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INCH-POUND

MIL-PRF-32004
23 May 1997

PERFORMANCE SPECIFICATION

PACKAGING OF FOOD IN POLYMERIC TRAYS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance criteria for packaging materials and the packaging of food in polymeric trays to include the filling and hermetic sealing of the tray, the processing of the filled and sealed tray, and the application of a protective sleeve for the tray and lid. The combination of the tray and tray lid is referred to as the container.

1.2 Classification. Packaged and processed products will be of the following types and classes, as specified (see 6.1).

1.2.1 Types. The types of tray materials are as follows:

Type I - without oxygen absorbant additive (18 month at 80°F shelf life)
Type II - with oxygen absorbant additive (36 month at 80°F shelf life)

1.2.2 Classes. The classes of processing are as follows:

Class 1 - For retortable products
Class 2 - For hot-filled products
Class 3 - For oven-baked products

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army Soldier Systems Command, Natick Research, Development, and Engineering Center, ATTN: SSCNC-WRE, Natick, MA 01760-5018 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 89GP

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2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in section 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in section 4 of this specification, whether or not they are listed.

2.2 Government documents. None.

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.1).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 999 - Methods of Vibration Testing of Shipping Containers

D 1974 - Methods of Closing, Sealing and Reinforcing Fiberboard Shipping Containers

D 3985 - Oxygen Gas Transmission Rate Through Plastic Film and Sheeting Using a Coulometric Sensor

D 5118 - Fabrication of Fiberboard Shipping Boxes

D 5276 - Test method for Drop Test of Loaded Containers by Freefall

F 1249 - Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

(Application for copies should be addressed to the American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive , West Conshohocken, PA 19428)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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3. REQUIREMENTS

3.1 Performance characteristics.

3.1.1 Tray configurations and dimensions. Tray material shall be fabricated into trays as specified in figure 1. The tray shall have a minimum capacity of 96 fluid ounces.

3.1.2 Oxygen gas transmission rate.

3.1.2.1 Type I tray material. The oxygen gas transmission rate (O_2GTR) of the material shall not exceed 0.01 cc/100 sq. in./24 hrs.

3.1.2.2 Type II tray material (Class 1 and 2 only). The O_2GTR of the material shall not exceed 0.01 cc/100 sq. in./24 hrs. The material shall also have the added capability to control (absorb) oxygen permeation through the tray walls as well as headspace oxygen within the filled, sealed, and processed tray throughout the 36 months at 80°F shelf life of the tray product.

3.1.2.3 Tray lid. The O_2GTR of the material (types I and II) shall not exceed 0.0039 cc/100 sq. in./24 hrs/atm.

3.1.3 Water vapor transmission rate.

3.1.3.1 Tray material. The water vapor transmission rate (WVTR) of the material shall not exceed 0.69 cc/100 sq. in./24 hrs.

3.1.3.2 Tray lid. The WVTR of the material shall not exceed 0.00064 cc/100 sq. in./24 hrs.

3.1.4 Processing. The tray and lid material shall be capable of withstanding the process specified in the applicable food document.

3.1.5 Lid material. The lid material shall be capable of hermetically sealing the tray filled with product.

3.1.6 Protective sleeve. The sleeve shall protect the tray, lid, and seals from physical damage. The maximum height of the filled, sealed and processed tray with protective sleeve shall not exceed 2-1/8 inches. The length of the protective sleeve shall cover the entire tray flange, and shall not exceed 12-3/4 inches. The width of the protective sleeve shall fit snugly against the tray flange so as to restrict the sliding motion of the tray within the sleeve. The top and bottom faces of the sleeve at the open ends shall be compressed in such a manner so as to keep the top sleeve face flush against the tray lid and seams. The tray shall be restrained within the sleeve in such a manner so as to prevent the tray from sliding out through an open end. The sleeve shall provide added stacking strength to the tray. The color of all inside and outside surfaces of the sleeve shall

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be natural kraft, tan, or dull gray. A label with the following instructions shall be printed, stamped, or otherwise applied onto the protective sleeve, in a manner that does not damage the sleeve, with permanent ink of any contrasting color.

