

State of Oregon  
Department of Environmental Quality

Memorandum

Date: 10/30/2019

**To:** File/George Yun  
**From:** Thomas Rhodes

**Subject:** Source Test Review Report  
Owens-Brockway Glass Container  
Permit Number: Title V 26-1876

Test Dates: May 15-17 & 20-23, 2019  
Report Received: July 26, 2019  
Revised Report Received: August 14, 2019  
Source Testers: Montrose Air Quality Services  
DEQ Observed: Yes

**I) Source Description:** Glass container manufacturing facility.

**II) Process (es)/Emissions Unit(s) Tested:** Glass melting furnace A (GM1) producing amber glass. Glass melting furnace D (GM4) producing antique green glass (G56).

**III) Test Purpose:** Compliance with Notice of Civil Penalty Assessment and Order Case No. AQ/V-NWR-2019-016 requirements to demonstrate compliance the particulate and metal HAP emission limits. To verify the accuracy of the emission factors for PSEL compliance for particulate matter (PM), nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), and volatile organic compounds (VOCs). To quantify emission rate of arsenic, cadmium, chromium, hexavalent chromium (Cr<sup>+6</sup>), lead, manganese, nickel, antimony, beryllium, cobalt, copper, mercury, selenium, and formaldehyde. Testing was also used to evaluate emissions for the development of an Emissions Inventory for Cleaner Air Oregon.

**IV) Testing Location(s):**

**Furnace A (GM1) South Exhaust Duct:**

Diameter: 44" x 44.5" (elliptical)  
Distance A (Method 1): 180" (4.0 Diameter)  
Distance B (Method 1): 100" (2.2 Diameters)  
Number traverse points utilized: 24

**Furnace A (GM1) North Exhaust Duct:**

Diameter: 44.4"  
Distance A (Method 1): 180" (4.1 Diameters)  
Distance B (Method 1): 108" (2.4 Diameter)  
Number traverse points utilized: 24

**Furnace D (GM4) Exhaust Duct:**

Diameter: 29"  
Distance A (Method 1): 348" (12.0 Diameter)  
Distance B (Method 1): 18" (0.6 Diameters)  
Number traverse points utilized: 24

**V) Testing Methodology:** The following testing methods were utilized during the testing program:

Flow Rate, O<sub>2</sub> & CO<sub>2</sub>, & Moisture Content: EPA Methods 1, 2, 3A & 4  
Total Particulate: ODEQ Method 5  
Sulfur Dioxide: EPA Method 6C  
Nitrogen Oxides: EPA Method 7E  
Carbon Monoxide: EPA Method 10  
Volatile Organic Compounds: EPA Method 25A  
Metals: EPA Method 29  
Chromium and hexavalent chromium: CARB Method 425  
Formaldehyde: EPA Method 316

**VI) Summary of Results:** The testing parameters, test results and operating parameters are summarized in the Tables below:

Table 1: Furnace A (GM1) – Particulate, SO<sub>2</sub>, NO<sub>x</sub>, CO, VOC  
Table 2: Furnace A (GM1) – Formaldehyde  
Table 3: Furnace A (GM1) – Multi-metals  
Table 4: Furnace A (GM1) – Chromium and hexavalent chromium  
Table 5: Furnace A (GM1) South Stack – Particulate  
Table 6: Furnace A (GM1) North Stack – Particulate  
Table 7: Furnace A (GM1) South Stack – Formaldehyde  
Table 8: Furnace A (GM1) North Stack – Formaldehyde  
Table 9: Furnace A (GM1) South Stack – Multi-metals  
Table 10: Furnace A (GM1) North Stack – Multi-metals  
Table 11: Furnace A (GM1) South stack – Chromium and hexavalent chromium  
Table 12: Furnace A (GM1) North Stack – Chromium and hexavalent chromium  
Table 13: Furnace D (GM4) – Formaldehyde, SO<sub>2</sub>, NO<sub>x</sub>, CO, VOC  
Table 14: Furnace D (GM4) – Particulate  
Table 15: Furnace D (GM4) – Multi-metals  
Table 16: Furnace D (GM4) – Chromium and hexavalent chromium  
Table 17: Operating Parameters

**TABLE 1: Furnace A (GM1) – PM, SO<sub>2</sub>, NO<sub>x</sub>, CO, VOC**

TESTING PARAMETERS (PM, SO <sub>2</sub> , NO <sub>x</sub> , CO, VOC)	Run 1	Run 2	Run 3 <sup>d</sup>	Average	Permit Limit / (EF)
Test Date	5/20/2019	5/20/2019	5/20/2019	---	
Test Time	1146-1411	1507-1700	1731-1930	--	
Exhaust Gas Temperature (°F) <sup>a</sup>	387	386	383	385	
Exhaust Gas Moisture (%) <sup>a</sup>	5.1	5.0	4.5	5.1	
Exhaust O <sub>2</sub> (% dry vol)	17.3	17.2	17.4	17.3	
Exhaust CO <sub>2</sub> (% dry vol)	2.7	2.8	2.6	2.7	
Exhaust Gas Flow Rate (dscfm) <sup>a</sup>	31,711	31,228	32,852	31,470	
Filterable Particulate (PM) Emissions:					
• gr/dscf <sup>a</sup>	0.014	0.014	0.013	0.014	
• lb/hr <sup>b</sup>	3.79	3.60	3.76	3.70	
• lb/ton of glass	0.39	0.37	0.39	0.38	1
Total Particulate (PM) Emissions:					
• gr/dscf <sup>a</sup>	0.035	0.029	0.031	0.032	0.1
• lb/hr <sup>b</sup>	9.39	7.73	8.70	8.56	
• lb/ton of glass	1.06	0.86	0.97	0.96	(0.66)
Sulfur Dioxide (SO <sub>2</sub> ) Emissions:					
• ppmvd	84.7	90.2	85.6	86.9	
• lb/hr	26.8	28.1	28.0	27.5	
• lb/ton of glass	3.18	3.33	3.33	3.23	(1.5)
Nitrogen Oxides (NO <sub>x</sub> ) Emissions:					
• ppmvd	146.8	152.1	131.5	143.5	
• lb/hr	33.3	34.0	30.9	33.7	
• lb/ton of glass	3.95	4.03	3.67	3.99	(5.4)
Carbon Monoxide (CO) Emissions:					
• ppmvd	<1.1 <sup>c</sup>	<1.1 <sup>c</sup>	<1.1 <sup>c</sup>	<1.1 <sup>c</sup>	
• lb/hr	<0.16	<0.15	<0.16	<1.16	
• lb/ton of glass	<0.019	<0.018	<0.019	<0.019	
• lb/10 <sup>6</sup> scf natural gas	<1.04	<1.03	<1.07	<1.04	(35)
VOC Emissions as Propane:					
• ppmvd	7.4	6.5	6.3	6.8	
• lb/hr	1.6	1.4	1.4	1.5	
• lb/ton of glass	0.19	0.17	0.17	0.18	
• lb/10 <sup>6</sup> scf natural gas	10.70	9.37	9.52	10.04	(5.8)
% Opacity <sup>a</sup>	4.0	3.9	3.6	3.8	20
Glass Production (tons/day)	202.1	202.1	202.1	202.1	
Type of glass	Amber	Amber	Amber	Amber	
% Cullet	81	81	81	81	
Raw material feed rate (tons/day)	242.3	242.3	242.3	242.3	
Natural Gas Usage (kscf/hr)	151.0	149.0	151.4	150.5	
Electric Boost (kWh/hour)	885.1	885.1	885.1	885.1	
Bridgewall Temperature (°F)	2784	2785	2776	2782	

