

APPENDIX B

**Emission Reduction Analysis for
Proposed Amendments to
Rule 4354 (Glass Melting Furnaces)**

December 16, 2021

SAN JOAQUIN VALLEY UNIFIED AIR POLLUTION CONTROL DISTRICT

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I. SUMMARY

The District committed to amending Rule 4354 as part of the *2018 PM2.5 Plan*. This appendix details the calculations and assumptions used to estimate the NOx, SOx, PM10, and PM2.5 emission reductions associated with the proposed amendments to Rule 4354.

Table B-1 summarizes the estimated emission reductions from each of these pollutants from the baseline emissions inventory in the *2018 PM2.5 Plan*. The calculation methodology is outlined in Section III of this appendix. When fully implemented, the proposed amendments are estimated to total approximately 1.67 tons per day (tpd) of NOx emissions reductions (43% of baseline emission inventory), SOx emissions reductions of 0.07 tpd (4.1% of baseline emission inventory), PM10 emissions reductions of 0.13 tpd (49% of baseline emission inventory), and PM2.5 emissions reductions of 0.13 tpd (58% of baseline emission inventory). Since PM2.5 is a subset of PM10, and since for glass melting furnaces the majority of PM10 emissions are PM2.5 emissions, the emissions reduction estimates for PM2.5 are nearly the same as PM10. This is further described in Section III of this appendix.

Pollutant	2024	2025	2026	2027	2028	2029	2030	2031
NOx	0.64	0.64	0.64	0.64	0.64	0.64	1.67	1.67
SOx	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
PM10	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
PM2.5	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13

II. BACKGROUND

The San Joaquin Valley is home to six glass manufacturing facilities that represent three different glass industry types: container glass, flat glass and fiberglass. There are 12 glass melting furnaces at these six facilities that are subject to Rule 4354. For the purposes of this analysis, the furnaces at each facility will be aggregated into a single calculation. Of the six facilities, three produce container glass, two flat glass, and one fiberglass. Since emissions limits are not being lowered for glass melting furnaces at fiberglass facilities, this analysis will focus on the five remaining facilities with annual throughput limits as indicated in Table B-2.

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Table B-2 – Affected Facility Annual Throughput Limits	
Glass Category	Permitted Glass Throughput (ton/yr)
Container Glass Facility	736,571
Container Glass Facility	357,335
Container Glass Facility	351,890
Flat Glass Facility	255,500
Flat Glass Facility	237,250

The District’s *2018 PM2.5 Plan* emissions inventory from the 2016 California Emissions Projection Analysis Model (CEPAM) version 1.05 is used throughout this analysis, as this was the foundation for the *2018 PM2.5 Plan*. The emissions inventories for the two affected categories are represented by two emissions inventory codes (EICs). Table B-3 shows the emissions inventory for the two EICs affected by this proposed amendment.

Table B-3 – Emissions Inventory for Affected Facility Types (tons per day)¹									
Glass Category	Pollutant	2024	2025	2026	2027	2028	2029	2030	2031
Container Glass EIC: 460-460-7037-0000	NOx	1.791	1.791	1.791	1.791	1.791	1.791	1.791	1.791
	SOx	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032
	PM10	0.074	0.074	0.074	0.074	0.074	0.074	0.074	0.074
	PM2.5	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073
Flat Glass EIC: 460-460-7039-0000	NOx	1.713	1.713	1.713	1.713	1.713	1.713	1.713	1.713
	SOx	0.732	0.732	0.732	0.732	0.732	0.732	0.732	0.732
	PM10	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122
	PM2.5	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118

III. EMISSIONS AND EMISSION REDUCTION METHODOLOGY

This section of the report outlines the procedures used to calculate the current emissions and the estimated emission reductions associated with the proposed amendments to Rule 4354.

The emissions reduction percentages resulting from this rule amendment can be applied directly to the baseline emissions inventory from the *2018 PM2.5 Plan*. These “SIP Currency” reductions (Table B-1) are being credited to the aggregate emissions reduction commitments from the *2018 PM2.5 Plan* (*2018 PM2.5 Plan* Table 4-3, page 4-12).

