

1 SCOPE

- a. This specification establishes the requirements for plastic film for markers used as informational signs and as decorative markings on aircraft.
- b. This specification requires qualified products.

1.1 CONTENTS

<u>Section</u>	<u>Subject</u>	<u>Page</u>
1	SCOPE	1
1.1	CONTENTS	1
2	CLASSIFICATION	2
2.1	TYPES	2
2.2	GRADES	3
3	REFERENCES	3
4	DEFINITIONS	4
5	MATERIAL REQUIREMENTS	4
6	QUALIFICATION	6
6.1	REQUESTS FOR QUALIFICATION	6
6.2	SAMPLES AND TEST REPORTS	6
6.3	APPROVAL	7
7	QUALITY CONTROL	7
7.1	SUPPLIER QUALITY CONTROL	7
7.2	PURCHASER QUALITY CONTROL	7
8	MATERIAL TEST METHODS	8
8.1	GENERAL	8
8.2	TEST PANEL PREPARATION	8
8.2.1	CLEANING OF TEST PANELS	8
8.2.2	APPLICATION OF MATERIAL	8

Authorizing Signatures on File	PLASTIC FILM FOR MARKERS	BMS 10-26J
	BOEING MATERIAL SPECIFICATION	PAGE 1 OF 13

1.1	<u>CONTENTS</u> (Continued)	
8.3	TEST METHODS	9
8.3.1	COLOR	9
8.3.2	GLOSS	9
8.3.3	FILM THICKNESS	9
8.3.4	FLEXIBILITY	9
8.3.5	ADHESION	9
8.3.6	OPACITY	10
8.3.7	STORAGE STABILITY	10
8.3.8	WEATHERING (ACCELERATED)	10
8.3.9	FLUID RESISTANCE	11
8.3.10	SOIL RESISTANCE	12
8.3.11	ACCELERATED AGING	12
8.3.12	FLAMMABILITY	12
9	MATERIAL IDENTIFICATION	13
10	PACKAGING AND MARKING	13

LIST OF TABLES

<u>Number</u>	<u>Title</u>	<u>Page</u>
TABLE I	TEST REQUIREMENTS	5

2 CLASSIFICATION

The following types of films are covered by this specification:

2.1 TYPES

Type designates the type of material making up the film, and whether the film is coated with an adhesive and protective backing sheet. If no Type is specified, Type I or Type VI shall be used.

- Type I – An unperforated vinyl film that is coated on its back side with adhesive and a removable backing sheet to protect the adhesive. Type I material is intended for use on interior surfaces.
- Type II – Obsolete. Type III (VII) or IV (VIII) wherever Type II is specified.
- Type III – An unperforated weather-resistant polyester film that is coated on its front side with a removable protective backing sheet to protect the face, and on its back side with adhesive and a removable backing sheet to protect the adhesive. Type III material is intended for use on exterior surfaces.
- Type IV – Type III material that is perforated with 0.016–0.022 inch diameter holes on 0.27 – 0.29 inch centers in a square pattern. Type IV material is intended for use on exterior surfaces.

2.1 TYPES (Continued)

- Type V – An unperforated polyester film that has no adhesive on the back side. Type V material is available as Grade C only, and is intended for use on exterior surfaces.
- Type VI – A fire-resistant, unperforated polycarbonate film that has no adhesive on its back side. Type VI material is intended for use on interior surfaces.
- Type VII – An unperforated weather-resistant polyester film that is coated on its front side with a removable protective backing sheet to protect the face, and on its back side with adhesive and a removable backing sheet to protect the adhesive. Type VII material is intended for use on exterior surfaces. Type VII is equivalent to Type III when tested with the compatible ink, clear coat and edge seal.
- Type VIII – Type VII material that is perforated with 0.016–0.022 inch diameter holes on 0.27 – 0.29 inch centers in a square pattern. Type VIII material is intended for use on exterior surfaces. Type VIII is equivalent to Type IV when evaluated with the compatible ink, clear coat and edge seal.

