Notice of Construction Application Report

Fluid Motion Proposed Facility
Auburn, Washington

October 30, 2024

Prepared for

Ranger Tugs, dba Fluid Motion, LLC
17341 Tye Street SE
Monroe, Washington 98272

Notice of Construction Application Report
Fluid Motion Proposed Facility
Auburn, Washington

This document was prepared by, or under the direct supervision of, the technical professionals noted below.

Document prepared by: Anne Klinke Annie Klinke
Project Manager; Primary Author

Document reviewed by: Eric Albright Eric Albright, PE, ME
Principal; Quality Reviewer

Date:	October 30, 2024
Project No.:	1787007.010
File Path:	\\edmdata01\projects\1787\007\.010\r\landau_fluid motion auburn_noc report.docx
Project Coordinator:	KEE

LANDAU ASSOCIATES

This page intentionally left blank.

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

ACMA	American Composites Manufacturers Association
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute, Inc.
AOP	Air Operating Permit
ASIL	acceptable source impact level
ASOS	Automated Surface Observation System
avg	average
BACT	Best Available Control Technology
BPIP PRIME	Building Profile Input Program-Plume Rise Model Enhancements
CFR	Code of Federal Regulations
Ecology	Washington State Department of Ecology
EPA	US Environmental Protection Agency
Facility	506 44th Street NW, Auburn, Washington
Fluid Motion	Ranger Tugs, dba Fluid Motion, LLC
gr/dscf	grains per dry standard cubic foot
HAP	hazardous air pollutant
K	Kelvin
km	kilometer
KSEA	NWS meteorological station in Seattle, Washington
L/mol	liters per mole
Landau	Landau Associates, Inc.
lb/avg period	pounds per averaging period
lb/boat	pounds per boat
lb/day	pounds per day
lb/worker-hour	pounds per worker hour
m	meter
m/s	meters per second
MACT	maximum achievable control technology
$\mu g/m^3$	micrograms per cubic meter
MMA	methyl methacrylate
NAD83	North American Datum of 1983
NED	National Elevation Dataset
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NOC	Notice of Construction
NSPS	New Source Performance Standards
NSR	new source review
NWS	National Weather Service
PM	particulate matter

ppmw	parts per million by weight
PSCAA	Puget Sound Clean Air Agency
PSD	prevention of significant deterioration
SEA	Seattle-Tacoma International Airport
SEPA	State Environmental Policy Act
SQER	small quantity emission rate
Subpart VVVV	40 CFR 63, Subpart VVVV
TAP	toxic air pollutant
tBACT	Best Available Control Technology for toxics
tpy	tons per year
USGS	US Geological Survey
UTM	Universal Transverse Mercator
VOC	volatile organic compound
WAC	Washington Administrative Code

1.0 INTRODUCTION

Landau Associates, Inc. (Landau) prepared this Notice of Construction (NOC) application on behalf of Ranger Tugs, dba Fluid Motion, LLC (Fluid Motion) for Fluid Motion's proposed operations at 506 44th Street NW in Auburn, Washington (Facility). Because the Facility has the potential to emit air pollutant emissions and the Facility is located within the jurisdiction of the Puget Sound Clean Air Agency (PSCAA), an NOC application must be submitted to PSCAA before new emission units can be installed and operated. This document provides the information necessary for PSCAA to assess the Facility's compliance with the requirements of PSCAA's New Source Review (NSR) program and other applicable regulations. A completed and signed NOC application form is provided as Appendix A.

2.0 PROJECT DESCRIPTION

Fluid Motion has rented the property located at 506 44th Street NW in Auburn, Washington, and plans to install and operate equipment and begin boat-manufacturing operations that are the same as those employed at other Fluid Motion facilities in PSCAA's jurisdiction (i.e., Monroe and Arlington). The Facility will manufacture fiberglass boats by hand that will be sized between 25 feet and 45 feet in length. The manufacturing process consists of successive layers of gelcoat, vinyl ester resin, polyester resins, and fiberglass laminated inside open female molds. A variety of molds are used to make the decks, hulls, and small parts that go into the boat-manufacturing process.

Operations from the Facility are expected to produce emissions of particulate matter (PM) and volatile organic compounds (VOCs), some of which are considered toxic air pollutants (TAPs) according to Washington State regulations and/or hazardous air pollutants (HAPs) according to federal regulations. Some of the compounds expected to be emitted by the Facility are potential odorants.

3.0 EMISSIONS ESTIMATES

The Facility is expected to generate VOC emissions as a result of evaporation from the application and curing of polyester or vinyl ester plastic resins and gelcoats. Styrene is expected to be the primary VOC emitted from the resins and gelcoats used at the Facility. Gelcoats used at the Facility also contain methyl methacrylate (MMA). Styrene and MMA emissions from the application of gelcoats, resins, and putty were quantified using emissions factors provided in the Unified Emission Factors for Open Molding of Composites (American National Standards Institute, Inc./American Composites Manufacturers Association [ANSI/ACMA] 2001).

Respirable silica is considered a TAP under Washington Administrative Code (WAC) 173-460-150. Emissions of PM as silica from fiberglass-spraying operations were quantified using the conservative assumptions that 65 percent of the silica in coatings will be emitted as overspray and that 98 percent of that overspray would be captured by wall filter systems. Silica is the only particulate-based HAP or TAP.

For all other operations, maximum potential emissions were estimated using the conservative assumption that 100 percent of all VOCs, as well as volatile TAPs and HAPs, contained in the materials used in the manufacturing process will be emitted during the manufacturing process.

Table 1 below presents a summary of potential emissions of VOCs, TAPs, and HAPs:

Table 1: Maximum Potential Annual Air Pollutant Emissions

		Emissions (tpy)				
Material Used	**Amount Used (tpy)**	**Styrene**	**MMA**	**Silica**	**Other HAPs/TAPs**	**Total VOCs**
Gelcoat	126	13.5	2.83	0.0273	--	16.3
Tooling Gelcoat	1.64	0.263	--	--	--	0.263
Polyester Resin	522	20.1	--	--	--	20.1
Tooling Resin	6.55	0.291	--	--	--	0.291
Vinyl Ester Resin	58.9	2.27	--	--	--	2.27
Radius Putty	66.8	2.54	--	--	--	2.54
Initiator	15.7	--	--	--	0.785	0.785
Mold Release	1.18	--	--	--	0.471	0.471
Wood Stain	0.118	--	--	--	--	0.117
Spray Adhesive	0.982	--	--	--	--	0.481
3M Spray Adhesive	1.80	--	--	--	0.342	0.918
Total Emissions (tpy)		39.0	2.83	0.0273	1.60	44.6

Abbreviations:
HAP = hazardous air pollutant
MMA = methyl methacrylate
TAP = toxic air pollutant
tpy = tons per year
VOC = volatile organic compound

Detailed potential emission calculations are provided as Appendix B. Hourly average emissions were calculated using the annual emission totals shown in Table 1, 6,240 hours per year of operation, and the assumption that manufacturing operations are uniform throughout the year. The maximum potential daily TAP emissions were calculated by multiplying the hourly average emission rate by 24 hours per day. In Table 2 below, maximum potential TAP emissions are compared with the applicable small quantity emission rates (SQERs) from WAC 173-460-150.

Table 2: Toxic Air Pollutant Emissions Screening

Product Used	Averaging Period	Potential Emissions (lb/avg period)	SQER (lb/avg period)	Greater than SQER?
Styrene	24-hour	300	65	Yes
Methyl methacrylate	24-hour	21.8	52	No
Methyl ethyl ketone	24-hour	6.04	370	No
n-Hexane	24-hour	0.42	52	No
Silica	24-hour	0.21	0.22	No
Toluene	24-hour	0.14	370	No
Cyclohexane	24-hour	3.89	440	No

Abbreviations:
SQER = small quantity emission rate
lb/avg period = pounds per averaging period

4.0 REGULATORY REVIEW

The Facility is potentially subject to federal, state, and local regulations. This section discusses the applicability or inapplicability of certain regulations, and the Facility's expected compliance status with respect to those that are applicable following the commencement of production at the Facility

4.1 Permitting Programs

4.1.1 New Source Review

Section 6.03(a) of PSCAA's Regulation 1 prohibits the construction, installation, establishment, or modification of a stationary source unless an NOC application has been filed with PSCAA and PSCAA has issued an "Order of Approval." Exceptions to this rule are those sources that are exempted from the requirements under Sections 6.03(b) or 6.03(c) of Regulation 1. The Facility does not qualify for any of the listed exemptions and is therefore subject to PSCAA's NSR regulations and is required to obtain an Order of Approval from PSCAA. The area surrounding the Facility is designated as in-attainment or unclassifiable for all ambient air quality standards.

NSR regulations require PSCAA to review new or modified sources of air contaminants and require the applicant to demonstrate that installation and operation of the new equipment will:

- Not cause violations of the ambient air quality standards
- Result in TAP emission increases that are sufficiently low to be protective of human health and safety
- Meet all applicable regulatory emission standards
- Employ Best Available Control Technology (BACT) and BACT for toxics (tBACT)
- Obtain a State Environmental Policy Act (SEPA) determination from the appropriate lead agency.

This report provides PSCAA with information necessary to assess the proposed Facility's compliance with all NSR requirements.

4.1.2 Prevention of Significant Deterioration

The Washington State Department of Ecology (Ecology) administers the prevention of significant deterioration (PSD) air quality permit process that applies to major sources. A major source, as defined in PSD regulations, emits more than either 100 or 250 tpy of a regulated pollutant, depending upon the type of facility. A project at an existing source is subject to PSD review only if: (1) the existing source to be modified is a major source, and (2) the net increase of any pollutant emitted by the source, as a result of the project, exceeds prescribed "Significant Emission Rates." The Facility does not have the potential to increase emissions in quantities that would subject it to PSD review.

4.1.3 Air Operating Permits

PSCAA implements the US Environmental Protection Agency's (EPA's) Air Operating Permit (AOP) program, also known as "Title V," through Regulation 1, Article 7. This program defines a "major source" of air pollutants as a stationary source that has the potential to emit 10 tons or more per year of any single HAP, 25 tons or more per year of any combination of HAPs, or 100 tons or more per year of any other air pollutant subject to regulation. As a result of potential styrene emissions being expected to exceed 10 tpy, the Facility will be a major source under PSCAA's AOP program. Table 3 below presents the individual and total potential HAP emissions from the Facility. An initial AOP application will be submitted within 1 year of commencing operations, in accordance with WAC 173-401.

Table 3: HAP Potential to Emit

Pollutant	Emission Rate (tpy)
Styrene	39.0
Methyl methacrylate	2.83
n-Hexane	0.05
Toluene	0.02
Silica	0.03
Total HAPs	41.9

Abbreviations:
HAP = hazardous air pollutant
tpy = tons per year

4.2 Emissions Standards

4.2.1 New Source Performance Standards

New Source Performance Standards (NSPS) are uniform standards that apply nationwide to specific categories of stationary sources constructed, modified, or reconstructed after each individual standard was proposed. NSPS are found in Title 40, Part 60 of the Code of Federal Regulations (CFR). NSPS usually represent a minimum level of control that is required for a new source. The Facility will not include any equipment or operations to which NSPS apply; therefore, there are no NSPS that will apply to the Facility.

4.2.2 National Emission Standards for Hazardous Air Pollutants

Prior to the 1990 Clean Air Act Amendments, National Emission Standards for Hazardous Air Pollutants (NESHAPs) were risk-based emission standards for eight HAPs. Under the provisions of Section 112 of the 1990 Clean Air Act Amendments, Congress required that the EPA regulate the emissions of 189 HAPs from all stationary and mobile sources. The EPA has promulgated industry category-specific regulations in 40 CFR, Part 63 that require controls tailored to the major sources of emissions and the HAPs of concern associated with that industry. The rules promulgated under Section 112 generally specify the maximum achievable control technology (MACT) that must be applied by a given industry category. Consequently, these rules are often called MACT standards.

There are two types of NESHAPs, those that apply to "major" sources of HAP emissions and those that apply to "area" sources of HAP emissions. Major sources are facilities that have the potential to emit more than 10 tons of a single HAP per year, or 25 tons per year of all HAPs combined. Area sources are facilities that are not major sources.

The NESHAP for boat manufacturing (40 CFR 63, Subpart VVVV [Subpart VVVV]) applies to the Facility because, as a result of potential annual styrene emissions, it is a major source of HAPs. Subpart VVVV requires that 12-month rolling average HAP content be calculated using Equation 1 for material use presented in Section 63.5698 of the Subpart for comparison with the applicable limit. Subpart VVVV provides three compliance options; Fluid Motion proposes to demonstrate compliance by maintaining records of the maximum resin and gelcoat concentrations, which will be calculated using the maximum weighted average percentage provided in Table 2 of Subpart VVVV, and which are summarized below in Table 4.

Table 4: Alternative Content Requirements for Open Molding Resin and Gelcoat Operations

Operation	Application Method	Weighted-Average Requirement (%)[a]
Production Resin	Non-atomized	35
Pigmented Gelcoat	Any	33
Clear Gelcoat	Any	48
Tooling Resin	Non-atomized	39
Tooling Gelcoat	Any	40

Notes:

a. Weighted average HAP content from Table 2 to Subpart VVVV of Part 63

The values in Table 4 are referenced in Approval Order 12155 issued by PSCAA to Fluid Motion's facility in Arlington, Washington. Fluid Motion anticipates that these values will similarly be referenced in the Approval Order issued by PSCAA for this Facility. Fluid Motion will employ the compliant materials option to meet MACT at the Facility as specified in Subpart VVVV.

4.3 General Air Pollution Control Regulations

Regulations in Article 9 of PSCAA Regulation 1 that address general air pollution sources will apply to the Facility, which is not exempt from any of these general requirements. These general standards for maximum emissions from air pollution sources in PSCAA's jurisdiction include the following limits:

- Visible emissions to 20 percent opacity except for 3 minutes per hour (PSCAA Regulation 1, Section 9.03)
- PM emissions from equipment used in a manufacturing process to 0.05 grain per dry standard cubic foot (gr/dscf) (PSCAA Regulation 1, Section 9.09)
- Nuisance particulate fallout, fugitive dust, and odors (PSCAA Regulation 1, Section 9.11)
- Fugitive dust emissions from equipment and haul roads (PSCAA Regulation 1, Section 9.15).

4.4 Toxic Air Pollutant Regulations

Air pollutants identified as TAPs in Washington State are regulated by Chapter 173-460 WAC, which requires new or modified sources of TAPs to employ tBACT to limit TAP emission increases (WAC 173-460-060) and to demonstrate that ambient TAP impacts will not exceed regulatory health-based thresholds (WAC 173-460-070). The ambient impact assessment is accomplished either by comparing proposed TAP emission increases with the SQERs provided in WAC 173-460-150 or by comparing ambient TAP concentration increases calculated using a dispersion model with the acceptable source impact levels (ASILs), which are also provided in WAC 173-460-150.

Maximum potential emissions attributable to the Facility are compared to the SQER in Table 2. Because the styrene emissions are expected to exceed the applicable SQER, assessments that tBACT will be employed and in compliance with the ambient impact requirement were prepared and are provided in Sections 5.0 and 6.0, respectively.

4.5 State Environmental Policy Act

All projects required to obtain an Order of Approval are subject to SEPA regulations, which require that state agencies consider environmental impacts before deciding whether to approve a proposal. A SEPA checklist is included as Appendix C.

5.0 BEST AVAILABLE CONTROL TECHNOLOGY

BACT is an emission limitation or work practice standard based on the maximum degree of reduction that can be achieved while taking feasibility, performance, adverse environmental and energy impacts, and cost into consideration. The only criteria pollutant that will require a BACT assessment is VOC, which is a surrogate for ozone. Because styrene is a VOC, the BACT analysis presented here addresses BACT as well as tBACT, which is required by WAC 173-460-040 as a result of the expected maximum potential styrene emissions exceeding the applicable SQER (see Section 3.0). The top-down BACT process recommended by EPA, Ecology, and PSCAA comprises the following five steps:

1) Identify all available emission reduction alternatives.
2) Assess technical feasibility and eliminate infeasible alternatives.
3) Rank the remaining alternatives according to effectiveness.
4) Remove alternatives expected to produce unacceptable economic, environmental, and/or energy impacts.
5) Select the top-ranked remaining alternative as BACT/tBACT.

BACT and tBACT analyses for VOCs and styrene show that all available emission reduction alternatives were identified and technically infeasible options were eliminated, as presented in Appendix E. In past BACT analyses, PSCAA has determined that the nature of the process at Fluid Motion (i.e., intermittent batch production using open molds with high-volume exhaust gas flow) introduces technical challenges for the use of thermal controls and carbon absorption systems. The thermal oxidation, catalytic oxidation, and carbon adsorption systems would be sized to treat a high-volume exhaust, which would make them infeasible for the intermittent nature of the Facility. The following technologies were determined to be technically feasible for reducing emissions of VOCs from manufacturing operations and processes employed by Fluid Motion at the Facility:

- Use of Low-monomer Resins and Gels
- Non-atomizing Resin Application Techniques

Fluid Motion proposes that BACT and tBACT for emissions attributable to the Facility are the use of Low-monomer Resins and Gels and Non-atomizing Resin Application Techniques, which have been determined to be BACT for similar equipment and operations at Fluid Motion’s Arlington and Monroe facilities.

6.0 AMBIENT AIR QUALITY IMPACT ASSESSMENT

Landau reviewed regulatory modeling guidance to select the most appropriate air quality dispersion model to simulate dispersion of air pollutant emissions attributable to the Facility for an assessment of near-field air quality impacts. The potential for building downwash and exhaust plumes that impact complex terrain are issues that often influence the selection of regulatory modeling tools. The terrain in the area immediately surrounding the Facility is relatively flat but the modeling domain does include some complex terrain, and the process building has the potential to interact with emission plumes and cause downwash effects.

AERMOD is the model currently recommended by the EPA's Guideline on Air Quality Models (codified as Appendix W to 40 CFR Part 51, hereafter referred to as "the Guideline") as the preferred dispersion model for complex source configurations and for sources subject to building downwash. Landau applied AERMOD (Version 22112) to predict all concentration increases in the analysis using the regulatory default options, except as noted below.

6.1 Elevation Data and Receptor Network

Terrain elevation data used to calculate receptor, onsite structure, and emission source locations were prepared using one-third arc-second data developed by the US Geological Survey (USGS) for the National Elevation Dataset (NED), which is available on the internet from the USGS National Map Viewer. These data have a horizontal spacing of 10 meters (m). Terrain heights surrounding the Facility indicate that some of the receptors used in the simulations were located in intermediate or complex terrain (i.e., above stack or plume height, respectively).

For the modeling analysis, nested grids of receptors were prepared using procedures recommended in Ecology's First, Second, and Third Tier Review of Toxic Air Pollutant Sources guidance document (Ecology 2015). The fenceline at the property was assumed to be the ambient air boundary. The receptor locations used in the modeling are shown on Figure 1 below. The base elevation and hill height scale for each receptor were calculated using the NED data described above and the EPA's terrain processor, AERMAP (Version 18081), which generated formatted receptor output files that were read by AERMOD. All receptor locations are in Universal Transverse Mercator (UTM) Zone 10 coordinates, with a North American Datum of 1983 (NAD83) datum.

