BOMBARDIER

de Havilland
Material Specification

TITLE:	**EPOXY ADHESIVE FILM FOR COMPOSITE MATERIAL**
SPECIFICATION NUMBER:	**DHMS A 6.08**
ISSUE:	**E**
AMENDMENT:	**--**
DATE:	**March 3, 2016**
PAGE:	**1 of 13**

Prepared by: Approved by:

SIGNED ORIGINAL ON FILE

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REVISION RECORD

Issue	Page	Description and Reason for Change
A		This is a revised specification. Deleted changes will not be noted.
Amd. 1	11	QPL change. American Cyanamid added for Class 1, ICI deleted.
B		This is a complete revised issue. Detail changes have not been noted.
Amd. 1	2	Revised Class 3 and Class 4 definition. Table 1 revised.
	4	Definition of Storage life and Workmanship revised.
	5	Section 4.2 revised.
	8	Table 2: Qualification and acceptance test revised.
	11	QPL change. Sovereign Engineered adhesives LLC added for Class 3 and Class 4.
Amd. 2	11	QPL change: Cytec deleted from Class 3
Adm. 3	4	Working Life changed from 7 days to 10 days. Cytec name changed to Cytec Fiberite Inc. Sovereign name changed to SIA Adhesives Inc.
C		This is a revised specification. Detail changes have not been noted.
Amd. 1	QPL	SIA Adhesive name and address changed to Henkel Loctite
D		This is a revised specification. Detail changes have not been noted.
	8-10	Clarified acceptance testing is required for both supplier and purchaser. Table 2, clarified testing requirement.
	Table 1, QPL	Added L316-11(PV) to class 5

REVISION RECORD

Issue	Page	Description and Reason for Change
D		
Amd. 1	2	Re-classified Class 3 as adhesive with polyester matt carrier
		Table 1: Class 2 is obsolete
		Class 3 Was: 0.06 psf ± 0.005; Is: 0.035 psf ± 0.005
	13	QPL : PL795-1 now available as supported film adhesive only. Remove PL795-1 from class 4, product name change Was PL795-1 Is: PL795-1M for class 3
		Previous stock of PL795-1 adhesive can be used to depletion.
	4	Para. 4.1, Conditioning of the test panels changed: Was: 40 hrs, Is: 24 hrs
Amd. 2	5	Para. 4.3, 4.4 Correct reference to Figure 2 for bagging procedure of Lap Shear panels.
E	4	3.2.1 Storage life changed as per supplier request. WAS: 210 days from Date of manufacture, IS: 270 days from date of manufacture
		4.1 Revised relative humidity . Was: 50% ± 5%, Is: 70% max
	10	6.3.2 Revised Batch definition
	11	8.1.2 Removed information : spec name, rev, PO# from the label inside the core
		8.2 Added section for labelling the outer packaging.
	13	QPL: Added Cytec Product Surface Master SM 905
		Removed J.D.Lincoln product L316/11 (PV) as product no longer available. Previous stock can be used to depletion.
		Added product FM300-2M to Class 3

1 SCOPE

This specification covers the requirements for a supported/unsupported epoxy film adhesive for bonding pre-cured laminates, metal doublers and reinforcing strips on interior and exterior composite parts.

1.1 Classification

The epoxy film adhesive covered by this specification shall be furnished in one of the following classes and types:

Class 1 - suitable for 250°F cure systems (structural film adhesive)

Class 2 - suitable for 350°F cure systems (structural film adhesive)

Class 3 - suitable for 250°F cure systems (non-structural film adhesive with non woven polyester matt carrier)

Class 4 - suitable for 350°F cure systems (non-structural unsupported film adhesive)

Class 5 - suitable for 250/350°F cure systems (surfacing film adhesive with non woven polyester veil carrier)

Table 1: Classification of adhesive

Class	Type	Film Weight (psf)	Film Thickness (in) Nominal
CLASS 1	1	0.040 ± 0.005	0.007
	2	0.060 ± 0.005	0.010
	3	0.080 ± 0.005	0.014
CLASS 2	1	0.030 ± 0.005	0.007
	2	0.050 ± 0.005	0.010
	3	0.080 ± 0.005	0.014
CLASS 3	1	0.012 ± 0.002	0.0016
	2	OBSOLETE	OBSOLETE
	3	0.035 ± 0.005	0.007
CLASS 4	1	0.012 ± 0.002	0.0016
	2	0.040 ± 0.005	0.007
	3	0.060 ± 0.005	0.010
CLASS 5	1	0.035 ± 0.005	0.007

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 & Materials

ASTM D1002	Strength Properties of Adhesives in Shear by Tension Loading (Metal to Metal)

