to understand if and how capture efficiency (CE) was addressed during testing. The VOC test results included in the final dataset are summarized in Table A-1 of Attachment A. Table A-2 of Attachment A provides a summary of the VOC test results for each test program that were reviewed for this evaluation, and identifies whether the data were included in the final data set used in ALL4's analysis. Brief summaries of the VOC test programs that were reviewed for this evaluation are provided in Attachment B.

2.2 DATA SCREENING

ALL4 used a multi-step process to select, screen, and analyze the VOC emissions test results to assure the representativeness and validity of the data. Several of the emissions tests in the dataset include VOC measurements before and after a regenerative thermal oxidizer (RTO) VOC control device. Because the intent of this assessment is to evaluate and derive uncontrolled VOC emissions factors, only uncontrolled VOC emissions data were used in the evaluation for those

² U.S. EPA Office of Air Quality Planning and Standards, EPA-453/B-21-001, Recommended Procedures for Development of Emissions Factors and Use of the WebFIRE Database (November 2021), https://www.epa.gov/system/files/documents/2021-11/final-webfire-procedures-document_nov-2021.pdf.

facilities equipped with an RTO or other VOC control device. For facilities with particulate matter (PM) control devices (e.g., cyclones, fabric filters, PM scrubbers), VOC emissions data collected prior to the PM control device were used, where available. Otherwise, VOC emissions data collected after PM control devices were used and considered uncontrolled.

Several different VOC test methods, including U.S. EPA Reference Methods 25, 25A, 25C and other state methods, were used by the various facilities to quantify metal shredder VOC emissions. Additional VOC test methods (e.g., Method 18, Method TO-12, and Method TO-15) were used during several test programs to speciate VOC exhaust constituents either to establish a mass VOC emission rate or to speciate “exempt” VOC [i.e., those compounds excluded from the definition of volatile organic compounds under 40 CFR §51.100(s)(1)]. As the majority of test programs included in this evaluation used Method 25A to quantify total hydrocarbons (THC) with results expressed in terms of a calibration standard (e.g., parts per million [ppm] as propane), Method 25A was selected to allow relative comparability amongst the test data. For test programs that used other test methods in addition to Method 25A, only the Method 25A results were included in this analysis. Test results for total VOC from test methods other than Method 25A were used only if Method 25A results were unavailable. Relying primarily on Method 25A test results presents an overall high bias and is therefore a conservative approach for compliance determinations because Method 25A measures total hydrocarbons (THC), which include non-VOC and VOC-exempt organic compounds, which are likely present in shredder exhaust. Except as noted in Appendix B, results used herein were not corrected for exempt VOC.

Method 25A test results were typically expressed in terms of a single compound such as carbon, methane, propane, or hexane. ALL4 converted the VOC test results in the dataset to a common propane basis to statistically evaluate the VOC emissions expressed in terms of the same compound consistent with how U.S. EPA has evaluated similar VOC emissions data for metal shredders. The conversion of the VOC emission test results to a common propane basis simply changes the measurement unit to allow for comparable results and does not introduce error or bias into the dataset.

The VOC test results that were used to develop the VOC emissions factors reflect measured mass VOC emissions rates (lb VOC as propane/hour). ALL4 normalized the measured mass VOC emissions rates to a mass per net ton of feed basis (lb VOC per net ton feed) using the associated shredder feed rates that were determined in conjunction with the VOC test programs.

2.3 IDENTIFICATION OF OUTLIERS AND NON-REPRESENTATIVE DATA

Non-representative data, unreliable data, and data outliers were identified and excluded using qualitative and quantitative methods. ALL4 qualitatively reviewed the emissions test reports in the raw dataset to identify results that were not representative. VOC test results that were deemed unreliable within individual test reports, test reports with key information redacted, and VOC results measured by incomplete or suspect test methods were considered non-representative.

VOC test results were then grouped by feed type. The grouped and sorted datasets were further analyzed to identify maximum and minimum values and were examined for suspected outliers. The data was plotted for further assessment, and the suspected outliers were reviewed for bias. Suspected outliers that were not removed during the qualitative assessment were evaluated using the Dixon's Outlier Test to determine whether the suspect values were statistical outliers. Dixon's Outlier Test is a U.S. EPA recommended calculation to confirm statistical outliers.³ Any outliers that were identified through the qualitative and quantitative assessments described above were excluded from the final datasets.

³ U.S. EPA, EPA/240/B-06/003, Data Quality Assessment: *Statistical Methods for Practitioners* (February 2006), <https://www.epa.gov/sites/default/files/2015-08/documents/g9s-final.pdf>.



SECTION 3

Emissions Factors Development

3.1 APPROACH AND BASIS

ALL4 initially completed an Exploratory Data Analysis (EDA) to further refine the dataset. An EDA is the process of investigating data to identify patterns, anomalies, and summarize statistical parameters.⁴ The data was segregated based on common characteristics such as feed type, feed rate, and emissions test method.

ALL4 used results of the EDA to identify factors potentially affecting the magnitude of VOC emissions from the shredding operations. ALL4 evaluated shredder feed type, feed rates, VOC test methods, exhaust gas temperature, and measured exhaust volumetric flowrates to determine their influence on measured VOC emission rates. Based on the analysis, ALL4 identified shredder feed types as a key factor potentially influencing VOC emissions rates and subsequently grouped VOC emissions test results based on common shredder feed types. The variable source characteristics associated with most of the test programs limited the ability to more narrowly categorize emissions data based on all factors.

