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INVESTIGATION OF THE TOXIC POTENCY OF THE COMBUSTION PRODUCTS OF *SUPRESS SED*, IN ACCORDANCE WITH ARTICLE 4, SECTION 27-335.1(2) AND ARTICLE 5, SECTION 27-348E OF THE BUILDING CODE OF THE CITY OF NEW YORK

FINAL REPORT
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ABSTRACT

Supress Products, LLC, located in San Rafael, California, submitted a material identified as *Supress SED,* for testing in accordance with the University of Pittsburgh Test Protocol for Measurement of Acute Lethality of Thermal Decomposition Products of Specimens (UPitt), issued December 1988. The material was described by the Client as a Sound Engineered gypsum wallboard laminated with acrylic adhesive.

When tested under the controlled laboratory conditions specified in this report, the LC_{50} value for *Supress SED* was 85.2 g. The Building Code of the City of New York requires the material to be "not more toxic than wood," which requires a passing value of greater than or equal to 19.7 g. Therefore, the *Supress SED* **meets** the requirements for interior finish material as defined by Title 27, Chapter 1, Subchapter 5, Article 5, of the Building Code of the City of New York. Detailed toxicity data can be found in the text.

This test method is intended to measure and describe the properties of materials, products, or assemblies in response to heat under controlled laboratory conditions, and should not be used to describe or appraise the fire hazard or the fire risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment, which takes into account all the factors that are pertinent to an assessment of the fire hazard of a particular end use.

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1.0 OBJECTIVE

The objective of this program was to obtain required data on the toxic potency of the combustion products of a test sample identified as *Supress SED* submitted for evaluation by Supress Products, LLC, of San Rafael, California. This sample was tested in accordance with *Title 27, Chapter 1, Subchapter 5, Articles 4* and *5* of the Building Code of the City of New York [1]. Article 4, Section 27-335.1(2) describes the requirements for exterior finish material. Article 5, Section 27-348(e) refers to interior finish material. The intent of this test was to evaluate the performance of the test article in relation to wood as required by both Sections 27-335.1(2) and 27-348(e) of the Building Code of the City of New York (NYC). The test procedure is a modification of the combustion toxicity protocol developed at the University of Pittsburgh.

This report contains a description of the material tested, the test procedure, and the test results. The test results only apply to the sample tested, in the manner tested, and not to the entire production of this material or similar materials, nor to the material's performance when used in combination with other materials.

2.0 TECHNICAL APPROACH

The major function of the University of Pittsburgh (UPitt) laboratory test method is to provide a means of evaluating the lethal toxic potency of thermal decomposition products of test materials [2].

The test protocol calls for samples to be subjected to continuously changing temperature conditions starting at 30°C and increasing at a rate of 20°C/min. The test system generates decomposition products that continuously change in chemical composition as the temperature increases. Animals are exposed to the decomposition products starting when the test sample loses one percent of its initial weight and continues for 30 min.

The UPitt protocol utilizes rodent (mouse) lethality as the primary source in evaluating the toxicity of the combustion atmosphere produced by a material. Groups of four animals at a time are exposed to the combustion gases generated from different initial quantities of the test material. This establishes a concentration-response relationship. From this relationship, the concentration (defined by the protocol as the weight of sample loaded into the test furnace) estimated to produce lethality in 50 percent of the animals within the specified time is obtained by interpolation. This concentration, commonly termed the LC_{50}, is a measure of the toxic potency of the combustion atmosphere. Animal lethality data are supplemented with observations of the eye condition of the test animals, expressed as "all apparently normal," "some apparent damage," or "some severe damage."

3.0 EXPERIMENTAL DESIGN

3.1 Description of Test Material

The test material was received from Supress Products, LLC, on September 21, 2006, and was described as shown in Table 1.

TABLE 1. DESCRIPTION OF MATERIAL.