2.2 GRADES

GRADE designates the method of printing for which the film is prepared for printing. When no Grade is specified, Grade A shall be used for Types I, III, IV, VII and VIII. When Type I is specified for parts in accordance with Book Number 27, either Grade A or Grade B may be used.

- Grade A – Material prepared for printing on the front surface by a silk-screening process.
- Grade B – Material prepared for printing on the back surface by a thermal printing process. Grade B material is intended for use in non-aesthetic areas such as wheel wells, ground stud markers, and electrical panels.
- Grade C – Material prepared for printing on the back surface by a silk-screening process.

3 REFERENCES

The issue of the following references in effect on the date of invitation for bid forms a part of this specification to the extent indicated herein .

- ASTM D 1729 – Standard Practice for Visual Evaluation of Color Differences of Opaque Materials
- ASTM G 53 – Standard Practice for Operating Light and Water-Exposure Apparatus
- BAC5312 – Application of Plastic Film Markers
- BAC5316 – Manufacture of Markers
- BAC5719 – Chemical Conversion Coatings for Aluminum and Aluminum Alloys
- BAC5736 – Application of Chemical and Solvent Resistant Finishes

3 REFERENCES (Continued)

- BAC5750 – Solvent Cleaning
- BAC5845 – Application of Polyurethane Enamel
- BSS7230 – Determination of Flammability Properties of Aircraft Materials
- D-14080 – Color Standardization, Materials and Processes
- FED-STD-595 – Federal Color Standards
- FED-STD-141 – Paint, Varnish, Lacquer, and Related Materials, Methods of Inspection, Sampling and Testing

4 DEFINITIONS

Not applicable to this specification.

5 MATERIAL REQUIREMENTS

- a. This specification requires material qualification prior to acceptance of production orders.
- b. Workmanship and appearance shall be free from blisters, cracks, foreign matter, and any other defect.
- c. Premask and adhesive backing sheets shall be capable of being removed intact by stripping, without the use of water or other solvents.
- d. Materials shall meet the requirements listed in Table I.

5 MATERIAL REQUIREMENTS (Continued)

TABLE I TEST REQUIREMENTS

ITEM	TEST	REQUIREMENTS	TYPE/GRADE								TEST METHODS	
			I/A	I/B	III/A	IV/A	V/C	VI/C	VII/A	VIII/A		
1	Color	Conforms to FED-STD-595 or D-14080	x	x	x	x	x	x	x	x	x	8.3.1
2 FL 4	Specular Gloss	Gloss minimum	40	NA	60	60 FL 1	90	25 max.	60	60 FL 1	8.3.2	
		Semi-Gloss 6 to 40 Flat 5 max.		x				- -	- -	- -		
3	Film Thickness	0.0065 inch maximum including adhesive	x	x	x	x	x	FL 2	x	x	8.3.3	
4	Flexibility	No cracking after twenty folds	x	x	x	x	x	NA	x	x	8.3.4	
		No cracking after impact of 10 ft-lbs at -20 ± 2 F	x	x	x	x	x	NA	x	x		
5	Adhesion	40 oz/inch width - Minimum without backing	x	x	x	x	NA	FL 3	x	x	8.3.5	
6	Opacity	Minimum Contrast Ratio									8.3.6	
		Blue/Black 1.00	x	x	x	x	x	NA	x	x		
		Light Blue/Green /Maroon and Grey 0.98	x	NA	x	x	x	NA	x	x		
		Cream/Orange 0.96	x	NA	x	x	x	NA	x	x		
		White 0.95	0.95	0.95	0.95	0.95	0.90	NA	0.95	0.95		
Reds/Yellows 0.87	x	NA	x	x	x	NA	x	x				
7	Storage	12 months from the date of manufacture at 40 to 90 F	x	x	x	x	x	x	x	x	8.3.7	
8	Accelerated Weathering	200 hrs UV exposure ASTM G 53	NA	NA	NA	NA	x	NA	NA	NA	8.3.8	
9 FL 4	Fluid Resistance	8 hours - distilled water	x	x	x	x	x	x	x	x	8.3.9a.	
		TT-S-735 1 hr	NA	NA	x	x	x	x	NA	NA	8.3.9b.	
		Jet A 1hr	NA	NA	NA	NA	NA	NA	x	x	8.3.9b.	
		MIL-L-7808 24 hrs	NA	NA	NA	NA	NA	NA	x	x	8.3.9c.	
		MIL-L-7808 2 hrs	NA	NA	x	x	x	x	NA	NA	8.3.9c.	
		BMS3-11	NA	NA	NA	NA	x	NA	NA	NA	8.3.9d.	
10	Soil Resistance	No more than barely visible	NA	NA	NA	NA	NA	x	NA	NA	8.3.10	
11	Accelerated Aging	336 hours at 120 ± 5 F	NA	NA	NA	NA	NA	x	NA	NA	8.3.11	
12	Flammability	Maximum burn rate = 4 inches/minute	NA	NA	NA	NA	NA	x	NA	NA	8.3.12	

