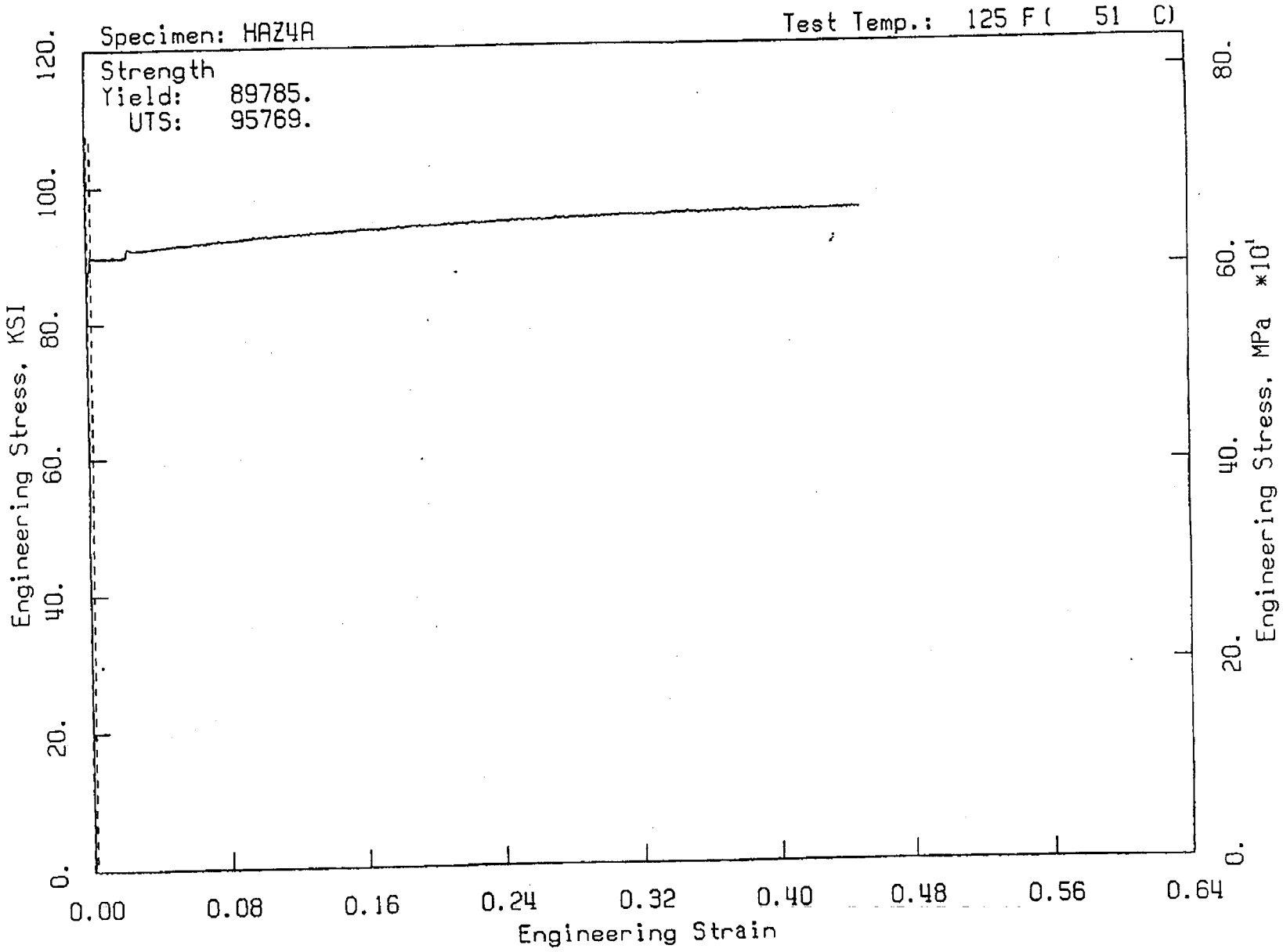
27 Jun., 1994
File: HAZ4A



TADS
<890928.1259> TENSILE DATA ANALYSIS

1 Jul., 1994
File: W5

SPECIMEN ID PARAMETERS

Date of test	6/30/94	
Operator	bjv	
Project number	0135	
Specimen	W5	
Test temperature	125 F	52. C
Material	WELD	
Modulus	29575. ksi	203920. MPa
Cross Section type	CIRC	
Fluence	0.0000E+00	
Technical Specification . .	TP-78-12	

SET UP PARAMETERS

Initial disp rate	.0050 in/min	.127 mm/min
Second. disp rate	.0200 in/min	.51 mm/min
Gauge length (Ext)	.500 in	12.70 mm

DIMENSIONAL

Diameter INITIAL	.1600 in	4.06 mm
FINAL	.1260 in	3.20 mm
Axial Fidical INITIAL . .	.5000 in	12.70 mm
FINAL . .	.0000 in	.00 mm

