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MILITARY SPECIFICATION

INSTALLATIONS: AIRCRAFT ARMOR

This specification has been approved by the
Bureau of Aeronautics, Department of the Navy

1. SCOPE

1.1 This specification establishes the requirements for the installation of armor and bullet-resistant glass in naval aircraft.

2. APPLICABLE SPECIFICATIONS, OTHER PUBLICATIONS AND DRAWINGS

2.1 The following specifications of the issue in effect on date of invitation for bids, form a part of this specification.

SPECIFICATIONS

Military

JAN-W-41	Welding of Armor: Metal-Arc, Manual (With Austenitic Electrodes) (For Aircraft)
JAN-A-256	Armor, Homogeneous, Rolled Steel; Aircraft-Type
JAN-A-434	Armor, Steel; Plate, Rolled; Non-Magnetic (5/32 to 1-1/16 In. Incl.) Aircraft Type
JAN-A-784	Armor, Steel; Plate, Rolled, Face-Hardened 1/4 to 1 1/8 inches
MIL-G-5485	Glass, Laminated, Bullet-Resistant, Flat
MIL-A-7168	Armor, Aircraft, Aluminum-Alloy-Plates; Deflector
MIL-A-7169	Armor, Aircraft, Aluminum-Alloy-Plates; Protector

(Copies of Military Specifications may be obtained upon application to the Commanding Officer, Naval Air Station, Johnsville, Pennsylvania, Attention: Technical Records Division.)

2.2 Precedence - If the requirements of this specification and the applicable aircraft detail specification are in conflict, the requirements of the detail specification shall have precedence.

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3. REQUIREMENTS

3.1 Material - Materials used in the installation shall conform to applicable specifications and shall be as specified herein. Materials which are not covered by applicable specifications, or which are not specifically described herein, shall be of the best quality, of the highest practicable weight and suitable for the purpose intended.

3.1.2 Weight - The weight of armor, bullet resistant glass and attachment fittings shall be included in the weight empty of the airplane. Weights of attachment fittings shall be included in all estimated or stated weights of armor installations.

3.1.3 The contractor shall endeavor to avoid designs which necessitate any alterations or modifications of government furnished equipment. If, in the interest of better design, alterations are considered necessary, they shall be referred to the Bureau of Aeronautics for approval.

3.2 Design and Construction

3.2.1 Design Data - Drawings of armor details shall be submitted to the Bureau of Aeronautics prior to the fabrication of armor plate. Drawings shall be dimensioned to show the location of all attachment holes relative to each other and all tolerances. The drawings shall include a three view drawing of the airplane showing the flight line at Vmax, the location of all protective devices including armor plate, deflecting plates, bullet-resistant glass, and yaw plates or parts of the airplane structure considered in the design as equivalent to yaw plates. For Class VP airplanes, drawings shall be submitted showing the cross section at each station where armor is installed. The drawings shall indicate the angles of gunfire for which the protection is afforded by a given device. These drawings will be examined by the Bureau of Aeronautics to determine their compliance with the requirements of this specification. Deviations from the requirements contained herein or from the airplane specification shall be clearly indicated. Requests for authority to deviate from requirements shall each be accompanied by a detailed explanation of the reasons therefor. Any deviation shall be in writing, authorized by the Bureau of Aeronautics.

3.2.1.1 The contractor shall include on the armor installation drawings submitted to this bureau for approval a statement of the number of man hours required for the removal of each armor plate and, assuming the maximum number of men that can work simultaneously, the approximate actual time required.

3.2.1.2 The contractor shall include in the Handbook of Maintenance Instructions of each combat model airplane an indication of the degree of removability of the armor, listing each plate with its weight under one of the following three categories:

- 3.2.1.2.1 Plates which can be removed in three hours or less by operating units.
- 3.2.1.2.2 Plates which can be removed in more than three hours but less than twelve hours by operating units.
- 3.2.1.2.3 Plates which are not considered to be removable by operating units.

3.2.1.3 The contractor shall include in the Handbook of Maintenance Instructions photographs and complete instructions for the removal of armor bullet-resistant glass.

3.2.1.4 Correspondence, design data and drawings pertaining to armor shall be classified as follows:

- 3.2.1.4.1 Confidential for experimental airplanes.
- 3.2.1.4.2 Restricted for production model airplanes after delivery to operating units.