2.2 de Havilland Specifications & Standards

DHMS A6.03	Modified Epoxy, Moderate Temperature Curing, High Strength, Structural Adhesive System
DHMS P1.24	Fabric, Aramid Fibre, High Modulus, 250°F Cure Epoxy Resin, Impregnated
DHMS P1.39	Fabric, Aramid Fibre High Modulus 350°F Cure Epoxy Resin, Impregnated (For Exterior Use)
DSC 234	Composite Manufacture Expendable Materials

3 REQUIREMENTS

3.1 Film Adhesive

The product shall be one of the classes noted in **Table 1** of this specification, a "B" staged, epoxy type, unsupported or supported capable of meeting the requirements specified herein.

3.2 Physical Properties of Uncured film

3.2.1 Storage Life - The storage life of the adhesive shall be a minimum of 180 days from the date of shipment, 270 days from the date of manufacture (Material to be shipped within 90 days from date of manufacture), when stored at a temperature of 0°F or below.

3.2.2 Working Life - The product shall meet the requirements of this specification when tested after exposure to a temperature not exceeding 77°F with a humidity not greater than 60%, for a continuous period of up to 10 days.

3.2.3 Tack - The product shall exhibit a degree of tackiness for 10 days at a temperature of 77°F, with a relative humidity not greater than 60%.

3.2.4 Shrinkage of Film Adhesive - shall not be more than 3% in either direction when exposed for 24 hours at $75^{o}F \pm 5^{o}F$. and a relative humidity of 50 ± 5%,in a horizontal position.

3.2.5 Dimensions

Width - Unless otherwise specified, the overall width of the film adhesive, as supplied, shall be as specified on the purchase order.

Length - Unless otherwise specified, the overall length of the film adhesive, as supplied, shall be 25 ± 1 yard, 50, 100 or 150 ± 5 yards.

3.2.6 Workmanship - The film adhesive shall be of uniform in quality and free from gaps, holes, resin pockets, areas lacking resin, excess resin, patches and other similar defects which would render the product unsuitable for its intended purpose.

3.3 Mechanical Properties

3.3.1 Shear Strength - The film adhesive shall be capable of being used to make up aramid laminate lap shear specimens as per **Para.4.3**, which will have a minimum average lap shear strength of 1,500 psi when tested in accordance with ASTM D1002. No individual value shall be less than 90% of this specified minimum.

3.3.2 Shear Strength on Aluminum - The film adhesive shall be capable of being used to make up metal to metal shear specimen as per **Para.4.4**, which will have a minimum average lap shear strength of 2500 psi when tested in accordance with ASTM D1002. No individual value shall be less than 90% of this specified minimum.

4 TEST PANEL FABRICATION AND TEST METHODS

4.1 General

Unless otherwise specified, tests shall be conducted at 75 ± 5° F and a relative humidity of maximum 70%. At least five specimens shall be used per test, and the results averaged. No individual value shall be less than 90% of the value specified.

4.1.1 After bonding, the test panels shall be cut into specimens for testing in accordance with the provisions of applicable tests. Panels shall not be cut into specimens until at least 24 hours after bonding. All cuts shall be accomplished so as to avoid overheating and/or mechanical damage to the bond. Use of lubricants or liquid coolants during cutting is prohibited. Unless otherwise specified by the referenced specification, condition the test panels and/or specimens at a temperature of 75°F ± 5°F and 50% ± 5% relative humidity for at least 24 hour prior to testing.

For environmental exposure testing, test the specimens at room temperature immediately after conditioned.

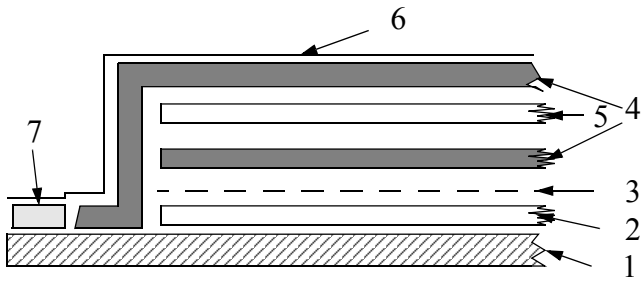
4.2 Lap Bond Shear Test Specimen

4.3 Shear Strength

One six ply laminate (8" fill x 10" warp) shall be made from DHMS P1.24, Type 2 prepreg for Class 1 and 3 film adhesives or DHMS P1.39, Class 2, Type 3 prepreg for Class 2 and 4 film adhesives. The laminate shall be laid-up with a layer of peel ply (release ply F) on the toolside surface and bagged per **Figure 1**. The laminate shall be cured as per **Figure 3**. Two (7" fill x 4" warp) panels shall be cut from the cured laminate to manufacture shear strength panels according to the dimensions and orientation given in figure 1 of ASTM D1002. The layer of peel ply shall be removed and the bond area cleaned with a solvent (e.g. M.E.K.) and wiped off before it evaporates prior to the application of the adhesive. The bonded panels shall be bagged per **Figure 2** of this specification and cured per **Figure 3** .

