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10. UMTA-MA-06-0051-80-2

IDENTIFICATION AND EVALUATION OF OPERATIONAL ALTERNATIVES FOR MATERIALS DATA BANK

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RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION
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URBAN MASS TRANSPORTATION ADMINISTRATION
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16. Abstract A review of the organization and operation of the Urban Mass Transportation Administration's Materials Data Bank is presented. Alternatives to the current system of Data Bank Operation are identified and evaluated. It is recommended that the best method for managing and disseminating the technical data will be accomplished via the Transportation Systems Center. A notice of the availability of this system will be published in the Federal Register.			
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PREFACE

The Urban Mass Transportation Administration (UMTA) has expended considerable effort in assessing the fire performance characteristics of materials used in transit vehicles. The collection and dissemination of pertinent flammability information are an important part of this research. In this document the computerized materials flammability data system is described; its benefits to potential users are assessed and recommendations to improve its accessibility are presented.

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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
AREA				
in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
ac	square miles	2.6	square kilometers	km ²
	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	29	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
VOLUME				
teaspoon	teaspoons	5	milliliters	ml
Tablespoon	tablespoons	15	milliliters	ml
fluid ounce	fluid ounces	30	milliliters	ml
cup	cups	0.24	liters	l
pint	pints	0.47	liters	l
quart	quarts	0.95	liters	l
gallon	gallons	3.8	liters	l
cubic foot	cubic feet	0.03	cubic meters	m ³
cubic yard	cubic yards	0.76	cubic meters	m ³
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
km	kilometers	1.1	yards	yd
		0.6	miles	mi
AREA				
cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares (10,000 m ²)	2.5	acres	ac
MASS (weight)				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	ton
VOLUME				
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
m ³	cubic meters	0.26	gallons	gal
m ³	cubic meters	36	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³
TEMPERATURE (exact)				
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

Temperature conversion scales:

- Celsius (°C):** -40 to 100
- Fahrenheit (°F):** -40 to 212
- Rankine (°R):** 0 to 720

Conversion formulas:

- °C to °F: $°F = \frac{9}{5} °C + 32$
- °F to °C: $°C = \frac{5}{9} (°F - 32)$
- °C to °R: $°R = °C + 273.15$
- °F to °R: $°R = °F + 459.67$

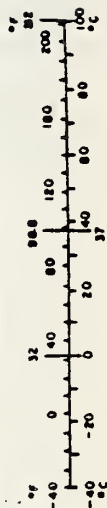


TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1. INTRODUCTION.....	1
Background.....	1
2. DATA BANK ORGANIZATION AND OPERATION.....	2
2.1 Data Bank Organization.....	2
2.1.1 Materials Identifiers.....	2
2.1.2 Identification of Data Sources.....	3
2.1.3 Materials Data.....	3
2.2 Data Bank Operation.....	4
2.2.1 Data Retrieval.....	5
2.2.2 Display and Printout of Data.....	5
2.2.3 Maintenance of Data.....	5
3. ALTERNATIVES TO THE PRESENT SYSTEM OF DATA BANK OPERATION.....	9
3.1 General Discussion.....	9
3.2 The Present System.....	9
3.2.1 Advantages.....	9
3.2.2 Disadvantages.....	9
3.3 Operational Alternatives.....	9
3.3.1 Access from Outside Terminals on "Read Only" Basis.....	9
3.3.1.1 Advantages.....	10
3.3.1.2 Disadvantages.....	10
3.3.2 Requested Data Provided by TSC Transportation Information Division.....	10
3.3.2.1 Advantages.....	10
3.3.2.2 Disadvantages.....	10
3.3.3 Cost Sharing with Other DOT Administrations.....	10
3.3.3.1 Advantages.....	10
3.3.3.2 Disadvantages.....	11
3.3.4 Combination with Another System.....	11
3.3.4.1 Advantages.....	11
3.3.4.2 Disadvantages.....	11
3.3.5 Periodic Publication of Data.....	11
3.3.5.1 Advantages.....	12
3.3.5.2 Disadvantages.....	12
3.3.6 Discontinuation of Data Bank.....	12
3.3.6.1 Advantages.....	12
3.3.6.2 Disadvantages.....	12
4. RECOMMENDATIONS.....	13
APPENDIX -- LIST OF TESTS AND MEASUREMENTS.....	A-1

LIST OF ILLUSTRATIONS

<u>Figure</u>	<u>Page</u>
1. Carpet Material Ranked According to Critical Radiant Panel Heat Flux..	6
2. Sample of Print-Out Format No. 1.....	7
3. Sample of Print-Out Format No. 2.....	8

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<p>16. Abstract</p> <p>The Urban Mass Transportation Administration (UMTA) has expended considerable effort in assessing the fire performance characteristics of materials used in transit vehicles. The collection and dissemination of pertinent flammability information are an important part of this research. The large volume of data associated with the flammability characteristics necessitated the establishment of a system for storing the data in such a manner that it would be easily available upon request. In the past, a request for such data required a search of files, journal articles, and manufacturers' literature. To address these problems, a plan for a computerized information storage and retrieval system was devised to accommodate such data queries. This report is intended to provide a review of the organization and operation of UMTA's Materials Data Bank which was established and is maintained by the Transportation Systems Center (TSC). Contained within the Materials Data Bank are two basic categories of information: 1) non-metallic materials flammability data and 2) fire extinguisher data. Included in this review are the reasons for the Bank's establishment, details of its contents, present operational status, and the identification and evaluation of operational alternatives directed at improving its visibility and its usefulness to the technical community.</p> <p>It is recommended that the best method for managing and disseminating the technical data will be accomplished through TSC. A notice of the availability of this system will be published in the Federal Register.</p>			
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1. INTRODUCTION

This report is intended to provide a review of the organization and operation of the Urban Mass Transportation Administration's (UMTA) Materials Data Bank established and maintained by the Transportation Systems Center (TSC). Included in this review are the reasons for its establishment, details of the data bank contents, present operational status, and the identification and evaluation of a series of operational alternatives directed at improving its visibility and its usefulness to the technical community. Resulting from this review are a series of recommendations for implementation of a system for enhancing the usefulness of the Materials Data Bank.

BACKGROUND

The Materials Data Bank was developed in support of the UMTA fire safety program. A part of this fire safety program is directed at the flammability characteristics of the materials used in transit systems and has resulted in the development of guidelines for these characteristics. The large volume of data associated with these flammability characteristics necessitated the establishment of a system for storing the data in such a manner that it would be easily available upon request. In the past a request for such data required a search of files, journal articles and manufacturers' literature. The comparison of flammability data on several materials was an even more arduous task. To address these problems a plan for a computerized information storage and retrieval system was devised to accommodate such data queries. To implement this plan, a contract was awarded to the Boeing Commercial Airplane Company on November 1, 1974 (DOT-TSC-926), and initial work was completed eight months later. An additional contract was awarded to the Boeing Co. in April 1978 (DOT-TSC-1534) for the purpose of updating the system, modifying the software program and adding data.

2. DATA BANK ORGANIZATION AND OPERATION

Contained within the Materials Data Bank are two basic categories of information: (1) non-metallic materials flammability data and (2) fire extinguisher data. The materials data stored in the bank addresses the following data types: (1) Materials Descriptions, (2) Materials Data and (3) Data Source Identification. The fire extinguisher data stored in the bank addresses the following data types: (1) type of fire on which specific extinguishers can be used, (2) extinguishing agent type and (3) toxicity of agent. As the fire extinguisher data is at present quite limited, this report addresses only the category of non-metallic materials flammability data.

2.1 DATA BANK ORGANIZATION

The design of the data bank (see Reference 1)* allows for storage and rapid retrieval of the desired data. The structure of the data bank was determined by the requirement that it should house and allow ready access to materials properties needed for designing a variety of items used in transit systems (seats, wall and ceiling panels, flooring, etc.).

Three separate types of information are stored for each material:

Materials identifiers (which identify the material by its manufacturer's designation, materials type, materials use, etc.).

Identification of data sources or where the data was obtained (report number, etc.).

Materials data and the test methods and results.

This information provides a comprehensive data base for use by system designers, planners, and regulatory officials concerned with operational safety.

2.1.1 Materials Identifiers

The materials are identified by manufacturer, commercial designation, material utilization, material type (form), and material composition.

The manufacturer and associated commercial designation are entered in the data bank in their entirety or suitably abbreviated to fit the allotted space.

