Report: atr4jtest
Operator: BJ
Date: Fri Jan 06 11:02:31 1995
Template: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend4

J-Delta a(p) Data Tables : <w-11jic>

Specimen <w-11>

Step	Displ. (in)	J Exclusion	Delta a(p) Max/Min	Displ. for J calc. (in)
1	0.003569	Invalid	Valid	0.001131
2	0.007170	Invalid	Valid	0.002736
3	0.010736	Invalid	Valid	0.004296
4	0.014372	Invalid	Valid	0.005960
5	0.017955	Invalid	Valid	0.007765
6	0.021539	Invalid	Invalid	0.009886
7	0.025123	Invalid	Invalid	0.012411
8	0.028724	Invalid	Invalid	0.015422
9	0.032342	Invalid	Invalid	0.018754
10	0.035891	Invalid	Invalid	0.022293
11	0.039527	Valid	Valid	0.026169
12	0.043179	Valid	Valid	0.030206
13	0.046780	Valid	Valid	0.034157
14	0.050381	Valid	Valid	0.038038
15	0.053930	Valid	Valid	0.041947
16	0.057531	Valid	Valid	0.046048
17	0.061150	Valid	Valid	0.050522
18	0.064733	Valid	Valid	0.054512
19	0.068351	Invalid	Invalid	0.058494
20	0.071918	Invalid	Invalid	0.062343
21	0.075519	Invalid	Invalid	0.066411
22	0.079172	Invalid	Invalid	0.070547
23	0.082807	Invalid	Invalid	0.074519
24	0.086391	Invalid	Invalid	0.078450
25	0.090009	Invalid	Invalid	0.082526

Report: atr4jtest
Operator: BJ
Date: Fri Jan 06 11:02:31 1995
T plate: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend4

J-Delta a(p) Data Tables : <w-11jic>

Specimen <w-11>

Step	Normalized Compliance ((none))	Energy for J calc. (in-lbf)
1	60.9464	0.373818
2	52.8646	1.28978
3	51.5544	2.69636
4	48.5332	4.74875
5	45.8556	7.55804
6	44.6021	11.4376
7	43.4474	16.5858
8	46.6427	23.1544
9	46.6114	30.6522
10	50.4884	38.7217
11	53.3857	47.4769
12	57.6851	56.3412
13	60.5305	64.8040
14	65.1999	72.9079
15	69.1676	80.8797
16	76.9229	88.9687
17	88.3431	97.2752
18	96.1981	104.217
19	104.763	110.913
20	104.538	117.185
21	117.146	123.549
22	126.384	129.705
23	136.879	135.324
24	143.847	140.668
25	156.579	145.951

Report: atr4jtest
Operator: BJ
Date: Fri Jan 06 11:04:23 1995
Template: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend4

Test Summaries : <w-11jic>

	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:	OATRsmlbend4
Comments:	O
Specimen Name:	Ow-11
Comments:	O
	O
-- Geometry: --	O
Specimen Geometry:	OSE(B)
Width	O0.999 Oin
Notch Length	O0.5 Oin
Thickness	O0.501 Oin
Net Thickness	O0.4 Oin
Span	O4 Oin
Modulus of Elasticity	O3e+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: atr4jtest
Operator: BJ
Date: Fri Jan 06 11:04:23 1995
Template: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend4

Test Summaries : <w-11jic>

Precrack Pmax	O0 Olbf
Precrack Final P	O-900 Olbf
Precrack crack length	O0.5969 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:	O5 Oin
Frame Stiffness:	O164700 Olbf/in
	O
-- JIC Data Storage: --	O
Event Log Filename:	Oelog.txt
Raw Data Filename:	Ojcc.000

Report: atr4jtest
Operator: BJ
Date: Fri Jan 06 11:04:23 1995
Template: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend4

Test Summaries : <w-11jic>

	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	O0.608 Oin
Precrack length 2	O0.611 Oin
Precrack length 3	O0.6114 Oin
Precrack length 4	O0.6107 Oin
Precrack length 5	O0.6181 Oin
Precrack length 6	O0.6132 Oin
Precrack length 7	O0.6092 Oin
Precrack length 8	O0.6051 Oin
Precrack length 9	O0.6001 Oin
Average Precrack:	O0.610344 Oin
	O
-- Final JIC Crack Lengths: --	O
Final crack length 1	O0.7332 Oin
Final crack length 2	O0.7242 Oin
Final crack length 3	O0.7281 Oin
Final crack length 4	O0.7247 Oin
Final crack length 5	O0.7308 Oin
Final crack length 6	O0.7432 Oin
Final crack length 7	O0.7539 Oin
Final crack length 8	O0.7626 Oin
Final crack length 9	O0.776 Oin
Average Physical Crack:	O0.740263 Oin
	O
-- Calculated Crack Lengths: --	O
Pre Test Normalized Compliance:	O68.9191 O(none)
Calculated Pre Test Crack Length:	O0.610021 Oin
Test Termination Normalized Compliance:	O156.765 O(none)
Calculated Test Term. Crack Length:	O0.723034 Oin
	O

```
Report:      atr4jtest
Operator:    BJ
Date:        Fri Jan 06 11:04:23 1995
Template:    JIC Fracture Toughness
F  cedure:   SE(B)
B. .ch:      ATRsmlbend4


Test Summaries : <w-11jic>

      -- Run-Time Report: --                  O
Test Duration:                                O744.611 OSec
Maximum Load:                                 O2173.46 Olbf
Maximum COD:                                  O0.0566533 Oin
Maximum Displacement:                         O0.0899376 Oin
Run Time Parm Mods                            OYes
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:                              O250 Olbf/in
Modulus Factor Lambda:                        O1 O(none)
Delta a(p) offset:                            O0 Oin
                                              O
      -- JIC Analysis Calculations: --        O
Effective Yield Strength                      OAvg. of Yield & Ultimate
Unload/Reload Compliance                      OUnload & Reload
Rotational Correction                         OASTM E813-89
 :  alculation                                OASTM E813-89
J-Delta 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:                        O25
Number of Valid Data Points:                  O8
Delta a(p) Min Limit Line:                    O0.00904714 Oin
Delta a(p) Max Limit Line:                    O0.0659252 Oin
Regression Slope dJQ/da at delta-aQ:          O23458.9 Olbf/in^2
J-Delta a(p) Equation:                        O
   J (in-lbf/in^2) =                          O
      c1 * (Delta a(p) (in)) ^^ c2            O
   c1                                         O3931
   c2                                         O0.3936
JQ                                            O672.009 Oin-lbf/in^2
Delta a(Q)                                    O0.0112939 Oin
Kj Value:                                     O141987 Olbf/in^1.5
                                              O
-- Validation Criteria ASTM E 813-89: --O
ASTM E813-89 Section 8.4.2:                   O
   tp = 68.1 Sec                              O
   Is tp b/w 6 Sec                            O
      and 600 Sec?                            OYes
ASTM E813-89 Section 7.1.1:                   O
```