PROTECTIVE SLEEVE

DO NOT THROW AWAY

SAVE AND RE-USE TO PROTECT TRAY FROM DAMAGE

To Avoid Damaging Tray Lid:

1. Keep This Protective Sleeve Secured to Tray Until Ready to Heat, Then Remove.

2. Insert Tray Back Into Sleeve After Heating.

3. Always Use Sleeves When Transporting Trays in Insulated Containers.

4. If Sleeves Are Unavailable, Stack Trays Lid-to-Lid with Fiberboard Pads in Between.

3.1.7 Rough handling survivability. After processing, the filled and sealed container, with protective sleeve added, shall be capable of withstanding rough handling.

3.1.8 Residual gas. Residual gas volume in the filled, sealed and processed trays shall not exceed 175.0 cubic centimeters.

3.1.9 Closure seal. The closure seal shall be a minimum of 1/8 inch wide. The closure seal shall be continuous along the flange surface. The closure seal shall be free of impression or design on the seal surface. The closure seal shall be free of wrinkles, occluded matter, or evidence of entrapped moisture or grease.

3.1.10 Internal pressure. The filled, sealed and processed trays shall withstand an internal pressure of 20 psig.

3.1.11 Lid opening. The tray lid shall be easily removed with a knife.

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3.1.12 Camouflage. The color of exterior surfaces of the tray and tray lid shall contribute to woodland camouflage (i.e., earth brown, black, olive drab, forest green, etc.).

4. VERIFICATION

4.1 Conformance inspection. Conformance inspection includes those examinations and tests from table I as defined in the contract or purchase order, performed on specified samples (see 6.1 and 6.2).

TABLE I. Verification methods

Characteristic 1/	Requirement	Verification
Tray configurations and dimensions	3.1.1	4.4.1
Oxygen gas transmission rate (Type I)	3.1.2.1	4.4.2
Oxygen gas transmission rate (Type II)	3.1.2.2	4.4.3
Water vapor transmission rate	3.1.3	4.4.4
Processing	3.1.4	4.4.5
Lid material	3.1.5	4.3
Protective sleeve	3.1.6	4.4.6
Rough handling survivability	3.1.7	4.4.7
Residual gas	3.1.8	4.4.8
Closure seal	3.1.9	4.3
Internal pressure	3.1.10	4.4.9
Lid opening	3.1.11	4.4.10
Camouflage	3.1.12	4.4.11

1/ In lieu of testing, determination of compliance to camouflage requirements may be ascertained by examination of records, invoices, or other valid documents. In addition, compliance to the

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requirements for O_2GTR, WVTR, processing, rough handling survivability, outside tray dimensions, and tray capacity may be verified by certificate of conformance.

4.2 Verification methods. The types of verification methods may be visual inspection, measurement, sample tests, full scale demonstration tests, simulation modeling, engineering evaluation, component properties analysis, and similarity to previously-approved or previously-qualified designs.

4.2.1 Verification alternatives. The manufacturer may propose alternative tests methods, techniques, or equipment, including the application of statistical process control, tool control, or cost-effective sampling procedures to verify performance. The contract may specify alternatives that replace verifications required by this specification.

4.3 Examination of container. After processing, the container shall be visually examined for compliance with 3.1.4, 3.1.5, and 3.1.9. Defects and defect classifications are listed in table II.

TABLE II. Filled, sealed and processed container defects

Category				Defect
Critical	Major A	Major B	Minor	
1				Swollen container
2				Tear, crack, cut, hole, or if a multi-layered laminate is used, abrasion through more than one layer of the tray or through the barrier (e.g. foil) layer of the lid material or leakage through any seal or surface
3				Abrasion on the lid material within 1/16 inch of the food product edge of seal
4				Closure seal not continuous along tray flange
5				Closure seal width less than 1/8 inch
6				Foldover wrinkle extending into the seal such that the closure seal is reduced to less than 1/8 inch
7				Presence of entrapped matter (for example, product, moisture, grease, etc.) that reduces the closure seal to less than 1/8 inch

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TABLE II. Filled, sealed and processed container defects (cont'd)

Category				Defect
Critical	Major A	Major B	Minor	
8				Presence of delamination when a multi-layered laminate is used 1/
	101			Unclean container 2/
	102			Any impression or design on the seal surfaces which conceals or impairs visual detection of seal defects
		151		Presence of delamination when a multi-layered laminate is used 1/
			201	Presence of delamination when a multi-layered laminate is used 1/
			202	Color does not contribute to woodland camouflage

1/ Delamination defect classification:

Critical - Evidence of outer ply delamination such that the adjacent ply in the lid body is exposed or evidence of two ply delamination such that the food contact layer is exposed. Any evidence of outer ply delamination for the tray body.