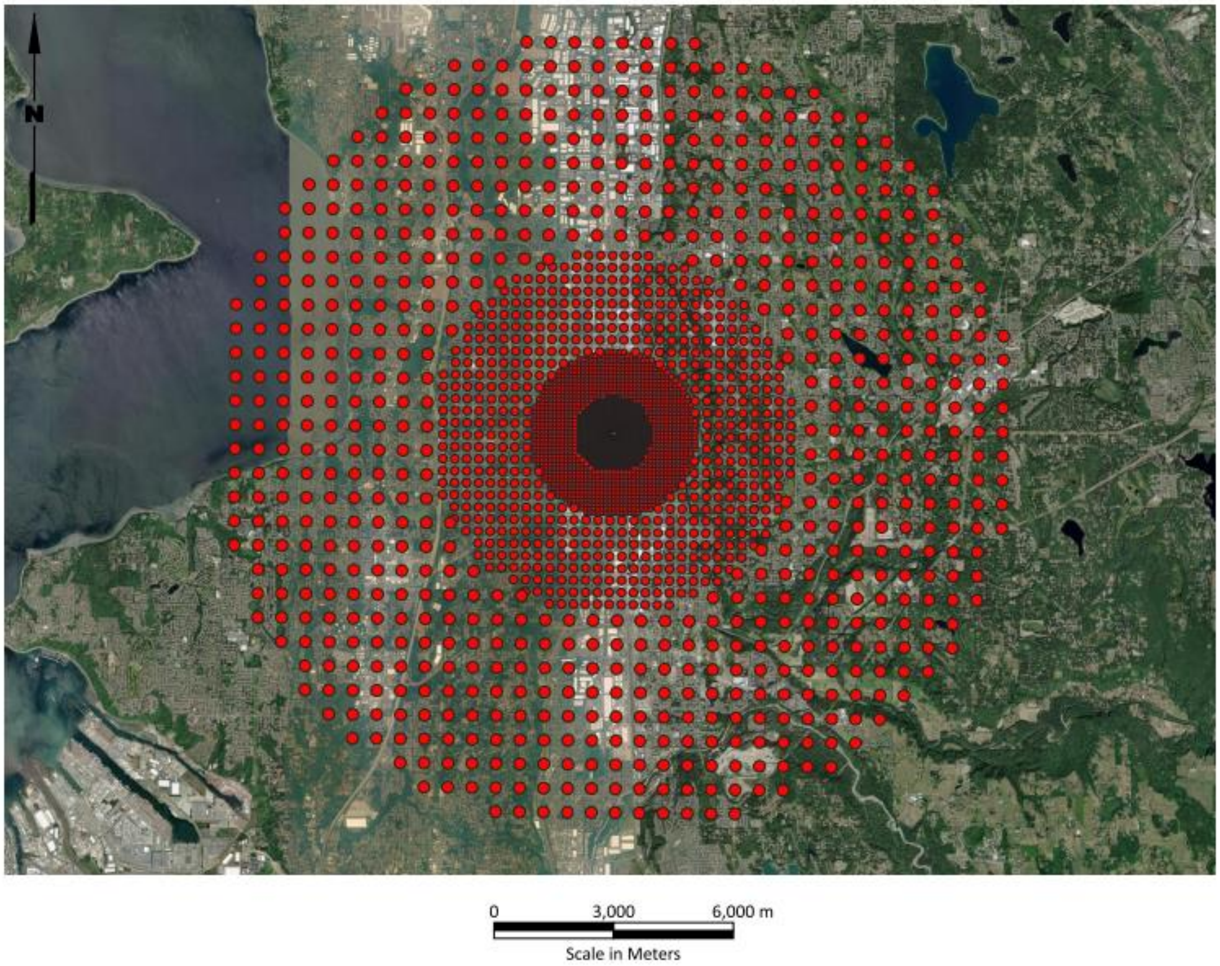


Figure 1: Receptor grid

6.2 Meteorological Data

The Facility is located 8 miles southeast of Seattle-Tacoma International Airport (SEA), where a National Weather Service (NWS) Automated Surface Observation Station (ASOS) station is located.

The EPA meteorological preprocessor program AERMET (Version 22112) was used to combine wind speed and wind direction measurements, the surface meteorological observations, and the twice-daily upper air soundings to calculate the meteorological parameters and profiles required by AERMOD. One-minute wind speed and wind direction data from NWS meteorological station KSEA in Seattle were used to resolve calm and variable wind conditions using the current version of the AERMINUTE (Version 15272) preprocessor.

Figure 2. below presents the AERMET-processed KSEA wind speed and wind direction data in a “windrose” format.

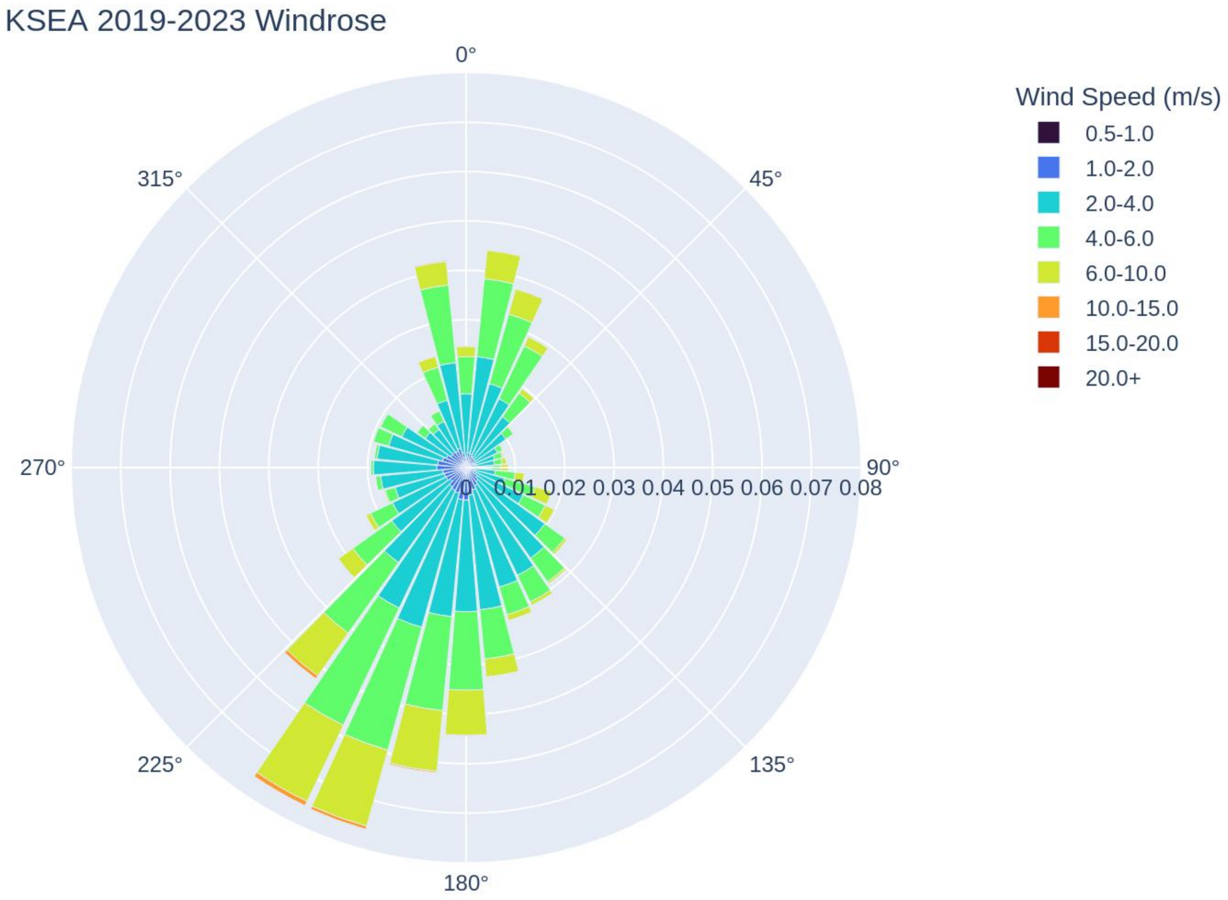


Figure 2: Windrose of processed Seattle-Tacoma International Airport Data for 2019 - 2023

Additional meteorological and geophysical parameters are required by AERMOD to estimate the surface energy fluxes and construct boundary layer profiles. Surface characteristics including albedo, Bowen ratio, and surface roughness length were determined for the area surrounding the SEA meteorological station using the AERMET surface characteristic preprocessor; AERSURFACE (Version 20060); and the USGS 2016 National Land Cover (NLCD2016) land use, the USGS 2016 Impervious surface (MPRV2016), and the USGS tree canopy (CNPY2016) datasets (MRLC undated). The NLCD2016 dataset used in the analysis has 30-m horizontal spacing and includes 21 land use categories. Monthly surface parameters were calculated using AERSURFACE and the methodology recommended by EPA guidance (EPA 2023; EPA 2020).

Monthly albedo and Bowen ratio values were averaged over a 10-kilometer (km) by 10-km region centered on the KSEA meteorological station. An unweighted arithmetic average was used to calculate monthly albedo, while an unweighted geometric average was used to calculate monthly Bowen ratio.

Monthly surface roughness values were calculated for twelve 30-degree sectors that extended 1 km from the KSEA meteorological station. An inverse distance-weighted geometric average was used to calculate monthly surface roughness length values for each of the 12 sectors.

AERSURFACE requires additional location and climatological information regarding the primary meteorological station (in this case, KSEA). The following information was provided to AERSURFACE to process monthly surface parameters for the meteorological station:

- The site is located at an airport.
- The site was assumed to not have continuous snow cover most of the winter; there is typically little snowfall in the area.
- The site was assumed to not be located in an arid region.

6.3 Emission Unit Release Parameters

Figure 3 below shows the Facility layout superimposed on a recent aerial photograph of the Facility. Locations of point sources are indicated, as well as the onsite structure that could potentially influence dispersion.

Figure 3: Facility layout with ambient air boundary identified

Table 5 below provides a summary of the parameters used to represent the stacks at the Facility. Each stack will have an exhaust flow rate of 20,000 cubic feet per minute. Vendor data and stack parameters were provided by Fluid Motion and are included as Appendix D.

Table 5: Stack Parameters

Stack ID	Release Height above Grade (m)	Release Temperature (K)	Exit Velocity (m/s)	Inside Diameter (m)
Stacks 1-7	12.19	291.5	14.3	0.91

Abbreviations:
m = meters
K = Kelvin
m/s = meters per second

In addition to the release parameters discussed above, the building dimensions and Facility configuration were provided to AERMOD to assess potential downwash effects. Wind direction-specific building profiles were prepared for the modeling using EPA's Building Profile Input Program including the Plume Rise Model Enhancements algorithm (BPIP PRIME). The Facility layout and height-above-grade of the Facility buildings and nearby buildings were used to prepare data for BPIP PRIME, which calculates the necessary input data for AERMOD.

To address the intermittent nature of styrene emissions from the process, Fluid Motion proposes to use a lamination worker-hour limitation to ensure that the modeling represents a worst-case 24-hour styrene emissions rate. The emission factors for styrene include a 25 percent safety factor. Table 6 below presents the worker-hour calculations. The maximum styrene emission rate of 481.2 pounds per day (lb/day) will be used in air dispersion modeling to assess the worst-case short-term ambient concentrations of styrene.

Table 6: Lamination Worker-Hour Styrene Calculation

Boat Type	Styrene Emissions (lb/boat)	Production Time (worker-hour/boat)	Emission Factor[1] (lb/worker-hour)	Maximum Styrene Emissions (lb/day)[2]
28-foot Cutwater	95.5	240	0.498	394.0
24-foot Cutwater	88.5	210	0.527	417.0
32-foot Cutwater	186.5	450	0.518	410.3
42-foot Cutwater	466.6	960	0.608	481.2

Notes:

1. Emission factor includes 25 percent safety factor.
   Emission Factor (lb/worker-hour) = (pounds/boat)/(worker-hour/boat)*1.25
2. Maximum daily styrene emissions based on the worst-case boat type styrene usage.

Abbreviations:
lb/boat = pounds per boat
lb/day = pounds per day
lb/worker-hour = pounds per worker hour

Due to the nature of the process and the ventilation system to be employed by the Facility, it is possible that emissions from the operations could be released from any of the seven stacks. To obtain a worst-case ambient impact prediction, each stack was modeled individually with a styrene emission rate equal to the maximum potential total daily emissions from all operations. It is unlikely that such a scenario could occur as styrene emissions will almost certainly be divided among multiple stacks, so the model results presented can be considered conservative estimates of potential ambient impacts. The maximum model-predicted concentration increases from all modeled stack scenarios were compared to the regulatory thresholds.

The maximum methyl methacrylate emission increase attributable to the Facility does not exceed the SQER threshold provided in WAC 173-460-150 (see Table 2) and is therefore not presented in Table 6, but MMA emissions were included in the modeling analysis to obtain a maximum ambient concentration for comparison with odor thresholds. Based on a review of material compositions, Fluid Motion estimates that methyl methacrylate emissions are 7.5 percent of styrene emissions.

6.4 Results

The results of the styrene modeling are presented below in Table 8 with the ASIL for styrene from WAC 173-460-150 for comparison to assess compliance with PSCAA TAP regulations. As shown in Table 7, the maximum model-predicted styrene concentration increase is less than the ASIL.

Table 7: AERMOD Modeling Results

Pollutant	Modeled Concentration ($\mu g/m^3$)	ASIL ($\mu g/m^3$)	Less than ASIL?
Styrene	863	870	Yes

Abbreviations:
ASIL = acceptable source impact level
$\mu g/m^3$ = micrograms per cubic meter

At Fluid Motion's request, Landau used AERMOD to predict the maximum concentration increases of styrene and MMA associated with the Facility for comparison with odor thresholds. The analysis predicted 3-minute average concentrations for the comparisons with odor thresholds. AERMOD was designed primarily for use in the air permitting process and is therefore capable of calculating pollutant concentrations based on averaging periods that match those of ambient standards, the shortest of which is 1 hour. To produce a 3-minute average concentration, a scaling factor (Turner 1969) was used to extrapolate maximum 3-minute average concentration increases from maximum 1-hour average concentration increases calculated using AERMOD. The maximum 1-hour average concentration increases calculated by AERMOD and the scaled maximum 3-minute average concentration increases, as well as the odor threshold ranges for comparison, are presented in Table 8. Concentrations in the low part of the range are unlikely to cause odor issues.

Table 8: Odor Threshold Comparison

Pollutant	1-Hour Avg Concentration (µg/m³)	3-Minute Avg Concentration (µg/m³)	3-Minute Avg Concentration (ppmv)	Odor Threshold Range (ppmv)
Methyl Methacrylate	183	33	0.081	0.014 – 0.66
Styrene	2,435	4,434	1.04	0.0028 – 61

Notes:

1. One-hour model-predicted concentrations were converted to 3-minute average concentrations using Equation 5.12 from Turner Workbook (Turner 1969). Example for styrene:

$$4{,}434\ \frac{\mu g}{m^3} = 2{,}435\ \frac{\mu g}{m^3} * \left(\frac{60\ min}{3\ min}\right)^{0.2}$$

2. Three-minute average concentrations were converted to parts per million assuming a molar volume of 24.45 liters per mole (L/mol) at standard temperature and pressure. Example for styrene:

$$1.04\ ppmv = \frac{4{,}434\ \mu g\ styrene}{m^3\ air} * \frac{mol\ sty.}{104\ g\ sty.} * \frac{1\ g\ sty.}{10^6 \mu g\ sty.} * \frac{24.45\ L\ sty.}{mol\ sty.} * \frac{m^3\ sty.}{1000\ L\ sty.} * \frac{10^6\ m^3\ air}{million\ m^3\ air}$$

3. Odor threshold ranges from American Industrial Hygiene Association (AIHA) *Odor Thresholds for Chemicals with Established Occupational Health Standards*, 2nd Edition (Murnane, et al 2013).

Abbreviations:
avg = average
µg/m³ = micrograms per cubic meter
ppmv = parts per million by weight

7.0 USE OF THIS REPORT

This report has been prepared for the exclusive use of Fluid Motion, LLC for specific application to the Fluid Motion Auburn NOC Application submitted to PSCAA for issuance of an Order of Approval for the Facility. No other party is entitled to rely on the information, conclusions, and/or recommendations included in this document without the express written consent of Landau. Further, the reuse of information, conclusions, and/or recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau, shall be at the user's sole risk. Landau warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

8.0 REFERENCES

ANSI/ACMA. 2001. Table: Unified Emission Factors for Open Molding of Composites. American National Standards Institute, Inc./American Composites Manufacturers Association. July 23.

Ecology. 2015. Guidance Document: First, Second, and Third Tier Review of Toxic Air Pollution Sources (Chapter 173-460 WAC). Publication Number: 08-02-025. Washington State Department of Ecology. August 15.

EPA. 2020. User's Guide for AERSURFACE Tool. EPA-454/B-20-008. U.S. Environmental Protection Agency. February.

EPA. 2023. AERMOD Implementation Guide. EPA-454/B-23-009. U.S. Environmental Protection Agency. October.

Murnane, Sharon S., Alex H. Lehocky, and Patrick D. Owens. 2013. *Odor Thresholds for Chemicals with Established Health Standards*.

Turner, Bruce D. 1969. Workbook of Atmospheric Dispersion Elements. 999-AP-26. U.S. Department of Health, Education, and Welfare.

APPENDIX A

NOC Application Forms

AGENCY USE ONLY	NOC#: 12505	REG#: 30500	Date Fee Pd:	Eng. Assigned:

PUGET SOUND
Clean Air Agency

1904 3rd Ave #105, Seattle, WA 98101
206-343-8800
pscleanair.gov

NOTICE OF CONSTRUCTION APPLICATION FOR ORDER OF APPROVAL

The following information must be submitted as part of this application packet before an Agency engineer is assigned to review your project.

SECTION 1. FACILITY INFORMATION

Business Name Fluid Motion LLC

Equipment Installation Address 506 44th Street NW	City Auburn	State WA	Zip 98001

Is the business registered with the Agency at this equipment installation address?

Yes. Current Registration or AOP No. __________________ [✓ No, not registered] Unknown

Business Owner Name John LIvingston

Business Mailing Address 17300 Tye St. SE	City Monroe	State WA	Zip 98272

Type of Business Boat Manufacturing

Is the installation address located within the city limits?

[✓ Yes] No

NAICS Code 336612	NAICS Description Boat Building

Contact Name (for this application) Dennis Pearson	Phone 425-212-8136	Email dennispearson@rangertugs.com

Description for Agency Website

Provide a 1-2 sentence simple description of this project. See examples www.pscleanair.gov/176

Fluid Motion proposes to expand production into Building 10 located at their Arlington Facility

SECTION 2: REQUIRED APPLICATION PACKET ATTACHMENTS

1) **Process flow diagram**
   [✓ YES, attached.] NO, not attached. This application is incomplete
2) **Emission estimate**. Emission rate increases for all pollutants.
   [✓ YES, attached.] NO, not attached. This application is incomplete.
3) **Environmental Checklist** (or a determination made by another Agency under the State Environmental Policy Act) www.pscleanair.gov/DocumentCenter/View/170
   [✓ YES, attached.] NO, not attached. This application is incomplete.