FL 1 Gloss measurement is made before the material is perforated.

FL 2 Polycarbonate thicknesses greater than 0.01 inch shall be within ± 10 percent of the reported value.

FL 3 Maximum thickness 0.010 inch excluding adhesive for the adhesion test.

FL 4 Type VII and Type VIII material shall be tested with the appropriate ink, overcoat, and edge seal as defined in BAC5316 and BAC5312.

6 QUALIFICATION

6.1 REQUESTS FOR QUALIFICATION

- a. All requests for qualification shall be directed to a Materiel department of The Boeing Company. Materiel will forward the request to the appropriate Engineering department for evaluation. After receiving written authorization from Materiel, the manufacturer shall submit the data and samples required for qualification purposes.
- b. No changes in approved product formulation, raw materials, basic methods of manufacture, or plant site shall be made without notification and prior approval in writing. Requalification of the revised material may be required and a revised product designation may be requested.
- c. Qualified products shall be listed in the QPL.
- d. Production materials shall be capable of meeting all qualification requirements.

6.2 SAMPLES AND TEST REPORTS

- a. Prior to submitting a material for qualification to this specification, the supplier shall provide its Material Safety Data Sheet, and if requested its chemical formulation. Agreements for non-disclosure and control of proprietary information shall be considered and executed as appropriate. The information provided shall be submitted to the appropriate Boeing Safety, Health, and Environmental Affairs Organizations to evaluate it, determine whether it is adequate or whether additional information is necessary, and identify and document appropriate precautions for the material's use.
- b. The test samples shall consist of at least one 12 by 12 inch sample of the color on which qualification is desired (gloss or lusterless). If qualification is desired for the full range of colors (gloss or lusterless), the manufacturer shall submit six multicolor samples 12 by 12 inches. Material for Type I, Grade B shall be in roll form, white only, and not less than 25 feet in length. Material for Type VI, Grade C shall be in translucent only.

(1) The colors shall consist of

- Red (Color No. 11136)
- White (Color No. 17875)
- Yellow (Color No. 13655) For Gloss
- Black (Color No. 17038)

and

- Red (Color No. 31136)
- White (Color No. 37875)
- Yellow (Color No. 33655) For Lusterless
- Black (Color No. 37038)

Colors are in accordance with FED-STD-595.

- (2) The samples shall be plainly identified by securely attached durable tags, by rubber stamping or by printing with the following information:

TEST SAMPLE

BMS10-26, Type - Grade

To match color number and color name
 Manufacturer's name
 Manufacturer's designation

6.2 SAMPLES AND TEST REPORTS (Continued)

- c. Qualification samples submitted for approval shall be accompanied by a test report giving actual data obtained from the submitted samples, which will provide evidence that the material conforms to the requirements of this specification.
- d. All suppliers shall have test facilities required to test in accordance with this specification or use certified commercial test laboratories with capability to test in accordance with this specification.