<sup>a</sup> Average of the South and North stack values.

<sup>b</sup> Sum of South and North stack emission rates.

<sup>c</sup> CO results reported as less than 2% of span.

<sup>d</sup> Most of the run 3 data is presented as informational only and is not included in the averages. See comment 2.

**TABLE 2: Furnace A (GM1) – Formaldehyde**

TESTING PARAMETERS (Formaldehyde)	Run 1	Run 2	Run 3 <sup>c</sup>	Average
Test Date	5/20/2019	5/20/2019	5/20/2019	--
Test Time	1146-1411	1503-1701	1730-1930	--
Exhaust Gas Temperature (°F) <sup>a</sup>	374	371	377	374
Exhaust Gas Moisture (%) <sup>a</sup>	5.0	5.7	5.2	5.4
Exhaust O <sub>2</sub> (% dry vol)	17.3	17.2	17.4	17.3
Exhaust CO <sub>2</sub> (% dry vol)	2.7	2.8	2.6	2.7
Exhaust Gas Flow Rate (dscfm) <sup>a</sup>	34,615	32,118	32,627	33,366
Formaldehyde Emissions:				
• ppmvd <sup>a</sup>	<0.014	<0.013	<0.014	<0.013
• mg/dscm <sup>a</sup>	<0.017	<0.016	<0.017	<0.017
• lb/hr <sup>b</sup>	<2.19E-03	<1.97E-03	<2.08E-03	<2.08E-03
• lb/ton of glass	<2.60E-04	<2.34E-04	<2.47E-04	<2.47E-04
Glass Production (tons/day)	202.1	202.1	202.1	202.1
Type of glass	Amber	Amber	Amber	Amber
% Cullet	81	81	81	81
Raw material feed rate (tons/day)	242.3	242.3	242.3	242.3
Natural Gas Usage (kscf/hr)	151.0	149.0	151.4	150.5
Electric Boost (kWh/hour)	885.1	885.1	885.1	885.1
Bridgewall Temperature (°F)	2784	2785	2776	2782

<sup>a</sup> Average of the South and North stack values.

<sup>b</sup> Sum of South and North stack emission rates.

<sup>c</sup> Most of the run 3 data is presented as informational only and is not included in the averages. See comment 2.

'<' denotes results calculated using the MDL for results that were non-detect.

**TABLE 3: Furnace A (GM1) – Metals**

TESTING PARAMETERS (Sb, As, Be, Cd, Co, Cu, Pb, Mn, Hg, Ni, Se)	Run 1	Run 2	Run 3	Average
Test Date	5/21/2019	5/22/2019	5/23/2019	--
Test Time	900-1800	830-1730	800-1600	--
Exhaust Gas Temperature (°F) <sup>a</sup>	377	379	381	379
Exhaust Gas Moisture (%) <sup>a</sup>	5.2	5.2	5.5	5.3
Exhaust O <sub>2</sub> (% dry vol)	17.5	16.8	17.1	17.1
Exhaust CO <sub>2</sub> (% dry vol)	2.6	2.8	2.7	2.7
Exhaust Gas Flow Rate (dscfm) <sup>a</sup>	34,473	35,037	35,495	35,002
Antimony (Sb) Emissions:				
• mg/dscm <sup>a</sup>	<6.08E-03	<5.15E-03	<5.19E-03	<5.48E-03
• lb/hr <sup>b</sup>	<7.82E-04	<6.74E-04	<6.89E-04	<7.15E-04
• lb/ton of glass	<9.29E-05	<8.00E-05	<8.18E-05	<8.49E-05
Arsenic (As) Emissions:				
• mg/dscm <sup>a</sup>	1.19E-01	1.10E-01	1.08E-01	1.12E-01
• lb/hr <sup>b</sup>	1.53E-02	1.44E-02	1.43E-02	1.47E-02
• lb/ton of glass	1.82E-03	1.72E-03	1.70E-03	1.74E-03
Beryllium (Be) Emissions:				
• mg/dscm <sup>a</sup>	<1.69E-05	<1.63E-05	<1.60E-05	<1.64E-05
• lb/hr <sup>b</sup>	<2.17E-06	<2.14E-06	<2.12E-06	<2.14E-06
• lb/ton of glass	<2.58E-07	<2.54E-07	<2.52E-07	<2.55E-07
Cadmium (Cd) Emissions:				
• mg/dscm <sup>a</sup>	<4.31E-03	<3.00E-03	<2.92E-03	<3.41E-03
• lb/hr <sup>b</sup>	<5.60E-04	<3.94E-04	<3.87E-04	<4.47E-04
• lb/ton of glass	<6.65E-05	<4.68E-05	<4.60E-05	<5.31E-05
Cobalt (Co) Emissions:				
• mg/dscm <sup>a</sup>	<4.46E-05	<4.13E-05	<4.42E-05	<4.34E-05
• lb/hr <sup>b</sup>	<5.74E-06	<5.40E-06	<5.87E-06	<5.67E-06
• lb/ton of glass	<6.82E-07	<6.42E-07	<6.97E-07	<6.74E-07
Copper (Cu) Emissions:				
• mg/dscm <sup>a</sup>	<5.67E-03	<5.26E-03	<5.03E-03	<5.32E-03
• lb/hr <sup>b</sup>	<7.32E-04	<6.90E-04	<6.67E-04	<6.96E-04
• lb/ton of glass	<8.70E-05	<8.19E-05	<7.92E-05	<8.27E-05
Lead (Pb) Emissions:				
• mg/dscm <sup>a</sup>	<3.05E-01	<2.57E-01	<2.38E-01	<2.67E-01
• lb/hr <sup>b</sup>	<3.94E-02	<3.38E-02	<3.16E-02	<3.49E-02
• lb/ton of glass	<4.68E-03	<4.01E-03	<3.75E-03	<4.15E-03
Manganese (Mn) Emissions:				
• mg/dscm <sup>a</sup>	4.99E-04	4.56E-04	3.26E-03	1.41E-03
• lb/hr <sup>b</sup>	6.46E-05	5.97E-05	4.29E-04	1.84E-04
• lb/ton of glass	7.67E-06	7.09E-06	5.10E-05	2.19E-05
Mercury (Hg) Emissions:				
• mg/dscm <sup>a</sup>	<6.87E-04	<4.14E-04	<4.34E-04	<5.11E-04
• lb/hr <sup>b</sup>	<8.88E-05	<5.41E-05	<5.75E-05	<6.68E-05
• lb/ton of glass	<1.05E-05	<6.42E-06	<6.83E-06	<7.93E-06

<sup>a</sup> Average of the South and North stack values.

