

MIL-H-83147 (USAF)
24 June 1968

MILITARY SPECIFICATION
HELMET SHELL, FLYING, HGU-22/P

1. SCOPE

1.1 Scope. This specification covers one type of protective helmet shell designated HGU-22/P.

1.2 Classification. The helmet shell shall be furnished in size medium, large, or extra large, as specified (see 6.2).

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.

SPECIFICATIONS

Military

MIL-P-9400 ✓	Plastic Laminate Materials and Sandwich Construction, Glass Fiber Base, Low Pressure Aircraft Structural, Process Specification Requirements
MIL-P-19644 ✓	Plastic Foam, Molded Polystyrene, (Expanded Bead Type)
MIL-P-25421 ✓	Plastic Materials, Glass Fiber Base-Epoxy Resin, Low Pressure Laminated

STANDARDS

Federal

FED-STD-595 ✓	Colors
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Military

MIL-STD-105 ✓	Sampling Procedures and Tables for Inspection by Attributes
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DRAWINGS

Air Force

64A2217	Pads Fitting, Flying Helmet
64B2228	Fastener Tapes, Crown Pad

FSC 8475

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64B2229	Fastener Tapes, Front Pad
64B2230	Fastener Tapes, Back Pad
64C2231	Template - Marking Tape Location, Crown
64C2232	Template - Marking, Fastener Tape Location, Front Pad
64C2233	Template - Marking, Fastener Tape Location, Back Pad
68H274	Helmet Shell, Flying, HGU-22/P Assembly of

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Qualification. The helmet shell furnished under this specification shall be a product which is qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.4 and 6.3).

3.2 Components. The helmet shell shall consist of the following components:

- (a) Shell (see 3.6.1)
- (b) Energy absorbing liner (see 3.6.2)
- (c) Front edge pad (see 3.6.3)
- (d) Shell edge bead (see 3.6.4)
- (e) Chin strap (see 3.6.5)
- (f) Nape strap (see 3.6.5).

3.3 Materials. The materials used in the fabrication and assembly of helmet shell components shall comply with the requirements of specifications referenced on the applicable drawings and as specified herein. Materials, which are not specifically designated or which are offered as equivalent to specified manufacturer's part numbers, shall require approval by the procuring activity.

3.3.1 Shell. The shell shall be a glass fabric reinforced-epoxy resin laminate conforming to type I, class 1, fabric number 181 or 181-150 of MIL-P-25421. The surface coating shall be an epoxy paint, color white conforming to 17875 of FED-STD-595.

3.3.2 Liner. The energy absorbing liner shall be fabricated from expandable polystyrene plastic foam conforming to type N of MIL-P-19644 and having a density of 2 (plus 0.5, minus 0) pounds per cubic foot. The inner surface (concave side) of the liner shall be given two coats of white shellac or water thinned white latex coating which will not collapse, soften, or visibly affect the foam structure and which will form a suitable base for adhesion of the fastener tapes to the liner.

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3.3.3 Adhesives. The adhesives shall meet the applicable performance requirements specified under 3.5. The adhesive for bonding the edge bead to the shell shall be a synthetic-rubber-base, curing type. The adhesive for bonding the front edge pad to the shell shall be a rubber-base type and shall not loosen when subjected to heat exposure (see 3.5.4).

3.4 Design and construction. The design and construction of the helmet shell shall be in accordance with Drawing 68H274, the applicable detail drawings, and as specified herein.

3.4.1 Visor hardware. The flanged nuts with washers shall be installed in the visor mounting holes as shown on Drawing 68H274.

3.4.2 Fastener tape installation. The fastener tapes specified on Drawings 64B2228, 64B2229, and 64B2230 shall be securely bonded to the inside surface of the liner. The front tapes shall extend over the front edge pad as determined with the marking template. The position of the tapes shall be determined by marking each tape location as follows:

(a) **Front tapes:** Using a template conforming to Drawing 64C2232, position point A on the centerline at lower edge of the front edge pad and point B on the centerline of the liner. Fit the template against the surface, and mark the six tape locations as indicated by the heavy lines.

(b) **Crown tapes:** Using a template conforming to Drawing 64C2231, position points A and B on the longitudinal centerline and points C and D on the lateral centerline of the liner. Point A shall be towards the front of the helmet shell. Mark the two tape locations as indicated.