3.3 Shape and Contour - The armor plate shall be flat insofar as possible and sharp angles cut into contours shall be avoided. A minimum of irregular and formed shapes shall be used.

3.3.1 The number of holes in the plate shall be kept to a minimum consistent with adequate support.

3.3.2 Where curved plates are required, the curvature need not be restricted to one plane. However, the radius of curvature shall be as large as practicable.

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3.3.3 The extent of plate overhang beyond the points of support shall be reduced to a minimum.

3.3.4 On symmetrical pieces of face-hardened armor, the bolt mounting, if used, shall be unsymmetrical in order to preclude incorrect installation of the plates.

3.3.5 Dimensions - Dimensional tolerances to be required of the armor manufacturer are given below. The indicated minimum tolerances may be increased at the discretion of the airplane contractor.

3.3.5.1 Nominal Hole Size - Holes in armor for mounting shall be 1/16 inch greater than the bolt diameter.

3.3.5.2 Specific Hole Size - Drilled holes shall not vary more than ± 0.010 , -0.003 from the specified hole size.

3.3.5.3 Hole Positions - The distances between holes in armor plate shall not vary more than $\pm 1/32$ inch in 24 inches, or more than an additional 1/16 inch for each additional foot or fraction thereof.

3.3.5.4 Flatness of Plate - 1/32 inch per foot accumulative in any direction.

3.3.5.5 Overall Dimensions - Minimum tolerances are $\pm 1/32$ inch up for plates up to 30 inches wide or $\pm 1/16$ inch for plates over 30 inches wide. The recommended tolerances are $\pm 1/16$ inch for plates up to 30 inches wide and $\pm 1/8$ inch for plates over 30 inches wide.

3.3.5.6 Angular tolerances - When wide angular tolerances are permissible, bends shall be expressed in degrees with a minimum tolerance of ± 2 degrees. When closer control is necessary, offset dimensions shall be used. On offset dimensions, a minimum tolerance of $\pm 1/32$ inch per foot shall be used.

3.3.5.7 Position of Welded Clips or Lugs - Whenever practicable, the minimum tolerance shall be $\pm 1/32$ inch up to 24 inches, and an additional $\pm 1/64$ inch for each additional foot or fraction thereof. When necessary, the minimum tolerance shall be ± 0.010 inch provided special arrangement be made with the armor manufacturer for rework or machining after heat treatment and welding.

3.3.5.8 Location of Holes in Attachment Clips - The minimum tolerance shall be ± 0.002 inch considering that the holes can be .015 drilled after welding and heat treatment.

3.3.6 The minimum edge distance of holes shall be equal to the thickness of the plate and shall be measured from the edge of the hole to the edge of the plate.

3.3.7 The minimum distance between holes shall be equal to twice the diameter of the hole measured between hole centers. In cases where holes are of different diameters the diameter of the large hole shall govern.

3.3.8 All edges shall be broken.

3.3.9 The minimum bend radius shall be 4 "t" for homogeneous armor and 9 "t" for face-hardened armor where "t" is the plate thickness.

3.3.10 The corner radii for flat shapes and cuts shall be not less than 1/2 inch.

3.3.11 Size - The maximum size of plate used shall be 60 inches X 120 inches for homogeneous armor and 42 inches X 78 inches for face-hardened armor. The maximum depth after forming shall not exceed 20 inches whenever practicable.

3.4 Marking - An area for identification marking of the plates which is approximately 3 inches square shall be indicated on the detail drawing of each individual piece of armor. This area shall be as close to the edge of the plate as possible and shall be visible when the plate is installed in the aircraft, if practicable. This area shall be labeled and

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outlined in phantom lines on the drawing.

3.4.1 The following items shall be stamped in the space in the order set forth below. No identifying words need be used ahead of the items since this fixed order is to be used.

The word "SOFT" on the rear of the face-hardened armor. No similar identification shall be placed on homogeneous armor.
The manufacturer's symbol.
The part number as listed by the airplane manufacturer, prefixed with the symbol "#".
The mill heat number which may be coded.
The group or lot number.
The serial number of the plate.