<sup>b</sup> Sum of South and North stack emission rates.

'<' denotes results calculated using the MDL for front half or back half results that were non-detect.

**TABLE 3 Continued: Furnace A (GM1) – Metals**

<b>TESTING PARAMETERS (Sb, As, Be, Cd, Co, Cu, Pb, Mn, Hg, Ni, Se)</b>	<b>Run 1</b>	<b>Run 2</b>	<b>Run 3</b>	<b>Average</b>
<b>Test Date</b>	5/21/2019	5/22/2019	5/23/2019	--
<b>Test Time</b>	900-1800	830-1730	800-1600	--
<b>Nickel (Ni) Emissions:</b>				
• mg/dscm <sup>a</sup>	4.90E-04	3.49E-04	4.55E-04	4.32E-04
• lb/hr <sup>b</sup>	6.31E-05	4.52E-05	6.03E-05	5.62E-05
• lb/ton of glass	7.50E-06	5.37E-06	7.16E-06	6.68E-06
<b>Selenium (Se) Emissions:</b>				
• mg/dscm <sup>a</sup>	2.38E-02	3.17E-02	2.22E-02	2.59E-02
• lb/hr <sup>b</sup>	3.07E-03	4.14E-03	2.95E-03	3.38E-03
• lb/ton of glass	3.64E-04	4.91E-04	3.50E-04	4.02E-04
<b>% Opacity <sup>a</sup></b>	4.0	3.6	3.6	3.7
<b>Glass Production (tons/day)</b>	202.1	202.1	202.1	202.1
<b>Type of glass</b>	Amber	Amber	Amber	Amber
<b>% Cullet</b>	81	81	81	81
<b>Raw material feed rate (tons/day)</b>	242.3	242.3	242.3	242.3
<b>Natural Gas Usage (kscf/hr)</b>	153.4	147.7	148.7	149.9
<b>Electric Boost (kWh/hour)</b>	997.1	793.4	827.5	872.7
<b>Bridgewall Temperature (°F)</b>	2757	2789	2793	2780

<sup>a</sup> Average of the South and North stack values.

<sup>b</sup> Sum of South and North stack emission rates.

**TABLE 4: Furnace A (GM1) – Chromium & Hexavalent Chromium**

TESTING PARAMETERS (Cr & Cr <sup>+6</sup> )	Run 1	Run 2	Run 3	Average
Test Date	5/21/2019	5/22/2019	5/23/2019	--
Test Time	900-1800	830-1730	800-1600	--
Exhaust Gas Temperature (°F)	366	372	371	370
Exhaust Gas Moisture (%)	4.7	5.6	4.9	5.1
Exhaust O <sub>2</sub> (% dry vol)	17.5	16.8	17.1	17.1
Exhaust CO <sub>2</sub> (% dry vol)	2.6	2.8	2.7	2.7
Exhaust Gas Flow Rate (dscfm)	37,154	36,031	37,084	36,756
Total Chromium (Cr) Emissions:				
• mg/dscm <sup>a</sup>	3.90E-02	4.43E-02	3.81E-02	4.05E-02
• lb/hr <sup>b</sup>	5.43E-03	5.99E-03	5.30E-03	5.57E-03
• lb/ton of glass	6.45E-04	7.11E-04	6.30E-04	6.62E-04
Hexavalent Chromium (Cr <sup>+6</sup> ) Emissions:				
• mg/dscm <sup>a</sup>	1.06E-04	9.22E-05	9.32E-05	9.72E-05
• lb/hr <sup>b</sup>	1.47E-05	1.24E-05	1.30E-05	1.34E-05
• lb/ton of glass	1.75E-06	1.47E-06	1.54E-06	1.59E-06
Glass Production (tons/day)	202.1	202.1	202.1	202.1
Type of glass	Amber	Amber	Amber	Amber
% Cullet	81	81	81	81
Raw material feed rate (tons/day)	242.3	242.3	242.3	242.3
Natural Gas Usage (kscf/hr)	153.4	147.7	148.7	149.9
Electric Boost (kWh/hour)	997.1	793.4	827.5	872.7
Bridgeway Temperature (°F)	2757	2789	2793	2780

<sup>a</sup> Average of the South and North stack values.

<sup>b</sup> Sum of South and North stack emission rates.

**TABLE 5: Furnace A South Stack (GM1) – PM**

TESTING PARAMETERS (PM)	Run 1	Run 2	Run 3	Average	Permit Limit
Test Date	5/20/2019	5/20/2019	5/20/2019	---	
Test Time	1146-1351	1531-1700	1731-1900	--	
Exhaust Gas Temperature (°F)	361	353	360	358	
Exhaust Gas Moisture (%)	5.0	4.7	4.6	4.8	
Exhaust O <sub>2</sub> (% dry vol)	17.3	17.2	17.4	17.3	
Exhaust CO <sub>2</sub> (% dry vol)	2.7	2.8	2.6	2.7	
Exhaust Gas Flow Rate (dscfm)	31,594	30,409	33,877	31,960	
Sample Volume (dscf)	43.410	41.847	46.311	43.856	
Isokinetic Variation (%)	100.2	100.3	99.6	100.0	
Filterable Mass of PM Collected (mg)	35.7	35.0	38.8	36.5	
Total Mass of PM Collected (mg)	100.4	71.8	102.4	91.5	
Filterable Particulate (PM) Emissions:					
• gr/dscf	0.013	0.013	0.013	0.013	
• lb/hr <sup>a</sup>	1.71	1.68	1.87	1.75	
Total Particulate (PM) Emissions:					
• gr/dscf	0.036	0.026	0.034	0.032	0.1
• lb/hr <sup>a</sup>	4.82	3.44	4.94	4.40	
% Opacity	3.9	3.6	3.5	3.7	20

<sup>a</sup> Stack only has flow for 30 minutes out of every hour.

