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Shields, Protective, Aircraft and Missiles

FSC 1730

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

STABILIZED NOTICE

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NOTICE

This document has been taken directly from U.S. Military Specification MIL-S-6451E and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace MIL-S-6451E. Any part numbers established by the original specification remain unchanged.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

Under Department of Defense policies and procedures, any qualification requirements and associated qualified products lists are mandatory for DOD contracts. Any requirement relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this SAE technical document.

1. SCOPE:

1.1 Scope:

This specification covers protective shields for engine and tailpipe openings of aircraft and missiles.

1.2 Classification:

Shields shall be of the following classes, as specified (see 6.2).

Class 1 - Metallic
Class 2 - Nonmetallic

2. APPLICABLE DOCUMENTS:

2.1 Issues of documents:

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

FEDERAL

C-F-206	Felt Sheet: Wool, Pressed
L-P-390	Plastic Molding and Extrusion Material, Polyethylene and Copolymers (Low, Medium, and High Density)
QQ-A-250/5	Aluminum Alloy Alclad 2024, Plate and Sheet
QQ-S-250/8	Aluminum Alloy, 5052, Plate and Sheet
MMM-A-1617	Adhesive, Rubber Base, General Purpose
PPP-B-636	Box, Shipping, Fiberboard

MILITARY

MIL-P-116	Preservation-Packaging, Methods of
MIL-C-10799	Cloth, Coated, Cotton, Vinyl Coated, Fire and Mildew Resistant

2.1 (Continued):

STANDARDS

MILITARY

MIL-STD-100	Engineering Drawing Practices
MIL-STD-129	Marking for Shipment and Marking
MIL-STD-130	Identification Marking of US Military Property
MIL-STD-143	Standards and Specifications Order of Precedence for the Selection of
MIL-STD-808	Finishes, Protective, and Codes, for Finishing Schemes for Ground and Ground Support Equipment
MIL-STD-810	Environmental Test Methods
MIL-STD-831	Test Reports, Preparation of
MIL-STD-889	Dissimilar Metals
MIL-STD-1186	Cushioning, Anchoring, Bracing, Blocking, and Waterproofing, with Appropriate Test Methods

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

2.2 Other publications:

The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials

Test Method D1238-65T	Tentative Method of Measuring Flow Rates of Thermoplastics by Extrusion Plastometer

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

National Aerospace Standards Association, Inc.

NAS 1756	Streamer, Warning

(Application for copies should be addressed to the National Aerospace Standards Association, Inc., 1321 Fourteenth St., N.W., Washington, DC 20005.)

3. REQUIREMENTS:

3.1 Preproduction:

This specification makes provisions for preproduction testing.

3.2 Selection of standards and specifications:

Standards and specifications for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.3 Materials:

3.3.1 Fungus-proof materials: Materials that are nutrients for fungi shall not be used where it is practical to avoid them.

3.3.2 Protective treatment: When materials are used in construction of the shield that are subject to deterioration when exposed to climatic and environmental conditions likely to occur during service usage, they shall be protected against such deterioration in a manner that will in no way prevent compliance with the performance requirements of this specification. Protective coatings that will crack, chip, or scale with age or extremes of climatic and environmental conditions shall not be used.

3.3.3 Metals: Metals shall be of the corrosion-resistant type or treated to resist corrosion due to fuels, salt fog, or atmospheric conditions likely to be met in storage or normal service.

3.3.3.1 Dissimilar metals: Unless protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other. Dissimilar metals are defined in MIL-STD-889.

3.3.4 Nonmetallic materials: Nonmetallic material for shields shall be in accordance with type III, class H, grade 2, Category 5 of L-P-390. Melt index shall not be greater than 0.35 as determined by ASTM Test Method D1238-65T. Material noncorrosive to bare 2024 or 7075 aluminum alloy.

