

Section V. Durability Toxicity & Environmental

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Chapter Twenty nine

Toxicity and Environmental Tests

EPA 24- US Testing Company, 2000

NES 713- VTEC Laboratory, 1996

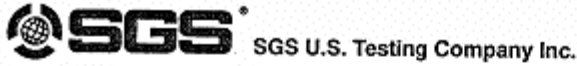
NYS Modified Pittsburgh Protocol- US Testing Company, 1996

ASTM E662- HPVA Laboratory, 1996

MIL M-14H- US Testing Company, 1989

ASTM D-3359- 1996

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291 Fairfield Avenue
Fairfield, NJ 07004-3833
Tel: 973-575-5252
Fax: 973-244-1694

Report Number: 136678
Date: 02/18/00
Page: 1 of 1

CLIENT: No Fire Technologies Inc.
Attn: Sam Godfried
21 Industrial Avenue
Upper Saddle River NJ 07458

REPORT OF TEST

SUBJECT: One (1) sample received on 02/09/00 and identified by the client as:

Nofire A18 #930759

AUTHORIZATION: Client's Purchase Order #00-NF859

PURPOSE: To measure VOC of the sample.

TEST DATES: 02/11/00 - 02/16/00

PROCEDURE: Testing was conducted in accordance with EPA 24 for VOC.

RESULTS:	% Solids	68.6%
	Density (lb/gal)	11.97 lb/gal
	(g/L)	1436g/L
	Water Content (%)	29.8%
	VOC (lb/gal)	0.336 lb/gal
	(g/L)	40.22 g/L

SIGNED FOR THE COMPANY BY:

Lisa Van Savage
Manager, Specialty & Applied Chemistry

Joseph Kwiatkowski
Director, Chemistry Department

/sm

Member of the SGS Group

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TOXICITY TESTING
PER NES 713
FOR NO FIRE TECHNOLOGIES
UPPERSADDLE RIVER, NJ
ON NO FIRE FORMULA A
VTEC # 100-590
TESTED: JANUARY 29, 1996



VTEC Laboratories Inc.

January 29, 1996

Client: NO Fire Technologies
21 Industrial Ave.
Uppersaddle River, NJ 07458

Attn: Mr. Sam Gottfried

Subject: Measure Toxicity Index of No Fire Formula A
Amount of toxicity generated in method of testing as stated by
Naval Engineering Standard 713 with the following changes:

1. No test for HBR
2. Maximum temperature 1346° F
3. Gas Flow for air and natural gas 10 L/m and 1.5 L/hr.
4. Sample weight 115 gms.
5. Combustion period minimum 7 min.-maximum 10 min.
6. Continuous monitoring of flame temperature with thermocouple.
7. Correction applied for non complete combustion.

This test result alone does not assess the fire hazard of the material, or a product made from this material, under actual fire conditions. Consequently, the results of this test alone are not to be quoted in support of claims with respect to the fire hazard of the material or product under actual fire conditions. The results when used alone are only to be used for research and development, quality control and material specifications.

The gases tested for are as follows:

Hydrogen sulfide, acrylonitrile, phosgene, sulfur dioxide, carbon monoxide, hydrogen cyanide, ammonia, formaldehyde, hydrogen chloride, hydrogen fluoride, phenol, carbon dioxide and nitrogen oxides.

The index is the average of 3 tests and corrected for background levels.

Notice: VTEC Laboratories Inc. will not be liable for any loss or damage resulting from the use of the data in this report, in excess of the invoice. This report pertains to the sample tested only. Such report shall not be interpreted to be a warranty, either expressed or implied as to the suitability or fitness of said sample for such uses or applications, as the party contracting for the report may apply such sample.

212 Manida Street, Bronx, New York 10474 • 718-542-8248 • FAX 718-542-8759

NES 713 TOXICITY TEST FOR NO FIRE TECHNOLOGIES

TEMPERATURE (F): 59.2
RELATIVE HUMIDITY (%): 39
BAROMETRIC PRESS.(Hg): 30.3
WEIGHT AFTER TOTAL BURN (g): 98.8
MATERIAL: NO FIRE FORMULA A

GAS	AVG. (PPM)	LETHAL LIMIT (PPM)
H2S	0.0	750
ACRYL	26.6	400
PHOS	0.0	25
SO2	78.7	400
CO	1,429.7	4,000
HCN	11.7	150
NH3	0.0	750
FORM	8.5	500
HCL	0.0	500
HF	0.0	100
PHENOL	0.0	250
CO2	93,803.3	100,000
NOX	37.9	250

TOXICITY INDEX = 1.8

DISCLAIMER:

This is a factual report of the results obtained from the laboratory test of sample products. The results may be applied only to the products tested and should not be constructed as applicable to other similar products of the manufacture. The report is not a recommendation or a disapprobation by VTEC Laboratories, Inc. of the material tested. While this report may be used for obtaining product acceptance, it may not be used in advertising.


Neil Schultz
Executive Director


Amirudin Rahim
Technical Director

VTEC LABORATORIES, INC. 100-590

Jan 29, 1996



291 Fairfield Avenue
 Fairfield, NJ 07004-3833
 Tel: 201-575-5252
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SGS U.S. Testing Company Inc.

Report Number: 202527
 Date: 05/10/96

REPORT OF TEST

**Acute Inhalation Toxicity of
 Thermal Degradation Products
 Using The NYS Modified
 Pittsburgh Protocol
 on**

NoFire® A18

Conducted for:

**NoFire Technologies, Inc.
 21 Industrial Avenue
 Upper Saddle River, NJ 07458-2301**

Worked Performed By:

Stefania Giobbe
 Associate Scientist

SIGNED FOR THE COMPANY BY:

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Report Number: 202527
Date: 05/10/96

Subject:

Sample submitted and identified by the Client as:

NoFire® A18

Chemical Composition:

One part non-flammable water based intumescent coating

Study Initiation:

May 1, 1996

Sample Description:

Beige color coating submitted on plate glass

Project Summary:

An inhalation test with laboratory mice was conducted in order to evaluate the acute inhalation health hazards associated with combustion products generated from certain building materials and interior finishes. The test used was based on a method developed by Dr. Yves Alarie of the University of Pittsburgh and is performed in accordance with the protocol and methodology as outlined and specified in the New York State Uniform Fire Prevention and Building Code, Article 15, Part 1120, Combustion Toxicity Testing, 9 NYCRR 1120 (2). 10 exposure dose levels were examined. The exposure dose levels ranged from 10 g to 170.9 g. Using the formula established by Weil (4), the LC50 of NoFire® A18 was estimated to be 41.68 g (95% CI N/A). Additional data are presented in Tables 1, and 2.

REPORT OF TEST

Introduction:

The purpose and intent of this safety test was to evaluate acute inhalation health hazards associated with combustion products generated from certain building materials and interior finishes. In this bioassay test procedure, laboratory mice were exposed to thermal decomposition products generated from the test article under standard conditions to evaluate the lethal potential of such thermal decomposition products (1).

This procedure was performed in accordance with the protocol and methodology as outlined and specified in the New York State Uniform Fire Prevention and Building Code, Article 15 Part 1120 Combustion Toxicity Testing, 9 NYCRR 11 20 (2), and documented in United States Testing Co., Inc. Test Procedure SOP/TOX UPITTS.046.