**TABLE 6: Furnace A North Stack (GM1) – PM**

TESTING PARAMETERS (PM)	Run 1	Run 2	Run 3 <sup>a</sup>	Average	Permit Limit
Test Date	5/20/2019	5/20/2019	5/20/2019	---	
Test Time	1205-1411	1507-1706	1801-1930	--	
Exhaust Gas Temperature (°F)	413	418	405	412	
Exhaust Gas Moisture (%)	5.2	5.3	4.3	5.3	
Exhaust O <sub>2</sub> (% dry vol)	17.3	17.2	17.4	17.3	
Exhaust CO <sub>2</sub> (% dry vol)	2.7	2.8	2.6	2.7	
Exhaust Gas Flow Rate (dscfm)	31,827	32,047	31,826	31,937	
Sample Volume (dscf)	45.737	45.673	44.733	45.705	
Isokinetic Variation (%)	104.0	103.1	101.7	103.6	
Filterable Mass of PM Collected (mg)	45.3	41.5	40.3	43.4	
Total Mass of PM Collected (mg)	99.5	92.7	80.1	96.1	
Filterable Particulate (PM) Emissions:					
• gr/dscf	0.015	0.014	0.014	0.015	
• lb/hr <sup>b</sup>	2.08	1.92	1.89	2.00	
Total Particulate (PM) Emissions:					
• gr/dscf	0.034	0.031	0.028	0.032	0.1
• lb/hr <sup>b</sup>	4.57	4.29	3.76	4.43	
% Opacity	4.0	4.2	3.7	4.0	20

<sup>a</sup> Run 3 data is presented as informational only and is not included in the averages. See comment 1.

<sup>b</sup> Stack only has flow for 30 minutes out of every hour.



**TABLE 7: Furnace A South Stack (GM1) – Formaldehyde**

TESTING PARAMETERS (Formaldehyde)	Run 1	Run 2	Run 3 <sup>a</sup>	Average
Test Date	5/20/2019	5/20/2019	5/20/2019	--
Test Time	1146-1351	1531-1701	1730-1900	--
Exhaust Gas Temperature (°F)	353	359	351	354
Exhaust Gas Moisture (%)	5.1	6.6	5.0	5.8
Exhaust O <sub>2</sub> (% dry vol)	17.3	17.2	17.4	17.3
Exhaust CO <sub>2</sub> (% dry vol)	2.7	2.8	2.6	2.7
Exhaust Gas Flow Rate (dscfm)	34,561	30,331	31,240	32,446
Sample Volume (dscf)	32.402	29.894	30.146	30.998
Isokinetic Variation (%)	96.3	101.3	99.2	98.8
Total Mass of Formaldehyde Collected (µg)	<15.3	<12.8	<15.3	<14.1
Formaldehyde Emissions <sup>b</sup> :				
• ppmvd	<0.013	<0.012	<0.014	<0.013
• mg/dscm	<0.017	<0.015	<0.018	<0.016
• lb/hr <sup>c</sup>	<1.08E-03	<8.57E-04	<1.05E-03	<9.67E-04

<sup>a</sup> Run 3 data is presented as informational only and is not included in the averages. See comment 2.

<sup>b</sup> Formaldehyde was calculated using the MDL for each run.

<sup>c</sup> Stack only has flow for 30 minutes out of every hour.

**TABLE 8: Furnace A North Stack (GM1) – Formaldehyde**

TESTING PARAMETERS (Formaldehyde)	Run 1	Run 2	Run 3	Average
Test Date	5/20/2019	5/20/2019	5/20/2019	--
Test Time	1205-1411	1503-1700	1801-1930	--
Exhaust Gas Temperature (°F)	394	382	402	393
Exhaust Gas Moisture (%)	4.8	5.4	5.3	5.2
Exhaust O <sub>2</sub> (% dry vol)	17.3	17.2	17.4	17.3
Exhaust CO <sub>2</sub> (% dry vol)	2.7	2.8	2.6	2.7
Exhaust Gas Flow Rate (dscfm)	34,668	33,904	34,014	34,195
Sample Volume (dscf)	33.263	32.030	32.900	32.731
Isokinetic Variation (%)	99.8	98.3	100.3	99.6
Total Mass of Formaldehyde Collected (µg)	<16.2	<15.9	<15.2	<15.8
Formaldehyde Emissions <sup>a</sup> :				
• ppmvd	<0.014	<0.014	<0.013	<0.014
• mg/dscm	<0.017	<0.018	<0.016	<0.017
• lb/hr <sup>b</sup>	<1.11E-03	<1.11E-03	<1.01E-03	<1.09E-03

<sup>a</sup> Formaldehyde was calculated using the MDL for each run.

<sup>b</sup> Stack only has flow for 30 minutes out of every hour.

