

INCH-POUND  
TT-P-1952E  
06 August 2007  
SUPERSEDING  
TT-P-1952D  
January 7, 1994

## FEDERAL SPECIFICATION

### PAINT, TRAFFIC AND AIRFIELD MARKING, WATERBORNE

The General Services Administration has authorized the use of this federal specification by all federal agencies.

#### 1. SCOPE AND CLASSIFICATION.

1.1 Scope. This specification covers three types of low VOC (volatile organic compounds), ready-mixed, one-component, 100% acrylic waterborne airfield and traffic marking paint. The paint is suitable for application on such traffic-bearing surfaces as Portland cement concrete, bituminous cement concrete, asphalt, tar, and previously painted areas of these surfaces. The paint may be used either alone or to bind reflective beads.

#### 1.2 Classification.

1.2.1 Types. The paint shall be furnished in the following types, as specified (see 6.2):

Type I - For use under normal conditions

Type II - For use under adverse conditions (see 6.1)

Type III - For increased durability

1.2.2 Color. Traffic paint shall be furnished in white and any Federal Standard 595 color, as specified (see 3.2.7 and 6.3).

2. APPLICABLE DOCUMENTS. The following documents, of the issues in effect on date of invitation for bids or request for proposal, form a part of this description to the extent specified herein.

2.1 Government Publications. The issues of the following documents, in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

Beneficial comments, recommendations, additions, deletions, clarifications, etc. and any data which may improve this document should be sent to: HQ AFCESA/CESC, 139 Barnes Drive, Suite 1, Tyndall AFB FL 32403-5319.

FSC 8010

Distribution Statement A. Approved for public release. Distribution is unlimited.

TT-B-1325 - Beads (Glass Sphere), Retro-reflective

FED-STD-595 - Colors Used in Government Procurement

(Single copies of this specification, and other federal specifications and commercial item descriptions required by activities outside the Federal Government for bidding purposes are available without charge from the General Services Administration, Federal Supply Service, Specification Section, Suite 8100, 470 L'Enfant Plaza, SW, Washington, DC, 20407)

## 2.2 Federal Regulations.

40 CFR Part 60, Appendix A

29 CFR Part 1910.1200

(The Code of Federal Regulations (CFR) is available online at <http://www.gpoaccess.gov/cfr/index.html> or for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

2.3 Other publications. The following documents form a part of this description to the extent specified herein. Unless a specific issue is identified, the issue in effect on the date of invitation for bids or request for proposal shall apply.

### 2.3.1 American Society for Testing and Materials (ASTM) Standards.

- D 522 - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
- D 562 - Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
- D 711 - Standard Test Method for No-Pick-Up-Time of Traffic Paint
- D 968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasives
- D 969 - Standard Test Method for Laboratory Determination of Degree of Bleeding of Traffic Paint
- D 1210 - Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
- D 1394 - Standard Test Methods for Chemical Analysis of White Titanium Pigments
- D 1640 - Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
- D 1729 - Standard Practice for Visual Appraisal of Colors and Color Differences of Diffusely Illuminated Opaque Materials
- D 1849 - Standard Test Method for Package Stability of Paint

- D 2243 - Standard Test Methods for Freeze-Thaw Resistance of Water-Borne Coatings
- D 2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
- D 2369 - Standard Test Method for Volatile Content of Coatings
- D 2486 - Standard Test Methods for Scrub Resistance of Wall Paints
- D 2697 - Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
- D 2805 - Hiding Power of Paints by Reflectometry
- D 3335 - Standard Test Method for Low Concentrations of Lead, Cadmium and Cobalt in Paint by Atomic Absorption Spectroscopy
- D 3718 - Standard Test Method for Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy
- D 3723 - Standard Test Method for Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing
- E-1347 - Standard Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry.
- G 154 - Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, (610) 832-9500, [www.astm.org](http://www.astm.org).)