(c) **Back tapes:** Using a template conforming to Drawing 64C2233, position points A and B on the centerline of the liner with point A at the bottom edge. Mark the six tape locations as indicated.

3.4.2.1 Alternate marking method. As an option the contractor may mark the tape locations on the liner by means of thin raised beads placed on the liner during the molding process, provided that the locations marked correspond with those of the marking templates referenced herein.

3.5 Performance

3.5.1 Fastener tape bond. The adhesive for bonding the fastener tapes to the liner shall contain no solvents that dissolve or soften the liner material and shall meet the bonding requirements when tested as specified in 4.6.1.

3.5.2 Edge bead bond. The adhesive for bonding the edge bead to the shell shall meet the bonding requirements when tested as specified in 4.6.2.

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3.5.3 Shell finish adhesion. The coating for the shell finish specified in 3.6.1.1 shall exhibit good adhesion.

3.5.4 Heat exposure. When subjected to heat exposure, the helmet shell shall not change in weight more than 1 percent nor shall there be a change in distance between the shell center reference dimples greater than 1/4 inch. No other change affecting appearance or serviceability nor visible distortion of the components shall take place as a result of the heat exposure.

3.5.5 Penetration resistance. When tested as specified in 4.6.5, the total protrusion of the impact bob into the helmet shall not exceed a depth of 1/4 inch at any test point.

3.5.6 Impact performance. When the helmet shell is tested as specified in 4.6.6, there shall be no evidence of bottoming and the acceleration shall not exceed 400g.

3.5.7 Liner adhesive compatibility. The adhesive for bonding the energy absorbing liner to the shell shall be compatible with the liner and shall contain no solvents that will dissolve or soften the liner material.

3.6 Details of components

3.6.1 Molded shell. The shell shall be comprised of a minimum of five plies of reinforcing material throughout, plus any additional plies required to insure adequate strength to meet performance requirements. The patterns for and orientation of adjacent plies shall be determined by the contractor and referenced in the shell process specification. The shell shall be a semi-void-free laminate and shall contain no defects which exceed those defined under the paragraph entitled "Defects" of MIL-P-9400. The molded shell shall conform in shape and contour to the applicable detail drawing. The thickness of the shell shall be within a range 0.048 and 0.078 inch, except that a maximum of 0.095 inch shall be permitted in areas of the laminate where reinforcing material is overlapped.

3.6.1.1 Finishing. The molded shell shall be trimmed to the specified edge contour and all holes cleanly punched or drilled at the required locations. All flash shall be removed. The exterior surface shall be cleaned and smoothed. The edge shall be sanded to remove sharp surfaces. The exterior surface shall be primed and then coated with a white epoxy paint that will meet the adhesion requirement specified in 3.5.3. After drying, the paint finish shall be smooth, and the color and gloss shall conform to 17875 of FED-STD-595.

3.6.2 Energy absorbing liner. The energy absorbing liner shall be molded in one piece to fit the inside contour of the shell as shown on applicable detail drawings. The molded liner shall conform to the requirements of MIL-P-19644. To facilitate installation and assure intimate contact between the shell and liner surfaces, the liner may be split along its longitudinal or lateral centerlines. The liner shall be properly centered with and bonded to the shell. The front and back edge contours of the shell and liner shall be aligned as specified on the applicable drawings. When the

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liner is installed, there shall be no gaps more than 1/8 inch between the shell and liner or between the split sections of the liner.

3.6.3 Front edge pad. The front edge pad shall be fabricated in accordance with the applicable detail drawing and bonded in place between the shell and liner edge contours as shown on the Drawing 68H274. There shall be no gaps between the edge pad and liner after installation.

3.6.4 Shell edge bead. The shell edge bead shall be fabricated in accordance with the detail drawing and bonded to the shell edge contour as shown on Drawing 68H274.

3.6.5 Chin strap and nape strap. The chin strap and the nape strap shall be fabricated in accordance with the applicable detail drawings and installed on the helmet shell as shown on the Drawing 68H274. Thread adhesive shall not be used on the mounting screws and nuts when assembling these straps on the shell.

