AIR EMISSION TEST REPORT

Title	AIR EMISSION TEST REPORT FOR THE VERIFICATION OF ALUMINUM FOUNDRY AIR POLLUTANT EMISSIONS
Report Date	July 5, 2018
Test Dates	May 8-10, 2018

Facility Information	
Name	Dicastal North America, Inc.
Street Address	1 Dicastal Drive
City, County	Greenville, Montcalm
SRN	N7688

Facility Permit Information	
Permit No.	78-15D
Emission Units	EU-ChipDryer and FG-Melting

Testing Contractor	
Company	Derenzo Environmental Services
Mailing Address	39395 Schoolcraft Road Livonia, MI 48150
Phone	(734) 464-3880
Project No.	1801086

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AIR EMISSION TEST REPORT
FOR THE VERIFICATION OF
ALUMINUM FOUNDRY AIR POLLUTANT EMISSIONS

DICASTAL NORTH AMERICA, INC.
GREENVILLE, MI

1.0 INTRODUCTION

Dicastal North America, Inc. (Dicastal) owns and operates a facility located in Greenville, Montcalm County (State Registration No. N7688) that manufactures aluminum alloy wheels. The facility consists of aluminum foundry and finishing processes. In the foundry, ingots and chips are melted in natural-gas fired melting furnaces and transferred to holding furnaces for low pressure die-casting.

Melting operations are identified in Permit to Install (PTI 78-15D) as Flexible group FG-Melting, which includes the melt furnaces, hold furnaces, and associated fluxing and dossing processes. Exhaust air collected from the melting operations is directed to a lime-injected baghouse.

The chips are recovered from downstream machining operations and returned to the foundry for remelting. Before melting, the metalworking fluid (oil/water coolant emulsion) is removed from the chips and the chips are dried in a thermal chip dryer (emission unit EU-ChipDryer). The effluent gas from the chip dryer is directed to a thermal oxidizer (TOX) for the reduction of organic compounds before being released to atmosphere.

The conditions of PTI 78-15D require that Dicastal verify the:

- Volatile organic compound (VOC) destruction efficiency of the EU-ChipDryer TOX and particulate matter (PM), PM-10, and PM-2.5 emission rates from EU-ChipDryer.

- PM, PM-10, PM-2.5, hydrogen chloride (HCl) and hydrogen fluoride (HF) emission rates from FG-Melting.

The compliance testing was performed by Derenzo Environmental Services (DES) representatives Andy Rusnak, Robert Harvey, Blake Beddow, Clay Gaffey, Kevin Anderson, and Tom Anderson.

The exhaust gas sampling and analysis was performed using procedures specified in the Test Plan dated March 9, 2018 that was reviewed and approved by the Michigan Department of Environmental Quality (MDEQ). Thomas Gasloli and Eric Grinstern of the MDEQ Air Quality Division (AQD) were onsite to witness portions of the test event.

Questions regarding this testing program should be directed to:

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Report Certification

This test report was prepared by Derenzo Environmental Services (DES) based on field sampling data collected by DES. Facility process data were collected and provided by Dicastal employees or representatives. This test report has been reviewed by Dicastal representatives and approved for submittal to the MDEQ.

I certify that the testing was conducted in accordance with the specified test methods and submitted test plan 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:

Robert L. Harvey, P.E.
General Manager
Derenzo Environmental Services

I certify that the facility and emission units were operated at maximum routine operating conditions for the test event. Based on information and belief formed after reasonable inquiry, the statements and information in this report are true, accurate and complete.

Emission Source Certification:

Jacob Kizer
Environmental Health & Safety Specialist
Dicastal North America, Inc.

2.0 SUMMARY OF TEST RESULTS AND OPERATING CONDITIONS

A summary of the measured EU-ChipDryer and FG-Melting emission test results is presented in Table 2.1 below. Process and control device operating data for each test period are presented in Section 3.0 of this report. Measured exhaust gas properties and pollutant emission rates for each test period are presented in Section 6.0 of this report.