3.4 Design:

The shield shall be designed to prevent sand, dust, water, et cetera, from entering the engine through the air inlet duct or exhaust tailpipe. When specified (see 6.2), class 1 shields shall serve as a medium for attaching heater ducts for preheating aircraft or missile engines, et cetera. When the configuration of the aircraft or missile is such that it is impractical to fit the shield into the orifice, the shield shall be designed to mount on the face of the orifice. When the orifice is such that it is impractical to provide a one-piece shield, the shield shall consist of an assembly with a minimum number of sections. When specified by the procuring activity, shields shall be fabricated into sections to reduce the stowage problem (see 6.2).

3.4.1 Configuration: Shields for radial engines shall be designed as shown on figure 1, and shall fit 2 inches into the engine cowl ring when practical. Shields for the cowl ring of jet aircraft shall be designed as shown on figure 2. The entire opening between the engine and the inlet air duct shall be closed by the shield.

3.4.1.1 General appearance: The shield shall be so designed as to present a neat appearance. The shield shall be compact and free of excess materials.

3.4.2 Engine cranking: Shields for radial engines shall be designed to permit engine cranking with the shields installed in the cowling. Heater duct attachments, when required, shall not interfere with engine cranking.

3.4.3 Service life: The shield shall be designed to assure a minimum service life of 1 year.

3.5 Construction:

The shield shall be so constructed that, when assembled, all protruding parts will be well supported and will not extend beyond the outer limits of the shield. The shield shall withstand the strains, shock, vibrations, nd other detrimental conditions incident to operation, shipping, and storage with a minimum loss of time for maintenance, repair, and periodic servicing.

3.5.1 Class 1 shield: The class 1 shield shall be as shown on figure 1 or 2. The shield shall be constructed of aluminum-alloy sheet conforming to QQ-A-250/8, 1/2 hard; or QQ-A-250/5, temper 0, at least 0.064 inch thick for shields less than 3 feet in diameter and at least 0.125 inch thick for shields greater than 3 feet in diameter. The shield for radial engines shall be in two sections joined at the horizontal centerline of the engine propeller shaft. The shield shall fit into the engine cowl or to the cowl face, and against the propeller hub to form a tight seal. The construction shall be such that oil-canning will not occur. Provisions shall be made in a felt seal specified in 3.5.1.3 to allow clearance for the propeller feathering controls or anti-icing equipment. The shield shall fit 2 inches inside of the cowl ring and orifice openings when installed inside the opening.