Shredder type/age, use of water/foam injection, geographic location, and qualitative elements such as the degree of ELV source control⁵ and site-specific operating practices are factors that could not be evaluated due to the limited dataset or, more accurately, due to an absence of such documentation and an inability to standardize the impact of such factors. ALL4 reviewed several quantitative factors such as exhaust volumetric flow rate, exhaust gas temperature, feed type, and feed rate for which data was available for a majority of the tests. ALL4 found insufficient statistical evidence in the dataset ($p > 0.05$)⁶ to conclude that there is a relationship between exhaust volumetric flowrate, shredder feed rate, or exhaust gas temperature when compared to shredder VOC emission factors. Sufficient data points for the statistical analysis were available for the following shredder feed types and feed mixes:

- ELV — 100% ELV including materials characterized as vehicles and car bodies;
- Light iron — 100% light or sheet iron including non-automobile scrap such as light gauge steel and appliances; and
- ELV and light iron blend — a mixture of ELV and light iron.

⁴ U.S. EPA, Exploratory Data Analysis, <https://www.epa.gov/caddis-vol4/exploratory-data-analysis>.

⁵ “Source control” is a term used by the industry to generally describe pollution prevention measures to remove materials (e.g., lubricants, fuel, fluids, etc.) from shredder feed materials prior to processing in the shredder.

⁶ U.S. EPA, Basic Principles & Issues, <https://www.epa.gov/caddis-vol4/basic-principles-issues-2>.

3.1.1 Capture Efficiency

ALL4 reviewed the available documentation associated with each of the emissions tests (i.e., test reports, appendices, test protocols, and permits) to evaluate if and how capture efficiency (CE) of VOC was considered during the test programs. Multiple tested facilities equipped with air pollution control systems were equipped with emissions capture systems by default. Other tested facilities that were not equipped with air pollution control systems used temporary total enclosures (TTE) to capture shredder emissions for emission testing purposes. The associated documentation of CE during testing ranged from no mention of CE to qualitative and/or quantitative documentation in the form of enclosure pressure differential measurements, FLIR camera observations of enclosure openings, Method 22 visible emissions observations of enclosure openings, calculation of enclosure air inflow based on enclosure opening area (ft²) and volumetric flowrate (scfm) measured during the test program. Specific CE documentation for various test locations are identified in Appendix B, as applicable.

U.S. EPA expressed their concerns to ReMA regarding the CE of the TTEs associated with Tests 1, 2, 3, and 5 used in the first iteration of this report. Their concerns were based primarily on their site-specific observations (e.g., steam and visible emissions not being fully captured by TTEs) during those test programs. While retroactively assessing CE for specific tests is not feasible, ALL4 adjusted the VOC test results from Tests 1, 2, 3 and 5 using a relative CE estimation.

ALL4 first compared the test results with known CE values (as reported in each test report) to the test results with uncertain CE values to derive relative CE values for each feed type (i.e., ELV, light iron, and ELV and light iron blend). The “Tests with Known CE” column in Table 3-1 reflects test programs conducted on metal shredders equipped with add-on VOC controls, presumed to reflect enclosed shredders and which included quantitative or qualitative documentation of CE. Due to lack of sufficient data within ‘ELV’ and ‘Light Iron’ categories, the assessment was completed only on the ELV and light iron blend feed category, which includes results from three of the four tests (Tests 1, 2, and 5) that are adjusted for CE. Relative CE values for the “Tests with Uncertain CE” were derived based on a direct comparison of average test results with the “Tests with Known CE.” Table 3-1 shows that the relative CE for the “Tests with Uncertain CE” for the ELV and light iron blend feed type category was 0.674, which was rounded to nearest tenth to obtain 0.7 or 70%.⁷

⁷ The results presented herein pertain exclusively to this particular estimation exercise and are not to be extended or construed as applicable to prior or subsequent test results. The principal objective of this estimation exercise was to address U.S. EPA concerns with regard to CE for the designated tests. It was not intended, nor should it be interpreted, to establish a ‘default’ CE that may be universally applied. Any use or dissemination of these results outside of this specified context may result in incorrect conclusions or actions.

Table 3-1 Derived Relative Capture Efficiency Summary

Feed Type	Tests with Uncertain CE (lb/ net ton as propane)	Tests with Known CE (lb/ net ton as propane)	Relative CE (%)
ELV and Light Iron Blend	0.155	0.230	70%

A CE of 70% was applied to Tests 1, 2, 3, and 5 to account for CE and to address U.S. EPA's capture efficiency concerns identified for these specific tests.

3.2 FINAL DATASET

The final dataset includes 19 VOC test results from 11 different metal shredder facilities. Figure 3-1 shows the distribution of VOC test results in the final dataset by feed type. The VOC test results for metal shredders included two VOC test programs that were performed less than three months apart at the same facility on the same shredder while processing identical feed types (the two test programs were performed for both the 100% ELV and 100% light iron feed types). Inclusion of results from the same shredder while processing identical feed types introduces representation bias by skewing the final average value. This is particularly true when working with limited data. Averaging test results from the same shredder processing identical feed type ensures that emissions rates from one shredder or facility does not disproportionately influence the final average. In addition, Tests 1, 2, 3 and 5 were adjusted for CE as discussed in Section 3.1.1.

