



**LASER INDUCED REACTION FOR PREBOND SURFACE  
PREPARATION OF ALUMINUM ALLOYS**

**Stage I Report (5-6/93)  
Contract No. F61708-93-C005**

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## INTRODUCTION

The potential of UV lasers for prebonding treatment of Al-2024 alloy was proved in a previous investigation [1] with a modified epoxy adhesive.

Surface treatment of Al by excimer laser results in oxidation and morphological changes of the surface promoting high shear adhesion strength at optimal laser conditions. The objective of this research is to establish the effect of excimer ArF UV laser on the Al alloy surface microstructure and chemical activity and its correlation with the macro behaviour of shear and peel strength and failure locus of adhesively bonded joints using structural adhesives for structural and repair applications.

The first stage of this research (0001 of the contract) is summarized in this report. This stage includes the preparation of all Al specimens with required configurations for the various tests.

## EXPERIMENTAL

### Adhesives and Primer

3 kinds of structural adhesives for various service temperatures and their primer were ordered. The details of the adhesives and the primer are given in Table 1.

Table 1: The structural adhesives and the primer

COMMERCIAL NAME (CYANAMID)	CURING CONDITIONS	APPLICATION FORM	SERVICE TEMPERATURE RANGE
FM73	1 Hr. 120 <sup>0</sup> C 40psi	FILM, 0.38mm POLYESTER CARRIER	-55 <sup>0</sup> C to +120 <sup>0</sup> C
FM3002K	1.5Hr. 120 <sup>0</sup> C 40psi	FILM, 0.3mm POLYESTER CARRIER	-55 <sup>0</sup> C to +175 <sup>0</sup> C
FM350NA	1Hr. 177 <sup>0</sup> C 30psi	FILM GLASS CARRIER	-65 <sup>0</sup> C to +177 <sup>0</sup> C
BR127	1/2Hr. R.T. 1/2Hr. 121 <sup>0</sup> C	MIXING, BRUSHING	-55 <sup>0</sup> C to +177 <sup>0</sup> C

All adhesives and the primer will pass quality control tests including epoxy content, solid content, volatiles and percent of fluency, before application.

Adherends Preparation

Four kinds of Al 2024 adherends were prepared:

- 1- Single lap shear adherends (see Fig. 1) according to ASTM D-1002-72  
25 X 100X 1.6 mm (2 for each sample).
  
- 2- Peel adherends according to ASTM D-3167 (see Fig. 2).  
25 X 250 X 1.6 mm (rigid).  
25 X 250 X 0,5 mm (flexible).  
(One of each for each sample).

- 3- Tensile adherends according to ASTM C-297  
 (Flat wise, FW)  
 37 X 37 X 37 mm with a central penetrating hole  
 (described in Fig. 3)  
 (2 for each sample).
- 4- Wedge adherends  
 According to ASTM D-3762  
 25 X 250 X 1.6 mm  
 (2 for each sample + a wedge).  
 The sample is described in Fig. 4.

