

MIL-B-44315(GL)

22 DEC 1987

MILITARY SPECIFICATION

BODY ARMOR, CHEST PLATE AND FACE SHIELD, EXPLOSIVE ORDNANCE DISPOSAL

This specification is approved for use by the U.S. Army Natick Research, Development, and Engineering Center, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This document covers body armor to be worn by ordnance disposal personnel.

1.2 Classification. The body armor, chest plate and face shield assembly shall be one type and in the following sizes (see 6.2):

Sizes

Small
Medium
Large

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Documents. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issue of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: U. S. Army Natick Research, Development, and Engineering Center, Natick, Ma 01760-5014 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 8470

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MIL-B-44315(GL)

SPECIFICATIONS

FEDERAL

- DDD-L-20 - Label: For Clothing, Equipage, And Tentage, (General Use)
- PPP-T-45 - Tape, Gummed, Paper Reinforced And Plain, For Sealing And Securing
- PPP-B-636 - Box, Shipping, Fiberboard

MILITARY

- MIL-P-116 - Preservation, Methods Of
- MIL-C-6799 - Coating, Sprayable, Strippable, Protective, Water Emulsion
- MIL-L-35078 - Loads, Unit: Preparation of Semiperishable Subsistence Items; Clothing, Personal Equipment and Equipage; General Specification For
- MIL-P-46593 - Projectile, Calibers .22, .30, .50 And 20mm Fragment-Simulating

STANDARDS

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
- MIL-STD-129 - Marking for Shipment And Storage
- MIL-STD-147 - Palletized Unit Loads
- MIL-STD-662 - V50 Ballistic Test For Armor
- MIL-STD-731- Quality of Wood Members for Containers and Pallets

FEDERAL

- FED-STD-406 - Plastics, Methods of Testing

DRAWINGS

U.S. ARMY NATICK RESEARCH, DEVELOPMENT, AND ENGINEERING CENTER

- 2-1-1977 - Chest Plate, Small Size
- 2-1-1978 - Chest Plate, Medium Size
- 2-1-1979 - Chest Plate, Large Size
- 2-1-1649 - Chart, Master, Chest Plate
- 2-1-1650 - Shield, Face
- 2-1-1651 - Face and Chest Protective Armor Assembly
- 2-1-1652 - Plate, Chest Protective Armor
- 2-1-1653 - Plate, Face Protective Armor

MIL-B-44315(GL)

(Copies of documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other 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 shall be those listed in the issues of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issues of the nongovernment documents which are current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- D 1003 - Haze and Luminous Transmittance of Transparent
Plastics, Test Method for
- D 3951 - Practice for Commercial Packaging

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

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

- Z87.1 - 1986 - Occupational and Educational Eye and Face
Protection, Practice for

(Application for copies should be addressed to the American National Standards Institute, Inc., 10 East 40th Street, New York, NY 10016).

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

2.3 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 shall take precedence. Nothing in this document however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.3, 6.2, and 6.4).

3.2 Guide samples. Samples, when furnished, are solely for guidance and information to the contractor (see 6.3). Variations from this document may appear in the samples, in which case the document shall govern.

MIL-B-44315(GL)

3.3 Materials and components. Materials and components shall be as specified on the applicable drawings and as specified herein (see 6.5). For materials or components for which it is stated "or equal", if the contractor proposes to use an item considered to be equal to the material or component specified, prior to its use the contractor shall furnish a sample of the material or component, with supporting data to the contracting officer for subsequent evaluation by the responsible military agency. The supporting data required shall prove the functional equivalence and design compatibility of the item proposed to be used.

3.3.1 Chest plate. The chest plate shall be constructed with the materials specified on Drawing 2-1-1652.

3.3.2 Face shield. The face shield shall be constructed with the materials specified on Drawing 2-1-1653.

3.3.3 Hardware. The hardware used in attaching the face shield to the chest plate shall be as specified on Drawing 2-1-1651.

3.4 Design and construction. The design and construction of the chest plate and face shield shall conform to the drawings listed in 2.1 and as specified herein.

3.4.1 Chest plate. The chest plate shall be a one piece construction composed of a minimum of 18 plies of impregnated fiberglass specified on Drawing 2-1-1652 bonded together with the low-pressure laminating polyester resin specified on Drawing 2-1-1652. The resin content shall be 18-22 percent by weight (see 4.4.1.5). The areal density of the finished chest plate shall not exceed that specified on Drawing 2-1-1652. The finished chest plate shall be free from blisters, torn fabric dents, crazing and surface roughness when inspected as specified in 4.4.2.1, 4.4.2.2 and 4.4.3. Glass fibers protruding along the edges shall be removed.

3.4.2 Face shield. The face shield shall be a sandwich type construction as shown on Drawing 2-1-1653. It shall consist of a UV stabilized urethane film sandwiched between 0.375 inch thick acrylic and 0.25 inch polycarbonate as specified on Drawing 2-1-1653. The completed face shield shall be laminated on both surfaces with the abrasion resistant coating specified on Drawing 2-1-1653. The face shield shall be symmetrical and formed so that the acrylic is facing outward. The surfaces of the completed face shield shall be: optically clear, smooth, uniform, free of sink marks, contain no distortions, cracks, roughness, or discoloration when inspected as specified in 4.4.3. There shall be no undulations, lenticulations, or stria, the shield shall be clear and show no presence of embedded air particles, grit, dirt, or other foreign matter throughout the thickness of the face shield when inspected as specified in 4.4.3.

MIL-B-44315(GL)

3.4.3 Holes for attachment of chest plate and face shield. Holes for attaching the chest plate and the face shield together shall be drilled and shall be as specified in Drawing 2-1-1651. There shall be no puncturing or tearing of the chest plate shell material when inspected as specified in 4.4.2. There shall be no chipping or cracking of the face shield when inspected as specified in 4.4.2.

3.4.4 Assembly of face shield to chest plate. Assembly of the face shield to the chest plate shall be as specified on Drawing 2-1-1651.

3.5 Performance

3.5.1 Ballistic resistance. The V_{50} ballistic limit for each chest plate or face shield shall be not less than 3600 feet per second for the chest plate and not less than 2050 feet per second for the face shield when tested as specified in 4.5.2.

3.5.2 Water immersion. The coating on the outside surface of the chest plate shall show no evidence of softening, peeling, or blistering when tested as specified in 4.5.3.