**TABLE 9: Furnace A South Stack (GM1) – Metals**

TESTING PARAMETERS (Sb, As, Be, Cd, Co, Cu, Pb, Mn, Hg, Ni, Se)	Run 1	Run 2	Run 3	Average
Test Date	5/21/2019	5/22/2019	5/23/2019	--
Test Time	930-1800	830-1643	830-1600	--
Exhaust Gas Temperature (°F)	354	355	350	353
Exhaust Gas Moisture (%)	5.0	5.0	5.0	5.0
Exhaust O <sub>2</sub> (% dry vol)	17.5	16.8	17.1	17.1
Exhaust CO <sub>2</sub> (% dry vol)	2.6	2.8	2.7	2.7
Exhaust Gas Flow Rate (dscfm)	32,485	33,794	35,868	34,049
Sample Volume (dscf)	142.022	148.762	159.300	150.028
Isokinetic Variation (%)	94.1	94.7	95.6	94.8
Antimony (Sb) Emissions:				
• mg/dscm	6.34E-03	<5.40E-03	<5.35E-03	<5.70E-03
• lb/hr <sup>a</sup>	3.85E-04	<3.41E-04	<3.59E-04	<3.62E-04
Arsenic (As) Emissions:				
• mg/dscm	1.20E-01	1.14E-01	1.08E-01	1.14E-01
• lb/hr <sup>a</sup>	7.27E-03	7.19E-03	7.25E-03	7.23E-03
Beryllium (Be) Emissions:				
• mg/dscm	<1.81E-05	<1.71E-05	<1.60E-05	<1.71E-05
• lb/hr <sup>a</sup>	<1.10E-06	<1.08E-06	<1.07E-06	<1.08E-06
Cadmium (Cd) Emissions:				
• mg/dscm	<3.59E-03	2.69E-03	<2.51E-03	<2.93E-03
• lb/hr <sup>a</sup>	<2.18E-04	1.70E-04	<1.69E-04	<1.86E-04
Cobalt (Co) Emissions:				
• mg/dscm	<4.60E-05	<4.37E-05	<4.77E-05	<4.58E-05
• lb/hr <sup>a</sup>	<2.79E-06	<2.76E-06	<3.20E-06	<2.92E-06
Copper (Cu) Emissions:				
• mg/dscm	5.45E-03	5.21E-03	4.94E-03	5.20E-03
• lb/hr <sup>a</sup>	3.31E-04	3.29E-04	3.31E-04	3.30E-04
Lead (Pb) Emissions:				
• mg/dscm	<2.86E-01	2.30E-01	<2.26E-01	<2.47E-01
• lb/hr <sup>a</sup>	<1.74E-02	1.45E-02	<1.52E-02	<1.57E-02
Manganese (Mn) Emissions:				
• mg/dscm	4.65E-04	4.57E-04	3.20E-04	4.14E-04
• lb/hr <sup>a</sup>	2.82E-05	2.89E-05	2.14E-05	2.62E-05
Mercury (Hg) Emissions:				
• mg/dscm	<6.45E-04	<4.32E-04	<3.89E-04	<4.88E-04
• lb/hr <sup>a</sup>	<3.92E-05	<2.73E-05	<2.61E-05	<3.08E-05
Nickel (Ni) Emissions:				
• mg/dscm	4.90E-04	4.63E-04	3.61E-04	4.38E-04
• lb/hr <sup>a</sup>	2.97E-05	2.92E-05	2.42E-05	2.77E-05
Selenium (Se) Emissions:				
• mg/dscm	2.38E-02	3.45E-02	2.36E-02	2.73E-02
• lb/hr <sup>a</sup>	1.44E-03	2.18E-03	1.58E-03	1.73E-03
% Opacity	3.8	3.4	3.2	3.5

<sup>a</sup> Stack only has flow for 30 minutes out of every hour.

'<' denotes results calculated using the MDL for front half or back half results that were non-detect.

**TABLE 10: Furnace A North Stack (GM1) – Metals**

TESTING PARAMETERS (Sb, As, Be, Cd, Co, Cu, Pb, Mn, Hg, Ni, Se)	Run 1	Run 2	Run 3	Average
Test Date	5/21/2019	5/22/2019	5/23/2019	--
Test Time	900-1630	900-1730	800-1530	--
Exhaust Gas Temperature (°F)	400	402	412	405
Exhaust Gas Moisture (%)	5.4	5.5	5.9	5.6
Exhaust O <sub>2</sub> (% dry vol)	17.5	16.8	17.1	17.1
Exhaust CO <sub>2</sub> (% dry vol)	2.6	2.8	2.7	2.7
Exhaust Gas Flow Rate (dscfm)	36,460	36,280	35,122	35,954
Sample Volume (dscf)	164.169	163.029	158.375	161.858
Isokinetic Variation (%)	99.6	99.4	99.8	99.6
Antimony (Sb) Emissions:				
• mg/dscm	<5.82E-03	<4.91E-03	<5.03E-03	<5.25E-03
• lb/hr <sup>a</sup>	<3.97E-04	<3.33E-04	<3.30E-04	<3.53E-04
Arsenic (As) Emissions:				
• mg/dscm	1.19E-01	1.07E-01	1.07E-01	1.11E-01
• lb/hr <sup>a</sup>	8.08E-03	7.26E-03	7.05E-03	7.46E-03
Beryllium (Be) Emissions:				
• mg/dscm	<1.57E-05	<1.56E-05	<1.61E-05	<1.58E-05
• lb/hr <sup>a</sup>	<1.07E-06	<1.06E-06	<1.05E-06	<1.06E-06
Cadmium (Cd) Emissions:				
• mg/dscm	5.02E-03	<3.30E-03	<3.33E-03	<3.88E-03
• lb/hr <sup>a</sup>	3.42E-04	<2.24E-04	<2.19E-04	<2.62E-04
Cobalt (Co) Emissions:				
• mg/dscm	<4.32E-05	<3.90E-05	<4.08E-05	<4.10E-05
• lb/hr <sup>a</sup>	<2.95E-06	<2.64E-06	<2.68E-06	<2.76E-06
Copper (Cu) Emissions:				
• mg/dscm	<5.89E-03	<5.32E-03	<5.12E-03	<5.44E-03
• lb/hr <sup>a</sup>	<4.01E-04	<3.61E-04	<3.36E-04	<3.66E-04
Lead (Pb) Emissions:				
• mg/dscm	3.23E-01	<2.84E-01	<2.50E-01	<2.86E-01
• lb/hr <sup>a</sup>	2.20E-02	<1.93E-02	<1.64E-02	<1.92E-02
Manganese (Mn) Emissions:				
• mg/dscm	5.34E-04	4.55E-04	6.21E-03	2.40E-03
• lb/hr <sup>a</sup>	3.64E-05	3.08E-05	4.08E-04	1.58E-04
Mercury (Hg) Emissions:				
• mg/dscm	7.29E-04	<3.95E-04	<4.79E-04	<5.34E-04
• lb/hr <sup>a</sup>	4.97E-05	<2.68E-05	<3.15E-05	<3.60E-05
Nickel (Ni) Emissions:				
• mg/dscm	4.90E-04	3.86E-04	5.50E-04	4.75E-04
• lb/hr <sup>a</sup>	3.34E-05	2.65E-05	3.61E-05	3.19E-05
Selenium (Se) Emissions:				
• mg/dscm	2.38E-02	2.89E-02	2.08E-02	2.45E-02
• lb/hr <sup>a</sup>	1.63E-03	1.96E-03	1.36E-03	1.65E-03
% Opacity	4.2	3.8	4.0	4.0

<sup>a</sup> Stack only has flow for 30 minutes out of every hour.

'<' denotes results calculated using the MDL for front half or back half results that were non-detect.

**TABLE 11: Furnace A South Stack (GM1) – Chromium & Hexavalent Chromium**

TESTING PARAMETERS (Cr & Cr <sup>+6</sup> )	Run 1	Run 2	Run 3	Average
Test Date	5/21/2019	5/22/2019	5/23/2019	--
Test Time	930-1800	830-1645	830-1600	--
Exhaust Gas Temperature (°F)	344	351	351	349
Exhaust Gas Moisture (%)	4.6	5.4	4.5	4.8
Exhaust O <sub>2</sub> (% dry vol)	17.5	16.8	17.1	17.1
Exhaust CO <sub>2</sub> (% dry vol)	2.6	2.8	2.7	2.7
Exhaust Gas Flow Rate (dscfm)	39,576	35,463	36,821	37,287
Sample Volume (dscf)	116.757	99.951	102.838	106.515
Isokinetic Variation (%)	94.5	95.4	94.6	94.8
Total Chromium (Cr) Emissions:				
• mg/dscm	3.98E-02	4.35E-02	3.30E-02	3.88E-02
• lb/hr <sup>a</sup>	2.95E-03	2.89E-03	2.28E-03	2.71E-03
Hexavalent Chromium (Cr <sup>+6</sup> ) Emissions:				
• mg/dscm	1.02E-04	1.04E-04	6.59E-05	9.06E-05
• lb/hr <sup>a</sup>	7.56E-06	6.91E-06	4.54E-06	6.34E-06

<sup>a</sup> Stack only has flow for 30 minutes out of every hour.

