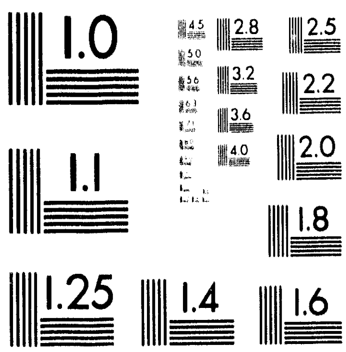
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The Effect of Electric Discharge Machined Notches on the Fracture Toughness of Several Structural Alloys

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ABSTRACT

Recent computational studies of the stress and strain fields at the tip of very sharp notches have shown that the stress and strain fields are very weakly dependent on the initial geometry of the notch once the notch has been blunted to a radius that is 6 to 10 times the initial root radius. It follows that if the fracture toughness of a material is sufficiently high so that fracture initiation does not occur in a specimen until the crack-tip opening displacement (CTOD) reaches a value from 6 to 10 times the size of the initial notch tip diameter, then the fracture toughness will be independent of whether a fatigue crack or a machined notch served as the initial crack.

In this experimental program the fracture toughness (J_{Ic} and J resistance (J-R) curve, and CTOD) for several structural alloys was measured using specimens with conventional fatigue cracks and with EDM machined notches. The results of this program have shown, in fact, that most structural materials do not achieve initiation CTOD values on the order of 6 to 10 times the radius of even the smallest EDM notch tip presently achievable. It is found furthermore that tougher materials do not seem to be less dependent on the type of notch tip present. Some materials are shown to be much more dependent on the type of initial notch tip used, but no simple pattern is found that relates this observed dependence to the material strength, toughness, or strain hardening rate.

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PRIOR REPORTS

Prior reports is this series are listed below:

1. J. A. Joyce, "Application of the Key Curve Method to Determining J-R Curves for A533B Steel," NUREG/CR-1290, U.S. Nuclear Regulatory Commission, Washington, DC (January 1980).

2. J. P. Gudas, M. G. Vassilaros, J. A. Joyce, D. A. Davis, and D. R. Anderson, "Summary of Recent Investigations of Compact Specimen Geometry Effects on the J_I-R Curve of High Strength Steels," NUREG/CR-1813, U.S. Nuclear Regulatory Commission, Washington, DC (November 1980).

3. J. A. Joyce, "Static and Dynamic J-R Curve Testing of A533B Steel Using the Key Curve Analysis Technique," NUREG/CR-2274, U.S. Nuclear Regulatory Commission, Washington, DC (July 1981).

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24. Dodds, R.H., Jr., Shih, C.F., and Anderson, T.L., "Continuum and Micromechanics Treatment of Constraint in Fracture," NUREG/CR-5971, U.S. Nuclear Regulatory Commission, Washington, DC (July 1993).

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1.0 OBJECTIVE

Standard techniques for evaluating the fracture toughness of a material involve testing a notched specimen that contains a real crack at the tip of the notch. The crack is introduced by fatigue loading the specimen at a load that is a small fraction of that required to initiate stable tearing. The fatigue cracking procedure results in a very sharp, natural crack that is designed to provide a high level of constraint and hence, a measurement of the fracture toughness near the lower bound. The fatigue cracking procedure can be a time-consuming process and adds to the cost and complexity of conducting fracture toughness tests. For many situations of practical interest such as the testing of weldments, it may be difficult, if not impossible, to produce a satisfactory fatigue crack that samples the material of interest. This is particularly true when trying to measure the fracture toughness of a heat affected zone or local brittle zone in a weldment. Residual stresses and inhomogeneity of material properties can lead to unsatisfactory crack fronts that do not sample the desired material or microstructure. Fracture toughness testing procedures could be greatly simplified if a very sharp, machined notch could be used as the initial crack in lieu of a real fatigue crack.

Conventional machining methods cannot produce a sharp enough notch that can adequately simulate a fatigue crack. Work by Joyce and Gudas[1] showed that machined notches with sharp tips (≈ 0.001 in. radius) but with included angles of 60° caused the measured J_{Ic} fracture toughness to be elevated by a factor of between three and four for an HY130 steel. Over the past decade, advances in electric discharge machining (EDM) equipment and procedures have made it possible to produce much narrower notches than previously available with notch tip radii on the order of 0.002 inches. It is a simple matter to produce slots in typical fracture specimens that are 0.004 in. wide with a 0.002 in. root radius at the tip of the notch. The advantage of an EDM notch over a fatigue crack is that the EDM notch can be located precisely at the microstructure of interest and the notch will be perfectly straight.

A basic assumption of elastic-plastic fracture mechanics is that a single parameter, the crack tip opening displacement (CTOD) or J integral is sufficient to describe the stress and strain distribution at the tip of a crack and that crack initiation occurs when this parameter attains a critical value. The fracture toughness is defined as the critical value of this parameter at the onset of significant ductile crack extension. Recent computational studies of the stress and strain fields at the tip of sharp notches have shown that the stress and strain fields are very weakly dependent on the initial geometry of the notch once the notch has been blunted to a radius that is 6 to 10 times the initial root radius[1]. It follows that if the fracture toughness of a material is sufficiently high so that fracture does not occur in a specimen until the CTOD reaches a value from 6 to 10 times the size of the initial notch tip diameter, then the fracture toughness will be independent of whether a fatigue crack or a smooth notch served as the initial crack.

The objective of this experimental program was to measure the fracture toughness, δ_i and J_{Ic}, and resistance curves (CTOD-R and J-R) for several structural alloys using specimens with conventional fatigue cracks and also with EDM notches. The results were then compared in terms of the ratio of the measured CTOD at crack initiation to the initial notch radius. It is expected from the preceding argument, that low toughness alloys will demonstrate a dependence of fracture toughness on the crack tip geometry, while tougher materials will not.

[1] Private communication, C.F. Shih, Brown University, USA, 1991.

2.0 EXPERIMENTAL DETAILS

2.1 Material Description

Six steel alloys and one aluminum alloy were examined in this investigation. Three of the steels were pressure vessel steels, ASTM A302, A533 Grade B, and A515. Two were high strength structural steels, HY-100 and ASTM A710 and the aluminum was a magnesium-molybdenum aluminum alloy, CS-19. This selection of alloys provides a wide range of strength and toughness with which to evaluate the effects of EDM notches on toughness. The aluminum alloy and HY-100 steel have a CTOD fracture toughness (using standard fatigue pre-cracked specimens) on the order of the EDM notch width used in this study. The remaining steels have a CTOD fracture toughness which is greater than the width of the EDM notch to varying degrees. The chemical composition and mechanical properties of the materials used in this study are listed in Table 1. The strain hardening exponent, N, was determined from the relationship[2]

$$\frac{UTS}{YS} = \frac{\left(\frac{n}{0.002}\right)^{n}}{\exp(n)} \tag{1}$$

where N=1/n.

2.2 Specimen Details

The specimen geometries used in this investigation were 1T C(T) and 1T SE(B) specimens. The C(T) specimens were used for the CS-19 aluminum and A710 steel and were 1 in. thick. SE(B) specimens were used for all other tests. The A302 and A515 steel specimens were 2 in. thick and the HY-100 and A533B steel specimens were 1 in. thick. All specimens were side grooved to a depth of 10% of the specimen thickness on each face. The SE(B) specimens had a flex bar mounted on one face of the specimen to measure the load-line displacement.

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[2] Anderson, T.L. and Dodds, R.H., Jr., "Simple Constraint Corrections for Subsize Fracture Toughness Specimens," ASTM International Symposium on Small Specimen Test Techniques and Their Application to Nuclear Reactor Vessel Thermal Annealing and Plant Life Extension, January 29-30, 1992, New Orleans, LA.

Table 1 Chemical composition and mechanical properties of materials used in this study (Values are in weight percent).

	ASTM A302,Gr.B	ASTM A515,Gr.70	ASTM A533, Gr.B	HY-100	ASTM A710	CS-19
Carbon	0.18	0.28	0.19	0.16	0.04	-
Manganese	1.24	0.82	1.28	0.26	0.59	0.8
Phosphorus	0.012	0.009	0.012	0.003	0.005	-
Sulphur	0.023	0.028	0.013	0.009	0.004	-
Silicon	0.22	0.21	0.21	0.19	0.25	0.08
Nickel	-	-	0.64	2.76	0.90	-
Chromium	-	-	-	1.57	0.70	0.10
Molybdenum	0.47	-	0.55	0.42	0.19	-
Aluminum	-	-	-	-	-	Bal.
Iron	Bal.	Bal.	Bal.	Bal.	Bal.	0.07
Copper	-	-	-	-	1.17	-
Vanadium	-	-	-	0.003	0.003	-
Titanium	-	-	-	-	0.06	-
Columbium	-	-	-	-	0.03	-
Magnesium	-	-	-	-	-	8.42
Beryllium	-	-	-	-	-	0.001
0.2% YS, Mpa (ksi)	393 (57)	262 (38)	443 (64.7)	747 (109)	511 (74.6)	251 (36.4)
UTS, Mpa (ksi)	538 (78)	517 (75)	622 (90.8)	877 (128)	601 (87.7)	408 (59.2)
%Elon. in 50 mm (2 in.)	33	35	26	16.5	33	24
Red. of Area, %	68	54	60	57	74	29
Hardening Exponent, N	9	5	9	15	15	7

Notches were prepared by wire electric discharge machining to extend the crack starter slot a minimum of 0.2 in., resulting in a final notch length, a/W, between 0.6 and 0.7. The wire diameter was 0.004 in. The EDM operation resulted in approximately semi-circular notch tips with a radius of 0.002 in. Photographs of the notch tip in a CS-19 aluminum and an A533B steel specimen are shown in Figure 1.

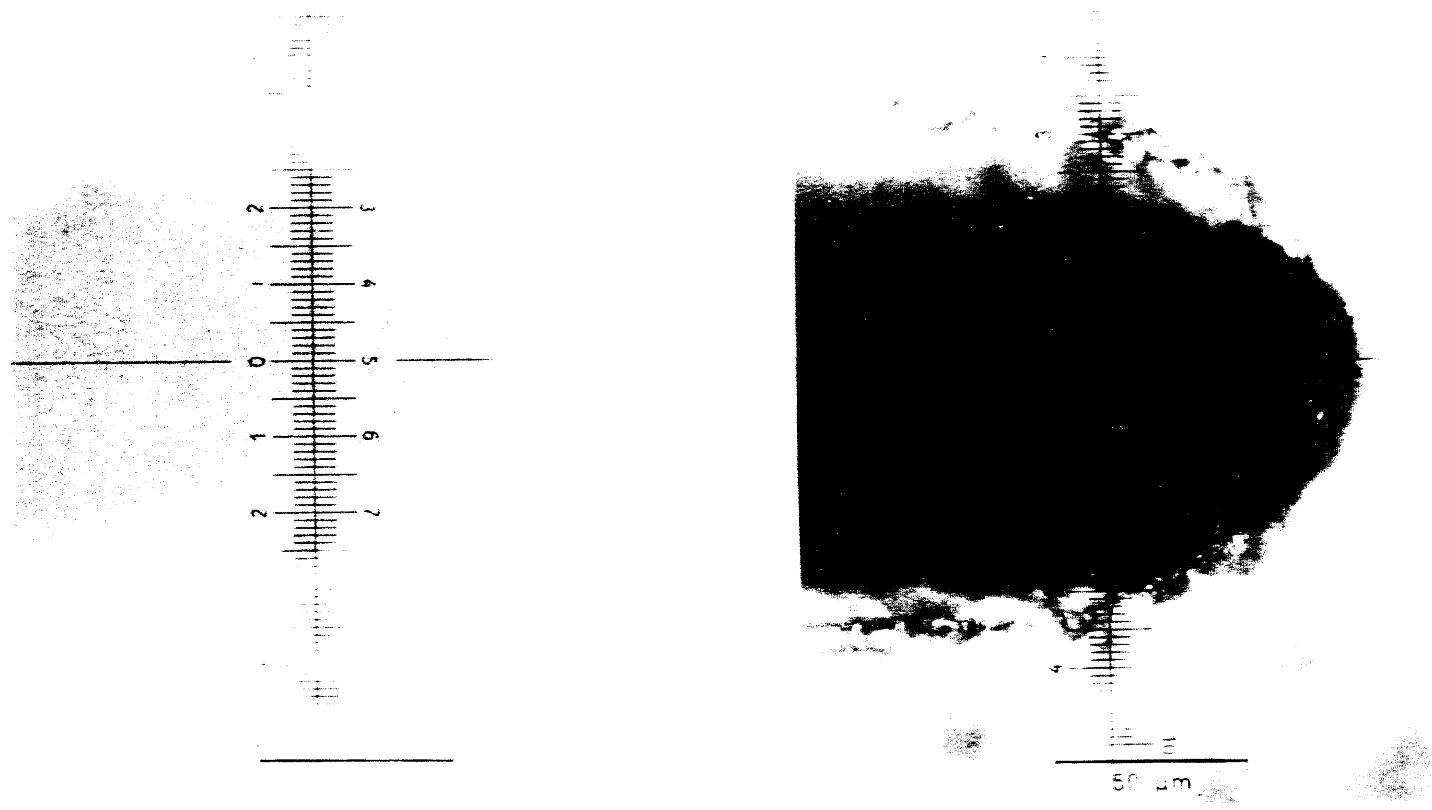
2.3 Test Procedure

Fracture toughness tests were conducted using the unloading compliance technique and following the guidelines in the relevant ASTM standards, E813, E1152 and E1290. The loading was carried out until a total crack extension of approximately 0.2 in. was achieved. Some results for the fatigue pre-cracked specimens were obtained from pre-existing data, and these had been tested to different final crack extensions. All data sets were analyzed using the equations and methods described in the following sections. J integral calculations were made using the crack growth corrected J equations of ASTM E1152, and these calculations are acceptable for J_{Ic} calculations according to ASTM E813. The CTOD (δ) calculations were made using two different equations so that comparisons between ASTM E1290 and the new ASTM Task Group E24.08.01 "Common Method"[3] procedure could be made. In order to obtain the most accurate comparison of J_{Ic} and δ_i values, the initialization procedure that has recently been developed by ASTM Task Group E24.08.03[4] was applied to all data. This procedure evaluates an average initial crack length that is then used for all crack extension estimations. This method avoids arbitrary "eyeball" data shifts that have characteristically been applied to J-R curves before evaluation of both J_{Ic} and δ_i values.

All testing was conducted at temperatures corresponding to the upper shelf for each

[3]"Standard Method for Measurement of Fracture Toughness," Draft 11, September 1992. Working document of ASTM Task Group E24.08.01, American Society for Testing and Materials, Philadelphia, PA 19103.

[4]"Standard Test Method for J-Integral Characterization of Fracture Toughness," Draft 8-4, January 1993, Working document of ASTM Task Group E24.08.03, American Society of Testing and Materials, Philadelphia, PA, 19103.



(a) (b)

Figure 1 EDM notch tip geometry appearance in (a) CS-19 aluminum specimen and (b) A533B steel specimen.

material. The HY-100, A710, A302 and CS-19 alloys were tested at room temperature. The A533B specimens were tested at 240°F and the A515 specimens were tested at 302°F.

3.0 ANALYSIS

3.1 Equations

The J resistance curves were calculated using the equations of E1152-87. The J integral was calculated using the relationship that:

$$J_{(i)} = \frac{K_{(i)}^2(1-\nu^2)}{E} + J_{pl(i)} \tag{2}$$

where $K_{(i)}$ is taken from Test Method E399-90 for the SE(B) specimen:

$$K_{(i)} = \left[\frac{P_i S}{(B B_N)^{1/2} W^{3/2}}\right] f(a_i/W) \tag{3}$$

with:

$$f(a_i/W) = \frac{3(a_i/W)^{1/2}[1.99 - (a_i/W)(1-a_i/W)(2.15 - 3.93(a_i/W) + 2.7(a_i/W)^2)]}{2(1+2a_i/W)(1-a_i/W)^{3/2}} \tag{4}$$

and $K_{(i)}$ for the C(T) is:

$$K_{(i)} = \frac{P_i}{(B\ B_N\ W)^{1/2}} f(a_i/W)$$

with:

$$f(a_i/W) = (2 + a_i/W) \frac{[0.866 + 4.64a_i/W - 13.32(a_i/W)^2 + 14.72(a_i/W)^3 - 5.6(a_i/W)^4]}{(1 - a_i/W)^{3/2}}$$

For both the SE(B) and C(T) specimens:

$$J_{pl(i)} = \left[J_{pl(i-1)} + \left(\frac{\eta_i}{b_i}\right)\frac{A_{pl(i)} - A_{pl(i-1)}}{B_N}\right]\left[1 - \gamma_i \frac{(a_i - a_{i-1})}{b_i}\right] \tag{7}$$

where for the C(T) specimen:

η_i = 2.0 + 0.522 b_i/W, and γ_i = 1.0 + 0.76 b_i/W,

and for the SE(B) specimen:

η_i = 2.0 and γ_i = 1.0.