Principle of the Test

Groups of laboratory mice were restrained in an all-glass chamber (head only exposure) and exposed for 30 minutes to thermal decomposition products generated from the test article under controlled heating conditions. By combusting different sample charge masses, a "dose"-lethality profile for the thermal decomposition products was obtained. These data would then be transformed by appropriate statistical methods to calculate a median lethal concentration (LC50) for the thermal decomposition products generated from the test article. In addition to the calculated LC50 value, ancillary data regarding exposure conditions and the production of certain toxic gases were recorded and amended to the report. Such information served to validate the test procedure and was part of the data required for registering materials with the New York State Department of State, Office of Fire Prevention and Control.

REPORT OF TEST

REPORT OF TEST

Materials and Methods:

Apparatus/Equipment: Refer to Test Apparatus Setup for configuration of test apparatus.

Furnace, Programmer, Sample Holder and Mass Sensor

Lindberg Model 51894-5 special box furnace (22.9x22.9x35.6cm) with Model 59344-ES-B programmable control console. This special order furnace with access holes had a 3,500 W rating with a maximum operating temperature of 1100°C.

The programmer was capable of heating the furnace at a linear rate of 20°C/min from ambient temperature to 1000°C. Temperature was monitored by a Type K thermocouple. Within the furnace, a ceramic crucible sample holder was placed on a quartz pedestal. The pedestal extended through the bottom wall of the furnace and rests on a balance mass sensor. This balance, Scientech Model 3340, with a remote sensor unit, measured sample mass loss as the sample degraded in the box furnace.

Both the furnace temperature and the sample mass were recorded continuously via output to a two-channel Linseis Model L 601 flatbed strip chart recorder.

Glassware and All-glass Exposure Chamber

These custom made items were manufactured by Kontes Scientific Glassware, Vineland, N.J. to specification as directed in NYS UFPBC Article 15.

Exposure Chamber Atmosphere Monitoring

Temperature within the animal exposure chamber was monitored with a 0-60°C NBS traceable thermometer. Atmosphere concentrations of a carbon monoxide (CO) and carbon dioxide (CO₂) were continuously monitored using a non-dispersive infrared analyzer, a Horiba MEXA 311-GE. These gas concentration measurements were continuously recorded with another Linseis two-channel recorder. Oxygen concentrations in the exposure chamber were monitored at defined intervals with a Lynn Product oxygen analyzer. Hydrogen cyanide (HCN) was measured by the use of direct sample Drager detector tubes only at selected run.

Control of Dynamic Inhalation System

The Pittsburgh test was a dynamic inhalation system and was driven by a vacuum pump (Gast Manufacturing Model DOA-P104BAA) capable of pulling a mixture of air from furnace (11 LPM) and chilled dilutant air (9 LPM) through the exposure chamber for a total of 20 LPM. Airflows were controlled by 0-20 and 0-30 LPM flowmeters (Dwyer).



REPORT OF TEST

Test Animals

The animal model for the bioassay was the Swiss-Webster albino male mouse (22-30gm). Animals were housed and cared for following standard procedures (3). Test animals 5 to 7 weeks old were ordered from a registered USDA supplier. Upon receipt, animals were housed in groups of four in clear polycarbonate caging (29 x 19 x 13cm) with wood shaving bedding. Pelleted food and water were available ad libitum. Animals were held for observation for at least 7 days prior to testing to ensure healthy subjects were used in testing. All animal receipt records and acclimation records were kept in laboratory files in chronological order and available for inspection.

There was no randomization procedure used in this type of study. The animals used in this study, however, were selected without bias from a pool of animals provided that they met the health and body weight requirement.

The test animals were uniquely identified by markings on their tails. They were housed post exposure, whenever appropriate, in the polycarbonate caging of not more than four test animals per cage. An index card or label on the cage identified the test animals by their test run numbers, date of the test run and weight of sample of the test run.

Source

Ace Animals, Boyertown, PA

Animal Receipt Date

04/09, 04/16, and 04/30/96.

Sample Preparation

Prior to initiating testing, all samples evaluated by this procedure were stored for at least 48 hours in a controlled (40%-60% relative humidity) environment and ambient temperature.

Test Apparatus

All glassware and the exposure chamber were cleaned and dried between test runs. The furnace and programmer and all electrical equipment were switched on and allowed to stabilize for 15 minutes prior to adjustments or calibrations. The air chiller ice bath was filled with ice and tap water. All gas concentration analyzers (O₂, CO, CO₂) were calibrated on a weekly basis and prior to LC50 run using certified standard calibration gases. The test sample mass balance was also calibrated daily.

REPORT OF TEST

Test Procedure

Four test animals in the 22 to 30gm range were used for each run. Each of the four was placed in an animal holder with the head extending through the perforated rubber dental dam seal (reinforced with duct tape) into the exposure chamber. The animals were secured and acclimated for 10 minutes with room air-pulled through the system. During acclimation, air flowmeters were adjusted to allow 9 LPM of air to come through the chiller and 11 LPM from the furnace for a total air flow through the exposure system at 20 LPM.

The test sample was placed in the sample holder within the furnace. For the initial run, a sample mass of 10gm was used. Upon verification that the sample weight sensor and recorder were correct and match, the temperature programmed furnace was activated from ambient temperature to increase at 20°C/min. The temperature at which 1% of the sample weight was lost was recorded. At this time, the exposure chamber was quickly connected to the furnace and the 30 minute exposure run was initiated.

During the 30 minute exposure, the furnace temperature, the sample ignition temperature and exposure chamber atmospheric conditions (CO₂, CO, O₂ and temperature °C) were monitored. At the end of the 30 minute exposure, the final sample weight was noted and the exposure chamber was disconnected from the furnace. Room air was drawn through the exposure chamber at 20 l/min for a 10 minute recovery period for the animals. Animals were then removed from the chamber and the eyes of the surviving animals were examined for corneal opacities. The number of dead animals was recorded.

After a dose-lethality relationship had been established for a test article by exposing groups of mice to at least four different sample charges, the LC50 value, in grams, was calculated by the method of Weil (4). Using this calculated sample charge, one additional test run, without animals, was performed to obtain representative test temperatures and gas analyses for the test article.

The test animals were observed not less than 10 minutes apart during the exposure. Per request of Client, test animals that survived the 30 minute exposure might be kept alive for an additional 48 hours. During the 48 hours post exposure period, the test animals were to be observed not less than once per 24 hours.

Experimental Results:

The results of this sample are presented in Table 1, & 2. The sample began to decompose at 292°C and decomposed throughout with 58.0% of the sample remaining after the 30 minutes of heating. Flaming ignition occurred at 368°C (Detectable autoignition in 6 of 10 runs).

10 exposure dose levels were examined. The exposure dose levels ranged from 10 g to 170.9 g. Using the formula established by Weil (4), the LC50 of NoFire® A18 was estimated to be 41.68 g (95% CI N/A).

The maximum level of CO, CO₂ were 7,000 ppm and 2.0% respectively, at the LC50 sample run. Oxygen level consistently remained above 18.1%.