**TABLE 12: Furnace A North Stack (GM1) – Chromium & Hexavalent Chromium**

TESTING PARAMETERS (Cr & Cr <sup>+6</sup> )	Run 1	Run 2	Run 3	Average
Test Date	5/21/2019	5/22/2019	5/23/2019	--
Test Time	900-1630	900-1730	800-1530	--
Exhaust Gas Temperature (°F)	387	394	391	391
Exhaust Gas Moisture (%)	4.7	5.9	5.4	5.3
Exhaust O <sub>2</sub> (% dry vol)	17.5	16.8	17.1	17.1
Exhaust CO <sub>2</sub> (% dry vol)	2.6	2.8	2.7	2.7
Exhaust Gas Flow Rate (dscfm)	34,733	36,599	37,347	36,226
Sample Volume (dscf)	116.433	123.944	125.827	122.068
Isokinetic Variation (%)	97.1	98.1	97.6	97.6
Total Chromium (Cr) Emissions:				
• mg/dscm	3.82E-02	4.52E-02	4.32E-02	4.22E-02
• lb/hr <sup>a</sup>	2.48E-03	3.10E-03	3.03E-03	2.87E-03
Hexavalent Chromium (Cr <sup>+6</sup> ) Emissions:				
• mg/dscm	1.10E-04	8.03E-05	1.21E-04	1.04E-04
• lb/hr <sup>a</sup>	7.18E-06	5.51E-06	8.44E-06	7.04E-06

<sup>a</sup> Stack only has flow for 30 minutes out of every hour.

**TABLE 13: Furnace D (GM4) – PM**

TESTING PARAMETERS (PM)	Run 1	Run 2	Run 4	Average	Permit Limit / (EF)
Test Date	5/15/2019	5/15/2019	5/15/2019	--	
Test Time	932-1104	1144-1247	1345-1447	--	
Exhaust Gas Temperature (°F)	712	702	711	708	
Exhaust Gas Moisture (%)	15.6	15.4	14.0	15.0	
Exhaust O <sub>2</sub> (% dry vol)	6.7	7.1	6.8	6.9	
Exhaust CO <sub>2</sub> (% dry vol)	9.9	9.7	9.8	9.8	
Exhaust Gas Flow Rate (dscfm)	5,943	5,749	6,105	5,932	
Sample Volume (dscf)	43.348	41.448	44.064	42.953	
Isokinetic Variation (%)	96.5	95.4	95.5	95.8	
Filterable Mass of PM Collected (mg)	270.2	302.9	270.6	281.2	
Total Mass of PM Collected (mg)	349.5	372.6	311.8	344.6	
Filterable Particulate (PM) Emissions:					
• gr/dscf	0.096	0.11	0.095	0.10	
• lb/hr	4.89	5.55	4.95	5.13	
• lb/ton of glass	0.59	0.68	0.60	0.63	1
Total Particulate (PM) Emissions:					
• gr/dscf	0.12	0.14	0.11	0.12	0.1
• lb/hr	6.33	6.82	5.70	6.28	
• lb/ton of glass	0.79	0.85	0.70	0.78	(0.70)
% Opacity (6-min averages)	4.4	4.7	4.6	4.6	20
Glass Production (tons/day)	177.7	177.7	177.7	177.7	
Type of glass	AG	AG	AG	AG	
% Cullet	75	75	75	75	
Raw material feed rate (tons/day)	211.5	211.5	211.5	211.5	
Natural Gas Usage (kscf/hr)	24.00	23.36	24.10	23.82	
Electric Boost (kWh/hour)	696.6	696.6	696.6	696.6	
Bridgewall Temperature (°F)	2853	2853	2853	2853	

**TABLE 14: Furnace D (GM4) – Formaldehyde, SO<sub>2</sub>, NO<sub>x</sub>, CO, VOC**

TESTING PARAMETERS (Formaldehyde, SO <sub>2</sub> , NO <sub>x</sub> , CO, VOC)	Run 1	Run 2	Run 3	Average	Permit Limit / (EF)
Test Date	5/15/2019	5/15/2019	5/15/2019	---	
Test Time	932-1104	1144-1247	1345-1447	--	
Exhaust Gas Temperature (°F)	713	706	709	709	
Exhaust Gas Moisture (%)	15.6	15.7	15.4	15.5	
Exhaust O <sub>2</sub> (% dry vol)	6.7	7.1	6.9	6.9	
Exhaust CO <sub>2</sub> (% dry vol)	9.9	9.7	9.8	9.8	
Exhaust Gas Flow Rate (dscfm)	6,207	5,823	5,862	5,964	
Sample Volume (dscf)	38,792	36,964	37,292	37,683	
Isokinetic Variation (%)	97.1	98.6	98.9	98.2	
Formaldehyde Collected (µg)	<15.2	<16.6	<14.6	<15.5	
Formaldehyde Emissions <sup>a</sup> :					
• ppmvd	<0.011	<0.013	<0.011	<0.012	
• mg/dscm	<0.014	<0.016	<0.014	<0.015	
• lb/hr	<3.21E-04	<3.45E-04	<3.03E-04	<3.23E-04	
• lb/ton of glass	<4.34E-05	<4.66E-05	<4.09E-05	<4.36E-05	
Sulfur Dioxide (SO <sub>2</sub> ) Emissions:					
• ppmvd	406	374	380	387	
• lb/hr	25.1	21.7	22.2	23.0	
• lb/ton of glass	3.4	2.9	3.0	3.1	(1.8)
Nitrogen Oxides (NO <sub>x</sub> ) Emissions:					
• ppmvd	631	629	635	632	
• lb/hr	28.0	26.2	26.6	26.9	
• lb/ton of glass	3.8	3.5	3.6	3.6	(5.6)
Carbon Monoxide (CO) Emissions:					
• ppmvd	<1.1 <sup>b</sup>	<1.1 <sup>b</sup>	<1.1 <sup>b</sup>	<1.1 <sup>b</sup>	
• lb/hr	<0.031	<0.029	<0.029	<0.029	
• lb/ton of glass	<0.0041	<0.0039	<0.0039	<0.0040	
• lb/10 <sup>6</sup> scf of Natural Gas	<1.3	<1.2	<1.3	<1.3	(35)
VOC Emissions as Propane:					
• ppmvd	1.6	1.7	1.6	1.6	
• lb/hr	0.066	0.066	0.065	0.066	
• lb/ton of glass	0.0089	0.0089	0.0087	0.0089	
• lb/10 <sup>6</sup> scf natural gas	2.7	2.8	2.9	2.8	(5.8)
Glass Production (tons/day)	177.7	177.7	177.7	177.7	
Type of glass	AG	AG	AG	AG	
% Cullet	75	75	75	75	
Raw material feed rate (tons/day)	211.5	211.5	211.5	211.5	
Natural Gas Usage (kscf/hr)	24.00	23.36	22.25	23.20	
Electric Boost (kWh/hour)	696.6	696.6	696.6	696.6	
Bridgwall Temperature (°F)	2853	2853	2853	2853	

