BTEC Inc.

Coating Machine
Permanent Total Enclosure Evaluation
Summary Report

Prepared for:

Hutchinson Antivibration Systems

Grand Rapids Plant
460 Fuller Avenue Northeast
Grand Rapids, Michigan 49503

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BTEC Inc.

Executive Summary

BT Environmental Consulting, Inc. (BTEC) was retained by Hutchinson Antivibration Systems (Hutchinson) to evaluate the permanent total enclosure status of eight coating application and drying machines and one solvent cleaning station at the Hutchinson facility located in Grand Rapids, Michigan. The purpose of the evaluation was to verify that the machines satisfy the criteria for permanent total enclosures as specified by Section 6 of Method 204 codified at Title 40, Part 51, Appendix M of the Code of Federal Regulations. Fieldwork for the Method 204 evaluation was completed on January 29, 2016.

The overall results of the Method 204 evaluation are summarized by Table 1.

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1.0 Introduction

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The following BTEC professionals participated in the completion this evaluation: Randal Tysar, Senior Environmental Engineer, and Shane Rabideau, Environmental Technician. Mr. James Niesen, Maintenance Manager with Hutchinson, provided on-site coordination for this project.

2.0 Process Description

Machines included in the evaluation are described in Michigan RO Permit No. MI-ROP-E5094-2012c as EUSIL01, EUSIL02, EUSIL03, EUSIL04, EUCOE01, and EUAMS02 as well as a solvent cleaning station. Since EUCOE01 and EUAMS02 each consist of two enclosures, the evaluation included a total of nine enclosures. These enclosures as well as their respective natural draft openings are summarized by Table 1. Each enclosure, with the exception of EUSIL02, has a single exhaust duct and EUSIL02 has two exhaust ducts. Each individual exhaust duct vents to a common header that routes the exhaust gas to a regenerative thermal oxidizer.

3.0 Evaluation Methodology

The procedure for verification of permanent total enclosure status is included in Sections 8.1 through 8.4 of Method 204. The procedure specifications as well as summaries of the methodologies used to satisfy Method 204, Sections 8.1 through 8.4 are summarized in Sections 3.1 through 3.4 of this report, respectively. The overall results of the Method 204 evaluation are summarized by Table 1.

3.1 NDO Distances

"Determine the equivalent diameters of the NDO's and determine the distances from each VOC emitting point to all NDO's. Determine the equivalent diameter of each exhaust duct or hood and its distance to all NDO's. Calculate the distances in terms of equivalent diameters. The number of equivalent diameters shall be at least four."

Table 1 summarizes, for each coating application machine, the NDO's, their equivalent diameters, and their distances from each VOC emitting point. The distances from each NDO to an exhaust duct or hood is not summarized because the criteria of Method 204, Section 5.2 does not apply to permanent total enclosures.

3.2 NEAR Ratio

"Measure the total surface area (AT) of the enclosure and the total area (AN) of all NDO's in the enclosure. Calculate the NDO to enclosure area ratio (NEAR) as follows:

$$NEAR = \frac{A_N}{A_T}$$

The NEAR must be ≤0.05."

Table 1 summarizes, for each coating application machine, the NDO's, the total area of the NDO's of each machine, the total surface area of the enclosure, and NEAR for each machine.

3.3 Average Facial Velocity

"Measure the volumetric flow rate, corrected to standard conditions, of each gas stream exiting the enclosure through an exhaust duct or hood using EPA Method 2. In some cases (e.g., when the building is the enclosure), it may be necessary to measure the volumetric flow rate, corrected to standard conditions, of each gas stream entering the enclosure through a forced makeup air duct using Method 2. Calculate FV using the following equation:

$$FV = \frac{Q_O - Q_I}{A_N}$$

Where:

QO= the sum of the volumetric flow from all gas streams exiting the enclosure through an exhaust duct or hood.

QI= the sum of the volumetric flow from all gas streams into the enclosure through a forced makeup air duct; zero, if there is no forced makeup air into the enclosure.

AN= total area of all NDO's in enclosure.

