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FEDERAL TEST METHOD STANDARD

FLOOR COVERINGS, RESILIENT, NONTEXTILE: SAMPLING AND TESTING

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INFORMATION SHEET

ON

FEDERAL TEST METHOD STANDARDS

This Federal Test Method Standard is issued in looseleaf form to permit the insertion or removal of new or revised sections and test methods.

All users of Federal Test Method Standards should keep them up to date by inserting revised or new sections and test methods as issued and removing superseded and canceled pages.

New and revised material and cancellations will be issued under Change Notices which will be numbered consecutively and will bear the date of issuance. Change Notices should be retained and filed in front of the Alphabetical Index of the Standard until such time as they are superseded by a reissue of the entire Standard.

FEDERAL TEST METHOD STANDARD

FLOOR COVERINGS, RESILIENT, NONTEXTILE SAMPLING AND TESTING

Authority. *This standard is issued pursuant to the Federal Property and Administrative Services Act of 1949, as amended, and its application to the purchase of commodities referred to herein is mandatory on all Federal agencies.*

SECTION 1

SCOPE AND CONTENTS

1. SCOPE

1.1 This standard describes the physical and chemical methods for testing resilient nontextile floor coverings for conformance with tile requirements of Federal specifications. It was prepared in order to eliminate unnecessary or undesirable variations in general sampling and testing procedures. This standard does not include special test methods described in the appropriate detail specifications that are applicable only to certain floor coverings, nor does it include all the test methods for floor coverings used in industry. In case of conflict between the provisions of these methods and the individual test procedures in specifications for particular materials, the latter shall take precedence.

1.2 New methods and revisions. The methods in this standard are prepared in loose-leaf form for convenience in adding new and revised methods.

1.2.1 Each method is assigned a whole number and when it is necessary to correct or change an existing method, it is rewritten, a decimal number added to the whole number to indicate the revision, and the date charged to the current effective date. For example, if it should be necessary to rewrite method 2141 on thickness, dated June 15, 1966, the date would be changed accordingly and the numerical designation would become 2141.1, tile decimal number indicating the first revision.

1.2.2 When referencing a test method in a detail specification or in another test method, the whole number only, without any decimal number that, may appear in its current numerical designation, should be specified, with the intent, that tile latest revision in effect on date of invitation to bid will be used to conduct the test. For example, if the method for determining residual indentation were currently designated as 3231.2, it should be specified as method 3231, but method 3231.2 would be used to conduct the test.

1.2.3 New and revised methods may be obtained from the source listed for Federal Standardization Documents in note 2, section 6.

2. CONTENTS

2.1 The contents of this standard are as follows :

Sections:

Groups:

SECTION 2

ALPHABETICAL INDEX OF TEST METHODS

ALPHABETICAL INDEX OF TEST METHODS—Continued

SECTION 3

NUMERICAL INDEX OF TEST METHODS

NUMERICAL INDEX OF TEST METHODS—Continued

SECTION 4

SUBJECT INDEX

SUBJECT INDEX—Continued

SECTION 5

SAMPLING AND ACCEPTANCE PROCEDURES

1. SCOPE

This section describes the sampling procedures for inspection and testing of resilient nontextile floor coverings and tile procedures for acceptance of lots of floor coverings.

2. DEFINITIONS OF TERMS

2.1 Inspection and test.

2.1.1 *Inspection.* Inspection, as used in this Standard, refers to examination of the material for visual characteristics and for the determination of any dimensional characteristic that does not necessitate destruction of the material.

2.1.2 *Test.* Test, as used in this standard, refers to the measurement of the physical and chemical properties of the material and to the (determination of dimensional characteristics necessitating destruction of the material.

2.2 Delivery. The quantity of floor covering purchased under a single contract that is to be delivered at one specified time.

2.3 Lot. A delivery or a portion of a delivery composed of material of any one type, grade, class, color, size, and composition (see 3.2). A lot is either accepted or rejected as a whole on the basis of inspection and/or test carried out on a portion of the lot.

2.4 Unit. A quantity of floor covering in the form in which it is purchased, such as an individual tile or a roll.

2.5 Test unit. The total quantity of material necessary to obtain test results for all the physical and chemical properties for which requirements are specified and for all dimensional measurements which require destruction of a unit. In the case of tiles, the material originating from any particular tile shall not be used in more than a single test unit. In the case of rolls, all the material for a particular test unit shall originate from it single roll. A test unit may consist of a unit, a portion of a unit, or two or more units.

2.6 Specimen. A test unit or a portion of a test unit designated for a particular physical or chemical test, or for a dimensional measurement requiring destruction of a unit.

2.6.1 In some cases, a specimen can be used for the determination of two or more properties.

2.6.2 The specimens taken from a singlet test unit for a given test shall, as far as practicable, be taken from different locations selected at random on the test unit. Thus, if the test unit consists of several units, the specimens shall be taken from as many of these units as possible.

2.7 Sample.

2.7.1 *Sample for inspection.* A specified number of units taken from a lot for the purpose of inspection, 2.1.1.

2.7.2 *Sample for test.* A specified number of test units taken from a lot for the purpose of determining the physical and chemical properties for which requirements are specified, or specified dimensions which require destruction of a unit.

2.8 Lot size. The number of square feet of tile or rolls, 2.4, of which the lot is composed.

2.9 Sample size.

2.9.1 *Sample size for inspection.* The number of units, 2.4, of which the sample. for inspection is composed.

2.9.2 *Sample size for test.* The number of test units, 2.5, of which the sample for test is composed.

2.10 Test result. A single numerical value calculated by a prescribed procedure from all the measurements for a given property carried out on a single test unit. In most cases, the test result is an average of the measurements, but there are instances where another function such as the median is used.

2.11 Defective unit. A unit that fails to conform to one or more of the requirements for which it has been inspected, 2.1.1.

2.12 Defective test unit. A test unit that fails to conform to one or more of the requirements for which it has been tested, 2.1.2.

2.13 Acceptance of lot. The approval of a lot as (Informing to contract and/or specificat ion.

2.14 Rejection of lot. The disapproval of a lot as not conforming to contract and/or specification.

2.15 Acceptance number. A number used in connection with a sampling plan (see 4.2.3.2.l), such that if the number of defective test units in the sample for test is less than or equal to this number, the lot should be accepted provided that it is acceptable on the basis of inspect ion.

2.16 Rejection number. A number used in connection with a sampling plan (see 4.2.3.1.2 and 4.2.3.2.1), such that if the number of defective units or defective test units in the sample taken from the lot is equal to or greater than this number, the lot shall be rejected.

3. GENERAL SAMPLING PROCEDURE

3.1 Scope. The term "sampling" is used throughout this standard to signify lot-by-lot acceptance sampling, the essential feature of which is that the contractor submits his products grouped into lots, each of which is accepted or rejected in its entirety on the basis of the performance of one or more samples taken from it, samples to be selected and tested within 30 days from the date of delivery of the lot.

3.2 Formation of lots. For purposes of sampling, the manufacturer shall submit the delivery in lots, each of which is composed of material produced under essentially the same conditions, 2.3. Whereas no exact instructions for the formation of lots can be given that will cover all cases, the following rules shall be adhered to as far as is practicable.

3.2.1 The material in any lot shall be composed of any one type, grade, class, color, size, and composition and shall be produced as follows:

a. By a single production method.
b. From a single production line.
c. During a period of not more than 24 hours, starting from the time the lot begins to leave the production line.

3.22 The quantity of material included in a lot shall be as large as possible subject to:

a. The considerations immediately preceding.
b. Limitation, if any, mentioned in the relevant detail specification.
c. The condition that all the material in the lot shall be reseanably accessible for sampling purposes.

3.2.3 No material shall be added to or removed from a lot by the contractor once the drawing of samples from the lot has begun. However, if some damaged units are noticed (by accident or other circumstances not related to the manufacturing process) before beginning to sample, and if the damage is of such char acter that it is apparent that no other similarly damaged units are distributed throughout the lot, then this damaged material shall be removed from the lot before drawing a sample. Damaged units may be replaced with material from the same production lot.

3.3 Place of sampling. Materials may be sampled, inspected, and/or tested either at the place of manufacture or a the point of delivery. If the inspection and tests are to be made at the point of manufacture, the manu - facturer shall provide a place for conductting the test, the necessary labor, equipment, and other facilities, and the manufacturer and/or the contractor shall notify the purchasing officer sufficiently in advance of the completion of manufacture of material to permit arrangement for inspection.

3.4 Method of sampling. In order to insure that particular portions of the lot are not favored in the selection of units for inspection and test, tile following procedure shall be used as far as practicable.

3.4.1 In the case of tiles, the number of packages selected for inspection shall be equal to one-fifth of the number of units in the sample size (see table I). Five tiles shall be

taken from each package selected. The packages from which the sample for einspection is taken shall be selected at random from all the packages of the lot. The sample for tests shall be taken from packages selected for inspection, but only one test unit shall be taken from a single package.

3.4.2 In the case of rolls, the rolls which are to be inspected or from which test units are to be taken shall be selected at random from among all roles in the lot. In each roll thus selected, test units shall be taken from a portion not including the first or last foot of the roll. For inspection, however, no portion of the roll shall be deliberately excluded. Inspection of a roll shall be carried out on an unfolded portion not less than 10 feet in length.

3.4.3 The rules for the size of samples are given in 4.2.3.1.2 and 4.2.3.2.1.

4. SAMPLING PLANS AND THEIR GENERAL CHARACTERISTICS

4.1 Scope. In this section, consideration is given to criteria for acceptance or rejection of a lot on the basis of performance of one or more samples taken from the lot.

4.2 Sampling plans.

4.2.1 *Purpose.* A sampling plan aims to accept frequently lots that contain only a small proportion of nonconforming units and to reject frequently lots that contain a large proportion of nonconforming units.

4.2.2 *Protection features.*

4.2.2.1 *Protection to the contractor.* One essential feature of a sampling plan is the protection that it affords to the contractor,in the sense that in the long run lots which contain a certain small proportion of nonconforming units shall not be rejected in more than a specfied percentage of cases in which they are submitted.

4.2.2.2 *Protection to the consumer.* Another essential feature of a sampling plan is the protection that it affords to the consumer, in that it limits his risk of accepting a lot containing more than a certain proportion of nonconforming units.

4.2.3 *Sampling for inspection and sampling for test.* It should first be ascertained that the conditions of 3.2.1 and 3.2.2 are satisfied and that the instructions in 3.2.3 and 3.4 are observed. The sampling procedure adopted in this standard consists of first obtaining a sample for inspection, 2.1.1, and then using all or a portion of the sample for tests, 2.1.2.

4.2.3.1 *Sampling for inspection.*

4.2.3.1.1 *Sampling procedure.* The sample required for inspection of the lot for visual and dimensional characteristics shall be taken from the lot as described in 3.4.1 or 3.4.2.

4.2.3.1.2 *Sample size.* Unless otherwise specified in the detail specification, the number of units to be taken from a lot for the purpose of inspection shall depend on the size of the lot in accordance with table I.

Table I. *Sampling for inspection*

Lot size [1]	Sample size [2]	Rejection number R
Square feet	*Units*	*Units*
Under 5,000	15	2
5,000 to 9,999	25	2
10,000 to 19,999	35	3
20,000 to 39,999	50	4
40,000 to 79,999	75	5
80,000 and over	110	7

[1] In the case of wall base, the lot size shall be expressed in linear feet and the unit may be a section.

[2] If the lot comprises fewer rolls than units indicated, each roll shall be inspected.

4.2.3.1.3 *Instructions for use of table I.* The size of the lot to be samplee shall be located in the first column of the table. The sampling plan to be used is the one given on the line corresponding to this lot size. A11 units of the sample shall be inspected. The number of nonconforming units shall be recorded. The lot should be rejected and should not be tested for physical or chemical characteristics if the number of defective units in the sample equals or exceeds the "Rejection number R." If the number of defective units in the sample is less than the "Rejection number R," the lot should be sampled for physical and chemical tests, to determine its acceptability.

4.2.3.1.3.1 *Dimensional measurements.* Inspection includes both visual examination and all specified dimensional measurements that do not require destruction of the material. Therefore, in general, all units in the sample for inspection should be subjected to these measurements. However, in certain cases, the importance of dimensional requirements may not be sufficient to warrant the time that would be spent in measuring all units in the sample. In such cases, it will be permissible to carry out the dimensional mesurements on a portion of the sample for inspection. The size of this portion shall be not less than 20 percent of the sample for inspection, and the units on which the measurements are made shall be taken at random from the sample for inspection. If one or more defective units are found in this portion, the complete inspection of the entire sample for inspection ion is mandatory.

4.2.3.2 *Sampling for tests.* Unless otherwise specified in the detail specification, sampling for tests shall be in accordance with the following procedures:

4.2.3.2.1 *Sampling procedure.* The sample required for testing the lot shall be taken from the sample for inspection in accordancenc with a random process. For this purpose, each unit of the sample for inspection including defective units, 2.11, shall be given an equal chance of being included in the sample for tests. Should the sample for inspection be too small to provide the required number of test units (table 11), additional test units shall be taken from the lot, using the same precautions as observed for obtaining the sample for inspection. Table II gives the sampling plan in tabular form.

Table II. *Sampling for test* [1]

Lot size [2]	First sample			Second sample	Combined sample	
	Test units [3]	Acceptance No.	Rejection No.	Test units	Test units	Rejection No.
Square feet						
Under 5,000	1	0	1			
5,000 to 9,999	2	0	2	4	6	2
10,000 to 19,999	4	0	2	4	8	2
20,000 to 39,999	5	0	2	5	10	2
40,000 to 79,999	8	0	3	8	16	3
80,000 and over	15	1	3	15	30	4

[1] This sampling plan is based on acceptance of the lot at least 95 percent of the time if the proportion of defective test units contained in it does not exceed 5 percent and rejection of the lot at least 95 percent of the time if the proportion of defective units reaches 60 percent for lots of 5,000 square feet or 28 percent for lots over 80,000 square feet.

[2] In the case of wall base, the lot size shall be expressed in linear feet.

[3] The test unit shall consist of sufficient material to make all the tests specified. (See 2.5 and 3.4.)

4.2.3.2.2 *Instructions for the use of table II.* The size of the lot to be sampled shall be located in the first column of the table. The sampling plan to be used is the one given on the line corresponding to this lot size. The procedure shall then be as follows:

a. A first sample shall be taken consisting of a number of test units equal to the number in the column headed: "First sample, test units."

b. Each of the test units of this sample shall be subjected to all of the required tests.

c. The number of defective test units thus found shall be recorded.

d. The lot is considered to meet the requirements relating to tests if this

number does not exceed the number given under the heading: "first sample, acceptance number."

The lot shall be considered as having failed to meet the requirements of the detail specification if the number of defective test units in the first sample equals or exceeds the number given under the heading: "First sample, rejection number."

If the number of defective test units in the first sample exceeds the acceptance number for the first sample, but is less than the rejection number for the first sample, proceed to e.

e. A second sample shall be taken consisting of a number of test units equal to the number given under the heading: "Second sample, number of test units."

f. Each of the test units of this sample shall be subjected to all of the required tests.

g. The number of defective test units found in the second sample shall be recorded and this number shall be added to the number of defective test units which were found in the first sample.

h. The lot is considered to meet the requirements relating to tests if the total number of defective test units found in the two samples is less than the number given under the, heading: "Combined samples, rejection number."

i. The lot shall be considered as having failed to meet the requirements of the detail specification if the total number of defective test units found in the two samples is equal to or greater than the number given under the heading: "Combined samples, rejection number."

SECTION 6

NOTES

1. DETAIL SPECIFICATIONS

Detail specifications for floor coverings should specify the number of the method to be used for a particular test (see 1,2.2, sec. 6). Special requirements for conditioning and preconditioning and the conditions under which tests are to be made should also be specified in the detail specifications when they are not provided for in method 1041 or within each group of test methods.

2. SOURCES OF FEDERAL STANDARDIZATION DOCUMENTS

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C., 20402.

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration regional offices in Boston, New York, Washington, D. C., Atlanta, Chicago, Kansas City, Mo., Dallas, Denver, San Francisco, Los Angeles, and Seattle, Wash.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

3. METRIC EQUIVALENTS

When laboratory apparatus is calibrated in accordance with the metric system, metric units may be substituted in those methods which specify only English units. Conversion to metric equivalents should be made in accordance with the ASTM Metric Practice Guide, published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa., 19103.

4. Although some of the floor coverings for which these test methods are intended have fabric backings or fabric insertions, the term “nontextile” is used throughout the standard to make it clear that the methods are intended primarily for floor coverings having wearing surfaces composed of resilient materials such as rubber, vinyl plastic, vinyl asbestos, linoleum, asphalt, and cork and not to textile floor coverings such as carpets and rugs, having wearing surfaces composed of fibers or filaments.

SECTION 7

TEST METHODS

1. SCOPE

This section is arranged in 9 groups numbered 1000 through 9000 covering methods of preparation and testing resilient nontextile floor coverings. Methods are described for making geometrical measurements, rheological tests, tension tests, accelerated aging tests, thermal tests, miscellaneous physical tests, electrical tests, and chemical tests.

2. GENERAL METHODS

The methods described in group 1000 and in the method at the beginning of each group from 2000 to 9000, inclusive, are general methods.

2.1 Group 1000 contains methods and procedures for the preparation of material for test. Methods 1011, 1021, and 1031 are concerned with the preparation of specimens for various tests. Method 1041 describes procedures for conditioning and preconditioning test specimens prior to testing and specifies the atmospheric conditions under which physical tests should be made. These methods are applicable to practically all of the other test methods in the standard and shall be considered a part of them. In case of conflict between the general methods in group 1000 and the individual test methods, the latter shall take precedence.

2.2 The general method at the beginning of each group from 2000 to 9000, inclusive, contains information and instructions pertaining to test conditions, apparatus, reagents, specimens, etc., which are common to all or most of the other methods in that particular group, and, insofar as applicable, shall be considered a part of each method in that group. In case of conflict between the provisions of the general method and the individual test method. the latter shall take precedence.

3. REFERENCED METHODS

Throughout the test methods in section i', reference is made in the procedure to another method for obtaining auxiliary data, such as thickness for use in calculating the amount of indentation. It should be noted t hat such met h-ods may specify variations from the referenced method to suit the particular requirements.

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SEPARATION OF FABRIC OR OTHER MATERIALS

1. SCOPE

This method describes procedures for use when it is necessary to remove fabric or other materials from floor coverings before conduct - ing tests. It is particularly applicable to rub ber floor coverings.

2. PIECE

The piece for removal of fabric or other ma-aterial shall be a portion of the test unit of sufficient size to permit preparation of the specimens required for test.

3. APPARATUS

The apparatus shall be as follows:

3.1 Knife or other instrument for cutting the piece.

3.2 Iso-octane or other solvent which will not perminently injure the floor covering. The iso-octane shall have a freezing point greater than — 107.5° C. (–161.5° F.).

4. PROCEDURE

If it is practicable, the separation of fabric or other material from the floor covering shall be performed without the use of solvents. The part from which the fabric or other material is to be removed shall be gripped as near the point of separation as possible and separated slowly with a minimumn of deformation. If iso-octane is used, the portion of the floor covering from which the fabric has been removed shall be placed so as to permit evaporation of the solvent from all parts of the surface and shall be allowed to rest for at least 1 hour before being tested.

BUFFING

1. SCOPE

This method is intended for use in removing from resilient nontextile floor coverings any unevenness of surface such as fabric impressions or corrugations which would interfere with the measurement of thickness or other tests. It is also applicable where it is necessary to reduce the thickness of materials before testing and to remove fabric backing. The method is particularly applicable to rubber floor coverings.

2. PIECE

Unless otherwise specified in the detail specification or applicable method of test, the piece for buffing shall consist of either the specimen for physical test as described in the applicable test method, or a portion of the test unit of sufficient size and shape to permit the preparation of the specimen for physical test.

3. APPARATUS

The apparatus shall consist of a grinder equipped with a motor-driven abrasive wheel of approximately 30 grit, 5 inches in diameter, which revolves at a speed of 2,500 to 3,500 revolutions per minute (r.p.m.). Larger diameter wheels may be used provided the speed is adjusted to give a surface speed equivalent to a 5-inch wheel operating at 2,500 to 3,500 r.p.m. The grinder shall also be equipped with a slow feed in order that, very little of the material will be removed at one cut.

4. PROCEDURE

4.1 The face of the abrasive wheel shall be sharp during the buffing operation. The abrasive wheel shall be adjusted to a speed of from 2,500 to 3,500 r.p.m. when a 5-inch wheel is used. A very small amount of floor covering or fabric shall be removed from the piece at one time in order to avoid damage by overheating. Buffing shall be carried just to the point where the unevenness disappears, except in the case of thick materials where it is necessary to reduce the thickness before testing. When it is necessary to reduce the thickness before testing, it may be desirable to slice the material to the approximate required thickness with a sharp instrument before buffing. If the material has a fabric backing, the piece shall be buffed until the fabric just disappears. The final buffed surface shall be finished uniformly and smoothly. The piece shall be permitted to rest at least 30 minutes between buffing and testing the specimen.

4.2 Pieces from which specimens are to be taken for tension tests shall be buffed in the strip form before specimens are cut with a die.

PREPARATION OF SPECIMENS

1. SCOPE

This method is intended for use in the preparation of specimens of resilient nontextile floor coverings for physical tests. It is particularly applicable to linoleum, felt base, vinyl plastic, and vinyl asbestos floor coverings.

2. PIECE

The piece of material shall consist of a portion of the test unit of sufficient size to permit the preparation of the specimens required by the applicable method of test.

3. APPARATUS

The apparatus shall be as follows:

3.1 A die, knife, saw, or other device for cutting specimens of floor coverings with smooth and uniform surfaces.

3.2 Equipment for measuring dimensions as required in methods 2111 to 2211, inclusive.

3.3 Straightedge.

4. PROCEDURE

Suitable procedures for the preparation of specimens are described in 4.1 and 4.2.

4.1 Asphalt tile and vinyl asbestos tile. Specimens of semirigid floor coverings, e.g., vinyl asbestos and asphalt tile, for tests such as deflection, impact, etc., may be conveniently prepared by scoring the material with a knife and snapping the specimen when the score is over the edge of the straightedge.

4.1.1 When conditioning in a water bath is permitted, the specimen may be readily cut with a knife from material which has been conditioned in the water bath described in method 1041.

4.2 Linoleum, vinyl plastic, rubber, felt-backed floor coverings, etc. Test specimens can be readily cut from these materials with a knife, die, or other sharp cutting tool. Method 4111 describes in detail the procedure for preparing tensile strength specimens of rubber-type floor coverings.

4.2.1 *Felt-backed floor coverings.* When it is necessary to make tests of either the wearing surface or backing of felt-backecl floor coverings, the part not being tested must be completely removed from the part undergoing test, as for example in determining the thickness of the wearing surface of felt-backed vinyl floor covering. This separation maybe accomplished in any manner that will completely remove the backing from the wearing surface, or vice versa, without damaging or in any way changing the part to be tested. In general, the separation can be made by careful splitting of the materials at the bond with a razor blade. After splitting, any of the material being removed that still remains on the portion to be tested is removed by careful scraping with a razor blade, followed by gentle sanding with fine sandpaper or cloth until just the last remnant disappears. Care must be taken not to remove or abrade any of the portion to be tested.

5. RESULTS

The number of specimens to be tested shall be as required in applicable test method.

CONDITIONING

1. SCOPE

This method describes procedures for conditioning and preconditioning specimens of resilient nontextile floor coverings prior to testing and the conditions under which they are tested.

2. SPECIMEN

The specimen shall be as described inthe appropriate method of test or as specified in the detail specification.

3. APPARATUS

The apparatus shall be as follows:

3.1 Oven. Circulating-air oven with automatic temperature controls that will maintain the required termperature throughout the oven within plus or minus 2° C. (3.6° F.).

3.2 Thermometers, copper constantan thermocouple , and potentiometer or other suitable device for measuring the temperature to within l°C. (l.8° F.).

3.3 Temperature and humidity room or cabinet. A conditioning room or cabinet equipped with automatic temperature and humidity controls that will maintain the temperature at 23°±3.6° F.) and the relative humidity at 50±5 percent. The temperature and humidity should be maintained as closely as practicable to 23° C. and 50 percent relative humidity. The tolerances are meant to cover variations which may occur at different locations in the room or cabinet.

3.4 Constant temperature water bath. A water bath equipped with automatic temperature contols that will maintain the required temperature throughout the bath within 0.5° C. (0.9° F.) and of sufficient size to accommodate testing equipment such as an indention tester.

4. PROCEDURE

4.1 Unless otherwise specified, all physical tests shall be made at room temperature, 23°±5° C. (73.4°±9° F.), except in the case of dispute or disagreement bewteen labora - tories (see 4.2).

4.2 Standard conditions. Unless otherwise specified, in the case of dispute or disagreement between laboratories, the specimen shall be conditioned and tested in a standard atmosphere, i.e., in air maintained at a relative humidity of 50±5 percent and a temperature of 23°±2° C. (73.4°±3.6° F.). It is intended that the room or cabinet be maintained as closely as possible at a temperature of 23° C. and a relative humidity of 50 percent. The tolerances indicated are meant to cover variations from the specified conditions which may occur at different locations in the room or cabinet.

4.2.1 The specimen or test unit from which the specimen is taken shall be supported in the conditioning atmosphere on a screen or other surface that will permit the air to circulate freely around the surfaces of the material.

4.2.2 Unless otherwise specified, the specimen shall be conditioned for not less than 15 nor more hours before being tested.

4.3 Conditioning in water.

4.3.1 Unless otherwise specified, the water shall be immersed for not less than 15 nor more 0.5° C. (77°±0.9° F.).

4.3.2 Unless otherwise specified, specimens shall be immersed for not less than 15 nor more than 30 minutes before testing.

4.3.3 Rubber, linoleum, and backed floor coverings shall not be conditioned or tested in water.

4.3.4 When the specimen must be removed from the water before testing, it shall be tested immediately after removal.

Note. It is recommended that specimens be conditioned in air when the test cannot be made while the specimen is immersed in water.

4.3.5 When tests are made with the specimen immersed, the portions of the testing apparatus that contact the specimen shall be conditioned in the water for not less than 15 minutes immediately before testing.

4.4 Preconditioning.

4.4.1 Unless otherwise specified, when preconditioning is required, as in the case of linoleum, the specimen shall be exposed in circulating air at a temperature of 70°±2° C. (158°± 3.6° F.) for 4±¼ hour.

4.4.2 Unless otherwise specified, the specimen after preconditioning shall be conditioned in standard atmosphere, 4.2, for not less than 20 hours before testing.

5. RESULTS

The number of specimens tested and the recording of data shall be as described in the applicable test method or as specified in the detail specification.

GEOMETRICAL MEASUREMENTS, GENERAL

1. SCOPE

1.1 This group of methods is intended for use in determining the geometrical properties of resilient nontextile floor coverings. Geometrical measurements are made for one of the following three purposes:

1.1.1 To determine conformance with specification requirements regarding geometrical properties of whole units, such as the size of tile or length of roll. In such a case, determination of the geometrical property is considered as an inspection, and measurements are made on one or more locations of each unit in the sample for inspection.

1.1.2 To determine conformance with specification requirements regarding particular functional parts of the test unit, such as the thickness of the wearing surface of felt-backed floor coverings. In such a case, determination of the geometrical property is considered as a test since it necessitate-s destruction of the material, and measurements are made on one or more specimens taken from each test unit.

1.1.3 To determine geometrical values that are necessary in the calculation of test results for a physical property for which requirements are specified, such as the thickness of a specimen for tensile strength. In such a case, measurements are made on the specimens on which the physical property in question is measured and the geometrical values found are only an adjunct to the determination of the physical property.

1.2 Methods are described for determining average, minimum, and maximum thickness, width, and length of the various types of floor coverings and for determining the squareness of tile. Minimum thickness, width, and length shall be interpreted as meaning thickness at the thinnest place, width at the narrowest place, and length at the shortest place, respectively. Maximum thickness, width, and length shall be interpreted as meaning thickness at the thickest place, width at the widest place, and lengh at the longest place, respectively. The method to be used for measurement shall be as specified in the detail specification or appropriate test method.

2. SPECIMEN

2.1 Unit or test unit. The specimen shall consist of a unit or test unit, or a portion of a unit or test unit, 1.1.1 and 1.1.2.

2.1.1 It is not always practicable to specify the size of a specimen for determining geometrical properties. In general, the specimen shall consist of the largest single piece of material in the unit or the specified part of the test unit that it is practicable to measure.

2.2 Physical test. The specimen shall be as described in the applicable test method, 1.1.3.

3. PROCEDURE

3.1 Geometrical measurements shall not be made at places on the specimen where damage or defects are apparent that may interfere with the geometrical property.

3.2 Unless otherwise specified in the detail specification or applicable test method, all specimens for geometrical measurements shall be conditioned as described in method 1041.

3.3 Specimens for geometrical measurements shall be prepared as described in methods 1011 to 1031, inclusive, as applicable.

THICKNESS, DIAL MICROMETER

1. SCOPE

This method is intended for use in determining the thickness of resilient nontextile floor coverings having flat surfaces such as linoleum, asphalt tile, etc. It is applicable to the determination of the thickness of units. test units, and specimens for physical tests.

2. SPECIMEN

The specimen shall be as described in 2 of method 2001, as applicable.

3. APPARATUS

The apparatus shall consist of a dial micrometer having a flat anvil not less than 0.25 inch in diameter and a flat presser foot 0.25±0.01 inch in diameter which exerts a total force of 16±0.1 ounce on the specimen, the force being applied by means of weight. The contact surfaces of anvil and presser foot shall be parallel to within 0.0001 inch. The dial shall be graduated to read to 0.001 inch.

4. PROCEDURE

4.1 Thickness measurement. The specimen shall be placed on the anvil of the dial micronmeter and the presser foot lowered gently until it contacts the surface of the specimen. The thickness shall be read from the dial to the nearest 0.001 inch. If more than one measurement is madle on the specimen, the measurements shall be equally spaced over the specimen. The measurements shall be made at least ¾ inch from any edge of the specimen. Care shall be taken that the specimen is flat against the anvil of the micrometer.

4.2 Average thickness.

42.1 *Unit or test unit.* Unless otherwise specified in detail specification, a total of 10 measurements shall be made on the unit or test unit. The measurements shall be made as described in 4.1, and if made on more than one specimen they shall be equally distributed as nearly as practicable among all the specimens from the unit or test unit.

4.2.2 *Specimen for physical test.* Unless otherwise specified in the applicable test method, three measurements shall be made on the specimen. Tile measurements shall be made asi described in 4.1.

4.3 Minimum thickness.

4.3.1 *Unit or test unit.* The unit or test unit shall be examined for the thinnest place. If the thinnest place is found, the specimen shall be taken so its to include it, and a measurement shall be made at that place as described in 4.1. If no thinnest place is found, measurements shall be made as described in 4.2.1, and the smallest value obtained shall be the minimum thickness of the unit or test unit.

4.3.2 *Specimen for physical test.* The specimen shall be examined for the thinnest place. If the thinnest place is found, a measurement shall be made at that place as described in 4.1. If no thinnest place is found, measurements shall be made as described in 4.2.2, and the smallest value obtained shall be the minimum thickness of the specimen.

4.4 Maximum thickness.

4.4.1 *Unit or test unit.* The unit or test unit shall be examined for the thickest place. If the thickest place is found, the specimen shall be taken so as to include it, and a measurement shall be made at that place as described in 4.1. If no thickest place is found, measurements shall be made as described in 4.2.1, and the largest value obtained shall be the maximum thickness of the unit or test unit.

4.4.2 *Specimen for physical test.* The specimen shall be examined for the thickest place. If the thickest place is found, a measurement shall be made at that place as described in 4.1. If no thickest place is found, measurements shall be made as described in 4.2.2, and the largest value obtained shall be the maximum thickness of the specimen.

5. RESULTS

5.1 Unit or test unit.

5.5.1 *Average thickness.* The average thickness of the unit or test unit shall be the average ao all the values obtained in 4.2.1.

5.1.2 *Minimum thickness.* The minimum thickness of the unit or test unit shall be the value obtained when measurements are made as described in 4.3.1.

5.1.3 *Maximum thickness.* The maximum thickness of the unit or test unit shall be the value obtained when measurements are made as described in 4.4.1.

5.1.4 The average, minimum, and maximum thicknesses shall be recorded to the nearest 0.001 inch.

5.2 Specimen for physical test. The number of specimens to be tested and the treatment of data shall be as required in the applicable test method.

THICKNESS, DIAL MICROMETER (LIGHT LOAD)

1. SCOPE

This method is intended for use in determining the thickness of nontextile floor coverings with flat surfaces made from soft flexible materials, such as rubber and plastics, that may be deformed when tested by method 2111 or 2131. The method is applicable to the determination of thickness of units, test units, and specimens for physical tests.

2. SPECIMEN

The specimen shall be as described in 2 of method 2001, as applicable.

3. APPARATUS

The apparatus shall consist of a dial micrometer having a flat anvil not less than 0.25 inch in diameter and a flat presser foot 0.25± 0.01 inch in diameter which exerts a total force of 3.0±0.1 ounce on the specimen, the force being applied by means of a weight. The contact surfaces of the anvil and presser foot shall be parallel to within 0.0001 inch. The dial shall be graduated to read to 0.001 inch.

4. PROCEDURE

4.1 Thickness measurement. The specimen shall be placed on the anvil of the dial micrometer and the presser foot lowered gently until it contacts the surface of the specimen. The thickness shall be read from the dial to the nearest 0,001 inch. If more than one measurement is made on the specimen, the measurements shall be equally spaced over the specimen. The measurements shall be made at least ¾ inch from any edge of the specimen. Care shall be taken that the specimen is flat against the anvil of the micrometer.

4.2 Average thickness.

4.2.1 *Unit or test unit.* Unless otherwise specified in the detail specification, a total of 10 measurements shall be made on the unit or test unit. The measurements shall be made as described in 4.1, and if made on more than one specimen they shall be equally distributed as nearly as practicable among all the specimens from the unit or test unit.

4.2.2 *Specimen for physical test.* Unless otherwise specified in the applicable test method, three measurements shall be made on the specimen. The measurements shall be made as described in 4.1.

4.3 Minimum thickness

4.3.1 *Unit or test unit.* The unit or test unit shall be examined for the thinnest place. If the thinnest place is found, the specimen shall be taken so as to include it, and a measurement shall be made at that place as described in 4.1. If no thinnest place is found, measurements shall be made as described in 4.2.1, and the smallest value obtained shall be the minimum thickness of the unit or test unit.

4.3.2 *Specimen for physical test.* The specimen shall be examined for the thinnest place. If the thinnest place is found, a measurement shall be made at that place as described in 4.1. If no thinnest place is found, measurements shall be made as described in 4.2.2, and the smallest value obtained shall be the minimum thickness of the specimen.

4.4 Maximum thickness.

4.4.1 *Unit or test unit.* The unit or test unit shall be examined for the thickest place. If the thickest place is found, the specimen shall be taken so as to include it, and a measurement shall be made at that place as described in 4.1. If no thickest place is found, measurements shall be made as described in 4.2.1, and the largest value obtained shall be the maximum thickness of the unit or test unit.

4.4.2 *Specimen for physical test.* The specimen shall be examined for the thickest place. If the thickest place is found, a measurement shall be made at that place as described in 4.1.

If no thickest place is found, measurements shall be made as described in 4.2.2, and the largest value obtained shall be the maximum thickness of the specimen.

5. RESULTS

The results shall be as described in method 2111.

THICKNESS, MICROMETER CALIPER

1. SCOPE

This method is intended for use in determining the thickness of relatively rigid nontextile floor coverings having flat surfaces such as asphalt and vinyl asbestos tile and vinyl plastic tile and rolls. It is applicable to the determination of thickness of units, test units, and specimens for physical tests.

2. SPECIMEN

The specimen shall be as described in 2 of method 2001, as applicable.

3. APPARATUS

The apparatus shall consist of a micrometer caliper having flat contact surfaces, each not less than 0.25 inch in diameter. The contact surfaces shall be parallel to within 0.0001 inch. The micrometer caliper shall be graduated to read to 0.001 inch. It shall be equipped with a locknut and a ratchet friction stop which slips when the excess pressure is applied.

4. PROCEDURE

4.1 Thickness measurement. The, specimen shall be placee between the contact surfaces of the micrometer caliper. The micrometer caliper shall be closed on the specimen in such a manner that the specimen is not distorted. The criterion of contact is the initial development of frictional resistance to movement of the specimen between the micrometer surfaces. The thickness of the specimen shall be read from the micrometer scale to the nearest 0.001 inch. If more than one measurement is made on the specimen, the measurements shall be equally spaced over the specimen. The measurements shall be made at least 3/4 inch from any edge of the specimen.

4.2 Average thickness.

4.2.1 *Unit or test unit.* Unless otherwise specified in the detail specification, a total of 10 measurements shall be made on the unit or test unit. The measurements shall be made as described in 4.1, and if made on more than one specimen they shall be equally distributed, as nearly as practicable, among all the specimens from the unit or test unit.

4.2.2 *Specimen for physical test.* Unless otherwise specified in the detail specification, three measurements shall be made on the specimen. The measurements shall be made as described in 4.1.

4.3 Minimum thickness.

4.3.1 *Unit or test unit.* The unit or test unit shall be examined for the thinnest place. If the thinnest place is found, the specimen shall be taken so as to include it, and a measurement shall be made at that place as described in 4.1. If no thinnest place is found, measurements shall be made as described in 4.2.1, and the smallest value obtained shall be the minimum thickness of the unit or test unit.

4.3.2 *Specimen for physical test.* The specimen shall be examined for the thinnest place. If the thinnest place is found, a measurement shall be made at that place as described in 4.1. If no thinnest place is found, measurements shall be made as described in 4.2.2, and the smallest value obtained shall be the minimum thickness of the specimen.

4.4 Maximum thickness.

4.4.1 *Unit or test unit.* The unit or test unit shall be examined for the thickest place. If the thickest place is found, the specimen shall be taken so as to include it, and a measurement shall be made at that place as described in 4.1. If no thickest place is found, measurements shall be made as described in 4.1.2.1, and the largest value obtained shall be the maximum thickness of the unit or test unit.

4.4.2 *Specimen for physical test.* The specimen shall be examined for the thickest place. If the thickest place is found, a measurement shall be made at that place as described in 4.1.

If no thickest place is found, measurements shall be made as described in 4.2.2, and the largest value obtained shall be the maximum thickness of the specimen.

5. RESULTS

The results shall be as described in method 2111.

THICKNESS, WEARING SURFACE

1. SCOPE

This method is intended for use in determining the thickness of the wearing surface of resilient nontextile floor coverings backed with materials such as felt. The method is applicable to the determination of thickness of the wearing surface of units, test units, and specimens for physical tests.

2. SPECIMEN

The specimen shall be as described in 2 of method 2001, as applicable, except that when the minimum thickness of the wearing surface of a unit or test unit is specified in the detail specification, the specimen shall be approximately 2 by 2 inches.

3. APPARATUS

The apparatus shall be as described in method 2111, 2121, or 2131, as specified in the detail specification.

4. PROCEDURE

4.1 Separation of backing from wearing surface. The backing material shall be removed from the wearing surface as described in method 1031. The backing and any paint or adhesive shall be carefully removed from a sufficient area of the wearing surface to permit the entire contact surface of the thickness measuring apparatus to be applied flat against the two sides of the wearing surfice.

4.2 Thickness of wearing surface. The average, minimum, or maximum thickness of the wearing layer shall be determined as described in method 2111, 2121, or 2131, as specified in the detail specification, except that when tile minimum thickness of the wearing surface of a unit or test unit is required, (1) five specimens shall be tested from the unit or test unit, and (2) no examination shall be made for the thinnest place.

5. RESULTS

The results shall be as described in method 2111, 2121, or 2131, as specified in the detail specification, except that when the minimum thickness of units or test units is specified, the smallest value for the five specimens measured shall be the minimum thickness of the unit or test unit.

THICKNESS, WEARING SURFACE, OPTICAL

1. SCOPE

This method is intended for use in determining the thickness of the wearing surface of resilient nontextile floor coverings such as felt-backed materials. The method is applicable to the determination of thickness of units, test units, and specimens for physical tests.

2. SPECIMEN

The specimen shall be as described in 2 of method 2001, as applicable, except that when the minimum thickness of the wearing surface of a unit or tetst unit is specified in the detail specification, the specimen shall be a rectangular portion of the unit or test unit approximately 2 inches long and ¾ inch wide with full cross section cut perpendicular to the principal surfaces of the material.

3. APPARATUS

The apparatus shall be as follows:

3.1 A microscope equipped with devices capable of making measurements accurately to 0.0005 inch. A suitable instrument is a microscope equipped with a 6- or8-power eyepiece, an objective of 32-mm. focal length, a mechanical stage, and a ruled glass disk or ocular micrometer.

3.2 A vise or other apparatus for holding the specimen while preparing theedge for measurement. The apparatus has smooth hardened-steel jaws approximately 3/8 inch tahick, 1 inch wide, and 4 inches long, with the exposed edges ground flat.

4. PROCEDURE

4.1 Preparation of specimen. The speci-pImen, 2, shall be clamped firmly lengthwise in the vise or other apparatus with approximately 1/16 inch of the edge protruding above the surface of the jaws, care being taken that the specimen is not compressed or distorted. The protruding portion of the specimen shall be cut off with a single-edge razor blade or equivalent cutting tool. The cutting edge of the blade shall be held perpendicular to the long axis of the specimen at an angle of about 5° from the horizontal and against the jaws of the clamping device. While the blade is held in this position it is moved through the material, care being taken not to distort the edge of the specimen.

4.2 Thickness measurement. The specimen shall be mounted on the microscope and the ruled disk placed on the cut surface, 4.1, of the cross section with the ruled surface in contact with the material. The thickness of the wearing surface of the specimen, if in the field of view, shall be read directly from the rulings on the disk to the nearest 0.0005 inch. If the thickness is such that it does not all lie in the field of view, the specimen shall be moved by means of the mechanical stage until the thickness of the complete wearing surface passes through the field. The rulings on the disk passed over during the movement shall be counted, and the distance recorded to the nearest 0.0005 inch.