<sup>a</sup> Formaldehyde was calculated using the MDL for each run.

<sup>b</sup> CO results reported as less than 2% of span.

**TABLE 15: Furnace D (GM4) – Metals**

TESTING PARAMETERS (Sb, As, Be, Cd, Co, Cu, Pb, Mn, Hg, Ni, Se)	Run 1	Run 2	Run 3	Average
Test Date	5/16/2019	5/16/2019	5/17/2019	--
Test Time	850-1352	1507-1933	751-1216	--
Exhaust Gas Temperature (°F)	711	719	710	713
Exhaust Gas Moisture (%)	15.3	16.0	15.9	15.7
Exhaust O <sub>2</sub> (% dry vol)	6.8	7.4	7.3	7.2
Exhaust CO <sub>2</sub> (% dry vol)	9.4	9.4	9.6	9.5
Exhaust Gas Flow Rate (dscfm)	5,487	5,536	5,640	5,555
Sample Volume (dscf)	141.613	145.466	148.725	145.268
Isokinetic Variation (%)	96.9	97.0	97.3	97.1
Antimony (Sb) Emissions:				
• mg/dscm	9.43E-03	1.18E-02	1.04E-02	1.05E-02
• lb/hr	1.93E-04	2.45E-04	2.19E-04	2.19E-04
• lb/ton of glass	2.61E-05	3.31E-05	2.95E-05	2.96E-05
Arsenic (As) Emissions:				
• mg/dscm	1.72E-01	2.22E-01	1.99E-01	1.98E-01
• lb/hr	3.53E-03	4.59E-03	4.21E-03	4.11E-03
• lb/ton of glass	4.77E-04	6.20E-04	5.68E-04	5.55E-04
Beryllium (Be) Emissions:				
• mg/dscm	<4.14E-05	<4.13E-05	<4.34E-05	<4.20E-05
• lb/hr	<8.49E-07	<8.54E-07	<9.16E-07	<8.73E-07
• lb/ton of glass	<1.15E-07	<1.15E-07	<1.24E-07	<1.18E-07
Cadmium (Cd) Emissions:				
• mg/dscm	1.72E-02	<2.02E-02	<2.00E-02	<1.91E-02
• lb/hr	3.52E-04	<4.17E-04	<4.21E-04	<3.97E-04
• lb/ton of glass	4.76E-05	<5.63E-05	<5.68E-05	<5.36E-05
Cobalt (Co) Emissions:				
• mg/dscm	1.65E-04	2.21E-04	1.18E-04	1.68E-04
• lb/hr	3.38E-06	4.58E-06	2.48E-06	3.48E-06
• lb/ton of glass	4.56E-07	6.18E-07	3.35E-07	4.70E-07
Copper (Cu) Emissions:				
• mg/dscm	1.99E-02	2.15E-02	2.04E-02	2.06E-02
• lb/hr	4.08E-04	4.44E-04	4.31E-04	4.28E-04
• lb/ton of glass	5.51E-05	6.00E-05	5.81E-05	5.77E-05
Lead (Pb) Emissions:				
• mg/dscm	2.24	2.42	2.29	2.32
• lb/hr	4.60E-02	5.00E-02	4.84E-02	4.81E-02
• lb/ton of glass	6.21E-03	6.76E-03	6.53E-03	6.50E-03
Manganese (Mn) Emissions:				
• mg/dscm	7.28E-03	6.03E-03	3.32E-03	5.54E-03
• lb/hr	1.49E-04	1.25E-04	7.00E-05	1.15E-04
• lb/ton of glass	2.02E-05	1.69E-05	9.45E-06	1.55E-05
Mercury (Hg) Emissions:				
• mg/dscm	<2.63E-03	<2.78E-03	<2.17E-03	<2.53E-03
• lb/hr	<5.39E-05	<5.76E-05	<4.57E-05	<5.24E-05
• lb/ton of glass	<7.29E-06	<7.78E-06	<6.17E-06	<7.08E-06

'<' denotes results calculated using the MDL for front half and/or back half results that were non-detect.

**TABLE 15 Continued: Furnace D (GM4) – Metals**

<b>TESTING PARAMETERS (Sb, As, Be, Cd, Co, Cu, Pb, Mn, Hg, Ni, Se)</b>	<b>Run 1</b>	<b>Run 2</b>	<b>Run 3</b>	<b>Average</b>
<b>Test Date</b>	<b>5/16/2019</b>	<b>5/16/2019</b>	<b>5/17/2019</b>	<b>--</b>
<b>Test Time</b>	<b>850-1352</b>	<b>1507-1933</b>	<b>751-1216</b>	<b>--</b>
<b>Nickel (Ni) Emissions:</b>				
• <b>mg/dscm</b>	<b>7.63E-03</b>	<b>1.31E-02</b>	<b>7.50E-03</b>	<b>9.41E-03</b>
• <b>lb/hr</b>	<b>1.57E-04</b>	<b>2.71E-04</b>	<b>1.58E-04</b>	<b>1.95E-04</b>
• <b>lb/ton of glass</b>	<b>2.11E-05</b>	<b>3.66E-05</b>	<b>2.14E-05</b>	<b>2.64E-05</b>
<b>Selenium (Se) Emissions:</b>				
• <b>mg/dscm</b>	<b>1.13E-01</b>	<b>1.40E-01</b>	<b>1.35E-01</b>	<b>1.29E-01</b>
• <b>lb/hr</b>	<b>2.32E-03</b>	<b>2.89E-03</b>	<b>2.84E-03</b>	<b>2.68E-03</b>
• <b>lb/ton of glass</b>	<b>3.13E-04</b>	<b>3.90E-04</b>	<b>3.83E-04</b>	<b>3.62E-04</b>
<b>% Opacity (6-min averages)</b>	<b>5.4</b>	<b>5.3</b>	<b>5.3</b>	<b>5.3</b>
<b>Glass Production (tons/day)</b>	<b>177.7</b>	<b>177.7</b>	<b>177.7</b>	<b>177.7</b>
<b>Type of glass</b>	<b>AG</b>	<b>AG</b>	<b>AG</b>	<b>AG</b>
<b>% Cullet</b>	<b>75</b>	<b>75</b>	<b>75</b>	<b>75</b>
<b>Raw material feed rate (tons/day)</b>	<b>211.5</b>	<b>211.5</b>	<b>211.5</b>	<b>211.5</b>
<b>Natural Gas Usage (kscf/hr)</b>	<b>27.48</b>	<b>22.36</b>	<b>22.44</b>	<b>24.09</b>
<b>Electric Boost (kWh/hour)</b>	<b>754.5</b>	<b>754.5</b>	<b>813.6</b>	<b>774.2</b>
<b>Bridgwall Temperature (°F)</b>	<b>2,853</b>	<b>2,839</b>	<b>2,844</b>	<b>2,845</b>



