

FATIGUE LIFE

Dimensions (Specimens from A, B, C and E batch)

TABLE 16.0

BATCH A

No	L (mm)	Wa (mm)	Wb (mm)	ta (mm)	tb (mm)
A9	150,6	21,0	10,26	3,1	2,92
A10	150,8	20,64	10,58	3,30	3,18
A11	152,0	20,86	10,84	3,04	3,04
A12	151,4	21,26	10,96	3,10	3,06
A13	153,0	21,24	11,46	3,12	3,10
A14	146	20,54	10,70	3,35	3,20

BATCH B

No	L (mm)	Wa (mm)	Wb (mm)	ta (mm)	tb (mm)
B6	151,2	22,1	11,30	3,36	3,38
B7	152	21,8	11,3	3,56	3,56
B8	149,9	21,24	11,20	3,24	3,22
B9	151,7	21,14	11,0	3,20	3,34
B10	149,5	20,28	10,14	3,26	3,20
B11	152,1	21,64	11,38	3,24	3,44
B12	152,1	21,64	11,28	33,44	3,12
B13	148,08	20,32	10,18	3,02	3,14
B14	142,8	21,20	11,02	3,12	3,18
B15	149,24	20,34	10,06	3,28	3,18
B16	152,6	22,40	11,98	3,32	2,88
B17	147,5	22,24	11,72	3,10	3,14
B18	149,22	20,56	10,00	3,28	3,38
B19	148,2	21,34	11,38	3,48	3,18
B20	139,4	21,24	11,72	3,32	3,16
B21	151,1	21,24	11,18	3,28	2,70
B22	150,3	22,10	11,88	2,84	3,10
B23	149,5	20,38	10,18	3,28	3,10

BATCH C

No	L (mm)	Wa (mm)	Wb (mm)	ta (mm)	tb (mm)
C6	153,34	21,9	11,74	3,22	3,12
C7	153,70	21,8	11,96	3,40	3,32
C8	153,70	21,74	11,72	3,14	3,18
C9	154,6	21,88	11,78	3,24	3,30
C10	154,12	21,92	11,90	3,20	3,14
C11	154,50	22,00	11,82	3,24	3,20
C12	153,64	21,94	11,96	3,32	3,34
C13	154,30	21,92	11,98	3,28	3,34
C14	154,72	21,82	12,0	3,36	3,42
C15	154,5	21,92	11,88	3,28	3,20
C16	154,5	21,80	11,80	3,04	3,04

BATCH D

No	L (mm)	Wa (mm)	Wb (mm)	ta (mm)	tb (mm)
D6	159,2	22,72	13,34	3,26	3,30
D7	159,5	23,10	12,82	3,44	3,36
D8	159,2	23,6	13,60	3,40	3,38
D9	160,7	23,22	13,62	3,32	3,38
D10	160,96	23,16	13,50	3,20	3,06
D11	159,8	22,5	13,22	3,40	3,50
D12	159,9	21,9	12,56	3,42	3,18
D13	159,6	22,62	12,30	3,34	3,24
D14	158,72	22,00	13,4	3,42	3,28
D15	159,68	23,18	13,78	3,56	3,32

BATCH E

No	L (mm)	W (mm)	t (mm)	A (mm ²)
E2	150,0	10	1,0	10,0
E4	152,0	10,5	1,0	10,5
E6	151,2	10,1	1,1	11,56
E8	153,4	11,2	1,2	13,44
E9	150,0	10,0	1,3	13
E14	154,2	11,2	1,4	15,68
E15	151,2	10,8	1,0	10,8
E16	152,6	10,6	1,0	10,6
E3	154,3	10,0	1,0	10
E7	150,0	10,0	1,0	10
E1	151,1	10,1	1,0	10,1
E12	154,3	10,0	1,0	10
E11	151,6	10,0	1,0	10
E13	151,8	10,0	1,0	10
E26	153,7	10,2	1,1	11,33
E19	156,0	10,7	1,0	10,7
E24	155,4	10,0	1,0	10
E25	151,0	10,5	1,0	10,5
E31	150,3	10,8	1,1	11,88
E29	150,6	10,0	1,2	12
E27	151,7	11,4	1,0	11,4
E36	152,4	11,2	1,0	11,2
E22	151,8	11,3	1,4	15,82
E34	152,6	11,3	1,0	11,3
E32	157,0	11,7	1,0	11,7
E33	153,3	10,9	1,0	10,9
E21	153,6	10,8	1,3	14,04
E28	154,8	10,8	1,4	15,12
E39	151,2	10,4	1,0	10,4
E40	150,0	10,4	1,0	10,4
E46	150,6	10,0	1,1	11
E43	152,3	10,8	1,0	10,8
E45	154,0	10,2	1,0	10,2
E49	156,3	11,1	1,4	15,54
E51	155,2	10,1	1,0	10,1
E52	150,0	10,0	1,2	12
E54	150,0	10,0	1,1	11
E42	150	10,2	1,0	10,2

BATCH E

TEMPERATURE BUILT UP AS A FUNCTION OF LOAD LEVEL

TABLE 17.0

Temperature (°C)	Load (MN/m ²)	Frequency (Fixed at 15 Hz)
0	200	15
0.5	220	15
0.8	340	15
0.7	500	15
1.2	580	15
2.0	620	15

Temperature (°C)	Load (MN/m ²)	Frequency (Fixed at 30 Hz)
0	200	30
2.	350	30
2..	460	30
2.6	500	30
3.0	550	30
5.0	580	30

APPENDIX D

- D.1 Instron model TT-CM
- D.2 ESH- Fatigue testing machine
- D.3 Microscope camera

OPERATING PROCEDURE FOR EQUIPMENT

D.1 INSTRON MODEL TT-CM

The machine was used for the ultimate tensile strength tests. The grips used were manual and not hydraulic. A calibration was necessary and the load cell used was the 5000 Kg one. The machine operates by means of the main power and amplyne switches. The set balance and zero knob were used in order to indicate the starting point before any load is applied. The IKN full range was selected. Check was carried out each time a weight was applied. The testing procedure is covered in the manual.

D.2 ESH TESTING MACHINE

The ESH testing machine was used for all fatigue testing. The main two methods used to trip the machine were (i) extension trip and (ii) voltage trip. Both the operation and the trip methods are described in the manual handbook.

D.3 MICROSCOPE CAMERA

The Olympus PM-10-M photomicrographic system camera was used. See Fig 10. A light meter was not available and photographs were all bracketed at exposures of 1/2, 1/8 and 1/16th of a second. Focusing was always very important. An instruction manual was also available.

APPENDIX E

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1. Fracture of Structural Composites



