

**MATERIAL AND EQUIPMENT STANDARD**  
**FOR**  
**TWO PACK ALIPHATIC POLYURETHANE PAINT**  
**AS**  
**TOP COAT**  
**(CAMOUFLAGE COLORS)**

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## 1. SCOPE

This Standard specification covers the minimum requirements for the composition, properties, storage life, packaging, inspection and labeling of a low reflective, two pack aliphatic polyurethane paint for use as top coat.

## 2. REFERENCES

Throughout this Standard the following standards and codes are referred to. The editions of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Vendor:

### **ANSI (AMERICAN NATIONAL STANDARD INSTITUTE)**

ANSI Z 129.1 "Precautionary Labeling of Hazardous Industrial Chemicals"

### **ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)**

#### **Specification for Packaging**

D 3951 (88) "Standard Practice for Commercial Packaging"

#### **Test Methods for Properties**

D 803 "Standard Methods of Testing Tall Oil"

D 1210 "Standard Test Method for Fineness of Dispersion of Pigment-Vehicles Systems"

D 1307 "Phthalic Anhydride Content of Alkyd Resins and Esters Containing Other Dibasic Acids"

D 2455 "Identification of Carboxylic Acids in Alkyd Resins"

D 2572 "Isocyanate Group Content Test"

D 2998 "Polyhydric Alcohols in Alkyd Resins"

### **IPS (IRANIAN PETROLEUM STANDARD)**

(Not applicable for procurement)

IPS-E-TP-100 "Paints"

### **SSPC (STEEL STRUCTURES PAINTING COUNCIL)**

SSPC PA Guide "A Guide to Safety in Paint Application System"

### **US FEDERAL STANDARDS**

#### **US Federal Test Method Standard No. 141 a**

Method 2011 "Preparation of Steel Panels"

Method 3011 "Condition in Container"

Method 4021 "Pigment Content (Ordinary Centrifuge)"

Method 4022 "Pigment Content (Super Centrifuge)"

Method 4041	"Volatile and Nonvolatile Content (Ordinary Laboratory Oven)"
Method 4052	"Vehicle Solids (Super Centrifuge)"
Method 4061	"Drying Time (Oil-Base Paints)"
Method 4082	"Water in Paints and Varnishes"
Method 4261	"Appearance of Transparent Liquids"
Method 4271	"Viscosity (Gardener Tube)"
Method 4281	"Consistency of Pigmented"
Method 4312	"Volume Percentage at Pigment Is Total Nonvolatile P/NV (Centrifuge Method)"
Method 4331	"Spraying Properties"
Method 4411	"Fineness of Grind"
Method 5073	"Acid Number (Varnishes)"
Method 5271	"Matter Insoluble in Acid"
Method 6011	"Immersion Resistance"
Method 6101	"60-Degree Spicular Gloss"
Method 6103	"65-Degree Specular Gloss (Sheen)"
Method 6221	"Flexibility"
Method 6242	"Infrared Reflectance (from Reflectometer)"
Method 6304	"Knife Test"
Method 7355	"Distillation of Solvents from Solvents Liquere"
Method 7356	"Enamels and Enamel Thinners Solvent Content of (Gas Chromatography)"
Method 7381	"Hydroxy Number"

### 3. UNITS

This Standard is based on International System of Units (SI), except where otherwise specified.

### 4. COMPOSITION

#### 4.1 Ingredients and Proportions

The paint material shall be furnished in two components, Component A shall consist of orthophthalic-trimethylopropane polyesters combined with prime and extended pigments and volatile solvents; Component B shall consist of an aliphatic isocyanate prepolymer combined with volatile solvents. When mixed according to manufacturer recommendation product meeting the requirements of this specification shall result.

