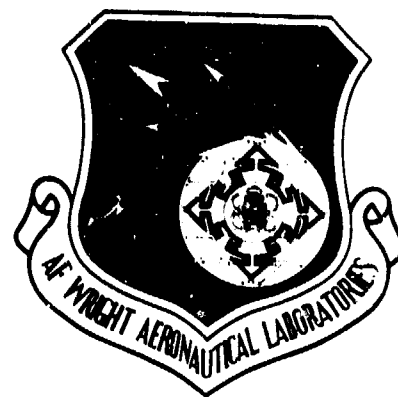


AFWAL-TR-86-3017
Volume III



ADVANCED DURABILITY ANALYSIS
VOLUME III - FRACTOGRAPHIC TEST DATA

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August 1, 1986

FINAL REPORT OCTOBER 1984 - SEPTEMBER 1985

Approved for public release; distribution unlimited

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; Distribution Unlimited		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S)			5. MONITORING ORGANIZATION REPORT NUMBER(S) AFWAL-TR-86-3017 Volume III		
6a. NAME OF PERFORMING ORGANIZATION General Dynamics-FWD		6b. OFFICE SYMBOL (If applicable)		7a. NAME OF MONITORING ORGANIZATION Air Force Wright Aeronautical Laboratories	
6c. ADDRESS (City, State and ZIP Code) P. O. Box 748 Fort Worth, TX 76101			7b. ADDRESS (City, State and ZIP Code) AFWAL/FIBEC Wright-Patterson AFB OH 45433-6553		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Wright Aeronautical Laboratories		8b. OFFICE SYMBOL (If applicable) FIBEC		9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F33615-84-C-3208	
8c. ADDRESS (City, State and ZIP Code)			10. SOURCE OF FUNDING NOS.		
			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.
			62201F	2401	01
11. TITLE (Include Security Classification) Advanced Durability Analysis Vol III - Fractographic Test Data			WORK UNIT NO. 89		
12. PERSONAL AUTHOR(S) D.E. Gordon, S.B. Kirschner, L.E. Brubaker, K. Koepsel, S.D. Manning, J.N. Yang					
13a. TYPE OF REPORT Final Report		13b. TIME COVERED FROM Oct 84 TO Sep 85		14. DATE OF REPORT (Yr., Mo., Day) 86, Aug. 1	
				15. PAGE COUNT 255	
16. SUPPLEMENTARY NOTATION The associate investigator for this report was J.N. Yang of United Analysis Inc.					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB. GR.			
0103	1404	1305	Durability, fatigue, fractography, fastener hole quality, small cracks, time-to-crack-initiation (TTCI), equivalent-initial-flaw-size (EIFS), F-16 spectrum, B-1 spectrum		
19. ABSTRACT (Continue on reverse if necessary and identify by block number) This report contains the test results and raw fractographic data for over 180 fatigue cracks acquired under the "Advanced Durability Analysis" program. Natural fatigue cracks were acquired in fastener holes in 7475-T7351 aluminum. Three specimen fastener hole configurations were considered: (1) open hole, (2) bolt-in-hole (passive), and (3) bolt load transfer. Both straight-bore and countersunk fastener holes were considered. Strain survey results for a double-reversed dog-bone specimen (designed for 15% bolt load transfer) are presented. The fractographic data in this report can be used to quantify the initial fatigue quality or equivalent initial flaw size (EIFS) cumulative distribution for clearance-fit fastener holes. These data can be used to determine the initial flaw size for the durability and damage tolerance analyses of mechanically fastened joints.					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☒ DTIC USERS ☐			21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED		
22a. NAME OF RESPONSIBLE INDIVIDUAL Margery E. Artley			22b. TELEPHONE NUMBER (Include Area Code) (513) 255-6104		22c. OFFICE SYMBOL AFWAL/FIBEC

FOREWORD

This report was prepared by General Dynamics, Fort Worth Division under Phases 1 and 2 of the "Advanced Durability Analysis" program (Air Force Contract F33615-84-C-3208) for the Air Force Wright Aeronautical Laboratories (AFWAL/FIBEC). James L. Rudd was the Air Force Project Engineer and Dr. Jack W. Lincoln of ASD/ENFS was a technical advisor. Dr. S. D. Manning of the General Dynamics' Structures Technology Staff was the program manager and co-principal investigator along with Dr. J. N. Yang of United Analysis Incorporated (Springfield, VA).

All tests were performed in General Dynamics' Metallurgy Laboratory by R. O. Nay under the direction of R. L. Jones. D. E. Gordon was responsible for specimen acquisition. Fractographic evaluations were performed by D. E. Gordon, S. B. Kirschner and K. Koepsel. L. E. Brubaker coordinated the fractographic data acquired.

This report (Vol. III) contains test results, raw fractographic data, and strain survey data developed under the "Advanced Durability Analysis" program. Other volumes for this program are as follows:

- o Volume I - Analytical Methods (Tasks I, II, III)
- o Volume II - Analytical Predictions, Test Results, and Analytical/Experimental Correlations (Tasks I, III, IV, and V)
- o Volume IV - Executive Summary



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SECTION I

INTRODUCTION

This report contains test and raw fractographic data acquired under the "Advanced Durability Analysis" program [1]. Applicable test results, fractography and strain survey data acquired by the General Dynamics Fort Worth Division under independent research are also presented [2,3].

The test matrix and specimen details for this program are described in Section II. Test setups, testing procedures and data acquisition details are described elsewhere [4-6]. Raw test and fractographic results are presented in this Volume (III) and the results are evaluated in Volume II [4].

The fractographic data presented in this report can be used to quantify the initial fatigue quality (IFQ) or equivalent initial flaw size distribution for clearance-fit fastener holes in 7475-T7351 aluminum. Other sources for IFQ data are available [e.g., 6-12].

SECTION II

TEST PROGRAM AND RESULTS

2.1 INTRODUCTION

The test matrix and specimen details for the Phase 1 and 2 test programs are described in this section. Test results are summarized. The raw fractographic data and strain survey results acquired are presented in applicable appendices.

2.2 PHASE 1 TEST PROGRAM

Objectives of the Phase 1 test program were:

1. Acquire fractographic data for multiple-hole dog-bone specimens and use the data to evaluate the statistical scaling concept for defining the initial fatigue quality of fastener holes.
2. Obtain data for evaluating the effects of specimen size on the equivalent initial flaw size distribution (EIFSD).
3. Acquire fractographic data for unflawed fastener holes and use the results to evaluate the advanced durability analysis methodology for both small (e.g., ≤ 0.10 ") and large (e.g., > 0.10 ") through-the-thickness crack sizes.

The test matrix for the Phase 1 effort (Task 1) is shown in Table 1 and the specimen details are shown in Fig. 1. Details of the Test Setup and procedures are given in Volume II [4].

Thirty-one replicate dog-bone specimens (Fig. 1), with no intentional preflaws in the fastener holes, were fatigue tested to failure at room temperature in a lab air environment. Two different load spectra were used. Test results for the Phase 1 effort are summarized in Table 2, including the final crack sizes for each of the three holes per specimen. Fractographic results for the fighter and bomber load spectra are presented in Appendix A and B, respectively.

2.3 PHASE 2 TEST PROGRAM

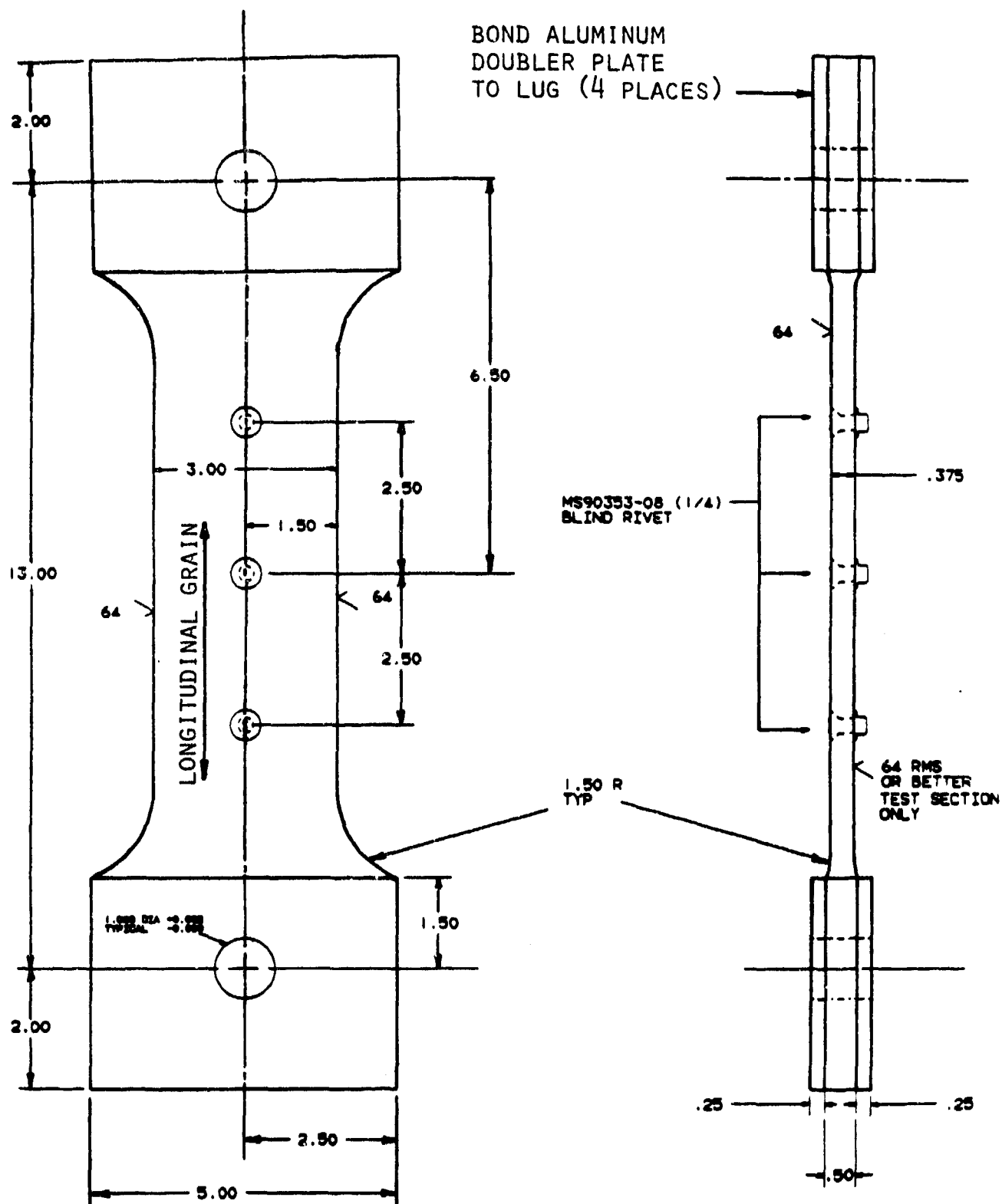
The Phase 2 test program had the following objectives:

1. Acquire fractographic results for large through-the-thickness fatigue cracks in unflawed (no intentional preflaws introduced) fastener holes.
2. Obtain both small and large fatigue crack growth data that can be used to quantify the initial fatigue quality of fastener holes.

TABLE 1 PHASE 1 TEST MATRIX

SPECIMEN	MATERIAL	TEST SERIES	NO. HOLES PER SPECIMEN	% LOAD TRANSFER	LOAD SPECTRA	MAX. STRESS LEVEL (KSI)	FASTENER I.D.	NO. SPECIMEN
	7475-T7351 	I(a)	3 	0 	F-16 400HR	34	MS90353-08(1/4) 	15
		I(b)			B-1 BOMBER	36		16

NOTE: ALL TEST PERFORMED AT ROOM TEMPERATURE IN LAB AIR

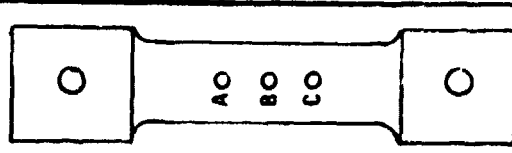
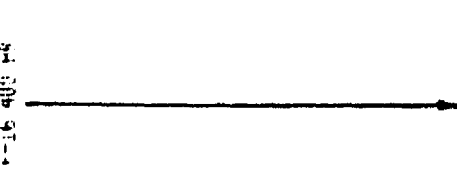
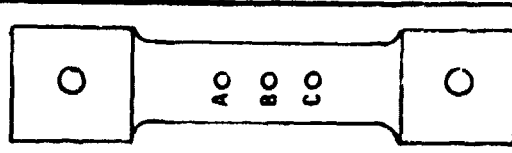
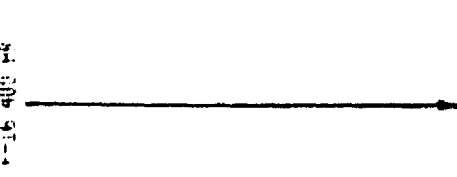


Notes

1. Material: 7475-T7351 aluminum plate (1/2" stock)
2. Drill holes using modified Winslow Spacematic drill without deburring
3. Drill and install MS90353-08 rivets per M198.

Fig. 1 Multiple Hole Dog-Bone Specimen Details

TABLE 2 SUMMARY OF PHASE I TEST RESULTS

SPECIMEN	SPECIMEN I.D.	LOAD SPECTRA	MAX STRESS (KSI) ⑤	TEST SERIES	FAILURE FLT HRS	FAILURE MODE	FINAL CRACK SIZE (IN.) ⑥						FRACTOGRAPHY REF PG
							A		B		C		
							LH	RH	LH	RH	LH	RH	
	W1-1 (Dur. 1)		34	I(a)	31200	B	0.630	0.930	0.73	0.77	<0.010	0.105	A-2 - A-5
	-2 (Dur. 2)				27200	C	0.140	0.304	0.180	0.355	0.55	0.72	A-6 - A-9
	-3 (Dur. 3)				① 23600	B	0.360	0.630	0.782	0.715	0.180	0.120	A-10 - A-12
	-4 (Dur. 4)				39400	A	0.49	0.745	0.068	0.174	0.050	0.133	A-13 - A-16
	-5 (Dur. 5)				30800	A	0.71	0.52	0.035	0.025	0.290	0.200	A-17 - A-19
	-6 (Dur. 6)				17600	A	0.565	0.710	0.020	0.048	<0.010	0.067	A-20 - A-23
	-7 (Dur. 7)				16400	A	0.94	0.77	0.180	0.131	0.031	<0.010	A-24 - A-27
	-8 (Dur. 8)				28000	B	<0.01	NO FLAW	1.020	0.620	>0.34	>0.300	A-28 - A-29
	-9 (Dur. 9)				36480	A	1.05	0.61	0.25	0.22	0.252	0.25	A-30 - A-33
	-10 (Dur. 10)				30080	C	0.250	0.220	0.152	0.025	0.823	0.710	A-34 - A-37
	-11 (Dur. 11)				20400	A	0.98	0.75	0.090	0.025	0.380	0.105	A-38 - A-40
	-12 (Dur. 12)				② 30240	B	≈ 0.10	≈ 0.080	0.140	0.085	≈ 0.180	0.100	A-41 - A-42
	-13 (Dur. 13)				32400	B	0.26	0.24	0.850	0.78	<0.010	NO FLAW	A-43 - A-44
	-14 (Dur. 14)				29360	B	0.362	0.310	1.03	0.39	0.111	<0.010	A-45 - A-48
	-15 (Dur. 15)				33000	A ④	0.750	0.50	<0.010	NO FLAW	≈ 0.036	NO FLAW	A-49 - A-51
	W1-1 (Dur. 15)		36	I(b)	41449	C	0.086	NO FLAW	0.0172	0.0076	0.826	0.705	B-2 - B-3
	-2 (Dur. 17)				44730	A ②	0.089	0.758	0.663	0.635	NO FLAW	NO FLAW	B-4
	-3 (Dur. 18)				43210	A	0.594	0.109	0.770	0.668	0.0437	0.0469	B-5 - B-9
	-4 (Dur. 19)				58050	B	0.716	0.589	0.187	0.147	NO FLAW	NO FLAW	B-10 - B-12
	-5 (Dur. 20)				51975	A	0.378	0.589	0.187	0.147	0.385	0.141	B-13 - B-16
	-6 (Dur. 21)				36400	C	0.091	0.559	0.118	0.114	0.169	NO FLAW	B-17 - B-19
	-7 (Dur. 22)				34601	A	0.357	0.621	0.0815	0.0748	0.055	0.0388	B-20 - B-23
	-8 (Dur. 23)				37079	B	0.426	0.351	0.714	0.593	0.119	0.0479	B-24 - B-28
	-9 (Dur. 24)				53020	C	0.426	0.351	0.272	0.0597	0.903	0.525	B-29 - B-32
	-10 (Dur. 25)				39129	A	0.749	0.544	0.0546	0.0304	NO FLAW	NO FLAW	B-33 - B-35
	-11 (Dur. 26)				28276						⑦		
	-12 (Dur. 27)				40070	C	0.140	0.105	0.433	0.428	0.802	0.652	B-36 - B-39
	-13 (Dur. 30)				37659	B	0.120	0.122	0.261	0.0567	0.238	0.0528	B-40 - B-43
	-14 (Dur. 31)				52080						⑦		
	-15 (Dur. 32)				24933						⑦		
	-16 (Dur. 33)				43966	A	0.876	0.326	0.188	0.231	0.0322	0.0413	B-44 - B-46

Notes for Table 2

- 1 Failed when disk drive was disconnected from computer system
- 2 Specimen bent in compression due to load cell malfunction
- 3 Hole with largest crack
- 4 Crack originated in countersink area
- 5 Maximum gross stress calibrated to maximum load in spectrum
- 6 Measured in direction of crack propagation with respect to bore of hole.
- 7 Lug end failure

3. Use the acquired data to verify the advanced durability methods developed for large through-the-thickness cracks associated with fuel leaks and ligament breakage.

4. Do a specimen strain survey using a double-reversed dog-bone type specimen and verify the percentage of bolt load transfer as a function of the applied load level.

The complete test matrix for the Phase 2 effort (Task IV) is shown in Table 3. Specimen details are shown in Figures 2 and 3. The test setups and procedures are documented in Volume II [4].

In Table 3 all fatigue tests were conducted at room temperature in a lab air environment. Three different load spectra were considered. Fatigue test results for Phase 2 (i.e., time-to-failure and final crack sizes in the fastener holes) are summarized in Tables 4-11 by test series. Fractographic results for test series IV(a) - IV(c), IV(h), IV(d) - IV(g) are presented in Appendices C through J, respectively.

Eight dog-bone specimens (Fig. 2) were fatigue tested and fractographically evaluated under General Dynamics, Fort Worth Division independent research [2]. Test specimens were made from the same batch of material used for this program. Four specimens each were fatigue tested the same way as test series IV(a) and (b) (see Table 3). Test and fractographic results for these tests are also included in Appendix C and D. These results and those for Test Series IV(a) and (b) are used in the durability analysis methodology evaluation in Volume II [4].

A strain survey was performed using a double-reversed dog-bone specimen (Fig. 3). Details of the strain survey and results are given in Appendix K. A more comprehensive strain survey has been performed using a replicate test specimen from the same material batch [3]. These strain survey results are also presented in Appendix K. The strain survey results presented in this Volume (III) are evaluated in Volume II [4].

TABLE 3 PHASE 2 TEST MATRIX

Specimen	Material	Test Series	No. Holes per Specimen	Load Transfer	Load Spectra	Max Stress Level (ksi)	Fastener			No. Specimens Tested
							Type	Dia (in)	ID	
 (Fig 2)	7475-T7351 Al	IV(a)	1	0	F-16 400-Hr	34	PH	1/4	NAS6204	9
		IV(b)			B-1 Bomber	34				8
		IV(c)			F-16 C/D	34				5
		IV(h)				40.8				8
					F-16 400-Hr	40.8	Open Hole (1/4" Dia.)			15
 (Fig 3)		IV(d)	4	15%	F-16 400-Hr	34	CSK	1/4	MS90353-08	15
		IV(e)				40.8				
		IV(f)			B-1 Bomber	34				
		IV(g)				40.8				
		IV(i)			Strain Survey	—				1

Notes

1. Material: 7475-T7351 aluminum plate (1/2" stock)
2. Drill holes using modified Winslow Spacematic drill without deburring
3. Drill and install fastener per M198.

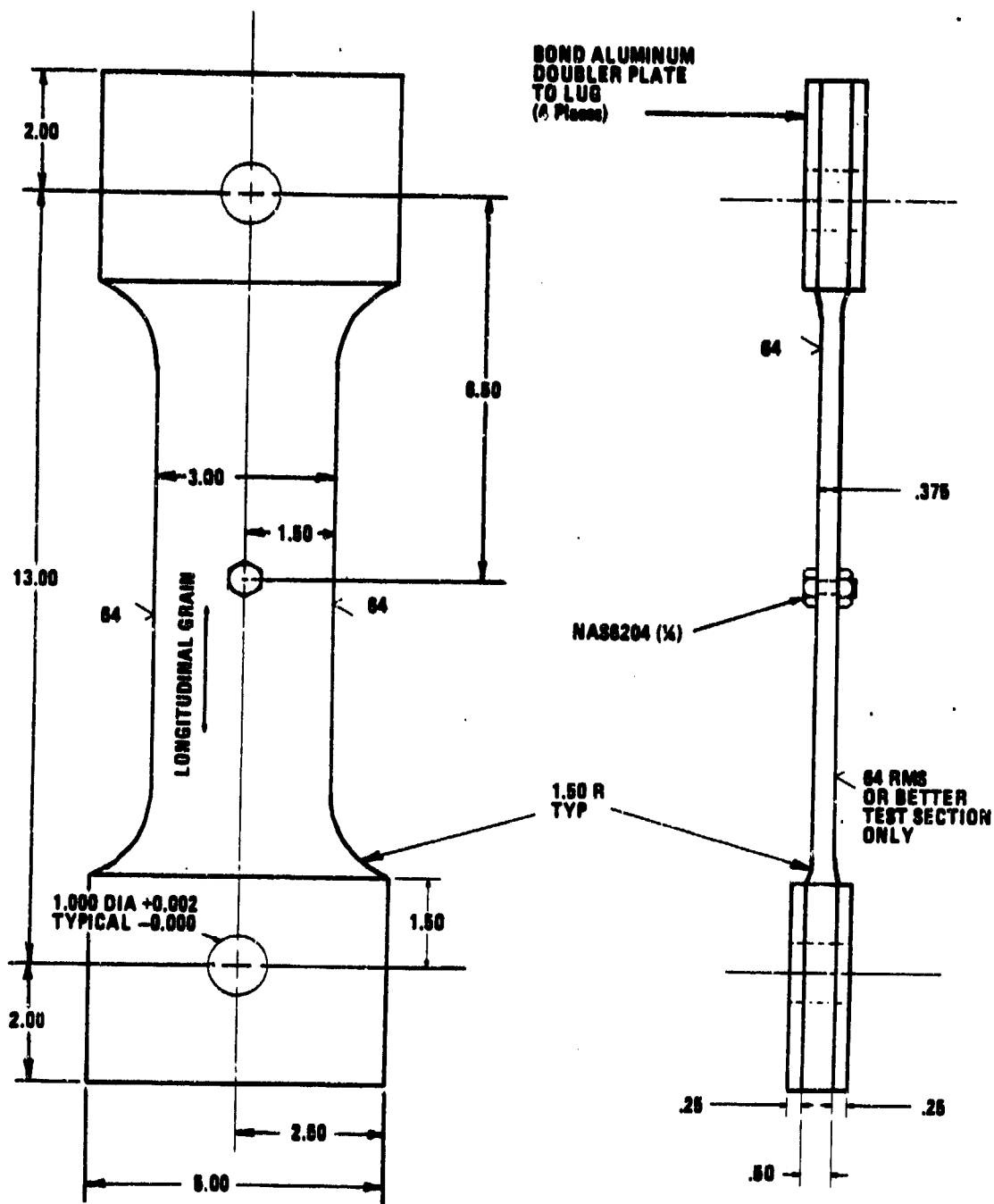
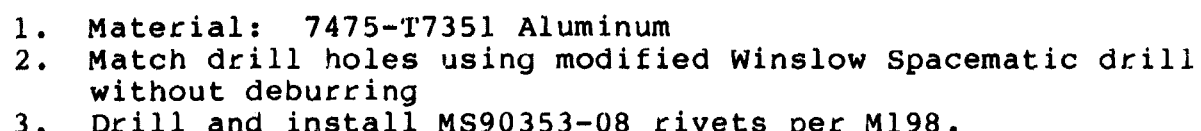


Fig. 2 Dog-Bone Specimen With Single Hole



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TABLE 4 TEST RESULTS FOR TEST SERIES IV(a)

LOAD SPECTRA	MAX. STRESS LEVEL (KSI)	SPECIMEN I.D.	TTF (FLT HRS)	FINAL CRACK SIZE (IN.)		FRACTOGRAPHY REF. PG.
				LH	RH	
F-16 400 HR	34	WMF -5(DJR 40)	25931	.85	.74	C-2
		-6(DJR 41)	26336	.85	.69	C-3
		-7(DJR 42)	27551	.65	.78	C-4
		-8(DJR 43)	28355	.89	.87	C-5
		-9(DJR 44)	19884	.79	.67	C-6
		-10(DJR 45)	21880	.73	.76	C-7
		-11(DJR 46)	27827	.90	.95	C-8
		-12(DJR 47)	25120	.93	.72	C-9
		-13(DJR 48)	25150	.60	.75	C-10

TABLE 5 TEST RESULTS FOR TEST SERIES IV(b)

LOAD SPECTRA	MAX. STRESS LEVEL (KSI)	SPECIMEN I. D.	TTF (FLT HRS)	FINAL CRACK SIZE (IN.) [*]		FRACTOGRAPHY REF. PG.
				LH	RH	
B-1 BOMBER	34	WMPB -5(DUR 49) -6(DUR 50) -7(DUR 51) -8(DUR 52) -9(DUR 53) -10(DUR 54) -11(DUR 55) -12(DUR 56)	36492	.7909	.6765	D-2
			28051	.9081	.8204	D-3
			38596	.6737	.6553	D-4
			40494	.8043	.7279	D-5
			35432	.8475	.7546	D-6
			38596	.8365	.8137	D-7
			43664	.8091	.7095	D-8
			40494	.7839	.6999	D-9

* MEASURED IN DIRECTION OF CRACK PROPAGATION WITH RESPECT TO BORE OF HOLE

TABLE 6 TEST RESULTS FOR TEST SERIES IV(C)

LOAD SPECTRA	MAX. STRESS LEVEL (KSI)	SPECIMEN I.D.	TTF (FLT HRS)	FINAL CRACK SIZE (IN.)**		FRACTOGRAPHY REF. PG.
				LH	RH	
F-16C/D	34 ↓	WMPCL-1 (DUR 142)	32124*	---	---	E-2
		-2 (DUR 143)	55192	.9115	.6584	E-3
		-3 (DUR 144)	59252	.9867	.2110	E-4
		-4 (DUR 145)	45992	1.0334	.1570	E-5
		-5 (DUR 146)	38792	.7356	.6901	E-6
	40.8 ↓	WMPCH-1 (DUR 147)	33652	.7144	.4823	E-7
		-2 (DUR 148)	21112	.9642	.3003	E-8
		-3 (DUR 149)	24700	.9281	.3843	E-9
		-4 (DUR 150)	32288	.9829	.3152	E-10
		-5 (DUR 151)	24980	.9523	.5457	E-11
		-6 (DUR 152)	31252	.7561	.5316	E-12
		-7 (DUR 153)	24924	.8176	.7431	E-13
		-8 (DUR 154)	13888	.9001	.3924	E-14

NOTES: * LUG FAILED (SPECIMEN TESTED WITH OUT LUG END DOUBLERS)

** MEASURED IN DIRECTION OF CRACK PROPAGATION WITH RESPECT TO BORE OF HOLE

TABLE 7 TEST RESULTS FOR TEST SERIES IV(h)

LOAD SPECTRA	MAX. STRESS LEVEL (KSI)	SPECIMEN I.D.	TTF (KFLT HRS)	FINAL CRACK SIZE (IN.)**		FRACTOGRAPHY REF. PG.
				LH	RH	
F-16 400 HR	34	WINPFO -1(DUR 125)	22348	.8882	.8472	F-2
		-2(DUR 126)	15478	.8552	.7568	F-3
		-3(DUR 127)	19635	.6317	.6139	F-4
		-4(DUR 128)	24406	.7789	.6250	F-5
		-5(DUR 129)	26806	.7558	.5482	F-6
		-6(DUR 130)	26006	.9410	.6768	F-7
		-7(DUR 131)	27235	.7726	.5945	F-8
		-8(DUR 132)	22806	.8193	.7290	F-9
		-9(DUR 133)	23606	.7831	.5909	F-10
		-10(DUR 134)	20435	.6601	.5981	F-11
		-11(DUR 135)	23606	.6979	.6584	F-12
		-12(DUR 136)	24000	.8523	.7838	F-13
		-13(DUR 137)	20035	.6854	.5816	F-14
		-14(DUR 138)	21206	.7966	.6256	F-15
		-15(DUR 139)*	---	---	---	F-16

NOTES: * LUG FAILED (SPECIMEN TESTED WITH OUT LUG END DOUBLERS)
 ** MEASURED IN DIRECTION OF CRACK PROPAGATION WITH RESPECT TO BORE OF HOLE

TABLE 8 TEST RESULTS FOR TEST SERIES IV(d)

LOAD SPECTRA	MAX. STRESS LEVEL (KSI)	SPECIMEN I.D.	TTF (FLT HRS)	FINAL CRACK SIZE (IN.)#										FRACTOGRAPHY REF. PG.
				HOLE 1A		HOLE 1B		HOLE 2A		HOLE 2B				
				LH	RH	LH	RH	LH	RH	LH	RH			
F-16 400HR	34	WAFXMR4	-1(DUR 61)	21208	.9150	.7710	---	.5548	.0935	---	.0153	---	0-2	
		-2(DUR 62)	28436	.2743	---	.8337	.7244	.4791	---	.4803	---	0-3		
		-3(DUR 63)	33208	.5596	---	.5946	---	.6642	---	.7590	.6533	0-4		
		-4(DUR 64)	22836	.1071	---	.1209	---	.7855	.6984	.4135	---	0-5		
		-5(DUR 65)	17236	.7388	.6226	.6521	---	NO FLAW	---	.0366	---	0-6		
		-6(DUR 66)	11608	NO FLAW	---	.6000	---	NO FLAW	---	.9895	.8299	0-7		
		-7(DUR 67)	19637	.2707	---	.3519	---	.7916	.6840	.8251	---	0-8		
		-8(DUR 68)	30036	.6487	---	.7677	.6834	.1457	---	.2323	---	0-9		
		-9(DUR 69)	12808	NO FLAW	---	.1885	---	.9341	.6972	.5810	---	0-10		
		-10(DUR 70)	15208	.8875	.8107	.5568	---	NO FLAW	---	.0741	---	0-11		
		-11(DUR 71)	18436	.7304	.6856	.6857	---	NO FLAW	---	NO FLAW	---	0-12		
		-12(DUR 72)	21792	.1326	---	.1344	---	1.2976	1.0500	.4373	---	0-13		
		-13(DUR 73)	15304	.7631	---	.9037	.6478	NO FLAW	---	.0444	---	0-14		
		-14(DUR 74)	31636	.0442	---	.0921	---	.8949	.5769	.4003	---	0-15		
		-15(DUR 75)	21636									0-16		

NOTE: * MEASURED IN DIRECTION OF CRACK PROPAGATION WITH RESPECT TO BORE OF HOLE

TABLE 9 TEST RESULTS FOR TEST SERIES IV(e)

Load Spectra	Max Level Stress (KSI)	Specimen ID	TTF (Flt Hrs)	Final Crack Size (Inch)*												Fractography Ref. PG.
				Hole 1A		Hole 1B		Hole 2A		Hole 2B						
				LH	RH	LH	RH	LH	RH	LH	RH					
F-16 400 HR	40.8	WAFXHR4-1 (DUR 76)	7297	0.760	-	0.0814	-	0.060	0.040	0.1138	-	-	H-2			
		-2 (DUR 77)	5616	0.2363	0.205	0.3016	0.280	0.2844	0.180	0.85	-	-	H-3			
		-3 (DUR 78)	12968	0.790	0.750	0.511	0.2504	0.1117	0.080	0.0944	0.040	0.040	H-4			
		-4 (DUR 79)	9323	0.79	0.55	0.130	-	0.180	0.150	0.240	0.220	0.220	H-5			
		-5 (DUR 80)	10943	0.420	0.410	0.290	0.260	0.410	0.350	0.580	0.560	0.560	H-6			
		-6 (DUR 81)	8108	0.090	0.070	0.68	0.51	0.220	0.210	0.070	0.035	0.035	H-7			
		-7 (DUR 82)	14589	0.65	0.58	-	-	0.098	0.070	0.160	0.130	0.130	H-8			
		-8 (DUR 83)	13649	0.270	0.190	0.158	0.140	0.315	0.250	0.88	0.85	0.85	H-9			
		-9 (DUR 84)	10567	0.035	-	0.070	0.035	0.540	0.390	0.63	0.54	0.54	H-10			
		-10 (DUR 85)	9597	0.154	-	0.070	0.070	0.78	0.64	0.88	0.88	0.88	H-11			
		-11 (DUR 86)	10972	0.515	0.510	0.590	0.540	0.010	-	-	-	-	H-12			
		-12 (DUR 87)	11458	0.170	0.152	0.160	0.080	1.02**	0.61	0.180	0.130	0.130	H-13			
		-13 (DUR 88)	12592	0.442	0.320	0.678	0.55	0.125	0.030	0.092	0.020	0.020	H-14			
		-14 (DUR 89)	16643	0.72	0.46	0.350	0.230	0.080	0.042	0.272	0.166	0.166	H-15			
		-15 (DUR 90)	7732	0.1036	0.0673	0.1427	0.1199	0.6137	0.5206	0.2520	0.1726	0.1726	H-16			

Notes: *Measured in direction of crack propagation with respect to base of hole

**Crack originated on faying surface.

TABLE 10 TEST RESULTS FOR TEST SERIES IV(f)

Load Spectra	Max Level Stress (KSI)	Specimen ID	TTF (Flt Hrs)	Final Crack Size (Inch)*										Fractography Ref. Pg.
				Hole 1A		Hole 1B		Hole 2A		Hole 2B				
				LH	RH	LH	RH	LH	RH	LH	RH			
B-1 Bomber	34.0	WXWPB-1 (DUR 91)	27830	0.0906	-	0.9746	0.7740	0.1940	-	0.1806	-	-	I-2	
		-2 (DUR 92)	39644	0.4487	-	0.8178	0.6123	0.2866	-	0.1761	-	-	I-3	
		-3 (DUR 93)	30470	0.7605	-	0.8428	0.5690	-	-	-	-	-	I-4	
		-4 (DUR 94)	42595	0.07516	-	0.919	0.6783	0.1157	-	0.0743	-	-	I-5	
		-5 (DUR 95)	40698	0.3332	-	0.7005	-	0.9225	0.7712	0.0460	-	-	I-6	
		-6 (DUR 96)	42595	0.1330	-	0.1473	-	0.7423	0.6421	0.5983	-	-	I-7	
		-7 (DUR 97)	55677	0.1972	-	1.00	0.7213	0.1757	-	0.3708	-	-	I-8	
		-8 (DUR 98)	40784	1.10	0.7450	0.2982	-	-	-	-	-	-	I-9	
		-9 (DUR 99)	51352	1.0614	0.7268	0.3387	-	-	-	0.1469	-	-	I-10	
		-10 (DUR 100)	55571	0.8991	0.5266	0.1541	-	0.0659	-	0.8674	-	-	I-11	
		-11 (DUR 101)	36743	0.3777	-	0.950	0.7324	-	-	-	-	-	I-12	
		-12 (DUR 102)	47870	0.0624	-	1.0249	0.6919	0.3786	-	0.1041	-	-	I-13	
		-13 (DUR 103)	38798	0.9049	0.5472	0.3723	-	0.4977	-	0.6103	-	-	I-14	
		-14 (DUR 104)	53832	0.5080	-	1.1447	0.9284	0.3651	-	0.1887	-	-	I-15	
		-15 (DUR 105)	46815	0.4095	-	0.9502	0.7940	0.4200	-	0.1869	-	-	I-16	

*Measured in direction of crack propagation with respect to base of hole.

TABLE 11 TEST RESULTS FOR TEST SERIES IV(g)

Load Spectra	Max Level Stress (KSI)	Specimen ID	TTF (Flt Hrs)	Final Crack Size (Inch)*										Fractography Ref. Pg.
				Hole 1A		Hole 1B		Hole 2A		Hole 2B				
				LH	RH	LH	RH	LH	RH	LH	RH			
B-1 Bomber	40.8	WABXHR4-1 (DUR 106)	15385	0.6935	0.5074	0.6118	-	0.2176	-	-	-	-	J-2	
		-2 (DUR 107)	17389	0.0337	-	0.4117	-	0.9139	0.6482	0.4123	-	-	J-3	
		-3 (DUR 108)	19815	0.5828	0.5238	0.5763	-	0.1091	-	0.2425	-	-	J-4	
		-4 (DUR 109)	12644	0.1611	-	0.1088	-	0.7390	0.5930	0.2278	-	-	J-5	
		-5 (DUR 110)	16650	0.1700	-	0.2803	-	0.8008	0.6803	0.4864	-	-	J-6	
		-6 (DUR 111)	19815	0.1804	-	0.6531	0.3496	0.5684	-	0.4155	-	-	J-7	
		-7 (DUR 112)	12643	0.0981	-	0.2582	-	0.7386	-	0.1517	-	-	J-8	
		-8 (DUR 113)	11589	0.1240	-	0.4091	-	0.5523	0.4987	0.0523	-	-	J-9	
		-9 (DUR 114)	15808	0.1489	-	0.3591	-	0.8323	0.7074	0.2668	-	-	J-10	
		-10 (DUR 115)	15595	0.2034	-	0.5681	-	0.5702	0.5429	0.2857	-	-	J-11	
		-11 (DUR 116)	11875	0.1156	-	0.0296	-	0.9536	0.7688	0.5191	-	-	J-12	
		-12 (DUR 117)	13700	-	-	0.1872	-	0.7463	0.6701	0.1218	-	-	J-13	
		-13 (DUR 118)	14540	0.7026	0.4960	0.4058	-	0.1177	-	0.0492	-	-	J-14	
		-14 (DUR 119)	13277	0.0664	-	0.1785	-	0.7646	0.7183	0.1490	-	-	J-15	
		-15 (DUR 120)	11486	0.2806	-	0.8247	0.7203	0.1157	-	-	-	-	J-16	

* Measured in direction of crack propagation with respect to base of hole

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4. S. D. Manning and J.N. Yang, "Advanced Durability Analysis, Volume II- Analytical Predictions, Test Results, and Analytical/Experimental Correlations", Air Force Flight Dynamics Laboratory, AFWAL-TR-86-3017 Volume II, October 1986.
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8. "Fractographic Examination of A-7D ASIP Initial Quality Specimens," Vought Aerospace Corp., Report ETR-53452-078, 19 June 1975.
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10. W. R. Garver and R. D. Bruner, "Spectrum Fatigue Testing of Mechanical Fasteners for Structural and Fuel Integrity," General Dynamics, Fort Worth Division, ERR-FW-2069, April 1981.
11. "Assembly Hole Inspection," F-16 Technical Modernization Program, Vol. II, General Dynamics, Fort Worth Division, Report TM22 (II), 31 October 1979, p. 287.
12. D. E. Gordon, et al, "Development of Fatigue and Crack Propagation Design and Analysis Methodology in a Corrosive Environment for Typical Mechanically-Fastened Joints, Volume IV - Phase II Test and Fractographic Results," Naval Air Development Center (Warminster, PA), Report No. NADC-83126-60 (Vol. IV), 30 August 1984.

APPENDIX A

FRACTOGRAPHIC RESULTS FOR MULTIPLE HOLE DOG-BONE SPECIMENS
(Phase 1; Test Series I(a))

Test Date

Batch Set WFI

Specimen No. WFI-1 (DUB. 1)

Material 7475-77851 AL

Boat Load Transfer 0%

Fastener MS90352-Q8 (1/4" DIA) FINEST

Avg. W. 5th

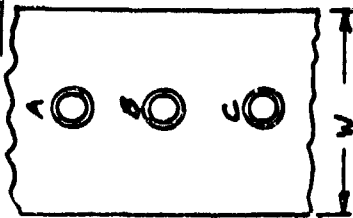
Avg. Thickness

Spectrum F-16 400 Hz

Max. Stress Level 34,452 (GROSS)

Fatigue Life 31200 FLT.HRS (3,90 LINES)

Failure In Hole B

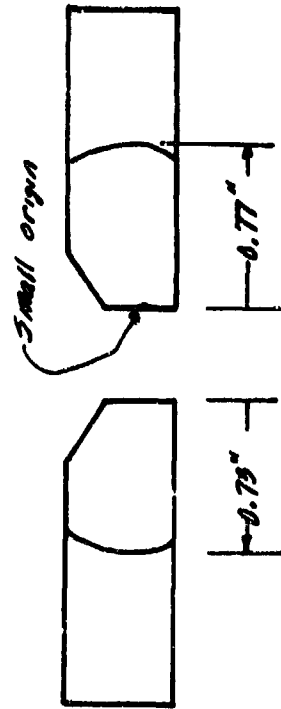


Hole Crack Final Dimensions

Hole	Final Crack Size (in.)
A	.030
B	.73
C	<.010

Fractographic Data WFI-1(BL) HOLE B

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
12400	.0072	20400	.0324	28400	.2531
12800	.0080	20800	.0595	28800	.2720
13200	.0088	21200	.0680	29200	.3122
13600	.0097	21600	.0767	29600	.3611
14000	.0104	22000	.0855	30000	.4214
14400	.0119	22400	.0958	30400	.4885
14800	.0124	22800	.1020	30800	.570
15200	.0147	23200	.1083	31200	.77
15600	.0160	23600	.1154		
16000	.0179	24000	.1234		
16400	.0194	24400	.1305		
16800	.0215	24800	.1389		
17200	.0231	25200	.1494		
17600	.0254	25600	.1614		
18000	.0281	26000	.1701		
18400	.0309	26400	.1832		
18800	.0337	26800	.1951		
19200	.0378	27200	.2082		
19600	.0449	27600	.2234		
20000	.0478	28000	.2404		



NOTES

① Crack dimension in direction of crack propagation

Plate Set WFI

Specimen No. WFI-1 (ave. 1)

Material 1075-T7351 AL

Bolt Load Transfer OT

Fastener MS 90353-08 (1/4 in.) RIMST

Ave. Width _____

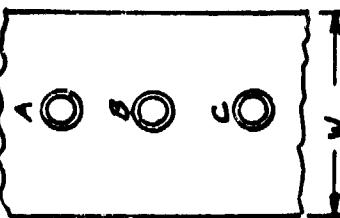
Ave. Thickness _____

Spectrum F-16 400 Hz

Max. Stress Level 34 ksi (6002)

Fatigue Life 31200 FETMS (3.90 Lines)

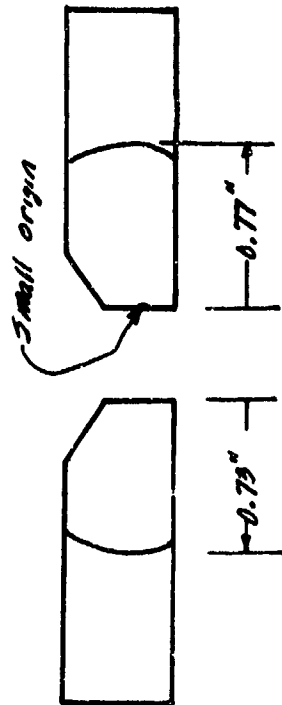
Failure in Hole B



Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	.080	.099
B	.73	.77
C	<.010	.1046

PLT. MRS.	CRACK SIZE	PLT. MRS.	CRACK SIZE	PLT. MRS.	CRACK SIZE
12400		20400	.0305	28400	.2282
12800		20800	.0329	28800	.2553
13200		21200	.0355	29200	.2916
13600		21600	.0383	29600	.3374
14000		22000	.0412	30000	.399
14400		22400	.0438	30400	.465
14800		22800	.0470	30800	.570
15200	.0099	23200	.0511	31200	.73
15600	.0111	23600	.0560		
16000	.0123	24000	.0618		
16400	.0137	24400	.0682		
16800	.0151	24800	.0753		
17200	.0165	25200	.0837		
17600	.0179	25600	.0925		
18000	.0195	26000	.107		
18400	.0212	26400	.1194		
18800	.0229	26800	.1306		
19200	.0248	27200	.1473		
19600	.0267	27600	.1684		
20000	.0287	28000	.1939		



NOTES

① Crack dimension in direction of crack propagation

TEST DATE 2-27-85

DATA SET WFI

SPECIMEN NO. WFI-1 (QUT.1)

MATERIAL 7475-77851 AL

BOLT LOAD TRANSFER 0%

FASTENER MS90359-08 (1/4 IN) RINSE

AVE. WIDTH

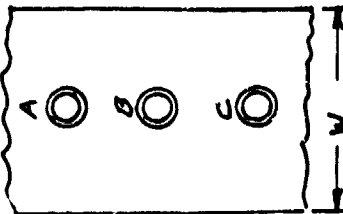
AVE. THICKNESS

SPECTRUM F-16 400 Hz

MAX. STRESS LEVEL 34.0 KSI (S1008)

FATIGUE LIFE 31200 FLIGHTS/3.90 LIVES

FAILURE IN HOLE B



HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE ⁽¹⁾ (in.)
A	0.030
B	0.73
C	<0.010

FRactOGRAPHIC DATA

WFI-1 CL

HOLE C

FLT. MES.	CRACK SIZE	FLT. MES.	CRACK SIZE	FLT. MES.	CRACK SIZE
24000	0.0110				
24400	0.0125				
24900	0.0150				
25200	0.0178				
25600	0.0202				
26000	0.0240				
26400	0.0286				
26800	0.0331				
27200	0.0375				
27600	0.0420				
28000	0.0470				
28400	0.0530				
28800	0.0589				
29200	0.0649				
29600	0.0714				
30000	0.081				
30400	0.089				
30800	0.097				
31200	0.1046				



NOTES

(1) Crack dimension in direction of crack propagation

TEST DATE

Data Set WFI

Specimen No. WFI-2 (DUG-2)

Material 7475-T7351 AL.