REPORT OF TEST

REPORT OF TEST

Table 1
Summary of Results

Description of Test Article: Beige color coating submitted on plate glass

Number of Test Performed: 10

LC50: 41.68 g (95% CI N/A)

Furnace Temperature at 1% Sample Mass Loss (°C): 292

Mean Furnace Temperature of Sample Autoignition (°C): 368
(Detectable autoignition in 6 of 10 runs)

Furnace Temperature range of most rapid weight loss (°C): 290-950

Number of time and average duration exposure chamber exceed 45°C:
0 Time for 0 minutes and 0 seconds (LC50 run)

Post-exposure condition of test animal eyes: slight irritation

Mean Residue (%): 58.0

Table 2
 Test Run with LC50 Sample

REPORT OF TEST

Variables Measured	Sample: NoFire® A18
Decomposition and Exposure start at (°C)	292
LC50 (Grams) (95% C.I.) =	41.68 N/A
LT ₅₀ (Minutes) (Temp. °C)	12:00 550
Size of Sample (inches)	N/A Sample submitted as coating on plate glass
Max CO (ppm)	7.000
Time (min)	12:00
Temp (°C)	550
Min O ₂ (%)	18.1
Time (min)	18:00
Temp (°C)	656
Max CO ₂ (%)	2.0
Time (min)	14:00
Temp (°C)	590
Residue After Burning (%)	57.7
Flaming Ignition (°C)	Non Detected

References:

1. 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.
2. Criteria and Procedures for Designation of Testing Laboratories Acceptable to the Secretary of State (in the manner set forth in 19 NYCRR 431).
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 (LD50 or ED50) and instruction for their use", Biometrics, Vol. 8, 1952, pp. 249-261.
5. Round-Robin Study of LC50 of various woods performed under auspices of the Department of Buildings, Material and Equipment Division, City of New York. Data submitted 1989.

REPORT OF TEST

TEST APPARATUS SET UP

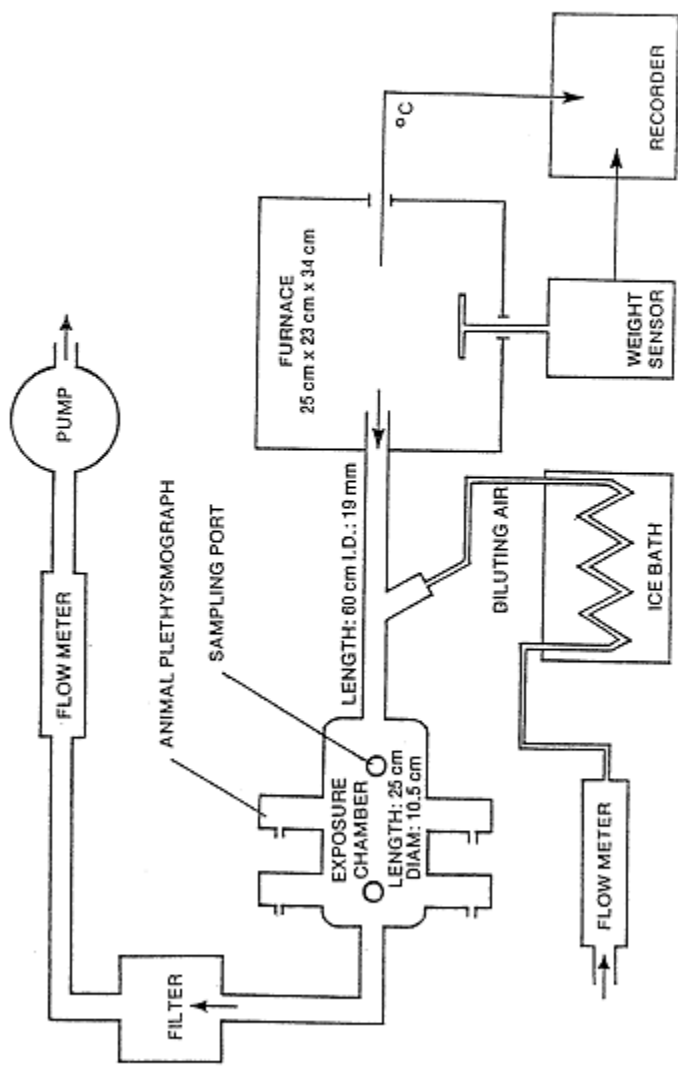


Figure No. 1



Appendix

LIMITS OF ACCEPTABILITY
FOR SAMPLE WITH 25% OR LESS CI OR F
IN THE COMBUSTIBLE PORTION

Mass

The passing value based on weight has been defined to be 19.7 grams. This mean value was obtained from 44 experiments conducted in four (4) laboratories which are certified by New York City for the conducting of the Pittsburgh Test. The study included oak, mahogany, Douglas fir and pine. Data from these tests are presented in Table I.

Surface Area

The passing values for surface area are defined on the basis of data presented in Table I. To compare favorably, the surface area of the candidate product must be as large or larger than the surface area of wood as determined in the studies reported there. The following interpretation will be applied.

<u>Product Thickness</u>	<u>Passing Value</u> ² (MM ²)
Up to and including 1/28" (1.0 mm)	31,392
More than 1/28" up to and including 3/32" (2.5 mm)	12,120
More than 3/32" up to and including 3/16" (5.0 mm)	5,730
More than 3/16" up to and including 3/8" (10.0 mm)	3,469
More than 3/8" (10.0 mm)	2,396

The Passing Value for Floor Covering

The passing value for floor covering is 1,635 mm². This is based on data presented in Table 2.



Procedure for Evaluation of Borderline Values

When a test value is close to but less than the passing value, the manufacturer can "prove" that it is not different than the reference number by establishing a series of test values upon which a statistical analysis may be performed. If the statistical analysis (t test) shows that the specimen is no different than wood, the product will be considered to be acceptable. For this purpose, a coefficient of variation of 25% will be used for the appropriate wood value selected for comparison with the candidate product. Thus, this is not a traditionally interpreted absolute boundary between pass and fail since specimens with a value close to the boundary may be tested further.

For Sample with Greater Than 25% Cl or F in the Combustible Portion

If the principal toxicant is HCl, a direct comparison of LC₅₀ values cannot be extrapolated to man. HCl is 7 to 10 times more potent to humans than to mice. If, in a mouse test, the principal toxic agent is HCl, a correction for the extra susceptibility of humans must be made before a meaningful prediction or comparison can be made.

In the interest of human not rodent safety, the test value for the smoke in which HCl or HF is the principal toxicant must be divided by a correction factor of seven (7). This is the comparison which satisfies the building code of New York City.

The same adjustment for potency differential between species will be required when HF is emitted as the principal toxicant.

Indication that Halogen (HCl or HF) is Principal Toxicant

If the combustible portion of a product contains more than 25% Cl or F, it can be assumed that the principal toxicant will be HCl or HF or that the halogen acid makes a highly significant contribution to the lethal effect. However, a chemically complex specimen containing Cl or F may exert its lethal effect via CO or HCN in spite of the presence of the halogen. Judgment concerning the use of the correction factor will be made according to the following paradigm.

1. For a specimen containing at least 25% or more Cl or F in the combustible portion and for which the CO is suspected of being the principal toxicant.

If the CO level measured in the experiment, using the LC₅₀ mass, is greater than 4000 ppm at the time of death of the test animals, the CO, not the halogen acid, will be considered the principal toxicant and the correction factor is not to be applied.

If, for the above specimen, the CO is less than 4000 ppm the halogen acid will be considered to be the principal toxicant and the correction factor is to be applied.



2. For a specimen containing at least 25% Cl or F in the combustible portion for which the HCN is suspected of being the principal toxicant.

If the HCN level measured in the experiment, using the LC₅₀ mass, is greater than 177 ppm at the time of death of the test animals, the HCN, not the halogen acid, will be considered the principal toxicant and the correction factor is not to be applied.

3. For a specimen containing at least 25% Cl or F in the combustible portion and for which the HCN and CO are suspected of being the principal toxicants.

If the HCN and CO are both present at levels equal to one half the presumptive lethal values (HCN, 88 ppm/CO, 2000, as in 1 and 2 above), the principal toxicants will be considered to be HCN and CO and no correction factor will be applied.