Figure 3-1 Distribution of VOC Emissions Results by Feed Type (Bias Corrected)

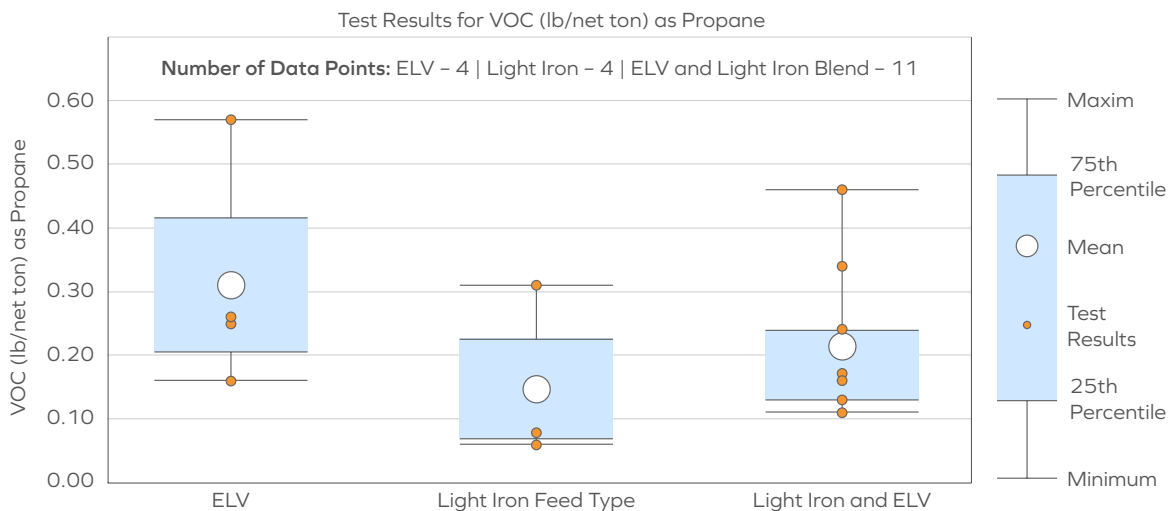


Figure 3-1 presents VOC emissions results without the bias associated with overweighted contributions from one facility. The bias was corrected by averaging individual VOC test results that were completed on the same shredder with the same feed material, on different dates within three months of each other. Figure 3-1 shows 19 VOC test results from 11 metal shredder facilities.

3.3 SHREDDER VOC EMISSIONS FACTORS

For each feed type, ALL4 used the average of the VOC test results in the final dataset to calculate the VOC emissions factors, by feed type, in terms of lb VOC per net ton feed basis. Emissions factors for uncontrolled metal shredder VOC emissions while processing ELV were developed using VOC test results from five test programs, two of which were performed at the same facility within three months of each other. Emissions factors for uncontrolled metal shredder VOC emissions while processing light iron were developed using VOC test results from five test programs, two of which were performed at the same facility and within three months of each other. Emissions factors for uncontrolled metal shredder VOC emissions while processing an ELV and light iron blend were developed using 11 VOC test results. The two VOC test results from the VOC test reports conducted at the same facility and the same shredder while processing identical feed types were first averaged together, and then averaged with the other data. In addition, Tests 1, 2, 3 and 5 were adjusted for CE as discussed in Section 3.1.1. Table 3-2 presents the average, minimum, and maximum VOC emissions rates based on feed type for the datasets.

Table 3-2 Summary of VOC Emission Rates by Feed Type (Bias Corrected)

Feed Type ^[1]	VOC EMISSIONS RATE ^[2]				Number of Test Results ^{[4][5]}
	Average ^[3]	Minimum	Maximum	Standard Deviation	
ELV	0.31	0.16	0.57	0.18	4
Light Iron	0.15	0.06	0.31	0.12	4
ELV and Light Iron	0.21	0.11	0.46	0.11	11

^[1] ELV is 100% ELV. Light Iron is 100% light iron. ELV and Light Iron Blend is a mixture of ELV and light iron reflecting ELV shredder feed fractions between 20% and 70%, with seven of the 11 test results reflecting a 50% ELV/50% Light Iron blend feed fraction.

^[2] Emission rates are presented in terms of lb VOC as propane per net ton feed basis.

^[3] The average VOC emission rate (lb VOC per net ton of feed) reflects a general VOC emissions factor for metal shredders associated with referenced feed types. Site or company specific source control techniques or emissions data may warrant case-specific adjustment of these factors.

^[4] Test Result is defined as either an average of multiple test runs (typically three) or a single test run during which the shredder was processing a consistent feed type or feed type blend.

^[5] Emission results completed on the same shredder unit and on the same feed type were averaged to remove bias from overweighted contributions from one facility. Test results from the same shredder unit but different feed types were considered separate test results.



3.4 SOURCE CONTROL PRACTICES AND VOC EMISSIONS

VOC emissions from metal shredders can be associated with organic liquids that may be present in shredder feed materials and that can partition to the vapor phase during the shredding process. Source control⁸ is an effective strategy used by the industry to minimize shredder VOC emissions by, among other methods, the removal of organic liquids from feed materials prior to shredding. While most facilities acknowledge their use of source control, sufficient information associated with individual facility source control practices was not available to quantify possible shredder VOC emissions reductions achieved through source control for this analysis. A facility's consistent use of source control may serve as a means to justify the use of lower VOC emissions factors than those presented in Table 3-2.

⁸ Ibid, note 5.