Table 2.1 Summary of EU-ChipDryer and FG-Melting emission test results (three-test averages)

	EU-ChipDryer		FG-Melting	
	Measured	Permit Limit	Measured	Permit Limit
PM emissions (lb/hr)	2.32	0.58	0.25	2.92
PM-10 emissions (lb/hr)	2.79	0.51	0.43	2.68
PM-2.5 emissions (lb/hr)	2.79	0.26	0.43	1.89
VOC emissions (lb/hr)	0.15	--	--	--
VOC DE (% wt)	25%	>95%	--	--
HCl emissions (lb/hr)	--	--	<0.02	7.69
HF emissions (lb/hr)	--	--	<0.01	1.67

The inlet and exhaust of the EU-ChipDryer TOX was sampled for three test periods to determine the VOC destruction efficiency. Additionally, PM, PM-10, and PM-2.5 emissions were measured at the exhaust. Comparison to the allowable (permit limit) PM emission rate is based on the measured filterable PM emissions; comparison to the allowable PM-10 and PM-2.5 emission rates was based on the total of the measured filterable and condensable emission rates.

The test results indicate that the VOC destruction efficiency for the EU-ChipDryer TOX is less than 95% by weight, which is the minimum required by PTI 78-15D. However, the inlet VOC loading to the TOX is relatively low; less than 5.5 parts per million (ppmv measured as propane) and 0.3 pounds per hour (lb/hr). The TOX exhaust gas contained less than 3.5 ppmv VOC. The low TOX VOC loading is most likely attributed to the fluid removal unit installed upstream of the chip dryers. This is presented in more detail in Section 6.0 of this report.

The measured PM, PM-10, PM-2.5 emission rates at the EU-ChipDryer TOX exhaust exceeded the corresponding limits in PTI 78-15D.

The exhaust from the FG-Melting baghouse was sampled using two separate sampling trains to determine the emission rates for particulates (PM, PM-10, PM-2.5) and hydrogen halides (HCl, and HF). All measured emission rates are less than (in compliance with) the limits specified in PTI 78-15D.

3.0 SOURCE AND SAMPLING LOCATION DESCRIPTION

3.1 Process Descriptions

Dicastal operates an aluminum alloy wheel manufacturing facility. In the foundry, ingots and chips are melted in natural-gas fired melting furnaces and the molten aluminum is poured into molds to form the wheels. The chips are recovered from downstream machining operations and conveyed to the foundry for remelting. Before remelting, the metalworking fluid (oil/water coolant emulsion) is removed from the chips and the chips are dried in a thermal chip dryer (emission unit EU-ChipDryer).

3.1.1 EU-ChipDryer

Prior to entering the chip dryer, the chips run through a spinner that uses centrifugal force to mechanically remove excess metalworking fluid from the chips. The chips are then directed to the thermal chip dryer for volatilizing any remaining emulsion on the chips using natural gas combustion (6.0 MMBtu/hr) for heat.

Conditions of the permit specify that the feedstock to EU-ChipDryer shall only be unpainted / uncoated chips.

3.1.2 FG-Melting

Flexible group FG-Melting includes emission units EU-Melt1, EU-Melt2, EU-Chip1, EU-Chip2, EU-Hold1, EU-Hold2, and EU-LadleHood. PTI 78-15D provides the following descriptions for each emission unit included in this group.

EUMelt-1/EUMelt-2: 10.1 MMBtu/hr natural gas fired aluminum melting furnace…with a retaining capacity of 13.2 tons. A dry, solid fluxing agent is used for removing impurities in the molten aluminum. Nitrogen gas is bubbled through the molten aluminum to remove impurities. Ducted to a common lime injected baghouse.

EU-Chip1/EU-Chip2: 6.2 MMBtu/hr natural gas fired aluminum chip melting furnace…with a retaining capacity of 13.2 tons. A dry, solid fluxing agent is used for removing impurities in the molten aluminum. Nitrogen gas is bubbled through the molten aluminum to remove impurities. Ducted to a common lime injected baghouse.