### 3. REQUIREMENTS.

#### 3.1 Composition.

3.1.1 Materials. The non-volatile portion of the vehicle for all types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis. The acrylic resin used for Type III shall be a 100% cross-linking acrylic as evidenced by infrared peaks at wavelengths 1568, 1624, and 1672 cm<sup>-1</sup> with intensities equal to those produced by an acrylic resin known to be 100% cross-linking.

3.1.2 Prohibited material. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, toluene, chlorinated solvents, hydrolysable chlorine derivatives, ethylene-based glycol ethers and their acetates, nor any carcinogen, as defined in 29 CFR 1910.1200. When tested as specified in 4.3.1, the lead content shall not exceed 0.06 percent by weight of the dry film and the test for chromium content shall be negative.

#### 3.2 Qualitative requirements.

3.2.1 Condition in the container. When tested, as specified in 4.3.2, the paint, as received, shall show no evidence of biological growth, corrosion of the container, livering, or hard settling. The paint shall be dispersible by hand stirring for 5 minutes to a

smooth and homogenous consistency, exempt of gel structures, persistent foam or air bubbles.

3.2.2 Appearance. When tested as specified in 4.3.3, the paint shall produce a film which is smooth, uniform, and free from grit, undispersed particles, craters, and pinholes.

3.2.3 Accelerated package stability. After storage as specified in 4.3.4, the sample shall conform to the requirements of 3.2.1 and 3.2.2. The sample shall show no change in consistency greater than 5 KU (Krebs Unit) from the value in Table 1.

3.2.4 Flexibility. When tested as specified in 4.3.6, the paint film shall not crack, chip or flake after the test panel is bent 180 degrees over a 13 mm (1/2 in) mandrel.

3.2.5 Water resistance. When tested as specified in 4.3.5, the paint film shall not soften, blister, wrinkle, lose adhesion, change color, or show other evidence of deterioration.

3.2.6 Freeze-thaw stability. When tested as specified in 4.3.8, the paint shall show no coagulation or flocculation, change in consistency greater than 10 KU from the value in Table 1, or a decrease in scrub resistance by more than 10 percent of the requirement in 3.2.13.

3.2.7 Color requirements.

3.2.7.1 Color match. For all colors except white and yellow, when tested as specified in 4.3.9.3, the paint shall match the specified Federal Standard 595 color number within a  $\Delta E$  or 6.0 CIELAB units.

3.2.7.2 Daylight directional reflectance. When tested as specified in 4.3.9.2, the white paint shall have the daylight directional reflectance specified in Table 1.

3.2.7.3 Yellow color match. The yellow traffic paint shall be an appropriate color match to Federal Standard 595 color number 33538 when tested in accordance with 4.3.9.4.

3.2.8 Heat-shear stability. When tested as specified in 4.3.13, the sample shall not show signs of gelling or other instability. The consistency shall be in compliance with Table 1.

3.2.9 Skinning. The paint shall not skin when tested as specified in 4.3.14.

3.2.10 Dry-through (early washout). For Type II only, the paint when tested as specified in 4.3.15 shall have a dry-through time less than 120 minutes.

3.2.11 Abrasion resistance. When tested as specified in 4.3.7, both baked and weathered paint films shall require not less than 150 liters of sand to abrade the paint film through to the substrate.

3.2.12 Accelerated weathering. When tested as specified in 4.3.10, the colored samples after weathering shall be in conformance with 3.2.7. The directional reflectance of white paint shall meet the requirement in Table 1. After performing the scrub resistance test in accordance with 4.3.12, the paint shall be in conformance with 3.2.13.

3.2.13 Scrub resistance. When tested as specified in 4.3.12, it shall not take less than 500 cycles to remove the paint film.

3.2.14 Titanium dioxide content. When tested in accordance with 4.3.16, the yellow, green, and blue colored paint shall contain a maximum of 23.7 g/L (0.2 lb/gal) rutile titanium dioxide. The white paint shall contain a minimum of 120 g/L (1 lb/gal) rutile titanium dioxide.

3.3 Quantitative requirements. The paint shall meet the quantitative requirements specified in Table 1.

Table I. Quantitative Requirements.