Boil Load Transfer 0%

Fastener MS90353-08 (1/4" DIA) FIRST

Ave. Width _____

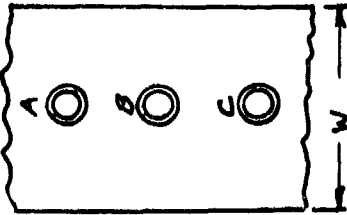
Ave. Thickness _____

Spectrum F-16 900 MC

Max. Stress Level 34,000 PSI (6000)

Fatigue Life 22000 Cycles / 13,400 Lives

Failure In Hole C



Hole Crack Final Dimensions

Hole	Final Crack Size ^(D) (In.)	Ratio
A	0.140	0.1042
B	0.180	0.355
C	0.55	0.72

FRAC TOG R A P H I C DATA WFI-2, N5 HOLE A

FLT. NOS.	CRACK SIZE	ALT. NOS.	CRACK SIZE	ALT. NOS.	CRACK SIZE
14501	0.0115	23200	0.0535		
15200	0.0130	23600	0.1565		
15600	0.0143	24000	0.1543		
16000	0.0155	24400	0.0635		
16400	0.0170	24800	0.11651		
16800	0.0186	25200	0.0731		
17200	0.0202	25600	0.1784		
17600	0.0216	26000	0.0835		
18000	0.0228	26400	0.0896		
18400	0.0241	26800	0.0905		
18800	0.0258	27200	0.1002		
19200	0.0278				
19600	0.0298				
20000	0.0322				
20400	0.0343				
20800	0.0367				
21200	0.0386				
21600	0.0415				
22000	0.0445				
22400	0.0464				
22800	0.0502				



NOTES

0 Crack dimension in direction of crack propagation

TEST DATE 2-27-85

DATA SET WFI

SPECIMEN NO. NFI-2 (REV. 2)

MATERIAL 7475-T7351 AL

BOLT LOAD TRANSFER 0%

FASTENER MS90359-08 (1/4 IN.) RIMET

AVE. WIDTH

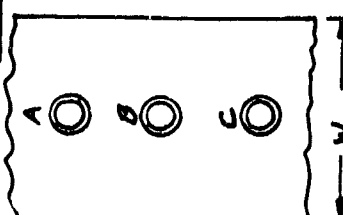
AVE. THICKNESS

SPECTRUM F-16 400 Hz

MAX. STRESS LEVEL 34,000 PSI (GROSS)

FATIGUE LIFE 22200 FIFTH 13.40 LINES

FAILURE IN HOLE C

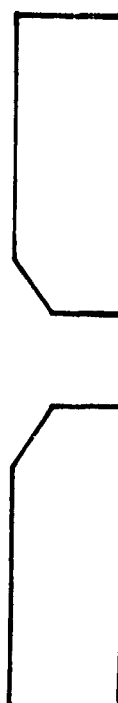


HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)	RIGHT
A	0.140	0.100/2
B	0.180	0.355
C	0.55	0.72

FRAC TOGRAPHIC DATA WFI-2 18D HOLE B

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
9600	0.0099	18000	0.0540	26400	0.2820
10000	0.0108	18400	0.0615	26800	0.318
10400	0.0117	18800	0.0675	27200	0.335
10800	0.0126	19200	0.0730		
11200	0.0136	19600	0.0791		
11600	0.0147	20000	0.0843		
12000	0.0158	20400	0.0919		
12400	0.0174	20800	0.1005		
12800	0.0191	21200	0.1084		
13200	0.0212	21600	0.1166		
13600	0.0234	22000	0.1254		
14000	0.0253	22400	0.1341		
14400	0.0274	22800	0.1435		
14800	0.0295	23200	0.1533		
15200	0.0316	23600	0.1630		
15600	0.0336	24000	0.1747		
16000	0.0358	24400	0.1869		
16400	0.0381	24800	0.1997		
16800	0.0422	25200	0.216		
17200	0.0454	25600	0.236		
17600	0.0492	26000	0.2565		



NOTES

0 Crack dimension in direction of crack propagation

TEST DATE

DATE SET WFI

SPECIMEN NO. WFI-2 (PVR.2)

MATERIAL 7475-77251 AL.

BOLT LOAD TRANSFER 0%

FASTENER MS90352-08 (1/4 IN) RINSE

AVE. WIDTH

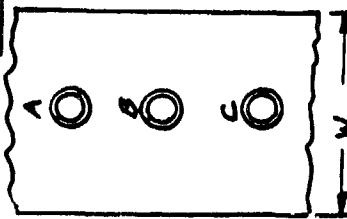
AVE. THICKNESS

SPECTRUM F-16 400 HR

MAX. STRESS LEVEL 34 KSI (61000)

FATIGUE LIFE 27200 CYCLES (340 LINES)

FAILURE IN HOLE C

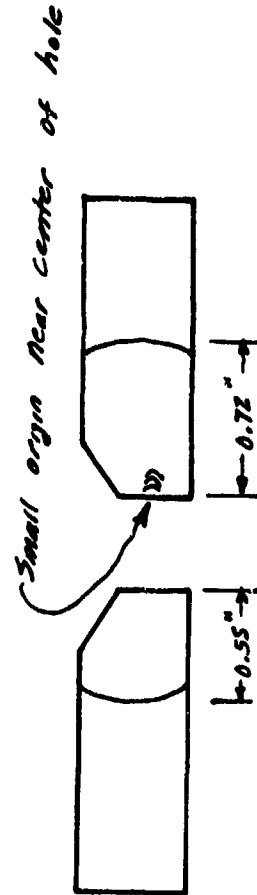


HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)
A	.140
B	.180
C	.155

FRAC TOGRAPHIC DATA WFI-2 (CL) HOLE C

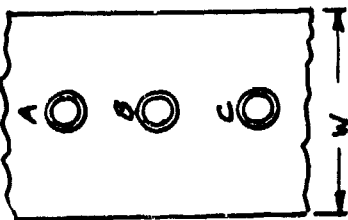
FLT. NOS	CRACK SIZE	ACT. NOS.	CRACK SIZE	ACT. NOS.	CRACK SIZE
8000	.0087	16000	.0711	24000	.2927
8400	.0107	16400	.0763	24400	.3193
8800	.0125	16800	.0817	24800	.3510
9200	.0145	17200	.0869	25200	.3821
9600	.0168	17600	.0927	25600	.4182
10000	.0196	18000	.1001	26000	.4648
10400	.0223	18400	.1065	26400	.520
10800	.0254	18800	.1133	26800	.575
11200	.0279	19200	.1217	27200	.720
11600	.0303	19600	.1305		
12000	.0354	20000	.1407		
12400	.0392	20400	.1512		
12800	.0429	20800	.1621		
13200	.0478	21200	.1741		
13600	.0513	21600	.1876		
14000	.0549	22000	.2013		
14400	.0583	22400	.2162		
14800	.0613	22800	.2337		
15200	.0647	23200	.2512		
15600	.0678	23600	.2709		



NOTES

① Crack dimension in direction of crack propagation

Test Date _____
 Ref. Set WFI
 Specimen No. WFI-2 (Pur. 2)
 Material 7475-T7351 AL.
 Bolt Load Transfer 0%
 Fastener A2590388-08 (1/4" dia) E1081
 Avg. Width _____
 Avg. Thickness _____
 Spectrum F-16 400 Hz
 Max. Stress Level 34 KSI (Gross)
 Fatigue Life 37200 Cycles (3.40 Lines)
 Failure in Hole C

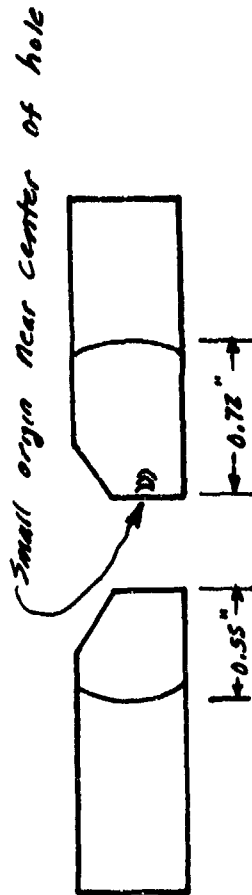


HOLE CRACK Final Dimensions

HOLE	Final CRACK SIZE @ (in.)	REMARK
A	.140	.1042
B	.180	.355
C	.55	.72

FRAC TOG RAPHIC DATA WFI-2(CS) HOLE C

FLT. MRS	CRACK SIZE	FLT. MRS.	CRACK SIZE	FLT. MRS.	CRACK SIZE
5000		16000	.0264	24000	.1604
8400		16400	.0285	24400	.1877
8800		16800	.0307	24800	.2110
9200		17200	.0335	25200	.2303
9600		17600	.0360	25600	.2395
10000		18000	.0395	26000	.2517
10400		18400	.0435	26400	.2665
10800	.0087	18800	.0468	26800	.266
11200	.0105	19200	.0501	27200	.55
11600	.0114	19600	.0535		
12000	.0123	20000	.0613		
12400	.0134	20400	.0670		
12800	.0147	20800	.0721		
13200	.0160	21200	.0796		
13600	.0174	21600	.0880		
14000	.0189	22000	.0939		
14400	.0201	22400	.1085		
14800	.0218	22800	.1227		
15200	.0231	23200	.1352		
15600	.0246	23600	.1507		



NOTES

① Crack dimension in direction of crack propagation

Test Date 2-27-85

Data Set WFI

Specimen No. WFI-3 (D.C. 3)

Material 7475-77951 AL

BoH Load Transfer 07.

Fastener MS90352-08 (1/4 in) Rivet

Ave Width

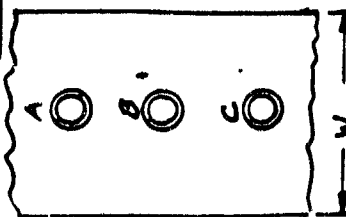
Ave. Thickness

Spectrum F-16 400 Hz

Max. Stress Level 340 ksi (6700)

Fatigue Life @ 236000 Hz / 2.95 Lives

Failure in Hole B



Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	0.300	0.030
B	0.282	0.715
C	0.180	0.120 ③

Fractographic Data Hole A WFI-3 (AL)

FLT. NOS	CRACK SIZE	ALT. NOS.	CRACK SIZE	ALT. NOS.	CRACK SIZE
5400	0.0104	14000	0.0637	22400	0.260
6000	0.0115	14400	0.0684	22800	0.274
6400	0.0128	14800	0.0748	23200	0.288
6800	0.0142	15200	0.0805	23600	0.300
7200	0.0157	15600	0.0869		
7600	0.0165	16000	0.0930		
8000	0.0181	16400	0.1008		
8400	0.0194	16800	0.1070		
8800	0.0208	17200	0.1147		
9200	0.0224	17600	0.1233		
9600	0.0247	18000	0.1325		
10000	0.0275	18400	0.1405		
10400	0.0304	18800	0.1508		
10800	0.0338	19200	0.1603		
11200	0.0368	19600	0.1706		
11600	0.0402	20000	0.1837		
12000	0.0456	20400	0.1962		
12400	0.0467	20800	0.2075		
12800	0.0505	21200	0.2214		
13200	0.0542	21600	0.2333		
13600	0.0588	22000	0.2464		

NOTES

- ① Crack dimension in direction of crack propagation
- ② No fractographic data, crack originated way out on countersink surfaces
- ③ Failed when disk drive was disconnected from computer system

Test Date

Ref. Set NFI

Specimen No. NFI-3 (PUL.3)

Material 7075-T7351 AL.

BoH Load Transfer 0%

Fastener MS90332-08 (1/4 in) Rivet

Ave. Width

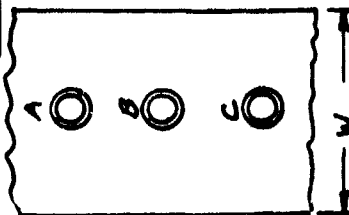
Ave. Thickness

Spectrum F-16 400 Hz

Max. Stress Level 34 KSI (6108)

Fatigue Life 23600 EST. HRS. (2.95 Lines)

Failure In Hole B

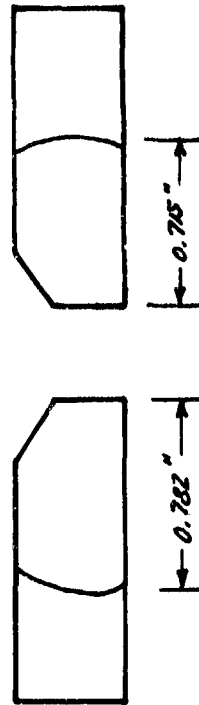


Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	RTN
A	.300	.030
B	.782	.715
C	.180	.120

Fractographic Data NFI-3 (BL) Hole B

Fit Hrs	Crack Size	Fit Hrs.	Crack Size	Fit Hrs.	Crack Size
3600	.0061	11600	.0425	17600	.2227
4000	.0075	12000	.0435	20000	.2412
4400	.0089	12400	.0499	20400	.2640
4800	.0103	12800	.0535	20800	.2782
5200	.0118	13200	.0580	21200	.3221
5600	.0133	13600	.0638	21600	.3576
6000	.0147	14000	.0698	22000	.4025
6400	.0163	14400	.0762	22400	.4538
6800	.0177	14800	.0838	22800	.5193
7200	.0192	15200	.0924	23200	.609
7600	.0210	15600	.0999	23600	.782
8000	.0229	16000	.1081		
8400	.0250	16400	.1174		
8800	.0268	16800	.1258		
9200	.0287	17200	.1353		
9600	.0306	17600	.1466		
10000	.0325	18000	.1587		
10400	.0359	18400	.1721		
10800	.0377	18800	.1874		
11200	.0397	19200	.2032		



NOTES

① Crack dimension in direction of crack propagation

② Failed when disk drive was disconnected from computer system

③ NO Fractographic data; Crack originated in countersink surface

TEST DATE

DATA SET WFI

SPECIMEN NO. WFI-3 (P.V.3)

MATERIAL 7075-T7351 AL.

BOLT LOAD TRANSFER 0%

FASTENER MS90322-08 (1/4 IN.) FIRST

AVG. WIDTH

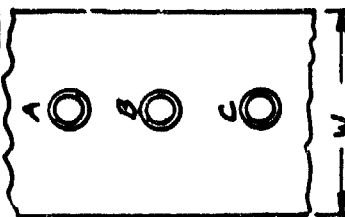
AVG. THICKNESS

SPECTRUM F-16 400 Hz

MAX. STRESS LEVEL 34 KSI (GROSS)

FATIGUE LIFE 23600 FET. HRS. (2.95 LINES)

FAILURE IN HOLE B

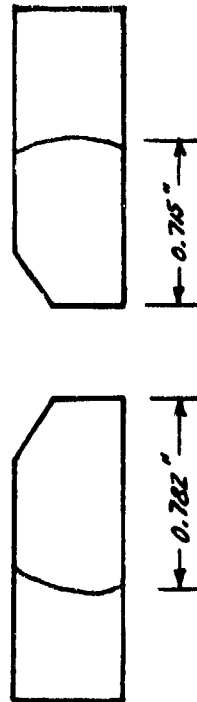


HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)	
	LEFT	RIGHT
A	.300	.030
B	.782	.715
C	.180	.120 (3)

FRAC TOGRAPHIC DATA WFI-3 (BS) HOLE B

FLT. HRS.	CRACK SIZE	ALT. HRS.	CRACK SIZE	ALT. HRS.	CRACK SIZE
3600		11600	.0399	17600	.1724
4000		12000	.0358	20000	.1919
4400		12400	.0378	20400	.2135
4800		12800	.0410	20800	.237
5200		13200	.0443	21200	.2658
5600		13600	.0477	21600	.3015
6000		14000	.0519	22000	.3421
6400		14400	.0558	22400	.3937
6800		14800	.0604	22800	.4560
7200		15200	.0648	23200	.520
7600		15600	.0697	23600	.715
8000		16000	.0761		
8400		16400	.0829		
8800		16800	.0903		
9200		17200	.0990		
9600		17600	.1083		
10000		18000	.1179		
10400	.0267	18400	.1286		
10800	.0387	18800	.1421		
11200	.0507	19200	.1552		



NOTES

① Crack dimension in direction of crack propagation

② Failed when disk drive was disconnected from computer system

③ NO Fractographic data; Crack originated in counter-sink surface

FRACTOGRAPHIC DATA WFI-4 (AL) HOLE A

TEST DATE

Batch Set WFI

Specimen No. WFI-4 (REV. 4)

Material 7475-T7351 AL

Bolt Load Transfer 0%

Fastener MS90322-Q8 (1/4" DIA) FIRST

Avg. Width

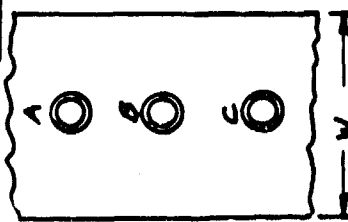
Avg. Thickness

Spectrum F-16 400 Hz

Max. Stress Level 24 KSI (GROSS)

Fatigue Life 30400 Fat. MS (S.B. Lives)

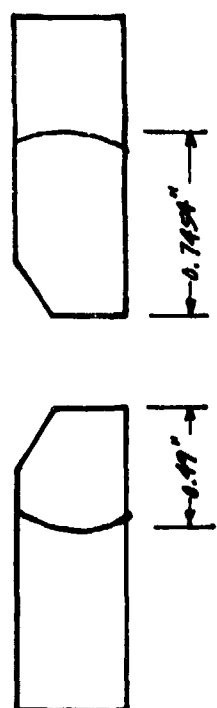
Failure In Hole A



HOLE CRACK FINAL DIMENSIONS

HOLE	Final CRACK SIZE (IN.)	Depth
A	.49	.7454
B	.069	.174
C	.050	.122

FAT. MS	CRACK SIZE	FAT. MS.	CRACK SIZE	FAT. MS.	CRACK SIZE
6000	.0030	14400	.0353	22800	.1715
6400	.0039	14800	.0380	23200	.1829
6800	.0047	15200	.0407	23600	.1957
7200	.0055	15600	.0434	24000	.2083
7600	.0064	16000	.0469	24400	.2206
8000	.0073	16400	.0510	24800	.2348
8400	.0084	16800	.0552	25200	.2520
8800	.0095	17200	.0617	25600	.2694
9200	.0106	17600	.0668	26000	.2867
9600	.0120	18000	.0726	26400	.3069
10000	.0123	18400	.0781	26800	.3268
10400	.0148	18800	.0852	27200	.3409
10800	.0162	19200	.0934	27600	.3732
11200	.0176	19600	.1003	28000	.4039
11600	.0194	20000	.1078	28400	.4394
12000	.0209	20400	.1167	28800	.4797
12400	.0230	20800	.1248	29200	.5214
12800	.0250	21200	.1322	29600	.578
13200	.0271	21600	.1412	30000	.647
13600	.0289	22000	.1516	30400	.7454
14000	.0320	22400	.1626		



NOTES
① Crack dimension in direction of crack propagation

TEST DATE

Batch Set NFI

Specimen No. NFI-4 (Rev. 4)

Material 7479-77851 AL

Boil Load Transfer 0%

Fastener MS90352-08 (1/4 in) Finest

Avg. Width

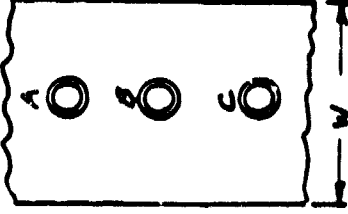
Avg. Thickness

Spectrum F-16 400 Hz

Max. Stress Level 24 ksi (Gross)

Fatigue Life 30400 Fat. Hrs (9.8 Lives)

Failure In Hole A

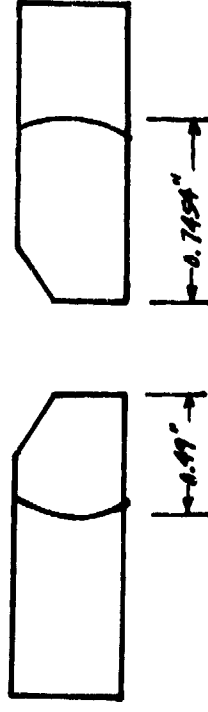


Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	.49	.7454
B	.068	.174
C	.050	.123

FRAC TOGRAPHIC DATA NFI-4 (AS) HOLE A

FLI. NOS	CRACK SIZE	FLI. NOS.	CRACK SIZE	FLI. NOS.	CRACK SIZE
6000		14400		22800	.0593
6400		14800		23200	.0594
6800		15200		23600	.0608
7200		15600		24000	.0617
7600		16000		24400	.0730
8000		16400	.0098	24800	.0801
8400		16800	.0110	25200	.0893
8800		17200	.0124	25600	.0987
9200		17600	.0137	26000	.1072
9600		18000	.0150	26400	.1182
10000		18400	.0167	26800	.1206
10400		18800	.0185	27200	.1467
10800		19200	.0220	27600	.1642
11200		19600	.0236	28000	.1841
11600		20000	.0255	28400	.2033
12000		20400	.0270	28800	.2373
12400		20800	.0290	29200	.2716
12800		21200	.0330	29600	.3174
13200		21600	.0374	30000	.377
13600		22000	.0422	30400	.490
14000		22400	.0462		



NOTES

① Crack dimension in direction of crack propagation

Test Date 2-27-85

Data Set WFI

Specimen No. WFI-4 (Rev. 4)

Material 7075-T7351 AL

Bolt Load Tension 0%

Fastener MS90353-08 (14 mm) Pinet

Ave Width

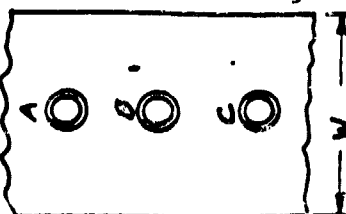
Ave. Thickness

Spectrum F-16 400 Hz

Max. Stress Level 34.0 Ksi (Gross)

Fatigue Life 30400 Cycles / 3.8 Lives

Failure in Hole A



Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	0.49	0.7454
B	0.068	0.174
C	0.050	0.133

Photographic Data WFI-4 (AL) Hole B

FLT Nos.	Crack Size	FLT Nos.	Crack Size	FLT Nos.	Crack Size
12400	0.0099	20800	0.0365	29200	0.1476
12800	0.0106	21200	0.0386	29600	0.1559
13200	0.0114	21600	0.0421	30000	0.1629
13600	0.0122	22000	0.0454	30400	0.174
14000	0.0129	22400	0.0486		
14400	0.0136	22800	0.0526		
14800	0.0143	23200	0.0562		
15200	0.0152	23600	0.0609		
15600	0.0162	24000	0.0657		
16000	0.0175	24400	0.0721		
16400	0.0186	24800	0.0761		
16800	0.0196	25200	0.0822		
17200	0.0209	25600	0.0876		
17600	0.0221	26000	0.0945		
18000	0.0237	26400	0.0997		
18400	0.0251	26800	0.1052		
18800	0.0271	27200	0.1115		
19200	0.0285	27600	0.1172		
19600	0.0302	28000	0.1235		
20000	0.0318	28400	0.1310		
20400	0.0343	28800	0.1395		

NOTES

0 Crack dimension in direction of crack propagation

Test Date 2-27-85

Data Set WFI

Specimen No. WFI-4 (REV. 4)

Material 7475-T7351 AL.

BoH Load Transfer 0%

Fastener MS90352-08 (1/4" x 0.0) Rivet

ave width

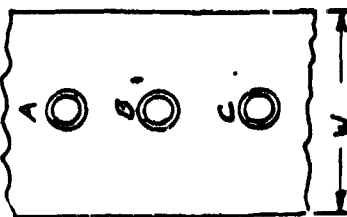
ave. Thickness

Spectrum F-16 400 Hz

max. Stress Level 34,000 psi (61000)

Fatigue Life 30400 FHMs/3.8 Lives

Failure In Hole A



Hole Crack Final Dimensions

Hole	Final Crack Size ^(D) (in.)	
	Left	Right
A	0.49	0.7454
B	0.068	0.174
C	0.050	0.133

FRactOGRAPHIC DATA WFI-4 (CL) HOLE C

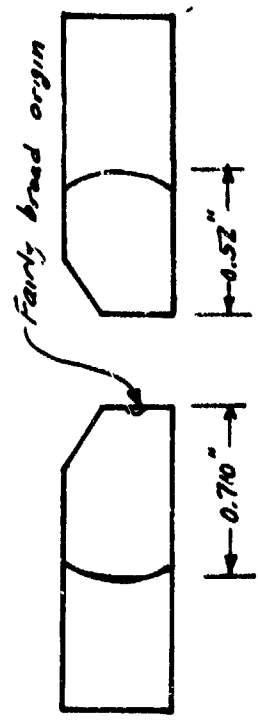
FLT. RES.	CRACK SIZE	FLT. RES.	CRACK SIZE	FLT. RES.	CRACK SIZE
16400	0.0100	24800	0.0456		
16800	0.0108	25200	0.0504		
17200	0.0116	25600	0.0543		
17600	0.0125	26000	0.0592		
18000	0.0134	26400	0.0644		
18400	0.0143	26800	0.0699		
18800	0.0153	27200	0.0749		
19200	0.0162	27600	0.0797		
19600	0.0172	28000	0.0854		
20000	0.0181	28400	0.0908		
20400	0.0192	28800	0.0983		
20800	0.0203	29200	0.1057		
21200	0.0216	29600	0.114		
21600	0.0229	30000	0.122		
22000	0.0257	30400	0.133		
22400	0.0270				
22800	0.0299				
23200	0.0333				
23600	0.0365				
24000	0.0396				
24400	0.0428				



NOTES

① Crack dimension in direction of crack propagation

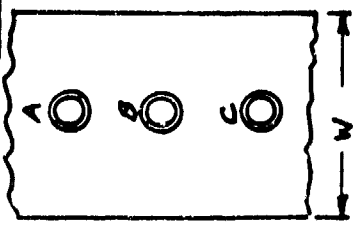
FLT. NOS.	CRACK SIZE	ALT. NOS.	CRACK SIZE	ALT. NOS.	CRACK SIZE
11200	.0044	19200	.0431	27200	.3853
11600	.0055	19600	.0524	27600	.3071
12000	.0069	20000	.0536	28000	.2884
12400	.0082	20400	.0666	28400	.3680
12800	.0094	20800	.0738	28800	.3958
13200	.0106	21200	.0810	29200	.4865
13600	.0126	21600	.0892	29600	.4738
14000	.0145	22000	.0986	30000	.5311
14400	.0164	22400	.1070	30400	.610
14800	.0181	22800	.1165	30800	.710
15200	.0201	23200	.1277		
15600	.0223	23600	.1391		
16000	.0245	24000	.1514		
16400	.0263	24400	.1639		
16800	.0283	24800	.1773		
17200	.0316	25200	.1914		
17600	.0340	25600	.2035		
18000	.0371	26000	.2237		
18400	.0407	26400	.2439		
18800	.0442	26800	.2630		



NOTES

- ① Crack dimension in direction of crack propagation
- ② Crack sawed & unable to read fractography

Data Set WFI
 Specimen No. WFI-5 (PVE.5)
 Material 7075-T7351 AL.
 Bolt Load Transfer 0%
 Fastener MS90353-08 (1/4 in) RIMST
 Ave. Width _____
 Ave. Thickness _____
 Spectrum F-16 400 Hz
 Max. Stress Level 30 KPS (6108)
 Fatigue Life 30800 FLT. NOS. (3.25 Lines)
 Failure in Hole A



HOLE CRACK Final Dimensions

HOLE	Final CRACK SIZE (in.)	CRACK
A	.710	.52
B	.035	.025 (2)
C	.280	.200

TEST DATE

Plate Set NFI

Specimen No. NFI-5 (REV. 5)

Material 7475-T7351 AL

Bolt Load Transfer 0%

Fastener MS90353-08 (1/4 IN) RIMET

Avg. Width

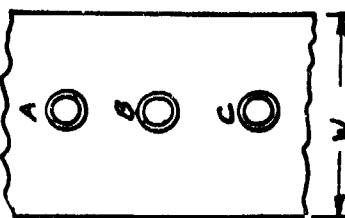
Avg. Thickness

Spectrum F-16 40 Hz

Max. Stress Level 30 KSI (6108)

Fatigue Life 3000 FET. MS. (3,05 Lines)

Failure In Hole A

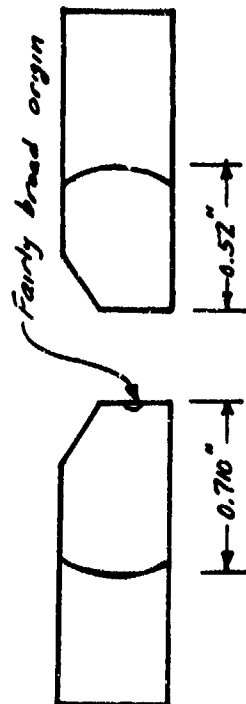


Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	.710	.52
B	.035	.025 (2)
C	.280	.200

Fractographic Data NFI-5 (REV. 5) Hole A

FLT. MS.	CRACK SIZE	ALT. MS.	CRACK SIZE	ALT. MS.	CRACK SIZE
11200		19200	.0858	27200	.1390
11600		19600	.0280	27600	.1338
12000		20000	.0300	28000	.1705
12400		20400	.0321	28400	.1921
12800		20800	.0348	28800	.2176
13200		21200	.0373	29200	.2587
13600		21600	.0405	29600	.290
14000		22000	.0438	30000	.343
14400		22400	.0465	30400	.414
14800		22800	.0507	30800	.52
15200		23200	.0536		
15600		23600	.0575		
16000	.0122	24000	.0652		
16400		24400	.0711		
16800	.0135	24800	.0780		
17200	.0153	25200	.0858		
17600	.0171	25600	.0944		
18000	.0192	26000	.1032		
18400	.0215	26400	.1143		
18800	.0236	26800	.1240		



NOTES

- Crack dimension in direction of crack propagation
- Crack sawed + unable to do fractography

TEST DATE 2-27-85

DATA SET WFE

SPECIMEN NO. WFE-5 (WJG-5)

MATERIAL 7475-T7351 AL.

BOLT LOAD TRANSFER 0%

FASTENER MS90339-08 (1/4 IN) RIVET

Avg Width

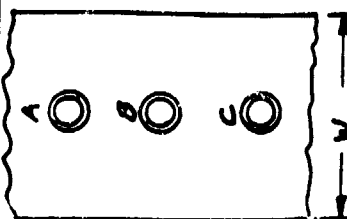
Avg Thickness

Spectrum F-16 400 Hz

Max. Stress Level 34.0 KSI (GROSS)

Fatigue Life 30800 Cycles

Failure In Hole A



HOLE CRACK Final Dimensions

HOLE	Final CRACK SIZE (in.)	RIGHT
A	0.710	0.52
B	0.035	0.025
C	0.280	0.200

PHOTOGRAPHIC DATA WFE-5 (CL) HOLE C

PLT NO.	CRACK SIZE	PLT NO.	CRACK SIZE	PLT NO.	CRACK SIZE
13600	0.0082	22000	0.0510	30800	0.2535
14000	0.0081	22400	0.0548	30800	0.2800
14400	0.0100	22800	0.0580		
14800	0.0110	23200	0.0630		
15200	0.01220	23600	0.0695		
15600	0.0135	24000	0.0766		
16000	0.0146	24400	0.0824		
16400	0.0159	24800	0.0887		
16800	0.0175	25200	0.0963		
17200	0.0197	25600	0.1032		
17600	0.0214	26000	0.1108		
18000	0.0232	26400	0.1182		
18400	0.0257	26800	0.1198		
18800	0.0271	27200	0.1282		
19200	0.0301	27600	0.1374		
19600	0.0323	28000	0.1500		
20000	0.0345	28400	0.1631		
20400	0.0369	28800	0.1762		
20800	0.0403	29200	0.1902		
21200	0.0432	29600	0.2094		
21600	0.0473	30000	0.2303		



NOTES

- ① Crack dimension in direction of crack propagation
- ② Crack sawed + unable to read tracography

TEST DATE

DATA SET WFI

SPECIMEN NO. WFI-6 (PDR.6)

MATERIAL 7475-T7351 AL.

BOLT LOAD TRANSFER 0%

FASTENER N590352-08 (1/4" DIA) R105T

AVE. WIDTH

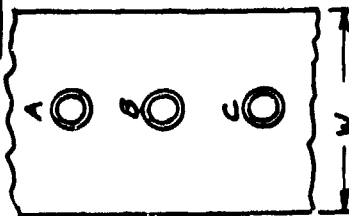
AVE. THICKNESS

SPECTRUM F-16 400 Hz

MAX. STRESS LEVEL 34453 (GROSS)

FATIGUE LIFE 17600 FLT. HRS. (2.2 Lines)

FAILURE IN HOLE A



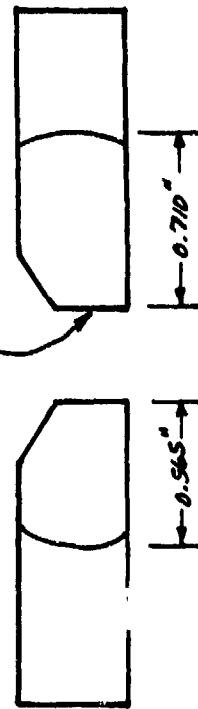
HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK LENGTH	CRACK SIZE (IN.)
A	.565	.710
B	<.020	.0478
C	<.010	.0672

FRAC TOG RAPHIC DATA WFI-6(AL) HOLE A

FLT. HRS	CRACK SIZE	FLT. HRS.	CRACK SIZE	FLT. HRS.	CRACK SIZE
5600	.0087	13600	.1478		
6000	.0098	14000	.1656		
6400	.0122	14400	.1852		
6800	.0139	14800	.2083		
7200	.0157	15200	.2487		
7600	.0175	15600	.2760		
8000	.0194	16000	.3216		
8400	.0227	16400	.3808		
8800	.0276	16800	.465		
9200	.0323	17200	.566		
9600	.0372	17600	.710		
10000	.0431				
10400	.0500				
10800	.0576				
11200	.0652				
11600	.0740				
12000	.0847				
12400	.0991				
12800	.1112				
13200	.1269				

Wide origin (Passing Method Scratches)



NOTES

① Crack dimension in direction of crack propagation

Test Date

Test Set WFI

Specimen No. WFI-6 (Pur. 6)

Material 7475-T7351 AL

Bolt Load Transfer 0%

Fastener MS90392-08 (1/4 in.) Pin

Avg. Width

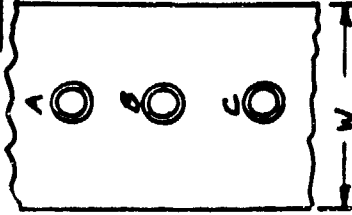
Avg. Thickness

Spectrum F-16 400 Hz

Max. Stress Level 34 ksi (6008)

Fatigue Life 17600 Cycles (2.2 Lines)

Failure in Mode A



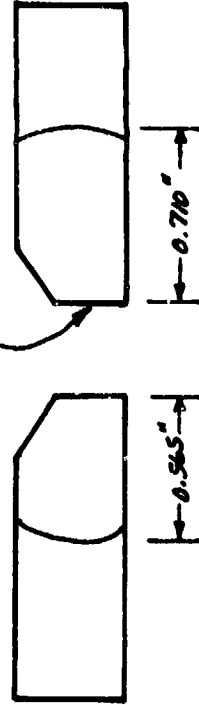
Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	.565	.710
B	<.020	.0428
C	<.010	.0672

Fractographic Data WFI-6 (25) HOLE A

FLT. MES.	CRACK SIZE	FLT. MES.	CRACK SIZE	FLT. MES.	CRACK SIZE
5600		13600	.0870		
6000		14000	.1072		
6400		14400	.1254		
6800		14800	.1404		
7200		15200	.1588		
7600		15600	.1796		
8000		16000	.2014		
8400		16400	.2585		
8800		16800	.3305		
9200		17200	.435		
9600		17600	.565		
10000					
10400					
10800					
11200					
11600					
12000	.8346				
12400	.0405				
12800	.0549				
13200	.0677				

Wide origin (possibly vertical scratch)



NOTES

① Crack dimension in direction of crack propagation

A-22

Test Date 2-27-85

Data Set WFI

Specimen No. WFI-6 (Sur. 6)

Material 7075-T7351 AL.

Bolt Load Transfer 0%

Fastener MS90359-08 (1/4 in.) Rivet

Ave. Width

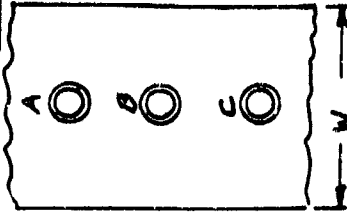
Ave. Thickness

Spectrum F-16 400 Hz

Max. Stress Level 34.0 Ksi (Gross)

Fatigue Life 17600 FIT HRS / 2.20 Lives

Failure In Hole A



Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Test
A	0.565	R1807
B	0.020	0.0478
C	0.010	0.0672

FEAT06GRAPHIC DATA WFI-6(CL) HOLE C

FLY MS	CRACK SIZE	FLY MS	CRACK SIZE	FLY MS	CRACK SIZE
8800	0.0093	17200	0.0608		
9200	0.0103	17600	0.0672		
9600	0.0112				
10000	0.0121				
10400	0.0130				
10800	0.0141				
11200	0.0150				
11600	0.0160				
12000	0.0171				
12400	0.0183				
12800	0.0205				
13200	0.0226				
13600	0.0247				
14000	0.0271				
14400	0.0300				
14800	0.0332				
15200	0.0370				
15600	0.0411				
16000	0.0451				
16400	0.0494				
16800	0.0553				



NOTES

0 Crack dimension in direction of crack propagation

FLAT TENSILE DATA WFI-7 (AL) HOLE A

TEST DATE

DATE SET WFI

SPECIMEN NO. WFI-7 (P.V. 7)

MATERIAL 7473-T7351 AL.

BOLT LOAD TRANSFER 0%

FASTENER MS90322-08 (14 AN) RIVET

AVE. WIDTH

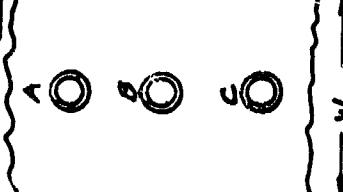
AVE. THICKNESS

SPECTRUM F-16 400 Hz

MAX. STRESS LEVEL 34 KSI (6028)

FATIGUE LIFE 16400 CYCLES (2.05 LINES)

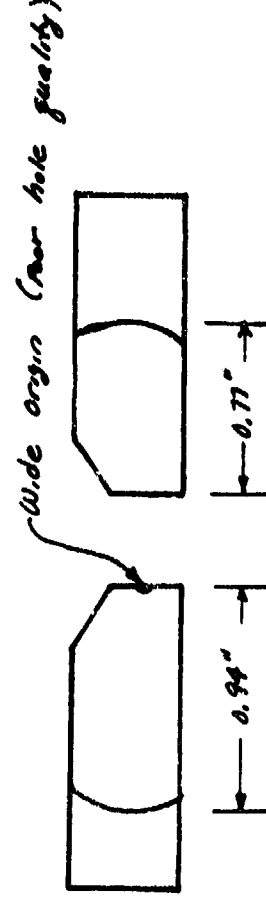
FAILURE IN HOLE A



HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SPEED (IN.)	REMARKS
A	.94	.77
B	.180	.191
C	.031	5.010

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
2400	.0090	10400	.0761		
2800	.0102	10800	.0833		
3200	.0118	11200	.0918		
3600	.0122	11600	.1028		
4000	.0151	12000	.1157		
4400	.0170	12400	.1215		
4800	.0197	12800	.1503		
5200	.0212	13200	.1701		
5600	.0255	13600	.1995		
6000	.0280	14000	.2285		
6400	.0309	14400	.2560		
6800	.0338	14800	.2970		
7200	.0367	15200	.3504		
7600	.0408	15600	.4254		
8000	.0453	16000	.5400		
8400	.0495	16400	.94		
8800	.0539				
9200	.0591				
9600	.0649				
10000	.0711				



NOTES

① Crack dimension in direction of crack propagation

FRAC TO G R A P H I C DATA WFI-7 (AS) HOLE A

TEST DATE _____

DATE SET _____ WFI _____

SPECIMEN NO. WFI-7 (PUC.7)

MATERIAL 7479-77951 AL

BOLT LOAD TRANSFER 0%

FASTENER MS90392-Q8 (1/4 IN) FINEST

AVE. WIDTH _____

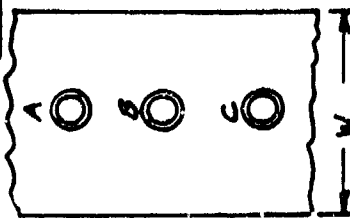
AVE. THICKNESS _____

SPECTRUM F-16 400 HR

MAX. STRESS LEVEL 34 KSI (GROSS)

FATIGUE LIFE 16400 FET. MS. (2.05 LINES)

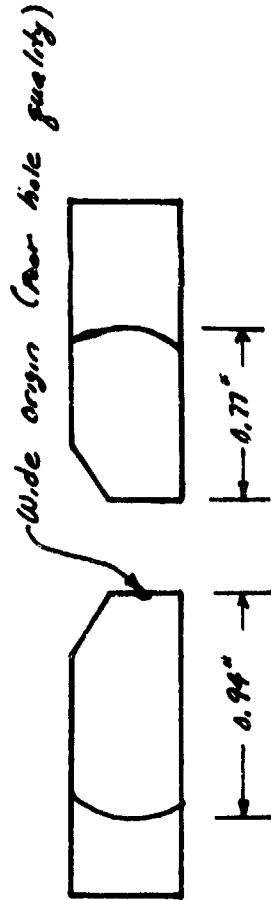
FAILURE IN HOLE A



HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)	THICKNESS
A	.94	.77
B	.189	.181
C	.031	5.010

FET. MS.	CRACK SIZE	FET. MS.	CRACK SIZE	FET. MS.	CRACK SIZE
2400		10400	.0395		
2800		10800	.0409		
3200		11200	.0564		
3600		11600	.0676		
4000		12000	.0784		
4400		12400	.0924		
4800		12800	.1102		
5200		13200	.1281		
5600		13600	.1507		
6000		14000	.1805		
6400		14400	.2112		
6800		14800	.2580		
7200		15200	.3167		
7600		15600	.3984		
8000		16000	.539		
8400		16400	.77		
8800	.0184				
9200	.0232				
9600	.0273				
10000	.0326				



NOTES
 ① Crack dimension in direction of crack propagation

Test Date 2-27-85

Test Set WFI

Specimen No. WFI-7 (D-7)

Material 7075-T7351 AL

Boil Load Transfer 0%

Fastener MS90353-08 (1/4 in) ER7

Ave Width

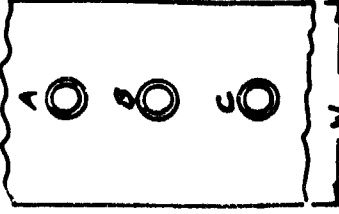
Ave Thickness

Spectrum F-16 to 42

Max. Stress Level 34,000 psi (6000)

Fatigue Life 10400 FH 42/205 Lives

Failure in Hole A



Hole Crack Final Dimensions

Hole	Final Crack Length	Final Crack Size (in.)
A	0.94	0.77
B	0.180	0.131
C	0.031	5.010

Fractographic Data WFI-7 (25) Hole B

FLT. NO.	CRACK SIZE	FLT. NO.	CRACK SIZE
6000	0.0102	14400	0.0838
6400	0.0117	14800	0.0911
6800	0.0131	15200	0.0978
7200	0.0144	15600	0.1071
7600	0.0161	16000	0.1175
8000	0.0177	16400	0.131
8400	0.0193		
8800	0.0224		
9200	0.0244		
9600	0.0270		
10000	0.0297		
10400	0.0330		
10800	0.0362		
11200	0.0400		
11600	0.0442		
12000	0.0488		
12400	0.0540		
12800	0.0593		
13200	0.0643		
13600	0.0712		
14000	0.0776		



NOTES

① Crack dimension in direction of crack propagation

Test Date 2-27-85

Data Set WFI

Specimen No. WFI-7 (Aug. 7)

Material 7075-T7351 AL

BoH Load Transfer 0%

Fastener M2590353-08 (HANA) Rivet

Ave Width _____

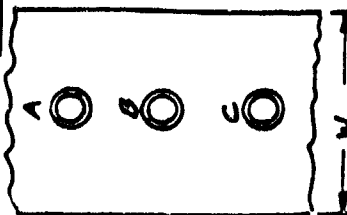
Ave. Thickness _____

Spectrum F-16 900 Hz

Max. Stress Level 36,000 psi (gross)

Fatigue Life 16800 FTH / 2.05 Lives

Failure In Hole A

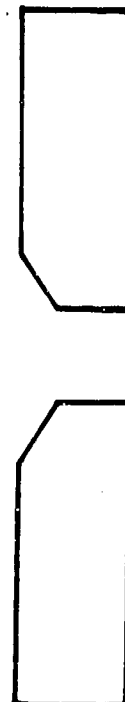


Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	0.94	0.77
B	0.180	0.131
C	0.031	<0.010

FRACTOGRAPHIC DATA WFI-7 (CL) HOLE C

FLT. NOS	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
11200	0.0098				
11600	0.0107				
12000	0.0116				
12400	0.0125				
12800	0.0134				
13200	0.0144				
13600	0.0161				
14000	0.0179				
14400	0.0198				
14800	0.0222				
15200	0.0245				
15600	0.0268				
16000	0.0292				
16400	0.031				



NOTES

① Crack dimension in direction of crack propagation

TEST DATE

DATA SET WFI

SPECIMEN NO. WFI-8 (REV. B)

MATERIAL 7475-77851 AL.

BOLT LOAD TRANSFER 0%

FASTENER MS90353-08 (1/4 IN) FINE

AVE. WIDTH

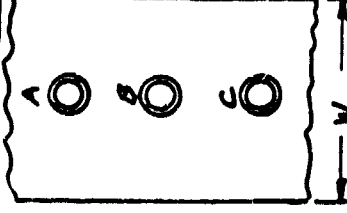
AVE. THICKNESS

SPECTRUM F-16 400 Hz

MAX. STRESS LEVEL 34 KSI (GROSS)

FATIGUE LIFE 20000 FT. LBS. (3.5 LINES)

FAILURE IN HOLE B

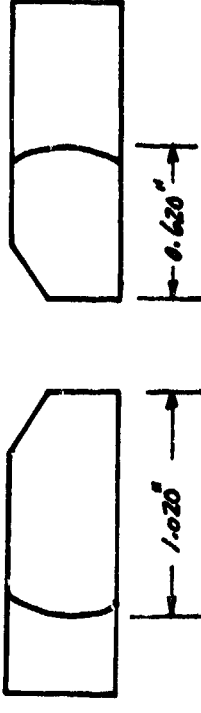


HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)	NO. FLAW
A	0.01	0.620
B	1.020	0.620
C	0.24	0.620

FRAC TOGRAPHIC DATA WFI-8 (BL) HOLE B

FLT. NOS	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
8400	.0089	16400	.0583	24400	.3101
8800	.0099	16800	.0624	24800	.3267
9200	.0109	17200	.0679	25200	.3684
9600	.0124	17600	.0729	25600	.4003
10000	.0136	18000	.0779	26000	.4325
10400	.0153	18400	.0825	26400	.4841
10800	.0167	18800	.0889	26800	.5424
11200	.0183	19200	.0961	27200	.6130
11600	.0202	19600	.1055	27600	.7176
12000	.0221	20000	.1185	28000	1.020
12400	.0240	20400	.1285		
12800	.0262	20800	.1401		
13200	.0288	21200	.1522		
13600	.0317	21600	.1654		
14000	.0346	22000	.1796		
14400	.0378	22400	.1958		
14800	.0414	22800	.2138		
15200	.0450	23200	.2371		
15600	.0496	23600	.2599		
16000	.0542	24000	.2831		

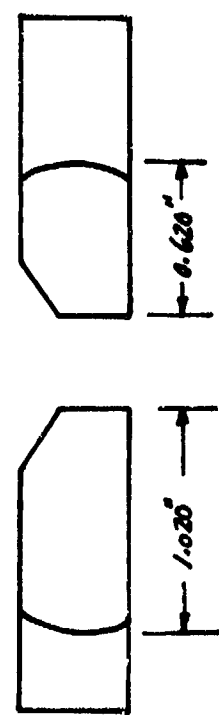
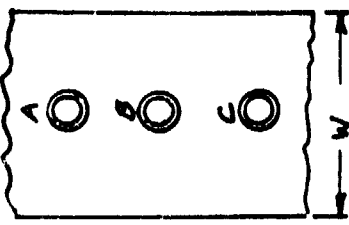


NOTES

- Crack dimension in direction of crack propagation
- Fracture surface sawed

FLT MRS	CRACK SIZE	FLT MRS.	CRACK SIZE	FLT MRS.	CRACK SIZE
8400		16400		24400	.0777
8800		16800		24800	.1010
9200		17200		25200	.1291
9600		17600		25600	.1624
10000		18000		26000	.2028
10400		18400		26400	.2537
10800		18800		26800	.334
11200		19200		27200	.407
11600		19600		27600	.491
12000		20000		28000	.620
12400		20400	.0091		
12800		20800	.0109		
13200		21200	.0129		
13600		21600	.0154		
14000		22000	.0195		
14400		22400	.0231		
14800		22800	.0277		
15200		23200	.0372		
15600		23600	.0479		
16000		24000	.0610		

TEST DATE _____
 DATE SET _____ WFI
 SPECIMEN NO. WFI-8 (REV. 8)
 MATERIAL 7479-77951 AL.
 BOLT LOAD TRANSFER 0.7
 FASTENER MS90323-08 (14.0A) FINEST
 AVG. WIDTH _____
 AVG. THICKNESS _____
 SPECTRUM F-16 400 HK
 MAX. STRESS LEVEL 34 KSI (6.028)
 FATIGUE LIFE 28000 FWT. MRS. (2.5 LINES)
 FAILURE IN HOLE B



HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)	REMARKS
A	5.01	NO FLAW
B	1.02	.620
C	7.34	7.300

NOTES
 ① Crack dimension in direction of crack propagation
 ② Fracture surface sawed

TEST DATE

DATA SET W/FI

SPECIMEN NO. W/FI-9 (GUE. 9)

MATERIAL 7475-T7351 AL.

