Explanation of Physical Test Procedures

The following explanation of test results is provided in order to understand the meaning and relevance of physical test procedures performed.

Weight

This test is important for the specifier in knowing the dead load weight for the structure. The results indicate the average dry weight of the finished floor, expressed as pounds per square foot per 1/4" thickness, unless otherwise indicated. Any reasonably accurate method for weighing a known area and thickness of this floor is suitable for this determination.

Compressive Strength

This test merely indicates the breaking strength of a given system under compression expressed in pounds per square inch (psi). In an actual flooring system, the compressive strength will always be higher than the value shown from the test because the floor is relatively thin compared to the test specimen. For comparison purposes, normal concrete floors have compressive strengths of 2,000-3,000 psi.

a. Materials having aggregates of 1/8" to 5/8" are cast into 2" cubes and are tested in accordance with ASTM Method C-306.

b. Materials having aggregates 1/8" or less are cast into 1" x 1" right circular cylinders and tested in accordance with ASTM Method C-579.

Tensile Strength

This test indicates the breaking strength expressed in pounds per square inch (psi) when the material is pulled apart. It is not generally considered as important as compressive strength since floor systems are not usually subjected to much tensile pull. This is indicated by the fact that ordinary concrete has a very poor tensile strength (250-400 psi) but is the most common industrial flooring material.

a. Materials installed 1/4" or thicker are made into briquette specimens and tested in accordance with ASTM Method C-307.

b. Materials installed less than 1/4" thick are cast into flat bars 1" x 1/8" x 8" long and tested in accordance with ASTM Method D-638.

Flexural Strength

This test measures the maximum strength it takes to break the material in bending. It is the load applied to the center of a suspended bar of the material and is expressed in pounds per square inch (psi). Flexural strength can be very important, depending upon the rigidity of the substrate. A material being installed over a concrete substrate does not require the flexibility that is required when going over wood, steel or aluminum decks.

a. Materials installed 1/4", or over, are cast into 1" x 10" bars in thickness from 1/4" to 1" and tested in accordance with ASTM Method C-580.

b. Materials installed under 1/4" thick are cast into flat bars (dimensions are given in Table I of ASTM D-790) and vary in size depending on thickness. The test is conducted in accordance with ASTM Method D-790.

Modulus of Elasticity (Tangent)

The modulus of elasticity is a calculated value. It is the ratio of the breaking strength (flexural strength) in pounds per square inch to the deformation (inches per inch) at break, and the value is expressed in pounds per square inch (psi). It is a number used by engineers and architects which indicates the relative rigidity and strength of materials. For example, steel has a modulus of 30 million (3.0×10^7) psi; concrete has one of 3 million (3.0×10^6) psi; while most of our resilient flooring materials have much lower values in the range of $l \times 10^5$ to $l \times 10^6$. Very flexible materials and/or low strength materials can be far below that range and probably would not make good flooring materials.

The value is calculated in accordance with ASTM Method C-580.

Coefficient of Thermal Expansion

This test measures the way a material changes in length with changes in temperature. All materials used in the flooring industry expand as the temperature rises. The important feature to remember is that the coefficient of expansion for the flooring material should be comparable to the substrate. This will help prevent separation of the floor from the substrate. PolySpec materials are designed to be comparable to the coefficient of expansion of the substrate.

Values are expressed as inches change per inch of length per degree Fahrenheit (in./in., °F). (Note: As this value is generally very small, it is expressed as a number times a negative power of ten**C**i.e., .00000625 in./in., °F becomes 6.25×10^{-6} in./in., °F.) Results of this test are in such small figures that it's hard to evaluate the practicality of the measurement with actual use conditions.

The test is conducted in accordance with ASTM Method C-53 1.

Water Absorption

This test indicates the tendency of a material to absorb or hold water. There is a difference between "absorb" and "adsorb", which is involved in this test. Actually, as far as this test is concerned and as far as practical meaning is concerned, there is no difference. We measure both what is absorbed (taken into the individual constituents) and/or what is absorbed (held on the surface of the individual constituents) by the composite system. A low value (less than 1.0%) indicates a system where water would run off and material would dry quickly. A high value (over 5.0%) indicates a system where considerable water would be absorbed and would dry slowly. The values are expressed as percent weight gained (a loss would indicate a soluble material and unsuitable as a flooring material) from before immersion to after immersion, with the time and temperature of immersion carefully noted. A reasonable limit of how porous a floor should be is about 5% maximum absorption.