3.7 Identification of product. Each helmet shell shall have a permanent type label applied to the exterior surface, at the back, approximately 1/2 inch above the edge bead. The label shall be 1 by 2 inches (approximately) and shall include the following printed information:

HELMET SHELL, FLYING, HGU-22/P

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Size 1/

Contract Number 1/

Contractor's Name 1/

1/ The contractor shall insert the applicable data.

3.8 Workmanship. Workmanship shall be in accordance with high grade practices for the processes involved. The helmet shell shall be clean and well finished. All components shall be within allowable dimensional tolerances, correctly assembled, and functional.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 supplies and services conform to prescribed requirements.

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4.2 Classification of tests. The inspection and testing of the helmet shells shall be classified as follows:

- (a) Qualification tests
- (b) Quality conformance tests.

4.3 Test conditions. Unless otherwise specified, all tests shall be performed at 73° (plus or minus 2°) Fahrenheit and 50 (plus or minus 4) percent relative humidity.

4.4 Qualification tests. Qualification tests shall consist of the examinations and tests specified in table I, conducted in the sequence listed therein on the specified test sample.

TABLE I. Qualification Tests

Test Number	Test Sample	Characteristic	Test Method
1	D	Dimensional examination (see 3.6 and 3.8)	4.5.1.2 and 4.5.1.2.1
2	D (liner)	Fastener tape bond (see 3.5.1)	4.6.1
3	A	Shell finish adhesion (see 3.5.3)	4.6.3
4	A	Edge bead bond (see 3.5.2)	4.6.2
5	B	End item examination (see 3.6 and 3.8)	4.5.1.3
6	B	Heat exposure (see 3.5.4)	4.6.4
7	A	Penetration resistance (see 3.5.5)	4.6.5
8	C	Impact performance (see 3.5.6)	4.6.6

4.4.1 Qualification test samples. The qualification test samples shall consist of the following items of each helmet shell size for which qualification is to be determined.

- (a) Three HGU-22/P helmet shells that are completely finished and assembled in accordance with this specification and the applicable drawings and are designated samples A, B, and C for reference purposes.

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(b) The following group of components shall be designated as sample D:

1 each	Molded shell, completely finished except not painted
1 each	Energy absorbing liner
1 each	Front edge pad
1 each	Edge bead
1 each	Chin strap assembly with installation hardware
1 each	Nape strap assembly with installation hardware
1 set	Fastener tapes, front, crown, and back
6 each	Flanged nut and washer (visor installation).

4.5 Quality conformance tests. Quality conformance tests shall consist of the sampling examinations and tests specified herein.

4.5.1 Sampling examinations. The sampling examinations shall be in accordance with MIL-STD-105.

4.5.1.1 Materials and hardware. The hardware such as screws, nuts, washers, eyelets, grommets, and washers and the materials used in the fabrication and assembly of the helmet shell components shall be inspected and tested in accordance with the requirements of referenced specifications, standards, and drawings. A certificate of compliance will be acceptable for these requirements.

4.5.1.2 Helmet shell components. The sample unit for the dimensional examination of helmet shell components shall be as specified in table II. The inspection level for this dimensional examination shall be S-1 of MIL-STD-105, and the acceptable quality level (AQL) shall be 2.5 defects per 100 units (dhu). The helmet shell components specified in table II shall be examined for compliance with dimensions required by the applicable drawing. Any dimension not within the allowable tolerance shall be classified as a defect.

TABLE II. Sample Unit for Dimensional Examination

Component	Sample Unit
Molded shell, unpainted	1
Shell edge bead	1
Energy absorbing liner	1
Front edge pad	1
Chin strap assembly	1
Nape strap assembly	1
Fastener tapes (front, crown, and back)	1 complete set

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4.5.1.2.1 Molded shell. The dimensional examination of the unpainted molded shell (see table II) shall be in accordance with the following:

(a) Check all hole sizes and locating dimensions for compliance with specified tolerances.

(b) Check the shell thickness at four random locations along the edge contour and at six widely scattered locations in each half of the shell (right and left). The average thickness shall be within the limits specified in 3.6.1.

(c) Check the overall shell length at the Y-Y axis and overall shell width at the center reference dimples. Each dimension shall be within $\pm 1/4$ inch of the specified total value.

