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December 20, 2022

Mr. Ray Kempa
Northeast Regional Office
Engineering Services Section Chief
PA Department of Environmental Protection
2 Public Square
Wilkes-Barre, PA 18701-1915

RE: *RACT III Submittal*
Carpenter Co., Upper Macungie Facility
Operating Permit No.: 39-00040

Dear Mr. Kempa,

Enclosed please find the RACT III submittal package for Carpenter Co. (Carpenter)'s manufacturing facility located in Fogelsville, Lehigh County, Pennsylvania. This package includes the alternative RACT proposal and accompanying application for a major modification to the facility's Title V permit.

The applications includes a $4,000 fee made payable to Commonwealth of Pennsylvania, Clean Air Fund. Notifications for the major modification application have been signed and are being sent to the required parties. Signed copies with receipts will be forwarded to you upon receipt of confirmation.

If you have any questions regarding this submittal and application or require any additional information, please feel free to contact myself at 610-280-3902 x2353.

Sincerely,
Trinity Consultants

Matthew Page

Matthew Page
Managing Consultant

RACT III PROPOSAL

INTIAL NOTIFICATION, ALTERNATIVE COMPLIANCE PROPOSAL & COMPLIANCE DEMONSTRATION

Carpenter Co. / Fogelsville, PA

Prepared By:

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December 2022

Project 223902.0080

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1. EXECUTIVE SUMMARY

Carpenter Co. (Carpenter) operates the Fogelsville manufacturing facility in Lehigh County, PA under Title V operating permit No. 39-00040. The facility manufactures foam products, including expanded polystyrene (EPS) and polyurethane products. The Fogelsville facility is considered a major source of volatile organic compounds (VOC) per Title 25 of the Pennsylvania Code, Chapter 121.1 (25 Pa Code 121.1). The Fogelsville facility is not a major source of nitrogen oxides (NO_X) and therefore, according to 25 Pa Code 129.96(a), is not subject to any of the NO_X related requirements of the rule.

The Pennsylvania Department of Environmental Protection (PADEP) published 25 Pa. Code, Chapter 129: Additional RACT Requirements for Major Sources of NOx and VOCs for the 2015 Ozone NAAQS (the "RACT III Rule") in the Pa Bulletin on November 12, 2022 (52 Pa. Bulletin 6960). The Fogelsville facility is subject to certain provisions of this regulation including the requirement to complete a case-by-case RACT analysis for certain VOC emitting sources which are either 1) unable to meet the presumptive RACT limits in the rule, or 2) are not subject to presumptive RACT requirements and have potential emissions that 2.7 tons per year (tpy) of VOC.

This proposal contains the initial notification, specified in 25 Pa. Code 129.115(a), and provides case-by-case RACT determinations for the EPS manufacturing process and the polyurethane foam manufacturing process which are not subject to presumptive RACT and have potential emissions that exceed 2.7 tpy of VOC. The RACT III Rule compliance strategy for the remaining emission units at the Fogelsville facility is also discussed. Appendix C contains the Title V major modificaiton application forms to update the current permit to comply with RACT III.

RACT is defined in 25 Pa Code 121.1 as "the lowest emission limit for VOCs or NO_x that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility."

For sources subject to VOC RACT, there are two options for compliance with the RACT III Rule:
Compliance Option 1: Meet the presumptive RACT limits on a source-by source basis[1]; or
Compliance Option 2: Develop a case-by-case RACT proposal.[2]

This RACT proposal consists of the following sections:

- Section 1: Executive Summary
- Section 2: Initial Notification
- Section 3: RACT Analysis
- Section 4: RACT Proposal

The following attachments are enclosed with this application:

- Appendix A: RBLC Search Results
- Appendix B: Cost Analysis for RTO for Polyurethane Foam Line
- Appendix C: Title V Major Modification Application Forms

[1] 25 Pa Code 129.112

[2] 25 Pa Code 129.114

2. INITIAL NOTIFICATION

This section of the report serves as the written notification, specified in 25 Pa Code §129.115(a), that describes how Carpenter proposes to comply with the requirements of 25 Pa Code §129.111-129.115. This report is being submitted to the appropriate regional manager by December 31st, 2022 to satisfy the requirements of 25 Pa Code §129.115(a)(1). Title V major modification forms are included in Appendix C to update the current permit to comply with RACT III.

2.1 Emission Unit and RACT III Compliance Strategy

The proposed RACT III compliance strategy for each emission unit at the Facility is provided in Table 2-1. This table serves to identify the air contamination sources at the Foglesville Facility and identify the applicable RACT requirements or exemption status as specified in 25 Pa Code §129.115(a).

Carpenter is submitting the following information as part of the RACT III initial notification requirements:

- 25 Pa Code §129.115(a)(1) – Submit the initial notification by December 31, 2022
  - This initial notification has been submitted prior to December 31, 2022.

- 25 Pa Code §129.115(a)(2) – Identify the air contamination sources in 25 Pa Code §129.111(a) as subject to a RACT requirement or exempt
  - See Table 2-1 below.

- 25 Pa Code §129.115(a)(3) – Identify the air contamination sources in 25 Pa Code §129.111(b) as subject to a RACT requirement or exempt
  - The Facility is an existing major source of VOC. The facility is not a major source of NO_X. See Table 2-1 below.
- 25 Pa Code §129.115(a)(4) – Identify the air contamination sources in 25 Pa Code §129.111(c) which are exempt
  - See the exempt sources in Table 2-1 below.
- 25 Pa Code §129.115(a)(5) – Provide a description of each air contamination source listed in 25 Pa Code §129.115(a)(2) including, description, make, model and location, applicable RACT requirement, how the unit will comply with RACT III, and reason for exemption (if applicable).
  - See Table 2-1 below and the source descriptions in Section 2.2.

- 25 Pa Code §129.115(a)(6) – Provide a description of each air contamination source listed in 25 Pa Code §129.115(a)(3) including, description, make, model and location, applicable RACT requirement, how the unit will comply with RACT III, and reason for exemption (if applicable).
  - Not applicable, the Fogelsville Facility is an existing major source of VOC and is not subject to (a)(3). Any applicable units are specified in Table 2-1 below and specified in Section 2.2.

- 25 Pa Code §129.115(a)(7) – Provide a description of each air contamination source listed in (a)(4) including, description, make, model and location and information sufficient to demonstrate that the source has a PTE less than 1 tpy of NO_X or 1 tpy of VOC, as applicable.
  - See the exempt sources in Table 2-1 below.

At the Fogelsville facility, Carpenter manufactures foam products, including EPS and polyurethane.

Table 2-1. VOC Sources Subject to RACT III at the Fogelsville Plant

Emission Source ID from Title V Permit	Source Description	VOC RACT Status	Potential VOC Emissions (tpy)[3]	Actual VOC Emissions (tpy)[4]
101	EPS manufacturing process	Case-by-Case	88.8	44.29
102	Polyurethane foam manufacturing process	Case-by-Case	20	3.86
033	Boiler – EPS Building	Exempt	< 1	< 1
N/A	Polyester fiber line	Exempt	< 1	< 1
N/A	BFL line	Exempt	< 1	< 1
N/A	Laser cutter	Exempt	< 1	< 1
N/A	$CaCO_3$ unloading	Exempt	< 1	< 1
N/A	Polyurethane foam line storage tanks	Exempt	< 1	< 1

2.2 Source Descriptions and Applicable Limits

The following section provides source descriptions for each unit at the Fogelsville Facility as well as any applicable Presumptive RACT III emission limits. The information provided in this section is required under 25 Pa Code §129.115(a)(5). Each of the sources listed in Table 2-1 is located within the Carpenter Fogelsville Facility at 57A Olin Way, Fogelsville, PA 18051.

2.2.1 EPS Manufacturing Process (Source ID 101)

The EPS manufacturing process (Source ID 101) uses steam to convert raw materials to styrene. The process steps generally include bead expansion, bead drying, bead storage, block molding, block aging and final product fabrication. The raw material consists of beads impregnated with pentane to act as a blowing agent. The beads are received in "supersacks". Beads are fed to the expander where steam is used to expand the beads to approximately 1/8" diameter, in a one- or two-stage operation. The expanded beads flow to a fluidized bed dryer, where surface moisture is removed using air blown through the "bed" of beads. The beads flow through an airlock and are blown to storage bags. After aging in storage bags, to stabilize the prepuff, the beads are transferred to a mold where steam further expands and fuses them together into block form. After aging to stabilize, the block is cut and fabricated for insulation products or architectural shapes.

Pentane is lost during the expansion process. Pentane emissions from the EPS manufacturing process are currently controlled by a 16.329 MMBtu/hr boiler (Source ID 33, Stack ID S03). The Epsilon system collects the pentane vapors from the process and injects them into the boiler's combustion air. As a result, the pentane replaces some of the natural gas used as boiler fuel. The boiler has a destruction efficiency of greater than 99% for VOC,[5]

[3] Potential VOC emissions are shown as the limits for annual actual VOC emissions established in Title V Operating Permit 39-00040, Section D, Source ID 101, Condition #002 and Source ID 102, Condition #001. Facility-wide PTE is limited to 108.8 tpy under Section C, Condition #006 of the permit.

[4] Actual emissions from 2021.

[5] Efficiency must be at least 99%, per Title V Operating Permit 39-00040, Section D, Source ID 101, Conditions #003.

Fugitive pentane is also emitted from the storage and fabrication area. This area is ventilated via five wall-mounted fans.

2.2.2 Polyurethane Manufacturing Process (Source ID 102)

In the polyurethane foam manufacturing process (Source ID 102), the primary ingredients include polyol, toluene diisocyanate (TDI) or methylenediphenyl diisocyanate (MDI), and water. The raw materials, along with secondary additives such as carbon dioxide (CO_2) blowing agent, catalysts, surfactants, and colorants are metered into a mixing chamber and then dispersed onto a moving conveyor. The foaming action starts almost immediately and is complete within five minutes.

VOCs are emitted from the polyols, TDI, MDI, and amine catalysts used the process. Most of the VOC emissions from the polyurethane manufacturing process are vented from the pouring tunnel through six large exhaust vents ducted into one exhaust stack above the roof (Stack S04). Additional VOC emissions are vented to a second exhaust stack (Stack S05) after the pouring tunnel. After the foam progresses through the tunnel, it is cut into convenient slab lengths for storage. The slabs are moved from the pouring line to the slab room.

Fugitive VOCs are generated during the curing process in the slab room. The room is ventilated via eight wall-mounted exhaust fans. After the slabs have cured for a minimum time, the foam is ready to be cut according to customer requirements.

In addition, the foam is subject to flammability testing in a quality control laboratory known as the "burn room." Tests are short in duration, approximately one hour, and occur every few days. Minor smoke emissions occur from this testing. The final products produced from the foam slabs may be furniture cushions, carpet underlay, medical pads for hospitals, bedding, automotive pads, or any product that requires flexible foam.

2.2.3 Other Source Information

A boiler rated at 16.329 MMBtu/hr which is fired on natural gas and pentane serves as a control device for pentane emissions from the EPS manufacturing process. The polyurethane foam line includes several storage tanks which store VOCs. There are several other emission points throughout the facility which exhaust to the atmosphere, including exhaust stacks for the polyester fiber line, exhaust stacks for the bonded foam line (BFL), laser cutters, and calcium carbonate ($CaCO_3$) unloading operations. Emissions from the foam grinding system (FGS) are discharged inside the building.

2.2.4 Units Exempt from RACT

Units with a potential to emit of one (1) tpy or less of VOC are exempt from the RACT III VOC related requirements, in accordance with 25 Pa Code 129.111(c). The EPS Boiler (Source ID 033), the polyester fiber line, the BFL line, the laser cutters, and the $CaCO_3$ unloading operations have potential emissions of VOC less than one (1) tpy. As such, these sources are exempt from VOC RACT requirements and do not require further assessment. See Table 2-1 for exempt units.

Units which are subject to various sections of 25 Pa Code 129 are exempt from the RACT III VOC related requirements, in accordance with 25 Pa Code 129.11(a). The VOC-containing storage tanks used in the polyurethane foam manufacturing process are subject to 25 Pa Code 129.56 and 129.57. As such, these sources are exempt from VOC RACT requirements and do not require further assessment.

2.2.5 Case-by-Case RACT Determination

For sources which do not qualify for one of the source categories that have presumptive RACT limits, Option 2 for RACT compliance applies. Under this option, facilities must propose an alternative RACT emission limitation (i.e., a "case-by-case RACT limit") and submit a permit modification request, or Plan Approval application[6] to PADEP to establish this RACT III limit. The EPS and polyurethane foam manufacturing processes at the Fogelsville facility are subject to a case-by-case VOC RACT determination.

Pursuant to 25 Pa Code 129.92 and 129.114(d), the case-by-case RACT limit proposal must include each of the elements required under 25 Pa Code 129.92(a)(1)-(5), (7)-(10) and (b). Table 2-2 includes a cross reference for the location of these requirements in this RACT proposal for the Fogelsville facility.

