NBS TECHNICAL NOTE 822

U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

A Review of Federal and Military Specifications for Floor Coverings

NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards [1] was established by an act of Congress March 3, 1901. The Bureau's overall goal is to strengthen and advance the Nation's science and technology and facilitate their effective application for public benefit. To this end, the Bureau conducts research and provides: (1) a basis for the Nation's physical measurement system, (2) scientific and technological services for industry and government, (3) a technical basis for equity in trade, and (4) technical services to promote public safety. The Bureau consists of the Institute for Basic Standards, the Institute for Materials Research, the Institute for Applied Technology, the Institute for Computer Sciences and Technology, and the Office for Information Programs.

THE INSTITUTE FOR BASIC STANDARDS provides the central basis within the United States of a complete and consistent system of physical measurement; coordinates that system with measurement systems of other nations; and furnishes essential services leading to accurate and uniform physical measurements throughout the Nation's scientific community, industry, and commerce. The Institute consists of a Center for Radiation Research, an Office of Measurement Services and the following divisions:

Applied Mathematics — Electricity — Mechanics — Heat — Optical Physics — Nuclear Sciences [2] — Applied Radiation [2] — Quantum Electronics [3] — Electromagnetics [3] — Time and Frequency [3] — Laboratory Astrophysics [3] — Cryogenics [3].

THE INSTITUTE FOR MATERIALS RESEARCH conducts materials research leading to improved methods of measurement, standards, and data on the properties of well-characterized materials needed by industry, commerce, educational institutions, and Government; provides advisory and research services to other Government agencies; and develops, produces, and distributes standard reference materials. The Institute consists of the Office of Standard Reference Materials and the following divisions:

Analytical Chemistry — Polymers — Metallurgy — Inorganic Materials — Reactor Radiation — Physical Chemistry.

THE INSTITUTE FOR APPLIED TECHNOLOGY provides technical services to promote the use of available technology and to facilitate technological innovation in industry and Government; cooperates with public and private organizations leading to the development of technological standards (including mandatory safety standards), codes and methods of test; and provides technical advice and services to Government agencies upon request. The Institute consists of a Center for Building Technology and the following divisions and offices:

Engineering and Product Standards — Weights and Measures — Invention and Innovation — Product Evaluation Technology — Electronic Technology — Technical Analysis — Measurement Engineering — Structures, Materials, and Life Safety [4] — Building Environment [4] — Technical Evaluation and Application [4] — Fire Technology.

THE INSTITUTE FOR COMPUTER SCIENCES AND TECHNOLOGY conducts research and provides technical services designed to aid Government agencies in improving cost effectiveness in the conduct of their programs through the selection, acquisition, and effective utilization of automatic data processing equipment; and serves as the principal focus within the executive branch for the development of Federal standards for automatic data processing equipment, techniques, and computer languages. The Institute consists of the following divisions:

Computer Services — Systems and Software — Computer Systems Engineering — Information Technology.

THE OFFICE FOR INFORMATION PROGRAMS promotes optimum dissemination and accessibility of scientific information generated within NBS and other agencies of the Federal Government; promotes the development of the National Standard Reference Data System and a system of information analysis centers dealing with the broader aspects of the National Measurement System; provides appropriate services to ensure that the NBS staff has optimum accessibility to the scientific information of the world. The Office consists of the following organizational units:

Office of Standard Reference Data — Office of Information Activities — Office of Technical Publications — Library — Office of International Relations.

---

[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.
[2] Part of the Center for Radiation Research.
[3] Located at Boulder, Colorado 80302.
[4] Part of the Center for Building Technology.

A Review of Federal and Military Specifications for Floor Coverings

Winthrop C. Wolfe

Center for Building Technology
Institute for Applied Technology
National Bureau of Standards
Washington, D.C. 20234

U.S. DEPARTMENT OF COMMERCE, Frederick B. Dent, *Secretary*
NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, *Director*

Issued April 1974

National Bureau of Standards Technical Note 822

Nat. Bur. Stand. (U.S.), Tech. Note 822, 99 pages (Apr. 1974)

CODEN: NBTNAE

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON: 1974

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
(Order by SD Catalog No. C13.46:822). Price $1.50

TABLE OF CONTENTS

CONVERSION FACTORS

In view of the present practice of writing Federal and other United States Government specifications, common U. S. units of measurement have been used throughout in this paper. However, in recognition of the position of the United States as a signatory to the General Conference on Weights and Measures, which gave official status to the metric SI system of units in 1960, attention is drawn to the following table of conversion factors:

Length

1 in (in) = 0.0254* meter (m) 1 mil = 0.001* inch = $2.54 \times 10^{-5*}$ m
1 foot (ft) = 0.3048* m
1 yard (yd) = 0.9144* m

Area

1 sq. in. (in^2) = $6.4516^* \times 10^{-4}$ m^2
1 sq. ft. (ft^2) = 0.09290 m^2
1 sq. yd. (yd^2) = 0.8361 m^2

Volume

1 cu. in. (in^3) = 1.6387×10^{-5} m^3
1 cu. ft. (ft^3) = 2.8317×10^{-2} m^3

Mass

1 ounce (mass) avoirdupois (oz av) = 2.83495×10^{-2} kilogram (kg)
1 pound (mass) (lbm av) = 0.45359 kg

Force

1 pound (force) (lbf av) = 4.448 newton (N)

Pressure, Stress (Force/Area)

1 lb. (force) per sq. in. (psi) = 6895 N/m^2

Mass/Area

1 ounce (mass) per sq. yd. (oz av/yd^2) = 3.3906×10^{-2} kg/m^2

Mass/Volume

1 lb. (mass) per cu. ft. (lbm/ft^3) = 16.02 kg/m^3

Temperature*

$t_C = (t_F - 32)/1.8$, where
t_C = degrees Celsius (°C.)
t_F = degrees Fahrenheit (°F.)

*exactly

A REVIEW OF FEDERAL AND MILITARY SPECIFICATIONS FOR FLOOR COVERINGS

Winthrop C. Wolfe

In this manual, which is organized so as to aid ready reference, requirements and test methods in Federal and Military Specifications for flooring, or floor coverings are combined, indexed and reviewed. The manual covers carpet, resilient flooring, monolithic surfacings or seamless flooring, and polyurethane coatings related to seamless flooring. It also covers all serviceability requirements except those relating to flammability, fire safety and acoustical properties.

Physical and material requirements in Federal Specifications for floor coverings are considered in separate sections. Military Specifications for monolithic surfacings and Federal Specifications for floor coverings and polyurethane coatings are summarized in comprehensive tables. Under each physical requirement, comments indicate whether it is a quality control or a performance requirement. Each comment is followed by a list of those Federal Specifications which include the requirement and a brief description of the criteria and test methods in the specifications. Comments on materials requirements relate to their adequacy and applicability to the product for which they were written. Finally, recommendations are made for improvements in performance requirements which should be considered for inclusion in future flooring and floor covering specifications.

Keywords: Carpets; floor coverings; government; performance; procurement; specifications; standards; tests; user needs.

1. INTRODUCTION

For many years, the National Bureau of Standards has assisted in writing Federal Specifications and Test Method Standards and has participated in the development of related test methods. Also, test development has been done by technical committees of standards-making bodies in which the Bureau has participated. Recently flooring and other end-use or consumer products have received attention, with attempts being made to establish standards and specifications based on performance characteristics rather than on materials and design. Committees of the American Society for Testing and Materials (ASTM) presently working on test methods for flooring are as follows:

Resilient Floor Coverings
- Committee F-6 on Resilient Floor Coverings
- Committee D-21 on Polishes

Carpets and Rugs
- Committee D-13 on Textile Materials; Subcommittee D-13.21 on Pile Floor Coverings

Monolithic Surfacings or Seamless Flooring

Committee C-3 on Chemical-Resistant Nonmetallic Materials; Subcommittee CO-3.02 - Mortars and Monolithics

Committee D-1 on Paint, Varnish, Lacquer, and Related Products; Subcommittee DO-1.47 - Seamless Flooring

In 1967 the author prepared an unpublished report on performance specifications for floor coverings, which included a review and critique of Federal Specifications for resilient floor coverings and for carpets and rugs. ASTM Committee F-6 was interested in this report and the author received a number of inquiries and requests for it. The present publication is revised, expanded, and updated version of this unpublished report. The purpose of this publication is to provide a manual to facilitate location of requirements and test methods for floor coverings in Federal and Military specifications and to provide a review and critique designed to aid the improvement of these specifications. Improvements suggested in this manual include standardization of details and test conditions and suggestions for additional requirements and test methods. Additional requirements suggested are mostly of the performance type.

Requirements and test methods in Federal Specifications for floor coverings are summarized and indexed for the first time in this manual. All requirements except for those relating to flammability, fire safety, and acoustics are covered. The term "floor coverings" is used in the broad sense to cover carpets and rugs, resilient flooring or floor coverings, and monolithic surfacings or seamless flooring. Federal Specifications for floor coverings are listed and indexed in tables 1 and 2. Military Specifications for monolithic surfacings and Federal Specifications for polyurethane coatings are summarized in tables 3 and 4.

Federal Specifications for floor coverings are presently based on a combination of material, quality control, and performance requirements. Physical requirements are discussed in section 2 and materials requirements in section 5. Under each physical requirement in section 2 are comments indicating whether it is considered to be a quality control or a performance requirement. Following the comments is a list of those Federal Specifications which include each requirement and a description of the criteria and test methods in each specification. The description of the test method is more detailed in cases where there is disagreement between specifications or between a specification and a Federal Test Method Standard. Comments on materials requirements in section 5 relate to their adequacy and applicability to the product for which they were written.

This study was undertaken as a contribution to the standardization and improvement of Federal Specifications for flooring. It is recommended that test methods for each type of floor covering should be standardized and appear in a Federal Test Method Standard. Each specification should include performance requirements, criteria, and tests, so that decisions can be made as to what type of floor covering to use for a given type of service.

2. PHYSICAL REQUIREMENTS IN FEDERAL SPECIFICATIONS FOR FLOOR COVERINGS

While there are many test methods in Federal Specifications for floor coverings, the basic reference for test methods for nontextile resilient floor coverings is Federal Test Method Standard No. 501a, FLOOR COVERINGS, RESILIENT, NONTEXTILE: SAMPLING AND TESTING, June 15, 1966. The corresponding reference for carpets and rugs is Federal Test Method Standard No. 191, TEXTILE TEST METHODS, December 31, 1968. There is some cross-referencing in the specifications to these standards. Many specifications refer to Standard 501, which was superseded by 501a; and to Federal Specification CCC-T-191, which was superseded by CCC-T-191b and then by Federal Test Method Standard No. 191. References in this manual have been updated and checked to make sure that the method cited is correct.

Federal Specifications and Test Method Standards may be obtained from one of the GSA Business Centers or from General Services Administration, Specifications Activity, Printed Materials Supply Division, Building 197, Naval Weapons Plant, Washington, D. C. 20407. The best way to keep up with changes is to subscribe to INDEX OF FEDERAL SPECIFICATIONS AND STANDARDS, which appears annually. It is for sale by the Superintendent of Documents, United States Government Printing Office, Public Documents Department, Washington, D. C. 20402. The subscription price is presently $14.00 a year, which includes cumulative supplements. The INDEX is also available in United States Government Depository Libraries, a list of which is available in most major libraries.

Table 1. Federal Specifications[a] for Floor Coverings including Carpet

Floor covering	Specification No.	Type[b]	Date
Carpet			
CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE	DDD-C-95[c]		April 16, 1965
CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE	DDD-C-001173[d]	INT.	July 11, 1966
CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING	DDD-C-001559[d]	INT.	April 14, 1969
Resilient Floor Coverings			
FLOORING, VINYL PLASTIC	L-F-00450A[e]	INT.	May 27, 1970
FLOOR COVERING VINYL SURFACE (TILE AND ROLL), WITH BACKING	L-F-475A[f]		March 11, 1965
FLOOR COVERING TRANSLUCENT OR TRANSPARENT VINYL SURFACE WITH BACKING	L-F-001641	INT.	January 28, 1971
FLOOR COVERING LINOLEUM	LLL-F-1238A		September 17, 1970
FLOOR COVERING, ASPHALTIC FELT (BITUMINOUS TYPE SURFACE)	SS-F-001032	INT.	October 19, 1966
TILE, FLOOR: ASPHALT, RUBBER VINYL, VINYL-ASBESTOS	SS-T-312A[g]		June 2, 1966
Monolithic Surfacings or Seamless Flooring			
COATING SYSTEM DECORATIVE AND PROTECTIVE - SEAMLESS	TT-C-001685	INT.	May 10, 1971

a. Federal Specifications may be obtained from one of the GSA Business Centers or from General Services Administration, Specifications Activity, Printed Materials Supply Division, Bldg. 197, Naval Weapons Plant, Washington, D. C. 20407.

b. INT. if an INTERIM SPECIFICATION, which is optional; otherwise mandatory or an official standard.

Table 1. Federal Specifications[a] for Floor Coverings including Carpet (continued)

c. Including INTERIM AMENDMENT-2, July 9, 1970, superseding INT. AMENDMENT-1.

d. Including AMENDMENT-1, July 9, 1970.

e. Filled vinyl tile and roll (sheet) without backing.

f. Including AMENDMENT-1, October 11, 1965.

f. SS-T-312B in process to supersede SS-T-312A.

Table 2. Physical Requirements in Federal Specifications for Floor Coverings

Physical Requirement	Carpets and Rugs	Resilient Floor Coverings	Monolithic Surfacings or Seamless Floor Systems
Abrasion resistance		L-F-001641	TT-C-001685
Adherence of backing, cushioning	DDD-C-95 DDD-C-001559	L-F-475A LLL-F-1238A	
Adhesion to substrate			TT-C-001685
Aging (accelerated)	DDD-C-95 (backing, cushioning) DDD-C-001559 (cushioning)		
Appearance (See Color, Defects, Surface texturing)			
Application properties			TT-C-001685
Bleed-through control			TT-C-001685
Breaking strength	DDD-C-001173 DDD-C-001559 (vinyl cushioning)		
Color		L-F-475A SS-T-312A	TT-C-001685
Colorfastness	DDD-C-95 DDD-C-001173 DDD-C-001559		
Compressibility (rubber cushioning)	DDD-C-95 DDD-C-001559		
Compression set (rubber cushioning)	DDD-C-95 DDD-C-001559		
Curl resistance		SS-T-312A	TT-C-001685
Defects (finish, appearance) control	DDD-C-95 DDD-C-001173 DDD-C-001559	L-F-00450A L-F-475A L-F-001641 LLL-F-1238A SS-F-001032 SS-T-312A	
Deflection of tile		SS-T-312A	
Depth of depressed areas		SS-T-312A	
Dielectric strength		L-F-00450A	

Table 2. Physical Requirements in Federal Specifications for Floor Coverings (continued)

Physical Requirement	Carpets and Rugs	Resilient Floor Coverings	Monolithic Surfacings
Dimensional stability		L-F-00450A L-F-475A L-F-001641 SS-T-312A	
Dusting control (chips)			TT-C-001685
Electrical conductance		LLL-F-1238A	
Elongation (vinyl cushioning)	DDD-C-001559		
Finish		LLL-F-1238A	
Flame resistance	DDD-C-95 and INT. AMENDMENT-2 DDD-C-001173 and AMENDMENT-1 DDD-C-001559 and AMENDMENT-1		
Flexibility or Pliability	DDD-C-001173 DDD-C-001559 (vinyl cushioning)	L-F-00450A L-F-475A L-F-001641 LLL-F-1238A SS-F-001032 SS-T-312A	
Hardness		SS-T-312A	TT-C-001685
Impact resistance		SS-T-312A	TT-C-001685
Indentation resistance		L-F-00450a L-F-475A L-F-001641 LLL-F-1238A SS-F-001032 SS-T-312A	
Keying (See Adherence of backing)			
Moth repellency (See Resistance to larvae)			
Resistance to chemicals, grease, oil, and solvents		L-F-00450A L-F-475A L-F-001641 SS-F-001032 SS-T-312A	
Resistance to insects (See Resistance to larvae)			

Table 2. Physical Requirements in Federal Specifications for Floor Coverings (continued)

Physical Requirement	Carpets and Rugs	Resilient Floor Coverings	Monolithic Surfacings
Resistance to larvae	DDD-C-95 DDD-C-001173		
Resistance to microorganisms (See Resistance to mildew)			
Resistance to mildew	DDD-C-001173		
Scratch resistance (See Resistance to chemicals, grease, oil, and solvents)			
Seam strength	DDD-C-95		
Shrinkage resistance	DDD-C-95 DDD-C-001173 DDD-C-001559 (See Colorfastness)		
Size and tolerance control (See Thickness)	DDD-C-95 DDD-C-001173 DDD-C-001559	L-F-00450A L-F-475A L-F-001641 LLL-F-1238A SS-F-001032	
Squareness of tile		SS-T-312A L-F-475A	
Surface texturing (See Appearance)			
Tensile strength		SS-T-312A	
Thickness or Pile height	DDD-C-95 (pile, cushioning) DDD-C-001173 DDD-C-001559 (pile, cushioning)	L-F-00450A L-F-475A L-F-001641 LLL-F-1238A SS-F-001032 SS-T-312A	TT-C-001685 (chips)
Volatility control	DDD-C-001559 (vinyl cushioning)	SS-T-312A	
Water resistance			TT-C-001685
Wear (See Abrasion resistance)			
Weight	DDD-C-95 DDD-C-001173 DDD-C-001559		

Table 3. Military Specifications for Monolithic Surfacings[a] and Federal Specifications for Polyurethane Coatings[b]

Military Specifications for Monolithic Surfacings[a,b]

MIL-D-3134F: Adhesive strength, aging (as accelerated weathering resistance), color, corrosion resistance, fire resistance, heat resistance, impact resistance, indentation, moisture absorption, resistance to moisture and temperature changes, odor, oil resistance, shock resistance (mechanical), slip resistance, wear resistance.

MIL-F-52505: Aging (as accelerated weathering resistance), hardness, impact resistance, resistance to fumigants, resistance to microorganisms (as fungistatic and bacteriostatic resistance), resistance to reagents (as chemical resistance), resistance to stains, resistance to thermal shock, resistance to ultraviolet light, shrinkage resistance, water resistance (as porosity), wear or abrasion resistance.

MIL-D-0016680D: Color, density, impact resistance, indentation, moisture absorption, resistance to corrosion, resistance to elevated temperature, resistance to moisture and temperature changes, resistance to staining, serviceability (defects), shear strength, shock resistance (impact), slip resistance.

MIL-D-18873B: Adhesion or bonding, bond strength in shear, ease of repair, electrical conductivity, fire resistance, impact resistance, indentation, live load resistance, moisture absorption, nailability, resistance to oils, resistance to staining, slip resistance, sparking resistance, wear resistance, weight.

MIL-D-23134: Adhesion or bonding, bond strength in shear, impact resistance, indentation, thermal conductivity, water absorption, weight.

Federal Specifications for Polyurethane Coatings[b]

TT-C-540B, September 29, 1965, COATING, POLYURETHANE CLEAR, LINSEED-OIL MODIFIED: Abrasion resistance, adhesion, aging (as accelerated weathering resistance), appearance, color, film hardness, flexibility, impact resistance, odor, spotting resistance, water resistance.

TT-C-00542C, September 13, 1972, COATING, POLYURETHANE, OIL-FREE, MOISTURE-CURING: Appearance of dried film, flexibility, hardness (pencil), odor, wear or abrasion resistance.

a. The following Military Specifications cover resinous monolithic surfacings:

MIL-D-3134F, 24 January 1962, DECK COVERING MATERIALS, including AMENDMENT-5, 6 January 1969 and INTERIM AMENDMENT-6, 3 April 1972

MIL-F-52505, 22 April 1966, FLOOR COATING, RESINOUS MONOLITHIC, TROWEL TYPE (FOR WOOD AND CONCRETE FLOORS)

The following Military Specifications were written to cover magnesium oxychloride flooring:

MIL-D-0016680C, 15 July 1969, DECK COVERING MAGNESIA AGGREGATE MIXTURE, including AMENDMENT-2, 29 October 1962 (covers deck covering for use in galleys, pantries, and butcher shops aboard ship. It should not be used for areas or locations where it is subjected to continual wetting, such as washrooms, water closet spaces, and under equipment where the deck is generally wet).

MIL-D-18873B, 20 July 1959, DECK COVERING MAGNESIA AGGREGATE MIXTURE, including AMENDMENT-1, 11 September 1961 (covers deck covering for use over wood floors in ammunition box cars or ammunition vans).

MIL-D-23134, 17 January 1962, DECK UNDERLAY AND COVERING, INSULATING, MAGNESIA AGGREGATE MIXTURE (for use over such areas aboard ship as ballast tanks and hot machinery spaces).

b. Physical requirements are listed after each specification number.

