U.S. Department
of Transportation

**Urban Mass
Transportation
Administration**

Recommended Fire Safety Practices for Rail Transit Materials Selection

Office of Technical Assistance
Safety and Security Office
Washington DC 20590

Prepared by
Transportation Systems Center
Kendall Square
Cambridge, MA 02142

August 1984
Reprint
June 1988

UMTA Technical Assistance Program

Urban Mass Transportation Administration

Recommended Fire Safety Practices for Rail Transit Materials Selection

AGENCY: Urban Mass Transportation Administration, DOT

ACTION: Notice.

SUMMARY: The Urban Mass Transportation Administration is issuing recommendations for testing flammability and smoke emission characteristics of materials used in the construction of rapid rail transit and light rail transit vehicles. These recommendations are based on the Transportation Systems Center's "Proposed Guidelines for Flammability and Smoke Emission Specifications," which the transit industry, in general, uses on a voluntary basis.

EFFECTIVE DATE: August 14, 1984.

FOR FURTHER INFORMATION CONTACT: James A. O'Connor, U.S. Department of Transportation, Urban Mass Transportation Administration Director, Safety and Security Staff, (202) 426-2896.

SUPPLEMENTARY INFORMATION:

Background

On November 26, 1982, the Urban Mass Transportation Administration (UMTA) published a Notice and Request for Public Comment on "Recommended Fire Safety Practices for Rail Transit Materials Selection," Vol. 47 FR 53559. That Notice proposed recommendations for testing the flammability and smoke emission characteristics of materials used in the construction of rapid rail transit (RRT) and light rail transit (LRT) vehicles. Like the "Proposed Guidelines for Flammability and Smoke Emission Specifications" on which they are based, these Recommended practices are not regulatory in nature. Rather, these Recommended Practices are intended to be used to assess the fire risk of materials used in RRT and LRT vehicles. They do not duplicate actual fire conditions. However, their use will result in the selection of more fire resistant materials, which will minimize the fire threat in RRT and LRT vehicles and thereby reduce the injuries and property damage resulting from transit vehicle fires. Moreover, issuance of the Notice at this time is consistent with the Department of Transportation's position on promoting safety in transportation.

In response to comments, UMTA has made one major substantive change to the Recommended Practices, as well as various editorial and minor substance revisions. The major change was to delete all references to National Fire Protection Association (NFPA) standards. This change is discussed more fully below.

Approximately 25 organizations responded to the November 26, 1982 Notice. The majority of these, including all but one of the commenting transit agencies, generally supported the Recommended Practices. For the most part, these comments suggested only minor changes, such as correcting various typographical errors, and clarifying the list of referenced standards and the notes to Table 1. Most of these comments have been incorporated in this Notice. After careful review, UMTA has chosen not to adopt some comments. UMTA's goal in issuing the Recommended Practices is to suggest a means for providing the highest practical level of safety. It is UMTA's opinion that the comments not adopted would not further this goal.

The major substantive comments that were not adopted concerned: using small scale tests, most notably the American Society for Testing Materials (ASTM) E-162 test method; modifying certain aspects of the performance criteria; substituting tests; addressing toxicity; and expanding the scope of the Recommended Practices.

In regard to using small scale tests, several commenters questioned whether such tests, which test component materials separately, can adequately simulate the synergistic effects of burning the various vehicle assemblies, as may occur in an actual fire. UMTA has determined that small scale tests are the best method to test for the most practical level of safety feasible. Small scale tests are especially useful as a screening device to select materials. As such, they have the advantage of allowing a transit authority to choose its own preferred combination of materials in making up specifications for RRT and LRT vehicles. The fact that there is sufficient correlation between the results of full scale tests and those in the Recommended Practices to support use of those small scale tests has been borne out by full scale tests conducted by the Bay Area Rapid Transit District. Furthermore, there are disadvantages to the use of full scale tests. There are 18 different categories of materials application that require individual testing in a vehicle. A full scale fire test that would determine the merits of combinations of materials would require a series of such tests that would be prohibitive in cost and

impossible to perform in a manner that would satisfy all parties. In addition, they would eliminate the small manufacturer who would be unable to compete in such testing. Moreover, one noted expert has stated that full scale tests do not provide basic information on individual components or allow extrapolation to conditions other than those reached in that test.