EU-Hold1/EU-Hold2: 2.7 MMBtu/hr natural gas fired aluminum holding melting furnace…with a retaining capacity of 13.2 tons. A dry, solid fluxing agent is used for removing impurities in the molten aluminum. Ducted to a common lime injected baghouse.

EU-LadleHood: Fluxing and dossing station for transfer ladles. A dry, solid fluxing agent is used for removing impurities in the molten aluminum. Nitrogen gas is bubbled through the molten aluminum to remove impurities. Ducted to a common lime injected baghouse.

3.2 Air Emission Controls

The effluent gas from the chip dryer is directed to a high efficiency cyclone for PM control and a TOX for the reduction of organic compounds before being released to atmosphere. The TOX is a natural gas fired oxidation chamber that operates at a minimum temperature of 1292°F (700°C) and is equipped with an air-to-air heat exchanger (recuperator) that preheats the incoming gas stream from the chip dryer and cools the exhaust gas stream from the oxidation chamber. The exhaust is released to atmosphere through a vertical exhaust stack.

Air collected from the melting operations (FG-Melting) is directed to a lime-injected reverse-air pulse baghouse. The collected air is filtered in one of two parallel baghouse cells. The filtered air is drawn through a blower and directed to vertical exhaust stack.

Table 3.1 presents a summary of process and air pollution control device operating data for the emission test periods.

Attachment 1 provides operating records provided by Dicastal representatives for the test periods and a data sheet (SDS) for the metalworking fluid used in the machining process.

3.3 Sampling Locations

The EU-ChipDryer TOX exhaust gas is released to the atmosphere through a vertical exhaust stack that has an inner diameter of 32 inches. The stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location greater than 20 feet upstream and 30 feet downstream from any flow disturbance and satisfies the USEPA Method 1 criteria for a representative sample location.

The FG-Melting baghouse exhaust gas is released to the atmosphere through a vertical exhaust stack that has an inner diameter of 89.5 inches. The stack is equipped with four (4) sample ports, spaced every 90°, that provide a sampling location 7.5 feet (1 duct diameters) upstream and 15 feet (2 duct diameters) downstream from any flow disturbance and satisfies the USEPA Method 1 criteria for a representative sample location.

Individual traverse points were determined in accordance with USEPA Method 1.

Attachment 2 provides diagrams of the emission test sampling locations.

Table 3.1 Production process and pollution control device operating conditions for each emission test period

	Test 1	Test 2	Test 3	Average
EU-ChipDryer (PM/VOC)	5/8/2018	5/9/2018	5/9/2018	
24-hr clock	1600-1805	1237-1401	1437-1541	
Chip Dryer charge rate (ton/hr)	2.37	2.10	2.09	2.19
TOX chambert temp (°C)	731	727	729	729
TOX fan speed (scfm)	7,521	6,986	6,729	7,079
Chip dryer temp (°C)	167	186	199	184
Cyclone inlet (in H_2O)	-3.23	-1.01	-1.02	-1.75
Cyclone outlet (in H_2O)	-10.06	-6.80	-7.02	-7.96
FG-Melting (PM)	5/10/2018	5/10/2018	5/10/2018	
24-hr clock	1028-1252*	1342-1605†	1641-1854	
Baghouse side 1 dP (Pa)	1410	1403	1388	1400
Baghouse side 2 dP (Pa)	1283	1284	1264	1277
PM Loading (mg/m^3)	2.82	2.82	2.82	2.82
Inlet temperature (°C)	142	109	121	124
Lime injection (lb/hr)	5.90	5.90	5.90	5.90
Melt Furnace A (ton/hr)	2.37	3.05	2.99	2.80
Melt Furnace B (ton/hr)	2.45	2.25	1.80	2.17
Chip Furnaces (ton/hr)	2.66	1.02	2.53	2.07
FG-Melting (HCl/HF)	5/10/2018	5/10/2018	5/10/2018	
24-hr clock	1026-1217*	1324-1441†	1525-1647	
Baghouse side 1 dP (Pa)	1410	1403	1381	1398
Baghouse side 2 dP (Pa)	1285	1280	1265	1277
PM Loading (mg/m^3)	2.82	2.82	2.82	2.82
Inlet temperature (°C)	138	127	93	119
Lime injection (lb/hr)	5.90	5.90	5.90	5.90
Melt Furnace A (ton/hr)	2.77	1.80	3.12	2.56
Melt Furnace B (ton/hr)	2.19	3.03	2.70	2.64
Chip Furnaces (ton/hr)	2.80	1.01	1.85	1.89