3.5.3 Optical requirements for face shield. The face shield shall conform to the applicable requirements of ANSI Z87.1-1986 except the requirements for prismatic power, haze, luminous transmittance, and astigmatism shall be as follows.

3.5.3.1 Prismatic power. Horizontal prismatic power shall not exceed 1.0 prism diopters (4.2 inch horizontal deviation) and vertical prismatic power shall not exceed 0.25 prism diopters (1.05 inch vertical deviation) for either of the two test positions when tested as specified in 4.5.4.1.

3.5.3.2 Prism imbalance. Horizontal prism imbalance shall not exceed 2.0 prism diopters (1.6 inch horizontal deviation) and the vertical prism imbalance shall not exceed 0.5 prism diopters (0.4 inch vertical deviation) when tested as specified in 4.5.4.2.

3.5.3.3 Haze. Haze shall not exceed 6 percent when tested as specified in 4.5.4.3.

3.5.3.4 Luminous transmittance. Luminous transmittance shall be 80 percent or greater for both of the two test positions when tested as specified in 4.5.4.4.

3.5.3.5 Astigmatism. Astigmatism shall not exceed 0.33 diopters for either of the two test positions when tested as specified in 4.5.4.5.

3.6 Repair. Except as otherwise specified herein, repairs are not allowed to be made to the body armor assembly.

MIL-B-44315(GL)

3.7 Replacement of defective components. During the spreading, cutting and manufacturing process, textile components having material defects or damages that are classified as defects in 4.4.1 and 4.4.2 shall be removed from production and replaced with non-defective components.

3.8 Identification marking. The manufacturer's code number, contract number, lot number, serial number, and date of manufacture, as well as the nomenclature, federal stock number, and size of the body armor assembly shall be permanently and legibly marked on the center of the face surface of each chest plate, at the lower end of the plate approximately 1 inch above the edge, in characters 1/4 inch high minimum. The above marking shall conform to type IV, class 9 of DDD-L-20. The fastness for the class 9 label shall be as specified for class 5 labels. A list in duplicate of the serial numbers used for each armor production lot shall be furnished the contracting officer at time of delivery.

3.9 Workmanship. The body armor assembly shall conform to the quality of product established by this document. The occurrence of defects shall not exceed the applicable acceptable quality levels (AQL).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, 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 this document where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this document shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the document shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Responsibility for dimensional requirements. Unless otherwise specified in the contract or purchase order, the contractor is responsible for assuring that all specified dimensions have been met. When dimensions cannot be examined on the end item, inspection shall be made at any point, or at all points in the manufacturing process necessary to assure compliance with all dimensional requirements.

MIL-B-44315(GL)

4.1.3 Certificates of compliance. When certificates of compliance are submitted, the Government reserves the right to inspect such items to determine the validity of the certification.

4.2 Classification of inspection. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.3).
- b. Quality conformance inspection (4.4).

4.3 First article inspection. When a first article is required (see 6.2), it shall be examined for the defects specified in 4.4.1.1, 4.4.1.2, 4.4.3 and 4.4.4 and tested for the characteristics specified in table I. The presence of any defect or failure to pass any test shall be cause for rejection of the first article.

4.4 Quality conformance inspection. Unless otherwise specified, sampling for inspection shall be performed in accordance with MIL-STD-105.

4.4.1 Component and material inspection. In accordance with 4.1, components and materials shall be inspected in accordance with all the requirements of referenced documents unless otherwise excluded, amended, modified, or qualified in this document or applicable purchase document.

4.4.1.1 Dimensional examination of chest plate component. The finished chest plate component shall be examined for conformance to the dimensional requirements specified on drawings 2-1-1977, 2-1-1978, 2-1-1979, 2-1-1649, and 2-1-1652. Any dimension that is not within the specified tolerance shall be classified as a defect. The lot size shall be expressed in units of chest plates. The sample unit shall be one completely fabricated chest plate. The inspection level shall be S-2 and the acceptable quality level (AQL), expressed in terms of defects per hundred units, shall be 6.5.

4.4.1.2 Dimensional examination of face shield component. The finished face shield component shall be examined for conformance to the dimensional requirements specified on drawings 2-1-1650 and 2-1-1653. Any dimension that is not within the specified tolerance shall be classified as a defect. The lot size shall be expressed in units of face shields. The sample unit shall be one completely fabricated face shield. The inspection level shall be S-2 and the acceptable quality level (AQL), expressed in terms of defects per hundred units, shall be 6.5.

4.4.1.3 Testing of chest plate component. Testing shall be performed on the finished chest plate component for the characteristics listed in table I. The lot size shall be expressed in units of fiberglass chest plates of one size only and shall not exceed 200. The sample unit shall be two fiberglass chest plates. One chest plate shall be used for ballistic testing and the other shall be used for water immersion testing. The sample sizes shall be as listed below. Failure of any test shall be cause for rejection of the lot.

MIL-B-44315(GL)

<u>Lot size</u>	<u>Sample size</u>
100 or less	1
101 up to and including 200	2

4.4.1.4 Testing of face shield component. Testing shall be performed on the finished face shield component for the characteristics listed in table I. The lot size shall be expressed in units of face shields of one size only and shall not exceed 200. The sample unit shall be two face shields of one size. One face shield shall be used for ballistic testing and the other shall be used for all optic tests. The sample sizes shall be as listed below. Failure of any test shall be cause for rejection of the lot.

<u>Lot size</u>	<u>Sample size</u>
100 or less	1
101 up to and including 200	2

TABLE I. Component testing

<u>Characteristic</u>	<u>Requirement paragraph</u>	<u>Test method</u>
Chest plate		
Ballistic resistance	3.5.1	4.5.2
Water immersion	3.5.2	4.5.3
Face shield		
Ballistic resistance	3.5.1	4.5.2
Prismatic power	3.5.3.1	4.5.4.1
Prism imbalance	3.5.3.2	4.5.4.2
Haze	3.5.3.3	4.5.4.3
Luminous transmittance	3.5.3.4	4.5.4.4
Astigmatism	3.5.3.5	4.5.4.5

4.4.1.5 Certification. The contractor shall furnish a certificate of compliance certifying the following.

- a. That all materials and components for which requirements are not covered by a Federal Specification, Military Specification or standard, conform to the requirements specified herein and on the applicable drawings.
- b. That the percent resin content is as specified in 3.4.1.
- c. That the areal density is as specified on Drawing 2-1-1652.

