DE HAVILLAND AIRCRAFT OF CANADA LIMITED

De Havilland
Material Specification

TITLE:	**RESIN, EPOXY BASE, LOW DENSITY, HONEYCOMB CORE FILLER**
SPECIFICATION NUMBER:	**DHMS P 1.30**
ISSUE:	**K**
AMENDMENT:	**2**
DATE:	**March 17, 2020**
PAGE:	**1 of 14**

Prepared by: Approved by:

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REVISION RECORD

Issue	Page	Description and Reason for Change
C	21	This is a complete revision and detail changes have not been noted.
C	3	Para. 3.1.5 - Changed application time of Grade 3 material.
Amd.1	11	Changed Fiber Resin address and phone number per manufacturer's request.
	11	Changed Furane Company name - removed reference to Rohm and Haas.
	11	Changed Epocast Grade 3 product designation per manufacturer's request.
Amd.2		This Amendment 2 specifies Heath Tecna Material Specification HMS C2-001 is equivalent to DHMS P1.30.
Amd.3	11	Fiber Resin name and address updated. Grate 1 material Furane Epocast 87269-A/B deleted from QPL. Grade 2 material Furane Epocast 8623A/9861 changed to 8623-A81/9861. Grade 2A material Furane Epocast 8623A/946 changed to 8623-A81/946.
Amd.4	11	Grade 2 material Furane Epocast 8623-A81/9861 changed to 8623 A/9861 Grade 2A material Furane Epocast 8623-A81/946 changed to 8623 A/946.
D		This is a complete revised issue. Detail changes have not been noted.
Amd.1	QPL	Fiber Resin Corp. address has been changed.
Amd.2	10	QPL: Reference to Ciba-Geigy Corp. has been added.
Amd.3	10	QPL: Reference to PQS corrected.
E	All	This is a complete revision, detail changes not noted.
Amd. 1	4	Compressive strength requirement for Gr. 1 material lowered from 2700 to 2000 psi.

REVISION RECORD

Issue	Page	Description and Reason for Change
F	All	Lap Shear qualifications requirements (Gr.2, 2A, 3, &5) deleted. Insert pull-out test requirement added for qualification (Gr. 2, 2A, 3) Dynamold and Cytec added to QPL. Mixing Ratio added to QPL.
Amd. 1	2	Updated section 1.1 to match Table 1.
G	QPL	Grade 3 material, CG 1305 from CIBA was added to QPL. Grade 1 material, Epocast 87005 A/B-80 from CIBA was added to QPL. Correct material designation for Dynamold product, SF 14 A/B Specification expanded to 11 pages.
	4	Add a note to section 4.3 "with exception noted in QPL"
	3	Remove reference to Tensile Lap Shear in 3.1.5 Add a note to section 3.2 “with exception noted in QPL” Storage life changed to 75± 15^{o}F
	7	Table 2, add note “Requires for grade 2, 2A, 3 only”
Amd. 1	QPL	Grade 1 material, Magnobond 76-1 A/B from Magnolia was added to QPL Supplier Ciba name changed to Vantico
Amd. 2	QPL	Storage Life requirement for Epocast 8623A/9861 (Grade 2) and Epocast 8623A/946 (Grade 2A) changed from 6 months to 12 months as per Vantico requested.
Amd. 3	QPL	Correct material designation CG1305 R/H, Vantico changes to Vantico A&T Storage Life requirement for CG 1305 R/H (Grade 3) changed from 6 months to 12 months as per Vantico requested. Mixed viscosity of CG 1305 R/H changed to 11000-26000 cps as per Vantico requested. Pot life of CG 1305 R/H changed to 60-120 minutes as per Vantico requested.
	2,4	ASTM D2393 changed to ASTM D2196