TEST RESULTS

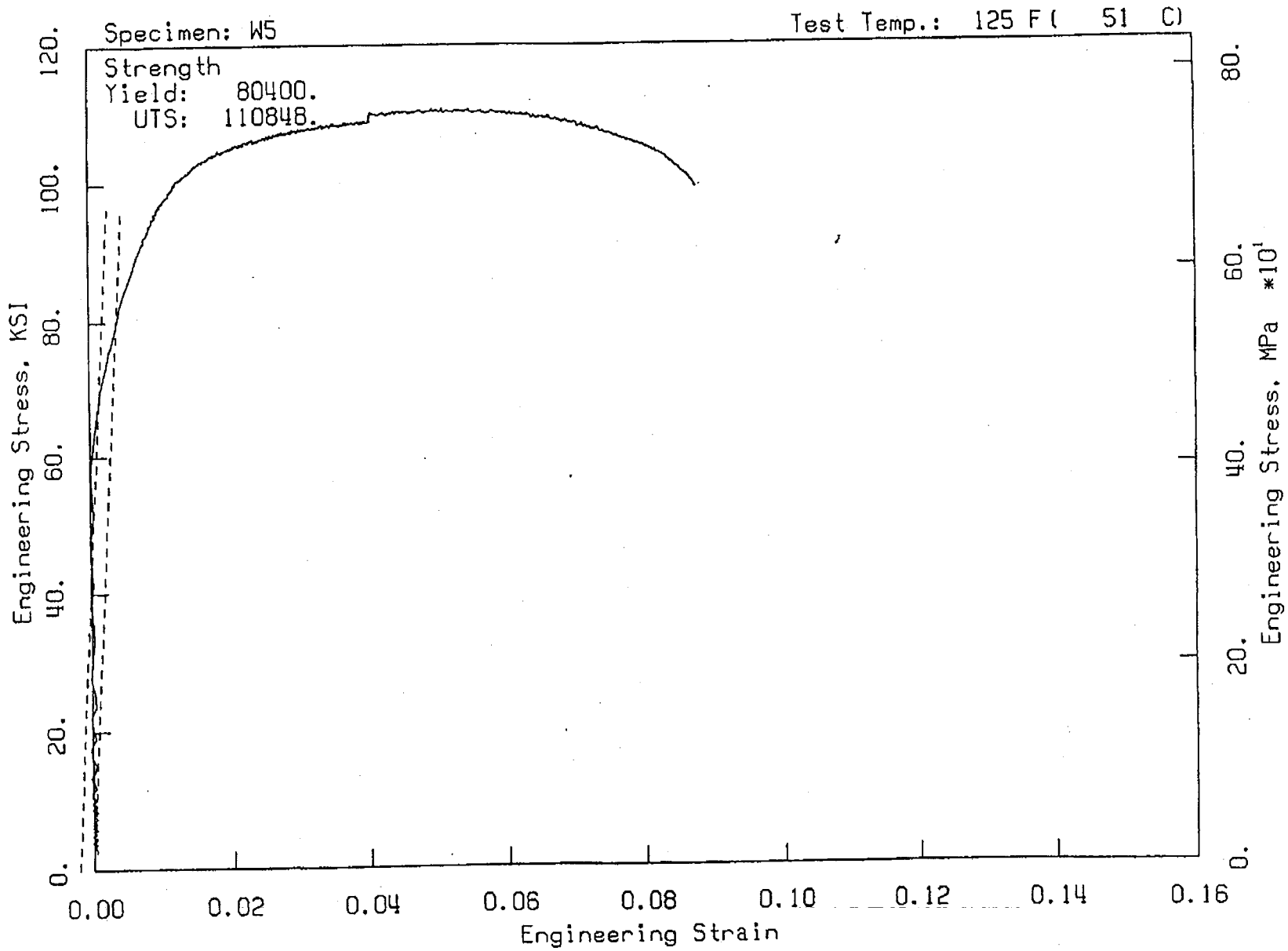
Yield Strength	80400. psi	554.4 MPa
Tensile Strength	110848. psi	764.3 MPa
Fracture Load	1992. lb	8860. N
Fracture Stress	159755. psi	1101.5 MPa
Fracture Strength	99073. psi	683.1 MPa
Young's Modulus	2.01E+07 psi	1.38E+05 MPa
Elongation (fiducial). . .	-1.0000	
Uniform Elongation (Ext) .	.0475	
Total Elongation (Ext) . .	.0844	
Reduction in Diameter. . .	21.2 %	
Reduction in Area	38.0 %	

CURVE FIT

Ramberg-Osgood Equation

		Fit Std Dev
Alpha	.296	.022
N	10.767	.071

1 Jul., 1994
File: W5



TADS
<890928.1259> TENSILE DATA ANALYSIS

1 Jul., 1994
File: W6

SPECIMEN ID PARAMETERS

Date of test	7/1/94	
Operator	BJV	
Project number	0135	
Specimen	W6	
Test temperature	125 F	52. C
Material	WELD	
Modulus	29575. ksi	203920. MPa
Cross Section type	CIRC	
Fluence	0.0000E+00	
Technical Specification . .	TP-78-12	

SET UP PARAMETERS

Initial disp rate	.0050 in/min	.127 mm/min
Second. disp rate	.0200 in/min	.51 mm/min
Gauge length (Ext)	.500 in	12.70 mm

DIMENSIONAL

Diameter INITIAL	.1600 in	4.06 mm
FINAL	.1330 in	3.38 mm
Axial Fidical INITIAL . .	.5000 in	12.70 mm
FINAL . .	.0000 in	.00 mm