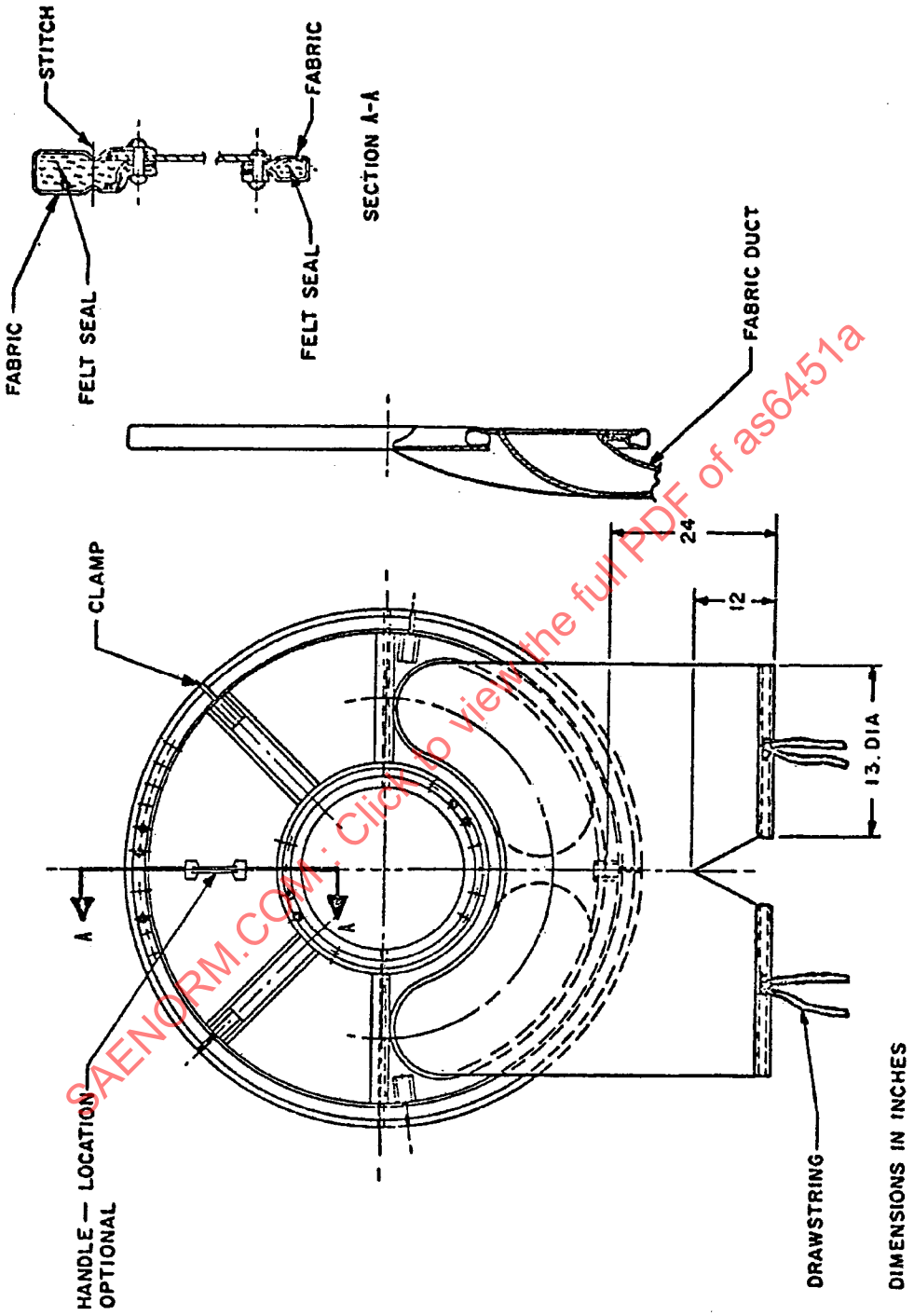

FIGURE 1. Radial engines.

