EMISSION TEST REPORT

Report Title:	Test Report for the Verification of Total Chromium Emissions from Hard Chrome Electroplating Operations
Report Date:	July 31, 2024
Test Date:	June 5, 2024

Facility Information	
Name:	Dart Container Corporation of Michigan, LLC
Street Address:	Building 5 3120 ½ Howell Road
City, County:	Mason, Ingham
Phone:	(517) 244-2452
SRN:	D8065

Facility Permit Information	
Permit No.:	MI-ROP-D8065-2020
Emission Units	EU-B5CHRMPLATR

Testing Contractor	
Company:	Impact Compliance & Testing, Inc.
Mailing Address:	4180 Keller Road, Suite B Holt, MI 48842
Phone:	(517) 268-0043
Project No.:	2400116

TABLE OF CONTENTS

		Page
1.0	**INTRODUCTION**	1
2.0	**SUMMARY OF RESULTS**	3
3.0	**SOURCE DESCRIPTON**	4
	3.1 General Process Description	4
	3.2 Emission Control System Description	4
	3.3 Process Operating Conditions during the Compliance Test	4
4.0	**SAMPLING AND ANALYTICAL PROCEDURES**	4
	4.1 Exhaust Gas Velocity and Flowrate (USEPA Methods 1 and 2)	5
	4.2 Exhaust Gas Molecular Weight	5
	4.3 Exhaust Gas Moisture Content (USEPA Method 4)	5
	4.4 Total Chromium Emission Rate (USEPA Method 306)	5
5.0	**QA/QC ACTIVITIES**	7
	5.1 Exhaust Gas Flow Measurement	7
	5.2 Meter Box Calibrations	7
	5.3 Total Chromium Recovery and Analysis	7
	5.4 Laboratory QA/QC Procedures	8
6.0	**TEST RESULTS AND DISCUSSION**	9
	6.1 Test Results and Allowable Emission Limits	9
	6.2 Variations from Normal Sampling Procedures or Operating Conditions	9

LIST OF TABLES

Table		Page
2.1	Summary of hard chrome electroplating process operating parameters.	3
2.2	Summary of hard chrome electroplating process test results	3
6.1	Measured exhaust gas conditions and pollutant emission rates for EU-B5CHRMPLATR	10

LIST OF APPENDICES

APPENDIX 1 TEST PROTOCOL APPROVAL LETTER

APPENDIX 2 SAMPLING LOCATION DRAWING

APPENDIX 3 OPERATING DATA

APPENDIX 4 EMISSION CALCULATIONS AND FIELD DATA SHEETS

APPENDIX 5 LABORATORY REPORT

APPENDIX 6 QA / QC DATA

TEST REPORT
FOR THE
VERIFICATION OF TOTAL CHROMIUM EMISSIONS
FROM
HARD CHROME ELECTROPLATING OPERATIONS

DART CONTAINER CORPORATION OF MICHIGAN, LLC
MASON, MICHIGAN

1.0 INTRODUCTION

Dart Container Corporation of Michigan, LLC (Dart) located in Mason, Ingham County, Michigan operates a hard chrome plating process installed under State of Michigan Permit to Install (air permit) No. 121-18 issued August 13, 2018 by the Michigan Department of Environmental Quality – Air Quality Division (MDEQ-AQD), now known as the Michigan Department of Environment, Great Lakes, and Energy, Air Quality Division (EGLE-AQD). This was later rolled into MI-ROP-D8065-2020 and is operated under said ROP.

The chrome plating system is used to provide a chrome finish to molds used for polystyrene product production. EU-B5CHRMPLATR consists of two chrome electroplating tanks (tanks 4A and 4B), each with a 2,000-amp rectifier and associated cleaning and rinse tanks (tanks 2, 3, 5, and 6) and evaporator. Emissions from each plating tank, 4A and 4B, are controlled using three-stage composite mesh pad scrubbers with a combined fourth stage HEPA filters.

Conditions of Permit No. MI-ROP-D8065-2020 require Dart to perform compliance testing at a minimum of every 5 years from the date of the last test to verify compliance with the emission rate limitations that are specified in the permit for EU-B5CHRMPLATR, and to establish allowable operating parameters. The last test event occurred June 13-14, 2019.

The testing was performed June 5, 2024. Testing performed by Impact Compliance & Testing, Inc. (ICT) representatives Clay Gaffey and Scott Herron. EGLE representatives David Rauch, Trevor Drost, and Clayton DeRonne witnessed the test event. The project was coordinated by Mr. Don Wiltse of Dart.

