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FEDERAL SPECIFICATION

CUSHIONING MATERIAL, EXPANDED POLYSTYRENE LOOSE-FILL BULK (FOR PACKAGING APPLICATION)

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers requirements for a loose-fill cushioning material (see 6.1).

1.2 Classification. Loose-fill material shall be of the following types and classes as specified (see 6.2):

Type I - Medium Peak Acceleration.

Class 1 - Flowable.
Class 2 - Non-flowable.

Type II - High Peak Acceleration.

Class 1 - Flowable.
Class 2 - Non-flowable.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

Federal Specifications:

PPP-B-601	Boxes, Wood, Cleated-Plywood.

Federal Standards:

FED-STD-123	Marking for Domestic Shipment (Civil Agencies).

(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and commercial item descriptions as outlined under General Information in the Index of Federal Specifications, Standards and Commercial Item Descriptions. The Index, which includes cumulative bimonthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, US Government Printing Office, Washington DC 20402.)

(Single copies of this specification and other Federal Specifications and Commercial Item Descriptions required by activities outside the Federal Government for bidding purposes are available without charge from the General Services Administration Business Service Centers in Boston, MA; New York, NY; Philadelphia, PA; Washington, DC; Atlanta, GA; Chicago, IL; Kansas City, MO; Fort Worth, TX; Houston, TX, Denver, CO; San Francisco, CA; Los Angeles, CA; and Seattle, WA.)

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

Military Specifications:

MIL-F-18405	Fuse, Firecracker, 30-second

Military Standards:

MIL-STD-129	Marking for Shipment and Storage

(Copies of Military Specifications and Standards required by the contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply:

AMERICAN SOCIETY FOR TESTING AND MATERIALS

D2221 - Standard Test Method for Creep Properties of Package Cushioning Materials.

(Applications for copies should be addressed to the American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pennsylvania 19103.)

NATIONAL MOTOR FREIGHT ASSOCIATION INC., AGENT

National Motor Freight Classification.

(Application for copies should be addressed to the American Trucking Association, Attention: Traffic Order Section, 1616 P Street N.W., Washington DC 20036.)

UNIFORM CLASSIFICATION COMMITTEE; AGENT:

Uniform Freight Classification Rules.

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 S. Riverside Plaza, Chicago, Illinois 60606.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 First article inspection. This specification provides for first article testing (see 4.2).

3.2 Materials. Expanded polystyrene shall be made from such materials and by such processes as to assure compliance with this specification.

3.3 Classification.

3.3.1 Type. The loose-fill material shall be typed as determined by the levels of peak acceleration existing throughout the static stress range from 0.15 to 0.45 pounds per square inch (psi).

Type I - Medium Peak Acceleration. Peak acceleration values shall not exceed the 60G level when subjected to the dynamic test (see 4.6).

Type II - High Peak Acceleration. Peak acceleration values shall not exceed 90G when subjected to the dynamic test (see 4.6).

3.3.2 Class. The loose-fill material shall be classed as follows:

Class 1 - Flowable. The flow rate shall be 6.0 cubic feet per minute or greater (see 4.7).

Class 2 - Non-Flowable. The flow rate shall be less than 6.0 cubic feet per minute (see 4.7).

3.4 Color.

3.4.1 Type I shall be white only (see 4.4.2.1).

3.4.2 Type II shall be any distinguishing color except white (see 4.4.2.1).

3.5 Configuration. The cushioning material configuration shall be at the option of the supplier unless otherwise specified (see 6.2). Configurations shall be homogeneous to the first article sample (see 4.4.2.1).

3.6 Dimensions. No configuration shall have an overall outside dimension greater than 2 inches unless the item is a strand configuration. A strand shall have two dimensions less than 3/8 inch and the length shall be greater than 2 inches, but less than 8 inches. Outside measurements are to be taken of all configurations at rest on a horizontal plane surface, one measurement perpendicular to the plane surface and the other measurements at right angles to each other and horizontal to the plane surface (see 4.8 and figure 1).

3.6.1 Tolerance. Measured dimensions shall not vary more than ± 20 percent from the first article sample, except for the length dimension for a strand configuration in which case a ± 40 percent tolerance is acceptable.

3.7 Vibrational settling. The prototype test load shall have a maximum displacement of not more than 30 percent when tested in accordance with 4.9.

3.8 Loaded bulk density. The loose-fill material shall have a bulk density of not less than .3 pounds per cubic foot nor more than 1.5 pounds per cubic foot (see 4.10). Bulk density shall not vary more than ± 10 percent from the first article sample.