Characteristics	Min	Max
Consistency	80	90
Volatile organic content (VOC), grams/liter	---	150
Solids by volume <sup>1</sup>		
Yellow or white	60	---
Other colors	58	---
Pigment, percent by weight	60	62
Dry opacity - White and colors	0.92	---
Black	1.00	
Directional reflectance of white paint, percent	85	---
Drying time for no pick up, min.	---	10
Fineness of dispersion, Hegman	3.0	---
Heat-shear stability, consistency, KU	68	105
Bleeding ratio	0.95	---

<sup>1</sup> Manufacturers may calculate this requirement from batch card data, but in case of dispute the method specified in Table 2 must be used.

3.4 Material Safety Data Sheet. A Material Safety Data Sheet (MSDS) shall be submitted in accordance with FED-STD-313 (see 6.2).

#### 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 that supplies and services conform to prescribed requirements.

4.2 Classification of inspections. Inspections shall be classified as follows: (a) inspection of preparation for delivery (see 4.2.1); (b) acceptance testing (see 4.2.2).

4.2.1 Inspection in preparation for delivery. Prior to shipment, containers shall be examined for compliance with Section 5.

4.2.2 Acceptance testing. Testing for acceptance of individual lots shall be done in accordance with section 1000 of FED-STD-141 and shall consist of test and inspections as indicated in Table 2.

4.3 Test methods. Samples shall be tested as specified in Table 2. Unless otherwise specified, tests shall be performed at standard conditions, which are 25° ± 1°C and 50% ± 5% relative humidity. All test reports shall contain the individual values used in expressing the final result. Test results shall be evaluated for conformance to requirements. The sample shall be unacceptable if any test result is not in conformance with the corresponding requirement in section 3.

Table II. Index

Characteristic	Acceptance Testing	Requirement Paragraph	ASTM Method	Test Paragraph
Lead content		3.1.2	D 3335	4.3.1.1
Chromium content		3.1.2	D 3718	4.3.1.2
Condition in container	Yes	3.2.1	---	4.3.2
Appearance	Yes	3.2.2	---	4.3.3
Accelerated package stability		3.2.3	D 1849	4.3.4
Flexibility	Yes	3.2.4	D 522	4.3.5
Water resistance	Yes	3.2.5	---	4.3.6
Freeze-thaw stability	Yes	3.2.6	D 2243	4.3.8
Color	Yes	3.2.7	D 2244	4.3.9
Directional reflectance	Yes	3.2.7.2	E 1347	4.3.9.2
Yellow color match	Yes	3.2.7.3	D 1729	4.3.9.4
Heat-shear stability	Yes	3.2.8	---	4.3.13
Skinning	Yes	3.2.9	---	4.3.14
Dry-through (early washout)	Yes	3.2.10	D 1640	4.3.15
Abrasion resistance	Yes	3.2.11	D 968	4.3.7

Accelerated weathering		3.2.12	G 154	4.3.10
Scrub resistance	Yes	3.2.13	D 2486	4.3.12
Volatile organic content		Table 1	D 2369	---
Consistency	Yes	Table 1	D 562	---
Solids by volume	Yes	Table 1	D 2697	---
Dry opacity	Yes	Table 1	D 2805	4.3.11
Dry time (no pick up)	Yes	Table 1	D 711	---
Fineness of dispersion	Yes	Table 1	D 1210	---
Bleeding ratio		Table 1	D 969	---
Pigment (percent by weight)		Table 1	D 3723	---
Titanium dioxide		3.2.14	D 1394	4.3.16

#### 4.3.1 Prohibited materials.

4.3.1.1 Lead content. Determine lead in accordance with ASTM D 3335 or by the use of an X-ray fluorescence spectrometer in accordance with the manufacturer's manual. The X-ray method shall be used in case of dispute. Evaluate for compliance with 3.1.2.