Report: atr4jtest
Operator: BJ
Date: Fri Jan 06 11:04:23 1995
Template: JIC Fracture Toughness
F cedure: SE(B)
B..ch: ATRsmlbend4

Test Summaries : <w-11jic>

25 JQ/SFS = 0.171 in	O
Is b0 > 25 JQ/SFS?	OYes
Is B > 25 JQ/SFS?	OYes
ASTM E813-89 Section 7.2.2:	O
a0/W = 0.611	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 = 0.1103 in	O
Is precrack extension >= 0.05a0	O
and >= 0.05118 in?	OYes
ASTM E813-89 Section 7.6.1:	O
PL = 2483 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

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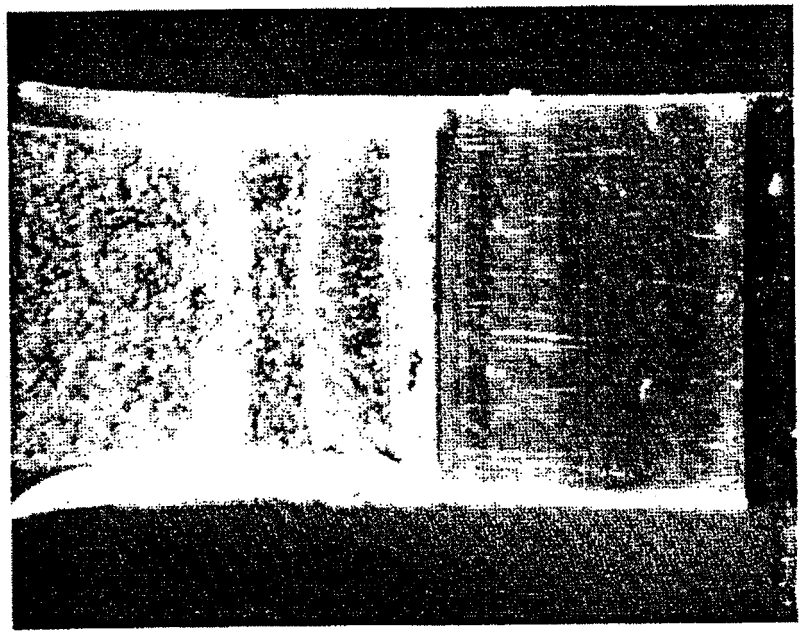
Operator: BJ
Date: Fri Jan 06 11:04:23 1995
Template: JIC Fracture Toughness
Procedure: SE(B)
Batch: ATRsmlbend4

Test Summaries : <w-11jic>

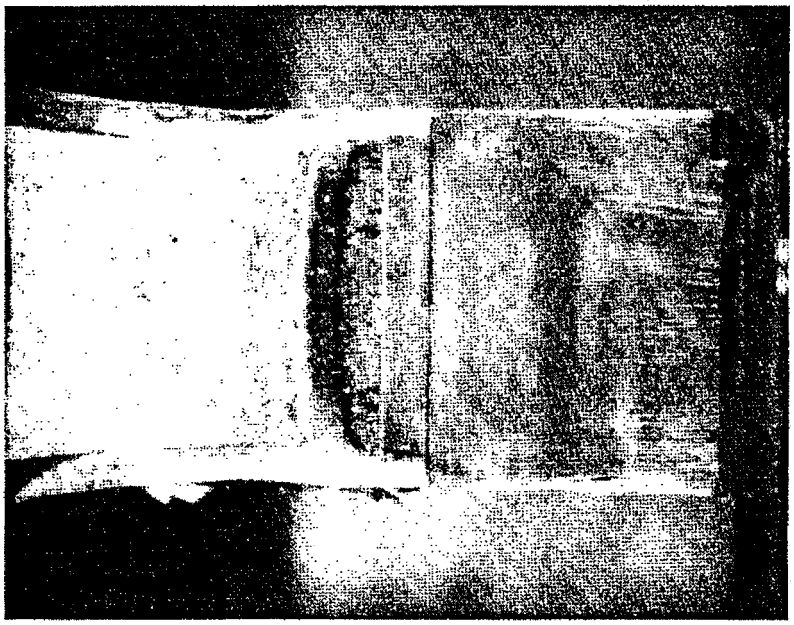
extensions found from compliance	O
and the 9-point averages within	O
15 pct. of either of the 9-point	O
average or Delta a(p) max?	OYes
ASTM E813-89 Section 9.4.1.7:	O
EM from 9-point precrack front	O
average = 3.006e+07 lbf/in^2	O
Is EM within 10 pct. of nominal E?	OYes
Were the J values and curve fit	O
calculated per ASTM E813-89?	OYes
Is JQ = JIC per ASTM E813-89?	OYes
JIC Value (ASTM E813-89):	O672.009 Oin-lbf/in^2