SECTION 2: REQUIRED APPLICATION PACKET ATTACHMENTS (CONT)

4) Attach **equipment form**(s) applicable to your operation. Forms are available online at www.pscleanair.gov/179

[✓ YES, attached.] NO, not attached. This application is incomplete.

5) **Detailed Project Description**

The project description must include a detailed description of the project, a list of process and control equipment to be installed or modified, a description of how the proposed project will impact your existing operations (if applicable), and measures that will be taken to minimize air emissions.

Detailed description of the proposed project included in packet?

[✓ YES, attached.] NO, not attached. This application is incomplete.

6) **$3,000 filing fee** (nonrefundable)

PAY BY CHECK – Attached and made payable to **Puget Sound Clean Air Agency**

PAY BY CREDIT – Accounting technician will contact person identified below for payment information

Contact Name:	Contact Number:

SECTION 3: PROCESS AND CONTROL EQUIPMENT (attach additional pages if necessary)

Process Equipment		Does this equipment have air pollution control equipment?	**Air Pollution Control Equipment**	
# of Units	Equipment Type & Design Capacity		# of Units	Equipment Type
1	Boat Manufacturing Area	[✓ Yes] No	1	Fabric Filter System
		Yes No		
		Yes No		
		Yes No		

SECTION 4: CERTIFICATION STATEMENT

I, the undersigned, certify that the information contained in this application and the accompanying forms, plans, specifications, and supplemental data described herein is, to the best of my knowledge, accurate and complete.

Signature

10-28-24

Date

DENNIS PEARSON

Printed Name

ENVIRONMENTAL MGR.

Title

SECTION 5: APPLICATION SUBMITTAL

EMAIL application and attachments to:

NOC@pscleanair.gov

-OR-

MAIL application, payment, and attachments to:

Puget Sound Clean Air Agency
ATTN: NOC Application Submittal
1904 3rd Ave, Suite 105 - Seattle, WA 98101

PUGET SOUND
Clean Air Agency

1904 3rd Ave #105, Seattle, WA 98101
206-343-8800
pscleanair.gov

NOC APPLICATION SUPPLEMENTAL FORM

Spray Coating Operations

This application is for activities or equipment that is:

☒ New (including existing, unpermitted equipment)
☐ Physical or operational modification of existing equipment
☐ Relocation of existing equipment

This application is for activities or equipment that is:

☐ Aerospace
☐ Wood furniture
☐ Motor vehicles
☒ Other, please describe: Boat Manufacturing

Note: Spray coating operations for motor vehicles may instead qualify for the General Order of Approval - Automotive Refinishing Operations Spray Booths. www.pscleanair.gov/AutobodyGeneralOrder

Hours of operation per day: 24
Hours of operation per year: 6240

Spray Coating area is:

☒ Spray booth/room
☐ Outdoor spray area, describe enclosure: ______
☐ Prep area
☐ Other, please describe: ______

Design Specifications

Volume of enclosure (cubic feet): ______
Exhaust flow rate (cfm): 20,000
Make: ______ Model: ______

Exhaust System Overspray Control

☐ Dry filter system:
Dry filter make: ______ Dry filter model: ______
Manometer or differential pressure gauge installed: ☐ Yes ☐ No

☐ Water wash system:
Water flow rate (feet/minute): ______
Flow meter installed: ☐ Yes ☐ No

Spray Gun Parameters

Type of spray equipment:

☐ Air-assisted airless
☐ Airless; specify viscosity of coatings: ______________________________
☐ Electrostatic
☐ High volume low pressure (HVLP)
☐ Low volume low pressure (LVLP)
☒ Other, please describe: controlled spray of gelcoat, mechanical non-atomized application

Stack Parameters

☒ Stack information is specified on NOC Application Supplemental Form for proposed control device
☐ Stack information specified below:

Stack damper/rain guard:

☐ None ☐ Hexagonal ☐ Stack within stack ☐ Butterfly ☐ Inverted Cone
☐ Other (specify): _________________________

Stack diameter (inches): _____________ Stack height above ground (feet): _______________

Building Dimensions of project location:

Building Height (highest point of roof) (feet): ____________

Building Width (feet): ___________ Building Length (feet) ___________

Required Attachments

1. Table (Excel file preferred) containing proposed annual usage (gallons/year) of each coating, solvents and other VOC containing materials. Coatings, solvents, and VOC containing materials must be identified with manufacturer, name, product ID, and VOC content (lb/gal)
2. Safety Data Sheets (SDS) for each coating to be applied.
3. Environmental Data Sheets (EDS), Product Data Sheets (PDS), or SDS which show the VOC content (lb/gal) of each coatings and solvents to be applied or used during surface preparation and surface coating

APPENDIX B

Emission Calculations

Fluid Motion LLC

Auburn, WA

23-Oct-24

Auburn Facility Emissions

Hours/day	24	
Days/week	5	
Weeks/year	52	
Total Hours/year	6,240	
Coating Overspray	65%	(applied only to silica emissions)
Coating Filtration Efficiency	98%	(applied only to silica emissions)

Product Used	Material Usage	Styrene	MMA	Methyl ethyl ketone	Cyclohexane	Dimethyl ether	n-Hexane	Toluene	Silica/PM	VOC
Gelcoat (1)	126	33%	3%	0%	0%	0%	0%	0%	3%	36%
Tooling Gel Coat	2	40%								
Polyester resin (2)	522	35%	0%	0%	0%	0%	0%	0%	0%	35%
Tooling Resin	7	39%								
Vinyl ester resin(3)	59	35%	0%	0%	0%	0%	0%	0%	0%	35%
Radius Putty(4)	67	20%	0%	0%	0%	0%	0%	0%	0%	20%
Initiator (MEKP-925)(5)	16	0%	0%	5%	0%	0%	0%	0%	0%	5%
Spray Adhesive(6)	1	0%	0%	0%	20%	20%	0%	0%	0%	40%
Mold Release(7)	0	0%	0%	0%	0%	0%	0%	0%	0%	99%
Wood Spray(8)	1	0%	0%	0%	0%	0%	0%	0%	0%	49%
3M Spray Adhesive (9)	2	0%	0%	0%	15%	0%	3%	1%	0%	51%
	HAP	Y	Y	N	N	N	Y	Y	Y	N
	TAP	Y	Y	Y	Y	N	Y	Y	Y	N
	VOC	Y	Y	Y	Y	Y	Y	Y	N	Y

Fluid Motion LLC

Auburn, WA

23-Oct-24

Auburn Facility Emissions

	Material Usage	Annual Increase in VOCs, HAPs and TAPs											
		Styrene		Methyl methacrylate		Methyl ethyl ketone	Cyclohexane	Dimethyl ether	n-Hexane	Toluene	Silica/PM	VOC	Total HAPs
Product Used	(ton/yr)	Emission Factor (10) (lb/ton)	(ton/yr)	Emission Factor (10) (lb/ton)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)
Gelcoat (1)	126	215	13.5	45.0	2.83	--	--	--	--	--	0.0273	16.3	
Tooling Gel Coat	2	321	0.263	--	--	--	--	--	--	--	--	0.3	
Polyester resin (2)	522	77.0	20.1	--	--	--	--	--	--	--	--	20.1	
Tooling Resin	7	89.0	0.291	--	--	--	--	--	--	--	--	0.3	
Vinyl ester resin(3)	59	77.0	2.27	--	--	--	--	--	--	--	--	2.27	
Radius Putty(4)	67	76.0	2.54	--	--	--	--	--	--	--	--	2.54	
Initiator (MEKP-925)(5)	16	--	--	--	--	0.79	--	--	--	--	--	0.79	
Spray Adhesive(6)	1.2	--	--	--	--	--	0.236	0.236	--	--	--	0.471	
Mold Release(7)	0.12	--	--	--	--	--	--	--	--	--	--	0.117	
Wood Spray(8)	1.0	--	--	--	--	--	--	--	--	--	--	0.481	
3M Spray Adhesive (9)	1.80	--	--	--	--	--	0.270	--	0.0540	0.0180	--	0.92	
Total:		ton/year	39.0	--	2.83	0.79	0.51	0.24	0.05	0.018	0.03	44.6	
		lb/hr	12.5	--	0.91	0.252	0.162	0.076	0.017	0.006	0.0087	14.3	
		lb/day	300		21.8	6.04	3.89	1.81	0.42	0.14	0.210	343	
Total HAPS		ton/year	39.0	--	2.83	--	--	--	0.05	0.02	0.0273	--	41.9

(1) SDS for HK Research Corp Product No. HD-2588

(2) SDS for Ashland Aropol Q-67700 T-30

(3) SDS for Ashland AME 6001 T-25 Resin

(4) SDS for U.S. Chemical putty Duraglas

(5) SDS for Cadox L-50 A MEKP

(6) SDS for Fast Tack Hi-Temp Heavy Duty Spray Adhesive

(7) SDS for Henkel WOLO

(8) SDS for Minwax Helmsman

(9) SDS for 3M Spray Adhesive 77

(10) Unified Emission Factors for Open Modling of Composites, July 23,2001

Fluid Motion LLC

Daily Styrene Emissions

Hours worked per employee	8	hours/day
Number of Shifts	3	shifts/day
Lamination workers per shift	33	lamination workers/shift

	Styrene Emissions	**Production Time**	**Emission Factor***
	Pounds/boat	Lamination worker-hours/boat	lb/lamination worker-hour
28' cutwater	95.5	240	0.498
24' cutwater	88.5	210	0.527
32' cutwater	186.5	450	0.518
42' cutwater	466.6	960	0.608

* Emission Factors for styrene for each boat type include a 25% safety factor, consistent with the application for Fluid Motion Arlington NOC #12155

Boat Size with Maximum Styrene	**Maximum Styrene Emissions**	**Styrene SQER**
	lb/day	lb/day
42' Cutwater	481.2	65

APPENDIX C

SEPA Checklist

pscleanair.org
Puget Sound Clean Air Agency

Puget Sound Clean Air Agency
1904 Third Avenue, Suite 105 | Seattle, WA 98101-3317
Phone 206-343-8800 | 206-343-7522 Fax

ENVIRONMENTAL CHECKLIST

Because of the State Environmental Policy Act, the action for which you are filing a Notice of Construction and Application for Approval to this Agency requires the completion of an environmental checklist.

BUT: If you can answer "yes" to either of the following statements with respect to the action being proposed, the attached checklist need not be completed:

1. I have obtained a State, City, or County Permit and filled out an environmental checklist.

☐ **Yes** ☒ **No**

If yes, complete the following:

State, City or County Department: ______________________________

Date the checklist was completed: ______________________________

Attach a copy of the checklist

2. An environmental checklist or assessment has previously been filled out for another agency.

☐ **Yes** ☒ **No**

If yes, complete the following:

Agency: ______________________________

Date the checklist was completed: ______________________________

Attach a copy of the checklist

If your answers are NO to both of the above statements, you must complete the attached environmental checklist.

Prepared by:

Signature ______________________________

Name ______________________________

Position ______________________________

Agency/Organization ______________________________

Date Submitted ______________________________

ENVIRONMENTAL CHECKLIST

Date: 10/23/24

Proponent: Puget Sound Clean Air Agency

Project, Brief Title: Facility Buildout

Purpose of Checklist:

Governmental agencies use this checklist to help determine whether the environmental impacts of your proposal are significant. This information is also helpful to determine if available avoidance, minimization or compensatory mitigation measures will address the probable significant impacts or if an environmental impact statement will be prepared to further analyze the proposal.

Instructions for Applicants:

This environmental checklist asks you to describe some basic information about your proposal. Please answer each question accurately and carefully, to the best of your knowledge. You may need to consult with an agency specialist or private consultant for some questions. You may use “not applicable” or "does not apply" only when you can explain why it does not apply and not when the answer is unknown. You may also attach or incorporate by reference additional studies reports. Complete and accurate answers to these questions often avoid delays with the SEPA process as well as later in the decision-making process.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The agency to which you submit this checklist may ask you to explain your answers or provide additional information reasonably related to determining if there may be significant adverse impact.

Instructions for Lead Agencies:

Please adjust the format of this template as needed. Additional information may be necessary to evaluate the existing environment, all interrelated aspects of the proposal and an analysis of adverse impacts. The checklist is considered the first but not necessarily the only source of information needed to make an adequate threshold determination. Once a threshold determination is made, the lead agency is responsible for the completeness and accuracy of the checklist and other supporting documents.

Use of Checklist for Nonproject Proposals:

For nonproject proposals (such as ordinances, regulations, plans and programs), complete the applicable parts of Sections A, B, and C plus section D: Supplemental Sheet for Nonproject Actions.

Please completely answer all questions that apply and note that the words "project," "applicant," and "property or site" should be read as "proposal," "proponent," and "affected geographic area," respectively. The lead agency may exclude (for non-projects) questions in Section B: Environmental Elements that do not contribute meaningfully to the analysis of the proposal.

ENVIRONMENTAL CHECKLIST

A. BACKGROUND

1. Name of proposed project, if applicable:
Facility Expansion

2. Name of Applicant
Fluid Motion LLC

3. Applicant Address 506 44th Street NW	City Auburn	State WA	Zip 98001

Applicant Phone 425-212-8136	Applicant Email dennispearson@rangertugs.com
Contact Person Dennis Pearson	Title

Company/Firm
Ranger Tugs

4. Date Checklist Prepared 10/23/24	**5.** Agency Requesting Checklist PSCAA

6. Proposed timing or schedule (including phasing, if applicable).

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? ☐ Yes ☒ No. If yes, explain.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.
NOC Application Report Submitted by Landau Associates, Inc.

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? ☐ Yes ☒ No. If yes, explain.

10. List any government approvals or permits that will be needed for your proposal, if known.
PSCAA Order of Approval

ENVIRONMENTAL CHECKLIST

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page.

Start production of fiberglass boats in existing building - see NOC application

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.

Fluid Motion LLC complex at 506 44th Street NW in Auburn, Washington.

ENVIRONMENTAL CHECKLIST

B. ENVIRONMENTAL ELEMENTS

1. EARTH

a. General description of the site:

☒ flat ☐ rolling ☐ hilly ☐ steep slopes ☐ mountains

☐ other ____

b. What is the steepest slope on the site (approximate percent slope)?

0%

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them, and note any agricultural land of long-term commercial significance and whether the proposal results in removing any of these soils.

Not applicable - existing industrial building

d. Are there surface indications or history of unstable soils in the immediate vicinity? ☐ Yes ☒ No. If yes, describe.

e. Describe the purpose, type, total area, and approximate quantities and total affected area of any filling, excavation, and grading proposed. Indicate source of fill.

Not applicable - existing industrial building

f. Could erosion occur as a result of clearing, construction, or use? ☐ Yes ☒ No. If yes, generally describe.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

Not applicable - existing building

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

Not applicable - existing building

ENVIRONMENTAL CHECKLIST

2. AIR

a. What types of emissions to the air would result from the proposal (i.e., dust, automobile, odors, industrial wood smoke, greenhouse gases) during construction, operation, and maintenance when the project is completed? If any, generally describe and give approximate quantities, if known.

Increase in emissions of VOCs and toxic air pollutants (45 tpy VOCs, 41.9 tpy HAP). See NOC application for detailed emission calculations

b. Are there any off-site sources of emissions or odor that may affect your proposal? ☒ Yes ☐ No. If yes, generally describe.

AERMOD model used to predict concentrations of TAPs and odor impacts. See NOC application for detailed results

c. Proposed measures to reduce or control emissions or other impacts to air, if any:

Coating requirements similar to BACT for Arlington Facility (Approval Order 12411). See NOC application for detailed control technology assessment.

3. WATER

a. Surface

1. Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands) ? ☐ Yes ☒ No. If yes, describe type and provide names. If appropriate, state what stream or river it flows into.

2. Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? ☐ Yes ☒ No. If yes, please describe and attach available plans.

3. Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.

Not Applicable

4. Will the proposal require surface water withdrawals or diversions? ☐ Yes ☒ No. Give general description, purpose, and approximate quantities if known.

5. Does the proposal lie within a 100-year floodplain? ☐ Yes ☒ No. If yes, note location on the site plan.

ENVIRONMENTAL CHECKLIST

6. Does the proposal involve any discharges of waste materials to surface waters? ☐ Yes ☒ No. If yes, describe the type of waste and anticipated volume of discharge.

b. Ground Water

1. Will groundwater be withdrawn from a well for drinking water or other purposes? ☐ Yes ☒ No. If yes, give a general description of the well, proposed uses and approximate quantities withdrawn from the well.

   Will water be discharged to groundwater? ☐ Yes ☒ No. If yes, give general description, purpose, and approximate quantities, if known.

2. Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: domestic sewage; industrial, containing the following chemicals...; agricultural; etc.). Describe the general size of the systems, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.

Not applicable - existing building

c. Water Runoff (including storm water)

1. Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? ☐ Yes ☒ No. If yes, describe.

2. Could waste material enter ground or surface waters? ☐ Yes ☒ No. If yes, generally describe.

3. Does the proposal alter or otherwise affect drainage patterns in the vicinity of the site? ☐ Yes ☒ No. If yes, describe.

d. Proposed measures to reduce or control surface, ground, and runoff water, and drainage pattern impacts, impacts, if any:

Not applicable - existing building

ENVIRONMENTAL CHECKLIST

4. PLANTS

a. Check the types of vegetation found on the site:

Deciduous Trees:	☐ Alder	☐ Maple	☐ Aspen	☐ other (specify):
Evergreen Trees:	☐ Fir	☐ Cedar	☐ Pine	☐ other (specify):
☐ Shrubs				
☐ Grass				
☐ Pasture				
☐ Crop or Grain				
☐ Orchards, Vineyards, or other permanent crops				
☐ Other types of Vegetation (specify):				
Wet Soil Plants:	☐ Cattail	☐ Buttercup		☐ other (specify):
	☐ Bulrush	☐ Skunk Cabbage		
Water Plants:	☐ Water Lily	☐ Eelgrass	☐ Milfoil	☐ other (specify):

b. What kind and amount of vegetation will be removed or altered?

None

c. List threatened or endangered species known to be on or near the site.

None

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:

None

e. List all noxious weeds and invasive species known to be on or near the site.

None

ENVIRONMENTAL CHECKLIST

5. ANIMALS

a. Indicate birds and other animals that have been observed on or near the site or are known to be on or near the site.

Birds:	☐ Hawk	☐ Heron	☐ other (specify):
	☐ Eagle	☐ Songbirds	
Mammals:	☐ Deer	☐ Bear	☐ other (specify):
	☐ Elk	☐ Beaver	
Fish:	☐ Bass	☐ Salmon	☐ Trout
	☐ Hearing	☐ Shellfish	☐ other (specify):

b. List any threatened or endangered species known to be on or near the site.

None

c. Is the site part of a migration route? ☐ Yes ☒ No. If yes, explain.

d. Proposed measures to preserve or enhance wildlife, if any:

None

e. List any invasive animal species known to be on or near the site.

None

6. ENERGY AND NATURAL RESOURCES

a. What kinds of energy (electric, natural gas, oil, woodstove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

Natural gas for heating

b. Would your project affect the potential use of solar energy by adjacent properties? ☐ Yes ☒ No.
If yes, generally describe.

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:

N/A - operations in existing building

ENVIRONMENTAL CHECKLIST

7. ENVIRONMENTAL HEALTH

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste that could occur as a result of this proposal? ☐ Yes ☒ No.
If yes, describe:

2. Describe any known or possible contamination at the site from present or past uses.

None

3. Describe existing hazardous chemicals/conditions that might affect project development and design. This includes underground hazardous liquid and gas transmission pipelines located within the project area and in the vicinity.