The sampling and analysis were performed using procedures specified in the test protocol documents dated April 30, 2024. This was approved by the EGLE-AQD before testing began on June 5, 2024.

Appendix 1 contains a copy of the test protocol approval letter as well as approval of testing requirement adjustments before testing.

Questions concerning the source and test report should be addressed to:

Testing Contractor:
Clay Gaffey
Environmental Consultant
Impact Compliance & Testing, Inc
4180 Keller Road, Suite B
Holt, MI 48842
(517) 481-3645
Clay.Gaffey@impactCandT.com

Site Operations:
Don Wiltse, CHMM
Environmental Engineer
Dart Container Corporation
500 Hogsback Road
Mason, MI 48854
(517) 244-2452
Don.Wiltse@dart.biz

Report Certification

This test report was prepared by Impact Compliance & Testing, Inc. based on field sampling data collected by ICT. Facility process data were collected and provided by Dart employees or representatives. This test report has been reviewed by Dart representatives and approved for submittal to the EGLE-AQD.

I certify that the testing was conducted in accordance with approved methods unless otherwise specified in this report. I believe the information provided in this report and its attachments are true, accurate, and complete.

Report Prepared By:

Clay Gaffey
Project Manager
Impact Compliance & Testing, Inc.

2.0 SUMMARY OF RESULTS

Exhaust gases from the hard chrome electroplating processes were sampled to determine the total chromium exhaust gas concentration. Three (3) two-hour test periods were performed for each system. Exhaust gas velocity measurements were performed during each test period to determine volumetric flowrate and pollutant mass emission rate. The average measured total chromium mass emission rates were less than the limits specified in MI-ROP-D8065-2020 and the Hard Chrome Electroplating NESHAP (Subpart N).

Table No. 2.1 presents a summary of the operating parameters measured during the testing.

Table No. 2.2 presents a summary of the total chromium test results.

The data presented in the tables below are the average for three (3) two-hour test periods. Data and measurements for each test period are presented at the end of this report in Section 6.0

Table 2.1 Summary of hard chrome electroplating line operating parameters

Operating Parameters:	Average Measured Value Pressure drop (inH_2O)				
Filter Stage	1st	2nd	3rd	HEPA	Total
EU-B5CHRMPLATR Tank No. 4A	0.76	0.50	0.96	1.44	3.88
EU-B5CHRMPLATR Tank No. 4B	0.56	0.70	0.99	1.44	3.76

Table 2.2 Summary of hard chrome electroplating process test results

Analyte	EU-B5CHRMPLATR
Total Chromium Conc. (mg/dscm) *NESHAP Limit (mg/dscm)*	5.00E-03 *0.006*

3.0 SOURCE DESCRIPTION

3.1 General Process Description

Dart operates a hard chrome electroplating line that contains two (2) chromium tanks; 4A and 4B. Hard chrome electroplating the surface of cup molds requires the parts to be chromic acid etched, dipped in various metal solutions, and put into the chromium plating bath. Once the parts are placed into the chromium plating system tanks, chrome is electrolytically deposited onto the coated cup mold in varying thicknesses depending on the application.

Process gas from the hard chrome electroplating processes is captured and exhausted to independent chrome separator / composite mesh pad scrubber control devices, which are used to reduce chromium emissions to the atmosphere.

3.2 Emission Control System Description

EU-B5CHRMPLATR (Tank Nos. 4A and 4B) are controlled by two 3-stage composite mesh pad scrubbers with a 4th stage HEPA filter which are routed to exhaust stack SV-CHROME/STRIP. The associated cleaning tank 2 is equipped with a wet packed bed fume scrubber.

Appendix 2 provides sampling location drawings for the scrubber exhaust.

3.3 Process Operating Conditions During the Compliance Testing

The facility typically operates <100% capacity; therefore, testing was performed using larger, obsolete molds that required a higher amperage setting of 1,500+ amps and were plated continuously during each test period. This results in a conservative, worst-case testing scenario and was approved by Trevor Drost of EGLE-AQD.

EU-B5CHRMPLATR processed the larger molds continuously at an amperage around 1,500 amps for each two (2) hour test period. The 3 stage local scrubbers with 4th stage HEPA filter for the chromium-containing process tanks (Tank Nos. 4A and 4B) average pressure drops are presented in Tables 2.1 and 6.1

Appendix 3 provides plating process and control device operating data for the test periods.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

A test protocol was prepared by ICT and submitted to the EGLE-AQD prior to performing the compliance test. This section provides a summary of the sampling and analytical procedures that were used during the tests and presented in the protocol.