An emissions factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a

¹ 2016 CEPAM v.1.05

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unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., pounds of NO_x emitted per hour). Such factors facilitate an estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in the source category (i.e., a population average).

In general emissions can be calculated from the activity rate and emissions factor as:

$$E = A \times EF \quad (1)$$

Where:

- E = emissions;
- A = activity; and
- EF = emissions factor

For glass melting furnaces, emissions factors will be determined from permit limits for existing permit units and compared to proposed rule limits in the proposed amended rule. These emissions factors will be in pounds of pollutant per ton of glass produced (lb/ton) for NO_x, SO_x, PM_{2.5} and PM₁₀. Permits for glass melting furnaces also identify an annual throughput limit in tons of glass (ton/yr) which will serve as the activity to calculate annual emissions.

For this analysis, Equation 1 shall be applied to each affected facility for the permitted activity rate at the current permit limit and at the proposed amended limit(s) to calculate potential emissions from each facility at each limit. The total potential current emissions and the total of the potential emissions at the proposed limits summed for each glass category will be used to determine a percent reduction for each pollutant from each affected glass category, as follows:

$$\%_{Reduced} = \frac{(\sum E_{Current} - \sum E_{Proposed})}{\sum E_{Current}} \quad (2)$$

Where:

- $\%_{Reduced}$ = percent reduction;
- $E_{Current}$ = current potential emissions, per Equation 1; and
- $E_{Proposed}$ = the potential emissions at proposed limits, per Equation 1.

Finally, the emissions reductions will be calculated by multiplying the emissions inventory defined in Table B-3 by the calculated percent reductions determined with Equation 2, as follows:

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$$ER = EI \times \%_{Reduced} \tag{3}$$

Where:

ER = emission reduction;

EI = emission inventory; and

$\%_{Reduced}$ = calculated percent reductions, per Equation 2.

A. NOx Emission Reduction Calculations

Proposed emission limits for NOx will be implemented in two phases. Phase I will lower the NOx limit to 1.1 lb/ton for container glass and 2.5 lb/ton for flat glass starting in 2024, and Phase II will lower the NOx limit to 0.75 lb/ton for container glass and 1.5 lb/ton for flat glass starting in 2030. Table B-4 shows calculations for potential NOx emissions using Equation 1 for each facility, and converting the emissions into ton/yr.

Table B-4 – NOx Emission Potentials for Affected Facilities							
Glass Category	Permitted Glass Throughput (ton/yr)	Permitted NOx Limit (lb/ton)	Permitted NOx Potential (ton/yr)	Proposed Phase I NOx Limit (lb/ton)	Phase I NOx Potential (ton/yr)	Proposed Phase II NOx Limit (lb/ton)	Phase II NOx Potential (ton/yr)
Container	736,571	1.3	478.8	1.1	405.1	0.75	276.2
Container	357,335	1.5	268.0	1.1	196.5	0.75	134.0
Container	351,890	1.3	228.7	1.1	193.5	0.75	132.0
Flat	255,500	3.2	408.8	2.5	319.4	1.5	191.6
Flat	237,250	2.9	344.0	2.5	296.6	1.5	177.9

Table B-5 shows the total potential NOx emissions, summed over the glass categories, and the percent reduced by each phase by applying Equation 2.

Table B-5 – Percent NOx Reductions					
Glass Category	Permitted NOx Potential (ton/yr)	Phase I NOx Potential (ton/yr)	Phase II NOx Potential (ton/yr)	Phase I NOx %Reduced	Phase II NOx %Reduced
Container	975.5	795.2	542.2	18.5%	44.4%
Flat	752.8	615.9	369.6	18.2%	50.9%

Table B-6 shows the results of Equation 3 with the percent reductions in Table B-5 applied to the NOx emissions inventory in Table B-3.