2. Stress Intensity at Root of Notch

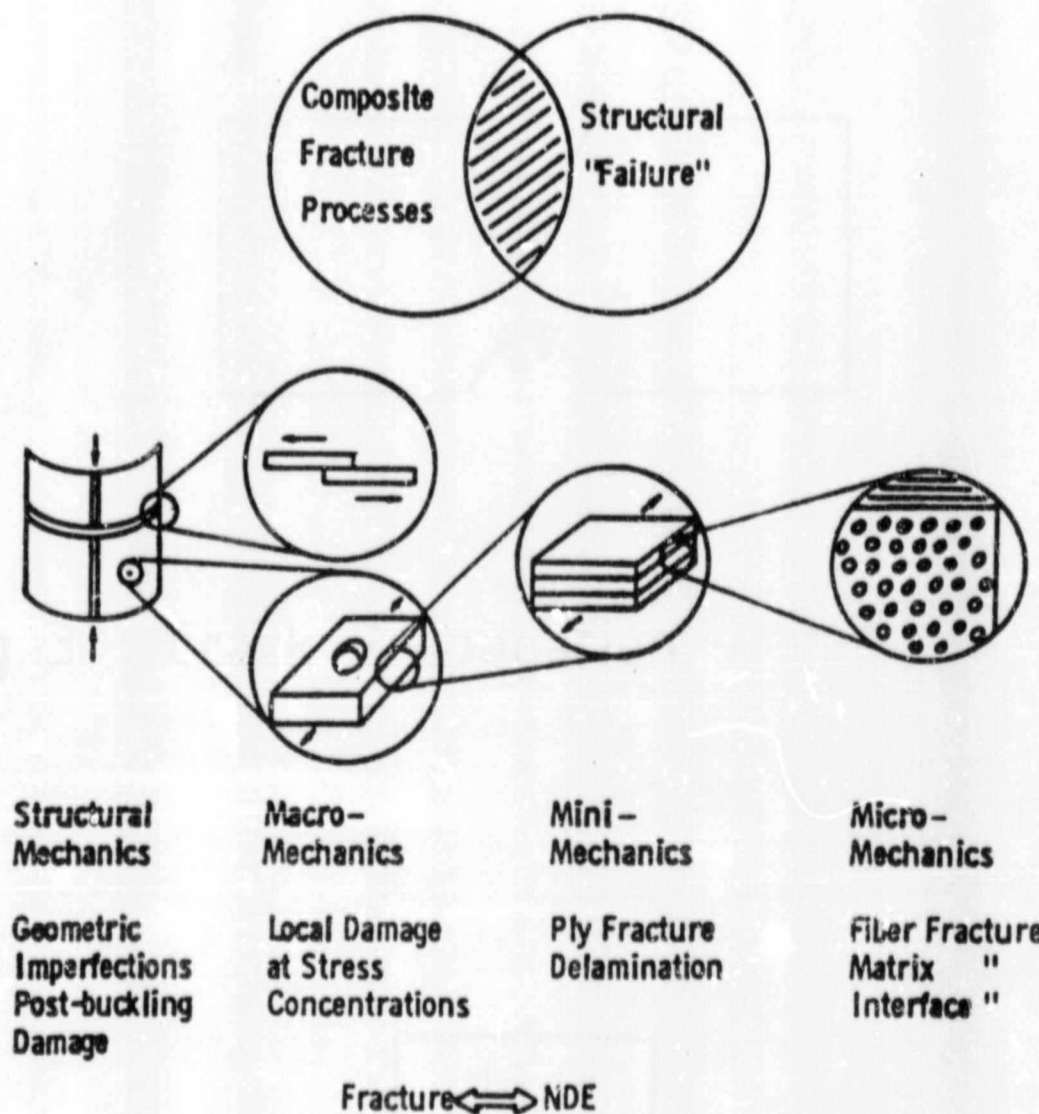


Fig 1 : Fracture of Structural Composites

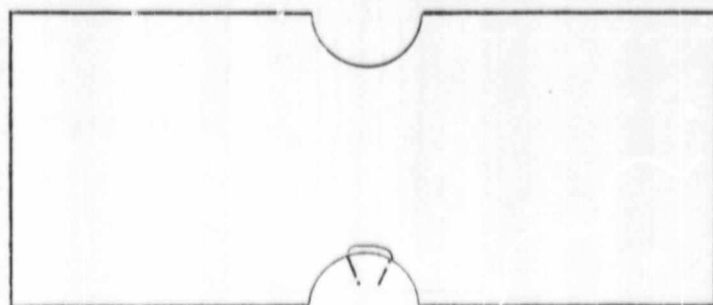


Fig 2 : Crack Initiation at root of Notch

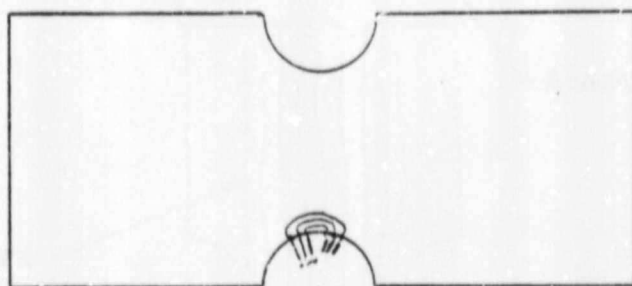


Fig 3 : Crack Propagation

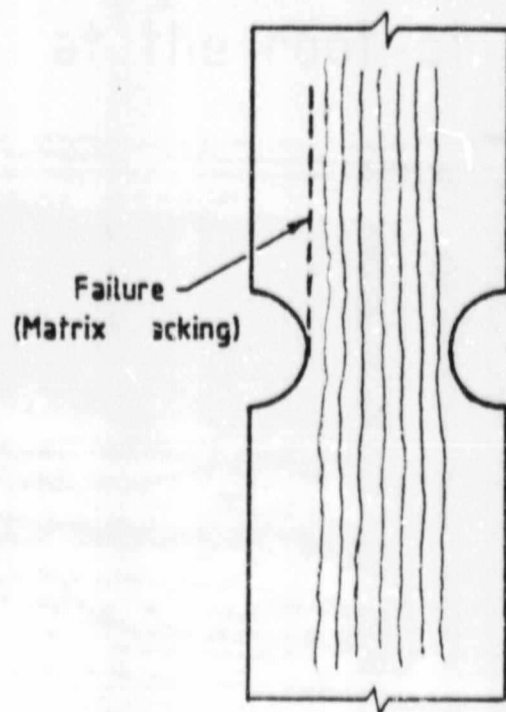


Fig 4: Longitudinal cracking originating at the root of the notch.