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REVISION RECORD

Issue	Page	Description and Reason for Change
G	QPL	Removed Grade 1, product Magnobond 77 A/B due to presence of banned Adm. 4 chemicals Octa- and Penta- Bromodiphenyl Ether (CAS#32534-81-9 and CAS#32536-85-0)
Amd. 5	10-QPL	Removed product Epocast 87005 A/B-80 due to presence of banned chemicals
Amd. 6	QPL	Added Grade 1, product Magnobond 77-3A/B and Magnobond 77-4A/B.
Amd.7	QPL	Corrected the colour of Magnobond 76-1: Was "Amber" Now "White"
Amd. 8	3 QPL	Table 1: Replaced TBD with requirement for Insert pull out. Corrected the colour of Magnobond 77: Was "Amber" Now "Brown" Vantico name changed to Huntsman Advanced Materials Americas Inc.
H	QPL	Clarified Pot Life of Magnobond 77-3A/B and 77-4A/B: Was "50 min." Now "30-55 minutes"
Amd. 1	2,3	Specific Gravity range of grade 5 Corfill 615/DTA updated: Was: "0.70-0.85 g/cc" Now: "0.60 - 0.70 g/cc"
Amd. 2	4	Table 1: % Water absorption of Grade 2A Was "0.8%" , Now " 2.5% Max". Standardize the requirement.
I		Not use
J	6, 7 8 QPl	Updated Section 5, Section 6. Table 2, clarified test requirements for supplier, purchaser/user Magnolia name changed to Magnolia Advanced Materials. Street name changed.

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REVISION RECORD

Issue	Page	Description and Reason for Change
J		
Adm. 1	QPl	Added Magnolia Advanced Materials new manufacturing site, Atlanta, GA for Grade 1 Materials from Chamblee, GA site can be used until depletion.
K		Updated Company name
	4	4.1 Specified accelerate cure for Grade 2
		4.2 Added ASTM D1622 as alternative test method for specific gravity
	QPL	Added Epocast 1648 A/B to Grade 2
	QPL	Product Epocast 8623/9861 and 8623/946 are now OBSOLETE.Stock can be used to depletion.
		Revised section 9 Health and Safety
Adm. 1	4	4.3 Specified extrudability rate as per QPL.
	QPL	Name changed and address changed for Dynamold product SF 14.
		Was: Dynamold Inc.
		Now: Dysol Inc. dba (Doing business as) Socomore
	QPL	Added mix viscosity for Grade 2: Minimum initial 20 gm/min as per Supplier suggestion
Adm. 2	QPL	Changed mix viscosity for Grade 2: Changed from 20gm/min to 120gm/min as per Supplier suggestion.

1 SCOPE

This specification covers the requirements for low density, two part, room temperature curing, epoxy resin. The resin is intended for use as potting compounds (for inserts, bearing points, etc.) and as edge fillers for honeycomb core sandwich panels.

1.1 Classification

Resin supplied to this specification shall be one of the following grades, as specified on the purchase order:

Grade 1	-	Specific Gravity 0.35-0.55 Maximum
Grade 2	-	Specific Gravity 0.55- 0.75 Maximum
Grade 2A	-	Specific Gravity 0.55-0.75 Maximum
Grade 3	-	Specific Gravity 0.75-0.95 Maximum
Grade 5	-	Specific Gravity 0.60-0.70 Maximum

Specific gravity noted refers to the cured resin mix.

2 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. In the event of conflicting requirements between this and the specifications listed below. The requirements of this specification shall govern. Where a specific issue of a document is not specified, the current issue shall be used.

2.1 American Society for Testing and Materials

D570	-	Water Absorption of Plastics
D695	-	Compressive Properties of Rigid Plastics
D792	-	Specific Gravity and Density of Plastics by Displacement
D2196	-	Viscosity of Epoxy Resins and Related Components,Brookfield viscometer

2.2 De Havilland Specifications and Standards

P.P.S. 2.64	-	Installation of Potting Type Sandwich Panel Fasteners
P.P.S. 10.35	-	Fabrication of 250^{o}F Cure, Epoxy Resin Pre-Impregnated, Fibre Reinforced Composite Parts

3 REQUIREMENTS

3.1 General

3.1.1 Materials - The two-part resin system shall consist of an epoxy resin base material, containing a light weight, compatible filler and a suitable hardening agent. When mixed in accordance with manufacturer's recommendation, the mix shall be of a uniform and homogenous consistency. When cured per **Para.3.1.4**, the resin shall meet the requirements specified herein.

3.1.2 Colour - A mixed batch of epoxy resin base and hardener shall have a colour as noted in the **QPL** of this specification.

3.1.3 Odour - The epoxy resin, when cured per **Para.3.1.4**, shall be free from any objectionable odour.

3.1.4 Cure to Handle- The epoxy resin shall be dry to the touch and machinable (i.e. can be sanded and cut using standard tools without chipping, cracking, or flaking) after curing for 24 hours at a temperature of $75^{o} \pm 5^{o}$F and 50 ±5%% relative humidity.