Table 2-2. Case-by-Case RACT Proposal Requirements

Regulatory Requirement		Location in Proposal
25 Pa Code 129.92(a)(1)	A list of each source subject to the RACT requirements	Section 2.2
25 Pa Code 129.92(a)(2)	The size or capacity of each affected source and types of fuel combusted or the types and quantities of materials processed or produced in each source.	Section 4
25 Pa Code 129.92(a)(3)	A physical description of each source and its operating characteristics.	Section 2.2
25 Pa Code 129.92(a)(4)	Estimates of the potential and actual VOC emissions from each source and associated supporting documentation.	Table 2-1
25 Pa Code 129.92(a)(5) and (b)	A RACT analysis which meets the requirements of subsection (b), including technical and economic support documentation for each affected source.	Section 3
25 Pa Code 129.92(a)(7)	The testing, monitoring, recordkeeping and reporting procedures proposed to demonstrate compliance with RACT.	Section 4
25 Pa Code 129.92(a)(8)	A plan approval application that meets the requirements of this article if required under §127.11 (relating to plan approval requirements).	N/A
25 Pa Code 129.92(a)(9)	An application for an operating permit amendment or application to incorporate the provisions of the RACT proposal.	Appendix C
25 Pa Code 129.92(a)(10)	Additional information requested by the Department that is necessary for the evaluation of the RACT proposal.	To be provided upon request by the Department

[6] A Plan Approval is required in the case that additional pollution controls are to be installed as part of the case-by-case RACT determination.

3. RACT ANALYSIS

As discussed above, the EPS and polyurethane foam manufacturing processes at the Fogelsville facility are subject to a case-by-case RACT determination. This section provides details on the methodology used to determine the proposed RACT.

3.1 Top-Down Methodology

Case-by-case RACT determinations are traditionally based on a top-down methodology. PADEP has outlined the required elements of a RACT analysis and determination in 25 Pa Code 129.99(d) and 129.92(b). Presented below are the five basic steps of the top-down RACT review as identified by PADEP.

3.1.1 Step 1: Identify All Control Technologies

Under Step 1, all available control technologies are identified for each emission unit in question. The following methods may be used to identify potential technologies:

- Researching the RACT/BACT/LAER Clearinghouse (RBLC) database;
- Surveying regulatory agencies;
- Drawing from previous engineering experience;
- Surveying air pollution control equipment vendors; and
- Surveying available literature.

Once identified, the control technologies are ranked in descending order of expected control effectiveness.

3.1.2 Step 2: Eliminate Technically Infeasible Options

After control technologies are identified under Step 1, an analysis is conducted to eliminate technically infeasible options. A control option is eliminated from consideration if there are process-specific conditions that prohibit the implementation of the control technology or if the highest control efficiency of the option would result in an emission level that is higher than any applicable regulatory limits, such as a New Source Performance Standard (NSPS) or National Emission Standard for Hazardous Air Pollutants (NESHAP).

3.1.3 Step 3: Rank Remaining Control Technologies by Control Effectiveness

In Step 3, remaining control technology options are ranked based on their control effectiveness, from highest to lowest control efficiency. This list must identify, at a minimum, the baseline emissions of VOCs before implementation of each control option, the estimated reduction potential or control efficiency of each control option, the estimated emissions after the application of each control option and the economic impacts.

3.1.4 Step 4: Evaluate Most Effective Controls and Document Results

Beginning with the highest-ranked control technology option from Step 3, detailed economic, energy, and environmental impact evaluations are performed in Step 4. If a control option is determined to be economically feasible without adverse energy or environmental impacts, it is not necessary to evaluate the remaining options with lower control efficiencies.

The economic evaluation centers on the cost effectives of the control option. Costs of installing and operating control technologies are estimated and annualized following the methodologies outlined in the U.S. EPA's Office of Air Quality Planning and Standards (OAQPS) Control Cost Manual (CCM) and other industry resources.[7]

3.1.5 Step 5: Select RACT

Using the result of the prior steps to determine the appropriate control technology, the final step is to determine the emission limit that represents the RACT limit.

3.2 VOC RACT Assessment for EPS Manufacturing Process

This section addresses the RACT assessment for the EPS manufacturing process at the Fogelsville facility.

3.2.1 Step 1: Identify All Control Technologies for VOC

Step 1 in a top-down analysis is to identify all available control technologies. The evaluation of potential controls for VOC emissions from the EPS manufacturing process involves an investigation of control and destruction of VOC emissions. The RBLC database was reviewed to identify potential add-on control technologies for processes similar to the EPS manufacturing process. Results of the RBLC search for foam manufacturing processes are provided in Appendix A. It should be noted that the RBLC search results presented include RACT determinations as well as any best available control technology (BACT) and lowest available emission reduction (LAER) determinations, which may be more stringent than RACT.

Table 3-1 contains a list of the various technologies that have been identified for possible control of VOC emissions from the EPS manufacturing process.

Table 3-1. Potentially Available VOC Control Technologies for the EPS Manufacturing Process

Potentially Applicable VOC Control Technologies
Thermal Oxidizer
Catalytic Oxidizer
Carbon Adsorption
Current Control – Emissions Routed to Boiler

Other general VOC control technologies exist in addition to those listed in Table 3-1 that are widely used for VOC control on other types of emissions sources. However, several of these have been identified as not applicable for use on EPS manufacturing processes, and therefore have not been considered for this top down RACT assessment. These technologies include, but are not limited to:

Refrigerated Condensers; and
Flares

[7] OAQPS, *U.S. EPA Air Pollution Control Cost Manual*, Sixth Edition, EPA 452-02-001 (http://www.epa.gov/ttn/catc/products.html#cccinfo), Daniel C. Mussatti & William M. Vatavuk, January 2002.

Based on our research, neither of the technologies listed above have been commercially demonstrated on EPS manufacturing processes similar to those at the Fogelsville facility. Also, these technologies are not identified in the RBLC search results for similar processes presented in Appendix A.

The use of alternative blowing agents is not reviewed as a potential VOC control technology for the EPS manufacturing process under RACT. There are no commercially available blowing agents which are appropriate for use in the EPS manufacturing process other than pentane. According to the EPA's "Control of VOC Emissions from Polystyrene Foam Manufacturing" report (EPA Polystyrene Report), published in 1990, pentane is the only blowing agent that is has a high enough molecular weight to not vaporize at ambient air pressure during aging and storage of impregnated beads but a low enough molecular weight to vaporize during bead expansion.[8]

3.2.2 Review of Potentially Applicable VOC Control Technologies

The following section provides a discussion of each potentially applicable technology identified above, as it might be applied to the processes at the Fogelsville facility.

3.2.2.1 Thermal Oxidation

Thermal oxidation removes VOCs from an exhaust stream by passing the exhaust through a combustion chamber where the VOCs are converted via combustion into carbon dioxide, water vapor and small quantities of other compounds, depending on the constituents of the exhaust. Since the inlet waste gas stream temperature is generally much lower than that required for combustion, energy must be supplied to the incinerator to raise the waste gas temperature. Seldom, however, is the energy released by the combustion of the total organics (VOCs and others) in the exhaust stream sufficient to raise its own temperature to the desired levels, so auxiliary fuel (e.g., natural gas or propane) must be added.[9] In addition, depending on the concentrations of the components in the exhaust stream, additional combustion air must be added to complete the oxidation process.

The simplest design for thermal oxidizers is a direct flame incinerator, which consists of a combustion chamber only. However, other designs for thermal oxidizers are available which can increase the energy efficiency of the process by including a heat exchanger prior to the combustion chamber. These heat exchangers increase the temperature of the incoming exhaust gases, thus reducing the energy required for the combustion reaction. One such design is a recuperative oxidizer, which uses the hot gases exiting the combustion chamber to heat the incoming exhaust, combustion air, or both. Alternatively, regenerative thermal oxidizers (RTOs) operate by passing the exhaust gases through a hot ceramic bed thereby heating the stream (and cooling the bed) prior to the combustion chamber. Auxiliary fuel is still burned in the combustion chamber as required to achieve oxidation. The hot gases then exit the combustion chamber while passing through another ceramic bed, thereby heating it to the combustion chamber outlet temperature. The process flows are then switched, feeding the exhaust stream to the hot bed and routing the hot combustion gases through the cooled bed.

8 OAQPS, Control Technology Center, Control of VOC Emissions from Polystyrene Foam Manufacturing, EPA-450/3-90-020, (https://www3.epa.gov/airquality/ctg_act/199009_voc_epa450_3-90-020_polystyrene_foam_ manufacturing.pdf), August 1990. p 6-11.

9 OAQPS, U.S. EPA Air Pollution Control Cost Manual, Sixth Edition, EPA 452-02-001 (http://www.epa.gov/ttn/catc/products.html#cccinfo), Daniel C. Mussatti & William M. Vatavuk, January 2002.

3.2.2.2 Catalytic Oxidation

Catalytic oxidation is similar to thermal oxidation; however, the combustion process takes place in the presence of a catalyst, such as platinum or copper, to lower the ignition temperature of the VOC stream. This allows the oxidizer to operate at lower temperatures, typically ranging from 300° to 900°F[10] which reduces supplemental fuel consumption and associated operating costs. Catalytic oxidizers may also be equipped with a preheater system, utilizing either a primary combustion chamber, or the hot outlet gases from the oxidation process. Catalytic oxidizers come in two general varieties; fixed-bed or fluid-bed. These varieties differ in the design and configuration of the catalyst material through which the exhaust gases are passed. Catalytic oxidizers require an extremely clean exhaust stream to insure the catalyst does not foul.

3.2.2.3 Carbon Adsorption

The carbon adsorption process operates by passing the exhaust stream through a bed of activated carbon. Here, the VOCs are adsorbed onto the carbon until the VOC capacity of the carbon bed is reached. Upon reaching capacity in the carbon bed, the VOCs can be desorbed and recycled for further use or incinerated. Another typical desorption process involves passing a low pressure steam through the carbon bed. As the steam passes, the VOCs are released from the carbon and condensed in the steam, creating VOC-laden water. The VOC-laden water can then be treated further or discharged as wastewater depending on its quality.

Carbon adsorption can be employed in two forms: fixed-bed adsorption and fluidized-bed adsorption. Fixed-bed carbon adsorption uses two or more carbon beds. While two or more beds are in regeneration, one bed is in use. Fluidized-bed adsorption employs a single bed that contains beaded activated carbon. The VOC stream is pushed through the bed of activated carbon and exits while the VOC-laden carbon is continually removed and replaced for regeneration.

3.2.2.4 Current Control – Emissions Routed to Boiler

Pentane emissions from the EPS manufacturing process are currently controlled by a 16.329 MMBtu/hr boiler (Source ID 33, Stack ID S03). The Epsilon system collects the pentane vapors from the process and feeds it to the boiler's combustion air. The pentane replaces some of the natural gas used as boiler fuel. The boiler has a pentane destruction efficiency of 99.5%.

3.2.3 Step 2: Eliminate Technically Infeasible Options for VOC Control

Step 2 in a RACT top-down analysis is to eliminate the control options identified in Step 1 which are technically infeasible. The remaining technologies are then carried into Step 3.

3.2.3.1 Thermal Oxidation

Thermal oxidation is a potentially feasible control device for the EPS manufacturing process. The RBLC lists RTO systems as control devices for several similar polystyrene foam manufacturing processes, although RTO is defined as BACT, and not RACT, in these situations. See Appendix A for more information on the RBLC search results. This type of technology is technically feasible for Carpenter's EPS manufacturing process

10 OAQPS, U.S. EPA Air Pollution Control Cost Manual, Sixth Edition, EPA 452-02-001 (http://www.epa.gov/ttn/catc/products.html#cccinfo), Daniel C. Mussatti & William M. Vatavuk, January 2002.

and is further reviewed in the following section. VOC emissions routed to a boiler would be considered equivalent to thermal oxidation.

3.2.3.2 Catalytic Oxidation

Catalytic oxidation is a potentially feasible control device for the EPS manufacturing process. The RBLC does not list catalytic oxidation systems as control devices for similar polystyrene foam manufacturing processes. This type of technology is technically feasible for Carpenter's EPS manufacturing process and is further reviewed in the following section.

3.2.3.3 Carbon Adsorption

Carbon adsorption is a potentially feasible control device for the EPS manufacturing process. The RBLC does not list catalytic oxidation systems as a control devices for any similar polystyrene foam manufacturing processes. See Appendix A for more information on the RBLC search results. However, the EPA Polystyrene Report has determined that carbon adsorption has been demonstrated as a VOC emissions control device for the polystyrene foam manufacturing industry, stating that activated carbon is effective in capturing pentane by the physical adsorption mechanism.[11] The EPA report also notes that polymerization of the styrene on the carbon is a concern because it will quickly deactivate the bed. However, the styrene content in the vent stream from the EPS manufacturing process is expected to occur at trace levels.[12] As such, this type of technology is further reviewed in the following section.

3.2.3.4 Current Control – Emissions Routed to Boiler

The continued use of a boiler to control pentane emissions from the EPS manufacturing system is a technically feasible control strategy for the EPS manufacturing process at Carpenter's Fogelsville facility. The RBLC shows two other polystyrene processes which are controlled by boilers.[13]

3.2.4 Step 3: Rank Remaining Control Technologies by Control Effectiveness

In Step 3, the remaining control technology options are ranked based on their control effectiveness, from highest to lowest control efficiency. Table 3-2 provides the ranked control technologies for the EPS manufacturing process at Carpenter's Fogelsville facility.

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11 OAQPS, Control Technology Center, Control of VOC Emissions from Polystyrene Foam Manufacturing, EPA-450/3-90-020, (https://www3.epa.gov/airquality/ctg_act/199009_voc_epa450_3-90-020_polystyrene_foam_ manufacturing.pdf), August 1990. pp 2-3 and 6-6.