4.2.1 When the scale is in the eyepiece, the ruled glass disk or ocular micrometer shall be placed in the ocular and calibrated. The specimen shall be placed on the stage with the cut surface, 4.1, perpendicular to the optical axis of the microscope so as to expose the full thickness of the wearing surface. The microscope shall be f'ocused on the specimen, the thickness determined by counting the divisions of the ruled (disk in the eyepiece that cover the distance from one edge of the wear layer to the other, and the distance recorded to the nearest 0.0005 inch.

4.2.2 If more than one measurement is made on the specimen, the measurements shall be equally spaced over the specimen.

4.3 Average thickness.

4.3.1 *Unit or test unit.* Unless otherwise specified in the detail specification, a total of 10

measurements shall be made on the unit or test unit. The measurements shall be made as described in 4.2. If measurements are made on more than one specimen, they shall be equally distributed as nearly as practicable among all the specimens from the unit or test unit.

4.3.2 *Specimen for physicul test.* Unless otherwise specified in the applicable test method, three measurements shall be made on the specimen. The measurements shall be made as described in 4.2.

4.4 Minimum thickness, unit or test unit. When specified minimum thickness of the unit or test unit is specified in the detail specfication, the specimen, 2, shall be examined for the thinnest place. If the thinnest place is found, a measurement shall be made at that place as described in 4.2. If no thinnest place is found in the specimen, two measurements shall be made as described in 4.2.

5. **RESULTS**

5.1 Unit or test unit.

5.1.1 *Average thickness.* The average thickness of the wearing surface of the unit or test unit shall be the average of a11 the values obtained in 4.3.1.

5.1.2 *Mininimum thickness.*

5.1.2.1 Unless otherwise specified in the detail specification, five specimens from each unit or test unit shall be tested.

5.1.2.2 The minimum thickness of the ing surface of the unit or test unit shall be the smallest of all the values obtained from the specimens tested.

5.1.3 The average and minimum thicknesses shall be recorded to the nearest 0.001 inch.

5.2 Specimen for physical test. The number of specimens to be tested and the treatment of data shall be as required in the applicable test method.

WIDTH, SCALE OR TAPE

1. SCOPE

This method is intended for use in determining the width of resilient nontextile floor coverings. The method is applicable to the determination of width of units, test units, and specimens for physical tests. The method may also be used to determine the length of short units, test units, or specimens for physical tests.

2. SPECIMEN

The specimen shall be as described in 2 of method 2001, as applicable.

3. APPARATUS

The apparatus shall consist of a scale or tape graduated to 0.01, l/64, or 1/32 inch, as required.

4. PROCEDURE

4.1 Width measurement. The specimen shall be placed on a flat surface so as to expose the full width. The graduated scale or tape shall be applied over the specimen in such a manner that the width is not distorted. The width shall be read from the scale or tape to the nearest 0.01, 1/64, or 1/32 inch, as applicable. If more than one measurement is made on the specimen, the measurements shall be equally spaced over the specimen.

4.2 Average width.

4.2.1 *Unit or test unit.* Unless otherwise specified in the detail specification, a total of 10 measurements shall be made on the unit, or test unit, as described in 4.1. If the measurements are made on more than one specimen, they shall be equally distributed as nearly as practicable among all the specimens from the unit or test unit.

4.2.2 *Specimen for physical test.* Unless otherwise specified in the applicable test method, three measurements shall be made on the specimen, as described in 4.1.

4.3 Minimum width.

4.3.1 *Unit or test unit.* The unit or test unit shall be examined for the narrowest place. If the narrowest place is found, the specimen shall be taken so as to include it, and a measurement made at that place as described in 4.1. If no narrowest place is found, measurements shall be made as described in 4.2.1, and the smallest value obtained shall be the minimum width of the unit or test unit.

4.3.2 *Specimen for physical test.* The specimen shall be examined for the narrowest place. If the narrowest place is found, a measurement shall be made at that place, as described in 4.1. If no narrowest place is found, measurements shall be made as described in 4.2.2, and the smallest value obtained shall be the minimum width of the specimen.

4.4 Maximum width.

4.4.1 *Unit or test unit.* The unit or test unit shall be examined for the widest place. If the widest place is found, the specimen shall be taken so as to include it, and a measurement made at that place as described in 4.1. If no widest, place is found, measurements shall be made as described in 4.2.1, and the largest value obtained shall be the maximum width of the unit or test unit.

4.4.2 *Specimen for physical test.* The specimen shall be examined for the widest place. If the widest place is found, a measurement shall be made at that place as described in 4.1. If no widest place is found, measurements shall be made as described in 4.2.2, and the largest value obtained shall be the maximum width of the specimen.

5. RESULTS

The results shall be as described in method 2111.

SIZE, DIAL GAGE

1. SCOPE

This method is intended for use in determining the dimensions of resilient nontextile floor covering in the form of tile.

2. SPECIMEN

Tile specimen shall consist of a tile from the test unit.

3. APPARATUS

3.1 The apparatus shall consist essentially of a dial gage and a horizontal index strip mounted on a flat bedplate, and a reference gage for setting the dial indicatori at zero. Satisfactory apparatus is shown in figures 2231A and 22311B.

3.1.1 *Dial gage.* The dial gage is located at the top of the bedplate with the stem extending downward. The dial is graduated to read to 0.001 inch and has a stem travel of approximately one inch. The stem of the gage is adjustable by means of a slide adapter. The contact foot of the indicator stem is 0.25±0.01 inch in diameter which exerts a total force on the specimen of 3.0±0.01 ounce.

3.1.2 *Index strip.* The index strip is mounted in a horizontal position on the lower part of the bedplate and at right angles to the stem of the gage in such a manner that it will support the specimen so that one edge will be perpendicular to the indicator stem. The surface of the edge of the index strip and the surface of the contact foot of the gage shall be parallel to within 0.0005 inch.

3.1.3 *Reference gage.* A reference gage as shown in figure 2231B for use in setting the dial gage at zero for distances of 6.000±0.001 inch, 9.000±0.001 inch, or 12.000±0.001 inch, designated in the figure as A, B, and C, respectively.

4. PROCEDURE

4.1 The dial indicator shall be set at zero reading by means of the reference gage corresponding to the dimension to be measured. The reference gage shall be placed flat on the surface of the bedplate. The proper reference length, A, B, or C, in figure 2231B shall be selected and inserted between the lower index strip and the dial indicator foot. The stem of the dial indicator shall be retracted about one-half inch or one-half of its total travel, the stem fastened in position with the foot resting on t he reference gage, and the indicator dial set at zero for the selected reference length. The adjustment of the stem of the indicator is made by releasing the nut on the slide adapter and sliding the indicator along the slotted guide to the desired position and locking in place.

4.2 The reference gage shall be removed from the apparatus. The specimen shall be placed flat on the bedplate with one edge flush against, the index strip immediately beneath the indicator foot which is held in the fully retracted posit ion. The specimen shall be held firmly against the index strip, without distortion, and the indicator foot lowered gently until it contacts the opposite edge of the specimen. The amount that the specimen exceeds or is less than the selected reference value shall be read from the dial gage and the value recorded to the nearest 0.001 inch.

4.3 For tiles considered square, each specimen shall be measured at two equally spaced points along the edge while in the above position. The specimens shall then be turned 90° and the same procedure followed for determining the dimension at right angles to the first measurements. For tiles that are not required to be square, three measurements shall be made on each specimen in each direction.

5. RESULTS

5.1 Unless otherwise specified n the detail specification, five specimens from each test unit shall be measured.

5.2 For square tile, the size shall be the smallest of all the values obtained from the specimens tested. For tile not required to be square, the size shall be the smallest value obtained in each direction from the specimens tested.

5.3 The size of the tile shall be recorded to the nearest 0.001 inch.

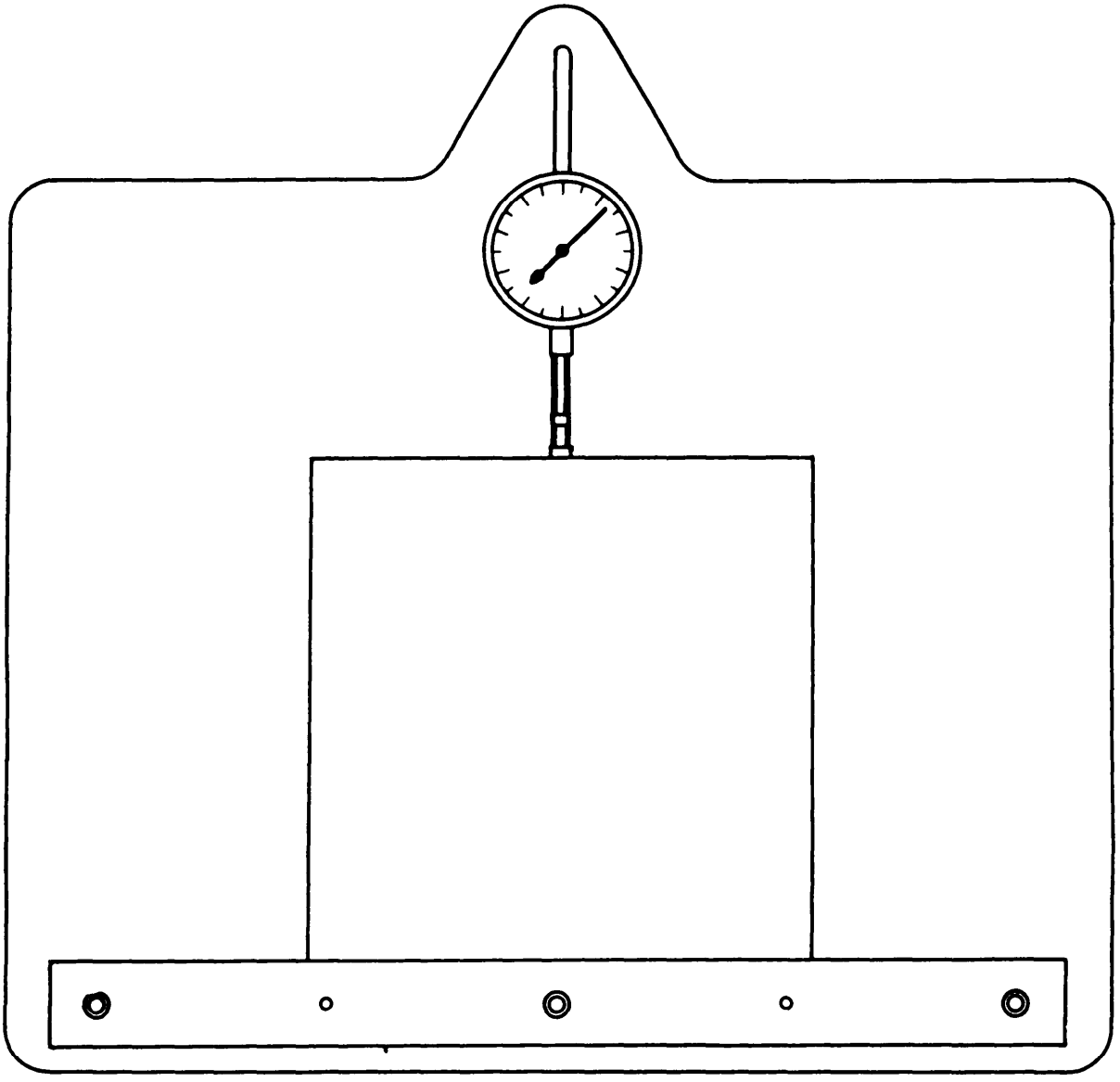

FIGURE 2231A. Apparatus for size measurement.

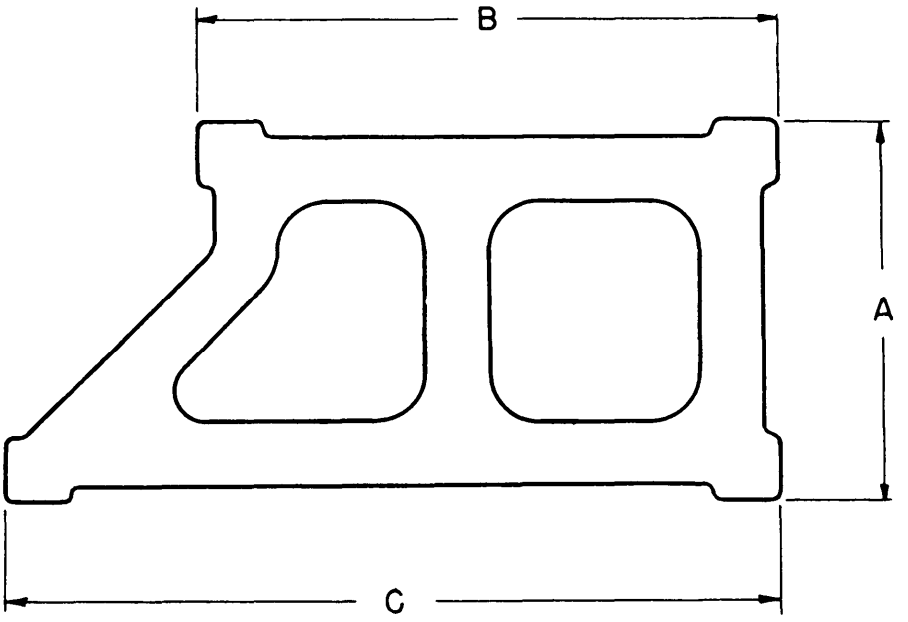

FIGURE 2231B. Reference gage.

LENGTH, SCALE OR TAPE

1. SCOPE

This method is intended for use in determining the length of resilient nontextile floor coverings such as linoleum and matting. It is applicable for the determination of length of units, test units, and specimens for physical tests.

2. SPECIMEN

The specimen shall be as described in 2 of Imthod 2001, as applicable.

3. APPARATUS

The apparatus shall consist of a scale or tape graduated to 1/64, or 1/8 inch, as required.

4. PROCEDURE

4.1 Length measurement. The specimen shall be placed on a flat, smooth surface so that the full length is exposed. The graduated scale or tape shall be applied over the specimen in such a manner that the length is not distorted. The length shall be read from the scale or tape to the nearest 1/64, 1/32, or 1/8inch as required. If more than one measurement is made on the specimen, the measurements shall be equally spaced over the specimen.

4.2 Unit or test unit. Unless otherwise specified in the detail specification, a total of two measurements shall be made on the unit or test unit, as described in 4.1.

4.3 Specimen for physical test. Unless otherwise specified in the applicable test method, three measurements shall be made on the specimen.

5. RESULTS

5.1 Unit or test unit.

5.1.1 The length of the unit or test unit shall be the average of all the values obtained in 4.2.

5.1.2 The average length of the unit or test unit shall be recorded to the nearest 1/64, 1/32,, or 1/8 inch, as required.

5.2 Specimen for physical test. The number of specimens to be tested and the treatment of data average, etc.) shall be as required in the applicable test method.

SIZE, BENCH MICROMETER

1. SCOPE

This method is intended for use in determining the dimensions of resilient nontextile floor coverings in the form of tile. The method may also be used for the determination of the width of narrow units, test units, and specimens for physical tests.

2. SPECIMEN

The specimen shall consist of a tile from the test unit.

3. APPARATUS

3.1 The apparatus shall consist of a bench micrometer graduated to read to 0.001 inch or finer. A bench micrometer consisting of the following has been found satisfactory:

3.1.1 An accurately graduated metal bar equipped with an ocular having a crosshair for accurately alining one edge of the specimen with a selected gradtuation on the bar corresponding with the specified or nominal dimension of the specimen.

3.1.2 A micrometer scale graduated to read to 0.001 inch or finer is permanently attached to the zero end of the bar. The micrometer thimble has a travel length of approximately 1 inch or more.

3.1.3 A second ocular with crosshair is permanently attached to the micrometer spindle so that the crosshair can be alined with the edge of the specimen by turning the thimble of the micrometer. The ocular is attached to the micrometer in such a manner that when the crosshair is alined with zero on the bar the micrometer reading will be approximately ½ inch or one-half of the travel distance of the micrometer thimble.

4. PROCEDURE

4.1 The specimen shall be placed on a smooth, flat surface so as to expose the full dimension to be measured. The bench micrometer shall be placed over the specimen in such a manner that the specimen is not distorted. The crosshair in the ocular attached to the micrometer shall be alined with the zero graduation on the bar, and the micrometer scale reading recorded to the nearest 0.001 inch. one edge of the specimen perpendicular to the dimension to be measured shall be adjusted to coincide with a selected graduation mark on the bench micrometer by means of the ocular with crosshair. The selected graduation mark should be the specified or nominal dimension of the specimen being measured. The micrometer shall then be adjusted so that the crosshair in the ocular attached to the micrometer stem coincides with the opposite edge of the specimen, and the micrometer scale reading recorded to the nearest 0.001 inch. The difference between the two readings from the micrometer scale is the amount that the specimen exceeds or is less than the selected value and shall be recorded to the nearest 0.001 inch.

4.2 For tiles considered square, the above dimension shall be measured at two equally spaced points on the specimen. The specimen shall then be turned 90° and the same procedure followed for determining the dimension at right angles to the first measurements. For tiles that are not required to be square, three measurements shall be made on each specimen in each direction.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, five specimens from each test unit shall be measured.

5.2 For square tile, the size shall be the smallest of all the values obtained from the specimens tested. For tile not required to be square, the size shall be the smallest value obtained in each direction from the specimens tested.

5.3 The size of the tile shall be recorded to the nearest 0.001 inch.

SQUARENESS, TILE, T-SQUARE METHOD

1. SCOPE

This method is intended for use in determining the squareness of resilient nontextile floor coverings in the form of tile. The method consists of measuring the maximum amount the edge of a tile deviates from a line perpendicular to the adjoining edge of the tile.

2. SPECIMEN

The specimen shall consist of a tile from the test unit.

3. APPARATUS

3.1 A T-square with head fixed at a 90° angle to the blade.

3.2 A scale graduated to 0.01 or 1/64 inch as required.

4. PROCEDURE

The T-square shall be placed over the specimen with the blade parallel to one dimension and the head parallel to the other dimension of the tile. The T-square shall be adjusted so that the blade is in contact with the edge of the tile along the entire length of the specimen. With one edge of the specimen in contact with the blade at all points, the T-square shall be moved until the head contacts the edge of the other dimension of the specimen at one point. The maximum distance between the head of the T-square and the edge of the specimen shall be measured by means of the graduated scale. Measurements shall be made on all four corners of the specimen and the maximum value obtained recorded to the nearest 0.01 or 1/64 inch, as required in the detail specification, as the out-of-square of the specimen,

5. RESULTS

5.1 Unless otherwise specified in the detail specification, five specimens from each test unit shall be tested.

5.2 The out-of-square of the test unit shall be the largest of all the values obtained from the specimens tested.

5.3 The out-of-square of the test unit shall be recorded to the nearest 0.01 or 1/64 inch, as required.

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SQUARENESS, TILE, DIAL GAGE METHOD

1. SCOPE

This method is intended for use in determining the squareness of resilient nontextile floor coverings in the form of tile. The method consists of measuring the amount each corner of the tile deviates from 90°. It is more accurate than method 2411.

2. SPECIMEN

The specimen shall consist of a tile from the test unit.

3. APPARATUS

3.1 The apparatus shall consist essentially of a dial gage and two index strips mounted in a flat bedplate so as to form an angle of exactly 90° and a reference, gage for setting the dial indicator at zero. Satisfactory apparatus is shown in figures 2421 and 2231 B.

3.1.1 *Dial gage.* The dial gage is located in the lower left-hand corner of the apparatus with the stem extending horizontally so that the foot will contact tile edge of a tile held in contact with two referent-e strips. The dial is graduated to read to 0.001 inch and has a stem travel of approximately 1 inch. The stem of the gage is adjustable by means of a slide adapter. The contact foot of the indicator stem is 0.25±0.01 inch in diameter which exerts a total force on the specimen of not more than 3 ounces.

3.1.2 *Index strips.* One of the index strips for holding the specimen in proper position is located horizontally along the bottom of the base plate and the other is attached on the left side of the plate and at an angle of exactly 90° to the horizontal strip. The lower end of the index strip on the left-hand side is ½ to ¾ inch above the horizontal strip to permit the stem of the dial indicator to project between the two strips so that the foot contacts the edge of the tile near the corner. The angle between the two index strips shall be exactly 90° so that, the vertical edge of a square tile pressed against the two strips will contact the foot of the stem of the dial indicator at a 90° angle.

3.1.3 *Reference gage.* A reference gage as shown in figure 2231B for use in setting the dial indicitor to zero and checking the angle of the index strips.

4. PROCEDURE

4.1 The reference gage shall be placed in the apparatus and pressed firmly against the two index strips. The reference gage should fit evenly against the strips at all contact surfaces if the index strips are at exactly a 90° angle to each other. If the strips are not fixed at a 90° angle, they shall be properly adjusted.

4.2 The reference gage shall be pressed firmly against the index strips without undue pressure. The stem of the dial indicstor shall be retracted approximately ½ inch or one-half of its total travel, the stem fastened into position with the foot against the edge of the reference gage, and the indicator dial set, at zero. The adjustment of the stem of the indicator is made by releasing the nut on the slide adapter and sliding the indicator along the slotted guide to the desired position and locking in place.

4.3 The reference gage shall be removed from the apparatus. The specimen shall be placed on the bedplate with the entire length of one of the edges held flush against the horizontal index strip and approximately 1 inch from the left-hand index strip. The stem of the dial indicator shall be held in the retracted position and the specimen moved to the left while maintaining contact with the horizontal index strip, until the left-hand edge of the specimen is in contact with the left-hand strip. While pressing the specimen firmly against the vertical index strip, wit bout. distortion of the

material, the dial indicator stem shall be released gently, without impact, until the foot contacts the edge of the specimen. The out-of-square shall be read from the indicator scale to the nearest 0.001 inch. Measurements shall be made on all four corners of the specimen and the maximum value obtained recorded to the nearest, 0.001 inch as the out-of-square of the specimen.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, five specimens from each test unit shall be tested.

5.2 The out-of -square of the test unit, shrill be the largest of all the values obtained from the specimens tested.

5.3 The out-of-square of the test unit shall be recorded to the nearest 0.001 inch.

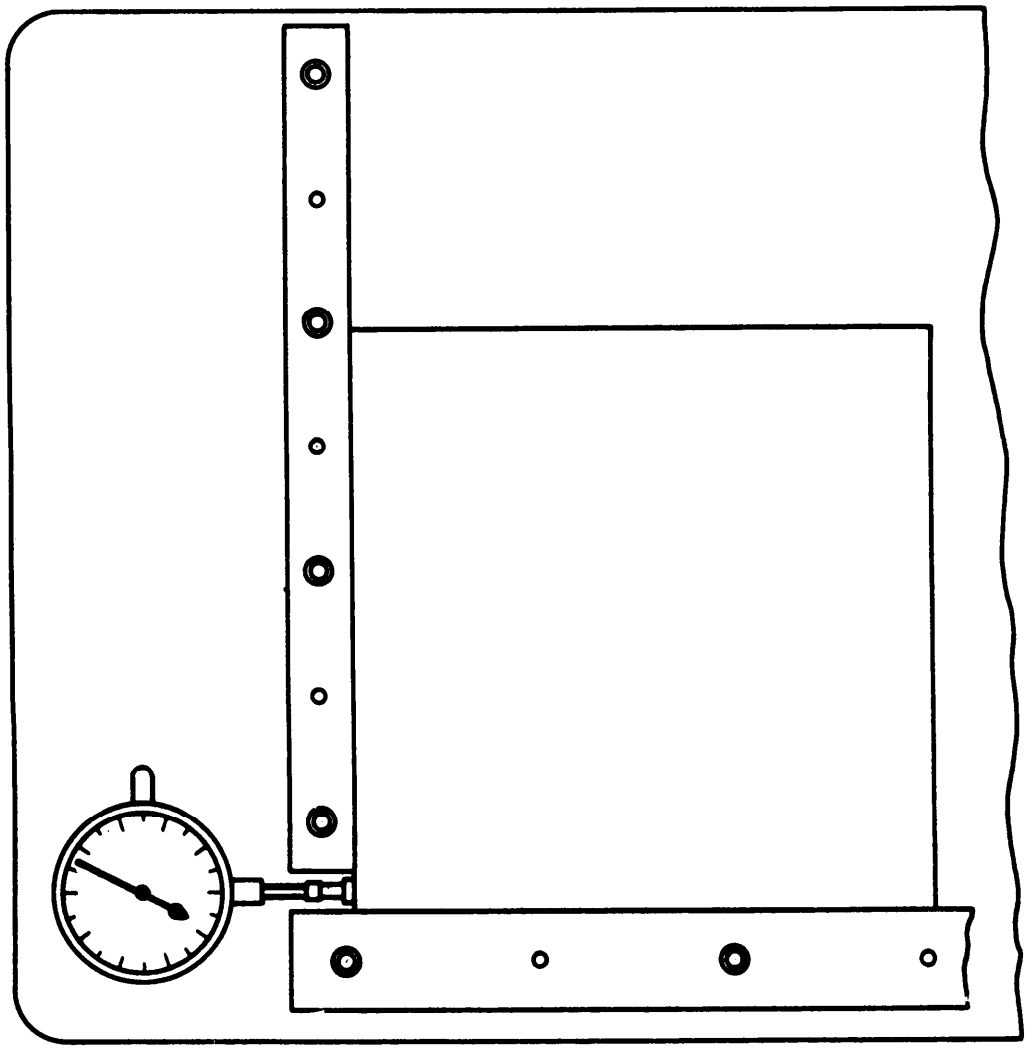

FIGURE 2421. Squareness measuring apparatus. (For reference gage, see fig. 2231B.)

THEOLOGICAL TESTS, GENERAL

1. SCOPE

This group of methods is intended for use in determining the theological properties of resilient nontextile floor coverings.

2. SPECIMEN

2.1 Specimens for theological tests shall be free from defects or damage that may interfere with the property for which test is made. The shape and dimensions of specimens shall be as described in the individual test. method.

2.2 In the case of tile, only one specimen shall be taken from a unit for the tests described in methods 3111, 3131, 3311, and 3411.

3. PROCEDURE

3.1 Unless otherwise specified in the detail specification, tests for rheological properties shall be made on specimens conditioned as described in method 1041, and tests shall be carried out under the same conditions.

3.2 Unless otherwise specified in the detail specification or applicable test method, when specimens are conditioned in a water bath as described in method 1041, tests for theological properties shall be made while immersed or immediately after each specimen is removed from the water.

3.3 Specimens for theological tests shall be prepared as described in methods 1011 to 1031, inclusive, as applicable.

FLEXIBILITY, MANDREL METHOD

1. SCOPE

This method is intended for use in determining the flexibility of resilient nontextile floor coverings such as linoleum, felt base, and vinyl plastic.

2. SPECIMEN

2.1 The specimen shall consist of a portion of the test unit 2 inches in width and 9 inches in length.

2.2 Unless otherwise specified in the detail specification, the thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

The apparatus shall be as follows:

3.1 A mandrel of the size specified in the detail specification.

3.2 A stopwatch or other timing device that will indicate the time in seconds.

4. PROCEDURE

With the wearing surface outside, the specimen shall be bent at approximately the center around a mandrel of the specified size, 3.1, through an angle of 180° at a uniform rate, completing the bend within 3 to 5 seconds. At the end of the bending operation, the specimen shall be examined visually for breaks, cracks, or other damage.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, four specimens from each test unit shall be tested: two specimens with the long dimension parallel to the grain of the unit and two specimens with the long dimension perpendicular to tile grain of the unit.

5.2 The number of specimens tested from each test unit and the number that show cracks, breaks, or other damage shall be recorded.

FLEXIBILITY, FOLDING METHOD

1. SCOPE

This method is intended for use in determining the flexibility of resilient nontextile floor coverings such as rubber and plastic matting. The method consists of folding the material on itself, applying a load to the fold, and examining the fold visually for damage.

2. SPECIMEN

2.1 The specimen shall consist of a portion of the test unit at least 12 by 12 inches.

2.2 Unless otherwise specified in the detail specification, the thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

The apparatus shall be as follows:

3.1 A 100-pound weight.

3.2 A board 12 inches in length and about 4 inches in width.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the load shall be applied to the specimen for 300310 seconds.

4.2 The specimen shall be folded on itself along the center and placed on a flat surface. If the material is corrugated, the specimen shall be folded so that the corrugations are on the outside of the fold. The board shall be placed over the fold with the long dimension parallel to the long dimension of the fold. The 100-pound weight shall be placed on the board so that the full weight rests on the fold of the specimen. The weight shall remain on the specimen for the required time, 4.1. At the end of the required time, the specimen shall be removed and the fold examined visually for cracks, breaks, or other damage.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, two specimens from each test unit shall be tested.

5.1.1 If the material is corrugated, one specimen shall be folded with the fold parallel to the corrugations, and one specimen shall be folded with the fold perpendicular to the corrugations.

5.1.2 If the material is not corrugated, one specimen shall be folded with the fold parallel to the long dimension of the unit, and one specimen shall be folded with the fold perpendicular to the long dimension of the unit.

5.2 The number of specimens tested from each test unit and the number that show cracks, breaks, or other damage shall be recorded.

DEFLECTION

1. SCOPE

This method is intended for use in determining the deflection of resilient nontextile floor coverings such as vinyl asbestos and asphalt tile.

2. SPECIMEN

2.1 The specimen shall consist of a portion of the test unit, 2.00±0.05 inch in width and 9 inches in length.

2.2 Unless otherwise specified in the detail specification, the thickness of the specimen shall be the thickness of the material undergoing test. In the case of tile, only one specimen shall be taken from a unit.

3. APPARATUS

The apparatus shall be as follows:

3.1 A tension testing machine, method 4111, with the grips replaced by the apparatus described in 3.2.

3.2 An apparatus consisting of two parallel rods, ¼ inch in diameter, spaced 8±1/16 inch apart from center to center for supporting the specimen as a simple beam, and a loading bar of the same dimension through which force is applied to the specimen midway between the supports. The supports and loading bar are no shorter than the width of the specimen. The loading bar replaces the grip of the machine through which force is applied, and the supports replace the other grip of the testing machine, 3.1. The supports and loading bar are mounted parallel to each other in the machine and in such a manner that the force is applied to the specimen midway between the parallel supports when the specimen rests on the supports.

3.3 Extensometer, scale, or other device, graduated to 0.05 inch for measuring the deflection of the specimen.

4. PROCEDURE

With the wearing surface facing upward, the specimen shall be placed on the two parallel supporting rods in the testing machine so that its midpoint coincides with the midpoint between the supports. The loading bar shall be placed in position so that the force will be applied to the specimen midway between the lines of support. The machine shall be started and the force applied through the loading bar perpendicular to the specimen and midway between the lines of support so that the rate of travel of the loading bar is 4±1/8 inch per minute. The force shall be applied until the specimen breaks or bends to the extent that it will pull out of the supports. The amount. of deflection at the center of the span shall be followed continuously by means of the extensometer, scale, or other device. At the moment the specimen breaks or starts to pull out of the supports, the deflection shall be read from the extensom - eter, scale, or other device, and the value recorded to the nearest 0.05 inch.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, six specimens from each test unit shall be tested: three specimens with the long dimension parallel to the grain of the test unit, and three specimens with the long dimension perpendicular to the grain of the test unit.

5.2 The deflection of the test unit shall be the smallest of the values obtained from the specimens tested.

5.3 The deflection of the test unit shall be recorded to the nearest 0.05 inch.

INDENTATION, SPHERICAL FOOT

1. SCOPE

This methods intended for use in determining the indentation of resilient nontextile floor coverings such as vinyl asbestos and asphalt tile.

2. SPECIMEN

2.1 Tile. The specimen shall consist of a single unit from the test unit.

2.2 Roll. The specimen shall consist of a portion of the test unit not less than 6 by 6 inches.

2.3 Unless otherwise specified in the detail specification, the thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

The apparatus shall be as follows:

3.1 An indentation tester consisting essent ially of an indentor acting under a dead weight and a suitable dial indicator for measuring the depth of indentation. A suitable apparatus is shown in figure 3211.

3.1.1 The indenter consists of a vertical rod having at its lower end a hemispherical point 0.2500±0.0005 inch in diameter. The upper end of the indentor rod activates a dial indicator from which the depth of penetration of the indenter can be read.

3.1.2 The indentor is rigidly mounted in a vertical position and in such a manner that an initial dead-weight load of 2.00±0.02 pound and a total dead-weight load of 30.00±0.25 pound can be applied without impact to the specimen through the indentor. Means shall be provided for applying the total load to the specimen in a period of 5 seconds or less after application of the initial load.

3.1.3 The dial indicator attached to the upper end of the indentor is equipped with a scale that is graduated to read the depth of penetration to 0.0001 inch.

3.1.4 A rigid base and supports maintain the indentor in a vertical position during application of the loads.

3.2 A flat glass or steel plate at least ¼ inch in thickness for supporting the specimen during the test.

3.3 A stopwatch or other timing device that will indicate the time in seconds.

4. PROCEDURE

4.1 The specimen shall be placed on the steel or glass plate with the wearing surface upward. The hemispherical end of the indenter shall be placed on the wearing surface of the specimen, an initial load of 2 pounds gently applied to the indentor, and tile scale of the dial indicator set at zero reading.

4.2 Within 5 seconds after setting the dial indicator to zero, the total load of 30 pounds, that is, the initial load plus 28 pounds, shall be applied to the indentor without removing the initial load. After the 30-pound load has been applied to the specimen for (60±1 second, the indentation shall be read from the scale of the dial indicator to the nearest 0.0001 inch. After the 30-pound load has been applied to the specimen for 600±5 seconds, the indentation shall again be read from the scale of the dial indicator to the nearest 0.0001 inch.

4.3 One-minute and ten-minute readings shall be taken at three equally spaced places over each specimen and the values recorded to the nearest 0.0001 inch. The median of the three 1-minute readings and the median of the three 10-minute readings shall be recorded separately to the nearest 0.0001 inch as the indentation of the specimen at 1 minute and 10 minutes, respectively.

4.4 When the specimen is conditioned and tested in a water bath, the total time for conditioning and determining the indentation of the specimen shall not exceed 60 minutes.

5. RESULTS

5.1 Unless otherwise specified in the detail Specification, two specimens from each test unit shall be tested.

5.2 The indentation of the test unit shall be the average of the median values obtained from the specimens tested.

5.3 The indentation of the test unit shall be recorded to the to the nearest 0.0001 inch.

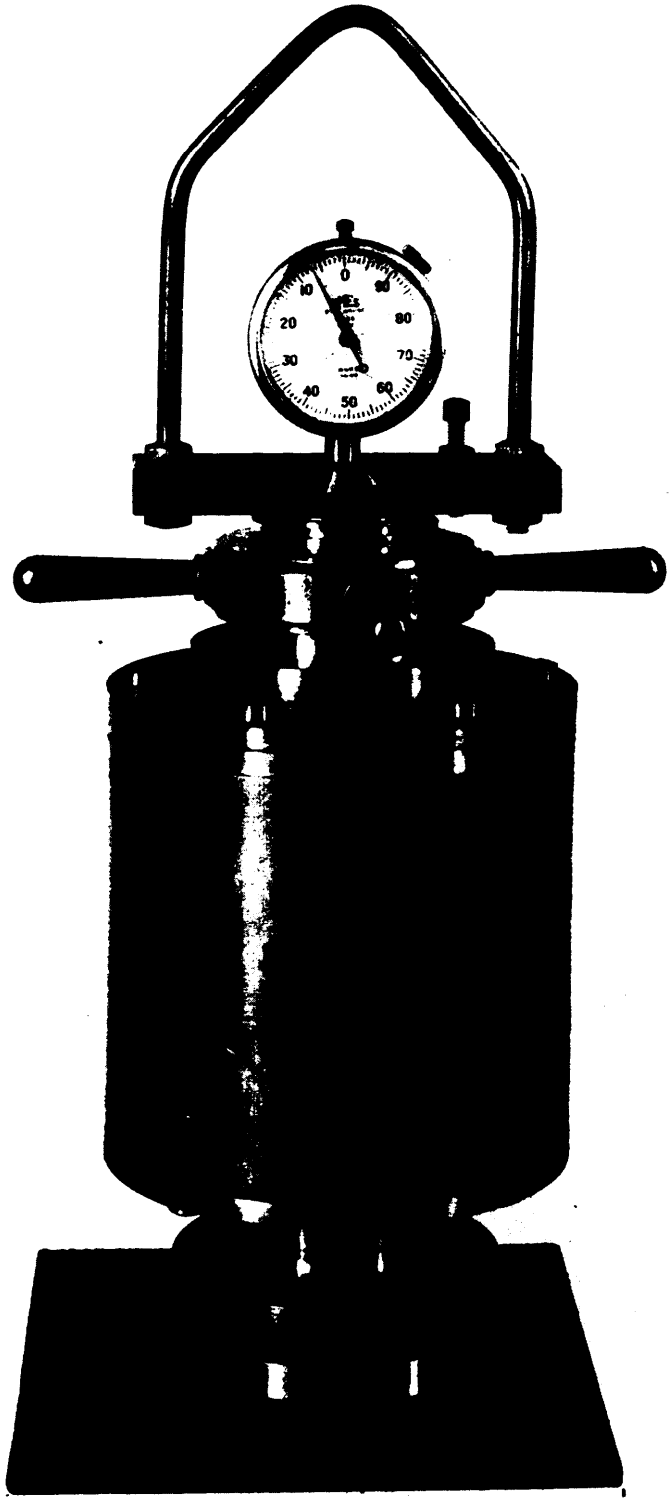

FIGURE 3211. Indentation tester, spherical foot.

INDENTATION, FLAT FOOT

1. SCOPE

This method is intended for use in determining the indentation of resilient nontextile floor coverings such as vinyl plastic, cork, felt-backed materials, and linoleum. The indentation is determined as percentage of the original thickness of the specimen.

2. SPECIMEN

2.1 The specimen shall consist of a portion of the test unit at least 2 by 2 inches if rectangular, or 2 inches in diameter if circular in shape.

2.2 Unless otherwise specified in the detail specification, the thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

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The apparatus shall be as follows:

3.1 An indentation tester consisting of an indenter acting under a dead weight, a dial indicator for measuring the depth of indentation, a rigid metal plate for supporting the specimen, ant] a rigid metal frame for supporting the weight and indentor. A suitable apparatus is shown in figure 3221.

3.1.1 The indentor consists of a steel bar rigidly supported vertically in such a manner that the face of the lower end (foot) is parallel to the specimen support, 3.1.3. The face of the indentor foot that contacts the specimen is flat and buffed smooth but not rounded. The foot of the indentor should be detachable to permit the use of varying foot sizes. 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 from which the depth of penetration of the indenter can be read. The weight of the indentor shall be 1±0.01 pound,

3.1.2 The dial indicator attached to the upper end of the indenter is equipped with a scale graduated to read the depth of indentation to 0.001 inch.

3.1.3 The metal 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.

3.2 A stopwatch or other timing device that will indicate the time in seconds.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the diameter of the lower end of the indent or shall be 0.178 inch. The load applied to the specimen shall be as specified in the detail specification.

4.2 Unless otherwise specified in the detail specification, the time of application of the weight shall be 30±2 seconds.

4.3 The thickness of the specimen at the center shall be determined as described in method 2111 and the value recorded to the nearest 0.001 inch as T_1.

4.4 The specimen shall be placed flat on the supporting plate of the apparatus with the wearing surface facing upward. The indentor foot of the required size, 4.1, 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, the specified load, 4.1, applied to the specimen by means of the weight release, and the load maintained for the required time, 4.2. At the end of the required time of application of the weight, the indentation shall be read from the scale of the dial indicator and the value recorded to the nearest 0.001 inch as T_2.

4.4.1 When the specimen is conditioned and tested in a water bath, the total time for conditioning and determining the indentation of the specimen shall not exceed 60 minutes.

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5. RESULTS

5.1 Calculation. The indentation of the specimen shall be calculated as follows:

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

where:

T_1 is the thickness of the uncompressed specimen in inches.

T_2 is the indentation of the specimen in inches.

5.2 Unless otherwise specified in the detail specification, three specimens from each test unit shall be tested.

5.3 Unless otherwise specified in the detail specification, the indentation of the test unit shall be the average of the values obtained from the specimens tested.

5.4 The indentation shall be recorded to the nearest 0.1 percent.

5.5 The size of the indentor foot, the load applied, and the time of application of the load shall be recorded.

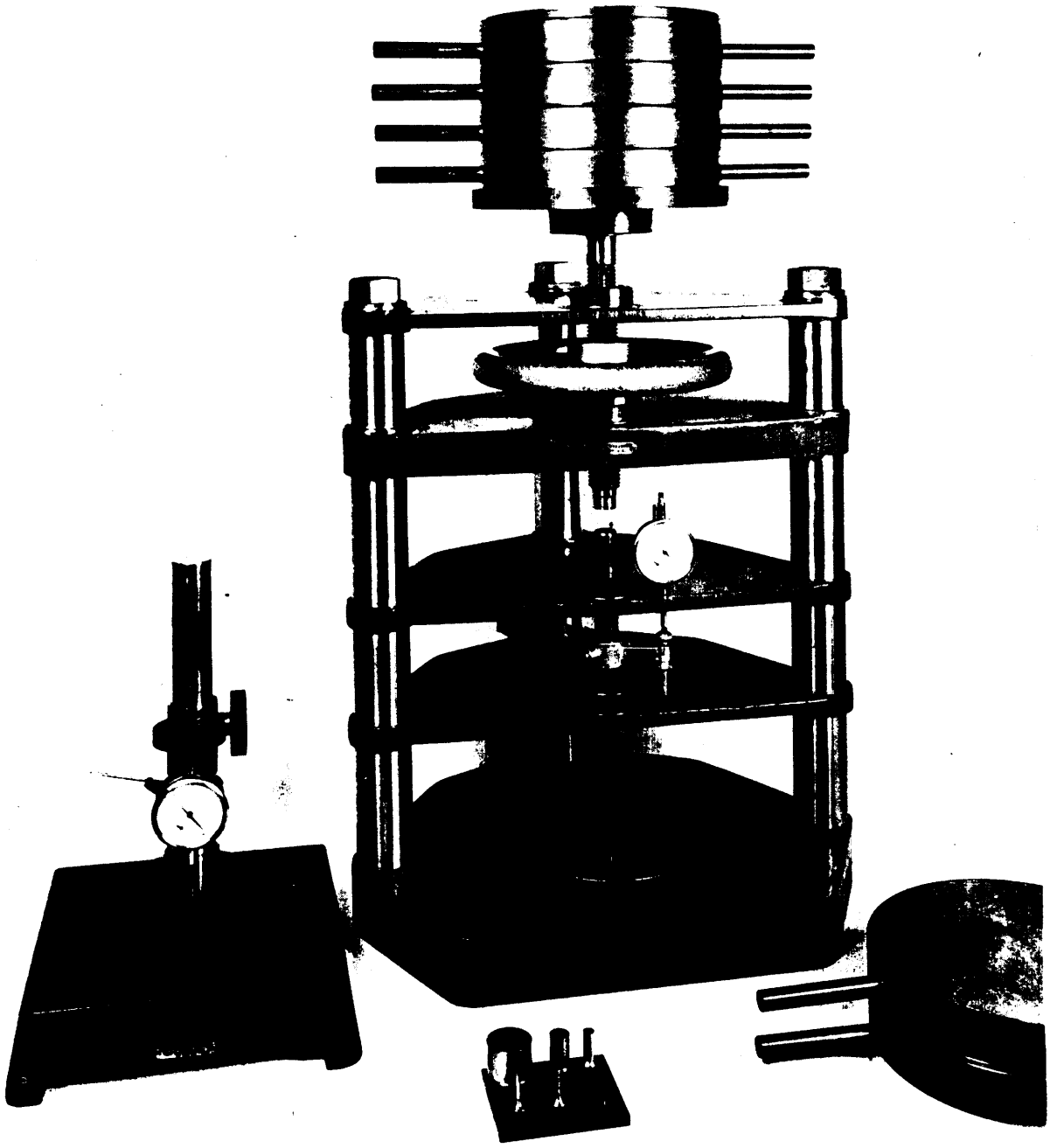

FIGURE 3221. Indentation tester, flat foot.