(d) Check the overall shell width at the front edge contour at the following specified stations. Each dimension shall be within $\pm 1/4$ inch of the specified total value.

Size medium: Stations 6.850 and 8.850

Size large: Stations 7.625 and 9.625

Size extra large: Stations 7.625 and 9.625.

4.5.1.3 End item examination. The end item shall be examined for defects. The sample unit for this examination shall be one complete helmet shell. The inspection level for this examination shall be II of MIL-STD-105, and the AQL shall be 2.5 dhu for major defects and 10 dhu for minor defects. The defects found in the end item shall be classified as specified in table III. Any defect not listed in table III but which in the opinion of inspection personnel adversely affects helmet performance or appearance shall be classified major or minor in accordance with MIL-STD-105 and scored accordingly.

4.5.2 Sampling tests

4.5.2.1 End item tests. The end item shall be tested for the characteristics listed in table IV. The sample size shall be one complete helmet shell from each lot of 500 or fraction thereof. The lot shall be unacceptable if the sample fails to meet any test requirement specified.

4.5.2.2 Liner adhesive tests. Each batch of adhesive to be used for adhering the liner to the molded shell shall be tested, in accordance with 4.6.7, for compatibility with the liner material prior to use.

4.6 Test methods

4.6.1 Fastener tape bond. Inner fitting pads conforming to Drawing 64A2217 (see 6.4) shall be firmly pressed in place over the fastener tapes at the front, crown, and back of the liner. The pads shall then be separated from the liner by peeling apart. The fitting pad installation and peeling sequence shall be performed twenty-five times. All fastener tapes shall be examined, and any tape which has loosened more than 25 percent of its total area shall constitute failure to meet the bonding requirements.

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TABLE III. Classification of Defects

Defect	Major	Minor
<u>Helmet Shell</u>		
Any visor installation nut missing	x	
Shell visibly warped or distorted	x	
Color not uniform over total surface of shell	x	
Reference dimple not discernible	x	
Gloss of finish less than standard color chip		x
Orange peel, runs, or sags in paint		x
Scratched, scuffed, or abraded areas on shell surface		x
Identification label missing or illegible		x
Identification label not permanent type		x
<u>Shell Edge Bead</u>		
Edge bead not securely adhered to helmet shell	x	
Tears, cracks, or holes in beading	x	
Color or surface defects adversely affecting appearance		x
<u>Chin Strap or Nape Strap</u>		
Any grommet or eyelet missing or insecurely set	x	
Snap fastener incorrectly installed for opening	x	
Snap fastener components insecurely set	x	
Screws bind in nuts precluding easy removal	x	
Loose stitching, skipped stitches, or not backstitched	x	
Ends of webbing not seared		x
Lacing cord on nape strap not seared		x
Frayed thread ends		x
Buckle tab on chin strap missing		x
Soiled or stained areas		x
<u>Energy Absorbing Liner</u>		
Liner not properly aligned in helmet shell	x	
Any gaps between liner and shell exceeding 1/8 inch	x	
Inner surface of liner not coated	x	
Any fastener tape missing	x	
Centerline beads not discernible		x
Size code letter not discernible		x
Liner not uniformly bonded to shell		x
Soiled or stained areas		x
<u>Front Edge Pad</u>		
Any gap between edge pad and liner exceeding 1/8 inch	x	
Edge pad not properly centered and aligned with edge of shell	x	
Edge pad not securely bonded to shell		x
Soiled or stained areas		x

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TABLE IV. Sampling Tests

Characteristic	Test Method
Heat exposure (see 3.5.4)	4.6.4
Penetration resistance (see 3.5.5)	4.6.5
Shell finish adhesion (see 3.5.3)	4.6.3
Edge bead bond (see 3.5.2)	4.6.2
Fastener tape bond (see 3.5.1)	4.6.1
Impact performance (see 3.5.6) <u>1/</u>	4.6.6

1/ Impact performance tests shall be performed only when specified by the procuring activity (see 6.2).

4.6.2 Edge bead bond. The adhesion of the edge bead to the shell shall be determined by visual and manual inspection of the edges of the beading on both the inner and outer surfaces of the shell. An area of the bead is unbonded when the edge can be rolled back away from the shell by the ball of the thumb or finger. Any individual unbonded area longer than 1/2 inch or wider than 1/8 inch or a total of unbonded areas exceeding 2 inches in length shall constitute failure to pass this test.