Table 4. Physical Requirements for Monolithic Surfacings in Military Specifications and for Polyurethane Coatings in Federal Specifications

Abrasion resistance, Wear resistance MIL-D-3134F, MIL-F-52505, MIL-D-18873B, Fed. Spec. TT-C-540B, TT-C-00542C

*Adhesive strength, adhesion, bonding, MIL-D-3134F, MIL-D-18873B, MIL-D-23134, Fed. Spec. TT-C-540B

Aging, accelerated weathering resistance, MIL-D-3134F, MIL-F-52505, Fed. Spec. TT-C-540B

Appearance, Fed. Spec. TT-C-540B, TT-C-00542C

Color, MIL-D-3134F, MIL-D-0016680C, Fed. Spec. TT-C-540B

*Corrosion resistance, MIL-D-3134F, MIL-D-0016680C

*Density, MIL-D-0016680C

*Ease of repair, MIL-D-18873B

Electrical conductivity, MIL-D-18873B

*Fire resistance, MIL-D-3134F, MIL-D-18873B

Flexibility, Fed. Spec. TT-C-540B, TT-C-00542C

Hardness, film hardness, MIL-F-52505, Fed. Spec. TT-C-540B, TT-C-00542C

*Heat resistance, resistance to elevated temperature, MIL-D-3134F, MIL-D-0016680C

Impact resistance, MIL-D-3134F, MIL-F-52505, MIL-D-0016680C, MIL-D-18873B, MIL-D-23134, Fed. Spec. TT-C-540B

Indentation, MIL-D-3134F, MIL-D-0016680C, MIL-D-18873B, MIL-D-23134

*Live load resistance, MIL-D-18873B

*Moisture absorption, water absorption, MIL-D-3134F, MIL-D-0016680C, MIL-D-18873B, MIL-D-23134

*Nailability, MIL-D-18873B

*Odorlessness, odor, MIL-D-3134F, Fed. Spec. TT-C-540B, TTOC-00542C

*Resistance to fumigants, MIL-F-52505

Table 4. Physical Requirements for Monolithic Surfacings in Military Specifications and for Polyurethane Coatings in Federal Specifications (continued)

Resistance to microorganisms, fungistatic and bacteriostatic resistance, MIL-F-52505

Resistance to moisture and temperature changes, MIL-D-3134F, MIL-D-0016680C

Resistance to oils, oil resistance, MIL-D-3134F, MIL-D-18873B

Resistance to reagents, chemical resistance, MIL-F-52505

*Resistance to stains or staining, MIL-F-52505, MIL-D-0016680C, MIL-D-18873B

*Resistance to thermal shock, MIL-F-52505

*Resistance to ultraviolet light, MIL-F-52505

Serviceability (defects), MIL-D-0016680C

*Shear strength, MIL-D-0016680C, MIL-D-18873B, MIL-D-23134

Shock resistance (mechanical or impact), MIL-D-3134F, MIL-D-0016680C

Shrinkage resistance, MIL-F-52505

*Slip resistance, MIL-D-3134F, MIL-D-0016680C, MIL-D-18873B

*Sparking resistance, MIL-D-18873B

*Spotting resistance, Fed. Spec. TT-C-540B

*Thermal conductivity, MIL-D-23134

Water resistance, porosity, MIL-F-52505, Fed. Spec. TT-C-540B

Weight, MIL-D-18873B, MIL-D-23134

---

*Does not appear in table 3.

Physical requirements in Federal Specifications for floor coverings are listed alphabetically in this section. After each requirement are comments and a list of specifications in which the requirement is found. Under each specification is a description of criteria and test methods applying to the particular requirement.

Requirement: Abrasion resistance

Comments: See Wear

Specifications:

FLOOR COVERING TRANSLUCENT OR TRANSPARENT VINYL SURFACE WITH BACKING, L-F-001641, 3.3, 3.4, Table I.

Criterion: No break through of vinyl surface at any point with zinc weight loss as follows:

Class	1	2	3
Wearing surface thickness, minimum, inch	0.020	0.014	0.010
Zinc loss, gram	1.5	1.0	0.6

Test: Method B - Bonded Abrasive on Cloth or Paper (Abrasive Tape), ASTM D 1242-56 (reapproved 1969), Standard Method of Test for RESISTANCE TO ABRASION OF PLASTIC MATERIALS with additional requirements as follows:

a. Specimens shall be cut in factory machine direction.
b. Specific gravity need not be determined.
c. Coarse grit procedure of Note 5 using OE Flint Abrasive Paper shall be applicable.
d. Zinc standard shall be weighed prior to start of test.
e. Sufficient cycles shall be completed to obtain the required zinc weight loss for the applicable class.
f. Specimen shall be observed at the conclusion of the test using a low power magnifying glass.

COATING SYSTEM - DECORATIVE AND PROTECTIVE, SEAMLESS, TT-C-001685, 3.1.4. Top coat (glazed) - Unit 4.

Criterion: Maximum wear index 50 with CS 17 wheel; 1000 gram load on each wheel; 1000 cycles.

Test: As in Federal Specification TT-C-00542C, 4.3.11, Tables I and III, referring to Method 6192, Federal Test Method Standard No. 141a.

Requirement: Adherence of backing or cushioning

Comments: This is a quality control requirement for carpets and rugs, linoleum, and backed vinyl and refers to adhesion of the woven fiber or wear layer to a backing or cushioning material.

Specifications

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95

Criterion: Adherence of backing reinforcement, 3.7.1.2.2, 4.4, 4.5.5, Table XI.

Test: Method 5100, Federal Test Method Standard No. 191 with the following modifications:

Cut finished samples, with backing reinforcement applied, 2 inches wide in width direction by 6 inches long in length direction. Strip the backing reinforcement from the test specimen for approximately 1-1/2 inches at one end of the 2 inch wide ends. Set jaws 1 inch apart, clamp the loose end of the backing reinforcement in the lower jaw and the loose end of the carpet in the upper jaw. Start tester and record the average load required to strip the backing reinforcement. Make three tests, average results, and divide by two to secure the pounds strip per inch of width. The average shall be reported to the nearest 0.1 pound. The strip requirement shall be a minimum of 2.0 pounds per inch of width.

Criterion: Adherence of cushioning, 3.2.5.e, 4.4, 4.5.10, Table XI. (Classes, see under Compressibility).

Test: Class 1 rubber cushioning should tear before pulling free from the carpet. A specimen of carpet with attached cushioning is exposed to accelerated aging by exposure in a circulating air oven for 96 hours at 90° ± 2°F. After removal of the sample from the oven, the sample is allowed to cool to room temperature, then the base carpet is grasped with the fingers of one hand and the thickness of the rubber cushioning with the fingers of the other hand and pulled firmly in opposite directions. The cushioning should tear before pulling free from the carpet.

Test: Class 2 rubber cushioning attached to carpet or rug in strip form by an adhesive shall have a minimum strip strength of 2.0 pounds per inch of width, when tested in accordance with 4.5.5, or as in Adherence of backing reinforcement.

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED WITH ATTACHED CUSHIONING, DDD-C-001559

Criterion: Adherence of attached rubber cushioning, 3.3.5.1.3, 4.4, 4.5.8, Table V.

Test: Grasp the base carpet with the fingers of one hand and the thickness of the cushioning with the fingers of the other hand and pull firmly in opposite directions. The cushioning should tear before pulling free from the carpet.

FLOOR COVERING, VINYL SURFACE (TILE AND ROLL), WITH BACKING, L-F-475A, 3.3

Criterion: The backing shall be bonded to the back of the wear layer.

Test: When an attempt is made to pull the wear layer from the backing by hand, the backing shall delaminate or break before the bonding fails.

FLOOR COVERING, LINOLEUM, LLL-F-1238A
3.1.3.1, Organic felt backing, Type I, class 1 and Type III

Criterion: The backing material shall be securely bonded to the wear layer.

Test: When an attempt is made to pull the wear layer from the backing by hand, the backing shall split or break before the bonding fails. The exposed side of the backing shall not mar the appearance of the wearing surface or cause sticking at points of contact.
3.1.3.2, Burlap backing, Type I, class 2 and Type II.

Criterion: The burlap backing shall be firmly bonded and keyed to the linoleum mix so as to be partially concealed in the mix.

ADHESION

Requirement: Adhesion to substrate

Comments: This is a performance requirement for monolithic surfacings, which applies to coatings and to floor coverings applied with adhesives.

Specification:

COATING SYSTEM - DECORATIVE AND PROTECTIVE, SEAMLESS, TT-C-001685, 3.6.2, 4.3.9, Table IV

Criterion: The system shall show no removal or otherwise loosening of the whole coating system beyond 1/16 inch on either side of the score line. There shall be no separation or flaking of the coats.

Test: Two 9- by 9-inch commercial vinyl asbestos tiles are stripped; cleaned with detergent; rinsed with water; and dried. The coating system is then applied in the following order: base coat; intermediate coat; flakes; intermediate coat; 5 coats of moisture-cure

polyurethane. A line is scored on one corner of each panel with a sharp pointed knife, clear to the edge and through the coating to the substrate. The film (coating system) is then taped perpendicular to and across the line with waterproof, pressure sensitive tape, 3/4 inch wide, conforming to Type IV, Federal Specification PP-T-60. The tape is pressed in firm contact with the film and extends for approximately 1 inch on each side of the score line. All air bubbles are rolled out by firm pressure of the thumb. Approximately 10 seconds are allowed for the test area to return to room temperature. A free end of the tape is grasped and stripped from the film at a rapid speed, pulling the tape back at an angle of 180°.

AGING

Requirement: Aging

Comments: Accelerated aging is a quality control test for rubber cushioning used in carpets and rugs. A test of this type might be developed to predict the service life of floor coverings. A practical test for service change of appearance has been developed for carpets and rugs. (See Appearance). Service change of appearance is a performance requirement related to aging and also to wear or abrasion resistance.

Specifications:

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95, 3.2.5.f, 4.5.11 (See also 4.5.10.1 and Adherence of backing, DDD-C-95)

Criterion and Test: The specimen is placed in an oxygen bomb at 158°F. and 300 ± 10 lbs. per sq. in. (psi) for 7 days. Upon removal the sample shall not be sticky or crack when bent back upon itself.

Attached or class 1 rubber cushioning is removed from the carpet as described under Compressibility, DDD-C-95, Test. Class 2 rubber cushioning is tested before adhering to the carpet.

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559

Criterion and Test: Rubber cushioning, accelerated aging test, 3.3.5.1.f, 4.4, 4.5.9, Table V.

A piece of the rubber cushioning shall be placed in an oxygen bomb (not more than 1 ounce of rubber per 170 cu. in. of oxygen) at a temperature of 158°F. and a pressure of 300 lbs. (±10 lbs.) per sq. in. (psi) for a period of 7 days. Upon removal, the sample shall not be sticky and shall not crack when bent back upon itself.

Criterion and Testing: Vinyl cushioning, accelerated weathering, 3.3.5.2.d, 4.4, Table V.

When subjected to an accelerated weathering test, the cushion shall not crack, become stiff and brittle, or soft and tacky, and shall not change color appreciably when compared to the unexposed sample after 100 hours in the weatherometer. Reference: Method 5804, Federal Test Method Standard No. 191.

APPEARANCE

Requirement: Appearance

Comments: Appearance and service change of appearance are performance characteristics. As a performance requirement, appearance might be considered under defects (finish and appearance). The term appearance should cover color, grain, pattern, design, texture, and other surface properties visible to the eye. Floor covering should be attractive in appearance and representative samples should be submitted by the bidders. The product supplied to the purchaser should be as represented by the sample and should be uniform in appearance. Consideration should be given to change in appearance during normal use. A practical test which has been developed for carpets and rugs is ASTM D2401-67, Standard Method of Test for SERVICE CHANGE OF APPEARANCE OF PILE FLOOR COVERINGS. In this method, a corridor is covered with test specimens and pedestrian traffic is counted. After the test period, photographs are taken and compared with reference photographs which show degrees of change of appearance. Smooth surface resilient floor coverings should be supplied and installed in such a manner that the seams are straight and parallel or perpendicular to the grain or pattern of the material. Joint lines or seams between tiles should be even and straight and should form a grid of mutually perpendicular lines.

Specifications: See Defects (finish and appearance).

FLOOR COVERING TRANSLUCENT OR TRANSPARENT VINYL SURFACE WITH BACKING, L-F-001641, 3.2, 6.2

Criterion and Test: The color or pattern shall be as specified. The overall color and pattern effect shall be obtained by printing, coloring, or surface texturing, or any combination. A background may be printed under the wear layer with suitably formulated fade resistant inks or otherwise prepared to create a pattern or texture. Dye colors, pigments, and extenders may be incorporated throughout the wear layer. The wear surface may be smooth, embossed, or otherwise textured.

APPLICATION

Requirement: Application properties

Comments: This is a performance requirement for monolithic surfacings, which applies to coatings and to floor coverings applied with adhesives.

Specification:

COATING SYSTEM - DECORATIVE AND PROTECTIVE, SEAMLESS, TT-C-001685, 3.6.1, 4.3.8, Table IV

Criterion: The base coat, intermediate coat, and the (polyurethane) top coat shall brush, spray, and roll satisfactorily.

Test: Three asphalt tiles, conforming to Federal Specification SS-T-312A, are cleaned first with wax remover, then with detergent and are then rinsed with water and dried. On one of the tiles are then brushed two coats of the base coat at the spreading rate of approximately 250 square feet per gallon, allowing 2 hours between coats. While brushing, observe for pull under brush and for separation or breaks in the film. Allow to dry for 2 hours, then examine for film irregularities. Apply the intermediate coat at the same spreading rate over the base coat and observe for lifting, compatibility, and film irregularities. Then spread the decorative chips evenly and in excess. Allow 45 minutes to set and then wipe off excess chips. Apply one coat of the intermediate at the same spreading rate and allow to dry for 24 hours.

BLEED-THROUGH

Requirement: Bleed-through control

Comments: This is a quality control requirement for monolithic surfacings applied over previously finished or old surfaces, as in rehabilitation. This requirement would also apply to organic coatings.

Specification:

COATING SYSTEM - DECORATIVE AND PROTECTIVE, SEAMLESS, TT-C-001685, 3.6.3, 4.3.10, Table IV

Criterion: The coating system shall show no bleeding through or discoloration of the outer film. There shall be no difference between a stained and unstained test tile.

Test: Using the other cleaned panel from the adhesion test (See under Requirement: Adhesion to substrate), apply on the surface of the clean panel a generous portion of the following stains: asphalt cut-back tile adhesive; umber, ochre, and sienna oil pigments; black lanolin wax shoe polish; black alcohol base ink used in felt tip marking pens; black paste type shoe polish; red lipstick; red china marking crayon; and aqueous Mercurochrome solution. Place the stains at least 2 inches apart and allow to dry at room temperature for 24 hours. Apply the coating system as in the adhesion test and condition for 5 days.

Requirement: Breaking strength

Comments: Breaking strength is a quality control test for nonwoven polypropylene carpet or for vinyl cushioning.

Specifications:

CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE, DDD-C-001173, 3.4, 4.4, Tables I, VI

Criterion: The finished carpet shall have a breaking strength of 70 lbs. force in the machine direction (lengthwise) and 90 lbs. in the width direction.

Test: Method 5100, Federal Test Method Standard No. 191, with 4-inch separation or jaws. The 4- by 6-inch specimen is placed in the jaws (1 inch wide) of a tensile testing machine with 4 inches gage length.

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559

Criterion and Test: Vinyl cushioning, 3.3.5.2.b, 4.4, 4.5.10, Table V. Breaking strength shall be not less than 20 lbs. force in both machine and transverse directions as determined by a modification of Method 4111, Federal Test Method Standard No. 501a. Report shall be made in lbs. rather than in lbs. per sq. in. (psi). Thickness of sample need not be determined. Die II should be used in lieu of die III.

Requirement: Color

Comments: See Appearance

Specifications:

FLOOR COVERING, VINYL SURFACE (TILE AND ROLL), WITH BACKING, L-F-475A, Interim Amendment-2, 3.4

Criterion and Test: The color and pattern of the wearing surface shall be as specified, as by specific color numbers of the manufacturer. In through-surface patterns the color and pattern shall extend throughout the thickness of the wearing surface. In surface pattern products the color and pattern need not extend throughout the entire thickness of the wearing surface.

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.2

Criterion and Test: Tiles of plain color shall be uniform throughout. In mottled and marbleized tile, the marbleizing and mottling shall be throughout the thickness of the tile. In surface pattern tile, the pattern for contrasting colors is only on the surface.

COATING SYSTEM - DECORATIVE AND PROTECTIVE, SEAMLESS, TT-C-001685, 3.4.2

Criterion and Test: The color shall match standard color specified by purchaser. The color pattern shall be mutually agreed upon by purchaser and supplier.

COLORFASTNESS

Requirement: Colorfastness

Comments: Colorfastness is a quality control test for carpets and rugs but might be considered as a colorfastness requirement for all types of floor coverings.

Specifications:

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95, 3.3.1, 4.4, 4.5.12, Table XI

Criterion: The carpeting or rugs shall show fastness to light and wet-method cleaning equal to or better than the standard sample. When no standard sample is established, the carpeting and rugs shall show good fastness to wet-method cleaning and light. They shall show a rating of good for light colors after 20 standard fading hours (2000 Langleys), and for dark colors after 40 standard fading hours (4000 Langleys). The supplier is to submit with his bid and samples a certified list of the colors, identification of these colors by the bidder's color number, and the category of "light" and "dark" into which each color is classified by the supplier. This list is to be submitted for each pattern and coloration.

Test: For colorfastness to light, testing shall be as specified in Federal Test Method Standard No. 191, Method 5660 (or 5662, in disputed cases).

Test: For colorfastness to wet-method cleaning, a 12 by 12 inch sample of the specified carpet shall be conditioned under standard conditions specified in Section 4, Federal Test Method Standard No. 191 for a period of 24 hours. The specimen shall then be marked and measured at three different locations in the length and width directions. Immerse the sample in 110°F. water for 15 minutes; mix 2 g of sodium alkyl sulfate type of detergent with 50 g water at 110°F. and apply to the pile surface of the carpet. Scrub the sample with a soft bristle brush by stroking back and

forth 20 times[1/] (10 times in each unilateral direction) in both length and width directions; rinse well to remove majority of detergent; squeeze dry[2/]; and dry in an oven at 125°F until bone dry[2/]; again condition under standard conditions for 24 hours. Colorfastness evaluation shall be in accordance with 5.10, Method 5610[3/], Federal Test Method Standard No. 191.

CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE, DDD-C-001173, 3.7, 4.4, 4.5.6, Table VI

Criterion: The carpet shall show good fastness to light after 500 hours and good fastness to wet-method cleaning.

Test: Colorfastness to light shall be determined as in Method 5660, Federal Test Method Standard No. 191.

Test: The sample subjected to the shrinkage test (see Shrinkage resistance, DDD-C-001173) shall be evaluated for colorfastness to wet-method cleaning in accordance with Method 5610[4/], Federal Test Method Standard No. 191.

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559, 3.4.1, 4.4, 4.5.12, Table V

Criterion: The carpet shall show fastness to light and wet-method cleaning equal to or better than the standard sample. When no standard sample is established, the carpet shall show good fastness to wet-method cleaning and light. It shall show a rating of good for light colors after 20 standard fading hours (2000 Langleys), and for dark colors after 40 standard fading hours (4000 Langleys).

Test: Colorfastness to light shall be as in Method 5660[4/], Federal Test Method Standard No. 191, TEXTILE TEST METHODS.[4/] In the event of a dispute resulting from the test with Method 5660[4/] or as a result of suspected anomalous behavior of certain dye types or formulations, the contracting officer shall authorize the exposure to natural light in accordance with Method 5662[4/].

Test: Colorfastness to wet-method cleaning is described under Shrinkage.

1/ This is the wording used in DDD-C-95. However, this apparently means back and forth ten times or for a total of ten cycles.
2/ These terms are used in DDD-C-95 and need to be defined.
3/ Method 5610 refers to Method 9010 for evaluation of colorfastness. Method 9010 differs from Methods 5660 and 5662, used to evaluate colorfastness to light.
4/ See Footnote 3 under DDD-C-95.

Requirement: Compressibility

Comments: This is a performance requirement for rubber cushioning for carpets, related to body comfort.

Specifications:

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95, 3.2.5.c, 4.4, 4.5.8, Table XI

Criterion: The number of pounds required to compress the sample shall be the compressibility, which shall be not less than 5 nor more than 9.

Test: Class 1 - Rubber cushioning manufactured and cured in place. Class 2 - Rubber cushioning manufactured prior to application and fastened to the carpet with adhesive. Specimen for test for Class 1 shall be a one-inch square sample the thickness of the cushioning, secured by dissecting the carpet materials, using care to minimize the removal of rubber with the embedded carpet material. Specimen for test for Class 2 shall be a one-inch square sample cut from the full thickness of the cushioning material before adhering to the carpet.

In the test, the specimen shall be compressed to 75 percent of its original thickness. Thickness shall be measured with a gage having a circular foot one square inch in area under a load of 100 grams (0.220 lbs.)

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559, 3.3.5.1.c, 4.4, 4.5.6.1, Table V.

Criterion: The compressibility shall be not less than 3.5 pounds nor more than 7.5 pounds.

Test: Same classes of rubber cushioning, method of sampling, and test method as for DDD-C-95 above.

COMPRESSION

Requirement: Compression set

Comments: Compression set is a performance requirement for rubber cushioning used in carpets and rugs, relating to matting from furniture and footwear.

Specifications:

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95, 3.2.5.d, 4.4, 4.5.9, Table XI

Criterion: The compression set of the rubber cushioning shall not be more than 15 percent.

COMPRESSION

Test: The specimen shall be a two-inch square secured as under Compressibility. Thickness shall be measured as under Compressibility. The specimen shall be compressed 50 percent of its original thickness between two parallel plates. The sample compressed shall be placed in a Geer oven at 158°F. (±2°F) for 22 hours (±1/2 hr.), removed from the plates, and allowed to rest at room temperature for 30 minutes. The loss in thickness or compression set shall be expressed as a percentage of the original thickness.

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559, 3.3.5.1.d, 4.4, 4.5.7, Table V.

Criterion: The compression set of the rubber cushioning shall be not more than 15.0 percent for class 1 rubber and not more than 7.5 percent for class 2 rubber.

Test: Same as for DDD-C-95 above, same classes of rubber cushioning, and same method of sampling.

CURL

Requirement: Curl resistance

Comments: Resistance to curl due to contact with water may be considered to be a performance requirement for tile. However, this effect might be tested in a more realistic manner. Specimens might be cemented to porous concrete in the manner and with the adhesive used in service and subjected to water pressure. Curling also refers to that of chips used in monolithic surfacings or seamless floors.

Specifications:

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.14, 4.4, Table III, Type I-Asphalt

Criterion: Curl in the tile shall not exceed 0.030 inch.

Test: Method 3411, Federal Test Method Standard No. 501a.

COATING SYSTEM - DECORATIVE AND PROTECTIVE, SEAMLESS, TT-C-001685, 3.4.4

Criterion and Test: The chips used in the coating system shall not show excess curling or roll up into a tight ball. (See Requirement: Water resistance)

DEFECTS

Requirement: Defects (finish and appearance) control. See 2. Sampling and Inspection.

Comments: Control of defects or the setting of limits for defects is a quality control requirement which is usually judged by visual inspection. A reevaluation should be made as to which defects are truly of major and minor importance and these findings should be outlined in the appropriate Federal Test Method Standards and Federal Specifications.