3.5 Protection for Personnel in Combat Classes of Naval Aircraft - Table I may be used as a guide for providing armor and bullet resistant glass for the various combat classes of naval aircraft. The protection that may be required for a particular model airplane, the armor material and thickness of the material shall be specified by the Bureau of Aeronautics.

TABLE I

CONES OF PROTECTION AND THICKNESSES OF ARMOR IN AIRCRAFT INSTALLATIONS

Class of Airplane	Cone of Protection (Included angle in degrees) (Note 1)	Location of Armor	Plate Thickness in Inches (Steel Armor unless noted)
			.50 Cal. Protection Level
VF	0	Pilot fwd. (Note 2), Above, Horizontal	3/8
	15	Pilot fwd., Horizontal and Below	3/8
	15	Pilot fwd. (Dural Cowling)	1/4
	0	Pilot fwd. above-Bullet-Resistant Glass Note (3)	2-1/2 at 45° 2-1/4 at 35°
	15	Pilot fwd., Sides & Below - Bullet-Resistant Glass	2-1/2 at 45° 2-1/4 at 35°
	30	Pilot-Rear, Head and Shoulders	3/8
VA	30	Pilot-Rear, Back	5/16
	See Note 6	Pilot-Bottom, Seat Bucket	3/8
	0	Pilot fwd., Above-Horizontal	3/8
	15	Pilot fwd., Horizontal and Below	3/8

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Class	Cone	Location	Thickness
	15	Pilot-fwd. (Dural Cowling)	1/4
	0	Pilot fwd., Above-Bullet Resistant Glass	2-1/2 at 45° 2-1/4 at 35°
	15	Pilot fwd., Horizontal & Below Bullet Resistant Glass	2-1/2 at 45° 2-1/4 at 25°
	30	Pilot-Rear, Head and Shoulders	3/8
	30	Pilot-Rear, Back	5/16
	See Note 6	Pilot-Bottom, Seat Bucket	3/8
	(Note 4)		
	5	Gunner, Head & Shoulders	3/8
	5	Gunner, Lower	5/16
VP	0	Pilot fwd., Above	3/8
	15	Pilot fwd., Horizontal and Below	3/8
	0	Pilot fwd., Above-Bullet Resistant Glass	4-1/2 at 0° 2-1/2 at 45°
	15	Pilot fwd., Horizontal & Below Bullet Resistant Glass	4-1/2 at 0° 2-1/2 at 45°
	(Note 5)		
	30 or 45	Pilot-Rear, Head & Shoulders	3/8
	30 or 45	Pilot-Rear, Back	5/16
	(Note 6)	Pilot - Lower	3/8
	5	Gunner-Head & Shoulders	1/2
	5	Gunner - Lower	7/16
	45	Bombardier - Rear	3/8
	(Note 6)	Bombardier - Lower	5/16
	45	Other Stations - Rear	3/8

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Class	Cone	Location	Thickness
VO	0	Pilot fwd., Above	3/8
	15	Pilot fwd., Horizontal & Below	3/8
	15	Pilot fwd., Dural Cowling	1/4
	0	Pilot fwd., Above-Bullet Resistant Glass	2-1/2 at 45° 2-1/4 at 35°
	15	Pilot fwd., Horizontal & Below Bullet Resistant Glass	2-1/2 at 45° 2-1/4 at 35°
	30 or 45	Pilot-Rear, Head and Shoulders Pilot - Rear, Back	3/8 5/16
	(Note 4)		
	5	Gunner-Head & Shoulders	3/8
	5	Gunner-Back	5/16
Turrets in all Classes	5	(Above Shoulders of Gunner may be Glass or Armor) (Note 3)	2-1/2 at 45° 2-1/4 at 35°
		Armor (Above Shoulders of Gunner)	1/2
		Armor (Below Shoulders of Gunner)	7/16

(Note 1) The cone of protection describes the angle through which protection shall be afforded.

- (a) The axis of the cone is a line parallel to the flight path of the airplane at V_{max} .
- (b) The extent of the armor shall be determined by extending construction lines from the outline of the object or person being protected to the plane of the armor plate. These construction lines shall be inclined to the axis of the cone at an angle equal to one half of the angle specified in Table I.
- (c) The apex of the cone shall be on the side of the object or person away from the armor.

(Note 2) In providing protection for the pilot:

- (a) From ahead, the pilot shall be considered in the sighting position.
- (b) From the rear, the pilot shall be considered in the normal flight position.