* Furnace A was broadcast fluxed at 1036
† Chip Furnace B was fluxed at 1345

4.0 SAMPLING AND ANALYTICAL PROCEDURES

A test protocol for the air emission testing was reviewed and approved by the MDEQ-AQD prior to the test event. This section provides a summary of the sampling and analytical procedures that were used during the testing periods.

Attachment 3 provides a copy of the MDEQ-AQD test plan approval letter.

4.1 Summary of Sampling Methods

USEPA Method 1	Exhaust gas velocity measurement locations were determined based on the physical stack arrangement and requirements in USEPA Method 1
USEPA Method 2	Exhaust gas velocity pressure was determined using a Type-S Pitot tube connected to a red oil incline manometer; temperature was measured using a K-type thermocouple connected to the Pitot tube.
USEPA Method 3A	Exhaust gas O_2 and CO_2 content was determined using zirconia ion/paramagnetic and infrared instrumental analyzers, respectively.
USEPA Method 4	Exhaust gas moisture was determined based on the water weight gain in chilled impingers.
USEPA Method 5/202	Isokinetic sampling with gravimetrical analysis for filterable PM. Back half analysis for condensable PM.
USEPA Method 25A	VOC concentration in the TOX inlet and exhaust gas streams was determined using flame ionization analyzers.
USEPA Method 26A	Isokinetic sampling with ion chromatography analysis for HCl and HF emissions.

4.2 Exhaust Gas Velocity Determination (USEPA Method 2)

The exhaust gas velocity and volumetric flow rate were determined using USEPA Method 2 during each test period. For the EU-ChipDryer TOX inlet, a flow measurement was performed for each test period; the TOX and baghouse exhaust flow measurements were performed as part of the isokinetic sampling procedures. An S-type Pitot tube connected to a red-oil manometer was used to determine velocity pressure at each traverse point across the stack cross section. Gas temperature was measured using a K-type thermocouple mounted to the Pitot tube.

4.3 Exhaust Gas Molecular Weight Determination (USEPA Method 3A)

CO_2 and O_2 content in the stack exhaust gas streams was measured during each test period in accordance with USEPA Method 3A. A continuous sample of the exhaust gas was analyzed for CO_2 content using a single beam single wavelength (SBSW) infrared gas analyzer and O_2 content using a gas analyzer that uses a paramagnetic sensor.

Prior to, and at the conclusion of each test period, the instruments were calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document).

Diluent gas content in the TOX inlet gas stream was determined once per test period using a Fyrite® gas analyzer.

4.4 Exhaust Gas Moisture Content (USEPA Method 4)

Moisture content of the sampled gas streams was determined in accordance with USEPA Method 4 using a chilled impinger sampling train. For the EU-ChipDryer TOX inlet, an independent Method 4 chilled impinger sampling train was used for each test period. For the TOX and baghouse exhaust, moisture was determined as part of the isokinetic sampling procedures.

At the conclusion of each sampling period, the moisture gain in the impingers was determined gravimetrically by weighing each impinger to determine net weight gain.

4.5 Particulate Matter Emissions (USEPA Methods 5/202)

PTI 78-15D specifies PM, PM-10 and PM-2.5 emission limits for EU-ChipDryer and FG-Melting. Filterable particulate matter emissions (PM) were measured using USEPA Method 5. The front half of the sample train (from the sampling nozzle to the heated filter) captured filterable PM for comparison to the allowable PM emission limits. A USEPA Method 202 impinger train was added to the back half of the Method 5 sampling system to measure condensable particulate matter. The back half of the sampling train (from the exit of the heated filter, through the dry impingers, to the condensable PM filter) captured condensable PM. The filterable and condensable fractions were combined to determine total primary PM emissions (PM-10 and PM-2.5) for comparison to the PTI 78-15D limits.