The material is cast into 2" x 2" x 1/4" specimens and run in accordance with MIL-D-3134 Par. 4.7.8.

Oil Absorption

This test is similar to water absorption and indicates how much oil could be taken up by a flooring system. Oil also can cause swelling (much worse than water) which, if great enough (over 5%), could cause deterioration of the floor. This test is important for functional floors, but has little meaning for decorative terrazzo floors because the oil will stain them and ruin the appearance of the floor.

This test is similar to the Water Absorption test as described above except that the material is immersed in a medium No. 3 (high swelling) petroleum base oil (listed in Method 6001 of Standard FED-STD-601) for 24 hours. Two values are determined: % gain in weight and % gain in volume.

The test is conducted in accordance with MIL-D-3134 Par. 4.7.12.

Indentation

This test is a severe one, as it measures the indent ability of a floor system under a dead load of 2,000 psi for 30 minutes. A 135-lb. woman wearing a true "spike" heel impresses a load of 3,000 psi only for moments, as she would never stand still in one spot for a half hour. The average desk impresses a load of 150 psi, while a 4-foot-high filing cabinet only exerts 10 psi because the weight is distributed over a larger area. The more easily indentable systems should be installed as thin as practical, as they will not indent nearly as much if they are kept close in thickness to the maximum aggregate size used in the product. Indentation is used also to show if a material is resilient.

This test measures the amount of indentation at room temp. (approx. 72° F) that is caused by a steel indenter (cylindrical with a one square inch cross-sectional area) after a load of 2000 lbs. is impressed for 30 minutes.

It is expressed either as inches or as a percent of the original sample thickness. The test is run in accordance with MIL-D-3134 Par. 4.7.4.

Resistance to Temperature-Indentation

This test is similar to the indentation test but shows how higher temperatures affect the indentability of the floor system. We use temperatures of 100°, 120°, and 140°F, since they are practical and possible floor temperatures. Floor temperatures higher than 140° F are not practical since people could not stand to be on floors with higher temperatures.

This is the reason that a "gimmick" test, using boiling water and a metal probe, does not mean anything to the owner or architect, as it is not a practical condition that will be encountered in actual use of the floor.

This test is run exactly as Indentation (Test 9) except at elevated temperatures, 100°F, 120°F, and 140°F. Values are expressed either as inches or %.

The test is run in accordance with ML-D-3134 Par. 4.7.4, but with the temperature varied from 100°F, 120°F, and 140°F.

Non-Slip Properties

This test measures the relative amount of pull it takes for a leather heel and a rubber heel to start slipping (static friction) or to continue slipping (sliding friction) under dry, wet (water) and oily conditions, and are expressed in pounds. The values are only relative, but for test evaluation, the test readings are classified as:

0.60 or more	Relatively non-slippery
0.5 to 0.6	Generally acceptable
0.5 or less	Relatively slippery

This test has limited meaning because of the variations in the surface texture of the floor due to the technique differences of various mechanics.

The test is run in accordance with MIL-D-3134 Par. 4.7.6 with the "Horizontal Pull Slipmeter", manufactured by Olson Medical Products, Inc., Ashland, Massachusetts

Resistance to Impact

This test measures the ability of a floor to resist cracking, chipping or breaking bond under an impact load. It is generally run with our materials over steel, for if the test were made over concrete (3,000 psi) it would take at least four inches and, in some cases, six inches of reinforced concrete to ensure not breaking the substrate. In other words, PolySpec flooring materials have much better impact resistance than good reinforced concrete.

This test is a very good indication of overall quality of the material and its adhesion to the subfloor. It corresponds well to a severe abuse condition of the floor in actual conditions. This test measures the ability of a floor to withstand the impact of a 2-lb. ball dropped twice on the same test specimen from a distance of 8 ft. The depth of impression is noted (expressed in inches) and the condition of the sample noted as to chipping, cracking or detachment from substrate.

The test is run in accordance with ML-D-3134 Par. 4.7.3.