12 OAQPS, Control Technology Center, Control of VOC Emissions from Polystyrene Foam Manufacturing, EPA-450/3-90-020, (https://www3.epa.gov/airquality/ctg_act/199009_voc_epa450_3-90-020_polystyrene_foam_ manufacturing.pdf), August 1990. p 6-7.

13 Dart Container of KY's polystyrene container manufacturing process (RBLC ID KY-0080) and Western Insulfoam's foam panel manufacturing process (RBLC ID AZ-0019).

Table 3-2. Ranked Control Technologies for EPS Manufacturing Process

Ranked Control Technologies	Control Efficiency	Reference
1. Current Control – Emissions Routed to Boiler	99%	Title V Permit 39-00040, Section D, Source ID 101, Condition #003
2. Thermal Oxidation	99%	EPA Polystyrene Report, Section 6.2.1 [14]
3. Catalytic Oxidation	95%	EPA Polystyrene Report, Section 6.2.1 [15]
4. Carbon absorption	90%	EPA Polystyrene Report, Section 7.1. Short term carbon adsorption may be 95% or higher, but a more realistic time weighted average is 90%. [16]

3.2.5 Step 4: Evaluate Most Effective Controls and Document Results

As shown in the table above, the technology currently used to control VOC emissions from the EPS manufacturing process, routing emissions to the boiler, is the most effective technically feasible control technology for the process. The EPA Polystyrene Report confirms that where applicable, use of existing boilers would be the most effective control option.[17] Although thermal oxidation has a similar control efficiency, the cost effectiveness of implementing this new control technology would obviously be much higher than the cost effectiveness of continuing to operate the existing control technology currently in place. Also, the current control technology offsets a portion of the fuel required to produce the steam needed for the EPS manufacturing process. Implementation of a new control technology would result in an undesirable increase in fuel usage at the facility. The less effective control options are eliminated as potential RACT technologies and are not reviewed further.

3.2.6 Step 5: Select RACT

Based upon the analysis provided above, Carpenter has identified the existing control technology, routing emissions to the boiler, as RACT for the EPS manufacturing process processes at the Fogelsville facility. Under the facility's current Title V operating permit, the boiler is required to be operating within the parameters established in the Compliance Assurance Monitoring (CAM) plan whenever the EPS manufacturing process is operational and must achieve at least 99% destruction efficiency for VOC.[18] Carpenter is operating in compliance with the standards. Carpenter proposes that these permit

14 OAQPS, Control Technology Center, Control of VOC Emissions from Polystyrene Foam Manufacturing, EPA-450/3-90-020, (https://www3.epa.gov/airquality/ctg_act/199009_voc_epa450_3-90-020_polystyrene_foam_ manufacturing.pdf), August 1990. p 6-5.

15 Ibid.

16 OAQPS, Control Technology Center, Control of VOC Emissions from Polystyrene Foam Manufacturing, EPA-450/3-90-020, (https://www3.epa.gov/airquality/ctg_act/199009_voc_epa450_3-90-020_polystyrene_foam_ manufacturing.pdf), August 1990. p 7-3.

17 OAQPS, Control Technology Center, Control of VOC Emissions from Polystyrene Foam Manufacturing, EPA-450/3-90-020, (https://www3.epa.gov/airquality/ctg_act/199009_voc_epa450_3-90-020_polystyrene_foam_ manufacturing.pdf), August 1990. P 6-5.

18 Title V Operating Permit 39-00040, Section D, Source ID 101, Conditions #003 and #008

requirements as well as the current VOC emission limit of 88.8 tpy be applied as RACT for the EPS manufacturing process at the Fogelsville facility.

3.3 VOC RACT Assessment for the Polyurethane Manufacturing Process

This section addresses the RACT assessment for the polyurethane foam manufacturing process at the Fogelsville facility. As an area source of HAP emissions, the Fogelsville plant is currently subject to a Generally Available Control Technology (GACT) Standard, under Title 40 of the Code of Federal Regulations, Part 63, Subpart OOOOOO National Emission Standards for Hazardous Air Pollutants for Flexible Polyurethane Foam Production and Fabrication Area Sources (NESHAP Subpart OOOOOO), which was originally published on July 16, 2007, and last updated on September 21, 2021. While the standards in NESHAP Subpart OOOOOO are applicable to HAPs only, HAP emissions generated from polyurethane foam manufacturing processes are a subset of VOCs. The GACT standard for slabstock flexible polyurethane foam production were established without the requirement to reduce HAP emissions or install add-on controls. Carpenter complies with NESHAP OOOOOO by not using methylene chloride.

3.3.1 Step 1: Identify All Control Technologies for VOC

Step 1 in a top-down analysis is to identify all available control technologies. The evaluation of potential controls for VOC emissions from the polyurethane foam manufacturing process involves an investigation of control and destruction of VOC emissions. The RBLC database was reviewed to identify potential add-on control technologies for processes similar to the polyurethane foam manufacturing process. Results of the RBLC search for foam manufacturing processes are provided in Appendix A. It should be noted that the RBLC search results presented include RACT determinations as well as any BACT and LAER determinations, which may be more stringent than RACT.

Table 3-3 contains a list of the various technologies that have been identified for the control of VOC emissions from the polyurethane foam manufacturing process.

Table 3-3. Potentially Available VOC Control Technologies for the Polyurethane Manufacturing Process

Potentially Applicable VOC Control Technologies
Thermal Oxidizer
Catalytic Oxidizer
Carbon Adsorption
Current Control – Good Operating and Management Practices

Other general VOC control technologies exist in addition to those listed in Table 3-3 that are widely used for VOC control on other types of emissions sources. However, several of these have been identified as not applicable for use on polyurethane foam manufacturing processes, and therefore have not been considered for this top down RACT assessment. These technologies include, but are not limited to:

Refrigerated Condensers; and
Flares

Based on our research, neither of these technologies listed above have been commercially demonstrated on polyurethane foam manufacturing processes similar to those at the Fogelsville facility. These technologies are not identified in the RBLC search results for similar processes presented in Appendix A. Therefore, the control technologies are not considered as potentially applicable in our case and have been eliminated as potential RACT technologies.

The use of alternative primary ingredients and secondary alternatives are not reviewed as a potential VOC control technology for the polyurethane foam manufacturing process under RACT. RBLC search results include requirements for the utilization of best management practices, including the use of the lowest VOC-content foam production materials where technically feasible for BACT on under the federal Prevention of Significant Deterioration (PSD) program.[19] The process does not use VOC-containing blowing agents.

3.3.2 Review of Potentially Applicable VOC Control Technologies

The following section provides a discussion of each potentially applicable technology identified above, as it might be applied to the processes at the Fogelsville facility.

3.3.2.1 Thermal Oxidation

See Section 3.2.2.1 for control technology description.

3.3.2.2 Catalytic Oxidation

See Section 3.2.2.2 for control technology description.

3.3.2.3 Carbon Adsorption

See Section 3.2.2.3 for control technology description.

3.3.2.4 Current Control – Good Operating and Management Practices

Carpenter is already employing appropriate work practices to minimize VOC emissions, such as using non-VOC blowing agents and ensuring that all clean up solvent operations comply with Best Available Technology to minimize emissions.[20] All new and used cleaning solvents are stored in closed containers. Carpenter is operating in compliance with these standards.

3.3.3 Step 2: Eliminate Technically Infeasible Options for VOC Control

Step 2 in a RACT top-down analysis is to eliminate the control options identified in Step 1 which are technically infeasible. The remaining technologies are then carried into Step 3.

3.3.3.1 Thermal Oxidation

Due the nature of Carpenter's operations, air from the foam machine tunnel is exhausted at a high flowrate, with a low concentration of VOC. The application of traditional thermal oxidation for this type of process is challenging, and would require a large energy input to maintain a feasible oxidation reaction. Although the RBLC lists thermal oxidation systems as control device for one polyurethane foam manufacturing process, thermal oxidizers are defined as BACT, and not RACT, in this situation. However, this type of technology is

19 Foamex Innovations, Inc.'s Indiana facility (RBLC ID IN-0137)

20 Title V Operating Permit 39-00040, Section D, Source ID 102, Conditions #003 and #008

technically feasible for Carpenter's polyurethane foam manufacturing process and is further reviewed in the following section.

3.3.3.2 Catalytic Oxidation

To employ catalytic oxidation on polyurethane foam manufacturing processes at Carpenter, the high volume of gas collected by the exhaust vents would require multiple oxidizers for each stack. In addition, the various ingredients and additives used in the process may create the potential problem of fouling the catalyst, thus reducing the efficiency of the oxidation reaction. The RBLC does not list catalytic oxidation systems as control devices for similar polyurethane foam manufacturing processes. Since this technology has not been demonstrated in practice, Carpenter considers this technology to be technically infeasible and eliminates catalytic oxidation as RACT. Further evaluation of the technology is not required.

3.3.3.3 Carbon Adsorption

While carbon adsorption was not listed in the RBLC for polyurethane foam manufacturing processes, four Carpenter facilities currently utilize a carbon adsorption bed to control VOC emissions from the polyurethane foam manufacturing line exhaust. Therefore, Carpenter believes carbon adsorption to be technically feasible for the polyurethane foam manufacturing process and is further reviewed in the following section.

3.3.3.4 Current Control – Good Operating and Management Practices

The continued use of good operating and management practices are a technically feasible control strategy for the Fogelsville facility polyurethane foam manufacturing process.

3.3.4 Step 3: Rank Remaining Control Technologies by Control Effectiveness

In Step 3, the remaining control technology options are ranked based on their control effectiveness, from highest to lowest control efficiency. Table 3-4 provides the ranked control technologies for the polyurethane foam manufacturing process at Carpenter's Fogelsville facility.

Table 3-4. Ranked Control Technologies for Polyurethane Manufacturing Process

Ranked Control Technologies	Control Efficiency	Reference
1. Thermal Oxidation	98%	EPA Air Pollution Control Technology Fact Sheet for Thermal Incinerator (EPA-452/F-03-022)
2. Carbon Adsorption	90%	EPA Expected Control
3. Current Control – Good Operating and Management Practices	--	

3.3.5 Step 4: Evaluate Most Effective Controls and Document Results

The most efficient, control technologies which are technically feasible for the polyurethane foam manufacturing process are carbon adsorption and thermal oxidation. Therefore, a cost analysis was performed on the carbon adsorption and thermal oxidation control technologies for the polyurethane foam manufacturing process. The majority of the VOC emissions generated from the polyurethane foam manufacturing process are produced as fugitive emissions as the curing process takes place in the slab room. The cost to route the fugitive emissions to the control device would be significant. Therefore, Carpenter analyzed the cost of two potential control device configurations for both the carbon adsorber and thermal oxidizer:

- Cost effectiveness of controlling only the VOC stack emissions with a control device. Combined emissions from the two exhaust points (S04 and S05) are considered and ductwork to the control device are conservatively excluded from the cost calculation.
- Cost effectiveness of controlling the total VOC from the process, including stack and fugitive emissions. Calculations include a conservative estimate of the cost of ductwork from the exhaust fans in the slab room to the control device. Carpenter conservatively assumed that 100% of emissions could be captured in the exhaust.

A control efficiency of 98% was assumed for the thermal oxidizer, and a control efficiency of 90% was assumed for the carbon adsorber. Other assumptions and cost estimates used in the analysis are based on methods found in the OAQPS CCM, Sixth Edition and Seventh Editions. The results of this cost analysis demonstrate an annualized cost effectiveness for the thermal oxidizer of over $360,000 per ton of VOC controlled from the stack emissions only and an annualized cost effectiveness of over $50,000 per ton of VOC controlled from combined stack and fugitive emissions. The results of this cost analysis also demonstrate an annualized cost effectiveness for the carbon adsorber of over $260,000 per ton of VOC controlled from the stack emissions only and an annualized cost effectiveness of over $30,000 per ton of VOC controlled from combined stack and fugitive emissions. Both cost estimates are based on an assumed 10-year life span of the equipment. See detailed analysis is Appendix B. Carpenter believes that the cost effectiveness of these control devices is not reasonable, therefore neither carbon adsorption nor thermal oxidation is not RACT for the polyurethane foam manufacturing process processes.

3.3.6 Select RACT

Based upon the analysis provided above, Carpenter has not identified any add-on control technologies as RACT for the polyurethane foam manufacturing process at the Fogelsville facility. In addition, Carpenter is already employing appropriate work practices to minimize VOC emissions, such as using non-VOC blowing agents and ensuring that all clean up solvent operations comply with Best Available Technology to minimize emissions.[21] All new and used cleaning solvents are stored in closed containers. Carpenter is operating in compliance with these standards. Carpenter proposes that work practice standards noted above as well as the existing VOC emission limit of 20 tpy from the foam line be applied as RACT for the polyurethane foam manufacturing process at the Fogelsville facility.

21 Title V Operating Permit 39-00040, Section D, Source ID 102, Conditions #003 and #008

The Fogelsville facility proposed RACT and related monitoring, testing, recordkeeping and reporting are summarized in Table 4-1 and Table 4-2 below for sources subject to a case-by-case RACT analyses.