Material utilization (component type, i.e. flooring, wall), and material composition are all entered in coded form. The use of codes permits conservation of computer storage and simplification of input. A large number of codes have been provided for these items. New codes can be entered by the programmer to cover those materials aspects not previously included. The component use type categories and codes consist of the following:

<u>Component Use Type</u>	<u>Component Use Type Code</u>
ADHESIVE	AD
ACOUSTICAL INSULATION	AI
CEILING PANELS	CP
CARPET	CT
DRAPERIES/CURTAINS	DP
ELECTRICAL INSULATION	EI
ELECTRICAL WIRE	EW
FLOORING	FL
GLASS WINDOWS	GW
LIGHTING DIFFUSERS	LD
LINERS	LR
PLASTIC WINDOWS	PW
SEAT CUSHIONS	SC

*1. Boeing Commercial Airplane Co., "Transportation System Center Material Data Bank User's Manual," DCT-TSC-1534-2, Nov. 1978. Material on File.

<u>Component Use Type</u>	<u>Component Use Type Code</u>
SEAT FRAMES	SF
THERMAL INSULATION	TI
UPHOLSTERY	UP
WALL PANELS	WP
PANELS, NOT OTHERWISE CLASSIFIED	XP
OTHER COMPONENTS	XX
NOT SPECIFIC	YY

An example of the procedure utilized in interpreting the materials identifiers' codes is shown below.

<u>Manufacturer's Designation</u>	<u>Manufacturer</u>	<u>Component Use</u>	<u>Material Code</u>
EPON 828/VERS ^R	Shell Chem/ Gen Mills	YY	AEBLGS ^R

This means that the material EPON 828/VERS 125, manufactured by Shell Chemical/General Mills, is not specific to any particular component (component use YY) and is a two-part, polyamide cured liquid epoxy adhesive (AEBLGS). Reference 1* provides more detail.

2.1.2 Identification of Data Sources

The data source is entered in the form of a report number, and the identification of the performing facility is entered in code. Several facilities have been identified as shown below and others may be added. Currently, the data are obtained principally from the FAA/NAFEC Fire Safety Branch and the materials testing area of the Boeing Company Chemical Technology Group. A limited amount of data comes from other sources, including material suppliers and their designated testing laboratories.

<u>Data Source</u>	<u>Code</u>
AIRRESEARCH MFG. CO.	AR
BOEING	BO
DOT/TSC	DT
ROCKWELL	FA
FLIGHT SAFETY OFFICE, MSC	FS
GAEC	GA
GENERAL MOTORS, AC ELECTRONICS DIVISION	GM
MCDONNELL - DOUGLAS	MD
NAFEC	NA
NATIONAL BUREAU OF STANDARDS	NB
NR/SD	NR
CREW SYSTEMS DIVISION JSC	PL
UNITED STATES TESTING CO.	US
VENDOR	VR
WHITE SANDS	WS

At present data from NASA's Non-Metallic Materials Design Guidelines Test Handbook are not included for two reasons: (1) The NASA test procedures are standard only to NASA, and (2) The test environments are at other than atmospheric pressure or at other than the normal oxygen/nitrogen ratio.

2.1.3 Materials Data

The data bank has been designed so that a broad variety of materials data acquired by different test methods can be stored. Test types include flame spread indices; smoke emission; toxic gas evolution; chemical, physical, mechanical and electrical properties; and maintainability and durability. Cost has not been included because of the difficulty in updating. The Appendix contains a complete listing of all the test types, their respective test codes and the test measurements for each test type. The data required to describe the results of a test normally consist of more than one measurement, so for each type of test, there may be several measurements taken; these measurements may be either test parameters or test results. With the present design of the data bank, it is possible to store up to twelve measurements

*1. op. cit.

for each type of test. This provides the system with its unique versatility, since each of the twelve measurements contains a piece of information such as the example shown below:

F14	ASTM E 162:MATL SURFACE FLAMM USING RADIANT ENERGY
F14A	MATERIAL THICKNESS
F14B	NUMBER OF SPECIMENS
F14C	FLAME SPREAD FACTOR F_s
F14D	STANDARD DEVIATION OF FLAME SPREAD FACTOR F_s
F14E	HEAT EVOLUTION FACTOR Q
F14F	STANDARD DEVIATION OF HEAT EVOLUTION FACTOR Q
F14G	FLAME SPREAD INDEX I_s
F14H	STANDARD DEVIATION OF FLAME SPREAD INDEX I_s

The test code F14 is the ASTM E162 test for material surface flammability using a radiant energy source. The codes F14A thru F14H refer to eight measurements that may be used to fully describe the test and its results. Although it is possible to make up to twelve measurements with each test only eight are used in conjunction with the ASTM E162 test.

Individual materials may be retrieved by the use of an assigned identification number. For comparison purposes, groups of materials may be retrieved based on a variety of categories, for example, by specific manufacturer, chemical composition, test procedure, data source, or use category. Moreover, the items may be retrieved by specific upper and lower values of test data in ascending or descending order.

In summary, the following items are included under the following identifiers:

Manufacturer's Designation

Manufacturer

Component Use

Material Type and Composition

Flame Spread Index

Smoke Evolution

Toxic Gas Evolution

Physical, Mechanical and Electrical Properties

Chemical Properties

Maintainability and Durability.

Test results are listed by the particular test procedure that was used as well as the testing organization and the date of the test. The data are available in the English system or in the equivalent metric system. Periodically, test data are forwarded to product manufacturers for review.

2.2 DATA BANK OPERATION

The operation of the data bank from a user's point of view is described by Reference 1,* an unpublished User's Manual, DOT-TSC-1534-2, Section 4. The detailed software construction is described by Reference 2,** an unpublished Programmer's Manual, DOT-TSC-1534-1. Principal features of the data bank operation are described in the following sections.

The data bank is operated on the TSC DEC System 10 computer and utilizes the resident System 1022 software. The computer is accessed from teletype-compatible

* 1. op. cit.

**2. Boeing Commercial Airplane Co., "Transportation Systems Center Materials Data Bank Programmer's Manual," DOT-TSC-1534-1, Jan. 1979. Material on file.

terminals currently available at TSC (such as the Hazeltine 2000 or the CID 1030, both of which have hard copy printed output capabilities). The data bank is protected from unauthorized usage by System 1022 software passwords and, at present, is accessible only from TSC and the Boeing Commercial Airplane Co.

Three logical groups of data manipulation capabilities are provided in the data bank design:

Data retrieval

Display and Printout of Data

Maintenance of Data.

2.2.1 Data Retrieval

The data bank is accessible on TSC computing equipment in a conversational mode to personnel with a minimal background in computers.

An inquirer seeking information from the data bank is requested by the computer to respond to a series of questions, which the computer uses to identify and recall the appropriate data. The data are then displayed at the terminal. Data from several materials or an entire category of materials can be arranged using simple and appropriate conversational commands to the computer, to rank materials in either increasing or decreasing order of merit. Such ranking can be done on the basis of any of several criteria (each generally the result of a test type), so that design tradeoffs can be effected. With this ability it is then possible to select all the materials within a particular component category and to arrange them on the basis of certain fire test result priorities. Figure 1 shows an example where several carpet materials were ranked in the data bank printout according to their critical radiant heat flux (meas. #2).

2.2.2 Display and Printout of Data

After the desired set of data has been identified and selected, the values of the data can be displayed immediately at the terminal. One feature which should be emphasized is the user's ability to specify the order in which the data is displayed. Data may be sorted and displayed in several forms depending on the desired data use (see Section 2.2.1). A printed copy may then be obtained at the terminal printer or through the TSC computer center.

A high volume display capability has been provided so that a high-speed printer can be used when the entire data base or a selected set is to be displayed.

Figures 2 and 3 represent a sample of the type of printout available for a specific material. Displayed in the left column of both figures is the material identification number (MAT ID, BWP016). Each material in the data base has its own unique identification number. The remaining information in the Figures is self-explanatory.

2.2.3 Maintenance of Data

Maintenance involves deleting, changing, or adding new information to the data base. Maintenance operations are protected by special passwords. These operations allow a programmer to make alterations to any record in the data base. This may involve changing any data item for any record in the data base, adding records, and deleting records. Capability is also provided to add, change, or delete any of the test methods or materials identification codes.

For batch updating, the capability to add records that have been previously placed on a disk data set is provided. This can lessen the amount of typing required at the terminal if data to be added exist on computer readable media. Normally, some support from data processing personnel may be required to edit and reformat available data. See Section 2.3.2 of the Programmer's Manual (Reference 2) for a complete description of this capability.