ATTACHMENT A

Summaries of Test Results and Test Programs Included in the Evaluation

Table A-1 Summary of VOC Emissions Test Results Used in Evaluation

Feed Type ^[1]	ID ^[2]	Test Method ^{[3][4]}	VOC Emission Results ^[5]
End-of-Life Vehicles (ELV)	5	Method 25A	0.16
	7/8	Method 25A	0.57
	15	Method 25A	0.25
	16	SCAQMD Method 25.1	0.26
Light Iron	3	Method 25A	0.07
	7/8	Method 25A	0.31
	15	Method 25A	0.14
	16	SCAQMD Method 25.1	0.06
ELV and Light Iron	1	Method 25A	0.13
	2	Method 25A	0.17
	2	Method 25A	0.13
	5	Method 25A	0.11
	6	Method 18 and Method TO-12	0.24
	11	Method 25A	0.46
	12	Method 25A	0.22
	13	Method 25A	0.20
	16	SCAQMD Method 25.1	0.34
	18	Method 25A	0.11
	20	Method 25A	0.16



- ^[1] End-of-life Vehicles (ELV) is defined as 100% ELV including materials characterized as vehicles and car bodies. Light Iron is defined as 100% light or sheet iron including non-automobile scrap such as light gauge steel and appliances. ELV and Light Iron Blend is defined as a mixture of ELV and light iron. The final ELV and Light Iron Blend dataset includes results from tests conducted on ELV feeds between 20–75%. Seven of the 11 test results for the ELV and Light Iron Blend were measured while processing approximately 50% ELV and 50% Light Iron.
- ^[2] The VOC test results included two VOC test programs that were performed within three months of each other at the same facility and on the same shredder while processing identical feed types (the two test programs were performed for both the 100% ELV and 100% Light Iron feed types). The VOC test results from those two VOC test programs were averaged and treated as a single VOC test result data point for each feed type. Test results completed on the same shredder unit where different feed types or mixes were processed were considered separate test results.
- ^[3] In some cases, a test program measured the VOC emissions rate using multiple VOC test methods (e.g., Method 25A and Method 25C). If a single test program included VOC results from differing test methods conducted simultaneously, Method 25A results were used in this evaluation. Two VOC test results reflecting combined ELV and light iron feed materials associated with ID No. 2 were not averaged because the proportions of the feed materials differed for each test.
- ^[4] While most test programs evaluated in this analysis used Method 25A to quantify VOC mass emissions rates, the test results performed by other VOC test methods were within the range of results produced by Method 25A and thus were treated on an identical basis as the Method 25A results.
- ^[5] Emission results are presented in terms of lb VOC as propane per net ton feed basis. All emissions rates are uncontrolled. If a VOC control device was present at the facility, the shredder VOC emissions measured prior to the VOC control device were used. For Tests 1, 2, 3, and 5 a CE of 70% was applied to account for capture efficiency as discussed in Section 3.1.1.

Table A-2 Summary of Evaluated VOC Emissions Test Programs and Capture Efficiency Discussion

Test Program ID	Test Program Date(s)	Test Data Included in this Analysis	Notes	Test Report Discussion Relevant to Capture Efficiency (CE)
1	Sept. 20, 2019	Yes		Temporary total enclosure (TTE) at under mill oscillator (UMO) was used to capture shredder emissions. Unknown CE adjusted to 70%.
2	Sept. 15-20, 2017	Yes		Pre-test discussion indicated that a partial enclosure was present. TTE around the UMO was used to capture shredder emissions. Unknown CE adjusted to 70%.
3	May 18, 2017	Yes		The shredder is enclosed and vented by a 20,000 CFM centrifugal fan and stack, with 64 ft ² of enclosure openings documented and an approximate air inflow of 312 fpm. Unknown CE adjusted to 70%.
4	July 18-19, 2017	No	Feed rate and VOC lb./ton data not available.	The shredder is enclosed with emissions directed to a cyclonic separator and wet scrubber.
5	Nov. 18-20, 2015	Yes, See Notes	The redacted emissions data, which were considered unexpected and anomalous by the test report, were excluded from the analysis. The test report did not report the cause of the anomalous readings. Valid data were included.	The shredder is enclosed with emissions directed to a cyclonic separator and wet scrubber. CE was not addressed in the report. Unknown CE adjusted to 70%.
6	June 28-29, 2017	Yes		Shredder is enclosed with emissions directed to a scrubber and demister. CE is estimated to be 95%.
7	Oct. 29-31, 2018	Yes, See Notes	The excluded test results (Method 25C and Method TO-12) were considered unreliable by the test report. The test report suspects that the canisters collected for Method 25C and Method TO-12 analysis had a leak as the results provided were substantially less than the Method 25A test.	Shredder is enclosed and CE was assumed to be 95% based on design requirements.
8	Jan. 21-23, 2019	Yes, See Notes	Only Method 25A test result was included in the analysis. Method 25C and Method TO-12 were not included.	Shredder is enclosed and CE was assumed to be 95% based on design requirements.



Test Program ID	Test Program Date(s)	Test Data Included in this Analysis	Notes	Test Report Discussion Relevant to Capture Efficiency (CE)
9				
10	Nov. 23–24, 2020	No	Emissions were sampled after the regenerative thermal oxidizer (RTO).	Shredder is enclosed and CE was assumed to be 100% based on design requirements. CE was demonstrated based on pressure differential measurements across the enclosure and Method 22 visible emissions observations.
11	Nov. 18, 2019	Yes, See Notes	The data from emissions that were sampled after the RTO were excluded from the analysis. Valid and uncontrolled data were included.	The shredder is enclosed and CE was estimated to be 90% based on design requirements and visible emissions observations.
12	May 25, 2018	Yes		Shredder is enclosed and CE was estimated to be 90% based on design requirements and observations during testing. Testing was conducted at the outlet of the capture hood.
13	July 26–27, 2017; Aug. 1–2, 2017	Yes		Shredder exhaust is captured and directed to a cyclone, wet scrubber, and fabric filter system. CE is not addressed in the test report.
14	June 18–20, 2012	No	All test results were excluded based on insufficient information to assess test data, feed materials, and process rates during testing.	Shredder exhaust is captured and directed to an RTO and scrubber.
15	Oct. 27–29, 2009	Yes		The results of the TE evaluation (CO tracer gas injection) indicated that TE was approximately 96.4% during testing.
16	April 28– May 1, 2007	Yes		Shredder exhaust is captured and directed to a particulate matter control system. CE not addressed in test report.
17	Aug. 30– Sept. 1, 2005	No	Emissions sampling was completed at the air pollution control device (APCD) inlet and outlet simultaneously. All test results were excluded based on operational concerns.	Shredder exhaust is captured and directed to a particulate matter control system. Exhaust volume of emissions capture efficiency was operating at approximately 20% of capacity.