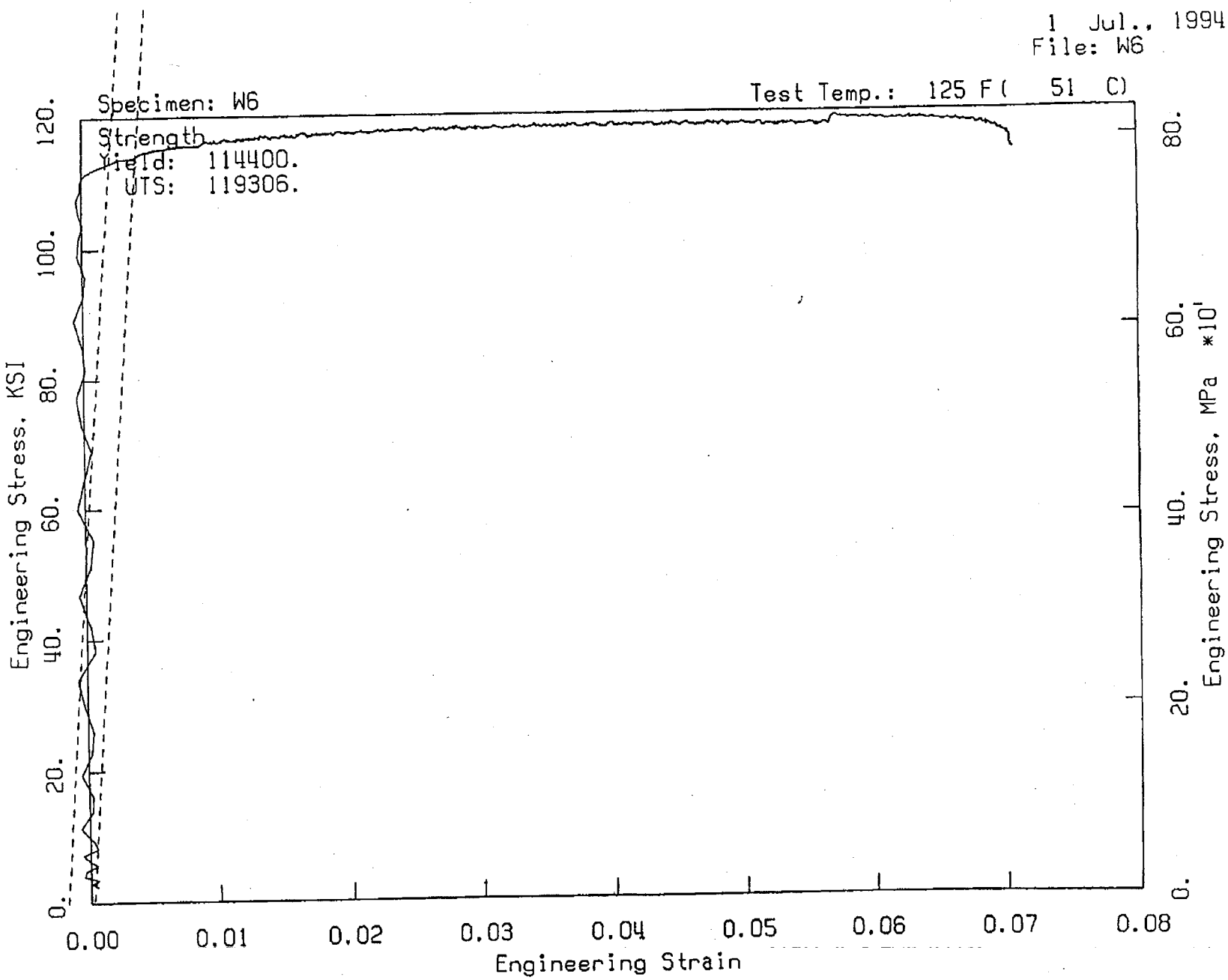
TEST RESULTS

Yield Strength	114400. psi	788.8 MPa
Tensile Strength	119306. psi	822.6 MPa
Fracture Load	2120. lb	9431. N
Fracture Stress	152621. psi	1052.3 MPa
Fracture Strength	105458. psi	727.1 MPa
Young's Modulus	2.96E+07 psi	2.04E+05 MPa
Elongation (fiducial). . .	-1.0000	
Uniform Elongation (Ext) .	.0533	
Total Elongation (Ext) . .	.0671	
Reduction in Diameter. . .	16.9 %	
Reduction in Area	30.9 %	

CURVE FIT

Ramberg-Osgood Equation

		Fit Std Dev
Alpha	.865	.014
N	32.460	.209


1 Jul., 1994
File: W6
Specimen: W6
Test Temp.: 125 F (51 C)
Strength
Yield: 114400.
UTS: 119306.
Engineering Stress, KSI
Engineering Stress, MPa *10¹
Engineering Strain
0.
20.
40.
60.
80.
100.
120.
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08

TADS
<890928.1259> TENSILE DATA ANALYSIS

7 Jul., 1994
File:

SPECIMEN ID PARAMETERS

Date of test	6/29/94	
Operator	BJV	
Project number	0135	
Specimen	W7	
Test temperature	125 F	52. C
Material	WELD	
Modulus	29575. ksi	203920. MPa
Cross Section type	CIRC	
Fluence	0.0000E+00	
Technical Specification . .	TP-78-12	

SET UP PARAMETERS

Initial disp rate	.0050 in/min	.127 mm/min
Second. disp rate	.0200 in/min	.51 mm/min
Gauge length (Ext)	.500 in	12.70 mm

DIMENSIONAL

Diameter INITIAL	.1600 in	4.06 mm
FINAL	.1200 in	3.05 mm
Axial Fidical INITIAL . .	.5000 in	12.70 mm
FINAL . .	.0000 in	.00 mm