3.1.5 Full Cure- The epoxy resin must meet the requirements for compressive strength,and specific gravity listed in table 1 after curing at a temperature of 75°±5° F and 50 ±5% relative humidity for the time specified in the **QPL** of this specification.

3.1.6 Pot Life - Mix a 100g batch (50 g for grade 2A material) of the material to be tested, according to the manufacturer's instructions in a cup. Check the material every 5 min at first then every min as the expected pot life limit is approached (see the **QPL** of this specification for the applicable product pot life). The pot life shall be considered to be expired if the material can no longer be used in the manner outlined in the applicable production process (i.e. extruded, spread, or brushed).

3.1.7 Storage Life - The epoxy resin shall meet the requirements of this specification at any time during its storage life. Storage life is specified in the **QPL** for each product and is from the date of receipt by the purchaser, when stored at temperatures of 75 $\pm 15^{o}$F in its original containers. For Grade 2 product the storage life if 6 months from date of shipment.

3.2 Physical Properties

When tested per **Section 4**, the physical properties of the cured epoxy resin shall meet the requirements of **Table 1** with exception noted in **QPL** .

Table 1: Physical/Mechanical Properties of Cured Epoxy Resin

Property	Grade 1	Grade 2	Grade 2A	Grade 3	Grade 5
Specific Gravity, (max)	0.35-0.55	0.55-0.75	0.55-0.75	0.75-0.95	0.60-070
Mixed Viscosity, (cps)	Non-Flow	Para.4.3	Para.4.3	20,000-30,000	Non-Flow
Compressive Strength (min. average), (psi)	2,000	4,000	4,000	9,000	3,500
Insert Pull-Out (Flatwise Tension), (lbs)	N/A	250	250	250	N/A
Insert Pull-Out (Torsion), (in lbs)	N/A	60	60	60	N/A
Water Absorption (% max) 24 hrs immersion	2.5	2.5	2.5	2.5	2.5

4 TEST METHODS

4.1 Unless otherwise specified in the individual test method, testing shall be performed at a temperature of 75 ± 5°F and a relative humidity of 50 ± 5% . **Note: For materials with a full cure cycle of greater than 24h at R.T, an accelerated cure (24h @ R.T + 5h @ 125° F) may be used for acceptance testing. For Grade 2 product accelerate cured: 12-25 minutes gel at 77± 5°F +5h @ 125± 5°F.**

4.2 Specific Gravity

A sample of epoxy resin shall be prepared per the manufacturer's instructions and tested in accordance with ASTM D792 to determine the specific gravity of the material. Test results shall meet the requirements of Table 1. Alternatively, ASTM D1622 can be used to determine specific gravity of the material.

4.3 Mixed Viscosity

The viscosity of Grade 2, and 2A resins shall be such as to ensure the following characteristics: excellent handling properties, no sag when applied and extrudability through a 1/8" dia. nozzle in a Semco sealant gun with a #440 nozzle. The extrudability rate measured in 10-20 sec shall be as per QPL.

A sample of Grade 3 epoxy resin shall be prepared and tested in accordance with ASTM D2196 using a #6 spindle at 20 rpm to determine the viscosity of the material. Test results shall meet the requirements of Table 1 with exception noted in QPL.

Due to the physical nature of the Grade 1 & 5 resins, there are no viscosity requirements.

4.4 Compressive Strength

Test specimens shall be prepared in ant tested in accordance with ASTM D695 to determine the compressive strength. Test results shall meet the requirements of **Table 1**.

4.5 Insert Pull-Out (Flatwise Tension)

Manufacture test panel as per **Figure 1**, and in accordance with P.P.S. 10.35. All panels should be vacuum cured.

Install 10 NAS 1836-3-14 metal inserts with the potting compound in question, according to P.P.S. 2.64. The inserts should be spaced evenly on the panel as per **Figure 2**.

Record the time and date the inserts were potted on the panel.

Once the meterial's full cure cycle has been achieved perform the flatwise pull-out test, on 5 of the inserts, by installing NAS 1303-10 bolts, and extracting the inserts from the secured panel using a testing rig with a cross-head speed of 0.05 in/min.

Record the failure load and mode of failure for each insert as well as the average failure load.

4.6 Insert Pull-Out (Torsion)

Using the remaining 5 inserts from the above panel, perform the torsion pull-out test by installing NAS 1303-10 bolts and twisting the inserts out of the secured panel using a torque wrench capable of recording the peak applied torque.