MIL-B-44315(GL)

4.4.2 In-process inspection. Inspection shall be made of the following operations and requirements to establish conformance to specified requirements. Whenever nonconformance is noted, correction shall be to the items affected and to the operation.

- a. Fiberglass cloth conforms to requirements on Drawing 2-1-1652.
- b. No puncturing or tearing of shell material (see 3.4.3).
- c. No chipping or cracking of face shield (see 3.4.3).

4.4.2.1 Visual examination of chest plate prior to finishing (immediately after molding). Every chest plate prior to the finishing operation shall be examined for any evidence of a blister or delamination. Any blister or delamination, as well as any evidence of a blister or delamination that was modified by any means after molding (see 3.4.1), shall be classified as a defect and the chest plate shall be rejected. At its discretion the Government may verify the results of the contractors examination by 100 percent examination or by sampling inspection.

4.4.2.2 Visual examination of chest plate prior to application of coating. The chest plate shall be examined for the defects listed below. The sample unit shall be one chest plate before application of coating (see Drawing 2-1-1652). The lot size shall be expressed in units of chest plates of one size only. The inspection level shall be II and the AQLs, expressed in terms of defects per hundred units, shall be 2.5 for major defects and 6.5 for total defects (major and minor defects combined).

NOTE: When an asterisk appears in the major defects column, the defect shall be classified as follows:

Major - When seriously affecting appearance or serviceability.

Minor - When not seriously affecting appearance or serviceability.

Examine	Defect	Classification	
		Major	Minor
Chest plate (exterior and interior)	Any fabric fibers visibly cut or raised on the shell body except along edge	*	
	Any surface dent, depression or area not smooth	*	
	Any delamination, pimple or blister	X	
	Any evidence of cracking	*	
	Any evidence of dry spot, any area of nonresin flow or other molding deficiency	*	
	Any raised pleat or wrinkle or crease (groove) longer than 1/2 inch but less than 1 inch		X
	Any raised pleat or wrinkle or any crease 1/2 inch or less in length that is not smooth		X

MIL-B-44315(GL)

Examine	Defect	Classification	
		Major	Minor
Chest plate (exterior and interior) (cont'd)	Any raised pleat or wrinkle or any crease 1 inch or longer	X	
	Any unauthorized repair or reworking	X	
	Any evidence of metallic fasteners	X	
	Any benchmarks omitted or obliterated <u>1/</u>		X

1/ There is a total of ten benchmarks, 5 inside and 5 corresponding benchmarks on the outside of the chest plate.

4.4.3 End item visual examination. The chest plate and face shield assemblies shall be examined for the defects listed in table II. The lot size shall be expressed in units of chest plates and face shields assemblies. The sample unit shall be one completely fabricated chest plate and face shield assembly (see Drawing 2-1-1651). The inspection level shall be II and AQL, expressed in terms of defects per hundred units, shall be 4.0 major and 10.0 total (major and minor defects combined).

TABLE II. End item visual defects

Examine	Defect	Classification	
		Major	Minor
Chest plate finish	Any scuffed area or scratch		X
	Thin film (shell showing through)		X
	Finish wet or tacky to the touch	X	
	Coating furrows, flakes or peels when scratched with fingernail		X
	Blemish, such as peeling, blistering or flaking	X	
	Not a smooth, uniform coating, i.e., run or sag affecting an area more than one square inch		X
	Foreign matter imbedded in or appearing on the finish, such as dirt, stain, oil or grease		X
	Color of finish not as specified		X
	Any unauthorized repair	X	

MIL-B-44315(GL)

TABLE II. End item visual defects (cont'd)

Examine	Defect	Classification	
		Major	Minor
Face shield	Not optically clear, i.e., discoloration, embedded air particles, grit, dirt or other foreign matter	X	
	Any Surface cracked, distorted, scuffed or scratched	X	
	Blemish, such as peeling, blistering or flaking	X	
	Not a smooth, uniform surface, i.e. undulations, lenticulations, stria or sink marks	X	
	Coating furrows, flakes or peels when scratched with fingernail	X	
	Any unauthorized repair	X	
Hardware	Any sharp edge or burr		X
	Any nut and screw not secured in the orientation specified in drawing 2-1-1651		X
	Any screw not securely tightened		X
	Any hardware missing or not as specified	X	
Identification markings	Not as specified or improper size		X
	Missing or illegible	X	

4.4.4 End item dimensional examination. Examination shall be made of the chest plate and face shield assembly for the dimensions specified on Drawing 2-1-1651. Any dimension not within specified requirements shall be classified as a defect. The lot size shall be expressed in units of chest plate and face shield assemblies. The sample unit shall be one completely fabricated chest plate and face shield assembly. The inspection level shall be S-2 and the AQL, expressed in terms of defects per hundred units, shall be 6.5.

4.4.5 Packaging examination. The fully packaged end item shall be examined for the defects listed below. The lot size shall be expressed in units of shipping containers. The sample unit shall be one shipping container fully packaged. The inspection level shall be S-2 and the AQL, expressed in terms of defects per hundred units, shall be 2.5.

MIL-B-44315(GL)

Examine	Defect
Marking (exterior and interior)	Omitted; incorrect; illegible; of improper size, location, sequence, or method of application.
Materials	Any component missing, damaged, or not as specified.
Workmanship	Inadequate application of components such as: incomplete sealing or closure of flap; improper taping, loose strapping or inadequate stapling. Bulged or distorted container.
Content	Number per container is more or less than required. Number of intermediate containers is more or less than required.

4.4.6 Palletization examination. The fully packaged and palletized end items shall be examined for the defects listed below. The lot size shall be expressed in units of palletized unit loads. The sample unit shall be one palletized unit load, fully packaged. The inspection level shall be S-1 and the AQL, expressed in terms of defects per hundred units, shall be 6.5.

Examine	Defect
Finished dimension	Length, width, or height exceeds specified maximum requirement.
Palletization	Pallet pattern not as specified. Load not bonded with required straps as specified.
Weight	Exceeds maximum load limit.
Marking	Omitted; incorrect; illegible; of improper size, location, sequence, or method of application.

MIL-B-44315(GL)

4.5 Method of inspection

4.5.1 Test conditions. Unless otherwise specified, all tests shall be performed at $73^{\circ} \pm 2^{\circ}\text{F}$ and 30 percent minimum up to 80 percent maximum relative humidity and the test samples shall be exposed to these conditions for at least 24 hours prior to the test.