4.6.3 Shell finish adhesion. With a scribe held at approximately a 30-degree angle, three parallel lines 1/16 inch apart shall be cut on the painted surface of the painted shell. These lines shall be crossed at right angles with three parallel cuts 1/16 inch apart, forming four squares. Sufficient pressure shall be applied on the scribe to cut completely through the painted surface. Lifting of any of the squares shall constitute failure to pass this test.

4.6.4 Heat exposure. The helmet shell shall be stabilized for 1 hour at standard test conditions. The helmet shell shall then be weighed, and the distance between the shell center reference dimples on the shell shall be measured. The helmet shall be placed on its crown in an air-circulating oven at a temperature of 160° ±5° Fahrenheit for a 4-hour period. The helmet shell shall then be removed from the oven and stabilized for 1 hour at standard test conditions. Any change in weight shall not exceed 1 percent nor shall the measured distance vary more than 1/4 inch from the original measurement. A visual inspection of the helmet shall be made, and any appreciable distortion of helmet components, defects in finish, or loosening of adhesive bonds shall constitute failure to pass this test.

4.6.5 Penetration resistance. The helmet shell (see 6.4) shall be fit on a rigid head form to assure firm support around the target area when properly positioned for tests. The helmet shell shall be subjected to impacts by a 16-ounce steel bob, having

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a 60 degree included angle pointed tip with a radius not greater than 0.015 inch and minimum Rockwell hardness of C-60. The bob shall be dropped (free fall) from a height of 10 feet onto the outside surface of the helmet shell in a direction perpendicular to the surface. The points of impact shall be one in each 60-degree sector at a radial distance of 4-1/2 ($\pm 1/2$) inches from the apex and at the apex. After each impact the test bob shall be reinserted into the depression with approximately a 10-pound force, and the total depth of its penetration into the helmet shell shall be measured. Penetration in excess of 1/4 inch at any test point shall constitute failure to pass this test.

4.6.6 Impact performance. The helmet shell shall be tested on a drop type impact machine (see figure 1). The impact shall be supplied by dropping a 16.3-pound weight with a 1.9-spherical-radius impacting surface onto a free swinging head form. The test head form configurations shall conform to series 2HCL, 4HCL and 6HCL (6570th Aerospace Medical Research Laboratories, WPAFB, Ohio) for testing helmet sizes medium, large and extra large, respectively. The head forms shall be cast of high damping magnesium alloy with a nominal wall thickness of 1 inch and shall be provided with an opening in the face area approximately 3 1/2 by 3 1/2 inches to permit access to the inner surface. A crystal accelerometer shall be hard mounted to the inner surface of the head form directly beneath the point of impact. The accelerometer shall be connected through a 3-kc, low-pass filter to a suitable oscilloscope to record acceleration versus time. The helmet shall be properly fit to the applicable head form, and the weight shall be dropped onto the helmet from a height of 6 feet 1 1/2 inches above the point of impact (100 foot-pounds, impact energy). The acceleration-time characteristics shall be evaluated from the oscillogram. Acceleration in excess of 400g or evidence of bottoming shall constitute failure to pass this test. Bottoming is indicated by radical departure of the acceleration-time curve from a smooth energy absorbing pattern and the appearance of sharp discontinuities in the rising portion of the curve (see figure 2). The helmet shall be impacted at the front, both sides, and the rear.

4.6.7 Liner adhesive compatibility. One coat of the adhesive to be used for adhering the energy absorbing liner to the helmet shell shall be applied to a test sample liner over a 3- by 3-inch square area and allowed to dry. Any evidence of softening or erosion of the liner material shall be unacceptable, and the adhesive shall not be used for the installation of liners in helmet shells.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery shall be in accordance with the instructions of the procuring activity.

6. NOTES

6.1 **Intended use.** The helmet shell covered by this specification is employed as the basic unit to which other essential components and accessory items are installed by various using activities to obtain the required final helmet configuration.