INDENTATION, RESIDUAL

1. SCOPE

This method is intended for use in determining the residual indentation of resilient nontextile floor coverings such as plastic, linoleum, and felt-backed coverings.

2. SPECIMEN

2.1 The specimen shall consist of a portion of the test unit at least 2 by 2 inches if rectangular, or 2 inches in diameter if circular.

2.2 Unless otherwise specified in the detail specification, the thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

The apparatus shall be as described in method 3221 except that the dial indicator for reading the indentation is not needed.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the diameter of the lower end of the indentor shall be 0.178 inch. The load applied to the specimen shall be as specified in the detail specification.

4.2 Unless otherwise specified in the detail specification, the time of application of the weight shall be 30±2 seconds.

4.3 Unless otherwise specified in the detail specification, the specimen shall be permitted to rest 60±1 minute from the removal of the load to the measurement of the final thickness.

4.4 The thickness of the specimen at the center shall be determined as described in method 2111 except that the size of the presser foot shall be smaller than the indentor foot. The value shall be recorded to the nearest 0.001 inch as T_1.

4.5 The specimen shall be placed flat on the supporting plate with the wearing surface up. The indentor foot of the required size, 4.1, shall be lowered gently, without impact, until it contacts the surface of the specimen where the thickness measurement was made. The specified load, 4.1, shall be immediately applied to the specimen without impact by means of the weight release and maintained for the required time, 4.2. At the end of the required time of application of the weight, the weight shall be immediately removed and the specimen set aside to rest for the required time, 4.3, before the final thickness is measured. At the end of the rest period, thickness measurement as described in 4.4 shall again be made at the same point where the original measurement was made, and the value recorded as T_2.

4.6 When the specimen is conditioned and tested in a water bath, the total time for conditioning and determining the indentation of the specimen shall not exceed 60 minutes.

5. RESULTS

5.1 Calculation. The residual indentation of the specimen shall be calculated as follows:

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

where:

T_1 is the thickness of the uncompressed specimen in inches.

T_2 is the thickness of the specimen in inches after resting for the required time.

5.2 Unless otherwise specified in the detail specification, three specimens from each test unit shall be tested.

5.3 Unless otherwise specified in the detail specification, the residual indentation of the test unit shall be the average of the values obtained from the specimens tested.

5.4 The residual indentation of the test unit shall be recorded to the nearest 0.1 percent.

5.5 The size of the indentor foot, the weight applied to the specimen, the time of application of the weight, and the rest period after removal of the weight shall be recorded.

RECOVERY FROM INDENTATION

1. SCOPE

This method is intended for use in determining the amount of recovery of resilient nontextile floor coverings such as cork tile after release of the weight, of indentation. The recovery is determined as a percentage of the original thickness of the material.

2. SPECIMEN

2.1 The specimen shall consist of a portion of the test unit at least, 2 by 2 inches if rectangular, or 2 inches in diameter if circular.

2.2 Unless otherwise specified in the detail specification, the thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

The apparatus shall be as described in method 3221 except that the dial indicator for reading the indentation is not needed.

4. PROCEDURE

4.1 The size of the indenter foot used and the weight applied to the specimen shall be as specified in the detail specification.

4.2 Unless otherwise specified in the detail specification, the time of application of the weight shall be 600±10 seconds.

4.3 Unless otherwise specified in the detail specification, the specimen shall be permitted to rest 60±1 minute from the time of removal of the load to measurement of the final thickness.

4.4 The thickness of the specimen at the center shall be determined as described in method 2111 except that the size of the presser foot shall be smaller than the indentor foot. The value shall be recorded to the nearest 0.001 inch as T_1.

4.5 The specimen shall be placed flat on the supporting plate with the wearing surface upward. The indenter foot of the required size, 4.1, shall be lowered gently, without impact, until it contacts the surface of the specimen at the point where the thickness measurement was made. The required load, 4.1, shall be immediately applied to the specimen without! impact by means of the weight release and maintained for the required time, 4.2. Immediately at the end of the required time of application of the weight, the weight shall be removed and the thickness again measured, within 10 seconds, as described in 4.4 at the same point where the original measurement was made, and the value recorded as T_2.

4.6 The specimen shall be set aside to rest for the required time.

4.7 Immediately at the end of the rest period, thickness measurement shall again be made at the same point where previous measurements were made, and the value recorded as T_3.

5. RESULTS

5.1 Calculation. The recovery of the specimen shall be calculated as follows:

$$\text{Recovery, percent} = \frac{T_3 - T_2}{T_1} \times 100$$

where:

T_1 is the thickness of the uncompressed specimen in inches.

T_2 is the thickness of the specimen after compression in inches.

T_3 is the thickness of the specimen after recovery in inches.

5.2 Unless otherwise specified in the detail specification, three specimens from each test unit shall be tested.

5.3 Unless otherwise specified in the detail specification, the recovery of the test unit shall be the average of the values obtained from the specimens tested.

5.4 The recovery shall be recorded to the nearest 0.1 percent.

5.5 The size of the indenter foot, the weight applied to the specimen, the time of application of the weight, and the recovery period shall be recorded.

IMPACT

1. SCOPE

This method is intended for use in determining the resistance to impact of resilient nontextile floor coverings such as vinyl asbestos and asphalt tile.

2. SPECIMEN

The specimen shall consist of a portion of the test unit 6 by 6 inches.

3. APPARATUS

The apparatus shall be as follows:

3.1 An impact testing apparatus consisting essentially of a specimen support, weights, and a device for guiding a. freely falling weight. A suitable apparatus is shown in figure 3311.

3.1.1 The specimen support consists of three steel balls, each 1 inch in diameter, equally spaced over a rigid steel base so that a circle drawn through the centers of the balls is 5 inches in diameter. The three balls shall be firmly attached to the base plate and the balls and the base plate shall weigh not less than 10 pounds.

3.1.2 The weights consist of a l-inch-diameter steel ball, weighing 0.143±0.002 pound, for testing 1/8-inch floor covering, and a l-inch-diameter steel cylinder, weighing 0.350±0.005 pound and having a spherical end, for testing 3/16- and ¼-inch material.

3.1.3 A slotted tube, graduated in ¼-inch divisions, about 20 inches in height and of sufficient size to permit the weight to fall through it freely, is mounted vertically over the specimen support so as to guide the freely falling weight to the center of the circle formed by the three balls.

3.2 Zinc oxide paste made by mixing powdered zinc oxide with water to form a thin paste.

4. PROCEDURE

4.1 The height from which the weight is dropped and the number of times the weight is dropped shall be as specified in the detail specification.

4.2 A thin coating of zinc oxide paste shall be spread over the center of the wearing surface of the specimen so as to form a circle 3±1/8 inch in diameter. With the coated side down, the specimen shall be immediately centered over the three balls attached to the specimen support so that the falling weight will strike the specimen at the center. The required weight, 3.1.2, shall be dropped freely through the guide tube from the specified height the specified number of times, 4.1, so that it will strike the specimen at the center. Care should be taken to return the specimen to its original position after each impact. After the final drop, the specimen shall be removed and examined for breaks or cracks that extend beyond the coated circle. The coated surface shall be examined under good illumination without flexing the specimen. A second specimen shall be tested by placing it on the supports so that the grain is at 90° to that of the first specimen.

4.2.1 When the specimen is conditioned in water, it shall be removed from the water, immediately wiped dry, and coated with zinc oxide paste as described in 4.2, requiring not more than 15 seconds to apply the paste, and immediately tested as described in 4.2.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, two specimens from each test unit shall be tested, one with the grain at 90° to the other.

5.2 The number of specimens tested from each test unit and the number that show breaks or cracks extending beyond the circle of zinc oxide shall be recorded.

5.3 The weight used, the height from which the weight was dropped, and the number of drops shall be recorded.

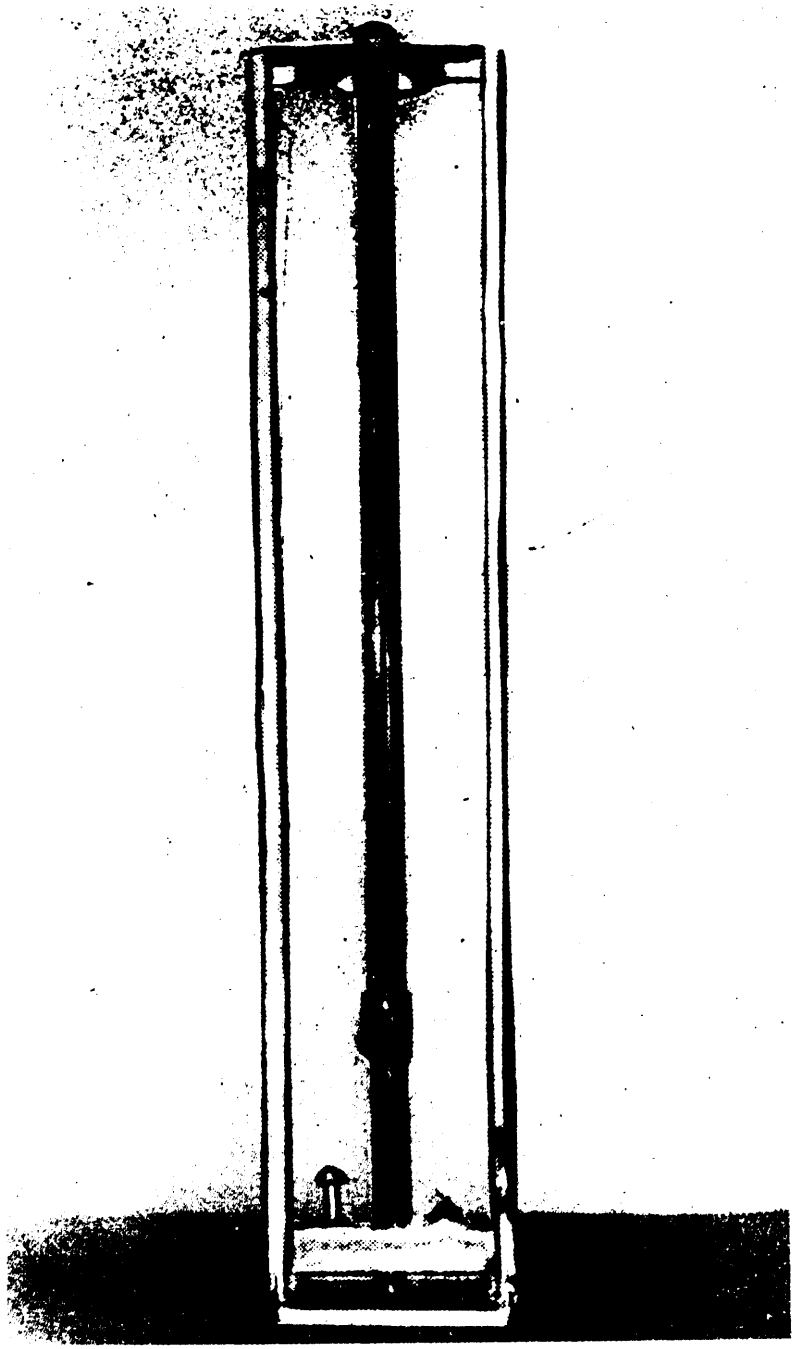

FIGURE 3311. Impact tester.

CURL

1. SCOPE

This method is intended for use in determining the amount of curl of resilient nontextile floor coverings such as vinyl asbestos and asphalt tile.

2. SPECIMEN

2.1 . The specimen shall consist of a portion of the test unit 6 by 6 inches.

2.2 Unless otherwise specified in the detail specification, the thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

The apparatus shall be as follows:

3.1 A straightedge, or similar device, equipped with a dial gage graduated to 0.001 inch for measuring the distance from the straightedge to the center of the specimen. The straightedge shall be of sufficient length to extend diagonally 'across the specimen. The weight of the straightedge and gage shall not exceed 0.50 pound. A suitable apparatus is shown in figure 3411.

3.2 Flat slabs of limestone or similar porous material having a water absorption of not less than 4 percent nor' more than 8 percent by weight when immersed in water at room temperature for 120 hours. The dimensions of the slabs shall be at least 6¾ by 1¼ inches.

3.3 A water bath equipped so that it will support one or more of the slabs described in 3.2 in a horizonta] position so that the slab is partially immersed in the water, leaving ¾ to 1 inch of the thickness above the surface of the water. Means for maintaining the water at a temperature of 23°±5° C. (73.4°±9° F.).

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the specimen shall be exposed at room temperature (see method 1041) for 120±½ hour.

4.2 The specimen shall be placed on the flat slab of limestone or other porous material, the measuring apparatus placed diagonally across the specimen with the ends resting on opposite corners, the stem of the dial indicator adjusted so that the foot contacts the specimen at the center, and the reading of the scale recorded. Measurements shall be made on both diagonals of the specimen.

4.3 With the specimen resting on the surface, the slab shall be partially immersed in the water bath so that the surface of the slab in contact, with the specimen is ¾ to 1 inch above the surface of the water, and allowed to remain in the water bath for the required time at the required temperature, 4.1. At the end of the exposure period, the measurements on the two diagonals of the specimen shall be repeated. The difference between the initial and final measurements shall be recorded as the amount of curl. The average of the values obtained from the two diagonals shall be recorded to the nearest 0.001 inch as the curl of the specimen.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, two specimens from each test unit shall be tested.

5.2 The curl of the test unit shall be the largest of the values obtained from the specimens tested.

5.3 The curl shall be recorded to the nearest 0.001 inch.

5.4 The temperature of the test and the time of exposure of the specimen shall be recorded.

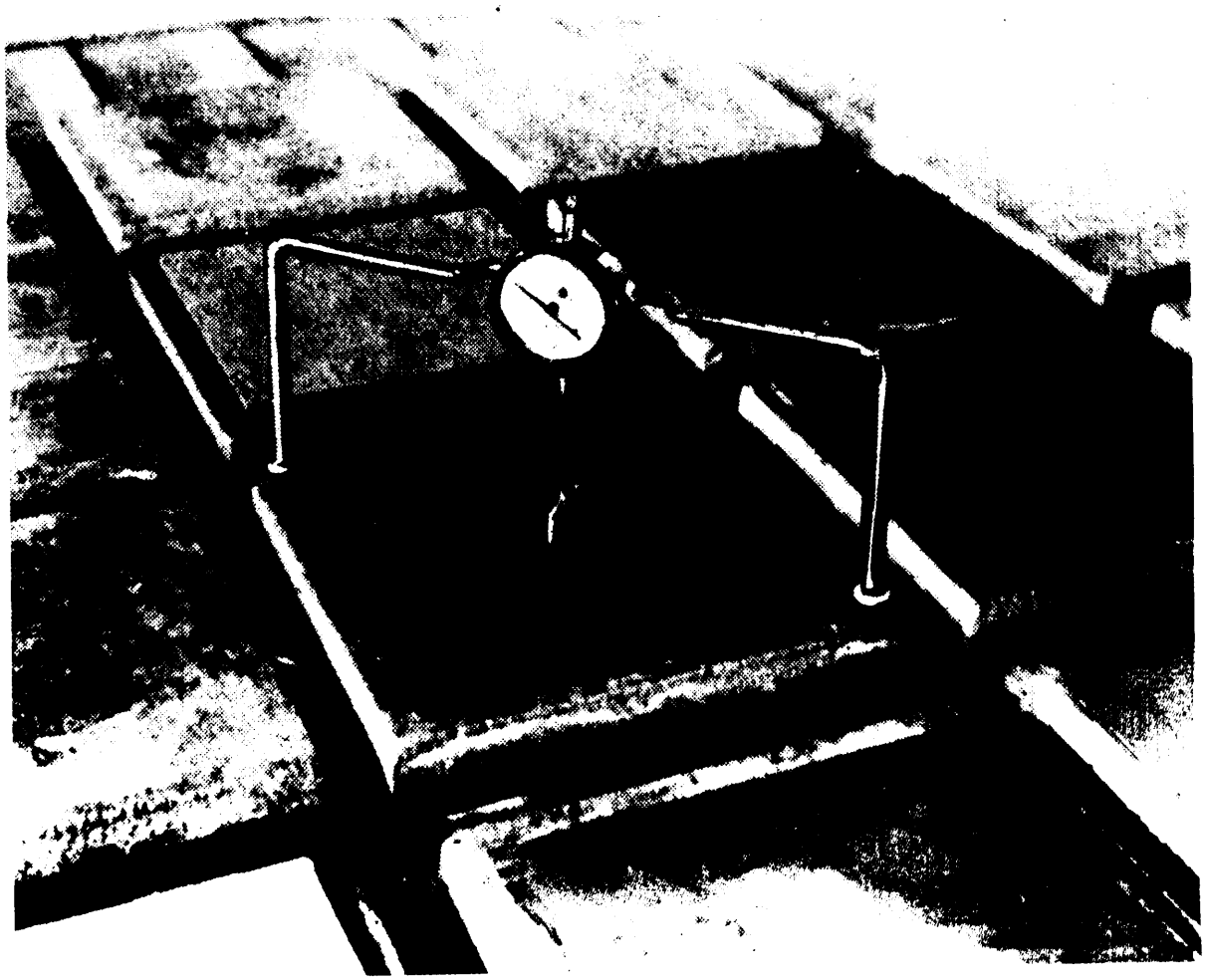

FIGURE 3411. Dial gage.

DUROMETER HARDNESS

1. SCOPE

1.1 This method describes the procedure for determining the hardness of elastomeric floor coverings using a durometer. The test is empirical and is intended primarily for control purposes. No simple relationship exists between indentation hardness determined by this method and ally fundamental property of the material tested. For referee testing, it is recommended that method 3531 be used.

1.2 For the purpose of this method, a durometer is any instrument that conforms to the requirements in 3.

2. SPECIMEN

2.1 The specimen shall consist of a portion of the test unit at, least 1.0 by 1.0 inch (25 by 25 mm.) or 1.0 inch (25 mm.) in diameter if circular in shape.

2.1.1 Unless otherwise specified in the detail specification, the specimen shall be at least 0.25 inch (6 mm.) in thickness. In the case of floor coverings less than 0.25 inch (6 mm.) in thickness, the specimen shall consist of a double thickness. The principal surfaces of the specimen shall be as nearly parallel as possible.

3. APPARATUS

The apparatus shall consist of a type A durometer and stopwatch.

3.1 The durometer shall have the following parts:

3.1.1 *Presser foot.* A presser foot with a hole between 0.10 and 0.13 inch (2.5 and 3.2 mm.) in diameter, centered at least *0.25* inch (6 mm.) from any edge of the foot.

3.1.2 *Indentor.* An indentor formed from hardened steel rod between 0.045 and 0.055 inch (1.15 and 1.40 mm.) in diameter, to the shape and dimensions shown in figure 3511. The indenter point projects through the hole in the presser foot.

3.1.3 *Indicator gage.* A dial gage on which the amount of extension of the indenter point beyond the face of the presser foot is read in terms of graduations ranging from zero for full extension to 100 for zero extension. The reading is 100 when the indenter point and the surface of the presser foot are pressed firmly against a hard, smooth surface, such as glass plate. At zero reading, the indentor point extends 0.097 to 0.100 inch (2.46 to 2.54 mm.) beyond the face of the presser foot.

3.1.4 *Calibrated spring.* A calibrated spring within the instrument for applying force to the indentor in accordance with the following equation:

$$\text{Force, grams} = 56 + 7.66H$$

where:

H is the hardness reading on the durometer.

When the spring is calibrated in accordance with method 3521, the measured force shall equal the force calculated by the equation within plus or minus 8 grams.

3.2 A stopwatch or other timing device that will indicate the time in seconds.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the durometer and specimens shall be conditioned as specified in method 1041.

4.2 If the material has an uneven surface that may interfere with tile test, the material shall be buffed as described in method 1021.

4.3 The specimen shall be free from mechanical damage. The specimen shall be placed on a, hard, smooth, horizontal surface. Care shall be taken to insure that the plies of double thickness specimens are in contact. The durometer shall be held in a vertical position with the point of the indenter at least 0.5 inch (12 mm.) from any edge of the specimen. The presser foot shall be lowered as rapidly as possible, without shock, keeping the foot parallel to the surface of

the specimen, and with just sufficient pressure to obtain firm contact between the presser foot and the specimen. No hardness determination shall be made with the center of the indentor point less than 0.5 inch (12 mm.) from any edge of the he specimen and no determination shall be made unless the presser foot contacts the specimen over an area having a radius of at leasat 0.25 inch (6 mm.) from the indentor point.

4.4 Unless otherwise specified in the detail specification, the scale shall be read within 1 second after the presser foot is in firm contact with the specimen unless the durometer has a maximum indicator, in which case the maximum reading may be taken at the convenience of the operator. If a reading after a time interval is specified, the presser foot shall be held in contact with the specimen, without change in position or pressure, the scale read after the required period, and the value recorded to the nearest whole scale number. Durometers having only maximum indicators cannot be used to obtain hardness values at various time intervals.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, five specimens f'rom each test unit shall be tested.

5.2 The hardness of the test unit shall be the median of the values obtained f'rom the specimens tested. For the definition of median see method 4001.

5.3 The hardness of the test unit shall be recorded to the nearest whole scale number.

5.4 If any time interval is allowed before reading the instrument, the amount shall be recorded.

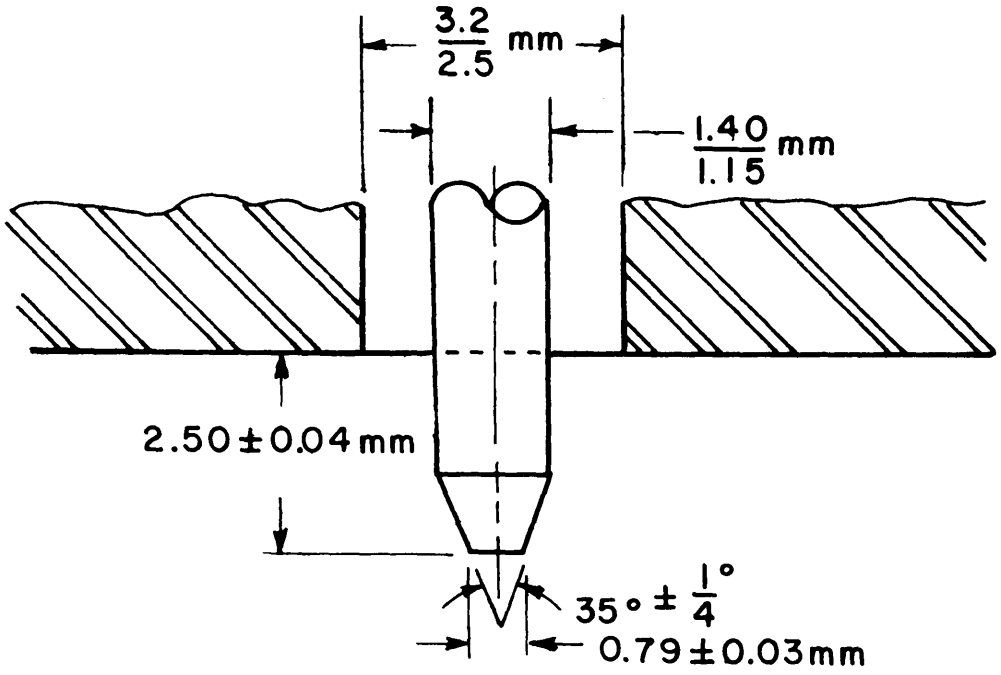

FIGURE 3511. Indentor for type A durometer.

CALIBRATION OF DUROMETER

1. SCOPE

This method is intended for use inl calibrating the type A durometer described in method 3511.

2. APPARATUS

2.1 The apparatus shall be as follows:

2.1.1 A balance of the Harvard trip type with two pans, one of which is equipped with a spacer having a small cylindrical stem approximately 0.05 inch (1.25 mm.) in diameter, slightly cupped to accommodate the indenter point, to prevent interference between the presser foot and pan when the durometer is placed in position as shown in figure 3521. The balance shall be capable of measuring or applying a force on the indenter within 0.4 gram. Other instruments specifically designed for calibration of durometers that are capable of measuring or applying this force to the indentor may be used.

2.1.2 A stand or other equipment for supporting the durometer in a vertical position on

2.1.3 Weights of such denomination as to provide varying loads from 50 to 850 grams.

3. PROCEDURE

3.1 Calibration of spring. The durometer shall be aligned on the stand with the indenter point resting on the spacer stem as shown in figure 3521. Tile weight of the sparer shall be balanced by a tare on the opposite pan of the balance. Weights shall be added to the other pan to balance the force on the indentor at various scale reachings. The measured force shall equal the force calculated by the following equation within plus or minus 8 grams:

$$\text{Force, grams} = 56 + 7.66H$$

where:

H is the hardness reading on a type A durometer.

Durometers which do not meet these requirements should be adjusted in accordance with the manufacturer's instructions. Calibration at least once a month is recommended.

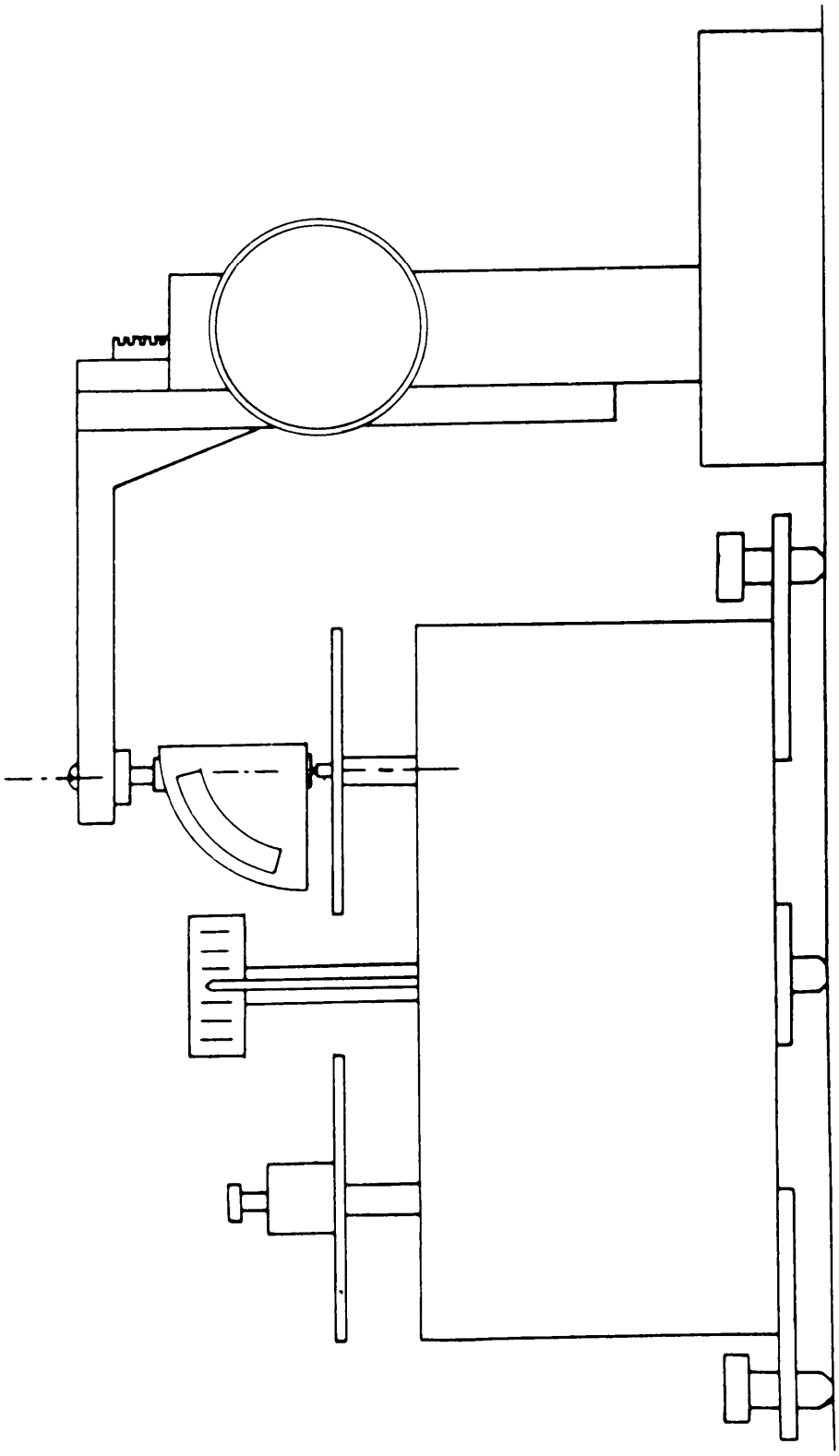

FIGURE 3521. Apparatus for calibration of durometer spring.

INTERNATIONAL HARDNESS OF ELASTOMERS

1. SCOPE

1.1 The International Hardness test is based on measurement of the penetration of a rigid ball into the elastomer specimen under specified conditions. The measured penetration is converted into International Rubber Hardness degrees, the scale of degrees being so chosen that 0 represents a material having an elastic modulus of zero, and 100 represents a material of infinite modulus. The scale chosen also fulfills the following conditions over most of the normal range of hardness:

(1) One International Rubber Hardness degree always represents approximately the same proportionate difference in Young's modulus and

(2) Readings in International Rubber Hardness degrees are approximately the same as those given by the durometer described in method 3511.

For substantially elastic isotropic materials like well-vulcanizecl natural rubbers, the hardness in International Rubber Hardness degrees bears a known relation to Young's modulus, although for markedly plastic or anisotropic rubbers the relationship will be less precisely known.

The relation betweem the difference of penet ration and the hardness expressed in International Rubber Hardness degrees is based on the following:

(1) The known relation* between penetrat ion and Young's modulus for a perfectly elastic isotropic material; namely,

$$F/M = 0.00017\ R^{0.65} P^{1.35}$$

where:

F= indenting force in kilograms.
M= Young's modulus in kilograms per square centimeter,
R= radius of ball in centimeters.
P= penetration in hundredths of millimeters.

*This relation is approximate and is included as an indication.

(2) Use of a probit (integrated normal error) curve to relate $\log_{10}M$ and the hardness in International Rubber Hardness degrees, as shown in figure 3531. The curve is defined as follows :

> The value of $\log_{10}M$ corresponding to the midpoint of the curve is equal to 1.372, that is M = 23.55 kilograms per square centimeter or 335 pounds per square inch.

The maximum slope is equal to 57 International Rubber Hardness degrees per unit increase in $\log_{10}M$.

1.2 The hardness test consists in measuring the difference between the depths of penetration of the ball into tile elastomer under a small initial load and a large final load. Two types of apparatus are described to accommodate specimens of different dimensions: (1) The standard tester for testing specimens with smooth, flat, and parallel surfaces greater than 4 mm. in thickness, preferably 8 to 10 mm., and (2) the microtester for testing specimens less than 4 mm. in thicklness, specimens thicker than 4 mm. having lateral dimensions less than those specified for the standard test, and articles that do not have flat surfaces suitable for use in the standard tester. In both procedures, the hardness in International Rubber Hardness degrees (IRHD) is derived from the difference in penetration and a table or graph constructed from the table. The value obtained on the microtester for difference in penetration must first be multiplied by the scale factor 6. Alternatively, the penetration measuring instrument may be calibrated directly in International Rubber Hardness degrees.

2. SPECIMEN

2.1 Tests intended to be comparable shall be made on specimens of the same thickness that have smooth, flat, and parallel upper and lower surfaces. Two pieces of elastomer, but not more

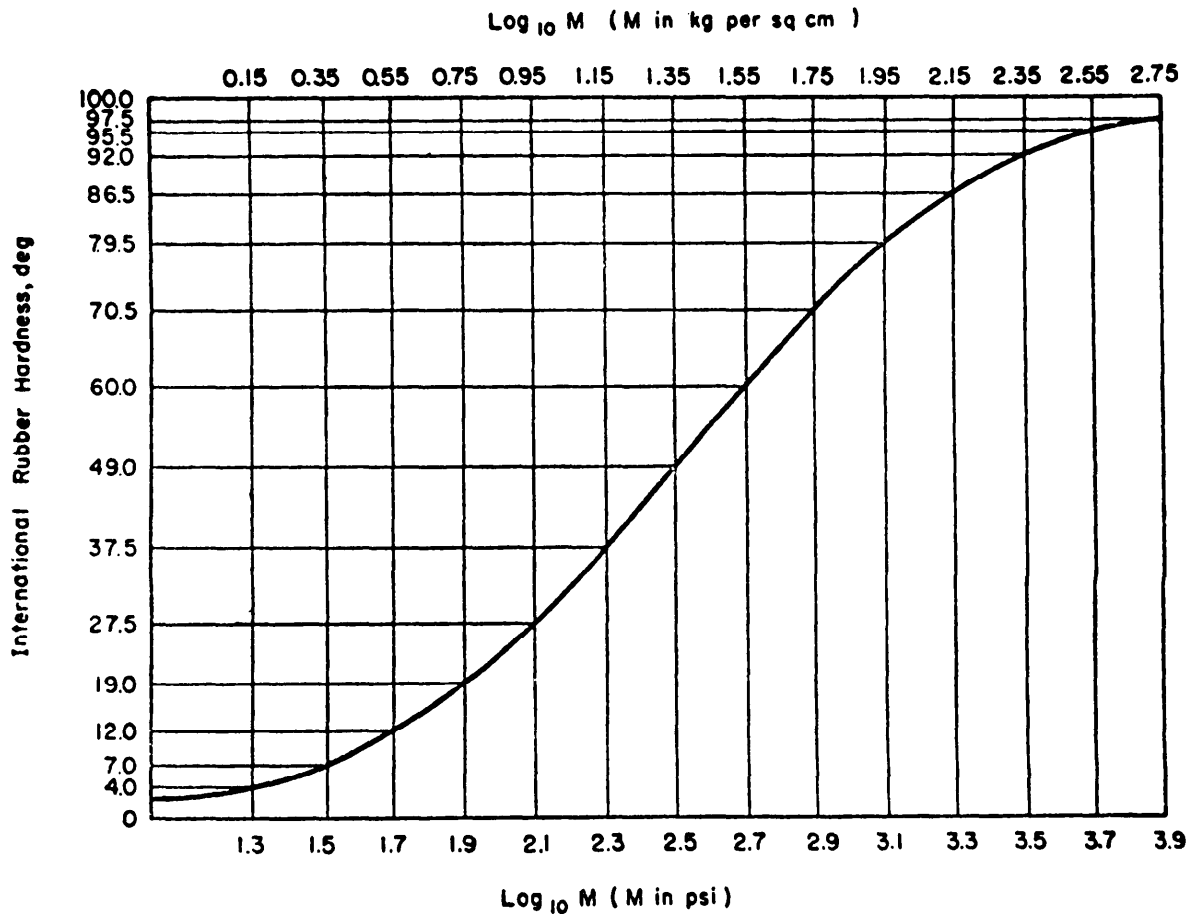

FIGURE 3531. Probit curve to relate $\log_{10}M$ and the hardness in International Rubber Hardness degrees.

than two, may be superimposed to obtain the required thickness. The dimensions of the specimens depend on the tester used to measure the hardness.

2.1.1 *Standard tester.* Unless otherwise specified in the detail specification, the specimen shall be a portion of the test unit not less than 8 mm. nor more than 10 mm. thick. When specified in the detail specification, specimens thicker or thinner may be tested, but in no case shall they be less than 3 mm. thick. The lateral dimensions of the specimen shall be not less than 20 mm. and no test shall be made at a distance from the edge of the specimen less than the appropriate distance shown in table I.

2.1.2 *Microtester.* Unless otherwise specified in the detail specification, the specimen shall be a portion of the test unit not less than 2 mm. nor more than 2.5 mm. in thickness and its lateral dimensions shall be such that no test is made at a distance less than 2 mm. from the edge. Specimens 2 to 2.5 mm. in thickness give hardness values practically identical to those obtained with the standard tester on specimens 8 to 10 mm. in thickness. When specified in the detail specification, thicker or thinner specimens may be tested but in no case shall they be less than 1 mm. thick. When specimens thicker than 4 mm. are tested on the microtester because lateral dimensions or area of flatness do

Table **I.** *Minimum distance from edge of specimen at which test is made*

Total thickness of specimen		Minimum distance from edge	
Millimeters	*Inch*	*Millimeters*	*Inch*
4	0. 16	7. 0	0. 28
6	. 25	8. 0	. 31
8	. 3	9. 0	. 35
10	. 4	10. 0	. 40
15	. 6	11. 5	. 45
25	1. 0	12. 5	. 50

not permit testing on a standard tester, the test shall be made at a distance from the edge as great as possible.

3. APPARATUS

The essential parts of the apparatus shall be as follows, the appropriate dimensions and loads being given in table II:

3.1 A vertical plunger terminating in a rigid ball.

3.2 Means for applying a minor load and a major load tot he ball; the weight of the plunger and of any fittings attached to it and the force of any spring acting on it being included in the minor and major loads in order that the loads actually applied to the ball shall be as specified.

3.3 A mechanical, optical, or electrical device graduated either in standard units of length or in International Rubber Hardness degrees for measuring the increase in depth of penetration of the plunger caused by the major load.

3.4 A flat annular-shaped foot that is rigidly fastened to the penetration-measuring device and normal to the axis of the plunger, and that during the test is forced against the specimen in order to determine accurately the position of the upper surface.

3.5 Means, e.g., an electrically operated buzzer, for gently vibrating the apparatus to overcome any slight, friction which should not exceed 5 percent of the minor load. This part may be omitted on apparatus without any friction.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, specimens shall be conditioned by the procedure described for standard conditions in method 1041 and tested in the same atmosphere. When higher or lower temperatures are specified, the specimens shall be maintained at the conditions of test for a time sufficient to reach equilibrium with the testing chamber.

4.2 If the material is too thick or has an uneven surface that may interfere with the test, the material shall be cut or buffed as described in method 1021.

4.3 The specimen shall be f ree f rom mechanical damage. The upper and lower surfaces of

Table II. *Apparatus requirements*

	Standard testers		Microtester
Diameter of ball, mm	2. 38 ± 0. 01	2. 50 ± 0. 01	0. 395 ± 0. 005
Minor load on ball, grams [a]	30 ± 2	30 ± 2	0. 85 ± 0. 05
Major load on ball, grams	534 ± 1	550 ± 1	14. 85 ± 0. 05
Total load on ball, grams	564 ± 3	580 ± 3	15. 70 ± 0. 10
Outside diameter of foot, mm	20 ± 1	20 ± 1	3. 35 ± 0. 15
Inside diameter of foot, mm	6 ± 1	6 ± 1	1. 00 ± 0. 15
Load on foot, grams [b]	850 ± 150	850 ± 150	24 ± 3 [c]

[a] Includes frictional forces in apparatus.

[b] The load should be adjusted within these limits to the actual area of the foot so that the pressure on the specimen is about 300 ± 5 grams per square centimeter.

[c] Load on foot during application of total load on ball; load on foot during application of minor load on ball, 21 gram minimum, 42-gram maximum.

Table III. *Relation between International Rubber Hardness degrees (IRHD) and indentations measured in millimeters and inches*

IRHD	Movement of plunger		IRHD	Movement of plunger		IRHD	Movement of plunger		IRHD	Movement of plunger	
	Mm.	*Mils*		*Mm.*	*Mils*		*Mm.*	*Mils*		*Mm.*	*Mils*
28	1.934	76.1	47	1.055	41.5	66	0.589	23.2	85	0.280	11.0
29	1.867	73.5	48	1.024	40.3	67	.570	22.5	86	.266	10.5
30	1.803	71.0	49	.994	39.1	68	.552	21.7	87	.251	9.9
31	1.743	68.6	50	.964	38.0	69	.534	21.0	88	.237	9.3
32	1.685	66.4	51	.936	36.8	70	.516	20.3	89	.223	8.8
33	1.630	64.2	52	.908	35.8	71	.498	19.6	90	.209	8.2
34	1.578	62.1	53	.881	34.7	72	.481	18.9	91	.195	7.7
35	1.528	60.1	54	.855	33.7	73	.464	18.3	92	.180	7.1
36	1.479	58.2	55	.830	32.7	74	.447	17.6	93	.166	6.5
37	1.433	56.4	56	.805	31.7	75	.431	17.0	94	.151	5.9
38	1.389	54.7	57	.781	30.8	76	.415	16.3	95	.135	5.3
39	1.346	53.0	58	.758	29.8	77	.399	15.7	96	.119	4.7
40	1.305	51.4	59	.735	28.9	78	.384	15.1	97	.102	4.0
41	1.265	49.8	60	.713	28.1	79	.368	14.5	98	.083	3.3
42	1.227	48.3	61	.691	27.2	80	.353	13.9	99	.060	2.4
43	1.190	46.9	62	.670	26.4	81	.338	13.3	100	.000	0
44	1.155	45.5	63	.649	25.5	82	.323	12.7			
45	1.120	44.1	64	.629	24.7	83	.309	12.2			
46	1.087	42.8	65	.609	24.0	84	.294	11.6			

the specimen shall be slightly dusted with tale. The specimen shrill be supported on a horizontal rigid surface and the foot lowered to rest on the surface of the specimen. The plunger, with the minor load on the indenting ball, shall be pressed vertically onto the specimen for 5 seconds.