Test Program ID	Test Program Date(s)	Test Data Included in this Analysis	Notes	Test Report Discussion Relevant to Capture Efficiency (CE)
18	June 16–18, 2021	Yes		The shredder is enclosed and CE was implied to be 100% based on design requirements and enclosure visible emissions observations. No VE or steam was observed from the enclosure.
19	Aug. 10–11, 2004	No	ELV test result was initially considered and deemed an outlier based on Dixon's Outlier Test.	Mill box exhausted (~31,000 scfm) to a particulate matter control system consisting of a cyclone, wet scrubber, HEAF filter, and mist eliminator.
20	Jan. 5, 2021	Yes		Shredder is enclosed. Shredder exhaust is captured and directed to a particulate matter control system with required 80% CE.
21	Oct. 12, 1999	No	The test results were excluded due to incompleteness and quality concerns of the test report.	Shredder exhaust is captured and directed to a particulate matter control system.
22	Feb. 28, 2007	No	Test results were excluded due to insufficient emissions rate (lb/ton) and feed rate (tph) data as this information was redacted.	Shredder exhaust is captured and directed to a particulate matter control system.

ATTACHMENT B

Test Report Summaries

Test Program No. 1 (September 20, 2019) — Uncontrolled emissions of total hydrocarbons (THC) were measured by Reference Method 25A, and methane and ethane emissions were measured by Fourier transform infrared (FTIR). The shredder under mill oscillator (UMO) was determined to be the emissions point and a temporary total enclosure (TTE) was used to capture shredder emissions. Testing was conducted at the outlet of the TTE. CE was estimated to be 98% and was checked using inflow measurements (200 fpm) and a forward-looking infrared (FLIR) camera. The reported VOC emission test results were corrected for estimated CE. The test report mentioned U.S. EPA's acceptance of TTE and CE. However, for this analysis, the CE was adjusted to 70% (See Section 3.1.1). Water injection was used during the test program at an average rate of 58.1 gpm. The target shredder feedstock was 50% ELV and 50% light iron (sheet iron). Actual feed rates during the test program were 49% ELV and 51% light iron (sheet iron). The facility practiced source control on ELV. Corrected VOC test results were expressed as total non-ethane, non-methane organic carbon (TNMNEOC) as propane.

Test Program No. 2 (September 15–20, 2017) — Uncontrolled emissions of THC were measured by Reference Method 25A, and methane and ethane emissions were determined using Reference Method 18, and tentatively identified compounds (TICs) including exempt VOC species were determined using Method TO-15. The shredder UMO was determined to be the emission point and a TTE was used to capture shredder emissions. However, for this analysis, the CE was adjusted to 70% (See Section 3.1.1). Testing was conducted at the outlet of the TTE. CE was estimated to be 100% and was checked using inflow measurements (200 fpm), enclosure pressure differential measurements, and smoke tests. The test report mentioned U.S. EPA's acceptance of the TTE. Water injection was assumed to be used during the test program but not confirmed. Two feedstock scenarios were tested: 50% ELV/50% light iron and 75% ELV/25% light iron. The facility practiced source control on ELV. Corrected VOC test results were expressed as total non-methane hydrocarbons (TNMHC) as propane.

Test Program No. 3 (May 18, 2017) — Uncontrolled emissions of TNMHC were measured by Reference Method 25A, and TICs, including methane and organic hazardous air pollutants (HAP), were collected and measured using Method TO-15 and Method 18. CE was not specifically mentioned in the report. However, based on the description included in the test report, the shredder is enclosed and vented by a 20,000 CFM centrifugal fan and stack, with 64 ft² of enclosure openings documented and an approximate air inflow of 312 fpm. Visible emissions determinations using Method 22 were used to confirm CE. However, for this analysis, the CE was adjusted to 70% (See Section 3.1.1). Testing was conducted at the enclosure outlet stack. Water injection with a wetting agent was used during the test program at an average rate of 10 gpm.

over the three run test program. One feedstock scenario was tested: 100% light iron. However, the test report noted that light iron may include up to 5% flattened auto bodies. VOC test results were expressed as TNMHC as propane (no methane was detected).

Test Program No. 4 (July 18–19, 2017) — Uncontrolled emissions of VOC were measured by Reference Method 25. CE was not mentioned in the test report nor demonstrated during the test. However, based on the description included in the test report, the shredder is enclosed with emissions directed to a cyclonic separator and wet scrubber. Testing was conducted at the scrubber stack. Water injection was used during the test program at an average rate of 20 gpm over the test program. Feedstock information was not included in the test or obtained from the facility. Corrected VOC test results were expressed as VOC as propane.