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Table B-6 – NOx Emission Reductions								
Glass Category	2024	2025	2026	2027	2028	2029	2030	2031
Container	0.331	0.331	0.331	0.331	0.331	0.331	0.796	0.796
Flat	0.311	0.311	0.311	0.311	0.311	0.311	0.872	0.872
Total	0.643	0.643	0.643	0.643	0.643	0.643	1.668	1.668

B. SOx Emission Reduction Calculations

Proposed emissions limits will lower the SOx limit to 0.85 lb/ton for container glass with limits for flat and fiberglass to remain unmodified. Table B-7 shows calculations for potential SOx emissions using Equation 1 for each facility, and converting the emissions into ton/yr. One facility has an existing permit lower than the proposed 0.85 lb/ton rule limit. The reduction of the rule limit to 0.85 lb/ton will not allow that facility to increase their permit limit, so the new SOx potential for that facility will remain based on the 0.8 lb/ton limit in their current permit.

Table B-7 – SOx Emission Potentials for Affected Facilities					
Glass Category	Permitted Glass Throughput (ton/yr)	Permitted SOx Limit (lb/ton)	Permitted SOx Potential (ton/yr)	Proposed SOx Limit (lb/ton)	New SOx Potential (ton/yr)
Container	736,571	0.95	349.9	0.85	313.0
Container	357,335	0.9	160.8	0.85	151.9
Container	351,890	0.8	140.8	0.8	140.8

Table B-8 shows the total potential SOx emissions, summed over the glass categories, and the percent reduced by each phase by applying Equation 2.

Table B-8 – Percent SOx Reductions			
Glass Category	Permitted SOx Potential (ton/yr)	New SOx Potential (ton/yr)	SOx %Reduced
Container	651.4	605.7	7.0%

Table B-9 shows the results Equation 3 with the percent reductions in Table B-8 applied to the SOx emissions inventory in Table B-3.

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Table B-9 – SOx Emission Reductions								
Glass Category	2024	2025	2026	2027	2028	2029	2030	2031
Container	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073
Total	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073

C. PM Emission Reduction Calculations

Particulate matter permit and rule limits for glass melting furnaces are for the size fraction of PM10. Since PM2.5 is directly proportional and is a subset of PM10, the emissions controls to reduce PM10 will likewise reduce PM2.5. Within the emissions inventory established for the *2018 PM2.5 Plan*, a ratio is used to convert PM10 into PM2.5. For this analysis, Equation 1 and Equation 2 will use PM10 limits to determine a percent reduction, and will apply that percent reduction with Equation 3 to both the PM10 and PM2.5 planning inventories to determine emission reductions.

Proposed emissions limits will lower the PM10 limit to 0.2 lb/ton for both container and flat glass with limits for fiberglass to remain unmodified. Table B-7 shows calculations for potential PM10 emissions using Equation 1 for each facility, and converting the emissions into ton/yr.

Table B-9 – PM10 Emission Potentials for Affected Facilities					
Glass Category	Permitted Glass Throughput (ton/yr)	Permitted PM10 Limit (lb/ton)	Permitted PM10 Potential (ton/yr)	Proposed PM10 Limit (lb/ton)	New PM10 Potential (ton/yr)
Container	736,571	0.45	165.7	0.20	73.7
Container	357,335	0.50	89.3	0.20	35.7
Container	351,890	0.45	79.2	0.20	35.2
Flat	255,500	0.70	89.4	0.20	25.6
Flat	237,250	0.70	83.0	0.20	23.7

Table B-11 shows the total potential PM10 emissions, summed over the glass categories, and the percent PM10 reduced by each phase by applying Equation 2.

Table B-10 – Percent PM10 Reductions			
Glass Category	Permitted PM10 Potential (ton/yr)	New PM10 Potential (ton/yr)	PM %Reduced
Container	334.2	144.6	56.7%
Flat	172.5	49.3	71.4%

Table B-12 shows the results of Equation 3 with the percent reductions in Table B-11 applied to the PM10 emissions inventory in Table B-3.

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Table B-11 – PM10 Emission Reductions								
Glass Category	2024	2025	2026	2027	2028	2029	2030	2031
Container	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
Flat	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087
Total	0.129	0.129	0.129	0.129	0.129	0.129	0.129	0.129

Table B-13 shows the results Equation 3 with the percent reductions in Table B-11 applied to the PM2.5 emissions inventory in Table B-3.

Table B-12 – PM2.5 Emission Reductions								
Glass Category	2024	2025	2026	2027	2028	2029	2030	2031
Container	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
Flat	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085
Total	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126

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