Record the failure torque and mode of failure for each insert as well as the average failure torque.

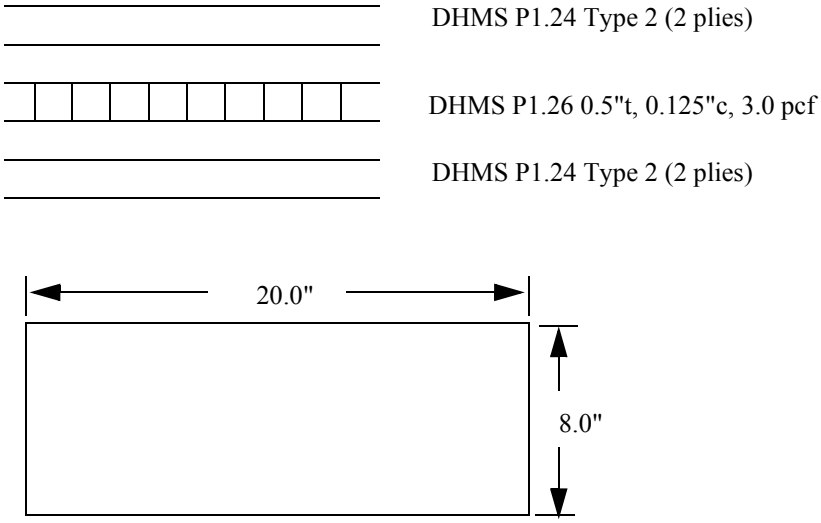

FIGURE 1. Insert Pull-Out Panel

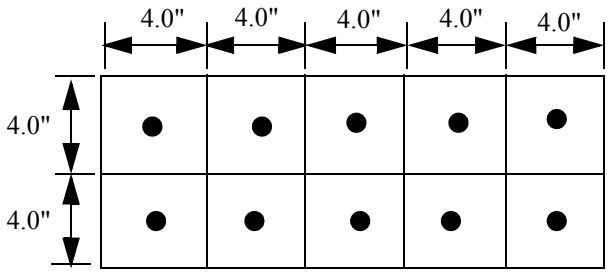

FIGURE 2. Spacing for Insert Installation

4.7 Water absorption

Test specimens shall be prepared and tested in accordance with ASTM D570 to determine the water absorption value. Test results shall meet the requirements of **Table 1**.

5 MATERIAL QUALIFICATION REQUIREMENTS

5.1 Request For Qualification

All requests for qualification to this specification shall be addressed to De Havilland Materials Technology Engineering department for approval.

All material qualification shall be site specific.

An audit of the manufacturers and/or test facilities by Materials Technology Engineering may be necessary prior to approval.

5.2 Qualification testing

Potential suppliers shall submit a written qualification test report based on 3 batches/lots of materials showing compliance with the requirements contained in section 3. The test report shall contain actual numerical test values, average test results as well as failure modes where applicable.

5.2.1 A sample shall be submitted for testing at the discretion of De Havilland Materials Technology for evaluation.

5.3 Qualification by Similarity

Where a product has been qualified to another similar specification, the supplier may submit the qualification data applicable to this specification for consideration. The similar specification may be a government, company, or other specification where the requirements are similar to this specification.

5.4 Process Control Document

5.4.1 The manufacturer shall develop and maintain a Process Control Document (PCD).

5.4.2 The PCD shall define the manufacturing and quality control requirements and procedures for assuring consistent, uniform and compliant products. The PCD shall identify baseline chemical constituents, in-process test procedures and requirements, and manufacturing procedures. All specifications and test procedures employed during the process shall also be listed and issue/date controlled.

5.4.3 When qualification has been granted, the PCD shall be signed by the supplier and Materials Technology Engineering and shall not be changed without prior written approval.

5.4.4 The PCD and all production data shall be available to De Havilland auditors when requested.

5.5 Qualification Approval

5.5.1 Upon review of supplier's data, PCD and De Havilland tests, the supplier will be advised either of product qualification or reasons for not qualifying the product.

5.5.2 Products that are qualified will be listed in the Qualified Products List of this specification.

5.5.3 No changes in the method of manufacture and/or formulation, shall be made without notification and prior written approval of Materials Technology Department.

5.5.4 Re-qualification of the product may be requested by the De Havilland Materials Technology if there are any changes in the method of manufacture and/or formulation.