For CTOD calculations, individual δ values were calculated in two ways. For the ASTM E1290 δ calculations the equation used was:

$$\delta = \frac{K^2(1-\nu^2)}{2\sigma_{YS}E} + \frac{r_p(W-a_0)v_{pl}}{r_p(W-a_0)+a_0+z} \tag{8}$$

where the center of rotation is defined by r_p, with r_p=0.44 for the SE(B) and r_p=0.4(1+α) for the C(T) specimen with α defined by:

$$\alpha = 2\sqrt{\left(\frac{a_0}{b_0}\right)^2 + \frac{a_0}{b_0} + \frac{1}{2}} - 2\left(\frac{a_0}{b_0} + \frac{1}{2}\right) \tag{9}$$

and $v_{pl(i)}$ is the plastic component of the crack mouth opening displacement measured at a distance z outside of the specimen crack surface. This equation estimates the crack tip opening displacement at the position of the original crack tip using the original crack length for all calculations, i.e. for the calculation of K, r_p, and $b_o = (W - a_o)$.

For the ASTM E24.08.01 "Common Method"[5] δ calculations the equation used was:

$$\delta_{(i)} = \frac{K_{(i)}^2(1-\nu^2)}{2\sigma_{ys}E} + \frac{[r_p(W-a_{(i)})+\Delta a]\nu_{pl(i)}}{[r_p(W-a_{(i)})+a_{(i)}+z]} \qquad (10)$$

with Δa being the crack extension that has occurred since the beginning of the test.

This "Common Method" equation is estimating the CTOD at the original crack tip using a specimen center of rotation that is adjusted to account for the true crack length as the test proceeds.

3.2 Analysis Methods

Values of the fracture toughness at the initiation of stable tearing, J_{Ic} and δ_i were determined for each specimen in accordance with the procedures in E813 and E1290, respectively. The J_{Ic} procedure of ASTM E813 involves a fit of a two parameter power law equation to the J-R curve data in an "exclusion zone" just beyond the point of ductile crack initiation, as shown in Figure 2. The J_Q point is evaluated from the intersection of this best-fit power law and an offset line as shown on Figure 2, and becomes J_{Ic} if specimen size and other criteria are satisfied. This method of evaluating J_{Ic} is very sensitive to value of the initial crack length used to estimate the crack extension of each data point on the J-R curve (or δ-R curve). The ASTM E813 method requires the use of a pre-test initial crack length, which often is not the best value to use for the evaluation of J_{Ic}. A new method has recently been developed by a

[5] "Standard Test Method for Measurement of Fracture Toughness," Draft 11, September 1992. Working Document of ASTM Task Group E24.08.01, American Society for Testing and Materials, Philadelphia, PA 19103.

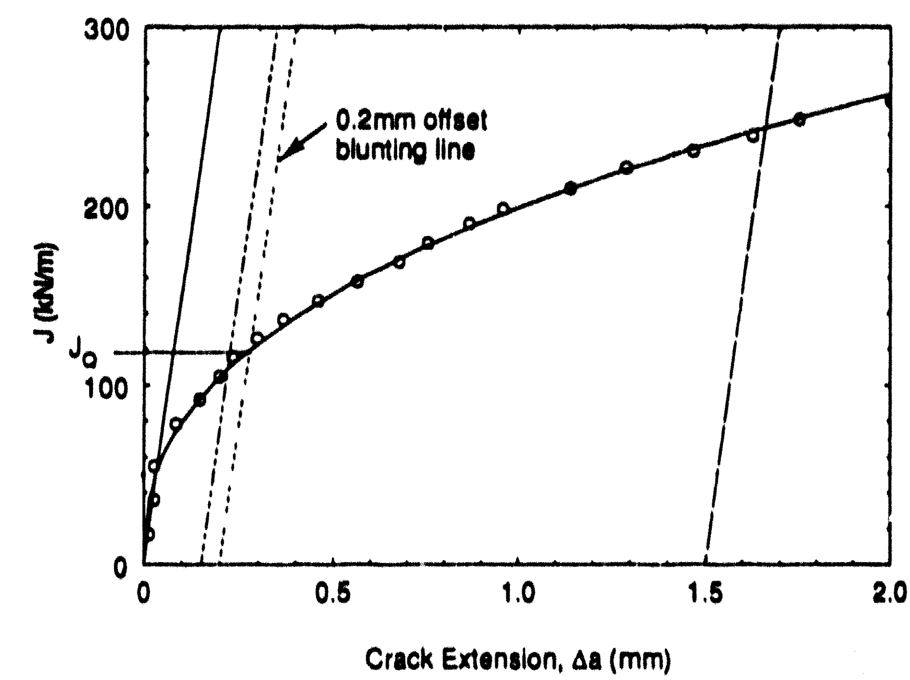


Figure 2 Schematic showing E813 procedure to obtain J_Q using an offset construction line procedure.

working group of ASTM Subcommittee E24.08.03[6] which fits a construction line to the initial J_i - a_i data to evaluate a best-fit average initial crack length for use in estimating Δa and hence the J-R curve and J_{Ic}. This procedure has been used for all results presented here. The schematic in Figure 3 shows how this method fits a "construction" line with the equation $J=2\sigma_f\Delta a$ to the J-R curve data with $0.2J_Q \leq J_i \leq 0.6J_Q$ and then extrapolates to the abscissa to evaluate a average initial crack length. This crack length is used for the evaluation of the J and δ resistance curves and then for the evaluation of J_{Ic} and δ_i.

The procedure for evaluating δ_i given in ASTM E1290 involves fitting a three-parameter power law to the initial region of the δ_i-R curve, as shown in Figure 4, and then evaluating the CTOD at a crack extension of 0.2 mm (0.008 in.) using a vertical line as shown in Figure 4. This procedure is simpler than the E813 J_{Ic} procedure described above, but it is even more sensitive to the initial crack length that is used to calculate the Δa_i values used to generate the δ-R curve. As discussed further below, this procedure has serious flaws, and often results in toughness measures that severely underestimate the true toughness of the material.

The Common Method Subcommittee has proposed an alternative procedure for determining the CTOD initiation fracture toughness for implementation in a common fracture toughness testing standard under development. The proposed procedure is very similar to the E813 J_{Ic} procedure with a two-parameter power law fit to the data near crack initiation and defines the initiation point as the intersection of the fitted curve with a line offset from the blunting line as in the procedure for J_{Ic}. A schematic of this method is shown in Figure 5. This value of CTOD has been denoted as δ_{icM} (subscript CM for Common Method) in this report to distinguish it clearly from the E1290 δ_i quantity. One objective of the "Common Method" is to make this value of CTOD at "initiation" correspond to the J_{Ic} initiation point of the E813 procedure. In this work, correspondence is taken to mean that for a given specimen the J_{Ic} and

[6] "Standard Test Method for J-Integral Characterization of Fracture Toughness," Draft 12, Working Document of ASTM Task Group E24.08.03, American Society for Testing and Materials, Philadelphia, PA, 19103.

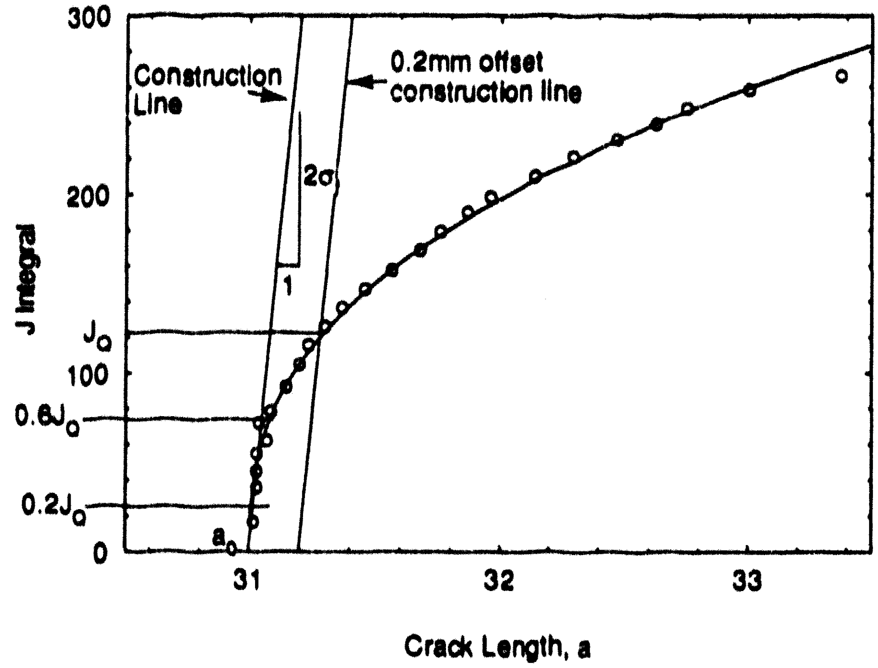


Figure 3 Schematic showing proposed procedure to evaluate the best initial crack length from unloading compliance results.

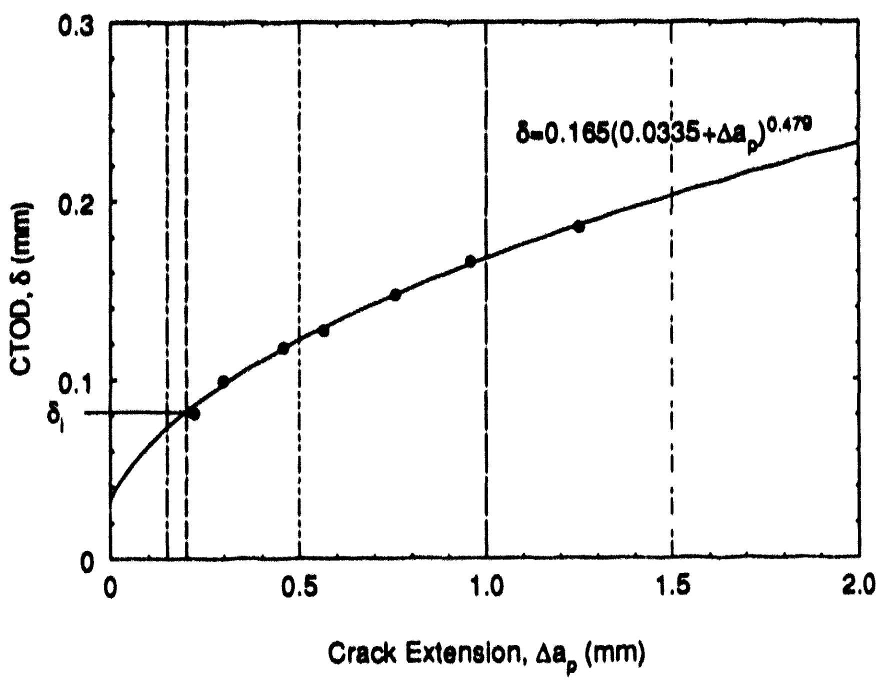


Figure 4 Schematic of E1290 procedure to obtain δ_i.

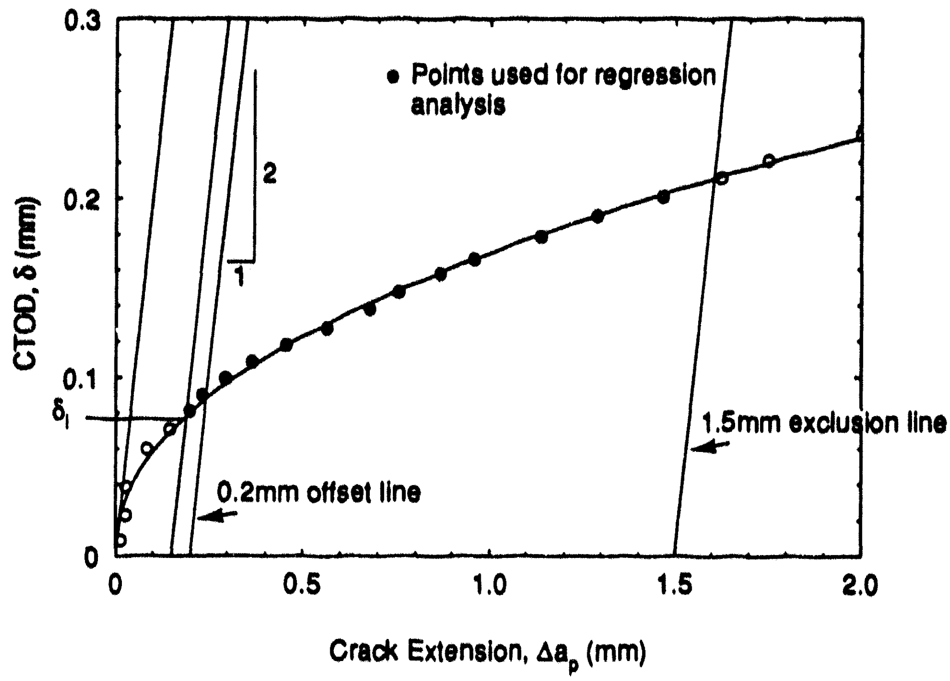


Figure 5 Schematic showing the Common Method offset construction line procedure used to obtain δ_i.

δ_i values obtained would relate to the same amount of ductile crack extension. In a later section a modification of the Common Method is proposed which improves the correspondence of the J_{Ic} and δ_{iCM} crack initiation measures.

4.0 DISCUSSION OF RESULTS

4.1 Resistance Curve Results

J-integral resistance curves for EDM notched and fatigue cracked specimens are plotted in Figure 6-11 for each material. Detailed listings of the results from each test are included in Appendix A. A quick perusal of these figures shows that, as expected, some materials appear to be very sensitive to the type of notch used, while some materials are quite insensitive. Unfortunately, it does not appear that a simple toughness criteria amply predicts which materials are sensitive and which are not. CTOD resistance curves for the same set of specimens are presented in Figure 12-17 and they show exactly the same pattern as demonstrated by the J-R curves. In all cases the resistance curves of EDM specimens are elevated in comparison with the fatigue precracked specimens. In some instances, the elevation is small and the resistance curves overlap somewhat as shown by the A515 alloy while the A533B alloy shows a modest, but clear, elevation, and the CS-19 aluminum shows a dramatic effect, with an elevation by a factor of 3 at a given value of crack extension.

The material tearing resistance, defined as:

$$T_{mat} = \frac{E}{\sigma_o^2} \frac{dJ}{da} \qquad (11)$$

is evaluated for each material/notch geometry data set at a crack extension of 1 mm (0.039 in.) in Table 2. Both modest increases and decreases seem to result for the EDM notch geometry. The low toughness materials, HY-100 steel and CS-19 Aluminum show a 31% decrease and a 55% increase, respectively. The high toughness A710 alloy seems to be unaffected by the notch geometry, while the intermediate toughness materials are only modestly affected by the presence of the EDM notch. The numbers in Table 2, for instance, show a toughness decrease of 19% for the A515 steel, yet this does not seem justified looking at the J-R curves of Figure 7 which shows that considerable data scatter is present for the four specimens tested in this case. It appears that the data is too limited to make any clear conclusion except that no strong effect seems to be present when the fatigue crack is replaced by an EDM notch.