6.3 APPROVAL

- a. Qualification to this specification shall be based on submission of the above required data and information and upon testing by The Boeing Company. The latter shall consist of any or all of the tests required in this specification and any additional tests deemed necessary. When approved, the vendor is automatically qualified for any additional color and gloss without additional testing.
- b. Interim approval may be granted prior to completion of the Storage Stability test, providing all other requirements have been met.
- c. Written approval will be granted the supplier of the material submitted for qualification to this specification by The Boeing Company, and Qualified Products and Suppliers will be listed in the Boeing Materials Specification QPL provided:
 - (1) The qualification is in accordance with the procedures of this specification.
 - (2) The submitted material conforms to the requirements of this specification.
 - (3) The submitted material passes manufacturing suitability tests.
- d. When samples fail to qualify to the requirements of this specification, the supplier will be so notified by The Boeing Company Materiel Department.

7 QUALITY CONTROL

7.1 SUPPLIER QUALITY CONTROL

The Supplier shall certify that each shipment of production material meets the requirements as stated in the manufacturers product data sheet which is qualified to this specification.

7.2 PURCHASER QUALITY CONTROL

The purchaser shall ensure the consistency of all raw materials.

Purchase Quality Assurance shall review all supplier test data submitted with shipment and perform any additional inspection or testing necessary to assure that the production material meets all requirements specified herein.

8 MATERIAL TEST METHODS

8.1 GENERAL

- a. Sizes designated are approximate. For the purposes of these tests adhesive listed in BAC5316 shall be applied to the raw material if it does not come with an adhesive if so required.
- b. Unless otherwise specified, specimens shall be applied, conditioned, and tested at an air temperature of 73.4 ± 2 F (23 ± 1.1 C) and a relative humidity of 50 ± 4 percent. Unless otherwise specified, the applied marking material shall be allowed to stand 72 hours at above conditions prior to testing.
- c. Where bare and painted test panels are required, they shall be prepared from QQ-A-250/5 alclad aluminum sheet, T3 temper, 0.040 inch thick and 2 by 4, 3 by 6, or 4 by 12 inches in size. Bare panels shall be treated in accordance with BAC5719, Type I, Class B. Painted panels shall be treated in accordance with BAC5719, Type I, Class B and coated with BMS10-11, Type I in accordance with BAC5736 and BMS10-60 in accordance with BAC5845. Painted panels shall be allowed to dry 18 hours minimum prior to material application.
- d. All test panels shall be manually solvent cleaned in accordance with BAC5750 immediately prior to applying the material. Remove the material premask (where applicable) prior to removing the backing sheet. To the center of the 3 by 6 and 4 by 12 inch panels, apply 2 by 4 and 3 by 12 inch strips of the marker respectively. Lengthwise to the center of the 2 by 4 inch panels, apply a 1 by 8 inch strip of the material allowing it to overlap 4 inches on one end. Press down the material with 6 to 8 passes of a rubber covered roller, approximately 3-1/3 inches in diameter, 2 inches in width and weighing 4-1/2 pounds. The surface of the roller shall have Shore A Durometer hardness of 70 to 80. Allow the applied material to cure 72 hours minimum prior to testing.

8.2 TEST PANEL PREPARATION

8.2.1 CLEANING OF TEST PANELS

Immediately prior to application of the material, clean the surface of the test panel as follows:

- a. Aluminum and painted panels – solvent clean in accordance with BAC5750.
- b. Morest Charts – remove dust with soft lintless cloth.

8.2.2 APPLICATION OF MATERIAL

- a. Unless otherwise specified, test panels shall be prepared as described herein. The material shall be so cut that a portion of each color involved in the samples is included in the test panel, if possible. If this cannot be done, successive samples, where color is involved in the particular test, shall be run until all of the colors of the sample have been included.
- b. Apply material in accordance with Section 8.1d.

8.3 TEST METHODS

8.3.1 COLOR

- a. Bare untreated panels are used for this test.
- b. Determine the color match of the material to the appropriate color standard in accordance with D-14080 or FED-STD-595 using a MacBeth Daylight Booth under Illuminant C or ASTM D 1729, Illuminant daylight.

8.3.2 GLOSS

- a. Bare untreated panels are used for this test.
- b. The specular gloss of each color of the material shall be determined by FED-STD-141, Method 6101 on a panel 3 by 6 inches in width.
- c. The specular gloss shall be equal to or greater than the requirements specified in Table I, Item 2.