Major B - Delamination of the outer ply in the lid seal area that can be propagated to expose the adjacent ply at the food product edge of the lid. The separated outer ply shall be grasped between thumb and forefinger and gently lifted toward the food product edge of the seal or if the separated area is too small to be held between thumb and forefinger, a number two stylus shall be inserted into the delaminated area and a gentle lifting force applied against the outer ply. If separation of the outer ply can be made to extend to the product edge of the seal with no discernible resistance to the gentle lifting, the delamination shall be scored as a Major B defect. Additionally, spot delamination of the outer ply in the body of the lid that is able to be propagated beyond its initial borders is also a Major B defect. To determine if the delaminated area is a defect, use the following procedure: Mark the outside edges of the delaminated area using a bold permanent marking pen. Open the tray and remove the contents. Cut the lid transversely not closer than 1/4 inch (± 1/16 inch) from the delaminated area. Hold the

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delaminated area between the thumb and forefinger of each hand with both thumbs and forefingers touching each other. The delaminated area shall then be rapidly flexed 10 times by rotating both hands in alternating clockwise-counter clockwise directions. After flexing, the separated outer ply shall be grasped between thumb and forefinger and gently lifted away from the lid surface or if the separated area is too small to be held between thumb and forefinger, a number two stylus shall be inserted into the delaminated area and a gentle lifting force applied against the outer ply. Any propagation of the delaminated area, as evidenced by the delaminated area exceeding the limits of the outlined borders, shall be scored as a Major B defect.

Minor - Minor delamination of the outer ply in the lid seal area is acceptable and shall not be classified as a minor defect unless it extends to within 1/16 inch of the food product edge of the seal. Isolated spots of delamination in the body of the lid that do not propagate when flexed as described above shall be classified as minor.

2/ Scale or dust on the outside of container caused by retort water may be removed by washing. The following examples shall not be scored as defects for unclean:

a. Water spots.

b. Ten or less specks of dried product each of which measure 1/8 inch by 1/8 inch or equivalent area, or less.

c. Any foreign matter which presents no health hazard or no potential container damage and which readily falls off when container is lifted and shaken lightly.

d. Very thin film of grease, oil, or product residue which is discernible to touch, but not readily discernible by visual examinations.

e. Thin strips or drops of adhesive.

4.4 Tests.

4.4.1 Tray configurations and dimensions. Prior to filling, sealing and processing, tray dimensions shall be measured and compared to the requirements of figure 1. The tray shall be placed on a flat surface and filled with 96 fluid ounces of water. Any tray dimension exceeding the requirements of figure 1; or tray which cannot hold a minimum of 96 fluid ounces of water shall be considered a test failure.

4.4.2 Oxygen gas transmission rate (Type I). The O_2GTR of the material shall be determined in accordance with ASTM D 3985 at 73°F and 50 % relative humidity.

4.4.3 Oxygen gas transmission rate (Type II). The O_2GTR of the material shall be determined in

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accordance with ASTM D 3985 at 73°F and 50 % relative humidity. An added capacity to absorb headspace oxygen within the filled, sealed, and processed tray as well as oxygen permeation through the tray walls for a minimum of 36 months at 80°F shall be verified by certificate of conformance.

4.4.4 Water vapor transmission rate. The WVTR of the material shall be determined in accordance with ASTM F 1249 at 104°F and 90 % relative humidity.

4.4.5 Processing. Testing for processing of the material shall be as follows: Material shall be formed into trays in accordance with figure 1. For Class 1, trays shall be filled with approximately 96 ounces of water, sealed with the tray lid material, and exposed to the same processing conditions as required by the food product document. For Class 2 and 3, trays shall be filled and sealed with representative product in accordance with the appropriate food product document. Following processing, containers shall be examined in accordance with table II.