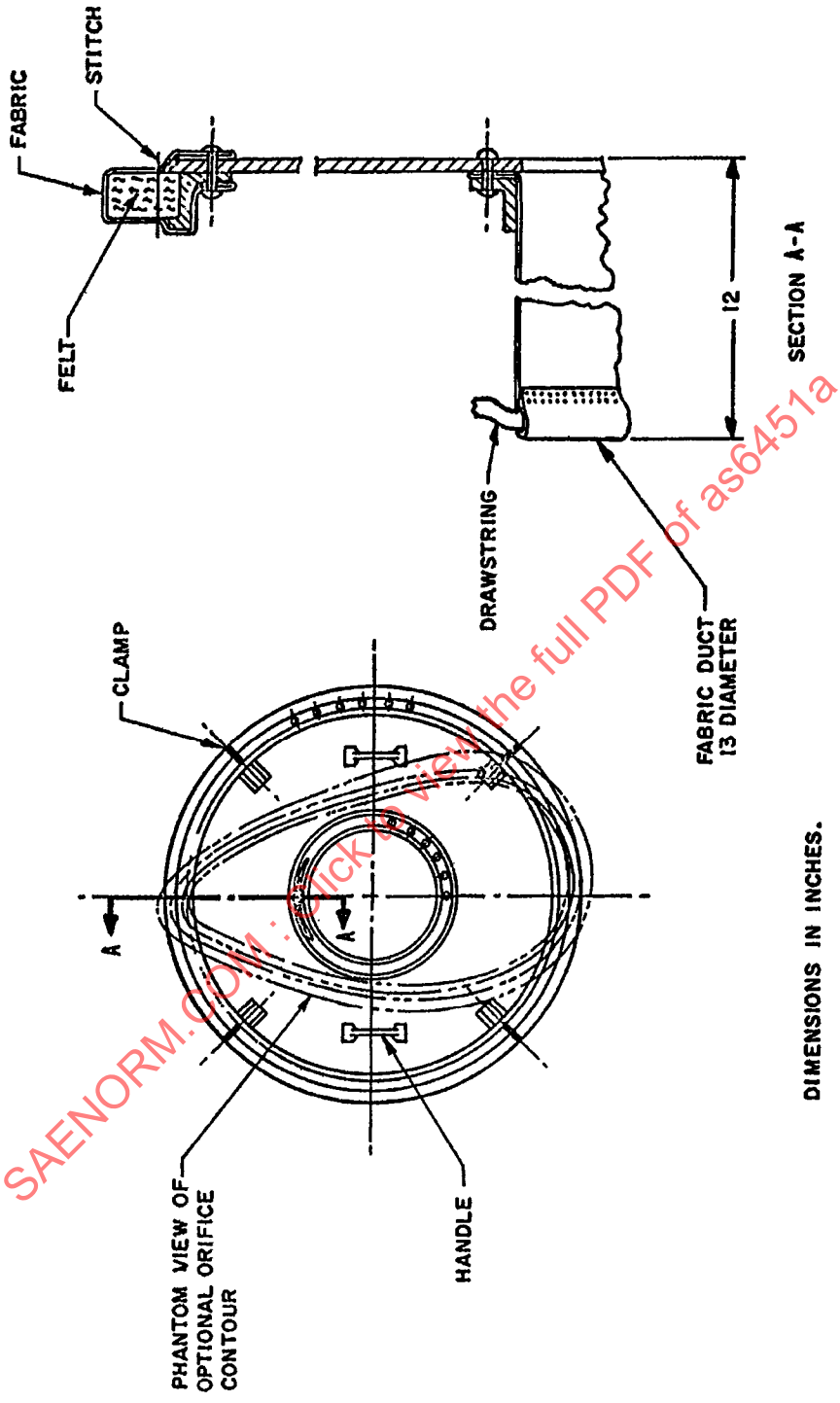

FIGURE 2. Jet aircraft or missiles.

3.5.1.1 Clamps: Clamps shall be substantially as shown on the applicable figure to secure the shield in place. Where practical, the clamps shall be located as shown on figures 1 and 2. When the configuration of the shield will not permit four clamps, a sufficient number of clamps shall be used to hold the shield in place. Each clamp shall press against the aircraft skin to hold the shield in place. The force exerted from the clamp shall not damage the skin. If the aforementioned clamp is not practical, the clamp shall be designed and constructed to be inserted into the air duct, or for fastening to the engine cowl.

3.5.1.2 Channel attachment: The two sections of the shield for radial engines shall be joined by a channel to form a tongue-and-groove attachment. The bottom horizontal edge of the upper shield shall receive and retain the upper edge of the lower shield. The connection of the two shall form a dust-tight seal. The arrangement shall be such that the upper section will be installed in the cowl after the lower section has been installed.

3.5.1.3 Felt seal: The periphery of the shield and the inner periphery that contact the propeller hub shall be covered with 1.50 by .75-inch felt seal conforming to C-F-206. The seal shall absorb variations in the cowl and orifice opening to assure close fit and protect the aircraft skin. The felt shall compress .75 inch from the 1.50 inch thickness when installed in the opening.