Date Received	September 21, 2006
Date Tested	October 9 and 10, 2006
Material ID [1]	*Supress SED*
Trade Name [1]	Sound-Engineered Drywall
Sample Description [1]	Gypsum wallboard laminated with acrylic adhesive
Composition of Sample [1]	2 layers of gypsum wallboard, 1 layer of adhesive
Color	Off-white
Nominal Thickness	0.6 in. (15.7 mm)
Nominal Unit Weight	2.4 lb/ft^2 (11.9 kg/m^2)
Nominal Density	47.5 lb/ft^3 (0.8 g/cm^3)
Amount Received	5 panels, 12 × 12 in. (305 × 305 mm) each

[1] Information provided by the client

3.2 Combustion

The thermal decomposition of the test material was accomplished by heating the sample in the system depicted in Figure 1. The combustion device is a Lindbergh Box Furnace (Model 51894-S-PIT) with inside dimensions of 229 × 241 × 357 mm and a volume of 19.7 liters (l). The weighed test samples were heated, starting at a temperature no greater than 70°C, and increasing at a rate of 20 ± 2°C/min. A load cell connected to the sample platform continuously monitored sample mass.

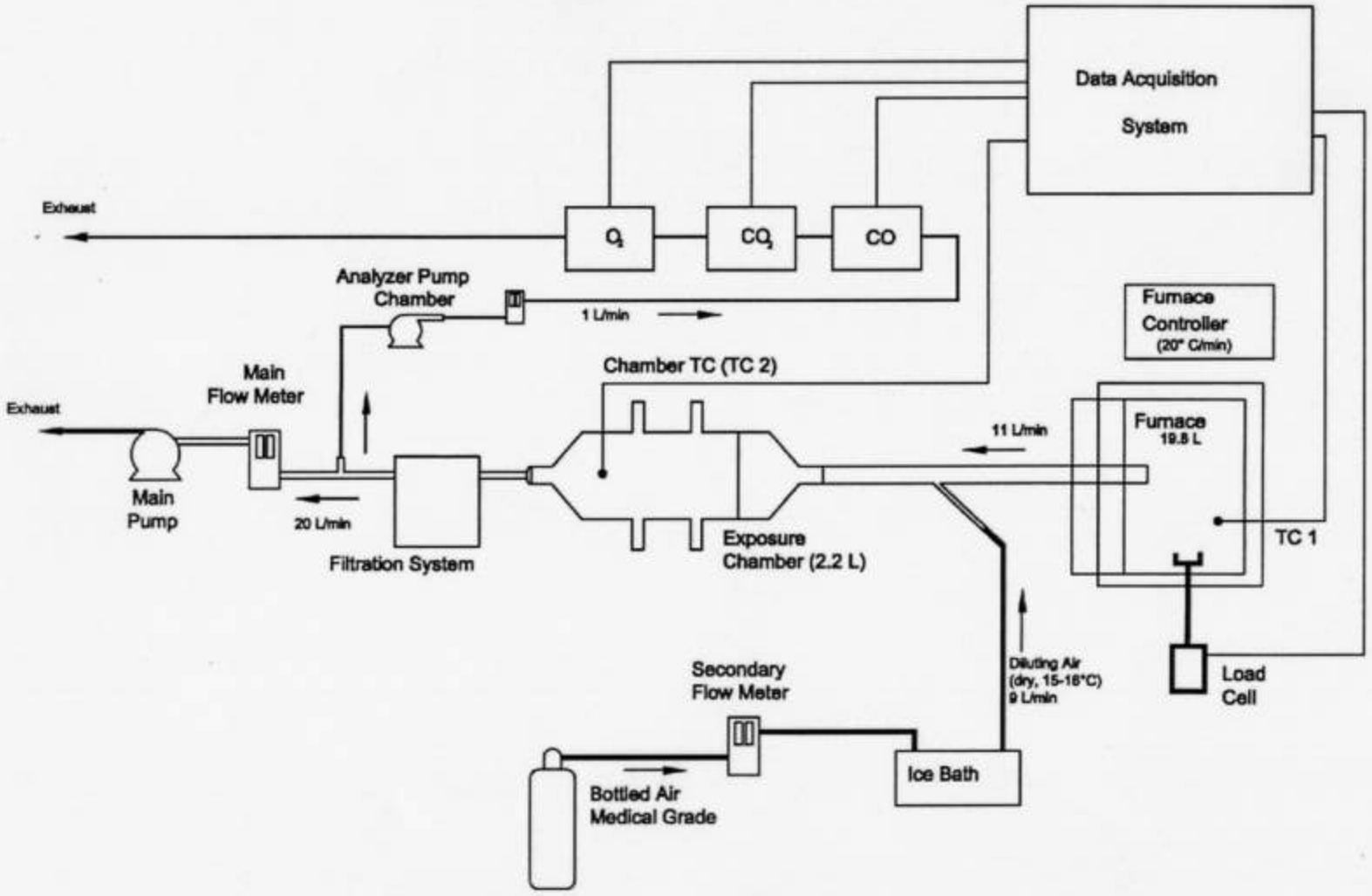

Figure 1. Schematic of the Test Apparatus.