MAT ID	MANUFACTURER'S DESIGNATION	MANUFACTURER	TEST METHOD	MEAS. # 2
TOT003	CARPET, FIBERGLASS/WOOL	CAROLINA NARROW FABRIC	F22	1.2000
TOT002	CARPET, FIBERGLASS/WOOL	CAROLINA NARROW FABRIC	F22	1.2000
TOT001	CARPET, FIBERGLASS/N	CAROLINA NARROW FABRICS	F22	1.1000
TOT004	CARPET, FIBERGLASS/WOOL	CAROLINA NARROW FABRIC	F22	1.1000
TOT008	LEVEL LOOP	LEES CARPET (No Underpad)	F22	0.9700
TOT015	CARPET	BURLINGTON IND. (LEES)	F22	0.7500
TOT016	CARPET	BURLINGTON IND. (LEES)	F22	0.7200
TOT014	CARPET	BURLINGTON IND. (LEES)	F22	0.6700
TOT013	CARPET	BURLINGTON IND. (LEES)	F22	0.6600
TOT010	LOOP	COMMERCIAL CARPET CO. (No Underpad)	F22	0.5400
TOT006	VELVET	LEES CARPET	F22	0.2700
TOT009	LEVEL LOOP	LEES CARPET (With Under pad)	F22	0.2700
TOT007	VELVET	LEES CARPET	F22	0.1300
TOT011	LOOP	COMMERCIAL CARPET CO. (With Underpad)	F22	0.1000

FIGURE 1. CARPET MATERIAL RANKED ACCORDING TO CRITICAL RADIANT PANEL HEAT FLUX

DOT / TSC MATERIALS DATA B A N K REPORT FORMAT 3A DATE: 13-Mar-80
(ENGLISH UNITS)

MAT ID B4P016 MANUFACTURER'S DESIGNATION SHEET-MOLDING COMPOUND 9300-30 MANUFACTURER H

FIELD COMPONENT USE CODE WP WALL PANELS
MATERIAL TYPE CODE AZ COMPOUND, MOLDING
MATERIAL COMPOSITION 1 CB POLYESTER, N.O.C.
MATERIAL COMPOSITION 2 FV FIBERGLASS FABRIC

MAT ID B4P016 TEST METH CODE F00 TEST FAC CODE B0 DATA SOURCE CODE TEST DATE 7/12/1978 INTEGER OF IDENTIFICATION 1517
TEST PROCEDURE FEDERAL AIR REGULATION 25, VERTICAL TESTS TEST REPORT NUMBER BMT 7A-00368 MISCELLANEOUS NOTES

TEST RESULT	UNIT OF MEASURE	IGNITION TIME	TEST RESULT NAME
60.0000	SECONDS	SELF-EXTINGUISHING TIME, ISOTROPIC/WARP	
1.7000	SECONDS	BURNED LENGTH, ISOTROPIC/WARP	
1.8000	INCHES	DRIP EXTINGUISHING TIME, ISOTROPIC/WARP	
0.0000	SECONDS	SELF-EXTINGUISHING TIME, FILL	
1.7000	SECONDS	BURNED LENGTH, FILL	
0.0000	SECONDS	DRIP EXTINGUISHING TIME, FILL	

MAT ID B4P016 TEST METH CODE F14 TEST FAC CODE B0 DATA SOURCE CODE TEST DATE 7/21/1978 INTEGER OF IDENTIFICATION 1516
TEST PROCEDURE ASTM E 1621 MATL SURFACE FLAMM USING RADIANT ENERGY TEST REPORT NUMBER BMT 7B-00368 MISCELLANEOUS NOTES

TEST RESULT	UNIT OF MEASURE	MATERIAL THICKNESS	TEST RESULT NAME
0.0750	INCHES <td>NUMBER OF SPECIMENS <td></td> </td>	NUMBER OF SPECIMENS <td></td>	
4.0000		FLAME SPREAD FACTOR F _s	
2.8000		STANDARD DEVIATION OF FLAME SPREAD FACTOR F _s	
1.4000		HEAT EVOLUTION FACTOR Q	
4.7000		STANDARD DEVIATION OF HEAT EVOLUTION FACTOR Q	
0.2000		FLAME SPREAD INDEX I _s	
13.2000		STANDARD DEVIATION OF FLAME SPREAD INDEX I _s	

FIGURE 2. SAMPLE OF PRINT-OUT FORMAT NO. 1

DOT / TBC MATERIALS DATA BANK REPORT FORMAT: JA DATE: 13-Mar-80
(ENGLISH UNITS)

MAT ID 8WP016 TEST METH CODE 811 TEST FAC CODE BO DATA SOURCE CODE 8/1/1978 INTEGER OF IDENTIFICATION 1519
TEST PROCEDURE NATIONAL BUREAU OF STANDARDS SHOCK DENSITY CHAMBER TEST REPORT NUMBER BMT 78-00369 MISCELLANEOUS NOTES
TEST RESULT 0.0750 UNIT OF MEASURE INCH TEST RESULT NAME MATERIAL THICKNESS
2.5000 WATT/SOCH THERMAL FLUX OF HEATER
13.1000 SPECIFIC OPTICAL DENSITY AT 1.5 MINUTE, FLAMING
5.1000 STD DEV DS AT 1.5 MINUTE, FLAMING
150.0000 SPECIFIC OPTICAL DENSITY AT 4.0 MINUTE, FLAMING
21.3000 STD DEV DS AT 4.0 MINUTE, FLAMING
276.2000 MAXIMUM SPECIFIC OPTICAL DENSITY, FLAMING
27.1000 STD DEV DMAX, FLAMING
10.8000 TIME TO MAXIMUM SPECIFIC OPTICAL DENSITY, FLAMING
-1.0000 STD DEV TIME TO DMAX, FLAMING

MAT ID 8WP016 TEST METH CODE 103 TEST FAC CODE BO DATA SOURCE CODE 5/25/1978 INTEGER OF IDENTIFICATION 1520
TEST PROCEDURE NBS SHOCK CHAMBER CONCENTRATION OF EVOLVED GASES TEST REPORT NUMBER BMT 78-900 MISCELLANEOUS NOTES
TEST RESULT 135.0000 UNIT OF MEASURE PARTS/MILLION TEST RESULT NAME CARBON MONOXIDE, FLAMING
0.0000 PARTS/MILLION OXIDES OF NITROGEN, FLAMING
0.0000 PARTS/MILLION HYDROGEN FLUORIDE, FLAMING
17.0000 PARTS/MILLION HYDROGEN CHLORIDE, FLAMING
2.0000 PARTS/MILLION HYDROGEN CYANIDE, FLAMING
0.0000 PARTS/MILLION SULFUR DIOXIDE, FLAMING
-1.0000 PARTS/MILLION CARBON MONOXIDE, SMOLDERING
-1.0000 PARTS/MILLION OXIDES OF NITROGEN, SMOLDERING
-1.0000 PARTS/MILLION HYDROGEN FLUORIDE, SMOLDERING
-1.0000 PARTS/MILLION HYDROGEN CHLORIDE, SMOLDERING
-1.0000 PARTS/MILLION HYDROGEN CYANIDE, SMOLDERING
-1.0000 PARTS/MILLION SULFUR DIOXIDE, SMOLDERING

FIGURE 3. SAMPLE OF PRINT-OUT FORMAT NO. 2

3. ALTERNATIVES TO THE PRESENT SYSTEM OF DATA BANK OPERATION

As noted in section 2.2, the data bank is accessible only at TSC and to the contractor presently involved in updating the data bank. To obtain data on a material, an organization must contact the TSC data bank operator and request the desired data. Since the existence of the bank is not widely known this arrangement has tended to limit its usefulness to a small sector of the technical community. This section identifies the available alternatives to improve the data bank's utility and also presents the advantages and disadvantages associated with each alternative.

3.1 GENERAL DISCUSSION

The majority of materials data contained in the data bank concerns information on materials common to all transportation modes and is not limited to transit systems. As such, the data bank is of value to the modal administrations. Other organizations may also find the data bank of use, since many of the materials are used in various sectors of society. At present the data bank usage is limited, as little effort has been made to publicize its existence. If expanded access to the bank is desired, an effort must be made to introduce potential users to the system via technical reports and announcements in NTIS, the Federal Register, Trade Journal and presentations at meetings and conferences.

3.2 THE PRESENT SYSTEM

The user contacts TSC personnel who access the data base and provide the requested information at no charge to the user.

3.2.1 Advantages

- a) Routine updating and maintenance of the data bank is easily accomplished and assures that the most recent data is provided to the user.
- b) Data are available on the frequency of data bank use, identity of user and type of data requested.
- c) Data additions and deletions performed only at TSC insure security of data in the data bank.

3.2.2 Disadvantages

- a) A high frequency of requests for data could involve a considerable investment of UMTA funds for staff and computer time to respond to the information and data requests. Although the expected number of requests cannot at present be estimated, it is possible that one labor year of effort would be required.
- b) The cost of providing data on request may result in the need to impose user charges which may decrease data bank usage and require the additional effort of setting up a bookkeeping system.

3.3 OPERATIONAL ALTERNATIVES

3.3.1 Access from Outside Terminals on "Read Only" Basis

With this alternative, any organization having the data bank telephone number, a compatible computer terminal and the appropriate password, could access the data bank directly. Such an arrangement would be on a "Read Only" basis where the user cannot add or delete any data in the data bank. This alternative would require that TSC only update and maintain the data bank, a task requiring a minimum level of effort. The cost to UMTA of such an arrangement will be dependent on the number of user requests.