3.9 Compressive creep. The compressive creep of loose-fill material shall not exceed the values specified in Table I (see 4.11).

3.10 Compressive set. The compressive set of loose-fill material shall not exceed values specified in Table I (see 4.12).

TABLE I

Load (psi)	0.4	0.8	1.2
Compressive Creep (Percent) Max.	10.	15.	18.
Compressive Set (Percent) Max.	5.	10.	13.

3.11 Flammability. The weight of material remaining after ignition test of each of five separate samples shall be equal to or greater than 50 percent of their original weights (see 4.13).

3.12 Electrostatic adhesion. The loose-fill material shall be non-static when tested in accordance with 4.14.

3.13 Workmanship. Loose-fill material shall be clean and free from foreign matter and free from foreign matter and imperfections in accordance with good commercial practice (see 4.4.2.1).

3.14 Net volume. The volume of loose-fill shall not settle 10 percent or more from the specified material quantity (see 4.15 and 6.2).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Classification of inspection. The examination and testing of the cushioning material shall be classified as follows:

(a) First article inspection (see 4.3).

(b) Quality conformance inspection (see 4.4).

4.3 First article inspection. The first article inspection shall consist of visual examinations and tests in Tables II, III, and IV. When specified (see 6.2) first article inspection shall be conducted by the contractor in the presence of a government representative designated by the contracting officer. Approval of the first article inspection sample does not preclude the requirements for performing the quality conformance inspection. First article inspection may be waived when the procuring activity or contract administration activity has data or other evidence to indicate that prior successful first article inspection has been conducted.

TABLE II FIRST ARTICLE TESTS

Property	Requirement	Test Method
Dynamic Cushioning	3.3.1	4.6
Flowability	3.3.2	4.7
Dimensions	3.6	4.8
Vibrational Settling	3.7	4.9
Loaded Bulk Density	3.8	4.10
Compressive Creep	3.9	4.11
Compressive Set	3.10	4.12

Flammability	3.11	4.13
Electrostatic Adhesion	3.12	4.14
Net Volume	3.14	4.15

4.3.1 First article samples. When specified by the contracting officer (see 6.2) the contractor shall submit a first article sample of sufficient material to conduct all tests required by this specification. The sample shall be produced by the contractor or furnished by a supplier and manufactured using the same production processes, procedures, and equipment used in fulfilling the contract. Prior to submission, the contractor shall inspect the sample to assure that it conforms to the requirements of the contract and shall submit a record of this inspection. A first article sample shall be submitted, as directed by the contracting officer, whenever a change occurs in manufacturing processes as determined by the Government. Failure of the first article sample to meet all the requirements of the specification shall be cause for rejection.

4.4 Quality conformance inspection. Quality conformance inspection shall consist of all examinations and tests listed in 4.4.2.

4.4.1 Sampling.

4.4.1.1 Size of lot. An inspection lot shall consist of all loose-fill cushioning material manufactured by the same process from the same components during one production run.

4.4.1.2 Sampling for inspection. From each lot, material shall be withdrawn in a random manner to make a composite sample sufficient in size for all examinations and tests.

4.4.2 Quality conformance.

4.4.2.1 Visual Examinations.

TABLE III VISUAL EXAMINATIONS

Examine	Requirement Paragraph	Defect
Color	3.4	Does not conform to Type
Configuration	3.5	Not homogeneous to first article (Figure 1)
Workmanship	3.13	Foreign matter, excessive (10%) deformed or fragmented particles.

4.4.2.2 Quality conformance tests.

TABLE IV QUALITY CONFORMANCE TESTS

Property	Requirement	Test Method
Dimensions	3.6	4.8
Loaded Bulk Density	3.8	4.10
Flammability	3.11	4.13
Electrostatic Adhesion	3.12	4.14
Net Volume	3.14	4.15

4.5 Test conditions. Unless otherwise specified, tests and measurements shall be at room temperature (70 to 90 degrees F). In case of dispute, the material shall be conditioned at least 24 hours and tested at 73.4 ± 3.6 degrees F and relative humidity of 50 ± 5 percent.

4.6 Dynamic test.

4.6.1 Apparatus.

4.6.1.1 Cleated plywood box. A cleated plywood box (Style A, PPP-B-601, except as specified herein) shall be fabricated. The box shall have an interior length, width and depth dimensions of 12 X 12 X 12 inches. The plywood panels shall be 1/2 inch thick material. The lumber for cleats shall be nominal 1 X 2 inch material. The cover shall set flat on the top of the box and shall be secured at the center point of each of the four edges by a carriage bolt passing through the cover and through the side cleats (see figure 2).