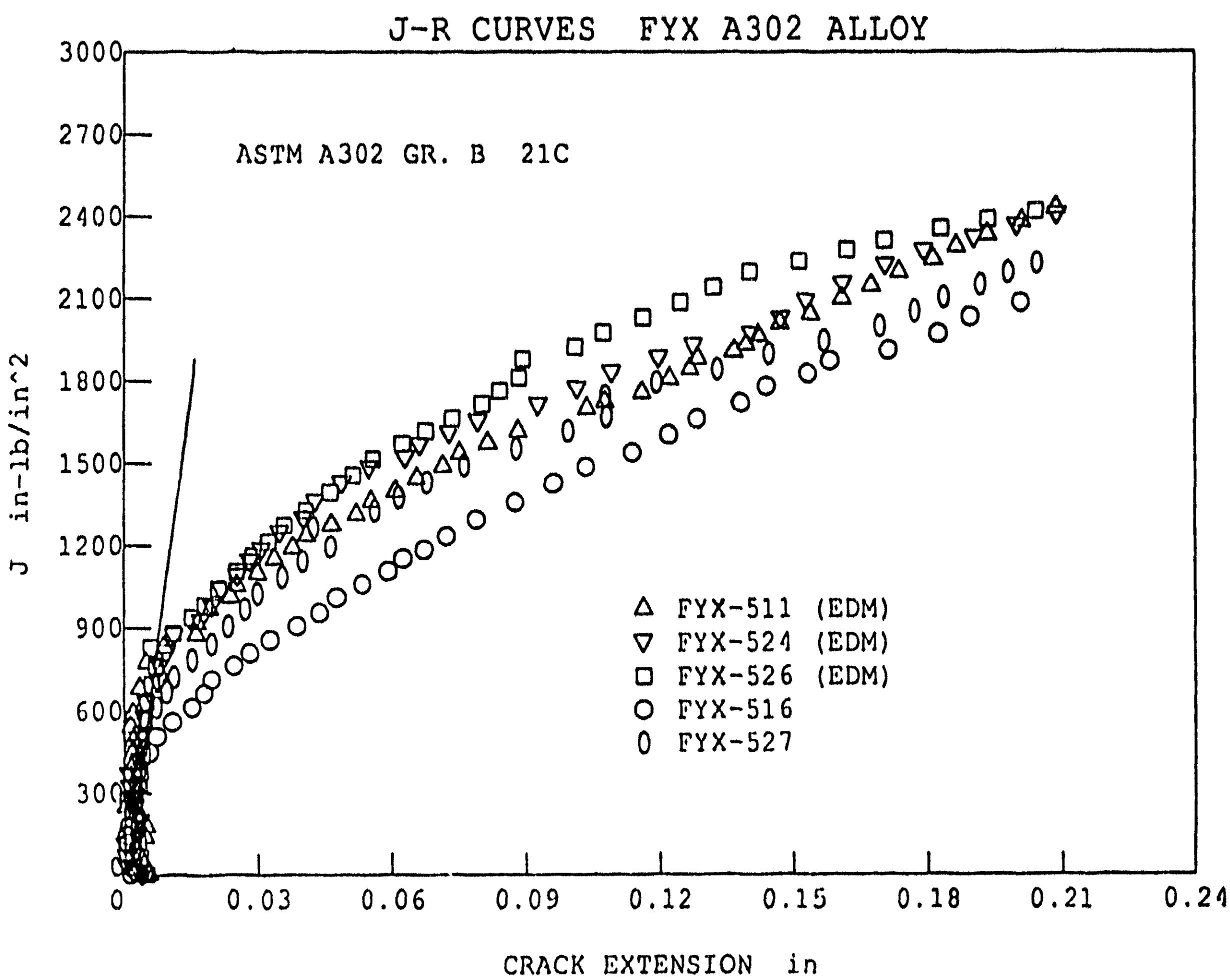


Figure 6 J-R curves for the ASTM A302 alloy showing EDM and fatigue precracked results.

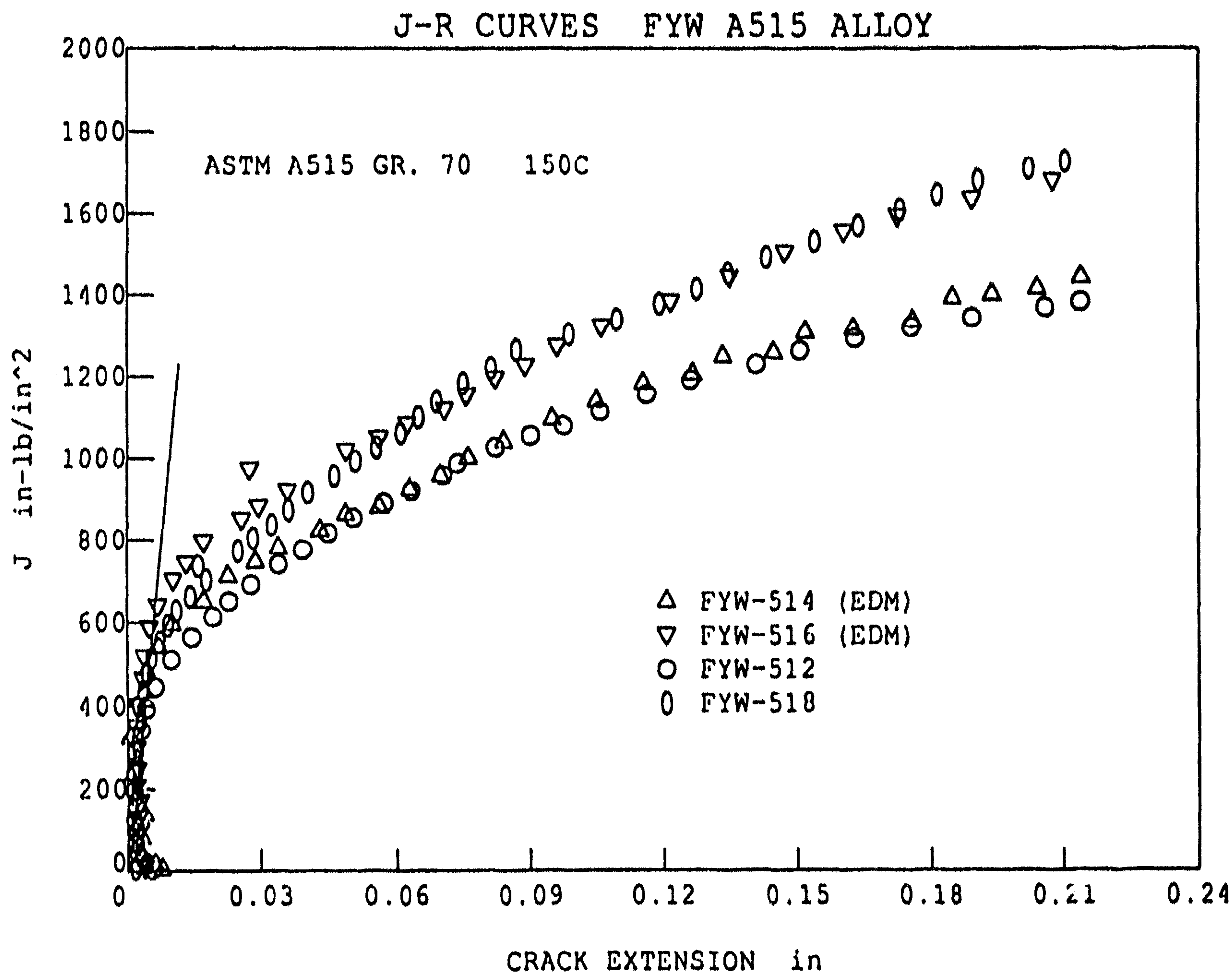


Figure 7 J-R curves for the ASTM A515 alloy showing EDM and fatigue precracked results.

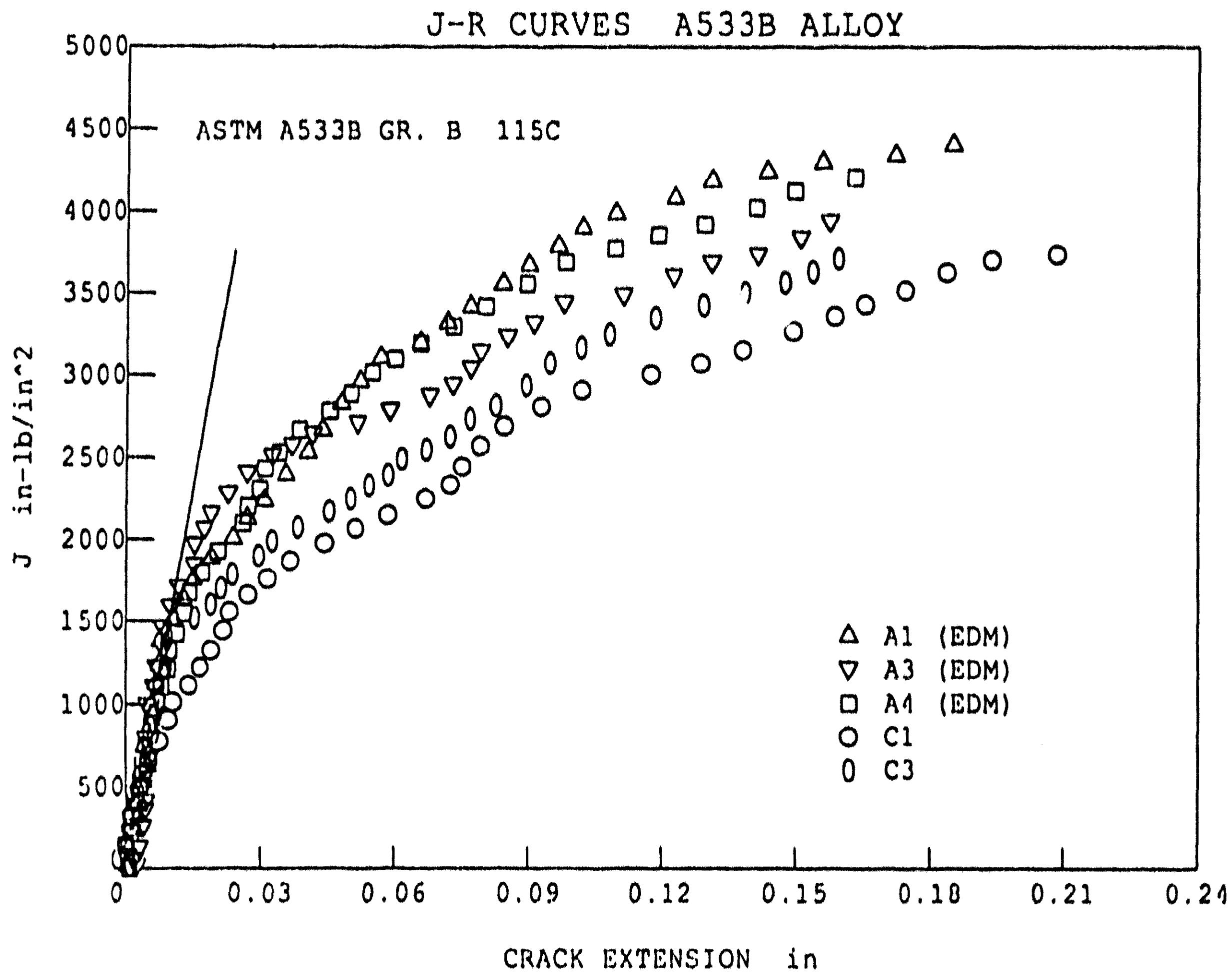


Figure 8 J-R curves for the ASTM A533B alloy showing EDM and fatigue precracked results.

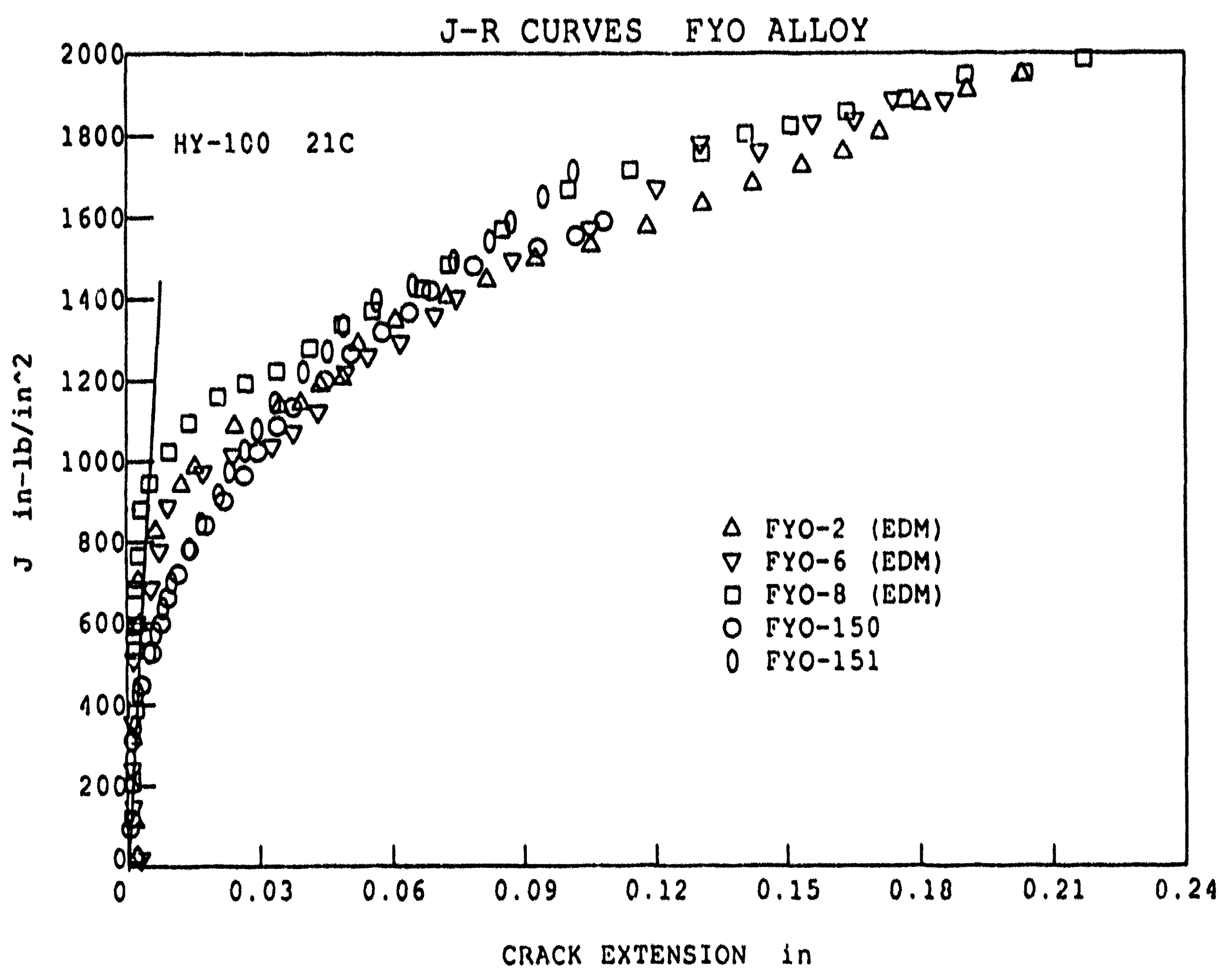


Figure 9 J-R curves for the HY-100 alloy showing EDM and fatigue precracked results.

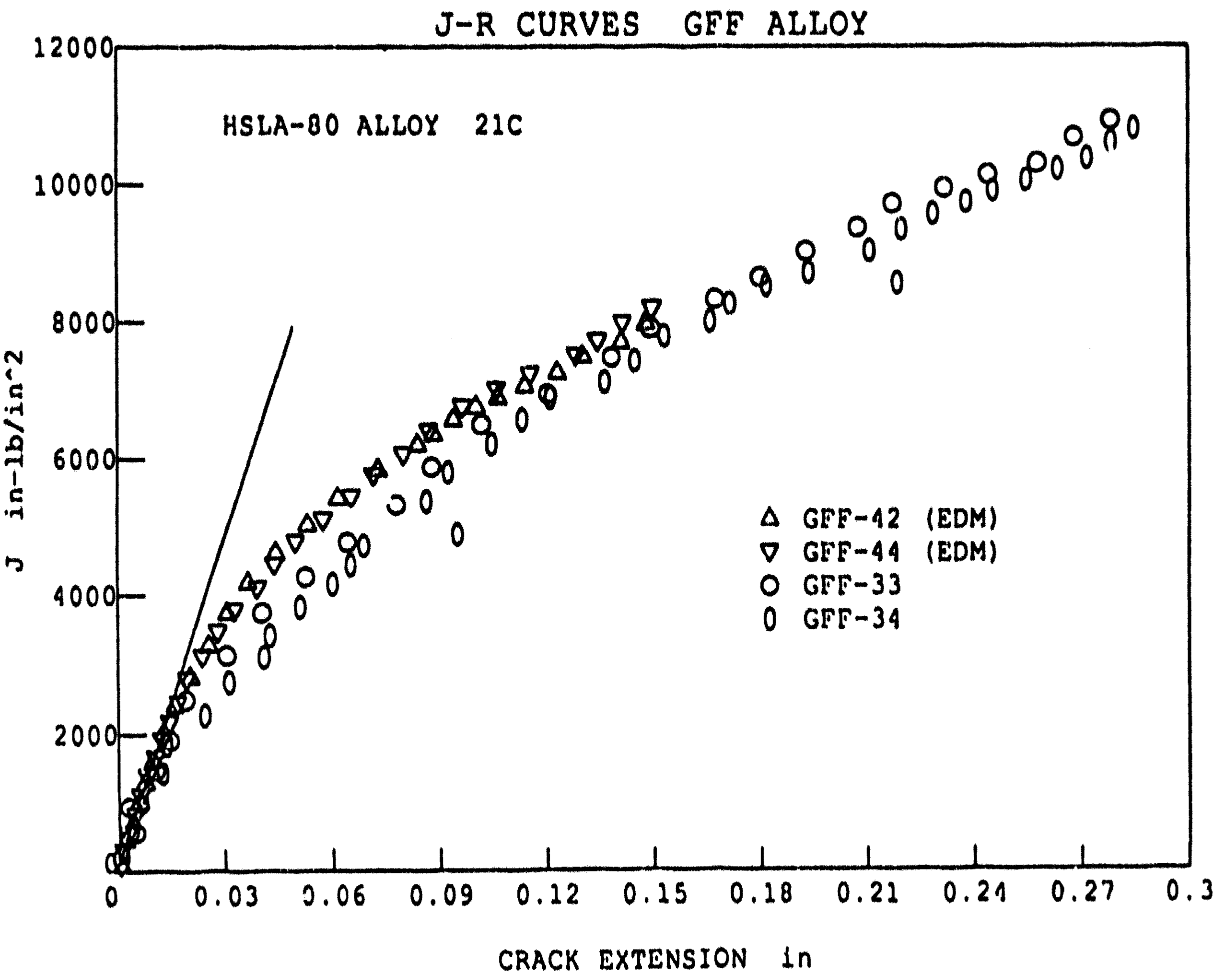


Figure 10 J-R curves for the ASTM A710 (HSLA-80) alloy showing EDM and fatigue precracked results.