(Note 3) The angle specified with the thickness of the bullet resistant glass is the angle between the longitudinal axis of the airplane and face of the glass.

(Note 4) The axis of the flexible gunner's cone of protection shall be a moving one oriented parallel to the direction in which his gun or guns are pointed.

(Note 5) The axis of the cone of protection from the rear in VP airplanes shall be inclined upward at an angle of $7-1/2^\circ$ to the flight path of the airplane at V_{max} .

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(Note 6) The protection from below shall be detachable. This armor is required for protection during strafing missions. The coverage to be provided shall be from 45° below and ahead to 90° from below and shall be from 15° on either side of the vertical.

(Note 7) Each crew member shall be considered to be a man 6 feet tall, weighing 175 lbs, and a width 19 inches.

3.6 Installation -

3.6.1 Armor plates shall be installed as far as practicable at such angles that the bullets are not deflected or guided into the personnel or vital equipment.

3.6.2 Bullet splash protection shall be provided for the particles of the projectiles which are thrown by the force of impact in a plane tangent to the armor at the point of impact. The danger of bullet splash lies in the possibility of striking personnel, weakening the fuselage structure, cutting control leads, or damaging vital equipment. Bullet splash protection shall consist of metal strips around the edge of armor plate at vital points in the form of a flange. The strips shall be made of 1/8 inch thick duralumin or of a 3/32 inch thick SAE 1020 steel or equivalent. The height of these plates shall be determined by extending a line from the far side of the plate at an angle of three degrees to the face of the plate to the personnel, vital equipment, or structure being protected. The splash strip shall extend normal to the face of the plate from the face to the line discussed above but not more than two inches. Splash strips may be bolted to the armor plate, to the structural members supporting the plate or to the structure of the airplane. Steel splash strips may be attached to the armor plate by continuous arc or resistance welding, subject to approval by the Bureau of Aeronautics Representative at the contractor's plant. Arc tack welding for attachment of splash strips is not acceptable.

3.6.3 Consideration may be given to the use of armor as structure whenever considerable weight savings may be effected such as in sections of fuselage skin, overturn structure and pilot's seats. Whenever armor is used as structure, it shall be as easily removable as an equivalent component of the airplane structure. Armor not used as structure shall be as removable as necessary in order to permit the installation of heavier armor if required in service. Armor installed for special missions shall be readily removable. The following disadvantages may be involved in the incorporation of protection as an integral part of the aircraft structure:

3.6.3.1 The inclusion of a rigid member such as an armor bulkhead in an aluminum alloy fuselage may introduce difficulties in load transference.

3.6.3.2 Replacement of damaged structural armor will be difficult.

3.6.3.3 The large tolerances required for armor plate may make it unsuitable for mass production assembly.

3.6.4 All armor plate installations shall provide space for a possible future 50 per cent increase in armor thickness.

3.6.5 The size of each plate shall be kept within the maximum which can be handled conveniently by the personnel installing the armor.

3.6.6 Whenever practicable, the area of a plate of armor shall not be less than 25 square inches or the width less than three inches.

3.6.7 Insofar as practicable, equipment such as fuel cells and radio sets shall be located adjacent to armor in order to supplement the protection afforded by the armor plate by yawing the projectile before it strikes the armor.

3.7 Selection Factors - The factors set forth below govern the selection of the materials listed in subparagraph 3.1.2 for the protection purposes.

3.7.1 The materials for armor are listed below in the order of their effectiveness against the specific types of impacts with "1" indicating the material affording the best protection and higher numbers signifying materials affording less protection. It is to

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be noted that the performance of aluminum is compared on the basis of equivalent steel weights rather than equivalent steel thicknesses.