4.4.6 Protective sleeve. The protective sleeve with filled, sealed and processed tray inside shall be placed on a flat surface and examined for conformance to dimension, labeling, and stacking strength requirements. Any sleeved trays with a height greater than 2-1/8 inches; or sleeves not covering the entire flange length; or sleeves exceeding 12-3/4 inches in length; or sleeves not preventing sliding of the tray along the sleeve width; or sleeves not compressed in such a manner as to keep the top sleeve face flush against the tray seal surfaces; or sleeves that do not prevent the tray from sliding out through an open end; or sleeves not providing added stacking strength equivalent or better than a sleeve constructed of grade 275 fiberboard in accordance with ASTM D 5118 and with flutes oriented parallel to the sleeve width; or sleeves not of a natural kraft, tan or dull gray color; or label instructions missing; or label instructions not legible shall be considered a test failure.

4.4.7 Rough handling survivability.

4.4.7.1 Standard temperature test. Four trays, filled with a representative food product, processed and prepared as specified in the applicable food document shall be inserted into the protective sleeve as specified in 3.1.6 and packed in a snug fitting fiberboard box conforming to style RSC-L, type CF, grade 275 of ASTM D 5118. The sleeved trays shall be placed flat with the first two trays placed with the lids together and the next two trays with the lids together. The inside of each box shall be provided with a box liner. The height of the box liner shall be equal to the full inside depth of the box (+ 0 inch, – 1/8 inch). The box shall be closed in accordance with ASTM D 1974. Condition the box of four trays in an atmosphere uniformly maintained at 72°F ± 2°F for a period of 48 hours. Conduct a drop test in accordance with ASTM D 5276, Assurance Level I for a series of 10 drops, to include: (1) a bottom corner drop at the manufacturer's joint; (2 & 3) edge drops on the shortest and next shortest edges radiating from the corner; (4) an edge drop on the longest edge radiating from that corner; (5 & 6) flatwise drops on the smallest and opposite smallest faces; (7 & 8) flatwise drops on the medium and opposite medium faces; (9 & 10) flatwise drops on the longest and opposite longest faces. Immediately after completion of the drop test, conduct a vibration test (on the same box of four trays) in accordance with ASTM D 999, at 268 RPM for a

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period of one hour. Remove trays from the box and examine visually. Any cracked, split or broken tray or lid at any location; or closure seal width less than 1/8 inches; or tear, hole, or puncture through protective sleeve causing a hole in the tray lid; or obviously wet or stained protective sleeve due to leaking trays; or any evidence of food product leakage from tray or lid; or absence of protective sleeve; or protective sleeve no longer preventing the tray from sliding out through an open end shall be considered a test failure.

4.4.7.2 Frozen temperature test. Prepare the box of four trays as specified in 4.4.7.1, but condition in an atmosphere uniformly maintained at -20°F ± 2°F for a period of 48 hours. While still in frozen state, conduct drop and vibration tests as specified in 4.4.7.1. Remove trays from the box and allow to fully thaw prior to visual examination. Any cracked, split or broken tray at any location, except along the outermost flange edges, or lid at any location; or closure seal width less than 1/8 inches; or tear, hole, or puncture through protective sleeve causing a hole in the tray lid; or obviously wet or stained protective sleeve due to leaking trays; or any evidence of food product leakage from tray; or absence of protective sleeve; or protective sleeve no longer preventing the tray from sliding out through an open end shall be considered a test failure.

4.4.8 Residual gas volume. The samples for test shall be opened under 75°F ± 5°F water and the gases shall be collected by water displacement in a graduated cylinder or other calibrated tube. The volume of the gases shall be reported to the nearest 1 cubic centimeter. Any residual gas volume exceeding 175.0 cubic centimeters shall be considered a test failure.