4. If, for the above specimen, the HCN is less than 177 ppm and CO is less than 4000 ppm or the HCN/CO are each below the defined levels (88/2000), the halogen acid will be considered to be the principal toxicant and the correction factor is to be applied.



Table 1

WOOD SMOKE TOXICITY DATA
UNIVERSITY OF PITTSBURGH TEST
FOR DEFINITION OF PASS/FAIL LIMITS
FOR THE CITY OF NEW YORK

Three densities of wood (hard, medium and soft) have been tested in the four commercial laboratories which are certified by the city of New York for thermal decomposition product testing. The woods selected were oak (hard), mahogany or Douglas fir (medium) and soft pine (soft). For the thin samples (1/28" and 3/16") the mahogany was tested in preference to Douglas fir as the fir is not commercially available in those thicknesses.

THICKNESS	LA50		
	LC50 (g)	(MM ²)	(CHES ²)*
1/28" (1.0 mm)	13.1	31,392	48.7
3/32" (2.5 mm)	21.8	12,120	18.8
3/16" (5.0 mm)	18.8	5,730	8.9
3/8" (10.0 mm)	18.0	3,469	5.4
3/4" (20.0 mm)	<u>26.7</u> 19.7 ± 5.0	2,396	3.7

*645 MM² = 1 square inch

Table 2

The Carpet and Rug Institute (CRI) and the American Textile Manufacturers Institute (ATMI) have recently looked into this issue. Since carpet is used for floor covering, a fair comparison would be with wood used for flooring. Typically, 3/4 inch red oak is used for this purpose. Thus, if LC₅₀ for red oak is obtained, carpets can then be tested and compared with this wood. Since flooring is obtained on the basis of surface area, it follows that the amount of wood burned to produce sufficient smoke to kill 50% of the exposed animals (LC₅₀) should be given on the basis of surface area rather than mass.

In testing red oak, two different burning modes were identified; flaming and smoldering. This produced a combined LC₅₀ as follows.

	LC ₅₀ (grams)	LC ₅₀ (mm ²)		LC ₅₀ (mm ²)
X	21.1	X	1635	
S.D.	5.1	S.D.	392	
C.V.	24%	C.V.	24%	
N	11	N	11	

Therefore, any specimen used for floor covering can be given as "no more toxic than wood" if the specimen tested is a final product with actual geometry preserved, thickness in particular, has an LC₅₀ equal to or greater than 1635 mm².

STANDARD OPERATING PROCEDURE



PREPARATION OF PAINT OR COATING SAMPLES

The initial run will use 10 grams of dried paint on a 7 x 9 inch (406 cm²) piece of window glass. Paint should be dried between coats and after the final coat, samples should be dried at least 24 hours before conditioning for 48 hours prior to testing. Manufacturer's instructions should be followed for extending the curing time. The 10 gram run will be used to establish critical temperatures and weights.

If higher sample weights are required, test runs may be conducted using 1 or 2 pieces of 9 x 12 inch (697 cm²) glass. This glass is too large to be placed on the weight sensor but instead will be placed leaning against the side of the furnace. The painted side of the glass should be facing toward the center of the furnace. Various sample weights will be made by scraping paint from the glass to the needed sample weight. The dried paint should average 2.5-3.0 grams/100 sq. cm. This will allow for LC₅₀ ranges up to 42 grams of dried material, maintaining 3 g/100 cm². If the paint or coating is normally used at heavier coatings than the 3.0 g/100 cm², the coating should be as thick as in normal applications.

If paint LC₅₀ requires sample weights above this level, one additional piece of glass may be added on the pedestal or the back. (Do not touch glass to the thermocouples.) Care should be given to keep paint as close to 2.5-3.0 grams as possible. The glass must be placed as not to interfere with airflow through the furnace. Glass may bend at high temperatures but will not adhere to the furnace walls.



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Report On
Smoke Density Characteristics
Determined By
ASTM E-662
Test Method

PREPARED FOR:
NoFire Technologies, Inc.
Upper Saddle River, New Jersey

TEST NUMBER S-1219

MATERIAL TESTED:
NoFire Formula A Fire Retardant Coating

DATE OF ISSUE 03/01/96

I. INTRODUCTION

The following Scope, Summary of Test Method, Test Specimens, and Specimen Conditioning sections are abridged from the Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials ASTM E662.

II. SCOPE

This fire-test response standard covers determination of the specific optical density of smoke generated by solid materials and assemblies mounted in the vertical position in thicknesses up to and including one inch. The test is based on the attenuation of a light beam by smoke accumulating within a closed chamber due to nonflaming pyrolytic decomposition and flaming combustion. Results are expressed in terms of specific optical density which is derived from a geometrical factor and the measured optical density, a measurement characteristic of the concentration of smoke.

The test is intended for use in research and development and not as a basis for ratings for regulatory purposes. At the present time, no means are provided for predicting the density of smoke which may be generated by the materials exposed to heat and flame under other fire conditions.

III. SUMMARY OF TEST METHOD

This method employs an electrically-heated radiant energy source mounted within an insulated ceramic tube and positioned so as to produce an irradiance level of 2.2 BTU/ft² · sec. (2.5 W/cm²) averaged over the central 1.5 inch diameter area of a vertically mounted specimen facing the radiant heater. The nominal 3 by 3 inch specimen is mounted within a holder which exposes an area measuring 2 9/16 by 2 9/16 inch. The holder can accommodate specimens up to one inch thick. This exposure provides the nonflaming condition of the test.

For the flaming condition, a six-tube burner is used to apply a row of air-propane flamelets across the lower edge of the exposed specimen area and into the specimen holder trough. The application of flame in addition to the specified irradiance level from the heating element constitutes the flaming combustion exposure.

The test specimens are exposed to the flaming and nonflaming conditions within a closed 18 ft³ chamber. A photometric system with a 36 inch vertical light path measures the decrease in light transmission as smoke accumulates.

IV. TEST SPECIMENS

The test specimens are 3 by 3 ± .03 inch by the intended installation thickness up to and including 1 inch thickness. Materials in thicknesses in excess of 1 inch are sliced to 1 inch and the original (uncut) surface tested. Multi-layer materials thicker than 1 inch with surface facings of different materials are sliced to 1 inch thickness, and each original (uncut) surface tested separately, if both surface facings are exposed to fire.

SB/BP:4/94

V. **SPECIMEN CONDITIONING**

Specimens are predried for 24 hours at $140 \pm 5^\circ\text{F}$ ($60 \pm 3^\circ\text{C}$) and then conditioned to equilibrium (constant weight) at an ambient temperature of $73 \pm 5^\circ\text{F}$ ($23 \pm 3^\circ\text{C}$) and a relative humidity of 50 ± 5 percent.

SB/BP:4/94



TEST NUMBER S-1219

DATE OF TEST 02/16/1996

I. MATERIAL TESTED

Material Description: NoFire Formula A Fire Retardant Coating
Batch/Lot Number 934515/1. Coating applied to 1/4" I.R.C.B. in two coats
at an application rate of 400 sq. ft. per gallon per coat for a final
coverage rate of 200 sq. ft. per gallon.

Manufacturer: NoFire Technologies, Inc.
Upper Saddle River, New Jersey

SAMPLE PREPARATION:

Sample edges and back surface covered with aluminum foil and backed with
1/2" inorganic millboard.