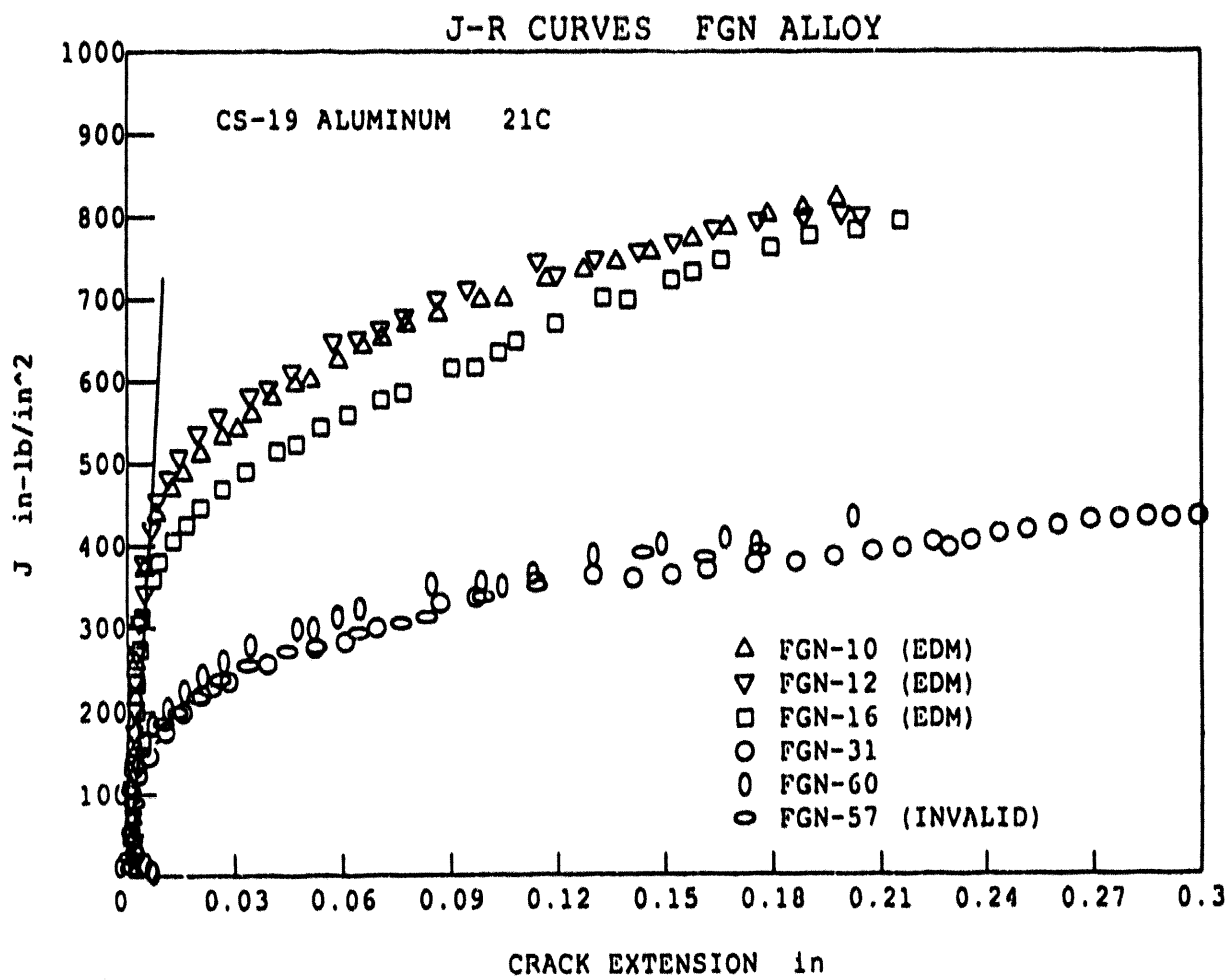


Figure 11 J-R curves for the CS-19 alloy showing EDM and fatigue precracked results.

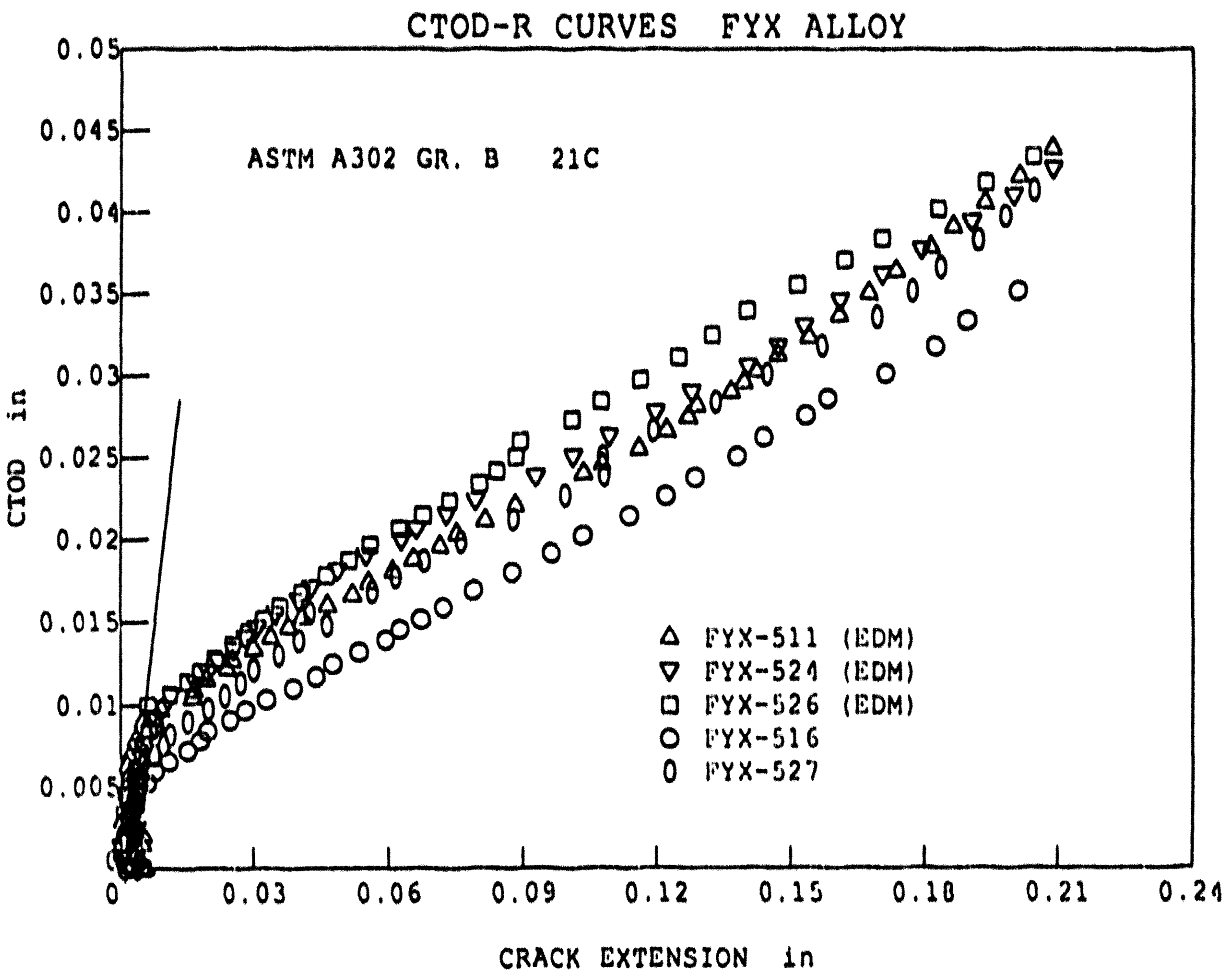


Figure 12 δ-R curves for the ASTM A302 alloy showing EDM and fatigue precracked results.

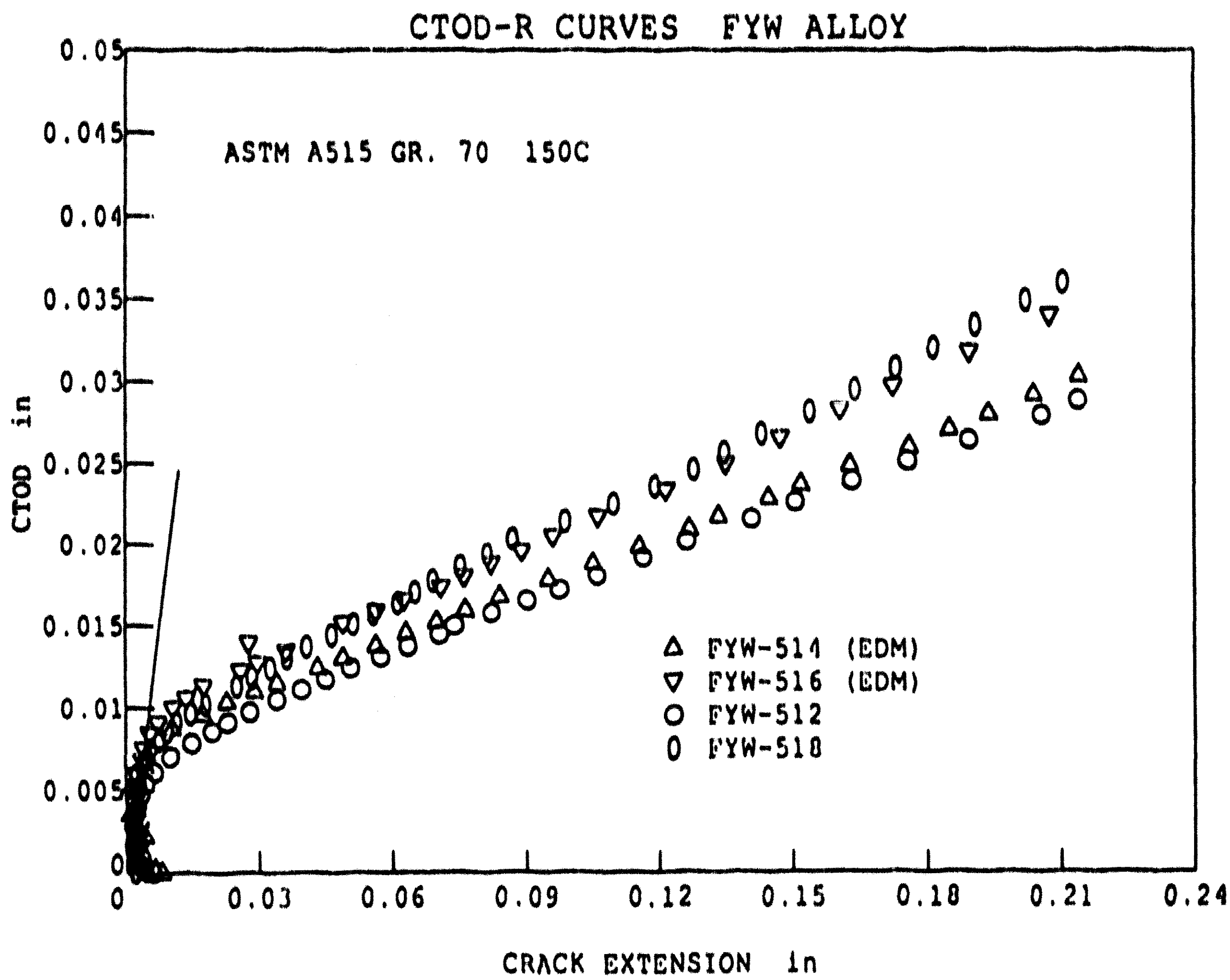


Figure 13 δ-R curves for the ASTM A515 alloy showing EDM and fatigue precracked results.

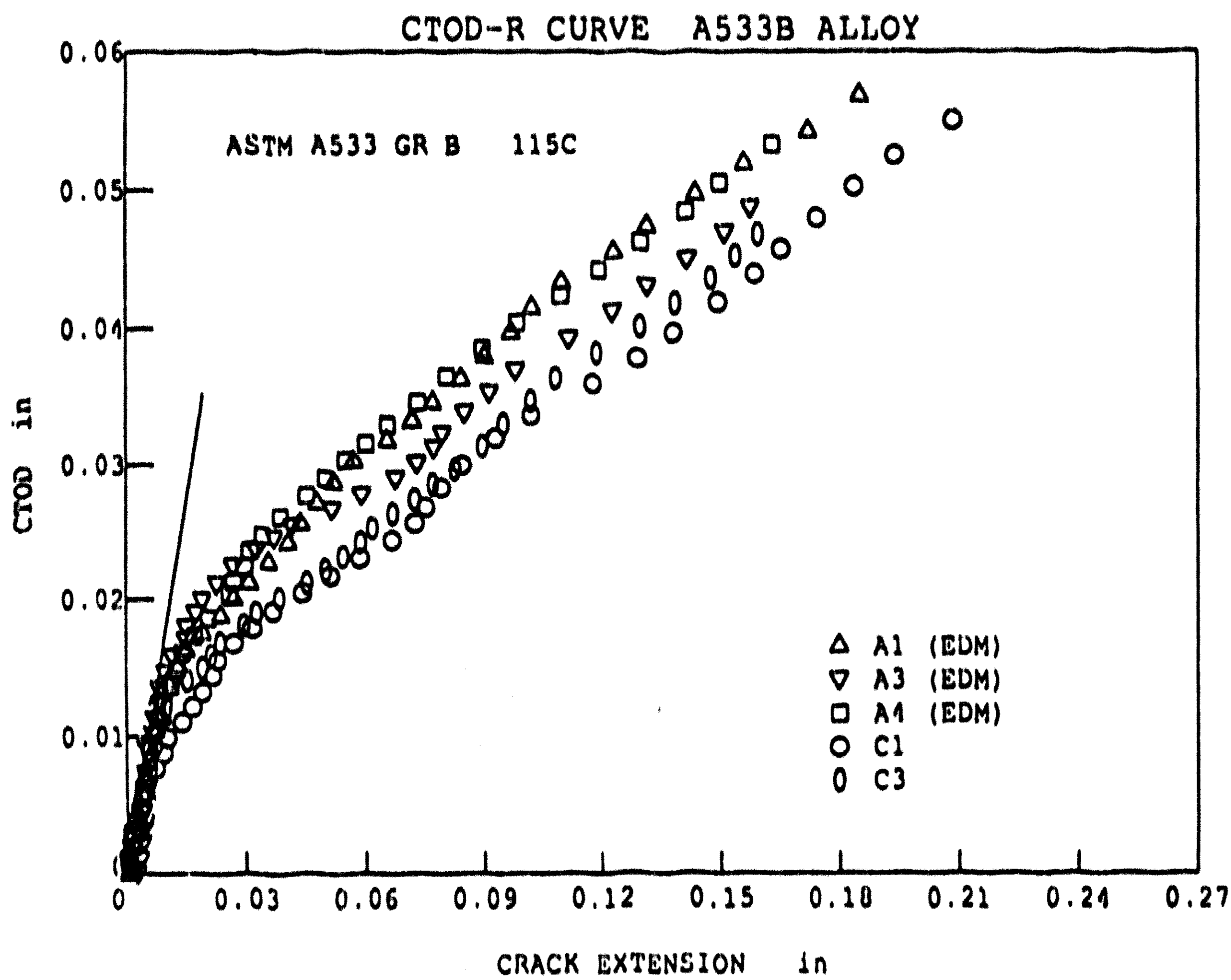


Figure 14 δ-R curves for the ASTM A533B alloy showing EDM and fatigue precracked results.