Abrasion Resistance

Abrasion resistance or wear resistance is one of the most controversial areas of testing we encounter. No one

minimizes its importance; people just don't agree on the significance or interpretation of laboratory tests when applied to practical situations. We have chosen two methods out of literally hundreds because one is for Federal Government tests and the other is most commonly used. The values are only relative and have no

absolute meaning. When and if an agreement is reached by a number of authorities on a given test, we will use that test.

The Taber Abrader is used for most materials and measures the abrasion resistance of floor surfaces to a standard Taber Abrader with a 1000 gm. load (each wheel), 1000 cycles using fresh CS-17 wheels, unless otherwise stated. The test is run in accordance with standard procedures as outlined in the Taber Abrader Instruction Manual. Values are expressed as Taber Index (i.e., Tabor Index **C** 47 represents 47 mg. loss or .047 gms. loss under conditions of test).

There is so much "gimmickry" involved in Taber Abrader tests that the conditions must be exactly spelled out. The two most commonly used wheels for this test are the CS-10 and CS-17. The CS-17 is about twice as abrasive as the CS-10 type wheel and is considered to provide abrasion associated with traffic or underfoot wear. It is important that the wheels be fresh for the test as they become less abrasive with age and/or use. The load must be 1,000 gms. on each wheel and the test must be run for 1,000 cycles. It is useless to compare results unless you use exactly the same conditions. The most abused part of this test is using a 500 gm. load on each wheel and calling it a 1,000 gm. load. This is incorrect, if not downright chicanery, and the use of old and/or worn wheels gives much lower index values. Also, 500 cycles will generally give somewhat less than half the value of 1,000 cycles and they can't be compared. All these variables make it very difficult to compare results.

This test measures the abrasion resistance of a floor surface to a set of arbitrary conditions.

The second method measures the actual wear of a floor surface to aluminum oxide (No. 80) under an arbitrary set of conditions on a wear test machine, details of which are given in Figure 1 and Figure 2 of the Government Specification MIL-D-3134 Par. 4.7.10. Values are expressed in inches of wear (e.g., 0.150"). The MIL-D specification has an allowable value of 0.150", which is somewhat high, and any flooring material that didn't pass it would be a poor one. The test is used for materials complying with Department of Defense Military Specifications.

Fire Resistance

In recent years, this classification has become the most controversial because of the confusing number of test methods now being employed. While most tests are designed to give the relative rating of the flammability of various flooring materials, a floor that can pass one test can very well fail another. While all testing is done on a scientific basis, they do not predict what will happen in a real fire. Toxic components of combustion products that could bring about death are not normally measured in any of the tests. Published literature also states that certain tests run at different locations failed to correlate between the locations.

Perhaps the best way to show that PolySpec is more than keenly interested in the hazards of fires, is to select as the prime test the tunnel test as specified in MIL-D-3134. This is because it is used as a basis for determining whether materials are safe, from a fire standpoint, for use on Naval Ships. Accordingly, the Government insists that materials which are to be used aboard Naval vessels be rated at least Fire Retardant under their difficult test requirements.

The second test that we report in some instances is the ASTM-E-162 Surface Flammability Test. This test is sometimes referred to as the "Radiant Panel" test, and it goes beyond the surface burning characteristics in that smoke solids are weighed and the optical density of the smoke is measured.

a. MIL-D-3134 Par. 4.7.11 provides for a regulated gaseous fuel supply mixed with air and the resultant mixture is ignited and the flame is allowed to travel over a test specimen using a controlled air draft through a flue.

Fire Resistance Ratings:

1) "Incombustible" - won't burn.

2) "Fire Retardant" - will only burn in an intense fire and when the flame goes out, it will contribute nothing to propagate the fire.

3) "Slow Burning" - the fire will continue after the external flame is removed.

b. Surface Flammability Test ASTM E-162 provides for a regulated gaseous fuel supply mixed with air, and the resultant mixture is ignited and the flame is allowed to come within a measured distance of the test specimen and, again, a controlled air draft through a flue is provided.

Fire Classification:

The National Bureau of Standards, some years ago, established five Flammability Classification Standards (NBS I to V, inclusive). Classification is the most fire retardant, whereas Classification V would be the least fire retardant.

Adhesive Strength

One of the most important functions of most flooring systems is to be sure it adheres well to the substrate. This is measured by a bond test to steel. The test indicates in a practical manner the tenacity with which a floor system will adhere to the substrate. The values are expressed in pounds per square inch (psi).