Preconditioning = 24 Hours @ 140 +/- 5 degrees F
Conditioning @ 73 +/- 5 degrees F and 50% +/- 5% RH For 17 Days.
Type of Holder Used: Trough

NONFLAMING MODE BURN NUMBER	1	2	3	AVG
Thickness in Inches	--	--	--	--
Weight in Grams	--	--	--	--
Chamber Pressure (in. water)	--	2.2	2.5	--
Chamber Temp. (degrees F)	--	96	97	--
Color Of Smoke	Gray			
FLAMING MODE BURN NUMBER	1	2	3	AVG
Thickness in Inches	--	--	--	--
Weight in Grams	--	--	--	--
Chamber Pressure (in. water)	--	4.0	4.0	--
Chamber Temp. (degrees F)	--	98	97	--
Color Of Smoke	Gray			

Observations of the burning or smoldering characteristics of the specimen
during test exposure, such as delamination, shrinkage, melting or collapse.

Charring. No Melting or dripping.



TEST NUMBER S-1219

DATE OF TEST 02/16/1996
OPERATOR K. Haile

MATERIAL TESTED:

NoFire Formula A Fire Retardant Coating

II. OPERATING CONDITIONS

Radiometer Reading	7.54 mV	Irradiance	2.5 watts/sq.cm.
Furnace Temperature	1,450 Degrees F		
NONFLAMING MODE BURN NUMBER	1	2	3
			AVG
Ds @ 90 Seconds	--	0	0
Ds @ 4 Minutes	--	3	4
Max. Specific Optical Density Dm	--	23	27
Time to Max Dm (minutes)	--	17.4	16.9
Dm (Corrected)	--	20	24
FLAMING MODE BURN NUMBER	1	2	3
			AVG
Ds @ 90 Seconds	--	1	1
Ds @ 4 Minutes	--	11	9
Max. Specific Optical Density Dm	--	31	28
Time to Max Dm (minutes)	--	14.0	13.6
Dm (Corrected)	--	27	24

REMARKS: BSS 7239 toxicity testing conducted simultaneously with ASTM E 662 test. ASTM E 662 test results are incomplete and are provided for informational purposes only.

REPORT PREPARED BY:

Kevin P. Haile

KEVIN P. HAILE
FIRE TECHNOLOGIST

REPORT REVIEWED BY:

Russell L. Chapman

RUSSELL L. CHAPMAN
FIELD SERVICES DIRECTOR

Conformance to the test standard is verified by a registered professional engineer. This is a factual report of the results obtained from laboratory tests of sample products. The results may be applied only to the products tested and should not be construed as applicable to other similar products of the manufacturer. The HPVA does not verify the description of materials and products when the description is provided by the client. The report is not a recommendation or a disapprobation by the Hardwood Plywood & Veneer Association of the material or product tested. While this report may be used for obtaining product acceptance; it may not be used in advertising.



GAS ANALYSIS BY THE DRAGER TUBE METHOD

SCOPE

An Introduction, General Description of Drager Tube Method, and a listing of Specific Gases, the presence or absence of which is determined by this analysis, are included in this report. A more complete detailing of this gas analysis method is described in the Drager Detector Tube Handbook, Air Investigations and Technical Gas Analysis with Drager Tubes, 7th Edition (July 1989).

INTRODUCTION

Dragerwerk AG Lubeck, a German company, has been manufacturing a variety of Drager detector tubes since 1950. There are now about 200 different Drager tubes available with which a large number of gases and vapors can be determined in an environment.

GENERAL DESCRIPTION OF THE DRAGER TUBE METHOD

The Drager gas analysis method is performed by inserting Drager detector tubes into the top center of the NBS-Aminco Smoke Density Chamber and withdrawing known volumes of gas using a vacuum pump. Certain specifications such as BSS 7239, SMP 801 and ATS 1000.001 permit the use of Drager tubes for determining the relative toxicity of materials. These specifications require gas sampling to be initiated at 240 seconds into the test and may be conducted simultaneously with the NBS smoke generation tests such as the Smoke Generation by Materials on Combustion (BSS 7238) or the ASTM E 662 test method.

The HPVA uses an electric vacuum pump to draw gas samples through either one-tenth liter or five-tenths liter capacity stainless steel cylinders. Depending upon the volume of a specific gas required to produce a reaction, one or more strokes of the pump are used to draw the gas sample through a detector tube. With a known gas quantity, the length of discoloration in a detector tube can be related to the concentration of a specific gas for which the detector tube is designed to measure. The detector tubes have a built-in aperture which determines the proper rate of gas flow for the reaction kinetics of the reagent employed. The gas plus reagent system yield a reaction product, the color of which is known and read on a scale. Most detector tube scales are calibrated to measure in parts per million (volume/volume). The principle on which this method is based is the relationship between gas concentration, number of strokes, and length of the discoloration.

The Drager Handbook lists a "Threshold Limit Value" (TLV) of a gas based on findings of the American Conference of Governmental Industrial Hygienists. The TLV's are those concentrations of airborne toxic substances to which it is believed that exposure for eight hours daily is not detrimental. Threshold Limit Values should be regarded only as guiding values and not as the fine dividing lines between safe and dangerous concentrations.



TEST NO. 5-1219

DATE OF TEST 2/16/96

BSS 7239										
GAS ANALYSIS - DRAGER TUBE METHOD										
Type of Gas	Test Order	NONFLAMING MODE				FLAMING MODE				
		2	3	Avg. ppm	Std. Dev. s	Test Order	2	3	Avg. ppm	Std. Dev. s
Hydrochloric Acid Gas (HCl) - ppm	1 13	0	0	0	0	1 13	0	0	0	0
Hydrocyanic Acid (HCN) - ppm	2 12	0	0	0	0	2 12	0	0	0	0
Hydrogen Fluoride (HF) - ppm	3 11	0	0	0	0	3 11	0	0	0	0
Nitrous Fumes (NO + NO ₂) - ppm	4 10	0	5	2.5	3.54	4 10	5	5	5	0
Carbon Monoxide (CO) - ppm	5 9	5	10	7.5	3.54	5 9	25	30	27.5	3.54
Sulfur Dioxide (SO ₂) - ppm	6 8	0	0	0	0	6 8	0	0	0	0
Carbon Dioxide (CO ₂) - ppm	7 7	1,000	1,000	1,000	0	7 7	5,000	5,000	5,000	0
Hydrogen Sulphide (H ₂ S) - ppm	8 6	0	0	0	0	8 6	0	0	0	0
Ammonia (NH ₃) - ppm	9 5	10	25	17.5	10.61	9 5	15	25	20	7.07
Formaldehyde (HCHO) - ppm	10 4	0	0	0	0	10 4	0	0	0	0
Acrylonitrile (CH ₂ =CH-CN) - ppm	11 3	6	3	4.5	2.12	11 3	7	4	5.5	2.12
Phenol (C ₆ H ₅ OH) - ppm	12 2	0	0	0	0	12 2	0	0	0	0
Phosgene (Cl ₂ CO) - ppm	13 1	0	0	0	0	13 1	0	0	0	0

Remarks: Gases tested in reverse sequences beginning at 240 seconds into the test.