APPENDIX C

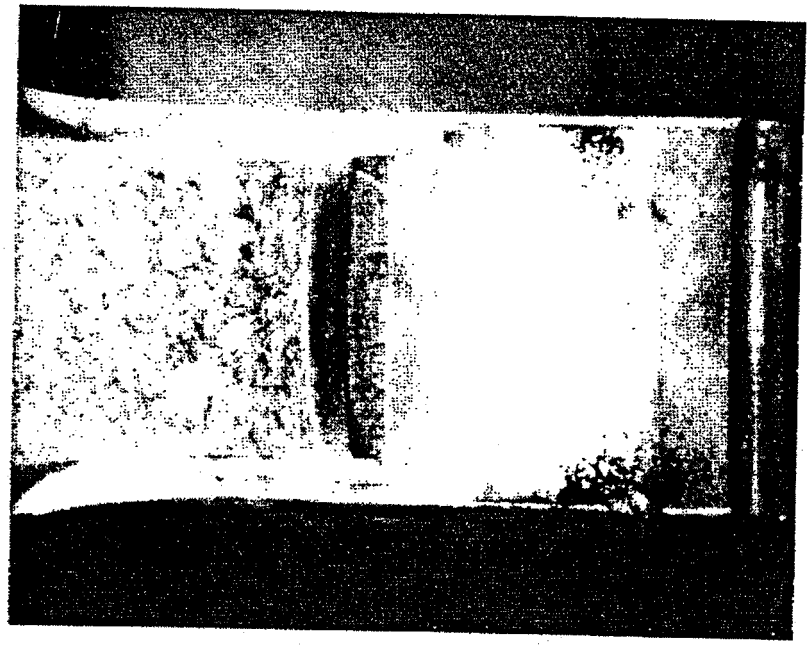
Fracture Toughness Test Results (large bend specimens)