8.3.3 FILM THICKNESS

- a. Cut strips from the material in a manner such that all colors are represented. Remove the premask and backing sheet when appropriate.
- b. Measure the thickness using equipment accurate to ± 0.0002 inch taking a minimum of four readings conforming to the requirements of Table I, Item 3.

8.3.4 FLEXIBILITY

- a. Cut a 1 by 2 inch strip from the material and remove the premask (where applicable) and backing sheet. Talc the adhesive to prevent sticking. The material shall then be folded forward and backward on itself twenty times along the same line creasing it with thumb and forefinger after each fold. The creased section shall be examined for conformance to the requirements of Table I, Item 4.

- b. Evaluation at -20 ± 2 F

The material, applied to a 3 by 6 inch bare metal panel in accordance with Section 8.1c. shall be clamped to a 9 by 9 by 0.05 inch steel plate and placed horizontally, product side up, in a chamber maintained at -20 ± 2 F. After conditioning for $5 \pm 1/4$ hours, remove the panel from the chamber and immediately thereafter drop a 5 pound nominal spherical steel ball on the material from a maximum height of 2 feet. The impact area shall be examined for conformance to the requirements of Table I, Item 4.

8.3.5 ADHESION

The adhesion of the material to panel, applied to five each 2 by 4 inch bare and painted metal panels in accordance with Section 8.1c. shall be evaluated as follows:

- a. Clamp the end of the panel opposite that having the product overlap in the lower jaw of a dead weight pendulum or crosshead type tensile testing machine.
- b. Double back (at 180 degrees) the overlap and clamp in the upper jaw.

8.3.5 ADHESION (Continued)

- c. Remove the material from the panel at a constant rate of 12 ± 1 inches per minute measuring the average force required when removing the second inch. If the material breaks at any point during removal, the test on that panel shall be terminated and the force applied at the time of breakage recorded.
- d. The average value shall be equal to or greater than the requirements specified in Table I, Item 5.

8.3.6 OPACITY

- a. Bare untreated panels are used for this test.
- b. Condition panel for a minimum of 72 hours.
- c. Determine Contrast Ratio in accordance with FED-STD-141, Method 4121.
- d. The value shall be equal to or greater than the requirements specified in Table I, Item 6.

8.3.7 STORAGE STABILITY

The material, in its original packaging container, shall meet all requirements of this specification after 12 months from the date of manufacture when stored at a temperature range of 40 to 90 F.

8.3.8 WEATHERING (ACCELERATED)

- a. Prepare bare and painted panels in accordance with Section 8.1c. with material applied in accordance with Section 8.2.2.
- b. Expose in UV Con for 200 hours in accordance with ASTM G 53. Cycle at $8 \pm 1/4$ hours with UV and $4 \pm 1/4$ hours condensation.
- c. Wash panels with soapy water and a sponge and examine marker for film failures.
- d. After exposure, the panels shall be examined and the marking material shall exhibit no evidence of deterioration or failure such as cracking, checking, or loss of adhesion. Slight loss of gloss and slight color change is acceptable.

8.3.9 FLUID RESISTANCE

a. Water Resistance

Bare and painted test panels prepared in accordance with Section 8.1c. with material applied in accordance with Section 8.1d. shall be force dried at 150 ± 5 F for 2 hours minimum, then cooled at standard conditions. The panels should then be positioned vertically in a beaker or other suitable container filled with distilled water to a depth of 3 inches. The panels shall remain partially submerged in the distilled water for a minimum of 8 hours at standard conditions. The test panels shall then be removed from the water and examined approximately 5 minutes after removal and $24 \pm 1/4$ hours after removal. The marking material shall exhibit no evidence of blistering, peeling, or color changes and the immersed portion shall be equal in all respects to the non-immersed portion.