Table 4-1. Fogelsville Plant Proposed RACT Summary – EPS Manufacturing Process

Emission Source ID(s):	Title V Source ID 101: EPS manufacturing process
Source Description(s):	Process in which polystyrene beads are expanded into foam with pentane as a blowing agent. Capacity of the process is 4,000 pounds pentane per hour.
Description of RACT:	Case-by-case
	► The annual VOC emissions from the Source ID 101 should not exceed 88.8 tons per year based on a 12-month rolling average as calculated by the company and approved by the Department; and ► The facility shall achieve at least 99% destruction efficiency for the VOC emissions in the control device (C33); and ► The company shall ensure that the capture system and control device (C33) area operated at all times the source (101) is in operation. The boiler must be operating within the parameters established in the CAM plan whenever the EPS process is operating.

Proposed Monitoring:

- ► The facility shall ensure that the boiler is equipped with the applicable monitoring equipment and the monitoring equipment shall be installed, calibrated, and maintained in accordance with good manufacturing practices at all times the boiler is in use.
- ► The operating range of the boiler is 15-270 psi of steam pressure as per boiler manual. The permittee shall monitor the steam pressure once a day during normal operating hours whenever source 101 is in operation (excluding weekends and holidays). If the boiler fails, pentane will still be collected by Process 101 until the concentration reaches 50% of the LEL, at which point the pentane is related and emitted. When the boiler is operating properly and pentane concentration in Process 101 reaches 85% of the LEL, then pentane is released and emitted. This would constitute a failure of the control device.

Proposed Testing: N/A

Proposed Recordkeeping:

- ► The permittee shall record the steam pressure once a day during normal operating hours whenever source 101 is in operation (excludes weekends and holidays).

Proposed Reporting: N/A

Table 4-2. Fogelsville Plant Proposed RACT Summary – Polyurethane Foam Manufacturing Process

Emission Source ID(s):	Title V Source ID 102: Polyurethane foam manufacturing process
Source Description(s):	
Description of RACT:	Case-by-case
	► The annual VOC emission rate from this source shall not exceed 20 tons per year based on a 12-month rolling average as calculated by the company and approved by the Department; and ► All clean up solvent operations must comply with Best Available Technology to minimize VOC emissions. All cleaning operations must store new and used cleaning solvents in closed containers; and ► The company shall use only a non-traditional blowing agent (i.e., carbon dioxide) in the process. VOC blowing agents are prohibited from being used.

Proposed Monitoring: N/A

Proposed Testing: N/A

Proposed Recordkeeping:

► Compliance with the VOC emission limit shall be demonstrated by recording the chemical usage for the foam line on a daily and monthly basis.

Proposed Reporting: N/A

APPENDIX A. RBLC SEARCH RESULTS

RBLC Search Results for EPS Manufacturing

RBLC ID	Permit Number	Permit Date	Facility Name	Source	Primary Fuel	Type of Requirement	Polluation Prevention / Add-on Control Description
IN-0208	023-34689-00035	11/25/2014	NHK SEATING OF AMERICA, INC.	SEAT FOAM PRODUCTION LINE		OTHER CASE-BY-CASE	REGENERATIVE THERMAL OXIDIZER
IN-0219	143-35401-00016	7/6/2015	GENPAK, LLC	THREE (3) POLYSTYRENE FOAM EXTRUSION OPERATIONS - BUTANE ONLY BLOWING AGENT		OTHER CASE-BY-CASE	PERMANENT TOTAL ENCLOSURE AND RTO FOR SCRAP REPELLETIZER
IN-0238	039-35547-00086	12/28/2015	CARPENTER COMPANY	EXPANDED POLYSTYRENE (EPS) FOAM MANUFACTURING LINE	NATURAL GAS	N/A	REGENERATIVE THERMAL OXIDIZER (RTO)
IN-0270	039-37587-00086	5/25/2017	CARPENTER CO	POLYSTYRENE FOAM MANUFACTURING PROCESS	NATURAL GAS	OTHER CASE-BY-CASE	REGENERATIVE THERMAL OXIDIZER
IN-0269	067-38176-00053	6/5/2017	SYNDICATE SALES, INC.	FOAM PRODUCTION LINE		OTHER CASE-BY-CASE	GOOD MANAGEMENT AND WORK PRACTICES

RBLC Search Results for Polyurethane Manufacturing

RBLC ID	Permit Number	Permit Date	Facility Name	Source	Type of Requirement	Polluation Prevention / Add-on Control Description
IN-0208	023-34689-00035	11/25/2014	NHK SEATING OF AMERICA, INC.	SEAT FOAM PRODUCTION LINE	OTHER CASE-BY-CASE	REGENERATIVE THERMAL OXIDIZER
IN-0190	063-34203-00071	6/12/2014	FAGERDALA PACKAGING INC. (INDIANA)	POLYETHYLENE SHEET FOAM EXTRUDER LINE (SFE-01)	OTHER CASE-BY-CASE	REGENERATIVE THERMAL OXIDIZER
IN-0210	063-35542-00071	6/8/2015	FAGERDALA PACKAGING INC. (INDIANA)	POLYETHYLENE SHEET FOAM EXTRUDER LINE	OTHER CASE-BY-CASE	REGENERATIVE THERMAL OXIDIZER (RTO) WITH PERMANENT TOTAL ENCLOSURE (PTE)
IN-0269	067-38176-00053	6/5/2017	SYNDICATE SALES, INC.	FOAM PRODUCTION LINE	OTHER CASE-BY-CASE	GOOD MANAGEMENT AND WORK PRACTICES
*TN-0184	980244	9/22/2022	ADIENT US LLC - PULASKI	Polyurethane Foam Manufacturing	N/A	Good work practices and permitted VOC limit

APPENDIX B. COST ANALYSES FOR RTO FOR THE POLYURETHANE FOAM LINE

Polyurethane Pouring Process Cost Estimate

Cost equations are adapted from the EPA Air Pollution Control Cost Manual, Sixth Edition (Jan 2002), Section 3.2 Chapter 2, for incinerators used for VOC Control. Equations taken from the manual are referenced by equation number or table number as they appear in Section 3.2 Chapter 2 unless otherwise stated.

Total Capital Investment (TCI)

Equipment Cost for Incinerators

$$EC = 2.204 \times 10^5 + 11.57 * Q_{tot} \quad (2.33)$$

1999 Cost Estimate Equipment Cost (EC) =	EPA Cost Manual, Section 3.2, Chapter 2, Equation 2.33	$481,708	in 1999 dollars
CPI, 1999	Bureau of Labor Statistics	166.6	
CPI, May 2016	Bureau of Labor Statistics	240.2	
CPI, October 2022	Bureau of Labor Statistics	298.0	
Total Flow Rate (Q_{tot}) =	Title V Renewal[1]	22,585	scfm
Destruction Efficiency =	EPA Thermal Incinerator Manual expected control	98%	
Equipment Cost (EC) =	Linearly scaled using Eq. 2.33[2]	$861,674	in 2022 dollars
Auxiliary Equipment Cost (Aux) =	Assumes no auxiliary equipment required		in 2022 dollars
Equipment and Auxiliary Cost (A) =	EC + Aux =	$861,674	in 2022 dollars
Instrumentation =	0.10 * A (Table 2.8)	$0	in 2022 dollars
Sales Tax =	No sales tax on control equipment in PA		in 2022 dollars
Freight =	0.05 * A (Table 2.8)	$43,084	in 2022 dollars
Purchased Equipment Cost (PEC) =	A + Tax + Freight = 1.11A	**$904,758**	**in 2022 dollars**
Foundation & supports =	0.08 * PEC (Table 2.8)	$72,381	in 2022 dollars
Handling & erection =	0.14 * PEC (Table 2.8)	$126,666	in 2022 dollars
Electrical =	0.04 * PEC (Table 2.8)	$36,190	in 2022 dollars
Piping =	0.02 * PEC (Table 2.8)	$18,095	in 2022 dollars
Insulation for ductwork =	0.01 * PEC (Table 2.8)	$9,048	in 2022 dollars
Painting =	0.01 * PEC (Table 2.8)	$9,048	in 2022 dollars
Direct Installation Costs (DIC) =	0.30 * PEC (Table 2.8)	$271,427	in 2022 dollars
Total Direct Costs (DC) =	PEC + DIC =	**$1,176,185**	**in 2022 dollars**
Engineering =	0.10 * PEC (Table 2.8)	$90,476	in 2022 dollars
Construction and field expenses =	0.05 * PEC (Table 2.8)	$45,238	in 2022 dollars
Contractor fees =	0.10 * PEC (Table 2.8)	$90,476	in 2022 dollars
Start-up =	0.02 * PEC (Table 2.8)	$18,095	in 2022 dollars
Performance test =	0.01 * PEC (Table 2.8)	$9,048	in 2022 dollars
Contingencies =	0.03 * PEC (Table 2.8)	$27,143	in 2022 dollars
Total Indirect Costs (IC) =	0.29 * PEC (Table 2.8)	**$280,475**	**in 2022 dollars**
Total Capital Investment (TCI) =	DC + IC =	**$1,456,660.00**	**in 2022 dollars**

1. Total flow rate based on the sum of the exhaust flow rates for the pour line stack exhaust point (S04) and the cut off saw exhaust point (S05).
2. Equation for equipment cost is linearly dependent on flow rate from 10,000 scfm to 100,000 scfm.

Polyurethane Pouring Process Cost Estimate

Cost equations are adapted from the EPA Air Pollution Control Cost Manual, Sixth Edition (Jan 2002), Section 3.2 Chapter 2, for incinerators used for VOC Control. Equations taken from the manual are referenced by equation number or table number as they appear in Section 3.2 Chapter 2 unless otherwise stated.

Annual Costs

Direct Annual Costs (DAC)

DAC = (Annual Electricity Cost) + (Annual Fuel Cost) + (Annual Labor and Materials)

Annual Electricity Cost at 90% uptime =	90% x 8760 x p_ekW =	$61,221.35	in 2022 dollars
Electricity price in PA (p_e)[1] =	from U.S. Energy Information Administration	$0.09	$/kWh
Total Flow Rate (Q_{tot}) =	Title V renewal	22,585	scfm
Electricity Use of Fan (kW) =	Based on EPA cost manual, estimating 19 inches of water pressure drop and a 60% fan efficiency, EPA Control Cost Manual Section 3.2, Chapter 2, 2.5.2.1	83.7	kW
Annual Fuel Cost at 90% uptime =	Conservatively excluding from calculation		in 2022 dollars
Fuel price of Natural Gas in PA (p_f)[2] =	from U.S. Energy Information Administration	$9.76	$/mscf
Fuel Use (G) =	Expected fuel usage based on similar facilities	4.0	mscf/hr
Operator Labor Unit Cost [3]	BLS Operator Wage Rate	$33.22	in 2022 dollars
Operator Labor	0.5 hr/shift, 8 hr shift all year	$18,188.23	in 2022 dollars
Supervisor Labor	Table 2.10, 15% of operator	$2,728.23	in 2022 dollars
Maintenance Labor Unit Cost	10% increase from operator labor per EPA Control Cost Manual Section 1, Chapter 2, 2.5.5.2	$36.54	in 2022 dollars
Maintenance Labor	0.5 hr/shift, 8 hr shift all year	$20,007.05	in 2022 dollars
Maintenance Materials	Table 2.10, 100% of maintenance labor	$20,007.05	in 2022 dollars
Direct Annual Cost (DAC) =		**$122,152**	**in 2022 dollars**

1. Average electricity cost for industrial consumers in August 2022 in Pennsylvania, US Energy Information Administration
2. Natural gas cost for industrial consumers in August 2022, US Energy Information Administration
3. US Department of Labor, Bureau of Labor Statistics, May 2016 PA Occupational Employment and Wage Estimate for Plant and System Operators, All Other (occupation code 51-8099). Adjusted to October 2022 dollars using CPI data.

Indirect Annual Cost (IDAC)

IDAC = Overhead + Administrative Charges + Property Taxes + Insurance + Capital Recovery Costs

Overhead =	60% of total labor and maint. (Table 2.10)	$36,558	in 2022 dollars
Administrative Charges =	0.02 * TCI (Table 2.10)	$29,133	in 2022 dollars
Property Taxes =	0.01 * TCI (Table 2.10)	$14,567	in 2022 dollars
Insurance =	0.01 * TCI (Table 2.10)	$14,567	in 2022 dollars
Capital Recovery [1] =	CRF * TCI (Table 2.10)	$137,498	in 2022 dollars
Indirect Annual Cost (IDAC) =		**$232,323**	**in 2022 dollars**

1. Based on equipment life of 20 years and 7% interest rate.

Total Annual Cost (TAC)

TAC = Direct Annual Costs + Indirect Annual Costs

Direct Annual Costs (DAC) =		$122,152	in 2022 dollars
Indirect Annual Costs (IDAC) =		$232,323	in 2022 dollars
Total Annual Costs (TAC) =	DAC + IDAC =	**$354,475**	**in 2022 dollars**

Cost Effectiveness

Cost Effectiveness = Total Annual Cost/ VOC Removed/year

Total Annual Cost (TAC) =	$354,475	per year in 2022 dollars
VOC Removed =	1.0	tons/year[1]
Cost Effectiveness =	**$361,709.23**	**per ton of VOC removed in 2022 dollars**

1. Maximum potential VOC removed if the exhaust currently routed to the two stacks in the polyurethane area (S04 and S05) are routed to the RTO. VOC removed is based on 5% of the total PTE from the polyurethane line (20 tpy), because 5% of total polyurethane emissions are routed to the existing stacks.