##### 4.1.1 Pigment

The hiding pigments shall be yellow iron oxide, red iron oxide, and phthalocyanine blue. Organic blacks and antimony sulfide shall not be used. Hiding pigments shall be chemically pure and free from extenders. Small amounts of other shading pigments and titanium dioxide may be used when necessary to match the color, provided these pigments have good color permanence. Extender pigments shall be a combination of crystalline and diatomaceous silica, shall be free from talc and shall not exceed the amount specified in Table 1 when tested as follows: extract the pigment as in Method 4021 of US Fed test Method Standard No. 141, using only acetone as the extraction solvent continue extraction until the supernant is colorless.

##### 4.1.2 Nonvolatile vehicle

Non volatile vehicle shall preferably be composed as follows:

###### 4.1.2.1 Component A

###### 4.1.2.1.1 Dicarboxylic acids

When tested as by ASTM D 2455 the dicarboxylic acids shall be orthophthalic with only trace amounts of other acids.

#### **4.1.2.1.2 Polyols**

When tested as by ASTM D 2998 the polyols shall be trimethylolpropane with only trace amounts of other polyols.

#### **4.1.2.2 Component B**

When tested as in 4.2.2.2 the non-volatile vehicle in Component B shall be an aliphatic isocyanate prepolymer. It shall contain no toluene diisocyanate and no aromatic or aromatic substituted isocyanates.

#### **4.1.3 Volatile content**

The volatile content of the mixed coating shall consist of a non-photochemically reactive solvent blend and shall conform to the following requirements by volume when tested as by the methods 7355 and 7356 as US Federal Standard 141.

**4.1.3.1** Aromatic compounds with eight or more carbon atoms except ethyl benzene: 8 percent maximum.

**4.1.3.2** Ethyl benzene and toluene: 20 percent maximum.

**4.1.3.3** Solvents with an olefinic or cyclo-olefinic type of unsaturation: negative.

**4.1.3.4** Total of 4.1.3.1 + 4.1.3.2 : 20 percent maximum.

**4.1.3.5** Ethylene glycol monoethyl ether acetate: 25 percent minimum.

### **4.2 Quantitative Requirements**

#### **4.2.1 Component A (polyester)**

Component A shall conform to the quantitative requirements of Table 1.

**TABLE 1 - COMPONENT A (POLYESTER) REQUIREMENTS**

<b>CHARACTERISTICS</b>	<b>MIN.</b>	<b>MAX.</b>	<b>US FEDERAL STD. No. 141</b>	<b>ASTM STANDARD</b>
Nonvolatile, percent by weight of Component A	61	—	4041	
Pigment, percent by weight of Component A	42	46	4022	
Extender pigment, percent by weight of pigment	65	70	5271	
Pigment volume	47	—	4312	
Nonvolatile vehicle, percent by weight of Component A	18	—	4052	
Phthalic anhydride, percent by weight of nonvolatile vehicle	44	—		D 1307
Acid number, based on nonvolatile vehicle	—	4	5073	
Hydroxyl number, based on nonvolatile vehicle	165	195	7381	
Alcohols, hydroxyl number units	—	10	—	
Water, percent by weight of Component A	—	0.5	4082	
Coarse particles and skins (retained on 0.044 mm no. sieve 325 mesh sieve), percent by weight of pigment	—	1.0	4092	
Viscosity, krebs stormer shearing rate - 200 RPM grams	75	125	4281	
Fineness of grind (HEGMAN UNIT)	2	—	4411	D 1210

#### **4.2.2 Component B (isocyanate)**

Component B shall conform to the quantitative requirements of Table 2 when tested as follows:

#### 4.2.2.1 Isocyanate content

##### 4.2.2.1.1 Reagent

Dissolve 32 grams of anhydrous dibutylamine in anhydrous chlorobenzene and dilute to 250 ml. Volume with chlorobenzene. Store in a brown bottle. If high purity reagent materials are not available, the dibutylamine shall be freshly distilled and the chlorobenzene dried over calcium chloride and redistilled.