3.3.1.1 Advantages

a) The expected cost to UMTA of the data bank operation may be decreased as TSC personnel will not be required to respond to all requests from users. Additional costs for computer time may increase if requests to the computer are substantial. These additional costs could be billed to the user.

b) For a properly equipped and knowledgeable user, this arrangement would provide a rapid response to requests and would be very convenient.

3.3.1.2 Disadvantages

- a) The user must acquire the necessary terminal hardware and train personnel in the hardware usage and the DEC 1022 software program.
- b) The cost to the user of acquiring the terminal hardware and understanding of the software program may not be justified if their usage rate is limited.
- c) UMTA costs for computer time will increase if user demands are substantial and not billed to user.

3.3.2 Requested Data Provided by TSC Transportation Information Division

This option could be designed to handle routine requests for information on a "charge-for-data" basis. In general, the funds collected would provide for a pay-as-you-go program.

3.3.2.1 Advantages

- a) The data bank would, with the exception of updating and maintenance, be largely self-supporting.
- b) Records identifying users, access frequencies and specific costs (connect time, disc access and search time) could be well documented and easily maintained.

3.3.2.2 Disadvantages

This alternative could possibly discourage potential users outside the transit community.

3.3.3 Cost Sharing with Other DOT Administrations

As noted in Section 3.1, the information in the materials data bank is applicable to all DOT agencies and their respective industries. Furthermore, the materials data bank is the only DOT data bank containing information on the flammability, smoke and toxicity characteristics of transportation materials. This alternative is directed at having all the DOT agencies participate in sharing the costs associated with maintaining the data bank. As such, all agencies and their respective industries would have access to and provide input for the data bank.

3.3.3.1 Advantages

- a) UMTA's cost to support the data bank would be minimized.
- b) Sharing with the other DOT agencies would encourage and enhance the usage and overall value of the data bank.

This alternative would promote UMTA's technology-sharing image.

3.3.3.2 Disadvantages

- a) The data bank will not be directed solely to the transit community.
- b) Any future data bank changes which UMTA desires may pose problems for other DOT agencies.

3.3.4 Combination with Another System

This alternative is directed at incorporating the materials data bank into another existing materials data bank or system. A search was recently made to seek out other materials data banks in both government and industry with the objective of a mutual exchange of information. The few data banks that were found were of two types:

- a) Those that contain only reference to technical journals, articles, and reports containing pertinent data.
- b) Those that contain only materials' physical properties data.

Data banks of the first type are cumbersome. They contain lists of documents, sometimes with short abstracts, with information on a particular type of material. One has to obtain these documents, cull them for the pertinent information, and then assemble the individual data into some meaningful arrangement.

The only data banks found of the second type were UMTA's and those at the NASA Johnson Space Center (JSC). These data banks store materials data in various categories, including manufacturer, trade name, application, material type, material composition source of data, and the results of a wide variety of test procedures. Data can be retrieved in any manner permitted by the software program.

The data sorted at JSC are not useful to the transit community for two reasons:

- 1) The test methods were developed by NASA and are used only by NASA. They differ from other standard test methods, and it is impossible to use a correlation factor.
- 2) The tests are made at other than normal atmospheric pressure and at oxygen concentrations that differ from atmospheric.

Although there is no totally compatible data bank or system with which the UMTA data bank may be combined, this alternative is still put forth as a possibility.

3.3.4.1 Advantages

- a) The present operational costs to UMTA would be reduced and possibly eliminated.
- b) Data response time to the user could be reduced.
- c) Potentially, more materials data would be available to the transit community.

3.3.4.2 Disadvantages

- a) May limit UMTA involvement in future changes to materials data bank.
- b) The difficulty in identifying and modifying the appropriate data bank or system with which to combine the materials data bank.
- c) If the data bank or system is accessed only from outside facilities, the disadvantages identified in Sections 3.3.1.1 and 3.3.1.2 will apply.

3.3.5 Periodic Publication of Data

This alternative is designed to reach the largest segment of the technical community by periodically publishing the data bank information through the National Technical Information Service (NTIS). The report format would be in the form shown in Figure 2. To limit the size of the report, there would be several volumes, each containing the available data on a specific component category or application (i.e., carpet material). Updated information could be provided to users to supplement the periodic publications.

3.3.5.1 Advantages

- a) This alternative would eliminate the need for users to contact TSC for data. UMTA costs would be reduced.
- b) All the materials information of a specific component application will be available in a single document.
- c) NTIS has a wide distribution and as such would provide a wide distribution for the data bank information.

3.3.5.2 Disadvantages

- a) NTIS charges a nominal fee for each report. Users desiring only a small portion of the information on a specific component will be required to obtain the entire report.
- b) Users would not be aware of data additions or deletions made between publication dates.

3.3.6 Discontinuation of Data Bank

3.3.6.1 Advantages

This alternative would eliminate the need for UMTA to support this segment of the Fire Safety in Transit Systems Program.

3.3.6.2 Disadvantages

The flammability and other physical characteristics of materials of interest, particularly to the modal administrations, would no longer be made available in a computerized fashion.

4. RECOMMENDATIONS

It is recommended that the alternative described in Section 3.3.2, "Requested Data Provided by TSC's Transportation Information Division" is the best method for managing and disseminating the information in the computerized materials data bank. This recommendation will be implemented by publishing in the Federal Register a notice of the availability of the data bank and the organizational contact at TSC with a telephone number and mailing address for obtaining additional information, or for obtaining information for specific materials applications. A minimum nominal fee will be charged for materials information.

APPENDIX

LIST OF TESTS AND MEASUREMENTS

A01 ASTM D1002: STRENGTH OF ADHESIVES IN SHEAR
 A01A NUMBER OF SPECIMENS
 A01B FAILURE LOAD
 A01C STD DEV FAILURE LOAD
 A02 ASTM D882: TENSILE PROPS. OF THIN PLASTIC SHEETING
 A02A NUMBER OF SPECIMENS
 A02B RATE OF HEAD MOVEMENT
 A02C SPECIMEN LENGTH
 A02D SPECIMEN WIDTH
 A02E SPECIMEN THICKNESS
 A02F TENSILE STRENGTH
 A02G STD DEV TENSILE STRENGTH
 A02H TENSILE STRENGTH AT BREAK
 A02I ELONGATION AT BREAK
 A02J YIELD STRENGTH
 A02K ELONGATION AT BREAK
 A02L ELASTIC MODULUS
 A04 ASTM D1876: PEEL RESISTANCE OF ADHESIVES (T-PEEL TEST)
 A04A NUMBER OF SPECIMENS-WARP
 A04B T-PEEL STRENGTH-WARP
 A04C STD DEV T-PEEL STRENGTH-WARP
 A04D NUMBER OF SPECIMENS-FILL
 A04E T-PEEL STRENGTH-FILL
 A04F STD DEV T-PEEL STRENGTH-FILL
 A05 FTMS 191, METHOD 5850: OVEN AGING OF CLOTH
 A05A NUMBER OF SPECIMENS
 A05B BREAKING STRENGTH CHANGE
 A05C STD DEV BREAKING STRENGTH CHANGE
 A06 ASTM D638; TENSILE PROPERTIES OF PLASTICS
 A06A NUMBER OF SPECIMENS
 A06B TENSILE STRENGTH
 A06C STD DEV TENSILE STRENGTH
 A06D TENSILE MODULUS
 A06E STD DEV TENSILE MODULUS
 A06F ULTIMATE ELONGATION
 A06G STD DEV ULTIMATE ELONGATION
 B02 FTMS 191, METH 5122: STRENGTH OF CLOTH, DIAPH BURST
 B02A NUMBER OF SPECIMENS
 B02B BURST STRENGTH
 B02C STD DEV BURST STRENGTH
 B03 FTMS 191, METH 5120: STRENGTH OF CLOTH, BALL BURST
 B03A NUMBER OF SPECIMENS
 B03B BURSTING STRENGTH
 B03C STD DEV BURSTING STRENGTH
 B04 FTMS 191, METH 5304.1: WYZENBEEK ABRASION TEST
 B04A NUMBER OF SPECIMENS
 B04B LOSS OF STRENGTH IN WARP/ISOTROPIC DIRECTION
 B04C STD DEV LOSS OF STRENGTH IN WARP/ISOTROPIC DIRECTION
 B04D LOSS OF STRENGTH IN FILL DIRECTION
 B04E STD DEV LOSS OF STRENGTH IN FILL DIRECTION