At the end of each test period, the filterable PM and condensable PM (CPM) were recovered from the sample train using the procedures specified in Methods 5 and 202. The recovered filters and rinses were analyzed by Enthalpy Analytical in Wilmington, NC.

Attachment 4 provides the Enthalpy Analytical PM / CPM analytical report.

4.6 EU-ChipDryer TOX VOC Destruction Efficiency (USEPA Method 25A)

PTI 78-15D specifies a minimum VOC destruction efficiency (DE) of 95% by weight for the EU-ChipDryer TOX. The VOC DE was determined based on simultaneous sampling of the oxidizer inlet and exhaust gas streams during three (3) sampling periods. Total hydrocarbon (THC) concentration for the TOX inlet duct was measured using a Thermo Environmental Instruments (TEI) 51C heated flame ionization analyzer (FIA). The TOX outlet was monitored using a TEI 55I, an FIA instrument with an internal methane separation column. Propane was used as the calibration standard for both instruments.

The molecular weight of propane was used with the measured THC or nonmethane hydrocarbon (NMHC) concentration to calculate VOC mass flowrate for each gas stream. VOC destruction efficiency for each test period was calculated using the following equation:

$$DE_{VOC} = 1 - [(Q_{out} \times C_{NMHC,out}) / (Q_{in} \times C_{THC,in})] \times 100\%$$

Where:
- DE_{VOC} = VOC destruction efficiency (% wt)
- Q_{out} = Volumetric flowrate, oxidizer stack (scfm)
- $C_{NMHC,out}$ = Concentration NMHC measured at oxidizer stack (ppmv propane)
- Q_{in} = Volumetric flowrate, oxidizer inlet (scfm)
- $C_{THC,in}$ = Concentration THC measured at oxidizer inlet (ppmv propane)

4.7 FG-Melting HCl and HF Concentration Measurements (USEPA Method 26A)

HCl and HF concentration in the FG-Melting baghouse gas was determined using USEPA Method 26A. A continuous sample of the exhaust gas was bubbled through chilled impingers containing 0.1 normal sulfuric acid (0.1N H_2SO_4). All sample train components in contact with the gas stream were constructed of glass, except for the probe union, which was silonite-coated stainless steel.

At the end of each one-hour test period, the impinger solutions and rinses were recovered and shipped to Element One (Wilmington, NC) for HCl and HF analysis by ion specific electrode analysis in accordance with USEPA Method 26A.

Attachment 5 provides the Element One HCl / HF analytical report.

Attachment 6 provides field data sheets and emission calculations for EU-ChipDryer.

Attachment 7 provides field data sheets and emission calculations for EU-Melting.

Attachment 8 provides instrumental analyzer data for each test day.

5.0 QA/QC ACTIVITIES

5.1 Exhaust Gas Flow

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

The Pitot tubes and connective tubing were leak-checked prior to use to verify the integrity of the measurement system.

The absence of significant cyclonic flow at the measurements locations was verified using an S-type Pitot tube and oil manometer. The Pitot tube was positioned at each velocity traverse point 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 Gas Divider Certification (USEPA Method 205)

A STEC Model SGD-710C 10-step gas divider was used to obtain appropriate calibration span gases. The ten-step STEC gas divider was NIST certified (within the last 12 months) with a primary flow standard in accordance with Method 205. When cut with an appropriate zero gas, the ten-step STEC gas divider delivered calibration gas values ranging from 0% to 100% (in 10% step increments) of the USEPA Protocol 1 calibration gas that was introduced into the system. The field evaluation procedures presented in Section 3.2 of Method 205 were followed prior to use of gas divider. The field evaluation yielded no errors greater than 2% of the triplicate measured average and no errors greater than 2% from the expected values.

5.3 Instrument Calibration and System Bias Checks

At the beginning of each test day, initial three-point instrument calibrations were performed for the CO_2 and O_2 analyzers by injecting calibration gas directly into the inlet sample port for each instrument. System bias checks were performed prior to and at the conclusion of each sampling period by introducing the upscale calibration gas and zero gas into the sampling system (at the base of the stainless steel sampling probe prior to the particulate filter and Teflon® heated sample line) and determining the instrument response against the initial instrument calibration readings.