3.5.1.3.1 Felt bonding: The felt shall be bonded into the channel with cement conforming to MMM-A-1617, type II. The cured adhesive shall be stronger than the felt. The felt shall be covered and held in place with waterproofed, type 2, class 5 cloth conforming to MIL-C-10799. The cloth shall overlap the channel and shall be riveted through two thicknesses of the fabric.

3.5.1.4 Handles: The shield shall be provided with commercial-type handles located to facilitate installation and removal. The upper shield for radial engines shall be equipped with two handles. The lower shield need not be provided with handles. The shields for jet aircraft shall be equipped with one or two handles.

3.5.1.5 The shields shall be so constructed that simple handtools, such as screwdrivers and open end wrenches, may be used for maintenance and servicing.

3.5.2 Class 2 shield: The class 2 shield shall be constructed of material conforming to the requirements of 3.3.4. Thermal and ultraviolet stabilizers shall be added to the virgin base resin adequate to prevent fading of color and deterioration of material due to elevated temperatures and prolonged exposure to sunshine. Specified color shall be achieved by the addition of inorganic pigments. The shield shall provide an interference press fit when placed within the opening or on the flange of the desired orifice. The structural design of the shield shall be governed by the required size of the opening and the minimum thickness shall be 0.1 inch. The shield shall be of one- or two-piece sections as specified in 3.5.1 and 3.5.2.1.

3.5.2.1 Sectionalized class 2 shield: Sectionalized class 2 shields, when required, shall be joined by an integral preformed channel to form a tongue-and-groove attachment. The arrangement of each section of the shield shall conform to the best engineering practice. The assembled shield shall form a dust-tight seal.

3.5.2.2 Installation and removal: Provisions shall be made for installation and removal of the shield from the required orifice. The provisions shall be formed as an integral part of the shield and not assembled to the shield.

3.5.3 Heater ducts: When specified (see 6.2), heater ducts shall be provided on class 1 shields only to serve as a media for attaching ground heater ducts for preheating aircraft or missile engines, et cetera.

3.5.3.1 Heater duct sleeve: When specified (see 6.2), a heater duct sleeve shall be provided as follows.

3.5.3.1.1 Openings: The preheat access opening in the shield for most radial engines shall consist of two apertures. The openings shall be in the lower half of the shield, and shall be of the largest cross-sectional area obtainable within the limits of the shield. When the combined area of the two openings does not equal the area of a 12-inch diameter circle, an additional opening shall be made in the upper half of the shield. This opening shall be the largest cross-sectional area obtainable within the limits of the clamps. The heater duct sleeve shall vent into the shield so that all apertures will receive a heater duct. The opening for jet aircraft shall be 12 inches in diameter, centrally located in the shield. If the configuration of the shield will not permit a 12-inch diameter opening, the largest cross-sectional area obtainable within the limits of the shield shall be provided.

3.5.3.1.2 Sleeve construction: The sleeve shall be fabricated of type II, class 5 cloth conforming to MIL-C-10799. The opening in the free end of the sleeve shall accept a 12-inch diameter heater duct or a 6-inch diameter heater duct by utilizing a drawstring. If the configuration of the shield will not permit the 12-inch diameter opening, the fabric sleeve shall taper out to accommodate the heater ducts.

3.5.3.2 Preheat openings: A preheat access opening for other than engine inlet shields shall be designed with the best engineering practice for the required operation. The design shall be approved by the procuring activity.

3.5.4 Warning streamer: Unless otherwise directed by the contracting officer (see 6.2), all shields shall have warning streamers attached. Warning streamers shall be in accordance with NAS 1756.

3.6 Performance:

3.6.1 Environmental conditions: The shield shall be capable of withstanding or operating under the following conditions:

a. Temperatures - Operation at -54° to +51.7°C; storage at a-54° to +71°C
b. Humidity - 95 percent up to 38°C
c. Sand and dust particles as encountered in desert areas
d. Fungus growth as encountered in tropical areas
e. Salt fog atmosphere
f. Sunshine as encountered in desert areas
g. Rain.