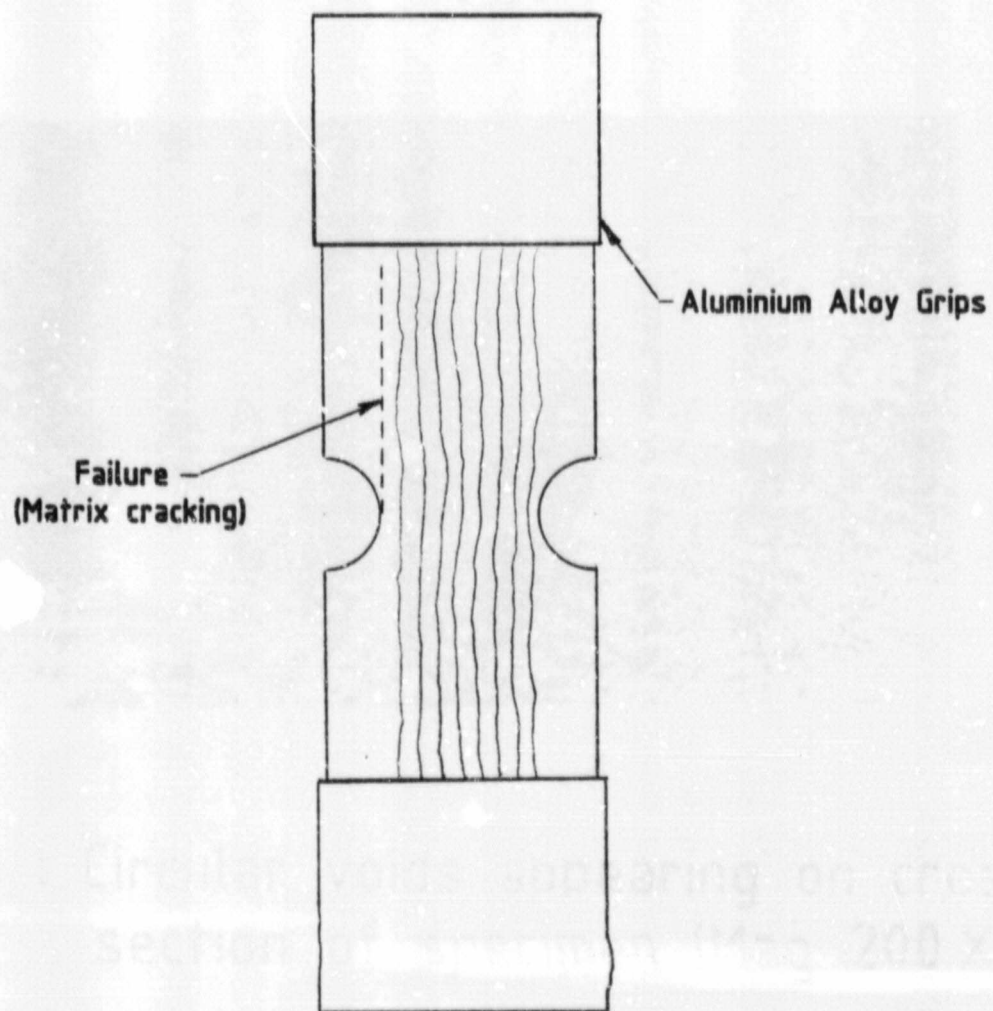


Fig 5 : Longitudinal cracking originating at the root of the notch

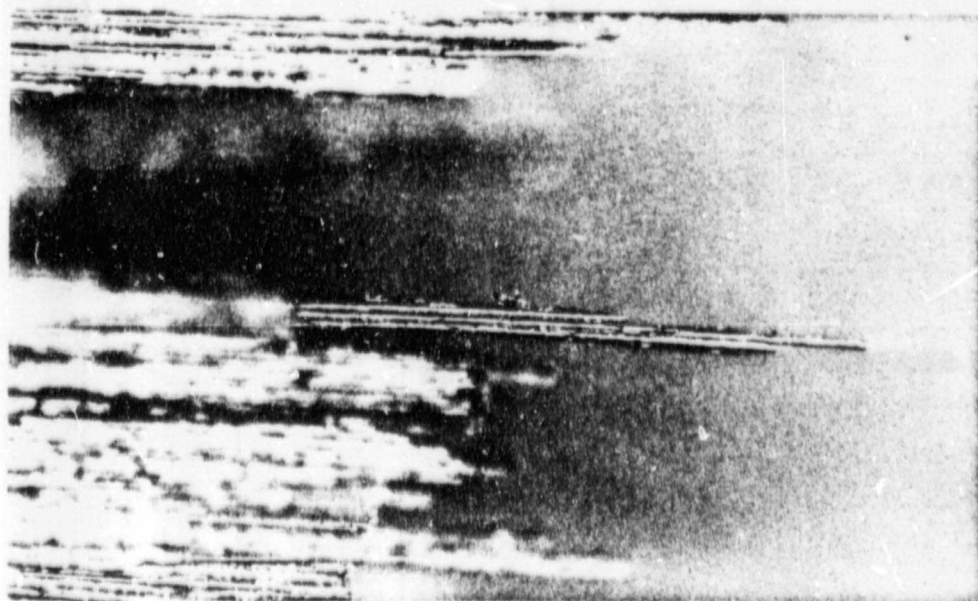


Fig 6 : Jagged appearance due to extensive shear cracking. (Mag. 100 X)

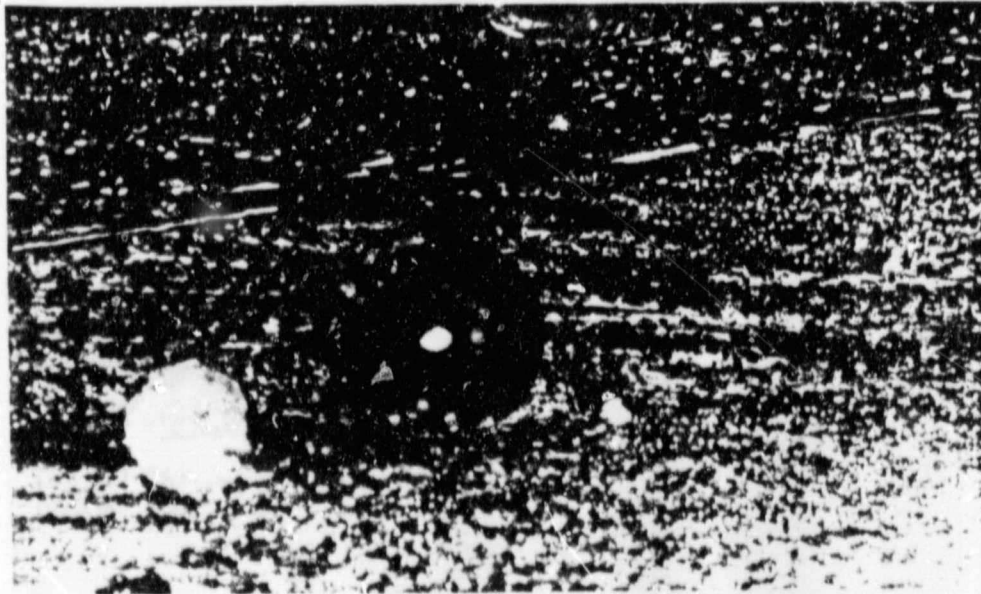


Fig 7 : Circular voids appearing on cross-section of specimen (Mag. 200 X).

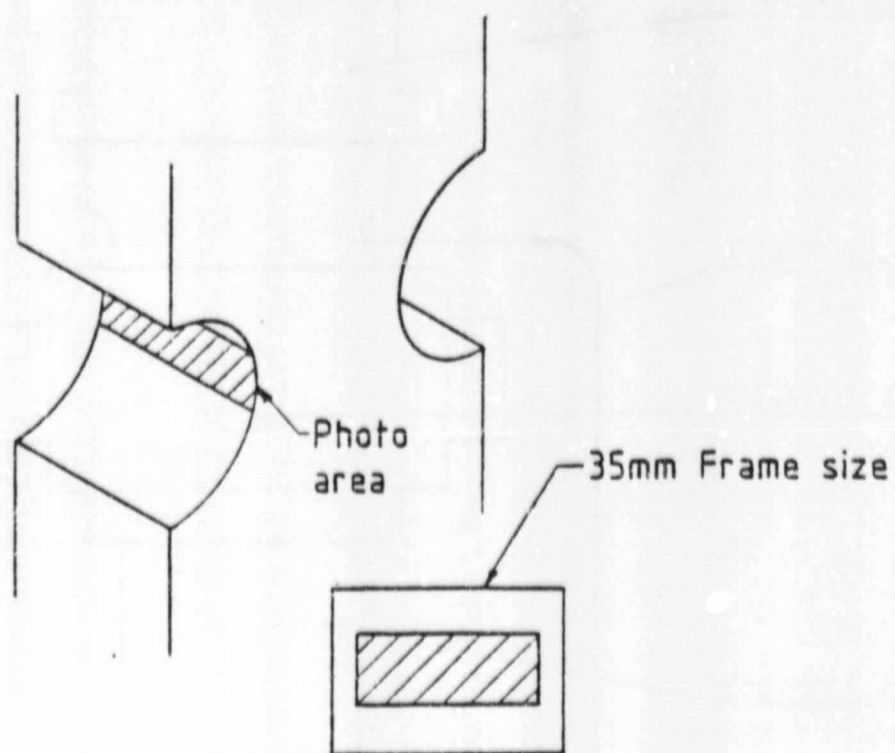


Fig 8: Schematic view of semicircular notched area

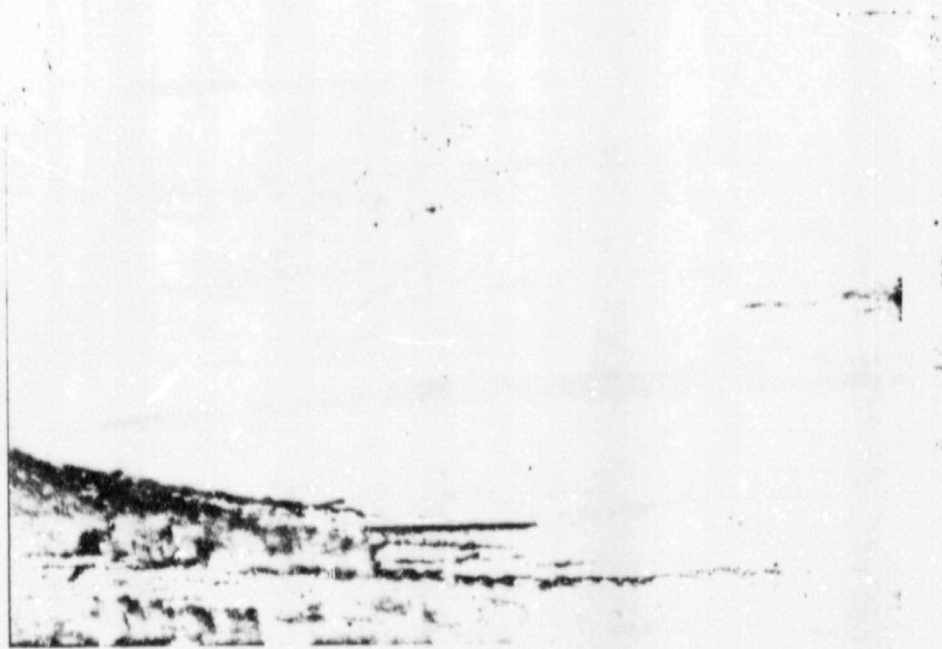


Fig 9 : Crack appearing at root of notch.
Resin-rich area apparent.