##### 4.2.2.1.2 Procedure

Weigh accurately from a dropping bottle, a sample of Component B that does not exceed 2 grams, into a 250 ml. Erlenmeyer flask. Add from a pipet 10 ml. of the dibutylamine reagent solution and swirl until clear but not less than 2 minutes. Pipet another 10 ml. of a reagent into a separate flask to be titrated as a blank. Add 2 to 3 drops of a 1 percent alcoholic solution of bromophenol blue indicator. Add 100 ml. of absolute methanol slowly with swirling of the sample. Titrate the excess dibutylamine with aqueous 1 N hydrochloric acid using a 10 ml. buret with 0.05 ml. divisions, to a color change from blue to yellow.

##### 4.2.2.1.3 Calculation

$$\%NCO = \frac{(ml. HCl \text{ for blank} - ml. HCl \text{ for sample}) \times normality \times 4.2}{Weight \text{ of sample in grams}}$$

Check for compliance with Table 2.

##### 4.2.2.2 Isocyanate type

Vacuum dry a film of the vehicle on a salt plate and scan the infrared spectrum from 2 to 15  $\mu$ m. The spectrum will closely resemble the spectrum shown in Fig. 2, that is, it will show the presence of an aliphatic isocyanate and the absence of aromatic bands.

**TABLE 2 - COMPONENT B (ISOCYANATE) REQUIREMENTS**

Characteristics	Minimum	Maximum	US Federal Std. No. 141	ASTM Standard
Nonvolatile, percent by weight of component B	73	77	4041	
Viscosity, gardner tubes	F	M	4271	D 803
Isocyanate content, percent by weight of nonvolatile	18	21		D 2572

#### 4.2.3 Mixed paint

When mixed, according to the manufacturer recommendation, paint shall conform to the quantitative requirements of Table 3.

TABLE 3 - MIXED COATING REQUIREMENTS

Characteristics	Minimum	Maximum	US Federal Std. No. 141	ASTM Standard
Hiding power (contrast ratio)	0.97	—	4122	
Drying time				
Dry to touch, minutes	5	30	4061	
Dry hard, hours	—	4		
Specular gloss				
60 degree	—	0	6101	
85 degree	—	0	6103	
Infrared reflectance, percent	25	35	6242	

## 5. REQUIREMENTS

The component A and B and mixed paint shall meet the requirements of sub-Clauses 5.1 through 5.9

### 5.1 Color

The color of the paint shall match color No. 34087 of US Fed Standard No. 595.

### 5.2 Mixing Properties

Thoroughly mix 4 parts by volume of Component A with 1 part by volume of Component B, a smooth homogeneous mixture shall result and the paint shall be free from grit, seed, skins, or lumps.

Place 3 ounces of the material in a 4 ounce glass jar and do not agitate or disturb for 8 hours. At the end of this period the paint shall show no signs of gelatin.

### 5.3 Spraying Properties

Reduce 4 parts by volume of the mixed paint with 1 part by volume of thinner conforming to Mil-T-81772. Spray the paint on a steel panel to a dry film thickness between 23  $\mu\text{m}$  and 28  $\mu\text{m}$  and observe for spraying properties in accordance with method 4331 of US Federal test Method Standard No. 141. The paint shall spray satisfactorily in all respects and shall show no running, sagging, or streaking the dried film shall show no dusting, mottling, or color separation and shall present a smooth lusterless finish free from seediness.

### 5.4 Flexibility

Determine flexibility in accordance with method 6221 of US Federal test Method Standard No. 141. Draw down a film of the mixed paint with a 50  $\mu\text{m}$  (100  $\mu\text{m}$  gap clearance) film applicator on a No. 31 gage (272  $\mu\text{m}$ ) cold Rolled, luster finish steel panel prepared as in procedure B, Phosphoric Acid Etch, Method 2011 of US Federal test method Standard No. 141. Age the film in a horizontal position for 168 hours then bake for 96 hours at 105  $\pm$ 2°C. Condition the panel for ½ hour under referee conditions. Bend over a 6.3 mm mandrel. The film of the paint shall withstand bending without cracking or flaking.