4.5.2 Ballistic resistance test. The ballistic resistance test shall be conducted in accordance with MIL-STD-662 except as specified in 4.5.2.1. The fragment simulating projectile shall be the .22 caliber, type 2 conforming to MIL-P-46593 except as modified by Figure 1 of this document and it shall weight 17 ± 0.25 grains. Test reports shall contain all individual values utilized in expressing the V_{50} ballistic resistance for each chest plate and face shield. Failure of any chest plate and face shield to conform to the ballistic resistance requirements of 3.5.1 shall constitute a test failure.

4.5.2.1 Ballistic test method. The chest plate and face shield assembly shall be stored in the ballistic test chamber for not less than 24 hours prior to testing. The test area of the chest plate and face shield shall be any surface. The impact points shall be a minimum distance of 1-1/2 inches from each other. An impact shall be invalid if the impact causes delamination (chest plate) or cracking (face shield) which extends into the area of the previous impact. The chest plate or face shield shall be rigidly mounted with the area of impact normal to the line of fire. The witness plate shall be mounted 2 inches behind the area of impact.

4.5.2.1.1 Barrel. The barrel shall be a .22 caliber rifled barrel with a one-in-sixteen twist. The barrel length shall be 28 inches. The barrel shall be chambered to accommodate firing the specified sabot.

4.5.2.1.2 Yaw card measurement system. A yaw card shall be used to determine yaw. The following procedure shall be employed:

- a. Place the yaw card directly in front of the test sample with the emulsion side facing the sample (The yaw card will be devoid of any markings. Kodak photographic paper, single weight, Kodabromide, equal may be used for the yaw card.)
- b. After the test, the yaw card shall be carefully measured to determine the largest dimension of the hole caused by penetration of the projectile. An optical magnification device with a magnification between 5X and 10X shall be used for making this measurement. This measurement shall be compared to the X-axis of Graph on Figure 3. The Y-axis of Graph on Figure 3 will be used for determining the degree of the yaw.

MIL-B-44315(GL)

- c. Yaw shall be measured at intervals no less than those indicated below. When the barrel is new, a minimum of 25 shots shall be fired to "break-in" the barrel. Measurement of the yaw shall be five successful shots at each interval.

Measurement Interval

1. After minimum of 25 shots "break-in"
 2. After 250 shots
 3. After 500 shots
 4. After 750 shots
 5. After 1000 shots
 6. After 1000 shots; every 100 shots thereafter.
- d. In the event that any shot fired indicates yaw greater than 5, it shall not be used to calculate V₅₀ ballistic resistance and the barrel shall be discarded as unserviceable.
- e. In case of dispute concerning a particular barrel, yaw shall be measured by a photographic measurement system using a multiframe light source to determine projectile velocity and yaw. Yaw will be measured by the system to an accuracy of 0.5 degree.

4.5.2.1.3 Sabot. A sabot shall be used in loading and firing the projectile. The sabot shall be manufactured to conform to Figure 2. The projectile is to be loaded in such a manner that the whole body of the projectile is in the sabot except for the gas ring. The projectile shall be loaded so that the base of the projectile is in contact with the pusher plate (4.5.2.1.4).

4.5.2.1.4 Pusher Plate. A pusher plate shall be utilized and placed flush with the edge of the throat of the cartridge. The pusher plate shall have the following characteristics:

- a. Diameter - 0.304 inch (reference dimension)
- b. Thickness - 0.050 inch (reference dimension)
- c. Material - Aluminum, 7075T6 or 6061T6

MIL-B-44315(GL)

4.5.2.1.5 Location of rifle, triggering devices and target material. The following dimensions may be varied slightly to fit individual conditions and range arrangement but the accuracy of measurements must be maintained. The first triggering device shall be located 5 feet forward of the rifle muzzle and perpendicular to the trajectory of the projectile. The second triggering device shall be 10 feet forward of the rifle muzzle. It is mandatory that the 5 foot separation between the first and second triggering devices be maintained to a tolerance of 0.0125 inches. The test item shall be 12.5 feet forward of the rifle muzzle and perpendicular to the trajectory of the projectile.

4.5.2.1.6 Ballistic limit protection, BL(P). The BL(P) for each test target material shall be the average of 10 fair impact velocities consisting of the five lowest velocity complete penetrations and the five highest partial penetration velocities provided that the spread for the 10 velocities is no greater than 125 feet per second. In cases where the zone of mixed results (the highest partial penetration velocity is higher than the lowest complete penetration velocity) is greater than 125 feet per second, the BL(P) shall be the average of 14 fair impact velocities consisting of the seven lowest complete penetration velocities and the seven highest partial penetration velocities. If the 14-round limit cannot be attained within a velocity spread of 150 feet per second or less, retesting shall be required.

4.5.3 Water immersion of chest plate. The chest plate shall be immersed in tap water at 60° to 80°F for 16 hours minimum. At the expiration of this time, the chest plate shall be removed and allowed to air dry or by forced air drying under the same temperature conditions. The coating on the outside surface of the chest plate shall be examined for compliance with the water immersion requirements of 3.5.2 and failure to conform to the water immersion requirements shall constitute a test failure.

4.5.4 Test method for optical requirements for face shield. The face shield shall be tested as follows for compliance to the optical requirements of 3.5.3.

4.5.4.1 Prismatic power. The face shield shall be tested for prismatic power with a telescope of $8 \pm .5$ power which has an effective aperture of .74 inches and is equipped with crosshairs in the focal plane of the ocular. The telescope is to be focused on an illuminated dot at a distance of 420 inches (35 feet) from the telescope objective. The telescope shall be so aligned that the image of the dot falls on the intersection of the crosshairs in the focal plane of the ocular. Prismatic power shall be measured in two locations on each face shield. The two locations correspond to the viewing axis of each eye when the face shield is worn. These points are 9 inches from the bottom of the face shield, 2.52 inches apart and centered in the horizontal plane of the face shield. Each of the two test positions is held in front of the objective lens of the telescope such that the usual visual axis in the as worn position is parallel to the telescope. The deviation of the crosshairs from the dot is measured in both the horizontal and vertical directions. These two measurements (vertical and

MIL-B-44315(GL)

horizontal deviation) are the result of horizontal and vertical prismatic power in the face shield and shall be expressed in prism diopters. Failure of either test position on the face shield to conform to the prismatic power requirements of 3.5.3.1 shall constitute a test failure.