None - manufacturing confined within existing building

4. Describe any toxic or hazardous chemicals that might be stored, used, or produced during the project's development or construction, or at any time during the operating life of the project.

Material coating containing styrene and other HAPs and TAPs described in the NOC application

5. Describe special emergency services that might be required.

None - exposure below DOSH time weighted average

6. Proposed measures to reduce or control environmental health hazards, if any:

Air permit conditions

b. Noise

1. What types of noise exist in the area that may affect your project (for example, traffic, equipment, operation, other)?

N/A

2. What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example, traffic, construction, operation, other)? Indicate what hours noise would come from the site.

None

3. Proposed measures to reduce or control noise impacts, if any:

None

8. LAND AND SHORELINE USE

a. What is the current use of the site and adjacent properties? Will the proposal affect current land uses on nearby or adjacent properties? ☐ Yes ☒ No. If yes, describe.

Existing industrial building

b. Has the project site been used as working farmlands or working forest lands? ☐ Yes ☒ No. If yes, describe. How much agricultural or forest land of long-term commercial significance will be converted to other uses as a result of the proposal, if any? If resource lands have not been designated, how many acres in farmland or forest land tax status will be converted to nonfarm or nonforest use?

1. Will the proposal affect or be affected by surrounding working farm or forest land normal business operations, such as oversize equipment access, the application of pesticides, tilling, and harvesting? ☐ Yes ☒ No. If yes, how?

c. Describe any structures on the site.

Existing industrial building

d. Will any structures be demolished? ☐ Yes ☒ No. If yes, what?

e. What is the current zoning classification of the site?

Industrial

f. What is the current comprehensive plan designation of the site?

Industrial

g. If applicable, what is the current shoreline master program designation of the site?

N/A

h. Has any part of the site been classified as a critical area by the city or community? ☐ Yes ☒ No. If yes, specify.

i. Approximately how many people would reside or work in the completed project?

33 employees

ENVIRONMENTAL CHECKLIST

j. Approximately how many people would the completed project displace?

None

k. Proposed measures to avoid or reduce displacement impacts, if any:

N/A

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

N/A

m. Proposed measures to ensure the proposal is compatible with nearby agricultural and forest lands of long-term commercial significance, if any:

N/A

9. HOUSING

a. Approximately how many units would be provided, if any? Indicate whether high- middle- or low-income housing.

N/A

b. Approximately how many units, if any, would be eliminated? Indicate whether high- middle- or low-income housing.

N/A

c. Proposed measures to reduce or control housing impacts, if any:

N/A

10. AESTHETICS

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

N/A - existing building

b. What views in the immediate vicinity would be altered or obstructed?

N/A - existing building

c. Proposed measures to reduce or control aesthetic impacts, if any:

N/A

ENVIRONMENTAL CHECKLIST

11. LIGHT AND GLARE

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

N/A

b. Could light or glare from the finished project be a safety hazard or interfere with views?

N/A

c. What existing off-site sources of light or glare may affect your proposal?

N/A

d. Proposed measures to reduce or control light and glare impacts, if any:

N/A

12. RECREATION

a. What designated and informal recreational opportunities are in the immediate vicinity?

N/A

b. Would the proposed project displace any existing recreational uses? ☐ Yes ☒ No. If yes, describe.

c. Proposed measures to reduce or control impacts on recreation, including recreational opportunities to be provided by the project or applicant, if any:

N/A

13. HISTORIC AND CULTURAL PRESERVATION

a. Are there any buildings, structures, or sites, located on or near the site that are over 45 years old listed in or eligible for listing in national, state, or local preservation registers located on or near the site?
☐ Yes ☒ No. If yes, specifically describe.

b. Are there any landmarks, features, or other evidence of Indian or historic use or occupation? This may include human burials or old cemeteries. Are there any material evidence, artifacts, or areas of cultural importance on or near the site? Please list any professional studies conducted at the site to identify such resources.

N/A

c. Describe the methods used to assess the potential impacts to cultural and historic resources on or near the project site. Examples include consultation with tribes and the department of archeology and historic preservation, archaeological surveys, historic maps, GIS data, etc.

N/A

d. Proposed measures to avoid, minimize, or compensate for loss, changes to, and disturbance to resources. Please include plans for the above and any permits that may be required.

N/A

14. TRANSPORTATION

a. Identify public streets and highways serving the site or affected geographic area and describe proposed access to the existing street system. Show on-site plans, if any.

N/A

b. Is site or affected geographic area currently served by public transit? ☐ Yes ☒ No. If yes, generally describe. If not, what is the approximate distance to the nearest transit stop?

c. How many parking spaces would the completed project or non-project proposal have? How many would the project or proposal eliminate?

N/A

d. Will the proposal require any new or improvements to existing roads, streets, pedestrian, bicycle or state transportation facilities, not including driveways? ☐ Yes ☒ No. If yes, generally describe (indicate whether public or private).

e. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation?
☐ Yes ☒ No. If yes, generally describe.

f. How many vehicular trips per day would be generated by the completed project or proposal? If known, indicate when peak volumes would occur and what percentage of the volume would be trucks (such as commercial and nonpassenger vehicles). What data or transportation models were used to make these estimates?

Existing manufacturing building - adding employees will create additional arrivals and departures

g. Will the proposal interfere with, affect or be affected by the movement of agricultural and forest products on roads or streets in the area? ☐ Yes ☒ No. If yes, generally describe.

h. Proposed measures to reduce or control transportation impacts, if any:

N/A

15. PUBLIC SERVICES

a. Would the project result in an increased need for public services (for example, fire protection, police protection, public transit, health care, schools, other)? ☐ Yes ☒ No. If yes, generally describe.

b. Proposed measures to reduce or control direct impacts on public services, if any:

N/A

16. UTILITIES

a. Indicate utilities currently available at the site:

☒ Electricity	☒ Natural gas	☒ Water	☒ Refuse Service
☒ Telephone	☒ Sanitary Sewer	☐ Septic System	☐ Other (specify):

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity that might be needed.

None

ENVIRONMENTAL CHECKLIST

C. SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature	
Name	DENNIS PEARSON
Position	ENVIRONMENTAL MAR.
Agency/Organization	FLUID MOTION LLC
Date Submitted	10-29-24

D. SUPPLEMENTAL SHEET FOR NON-PROJECT ACTIONS

(Do not use this sheet for project actions)

Because these questions are very general, it may be helpful to read them in conjunction with the list of the elements of the environment in section B of this checklist.

When answering these questions, be aware of how the extent the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. Respond briefly and in general terms.

1. How would the proposal be likely to increase discharge to water; emissions to air; production, storage, or release of toxic or hazardous substance; or production of noise?
Proposed measures to avoid or reduce such increases are:
2. How would the proposal be likely to affect plants, animals, fish, or marine life?
Proposed measures to protect or conserve plants, animals, fish, or marine life are:
3. How would the proposal be likely to deplete energy or natural resources?
Proposed measures to protect or conserve energy and natural resources are:
4. How would the proposal be likely to use or affect environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection; such as parks, wilderness, wild and scenic rivers, threatened or endangered species habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands?
Proposed measures to protect such resources or to avoid or reduce impacts are:
5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

ENVIRONMENTAL CHECKLIST

Proposed measures to avoid or reduce shoreline and land use impacts are:
6. How would the proposal be likely to increase demands on transportation or public services and utilities?
Proposed measures to reduce or respond to such demand(s) are:
7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.

APPENDIX D

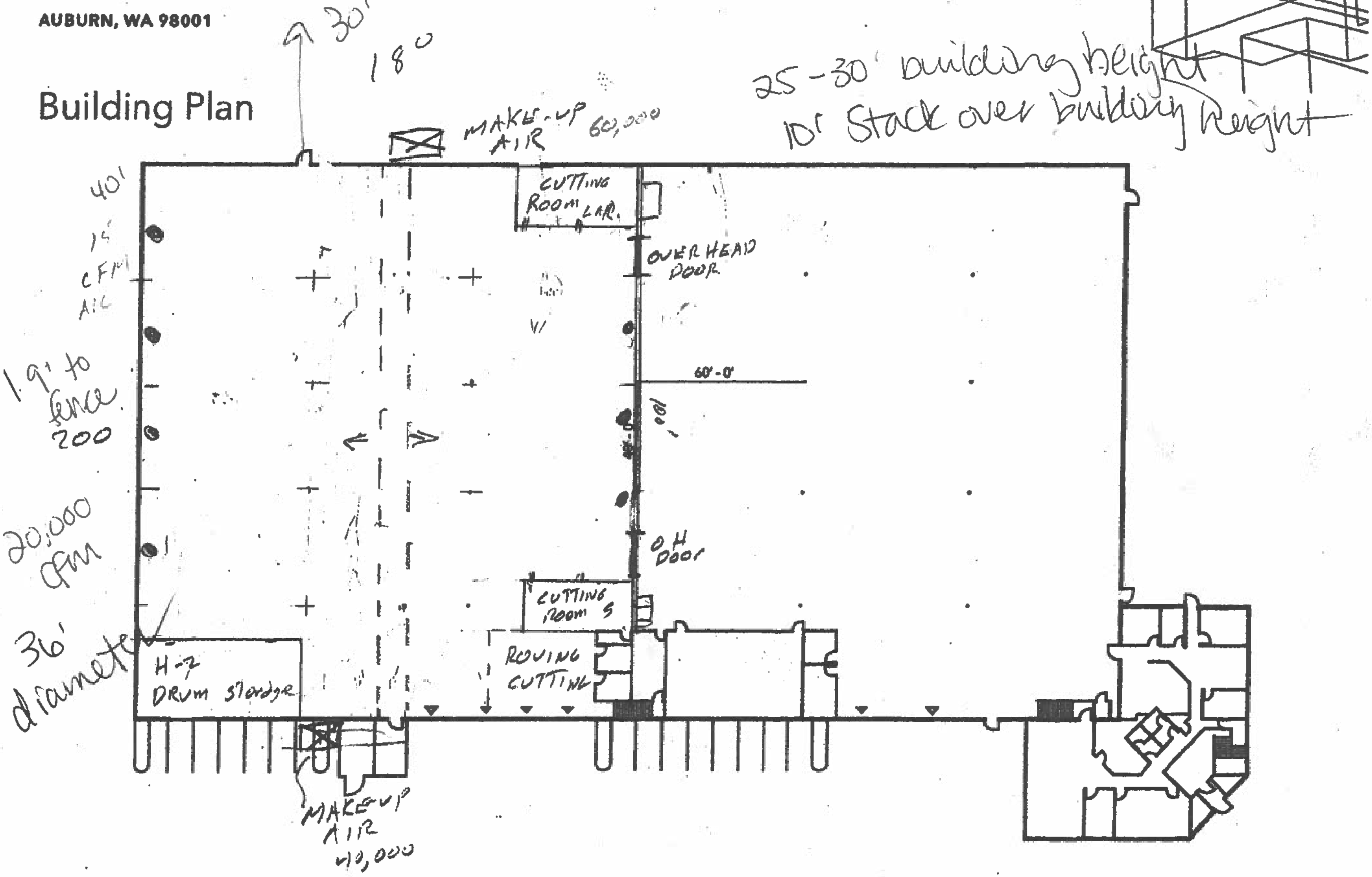
Stack Information from Fluid Motion

FOR LEASE

506 44th St NW

AUBURN, WA 98001

Building Plan



KIDDER.COM

Kidder Mathews

APPENDIX E

Best Available Control Technology Analysis

Technical Memorandum

TO: Dennis Pearson, Fluid Motion

FROM: Eri Ottersburg, Jecca Canet, and Jolaine Johnson

DATE: May 24, 2019

RE: **Best Available Control Technology Analysis**
Fluid Motion, LLC Manufacturing Facilities
Arlington, Washington
LAI Project No. 1787002.010

Introduction

Fluid Motion, LLC (FML) has proposed physical changes at its boat manufacturing facility (facility) located in Arlington, Washington that required a Notice of Construction (NOC) application submission to the Puget Sound Clean Air Agency (PSCAA). FML has proposed to relocate some of its existing operations to another building at the facility. Upon review of the NOC application, PSCAA requested a top-down evaluation of Best Available Control Technology (BACT) for emissions of particulate matter, volatile organic compounds (VOCs), hazardous air pollutants, and odorous compounds, specifically for styrene and methyl methacrylate (MMA).

FML's NOC application for this relocation project relied on an emissions inventory developed for the initial construction and operation of manufacturing operations at the facility. The original emissions inventory was included in PSCAA's Worksheet for Approval Order No. 10761 (PSCAA 2015). Since the issuance of Approval Order No. 10761 by PSCAA in 2016, FML has replaced some of the products used in the manufacturing process with products that use reduced amounts of toxic and hazardous air pollutants. The emissions inventory has been updated to represent current products and methods for estimating emissions.

At the request of FML, Landau Associates, Inc. (LAI) prepared this technical memorandum, which presents the revised emissions inventory for FML's operations. This memorandum also describes the methods used to conduct the BACT analysis and the findings of the BACT analysis.

Facility Description

FML manufactures fiberglass boats at its facility located at 17939 59th Avenue NE, in Arlington, Washington. Approval Order No. 10761 was issued by PSCAA in 2016 for the construction and operation of the facility. FML submitted an NOC application for its plans to move some of the current operations from Building Three to another building at the facility, Building Two. New exhaust fans and filters will be installed in Building Two for emissions control.

Future manufacturing operations will be conducted in both buildings. FML does not plan to acquire any new equipment or increase product usage as part of the proposed process changes. The move is intended to increase the space available for production of larger craft. While air emissions will not increase facility-wide with this relocation, Building Two is a new emissions point within the facility. For this review, LAI has conservatively assumed that all operations will be conducted in Building Two and all emissions will occur from that point.

Emission Sources

FML manufactures large fiberglass boats in batch operations at its Arlington facility. VOC emissions are generated by the evaporation of polyester or vinyl ester plastic resins and gel coats during application and curing. The primary VOC from resins and gel coats is styrene. Gel coats also contain MMA. Other pollutants in various products used at the facility include, methyl ethyl ketone, n-hexane, xylene, toluene, cyclohexane, ethylbenzene, benzene, and dimethyl ether.

Revised Emissions Inventory

In the interest of reducing potential emissions of contaminants that are regulated as hazardous air pollutants (HAPs) and toxic air pollutants (TAPs), FML has replaced some of the products used in the manufacturing process. A revised inventory of potential emissions has been developed based upon the products currently in use and to refine previous estimates of total VOC emissions.

The revised emissions inventory is based on the maximum amount of products that will be used in each part of the manufacturing process at the facility and the maximum content of VOCs, TAPs, and HAPs in each product type. Emissions of styrene and MMA from process applications of gel coats, resins, and putty are based on emissions factors presented in the Unified Emission Factors for Open Molding of Composites (ANSI/ACMA 2011). For all other operations, maximum potential emissions estimates are based on the conservative assumption that all of the VOCs, TAPs, or HAPs contained in the product will be released during the operation.

When volatile materials are atomized for application in fiberglass manufacturing operations, particulate matter (PM) emissions may be generated. The original emissions inventory for the FML Arlington operations assumed that mechanical atomized application techniques would be used to apply these materials. When mechanical non-atomizing catalyzed resin application techniques are used, PM emissions are assumed to be zero.[1] FML's Arlington operations use mechanical non-atomized resin application techniques, so the PM emissions are assumed to be negligible for these operations.

Table 1 below presents a summary of potential emissions of VOCs, TAPs, and HAPs for each process operation.

---

[1] Clean Air Engineering Project No. 7735: Test Report July 11, 1996. Summary of PM/PM_{10} Emission Testing Conducted at US Marines Pipestone III Facility.

Table 1: Potential Air Emissions from Fluid Motion's Arlington Boat Manufacturing Operations

Product Used	Amount Used (tons/year)	Air Contaminant Emissions (tons/year)			
		Styrene	MMA	Other HAPs/TAPs	Total VOCs
Gel Coat	32	3.44	0.72	0	4.16
Polyester Resin	133	5.12	0	0	5.12
Vinyl Resin	15	0.58	0	0	0.58
Radius Putty	17	0.65	0	0	0.65
Initiator	4	0	0	0.200	0.200
Mold Release	0.014	0	0	0.018	0.014
Wood Stain	0.2	0	0	0.109	0.112
Spray Adhesive	0.3	0	0	0.120	0.120
Total Emissions (tons/year)		9.78	0.72	0.447	11.05

HAP = hazardous air pollutant
MMA = methyl methacrylate
TAP = toxic air pollutant
VOC = volatile organic compound

A detailed worksheet for potential emissions is provided in Attachment 1.

Future actual emissions for facility-wide manufacturing operations will be the same as potential emissions.

General Approach for BACT Assessment

BACT is applied to new or modified stationary sources for each air pollutant subject to regulation under Chapter 70.94 of the Revised Code of Washington. BACT is an emission limitation based on the maximum degree of reduction that can be feasibly achieved for each air pollutant emitted from any new or modified stationary source. This section describes the approach taken for evaluation of BACT for VOCs, HAPs and odorous compounds from FML's Arlington manufacturing facility.

EPA Top-Down BACT Evaluation Approach

PSCAA has requested a full BACT evaluation using a "top-down" approach as described in the US Environmental Protection Agency's (EPA's) draft New Source Review Workshop Manual: Prevention of Significant Deterioration and Non-Attainment Area Permitting (EPA 1990). The following five steps make up the top-down process:

- The first step in the top-down analysis is to identify all available control technologies that can be practicably applied for each emission unit.

- The second step is to determine the technical feasibility of potential control options and to eliminate options that are demonstrated to be technically infeasible.
- The third step is to rank all remaining options based on control effectiveness, with the most effective control alternative at the top.
- The fourth step is to evaluate the remaining control alternatives. If the top-ranked control alternative is considered unacceptable based on disproportionate economic, environmental, and/or energy impacts, it is discarded. Justifications for discarding top-ranked control options must be approved by the permitting authority.
- The fifth and final step is to choose the top-ranked alternative from the list of control options remaining after applying Steps 1 through 4. This option is then established as BACT and the maximum resulting emission rate becomes the emission limitation.

Reference Materials for BACT Evaluation

The following resources were referenced to determine possible control technologies, technical feasibility, and control effectiveness:

- PSCAA's NOC Worksheet for NOC Approval Order No. 10761
- Control Techniques Guidelines for Fiberglass Boat Manufacturing Materials (EPA 2008)
- EPA's Assessment of Styrene Emission Controls for FRP/C and Boat Building Industries (Kong et al. 1996a, b)
- EPA's Reasonably Available Control Technology (RACT)/BACT/Lowest Achievable Emission Rate (LAER) Clearinghouse (RBLC) (EPA; accessed April 8, 2019)
- State guidance and databases
  - Bay Area Air Quality Management District (AQMD)
  - South Coast AQMD
  - San Diego Air Pollution Control District (APCD)
  - San Joaquin APCD
  - Sacramento Metropolitan AQMD
  - Texas Commission on Environmental Quality (TCEQ).