4.6.1.2 Prototype load. A rigid cubical prototype test load shall be fabricated of wood, steel, aluminum or other rigid materials having length, width, and depth dimensions of 6 X 6 X 6 inches so as to provide a 36 square inch bearing area on the loose-fill material. The prototype shall be constructed in such a manner that all faces will be flat. The prototype load shall be designed so that its weight can be varied to provide bearing stresses betweeen 0.1 psi and 0.6 psi. The prototype should be constructed so that a void space is provided at the geometic center of the cube for the mounting of triaxially oriented accelerometers.

NOTE: An effective means of varying the weight of the prototype model is to fabricate the model from 6 X 6 inch plates of various thicknesses and material compositions. Combinations of these plates can then be bolted together to obtain model weights which produce the desired bearing stress. Assembly bolts or hardware should not project above any surface of the model.

4.6.1.3 Drop tester. The drop test apparatus used shall permit the container to be placed in a position, prior to release, that will assure correct orientation, within 2 degrees at impact, for a flat face drop.

4.6.1.4 Recording equipment. The selection of specific acceleration recording equipment is optional. However, all recording equipment (including both transducers and recorders) shall have a frequency response adequate to measure the peak acceleration values to an accuracy of ± 5 percent.

4.6.2 Pack assembly. The inside bottom surface of the cleated plywood box shall be covered with a uniform 3 inch layer of the loose-fill material. Obtain a uniform 3 inch depth by adding material, if required, after briskly rocking the box from side to side for 30 seconds. Place the prototype test load on the loose-fill material and center it within the plywood box. Fill the box to the top with loose-fill material. Over-fill with an extra amount of material so that when 50 pound weight is placed on the cover, there is a gap of approximately 1/8 inch between the cover and the box. Secure the cover with four carriage bolts (see figure 2).

4.6.3 Test procedure. Subject the completed pack assembly, at each static stress level, to ten successive free fall drops on the bottom face of the box. The drops shall be made on a rigid, level floor. A drop height of 30 inches shall be used. The peak accelerations shall be recorded for each drop and a plot of peak accelerations versus static stress shall be made. The curve shall include a sufficient number of data points uniformly distributed to provide reasonable accuracy and validity of the curve. A minimum of five data points between 0.1 and 0.6 psi are required. Each data point shall be determined by averaging the resultant peak acceleration values for the last eight drops made at a given static stress level.

4.7 Flowability test.

4.7.1 Apparatus.

4.7.1.1 Funnel. A funnel as shown in figure 3 shall have a capacity of three cubic feet. The inside surface of the funnel shall be smooth, particularly where the cone of the funnel intersects the 6 inch diameter tube. The slope of the funnel wall shall be 45 degrees. The gate at the bottom of the funnel, when fully opened, shall not restrict the flow of the material.

4.7.1.2 Stop watch. A stop watch or comparable time measuring device capable of recording 1 second increments shall be required.

4.7.2 Test procedure. All inside surfaces of the funnel shall be wiped clean with a dry cloth. Fill the funnel with loose-fill material insuring the tube is full before the cone of the funnel is

filled. Level off with a straight edge. Remove the gate at the bottom of the funnel and record the time elapsed for the funnel to empty. The funnel is considered empty if no more than 1 percent (by volume) of the test material remains in the funnel.

4.8 Dimensions. A scale or instrument graduated to 1/16 inch shall be used to measure 25 particles randomly selected from the composite sample (see 4.4.1.2). The dimensions for a given configuration shall be determined by averaging the individual measurements after discarding the two least representative particles.

4.9 Vibrational settling.

4.9.1 Pack assembly. The pack assembly shall be the same as specified in 4.6.2, except the prototype load shall be for 0.15 and 0.45 psi and the vertical distance from the top of the prototype test load to the top of the plywood box shall be measured and recorded.

4.9.2 Test procedure. Place the completed pack upon a vibration table, but do not fasten it to the table. Fences or blocking shall be used to keep the pack in position without unnecessarily restricting its movement. Vibrate the specimen for 30 minutes at 1 inch double (vertical displacement) amplitude at approximately 4.5 Hz. Remove the pack assembly from the table and carefully remove the material from above the test load. Repeat the measurement of the vertical distance from the top face of the prototype load to the top of the box as described in 4.9.1. Report the vertical displacement (vibrational settling) as a percentage of the initial distance measured.