B05 ASTM D1682: LOAD & ELNGATM OF TEXTILE FABRICS
 B05A NUMBER OF SPECIMENS-WARP
 B05B BREAKING LOAD-WARP
 B05C STD DEV BREAKING LOAD-WARP
 B05D APPARENT ELONGATION-WARP
 B05E STD DEV APPARENT ELONGATION-WARP
 B05F NUMBER OF SPECIMENS-FILL
 B05G BREAKING LOAD-FILL
 B05H STD DEV BREAKING LOAD-FILL
 B05I APPARENT ELONGATION-FILL
 B05J STD DEV APPARENT ELONGATION-FILL
 B06 ASTM D1683: SEAM BREAKING STRNGTH OF WOVEN FABRICS
 B06A NUMBER OF SPECIMENS-WARP
 B06B BREAKING LOAD-WARP
 B06C STD DEV BREAKING LOAD-WARP
 B06D NUMBER OF SPECIMENS-FILL
 B06E BREAKING LOAD-FILL
 B06F STD DEV BREAKING LOAD-FILL
 B11 ASTM D2136: COATED FABRICS-LOW TEMPRTURE BEND TEST
 B11A NUMBER OF SPECIMENS
 B11B EXPOSURE TEMPERATURE
 B11C EXPOSURE TIME
 B11D TEST RESULT (1=PASS: 0=FAIL)
 C01 ASTM D395-69: COMPRESSION SET OF RUBBER
 C01A NUMBER OF SPECIMENS
 C01B SPECIMEN THICKNESS, ORIGINAL
 C01C SPECIMEN DIAMETER, ORIGINAL
 C01D HEAT TREATMENT TIME
 C01E HEAT TREATMENT TEMPERATURE
 C01F COMPRESSION SET, CONSTANT LOAD
 C01G STD DEV COMPRESSION SET, CONSTANT LOAD
 C01H COMPRESSION SET, CONSTANT DEFLECTION
 C01I STD DEV COMPRESSION SET, CONSTANT DEFLECTION
 C02 ASTM D412: PROPERTIES OF RUBBER IN TENSION
 C02A NUMBER OF SPECIMENS
 C02B SPECIMEN THICKNESS
 C02C TENSILE STRENGTH
 C02D STD DEV TENSILE STRENGTH
 C02E ULTIMATE ELONGATION
 C02F STD DEV ULTIMATE ELONGATION
 C02G TENSILE SET AT 200% ELONGATION
 C02H STD DEV TENSILE SET AT 200% ELONGATION
 C03 ASTM D624: TEAR RESISTANCE OF RUBBER
 C03A NUMBER OF SPECIMENS
 C03B SPECIMEN THICKNESS
 C03C TEAR RESISTANCE
 C03D STD DEV TEAR RESISTANCE
 C03E TEAR RESISTANCE PER ISO/R34
 C03F STD DEV TEAR RESISTANCE PER ISO/R34
 C05 FTMS 406, METHOD 1021: CMRSSH PROPS RIGID PLASTCS

C05A NUMBER OF SPECIMENS - WARP
 C05B COMPRESSIVE STRENGTH - WARP
 C05C STD DEV COMPRESSIVE STRENGTH - WARP
 C05D COMPRESSIVE MODULUS - WARP
 C05E STD DEV COMPRESSIVE MODULUS - WARP
 C05F NUMBER OF SPECIMENS - FILL
 C05G COMPRESSIVE STRENGTH - FILL
 C05H STD DEV COMPRESSIVE STRENGTH - FILL
 C05I COMPRESSIVE MODULUS - FILL
 C05J STD DEV COMPRESSIVE MODULUS - FILL
 C06 ASTM C366: MEAS. OF THICKNESS OF SANDWICH CORES
 C06A THICKNESS
 C06B STD DEV THICKNESS
 C09 ASTM D695: COMPRESSIVE PROPERTIES OF RIGID PLASTICS
 C09A NUMBER OF SPECIMENS
 C09B RATE OF HEAD MOVEMENT
 C09C SPECIMEN LENGTH
 C09D SPECIMEN WIDTH
 C09E SPECIMEN THICKNESS
 C09F COMPRESSIVE STRENGTH
 C09G STD DEV COMPRESSIVE STRENGTH
 C09H COMPRESSIVE YIELD STRENGTH
 C09I STD DEV COMPRESSIVE YIELD STRESS
 C09J OFFSET YIELD STRESS
 C09K MODULUS OF ELASTICITY
 C09L STD DEV MODULUS OF ELASTICITY
 C12 ASTM D1621: COMPRESSIVE PROPS OF RGD CELLULR PLASTC
 C12A NUMBER OF SPECIMENS
 C12B COMPRESSIVE STRENGTH
 C12C STD DEV COMPRESSIVE STRENGTH
 C12D COMPRESSIVE MODULUS
 C12E STD DEV COMPRESSIVE MODULUS
 C12F DEFORMATION
 C12G STD DEV DEFORMATION
 C18 ASTM D575: PROPERTIES OF RUBBER IN COMPRESSION
 C18A NUMBER OF SPECIMENS
 C18B COMPRESSION DEFLECTION
 C18C STD DEV COMPRESSION DEFLECTION
 C18D COMPRESSION FORCE
 C18E STD DEV COMPRESSION FORCE
 C19 ASTM D1564: FLEXBL CELLULR MATLS-SLAB URETHNE FOAM
 C19A NUMBER OF SPECIMENS
 C19B DENSITY
 C19C STD DEV DENSITY
 C19D COMPRESSION SET
 C19E STD DEV COMPRESSION SET
 C19F IMPACT RESILIENCE, PERCENT REBOUND
 C19G STD DEV IMPACT RESILIENCE, PERCENT REBOUND
 C19H COMPRESSIVE STRESS FOR 25% DEFLECTION
 C19I COMPRESSIVE STRESS FOR 50% DEFLECTION

C21 AATCC TEST METH. 16E-1977: COLORFASTNESS TO LIGHT
 C21A NUMBER OF SPECIMENS
 C21B GRAY SCALE COLOR CHANGE
 C22 AATCC TEST METH. 8-1977: COLORFASTNESS TO CROCKING
 C22A NUMBER OF SPECIMENS
 C22B GRAY SCALE COLOR CHANGE
 CH1 GENERAL RESISTANCE TO CHEMICALS
 CH1A STRONG ACIDS (-1=UNKNWN,0=RST TO,1=ATTACKED BY)
 CH1B WEAK ACIDS (-1=UNKNWN,0=RST TO,1=ATTACKED BY)
 CH1C STRONG ALKALI (-1=UNKNWN,0=RST TO,1=ATTACKED BY)
 CH1D WEAK ALKALI (-1=UNKNWN,0=RST TO,1=ATTACKED BY)
 CH1E WATER (-1=UNKNWN,0=RST TO,1=ATTACKED BY)
 CH1F KETONES & ESTERS (-1=UNKNWN,0=RST TO,1=ATTACKED BY)
 CH1G ALCOHOLS (-1=UNKNWN,0=RST TO,1=ATTACKED BY)
 CH1H HYDROCRBN SLVNTS (-1=UNKNWN,0=RST TO,1=ATTACKED BY)
 CH1I CL HYDCBN SLVNTS (-1=UNKNWN,0=RST TO,1=ATTACKED BY)
 CH1J PHENOLS (-1=UNKNWN,0=RST TO,1=ATTACKED BY)
 CH1K LUBRICATING OILS (-1=UNKNWN,0=RST TO,1=ATTACKED BY)
 CH1L SEE MISC NOTES (-1=UNKNWN,0=RST TO,1=ATTACKED BY)
 D01 ASTM D2440: RUBBER PROPERTY - DUROMETER HARDNESS
 D01A NUMBER OF SPECIMENS
 D01B DUROMETER HARDNESS
 D01C STD DEV DUROMETER HARDNESS
 D03 ASTM D297: SPECIFIC GRAVITY OF RUBBER PRODUCTS
 D03A NUMBER OF SPECIMENS
 D03B SPECIFIC GRAVITY
 D03C STD DEV SPECIFIC GRAVITY
 D04 FTMS 406, METHOD 5012: SPECIFIC GRAVITY, WT & VOLM
 D04A NUMBER OF SPECIMENS
 D04B SPECIFIC GRAVITY
 D04C STD DEV SPECIFIC GRAVITY
 D05 ASTM D792: SPECIFIC GRAVITY AND DENSITY OF PLASTCS
 D05A NUMBER OF SPECIMENS
 D05B SPECIFIC GRAVITY
 D05C STD DEV SPECIFIC GRAVITY
 D05D DENSITY
 D05E STD DEV DENSITY
 D08 DIMENSIONAL STABILITY OF TEXTILES ON CLEANING
 D08A NUMBER OF SPECIMENS
 D08B DIMENSIONAL CHANGE - WARP/WALE
 D08C STD DEV DIMENSIONAL CHANGE - WARP/WALE
 D08D DIMENSIONAL CHANGE - FILL/COURSE
 D08E STD DEV DIMENSIONAL CHANGE - FILL/COURSE
 D09 ASTM D648: TEMPERATURE OF DEFLECTION ONSET, PLSTCS
 D09A NUMBER OF SPECIMENS
 D09B FLEXURAL LOAD
 D09C DEFLECTION TEMPERATURE
 D09D STD DEV DEFLECTION TEMPERATURE
 E02 FTMS 191, METH 5100.1: STRNGTH OF CLOTH; GRAB METH
 E02A NUMBER OF SPECIMENS - WARP