6 QUALITY ASSURANCE REQUIREMENTS

6.1 Supplier Batch/Lot Acceptance Tests

6.1.1 The manufacturer/supplier is responsible for the performance of all sampling, inspection and testing of each batch/lot as specified in **Table 2.**

6.1.2 The manufacturer/supplier shall issue with each batch of product one copy of an Acceptance Test report showing actual test data conformance to the acceptance tests specified in **Table 2** The report shall include the supplier's batch identification, materials specification and date of testing.

6.1.3 De Havilland Materials Technology Engineering reserves the right to perform any or all of the tests set forth in this specification to ensure that the product continues to meet specification requirements. Any product not meeting the requirements of this specification will be returned to the supplier at the supplier's expense.

6.1.4 The manufacturer/supplier shall certify with a Certificate Conformance that each batch of each shipment meets the requirements of this specification.

6.2 Purchaser Batch/Lot acceptance tests

6.2.1 The purchaser/user is required to perform of all sampling, inspection and testing of each batch/lot as specified in **Table 2.**

Table 2: Qualification and Acceptance Tests

Property	Requirement	Qualification	Acceptance	
		(Supplier)	Supplier	Purchaser/User
Colour	Para.3.1.2	x	x	
Odour	Para.3.1.3	x		
Cure to Handle	Para.3.1.4	x	x	
Full Cure	Para.3.1.5	x		
Pot Life	Para.3.1.6	x	x	
Specific Gravity	Table 1	x	x	x
Viscosity	Table 1	x	x	x
Compressive Strength	Table 1	x	x	x
Insert Pull-Out (Flatwise Tension)*	Table 1	x		
Insert Pull-Out (Torsion)*	Table 1	x		
Water Absorption	Table 1	x		
* Requires for Grade 2, 2A and 3 only				

6.3 Sampling

6.3.1 Sampling Schedule - Sampling shall be in accordance with **Table 3**.

TABLE 3. Sampling Schedule

Number of can/kit in Batch	Frequency of Inspection
1 - 10	1 can/kit
11 - 39	2 can/kit
40 and more	3 can/kit

6.3.2 Batch - A batch shall be all the product produced in a single production run from the same lot of raw materials under the same fixed conditions and submitted for inspection at one time.

7 ORDERING DATA

7.1 Prerequisite

Produces furnished under this specification for production use shall be qualified and listed on the Qualified Products List prior to issuing of a purchase order.

7.2 Procurement Documents

Procurement documents shall specify the following:

- Title, Number, Issue and Amendment Number of this Specification
- Resin Grade
- Type and Size of Containers (Imperial, US or Metric Measure)
- Manufacturer's Material Designation
- Total Quantity

8 PREPARATION FOR DELIVERY

8.1 Identification

The material containers shall be identified with a label or marking securely affixed, which shall be legible and shall not be obliterated by normal handling and shall contain the following information:

- DHMS P1.30, Latest Issue and Amendment (Enter Grade)
- Base Resin or Hardener (As applicable)
- Mixing Ratio

- Manufacturer's Material Designation
- Date of Manufacture
- Batch Number
- Net Quantity (U.S., Imperial or Metric)
- Recommended Storage Temperature
- Purchase Order Number.

8.2 Packaging

8.2.1 The base resin and hardener shall be packaged in such a manner as to assure that, during shipment and storage, the product will be protected against damage from exposure to hazards which would affect adversely the property conformance to the requirements of this specification.

8.2.2 Each component of each kit shall be packaged in clean, air-tight containers of a type that will not contaminate the contents.

8.2.3 The low density, epoxy based resin shall be supplied in kit form or as agreed upon between the manufacturer and the purchaser

8.3 Shipping Documentation

8.3.1 Each shipping container shall have the exterior legibly marked with the following information in such a manner that the markings shall not smear or be obliterated during normal handling or use:

- Resin, Epoxy Base, Low Density
- DHMS P1.30, Latest Issue and Amendment (Enter Grade)
- Base Resin or Hardener (As applicable)
- Manufacturer's Material Designation
- Purchase Order Number
- Batch Number
- Date of Manufacture
- Number of Kits (A kit comprises base resin and appropriate quantity of hardener)
- Net Quantity (Imperial, US or Metric Measure)
- Recommended Storage Temperature.

8.3.2 Containers shall be prepared for shipment in accordance with commercial practice to assure carrier acceptance and safe transportation to the point of delivery.