4.10 Loaded bulk density. The bulk density of each loose-fill material shall be measured using the cleated plywood box specified in 4.6.1.1. Level fill the box with loose-fill material. Place an 11-7/8 X 11-7/8 X 3/4 inch plywood leveling board on top of the material and load the board with a 50 pound weight. Measure the distance from the top of the box to each top corner of the leveling board and record the average of the four readings. Determine the net weight of the loose-fill material and compute the bulk density by one of the following formulas:

$$\text{Bulk Density (lbs cu. ft.)} = \frac{0.0265W}{11.25-D}$$ Where the top of the leveling board is below the top of the test box.

$$\text{or} \quad = \frac{0.0265W}{11.25+D}$$ Where the top of the leveling board is above the top of the test box.

where: W = net weight of loose-fill material (grams)
D = average corner depth measured (inches)

Bulk density shall be reported to the nearest 0.05 pounds per cubic foot.

4.11 Determination of creep. Creep shall be determined in accordance with ASTM D2221 - Creep Properties of Package Cushioning Materials with the following exceptions:

a. Preworking specified will not be required for loose-fill materials.

b. Three samples of each loose-fill material shall be loaded at the levels specified in Table I.

c. Initial thickness shall be between 2 to 4 inches under load and recorded as T (original thickness).

d. The specimens shall remain under constant load and thickness measurements recorded approximately six minutes after initial load application and every 24 hours thereafter for seven days (168 hours) after loading. The percentage of creep shall be calculated in accordance with section 10.5 of ASTM D2221.

4.12 Compressive set. Compressive set shall be calculated in accordance with section 10.6 of ASTM D2221 following the creep test specified in 4.11 using the same samples. Twenty-four hours after the load is removed, the value for specimen thickness (T_o) to be used in the calculation shall be measured in accordance with section 9.4 of ASTM D2221.

4.13 Flammability.

4.13.1 Test apparatus.

4.13.1.1 Basket. An 8 inch long by 6 inch wide by 8 inches high basket shall be fabricated from 1/4 inch mesh brass screen with 0.060-0.072 inch wire diameter.

4.13.1.2 Fuse. A fuse with the burning rate of 30 seconds per foot meeting the requirements of MIL-F-18405 shall be used.

4.13.1.3 Tripod. A common laboratory tripod, 9 inches high, with ring dimensions of 4 1/2 inches I.D. and 6 inches O.D. shall be used.

4.13.1.4 Stop watch. A stop watch or comparable time measuring device capable of recording 1 second increments shall be employed to determine the burning rate of the fuse.

4.13.2 Procedures.

4.13.2.1 Sampling. Tests shall be conducted on five separate specimens randomly selected from the composite sample. Failure of one (or more) specimens shall result in rejection of the entire lot.

4.13.2.2 Specimen preparation. Prior to each test, the basket and tripped shall be thoroughly cleaned. A wire brush and high temperature burner are recommended to accomplish the cleaning. Fill a basket to an approdimate depth of 4 inches. Thread one foot length of fuse through the center of the 6 inch dimension of the basket (see figure 4). Eliminate excessive slack in the fuse by pulling simultaneously on both ends and complete filling the basket with loose-fill. Weigh the basket and contents, subtract the weight of the basket plus one gram for the fuse, and record the original net weight of the loose-fill.

4.13.2.3 Test procedure. Place the filled basket on the tripod in a draft free environment and ignite the fuse. If the fuse burns for less than 25 seconds or for more than 35 seconds, the test is considered void and shall be repeated. After all the flames have been extinguished, reweigh the basket and contents. Compute the final net weight of the loose-fill, by subtracting the original basket weight and one gram for the fuse.

4.13.2.4 Calculation of results. The percentage of material remaining after ignition shall be determined to the nearest whole percent as follows:

$$\text{Percent material remaining} = \frac{\text{Final net weight}}{\text{Original net weight}} \times 100$$

4.14 Electrostatic adhesion.

4.14.1 Test apparatus. The test apparatus for this test shall consist of a 5 gallon, all fiber drum with a telescoping lid. The fiber drum shall not have any internal surface treatment.

4.14.2 Test procedure. Fill the drum one-third full with loose-fill material and place the drum on its side. With two persons placed approximately ten feet apart, roll the drum back and forth across the floor for a period of three minutes. The rate of revolution should be between 50 and 70 revolutions per minute. Within 30 seconds after the drum has ceased rolling, and without shaking, pour the material out. Material that has an excessive electrostatic charge will tend to cling to the walls of the drum. If no more than six pieces cling to the sides of the drum immediately after pouring, the material shall have passed the test.