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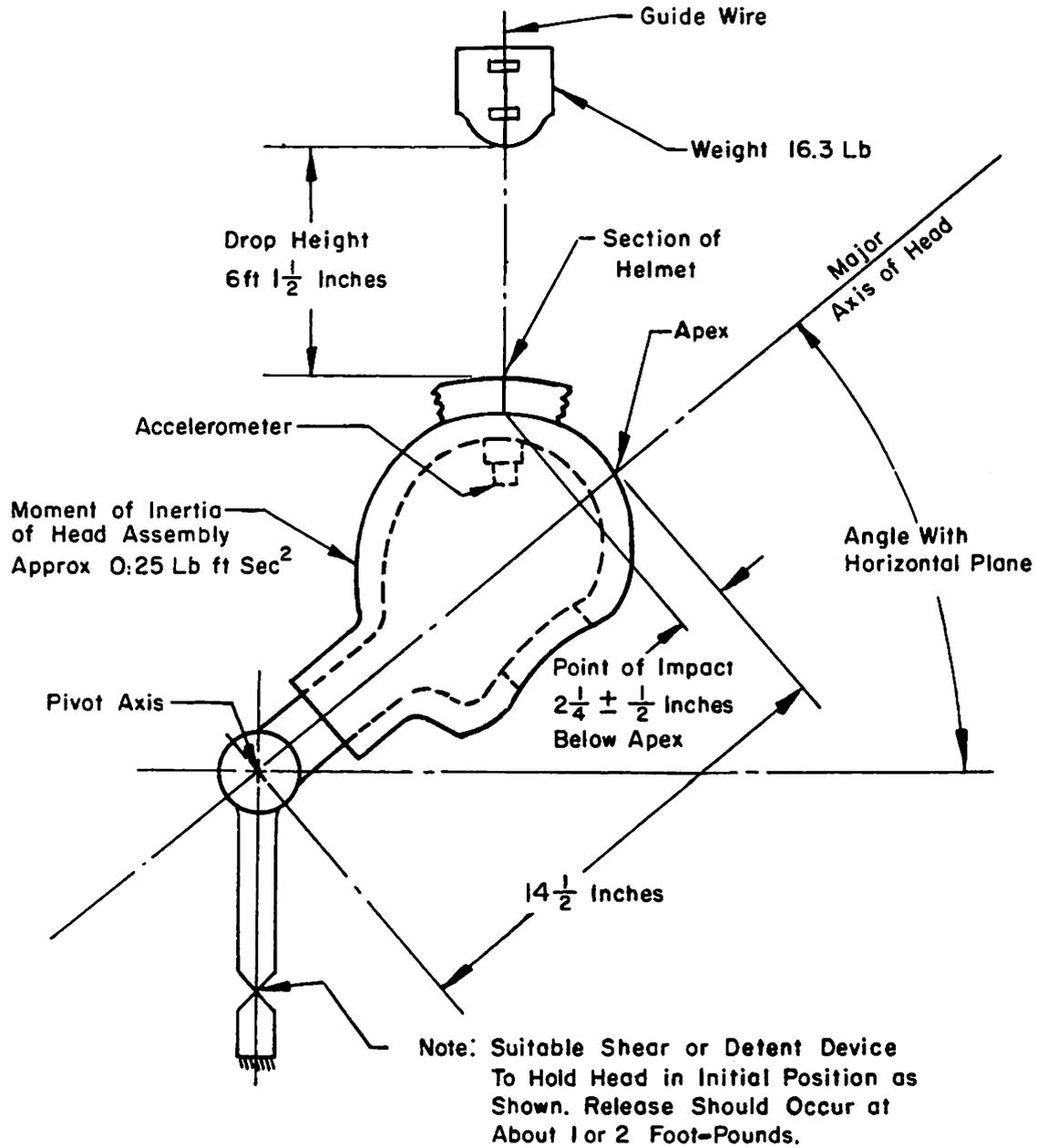
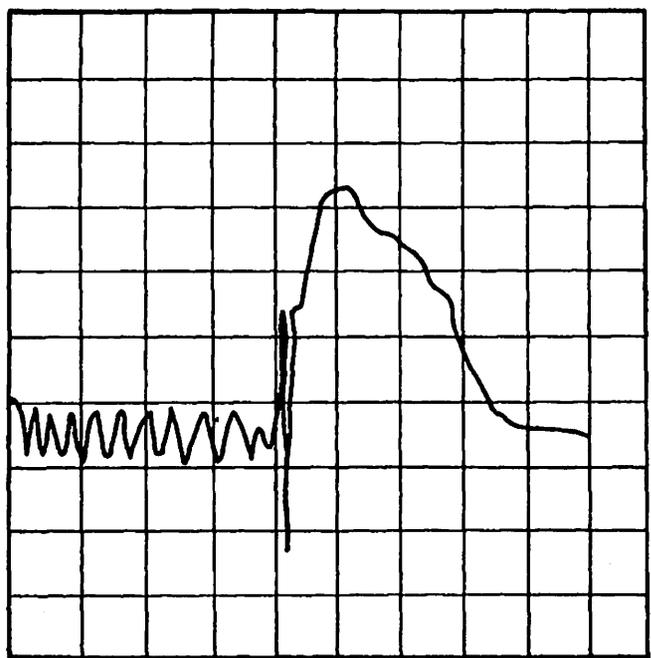
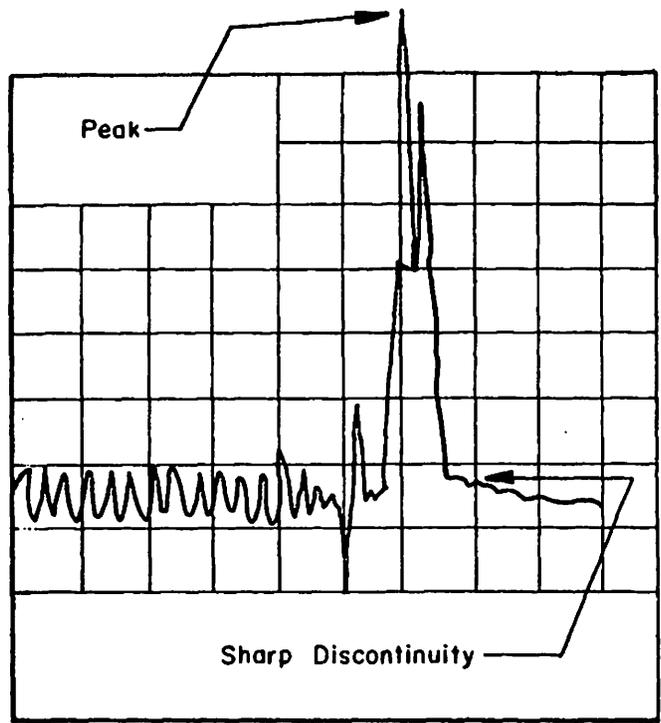