4.4 Shear Strength on Aluminum

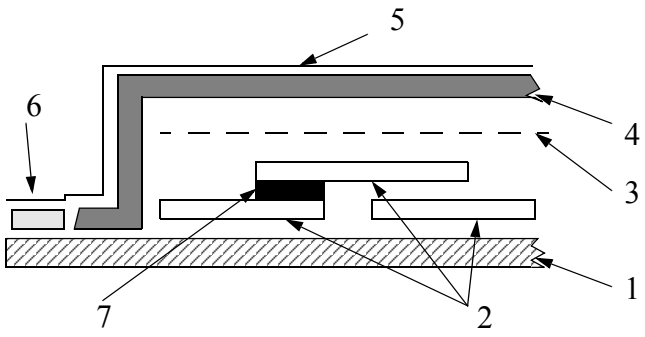
Test panels shall be made from 0.063" thick 2024-T3 aluminum sheet to QQ-A-250/5, using FPL etch or phosphoric acid anodize surface treatment and primed with DHMS A6.03-1. Two (7" x 4") panels shall be cut from the surface treated and primed aluminum sheet to manufacture shear strength panels according to the dimensions and orientation given in figure 1 of ASTM D1002. The bond area shall be cleaned with a solvent (e.g. M.E.K.) and wiped off before it evaporates prior to the application of the adhesive. The bonded panels shall be bagged per **Figure 2** of this specification and cured per **Figure 3**. Each test specimen shall be tested per ASTM D1002 and must exhibit cohesive failure within the adhesive. Specimens exhibiting any adhesive failure (between adhesive and skin) are not acceptable and the test must be repeated.



Use DSC 234 expendable materials

1. Tool (coated with mould release Frekote 44NC or 700NC)
2. PART
3. A4000 P3 Perforated Release Film
4. Airweave SS-FR Breather
5. Intensifier (0.032" to 0.060" Al. Plate)
6. Ipplon DP1000 Nylon Vacuum Bag
7. GS43 MR Vacuum Sealant Tape

FIGURE 1. Bagging Procedure for Laminates



Use DSC 234 expendable materials

1. Tool (coated with mould release Frekote 44NC or 700NC or release film)
2. Lap Shear Panels and Packer Plate (same thickness as lap shear panels)
3. A4000 P3 Perforated Release Film
4. Airweave SS-FR Breather
5. Ipplon DP1000 Nylon Vacuum Bag
6. GS43 MR Vacuum Sealant Tape
7. Film Adhesive

FIGURE 2. Bagging Procedure for Lap Shear Panels

APPROVED EXPENDABLE MATERIALS TO DSC 234

Vacuum bag, Ipplon DP1000	(DSC 234-1-54)	Airtech International Inc.,
Perforated Release Film A4000P3	(DSC 234-5-48)	"
Airweave SS-FR Breather	(DSC 234-11)	"
Vacuum Sealant Tape, GS 43 MR	(DSC 234-17-1)	"
Mould Release, Frekote 44NC or 700NC	(DSC 234-13)	Henkel

NOTE: Additional sources are listed in DSC 234.