4.3.1.2 Chromium (hexavalent) content. Add 5 ml of 25 percent aqueous KOH (potassium hydroxide) to 0.5 g of the extracted pigment contained in a centrifuge tube. Agitate by shaking and centrifuge. A yellow color in the supernatant liquid indicates the presence of hexavalent chromium. If the results of the above test are inconclusive, then use the procedure in ASTM D 3718 to test for chromium content. Evaluate results for compliance with 3.1.2.

4.3.2 Condition in the container. Before stirring the contents of the container in which the material was originally packaged, check for evidence of biological growth and corrosion. Then lower a spatula into the container and determine whether the paint has livered or developed hard settling. Disperse the paint with the spatula for 5 minutes and examine for compliance with 3.2.1.

4.3.3 Appearance. Draw down the paint on a clear glass panel to a wet film thickness of 0.33 mm (0.013 in), and allow to dry for 24 hours at standard conditions. Evaluate for conformance with 3.2.2.

4.3.4 Accelerated package stability. Fill a 550 mL (1 pint) resin-lined friction-top can with the sample. Ensure that the bulk sample from which the cans are filled is well stirred and uniform, that the containers used are clean, and that the lids are applied promptly to the cans to prevent evaporation losses. Store at a temperature of 52°C for 2 weeks. Evaluate following the procedure in ASTM D 1849, except allow hand stirring for

5 minutes to ensure uniform distribution. Evaluate the consistency for conformance with Table 1. Draw down the paint as described in 4.3.3. Evaluate for conformance with 3.2.3.

4.3.5 Flexibility. Determine flexibility in accordance with Method B of ASTM D 522. Draw down the paint to a wet film thickness of 0.13 mm (0.005 in) on a clean, bare, cold-rolled steel panel. Air-dry the panel for 24 hours at standard conditions, then bake for 5 hours at  $105^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , and finally condition the panel for 30 minutes at standard conditions. Bend over a 13 mm (0.5 in) diameter cylindrical mandrel and examine under a magnification of 7 diameters for compliance with 3.2.4.

4.3.6 Water resistance. Prepare a 10 by 15 cm concrete panel as specified in Method 2051 Procedure B of FED-STD-141. Draw down to a wet film thickness of 0.33 mm (0.013 in) and allow it to dry in a horizontal position at standard conditions for 72 hours. Immerse one-half of the painted panel in distilled water at  $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$ . After 18 hours, remove the panel from the water and allow it to dry for 2 hours at standard conditions. Evaluate for conformance with 3.2.5.

#### 4.3.7 Abrasion resistance.

4.3.7.1 Sample preparation. Draw down the paint on four glass panels measuring approximately 100 by 200 mm to a dry film thickness of 0.102 mm to 0.107 mm.

4.3.7.2 Baked films. Air-dry two of the panels for 24 hours at standard conditions and then bake for 5 hours at  $105^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . After baking, condition the panels for 30 minutes at standard conditions and then run the abrasion test as specified in 4.3.7.4.

4.3.7.3 Weathered films. Air-dry the other two panels for 48 hours at standard conditions then subject the panels to accelerated weathering in accordance with 4.3.10. Remove the panels and condition for 24 hours at standard conditions, then run the abrasion test as specified in 4.3.7.4.

4.3.7.4 Test. Subject the panels to the abrasion test in accordance with ASTM D 968, Method A, except that the inside diameter of the metal guide tube shall be from 18.97 to 19.05 mm. Five liters of unused sand shall be used for each test panel. The test shall be run on two test panels. (Note: Five liters of sand weigh 7.94 kg.) Evaluate for compliance with 3.2.11.

4.3.8 Freeze-thaw stability. Test in accordance with ASTM D 2243 for three freeze-thaw cycles. Perform the consistency test in accordance with ASTM D 562 and the scrub resistance test as described in 4.3.12. Check for conformance with 3.2.6.



#### 4.3.9 Color.

4.3.9.1 Sample preparation. Use the test panels prepared for the accelerated weathering test (4.3.10.1).

4.3.9.2 Daylight directional reflectance. For the white paint, determine the directional reflectance before and after weathering in accordance with ASTM E 1347 using the 45/0 illumination. Evaluate for conformance with Table 1.