Polyurethane Pouring Process Cost Estimate

Cost equations are adapted from the EPA Air Pollution Control Cost Manual, Sixth Edition (Jan 2002), Section 3.2 Chapter 2, for incinerators used for VOC Control. Equations taken from the manual are referenced by equation number or table number as they appear in Section 3.2 Chapter 2 unless otherwise stated.

Total Capital Investment (TCI)

Equipment Cost for Incinerators

$$EC = 2.204 \times 10^5 + 11.57 * Q_{tot} \quad (2.33)$$

1999 Cost Estimate Equipment Cost (EC) =	EPA Cost Manual, Section 3.2, Chapter 2, Equation 2.33	$1,377,400	in 1999 dollars
CPI, 1999	Bureau of Labor Statistics	166.6	
CPI, May 2016	Bureau of Labor Statistics	240.2	
CPI, October 2022	Bureau of Labor Statistics	298.0	
Total Flow Rate (Q_{tot}) =	Maximum in EPA's expected range[1]	100,000	scfm
Destruction Efficiency =	EPA Thermal Incinerator Manual expected control	98%	
Equipment Cost (EC) =	Linearly scaled using Eq. 2.33[2]	$2,463,876	in 2022 dollars
Auxiliary Equipment Cost (Aux) =	Assumes no auxiliary equipment required		in 2022 dollars
Equipment and Auxiliary Cost (A) =	EC + Aux =	$2,463,876	in 2022 dollars
Instrumentation =	0.10 * A (Table 2.8)	$0	in 2022 dollars
Sales Tax =	No sales tax on control equipment in PA		in 2022 dollars
Freight =	0.05 * A (Table 2.8)	$123,194	in 2022 dollars
Purchased Equipment Cost (PEC) =	A + Tax + Freight = 1.11A	**$2,587,070**	**in 2022 dollars**
Foundation & supports =	0.08 * PEC (Table 2.8)	$206,966	in 2022 dollars
Handling & erection =	0.14 * PEC (Table 2.8)	$362,190	in 2022 dollars
Electrical =	0.04 * PEC (Table 2.8)	$103,483	in 2022 dollars
Piping =	0.02 * PEC (Table 2.8)	$51,741	in 2022 dollars
Insulation for ductwork =	0.01 * PEC (Table 2.8)	$25,871	in 2022 dollars
Painting =	0.01 * PEC (Table 2.8)	$25,871	in 2022 dollars
Direct Installation Costs (DIC) =	0.30 * PEC (Table 2.8)	$776,121	in 2022 dollars
Total Direct Costs (DC) =	PEC + DIC =	**$3,363,191**	**in 2022 dollars**
Engineering =	0.10 * PEC (Table 2.8)	$258,707	in 2022 dollars
Construction and field expenses =	0.05 * PEC (Table 2.8)	$129,353	in 2022 dollars
Contractor fees =	0.10 * PEC (Table 2.8)	$258,707	in 2022 dollars
Start-up =	0.02 * PEC (Table 2.8)	$51,741	in 2022 dollars
Performance test =	0.01 * PEC (Table 2.8)	$25,871	in 2022 dollars
Contingencies =	0.03 * PEC (Table 2.8)	$77,612	in 2022 dollars
Total Indirect Costs (IC) =	0.29 * PEC (Table 2.8)	**$801,992**	**in 2022 dollars**
Total Capital Investment (TCI) =	DC + IC =	**$4,165,182.25**	**in 2017 dollars**

1. Total flow rate based on the sum of the exhaust flow rates for the pour line stack exhaust point (S04) and the cut off saw exhaust point (S05), as well as the flow rate from the ductwork fans. The flow rate is capped at 100,000 scfm to meet the EPA Cost Manual equipment cost equation requirement in the Section 3.2, Chapter 2, Section 2.5.1.1. Actual flow rate is likely higher than 100,000 scfm.

2. Equation for equipment cost is linearly dependent on flow rate from 10,000 scfm to 100,000 scfm.

Polyurethane Pouring Process Cost Estimate

Cost equations are adapted from the EPA Air Pollution Control Cost Manual, Sixth Edition (Jan 2002), Section 3.2 Chapter 2, for incinerators used for VOC Control. Equations taken from the manual are referenced by equation number or table number as they appear in Section 3.2 Chapter 2 unless otherwise stated.

Annual Costs

Direct Annual Costs (DAC)

DAC = (Annual Electricity Cost) + (Annual Fuel Cost) + (Annual Labor and Materials)

Annual Electricity Cost at 90% uptime =	90% x 8760 x p_ekW =	$271,070.84	in 2022 dollars
Electricity price in PA (p_e)[1] =	from U.S. Energy Information Administration	$0.09	$/kWh
Total Flow Rate (Q_{tot}) =	Title V renewal	100,000	scfm
Electricity Use of Fan (kW) =	Based on EPA cost manual, estimating 19 inches of water pressure drop and a 60% fan efficiency, EPA Control Cost Manual Section 3.2, Chapter 2, 2.5.2.1	370.5	kW
Annual Electricity Cost of Ductwork	See Ductwork calculations	$45,875.75	in 2022 dollars
Annual Fuel Cost at 90% uptime =	Conservatively excluding from calculation		in 2022 dollars
Fuel price of Natural Gas in PA (p_f)[2] =	from U.S. Energy Information Administration	$9.76	$/mscf
Fuel Use (G) =	Expected fuel usage based on similar facilities	4.0	mscf/hr
Operator Labor Unit Cost [3]	BLS Operator Wage Rate	$33.22	in 2022 dollars
Operator Labor	0.5 hr/shift, 8 hr shift all year	$18,188.23	in 2022 dollars
Supervisor Labor	Table 2.10, 15% of operator	$2,728.23	in 2022 dollars
Maintenance Labor Unit Cost	10% increase from operator labor per EPA Control Cost Manual Section 1, Chapter 2, 2.5.5.2	$36.54	in 2022 dollars
Maintenance Labor	0.5 hr/shift, 8 hr shift all year	$20,007.05	in 2022 dollars
Maintenance Materials	Table 2.10, 100% of maintenance labor	$20,007.05	in 2022 dollars
Direct Annual Cost (DAC) =		**$377,877**	**in 2022 dollars**

1. Average electricity cost for industrial consumers in August 2022 in Pennsylvania, US Energy Information Administration
2. Natural gas cost for industrial consumers in August 2022, US Energy Information Administration
3. US Department of Labor, Bureau of Labor Statistics, May 2016 PA Occupational Employment and Wage Estimate for Plant and System Operators, All Other (occupation code 51-8099). Adjusted to April 2017 dollars using CPI data.

Indirect Annual Cost (IDAC)

IDAC = Overhead + Administrative Charges + Property Taxes + Insurance + Capital Recovery Costs

Overhead =	60% of total labor and maint. (Table 2.10)	$36,558	in 2022 dollars
Administrative Charges =	0.02 * TCI (Table 2.10)	$83,304	in 2022 dollars
Property Taxes =	0.01 * TCI (Table 2.10)	$41,652	in 2022 dollars
Insurance =	0.01 * TCI (Table 2.10)	$41,652	in 2022 dollars
Capital Recovery [1] =	CRF * TCI (Table 2.10)	$393,164	in 2022 dollars
Indirect Annual Cost (IDAC) =		**$596,329**	**in 2022 dollars**

1. Based on equipment life of 20 years and 7% interest rate.

Total Annual Cost (TAC)

TAC = Direct Annual Costs + Indirect Annual Costs

Direct Annual Costs (DAC) =		$377,877	in 2022 dollars
Indirect Annual Costs (IDAC) for RTO =		$596,329	in 2022 dollars
Indirect Annual Costs (IDAC) for Ductwork for slab room fugitives (see Ductwork calculations)		$30,990	in 2022 dollars
Total Annual Costs (TAC) =	DAC + IDAC =	**$1,005,197**	**in 2022 dollars**

Cost Effectiveness

Cost Effectiveness = Total Annual Cost/ VOC Removed/year

Total Annual Cost (TAC) =	$1,005,197	per year in 2022 dollars
VOC Removed =	19.6	tons/year[1]
Cost Effectiveness =	**$51,285.56**	**per ton of VOC removed in 2022 dollars**

1. VOC removed estimated based on the PTE of the polyurethane foam line (Unit ID 102) of 20 tons per year. This conservatively assumes all emissions from the polyurethane process, including fugitive emissions from the slab room, are routed to an RTO.

Polyurethane Pouring Process Cost Estimate

Cost equations are adapted from the EPA Air Pollution Control Cost Manual, Seventh Edition (October 2018), Section 3.1, Chapter 1, for Carbon Absorbers used for VOC Control.
Equations taken from the manual are referenced by equation number or table number as they appear in Section 3.1 Chapter 1 unless otherwise stated.

Total Capital Investment (TCI)

Equipment Cost for Carbon Adsorber

$$EC = 2.204 \times 10^5 + 11.57 * Q_{tot} \quad (2.33)$$

Total Adsorber Equipment Cost	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.27	$192,289	in 1999 dollars
Carbon Cost [1]	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.16	$286	in 2018 dollars
Carbon Cost	Calculated based on CPI	$189	in 1999 dollars
Total Carbon Charge [2]	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.14	184.3	lbs Carbon
Equilibrium Capacity [3]	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.1	0.4	lb VOC/lb Carbon
Vessel Cost [4]	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.25	$62,576	in 1999 dollars
Surface Area of Vessel [5]	EPA Cost Manual, Section 3.1, Chapter 1, Equations 1.18, 1.19, and 1.24	1091.0	ft^2
Ratio of Equipment Cost to Vessel Cost	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.26	1.5	
CPI, 1999	Bureau of Labor Statistics	166.6	
CPI, May 2016	Bureau of Labor Statistics	240.2	
CPI, July 2018	Bureau of Labor Statistics	252.0	
CPI, October 2022	Bureau of Labor Statistics	298.0	
Total Flow Rate (Q_{tot}) =	Title V Renewal[6]	22,585	scfm
Destruction Efficiency =	EPA Expected Control	90%	
Total Equipment Cost (EC) =	Calculated based on CPI	$343,965	in 2022 dollars
Auxiliary Equipment Cost (Aux) =	Assumes no auxiliary equipment required		in 2022 dollars
Equipment and Auxiliary Cost (A) =	EC + Aux =	$343,965	in 2022 dollars
Instrumentation =	0.10 * A (Table 1.4)	$0	in 2022 dollars
Sales Tax =	No sales tax on control equipment in PA		in 2022 dollars
Freight =	0.05 * A (Table 1.4)	$17,198	in 2022 dollars
Purchased Equipment Cost (PEC) =	A + Tax + Freight = 1.18A	**$361,163**	**in 2022 dollars**
Foundation & supports =	0.08 * PEC (Table 1.4)	$28,893	in 2022 dollars
Handling & erection =	0.14 * PEC (Table 1.4)	$50,563	in 2022 dollars
Electrical =	0.04 * PEC (Table 1.4)	$14,447	in 2022 dollars
Piping =	0.02 * PEC (Table 1.4)	$7,223	in 2022 dollars
Insulation for ductwork =	0.01 * PEC (Table 1.4)	$3,612	in 2022 dollars
Painting =	0.01 * PEC (Table 1.4)	$3,612	in 2022 dollars
Direct Installation Costs (DIC) =	0.30 * PEC (Table 1.4)	$108,349	in 2022 dollars
Total Direct Costs (DC) =	PEC + DIC =	**$469,512**	**in 2022 dollars**
Engineering =	0.10 * PEC (Table 1.4)	$36,116	in 2022 dollars
Construction and field expenses =	0.05 * PEC (Table 1.4)	$18,058	in 2022 dollars
Contractor fees =	0.10 * PEC (Table 1.4)	$36,116	in 2022 dollars
Start-up =	0.02 * PEC (Table 1.4)	$7,223	in 2022 dollars
Performance test =	0.01 * PEC (Table 1.4)	$3,612	in 2022 dollars
Contingencies =	0.03 * PEC (Table 1.4)	$10,835	in 2022 dollars
Total Indirect Costs (IC) =	0.29 * PEC (Table 1.4)	**$111,961**	**in 2022 dollars**
Total Capital Investment (TCI) =	DC + IC =	**$581,472.77**	**in 2022 dollars**

1. Assumes a cost of $1.55/lb for reactivated carbon.
2. Assumes 1 adsorbing bed and 1 desorbing bed opertating continuously, with an adsorption and desorption time of 8 hours. Hourly emissions based on a PTE of 20 tpy.
3. Uses the values from Table 1.2 for toluene.
4. Assumes a value of 1.0 for 304 stainless steel, from Table 1.3.
5. Assumes a gas velocity of 65 ft/min.
6. Total flow rate based on the sum of the exhaust flow rates for the pour line stack exhaust point (S04) and the cut off saw exhaust point (S05).

Polyurethane Pouring Process Cost Estimate

Cost equations are adapted from the EPA Air Pollution Control Cost Manual, Seventh Edition (October 2018), Section 3.1, Chapter 1, for Carbon Absorbers used for VOC Control. Equations taken from the manual are referenced by equation number or table number as they appear in Section 3.1 Chapter 1 unless otherwise stated.