Test Program No. 5 (November 18–20, 2015) — Uncontrolled emissions of THC were measured by Reference Method 25A and organic HAP was measured using Method TO-15. CE was not mentioned in the test report nor demonstrated during the test. However, based on the description included in the test report, the shredder is enclosed with emissions directed to a cyclonic separator and wet scrubber. However, for this analysis, the CE was adjusted to 70% (See Section 3.1.1). Testing was conducted at the scrubber stack, which represented direct emissions from the shredder. VOC emissions were also measured at two separate downstream sorting stacks. Water injection was used during the test program at an average rate of 26 gpm during ELV runs and 25 gpm over “blend” runs. Three feedstock scenarios were tested: 100% ELV, 100% “other”, and a blend of ELV, other, and light iron. The facility practiced source control on ELV. VOC test results were expressed as methane. VOC emissions for the 100% “other” feedstock were unusually high and the report suggests that the results are unreliable without citing any particular root cause. In addition, the “other” feed type was redacted. Therefore, the “other” (redacted) emissions data were excluded from the analysis.

Test Program No. 6 (June 28–29, 2017) — Uncontrolled emissions of VOC were measured by Reference Methods 18 and TO-12. CE was not mentioned in the test report nor demonstrated during the test. However, based on the description included in the test report, the shredder is enclosed with emissions directed to a scrubber and demister. Testing was conducted at the demister stack. Water injection was used during the test program but usage was not provided in the report. One feedstock scenario was tested: 50% ELV and 50% light iron. The facility practiced source control on ELV. Speciated VOC test results were converted to and expressed as methane.

Test Program No. 7 (October 29–31, 2018) — Uncontrolled emissions of VOC were measured by Reference Methods 25A, 25C, and TO-12. CE was not mentioned in the test report nor demonstrated during the test. However, based on the description included in the test report, the shredder is enclosed and CE was assumed to be 95% based on design requirements. Water injection was used during the test program but usage data was not provided in the report. Two feedstock scenarios were tested: 100% ELV and 100% light iron. The facility practiced source

control on ELV. VOC test results for each method were converted to and expressed as methane. The results from the Method 25A, 25C, and TO-12 testing showed no correlation and the Method 25C and TO-12 test results were deemed unreliable due to collection issues and were not used. Only results from Method 25A were used in the evaluation.

Test Program No. 8 (January 21–23, 2019) — Uncontrolled emissions of VOC were measured by Reference Methods 25A, 25C, and TO-12. CE was not mentioned in the test report nor demonstrated during the test. However, based on the description included in the test report, the shredder is enclosed and CE was assumed to be 95% based on design requirements. Water injection was used during the test program but usage data was not provided in the report. Two feedstock scenarios were tested: 100% ELV and 100% light iron. The facility practiced source control on ELV. VOC test results for each method were converted to and expressed as methane. Method 25A test results were used in the evaluation.

Test Program No. 9 — For this evaluation, ID No. 9 was not designated as a test program.

Test Program No. 10 (November 23–24, 2020) — Controlled emissions of VOC were measured by Reference Methods 25A and South Coast Air Quality Management District (SCAQMD) Method 25.3. Based on the description included in the test report, the shredder is enclosed and CE was assumed to be 100% based on design requirements. CE was demonstrated based on pressure differential measurements across the enclosure and Method 22 visible emissions observations. Water injection with a surfactant was used during the test program. One feedstock scenario was tested: 40% ELV and 60% light iron. The facility practiced source control on ELV. VOC test results for each method were converted to and expressed as methane. The controlled emissions rates measured during this program were not included in the evaluation.

Test Program No. 11 (November 18, 2019) — Uncontrolled and controlled emissions of VOC were measured by Reference Method 25A. Methane and ethane emissions were measured by Method 18. Only the uncontrolled emissions rates measured during this program were included in the evaluation. Based on the description included in the test report, the shredder is enclosed and CE was estimated to be 90% based on design requirements and visible emissions observations. Water injection was used during the test program but not documented. One feedstock scenario was tested: 50% ELV and 50% light iron. VOC test results were expressed as THC as methane.

Test Program No. 12 (May 25, 2018) — Uncontrolled emissions of VOC were measured by Reference Method 25A. Methane and ethane emissions were measured by Method 18. Based on the description included in the test report, the shredder is enclosed and CE was estimated to be 90% based on design requirements and observations during testing. Testing was conducted at the outlet of the capture hood. Water injection was used during the test program at an average rate of 41.3 gpm. One feedstock scenario was tested: 21% ELV and 79% mixed recyclable metals (light iron). VOC test results were expressed as THC as propane.



Test Program No. 13 (July 26–27, 2017 and August 1–2, 2017) — Uncontrolled emissions of VOC were measured by Reference Method 25A. Methane and ethane emissions were measured by Method 18. CE is not documented in the report. However, shredder exhaust is captured and directed to a cyclone, wet scrubber, and fabric filter system. Water injection is assumed but not documented. The feedstock scenario is not documented in the report. ALL4 has assumed that the test results reflect the processing of a mix of ELV and light iron. VOC test results were expressed as THC as propane.

Test Program No. 14 (June 18–20, 2012) — Uncontrolled and controlled emissions of VOC were measured by SCAQMD Method 25.3. Only the uncontrolled emissions rates measured during this program were included in the evaluation. CE is not documented in the report. However, shredder exhaust is captured and directed to a regenerative thermal oxidizer and scrubber. Water injection is assumed but not documented. The feedstock scenario and process rate is not documented. VOC test results were expressed as total non-methane hydrocarbons (TGNMNEHC) as carbon (RTO inlet) and as methane (scrubber exhaust).