4.5.4.2 Prism imbalance The face shield shall be placed on an Alderson 50th percentile male headform in an "as worn" position in the optical system shown in Figure 4. Referring to Figure 4, the lens (L) shall be located at a distance of 78.7 inches in front of the image plane (IP). The aperture plate (AP) is placed between the lens (L) and the face shield. The separation of the two apertures in the aperture plate (AP) shall be 2.52 inches, which corresponds to the average Inter-Pupillary distance (PD) used for the face shields. Since the lens (L) has a focal length of 39.4 inches the distance from the plate (P) to the lens (L) shall be approximately 78.7 inches. The plate (P) with its pinhole aperture shall be adjusted so that one image is formed in the image plane (IP) when no face shield is on the headform. After the plate (P) with its pinhole aperture has been sharply imaged in the image plane (IP) without the face shield in the system, no component spacing shall be changed for the duration of the test. The position of that image shall be marked or noted and will be called P_0 . After the face shield has been placed in the system, two images will usually be seen in the image plane. In the case of a face shield having zero prism imbalance, only one image may be seen in the image plane while in the usual case two images will be seen. By blocking beams from each of the two eye positions, it can be determined which images come from the left and right eye and the position of these images will be called P_L and P_R respectively. Distances between images are measured from their centers. The horizontal distance between the two images is the result of horizontal prism imbalance in the face shield and the vertical distance between the two images is the result of vertical prism imbalance in the face shield and both shall be expressed in prism diopters. Failure of the face shield to conform to the prism imbalance requirements of 3.5.3.2 shall constitute a test failure.

4.5.4.3 Haze. The face shield shall be measured for percent haze in accordance with the FED-STD-406, Method 3022 for Haze and Luminous Transmittance of Transparent Plastics, ASTM D 1003. The measurement shall be for CIE Illuminant A. Failure of the face shield to conform to the haze requirements of 3.5.3.3 shall constitute a test failure.

4.5.4.4 Luminous transmittance. The luminous transmittance for the face shield shall be determined by the use of a spectrophotometer and calculation listed below using appropriate weighting factors given in Table III. Luminous transmittance shall be measured in two locations on each face shield. These two locations shall be as specified in 4.5.4.1 and correspond to the viewing axis of each eye when the face shield is worn. Since transmittance values can be affected by the choice of wavelength steps used for numerical integration, it is necessary to measure every 10nm between 380nm and 760nm so as to yield accurate results. Luminous transmittance shall be determined by weighing spectrophotometer data with luminous sensitivity values for the CIE 1931 observer and CIE

MIL-B-44315(GL)

Illuminant A emittance values. These weighting factors are given in Table III. Failure of either test position on the face shield to conform to the luminous transmittance requirements of 3.5.3.4 shall constitute a test failure.

$$\text{Luminous transmittance (\%)} = T_1 = \frac{\int_{380}^{760} T(\lambda) \bar{y}(\lambda) S(\lambda) d\lambda}{\int_{380}^{760} \bar{y}(\lambda) S(\lambda) d\lambda}$$

TABLE III. Weighting factors for luminous transmittance.

Values of Spectral Luminous Sensitivity $\bar{y}(\lambda)$ for the CIE 1931 Standard Colorimetric Observer

Values of Relative Spectral Emittance $S(\lambda)$ for CIE Illuminant A

(nm)	$\bar{y}(\lambda)$	$S(\lambda)$	(nm)	$\bar{y}(\lambda)$	$S(\lambda)$
380	0.0000	9.80	580	0.8700	114.44
390	0.0001	12.09	590	0.7570	121.73
400	0.0004	14.71	600	0.6310	129.04
410	0.0012	17.68	610	0.5030	136.35
420	0.0040	20.99	620	0.3810	143.62
430	0.0116	24.67	630	0.2650	150.84
440	0.0230	28.70	640	0.1750	157.98
450	0.0380	33.09	650	0.1070	165.03
460	0.0600	37.81	660	0.0610	171.96
470	0.0910	42.87	670	0.0320	178.77
480	0.1390	48.24	680	0.0170	185.43
490	0.2080	53.91	690	0.0082	191.93
500	0.3230	59.86	700	0.0041	198.26
510	0.5030	66.06	710	0.0021	204.41
520	0.7100	72.50	720	0.0010	210.36
530	0.8620	79.13	730	0.0005	216.12
540	0.9540	85.95	740	0.0002	221.67
550	0.9950	92.91	750	0.0001	227.00
560	0.9950	100.00	760	0.0001	232.12
570	0.9520	107.18			

All data from Publication CIE
No. 15 (E-1.3.1.) 1971
"COLORIMETRY"

MIL-B-44315(GL)

4.5.4.5 Astigmatism. The face shield shall be tested for astigmatism with a telescope of $8 \pm .5$ power which has an objective lens with a clear aperture of .74 inches. The telescope is to be focused on an illuminated test chart depicted in figure 5 at a distance of 420 inches (35 feet) from the telescope objective. Astigmatism shall be measured in two locations on each face shield. These two locations shall be as specified in 4.5.4.1 and correspond to the viewing axis of each eye when the face shield is worn. Each of the two locations shall be mounted in front of the objective lens of the telescope such that the usual visual axis in the as worn position is parallel to the axis of the telescope. The telescope is focused on the radial lines until they appear as sharp as possible. Two possibilities may occur. If all radial lines appear equally well-focused ("sharp") at the same position of the telescope eyepiece, the face shield has no measurable astigmatism. If lines in only one meridian appear sharpest at a given focus, then the telescope is refocused to determine best focus for lines in the meridian which yield an extreme (maximum or minimum) power reading. This power reading is noted. The telescope is then refocused for lines in the meridian which yield the opposite extreme power reading. This reading is also noted. The absolute difference in the two extreme power readings expressed in diopters is the astigmatism. Failure of either test position on the face shield to conform to the astigmatism requirements of 3.5.3.5 shall constitute a test failure.