BEAM LOAD TRANSFER 0%

FASTENER MS90353-08 (14.0A) RIVET

AVE. WIDTH

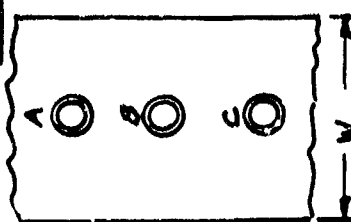
AVE. THICKNESS

SPECTRUM F-16 400 Hz

MAX. STRESS LEVEL 34 KSI (GROSS)

FATIGUE LIFE 36,400 CYCLES (1.56 LINES)

FAILURE IN HOLE A



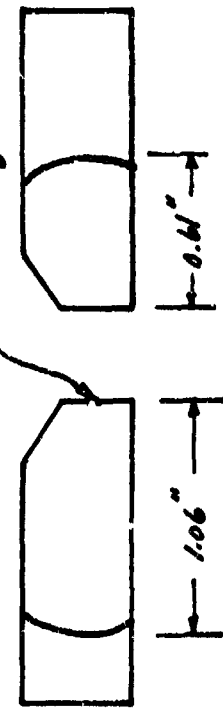
HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)	REMARKS
A	1.06	.61
B	.25	.22 (2)
C	.25	.25

FLATTOGRAPHIC DATA W/FI-9(AL) HOLE A

FLT. NOS	CRACK SIZE	ACT. NOS.	CRACK SIZE	ACT. NOS.	CRACK SIZE
12000	.0096	20400	.0428	28800	.1970
12400	.0105	20800	.0451	29200	.2077
12800	.0114	21200	.0497	29600	.2185
13200	.0123	21600	.0531	30000	.2347
13600	.0134	22000	.0586	30400	.2478
14000	.0144	22400	.0638	30800	.2607
14400	.0155	22800	.0695	31200	.2750
14800	.0169	23200	.0758	31600	.2902
15200	.0183	23600	.0824	32000	.3073
15600	.0195	24000	.0885	32400	.3253
16000	.0205	24400	.0950	32800	.3440
16400	.0218	24800	.1031	33200	.3657
16800	.0235	25200	.1095	33600	.3913
17200	.0256	25600	.1174	34000	.4192
17600	.0270	26000	.1257	34400	.4495
18000	.0284	26400	.1351	34800	.4843
18400	.0303	26800	.1443	35200	.5260
18800	.0330	27200	.1543	35600	.5704
19200	.0345	27600	.1641	36000	.658
19600	.0366	28000	.1747	36400	.760
20000	.0370	28400	.1852	36800	1.060

Small origin



NOTES

- Crack dimension in direction of crack propagation
- Read smaller crack in bore of hole

Test Date

Test Set WFE

Specimen No. WFE-9 (Rev. 5)

Material 7475-T7351 AL

Bolt Load Transfer 0%

Fastener MS90322-08 (4.4mm) Rivet

Ave. Width

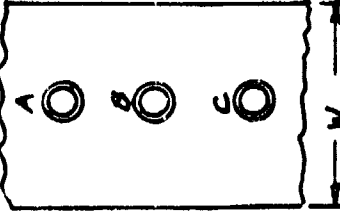
Ave. Thickness

Spectrum F-16 400 Hz

Max. Stress Level 36 KSI (Gross)

Fatigue Life 36,480 Cycles (4.56 Lines)

Failure in Hole A

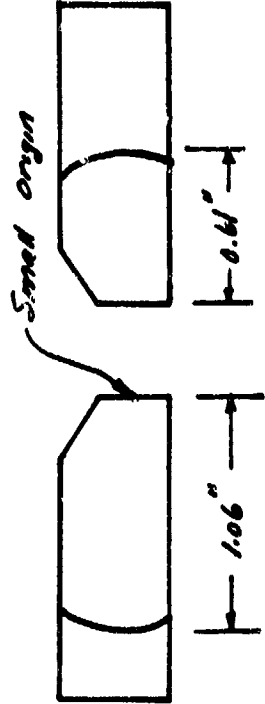


Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	1.06	.61
B	.25	.22
C	.25	.25

Fractographic Data WFE-9 (AS) Hole A

FLT. MRS	CRACK SIZE	FLT. AREA	CRACK SIZE	FLT. AREA	CRACK SIZE
12000		20400		20400	.0117
12400		20800		20800	.0125
12800		21200		21200	.0134
13200		21600		21600	.0143
13600		22000		22000	.015
14000		22400		22400	.016
14400		22800		22800	.0171
14800		23200		23200	.0180
15200		23600		23600	.0185
15600		24000		24000	.0199
16000		24400		24400	.0211
16400		24800		24800	.0236
16800		25200		25200	.0239
17200		25600		25600	.0256
17600		26000		26000	.0272
18000		26400		26400	.0292
18400		26800		26800	.0315
18800		27200		27200	.0341
19200		27600		27600	.0376
19600		28000		28000	.0413
20000		28400		28400	.0456
		28800		28800	.0500
		29200		29200	.0557
		29600		29600	.0612
		30000		30000	.0661
		30400		30400	.0718
		30800		30800	.0776
		31200		31200	.0840
		31600		31600	.0906
		32000		32000	.0966
		32400		32400	.1027
		32800		32800	.1082
		33200		33200	.1147
		33600		33600	.1212
		34000		34000	.1267
		34400		34400	.1326
		34800		34800	.1395
		35200		35200	.1464
		35600		35600	.1536
		36000		36000	.1603
		36400		36400	.167
		36800		36800	.1732
		37200		37200	.1795
		37600		37600	.185
		38000		38000	.191
		38400		38400	.196
		38800		38800	.201
		39200		39200	.206
		39600		39600	.211
		40000		40000	.216
		40400		40400	.221
		40800		40800	.226
		41200		41200	.231
		41600		41600	.236
		42000		42000	.241
		42400		42400	.246
		42800		42800	.251
		43200		43200	.256
		43600		43600	.261
		44000		44000	.266
		44400		44400	.271
		44800		44800	.276
		45200		45200	.281
		45600		45600	.286
		46000		46000	.291
		46400		46400	.296
		46800		46800	.301
		47200		47200	.306
		47600		47600	.311
		48000		48000	.316
		48400		48400	.321
		48800		48800	.326
		49200		49200	.331
		49600		49600	.336
		50000		50000	.341
		50400		50400	.346
		50800		50800	.351
		51200		51200	.356
		51600		51600	.361
		52000		52000	.366
		52400		52400	.371
		52800		52800	.376
		53200		53200	.381
		53600		53600	.386
		54000		54000	.391
		54400		54400	.396
		54800		54800	.401
		55200		55200	.406
		55600		55600	.411
		56000		56000	.416
		56400		56400	.421
		56800		56800	.426
		57200		57200	.431
		57600		57600	.436
		58000		58000	.441
		58400		58400	.446
		58800		58800	.451
		59200		59200	.456
		59600		59600	.461
		60000		60000	.466
		60400		60400	.471
		60800		60800	.476
		61200		61200	.481
		61600		61600	.486
		62000		62000	.491
		62400		62400	.496
		62800		62800	.501
		63200		63200	.506
		63600		63600	.511
		64000		64000	.516
		64400		64400	.521
		64800		64800	.526
		65200		65200	.531
		65600		65600	.536
		66000		66000	.541
		66400		66400	.546
		66800		66800	.551
		67200		67200	.556
		67600		67600	.561
		68000		68000	.566
		68400		68400	.571
		68800		68800	.576
		69200		69200	.581
		69600		69600	.586
		70000		70000	.591
		70400		70400	.596
		70800		70800	.601
		71200		71200	.606
		71600		71600	.611
		72000		72000	.616
		72400		72400	.621
		72800		72800	.626
		73200		73200	.631
		73600		73600	.636
		74000		74000	.641
		74400		74400	.646
		74800		74800	.651
		75200		75200	.656
		75600		75600	.661
		76000		76000	.666
		76400		76400	.671
		76800		76800	.676
		77200		77200	.681
		77600		77600	.686
		78000		78000	.691
		78400		78400	.696
		78800		78800	.701
		79200		79200	.706
		79600		79600	.711
		80000		80000	.716
		80400		80400	.721
		80800		80800	.726
		81200		81200	.731
		81600		81600	.736
		82000		82000	.741
		82400		82400	.746
		82800		82800	.751
		83200		83200	.756
		83600		83600	.761
		84000		84000	.766
		84400		84400	.771
		84800		84800	.776
		85200		85200	.781
		85600		85600	.786
		86000		86000	.791
		86400		86400	.796
		86800		86800	.801
		87200		87200	.806
		87600		87600	.811
		88000		88000	.816
		88400		88400	.821
		88800		88800	.826
		89200		89200	.831
		89600		89600	.836
		90000		90000	.841
		90400		90400	.846
		90800		90800	.851
		91200		91200	.856
		91600		91600	.861
		92000		92000	.866
		92400		92400	.871
		92800		92800	.876
		93200		93200	.881
		93600		93600	.886
		94000		94000	.891
		94400		94400	.896
		94800		94800	.901
		95200		95200	.906
		95600		95600	.911
		96000		96000	.916
		96400		96400	.921
		96800		96800	.926
		97200		97200	.931
		97600		97600	.936
		98000		98000	.941
		98400		98400	.946
		98800		98800	.951
		99200		99200	.956
		99600		99600	.961
		100000		100000	.966



NOTES

- ① Crack dimension in direction of crack propagation
- ② Read smaller crack in bore of hole

Test Date 2-27-85

Data Set WFI

Specimen No. WFI-9 (Aug. 9)

Material 7475-T7351 AL

BoH Load Transfer 0%

Fastener MS90329-08 (1/4 in) Rivet

Ave Width

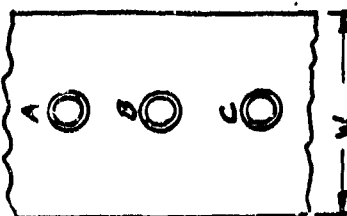
Ave. Thickness

Spectrum F16 400 Hz

Max. Stress Level 340 ksi (gross)

Fatigue Life 3680 FTH / 454 LIVES

Failure in Hole A

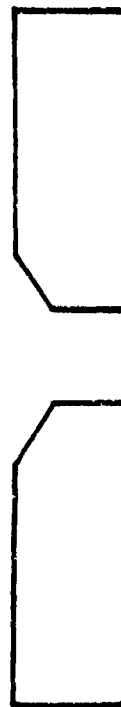


Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	1.06	0.61
B	0.25	0.22 ③
C	0.2525	0.25

Fractographic Data WFI-9 (85) Hole B

ALT. NOS.	CRACK SIZE	ALT. NOS.	CRACK SIZE	ALT. NOS.	CRACK SIZE
30800	0.0851				
31200	0.0931				
31600	0.0998				
32000	0.1055				
32400	0.1134				
32800	0.1202				
33200	0.1284				
33600	0.133				
34000	0.1399				
34400	0.1465				
34800	0.153				
35200	0.161				
35600	0.1712				
36000	0.187				
36400	0.199				
36480	0.208				



NOTES

- Crack dimension in direction of crack propagation
- Lead smaller crack in bore of hole
- Difficult to read below this point

Test Date 2-27-85

Batch Set WFI

Specimen No. WFI-9 (Dur. 9)

Material 7475-T7351 AL.

Boil Load Transfer 0%

Fastener MS90359-08 (14 mm) Rivet

Ave Width

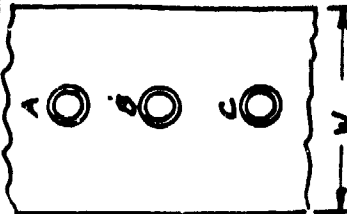
Ave. Thickness

Spectrum F-16 400 MK

Max. Stress Level 34000 Psi. (Gross)

Fatigue Life 36480 Cycles

Failure In Hole A



Hole Crack Final Dimensions

Hole	Final Crack Length (in.)
A	1.06
B	0.25
C	0.2525

FLATOTERRAMIC AND WFI-9CL) HOLE C

FLT. RES.	CRACK SIZE	RES. RES.	CRACK SIZE	RES. RES.	CRACK SIZE
19400	0.0100	26800	0.0440	35200	0.1990
18800	0.0107	27200	0.0460	35600	0.2097
19200	0.0118	27600	0.0483	36000	0.2263
19600	0.0127	28000	0.0511	36400	0.2425
20000	0.0137	28400	0.0530	36800	0.2525
20400	0.0148	28800	0.0579		
20800	0.0163	29200	0.0603		
21200	0.0176	29600	0.0656		
21600	0.0190	30000	0.0718		
22000	0.0205	30400	0.0780		
22400	0.0219	30800	0.0853		
22800	0.0236	31200	0.0922		
23200	0.0248	31600	0.1009		
23600	0.0271	32000	0.1091		
24000	0.0285	32400	0.1200		
24400	0.0309	32800	0.1291		
24800	0.0329	33200	0.1380		
25200	0.0357	33600	0.1515		
25600	0.0381	34000	0.1628		
26000	0.0398	34400	0.1769		
26400	0.0421	34800	0.1884		



NOTES

- Crack dimension in direction of crack propagation
- Read Smaller crack in bore of hole

Test Date 2-27-85

Data Set WFI

Specimen No. WFI-10 (Dur. ID)

Material 7475-T7351 AL.

Bolt Load Transfer 0%

Fastener MS90333-08 (1/4" DIA) FIRST

Ave. Width

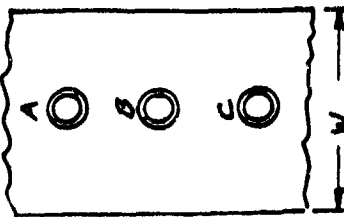
Ave. Thickness

Spectrum F-16 100 Hz

Max. Stress Level 34,000 psi (Gross)

Fatigue Life 300000 Cycles / 3.75 Lives

Failure in Hole C



Hole Crack Final Dimensions

Hole	Final Crack Size ^① (in.)	
	Left	Right
A	0.250	0.220
B	0.150	≤ 0.025
C	0.823	0.710

PHOTOGRAPHIC DATA

WFI-10 (Dur. ID)

HOLE A

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
8800	0.0095	17200	0.0377	25600	0.1145
9200	0.0104	17600	0.0403	26000	0.1225
9600	0.0115	18000	0.0426	26400	0.1306
10000	0.0125	18400	0.0451	26800	0.1385
10400	0.0134	18800	0.0475	27200	0.1475
10800	0.0145	19200	0.0500	27600	0.1576
11200	0.0156	19600	0.0523	28000	0.1690
11600	0.0165	20000	0.0552	28400	0.1807
12000	0.0175	20400	0.0578	28800	0.1975
12400	0.0188	20800	0.0607	29200	0.2139
12800	0.0197	21200	0.0630	29600	0.2322
13200	0.0206	21600	0.0647	30000	0.250
13600	0.0219	22000	0.0670		
14000	0.0230	22400	0.0709		
14400	0.0245	22800	0.0737		
14800	0.0261	23200	0.0770		
15200	0.0277	23600	0.0817		
15600	0.0294	24000	0.0872		
16000	0.0309	24400	0.0934		
16400	0.0331	24800	0.1009		
16800	0.0354	25200	0.1077		



NOTES

① Crack dimension in direction of crack propagation

TEST DATE 2-27-85

DATA SET WFL

SPECIMEN NO. WFL-10 (DUNID)

MATERIAL 7475-77851 AL

LOAD TRANSFER 0%

FASTENER MS90352-08 (1/4 IN) FIRST

Avg Width

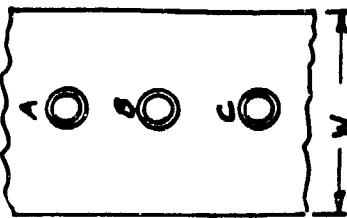
Avg Thickness

Spectrum F-16 400 Hz

Max. Stress Level 340 Ksi (Gross)

Fatigue Life 30000 Cycles

Failure In Hole C



Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	0.250	0.220
B	0.152	0.025
C	0.823	0.710

Fractographic Data WFL-10 (AL) Hole B

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
12400	0.0092	20800	0.0409	29200	0.1410
12800	0.0108	21200	0.0438	29600	0.1459
13200	0.0116	21600	0.0465	30000	0.1521
13600	0.0125	22000	0.0500		
14000	0.0133	22400	0.0530		
14400	0.0144	22800	0.0566		
14800	0.0153	23200	0.0596		
15200	0.0165	23600	0.0680		
15600	0.0179	24000	0.0721		
16000	0.0196	24400	0.0763		
16400	0.0206	24800	0.0813		
16800	0.0220	25200	0.0859		
17200	0.0231	25600	0.0904		
17600	0.0245	26000	0.0957		
18000	0.0264	26400	0.1009		
18400	0.0286	26800	0.1053		
18800	0.0302	27200	0.1103		
19200	0.0317	27600	0.1167		
19600	0.0333	28000	0.1226		
20000	0.0358	28400	0.1287		
20400	0.0380	28800	0.1355		



NOTES

① Crack dimension in direction of crack propagation

TEST DATE

TEST SET WFI

SPECIMEN NO. WFI-10 (DUAL)

MATERIAL 7475-77951 AL

BEAM LOAD TRANSFER 0%

FASTENER MS90322-08 (1/4" DIA) FIRST

AVE. WIDTH

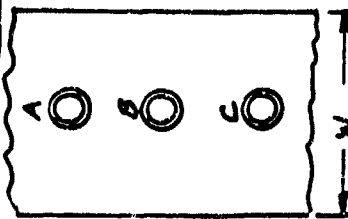
AVE. THICKNESS

SPECTRUM F-16 400 Hz

MAX. STRESS LEVEL 34 KSI (6008)

FATIGUE LIFE 30000 FWT. AVE. (3.73 LIVES)

FAILURE IN HOLE C

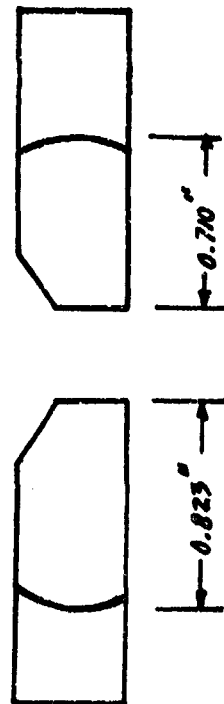


HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)
A	.250
B	.152
C	.829

FLATOGRAPHIC DATA WFI-10 (CL) HOLE C

FLT. AREA	CRACK SIZE	ALT. AREA	CRACK SIZE	ALT. AREA	CRACK SIZE
6800	.0079	15200	.0328	23600	.1645
7200	.0089	15600	.0396	24000	.1743
7600	.0099	16000	.0417	24400	.1848
8000	.0108	16400	.0446	24800	.2063
8400	.0117	16800	.0479	25200	.2225
8800	.0126	17200	.0521	25600	.2400
9200	.0136	17600	.0567	26000	.2591
9600	.0148	18000	.0612	26400	.2773
10000	.0160	18400	.0663	26800	.2989
10400	.0171	18800	.0714	27200	.3230
10800	.0182	19200	.0758	27600	.3556
11200	.0193	19600	.0825	28000	.3871
11600	.0205	20000	.0886	28400	.4303
12000	.0223	20400	.0948	28800	.4782
12400	.0241	20800	.1004	29200	.5308
12800	.0258	21200	.1076	29600	.6301
13200	.0276	21600	.1144	30000	.823
13600	.0293	22000	.1219		
14000	.0312	22400	.1303		
14400	.0335	22800	.1419		
14800	.0357	23200	.1511		



NOTES

① Crack dimension in direction of crack propagation

Test Date

Batch Set WFI

Specimen No. WFI-10 (PWA-10)

Material 7475-77951 AL

Bolt Load Transfer 0%

Fastener MS90393-08 (1/4" DIA) FIRST

Avg. Width

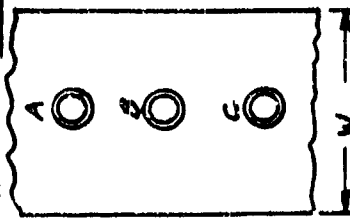
Avg. Thickness

Spectrum F-16 400 Hz

Max. Stress Level 34 KSI (670 MPa)

Fatigue Life 30000 Cycles (2.75 lives)

Failure In Hole C

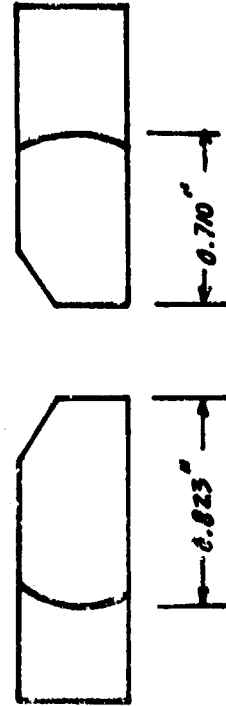


Hole Crack Final Dimensions

Hole	Final Crack Size (in.)
A	.250
B	.152
C	.023

Fractographic Data WFI-10 (CS) Hole C

FLT. NOS	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
6800		15200	.0399	23600	.167
7200		15600	.0255	24000	.1295
7600		16000	.0275	24400	.145
8000		16400	.0295	24800	.1531
8400		16800	.0317	25200	.163
8800		17200	.0339	25600	.1811
9200		17600	.0363	26000	.1978
9600		18000	.0392	26400	.2158
10000		18400	.0428	26800	.2342
10400		18800	.0472	27200	.2577
10800		19200	.0509	27600	.2808
11200		19600	.0548	28000	.3117
11600	.0098	20000	.0585	28400	.3517
12000	.0110	20400	.0641	28800	.4008
12400	.0124	20800	.0686	29200	.462
12800	.0139	21200	.0738	29600	.537
13200	.0153	21600	.0795	30000	.710
13600	.0174	22000	.0856		
14000	.0193	22400	.0919		
14400	.0208	22800	.0987		
14800	.0225	23200	.1069		



NOTES

① Crack direction in direction of crack propagation

Test Date

Part Set WFI

Specimen No. WFI-11 (DIN. 11)

Material 7475-T7351 AL.

Bolt Load Transfer 0%

Fastener MS90353-08 (14.0A) Rivet

Avg. Width

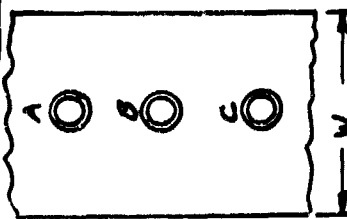
Avg. Thickness

Spectrum F-16 400 Hz

Max. Stress Level 34 KSI (Gross)

Fatigue Life 2000 RTMS (2.55 Lms)

Failure In Hole A

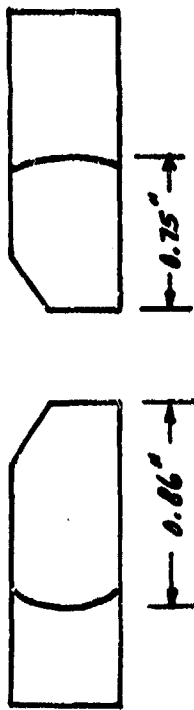


Hole Crack Final Dimensions

Hole	Final Crack Size ⁽¹⁾ (in.)	Ratio
A	.86	.75
B	.0895	.025
C	.380	.105 ②

Fractographic and WFI-11(Al) Hole A

FLT. No.	CRACK SIZE	FLT. No.	CRACK SIZE	FLT. No.	CRACK SIZE
6000	.0087	15200	.1365		
7200	.0099	15600	.1529		
7600	.0113	16000	.1698		
8000	.0133	16400	.1894		
8400	.0166	16800	.2141		
8800	.0195	17200	.2397		
9200	.0227	17600	.2712		
9600	.0257	18000	.3076		
10000	.0295	18400	.3524		
10400	.0343	18800	.4032		
10800	.0395	19200	.4704		
11200	.0444	19600	.5334		
11600	.0497	20000	.650		
12000	.0567	20400	.860		
12400	.0634				
12800	.0723				
13200	.0803				
13600	.0897				
14000	.1013				
14400	.1107				
14800	.1237				



NOTES

- Crack dimension in direction of crack propagation
- Originated out on countersink surface

FRactOGRAPHIC DATA WFI-11 (AS) HOLE A

TEST DATE

DATE SET WFI

SPECIMEN NO. WFI-11 (DUR. 11)

MATERIAL 7475-T7351 AL.

BOLT LOAD TRANSFER 0%

FASTENER MS90352-08 (1/4" DIA) FINEST

AVE. WIDTH

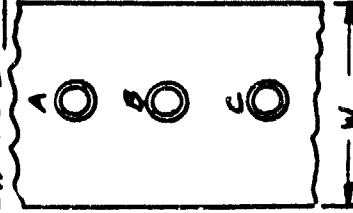
AVE. THICKNESS

SPECTRUM F-16 400 Hz

MAX. STRESS LEVEL 34 KSI (6198)

FATIGUE LIFE 20400 Cycles (2.55 Lines)

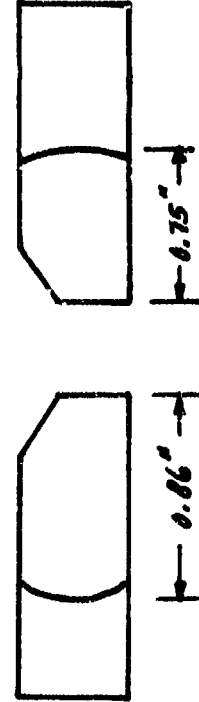
FAILURE IN HOLE A



HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (in.)
A	.06
B	.0095
C	.005

FLT. NOS.	CRACK SIZE	ALT. MEAS.	CRACK SIZE	ALT. MEAS.	CRACK SIZE
6800	.0108	15200	.0947	5200	.0051
7200	.0124	15600	.1046	5600	.0066
7600	.0138	16000	.1151	6000	.0080
8000	.0153	16400	.1259	6400	.0094
8400	.0181	16800	.1436	6800	.0090
8800	.0200	17200	.1632	7200	.0066
9200	.0217	17600	.1865	7600	.0051
9600	.0246	18000	.2134		
10000	.0271	18400	.2492		
10400	.0396	18800	.2934		
10800	.0321	19200	.3059		
11200	.0354	19600	.4598		
11600	.0390	20000	.615		
12000	.0427	20400	.750		
12400	.0453				
12800	.0494				
13200	.0538				
13600	.0587				
14000	.0683				
14400	.0765				
14800	.0862				



NOTES

- Crack dimension in direction of crack propagation
- Originated out on countersink surface

TEST DATE 2-27-85

DATA SET WEI

SPECIMEN NO. WEI-II (DUG-II)

MATERIAL 7475-T7351 AL.

BOLT LOAD TRANSFER 0%

FASTENER MS90359-08 (1/4 IN.) FINEST

AVE. WIDTH

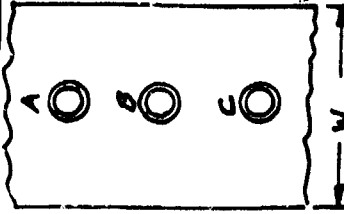
AVE. THICKNESS

SPECTRUM F-16 400 HR

MAX. STRESS LEVEL 340 KSI (6000)

FATIGUE LIFE 20400 FWH/2.55 LIVES

FAILURE IN HOLE A



HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)	RIGHT
A	0.86	0.75
B	0.0895	0.025
C	0.380	0.105

FRACTOGRAPHIC DATA WEI-II (DUG-II) HOLE B

FLY MAG.	CRACK SIZE	FLY MAG.	CRACK SIZE	FLY MAG.	CRACK SIZE
80X	0.0057	164X	0.0435		
84X	0.0105	168X	0.0473		
88X	0.0115	172X	0.0530		
92X	0.0124	176X	0.0570		
96X	0.0134	180X	0.0612		
100X	0.0144	184X	0.0653		
104X	0.0153	188X	0.0699		
108X	0.0170	192X	0.0750		
112X	0.0180	196X	0.0814		
116X	0.0192	200X	0.0840		
120X	0.0207	204X	0.0890		
124X	0.0221				
128X	0.0233				
132X	0.0247				
136X	0.0260				
140X	0.0276				
144X	0.0290				
148X	0.0311				
152X	0.0330				
156X	0.0362				
160X	0.0394				



NOTES

- Crack dimension in direction of crack propagation
- Originated out on countersink surface

Test Date

Data Set WFI

Specimen No. WFI-12 (DVR. 12)

Material 7473-77351 AL

Bolt Load Transfer 0%

Fastener MS90353-08 (4.0 in) Rust

Avg. Width

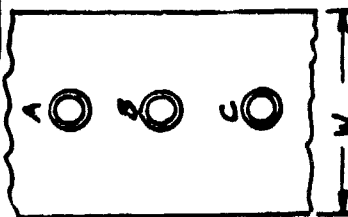
Avg. Thickness

Spectrum F-16 900 Hz

Max. Stress Level 34 KSI (6028)

Fatigue Life 30240 Cycles (3.78 Lines)

Failure In Hole B

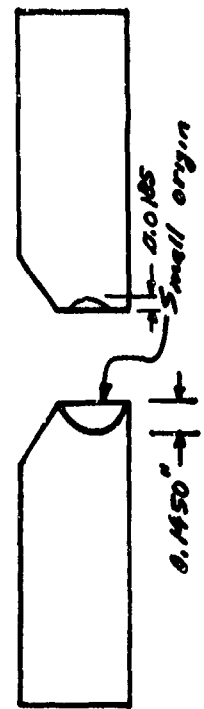


Hole Crack Final Dimensions

Hole	Final Crack Size ⁽¹⁾ (in.)	Ratio
A	~.100 ⁽⁴⁾	~.020 ⁽⁴⁾
B	.1450	.015
C	~.180 ⁽⁵⁾	.100

Fractographic Data WFI-12(AL) Hole B

FLT. MES	CRACK SIZE	FLT. MES.	CRACK SIZE	FLT. MES.	CRACK SIZE
16000	.0083	24400	.0516		
16400	.0091	24800	.0551		
16800	.0099	25200	.0608		
17200	.0110	25600	.0665		
17600	.0121	26000	.0722		
18000	.0139	26400	.0796		
18400	.0172	26800	.0863		
18800	.0151	27200	.0939		
19200	.0166	27600	.1009		
19600	.0180	28000	.1075		
20000	.0196	28400	.1146		
20400	.0214	28800	.1216		
20800	.0234	29200	.1276		
21200	.0257	29600	.1346		
21600	.0284	30000	.1397		
22000	.0311	30240	.1450		
22400	.0338				
22800	.0373				
23200	.0408				
23600	.0459				
24000	.0476				



- (1) Surface Crack
- (2) Originated on Counter Surface

NOTES

- (1) Crack dimension in direction of crack propagation
- (2) Specimen bent in compression due to load cell malfunction.
- (3) Hole with largest crack.

TEST DATE

DATA SET WFE

SPECIMEN NO. WFE-12 (REV. 12)

MATERIAL 7475-77851 AL.

BOLT LOAD TRANSFER 0%

F. STRESSER 90590323-08 (4.0A) R1017

AVE. WIDTH

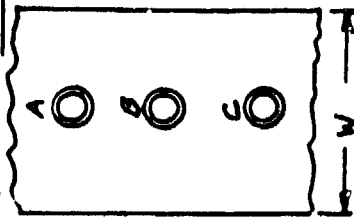
AVE. THICKNESS

SPECTRUM F-16 400 Hz

MAX. STRESS LEVEL 34 KSI (5700)

FATIGUE LIFE 30240 CYCLES (3.78 LINES)

FAILURE IN HOLE B

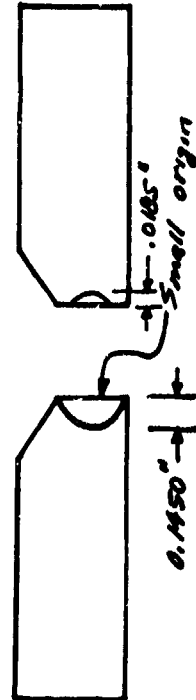


HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)
A	~.100" (B)
B	.1450 (C)
C	~.180 (C)

FRAC TOGRAPHIC DATA WFE-12(85) HOLE B

FLT. NOS	CRACK SIZE	FLT. NOS.	CRACK SIZE	ALT. NOS.	CRACK SIZE
16000		24400			
16400		24800			
16800		25200			
17200		25600			
17600		26000			
18000		26400			
18400		26800			
18800		27200	.0100		
19200		27600	.0109		
19600		28000	.0118		
20000		28400	.0129		
20400		28800	.0139		
20800		29200	.0147		
21200		29600	.0157		
21600		30000	.0171		
22000		30240	.0185		
22400					
22800					
23200					
23600					
24000					

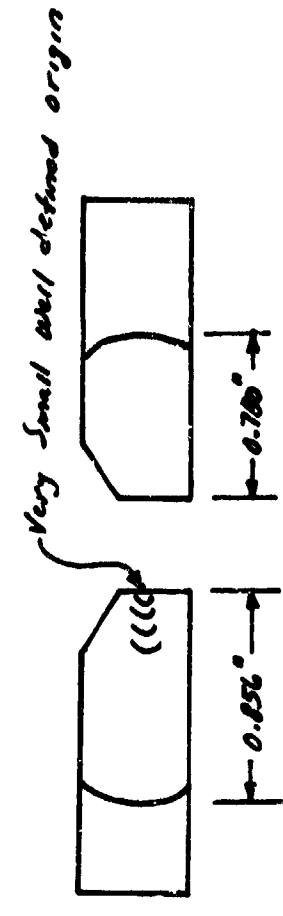


- ① Surface Crack
- ② Originated on Counter-Side Surface

NOTES

- ① Crack dimension in direction of crack propagation
- ② Specimen bent in compression due to load cell malfunction.
- ③ Hole with largest crack.

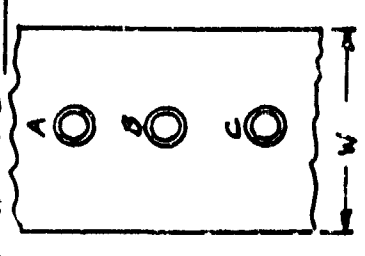
FLT. MES.	CRACK SIZE	FLT. MES.	CRACK SIZE	FLT. MES.	CRACK SIZE
11200	.0082	19600	.0458	28000	.2100
11600	.0094	20000	.0488	28400	.2209
12000	.0104	20400	.0530	28800	.2505
12400	.0112	20800	.0594	29200	.3797
12800	.0123	21200	.0571	29600	.3011
13200	.0126	21600	.0573	30000	.3313
13600	.0147	22000	.0620	30400	.3677
14000	.0162	22400	.0663	30800	.4120
14400	.0172	22800	.0726	31200	.4635
14800	.0184	23200	.0778	31600	.5295
15200	.0198	23600	.0847	32000	.624
15600	.0213	24000	.0912	32400	.856
16000	.0227	24400	.0989		
16400	.0242	24800	.1072		
16800	.0260	25200	.1165		
17200	.0281	25600	.1260		
17600	.0303	26000	.1366		
18000	.0333	26400	.1490		
18400	.0366	26800	.1618		
18800	.0398	27200	.1763		
19200	.0430	27600	.1950		



NOTES
 ① Crack dimension in direction of crack propagation
 ② Fracture surface caused by fractography

TEST DATE _____
 Date Set WFS
 Specimen No. WFS-13 (DUB.13)
 Material 7475-77951 AL.
 Bolt Load Transfer 0%
 Tester MS90352-08 (1/4 IN) FIRST
 Ave. Width _____
 Ave. Thickness _____
 Spectrum F-16 400 Hz
 Max. Stress Level 34 KSI (GROSS)

Fatigue Life 32400 FLT. MES. (4.05 Lines)
 Failure In Hole B



HOLE CRACK Final Dimensions

HOLE	Final CRACK SIZE (in.)	Final CRACK SIZE (in.)
A	.260	.240 (2)
B	.856	.780
C	<.010	---

TEST DATE

DATA SET WPI

SPECIMEN NO. WPI-13 (PUB. 13)

MATERIAL 7479-77351 AL.

BIT LOAD TRANSFER 0%

FASTENER MS90359-08 (1/4 IN.) RING

AVE. W.D.T.

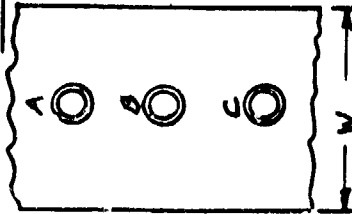
AVE. THICKNESS

SPECTRUM F-16 400 HR

MAX. STRESS LEVEL 34 KSI (GROSS)

FATIGUE LIFE 32400 CYCLES (AVERAGE)

FAILURE IN HOLE B



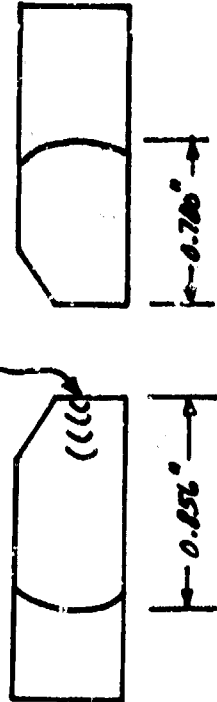
HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)
A	.260
B	.856
C	4.010

FRAC TOG RAPHIC DATA WPI-13 (35) HOLE B

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
11200		17600	.0187	28000	.1588
11400		20900	.0202	28900	.1746
12000		20400	.0225	29200	.1948
12400		20800	.0250	29300	.2116
12800		21200	.0273	29600	.2431
13200		21600	.0298	30000	.2631
13600		22000	.0326	30400	.2977
14000		22400	.0358	30800	.3404
14400		22800	.0402	31200	.3907
14800		23200	.0459	31600	.4504
15200		23600	.0521	32000	.570
15600		24000	.0574	32400	.780
16000		24400	.0633		
16400		24800	.070		
16800		25200	.0803		
17200	.0101	25600	.0897		
17600	.0112	26000	.0974		
18000	.0125	26400	.1074		
18400	.0138	26800	.1196		
18800	.0153	27200	.1318		
19200	.0169	27600	.1448		

Very Small and Defined origin



NOTES

- Crack dimension in direction of crack propagation
- Fracture surface showed no fractography

TEST DATE 2-27-85

DATA SET WFI

SPECIMEN NO. WFI-14 (OUT 14)

MATERIAL 7425-T7351 AL.

BOLT LOAD TRANSFER 0%

FASTENER MS90352-08 (1/4 IN.) DIA.

Avg. WIDTH

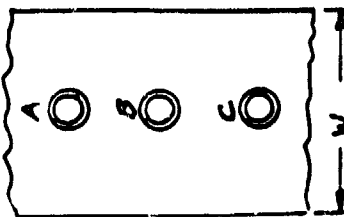
Avg. THICKNESS

SPECTRUM F-16 400 Hz

Max. STRESS LEVEL 340 ksi (600 MPa)

Fatigue Life 29360 Cycles / 347 Lines

Failure In Hole B



HOLE CRACK Final Dimensions

HOLE	Final CRACK SIZE (in.)	
	LEFT	RIGHT
A	.368	<0.010
B	1.03	0.39
C	0.111	<0.010

FRAC TOGRAPHIC DATA WFI-14(AL) HOLE A

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	ALT. NOS.	CRACK SIZE
8400	0.0031	16400	0.0452	25200	0.1831
9800	0.007	17200	0.0484	25600	0.1950
9200	0.0119	17600	0.0573	26000	0.2025
9600	0.0132	18000	0.0544	26400	0.2184
10000	0.0146	18400	0.0586	26800	0.2336
10400	0.0160	18800	0.0621	27200	0.2493
10800	0.0177	19200	0.0683	27600	0.2655
11200	0.0190	19600	0.0740	28000	0.2833
11600	0.0204	20000	0.0791	28400	0.3018
12000	0.0214	20400	0.0850	28800	0.3206
12400	0.0234	20800	0.0903	29200	0.3389
12800	0.0249	21200	0.0972	29360	0.3618
13200	0.0264	21600	0.1037		
13600	0.0285	22000	0.1107		
14000	0.0300	22400	0.1178		
14400	0.0320	22800	0.1260		
14800	0.0339	23200	0.1351		
15200	0.0358	23600	0.1422		
15600	0.0382	24000	0.1544		
16000	0.0410	24400	0.1643		
16400	0.0427	24800	0.1735		



NOTES

① Crack dimension in direction of crack propagation

TEST DATE

DATA SET WFI

SPECIMEN NO. WFI-14 (DUC. 19)

MATERIAL 7475-77851 AL

BOLT LOAD TRANSFER 29.

FASTENER MS 90322-08 (1/4 IN) EXIST

AVE. WIDTH

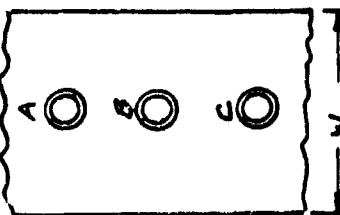
AVE. THICKNESS

SPECTRUM F-16 500 Hz

MAX. STRESS LEVEL 34 KSI (GROSS)

FATIGUE LIFE 29360 F.C. Cycles (2.67 Lines)

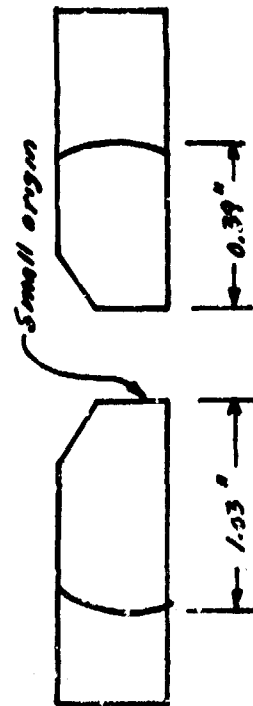
FAILURE IN HOLE B



HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)	REMARKS
A	.390	< .010
B	1.03	.39
C	.111	< .010

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
5600	.0083	14000	.0457	22400	.2323
6000	.0102	14400	.0497	22800	.2485
6400	.0110	14800	.0527	23200	.2669
6800	.0119	15200	.0567	23600	.2853
7200	.0128	15600	.0619	24000	.3030
7600	.0137	16000	.0671	24400	.3260
8000	.0147	16400	.0733	24800	.3492
8400	.0164	16800	.0806	25200	.3742
8800	.0175	17200	.0861	25600	.4002
9200	.0190	17600	.0929	26000	.4285
9600	.0209	18000	.1012	26400	.4551
10000	.0227	18400	.1088	26800	.4725
10400	.0244	18800	.1175	27200	.5387
10800	.0266	19200	.1290	27600	.5774
11200	.0283	19600	.1394	28000	.6266
11600	.0304	20000	.1522	28400	.683
12000	.0329	20400	.1651	28800	.753
12400	.0344	20800	.1784	29200	.852
12800	.0363	21200	.1930	29600	1.020
13200	.0394	21600	.2061		
13600	.0422	22000	.2177		



NOTES

① Crack dimension in direction of crack propagation

TEST DATE

DATA SET WFI

SPECIMEN NO. WFI-14 (DUC. 14)

MATERIAL 7475-77351 AL.

BOLT LOAD TRANSFER 0%

FASTENER MS90353-08 (1/4 IN.) FINEST

AVE. WIDTH

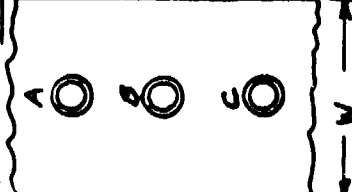
AVE. THICKNESS

SPECTRUM F-16 400 Hz

MAX. STRESS LEVEL 34 KSI (6102)

FATIGUE LIFE 29360 FET. MS. (2.67 LINES)

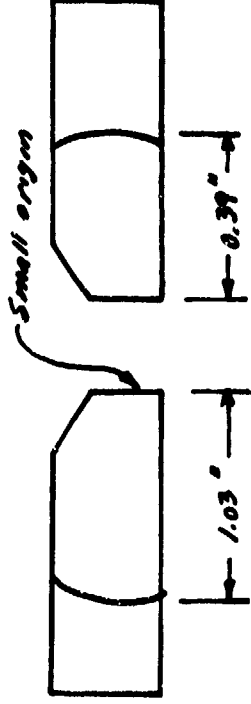
FAILURE IN HOLE B



HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE ⁽¹⁾ (IN.)
A	.590
B	1.03
C	.111

FLT. MS	CRACK SIZE	AV. MS.	CRACK SIZE	AV. MS.	CRACK SIZE
5600		14000		32400	.0078
6000		14400		32800	.0109
6400		14800		33200	.0138
6800		15200		33600	.0162
7200		15600		34000	.0194
7600		16000		34400	.0229
8000		16400		34800	.0270
8400		16800		35200	.0319
8800		17200		35600	.0325
9200		17600		36000	.0461
9600		18000		36400	.0594
10000		18400		36800	.0660
10400		18800		37200	.0817
10800		19200		37600	.1013
11200		19600		38000	.1258
11600		20000		38400	.1601
12000		20400		38800	.2039
12400		20800		39200	.275
12800		21200		39600	.370
13200		21600			
13600		22000			



NOTES

(1) CRACK DIMENSION IN DIRECTION OF CRACK PROPAGATION

Test Date 2-27-85

Data Set WFI

Specimen No. WFI-14 Rev. 14

Material 7475-T7351 AL.

Bolt Load Transfer 0%

Fastener MS90352-08 (1/4 in) ER7

Ave. Width

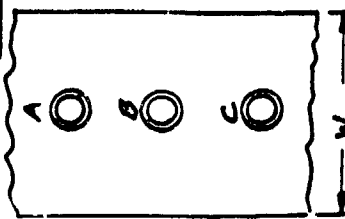
Ave. Thickness

Spectrum F-16 400 Hz

Max. Stress Level 34 DKSI (Gross)

Fatigue Life 29360 FITHS/3.67 Lives

Failure In Hole B



Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	
	Left	Right
A	0.990	2.0010
B	1.03	0.39
C	1.11	2.0010

FRACTOGRAPHIC DATA

WFI-M(6) HOLE C

FLT. NOS.	CRACK SIZE	RET. NOS.	CRACK SIZE	ALT. NOS.	CRACK SIZE
16800	0.0097	25200	0.0468		
17200	0.0106	25600	0.0509		
17600	0.0117	26000	0.0558		
18000	0.0126	26400	0.0604		
18400	0.0135	26800	0.0656		
18800	0.0145	27200	0.0707		
19200	0.0152	27600	0.0763		
19600	0.0174	28000	0.0836		
20000	0.0186	28400	0.0899		
20400	0.0200	28800	0.0957		
20800	0.0214	29200	0.1013		
21200	0.0230	29600	0.1110		
21600	0.0244				
22000	0.0261				
22400	0.0279				
22800	0.0302				
23200	0.0325				
23600	0.0345				
24000	0.0370				
24400	0.0404				
24800	0.0430				

NOTES

① Crack dimension in direction of crack propagation

TEST DATE

DATA SET WFEI

SPECIMEN NO. WFEI-15 (DUR. 16)

MATERIAL 7475-T7351 AL.