4.4.9 Internal pressure. Internal pressure resistance shall be determined by pressurizing the container without protective sleeve while they are restrained between two rigid plates spaced 1-15/16 inch ± 1/16 inch apart. A four-seal tester (designed to pressurize filled container by use of a hypodermic needle through the container wall or lid) shall be used and all four seals tested simultaneously. Pressure shall be applied at the approximate uniform rate of 1 psig per second until 20 psig pressure is reached. The 20 psig pressure shall be held constant for 30 seconds and then released. The container then shall be examined for separation or yield of the heat seals. Any rupture of the container or evidence of any seal separation that reduces the effective closure seal width to less than 1/8 inch shall be considered a test failure.

4.4.10 Lid opening. Place a filled, sealed and processed tray on a flat surface and remove the protective sleeve, if necessary. Position one hand along the tray flange and use a knife in the other hand to cut open the lid along the inside edge of the complete tray flange, approximately 1/4 inches away from the flange edge. The inability to open the lid in the manner described herein shall be considered a test failure.

4.4.11 Camouflage. Visually examine the exterior surfaces of the tray and tray lid after processing.

5. PACKAGING

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This section is not applicable to this specification.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Acquisition requirements. Acquisition documents must specify the following:

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

b. Type and class required (see 1.2).

c. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1 and 2.3).

d. Sampling for conformance inspection (see 4.1).

6.2 Conformance inspection. Affordable conformance inspection with confidence varies depending upon a number of procurement risk factors. Some of these factors include contractor past performance, government schedules and budget, product material and design maturity, manufacturing capital equipment and processes applied, the controlled uniformity of those processes, labor skill and training, and the uniformity of measuring processes and techniques. During the solicitation, contracting documents should indicate those tests desired from table I and their designated frequency based on a risk assessment for the procurement.

6.3 Tray material.

6.3.1 Type I material. The U.S. Army Soldier Systems Command (SSCOM), Natick Research, Development and Engineering Center (NRDEC) has found that a seven layer coextruded structure consisting of polypropylene, regrind, tie, ethylene vinyl alcohol (EVOH), tie, regrind, and polypropylene, when formed into a tray with a minimal wall thickness of 0.022 inches, a tray weight of 125 grams ± 12 grams, an EVOH content of 6 percent, and a minimum EVOH barrier layer thickness of 0.001 inches meets the performance criteria of this specification. A polymeric tray (Drawing #9212, Revision B) constructed of the above material is available from Rexan Containers, Union, MO 63084.

6.3.2 Type II material. SSCOM (NRDEC) has found that the type I material structure (see 6.3.1) modified to include a 30% loading of Amosorb® oxygen scavenger additive (a product of Amoco Chemical Company) meets the performance criteria of this specification.

6.4 Lid material. SSCOM (NRDEC) has found that a lid material structure consisting of, from

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inside to outside, 0.003 to 0.004 inch thick polyolefin, 0.00035 to 0.0007 inch thick aluminum foil and 0.0005 inch thick polyester meets the performance criteria of this specification. However, SSCOM (NRDEC) has observed that during rough handling testing at -20°F (see 4.4.7.2), the possibility exists that the lidding material may pinhole, puncture, or develop raised bumps from frozen food product within the tray. Care should be taken to minimize the handling of polymeric trays when frozen.

6.5 Protective sleeve material. SSCOM (NRDEC) has found that a protective sleeve material constructed of grade 275 fiberboard in accordance with ASTM D 5118, oriented with flutes parallel to the sleeve width, jointed and hot melt glued along the vertical length of the sleeve, and securely taped around the entire sleeve and across the open ends at their midpoint meets the performance criteria of this specification.

6.6 Technical information. Specific technical inquires may be addressed to the Commander, U.S. Army Soldier Systems Command, Natick Research, Development and Engineering Center, ATTN: SSCNC-WRE, Natick, MA 01760-5018.