At the beginning of each test day, appropriate high-range, mid-range, and low-range span gases followed by a zero gas were introduced to the THC and NMHC analyzers, in series at a tee connection, which is installed between the sample probe and the particulate filter, through a spring-loaded check valve. After each one hour test period, mid-range and zero gases were re-introduced in series at the tee connection in the sampling system to check against the method's performance specifications for calibration drift and zero drift error.

The instruments were calibrated with USEPA Protocol 1 certified concentrations of CO_2 and O_2 in nitrogen and zeroed using nitrogen. The THC and NMHC instruments were calibrated with USEPA Protocol 1 certified concentrations of propane in air and zeroed using hydrocarbon-free air. A STEC Model SGD-710C ten-step gas divider was used to obtain intermediate calibration gas concentrations as needed.

5.4 Meter Box Calibrations and Isokinetic Sampling

The dry gas meter isokinetic sampling consoles were calibrated prior to and after the test event. This calibration uses the critical orifice calibration technique 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 diameter of each sampling nozzle used was verified with a micrometer using the 3-point measurement technique.

Calculations were performed to verify that the actual stack gas sampling rate was within 10% of the ideal isokinetic sampling rate for each test period.

5.5 Particulate Matter Recovery and Analysis

All recovered particulate matter samples were stored and shipped in pre-cleaned amber glass 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 reagents used in the test event (200 milliliters each of deionized high-purity water, acetone and hexane) were sent to the laboratory for analysis to verify that the reagents used to recover the samples have low particulate matter residues. QA/QC procedures used by the laboratory are included in the final report provided by Enthalpy Analytical.

The glassware used in the condensable PM impinger trains was washed and rinsed prior to use in accordance with the procedures of USEPA Method 202. The glassware was not baked prior to use; therefore, DES used the field train proof blank option provided in USEPA Method 202. Analysis of the field train proof blank collected from the sample train prior to use resulted in less than 1 milligram (mg) of recovered PM from the sample train.

In addition, a field train recovery proof blank was performed following the second sampling period. Analysis of the field train recovery proof blank resulted in 1.4 mg of recovered PM from the sample train.

5.6 HCl / HF Recovery and Analysis

All recovered Method 26A impinger solutions and rinses were stored in appropriate HDPE 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. A blank solution was prepared using 0.1 N H_2SO_4 and the high-purity water used for recovery and analyzed by the laboratory with the sample train solutions. QA/QC procedures used by the laboratory are included in the final report provided by Element One.

Attachment 9 presents test equipment quality assurance data (instrument calibration and system bias check records, calibration gas and gas divider certifications, dry gas meter calibration records, Pitot tube, nozzle, and probe calibration records, etc.).

6.0 RESULTS

6.1 Test Results and Allowable Emission Limits

6.1.1 EU-ChipDryer TOX VOC DE Test Results

The inlet and exhaust of the EU-ChipDryer TOX was sampled for three test periods to determine the VOC destruction efficiency. The EU-ChipDryer TOX VOC destruction efficiency test results are presented in Table 6.1.

The measured THC concentration at the TOX inlet was low; less than 5.5 ppmv. This resulted in measured NMHC concentrations at the TOX exhaust that were less than 3.5 ppmv. However, the calculated VOC destruction efficiency did not satisfy the minimum specified by PTI 78-15D, which is 95% by weight. At the measured VOC loading, the TOX outlet VOC concentration would have to be less than 0.3 ppmv to satisfy the 95% reduction criteria.

Based on information obtained from Dicastal, the low VOC inlet to the EU-ChipDryer TOX is likely attributable the efficacy of the machining fluid removal unit, which removes a majority of the oil water emulsion from the chips prior to the chip dryer. Additionally, the coolant used in the machining process has a low VOC content (approximately 0.5 pounds per gallon) and is diluted 9:1 with water when it is used. Therefore, the VOC emissions generated by the chip dryer, and controlled by the TOX, is much less than anticipated when the process was designed.