Conditions of Impact	Face-Hardened Armor	Homog. Armor	Non-Mag. Armor	Alum. Armor
A. Normal unyawed impact (for material up to 0.3 inch of steel for .50 cal AP)	2	3	4	1
B. Normal unyawed impact (for material above 0.3 inch of steel)	1	3	4	2
C. Normal fully yawed impact (for all thicknesses)	2	2	2	1
D. Unyawed impacts at 20° obliquity (for all thicknesses)	1	2	4	3
E. Unyawed impacts at 50° obliquity (for all thicknesses)	2	3	4	1
F. Impacts of 20 mm H. E. projectiles exploding on the plate (for thicknesses up to 3/8 inch of steel)	2	1	3	4
G. Impacts of 20 mm H. E. projectiles exploding on the plate (for thicknesses on 3/8 and above.)	1	1	1	1

3.8 Definitions

3.8.1 **Yaw** - Yaw is the angle between the longitudinal axis of the projectile and the flight path of the projectile. When the projectile is travelling perpendicular to a plate at the time of impact, an unyawed projectile will strike point first while a fully yawed projectile will strike side first.

3.8.2 **Obliquity** - Obliquity is the angle between a line perpendicular to the plate and the path of the projectile. A projectile travelling perpendicular to the plate has 0° obliquity and such an impact is called a normal impact. A projectile fired at 90° obliquity to a plate travels parallel to the face of the plate.

3.9 **General** - The thicknesses of armor are set forth in Table I, paragraph 3.3.13. The selection of materials will be made by BuAer after consideration of the installation in general accordance with paragraph 3.5.1 above and the following:

3.9.1 Face-Hardened steel armor shall be used where thicknesses of steel of 3/8 inch and above are specified.

3.9.2 Aluminum alloy shall be used in place of steel of 5/16 inch thicknesses and below, in place of steel for all plates expected to be struck high obliquity impacts and in place of non-magnetic steel armor.

3.9.3 Homogeneous armor shall be used when space does not permit using aluminum alloy or where fabricating difficulties do not permit the use of face-hardened armor.

3.9.4 Non-magnetic steel armor shall be used where armor is required within 21 inches of a magnetic compass and where space does not permit using aluminum alloy. Not more than 15 pounds of magnetic armor shall be located within 30 inches of magnetic compass.

3.10 Attachment Fittings

3.10.1 The mounting attachments for armor shall be of sufficient strength to resist the shock of projectile impact. The magnitude of reactions cannot be stated here since the

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reactions will depend on the weight of the plate, direction and position of the impact and rigidity of the attachment. Experience indicates that the normal attachment arrangements required to carry other aircraft equipment of comparable weight will be adequate for armor except in cases where the weight of the armor plate is less than five pounds. In such cases more substantial support is required. The attachment fittings shall be so placed that they are protected, as far as practicable, by the armor plate.

Whenever practicable, the armor supports shall be designed to take the impact loads in shear but not in tension.

3.10.2 The minimum size mounting bolt shall be 1/4 inch in multiple groups. The use of single 3/8 inch bolts is recommended. Wherever possible, bolts shall be installed so that the bolt heads are away from the object being protected by the armor.

3.10.3 Whenever practicable, armor shall be mounted at three or more points of sufficient strength that if one attachment point is shot away the armor will remain in place.

3.10.4 Welding mounting clips, angles, or lugs shall be one-half the thickness of the armor plate except that the minimum thickness shall be 3/16 inch. These clips shall be fabricated from SAE 1020 steel or its equivalent.

3.10.4.1 Continuous fillet welds are recommended for the attachment of clips and lugs to armor.

3.10.5 Templates - When the armor design has been approved by the Bureau of Aeronautics, the contractor shall provide a set of templates of the exact shape and dimensions of the finished armor to check the fit of the armor and positioning of the mountings. An additional identical set of templates shall be furnished the armor manufacturer together with the detail drawings of the armor showing all tolerances.

3.10.5.1 Templates shall be made of mild steel whenever practicable. Otherwise the templates shall be of a material agreed upon by the airplane contractor and the armor manufacturer.

3.11 Experimental Aircraft

3.11.1 Experimental models of combat airplanes shall be provided with dummy armor fabricated from mild steel except as specified in detail specifications.

3.11.1.1 This non-protective armor shall be clearly stamped on both sides of the plate as follows:

Dummy Armor - Not for Combat

3.12 Bullet-Resistant Glass

3.12.1 Bullet-resistant glass is laminated plate glass (See MIL-G-5485) and shall be installed where vision is required in an area which should be protected: e.g. at pilot's windshields and for turret gunner's face plates.

3.12.2 Provision shall be made for readily cleaning both surfaces of the front windshield glass and of the bullet-resistant glass, but not necessarily in flight.