PM-1

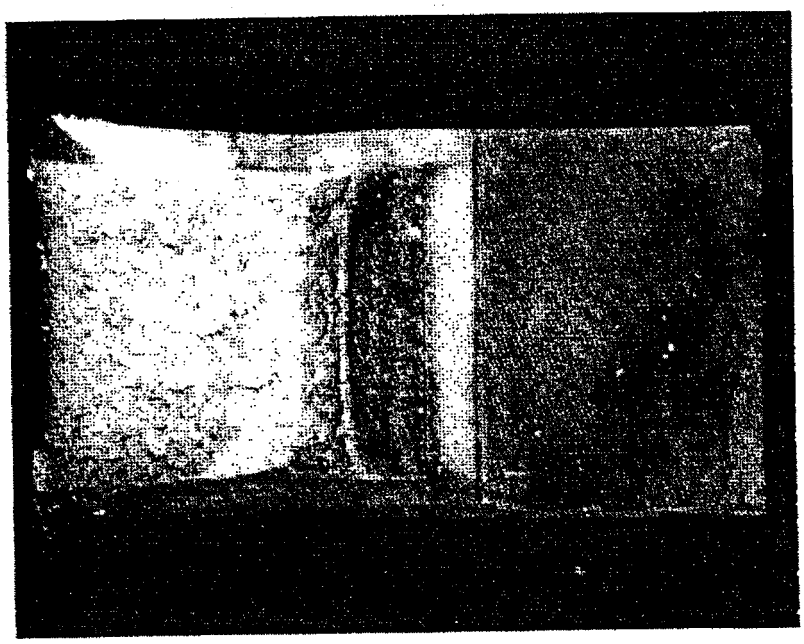


PM-2

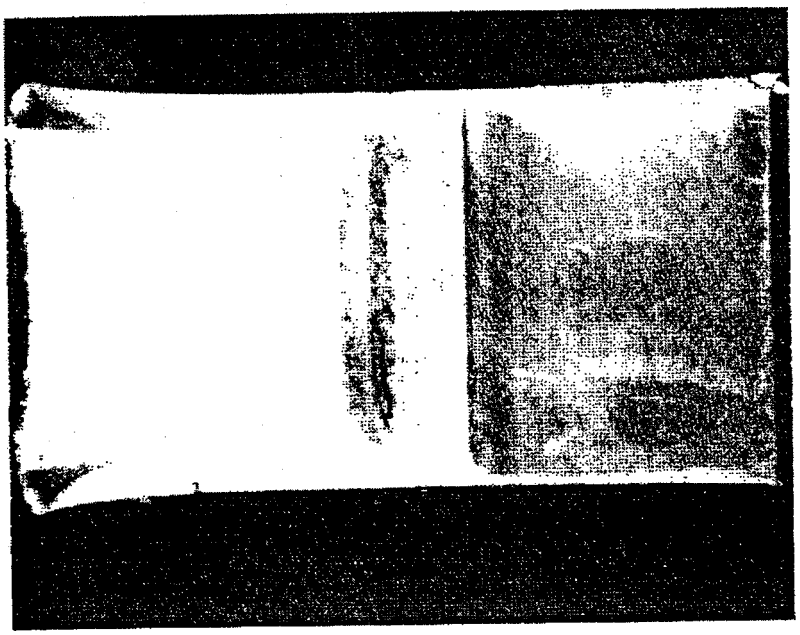


PM-3

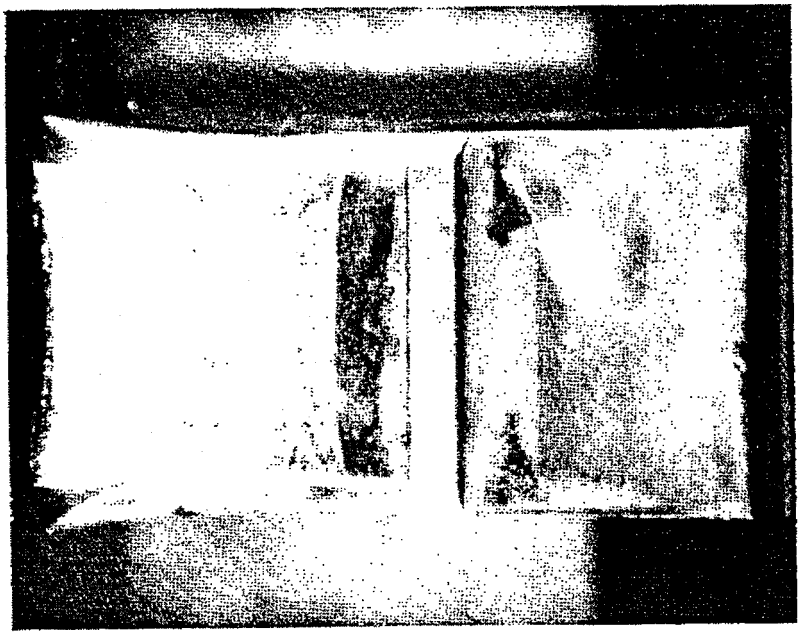
PM-5



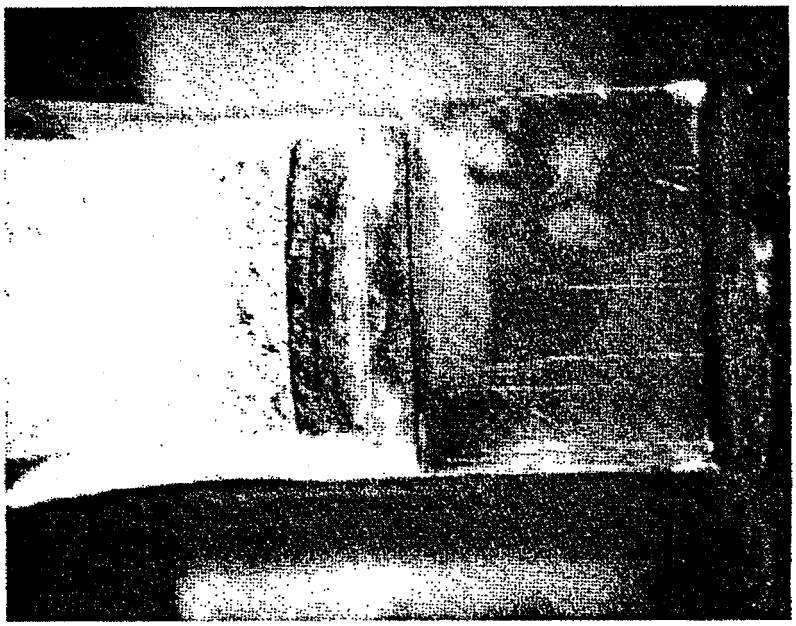