This method involves bonding the floor sample to a steel plate and shearing the two materials apart in a special jig. It is run in accordance with MIL-D-3134, Par. 4.7.14.

Accelerated Light & Immersion Resistance

This test is a synthetic acceleration test designed to simulate actual conditions of exposure to salt water and sunlight. While its correlation with actual weather conditions may be doubtful, a failure under the conditions of the test would indicate a very unsatisfactory material for outdoor exposure. The test is run for 72 hours with 36 cycles consisting of four (4) minutes immersion in 10% sodium chloride and 1 hour and 56 minutes exposure to a carbon arc. Changes in color, cracking, checking, crazing and any other signs of deterioration are carefully noted.

The test is conducted in accordance with MIL-D-3134, Par. 4.7.15.

Accelerated Light & Weather Aging Resistance

This test is similar to Test 16 except that a water spray is used instead of salt-water immersion. A premature failure in this test would indicate probable failure of the system in outdoor exposure from a few months to a couple of years. The test is run for 200 hours. Changes are noted in color, cracking, checking, crazing and any other signs of deterioration.

The test is run in accordance with MIL-D-3134, Par. 4.7.16.

Electrical Resistivity (Conductivity Test)

The test set up by the National Fire Protection Association, and described in Bulletin 99, requires a special apparatus known as a Megger and must be run exactly as specified.

The purpose of the test is to measure the amount of "resistance" the floor has to the electric charge being sent through it by an electrostatic generator. If the floor has little resistance, most of the charge will go through the flooring and back to the voltmeter and will show a reading that is low (from 0 to 50,000 ohms). This floor will quickly conduct the static electricity that comes in contact with it since its resistance is low. (Steel has little resistance and, therefore, is a good conductor and would read 0 ohms; however, it will spark.)

A floor that has a high resistance does not allow much of the electrical charge to get through the floor. The meter will show readings on the high side of the scale namely, 1,000,000 ohms or over. This floor does not want to accept static electricity and actually resists it, and is a nonconductive floor or one that is highly resistant. Rubber resists electricity and is nonconductive.
Floors in areas of high explosion potential, such as munitions plants or storage areas, plants with high dust and solvent content, must have a conductive and non-spark flooring with conductivity parameters of 0 to 250,000 ohms.

Floors for areas where electronic components could be subject to damage or destruction by static electricity should have conductive properties in the range of 100,000 to 1,000,000 ohms.

Floors in hospital operating and delivery rooms must have conductive readings that average 25,000 to 1,000,000 ohms when measured in accordance with procedures set forth in NFPA Bulletin 56.

Thermal Conductivity (K Value)

The most exact method developed to date and accepted as a standard method of determining the insulating qualities of construction products is a test procedure developed by the American Society for Testing and Materials. In essence, the product to be tested is sandwiched between two hot plates (sources of heat), one of which is the "hot side" and the other the "cool side". By means of thermocouples, any transmission of heat (heat loss) can then be determined. This heat loss is then expressed in BTU's.

"K" value is the expression of thermal conductivity. This is the amount of heat, expressed in BTU's, that is transmitted in one hour, through one square foot of a homogenous singular material, one inch thick for each one degree Fahrenheit of temperature difference between the two surfaces of the material ("hot side" and "cold side").

"K" value = BTU/hour/sq. ft./°F.

The test procedure is ASTM Test C-177 "Thermal Conductivity of Materials by means of the Guarded Hot Plate.@

Elongation

This test is only applicable to "rubbery" materials such as our DEK Waterproof Membrane. It is a measure of "elasticity" or the amount of "stretch" that a material will take to a point of "break" and is expressed in percent distortion of parallel reference lines.

The test is determined according to ASTM Test D-75 1.

Moisture Vapor Permeability

This test is used to determine the rate at which moisture will pass through a film or membrane. The test specimen is mounted as a "gasket material in a permeability cut" with 100% relative humidity inside the cup and a desiccated (completely dry) atmosphere outside the cup, thus creating a moisture differential across the test specimen.

The permeability of the test specimen is defined as the milligrams of water that permeate 1 square centimeter of film of 1-mm thickness each 24 hours after a constant rate has been obtained under the test conditions.

The test is run in accordance with ASTM Test D-1653.

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