3.12.3 A readily replaceable frame, completely surrounding the bullet-resistant glass section, shall be provided. The frame and mounting brackets shall be so designed that complete replacement of the frame and bullet-resistant glass assembly can be readily made without interference with the alignment of the gunsight.

3.12.4 Other features of the bullet-resistant glass installation shall be as specified in the airplane detail specification.

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3.13 Equipment Protection - Consideration shall be given to the location of vital equipment, oxygen breathing apparatus and especially oxygen cylinders, electrical circuits, and hydraulic, fuel and oil lines so as to utilize to the maximum practicable extent the natural protection afforded by heavy components of the airplane structure. Personnel protection shall be fully utilized wherever practicable to serve the dual purpose of protecting personnel and equipment.

3.13.1 Where practicable, the armor thickness and the cone of protection for vital equipment shall be the same as that specified for personnel.

3.13.2 To the extent to which the airplane is capable of carrying armor in addition to that necessary for the protection of personnel, consideration shall be given to the protection of equipment in the following order or priority:

- (a) Fuel sumps, fuel pumps, and fuel selector valve.
- (b) Carburetor.
- (c) Coolant tank and radiator for liquid cooled engines.
- (d) Oil coolers, filters, and lines
- (e) Oil tank (when self-sealing tanks are not provided).

3.13.3 The quantity of oil protected by armor shall be proportionate to the amount of protected fuel. When the weight of armor for the protection of the oil tank is prohibitive, part of the oil supply should be protected by making provision for armoring the lower portion of the tank and the sump only.

3.13.4 The contractor shall furnish an analysis showing the amount of additional weight required to provide space and local strength for armoring the forward and rear sides of .50 caliber wing gun ammunition boxes and for armoring the forward and rear sides and the tops and bottoms of 20 mm. ammunition boxes. The decision as to whether or not such space and local strength provisions shall be incorporated in the airplane design will be made upon receipt of this weight analysis. Armor protection provided for the gunner, in flexible gun installations shall be utilized and extended, where practicable, to protect .50 caliber and 20 mm. ammunition in close proximity to the gunner.

3.13.5 In Class VP airplanes, armor protection shall be provided for the spare flare stowage, but not for the ready flare containers. The weight of this armor shall be included in "weight empty - special equipment", not included in weight empty.

3.13.6 Special consideration shall be given to the location of the oxygen bottle to accomplish one of the following ends:

3.13.6.1 Protection of the bottle by armor installed for protection of personnel or equipment.

3.13.6.2 Protection of personnel from the blast from the bottle by interposing airplane structure between the bottle and all personnel.

3.14 Workmanship

3.14.1 Surface Finish

3.14.2 Armor plate shall be finished in accordance with the following procedure:

3.14.2.1 Plates exposed to outside visibility shall be painted with two coats of zinc chromate primer and two coats of lacquer or one coat of enamel of such color and gloss as to match the adjacent surfaces.

3.14.2.2 Unexposed plates shall be painted with two coats of zinc chromate primer (Specification MIL-P-6889).

3.14.2.3 In preparing the armor for finishing, light sand or shot blasting may be employed, but no acid pickling process shall be used. The plates shall not be heated or

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subjected to temperatures above 212 degrees Fahrenheit in being prepared for painting.

3.14.3 Flare - Cutting of Armor - Flame-cutting of armor is not specifically prohibited by Bureau of Ordnance Specifications, provided the metal affected by such operations is removed by mechanical means. Localized heating or welding of armor plate shall not be allowed after the first heat treatment without special authorization in each case by the Bureau of Aeronautics Representative in the contractor's plant.

4. INSPECTION AND TEST PROCEDURES

4.1 The inspections, tests, and demonstrations, as prescribed by the requirements of this specification shall be as indicated below. However, it should be noted that the ballistic tests are to be in accordance with specifications shown in Section 2 but for the purposes of clarification and continuity, portions of these specifications dealing with armor plate and bullet resistant glass acceptance tests are reiterated in the paragraph below.

4.2 Attachment Fitting Tests - The contractor for VF, VA or VO type airplanes shall, when required by the Bureau of Aeronautics, furnish one complete set of armor and armor attachment fittings of each armor installation not previously tested by gunfire and shall deliver these items as listed in the following subparagraphs.

