

3M

Scotch-Weld™

Structural Adhesive Primer

EC-1593

Technical Data

August, 2001

Introduction

3M™ Scotch-Weld™ Structural Adhesive Primer EC-1593 is a sprayable primer for use with 3M™ Scotch-Weld™ Structural Adhesive Film AF 30. This product is suggested for use where good aluminum and magnesium overlap shear strengths from -67°F to 180°F (-55°C to 82°C) are required. Scotch-Weld EC-1593 offers the following advantages:

- Ensures complete wetting of film adhesive to the adherend surfaces.
- Cured primer protects cleaned surfaces for future adhesive bonding (up to 90 days).
- Primer color changes upon curing (blue to green).
- Imparts corrosion protection to the metal.
- Provides good compatibility with surface preparations used on magnesium.
- Qualified to MMM-A-132, Type I, Class 2 when used with Scotch-Weld AF 30. (This system is called AF 9930).

Description

Color:	Blue (uncured); Green (cured)
Base:	Synthetic Rubber
Net Weight:	7.5 ± .2 lbs/gallon (.90 ± .02 kg/l)
Viscosity:	40-120 cps (Brookfield Model RVF, No. 2 spindle @ 20 rpm @ 80°F)
Solids:	10 ± 1%
Available Sizes:	5 gallon pail, 1 gallon can

Scotch-Weld™

Structural Adhesive Primer

EC-1593

Surface Preparation

MMM-A-132 Type I, Class 2 Test Data

The following is a list of average test results for the structural adhesive system 3M™ Scotch-Weld™ Structural Adhesive Film AF 30/EC-1593 when bonded specimens were prepared and tested in accordance with Military Specification MMM-A-132, Type I, Class 2. **Note:** They should not be used for specification purposes.

Test Condition	MMM-A-132 Type I Class 2 & 3 Requirement (Min. Ave.)	AF 30 with EC-1593 Primer
A. Tensile Shear		
1. Normal temperature (75°F [24°C])	2500 psi (17.2 MPa)	3280 psi (22.6 MPa)
2. 10 min. @ 180°F (82°C)	1250 psi (8.6 MPa)	1850 psi (12.7 MPa)
3. 10 min. @ -67°F (-55°C)	2500 psi (17.2 MPa)	3880 psi (26.7 MPa)
4. Normal temperature (75°F [24°C]) after 30 days salt water spray	2250 psi (15.5 MPa)	3400 psi (23.4 MPa)
5. Normal temperature (75°F [24°C]) after 30 days @ 120°F (49°C) and 95-100% relative humidity	2250 psi (15.5 MPa)	3120 psi (21.5 MPa)
6. Normal temperature (75°F [24°C]) after 30 days immersion in tap water	2250 psi (15.5 MPa)	3520 psi (24.3 MPa)
7. Normal temperature (75°F [24°C]) after 7 days immersion in JP-4 fuel (MIL-J-5624)	2250 psi (15.5 MPa)	3360 psi (23.2 MPa)
8. Normal temperature (75°F [24°C]) after 7 days immersion in anti-icing fluid (MIL-F-5566)	2250 psi (15.5 MPa)	3640 psi (25.1 MPa)
9. Normal temperature (75°F [24°C]) after 7 days immersion in hydraulic oil (MIL-H-5606)	2250 psi (15.5 MPa)	3270 psi (22.5 MPa)
10. Normal temperature (75°F [24°C]) after 7 days immersion in Type III hydrocarbon fluid (MIL-S-3136)	2250 psi (15.5 MPa)	3270 psi (22.5 MPa)
B. Creep Rupture		
11. Normal temperature (75°F [24°C]) 192 hours @ 1600 psi (11.0 MPa)	0.015 in. (0.381 mm) max. deformation	0.0066 in. (0.1676 mm)
12. 180°F (82°C), 192 hours @ 800 psi (5.5 MPa)	0.015 in. (0.381 mm) max. deformation	0.0128 in. (0.3251 mm)
C. Fatigue		
13. Normal temperature (75°F [24°C]) 750 psi (5.9 MPa) @ 10 ⁶ cycles	No glue line failure	No glue line failure

Product Application

A thoroughly cleaned, dry, grease free surface is essential for maximum performance. Cleaning methods which will produce a breakfree water film on metal surfaces are generally satisfactory. Surface preparations should be fully evaluated with the adhesive, especially if resistance to specific environments are anticipated.