Test Program No. 15 (October 27–29, 2009) — Uncontrolled emissions of VOC were measured by Reference Method 25A and Method TO-15. The test report mentioned that the test program, including CE testing, was conducted in accordance with an approved test protocol. The shredder is not enclosed. The shredder exhaust is pulled directly from the hammermill and conveyed through an exhaust system. The test firm evaluated CE by introducing a measured quantity of tracer gas (carbon monoxide) into the hammermill sidewall and measuring CO at the test location during the test program. The results of the TE evaluation indicated that TE was approximately 96.4% during testing. Water injection was used. Two feedstock scenarios were tested: 100% ELV and 100% sheet iron (light iron). The facility practiced source control on ELV. The Method TO-15 results by species were summed and expressed as total VOC. The Method 25A test results were expressed as propane. Method 25A test results were used in the evaluation.

Test Program No. 16 (April 28 – May 1, 2007) — VOC emissions were measured at the inlet and exhaust of the particulate matter control system using SCAQMD Method 25.1 and Method TO-15. CE is not documented in the report. However the shredder exhaust is captured and directed to a particulate matter control system. The facility typically uses water injection in the duct between the shredder and cyclone to improve the cyclone removal efficiency but the duct water injection system was not operating during Run 2. Three feedstock scenarios were tested: 50% ELV and 50% light iron (scrap), 100% ELV, and 100% light iron (scrap). VOC data collected at the inlet test location were used in the analysis. Results were expressed in terms of TGNMO, as methane.

Test Program No. 17 (August 30 – September 1, 2005) — Uncontrolled emissions of VOC were measured by SCAQMD Method 25.3. CE is not documented in the partial report. However shredder exhaust is captured and directed to a particulate matter control system. Water injection was used. Two feedstock scenarios were tested: 20% ELV and 80% light iron and 100% light iron. VOC test results were expressed as total gaseous non-methane organics (TGNMO) as hexane.

Test Program No. 18 (June 16–18, 2021) — Uncontrolled emissions of VOC were measured by Reference Method 25A. Exempt VOC compounds were determined separately by EPA Method 18. Based on the description included in the test report, the shredder is enclosed and CE was estimated to be 100% based on design requirements and enclosure visible emissions observations. Water injection was used at a rate of 186 gpm. One feedstock scenario was tested: 50% ELV and 50% light iron (tin scrap). The facility practiced source control on ELV. VOC test results were expressed as VOC as methane. The Method 25A data were not corrected for exempt VOC compounds (acetone, freon, and methane).

Test Program No. 19 (August 10–11, 2004) — Testing was performed at two shredders. Because one of the shredders only processed industrial grades, including clips and aluminum breakage, results from that shredder were not used. Uncontrolled emissions of VOC were measured by Reference Method 25A. CE is not documented in the report. However, shredder exhaust (~31,000 scfm) is reported to have been drawn directly from the top of the mill and directed to a particulate matter control system. Water injection was used. Test results within the report included measurements at the inlet and exhaust of particulate matter control devices. Although other feedstock scenarios were tested, those considered in this analysis included two 100% ELV runs. At the time of the test, the facility practiced source control and had specific source control related permit conditions required within its air permit. VOC test results were expressed as VOC as methane and were not corrected for exempt VOC species.

Test Program No. 20 (January 5, 2021) — Uncontrolled emissions of VOC were measured by Reference Method 25A. CE is not documented in the report but permit required CE is 80%. However, shredder exhaust is captured and directed to a particulate matter control system. Water injection was used at 30.5 gpm during tests. Feedstock scenarios were not documented during the test program, but typical feedstock mix is 30% ELV and 70% light iron. The facility practiced source control on ELV. VOC test results were expressed as VOC as methane and were not corrected for exempt VOC species.

Test Program No. 21 (October 12, 1999) — Uncontrolled emissions of VOC were measured by Reference Method 25A and TO-14. CE is not documented in the report. However, shredder exhaust is captured and directed to a particulate matter control system. Water injection is assumed but not documented. Feedstock scenarios or feed rates were not documented during the test program. VOC test results were expressed as VOC as methane and were not corrected for exempt VOC species.

Test Program No. 22 (February 28, 2007) — Uncontrolled emissions of VOC were measured by Reference Method 25. CE is not documented in the report. However, shredder exhaust is captured and directed to a particulate matter control system. Water injection use during test program was documented in report, but the water injection rate was redacted. Feedstock scenarios were not documented during the test program, but according to the test report, typical feedstock consists primarily of ELV. VOC test results were expressed as VOC as methane and were not corrected for exempt VOC species. The facility practiced source control on ELV.