The thermal decomposition products were transferred to the animal exposure chamber by a glass tube[1] approximately 0.80 m in length having an inside diameter of 19 mm. The furnace chamber was aspirated at a rate of 11 l/min. Furnace effluent was cooled and diluted by an additional 9 l/min of cooled medical grade breathing air, resulting in a total flow rate of 20 l/min through the animal chamber. The diluent air is run through coiled copper tubing (6.35 mm [0.25 in.] O.D.) immersed in an ice bath filled with ice and tap water. Prior to each test run, the accuracy of the flow meters was checked with a primary standard gas flow meter by connecting it to the inlet of the Pyrex glass tube leading to the animal exposure chamber. Values are obtained with and without the dilution air flowing into the test chamber. During each test, both flow meters were continuously monitored visually and readjusted to their pre-test setting as necessary.

3.3 Animals

Male Swiss Webster mice, weighing from 22 to 30 grams on the day of exposure, were used in these experiments. No formal randomization procedure was utilized in the selection of animals for each test group; animals were selected on the basis of appropriate body weight and obvious signs of good health.

The test animals were housed and cared for following standard procedures [3]. Facilities for housing and care of animals are accredited under the rules and regulations of the American Association for Laboratory Animal Sciences and are licensed by the USDA according to Public Law 91-579 (Animal Welfare Act of 1970).

3.4 Exposure

The weighed test sample was placed on a noncombustible substrate resting on the load cell pedestal within the furnace. The starting point for exposure of animals was established during an initial experiment with 45.0 grams of the test material by recording the temperature at which one percent of the sample mass was lost ($T_{1\%}$). This temperature (132.4°C) was used in ensuing runs as the temperature at which animal exposures were initiated. At $T_{1\%}$, the animal exposure chamber was quickly connected to the furnace and the 30-min exposure run initiated. Exposure chamber and furnace temperatures were monitored by thermocouples throughout the test period. Animal exposures were conducted for 30 min from the point of $T_{1\%}$. If all animals expired prior to 30 min, the test was terminated when recorded CO levels returned to baseline. All glassware was cleaned and dried between runs.

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1 As depicted in Figure 1, the glass *tube* is composed of two sections. The first section is manufactured of quartz and is inserted into the center region of the furnace chamber. The second section is manufactured of Pyrex® and has a sidearm for the connection of the diluting air supply. Ground glass ball joints and clamps provide airtight containment.

3.5 Biological Measurements

A sufficient number of experiments are typically conducted with varying amounts of sample weight to enable the development of the concentration-response relationship and the derivation of the LC_{50} and 95 percent confidence limits by the moving averages method of Weil [4]. Each experiment is followed by a 10-min recovery period, during which the animals are observed for lethality and examined for the presence of eye damage (corneal opacity), as required by the test method.

3.6 Combustion Atmosphere Analysis

Analysis for O_2, CO, and CO_2 was made continuously at a sampling rate of 0.5 to 1.0 l/min. The experimental setup for the analysis of CO, CO_2, and O_2 is shown in Figure 1. Routine calibration of the CO and CO_2 analyzers was performed prior to each day's testing. Calibration gases (0.7 percent CO, 3.5 percent CO_2, certified by Specialty Gas Products) were metered into the analyzers in the same way that unknown samples were introduced. The O_2 analyzer was calibrated with room air. Calibration of the analyzers was established to within one percent of full scale.

4.0 TEST RESULTS

The tests were conducted on October 9 and 10, 2006, at the Fire Technology Department of Southwest Research Institute (SwRI), located in San Antonio, TX. A summary of the test results presented in a manner consistent with the Building Code of NYC filing format (Section 27-131) is provided in Table 2. A tabular summary of the individual test runs is included in Appendix A. Performance characteristics of the test materials during thermal decomposition at the representative LC_{50} weight is provided graphically in Figure 2, showing continuous mass loss ($T_{1\%}$) and CO, CO_2, and O_2 levels as a function of furnace temperature. Additional curves depicting exposure chamber and furnace temperatures are provided in Appendix B.