5. PACKAGING

5.1 Preservation. Preservation shall be level A or Commercial, as specified (see 6.2).

5.1.1 Level A. The chest plate shall be cleaned and preserved in accordance with methods C-1 and III of MIL-P-116. The face shield shall be cleaned and preserved with a protective coating conforming to type I, class 1 of MIL-C-6799. The face shield portion shall be covered by a cotton flannel bag, which shall be secured in place. The assembly shall then be unit packed in a one-piece folder box conforming to type CF (variety SW) or SF, class domestic, grade 200 of PPP-B-636. The inside dimensions of the box shall be approximately 24-1/2 inches in length, 20 inches in width and 9-3/4 inches in depth. The box shall be closed with 2-inch minimum width gummed tape conforming to type III, grade A of PPP-T-45.

5.1.2 Commercial. Each assembly shall be preserved in accordance with ASTM D-3951.

5.2 Packing. Packing shall be level A, B, or Commercial, as specified (see 6.2).

5.2.1 Level A. One assembly, preserved as specified, shall be packed in a fiberboard box conforming to type RSC, grade V2s of PPP-B-636. The inside dimensions of the box shall be approximately 24-5/8 inches in length, 20-1/8 inches in depth and 10 inches in height. Each shipping container shall be closed in accordance method III, waterproofed in accordance with method V and

MIL-B-44315(GL)

reinforced as specified in the appendix of PPP-B-636, except that the inspection shall be in accordance with 4.4.5. Shipping containers shall be arranged in unit loads in accordance with MIL-L-35078 for the type and class of the load specified (see 6.2). Strapping shall be limited to nonmetallic strapping, except for type II, class F loads.

5.2.2 Level B. One assembly, preserved as specified, shall be packed in a fiberboard box conforming to style RSC, type CF (variety SW) or SF, class domestic, grade 275 of PPP-B-636. The inside dimensions shall be as specified in 5.2.1. Each shipping container shall be closed in accordance with method II as specified in the appendix of PPP-B-636, except that the inspection shall be in accordance with 4.4.5.

5.2.2.1 Weather-resistant fiberboard container. When specified (see 6.2), the shipping container shall be grade V3c, V3s or V4s fiberboard box fabricated in accordance with PPP-B-636, except that the inspection shall be in accordance with 4.4.5.

5.2.3 Commercial. One assembly, preserved as specified, shall be packed in accordance with ASTM D 3951.

5.3 Palletization. When specified (see 6.2), assemblies packed as specified in 5.2.2 and 5.2.3, shall be palletized in accordance with load type 1 of MIL-STD-147. Pallet type shall be type I (4-way entry), type IV or V in accordance with MIL-STD-147. Pallets shall be fabricated from wood groups I, II, III or IV of MIL-STD-731. Each prepared load shall be bonded with primary and secondary straps in accordance with bonding means K and L or film bonding means O or P. Pallet pattern shall be number 90 in accordance with the appendix of MIL-STD-147.

5.4 Marking. In addition to any special marking required by the contract or purchase order, unit packs, shipping containers, and palletized unit loads shall be marked in accordance with MIL-STD-129 or ASTM D 3951, as applicable.

6. NOTES

6.1 Intended use. The chest plate and face shield are intended for use as part of the Bomb Disposal Suit used by ordnance disposal personnel.

6.2 Ordering data. Acquisition documents should specify the following:

- a. Title, number and date of this document.
- b. Body armor, chest plate and face shield assembly size required (see 1.2).
- c. When a first article sample is required (see 3.1).
- d. Selection of applicable levels of preservation and packing (see 5.1 and 5.2).
- e. Type and class of unit load required (see 5.2.1).
- f. When weather-resistant grade fiberboard shipping containers are required for level B packing (see 5.2.2.1).
- g. When palletization is required (see 5.3).

MIL-B-44315(GL)

6.3 Sample. For access to samples, address the contracting activity issuing the invitation for bids.

6.4 First article. When a first is required, it shall be inspected and approved under the appropriate provisions of FAR 52.209. The first article should be a preproduction sample. The contracting officer should specify the appropriate type of first article and the number of units to be furnished. The contracting officer should include specific instructions in all acquisition instruments regarding arrangements for selection, inspection, and approval of the first article.

6.5 Recycled material. It is encouraged that recycled material be used when practical as long as it meets the requirements of this document (see 3.3).

6.6 Subject term (key word) listing.

Armor, body
Body Armor
Disposal, Explosive Ordnance

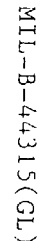
Custodian:

Army - GL

Preparing activity:

Army - GL

Project No. 8470-0120



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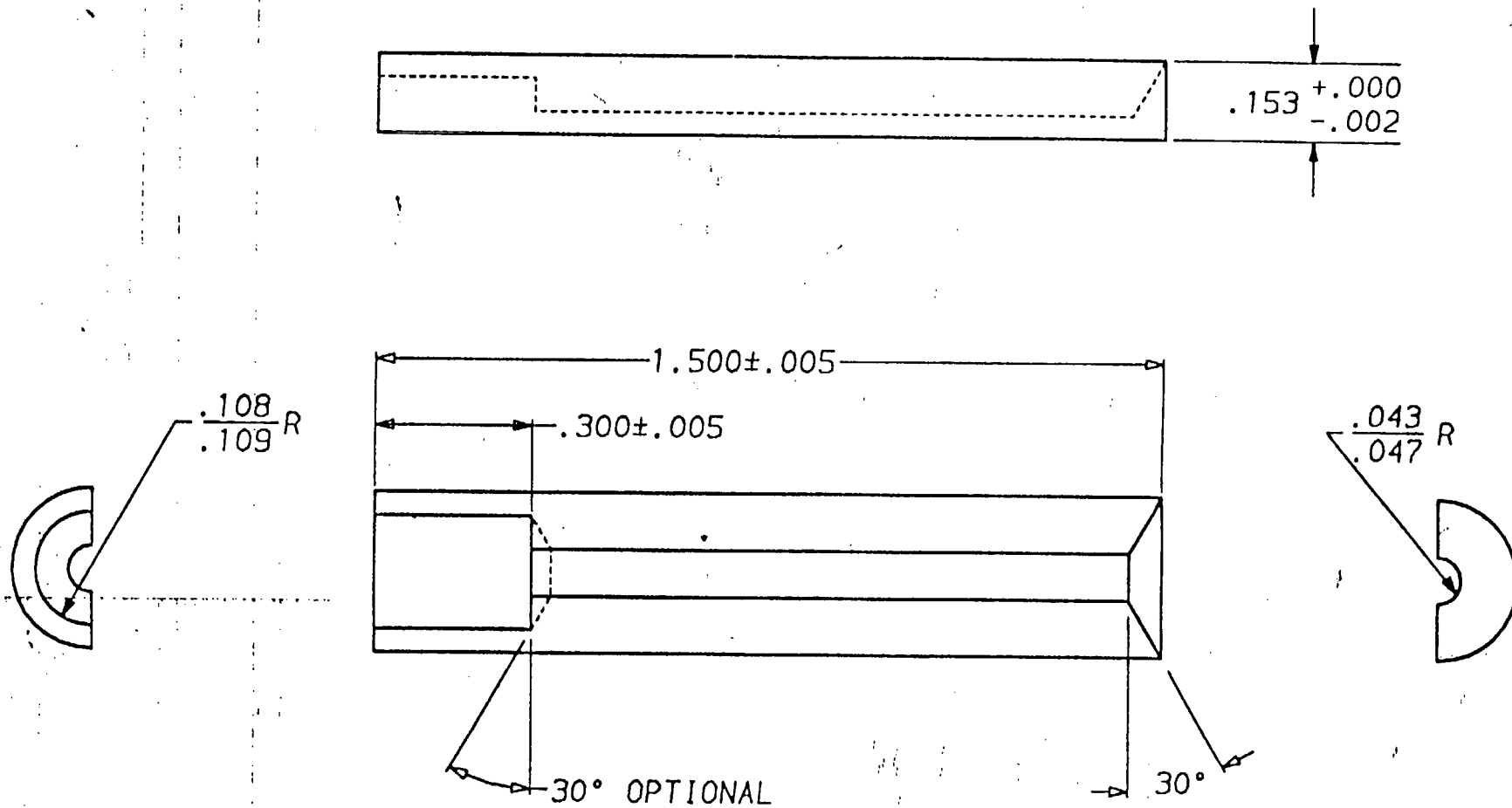
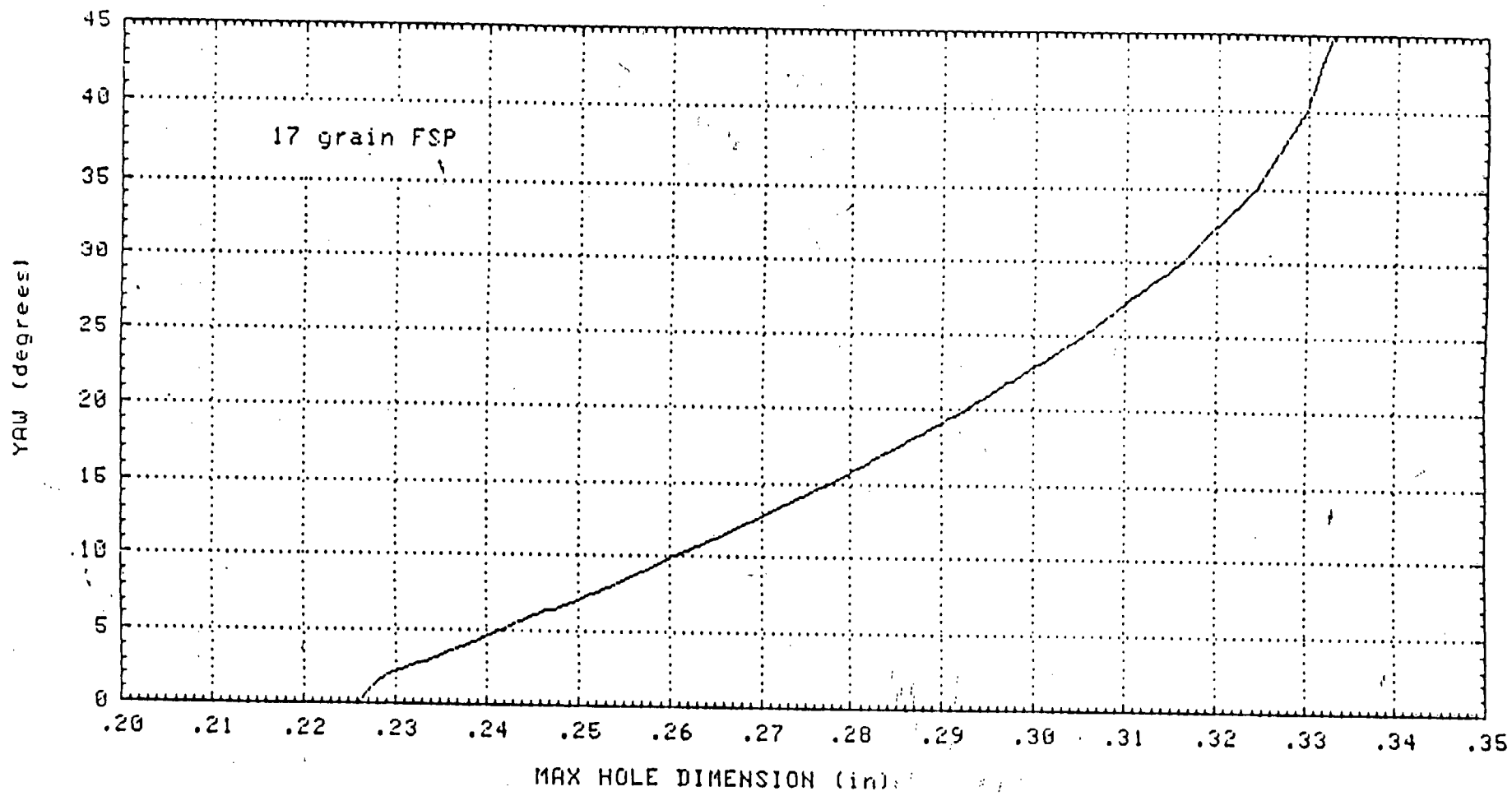