6.1.2 EU-ChipDryer PM Test Results

The EU-ChipDryer TOX exhaust was sampled for PM, PM-10, and PM-2.5 emission rate during each of the three destruction efficiency test periods. The measured PM and total PM (PM-10, PM-2.5) emission rates exceeded the corresponding permit limits. The EU-ChipDryer particulate matter emission test results are presented in Table 6.2.

The measured PM emission rate for Test 1 is approximately five times the measured emission rate for Tests 2 and 3. Based on a review of the recorded control device operating parameters (presented in Table 3.1 and Attachment 1), the cyclone operating pressures for Test 1 are significantly different as compared to Tests 2 and 3. However, the actual cause of this discrepancy is unknown.

The test period length was reduced from two hours to one hour based on the amount of particulate catch observed during Test 1.

6.1.3 FG-Melting Test Results

The exhaust from the FG-Melting baghouse was tested using two separate sampling trains; one for particulate matter and one for HCl/HF. The tests were performed over the same period of time, though the PM test periods were two hours each compared to one hour for the HCl/HF test periods. The FG-Melting particulate matter and HCl/HF emission test results are presented in Tables 6.3 and 6.4 respectively.

All measured emission rates are less than (in compliance with) applicable permit limits. The laboratory reported that the concentration of HCl and HF in the recovered impinger solutions was less than the method detection limits for all test periods with the exception of HCl in Test 1.

6.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing for all pollutants was performed in accordance with USEPA methods and the approved test protocol unless noted in this section.

Test 1 for EU-ChipDryer was a two-hour test. It was later determined that the process shut down with approximately 10 minutes remaining in the test period. Based on the PM loading observed for Test 1, the test periods for Test Nos. 2 and 3 were reduced to one hour each.

The sampled gas streams were relatively dry (5% moisture or less). A small amount of condensate was recovered in the Method 202 dry impingers. However, DES elected not to perform the Method 202 CPM nitrogen purge step due to the risk of contamination versus the limited benefit associated with purging a small quantity of condensate.

The isokinetic metering console used for the FG-Melting HCl/HF sample train was connected to an electricity generator that caused minor variability in the pump operation. As a result, one test period (Test 2) had a calculated isokinetic variation of greater than 10% (i.e., less than 90% of the ideal isokinetic sampling rate). Since HCl and HF are gaseous pollutants and the baghouse exhaust is a relatively dry gas stream (no water droplets or acidified PM were present) maintaining an isokinetic sampling rate is not imperative to obtaining accurate data and the results are not expected to be biased one way or another.

Table 6.1 EU-ChipDryer thermal oxidizer VOC destruction efficiency test results

	Test 1	Test 2	Test 3	Three
Date	5/8/18	5/9/18	5/9/18	Test
Test Times	1600-1753	1238-1401	1437-1541	Avg
TOX Operating Data				
Average Temperature (°C)	731	727	728	729
Minimum Temperature (°C)	727	724	721	--
TOX Inlet Gas				
Temperature (°F)	309	295	315	306
Flowrate (scfm)	8,448	7,706	7,409	7,855
Average THC conc. (ppmv C_3)	3.14	3.04	5.21	3.80
Calculated VOC mass flow (lb/hr)	0.18	0.16	0.27	0.20
TOX Exhaust Gas				
Temperature (°F)	860	791	809	820
Flowrate (scfm)	8,734	8,037	7,884	8,218
Average NMHC conc. (ppmv C_3)	2.31	2.40	3.31	2.68
Calculated VOC mass flow (lb/hr)	0.14	0.13	0.18	0.15
Calculated VOC Destruction				
1 - [TOX out / TOX in] x 100%	24%	18%	32%	25%
			DE Requirement	> 95%

Table 6.1 Notes
TOX VOC tests were conducted simultaneous with the PM test periods. Test 1 was cut short of two hours due to a process shutdown. The test periods for Tests 2 and 3 were reduced to one hour each.