When tested under the controlled laboratory conditions specified in this report, the LC_{50} value for *Supress SED,* was 85.2 g, with a 95 percent confidence interval of 64.5 to 112.5 g. The Building Code of the City of New York requires the material to be "not more toxic than wood," which has been established to require a passing value of greater than or equal to 19.7 g.

5.0 CONCLUSION

When tested in accordance with the combustion toxicity protocol developed at the University of Pittsburgh, the *Supress SED* **meets** the requirements for interior finish material as defined by Title 27, Chapter 1, Subchapter 5, Article 5, of the Building Code of the City of New York.

TABLE 2. SUMMARY OF UPITT/NYC TESTING

MATERIAL ID: *SUPRESS SED*

PERFORMANCE PARAMETER	RESULTS
LC_{50}	85.2
95% Confidence Limits	64.5 – 112.5 g
LA_{50}	–
95% Confidence Limits	–
Mean Percent Sample Residue	73.6%
Furnace Temperature at 1% Weight Loss *	132.4°C
Temperature Range at Major Decomposition**	205 – 425°C
Mean Temperature at Ignition	404°C
Peak CO**	4,790 ppm
Temperature at Peak CO**	436°C
Peak CO_2**	1.65%
Temperature at Peak CO_2**	487°C
Minimum O_2**	19.12%
Temperature at Minimum O_2**	484°C
Number of Times the Exposure Chamber Temperature Exceeded 45°C**	1
Average Duration of Temperature Excursion (min:sec)	24:40
Eye Condition of Test Animals*** (from LC_{50} test)	A
Number of Tests Conducted	4