6.7 Subject term (key word) listing.

Combat field feeding
Operational rations

Custodians:
Army - GL, QM
Navy - MC

Review activities:
Army - MD
Navy - SA
Air Force - 35
DLA - SS

Civil agency coordinating activity:
USDA - FV

Preparing activity:
Army - GL

(Project 89GP-0137)

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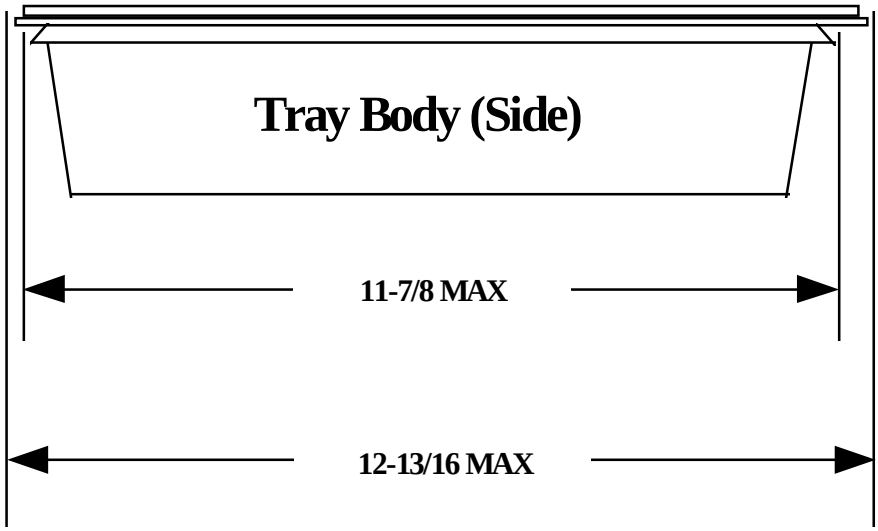

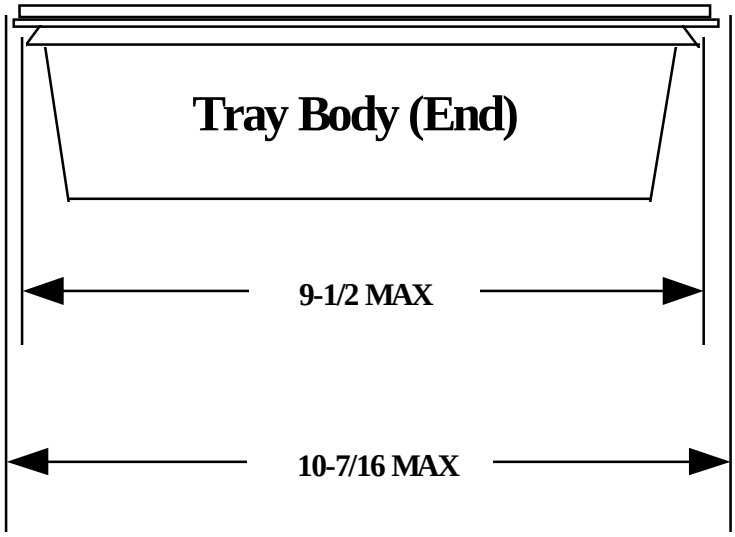

FIGURE 1: Dimensional Requirements for the Polymeric Tray.

All Dimensions are in Inches.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. **The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.**
2. **The submitter of this form must complete blocks 4, 5, 6, and 7.**
3. **The preparing activity must provide a reply within 30 days from receipt of this form.**

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I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-PRF-32004	**2. DOCUMENT DATE (*YYMMDD*)** 1997 May 23

3. DOCUMENT TITLE PACKAGING OF FOOD IN POLYMERIC TRAYS

4. NATURE OF CHANGE ***(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)***

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME ***(Last, First, Middle Initial)***	**b. ORGANIZATION**	
c. ADDRESS ***(Include Zip Code)***	**d. TELEPHONE (*Include Area Code*)** **(1) Commercial** **(2) AUTOVON** ***(If applicable)***	**7. DATE SUBMITTED** ***(YYMMDD)***

8. PREPARING ACTIVITY

a. NAME U.S. Army Soldier Systems Command, Natick Research, Development, and Engineering Center	**b. TELEPHONE** ***(Include Area Code)*** **(1) Commercial** 508-233-5907 **(2) AUTOVON/DSN** 256-5907
c. ADDRESS ***(Include Zip Code)*** Commander, U.S. Army Soldier Systems Command, Natick Research, Development, and Engineering Center ATTN: SSCNC-WRE, Natick, MA 01760-5018	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** **Standardization Program Division** **5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466** **Telephone (703) 681-9340 AUTOVON 761-9340**