Specifications:

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95, 3.11, 4.2.2.1, 4.2.2.2, Table XI

Criterion: The occurrence of defects shall not exceed the acceptable quality levels (AQLs). The AQL shall be 2.5 major and 6.5 total defects (major and minor) per 100 units (square yards).

Test: The defects listed in Table IX shall be counted regardless of their proximity to one another, except where two or more defects represent a single local condition of the carpet or rug, in which case only the more serious defect shall be counted. Continuous defects shall be counted as one defect for each yard or fraction thereof in which they occur. The sample unit for this examination shall be one square yard. Visual examination shall be made at a distance of approximately six feet.

DDD-C-95, Table IX. Classification of Defects

Examine	Defects	Classification Major	Minor
Finish and appearance	Spot or stain		X
	Not evenly constructed, affecting appearance		X
	Marks across carpet	X	
	Discolored areas affecting appearance (Variations in color due to crushing of pile shall not be considered a defect)		X
	Any noticeable uneveness on top surface affecting appearance		X
	Any objectionable speck of color other than specified visible on top surface of pile		X
	Any obviously objectionable streak lengthwise of weave	X	
Materials and workmanship	Tufts missing in pile		X
	Any hole or tear through to back	X	
	Seams (when specified) - not properly sewed or taped	X	
	Binding		
	- edges not bound (when required)	X	
	- poor color match		X
	Back-coating skips		X

DDD-C-95, Table IX. Classification of Defects (continued)

Examine	Defects	Classification Major	Minor
	Backing reinforcement (when specified) imperfectly applied; wrinkles, poor adherence		X
	Attached rubber cushioning (when specified in contract) imperfectly applied; poor adherence		X

Criterion and Test: For overall examination, each defect listed shall be counted not more than once in each unit examined. The sample unit for this examination shall be one roll or rug. The lot shall be unacceptable if one or more of the following defects are found:

Overall uncleanness
Color of pattern other than specified
Rancid or otherwise objectionable odor
Type not as specified
Edges of rugs not finished as required

CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE, DDD-C-001173, 3.9, 4.3.2, Tables III, IV

Criterion and Test: The occurrence of defects (Table IV) shall not exceed the acceptable quality levels (AQLs). The rules for counting defects are the same as in DDD-C-95. The acceptable quality levels shall be 1.5 major and 6.5 total defects (major and minor combined) per hundred units. The sample unit shall be 1 linear yard when full length rolls are specified and one piece when special cut sizes are specified.

Criterion and Test:

Overall examination. Each defect listed shall be counted not more than once in each unit examined. The sample unit shall be one roll or piece. The number of rolls or pieces taken for visual examination shall be the sample size. The lot shall be unacceptable if one or more of the following defects are found:

Overall uncleanness
Color other than specified
Objectionable odor
Uneven felting or poor interlocking of fibers
Edges not finished as required

Criterion and Test:

Length examination (full length rolls only). Each roll shall be

examined for gross length. Any gross length found to be less than that marked on the roll ticket, or not in a continuous length, shall be considered a defect with respect to length. The sample unit shall be one roll. The rolls used for the visual examination shall be used for this examination. The lot shall be unacceptable if one or more defects are found in the sample.

DDD-C-001173, Table III - Sample Size

Lot size (units)	Sample size (No. of units)
800 or less	2
801 to 22,000	3
22,001 and over	5

DDD-C-001173, Table IV - Classification of Defects

Defects	Classification Major	Minor
Cut, hole, or tear - any size	X	
Thin or weak place - any size	X	
High place or lump		X
Spot or stain		X
Not evenly constructed, affecting appearance		X
Discolored areas affecting appearance		X
Width (full length rolls only):		
more than 1/2 inch over the specified width		X
less than the specified width by more than 1/8 inch	X	
Width and length (special sizes):		
more than 1/2 inch over the specified width or length		X
less than the specified width or length by more than 1/8 inch	X	
Back of carpet not smooth and flat		X
Crack or split	X	
Embedded foreign matter		X
Poor interlocking of fibers	X	
Color does not extend through the entire carpet		X

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559, 4.3.2.1, 4.3.2.2, 4.3.2.3, 4.4, Table IV:

Criterion and Tests: The acceptable quality levels (AQLs) shall be 2.5 major and 6.5 total defects (major and minor combined) per hundred units (linear yards), as in Table IV. Visual examination shall be at a distance of approximately six feet. The rules for counting defects are the same as in DDD-C-95. Overall examination is the same as in DDD-C-001173 except for the defects, which are:

Overall uncleanness, as in DDD-C-001173
Color or pattern other than specified
Objectionable odor, as in DDD-C-001173
Type not as specified
Edges not finished as required, as in DDD-C-001173

DDD-C-001559, Table IV. Classification of defects

Defects	Classification Major	Minor
Spot or stain		X
Not evenly constructed, affecting appearance		X
Marks across carpet	X	
Discolored areas affecting appearance		X
Any noticeable unevenness on top surface affecting appearance		X
Length of pieces or width not as specified	X	
Any obviously objectionable streak lengthwise of weave	X	
Tufts missing in pile	X	
Cut, hole or tear	X	
Seams (when specified) not properly sewed, or taped	X	
Cushioning imperfectly applied; poor adherence	X	
Embedded foreign matter		X

FLOORING, VINYL PLASTIC, L-F-00450A, 3.3, 4.2, 4.4

Criteria and Tests: The flooring shall have a smooth wearing surface free from blisters, cracks, protruding particles and embedded foreign matter. The color, finish, wearing surface, and mottling shall match a sample agreed upon by buyer and seller. Flooring of plain color shall be uniform throughout. In mottled flooring, the mottling shall be worked throughout the full thickness of the flooring. The sample shall be compared with the samples agreed upon in north daylight or equivalent.

The dispersion of the mottling or marbleizing shall be determined by examining two pieces of the flooring. Each portion examined shall be cut parallel to the edges of the flooring into 4 pieces of approximately the same size. On examination, the edges of the pieces shall show evidence of mottling or marbleizing dispersed throughout the thickness, and the mottling, or marbleizing shall not be confined to the top surface. In this respect, the flooring shall also match the samples submitted with the bid.

Examination of the flooring

Examine	Defect
Appearance	As applicable, color, finish and pattern, not as specified
	Any holes, tears, cuts or patches
	Presence of dirt, foreign material, embedded particles
	Blisters, protruberances, rough surface
Workmanship	Wrinkles, wavy edges
	Edges not straight, smooth and parallel

FLOOR COVERING VINYL SURFACE (TILE AND ROLL), WITH BACKING, L-F-475A, 3.10, 4.2.1, 4.3, 4.3.1, Table I

Criteria and Tests: The wearing surface of the floor covering shall be smooth and free from blisters, cracks, protruding particles, and embedded matter. The occurrence of defects shall not exceed the acceptable quality level (AQL) specified herein. The AQL shall be 2.5 defects per hundred units for major defects and 6.5 defects per hundred units for total defects.

L-F-475A, Table I. Classification of defects

Examine	Defect	Classification Major	Minor
Material, construction, workmanship	Color and pattern not as specified	X	
	Depth of color and pattern not as specified	X	
	Exposed side of backing not as specified		X
	Edges not straight		X
	Not smooth		X
	Blisters		X
	Cracks		X
	Protruding particles		X
	Embedded matter		X

The floor covering shall also be examined for dimensional defects.

FLOOR COVERING TRANSLUCENT OR TRANSPARENT VINYL SURFACE WITH BACKING, L-F-001641, 4.3.2.1, Table II

Criteria and Tests: The acceptable quality level (AQL) shall be 4.0 for major defects and 6.5 for total defects (major and minor combined) per hundred units.

L-F-001641, Table II. Classification of defects

Examine	Defect	Classification Major	Minor
Material	Not type specified	X	
	Color and pattern not as specified	X	
Workmanship	Edges not straight		X
	Surface not as specified		X
	Surface blistered or cracked	X	
	Embedded matter in surface		X

FLOOR COVERING, LINOLEUM, LLL-F-1238A, 3.9, 4.4, 4.6, Tables II and III

Criteria and Tests: The wearing surface of the floor covering shall be free from blisters, cracks, protruding particles, and embedded matter. Sampling shall be as in section 5, Federal Test Method Standard No. 501a.

LLL-F-1238A, Table II. Classification of Defects

Defects	Major	Minor
Type and style not as specified	X	
Color not as specified	X	
Wearing surface not coated	X	
Blisters, cracks, protruding particles, and embedded matter		X

FLOOR COVERING, ASPHALTIC FELT (BITUMINOUS TYPE SURFACE), SS-F-001032, 4.3.2.1, 4.3.2.2, Table II

Criteria and Tests: One linear yard in each roll is examined for defects and acceptable quality levels are 2.5 major and 6.5 total defects (major and minor combined) per hundred yards examined, as in Table II. The lot is unacceptable if one or more of the following defects are found:

Overall uncleanness
Color other than specified
Rancid or otherwise objectionable odor
Type not as specified

SS-F-001032, Table II. Classification of Defects

Defects	Classification Major	Minor
Material not fabricated as specified	X	
Stains or dirty		X
Blisters, cracks or embedded foreign material	X	
Color not as specified	X	
Any obviously objectionable streaks		X
Exposed side of backing not finished as specified	X	
Discolored areas affecting appearance		X
Edges not straight	X	
Width more than 1/4 inch over the specified width		X
Less than the specified width by more than 1/8 in.	X	
Finish not as specified		X
Abrasions resulting in weak areas	X	
Surface not securely bonded to asphalt treated base	X	
Silicate not embedded in wear surface (Type II only)	X	
Color does not extend through wear layer		X

SS-F-001032, Table II. Classification of Defects (continued)

Defects	Classification Major	Minor
Vinyl chips missing (when specified for Type I)	X	
Any material defect which will seriously affect serviceability or appearance	X	
Any material defect which will slightly affect serviceability or appearance		X

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A 3.16

Criterion and Test: The tile shall be smooth where applicable and free of blisters, cracks, embedded foreign material, pattern irregularity, dull spots, broken edges. It shall have no objectionable odors and no delamination of layers.

DEFLECTION

Requirement: Deflection. See Flexibility or Pliability.

Comments: Deflection of tile indicates its ability to conform to surface irregularities without cracking or breaking and is an important performance requirement. Since roll and sheet flooring are shipped in a rolled up state, the products are necessarily flexible enough to more than pass the deflection test. Hence, this requirement and test might be superfluous for roll and sheet material.

Specifications:

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.9, 4.4, Table III. Type I (Asphalt) and Type IV (Vinyl-asbestos) tile

Criterion: Type 1 (asphalt) tile shall deflect not less than 0.4 inch and Type IV (vinyl-asbestos) tile, when tested before heating, shall deflect not less than 1.0 inch; both across and with the grain, without breaking.

Test: Method 3131, Federal Test Method Standard No. 501a.

Criterion: After being subjected to heat, Type IV (vinyl-asbestos) tile shall deflect not less than 1.0 inch, both across and with the grain without breaking.

Test: Tile shall be subjected to heat as in Method 6211 and tested as in Method 3131, Federal Test Method Standard No. 501a.

DEPTH

Requirement: Depth of depressed areas

Comments: This is a performance requirement because it relates to cleanability and wear, especially with respect to smooth surface floor coverings. Embossed resilient floor coverings are likely to be more difficult to clean than smooth flooring and may trap dirt. Embossing might also cause the floor covering to wear more rapidly, since traffic is concentrated in a smaller area. It might also present problems in placing furniture. Multi-level carpet might also cause cleaning problems as compared to single level carpet and wear life might be affected by multiple levels. Tests for depth of depressed areas of carpet appear in DDD-C-95 and DDD-C-001559 under tests for thickness of multi-level carpet.

Specification:

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.2.2.2, 4.4.3.2

Criterion: The depressed areas of embossed tile must be no deeper than 1/3 of the tile thickness. The same or a different color may be added to the depressed areas.

Test: Depths of depressed areas shall be measured by means of a depth gage with a needle point. The gage shall be zeroed on a flat, raised part of the tile surface, representative of the entire tile and at least 0.125 inch from the edge of any depressed area and from the edge of the tile itself. Five measurements shall be made on each test unit allowing for a minimum of one measurement per side; the largest reading obtained shall be the maximum depressed depth of the test unit.

Criterion: The depressed areas of embossed tile shall involve no more than 1/3 of the original flat tile surface area prior to embossing, as measured on a full tile. There shall be no depressed area into which a 5/8 inch diameter circle can be placed.

Test: Certificate of compliance from the supplier.

DIELECTRIC

Requirement: Dielectric strength

Comments: This is a performance requirement for certain special applications.

Specification:

FLOORING, VINYL PLASTIC, L-F-00450A

Criterion: Dielectric strength, 3.9, 6.1

When specified, the flooring shall not fail at less than 30,000 volts.

Test: 4.5.2, Table I: Method 8211, Federal Test Method Standard No. 501a.

Criterion: Voltage, 3.10: When specified, the flooring shall not puncture, become appreciable warm at any spot, nor show any sign of weakness.

Test: Voltage withstand, 4.5.6: Method 8111, Federal Test Method Standard No. 501a with specimens 9 inches square and test voltage of 15,000, applied for 1 minute at each position of the electrodes.

DIMENSIONAL

Requirement: Dimensional stability. See Shrinkage resistance.

Comments: This is a performance requirement but present test methods are not correlated with service conditions. Requirements in various specifications should be examined to see whether one requirement could apply to all products. A standard test method should be developed and included in Federal Test Method Standard No. 501a.

Specifications:

FLOORING, VINYL PLASTIC, L-F-00450A, 3.8, 4.5.5

Criterion: The flooring shall not change in linear dimension more than ±0.020 inch per linear foot.

Test: Method 6211, Federal Test Method Standard No. 501a, modified as follows:

The specimen shall be heated for a period of 6 hours at a temperature of 82° ± 1.0°C. (180° ± 1.8°F.). If a water bath is used for conditioning, all measurements shall be made within 5 minutes after removal of the specimen from the water. If this cannot be accomplished, the specimen shall be reconditioned for a 15 minute period before completing the measurement.

FLOOR COVERING VINYL SURFACE (TILE AND ROLL), WITH BACKING, L-F-475A, 3.8, 4.6.6, Table II

Criterion: When the floor covering is tested as in 4.6.6, the linear dimension shall not change more than ±0.3 percent.

Test:

4.6.6 Dimensional stability

4.6.6.1 Apparatus. The following apparatus shall be required:

(a) A circulating air oven equipped with a temperature control that will maintain the required temperature during test and equipped with horizontal rigid steel plates not less than 12 gage steel for supporting the specimen during exposure. The plates shall be not less than 1 inch larger in each linear dimension than the specimen.

(b) A flat glass or steel plate not less than 1 inch larger in each linear dimension than the specimen.

(c) A micrometer-comparator, bench micrometer, or equal that will measure the distance between reference marks to 0.001 inch. The micrometer-comparator should consist of an Invar steel bar on which are mounted two low-power microscopes equipped with filar micrometers graduated to not less than 0.001 inch. The microscopes should be clamped on the bar so that corresponding graduations of the two micrometers are 8 inches apart.

(d) A 7 by 7 by 1/2 inch steel plate.

4.6.6.2 Procedure. Mark two sets of equally spaced reference points in each linear dimension on a sample tile or a 9- by 9-inch specimen from the sample roll in such a manner that a straight line drawn through these points will be perpendicular to the two parallel edges. Set the marks approximately 8 inches apart. Place the specimen on the flat supporting plate and then place the steel plate on top of the specimen. Determine the distance between the marks to the nearest 0.001 inch. Place the specimen - wearing surface up - in the circulating air oven in a horizontal position on the metal plates. Then heat for a period of 20 hours ±1/4 hour at a temperature of 70° ± 2°C. (158° ± 3.6°F.). At the end of the heating period, remove the specimen from the oven and stabilize at room temperature and place on the flat steel plate. Determine the distance between the reference points to the nearest 0.001 inch. Average the readings. Change in linear dimension exceeding ±0.3 percent in either direction shall constitute failure of this test.

FLOOR COVERING TRANSLUCENT OR TRANSPARENT VINYL SURFACE WITH BACKING, L-F-001641, 3.4, 4.4.3, Table I.

Criterion: The average change in either direction when tested as in 4.4.3 shall be no more than 0.3 percent.

Test:

4.4.3 Dimensional stability

Apparatus. The apparatus shall include an eight inch trammel (5/16-inch square mild steel bar with two tapered holes drilled eight inches ±0.020 inch apart and hard phonograph needles set in

holes to protrude about 3/16 inch), a microscope fitted with a reticle calibrated in mils, 60X magnification and a circulating air oven equipped with temperature controls which is capable of maintaining 180°F.

Procedure: After conditioning samples (8.5 inches square) at 73°F ± 2°F, 50% ± 4% relative humidity, place the eight inch trammel on the face of the sample of the floor covering. Hold the bar of the trammel parallel to machine direction. Puncture the surface with the two pins simultaneously making sure that the material is flat. Repeat with the bar parallel to across machine direction. Mark the location and identify the punctures.

Place the samples face up in the oven supporting the samples on flat plates. After 1 hour at 180°F. remove the samples and condition for 1 hour at 73° ± 2°F., 50 ± 4 percent relative humidity.

Place one pin of the trammel in one of the original holes and make a scratch with the other pin so that the scratch passes through a point of nearest approach to the original hole. The sample should be flat while this scratch is being made. Using the microscope, measure the least distance from the center of the hole to the center of the scratch.

Reported values: The average of two readings in each direction is converted to percent expansion or contraction.

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A 3.11, 4.4.2, Table III

Criteria: Type III (vinyl) tile shall not change in linear dimension more than 0.02 inch per linear foot and Type IV (vinyl-asbestos) tile shall not change more than 0.024 inch per linear foot. There is no requirement for Type I (asphalt) or Type II (rubber) tile.

Test: Reference marks are made on a specimen and the distance between the marks measured carefully before and after oven heating, as in Method 6211, Federal Test Method Standard No. 501a.

DUSTING

Requirement: Dusting control

Comments: This is a quality control requirement for the chips used in monolithic surfacings or seamless floors.

DUSTING

Specification:

COATING SYSTEM - DECORATIVE AND PROTECTIVE, SEAMLESS, TT-C-001685, 3.4.5

Criterion and Test: The chips shall not have more than 15 percent maximum pass through weight loss on an 8 mesh screen.

ELECTRICAL

Requirement: Electrical conductance

Comments: This is a performance requirement for certain special applications.

Specifications:

FLOOR COVERING, LINOLEUM, LLL-F-1238A, 3.1.2, 3.8, 4.5, Table III

Criteria: Type II (Static linoleum) shall have built-in electrically conductive properties. Grade H (hospital duty) shall have a resistance of not less than 25,000 ohms nor more than 1,000,000 ohms. Grade I (industrial duty) shall have no resistance (0 ohms) or a maximum resistance of not more than 250,000 ohms.

Test: Method 8311, Federal Test Method Standard No. 501a.

Test: The electrical conductance of Type II may be determined by following the methods specified in section 25 of NFPA 56A in lieu of Method 8311. NFPA No. 56A, Code for the Use of Flammable Anesthetics 1968 is published by the National Fire Protection Association, 60 Batterymarch Street, Boston, Massachusetts 02110.

ELONGATION

Requirement: Elongation

Comments: This is a quality control test for vinyl cushioning for carpet.

Specifications:

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559, 3.3.5.2.c, 4.4, 4.5.10, Table V.

Criterion and Test: Ulitmate elongation of cushioning shall not be less than 60 percent in both machine and transverse directions when tested as in Method 4121, Federal Test Method Standard No. 501a.

FINISH

Requirement: Finish

Comments: This might be considered as a performance requirement but there is a question as to whether the finish is part of the product as supplied by the manufacturer or a coating applied in the course of maintenance. A factory-applied coating may be a protective measure for handling and shipment and which may be removed and possibly renewed after installation. See also Defects (finish and appearance).

Specifications:

FLOOR COVERING, LINOLEUM, LLL-F-1238A, 3.3.4, 6.4

Criterion and Test: Unless otherwise specified, the surface of the linoleum shall be factory finished with a clear, transparent coating for Type I (regular) and Type III (molded), less than 0.005 inch in thickness for protection and to facilitate adhesion of floor wax.

FLAME

Requirement: Flame resistance

Comments: This is an important performance requirement and is found in specifications for carpets and rugs.

Specifications:

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95, 3.9, 4.4, 4.5.13, Table XI; INTERIM AMENDMENT-2, 4.5.13

CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE, DDD-C-001173, 3.5, 4.4, 4.5.4, Tables I, VI; AMENDMENT-1, 4.5.4

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559, 3.9, 4.4, 4.5.13, 6.2, Table V; AMENDMENT-1, 3.9, 4.5.13

Criterion and Test: Methenamine pill test with criterion as stated.

FLEXIBILITY

Requirement: Flexibility or Pliability

Comments: Flexibility or pliability indicates the ability to roll and unroll sheet or roll floor covering without causing cracking or breaking. This is related to manufacture, shipping, and installation and is not a performance requirement, since it is not related to the properties of the installed floor covering. However, after installation, the material must conform to surface irregularities as described under Deflection.

Specifications:

CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE, DDD-C-001173, 3.5, 4.4, 4.5.5, Tables I, VI

Criterion and Test: A sample of the carpet shall be bent 160 degrees over a rod equal in diameter to the thickness of the sample. Any visible sign of cracking of the sample shall be cause for rejection.

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559, 3.3.5.2.e, 4.4, 4.5.11, Table V.

Criterion: When subjected to a flexibility test at both 70°F. and 30°F., the cushion shall not crack, flake, craze, or show any other indication of failure.

Test: Flexibility at 70°F. A specimen of cushioning, not less than 4 by 4 inches shall be doubled and pressed flat on itself in any direction with the topside outside and held in this position for a period of five minutes. At the end of the five minute period the specimen shall be examined for breaking, cracking, or any other evidence of failure, while in the doubled and pressed flat state. The examination shall be visual and at a normal reading distance of one foot. One determination shall be performed for each sample unit and the result shall be expressed as pass or fail.