TEST RESULTS

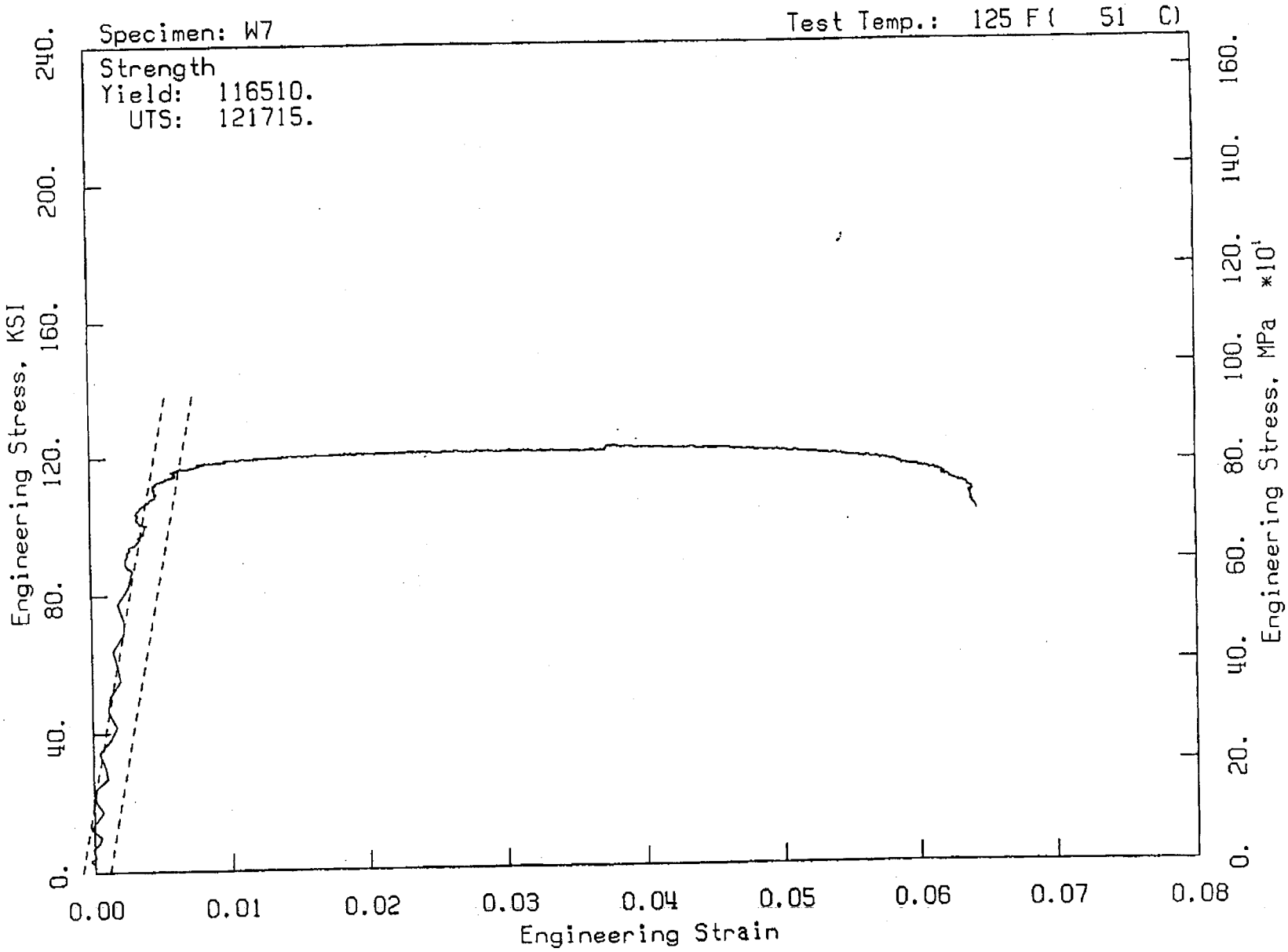
Yield Strength	116510. psi	803.3 MPa
Tensile Strength	121715. psi	839.2 MPa
Fracture Load	2046. lb	9099. N
Fracture Stress	180884. psi	1247.2 MPa
Fracture Strength	101747. psi	701[illegible]5 MPa
Young's Modulus	2.14E+07 psi	1.47E+05 MPa
Elongation (fiducial). . .	-1.0000	
Uniform Elongation (Ext) .	.0337	
Total Elongation (Ext) . .	.0608	
Reduction in Diameter. . .	25.0 %	
Reduction in Area	43.8 %	

CURVE FIT

Ramberg-Osgood Equation

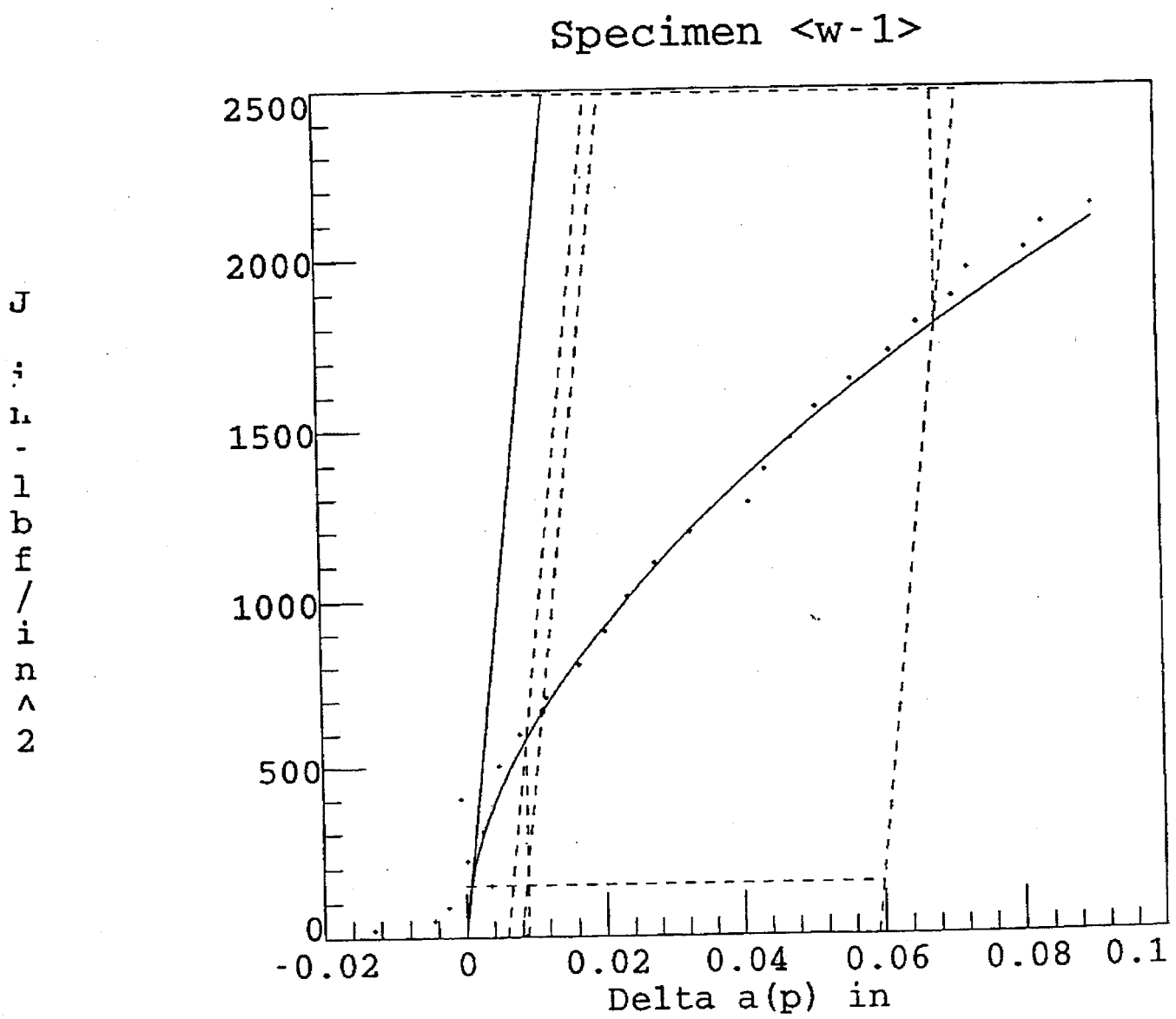
		Fit Std Dev
Alpha	.504	.016
N	39.877	.289