Exhaust Gas Velocity and Flowrate (USEPA Methods 1 and 2)

Exhaust gas sampling was performed using stack sampling ports that satisfied USEPA Method 1 criteria. For EU-B5CHRMPLATR, these ports are located in the 17-inch diameter exhaust stack 58-inches (3.41 duct diameters) downstream of the nearest flow disturbance and 17.5-inches (1.02 duct diameters) upstream from the nearest flow disturbance.

To determine pollutant mass flow emission rates, the stack gas velocity was measured using procedures specified in USEPA Method 2 throughout each test period using the isokinetic sample probe. Gas velocity (pressure) measurements were performed at each traverse point with an S-type Pitot tube and red-oil manometer. Temperature measurements were conducted at each traverse point using a K-type thermocouple and a calibrated digital thermometer.

Appendix 4 provides copies of exhaust gas velocity field data sheets and flowrate calculations.

4.2 Exhaust Gas Molecular Weight

The exhaust gas consists of captured building air that has been drawn through the CMP system. A dry molecular weight of 29.0 was used as specified in Section 8.6 of USEPA Method 2.

4.3 Exhaust Gas Moisture Content (USEPA Method 4)

The moisture content of the scrubber exhaust gas was determined in accordance with the USEPA Method 4 chilled impinger method as part of the isokinetic sampling procedures for chromium (i.e., not as a separate measurement train). The amount of moisture removed from the sample stream by the chilled impingers was determined gravimetrically by weighing the impinger contents before and after the test period to determine net weight gain.

Appendix 4 provides moisture train sampling data and calculations.

4.4 Total Chromium Emission Rate (USEPA Method 306)

USEPA Method 306, Determination of Chromium Emissions from Decorative and Hard Chrome Electroplating and Chromium Anodizing Operations, was used to determine total chromium concentration in the scrubber exhaust gas. Process gas was withdrawn from the scrubber exhaust stack at an isokinetic sampling rate using a glass sampling nozzle, glass-lined probe and an impinger train containing 0.1N sodium hydroxide (NaOH) solution. Pursuant to USEPA Method 306, the sample probe was not heated, and the filter was omitted. Therefore, the glass probe liner was connected directly to the first impinger using a Teflon line.

Stack gas temperature and velocity pressure at each traverse point were monitored and recorded throughout each two-hour test period to determine volumetric flowrate.

At the conclusion of each two-hour test period the weight of each impinger was measured. The total silica gel moisture gain was determined gravimetrically, and the stack gas total moisture was determined based on the total weight gain of the impingers and silica gel. The sample nozzle, probe liner, first three impingers and connective glassware were rinsed using 0.1N NaOH solution. The rinse and impinger solutions were combined and shipped to Element One, Inc. (Wilmington, North Carolina) for analysis. Prior to shipment, the pH of the recovered solutions was checked using litmus paper to verify that the pH exceeded 8.5.

The total chrome content in the recovered solutions was determined by Element One, Inc. using inductively coupled plasma mass spectrometry (ICP-MS).

Appendix 5 contains a copy of the Element One laboratory report.

The total chromium concentration was determined using the laboratory reported chromium mass and the following equation:

$C_{Cr} = M_{Cr} / V_m / (1{,}000\ \mu g/mg)$

C_{Cr}	= Concentration of total Cr (mg/dscm)
M_{Cr}	= Mass Cr in recovered solutions (µg)
V_m	= Sample gas volume for test period (dscm)

Therefore:

T1:
12.90 (µg) / 2.43 (dscm) / (1,000 µg/mg) = 0.00531 mg/dscm

T2:
12.80 (µg) / 2.39 (dscm) / (1,000 µg/mg) = 0.00535 mg/dscm

T3:
9.97 (µg) / 2.29 (dscm) / (1,000 µg/mg) = 0.00435 mg/dscm

Average: 0.005 mg/dscm

Permit Limit: 0.006 mg/dscm

5.0 QA/QC ACTIVITIES

5.1 Exhaust Gas Flow Measurement

Prior to arriving onsite, the instruments used during the source test to measure exhaust gas properties and velocity (barometer, pyrometer, and Pitot tube) were calibrated to specifications in the sampling methods.

The absence of cyclonic flow for each sampling location was verified using an S-type Pitot tube and oil manometer. The Pitot tube was positioned at each of the velocity traverse points with the planes of the face openings of the Pitot tube perpendicular to the stack cross-sectional plane. The Pitot tube was then rotated to determine the null angle (rotational angle as measured from the perpendicular, or reference, position at which the differential pressure is equal to zero).