PM-6



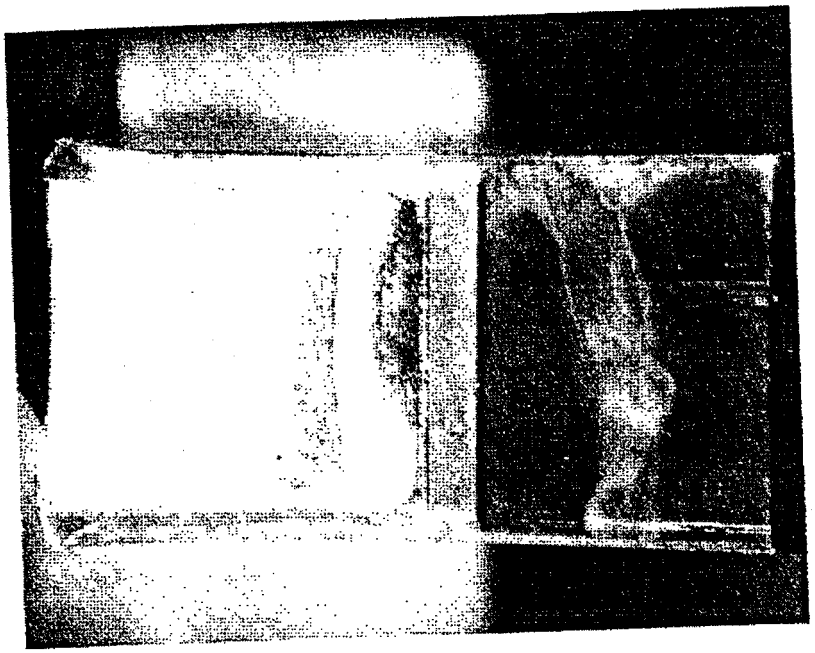
HAZ-1



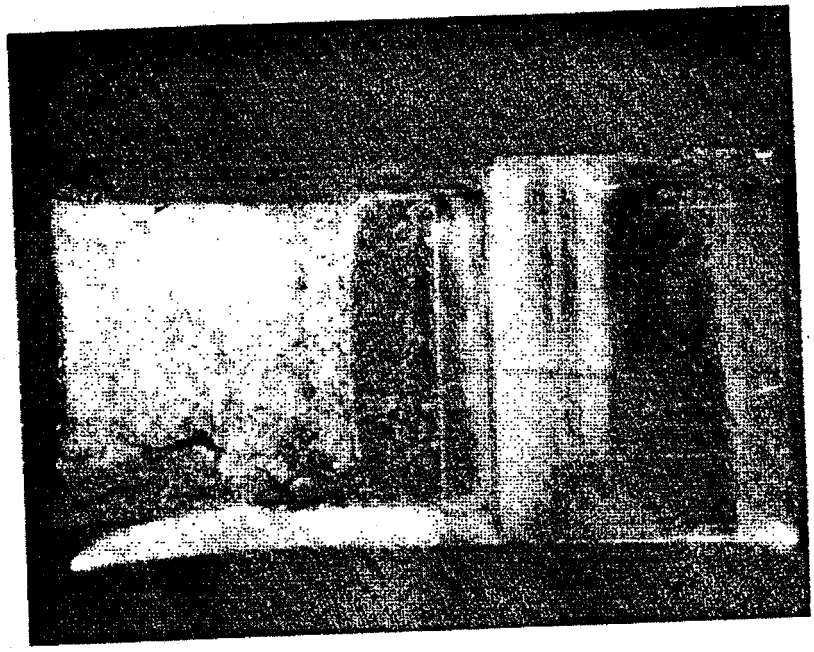
HAZ-2



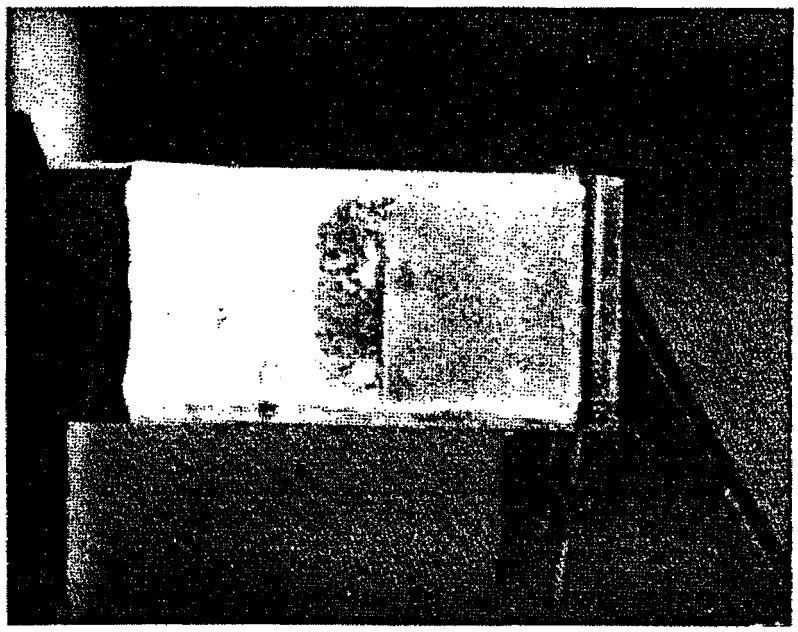
HAZ-3



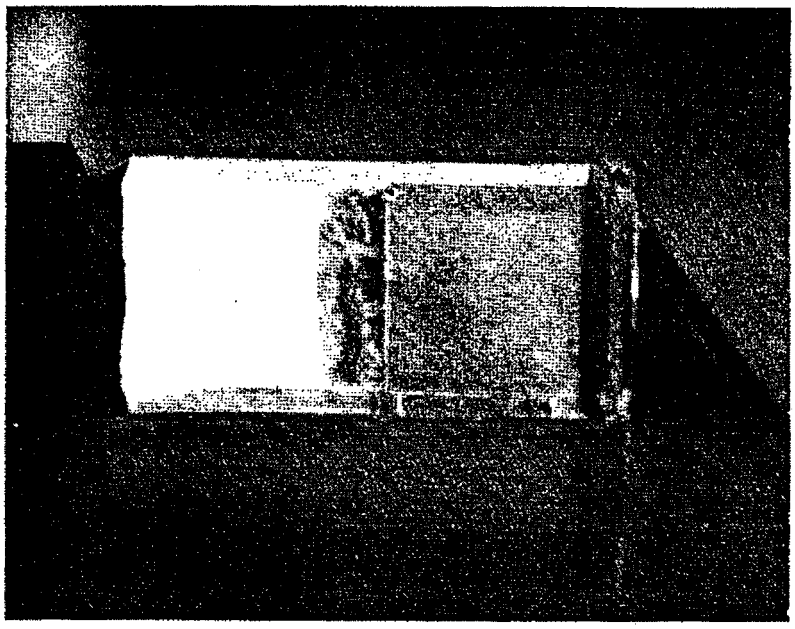