Appendix B

Stack Test Method Descriptions

Table B-1 Stack Test Method Descriptions

Test Method	Summary	Advantages	Disadvantages
Method 25A — Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer ⁴⁴	Sample gas is routed to an instrument through a heated sample line. The flame ionization detector (FID) responds to most (but not all) carbon-containing species. The analyzer is calibrated with a selected gas species (typically propane or methane), and a single result is acquired, representing all hydrocarbon compounds in the tested gas. If used for the determination of VOC, the M25A response can be biased high due to inclusion of responses from compounds excluded by U.S. EPA from the VOC list (e.g., methane and ethane). It can also be biased low due to depressed instrument response for individual organic species. Recommended by U.S. EPA if VOC concentration is less than 50 parts per million (ppm).	• Continuous data allows interpretation of trends. • Real-time data; can respond to process changes. • FID is linear over a great range, although this could require real-time recalibration.	• No speciation of results; all hydrocarbon species are aggregated into a single result. • Positive biases occur from inclusion of VOC-excluded compounds (e.g., methane and ethane). • Negative biases occur from species with depressed FID response (e.g., methanol).
Method 25 — Determination of Total Gaseous Nonmethane Organic Emissions as Carbon (and variants) ⁴⁵	Sample gas is collected in an evacuated canister. Method variants use a condenser prior to the evacuated canister. Sample fractions are analyzed for Total Gaseous Non-Methane Organics (TGNMO). The sample gas (and condensate) is routed to an instrument that separates the methane (CH ₄), carbon monoxide (CO), and carbon dioxide (CO ₂) from the sample. The remaining sample is then catalytically oxidized (to create CO ₂) and then catalytically reduced and/or hydrogenated (to create CH ₄). The fully processed sample, in a gaseous form, is then analyzed by a flame ionization detector (FID). The condensate fraction of the sample is vaporized and processed through the FID. Not recommended by U.S. EPA if VOC concentrations are less than 50 ppm.	• Robust methodology, converting any carbon-containing compound collected in either the gas or condensate into methane for eventual analysis and inclusion as TGNMO.	• No speciation of results; all hydrocarbon species are agglomerated into a single result. • Data is not real-time, must wait for analytical results. • Positive biases occur from inclusion of VOC-excluded compounds (e.g., ethane).

⁴⁴ https://www.epa.gov/sites/default/files/2017-08/documents/method_25a.pdf

⁴⁵ <https://www.epa.gov/system/files/documents/2023-06/Method%2025%202023%20revision-2.pdf>



Test Method	Summary	Advantages	Disadvantages
Method 18 — Measurement of Gaseous Organic Compound Emissions by Gas Chromatography ⁴⁶	The configuration and implementation of the sample collection, sample preparation, and sample analysis methods are specific to the target analyte. Gas samples can be collected directly (e.g., Tedlar bags) and analyzed by direct gas chromatograph (GC) injection. Samples can be collected indirectly (e.g., sorbent), desorbed (or extracted) from the sorbent and analyzed by GC. Can be used as a supplemental measurement method to better understand the composition and mix of the organic compounds in the stack gas.	- Typically used to measure methane and ethane concentrations for correction of Method 25A total hydrocarbon data. - Interferences are minimized by looking for select analytes. - Quality Assurance (QA)/Quality Control (QC) is focused on the target analytes.	- Target analytes must be identified before collection. - Each compound is evaluated separately; multiple analytes may require multiple test trains. - Data is not real-time, must wait for analytical results.
TO-12 — Method for The Determination of Non-Methane Organic Compounds (NMOC) in Ambient Air Using Cryogenic Preconcentration and Direct Flame Ionization Detection ⁴⁷	Samples are collected into evacuated canisters, which are then transported to a laboratory for analysis. Canister contents (sample gases) are cryogenically concentrated to improve sensitivity and remove methane before analysis using GC and FID. The method was developed for use in ambient air and there are challenges when adapting an ambient method for collection and analysis of a stack gas sample. The matrix of stack gas is more challenging, and the methodology must address the additional complications. With appropriate care, Method TO-12 can be configured and operated to obtain meaningful results. Can be used as a supplemental measurement method to better understand the composition and mix of the organic compounds in the stack gas.	- Sample collection is straightforward, using an evacuated canister. Little (or no) additional equipment is required. - Interferences are minimized by looking for select analytes. QA/QC is focused on the target analytes.	- Data is not real-time, must wait for analytical results. - Method was developed for ambient air. - Sample train preparation needed to ensure that the components of the source gas do not interfere with the measurement.
TO-15 — Determination of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography/Mass Spectrometry (GC/MS) ⁴⁸	Same basic methodology as TO-12, except with analysis using gas chromatography (GC) and mass spectroscopy (MS). Can be used as a supplemental measurement method to better understand the composition and mix of the organic compounds in the stack gas.	- Same as TO-12. - Analysis by GCMS vs FID (TO-12) allows for the identification of a wider range of organic compounds (as tentatively identified compounds) through use of reference spectra.	Same as TO-12

⁴⁶ https://www.epa.gov/sites/default/files/2019-06/documents/method_18_0.pdf

⁴⁷ <https://www3.epa.gov/ttnamti1/files/ambient/airtox/to-12.pdf>

⁴⁸ <https://www3.epa.gov/ttnamti1/files/ambient/airtox/to-15r.pdf>



Test Method	Summary	Advantages	Disadvantages
Method 0010 — Modified Method 5 Sampling Train ⁴⁹ Method 0030 — Volatile Organic Sampling Train ⁵⁰	These methods were developed to collect samples from stack gases and provide excellent detection limits within the variety of matrices that can be present in typical stack gas emissions. For each method, the sample is extracted from the stack and routed to a chilled sorbent cartridge, which is transported to a laboratory for sample preparation and analysis by GC with MS. Method 0010 targets semi-volatile analytes using solvent extraction followed by GC/MS analysis. Method 0030 targets volatile analytes using thermal desorption with cryogenic concentration followed by GC/MS analysis.	• Detection limits for these methods are excellent [parts per billion (ppb) and below]. • Can identify and quantify unknown species in the gas. • Can determine volatile and semi-volatile organic species.	• These methods are rigorous, and therefore more expensive to implement. • Extended sampling times, intricate sampling trains, intensive sample preparation and analytical procedures.

⁴⁹ <https://www.epa.gov/sites/default/files/2015-12/documents/0010.pdf>

⁵⁰ <https://www.epa.gov/sites/default/files/2015-12/documents/0030.pdf>

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