4.15 Determination of fill of containers. A filled shipping container shall be examined to determine the net volume and net weight.

4.15.1 Volume. The volume of a container shall be determined from the following equation:

$$\text{Volume (cubic feet)} = \frac{\text{net weight (lbs/container)}}{\text{bulk density (lbs/cu.ft.)}}$$

4.15.2 Net weight. The net weight of the shipping container contents shall be determined to the nearest ounce.

4.15.3 Bulk density. (See 4.10 - Loaded Bulk Density).

4.16 Inspection of preparation for delivery. The packing and marking of cushioning material shall be examined for compliance with the requirements of section 5.

5. PREPARATION FOR DELIVERY

5.1 Packing. The cushioning material shall be purchased in containers which provide ventilation adequate to prevent the accumulation of the volatile agents used in the expanding process. The volume of the container fill shall be determined according to 4.15.

5.1.1 Level C. The same type, class, and configuration of cushioning material shall be packed in a fiberboard box conforming to the latest revision of Rule 41 of the Uniform Freight Classification. The box shall be closed with sealing strips in accordance with section 7, paragraph C of Rule 41.

5.1.1.1 Optional Level C. When specified (see 6.2) twenty cubic feet of the same type, class, and configuration (8 to 30 pounds) of cushioning material shall be packed in a bag that conforms to 5.1 and the National Motor Freight Classification Rules. This container should only be used when ordering truckload quantities, and specifically when the containers will not be used for reshipment.

5.2 Marking.

5.2.1 Civil agencies. In addition to any special markings required by the contract or order, shipments shall be marked in accordance with FED-STD-123.

5.2.2 Military agencies. In addition to any special markings required by the contract or order, shipments shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. The material covered by this specification is intended for use in packing or shipping applications as cushioning and dunnage where a bulk, loose-fill, lightweight material is desirable. If the material is not damaged beyond permanent deformation, it should be suitable for one or more reuses.

6.1.1 Application. To provide the optimum degree of protection when used for cushioning applications the container should be filled to top of pack, vibrated slightly so that the material will fill voids and settle particles; then overfill container to a point where it may be just closed by using fairly heavy pressure on flaps or lid.

6.1.2 Wrapping. Items subject to corrosion, or which have voids or crevices where the material can be entrapped, should be wrapped in a non-corrosive barrier material.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents.

a. Title, number, and date of this specification.

b. Type and class (see 1.2 and 3.3).

c. Configuration (see 3.5).

d. When optional level C packing is applicable (see 5.1.1).

e. State quantity by volume in cubic feet (see 3.14).

f. First article samples (see 4.3). When a supplier is in continuous production from contract to contract, consideration should be given to waive the first article inspection.. If first article inspection is required, the contracting officer shall specify:

(1) Where first article inspection is to be conducted.

(2) That approval of first article samples or waiving of the first article inspection shall not relieve the supplier of his obligation to fulfill all other requirements of this specification and contract.

6.2.1 The following statement should be included in the purchase contract: Type I material shall be substituted for a specified Type II material if the substitution results in a lower procurement cost to the Government.

MILITARY INTERESTS:

Custodians

Army - GL
Navy - SA
Air Force - 69

Review Activities

Air Force - 99

User Activities

Navy - AS

CIVIL AGENCY COORDINATING ACTIVITIES:

GSA-FSS
FAA-ACO

PREPARING ACTIVITY:

Air Force - 69

DOD Project 8135-0606

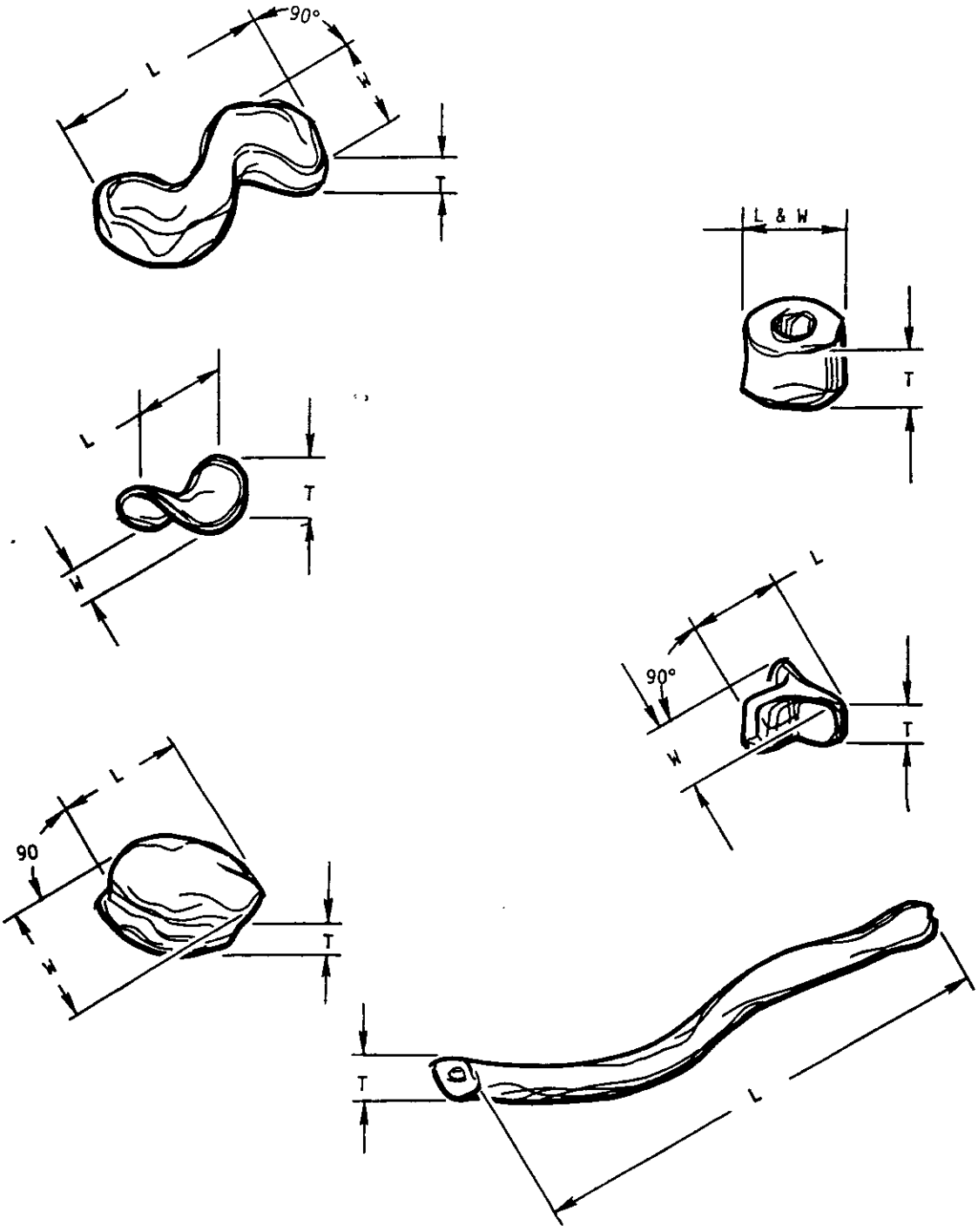

FIGURE 1 - CONFIGURATIONS

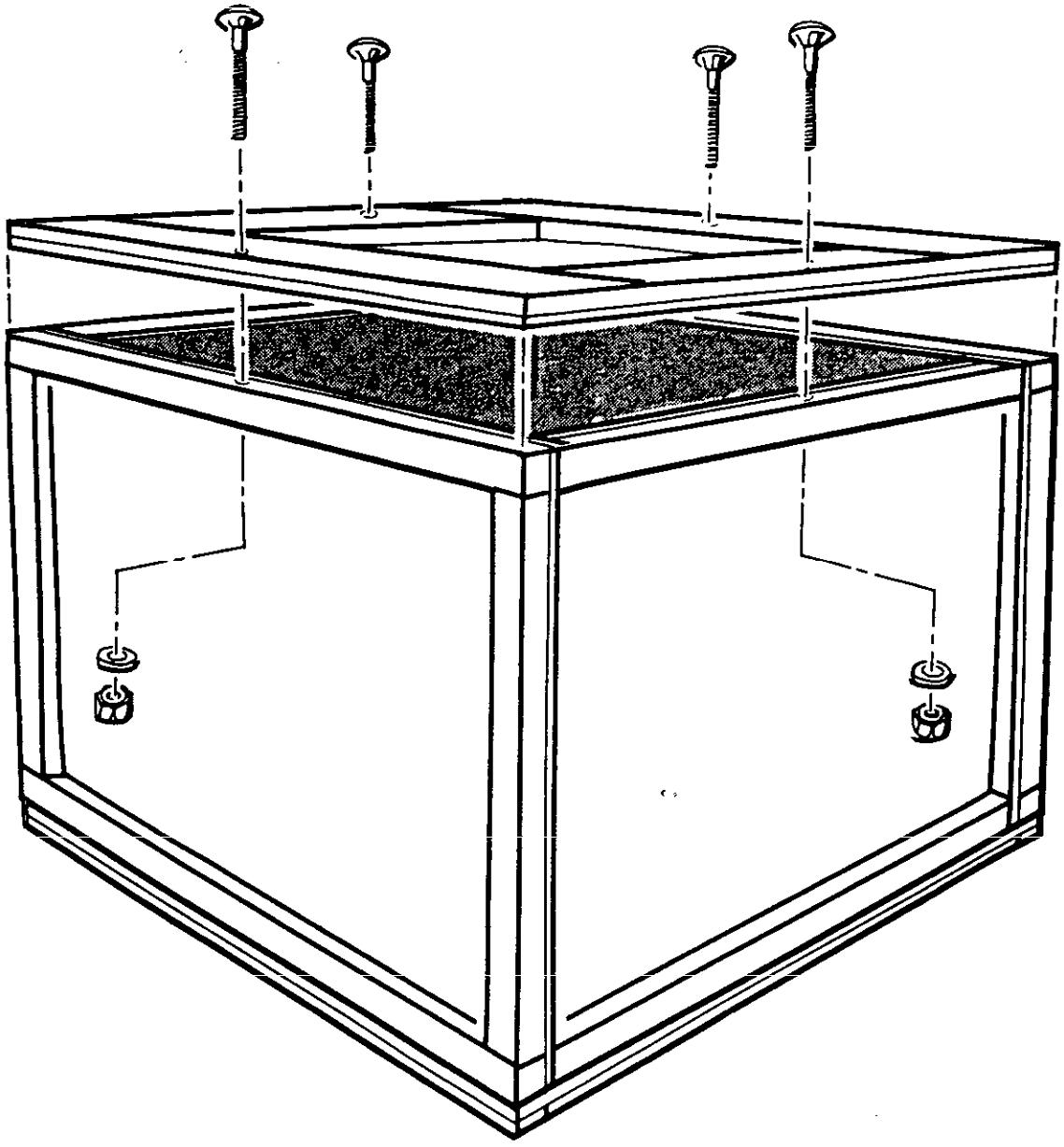