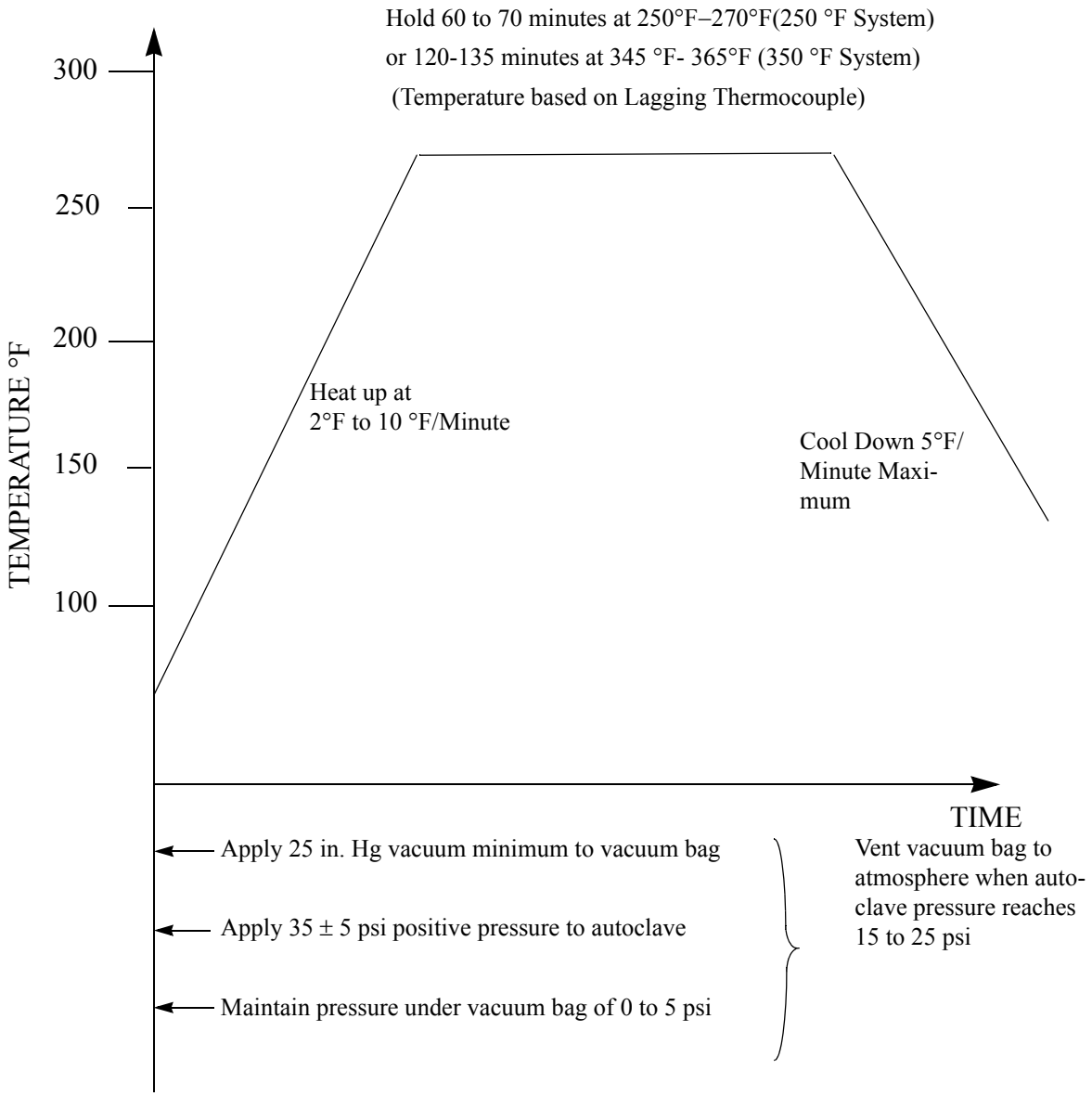


FIGURE 3. Cure Cycle

5 MATERIAL QUALIFICATION REQUIREMENTS

5.1 Request For Qualification

All requests for qualification to this specification shall be addressed to Bombardier Aerospace 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

5.2.1 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.

5.2.2 A sample shall be submitted for testing at the discretion of Bombardier Aerospace Materials Technology for evaluation.

5.2.3 Upon review of supplier's data, PCD and Materials Technology tests, the supplier will be advised either of product qualification or reasons for disqualification.

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

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

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

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). 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.

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

5.4.3 The PCD and all production data shall be available to any Bombardier Aerospace 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 disqualification.

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 Bombardier Materials Technology if there are any changes in the method of manufacture and/or formulation.

6 QUALITY ASSURANCE REQUIREMENTS

6.1 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 Bombardier Aerospace 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 is required to perform of all sampling, inspection and testing of each batch/lot as specified in **Table 2.**

Table 2: Qualification and Batch Acceptance Tests

Test	Paragraph	Qualification	Acceptance (supplier and purchaser)
Storage Life	Para.3.2.1	x	
Working Life	Para.3.2.2	x	
Tack	Para.3.2.3	x	x
Shrinkage	Para.3.2.4	x	
Dimensions	Para.3.2.5	x	
Workmanship	Para.3.2.6	x	
Shear Strength on Composite	Para.3.3.1	x	
Shear Strength on Aluminum*	Para.3.3.2	x	x

* Not required for class 3 type 1, Class 4 type 1, and Class 5

6.3 Sampling

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

Table 3: Sampling Schedule

Number of Rolls in Batch	Frequency of Inspection
1 - 10	1 roll
11 - 39	2 rolls
40 and more	3 rolls

6.3.2 Batch - A batch shall be consecutively numbered rolls of adhesive film coated from one homogeneous mixture, manufactured under the same fixed conditions at one time.