**TABLE 16: Furnace D (GM4) – Chromium & Hexavalent Chromium**

TESTING PARAMETERS (Cr & Cr <sup>+6</sup> )	Run 1	Run 2	Run 3	Average
Test Date	5/16/2019	5/16/2019	5/17/2019	--
Test Time	850-1343	1507-1947	751-1238	--
Exhaust Gas Temperature (°F)	703	718	699	706
Exhaust Gas Moisture (%)	15.7	14.2	14.9	14.9
Exhaust O <sub>2</sub> (% dry vol)	6.8	7.4	7.3	7.2
Exhaust CO <sub>2</sub> (% dry vol)	9.4	9.4	9.6	9.5
Exhaust Gas Flow Rate (dscfm)	5,692	5,784	5,757	5,744
Sample Volume (dscf)	123.710	74.489	74.366	90.855
Isokinetic Variation (%)	94.3	93.0	93.3	93.6
Total Chromium (Cr) Emissions:				
• mg/dscm	0.074	0.120	0.150	0.115
• lb/hr	1.57E-03	2.60E-03	3.24E-03	2.47E-03
• lb/ton of glass	2.12E-04	3.51E-04	4.37E-04	3.33E-04
Hexavalent Chromium (Cr <sup>+6</sup> ) Emissions:				
• mg/dscm	<1.03E-04	<8.26E-05	<9.17E-05	<9.25E-05
• lb/hr	<2.20E-06	<1.79E-06	<1.98E-06	<1.99E-06
• lb/ton of glass	<2.97E-07	<2.42E-07	<2.67E-07	<2.69E-07
Glass Production (tons/day)	177.7	177.7	177.7	177.7
Type of glass	AG	AG	AG	AG
% Cullet	75	75	75	75
Raw material feed rate (tons/day)	211.5	211.5	211.5	211.5
Natural Gas Usage (kscf/hr)	27.48	22.36	22.44	24.09
Electric Boost (kWh/hour)	754.5	754.5	813.6	774.2
Bridgwall Temperature (°F)	2,853	2,839	2,844	2,845

'<' denotes results calculated using the MDL for results that were non-detect.

**TABLE 17: Furnace Operations**

<b>OPERATING PARAMETERS</b>	<b>Average during testing</b>	<b>May 2018 thru April 2019 90<sup>th</sup> Percentile</b>	<b>May 2018 thru April 2019 Average</b>
<b>Furnace A</b>			
• Glass Production (tons/day)	202.1	229.0	208.3
• % Cullet	81.0	78.0	73.3
• Natural Gas Usage (kscf/hr)	150.2	165.4	150.8
• Electric Boost (kWh/hour)	875.8	995.6	854.8
• Bridgewall Temperature (°F)	2,780.5	2810.7	2,796.3
<b>Furnace D (G56)</b>			
• Glass Production (tons/day)	177.7	189.8	180.3
• % Cullet	75.0	75.0	70.2
• Natural Gas Usage (kscf/hr)	23.6	23.8	22.0
• Electric Boost (kWh/hour)	754.9	912.6	749.9
• Bridgewall Temperature (°F)	2,849.1	2,870.0	2,832.1

**VII) Concerns & Comments:**

- 1) Furnace D sample port location does not meet the EPA Method 1 criteria of at least two stack or duct diameters downstream from any flow disturbance. Future sampling shall be done at a location that meets EPA Method 1 minimum upstream/downstream criteria for flow disturbances.
- 2) For the ODEQ Method 5 run 3 on the Furnace A North stack, the post test leak check was done at 11" of vacuum while the highest vacuum observed during the test run was 13.5". Per EPA Method 5, 8.4.4 *"shall be conducted at a vacuum equal to or greater than the maximum value reached during the sampling run."* The run data is presented in the table but not included in the averages.
- 3) For the EPA Method 316 run 3 on the Furnace A South stack, the post test leak check was done at 12" of vacuum while the highest vacuum observed during the test run was 15". Per EPA Method 316, 8.5.3.1 *"shall be conducted at a vacuum equal to or greater than the maximum value reached during the sampling run."* The run data is presented in the table but not included in the averages.
- 4) For the ODEQ Method 5 run 1 on the Furnace D stack, only 11 of 12 data points were recorded for the traverse on the second port, page 141.
- 5) On page 137, the field data sheet has the wrong nozzle diameter recorded. The nozzle diameter is 0.2132. The correct nozzle diameter was used in the report calculations.
- 6) The nozzle ID was not recorded on the field data sheets for the EPA Method 316 testing on Furnace D, pages 157-159. Based on the nozzle diameter recorded it appears that the nozzle ID should be 516, page 147.
- 7) Condition 8 of the Test Plan Approval stipulated, "Source testing should be done at the highest achievable operating rate but shall not be less than 90% of the maximum operating rate." Per the source sampling manual, normal maximum operating rate is defined as the 90<sup>th</sup> percentile of the average hourly operating rates during a 12 month period immediately preceding the source test.

During the source test Furnace A was only operating at 88.3% of the 90<sup>th</sup> percentile operating rate for the previous 12 month period.

- 8) Percent cullet usage was higher during the testing on Furnace A and Furnace D than the average cullet rates during 2018.
- 9) Furnace D was not producing green glass with the greatest potential to emit chromium.

**VIII) Overall Evaluation:** The test methods conducted and the data provided are sufficient to evaluate the emissions from the units at the operating conditions tested.

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