4.4 If the gage is graduated directly in International Rubber Hardness degrees, the gage shall be adjusted to indicate 100. Care shall be exercised to avoid exerting any vertical pressure on the gage. The major load shall be added to the specimen and the total load on the ball maintained for 30 seconds. During the loading periods, the apparatus shall be gently vibrated if there is any friction. The reading on the gage shall be recorded as the hardness in International Rubber Hardness degrees.

4.5 If the gage is graduated in metric or inch units, the movement of the plunger caused by application of the major load for 30 seconds shall be recorded. If the microtester is used, multiply this movement by the scale factor 6. The value shall be converted into International Rubber Hardness degrees by using table III or a graph constructed from this table.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, five specimens shall be tested from each test unit.

5.2 The hardness of the test unit shall be the median of the values obtained from the specimens tested.

5.3 The hardness of the test unit shall be recorded to the nearest whole scale reading and shall be expressed in International Rubber Hardness degrees (IRHD).

5.4 The dimensions of the specimen and the number of pieces, i.e., one or two, shall be recorded.

5.5 The type of surface tested, i.e., molded, buffed, or otherwise, shall be recorded.

5.6 The type of tester used, i.e., standard or micro, shall be recorded.

5.7 The temperature of test shall be recorded.

TENSION TESTS, GENERAL

1. SCOPE

This group of tests is intended for use in determining the effect of application of tensile load to resilient nontextile floor covering. These tests are particularly applicable to floor coverings made from rubber compounds or rubberlike materials. Met nods are described for determining tensile strength, elongation, tensile stress, and tension set.

2. SPECIMEN

2.1 Specimens for tension tests shall be free from defects or damage that may interfere with the property for which the test is made.

2.2 A dumbbell specimen as described in method 4111 or a straight specimen as specified in the detail specification shall be used for tension tests. Preparation of the specimen is described in detail in method 4111.

2.3 Unless otherwise specified in the detail specification or method of test, the specimen shall be cut parallel to the long dimension for floor covering such as matting, and parallel to the grain for tiles.

3. DEFINITIONS

3.1 Tensile strength. Tensile strength is the force per unit of the original cross-sectional area of the unstretched specimen which is applied at the time of rupture of the specimen. It is calculated as follows:

$$\text{Tensile strength} = \frac{P}{WT}$$

where:

P is force in pounds at break.
W is width of the specimen in inches.
T is thickness of the specimen in inches.

For example, if a specimen 0.25 by 0.10 inch in cross section breaks at a force of 50 pounds, the tensile strength would be 50 divided by (0.25 X 0.10) which is equal to 2,000 pounds per square inch. When a stress is applied to a specimen, the specimen stretches with an accompanying reduction in cross-sectional area. Since precise measurements of the cross-sectional area of the specimen cannot be made at the moment the specimen breaks, calculation of the tensile strength at break is based on the cross-sectional area of the specimen before application of any force.

3.2 Elongation. Elongation is the extension between bench marks produced by a tensile force applied to the specimen, and is expressed as percentage of the original distance between the marks on the unstretched specimen. Ultimate elongation is the elongation at the moment of rupture. For example, if a l-inch length is marked on the unstretched specimen and the specimen is stretched until the marks are 3 inches apart, elongation is 3 — 1 = 2 inches, or 200 percent.

3.3 Tensile stress. Tensile stress is the force per unit of the original cross-sectional area of the unstretched specimen required to stretch the specimen to a stated elongation. It is expressed in pounds of tensile force per square inch at the stated elongation; for example, 400 pounds per square inch at 200 percent elongation. The tensile stress for a specified elongation is sometimes designated by the term "modulus.)"

3.4 Tension set. Tension set is the elongation remaining after a specimen has been stretched and held at a specified elognation for a definite period of time, then relieved of the force and allowed to rest for a definite period of time. It is expressed as percentage of the original length or distance between benchmarks on the unstretched specimen. For example, a specimen is stretched from 1 to 3 inches for a period of 10 minutes and then released. The length after the 10-minute rest is 1.20 inches, so that the set under these conditions is 0.20 inch or 20 percent.

3.5 Median. If numerical values are arranged in an ascending or descending order, the median is (1) the middle value of the series if the number of values is odd, and (2) the mean of

the two middle values if the number of values is even.

4. PROCEDURE

4.1 When tensile strength, elongation, and tensile stress are specified in the detail specification, these tests shall be made on the same specimen during a single test.

4.1.1 The number of specimens required for determining any of the properties in 4.1 shall be used for determining the other two properties.

4.2 Buffing. If the material is too thick or has a backing of fabric or other material, or an uneven surface that may interfere with the tension test, the material shall be buffed as described in method 1021. If the material contains a cloth insertion, the fabric shall be removed by separating as described in method 1011 or by bufling as described in method 1021 before cutting the test specimen. Portions of the test unit from which specimens are to be taken for tension tests shall be buffed in the strip form before cutting the specimen with a die.

4.3 Cutting of specimen. To facilitate cutting of the specimen, the edge of the die may be lubricated with water containing a wetting agent and a corrosion inhibitor such as 0.5 percent sodium chromate or with silicone mold release emulsion before each specimen is cut.

TENSILE STRENGTH

1. SCOPE

This method is intended for use in determining the tensile strength of resilient nontextile floor coverings such as rubber matting.

2. SPECIMEN

2.1 The specimen shall consist of a portion of a test unit as described in 2.1.1 or 2.1.2, as specified in the detail specification.

2.1.1 A dumbbell-shaped specimen cut by one of the dies shown in figure 4111. Unless otherwise specified in the detail specification, die III shall be used for tensile strength.

2.1.2 A rectangular strip 1.00&0.01 inch in width and 6 inches in length.

2.2 The thickness of the specimen maybe the thickness of the material undergoing test but shall not exceed 0.125 inch.

3. APPARATUS

The apparatus shall be as follows:

3.1 A power-driven testing machine which meets the following requirements.

3.1.1 The applied tension is indicated to within plus or minus 2 percent by a dial, scale, or automatic recorder when properly calibrated as described in 4.1.

3.1.2 If the testing machine is not equipped with a recorder, a device shall be provided that indicates the maximum force applied during extension.

3.1.3 Unless otherwise specified in the detail specification, the power-actuated grip shall travel at a uniform rate of 20±2 inches per minute.

3.1.4 The response of either an indicator or recorder shall be sufficiently rapid that the applied force is measured within the tolerance specified in 3.1.1 at the time of rupture.

3.1.5 If the machine is equipped with a dynamometer head of the compensating type for convenience in eliminating calculations, the head shall have adjustments for variation in thickness of the specimen.

3.1.6 *Grips.*

3.1.6.1 *Dumbbell specimen.* The grips shall be the type which tighten automatically as the applied tension increases and which exert a uniform pressure across the gripping surfaces so as to avoid uneven slipping and to f aver failure of the specimen in the recluced section.

3.1.6.2 *Straight specimen.* For a straight specimen, either wedge, toggle, or flat grips may be used. The distance between the grips at the start of the test shall be 3±1\8 inch.

3.2 Die.

3.2.1 *Dumbbell specimen.* A metal die of the shape and construction shown in figure 4111 and with dimensions as shown in the accompanying legend, for cutting a dumbbell specimen, 2.1.1. It is recommended that the reduced section of the die be equipped throughout, its entire length with a spacer to maintain a definite distance between the cutting edges. The spacers are held by at least two bolts through the body of the die. The difference between the minimum and maximum distance between the cutting edges of the die in the reduced section shall not exceed 0.002 inch. The inside faces in the reduced section are polished and perpendicular to the plane formed by the cutting edges for a depth of at least 0.2 inch. The angle between the inner and outer faces at the cutting edge shall be not less than 30° nor more than 35°. The outer face extends at this angle from the cutting edge for approximately 1/64 inch and forms an angle between 18° and 22° with the inner face.

3.22 *Straight specimen.* A metal die or other suitable apparatus for cutting straight specimens of the dimensions in 2.1.2.

3.2.3 The die shall be sharp and free from nicks in order to prevent leaving ragged cut edges on the specimen. The cutting edges of the die may be kept sharp by daily light honing and touching up with jeweler's hard Arkansas

honing stones. The condition of the die may be judged by investigating the rupture point of any series of broken specimens. When broken specimens are removed from the grips of the testing machine, it is advantageous to pile them and note if there is any tendency to break at or near the same portion of each specimen. Rupture points consistently at the same place on the specimen may indicate that the die is dull, nicked, or bent at that particular position.

3.3 Cutting support. A cutting support consisting of a smooth, slightly yielding surface for supporting a portion of the test unit from which the specimen is to be cut, so that the blade of the die is not injured during the cutting of the specimen.

3.3.1 It is recommended that the cutting support have three parts: (1) A solid foundation, such as hardwood or plate glass; (2) a semi-hard pad, such as plastic or masonite; and (3) a smooth cutting surface, such as rubber belting, leather belting, or light cardboard.

3.4 A suitable hook for holding weights, which can be attached to the lower grip of the testing machine.

3.5 Accurately known weight assemblies equal to 10, 20, and 50 percent of the capacity of the machine are recommended.

3.6 A dumbbell-shaped piece of rubber prepared from a tread compound by means of one of the dies described in 3.2.1.

4. PROCEDURE

4.1 Calibration of testing machine. Testing machines having an inertialess-type dynamometer shall be calibrated by standard weights at three or more points in the range at which specimens break, and the calibration shall be verified daily by checking with at least one weight. Testing machines having an inertia-type dynamometer shall be calibrated in the following manner:

4.1.1 One end of the dumbbell-shaped piece of rubber, 3.6, shall be placed in the upper grip of the testing machine. The lower grip shall be removed from the machine and attached to the other end of the specimen. The hook for holding the weights shall be attached to the lower grip. .4 weight assembly, 3.5, equal to approximately 10, 30, or 50 percent of the capacity of the machine shall be suspended from the hook which is attached to the grip in such a manner that it will permit the weight assembly to rest on the grip holder. If the machine has a dynamometer head of the compensating type, it shall be calibrated at two or more settings of the compensator. The motor shall be started as in normal testing and run until the weight assembly is freely suspended by the specimen. If the dial, scale, or automatic recorder, whichever is normally used in testing, does not indicate the weight applied or its equivalent in stress for compensating-type testers within plus or minus 2 percent of the machine capacity, the machine shall be thoroughly checked for excess friction in the bearings and all other moving parts.

4.1.2 After eliminating as nearly as possible all the excess friction, the machine shall be recalibrated as described in 4.1.1 until the machine indicates correctly. The machine shall be calibrated at a minimum of three points, using weight assemblies of approximately 10, 20, and 50 percent of the capacity of the machine. The weight of the grip and hook shall be included as part of the calibration weight. If pawls or ratchets are used during the test, they shall be used during the calibration. The friction in the head may be checked by calibrating with the pawls up. Calibration of the machine at least once a month is recommended.

4.2 Preparation of specimen.

4.2.1 *Buffing.* If the material is too thick or has a backing of fabric or other material, or an uneven surface that may interfere with the test, the material shall be buffed as described in method 1021. If the floor covering contains a cloth insertion, the cloth shall be removed as described in method 1011 or 1021. The portion of the test unit from which the specimen is to be cut shall be buffed in the strip form before cutting with the die. The specimen shall be free from mechanical damage.

4.2.2 *Dumbbell specimen.* The portion of the test unit from which the specimen is to be cut shall be placed on the cutting support and the specimen of the required size cut by means

of the required die. The cut edges shall be perpendicular to the other surfaces of the specimen, have a minimum of concavity, and be free from ragged edges.

4.2.3 *Straight specimen.* A straight specimen shall be cut with the die or other apparatus, 3.2.2, by the procedure in 4.2.2.

4.2.4 If practicable, all specimens shall be cut with a single stroke of the die so as to obtain smoothly cut surfaces.

4.2.5 To facilitate cutting the specimen with smooth cut surfaces, the edge of the die may be lubricated with water containing a wetting agent and a corrosion inhibitor such as 0.5 percent sodium chromate, or with silicone mold release emulsion before each specimen is cut.

4.3 Cross-sectional area of specimen.

4.3.1 *Thickness.* The thickness of the specimen shall be determined as described in method 2121, except that three measurements shall be made: one at the center and one near each end of the reduced section of the dumbbell specimen. In the case of a straight specimen, the three measurements shall be equally distributed over the middle 3-inch portion of the specimen. The median of the three measurements shall be used as the thickness of the specimen in calculating the cross-sectional area of the specimen. Specimens shall be discarded when the difference between maximum and minimum thickness exceeds 0.003 inch.

4.3.2 *Width.*

4.321 *Dumbbell specimum.* The width of the specimen shall be the width between the cuttting edges of the die in the reduced section.

4.32.2 *Straight specimen.* If the specimen is cut with a die, the width of the specimen shall be the width between the cutting edges of the die. If the specimen is cut by other means, the width shall be determined as described in method 2211 except that three measurements equally spaced over the center of the 3-inch portion of the specimen shall be made. The median of the three measurements shall be used as the width in calculating the cross-sectional area of the specimen.

4.4 Determination of tensile strength. The specimen shall be placed in the grips of the testing machine and adjusted symmetrically so that the tension will be distributed uniformly over the cross section. If the tension is greater on one side of the specimen than on the other, the maximum strength of the specimen will not be developed. The machine shall be started and the power-actuated grip shall travel at the required speed, 3.1.3, until the specimen ruptures. After rupture of the specimen, the breaking force in pounds shall be read from the dial or automatic recorder and the value recorded as F.

5. RESULTS

5.1 Calculations. The tensile strength of the specimen shall be calculated as follows:

$$\text{Tensile strength, pounds per square inch} = \frac{F}{C}$$

where:

C is the cross-sectional area of the unstretched specimen in square inches.

F is the breaking force in pounds.

5.2 Unless otherwise specified in the detail specification, three specimens from each test unit shall be tested except that under the following conditions five specimens shall be tested:

5.2.1 If the tensile strength of one or more specimens does not meet the specified requirements in the detail specification.

5.2.2 If referee tests are being made.

5.3 The tensile strength of the test unit shall be the median of the values obtained from the specimens tested.

5.4 The tensile strength of the test unit shall be recorded to the nearest 10 pounds per square inch.

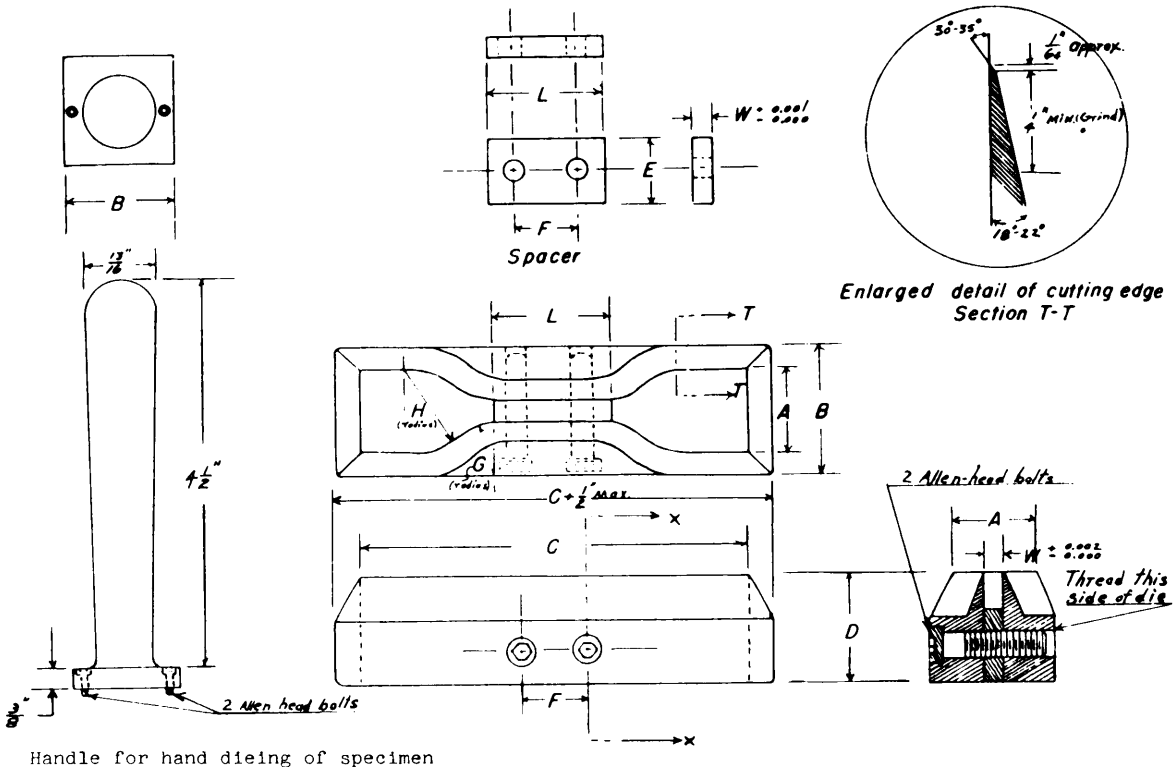

FIGURE 4111. Dies for dumbbell specimen.

Dimensions of dies, inches

Dimension	Tolerance	Die						
		I	II	III	IV	V	VI	VII
A	±1/32	1	1	1	5/8	5/8	5/8	5/8
B	Maximum	1½	1½	1½	1⅛	1⅛	1⅛	1⅛
C	Minimum	5½	5½	4½	4	5	5	4½
D	[1] ±¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼
D–E	±1/32	½	½	½	½	½	½	½
F	±1/16	1½	1½	¾	¾	1½	1½	¾
G	±1/32	9/16	9/16	9/16	9/16	9/16	9/16	9/16
H	±1/16	1	1	1	5/8	5/8	5/8	5/8
L	±1/16	2 5/16	2 5/16	1 5/16	1 5/16	2 5/16	2 5/16	1 5/16
W	[2]	0.500	0.250	0.250	0.125	0.125	0.250	0.250

[1] For dies used in clicking machines, it is preferable that this tolerance be ±1/64 inch.
[2] See figure.

ELONGATION, ULTIMATE

1. SCOPE

This method is intended for use in determining the elongation of resilient nontextile floor coverings such as, rubber matting.

2. SPECIMEN

The specimen shall be as described in method 4111.

3. APPARATUS

The apparatus shall be as follows:

3.1 The apparatus described in method 4111.

3.2 A benchmarked having two parallel knife edges, ground smooth and true, between 0.002 and 0.003 inch in width at the edge and beveled at an angle of not more than 15° to the perpendicular. The distance between the centers of the knife edges shall be 1.000±0.003 or 2.000±0.003 inch as required.

3.3 A stamp pad consisting of a plane unyielding surface, such as hardwood, plate glass, or plastic, covered with a pad containing ink of the desired color and quality for marking the specimen. The ink shall have no deteriorating effect on the specimen and shall be of a contrasting color to that of the specimen.

3.4 A scale or other device for determining elongation to within 0.1 inch.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, elongation shall be determined during the tensile strength test using the same specimen.

4.2 Preparation of specimen. The specimen shall be prepared as described in method 4111. In addition, two parallel benchmarks shall be placed symmetrically on the straight specimen and on the reduced section of the dumbbell specimen perpendicular to the longitudinal axis, by means of the benchmarked and ink. The specimen shall not be injured and the marks shall be not more than 0.010 inch wide. The distance between the knife edges of the benchmarked, 3.2, shall be recorded as D.

4.3 Determination of elongation. The specimen shall be placed in the grips of the testing machine and force applied as described for tensile strength in method 4111. The distance between the center of the two benchmarks on the specimen shall be noted continuously to the nearest 0.1 inch by means of the scale or other device," which shall be used in such a manner as not to injure or distort the specimen. Two operators may be required to conduct this test.. The distance between the benchmarks when the specimen ruptures shall be read from the scale or other device and the value recorded to the nearest 0.1 inch as D_1.

5. RESULTS

5.1 Calculation. The ultimate elongation of the specimen shall be calculated as follows:

$$\text{Ultimate elongation, percent} = \frac{D_1 - D}{D} \times 100$$

where:

D is the distance in inches between the knife edges of the benchmarker.

D_1 is the distance in inches between benchmarks at the moment of rupture of the specimen.

5.2 Unless otherwise specified in the detail specification, three specimens from each test unit. shall be tested, except that under the following conditions five specimens shall be tested:

5.2.1 If the elongation of one or more specimens does not meet the specified requirements in the detail specification.

5.2.2 If referee tests are being made.

5.3 The elongation of the test unit shall be the median of the values obtained from the specimens tested.

5.4 The elongation of the test unit shall be recorded to the nearest 5 percent.

TENSILE STRESS

1. SCOPE

This method is intended for use in determining the tensile stress of resilient nontextile floor coverings such as rubber matting and rubber tile. Tensile stress is sometimes designated by the term "modulus.)'

2. SPECIMEN

The specimen shall be as described in method 4111.

3. APPARATUS

The apparatus shall be as described in methods 4111 and 4121.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, tensile stress shall be determined during the test for tensile strength and/or elongation using the same specimen.

4.2 The elongation in percent at which the tensile stress is to be determined shall be as specified in the detail specification.

4.3 Preparation of specimen. The specimen shall be prepared as described in methods 4111 and 4121.

4.4 Cross-sectional area of specimen. The cross-sectional area, C, of the specimen shall be determined as described in method 4111.

4.5 Determination of tensile stress. The procedure for determination of tensile stress shall be the same as that for determining tensile strength and elongation in methods 4111 and 4121, respectively, except that the force in pounds necessary to stretch the specimen to the specified elongation shall be read from the dial, scale, or automatic recorder, and the value recorded as F.

5. RESULTS

5.1 Calculation. The tensile stress of the specimen shall be calculated as follows:

$$\text{Tensile stress, pounds per square inch} = \frac{F}{C}$$

where:

F is the force in pounds required to stretch the specimen to the required elongation.

C is the cross-sectional area of the unstretched specimen in square inches.

5.2 Unless otherwise specified in the detail specification, three specimens from each test unit shall be tested except that under the following conditions five specimens shall be tested.

5.2.1 If the tensile stress of one or more specimens does not meet the specified requirements in the detail specification.

5.2.2 If referee tests are being made.

5.3 The tensile stress of the test unit shall be the median of the values obtained from the specimens tested.

5.4 The tensile stress of the test unit shall be recorded to the nearest 10 pounds per square inch.

5.5 The percent elongation at which the tensile stress is determined shall be recorded.

TENSION SET

1. SCOPE

This method is intended for use in determining the tension set of resilient nontextile floor coverings such as rubber matting.

2. SPECIMEN

Unless otherwise specified in the detail specification, the specimen shall be as described in method 4111. When tensile strength is required in the detail specification, the specimen shall be cut with the same die that is used for cutting the tensile strength specimen.

3. APPARATUS

The apparatus shall be as follows:

3.1 Any equipment suitable for stretching the specimen at a uniform speed and holding it at a specified elongation for a definite time. An apparatus that has been found satisfactory is shown in figure 4311.

3.2 Grips described in method 4111.

3.3 A stopwatch or other timing device that will indicate the time in seconds and minutes.

3.4 A scale or other device graduated to 0.1 inch for measuring the elongation. A straight rod of a length equal to the exact distance required between the benchmarks after stretching the specimen to the required elongation has been found suitable for measuring the elongation of the specimen.

3.5 A scale or other device graduated in 0.01 inch for measuring set.

3.6 A benchmarked as described in method 4121.

3.7 Stamp pad as described in method 4121.

4. PROCEDURE

4.1 The elongation or distance between the benchmarks of the stretched specimen shall be as specified in the detail specification. If no elongation is specified, the specimen shall be stretched to three-fourths of the ultimate elongation of the material undergoing test as determined by method 4121.

4.2 Unless otherwise specified in the detail specification, the specimen shall be held at the specified elongation for 10.0±0.1 minute after stretching.

4.3 Unless otherwise specified in the detail specification, the specimen shall be allowed to rest for 10.0±0.1 minute after release before the set is measured.

4.4 The specimen shall be prepared as described in method 4111 and marked with the benchmarked as described in method 4121.

4.5 The distance between the knife edges of the benchmarked shall be recorded as L_1.

4.6 The specimen shall be placed in the grips of the testing apparatus as described in method 4111. The grips of the apparatus shall be separated at an approximately uniform speed so as to require 15 seconds to reach the required elongation.

4.7 The specimen shall be held at the required elongation for the required period of time, then released immediately without being allowed to snap back, and permitted to rest for the required time.

4.8 At the end of the rest period, the distance between the benchmarks shall be measured and the value recorded to the nearest 0.01 inch as L_2.

4.9 In stretching the specimen to the required elongation, it has been found convenient to use a measured rod of a length equal to the exact distance required between the two benchmarks on the stretched specimen. Holding the rod beside the specimen while it is being stretched simplifies the operation and reduces the chance of stretching the specimen more than the required amount.

5. RESULTS

5.1 Calculations. The tension set of the specimen shall be calculated as follows:

$$\text{Tension, percent} = \frac{L_2 - L_1}{L_1}$$

where :

L_1 is the distance in inches between the edges of the benchmarked.

L_2 is the distance in inches between the benchmarks of the specimen at the end of the rest period.

5.2 Unless otherwise specified in the detail specification, three specimens from each test unit shall be tested except that under the following conditions five specimens shall be tested.

5.2.1 If the tension set of one or more specimens does not meet the specified requirements in the detail specification.

5.2.2 If referee tests are being made.

5.3 The tension set of the test unit shall be the median of the values obtained from the specimens tested.

5.4 The tension set of the test unit shall be recorded to the nearest one percent.

5.5 The elongation of the stretched specimen, the time the specimen was held at the specified elongation, and the rest period shall be recorded.

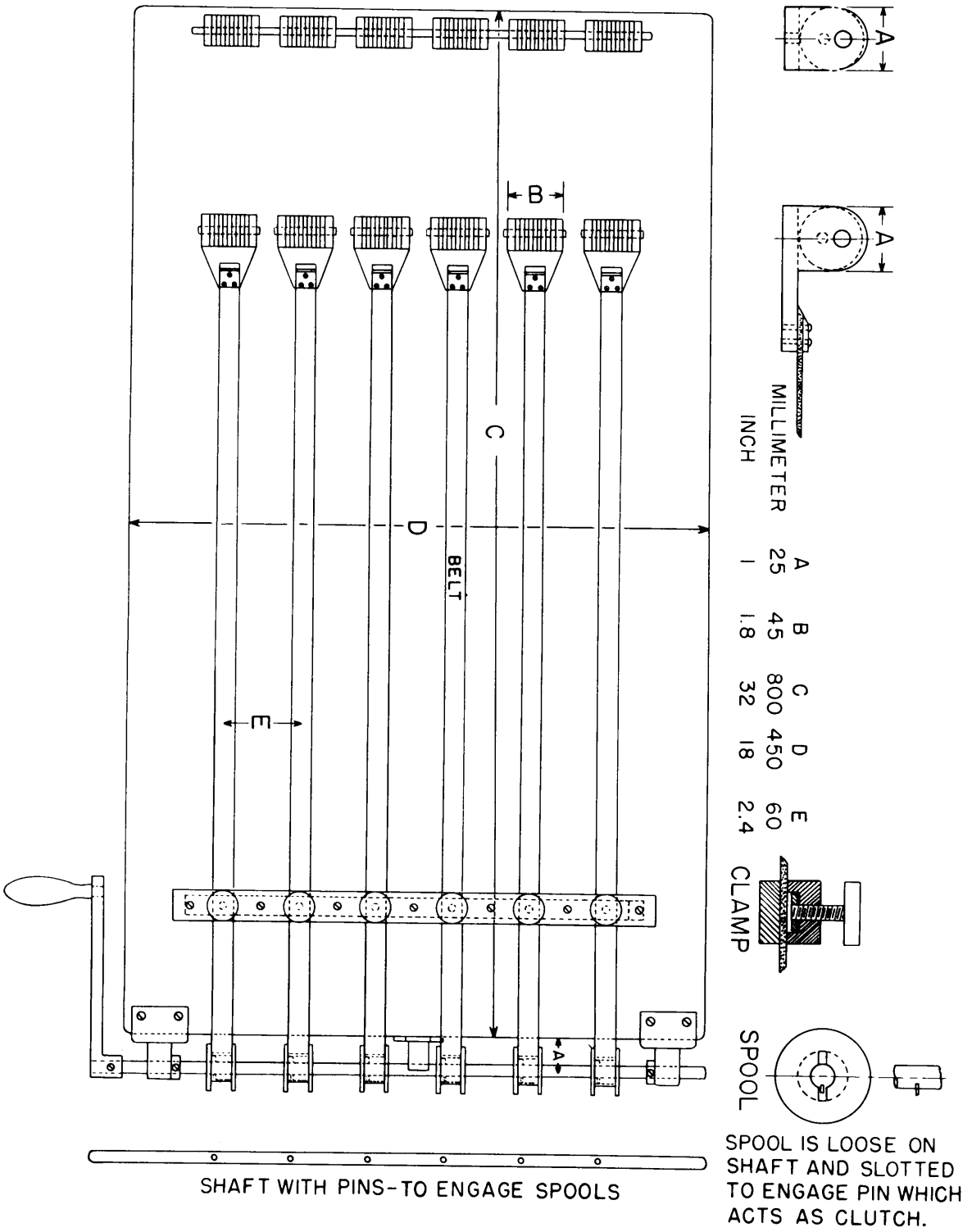

FIGURE 4311. Tension set apparatus.

ACCELERATED AGING TESTS, GENERAL

1. SCOPE

This group of methods is intended for use in determining the relative resistance of resilient nontextile floor coverings to the deteriorating influences of heat, light, and oxygen. In general, the tests consist of exposing a portion of a test unit to controlled deteriorating influences for a specified period of time and comparing the test result for a specified property obtained on the exposed material with the test result for the same property obtained on an unexposed portion of the test unit. In certain cases, however, the specified property is determined on the same specimen before and after exposure. In other cases, only the specified property of the aged material is required and the property of the unaged material is not determined.

2. SPECIMEN

Specimens for accelerated aging tests shall be free from defects or damage that may interfere with the property for which tests are made. Specimens from the same test unit shall be uniform in thickness within plus or minus 0.01 inch, determined by method 2111 or 2121.

3. PROCEDURE

3.1 Preparation of specimen. If the material is too thick or has a fabric backing or an uneven surface that may interfere with the test, the material shall be buffed as described in method 1021. Portions of the test unit from which specimens are to be taken for tension tests shall be buffed in the strip form before cutting with a die.

3.1.1 If buffing is necessary, it shall be done before exposure of the material.

3.2 If the specimen is not destroyed in determining the specified characteristic of the material before aging, the same specimen shall be exposed in the aging test. If it is necessary to destroy the specimen in determining the specified characteristic, two sets of specimens shall be prepared from the test unit: one set for determining the specified characteristic before aging and the other set for determining the specified characteristic after aging.

3.3 Where the specimen is destroyed in determining the specified characteristic of the material, such as tensile strength, the specified characteristic of the unaged material shall be determined within the period ranging from 24 hours before the start of the exposure period to the time the specified characteristic of the aged specimen is determined.

3.4 The characteristic used for measuring the amount of change shall be as specified in the detail specification and shall be determined as described in the applicable method of test.

3.5 If tensile strength and elongation are the properties used to measure the amount of change, these characteristics shall be determined as described in methods 4111 and 4121.

3.6 Where tensile strength or tensile stress is the property used to measure the amount of change, the cross-sectional area of the specimen shall be determined as described in method 4111 before exposure.

3.7 Benchmarks for determining the elongation of the aged specimen shall be placed on the specimen as described in method 4121 after it has been exposed.

3.8 The contents of the oven, bomb, or other aging chamber shall be restricted to specimens known to be of the same composition.

3.9 Apparatus such as thermometers, copper-constantan thermocouple and potentiometer, or other device shall be used for measuring the temperature to within 1° C. (1.8° F.). If the aging chamber is completely surrounded by a liquid heat-transfer medium, the temperature of the specimen may be considered to be the same as that of the liquid medium.

3.10 Radiation shields shall be placed between the specimen and any portions of the wall of the aging chamber not maintained within the required temperature limits.

3.11 Provisions shall be made for suspending the specimens vertically in the aging chamber without touching each other or the surface of the chamber.

3.12 Equipment shall be provided for automatically recording the temperature throughout the aging period.

3.13 The aging chamber shall be preheatd to the exposure temperature before the specimen is placed in it. If the temperature within the chamber changes while the specimen is being placed in it, the chamber and contents shall reach the specified temperature within 15 minutes after the specimen has been placed in the aging chamber.

3.14 Copper or brass parts shall not be exposed to the atmosphere used in the aging chamber when rubber flooring is being aged.

3.15 If a liquid heating medium that is injurious to the material is used, precautions shall be taken to prevent the liquid or its vapors from coming in contact with the material undergoing test.

3.16 Oil or other combustible organic fluids are extremely hazardous in the presence of oxygen and should not be used as a heating medium for the oxygen pressure test.

3.17 The volume of the aging chamber shall be at least 10 times the volume of the specimens being aged.

AIRHEAT TEST

1. SCOPE

This method is intended for use in determining the effect of air at atmospheric pressure and at an elevated temperature on resilient nontextile floor coverings.

2. SPECIMEN

The specimen shall be as required in the method of test specified in the detail specification for determining the amount of change due to aging or the characteristic after aging, or shall be as specified in the detail specification.

3. APPARATUS

The apparatus shall be as follows:

3.1 Aging chamber. A circulating-air oven having interior dimensions not less than 12 by 12 by 12 inches and not more than 36 by 36 by 48 inches, or equivalent. volume. The chamber is equipped so that specimens can be suspended vertically therein without touching each other or the surface of the oven.

3.2 The source of heat is optional but shall be located in the air supply outside of the aging chamber proper.

3.3 Heating medium. The heating medium in the aging chamber shall be air at atmospheric pressure. The heated air shall be thoroughly circulated by means of mechanical agitation. If a motor-driven fan is used, the air shall not come in contact with the fan motor brush discharge because of ozone formation, and baffles shall be used to prevent local overheating. The temperature control shall be located so as to furnish accurate temperature control of the heating medium, the preferred location being adjacent to the sensitive element of the temperature recorder, and checks shall be made by means of maximum reading thermometers or other temperature measuring apparatus located in various places in the heating medium to verify the uniformity of the temperature.

3.4 Equipment with suitable automatic controls for maintaining the required temperature throughout the heating medium during the aging period.

3.5 Apparatus such as thermometers, copper-constantan thermocouple and potentiometer, or other device for measuring the temperature to within 1° C. (1.8° F.).

3.5.1 Equipment for automatically recording the temperature throughout the aging period.

3.6 Equipment for complete and rapid circulation of the air heating medium.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the specimen shall be aged at a temperature of 70°±10 C. (158°±1.8° F.) for 166±1 hour.

4.2 Preparation of specimen. The specimen shall be prepared as described in the applicable test method or detail specification.

4.3 The specimen shall be free from mechanical damage. After adjusting the aging chamber to the required temperature, the specimen shall be suspended vertically in the chamber and the chamber closed immediately. If more than one specimen is tested, the specimens shall be suspended so that they will not touch each other or the surface of the chamber. The aging period shall start at the time the specimen is placed in the aging chamber and shall continue for the required time at the required temperature, 4.1. The temperature shall be automatically recorded through the aging period.

4.4 At the end of the aging period, the specimen shall be removed immediately from the aging chamber and set aside to rest for not less than 16 hours nor more than 96 hours at room temperature before determining the required property.

4.5 At the end of the rest period, the characteristic specified in the detail specification shall

be determined of the aged specimen as described in the applicable test method or in the detail specification. If the detail specification specifies the amount of change, the same characteristic shall also be determined of an unaged specimen as described in the applicable test method or in the detail specification for comparison with the aged specimen.

5. RESULTS

5.1 The number of specimens from each test unit exposed in air shall be as required in the method of test specified in the detail specifica - t ion for determining the characteristic after aging or as specified in the detail specification.

5.2 Amount of change.

52.1 When the amount of change in characteristic is specified in the detail specification, the change in tensile strength, elongation, or other specified characteristic shall be calculated as follows :

$$\text{Change in characteristic, percent} = \frac{O - E}{O} \times 100$$

where :

O is the characteristic of the test unit before aging.

E is the same characteristic of the test unit after aging.

5.2.2 The change in characteristic of the test unit shall be recorded to the nearest 1 percent.

5.3 Characteristic after aging. When the value of the test unit after aging is specified in the detail specification, the characteristic shall be recorded as required in the applicable method of test or as specified in the detail specification.

5.4 The temperature and time of aging and the characteristic of the test unit determined after aging shall be recorded.

OXYGEN PRESSURE TEST

1. SCOPE

This method is intended for use indetermining the effect of oxygen under pressure and at an elevated temperature on resilient nontextile floor coverings. Method 5111 is a preferable aging test since the oxygen pressure test is not particularly suited for testing floor coverings made from synthetic elastomers.

2. SPECIMEN

The specihen shall be as required in the method of test specified in the detail specification for determining the amount of change in characteristic or the characteristic after aging, or shall be as specified in the detail specification.

3. APPARATUS

The apparatus shall be as follows:

3.1 Aging chamber. .4 pressure aging chamber consisting of a metal vessel designed to retain an internal atmosphere of oxygen under pressure, with provisions for placing floor covering specimens within it and subjecting the whole to cent rolled uniform temperature. The size of the chamber is optional but is such that specimens can be suspended vertically therein without touching each other or the surface of the chamber. Provisions are made for rapid opening and closing of the chamber for introduct ion and removal of the specimens. Two suitable designs are shown in figures 5211A and 5211B.

3.2 A pressure gage attached to the aging chamber for registering the oxygen pressure.

3.3 A safety valve or rupture diaphragm attached to the pressure chamber, set to release at approximately 500 pounds per square inch pressure.

3.4 A source of oxygen under pressure.

3.5 The source of heat is optional but shall be located outside the pressure chamber.

3.6 Equipment with suitable automatic controls for maintaining the required temperature throughout the heating medium during the aging period.

3.7 Equipment for complete and rapid circulation of the heating medium.

3.8 Apparatus such as thermometers, copper-constantan thermocouple and potentiometer, or other device for measuring the temperature to within 1° C. (1.8° F.).

3.8.1 Equipment for automatically recording the temperature throughout the aging period.

3.9 Heating medium. The heating medium is optional, but a liquid medium is preferred because of more rapid heat transfer. Water, air, or other fluids known to be safe in the presence of oxygen may be used. Water has an advantage because of its rapid heat transfer and noncombustible nature. Oils or other organic combustible fluids are extremely hazardous in the presence of oxygen and should not be used as heating media for this test. When the aging chamber shown in figure 5211A is used, it shall be completely immersed in the heating medium.

3.9.1 If air is used as the heating medium, the heated air shall be thoroughly circulated around the aging chamber by means of mechanical agitation, baffles shall be used to prevent local overheating, a check of the temperature shall be made in various parts of the heating medium by means of a temperature measuring device to verify the uniformity of temperature, and the aging chamber shall have a thermometer or thermocouple well, extending into the chamber and filled with water or mercury for measuring the temperature in the aging chamber.

3.9.2 If liquid is used as the heating medium and the chamber is completely immersed in the liquid, the temperature within the chamber may be taken as that of the heating medium. The sensitive elements of the temperature measuring device shall be close to the chamber but not touching it. If the chamber is not completely

immersed in the liquid heating medium, the sensitive element of the temperature measuring device may be placed in a thermometer well, extending into the chamber. The thermometer well shall be filled with sufficient liquid medium, such as water or mercury, to cover the element. If it is confirmed by measurements that the temperature of the oxygen within the aging chamber is the same as that of the heating medium, the temperature may be taken in the heating medium instead of the thermometer well.

3.9.3 In either case, the recorded temperature shall be verified by checking with a temperature measuring device having its sensitive element directly exposed to the oxygen in the aging chamber.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the specimen shall be aged at a temperature of 70°±1° C. (158°±1.8° F.) and a pressure of 300±10 pounds per square inch of oxygen for 46±¼ hour.

4.2 The specimen shall be prepared as described in the applicable test method or detail specification.

4.3 Before starting the aging test, the chamber shall be flushed to remove all the air present, and the apparatus tested to make certain that it does not leak.

4.4 The specimen shall be free from mechanical damage. After adjusting the aging chamber to the required temperature, the specimen shall be suspended vertically in the chamber, the chamber closed immediately, and oxygen pressure applied. If more than one specimen is tested, the specimens shall be suspended so that, they will not touch each other or the surface of the chamber. The aging period shall start at the time the specimen is placed in the aging chamber and shall continue for the required time at the required temperature and pressure, 4.1. The temperature shall be automatically recorded throughout the aging period.

4.5 At the end of the aging period, the pressure shall be released in the chamber at a slow uniform rate, requiring at least 5 minutes for complete release of the pressure. This procedure is necessary in order to avoid possible formation of porosity in the specimen. The specimen shall be removed from the chamber immediately after release of the pressure and set aside to rest for not less than 16 hours and not more than 96 hours at room temperature before determining the required property.

4.6 At the end of the rest period, the characteristic specified in the detail specification shall be determined of the aged specimen as described in the applicable test method or in the detail specification. If the detail specification specifies the amount of change, the same characteristic shall also be determined of an unaged specimen as described in the applicable test method, for the purpose of comparison in determining the amount of change due to aging.

4.7 Adequate safety precautions shall be taken when heating oxidizable organic materials in oxygen at an elevated temperature and under pressure since the rate of reaction becomes rapid and very high pressure may develop, particularly if a large surface area is exposed. Oil or grease shall not be permitted to enter the apparatus during the test.

5. RESULTS

5.1 The number of specimens from each test unit exposed to oxygen shall be as required in the method of test specified in the detail specification for, determining the characteristic after aging or as specified in the detail specification.

5.2 Amount of change.

5.2.1 When the amount of change in characteristic is specified in the detail specification, the change in tensile strength, elongation, or other specified characteristic of the test unit after aging shall be calculated as follows:

$$\text{Change in characteristic, percent} = \frac{O-E}{O} \times 100$$

where:

O is the change in characteristic of the test unit before aging.

E is the change in characteristic of the test unit after aging.