FIGURE 2 - CLEATED PLYWOOD BOX

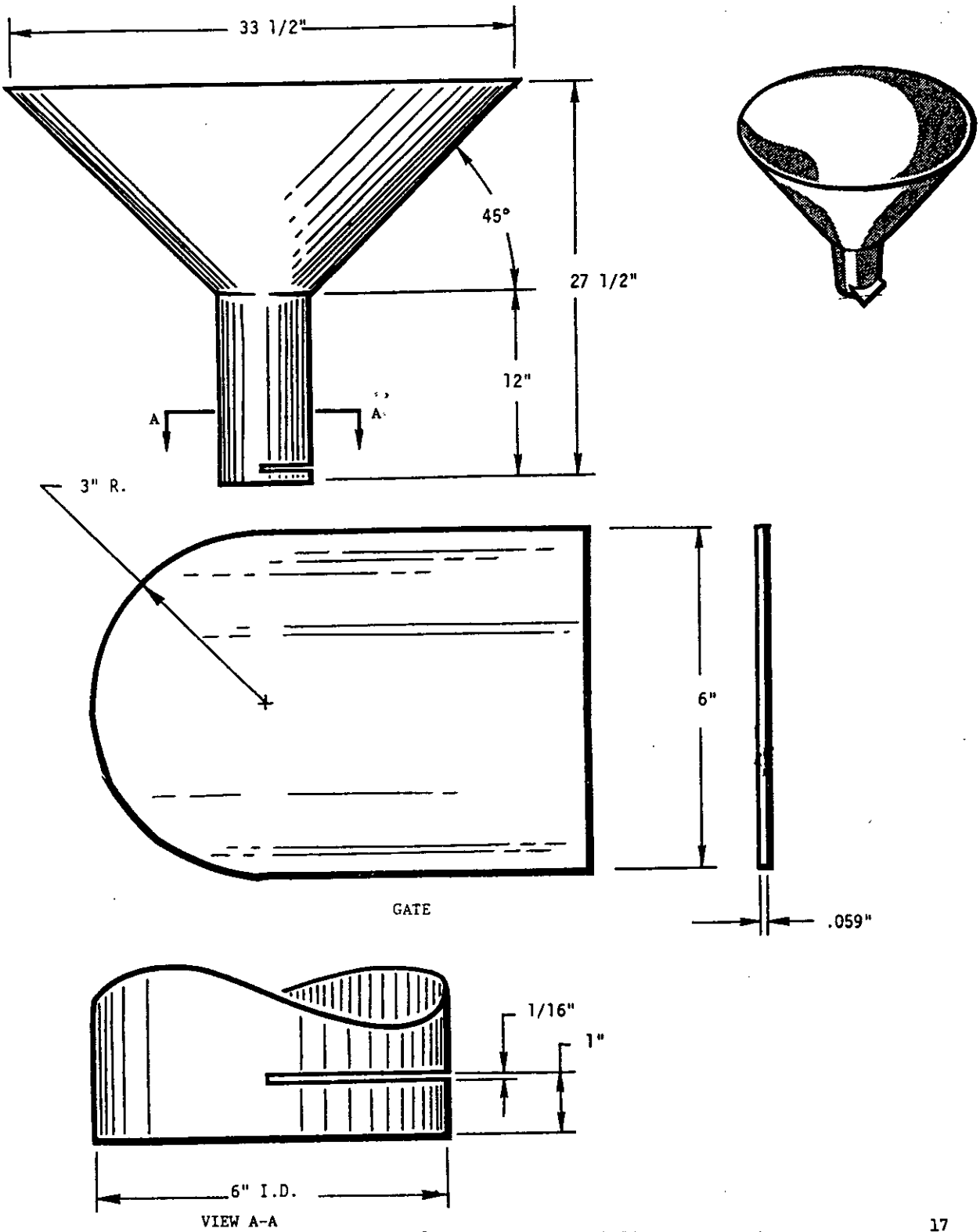

FIGURE 3 - FREE FLOW TEST APPARATUS