E02B BREAKING STRENGTH - WARP
 E02C STD DEV BREAKING STRENGTH - WARP
 E02D ELONGATION - WARP
 E02E STD DEV ELONGATION - WARP
 E02F NUMBER OF SPECIMENS - FILL
 E02G BREAKING STRENGTH - FILL
 E02H STD DEV BREAKING STRENGTH - FILL
 E02I ELONGATION - FILL
 E02J STD DEV ELONGATION - FILL
 E04 ASTM D696: LINEAR THERML EXPNSN COEFF. OF PLASTICS
 E04A NUMBER OF SPECIMENS
 E04B COEFFICIENT OF LINEAR THERMAL EXPANSION
 E04C STD DEV COEFFICIENT OF LINEAR THERMAL EXPANSION
 F00 FEDERAL AIR REGULATION 25, VERTICAL TESTS
 F00A IGNITION TIME
 F00B SELF-EXTINGUISHING TIME, ISOTROPIC/WARP
 F00C BURNED LENGTH, ISOTROPIC/WARP
 F00D DRIP EXTINGUISHING TIME, ISOTROPIC/WARP
 F00E SELF EXTINGUISHING TIME, FILL
 F00F BURNED LENGTH, FILL
 F00G DRIP EXTINGUISHING TIME, FILL
 F01 FEDERAL AIR REGULATIONS 25, NON-VERTICAL TESTS
 F01A SELF-EXTINGUISHING TIME, HZNTL TEST, ISOTROPIC/WARP
 F01B BURNED LENGTH, HZNTL TEST, ISOTROPIC/WARP
 F01C BURNING RATE, HZNTL TEST, ISOTROPIC/WARP
 F01D SELF-EXTINGUISHING TIME, HZNTL TEST, FILL
 F01E BURNED LENGTH, HZNTL TEST, FILL
 F01F BURNING RATE, HZNTL TEST, FILL
 F01G AFTER-GLOW TIME, 45 DEGREE TEST
 F01H FLAME PENETRATION, 45 DEGREE TEST (0=NO, 1=YES)
 F02 ASTM D 350: FLAMM FLEX TREATD ELEC INSULATN SLEEVNG
 F02A TIME TO BURN A LENGTH OF ONE INCH
 F03 ASTM D 568: FLAMMABILITY OF FLEXIBLE PLASTICS
 F03A MATERIAL THICKNESS
 F03B BURNING RATE
 F03C SELF-EXTINGUISHING TIME
 F03D DISTANCE BURNED
 F03E PRESENCE OF BURNING DROPS (-1=UNKNOWN, 0=NO, 1=YES)
 F04 ASTM D 635: FLAMM. OF SELF-SUPPORTING PLASTICS
 F04A MATERIAL THICKNESS
 F04B BURNING RATE
 F04C SELF-EXTINGUISHING TIME
 F04D DISTANCE BURNED
 F04E PRESENCE OF BURNING DROPS (-1=UNKNOWN, 0=NO, 1=YES)
 F05 ASTM D 757: FLAMM. OF PLASTICS, SELF-EXTNGSHNG TYPE
 F05A BURNING RATE
 F05B BURNING TIME
 F05C OCCURRENCE OF MELTING OR BURNING DROPS (0=NO, 1=YES)
 F06 ASTM D 777: FLAMM. OF TREATED PAPER AND PAPERBOARD
 F06A CHAR LENGTH

F06B DURATION OF AFTERGLOW
 F07 ASTM D 1230: FLAMMABILITY OF CLOTHING TEXTILES
 F07A FLAMMABILITY CLASS
 F08 ASTM D 1433: FLAMM. OF FLEX. THIN PLASTIC SHEETING
 F08A MATERIAL THICKNESS
 F08B BURNING RATE
 F08C PRESENCE OF BURNING DROPS (0=NO,1=YES)
 F09 ASTM D 1929:IGNITION PROPS OF PLASTICS(SETCHKIN)
 F09A FLASH IGNITION TEMPERATURE
 F09B SELF-EXTINGUISHING TEMPERATURE
 F10 ASTM D 2859: FLAMM. OF TEXTL FLOOR COVERING MATLS
 F10A NUMBER OF 8 SPECIMENS RESISTANT TO FLAMMABIIITY
 F11 ASTM D 2863:FLAMM. OF PLASTICS,OXYGEN INDEX METHOD
 F11A NUMBER OF SPECIMENS
 F11B OXYGEN INDEX
 F11C STANDARD DEVIATION - OXYGEN INDEX
 F12 ASTM D 69:COMBUSTBLE PROPS OF TRTD WOOD,FIRE-TUBE
 F12A MOISTURE CONTENT OF MATERIAL
 F12B WEIGHT LOSS OF MATERIAL AFTER BURNING HAS CEASED
 F13 ASTM E 84: SURFACE BURNING CHARACTERISTICS OF MATL
 F13A FLAME SPREAD CLASSIFICATION - DISTANCE
 F13B FLAME SPREAD CIASSIFICATION - FUEL CONTRIBUTION
 F13C FLAME SPREAD CIASSIFICATION - SMOKE CONTRIBUTION
 F14 ASTM E 162:MATL SURFACE FLAMM USING RADIANT ENERGY
 F14A MATERIAL THICKNESS
 F14B NUMBER OF SPECIMENS
 F14C FLAME SPREAD FACTOR FS
 F14D STANDARD DEVIATION OF FLAME SPREAD FACTOR FS
 F14E HEAT EVOLUTION FACTOR Q
 F14F STANDARD DEVIATION OF HEAT EVCLUTION FACTOR Q
 F14G FLAME SPREAD INDEX IS
 F14H STANDARD DEVIATION OF FLAME SPREAD INDEX IS
 F15 ASTM E 286: SURFC FLAMM OF BLDNG MATLS,8-FT TUNNEL
 F15A FLAME SPREAD INDEX
 F15B FUEL CONTRIBUTED INDEX
 F15C SMOKE DENSITY INDEX
 F16 FTMS 191, METHOD 5900: FLAME RES. OF CLOTH; HZNTL
 F16A FLAME RESISTANCE
 F17 FTMS 191, METHOD 5903: FLAME RES. OF CLOTH; VRTCL
 F17A AFTER-FLAME TIME
 F17B AFTER-GLOW TIME
 F17C CHAR LENGTH
 F18 FTMS 191, METHOD 5905:FLAME RES OF MATL;HIGH HEAT
 F18A REACTION OF MATERIAL TO FLAME:SEE USER'S MANUAL
 F19 FTMS 191, METHOD 5906: BURNING RATE OF CLOTH;HZNTL
 F19A BURNING RATE
 F20 FTMS 191, METHOD 5908:BURNING RATE OF CLOTH;45 DEG
 F20A FLAMMABILITY
 F21 OHIO STATE UNIV RELEASE RATE APPARATUS,FLAMMABILTY
 F21A THERMAL FLUX

F21B AIR FLOW
 F21C MATERIAL THICKNESS
 F21D ORIENTATION (-1=UNKNOWN,0=VERTICAL,1=HORIZONTAL)
 F21E IGNITION (-1=UNKNOWN,0=NON-PILOTED,1=PILOTED)
 F21F SLOPE E
 F21H TIME TO MAXIMUM HEAT RELEASE RATE
 F21I HEAT RELEASED AFTER 4 MINUTES
 F21J TOTAL HEAT RELEASED
 F22 NBS RADIANT PANEL FLOORING TEST
 F22A MATERIAL THICKNESS
 F22B CRITICAL RADIANT FLUX
 F22C STANDARD DEVIATION, CRITICAL RADIANT FLUX
 F22D NUMBER OF SPECIMENS TESTED
 F23 FLAMMABILITY TEST FOR ELECTRICAL WIRE
 F23A TIME TO IGNITION, VERTICAL
 F23B TIME TO IGNITION, HORIZONTAL
 F23C AFTER FLAME/GLOW TIME, VERTICAL
 F23D AFTER FLAME/GLOW TIME, HORIZONTAL
 F23E FLAME DAMAGE LENGTH, VERTICAL
 F23F FLAME DAMAGE LENGTH, HORIZONTAL
 F23G CONVEY FLAME, VERTICAL (0=NO;1=YES)
 F23H CONVEY FLAME, HORIZONTAL (0=NO;1=YES)
 F23I POST FLAME DIELECTRIC (VOLTS)
 F24 ASTM E-119: FIRE TESTS OF BUILDING CONSTRUCTION AND
 F24A RESULTS (0=FAIL;1=PASS)
 F25 ASTM D 3675: MTL SURFACE FLAMM USING RADIANT ENERGY
 F25A MATERIAL THICKNESS
 F25B NUMBER OF SPECIMENS
 F25C FLAME SPREAD FACTOR FS
 F25D STANDARD DEVIATION OF FLAME SPREAD FACTOR FS
 F25E HEAT EVOLUTION FACTOR Q
 F25F STANDARD DEVIATION OF HEAT EVOLUTION FACTOR Q
 F25G FLAME SPREAD INDEX IS
 F25H STANDARD DEVIATION OF FLAME SPREAD INDEX IS
 G03 ASTM D523: SPECULAR GLOSS
 G03A NUMBER OF SPECIMENS
 G03B 20 DEGREE GLOSS
 G03C STD DEV 20 DEGREE GLOSS
 G03D 60 DEGREE GLOSS
 G03E STD DEV 60 DEGREE GLOSS
 G03F 85 DEGREE GLOSS
 G03G STD DEV 85 DEGREE GLOSS
 G04 ASTM C177: THERMAL CONDUCTIVITY BY GUARDED PLATE
 G04A THERMAL CONDUCTIVITY
 G04B STD DEV THERMAL CONDUCTIVITY
 G05 ASTM C273: SHEAR PROPS. OF FLAT SANDWICH CONSTRUCTNS
 G05A NUMBER OF SPECIMENS
 G05B SHEAR STRENGTH
 G05C STD DEV SHEAR STRENGTH
 G05D ULTIMATE SHEAR STRAIN