5.2.2 The change in characteristic of the test unit, shall be recorded to the nearest 1 percent.

5.3 Characteristic after aging. When the value of the test unit after aging is specified in tile detail specification, the characteristic shall be recorded as required in the applicable method of test or as specified in the detail specification.

5.4 The temperature and time of aging and the characteristic of the test unit determined after aging shall be recorded,

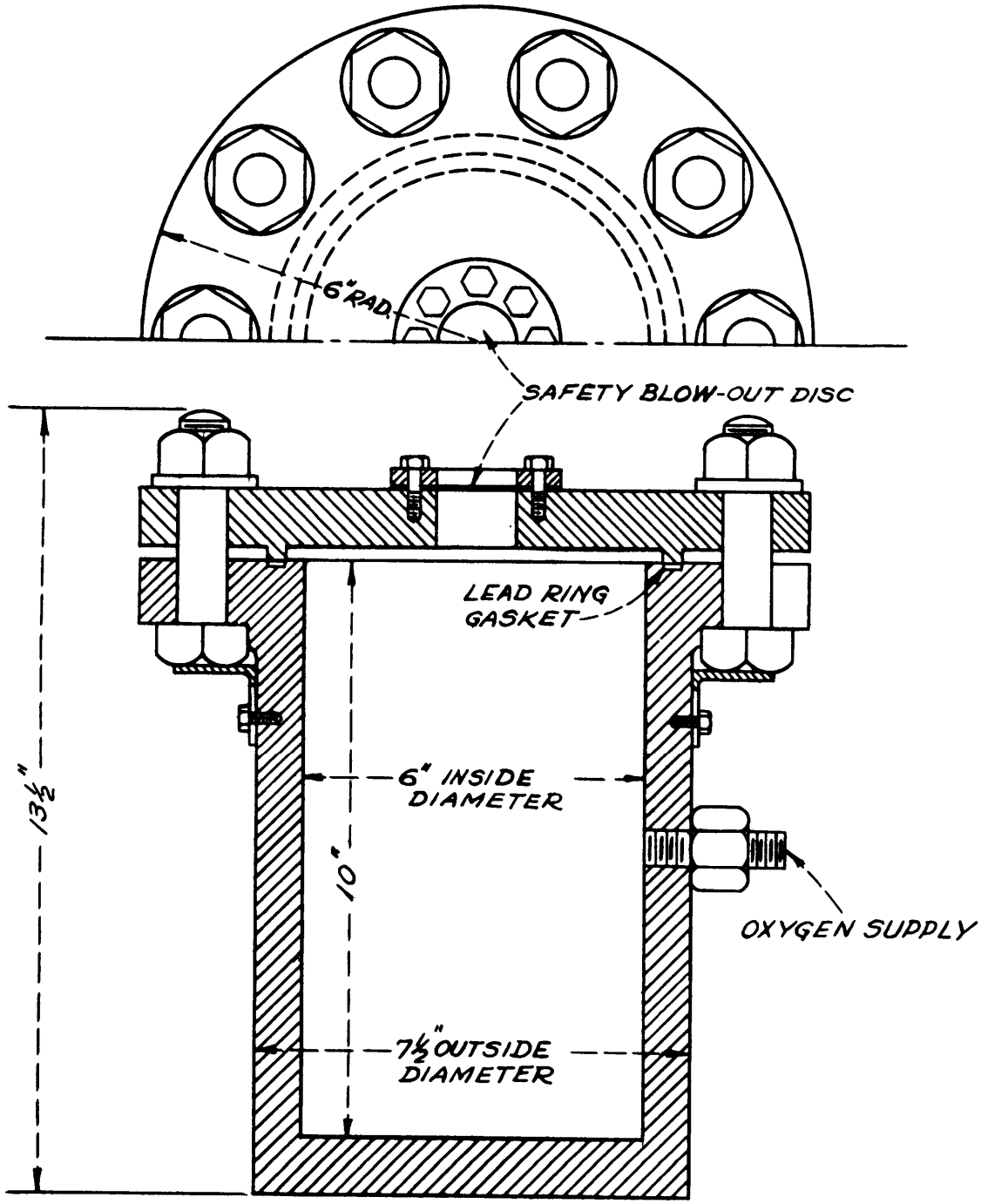

FIGURE 5211A. Pressure aging chamber.

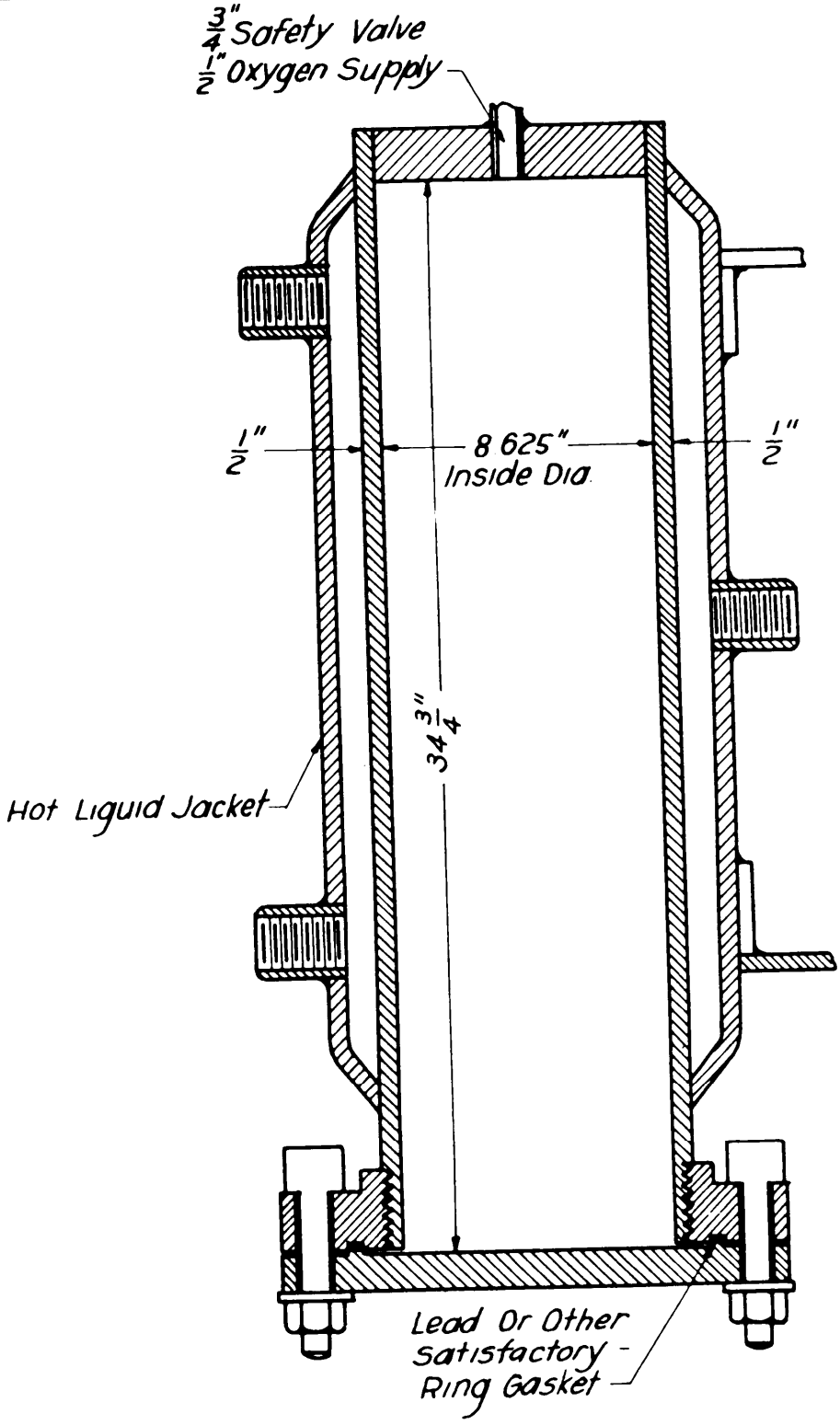

FIGURE 5211B. Pressure aging chamber, hot liquid jacketed.

RESISTANCE TO LIGHT

1. SCOPE

This method is intended for use in determining the resistance of resilient nontextile floor coverings, such as rubber and plastic, to the deteriorating influence of light having a frequency range approximately that of sunlight but having a greater intensity in the ultraviolet range than sunlight. The effect of exposure is determined by observing the nature and degree of cracking and checking and by comparing the tensile strength, elongation, or other specified characteristic of an exposed specimen with that of an unexposed specimen taken from the same test unit. The specimen is exposed in the stretched condition. The quantity of radiation to which the specimen is exposed is measured by means of the decomposition of uranyl oxalate solution.

2. SPECIMEN

2.1 The specimen shall consist of a portion of the test unit 1 by 6 or 2 by 6 inches.

2.1.1 Unless otherwise specified in the detail specification, the thickness of the specimen shall be the thickness of the material undergoing test, but shall not exceed 0.125 inch, and shall be uniform to within 0.003 inch. Specimens from the same test unit shall be of the same thickness within plus or minus 0.01 inch, determined by method 2111 or 2121.

3. APPARATUS

The apparatus shall be as follows:

3.1 Light source. A light source consisting of a vertical, ventilated, flaming carbon arc designed to accommodate 2 or 3 pairs of carbons, No. 22 upper and No. 13 lower, the arc to burn between only 1 pair of carbons at a time. The carbons shall be of the cored-type Sunshine carbons of National Carbon Co., or equal, designed to duplicate as closely as possible the spectral distribution of sunlight. The arc shall operate on 60 amperes and 50 volts across the arc on direct current.

3.1.1 Unless otherwise specified in the detail specification, the arc shall be enclosed by eight Corex D filters inserted into a filter frame, or other enclosure having equivalent absorbing and transmitting properties. Each Corex D panel is 4/64 to 5/64 inch in thickness. The, filters are attached so that they can be removed separately. Filters shall be replaced when pronounced cliscoloration or turbidity develops and in any case after 800 hours of service.

3.2 Framework. A cylindrical rotating framework designed to carry specimen holders in such a way that the surface of the specimen is 18½±½ inch from the center of the arc. The framework shall rotate around the arc at a uniform speed of one complete revolution every 2 hours.

3.3 Specimen holders. Specimen holders suitable for mounting specimens vertically while being rotated about the carbon arc to provide uniform distribution of light. Each holder is designed to accommodate either one strip of material 2 by 6 inches or two strips 1 by 6 inches in size and to stretch the material to any elongation up to 20 percent, A suitable specimen holder is shown in figure 5411A.

3.4 Drum. A cylindrical drum of corrosion-resisting material for enclosing the light source and framework. The cylinder is equipped with a protective cover for shielding the operator from radiation from the arc, an overflow for carrying away the water from the spray, and a sliding door to permit access to the specimen.

3.5 Spray nozzles. Fine-spray nozzles mounted inside the cylindrical drum in such a position that each specimen will be exposed to a complete wetting throughout its length one time during each revolution of the framework. Each nozzle shall be adjusted so that the water will not strike the Corex D filters and to deliver between 1.2 and 1.4 gallons of water per hour,

The pressure of the water entering the spray shall be 25 to 30 pounds per square inch. The water shall be maintained at a temperature between 10° and 25° C. (50° and 70° F.) during the test.

3.6 An exhaust fan for ventilating the arc, with a capacity of 100-*20 cubic feet per minute.

3.7 The temperature of the air in the drum shall be automatically recorded throughout the exposure period. The temperature of the air shall be measured to within plus or minus 1° C. (1.8° F.) by means of a black panel thermometer or thermocouple unit placed at the position of the specimen. The unit consists of a metal panel, to the base of which is attached the sensitive portion of a bimetallic dial-type thermometer or thermocouple. The entire base is coated twice with long-lasting black baked-enamel paint.

3.8 A suitable framework, complete with pulleys, cables, and counterweight for raising the lamp for inspect ion and replacement of the carbons.

3.9 Electrical control equipment. Electrical control equipment for automatically operating and maintaining the current of the arc approximately constant. The equipment shall include a constant voltage regulator to maintain the input voltage at 220±1 volt. It contains a pushbutton station for starting and stopping the unit, interlocked with the main-line contact, to insure complete electrical isolation of the arc equipment when changing carbons or working on the interior' mechanism of the lamp.

3.10 Actinometer cell. A cell of transparent fused quartz of the design and dimensions shown in figure 5411 B, for exposing the actinometer solution to tile radiation from the arc.

3.11 Cell holder. A holder for exposing the actinometer cell to the radiation from the arc. The holder completely encloses the cell enamel pain t. The holder is designed to take the place of a specimen holder and construtted so that, the center of the cell occupies the same relative horizontal position as the center of the specimen.

3.12 Automatic dispensing burette, figure 5411C.

3.13 Radiation actinometer solution.

Substance, reagent grade	Grams per liter	Molar value
Oxalic acid:		
Anhydrous ($H_2C_2O_4$)	6.30	0.050
or		
Hydrated ($H_2C_2O_4 \cdot 2H_2O$)	4.50	.050
Uranyl sulfate ($UO_2SO_4 \cdot 3H_2O$)	4.20	.0100

3.14 Evaluating solution.

Substance, reagent grade	Grams per liter	Oxidation equivalent
Potassium permanganate ($KMnO_4$)	3.16	0.100 *N*

4. PROCEDURE

4.1 Preparation, storage, and dispensing of solution. The solutions described in 3.13 and 3.14 may be prepared in ordinary diffused light.

4.1.1 *Evaluation solution.* A 0.1 *N* potassium permanganate solution shall be prepared by dissolving 3.16 grams (g.) of reagent grade potassium permanganate ($KMnO_4$) in distilled water and diluting the volume to 1 liter. The solution shall be set aside for 1 week in a dark place, filtered through a 1/8-inch glass fiber cloth, and stored in a glass-stoppered bottle protected from the light by a heavy coating of black paint.

4.1.2 *Actinometer solution.* The actinometer solution shall be prepared by dissolving 4.50 g. of anhydrous oxalic acid ($H_2C_2O_4$) or 6.30 g. of hydrated oxalic acid ($H_2C_2O_4 \cdot 2H_2O$), and 4.20 g. of reagent-grade uranyl sulfate ($UO_2SO_4 \cdot 3H_2O$) in distilled water and diluting to 1 liter. The solution shall be stored

in a glass-stoppered bottle painted with a heavy coat of black paint to protect the solution from light. An automatic dispensing burette, shown in figure 5411C, when heavily coated with black paint to exclude light is suitable for storing and dispensing the solutions.

4.2 Standardization of solutions. The evaluating solution, potassium permanganate, shall be standardized against reagent-grade sodium oxalate in the usual manner, with such precautions that its strength will be known within an accuracy of at least plus or minus 1 percent. The strength of the potassium permangmate shall be expressed in terms of milligrams (mg.) of anhydrous oxalic acid per milliliter (ml.) of solution. The actinometer solution shall be titrated against the standard potassium permanganate. An accurately measured volume of 50 ml. of the actinometer solution shall be transferred to a tall-form 200-ml. beaker, 20 to 25 ml. of distilled water added, and the solution acidified with 5 ml. of 1 to 3 sulfuric acid. The beaker shall be covered with a porcelain dish and the solution heated to 95° C. (203° F.) in a lightproof water bath, transferred to an open glass water bath, and maintained at approximately this temperature while resting on a flat, white-glass base. The solution shall be clearly seen by light from the glass base illuminated by a "daylight" lamp. The hot solution shall be titrated with the standard potassium permanganate evaluating solution from a dispensing burette while stirring constantly until an orange color is obtained which persists for at least 30 seconds. The titration shall be conducted in such a way that the volumes of solution used are precise to within plus or minus 0.05 ml.

4.3 Calibration of radiation. The intensity of radiation of the light shall be measured in terms of mg. of oxalic acid decomposed per square decimeter per minute and the quantity of radiation in any given period of time shall be measured in terms of the mg. of oxalic acid decomposed per square decimeter. An accurately measured volume of the actinometer solution shall be transferred to the quartz cell from a dispensing burette. The cell shall be immediately placed in the holder to prevent exposure of the solution to light. The cell holder shall be mounted on the cylindrical rotating framework of the apparatus in the same position as that of the specimen holder. The solution shall be exposed to the light under normal operating conditions. The time of exposure of the actinometer solution shall be sufficient to decompose not less than 10 percent nor more than 30 percent of the oxalic acid in the cell. At the end of the exposure period, the actinometer solution shall be immediately transferred from the cell to a 200-ml. beaker and titrated with the potassium permanganate evaluating solution as described in 4.2. The quantity of the evaluating solution required for the titration shall be recorded as V_1. The same volume of actinometer solution as that used in the light exposure shall be titrated under the same conditions, and the quantity of permanganate solution required for the titration recorded as V_2. The quantity of oxalic acid in reg., Q, decomposed by the radiation is given by the equation:

$$Q = a(V_2 - V_1)$$

where:

a is the number of mg. of oxalic acid equivalent to 1 ml. of evaluating solution.

The quantity or dosage of radiation is expressed as Q/A and the intensity of radiation as Q/At, where t is the time of exposure in minutes and A is the exposed area of the cell in square decimeters.

4.4 Unless otherwise specified in the detail specification, the total dosage of radiation shall be 2×10^4 mg. per square decimeter plus or minus 2 percent. Approximately 100 hours of exposure should be sufficient for this dosage.

4.5 Unless otherwise specified in the detail specification, tensile strength and elongation, methods 4111 and 4121, respectively, and the nature and degree of cracking and checking shall be used to determine the amount of change due to exposure to light.

4.6 Unless otherwise specified in the detail specification, four of the eight filters shall be removed, leaving every alternate filter in place in the apparatus during the light exposure.

4.7 Unless otherwise specified in the detail specification, the specimen 4.8.1, mounted in the specimen holder, shall be stretched to an

elongation of 10 percent within 3 hours after it has been buffed. The specimen shall be held in the stretched position at a temperature of 38°±2° C. (l00°±3.6° F.) for 16 to 24 hours before exposure to light.

4.8 Preparation of specimen.

4.8.1 *Specimen for light exposure, 4.7.* If the material is too thick or has fabric backing, an uneven surface, or coating that may interfere with the light exposure or physical test for determining the amount of change, the material shall be buffed as described in method 1021. If it is not necessary to buff the material for the above reasons, it shall be lightly buffed on both principal surfaces as described in method 1021 to remove any surface coating. The specimen shall be buffed before exposure to light.

4.8.2 *Specimen for physical test, 4.10.* The specimen shall be prepared from the exposed specimen, 4.9.1, as described in method 4111 Or other method of test used for determining the amount of change in material, except that the exposed material shall not be buffed.

4.9 The specimen shall be free from mechanical damage. Within 1 hour after the preconditioning period, the stretched specimen in the holder, 4.7, shall be placed in the rotating framework in such a position as to receive full radiation from the arc. It shall be exposed to the light until the total exposure is equivalent to that required to decompose the specified quantity of oxalic acid, 4.4. The light shall be calibrated as described in 4.3 to make certain that it is of the proper intensity. A measurement of intensity of radiation should be made near the start and near the end of each exposure and at such intervals during the exposure period as is necessary to insure that the light is operated at the proper intensity. The temperature of the air in the vicinity of the specimen shall be maintained at 60°±5° C. (140°±9° F.) during the exposure period by controlling the temperature, of the room and the ventilation of the space surrounding the specimen. The filters or other enclosure shall be cleaned at least once every 24 hours during the exposure period.

4.9.1 *Examination.* At the end of the exposure period, the holder with the exposed specimen shall be immediately removed and the specimen examined immediately by means of a binocular microscope for cracking and checking. The specimen shall be removed from the holder and set aside to rest for not less than 16 hours and not more than *96* hours at room temperature before other tests are made.

4.10 Tests. Unless otherwise specified in the detail specification, 4.5, at the end of the rest period tensile strength and elongation of the exposed specimen shall be determined as described in methods 4111 and 4121, respectively. If another property for determining the amount of change in characteristic is specified in the detail specification, the exposed specimen shall be tested as described in the specified method. The same test shall be conducted on unexposed material from the same test unit for the purpose of comparision in determining the amount of change due to exposure to light.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, the number of specimens from each test unit exposed to light shall be just sufficient to furnish the number of specimens required in methods 4111 and 4121, or other method of test specified for determining the amount of change in the material.

5.2 Calculation. The change in tensile strengh and elongation or other specified characteristic of the test unit due to light exposure shall be calculated as follows:

$$\text{Change in characteristic, percent} = \frac{O-E}{O} \times 100$$

where:

O is the characteristic of the test unit before light exposure.

E is the same characteristic of the test unit after light exposure.

5.3 The change in tensile strength, elongation, or other characteristic of the test unit shall be recorded to the nearest 1 percent.

5.4 The number of specimens exposed to light from each test unit and tile number from each test unit that show cracking or checking shall be recorded.

5.5 The dosage, percent elongation of the specimen during exposure, the number of filters used, and the characteristic used for determining the amount of change shall be recorded.

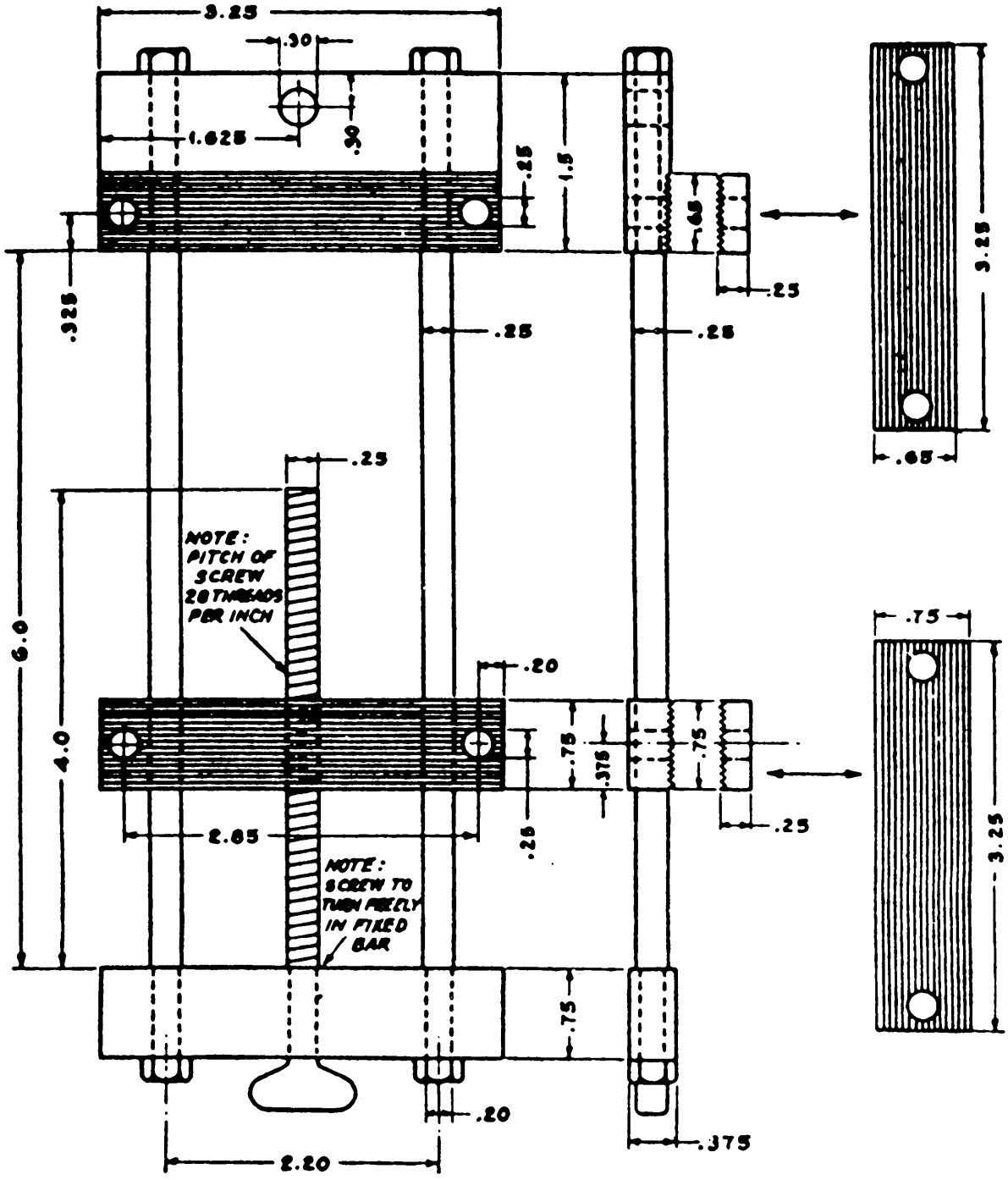

FIGURE 5411A. Specimen holder for light aging,

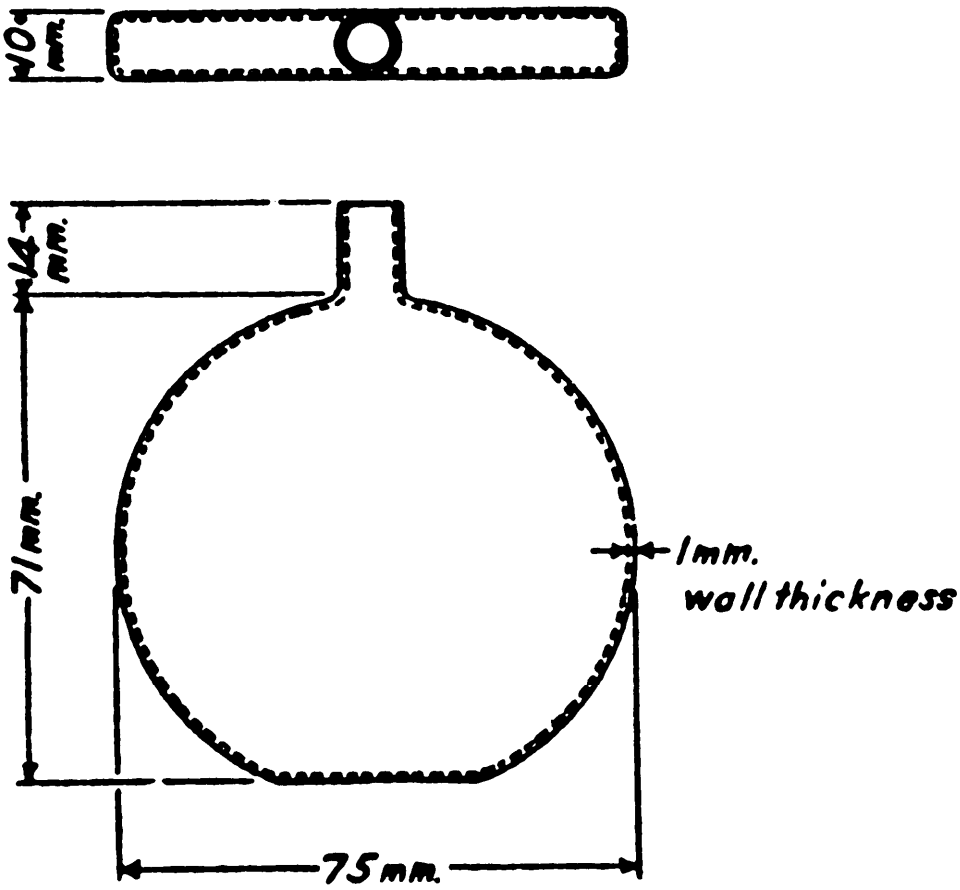

FIGURE 5411B. Transparent fused quartz cell.

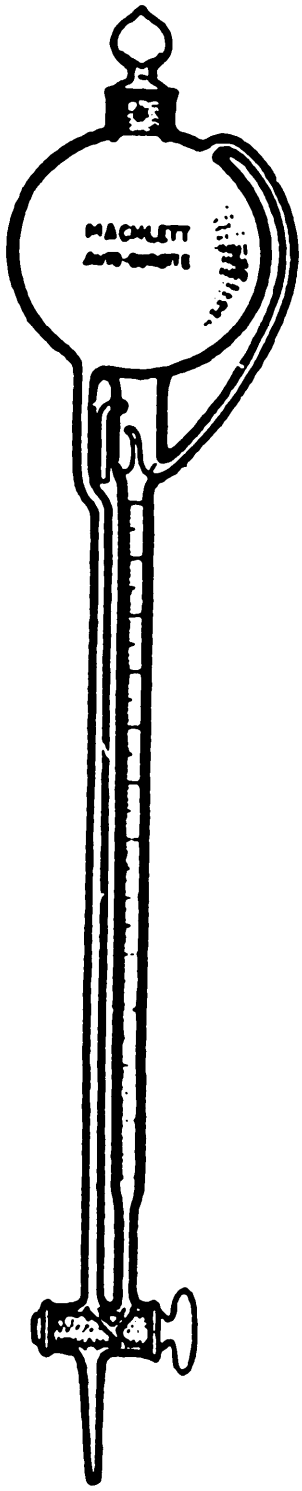

FIGURE 5411C. Dispensing burette.

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COLORFASTNESS TO LIGHT

1. SCOPE

1.1 This method is intended for use in determining the colorfastness to light of resilient nontextile floor coverings.

1.2 For the purpose of this method "appreciable change in color" is defined as the change in color that is immediately noticeable in comparng the tested specimen with the unexposed specimen. If closer inspection or change in angle of light is required to detect a slight change in color, the change is not considered appreciable.

2. SPECIMEN

2.1 The specimen shall be a portion of the test unit approximately 2½ by 3 inches.

3. APPARATUS

The apparatus shall be as follows:

3.1 Vertical carbon arc mounted at the center of a vertical cylindrical framework.

3.1.1 Clear globe of No. 9200 PX Pyrex glass for enclosing the arc, or other enclosure having equivalent absorbing and transmitting properties.

3.1.2 The arc operates on 12 to 14 amperes direct current or 15 to 17 amperes 60-cycle alternating current with the voltage at the arc 135 to 145 volts. The voltage of the power line shall be 208 to 250 volts.

3.1.3 The cylindrical framework shall be provided with specimen holders in which the specimen is suspended vertically and normally to radiation from the arc with the specimen at a radial distance of 10 inches from the center of the arc with no part over 5 inches above or below the arc.

3.1.4 The framework shall make two to four revolutions per minute.

3.1.5 The air surrounding the specimen during exposure shall be humidified and its temperature automatically controlled so that the relative humidity of the air about the face of the specimen when the apparatus is filled with specimens and operating normally shall not exceed 50 percent and its temperature shall not exceed 65° C. (149° F.).

3.2 The arc, 3.1.1, shall be calibrated with standard calibration paper to obtain standard fading hours equivalent to those produced in the National Bureau of Standards Master Fading Lamp.

3.2.1 *Calibration paper.* Calibration paper prepared by the National Bureau of Standards is used. It is blue colored paper 2 5/8 by 3 1/8 inches in size used in conjunction with a booklet containing a series of standard exposures of identical paper. The booklet contains standard exposures varying by 4-hour steps, from 16 to 32 hours. This paper is suitable for use in calibrating fading lamps for the time one trim of carbon serves, approximately 20 hours.

4. PROCEDURE

4.1 Calibration of fading lamps. A piece of calibration paper shall be placed in the lamp at the time of starting, after installing a new trim of carbons, and allowed to remain in the lamp during the time that this one trim of carbon serves or for an accurately measured number of hours in the neighborhood of 20 hours. The paper must be exposed on the proper face, as marked, and exposure conditions should be identical with those used for the test specimens with respect to mounting in the lamp.

4.2 Evaluation. Selection of standard fading hour.

4.2.1 The exposed paper after removal from the lamp shall be allowed to remain in a cool, dry place protected from strong light for 1 hour, or 30 minutes if it is allowed to remain in the lamp with the arc off long enough to permit the globe to cool to room temperature.

4.2.2 The unexposed portions of the exposed paper are then trimmed off to facilitate accu-

rate comparisons, and the paper is compared with the standard exposures. The comparisons should be made with the paper grain of the standards and control exposure placed in the same position, preferably in a horizontal direction. The exposed parts of both the standards and control should not be touched by the fingers because of the sensitivity to moisture and danger of soiling,

4.2.3 The standard exposure most closely approximating the exposed control paper in degree of fading should be selected, and the lamp shall be credited with baring operated for the corresponding number of standard fading hours instead of hours of actual operation regardless of whether they are identical or different.

4.2.4 Because any lamp may change in its fading rate from day to day, the calibration paper should be used as a control in all testing, that is, the paper should be exposed at the same time as the specimen undergoing test. In comparing the exposed control with the standards of fading hours in the master lamp; it is possible to interpolate 2-hour differences midway between the 4-hour standards.

4.3 The relative humidity of the air about the face of the specimen when the apparatus is filled with specimens and operating normally shall not exceed 50 percent, and the temperature shall not exceed 65° C. (149° F.).

4.4 The globe enclosing the carbon arc shall be cleaned when the carbons are changed or at least once in every 24 hours of operating time.

4.5 Unless otherwise specified in the detail specification, the specimen shall be exposed for 40 standard fading hours.

4.6 The specimen shall be exposed with a specimen of standard calibration paper for the required time, 4.5, and an equal adjacent, area of the original material retained but not exposed.

4.7 At the end of the exposure period, the specimen shall be removed from the fading lamp and allowed to lie in the dark at room temperature for a minimum of 2 hours before evaluation.

4.8 Evaluation. Fading shall be judged by visual comparison.

4.8.1 The comparison shall be made with the exposed specimen and the unexposed specimen in such a position that diffused daylight, ranging from average daylight to a slightly bluish north skylight or equivalent standsrd artificial light, falls on both at an angle of approximately 45°. The observer shall look squarely at the surface rather than at an angle to it. The test specimen shall be compared with an unexposed specimen from the same test unit and rated as follows :

Good: No appreciable change in color.
Fair: Appreciable but not objectionable change in color.
Poor: Objectionable change in color.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, one specimen shall be tested from each test unit.

5.2 Colorfastness to light of the test unit shall be recorded as “good,” “fair,” or “poor.”

THERMAL TESTS, GENERAL

1. SCOPE

This group of methods is intended for use in determining the properties of resilient nontextile floor coverings after exposure to high and low temperatures and to conditions encountered during fires. The methods are applicable to floor coverings such as linoleum, asphalt tile, plastics, etc. Methods are described for determining the effect of elevated temperature on dimensional stability and indent at ion, the effect of low temperature on flexibility, and the fire resistance and surface flammability of various types of floor coverings.

2. SPECIMEN

Specimens for thermal tests shall be free from defects or damage that may interfere with the property for which test is made.

3. PROCEDURE

3.1 Unless otherwise specified in the detail specification or applicable test method, physical tests for the evaluation of the change in the material due to exposure to high and low temperatures shall be made on specimens conditioned as described in method 1041.

3.2 Specimens for thermal tests shall be prepared as described in methods 1011 to 1031, inclusive, as applicable.

DIMENSIONAL STABILITY

1. SCOPE

This method is intended for use in determining the change in linear dimensions of resilient nontextile floor coverings, such as vinyl plastic and vinyl asbestos, after exposure to heat.

2. SPECIMEN

2.1 Tiles. The specimen shall consist of a tile taken from the test unit.

2.2 Rolls. The specimen shall consist of a portion of the test unit 9 by 9 inches.

2.3 The thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

The apparatus shall be as follows:

3.1 Apparatus described in method 5111.

3.2 A rigid steel plate for supporting the specimen in a horizontal position during the heating period and during measurement of the specimen. The plate shall be at least 1 inch larger in each linear dimension than the linear dimension of the specimen being tested.

3.3 A rigid steel plate approximately 1 to 2 inches less than each dimension of the specimen and ½ inch thick for keeping the specimen flat while being measured.

3.4 A micrometer comparator consisting essentially of an Invar steel bar on which is mounted two low-power microscopes, or other device suitable for measuring the distance between the reference points to within 0.001 inch. A satisfactory comparator is shown in figure 6211.

3.4.1 Each of the microscopes has an eyepiece equipped with a movable crosshair filar micrometer graduated to at least 0.001 inch.

3.4.2 The microscopes are mounted on the bar by means of clamps which permit the microscopes to be moved readily when necessary to adjust the distance between them and which will permit them to be held firmly in place when readings are being made.

3.4.3 The eyepiece of each microscope is also equipped with a control knob by which the crosshair can be moved over the entire range of the filar micrometer. The control knob contains a graduated scale by which any point between the graduations on the filar micrometer can be determined to the nearest 0.0002 inch.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, dimensional stability shall be determined by measuring the separation of reference points before and after heating the specimen at a temperature of 82°±2° C. (179.6°± 3.6° F.) for 6±¼ hour.

4.2 Two sets of equally spaced reference points, not more than ½ inch from the edges, shall be marked on the specimen in each linear dimension. .4 line passing through a given set of points shall form a perpendicular with the intersected edges of the specimen.

4.3 The specimen shall be conditioned in air as described in method 1041. The specimen shall be placed on the flat supporting plate, 3.2, and plate 3.3 placed on the specimen to keep it flat while being measured. The distance between the reference points in each set shall be measured with the comparator, and the value recorded to the nearest 0.001 inch.

4.4 In measuring the specimen, the microscopes shall be adjusted on the bar so that readings can be taken at the reference points. The left-hand microscope is set at zero with the crosshair on the fifth scale division and the specimen positioned so as to superimpose the crosshair on the left reference point on the specimen. The crosshair in the other microscope is similarly aligned with the reference point by adjusting the control knob, and the setting read from the filar micrometer and the

graduated scale on the knob to the nearest 0.0002 inch. Similar readings shall be made on each set of marks in both directions.

4.5 The circulating-air oven shall be adjusted to the required temperature, 4.1. With tehe wearing surface facing up, the specimen on the metal supporting plate, 3.2, shall be placed in the oven in a horizontal position and heated for the required time at the required temperature, 4.1. At the end of the heating period, the specimen and supporting plate shall be removed from the oven and allowed to cool to room temperature. The specimen shall then be removed from the supporting plate and again conditioned as required in 4.3. At the end of the conditioning period, the specimen shall be returned to the metal supporting plate, plate 3.3 placed on the specimen to keep if flat, the distance between the reference points, 4.2, again determined asdescribed in 4.3 amn 4.4 and the value recored to the nearest 0.001 inch. The temperature of the specimen during final measurement shall be within plus or minus 1° C. (1.8° F.) of the temperature during initial measurement, 4.3.

5. RESULTS

5.1 Calculation. The dimensional stability of the specimen at each set of reference points in each direction shall be calculated separatej y as follows:

$$\text{Dimensional stability, percent} = \frac{L_1 - L}{L} \times 100$$

where:

L is the distnace in inches between reference points of the specimen before heating.

L_1 is the distance in inches between reference points of the specimen after heating.

L_1–L may be a positive value or negative value depending on whether the specimen expands or contracts due to heating.

5.2 Unless otherwise specified in the detail specification, two specimens f rom each test unit shall be tested.

5.3 Unless otherwise specified in the, detail specification, the dimensional stability of the test unit shall be the largest value obtained from the specimens tested.

5.4 The dimensional stability of the test unit shall be recorded to the nearest 0.01 percent,

5.5 The temperature and time of beating of the specimen shall be recorded.

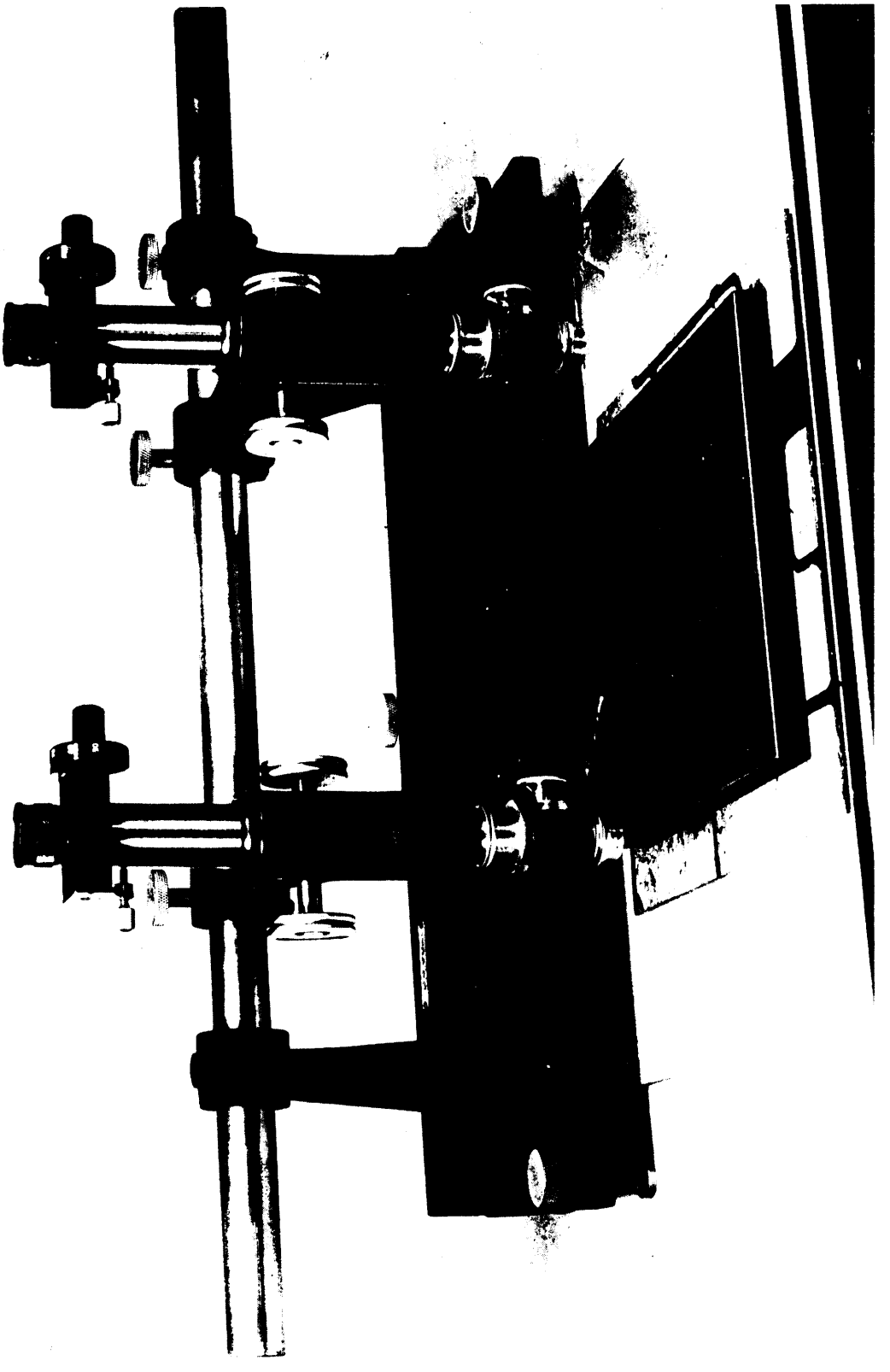

FIGURE 6211. Micrometer comparator apparatus.