Also in connection with small scale tests, several commenters referred to the fact that the NFPA states that several of its standards are intended only for use as research and development tools, not for regulatory purposes. Although the Recommended Practices are not regulatory, UMTA recognizes that they will be used for more than research and development. Accordingly, NFPA standards have been deleted from the Recommended Practices. ASTM tests E-662 and E-648 have been substituted for these tests.

Another commenter suggested that a "disclaimer" for the use of the flame spread rating required under a Federal Trade Commission consent order be included in the Recommended Practices. When read in its entirety, however, the disclaimer would not affect the use of the flame spread test as suggested in the Recommended Practices. Given that fact, as well as the fact that the context differs from that of the FTC Consent order, repeating the disclaimer is considered unnecessary.

Several commenters suggested modifying the performance criteria of the tests. Most of these comments suggested relaxing various performance criteria. The most common argument for doing so was that materials are not available that will meet the performance criteria. However, a review of the UMTA materials data bank revealed that in all cases there are sufficient materials to meet the criteria of the Recommended Practices. Moreover, a recent UMTA study, "Assessment of the Benefits and Costs associated with the Adoption of the Recommended Fire Safety Practices for Rail Transit Materials Selection," Transportation Systems Center, Report UMTA-MA-06-0098-81-3, December, 1982, found that the cost of implementing the Recommended Practices would be minimal for new vehicle construction. In addition, several transit agencies recently have used the Recommended Practices successfully in purchasing rail transit vehicles. Again, UMTA believes that relaxing any of the criteria as suggested by the commenters would result in an unacceptable decrease in safety.

Another comment concerning relaxing performance criteria was that the same criteria should not be used for both LRT and RRT vehicles. It is UMTA's position that there is not sufficient difference between the environments on LRT and RRT vehicles to warrant separate tests for their materials. An additional comment was that the restrictions on flammability are such that the restrictions on smoke emissions and, for carpets, critical radiant flux, are unnecessary. UMTA disagrees. There is not necessarily a relationship between flammability and smoke emission, so that the flammabilty test alone does not adequately test for those two characteristics. For example, some situations may result in very little flame spread, but a great deal of smoke. The low flammability will not indicate the smoke emission characteristics of such material.

Several commenters suggested making certain performance criteria more restrictive, for example by requiring additional vehicle materials categories to meet specific optical density requirements for smoke emission. For the most part, these greater restrictions would eliminate otherwise useful materials without a corresponding increase in safety. In the case of electrical cable used for rail transit purposes, there is not at this time enough information available to develop Recommended Practices.

In regard to substituting tests, several commenters objected to the use of the ASTM E-162 test method. UMTA did not adopt these comments because the ASTM E-162 is widely accepted both in the United States and abroad as a means of determining the flame spread of materials that may be used in RRT and LRT vehicles. For example, it is used to test materials for commercial aircraft. On the other hand, although the ASTM E-84, the suggested substitute test, is widely used in the construction industry, it is not necessarily suitable for testing materials for use in LRT and RRT vehicles. For instance, many materials that melt and sag cannot adequately be measured using the ASTM E-84. In addition, the ASTM E-84 is a larger scale test that the ASTM E-162 and therefore more costly. A related issue is whether the Recommended Practices will exist in addition to NFPA Standard 130, or be adopted by the NFPA to replace NFPA Standard 130. One commenter expressed concern over the possible existence of two industry standards. There in fact will be two test protocols if the NFPA does not fully adopt the Recommended Practices, in which case users will choose the best method. UMTA believes that the Recommended Practices reflect the state of the art.