BACT for Volatile Organic Compounds and Hazardous Air Pollutants

BACT evaluations are largely based on the calculation of annualized cost per ton of pollutant reduced for each technically feasible control option. As presented in the Revised Emissions Inventory section above, total potential VOCs from the facility's manufacturing operations are conservatively estimated at 11.1 tons/year. Total potential HAPs emissions are estimated at 10.9 tons/year. All of the HAPs emitted are also VOCs. It is presumed that controls that are effective for VOC reductions will be similarly effective in the reduction of HAPs emissions.

BACT for Odorous Compounds

Two odorous compounds emitted from the facility are styrene and MMA. AERMOD[2] dispersion modeling results, calculated 3-minute average concentrations, and the odor thresholds for styrene and MMA are shown in Table 2 below. The calculated values are based on a very conservative assumption that all styrene and MMA emissions from facility operations will be emitted from Building 2. In actuality, operations will occur from both Building 3 and Building 2. With two emissions points and much higher ventilation air flow rates, there will be more dispersion of the odorous compounds and lower ambient concentrations for both substances.

Table 2: Modeling Results and EPA Thresholds for Odorous Compounds Emitted by Facility Operations

Pollutant	Maximum Modeled 1-hour Average Concentrations (µg/m³)	Calculated 3-Minute Average Concentrations (ppm)	EPA Odor Threshold (ppm)
Styrene	1,981.29	0.26	0.32
Methyl Methacrylate	528.34	0.07	0.08

µg/m³ = micrograms per cubic meter
ppm = parts per million

The results presented in Table 2 indicate that modeled ambient concentrations of styrene and MMA are below the established odor thresholds for those substances. This suggests that there should not be a chronic odor issue associated with these operations.

Odor threshold values are concentrations at which half of a population of observers would not be able to detect the odor. Half of a population may still perceive the odor at and below the odor thresholds. Perception of odor is considered a logarithmic function, resulting in a need for substantial reductions of styrene and MMA to reduce odor to a point where it is unlikely for anyone to detect the odor.

Styrene and MMA are also regulated VOCs as well as HAPs and TAPs. Therefore, the BACT evaluations for reduction in emissions of these substances as odorous compounds will be considered in the BACT evaluation for VOCs. Additional technologies focused on odor control from fiberglass operations have also been considered in the odor BACT evaluation as described below.

BACT Evaluation for Volatile Organic Compounds, Hazardous Air Pollutants, and Toxic Air Pollutants

The emission rates and exhaust stream characteristics used for the BACT evaluations are provided in Table 3 below.

---

[2] American Meteorological Society (AMS)/US Environmental Protection Agency (EPA) regulatory model.

Table 3: Emissions and Exhaust Parameters for Facility BACT Evaluation

Variable	Value
Emissions	
VOCs	11.1 tpy
HAPs	10.6 tpy
TAPs	10.7 tpy
Odor Compounds (Styrene and MMA)	10.5 tpy
Exhaust Flow	40,000 acfm
Exhaust Temperature	65°F
Hours of Operation	2,030 hr/yr

°F = degrees Fahrenheit
acfm = actual cubic feet per minute
hr/yr = hours per year
tpy = tons per year

Step 1: Identify Available Control Technologies

General approaches to control of VOC emissions from fiberglass manufacturing and coating operations are substitute materials; alternative application techniques; and add-on controls.

Substitute Materials

Vapor-Suppressed Resins and Gel Coats

Vapor-suppressed resins and gel coats use an additive, typically wax, that suppress vaporization of VOCs. As material cures, the wax additive rises to the surface of the resin or gel coat material and inhibits the vaporization of styrene and MMA. This can reduce emissions from resins by as much as 40 percent. Emission reductions for gel coats are not known, but are expected to be in a similar range. Vapor-suppressed resins or gel coats can be used only in limited applications and are not ideal for large and complex structures or assemblies. Wax film must be removed before parts can be bonded, increasing labor, and the ultimate structural integrity of the bonds is reduced.

Low-Monomer Resins and Gel Coats

Low-monomer resins and gel coats, also known as low-VOC resins and gel coats, contain reduced concentrations of styrene and MMA. The use of low-monomer materials decreases the amount of VOCs available to be emitted (EPA 2008). Therefore, low-monomer resins and gel coats can significantly reduce VOC emissions without other changes in equipment or work practices.

Alternative Application Techniques

Non-Atomizing Resin Application

Non-atomizing resin application techniques include the following:

- Bucket and brush – Individual batches of resin are mixed with catalyst in a bucket or pail and applied by hand using a brush or paint roller. This method is feasible only for low volume production.
- Pressure-fed resin rollers – Similar to bucket and brush application, resin is applied by hand using a roller; however, the roller is fed a continuous supply of resin from a mechanical fluid pump. Resin rollers must operate almost continuously to prevent the resin from hardening between the mixer and roller cover.
- Flow coaters – Similar to spraying, but the resin leaves the flow coater in a stream rather than an atomized spray. Like pressure-fed rollers, flow coaters must be operated continuously to prevent hardening inside the applicator.
- Fabric impregnators – Dry fiberglass fabric is fed through resin-covered rollers. Resins can be manually mixed and added to the machine or fed to the machine by fluid pumps.
- Fluid impingement technology – Similar to spraying and flow coating, a gun dispenses two streams of resin that form a fan of large droplets. The larger droplet size minimizes emissions compared to atomized spray application.

Alternative Atomized Spray Application Techniques

Alternative spray techniques include the following

- Airless spray – This atomizing spray technique uses high pressures to coat materials. It can be used to coat large areas but requires the use of different nozzles for different spray patterns. With proper operation and nozzle maintenance, it can have a transfer efficiency between 65 and 70 percent (IDNR 1998).
- Air-assisted airless spray – This atomizing spray technique use lower pressures than airless spray. This technique can be used to coat large areas, but has a higher initial capital cost and requires more maintenance and operator training than airless spray. With proper operation and nozzle maintenance, this technique can have a high transfer efficiency.
- High-volume low-pressure spray – This atomizing spray technique uses low pressures and transfers high volumes. With proper operation and nozzle maintenance, this technique has increased transfer efficiency and reduced overspray.

Closed Molding

Closed molding techniques include vacuum bagging, vacuum-assisted resin transfer molding, resin transfer molding, and compression molding. Closed molding involves enclosing the entire part in a multi-part mold, preventing the resin surfaces from having contact with the air, thereby inhibiting evaporation. Closed molding has been successfully used for making small parts, but cannot be used for large surface areas or for gel coat operations, which are the source of MMA emissions.

Add-On Controls

Add-on controls to reduce VOC emissions include thermal and catalytic oxidizers, adsorption, and condensers. In 2008, the EPA did not identify any facilities in the fiberglass boat manufacturing industry using add-on controls to reduce VOC emissions. However, add-on controls have since been applied at several large fiberglass manufacturing facilities in California.

Thermal Oxidizer

A thermal oxidizer (TO), also known as a thermal incinerator, destroys VOCs through incineration. Supplemental fuel and air are added to maintain a flame that heats the waste gas to its ignition temperature. The appropriate reactor temperature and residence time depends on the level of VOC control desired and the composition of the waste gas. Several types of TOs exist: direct flame, recuperative, and regenerative. While direct flame TOs have only a combustion chamber, recuperative and regenerative types have systems to improve energy efficiency and/or energy recovery. TO controls are used most frequently when heat from the manufacturing process can be used to preheat the gases and reduce fuel use. Recuperative or regenerative type TOs are not technically feasible for batch operations.

Catalytic Oxidizer

A catalytic oxidizer, also known as a catalytic incinerator, is similar to a TO. A catalyst is used in the reaction chamber to enable conversion at lower reaction temperatures than a TO. Air streams containing compounds that poison the catalyst (e.g., chlorine, sulfur, lead, arsenic, and phosphorus), have a low heating value, or have a high particulate content are not recommended for catalytic oxidation because they foul the catalyst. In addition, volumetric flow rates and concentrations of combustibles in the waste gas should be relatively constant.

Adsorption

Adsorption systems provide VOC treatment by adsorbing contaminants onto adsorbent media. These systems are well-suited for air streams with low concentrations of VOCs or low volumetric gas flow rates, VOCs with intermediate molecular weights, low temperatures, and low moisture. Activated carbon is the most common adsorbent used, but alumina, zeolites, and polymers can also be used. Adsorption systems are either once-through or regenerative. The activated carbon can be regenerated using steam (generally for product recovery) or hot flue gas followed by a small oxidizer.

Condensers

Vapor condensers involve cooling the VOC-containing gas to condense the contaminants into liquid form. In many cases, very large temperature drops are required to achieve effective condensation, requiring significant energy investment to accomplish cooling. Condensers have a particular advantage if product recovery is desired.

Flare

A flare controls VOC emission through combustion. A waste VOC stream is piped to the flare and burned in an open flame. Flares can accommodate variable VOC concentrations, flows, heating values, and species contents. However, corrosion of the flare tip can occur with waste gas streams containing high concentrations of halogenated or sulfur compounds. Flares are primarily used in chemical plants and refineries to control releases of large volumes of gas during upset conditions.

Biofiltration

Biofiltration involves passing the off-gas through a wet, biologically active filter bed. When the vapor stream passes through the filter, contaminants are retained for degradation by micro-organisms such as bacteria, heterotrophs, oligotrophs, and fungi. Prior to biofiltration, the waste stream would go through a number of pre-treatment processes to remove particulates, equalize the flow, and adjust the humidity and temperature to maintain the optimum conditions for the micro-organisms. The treatment process generally produces end products of carbon dioxide, water, and mineral salts. Biofiltration can treat a variety of VOCs, but are of particular relevance to the treatment of benzene, toluene, ethylbenzene, and xylene compounds, and low concentrations of VOCs (less than 2,000 parts per million [ppm]). However, achieving reliable removal efficiencies can be problematic due to the variable nature of biological systems. Also, hot exhaust streams will require cooling upstream of the biofilter.

Step 2: Identify Feasible Control Technologies

Substitute Materials

Vapor Suppressed Resins and Gel Coats

As described in PSCAA's NOC Worksheet for Approval Order No. 10761, the wax additive in vapor-suppressed resins and gel coats rises to the surface of the curing material, inhibiting the evaporation of styrene and MMA. A wax film forms on top of the resin or gel coat and must be removed to bond different structural pieces together. The use of vapor-suppressed resins and gel coats lengthens the assembly process, increases labor costs, and compromises structural integrity. Thus, the use of vapor-suppressed resins and gel coats is considered technically infeasible for large or numerous boat fabrication operations.

Low-Monomer Resins and Gel Coats

Low-monomer resins and gel coats, due to reformulation, exhibit greater deficiencies and difficulty of use. Despite deficiencies, low-monomer VOC resins and gel coats can reduce VOC emissions without other changes in equipment or work practices. Low-monomer resins and gel coats are considered technically feasible.

Alternative Application Techniques

Non-Atomizing Resin Application

Non-atomizing resin application techniques include the following:

- Bucket and brush – The use of a bucket and brush for application is appropriate only for small surface areas and low volume production. This method is considered technically infeasible for high volume production.
- Pressure-fed resin rollers and flow coaters – Since resin rollers must operate continuously to prevent resin from hardening between the mixer and roller cover, this method is considered technically infeasible for batch operations.
- Flow coaters – Since flow coaters must operate continuously to prevent from hardening inside the applicator, this method is considered technically infeasible for batch operations.
- Fabric impregnators – Dry fiberglass fabric is fed through resin-covered rollers. Resins can be manually mixed and added to the machine or fed to the machine by fluid pumps. Since fabric impregnators have limited surface area application that is not suitable for manufacturing large boat hulls, this method is considered technically infeasible.
- Fluid impingement technology – Similar to spraying and flow coating, a gun dispenses two streams of resin that form a fan of large droplets. The larger droplet size minimizes emissions compared to atomized spray application. This application technique is considered technically feasible.

Non-atomizing technology is feasible for applying production and tooling resins and putty only.

Closed Molding

As described in PSCAA's NOC Worksheet for NOC Approval Order No. 10761, closed molding techniques are feasible only for small fabrication pieces, and cannot be applied to larger fabrication pieces that use gel coat operations. Therefore, closed molding is not considered technically feasible.

Add-On Controls

Thermal or Catalytic Oxidizer

Both a thermal and catalytic oxidizer require spraying operations to be enclosed and vented to the oxidizer. The effectiveness of VOC control is dependent on the efficiency of the ventilation capture system. Thermal and catalytic oxidizers are considered technically feasible for boat manufacturing operations. However, as described in PSCAA's NOC Worksheet for Approval Order No. 10761, regenerative-type oxidizers are not feasible for batch operations because efficiency gains are lost when the recovery refractory is reheated multiple times.

Adsorption

Adsorption systems, typically carbon, require that spraying operations are enclosed and vented to the adsorption system. The effectiveness of VOC control is dependent on the efficiency of the ventilation capture system and adsorption rate of the VOC constituents. Carbon adsorption has been demonstrated in practice for emissions from fiberglass manufacturing and is considered to be technically feasible. All of these systems (and those used at facilities in California) use adsorption in series with product recovery or oxidation equipment. The adsorber is used to concentrate the waste gas stream such that subsequent oxidation is self-sustaining (little or zero supplemental fuel is needed for combustion).

Condensers

Since condensers require very large temperature drops to achieve effective condensation, the system requires significant energy investment to accomplish cooling. Condensers are considered to be technically infeasible because of the large energy requirements of the system.

Flare

Fiberglass boat manufacturing operations emit low concentrations of VOCs. The expected gas streams would have a low flammability and would require the use of auxiliary fuel in a flare system. Due to this, a thermal or catalytic oxidizer is more appropriate for boat manufacturing operations, and the use of a flare is considered technically infeasible.

Biofiltration

Fiberglass boat manufacturing operations emit low concentrations of VOCs and emit pollutants that can be treated by biofiltration. However, it is difficult to apply this technology to the relatively high volumetric flow rates from FML's facility. According to the EPA's "Assessment of Styrene Emission Controls for FRP/C and Boat Building Industries," a boat manufacturer in Europe applied biofiltration. However, the flow rate of the source was 10,000 actual cubic feet per minute (acfm). Furthermore, buildup of acid byproduct could be the cause of decreased efficiency of this technology for treating styrene emissions over time (Kong et al. 1996b). Use of this technology has not been demonstrated in practice for styrene emissions.

Additional Methods and Technologies for Odor Control

To identify control technologies for odorous compounds from fiberglass manufacturing operations, LAI and FML contacted the National Marine Manufacturers Association (NMMA) for any information regarding odor reductions. John McKnight of NMMA reported that he was not aware of any add-on technologies that effectively reduce styrene odors to levels that are not detectable by everyone. He advised that some operations have attempted to add other chemical substances to disguise the styrene odor, but that too has proven ineffective. In an email dated April 30, 2019, Mr. McKnight indicated that, in his experience, the methods and emission limits established as Maximum Achievable Control Technology (MACT) pursuant to 40 CFR 63 Subpart VVVV – National Emission Standards for Hazardous Air Pollutants for Boat Manufacturing are the best available methods (McKnight 2019).

A web search was conducted for odor control technologies for fiberglass manufacturing operations. A company named Perry Fiberglass Products, Inc. specializes in odor control systems (Perry Fiberglass; accessed May 20, 2019). Technologies provided by this company and a brief discussion of technical feasibility are detailed below.

1. **Air Stripper**
   An air stripper, or degasifier, is not meant to control odorous compounds from the air, but to remove odorous contaminants in water. The odorous water is mixed with air to deodorize the water. The process air, then containing odorous compounds and HAPs (most likely), must be vented to an air emission control unit like an adsorption unit or catalyst. This technology is not appropriate for odor control of air emissions from boat manufacturing operations.

2. **Wet Scrubber**
   A wet-scrubber is primarily used to control inorganic gases (EPA 2003) but has been used for nuisance odor control. Wet scrubbers remove air pollutants through absorption into a liquid solvent. The pollutant to be absorbed must be soluble in the liquid. Packed-bed wet scrubbers consist of a chamber containing layers of packing material. In this chamber, scrubbing liquid is introduced above the packing and flows down through the bed while the gas stream flows up the chamber countercurrent to the liquid. Spray scrubbers consist of a chamber in which the gas stream is contacted with liquid droplets generated by spray nozzles. A wet scrubber is not considered feasible for the purposes of controlling low concentrations of VOCs, which requires impractically tall absorption towers, long contact times, and high liquid-gas ratios. Furthermore, styrene and MMA have low water solubility and more readily volatilize rather than being absorbed into a liquid or solvent.

3. **Biofilter**
   See previous discussion of biofilters for VOC control.

Step 2 Summary

Table 4 summarizes the technical feasibility of the control technologies listed in Step 1 above.

Table 4: Technical Feasibility of VOC Controls for Fiberglass Boat Manufacturing

Technology	Technical Feasibility
Vapor-Suppressed Resins and Gel Coats	The use of vapor-suppressed resins and gel coats are considered to be technically infeasible for use on major portions of the vessel due to bonding and structural integrity concerns.
Low-Monomer Resins and Gel Coats	Feasible.
Non-Atomizing Resin Application	Feasible for applying production and tooling resins only.
Closed Molding	Since closed molding is not possible for gel coat operations, this technique is considered to be technically infeasible.
Thermal Oxidizer	Feasible.
Catalytic Oxidizer	Feasible.
Adsorption	Feasible.
Condenser	The use of a condenser is considered to be technically infeasible because of the amount of temperature drop needed to condense emissions.
Flare	The gas stream has a relatively low heat content and this technology has not been demonstrated to be effective for this type of source. This option is technically infeasible.
Biofiltration	This technology has not been demonstrated in practice for treatment of styrene emissions and high flow rates. This option is technically infeasible.
Air Stripper	Not designed for control of odors from air streams. This option is technically infeasible.
Wet Scrubber	Not effective for low concentration and low solubility VOCs such as styrene. This option is technically infeasible.

Step 3: Rank Effectiveness

The commercially available control technologies identified in Step 2 as feasible for use in fiberglass boat manufacturing are ranked in Table 5 based on their effectiveness in controlling VOCs.

Table 5: Control Effectiveness of VOC Controls

Technology	Control Effectiveness
Thermal Oxidizer	61 - 93%
Adsorption	91%
Catalytic Oxidizer	90%
Non-Atomized Resin Application	41%
Low-Monomer Resins and Gel Coats	Case-by-case

Step 4: Evaluate Remaining Controls

The controls listed in Table 5 above were evaluated for economic feasibility starting with the most effective control. Costs presented in this section reflect annualized direct and indirect costs for each control equipment option. Costs were estimated using the EPA's Air Pollution Cost Control Manual

(EPA 2002) and the cost spreadsheet provided with the EPA's "Assessment of Styrene Emission Controls for FRP/C and Boat Building Industries" (Kong et al. 1996b). The direct equipment and operating costs were updated to 2019 dollars using the consumer price index from the US Bureau of Labor Statistics. The price for electricity and natural gas was obtained from the US Energy Information Administration. For this review, it was conservatively assumed that all emissions will occur from the new building with a flow rate of 40,000 acfm. Actual future operations will be conducted in two buildings with emissions split between them. Typically, a control technology is considered cost-effective if the annualized cost is less than $10,000 to $12,000 per ton of pollutant removal (Ecology 2016). Cost calculation spreadsheets are provided in Attachment 2.

Thermal Oxidizer

Costs associated with TOs were estimated using the EPA's Air Pollution Cost Control Manual (EPA 2002) with site-specific electricity and natural gas prices. Without heat recovery or energy recuperation, a TO is estimated to cost $27,373 per ton for VOCs and $34,172 per ton for odorous compounds (styrene and MMA). TOs are not cost-effective for FML operations.