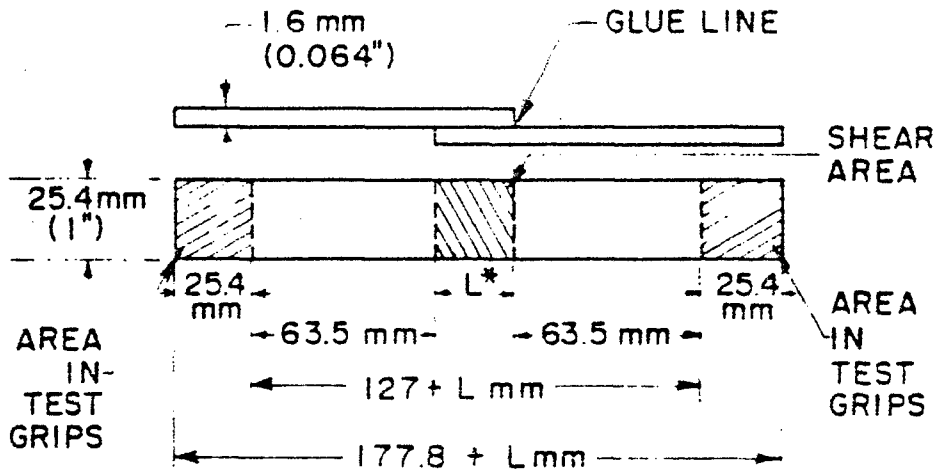
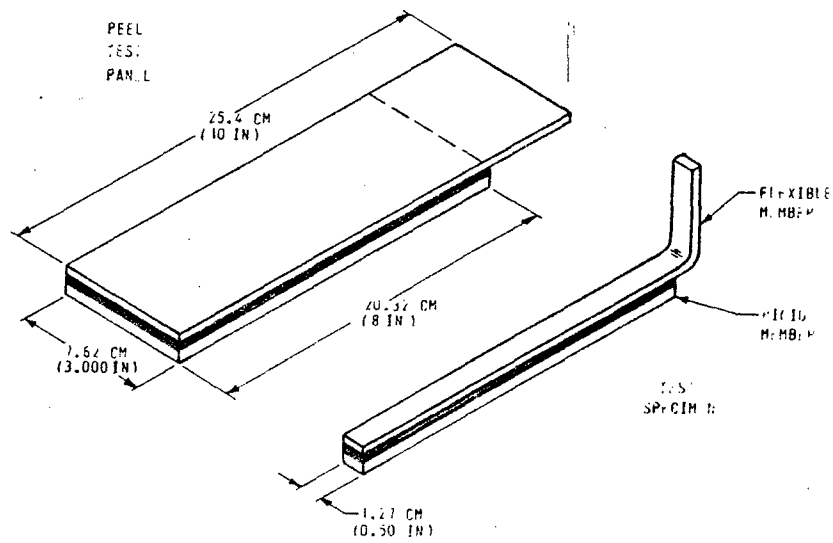


Fig. 1: SLS adherends.



NOTE—A 1.5 to 3.0-in. (38.1 to 74.2-mm) shim can be used to facilitate the start of peel.

Fig. 2: Peel tests' adherends

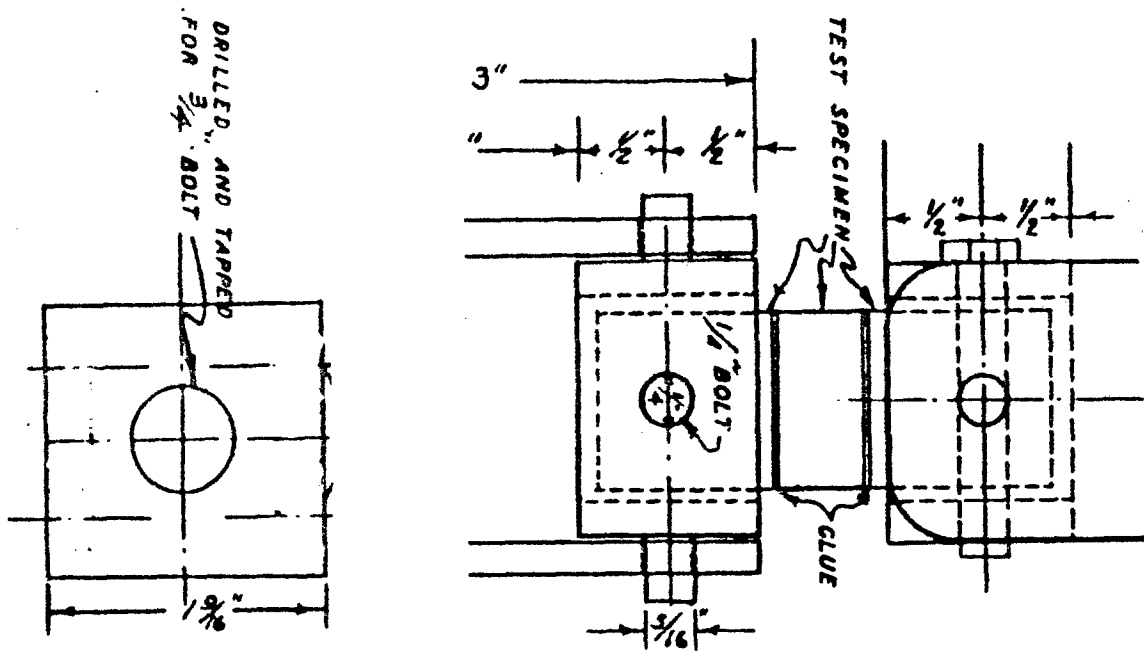


Fig. 3: Tensile tests' adherends.