### 5.5 Water Resistance

Prepare a test panel of the paint as in 5.4 and air Dry 168 hours. Coat all exposed unpainted metal surfaces with wax or suitable protective paint and immerse in water at 23  $\pm$ 1°C for 168 hours as in method 6011 of US Federal. Test method Standard No. 141. At the end of test period remove and examine. The film of the paint shall show no Blistering or Wrinkling and no more than a slight.

Whitening or softening immediately upon removal from the water. After 2 hours air drying the portion of the panel that was immersed shall be almost indistinguishable with regard to adhesion, hardness, color, and gloss from the portion that was not immersed.

## **5.6 Knife Test**

Perform the knife test as in method 6304 of US Federal Test method Standard No. 141 using the flat portion of the panels for the flexibility test. The film of the paint shall be tough, hard, and shall adhere tightly to the substrate. It shall be difficult to furrow off with the knife and shall not flake, chip or powder. The knife cut shall have beveled edges.

## **5.7 Hydrocarbon Fluid Resistance**

Prepare a film of paint as in 5.4 air dry the specimen for 168 hours and then immerse for 168 hours (at  $23 \pm 1^\circ\text{C}$ ) in a hydrocarbon fluid conforming to TT-S-735 type III as in Method 6011 of US Federal Test Method Standard No. 141. At the end of the test period remove and examine the film of paint shall show no Blistering or Wrinkling and no more than a slight whitening or softening upon removal from the fluid. After 2 hours air drying the portion of the panel that was immersed shall be almost.

Indistinguishable with regard to adhesion, hardness, color, and gloss from a panel prepared at the same time but not immersed.

## **5.8 Drying Time**

Draw down the mixed coating using a 50  $\mu\text{m}$  (100  $\mu\text{m}$  gap clearance) film applicator and determine the drying under referee 0.1 conditions in accordance with method 4061 of US Federal Test Method Standard No. 141.

# **6. STORAGE LIFE AND PACKAGING**

## **6.1 Condition in Container**

The paint (both component A and B) shall show no thickening, curdling, gelling or hard caking when tested as specified in US Federal Standard No. 141, methods 3011 and 4261 after storage for 24 months from the date of delivery, in a full, tightly covered container. The container shall not show evidence of excessive pressure or be deformed by gassing.

## **6.2 Packaging and Packing**

The polyurethane paint shall be supplied in a kit, packaged as a unit consisting of pigmented compound marked "Component A" and the unpigmented (or clear) hardener marked "Component B". The quantity of each component in the kit shall be in the proportions: as required, respectively. Component B shall be packed in full containers. The containers shall be thoroughly dry and filled in a dry atmosphere. The packaging shall also meet the relevant requirements of ASTM D3951 (88).

# **7. INSPECTION**

**7.1** All work and materials supplied under this specification shall be subject to timely inspection by the Purchaser or his authorized representative. The contractor shall correct such work or replace such material as is found defective under this specification. In case of dispute the arbitration or settlement procedure established in the procurement documents, shall be followed.

**7.2** Samples of paints shall be supplied upon request along with the supplier's name and identification for the materials.

**7.3** Unless otherwise specified, the methods of sampling and testing should be in accordance with US Federal Test Method Standard No. 141, or applicable methods of the American Society for Testing and Materials (ASTM).