5.2 Meter Box and Isokinetic Rate

The dry gas metering console, which was used for the isokinetic sampling, was calibrated prior to and after the testing program. This calibration uses the critical orifice calibration technique presented in USEPA Method 5. The metering console calibration exhibited no data outside the acceptable ranges presented in USEPA Method 5.

The digital pyrometer in the metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.

The sampling nozzle diameter was determined using the three-point calibration technique.

The sampling rate for all test periods was within 10% of the calculated isokinetic sampling rate required by USEPA Methods 306 and 5.

5.3 Total Chromium Recovery and Analysis

All recovered total chromium samples were stored and shipped in pre-rinsed polyethylene sample bottles with Teflon® lined caps. The liquid level on each bottle was marked with a permanent marker prior to shipment and the caps were secured closed with tape. Samples of the reagent used in the test event (500 milliliters of 0.1N sodium hydroxide) was sent to the laboratory for analysis to verify that the reagent used to recover the samples has low total chromium content.

The glassware used in the total chromium train was washed and rinsed prior to use in accordance with the procedures of USEPA Method 306. The glass sample nozzle, probe liner and Teflon line were washed, rinsed and soaked in acid prior to use in accordance with USEPA Method 306. Analysis of the reagent blank indicated that its chromium content was less than the method detection limit (i.e., ND, or no chromium detected).

5.4 Laboratory QA/QC Procedures

The laboratory total chromium analyses were conducted by a qualified third-party laboratory according to the appropriate QA/QC procedures specified in the associated USEPA test methods and are included in the final report provided by Element One (Wilmington, NC).

Appendix 6 presents test equipment quality assurance data (meter box calibration records, cyclonic flow determinations sheets, Pitot tube, nozzle and probe assembly calibration records).

6.0 TEST RESULTS AND DISCUSSION

6.1 Test Results and Allowable Emission Limits

Operating data and air pollutant emission measurement results for each two-hour test period are presented in Table 6.1.

The measured total chromium concentrations and emission rates for EU-B5CHRMPLATR and are less than the allowable limits specified in MI-ROP-D8065-2020 and the NESHAP (Subpart N) for the operation of the individual processes:

- 0.006 mg/dscm for EU-B5CHRMPLATR

6.2 Variations from Normal Sampling Procedures or Operating Conditions

Non-applicable operating data requirements were included in the Approval Letter from EGLE-AQD. This was discussed prior to the test event and the following modifications to the Plan Approval are described below:

- Surface tension of the electroplating tank during each test run
  - This was stricken from requirements due to Dart not using fume suppressants or surface tension modifier additives in the processing tanks.
- Foam blanket thickness on the electroplating tank during each run
  - This was stricken from requirements due to Dart not using foam blankets on the plating tanks, or obstructive devices (like plastic balls).
- The amount, date, and time of fume suppressant added to the tank during testing and for the previous 15 days.
  - This was stricken from the requirements due to Dart not using fume suppressant additives on the plating tanks.

Also approved was deviating from normal operation to a more conservative continuous operating scenario that presents a continuous, worst-case testing scenario for each of the 2-hour test runs.

The email verification of this is attached to approval letter in Appendix 1

Table 6.1 Measured exhaust gas conditions and total chromium emission rates for EU-B5CHRMPLATR

Date Test No.	06/05/24 1	06/05/24 2	06/05/24 3	Three Test Average
Tank No. 4A scrubber dP (inH_2O)	--	--	--	--
1st Stage CMP	0.7	0.8	0.8	0.76
2nd Stage CMP	0.5	0.5	0.5	0.50
3rd Stage CMP	0.9	1.0	1.0	0.96
4th Stage HEPA	1.42	1.45	1.45	1.44
Total	3.8	3.9	3.9	3.88
Tank No. 4B scrubber dP (inH_2O)	--	--	--	--
1st Stage CMP	0.5	0.6	0.6	0.56
2nd Stage CMP	0.7	0.7	0.7	0.70
3rd Stage CMP	1.0	1.0	1.0	1.0
4th Stage HEPA	1.42	1.44	1.45	1.44
Total	3.7	3.8	3.8	3.76
Exhaust gas flowrate (dscfm)	3,515	3,371	3,350	3,412
Sample volume (dscm)	2.43	2.40	2.29	3.37
Total chromium catch weight (µg)	12.9	12.8	9.97	11.89
EU-B5CHRMPLATR Total Chromium Emissions				
Total chromium conc. (mg/dscm)	5.31E-03	5.35E-03	4.35E-03	5.00E-03
Permitted Limit (mg/dscm)	--	--	--	*0.006*