HAZ-5



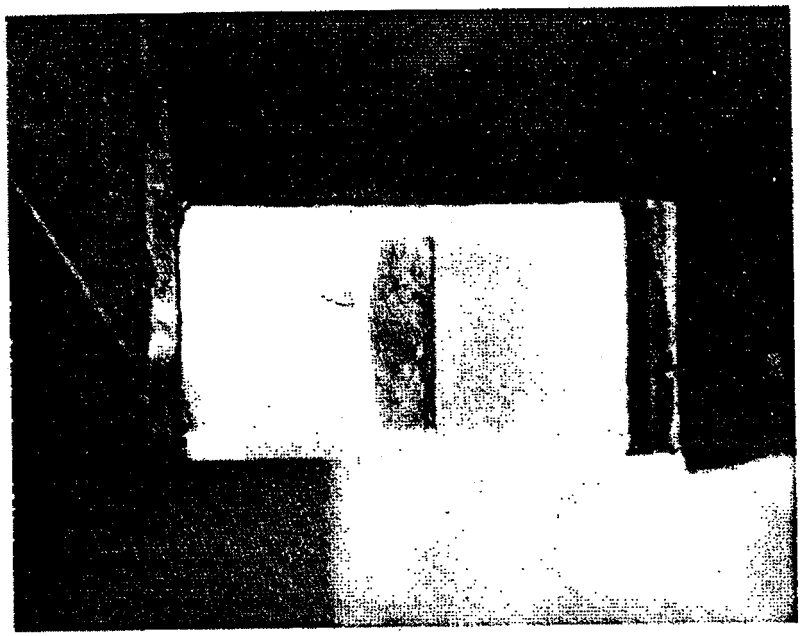
HAZ-7



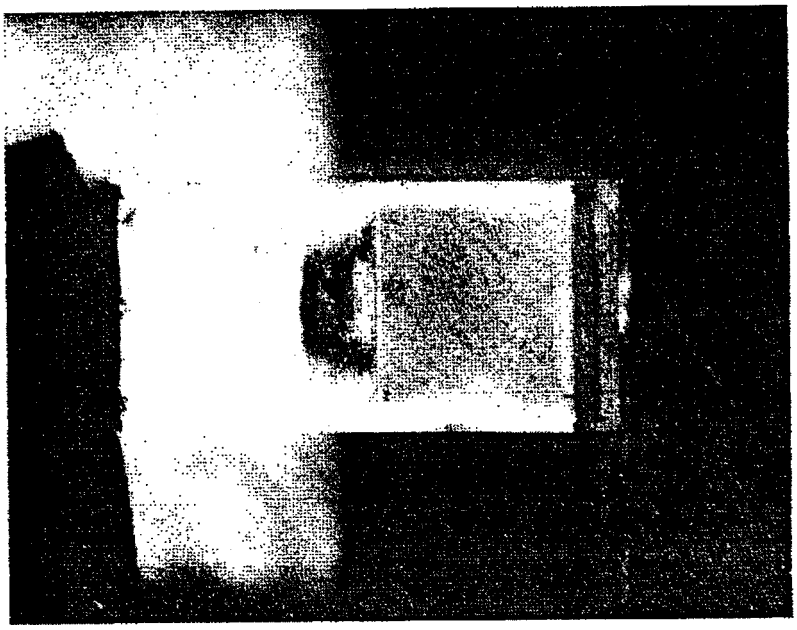
W-1



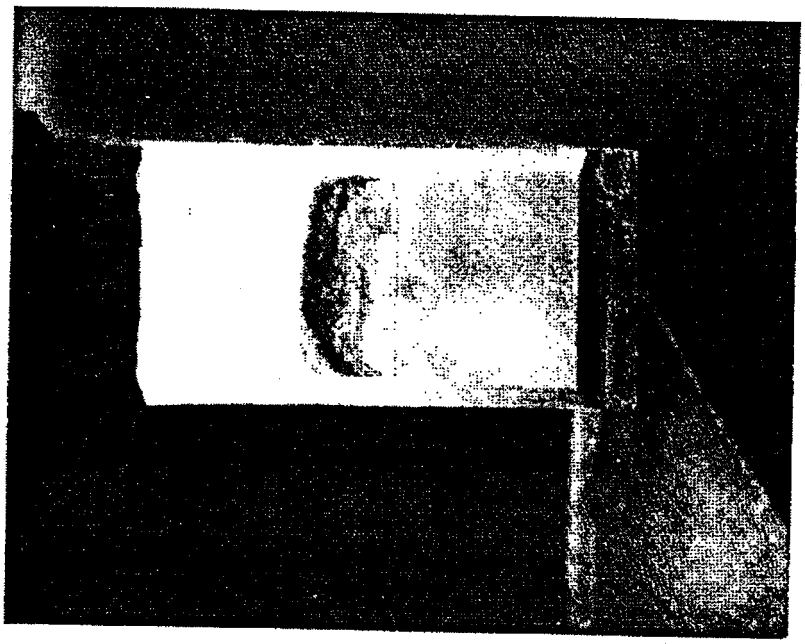
W-2



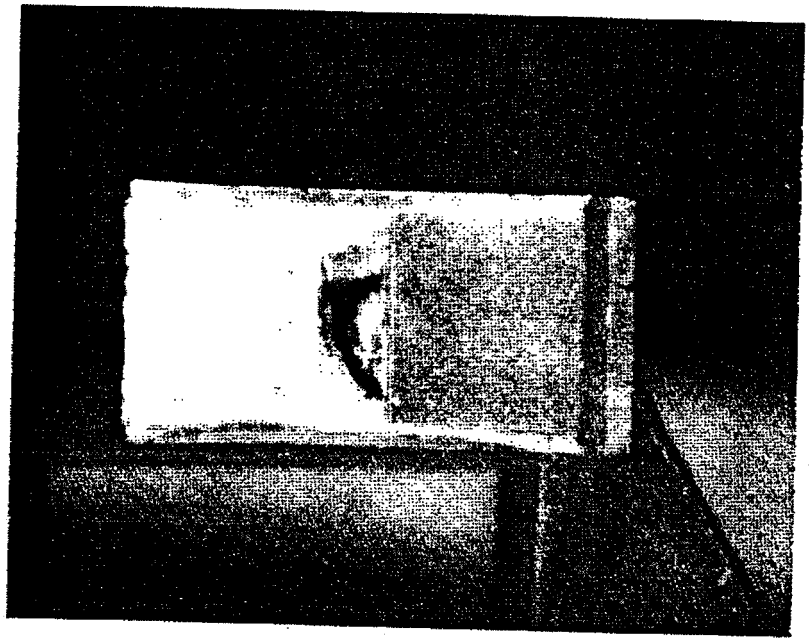