7 Jul., 1994
File:



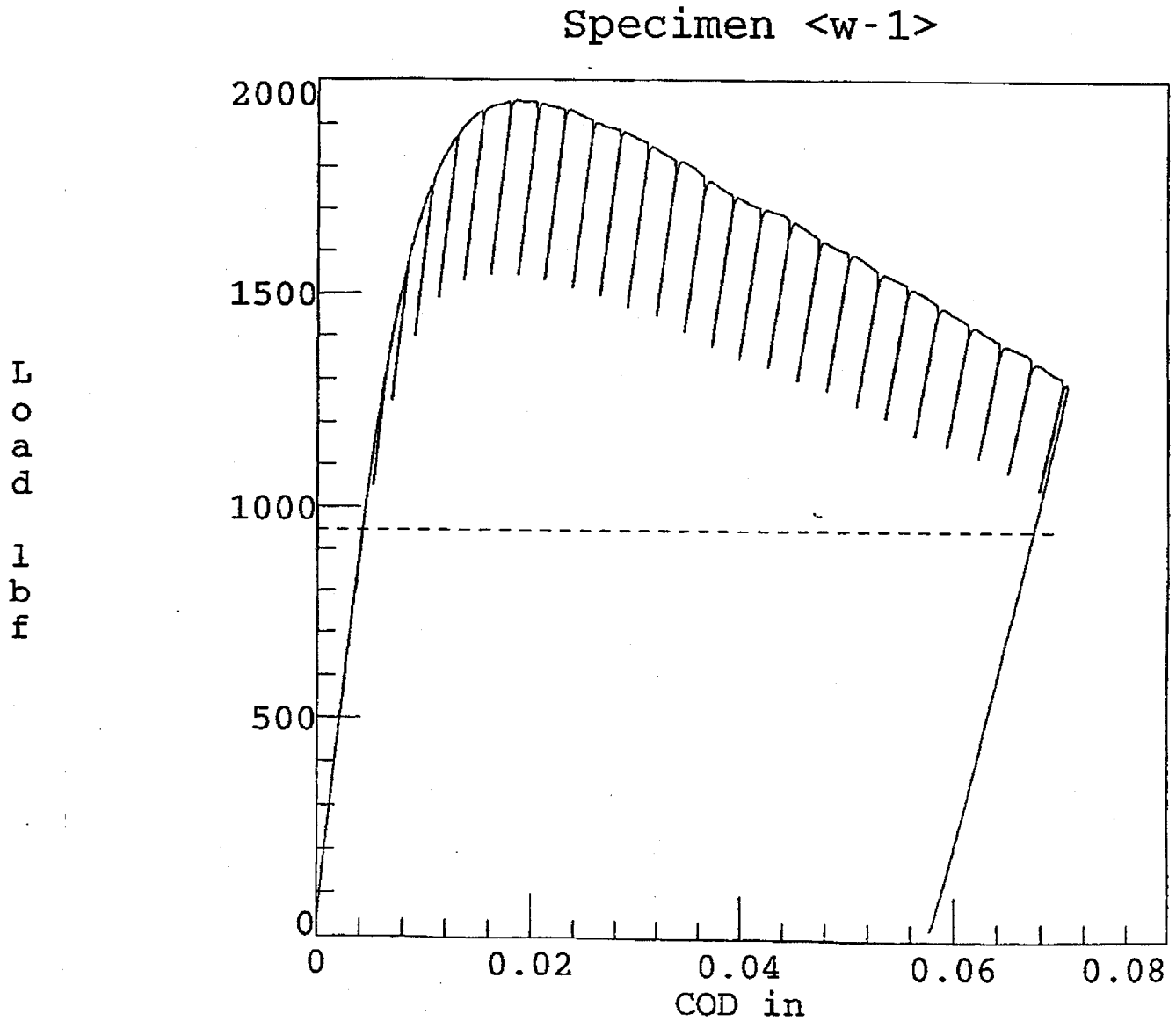
APPENDIX B

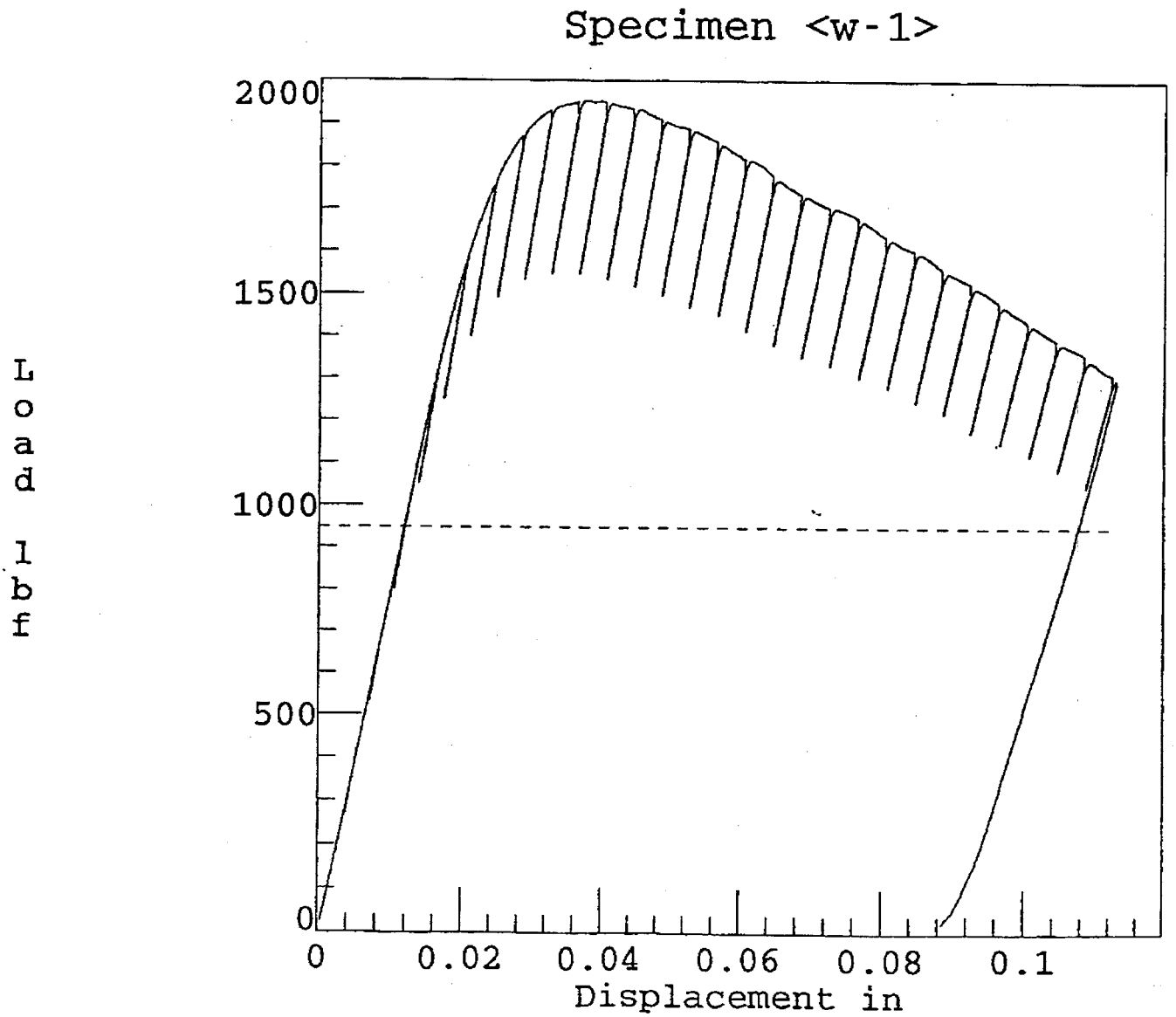
Fracture Toughness Test Results (small bend specimens)



JQ = 668.231 in-lbf/in^2

Delta a(Q) = 0.0112747 in


Specimen <w-1>
2000
1500
1000
500
0
Load lbf
0
0.02
0.04
0.06
0.08
COD in


Specimen <w-1>
2000
1500
1000
500
0
Load lbf
0
0.02
0.04
0.06
0.08
0.1
Displacement in

Report: atr3jtest
Operator: BJ
Date: Fri Jan 06 10:30:24 1995
T plate: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend3

J-Delta a(p) Data Tables : <w-1jic>

Specimen <w-1>

Step	J	Delta a(p)	Load	COD
	(in-lbf/in^2)	(in)	(lbf)	(in)
1	5.90434	0.008534	330.201	0.001253
2	21.5725	-0.012961	651.033	0.002752
3	47.6094	-0.004524	985.649	0.004423
4	87.0262	-0.002497	1302.00	0.006319
5	148.591	0.003619	1553.91	0.008318
6	219.804	0.000233	1733.45	0.010557
7	306.788	0.002466	1841.32	0.012884
8	402.147	-0.000567	1894.73	0.015296
9	502.196	0.004924	1914.03	0.017811
10	599.658	0.007972	1908.86	0.020448
11	709.208	0.011834	1895.42	0.022929
12	807.744	0.016516	1872.33	0.025600
13	908.925	0.020282	1850.28	0.028201
14	1010.44	0.023628	1818.57	0.030889
15	1105.90	0.027588	1781.01	0.033646
16	1197.87	0.032757	1742.07	0.036420
17	1282.60	0.041260	1700.37	0.039074
18	1381.02	0.043722	1670.04	0.041744
19	1471.53	0.047549	1644.89	0.044518
20	1561.28	0.051032	1600.78	0.047258
21	1641.46	0.056095	1568.38	0.050032
22	1723.03	0.061698	1524.96	0.052875