BOLT LOAD TRANSFER 0%

FASTENER MS90353-08 (14.0A) RIVET

AVE. WIDTH

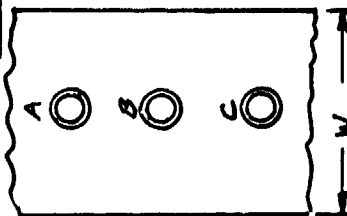
AVE. THICKNESS

SPECTRUM F-16 400 HR.

MAX. STRESS LEVEL 34 KSI (GROSS)

FATIGUE LIFE 33600 REV. MAX. (4.3 LINES)

FAILURE IN HOLE A



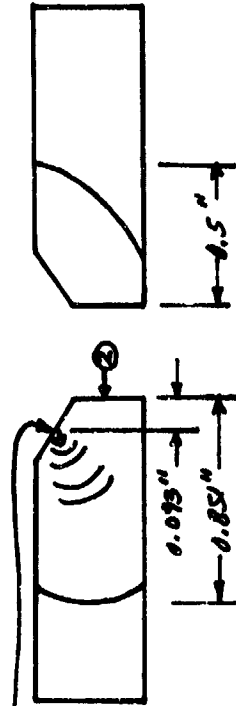
HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE ⁽¹⁾ (IN.)	REMARK
A	.851	.50
B	2.010	NO FLAW
C	2.080 ⁽³⁾	NO FLAW

FRATOGRAPHIC DATA WFEI-15(AL) HOLE A

FLT. MRS.	CRACK SIZE ⁽¹⁾	ALT. MRS.	CRACK SIZE ⁽²⁾	ALT. MRS.	CRACK SIZE ⁽³⁾
12800	.0094	21200	.0546	29600	.2804
13200	.0105	21600	.0604	30000	.3034
13600	.0122	22000	.0651	30400	.3296
14000	.0140	22400	.0701	30800	.3618
14400	.0156	22800	.076	31200	.396
14800	.0174	23200	.0821	31600	.4332
15200	.0190	23600	.0891	32000	.4741
15600	.0206	24000	.0962	32400	.519
16000	.0221	24400	.1035	32800	.570
16400	.0239	24800	.1099	33200	.639
16800	.0263	25200	.1176	33600	.758
17200	.0284	25600	.1273		
17600	.0309	26000	.1383		
18000	.033	26400	.1512		
18400	.0351	26800	.1627		
18800	.0374	27200	.1735		
19200	.0397	27600	.1863		
19600	.0428	28000	.2057		
20000	.0458	28400	.2192		
20400	.0494	28800	.2374		
20800	.0527	29200	.2578		

Crack originated in corner 0.093" from bore of hole



NOTES

- Crack dimension in direction of crack propagation
- All readings with respect to the surface
- Originating in countersink area
- Readings adjusted to make growth from bore of hole.

TEST DATE

DATE SET WFI

SPECIMEN NO. WFI-15 (DUR. 16)

MATERIAL 7475-T7351 AL.

BOLT LOAD TRANSFER 0%

FASTENER MS90393-08 (14.00) FIRST

AVE. WIDTH

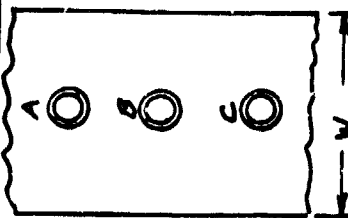
AVE. THICKNESS

SPECTRUM F-16 400 MC

MAX. STRESS LEVEL 34 KSI (6008)

FATIGUE LIFE 33600 REV. MAX. (4.21 hrs)

FAILURE IN NOTE A



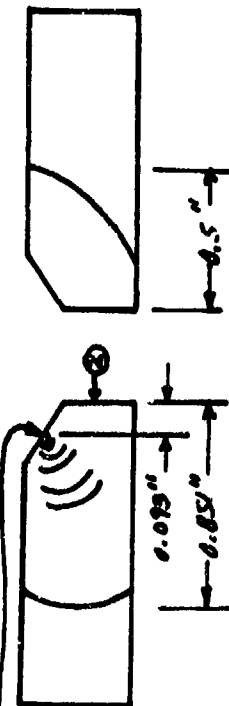
HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)	REMARKS
A	.851	.50
B	4.010	NO FLAW
C	2.080 (3)	NO FLAW

FLATOGRAPHIC DATA HOLE A WFI-15 (A)

FLT. NOS	CRACK SIZE	REV. NOS.	CRACK SIZE	REV. NOS.	CRACK SIZE
12800		21200		29600	.1678
13200		21600		30000	.1769
13600		22000		30400	.1825
14000		22400		30800	.2010
14400		22800		31200	.2179
14800		23200		31600	.2340
15200		23600		32000	.2564
15600		24000		32400	.286
16000		24400		32800	.330
16400		24800		33200	.392
16800		25200		33600	.500
17200		25600			
17600		26000			
18000		26400			
18400		26800			
18800		27200	.1283		
19200		27600	.1331		
19600		28000	.1382		
20000		28400	.1450		
20400		28800	.1528		
20800		29200	.1592		

Crack originated in corner .093" from base of hole



NOTES

- Crack dimension in direction of crack propagation
- All readings with respect to the surface
- Originating in Countersink area

Test Date 2-27-85

Data Set WFE

Specimen No. WFE-15 (DUG-16)

Material 7075-T7351 AL

Bolt Load Transfer 0%

Fastener MS90359-08 (4mm) Rivet

Ave Width

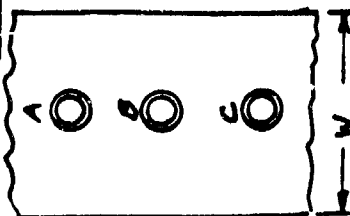
Ave Thickness

Spectrum F-16 400 Hz

Max. Stress Level 342 ksi (gross)

Fatigue Life 33,000 FH/4.2 Lives

Failure in Hole A



Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Retort
A	0.851	0.50
B	<0.010	NO PLAIN
C	0.036	NO PLAIN

FRATOGGRAPHIC AND WFE-15 (C4) HME C

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
26400	0.0098				
26800	0.0107				
27200	0.0115				
27600	0.0122				
28000	0.0129				
28400	0.0138				
28800	0.0149				
29200	0.0161				
29600	0.0172				
30000	0.0182				
30400	0.0196				
30800	0.0207				
31200	0.0226				
31600	0.0240				
32000	0.0261				
32400	0.0282				
32800	0.0303				
33200	0.0329				
33600	0.0356				



NOTES

- Crack dimension in direction of crack propagation
- There is a crack 20.080 depth in countersink area but a crack in the bore of the hole was read

APPENDIX B

FRACTOGRAPHIC RESULTS FOR MULTIPLE HOLE DOG-BONE SPECIMENS
(Phase 1; Test Series I(b))

Test date 3-19-85

Data Set WBI

Specimen no. W.B.T.-1 (Oct. 15)

Material 7475-77851 Ak.

Bolt Load Transfer 0%.

Fastener
MS90353-08 (4mm) Fast

Av. width 3.02"

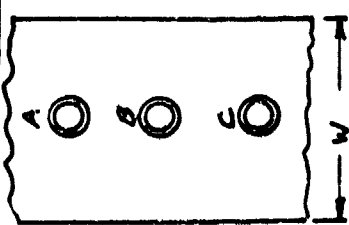
me. Thickness .3768"

Spectrum Bomber

Max. Stress Level 36.0 (Gross)

Fatigue Life. 41449 F.H. hrs/3.02 Lives

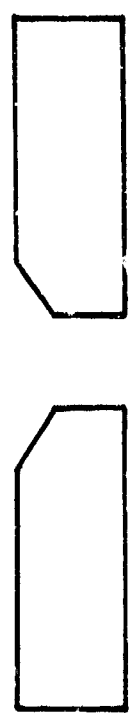
Failure in Note _____



HOLE	CRACK	FINAL DIMENSIONS
1		
2		
3		
4		
5		
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10		
11		
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13		
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100		

HOLE	FINN CRACK SURF [®] (IN.)	
	TOP	RISER
A		
B		
C		

<u>FLAC TOBERMAN</u>	<u>DATE</u>	<u>HOLD C</u>	<u>WBI-1(CS)</u>
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[illegible]

NOTES

① Crack dimension in direction of crack propagation

Test date 2-27-85

Data Set - WBI

Specimen no. WBI-2 (Oct. 17)

Material 7475-77351 AL.

BoN Load Transfer 0%

fastener MS 90353-08 (4 ea) R100T

Ave. width 3.0152"

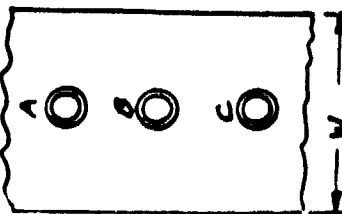
ave. Thickness .3772"

Spectrum bomber

Max. Stress Level 360Ksi (Gross)

Fatigue Life. 44739 FPM / 3.31 Lives

Failure In Mode



HOLE CRACK Final Dimensions

HOLE	FINISH CRACK SURF ⁰ (IN.)	
	2007	2009
A	0.0858	no Flaw
B	0.0112	0.0076
C	no Flaw	no Flaw

DATE 01/22/2016

WBZ-2(4L)

HOLE A

FLY NRS.	CRACK SIZE	FLY NRS.	CRACK SIZE	FLY NRS.	CRACK SIZE
39656	0.0102				
40500	0.0157				
41557	0.0235				
42409	0.0346				
43664	0.0534				
44739	0.0858				



NOTES

- ① Crack dimension in direction of crack propagation
③ Hole with largest crack

Test Date 2-27-85

Data Set VBI

Specimen no. WAI-3(Dur.18)

Material 7473-77851 AL

Bolt Load Transfer 0%

Fastener MS90353-08 (4.0mm) Rivet

ave. width 3.0215"

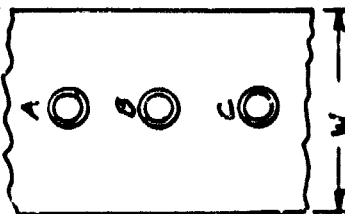
ave. Thickness .3759"

Spectrum Bomber

Max. Stress Level 36,000 psi (6000)

Fatigue Life 43200 El. hrs / 3.20 Lives

Failure In Hole A



Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	0.8984	0.7583
B	0.6631	0.6352
C	0.0437	0.0490

Fractographic Data VBI-3(AL) Hole A

FLT NBS	CRACK SIZE	ALT. NBS	CRACK SIZE	ALT. NBS	CRACK SIZE
31219	0.0134				
32273	0.0318				
33308	0.0523				
34383	0.0831				
35427	0.124				
36492	0.189				
37507	0.2483				
38601	0.3426				
39656	0.3994				
40500	0.472				
41555	0.5512				
42609	0.6811				
43200	0.8984				



NOTES

- Crack dimension in direction of crack propagation
- Out of countersink at surface

TEST DATE 2-27-85

DATE SET WBI

SPECIMEN NO. WBI-3 (QV. 18)

MATERIAL 7475-77951 AL

BOLT LOAD TRANSFER 0%

FASTENER MSY0352-08 (1/4" DIA) FINEST

AVE. WIDTH 3.0215"

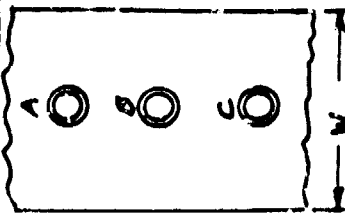
AVE. THICKNESS .3759"

SPECTRUM Bomber

MAX. STRESS LEVEL 36.0 KSI (GROSS)

FATIGUE LIFE 53200 EHLIN (3.22) LIVES

FAILURE IN HOLE A



HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)	REMARKS
A	0.8984	0.7583
B	0.6631	0.6352
C	0.6437	0.6469

FRACTOGRAPHIC DATA

WBI-3 (QV. 18) HOLE B

FLY	CRACK	WBI	CRACK	FLY	CRACK
WBI	SIZE	WBI	SIZE	WBI	SIZE
32273	0.0383				
32328	0.06				
34383	0.0902				
35427	0.13				
36492	0.1543				
37547	0.1968				
38601	0.2223				
39656	0.2821				
40500	0.3566				
41555	0.4551				
42609	0.5447				
43200	0.6631				



NOTES

- Crack dimension in direction of crack propagation
- out of countersink at surface

TEST DATE 2-27-85

DATA SET WBI

SPECIMEN NO. WBI-3 (Dur. 18)

MATERIAL 7475-T7351 AL.

BOH LOAD TRANSFER 0%

FASTENER MS90352-08 (1/4" DIA) RIVET

AVE. WIDTH 3.0215"

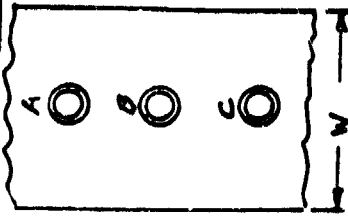
AVE. THICKNESS .3759"

SPECTRUM Bomber

MAX. STRESS LEVEL 36.0 KSI (GROSS)

FATIGUE LIFE 43200 Cycles / 3.20 Lines

FAILURE IN HOLE A



HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)	RIGHT
A	0.8984	0.7283
B	0.6631	0.6352
C	0.0431	0.0469

FLAT AUTOGRAPHIC DATA WBI-3 (BS) HOLE B

FLAT	CRACK	FLAT	CRACK	FLAT	CRACK
MS	SIZE	MS	SIZE	MS	SIZE
31219	0.0121				
32273	0.0301				
33328	0.0542				
34383	0.0915				
35437	0.158				
36492	0.1621				
37547	0.2032				
38601	0.2293				
39656	0.284				
40500	0.3525				
41555	0.4252				
42609	0.5067				
43200	0.6352				



NOTES

- Crack dimension in direction of crack propagation
- Out of waterfront at surface

TEST DATE 2-27-85

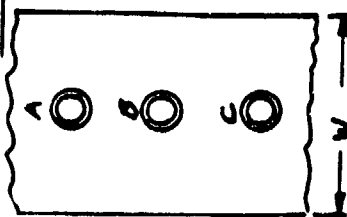
Pile Set WBI
 Specimen No. WBI-4 (DUB 19)
 Material 7473-77851 AL.
 Bolt Load Transfer 0%
 Fastener MS90389-08 (4.00) Rivet

Ave. Width 3.015"
 Ave. Thickness .375"
 Spectrum Bombard

Max. Stress Level 36.0 ksi (gross)

Fatigue Life 58000 FIT #14.30 LIPS

Failure In Hole B



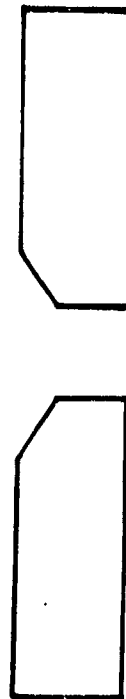
Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	0.5941	0.1091
B	0.7264	0.6682
C	no flaws	no flaws

FRACTOGRAPHIC DATA

WBI-4 (AL) HOLE A

FLT. NOS	CRACK SIZE	FLY. NOS.	CRACK SIZE	FLY. NOS.	CRACK SIZE
44719	0.0086				
45778	0.0225				
46828	0.0425				
47883	0.0664				
48937	0.0894				
49992	0.1234				
51047	0.1629				
52101	0.197				
53256	0.2445				
54000	0.3031				
55055	0.3875				
56109	0.4469				
57164	0.5369				
58050	0.5941				



NOTES

① Crack dimension in direction of crack propagation

FRATOGRAPHIC DATA WBI-4(BL) HOLE B

Test Date 2-27-85

Ref Set WBI

Specimen No. WBI-4 (Dist. 19)

Material 7475-T7351 AL.

Bit Load Transfer 0%

Fastener MS90352-08 (4.00) RING

Avg. Width 3.0151"

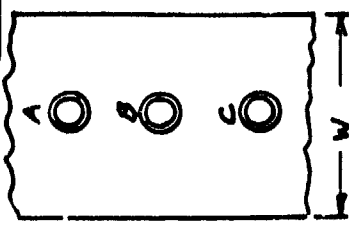
Avg. Thickness .3759"

Spectrum Bomber

Max. Stress Level 36.0 KSI (GROSS)

Fatigue Life 5805 DEF. hrs / 430 Lives

Failure in Hole B



FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
45773	0.0103				
46823	0.023				
47883	0.0432				
48938	0.0657				
49992	0.0959				
51047	0.1259				
52102	0.1802				
53156	0.2591				
54200	0.3441				
55055	0.4161				
56109	0.5262				
57164	0.7266				
58050	0.7704				

HOLE CRACK Final Dimensions

HOLE	Final CRACK SIZE (in.)	FLT. NOS.
A	0.5941	0.1091
B	0.7704	0.6682
C	No Flaws	No Flaws

NOTES
 ① Crack dimension in direction of crack propagation

FRACTOGRAPHIC DATA W05-4(BS) HOLE B

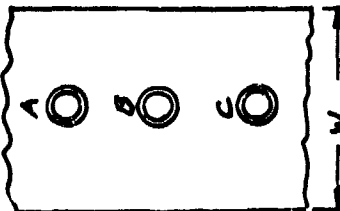
FLACTOBERAPHIC DATA

W01-4(Bs)

FLA 706 E A P H 1 C

FLA 706 E A PA

FLA



HOLE	FINAL CRACK SIZE (IN.)	
	2097	2109
A	0.5941	0.1091
B	0.7704	0.6682
C	no flaws	no flaws

NOTES

① Crack dimension in direction of crack propagation



FRAC TOBERMAN DATA WBL-5 (AL) HOLE A

FLT. MRS.	CARAC SIZE	ALT. MRS.	CARAC SIZE	ALT. MRS.	CARAC SIZE
35497	0.0075				
36492	0.0191				
37587	0.0326				
38601	0.0475				
39656	0.0633				
40500	0.092				
41555	0.1046				
42609	0.1225				
43664	0.1398				
44719	0.1609				
45773	0.1831				
46828	0.22				
47883	0.2551				
48937	0.3111				
49992	0.3852				
50947	0.5005				
51975	0.7159				

Specimen no. WBI-5(Dur. 20)

Material 7475-77351 AL.

BoH load Transfer 0%

Fastener
MS90353-08 (1/4 in) Flat

ave. width 3.0063"

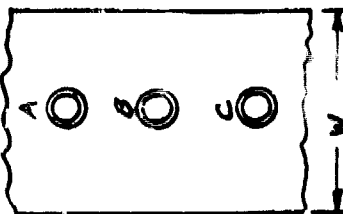
Av. Thickness .3752"

Spectrum Bomber

Max. Stress Level 36.0 ksi (Gross)

Fatigue Life. 51975 F1h.hrs / 3.85

2/9/1945



HOLE	CRACK	FINAL	Dimensions
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
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95			
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97			
98			
99			
100			

HOLE	FINAL CRACK SIZE @ (IN.)	
	28 DAY	90 DAY
A	0.7153	0.5886
B	0.1866	0.1465
C	0.3849	0.1211

NOTES

① Crack dimension in direction of crack propagation

TEST DATE 2-27-85

DATA SET WBI

SPECIMEN NO. WBI-5 (DUP. 20)

MATERIAL 7475-T7351 PL.

BOLT LOAD TRANSFER 0%

FASTENER A2590352-08 (1/4" DIA) STREET

AVE. WIDTH 3.0063"

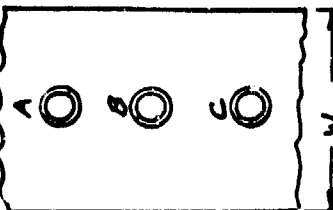
AVE. THICKNESS .3752"

SPECTRUM Bomber

MAX. STRESS LEVEL 36.0 KSI (GROSS)

FATIGUE LIFE 51975 FLT. HRS. / 3.85 LIVES

FAILURE IN HOLE A



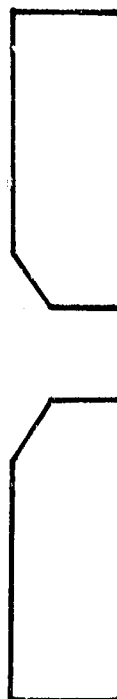
HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE (IN.)	REMARKS
A	0.7159	0.5596
B	0.1866	0.1465
C	0.3849	0.1411

FLATOGRAPHIC DATA

WBI-5 (AS) HOLE A

FLT. HRS.	CRACK SIZE	MAX. HRS.	CRACK SIZE	MAX. HRS.	CRACK SIZE
40500	0.0093				
41555	0.0217				
42609	0.0331				
43664	0.0464				
44719	0.0639				
45773	0.0809				
46828	0.1176				
47883	0.16				
48937	0.1959				
49992	0.2791				
51047	0.3796				
51975	0.5886				



NOTES

0 Crack direction in direction of crack propagation

Test date 2-27-85

Part Set WBT

Specimen no. WAI-5 (Oct. 20)

Material 7475-77351 AL.

Don't load Transfer 09.

fastener
10590353-08 (400) limit

Ans. W. 17th 3,0063"

me. Thickness .3752"

Spectrum Bomber

Max. Stress Level 36.0 ksi (Gross)

Fatigue Life. 51975 FIB/3.85 Lives

Failure in 16th

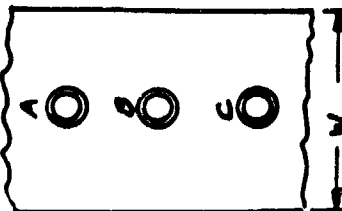
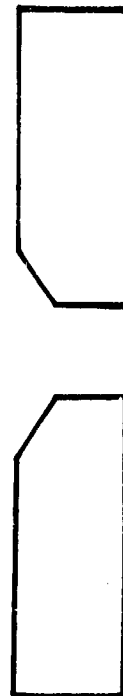
Hole Crack Final Dimensions

TABLE	FROM CRACK SURF (IN.)
	2004
A	0.7158
B	0.1866
C	0.3849
	0.1411

FLAC TO B R A P H I C DATA

(78)-5-28M

404 B

[illegible]

NOTES

① Crack dimension in direction of crack propagation

TEST DATE 2-27-85

Ref. Set WBI

Specimen No. WBI-5 (Dur. 20)

Material 7475-T7351 AL.

Bot. Load Transfer 0%

Fastener MS90359-08 (1/4 in) Rivet

Ave Width 3.0063"

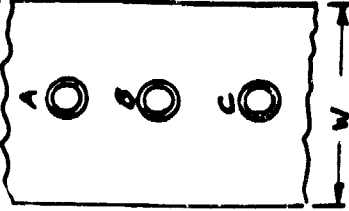
Ave. Thickness .3752"

Spectrum Bomber

Max. Stress Level 36,000 psi (60,000)

Fatigue Life 51975 FITHS/3.85 Lives

Failure in Hole A



Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ref.
A	0.7159	21807
B	0.1916	0.5886
C	0.3809	0.1465
		0.1411

FRAC TOGRAPHIC DATA WBI-5 (CL) HOLE C

FLY	CRACK	FLY	CRACK	FLY	CRACK
SIZE	SIZE	SIZE	SIZE	SIZE	SIZE
40.500	0.000				
41.555	0.0226				
42.609	0.0397				
43.664	0.0696				
44.719	0.1063				
45.774	0.1375				
46.828	0.1621				
47.883	0.1941				
48.937	0.2374				
49.992	0.2771				
51.047	0.3267				
51.975	0.3849				



NOTES

① Crack direction in direction of crack propagation

Test Date 3-4-85

Data Set WBI

Specimen No. WBI-6 (DVS.21)

Material 7475-T7351 AL.

Bolt Load Transfer 0%

Fastener A0590353-08 (1/4" DIA) FINEST

Avg Width 3.0250"

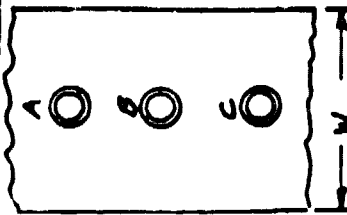
Avg. Thickness .3775"

Spectrum Bomber

Max. Stress Level 36,000 psi (GROSS)

Fatigue Life 31,408 ELMS/2,691 LIVES

Failure In Hole A



Hole Crack Final Dimensions

HOLE	Final Crack Size (in.)	Remarks
A	0.3775	no flow
B	0.1175	0.1143
C	0.1696	no flow

Fractographic Data WBI-6 (CD) Hole C

FLT. NOS.	CRACK SIZE	FLT. AREA	CRACK SIZE	FLT. AREA	CRACK SIZE
28055	0.0564				
29109	0.0433				
30164	0.0723				
31219	0.0938				
32273	0.0986				
33288	0.1152				
34303	0.1336				
35497	0.1564				
36408	0.1686				



NOTES

- Crack dimension in direction of crack propagation
- Measurement is distance through the hole plus flow at failure
Flow contacts bore at 0.215" from other side of hole

Test Date 3-4-85

Data Set WBI

Specimen No. WBI-7 (DUS.22)

Material 7475-77951 AL

Bolt Load Transfer 0%

Fastener MS90399-08 (1/4" dia) Finest

Ave. Width 3.0163"

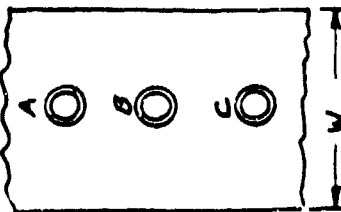
Ave. Thickness .3774"

Spectrum Bomber

Max. Stress Level 36,000 Psi (Gross)

Fatigue Life 54401 Cycles / 4.04 Lives

Failure in Hole A

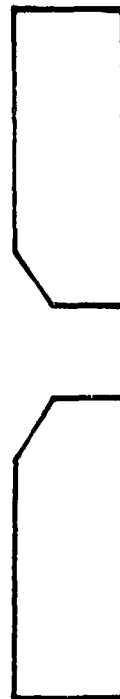


Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	0.891	0.5584
B	0.0815	0.0745
C	0.055	0.0358

Fractographic Data WBI-7 (AL) Hole A

FLT. NO.	CRACK SIZE	FLT. NO.	CRACK SIZE	FLT. NO.	CRACK SIZE
37547	0.0046				
38601	0.0202				
39656	0.0394				
40500	0.0565				
41555	0.078				
42609	0.1108				
43664	0.1373				
44719	0.1543				
45770	0.1824				
46828	0.205				
47883	0.2321				
48937	0.2522				
49992	0.2881				
51047	0.3277				
52101	0.3763				
53256	0.4441				
54000	0.5411				
54401	0.891				



NOTES

① Crack dimension in direction of crack propagation

3-4-85-

WAI

WBI-7 (Dec. 22)

7475-77951 AL.

7.

MS 90353-08 (1/4 sec) E. Net

3.0163^u

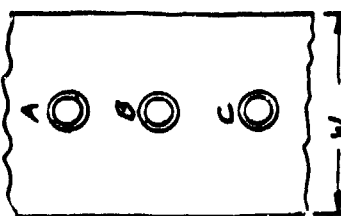
3774

Bomber

36.0 Ksi (Gross)

554601 Eft.bcs/4.04 Lives

A

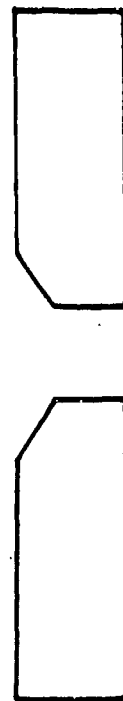


Final Dimensions

NOLE	FINAL CRACK SIZE ⁽¹⁾ (IN.)
	TEST RIBBY
A	.891
B	0.815
C	1.055
	0.5584
	0.0748
	0.0384

WAI-7(AS) Hole A

FLY MS.	CRACK SIZE	FLY MS.	CRACK SIZE	FLY MS.	CRACK SIZE
46828	0.0084				
47883	0.0256				
48937	0.0513				
49992	0.0759				
5047	0.1085				
52101	0.1614				
53156	0.2383				
54000	0.354				
54601	0.5584				



NOTES

① Crack dimension in direction of crack propagation

TEST DATE 3-4-85

DATA SET WBI

SPECIMEN NO. WBI-8 (DUR. 23)

MATERIAL 7475-T7351 AL.

BOLT LOAD TRANSFER 0%

FASTENER M590359-08 (14 AN) FIRST

AVE. WIDTH 3.0175"

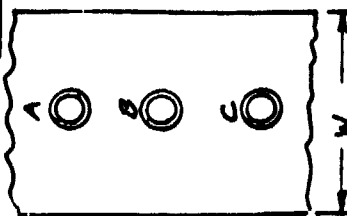
AVE. THICKNESS .3736"

SPECTRUM Bomber

MAX. STRESS LEVEL 36,000 psi (GROSS)

FATIGUE LIFE 37979 FLIGHT/2.81 LIVES

FAILURE IN HOLE B



HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE [®] (IN.)	
	TEST	REMARK
A	0.3574	0.3213
B	0.7161	0.5427
C	0.1188	0.0479

FRAC TO G R A P H I C DATA WBI-8 (AS) HOLE A

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
28055	0.0012				
29009	0.0089				
30004	0.0177				
31219	0.0308				
32223	0.0496				
33338	0.07				
34583	0.0931				
35437	0.1306				
36492	0.1777				
37547	0.2611				
37979	0.3213				



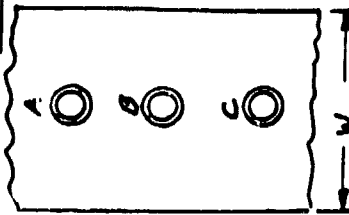
NOTES

① Crack dimension in direction of crack propagation

TEST DATE 3-4-85

DATA SET WBT
SPECIMEN NO. WBT-8 (DUP. 23)
MATERIAL 7475-T7351 AL.
BOLT LOAD TRANSFER 0%
FASTENER MS90359-08 (1/4 IN) 2100T
AVE. WIDTH 3.0125"
AVE. THICKNESS .3736"
SPECTRUM Bomber

MAX. STRESS LEVEL 36.0 KSI (GROSS)
FATIGUE LIFE 37979 FH.HRS./2.81 LIVES
FAILURE IN HOLE B

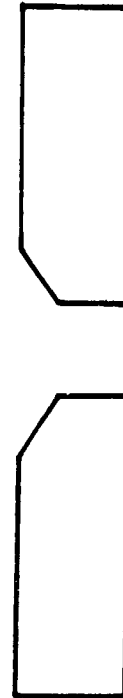


HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE @ (IN.)	
	TEST	REMARK
A	0.3524	0.3213
B	0.7161	0.5927
C	0.1188	0.0479

FRATOGGRAPHIC DATA WBT-8 (BL) HOLE B

FLT. HRS.	CRACK SIZE	ALT. MEAS.	CRACK SIZE	ALT. MEAS.	CRACK SIZE	ALT. MEAS.
26156	0.0083					
27000	0.0248					
28050	0.0477					
29009	0.0724					
30004	0.0953					
31319	0.118					
32273	0.1427					
33328	0.1766					
34383	0.22					
35437	0.2805					
36492	0.3689					
37547	0.5273					
37979	0.7161					



NOTES

① Crack dimension in direction of crack propagation

Test Date 3-8-85

Plate Set WBI

Specimen No. WBI-9 (DUC.24)

Material 7075-T7351 AL.

Bolt Load Transfer 0%

Fastener MS90332-08 (1/4" dia) Nut

Ave. Width 3.0193"

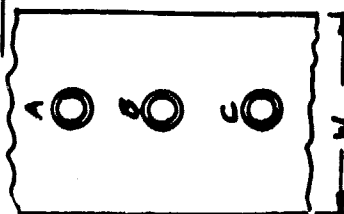
Ave. Thickness .3760"

Spectrum Breaker

Max. Stress Level 36.0 KSI (610 MPa)

Fatigue Life 59020 Elong./4,374 Cycles

Failure In Hole C



Hole Crack Final Dimensions

Hole	Final Crack Length (in.)	Final Crack Width (in.)
A	0.4255	0.051
B	0.2729	0.0597
C	0.4031	0.5253

FLATOGRAPHIC PHOTO WBI-9 (AL) HOLE A

PLT. NOS.	CRACK SIZE	PLT. NOS.	CRACK SIZE	PLT. NOS.	CRACK SIZE
46828	0.0075				
47893	0.022				
48938	0.0364				
49992	0.0547				
51042	0.0752				
52102	0.1044				
53156	0.1301				
54002	0.1658				
55055	0.2047				
56109	0.2587				
57164	0.3117				
58219	0.3781				
59020	0.4255				



NOTES

① Crack dimension in direction of crack propagation

Test Date 3-8-85

Data Set WBI

Specimen no. WBI-9 (Dec. 24)

Material 7475-77951 AL.

Boat Load Transfer 0%

Fastener
MS90353-08 (1/4" x 1") Pin

Ave. W. 8th

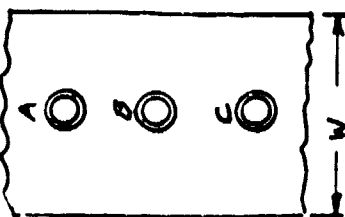
ave. Thickness .3760"

Spectrum Bomber

Max. Stress Level 36.0 Ksi (Gross)

Fatigue Life 59020 F11 hrs / 4.37 Lives

Failure In Note c



HOLE	CRACK	FINAL DIMENSIONS
1		
2		
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100		

HOLE	FINAL CRACK SIZE ^① (in.)	
	1975	1980*
A	0.4255	0.051
B	0.2728	0.0597
C	0.9031	0.5253

FLAUTOGRAPHIC DATA

WBI-9(64) HOLE C

FLT NOS.	CRACK SIZE	FLT NOS.	CRACK SIZE	FLT NOS.	CRACK SIZE	FLT NOS.	CRACK SIZE
46928	0.0084						
47893	0.0368						
48938	0.0772						
49892	0.124						
51047	0.1651						
52102	0.2276						
53656	0.283						
54000	0.3397						
55053	0.3917						
56109	0.4558						
57164	0.5404						
58219	0.659						
59020	0.9031						



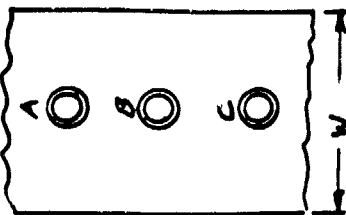
NOTES

① Crack dimension in direction of crack propagation

4060 C

Data Set	WBI
Specimen No.	WBI-9(Dur. 24)
Material	7075-T7351 AL.
Bolt Load Transfer	0%
Fastener	N590353-08 (14 mm) FINE
Ave. Width	3.0193"
Ave. Thickness	.3760"
Spectrum	Bomber
Max. Stress Level	36.0 Ksi (6,000)

Fatigue Life. 59020 Ftl.hrs/4.37 Lives
Failure in Hole C

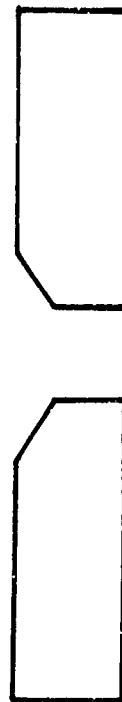


HOLE	Final Crack Size (In.)	
	Left	Right
A	0.4255	0.051
B	0.2728	0.0597
C	0.9031	1.8753

NOTES

① Crack dimension in direction of crack propagation

FLT. MRS.	CRACK SIZE	FLT. MRS.	CRACK SIZE	FLT. MRS.	CRACK SIZE
49992	0.0105				
51047	0.0234				
52102	0.0422				
53156	0.0528				
54000	0.0831				
55055	0.1151				
56109	0.1559				
57164	0.2132				
58219	0.3057				
59020	0.5253				



Test Date 3-8-85

Data Set WBI

Specimen No. WBI-10(DIC 25)

Material 7475-T7351 AL

Bolt Load Transfer 0%

Fastener MS90353-08 (14mm) Rivet

Ave. Width 3.0210"

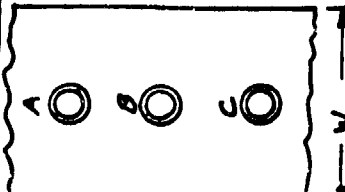
Ave. Thickness .3755"

Spectrum Bomber

Max. Stress Level 3610 Ksi (Gross)

Fatigue Life 39129 ELN hrs / 2.99 Lives

Failure in Hole A



Hole Crack Final Dimensions

Hole	Final Crack Size (in.)	Ratio
A	0.743	0.6445
B	0.0646	0.0304
C	no flaw	no flaw

FRATOGRAPHIC DATA

Hole A

WBI-10(AL)

FLT. NOS	CRACK SIZE	ACT. MAX.	CRACK SIZE	ACT. MAX.
25101	0.0085			
26156	0.0169			
27000	0.0371			
28055	0.0605			
29109	0.0787			
30144	0.1103			
31219	0.1347			
32273	0.1572			
33328	0.1875			
34383	0.2174			
35437	0.2655			
36492	0.3284			
37547	0.4208			
38601	0.5791			
39129	0.743			



NOTES

0 Crack dimension in direction of crack propagation

Test date 3-8-85

Data Set WBI

Specimen no. WBI-10(Dr. 25)

Material 7475-77951 AL.

BoH Load Transfer 0%

Fastener
MS90353-08 (420) E1481

Ave. width 3.0210"

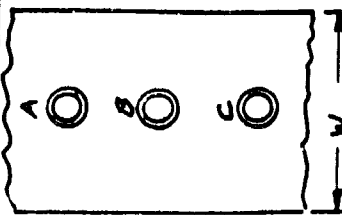
Ave. Thickness .3755"

Spectrum Bomber

Max. Stress Level 36.1 ksi (Gross)

Fatigue Life 39129 Fillohs/2.89 Lives

Failure In Able A



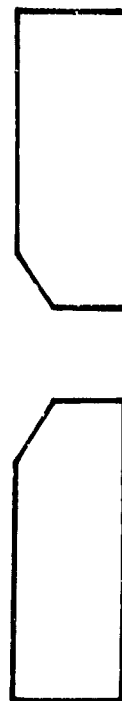
HOLE CRACK Final Dimensions

HOLE	FINAL CRACK SIZE ^① (in.)	
	TOP	BOTTOM
A	0.743	0.64445
B	0.0646	0.0304
C	no Flow	no Flow

FACTOGRAPHIC DATA

WB7-10(AS)

FLY. NOS.	CRACK SIZE	FLY. NOS.	CRACK SIZE	FLY. NOS.	CRACK SIZE	FLY. NOS.	CRACK SIZE
1064	0.0116						
3129	0.0423						
32273	0.0758						
33328	0.1084						
34383	0.1435						
35437	0.1842						
36492	0.2492						
37547	0.3334						
38601	0.4183						
39129	0.4445						



NOTES

① Crack dimension in direction of crack propagation

Test date	3-8-85
1	100
2	100
3	100
4	100
5	100
6	100
7	100
8	100
9	100
10	100
11	100
12	100
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19	100
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22	100
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34	100
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100	100

WBI
Data Set

Specimen no. WBI-10 (Apr. 25)

Material 7475-77851 AL.

Boat Load Transfer 09.

Fastener
MS90353-08 (1/4" x 1") F113T

Ave. width 3.0210"

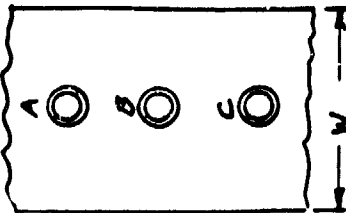
Ave. Thickness , 375"

Spectrum Bomber

Max. Stress Level 36.0 Ksi (60%)

Fatigue Life. 39129 FIVE / 2.89 lives

Failure In Noble A



B-35

FRACTOGRAPHIC DATA WBT-10 (BL) HOLE B

[illegible]

100

HOLE CRACK FINAL DIMENSIONS

MOLE	FINAL CRACK SIZE ^(a) (mm)	
	TOP	RIGHT
A	0.743	0.6445
B	0.0646	0.0304
C	no flow	no flow

NOTES

① Crack dimension in direction of crack propagation

3-13-85

WBI

Specimen no. WBE-13 (Nov. 27)

Material 7475-T7351 AL.

Bolt Load Transfer 07.

Fastener
MS 90353-08 (1/4 in) Rivet

ave. width 3.0193"

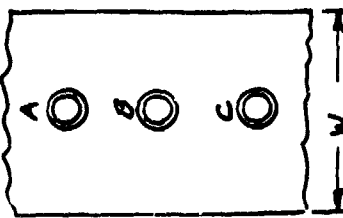
Av. Thickness .3761"

Spectrum Bomber

Max. Stress level 36.0 Ksi (600g)

Fatigue Life. 40078/2.97 Lives

Failure In Mole C



HOLE	Crack	Final P. dimensions
1		
2		
3		
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HOLE	FINAL CRACK SIZE ⁽¹⁾ (in.)	
	TOP	RIGHT
A	0.1491	0.1052
B	0.4331	0.428
C	0.8015	0.6522

FLUOROGRAPHIC DATA WBI-12(AL) Hole A

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
32273	0.0191						
33328	0.0267						
34383	0.0385						
35437	0.0499						
36492	0.0663						
37547	0.089						
38601	0.1119						
39656	0.1339						
40078	0.1491						



NOTES

① Crack dimension in direction of crack propagation

TEST DATE 3-13-85

DATA SET WBI

SPECIMEN NO. WBI-12 (DUR. 27)

MATERIAL 7075-T7351 AL

BOLT LOAD TRANSFER 0%

FASTENER M2590353-08 (1/4" DIA) RIVET

Avg. Width 3.0193"

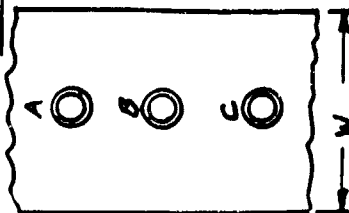
Avg. Thickness .3761"

Spectrum Bomber

Max. Stress Level 34,000 psi (6000)

Fatigue Life 40078 Cycles / 2.97 Hrs

Failure in Hole C



HOLE CRACK FINAL DIMENSIONS

HOLE	Final CRACK SIZE (in.)
	2007
A	0.1491
B	0.4331
C	0.8015

FRAC TOGRAPHIC DATA WBI-12 (AL) HOLE B

FLT. NOS	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
30164	0.0105				
31219	0.017				
32273	0.0248				
33328	0.0409				
34383	0.0937				
35497	0.1348				
36492	0.1953				
37547	0.238				
38601	0.3056				
39656	0.3801				
40078	0.4531				



NOTES

① Crack dimension in direction of crack propagation

Test date 3-13-85

Data Set WBI

Specimen no. WBI-12 (Dug. 27)

Material 7475-77951 AL.

BoH Load Transfer 0%

Fastener
MS90353-08 (1/4 in) Finest

ave. width 3.0193"

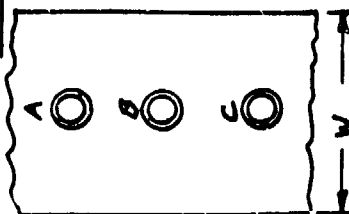
Ave. Thickness .376!"

Spectrum Bomber

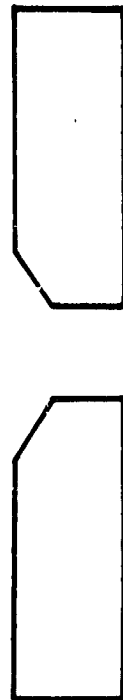
Max. Stress Level 36.0 Ksi (Gross)

Fatigue Life. 40078 F1k hrs/2.97 Lives

Failure In Hole C

[illegible]

FLT. MRS.	CRACK SIZE	FLT. MRS.	CRACK SIZE	FLT. MRS.	CRACK SIZE	FLT. MRS.	CRACK SIZE
30164	0.0074						
31219	0.0213						
32273	0.037						
32328	0.0639						
34383	0.0845						
35497	0.1266						
36492	0.155						
37547	0.2414						
38601	0.3235						
39656	0.4916						
40078	0.6522						



Hole	Crack	Final Dimensions
1	1/2"	1/2"
2	1/2"	1/2"
3	1/2"	1/2"
4	1/2"	1/2"
5	1/2"	1/2"
6	1/2"	1/2"
7	1/2"	1/2"
8	1/2"	1/2"
9	1/2"	1/2"
10	1/2"	1/2"
11	1/2"	1/2"
12	1/2"	1/2"
13	1/2"	1/2"
14	1/2"	1/2"
15	1/2"	1/2"
16	1/2"	1/2"
17	1/2"	1/2"
18	1/2"	1/2"
19	1/2"	1/2"
20	1/2"	1/2"
21	1/2"	1/2"
22	1/2"	1/2"
23	1/2"	1/2"
24	1/2"	1/2"
25	1/2"	1/2"
26	1/2"	1/2"
27	1/2"	1/2"
28	1/2"	1/2"
29	1/2"	1/2"
30	1/2"	1/2"
31	1/2"	1/2"
32	1/2"	1/2"
33	1/2"	1/2"
34	1/2"	1/2"
35	1/2"	1/2"
36	1/2"	1/2"
37	1/2"	1/2"
38	1/2"	1/2"
39	1/2"	1/2"
40	1/2"	1/2"
41	1/2"	1/2"
42	1/2"	1/2"
43	1/2"	1/2"
44	1/2"	1/2"
45	1/2"	1/2"
46	1/2"	1/2"
47	1/2"	1/2"
48	1/2"	1/2"
49	1/2"	1/2"
50	1/2"	1/2"
51	1/2"	1/2"
52	1/2"	1/2"
53	1/2"	1/2"
54	1/2"	1/2"
55	1/2"	1/2"
56	1/2"	1/2"
57	1/2"	1/2"
58	1/2"	1/2"
59	1/2"	1/2"
60	1/2"	1/2"
61	1/2"	1/2"
62	1/2"	1/2"
63	1/2"	1/2"
64	1/2"	1/2"
65	1/2"	1/2"
66	1/2"	1/2"
67	1/2"	1/2"
68	1/2"	1/2"
69	1/2"	1/2"
70	1/2"	1/2"
71	1/2"	1/2"
72	1/2"	1/2"
73	1/2"	1/2"
74	1/2"	1/2"
75	1/2"	1/2"
76	1/2"	1/2"
77	1/2"	1/2"
78	1/2"	1/2"
79	1/2"	1/2"
80	1/2"	1/2"
81	1/2"	1/2"
82	1/2"	1/2"
83	1/2"	1/2"
84	1/2"	1/2"
85	1/2"	1/2"
86	1/2"	1/2"
87	1/2"	1/2"
88	1/2"	1/2"
89	1/2"	1/2"
90	1/2"	1/2"
91	1/2"	1/2"
92	1/2"	1/2"
93	1/2"	1/2"
94	1/2"	1/2"
95	1/2"	1/2"
96	1/2"	1/2"
97	1/2"	1/2"
98	1/2"	1/2"
99	1/2"	1/2"
100	1/2"	1/2"

HOLE	FINAL CRACK SIZE (in.)	
	1975	1980
A	0.1491	0.1052
B	0.4331	0.4228
C	0.2015	0.4522

NOTES

① Crack dimension in direction of crack propagation

Test Date 3-19-85

Data Set WBI

Specimen No. WBI-16(DX.33)

Material 7475-77951 AL

Boil Load Transfer 0%

Fastener M590353-08 (1/4 in) Finet

Ave Width 3.0170"

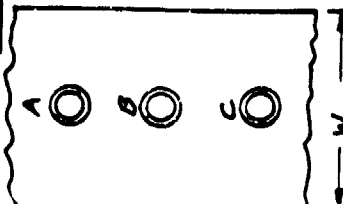
Ave Thickness .3757"

Spectrum Bomber

Max. Stress Level 36.0 Ksi (6008)

Fatigue Life 49866 Fth hrs / 3.69 Lives

Failure in Hole A



Hole Crack Final Dimensions

HOLE	FINAL CRACK SIZE ^① (in.)	
	LEFT	RIGHT
A	0.8764	0.3255
B	0.1081	0.2312
C	0.0323	0.0413

Fractographic Data WBI-16(AL) Hole A

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
32273	0.012				
33328	0.0199				
34383	0.0299				
35497	0.045				
36492	0.0591				
37547	0.0752				
38601	0.1043				
39656	0.1414				
40500	0.1941				
41553	0.228				
42609	0.2942				
43664	0.368				
44719	0.4374				
45773	0.4975				
46828	0.581				
47883	0.6931				
48938	0.932				
49866	0.9764				



NOTES

① Crack dimension in direction of crack propagation

TEST DATE 3-19-85

DATA SET WBI

SPECIMEN NO. WBI-16 (OUT. 33)

MATERIAL 7473-T7851 AL.