8.3.3 Each shipment shall contain a copy of the Materials Safety Data Sheet.

9 HEALTH AND SAFETY DATA

When supplying samples for qualification per **Para.5.2.1**, the supplier shall submit a Safety Data Sheet (SDS) complying with Workplace Hazardous Material Information System (WHMIS) Regulations. The document must state all hazardous ingredients, safe-handling procedures, first-aid measures, fire and explosion data, re-activity data, physical properties, preparation information and procedures for storage and disposal.

This (SDS) must then be supplied with a completed EHS-FO-025 "Application To Introduce A New Material" form to the Material Safety Review Committee.

Upon receipt of EHS-FO-025 "Recommendation" form that approves the use of the material, it can then be included on the Qualified Products List.

9.1 Environmental Compliance

Materials and ingredients use in manufacturing the product shall comply to environmental regulations such as REACH, EPA, CEPA. Prohibited substances or restricted from certain uses under an Environmental Regulation shall not be used for the specified prohibited applications.

Supplier shall notify De Havilland Materials Technology if the product contains targeted substances.

QUALIFIED PRODUCTS LIST

MANUFACTURER'S NAME AND ADDRESS	MANUFACTURER'S PRODUCT IDENTIFICATION NO.	MATERIALS SAFETY DATA SHEET NO.	PRODUCT QUALIFICATION SHEET NO.	DATE OF PRODUCT APPROVAL
	Grade 1			
Magnolia Advanced Materials. 4360 Northeast Expressway Atlanta, GA 30340	Magnobond 76-1 Storage Life: 6 months Mixing ratio: 100:20 Colour: White Pot Life: 30-50 min Full Cure: 7 days	3409	PQS 14 PQS 17	Dec 8, 2000
	Magnobond 77-3 A/B Storage Life: 6 months Mixing ratio: 100:14 Colour: Brown Pot Life: 30-55 min. Full Cure: 7 days	3685	PQS 15 PQS 17	July 16, 2004
	Magnobond 77-4 A/B Storage Life: 6 months Mixing ratio: 100:14 Colour: Brown Pot Life: 30-55 min Full Cure: 7 days	3685	PQS 16 PQS17	July 16, 2004
	Grade 2			
Huntsman Advanced Materials Americas Inc. 5121 San Fernando Road W. Los Angeles, CA 90039	Epocast 8623 A/9861 Storage Life:12 months Mixing Ratio: 100:20 Colour: Off White Pot Life: 50-70 min Full Cure: 24 hours **OBSOLETE**	0410 1055	PQS 4	Sept. 28, 1977
	Epocast 1648 A/B Storage Life: 6 months DOS Mixing Ratio: 100:20 Mixed viscosity, Minimum Initial: 120 gm/min Colour: Off White Pot Life: 15-25 min Full Cure:7 days		PQS18	Sept, 2019

MANUFACTURER'S NAME AND ADDRESS	MANUFACTURER'S PRODUCT IDENTIFICATION NO.	MATERIALS SAFETY DATA SHEET NO.	PRODUCT QUALIFICATION SHEET NO.	DATE OF PRODUCT APPROVAL
	Grade 2A			
Huntsman Advanced Materials Americas Inc.	Epocast 8623 A/946 Storage Life: 12 months Mixing Ratio: 100:14 Colour: Off White Pot Life: 12-18 min Full Cure: 24 hours **OBSOLETE** **Use Grade 2**	0410 0321	PQS 5	Sept. 28, 1977
	Grade 3			
Dysol Inc. Socomore 791 Westport Pkwy Fort Worth, Texas 76177, United States	SF-14 A/B Storage Life: 12 months Mixing Ratio: 100:10 Colour: Off White Pot Life: 60-180 min. Full Cure: 7 days	2753 2754	PQS 10	July 20, 1999
Huntsman Advanced Materials Americas Inc.	CG1305 R/H Storage Life: 12 months Mixing Ratio: 100:20 Mixed vicosity: 11000-26000 cps Colour: Off White Pot Life: 60-120 min Full cure: 7 days	2885 2886	PQS 12	April 5, 2000
	Grade 5			
Cytec Engineered Materials, Inc. 1300 Revolution St. Havre De Grace, MD 21076	Corfil 615/DTA Storage Life: 6 months Mixing Ratio: 100:7 Colour: Purple Pot Life: 30-120 min. Full Cure: 24 hours	2543 2540	PQS 11	July 19, 1999