Scotch-Weld™
Structural Adhesive Primer
 EC-1593

Surface Preparation

Suggested Cleaning Procedure for Aluminum

1. Alkaline Degrease – Oakite 164 solution (9-11 oz./gallon of water) at 190° ± 10°F (88° ± 6°C) for 10-20 minutes. Rinse immediately in large quantities of cold running distilled, deionized, or tap water.
2. Optimized FPL Etch Solution (1 liter):*

<u>Material</u>	<u>Amount</u>
Distilled Water	700 ml plus balance of liter (see below)
Sodium Dichromate	28 to 67.3 grams
Sulfuric Acid	287.9 to 310.0 grams
Aluminum Chips	1.5 grams/liter of mixed solution

To prepare 1 liter of this solution, dissolve sodium dichromate in 700 ml of distilled water. Add sulfuric acid and mix well. Add additional distilled water to fill to 1 liter. Heat mixed solution to 66 to 71°C (150 to 160°F). Dissolve 1.5 grams of 2024 bare aluminum chips per liter of mixed solution. Gentle agitation will help aluminum dissolve in about 24 hours.

***Note:** Review and follow suppliers environmental health and safety recommendations for each component prior to preparing this etch solution.

To FPL etch panels, place them in the above solution at 150° to 160°F (66° to 71°C) for 12 to 15 minutes.

3. Rinse – Rinse panels in clear running tap water.
4. Dry – Air dry 15 minutes; force dry 10 minutes minimum at 140°F (60°C) maximum.
5. It is advisable to coat the freshly cleaned surfaces with Scotch-Weld EC-1593 within 4 hours after surface preparation.
6. Care should be taken to avoid contaminating the cleaned aluminum by any substance which will hinder the wetting action of Scotch-Weld EC-1593.

Primer Application:

The following spray equipment is suggested to obtain optimum results.

Spray Gun	DeVilbiss JGA
Air Cap	78
Tip	AV-15-FX
Needle	FX
Line Pressure	50-60 psi
Fan Setting	Open halfway
Spray Pattern	Single Cross Coat

Primer Dry:

The following primer dry is suggested to obtain optimum results:

- 2-12 hours @ 75°F (24°C)
- 60 minutes in a 290°F (143°C) circulating air oven.

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Structural Adhesive Primer

EC-1593

Application Procedure

When using Scotch-Weld EC-1593, the peel strength will be significantly affected by the primer thickness and dry time between passes. Peel tests at different thicknesses or coat weights, reveal that the climbing drum peel strength is maximized when the coat weight after curing is about 2.6 g/ft². This corresponds to about 2 grams of Scotch-Weld EC-1593 per 8 x 14 in² area. The coating / spraying procedure is discussed at length in the next section.

Spraying Procedure

The desired thickness of the primer coating is about 1 mil, and this corresponds to a coat weight of 2 grams per 8 x 16² after baking (or curing). The following procedure is to be followed to get satisfactory results.

General Rules

- It is necessary to coat lighter weights during each pass, let the panel dry for about 4-5 minutes, and take about 9-10 passes to build up the ultimate coat weight.
- Take all weights 1 minute after each pass so that “some” solvent evaporates before taking the “wet” weight. It is advisable to keep this “time before weighing” constant at 1 minute to get consistent results.
- After the final pass, let the panels dry at 75°F (24°C) for at least 2 hours.

Spray Gun Settings

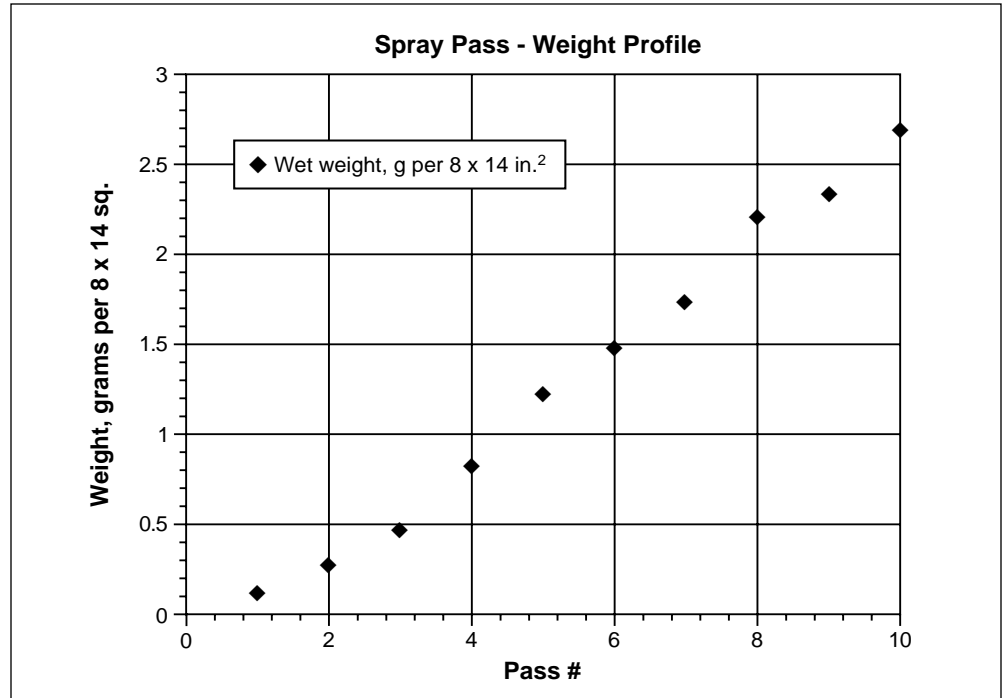
Line pressure = 55 psi; Pot pressure = 13-14 psi