FIGURE 1. Helmet Impact Test Apparatus



Oscillogram No. 1 (Satisfactory Performance)



Oscillogram No. 2 (Unsatisfactory Performance)

Peak g in Oscillogram No. 2 in Excess of 400 g

FIGURE 2. Sample Impact Oscillogram

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6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification
- (b) Sizes required (see 1.2)
- (c) Specify whether quality conformance tests include the impact performance test (see table IV)
- (d) Preparation for delivery.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for such products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the supplier is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Life Support System Project Office (ASWL), Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio 45433, and information pertaining to qualification of products may be obtained from that activity.

6.4 Fitting pads. The contractor shall fabricate or otherwise procure complete sets of the fitting pads referenced on Drawing 64A2217 as required for use in conducting the fastener tape bonding tests and for fitting the helmet to head forms when conducting the penetration tests required by this specification.

Custodian:
Air Force - 11

Preparing activity:
Air Force - 11

Reviewers:
Air Force - 82, 85

Project No. 8475-F013

SPECIFICATION ANALYSIS SHEET		Form Approved Budget Bureau No. 22-R255
<p>INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.</p>		
SPECIFICATION		
ORGANIZATION		
CITY AND STATE		CONTRACT NUMBER
MATERIAL PROCURED UNDER A <input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT		
1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE? A. GIVE PARAGRAPH NUMBER AND WORDING.		
B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES		
2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID		
3. IS THE SPECIFICATION RESTRICTIVE? <input type="checkbox"/> YES <input type="checkbox"/> NO (If "yes", in what way?)		
4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)		
SUBMITTED BY (Printed or typed name and activity - Optional)		DATE

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1 JAN 66

REPLACES EDITION OF 1 OCT 64 WHICH MAY BE USED.

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