The FV shall be at least 3,600 m/hr (200 fpm). Alternatively, measure the pressure differential across the enclosure. A pressure drop of 0.013 mm Hg (0.007 in. H2O) corresponds to an FV of 3,600 m/hr (200 fpm)."

Exhaust gas flowrates were measured in triplicate for each duct exhausting air from each machine. Because all of the exhaust ducts were 12 inches in diameter or less, exhaust gas velocities were measured using a standard pitot tube and using the procedures of Methods 1A and 2C. There is a single exhaust duct from each machine with the exception of Silver Line 2, which has two exhaust ducts, for a total of ten exhaust ducts from which exhaust gas flowrates were measured. Five of the exhaust ducts are 12" in diameter and flow measurements included eight traverse points in each direction. Two of the exhaust ducts are 10" in diameter and flow measurements included six traverse points in each direction. Three of the exhaust ducts are 6" in diameter and flow

measurements included four traverse points in each direction. For each duct, the exhaust gas temperature was measured a single time and assumed to be the same at each traverse point. The exhaust gas molecular weight was ambient in each duct (i.e., 20.9% O_2 and 0% CO_2) and the exhaust gas moisture content was conservatively assumed to be 1% on each duct.

Exhaust gas flowrate results are summarized by Table 2. Exhaust gas flowratre summaries and field measurement sheets are included in Appendix A. Average NDO facial velocities for each machine are summarized by Table 1.

3.4 Flow Directions

"Verify that the direction of air flow through all NDO's is inward. If FV is less than 9,000 m/hr (500 fpm), the continuous inward flow of air shall be verified using streamers, smoke tubes, or tracer gases. Monitor the direction of air flow for at least 1 hour, with checks made no more than 10 minutes apart. If FV is greater than 9,000 m/hr (500 fpm), the direction of air flow through the NDOs shall be presumed to be inward at all times without verification."

On January 29, 2016, flow directions at each NDO were verified at 10 minute intervals for one hour using smoke tubes. The flow direction was clearly inward at each NDO. Flow direction verification field sheets for the smoke tube testing are included in Appendix B.

4.0 Overall Results

The overall results of the permanent total enclosure verification testing are summarized by Table 1.

TABLES

Table 1
Method 204 Evaluation Results Summary
Hutchinson Antivibration Systems
Grand Rapids, Michigan

Machine	NDO Description	NDO Dimensions[A]	NDO Area[B] (in^2)	NDO Equivalent Diameter[C] (in)	Distance to Nearest VOC Emitting Point[D] (in)	Section 5.1 - Number of NDO Diameters from Nearest VOC-Emitting Point[E]	Enclosure Average Exhaust Gas Flowrate[F] (scfm)	PTE Total NDO Area[G] (ft^2)	Section 5.4 - NDO Average Facial Velocity[H] (ft/min)	PTE Height (in)	PTE Width (in)	PTE Length (in)	Total PTE Area of Ceiling, Walls, and Floor[I] (ft^2)	Section 5.3 - Area of NDO's as % of PTE Surface Area[J]
Chain on Edge South Booth	Booth Entry	10" x 17"	170	14.7	127	9	605	1.48	410	94	69	120	361.8	0.4%
	Round Holes in Front of Enclosure Doors	3" (6)	7.07	3.0	42	14								
Chain on Edge North Booth	Booth Entry	10" x 17"	170	14.7	128	9	370	1.48	251	94	69	120	361.8	0.4%
	Round Holes in Front of Enclosure Doors	3" (6)	7.07	3.0	41	14								
Silver Line 1	Booth Entry	11" x 21"	231	17.1	16	1	1,251	3.27	382	78	86	86	289.1	1.1%
	Booth Exit	12" x 20"	240	17.5	83	5								
Silver Line 2	Booth Entry	10" x 17"	170	14.7	91	6	831	2.36	352	95	110	102	435.6	0.5%
	Booth Exit	10" x 17"	170	14.7	92	6								
Silver Line 3	Booth Entry	10" x 19"	190	15.6	15	1	932	2.77	336	78	86	86	289.1	1.0%
	Booth Exit	11" x 19"	209	16.3	75	5								
Silver Line 4	Booth Entry	10" x 19"	190	15.6	24	2	770	2.51	307	78	86	86	289.1	0.9%
	Booth Exit	9" x 19"	171	14.8	72	5								
AMS East Booth	Round Holes in Side of Enclosure	0.875" (8)	0.60	0.88	4	5	233	0.03	6,975	12	28	20	15.8	0.2%
AMS West Booth	Round Holes in Side of Enclosure	0.875" (8)	0.60	0.88	4	5	217	0.03	6,496	12	28	20	15.8	0.2%
Solvent Cleaning Station	Round Holes in Side of Enclosure	2" (3)	3.14	2.00	7	4	234	0.07	3,575	54	24	44	65.7	0.1%