Procedure

1. Each pass consists of one horizontal spray and one vertical spray.
2. For the first pass, the gun opening is about 1/2 turn, and for the subsequent passes the opening is increased to about 5/8 to 3/4 turn to get the required weights. Note that the weight depends on the (i) gun opening, (ii) distance between the panel and the gun and (iii) the speed of movement of the spray gun. You may optimize the above factors to match the following spray pass-weight profile which seems to work in almost all experiments.
3. During the spray process, it is necessary to wait for about 1 minute before taking the weight after each pass, and four (4) more minutes before spraying the next pass. That is, the total wait between passes is about five (5) minutes, and this wait is necessary to allow the solvents to dry. This reduces solvent entrapment, and results in a coating with desired modulus. The following spray pass-weight profile was proved successful. Note again that each pass means one horizontal (normal) and one vertical (perpendicular) spray.

Pass #	Wet weight per 8 x 14 in ²	Dry weight per 8 x 14 in ²
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Application Procedure
(continued)



Practice with a few panels to achieve approximately 0.04 gram for the first pass, and about 0.90 to 0.10 gram for the subsequent passes.

Primer drying and curing

4. 2-12 hour air dry at 75°F (24°C); Heat cure at 290°F (143°C) for 60 minutes.

Adhesive bonding

5. The adhesive bonding cure cycle for Scotch-Weld EC-1593 with 3M™ Scotch-Weld™ Structural Adhesive Film AF 30 is 35-37 minutes at 350°F, 7.5°F/min. rise rate; 50-55 psi pressure.
6. For climbing drum peel specimens, no non-porous release should be used above or below the bondline. Bleeder cloth may be used above the specimens. This would help avoid trapping any volatiles.
7. For overlap shear bonds – it is very important to avoid non-uniform or non-horizontal bondlines. The bondline thickness needs to be uniform. Since Scotch-Weld AF 30 is a thick adhesive film (10 mil in. thickness), the following optimum procedure is developed.

Use 5-layers of 2 mil thick aluminum foil or 1-layer of 8 mil (.008 in.) thick stainless steel shim to keep the bondline thickness uniform and under control. Lay up the bonds as close to each other as possible. Place the shims as close to the bondline as possible. That is, the overlap shear bonds should be laid up in such a way that the panel underneath almost touches the adhesive of the bond above, and the aluminum foil shim (5-layers) go in between the two bonds. This would help eliminate any “bending” of the bondlines. Once again, no tedlar was used above or below the bonds. We only had the bleeder cloth. This would help avoid trapping any volatiles.

Scotch-Weld™

Structural Adhesive Primer

EC-1593

Application Procedure (continued)

8. When these precautions were taken, all of the testing results were satisfactory.

Climbing drum peel and Overlap shear data

It may be noted that climbing drum peel numbers were higher when the number of passes was higher (about 9-10 passes) as opposed to only 4-5 passes. It appears that solvent evaporation is rather critical. Similarly, the overlap shear numbers seem to be critically dependent on the “uniformity” in bondline thickness.

Storage

Avoid heat and dampness in storage. Store new shipments behind older lots. Refrigerated storage 40° ± 5°F (4° ± 2.8°C) is suggested for EC-1593.

3M standard shelf life of Scotch-Weld EC-1593 is six months from date of manufacture when stored at 40°F (4°C) or below.

Caution: Scotch-Weld EC-1593 should be permitted to thoroughly warm to room temperature before being used in order to prevent moisture condensation.

Precautionary Information

Refer to Product Label and Material Safety Data Sheet for health and safety information before using this product. For additional health and safety information, call 1-800-364-3577 or (651) 737-6501.

For Additional Information

To request additional product information or to arrange for sales assistance, call toll free (800) 235-2376. Our fax number is (417) 869-5219. Address correspondence to: 3M Aerospace Central, 3211 E. Chestnut Expressway, Springfield, MO 65802.

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ISO 9002

This Engineered Adhesives Division product was manufactured under a 3M quality system registered to ISO 9002 standards.

For Additional Product Safety and Health Information, See Material Safety Data Sheet, or call:



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Printed in U.S.A.
©3M 2001 78-6900-9581-1_08-01