Annual Costs

Direct Annual Costs (DAC)

DAC = (Annual Electricity Cost) + (Annual Fuel Cost) + (Annual Labor and Materials)

Annual Electricity Cost at 90% uptime =	90% x 8760 x 0.746 x hP x Electricity Cost/kWh =	$61,634.45	in 2022 dollars
Electricity price in PA (p_e)[1] =	from U.S. Energy Information Administration	$0.09	$/kWh
Total Flow Rate (Q_{tot}) =	Title V renewal	22,585	scfm
Annual Steam Cost [2]	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.28	$1,776,320.00	in 2022 dollars
Annual Cooling Water Cost [3]	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.29	$3,961,650.00	in 2022 dollars
System Fan Horsepower Equivalent (hP) =	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.29, estimating 19 inches of water pressure drop	112.9	hP
Carbon Replacement Cost	Included in Operator Labor		
Fuel price of Natural Gas in PA (p_f)[4] =	from U.S. Energy Information Administration	$9.76	$/mscf
Operator Labor Unit Cost [5]	BLS Operator Wage Rate	$33.22	in 2022 dollars
Operator Labor	0.5 hr/shift, 8 hr shift all year	$18,188.23	in 2022 dollars
Supervisor Labor	Table 2.10, 15% of operator	$2,728.23	in 2022 dollars
Maintenance Labor Unit Cost	10% increase from operator labor per EPA Control Cost Manual Section 1, Chapter 2, 2.5.5.2	$36.54	in 2022 dollars
Maintenance Labor	0.5 hr/shift, 8 hr shift all year	$20,007.05	in 2022 dollars
Maintenance Materials	Table 2.10, 100% of maintenance labor	$20,007.05	in 2022 dollars
Direct Annual Cost (DAC) =		**$122,565**	**in 2022 dollars**

1. Average electricity cost for industrial consumers in August 2022 in Pennsylvania, US Energy Information Administration
3. Assumes the cost for steam is 130% of the fuel price for natural gas. Hourly emissions based on a PTE of 20 tpy.
3. Assumes a cost of $8.25/thousand gallons for colling water.
4. Natural gas cost for industrial consumers in August 2022, US Energy Information Administration
5. US Department of Labor, Bureau of Labor Statistics, May 2016 PA Occupational Employment and Wage Estimate for Plant and System Operators, All Other (occupation code 51-8099). Adjusted to October 2022 dollars using CPI data.

Indirect Annual Cost (IDAC)

IDAC = Overhead + Administrative Charges + Property Taxes + Insurance + Capital Recovery Costs

Overhead =	60% of total labor and maint. (Table 2.10)	$36,558	in 2022 dollars
Administrative Charges, Property Taxes and Insurance =	0.04 * TCI (Section 1.2)	$23,259	in 2022 dollars
Capital Recovery [1] =	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.39	$54,852	in 2022 dollars
Indirect Annual Cost (IDAC) =		**$114,670**	**in 2022 dollars**

1. Based on equipment life of 20 years and 7% interest rate.

Total Annual Cost (TAC)

TAC = Direct Annual Costs + Indirect Annual Costs

Direct Annual Costs (DAC) =		$122,565	in 2022 dollars
Indirect Annual Costs (IDAC) =		$114,670	in 2022 dollars
Total Annual Costs (TAC) =	DAC + IDAC =	**$237,235**	**in 2022 dollars**

Cost Effectiveness

Cost Effectiveness = Total Annual Cost/ VOC Removed/year

Total Annual Cost (TAC) =	$237,235	per year in 2022 dollars
VOC Removed =	0.9	tons/year[1]
Cost Effectiveness =	**$263,594.14**	**per ton of VOC removed in 2022 dollars**

1. Maximum potential VOC removed if the exhaust currently routed to the two stacks in the polyurethane area (S04 and S05) are routed to the adsorber. VOC removed is based on 5% of the total PTE from the polyurethane line (20 tpy), because 5% of total polyurethane emissions are routed to the existing stacks.

Polyurethane Pouring Process Cost Estimate

Cost equations are adapted from the EPA Air Pollution Control Cost Manual, Seventh Edition (October 2018), Section 3.1, Chapter 1, for Carbon Absorbers used for VOC Control. Equations taken from the manual are referenced by equation number or table number as they appear in Section 3.1 Chapter 1 unless otherwise stated.

Total Capital Investment (TCI)

Equipment Cost for Carbon Adsorber

$$EC = 2.204 \times 10^5 + 11.57 * Q_{tot} \quad (2.33)$$

Total Adsorber Equipment Cost	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.27	$501,524	in 1999 dollars
Carbon Cost [1]	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.16	$286	in 2018 dollars
Carbon Cost	Calculated based on CPI	$189	in 1999 dollars
Total Carbon Charge [2]	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.14	184.3	lbs Carbon
Equilibrium Capacity [3]	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.1	0.4	lb VOC/lb Carbon
Vessel Cost [4]	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.25	$199,128	in 1999 dollars
Surface Area of Vessel [5]	EPA Cost Manual, Section 3.1, Chapter 1, Equations 1.18, 1.19, and 1.24	4830.8	ft^2
Ratio of Equipment Cost to Vessel Cost	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.26	1.3	
CPI, 1999	Bureau of Labor Statistics	166.6	
CPI, May 2016	Bureau of Labor Statistics	240.2	
CPI, July 2018	Bureau of Labor Statistics	252.0	
CPI, October 2022	Bureau of Labor Statistics	298.0	
Total Flow Rate (Q_{tot}) =	Maximum in EPA's expected range[6]	100,000	scfm
Destruction Efficiency =	EPA Expected Control	90%	
Total Equipment Cost (EC) =	Calculated based on CPI	$897,120	in 2022 dollars
Auxiliary Equipment Cost (Aux) =	Assumes no auxiliary equipment required		in 2022 dollars
Equipment and Auxiliary Cost (A) =	EC + Aux =	$897,120	in 2022 dollars
Instrumentation =	0.10 * A (Table 1.4)	$0	in 2022 dollars
Sales Tax =	No sales tax on control equipment in PA		in 2022 dollars
Freight =	0.05 * A (Table 1.4)	$44,856	in 2022 dollars
Purchased Equipment Cost (PEC) =	A + Tax + Freight = 1.18A	**$941,976**	**in 2022 dollars**
Foundation & supports =	0.08 * PEC (Table 1.4)	$75,358	in 2022 dollars
Handling & erection =	0.14 * PEC (Table 1.4)	$131,877	in 2022 dollars
Electrical =	0.04 * PEC (Table 1.4)	$37,679	in 2022 dollars
Piping =	0.02 * PEC (Table 1.4)	$18,840	in 2022 dollars
Insulation for ductwork =	0.01 * PEC (Table 1.4)	$9,420	in 2022 dollars
Painting =	0.01 * PEC (Table 1.4)	$9,420	in 2022 dollars
Direct Installation Costs (DIC) =	0.30 * PEC (Table 1.4)	$282,593	in 2022 dollars
Total Direct Costs (DC) =	PEC + DIC =	**$1,224,569**	**in 2022 dollars**
Engineering =	0.10 * PEC (Table 1.4)	$94,198	in 2022 dollars
Construction and field expenses =	0.05 * PEC (Table 1.4)	$47,099	in 2022 dollars
Contractor fees =	0.10 * PEC (Table 1.4)	$94,198	in 2022 dollars
Start-up =	0.02 * PEC (Table 1.4)	$18,840	in 2022 dollars
Performance test =	0.01 * PEC (Table 1.4)	$9,420	in 2022 dollars
Contingencies =	0.03 * PEC (Table 1.4)	$28,259	in 2022 dollars
Total Indirect Costs (IC) =	0.29 * PEC (Table 1.4)	**$292,013**	**in 2022 dollars**
Total Capital Investment (TCI) =	DC + IC =	**$1,516,581.66**	**in 2022 dollars**

1. Assumes a cost of $1.55/lb for reactivated carbon.
2. Assumes 1 adsorbing bed and 1 desorbing bed opertating continuously, with an adsorption and desorption time of 8 hours. Hourly emissions based on a PTE of 20 tpy.
3. Uses the values from Table 1.2 for toluene.
4. Assumes a value of 1.0 for 304 stainless steel, from Table 1.3.
5. Assumes a gas velocity of 65 ft/min.
6. Total flow rate based on the sum of the exhaust flow rates for the pour line stack exhaust point (S04) and the cut off saw exhaust point (S05), as well as the flow rate from the ductwork fans. The flow rate is capped at 100,000 scfm to meet the EPA Cost Manual equipment cost equation requirement in the Section 3.1, Chapter 1, Section 1.6.1. Actual flow rate is likely higher than 100,000 scfm.

Polyurethane Pouring Process Cost Estimate

Cost equations are adapted from the EPA Air Pollution Control Cost Manual, Seventh Edition (October 2018), Section 3.1, Chapter 1, for Carbon Absorbers used for VOC Control. Equations taken from the manual are referenced by equation number or table number as they appear in Section 3.1 Chapter 1 unless otherwise stated.

Annual Costs

Direct Annual Costs (DAC)

DAC = (Annual Electricity Cost) + (Annual Fuel Cost) + (Annual Labor and Materials)

Annual Electricity Cost at 90% uptime =	90% x 8760 x 0.746 x hP x Electricity Cost/kWh =	$272,899.93	in 2022 dollars
Electricity price in PA (p_e)[1] =	from U.S. Energy Information Administration	$0.09	$/kWh
Total Flow Rate (Q_{tot}) =	Title V renewal	100,000	scfm
Annual Steam Cost [2]	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.28	$1,776,320.00	in 2022 dollars
Annual Cooling Water Cost [3]	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.29	$3,961,650.00	in 2022 dollars
System Fan Horsepower Equivalent (hP) =	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.29, estimating 19 inches of water pressure drop	500.0	hP
Carbon Replacement Cost	Included in Operator Labor		
Fuel price of Natural Gas in PA (p_f)[4] =	from U.S. Energy Information Administration	$9.76	$/mscf
Operator Labor Unit Cost [5]	BLS Operator Wage Rate	$33.22	in 2022 dollars
Operator Labor	0.5 hr/shift, 8 hr shift all year	$18,188.23	in 2022 dollars
Supervisor Labor	Table 2.10, 15% of operator	$2,728.23	in 2022 dollars
Maintenance Labor Unit Cost	10% increase from operator labor per EPA Control Cost Manual Section 1, Chapter 2, 2.5.5.2	$36.54	in 2022 dollars
Maintenance Labor	0.5 hr/shift, 8 hr shift all year	$20,007.05	in 2022 dollars
Maintenance Materials	Table 2.10, 100% of maintenance labor	$20,007.05	in 2022 dollars
Direct Annual Cost (DAC) =		**$333,830**	**in 2022 dollars**

1. Average electricity cost for industrial consumers in August 2022 in Pennsylvania, US Energy Information Administration
3. Assumes the cost for steam is 130% of the fuel price for natural gas. Hourly emissions based on a PTE of 20 tpy.
3. Assumes a cost of $8.25/thousand gallons for colling water.
4. Natural gas cost for industrial consumers in August 2022, US Energy Information Administration
5. US Department of Labor, Bureau of Labor Statistics, May 2016 PA Occupational Employment and Wage Estimate for Plant and System Operators, All Other (occupation code 51-8099). Adjusted to October 2022 dollars using CPI data.

Indirect Annual Cost (IDAC)

IDAC = Overhead + Administrative Charges + Property Taxes + Insurance + Capital Recovery Costs

Overhead =	60% of total labor and maint. (Table 2.10)	$36,558	in 2022 dollars
Administrative Charges, Property Taxes and Insurance =	0.04 * TCI (Section 1.2)	$60,663	in 2022 dollars
Capital Recovery [1] =	EPA Cost Manual, Section 3.1, Chapter 1, Equation 1.39	$143,120	in 2022 dollars
Indirect Annual Cost (IDAC) =		**$240,342**	**in 2022 dollars**

1. Based on equipment life of 20 years and 7% interest rate.

Total Annual Cost (TAC)

TAC = Direct Annual Costs + Indirect Annual Costs

Direct Annual Costs (DAC) =		$333,830	in 2022 dollars
Indirect Annual Costs (IDAC) =		$240,342	in 2022 dollars
Total Annual Costs (TAC) =	DAC + IDAC =	**$574,172**	**in 2022 dollars**

Cost Effectiveness

Cost Effectiveness = Total Annual Cost/ VOC Removed/year

Total Annual Cost (TAC) =	$574,172	per year in 2022 dollars
VOC Removed =	18.0	tons/year[1]
Cost Effectiveness =	**$31,898.46**	**per ton of VOC removed in 2022 dollars**

1. VOC removed estimated based on the PTE of the polyurethane foam line (Unit ID 102) of 20 tons per year. This conservatively assumes all emissions from the polyurethane process, including fugitive emissions from the slab room, are routed to an adsorber.

Ductwork Cost Calculation for Polyurethane Slab Room

Configuration assumes that the eight fans currently located in the slab room will each be individual routed to a common collection point via individual ducts. From here, a single, combined duct will transport the exhaust to the control device.