## 8. LABELING

**8.1** Refer to ANSI Standard Z129.1 "Precautionary Labeling of Hazardous Industrial Chemicals".

### 8.2 Marking of Containers

Each container shall be legibly marked with the following information:

**Name:** Two Pack Aliphatic Polyurethane Paint as Intermediate and Top Coat, (Camouflage Color)

**Specification:** IPS-M-TP-240 .....

**MESC No.:** .....

**No. of components:** .....

**Component:**..... A (or B) .....

**Maximum temperature resistance:** .....

**Type of spray:** .....

**Kind and size of spray nozzle tip:** .....

**Cleaning material:** .....

**Flash point °C :** .....

**Pot life (hours):** .....

**Drying time for overcoating:** .....

**Kind of thinner:** .....

**Lot or batch Number:** .....

**Stock Number:** .....

**Date of Manufacture:** .....

**Quantity of paint in container:** .....

**Information and Warnings, (if needed)** .....

**Manufacturer's Name and Address** .....

**Design Guide:** For guidance on the usage of this paint for various application/environment and temperature range, reference shall be made to IPS-E-TP-100.

### 8.3 Directions for Use

The manufacturer shall supply complete instructions covering uses, surface preparation, mixing, thinning, application method, application conditions, pot life, wet and dry film thicknesses, temperature and humidity limitation, drying time, etc., with each container of paint.

The following are guidelines for the instructions required:

#### Mixing and Thinning

Each coating component shall be stirred to a smooth homogeneous mixture. Then the proper amount of components A and B, as recommended by the manufacturer, should be added together and mixed thoroughly. After allowing to stand for ... minutes at  $25 \pm 2^\circ\text{C}$  the paint may be thinned up to ... % by volume of the total paint for spraying. The paint should be applied within the manufacturer's pot life limitations.

#### Coating Thickness

The paint is usually applied by spray to a dry film thickness of ... microns per coat.

#### Cure Time Between Coats

Under normal conditions, each coat should be air dried a minimum of ... hours, but no more than ... hours between application coats. In very hot weather with surfaces exposed to direct sunlight, if may be necessary to limit the intercoat drying period to ... hours or less.

Long drying time between coats may cause poor intercoat adhesion. These coatings shall not be applied at temperatures below ... °C.

#### 8.4 Direction for Safety

The following directions for safety shall be supplied with each container of paint.

Paints are hazardous because of their flammability and potential toxicity. Proper safety precautions shall be observed to protect against these recognized hazards. Safe handling practices are required and should include, but not be limited to, the provisions of SSPC-PA Guide 3, "A Guide to Safety in Paint Application."

The paints specified herein may not comply with some air pollution regulations because of their hydrocarbon solvent content.

Ingredients in urethane paints which may pose a hazard include isocyanates and solvents. Applicable regulations governing safe handling practices shall apply to the use of urethane coatings. The main items to consider and keep in mind when working with urethane paint systems are as follow:

- Become informed and aware of the hazards and appropriate control procedures. This can be done by reading the label, the material safety data sheet, if available, or by contacting the supplier of the paint system for other literature and information.
- Follow the recommendations prescribed for use during handling and application as set forth by the supplier.
- Follow all applicable local, regulations.

#### COMMENT

Toxicological research as well as practical experience has shown that diisocyanates can cause irritation of the skin, respiratory tract, eyes, nose and throat. In addition, sensitization resulting in allergic dermatitis or asthmatic symptoms can occur following overexposure to diisocyanates. Toxicological research has shown that polyisocyanates have a reduced potential to cause irritation and sensitization relative to their monomeric precursors.

Irritation is an acute response which results from the direct contact of isocyanates on the body surface, i.e., skin, mucous membranes of the nasal passages, throat and respiratory tract, eyes, etc. Symptoms usually include watering of the eyes, and a burning sensation in the nose and throat. The amount of irritation is dependent upon the dose, tissue exposed and individual susceptibility, but it is generally independent of the individual's exposure history. These acute symptoms are generally reversible soon after the individual is removed from the contaminated area or removal of the material from the skin in cases of skin contact.

Sensitization is a systemic response and is not limited to the area of contact. Sensitization usually occurs as a result of numerous overexposures or one exposure to very high concentration. Both respiratory and dermal sensitization can occur depending upon the toxicologic properties of the diisocyanate, route of exposure and individual susceptibilities. Exposures subsequent to the exposure(s) which actually resulted in sensitization may cause a very strong allergic type of reaction.