23	1804.95	0.065703	1492.23	0.055563
24	1881.21	0.070757	1450.87	0.058423
25	1963.84	0.072946	1404.35	0.061352
26	2020.43	0.081144	1361.96	0.064264
27	2094.85	0.083551	1324.40	0.067056
28	2145.59	0.090626	1281.32	0.069950

Report: atr3jtest
Operator: BJ
Date: Fri Jan 06 10:30:24 1995
Template: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend3

J-Delta a(p) Data Tables : <w-1jic>

Specimen <w-1>

Step	Displ. (in)	J Exclusion	Delta a(p) Max/Min	Displ. for J calc. (in)
1	0.004379	Invalid	Invalid	0.002374
2	0.008359	Invalid	Invalid	0.004406
3	0.012408	Invalid	Invalid	0.006423
4	0.016370	Invalid	Invalid	0.008465
5	0.020385	Invalid	Invalid	0.010950
6	0.024382	Invalid	Invalid	0.013857
7	0.028379	Invalid	Invalid	0.017199
8	0.032376	Invalid	Invalid	0.020872
9	0.036408	Invalid	Invalid	0.024787
10	0.040405	Invalid	Invalid	0.028815
11	0.044368	Valid	Valid	0.032860
12	0.048383	Valid	Valid	0.037014
13	0.052380	Valid	Valid	0.041146
14	0.056377	Valid	Valid	0.045335
15	0.060409	Valid	Valid	0.049595
16	0.064354	Valid	Valid	0.053777
17	0.068386	Valid	Valid	0.058062
18	0.072366	Valid	Valid	0.062226
19	0.076380	Valid	Valid	0.066393
20	0.080395	Valid	Valid	0.070676
21	0.084340	Valid	Valid	0.074818
22	0.088424	Valid	Valid	0.079165
23	0.092438	Valid	Valid	0.083378
24	0.096384	Invalid	Invalid	0.087575
25	0.100415	Invalid	Invalid	0.091889
26	0.104395	Invalid	Invalid	0.096126
27	0.108375	Invalid	Invalid	0.100334
28	0.112528	Invalid	Invalid	0.104748