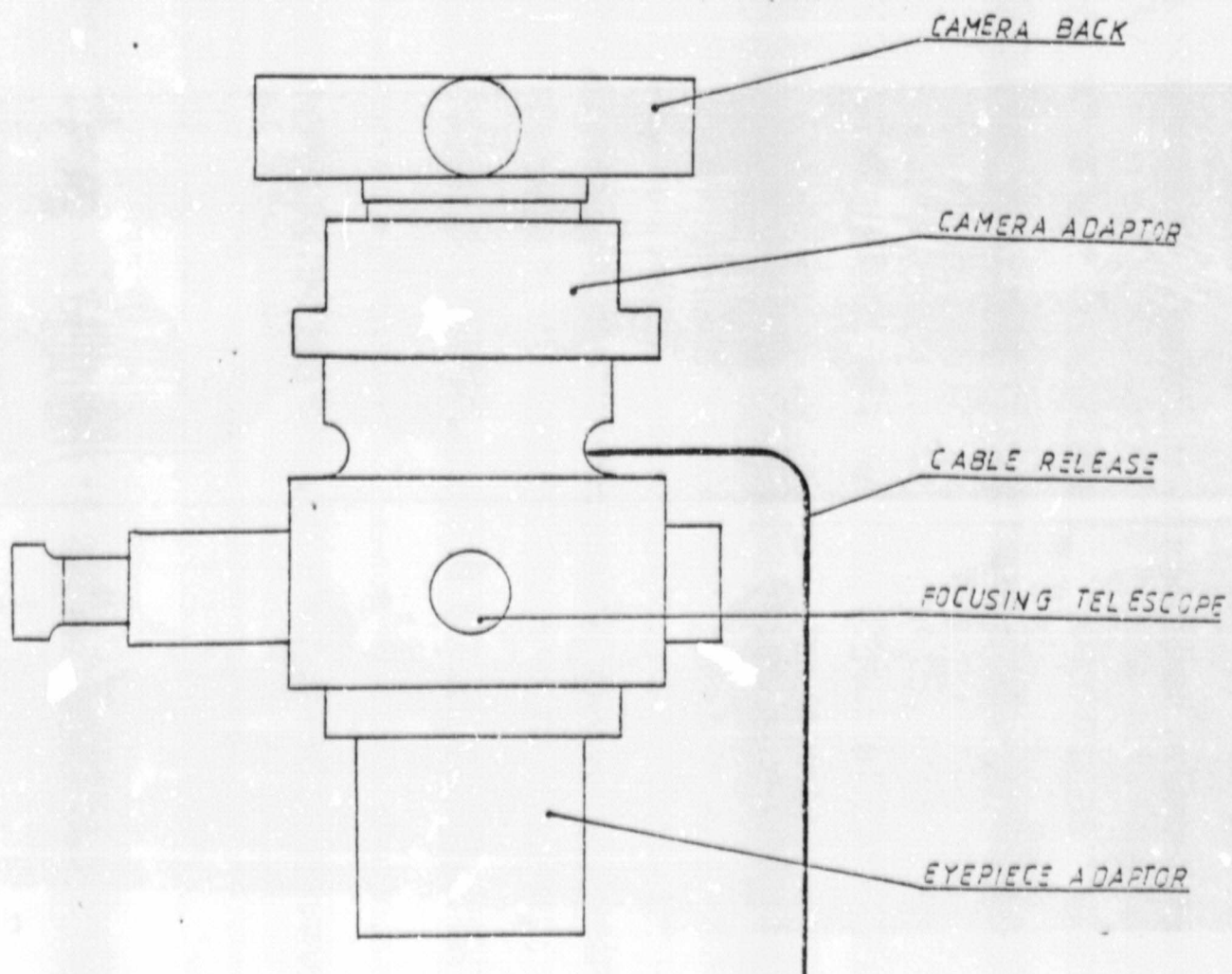


Fig 10 : Principal Components of
Photomicrographic system.

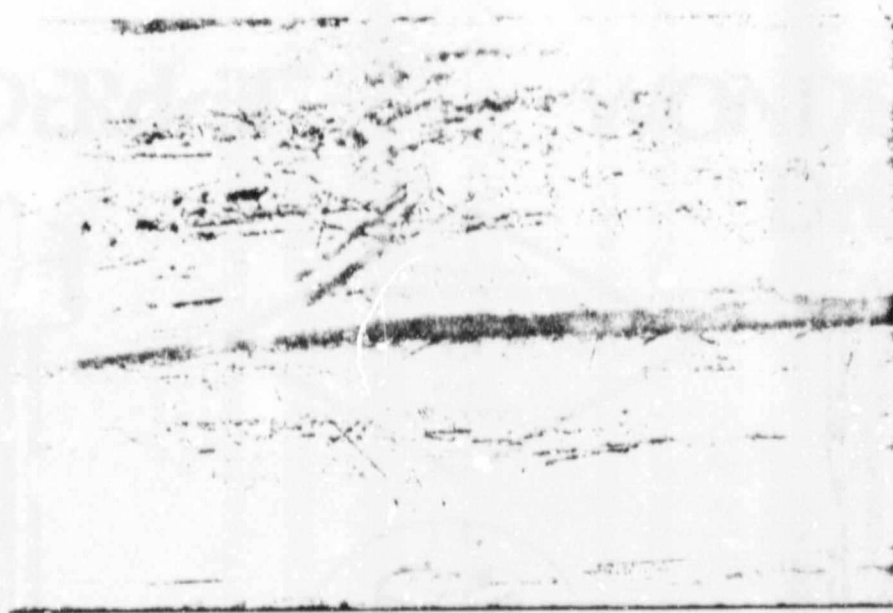


Fig 11 : Smashed carbon fibres along surface of specimen (Mag. 50 X)

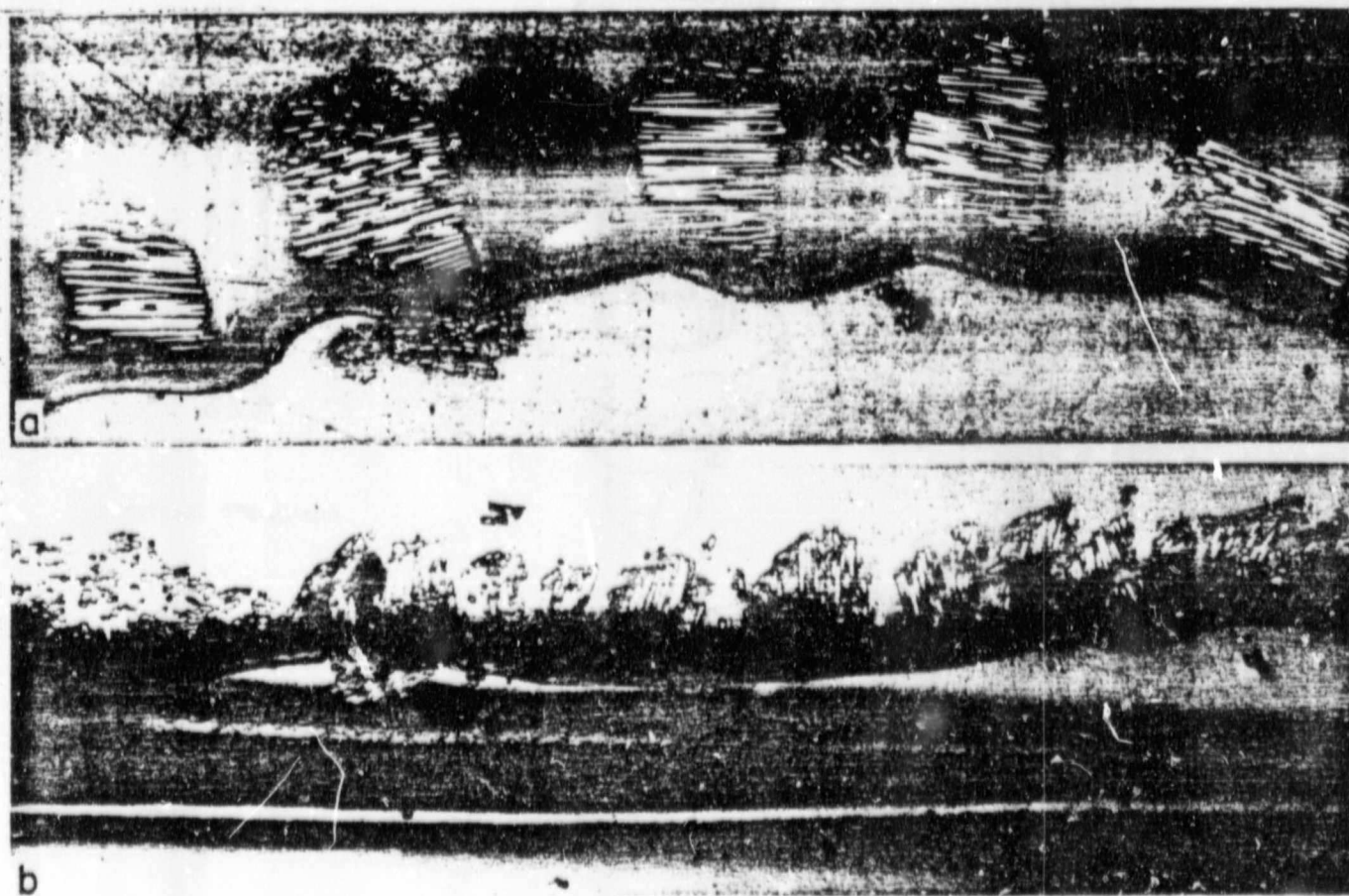
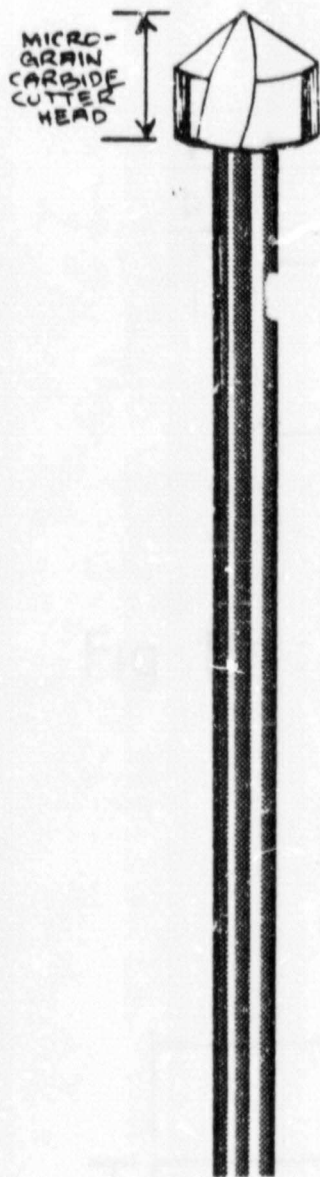
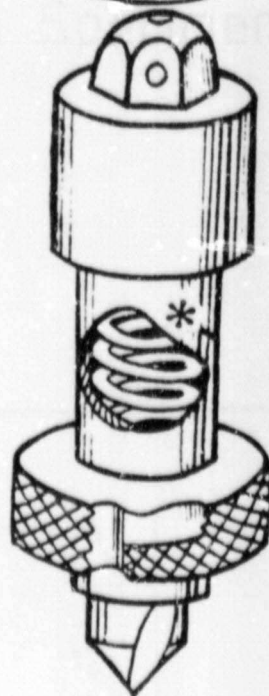
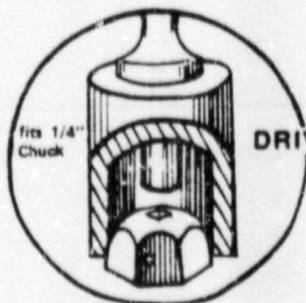