Test: Flexibility at 30°F. Low temperature flexibility shall be tested using a 1 ± 1/8 inch diameter mandrel by Method 6511, Federal Test Method Standard No. 501a.

FLOORING, VINYL PLASTIC, L-F-00450A, 3.6, 4.5.2, Table I

Criterion: The flooring shall not crack, bend, or show any indication of failure when bent over a mandrel one inch in diameter at 23.0 ± 1.1°C. (73.5 ± 2.0°F.) and 50 ± 4 percent relative humidity.

Test: Method 3111, Federal Test Method Standard No. 501a.

Criterion: The flooring shall not crack, break, or show any indication of failure when bent over a mandrel one inch in diameter after heating to 82 ± 2°C. (179.6 ± 3.6°F.) for 6 ± 1/4 hour as in Method 6211, Federal Test Method Standard No. 501a.

Test: Method 3111, Federal Test Method Standard No. 501a.

FLOOR COVERING, VINYL SURFACE (TILE AND ROLL), WITH BACKING, L-F-475A, 3.7, 4.6.5.

Criterion and Test: Two specimens, 2 in. wide and not less than 7 in. long, shall be cut longitudinally and transversely from the sample. Bend the specimen with the backing next to the surface of the 1-1/2 inch diameter mandrel through an arc of 180° in not less than 5 seconds at a uniform speed. The wear layer shall not crack or break while the specimen is in the bent position. Specimens shall be conditioned and tests run at 23.0 ± 1.1°C. (73.5 ± 2.0°F) and 50 ± 4 percent relative humidity.

FLOOR COVERING TRANSLUCENT OR TRANSPARENT VINYL SURFACE WITH BACKING, L-F-001641, 3.4, Table I

Criterion and Test: The floor covering shall not crack or break when bent over a 1/4-inch diameter mandrel as in Method 3111, Federal Test Method Standard No. 501a. The wear layer shall be against the mandrel. All tests in L-F-001641 shall be performed and specimens conditioned at 23 ± 2°C. (73.4 ± 3.6°F.) and 50 ± 5 percent relative humidity.

FLOOR COVERING LINOLEUM, LLL-F-1238A, 3.7, 4.5, Table III

Criterion and Test: When tested as in Method 3111, Federal Test Method Standard No. 501a, the floor covering shall show no sign of cracking or bending. For Type I, class 1 (regular linoleum, felt backed), a 4-inch diameter mandrel and for Type I, class 2 (regular linoleum, burlap backed) or Type II (static linoleum), a 2-1/2 inch diameter mandrel is used. A 7-inch mandrel is used for Type III (molded linoleum with or without embossing). Conditioning and testing shall be as in Method 1041, Federal Test Method Standard No. 501a, at 23° ± 2°C. (73.4 ±3.6°F) and 50 ± 5 percent relative humidity.

FLOOR COVERING, ASPHALTIC FELT (BITUMINOUS TYPE SURFACE), SS-F-001032, 3.6, 4.4, 4.5.4, Tables I and III

Criterion and Test: The floor covering shall be unaffected except as noted when bent over a 4-inch diameter mandrel for regular floor covering or 6-inch diameter mandrel for slip resistant floor covering as in Method 3111, Federal Test Method Standard No. 501a. Small cracks or checks in the surface that will heal when the floor covering is laid or compressed are permissible. No conditions of temperature or humidity are specified for conditioning or test.

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.10, 4.4, Table III. Type III (Vinyl) tile.

Criterion and Test: The tile shall not crack, break, or show any indication of weakness when bent over a 1-inch diameter mandrel as in Method 3111, Federal Test Method Standard No. 501a before heating and also after heating as in Method 6211, op. cit. Conditioning

and testing shall be as in Method 1041, op. cit. See under LLL-F-1238A.

HARDNESS

Requirement: Hardness

Comments: This is a quality control requirement for rubber tile and seamless flooring.

Specifications

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.6, 4.4, Table III. Type II (Rubber) tile.

Criterion and Test: The tile shall have a durometer hardness of not less than 90 when tested as in Method 3511, Federal Test Method Standard No. 501a.

COATING SYSTEM - DECORATIVE AND PROTECTIVE, SEAMLESS, TT-C-001685, 3.1.4. Top coat (glazed) - Unit 4

Criterion: Minimum Pencil Hardness F.

Test: Federal Specification TT-C-00542C, 4.3.12.

IMPACT

Requirement: Impact resistance

Comments: The specified test method for asphalt and vinyl asbestos tile is a quality control test for handling characteristics prior to and during installation. An impact test on installed tile would be a performance test if it could be related to impact to be expected in service. The impact test for the seamless coating system may be considered to be a performance test.

Specifications:

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.8, 4.4, Table II, AMENDMENT-1, 4.4.5. Type I (Asphalt) and Type IV (Vinyl-asbestos Tile).

Criterion: The tile shall not crack or break when subjected to the impact test.

Test: Method 3311, Federal Test Method Standard No. 501a. The zinc oxide paste specified in Method 3311 shall not be used on embossed tiles. Instead a 3 ± 1/8 inch circle shall be inscribed centrally on each specimen with a felt pen, pencil, or other suitable marker. Type I tile shall be tested with a 0.143-pound weight dropped twice from a height of 4-1/4 inches. Type IV tile, 1/8 inch thick, shall be tested with a 0.143-pound weight dropped four times from a height of twenty inches. For tiles less than 1/8 inch thick, the height shall be ten inches.

IMPACT

COATING SYSTEM - DECORATIVE AND PROTECTIVE, SEAMLESS, TT-C-001685 3.6.4, 4.3.11, Table IV

Criterion: The coating system shall have a resistance to rapid deformation greater than 6-inch pounds.

Test: Standard Method of Test for RESISTANCE OF ORGANIC COATINGS TO THE EFFECTS OF RAPID DEFORMATION (IMPACT), ASTM D 2794, using a 1/2-inch diameter male punch and a 9/16-inch diameter female die. The test specimen shall be another section of the panel used in the adhesion test (See Requirement: Adhesion to substrate), with the coated side up.

INDENTATION

Requirement: Indentation resistance (of smooth surface resilient floor coverings)

Comments: Initial indentation might be important as a performance requirement if it could be related to resilience of the floor covering as related to body comfort. Residual indentation is an important performance requirement since it is related to denting from furniture, spike heels, etc. In the case of carpets and rugs see Compressibility, related to matting from furniture and footwear.

Smooth surface resilient floor coverings are tested for initial indentation and residual indentation. Initial indentation is that resulting from the application of a certain weight or load by means of a pressure foot to the floor covering for a specified time, usually 30 seconds. The initial indentation is measured by means of a dial indicator. Residual indentation is the indentation after application of a certain load by means of a pressure foot for a specified time, usually 30 seconds, followed by a recovery period, usually 60 minutes. Residual indentation is sometimes called recovery from indentation, as in Method 3241, Federal Test Method Standard No. 501a, in which the load is applied for 600 seconds or 10 minutes.

Two instruments are used to measure indentation of resilient floor coverings. One is used in Methods 3221, 3231, and 3241, Federal Test Method Standard No. 501a, and is commonly known as the Armstrong Indentation Machine 1/. The other, used in Methods 3211 and 6311, op. cit., is called the McBurney Tester 2/. The Armstrong Machine is used in all Federal Specifications for resilient floor coverings except for Type I (asphalt tile) and Type IV (vinyl asbestos tile) in SS-T-312A, in which cases the McBurney Tester is used.

1/ F. M. Gavan and J. T. Wein, Jr., "Indentation and Compression Testing of Floor Coverings", Chapter 12, Vol. I, Testing of Polymers, ed. by John W. Schmitz, Interscience Div. of Wiley, N.Y., 1965, pp. 379-386, Figs. 4, 5, 8.

2/ op. cit., pp. 387-8, Fig. 11

Specifications:

FLOORING, VINYL PLASTIC, L-F-00450A, 3.5, 4.5.3

Criteria: The average initial indentation shall be not less than 25 percent and the minimum initial indentation of any single specimen shall be not less than 23 percent. The residual indentation shall not exceed 8 percent and the maximum residual indentation of any single specimen shall not exceed 10 percent. Specimens shall be conditioned and tests run at 23.0° ± 1.1°C. (73.5° ± 2.0°F). and at 50 ± 4 percent relative humidity or in a water bath.

Test: The specimen shall be a piece of flooring not less than 2 inches square. The apparatus shall consist of an indentor acting under a weight of 140 lbs., a dial indicator for measuring depth of indentation, a smooth steel plate for supporting the specimen, and a rigid metal frame for supporting the weight and indicator.

(a) The indentor consists of a steel bar rigidly supported vertically in such a manner that the face of the lower end (foot) contacts the specimen perpendicularly to its face when the specimen is placed horizontally on the steel plate. The foot of the indentor shall be 0.178 inch in diameter, with flat end. The upper end of the indentor is provided with a weight releasing device for applying the load without impact to the indentor and for activating a dial indicator to read depth of penetration of the indentor. The weight of the indentor shall not exceed 1 lb.

(b) The dial indicator attached to the upper end of the indentor has a scale graduated to read depth of penetration to 0.001 inch.

(c) The steel plate for supporting the specimen shall be rigidly fixed in a horizontal position in the framework of the apparatus and shall have a smooth flat surface.

A thickness gage shall be provided for measuring the thickness of the specimen before and after indentation. The gage is equipped with a dial micrometer graduated in at least 0.001 inch and a flat ended pressure foot 0.125 ± 0.01 inch in diameter. The foot shall exert a pressure of 15 ± 5 pounds per square inch on the specimen. A stop watch or other equivalent means for determining the time of application of the load and time of recovery of the specimen shall also be provided.

Procedure. When a water bath is used for conditioning and testing the specimen for initial indentation, the indenting tool and base plate of the indentation tester shall also be immersed in water. conditioned for at least the same period of time as the specimen and The indentation shall be determined with the specimen, indenting tool, and base plate of the indentation tester fully immersed in water at a temperature of 73.5° ± 2°F. In this case the specimen is not conditioned before measuring the thickness. The thickness of the specimen shall be measured as near as practicable in the center of the specimen and the value recorded to the nearest 0.001 inch as T_1.

Initial indentation. The conditioned specimen shall be placed flat on the supporting plate of the apparatus with the wearing surface upward. The indentor foot shall be lowered gently, without impact, until it contacts the surface of the specimen where the thickness measurement was made. The scale on the dial indicator shall be set at zero reading, and within one to two seconds the total load of 140 pounds applied to the specimen by means of the weight release. In no case, however, shall the load be dropped on the specimen. The total load shall be maintained for a period of 10 minutes. At the end of the required time for application of the load, the initial indentation shall be read from the scale of the dial indicator and the value recorded to the nearest 0.001 inch as T_2. Care should be taken that the specimen lies flat on the base plate during the test.

Residual indentation. After recording the indentation of the specimen, the load shall be immediately and completely removed. If the initial indentation is determined in a water bath, the specimen shall be removed from the bath immediately after removal of the indenting load. Sixty plus or minus one minute after removal of the load, the thickness shall again be measured at the indented spot as described in 4.5.3.5 and the value recorded to the nearest 0.001 inch as T_3.

Results. The initial and residual indentation of the specimen shall be calculated as follows:

$$\text{Initial indentation, percent} = \frac{T_2 \times 100}{T_1}$$

where: T_1 is the thickness of the uncompressed specimen, inch,

T_2 is the indentation of the specimen at the end of 10 minutes, inch,

$$\text{Residual indentation, percent} = \frac{(T_1 - T_3) \times 100}{T_1}$$

where: T_3 is the thickness of the specimen after resting for the required time.

Four specimens equally spaced across the sample of flooring shall be tested.

The minimum initial indentation shall be the lowest value obtained for the four specimens tested. The average initial indentation shall be the average of all the values obtained on the sample.

FLOOR COVERING VINYL SURFACE (TILE AND ROLL), WITH BACKING, L-F-475A, 3.6, 4.6.4, Table II

Criterion: The residual indentation of the floor covering shall not be more than 0.007 inch at 23.0 ± 1.1°C. (73.4 ± 2.°F.), 50 ± 4 percent relative humidity.

Apparatus. A micrometer gage with 0.001 inch graduations and a flat pressure foot of 0.125 ± 0.002 inch in diameter shall be used to measure thickness. The foot shall exert a pressure of 20 ± 5 psi in the measuring range. An indentor consisting of a flat-ended cylindrical steel bar 0.250 ± 0.002 inch in diameter for applying a load of 75 ± 0.5 pound to the specimen and a steel plate for supporting the specimen shall be used. The bar shall be supported in a frame to insure the face of its foot being parallel to the surface of the steel plate. The edges of the face of the bar in contact with the specimen shall be buffed smooth but not rounded.

Procedure. By means of the micrometer gage, measure the thickness of a 2-inch square specimen. The measurement shall be made as near as practicable in the center of the specimen and the value recorded to the nearest 0.001 inch. Support the specimen on the steel plate and apply a load of 75 ± 0.5 pounds to the wearing surface of the specimen by means of the cylindrical steel bar at the same point at which the initial thickness was measured. The face of the foot of the bar shall be parallel to the surface of the steel plate. Apply the load until the bar is in full contact with the specimen but not compressed, then apply the full load in a maximum of 2 seconds. The load shall not be dropped on the specimen. Remove the load after 15 minutes. Sixty minutes after removal of the load, determine the thickness of the specimen at the same point at which the initial thickness was recorded. A difference of more than 0.007 inch between the initial thickness and thickness after recovery shall constitute failure of this test.

FLOOR COVERING TRANSLUCENT OR TRANSPARENT VINYL SURFACE WITH BACKING, L-F-001641, 3.4, 4.4.2, Table I

Criterion: Residual indentation of floor coverings shall be an average of 0.012 inch.

Test: Floor coverings without foam layer shall be tested under 75 lbs. load by Method 3231, Federal Test Method Standard No. 501a, conditioned as in Method 1041 at 23° ± 2°C. (73.4° ± 3.6°F), 50 ± 5 percent relative humidity.

Test: Floor coverings with foam layer shall be tested by a modification of Method 3231 described in section 4.4.2 or L-F-001641. In this modification a hemispherical pressure foot, 0.75 inch in diameter is loaded to give 50 lbs. pressure [1/]. Samples, not less

1/ This must mean 50 lbs. load, as a hemispherical foot gives a theoretical point load and the area of contact cannot be determined.

than 4 inches square, are conditioned for 24 hrs. at 72°F. and 50 percent relative humidity and tests are run under the same conditions. Measurements are made before and after indentation with a dead weight caliper gage with no loading on the plunger, all in an area within 0.003 inch of average thickness, circled with a marker. The initial measurement is made with a 1/4-inch diameter flat foot and the measurements after indentation are made with a 1/4-inch diameter hemispherical foot. The sample is indented by lowering the foot slowly until it just touches the surface, then lowering quickly until is is free from the ball bearing ring. After 5 minutes loading, the remaining thickness is noted and the load is immediately removed. The initial indentation is the difference in total thickness before and after indenting. The residual indentation is the difference in total thickness before indenting and after one hour recovery from indentation.

FLOOR COVERING, LINOLEUM, LLL-F-1238A, 3.6, 4.5, Table III

Criterion and Test: Type I, class 1 (regular linoleum, organic felt backed) and Type III, class 1 (molded linoleum, organic felt backed) shall have an average residual indentation of not more than 10 percent. The indenting load shall be 50 lbs., applied with a flat foot indentor for 15 minutes. After 60 minutes the residual indentation shall be measured, as in Method 3231, Federal Test Method Standard No. 501a, except that the diameter of the lower end of the indentor shall be 0.250 inch.

Criterion and Test: Type I, class 2 (regular linoleum, burlap backed) and Type II (static linoleum) shall show an average residual indentation of not more than 10 percent. No single specimen shall have a residual indentation of more than 12 percent. The indenting load for Type I shall be 140 lbs. for plain patterns and 80 lbs. for marbleized patterns. For Type II the indenting load shall be 80 lbs. The floor coverings shall be tested as in Method 3231, Federal Test Method Standard No. 501a. Specimens shall be conditioned for test as in Method 1041, op. cit. at 23° ± 2°C. (73.4° ± 3.6° F.), 50 ± 5 percent relative humidity.

FLOOR COVERING, ASPHALTIC FELT (BITUMINOUS TYPE SURFACE), SS-F-001032, 3.5, 4.4, 4.5.3, Tables I, III

Criterion and Test: The residual indentation shall be a maximum of 0.013 inch. Not less than 3 specimens, each about 2 inches in diameter, shall be cut from the floor covering. Thickness is measured to the nearest thousandth of an inch, before and after applying the load, using a micrometer gage with flat pressure foot, 0.125 ± 0.002 inch in diameter, exerting a pressure of 20 ± 5 psi. A load of 50 ± 0.5 lbs. is applied vertically by means of a flat-ended cylindrical steel bar, 0.250 ± 0.002 inch in diameter for 15 minutes with the specimen supported on a smooth, flat steel plate. The results from not less than 3 specimens shall be averaged. No conditions of temperature and humidity are specified, so it must be assumed that conditioning and test are under ambient conditions.

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A

Criterion and Test: Type I - Asphalt Tile:
SS-T-312A, 3.5.1, 4.4, Tables I, III. When tested at 77°F. in accordance with Method 3211 or 3221, Federal Test Method Standard No. 501a, the initial indentation at the end of one minute shall be not less than 0.006 inch and not more than 0.015 inch. The indentation at the end of 10 minutes loading shall be as in Table I, corresponding to the indentation at the end of 1 minute.

SS-T-312A, Table I. Ten minute indentation (Type I)

Min. after 1 minute loading Inch	Max. after 10 minutes loading Inch	Min. after 1 minute loading Inch	Max. after 10 minutes loading Inch
0.006	0.0100	0.011	0.0166
.007	.0114	.012	.0178
.008	.0127	.013	.0190
.009	.0140	.014	.0202
.010	.0153	.015	.0214

Criterion and Test: Type I - Asphalt Tile:

When tested at 115°F. in accordance with Method 6311, 3211 or 6311, 3221, Federal Test Method Standard No. 501a, the initial indentation shall be less than 0.036 inch at the end of 30 seconds.

Criteria and Test: Type III - Vinyl Tile:

SS-T-312A, 3.5.2, 4.4, Table III. When tested in accordance with Method 3221, Federal Test Method Standard No. 501a, the average residual indentation at the end of 60 minutes recovery shall not exceed 8 percent and the maximum residual indentation of any single specimen shall not exceed 10 percent.

Criteria and Test: Type IV - Vinyl Asbestos Tile:

SS-T-312A, 3.5.3, 4.4, Tables II, III. When tested at 77°F. in accordance with Method 3211, Federal Test Method Standard No. 501a, the indentation at the end of 1 minute shall be not less than 0.006 inch and not more than 0.015 inch. The indentation at the end of 10 minutes shall be as in Table II, corresponding to the indentation at the end of 1 minute.

SS-T-312, Table II. Ten minute indentation (Type IV)

Min. after 1 minute loading Inch	Max. after 10 minutes loading Inch	Min. after 1 minute loading Inch	Max. after 10 minutes loading Inch
0.006	0.0100	0.011	0.0162
.007	.0112	.012	.0174

SS-T-312A, Table II. Ten minute indentation (Type IV) (Cont.)

Max. after 1 minute loading	Max. after 10 minutes loading	Max. after 1 minute loading	Max. after 10 minutes loading
Inch	Inch	Inch	Inch
.008	.0124	.013	.0186
.009	.0137	.014	.0197
.010	.0149	.015	.0209

Criterion and Test: Type IV - Vinyl Asbestos Tile: When tested at 115°F in accordance with Method 6311, 3211 or 6311, 3221 Federal Test Method Standard No. 501a, the indentation shall be less than 0.032 inch at the end of 30 seconds.

KEYING

Requirement: Keying. See Adherence of backing, FLOOR COVERING LINOLEUM, LLL-F-1238A.

MOTH

Requirement: Moth repellency. See Resistance to insects, Resistance to larvae

Comments: This is an important performance requirement for carpets and rugs which are susceptible to attack by moths.

RESISTANCE - CHEMICAL

Requirement: Resistance to chemicals, grease, oil, and solvents

Comments: This is a performance requirement if the chemicals, etc. are those which are likely to be spilled on the floor covering in service and if the conditions can be standardized and correlated with service or use conditions. Substances mentioned in the requirement include household chemicals, such as sodium hydroxide, sodium bisulfate; cooking, animal, and vegetable fats, oils, and grease; vaseline; common solvents such as ethyl and isopropyl alcohol; and water. There is no such requirement in any of the Federal Specifications for carpets and rugs. If textile floor coverings are proposed for "wet areas" where water, chemicals, grease, etc. are likely to be spilled, this requirement should be included.

Specifications:

FLOORING, VINYL PLASTIC, L-F-00450A, 3.7, 4.5.4

Criterion and Test: When tested by Method 7711[1/], Federal Test

1/ This reference to Method 7711 should be changed to read Method 9311, as this method gives details of immersion of specimens, preparation of scratch tool, and references Method 7711.

Method Standard No. 501a, the width of the scratch shall not exceed 0.100 inch after immersion of separate specimens in 95 percent ethyl alcohol, tallow, mineral oil, and vegetable oil and shall not exceed 0.125 inch after immersion of separate specimens in a 5 percent solution of sodium hydroxide, a 5 percent solution of acetic acid, or a 5 percent solution of sulfuric acid. The flooring shall also not change in hue.

FLOOR COVERING VINYL SURFACE (TILE AND ROLL), WITH BACKING, L-F-475A, 3.9, 4.6.7, Table II

Criteria: After exposure of separate specimens to isopropyl alcohol, beef tallow, mineral oil, and cottonseed oil and testing as specified, the width of the scratch on each specimen shall not be more than 0.100 inch. After exposure of separate specimens to a 5 percent solution of sodium hydroxide; a 5 percent solution of acetic acid; and a 5 percent solution of sulfuric acid; and testing as specified; the width of the scratch on each specimen shall not be more than 0.120 inch. The scratch width requirement shall not apply to embossed areas nor to textured surfaces. When exposed to any one of the above materials the floor covering shall not change color.