G05E STD DEV ULTIMATE SHEAR STRAIN
 G05F SHEAR MODULUS
 G05G STD DEV SHEAR MODULUS
 G06 HIGH IMPTURE (180F) RSTNCE FOR POLYMR COATED FABRC
 G06A NUMBER OF SPECIMENS
 G06B TACKINESS, EMBRITTLEMENT, PUNGENT ODOR (1=YES;0=NO
 I03 ASTM D2444: IMPACT RSTNCE OF PLASTIC PIPE USNG TUP
 I03A NUMBER OF SPECIMENS
 I03B IMPACT RESISTANCE
 I03C STD DEV IMPACT RESISTANCE
 I04 ASTM D256: IMPACT RESISTANCE OF PLASTICS
 I04A IZOD IMPACT STRENGTH
 I04B STD DEV IZOD IMPACT STRENGTH
 I05 ASTM D2583: INDENTATION HARDNSS OF PLASTCS, BARCOL
 I05A NUMBER OF SPECIMENS
 I05B BARCOL HARDNESS
 I05C STD DEV BARCOL HARDNESS
 I08 ASTM D3029: IMPACT RSTNCE OF PLASTC SHEET USNG TUP
 I08A NUMBER OF SPECIMENS
 I08B SPECIMEN THICKNESS
 I08C IMPACT RESISTANCE
 I09D STD DEV IMPACT RESISTANCE
 L01 MIL-STD-401B: FLEXURAL PROPS OF SANDWCH CONSTRCTNS
 L01A NUMBER OF SPECIMENS
 L01B CORE SHEAR STRESS
 L01C STD DEV CORE SHEAR STRESS
 L01D FACING STRESS
 L01E STD DEV FACING STRESS
 L01F P/Y - INITIAL SLOPE OF LOAD/DEFLECTION CURVE
 L01G STD DEV P/Y-INITIAL SLOPE OF LOAD/DEFLECTION CURVE
 L01H CORE SHEAR MODULUS
 L01I STD DEV CORE SHEAR MODULUS
 L03 MIL-STD-401B: PEEL STRENGTH OF SANDWICH CONSTRCTNS
 L03A NUMBER OF SPECIMENS
 L03B PEEL STRENGTH
 L03C STD DEV PEEL STRENGTH
 L07 MIL-STD-401B: TENSILE STRENGTH OF SNDWCH CNSTRCTNS
 L07A NUMBER OF SPECIMENS
 L07B TENSILE STRENGTH
 L07C STD DEV TENSILE STRENGTH
 M01 FTMS 406, METHOD 1011: TENSILE PROPRTS OF PLASTICS
 M01A NUMBER OF SPECIMENS - WARP/ISOTROPIC
 M01B TENSILE STRENGTH - WARP/ISOTROPIC
 M01C STD DEV TENSILE STRENGTH - WARP/ISOTROPIC
 M01D ELONGATION - WARP/ISOTROPIC
 M01E STD DEV ELONGATION - WARP/ISOTROPIC
 M01F ELASTIC MODULUS - WARP/ISOTROPIC
 M01G NUMBER OF SPECIMENS - FILL
 M01H TENSILE STRENGTH - FILL
 M01I STD DEV TENSILE STRENGTH - FILL

M01J ELONGATION - FILL
 M01K STD DEV ELONGATION - FILL
 M01L ELASTIC MODULUS - FILL
 M02 FTMS 406, METHOD 1031: FLEXURAL PROPTS OF PLASTICS
 M02A NUMBER OF SPECIMENS - WARP
 M02B FLEXURAL STRENGTH - WARP
 M02C STD DEV FLEXURAL STRENGTH - WARP
 M02D FLEXURAL MODULUS - WARP
 M02E STD DEV FLEXURAL MODULUS - WARP
 M02F NUMBER OF SPECIMENS - FILL
 M02G FLEXURAL STRENGTH - FILL
 M02H STD DEV FLEXURAL STRENGTH - FILL
 M02I FLEXURAL MODULUS - FILL
 M02J STD DEV FLEXURAL MODULUS - FILL
 M03 ASTM D790: FLEXURAL PROPERTIES OF PLASTICS
 M03A NUMBER OF SPECIMENS
 M03B MAXIMUM FIBER STRESS
 M03C STD DEV MAXIMUM FIBER STRESS
 M03D FLEXURAL STRENGTH
 M03E STD DEV FLEXURAL STRENGTH
 M03F FLEXURAL YIELD STRESS
 M03G STD DEV FLEXURAL YIELD STRESS
 M03H FLEXURAL OFFSET YIELD STRESS
 M03I STD DEV FLEXURAL OFFSET YIELD STRESS
 M03J TANGENT MODULUS OF ELASTICITY
 M03K STD DEV TANGENT MODULUS OF ELASTICITY
 M03L SECANT MODULUS OF ELASTICITY
 M04 FTMS 191, METHOD 5134: TEARING STRENGTH OF CLOTH
 M04A NUMBER OF SPECIMENS - WARP
 M04B TEARING STRENGTH - WARP
 M04C STD DEV TEARING STRENGTH - WARP
 M04D NUMBER OF SPECIMENS
 M04E TEARING STRENGTH - FILL
 M04F STD DEV TEARING STRENGTH - FILL
 M05 ASTM D3512: PILLING RSTNCE OF TEXTILES-RANDM TUMBLR
 M05A NUMBER OF SPECIMENS
 M05B NUMBER OF PILLS
 M05C STD DEV NUMBER OF PILLS
 P01 PHYSICAL, MECHANICAL, AND ELECTRICAL PROPERTIES
 P01A SPECIFIC GRAVITY
 P01B THERMAL CONDUCTIVITY
 P01C THERMAL EXPANSION COEFFICIENT
 P01D TENSILE MODULUS
 P01E COMPRESSIVE STRENGTH
 P01F ULTIMATE TENSILE STRENGTH
 P01G ULTIMATE ELONGATION
 P01H IZOD NOTCHED IMPACT STRENGTH
 P01I COMPRESSION SET, FLEXIBLE FOAMS AFTER 22 HRS,158F
 P01J DIELECTRIC STRENGTH
 P01K DIELECTRIC CONSTANT AT 60 CYCLES/SEC