Table 6.2 EU-ChipDryer particulate matter emission test results

Date Test Times	Test 1 5/8/2018 1600-1805	Test 2 5/9/2018 1237-1401	Test 3 5/9/2018 1437-1541	Three Test Avg
Stack Exhaust Gas Properties				
Temperature (°F)	860	791	809	820
Moisture (% vol)	4.4	4.5	5.0	4.6
Flowrate (scfm)	8,734	8,037	7,884	8,218
Flowrate (dscfm)	8,354	7,676	7,489	7,840
Filterable Particulate Matter				
Sample volume (dscf)	111	44.1	42.3	65.9
PM catch primary filter (mg)	227	14.3	20.4	87
PM catch acetone rinse (mg)	288	20.8	24.1	111
PM emission rate (lb/hr)	5.11	0.81	1.04	2.32
			PM Limit (lb/hr)	*0.58*
Condensable and Total PM				
CPM catch organic (mg)	13.3	4.9	6.5	8.2
CPM catch inorganic (mg)	37.8	12.2	14.5	21.5
CPM emission rate (lb/hr)	0.51	0.39	0.49	0.46
Total PM emission rate (lb/hr)	5.62	1.20	1.54	2.79
			PM10 Limit (lb/hr)	*0.51*
			PM2.5 Limit (lb/hr)	*0.26*

Table 6.2 Notes
Test 1 was a two-hour test. The test periods for Tests 2 and 3 were reduced to one hour each.
Total PM emission rate based on the sum of filterable and condensable PM emissions.

Table 6.3 FG-Melting particulate matter emission test results

	Test 1	Test 2	Test 3	Three
Date	5/10/2018	5/10/2018	5/10/2018	Test
Test Times	1028-1252	1342-1605	1641-1854	Avg
Stack Exhaust Gas Properties				
Temperature (°F)	240	213	220	224
Moisture (% vol)	3.1	2.4	2.5	2.6
Flowrate (scfm)	44,815	48,086	47,276	46,726
Flowrate (dscfm)	43,434	46,952	46,114	45,500
Filterable Particulate Matter				
Sample volume (dscf)	80.7	85.2	84.8	83.6
PM catch primary filter (mg)	2.47	1.59	0.47	1.51
PM catch acetone rinse (mg)	1.79	2.34	1.79	1.97
PM emission rate (lb/hr)	0.31	0.28	0.17	0.25
			PM Limit (lb/hr)	*2.92*
Condensable and Total PM				
CPM catch organic (mg)	0.80	0.92	0.75	0.82
CPM catch inorganic (mg)	2.31	1.39	1.28	1.66
CPM emission rate (lb/hr)	0.22	0.17	0.14	0.18
Total PM emission rate (lb/hr)	0.53	0.45	0.31	0.43
		PM10/PM2.5 Limit (lb/hr)		*2.68*
		PM10/PM2.5 Limit (lb/hr)		*1.89*

Table 6.3 Notes
Total PM emission rate based on the sum of filterable and condensable PM emissions.

Table 6.4 FG-Melting HCl and HF emission test results

Date Test Times	Test 1 5/10/2018 1026-1217	Test 2 5/10/2018 1324-1441	Test 3 5/10/2018 1525-1647	Three Test Avg
Stack Exhaust Gas Properties				
Temperature (°F)	241	223	186	217
Moisture (% vol)	3.4	2.6	2.2	2.8
Flowrate (scfm)	48,359	41,488	41,983	43,943
Flowrate (dscfm)	46,698	40,393	41,047	42,713
Sample Train Data				
Sample volume (dscf)	40.0	32.3	35.9	36.1
HCl catch weight (mg)	0.228	<0.064	<0.072	<0.121
HF catch weight (mg)	<0.069	<0.065	<0.074	<0.069
HCl/HF Emission Rates				
HCl emission rate	0.04	<0.01	<0.01 *HCl Limit (lb/hr)*	<0.02 *7.69*
HF emission rate	<0.01	<0.01	<0.01 *HF Limit (lb/hr)*	<0.01 *1.67*

Table 6.4 Notes
Non-detect results reported as less than (<) detection limit.