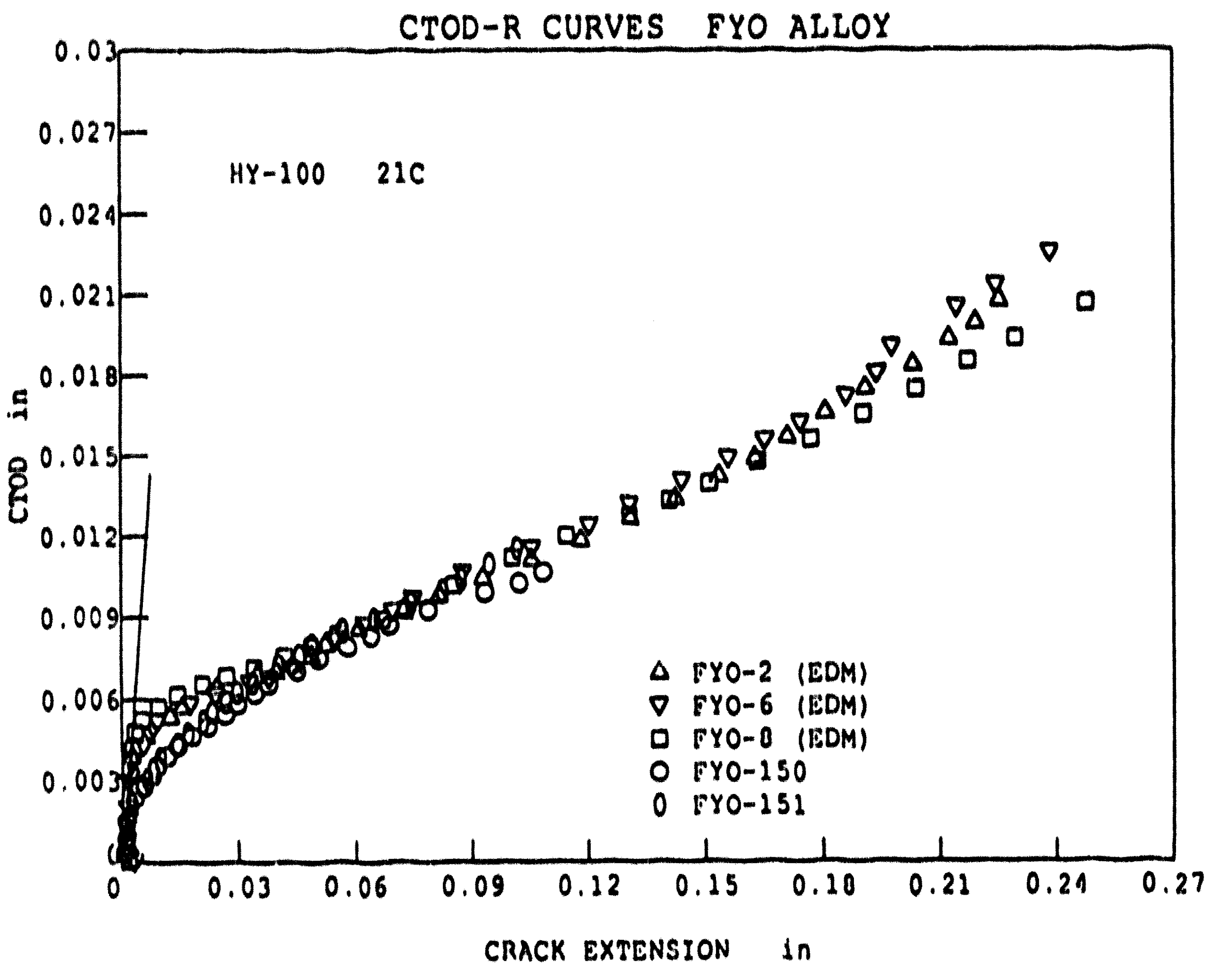


Figure 15 δ-R curves for the HY-100 alloy showing EDM and fatigue precracked results.

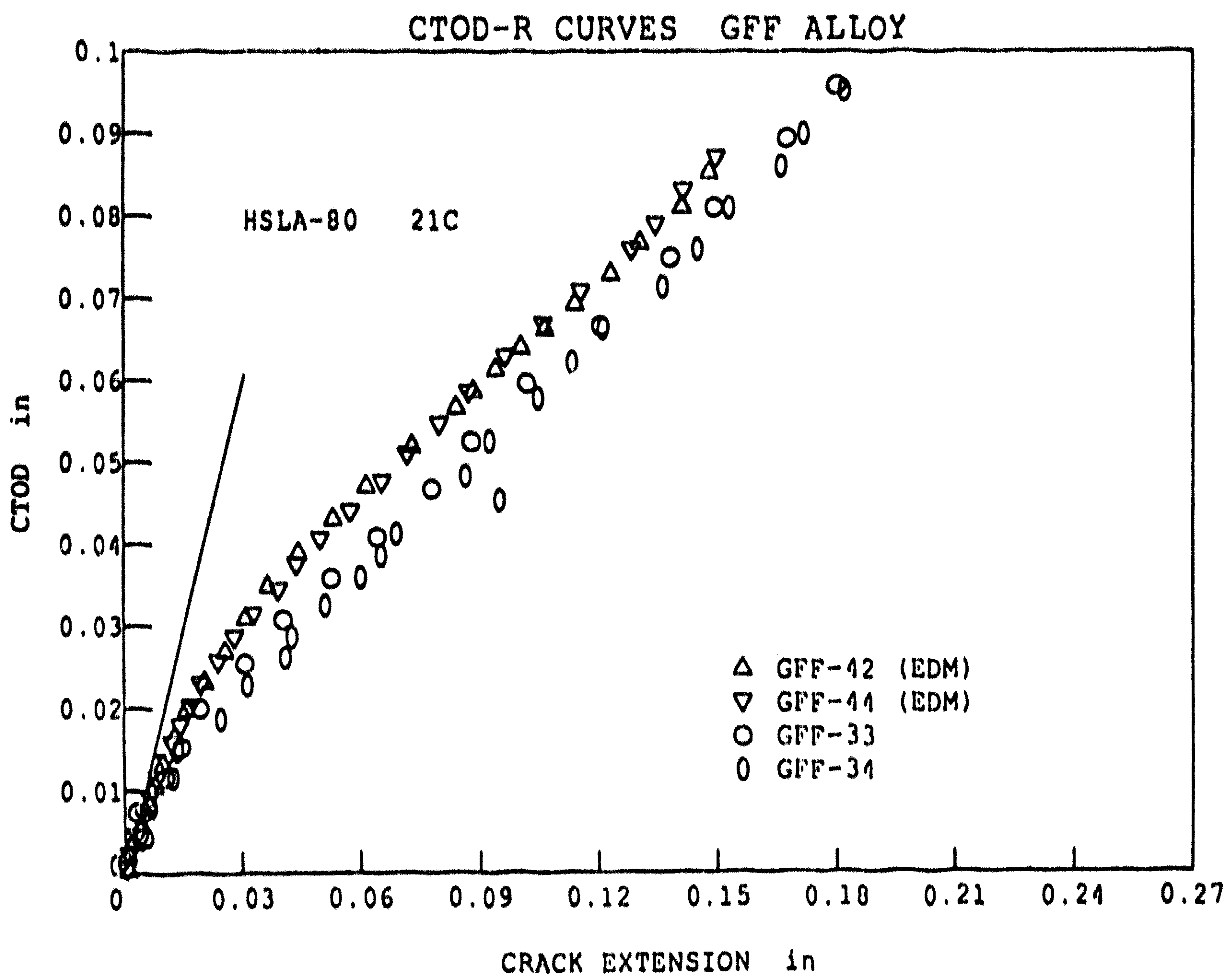


Figure 16 δ-R curves for the ASTM A710 (HSLA-80) alloy showing EDM and fatigue precracked results.

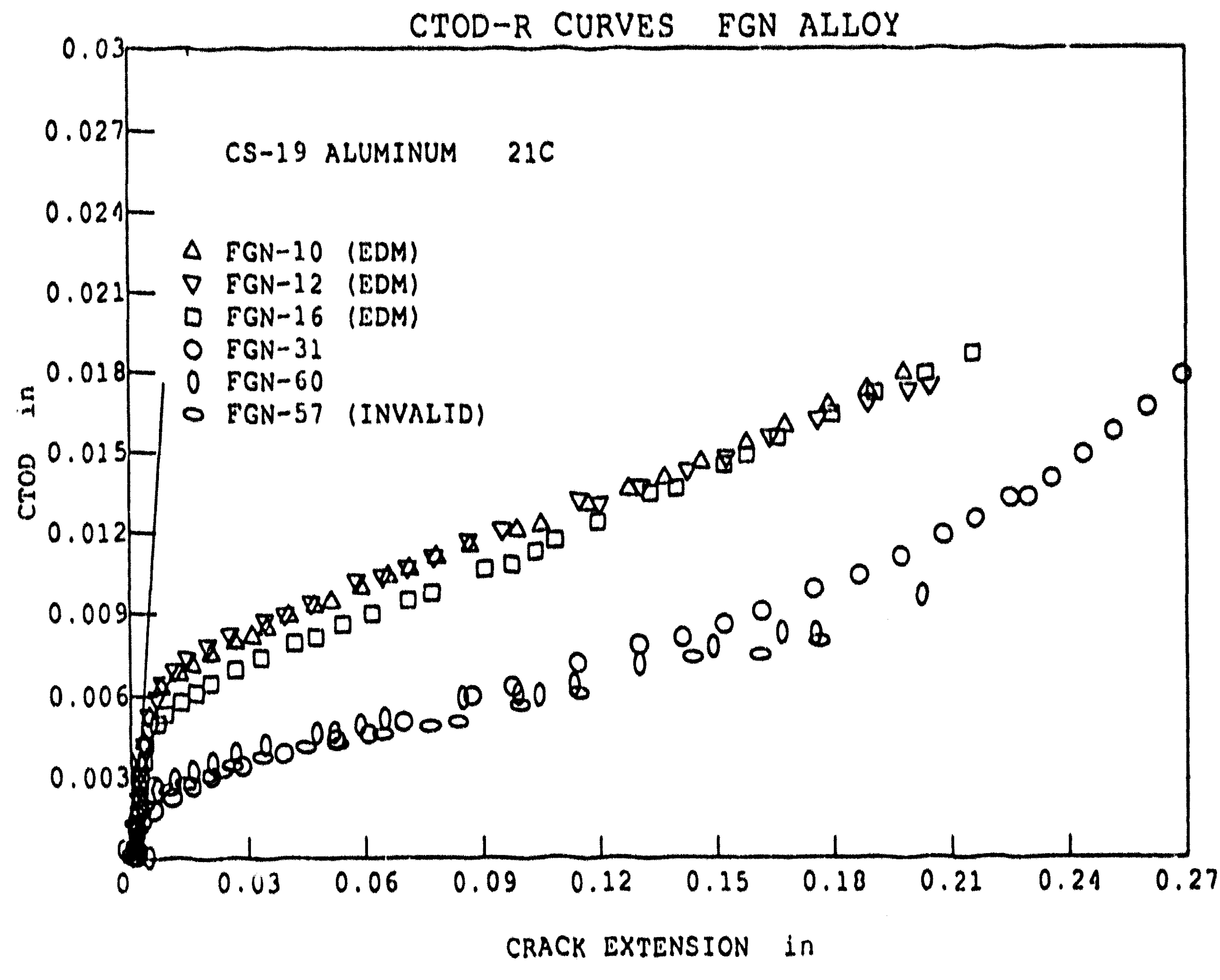


Figure 17 δ-R curves for the CS-19 alloy showing EDM and fatigue precracked results.

Table 2 Comparison of the average tearing modulus for fatigue precracked and EDM notched specimens.

Material	T at 1 mm.		
	Fatigue	EDM	% diff.
A302	134.	141.	5.2
A515	134.	108.	-19.
A533B	152.	162.	6.6
HY-100	46.5	32.	-31.
A710	240.	240.	0.0
CS-19	8.3	12.9	55.

4.2 Initiation Toughness Results

J_{Ic}, δ_i, and δ_{iCM}, calculated as described in the previous section, are tabulated in Table 3. The analysis used for J_{Ic} for specimen FYW-512 is shown in Figure 18, while the calculations of δ_i and δ_{iCM} are shown for the same specimen in Figure 19. The average values of fracture toughness for each material are tabulated in Table 4. Some material scatter is clearly present with J_{Ic} values ranging by up to 17% from the average, δ_i values ranging up to 12% from the average, and δ_{iCM} values ranging up to 16% from the average. In all cases, the EDM notched specimens exhibited higher initiation toughness than the fatigue precracked specimens. The elevation in fracture toughness varied from 11% to 152%, depending on the material and specific measure of fracture toughness considered. As would be expected, the CTOD toughness designated in the Common Method is consistently higher than that measured according to ASTM E1290 and it ranks the materials in exactly the same fashion as does the J_{Ic} measure of E813.

The E1290 definition of δ_i unfairly penalizes higher toughness materials that exhibit substantial crack tip blunting prior to tearing. This is clearly evident in the case of the ASTM A710 steel. The A710 steel had the highest J_{Ic} toughness of all materials tested. In terms of δ_i, the A710 ranked third in toughness, just below that of the A302 steel, which had a J_{Ic} of approximately one-third that of the A710. According to E1290, the critical event occurs at a fixed amount of crack extension, 0.008 in., regardless of whether the crack has actually begun to tear. The A710 steel is still exhibiting blunting behavior at this point, and as shown on

Table 3 Fracture toughness values for EDM notched and fatigue precracked specimens.

Material	Specimen ID	Notch Type	J_{Ic} (in-lb/in^2)	T at 1 mm	δ_i (in.)	δ_{ICM} (in.)	Δa at J_{Ic} (in.)	Δa at δ_{ICM} (in.)	Percent Diff. Δa
ASTM A302 Gr. B	FYX-511	EDM	864	128.	0.0090	0.0096	0.0145	0.0129	-11.0
	FYX-524	EDM	877	149.	0.0091	0.0099	0.0146	0.0131	-10.3
	FYX-526	EDM	913	147.	0.0098	0.0104	0.0148	0.0133	-10.1
	FYX-516	Fatigue	566	125.	0.0061	0.00621	0.0123	0.0112	-8.9
	FYX-527	Fatigue	730	144.	0.0072	0.00758	0.0135	0.0119	-11.9
ASTM A515 Gr. 70	FYW-514	EDM	614	107.	0.0086	0.00847	0.0135	0.0123	-8.9
	FYW-516	EDM	769	109.	0.0097	0.01032	0.0149	0.0133	-10.7
	FYW-512	Fatigue	534	128.	0.0068	0.00702	0.0128	0.0116	-9.4
	FYW-518	Fatigue	653	139.	0.0068	0.00909	0.0139	0.0127	-8.6
ASTM A 533 Gr. B	A1	EDM	1834	208.	0.0122	0.0147	0.0198	0.0154	-22.2
	A3	EDM	2287	108.	0.0148	0.0198	0.0227	0.0179	-21.1
	A4	EDM	2020	170.	0.0110	0.0169	0.0210	0.0165	-21.4
	C1	Fatigue	1292	156.	0.0084	0.0117	0.0163	0.0140	-14.1
	C3	Fatigue	1599	149.	0.0106	0.0135	0.0183	0.0148	-19.1
HY-100	FYO-2	EDM	929	32.6	0.0050	0.00507	0.0120	0.0106	-11.7
	FYO-6	EDM	847	35.3	0.0051	0.00472	0.0117	0.0105	-10.3
	FYO-8	EDM	1065	28.1	0.0058	0.00569	0.0126	0.0109	-13.5
	FYO-J3	Fatigue	748	38.1	0.0039	0.00385	0.0113	0.0100	-11.5
	FYO-J4	Fatigue	658	43.2	0.0038	0.00348	0.0109	0.0098	-10.1
	FYO-150	Fatigue	701	50.1	0.0034	0.00356	0.0111	0.0099	-10.9
	FYO-151	Fatigue	715	54.6	0.0035	0.00363	0.0111	0.0099	-10.5
HSLA-80	GFF-42	EDM	4063	229.	0.0097	0.0243	0.0339	0.0202	-40.
	GFF-44	EDM	3659	250.	0.0103	0.0217	0.0311	0.0189	-39.
	GFF-33	Fatigue	2836	235.	0.0087	0.0172	0.0256	0.0166	-35.
	GFF-34	Fatigue	2010	244.	0.0079	0.0125	0.0204	0.0143	-29.9
CS-19 Aluminum	FGN-10	EDM	464	13.6	0.0064	0.00640	0.0129	0.0113	-12.4
	FGN-12	EDM	488	12.4	0.0066	0.00686	0.0133	0.0115	-13.5
	FGN-16	EDM	408	12.7	0.0055	0.00560	0.0123	0.0108	-12.2
	FGN-31	Fatigue	175	8.5	0.0022	0.00214	0.0099	0.0092	-7.6
	FGN-57	Fatigue	171	7.4	0.0028	0.00241	0.0099	0.0094	-6.7
	FGN-60	Fatigue	200	9.0	0.0029	0.00272	0.0102	0.0093	-7.2