Test No. S-1219

Date of Test 2/16/96

SPECIFIC GASES TESTED

Gases Examined

- X Carbon Monoxide 10/b (CO)
Drager Tube No. CH 20601
Range 10 - 3,000 ppm
Number of Strokes - n = 10 (10 to 300 ppm)
n = 1 (100 to 3,000 ppm)
TLV - 50 ppm carbon monoxide (U.S.A. 1989)
Reaction: Carbon monoxide plus iodine pentoxide yields brownish green reaction product.
Cross-Sensitivity: Acetylene reacts in a similar indication as CO. Other interfering gases are retained in the precleanse layer. In cases of high concentrations of hydrocarbons, a carbon pretube may be required.
- Sulfur Dioxide 20/a (SO₂)
Drager Tube No. CH 24201
Range 20 - 2,000 ppm
Number of Strokes - n = 10
TLV - 2 ppm SO₂ (U.S.A. 1986-87)
Reaction: Indication is based on the reaction with iodine. Color change from brown-yellow to white. H₂S is indicated with the same sensitivity as SO₂.
Cross-Sensitivity: Hydrogen Sulfide (H₂S) is indicated with the same sensitivity (in ppm) as SO₂. In the presence of NO₂, minus errors occur in the SO₂ indication.
- X Hydrocyanic Acid 2/a (HCN) (Hydrogen Cyanide)
Drager Tube No. CH 25701
Range 2 - 150 ppm
Number of Strokes - n = 5 (2 to 30 ppm)
n = 1 (10 to 150 ppm)
TLV - 10 ppm (U.S.A. 1992)
Reaction: Hydrogen cyanide plus mercury chloride yields red reaction product.
Cross-Sensitivity: Both acid and basic interfering gases (hydrogen sulfide, hydrogen chloride, sulfur dioxide, nitrogen dioxide and ammonia) are retained in the precleanse layer.
- X Hydrogen Fluoride 1.5/b (HF)
Drager Tube No. CH 30301
Range 1.5 to 15 ppm
Number of strokes - n = 20
TLV - 3 ppm (U.S.A. 1989)
Reaction: The indication is based on the reaction with a Chinalzarine Zirconium complex. The color change is from light blue to pale pink.
Cross-Sensitivity: The gaseous hydrogen fluoride only is indicated. HF mists and fluorides (aerosol) are not measured. The reaction is specific to HF.



Test No. S-1219

Date of Test 2/16/96

SPECIFIC GASES TESTED

Gases Examined

- _____ Hydrochloric Acid 50/a (HCL) (Hydrogen Chloride)
Drager Tube No. 67-28181
Range 50 to 5,000 ppm
Number of Strokes - n = 10 (50 to 500 ppm)
 n = 1 (500 to 5,000 ppm)
TLV - 5 ppm (U.S.A. 1989)
Reaction: HCL plus Bromophenol Blue yields a white reaction product.
Cross-Sensitivity: Chlorine and NO_x are also indicated but the sensitivity of indication is different.
- X _____ Hydrochloric Acid 1/a (Hydrogen Chloride)
Drager Tube No. CH 29501
Range 0.5 - 25 ppm n = 5 2 - 20 ppm
Number of Strokes - n = 10 1 to 10 ppm
 n = 20 0.5 to 5 ppm
TLV - 5 ppm (U.S.A. 1991)
Reaction: The indication is based on reaction with bromophenol blue. In the presence of gaseous HCL, the indicating layer changes color from blue to yellow.
Cross-Sensitivity: Hydrogen sulfide and Nitrogen dioxide do not affect the HCL indication. Chlorine is indicated with a weak grey discoloration.
- _____ Nitrous Fumes 20/a (NO + NO₂)
Drager Tube No. 67 24001
Range 20 - 500 ppm
Number of Strokes - n = 2
TLV - 3 ppm NO₂; 25 ppm NO (U.S.A. 1989)
Reaction: In the presence of NO or NO₂ the indicating layer turns reddish-brown. Any NO which may be present in the nitrous fumes is oxidized to NO₂.
Cross-Sensitivity: Ozone and chlorine react in the same way as NO₂.
- X _____ Carbon Monoxide 5/c (CO)
Drager Tube No. CH 25601
Range 5 - 700 ppm
Number of Strokes - n = 2 (100 to 700 ppm)
 n = 10 (5 to 150 ppm)
TLV - 50 ppm (U.S.A. 1992)
Reaction: The CO indication is based on a color reaction with iodine pentoxide, selenium dioxide and fuming sulfuric acid. CO changes color of the indicating layer to brownish green.
Specificity (Cross-Sensitivity): Acetylene reacts similarly as CO. Other interfering gases are retained in the precleanse layer. In cases of high concentrations of hydrocarbons, a carbon pretube may be required.



Test No. S-1219

Date of Test 2/16/96

SPECIFIC GASES TESTED

Gases Examined

- X
- Ammonia 5/a (NH₃)
Drager Tube No. CH 20501
Range 5 - 700 ppm
Number of Strokes - n = 10 (5 - 70 ppm)
n = 1 (50 - 700 ppm)
TLV - 25 ppm (U.S.A. 1989)
Reaction: Ammonia plus acid plus bromophenol blue (Indicator) yields ammonium salt.
Cross-Sensitivity: Hydrazine and 1,1-dimethyl hydrazine react with the same sensitivity as ammonia (related to ppm). Organic bases (e.g. amines) are also indicated, but usually with a different sensitivity.
- _____
- Carbon Dioxide 0.1%/a (CO₂)
Drager Tube No. CH 23501
Range 0.1 - 1.2% and 0.5 - 6% Volume carbon dioxide
Number of Strokes - n = 5 (0.1 to 1.2%) (1,000 - 12,000 ppm)
n = 1 (0.5 to 6%) (5,000 - 60,000 ppm)
TLV - 5,000 ppm (U.S.A. 1986-87)
Reaction: Carbon dioxide plus hydrazine plus crystal violet yields violet reaction product.
Cross-Sensitivity: None
- X
- Nitrous Fumes 2/a (NO + NO₂)
Drager Tube No. CH 31001
Range 2 - 150 ppm n = 4 (up to a maximum of 150 ppm)
Number of Strokes - n = 10 (2 to 50 ppm)
n = 5 (5 to 100 ppm)
TLV - 3 ppm NO₂; 25 ppm NO (U.S.A. 1989)
Reaction: In the presence of NO or NO₂ the indicating layer turns dark blue-grey.
Cross-Sensitivity: Ozone and chlorine react in the same way as NO₂.
- _____
- Phosgene 0.25/b
Drager Tube No. CH 28301
Range 0.25 - 75 ppm
Number of Strokes - n = 1 (15 to 75 ppm)
n = 5 (0.25 to 15 ppm)
TLV - 0.1 ppm (U.S.A. 1987)
Specificity: The indication is based on the coupling reaction of phosgene with aromatic amino aldehydes; discoloration is blue-green. The reaction for phosgene is specific. Other gases have no influence on the phosgene indication.
- X
- Formaldehyde 0.2a
Drager Tube No. 67 33061
Range 0.2 - 5 ppm
Number of Strokes - n = 20 (0.2 to 2.5 ppm)
n = 10 (0.5 to 5 ppm)
TLV - 1 ppm (U.S.A. 1991)
Cross-Sensitivity: Acetaldehyde, acrolein, diesel fuel, furfuryl alcohol, styrene and vinyl acetate discolor the indicating layer yellow to brown, but with different sensitivity of indication.