4.3.9.3 Color match. For colors other than white and yellow, determine the color difference of the paint before and after weathering in accordance with ASTM D 2244 using CIE Illuminant D65 with the 10 degree standard observer. Evaluate for conformance with 3.2.7.

4.3.9.4 Yellow color match. Determine the color match for yellow paint before and after weathering in accordance with ASTM D 1729 with the daylight illumination represented by CIE Illuminant D75 or D65. Evaluate for conformance with 3.2.7.3.

#### 4.3.10 Accelerated weathering.

4.3.10.1 Sample preparation. Apply the paint at a wet film thickness of 0.33 mm (0.013 in) to four 8 by 15 cm solvent-cleaned aluminum panels. Air-dry the sample for 48 hours under standard conditions.

4.3.10.2 Testing conditions. Test in accordance with ASTM G 154 using both ultraviolet light (UV-B PS-40) and condensate exposure, 300 hours total, alternating 4 hours of UV exposure at 60°C and 4 hours of condensate exposure at 40°C.

4.3.10.3 Evaluation. Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in 4.3.9.2 and 4.3.9.3. Evaluate for conformance with the color requirements in 3.2.7. Using the procedure described in 4.3.12, run the scrub resistance test. Evaluate for conformance with 3.2.13.

4.3.11 Dry opacity. Use the procedure of ASTM 2805, calculate the contrast ratio of the paint applied at a wet film thickness of 0.13 mm (0.005 in). Evaluate for conformance with Table 1.

4.3.12 Scrub resistance. Using the procedure of ASTM D 2486 modified to use the 8 by 15 cm test panels from the accelerated weathering test (4.3.10), evaluate for conformance with 3.2.13.

4.3.13 Heat-shear stability. One pint of the paint is sheared in a kitchen blender at high speed to 65°C. The blender should have a tight-fitting lid and taped to minimize volatile loss. When the paint reaches 65°C, stop the blender, immediately can and apply

a cover. Let cool a minimum of 12 hours and examine for gelling or other signs of instability. Evaluate for compliance with 3.2.8.

4.3.14 Skimming. Place 188 mL of the paint in a 250 mL container and seal. Invert the container momentarily and then place upright in a dark environment at 22.2–26.7°C (70–80°F) for 48 hours. Examine for compliance with 3.2.9.

4.3.15 Dry-through (early washout) (For Type II only). Draw down the paint on a glass panel to a wet film thickness of 0.33 mm (0.013 in). Immediately place in a humidity chamber maintained at 23°C ± 2°C and 90% ± 3% relative humidity. Test in accordance with ASTM D 1640, except that the pressure exerted will be the minimum needed to maintain contact with the thumb and film. Check for compliance with 3.2.10.

4.3.16 Titanium dioxide content. Determine the titanium dioxide content using the aluminum reduction method of ASTM D 1394. Evaluate for conformance with 3.2.14.

## 5. PACKAGING.

5.1 Packaging, packing and marking. The paint shall be packaged in containers as required by the procurement documents. Unless otherwise specified, each container shall be labeled with the following information:

Name: PAINT, TRAFFIC AND AIRFIELD MARKING, WATERBORNE  
Specification: TT-P-1952E, Type:  
Color:  
Batch Number:  
Date of Manufacture:  
Quantity of Paint in Container:  
Information and Warnings as may be required by Federal and State Laws:  
Manufacturer's Name and Address:

### 5.2 Special marking.

5.2.1 Shipping container markings. Each shipping container shall be marked:

“PROTECT FROM FREEZING - STORE ABOVE 2°C (35°F)”

5.2.2 Unit container markings. Each unit container shall be marked as follows:

“PROTECT FROM FREEZING - STORE ABOVE 2°C (35°F)”

“After opening, maintain a thin layer of water on surface of paint during storage to prevent skinning.”