Fig 12 : Micrograph of specimens machined perpendicular to - and along the fibres

WONDERdrill™



PATENT PENDING



WONDERtwist™ Drill



PATENT PENDING

Fig 13 : Drill Prototype

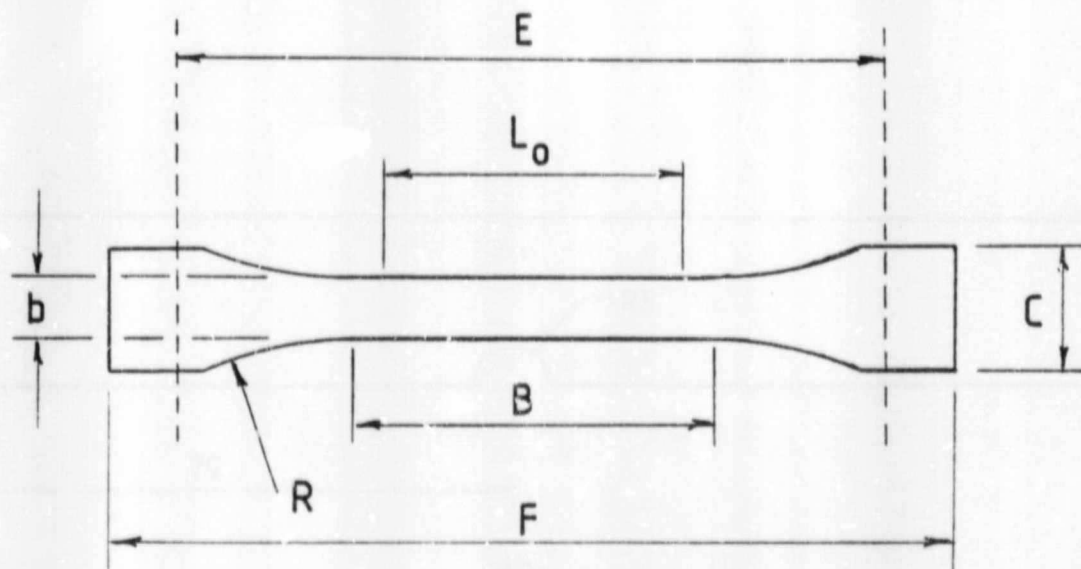


Fig 14 : Tensile Specimen

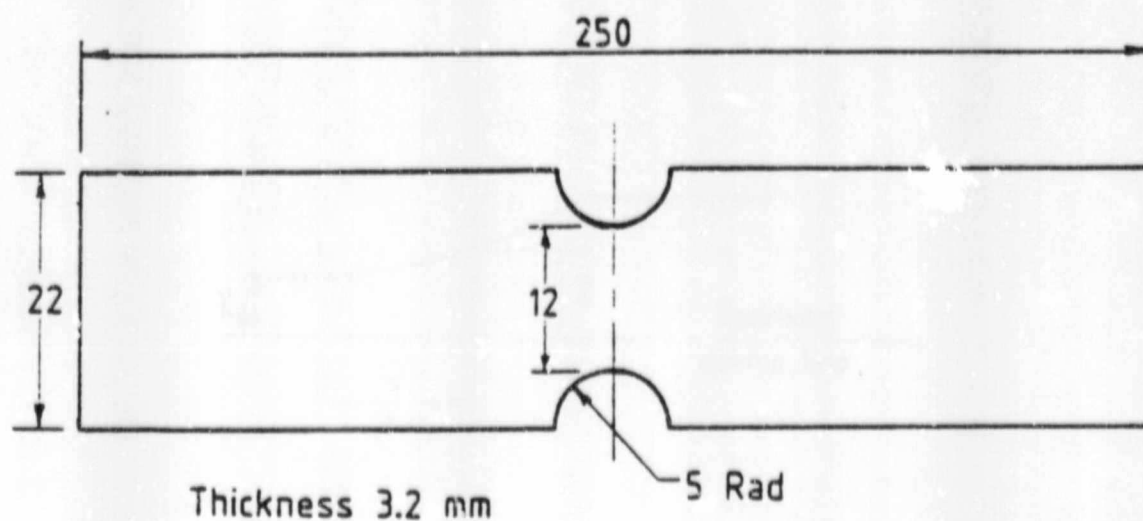
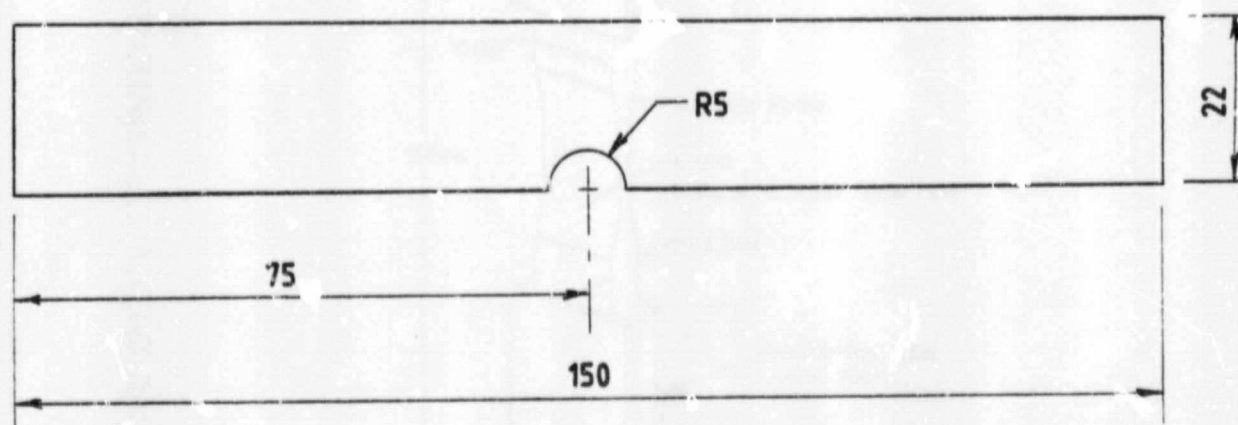