* From test conducted at 45.0 grams

** From test conducted at representative LC_{50} weight

*** Eye condition characterized as:

A) All apparently normal
B) Some apparent damage
C) Some severe damage

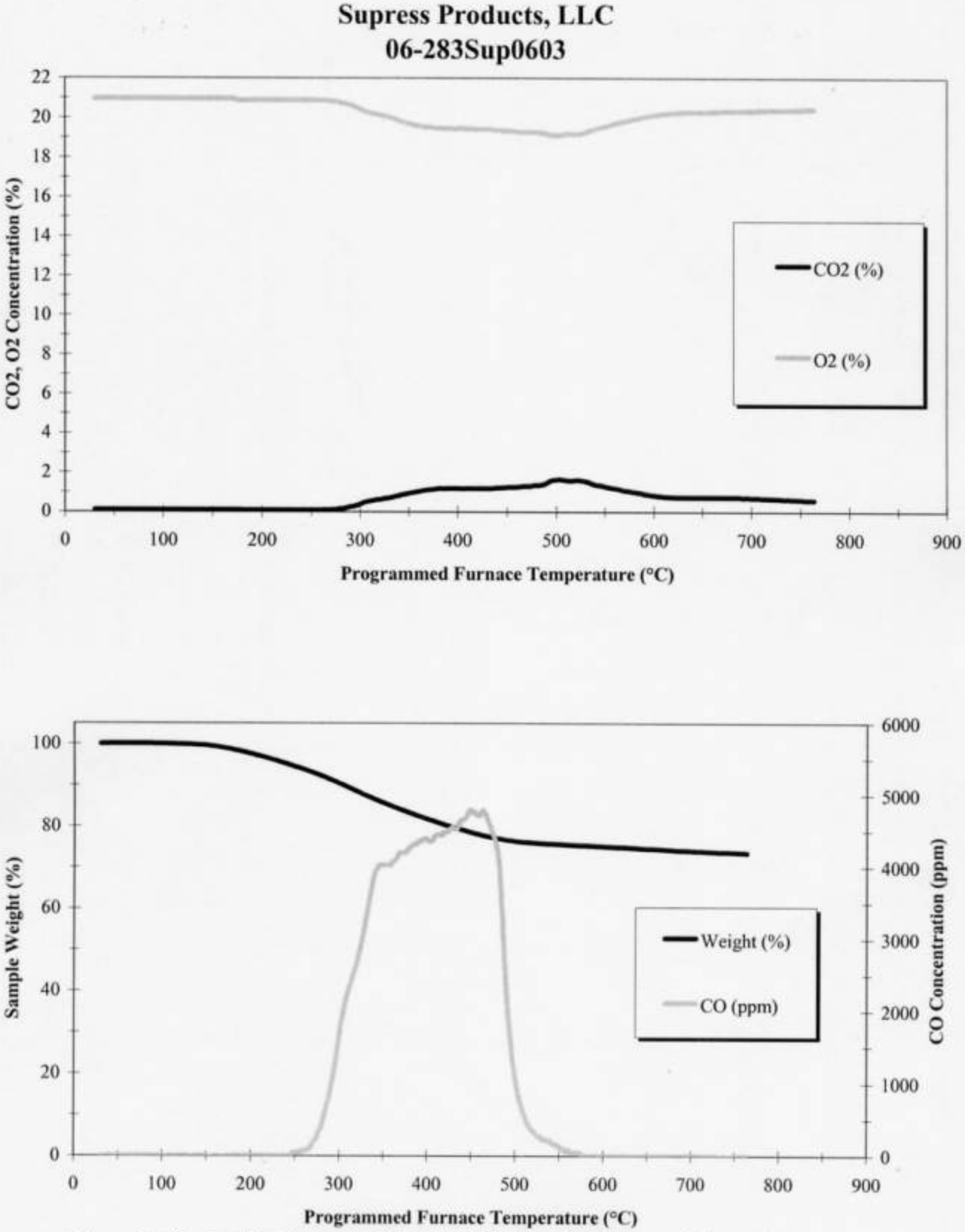

Figure 2. Physical Performance Characteristics During Decomposition at the Representative LC_{50} Weight.

6.0 REFERENCES

1. "Title 27 Construction and Maintenance, Chapter 1 - Building Code, Subchapter 5 - Fire Protection Construction Requirements," Building Code of the City of New York (1990-1991).

2. Alarie, Y. and Anderson, R.C. "Toxicology and acute lethal hazard evaluation of thermal decomposition products of synthetic and natural polymers," Toxicology and Applied Pharmacology, Vol. 51, 1979, pp. 341-362.

3. Guide for the Care and Use of Laboratory Animals, DHHS Publications No. (NIH) 85-23.

4. Weil, C. S., "Tables for Convenient Calculation of Median-Effective Dose (LD_{50} or ED_{50}) and Instrumentation for Their Use," Biometrics, Volume 8, pp. 249-261 (1952).

APPENDIX A

INDIVIDUAL SUMMARIES OF ANIMAL EXPOSURE DATA, ANALYTICAL DATA, AND MATERIAL PERFORMANCE CHARACTERISTICS

(Consisting of 1 Page)

TABLE A-1. SUMMARY OF ANIMAL EXPOSURE DATA, ANALYTICAL DATA, AND MATERIAL PERFORMANCE CHARACTERISTICS
SAMPLE: *SUPRESS SED*
LC_{50}: 85.2 (64.5 – 112.5) GRAMS
STARTING TEMPERATURE OF EXPOSURE: 132.4°C

	282Sup0601	282Sup0602	283Sup0603	283Sup0604
Sample Weight (g)	45.00	64.80	93.31	134.37
Percent Weight Loss	26.3	26.3	26.5	26.5
Flaming Temp. (°C)	ND	ND	305	503
Temp. Range at Most Rapid Weight Loss (°C)	193 – 393	210 – 420	205 – 425	225 – 445
Number Responding/Number Exposed	0/4	1/4	2/4	4/4
Percent Response	0	25	50	100
Maximum CO (ppm)	2,560	3,580	4,790	6,500
Total CO (Ct)(ppm-min)	22,018	33,917	41,023	47,878
Temperature at CO Maximum (°C)	363	368	436	450
Maximum CO_2 Concentration (%)	0.76	1.19	1.65	2.58
Total CO_2, (Ct)(percent-min)	13.67	19.37	24.55	32.73
Temperature at CO_2 Maximum (°C)	422	500	487	487
Minimum O_2 (%)	20.02	19.61	19.12	18.13
Temperature at O_2 Minimum (°C)	423	502	484	490
Eye Condition [1]	A	A	A	N/A

[1] Eye Condition of Surviving Animals
(A) All apparently normal
(B) Some apparent damage
(C) Some severe damage

N/A = Not Applicable
N/D = Not Detected

Average spontaneous ignition temp: 404°C
Residue (Sample Avg.): 73.6%

APPENDIX B

EXPOSURE CHAMBER AND FURNACE TEMPERATURES

(Consisting of 1 Page)

Supress Products, LLC
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