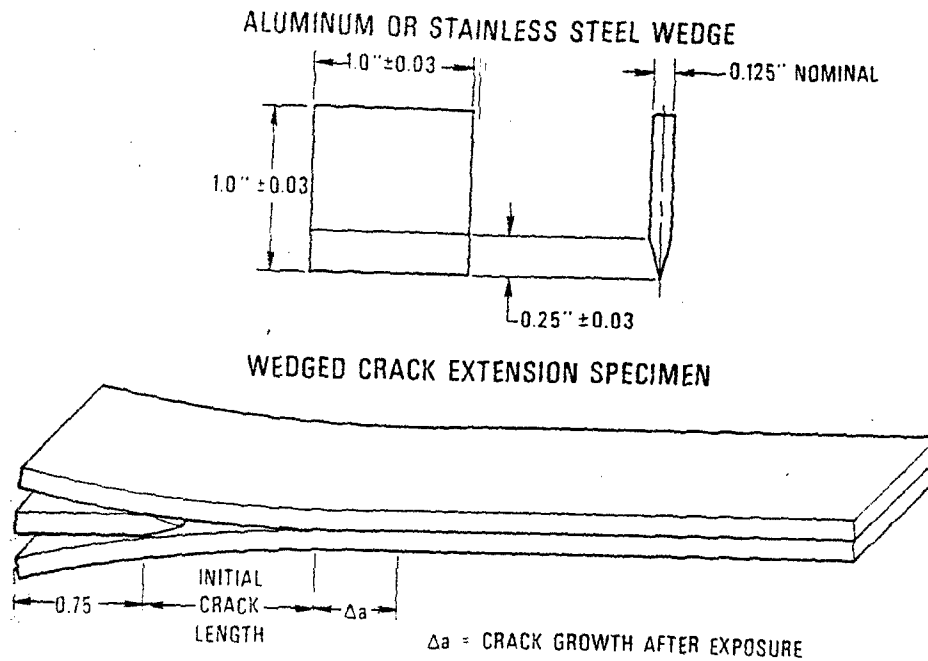


Fig. 4: Wedge test adherend.

#### Amount and Kinds of Samples

Two kinds of references will be used in all experiments for comparison with laser treated specimens. A non-treated Al sample, An unsealed chromic acid anodized Al sample (MIL-A-8625C).

SLS adherends will be tested at various laser parameters + 2 references in order to establish the optimal laser conditions.

Peel, tensile and wedge tests will be produced at optimal laser conditions only + 2 references.

The total amount of sample sets prepared are summarized in Table 2.

Anodization treatment for the reference adherends will be performed as close as possible to the adhesion stage.

Table 2: Number of sets needed for the various tests.

Adhesive	Adherends	SLS (1)	Peel (1)	Tensile (1)	Wedge (2)
FM 73	Laser irradiated	3	1	1	1
	Untreated	1	1	1	1
	Anodized	1	1	1	1
FM300 2K	Laser irradiated	3	1	1	1
	Untreated	1	1	1	1
	Anodized	1	1	1	1
FM350NA	Laser irradiated	3	1	1	1
	Untreated	1	1	1	1
	Anodized	1	1	1	1

(1) Each set = 5 samples

(2) Each set = 3 samples

The total amount of samples prepared are:

SLS (Shear)            75 samples  
FW (tensile)            45 samples  
PEEL (90°)            45 samples  
Wedge                    27 samples.

**SUMMARY**

All adherends for the various tests were prepared. Adhesives and primer were ordered and will be QI tested when received. Task No. 0001 was completed.