Fig 15: Double-notched specimen for fatigue-testing



Thickness = 3.2mm

Fig 16 : Test specimen with a semi-circular notch

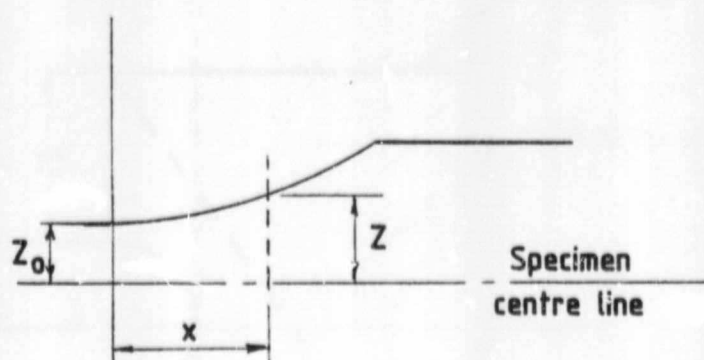


Fig 17 : Section of waisted specimen

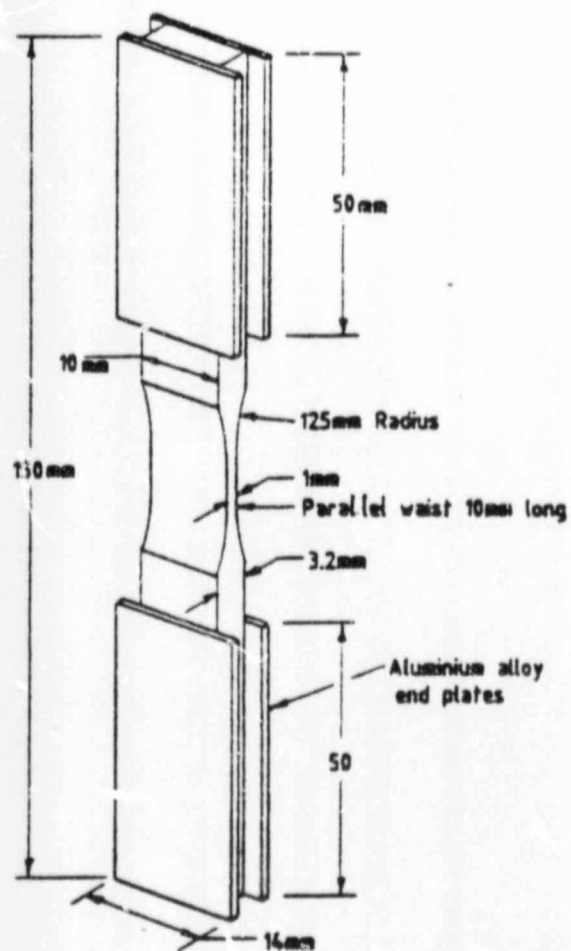


Fig 18 : Parallel-waisted tensile fatigue specimen

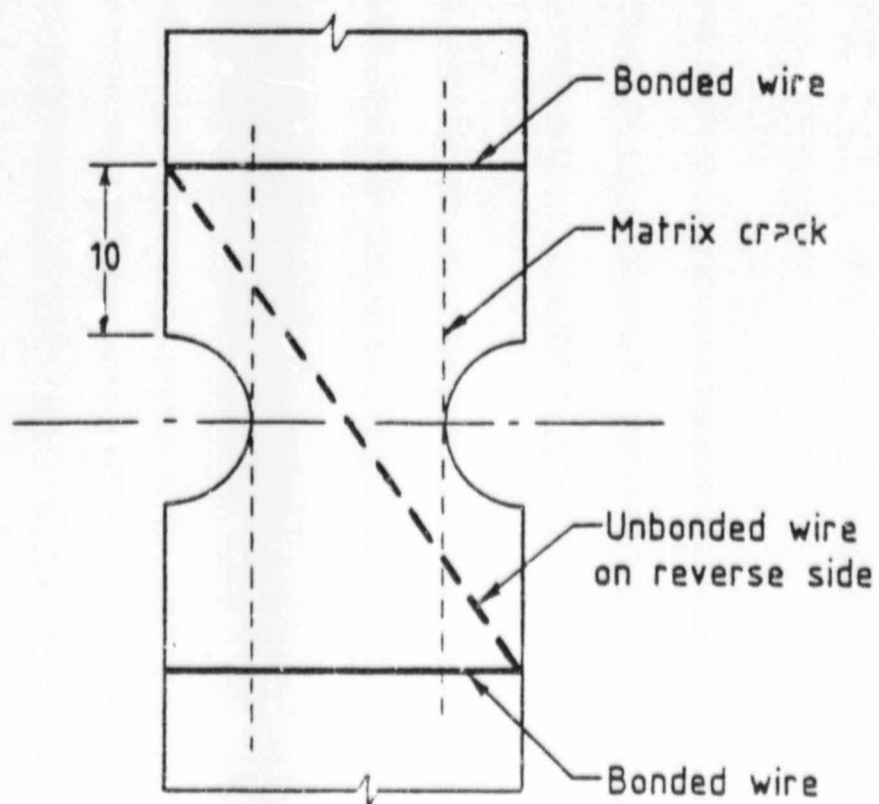
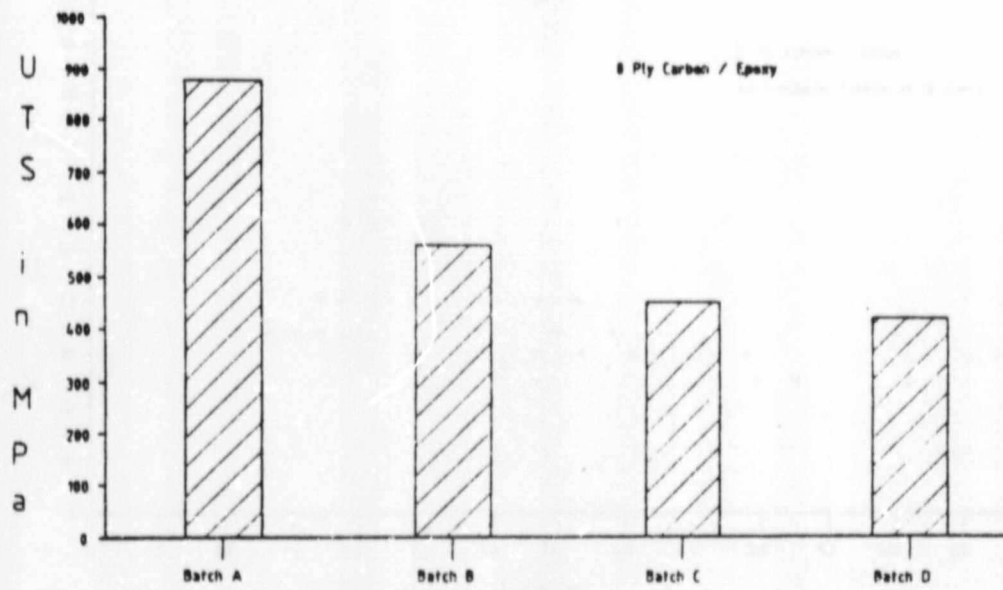