7 ORDERING DATA

7.1 Pre-requisite

Material 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
- Manufacturer's Material Designation
- Total Quantity

8 PREPARATION FOR DELIVERY

8.1 Identification

8.1.1 Each individual roll of adhesive shall have a legible identification label or marking securely affixed to the inside of the core.

8.1.2 The label or removable tag shall use characters of a size such as to be clearly legible and which will not be obliterated by normal handling. Each label or tag shall show the following information:

- Adhesive Film
- -Manufacturer's Material Designation
- -Lot and Roll Numbers
- Quantity
- Perishable - Store Below 0°F
- Date of Manufacture

8.2 Packaging

8.2.1 The film adhesive shall be wound on spools not less than 3 inches in hub diameter and interleaved with a non-adherent film. Winding shall be uniform and shall provide for proper unreeling.

8.2.2 Each roll shall be adequate support at both ends through the center of the core.

8.2.3 Each roll shall be sealed in a bag of suitable non-adherent material to prevent penetration of moisture or loss of impregnating resin solvent.

8.2.4 Each roll shall be label on the outer packaging with the following information:

- Adhesive Film
- DHMS A6.08, latest Issue and Amendment, Enter Class & Type
- Manufacturer's Material Designation
- Purchase Order Number
- Lot and Roll Numbers
- Quantity
- Perishable - Store Below 0°F

8.2.5 The roll shall be packed in an exterior shipping container capable of protecting the adhesive film adequately at 0°F or lower during shipment and storage.

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:

- Adhesive Film
- DHMS A6.08, latest Issue and Amendment, Enter Class & Type
- Manufacturer's Material Designation
- Purchase Order Number
- Lot and Roll Numbers
- Quantity
- Perishable - Store Below 0°F

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 Material Safety Data Sheet.

9 HEALTH AND SAFETY DATA

When supplying samples for qualification per Para. 5.2, the supplier shall submit a Material Safety Data Sheet (MSDS) complying with the "Controlled Products Regulations" of the Hazardous Products Act (also known as W.H.M.I.S. 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 (MSDS) must then be supplied with a completed DH 4339 "Application To Introduce A New Material" form to the Material Safety Committee.

Upon receipt of DH 4340 "Recommendation" form that approves the use of the material, it can then be included on the Qualified Products List.

NOTE: Any changes in the formulation of the material require a re-submission of the Material Safety Data Sheet.

QUALIFIED PRODUCTS LIST

MANUFACTURER'S NAME AND ADDRESS	MANUFACTURER'S PRODUCT IDENTIFICATION NO.	MATERIAL SAFETY DATA SHEET NO.	DE HAVILLAND QUALIFICATION SHEET NO.	DATE OF PRODUCT APPROVAL
	Class 1			
Cytec Solvay Group 1300 Revolution St. Havre de Grace Maryland 21078 U.S.A.	FM73U (Unsupported) Types 1 and 2 only	0415	See DHMS A6.03	February 1, 1980
	Class 2			
Cytec Solvay Group 1300 Revolution St. Havre de Grace Maryland 21078 U.S.A	FM 300M	942	PQS #2	January 18, 1984
	Class 3			
Henkel Loctite Corp. 2850 Willow Pass Rd. Bay Point, CA 94565 U.S.A	PL 795-1M	2525	PQS #4	Feb. 7, 2006
Cytec Solvay Group 1300 Revolution St. Havre de Grace Maryland 21078 U.S.A	FM 300-2M 0.06 psf	2523	PQS #7	Dec 2015

MANUFACTURER'S NAME AND ADDRESS	MANUFACTURER'S PRODUCT IDENTIFICATION NO.	MATERIAL SAFETY DATA SHEET NO.	DE HAVILLAND QUALIFICATION SHEET NO.	DATE OF PRODUCT APPROVAL
	Class 4			
Cytec Solvay Group 1300 Revolution St. Havre de Grace Maryland 21078 U.S.A	FM 300-2U	2523	PQS #3	October, 1991
	Class 5			
J.D.Lincoln, Inc. 851 W. 18th Street, Costa Mesa, CA 92627 Ph: (949) 650-8106 Fax: (949) 631-6190	L-316/11(PV) **OBSOLETE**	3842	PQS #5	March 31,/2011
Cytec Solvay Group 1300 Revolution St. Havre de Grace Maryland 21078 U.S.A.	Surface Master 905 (SM 905)	N/A	PQS #6	September 2015