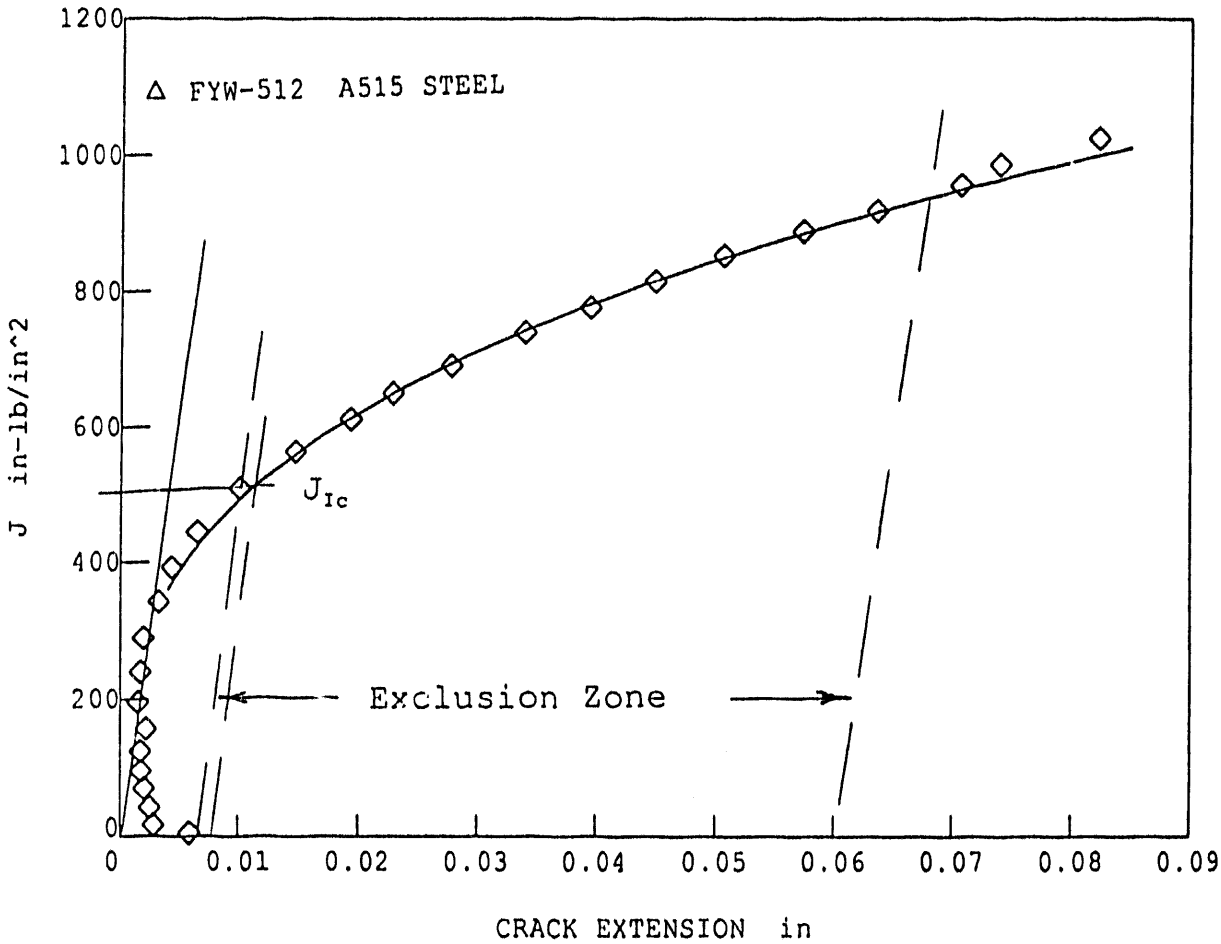


Figure 18 J_{Ic} evaluation for specimen FYW-512.

Table 4 Comparison of average fracture toughness measured for EDM notched and fatigue precracked specimens.

Material	J_{Ic} (in-lb/in^2)			δ_i (in.)			δ_{ICM} (in.)		
	Fatigue	EDM	% diff.	Fatigue	EDM	% diff.	Fatigue	EDM	% diff.
A302	648	884	36	0.0066	0.0093	41	0.0069	0.010	45
A515	594	692	16	0.0068	0.0092	44	0.0081	0.0094	16
A533B	1445	1987	38	0.0100	0.0135	35	0.0126	0.0171	36
HY-100	706	947	34	0.0036	0.0053	47	0.0036	0.0052	43
A710	2423	3861	59	0.0083	0.01	20	0.015	0.023	54
CS-19	181	453	150	0.0028	0.0062	121	0.0026	0.0063	142

Figure 20, it does not start to tear beyond blunting until approximately 0.4 mm of crack tip blunting has occurred. The definition of CTOD initiation proposed in the Common Method is (nearly - see below) consistent with the definition of J_{Ic} given in E813, and hence makes some allowance for blunting behavior by specifying that initiation is defined to occur at a fixed offset from the blunting line.

None of the fatigue precracked specimens had an initiation CTOD toughness that was on the order of 10 times the initial diameter of the EDM notch tip. The toughest materials, A533B and A710 had average δ_{ICM}'s of 0.0126 in. and 0.023 in., respectively, which is from 3.1 to 5.7 times the initial notch tip diameter. It is not clear that structural materials indeed exist which will demonstrate a δ_i, measured in any reasonable fashion, that is on the order of 0.040 in., and it certainly seems clear that weldments of this toughness are not a likely development in the near future. Thus, while the original hypothesis could not be verified, it seems clear that the use of EDM notches must be expected to result in higher initiation toughnesses, and if they are used to position a crack tip in a specific microstructure, some procedure would have to be used to correct the data for the presence of the EDM notch root radius.

It was expected that the tougher materials would show lower elevation than less tough

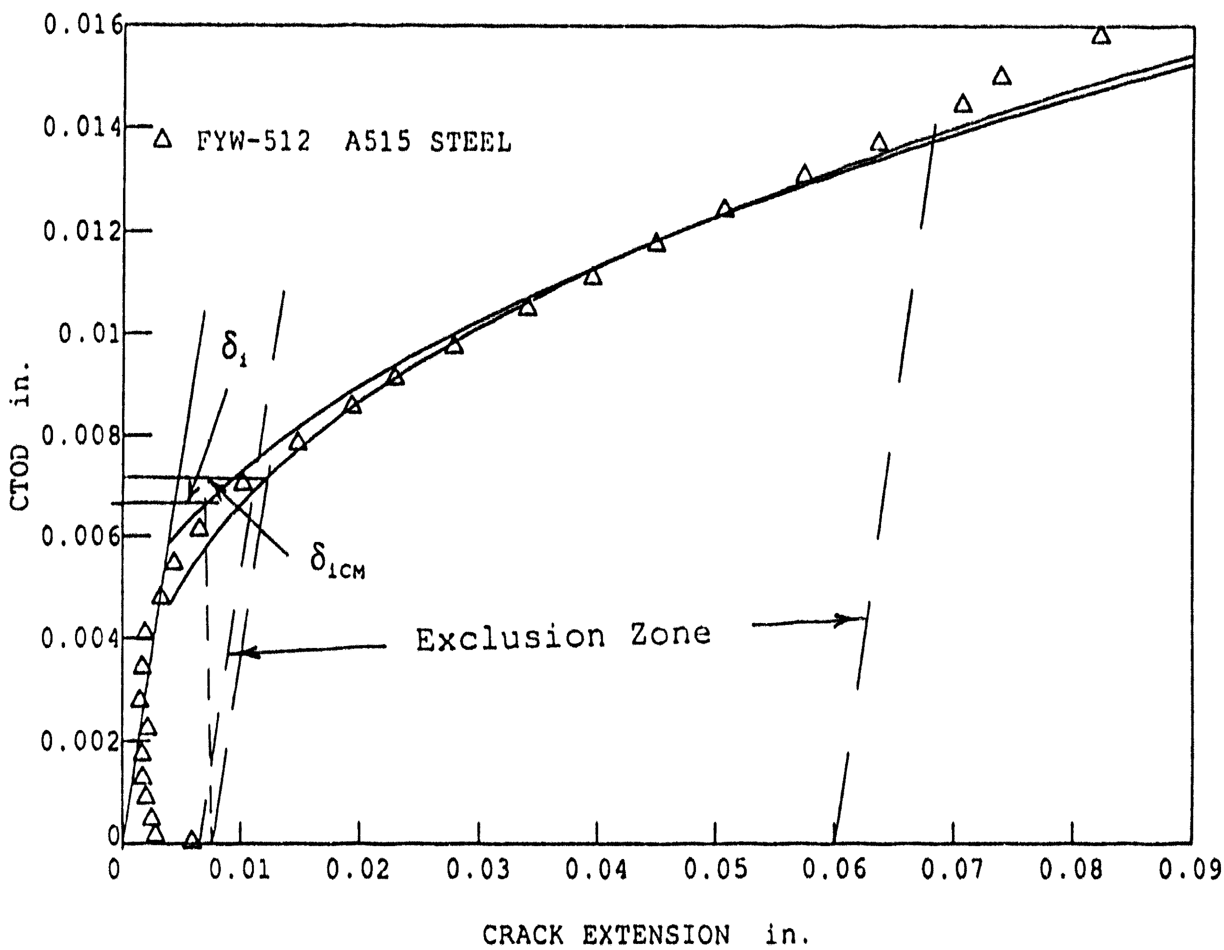


Figure 19 δ_i and δ_{iCM} comparison for specimen FYW-512.

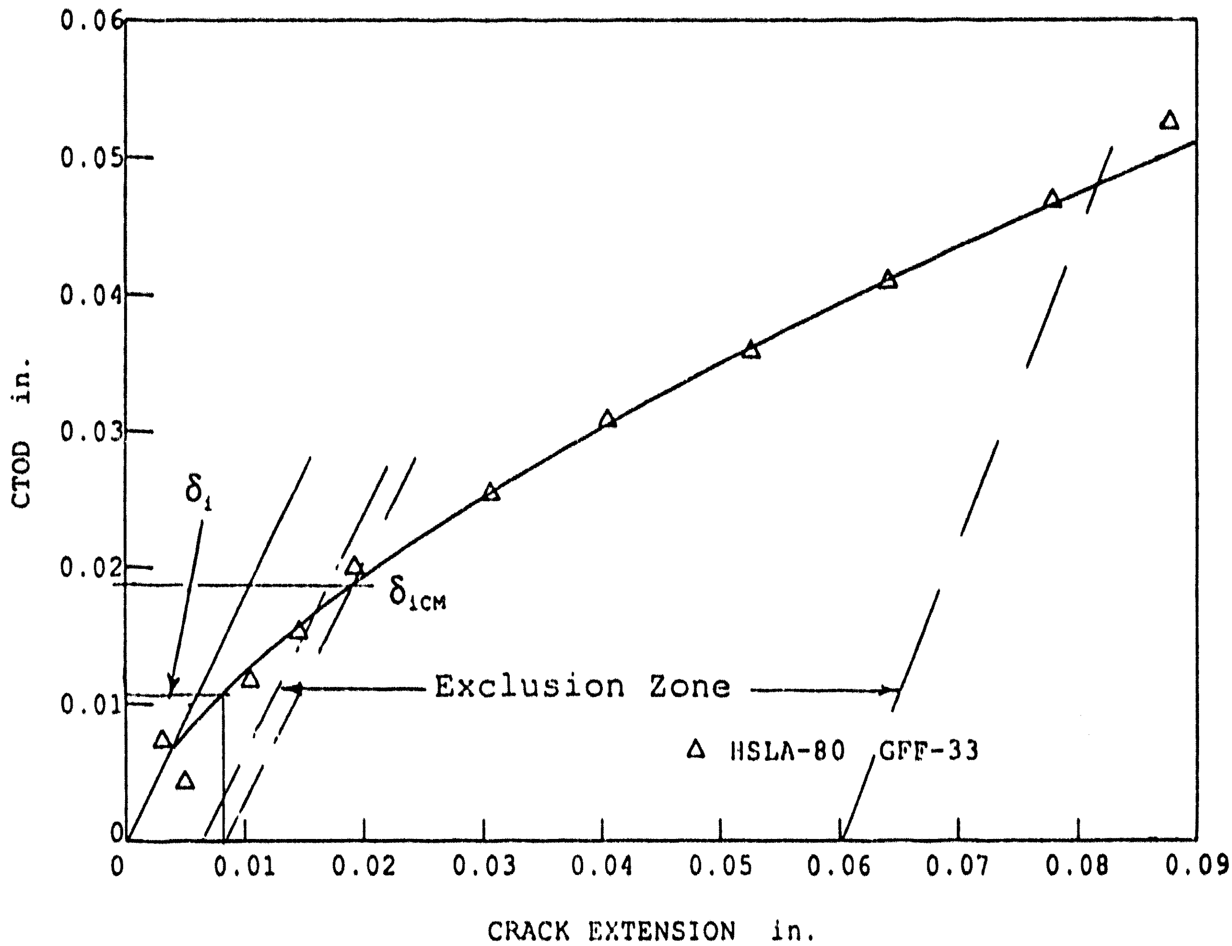


Figure 20 δ_i and δ_{ICM} comparison for specimen GFF-33.

materials. This trend was not observed in this investigation. The lowest toughness material, CS-19 aluminum, acted as expected by showing the greatest increase in toughness due to the EDM notch. For this material, the EDM notch tip diameter was approximately equal to the initiation toughness of a precracked specimen and the EDM notch specimen had an elevation on the order of 140% over the precracked specimen. The highest toughness materials, A533B and A710, showed smaller, but still substantial increases in crack initiation toughness (38% and 59% for J_{Ic} and 75% and 36% for δ_{ICM}). On the other hand, the A302 and A515 materials, with intermediate CTOD toughness, showed less sensitivity to the EDM notch, with increases in J_{Ic} of 36% and 16% respectively, and increases in δ_{ICM} of 45% and 16%. The HY-100 alloy, with the second lowest toughness in CTOD terms, shows the second lowest dependence on the notch tip radius.

The sensitivity of the initiation fracture toughness to the EDM notch does not seem to correlate with the strain hardening of the steel either. The HY-100 and A710 steel both have strain hardening exponents, N≈15 and the tougher A710 showed a greater sensitivity to the EDM notch than the HY-100. On the other hand, the A302 and A533B both have N≈9. For these two materials, the tougher A533B showed less sensitivity to the EDM notch than the A302. These conflicting trends indicate that there is not a one-to-one relationship between strain hardening and sensitivity of the fracture toughness to the presence of an EDM notch.

4.3 Improvement of the Common Method

The slope of the Common Method construction line that is used to evaluate δ_{ICM} was set as 2.0, assuming a circular opening of the crack tip. Comparing the crack extension at crack initiation that results from this assumption with the crack initiation at J_{Ic} of E 813, as shown in Table 3, demonstrates that this definition of δ_{ICM} is not very consistent with J_{Ic}. An improvement can be made if work of Paris et. al.[2], Shih [3] or Rice et. al.[4] is used giving:

$$\frac{d\delta}{da} = \alpha \frac{\frac{dJ}{da}}{\sigma_f} \tag{12}$$

with $\alpha = 0.65$ to 0.7, and substituting $dJ/da = 2\sigma_f$ gives

$$\frac{d\delta}{da} = 2\alpha = 1.3 - 1.4 \tag{13}$$

which implies that the slope of the δ blunting/construction line should have a slope of between 1.3 and 1.4 to be consistent with the slope of $2\sigma_f$ used by E813 and the Common Method for the case of bend type, plane strain test specimens. Recalculating δ_{ICM} using a construction line slope of 1.4 gives the results shown in Table 5. It is clear that the δ_{ICM} values have changed only slightly, but the crack extension at the initiation point has become much more consistent with that resulting from E813. The difference between the crack extension at J_{Ic} and δ_{ICM}, however, is greatly reduced using the smaller construction line slope, with the differences being reduced from a maximum of 40% to a maximum of 12.5%.

Table 5 Comparison of Δa at initiation using construction line slopes of 2.0 and 1.4.