“Use only in equipment designed for water-based paints.”

“This paint may be reflectorized by dropping glass beads conforming to TT-B-1325 onto the wet paint. The surface to be coated shall be free from dirt, oil, grease, curing compounds, or other contaminants, and loose, peeling, or poorly bonded paint. The paint shall be applied to the surface at a wet film thickness of 0.33 mm (0.013 in), while air and surface temperatures are above 10°C (50°F) and rising.”

## 6. NOTES.

INFORMATION FOR GUIDANCE ONLY. (This section contains information of a general or explanatory nature that is helpful, but is not mandatory.)

6.1 Intended use. (This paragraph is non-mandatory and shall not supersede specific use requirements in contract documents.) These paints are intended for use on concrete, bituminous, brick, or stone surfaces of airfields, highways, bridges, tunnels, streets, or parking lots when applied at a wet film thickness of 0.33 mm (0.013 in) by traffic-striping equipment designed for water-based paints. The white and yellow paint stripes should preferably be reflectorized for night visibility by adding glass beads conforming to TT-B-1325. A wet film thickness of 0.457–0.635 mm (0.018–0.025 in) is commonly specified when Type IV A beads are used and 0.381–0.457 mm (0.015–0.018 in) is commonly specified when Type IV B beads are used. The black paint is intended for use as a border around markings on light-colored pavements and as an obliterating paint for painting out existing markings to permit remarking in a different manner.

Type I - For use under normal weather conditions, i.e., 50% relative humidity, moderate temperatures and slight breezes. Not for use at the greater thickness required for the larger diameter Type IV beads.

Type II - For use under adverse conditions, i.e., night striping, higher humidity (around 80%), low air movement and lower surface temperatures, down to 10°C (50°F). Not for use at the greater thickness required for the larger diameter Type IV beads.

Type III - For use under normal weather conditions where higher durability and greater adhesion to glass beads is desired. Minimum application temperature should be 12.8°C (55°F) and rising. Low temperature will result in greater dry time, especially when specifying increased thickness as required when using Type IV beads.

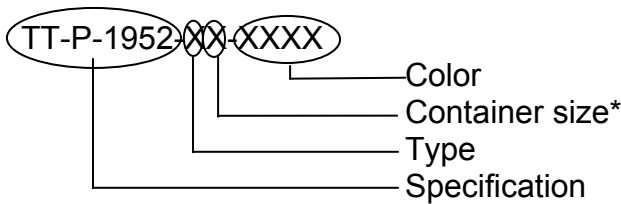
6.2 Ordering data. Purchasers should select the preferred options permitted herein, and include the following information in procurement documents:

- a. Title and date of this specification.
- b. Type required (see 1.2).
- c. Color required (see 1.2.2 and 6.3).
- d. Size and requirements for containers (see 5.1).
- e. Packaging and packing level.
- f. Marking required (see 5.1 and 5.2).
- g. Requirements for Material Safety Data Sheets.

6.3 Colors. The most common colors and their FED-STD-595 color chip numbers are:

- a. Yellow – 33538
- b. Green – 34108
- c. Black – 37038
- d. Blue -- 35180
- e. Red – 31136
- f. White -- 37925

6.4 Part Identification number (PIN). Part numbers for cataloging purposes under this specification may be coded as follows:



\*Container size codes:

- 1 - 3.78 liters (1 gallon)
- 2 - 18.9 liters (5 gallons)
- 3 - 113.4 liters (30 gallons)
- 4 - 207.9 liters (55 gallons)

6.5 Key Word Listing.

- a. Paint
- b. Reflective beads
- c. Traffic
- d. Airfield

MILITARY INTERESTS

Custodian  
Air Force -- 99  
Navy – YD  
  
Reviewing Activity  
Air Force – 50

CIVIL AGENCY  
COORDINATING ACTIVITIES:

FAA – AAS – 100

Preparing Activity  
Air Force-84

Agent activity  
Air Force-99

Project 8010-2007-011

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://assist.daps.dla.mil>.