Test: The apparatus and procedure are essentially the same as in Method 7711, Federal Test Method Standard No. 501a. Twenty-seven specimens from each sample are required for this test and each specimen shall be 2 inches wide by 3 inches long. Three specimens shall be set aside for predulling or checking the sharpness of the scratch tool. Of the remaining twenty-four specimens, three are controls and are not exposed to any of the solvents. Three specimens are exposed to each of seven solvents as follows:

Isopropyl alcohol, Federal Specification TT-I-735, grade A
Beef tallow
Cottonseed oil having the following characteristics:
Specific gravity at 77°F., 0.915 to 0.917
Iodine number, 105 to 114
Acid number, 1.0 maximum
Mineral oil, Federal Specification TT-S-735, Type IV
5 percent solution of acetic acid
5 percent solution of sodium hydroxide
5 percent solution of sulfuric acid

The top wearing surface of three specimens shall be exposed to approximately 10 ml. of each solvent for a period of 46 ± 1/4 hours. A watch glass or other suitable device shall be placed over the solvent on the exposed specimens to minimize evaporation. The exposed specimens shall be maintained at 23.0 ± 1.0°C. (73.4 ± 2.0°F.) except beef tallow specimens, which shall be heated to 50-55°C. (122-131°F.) and maintained at this temperature for the remainder of the exposure period. At the end of the exposure period the specimen shall be blotted (not rubbed) with a soft and absorbent

tissue and subjected to the scratch test not less than 30 minutes nor more than 60 minutes after exposure to the solvents. The scratch tool shall produce a scratch of between 0.050 and 0.065 inch on the controls or unexposed specimens. No measurement shall be made on the first part of the scratch where it is evident that the tool has dug deeper due to the starting of the test. The width of the 3-inch long scratch shall be measured at three equally spaced places and the value recorded to the nearest 0.005 inch. The order of measurement of specimens shall be a control or unexposed specimen, followed by one of the specimens exposed to each solvent in the order of solvents listed. This order of measurement shall be repeated twice or until all the specimens have been tested. The nine values obtained from the three unexposed specimens and the nine values from each set of three specimens exposed to the respective solvents shall be averaged separately and the results recorded to the nearest 0.005 inch as the scratch width of the unexposed sample and the sample after exposure respectively. An unexposed specimen and an exposed specimen from each set shall be placed on a plane surface beside each other and examined in a north light. A change in color of any exposed specimen as compared to that of an unexposed specimen shall constitute failure of this test.

FLOOR COVERING TRANSLUCENT OR TRANSPARENT VINYL SURFACE WITH BACKING, L-F-001641, Resistance to oils and chemicals, 3.4, 4.4.1, Table I

Criterion: There shall be no more than slight discoloration, softening, or other degradation of the surface when subjected to the test.

Test: Cut 14 specimens (6 inches square) from each sample to be tested. Two specimens are to be used for each solvent. Deposit 15 ml of the particular solvent onto the top wearing surface of each of the 2 specimens. Immediately cover the specimen with a 3-inch diameter watch glass and seal the perimeter of the watch glass with paraffin wax. The specimens are to remain exposed to the solvent for 46 ± 1/4 hours at 23.0 ± 1.1°C. (73.4 ± 2.0°F.). At the end of the exposure period the specimen shall be blotted (not rubbed) with a soft absorbent tissue. The exposed area shall then be probed with a spatula to ascertain whether or not degradation of the wear layer has occurred. The exposed area is also to be observed for color change. The solvents shall be the same as in FLOOR COVERING VINYL SURFACE (TILE AND ROLL), WITH BACKING, L-F-475A.

FLOOR COVERING, ASPHALTIC FELT (BITUMINOUS TYPE SURFACE), SS-F-001032, 3.6, 4.4, 4.5.5, Tables I, III. Resistance to acids and water.

Criterion: Floor covering shall be unaffected by exposure to 5% acetic acid, 10% hydrochloric acid, 10% sulfuric acid, and water.

Test: Immerse a specimen into the applicable solution for 3 minutes, remove it and observe for any wear layer softening after a 6 hour and 24 hour period. Also, place about 10 ml of the applicable solution on the wear layer of a specimen, cover with a watch glass (to inhibit evaporation) and observe for softening after a 6 hour and a 24 hour period.

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.12, 4.4, Table III

Criterion and Test: Type I - Asphalt Tile:

When tested according to Method 7711[1/], [2/] Federal Test Method Standard No. 501a, the width of the scratch shall not exceed 0.10 inch after immersion in a 5 percent solution of sodium hydroxide. See Scratch resistance.

Criterion and Test: Type III - Vinyl Tile: (See under Type I - Asphalt Tile). When tested according to Method 7711[1/], [2/] as in Type I, the width of the scratch shall not exceed 0.10 inch after immersion of separate specimens in 95 percent ethyl alcohol, tallow, mineral oil, and cottonseed oil and shall not exceed 0.125 inch after immersion of a specimen in a 5 percent solution of sodium hydroxide. The specimens of tile exposed to the above reagents shall show no appreciable change in hue when compared visually with unexposed specimens.

Criterion and Test: Type IV - Vinyl Asbestos Tile: (See under Type I - Asphalt Tile).

When tested by Method 7711[1/], [2/] as in Type I, the width of the scratch shall not exceed 0.10 inch after immersion of separate specimens in 95 percent ethyl alcohol, a 5 percent solution of sodium hydroxide, tallow, mineral oil, vegetable oil, and kerosene.

RESISTANCE - INSECTS

Requirement: Resistance to insects. See Moth repellency, Resistance to larvae

1/ The reference to Method 711 should be changed to read Method 9311, as this method gives details of immersion of specimens, preparation of scratch tool, and references Method 7711.

2/ Where there is sufficient raised flat area on an embossed tile for at least a 2-inch scratch, Method 7711 of Federal Test Method Standard No. 501a shall be used on the embossed tile. Otherwise, resistance to reagents for embossed tile shall be determined on unembossed stocks with the same formulation as the embossed tile and covered by the manufacturer's certificate of compliance.

Comments: This is a performance requirement for any floor covering which is or might be subject to insect attack. Competent authorities should be consulted on writing more comprehensive requirements for resistance of floor coverings to attack by various organisms.

Requirement: Resistance to larvae

Comments: This is a performance requirement for resistance of pile carpets and rugs to black carpet beetle larvae.

Specifications:

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95, 3.6, 4.4, Table XI

Criterion: The insect resistant classification shall not be less than "resistant".

Test: ASTM D1116-69, Standard Method of Test for Resistance of Pile Floor Coverings to Attack by Black Carpet Beetle Larvae.

CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE, DDD-C-001173, 3.5, 4.4, Tables I, VI

Criterion: Finished carpeting shall be unaffected.

Test: ASTM D1116-69

Requirement: Resistance to microorganisms. See Resistance to mildew

Requirement: Resistance to mildew

Comments: A more comprehensive requirement should be written to cover attack by other microorganisms, as rot, bacteria, etc. This would be a general performance requirement for floor coverings.

Specification:

CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE, DDD-C-001173, 3.5, 4.4, Tables I, VI

Criterion and Test: Shall be unaffected after exposure for at least two weeks as in Method 5752, Federal Specification CCC-T-191b. This method is now obsolete, as it was dropped from Federal Test Method Standard No. 191, which superseded Federal Specification CCC-T-191b.

Requirement: Scratch resistance

Comments: This is a performance requirement but laboratory tests have not been correlated with traffic conditions.

Specifications and Criteria: See Resistance to chemicals, etc.

Test: Method 7/11, Federal Test Method Standard No. 501a. The specimen is mounted on the table of the scratch tester by means of a holder; the scratch tool, loaded with a dead weight, is lowered gently; and the table is then rotated to produce the scratch.

SEAM

Requirement: Seam strength

Comments: This is a quality control test for carpets and rugs.

Specification:

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95, 3.7.3, 4.4, Table XI

Criterion and Test: Seams on carpets and rugs without attached rubber cushioning shall have a breaking strength of not less than 100 lbs. when tested as in Method 5100, Federal Test Method Standard No. 191.

SHRINKAGE

Requirement: Shrinkage resistance. See Dimensional stability.

Comments: This is a performance requirement for carpets and rugs, assuming that these products are to be washed in warm (110°F.) detergent solution. This requirement is related to shampooing, not to changes in ambient temperature and humidity as is the case with Dimensional Stability.

Specifications:

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95, 3.5, 4.4, 4.5.12, Table XI

Criterion: Shrinkage shall not exceed 3 percent in length or width[1/].

1/ Criteria for shrinkage vary between specifications from 1 to 3 percent. A criterion of 3 percent seems to allow for too much shrinkage and 1 percent shrinkage appears to be a more reasonable criterion.

SHRINKAGE

Test: A 12- by 12-inch sample of carpet shall be conditioned for 24 hours under standard conditions as defined in Section 4, Federal Test Method Standard No. 191. The specimen shall then be marked and measured at three different locations in the length and width directions. The specimen shall then be immersed in water at 110°F for 15 minutes. A solution shall be made of 2 g. sodium alkyl sulfate type of detergent and 50 g. water and this solution shall be applied to the pile surface of the carpet at 110°F. The specimen shall be scrubbed with a soft bristle brush by stroking back and forth 20 times[2/] (10 times in each unilateral direction) in both length and width directions. The sample shall then be rinsed well to remove most of the detergent; squeezed[3/]; dried in an oven at 125°F. until bone dry[3/]; and conditioned as before for 24 hours.

CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE, DDD-C-001173, 3.5, 4.4, 4.5.3, Tables I, VI

Criterion and Test: Percent shrinkage shall be a maximum of 1.0 percent of the length and 1.0 percent of the width[1/]. The test method is the same as in Federal Specification DDD-C-95.

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559, 3.6, 4.4, 4.5.12, Table V

Criterion: Shrinkage shall not exceed 2.0 percent in either the length or the width[1/]. See under Colorfastness.

Test: Same as in DDD-C-95.

SIZE

Requirement: Size and tolerance control. See Thickness.

Comments: This is a quality control requirement. Work should be done on standardization of necessary tolerances.

Specifications:

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95, 3.8, 4.2.2.3, 6.2

1/ Criteria for shrinkage vary between specifications from 1 to 3 percent. A criterion of 3 percent seems to allow for too much shrinkage and 1 percent appears to be a more reasonable criterion.

2/ This is the wording used in DDD-C-95, par. 4.5.12. However, this apparently means back and forth for a total of 10 cycles.

3/ The terms which are used in the specification need to be defined.

Criteria: Cut rugs are unacceptable if the width or length is more than 1 percent less than specified. Rolls cannot be more than 1 percent less in width than specified. The length of rolls must not be less than specified nor more than 10 percent longer[1/].

CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE, DDD-C-001173, 3.6, 4.3.2.3

Criteria: The carpeting shall be furnished in roll form on paperboard tubes as full length continuous pieces or as individual pieces cut to special sizes. Unless otherwise specified, the full length continuous pieces shall be not less than 90 ft. and the widths shall be 3, 6, 9, and 12 ft. as specified in the contract or order. The tolerances for full rolls shall be ±1/2 inch - 1/8 inch for width. The tolerances for special sizes shall be the same as for full rolls but for both width and length.

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559, 3.8, 6.2

Criteria: The length, width, and pattern of the carpets shall be as specified. The dimensional tolerances shall be as follows:

Cut to size - width or length - not more than 1 percent less than specified
Rolls - width - not more than 1 percent less than specified
Rolls - length - not less than specified nor more than 10 percent longer than specified
Individual roll - not more than 1 yard less[1/] than indicated on piece ticket
Total yardage in sample - gross total length of all pieces in sample not less than the total gross length marked on piece ticket

FLOORING, VINYL PLASTIC, L-F-00450A, 3.4.1, 4.4.5, 4.5.2, 6.1, Table I

Criteria: The flooring shall be 27, 36, 45, or 54 inches wide as specified with a plus tolerance of 1.00 inch[2/] at any point and no minus tolerance[3/]. Each roll of not less than 50 percent of the total number of rolls furnished shall be in one continuous piece; each roll of not more than 50 percent of the total number of rolls furnished shall be in not more than two pieces; the shortest piece shall be not less than 5 yards long.

1/ Tolerances for carpet dimensions vary considerably between different specifications. One percent of a 3-ft. width is 0.36 inch, while 1 percent of a 12-ft. width is 1.44 inches. This latter figure seems to be too great a tolerance. One yard less and 10 percent more than specified on length also appear to be too much.
2/ This seems too much, especially for purposes of installation.
3/ We suggest a tolerance of 0.016 in. per ft. as in SS-T-312A.

The sample unit for examination for average length shall be one roll. A minimum of five rolls shall be examined for length of flooring per roll. Unless otherwise specified, average length of rolls examined shall be not less than thirty yards.

The width of the flooring shall be measured by Method 2211, Federal Test Method Standard No. 501a. The tape or scale shall be graduated to 1/8 inch and the distance between the two edges of the specimen shall be read from the tape or scale and the value recorded to the nearest 1/8 inch.

FLOOR COVERING VINYL SURFACE (TILE AND ROLL), WITH BACKING, L-F-475A, 3.5.1, 6.5

Criteria: Type I floor covering (Tile) shall be of the length and width specified. Tolerance shall be ± 1/64 inch. The width of Type II floor covering (Roll) shall be standard width +1 inch[1/] - 0 inch[2/]. Vinyl roll material with backing is commercially available in rolls 6 ft. wide.

FLOOR COVERING TRANSLUCENT OR TRANSPARENT VINYL SURFACE WITH BACKING, L-F-001641, 3.3

Criteria: Unless otherwise specified, the floor covering shall be furnished in 6, 9, or 12-ft widths (minus 0 inch)[2/].

FLOOR COVERING LINOLEUM, LLL-F-1238A, 3.5, 4.5.2, Table III

Criteria: The length and width of the floor covering shall be as specified. Unless otherwise specified, the width of the floor covering shall be 72 inches with a tolerance of plus 1 inch[1/] minus zero inch[2/], by Method 2311, Federal Test Method Standard No. 501a. Length is measured by Method 2311.

FLOOR COVERING, ASPHALTIC FELT (BITUMINOUS TYPE SURFACE), SS-F-001032, 3.7

Criteria: Unless otherwise specified (6.2), the floor covering shall be furnished in roll form, 36 (+ 1/4 - 1/8) inches wide and not less than 90 ft. long.

TILE, FLOOR: ASPHALT RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.3, 4.4, Table III

1/ This seems too much especially for purposes of installation.
2/ We suggest a tolerance of 0.016 in. per ft. as in SS-T-312A.

SIZE

Criteria: Unless otherwise specified, the tile shall be 9 by 9 inches[1/], with a tolerance of ±0.016 in. per ft. The size of the tile is measured with a dial gage and a horizontal index strip as in Method 2231, Federal Test Method Standard No. 501a.

SQUARENESS

Requirement: Squareness

Comments: Like Size and tolerance control, this is a quality control requirement.

Specifications:

FLOOR COVERING VINYL SURFACE (TILE AND ROLL), WITH BACKING, L-F-475A, 3.5.3, 4.6.3

Criteria: The edges of the tile shall be straight and the out-of-squareness shall be not more than 0.01 inch. The criterion of out-of-squareness refers to the amount each corner of the tile deviates from 90 degrees or from squareness.

Test: The apparatus and procedure are as in Method 2421, Federal Test Method Standard No. 501a but only one tile is tested. The apparatus consists essentially of a dial gage and two index or reference strips mounted on a flat plate at an angle of exactly 90 degrees. A reference gage is provided to set the strips at a 90° angle. The dial gage is located between two strips such that its foot contacts the edge of a tile in contact with the reference strips. The tile is placed on the plate with one edge against the horizontal index str-p and approximately one inch from the vertical index strip. The stem of the dial indicator is retracted and the tile moved alongthe horizontal strip until the left hand edge of the tile contacts the vertical index strip. The tile is then pressed firmly against the vertical index strip without distorting the materil and the dial indicator stem released without impact until its foot contacts the edge of the tile. The reading on the dial indicator scale to the nearest 0.001 inch is taken as the out-of-squareness. The maximum value from all four corners sha-l be the value reported for the out-of-squareness criterion.

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.15, 4.4, Table III

1/ Also included should be the popular 12 by 12 inch size tile.

SQUARENESS

Criterion: The out-of-squareness of the tile shall not exceed 0.01 inch.

Test: Method 2411, Federal Test Method Standard No. 501a except in case of dispute, when Method 2421 shall be used.

SURFACE

Requirement: Surface texturing

Comments, Specifications: See Appearance.

TENSILE

Requirement: Tensile strength

Comments: This is a quality control requirement for rubber tile. See Breaking Strength.

Specification:

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.7, 4.4, Table III. Type II - Rubber tile.

Criterion: The tensile strength of rubber tile at 10 percent elongation shall be not less than 400 lbs. per sq. in. (psi).

Test: Method 4211, Federal Test Method Standard No. 501a. Tensile strength is calculated from the force in pounds necessary to stretch the specimen to the specified elongation.

THICKNESS

Requirement: Thickness or Pile height. See also Finish.

Comments: Thickness is not a performance requirement but is related to service life for a given product. See Wear.

Specifications:

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95, 4.4, 4.5.3, 4.5.6, Tables II, III, IV, V, VI, XI. See INTERIM AMENDMENT-2, Tables, July 9, 1970.

Criteria: The pile height depends on the construction and type of carpet. The thickness of the rubber cushioning shall average not less than 3/16 inch.

Test: Single level pile fabrics, Woven carpet: ASTM D418-42[1/]

Test: Single level pile fabrics, Tufted and knitted carpet: ASTM D1486-57T[1/]

Test: Multilevel or profile wire carpet: A metal rule graduated in 1/100 inch[2/], approximately 3/4 inch wide and 0.040 inch thick, shall be inserted between and parallel to the lengthwise pile rows; and the pile height in the high pile areas measured five times and the pile height in the low pile areas measured five times[3/]. The areas measured shall be selected so that lines drawn parallel to and perpendicular to the edge of the sample through the points of measurement shall be at least 2 inches apart. The average of the five measurements in the high pile areas shall be the high pile and the average of the five measurements in the low pile areas shall be the low pile height. The difference between the high pile height and the low pile height shall be the differential pile height[2/].

Test: Rubber cushioning - Class 1[4/] - Thickness: The specimen shall be one square yard of the finished item, with cushioning. The thickness between the two plane surfaces[5/] of the specimen shall be determined under a pressure of 0.100 lbs. per sq. in. (psi) ±0.001 psi, distributed over a circular area 3.00 ± 0.01 inch in diameter. Apply pressure slowly to avoid impact and protect the specimen from vibration during the test. Five readings shall be taken on the specimen and the average computed to the nearest 0.001 inch. The results from the sample units in the sample size shall be averaged and computed to the nearest 0.001 inch. This is the lot average thickness of the finished item. A one yard square specimen of the carpet before application of cushioning shall be tested for thickness as specified above[6/].

1/ These tests for pile height of single level pile fabrics have been superseded by the following:
ASTM D418-68, Standard Method of Testing WOVEN AND TUFTED PILE FLOOR COVERING,
sections 37-45, TUFT LENGTH (CUT-PILE FLOOR COVERINGS)
sections 46-54, LOOP LENGTH (LOOP-PILE FLOOR COVERINGS)
Sections 46-54 for loop length cover single and multilevel but not cut-loop pile floor coverings.

2/ The precision of measurement is not stated but implied by the specification that the metal rule shall be graduated in 1/100 inch. It seems unlikely that visual observations could be of this order of precision.

3/ Apparently this means that the pile height is measured in five high pile areas and in five low pile areas, once in each of the ten areas.

4/ For classes of rubber cushioning, see under Compressibility, Specification DDD-C-95.

5/ "Principal surfaces" is a more accurate term, as the surfaces of rubber cushioning are not plane.

6/ Apparently the purchaser must request samples of both finished carpet and cushioning and assume that the separate cushioning is the same as that on the finished carpet.

The results from the sample units in the sample size shall be averaged and computed to the nearest 0.001 inch. This is the lot average thickness of the carpet before application of the cushioning. The difference between the thickness before application of the cushioning and the thickness of the finished item shall be the average thickness of the rubber cushioning.

Test: Rubber cushioning - Class 2[1/] - Thickness:
The specimen shall be one square yard of Class 2 rubber cushioning and the thickness shall be determined as for Class 1 rubber cushioning.

CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE, DDD-C-001173, 3.5, 4.4, 4.5.1, Tables I, VI

Criterion: The minimum overall thickness shall be 0.20 inch.

Test: The sample of carpet shall be placed on a flat and level surface and the height measured with a metal rule graduated in 1/100 or 1/64 inch, approximately 3.5 inches wide and 0.040 inch thick. Five measurements are to be made at 2.0 inch intervals by placing the rule on the surface beside the sample and taking readings. The average of the five readings shall be taken as the carpet thickness.

Test: An alternative method is a modification of Method 5030, Federal Test Method Standard No. 191. The apparatus shall have a presser foot 1 ± 0.001 inch in diameter and shall exert a pressure of 9.4 ± 0.1 ounces, equivalent to 3/4 psi.

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559, 3.3.5.1.a, 3.3.5.2.a, 3.5.4.4, 4.5.3, 4.5.4, Tables I, V

Criterion: Pile height requirement depends on the type of carpet, as in Table I, 3.5.

Test: Single level pile carpet: ASTM D418-68, Standard Methods of Testing WOVEN AND TUFTED PILE FLOOR COVERING, sections 46-54, LOOP LENGTH.

Test: Multilevel carpet: Same as for pile height of multilevel carpet under DDD-C-95 except that the measurements shall be at least 1 inch apart.

Criterion: Rubber cushioning shall average not less than 0.187 inch thick with thickness differential from one side of the carpet to the other not to exceed 0.030 inch.

1/ For classes of rubber cushioning, see under Compressibility, Specification DDD-C-95.

Test: Same as for thickness of Class 1 and Class 2 rubber cushioning under DDD-C-95.

Criterion: Vinyl cushioning thickness shall be as specified in the contract or order.

Test: Method 2121, Federal Test Method Standard No. 501a. Test results shall be reported as the lot average. Results of tests conducted on vinyl cushioning prior to attachment to carpet may be accepted.