BOH LOAD TRANSFER 0%

FASTENER MS90352-08 (1/4" DIA) EIGHT

AVE. WIDTH 3.0170"

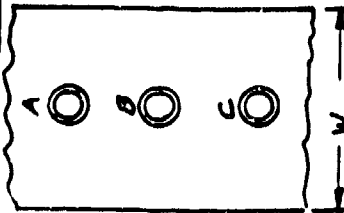
AVE. THICKNESS .3757"

SPECTRUM Bomber

MAX. STRESS LEVEL 3600 KSI (GROSS)

FATIGUE LIFE 49866 FH. HRS. / 3669 LIVES

FAILURE IN HOLE A



HOLE CRACK FINAL DIMENSIONS

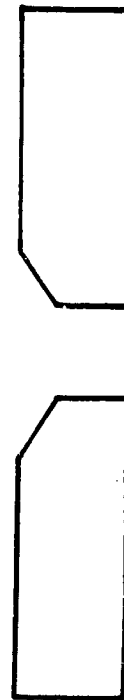
HOLE	FINAL CRACK SIZE (IN.)	RTMP
A	0.8764	0.3255
B	0.1081	0.2312
C	0.0322	0.0413

FRAC TOG RAPHIC DATA

HOLE A

WBI-16 (AS)

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
39656	0.0069				
40500	0.015				
41553	0.0314				
42609	0.0588				
43664	0.0748				
44719	0.1112				
45773	0.141				
46828	0.1754				
47883	0.2274				
48938	0.3019				
49866	0.3255				



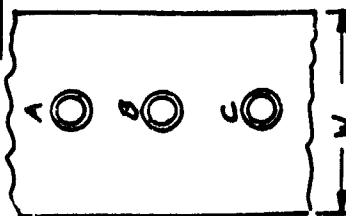
NOTES

0 Crack dimension in direction of crack propagation

FRAC TO G R A P H I C DATA WBI-14 (BL) HOLE B

Data Set	WDI
Specimen No.	WDI-16 (DIF.33)
Material	7475-77851 AL.
Bolt Load Transfer	0%
Fastener	N590359-08 (4.0A) FINE
Ave. Width	3.0170"
Ave. Thickness	.3757"
Spectrum	Bomber
Max. Stress Level	36.0 Ksi (Gross)

Fatigue Life. 49806 FHKs/3.62 Lvs
A
Failure In 1612

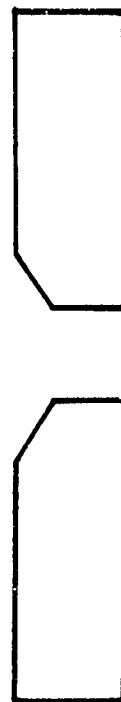


HOLE CRACK FINAL DIMENSIONS

HOLE	FINAL CRACK SIZE ^① (IN.)	
	LEFT	RIGHT
A	0.9764	0.3253
B	0.1081	1.2312
C	0.0322	0.0412

NOTES

① Crack dimension in direction of crack propagation



APPENDIX C

FRACTOGRAPHIC RESULTS FOR SINGLE HOLE DOG-BONE SPECIMENS (Phase 2; Test Series IV(a))

Fractographic results for dog-bone specimens (Fig. 2) tested under test series IV(a) are presented in this section. These tests were performed at room temperature in lab air using the F-16 400 hour spectrum [4].

Replicate fatigue tests were also performed under General Dynamics, Fort Worth Division research [2]. These additional test results and fractography are compatible with the results for test series IV(a). Moreover, the test specimens for Ref. 2 were from the same batch of material as those for test series IV(a). The test setup is shown in Fig. C-2 and fractographic results are presented in Table C-1. Typical fracture surfaces are shown in Fig. C-2.

TEST Series IV(a)

Plate Set WUPF

Specimen No. WUPF-5 (Dist 40)

Material 7075-T7351 AL

Boil Load Transfer 0%

Fastener NAS6204 (Y40)

Ave Width 3.0250"

Ave Thickness .3765"

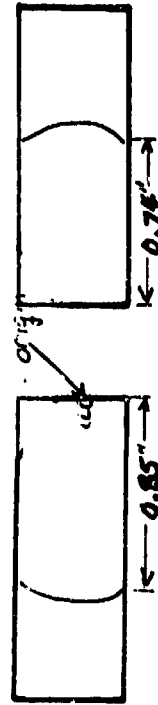
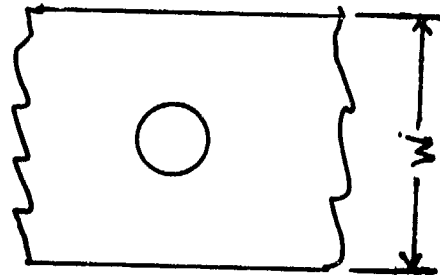
Spectrum F-16 400 Hz.

Max. Stress Level 340KSI (Gross)

Fatigue Life 25931 FWT HRS

Final Load Sizes	
LN	RH
0.85"	0.74"

Test Rate



Notes:

FLATOGRAAPHIC DATA

FLT. HRS	CRACK SIZE	AUT. HRS.	CRACK SIZE	AUT. HRS.	CRACK SIZE
10000	0.0089	15400	0.0165		
10400	0.0096	15500	0.1747		
10800	0.0107	19200	0.0823		
11200	0.0121	19300	0.0916		
11600	0.0130	20000	0.0984		
12000	0.0140	20400	0.1081		
12400	0.0152	20800	0.1201		
12800	0.0167	21200	0.1349		
13200	0.0178	21600	0.1551		
13600	0.0205	22000	0.1759		
14000	0.0236	22400	0.1990		
14400	0.0277	22800	0.2257		
14800	0.0311	23200	0.2548		
15200	0.0351	23600	0.2916		
15600	0.0393	24000	0.3399		
16000	0.0435	24400	0.3928		
16400	0.0469	24800	0.4504		
16800	0.0499	25200	0.5336		
17200	0.0536	25600	0.6143		
17600	0.0574	25931	0.85		
18000	0.0618				

4-12-85

Test Series III(a)

Ref Set WIPF

Specimen No. WIPF-6 (Rev. 41)

Material 7075-T7351 AL

BoN Load Transfer 0%

Fastener NAS11204

Ave Width 3.0100"

Ave Thickness .3770"

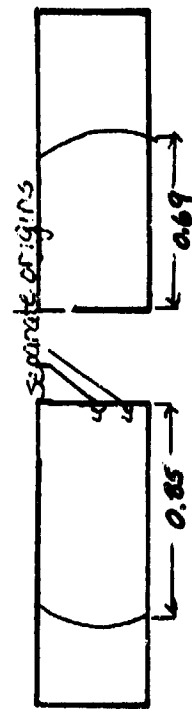
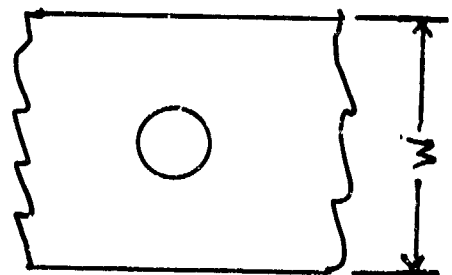
Spectrum F16 400 ME

Max. Stress Level 34,000 psi (Gross)

Fatigue Life 26336 FLT HRS

Final Crack Sizes	
LN	RM
0.85"	0.69"

Test Date



Notes:

FEAT06RAPHIC 0000

FLT HRS	CRACK SIZE	FLT HRS	CRACK SIZE	FLT HRS	CRACK SIZE
11600	0.0053	20000	0.0861		
12000	0.0066	20400	0.0975		
12400	0.0076	20800	0.107		
12800	0.0086	21200	0.1237		
13200	0.0094	21600	0.1435		
13600	0.0107	22000	0.1630		
14000	0.0127	22400	0.1852		
14400	0.0140	22800	0.2104		
14800	0.0159	23200	0.2465		
15200	0.0178	23600	0.2742		
15600	0.0203	24000	0.3106		
16000	0.0233	24400	0.3546		
16400	0.0266	24800	0.4117		
16800	0.0299	25200	0.4783		
17200	0.0346	25600	0.553		
17600	0.0398	26000	0.656		
18000	0.0454	26336	0.690		
18400	0.0512				
18800	0.0589				
19200	0.0663				
19600	0.0759				

8-16-85

Test Series II(a)

Part Set W/PIPE

Specimen No. W/PIPE-7 (REV. 4/2)

Material 1075-7251 AL.

Boil Load Transfer C %

Fastener NAS60204

ave width 3.0140"

ave Thickness .3770"

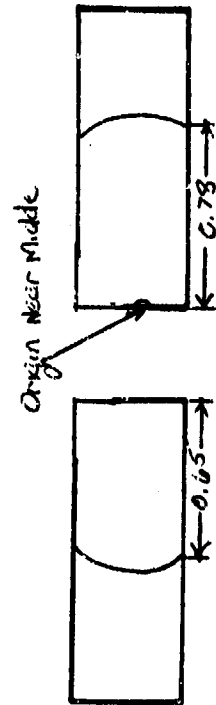
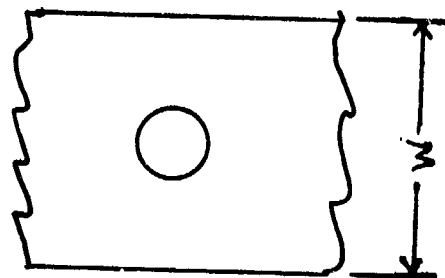
Spectrum F-16 100 Hz

Max. Stress Level 3400 ksi (gross)

Fatigue Life 27551

Final Crack Sizes	
LH	RH
0.65"	0.78"

Test Date



Notes:

FLATOGROANIC 2070

SLT NO.	CRACK SIZE	AVT. AREA	CRACK SIZE	AVT. AREA	CRACK SIZE
12000	0.0094	21400	0.0878		
12400	0.0104	20820	0.1979		
12800	0.0114	21200	0.1090		
13200	0.0126	21060	0.1223		
13600	0.0141	22000	0.1369		
14000	0.0156	22460	0.1547		
14400	0.0172	22800	0.1737		
14800	0.0194	23200	0.1946		
15200	0.0212	23600	0.2197		
15600	0.0240	24000	0.2435		
16000	0.0264	24400	0.2732		
16400	0.0287	24800	0.3044		
16800	0.0319	25200	0.3398		
17200	0.0351	25600	0.3811		
17600	0.0393	26000	0.4258		
18000	0.0436	26400	0.4744		
18400	0.0499	26800	0.5380		
18800	0.0520	27200	0.6255		
19200	0.0626	27551	0.780		
19600	0.0700				
20000	0.0770				

F-16-85

Test Series IV(a)

Ref. Set WINPF

Specimen No. WINPF-8 (Dir. 43)

Material 7075-T7351 AL

AN load Transfer 0 %

Fastener NA30-304

ave width 3.0245"

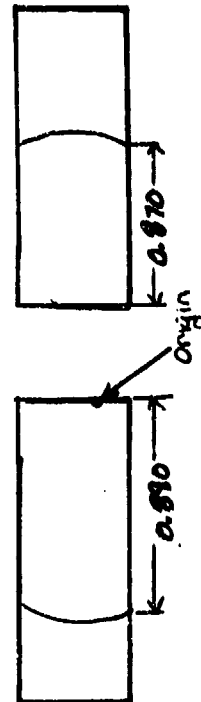
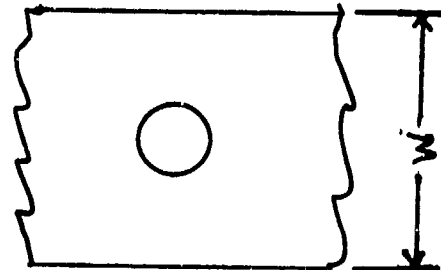
ave. Thickness .3765"

Spectrum F-16 400HR

max. stress level 340KSI (gross)

Fatigue Life 28355 FILMRS

Final Crack Sizes	
LM	RM
0.890"	0.870"



Notes:

FRATOGRAPIHIC DATA

FIL NOS	CRACK SIZE	AVG NPS.	CRACK SIZE	AVG NPS.	CRACK SIZE
13400	0.0275	2.0800	0.0352		
12800	0.0105	2.1200	0.0937		
13200	0.0114	2.1000	0.1028		
13600	0.0126	2.2000	0.1146		
14000	0.0139	2.2400	0.1276		
14400	0.0155	2.2800	0.1404		
14800	0.0170	2.3200	0.1572		
15200	0.0190	2.3600	0.1701		
15600	0.0213	2.4000	0.1982		
16000	0.0230	2.4400	0.2220		
16400	0.0246	2.4800	0.2446		
16800	0.0299	2.5200	0.2732		
17200	0.0325	2.5600	0.3038		
17600	0.0302	2.6000	0.3386		
18000	0.0347	2.6400	0.3742		
18400	0.0458	2.6800	0.4237		
18800	0.0506	2.7200	0.4779		
19200	0.0537	2.7600	0.5443		
19600	0.0609	2.8000	0.634		
20000	0.0688	2.8355	0.870		
20400	0.0754				

Test Date 4-16-85

Test Series IR(a)

Ref. Set WNIFF

Specimen No. WNIFF-9 (Rev. 44)

Material 7075-T7351 AL

BoM Load Transfer 0%

Fastener N45 6204

ave width 3.0230"

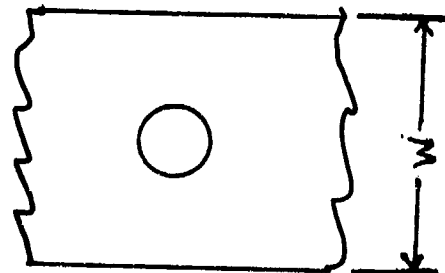
ave. Thickness .3780"

Spectrum F-16 40ME

max. stress level 340 Ksi. (gross)

Fatigue Life 19884 FET HES

Final Crack Sizes	
LN	RN
0.79"	0.67"



FLATOGRAPHIC DATA

FET HES	CRACK SIZE	AUT. HES.	CRACK SIZE	AUT. HES.	CRACK SIZE
6000	0.0104	14400	0.0817		
6400	0.0114	14800	0.0920		
6800	0.0124	15200	0.1030		
7200	0.0135	15600	0.1200		
7600	0.0147	16000	0.1364		
8000	0.0161	16400	0.1575		
8400	0.0179	16800	0.1809		
8800	0.0194	17200	0.2109		
9200	0.0226	17600	0.2446		
9600	0.0250	18000	0.2906		
10000	0.0271	18400	0.3432		
10400	0.0299	18800	0.4070		
10800	0.0323	19200	0.4869		
11200	0.0361	19600	0.6010		
11600	0.0400	19884	0.790		
12000	0.0438				
12400	0.0479				
12800	0.0531				
13200	0.0585				
13600	0.0644				
14000	0.0727				

Test Date 9-22-85

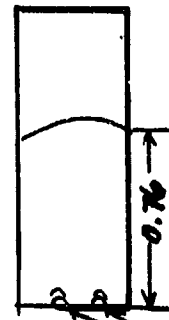
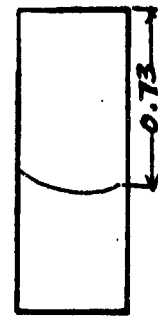
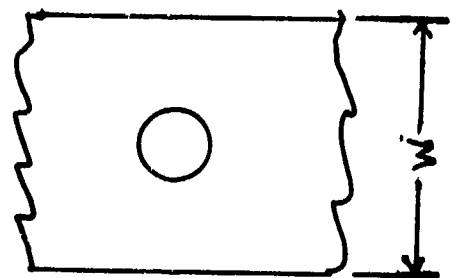


Separate Origins

Notes:

Test Series IV(a)
 Plate Set IN WMPF
 Specimen No. WMPF-10 (Quc 45)
 Material 7075-T7351 AL
 Bolt Load Transfer 0%
 Fastener NAS6204
 Ave Width 3.029"
 Ave Thickness 0.3763"
 Spectrum F-16 400 MC
 Max. Stress Level 342KSI (Gross)
 Fatigue Life 21550 FLT HRS

Final Crack Sizes	
LN	RH
0.73"	0.76"



Double Origins
grow together at 0.003

Notes:

FRAC TOGRAPHIC DATA

FLT HRS	CRACK SIZE	FLT HRS.	CRACK SIZE	FLT HRS.	CRACK SIZE
10500	0.0020	14200	0.2439		
11200	0.0103	19000	0.3319		
11600	0.0119	20000	0.3112		
12000	0.0145	20400	0.4199		
12400	0.0162	20500	0.4706		
12800	0.0187	21200	0.5328		
13200	0.0208	21600	0.617		
13600	0.0233	21800	0.76		
14000	0.0275				
14400	0.0310				
14800	0.0365				
15200	0.0473				
15600	0.0630				
16000	0.0784				
16400	0.0963				
16800	0.1171				
17200	0.1418				
17600	0.1698				
18000	0.1911				
18400	0.2247				
18800	0.2585				

Test date 4-23-85

Test Series III(a)

Batch Set WUPE

Specimen No. WUPE-11 (Rev. 4/6)

Material 7075-T7351 AL

Ben Load Transfer 87%

Fastener NIA3 6204

Ave Width 3.026"

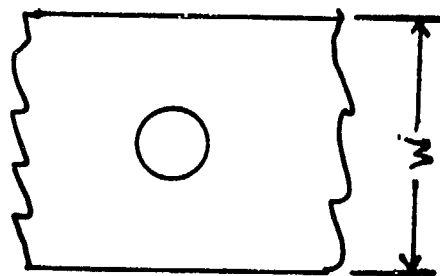
Ave Thickness 0.3769"

Spectrum F-16 400 Hz

Max. Stress Level 34.0 Ksi (Gross)

Fatigue Life 27827 Fat. Cycles

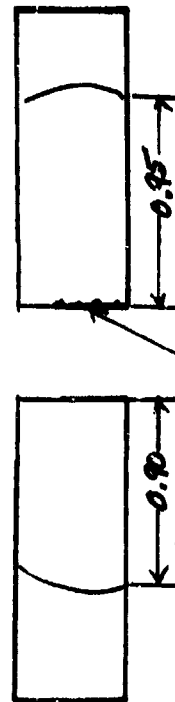
Final Crack Sizes	
LN	RM
0.90"	0.95"



Test Date 4-29-85

FEAT06GRAPHIC DATA

Fat. Cycles	Crack Size	Ave. Width	Crack Size	Ave. Width	Crack Size
11400	0.0098		20000	0.0706	
12000	0.0106		20400	0.0808	
12400	0.0117		20800	0.0924	
12800	0.0125		21200	0.1030	
13200	0.0135		21600	0.1143	
13600	0.0147		22000	0.1243	
14000	0.0160		22400	0.1368	
14400	0.0188		22800	0.1460	
14800	0.0203		23200	0.1525	
15200	0.0220		23600	0.1608	
15600	0.0248		24000	0.17206	
16000	0.0278		24400	0.18462	
16400	0.0307		24800	0.19739	
16800	0.0338		25200	0.2102	
17200	0.0367		25600	0.2224	
17600	0.0395		26000	0.2354	
18000	0.0434		26400	0.24824	
18400	0.0479		26800	0.2635	
18800	0.0531		27200	0.2799	
19200	0.0574		27600	0.2960	
19600	0.0638		27827	0.3195	

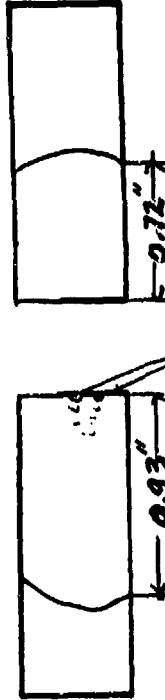
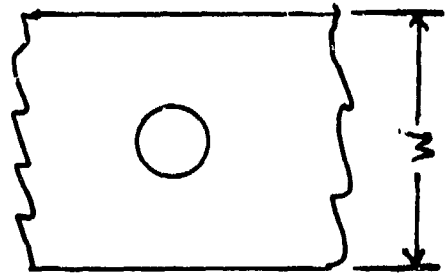


Notes:

Test Series IV (a)
 Data Set WNIPF
 Specimen No. WNIPF-12 (Inv. 47)
 Material 7075-T7351 AL
 B&H Load Transfer 0%
 Fastener NIAS4204
 Ave Width 3.022"
 Ave Thickness 0.3764"
 Spectrum F-16 400 MC
 Max. Stress Level 34,023 (6000)
 Fatigue Life 25120 FLT HRS

Final Crack Sizes	
LH	RH
0.93"	0.72"

Test Date 4-29-85



Separate Origins
 Merged at 0.045"

Notes:

FLATOGRAPHIC DATA

FLT HRS	CRACK SIZE	FLT HRS	CRACK SIZE	FLT HRS	CRACK SIZE
8400	0.0073	16800	0.0364	25120	0.93
8800	0.0086	17200	0.0964		
9200	0.0101	17600	0.1073		
9600	0.0112	18000	0.1184		
10000	0.0122	18400	0.1314		
10400	0.0135	18800	0.1454		
10800	0.0154	19200	0.1591		
11200	0.0185	19600	0.1740		
11600	0.0206	20000	0.1918		
12000	0.0223	20400	0.2089		
12400	0.0250	20800	0.2281		
12800	0.0288	21200	0.2504		
13200	0.0353	21600	0.2771		
13600	0.0359	22000	0.3084		
14000	0.0404	22400	0.3426		
14400	0.0443	22800	0.3746		
14800	0.0492	23200	0.4188		
15200	0.0540	23600	0.4641		
15600	0.0610	24000	0.5221		
16000	0.0679	24400	0.5927		
16400	0.0761	24800	0.69		

Test Series II(a)

Refr. Set WUPE

Specimen No. WUPE- (Dr. 48)

Material 7075-T7351 AL

Refr. Load Transfer 0%

Fastener NAS6204

Refr. Width 3.023"

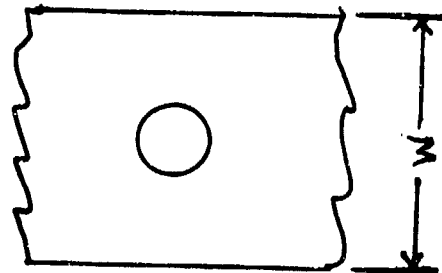
Refr. Thickness 0.3772"

Spectrum F-76 400 Hz

Refr. Stress Level 344ksi (Gross)

Fatigue Life 25150 Ref. Mes

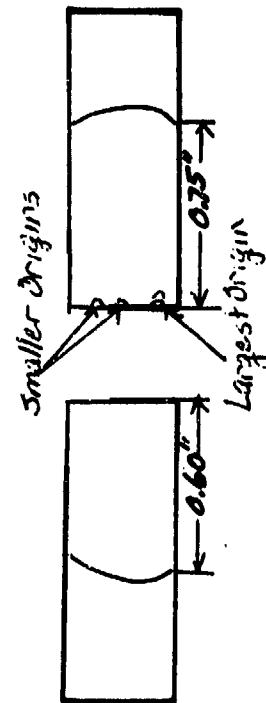
Final Crack Sizes	
LN	RN
0.60"	0.75"



FEATURING NAME

Ref. Mes	Crack Size	Ref. Mes.	Crack Size	Ref. Mes.	Crack Size
7200	0.0080	15000	0.0926	24000	0.4401
7600	0.0072	16000	0.0851	24400	0.5472
8000	0.0107	16400	0.0806	24800	0.6143
8400	0.0128	16800	0.1047	25200	0.750
8800	0.0148	17200	0.1146		
9200	0.0173	17600	0.1245		
9600	0.0194	18000	0.1342		
10000	0.0218	18400	0.1454		
10400	0.0240	18800	0.1557		
10800	0.0270	19200	0.1694		
11200	0.0298	19600	0.1826		
11600	0.0332	20000	0.1979		
12000	0.0380	20400	0.2152		
12400	0.0414	20800	0.2339		
12800	0.0444	21200	0.2546		
13200	0.0479	21600	0.2774		
13600	0.0520	22000	0.3031		
14000	0.0568	22400	0.3334		
14400	0.0619	22800	0.3651		
14800	0.0660	23200	0.4045		
15200	0.0744	23600	0.4422		

Test Date 4-29-85



Notes:

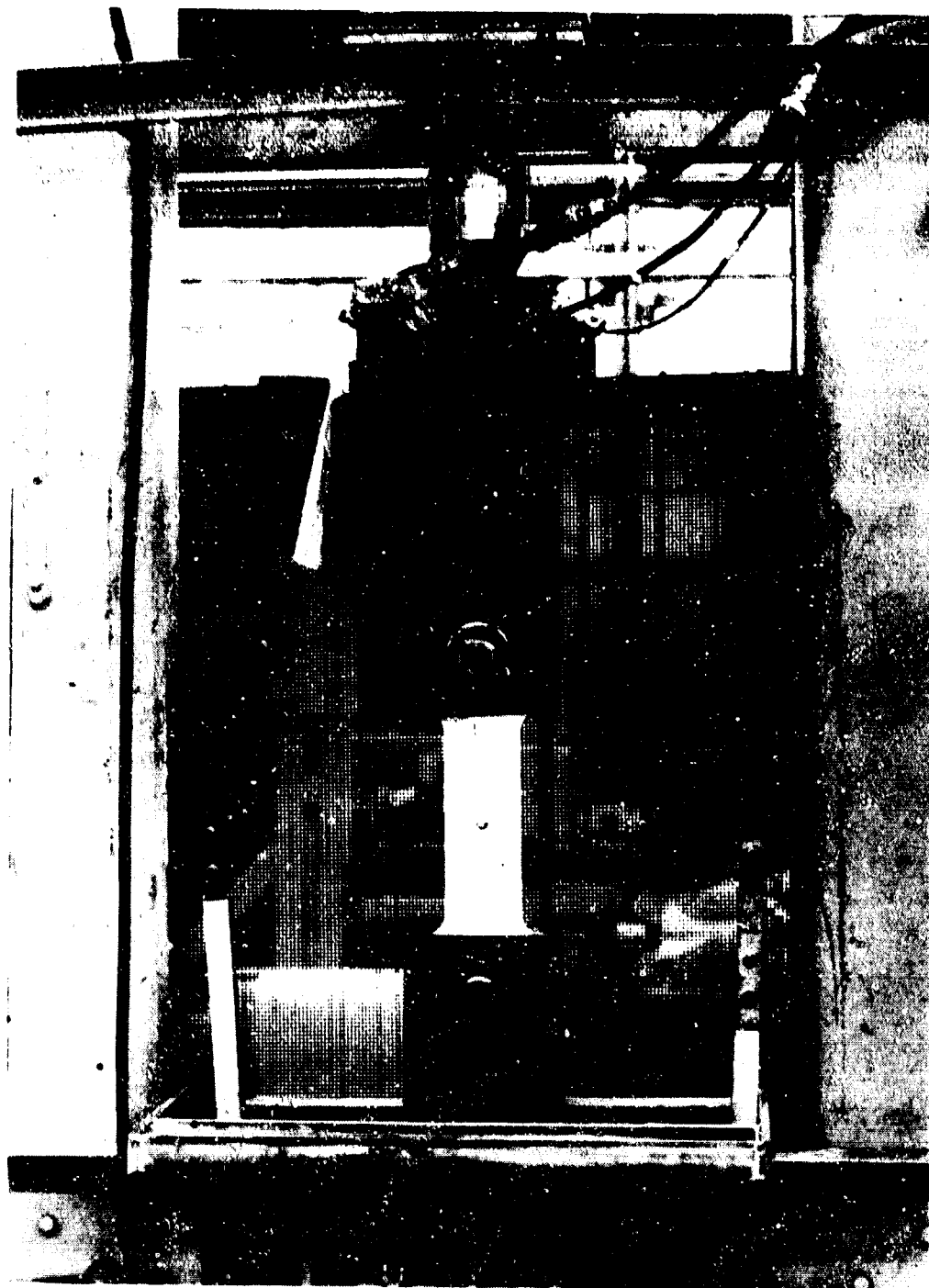


Fig. C-1 Test Setup for 3.00-Inch Wide Dog-Bone Specimens

Table C-1 SUMMARY OF FRACTOGRAPHIC RESULTS FOR DOG-BONE SPECIMENS
(W = 3.00", t = 0.375"; NAS 6204 BOLT IN HOLE). SUBJECTED
TO F-16 400 HR. SPECTRUM (WWPF DATA SET)

SPECIMEN NO. 1			SPECIMEN NO. 2			SPECIMEN NO. 3			SPECIMEN NO. 4		
FLT HRS.	CRACK DEPTH (IN.)		FLT HRS.	CRACK DEPTH (IN.)		FLT HRS.	CRACK DEPTH (IN.)		FLT HRS.	CRACK DEPTH (IN.)	
	L.H.	R.H.		L.H.	R.H.		L.H.	R.H.		L.H.	R.H.
29616	.690	.650	18806	.712	.6827	24435	.7800	.5173	25232	.678	.6471
29600	.680	.640	18400	.565	.5427	24000	.6315	.4327	24800	.563	.5262
29200	.530	.520	18000	.478	.4543	23600	.5581	.3714	24400	.483	.4450
28800	.495	.4509	17600	.4113	.3791	23200	.4950	.3206	24000	.415	.3778
28400	.4285	.3950	17200	.3478	.3181	22800	.4406	.2771	23600	.358	.3210
28000	.3727	.3492	16800	.2913	.2652	22400	.3958	.2399	23200	.305	.2719
27600	.3241	.3065	16400	.2491	.2265	22000	.3519	.2080	22800	.260	.2272
27200	.2846	.2691	16000	.2095	.1870	21600	.3165	.1778	22400	.218	.1905
26800	.2496	.2393	15600	.1763	.1568	21200	.2813	.1568	22000	.184	.1591
26400	.2219	.2100	15200	.1482	.1298	20800	.2517	.1397	21600	.152	.1346
26000	.1938	.1850	14800	.1250	.1032	20400	.2241	.1235	21200	.1290	.1123
25600	.1671	.1635	14400	.1012	.0853	20000	.2008	.1088	20800	.1089	.0923
25200	.1479	.1448	14000	.0863	.0672	19600	.1808	.0960	20400	.0908	.0778
24800	.1315	.1290	13600	.0759	.0579	19200	.1612	.0840	20000	.0781	.0641
24400	.1145	.1143	13200	.0682	.0482	18800	.1417	.0745	19600	.0679	.0536
24000	.0984	.1023	12800	.062	.0412	18400	.1284	.0651	19200	.0582	.0451
23600	.0887	.0915	12400	.0557	.0361	18000	.1158	.0570	18800	.0501	.0405
23200	.0799	.0809	12000	.0481	.0320	17600	.1050	.0504	18400	.0443	.0349
22800	.0721	.0712	11600	.0431	.0280	17200	.0950	.0449	18000	.0385	.0301
22400	.0664	.0636	11200	.0396	.0252	16800	.0850	.0386	17600	.0343	.0272
22000	.0624	.0549	10800	.0362	.0220	16400	.0755	.0322	17200	.0308	.0239
21600	.0568	.0480	10400	.0332	.0195	16000	.0665	.0278	16800	.0277	.0214
21200	.0516	.0431	10000	.0300	.0167	15600	.0593	.0251	16400	.0247	.0186
20800	.0473	.0376	9600	.0272	.0149	15200	.0534	.0218	16000	.0222	.0159
20400	.0427	.0324	9200	.0244	.0131	14800	.0472	.0186	15600	.0200	.0134
20000	.0375	.0290	8800	.0208	.0109	14400	.0429	.0166	15200	.0178	.0113
19600	.0346	.0262	8400	.0180	.0087	14000	.0379	--	14800	.0160	.0095
19200	.0317	.0233	8000	.0159	--	13600	.0339	--	14400	.0143	.0075
18800	.0284	.0206	7600	.0138	--	13200	.0317	--	14000	.0127	.0057
18400	.0255	.0185	7200	.0119	--	12800	.0292	--	13600	.0112	--
18000	.0231	.0164	6800	.0100	--	12400	.0268	--	13200	.0098	--
17600	.0211	.0145	6400	.0084	--	12000	.0245	--	12800	.0088	--
17200	.0192	.0128	6000	.0069	--	11600	.0225	--	12400	.0076	--
16800	.0173	.0110				11200	.0208	--	12000	.0066	--
16400	.0154	.0094				10800	.0190	--	11600	.0055	--
16000	.0138	--				10400	.0171	--	11200	.0046	--
15600	.0124	--				10000	.0154	--	10800	.0037	--
15200	.0110	--									
14800	.0100	--									
14400	.0089	--									
14000	.0079	--									
13600	.0070	--									
13200	.0061	--									
12800	.0052	--									
12400	.0043	--									
12000	.0035	--									

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	Material: 7475-T735 Aluminum Spectrum: F-16 400 Hr (Johns 2) Stress: 34 KSI (Gross)
--	---

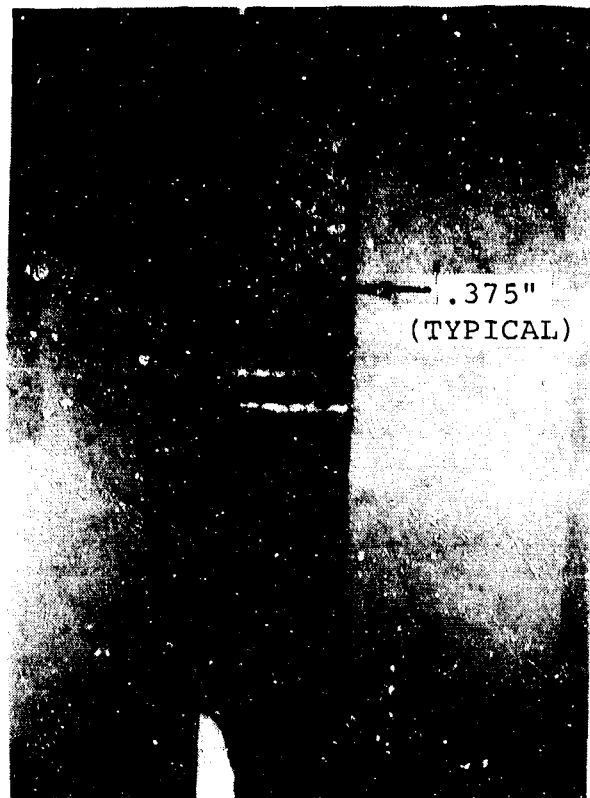


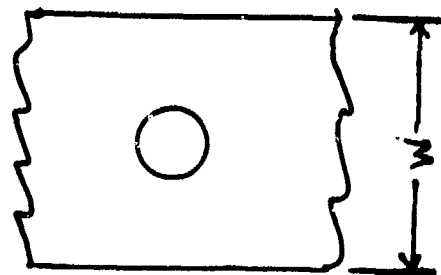
Fig. C-2 Photographs of Typical Fracture Surfaces for
3.00-Inch Wide Dog-Bone Specimens Tested
Using F-16 400 Hour Spectrum

APPENDIX D

FRACTOGRAPHIC RESULTS FOR SINGLE HOLE DOG-BONE SPECIMENS (Phase 2; Test Series IV(b))

Fractographic results for dog-bone specimens (Fig. 2) tested under test series IV(b) are presented in this section. The fatigue tests were performed at room temperature in lab air using the B-1 bomber spectrum [4].

Compatible fatigue test results and fractography were also acquired under General Dynamics, Fort Worth Division research [2]. Test specimens were made from the same batch of material as those for test series IV(b). Fractographic results are presented in Table D-1 and photographs of typical fracture surfaces are shown in Fig. D-1.



Note 1:

FLX70624941C 2077

[illegible]

D--4

II(b)

ww18

JWPB-8 (Dec. 52)

475-77951 AL.

0

NAS 6254

3.5255

0.3740"

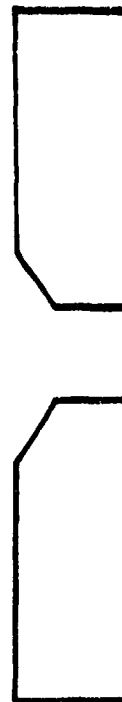
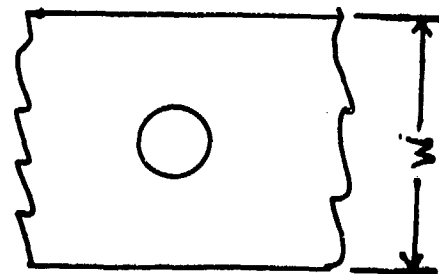
B-1 Bomb:

34.5 Ksc (600)

40494 FLS H25

Final Crack Sizes	
LH	RH
0.8043"	0.7170"

Test Date 4-1-85



Note 3:

FLATBERRY NOTE

[illegible]

III(6)

WWPB

141P8-9 (Dec 53)

473-77951

per 0%

WAS 6304

3,0085

0.3765

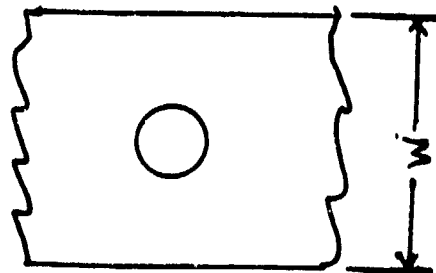
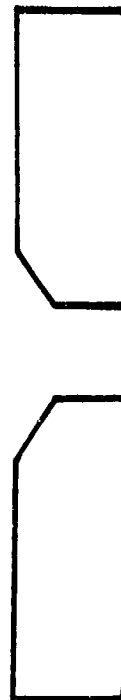
B-1 Bomber

34.0 Ksi (620g)

35432 FLT MRS

Final Crack Sizes	
LH	RH
0.8475"	0.7541"

Test Date 4-1-85

[illegible]

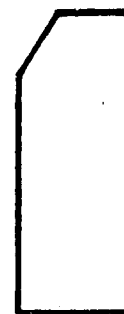
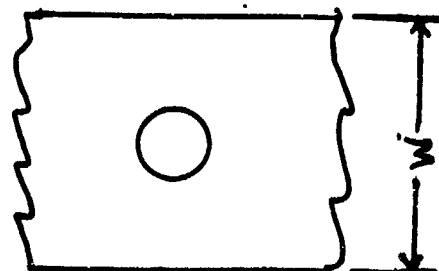
Notes:

FLAETGEBRANIC MOVO

[illegible]

Test date 4-5-85

Final Crack Sizes	
LN	RN
0.8365"	0.8137"



Notes:

TEST SERIES IE(b)

Ref Set WWPB

Specimen No. WWPB-11 (DCEJ5)

Material 7075-T7351 AL

BoN Load Transfer 0%

Fastener NAS 6204

Avs Width 3.0080"

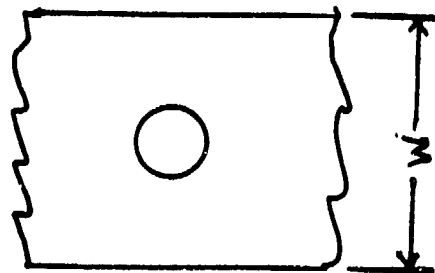
Avs Thickness 0.377"

Spectrum B-1 Bomber

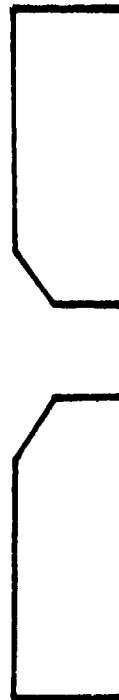
Max. Stress Level 34,000 psi (gross)

Fatigue Life 43664 FET MRS

Final Crack Sizes		
IN	EN	
0.8091"	0.7095"	



Test Date 4-5-85



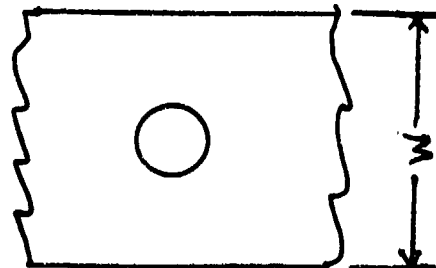
Notes:

FEAT06000000

FET MRS	CRACK SIZE	AVS MRS	CRACK SIZE	AVS MRS	CRACK SIZE
26156	0.0037				
27000	0.0163				
28050	0.0277				
29009	0.0493				
30004	0.0674				
31019	0.0811				
32223	0.0987				
33328	0.1271				
34383	0.1526				
35437	0.1692				
36492	0.2119				
37547	0.2446				
38601	0.2858				
39656	0.3313				
40500	0.4048				
41555	0.4736				
42609	0.5898				
43664	0.8091				

FLA T06R09N1C 20570

Test date 4-5-85



Note 3:

Table D-1 Summary of Fractographic Results for Dog-Bone Specimens ($w = 3.00"$, $z = 0.375"$, NAS 6204 Bolt in Hole) Subjected to B-1 Bomber Spectrum (WWPB Data Set)

SPECIMEN NO. 1			SPECIMEN NO. 2			SPECIMEN NO. 3			SPECIMEN NO. 4		
FLT	CRACK DEPTH (IN.)		FLT	CRACK DEPTH (IN.)		FLT	CRACK DEPTH (IN.)		FLT	CRACK DEPTH (IN.)	
HRS.	L.H.	R.H.	HRS.	L.H.	R.H.	HRS.	L.H.	R.H.	HRS.	L.H.	R.H.
29858	.8316	.770	34889	.805	.610	34910	.850	.570	39656	.690	.670
29109	.4730	.430	34383	.680	.460	34383	.680	.420	38602	.510	.4587
28055	.2789	.2448	33328	.480	.2140	33328	.540	.288	37547	.3689	.3367
27000	.1709	.150	32273	.368	.1449	32273	.445	.1919	36492	.2826	.2487
26156	.1354	.1007	31219	.293	.0974	31219	.3618	.1287	35438	.2184	.1866
25102	.1026	.0708	30164	.2405	.0655	30164	.3035	.0845	34383	.1680	.1395
24047	.0762	.0486	29109	.1998	.0414	29109	.2542	.0572	33328	.1325	.1040
22992	.0566	.0338	28055	.1639	.0322	28055	.2116	.0387	32273	.1056	.0781
21938	.0414	.0241	27000	.1380	.0245	27000	.1780	.0277	31219	.0850	.0594
20883	.0328	.0183	26156	.1148	.0208	26156	.1446	.0201	30164	.0686	.0461
19828	.0247	.0143	25102	.0942	.0155	25102	.1192	.0161	29109	.0549	.0349
18773	.0182	.0104	24047	.0762	.0111	24047	.0928	.0120	28055	.0454	.0274
17719	.0131	.0076	22992	.0614	.0081	22992	.0710	.0090	27000	.0381	.0216
16664	.0095	.0052	21938	.0513	.0065	21938	.0528	.0072	26156	.0316	.0174
15609	.0061	.0034	20883	.0405	.0056	20883	.0397	.0058	25102	.0256	.0138
14555	.0037	.0024	19828	.0335	.0048	19828	.0321	--	24047	.0211	.0100
13500	.0027	--	18773	.0282	.0040	18773	.0260	--	22992	.0167	.0076
12656	.0016	--	17719	.0232	.0034	17719	.0206	--	21938	.0128	.0051
			16664	.0186	.0028	16664	.0161	--	20883	.0101	--
			13609	.0156	--	15609	.0126	--	19828	.0078	--
			14555	.0134	--	14555	.0097	--	18773	.0057	--
			13500	.0116	--	13500	.0076	--			
			12656	.0100	--	12656	.0053	--			
			11602	.0084	--	11602	.0038	--			
			10547	.0071	--	10547	.0028	--			

multi-origins	multi-origins		multi-origins

	Material: 7475-T7351 Aluminum Spectrum: B-1 bomber (Norohna Special) Stress: 34 KSI (Gross)
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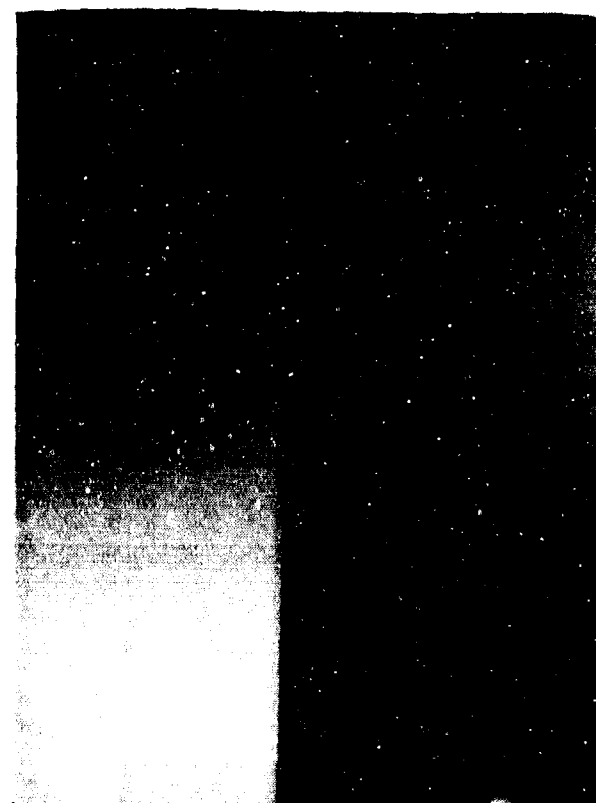
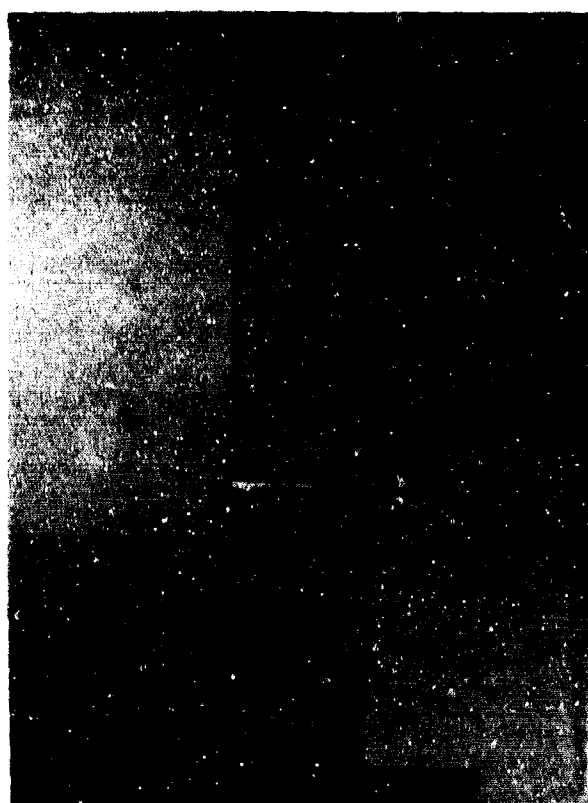
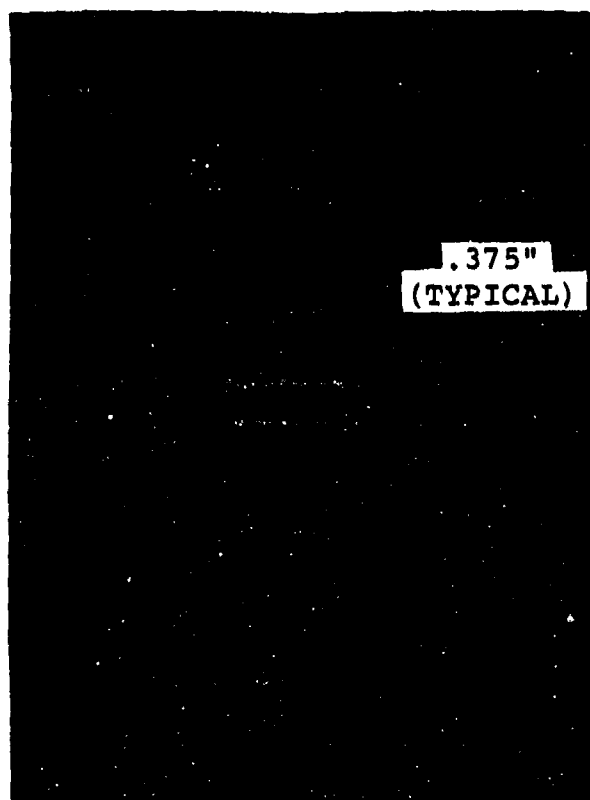