Adsorption

Costs associated with catalytic oxidizers were estimated using the EPA's Assessment of Styrene Emission Controls for FRP/C and Boat Building Industries (Kong et al. 1996b) with site-specific electricity and natural gas prices. The following adsorption technologies were reviewed by the EPA:

- MIAB – Fixed-bed and continuous duty fluidized-bed carbon adsorption systems to preconcentrate VOC emissions. The VOCs are desorbed for recovery or catalytic oxidation.
- Thermatrix PADRE – self-regenerable adsorbent system that removes and recovers VOCs. A two-stage condenser is used to recover the desorbed VOC as a liquid. In a few cases, waste gas is routed to an oxidizer. This system has been applied to low flow processes (less than 7,000 acfm).
- Polyad – Preconcentration system using fluidized-bed adsorber followed by catalytic oxidation or solvent recovery system.
- Rotary Concentrator – Rotary concentrator system using activated carbon or specialized zeolite adsorbent followed by a thermal or catalytic oxidizer.
- C&C Fluidized Bed Preconcentrator – Fluidized-bed adsorption unit followed by either a fluidized-bed or moving-bed desorption unit and condenser or oxidizer.

These technologies were evaluated and determined to be not cost-effective.

Catalytic Oxidizer

Costs associated with a catalytic oxidizer were estimated using the EPA's Air Pollution Cost Control Manual (EPA 2002) with site-specific electricity and natural gas prices. Without heat recovery or energy recuperation, a catalytic oxidizer is estimated to cost $69,977 per ton for VOCs and $87,371 per ton for odorous compounds (styrene and MMA). Catalytic oxidizers are not cost-effective for FML operations.

Step 4 Summary

Table 6 summarizes the cost effectiveness of the control technologies reviewed. The next ranked controls (low-monomer resins and gel coats and non-atomized resin application) are considered cost-effective for this facility.

Table 6: Cost Effectiveness of VOC Controls

Technology	Cost Effectiveness ($/ton of VOC)	Cost Effectiveness ($/ton of odor)
Thermal Oxidizer	$27,373	$34,172
Catalytic Oxidizer	$69,977	$87,371
Adsorption		
MIAB System		
MIAB F	$50,691	$53,083
MIAB C	$49,329	$51,678
Thermatrix PADRE	$74,596	$78,188
Polyad System	$43,874	$45,963
Rotary Concentrator	$41,471	$43,459
C&C Fluidized-Bed Preconcentrator		
Recovery	$46,434	$48,685
Oxidation	$52,354	$54,847

Step 5: Select BACT

Based on the information presented in Steps 1 through 4, the use of non-atomizing resin application techniques and low-monomer resins and gel coats is recommended for implementation as BACT for VOC, HAPs/TAPs, and odor control for the facility. Gel coats must still be applied with atomizing spray guns, so control of gel coat operations can be achieved only through the use of low-monomer gel coats.

The BACT level of control must be at least as stringent as emission standards under 40 CFR 60, 61, and 63. There are no Part 60, 61, or 63 emission standards that apply to the facility. However, emission standards for boat manufacturing at major sources are promulgated in 40 CFR 63 Subpart VVVV, National Emission Standards for Hazardous Air Pollutants for Boat Manufacturing. Under Subpart VVVV, the emission limits shown in Table 7 apply.

Table 7: Subpart VVVV Emission Limits

Operation	Application Method	Weighted Average Organic HAP Limit (weight percent)
Production resin operations	Non-atomized	35
Tooling resin operations	Non-atomized	39
Pigmented gel coat operations	Any method	33
Clear gel coat operations	Any method	48
Tooling gel coat operations	Any method	40
Carpet and fabric adhesive	Any method	5

Several states have developed BACT guidance and presumptive BACT limits. This guidance is summarized in Table 8 below. Search results from the EPA's RBLC and California clearinghouse are provided in Attachment 3. Low-VOC materials is the most common control technique found in these clearinghouses. Two facilities in California employ adsorption technology similar to those described in the EPA's styrene guidance document. However, none of these control techniques is cost effective for FML's facility operations.

Table 8: BACT Guidance Summary

Source	BACT Limit
Bay Area AQMD BACT Guideline for Polyester Resin Operation - Molding and Casting	Compliance with BAAQMD Reg.8, Rule 50 and use of aqueous emulsion cleaner instead of acetone for cleanup to maximum extent possible.
San Diego APCD BACT Guideline for Fiberglass Manufacturing Line (<10 tons/yr)	Compliance with Rule 67.12, Polyester Resin Operations.
San Joaquin APCD BACT Guideline for Fiberglass Boat Manufacturing Operation (< 120 gallons/day and < 25 tons VOCs per year)	For gelcoats: Air assisted application (or equivalent) and material VOC content (by weight) less than or equal to: - pigmented gelcoats: 33% - clear gelcoats: 48% - tooling gelcoats: 40% for resins, any of the following application methods: 1) non-atomized spray technique (such as the use of fluid impingement technology (FIT) spray guns), 2) flowcoaters, 3) pressure-fed rollers, 4) resin impregnators, 5) hand lay-up, or 6) any equivalent method as approved by the APCO; and materials with a material VOC content (by weight) less than or equal to: - resins: 35% - tooling resins: 39% and the use of non-VOC containing cleaning solvents
San Joaquin APCD BACT Guideline for Adhesive Application Operation – Bonding of Fiberglass Boat Hulls and Decks, Non-Atomizing Application	Use of adhesives with VOC content of 80 grams/liter or less (less water and exempt compounds)
TCEQ BACT Guideline for Mechanical Coatings/Fiber-Reinforced Plastics	Use of resins and gelcoats that meet the monomer limitations in 40 CFR Part 63, Subparts WWWW or VVVV. Use proper ventilation design to minimize styrene odor. 100% capture of monomer emissions to minimize fugitive emissions.

Source	BACT Limit
	Use high transfer efficiency spray application equipment. Airless, HVLP spray equipment, fluid impingement technology, non-atomized application equipment, brushes, or rollers. Implementation of ACMA controlled spray techniques, including operator training, spray gun calibration and the use of overspray containment flanges on molds may be required to achieve acceptable impacts. Collecting and venting VOC and exempt solvent to an add-on control device may be required for operations with VOC and exempt solvent emissions greater than 60 tpy. Efficiency of thermal control device is 98% or greater. Provide details. Good housekeeping and best management practices. Acetone replacement compounds should have a vapor pressure less than 1.0 mmHg at 40°C. Aqueous cleaners should have a VOC content less than 5.0% by weight. See applicable 40 CFR Part 63 requirements regardless of whether the requirements are directly applicable.

The FML Arlington facility uses gel coats with a maximum of 33 percent styrene and resins with a maximum of 35 percent styrene. Therefore, the current emission limits are proposed as the BACT emission limits. The emission limits are summarized in Table 9 below.

Table 9: Proposed BACT Emission Limits

Pollutant	BACT Limit
VOCs, HAPs, TAPs and odorous compounds	Gel coats with less than 33% organic HAPs Resins with less than 35% organic HAPs using non-atomizing application Adhesives with less than 5% organic HAPs

BACT for odor will match the BACT for VOCs, HAPs, and TAPs, which is reduced styrene and MMA product formulations and the use of non-atomized techniques for styrene resins. Additional odor BACT requirements can be included in proposed conditions in terms of operational practices – building doors, windows, and other openings will be required to be closed (except for incidental personal passage) at all times while applying resin or gel coat.

Limitations

This technical memorandum has been prepared for the exclusive use of Fluid Motion, LLC and applicable regulatory agencies for specific application to the NOC Application for Facility Operations Relocation project. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of LAI. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by LAI, shall be at the user's sole risk. LAI warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

This document has been prepared under the supervision and direction of the following key staff.

LANDAU ASSOCIATES, INC.

Eri Ottersburg

Eri Ottersburg
Senior Scientist

Jolaine Johnson

Jolaine Johnson
Senior Consultant

JGC/ELO/JAJ/ccy
P:\1787\002\R\LAI FML BACT Analysis_tm - 05-24-19.docx

References

ANSI/ACMA. 2011. *Estimating Emission Factors from Open Molding and Other Composite Processes*. ANSI/ACMA/ICPA UEF-1-2011a. American National Standards Institute/American Composites Manufacturers Association. October 5. https://anrweb.vt.gov/PubDocs/DEC/Air/Permits/2454.pdf.

Ecology. 2016. Memorandum: BACT and tBACT Cost-Effectiveness Thresholds. From Robert Koster, Washington State Department of Ecology, to File, Washington State Department of Ecology. August 2.

EPA. Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse. US Environmental Protection Agency. https://cfpub.epa.gov/rblc/index.cfm?action=Search.BasicSearch&lang=en.

EPA. 1990. Draft: *New Source Review Workshop Manual: Prevention of Significant Deterioration and Nonattainment Area Permitting*. US Environmental Protection Agency. October.

EPA. 2002. EPA Air Pollution Control Cost Manual. EPA/452/B-02-001. 6th ed. Office of Air Quality Planning and Standards, US Environmental Protection Agency. January. http://www.epa.gov/ttn/catc/dir1/c_allchs.pdf.

EPA. 2003. Air Pollution Control Technology Fact Sheet: Packed-Bed/Packed-Tower Wet Scrubber. EPA-452/F-03-015. US Environmental Protection Agency. https://www3.epa.gov/ttn/catc/dir1/fpack.pdf.

EPA. 2008. *Control Techniques Guidelines for Fiberglass Boat Manufacturing Materials*. EPA-453/R-08-004. US Environmental Protection Agency. September.

IDNR. 1998. WMRC Factsheet: Spray Painting Options. Publication No. TN98-048. Waste Management and Research Center, Illinois Department of Natural Resources. February. https://archive.epa.gov/airquality/community/web/pdf/98-048.pdf.

Kong, Emery J., Mark A. Bahner, and Sonji L. Turner. 1996a. Final Report: Addendum to Assessment of Styrene Emission Controls for Fiberglass-Reinforced Plastics/Composites and Boat Building Industries. Publication No. EPA-600/R-96-136. National Risk Management Research Laboratory, US Environmental Protection Agency. November.

Kong, Emery J., Mark A. Bahner, and Sonji L. Turner. 1996b. Final Report: Assessment of Styrene Emission Controls for Fiberglass-Reinforced Plastics/Composites and Boat Building Industries. Publication No. EPA-600/R-96-109. National Risk Management Research Laboratory, US Environmental Protection Agency. September.

McKnight, J. 2019. "Re: Control Technologies for Odorous Compounds from Fiberglass Manufacturing Operations." From John McKnight, Senior Vice President of Environmental Health and Safety, National Marine Manufacturers Association, to Jolaine Johnson, Senior Consultant, Landau Associates, Inc. April 30.

Perry Fiberglass. "Home Page: Perry Fiberglass Products, Inc." http://www.perryfiberglass.com/.

PSCAA. 2015. Notice of Construction Worksheet, Notice of Construction No. 10761 Issued to Fluid Motion, Inc. Puget Sound Clean Air Agency.

Attachments

Attachment 1: Revised Emissions Inventory Tables
Attachment 2: Cost Calculation Spreadsheets
Attachment 3: Search Results from the EPA’s RBLC and California Clearinghouses

ATTACHMENT 1

Revised Emissions Inventory Tables

Attachment 1
Revised Emissions Inventory Tables 05-20-2019
Fluid Motion, LLC – Arlington, Washington

Table 1-1: Product Usage and Constituents

Product Used	Application Method	Used (ton/yr)	Styrene (%)	MMA (%)	Methyl ethyl ketone (%)	n-Hexane (%)	Xylene (%)	Toluene (%)	Cyclohexane (%)	Ethyl benzene (%)	Benzene (%)	Dimethyl ether (%)	VOC (%)
Gelcoat (1)	controlled spray	32	33%	3%	0	0	0	0	0	0	0		36%
Polyester resin (2)	mechanical non-atomized	133	35%		0	0	0	0	0	0	0		35%
Vinyl ester resin(3)	mechanical non-atomized	15	35%		0	0	0	0	0	0	0		35%
Radius Putty(4)	mechanical non-atomized	17	20%	0%	0	0	0	0	0	0	0		20%
Initiator (MEKP-925)(5)		4	0%		5%	0	0	0	0	0	0		5%
Mold Release (6)		0.01	0%		0	35%	35%	20%	20%	7%	5%		98%
Wood Stain(7)		0.2	0%		0%	16.8%	16.8%	9.6%	9.6%	3.4%	2.4%		56%
Spray Adhesive(8)		0.3	0%	0%	0	0.0%	0.0%	0	20%	0	0	20%	40%
HAP			Y	Y	N	Y	Y	Y	N	Y	Y	N	NA
TAP			Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NA
VOC			Y	Y	y	Y	Y	Y	Y	Y	Y	Y	Y

(1) SDS for HK Research Corp Product No. HD-2588
(2) SDS for Ashland Aropol Q-67700 T-30
(3) SDS for Ashland AME 6001 T-25 Resin
(4) SDS for US Chemical putty Duraglas
(5) SDS for Cadox L-50 A MEKP
(6) SDS for TR-900 + SDS for WOLO +SDS for naphtha
(7) SDS for Minwax Spar Urethane Stain. Note product is 48% mineral spirits or naphtha derivative. SDS for naphtha used to determine hazardous constituents.
(8) SDS for Fast Tack Hi-Temp Heavy Duty Spray Adhesive

Attachment 1
Revised Emissions Inventory Tables 05-20-2019
Fluid Motion, LLC – Arlington, Washington

Table 1-2: Volatile Organic Compound, Hazardous Air Pollutant, and Toxic Air Pollution Emissions

Product	Amount Used	Annual Potential to Emit VOCs, HAPs and TAPs													
		Styrene		Methyl methacrylate		Methyl ethyl ketone	n-Hexane	Xylene	Toluene	Cyclohexane	Ethyl benzene	Benzene	Dimethyl ether	VOC	Total HAPs
	(ton/yr)	Emission Factor [10] (lb/ton)	(ton/yr)	Emission Factor [10] (lb/ton)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)	(ton/yr)
Gelcoat	32	215	3.440	45	0.720	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.160	
Polyester resin	133	77	5.121		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.121	
Vinyl ester resin	15	77	0.578		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.578	
5Gal Hi-Thix Radius	17	76	0.646		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.646	
Initiator (MEKP-925)	4	NA	0.000		0.000	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.200	
Mold Release	0.0146	NA	0.000		0.000	0.000	0.005	0.005	0.003	0.003	0.001	0.001	0.000	0.014	
Wood Stain	0.2	NA	0.000		0.000	0.000	0.034	0.034	0.019	0.019	0.007	0.005	0.000	0.112	
Spray Adhesive	0.3	NA	0.000		0.000	0.000	0.000	0.000	0.000	0.060	0.000	0.000	0.060	0.120	
Total:		ton/year	9.784		0.720	0.200	0.039	0.039	0.022	0.082	0.008	0.006	0.060	10.950	
		lb/hr	9.639		0.709	0.197	0.038	0.038	0.022	0.081	0.008	0.005	0.059	10.788	
Total HAPS			9.784		0.720	0.000	0.039	0.039	0.022	0.000	0.008	0.006	0.000		10.617

(10) Unified Emission Factors for Open Molding of Composites, July 23, 2001

Table 1-3: Toxic Air Pollutant Emissions Compared to Small-Quantity Emission Rates (Chapter 173-460 WAC)

TAP	SQER		Potential Emissions		Model?
Styrene	118	lb/24-hr	77.12	lb/24-hr	no
Methyl	92	lb/24-hr	5.67	lb/24-hr	no
Methyl ethyl	657	lb/24-hr	1.58	lb/24-hr	no
n-Hexane	92	lb/24-hr	0.31	lb/24-hr	no
Xylene	29	lb/24-hr	0.31	lb/24-hr	no
Toluene	657	lb/24-hr	0.17	lb/24-hr	no
Cyclohexane	789	lb/24-hr	0.65	lb/24-hr	no
Ethyl benzene	76.8	lb/24-hr	0.06	lb/24-hr	no
Benzene	6.62	lb/yr	11.06	lb/yr	no

ATTACHMENT 2

Cost Calculation Spreadsheets

Data Inputs

Select the type of oxidizer | Regenerative Thermal Oxidizer ▼

Enter the following information for your emission source:

Composition of Inlet Gas Stream					
Pollutant Name	**Concentration (ppmv)**	**Lower Explosive Limit (LEL) (ppmv)***	**Heat of Combustion (Btu/scf)**	**Molecular Weight**	tpy
Styrene	14.77	11,000	4,907	104.15	9.784
Methyl methacrylate	1.13	21,000	3,009	100.117	0.72
Dimethyl phthalate	1.94	9,000	559	194.186	2.4
Methyl ethyl ketone	0.17	18,000	2,729	72.107	0.08
Hexane	0.17	11,000	4,404	86.17	0.09541
Xylene	0.04	10,000	4,915	106.168	0.02611
Toluene	0.01	12,700	4,206	92.13	0.00312
Cyclohexane	0.01	13,000	4,180	84.162	0.00292
Ethyl benzene	0.00	10,000	4,977	106.168	0.001022
Benzene	0.00	14,000	3,475	78.11	0.00073

Note: The lower explosion limit (LEL), heat of combustion and molecular weight for some commonly used VOC/HAP are provided in the table below.

0.849 ft3/mol

Enter the design data for the proposed oxidizer:

Number of operating hours/year	2,030	hours/year	
Inlet volumetric flow rate(Q_{wi}) at 77^{o}F and 1 atm.	40,915	scfm	
Inlet volumetric flow rate(Q_{wi}) (actual conditions)	40,000	acfm	
Pressure drop (ΔP)	23	inches of water*	* 23 inches of water is the default pressure drop for thermal oxidizers; 19 inches of water is the default pressure drop for catalytic oxidizers. Enter actual value, if known.
Motor/Fan Efficiency (ε)	60	percent*	* 60% is a default fan efficiency. User should enter actual value, if known.
Inlet Waste Gas Temperature (T_{wi})	65	°F	
Operating Temperature (T_{fi})	1,700	°F	* Note: Default value for Tfi is 2000°F for thermal regenerative oxidizers. Use actual value if known. Tfi for regenerative oxidizers typically between 1800 and 2000°F.
Destruction and Removal Efficiency (DRE)	98	percent	
Estimated Equipment Life	20	Years*	* 20 years is the typical equipment life. User should enter actual value, if known.
Heat Loss (η)	1	percent*	* 1 percent is a default value for the heat loss. User should enter actual value, if known. Heat loss is typically between 0.2 and 1.5%.

Percent Energy Recovery (HR) = 0 percent ▼

Enter the cost data:

Desired dollar-year	2018				
CEPCI* for 2018	603.1	Enter the CEPCI value for 2018	541.7	2016 CEPCI	
Annual Interest Rate (i)	7	Percent			
Electricity ($Cost_{elect}$)	0.0479	$/kWh			
Natural Gas Fuel Cost ($Cost_{fuel}$)	0.00739	$/scf			
Operator Labor Rate	$26.61	per hour			* $26.61 per hour is a default labor rate. User should enter actual value, if known.
Maintenance Labor rate	$27.40	per hour			* $27.40 per hour is a default labor rate. User should enter actual value, if known.
Contingency Factor (CF)	10.0	Percent			* 10 percent is a default value for construction contingencies. User may enter values between 5 and 15 percent.