FLOORING, VINYL PLASTIC, L-F-00450A, 3.4.2, 4.5.2, 6.1, Table I

Criterion: Unless otherwise specified, the flooring shall be 0.125 inch thick with a tolerance of ±0.005 inch.

Test: Thickness shall be measured by Method 2131, Federal Test Method Standard No. 501a. The specimen shall consist of a portion 12 inches long and the full width of the roll. Five equally spaced measurements shall be made across the width of the specimen.

FLOOR COVERING VINYL SURFACE (TILE AND ROLL), WITH BACKING, L-F-475A, 1.2.1, 3.5.2, 4.6.2

Criterion: Tile and roll floor covering shall be furnished in the following thicknesses as specified:

Grade	Thickness, inch, minimum	
	Overall	Wear layer
A	0.085	0.050
B	0.065	0.030
C	0.055	0.020

Test: Measurements shall be made with a micrometer graduated to read to not less than 0.001 inch. The micrometer shall have a flat-ended pressure foot 0.250 ± 0.002 inch in diameter and an anvil that has an area of not less than 0.5 sq. in.[1/]. The pressure foot shall exert a pressure of 20 ± 5 lb./in^2 (psi) on the floor covering[2/]. No measurement shall be made nearer than 3/4 inch to

1/ A 6-inch square anvil is specified in the thickness test under L-F-001641, which raises the question as to the size and shape of the anvil which is necessary to obtain valid measurements.

2/ This is approximately equivalent to 16 ounces force on a 0.25 inch diameter pressure foot as in Method 2111, Fed. Test Method Std. No. 501a. However, for backed vinyl, Method 2121 (light load) seems more appropriate. In Method 2121 the load is 3 ounces on a 0.025 inch diameter foot or about 3.8 psi.

a cut edge. A specimen 9 inches wide by 12 inches long shall be taken from the end of the roll. Two measurements (of the wear layer and the overall thickness) shall be made for each tile or specimen from each roll. Variation between readings shall not be more than 0.010 inch.

FLOOR COVERING TRANSLUCENT OR TRANSPARENT VINYL SURFACE WITH BACKING, L-F-001641, 3.3, 3.4, Table I

Criteria: Unless otherwise specified the floor covering shall be furnished in the following minimum thicknesses:

	Overall inch	Wear layer inch
Class 1	0.065	0.020
Class 2	0.055	0.014
Class 3	0.055	0.010

The thickness of the backing shall be 0.020 inch minimum for all classes.

Test: Method 2121, Federal Test Method Standard No. 501a with dial micrometer, 6-inch square anvil[1/], flat pressure foot 0.250 inch in diameter, and one ounce weight on the plunger[2/]. The thickness of the foam layer, if present, shall not be included in determining the thickness of either the wear layer or the backing.

FLOOR COVERING, LINOLEUM, LLL-F-1238A, 1.2, 3.4, 4.5, Table III

Criteria: Type I floor covering shall be furnished in the thicknesses shown in Table I. Type II floor covering shall have a minimum overall thickness of 0.120 inch. Except for embossed areas, type III floor covering shall have a minimum average overall thickness of 0.085 inch and a minimum average wear layer of 0.040 inch. See par. 1.2, LLL-F-1238A.

LLL-F-1238A, Table I. Thicknesses

Grade	Overall thickness (inch min.)	Wear layer (inch min.)
A (class 1)	0.120	0.090
A (class 2)	0.120	--
B (class 1)	0.085	0.050
B (class 2)	0.085	--

1/ See footnote, L-F-475A, Test.
2/ This differs from Method 2121, Fed. Test Method Std. No. 501a. See Footnote 2/ under L-F-475A.

LLL-F-1238A, Table I. Thicknesses (continued)

Grade	Overall thickness (inch min.)	Wear layer (inch min.)
C (class 1)	0.060	0.022
C (class 2)	0.060	--

1.2 Classification. The floor covering shall be of the following types, classes, and grades, as specified (see 6.2)

Type I - regular linoleum
  Class 1 - Organic felt backed
  Class 2 - Burlap backed
  Grade A - Heavy gage
  Grade B - Standard gage
  Grade C - Light gage

Type II - Static linoleum
  Class 2 - Burlap backed
  Grade H - Hospital duty
  Grade I - Industrial duty

Type III - Molded linoleum with or without embossing
  Class 1 - Organic felt backed
  Grade B - Standard gage

Tests: Overall thickness shall be measured by Method 2111 and thickness of the wear layer by Method 2141, Federal Test Method Standard No. 501a.

FLOOR COVERING, ASPHALTIC FELT (BITUMINOUS TYPE SURFACE), SS-F-001032, 3.6, 4.4, 4.5.1, 4.5.2, Tables I, III

Criterion: The overall thickness shall be a minimum of 0.070 inch and the thickness of the wear layer shall be a minimum of 0.015 inch.

Test: Thickness shall be measured with a micrometer or gage with a flat-ended pressure foot of 0.250 ± 0.002 inch diameter, exerting a pressure of 20 ± 5 psi on the specimen[1/]. The average of 10 scattered measurements shall be taken as the overall thickness and no measurement shall be made nearer than 3/4 inch to a cut edge. The thickness of the wear layer shall be determined by scraping off all of the backing felt and any coating from a small section of the floor covering and calipering with the micrometer. If the first measurement is below the minimum specified for the wear layer, the average of 3 measurements shall be taken as the thickness.

1/ This is a reasonable pressure for the test but differs slightly from Method 2111, Fed. Test Method Std. No. 501a. See Footnote 2/ under L-F-475A.

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.4, 4.4.3, Table III

Criteria: Unless otherwise specified, asphalt (Type I) and rubber (Type II) tile shall be furnished in 1/8 inch thickness. Vinyl tile (Type III) shall be furnished in 1/16, 5/64, and 1/8 inch thickness. Vinyl asbestos tile (Type IV) shall be furnished in 1/16, 3/32, and 1/8 inch thickness. A tolerance of plus or minus 0.005 inch shall be permitted.

Tests: One of two methods may be used to measure thickness, both from Federal Test Method Standard No. 501a: Method 2111 (dial micrometer) or Method 2131 (micrometer caliper).

Measurements shall be made with a micrometer graduated to read not less than 0.001 inch. The micrometer shall have a flat-ended presser foot 0.250 inch ± 0.002 inch in diameter and an anvil that has an area of not less than 0.5 square inch. The presser foot shall exert a pressure of 20 p.s.i. ± 5 p.s.i. on the floor covering. No measurement shall be made nearer than 3/4 inch to a cut edge. The wear layer thickness and overall thickness of embossed or textured patterns may be determined by the above method if the pattern consists of substantially flat areas larger than the micrometer foot. For patterns that do not contain suitable flat areas, thickness of the wear layer should be determined by Method 2151 of Federal Test Method Standard No. 501a, at randomly selected points in the specimen. At least 5 points should be measured and averaged. The thickness of the backing should be measured by Method 2151 and added to the average obtained for the wear layer to obtain overall thickness. In cases of dispute, the thickness of the wear layer should be determined by measuring the volume of a 6- by 6-inch section of the specimen and dividing by the area of the specimen to obtain the average overall thickness. Thickness of the backing shall be determined by using Method 2151 and this value shall be subtracted from the overall thickness to obtain the average wear layer thickness.

COATING SYSTEM - DECORATIVE AND PROTECTIVE, SEAMLESS, TT-C-001685, 3.4.6, Table IV. Thickness of chips used in coating system.

Criterion and Test: The range of thickness of the chips shall be 4 to 6 mils, measured with a micrometer.

VOLATILITY

Requirement: Volatility control

Comments: Volatility is a quality control test for vinyl cushioning for carpet and for vinyl asbestos tile. This might be related to odorlessness, which could be considered a performance requirement.

Specifications:

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559, 3.3.5.2.f, 4.4, Table V Attached vinyl cushioning.

Criterion and Test: Volatile matter shall not exceed 1.0 percent by Method 9211, Federal Test Method Standard No. 501a. In this method, volatile material is determined by loss in weight after heating in a circulating air oven at 100° ± 1°C. (212 ± 1.8°F) for 6 ± 1/2 hours. The oven should be regulated to insure minimum air velocity[1/].

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.13, 4.4, Table III. Type IV - Vinyl asbestos tile.

Criterion and Test: Volatile matter shall not exceed 0.5 percent by Method 9211, Federal Test Method Standard No. 501a.

WATER

Requirement: Water resistance

Comments: This is a quality control requirement for chips used in monolithic surfacing or seamless floor coating system. Water resistance for the entire system or for installed flooring would be a performance requirement, as it relates to water spillage.

Specification:

COATING SYSTEM - DECORATIVE AND PROTECTIVE, SEAMLESS, TT-C-001685, 3.4.3, Table IV. Chips used in coating system. See Requirement: Curl Resistance.

Criterion and Test: When immersed in water for 5 minutes the chips shall not deteriorate, discolor, bleed, or curl.

WEAR

Requirement: Wear

Comments: This is a very important performance requirement which is not covered by most Federal Specifications for floor coverings. Recently Abrasion resistance was included in Federal Specification L-F-001641. In the resilient flooring industry, wear is generally related to service, while the term abrasion refers to an accelerated laboratory test.

1/ This statement in DDD-C-001559 is not precise; no reason is given for low air velocity.

Service wear has not been correlated with laboratory abrasion tests. The subject of wear, wear testing, and abrasion tests have been investigated thoroughly by a number of laboratories.

Specification, Criterion, and Test: See Abrasion resistance.

Requirement: Weight

Comments: Weight is a quality control requirement for carpets and rugs. Like Thickness, it may be related to the service life of the floor covering.

Specifications:

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95

Criteria and Tests:

Weight of pile yarn, 4.5.2, Tables I-VI, XI, INTERIM AMENDMENT-2, Tables, July 9, 1970. The pile yarn shall be separated from other yarns on a sample containing 16 square inches. The prescribed weight of pile yarn, as ounces per square yard of carpet or rug, depends on the type of carpet.

Weight of backing material, 3.2.3. The backing material shall be a woven fabric of either jute or cotton, weighing not less than 9.2 ounces per square yard.

Weight of backing reinforcement, 3.2.4. The backing reinforcement shall be a woven or knitted fabric weighing not less than 6.0 ounces per square yard.

Weight of attached rubber cushioning. Class 1, 3.2.5.b, 4.4, 4.5.7.1, Table XI. Specimens, one square yard each, of finished carpet (with cushioning) and carpet before application of cushioning shall be conditioned for at least 4 hours at 70 ± 2°F and 65 ± 2 percent relative humidity. Each specimen shall then be weighed to the nearest 0.01 pound per square yard. The difference shall be the lot average weight of the cushioning. Class 2 specimen shall be one square yard of cushioning. (Classes - see under Compressibility).

CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE, DDD-C-001173, 3.5, 4.4, 4.5.2, Tables I, VI

Criteria and Tests:

Weight of polypropylene fiber. The minimum weight shall be 22.0 ounces per square yard, not including polypropylene in the reinforcement cloth. The method used shall conform to the standards of the industry.

Weight of binding compound. The minimum weight shall be 7.0 and the maximum weight 10.0 ounces per square yard. The method used shall conform to the standards of the industry.

Weight, total. The minimum total weight shall be 32.0 ounces per square yard. The method used shall be Method 5040 or 5041, Federal Test Method Standard No. 191. When Method 5041 is used, one specimen with an area of at least 16 square inches shall be used.

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED, WITH ATTACHED CUSHIONING, DDD-C-001559, 3.3.3, 3.3.5.1, 3.5, 4.4, 4.5.2, 4.5.5, Tables I, II, V

Criteria and Tests:

Pile weight, ozs/sq. yd., 4.5.2, Table I, depends on the type of carpet. In the test, the pile yarn shall be separated from other yarns (prior to attachment of cushioning) on a sample containing 16 square inches. To express weight of pile yarn per carpet, the weight of the pile shall be calculated as follows: Weight of pile yarn (ounces) in 16 sq. in. sample x 81.0 = weight of pile yarn in ozs/sq. yd. of carpet.

Weight of backing material, 3.3.3, Table II. The backing material for use in tufted carpets shall be a woven fabric of jute weighing not less than 7.6 ounces per sq. yd., or a woven or nonwoven fabric of 100 percent polypropylene weighing not less than 3.0 ounces per square yard. Weight shall be determined by Method 5041, Federal Test Method Standard No. 191, TEXTILE TEST METHODS.

Weight of rubber cushioning, 3.3.5.1.b, 4.5.5.1, 4.5.5.2. The weight per sq. yd. shall not be less than 2.37 pounds for class 1 rubber and not less than 3.50 pounds for class 2 rubber.

For determining weight of class 1 rubber cushioning, the specimen shall be one square yard of the finished item (with cushioning). The specimen shall be conditioned for a minimum of 4 hours under standard conditions of 70°F (±2°F) and 65 percent (±2 percent) relative humidity for testing. The specimen shall be weighed to the nearest 0.01 pound per sq. yd. The results from the sample units in the sample size shall be averaged and computed to the nearest 0.01 pound per square yard. This is the lot average weight of the finished item.

One square yard of the carpet before application of the cushioning shall be tested for weight as specified above. The results from the sample units in the sample size shall be averaged and computed to the nearest 0.01 pounds per sq. yd. This is the lot average weight of the carpet before application of the cushioning. The difference between these two values is the lot average weight of the cushioning.

Specimen for determining weight of class 2 rubber cushioning shall be one sq. yd. of the material. The weight shall be determined as above.

(Classes - see under Compressibility).

3. SAMPLING AND INSPECTION

This subject is related to Defects, Size and Tolerances, and Thickness under 2. Physical Requirements in Federal Specifications for Floor Coverings. Sampling is an important part of any test or inspection procedure. Sampling and acceptance procedures is the subject of Section 5, Federal Test Method Standard No. 501a, FLOOR COVERINGS, RESILIENT, NONTEXTILE: SAMPLING AND TESTING. Sampling and number of specimens are covered by Section 3, Federal Test Method Standard No. 191, TEXTILE TEST METHODS. However, this section merely refers to the detail specifications for sampling and to the test methods or detail specifications for number of specimens to be tested. Smooth surface resilient floor coverings are covered by Standard 501a, while carpets and rugs are covered by Standard 191.

Most of the Federal Specifications for floor coverings (including carpet) refer to MIL-STD-105, which has been superseded by MIL-STD-105D, 26 April 1063, MILITARY STANDARD - SAMPLING PROCEDURES AND TABLES FOR INSPECTION BY ATTRIBUTES. Government agencies may obtain copies from Commanding Officer, Naval Publications and Forms Center, 5801 Taber Avenue, Philadelphia, Pennsylvania 19120. Others may write to the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Federal Specification LLL-F-1238A (linoleum) refers to Section 5 of Federal Test Method Standard No. 501a.

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95, 4.2.2.1 (visual examination), 4.2.2.2 (overall examination), 4.2.2.3 (dimensional examination).

The sample unit for overall and for dimensional examination shall be one roll or rug. The number of rolls or rugs for visual examination shall be the sample size for overall and dimensional examination.

The sample size shall be based on inspection level II of MIL-STD-105D. The lot size shall be expressed in units of one square yard. When examination is made of full rolls, not more than one fifth of the total sample square yardage shall be examined on any one roll. When the lot

consists of less than 5 rolls, an approximately equal number of square yards shall be examined on each roll to yield the sample yardage. When examination is made on cut rugs, the number of rugs selected shall be sufficient to yield the sample yardage.

CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE, DDD-C-001173, 4.3

Inspection shall be in accordance with MIL-STD-105D. The sample unit shall be 1 linear yard when full length rolls are specified and one piece when special cut sizes are specified. The inspection level shall be level II of MIL-STD-105D. The lot size shall be expressed in units of 1 linear yard when full length rolls are specified and one piece when special cut sizes are specified. When examination is made of full length rolls, not more than one third of the total sample yardage shall be examined in any one roll. When the lot consists of less than 5 rolls, an approximately equal number of yards shall be examined on each roll to yield the sample yardage.

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED WITH ATTACHED CUSHIONING, DDD-C-001559, 4.3.2.1

The sample size shall be based on inspection level II of MIL-STD-105D. The lot size shall be expressed in units of 1 linear yard. When examination is made of full rolls, notmore than one third of the total sample yardage shall be examined in any one roll. When the lot consists of less than 5 rolls, an approximately equal number of yards shall be examined on each roll to yield the sample yardage. When examination is made on carpets cut to size, the number of units selected shall be sufficient to yield the sample yardage. Each defect listed shall be counted not more than once in each unit examined, for overall examination. The sample unit for overall examination shall be one roll or cut piece.

FLOORING, VINYL PLASTIC, L-F-00450A, 4.2, 4.4.2, 4.4.3

Sampling for inspection shall be performed in accordance with the provisions of MIL-STD-105D except where otherwise indicated. The sample unit for examination of the end item for defects of appearance and workmanship shall be ten yards of flooring, omitting the outside turn.

FLOOR COVERING VINYL SURFACE (TILE AND ROLL), WITH BACKING, L-F-475A, 4.2, 4.3

Inspection for acceptance shall be in accordance with MIL-STD-105D, inspection level S-1 for Type I floor covering (tile) and inspection level I for Type II (roll) floor covering. The lot size for visual examination shall be expressed in units of tiles for Type I and in units of lineal feet[1/] for Type II. The lot size and sample units for examination for dimensional defects shall be expressed in units of tiles for Type I and in units of linear yards[1/] of the width on order for Type II. The inspection level for this examination shall be level S-1 of MIL-STD-105D.

FLOOR COVERING TRANSLUCENT OR TRANSPARENT VINYL SURFACE WITH BACKING, L-F-001641, 4.3

Sampling and inspection shall be performed in accordance with the provisions set forth in MIL-STD-105D except where otherwise indicated. For visual examination of the end item, the lot size shall be units of completed end item. The inspection level for this examination shall be level I of MIL-STD-105D. The unit product shall be one completed end item. For dimensional examination the lot size shall be units of rolls and the inspection level sha-1 be S-2 of MIL-STD-105D. The unit of production shall be one roll. Inspection level for inspection of preparation for delivery requirements shall be S-2 of MIL-STD-105D.

FLOOR COVERING, LINOLEUM, LLL-F-1238A, 4.2, 4.3

The lot shall be formed and a random sample of floor covering selected in accordance with Section 5 of Federal Test Method Standard No. 501a.

FLOOR COVERING, ASPHALTIC FELT (BITUMINOUS TYPE SURFACE), SS-F-001032, 4.3, 4.4

Inspection shall be performed in accordance with MIL-STD-105D except where otherwise indicated. The sample unit for visual examination shall be one linear yard. The inspection level shall be level II, MIL-STD-105D. The lot size shall be expressed in units of one linear yard. Not more than one fourth of the total sample linear yardage shall be examined in any one roll. When the lot consists of less than 5 rolls, an approximately equal number of linear yards shall be examined in each roll to yield the sample yardage. The sample unit for overall and for length examination shall be one roll. The rolls used for visual examination shall be the sample size for both of these examinations. The sample unit for testing of the end item shall be the quantity of material required to perform all of the tests listed in Table III. The lot size for end item testing shall be expressed in terms of linear yards. The sample size shall be as listed in Table IV. The lot shall be unacceptable if one or more units fail to meet any specified requirement.

Tests listed in SS-F-001032, Table III - End item testing

Material identification and content (quantitative)

Thickness, overall

Thickness, wearing surface

Residual indentation

1/ No reson is given for this inconsistency in the use of feet as the unit for visual examination and yards as the unit for dimensional defects.

Flexibility

Resistance to:

Acetic acid

Hydrochloric acid

Sulfuric acid

Water

SS-F-001032, Table IV - Sample size

Lot size (units)	Sample size
800 or less	2
801 to 22,000	3
22,001 and over	5

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 4.2, 4.3, 4.5

For inspection and tests, unless otherwise specified in the invitation for bids, the lot shall be formed and samples taken as described in section 5 of Federal Test Method Standard No. 501a. Sampling for defects shall be in accordance with MIL-STD-105D.

4. CONDITIONING REQUIREMENTS IN FEDERAL SPECIFICATIONS FOR FLOOR COVERINGS

This subject is related to the tests in 2. Physical Requirements in Federal Specifications for Floor Coverings. Conditioning requirements specified in these tests appear in Table 5.

Conditioning requirements for carpets and rugs are standardized and the same is true of smooth surface resilient floor coverings except for variations in tolerances and the water bath conditioning requirement for Federal Specification L-F-00450A. However, there should be agreement between conditioning requirements for the two classes of floor coverings. Gavan and Joy (Note 1, Table 4) discuss conditioning requirements for floor coverings and other materials and efforts to standardize the "standard" atmosphere. They recommend 73.4 ± 1.8°F. (23 ± 2°C.) and 50 ± 2% relative humidity "for all polymeric materials except those known to be unaffected by ambient variations". Greater tolerances may be used for such unaffected materials.

Table 5. Summary of conditioning requirements in Federal Specifications for floor coverings 1/

Specification Number	Time Hours 2/	Atmospheric Conditioning Temperature	Atmospheric Conditioning Relative Humidity Percent	Optional Water Bath Conditioning Time mins.	Optional Water Bath Conditioning Temperature
DDD-C-95	4,24 4/	21.1±1.1°C	65±2		
DDD-C-001173		(70±2°F)			
DDD-C-001559 3/					
L-F-00450A 5,6/	1	23.0±1.1°C (73.4±2.0°F)	50±4	15-30	23.0±1.1°C (73.4±2.0°F)
L-F-475A	16	23.0±1.1°C (73.4±2°F)	50±4		
L-F-001641 6,7/	3	23±2°C (73.4±3.6°F)	50±5	15-30	25±0.5°C (77±0.9°F)
LLL-F-1238A 6/	3	23±2°C (73.4±3.6°F)	50±5	15-30	25±0.5°C (77±0.9°F)
SS-F-001032					
SS-T-312A 6/	3	23±2°C (73.4±3.6°F)	50±5	15-30	25±0.5°C (77±0.9°F)

1/ See F. M. Gavan and F. A. Joy, "Conditioning Equipment for Polymer Testing, Chapter 2, Vol. 1, page 41, Testing of Polymers, ed. by John V. Schmitz, Interscience, Wiley, N.Y. 1965.

2/ Not less than the time period specified.