Input		Individual Ducts from Exhaust Fans	Combined Duct from All Fans to Control Device	Units / Equation	Reference
Inputs					
Number of exhaust fans		8			There are eight exhaust fans located in the polyurethane slab room. It is assumed that all eight fans will be ducted.
CPI, 1993		144.5			Bureau of Labor Statistics
CPI, October 2022		298.012			Bureau of Labor Statistics
Equipment Costs (EC)					
Duct diameter, D	u_t	2000	2000	ft/min	Section 2, Chapter 1, Table 1.4, minimum transport velocities range from 2,000 = 4,000 ft/min
	Q	30,000	240,000	scfm	Individual ducts - Volumetric flow rate per exhaust fan, Title V renewal application Combined duct - Sum of the individual flow rates for the eight fans
	$D_{calculated}$	4.37	12.36	ft = $D = 1.128(Q/u_t)^{1/2}$	Section 2, Chapter 1, Eqn 1.27
	$D_{adjusted}$	52.42	82.00	inches	If $D_{calculated}$ exceeds the maximum diameter for which the Cost Manual ductwork cost equation applies, diameter is adjusted down accordingly. Conversion from feet to inches

Carpenter RACT III Analysis

Ductwork Cost Calculation for Polyurethane Slab Room

Configuration assumes that the eight fans currently located in the slab room will each be individual routed to a common collection point via individual ducts. From here, a single, combined duct will transport the exhaust to the control device.

Input		**Individual Ducts from Exhaust Fans**	**Combined Duct from All Fans to Control Device**	**Units / Equation**	**Reference**
Straight Ductwork	Function Type	Power	Power		Section 2, Chapter 1, Table 1.9, circular spiral sheet-galvanized CS, 1-inch insulation (conservatively selected the lowest parameters), range for D is 3-82 inches
	a	1.55	1.55	--	Section 2, Chapter 1, Table 1.9, circular spiral sheet-galvanized CS, 1-inch insulation (conservatively selected the lowest parameters)
	b	0.936	0.936	--	Section 2, Chapter 1, Table 1.9, circular spiral sheet-galvanized CS, 1-inch insulation (conservatively selected the lowest parameters)
	$C_{duct, per foot}$	\$61	\$93	$\$/ft = C_{duct} = aD^b$	Section 2, Chapter 1, Eqn 1.40
	length of ductwork	1200	100	ft	Individual ducts - The slab room is approximately 600 ft in length. It is assumed that, on average, each exhaust fan will require 150 feet of ductwork to reach a common collection point. Combined duct - assumes duct to control device will be 100 feet long
	$C_{duct, total}$	\$73,589.76	\$9,321.38		Total cost of ductwork

Carpenter RACT III Analysis

Ductwork Cost Calculation for Polyurethane Slab Room

Configuration assumes that the eight fans currently located in the slab room will each be individual routed to a common collection point via individual ducts. From here, a single, combined duct will transport the exhaust to the control device.

Input		**Individual Ducts from Exhaust Fans**	**Combined Duct from All Fans to Control Device**	**Units / Equation**	**Reference**
Elbow	Function Type	Exponential	Exponential		Section 2, Chapter 1, Table 1.10, galvanized CS elbows, option which allows for largest diameter, range for D is 6-84 inches
	a	30.4	30.4		Section 2, Chapter 1, Table 1.10, galvanized CS elbows, option which allows for largest diameter
	b	0.0594	0.0594		Section 2, Chapter 1, Table 1.10, galvanized CS elbows, option which allows for largest diameter
	$C_{elbow, per unit}$	$684	$3,965	$/elbow = $C_{elbow} = ae^{bD}$	Section 2, Chapter 1, Eqn 1.41
	Total elbows	24	2	elbows	Individual ducts - Assumes 3 elbows are needed per exhaust fan. Combined duct - Assumes 2 elbows are needed for combined duct.
	$C_{elbow, total}$	$16,424.41	$7,929.85	total cost	

Carpenter RACT III Analysis

Ductwork Cost Calculation for Polyurethane Slab Room

Configuration assumes that the eight fans currently located in the slab room will each be individual routed to a common collection point via individual ducts. From here, a single, combined duct will transport the exhaust to the control device.

Input		Individual Ducts from Exhaust Fans	Combined Duct from All Fans to Control Device	Units / Equation	Reference
Dampers	Function Type	Power	Power		Section 2, Chapter 1, Table 1.10, dampers, louvered option which allows for largest diameter, range for D is 18-48 inches. Note that D for the combined duct (82 inches) and D for the individual ducts (52 inches) is outside of the range for dampers.
	a	78.4	78.4		Section 2, Chapter 1, Table 1.10, dampers, louvered option which allows for largest diameter
	b	0.86	0.86		Section 2, Chapter 1, Table 1.10, dampers, louvered option which allows for largest diameter
	$C_{damper, per unit}$	$1,282	$1,884	$/ft = $C_{damper} = aD^b$	Section 2, Chapter 1, Eqn 1.40
	Total dampers	8	2	dampers	Individual ducts - Assumes 1 damper is needed per exhaust fan. Combined duct - Assumes 2 dampers are needed for combined duct
	$C_{damper, total}$	$10,256.58	$3,767.23		
EC (1993 dollars)		$100,270.75	$21,018.46	$C_{total} = C_{duct,total} + C_{elbow,total} + C_{damper,total}$	Per Section 2, Chapter 1, Section 1.4, all costs are presented in second quarter 1993 dollars
EC (2022 dollars)		$206,795.07	$43,347.77		Scaled to October 2022 using consumer price indices
Purchased Equipment Cost (PEC)					
	Taxes	$0.00	$0.00		No sales tax on control equipment in PA
	Freight	$10,339.75	$2,167.39	0.05EC	Section 2, Chapter 1, Section 1.4.2
	PEC	$217,134.82	$45,515.16		

Carpenter RACT III Analysis

Ductwork Cost Calculation for Polyurethane Slab Room

Configuration assumes that the eight fans currently located in the slab room will each be individual routed to a common collection point via individual ducts. From here, a single, combined duct will transport the exhaust to the control device.

Input		Individual Ducts from Exhaust Fans	Combined Duct from All Fans to Control Device	Units / Equation	Reference
Total Capital Investment (TCI)					
	IF_d	0.25	0.25		Section 1.4.4, installation factors range from 25-50% for ductwork. Conservatively selected the lower end of the range
	TCI	$271,418.53	$56,893.95	$(1+IF_d)$ X PEC	
Direct Annual Costs (DAC)					
	pc	$0.093	$0.093	$/kwh	Average electricity cost for industrial consumers in August 2022 in Pennsylvania, US Energy Information Administration
	F_d	0.998	0.457	F_d / 100 ft = 0.136 $(1/D_d)^{1.18}$ $(u_t / 1,000)^{1.8}$; Fd = in. w.c.	Section 2, Chapter 1, Eqn 1.29, Static pressure drop through ventilation system, range for D is 0.25-5 ft. Note that D for the combined duct (6.8 ft) is outside of the range for dampers.
	Θ	8760	8760	hr/yr	
	ε	0.6	0.6	fan/motor efficiency	
	C_c (1993 dollars)	$4,764.48	$17,479.74	$Cc = (1.175 \times 10^{-4}) [(p_c Q F_d \Theta)/\varepsilon]$	Section 2, Chapter 1, Eqn 1.46, Incremental Electricity Cost Per Section 2, Chapter 1, Section 1.4, all costs are presented in second quarter 1993 dollars
	C_c (2022 dollars)	$9,826.11	$36,049.64		Scaled to October 2022 using consumer price indices
Indirect Annual Costs (IDAC)					
	n	20	20	equipment life	
	i	7%	7%	interest rate	
	CRF	0.0944	0.0944		Section 1, Chapter 2, Equation 2.8a
	Capital Recovery	$25,619.99	$5,370.39	TCI x CRF	

APPENDIX C. TITLE V MAJOR MODIFICATION APPLICATION FORMS

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

FOR OFFICIAL USE ONLY

OP #: ____________

Date: ____________

OPERATING PERMIT MODIFICATION APPLICATION

Section 1 – General Information

1.1 Application Type

Type of permit for which application is made:

☐ Minor Modification ☐ State-Only Operating Permit

☒ Significant Modification ☐ Title V Operating Permit

Existing Operating Permit No: 39-00040

1.2 Facility Information

Firm Name: Carpenter Co Federal Tax ID: 54-0499731

Facility Name: Carpenter Co / Upper Macungie Plant Code: 54-0499731

NAICS Code: 326140, 326150 SIC Code: 3086

Description of NAICS Code: Polystyrene Foam Product Manufacturing, Urethane and Other Foam Product (except Polystyrene) Manufacturing

Description of SIC Code: Plastics Foam Products

County: Lehigh Municipality: Upper Macungie

Latitude: 40° 34.912'N Longitude: 75° 36.364'W

Horizontal Reference Datum: ________ Horizontal Collection Method: ________ Reference Point: ________

1.3 Permit Contact Information

Name: Brian Geren Title: Technical Director

Address: 57A Olin Way

City: Fogelsville State: PA ZIP: 18051

Telephone: 610-366-8349

Email: brian.geren@carpenter.com

1.4 Small Business Question		
Are you a small business as defined by the Pennsylvania Air Pollution Control Act?	☐ Yes	☒ No
Are you a small business as defined by the U.S. Small Business Administration?	☐ Yes	☒ No

1.5 Request for Confidentiality

Do you request any information on this application to be treated as "Confidential"? ☐ Yes ☒ No

Place confidential information on separate page(s) marked "Confidential".

In order to request confidential treatment for information in any document, you must submit a redacted version of the relevant document with the confidential information blacked out (and thus suitable for public disclosure), along with a letter of request containing a table identifying the page and line number of each redaction, along with a justification for each redacted item as to why it should be deemed confidential under the specific criteria allowed under 25 Pa. Code §127.12(d) and Section 13.2 of the APCA.

1.6 Certification of Truth, Accuracy and Completeness by a Responsible Official

I certify that, subject to the penalties of Title 18 Pa. C.S.A. Section 4904 and 35 P.S. Section 4009(b)(2), I am the responsible official having primary responsibility for the design and operation of the facilities to which this application applies and that the information provided in this application is true, accurate, and complete to the best of my knowledge, information, and belief formed after reasonable inquiry.

(Signed)	[signature]	Date:	12/19/22
Name (Typed):	Cliff Wilson	Title:	Vice President
Telephone:	804-359-0800		
Email:	cliff.wilson@carpenter.com		

Section 2 – Inventory of Units Being Modified		
Unit ID No.	Unit Name	Unit Type
101	EPS manufacturing process	Process
102	Polyurethane foam manufacturing process	Process

Section 3 – Facility Changes

Complete this section ONLY if the changes are for the entire facility. If changes are for a source or sources, skip this Section and complete Section 4 for each Source in which a change is proposed.

3.1 Describe all proposed changes to this facility: **N/A**

3.2 If the proposed facility changes involve any changes in actual emissions, please complete the following table. Attach another table if needed.

Pollutant Name	CAS Number	Change in Actual Emissions (+ or -)

3.3 Anticipated date on which proposed change is scheduled to occur: ____________________________

3.4 List the proposed revision language for the operating permit conditions. This includes all changes to the emissions, monitoring, testing, record-keeping, reporting requirements and work practice standard requirements. Write in the type of applicable requirements in the column provided. Attach another table if needed.

Citation Number	Type of Applicable Requirement	Existing Operating Permit Condition or Condition Number	Proposed Language for Permit Condition

3.5 Provide a listing of all changes in chronological order (additions and subtractions) made at a facility since the last submittal and attach it to this application.

3.6 For renewals, please review the current operating permit. If you are proposing any changes to the conditions of the permit, please provide the condition number, the requested change, and justification for the requested change.

Section 4 – Unit Information (duplicate this section for each unit as needed)

4.1 Unit Type: ☐ Combustion ☐ Incinerator ☒ Process ☐ Control Device

4.2 General Source Information (Combustion/Incinerator/Process)

a. Source ID: 101 b. Source Name: EPS MANUFACTURING

c. Manufacturer: ____ d. Model No.: ____

e. Source Description: Process

f. Rated Capacity (for engines use BHP): ____ g. Installation Date: 05/25/2004

h. Rated Power/Electric Output: ____

i. Exhaust Temperature: 90 Units: Deg F j. Exhaust % Moisture: 50 k. Exhaust Flow Volume: 2,650 SCFM

4.3 General Control Device Information

a. Unit ID: No changes b. Unit Name: ____

c Used by Sources: ____

d. Type: ____

e. Pressure Drop (in. H_2O): ____ f. Capture Efficiency: ____

g. Flow Rate (specify unit): ____

h. Manufacturer: ____ i. Model No.: ____

j. Installation Date: ____

4.4 Proposed Changes to Unit

a. Describe all proposed changes to this unit: Implementation of Case by Case NO_X RACT III requirements under 25 Pa. Code 129.111-115. Please see the attached Case by Case RACT proposal and initial notification for details.

b. If the proposed unit changes involve any changes in actual emissions, please complete the following table. Attach another table if needed.

Pollutant Name	CAS Number	Change in Actual Emissions (+ or -)

c. Anticipated date on which proposed change is scheduled to occur: ___________________________________

d. List the proposed revision language for the operating permit condition. This includes all changes to the emission, monitoring, testing, record-keeping, reporting requirements and work practice standard requirement. Write in the type of applicable requirements in the column provided. Attach another table if needed.