Material	Specimen ID	Notch Type	δ_{u} (in.) Slope = 1.4	Δa at J_{Ic} (in.)	Δa at δ_{u} (in.)	% Difference
ASTM A302 Gr. B	FYX-511	EDM	0.0103	0.0145	0.0154	6.2
	FYX-524	EDM	0.0108	0.0146	0.0158	8.2
	FYX-526	EDM	0.0113	0.0148	0.0161	8.8
	FYX-516	Fatigue	0.0066	0.0123	0.0129	4.9
	FYX-527	Fatigue	0.0082	0.0135	0.0140	3.7
ASTM A515 Gr. 70	FYW-514	EDM	0.0088	0.0135	0.0144	6.7
	FYW-516	EDM	0.0108	0.0149	0.0158	6.0
	FYW-512	Fatigue	0.0074	0.0128	0.0134	4.7
	FYW-518	Fatigue	0.0096	0.0139	0.0149	7.2
ASTM A 533 Gr. B	A1	EDM	0.0170	0.0198	0.0201	1.5
	A3	EDM	0.0211	0.0227	0.0232	2.2
	A4	EDM	0.0194	0.0210	0.0219	4.3
	C1	Fatigue	0.0129	0.0163	0.0173	6.3
	C3	Fatigue	0.0147	0.0183	0.0185	1.1
HY-100	FYO-2	EDM	0.0052	0.0120	0.0118	-1.7
	FYO-6	EDM	0.0049	0.0117	0.0116	-0.8
	FYO-8	EDM	0.0058	0.0126	0.0122	-3.2
	FYO-13	Fatigue	0.0040	0.0113	0.0109	-3.5
	FYO-14	Fatigue	0.0036	0.0109	0.0107	-1.8
	FYO-150	Fatigue	0.0037	0.0111	0.0108	-2.7
	FYO-151	Fatigue	0.0038	0.0111	0.0108	-2.7
HSLA-80	OFT-42	EDM	0.0309	0.0339	0.0306	-9.7
	OFT-44	EDM	0.0279	0.0311	0.0282	-9.3
	OFT-33	Fatigue	0.0202	0.0256	0.0224	-12.5
	OFT-34	Fatigue	0.0151	0.0204	0.0188	-7.8
CS-19 Aluminum	FON-10	EDM	0.0066	0.0129	0.0128	-0.8
	FON-12	EDM	0.0070	0.0133	0.0131	-1.5
	FON-16	EDM	0.0056	0.0123	0.0121	-1.6
	FON-31	Fatigue	0.0022	0.0099	0.0097	-2.3
	FON-57	Fatigue	0.0023	0.0102	0.0101	-1.0
	FON-60	Fatigue	0028	0.0100	0.0098	-1.5

5.0 CONCLUSIONS

The following are the principal conclusions derived from this effort:

1) Wire EDM notches cannot be substituted for fatigue pre-cracks in fracture mechanics tests for any of the materials studied in this program without large changes in the measured initiation toughness resulting. The smallest EDM notch tip radii that could be cut were approximately 0.002 in. (0.05 mm) which was on the order of 1/5 the initiation CTOD measured - using the Common Method technique. The original precept of the work was that structural materials with initiation CTOD values on the order of 6 to 10 times the initial notch radius would likely be independent of the initial notch or fatigue crack geometry. This precept was not fully tested since it was found that few, if any, structural materials were tough enough to meet this criterion.

2) A pattern relating the initiation toughness notch geometry to material toughness was not found in this work. High toughness alone did not seem to make a material less sensitive to the initial crack tip geometry. Some materials were much more sensitive to the initial notch radius, but it was not necessarily the less tough materials that were the more sensitive.

3) The J-R curves slope, and the general shape of both the J-R and δ-R curves seemed quite insensitive to the type of notch geometry present in the specimen. If ductile tearing instability was the mode of failure of principal interest, then the use of EDM notches might be practical.

4) In general, if EDM notches were to be used, a research study is necessary to evaluate the effects of the blunt notches, and in all likelihood a correction would be necessary to estimate the true J_{Ic}, δ_i, or resistance curve that would be present if fatigue cracks existed in the structural application.

5) The initiation CTOD method of the ASTM E24.08.01 Common Method is strongly preferred in comparison with that of ASTM E1290. The E1290 method arbitrarily shortchanges the tougher materials by assuming that the onset of ductile tearing always occurs at 0.2 mm or 0.008 inches. The results of this work show that this is certainly not the case. The offset blunting line method of the Common Method document seems to give an initiation point consistent with the J_{Ic} measurement point of ASTM E813. A modification of the Common Method construction line slope is recommended, based on these results, which improves the correspondence between J_{Ic} and the Common Method δ_i.

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[3] Shih, C.F., "Relationships Between the J-Integral and the Crack Opening Displacement for Stationary and Extending Cracks," *Journal of the Mechanics and Physics of Solids*, Vol. 29, 1981, pp. 305-326.

[4] Rice, J.R. and Rosengren, G.F., "Plane Strain Deformation Near a Crack Tip in a Power-Law Hardening Material," *Journal of the Mechanics and Physics of Solids*, Vol. 16, 1968, pp. 1-12.

APPENDIX A

Data Tables for Individual Specimens

Specimen FYX-511

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in-lb)	LL Area (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	100	0.0021	881788	0.9999	0.0029	619753	0.9987	1986	0	−0	1.1940	0.0056	4	0	0.0000	−0.0000
2	65	0.0043	882132	0.9993	0.0059	617444	0.9962	3884	0	−0	1.1939	0.0055	17	−0	0.0001	−0.0000
3	55	0.0069	885163	0.9997	0.0096	614883	0.9978	5902	2	1	1.1928	0.0044	41	3	0.0003	0.0001
4	55	0.0097	888131	0.9999	0.0134	609899	0.9988	7654	8	8	1.1918	0.0033	76	13	0.0007	0.0003
5	52	0.0139	884167	0.9997	0.0189	611925	0.9992	9036	31	35	1.1932	0.0048	141	54	0.0015	0.0009
6	53	0.0161	883654	0.9996	0.0215	611425	0.9989	9245	49	57	1.1934	0.0049	180	88	0.0020	0.0013
7	60	0.0187	890752	0.9992	0.0247	605424	0.9978	9413	71	83	1.1908	0.0024	222	129	0.0025	0.0018
8	59	0.0204	896680	0.9990	0.0268	610732	0.9973	9487	87	101	1.1887	0.0003	252	157	0.0029	0.0022
9	60	0.0227	890054	0.9998	0.0296	597631	0.9948	9614	109	128	1.1911	0.0026	296	198	0.0035	0.0027
10	60	0.0244	889219	0.9998	0.0318	601482	0.9958	9726	122	143	1.1914	0.0029	322	221	0.0038	0.0031
11	59	0.0264	889679	0.9998	0.0344	600627	0.9956	9807	142	168	1.1912	0.0028	363	261	0.0043	0.0035
12	57	0.0287	891385	0.9998	0.0373	599797	0.9960	9932	164	196	1.1906	0.0022	407	303	0.0048	0.0040
13	57	0.0310	891761	0.9998	0.0403	596315	0.9948	10047	186	223	1.1905	0.0020	452	345	0.0053	0.0045
14	59	0.0332	891814	0.9995	0.0430	597737	0.9948	10144	207	248	1.1904	0.0020	492	384	0.0058	0.0050
15	58	0.0357	893330	0.9998	0.0462	600969	0.9953	10212	232	280	1.1899	0.0015	544	434	0.0064	0.0055
16	62	0.0381	891842	0.9998	0.0491	589274	0.9952	10333	255	309	1.1904	0.0020	591	478	0.0069	0.0060
17	61	0.0401	884623	0.9999	0.0517	594383	0.9946	10385	275	331	1.1930	0.0046	626	511	0.0074	0.0065
18	61	0.0428	887677	0.9998	0.0550	585124	0.9939	10464	301	367	1.1919	0.0035	683	567	0.0079	0.0071
19	64	0.0456	874526	0.9998	0.0585	585758	0.9947	10516	330	399	1.1967	0.0082	733	614	0.0086	0.0077
20	63	0.0476	883220	0.9993	0.0610	592843	0.9937	10525	350	426	1.1935	0.0051	776	658	0.0090	0.0082
21	64	0.0502	871965	0.9998	0.0641	581879	0.9938	10506	379	462	1.1976	0.0092	830	710	0.0097	0.0088
22	63	0.0529	852597	0.9998	0.0674	575801	0.9938	10491	406	494	1.2047	0.0163	877	754	0.0104	0.0095
23	62	0.0551	851815	0.9998	0.0702	574589	0.9929	10522	426	519	1.2050	0.0166	917	793	0.0108	0.0099
24	64	0.0577	844332	0.9998	0.0734	563435	0.9935	10490	454	554	1.2078	0.0193	969	845	0.0115	0.0106
25	65	0.0603	831982	0.9998	0.0764	559188	0.9925	10483	480	583	1.2124	0.0240	1012	885	0.0121	0.0112
26	65	0.0624	828181	0.9998	0.0791	552958	0.9940	10455	502	610	1.2138	0.0254	1053	926	0.0126	0.0117
27	63	0.0650	815943	0.9998	0.0822	548528	0.9919	10430	528	640	1.2185	0.0301	1098	969	0.0133	0.0124
28	65	0.0679	806445	0.9998	0.0856	540370	0.9922	10343	558	676	1.2221	[illegible]	1151	1023	0.0140	0.0131
29	65	0.0703	796036	0.9998	0.0884	538068	0.9920	10251	582	705	1.2262	[illegible]	1191	1063	0.0146	0.0137
30	65	0.0727	787855	0.9998	0.0913	527288	0.9917	10205	606	735	1.2294	0.0409	1235	1107	0.0152	0.0143
31	67	0.0752	773409	0.9997	0.0943	520037	0.9925	10112	632	763	1.2351	0.0466	1274	1145	0.0159	0.0150
32	67	0.0776	759987	0.9998	0.0971	517865	0.9920	10060	655	791	1.2404	0.0520	1312	1181	0.0166	0.0156
33	67	0.0804	751382	0.9997	0.1004	506590	0.9919	9980	681	824	1.2439	0.0555	1362	1231	0.0173	0.0163
34	67	0.0829	737769	0.9998	0.1033	502726	0.9914	9895	706	851	1.2495	0.0610	1397	1266	0.0180	0.0170
35	69	0.0857	726815	0.9996	0.1065	495980	0.9923	9801	732	883	1.2540	0.0655	1443	1312	0.0187	0.0178
36	69	0.0885	712943	0.9998	0.1098	487204	0.9917	9660	751	916	1.2598	0.0713	1487	1356	0.0196	0.0186
37	67	0.0916	704063	0.9987	0.1133	481843	0.9905	9535	789	949	1.2635	0.0751	1535	1406	0.0203	0.0194
38	72	0.0942	689192	0.9995	0.1164	471527	0.9932	9459	814	977	1.2699	0.0815	1571	1442	0.0211	0.0202
39	73	0.0975	673639	0.9994	0.1201	461986	0.9928	9312	844	1011	1.2767	0.0882	1615	1486	0.0221	0.0211
40	76	0.1036	639266	0.9996	0.1270	443955	0.9942	8939	902	1079	1.2920	0.1036	1698	1570	0.0240	0.0231
41	75	0.1060	630324	0.9996	0.1296	436501	0.9940	8835	919	1097	1.2961	0.1077	1721	1594	0.0246	0.0236
42	79	0.1089	612417	0.9995	0.1330	428960	0.9954	8716	945	1126	1.3044	0.1160	1756	1627	0.0255	0.0246
43	77	0.1127	599119	0.9996	0.1372	417849	0.9957	8608	975	1162	1.3107	0.1223	1805	1677	0.0266	0.0257
44	79	0.1156	589396	0.9996	0.1406	412873	0.9956	8543	999	1188	1.3153	0.1269	1842	1713	0.0275	0.0265
45	79	0.1182	585510	0.9980	0.1434	411707	0.9945	8468	1020	1212	1.3172	0.1288	1880	1752	0.0281	0.0272
46	81	0.1205	569662	0.9996	0.1461	403378	0.9955	8414	1040	1236	1.3250	0.1365	1905	1774	0.0290	0.0280
47	81	0.1227	564118	0.9996	0.1485	399115	0.9953	8367	1056	1254	1.3277	0.1393	1931	1801	0.0296	0.0286
48	81	0.1251	558578	0.9997	0.1512	395063	0.9957	8284	1076	1276	1.3304	0.1420	1964	1834	0.0303	0.0293
49	82	0.1284	548750	0.9996	0.1548	388270	0.9958	8182	1104	1306	1.3354	0.1469	2007	1878	0.0313	0.0303
50	85	0.1317	535060	0.9997	0.1585	381726	0.9958	8070	1130	1336	1.3424	0.1539	2042	1913	0.0323	0.0314
51	86	0.1361	521710	0.9996	0.1634	372763	0.9953	7909	1165	1375	1.3493	0.1609	2096	1968	0.0337	0.0328
52	89	0.1402	509392	0.9995	0.1679	362042	0.9954	7751	1197	1411	1.3558	0.1673	2144	2016	0.0350	0.0341
53	89	0.1447	497745	0.9995	0.1728	353157	0.9949	7618	1231	1447	1.3620	0.1736	2193	2066	0.0364	0.0354
54	90	0.1492	483694	0.9995	0.1778	347204	0.9953	7471	1265	1483	1.3697	0.1813	2239	2112	0.0378	0.0369
55	92	0.1534	474141	0.9994	0.1823	336843	0.9955	7326	1295	1518	1.3750	0.1865	2288	2163	0.0391	0.0382
56	94	0.1579	461715	0.9995	0.1872	331292	0.9956	7175	1328	1552	1.3820	0.1935	2331	2207	0.0406	0.0397
57	97	0.1627	448353	0.9992	0.1924	322735	0.9962	6982	1363	1591	1.3896	0.2012	2381	2259	0.0422	0.0413
58	100	0.1678	435420	0.9993	0.1979	313859	0.9959	6824	1397	1629	1.3972	0.2088	2429	2307	0.0439	0.0430

Specimen FYX-524

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area$_{pl}$ (in−lb)	LL Area$_{pl}$ (in−lb)	Crack Length (in.)	Crack Extension (in.)	J (in−lb/in^2)	J Plastic (in−lb/in^2)	CTOD (in.)	CTOD Plastic (in.)
1	119	0.0024	879255	0.9998	0.0035	564519	0.9993	2094	0	−0	1.1950	0.0041	5	0	0.0000	0.0000
2	88	0.0043	885771	0.9998	0.0062	562055	0.9986	3736	0	−1	1.1926	0.0017	14	−1	0.0001	0.0000
3	64	0.0068	890054	0.9993	0.0094	563439	0.9977	5655	2	−2	1.1911	0.0002	33	−2	0.0004	0.0001
4	57	0.0098	889937	0.9999	0.0133	551286	0.9979	7526	8	2	1.1911	0.0002	65	4	0.0008	0.0003
5	54	0.0131	890620	0.9995	0.0176	548037	0.9963	8797	23	16	1.1909	0.0000	108	26	0.0013	0.0007
6	61	0.0156	881417	0.9998	0.0208	548777	0.9947	9243	42	37	1.1942	0.0033	151	58	0.0019	0.0012
7	60	0.0182	880141	0.9999	0.0240	553383	0.9942	9399	64	65	1.1946	0.0038	196	101	0.0024	0.0017
8	62	0.0206	883709	0.9999	0.0271	552457	0.9948	9505	86	93	1.1934	0.0025	243	145	0.0030	0.0023
9	59	0.0229	885480	0.9999	0.0299	546734	0.9934	9629	107	119	1.1927	0.0018	285	185	0.0035	0.0028
10	58	0.0252	887285	0.9999	0.0327	548460	0.9930	9742	128	142	1.1921	0.0012	322	221	0.0040	0.0032
11	59	0.0276	887729	0.9998	0.0357	550315	0.9916	9876	150	170	1.1919	0.0010	369	265	0.0045	0.0038
12	61	0.0303	881459	0.9999	0.0391	554339	0.9927	9977	177	203	1.1942	0.0033	422	315	0.0052	0.0044
13	60	0.0329	881573	0.9999	0.0423	549667	0.9929	10102	200	234	1.1941	0.0033	472	362	0.0057	0.0049
14	56	0.0353	879364	0.9999	0.0452	549105	0.9918	10175	224	261	1.1949	0.0041	516	404	0.0063	0.0054
15	59	0.0378	877516	0.9999	0.0484	545540	0.9924	10272	249	292	1.1956	0.0047	567	452	0.0068	0.0060
16	58	0.0410	876609	0.9998	0.0523	541636	0.9924	10372	281	329	1.1959	0.0050	626	510	0.0075	0.0067
17	58	0.0450	868814	0.9999	0.0571	541817	0.9914	10489	321	377	1.1988	0.0079	702	581	0.0085	0.0076
18	59	0.0478	867920	0.9998	0.0606	532810	0.9914	10598	349	411	1.1991	0.0082	757	635	0.0091	0.0082
19	58	0.0507	863766	0.9999	0.0640	529851	0.9917	10670	379	444	1.2006	0.0097	810	685	0.0098	0.0088
20	59	0.0537	859312	0.9999	0.0677	525027	0.9909	10660	411	482	1.2022	0.0114	869	743	0.0105	0.0095
21	60	0.0566	843745	0.9995	0.0712	518673	0.9898	10691	441	517	1.2080	0.0171	922	792	0.0112	0.0103
22	59	0.0595	836617	0.9999	0.0746	521588	0.9905	10660	470	552	1.2107	0.0198	976	846	0.0119	0.0109
23	59	0.0624	831113	0.9998	0.0781	516926	0.9897	10643	501	591	1.2127	0.0219	1036	905	0.0126	0.0116
24	60	0.0651	821735	0.9998	0.0812	508913	0.9882	10623	529	624	1.2163	0.0254	1085	952	0.0133	0.0123
25	59	0.0681	814270	0.9998	0.0848	500795	0.9897	10635	560	659	1.2191	0.0283	1139	1005	0.0140	0.0130
26	59	0.0706	807807	0.9999	0.0878	498675	0.9901	10626	585	687	1.2216	0.0307	1182	1047	0.0146	0.0136
27	59	0.0739	797001	0.9999	0.0917	490550	0.9896	10568	620	729	1.2258	0.0349	1245	1109	0.0154	0.0144
28	62	0.0770	783343	0.9999	0.0952	489865	0.9889	10503	652	764	1.2311	0.0403	1295	1157	0.0162	0.0152
29	68	0.0802	776534	0.9998	0.0989	487036	0.9876	10461	684	805	1.2338	0.0429	1357	1220	0.0170	0.0160
30	63	0.0840	761982	0.9997	0.1033	479398	0.9859	10332	725	852	1.2396	0.0487	1426	1288	0.0181	0.0170
31	56	0.0873	746601	0.9998	0.1071	459260	0.9858	10171	758	892	1.2458	0.0550	1478	1342	0.0190	0.0179
32	60	0.0905	726957	0.9992	0.1107	453973	0.9843	10010	791	922	1.2539	0.0630	1516	1379	0.0199	0.0189
33	60	0.0933	719414	0.9996	0.1139	444791	0.9853	9908	817	955	1.2571	0.0662	1564	1427	0.0206	0.0196
34	62	0.0964	703679	0.9995	0.1175	442513	0.9871	9819	848	987	1.2637	0.0728	1606	1469	0.0215	0.0205
35	61	0.0993	688486	0.9996	0.1207	433639	0.9857	9659	875	1021	1.2702	0.0793	1650	1513	0.0223	0.0213
36	59	0.1038	657850	0.9993	0.1258	420653	0.9849	9396	919	1071	1.2836	0.0928	1708	1571	0.0238	0.0228
37	65	0.1083	638792	0.9995	0.1308	413924	0.9860	9240	957	1116	1.2922	0.1014	1767	1630	0.0250	0.0240
38	64	0.1124	621512	0.9995	0.1355	399934	0.9833	9103	994	1160	1.3002	0.1093	1825	1688	0.0263	0.0252
39	65	0.1171	599227	0.9991	0.1406	383572	0.9798	8913	1036	1203	1.3106	0.1198	1879	1741	0.0277	0.0267
40	62	0.1214	582839	0.9994	0.1454	365476	0.9809	8749	1071	1241	1.3185	0.1276	1927	1789	0.0290	0.0279
41	60	0.1260	557092	0.9991	0.1505	358392	0.9806	8550	1111	1280	1.3312	0.1403	1967	1827	0.0305	0.0295
42	65	0.1304	543571	0.9995	0.1553	361051	0.9832	8443	1145	1320	1.3380	0.1471	2022	1882	0.0317	0.0307
43	62	0.1344	532072	0.9994	0.1597	356743	0.9835	8310	1178	1362	1.3439	0.1530	2084	1945	0.0330	0.0319
44	60	0.1393	516790	0.9995	0.1650	363510	0.9959	8115	1218	1408	1.3519	0.1610	2147	2009	0.0345	0.0335
45	60	0.1443	498960	0.9995	0.1704	363732	0.9983	7965	1258	1459	1.3614	0.1705	2216	2077	0.0361	0.0351
46	63	0.1489	482829	0.9995	0.1754	360516	0.9996	7778	1293	1503	1.3702	0.1793	2271	2134	0.0376	0.0366
47	59	0.1539	462699	0.9996	0.1806	348180	0.9997	7526	1331	1547	1.3814	0.1905	2319	2182	0.0394	0.0384
48	61	0.1589	446047	0.9996	0.1858	339161	0.9996	7299	1368	1586	1.3910	0.2001	2362	2226	0.0411	0.0400
49	57	0.1638	430908	0.9998	0.1910	329965	0.9992	7151	1402	1622	1.3999	0.2090	2403	2268	0.0427	0.0417