P01L DIELECTRIC CONSTANT AT 1,000,000 CYCLES/SEC
 R03 ASTM D1329: RUBBER RETRACTION AT LOW TEMPERATURE
 R03A NUMBER OF SPECIMENS
 R03B SPECIMEN THICKNESS
 R03C TR 10
 R03D STD DEV TR 10
 R03E TR 30
 R03F STD DEV TR 30
 R03G TR 50
 R03H STD DEV TR 50
 R03I TR 70
 R03J STD DEV TR 70
 R08 SNAG RESISTANCE OF TEXTILES
 R08A NUMBER OF SPECIMENS
 R08B NUMBER OF SNAGS
 R08C STD DEV NUMBER OF SNAGS
 R14 ASTM D573: DETERIORATION OF RUBBER IN AN AIR OVEN
 R14A AGING TEMPERATURE
 R14B AGING TIME
 R14C DUROMETER HARDNESS
 R14D STD DEV DUROMETER HARDNESS
 R14E SPECIMEN THICKNESS FOR TENSILE PROPERTIES DETERMNTN
 R14F TENSILE STRENGTH
 R14G STD DEV TENSILE STRENGTH
 R14H ULTIMATE ELONGATION
 R14I STD DEV ULTIMATE ELONGATION
 R14J SPECIMEN THICKNESS FOR COMPRESSION SET DETERMINAT
 R14K SPECIMEN DIAMETER FOR COMPRESSION SET DETERMINATN
 R14L COMPRESSION SET AT CONSTANT LOAD
 S01 NFPA 258 (ASTM E662, NBS SMOKE CHAMBER)
 S01A MATERIAL THICKNESS
 S01B THERMAL FLUX OF HEATER
 S01C SPECIFIC OPTICAL DENSITY AT 1.5 MIN, FLAMING
 S01D SPECIFIC OPTICAL DENSITY AT 1.5 MIN, SMOLDERING
 S01E SPECIFIC OPTICAL DENSITY AT 4.0 MIN, FLAMING
 S01F SPECIFIC OPTICAL DENSITY AT 4.0 MIN, SMOLDERING
 S01G MAXIMUM SPECIFIC OPTICAL DENSITY, FLAMING
 S01H TIME TO MAXIMUM SPECIFIC OPTICAL DENSITY, FLAMING
 S01I MAXIMUM SPECIFIC OPTICAL DENSITY, SMOLDERING
 S01J TIME TO MAXIMUM SPECIFIC OPTICAL DENSITY, SMOLDNRG
 S02 ASTM D 2843: SMOKE DENSITY FROM BURNING PLASTICS
 S02A MATERIAL THICKNESS
 S02B SMOKE DENSITY RATING
 S03 SURFACE BURNING CHARACTERISTICS OF BURNING MATERIA
 S03A SMOKE CONTRIBUTION RELATIVE TO RED OAK
 S04 OHIO STATE UNIVERSITY RELEASE RATE APPARATUS, SMOKE
 S04A THERMAL FLUX
 S04B AIR FLOW
 S04C MATERIAL THICKNESS
 S04D ORIENTATION (-1=UNKNOWN; 0=VERTICAL; 1=HORIZONTAL)

S04E IGNITION (-1=UNKNOWN;0=NON-PILOTED;1=PILOTED)
 S04F SPECIFIC OPTICAL DENSITY AT 1.5 MINUTES
 S04G SPECIFIC OPTICAL DENSITY AT 4.0 MINUTES
 S04H MAXIMUM SPECIFIC OPTICAL DENSITY
 S05 SMOKE EMISSION: NAFEC PROJECT USING NBS CHAMBER
 S05A TOTAL NUMBER OF SPECIMENS TESTED OF MATERIAL TYPE
 S05B NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 0-16
 S05C NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 16-30
 S05D NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 30-70
 S05E NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 70-100
 S05F NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 100-200
 S05G NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 200-300
 S05H NUMBER OF SPECIMENS SHOWING DMAX IN RANGE 300-400
 S05I NUMBER OF SPECIMENS SHOWING DMAX GREATER THAN 400
 S05J NUMBER OF SPECIMENS NOT REACHING D= 16 IN 90 SECS
 S05K NUMBER OF SPECIMENS NOT REACHING D=100 IN 90 SECS
 S06 SMOKE EMISSION: NAFEC PROJECT USING XP2 CHAMBER
 S06A TOTAL NUMBER OF SPECIMENS TESTED OF MATERIAL TYPE
 S06B NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 0-5
 S06C NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 5-10
 S06D NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 10-30
 S06E NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 30-50
 S06F NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 50-70
 S06G NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 70-80
 S06H NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 80-90
 S06I NUMBER OF SPECIMENS SHOWING PERCENT LA MAX 90-100
 S06J NR SPECIMENS NOT REACHING 10% LA MAX IN 90 SECS
 S06K NR SPECIMENS NOT REACHING 40% LA MAX IN 90 SECS
 S11 NFPA 258 (ASTM 2662, NBS SMOKE CHAMBER)
 S11A MATERIAL THICKNESS
 S11B THERMAL FLUX OF HEATER
 S11C SPECIFIC OPTICAL DENSITY AT 1.5 MINUTE, FLAMING
 S11D STD DEV DS AT 1.5 MINUTE, FLAMING
 S11E SPECIFIC OPTICAL DENSITY AT 4.0 MINUTE, FLAMING
 S11F STD DEV DS AT 4.0 MINUTE, FLAMING
 S11G MAXIMUM SPECIFIC OPTICAL DENSITY, FLAMING
 S11H STD DEV DMAX, FLAMING
 S11I TIME TO MAXIMUM SPECIFIC OPTICAL DENSITY, FLAMING
 S11J STD DEV TIME TO DMAX, FLAMING
 T01 NBS SMOKE CHAMBER: MGRM TOXICANT EVOLVED/GRAM MATL
 T01A CARBON MONOXIDE, FLAMING
 T01B OXIDES OF NITROGEN, FLAMING
 T01C HYDROGEN FLUORIDE, FLAMING
 T01D HYDROGEN CHLORIDE, FLAMING
 T01E HYDROGEN CYANIDE, FLAMING
 T01F SULFUR DIOXIDE, FLAMING
 T01G CARBON MONOXIDE, SMOLDERING
 T01H OXIDES OF NITROGEN, SMOLDERING
 T01I HYDROGEN FLUORIDE, SMOLDERING
 T01J HYDROGEN CHLORIDE, SMOLDERING

T01K HYDROGEN CYANIDE, SMOLDERING
 T01L SULFUR DIOXIDE, SMOLDERING
 T02 TOXIC GAS EVOLUTION:SEE TEST NOTES FOR TEST METHOD
 T02A CARBON MONOXIDE
 T02B OXIDES OF NITROGEN
 T02C HYDROGEN FLUORIDE
 T02D HYDROGEN CHLORIDE
 T02E HYDROGEN CYANIDE
 T02F SULFUR DIOXIDE
 T03 NBS SMOKE CHAMBER: CONCENTRATION OF EVOLVED GASES
 T03A CARBON MONOXIDE, FLAMING
 T03B OXIDES OF NITROGEN, FLAMING
 T03C HYDROGEN FLUORIDE, FLAMING
 T03D HYDROGEN CHLORIDE, FLAMING
 T03E HYDROGEN CYANIDE, FLAMING
 T03F SULFUR DIOXIDE, FLAMING
 T03G CARBON MONOXIDE, SMOLDERING
 T03H OXIDES OF NITROGEN, SMOLDERING
 T03I HYDROGEN FLUORIDE, SMOLDERING
 T03J HYDROGEN CHLORIDE, SMOLDERING
 T03K HYDROGEN CYANIDE, SMOLDERING
 T03L SULFUR DIOXIDE, SMOLDERING
 V01 ASTM D903: PEEL STRENGTH OF ADHESIVE BONDS
 V01A PEEL STRENGTH-NYLON
 V01B STD DEV PEEL STRENGTH-NYLON
 V01C PEEL STRENGTH-MYLAR
 V01D STD DEV PEEL STRENGTH-MYLAR
 V01E PEEL STRENGTH AT ROOM TEMPERATURE
 V01F STD DEV PEEL STRENGTH AT ROOM TEMPERATURE
 V01G PEEL STRENGTH AT 120F AND 100% RELATIVE HUMIDITY
 V01H STD DEV PEEL STRENGTH AT 120F AND 100% RH
 V01I PEEL STRENGTH AT 160F
 V01J STD DEV PEEL STRENGTH AT 160F
 W02 WEIGHT OF TEXTILES AND SHEET MATERIALS
 W02A NUMBER OF SPECIMENS
 W02B THICKNESS
 W02C STD DEV THICKNESS
 W02D AREAL DENSITY
 W02E STD DEV AREAL DENSITY
 W02F SPECIFIC GRAVITY
 W02G STD DEV SPECIFIC GRAVITY
 W05 FTMS 406, METHOD 1091: TABER ABRASION TEST
 W05A NUMBER OF SPECIMENS
 W05B WEIGHT LOSS PER 1000 REVOLUTIONS
 W05C STD DEV WEIGHT LOSS PER 1000 REVOLUTIONS
 W07 ASTM D756: WEIGHT AND SHAPE CHANGES OF PLASTICS
 W07A NUMBER OF SPECIMENS
 W07B WEIGHT CHANGE
 W07C STD DEV WEIGHT CHANGE
 W07D LENGTH CHANGE

W07E STD DEV LENGTH CHANGE
W07F WIDTH CHANGE
W07G STD DEV WIDTH CHANGE
W07H THICKNESS CHANGE
W07I STD DEV THICKNESS CHANGE
W08 ASTM D570: WATER ABSORPTION BY PLASTICS
W08A NUMBER OF SPECIMENS
W08B WATER ABSORPTION
W08C STD DEV WATER ABSORPTION
W21 FTMS 406, METHOD 7031: WATER ABSORPTION BY PLASTCS
W21A NUMBER OF SPECIMENS
W21B WATER ABSORPTION
W21C STD DEV WATER ABSORPTION

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Hathaway, W. J.

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