3/ As in Federal Test Method Standard No. 191.

4/ Twenty-four hrs. for shrinkage and colorfastness tests for carpet; 4 hours for rubber cushioning.

5/ In the test for resistance to reagents, the immersed specimen is maintained at 23.0±1.1°C (73.4±2.0°F) and the scratch test performed at 21 - 24°C (70 - 75°F).

6/ As in Federal Test Method Standard No. 501a, Method 1041, unless otherwise indicated, standard conditions are shown in the table. Except in case of dispute, conditioning and testing shall be at room temperature, 23±5°C (73.4±9°F). In case of dispute specimens shall be conditioned and tested under standard conditions as shown in the table.

7/ For resistance to oils and chemicals, specimens shall be exposed to the solvents for 46±1/4 hours at 23.0±1.1°C (73.4±2.0°F). For residual indentation, specimens shall be conditioned and tested at 72°F, 50 percent relative humidity. Conditioning shall be for 24 hours.

5. MATERIALS REQUIREMENTS IN FEDERAL SPECIFICATIONS FOR FLOOR COVERINGS

As stated in the Introduction, Federal Specifications for floor coverings include physical and material requirements. Whereas the physical requirements were covered in part 2, the materials requirements are reviewed in this part. They include carpets and rugs, resilient floor coverings, and monolithic surfacings or seamless flooring. For each specification, the requirements for the materials in the product are listed together with comments about them.

CARPETS AND RUGS, WOOL, NYLON, ACRYLIC, MODACRYLIC, POLYESTER, POLYPROPYLENE, DDD-C-95, 1.2.1, 3.2, 3.7, 3.10, 4.2.1, Tables I-VII inclusive

Construction is classified into types and classes. The types include Axminster, Velvet, and Wilton woven carpet, indicating the type of loom; Tufted, Knitted, and Modified, indicating construction other than woven on a loom. The classes refer to the pile construction, as single or multilevel, loop or cut pile, twist, or whether woven through the back.

Comments: It is difficult for purchasing agents to determine the type of construction from examination of the end item, as this requires laboratory procedures.

Pile yarn shall be made of 100 percent wool, nylon, acrylic, modacrylic, polyester or polypropylene or blends of these fibers. Not less than 20 percent of any of the above fibers shall be used when blended with other fibers and such blends cannot consist of more than two fibers. Unless otherwise specified, spun yarn shall be at least 2-ply. Each carpet and rug sha-l be labeled, ticketed, or invoiced for fiber content in accordance with the Textile Fiber Products Identification Act.

Comments: This requires laboratory procedures for fiber identification and analysis.

Wool shall be thoroughly scoured carpet type fiber which has never been reclaimed from any woven, tufted, knitted, or felted products. The wool yarn shall contain a minimum of 97 percent wool based on the dry weight of the specimen.

Comments: It is difficult to establish the grade of wool even by laboratory analysis. Method 1100, Federal Test Method Standard 191, IDENTIFICATION OF WOOL, does not identify the type or species of wool which is suitable for carpet fiber. Federal Specification DDD-C-95 calls only for a supplier's certificate of compliance.

Staple nylon. Shall be carpet type fiber with average fiber size of 15 denier or coarser, which has never been reclaimed from any woven, tufted, knitted, or felted products. The finished yarn shall contain not more than 2.0 percent chloroform soluble material.

Filament nylon. Shall be continuous filament high bulk or texture carpet type yarn with other requirements the same as for staple nylon.

Acrylic, modacrylic, polyester, and polypropylene requirements are similar to those for nylon.

Comments on man-made fibers: Acrylic, modacrylic, polyester, and polypropylene are only generic terms and do not constitute a chemical description nor specify the average molecular weight. It would be better to specify such physical properties as breaking tenacity, crimp, abrasion resistance, water absorption, or weathering resistance of the fibers or yarns.

Attached rubber cushioning shall be made from natural or synthetic latex or a mixture of natural and synthetic latices.

Back coating shall be a synthetic resin or natural or synthetic latex compound.

Chain, Filling, Stuffer may be cotton, rayon, jute, kraft cord or mixtures.

Comments on cushioning, coating, chain, filling, stuffer: The material requirements are not specific enough.

CARPET, NONWOVEN, POLYPROPYLENE, OUTDOOR-INDOOR TYPE, DDD-C-001173, 3.3, 3.4, 3.5, 3.8, 4.3.1, Tables I, II

Polypropylene fiber shall be solution dyed, approximately 15.0 denier average. Additives to improve light resistance are allowable.

Reinforcement cloth shall be of polypropylene fibers or yarns, either woven or nonwoven, and shall weigh not less than 2.0 ozs. and not more than 3.0 ozs. per square yard. The cloth shall be constructed to enable the finished carpet to meet the requirements of this specification.

Binders. The binding material shall be odorless and of stable character, and shall be suitable for meeting the requirements of the finished carpet. Binders used shall not prevent carpet from meeting flame resistance requirements. The use of water soluble plasticizer materials is prohibited. The binders used shall produce a smooth and flat appearance on the back of the carpet.

Construction. The carpet shall consist of felted polypropylene fibers with cloth center reinforcement, manufactured by the needle loom, with binders. Back of the carpet shall be smooth and flat as produced by penetration of the bonding compound. The interlocking of fibers and construction of the carpet shall be of such quality as to prevent splitting under normal usage. Edges shall be evenly cut.

C mments: Remarks about man-made fibers under DDD-C-95 apply to the polypropylene fiber in DDD-C-001173. Other materials requirements relate to the end item, and to performance, for the most part, such as the statement that the reinforcement cloth and binders shall be such as to enable the carpet to meet the requirements of the specifications.

CARPET, LOOP, LOW PILE HEIGHT, HIGH DENSITY, WOVEN OR TUFTED WITH ATTACHED CUSHIONING, DDD-C-001559, 3.3, 3.5, 3.7

Pile yarn shall be 100 percent continuous filament high bulk or textured carpet type nylon, unless otherwise specified. Individual filament size shall average 15 denier or coarser. The finished yarn shall contain not more than 2.0 percent chloroform soluble material.

Chain, filling and stuffer yarns used in woven carpets shall be made of vegetable or synthetic fibers.

Backing material for tufted carpets shall be a woven jute fabric weighing not less than 7.6 ounces per square yard, or a woven or nonwoven fabric of 100 percent polypropylene weighing not less than 3.0 ounces per square yard. The nonwoven fabric may consist of less than 100 percent polypropylene fibers, but shall be not less than 75 percent polypropylene fibers with the balance ce-lulosic, nylon or polyester fibers. When vinyl cushioning is specified, a vinyl coated or impregnated fibrous glass cloth, not less than 17.5 by 15.5 mesh size, is acceptable.

Back coating. The back coating compound shall be a synthetic or natural latex compound.

Rubber cushioning shall be made from natural or synthetic latex or a mixture.

Vinyl cushioning shall be suitable compounded virgin polymer or copolymer of vinyl chloride resin, plasticized with phosphate or phthalate ester plasticizers only. The compound shall be uniform, free from fiber and objectionable odor. Virgin polymer shall be defined as a polymer or copolymer that has not been processed into a finished product prior to use in the cushioning.

Construction, as indicated in the title, may be woven or tufted. Classes are based on whether single or multilevel loop pile; the pile weight and height; number of tufts per square inch; pile yarn denier; ply twist; and tuft bind.

Comments: Same as for man-made fibers, cushioning, coating, etc. under DDD-C-95.

FLOORING, VINYL PLASTIC, L-F-00450A, 3.2

The flooring shall comprise a thoroughly blended composition of thermoplastic binder, fillers, and pigments. The thermoplastic binder shall be

a vinyl plastic as defined in ASTM D883. A carrier backing is not permitted. The coloring pigments shall be of good quality, insoluble, in water, and resistant to cleaning agents and light.

Comments: ASTM D883-69a, STANDARD NOMENCLATURE RELATING TO PLASTICS, defines vinyl plastics as those based on resins made from monomers containing the vinyl group, CH_2=CH-, as vinyl chloride, acetate, and alcohol plastics. Some vinyl plastics are generally classified by a more specific designation for the monomer, as acrylic plastics, based on acrylic acid, or styrene plastics, based on styrene. This is only a generic classification and does not define the plastic chemically. Fillers and pigments are not defined and plasticizers, stabilizers, etc. are not mentioned.

FLOOR COVERING VINYL SURFACE (TILE AND ROLL), WITH BACKING, L-F-475A, 3.1, 3.2, 3.3

Wearing surface[1/]. The wearing surface shall be a vinyl plastic layer consisting of a binder and, if included, fillers and pigments stabilized against heat and light deterioration. The binder shall consist of one or more vinyl resins and plasticizer and shall benot less than 34 percent by weight of the wearing surface. Each vinyl shall be a polyvinyl chloride or a copolymer of vinyl chloride not less than 85 percent of which is vinyl chloride. The vinyl resin shall be not less than 60 percent by weight of the binder. A clear protective coating not exceeding 0.005 in. thick may be applied to the floor covering. The protective coating shall not lessen the action of solvents on floor coverings when tested for resistance to solvents.

Comments: The percentage of vinyl chloride does not adequately describe the vinyl resin. Thus, for example, the properties also depend on the molecular weight and on monomers with which vinyl chloride may be co-polymerized. A complete material description of the vinyl resin should include physical properties relevant to manufacture and end use. The properties of floor coverings also depend on the amount and type of plasticizers and fillers, especially asbestos. Additional research may be necessary to establish the optimum thickness of the protective coating, which should be related to performance in service. We suggest that removal of any protective coating be included in the test method for resistance to solvents. This would eliminate restrictions on the thickness and solvent resistance of the coating.

Backing. The backing shall be fabricated of organic or inorganic fibers as specified by the purchasing agency. Organic fibers shall be felt treated with a resin or asphalt saturant. Inorganic fibers shall be saturated with a polymeric material resistant to alkali and moisture.

1/ "Wear layer" is a more accurate term, since a surface has only two dimensions.

Comments: The description of the two types of backing is only generic but the second type is required to be resistant to alkali and moisture, a performance requirement. No criteria or tests are mentioned for this requirement.

FLOOR COVERING TRANSLUCENT OR TRANSPARENT VINYL SURFACE WITH BACKING, L-F-001641, 3.1

Wear layer. The wear layer shall be a translucent or transparent vinyl plastic layer, which can include extender and pigment, stabilized against heat and light deterioration. The binder shall consist of one or more vinyl resins and plasticizers and shall be not less than 90 percent of the weight of the wear layer. Each resin shall be a poly-(vinylchloride) or a copolymer of vinyl chloride. The vinyl resin shall be not less than 60 percent by weight of the binder.

Comments: See Comments under L-F-475A, Wearing surface[1/].

Foam layer, when used, shall allow the finished floor covering to meet physical requirements.

Comments: The materials system is not defined but performance requirements are specified.

Backing. The backing shall be one of the following as applicable for the type specified and use intended:

Type I, Organic. Backing shall consist of organic fibers treated with asphalt or other moisture-resistant materials.

Type II, Filled Vinyl. Backing shall consist of a plasticized, stabilized, and filled vinyl resin.

Type III, Inorganic. Backing shall consist of inorganic fibers treated with a material resistant to alkali and moisture.

Comments: The description of the backings is generic. Performance requirements are included in Types I and III.

FLOOR COVERING, LINOLEUM, LLL-F-1238A, 3.1

Wearing surface. The wearing surface shall consist of oxidized linseed oil, fossil, or other resins or rosin or an equivalent completely oxidized oleoresinous binder thoroughly mixed with ground cork or wood flour, mineral filler, and pigments. Static linoleum shall have built-in electrically conductive properties. The requirement for Electrical conductance is under Physical Requirements.

1/ See footnote under the same.

Comments: Like the other materials requirements for floor coverings, this does not adequately define the product and is only a generic description. This requirement could be improved by including specifications for the linseed oil, resins, cork or wood floor, filler, pigments, and conditions under which the linoleum was oxidized after mixing and forming into sheet. The conductive material could also be specified.

Backing may be organic fiber felt backing treated with resin or asphalt saturant, or may be burlap.

Surface coating. Unless otherwise specified, the wearing surface of type I (regular) and type III (molded) linoleum shall be factory finished with a clean, transparent coating.

Comments: The description of backing and surface coating is generic.

FLOOR COVERING, ASPHALTIC FELT (BITUMINOUS TYPE SURFACE), SS-F-001032, 3.3, 3.5

Composition, Type I (regular). Type I floor covering shall consist of a bituminous wear layer of not less than 63 percent bituminous vehicle and not more than 37 percent permanent nonfading pigments, with surface securely bonded to an asphalt treated felt base coated on its back with a waterproof bituminous material. The felt backing shall be finished so that the exposed side of the backing shall not mar the wearing surface in unrolling the floor covering.

Composition, Type II (slip resistant). Same as Type I except for requirements of not less than 55 percent bituminous vehicle, not more than 45 percent pigments, and sufficient silicate embedded in the wear layer throughout the floor covering for slip resistance.

Comments: We suggest more specific material requirements for bituminous vehicle and silicate abrasive. Bituminous might refer to coal tar pitch or petroleum asphalt, both of which are available in various grades. A vehicle could contain various solvents and various percentages of solvents, thinners, and total solids. Silicates are also of various types. We suggest detailed material requirements and also a criterion and test for slip resistance of the floor covering.

Vinyl chips. When specified, vinyl chips in the color or colors specified shall be added to the type I floor covering for decoration and to camouflage tracking. Vinyl chips shall be permanently set up relatively flush with the top surface of the floor covering.

Comments: There is no specification for the vinyl chips or the coverage or the quantity to be applied per given area.

TILE, FLOOR: ASPHALT, RUBBER, VINYL, VINYL-ASBESTOS, SS-T-312A, 3.1, 4.4, Table III

Composition of wearing surface[1/] is guaranteed by a certificate of compliance from the supplier. There is no method of analysis or test.

Type I - asphalt tile. The tile shall consist of a thoroughly blended composition of the thermoplastic binder, asbestos fibers, mineral fillers, and pigments. The binder shall consist of asphaltic or resinous type materials.

Comments: This defines the generic type of product and allows a great deal of latitude in formulation. The description 'asphalt tile' is misleading if resins are used. Presumably the properties of the resins, together with plasticizers, simulate the properties of asphalt.

Type II - rubber tile. The tile shall be a compound of natural rubber or synthetic rubber, alone or in combination. The coloring matter shall be of good quality, insoluble in water, and resistant to alkali, cleaning agents, and light.

Comments: This also allows considerable latitude and there is no specification for the type of rubber or other compounding ingredients. Resistance to alkali for Types I, III, and IV tile is covered by the requirement for resistance to reagents under the physical requirements in the specification. However, Type II tile is not covered by the requirement for resistance to reagents.

Type III - vinyl tile. The tile shall be of vinyl plastic consisting of a blended composition of a binder, fillers, and pigments stabilized against heat and light deterioration. The binder shall consist of one or more vinyl resins and plasticizer and shall be not less than 34 percent by weight of the tile. Each vinyl shall be a polyvinyl chloride or a copolymer of vinyl chloride not less than 85 percent of which is vinyl chloride. The vinyl resin shall be not less than 60 percent by weight of the binder. A clear protective coating not exceeding 0.0005 inch thick may be applied to the floor covering. The protective coating shall not less the action of solvents on floor covering when tested for resistance to reagents.

Comments: Same as under L-F-475A, Wearing surface.

Type IV - vinyl asbestos tile. The tile shall consist of a thoroughly blended composition of thermoplastic binder, asbestos fibers, mineral fillers and pigments. The binder shall consist of a polyvinyl chloride resin or a copolymer resin compounded with suitable plasticizers and stabilizers.

1/ "Wear layer" is a more accurate term. See footnote under L-F-475A, Wearing surface.

Comments: This defines the generic type of product and allows a good deal of latitude in formulation, but it is not definitive.

COATING SYSTEM - DECORATIVE AND PROTECTIVE, SEAMLESS, TT-C-001685
Components of system, 3.1, Table 1

Base coat - Unit 1. The pigmented base coat shall consist of two components, a one to one blend of epoxy resin emulsion and polyamide resin as curing agent. The physical properties of these ingredients shall be as specified in Table I. Any suitable pigment or combination of pigments may be used which comply with the specification.

Intermediate coat - Unit 2. The translucent intermediate coat shall consist of two components, a one to one blend of epoxy resin emulsion and polyamide resin with properties as in Table I.

Decorative chips or flakes - Unit 3. The chips or flakes shall be opaque, colorfast, and shall comply with the physical properties in the specification.

Top coat (glazed) - Unit 4. The top coat shall be polyurethane, oil-free, moisture-curing, with some of characteristics as in Federal Specification TT-C-542B and Amendment-1 (Author's note: The later Interim Specification TT-C-00542C may be substituted for TT-C-542B and Amendment-1), except for the following:

	Minimum	Maximum
Nonvolatile percent by weight	40	--
NCO (available), percent by weight on nonvolatile vehicle	--	4
Free TDI (vapor hazard) percent on total coating	--	0.5
Viscosity (CPS)	80	200
Color (Gardner)	--	1
Flash point, deg. F. (Tag Close Tester)	80	--
Dry through, hours	--	2 1/2
Abrasion resistance, wear index (Taber, CS-17 wheel, 1000g, 1000 cycles)	--	50
Pencil hardness	F	--

TT-C-001685, Table I. Physical properties of the vehicle components

Physical properties	Values Minimum	Maximum
Epoxy resin emulsion:		
Color, Gardner Color Standard	--	4
Non-volatile content, percent by weight of resin	98	--
Epoxide equivalent[a]	185	200
Viscosity, poises, 25°C	100	160
Polyamide resin (curing agent):		
Amine value[b]	330	360
Color, Gardner Color Standard	--	9
Non-volatile content, percent by weight of resin	98	--
Viscosity, poises, 25°C	20	70

a. Grams of resin containing one gram equivalent of epoxide.
b. Milligrams of KOH equivalent to the amine alkalinity present in one gram of sample.

Application of system: See Requirements: Adhesion to substrate and Application properties.

Qualitative requirements for components, 3.2, Table IV

Base coat - Unit 1

Color: The color shall be white or a color agreed upon by purchaser and supplier and shall match a color chip as in Federal Standard No. 595.
Hiding power (contrast ratio): A dry film thickness of 0.0015 in. maximum (minimum apparent hiding power reflectivity 85 percent) shall have a contrast ratio of 0.95.

Base and Intermediate coats - Units 1 and 2

Storage stability of each component - partially full container: Each component shall show no skinning, curdling, livering, hard caking, or gummy sediment. It shall mix readily to a smooth, homogenous state; any skin formation shall be continuous and easily removed.

Storage stability - full container: Each component shall show no skinning, livering, hard and dry caking, or tough sediment and shall readily mix to a smooth, homogenous state.

Quantitative requirements for components, Tables II, III, and IV

TT-C-001685, Table II. Quantitative requirements of base coat

Characteristics	Requirements Minimum	Maximum
Total solids, percent by weight of coating	54	--
Pigment, percent by weight of coating	40	--
Non-volatile vehicle, percent by weight of coating	14	--
Consistency (Krebs units) at 25°C	100	115
Drying time:		
Set-to-touch, hour	1/4	--
Dry hard, hour	1	--
Reflectance, 45°, directional, white	85	--
Weight per gallon, pounds	12	--
Pot life, hours, at 25°C. and 50 percent relative humidity	2	--

TT-C-001685, Table III. Quantitative requirements of intermediate coat

Characteristics	Requirements Minimum	Maximum
Total solids, percent by weight of coating	39	54
Non-volatile, percent by weight of coating	37	47
Silica, percent by weight of coating	1	5
Consistency, Krebs units, 25°C	60	65
Drying time:		
Set-to-touch, hours	1	--
Dry hard, hours	--	16
Gloss, 60° Specular (cured 7 days at 25°C. and 50 percent relative humidity)	25	50
Pot life, hours (25°C. and 50 percent relative humidity)	8	--

TT-C-001685, Table IV. Index to Characteristics of Components

Characteristics	Requirement Reference, TT-C-001685	Applicable Test Methods: Federal Test Method Std. No. 141a, Method	Applicable Test Methods: TT-C-001685 par.
Base coat - Unit 1			
Color	3.2.1	4250[a]	4.3.4
Consistency	Table II	4281	
Drying time	Table II	4061	
Hiding power (contrast ratio)	3.2.4	4122[b]	4.3.7[b]
Nonvolatile vehicle	Table II	4053	
Pigment content	Table II	4021	
Pot life	Table II		4.3.12[c]
Reflectance	Table II	6121	
Total solids	Table II	4041	
Weight per gallon	Table II	4184	
Intermediate coat - Unit 2			
Color	Table III	4248	
Consistency	Table III	4281	
Drying time	Table III	4061	
Gloss, 60°, Specular	Table III	6101	
Nonvolatile vehicle	Table III	4053	
Pot life	Table III		4.3.12[c]
Silica	Table III	7251	
Total solids	Table III	4041	
Base and intermediate coats - Units 1 and 2			
Condition in container	3.2.2	3011	4.3.5[d]
Storage stability	3.2.3	3021, 3022	4.3.6[e]
Epoxy resin:			
Color	Table I	4248	
Epoxide equivalent	Table I		4.3.2[f]
Nonvolatile content	Table I	4041	
Viscosity	Table I	4287	
Polyamide resin:			
Amine value	Table I		4.3.3[g]
Color	Table I	4248	
Nonvolatile content	Table I	4041	
Viscosity	Table I	4287	

TT-C-001685, Table IV. Index to Characteristics of Components (cont.)