3.6.2 Functional performance: The shield shall be capable of constant usage without failure of any part while under normal conditions of handling and use. All wearing parts shall be readily replaceable. The shield shall be capable of remaining in place under all environmental conditions when the aircraft is not in operation. It shall be designed to allow for the differential expansion of shield and aircraft from a minimum temperature of -54°C to a maximum temperature of +51.7°C. The shield shall have sufficient flexibility to provide a good interference press fit throughout the above temperature range.

3.6.3 Impact resistance: The shield shall be capable of free fall from a height of 10 feet onto a concrete floor without damage.

3.7 Part numbering of interchangeable parts:

All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable. The item identification and part number requirements of MIL-STD-100 shall govern the manufacturer's part number and changes thereto.

3.8 Finishes and protective coatings:

Cleaning, painting, plating, anodic films, and chemical treatments shall be in accordance with MIL-STD-808. The final paint film shall be insignia red, film designation BG (plastic parts may be pigmented prior to molding). Class 2 (nonmetallic) shields and felt and fabric material shall not be painted.

3.9 Dimensions:

The overall dimensions of the shield shall be held to assure a press fit in the area being closed by the shield.

3.10 Weight:

The shield shall be of a minimum weight consistent with its size.

3.11 Identification of product:

A nameplate permanently and legibly marked in accordance with MIL-STD-130 shall be securely attached to each section (upper and lower) of the shield. The following special marking shall be included:

FOR USE ON TYPE _____ AIRCRAFT (OR MISSILES).

3.12 Workmanship:

The shields, including all parts and accessories, shall be constructed and finished in a thoroughly workmanlike manner. Particular attention shall be given to strength of welds, neatness and thoroughness of painting, riveting, machine-screw assemblies, molding, forming, fit, function, et cetera. Parts, assemblies and end items shall be free of defects such as, but not limited to, burrs, cracks or crazing, fatigue, loose components, and rough or sharp edges.

3.12.1 Dimensional tolerances: Dimensions and tolerances not specified shall be as close as is consistent with the best shop practices. Where dimensions and tolerances may affect the interchangeability, operation, or performance of the shield, they shall be held or limited accordingly.

3.12.2 Class 1 shields shall be fabricated by drawing or bending and welding, except where ease of servicing of the shields requires that a removable panel construction be used or where the applicable stresses dictate the use of strong aluminum alloy that does not provide a good weld; for such parts, riveting or bolting may be used.

3.12.3 Molding, forming, pressing, et cetera, of class 2 shields shall be accomplished with the use of accurate molds, presses, and forms. Shields shall be fabricated for ease of installation and removal and to provide a press fit in the required orifice.

3.12.4 Screw assemblies: Assembly screws and bolts shall be tight; restraint items such as lock washers, lock nuts, safety wiring, cotter pins, epoxy, et cetera, shall be used as necessary.

3.12.5 Riveting: Riveting operations shall be performed to insure that the rivets are tight and satisfactorily headed.

3.12.6 Cleaning: The shields shall be thoroughly cleaned of loose, spattered, or excess weld, metal chips, or other foreign material after final assembly. Burrs and sharp edges, as well as resin flash that may crumble, shall be removed.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

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

4.2 Classification of tests:

The inspection and testing of the shields shall be classified as follows:

a. Preproduction testing . . . . . See 4.4
b. Quality conformance tests . . . . . See 4.5.

4.3 Test conditions:

4.3.1 Standard test conditions: Unless otherwise specified herein, all tests shall be conducted under room conditions with the temperature at 25° ±10°C, the relative humidity at 90 percent or less, and the barometric pressure at 28 to 32 inches Hg.

4.4 Preproduction testing (see 6.2):

4.4.1 Test samples: The test samples shall be subjected to the preproduction test of 4.4.3. The samples shall be made by the same methods that are used in production.