Fig. D-1 Photographs of Typical Fracture Surfaces for
3.00-Inch Wide Dog-Bone Specimens Tested
Using B-1 Bomber Spectrum

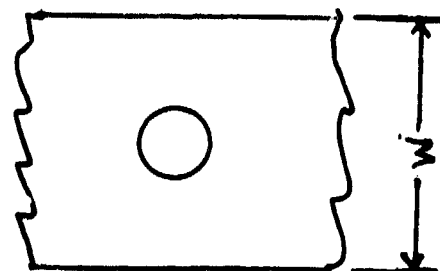
APPENDIX E

FRACTOGRAPHIC RESULTS FOR SINGLE HOLE DOG-BONE SPECIMENS
(Phase 2; Test Series IV(c))

Test Series IR(c)
 Ref. Set WWPCL
 Specimen no. WWPCL-2 (Per 143)
 Material 7075-T7351 Al.
 B/N load Transfer 0.70
 Fastener NAS.6204
 ave width 3.0155"
 Ave. Thickness 0.3770"
 Spectrum F-16 C/D
 ave. stress level 34,000 psi (gross)
 Fatigue Life 55192 Elt Hrs

Final Crack Sizes	
LN	RN
0.9115"	0.6584"

Test Date



FLATOGRAPHIC DATA

CRACK SIZE	FLY HRS.	CRACK SIZE	FLY HRS.	CRACK SIZE	FLY HRS.
0.0033	36400	0.1513	44800	0.5965	53200
0.0051	36800	0.1637	45200	0.6339	53600
0.0073	37200	0.1784	45600	0.6752	54000
0.0107	37600	0.1917	46000	0.7319	54400
0.0131	38000	0.2063	46400	0.8077	54800
0.0165	38400	0.2189	46800	0.9115	55192
0.0202	38800	0.2332	47200		
0.023	39200	0.249	47600		
0.0283	39600	0.2666	48000		
0.0332	40000	0.2903	48400		
0.0381	40400	0.3127	48800		
0.042	40800	0.3279	49200		
0.0473	41200	0.3443	49600		
0.0573	41600	0.3691	50000		
0.066	42000	0.391	50400		
0.0762	42400	0.414	50800		
0.092	42800	0.4364	51200		
0.1062	43200	0.4639	51600		
0.1111	43600	0.4898	52000		
0.1229	44000	0.5225	52400		
0.1363	44400	0.5546	52800		

7-10-85



Notes:

Test Series IE (c)

Ref Set WNL PCL

Specimen No. WNL PCL-3 (Dur 144)

Material 7075-T7351 AL

RN Load Transfer 0%

Fastener NAS 6204

ave w. dth 3.0155"

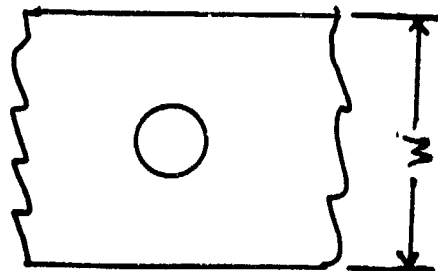
ave. Thickness 0.3780"

Spectrum F-16 C/D

ave. stress level 340.55 (6000)

Fatigue Life 58252 Fit Hrs

Final Crack Sizes	
LH	RH
0.9867"	0.2110"



Test Date 7-10-85

FLATBERRAND

FLR NO.	CRACK SIZE	AVG NO.	CRACK SIZE	AVG NO.	CRACK SIZE
40800	0.0697	49200	0.2856	57600	0.7589
41200	0.0775	49600	0.2943	58000	0.8014
41600	0.0859	50000	0.3003	58400	0.8456
42000	0.0921	50400	0.3037	58800	0.9031
42400	0.100	50800	0.3162	59200	0.9648
42800	0.1079	51200	0.3166	59652	0.9867
43200	0.1171	51600	0.3336		
43600	0.1253	52000	0.3526		
44000	0.1354	52400	0.3721		
44400	0.1472	52800	0.3918		
44800	0.1566	53200	0.4188		
45200	0.1694	53600	0.445		
45600	0.1802	54000	0.4708		
46000	0.1903	54400	0.4978		
46400	0.2009	54800	0.5251		
46800	0.2106	55200	0.5511		
47200	0.2273	55600	0.5835		
47600	0.2543	56000	0.6189		
48000	0.2604	56400	0.6485		
48400	0.2722	56800	0.6826		
48800	0.2796	57200	0.7246		



Notes:

origin in bore out of plane with rest of flaw
block 102 was smallest reading possible

Test Series IV(c)

Set Set WMPCL

Specimen no. WMPCL-4 (Per 145)

Material 7079-T2351 AL

Boil Load Transfer 0%

Fastener NA36204

ave. width 3.0255"

ave. Thickness 0.3778"

Spectrum F-14 CID

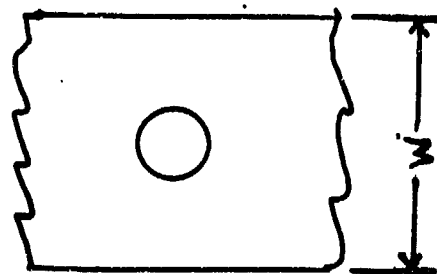
max. Stress Level 34,025.0 (Gross)

Fatigue Life 45992 FIT Hrs

Final Crack Sizes	
LH	RH
1.0334"	0.1570"

Test Date

7-10-85



Notes:

FEAT0600000000

FE	CRACK	FE	CRACK	FE	CRACK	FE	CRACK
NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE
30800	0.0129	39200	0.3777				
31200	0.0198	39600	0.398				
31600	0.0266	40000	0.4128				
32000	0.0369	40400	0.4317				
32400	0.0489	40800	0.4604				
32800	0.0606	41200	0.4884				
33200	0.0749	41600	0.5167				
33600	0.0921	42000	0.5417				
34000	0.1033	42400	0.5747				
34400	0.1198	42800	0.6106				
34800	0.1319	43200	0.6419				
35200	0.150	43600	0.6777				
35600	0.1709	44000	0.7185				
36000	0.1981	44400	0.7657				
36400	0.2066	44800	0.80				
36800	0.2371	45200	0.8573				
37200	0.258	45600	0.9205				
37600	0.2829	45992	1.0334				
38000	0.3078						
38400	0.3296						
38800	0.3519						

Test Series IR(c)

Ref. Set WINPCL

Specimen no. WINPCL-5 (Our 146)

Material 7075-T7351 AL

Ben Load Transfer 0%

Fastener NAS6204

ave width 3.0210"

ave thickness 0.3760"

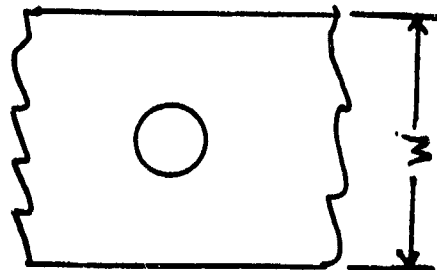
Spectrum F-16 L10

ave stress level 340KSI (gross)

Fatigue Life 38792 F11 Hrs

Final Crack Sizes	
IN	RN
0.7356"	0.6901"

Test Date



FEAT06GRAPHIC DATA

FLR NO.	CRACK SIZE	FLR NO.	CRACK SIZE	FLR NO.	CRACK SIZE
28000	0.0158	36400	0.3695		
28400	0.0205	36800	0.4009		
28800	0.0211	37200	0.4388		
29200	0.0339	37600	0.4856		
29600	0.0416	38000	0.5487		
30000	0.0492	38400	0.6419		
30400	0.0611	38792	0.7356		
30800	0.0687				
31200	0.0819				
31600	0.0985				
32000	0.1163				
32400	0.1332				
32800	0.1464				
33200	0.1632				
33600	0.1834				
34000	0.2059				
34400	0.2261				
34800	0.2464				
35200	0.2749				
35600	0.3111				
36000	0.3379				

7-10-85



Notes:

0.1

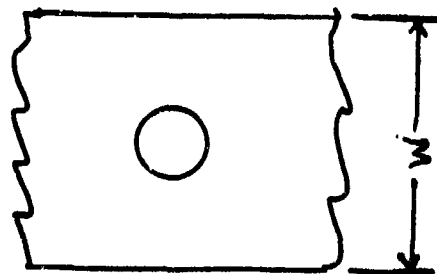
FLATBERRANTIC 2000

Test Series III(c)
 Plate Set WUPCH
 Specimen no. WUPCH-1 (Duc 147)
 Material 7075-T351 AL
 Bolt Load Transfer 0%
 Fastener NAS6204
 Ave Width 3.0250"
 Ave Thickness 0.3780"
 Spectrum F-16 C/D
 Ave. Stress Level 40.8Ksi (Gross)
 Fatigue Life 33052 FFL Hrs

Final Crack Sizes	
LN	RH
0.7144"	0.4823"

Test Date 7-19-85

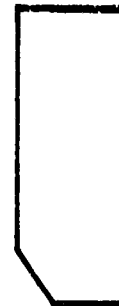
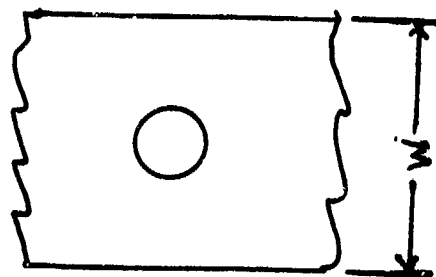
FLT NO.	CRACK SIZE	AST NO.	CRACK SIZE	AST NO.	CRACK SIZE
24800	0.0127	33200	0.5378		
25200	0.015	33600	0.6694		
25400	0.0229	33652	0.7144		
26000	0.0343				
26400	0.0434				
26800	0.0534				
27200	0.0696				
27600	0.0927				
28000	0.11				
28400	0.1325				
28800	0.1428				
29200	0.1615				
29600	0.1807				
30000	0.2114				
30400	0.2425				
30800	0.2709				
31200	0.2999				
31600	0.3387				
32000	0.3816				
32400	0.4271				
32800	0.4805				



Notes:

Test Series IR(C)
 Ref. Set WMPCH
 Specimen No. WMPCH-2 (Dec. 148)
 Material 7075-T7351 AL
 Bolt Load Transfer 0%
 Fastener NAS6224
 ave width 3.0195"
 Ave. Thickness 0.3783"
 Spectrum F-46 C/D
 Ave. Stress Level 40.8 KSI (gross)
 Fatigue Life 21112 FIT Hrs

Final Lock Sizes	
LH	RH
0.9642"	0.3003"



Notes:

FLATOGRAPHIC PHOTO

FIT HRS	GROSS SIZE	NET AREA	GROSS SIZE	NET AREA	GROSS SIZE
12000	0.0106	20400	0.6391		
12400	0.0245	20800	0.7064		
12800	0.0351	21112	0.9642		
13200	0.0512				
13600	0.070				
14000	0.0842				
14400	0.1034				
14800	0.1297				
15200	0.1456				
15600	0.1675				
16000	0.1804				
16400	0.197				
16800	0.2214				
17200	0.2559				
17600	0.3025				
18000	0.3363				
18400	0.3656				
18800	0.3936				
19200	0.4407				
19600	0.50				
20000	0.5524				

Test Date 7-22-85

Test Series IR(c)

Ref. Set WINPEN

Specimen No. WINPEN-4 (DUC-1576)

Material 7075-T7351 AL

BoN Load Transfer 0%

Fastener NAS 6204

BoN Width 3.0230"

BoN Thickness 0.3165"

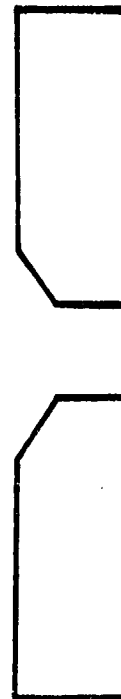
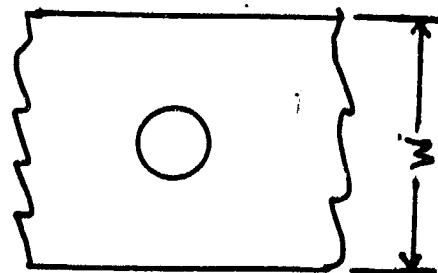
Spectrum F-16 C10

Max. Stress Level 40.8 Ksi (Gross)

Fatigue Life 32288 FH #3

Final Crack Sizes	
LH	RH
0.9829"	0.3152"

Test Date 7-22-85



Notes:

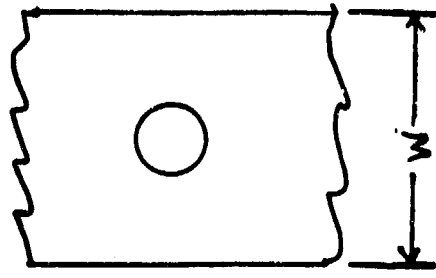
Origin at 0.0345 inches from bore of hole on surface

FLATBOREANALYSIS

FLT #25	CRACK SIZE	AIR NO.	CRACK SIZE	AIR NO.	CRACK SIZE
24000	0.0547		0.9829		
24400	0.0655				
24900	0.0742				
25200	0.0932				
25600	0.1165				
26000	0.1466				
26400	0.1756				
26800	0.2021				
27200	0.2356				
27600	0.2607				
28000	0.293				
28400	0.331				
28800	0.372				
29200	0.3989				
29600	0.4309				
30000	0.4729				
30400	0.5208				
30800	0.5704				
31200	0.6276				
31600	0.6883				
32000	0.7847				

Test Series IV (C)
 Data Set WUMPCN
 Specimen No. WUMPCN-5 (DUC 151)
 Material 7079-T7351 AL
 B/N Load Transfer 0%
 Fastener NAS 6224
 Ave Width 3.0215"
 Ave. Thickness 0.3710"
 Spectrum F-16 C/D
 Ave. Stress Level 46.8 Ksi (6000)
 Fatigue Life 24480 FH Hrs

Final Crack Sizes	
LN	RN
0.9523"	0.5457"



Test Date 7-23-85

FRATOGRAPHIC DATA

FLT. NO.	CRACK SIZE	Avg. MEAS.	CRACK SIZE	Avg. MEAS.	CRACK SIZE
18400	0.1449				
18800	0.162				
19200	0.1851				
19600	0.2061				
20000	0.2206				
20400	0.242				
20800	0.2683				
21200	0.30				
21600	0.3424				
22000	0.3786				
22400	0.4457				
22800	0.4885				
23200	0.5416				
23600	0.5832				
24000	0.6687				
24400	0.7686				
24800	0.8608				
24980	0.9523				



Notes:
 origin at 0.1045 from the bore on surface of specimen

Test Series IE(c)

Batch Set WWPCN

Specimen no. WWPCN-6 (DIN 152)

Material 7075-T7351 AL

R/N Load Transfer 0%

Fastener NA54204

ave w. dth 3.0205"

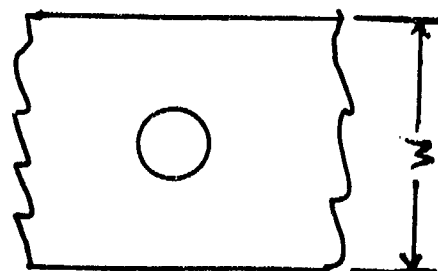
ave. Thickness .3767"

Spectrum F-16 C/D

max. stress level 40,845psi (6000)

Fatigue Life 31252 FH hrs

Final Crack Sizes	
LH	RH
0.7561"	0.5310"



FEATURING NOTE

FEI MES	CRACK SIZE	AVE MES.	CRACK SIZE	AVE MES.	CRACK SIZE
24400	0.0056				
24460	0.0287				
24500	0.046				
25200	0.063				
25600	0.0789				
26000	0.0921				
26400	0.1093				
26800	0.1313				
27200	0.1527				
27600	0.1839				
28000	0.2046				
28400	0.2351				
28800	0.266				
29200	0.316				
29600	0.3745				
30000	0.4281				
30400	0.4824				
30800	0.5735				
31200	0.6987				
31252	0.7561				

Test Date 7-23-85

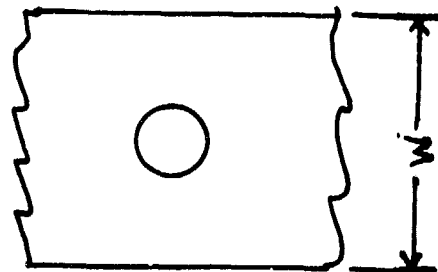
Notes:

Test Series II (C)
 Plate Set WMPCH
 Specimen No. WMPCH-7 (DUG 153)
 Material 7075-T7351 AL
 Bolt Load Transfer 0%
 Fastener NAS 6204
 Ave Width 3.6250"
 Ave Thickness 0.3747"
 Spectrum F-16 CLD
 Ave Stress Level 46.8 Ksi (Gross)
 Fatigue Life 24924 FH Hrs

Final Crack Sizes	
LN	RN
0.8176"	0.7431"

Test Date

7-26-85



Notes:

FRATOGGRAPHIC PHOTO

FLT mg	CRACK SIZE	FLT mm	CRACK SIZE	FLT mm	CRACK SIZE
15600	0.1687	24400	0.66436		
16000	0.0167	24800	0.7463		
16400	0.0284	24924	0.8176		
16800	0.0411				
17200	0.0547				
17600	0.0717				
18000	0.0877				
18400	0.1250				
18800	0.1441				
19200	0.1761				
19600	0.1966				
20000	0.2176				
20400	0.253				
20800	0.2762				
21200	0.3118				
21600	0.3495				
22000	0.3407				
22400	0.4232				
22800	0.4631				
23200	0.5175				
23600	0.5832				

Test Series IV(c)

Page 5 of 11 WWPCH

Specimen no. WWPCN-8 (Out 15)

Material 7473-77951 Ak

Don't load Transfer 0%

FASTENER NA56204

are w. 1/4 3,022"

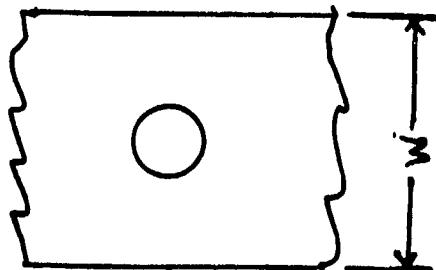
ave. Thickness .3755"

Spectrum F-14 C/D

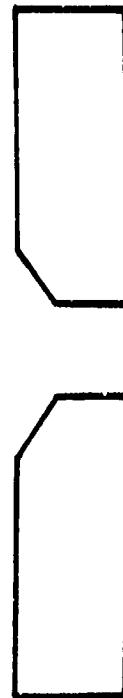
max. stress level 40.8 ksi (600g)

Fabryno Life 13888 Fit Arcs

Final Crack Sizes	
LN	RN
0.9001"	0.3924"



Test date 7-26-85



Note 3:

Origin is at 0.0188 inches from the bore on the specimen surface

APPENDIX F

FRACTOGRAPHIC RESULTS FOR SINGLE HOLE DOG-BONE SPECIMENS
(Phase 2; Test Series IV(h))

TEST Series IL(h)

Pole Set WNPFD

Specimen No. WNPFD-1 (Dur. 125)

Material 7079-T3951 AL

Load Transfer 0%

Fastener OPEN HOLE

ave width 3.0215"

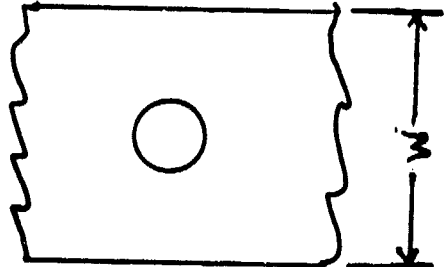
ave. Thickness 0.3755"

Spectrum F-16 400 HR

max. Stress Level 34.0 KSI (gross)

Fatigue Life 22348 FHRS

Final Crack Sizes	
LH	RH
0.8882"	0.8472"



FRATOGRAPHIC DATA

FLT NRS	CRACK SIZE	FLT NRS.	CRACK SIZE	FLT NRS.	CRACK SIZE
14800	0.0068				
15200	0.0127				
15600	0.0177				
16000	0.0318				
16400	0.0397				
16800	0.0534				
17200	0.0656				
17600	0.0806				
18000	0.0976				
18400	0.1097				
18800	0.1451				
19200	0.1664				
19600	0.2024				
20000	0.2392				
20400	0.2905				
20800	0.3386				
21200	0.3906				
21600	0.4748				
22000	1.5857				
22348	0.8882				

Test Date 6-20-85



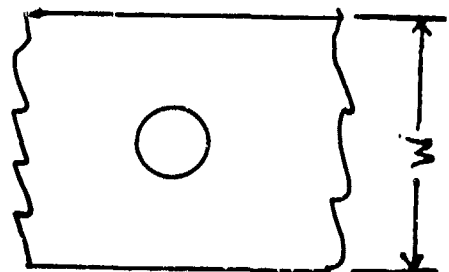
Notes:

Test Series 1W(h)
 Pch Set WMPFO
 Specimen No. WMPFO-2 (Dx. 126)
 Material 7075-T7351 AL
 BN Load Transfer 0 To
 Fastener OPEN Hole
 Riv Width 3.0220"
 Riv Thickness 0.3765"
 Spectrum F-16 400 Hz
 Max. Stress Level 34.0 ksi (Gross)
 Fatigue Life 15478 FIT Hrs

Final Check Sizes	
LN	RN
0.8532"	0.7568"

Test Date

6-20-85



FLATOGGRAPHIC DATA

Fit msg	CRACK SIZE	Air msg.	CRACK SIZE	Air msg.	CRACK SIZE
3600	0.0057	12000	0.2214		
4000	0.0084	12400	0.2588		
4400	0.0124	12800	0.2972		
4800	0.0156	13200	0.3306		
5200	0.0193	13600	0.3703		
5600	0.0223	14000	0.4148		
6000	0.0269	14400	0.4769		
6400	0.0329	14800	0.5492		
6800	0.0378	15200	0.6716		
7200	0.0436	15478	0.8352		
7600	0.0521				
8000	0.0589				
8400	0.0689				
8800	0.082				
9200	0.0926				
9600	0.1021				
10000	0.1151				
10400	0.13				
10800	0.1493				
11200	0.1698				
11600	0.1949				

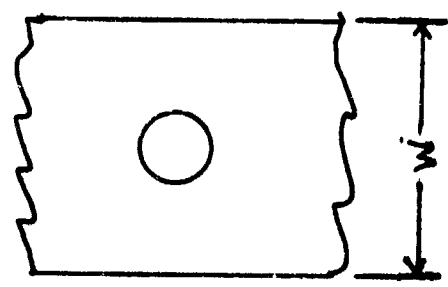


Notes:

Test Series 14 (n)
 Bolt Set WUPEO
 Specimen No. WUPE-4 (DUE.122)
 Material 7079-72951 AL.
 Bolt Load Transfer 0%
 Fastener Open Hole
 Ave Width 3.0215"
 Ave. Thickness 0.3772"
 Spectrum F-16 400 Hz
 Ave. Stress Level 340 Ksi (6000)
 Fatigue Life 24406 FIF Hrs

Final Crack Sizes	
LH	RH
0.7789"	0.10250"

Test Date



FRactographic Data

Test No.	Crack Size	Ret. No.	Crack Size	Ret. No.	Crack Size
15200	0.0004	23600	0.5204		
15600	0.0113	24000	0.10034		
16000	0.0222	24406	0.7789		
16400	0.0319				
16800	0.042				
17200	0.051				
17600	0.0648				
18000	0.0783				
18400	0.0937				
18800	0.1064				
19200	0.1148				
19600	0.1337				
20000	0.1535				
20400	0.1756				
20800	0.2025				
21200	0.2228				
21600	0.2564				
22000	0.295				
22400	0.3393				
22800	0.3859				
23200	0.4555				

6-20-85



Notes:

Test Series IV(h)

Ref Set WUWFO

Specimen No. WUWFO-5 (DIF. 129)

Material 7075-T7351 AL

BoN Load Transfer 0%

Fastener Open Hole

ave width 3.0215"

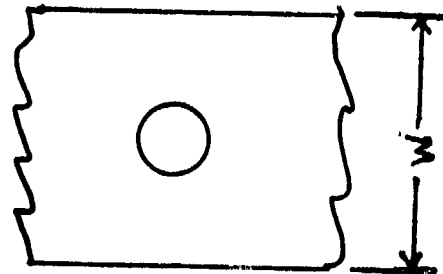
ave. Thickness 0.3732"

Spectrum F-16 400 HR

ave. Stress Level 34.0 Ksi (6000)

Fatigue Life 26,800 FH Hrs

Final Crack Sizes	
LN	EN
0.7558"	0.5492"



Test Date 6-24-85

FLATBOGGRAPHIC DATA

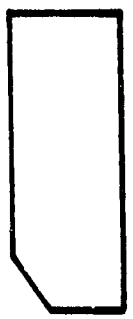
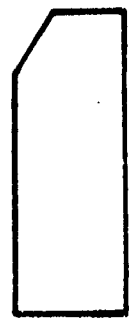
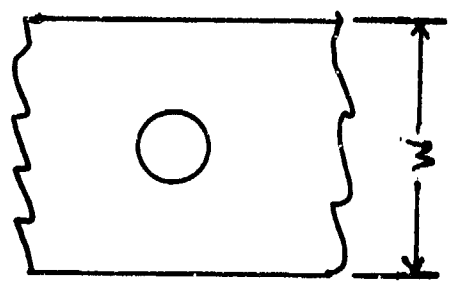
FLT NO.	CRACK SIZE	ALT NO.	CRACK SIZE	ALT NO.	CRACK SIZE
15600	0.0125	24000	0.3474		
16000	0.0194	24400	0.3851		
16400	0.0291	24800	0.4215		
16800	0.03	25200	0.4626		
17200	0.0478	25600	0.499		
17600	0.0598	26000	0.5416		
18000	0.0739	26400	0.6352		
18400	0.0801	26800	0.7558		
18800	0.097				
19200	0.107				
19600	0.118				
20000	0.1317				
20400	0.1518				
20800	0.1725				
21200	0.1889				
21600	0.2058				
22000	0.2222				
22400	0.2449				
22800	0.2677				
23200	0.2904				
23600	0.3146				



Notes:

Test Series 1E(h)
 Ref. Set WWPFO
 Specimen No. WWPFO-6 (DSE-130)
 Material 7075-T7351 AL
 B.N. Load Transfer 0%
 Fastener Open Hole
 Ave Width 3.0195"
 Ave Thickness 0.3760"
 Spectrum F-16 900 HR
 Max. Stress Level 34.6 Ksi (6000)
 Fatigue Life 260006 FLY HRS

Final Crack Sizes	
IN	MM
0.9410	0.6768"



FRactOGRAPHIC DATA

FLY hrs	CRACK SIZE	Avg. RES.	CRACK SIZE	Avg. RES.	CRACK SIZE
16800	0.0046	25200	0.51672		
17200	0.0138	25600	0.6794		
17600	0.0276	26006	0.9410		
18000	0.043				
18400	0.0581				
18800	0.0755				
19200	0.0904				
19600	0.1046				
20000	0.1175				
20400	0.1382				
20800	0.1663				
21200	0.1809				
21600	0.1946				
22000	0.2152				
22400	0.2398				
22800	0.2813				
23200	0.3047				
23600	0.3413				
24000	0.385				
24400	0.4229				
24800	0.4898				

Test Date 6-24-85

Notes:

Test Series IE(h)

Ref Set WWPFD

Specimen No. WWPFD-7 (DVC.131)

Material 7075-T7351 AL.

BoN Load Transfer 0 %

Fastener Open Hole

Ave Width 3.0215"

Ave. Thickness 0.3770"

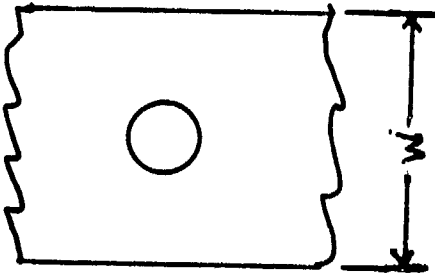
Spectrum F-16 400 Hz

Max. Stress Level 340 KSI (6000)

Fatigue Life 27235 FHMs

Final Crack Sizes	
LH	RH
..7726"	.5945"

Test Date 6-24-85



Notes:

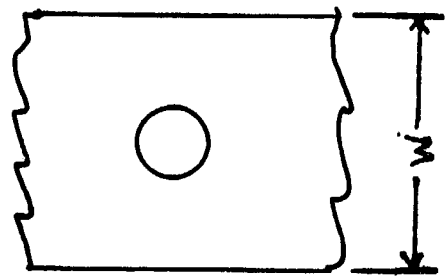
FRAC TOG R R A N N C

FLT NO.	CRACK SIZE	AVG NO.	CRACK SIZE	AVG NO.	CRACK SIZE
11400	0.0043	24800	0.3754		
11800	0.0079	25200	0.4626		
17200	0.0207	25600	0.4482		
17600	0.0297	26000	0.4922		
18000	0.0438	26400	0.5637		
18400	0.0581	26800	0.6459		
18800	0.0682	27235	0.7726		
19200	0.0825				
19600	0.095				
20000	0.107				
20400	0.1213				
20800	0.1409				
21200	0.1575				
21600	0.1769				
22000	0.1993				
22400	0.2164				
22800	0.2364				
23200	0.2568				
23600	0.2823				
24000	0.3012				
24400	0.3358				

Test Series TP (h)
 Bolt Set WHPFO
 Specimen No. WHPFO-8 (Dnr. 132)
 Material 7075-T2351 AL
 Bolt Load Transfer 0 %
 Fastener Open Hole
 Ave Width 3.0320"
 Ave Thickness 0.3755"
 Spectrum F-16 900 Hz
 Max. Stress Level 34.0 ksi (gross)
 Fatigue Life 22806 FIF Hrs

Final Crack Sizes	
LH	RH
0.8193"	0.7290"

Test Date 6-24-85



FRACTOGRAPHIC DATA

ALT. NO.	CRACK SIZE	ALT. NO.	CRACK SIZE	ALT. NO.	CRACK SIZE
14800	0.0074				
15200	0.011				
15600	0.0154				
16000	0.0312				
16400	0.044				
16800	0.0598				
17200	0.0753				
17600	0.0924				
18000	0.1101				
18400	0.1294				
18800	0.1458				
19200	0.1777				
19600	0.2007				
20000	0.2257				
20400	0.2642				
20800	0.3104				
21200	0.3588				
21600	0.4279				
22000	0.4976				
22400	0.6054				
22806	0.8193				



Notes:

Test Series IL(h)

Plate Set WNPF0

Specimen No. WNPF0-9 (DUC. 133)

Material 7075-T7351 AL.

Load Transfer 0%

Fastener Open Hole

ave width 3.0195"

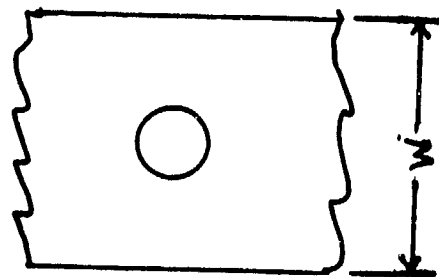
ave. Thickness 0.3780"

Spectrum F-16 500 Hz

max. Stress Level 34,000 psi (gross)

Fatigue Life 236006 Cycles

Final Crack Sizes	
LN	RN
0.7831"	0.5909"



FRAC TOGRAPHIC DATA

FLT NO.	CRACK SIZE	FLT NO.	CRACK SIZE	FLT NO.	CRACK SIZE
12000	0.0024	20400	0.2731		
12400	0.0079	20800	0.3085		
12800	0.0113	21200	0.3399		
13200	0.0189	21600	0.3833		
13600	0.0241	22000	0.4274		
14000	0.033	22400	0.4853		
14400	0.0381	22800	0.5494		
14800	0.0432	23200	0.6367		
15200	0.0529	23600	0.7931		
15600	0.0652				
16000	0.0776				
16400	0.0925				
16800	0.1056				
17200	0.1201				
17600	0.1275				
18000	0.145				
18400	0.1631				
18800	0.18				
19200	0.2021				
19600	0.2193				
20000	0.2399				

Test Date 6-24-85



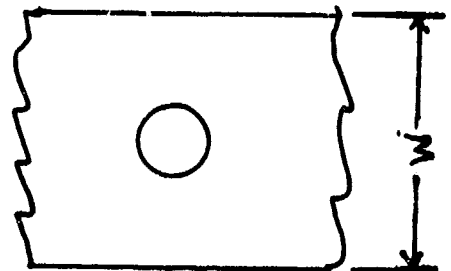
Notes:

Test Series TP (h)
 Ref. Set WUPFO
 Specimen no. WUPFO-10 (Doc. 134)
 Material 7079-T7351 AL
 App. Load Transfer 0.75
 Fastener Open Hole
 Ave. width 3.0225"
 Ave. Thickness 0.3752"
 Spectrum E-16 400 Hz
 Max. Stress Level 34.0 Ksi (Gross)
 Fatigue Life 20435 FIF Hrs.

Final Crack Sizes	
LH	RH
0.6601"	0.5981"

Test Date

7-1-85



Notes:

FRATOGRAPHIC DATA

FLT. NO.	CRACK SIZE	AV. NO.	CRACK SIZE	AV. NO.	CRACK SIZE
11200	0.004	19600	0.4468		
11600	0.0076	20000	0.5259		
12000	0.0104	20435	0.6601		
12400	0.0139				
12800	0.0183				
13200	0.024				
13600	0.0301				
14000	0.0359				
14400	0.0432				
14800	0.0516				
15200	0.0714				
15600	0.0894				
16000	0.1079				
16400	0.1221				
16800	0.1445				
17200	0.1688				
17600	0.2009				
18000	0.2333				
18400	0.2797				
18800	0.3294				
19200	0.3791				

Test Series UN (H)

Batch Set UNWTFD

Specimen No. UNWTFD-11 (Q15.135)

Material 7075-T7351 AL

BoM Load Transfer 0%

Fastener Open Hole

Avg Width 3.0195"

Avg Thickness 0.3785"

Spectrum F-16 400 Hz

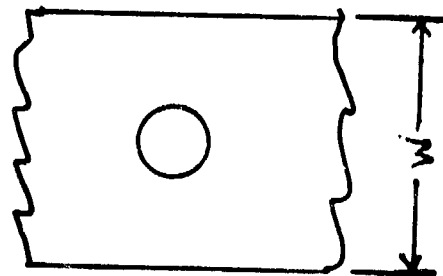
Max. Stress Level 34.0 KSI (6000)

Fatigue Life 23606 FTHrs

Final Crack Sizes	
LH	RH
0.6979"	0.6584"

Test Date

7-1-85



Notes:

FRATOGRAPIH 0070

FLR NOS	CRACK SIZE	AUT NBS	CRACK SIZE	AUT NBS	CRACK SIZE
15200	0.0016				
15600	0.0089				
16000	0.0159				
16400	0.0245				
16800	0.0362				
17200	0.0436				
17600	0.0532				
18000	0.0655				
18400	0.0838				
18800	0.0985				
19200	0.1081				
19600	0.1299				
20000	0.1519				
20400	0.1814				
20800	0.2043				
21200	0.2516				
21600	0.2972				
22000	0.3433				
22400	0.3846				
22800	0.4675				
23200	0.5554				

Test Series IV(h)

Part Set WIPPO

Specimen No. WINPO-12 (Duo. 13)

Material 7075-T7351 AL

Boil Load Transfer 0

Fastener Open Hole

Ave Width 30.300

Ave Thickness 0.3745

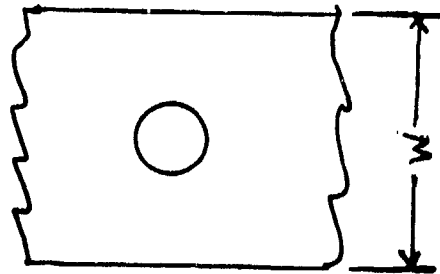
Spectrum F-16 400 Hz

Max. Stress Level 34.0 Ksi (Gross)

Fatigue Life 24000 Fit Hrs

Final Crack Sizes	
LH	RH
0.8523	0.7838

Test Date 7-1-85



FRATOGRAPHIC DATA

Fit hrs	Crack Size	Alt. mm.	Crack Size	Alt. mm.	Crack Size
12800	0.0032		0.2824		
13200	0.0068	21200	0.3088		
13600	0.0088	21600	0.3539		
14000	0.0106	22000	0.3969		
14400	0.0186	22400	0.4536		
14800	0.026	22800	0.5196		
15200	0.0336	23200	0.6205		
15600	0.0425	23600	0.8523		
16000	0.0513	24000			
16400	0.0601				
16800	0.0702				
17200	0.0815				
17600	0.0919				
18000	0.1049				
18400	0.12				
18800	0.1325				
19200	0.1512				
19600	0.1723				
20000	0.1941				
20400	0.2139				
20800	0.2436				

Notes:

Test Series IX (h)

Rel. Set WUPFO

Specimen No. WUPFO-3 (Doc. 137)

Material 7075-T7351 AL

Load Transfer 0.90

Fastener Open Hole

ave width 3.0195"

ave. Thickness 0.3750"

Spectrum F-16 400 Hz

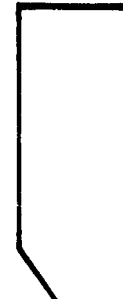
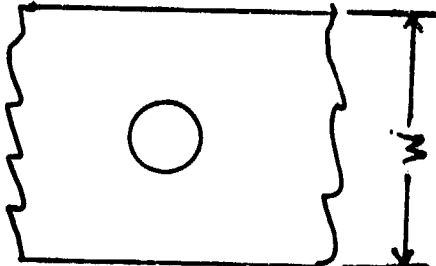
Max. Stress Level 340ksi (gross)

Fatigue Life 20035 FHrs

Final Crack Sizes	
LN	RN
0.6854"	0.5816"

Test Date

7-1-85



Notes:

FLAT TO BE RAMPED NOTED

FLT HRS	CRACK SIZE	AUT. MEAS.	CRACK SIZE	AUT. MEAS.	CRACK SIZE
10800	0.0064		0.4731	19200	
11200	0.0114		0.5495	19400	
11600	0.0146		0.6854	20035	
12000	0.0256				
12400	0.0382				
12800	0.0522				
13200	0.0649				
13600	0.0769				
14000	0.0896				
14400	0.1025				
14800	0.1134				
15200	0.1328				
15600	0.1521				
16000	0.1711				
16400	0.1944				
16800	0.2116				
17200	0.2412				
17600	0.2763				
18000	0.3047				
18400	0.3509				
18900	0.4033				

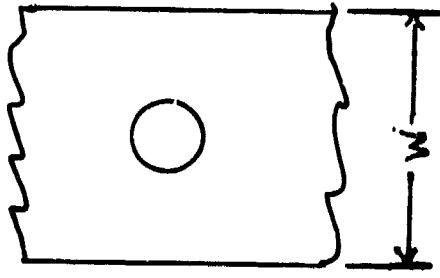
FLATOGRAPHIC DATA

Test Series JE(h)
 Plate Set WUWFO
 Specimen no. WUWFO-A (DUC. 138)
 Material 7075-T7351 AL
 Bolt Load Transfer 0%
 Fastener Open Hole
 Ave Width 3.0240"
 Ave Thickness 0.3777"
 Spectrum F-16 511.4 HL
 Ave. Stress Level 340KSI (6000)
 Fatigue Life 21206 Cycles

Final Crack Sizes	
LH	RH
0.7916"	0.6256"

Test Date

7-1-85



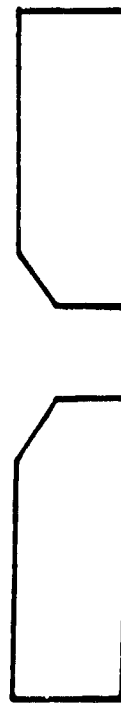
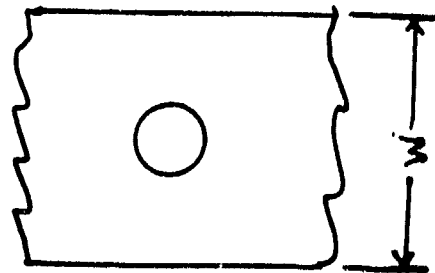
Notes:

FLC NO.	CRACK SIZE	FLC NO.	CRACK SIZE	FLC NO.	CRACK SIZE
8000	0.0057	16400	0.181		
8400	0.0081	16800	0.1989		
8800	0.0106	17200	0.221		
9200	0.0129	17600	0.2393		
9600	0.0149	18000	0.2684		
10000	0.0164	18400	0.3012		
10400	0.0173	18800	0.3314		
10800	0.022	19200	0.3797		
11200	0.0279	19600	0.4214		
11600	0.0353	20000	0.4834		
12000	0.045	20400	0.5722		
12400	0.0548	20800	0.6457		
12800	0.0665	21206	0.7966		
13200	0.0792				
13600	0.0882				
14000	0.0973				
14400	0.1101				
14800	0.1204				
15200	0.1388				
15600	0.1593				
16000	0.2709				

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[illegible]

Test Date 7-8-85



Notes: Specimen failed at lug end
(Specimen tested without lug end doublers)

APPENDIX G

FRACTOGRAPHIC RESULTS FOR DOUBLE REVERSED DOG-BONE SPECIMENS
(Phase 2; Test Series IV(d))

DATE	NAME	
5-18-63	NAME	

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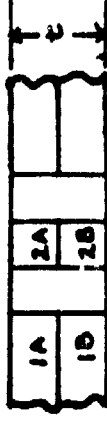
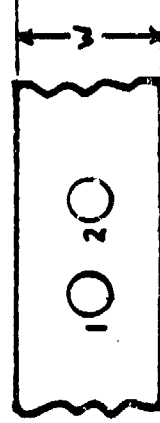
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[illegible]

Hole	Crack	Final Dimensions
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
10	10	10
11	11	11
12	12	12
13	13	13
14	14	14
15	15	15
16	16	16
17	17	17
18	18	18
19	19	19
20	20	20
21	21	21
22	22	22
23	23	23
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26	26	26
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35	35	35
36	36	36
37	37	37
38	38	38
39	39	39
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41	41	41
42	42	42
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46	46	46
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74	74	74
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81	81	81
82	82	82
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84	84	84
85	85	85
86	86	86
87	87	87
88	88	88
89	89	89
90	90	90
91	91	91
92	92	92
93	93	93
94	94	94
95	95	95
96	96	96
97	97	97
98	98	98
99	99	99
100	100	100

Hole	Final Crack Size (In)	
	Large	Small
1A	0.9150"	0.7710"
1B	0.5548	—
2A	0.0835	—
2B	0.0153	—

Test Series TV (d)
 Bolt Set WAFENR4
 Specimen no. WAFENR4-2 (Duc 62)
 Material 7075-T7351 AL
 Bolt Load Transfer 150%
 Fastener MS90352-00 (4000) FMS
 Ave Width 3.0065"
 Ave Thickness .3910"
 Spectrum F-16 400 Hr
 max. Stress Level 34.0 ksi (6000)
 Fatigue Life 28436 FTHs
 Failure In Mode 1B



FRAC TOGRAPHIC DATA

FLT NO.	CRACK SIZE	FLT NO.	CRACK SIZE	FLT NO.	CRACK SIZE
14800	0.0004	23200	0.2974		
15200	0.0108	23600	0.5236		
15600	0.020	24000	0.3568		
16000	0.0328	24400	0.3798		
16400	0.0396	24800	0.4051		
16800	0.0480	25200	0.4335		
17200	0.0568	25600	0.4563		
17600	0.0672	26000	0.4842		
18000	0.0725	26400	0.5187		
18400	0.0840	26800	0.5513		
18800	0.0958	27200	0.5858		
19200	0.1083	27600	0.6447		
19600	0.1182	28000	0.7247		
20000	0.132	28436	0.8337		
20400	0.146				
20800	0.165				
21200	0.1828				
21600	0.2052				
22000	0.2293				
22400	0.2553				
22800	0.2743				

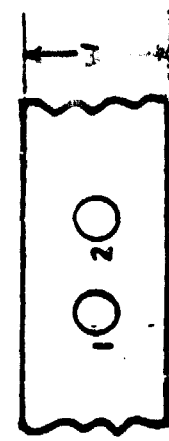


Hole Crack Final Dimensions

Hole	Final Crack Size (In)
	Large
1A	0.2743"
1B	0.8337"
2A	0.4791"
2B	0.4803"

Notes:

Test Series IV(d)
 Ref. Set WAFPMCA
 Specimen No. WAFPMCA-3 (DUC. 103)
 Material 7079-77951 AL
 Bolt Load Transfer 15%
 Fastener M590359-08 (4.0mm) R6001
 Ave. Width 3.0080"
 Ave. Thickness .3915"
 Spectrum F-16 400 Hz
 Max. Stress Level 34,000 psi (6000)
 Fatigue Life 33208 FIT Hrs
 Failure In Note 2B



FRAC TOGRAPHIC DATA

FLT. NOS	CRACK SIZE	RET. NOS.	CRACK SIZE	RET. NOS.	CRACK SIZE
20800	0.1075	29200	0.352		
21200	0.1575	29600	0.3664		
21600	0.1605	30000	0.3888		
22000	0.1659	30400	0.4088		
22400	0.1702	30800	0.4344		
22800	0.1712	31200	0.4595		
23200	0.175	31600	0.4897		
23600	0.1799	32000	0.5255		
24000	0.1847	32400	0.5693		
24400	0.1924	32800	0.6331		
24800	0.1991	33200	0.7580		
25200	0.2095				
25600	0.2158				
26000	0.2239				
26400	0.2338				
26800	0.2416				
27200	0.2624				
27600	0.2763				
28000	0.2944				
28400	0.3129				
28800	0.3267				