Fig 19: Wire bonded to specimen

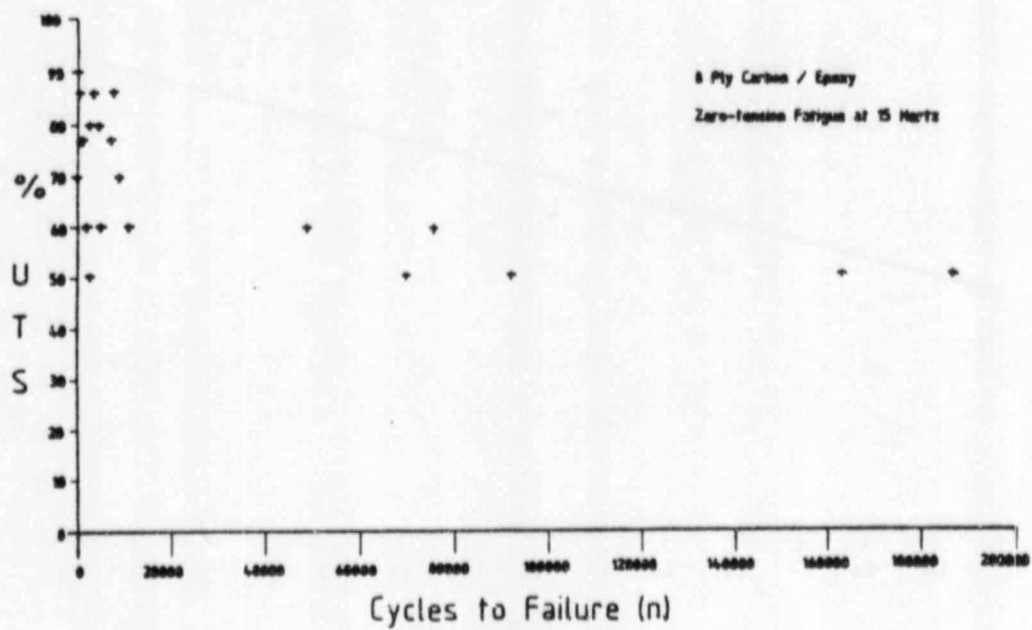
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E2 LIST OF GRAPHS

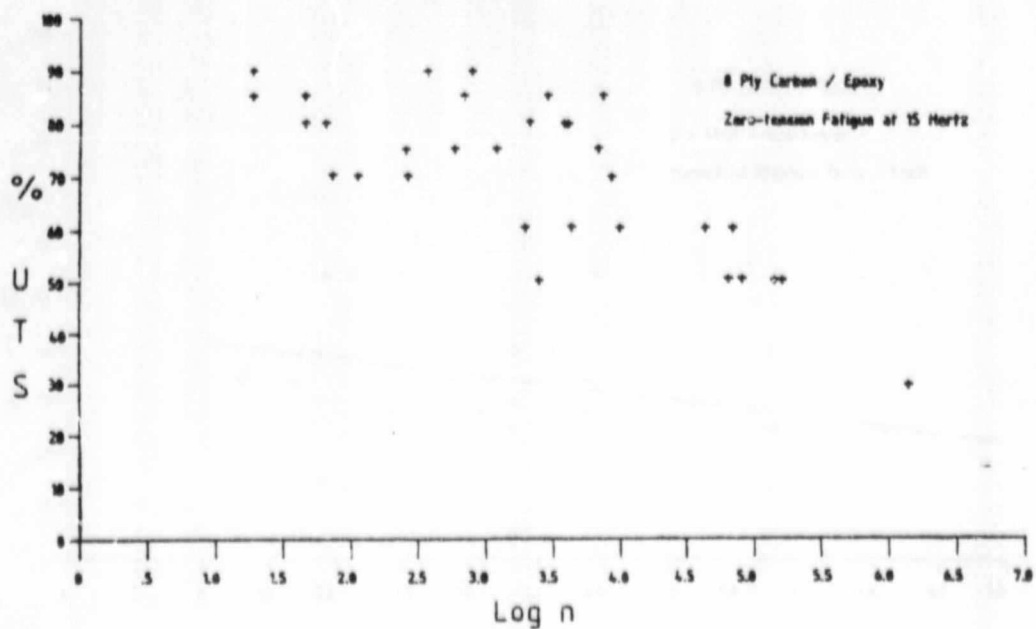
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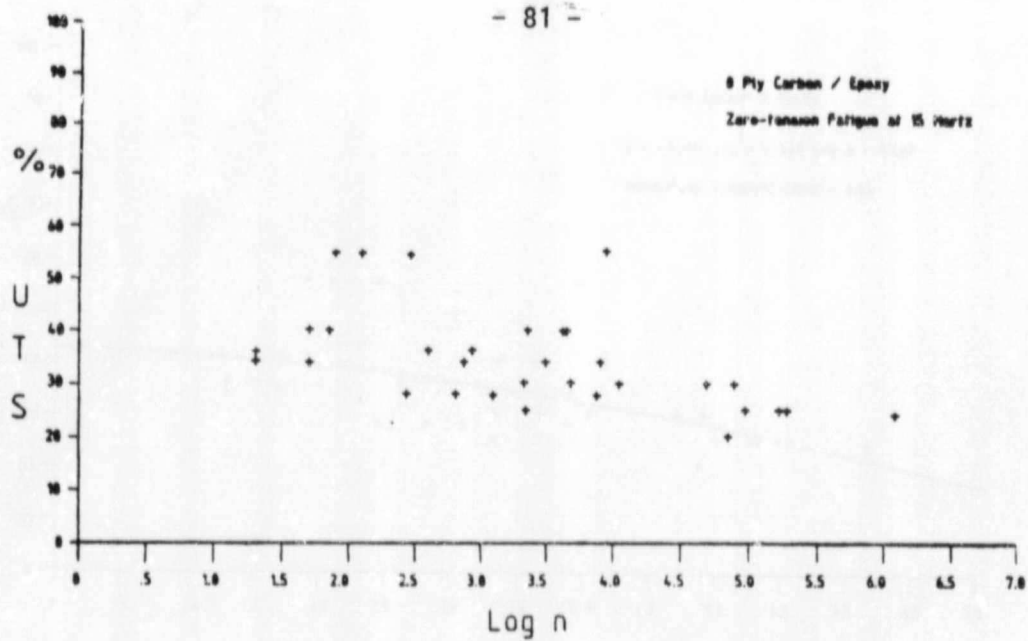
Graph 1 : Ultimate Tensile Strengths



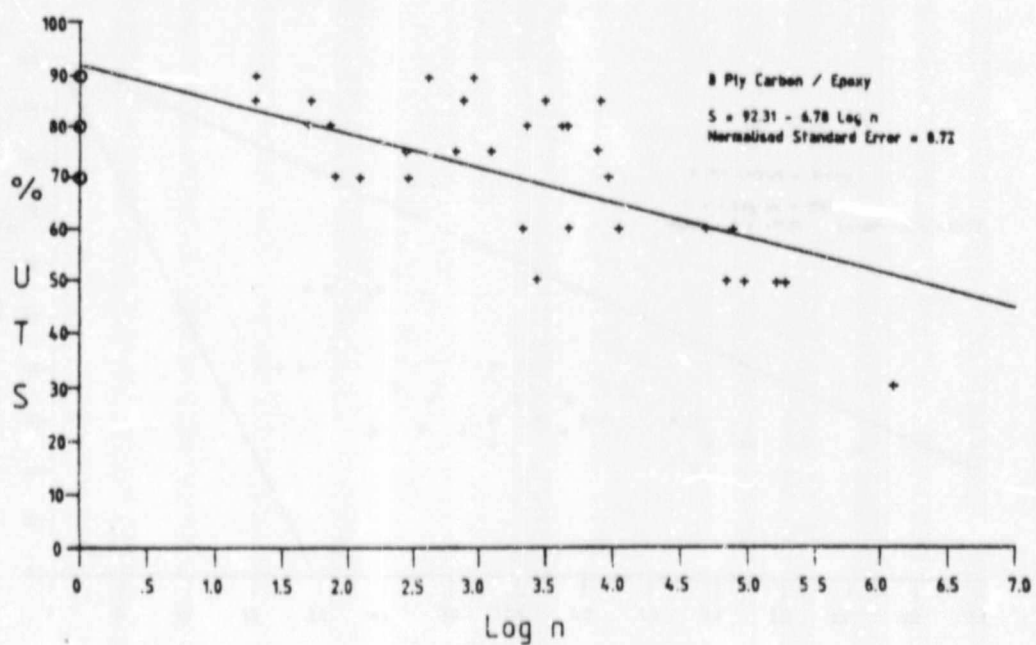
Graph 2 : Test Results (Linear Axes)