Report: atr3jtest
Operator: BJ
Date: Fri Jan 06 10:30:24 1995
T plate: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend3

J-Delta a(p) Data Tables : <w-1jic>

Specimen <w-1>

Step	Normalized Compliance ((none))	Energy for J calc. (in-lbf)
1	74.7230	0.372064
2	61.8088	1.35723
3	67.2593	3.01221
4	65.3255	5.38393
5	62.2519	8.99251
6	61.1699	13.8597
7	61.2784	19.9482
8	60.3653	26.9385
9	62.7552	34.5250
10	68.2837	42.3685
11	65.6117	50.2035
12	71.0130	58.1758
13	73.8273	65.9928
14	76.5905	73.8197
15	82.8537	81.6217
16	87.7586	89.1440
17	93.5210	96.6441
18	95.1017	103.785
19	99.3331	110.826
20	105.083	117.896
21	110.339	124.574
22	115.229	131.425
23	120.199	137.896
24	123.796	144.184
25	133.173	150.449
26	135.269	156.413
27	146.546	162.172
28	158.261	168.007

Report: atr3jtest
Operator: BJ
Date: Fri Jan 06 10:33:00 1995
Template: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend3

Test Summaries : <w-1jic>

	O
-- Identification: --	O
Template:	OJIC Fracture Toughness
Procedure:	OSE(B)
General Information:	O
This Test is designed to run SE(B)	style specimens.■The test will be run u
Batch:	OATRsmlbend3
Comments:	O
Specimen Name:	Ow-1
Comments:	O
	O
-- Geometry: --	O
Specimen Geometry:	OSE(B)
Width	O0.998 Oin
Notch Length	O0.5 Oin
Thickness	O0.501 Oin
Net Thickness	O0.4 Oin
Span	O4 Oin
Modulus of Elasticity	O3.36e+07 Olbf/in^2
Yield Strength	O89900 Olbf/in^2
Ultimate Tensile Strength	O106600 Olbf/in^2
Poisson's Ratio	O0.3 O(none)
Crack Plane Orientation	O
Test Temperature	O125 Odeg_F
Compliance Calibration File:	OC:\ts2\79050\SE(B).CPL
K-Calibration File:	OC:\ts2\79050\SE(B).KCL
	O
-- Precrack Parameters: --	O
Final Kmax	O20000 Olbf/in^1.5
Load Ratio, R (min/max)	O0.1 O(none)
Test Frequency	O10 OHz
Final Crack Length	O0.645 Oin
Cycle Limited	OOff
Maximum Number of Cycles	O10000
Manual measurement	OOff
Compliance measurement	OOn
Upper LSF data range	O90 O%
Lower LSF data range	O10 O%
Automatic Inspection Hold	OOff
Inspection Interval (cycles)	O10000
	O
-- Precrack Results: --	O
Precrack Cycles	O0
Precrack Kmax	O0 Olbf/in^1.5
Precrack Final K	O0 Olbf/in^1.5

Report: atr3jtest
Operator: BJ
Date: Fri Jan 06 10:33:00 1995
Template: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend3

Test Summaries : <w-1jic>

Precrack Pmax	O0 Olbf
Precrack Final P	O-900 Olbf
Precrack crack length	O0.5875 Oin
Precrack user comment	Oonly precrack length is valid
	O
-- Precrack Setup: --	O
Load Sensor:	OForce 1
Load Range:	O10000 Olbf
COD Sensor:	OLength 2
COD Range:	O0.5 Oin
	O
-- JIC Execution Parameters: --	O
Precycle Load	O-500 Olbf
Test Control	ODisplacement
Ramp Rate	O-0.0002 Oin/Sec
UnLoad on Load Step	OOff
Load Step	O300 Olbf
UnLoad on COD Step	OOff
COD Step	O0.001 Oin
UnLoad on Displacement Step	OOn
Displacement Step	O0.004 Oin
Unload Pct of Current Load	OOn
Percent Unload	O20 O%
Unload Absolute	OOff
Absolute Unload	O300 Olbf
Number of Unloads	O2
Crack Propagation Hold Time	O2 OSec
Unload Rate	O300 Olbf/Sec
Reload Rate	O300 Olbf/Sec
Ramp To Initial Load	OOn
Pct Of Final Precrack Load	O100 O%
Load Ramp Rate	O-100 Olbf/Sec
	O
-- JIC Test Setup: --	O
Load Sensor:	OForce 1
Load Range:	O10000 Olbf
COD Sensor:	OLength 2
COD Range:	O0.5 Oin
Displacement Sensor:	OLength 1
Displacement Range:	O0.5 Oin
Frame Stiffness:	O164700 Olbf/in
	O
-- JIC Data Storage: --	O
Event Log Filename:	Oelog.txt
Raw Data Filename:	Ojff.000

Report: atr3jtest
Operator: BJ
Date: Fri Jan 06 10:33:00 1995
Template: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend3