INDENTATION, ELEVATED TEMPERATURE

1. SCOPE

This method is intended for use in determining the indentation at an elevated temperature of resilient nontextile floor coverings such as vinyl asbestos and asphalt tiles.

2. SPECIMEN

The specimen shall be as described in method 3211.

3. APPARATUS

The apparatus shall be as follows:

3.1 The apparatus described in method 3211.

3.2 Constant temperature water bath described in 3.4 of method 1041.

3.3 Temperature measuring apparatus described in 3.2 of method 1041.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the specimen shall be conditioned and tested at a temperature of 46°±1° C. (114.8°±l.8° F.).

4.2 The specimen, supporting plate, base of the indentation apparatus, and the hemispherical indentor point shall be placed in the water bath and conditioned for not less than 15 and not, more than 25 minutes. After conditioning, the specimen shall be adjusted on the supporting plate with wearing surface upward without removal from the bath. The hemispherical end of the indentor sha]l be placed on the wearing surface of the specimen, an initial load of 2 pounds gently applied to the indentor, and the scale of the dial indicator set at zero reading. Within 5 seconds after setting the dial indicator to zero, the total load of 30 pounds, initial load plus 28 pounds, shall be applied to the indenter without removing the initial load. Care shall be taken that a minimum of time elapses from the time the indentation tester is placed on the specimen and the application of the total load, as the tile may be relatively soft at this temperature and a false reading may be obtained. In no case shall the clasped time exceed 15 seconds. After the load has been applied to the specimen for 30±1 second, the indentation shall be read from the scale and the value recorded to the nearest 0.001 inch. Indentation readings shall be taken at three equally spaced places over the specimen. The total time for conditioning and testing the specimen shall not exceed 30 minutes. The median of the three readings shall be recorded to the nearest 0.001 inch as the indentation of the specimen.

5. RESULTS

5.1 Unless otherwise. specified in the detail specification, two specimens from each test unit shall be tested.

5.2 Indentation of test unit. The indentation of the test unit shall be the average of the median values obtained from the specimens tested.

5.3 The indentation of the test unit shall be recorded to the nearest 0.001 inch.

5.4 The temperature at which the specimen was conditioned and tested shall be recorded.

FIRE RESISTANCE

1. SCOPE

This methlod is intended for use in determining the fire resistance of resilient nontextile floor coverings such as fire-retardant rubber matting, fire-retardant viny] asbestos tile, anl fire-retardant linoleum.

2. SPECIMEN

2.1 Tiles. The specimen shall consist of a sufficient number of tiles to provide an area of floor covering about 31½ inches in length and 7 inches in width.

2.2 Rolls. The specimen shall consist of a portion of the test unit about 31½ inches in length and 7 inches in width.

2.3 The thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

The apparatus shall be as follows :

3.1 A fire resistance testing apparatus as shown in figure 6411A. The apparat us consists essentially of a hood, gas burners, and specimen holder assembled on a suitable framework.

3.1.1 *Hood.* The hood consists of a horizontal flue 30 inches in length communicating with a vertical flue 18 inches in length. The flues are 8 inches in width by 6 inches in depth. The bottom plate of the horizontal flue is made of sheet steel and the remainder of, the hood is constructed of asbestos board. The front end of the bottom plate is cut back about 3 inches so as to provide clearance for the flames of the gas burner.

3.1.2 *Specimen holder.* The horizontal flue is equipped with a specimen holder consisting of a plate of 1/8-inch thick mild steel, 31½ inches in length and 7 inches in width, supported by means of flanges placed 2 inches :above the bottom plate. The specimen holder is located so that there is a space of 3 inches between the end and the back of the vertical flue to permit hot gases passing under the specimen to be vented through the vertical flue.

3.1.3 *Burners.* Four open blast gas burners are, located side by side at the front end of the horizontal flue, parallel to the front end of the specimen holder, and on 1¾-inch centers equi - distant from each side of the flue. The center of the burners shall be located 4 inches below the bottom surface of the specimen holder and shall be ½ inch in front of the end of the specimen holder. Gas and air are supplied to the burners through a common manifold. Details of the specimen holder are shown in figure 6411B and of the gas burners in figure 6411C.

3.2 Commercial propane gas having a heat - ing value of 2,550 British thermal units per cubic foot at a temperature of 15.6° C. (60° F.) and atmospheric pressure of 30 inches of mercury. The ga system shall be equipped with controls for maintaining the flow at 9.6 cubic feet per hour.

3.3 A source of compressed air and equipment for controlling the rate of flow at 150 cubic feet per hour.

3.4 Equipment such as a fan, or other device, and water column for controlling the draft through the flues at the required rate corresponding to 0.06 inch of writer pressure.

3.5 Cement, fire-retardant, as specified in the detial specification.

3.6 A stopwatch or other timing device that will indicate the time in seconds.

3.7 Scale or tape graduated to 0.1 inch.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the time of application of the flame shall be 240± 5 seconds.

4.2 The specimen shall be cemented to the specimen holder in the usual manner by means of the fire-retardant cement, 3.5, and allowed to dry for at least 96 hours at room temperature.

4.3 At the end of the drying period, the specimen holder with specimen attached shall be mounted on the flanges located 2 inches above the bottom of the horizonal flue. The draft through the flues shall be adjusted to an airflow corresponding to 0.06±0.01 inch of water pressure. The flames of the burners shall be adjusted by regulation of the gas and air flow to 9.6 cubic feet per hour and 150 cubic, feet. per hour, respectively. The flames shall be applied to the specimen for the required time, 4.1, and immediately removed.

4.4 Unless otherwise specified in the detail specification, after removal of the flame, the following shall be recorded.

4.4.1 *Combustion plus iqnition time.* The time from the initial application of the flame until the flaming of the specimen ceases shall be recorded.

4.4.2 *Length of char. The* average length of the part of the specimen permanently damaged by burning or charring shall be recorded to the nearest 0.1 inch.

4.4.3 *Length of flame.* The maximum length of the flame shall be recorded to the nearest inch.

44.4 *Density of smoke.* The density of the smoke shall be recorded as "light, " "medium," or "heavy."

5. RESULTS

5.1 Unless otherwise specified in the detail specification, one specimen from each test unit shall be tested.

5.2 Test unit.

5.2.1 *Combustion plus ignition time.* When one specimen is tested from the test unit, the combustion plus ignition time of the test unit shall be the value obtained from the specimen tested. When more than one specimen is tested from the test unit, the combustion plus ignition time of the test unit shall be the average of the values obtained from the specimens tested.

5.2.2 *Length of char.* When one specimen is tested from the test unit, the length of char of the test unit shall be the value obtained from the specimen tested. When more than one specimen is tested from the test unit, the length of char of the test unit shall be the average of the values obtained from the specimens tested.

52.3 *Length of flame.* When one specimen is tested from the test unit, the maximum length of flame of the test unit shall be the value obtained from the specimen tested. When more than one specimen is tested from the test unit, the maximum length of flame of the test unit shall be the average of the values obtained from the specimens tested.

5.2.4 *Density of smoke.* When one specimen is tested from the test unit, the density of the smoke of the test unit shall be the value obtained from the specimen tested. When more that, one specimen is tested from the test unit, the density of the smoke of the test unit shall be the value assigned to the specimen from which the smoke is densest.

52.5 The combustion plus ignition time of the test unit shall be recorded to the nearest 5 seconds. The length of char of the test unit shall be recorded to the nearest 0.1 inch. The density of smoke from the test unit shall be recorded as "light," "medium," or "(heavy."

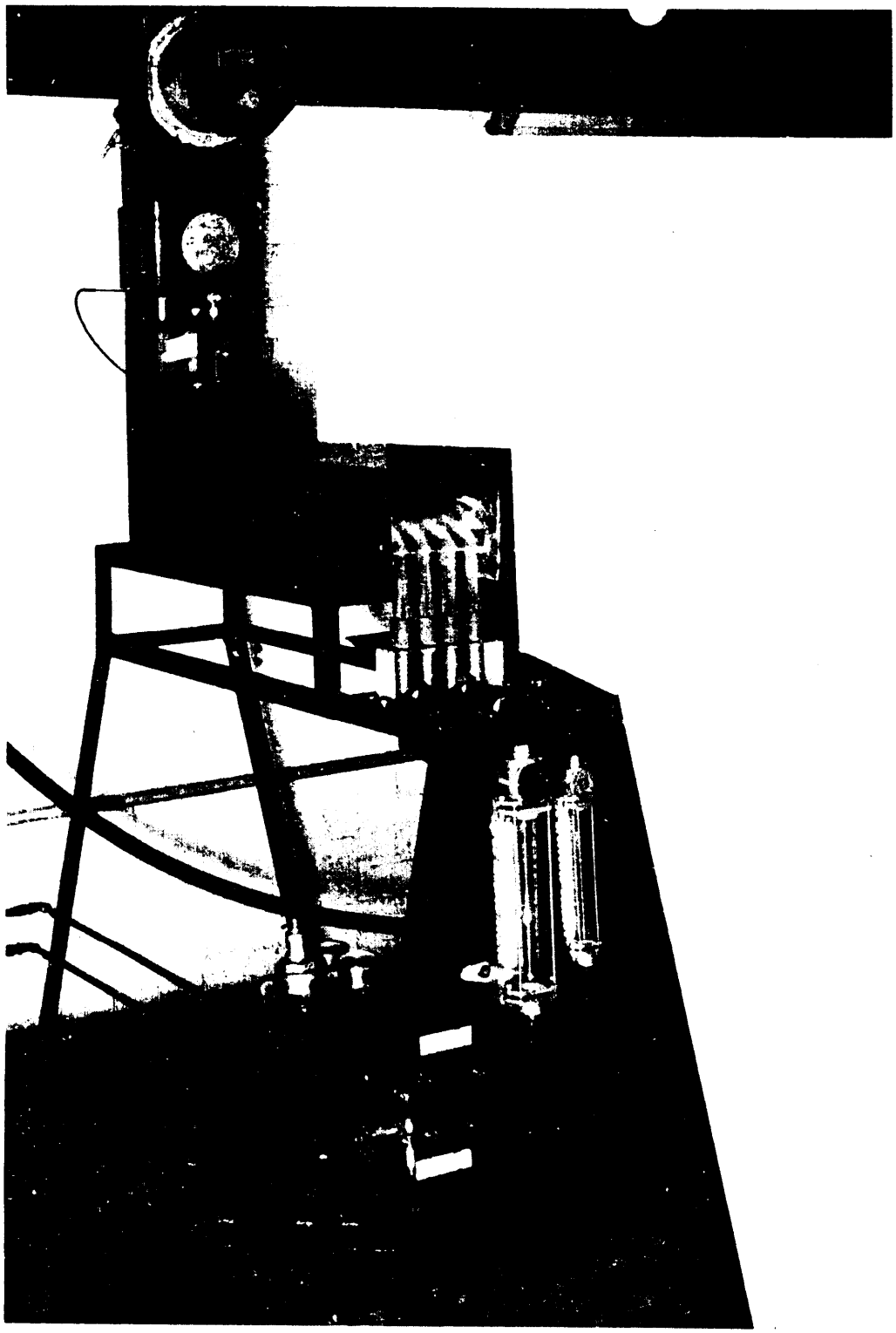

FIGURE 6411A. Side view of assembled fire-resistance apparatus.

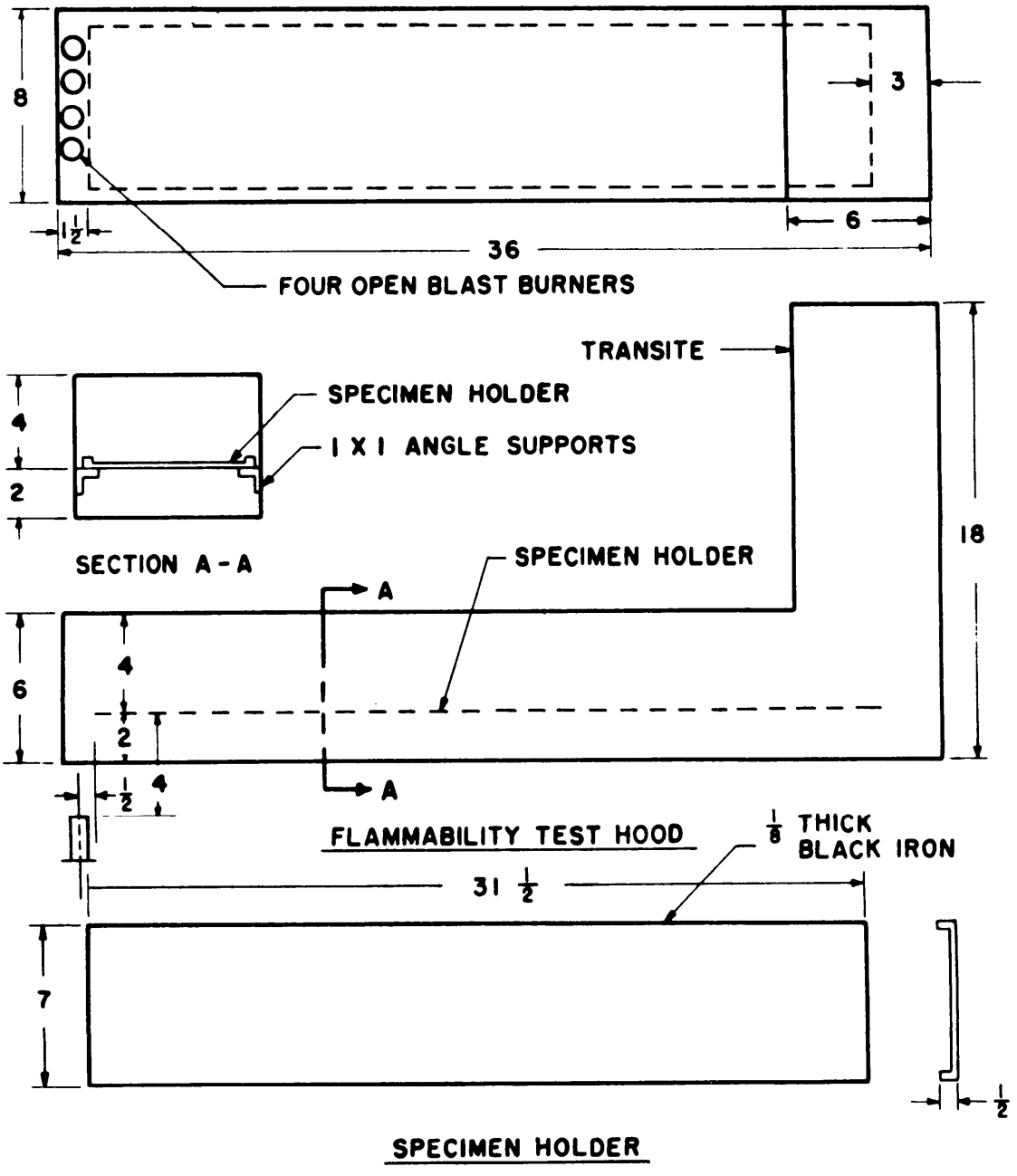

FIGURE 6411B. Details of fire-resistance test apparatus.

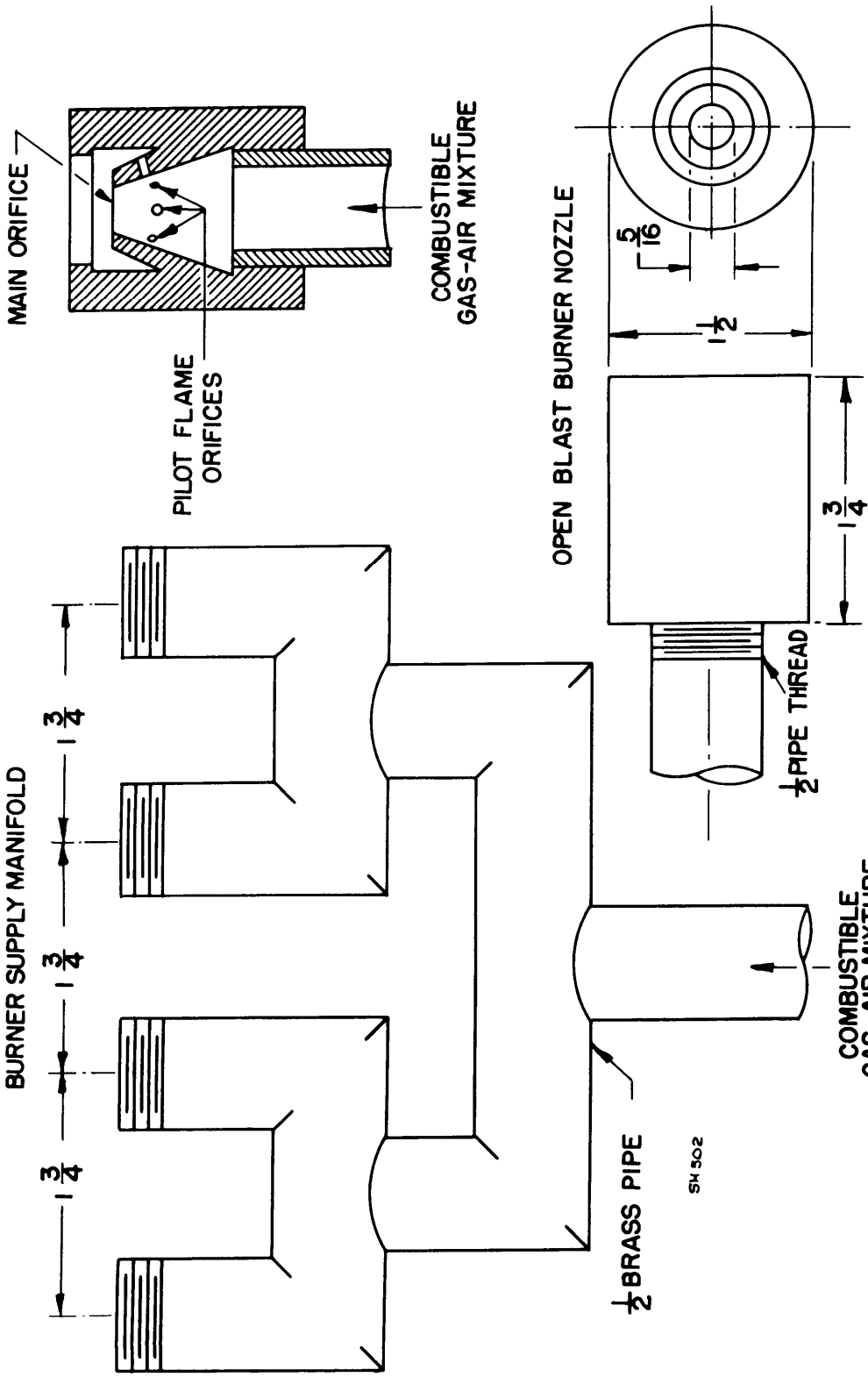

FIGURE 6411C. Burner and air supply.

FLAME SPREAD INDEX [1]

1. SCOPE

1.1 This method is intended for use in determining the flame spread index of resilient nontextile floor coverings such as fire-retardant rubber matting, fire retardant vinyl asbestos tile, and fire-retardant linoleum.

1.2 The method employs a radiant heat source consisting of a 12- by 18-inch panel in front of which an inclined 6- by 18-inch specimen of the material under test is placed. The orientation of the specimen is such that ignit ion is forced near the upper edge of the specimen and tile flame front progresses downward. Figure 6421A illustrates the assembled test equipment in use:

1.3 A factor for the progress of the flame front and a factor which is related to the rate of heat generation by the material under test are combined by means of an empirical relationship to provide a flame-spread index for the material.

1.4 The method includes means for the quantitative determination of the amount of smoke evolved during the test. While not a factor in the determination of the flame-spread index, this indicates the extent of a parallel hazard.

1.5 The results obtained by use of the test method in the prescribed manner are relatively unaffected by slight changes in ambient variables and modification in mechanical adjustment. The classification of materials with respect to surface flammability, derived by the method, appears to be generally consistent with information available on the behavior of such materials during fires.

2. SPECIMEN

2.1 The specimen shall consist of a portion of the test unit 6 by 18 inches, or, in the case of tiles, sufficient tiles or portions of tiles from the test unit to provide 6 by 18 inches.

2.2 For calibration purposes, the specimen shall consist of an asbestos cement board specimen 6 by 18 inches.

3. APPARATUS

The apparatus shall consist of the following test eqquipment installed in a room, laboratory, or test area in such a manner as to be free from strong drafts which could disturb the pattern of burning on the specimen surface or the measurement of its heat evolution. No restrictive side walls or tables, highly reflective surfaces or windows shall be placed in front of the plane of the radiating surface and within 3 feet of the radient panel or specimen.

3.1 Radiant panel[2] A porous refractory material enclosed, on all but one face, in a cast iron frame, vertically mounted. The overall dimensions are 19 by 13 by 4 inches, the vertical refractory face 18 by 12 inches. The panel is equipped with a venturi-type aspirator for mixing gas supplied at approximately atmospheric pressure with air. The air is supplied by a centrifugal blower with rated capacity of 100 cubic feet per minute at 2.8 inches water pressure, or equivalent. An air filter is provided to prevent dust from obstructing the panel pores. A pressure regulator and a control and shutoff valve are provided for the gas supply.

3.2 Specimen holder and framework. A specimen holder and framework as shown in figures 6421B and 6A21C. The specimen holder, preferably fabricated of heat-resistant steel, is placed on a metal framework which is arranged for maintaining the correct spacing and for positioning the specimen centrally with respect to the radiant panel. The framework dimen-

[1] Factors in the development of the test method are described in "A Method for Measuring Surface Flammability of Materials Using a Radiant Energy Source," by A. F. Robertson, D. Gross, and J. Loftus, ASTM Proceedings, vol. 26 (1956).

[2] Type 1 surface combustor, 12 by 18 inches, and associated air and gas supply system, manufactured by Radiant Heat Ltd., London, N., England, and distributed through their export agent, Standard Sales, Ltd., 74 Borough High Street, London, S.E. 1, England.

4.2.5 After steady-state conditions at the stack have been reached, remove one specimen from the conditioning room and bring to the test apparatus. Either of two procedures may be followed:

(a) Mount specimen in a cool specimen holder in the conditioning room and bring the assembly to the test apparatus in a vapor barrier jacket, or

(b) Wrap the specimen in a vapor barrier jacket, bring to the test apparatus, remove from the jacket, and quickly mount in a cool specimen holder.

In either case, all specimens except those over 3/4-inch thick should be backed with ½-inch-thick asbestos millboard of 60 pounds per cubic foot density. The specimen should be tested as quickly as practicable after having been removed from the conditioning room in order to minimize any changes in the moisture content and temperature of the specimen attained in the conditioning room.

4.2.6 Place the smoke sampling device in position above the stack and adjust the gas flow through it (see 3.5) : maintain this gas flow, if possible, by adjusting the suction throughout the test.

4.2.7 Ignite the pilot burner and adjust the flame to 2 to 3 inches length. Swing the pilot burner into operating position and maintain for the duration of the test. If, during the test, the pilot burner flame is extinguished, relight. For materials which tend to shrink or contract upon application of heat, the pilot burner tip should be turned toward the specimen so that more direct flame impingement on the specimen is assured.

4.2.8 Place the specimen holder containing the specimen in test position and start the timer simultaneously. A single operator may accomplish this conveniently by means of a foot-operated switch on the timer as shown in figure 6421.4. Make continuous observations of the development and spread of flames on the specimen surface, recording both the elapsed times at which any portion of a sustained flame front arrives at points marked 3, 6, 9, 12, and 15 inches from the upper edge of the specimen and important visual observations.

4.2.9 Continue the test until the flame front shall have progressed the full length of the exposed specimen or until 15 minutes, which-ever is less. Discard the specimen and allow the specimen holder to cool.

4.2.10 Carefully remove and reweigh the smoke sampling filter disk. Making allowance for the loss in weight of the filter disk at the operating temperature (see 4.1.2), determine the weight of the smoke deposit to the nearest 0.0001g.

4.2.11 After weighing, the smoke sampling filter disk shall be measured for optical density with a transmission densitometer (see 3.12). Likewise, the clear peripheral area of the filter disk shall be measured for optical density.

4.2.12 Determine the maximum stack thermocouple temperature from the automatic recording potentiometer.

4.2.13 Determine the mean temperature measured by the stack thermocouples over the final 10 minutes of a 15-minute interval using an asbestos-cement board specimen with pilot burner in position. The difference between this temperature and the maximum stack thermocouple temperature (see 4.2.12) is the value of $\Delta\theta$ for the test specimen.

4.3 Maintenance. In addition to the normal operating procedures, various procedures should be carried out as required.

4.3.1 *Radiant panel.* The air intake filter should be checked occasionally and cleaned or replaced as needed to prevent the passage of dust which might obstruct pores in the refractory.

4.3.2 *Stack thermocouples.* The thermocouples should be inspected and brushed off periodically since heavy deposits of combustion products reduce the response and accuracy of the temperature measurements. The thermocouples should be cleaned no less frequently than after 40 hours of use. With very heavy smoke-producing materials, it may be necessary to clean the thermocouples after each test.

4.3.3 *Smoke sampling device.* The smoke sampling device should be checked for leaks periodically.

4.3.4 *Position checks.* The positioning, by stops, guides, etc., of movable components

(specimen holders, smoke sampling device, radiation pyrometer, etc.) should be checked periodically.

4.3.5 *Calibration checks.* The calibrations of all measuring instruments, meters, potentiometer, and other auxiliary equipment should be checked periodically.

4.3.6 *Pilot burner.* The pilot burner should be replaced or cleaned periodically to remove deposits formed on the interior surface.

5. RESULTS

5.1 Calculation of flame-spread index.

5.1.1 The flame-spread index, I_s, is taken as the product of the flame-spread factor, F_s, and the heat evolution factor, Q, thus:

$$I=F_sQ$$

Where:

$$F_s=1+\frac{1}{t_3}+\frac{1}{(t_6-t_3)}+\frac{1}{(t_9-t_6)}+\frac{1}{(t_{12}-t_9)}+\frac{1}{(t_{15}-t_{12})}$$

in which t_3, t_6, t_9, t_{12}, and t_{15} are the elapsed times in minutes, from the start of specimen exposure until arrival of the flame front at distances from the top of the sepcimen indicated by the numerical subscripts. Certain materials, or specimens, may show local advance more rapid than the general flame front advance not due to melting and running or dripping of burning material, but caused by nonhomogeneity of the material (local fissure, combustible-rich segment, etc.). The times associated with the furthest advance, whether local or general, shall be used in computing the flame-spread factor F_s.

5.1.2 For some materials, particularly those with flame-retardant treated surfaces, a significant delay may occur in the start surface flaming, followed by a very rapid flame progression which may envelop one or more markings before a sustained flame establishes itself, In many cases, the progression of the sustained flame front after this has occurred, will be regular and times for the flame front to pass succeeding 3-inch marks may be readily measured. However, in some cases, the sustained flame front progression will be limited, providing no additional time-distance data. If the rapid flaming envelopes two or more markings, the time interval (s) involved, even if measurable would result in a, disproportionately high number being used in summing up the components of the flame-spread factor. In order to obtain more representative factors in such situations, the following procedures shall be used.

(1) Measure or estimate the distance D, in inches, and the corresponding time t, in minutes, when the flaming establishes very rapidly past the 3-inch mark or past the 3- and 6-inch marks or past the 3-, 6-, and 9-inch marks.

(2a) In the case where succeeding time-distance data are available, plot D on rectangular coordinates as a function of t on logarithmic coordinates.

(2b) In the case where no succeeding time-distance data are available, determine the distance D_o corresponding to a time of 1.0 minute from the following equation, $D= D_o + 6.5 \log_e t$.

(3a) Extrapolate the curve (or line) back to obtain estimated times for the 3-inch or 3- and 6-inch markings.

(3b) Using the value of D_o and the same equation from (2b), calculate the corresponding times for distances of 3 inches, 3 and 6 inches, or 3, 6, and 9 inches.

(4) Use these extrapolated or calculated times and corresponding distances to calculate the flame-spread index.

5.1.3 The heat evolution factor Q, is calculated according to the relation:

$$Q=\frac{0.1\Delta\theta}{\beta}$$

in which 0.1 is a constant, $\Delta\theta$ is the observed maximum stack thermocouple temperature rise at any stage of combustion of the specimen, in degrees F., over that observed with an asbestos-cement board specimen, and β is the maximum stack thermocouple temperature rise for unit heat input rate to the calibration burner, degrees F. min. per B.t.u.

5.2 Calibration of smoke deposit. From the measured weights of the filter disk before and after the test, making correction for any loss in weight due to moisture in the disk, determine the weight of the smoke deposit to the nearest 0.0001 g. After weighing, the optical density of the deposited smoke film shall be determined by subtracting the average optical density of the clear filter paper disk around

sions must be maintained to within 1/8 inch of the values given in figure 6421B.

3.3 Pilot burner. A pilot burner used to force ignition, when possible, at the top of the specimen. The burner consists of a short length of stainless steel tubing, 3/16 inch in outside diameter, 1/8 inch in inside diameter, the exposed portion of which is protected by a porcelain tube 9/32 inch in outside diameter. The pilot burner is fed with acetylene premixed with air. The air may be supplied from any suitable mixing device such as an aspirating-type fitting. To reduce the frequency of replacement of the pilot burner from oxidation effects, it is mounted to swing out of position readily when not in use. When in use, the Burner is horizontal and at a slight angle with respect to the specimen. The position of the burner tip is such that a minimum of 2 inches of the burner flame is in contact with or not more than ½ inch from the central uppermost area of the exposed surface of the specimen.

3.4 Stack and thermocouples. Dimensions of the vertically mounted stack, locations for eight thermocouples therein, and position of the stack with respect to the specimen and radiant panel are shown in figure 6421B. The thermocouples, of 0.020-inch chromel and alumel wires, are supported within porcelain insulators as shown in figure 6421D. The thermocouples are matched for equal resistance and connected in parallel to give a single output indicative of the average of the temperatures at the eight junctions. This output is recorded by an automatic recording potentiometer (see 3.6).

3.5 Smoke sampling device. A means for drawing air and gases from the top of the stack through a, glass fiber filter paper.[3] The details are shown in figure, 6421E. A flowmeter or other gas metering device and an aspirator or vacuum pump are used to maintain a constant velocity of flow over the 7/8-inch-diameter exposed filter disk equivalent to 40 feet per minute of air at 21° C. (70° F.).

[3] Type 1106 All-Glass Filter Media, distributed by Mine Safety Appliances Co., 201 North Braddock Avenue, Pittsburgh, Pa., 15208, or equivalent.

3.6 Recording potentiometer. A recording potentiometer covering the range of 50° to 550° C. (100° to 1,000° F.). The recorder should give a continuous record or print every 15 seconds or less.

3.7 Radiation pyrometer. A radiation pyrometer for standardization of the radiant output of the panel. The device should be suitable for viewing a circular area of 10-inch diameter at a convenient range. It is preferable that a wide-angle radiation pyrometer with high transmission in the infrared, such as one employing a calcium fluoride lens or window, be used.

3.8 Potentiometer indicator or recorder. Manual or automatic potentiometer indicator or recorder to monitor the electrical output of the radiation pyrometer. It should have a range suitable for indicating the output of the radiation pyrometer at the operating black body temperature (see calibration procedure, 4.1.3) and when used with the radiation pyrometer should have a sensitivity and a limit of error corresponding to an error in the black body temperature of 2° C. (3.6° F.).

3.9 Timer. The timer should have start, stop, and reset features and should be suitable for rapid visual reading. It should be calibrated up to at least 15 minutes, preferably in minutes and hundredths.

3.10 Conditioning room. A room or chamber of sufficient size to hold the specimens and controlled to provide an ambient of 23° ±3° C. (73° ±5° F.) and 50±5 percent relative humidity. It should be sufficiently close to the test apparatus that the transport of each individual test specimen between the two may be made readily. Vapor barrier jackets in which specimens may be placed for this triansport should be available.

3.11 Hood. For standardization of the smoke measurement, a hood with exhaust blower placed above the stack is required. The blower should be capable of producing a velocity of 100 feet per minute at the top of the stack with the radiant panel not operating. This corresponds to approximately 250 feet per minute with the radiant panel at operating temperature. The velocity through the stack is not critical for

flame-spread measurements provided a stack thermocouple temperature calibration is performed for the established test conditions (see 4.1.4). The hood surface should clear the top and sides of the stack by a minimum of 10 and 7½ inches, respectively.

3.12 Smoke transmission densitometer. A photometer using an S-4 photosensitive surface together with an incandescent light source shall be used for optical density measurements of the deposited smoke film over a density range of 0 to 4.5.

4. PROCEDURE

The operational procedures to be followed with the apparatus described are divided into two general groups: those necessary for the calibration and standardization of the apparatus (see 4.1), and those necessary for the performance of a test of a specimen (see 4.2).

4.1 Calibration procedures. In setting up the apparatus, initially, several precautions should be observed and calibrations made.

4.1.1 *Alignment.* Considerable care should be taken that the various components are well supported, aligned, and at the correct distances from one another, in accordance with figure 6421B. Stops, guides, or rests should be provided so that the movable parts and those that require periodic cleaning or replacement, may be moved into normal operating positions easily and accurately. These include the pilot burner, smoke sampler, radiation pyrometer, stack, and specimen holder.

4.1.2 *Smoke sampling.*

4.1.2.1 The smoke-sampling device, including all connect ions should be tested by substituting an impermeable diaphragm for the filter disk. With the vacuum pump or aspirator in operation, the flowmeter should indicate zero airflow. Since the gas-flow resistance of the filter disk is not negligible, leaks would result in erroneously low smoke deposits on the disk and should be eliminated.

4.1.2.2 Allowance for the equilibrium moisture content of the glass fiber filter disks should be made in the smoke deposit measurements. During the test of an asbestos-cement board specimen, the loss in weight of the filter disk should be recorded. This weight, loss should be applied as a correction to the smoke deposit measurements obtained in tests of materials. (See 4.2.10.)

4.1.3 Radiation pyrometer.

4.1.3.1 The radiation pyrometer should be calibrated at the operating point, i.e., a black body temperature of 670° C. (1238° F.), and its approximate temperature-electromotive force relation in this vicinity determined. This provides data on a segment of the calibration curve necessary for operation within the limits set (see 4.2.2). The calibration consists in measuring the electromotive force produced when the pyrometer is sighted on a black body source, the temperature of which is measured by means of a calibrated thermocouple. A suitable black body enclosure may consist of a hollow rough-surfaced chromel cylinder closed at one end and with a sight hole in the other end, placed within a furnace and maintained at a uniform temperature. A 20:1 ratio of the total area of the internal surface of the black body to the area of the black body opening is considered adequate. The radiation pyrometer is placed so that its field of view is confined to the opposite end of the cylinder where a thermocouple inserted within a drilled hole in the body wall and extending almost to the base of the cylinder indicates the black body temperature.

4.1.3.2 The proper position for the radiation pyrometer when monitoring the output of the radiant panel is along the normal through the center of the panel surface and at the distance to view a central circular area 10 inches in diameter on the panel. This position should be determined as follows: With the panel operating and the pyrometer sighting along the normal, slowly insert an incombustible opaque shutter in front of the panel from top, bottom, and each side in turn, noting how far the shutter must be inserted before the pyrometer output reading starts to decrease. Adjust the pyrometer along the normal until the position is found at which the output decrease starts when the shutter is 1 inch from each side and 4 inches from the top or bottom. The pyrometer should be fixed in this position on a sturdy mount.

4.1.4 *Stack thermocouples.*

4.1.4.1 With the panel at operating temperature, and the exhaust blower producing an established stack velocity, note the temperature of the stilck thermocouples. The operating stack thermocouple temperature is dependent upon the position of the hood exhaust system opening with respect to the stack Although flame-spread measurements may be readily made for a wide range of operating stack thermocouple temperatures (i.e., prior to placing test specimen in position), difficulties with smoke measurements have been noted in (cases where this temperature was significantly greater than 230°C. (446° F.). For this reason it is recommended that initial positioning of the hood exhaust system be made so as to maintain the operating stack thermocouple temperature within the range 180° to 230° C. (356° to 446° F.)

4.1.4.2 Place an asbestos-cement board speci - men, with a ½-inch asbestos millboard backing, in test position, and note tile ensuing equilibrium temperature of the stack thermocouples which will be used as a base temperature for the following procedure.

4.1.4.3 A multiported diffusion (no premixed air) burner shall be prepared from a 12- to 15-inch length of ¼-inch standard wrought iron or steel pipe capped at one end and containing ten 0.070-inch-diameter radial holes spaced 5/8 inch on centers along a line parallel to the axis of the pipe. Place the centerline of the pipe burner in a horizontal position, 1 inch (measured along the specimen surface) below the upper exposed edge of the asbestos-cement board specimen. The pipe wall shall be in contact with both side edges of the specimen holder so that tile portion of tile pipe containing tile burner holes is centered with respect to the speimen. The axes of the burner holes shall be vertical causing flames from the burner to impinge at or near the top of the asbestos-cement board specimen. The type and orientation of the yellow diffusion flames produced are comparable to the flames emitted from a burning specimen. Record the maximum stack thermocouple temperature rise above the previously defined base for each of several gas flow-rates to the burner allowing a minimum of 10 minutes at each flow rate for stack temperature stabilization. The gas supplied to the calibration burner shall be manufactured methane, or natural gas, or combination of these gases. The gas-flow rate to the calibration burner should be measured by means of a calibrated flow meter. Use the higher (gross) heating value of the gas to convert the gas-flow rates to heat input rates. Moisture, temperature, and pressure corrections should be applied, when applicable, to convert the gas flow rates and the higher (gross) heating value of the gas to a dry basis at a standard temperature of 15.6° C. (60° F.) and a standard pressure of 30.0 inches of mercury. Plot the maximum stack temperature rise, in degrees F., as a function of the corresponding measured bent input rate in British thermal units per minute. The slope of the line fitted to these points is the value of β in the flame-spread index formula (see 5.1). If changes are made which affect the velocity through the stack, a new value of β must be determined for these new conditions.

4.2 Test procedure.

4.2.1 Tile specimen shall be applied with the cement specified in the detail specification to a 1/8-inch thick milled steel plate 6 inches in width by 18 inches in length. The specimen assembly shall be allowed to dry for at least 96 hours at a temperature of 23° ±3° C. (73° ±5° F.) and 50 percent relative humidity.

4.2.2 The gas-air mixture passing through the radiant panel is ignited and the panel allowed to heat for one-half hour, minimum. At the end of the preheat period, the radiant output is checked with the radiation pyrometer, positioned to view the central panel area of 10-inch diameter. The gas supply is adjusted to maintain the radiant output at that which would be obtained from a black body of the same dimensions and at a temperature of 670° ±4° C. (1238° ±7° F.). (See 4.1.3.)

4.2.3 Turn on and standardize the recording potentiometer for measurement of the stack thermocouple temperature rise.

4.2.4 Weigh a new filter disk to an accuracy of 0.0001 gram (g.) and place it in the smoke sampling device.

its periphery from the average optical density of the filter disk with deposited smoke.

5.3 Unless otherwise specified in the detail specification, four specimens from each test unit shall be tested.

5.4 The flame spread index of the test unit shall be the mean value obtained for the specimens tested.

5.5 The flame spread index of the individual specimens and the mean value obtained shall be recorded.

5.6 The mean smoke deposit weight to the nearest 0.0001 g. and the optical density of the deposited smoke film when measurements are in the range 0 to 4.5 shall be recorded.

5.7 Any visible changes in the individual specimens shall be recorded.

Notes:

(1) For checking operational and procedural details of this standard, a surface flammability standard (No. 1002) is available, at nominal cost, through the Standard Sample Office, National Bureau of Standards, Washington, D. C., 20234. The use of this standard material does not obviate the need for following the calibration and standardization procedures outlined herein,

(2) The proper calibration of the radiation pyrometer at a blackbody temperature of 670° C. (1,238° F.) as described in 4.1.3 is extremely important. Where facilities for performing such a calibration are not available to laboratories equipped with the radiant panel test apparatus, a check calibration may be performed upon request to the Fire Research Section, National Bureau of Standards, Washington, D. C., 20234.

FIGURE 6421A. Typical test equipment installation.