Commenters also requested that UMTA address the issue of toxicity of the products of combustion of these materials in the Recommended Practices. UMTA recognizes the need to address this issue, but because of

its complexity, is not able to do so in the Recommended Practices. Instead, in an effort to respond to transit industry needs UMTA has initiated a program to develop guidelines for assessing the combustion toxicity of materials. Recognizing the scope and extreme complexity of this issue. UMTA has requested the National Research Council's (NRC) Transportation Research Board and Materials Advisory Board of the Commission on Engineering and Technical Systems to assist in addressing this issue. In response to this request, the NRC has established a Committee on Toxicity Hazards of Materials Used in Rail Transit Vehicles. This committee, consisting of representatives of industry and academia, will review the present state of knowledge of combustion toxicity, identify specific toxicity hazards related to the use of polymeric materials in transit vehicles, and recommend a plan of action for developing guidelines for testing materials. A workshop will be convened to review the preliminary findings of the study group, with interested parties representing government, mass transit agencies, user groups, and industry in attendance.

Commenters also raised questions about the scope of the Recommended Practices, and their relation to the July, 1979, "Proposed Guidelines for Flammability and Smoke Emissions Specifications." The Recommended Practices supersede those 1979 proposed guidelines. The Recommended Practices are intended for use in selecting rail transit vehicle materials. UMTA does not have jurisdiction over such modes as trucks and mobile homes. Accordingly, it would be inappropriate for UMTA to recommend fire safety tests for selecting materials for those vehicles. Because buses operate in a different environment than RRT and LRT vehicles, UMTA believes it would be inappropriate to use RRT and LRT safety tests for buses. However, UMTA intends to develop similar fire safety materials guidelines for transit bus vehicles in the future.

In addition to suggesting changes to the Recommended Practices, commenters raised several questions that require clarification. One commenter expressed concern that the cost of retrofitting RRT and LRT vehicles would be prohibitively expensive. The Recommended Practices are guidelines, not requirements or regulations. UMTA believes that maintenance of safety on transit systems is a local responsibility and that the application of the guidelines by individual transit systems is a local decision reflecting operating conditions and vehicles in each system. It is not UMTA's intention to direct when and how the guidelines are used, but rather to make them available for use as safety technical assistance to operating and planned rail tansit systems.

Another commenter raised a series of technical questions. The first was whether the materials presented in Table 1 are the only components that require testing. They are. The tests usually prescribe the appropriate specimen geometry for testing the material specimens. If not, the tests should be to the most appropriate geometry.The second was whether Fed-Std. 191A and AATCC-86 are indicative of what will happen to fabrics over their predicted lives. These tests are merely meant to determine whether flame retardant is removed by cleaning the fabrics. The third question was why the Dmax value recommendation for NFPA 258 was deleted. This value was deleted because UMTA determined that measuring smoke obscuration by time was preferable to measuring total maximum smoke obscuration. Therefore, the Dmax value was deemed unnecessary. The final question was when there is more than one material that can be used for a function, to which does the test apply. The answer is that the test applies to all materials that can be used for a particular function.

Recommended Fire Safety Practices for Rail Transit Materials Selection

Scope

The Recommended Fire Safety Practices for Rail Transit Materials Selection are directed at improving the vehicle interior materials selection practices for the procurement of new vehicles and the retrofit of existing RRT and LRT vehicles. Adoption of these recommended fire safety practices will help to minimize the fire threat in rail transit vehicles and, thereby, reduce the injuries and damage resulting from vehicle fires.

Recommended Fire Safety Practices for Rail Transit Materials Selection Application

This document provides recommended fire safety practices for testing the flammability and smoke emission characteristics of materials used in the construction of RRT and LRT vehicles.

Referenced Fire Standards

The source of test procedures listed in Table 1 are as follows:

(1) Leaching Resistance of Cloth, FED-STD-191A-Textile Test Method 5830.

Available from: General Services Administration Specifications Division, Building 197 Washington Navy Yard, Washington, DC 20407.