Characteristics	Requirement Reference, TT-C-001685	Applicable Test Methods: Federal Test Method Std. No. 141a, Method	Applicable Test Methods: TT-C-001685 par.
Chips or flakes - Unit 3			
Color	3.4.2		h
Curling	3.4.4		h
Dusting	3.4.5		h
Thickness	3.4.6		h
Water resistance	3.4.3		h
Whole system			
Adhesion	3.6.2		4.3.9[h]
Application properties	3.6.1		4.3.8[h]
Bleed through	3.6.3		4.3.10[h]
Impact resistance	3.6.4		4.3.11[h]

Notes to TT-C-001685, Table IV:

a. Draw down a film of the base coat on a white, opaque glass panel, using an applicator that will deposit a dry film thickness of approximately 1 1/2 mils.
b. Draw down a film, using a suitable applicator that will deposit a 3 inch wide film with a dry film thickness of 0.0015 inch maximum. Check the reflectance; verify the film thickness in the area in which reflectance is measured; and calculate the contrast ratio.
c. Pot life shall be tested in accordance with the manufacturer's directions.
d. Determine condition in the container for each component.
e. For partially full container, determine skinning after 48 hours as in Method 3021. For full container, allow a full standard quart can of each component (base coat and intermediate coat) to stand undisturbed for one year and then examine the content. See under Qualitative requirements for components, Base and Intermediate Coats, Units 1 and 2.
f. Standard Method of Test for EPOXY CONTENT OR EPOXY RESINS, ASTM D1652.
g. The amine value is mg KOH equivalent to the amine alkalinity present in one g sample by ASTM D1652.
h. See under Requirements: Color, Curl resistance, Dusting control, Thickness, Water resistance, Adhesion to substrate, Application properties, Bleed through control, Impact resistance.

Comments: The materials requirements, criteria, and tests appear to constitute a complete characterization of the coating system, based mostly on accepted methods for chemical analysis, physical tests, and observations on the components and on the whole system.

6. CONCLUSIONS AND RECOMMENDATIONS FOR IMPROVEMENTS IN PERFORMANCE REQUIREMENTS

The need for improvement and standardization of physical requirements for floor coverings was indicated by the comments and footnotes in Parts 1, 2, and 3. Further comments follow on specific physical requirements. Remarks are addressed to tests or test methods but they may also apply to requirements and criteria with respect to need and applicability. References by letter and number refer to Federal Specifications.

Abrasion resistance appears only in L-F-001641 and TTOC-001685. Tests for abrasion resistance are needed in all Federal Specifications. Probably one test could be applied to all smooth surface floor coverings, including resilient floor coverings and monolithic surfacings or seamless flooring. A wear test would be valuable for evaluating different carpet constructions and materials. A wear test which would be applicable to all flooring would be valuable in economic decision making but may not be practicable.

Adhesion to substrate, found in TT-C-001685, is also important in resilient floor coverings and carpet which are applied with adhesive.

Aging. Different test methods are used for rubber and vinyl cushioning in DDD-C-95 and DDD-C-001559.

Appearance, specified in L-F-001641, should be covered in other Federal Specifications for floor coverings. Appearance is covered in several other specifications under Color.

Application properties or installation properties, covered by TT-C-001685, are important in every type of floor covering, although these properties will not always be the same.

Color, covered by L-F-475A, SS-T-312A, and TT-C-001685, is related to Appearance and should be included in other specifications.

Colorfastness is a requirement which appears in Federal Specifications for carpet but not in specifications for resilient floor coverings, for which it is also important, since pigments in resilient floor coverings might fade on exposure to light, detergents, etc. This may also apply to monolithic surfacings. Test methods for colorfastness would necessarily depend on the type of floor covering.

Defects control criteria and test methods depend on the nature of the floor covering to a large extent. Items such as "Uneven felting or poor interlocking of fibers", "Tufts missing in pile", and "Binding" defects are relevant only to carpet. Properties such as curl resistance and squareness apply only to resilient tile, except as curl resistance applies to chips in seamless flooring. Hardness and impact resistance apply only to smooth surface floor coverings and not to carpet. Classification of defects within each major category of floor coverings (carpets, resilient floor coverings, and monolithic surfacings) should be standardized as much as is practicable, using tables of classification of defects as in L-F-475A, L-F-001641, LLL-F-1238A, and SS-F-001032. Federal Specifications L-F-00450A and SS-T-312A could be improved by the use of such tables.

Deflection of tile was classified in Part 1 as a performance requirement but the criteria may be more related to quality control, as the requirement for vinyl asbestos tile is more severe than that for asphalt tile. This is probably because vinyl asbestos tile can be bent more than asphalt tile without breaking rather than because of considerations regarding performance in service, although it may be related to ease of handling during installation.

Depth of depressed areas appears in SS-T-312A, a recent revision of SS-T-312, and should be a part of all resilient floor covering specifications, since roll and sheet material is often embossed. The requirement for depth of depressed areas appears in DDD-C-95 and DDD-C-001559 carpet specifications under the test for thickness of multilevel carpet. It is probably not applicable to DDD-C-001173.

Dimensional stability is generally considered a requirement for nontextile floor coverings, which are comparatively rigid and do not stretch appreciably. Dimensional stability of carpets and rugs is covered under Shrinkage resistance. For resilient floor coverings, details lacking in Methods 6211 and 1041 (conditioning) of Federal Test Method Standard No. 501a are supplied in the detail specifications. There are some variations in the details. The temperature and relative humidity are the same in all of the specifications but tolerances vary. Time and temperature of oven heating differ from the Test Method Standard and from other specifications in L-F-475A, which specifies heating the specimens at 158°F. (70°C.) instead of the usual 180°F. (82°C.) and for 20 hours instead of the usual 6 hours. In L-F-001641, specimens are heated for only one hour at 180°F.

Flexibility or Pliability is not included in DDD-C-95, since this requirement is unnecessary for pile floor coverings without cushioning. Flexibility is important for nonwoven carpet (DDD-C-001173) and for carpet with attached cushioning (DDD-C-001559) and is included in the specifications mentioned. However, we question the requirements that nonwoven carpet should be bent at 160° angle (DDD-C-001173) and that carpet with attached cushioning should be tested by "doubling and pressing flat on itself" (DDD-C-001559). The question is whether this kind of treatment is to be expected during normal shipping and handling. The low temperature

flexibility requirement in DDD-C-001559 is probably due to the tendency of rubber cushioning to crack when flexed at low temperatures.

The flexibility of resilient floor coverings is tested by bending over mandrels of various diameters and examining for failures. Conditioning and testing is usually at 23° ± 2°C. (73.4 ± 3.6°F.) and 50 ± 5 percent relative humidity as in Method 1041, Federal Test Method Standard No. 501a. However, no conditions of temperature and humidity are specified in SS-F-001032, while in L-F-475A, the tolerances are ±1.1°C, (±2° F.) and ±4 percent relative humidity.

Indentation resistance. As already mentioned in part 1, the Armstrong machine is used for smooth surface resilient floor coverings except for asphalt and vinyl asbestos tile in SS-T-312A, for which indentation is measured with the McBurney tester. Aside from this variation, there are several versions of Method 3221 (initial indentation) and Method 3231 (residual indentation), Federal Test Method Standard No. 501a. Federal Specification L-F-001641 specifies Method 3231 (flat foot indentor) for floor covering without foam but a modification with hemispherical pressure foot for floor covering with a foam layer. Criteria or prescribed values for indentation vary between specifications and some require both initial and residual indentation; some only initial; and some only residual indentation. Unlike other floor coverings, asphalt and vinyl asbestos tile in SS-T-312A are tested at 77°F. and after heating to 115°F. In most cases conditioning and testing are at 73.5°F. (23°C.) and 50 percent relative humidity as in Method 1041, Federal Test Method Standard No. 501a. No conditions of temperature and humidity are specified in SS-F-001032.

Resistance to chemicals, grease, oil, and solvents. The method for resilient floor coverings is to immerse separate specimens for a certain period of time in alcohol, mineral oil, tallow, vegetable oil, and 5 percent aqueous solutions of acids and bases. The specimens are then subjected to the scratch test as in Method 7711, Federal Test Method Standard No. 501a. The allowable width of scratch is 0.100 inch for specimens exposed to alcohol, fats, and oils, and 0.120 to 0.125 inch for those exposed to dilute acids and bases. The reason for this is probably that floor coverings are probably more resistant to alcohol, fats, and oils than to dilute acids and bases. In L-F-475A, isopropyl alcohol is substituted for ethyl alcohol, which probably makes little difference. It is not clear why it is necessary to use both 5 percent acetic acid and 5 percent sulfuric acid, since sulfuric acid is a much stronger acid than acetic acid. In most cases, the criterion of color stability to reagents is added to resistance to softening implied in the scratch test. However, in SS-F-001032 and with asphalt and vinyl asbestos tile in SS-T-312A, no observation for color change is required. For vinyl tile in SS-T-312A, specimens are observed for color change. There is no requirement for chemical resistance of rubber tile in SS-T-312A, although this might be expected to compare favorably with the other types of tile. In L-F-001641 and SS-F-001032 only a qualitative test is used for softening. In SS-F-001032, specimens are tested only for

resistance to dilute acids and bases and in SS-T-312A, asphalt tile is tested only for resistance to 5 percent sodium hydroxide. This suggests that some products have severe limitations in kitchens, bathrooms, etc.

Shrinkage resistance. As already discussed in the footnotes, part 2, shrinkage requirements vary between specifications and some of the test conditions are not well defined. It might be closer to practice to use commercial rug cleaning equipment[1/] or a cylindrical wash wheel[2/]. Also, it might be a good idea to test shrinkage on repeated washing.

Size and tolerance control. As discussed in the footnote in part 2, tolerances for width and length of carpets and rugs vary considerably and some appear to be too large. In most cases the width tolerance for roll goods in smooth surface resilient floor coverings is plus 1.00 inch minus 0 inch, which seems unreasonable, as discussed in the footnote. A plus 1/4 minus 1/8 inch width tolerances as in SS-F-001032 seems more reasonable. The tolerances for tile in L-F-475A and SS-T-312A are approximately the same but should be exactly the same.

Thickness or Pile height. As remarked in footnotes, part 2, methods for measurement of pile height of carpets and rugs should be updated and revised. There are no tolerances for pile height of carpet or thickness of cushioning. Other comments on measuring thickness of cushioning appear in the footnotes. Variations between test methods for thickness of smooth surface resilient floor coverings and other comments appear in the footnotes, part 2. Tolerances for thickness are specified in L-F-00450A and SS-T-312A but not in L-F-475A, L-F-001641, LLL-F-1238A, or SS-F-001032.

A study of this manual shows a need for improvement and standardization of the requirements, criteria, and test methods in Federal Specifications for floor coverings and a revision of Federal Test Method Standards Nos. 501a and 191. Also, study of present requirements, criteria, and tests should assist in the development of criteria and test methods which can be used to establish performance requirements for floor coverings.

The following requirements might be considered in addition to those already mentioned here in writing specifications and standards for floor coverings. Those mentioned previously in this manual appear in parts 1 and 2.

Air contamination control. This is a broad performance requirement which might be expressed as follows: "Floor covering shall not emit dust, particulate matter, fumes, odors, or any volatile substance which

---

1/ Martha E. Hensley and Ruth E. Ridgely, "Effect of soiling and cleaning cotting floor coverings of selected colors", Journal of Home Economics, vol. 55, No. 3, 173-183 (March, 1963).

2/ Method 5550, Federal Test Method Standard No. 191.

will endanger health, reduce the efficiency of persons using the space, or damage equipment or furniture". This includes requirements presently listed under Odorlessness and Volatility.

Bleeding of tile is a quality control requirement used in the floor covering industry to determine whether plasticizers are likely to migrate from resilient tile by absorption and mechanical action of footwear, etc. Loss of plasticizer causes the tile to become brittle and hard with loss of flexibility. The test can be made by applying cigarette paper to the tile under pressure and noting whether the paper becomes wetted with plasticizer. This is known as a "sweat test".

Cleanability is a performance requirement which covers washability, scrubability and ability to respond to all cleaning methods such as vacuuming, shampooing, and stain removal. It might be written as follows: "The floor covering shall be capable of being maintained in an attractive and sanitary condition without excessive maintenance cost".

Competitive life-cost. This performance requirement is the broadest way of expressing such characteristics as cleanability, durability, wear or abrasion resistance, ease of repair and maintenance and might be written as follows: "The life-cost of the floor covering shall be competitive with the life-cost of flooring presently used in the area under consideration. Life-cost is the sum of installed cost and costs of operation, maintenance, repair, and replacement".

Durability is a broader requirement than wear or abrasion resistance as it covers resistance to deterioration of all properties, including appearance, color, and thickness of wearing surface. This requirement might be written as follows: "Floor coverings shall maintain their serviceability and retain their original properties for at least ten years under the expected conditions of use".

Freedom of movement of wheeled vehicles expresses a problem usually associated with carpeting. In locations such as hospitals and supermarkets, use of carpet often causes greater difficulty than smooth floor coverings in moving the carts and other wheeled equipment normally used in such areas. The requirement might be worded: "Floor covering shall not impede the movement of wheeled equipment normally used in the area under consideration".

Levelness is a requirement which might be used for smooth surface flooring but would not apply to carpet. Some standard of levelness and planeness of the surface should be established for smooth flooring, including the underlayment or subfloor.

Noise reduction is a problem for experts in acoustical properties of materials and will not be dealt with here.

Resilience as related to foot comfort is a desirable but not necessary property and criteria and test methods are needed to determine the trade-off advantage of carpet and other soft floor coverings.

Resistance to boiling water might be considered to be a performance requirement for floor coverings to be used in kitchens or other areas which might be subjected to hot water. The requirements for resistance against disintegration in boiling water appears in the now discontinued Federal Specification LLL-T-431b for Cork Tile. Since this requirement and test may be of interest and the specification is no longer available, the criterion and test method follow.

Fed. Spec. LLL-T-431b, 3.5, 4.3.7. Disintegration and Resistance to boiling water

One specimen not less than 1 sq. in. in area from each test unit shall be floted on the surface of boiling water for 3 hours. At the end of the flotation period, the specimen shall be examined for evidence of disintegration.

Resistance to static charge expresses a problem with carpet and with special situations such as pedestal floors in computer rooms and floors in areas where flammable or explosive materials are used or manufactured. Such areas include hospital operating rooms in which flammable anesthetics are used. The requirement might be written as follows: "The floor covering shall be designed, built, and made of materials such as to minimize electrical shock and sparks due to static electricity, as developed from persons walking on the floor. Carpet shall have a static level of less than 3 kilovolts by AATCC Test Method 134-1969, Technical Manual, vol. 46, 1970, American Association of Textile Chemists and Colorists".

Warmth to touch is a requirement of which everyone is aware but it is difficult to define. It is probably significant only in areas such as bathrooms where persons walk or stand in their bare feet. It is proportional to the product of thermal conductivity and volumetric heat capacity of the flooring.

Water resistance is a requirement for flooring sometimes expressed as porosity; it was applied to seamless flooring chips in part 1. A more generalized requirement is desirable. Water resistance may refer to water absorption or water penetration. This might be resistance to liquid water penetration or water vapor transmission, as in ASTM E-96. Water resistance is a performance requirement, as it relates to water spillage on an installed floor. See Resistance to boiling water in this section. Requirements for water absorption and water resistance appear in Federal Specification LLL-L-351b for LINOLEUM; BATTLESHIP but requirements have been deleted. The water resistance requirement was actually for water spotting of the finish. Since these requirements and tests may be of interest and the specification is no longer available, the criteria and test methods follow.

Fed. Spec. LLL-L-351b, 3.9, 4.4.9. Water absorption

Maximum water absorption in percent for 1/8 inch linoleum shall be 4 1/2 percent and for 3/16 inch linoleum, 3 1/2 percent. Two specimens, each 6 inches by 3 inches, shall be cut from the sample, the backing removed, and the rough surface buffed and finished with No. 00 sandpaper or other suitable means until the average thickness of 1/8 inch linoleum is approximately 0.09 inch and the thickness of 3/16 inch linoleum is 0.15 inch. Each specimen shall be weighed and immersed in fresh tap water at 70-75° F. for 24 hours. The specimens shall then be removed and the surfaces and edges dried between blotting or filter paper and weighed before 2 minutes have elapsed. The increase in weight in percent shall be calculated and the average of the results on two specimens reported.

Fed. Spec. LLL-L-351b, 4.4.2. Finish (Water resistance)

A small portion of the surface shall be thoroughly cleaned by wiping vigorously with a clean, dry cloth. Using a medicine dropper or glass rod, one drop of water shall be placed on the cleaned area. After 5 minutes, tap or shake off the water and again wipe the surface with a clean, dry cloth. Unfinished linoleum shall be wetted, marked, and smeared, while properly finished linoleum shall remain unwetted and unmarked by this treatment.

INDEX

FORM NBS-114A (1-71)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. NBS TN-822	2. Gov't Accession No.	3. Recipient's Accession No.

4. TITLE AND SUBTITLE

A Review of Federal and Military Specifications for Floor Coverings

5. Publication Date April 1974

6. Performing Organization Code

7. AUTHOR(S) Winthrop C. Wolfe

8. Performing Organ. Report No.

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Complete Address *(Street, City, State, ZIP)*

Same as No. 9.

13. Type of Report & Period Covered Final

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

In this manual, which is organized so as to aid ready reference, requirements and test methods in Federal and Military Specifications for flooring, or floor coverings are combined, indexed and reviewed. The manual covers carpet, resilient flooring, monolithic surfacings or seamless flooring, and polyurethane coatings related to seamless flooring. It also covers all serviceability requirements except those relating to flammability, fire safety and acoustical properties.

Physical and material requirements in Federal Specifications for floor coverings are considered in separate sections. Military Specifications for monolithic surfacings and Federal Specifications for floor coverings and polyurethane coatings are summarized in comprehensive tables. Under each physical requirement, comments indicate whether it is a quality control or a performance requirement. Each comment is followed by a list of those Federal Specifications which include the requirement and a brief description of the criteria and test methods in the specifications. Comments on materials requirements relate to their adequacy and applicability to the product for which they were written. Finally, recommendations are made for improvements in performance requirements which should be considered for inclusion in future flooring and floor covering specifications.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Carpets; floor coverings; government; performance; procurement; specifications; standards; tests; user needs.

18. AVAILABILITY

[X] Unlimited

[ ] For Official Distribution. Do Not Release to NTIS

[ ] Order From Sup. of Doc., U.S. Government Printing Office Washington, D.C. 20402, SD Cat. No. C13.46:822

[ ] Order From National Technical Information Service (NTIS) Springfield, Virginia 22151

19. SECURITY CLASS (THIS REPORT) UNCLASSIFIED

21. NO. OF PAGES 99

20. SECURITY CLASS (THIS PAGE) UNCLASSIFIED

22. Price $1.50

USCOMM-DC 29042-P74

NBS TECHNICAL PUBLICATIONS

PERIODICALS

JOURNAL OF RESEARCH reports National Bureau of Standards research and development in physics, mathematics, and chemistry. Comprehensive scientific papers give complete details of the work, including laboratory data, experimental procedures, and theoretical and mathematical analyses. Illustrated with photographs, drawings, and charts. Includes listings of other NBS papers as issued.

Published in two sections, available separately:

• Physics and Chemistry (Section A)

Papers of interest primarily to scientists working in these fields. This section covers a broad range of physical and chemical research, with major emphasis on standards of physical measurement, fundamental constants, and properties of matter. Issued six times a year. Annual subscription: Domestic, $17.00; Foreign, $21.25.

• Mathematical Sciences (Section B)

Studies and compilations designed mainly for the mathematician and theoretical physicist. Topics in mathematical statistics, theory of experiment design, numerical analysis, theoretical physics and chemistry, logical design and programming of computers and computer systems. Short numerical tables. Issued quarterly. Annual subscription: Domestic, $9.00; Foreign, $11.25.

DIMENSIONS, NBS

The best single source of information concerning the Bureau's measurement, research, developmental, cooperative, and publication activities, this monthly publication is designed for the layman and also for the industry-oriented individual whose daily work involves intimate contact with science and technology *—for engineers, chemists, physicists, research managers, product-development managers, and company executives.* Annual subscription: Domestic, $6.50; Foreign, $8.25.

NONPERIODICALS

Applied Mathematics Series. Mathematical tables, manuals, and studies.

Building Science Series. Research results, test methods, and performance criteria of building materials, components, systems, and structures.

Handbooks. Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

Special Publications. Proceedings of NBS conferences, bibliographies, annual reports, wall charts, pamphlets, etc.

Monographs. Major contributions to the technical literature on various subjects related to the Bureau's scientific and technical activities.

National Standard Reference Data Series. NSRDS provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated.

Product Standards. Provide requirements for sizes, types, quality, and methods for testing various industrial products. These standards are developed cooperatively with interested Government and industry groups and provide the basis for common understanding of product characteristics for both buyers and sellers. Their use is voluntary.

Technical Notes. This series consists of communications and reports (covering both other-agency and NBS-sponsored work) of limited or transitory interest.

Federal Information Processing Standards Publications. This series is the official publication within the Federal Government for information on standards adopted and promulgated under the Public Law 89–306, and Bureau of the Budget Circular A–86 entitled, Standardization of Data Elements and Codes in Data Systems.

Consumer Information Series. Practical information, based on NBS research and experience, covering areas of interest to the consumer. Easily understandable language and illustrations provide useful background knowledge for shopping in today's technological marketplace.

BIBLIOGRAPHIC SUBSCRIPTION SERVICES

The following current-awareness and literature-survey bibliographies are issued periodically by the Bureau:

Cryogenic Data Center Current Awareness Service (Publications and Reports of Interest in Cryogenics). A literature survey issued weekly. Annual subscription: Domestic, $20.00; foreign, $25.00.

Liquefied Natural Gas. A literature survey issued quarterly. Annual subscription: $20.00.

Superconducting Devices and Materials. A literature survey issued quarterly. Annual subscription: $20.00. Send subscription orders and remittances for the preceding bibliographic services to the U.S. Department of Commerce, National Technical Information Service, Springfield, Va. 22151.

Electromagnetic Metrology Current Awareness Service (Abstracts of Selected Articles on Measurement Techniques and Standards of Electromagnetic Quantities from D-C to Millimeter-Wave Frequencies). Issued monthly. Annual subscription: $100.00 (Special rates for multi-subscriptions). Send subscription order and remittance to the Electromagnetic Metrology Information Center, Electromagnetics Division, National Bureau of Standards, Boulder, Colo. 80302.

Order NBS publications (except Bibliographic Subscription Services) from: Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

U.S. OEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, O.C. 20234

OFFICIAL BUSINESS

Penalty for Private Use, $300

POSTAGE AND FEES PAIO
U.S. OEPARTMENT OF COMMERCE
COM-215