Notes:

(A) All natural draft openings (NDO) consist of either rectangular openings or as a series of round holes. For example, the NDO's for the Chain on Edge South Booth consist of a rectangular opening at the part entry point that is 10" wide and 17" high and six 3" diameter round holes in the doors on the front of the coating machine.

(B) The NDO Area is the area of each NDO. For example, for the Chain on Edge South Booth:

$10" \times 17" = 170\ in^2$
$(3")^2 \times (pi/4) = 7.07\ in^2$

(C) For round holes, the diameter is the same as the hole diameter. For rectangular holes, the equivalent diameter is the diameter if a circle that would have the same area as the rectangle. For example, for the Chain on Edge South Booth:

$(170\ in^2)^{0.5} \times (4/pi) = 14.7\ in$

(D) For each NDO other than the solvent cleaning station NDO's, the distance to the nearest VOC emitting point is the distance from the NDO to the coating spray applicator tip. For the solvent cleaning station, the distance is the distance from the NDO's to the nearest outer edge of the solvent container.

(E) For example, for the Chain on Edge South Booth:

$(127\ in)/(14.7\ in) = 9$
$(42\ in)/(3\ in) = 14$

(F) The exhaust gas flowrate from each enclosure is summarized by Table 2 as well as the flowrate measurement summaries included in Appendix A.

(G) For example, for the Chain on Edge South Booth:

$(170\ in^2) + (6 \times 7.07\ in^2) = 212.42\ in^2$
$(212.42\ in^2)/144 = 1.48\ ft^2$

(H) For example, for the Chain on Edge South Booth:

$(605\ ft^3/min)/(1.48\ ft^2) = 410\ ft/min$

(I) For example, for the Chain on Edge South Booth:

Top and Bottom of Booth = $(69\ in \times 120\ in) = 8,280\ in^2$
Right and Left Side of Booth = $(94\ in \times 69\ in) = 6,486\ in^2$
Front and Back of Booth = $(94\ in \times 120\ in) = 11,280\ in^2$

$(8,280\ in^2 \times 2) + (6,486\ in^2 \times 2) + (11,280\ in^2 \times 2) = 52,092\ in^2$
$(52,092\ in^2)/144 = 361.8\ ft^2$

(J) For example, for the Chain on Edge South Booth:

$(1.48\ ft^2)/(361.8\ ft^2) \times 100 = 0.4\%$

Table 2
Exhaust Flowrate Measurement Summary
Hutchinson Antivibration Systems
Grand Rapids, Michigan

Exhaust Duct ID	Run 1 Flowrate (scfm)	Run 2 Flowrate (scfm)	Run 3 Flowrate (scfm)	3-Run Average Flowrate (scfm)
Silver Line 1	1,272	1,243	1,238	1,251
Silver Line 2 (East Exhaust)	493	480	473	482
Silver Line 2 (West Exhaust)	334	349	364	349
Silver Line 3	939	925	932	932
Silver Line 4	768	763	778	770
Chain on Edge North	386	362	361	370
Chain on Edge South	589	619	608	605
AMS East	245	233	222	233
AMS West	217	217	217	217
Cleanup Booth	231	214	257	234
			Silver Line 2 Average Total:	831