W-5



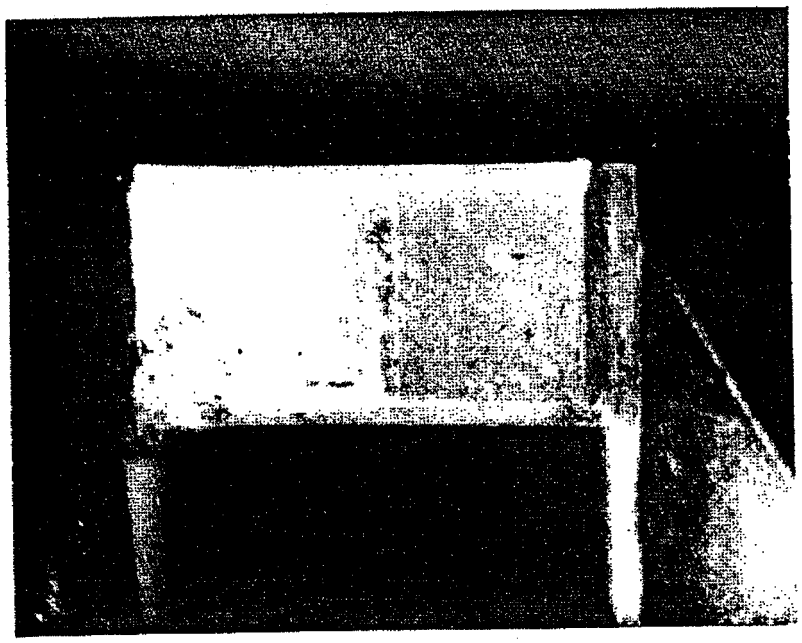
W-6



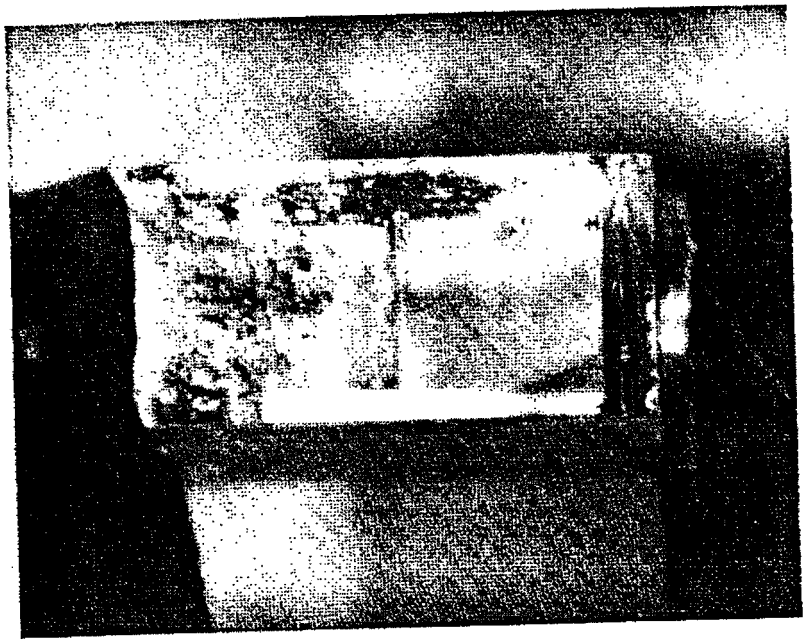
W-7



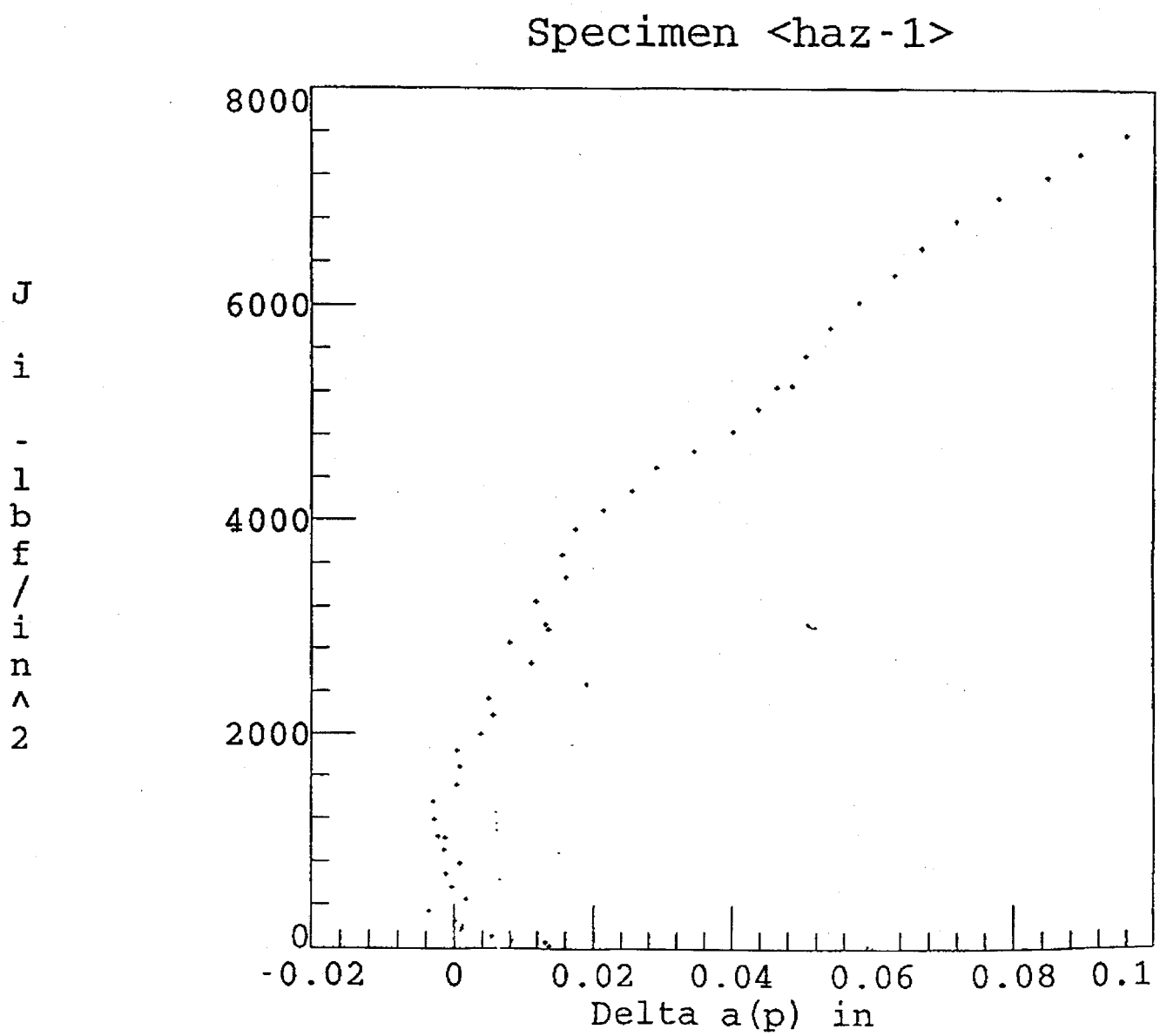
W-9

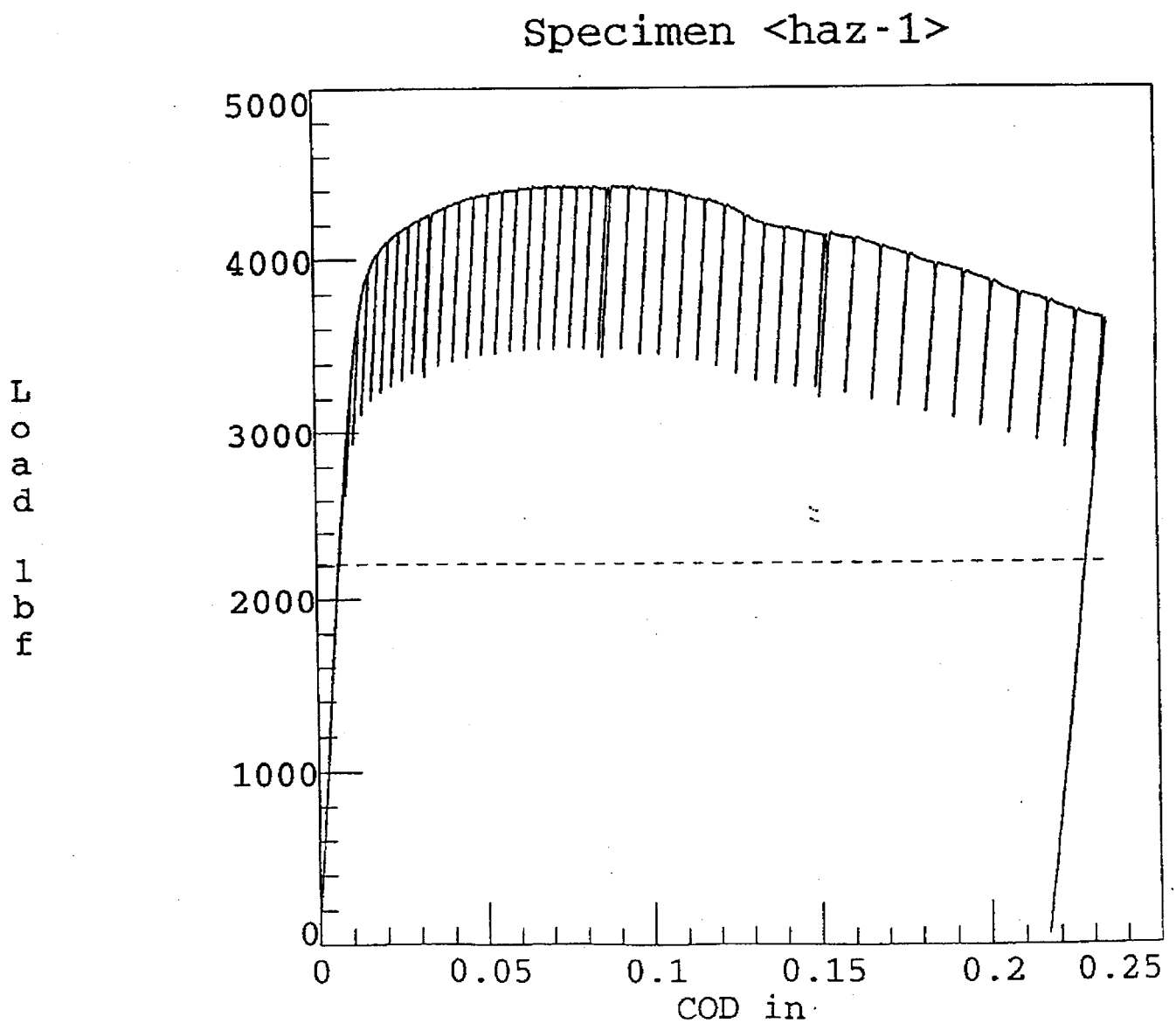


W-10



W-11


Specimen <haz-1>
J i - lbf/in^2
8000
6000
4000
2000
0
-0.02
0
0.02
0.04
0.06
0.08
0.1
Delta a(p) in


Specimen <haz-1>
5000
4000
3000
2000
1000
0
Load lbf
0
0.05
0.1
0.15
0.2
0.25
COD in