* CEPCI is the Chemical Engineering Plant Cost Escalation/De-escalation Index. The use of CEPCI in this spreadsheet is not an endorsement of the index for purposes of cost escalation or de-escalation, but is there merely to allow for availability of a well-known cost index to spreadsheet users. Use of other well-known cost indexes (e.g., M&S) is acceptable.

Design Parameters

The following design parameters for the oxidizer were calculated based on the values entered on the *Data Inputs* tab. These values were used to prepare the costs shown on the *Cost Estimate* tab.

Composition of Inlet Gas Stream		
Pollutant Name	**Concentration in Waste Stream (ppmv) From Data Inputs Tab**	**Adjusted Concentration with Dilution Air (ppmv)**
Styrene	15	NA
Methyl methacrylate	1	NA
Dimethyl phthalate	2	NA
Methyl ethyl ketone	0	NA
Hexane	0	NA
Xylene	0	NA
Toluene	0	NA
Cyclohexane	0	NA
Ethyl benzene	0	NA
Benzene	0	NA
Total	18	0

Constants used in calculations:

Temperature of auxiliary fuel (T_{af}) =	Reference Temperature (T_{ref}) =	77.0	°F
Density of auxiliary Fuel at 77 °F (ρ_{af}) =		0.0408	lb/ft^3
Heat Input of auxiliary fuel ($-\Delta h_{caf}$) =		21,502	Btu/lb
Density of waste gas at 77 °F (ρ_{wi}) =		0.0739	lb/ft^3
Mean Heat Capacity of Air (C_{pmair})	(For thermal oxidizers)	0.255	Btu/lb °F

Parameter	Equation	Calculated Value	Units	Value	Units
Sum of volume fraction of combustible components =	$= (\sum x_i) =$	18	ppmv		
Lower Explosive Limit of waste gas (LEL_{mix})	$= [\sum((x_j)/((\sum x_i) \times LEL_j))]^{-1} =$	11,105	ppmv		
	Where x_j is the volume fraction and LEL_j the lower explosive limit for each combustible component in the waste gas.				
% LEL_{mix}	= (Total Combustible Conc. In Mixture/LEL_{mix}) × 100 =	0.16	percent	* Note: Since the LEL of the waste gas stream is below 25%, no dilution air is needed.	
Dilution Factor	$= (LEL_{mix}$ x $0.249)/(\sum x_i) =$	Not applicable			
Lower Explosive Limit (LEL) of waste gas after addition of dilution air	= (Total Adjusted Conc. With Dilution Air/LEL_{mix}) × 100 =	Not Applicable			
Inlet volumetric flow rate(Qwi) at 77°F and 1 atm.	(From Data Inputs Tab) =	40,915	scfm		
Oxygen Content of gas stream	$= 100 - (\sum x_j \times 100/10^6)$ x $0.209 =$	20.90	percent		
Fan Power Consumption (FP)	$= [(1.17 \times 10^{-4}) \times Q_{wi} \times \Delta P]/\varepsilon$	179.4	kW		
Q_{wo}	$\approx Q_{wi} =$	40,915	scfm		
Operating temperature of oxidizer (T_{fi})	(From Data Inputs Tab)	1,700	°F		
Temperature of waste gas at outlet to preheater (T_{wo})	= Heat Recovery × $(T_{fi} - T_{wi}) + T_{wi} =$	65	°F		
Temperature of flue gas exiting the regenerative oxidizer (T_{fo})	$= T_{fi} - 0.95(T_{fi} - T_{wi}) =$	147	°F		
Heat Input of waste gas ($-\Delta h_{cwi}$)	$= \sum (-\Delta h_{ci})\ x_i$ Where $(-\Delta h_{ci})$ is the heat of combustion and x_i the fraction of component "i" at 77 °F.	0.08	Btu/scf	1.1	Btu/lb
Estimated Auxiliary Fuel Flow (Q_{af}) at 77 °F and 1 atm.	(Calculated using Equation 2.45 in Appendix B)	8.35	scfm		
Auxiliary fuel Energy Input =		7,322	Btu/min		
Minimum Energy required for combustion stabilization =	= 5% × Total Energy Input = $0.05 \times \rho_{fi} \times Q_{fi} \times C_{pmfi} \times (T_{fi} - T_{ref}) =$	62,581	Btu/min		
Is the calculated auxiliary fuel sufficient to stabilize combustion? (Note: If the auxiliary fuel energy input > 5% of Total Energy Input, then the auxilary fuel is sufficient.)		No		Note: Additional auxiliary fuel equivalent to 5% of total energy input is required to stabilize combustion.	
Auxiliary fuel flow (Qaf) (adjusted for fuel required for combustion stabilization)at 77°F and 1 atm. =		71	scfm		
Total Volumetric Throughput (Q_{tot}) at 77 °F and 1 atm.	$= Q_{fi} = Q_{wo} + Q_a + Q_{af} = Q_{wi} + Q_{af} =$	40,986	scfm		

Capital Recovery Factor:

Parameter	Equation	Calculated Value
Capital Recovery Factor (CRF) =	$i (1+ i)^n/(1+ i)^n - 1 =$	0.0944
	Where n = Equipment Life and i= Interest Rate	

Cost Estimate

Direct Costs

Total Purchased equipment costs (in 2018 dollars)

Incinerator + auxiliary equipment[a] (A) =			
Equipment Costs (EC) for Regenerative Oxidizer	=[2.664 x 100,000 + (13.98 x Qtot)] x (2018 CEPI/2016 CEPCI) =	$934,529	in 2018 dollars
Instrumentation[b] =	0.10 × A =	$93,453	
Sales taxes =	0.03 × A =	$28,036	
Freight =	0.05 × A =	$46,726	
	Total Purchased equipment costs (B) =	$1,102,744	in 2018 dollars

<u>Footnotes</u>

a - Auxiliary equipment includes equipment (e.g., duct work) normally not included with unit furnished by incinerator vendor.

b - Includes the instrumentation and controls furnished by the incinerator vendor.

Direct Installation Costs (in 2018 dollars)

Foundations and Supports =	0.08 × B =	$88,220	
Handlong and Errection =	0.14 × B =	$154,384	
Electrical =	0.04 × B =	$44,110	
Piping =	0.02 × B =	$22,055	
Insulation for Ductwork =	0.01 × B =	$11,027	
Painting =	0.01 × B =	$11,027	
Site Preparation (SP) =		$0	
Buildings (Bldg) =		$0	
	Total Direct Installaton Costs =	$330,823	
Total Direct Costs (DC) =	Total Purchase Equipment Costs (B) + Total Direct Installation Costs =	$1,433,567	in 2018 dollars

Total Indirect Installation Costs (in 2018 dollars)

Engineering =	0.10 × B =	$110,274	
Construction and field expenses =	0.05 × B =	$55,137	
Contractor fees =	0.10 × B =	$110,274	
Start-up =	0.02 × B =	$22,055	
Performance test =	0.01 × B =	$11,027	
	Total Indirect Costs (IC) =	$308,768	
Continency Cost (C) =	CF(IC+DC)=	$174,234	
Total Capital Investment =	**DC + IC +C =**	**$1,916,569**	**in 2018 dollars**

Direct Annual Costs

Annual Electricity Cost	= Fan Power Consumption × Operating Hours/year × Electricity Price =	$17,444
Annual Fuel Costs for Natural Gas	= $\text{Cost}_{\text{fuel}}$ × Fuel Usage Rate × 60 min/hr × Operating hours/year	$64,209
Operating Labor	Operator = 0.5hours/shift × Labor Rate × (Operating hours/8 hours/shift)	$3,376
	Supervisor = 15% of Operator	$506
Maintenance Costs	Labor = 0.5 hours/shift × Labor Rate × (Operating Hours/8 hours/shift)	$3,476
	Materials = 100% of maintenance labor	$3,476

Direct Annual Costs (DC) =		**$92,489 in 2018 dollars**

Indirect Annual Costs

Overhead	= 60% of sum of operating, supervisor, maintenance labor and maintenance materials	$6,501
Administrative Charges	= 2% of TCI	$38,331
Property Taxes	= 1% of TCI	$19,166
Insurance	= 1% of TCI	$19,166
Capital Recovery	= CRF[TCI-1.08(cat. Cost)]	$180,911

Indirect Annual Costs (IC) =		**$264,075 in 2018 dollars**
Total Annual Cost =	**DC + IC =**	**$356,563 in 2018 dollars**

Cost Effectiveness

Cost Effectiveness = (Total Annual Cost)/(Annual Quantity of VOC/HAP Pollutants Destroyed)

Total Annual Cost (TAC) =	$356,563	per year in 2018 dollars
VOC/HAP Pollutants Destroyed =	13.0	tons/year
Cost Effectiveness =	$27,373	per ton of pollutants removed in 2018 dollars

Attachment 2: Cost Calculation Spreadsheets
Adsorber Cost - Summary

ASSESSMENT OF STYRENE EMISSION CONTROLS FOR FRP/C AND BOAT BUILDING INDUSTRIES, September 1996

PARAMETER	***INPUT***				
Flowrate (cfm)	40,000				
Control device input mass (tons/year)	11				
Concentration (ppm)					
Facility operating schedule (hours/year)	2030	(a)			
Electricity Cost (¢/kWh)	4.79	(b)			
Natural Gas Cost (Dollars per Thousand Cubic Feet)	7.39				
	1988		1994	1995	1996
Conversion to 2019 dollars	2.15		1.72	1.68	1.62

	Cost per unit pollutant removed ($/ton)	
Conventional Technologies		
Cost spreadsheet for the MIAB system		
MIAB F	50,691	
MIAB C	49,329	
Cost spreadsheet for the Thermatrix PADRE system	74,596	
Cost spreadsheet for the Polyad system	43,874	
Cost spreadsheet for the rotary concentrator	41,471	
Cost spreadsheet for the Environmental C&C fluidized-bed preconcentrator		
Recovery	46,434	
Oxidation	52,354	(fuel cost not included)

(a) Average for WA 2018 https://www.eia.gov/electricity/data/browser/#/topic/7?agg=0,1&geo=000000000001&endsec=2&freq=A&start=2001&end=2018&ctype=linechart&ltype=pin&rtype=s&pin=&rse=0&maptype=0

(b) Industrial price in WA for 2018 https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_SWA_a.htm

Adsorber Cost - EC&C

Cost spreadsheet for the Environmental C&C fluidized-bed preconcentrator		
PARAMETER	***INPUT***	***CALC.***
Flowrate (cfm)	40,000	40,000
Control device input mass (tons/year)	11	11
Concentration (ppm)	0	17
Facility operating schedule (hours/year)	2030	
Styrene recovery value, ($/lb)	0.42	
Fuel cost, ($/million BTU)	7.25	
Electricity cost, ($/kwhr)	0.048	
COST CALCULATIONS		
Recovery or oxidation?	Recovery	Oxidation
Electrical power (kW)	69	69
Fuel usage (Btu/hr)	0	0
Equipment cost (EC), (Environmental C&C quote, 4/3/96)	674,535	799,535
Equipment Cost (EC), (CE equip. cost index, 2019 dollars)	1,092,746	1,295,246
Total Direct Cost (TDC), ($)	1,801,684	2,117,584
Total Capital Investment (TCI), ($)	2,208,186	2,599,416
Direct operating costs, minus utilities ($/year)	28,760	28,760
Direct operating costs, minus utilities (2019 $/year)	48,317	48,317
Thermal incinerators fuel cost ($/year)	0	0
Electrical cost ($/year)	6,668	6,668
Overhead, property tax, insurance, administration ($/year)	117,318	132,967
Capital recovery cost ($/year)	321,711	378,709
Styrene recovery cost ($/year)	-8,778	0
Total annualized cost ($/year)	485,235	547,103
Cost per unit pollutant removed ($/ton)	46,434	52,354

Attachment 2: Cost Calculation Spreadsheets
Adsorber Cost - MIAB

	A	B	C
2	***PARAMETER***	***INPUT***	***CALC.***
3	Flowrate (cfm)	40,000	40,000
4	Control device input mass (tons/year	11	11
5	Concentration (ppm)	0	17
6	Facility operating schedule (hours/year	2030	
7	Catalytic oxidizer temperature (F	650	
8	Fuel cost, ($/million BTU)	7.25	
9	Electricity cost, ($/kwhr)	0.048	
10	Styrene recovery value, ($/lb	0.42	
11	Replacement carbon cost ($/lb	1.6	
12			
13	***COST CALCULATIONS***		
14			
15	Unit Type	MIAB F	MIAB C
16	Electrical power (kW)	62	62
17	Fuel usage (Btu/hr)	534,250	106,850
18			
19	Equipment cost (EC), (MIAB cost sheet, January 24, 1996)	715,000	705,217
20	Equipment Cost (EC), (CE equip. cost index,2019 dollars)	1,158,300	1,142,451
21	Total Direct Cost (TDC), ($)	1,903,948	1,879,223
22	Total Capital Investment (TCI), ($)	2,334,836	2,304,215
23	Total Capital Investment (TCI), (2019 $)	3,922,524	3,871,082
24			
25	Direct operating costs, minus utilities ($/year	30,597	29,755
26	Direct operating costs, minus utilities (2019 $/year	51,403	49,988
27	Catalytic oxidizer fuel cost ($/year)	7,858	1,572
28	Electrical cost ($/year)	6,068	6,068
29	Overhead, property tax, insurance, administration ($/yea	124,235	122,161
30	Capital recovery cost ($/year	340,162	335,701
31	Styrene recovery cost ($/year	0	0
32	Total annualized cost ($/year	529,725	515,489
33			
34	Cost per unit pollutant removed ($/ton	50,691	49,329

Attachment 2: Cost Calculation Spreadsheets
Adsorber Cost - Polyad

	A	B	C
2	***PARAMETER***	***INPUT***	***CALC.***
3	Flowrate (cfm)	40,000	40,000
4	Control device input mass (tons/year	11	11
5	Concentration (ppm)	0	17
6	Facility operating schedule (hours/year	2030	
7	Catalytic oxidizer temperature (F	650	
8	Fuel cost, ($/million BTU)	7.25	
9	Electricity cost, ($/kwhr)	0.048	
10	Styrene recovery value, ($/lb	0.42	
11			
12	***COST CALCULATIONS***		
13			
14	Electrical power (kW)	82	
15	Fuel usage (Btu/hr)	128,000	
16			
17	Equipment cost (EC), (Polyad cost sheet, July 1995)	609,007	
18	Equipment Cost (EC), (CE equip. cost index,2019 dollars)	1,023,132	
19	Total Direct Cost (TDC), ($)	1,693,086	
20	Total Capital Investment (TCI), ($)	2,073,691	
21			
22	Direct operating costs, minus utilities ($/year	31,656	
23	Direct operating costs, minus utilities (2019 $/year	53,182	
24	Catalytic oxidizer fuel cost ($/year)	1,883	
25	Electrical cost ($/year)	7,973	
26	Overhead, property tax, insurance, administration ($/yea	114,857	
27	Capital recovery cost ($/year	302,116	
28	Styrene recovery cost ($/year	0	
29	Total annualized cost ($/year	458,485	
30			
31	Cost per unit pollutant removed ($/ton	43,874	

Attachment 2: Cost Calculation Spreadsheets
Adsorber Cost - PADRE

	A	B	C	D	E	F
2	***PARAMETER***	***INPUT***	***CALC.***			
3	Flowrate (cfm)	40,000	40,000			
4	Control device input mass (tons/year	11	11			
5	Concentration (ppm)	0	17			
6	Facility operating schedule (hours/year	2030				
7	Electricity cost, ($/kwhr)	0.048				
8	Styrene recovery value, ($/lb	0.42				
9						
10	***COST CALCULATIONS***					
11						
12	Electrical power (kW)	28				
13	Number of desorption units required	1				
14						
15	Equipment cost (EC), (Purus cost sheet, 12/2/94)	1,106,000				
16	Equipment Cost (EC), (CE equip. cost index,2019 dollars)	1,902,320				
17	Total Direct Cost (TDC), ($)	3,064,619				
18	Total Capital Investment (TCI), ($)	3,772,282				
19						
20	Direct operating costs, minus utilities ($/year	31,656				
21	Direct operating costs, minus utilities (2019 $/year	53,182				
22	Electrical cost ($/year)	2,739				
23	Overhead, property tax, insurance, administration ($/yea	182,801				
24	Capital recovery cost ($/year	549,584				
25	Styrene recovery cost ($/year	-8,778				
26	Total annualized cost ($/year	779,528				
27						
28	Cost per unit pollutant removed ($/ton	74,596				

Attachment 2: Cost Calculation Spreadsheets

Adsorber Cost - Rotary

Cost spreadsheet for the rotary concentrato		
PARAMETER	***INPUT***	***CALC.***
Flowrate (cfm)	40,000	40,000
Control device input mass (tons/year	11	11
Concentration (ppm)	0	17
Facility operating schedule (hours/year	2030	
Thermal oxidizer temperature (F	1450	
Fuel cost, ($/million BTU)	7.25	
Electricity cost, ($/kwhr)	0.048	
COST CALCULATIONS		
Heat recovery (%)	60	
Electrical power (kW)	31	
Fuel usage (Btu/hr)	2,250,392	
Equipment cost (EC), (Durr budgetary costs, 3/15/96)	449,757	
Equipment Cost (EC), (CE equip. cost index,2019 dollars)	728,607	
Total Direct Cost (TDC), ($)	1,233,627	
Total Capital Investment (TCI), ($)	1,504,668	
Direct operating costs, minus utilities ($/year	42,950	
Direct operating costs, minus utilities (2019 $/year	72,156	
Thermal incinerators fuel cost ($/year)	33,098	
Electrical cost ($/year)	5,427	
Overhead, property tax, insurance, administration ($/yea	103,480	
Capital recovery cost ($/year	219,215	
Styrene recovery cost ($/year	0	
Total annualized cost ($/year	433,376	
Cost per unit pollutant removed ($/ton	41,471	

Data Inputs

Select the type of oxidizer Catalytic Oxidizer - Fixed Bed ▼

Enter the following information for your emission source:

Note: The lower explosion limit (LEL), heat of combustion and molecular weight for some commonly used VOC/HAP are provided in the table below.