4.4.2 Test report: After completing the preproduction tests, a test report shall be prepared in accordance with MIL-STD-831.

4.4.3 Preproduction tests: The preproduction tests shall consist of all tests described under 4.6. The tests shall be conducted on the preproduction samples as follows:

4.4.3.1 Class 1 shields: Two samples, representative of each design being procured, shall be subjected to the following tests conducted in the sequence listed:

a. Examination of product . . . . . See 4.6.1
b. Rain . . . . . See 4.6.3.1
c. Dust . . . . . See 4.6.3.2
d. Salt fog . . . . . See 4.6.3.7
e. Adhesive . . . . . See 4.6.4
f. Drop test. . . . . See 4.6.5.

4.4.3.2 Class 2 shields:

4.4.3.2.1 Two samples, representative of each design being procured, shall be subjected to the following tests conducted in the sequence listed:

a. Examination of product . . . . . See 4.6.1
b. High temperature . . . . . See 4.6.3.3
c. Low temperature . . . . . See 4.6.3.4
d. Rain. . . . . See 4.6.3.1
e. Dust. . . . . See 4.6.3.2
f. Drop test . . . . . See 4.6.5.

4.6.3.2.1.1 After completion of the tests, the two samples shall be installed on one aircraft of the model and series for which it is intended to demonstrate fit and function.

4.6.3.2.2 A sample of the material used in the design of each class 2 shield shall be subjected to the following tests as described under 4.6:

a. Solar radiation (sunshine) . . . . . See 4.6.3.5
b. Fungus . . . . . See 4.6.3.6.

4.5 Quality conformance tests:

The quality conformance tests shall consist of the following:

a. Individual tests . . . . . See 4.5.1
b. Sampling tests . . . . . See 4.5.2.

4.5.1 Individual tests: Each shield shall be subjected to the following tests as described under 4.6:

a. Examination of product . . . . . See 4.6.1
b. Functional tests . . . . . See 4.6.2.

4.5.2 Sampling tests: One shield representative of each design shall be selected at random from every 25 or fraction thereof produced and shall be subjected to the following tests. For production sampling, these tests are not required provided adequate quality control, with applicable records, are maintained to assure that compounding, fabrication, and physical properties of the production shields are the same as those which have passed preproduction testing.

a. Rain
b. Dust (for a period of 1 hour).

4.5.2.1 Rejection and retest: When an item selected from a production run fails to conform to this specification, items still on hand or later produced shall not be accepted until the extent and cause of failure have been determined and appropriately corrected. The contractor shall explain to the Government representative the cause of failure and the action taken to preclude recurrence. After correction, all of the tests shall be repeated.

4.5.2.2 Individual tests may continue: For production reasons, individual tests or other sampling plans may be continued pending the investigation of a sampling test failure. Final acceptance of the items on hand or produced later shall not be made until it is determined that all items meet all the requirements of the specification.

4.5.3 Defects in items already accepted: The investigation of a test failure could indicate that defects may exist in items already accepted. If so, the contractor shall fully advise the procuring activity of all the defects likely to be found and take action to correct them at no expense to the Government.

4.6 Test methods:

4.6.1 Examination of product: The shield shall be examined to determine conformance to the requirements of this specification that are not covered by specific test procedures, with respect to accuracy of dimensions, quality of workmanship, use of proper materials and finishes, and visible defects. In addition, all moving parts shall be visually examined to insure that they operate freely, without sticking or binding, yet fit with sufficient tightness to preclude the possibility of malfunction. The shield shall be examined uninstalled to assure that oil-canning does not occur.

4.6.2 Functional test: The shield shall be placed in the required orifice and visually inspected to determine that the entire opening is closed, and any misalinement, distortion, or any other defects that may prevail shall be corrected. The compression of the felt seal in class 1 shields and the press fit of class 2 shields shall be observed to determine the effectiveness of the seal.