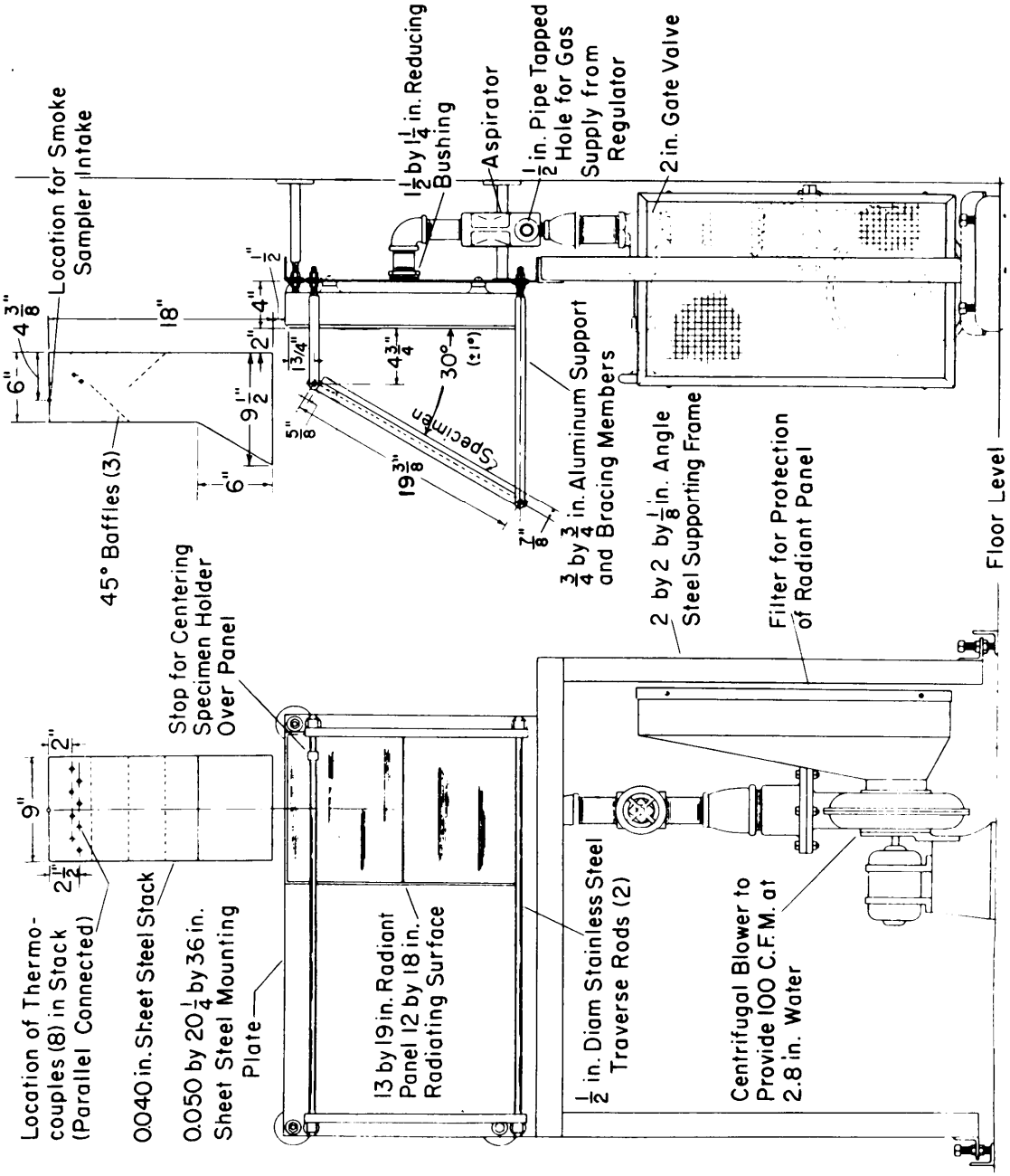

FIGURE 6421B. General arrangement drawing.

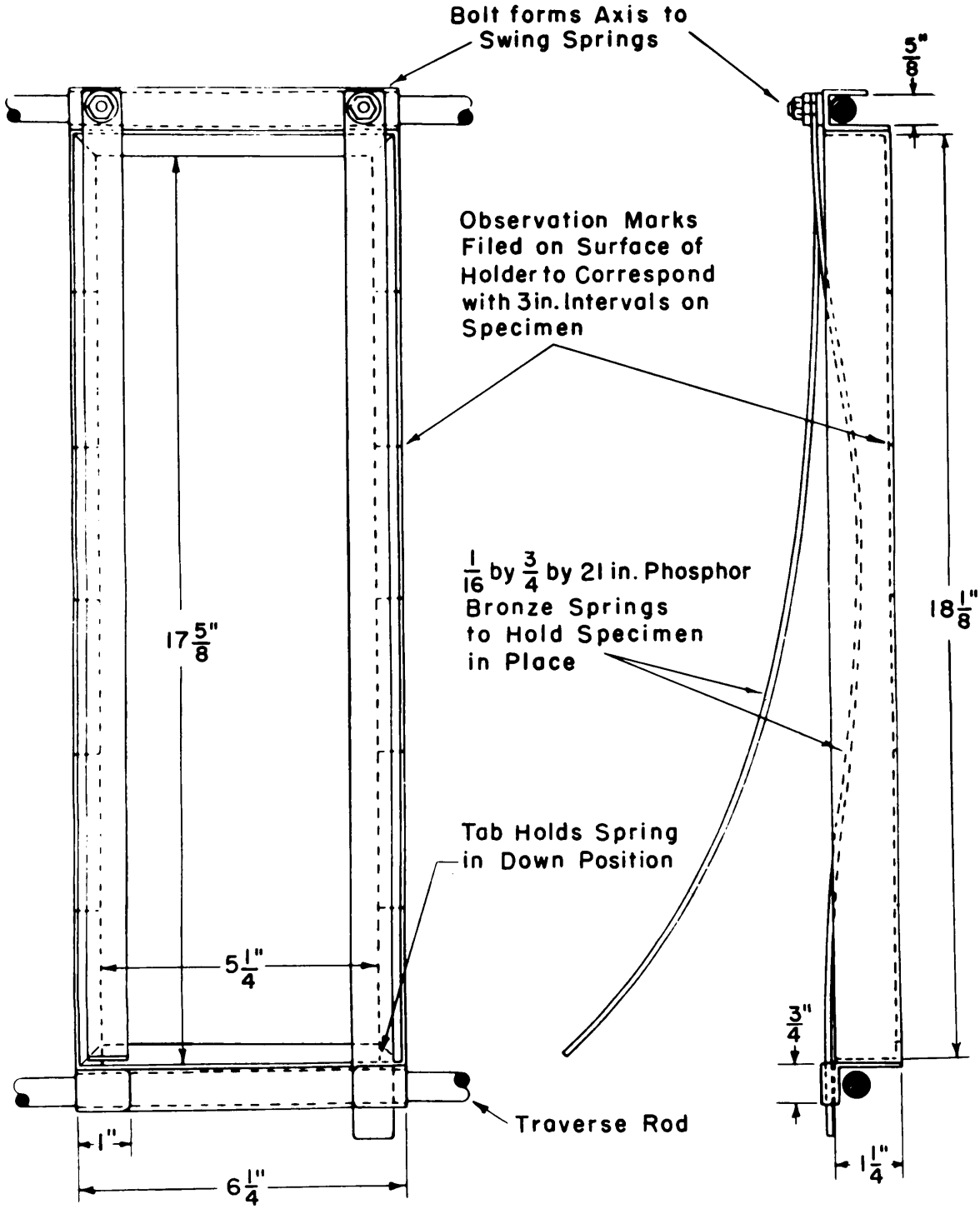

FIGURE 6421C. Specimen holder.

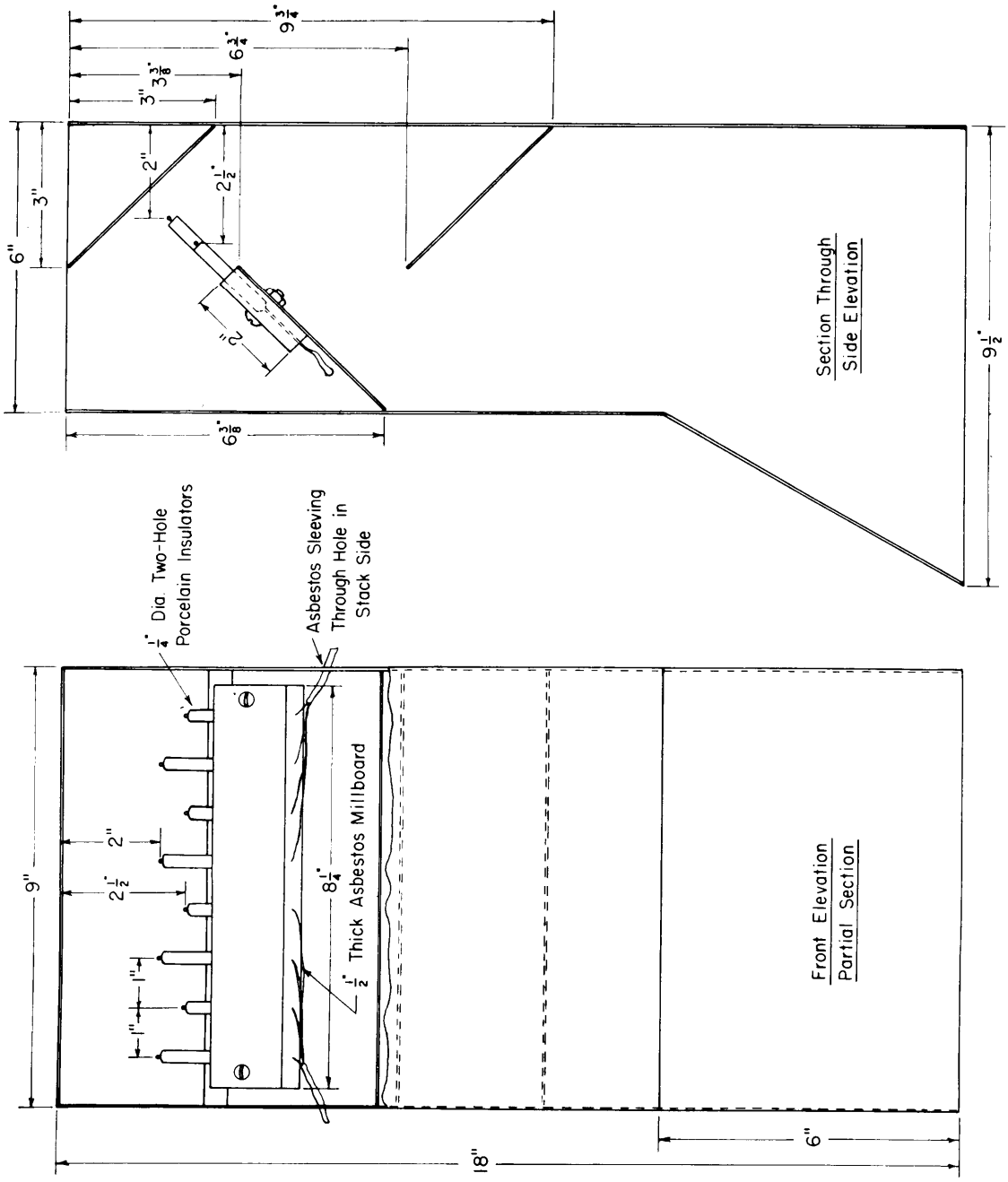

FIGURE 6421D. Stack thermocouple and baffle arrangements.

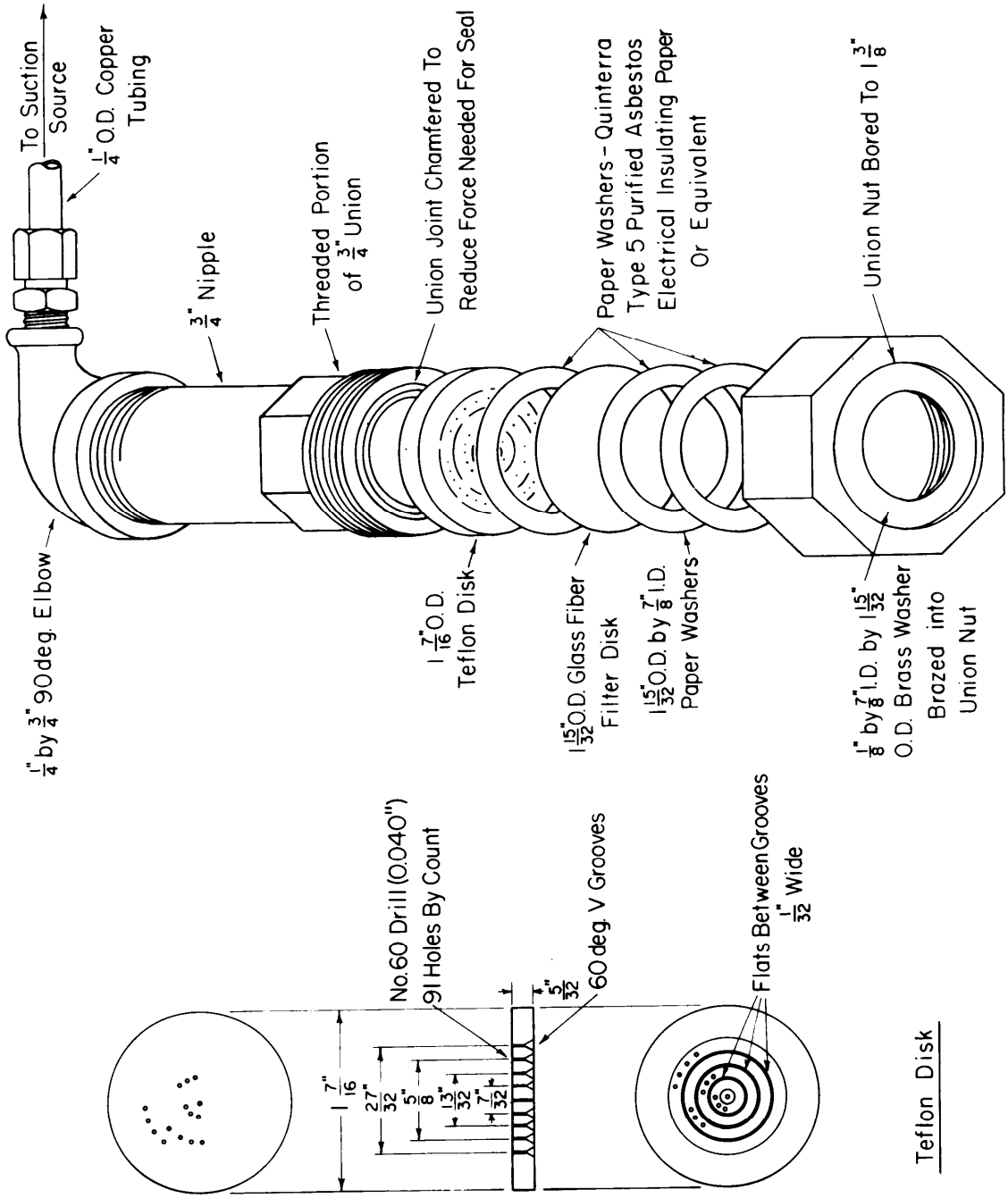

FIGURE 6421E. Smoke sampling device.

FLEXIBILITY, LOW TEMPERATURE

1. SCOPE

This method is intended for use in determining the flexibility of resilient nontextile floor coverings such as plastic and rubber matting, after exposure at low temperature.

2. SPECIMEN

The specimen shall be as described in method 3111.

3. APPARATUS

The apparatus shall be as follows:

3.1 A low-temperature cabinet or room with suitable automatic controls for maintaining the required temperature throughout the cabinet or room during the exposure period and of sufficient size to hold the specimen and mandrel. The cabinet is equipped with facilities such as glass windows, handholes with insulated sleeves, etc., that will permit bending of the specimen around the mandrel at the low temperature.

3.2 Apparatus such as thermometers, copper-constantan thermocouple and potentiometer, or other device for measuring the temperature to within 1° C. (1.8° F.).

3.3 A mandrel of the size specified in the detail specification.

3.4 A stopwatch or other timing device that will indicate the time in seconds.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the specimen shall be exposed at a temperature of ( )°±1° C. (32°±1.8° F.) for 4±¼ hour.

4.2 The specimen shall be placed in the low-temperature cabinet or room and maintained for the required time at the required temperature, 4.1. At least 1 hour before the end of the exposure period, a mandrel of the required size, 3.3, shall be placed in the cabinet in order that it may reach temperature equilibrium.

4.3 At the end of the exposure period, the test shall be conducted in the cabinet at the exposure temperature as follows: With the wearing surface outside, the specimen shall be bent at approximately the center around a mandrel of the specified size, 3.3, through an angle of 180° at a uniform rate, completing the bend within 3 to 5 seconds. At the end of the bending operation, the specimen shall be examined visually for cracks, breaks, or other damage.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, two specimens from each test unit shall be tested.

5.1.1 If the material is corrugated, one specimen shall be tested with the long dimension parallel to the corrugations and one specimen shall be tested with the long dimension perpendicular to the corrugations.

5.1.2 If the material is not corrugated, one specimen shall be tested with the long dimension parallel to the long dimension of the unit and one specimen shall be tested with the long dimension perpendicular to the long dimension of the unit.

5.2 The number of specimens tested from each direction of each test unit and the number. from each direction that show cracks, breaks, or other damage shall be recorded.

5.3 The temperature and time of exposure of the specimen shall be recorded.

MISCELLANEOUS PHYSICAL TESTS, GENERAL

1. SCOPE

This group of methods is intended for use in determining miscellaneous physical properties of resilient nontextile floor coverings. Methods are described for dynamic coefficient of friction, adhesion, keying, specular gloss, finish, water absorption, weight, and scratch resistance.

2. SPECIMEN

The specimens shall be free from defects or damage that may interfere with the property for which test is made.

3. PROCEDURE

3.1 Unless otherwise specified in the applicable test method or detail specification, tests shall be, made on specimens conditioned as described in method 1041.

3.2 Specimens shall be prepared as described in methods 1011 to 1031, inclusive.

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DYNAMIC COEFFICIENT OF FRICTION

1. SCOPE

This method is intended for use in determining the dynamic coefficient of friction of resilient nontextile floor coverings with relatively smooth surfaces. It is not intended for use on floor coverings with corrugated surfaces or with deep designs.

2. SPECIMEN

The specimen shall consist of a portion of the test unit at least 9 by 9 inches. Unless otherwise specified in the detail specification, the thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

The apparatus shall be as follows:

3.1 A slipperiness tester of the pendulum impact type as shown in figures 7121A, 7121B, and 7121C. The apparatus consists essentially of a pendulum on the lower end of which is attached a mechanical heel mounted in a frame so that a piece of rubber, leather, or other material is impacted onto and swept over the surface of the material being tested. A Sigler pendulum impact tester meets these requirements.

3.1.1 The rubber, leather, or other material is 1½ inch square by ¼ inch thick and attached to the underside of the mechanical heel at an angle of 20° with respect to a horizontal plane so that only the rear edge of the heel material makes contact with the specimen undergoing test. A helical spring presses the edge of the heel material against the surface of the material undergoing test. Details of the mechanical heel are shown in figure 7121C. The contact edge of the heel material is beveled so that the contact area measures 1½ by l/16 ± 1/32 inch.

3.1.2 A pointer attached to the framework records on a scale, graduated in inches of height of the center of gravity of the pendulum, the amount the swing of the pendulum is retarded by contact of the heel material with the surface of the specimen.

3.1.3 The complete apparatus assembly should be of sufficient weight so that it will not be displaced by impact of the mechanical heel on the surface of the specimen. This may be accomplished by constructing the base of heavy material or by attaching weights to the base. The base of the apparatus shall be equipped with leveling screws and a spirit level for leveling the apparatus.

3.1.4 A removable metal spacer 1/8 inch in thickness as shown with the mechanical heel in figure 7121B.

3.1.5 The effective weight of the pendulum shall be 3.15 ± 0.1 pound.

3.1.6 The length of heel contact with the surface of the specimen shall be 3.80 ± 0.10 inch.

3.1.7 The effective height of the center of gravity of the pendulum at the beginning of the swing shall be 9.70 ± 0.1 inch.

3.1.8 The average compressive force between the test heel and the surface of the specimen shall be 6.70±0.5 pound. The compressive force shall be not less than 5.2 pounds at the beginning and end of the contact and not greater than 8.2 pounds at the midpoint of contact between the test heel and the surface of the specimen.

3.2 Rubber. Standard Reference Compound No. 3 in method 14111 of Fed. Test Method Std. No. 601, for rubber test heel.

3.3 Leather. Leather meeting the requirements of Fed. Spec. KK–L-165 for Leather, Cattlehide, Vegetable-Tanned and Chrome Retanned, Impregnated; and Soles, type 1, or factory leather. The compressibility shall be 6±2 percent.

3.4 Abrasive paper No. 3/0 for preparing the test heel.

3.5 A brush for cleaning loose material from the surface of the test heel.

3.6 A smooth and rigid, base for holding the specimen firmly in position during the test. The following has been found satisfactory for

specimens up to 12 inches wide: A cold-rolled steel plate 10 by 30 by 3/8 inch mounted on four small legs so that it can be leveled and will rest solidly when placed on the table. Two pieces of 1/2 angle iron, heavy grade, 14 inches long, are mounted on the central portion of the plate with four screws. The two pieces of angle iron are spaced 3 inches apart and parallel to the long sides of the plate. Holes are drilled at the end of the pieces of angle iron to accommodate the screws, and corresponding holes drilled and tapped in the base plate. With this arrangement specimens of various thicknesses can be firmly clamped to the steel plate even though they may be slightly cupped or arched when laid loosely on a surface.

4. PROCEDURE

4.1 The type of test heel, i.e., rubber in accordance with 3.2 or leather in accordance with 3.3, shall be as specified in the detail specification. If a test heel other than rubber or leather is specified, the detail specification shall also specify the characteristics of the material to be used.

4.2 The detail specification shall specify whether the specimen shall be wet or dry during the test.

4.3 Calibration.

43.1 *Effective weight of the pendulum, W.* The mechanical heel and pendulum arm shall be detached from the axle. The counterbalance shall be adjusted until the mechanical heel, including the test heel, balances over a knife edge coinciding with the centerline of the pendulum arm. The pendulum arm and the mechanical heel shall be weighed to the nearest 0.02 pound and the weight, recorded as W, 3.1.5. W is the portion of the pendulum which effectively contributes to the oscillation of the pendulum when it is released from its initial height. The axle to which the pendulum is attached is balanced and therefore not included.

4.3.2 *Center of gravity of pendulum.* The center of gravity of the pendulum shall be determined by placing the portion W over a knife edge and experimentally locating the point of balance. It is usually found to be slightly below the top face of the mechanical heel. The scale shall be graduated to indicate the height to which the center of the pendulum rises above its lowest position.

4.3.3 *The effective height of the center of gravity of the pendulum at the beginning of the swing, H.* The mechanical heel and pendulum arm shall be firmly attached to the axle so that the distance of the center of gravity from the center of oscillation corresponds to that used in graduating the scale. By means of three screws and a spirit level, the instrument shall be leveled in the direction of the pendulum. The pointer contact arm shall be adjusted so that the pointer reads zero when the pendulum hangs plumb. The pendulum shall be placed in the release position and the holder adjusted until the pointer reads 10.0 inches. The pendulum shall be released several times from the position, and the normal frictional loss of the instrument, which includes that of the pointer determined. This is usually around 0.3 inch. The, pointer friction shall be at least 0.1 inch. The effective height of the center of gravity of the pendulum at the beginning of a swing H, shall be 10.0 inches minus the normal frictional loss or probably 10.0 – 0.25=9.75 inches. The h value is the scale reading or height of the center of gravity of the pendulum at the end of a swing when the usual contact between the mechanical heel and the walkway surface is made. The H value shall be determined to the nearest 0.05 inch, 3.1.7.

4.3.4 *Average compressive force between the test heel and the surface of specimzn, P.* The instrument shall be placed on the end of a table. A test heel, 1½ by l½ by ¼ inch, having sharp-cut edges (a hard wood block is recommended), shall be fastened on the instrument and the instrument leveled by means of screws and a spirit level. An equal-arm lever (equal arms of from 10 to 12 inches are recommended) shall be balanced over a fulcrum. A marked location on one end of the lever shall be rested on the test heel and sufficient weight suspended at an equal distance on the other end of the lever to just relieve the contact between the hinged metal strap and the stop on the mechanical heel. A slight tapping on the lever will indicate this relief.

This weight is the force pressing the edge of the heel against the surface being tested, at the beginning and end of contact and shall be taken as the minimum value of P. The value shall be recorded to the nearest, 0.05 pound.

4.3.4.1 The 1/8-inch metal spacer shall be placed between the hinged metal strap and the stop, and in a similar manner the weight necessary to relieve the contact between the strap and the spacer determined (a slight adjustment of the position of the fulcrum will be found necessary in order to rest the marked location of the lever against the edge of the test heel). This weight is the force pressing the edge of the heel against a walkway surface at the midpoint of contact and shall be taken as the maximum value of P. The' P (max.) value shall be recorded to the nearest 0.05 pound.

4.3.4.2 Although in slight error, the arithmetical mean is taken as the average compressive force between heel and floor during a test or

$$P=\frac{P\ (\text{min.})+P\ (\text{max.})}{2}$$

The helical spring may weaken with use and especially so when first put into use. Therefore, the value of P, 3.1.8, should be redetermined periodically to the nearest 0.5 pound.

4.3.5 *Length of heel contact with the surface of the specimen, D.*

4.3.5.1 The instrument, equipped with the same test heel used in determining P, shall be placed on a level, even surface. With the 1/8-inch spacer inserted between the hinged strap and the stop, the instrument shall be leveled in the direction of the swing of the pendulum so that the edge of the test heel is parallel to the surface of contact in the direction perpendicular to the swing. At the same time, the edge of the test heel must be adjusted to a definite height in relation to the surface of the contact. This latter adjustment is attained when the swing of the pendulum is retarded by 0.1 inch, that is, from a free swing H value of 9.75, to an h value of 9.65.

4.3.5.2 When the above adjustments have been completed, the 1/8-inch spacer shall be removed and the pendulum lowered by hand until the edge of the test heel rests on the surface of contact. The point of contact shall be marked on the surface of the specimen. The spring shall be compressed by hand and the pendulum swung forward until it rests again on the surface when the hand is removed. This point of contact shall also be marked on the surface. The distance between the two points of contact shall be recorded to the nearest 0.03 inch as D, 3.1.6.

4.4 The specimen shall be firmly clamped to the base. The 1/8-inch metal spacer shall be inserted bet ween the hinged metal strap and the stop as shown in figure 7121B, and the instrument leveled in the direction of the swing of the pendulum so that the edge of the test heel is parallel to the surface of the specimen in the direction perpendicular to the swing. The apparatus shall be adjusted so that the edge of the test heel is at a definite height in relation to the surface of the specimen. This latter adjustment shal be accomplished by adjusting the height of the test heel so that the scale reading at the end of the swing of the pendulum released from a scale reading of 10.0 inches with spacer inserted is lowered by 0.1 inch, that is, the scale reading is lowered from a free swing H value of 9.75 inches to an h value of 9.65 inches, 4.3.3.

4.5 Dry specimen. After the above adjustments are made, the contact edge of the test heel shall be ground lightly with the number 3/0 abrasive paper and brushed thoroughly to remove loose and foreign material such as wax, plasticizer, etc. The 1/8-inch spacer shall be removed, the pendulum released from a height of 10.0 inches scale reading, and the edge of the test heel permitted to sweep over the area of the specimen. The height to which the center of gravity of the pendulum swings beyond the plumb position, h value, shall be read from the scale and the value recorded to the nearest 0.05 inch. The test shall be repeated four times, taking two readings in one direction and two readings at right angles to the first two readings. The average of the four values shall be recorded to the nearest 0.05 inch as the h value.

4.5.1 In order to avoid damaging the test heel, it is advisable to catch the pendulum by hand before it strikes the walkway surface on

the return oscillation. By compressing the spring with the other hand, the pendulum can be readily returned to the release position.

4.6 Wet specimen. After the adjustments, 4.4, are made, the contact edge of the test heel shall be ground lightly with number 3/0 abrasive paper and brushed thoroughly to remove loose and foreign material. Distilled water at room temperature shall be placed on the specimen so as to form a puddle on the area to be contacted by the test heel. The edge of the test heel shall also be wetted by rinsing in water at room temperature for at least 1 hour. The 1/8-inch spacer shall be removed and the h value of the specimen determined as described in 4.5. Just prior to releasing the mechanical heel, the contact edge of the test heel shall be wetted by applying water directly to the edge by means of a brush, pipette, or dropper.

5. RESULTS

5.1 Calculation. The dynamic coefficient of friction of the specimen shall be calculated as follows:

$$\text{Dynamic coefficient of friction, } \mu = \frac{W(H-h)}{DP}$$

where :

h is as described in 4.3.3.
H is as described in 3.1.7.
W is as described in 3.1.5.
I) is as described in 3.1.6.
P is as described in 3.1.8.

5.2 Unless otherwise specified in the detail specification, three specimens from each test unit shall be tested.

5.3 The dynamic coefficient of friction of the test unit shall be the average of the values obtained from the specimens tested.

5.4 The dynamic coefficient of friction shall be recorded to the nearest 0.01.

FIGURE 7121.4. Pendulum impact tester.

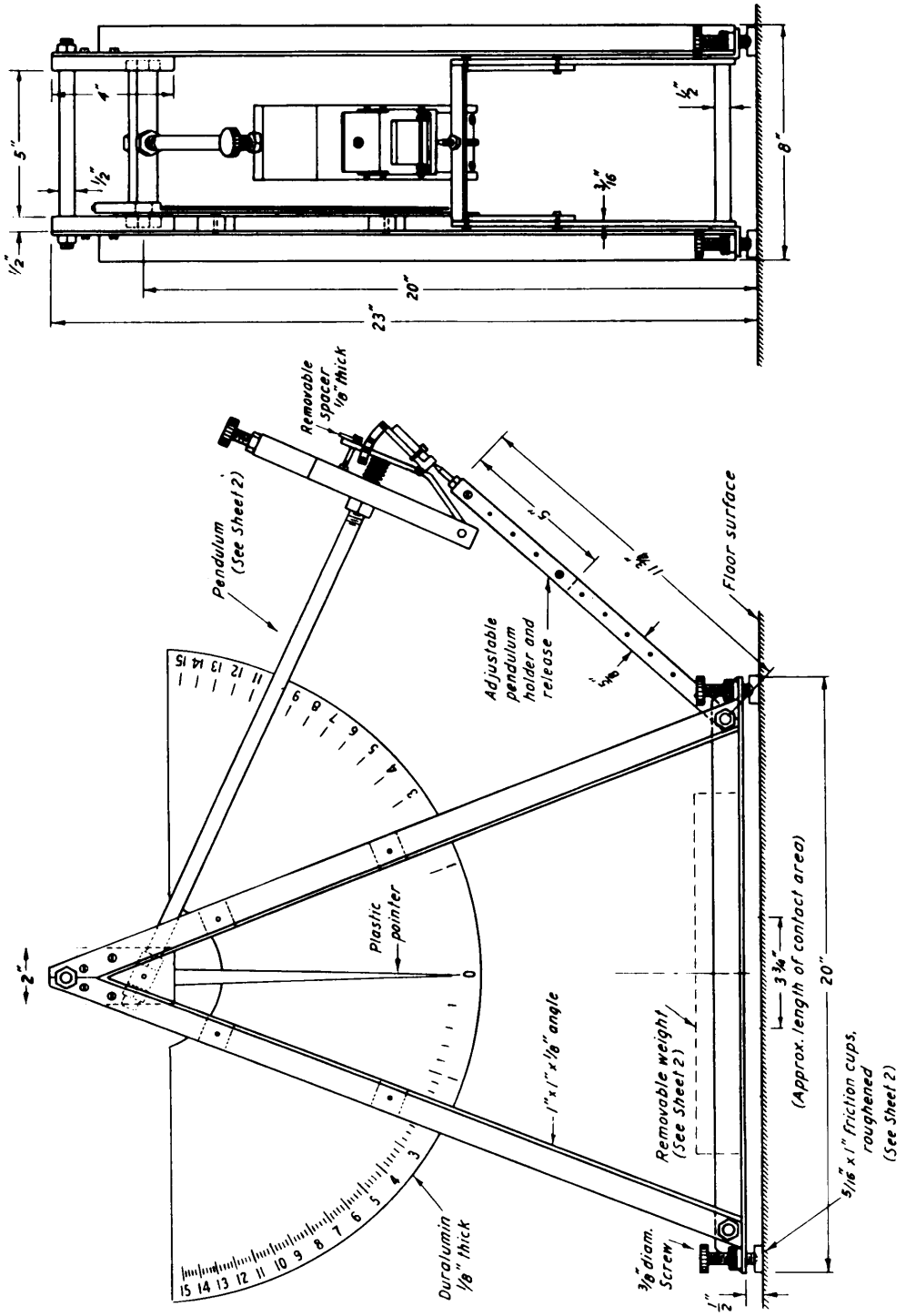

FIGURE 7121B. Details of pendulum impact tester.

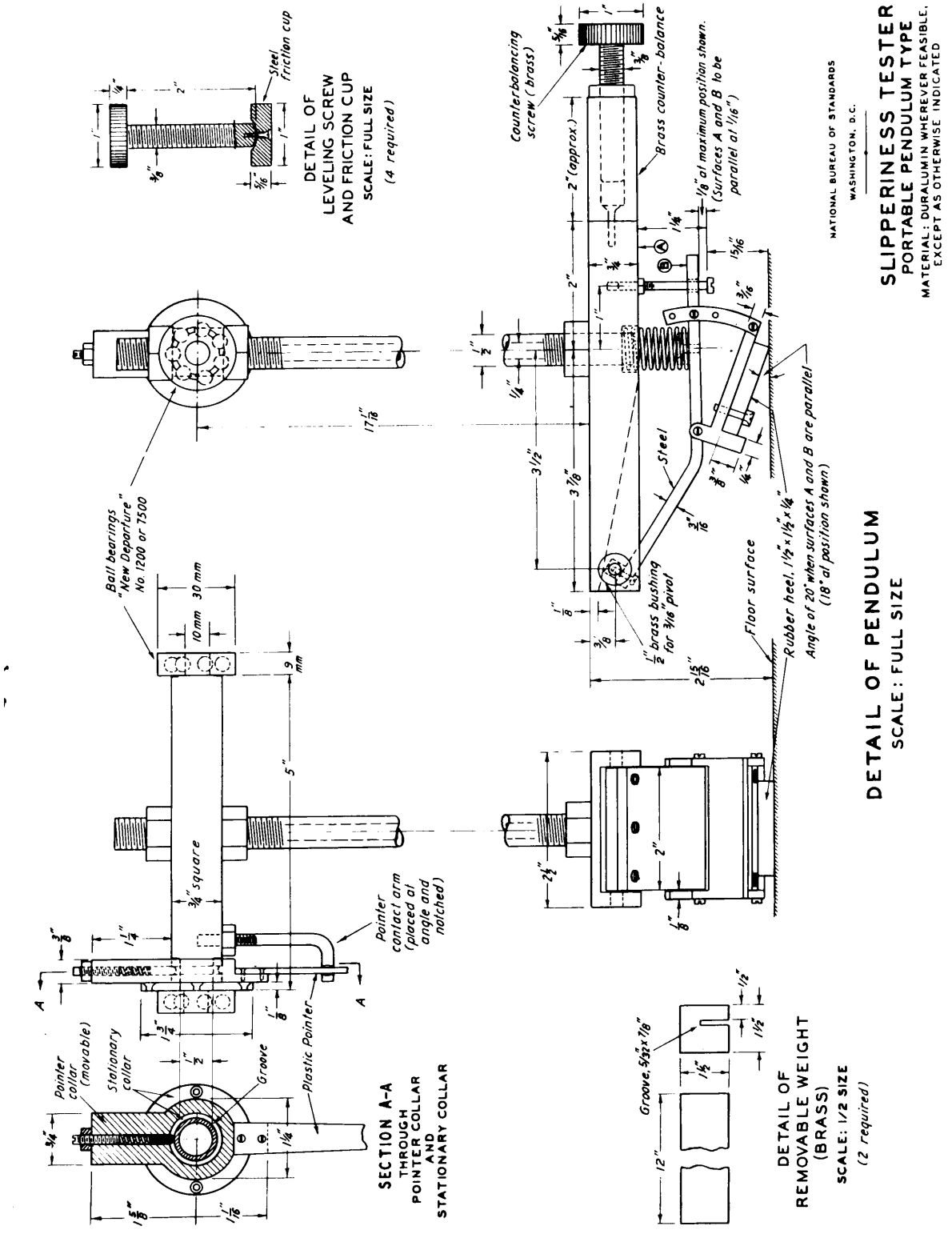

FIGURE 7121C. Details of pendulum.

ADHESION TO FABRIC

1. SCOPE

This method is intended for use in determining the adhesion between a layer of resilient nontextile floor covering and fabric. It is particularly applicable to determining the adhesion between the rubber layer and the fabric backing or fabric insertion of rubber matting.

2. SPECIMEN

2.1 The specimen shall consist of a portion of the test unit 1±0.01 inch, determined by method 2211, and of sufficient length to permit a distance of separation of at least 4 inches.

2.2 Unless otherwise specified in the detail specification, the thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

The apparatus shall be as follows:

3.1 A power-driven testing machine which meets the following requirements:

3.1.1 Indicates the tension to within plus or minus 2 percent by automatic recorder. For referee tests, the testing machine shall have an inertialess dynamometer for measuring the tension.

3.1.2 Records automatically the value of adhesion continuously during the test thus producing a chart showing the distance separated on one axis and the applied tension on the other axis.

3.1.3 Unless otherwise specified in the detail specification, the power-actuated grip shall travel at a uniform rate of 2±0.2 inch per minute.

3.1.4 If the machine has a pendulum dynamometer, the maximum applied tension during the adhesion test shall not exceed 85 percent nor be less than 15 percent of the rated capacity of the testing machine.

3.1.5 The machine is operated without any device for maintaining maximum load indication. In pendulum-type machines, the weight lever swings as a free pendulum without engagement of pawls.

3.2 A die or sharp tool for cutting the specimen.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the long dimension of the specimen shall be parallel to the long dimension of the unit.

4.2 The specimen shall be cut from the test unit by means of the die or sharp tool in such a manner that the edges will be smooth and all layers will have a uniform width of 1.00±0.01 inch.

4.3 The fabric layer of the floor covering to be tested shall be separated from the remainder of the specimen by land at one end a sufficient distance to permit clamping the ends of the layers in the grips of the testing machine. The fabric layer shall be clamped in one grip and the remaining layer in the other grip. The specimen shall be adjusted symmetrically and without twisting in the testing machine so that the tension will be distributed uniformly over the width of the specimen during the test. Provision shall be made to maintain the specimen during the test approximately in the plane of the grips of the machine. The autographic mechanism and chart shall be adjusted to zero and the machine started. The power-actuated grip shall travel at the required speed, 3.1.3. The fabric layer shall be stripped from the other layer at approximately an angle of 180° and the separation continued for a sufficient distance to indicate the adhesion value. If practicable, the separation shall be continued for a distance of at least 4 inches. The separat ion of the grips shall be autographically recorded in inches on one axis of the chart and the force in pounds on the other axis.

4.4 The average force required to separate the two layers shall be determined by drawing

a line on the chart parallel to the length of separation axis and as near as practicable midway between the maximum and minimum values for force. The line shall be drawn only over the port ion of the chart corresponding to actual separation of the layers being tested. The average adhesion of the specimen shall be read from the chart and the value recorded to the nearest 0.5 pound per inch of width.

4.5 For testing machines equipped with an integrator that determines the area under the force separation curve, the average force may be determined by dividing the area by the length of separation.

4.6 Tearing. If during the test one of the layers begins to tear instead of separating from the other layer of the specimen, the material torn shall be cut with a knife up to the surface of contact between the two layers and the test started again. If one of the layers repeatedly tears instead of separating from the other layer, the average force at which tear occurs shall be recorded as the adhesion of the specimen.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, one specimen from each test unit shall be tested.

5.2 Adhesion of test unit. When one specimen is tested from each test unit, the adhesion of the test unit shall be the value obtained from the specimen tested. If more than one specimen is tested from each test unit, the adhesion of the test unit shall be the average of the values obtained from the specimens tested.

5.3 The adhesion of the test unit shall be recorded to the nearest 0.5 pound per inch of width.

5.4 When tearing repeatedly occurs, the. number of specimens tested from each test unit and the number from each test unit that tear shall be recorded.

KEYING TEST

1. SCOPE

This method is intended for use in determining the adhesion between the woven backing and surface layer of resilient nontextile floor coverings such as linoleum. It is not applicable to felt-backed floor coverings.

2. SPECIMEN

2.1 The specimen shall consist of a portion of the test unit 3±0.01 inch in width and 9 inches in length.

2.2 Unless otherwise specified in the detail specification, the thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

3.1 The testing machine described in method 7211.

3.1.1 Unless otherwise specified in the detail specification, the power-actuated grip shall travel at a uniform rate of 2±0.2 inch per minute.

3.2 Any frictionless device which can be attached to one grip of the machine for holding the specimen so that the backing will be stripped from the surface layer at an angle of 80° to 90° as shown in figure 7221.

3.3.4 A sharp tool for cutting the specimen.

4. PROCEDURE

4.1 The specimen shall be cut with a sharp tool so as to leave smooth edges. At a distance of approximately 1 inch from the end of the specimen, the surface layer shall be partially cut through across the entire width with a sharp knife and completely severed by bending back at the cut leaving a 1-inch portion of the specimen attached only by the backing for clamping in one of the grips of the testing machine. The backing shall be carefully stripped by hand from the surface layer of the remainder of the specimen for a distance of about 1 inch so that the backing will not be injured.

4.2 The device for holding the specimen, 3.2, shall be clamped in one grip of the testing machine and the specimen mounted in the device. The l-inch piece attached by the backing only at the end of the specimen shall be clamped in the other grip of the testing machine. The specimen shall be adjusted in the testing machine symmetrically and without twisting so that the tension will be distributed uniformly over the width of the specimen during the test. The autographic mechanism and chart shall be adjusted to zero and the machine started. The power-actuated grip shall travel at the required speed, 3.1.1. The backing shall be stripped from the surface layer at an angle of 80° to 90° and the separation continued for a distance of at least 4 inches. The separation of the grips shall be autographically recorded in inches on one axis of the chart and the force in pounds on the other axis.

4.3 The average force required to separate the backing from the surface layer shall be determined by drawing a line on the chart parallel to the length of separation axis and as near as practicable midway between the maximum and minimum value of force. The line shall be drawn only over the portion of the chart corresponding to actual separation of the backing and the surface layer. The average force required to separate the backing from the specimen shall be read from the chart and the value recorded to the nearest 0.5 pound per 3-inch width as the adhesion or key of the specimen.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, four specimens from each test unit shall be tested: two specimens with the long di-

mension parallel to the warp direction and two specimens wit h the long dimension parallel to the filling direction of the backing.

5.2 The adhesion or key of the backing of the test unit shall be the smallest of the values obtained from t he specimens tested.