4.2.1 When a static test fuselage assembly is required to be furnished under the airplane contract, the contract also may require that following completion and acceptance of the static tests, the fuselage assembly be delivered to the Inspector of Naval Aircraft for shipment to the Naval Proving Ground, Dahlgren, Virginia, or other location designated for gunfire tests. In such cases as are practicable, the test fuselage as delivered for gunfire test, shall include all armor and armor attachment fittings which are properly a part of the fuselage assembly. Damage existing in the fuselage structure on completion of the static tests shall be repaired, for the purposes of the gunfire tests, only to the extent required to simulate the resistance of an undamaged structure to gunfire. The items of armor and armor attachment fittings which cannot be assembled in the test fuselage shall be shipped separately.

4.2.2 When the airplane contract does not require delivery of a static test fuselage assembly for gunfire tests, the complete set of armor and armor attached fittings shall be shipped to the Naval Proving Ground, Dahlgren, Virginia or other location designated by the Bureau of Aeronautics.

4.2.3 The airplane contractor shall install complete fuel and oil systems, including tank protection whenever practicable, in each static test fuselage before delivery for gunfire tests. Fittings shall be included for attaching the fuel and oil lines to an engine.

4.3 Acceptance Tests - Armor plate and bullet-resistant glass acceptance tests will be conducted by the Naval Proving Ground, Dahlgren, Virginia.

4.3.1 The following procedure shall be followed in notifying the Naval Proving Ground and the Bureau of Aeronautics upon award of sub-contracts for armor in order that ballistic acceptance tests may be authorized.

4.3.1.1 The Bureau of Aeronautics Representative at the aircraft manufacturer's plant shall obtain and forward necessary data regarding orders for armor placed by the aircraft manufacturer. These data shall be provided to:

- (a) Bureau of Aeronautics (2 copies)
- (b) Naval Proving Ground, Dahlgren, Virginia
- (c) Inspector at the Armor Manufacturer's Plant.

4.3.1.2 These data shall include the following pertinent information.

- (a) Name and address of plant of airplane manufacturer.
- (b) Name and address of plant of armor manufacturer.
- (c) Model airplane for which armor is being procured.
- (d) Quantity, weight, description, and required delivery of the armor. Drawings, templates, and all other data necessary for inspection shall be furnished to the Inspector at the armor plant.

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- (e) Specifications which apply to the armor.
- (f) Number of prime contract for the airplane and the designation of the order for the armor.
- (g) Any other pertinent information relative to the order for the armor.

4.3.1.3 The Inspector at the armor plant shall conduct the inspection of the armor as required by the purchase order. He shall furnish the Naval Proving Ground with all the necessary data relative to the armor under manufacture and to the ballistic plates selected for tests as required by the armor specifications.

4.3.1.4 The Naval Proving Ground will schedule and conduct the ballistic tests as soon as practicable after receipt of information regarding the delivery date of ballistic test plates. No tests will be scheduled or conducted by the Naval Proving Ground until the information noted under paragraphs 4.3.1.1 or 4.3.1.2 above is received. Immediately after the conclusion of the ballistic test, a preliminary report will be made and forwarded to the Bureau of Aeronautics with a copy direct to the Inspector at the armor plant for his and the company's information. The final report will be prepared and forwarded to the Bureau of Aeronautics as soon thereafter as practicable.

4.3.1.5 The Bureau of Aeronautics will, upon receipt of the preliminary report, address a letter to the Inspector at the armor plant officially authorizing acceptance of the group of armor insofar as the ballistic requirements are concerned. If rejection is recommended by the Naval Proving Ground, the Bureau of Aeronautics will review the delivery requirements of the airplanes involved and will then inform the Inspector of the acceptance or rejection of the group. Copies of these letters will be sent to the Bureau of Aeronautics Representative and to the Naval Proving Ground. A copy of the final report will be forwarded to the armor manufacturer via the Inspector when it is received from the Naval Proving Ground. The procedure of inspection and testing of bullet-resistant glass is outlined in Military Specification MIL-G-5485.

4.4 Mock-ups - Prior to the fabrication of armor, a mock-up shall be made of wood and shall be subject to approval of the Mock-up Board. This Board may be the one which examines the entire airplane mock-up, or a special board detailed to inspect the armor alone.