In the case of respiratory sensitization the reaction is similar to asthma, i.e., coughing, wheezing, tightness in the chest and shortness of breath. The skin sensitization reaction is allergic dermatitis which may include symptoms such as rash, itching, hives, and swelling of the arms and legs.

If an individual experiences an irritation response while handling an isocyanate it should be determined whether or not the isocyanate was the cause of the irritation. If the isocyanate is the cause, it is an indication that the operation, as performed, allows an overexposure to isocyanates which can result in later sensitization of that worker or others. A careful evaluation of the controls, protective equipment, and work practices, should be made to reduce the exposure. If irritation persists in spite of proper ventilation and protective measures the individual must be removed from areas where isocyanates are being processed or used.

If an individual is sensitized to isocyanates, complete removal from areas of potential exposure is mandated. This is true regardless of whether the isocyanate is present in vapor or mist form. Also, exposure to an isocyanate, other than the one suspected of causing the sensitization, must be avoided.

Solvents are also present in paints. Prolonged or repeated exposure or overexposure to these solvents by either inhalation or direct skin contact may also cause injurious health effects. The effects are dependent upon the solvent, the extent of exposure and the route of exposure.

**Protective Measures:** Since isocyanates have the potential to irritate and sensitize those working with or around them it is important that proper steps be taken to protect those potentially exposed from excessive contact with vapor, mist or overspray. This includes those actually handling the isocyanate as well as those in the immediate vicinity. Even during brush, roller and curtain paint applications, it is possible to be exposed to airborne concentrations of solvents and isocyanate vapors. During spray application, not only will vapors be present, but also spray mists or aerosolized droplets. These droplets contain pigments, solvents, resins, additives, and polymeric materials, as well as isocyanate and unreacted polyisocyanate. Each of these will have their own physiological effect on the organism.

Ideally, control of health hazards posed by vapors and spray mist is performed by engineering controls. Effective engineering controls should be used whenever possible to eliminate or reduce workers exposure. There are several engineering controls available to reduce exposure to isocyanate vapors and mists.

The most common is a properly designed and ventilated enclosure. General ventilation, local ventilation, or isolation may prove adequate under certain conditions. Use of alternative application equipment, e.g., airless or electrostatic spray equipment, may help reduce spray mist generation during spray painting.

Brush and roller application of the paint may be feasible in some cases. To reduce environmental contamination, exhausted air may need to be cleaned by means of filters or scrubbers. The final design and combination of these control measures is dependent upon the specific application.

Whenever a paint system is spray-applied it is essential that the applicator be protected from inhalation of both vapors and spray mists by the best possible respiratory protection. Under certain conditions, a fresh air supplied respirator will be required. In other cases, an air purifying type with a particulate filter may be employed. Applicators are urged to consult with their suppliers concerning the type of respiratory protection appropriate in a given application.

The appropriate selection and use of a respirator is an important part of protection from work-related chemical hazards. Other things also must be remembered and followed:

- Users of respirators must be properly trained in their use;
- always be sure the respirator is in good working order;
- know its limitations;
- be sure it fits properly;
- clean it after each use.

Respirator manufacturers may be helpful in developing a good respirator program.

In addition to respirators, other forms of recommended personal protective equipment include safety glasses or goggles. Nevertheless, should spray mist get into the eye, rinse immediately and sufficiently with lukewarm water and consult an eye doctor should irritation persist.

Regarding skin contact, it is suggested that as much of the exposed skin area as possible be covered with clothing or skin creams. Cured coating cannot be removed easily. Application of a protective skin cream to the hands prior to start of work will facilitate the soap and water removal of paint splashes or overspray. Skin areas covered only by protective creams should be kept to an absolute minimum. Aggressive solvents are unsuitable for skin-cleaning as they wash oils out of the skin and can cause secondary reactions.