5.3 The adhesion or key of the backing for the test unit shall be recorded.

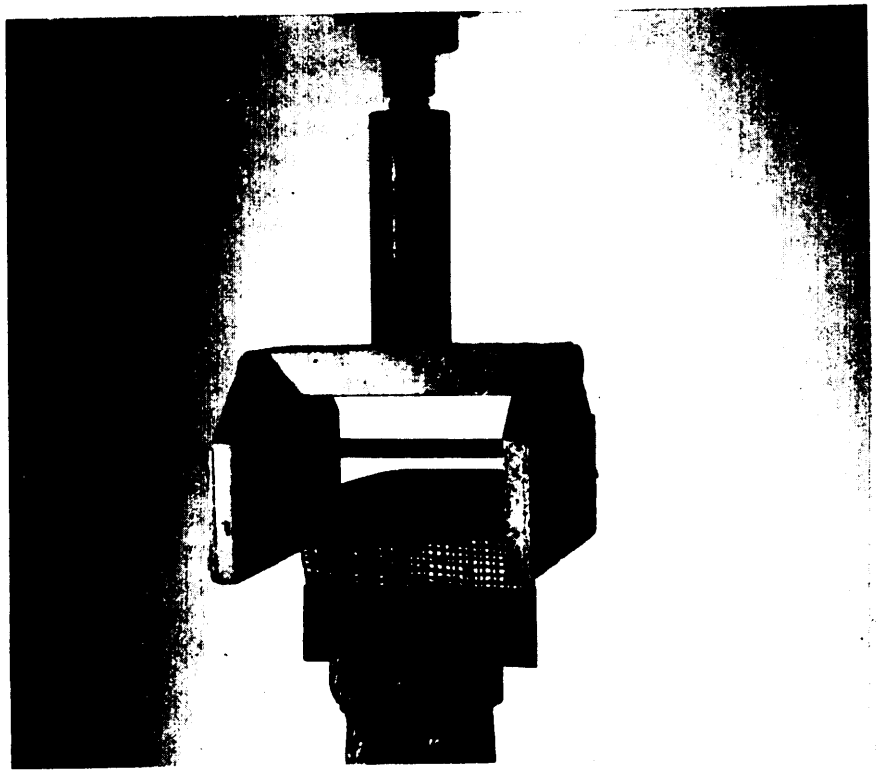

FIGURE 7221. Device for holding specimen.

SPECULAR GLOSS

1. SCOPE

1.1 This method is intended for use in determining the specular gloss of resilient nontextile floor coverings such as linoleum.

1.2 Definition. For the purpose of this method, specular gloss is defined as one thousand times the 60° specular reflectance of a specimen measured with apparatus having the illuminating and viewing beams described in 3.

2. SPECIMEN

The specimen shall consist of a portion of the test unit at least 6 by 6 inches.

3. APPARATUS

The apparatus shall be as follows:

3.1 Glossmeter. The glossmeter shall consist of a stable' light source furnishing an incident beam of rays, means for locating the surface of the specimen, and a receptor located to receive certain rays reflected by the specimen. These three parts shall be combined in a rugged instrument in which the Relat ive posit ions shall be as shown in figure 7411A or 7411B.

3.1.1 *Geometric conditions.* The axis of the incident, beam shall be 60° from perpendicular to the test surface, and the axis of the receptor beam shall be the direction of mirror reflection of the axis of the incident beam. With a flat piece of polished black glass or other front-surface mirror in specimen position, an image of the source shall be formed at the center of the receptor field stop (receptor window). The length of the illuminated area of the specimen shall be not more than one third of the distance from the center of this area to the receptor field stop. Source and receptor lenses shall be located as close to the specimen position as possible. The angular dimensions of source and receiver shall be as follows:

	Aperture and tolerance, degrees	
	In plane of measurement	Perpendicular to plane of measurement
Source	No more than 1	No more than 4.
Receiver	4.4 ± 0.1	11.7 ± 0.2.

These angles are double the extents to which rays in the incident and viewing beams may be spread from the principal rays [those from center of source to center of receptor field stop (recept or window)] and still register. Angular size of the source is measured from the source lens. Angular size of the receptor field stop is measured from the test surface in a converging-beam type of instrument and from the center of the receptor collimating lens in a collimated-beam type of instrument. If, for example, the source lens is 5.0 cm. from the lamp, the filament of the lamp must measure not more than 5.0 sin 1° (0.09 cm.) in the plane of' measurement and 5.0 sin 4° (0.035 cm.) across the plane of measurement. Similarly a receptor field stop 10.0 cm. from the center of the sample in a converging-beam instrument must measure 10.0 sin 4.4±01° (0.77 ± 0.04 cm.) across the plane of measurement. The most critical part of glossmeter geometery is the ratio of the size of the source image in the plane of the receptor entrance window to the size of this window. Thus the fraction of the receptor entrance window occupied by the source image must be not greater than 0.23 in the plane of measurement nor 0.35 perpendicular to the plane of measurement.

3.1.2 *Vignetting.* There shall be no vignetting or interception by stops or diaphragms of rays supposed to register, That is, all rays

shall register at the receptor if they pass the source lens or other aperture stop and travel paths to and from the sample that deviate from the paths of the principal rays by no more than one-half of the corresponding field angles in 3.1.1.

3.1.3 *Spectral conditions.* The instrument shall give results not significantly different from those that would be given if its source were the standard illuminant C recommended by the International Commission on Illumination (1. C. I.) and its receptor had the spectral response of the I.C.I. luminosity function. Since specular reflection by nonmetals is in general spectrally nonselective, it has proven unnecessary in practice to require close duplication of specified spectral conditions. Measurements made with an incandescent lamp and a barrier-layer photocell generally require no spectral correction.

3.1.4 *Measurement mechanism.* The receptor-measurement mechanism, such as photocell and microammeter, shall give a numerical indication that is proportional to the amount of light passing the receptor window within plus or minus 1.

3.2 Standards.

3.2.1 The theoretical specular gloss standard shall be the ideal, completely reflecting, perfect mirror which is assigned a value of 1000.

3.2.2 Specular gloss working standards may be highly polished, plane, black glass surfaces for which the reflectance may be calculated as a function of angle of incidence and refractive index by using Fresnel's equation [D.G. Moore and R. S, Hunter, "Use of Liquid Surfaces as Standards of Specular Gloss," Journal Am. Ceramic Sot., vol. 24, p. 167 (1941)]. Polished black glass with a refractive index of 1.52 has a specular gloss of 92.5 on this scale. Surfaces of liquids (see above reference) may also be used.

3.2.3 Intermediate- and low-gloss standards of ceramic tile, ground opaque glass, emery paper, and other semigloss materials having hard and uniform surfaces are suitable working standards of intermediate gloss when calibrated against a polished black glass or liquid on a glossmeter known to be in accurate adjustment. Suitable working standards for this gloss test are available from the National Bureau of Standards, Washington, D. C., 20234; the H. S, Gardner Laboratory, Inc., 3723 Elm Street, Bethesda, Md., 20014; and the Photovolt Corp., 1115 Broadway, New York, N. Y., 10010. All such intermediate standards should be checked from time to time for constancy of gloss value because contaminations by dirt and filmy deposits frequently cause unsuspected changes in gloss values.

4. PROCEDURE

4.1 The glossmeter shall be operated according to any instructions of the maker for power supply, warmup period, dust-free atmosphere, temperature, humidity, darkness of surroundings, and handling of specimens.

4.2 Settings on a standard shall be made at the start and completion of every period of glossmeter operation and at intervals during this operation sufficiently frequent to assure that the instrument response is practically constant.

4.3 The areas of the specimen to be measured shall not be rubbed or unnecessarily handled prior to measuring the reflection. A total of at least six measurements shall be made on each specimen and the average of the values obtained recorded as the gloss of the specimen. At least three of the measurements shall be made on a line running parallel to the length dimension of the specimen and at least three measurements made on a line running at right angles to the length dimension of the specimen.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, three specimens from each test unit shall be tested.

5.2 Test unit.

5.2.1 *Average glow. The* average gloss of the test unit shall be the average of the values obtained from the specimens tested.

5.2.2 *Minimum gloss.* The minimum gloss of the test unit shall be the smallest of all the values obtained from the specimens tested.

5.2.3 *Maximum glow.* The maximum gloss of the test unit shall be the largest of all the values obtained from the specimens tested.

5.3 The gloss of the test unit shall be recorded to the nearest unit.

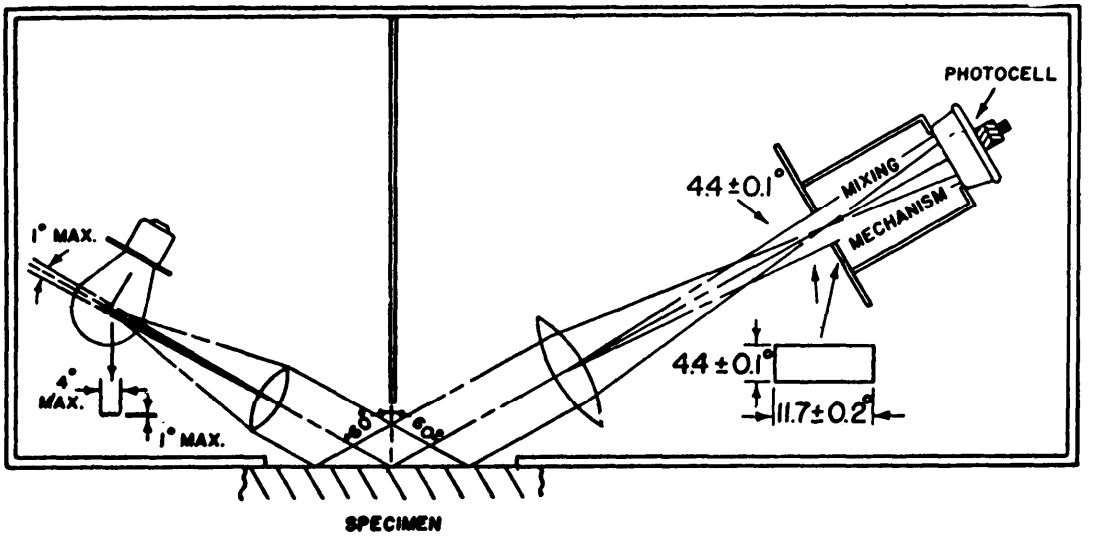

FIGURE 7411A. Collimated-beam type of glossmeter.

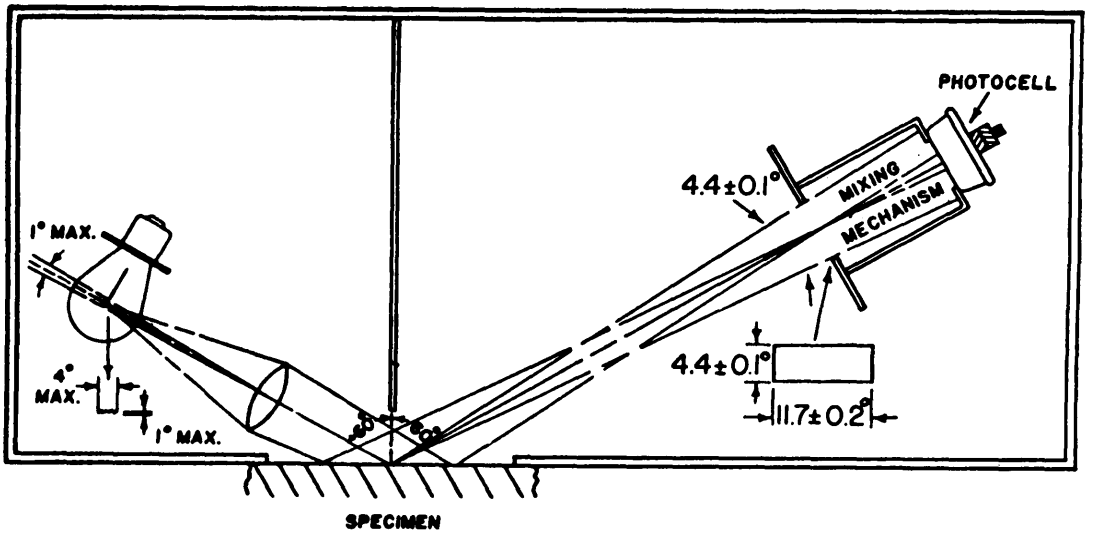

FIGURE 7411B. Converging-beam type of glossmeter.

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FINISH

1. SCOPE

This method is intended for use in determining whether resilient nontextile floor coverings such as linoleum, are properly finished.

2. SPECIMEN

The specimen shall consist of a portion of the test unit at least 1 square inch in area. The thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

The apparatus shall be as follows:

3.1 Glass rod, medicine dropper, or other device for applying a drop of water to the specimen.

3.2 Clean cloth.

3.3 Distilled water.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the period of time t hat the distilled water is allowed to remain on the surface of the specimen shall be 300±10 seconds.

4.2 An area of at least 1 square inch of the wearing surface of the specimen shall be cleaned with a dry, clean cloth. The specimen shall be supported in a horizontal position with the wearing surface up, and a drop of distilled water placed on the cleaned area by means of a glass rod or medicine dropper. At the end of the required time, 4.1, the specimen shall be shaken to remove the water, the surface wiped with a clean, dry cloth, and the area that was exposed to water examined visually for marks, discoloration, smears, and wetting.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, one specimen from each test unit shall be tested.

5.2 The number of specimens tested from each test unit and the number that were discolored, marked, smeared, and wetted shall be recorded.

WATER ABSORPTION

1. SCOPE

This method is intended for use in determining the amount of water absorbed by resilient nontextile floor coverings.

2. SPECIMEN

The specimen shall consist of a portion of the test unit about 6 by 6 by 3 inches.

3. APPARATUS

The apparatus shall be as follows:

3.1 Analytical balance that will weigh to an accuracy of 10 mg.

3.2 Cent airier for immersion of specimens in water.

3.3 Cloth or absorbent paper.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the specimen shall be immersed in tap water and maintained at a temperature of 23°±2° C. (73.4°±3.6° F.) for 24±¼ hour.

4.2 The specimen shall be prepared by the applicable procedures in methods 1011 to 1031, inclusive. Any backing material shall be removed and the surface from which the backing has been removed buffed until it is smooth. Any wax or other finish shall be removed from the wearing surface.

4.3 The specimen shall then be weighed to the nearest 10 reg., and the value recorded as W_1. The specimen shall be immersed in tap water at the required temperature for the required period of time, 4.1. At the end of the immersion period, the specimen shall be removed from the water and immediately blotted with an absorbent cloth to remove excess water and weighed, completing the weighing within 2 minutes after the specimen is removed from the water. The final weight shall be recorded as W_2.

5. RESULTS

5.1 Calculation. The water absorption of the specimen shall be calculated as follows:

$$\text{Water absorption, percent} = \frac{W_2 - W_1}{W_1} \times 100$$

where:

W_1 is the weight of the specimen in grams before immersion in water.

W_2 is the weight of the specimen in grams after immersion in water.

5.2 Unless otherwise specified in the detail specification, two specimens from each test unit shall be tested.

5.3 The water absorption of the test unit shall be the average of the values obtained from the specimens tested.

5.4 The water absorption of the test unit shall be recorded to the nearest 0.1 percent.

WEIGHT

1. SCOPE

This method is intended for use in determining the weight of resilient nontextile floor coverings such as linoleum and plastic tile.

2. SPECIMEN

The specimen shall consist of a portion of the test unit approximately 9 by 9 inches or 81 square inches in area. The thickness of the specimen shall be the thickness of the material undergoing test.

3. APPARATUS

The apparatus shall be a laboratory balance that will weigh to an accuracy of 0.1 gram.

4. PROCEDURE

The length and width of the specimen shall be measured to the nearest 0.01 inch as described in method 2211. The area of the specimen shall be calculated and the value recorded to the nearest 0.001 square yard as A. The specimen shall be weighed to the nearest 0.1 gram, the weight in grams converted to the nearest 0.001 pound, and the value recorded as W.

5. RESULTS

5.1 The weight of the specimen shall be calculated as follows:

$$\text{Weight in pounds per square yard} = \frac{W}{A}$$

where:

A is the area of the specimen in square yards.
W is the weight of the specimen in pounds.

5.2 Unless otherwise specified in the detail specification, two specimens from each test unit shall be tested.

5.3 The weight of the test unit shall be the average of the values obtained from the specimens tested.

5.4 The weight of the test unit shall be recorded to the nearest 0.1 pound per square yard.

SCRATCH RESISTANCE

1. SCOPE

This method is intended for use in determining the resistance to scratching of resilient nontextile floor coverings such as asphalt, vinyl asbestos, and vinyl plastic before and after immersion in acids, alkalies, and organic materials as described in method 9311.

2. SPECIMEN

The specimen shall be as described in method 9311.

3. APPARATUS

The apparatus shall be as follows:

3.1 A scratch tester consisting essentially of a horizontal rotating table, a specimen holder, a loading beam, and scratch tool. A suitable apparatus is shown in figure '7711.

3.1.1 *Table.* The table for mounting the specimen is approximately 4 inches in diameter and is attached to a base so that the table can be rotated by hand in a horizontal plane in a counterclockwise direction. The rotating table is equipped with a screw clamp with a rigid washer located in the center of the table, for holding the specimen in position during the test.

3.1.2 *Loading beam.* The loading beam is mounted on a horizontal projection shaft on the base of the apparatus. The loading beam is pivoted on precision ball bearings, the internal bore of which is a slide fit over the shaft. The shaft is located approximately 4 inches from the center of the specimen table and attached to the base of the apparatus by means of an adjustable bracket which permits raising or lowering the shaft, as the thickness of the specimen varies. By means of this adjustment, the loading beam is maintained parallel with the surface of the specimen. The graduation on the scale of the beam represents 10 grams per division. The sliding weight provides an adjustment in load from 0 to 500 grams.

3.1.3 *Scratch tool.* The scratch tool shall have a tungsten carbide cutting edge 0.189 inch wide, precision ground to 25-mm. radius. The tool is supported firmly in a clamp located on the underside of the loading beam and in line with the center of the table. The tool is held at a 22° shear angle in relation to the surface of the specimen. The tool shall be handled and stored carefully so that the cutting edge is not damaged.

3.2 Equipment for measuring the width of scratch to the nearest 0.005 inch. The apparatus in method 2151 or a Brinnell microscope has been found satisfactory.

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, a total load of 500 grams shall be applied to the specimen.

4.2 Preparation of scratch tool. The scratch tool shall be tested on an unexposed specimen as described in 4.3 before testing the specimen which has been exposed as described in method 9311. The tool shall produce a scratch on the unexposed specimen 0.050±0.005 inch in width under the required load, 4.1. If the tool produces a groove greater than 0.055 inch in width, it shall be dulled to produce the required width of groove by drawing it across the surface of a piece of the floor covering being tested. In any case, the width of the scratch shall be not less than 0.045 inch.

4.3 The specimen shall be clamped firmly on the table by means of the specimen holder. The loading beam shall be adjusted by means of the adjustable bracket so that the beam is parallel with the surface of the specimen. The loading beam with scratch tool in place shall be lowered gently until the tip of the tool is in contact with the surface of the specimen. The tool shall be at least 1/8 inch from any edge of the specimen.

The sliding weight shall be adjusted to apply the required total load, 4.1, to the specimen. The table shall be rotated slowly by hand counterclockwise until a scratch at least 3 inches in length is cut into the specimen. The specimen shall be removed from the holder and the width of the scratch measured at three places equally spaced along the length of the scratch and each value recorded to the nearest 0.005 inch.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, three specimens from each test unit shall be tested.

5.2 The scratch of the test unit shall be the average of the values obtained from the specimens tested.

5.3 The scratch resistance of the test unit shall be recorded to the nearest 0.001 inch.

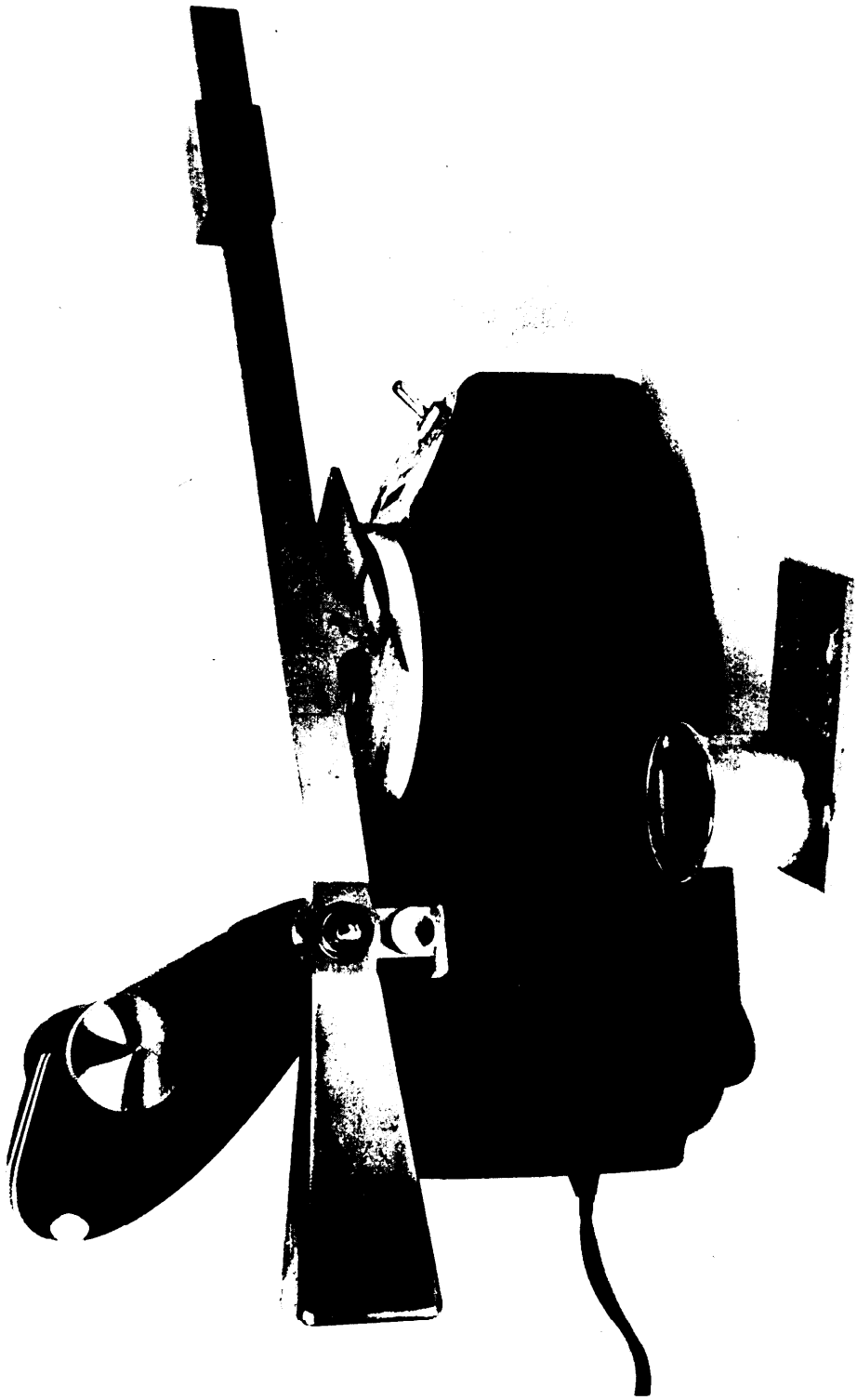

FIGURE 7711. Scratch tester.

ELECTRICAL TESTS, GENERAL

1. SCOPE

This group describes electrical tests for resilient nontextile floor coverings. Methods are provided for determining voltage withstand, dielectric breakdown voltage, and electrical conductance.

2. SPECIMEN

Specimens for electrical tests described in this group shall be free from defects or damage that may interfere with the property for which the test is made.

3. PROCEDURE

3.1 Specimens for tests described in this group shall be prepared in accordance with methods 1011 to 1031, inclusive.

3.2 Unless otherwise specified in the detail specification or applicable test method, specimens for electrical tests shall be conditioned as described in method 1041.

VOLTAGE WITHSTAND

1. SCOPE

This method is intended for use in determining the voltage withstand of resilient nontextile floor coverings such as rubber and plastic matting.

2. SPECIMEN

Unless otherwise specified in the detail specification, the specimen shall be as described in 4.3.

3. APPARATUS

The apparatus shall be as follows:

3.1 Source of voltage. Any suitable equipment, no part, of which has a capacity less than ½ kilovolt-ampere per square foot of elect rode surface. In no case shall the rating of any part of the apparatus be less than 5 kilovolt-amperes. The frequency of the test voltage shall not exceed 65 cycles.

3.2 Regulation of voltage. The method used for voltage control shall not distort the wave form of the testing voltage from a sine wave by more than 5 percent (crest factor limits 1.34 to 1.48). The following are considered acceptable.

3.2.1 Field regulation of the alternator supplying the transformer,

32.2 Induction-type regulator.

3.2.3 Variable-ratio-transformer-type regulator.

3.2.4 Potentiometer-type rheostatic control where the current in the portion of the potentiometer resistance in parallel with the primary of the transformer is at least five times the exciting current of the transformer.

3.3 Voltage measurement. Equipment for measuring the voltage consisting of one of the following:

3.3.1 A calibrated potential transformer with a voltmeter.

3.3.2 A properly calibrated electrostatic voltmeter connected directly across the material under test,

3.3.3 Any properly calibrated commercial-type alternating-current voltmeter connected to the low tension side of the transformer in conjunction with the ratio of transformation of the transformer, provided the ratio is definitely known for all test conditions, and any significant waveform discrepancies are known and allowed for.

3.3.4 Apparatus for controlling the application of the voltage so that it may be applied at a low value and gradually and steadily increased from 800 to 1,000 volts per second.

3.4 Electrodes. Elect rocks consisting of rectangular metal sheets of any convenient length having smoothly rounded edges and of a width such that arcing around the edges of the specimen will not occur.

4. PROCEDURE

4.1 The voltage applied to the matting shall be as specified in the detail specification.

4.2 Unless otherwise specified in the detail specification, the specified voltage shall be applied for 60±1 second.

4.3 Unless otherwise specified in the detail specification, the entire area of matting in the delivery shall be tested progressively, as described in 4.4.

4.4 The matting shall be mounted between the electrodes. The voltage shall be applied at a low value and gradually raised at a uniforn1 rate of 800 to 1,000 volts per second until the required voltage is reached, 4.1. The required voltage shrill be applied for the required time. 4.2, beginning at the instant the test voltage is reached. The frequency of the test voltage shall not exceed 65 cycles per second. The waveform of the test voltage shall not be distorted from a sine wave by more than 5 percent. During the application of the specified voltage, the matting shall be observed for any failure, such as puncturing, overheating, at any place, or other damage.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, the entire delivery shall be tested.

5.2 Whether the entire delivery withstands the test voltage without failure shall be recorded.

5.3 The voltage applied and the time of application shall be recorded.

DIELECTRIC BREAKDOWN VOLTAGE

1. SCOPE

This method is intended for use in determining the dielectric breakdown voltage of resilient nontextile floor coverings such as rubber and plastic matting.

2. SPECIMEN

The specimen shall consist of a portion of the test unit approximately 3 by 3 inches.

3. APPARATUS

The apparatus shall be as follows:

3.1 Apparatus described in 3.1 to 3.3.4 inclusive, of method 8111.

3.2 Circular metal electrodes 2 inches in diameter with edges rounded to ¼-inch radius.

4. PROCEDURE

The specimen shall be mounted between the electrodes. Voltage shall be applied at a low value and gradually raised at a uniform rate of 800 to 1,000 volts per second until breakdown of the specimen occurs. The frequency of the voltage shall not exceed 65 cycles per second. The waveform of the test voltage shall not be distorted from a sine wave by more than 5 percent. The breakdown voltage of the specimen shall be recorded to the nearest 100 volts.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, five specimens from each test unit shall be tested.

5.2 The dielectric breakdown voltage of the test unit shall be smallest value obtained from the specimens tested.

5.3 The dielectric breakdown voltage of the test unit shall be recorded to the nearest 100 volts.

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ELECTRICAL CONDUCTANCE

1. SCOPE

This method is intended for use in determining the electrical conductance (the inverse of resistance) of resilient nontextile floor coverings, such as vinyl plastic, linoleum, and rubber, for locations in which explosive vapors and flammable or explosive dusts are present and static electricity constitutes a potential hazard.

2. SPECIMEN

2.1 The specimen shall consist of a portion of floor covering 36 by 36 inches in area. If conductive intercoupling is used in installed floor covering, the specimen shall be applied with the intercoupling to ½-inch exterior-grade plywood.

2.2 When the floor covering is tested after installation, the specimen shall be a floor area not exceeding 20 by 20 feet in dimensions.

3. APPARATUS

The apparatus shall be as follows:

3.1 Ohmmeter. An ohmmeter with a nominal open-circuit output of 500 volts d.c., a short-circuit current of 2.5 to 10 milliamperes, and a range of 0 to 10 megohms.

3.2 Electrodes. Two metal electrodes with terminals for making connections to the ohmmeter. Each electrode shall weigh 5 pounds and shall have a dry, flat, circular contact area 2.5 inches in diameter, and measuring 50±10 hardness as determined with the durometer described in method 3511.

3.2.1 Recommended procedure for preparing the electrode is as follows: Place the foil on a hard, smooth surface, the rubber disk on the foil, and then the metal weight on the rubber disk. Draw the foil up around the weight and secure with a rubber or metal band or pressure-sensitive tape.

4. PROCEDURE

4.1 The specimen as described in 2.1 shall be placed on a nonconductive surface. The specimen shall be dry and shall be lightly wiped with a cloth to remove foreign material prior to placing of the electrodes. The electrodes shall be placed on the specimen 36 inches apart and at least 1 inch from the edge of the panel. Reading shall be taken 5 ± 1 second after the current is applied to the electrodes.

4.2 The specimen of floor area described in 2.2 shall be dry and lightly wiped with a cloth before placing of the electrodes. The electrodes shall be placed 3 feet apart on the specimen and at least 3 feet from any ground connection or grounded object resting on the floor and the floor specimen. Reading shall be taken as described in 4.1.

4.3 Unless otherwise specified in the detail specification, five measurements shall be made on each specimen with both electrodes at different locations for each measurement and the value recorded to two significant figures.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, one specimen shall be tested.

5.2 The average, minimum, and maximum values of the five measurements shall be recorded.

CHEMICAL TESTS, GENERAL

1. SCOPE

This group of methods describes chemical tests for resilient nontextile floor coverings. Methods are described for the determination of volatile matter in floor coverings and the resistance of floor coverings to various chemicals.

2. SPECIMEN

Specimens for chemical tests shall be free from impurities and physical defects or damage that may interfere with the property for which the test is made.

3. PROCEDURE

3.1 Unless otherwise specified in the applicable test method or detail specification, physical tests used for the evaluation of the effect of chemicals on the material shall be made on specimens conditioned as described in method 1041.

3.2 The immersion tests described in this group shall be made in the absence of direct light.

3.3 Unless otherwise specified in the applicable test method, specimens for chemical tests shall be prepared as described in methods 1011 to 1031, inclusive.

VOLATILE MATERIAL

1. SCOPE

This method is intended for use in determining the amount of volatile material in resilient nontextile floor coverings such as vinyl plastic matting and vinyl asbestos tile.

2. SPECIMEN

The specimen shall consist of a portion of the test unit 2 inches in width and 9 inches in length.

3. APPARATUS

The apparatus shall be as follows:

3.1 Analytical balance that will weigh to an accuracy of 10 mg.

3.2 A circulating-air oven with suitable automatic controls for maintaining the required temperature throughout the oven during the test. The oven shall be equipped with supports that will maintain the specimens in a horizontal position without touching each other during the test.

3.3 Apparatus such as thermometers, copper-constantan thermocouples and potentiometer, or other device for measuring the temperature to within 1° C. (1.8° F.)

4. PROCEDURE

4.1 Unless otherwise specified in the detail specification, the specimen shall be maintained at a temperature of 100°±1° C. (212°±1.8° F.) for 6±½ hour.

4.2 The specimen shall be conditioned in the standard atmosphere described in method 1041 until the weight is constant to within 10 mg. The conditioned specimen shall be weighed to the nearest 10 reg., and the value recorded as W_1. The specimen shall be placed in the oven and heated for the required time at the required temperature, 4.1. At the end of the heating period, the specimen shall be removed from the oven, cooled to room temperature, and again conditioned to constant weight in standard atmosphere. At the end of the conditioning period, the specimen shall be again weighed, and the value recorded as W_2.

5. RESULTS

5.1 Calculation. The amount of volatile material in the specimen shall be calculated as follows :

$$\text{Volatile material, percent} = \frac{W_1 - W_2}{W_1} \times 100$$

where:

W_1 is the weight of the specimen in grams before heating.

W_2 is the weight of the specimen in grams after heating.

5.2 Unless otherwise specified in the detail specification, two specimens from each test unit shall be tested.

5.3 The volatile material in the test unit shall be the average of the values obtained from the specimens tested.

5.4 The volatile material shall be recorded to the nearest 0.1 percent.

RESISTANCE TO ACIDS, ALKALIES, AND ORGANIC MATERIALS

1. SCOPE

This method is intended for use in determining the effects of acids, alkalies, and organic materials on resilient nontextile floor coverings such as asphalt, vinyl asbestos, and vinyl plastic.

2. SPECIMEN

2.1 The specimen shall consist of a portion of the test unit about 2 by 3 inches.

2.2 Three specimens shall be taken from each test unit for immersion in each media specified in the detail specification plus three specimens for predulling and checking the scratch tool.

3. APPARATUS

The apparatus shall be as follows:

3.1 A container of sufficient capacity to permit complete immersion of the specimens vertically in a volume of liquid equivalent to 12 to 20 times the volume of the specimens. The container shall be equipped with a cover that will prevent evaporation of the immersion liquid during the immersion period.

3.2 Equipment with suitable automatic controls for maintaining the required temperature throughout the immersion medium during the immersion period.

3.3 Apparatus such as thermometers or other device for measuring the temperature of the immersion medium within 1° C. (1.8° F'.).

3.4 Corrosion-resistant metal screens or glass framework to prevent the specimens from touching each other or the surface of the container.

3.5 Filter paper or other absorbent material.

3.6 Immersion media described in 3.6.1 to 3.6.10, inclusive, as specified in the detail specification. The percentages indicated are on the weight basis in distilled water.

3.6.1 Acetic acid, 5 percent solution, prepared from acetic acid conforming to the requirements of Fed. Spec. O-A-76.

3.6.2 Sulfuric acid, 5 percent solution, prepared from sulfuric acid conforming to the requirements of Fed. Spec. O-S–809.

3.6.3 Sodium hydroxide, 5 percent solution, prepared from sodium hydroxide conforming to the requirements of Fed. Spec. 0-3-598.

3.6.4 Trisodium phosphate, 2 percent solution, prepared from trisodium phosphate conforming to the requirements of Fed. Spec. O-S-642.

3.6.5 Ethyl alcohol, conforming to the requirements of class B, grade I or II, of Fed. Spec. O-E-760, or isopropyl alcohol conforming to the requirements of grade A of Fed, Spec. TT-I-735.

3.6.6 Kerosene conforming to the requirements of Fed, Spec. VV-K-211.

3.6.7 Lubricating oil SAE No. 10.

3.6.8 Olive oil conforming to the requirements of Fed. Spec. Z–O–351.

3.6.9 Tallow conforming to the requirements of Fed. Spec. C–T–91.

3.6.10 Cottonseed oil of edible quality having the following properties:

Specific gravity	0.915 to 0.917.
Iodine number	105 to 114.
Acid number	1.0 maximum.

3.7 Equipment for controlling the temperature of the specimen at 23°± 2°C, (73.4°± 3.6° F.) and the relative humidity at not more than 65 percent during the scratch test,

4. PROCEDURE

4.1 The immersion liquid used shall be as specified in the detail specification.

4.2 Unless otherwise specified in the detail specification, the time of immersion shall be 46 ± ¼ hour.

4.3 Unless otherwise specified in the detail specification, the specimen shall be immersed at a temperature of 23°± 2° C. (73.4°± 3.6° F.).

4.4 Unless otherwise specified in the detail specification, the effects of immersion in acids,

alkalies, and organic materials shrill be determined by the scratch test, method 7711. The specimen shall be tested in an atmosphere maintained at a temperature of 23°± 2° C. (73.4°± 3.6° F.) and a relative humidity of not more than 65 percent.

4.5 Before testing the immersed material, the scratch tool shall be dulled and checked for width of scratch as described in method 7711, using the unexposed set of specimens, 2.2. As a check on any change in the scratch tool, the unexposed set of specimens shall be tested alternately with the exposed set of specimens, the unexposed set being tested first.

4.6 The specimen shall be immersed vertically in the reagent, 4.1, so that the liquid will circulate freely around it. If more than one specimen is immersed in the same container, they shall be suspended so that they will not touch each other or the surface of the container. The amount of liquid added to the container shall be from 12 to 20 times the volume of the specimens. The specimen shall remain immersed in the liquid at the required temperature, 4.3, for the required time, 4.2. The container shall be covered to prevent evaporation of the liquid during the immersion period. At the end of the immersion period, the specimen shall be removed from the liquid and blotted (not rubbed) with a soft cloth and absorbent tissue. The scratch test shall be made in not less than 30 minutes and not more than 60 minutes after the specimen is blotted, as described in method 7411.

4.7 Procedure for tallow. The tallow shall be heated to a temperature of 50° to 55° C. (122° to 131° F.). The specimen shall be immersed in the melted tallow and the tallow allowed to cool to room temperature. The remainder of the procedure shall be as described in 4.4. At the end of the immersion period, it may be necessary to melt the tallow to facilitate removal of the specimen and removal of excess material from the specimen with cloth or absorbent paper.

50 RESULTS

5.1 Unless otherwise specified in the detail specification, three specimens from each test unit shall be immersed in each medium specified.

5.2 The scratch resistance or other characteristic of the test unit shall be the average of the values obtained from the specimens tested.

5.3 The scratch resistance after exposure to the reagent shall be recorded to the nearest 0.001 inch. If another characteristic of the test unit is specified, the characteristic shall be recorded as required in the applicable test method or detail specification.

5.4 The immersion liquid used, the time of immersion, and the temperature of immersion shall be recorded.

RESISTANCE TO SULFURIC ACID (TENSILE STRENGTH AND ELONGATION)

1. SCOPE

This method is intended for use in determining the effect of immersion in sulfuric acid at elevated temperature on tensile strength and elongation of resilient nontextile floor coverings such as rubber and plastic matting for electrical purposes.

2. SPECIMEN

The specimen shall be as described in method 4111.

3. APPARATUS

The apparatus shall be as follows:

3.1 A cylindrical container having a diameter not less than 1.5 nor more than 1.8 times the width of the specimen and of sufficient capacity to permit complete immersion of the specimen in a volume of liquid equivalent to 12 to 20 times the volume of the specimen. A test tube having an outside diameter of approximately 38 mm. and a length of 200 to 300 mm. has been found suitable.

3.2 Air or reflux condenser suitable for attaching to the container, 3.1, for maintaining the volume of the immersion medium during the immersion period.

3.3 Apparatus with suitable automatic controls for maintaining the required temperature throughout the immersion medium during the immersion period, such as a constant temperature bath or air oven with thermostatic control.

3.4 Apparatus such as thermometers, copper-constantan thermocouple and potentiometer, or other device for measuring the temperature of the immersion medium within 1° C. (1.8° F.).

3.5 Corrosion-resistant metal screens or glass framework to prevent the specimens from touching each other or the surface of the container.

3.6 Filter paper or other absorbent material.

3.7 Immersion medium consisting of 20 percent sulfuric acid, by weight, in distilled water. The specific gravity of this solution is about 1.14 at room temperature.

4. PROCEDURE.

4.1 Unless otherwise specified in the detail specification, the specimen shall be immersed at a temperature of 70°32° C. (158°±3.6° F.) for 463 ± ¼ hour.

4.2 Any surface coating on the principal surfaces of the specimen shall be removed by buffing as described in method 1021.

4.3 A volume of sulfuric acid equal to 12 to 20 times the volume of the specimen shall be transferred to the container. After adjusting the sulfuric acid to the required temperature, 4.1, the specimen shall be immersed vertically so that the liquid will circulate freely around the specimen during the immersion period. If more than one specimen is immersed in the same container, they shall be suspended so that they will not touch each other or the surface of the container. The condenser shall be attached to the container to maintain the volume of the liquid constant during the immersion period. The specimen shall remain immersed in the sulfuric acid for the required time at the required temperature, 4.1. At the end of the immersion period, the specimen shall be immediately removed from the liquid, rinsed with water at room temperature, blotted dry with filter paper or blotting paper, and benchmarks for determining elongation applied to the specimen as described in method 4121. The specimen shall be set aside to rest for 4±¼) hour at room temperature before tensile strength and elongation are determined.

4.4 At the end of the rest period, the cross-sectional area of the specimen shall be determined as described in methods 4111 and 4121, respectively. Tensile strength and elongation shall be determined on unexposed specimens from the same test unit for the purpose of comparison in determining the amount of change

in characteristic of the material due to immersion in sulfuric acid.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, the number of specimens from each test unit immersed in the sulfuric acid solution shall be as required in methods 4111 and 4121.

5.2 Calculation. The change in tensile strength and elongation of the test unit shall be calculated as follows:

Change in tensile strength or elongation,

$$\text{Percent} = \frac{O - E}{O} \times 100$$

where:

E is the tensile strength or elongation of the test unit after immersion.

O is the tensile strength or elongation of the test unit before immersion.

5.3 The change in tensile strength and elongation of the test unit shall be recorded separately to the nearest 1 percent.

5.4 The temperature of the immersion medium and the time of immersion shall be recorded.

RESISTANCE TO DETERGENTS

1. SCOPE.

This method is intended for use in determining the effect of a detergent solution on resilient nontextile floor coverings.

2. SPECIMEN

The specimen shall consist of a portion of the test unit about 2 by 6 inches.

3. APPARATUS

The apparatus shall be as follows:

3.1 A container suitable for immersing the specimen in detergent.

3.2 A thermometer or other device for measuring the temperature.

3.3 Filter paper or blotting paper.

3.4 Soap conforming to the requirements of Fed. Spec. P-S-606.

3.5 Lampblack conforming to the requirements of Fed. Spec. TT-L-70.

4. PROCEDURE

4.1 Preparation of detergent solution. The detergent shall consist of a mixture of the soap, 3.4, and lampblack, 3.5, in water. The detergent solution shall be prepared by dissolving one-half percent, by weight, of the soap in tap water at about 60° C. (140° F.) and adding lampblack until the mixture is dark gray.

4.2 The specimen shall be placed in the warm detergent solution in a vertical position so that about one-half of the length of the specimen is immersed and the other half remains above the surface of the solution. The specimen shall remain in the detergent solution for 1 hour. At the end of the immersion period, the specimen shall be removed from the solution, rinsed with tap water at about 60° C. (140° F.), and the surface water removed by blotting with filter paper or other absorbent material. The dry specimen shall be examined for any softening, staining, streaking, and change in color. The immersed portion of the specimen shall be compared with the portion that remained above the detergent solution.

5. RESULTS

5.1 Unless otherwise specified in the detail specification, three specimens from each test unit shall be tested.

5.2 The number of specimens tested from each test unit, and the number that show softening, staining; streaking, and color change shall be recorded.

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