Test No. S-1219

Date of Test 2/16/96

SPECIFIC GASES TESTED

Gases Examined

- X Formaldehyde 0.5/a
Drager Tube No. 67 26760
Range 0.5 - 10 ppm
Number of Strokes - n = 1 - 16; n = 1 (10 ppm) n = 10 (1 ppm)
n = 5 (2 ppm) n = 16 (0.5 ppm)
TLV - 1 ppm (U.S.A. 1986-87)
Reaction: The indication is based on the reaction of formaldehyde with xylene in the presence of sulfuric acid. The color change is from white to pink.
Cross-Sensitivity: Other aldehydes and styrene turn the indicating layer yellow to brown. No interference with the indication by 500 ppm n-octane, 5 ppm NO, 5 ppm NO₂.
- X Nitrous Fumes 2/a
Drager Tube No. CH 31001
Range 2 - 150 ppm
Number of Strokes - n = 10 2 - 50 ppm
n = 5 5 - 100 ppm
n = 4 0 - 150 ppm
TLV - 3 ppm NO₂; 25 ppm NO (U.S.A. 1989)
Reaction: In the presence of NO or NO₂ the indicating layer turns reddish-brown. Any NO which may be present in the nitrous fumes is oxidized to NO₂.
Cross-Sensitivity: Determination of nitrous fumes is not possible in the presence of ozone and/or chlorine.
- Oxygen 5%B
Drager Tube No. 67-28081
Range 5 to 23 Vol. % Oxygen
Number of Strokes - n = 1
Reaction: Oxygen changes the color of the indicating layer from blue-black to pale gray.
Cross-Sensitivity: Indication is based on oxidation of a titanium (III) compound by oxygen, giving a titanium (IV) compound. Carbon dioxide, carbon monoxide, halogenated hydrocarbons, solvent vapors and nitrous oxide do not interfere with the indication.
- X Phenol 1/a
Drager Tube No. 81-01361
Range 1 - 30 ppm
Number of Strokes - n = 20
TLV - 5 ppm (U.S.A. 1987)
Reaction: Phenol changes the color of the indicating layer to brown.
Cross-Sensitivity: Cresols will also result in a brown indication. High concentrations of ammonia (>200 ppm) result in a white discoloration and interfere with the phenol indication.



Test No. S-1219

Date of Test 2/16/96

SPECIFIC GASES TESTED

Gases Examined

- _____ Alcohol 100/a (Methanol-Ethanol)
Drager Tube No. CH 29701
Range 100 - 3,000 ppm
Number of Strokes - n = 10
Reaction: Methanol or Ethanol presence changes yellow indicating layer to green. (Scale values x 100 = alcohol concentration in ppm.)
Cross-Sensitivity: Propanols and butanols react with the same sensitivity (related to ppm) as methanol and ethanol. Aldehydes, ethers, ketones and esters react only when they are present in concentrations above their threshold limit values. Petroleum distillates, benzene and halogenated hydrocarbons do not affect the indication.
- X
_____ Carbon Dioxide 0.5%/a (CO₂)
Drager Tube No. CH 31401
Range 0.5 to 10 vol. % carbon dioxide
Number of Strokes - n = 1 (0.5 - 10 vol. %)
(5,000 - 100,000 ppm)
TLV - 5,000 ppm CO₂ (U.S.A. 1989)
1 ppm CO₂ = 1.8 mg CO₂/m³
1 mg CO₂/m³ = 0.56 ppm CO₂ (at 20°C; 1013 mbar)
Reaction: Carbon dioxide plus hydrazine plus crystal violet as redox indicator yields bluish violet reaction product.
Cross-Sensitivity: None
- X
_____ Carbon Dioxide 0.01%/a
Drager Tube No. CH 30801
Range 0.01 to 0.3 vol. % carbon dioxide
Number of Strokes - n = 10
(100 - 3,000 ppm)
TLV - 5,000 ppm (U.S.A. 1986-87)
Reaction: Carbon dioxide plus hydrazine plus crystal violet yields violet reaction product.
Cross-Sensitivity: None
- X
_____ Phosgene 0.02/a
Drager Tube No. 81-01521
Range 0.02 - 1 ppm
Number of Strokes - n = 40 (0.02 - 0.6 ppm)
n = 20 (0.02 - 1.0 ppm)
TLV - 0.1 ppm (U.S.A. 1987)
Specificity: The measurement is based on the color reaction of phosgene with aromatic amines.



Test No. S-1219

Date of Test 2/16/96

SPECIFIC GASES TESTED

Gases Examined

X **Acrylonitrile** 0.5/a (ACN)
Drager Tube No. 67 28591
Range 0.5 - 20 ppm
Number of Strokes n = 20 (0.5 to 10 ppm)
n = 10 (1 to 20 ppm)
TLV - 2 ppm (USA 1990)
Reaction: When air or gas is drawn through the combined tube consisting of a pretube and an indicating tube, the indicating layer changes color to red in the presence of acrylonitrile.
Cross-Sensitivity: No influence on the acrylonitrile indication by 1,000 ppm acetone, 20 ppm benzene, 1,000 ppm ethyl acetate, 1,000 ppm ethanol, 10 ppm ethyl benzene, 1,000 ppm hexane, 50 ppm styrene, 100 ppm toluene.

 Benzene 0.5/a (C₆H₆)
Drager Tube No. 67 28561
Range 0.5 - 10 ppm
Number of Strokes n = 2 (10 ppm)
n = 40 (0.5 ppm)
TLV 10 ppm (USA 1990)
Reaction: The tube contains a white indicating layer and a pale brown comparison layer. In the presence of benzene, the indicating layer changes color to a pale brown.
Cross-Sensitivity: Other aromates (toluene, xylene, ethyl benzene) are also indicated. Benzene measurement is not possible in such cases. Petroleum hydrocarbons, alcohols and esters do not interfere with the reading.

X **Formaldehyde** 0.2/a (HCHO)
Drager Tube No. 67 33081
Range 0.2 - 5 ppm
Number of Strokes n = 20 (0.2 to 2.5 ppm)
n = 10 (0.5 to 5 ppm)
TLV 1 ppm HCHO (USA 1990)
Reaction: Tube consists of a precleanse layer and indicating layer. The reagent in the precleanse layer is xylene vapor. The reagent in the indicating layer is sulfuric acid. In the presence of formaldehyde the indicating layer changes color to pink.
Cross-Sensitivity: Acetaldehyde, acroleine, diesel fuel, furfuryl alcohol, styrene and vinyl acetate discolor the indicating layer to brown, but with different sensitivity of indication.



Test No. S-1219

Date of Test 2/16/96

SPECIFIC GASES TESTED

Gases Examined

X **Hydrogen Sulfide** 0.5/a (H₂S)
Drager Tube No. 67 28041
Range 0.5 - 15 ppm
Number of Strokes n = 10 (0.5 - 15 ppm)
TLV 10 ppm H₂S (USA 1990)
Reaction: In the presence of hydrogen sulfide, the white indicating layer changes color to pale brown. The reagent is a mercury complex.
Cross-Sensitivity: No interference by other gases and vapors has been observed, but investigations are continuing.

X **Phosgene** 0.02/A (COCl₂)
Drager Tube No. 61 01521
Range 0.02 - 1 ppm
Number of Strokes n = 40 (0.02 to 0.6 ppm)
n = 20 (0.02 to 1 ppm)
TLV 0.1 ppm (USA 1987)
Reaction: Phosgene turns the white indicating layer red. The total length of discoloration is a measure of the phosgene concentration.
Specificity: The measurement is based on the color reaction of phosgene with aromatic amines. Within the concentration range up to 100 ppm, HCL has no influence on reading provided that the humidity is within certain limits. 2 ppm chlorine or 1 ppm acetyl chloride have no influence on the phosgene reading.



United States Testing Company, Inc.
 Chemical Services Division
 1415 PARK AVENUE • HOBOKEN, NEW JERSEY 07030 • 201-782-2400

REPORT OF TEST

May 24, 1989

CLIENT: No-Fire Engineering, Inc.
 24 Industrial Avenue
 Upper Saddle River, NJ 07458
 Attention: Mr. Otis Hastings

NUMBER
 032723-1

SUBJECT: Sample of "No Fire" supplied by the client.

AUTHORIZATION:

Telephone conversation of May 9, 1989.