Citation Number	Type of Applicable Requirement	Existing Operating Permit Condition or Condition Number	Proposed Language for Permit Condition
Section D, Source 101, Condition #004		39-00040	Please update the regulatory citation for this RACT requirement to: [25 Pa. Code 129.511 and §129.114]
Section D, Source 101, Condition #005		39-00040	Please update the regulatory citation for this RACT requirement to: [25 Pa. Code 129.511 and §129.114]
Section D, Source 101, Condition #006		39-00040	Please update the regulatory citation for this RACT requirement to: [25

			Pa. Code 129.511 and §129.114]

Section 4 – Unit Information (duplicate this section for each unit as needed)

4.1 Unit Type: ☐ Combustion ☐ Incinerator ☒ Process ☐ Control Device

4.2 General Source Information (Combustion/Incinerator/Process)

a. Source ID: 102 b. Source Name: POLYURETHANE FOAM MFG

c. Manufacturer: ______ d. Model No.: ______

e. Source Description: Process

f. Rated Capacity (for engines use BHP): ______ g. Installation Date: 07/19/2004

h. Rated Power/Electric Output: ______

i. Exhaust Temperature: ______ Units: ______ j. Exhaust % Moisture: ______ k. Exhaust Flow Volume: ______ SCFM

4.3 General Control Device Information

a. Unit ID: ______ b. Unit Name: ______

c Used by Sources: ______

d. Type: ______

e. Pressure Drop (in. H_2O): ______ f. Capture Efficiency: ______

g. Flow Rate (specify unit): ______

h. Manufacturer: ______ i. Model No.: ______

j. Installation Date: ______

4.4 Proposed Changes to Unit

a. Describe all proposed changes to this unit: Implementation of Case by Case NO_X RACT III requirements under 25 Pa. Code 129.111-115. Please see the attached Case by Case RACT proposal and initial notification for details.

b. If the proposed unit changes involve any changes in actual emissions, please complete the following table. Attach another table if needed.

Pollutant Name	CAS Number	Change in Actual Emissions (+ or -)

c. Anticipated date on which proposed change is scheduled to occur: ________________________________

d. List the proposed revision language for the operating permit condition. This includes all changes to the emission, monitoring, testing, record-keeping, reporting requirements and work practice standard requirement. Write in the type of applicable requirements in the column provided. Attach another table if needed.

Citation Number	Type of Applicable Requirement	Existing Operating Permit Condition or Condition Number	Proposed Language for Permit Condition
Section D, Source 102, Condition #004		39-00040	Please update the regulatory citation for this RACT requirement to: [25 Pa. Code 129.511 and §129.114]

Section 5 – Compliance Plan for the Facility			
		Yes	No
5.1	Will your facility be in compliance with all applicable requirements at the time of permit issuance and continue to comply with these requirements during the permit duration?	☒	☐
5.2	Will your facility be in compliance with all applicable requirements presently scheduled to take effect during the term of the permit?	☒	☐

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

AIR POLLUTION CONTROL ACT COMPLIANCE REVIEW FORM

Fully and accurately provide the following information, as specified. Attach additional sheets as necessary.

Type of Compliance Review Form Submittal (check all that apply)

☐ Original Filing

☒ Amended Filing

Date of Last Compliance Review Form Filing: 10/2017

Type of Submittal

☐ New Plan Approval ☐ New Operating Permit ☐ Renewal of Operating Permit

☐ Extension of Plan Approval ☐ Change of Ownership ☐ Periodic Submission (@ 6 mos)

☒ Other: Significant modification to Title V

SECTION A. GENERAL APPLICATION INFORMATION

Name of Applicant/Permittee/("applicant")
(non-corporations-attach documentation of legal name)

Carpenter Co.

Address 57 Olin Way
Fogelsville, PA 18051

Telephone 610-366-8349 **Taxpayer ID#** 54-0499731

Permit, Plan Approval or Application ID# 39-00040

Identify the form of management under which the applicant conducts its business (check appropriate box)

☐ Individual ☐ Syndicate ☐ Government Agency

☐ Municipality ☐ Municipal Authority ☐ Joint Venture

☐ Proprietorship ☐ Fictitious Name ☐ Association

☐ Public Corporation ☐ Partnership ☐ Other Type of Business, specify below:

☒ Private Corporation ☐ Limited Partnership

Describe below the type(s) of business activities performed.

The main building (57A Olin Way) contains the prime foam line, the bonded foam line and the polyester fiber line. The prime foam line converts raw materials into polyurethane foam, primarily used in bedding and furniture applications. Slabs of foam are glued into a continuous loop and then are slit into rolls. Foam that does not get slit into rolls is cut into blocks, which are approximately 8 feet in length. Blocks are either shipped to the customer or cut to customer specifications on various table saws. The bonded foam line primarily makes carpet cushion. Bonded foam is made from recycled foam. The recycled foam is ground up and glued back together with a binder. The foam/binder mixture is molded into slabs. Slabs of bonded foam are glued into a continuous loop and then they are slit into carpet cushion rolls. The fiber line produces sheets of unwoven polyester fiber primarily used in the furniture market.

The second building (57B Olin Way) manufactures expanded polystyrene (EPS). Carpenter sells polystyrene for many different applications but it is primarily used for insulation.

SECTION B. GENERAL INFORMATION REGARDING "APPLICANT"

If applicant is a corporation or a division or other unit of a corporation, provide the names, principal places of business, state of incorporation, and taxpayer ID numbers of all domestic and foreign parent corporations (including the ultimate parent corporation), and all domestic and foreign subsidiary corporations of the ultimate parent corporation with operations in Pennsylvania. Please include all corporate divisions or units, (whether incorporated or unincorporated) and privately held corporations. (A diagram of corporate relationships may be provided to illustrate corporate relationships.) Attach additional sheets as necessary.

Unit Name	Principal Places of Business	State of Incorporation	Taxpayer ID	Relationship to Applicant
Carpenter Co.	5016 Monument Ave, Richmond, VA 23230	VA	54-0499731	Parent Corporation

SECTION C. SPECIFIC INFORMATION REGARDING APPLICANT AND ITS "RELATED PARTIES"

Pennsylvania Facilities. List the name and location (mailing address, municipality, county), telephone number, and relationship to applicant (parent, subsidiary or general partner) of applicant and all Related Parties' places of business, and facilities in Pennsylvania. Attach additional sheets as necessary.

Unit Name	Street Address	County and Municipality	Telephone No.	Relationship to Applicant
Carpenter Co.	2337 E. Pleasant Valley Blvd., Altoona, PA 16601	Blair County, Antis Township	814.944.8612	Subsidiary
Carpenter Co.	400 Arrowhead Dr, Lititz, PA 17543	Lancaster County, Lititz Borough	717.627.1878	Subsidiary

Provide the names and business addresses of all general partners of the applicant and parent and subsidiary corporations, if any.

Name	Business Address

List the names and business address of persons with overall management responsibility for the process being permitted (i.e. plant manager).

Name	Business Address
Cliff Wilson, Vice President, Foam	5016 Monument Avenue, Richmond, VA 23230
Pat Naidu, Division Manager, Foam	Carpenter Co., 57A Olin Way, Fogelsville, PA 18051
Mark Powers, Vice President, EPS	Carpenter Co., 5016 Monument Avenue, Richmond, VA 23230
Blair Weller, General Manager, EPS	Carpenter Co., 57B Olin Way, Fogelsville, PA 18051

Plan Approvals or Operating Permits. List all plan approvals or operating permits issued by the Department or an approved local air pollution control agency under the APCA to the applicant or related parties that are currently in effect or have been in effect at any time 5 years prior to the date on which this form is notarized. This list shall include the plan approval and operating permit numbers, locations, issuance and expiration dates. Attach additional sheets as necessary.

Air Contamination Source	Plan Approval/ Operating Permit#	Location	Issuance Date	Expiration Date
Carpenter Co.	TV 39-00040	57 Olin Way, Fogelsville, PA 18051	9/5/2018	9/4/2023

Compliance Background. (Note: Copies of specific documents, if applicable, must be made available to the Department upon its request.) List all documented conduct of violations or enforcement actions identified by the Department pursuant to the APCA, regulations, terms and conditions of an operating permit or plan approval or order by applicant or any related party, using the following format grouped by source and location in reverse chronological order. Attach additional sheets as necessary. See the definition of "documented conduct" for further clarification. Unless specifically directed by the Department, deviations which have been previously reported to the Department in writing, relating to monitoring and reporting, need not be reported.

Date	Location	Plan Approval/ Operating Permit#	Nature of Documented Conduct	Type of Department Action	Status: Litigation Existing/Continuing or Corrected/Date	Dollar Amount Penalty
None						$
						$
						$
						$
						$
						$
						$
						$
						$
						$

List all incidents of deviations of the APCA, regulations, terms and conditions of an operating permit or plan approval or order by applicant or any related party, using the following format grouped by source and location in reverse chronological order. This list must include items both currently known and unknown to the Department. Attach additional sheets as necessary. See the definition of "deviations" for further clarification.

Date	Location	Plan Approval/ Operating Permit#	Nature of Deviation	Incident Status: Litigation Existing/Continuing Or Corrected/Date
6/21/2021	Carpenter Co. – Fogelsville	TV 39-00040	Device failure	Corrected. (1) Vent Repaired. (2) Add redundant sensor. Sensor on order. (3) Add alarm to show if vent is not closed all the way.

<u>CONTINUING OBLIGATION</u>. Applicant is under a continuing obligation to update this form using the Compliance Review Supplemental Form if any additional deviations occur between the date of submission and Department action on the application.

VERIFICATION STATEMENT	
Subject to the penalties of Title 18 Pa.C.S. Section 4904 and 35 P.S. Section 4009(b)(2), I verify under penalty of law that I am authorized to make this verification on behalf of the Applicant/Permittee. I further verify that the information contained in this Compliance Review Form is true and complete to the best of my belief formed after reasonable inquiry. I further verify that reasonable procedures are in place to ensure that "documented conduct" and "deviations" as defined in 25 Pa Code Section 121.1 are identified and included in the information set forth in this Compliance Review Form.	
[signature]	12/19/2022
Signature	Date
Cliff Wilson	
Name (Print or Type)	
Vice President	
Title	

December 15, 2022

Robert Ibach, Jr.
Township Manager
Upper Macungie Township
8330 Schantz Road
Breinigsville, PA 18031

Certified Mail No. 7022 2410 0003 1744 0184

RE: Major Operating Permit Modification Application
Carpenter Co. Fogelsville Facility
Operating Permit No.: 39-00040

Dear Mr. Ibach:

Pursuant to *25 Pa. Code §* 127.413, Carpenter Co. (Carpenter) hereby notifies the township of Upper Macungie of its submittal of a Major Operating Permit Modification Application to the Pennsylvania Department of Environmental Protection (PADEP) concerning its foam manufacturing plant located at 57A Olin Way, Fogelsville, Lehigh County, Pennsylvania. Carpenter is specifically requesting that PADEP modify its existing Title V Operating Permit No. 39-00040 to incorporate the conditions of an alternative RACT proposal. The application does not request any physical modification to the sources at the facility or any control devices.

Copies of the application are available for public review at DEP's Northeast Regional Office, 2 Public Square, Wilkes-Barre, PA, 18701. An appointment to review the documents may be scheduled by contacting the File Review Section of the DEP at 570 826-5472 between 8:00 A.M. and 4:00 P.M., Monday through Friday, except holidays.

Pennsylvania Code Title 25 (Environmental Protection – Air Resources) Section 127.413 requires notification of this application since this is a Title V facility. The 30-day comment period begins upon receipt of this formal notification. During this comment period, PADEP will accept such comments. Comments are to be sent to:

Air Quality – Environmental Program Manager
Pennsylvania Department of Environmental Protection
Northeast Regional Office
2 Public Square
Wilkes-Barre, PA, 18701
Phone: (570) 826-2511

Written comments should include the name, address and telephone number of the person(s) submitting the comments along with the reference number of the proposed permit.

If you have any questions regarding this application or require any additional information, please feel free to contact me at 610-366-8349 or via e-mail at brian.geren@carpenter.com.

Sincerely,

Brian Geren
Technical Director

December 15, 2022

Lehigh County Commissioners
17 South Seventh Street
Allentown, PA. 18101-2400

Certified Mail No. 7022 2410 0003 1744 0191

RE: Major Operating Permit Modification Application
Carpenter Co. Fogelsville Facility
Operating Permit No.: 39-00040

Dear Sir or Madam:

Pursuant to 25 Pa. Code § 127.413, Carpenter Co. (Carpenter) hereby notifies Lehigh County of its submittal of a Major Operating Permit Modification Application to the Pennsylvania Department of Environmental Protection (PADEP) concerning its foam manufacturing plant located at 57A Olin Way, Fogelsville, Lehigh County, Pennsylvania. Carpenter is specifically requesting that PADEP modify its existing Title V Operating Permit No. 39-00040 to incorporate the conditions of an alternative RACT proposal. The application does not request any physical modification to the sources at the facility or any control devices.

Copies of the application are available for public review at DEP's Northeast Regional Office, 2 Public Square, Wilkes-Barre, PA, 18701. An appointment to review the documents may be scheduled by contacting the File Review Section of the DEP at 570 826-5472 between 8:00 A.M. and 4:00 P.M., Monday through Friday, except holidays.

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Phone: (570) 826-2511

Written comments should include the name, address and telephone number of the person(s) submitting the comments along with the reference number of the proposed permit.

If you have any questions regarding this application or require any additional information, please feel free to contact me at 610-366-8349 or via e-mail at brian.geren@carpenter.com.

Sincerely,

Brian Geren
Technical Director