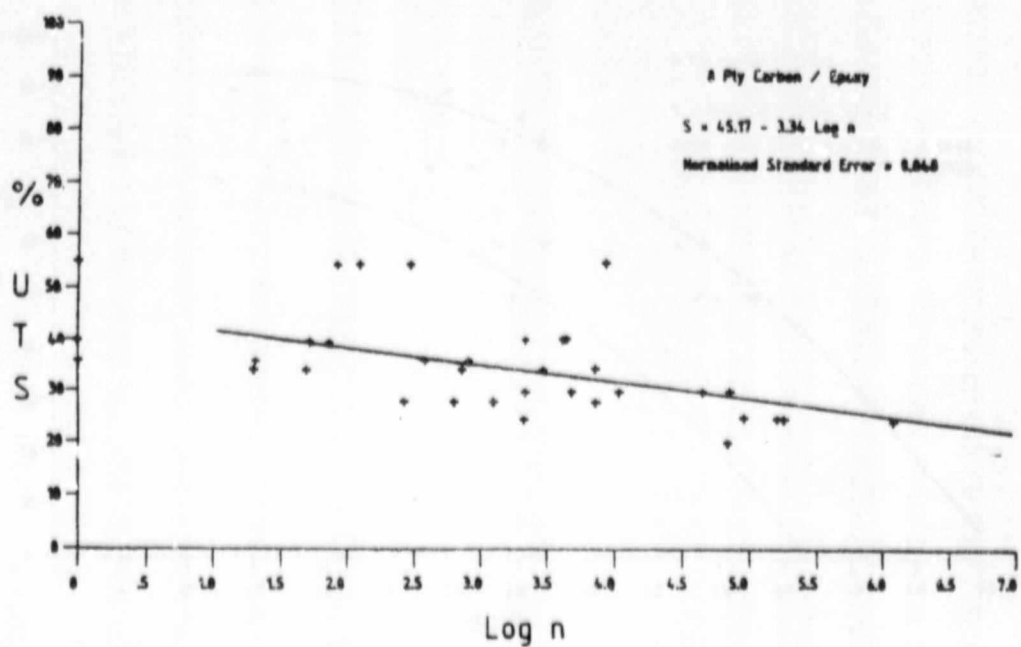
Graph 3 : Test Results (Log - Linear Axes)



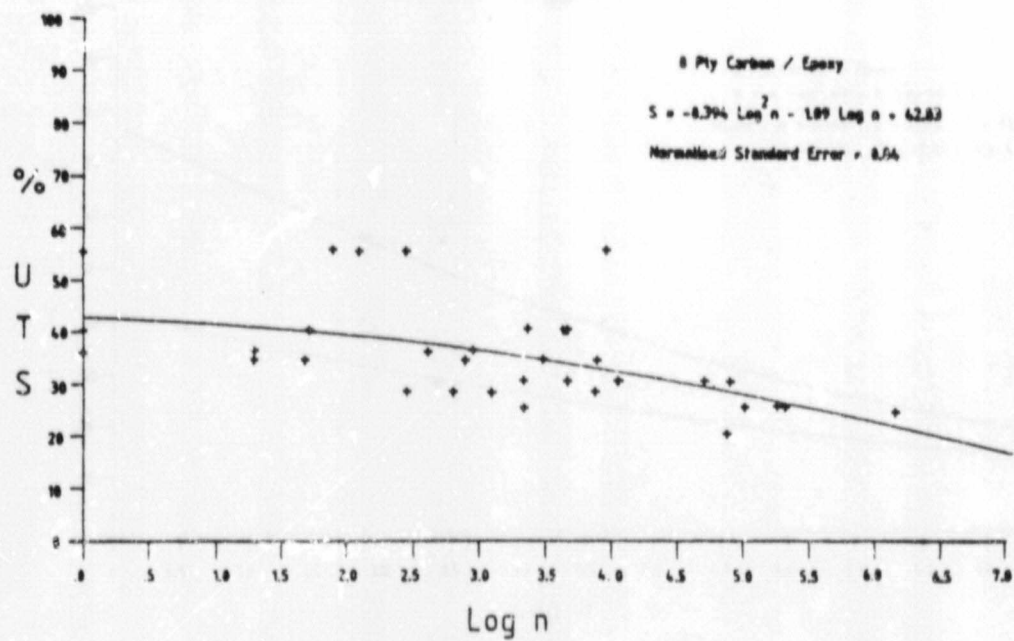
Graph 4 : Test Results w.r.t. UTS



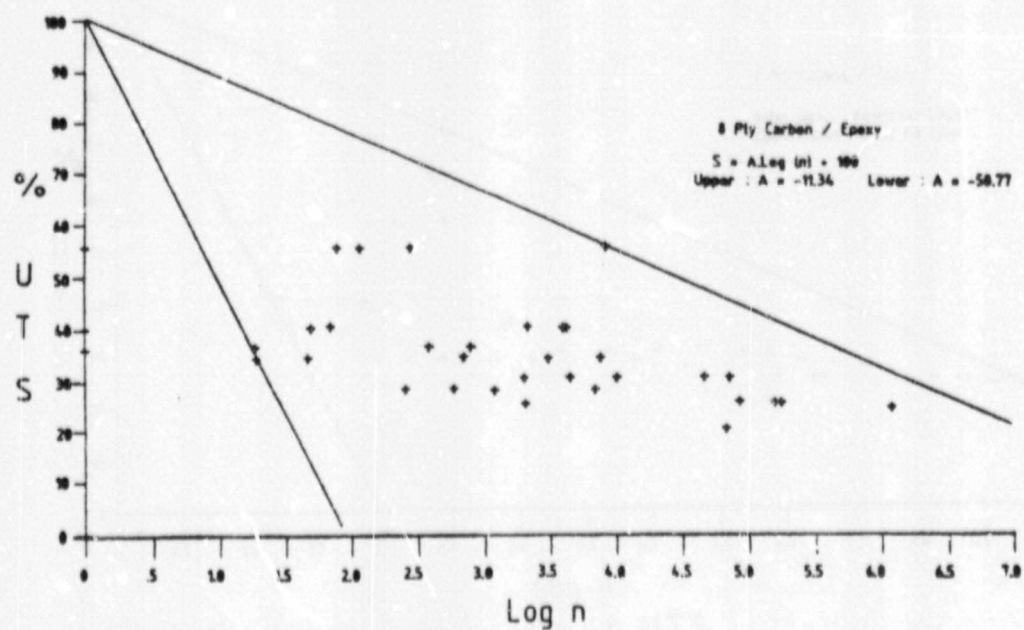
Graph 5 : Linear Fit Through Experimental Data



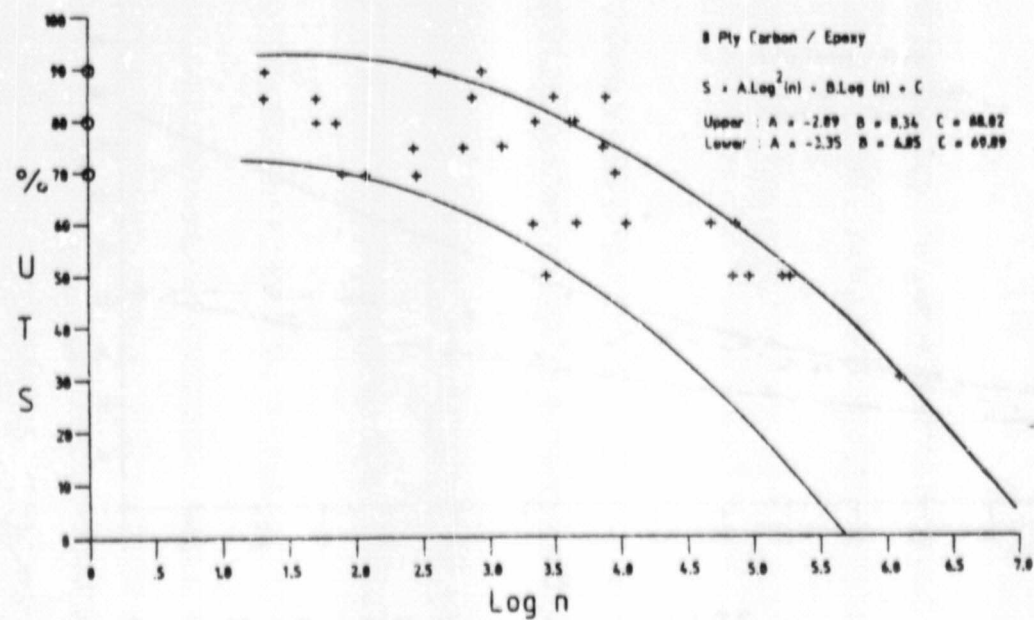
Graph 6 : Linear Fit w.r.t. UTS



Graph 7 : Parabolic Fit w.r.t. UTS



Graph 8 : Linear Limits w.r.t. UTS



Graph 9 : Proposed Parabolic Limits to data

Author Diamantakos Konstantinos

Name of thesis Tensile Fatigue Of Notched Carbon/epoxy. 1986

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