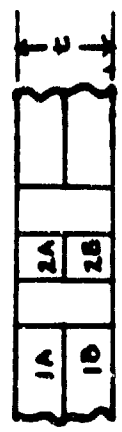
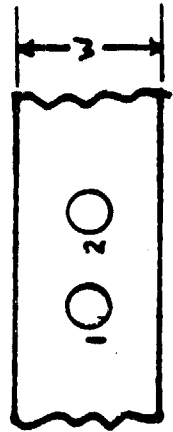


Note Crack Final Dimensions

Abk.	Final Crack Size (In.)
1A	0.5596"
1B	0.5946"
2A	0.6642"
2B	0.7580"

Notes:

Test Series IK(d)
 Pak Set WAFR M24
 Specimen No. WAFR M24-4 (DUT 144)
 Material 7079-T7351 AL
 B/N Load Transfer 15%
 Fastener M590359-08 (46 AN) Rmsr
 Ave Width 3.0140"
 Ave Thickness .3915"
 Spectrum F-16 400 Hr
 Max. Stress Level 34.0 Ksi (6700)
 Fatigue Life 22836 F1t Hrs
 Failure In Mode 2A



FRATOGRAPHIC DATA

FLT. HRS	CRACK SIZE	ALT. MAG.	CRACK SIZE	ALT. MAG.	CRACK SIZE
10000	0.0086	18400	0.2770		
10400	0.013	18800	0.3046		
10800	0.0203	19200	0.3226		
11200	0.0261	19600	0.3491		
11600	0.0341	20000	0.3767		
12000	0.040	20400	0.4067		
12400	0.0498	20800	0.4405		
12800	0.0619	21200	0.4798		
13200	0.0767	21600	0.5185		
13600	0.0932	22000	0.5679		
14000	0.1024	22400	0.6046		
14400	0.1132	22836	0.7855		
14800	0.1202				
15200	0.1322				
15600	0.1431				
16000	0.1554				
16400	0.1738				
16800	0.1916				
17200	0.2096				
17600	0.2297				
18000	0.2572				



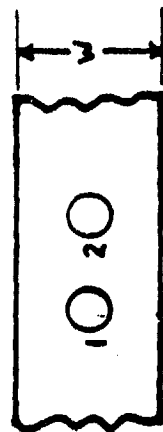
Hole Crack Final Dimensions

Hole	Final Crack Size (In)
1A	0.1071"
1B	0.1209"
2A	0.7855"
2B	0.4135"

Notes:

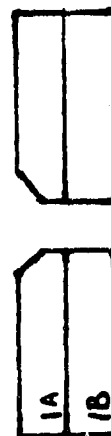
Test Series IE (d)
 Data Set WAFX MRA
 Specimen No. WAFX MRA-5 (Dir-65)
 Material 7079-77951 AL.
 B/N Load Transfer 15%
 Fastener A1590392-08 (4mm) Rivet
 Ave Width 3.0075"
 Ave. Thickness .3895"
 Spectrum F-16 400 Hz
 Max. Stress Level 34,000 psi (gross)
 Fatigue Life 17236 F1t Hrs
 Failure In Mode 1A

G-6



FLATBARRANIC 2079

FLT HRS	CRACK SIZE	ACT. HRS.	CRACK SIZE	ACT. HRS.	CRACK SIZE
7200	0.0242	15600	0.413		
7600	0.0324	16000	0.4627		
8000	0.0419	16400	0.5191		
8400	0.0541	16800	0.5978		
8800	0.0618	17236	0.7388		
9200	0.0723				
9600	0.0807				
10000	0.091				
10400	0.1035				
10800	0.1155				
11200	0.129				
11600	0.1378				
12000	0.1574				
12400	0.1691				
12800	0.1912				
13200	0.213				
13600	0.2405				
14000	0.2654				
14400	0.3003				
14800	0.3254				
15200	0.3753				

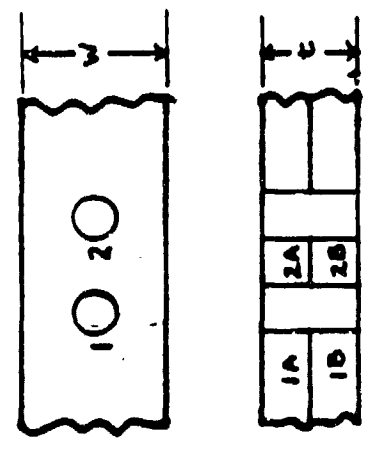


Notes:

Able Crack Final Dimensions

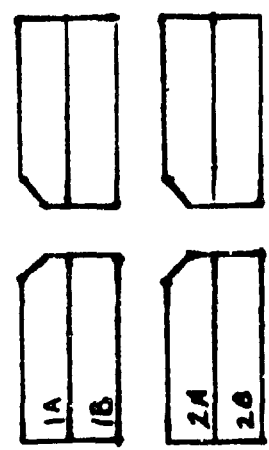
Abk.	Final Crack Size (In.)
	Large
1A	0.7388"
1B	0.6521"
2A	no flaw
2B	0.0366"

Test Series IV(d)
 Pole Set WAFRNIC4
 Specimen no. WAFRNIC4-6 (Dir 66)
 Material 7079-T3951 AL
 SN Load Transfer 15%
 Fastener M590399-08 (14.00) R1001
 Ave Width 3.0060"
 Ave Thickness .3900"
 Spectrum F-16 400 Hz
 Max Stress Level 3400 kpsi (gross)
 Fatigue Life 111008 Fit Hrs
 Failure In Note 2B



FRAC TOGRAPHIC DATA

FLT NO.	CRACK SIZE	FLT NO.	CRACK SIZE	FLT NO.	CRACK SIZE
4400	0.0156				
4900	0.0237				
5200	0.0396				
5600	0.0522				
6000	0.0609				
6400	0.0901				
6800	0.1067				
7200	0.1212				
7600	0.1389				
8000	0.1516				
8400	0.19				
8800	0.2102				
9200	0.2394				
9600	0.2832				
10000	0.3305				
10400	0.3865				
10800	0.41621				
11200	0.5469				
11608	0.9885				



Hole Crack Final Dimensions

Hole	Final Crack Size (In.)
1A	Large
1B	Small
2A	no Flaw
2B	no Flaws
2B	0.9895" 0.8299"

Notes:

TEST SERIES IX(d)

Part Set WAFEXMR4

Specimen No. WAFEXMR4-7 (DUR 67)

Material 7075-T7351 AL

Load Transfer 15%

Fastener M390392-08 (1/4" DIA) F1081

Ave Width _____

Ave. Thickness _____

Spectrum F-16 400 HL

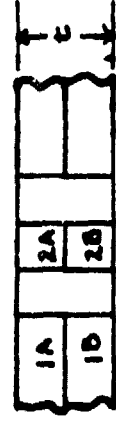
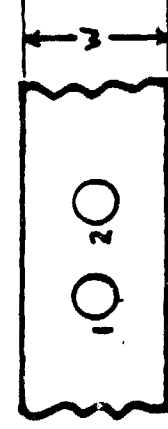
Max. Stress Level 34.0 KSI (Gross)

Fatigue Life 19637 AVE. MS

Failure In Hole 2A

FLATOGGRAPHIC DATA

FLY MS	CRACK SIZE	ALT. MS.	CRACK SIZE	ALT. MS.	CRACK SIZE
3200	0.0619	1600	0.1369	19637	0.7916
3600	0.0029	12000	0.1496		
4000	0.0057	12400	0.1609		
4400	0.0067	12800	0.1698		
4800	0.0129	13200	0.1857		
5200	0.0189	13600	0.1917		
5600	0.0228	14000	0.2077		
6000	0.0277	14400	0.2253		
6400	0.035	14800	0.241		
6800	0.0424	15200	0.2587		
7200	0.0498	15600	0.2705		
7600	0.0591	16000	0.2932		
8000	0.0677	16400	0.3142		
8400	0.0777	16800	0.3333		
8800	0.0857	17200	0.3598		
9200	0.0933	17600	0.3793		
9600	0.0985	18000	0.4125		
10000	0.1013	18400	0.4494		
10400	0.1106	18800	0.4769		
10800	0.1185	19200	0.5349		
11200	0.1246	19600	0.6381		



Hole Crack Final Dimensions

Hole	Final Crack Size (In.)
1A	0.2707"
1B	0.3519"
2A	0.7916"
2B	0.8251"

Notes:

Test Series IV(d)

Plate Set WAFXME4

Specimen No. WAFXME4-8 (Dir 68)

Material 7075-T3951 AL

Boil Load Transfer 15%

Fastener A590392-08 (4000) Steel

Ave Width 3.0070"

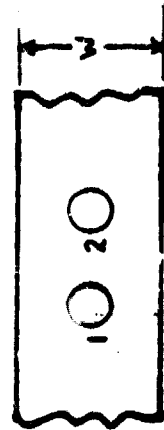
Ave Thickness .3830"

Spectrum F-16 400 Hz

Max. Stress Level 34.0 Ksi (gross)

Fatigue Life 30036 FIF Hrs

Failure In Mode 1B



FLATOGRAPHIC DATA

FIL nos	CRACK SIZE	ALT nos.	CRACK SIZE	ALT nos.	CRACK SIZE
14800	0.0054	23200	0.1875		
15200	0.0087	23600	0.2036		
15600	0.0127	24000	0.222		
16000	0.0183	24400	0.246		
16400	0.0238	24800	0.2632		
16800	0.0306	25200	0.2776		
17200	0.0363	25600	0.2901		
17600	0.0419	26000	0.3127		
18000	0.0469	26400	0.3366		
18400	0.0546	26800	0.3556		
18800	0.0622	27200	0.3732		
19200	0.0702	27600	0.3879		
19600	0.0799	28000	0.4196		
20000	0.0912	28400	0.4537		
20400	0.0951	28800	0.494		
20800	0.1084	29200	0.5489		
21200	0.1216	29600	0.6252		
21600	0.141	30036	0.7677		
22000	0.1544				
22400	0.1697				
22800	0.1825				

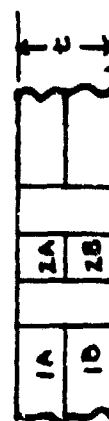
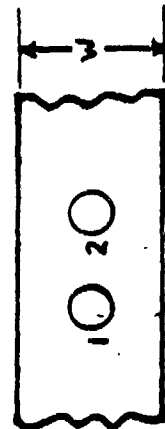


Notes:

Hole Crack Final Dimensions

Hole	Final Crack Size (In)
1A	0.6487"
1B	0.7477"
2A	0.1457"
2B	0.2323"

Test Series IV (d)
 Plate Set WAFXMR-4
 Specimen No. WAFXMR-9 (Dir 19)
 Material 7075-T7351 AL
 Bolt Load Transfer 15%
 Fastener M590352-08 (4000) Limit
 Ave Width 3.040"
 Ave. Thickness .3880"
 Spectrum F-16 400 Hz
 Ave. Stress Level 34.0 Ksi (Gross)
 Fatigue Life 12808 FIT Hrs
 Failure In Hole 2A



FRAC TOGRAPHIC DATA

FIT HRS	CRACK SIZE	FIT HRS.	CRACK SIZE	FIT HRS.	CRACK SIZE
3600	0.0136	12000	0.5899		
4000	0.0249	12400	0.7064		
4400	0.0427	12808	0.9341		
4800	0.0579				
5200	0.0743				
5600	0.0898				
6000	0.1013				
6400	0.1147				
6800	0.1247				
7200	0.137				
7600	0.1585				
8000	0.1723				
8400	0.1934				
8800	0.2218				
9200	0.2595				
9600	0.2945				
10000	0.320				
10400	0.3547				
10800	0.3943				
11200	0.4422				
11600	0.515				



Hole Crack Final Dimensions

Hole	Final Crack Size (In)
1A	as Flaw
1B	0.1885"
2A	0.9341"
2B	0.5810"

Notes:

Test Series IV(d)

Part Set WAFEX-124

Specimen No. WAFEX-124-10 (DUC. 70)

Material 7079-77951 AL

Load Transfer 15%

Fastener A1590355-08 (1/4" x 1/2")

ave width 3.0075"

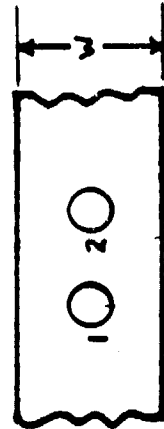
ave. Thickness .390"

Spectrum F-16 400 Hz

Max. Stress Level 34,000 PSI (6000)

Fatigue Life 15208 FIT HRS

Failure In Hrs 1A



FRATOGRAPHIC DATA

FIT HRS	CRACK SIZE	RET HRS	CRACK SIZE	RET HRS	CRACK SIZE
6800	0.0046	15208	0.8875		
7200	0.0113				
7600	0.0211				
8000	0.033				
8400	0.0486				
8800	0.0593				
9200	0.0715				
9600	0.0848				
10000	0.1028				
10400	0.124				
10800	0.1505				
11200	0.1747				
11600	0.1999				
12000	0.2328				
12400	0.2749				
12800	0.308				
13200	0.3422				
13600	0.3748				
14000	0.44				
14400	0.5108				
14800	0.6196				

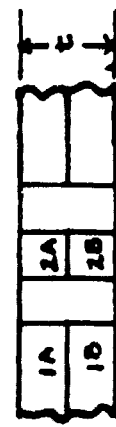
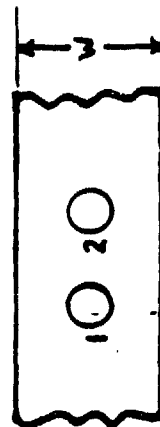


Hole Crack Final Dimensions

Hole	Final Crack Size (In.)
1A	0.8875"
1B	0.5568"
2A	no flow
2B	0.0741"

Notes:

Test Series IV(d)
 Ref. Set WAFEXM124
 Specimen no. WAFEXM124-11(DUCTILE)
 Material 7079-T7351 AL.
 B/N Load Transfer 15%
 Fastener M590399-08 (1/4" DIA) RIVET
 Ave Width 3.0120"
 Ave Thickness .3925"
 Spectrum F-16 400 Hz
 max. Stress Level 34,000 psi (Gross)
 Fatigue Life 18436 FIF Hr
 Failure in Abn 1A



PHOTOGRAPHIC DATA

FLY WTS	CRACK SIZE	FLY WTS	CRACK SIZE	FLY WTS	CRACK SIZE
8000	0.0028	16400	0.3087		
8400	0.0067	16800	0.3567		
8800	0.0126	17200	0.4016		
9200	0.021	17600	0.4699		
9600	0.0279	18000	0.5577		
10000	0.0363	18436	0.7304		
10400	0.0432				
10800	0.052				
11200	0.063				
11600	0.0725				
12000	0.0828				
12400	0.0968				
12800	0.1087				
13200	0.1219				
13600	0.1405				
14000	0.1603				
14400	0.177				
14800	0.1927				
15200	0.2181				
15600	0.2435				
16000	0.2788				

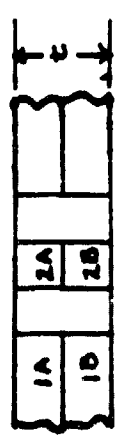
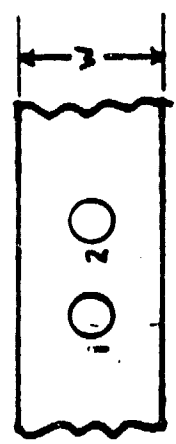
Hole Crack Final Dimensions

Hole	Final Crack Size (In.)
1A	0.7304"
1B	0.6856"
2A	no Flow
2B	no Flow



Notes:

Test Series III (d)
 Data Set WAFEXMRA
 Specimen No. WAFEXMRA-12 (DUT 72)
 Material 7079-T7351 AL
 Bolt Load Transfer 15%
 Fastener M590359-08 (4.00) FINEST
 Ave Width 3.0105"
 Ave Thickness .3843"
 Spectrum F-16 400 HR
 Max Stress Level 340 Ksi (Gross)
 Fatigue Life 21792 FH HR
 Failure In Note 2A



PHOTOGRAPHIC DATA

FIL NO.	CRACK SIZE	RET. NO.	CRACK SIZE	RET. NO.	CRACK SIZE
14800	0.0114				
15200	0.0274				
15600	0.0432				
16000	0.0595				
16400	0.0771				
16800	0.0906				
17200	0.1146				
17600	0.1455				
18000	0.1954				
18400	0.2377				
18800	0.2845				
19200	0.3412				
19600	0.3835				
20000	0.443				
20400	0.5185				
20800	0.5832				
21200	0.7363				
21600	0.9457				
21792	1.2976				



Hole Crack Final Dimensions

Hole	Final Crack Size (In.)	
	Large	Small
1A	0.1326"	—
1B	0.1344"	—
2A	1.2976"	1.05"
2B	0.9373"	—

Notes:

Test Series TR 7(d)

Batch Set WAFEX-M24

Specimen No. WAFEX-M24-14
(Per 74)

Material 7075-T7351 AL.

Boil load Transfer 15%

Fastener M590352-08 (4mm) F100

ave width 3.0135"

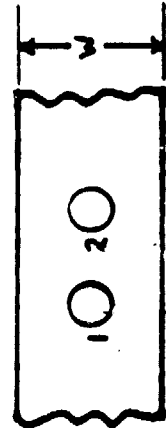
ave. Thickness .3875"

Spectrum F-16 400HR

ave. Stress Level 34.0 KSI (Gross)

Fatigue Life 31636 F11 Hrs

Failure In Mode 2A



PHOTOGRAPHIC DATA

FLT. NO.	CRACK SIZE	FLT. NO.	CRACK SIZE	FLT. NO.	CRACK SIZE
24400	0.0199				
24800	0.0272				
25200	0.04				
25600	0.0517				
26000	0.0648				
26400	0.0704				
26800	0.0876				
27200	0.1067				
27600	0.1288				
28000	0.152				
28400	0.1736				
28800	0.2083				
29200	0.25				
29600	0.2973				
30000	0.348				
30400	0.4131				
30800	0.4927				
31200	0.5884				
31636	0.8949				



Notes:

Hole Crack Final Dimensions

Hole	Final Crack Size (In.)
1A	Large 0.0442"
1B	Small 0.0921"
2A	0.8949"
2B	0.4003"

APPENDIX H

FRACTOGRAPHIC RESULTS FOR DOUBLE REVERSED DOG-BONE SPECIMENS (15%
LT)
(Phase 2; Test Series IV(e))

Test Series

(vii)

Data Set WATXHL4

WAFEX44-1

Specimen no. Qu. 76

Material 7473-77351 AL.

BoH Load Transfer 15-2/3

Fastener MS90359-08 (1/4 in) L, met

are w. dth 3,0165"

ave. Thickness 0.3920"

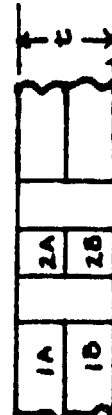
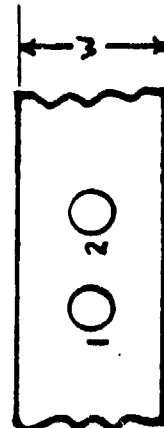
Spectrum F-16 400 NR

max. stress level! $\frac{47.8 \text{ KSI}}{(gross)}$

Fatigue Life 7297 Elt Hrs

Failure In Note 1A

Test Date	5-23-85
1	100
2	100
3	100
4	100
5	100
6	100
7	100
8	100
9	100
10	100
11	100
12	100
13	100
14	100
15	100
16	100
17	100
18	100
19	100
20	100
21	100
22	100
23	100
24	100
25	100
26	100
27	100
28	100
29	100
30	100
31	100
32	100
33	100
34	100
35	100
36	100
37	100
38	100
39	100
40	100
41	100
42	100
43	100
44	100
45	100
46	100
47	100
48	100
49	100
50	100
51	100
52	100
53	100
54	100
55	100
56	100
57	100
58	100
59	100
60	100
61	100
62	100
63	100
64	100
65	100
66	100
67	100
68	100
69	100
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72	100
73	100
74	100
75	100
76	100
77	100
78	100
79	100
80	100
81	100
82	100
83	100
84	100
85	100
86	100
87	100
88	100
89	100
90	100
91	100
92	100
93	100
94	100
95	100
96	100
97	100
98	100
99	100
100	100



1A	1B
----	----

2A	2B
----	----

Notes:

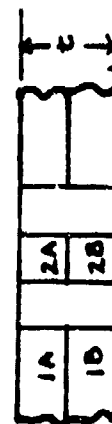
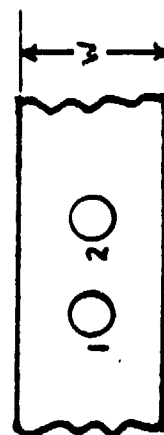
FLA 106 R 0.0 N/C DATA

[illegible]

Hole	Crack	Final Dimensions
1	1/2"	1/2" x 1/2" x 1/2"
2	1/2"	1/2" x 1/2" x 1/2"
3	1/2"	1/2" x 1/2" x 1/2"
4	1/2"	1/2" x 1/2" x 1/2"
5	1/2"	1/2" x 1/2" x 1/2"
6	1/2"	1/2" x 1/2" x 1/2"
7	1/2"	1/2" x 1/2" x 1/2"
8	1/2"	1/2" x 1/2" x 1/2"
9	1/2"	1/2" x 1/2" x 1/2"
10	1/2"	1/2" x 1/2" x 1/2"
11	1/2"	1/2" x 1/2" x 1/2"
12	1/2"	1/2" x 1/2" x 1/2"
13	1/2"	1/2" x 1/2" x 1/2"
14	1/2"	1/2" x 1/2" x 1/2"
15	1/2"	1/2" x 1/2" x 1/2"
16	1/2"	1/2" x 1/2" x 1/2"
17	1/2"	1/2" x 1/2" x 1/2"
18	1/2"	1/2" x 1/2" x 1/2"
19	1/2"	1/2" x 1/2" x 1/2"
20	1/2"	1/2" x 1/2" x 1/2"
21	1/2"	1/2" x 1/2" x 1/2"
22	1/2"	1/2" x 1/2" x 1/2"
23	1/2"	1/2" x 1/2" x 1/2"
24	1/2"	1/2" x 1/2" x 1/2"
25	1/2"	1/2" x 1/2" x 1/2"
26	1/2"	1/2" x 1/2" x 1/2"
27	1/2"	1/2" x 1/2" x 1/2"
28	1/2"	1/2" x 1/2" x 1/2"
29	1/2"	1/2" x 1/2" x 1/2"
30	1/2"	1/2" x 1/2" x 1/2"
31	1/2"	1/2" x 1/2" x 1/2"
32	1/2"	1/2" x 1/2" x 1/2"
33	1/2"	1/2" x 1/2" x 1/2"
34	1/2"	1/2" x 1/2" x 1/2"
35	1/2"	1/2" x 1/2" x 1/2"
36	1/2"	1/2" x 1/2" x 1/2"
37	1/2"	1/2" x 1/2" x 1/2"
38	1/2"	1/2" x 1/2" x 1/2"
39	1/2"	1/2" x 1/2" x 1/2"
40	1/2"	1/2" x 1/2" x 1/2"
41	1/2"	1/2" x 1/2" x 1/2"
42	1/2"	1/2" x 1/2" x 1/2"
43	1/2"	1/2" x 1/2" x 1/2"
44	1/2"	1/2" x 1/2" x 1/2"
45	1/2"	1/2" x 1/2" x 1/2"
46	1/2"	1/2" x 1/2" x 1/2"
47	1/2"	1/2" x 1/2" x 1/2"
48	1/2"	1/2" x 1/2" x 1/2"
49	1/2"	1/2" x 1/2" x 1/2"
50	1/2"	1/2" x 1/2" x 1/2"
51	1/2"	1/2" x 1/2" x 1/2"
52	1/2"	1/2" x 1/2" x 1/2"
53	1/2"	1/2" x 1/2" x 1/2"
54	1/2"	1/2" x 1/2" x 1/2"
55	1/2"	1/2" x 1/2" x 1/2"
56	1/2"	1/2" x 1/2" x 1/2"
57	1/2"	1/2" x 1/2" x 1/2"
58	1/2"	1/2" x 1/2" x 1/2"
59	1/2"	1/2" x 1/2" x 1/2"
60	1/2"	1/2" x 1/2" x 1/2"
61	1/2"	1/2" x 1/2" x 1/2"
62	1/2"	1/2" x 1/2" x 1/2"
63	1/2"	1/2" x 1/2" x 1/2"
64	1/2"	1/2" x 1/2" x 1/2"
65	1/2"	1/2" x 1/2" x 1/2"
66	1/2"	1/2" x 1/2" x 1/2"
67	1/2"	1/2" x 1/2" x 1/2"
68	1/2"	1/2" x 1/2" x 1/2"
69	1/2"	1/2" x 1/2" x 1/2"
70	1/2"	1/2" x 1/2" x 1/2"
71	1/2"	1/2" x 1/2" x 1/2"
72	1/2"	1/2" x 1/2" x 1/2"
73	1/2"	1/2" x 1/2" x 1/2"
74	1/2"	1/2" x 1/2" x 1/2"
75	1/2"	1/2" x 1/2" x 1/2"
76	1/2"	1/2" x 1/2" x 1/2"
77	1/2"	1/2" x 1/2" x 1/2"
78	1/2"	1/2" x 1/2" x 1/2"
79	1/2"	1/2" x 1/2" x 1/2"
80	1/2"	1/2" x 1/2" x 1/2"
81	1/2"	1/2" x 1/2" x 1/2"
82	1/2"	1/2" x 1/2" x 1/2"
83	1/2"	1/2" x 1/2" x 1/2"
84	1/2"	1/2" x 1/2" x 1/2"
85	1/2"	1/2" x 1/2" x 1/2"
86	1/2"	1/2" x 1/2" x 1/2"
87	1/2"	1/2" x 1/2" x 1/2"
88	1/2"	1/2" x 1/2" x 1/2"
89	1/2"	1/2" x 1/2" x 1/2"
90	1/2"	1/2" x 1/2" x 1/2"
91		

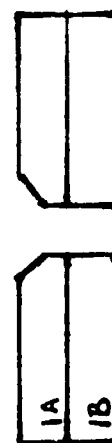
Hole	Final Crack Size (In.)	
	Large	Small
1A	0.710"	—
1B	0.0814"	—
2A	0.060"	0.040"
2B	0.1135"	—

Test Series IV(c)
 Data Set WAFEXH24
 Specimen No. WAFEXH24-3
(Rev. 73)
 Material 7075-T7351 AL
 Bolt Load Transfer 150%
 Fastener M590392-00 (4mm) Riser
 Ave Width 3.0140"
 Ave. Thickness 0.3910"
 Spectrum F-16 400-48
 Ave. Stress Level 40.3 Ksi (Gross)
 Fatigue Life 12405 FHrs
 Failure In Note 1A
 Test Date 5-30-85



FRACTOGRAPHIC DATA

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
4800	0.0051	12800	0.5083		
5200	0.0045	17408	0.790		
5600	0.0048				
6000	0.0044				
6400	0.0042				
6800	0.00313				
7200	0.00374				
7600	0.0040				
8000	0.00505				
8400	0.00608				
8800	0.00806				
9200	0.00915				
9600	0.01143				
10000	0.01400				
10400	0.01836				
10800	0.02276				
11200	0.02651				
11600	0.0295				
12000	0.03475				
12400	0.04082				



Hole Crack Final Dimensions

Hole	Final Crack Size (In)
1A	0.770"
1B	0.511"
2A	0.4117"
2B	0.0944"

Notes:

Test Series III(c)

Batch Set WAPR-HC-4

Specimen No. WAPR-HC-4 (A-79)

Material 7075-T7351 AL

BoN Load Transfer 15%

Fastener M590352-00 (4mm) Rmsr

Ave Width 3.0120"

Ave Thickness 0.3863"

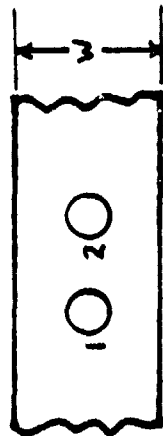
Spectrum F-10 400 HR

Max. Stress Level 40.3 (Gross)

Fatigue Life 4323 EIT Hrs

Failure In Mode 1A

Test Date 6-3-85



FRAC TOG RAPHIC DATA

FLT MKS	CRACK SIZE	FLT MKS.	CRACK SIZE	Air MKS.	CRACK SIZE
1200	0.0030	4323	0.79		
1400	0.0128				
1600	0.0203				
1800	0.0329				
2000	0.0453				
2200	0.0598				
2400	0.0743				
2600	0.0883				
2800	0.1027				
3000	0.1200				
3200	0.1356				
3400	0.1579				
3600	0.1804				
3800	0.2058				
4000	0.2311				
4200	0.2703				
4400	0.3175				
4600	0.3707				
4800	0.4499				
5000	0.5449				
5200	0.766				



Notes:

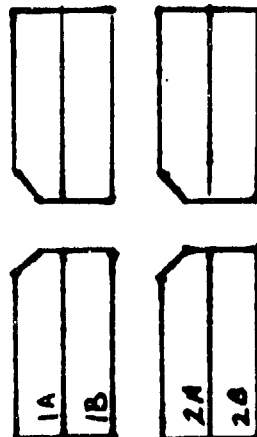
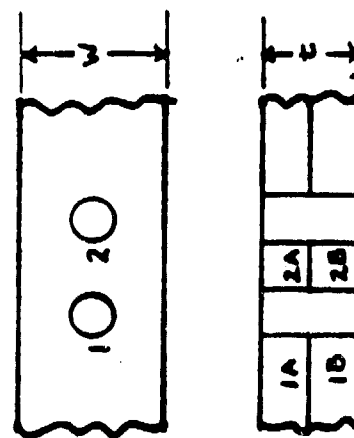
Hole Crack Final Dimensions

Hole	Final Crack Size (In)
1A	0.79"
1B	0.130"
2A	0.180"
2B	0.220"

PHOTOGRAPHIC DATA

Test Series III (c)
 Plate Set WAFER 4
 Specimen No. WAFER 4-5 (DUC. 30)
 Material 7075-T7351 AL.
 BN Load Transfer 150lb
 Fastener M590359-08 (4mm) RMP
 Ave Width 3.0115"
 Ave. Thickness 0.3500"
 Spectrum F-16 400 MHz
 Ave. Stress Level 40.3 Ksi (Gross)
 Fatigue Life 10943 FLL HRS
 Failure In Mode 20
 Test Date 6-3-85

H-6



Hole Crack Final Dimensions

Hole	Final Crack Large	Final Crack Small
1A	0.420"	0.310"
1B	0.296"	0.260"
2A	0.410"	0.350"
2B	0.680" @	0.580"

Notes:

① This data relates to origin on facing surface. The origin at the corner cannot be followed once it intercepts the origin on facing surface

Test Series IV(c)

Plate Set WAFEX HLT

Specimen No. WAFEX HLT - 6
(DWT 31)

Material 7075-T7351 AL.

Boil Load Transfer 150%

Fastener MS90352-08 (4000) Rms

ave width 3.0110"

ave. Thickness 0.3915"

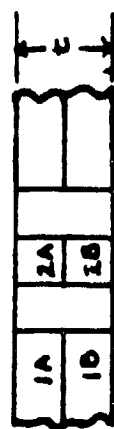
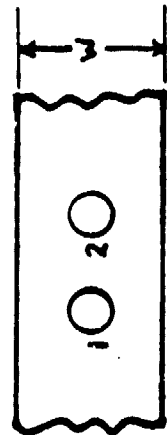
Spectrum F-16 400 Hz

ave. Stress Level 90.8 Ksi (Gross)

Fatigue Life 8103 FH Hrs

Failure In Note 1B

Test Date 6-3-85



FRATOGRAPHIC DATA

FLT. HRS	CRACK SIZE	ALT. MEAS.	CRACK SIZE	ALT. MEAS.	CRACK SIZE
400	0.0030				
800	0.0145				
1200	0.0209				
1400	0.0314				
1600	0.0455				
2400	0.0614				
2800	0.0786				
3200	0.0854				
3600	0.1171				
4000	0.1381				
4400	0.1523				
4800	0.1757				
5200	0.2053				
5600	0.2441				
6000	0.2832				
6400	0.3023				
6800	0.3333				
7200	0.3676				
7600	0.4210				
8000	0.4937				
8400	0.68				



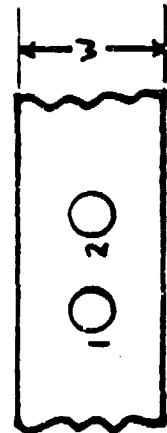
Hole Crack Final Dimensions

Hole	Final Crack Size (In)
1A	0.096"
1B	0.088"
2A	0.220"
2B	0.070"

Notes:

① corner crack - rapid growth at early stages

Test Series IV(c)
 Data Set WAFEXMEX-7
 Specimen No. (NIST)
 Material 7079-72851 AL.
 Ben Load Transfer 15%
 Fastener N590352-08 (4.20) RUST
 Ave Width 3.0100"
 Ave Thickness 0.3350"
 Spectrum F-14 400 Hz
 Max. Stress Level 40.8 Ksi (600)
 Fatigue Life N589 FHRS
 Failure In Mode 1A
 Test Date 6-5-85



FRAC TOGRAPHIC DATA

RET. NOS	CRACK SIZE	RET. NOS.	CRACK SIZE	RET. NOS.	CRACK SIZE
4400	0.0080	12800	0.3032		
4500	0.0118	13200	0.3529		
5200	0.0142	13600	0.4135		
5600	0.0187	14000	0.4852		
6000	0.0225	14400	0.5505		
6400	0.0275	14589	0.605		
6800	0.0325				
7200	0.0388				
7600	0.0429				
8000	0.0517				
8400	0.0599				
8800	0.0680				
9200	0.0816				
9600	0.0940				
10000	0.1078				
10400	0.1246				
10800	0.1474				
11200	0.1681				
11600	0.1904				
12000	0.2206				
12400	0.2601				

Hole Crack Final Dimensions

Hole	Final Crack Size (In)
1A	0.165"
1B	0.58"
2A	0.098"
2B	0.160"



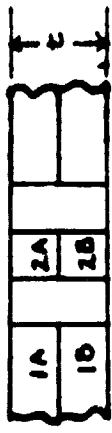
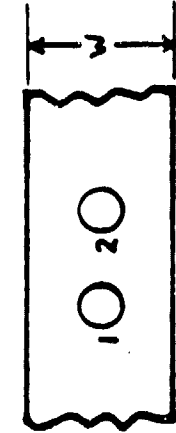
Notes:

Test Series IL(c)
 Plate Set WAFX-M24
 Specimen No. WAFX-M24-B
(Rev 83)
 Material 7075-T7351 AL
 Bolt Load Transfer 150%
 Fastener MS90399-08 (4400) F10T
 Ave Width 3.0070"
 Ave. Thickness 0.3910"
 Spectrum F-16 400 Hz
 Ave. Stress Level 46.8 Ksi (avg)
 Fatigue Life 13649 FIF Hrs
 Failure In Mode 2-B
 Test Date 6-6-85

H-9

FRATOGRAPHIC DATA

FLT NOS	CRACK SIZE	FLT NOS.	CRACK SIZE	FLT NOS.	CRACK SIZE
2000	0.0017	10400	0.2468		
2400	0.0070	10800	0.2655		
2800	0.0136	11200	0.2941		
3200	0.0174	11600	0.3354		
3600	0.0230	12000	0.3714		
4000	0.0290	12400	0.4179		
4400	0.0342	12800	0.4694		
4800	0.0394	13200	0.5242		
5200	0.0449	13600	0.6125		
5600	0.0492	13649	0.88		
6000	0.0576				
6400	0.0671				
6800	0.0774				
7200	0.0897				
7600	0.1028				
8000	0.1106				
8400	0.1341				
8800	0.1536				
9200	0.1747				
9600	0.1917				
10000	0.2139				



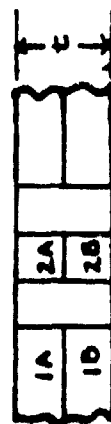
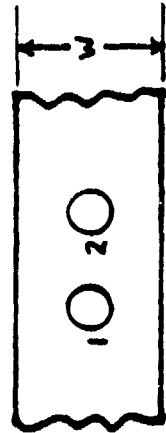
Hole Crack Final Dimensions

Hole	Final Crack Size (In)
1A	0.270"
1B	0.158"
2A	0.315"
2B	0.385"

Notes:

Test Series IV(c)
 Bolt Set WAFEXMCA-9
 Specimen No. (0.054)
 Material 7075-T7351 AL
 Bolt Load Transfer 154 $\frac{1}{2}$
 Fastener MS90352-00 (4000) RMP
 Ave Width 3.0090"
 Ave Thickness 0.3892"
 Spectrum F-16 440 HR
 Max. Stress Level 40.8 KSI (6000)
 Fatigue Life 10547 FIF MS
 Failure In Note 2B
 Test Date 6-6-85

H-10



FRAC TOGRAPHIC DATA

FLT MS	CRACK SIZE	RET. MAG.	CRACK SIZE	RET. MAG.	CRACK SIZE
800	0.0001	9200	0.3257		
1200	0.0125	9400	0.3224		
1400	0.0158	10000	0.3300		
2000	0.0193	10400	0.3405		
2400	0.0239	11570	0.403		
2800	0.0283				
3200	0.0331				
3600	0.0391				
4000	0.0453				
4400	0.0530				
4800	0.0645				
5200	0.0755				
5600	0.0874				
6000	0.1044				
6400	0.1244				
6800	0.1457				
7200	0.1733				
7600	0.1990				
8000	0.230				
8400	0.264				
8800	0.2947				

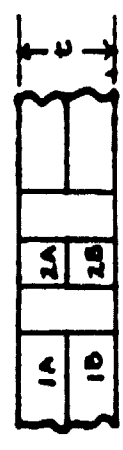
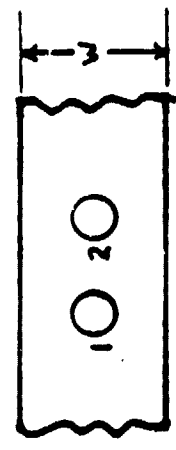


Hole Crack Final Dimensions

Hole	Final Crack Size (In)
	Large
1A	0.035"
1B	0.070"
2A	0.540"
2B	0.54"

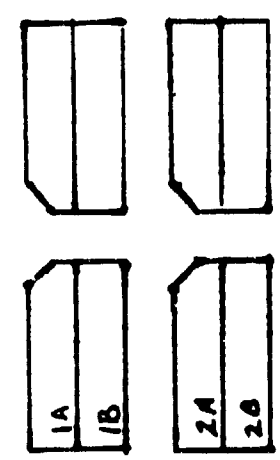
Notes:

TEST SERIES IL (c)
 Batch Set WAFK1444
 Specimen NO. WAFK1444-10 (DLC 85)
 Material 7075-T7351 AL
 B&N Load Transfer 15%
 Fastener A1930359-08 (40mm) R100T
 Ave Width 3.0105"
 Ave Thickness 0.3907"
 Spectrum F-16 400 HR
 Ave. Stress Level 40,815 psi (GROSS)
 Fatigue Life 9597 Cycles
 Failure In Mode 2B
 Test Date 6-6-85



FRATUROGRAPHIC DATA

FLT NO.	CRACK SIZE	FLT NO.	CRACK SIZE	FLT NO.	CRACK SIZE
200	0.0132	450	0.55		
1000	0.0187				
2000	0.0243				
2400	0.0320				
2800	0.0384				
3200	0.0476				
3600	0.0557				
4000	0.0640				
4400	0.0735				
4800	0.0840				
5200	0.0960				
5600	0.1087				
6000	0.1266				
6400	0.1437				
6800	0.1683				
7200	0.1951				
7600	0.2305				
8000	0.2821				
8400	0.3320				
8800	0.4112				
9200	0.5117				



Hole Crack Final Dimensions

Hole	Final Crack Size (In)
1A	0.154"
1B	0.076"
2A	0.78"
2B	0.88"

Notes:

Test Series INTC

Batch Set WAPXMR4

Specimen No. WAPXMR4-11

(REV. 5/6)

Material 7075-T2351 AL

Boil Load Transfer 15%

Fastener A2590352-08 (46mm) Rmsr

ave width 3.0035"

ave. Thickness 0.3910"

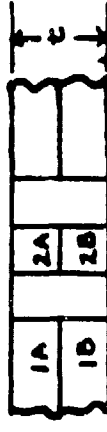
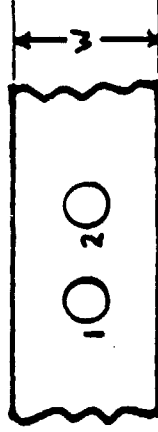
Spectrum F-15 400HR

ave. stress level 40.8KSI (gross)

Fatigue Life 10972 Cycles

Failure In Hole 1b

Test Date 6-7-85



FRAC TOGRAPHIC DATA

FLT MES	CRACK SIZE	ACT MES.	CRACK JUMP	ACT MES.	CRACK SIZE
2000	0.0097	10910	0.4332		
2400	0.0144	10540	0.5551		
2800	0.0195	10773	0.590		
3200	0.0274				
3600	0.0357				
4000	0.0426				
4400	0.0530				
4800	0.0623				
5200	0.0731				
5600	0.0554				
6000	0.0910				
6400	0.1053				
6800	0.1210				
7200	0.1306				
7600	0.1522				
8000	0.1762				
8400	0.2007				
8800	0.2264				
9200	0.2594				
9600	0.3080				
10000	0.3604				



Hole Crack Final Dimensions

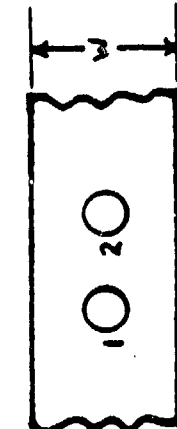
Hole	Final Crack Size (In)
1A	0.515"
1B	0.530"
2A	0.010"
2B	no crack

Notes:

Test Series W(c)
 Pole Set WAFEX-12
 Specimen No. (D.C. 81)
 Material 7075-T7351 AL.
 Bolt Load Transfer 15%
 Fastener M590392-08 (4.2mm) RMP
 Ave Width 30.220
 Ave Thickness 0.3733
 Spectrum F-10 400 Hz
 Max. Stress Level 40.8 Ksi (Gross)
 Fatigue Life 11453 FLL HRS
 Failure In Hole 2A
 Test Date 6-7-85

FRACTOGRAPHIC DATA

FLT HRS	CRACK SIZE	FLT HRS	CRACK SIZE	FLT HRS	CRACK SIZE
1200	0.0202	4000	0.3117		
1600	0.0254	10000	0.3640		
2000	0.0326	10400	0.4304		
2400	0.0401	10800	0.512		
2800	0.0487	11200	0.654		
3200	0.0558	11453	1.02		
3600	0.0626				
4000	0.0689				
4400	0.0754				
4800	0.0832				
5200	0.0900				
5600	0.0997				
6000	0.1094				
6400	0.1197				
6800	0.1313				
7200	0.1426				
7600	0.1627				
8000	0.1846				
8400	0.2091				
8800	0.2385				
9200	0.2745				



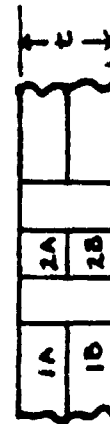
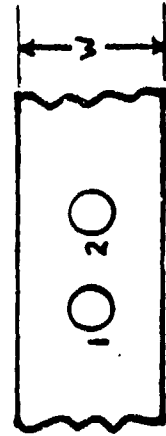
Hole Crack Final Dimensions

Hole	Final Crack Size(In)	
	Large	Small
1A	0.170"	0.152"
1B	0.140"	0.080"
2A	1.02" ①	0.61"
2B	0.180"	0.130"

Notes:

(1) Initiation on facing
 surface 0.016" from corner

Test Series IV (e)
 Data Set WAFR H24
 Specimen No. WAFR H24-13
(Rev. 83)
 Material 7075-T2851 AL
 Bolt Load Transfer 15%
 Fastener MS90322-08 (4.00) 5100
 Ave Width 3.0120"
 Ave Thickness 0.3342"
 Spectrum F-16 400 HR
 Ave. Stress Level 40.824 (5000)
 Fatigue Life 12542 FLT Hrs
 Failure in Hole 1B
 Test Date 6-10-85



FRAC TOG R APAC DATA

FLT HRS	CRACK SIZE	RET. MEAS.	CRACK SIZE	RET. MEAS.	CRACK SIZE
1200	0.0123	9000	0.2035		
1600	0.0177	10000	0.2238		
2000	0.0234	10500	0.2520		
2400	0.0282	10800	0.2879		
2800	0.0340	11200	0.3266		
3200	0.0403	11600	0.3679		
3600	0.0465	12000	0.4387		
4000	0.0524	12400	0.5294		
4400	0.0592	12542	0.678		
4800	0.0660				
5200	0.0748				
5600	0.0802				
6000	0.0877				
6400	0.0976				
6800	0.1051				
7200	0.1146				
7600	0.1243				
8000	0.1346				
8400	0.1477				
8800	0.1635				
9200	0.1833				



Hole Crack Final Dimensions

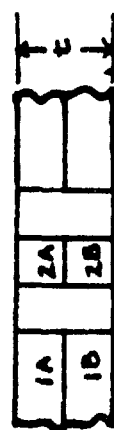
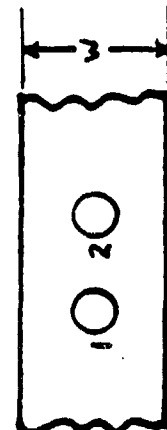
Hole	Final Crack Size (In.)
1A	0.442"
1B	0.678"
2A	0.125"
2B	0.092"

Notes:

FRATOGRAPIH

Test Series UK(C)
 Ref. Set WAFRHLA
 Specimen No. WAFRHLA-14 (DUG 34)
 Material 7075-T7351 AL
 BN Load Transfer 15%
 Fastener A590352-08 (4mm) Rmsr
 ave width 3.0135"
 Ave. Thickness 0.3342"
 Spectrum F-16 400 HR
 max. Stress Level 40.5 KSI (Gross)
 Fatigue Life 16643 FLT HR's
 Failure in Note 1A
 Test Date 6-10-85

FLT MES	CRACK SIZE	ALT MES.	CRACK SIZE	ALT MES.	CRACK SIZE
2000	0.0031	10400	0.1342		
2400	0.0063	10800	0.1476		
2800	0.0096	11200	0.1627		
3200	0.0134	11600	0.1764		
3600	0.0170	12000	0.1935		
4000	0.0215	12400	0.2102		
4400	0.0244	12800	0.2234		
4800	0.0255	13200	0.2263		
5200	0.0331	13600	0.2732		
5600	0.0373	14000	0.2480		
6000	0.0424	14400	0.3235		
6400	0.0472	14800	0.3532		
6800	0.0538	15200	0.3930		
7200	0.0602	15600	0.4352		
7600	0.0666	16000	0.4949		
8000	0.0745	16400	0.5727		
8400	0.0832	16643	0.72		
8800	0.0912				
9200	0.0996				
9600	0.1110				
10000	0.1278				



Note Crack Final Dimensions

Hole	Final Crack Size (In)
1A	Large 3.72"
1B	Small 0.46"
2A	0.350"
2B	0.230"
2A	0.080"
2B	0.042"
2B	0.272"
2B	0.166"

Notes:

Test Series IV(c)

Date Set WAFEXH24

Specimen no. WAFxHR4-15 (A-92)

Material 7475-77951 M.