PURPOSE:

To determine the volatiles generated by the samples as it dries.

PROCEDURE:

The sample was placed on a steel panel and the volatiles determined on the drying by mass spectroscopy.

RESULTS:

<u>Volatiles</u>	<u>% by Weight</u>	<u>Toxic</u>
Hydrogen Cyanide	.008	Yes
Ammonia	.001	Yes
Ethylamine	.0005	Yes
Urea	.0050	Very slight
Paraffinic Hydrocarbons (mineral spirit type substance)	.022	No
Balance of Volatiles was Water	---	No

Comments: No toxic substances were detected after the "No Fire" dried.

** ** *

SIGNED FOR THE COMPANY

BY *W.S. Gilman*
 William S. Gilman

Laboratories in: New York • Chicago • Los Angeles • Tulsa • Memphis • Philadelphia • Richland

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Form 803



United States Testing Company, Inc.

1415 PARK AVENUE • HOBOKEN, NEW JERSEY 07030 • 201-792-2400 • Fax: 201-656-0636

REPORT OF TEST

June 22, 1992

CLIENT: No Fire Engineering Inc. **JOB NO:** 053488-2
21 Industrial Avenue
Upper Saddle River, NJ 07458

Attention: Mr. Otis Hastings

SUBJECT: One sample received on June 17, 1992 and identified by the client as:

JPS-No Fire 16781/112/1174

AUTHORIZATION: Client's purchase order #NF000343.

TEST DATES: June 17, 1992.

PURPOSE: The general purpose of the test is to develop data to evaluate synthetic materials when they are subjected to high temperature heating. The test results are to evaluate the potential hazard from toxic gases produced should the material be burned or thermally decomposed in an enclosed area. The data developed included the determination of:

- 1) Ignition time
- 2) Burning time
- 3) Composition of the atmosphere produced
- 4) Weight loss of materials

** ** *

SIGNED FOR THE COMPANY BY

Bernadita Santos
Bernadita Santos
Assistant Lab Supervisor

Joseph Kwiatkowski
Joseph Kwiatkowski
Assistant Vice President

Page 1 of 3
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United States Testing Company, Inc.

CLIENT: No Fire Engineering Inc.

JOB NO: 053488-2

PROCEDURE:

The sample was cut into strips and baled to meet the sample size requirement.

The equipment used to burn or thermally decompose the sample material is similar to the equipment formerly employed at the Materials Laboratory of the New York Naval Shipyard and the Bureau of Mines Central Experiment Station at Pittsburgh for determining the flame resistance of thermosetting plastics. Also as reported in the United States Testing Company Report #83413 for the Bureau of Ships, United States Navy and referenced in Military Specification MIL M-14H, MIL M-24519C (Navy).

The equipment consists of a specimen support, heating coil and spark generators mounted in an essentially gas tight chamber, equipped with facilities for sampling the test atmospheres produced. In brief, the tests are conducted by placing a stick or sticks of the materials to be tested (sample size: 5" x 1/2" x 1/2") in the center of a heating coil which is situated in the air tight chamber.

The heating coil is activated and the number of seconds it takes, from the time the coil is activated until the sample begins to burn is recorded as the ignition time. After the stick has burned for 30 seconds, the heating coil is deactivated, the number of seconds it takes for the sample to stop burning (from the time of deactivation) is recorded as the burn time. When the sample has stopped burning, the atmosphere produced is mixed by an internal circulating fan. A manifold circulating pump is then activated and the atmosphere within the chamber is withdrawn into gas analyzing apparatus.

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RESULTS:

Original weight, g	26.18
Residual weight, g	24.56
Loss in weight, g	1.62
Ignition time, seconds	184.4
Burning time, seconds	26.0
Temperature of chamber, °C	29
Temperature of coil	(a)
Beilstein	(b)
Smoke	(c)
Flame	(d)
Ash	(e)

- (a) Equilibrium temperature 645°C
- (b) Negative
- (c) Light amount of light grey smoke
- (d) Approximately 0 - 2"
- (e) Light deposits of black soot

Composition of Atmosphere (ppm)

Acrylonitrile	6
Hydrogen chloride	0
Aldehydes as HCHO	2
Ammonia	0
Carbon monoxide	80
Carbon dioxide	700
Oxides of nitrogen as NO ₂	30
Cyanides as HCN	10

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Post-It brand fax transmittal memo 7071		of pages > 22	
To	BOB MANNING	From	AL DE JAGER
Co.	U.S. TESTING	Co.	NTS
Dept.		Phone F	812-835-0044
Fax F	201-575-8271	Fax F	813-272-1180

3.1.6.17 - Smoke and Toxicity

3.1.6.17.1 Horizontal Current Heating Test

Test the finished wire in accordance with Horizontal Current Heating Test Procedure of BSS 7324. Adjust the current flowing through the conductor so that the conductor temperature stabilizes at $200^{\circ}\text{C} \pm 5^{\circ}\text{C}$. Maintain the current for a period of 15 ± 1 minutes. The materials are acceptable, if the wire does not give off any visible smoke. In addition, the wire is required to pass the Wet Dielectric Withstand Voltage Test and Insulation Resistance Test of BSS 7324.

3.1.6.17.2 NBS Chamber Test


Test the finished wire in accordance with NBS Chamber Test Procedure of BSS 7324. The materials are acceptable, if the maximum specific optical density (D_s) does not exceed 50 after four minutes.

3.1.6.17.3 Toxic Gas Emission

Test the finished wire in accordance with Toxic Gas Emission of BSS 7324. The materials are acceptable, if the average value of the toxic gas emission in parts per million after four minutes does not exceed the values shown in Table 4.

TABLE 4
Toxic Gas Emission

Type of Gas	Gas Emission (PPM)
CO	3500
HCN	150
HF	200
HCl	300
SO ₂	100
NO _x	100

 BOEING CORPORATE OFFICES SEATTLE WA 98124	SIZE A	FSCM NO #1208	DRAWING NO		
			S280W653		
			SHEET 1	PAGE 18	REV
BOEING PROPRIETARY SEE PAGE 1 FOR DETAILS					



Bombardier Inc.
Mass Transit Division

MATERIAL AND PROCESS
SPECIFICATION

SUBJECT

TOXICITY

SMP 801

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3.0 FACILITIES (cont)

3.3 The calibration and gas analysis method and procedure will be the responsibility of the independent testing laboratory and subject to report.

4.0 REQUIREMENTS

4.1 Toxic Gas Level

To be submitted for Bombardier Approval and will be limited to a maximum concentration as shown below during the test.

<u>GAS</u>	<u>PPM</u>
CO	3500
NO + NO2	100
SO2	100
HCl	500
HF	100
HCN	100
NH3	1000

4.2 Specimen Control

As specified in reference 2 a)
One specimen shall be tested to measure the evolution of any specific toxic product.

4.3 Sampling time

The specimen will be initiated 30 (sec) (1 min) after

United States Testing Company, Inc.

CLIENT: NoFire Technologies

PROJECT NO: 407208-1
DATE: 01/19/96

RESULTS: Adhesion Tests:

3 steel plates coated NoFire Formula A	All the plates are rated 5B. The edges of the cuts are completely smooth. None of the squares of the lattice is detached.
3 steel plates coated with primer, oil base paint and NoFire Formula	All of the plates are rated 5B. The edges of the cuts are completely smooth. None of the squares of the lattice is detached
3 steel plates coated with oil base paint and NoFire Formula	All of the plates are rated 5B. The edges of the cuts are completely smooth. None of the squares of the lattice is detached.