b. Fuel Resistance

Bare and painted test panels prepared in accordance with Section 8.1c. with marking material applied in accordance with Section 8.1d. shall be partially immersed in hydrocarbon test fluid in a manner similar to Section 8.3.9a. The hydrocarbon test fluid shall conform to Type III fluid of TT-S-735. Exposure shall be for a minimum of 1 hour at standard conditions. After exposure, the test panels shall be removed from the hydrocarbon test fluid, stabilized at standard conditions for a minimum of 24 hours and carefully examined. The immersed portion of the material shall be equal in all respects to the unexposed portion. For Type VII and Type VIII, replace hydrocarbon test fluid, TT-S-735, with Jet A. Also test material shall be both 1) plastic film by itself, and 2) plastic film with an appropriate ink, clear coat and edge seal as defined by BAC5316 and BAC5312.

c. Oil Resistance

Bare and coated test panels prepared in accordance with Section 8.1c. with material applied in accordance with Section 8.1d. shall have edge sealer applied to exposed edges of the material. Sealer shall be applied with a narrow striping brush so that sealer covers an area approximately 1/4 inch on both sides of the film edge. The test panels shall be partially immersed in MIL-L-7808 oil for $2 \pm 1/4$ hours at 225 ± 5 F in a manner similar to Section 8.3.9a. The test panels shall then be removed from the hot oil, cooled to standard conditions and wiped dry with absorbent, lint free cloth or paper, and examined for defects. A slight reduction in gloss, slight shrinkage, slight discoloration, and slight edge attack shall not be cause for rejection. For Type VII and Type VIII, replace high temperature and 2 hour time duration with room temperature (standard conditions) and for 24 hours. Also test material shall be both 1) plastic film by itself and 2) plastic film with an appropriate ink, clear coat and edge seal as defined by BAC5316 and BAC5312.

d. BMS3-11 Resistance

Bare and coated test panels prepared in accordance with Section 8.1c. with material applied in accordance with Section 8.1d. shall have edge sealer applied to exposed edges of the marking material. Sealer shall be applied with a narrow striping brush so that the sealer covers an area approximately 1/4 inch on both sides of the film edge. The test panels shall be partially immersed in BMS3-11 for a maximum of 24 hours in a manner similar to Section 8.3.9a. The test shall be removed from the BMS3-11 and wiped dry with absorbent, lint free cloth or paper and allowed to dry for a minimum of 24 hours. A slight reduction in gloss, slight shrinkage, slight discoloration and slight edge attack shall not be cause for rejection.

8.3.10 SOIL RESISTANCE

- a. Prepare a test specimen 10 by 10 inches minimum.
- b. Apply the following items to the test specimen such that each covers an area of approximately 1 by 1 inch:

Butter

Mayonnaise

Coffee with cream

Chocolate (a syrup or melted chocolate)

Soup (broth base)

Orange juice

Tomato juice or Catsup

Mustard

Perspiration

Lipstick (red)

Hair oil

- c. Allow to dry for a minimum of 2 hours.
- d. Clean by scrubbing each area with Spray White E (Kelite Chemical Corp.) diluted 1:10 with water.
- e. Report any residual stain from each area after cleaning.
- f. The stain shall be no more than barely visible.

8.3.11 ACCELERATED AGING

- a. Prepare three 6 by 6 inch specimens from each lot.
- b. A circulating air oven controlled to ± 5 F shall be used. Place specimens in oven for a maximum of 336 hours at 120 ± 10 F.
- c. After aging, the specimen shall exhibit no fading, discoloration, bubbles, blisters, cracks, etc.

8.3.12 FLAMMABILITY

- a. Prepare three 3 by 13 inch specimens from each lot.
- b. Perform flammability test in accordance with BSS7230, Method F4 (15 second horizontal ignition test).
- c. Burn rate shall be equal to or less than the requirements specified in Table I, Item 12.

9 MATERIAL IDENTIFICATION

Material shall be identified with the Manufacturer Product Codes listed in the Qualified Products List (QPL) to this specification. Vendor does not need to mark the BMS10-26 designation on the material.

10 PACKAGING AND MARKING

Each shipping container shall be durably and legibly marked with the following information:

- a. Manufacturer Product Code, BMS10-26 (including the label revision letter) Type and Grade.
- b. Date and month of manufacture
- c. Purchase order number
- d. Quantity