Don Load Transfer 15-01/4

Fastener MS90359-08 (400) 5111

are with 3.6080 ^d

Av. Thickness 0.3910"

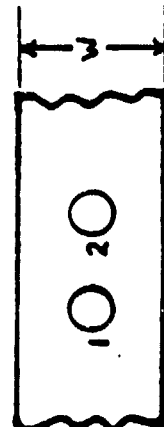
Spectrum F-16 400 HL

Max. Stress Level 40.8 Ksi (Grog)

Catque Life 7731.9 FLE HCS

2A
Failure In Note

Test Date 6-10-85



1A	1B

2A	2B
----	----

Note s:

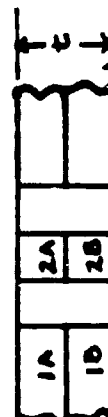
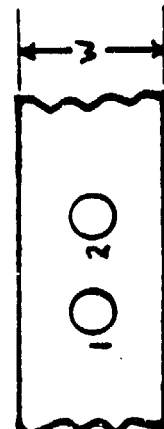
Node	Crack	Final	Dimensions
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10
11	11	11	11
12	12	12	12
13	13	13	13
14	14	14	14
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16	16	16	16
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90	90	90	90
91	91	91	91
92	92	92	92
93	93	93	93
94	94	94	94
95	95	95	95
96	96	96	96
97	97	97	97
98	98	98	98
99	99	99	99
100	100	100	100

Hole	Final Crack Size (In.)	
	Large	Small
1A	0.1036"	0.0673"
1B	0.1027"	0.1199"
2A	0.1137"	0.5226"
2B	0.2520"	0.1726"

APPENDIX I

FRACTOGRAPHIC RESULTS FOR DOUBLE REVERSED DOG-BONE SPECIMENS (15% LT)
(Phase 2; Test Series IV(f))

Test Series IL(F)
 Plate Set KXW/PB
 Specimen No. WXW/PB-2 (0.001)
 Material 7075-T7351 AL.
 B/N Load Transfer 15%
 Fastener M590359-08 (4.0mm) Limit
 Ave Width 3.0170"
 Ave. Thickness .3847"
 Spectrum Bombier
 Max. Stress Level 340,000 psi (6000)
 Fatigue Life 39644 FET Mes
 Failure In Mes 1A



FRAC TOGRAPHIC DATA

FET Mes	CRACK SIZE	ALT Mes	CRACK SIZE	ALT Mes	CRACK SIZE
19828	0.0043				
20883	0.0126				
21937	0.0239				
22992	0.0399				
24047	0.0622				
25701	0.0813				
26156	0.1091				
27000	0.1368				
28055	0.152				
29109	0.1735				
30164	0.1976				
31219	0.2233				
32273	0.2529				
33328	0.282				
34383	0.3227				
35437	0.3783				
36492	0.446				
37547	0.5312				
38601	0.6515				
39644	0.8173				



Hole Crack Final Dimensions

Hole	Final Crack Size (In)
1A	0.4487"
1B	0.8178"
2A	0.2966"
2B	0.1761"

Notes:

Test Series

(f) II

Book Set

WXWPB

Specimen no. WXWPB-3 (Oct. 93)

Material

7473-77951 AL.

BoM Load Transfer

15%

Fastener

NY 90358-08 (492) 5,101

are with

3,010"

me. Thickness

.3840"

Spectrum

3ember

-4

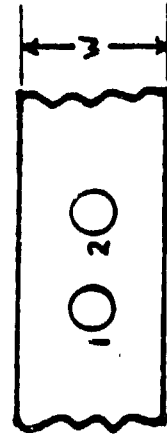
Max. Stress Level 34.0 Ksi (609)

Fatigue Life

30470 F1R HCS

Failure In Abt

LB



Notes:

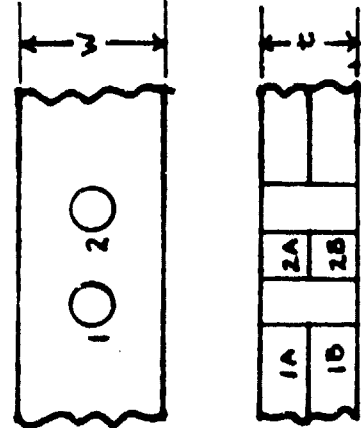
FLA 106 RDPNLC 0070

[illegible]

Hole	Crack	Final Dimensions
1	1/2"	1/2"
2	1/2"	1/2"
3	1/2"	1/2"
4	1/2"	1/2"
5	1/2"	1/2"
6	1/2"	1/2"
7	1/2"	1/2"
8	1/2"	1/2"
9	1/2"	1/2"
10	1/2"	1/2"
11	1/2"	1/2"
12	1/2"	1/2"
13	1/2"	1/2"
14	1/2"	1/2"
15	1/2"	1/2"
16	1/2"	1/2"
17	1/2"	1/2"
18	1/2"	1/2"
19	1/2"	1/2"
20	1/2"	1/2"
21	1/2"	1/2"
22	1/2"	1/2"
23	1/2"	1/2"
24	1/2"	1/2"
25	1/2"	1/2"
26	1/2"	1/2"
27	1/2"	1/2"
28	1/2"	1/2"
29	1/2"	1/2"
30	1/2"	1/2"
31	1/2"	1/2"
32	1/2"	1/2"
33	1/2"	1/2"
34	1/2"	1/2"
35	1/2"	1/2"
36	1/2"	1/2"
37	1/2"	1/2"
38	1/2"	1/2"
39	1/2"	1/2"
40	1/2"	1/2"
41	1/2"	1/2"
42	1/2"	1/2"
43	1/2"	1/2"
44	1/2"	1/2"
45	1/2"	1/2"
46	1/2"	1/2"
47	1/2"	1/2"
48	1/2"	1/2"
49	1/2"	1/2"
50	1/2"	1/2"
51	1/2"	1/2"
52	1/2"	1/2"
53	1/2"	1/2"
54	1/2"	1/2"
55	1/2"	1/2"
56	1/2"	1/2"
57	1/2"	1/2"
58	1/2"	1/2"
59	1/2"	1/2"
60	1/2"	1/2"
61	1/2"	1/2"
62	1/2"	1/2"
63	1/2"	1/2"
64	1/2"	1/2"
65	1/2"	1/2"
66	1/2"	1/2"
67	1/2"	1/2"
68	1/2"	1/2"
69	1/2"	1/2"
70	1/2"	1/2"
71	1/2"	1/2"
72	1/2"	1/2"
73	1/2"	1/2"
74	1/2"	1/2"
75	1/2"	1/2"
76	1/2"	1/2"
77	1/2"	1/2"
78	1/2"	1/2"
79	1/2"	1/2"
80	1/2"	1/2"
81	1/2"	1/2"
82	1/2"	1/2"
83	1/2"	1/2"
84	1/2"	1/2"
85	1/2"	1/2"
86	1/2"	1/2"
87	1/2"	1/2"
88	1/2"	1/2"
89	1/2"	1/2"
90	1/2"	1/2"
91	1/2"	1/2"
92	1/2"	1/2"
93	1/2"	1/2"
94	1/2"	1/2"
95	1/2"	1/2"
96	1/2"	1/2"
97	1/2"	1/2"
98	1/2"	1/2"
99	1/2"	1/2"
100	1/2"	1/2"

Hbk.	Final Crack Size (In.)	
	Large	Small
1A	0.7605"	—
1B	0.8428"	0.5692"
2A	0.6163	—
2B	0.6163	—

Test Series IL(F)
 Data Set WXWFB
 Specimen No. WXWFB-4 (Dur. 94)
 Material 7075-T7351 AL.
 B&N Load Transfer 15%
 Fastener A1590352-08 (4.0 in) Rivet
 Ave Width 3.0095"
 Ave. Thickness .3998"
 Spectrum Bomber
 Max. Stress Level 34.0 Ksi (Gross)
 Fatigue Life 42,595 EIT Hrs.
 Failure In Hole 1A



Hole Crack Final Dimensions

Hole	Final Crack Size (In.)	
	Large	Small
1A	0.07516"	—
1B	0.919"	0.6783"
2A	0.1157"	—
2B	0.0743"	—

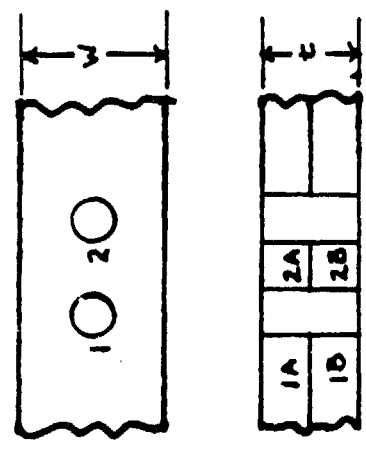
Notes:

FRAC TOG RAPHIC DATA

FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
18773	0.0057	40500	0.6752		
19929	0.0097	41555	0.8459		
20883	0.0153	42595	0.9119		
21937	0.0264				
22992	0.0383				
24047	0.0576				
25101	0.078				
26156	0.1023				
27000	0.1245				
28055	0.139				
29109	0.157				
30164	0.1762				
31219	0.1965				
32273	0.2198				
33328	0.2425				
34383	0.275				
35437	0.3018				
36492	0.3373				
37547	0.3795				
38601	0.4285				
39656	0.488				

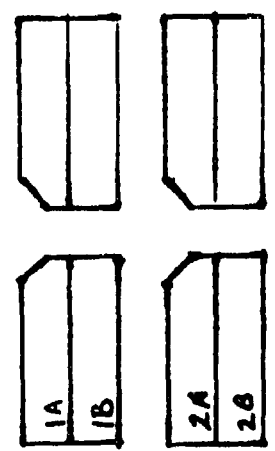


Test Series IR(f)
 Plate Set 4XW17B
 Specimen No. WXW17B-5 (Duc 95)
 Material 7475-T2851 AL.
 Bolt Load Transfer 15%
 Fastener M590359-08 (4.0mm) Rivet
 Ave Width 3.0090"
 Ave Thickness .3925"
 Spectrum Bomber
 Max. Stress Level 340 KSI (6000)
 Fatigue Life 40698 FTHrs
 Failure In Note 2A



FRAC TOGRAPHIC DATA

FLT. NOS	CRACK SIZE	FLT. NOS.	CRACK SIZE	FLT. NOS.	CRACK SIZE
24047	0.0048				
25701	0.0213				
26156	0.0286				
27000	0.0414				
28055	0.0578				
29109	0.0780				
30164	0.099				
31219	0.1302				
32273	0.1656				
33328	0.1486				
34383	0.2459				
35437	0.2447				
36492	0.338				
37547	0.4095				
38601	0.4865				
39656	0.6233				
40500	0.8655				
40698	0.9225				



Hole Crack Final Dimensions

Hole	Final Crack Size(In.)	
	Large	Small
1A	0.3332" ^①	—
1B	0.7005"	—
2A	0.9225"	0.7712"
2B	0.6460"	—

Notes: ① Larger Flaw Damaged with cut at 0.3332

Test Series IV(f)

Test Series

Data Set WXWPS

Specimen no. WXWPS-6 (Det. 9/6)

Material 7479-77951 AL.

BoH Load Transfer 15%

Fastener MS90359-08 (4920) E108T

are w. d. sh 3.0130"

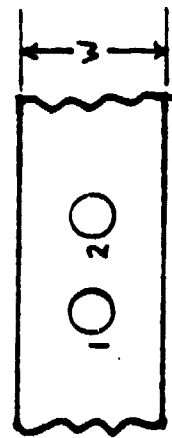
av. Thickness .3917"

Spectrum

max. stress level 34.0 ksi (600g)

Fatigue Life 42595 Flt Hrs

Failure In Note 2A

[illegible]

Hole Crack Final Dimensions

Hole	Final Crack Size (In)	
	Large	Small
1A	0.1330"	—
1B	0.1473"	—
2A	0.7423"	0.6421"
2B	0.5453"	—

Notes:

Test Series II(F)

Ref. Set WXW120

Specimen No. WXW120-7 (DUC 97)

Material 7075-T7351 AL

Load Transfer 15%

Fastener MS90359-08 (1/4" DIA) RMP

Av. Width 3.0140"

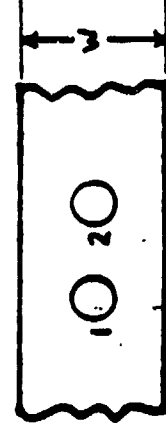
Av. Thickness .3922"

Spectrum Bomber

Max. Stress Level 34.0 KSI (Gross)

Fatigue Life 55677 FAT HRS

Failure In Abk 1A



PHOTOGRAPHIC DATA

FAT. HRS	CRACK SIZE	AV. THICK.	CRACK SIZE	AV. THICK.	CRACK SIZE
33328	0.0044		0.7317		
34383	0.0164		0.7317		
35437	0.0286		1.00		
36492	0.0412				
37547	0.049				
38601	0.0637				
39656	0.0914				
40500	0.1115				
41555	0.1315				
42609	0.1522				
43664	0.1773				
44719	0.2018				
45773	0.2219				
46828	0.2393				
47883	0.2467				
48937	0.2995				
49992	0.3215				
51047	0.3606				
52101	0.4086				
53156	0.4563				
54000	0.5186				

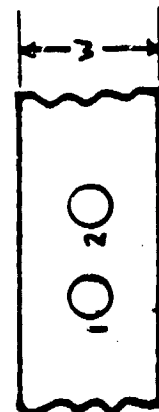


Note Crack Final Dimensions

Abk	Final Crack Size (In.)
1A	0.1972"
1B	1.00"
2A	0.1757"
2B	0.3708"

Notes:

Test Series III (4)
 Plate Set WXW/PB
 Specimen No. WXW/PB-8 (CUT 98)
 Material 7079-T2051 AL
 Bolt Load Transfer 15%
 Fastener M590399-00 (4.00) RUMF
 Ave Width 3.0110"
 Ave Thickness .3925"
 Spectrum Bomber
 Ave. Stress Level 34,045 (6000)
 Fatigue Life 40704 FET HRS
 Failure In Hole 1A



Notes:

FEAT06000000 0000

FET HRS	CRACK SIZE	ALT HRS	CRACK SIZE	ALT HRS	CRACK SIZE
18773	0.0147				
19828	0.0214				
20883	0.0314				
21937	0.0484				
22992	0.0583				
24047	0.0721				
25101	0.0881				
26156	0.1056				
27000	0.1333				
28055	0.1586				
29109	0.1876				
30164	0.2135				
31219	0.2417				
32273	0.2715				
33328	0.3131				
34383	0.3512				
35437	0.3985				
36492	0.4453				
37547	0.519				
38601	0.5981				
39656	0.7069				

Hole Crack Final Dimensions

Hole	Final Crack Large	Final Crack Small
1A	1.10"	0.7450"
1B	0.2982"	—
2A	no Flaws	—
2B	no Flaws	—

Test Series III (4)

Plate Set WXPB

Specimen No. WXPB-9 (Dr. 94)

Material 7025-T7351 AL.

BoN Load Transfer 15%

Fastener A2590352-00 (1/4" dia) Rivet

Ave Width 3.0130"

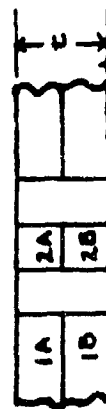
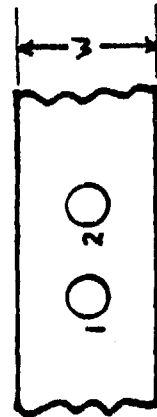
Ave Thickness .3922"

Spectrum Bomber

Max. Stress Level 34,000 psi (gross)

Fatigue Life 51352 FET HRS

Failure In Note 1A



FRAC TOG RAPHIC DATA

FET HRS	CRACK SIZE	RET. MEAS.	CRACK SIZE	RET. MEAS.	CRACK SIZE
30164	0.0037				
31219	0.0133				
32273	0.023	51352	1.0014		
33328	0.0379				
34383	0.056				
35437	0.0737				
36492	0.094				
37547	0.1176				
38601	0.1525				
39656	0.187				
40700	0.2224				
41755	0.2588				
42809	0.2918				
43864	0.3243				
44919	0.3694				
45973	0.4135				
46028	0.4641				
47083	0.5201				
48137	0.5912				
49192	0.681				
50247	0.7803				

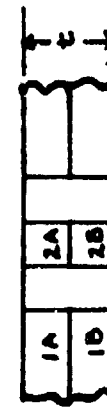
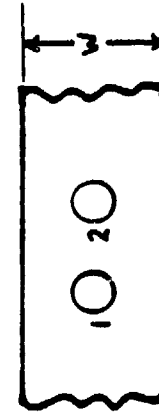
Hole Crack Final Dimensions

Hole	Final Crack Size (In)
1A	Large
1B	1.0014"
2A	0.3387"
2B	no flaws
2C	0.1469"

Notes: ① Composed of 2 flaws each on a different fracture plane

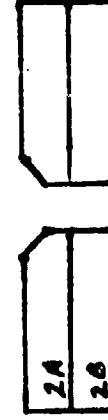
Test Series IV (F)
 Data Set WXWPB
 Specimen No. WXWPB-10 (Dur. 100)
 Material 7479-72951 AL
 Bolt Load Transfer 150%
 Fastener M590392-08 (46 mm) Rivet
 Ave Width 3.0310"
 Ave. Thickness .3847"
 Spectrum Bomber
 Max. Stress Level 34,000 psi (6000)
 Fatigue Life 55571 FHrs
 Failure In Hole 1A

I-11



FACTORY DATA

FLY NO.	CRACK SIZE	RET. MEAS.	CRACK SIZE	RET. MEAS.	CRACK SIZE
27000	0.0076	75937	0.0099		
28050	0.0142	77992	0.0478		
29109	0.0236	57047	0.494		
30144	0.0286	52101	0.5452		
31219	0.0467	53156	0.6003		
32273	0.0599	54000	0.6305		
33328	0.0768	55055	0.8031		
34383	0.0901	55571	0.8991		
35437	0.1055				
36492	0.1192				
37547	0.1375				
38601	0.1546				
39656	0.1726				
40500	0.1985				
41555	0.227				
42609	0.2472				
43664	0.267				
44719	0.2918				
45770	0.3173				
46828	0.3492				
47883	0.3745				



Hole Crack Final Dimensions

Hole	Final Crack Size (In.)	
	Large	Small
1A	0.8991"	1.5266" ¹⁰
1B	0.1541"	—
2A	0.0659"	—
2B	0.0674"	—

Notes: ① Damage at Origin

Test Series III (F)

Batch Set WXLWPB

Specimen No. WXLWPB-1 (DUR 101)

Material 7075-T7351 AL.

Run Load Transfer 15%

Fastener A19390392-00 (4.00) 8.00

Avg Width 3.0120"

Avg Thickness .3907"

Spectrum Broder

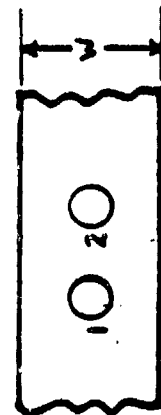
Max. Stress Level 340KSI (Gross)

Fatigue Life 36743 FLT HRS

Failure In Note 1B

PHOTOGRAPHIC DATA

FLT HRS	CRACK SIZE	ACT HRS.	CRACK SIZE	ACT HRS.	CRACK SIZE
18773	0.0179				
19828	0.0255				
20883	0.0378				
21937	0.0472				
22992	0.0588				
24047	0.0717				
25101	0.0819				
26156	0.099				
27000	0.1199				
28055	0.1416				
29109	0.1668				
30164	0.1968				
31219	0.2274				
32273	0.2734				
33328	0.3283				
34383	0.4006				
35437	0.5005				
36492	0.6891				
36743	0.95				



Note Crack Final Dimensions

Hole	Final Crack Size (In.)
	Large
1A	0.3777
1B	0.950
2A	no Flaw
2B	no Flaw

Notes:

Test Series IV (F)

Plate Set WXW178

Specimen No. WXW178-12 (DUP. 102)

Material 7475-T7351 AL

Boil Load Transfer 15%

Fastener M590359-08 (4000) RING

Ave Width 3.0100"

Ave Thickness .3885"

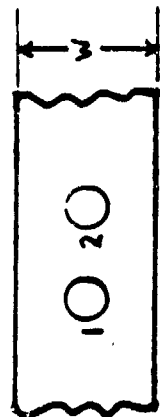
Spectrum Random

Max. Stress Level 34.0 KSI (Gross)

Fatigue Life 47870 Cycles Hrs

Failure In Abc 1B

I-13



FLAT PLATE TEST DATA

FLY NO.	CRACK SIZE	FLY NO.	CRACK SIZE	FLY NO.	CRACK SIZE
19828	0.0081	11535	0.4088		
20883	0.0136	12609	0.4482		
21937	0.0212	13664	0.5012		
22992	0.0343	14719	0.5627		
24047	0.0454	15773	0.6362		
25701	0.0542	16828	0.775		
26156	0.0648	17870	1.0248		
27000	0.0747				
28055	0.0835				
29109	0.0984				
30164	0.1147				
31219	0.1369				
32273	0.1635				
33328	0.1889				
34383	0.2036				
35437	0.2297				
36492	0.2536				
37547	0.2783				
38601	0.3064				
39656	0.3377				
40700	0.3662				



Notes:

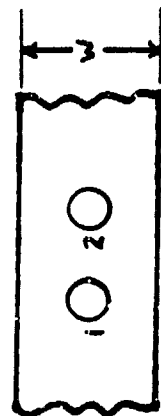
Abc Crack Final Dimensions

Abc	Final Crack Size (In)
1A	0.0624"
1B	1.0249"
2A	0.3786"
2B	0.1041"

FRAC TOGRAPHIC DATA

Test Series IR(4)
 Data Set WXPUB
 Specimen No. WXPUB-13 (Dur. 103)
 Material 7473-73951 AL.
 Bolt Load Transfer 15%
 Fastener M590359-08 (46mm) EIGHT
 Ave Width 3.0085"
 Ave. Thickness .3910"
 Spectrum Bomber
 Ave. Stress Level 340 KSI (GROSS)
 Fatigue Life 38798 E.HRS
 Failure in Note 1A

FLT. NOS.	CRACK SIZE	RET. NOS.	CRACK SIZE	RET. NOS.	CRACK SIZE
17719	0.0041				
18773	0.0117	38798	0.9049		
19829	0.0216				
20883	0.0293				
21537	0.0432				
22992	0.0574				
24497	0.0705				
25701	0.0866				
26156	0.1028				
27000	0.1249				
28055	0.1481				
29109	0.1767				
30464	0.2116				
31819	0.2445				
32273	0.2804				
33328	0.3218				
34383	0.3671				
35437	0.4221				
36492	0.4873				
37547	0.5641				
38601	0.6646				



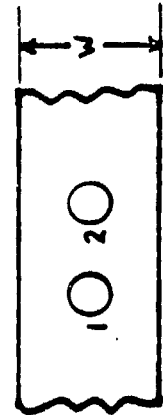
Hole Crack Final Dimensions

Hole	Final Crack Size (In)
1A	0.9049"
1B	0.3723"
2A	0.4977"
2B	0.6103"

Notes: ① may be damaged at final failure

Test Series II(F)
 Pch. Set WxWp8
 Specimen No. WxWp8-16 (Duct. 104)
 Material 7075-T7351 AL.
 BH Load Transfer 150%
 Fastener MS90352-08 (1/4-20) FINE
 Ave Width 3.0105"
 Ave Thickness .3905"
 Spectrum Bomber
 Max. Stress Level 34.0 KSI (Gross)
 Fatigue Life 53832 FTHrs
 Failure In Hole 1A

1-5



FRAC TOGRAPHIC DATA

FLT. NOS.	CRACK SIZE	ALT. NOS.	CRACK SIZE	ALT. NOS.	CRACK SIZE
27000	0.0036	48937	0.5292		
28053	0.0148	49992	0.5746		
29009	0.0273	51047	0.6456		
30004	0.0416	52101	0.7266		
31019	0.056	53156	0.8762		
32223	0.069	53832	1.1447		
33328	0.0824				
34383	0.0967				
35437	0.1115				
36992	0.1245				
37547	0.1401				
38601	0.1624				
39656	0.1854				
40500	0.2112				
41555	0.2333				
42609	0.2623				
43664	0.2868				
44719	0.3169				
45770	0.3391				
46828	0.412				
47883	0.4624				



Hole Crack Final Dimensions

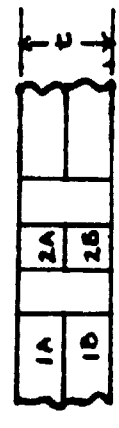
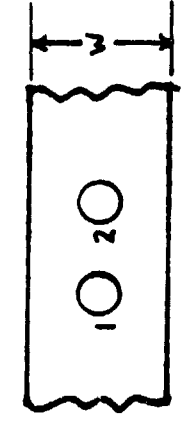
Hole	Final Crack Size (In.)	
	Large	Small
1A	0.5080"	_____
1B	1.1447"	0.9284"
2A	0.3651" ^①	_____
2B	0.1887"	_____

Notes: ① Damage to Flank at Failure and during sample preparation

Test Series IR(F)
 Data Set WXWFB
 Specimen No. WXWFB-15 (D05105)
 Material 7075-T7351 AL.
 BN Load Transfer 15%
 Fastener M590392-08 (4.4mm) R100T
 Ave Width 3.0155"
 Ave Thickness .3915"
 Spectrum Bomber
 Max. Stress Level 34,000 psi (6000)
 Fatigue Life 46,815 F1Hr
 Failure In Mode 1B

FRAC TOGRAPHIC DATA

FLY NO.	CRACK SIZE	ACT. MAG.	CRACK SIZE	ACT. MAG.	CRACK SIZE
25701	0.0013		46815	0.8502	
26156	0.0104				
27000	0.0215				
28055	0.0382				
29109	0.0551				
30164	0.073				
31219	0.0895				
32273	0.1104				
33328	0.1299				
34383	0.1468				
35437	0.1775				
36492	0.1971				
37547	0.2196				
38601	0.2481				
39656	0.2846				
40700	0.32				
41555	0.3623				
42609	0.422				
43664	0.4844				
44719	0.5655				
45773	0.7025				



Hole Crack Final Dimensions

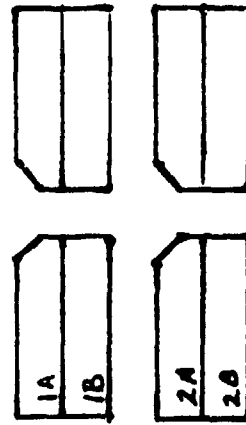
Hole	Final Crack Size (In.)
1A	0.4095"
1B	0.9502"
2A	0.4200"
2B	0.1849"

Notes:

APPENDIX J

FRACTOGRAPHIC RESULTS FOR DOUBLE REVERSED DOG-BONE SPECIMENS (15%
LT)
(Phase 2; Test Series IV(g))

Test Series	III(g)
Part Set	W18X40.4
Specimen No.	W18X40.4-2 (W18.417)
Material	A36-70
Beam Load Transfer	150 k
Fastener	A308-B8 (4.4) F1927
Ave Width	3.0105"
Ave Thickness	.3825"
Spectrum	Bombardier
Max. Stress Level	40.8 ksi (gross)
Fatigue Life	17389 FEM
Failure In Note	2A



Notes:

Hole	Final Crack Size (In)	
	Large	Small
1A	0.0337"	—
1B	0.4118"	—
2A	0.3139"	0.1482"
2B	0.4123"	—

FLAC TOBACCO NOTE

Test Series IV (g)

WABX AREA
Pole Set

WAXHEAD
(BASIC)

Material 1562-6181 7479-7751

66N low Transfer 150/2

30045mg
1059039-08 (400) 2.001

2008 W. 1st St 3,0120"

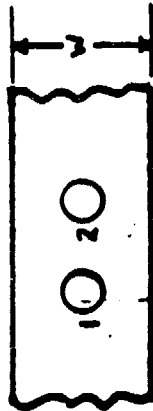
Av. Thickness .3900"

Spectrum Donner

Mr. Mess Love!
44.8 Ksi (avg)

Liquid Fit Drs

Expenses In 1862 7 A

[illegible]

Note Crack Final Dimensions

Hub.	Final Crack Size (In.)
	Large Small
1A	0.1011 " —
1B	0.1088 " —
2A	0.1390 " 1.5930 "
2B	0.2278 " —



Notes:

① Damage at Flaw

FLA 106 RDPN/C DATA

Test series III (g)

Date Set W/MSX 1424

Specimen no. WABX 1024-6 (Det.)

Material 7473-77951 AL.

Don Load Transfer 15%

Fastener
MS 9039-08 (4422) 8.1821

are with 3,0105"

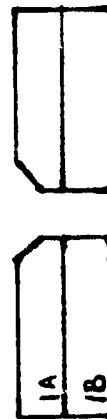
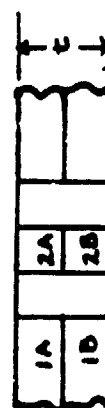
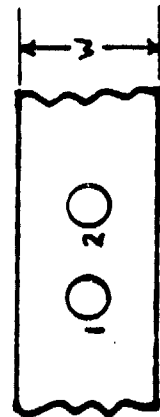
Av. Thickness 0.3917"

Spectrum

max. stress level 40.8 Ksi (gross)

19815 F11HRS

Failure In Note 18



Notes:

Hole	Crack	Final Dimensions
1	1/2"	1/2" x 1/2" x 1/2"
2	1/2"	1/2" x 1/2" x 1/2"
3	1/2"	1/2" x 1/2" x 1/2"
4	1/2"	1/2" x 1/2" x 1/2"
5	1/2"	1/2" x 1/2" x 1/2"
6	1/2"	1/2" x 1/2" x 1/2"
7	1/2"	1/2" x 1/2" x 1/2"
8	1/2"	1/2" x 1/2" x 1/2"
9	1/2"	1/2" x 1/2" x 1/2"
10	1/2"	1/2" x 1/2" x 1/2"
11	1/2"	1/2" x 1/2" x 1/2"
12	1/2"	1/2" x 1/2" x 1/2"
13	1/2"	1/2" x 1/2" x 1/2"
14	1/2"	1/2" x 1/2" x 1/2"
15	1/2"	1/2" x 1/2" x 1/2"
16	1/2"	1/2" x 1/2" x 1/2"
17	1/2"	1/2" x 1/2" x 1/2"
18	1/2"	1/2" x 1/2" x 1/2"
19	1/2"	1/2" x 1/2" x 1/2"
20	1/2"	1/2" x 1/2" x 1/2"
21	1/2"	1/2" x 1/2" x 1/2"
22	1/2"	1/2" x 1/2" x 1/2"
23	1/2"	1/2" x 1/2" x 1/2"
24	1/2"	1/2" x 1/2" x 1/2"
25	1/2"	1/2" x 1/2" x 1/2"
26	1/2"	1/2" x 1/2" x 1/2"
27	1/2"	1/2" x 1/2" x 1/2"
28	1/2"	1/2" x 1/2" x 1/2"
29	1/2"	1/2" x 1/2" x 1/2"
30	1/2"	1/2" x 1/2" x 1/2"
31	1/2"	1/2" x 1/2" x 1/2"
32	1/2"	1/2" x 1/2" x 1/2"
33	1/2"	1/2" x 1/2" x 1/2"
34	1/2"	1/2" x 1/2" x 1/2"
35	1/2"	1/2" x 1/2" x 1/2"
36	1/2"	1/2" x 1/2" x 1/2"
37	1/2"	1/2" x 1/2" x 1/2"
38	1/2"	1/2" x 1/2" x 1/2"
39	1/2"	1/2" x 1/2" x 1/2"
40	1/2"	1/2" x 1/2" x 1/2"
41	1/2"	1/2" x 1/2" x 1/2"
42	1/2"	1/2" x 1/2" x 1/2"
43	1/2"	1/2" x 1/2" x 1/2"
44	1/2"	1/2" x 1/2" x 1/2"
45	1/2"	1/2" x 1/2" x 1/2"
46	1/2"	1/2" x 1/2" x 1/2"
47	1/2"	1/2" x 1/2" x 1/2"
48	1/2"	1/2" x 1/2" x 1/2"
49	1/2"	1/2" x 1/2" x 1/2"
50	1/2"	1/2" x 1/2" x 1/2"
51	1/2"	1/2" x 1/2" x 1/2"
52	1/2"	1/2" x 1/2" x 1/2"
53	1/2"	1/2" x 1/2" x 1/2"
54	1/2"	1/2" x 1/2" x 1/2"
55	1/2"	1/2" x 1/2" x 1/2"
56	1/2"	1/2" x 1/2" x 1/2"
57	1/2"	1/2" x 1/2" x 1/2"
58	1/2"	1/2" x 1/2" x 1/2"
59	1/2"	1/2" x 1/2" x 1/2"
60	1/2"	1/2" x 1/2" x 1/2"
61	1/2"	1/2" x 1/2" x 1/2"
62	1/2"	1/2" x 1/2" x 1/2"
63	1/2"	1/2" x 1/2" x 1/2"
64	1/2"	1/2" x 1/2" x 1/2"
65	1/2"	1/2" x 1/2" x 1/2"
66	1/2"	1/2" x 1/2" x 1/2"
67	1/2"	1/2" x 1/2" x 1/2"
68	1/2"	1/2" x 1/2" x 1/2"
69	1/2"	1/2" x 1/2" x 1/2"
70	1/2"	1/2" x 1/2" x 1/2"
71	1/2"	1/2" x 1/2" x 1/2"
72	1/2"	1/2" x 1/2" x 1/2"
73	1/2"	1/2" x 1/2" x 1/2"
74	1/2"	1/2" x 1/2" x 1/2"
75	1/2"	1/2" x 1/2" x 1/2"
76	1/2"	1/2" x 1/2" x 1/2"
77	1/2"	1/2" x 1/2" x 1/2"
78	1/2"	1/2" x 1/2" x 1/2"
79	1/2"	1/2" x 1/2" x 1/2"
80	1/2"	1/2" x 1/2" x 1/2"
81	1/2"	1/2" x 1/2" x 1/2"
82	1/2"	1/2" x 1/2" x 1/2"
83	1/2"	1/2" x 1/2" x 1/2"
84	1/2"	1/2" x 1/2" x 1/2"
85	1/2"	1/2" x 1/2" x 1/2"
86	1/2"	1/2" x 1/2" x 1/2"
87	1/2"	1/2" x 1/2" x 1/2"
88	1/2"	1/2" x 1/2" x 1/2"
89	1/2"	1/2" x 1/2" x 1/2"
90	1/2"	1/2" x 1/2" x 1/2"
91		

Hole	Final Crack Size (In)
	Large Small
1A	0.1804" —
1B	0.6531" 0.3496"
2A	0.5684" —
2B	0.1155" —

FRAC TOB ROPN/C DATA

Test Series III (g)

Date Set WABxM24

Specimen no. W8X424-7
(D.F. 112)

Material 7475-77951 AL.

Boat Load Transfer 150%

Fastener MS 90352-08 (420) 5.0x8

for w. of $\frac{3.080^{\circ}}{}$

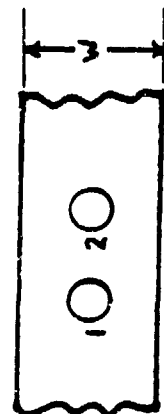
Re. Thickness 0.3927"

Spectrum

max. stress level 46.8 ksi (gross)

fatigue life 12643 FIT HRS

Failure in Note 2A



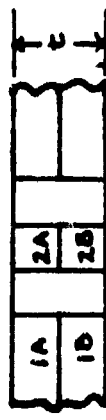
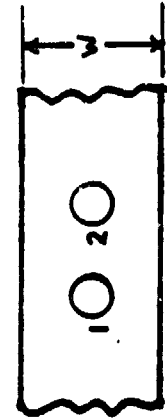
Notes:

Hole Crack Final Dimensions

Hole	Final Crack Size (In)	
	Large	Small
1A	0.098"	—
1B	0.2582"	—
2A	0.7386"	0.6237"
2B	1.1517"	—

FLATBERRY 2070

Test Series	II (g)
Batch Set	W 2014 R 2
Specimen No.	W 2014 R 2 - 10 (D5-115)
Material	7075-T7351 AL
BoN Load Transfer	15%
Fastener	A1590352-08 (4000) FINE
Ave Width	3.0075"
Ave Thickness	0.3920"
Spectrum	Bomber
Max. Stress Level	40.8 Ksi (Gross)
Fatigue Life	15,595 Cycles
Failure In Mode	2A
Test Date	6-19-85

[illegible]

Hole Crack Final Dimensions

Hole	Final Crack Size (In.)
1A	0.3034" —
1B	0.5681" —
2A	0.5702" 0.5429"
2B	0.2957" —

Notes:

Test Series

1811

五

WAF 429

Specimen No.

WABX 1100-15
(Oct 120)

(Car 120)

Warren!

7479-77951 AL.

Both load Transfer

15 0/0

Exister

100-658665-100

1000 W. 27th

3.0085"

Mr. Thicknoll

0.3912

Spectum

Bomber

mes. Virus level

40.8 KSL (Grog)

Exhaust 1.10

11486 F1 + 425

Failure In Able

18

Test date

6-71-85

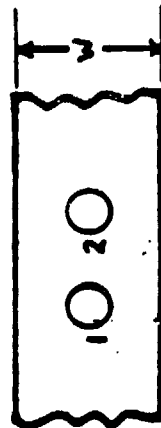


Plate	Crack	Final Dimensions
1		
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100		

Hbk.	Final Crack Size (In)	
	Large	Small
1A	0.2806"	—
1B	0.8241"	0.7203"
2A	0.1157"	—
2B	no data	—

Notes: Specimen also used for strain survey (Ref. Appendix K)

APPENDIX K

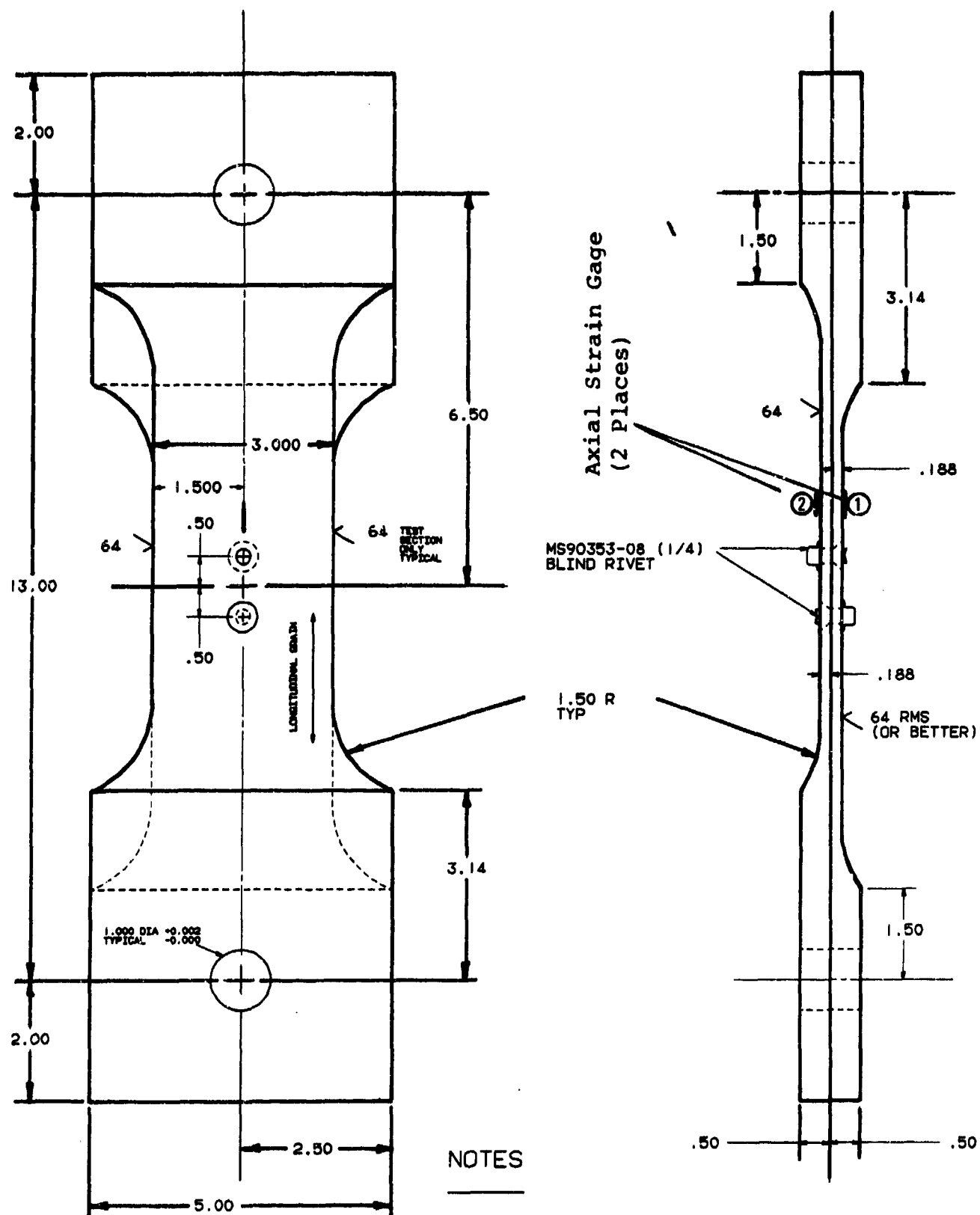
STRAIN SURVEY FOR DOUBLE REVERSED DOG BONE SPECIMEN (15% LT)

A strain survey was performed using a double-reversed dog-bone specimen. Specimen WABXHR4-15 (Dur. 120) was used for the strain survey and the survey was performed prior to fatigue testing the specimen to failure. Strain gage locations and specimen details are shown in Fig. K-1. Strain gage readings, summarized in Table K-1, are evaluated in Volume II [4].

Two additional strain surveys were performed under another program [3]. These results were based on a test specimen with the same details (Fig. K-1) and from the same material batch as the "Advanced Durability Analysis" program specimen. Since these strain survey results also apply to this program they are summarized herein.

The initial strain survey [3] was performed prior to any fatigue testing on the specimen. Initially only four strain gages were used. Strain survey results and strain gage locations are shown in Table K-2. The test specimen was then fatigue tested to 8000 flight hours using the F-16C/D Block 30G spectrum.

Following the fatigue test a follow-up strain survey was performed with two additional strain gages added. Results of the strain survey and the approximate strain gage locations are shown in Table K-3. These results from Ref. 3 are also evaluated in Volume II [4].



1. MATERIAL: 7475-T7351 ALUMINUM PLATE (1/2" STOCK)
2. MATCH DRILL HOLES USING MODIFIED WINSLOW SCHEMATIC DRILL (NO DEBURRING)
3. DRILL AND INSTALL MS90353-08 RIVETS PER M198

Fig. K-1 Double Reversed Dog-Bone Type Specimen
(15% Bolt Load Transfer) Used for
Strain Survey

TABLE K-1 SUMMARY OF STRAIN SURVEY
READINGS FOR DURABILITY SPECIMEN 120*

% LOAD	P_T (KIPS)	STRAIN READINGS (4-IN.)	
		ϵ_1	ϵ_2
0	0	0	0
20	9.18	845	594
40	18.36	1656	1228
60	27.54	2434	1910
80	36.72	3174	2620
100	45.9	3968	3417
0	0	0	0

* WABXHR4-15 (Ref. Table 11)

TABLE K-2 STRAIN SURVEY RESULTS FOR DOUBLE-REVERSED
DOG-BONE SPECIMEN WITHOUT PRIOR FATIGUE
TESTING

% LOAD	P_T (KIPS)	STRAIN READINGS (μ -IN.) (Ref. 3)			
		ϵ_1	ϵ_2	ϵ_3	ϵ_4
0	0	0	0	0	0
20	9.35	720	654	756	740
40	18.69	1471	1343	1534	1497
50	23.35	1847	1703	1918	1873

Strain Gage Locations

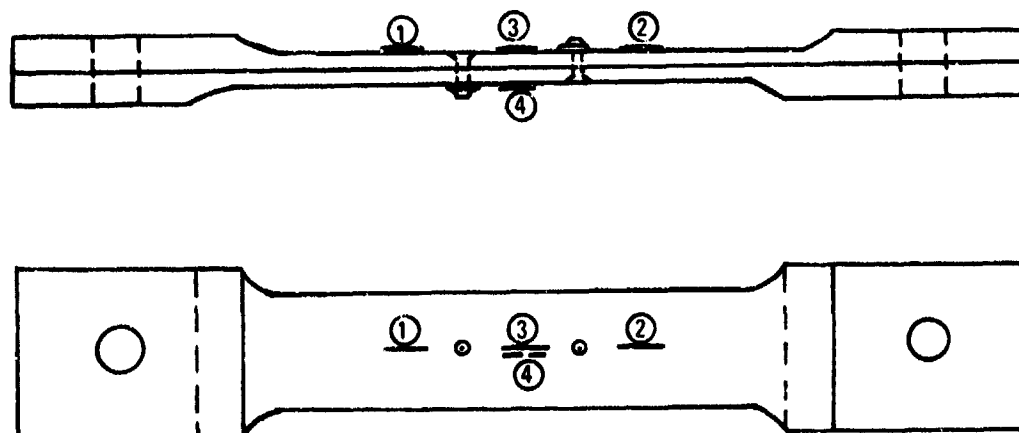
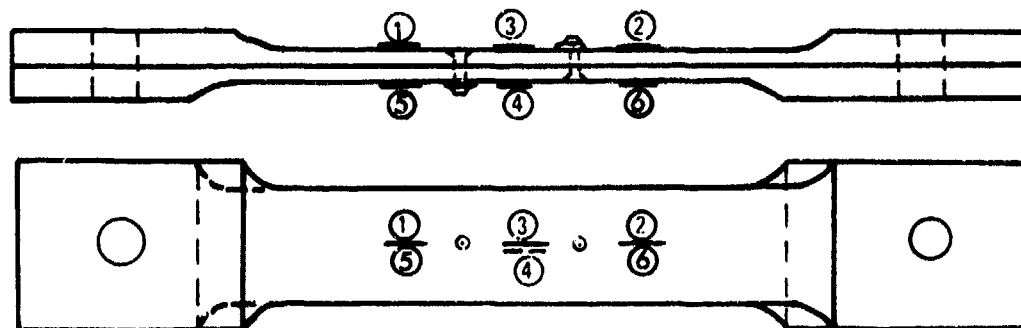


TABLE K-3 STRAIN SURVEY RESULTS FOR DOUBLE-REVERSED DOG-BONE SPECIMEN FOLLOWING 8000 FLT HOURS OF FATIGUE TESTING USING THE F-16C/D BLOCK 30G SPECTRUM

LOAD	P_T (KIPS)	STRAIN READINGS (μ -IN.) (Ref. 3)					
		ϵ_1	ϵ_2	ϵ_3	ϵ_4	ϵ_5	ϵ_6
0	0	0	0	0	0	0	0
10	4.67	630	590	635	658	665	622
20	9.35	1252	1215	1290	1325	1332	1289
30	14.05	1854	1830	1944	1989	1993	1954
40	18.69	2448	2440	2592	2640	2648	2615
50	23.35	3045	3059	3243	3292	3300	3275
40	18.69	2430	2436	2610	2650	2646	2615
30	14.05	1836	1825	1976	1994	1992	1953
20	9.35	1233	1206	1327	1332	1330	1287
10	4.67	614	587	670	669	668	621
0	0	4	14	23	6	3	5

Strain Gage Locations



- Notes: 1. All strain gages on ϕ of specimen
2. After 8000 flight hours of fatigue testing one fastener hole (the one with the largest crack size) had approximately a 0.50" crack on each side of the hole.