Composition of Inlet Gas Stream

Pollutant Name	Concentration (ppmv)	Lower Explosive Limit (LEL) (ppmv)*	Heat of Combustion (Btu/scf)	Molecular Weight	tpy
Styrene	14.77	11,000	4,907	104.15	9.784
Methyl methacrylate	1.13	21,000	3,009	100.117	0.72
Dimethyl phthalate	1.94	9,000	559	194.186	2.4
Methyl ethyl ketone	0.17	18,000	2,729	72.107	0.08
Hexane	0.17	11,000	4,404	86.17	0.09541
Xylene	0.04	10,000	4,915	106.168	0.02611
Toluene	0.01	12,700	4,206	92.13	0.00312
Cyclohexane	0.01	13,000	4,180	84.162	0.00292
Ethyl benzene	0.00	10,000	4,977	106.168	0.001022
Benzene	0.00	14,000	3,475	78.11	0.00073

0.849 ft3/mol

Enter the design data for the proposed oxidizer:

Number of operating hours/year	2,030	hours/year	
Inlet volumetric flow rate(Q_{wi}) at 77^{o}F and 1 atm.	40,915	scfm	
Inlet volumetric flow rate(Q_{wi}) (actual conditions)	40,000	acfm	
Pressure drop (ΔP)	19	inches of water	* 23 inches of water is the default pressure drop for thermal oxidizers; 19 inches of water is the default pressure drop for catalytic oxidizers. Enter actual value, if known.
Motor/Fan Efficiency (ε)	60	percent*	* 60% is a default fan efficiency. User should enter actual value, if known.
Inlet Waste Gas Temperature (T_{wi})	65	°F	
Operating Temperature (T_{fi})	900	°F	* Note: Default value for Tfi is 900°F for catalytic oxidizers. Use actual value if known. Tfi for catalytic oxidizers is typically between 300 and 900°F.
Destruction and Removal Efficiency (DRE)	98	percent	
Estimated Equipment Life	20	Years*	* 20 years is the typical equipment life. User should enter actual value, if known.
Catalyst Data:			
Estimated catalyst life (y)	4	years	* 4 years is a default value. User should enter actual value, if known.
Catalyst Unit Cost (CC)	650	$/ft^3	Section 2.5.2.1. "The cost, in 2014 dollars, of the replacement catalyst must be obtained from the vendor, but it may be estimated at $3,000/ft3 for noble metal catalysts and $650/ft3 for base metal oxide catalysts."
Space velocity for catalyst (Φ)	30,000	/hour	* 30,000 per hour is a default value. User should enter actual value, if known.

Percent Energy Recovery (HR) = 0 percent ▼

Enter the cost data:

Desired dollar-year	2018				
CEPCI* for 2018	603.1	Enter the CEPCI value for 2018	390.6	1999 CEPCI	
Annual Interest Rate (i)	7	Percent			
Electricity ($Cost_{elect}$)	0.0479	$/kWh			
Natural Gas Fuel Cost ($Cost_{fuel}$)	0.00739	$/scf			
Operator Labor Rate	$26.61	per hour			* $26.61 per hour is a default labor rate. User should enter actual value, if known.
Maintenance Labor rate	$27.40	per hour			* $27.40 per hour is a default labor rate. User should enter actual value, if known.
Contingency Factor (CF)	10.0	Percent			* 10 percent is a default value for construction contingencies. User may enter values between 5 and 15 percent.

* CEPCI is the Chemical Engineering Plant Cost Escalation/De-escalation Index. The use of CEPCI in this spreadsheet is not an endorsement of the index for purposes of cost escalation or de-escalation, but is there merely to allow for availability of a well-known cost index to spreadsheet users. Use of other well-known cost indexes (e.g., M&S) is acceptable.

Design Parameters

The following design parameters for the oxidizer were calculated based on the values entered on the *Data Inputs* tab. These values were used to prepare the costs shown on the *Cost Estimate* tab.

Composition of Inlet Gas Stream		
Pollutant Name	**Concentration in Waste Stream (ppmv) From Data Inputs Tab**	**Adjusted Concentration with Dilution Air (ppmv)**
Styrene	15	NA
Methyl methacrylate	1	NA
Dimethyl phthalate	2	NA
Methyl ethyl ketone	0	NA
Hexane	0	NA
Xylene	0	NA
Toluene	0	NA
Cyclohexane	0	NA
Ethyl benzene	0	NA
Benzene	0	NA
Total	18	0

Constants used in calculations:

Temperature of auxiliary fuel (T_{af}) =	Reference Temperature (T_{ref}) =	77.0	°F
Density of auxiliary Fuel at 77 °F (ρ_{af}) =		0.0408	lb/ft^3
Heat Input of auxiliary fuel ($-\Delta h_{caf}$) =		21,502	Btu/lb
Density of waste gas at 77 °F (ρ_{wi}) =		0.0739	lb/ft^3
Mean Heat Capacity of Air (C_{pmair}) =	(For catalytic oxidizers)	0.248	Btu/lb °F

Parameter	Equation	Calculated Value	Units	Value	Units
Sum of volume fraction of combustible components =	$= (\sum x_i) =$	18	ppmv		
Lower Explosive Limit of waste gas (LEL_{mix})	$= [\sum((x_j)/((\sum x_i) \times LEL_j))]^{-1} =$	11,105	ppmv		
	Where x_j is the volume fraction and LEL_j the lower explosive limit for each combustible component in the waste gas.				
% LEL_{mix}	= (Total Combustible Conc. In Mixture/LEL_{mix}) × 100 =	0.16	percent	* Note: Since the LEL of the waste gas stream is below 25%, no dilution air is needed.	
Dilution Factor	$= (LEL_{mix} \times 0.249)/(\sum x_i) =$	Not applicable			
Lower Explosive Limit (LEL) of waste gas after addition of dilution air	= (Total Adjusted Conc. With Dilution Air/LEL_{mix}) × 100 =	Not Applicable			
Inlet volumetric flow rate(Qwi) at 77°F and 1 atm.	(From Data Inputs Tab) =	40,915	scfm		
Oxygen Content of gas stream	$= 100 - (\sum x_j \times 100/10^6) \times 0.209 =$	20.90	percent		
Fan Power Consumption (FP)	$= [(1.17 \times 10^{-4}) \times Q_{wi} \times \Delta P]/\varepsilon$	148.2	kW		
Q_{wo}	$\approx Q_{wi} =$	40,915	scfm		
Operating temperature of oxidizer (T_{fi})	(From Data Inputs Tab)	900	°F		
Temperature of waste gas at outlet to preheater (T_{wo})	= Heat Recovery × (T_{fi} - T_{wi}) + T_{wi} =	65	°F		

Temperature of flue gas exiting the oxidizer (T_{fo})	$= T_{fi} - T_{wo} + T_{wi} =$	900 °F	
Heat Input of waste gas ($-\Delta h_{cwi}$)	$= \sum (-\Delta h_{ci}) x_i$ Where ($-\Delta h_{ci}$) is the heat of combustion and x_i the fraction of component "i" at 77 °F.	0.08 Btu/scf	1.1 Btu/lb
Estimated Auxiliary Fuel Flow (Q_{af}) at 77 °F and 1 atm.	(Calculated using Equation 2.21 in Chapter 2 of the Cost Manual)	788.64 scfm	
Auxiliary fuel Energy Input =		691,856 Btu/min	
Minimum Energy required for combustion stabilization =	= 5% × Total Energy Input = $0.05 \times \rho_{fi} \times Q_{fi} \times C_{pmfi} \times (T_{fi} - T_{ref}) =$	31,451 Btu/min	
Is the calculated auxiliary fuel sufficient to stabilize combustion? (Note: If the auxiliary fuel energy input > 5% of Total Energy Input, then the auxilary fuel is sufficient.)		Yes	
Auxiliary fuel flow (Qaf) at 77°F and 1 atm. =		789 scfm	
Total Volumetric Throughput (Q_{tot}) at 77 °F and 1 atm.	$= Q_{fi} = Q_{wo} + Q_a + Q_{af} = Q_{wi} + Q_{af} =$	41,703 scfm	

Calculation of Catalyst Volume and Estimated Temperature of Waste Gas Entering the Catalyst Bed

Volumetric Flow Rate at 60 °F and 1 atm (Q_{ft})	$= Q_{tot} \times (519)/(77\text{ °F} + 460) =$	40,306 scfm
Catalyst Volume (Vol_{cat})	Where Q_{ft} is the volumetric flow rate of the waste gas (Q_{fi}) corrected to 60 °F and 1	80.61 ft^3
Estimated inlet temperature to the catalyst bed (T_{ri}) =	(Calculated using Equation 2.27 in Chapter 2 of the Cost Manual)	896 °F

Capital Recovery Factor:

Parameter	Equation	Calculated Value
Capital Recovery Factor (CRF) =	$i\,(1+ i)^n/(1+ i)^n - 1 =$ Where n = Equipment Life and i= Interest Rate	0.0944

Future Worth Factor

Parameter	Equation	Calculated Value
Future Worth Factor (FWF) =	$i\,[1/(1+ i)^y - 1] =$ Where y = Catalyst Life and i= Interest Rate	0.2252

Cost Estimate

Direct Costs

Total Purchased equipment costs (in 2018 dollars)

Incinerator + auxiliary equipment[a] (A) =			
Equipment Costs (EC) for a Fixed Bed Catalytic Oxidizer	= (1,105 x Qtot ^(0.5471)) x (2018 CEPI/1999 CEPCI) =	$575,063	in 2018 dollars
Instrumentation[b] =	0.10 × A =	$57,506	
Sales taxes =	0.03 × A =	$17,252	
Freight =	0.05 × A =	$28,753	
	Total Purchased equipment costs (B) =	$678,575	in 2018 dollars

Footnotes

a - Auxiliary equipment includes equipment (e.g., duct work) normally not included with unit furnished by incinerator vendor.

b - Includes the instrumentation and controls furnished by the incinerator vendor.

Direct Installation Costs (in 2018 dollars)

Foundations and Supports =	0.08 × B =	$54,286	
Handlong and Errection =	0.14 × B =	$95,000	
Electrical =	0.04 × B =	$27,143	
Piping =	0.02 × B =	$13,571	
Insulation for Ductwork =	0.01 × B =	$6,786	
Painting =	0.01 × B =	$6,786	
Site Preparation (SP) =		$0	
Buildings (Bldg) =		$0	
	Total Direct Installaton Costs =	$203,572	
Total Direct Costs (DC) =	Total Purchase Equipment Costs (B) + Total Direct Installation Costs =	$882,147	in 2018 dollars

Total Indirect Installation Costs (in 2018 dollars)

Engineering =	0.10 × B =	$67,857	
Construction and field expenses =	0.05 × B =	$33,929	
Contractor fees =	0.10 × B =	$67,857	
Start-up =	0.02 × B =	$13,571	
Performance test =	0.01 × B =	$6,786	
	Total Indirect Costs (IC) =	$190,001	
Continency Cost (C) =	CF(IC+DC)=	$107,215	
Total Capital Investment =	**DC + IC +C =**	**$1,179,363**	**in 2018 dollars**

Direct Annual Costs

Catalyst Replacement Cost	= 1.08 × CC × Vol_{cat} × FWF Where CC is the $\$/ft^3$ cost for the replacement catalyst; Vol_{cat} is the volume of catalyst required based on the waste gas flow rate (Q_{ft}) and the catalyst space velocity (Φ); and FWF is the future worth factor.	$12,745
Annual Electricity Cost	= Fan Power Consumption × Operating Hours/year × Electricity Price =	$14,411
Annual Fuel Costs for Natural Gas	= $Cost_{fuel}$ × Fuel Usage Rate × 60 min/hr × Operating hours/year	$709,853
Operating Labor	Operator = 0.5hours/shift × Labor Rate × (Operating hours/8 hours/shift)	$3,376
	Supervisor = 15% of Operator	$506
Maintenance Costs	Labor = 0.5 hours/shift × Labor Rate × (Operating Hours/8 hours/shift)	$3,476
	Materials = 100% of maintenance labor	$3,476

Direct Annual Costs (DC) = $747,844 in 2018 dollars

Indirect Annual Costs

Overhead	= 60% of sum of operating, supervisor, maintenance labor and maintenance materials	$6,501
Administrative Charges	= 2% of TCI	$23,587
Property Taxes	= 1% of TCI	$11,794
Insurance	= 1% of TCI	$11,794
Capital Recovery	= CRF[TCI-1.08(cat. Cost)]	$110,024

Indirect Annual Costs (IC) = $163,700 in 2018 dollars

Total Annual Cost = DC + IC = $911,544 in 2018 dollars

Cost Effectiveness

Cost Effectiveness = (Total Annual Cost)/(Annual Quantity of VOC/HAP Pollutants Destroyed)

Total Annual Cost (TAC) =	$911,544	per year in 2018 dollars
VOC/HAP Pollutants Destroyed =	13.0	tons/year
Cost Effectiveness =	$69,977	per ton of pollutants removed in 2018 dollars

ATTACHMENT 3

Search Results from the EPA’s RBLC and California Clearinghouses

Clearinghouse	ID	Company	Process	Throughput	Pollutant	BACT Limit	Control Method	Issuance Date
South Coast AQMD	402868	Jacuzzi Whirlpool Bath	Polyester resin operation	57,000 scfm (27000 to cat-ox and 30000 to concentrator) with 250 lb/hr (1700 ppm as CH4) of styrene loading	VOC	18,030 lb/mo	Minimum VOC control efficiencies: concentrator 90%, cat-ox 95%, overall 90%. Glassing room must meet permanent total enclosure criteria in U.S.EPA Method 204. Glassing room is a permanent total enclosure (EPA Method 204) and vented via bag filters to concentrator/cat-ox system.	10/15/2002
South Coast AQMD	352856	Navigator Yachts	Polyester resin operation - non-atomizing resin application	400 gal/day of resin 60 gal/day of gelcoat 12000 scfm; 2700 ppm as CH4	VOC	30 lb/day (system) 61 lb/day (facility)	Non-atomized application of resin and gelcoat (required July 1, 2004) and use of compliant materials as follows: maximums of 22% styrene and 14% methyl methacrylate in gelcoat and 35% styrene in resin. Compliance with Rule 1171 (maximum of 25% VOC in cleanup materials). Carbon adsorption system must be regenerated after maximum of 5 days use and must achieve 93.4% overall VOC control. The thermal oxidizer temperature must be maintained at a minimum of 1500F and must achieve a minimum overall VOC control efficiency of 91.4%. BACT was determined to be compliance with Rule 1162. Add-on control was elected by the applicant to stay below public notice threshold (Rule 212). Carbon adsorber/thermal oxidizer system achieving 85% overall VOC control is now achieved in practice for this equipment category.	9/24/2002
Sacramento Metropolitan AQMD	24673 SMAQMD BACT Det. ID. 161	AA PRODUCT ASSEMBLY LLC	FIBERGLASS MFG PROCESS	<1,170 lb VOC/mo or <= 4,701 lb VOC/yr	ROCs		Open molding using compliant resins and gel coats (See comments), and the use of vapor suppressed Tub/Shower resins; or Closed Molding Maximum momomer content percent by weight: clear marble resin gel coats = 40%; All other clear gel coats = 44%; White and off-white gel coats = 30%; non-white gel coats = 37%; primer pigmented gel coats = 28%; specialty gel coats = 48%; tooling gel coat = 40%; Marble resins = 10% with fillers or 32% without; solid surface resins = 17%; Tub/Shower resins = 24% with fillers or 35% without; lamination resins = 31% with fillers or 35% without; fire retardant resins = 38%; corrosion resistant resins = 48%; high strength resins = 40%; atomized tooling resins = 39%; non-atomized tooling resins = 30%; all	8/25/2017
Sacramento Metropolitan AQMD	24673 SMAQMD BACT Det. ID. 162	AA PRODUCT ASSEMBLY LLC	FIBERGLASS MFG PROCESS	>= 1,170 lb VOC/mo or > 4,701 lb VOC/yr	ROCs		Compliant with Rule 465 and VOC Control System with >= 90% Collection Efficiency and >= 95% Destruction Efficiency, or the use of super compliant materials (<5% VOC by weight); or the Use of Low-VOC Materials resulting in equal emssions reduction	8/25/2017
EPA-RBLC	NV-0029	LASCO BATHWARE-DIV. OF TOMKINS INDUSTRIES, INC.	MFG OF FIBERGLASS BATHWARE		VOC	1959.00 lb/day 294.00 tons/yr	FIller and styrene resin limitations	1993
EPA-RBLC	MO-0045	TRACKER MARINE CORPORATION	INCREASE PRODUCTION OF FIBERGLASS BOATS		VOC	250 tons/yr	Increase stack height to ensure safe ambient concentration of HAPs	1994
EPA-RBLC	CA-0694	SANGER BOATS, INC.	FIBERGLASS OPERATION FOR BOAT MANUFACTURING		VOC	29.00 lb/day	LOW VOC RESIN (NO GREATER THAN 35% BY WT), AIR- LESS SPRAY GUN AND HAND LAYUP COMBINATION, NON- VOC CONTAINING CLEANUP SOLVENT	1996
EPA-RBLC	OR-0023	AQUA GLASS WEST, INC.	BATHTUB, SPA AND SHOWER STALL, FIBERGLASS/RFP		VOC	166.00 tons/yr	REFORMULATION/PROCESS CHANGES W/CONTROLS 85% REDUCTION OF VOC PLANTWIDE FROM DESIGN LEVELS, DECISION BASED ON REGEN. THERMAL OXID.	1997
EPA-RBLC	MI-0251	FIBER TECH INDUSTRIES, INC.	FIBERGLASS LAYUP, SPRAY		Styrene	18.5 lb/hr 44.9 tons/yr 444.0 lb/day	CONTROLLED SPRAYING TECHNIQUES, BARRIER FILM COVERED CURE, & RESINS	2000
EPA-RBLC	SC-0068	BENETEAU USA, INC.	FIBERGLASS BOAT MANUFACTURING		VOC Sytrene	249 tons/yr 249 tons/yr	Use of compliant coatings for specified applications Use of compliant coatings for specified applications	2000

Clearinghouse	ID	Company	Process	Throughput	Pollutant	BACT Limit	Control Method	Issuance Date
EPA-RBLC	SC-0067	STINGRAY BOAT COMPANY	FIBERGLASS BOAT MANUFACTURING		VOC	249 tons/yr	Use of compliant coatings for specified applications	2000
					Sytrene	249 tons/yr	Use of compliant coatings for specified applications	
EPA-RBLC	SC-0081	SEA FOX BOAT COMPANY, INC.	BOAT MANUFACTURING		VOC	0	WORK PRACTICES, NON-VOC CLEANUP SOLVENT, RESIN % VOC LIMITS	2002
EPA-RBLC	IL-0078	OASIS INDUSTRIES INC.	FIBERGLASS RESIN SPRAY BOOTHS		Styrene	24.25 tons/yr	none	
EPA-RBLC	SC-0086	SEA-PRO BOATS	FIBERGLASS BOAT MANUFACTURING		VOC	0	Limit VOC content in gelcoats and resin; No emission limit, material VOC limits	2004
EPA-RBLC	OR-0045	COUNTRY COACH, INC.	FIBERGLASS LAMINATION		VOC	0	VOC content limits (CA) and transfer efficiency requirements	2005
EPA-RBLC	IN-0162	FRONTLINE MANUFACTURING, INC.	FIBERGLASS PRODUCTION LINE ONE and TWO		VOC	0	COMPLIANCE WITH 40 CFR 63, SUBPART WWWW (reinforced plastic composits production) and operator training	2010
EPA-RBLC	IN-0274	CONTINENTAL STRUCTURAL PLASTICS	FIBERGLASS REINFORCED PLASTIC PART COATING LINE		VOC	0	Robotic or manual air atomization spray guns	2017

Abbreviations

APCD = air pollution control district
AQMD = air quality management district
BACT = best available control technology
CO = carbon monoxide
EPA-RBLC = United States Environmental Protection Agency RACT/BACT/LAER Clearinghouse
HAPs = hazardous air pollutants
HVLP = high-volume low-pressure
LAER = lowest achievable emission rate
lb/day = pounds per day
lb/hr = pounds per hour
lb/MMlb = pound per million metric pounds
NPOC = non-precursor organic compound
POC = precursor organic compound
ppm = parts per million
RACT = reasonably available control technology
scf = standard cubic foot
TCEQ = Texas Commission on Environmental Quality
tons/yr = tons per year
VOC = volatile organic compound