(2) Federal Aviation Administration Vertical Burn Test,

TABLE 1. RECOMMENDATIONS FOR TESTING THE FLAMMABILITY AND SMOKE EMISSION CHARACTERISTICS OF RAIL TRANSIT VEHICLE MATERIALS

Category	Function of Material	Test Procedure	Performance Criteria
Seating	Cushion[1,2,5,9*]	ASTM D-3675	$I_s \leq 25$
		ASTM E-662	$D_s(1.5) \leq 100$; $D_s(4.0) \leq 200$
	Frame[1,5,8]	ASTM E-162	$I_s \leq 35$
		ASTM E-662	$D_s(1.5) \leq 100$; $D_s(4.0) \leq 200$
	Shroud[1,5]	ASTM E-162	$I_s \leq 35$
		ASTM E-622	$D_s(1.5) \leq 100$; $D_s(4.0) \leq 200$
	Upholstery[1,2,3,5]	FAR 25.853 (Vertical)	Flame Time $\leq$ 10 sec; burn length $<$ 6 inch
		ASTM E 662	$D_s(4.0) \leq 250$ coated $D_s(4.0) \leq 100$ uncoated
Panels	Wall[1,5]	ASTM E-162	$I_s \leq 35$
		ASTM E-662	$D_s(1.5) \leq 100$; $D_s(4.0) \leq 200$
	Ceiling[1,5]	ASTM E-162	$I_s \leq 35$
		ASTM E-662	$D_s(1.5) \leq 100$; $D_s(4.0) \leq 200$
	Partition[1,5]	ASTM E-162	$I_s \leq 35$
		ASTM E-662	$D_s(1.5) \leq 100$; $D_s(4.0) \leq 200$
	Windscreen[1,5]	ASTM E-162	$I_s \leq 35$
		ASTM E-662	$D_s(1.5) \leq 100$; $D_s(4.0) \leq 200$
	HVAC Ducting[1,5]	ASTM E-162	$I_s \leq 35$
		ASTM E-662	$D_s(4.0) \leq 100$
	Window[4,5]	ASTM E-162	$I_s \leq 100$
		ASTM E-662	$D_s(1.5) \leq 100$; $D_s(4.0) \leq 200$
	Light Diffuser[5]	ASTM E-162	$I_s \leq 100$
		ASTM E-662	$D_s(1.5) \leq 100$; $D_s(4.0) \leq 200$
Flooring	Structural[6]	ASTM E 119	Pass
	Covering[7]	ASTM E-648	CRF $\geq 0.5 w/cm^2$
Insulation	Thermal[1,2,5]	ASTM E-162	$I_s \leq 25$
		ASTM E-662	$D_s(4.0) \leq 100$
	Acoustic[1,2,5]	ASTM E-162	$I_s \leq 25$
		ASTM E-662	$D_s(4.0) \leq 100$
Miscellaneous	Elastomers[1]	ASTM C-542	Pass
	Exterior Shell[1,5]	ASTM E-162	$I_s \leq 35$
		ASTM E-662	$D_s(1.5) \leq 100$; $D_s(4.0) \leq 200$
	Component Box covers[1,5]	ASTM E-162	$I_s \leq 35$
		ASTM E-662	$D_s(1.5) \leq 100$; $D_s(4.0) \leq 200$

*Refers to Notes on Table 1.

Available from: Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(3) American Society for Testing Materials (ASTM)

(a) Specification for Gaskets, ASTM C-542;

(b) Surface Flammability for Flexible Cellular Materials Using a Radiant Heat Energy Source, ASTM D-3675;

(c) Fire Tests of Building Construction and Materials, ASTM E-119;

(d) Surface Flammability of Materials Using a Radiant Heat Energy Source, ASTM E-162;

(e) Bonded and Laminated Apparel Fabrics, ASTM D-2724;

(f) Critical radiant flux of floor covering systems using a radiant heat energy source, ASTM E-648;

(g) Specific optical density of smoke generated by solid materials, ASTM E-662.

Available from: American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

In all instances, the most recent issue of the document or the revision in effect at the time of request should be employed in the evaluation of the material specified herein.

Definition of Terms

1. Critical radiant flux (CRF) as defined in A5TM E-648 is the level of incident radiant heat energy on the floor covering system at the most distant flame-out point. It is reported as W/cm^2.