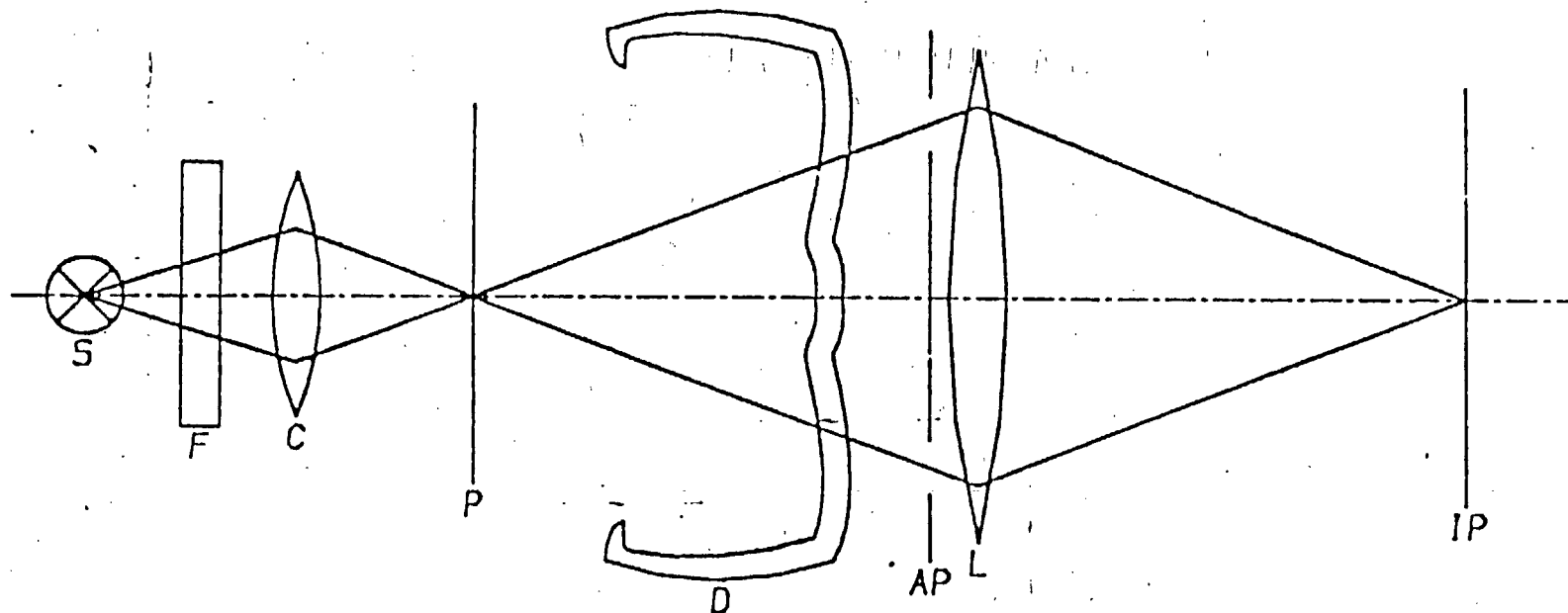
FIGURE 2. SABOT FOR 17 GRAIN FSP (FRAGMENT SIMULATED PROJECTILE)
 INJECTION MOLDED, TWO HALVES
 MATERIAL: POLYCARBONATE
 DIMENSIONS ARE IN INCHES

8-2-882

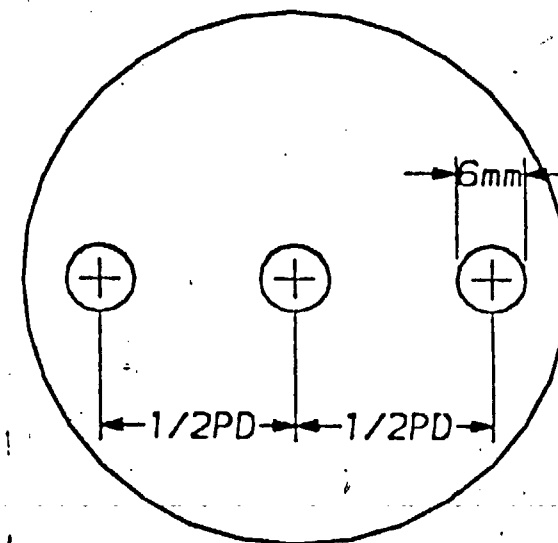


MIL-B-44315(GL)

FIGURE 3 PROJECTILE YAW VERSAS MAXIMUM HOLE DIMENSION

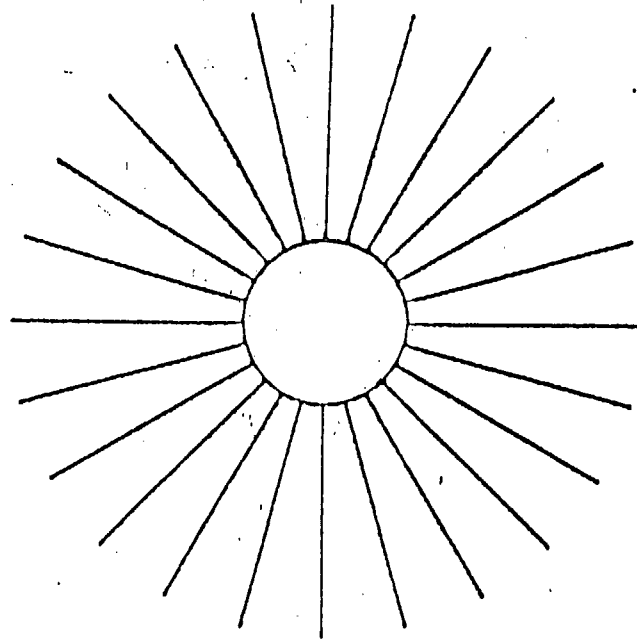


- S - SMALL TUNGSTEN LIGHT SOURCE
 F - INTERFERENCE FILTER, 2 MAX 590 ± 20 nm
 C - CONDENSOR LENS
 P - PLATE WITH 0.5mm DIAMETER HOLE
 D - EYE PROTECTOR MOUNTED ON HEADFORM
 (HEADFORM NOT SHOWN)
 AP - APERTURE PLATE WITH TWO OUTER APERTURES
 SEPARATED BY THE PUPILLARY DISTANCE (PD) OF
 THE PROTECTOR
 L - LENS OF 1000mm FOCAL LENGTH AND 80 mm DIAMETER
 IP - IMAGE PLANE



APERTURE PLATE

FIG. 4; APPARATUS FOR PRISM IMBALANCE TEST



NOTE, THE DIAMETER OF THE CIRCLE IS 1.05 INCHES.
THE RADIAL LINES ARE EQUISPACED ANGULARLY
EVERY 15° AND EXTEND OUT 1.5 INCHES FROM
CIRCLE.

FIGURE 5. TEST PATTERN FOR DETERMINATION OF ASTIGMATISM

2-1-1980