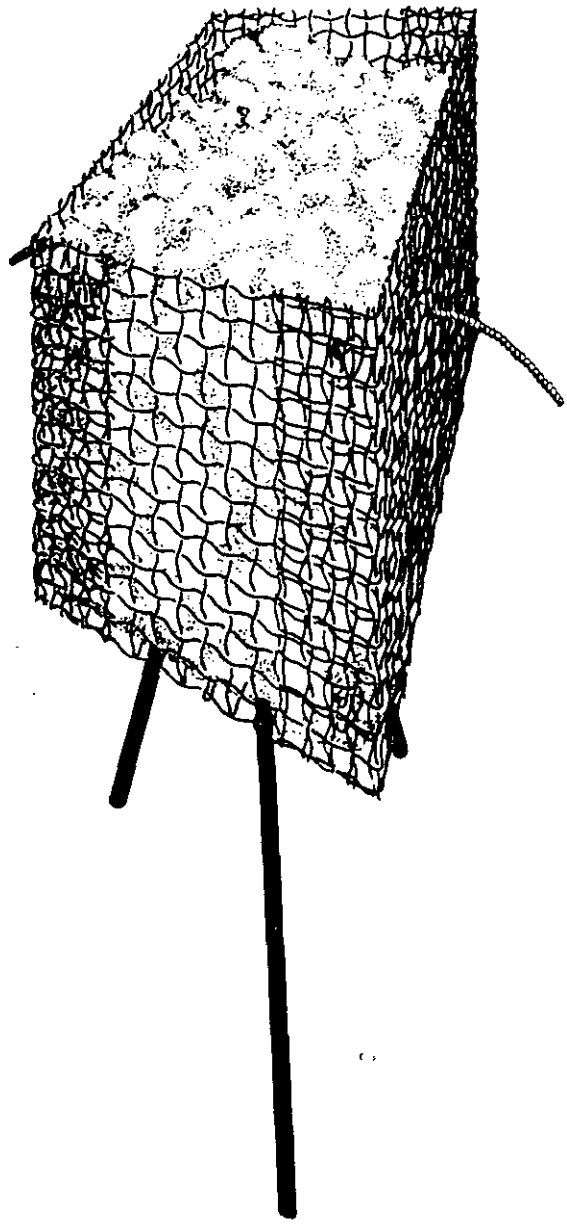

FIGURE 4 - FLAMMABILITY TEST APPARATUS

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