2. Flame spread index (I_s) as defined in ASTM E-162 is a factor derived from the rate of progress of the flame front (F_s) and the rate of heat liberation by the material under test (Q), such that $I_s = F_s \times Q$.

3. Specific optical density (D_s) is the optical density measured over unit path length within a chamber of unit volume produced from a specimen of unit surface area, that is irradiated by a heat flux of 2.5 watts/cm^2 for a specified period of time.

4. Surface flammability denotes the rate at which flames will travel along surfaces.

5. Flaming running denotes continuous flaming material leaving the site of material burning or material installation.

7. Light rail transit (LRT) vehicle means a streetcar-type transit vehicle operated on city streets, semi-private rights-of-way, or exclusive private rights-of-way.

8. Rapid rail transit (RRT) vehicle means a subway-type transit vehicle operated on exclusive-private rights-of-way with high-level platform stations.

Recommended Test Procedures and Performance Criteria

(a) The materials used in RRT and LRT vehicles should be tested according to the procedures and performance criteria set forth in Table 1.

(b) Transit agencies should require certification that combustible materials to be used in the construction of vehicles have been tested by a recognized testing laboratory, and that the results are within the recommended limits.

(c) Although, at present, there are no Recommended Fire Safety Practices for electrical insulation materials, information pertinent to the selection and specificationof electrical insulation for use in the rail transit environment is contained in the following UMTA reports:

1. Electrical Insulation Fire Characteristics, Volume I, Flammability Tests, December, 1978. UMTA-MA-06-0025-79-1, PB294 840/4GA

2. Electrical Insulation Fire Characteristics, Volume II, Toxicity, December, 1978, UMTA-MA-06-0025-79-2, PB294 841/2GA

3. Combustibility of Electrical Wire and Cable for Rail Transit Systems, Volume I, Flammability, May 1983, UMTA-MA-06-0025-83-7, PB83-233742

4. Combustibility of Electrical Wire and Cable for Rail Transit Systems, Volume II, Toxicity, May 1983, UMTA-MA-06-0025-83-7, PB83 233759

Available from: The National Technical Information Service, Springfield, VA 22161

Notes

1. Materials tested for surface flammability should not exhibit any flaming running, or flaming dripping.

2. The surface flammability and smoke emission characteristics of a material should be demonstrated to be permanent by washing if appropriate, according to FED-STD-191A Textile Test Method 5830.

3. The surface flammability and smoke emission characteristics of a material should be demonstrated to be permanent by dry-cleaning, if appropriate, according to ASTM D-2724. Materials that cannot be washed or dry cleaned should be so labeled and should meet the applicable performance criteria after being cleaned as recommended by the manufacturer.

4. For double window glazing, only the interior glazing should meet the material requirements specified herein; the exterior need not meet those requirements.

5. ASTM E-662 maximum test limits for smoke emission (specific optical density) should be measured in either the flaming or non-flaming mode, depending on which mode generates the most smoke.

6. Structural flooring assemblies should meet the performance criteria during a nominal test period determined by the transit agency. The nominal test period should be twice the maximum expected period of time, under normal circumstances, for a vehicle to come to a complete, safe stop from maximum speed, plus the time necessary to evacuate all passengers from a vehicle to a safe area. The nominal test period should not be less than 15 minutes. Only one specimen need be tested. A proportional reduction may be made in dimensions of the specimen provided that it represents a true test of its ability to perform as a barrier against undercar fires. Penetrations (ducts, etc.) should be designed against acting as conduits for fire and smoke.

7. Carpeting should be tested in accordance with ASTM E-648 with its padding, if the padding is used in actual installation.

8. Arm rests, if foamed plastic, are tested as cushions.

9. Testing is performed without upholstery.

Issued on: August 8, 1984.

Ralph L. Stanley,

Administrator.

[FR Doc. 84-21478 Filed 8-13-84: 8:45 am]
BILLING CODE 4910-57-M

☆ U.S. GOVERNMENT PRINTING OFFICE: 1988--501-398/80031 Region #1