Test Summaries : <w-1jic>

	O
-- JIC Test Termination: --	O
End on maximum load	OOff
Maximum Load	O5000 Olbf
End on maximum COD	OOff
Maximum COD	O0.1 Oin
End on maximum displ.	OOff
Maximum Displacement	O-0.245 Oin
End on maximum Crack Length	OOff
Maximum Crack Length	O1 Oin
End on maximum Crack Extension	OOff
Maximum Crack Length Extension	O1 Oin
Termination Type	OControlled
Hydraulic Shutdown	OOn
	O
-- Final Precrack Lengths: --	O
Precrack length 1	O0.6277 Oin
Precrack length 2	O0.6369 Oin
Precrack length 3	O0.6368 Oin
Precrack length 4	O0.6359 Oin
Precrack length 5	O0.6334 Oin
Precrack length 6	O0.6328 Oin
Precrack length 7	O0.6271 Oin
Precrack length 8	O0.6245 Oin
Precrack length 9	O0.6236 Oin
Average Precrack:	O0.631631 Oin
	O
-- Final JIC Crack Lengths: --	O
Final crack length 1	O0.7187 Oin
Final crack length 2	O0.7168 Oin
Final crack length 3	O0.7133 Oin
Final crack length 4	O0.7172 Oin
Final crack length 5	O0.7143 Oin
Final crack length 6	O0.7241 Oin
Final crack length 7	O0.7313 Oin
Final crack length 8	O0.7382 Oin
Final crack length 9	O0.7399 Oin
Average Physical Crack:	O0.723062 Oin
	O
-- Calculated Crack Lengths: --	O
Pre Test Normalized Compliance:	O73.1184 O(none)
Calculated Pre Test Crack Length:	O0.618361 Oin
Test Termination Normalized Compliance:	O144.123 O(none)
Calculated Test Term. Crack Length:	O0.711987 Oin
	O

```
Report:      atr3jtest
Operator:    BJ
Date:        Fri Jan 06 10:33:00 1995
Template:    JIC Fracture Toughness
I  cedure:   SE(B)
Ba.ch:       ATRsmlbend3


Test Summaries : <w-ljic>

      -- Run-Time Report: --                  O
Test Duration:                                O883.951 OSec
Maximum Load:                                 O1894.32 Olbf
Maximum COD:                                  O0.0699034 Oin
Maximum Displacement:                         O0.111991 Oin
Test Termination:                             O
                                              O
   -- JIC Analysis Inputs ASTM E 813: --      O
Upper LSF data range:                         O15 O%
Lower LSF data range:                         O85 O%
Blunting Factor M:                            O2 O(none)
Minimum J value:                              O150 Olbf/in
Modulus Factor Lambda:                        O1 O(none)
Delta a(p) offset:                            O-0.003 Oin
                                              O
      -- JIC Analysis Calculations: --        O
Effective Yield Strength                      OAvg. of Yield & Ultimate
Unload/Reload Compliance                      OUnload & Reload
Rotational Correction                         OASTM E813-89
J Calculation                                 OASTM E813-89
 :  elta a(p) Curve Fit                       OASTM E813-89
JIC Test Validity                             OASTM E813-89
                                              O
      -- JIC Test Results ASTM E 813: --      O
Number of Data Points:                        O28
Number of Valid Data Points:                  O13
Delta a(p) Min Limit Line:                    O0.00888855 Oin
Delta a(p) Max Limit Line:                    O0.068232 Oin
Regression Slope dJQ/da at delta-aQ:          O32628.5 Olbf/in^2
J-Delta a(p) Equation:                        O
   J (in-lbf/in^2) =                          O
      c1 * (Delta a(p) (in)) ^^ c2            O
   c1                                         O7910
   c2                                         O0.5513
JQ                                            O668.231 Oin-lbf/in^2
Delta a(Q)                                    O0.0112747 Oin
Kj Value:                                     O149842 Olbf/in^1.5
                                              O
-- Validation Criteria ASTM E 813-89: --      O
ASTM E813-89 Section 8.4.2:                   O
   tp = 76.59 Sec                             O
   Is tp b/w 6 Sec                            O
      and 600 Sec?                            OYes
ASTM E813-89 Section 7.1.1:                   O
   25 JQ/SFS = 0.17 in                        O
```

Report: atr3jtest
Operator: BJ
Date: Fri Jan 06 10:33:00 1995
Template: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend3

Test Summaries : <w-1jic>

Is b0 > 25 JQ/SFS?	OYes
Is B > 25 JQ/SFS?	OYes
ASTM E813-89 Section 7.2.2:	O
a0/W = 0.6329	O
Is a0/W b/w 0.5 & 0.75?	OYes
ASTM E813-89 Section 7.5:	O
Side grooving = 20.16 pct.	O
Is side grooving <= 25 pct.?	OYes
ASTM E813-89 Section 7.6.4:	O
Precrack extension = 0.1316 in	O
Is precrack extension >= 0.05a0	O
and >= 0.05118 in?	OYes
ASTM E813-89 Section 7.6.1:	O
PL = 2365 lbf	O
ASTM E813-89 Section 8.4.3.6:	O
Is the load range of all compliance	O
unloads <= 0.2PL or 0.5 times	O
the current load?	OYes
ASTM E813-89 Section 9.3.1:	O
Do all points used for regression lie	O
b/w Delta a(p) min & max?	OYes
ASTM E813-89 Section 9.2.2:	O
Does at least one data point lie b/w	O
the 0.005906 in & 0.01969 in excl.	OYes
Does at least one data point lie b/w	O
the 0.03937 in & 0.05906 in excl.	OYes
ASTM E813-89 Section 9.3.2:	O
Were at least 4 data points used for	O
the J-Delta a(p) regression?	OYes
ASTM E813-89 Section 9.4.1.3:	O
Is the slope of the regression curve	O
at JQ less than SFS?	OYes
ASTM E813-89 Section 9.4.1.5:	O
Are all precrack lengths within	O
7 pct. of the average?	OYes
ASTM E813-89 Section 9.4.1.5:	O
Are all final crack lengths within	O
7 pct. of the average?	OYes
ASTM E813-89 Section 9.4.1.6:	O
Are both near surface crack	O
extensions within 0.02W of the	O
extension at the center?	OYes
ASTM E813-89 Section 9.4.1.7:	O
Is the difference between the crack	O
extensions found from compliance	O

Report: atr3jtest
Operator: BJ
Date: Fri Jan 06 10:33:00 1995
Template: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend3

Test Summaries : <w-1jic>

and the 9-point averages within	O
15 pct. of either of the 9-point	O
average or Delta a(p) max?	OYes
ASTM E813-89 Section 9.4.1.7:	O
EM from 9-point precrack front	O
average = 3.669e+07 lbf/in^2	O
Is EM within 10 pct. of nominal E?	OYes
Were the J values and curve fit	O
calculated per ASTM E813-89?	OYes
Is JQ = JIC per ASTM E813-89?	OYes
JIC Value (ASTM E813-89):	O668.231 Oin-lbf/in^2