Specimen FYX-526

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD $Area_{pl}$ (in-lb)	LL $Area_{pl}$ (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	114	0.0023	880099	1.0000	0.0031	658039	1.0000	2081	−0	0	1.1947	0.0051	5	−0	0.0000	−0.0000
2	79	0.0043	881842	1.0000	0.0059	639461	1.0000	3754	0	1	1.1940	0.0045	17	1	0.0001	0.0000
3	68	0.0065	888714	1.0000	0.0087	633934	0.9999	5428	2	1	1.1916	0.0020	34	2	0.0003	0.0001
4	62	0.0095	884099	1.0000	0.0126	626983	0.9999	7293	8	7	1.1932	0.0037	68	11	0.0007	0.0003
5	60	0.0134	885548	1.0000	0.0176	624772	0.9999	8651	27	29	1.1927	0.0031	126	45	0.0014	0.0008
6	63	0.0164	886389	0.9999	0.0213	623459	0.9997	9042	49	56	1.1924	0.0028	173	86	0.0021	0.0014
7	63	0.0192	895511	0.9988	0.0247	628503	0.9988	9188	74	85	1.1891	−0.0004	221	132	0.0027	0.0020
8	63	0.0221	892811	0.9995	0.0284	623084	0.9991	9316	101	118	1.1901	0.0005	275	183	0.0034	0.0027
9	65	0.0251	884330	1.0000	0.0321	620188	0.9991	9457	128	150	1.1931	0.0036	327	231	0.0040	0.0033
10	63	0.0280	883578	0.9999	0.0358	617322	0.9994	9594	153	183	1.1934	0.0038	381	282	0.0047	0.0039
11	64	0.0311	882568	0.9999	0.0396	618252	0.9997	9762	181	217	1.1938	0.0042	437	335	0.0053	0.0046
12	61	0.0343	882925	0.9998	0.0435	617148	0.9999	9908	211	254	1.1936	0.0041	497	392	0.0060	0.0053
13	61	0.0381	880768	0.9997	0.0483	615037	0.9999	10088	248	298	1.1944	0.0049	569	460	0.0069	0.0061
14	61	0.0416	879570	0.9998	0.0524	614361	0.9999	10200	282	338	1.1948	0.0053	634	523	0.0077	0.0069
15	57	0.0449	877000	0.9998	0.0564	613145	0.9998	10321	314	378	1.1958	0.0062	697	583	0.0084	0.0076
16	63	0.0484	874347	0.9999	0.0607	609000	0.9998	10397	350	421	1.1967	0.0072	767	649	0.0092	0.0084
17	61	0.0516	877460	0.9991	0.0646	609672	0.9992	10452	383	460	1.1956	0.0061	830	711	0.0100	0.0091
18	62	0.0542	863626	0.9999	0.0678	600300	0.9997	10487	410	494	1.2006	0.0111	879	759	0.0106	0.0097
19	57	0.0574	852444	0.9999	0.0716	594088	0.9996	10446	442	532	1.2048	0.0152	937	814	0.0114	0.0105
20	59	0.0599	844690	0.9999	0.0746	590072	0.9997	10474	467	561	1.2076	0.0181	982	858	0.0120	0.0111
21	59	0.0632	836697	0.9999	0.0785	584476	0.9998	10475	501	601	1.2106	0.0211	1044	918	0.0128	0.0118
22	61	0.0664	825489	0.9999	0.0824	576005	0.9998	10464	534	641	1.2149	0.0253	1103	975	0.0136	0.0126
23	62	0.0696	816129	0.9999	0.0861	570526	0.9998	10431	566	678	1.2184	0.0289	1159	1030	0.0144	0.0134
24	61	0.0727	807204	0.9999	0.0897	565341	0.9999	10422	597	715	1.2218	0.0323	1214	1084	0.0151	0.0142
25	60	0.0759	797871	0.9999	0.0936	558183	0.9998	10425	630	753	1.2254	0.0359	1272	1141	0.0159	0.0150
26	60	0.0791	785317	0.9999	0.0972	550299	0.9997	10373	663	790	1.2304	0.0408	1327	1194	0.0168	0.0158
27	63	0.0830	771588	0.9999	0.1017	541825	0.9998	10306	702	836	1.2358	0.0462	1394	1260	0.0178	0.0168
28	62	0.0866	759449	0.9999	0.1060	532399	0.9998	10264	738	878	1.2406	0.0511	1455	1320	0.0187	0.0177
29	56	0.0902	747758	0.9999	0.1101	524167	0.9998	10177	774	918	1.2454	0.0558	1515	1379	0.0196	0.0186
30	64	0.0938	731816	0.9999	0.1142	514933	0.9999	10078	810	959	1.2519	0.0624	1571	1433	0.0206	0.0196
31	62	0.0968	719614	0.9999	0.1176	505910	0.9999	9930	840	993	1.2570	0.0674	1617	1480	0.0215	0.0205
32	64	0.1000	705430	0.9999	0.1211	497881	0.9999	9857	870	1026	1.2630	0.0734	1661	1524	0.0224	0.0213
33	69	0.1036	689780	0.9999	0.1252	487635	0.9999	9795	904	1065	1.2696	0.0801	1716	1576	0.0234	0.0224
34	68	0.1067	680775	0.9999	0.1287	480785	0.9999	9782	932	1096	1.2735	0.0840	1762	1621	0.0242	0.0231
35	67	0.1099	670692	0.9999	0.1323	475359	0.9998	9705	962	1130	1.2780	0.0884	1811	1670	0.0251	0.0240
36	66	0.1137	668663	0.9979	0.1366	472095	0.9981	9570	999	1172	1.2789	0.0893	1878	1740	0.0260	0.0250
37	68	0.1173	642811	0.9999	0.1406	457415	0.9999	9389	1036	1213	1.2904	0.1009	1924	1783	0.0273	0.0263
38	68	0.1213	628734	0.9999	0.1450	449273	0.9998	9250	1071	1252	1.2968	0.1073	1974	1835	0.0284	0.0274
39	73	0.1256	609642	0.9999	0.1497	436073	0.9999	9084	1110	1295	1.3057	0.1162	2029	1888	0.0298	0.0287
40	72	0.1301	591735	0.9998	0.1548	423393	0.9999	8900	1150	1340	1.3142	0.1247	2085	1946	0.0312	0.0301
41	72	0.1346	576277	0.9998	0.1597	412265	0.9999	8660	1189	1383	1.3217	0.1322	2140	2003	0.0325	0.0315
42	72	0.1393	560233	0.9997	0.1648	398121	0.9998	8437	1230	1427	1.3296	0.1401	2194	2060	0.0340	0.0330
43	83	0.1439	537973	0.9997	0.1698	386296	0.9999	8244	1268	1466	1.3409	0.1513	2234	2099	0.0356	0.0346
44	81	0.1485	517674	0.9997	0.1748	374019	0.9999	8087	1303	1506	1.3514	0.1619	2275	2139	0.0371	0.0361
45	83	0.1526	501887	0.9995	0.1791	365219	0.9999	7899	1334	1540	1.3598	0.1702	2312	2177	0.0384	0.0374
46	83	0.1577	478598	0.9992	0.1846	349194	0.9999	7661	1375	1584	1.3725	0.1830	2355	2219	0.0402	0.0392
47	86	0.1625	459670	0.9992	0.1898	337676	0.9998	7434	1409	1621	1.3831	0.1936	2399	2255	0.0419	0.0409
48	89	0.1670	441051	0.9989	0.1945	326186	0.9998	7214	1441	1656	1.3939	0.2043	2418	2285	0.0434	0.0425

Specimen FYX−516

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in−lb)	LL Area (in−lb)	Crack Length (in.)	Crack Extension (in.)	J (in−lb/in²)	J Plastic (in−lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	103	0.0023	825732	0.9998	0.0033	571186	0.9998	2026	1	1	1.2148	0.0012	4	−1	0.0000	−0.0000
2	97	0.0039	822108	0.9998	0.0055	575531	0.9996	3342	−0	−1	1.2161	0.0025	10	−4	0.0001	−0.0000
3	67	0.0060	829409	0.9999	0.0082	564681	0.9990	5002	0	−1	1.2134	−0.0002	25	−4	0.0002	−0.0000
4	62	0.0089	828999	0.9998	0.0120	561802	0.9983	7014	3	−1	1.2135	−0.0001	55	−3	0.0005	0.0001
5	62	0.0132	827698	0.9999	0.0176	558987	0.9982	8724	22	19	1.2140	0.0004	117	28	0.0013	0.0006
6	62	0.0150	827868	0.9999	0.0198	560218	0.9980	8956	35	35	1.2140	0.0003	146	53	0.0016	0.0009
7	62	0.0170	826492	0.9999	0.0223	560181	0.9976	9084	51	55	1.2145	0.0009	182	86	0.0020	0.0013
8	60	0.0192	821195	0.9998	0.0250	561398	0.9975	9217	70	78	1.2165	0.0029	221	122	0.0025	0.0018
9	61	0.0211	822827	0.9999	0.0274	559023	0.9974	9297	87	100	1.2159	0.0023	258	156	0.0029	0.0022
10	61	0.0228	824373	0.9999	0.0295	557307	0.9973	9407	101	117	1.2153	0.0017	286	183	0.0033	0.0025
11	61	0.0253	820853	0.9999	0.0326	555102	0.9971	9476	125	145	1.2166	0.0030	334	228	0.0039	0.0031
12	60	0.0284	820058	0.9999	0.0364	548916	0.9969	9628	152	178	1.2169	0.0033	390	281	0.0045	0.0037
13	61	0.0316	813193	0.9999	0.0403	545186	0.9963	9708	183	213	1.2195	0.0059	448	336	0.0052	0.0044
14	60	0.0347	808647	0.9999	0.0442	541385	0.9963	9824	211	248	1.2213	0.0077	506	391	0.0059	0.0051
15	60	0.0375	800190	0.9999	0.0476	538257	0.9961	9859	238	280	1.2245	0.0109	559	441	0.0066	0.0057
16	59	0.0405	789159	0.9998	0.0512	534328	0.9969	9952	265	313	1.2288	0.0152	613	491	0.0072	0.0063
17	62	0.0432	781937	0.9998	0.0546	532078	0.9966	9997	290	345	1.2317	0.0181	665	541	0.0078	0.0069
18	61	0.0458	777942	0.9999	0.0576	528979	0.9964	9977	315	375	1.2333	0.0196	714	589	0.0084	0.0075
19	60	0.0484	765284	0.9999	0.0608	520700	0.9959	9997	341	406	1.2383	0.0247	763	636	0.0091	0.0081
20	60	0.0510	756424	0.9999	0.0639	514419	0.9965	9971	365	435	1.2419	0.0282	809	680	0.0096	0.0087
21	62	0.0536	745204	0.9999	0.0671	508765	0.9960	9948	390	465	1.2464	0.0328	857	726	0.0103	0.0093
22	62	0.0564	730563	0.9999	0.0705	500473	0.9962	9963	416	497	1.2524	0.0388	906	772	0.0110	0.0100
23	59	0.0592	718383	0.9999	0.0738	491048	0.9949	9895	442	528	1.2575	0.0439	954	819	0.0117	0.0107
24	60	0.0624	709506	1.0000	0.0775	483573	0.9948	9796	474	563	1.2612	0.0476	1010	875	0.0124	0.0114
25	60	0.0652	695973	0.9999	0.0808	477972	0.9950	9770	500	594	1.2670	0.0534	1057	919	0.0132	0.0121
26	61	0.0681	682178	0.9999	0.0842	470871	0.9956	9705	526	625	1.2729	0.0593	1105	965	0.0139	0.0129
27	60	0.0708	674679	0.9999	0.0873	458766	0.9940	9608	551	655	1.2762	0.0626	1151	1013	0.0145	0.0135
28	60	0.0730	664337	0.9998	0.0899	452543	0.9936	9586	572	676	1.2808	0.0672	1183	1042	0.0151	0.0141
29	62	0.0759	653268	0.9998	0.0934	443744	0.9929	9520	599	708	1.2857	0.0721	1232	1090	0.0159	0.0148
30	60	0.0797	638158	0.9998	0.0979	434010	0.9936	9479	633	748	1.2925	0.0789	1294	1149	0.0169	0.0158
31	64	0.0838	619330	0.9999	0.1025	427627	0.9925	9391	670	790	1.3012	0.0876	1356	1209	0.0180	0.0169
32	60	0.0880	600891	0.9999	0.1074	415409	0.9917	9252	707	836	1.3098	0.0962	1425	1277	0.0192	0.0181
33	59	0.0921	586088	0.9999	0.1121	402284	0.9909	9164	742	875	1.3169	0.1033	1485	1335	0.0202	0.0191
34	59	0.0961	564723	0.9999	0.1167	395016	0.9904	9029	778	914	1.3274	0.1138	1537	1385	0.0214	0.0203
35	60	0.1005	548280	0.9998	0.1217	383949	0.9901	8905	814	958	1.3356	0.1220	1602	1449	0.0226	0.0215
36	62	0.1046	535644	0.9999	0.1262	376785	0.9903	8771	849	996	1.3421	0.1285	1661	1506	0.0238	0.0226
37	63	0.1088	517367	0.9999	0.1309	368757	0.9886	8580	886	1037	1.3516	0.1380	1718	1564	0.0251	0.0239
38	63	0.1130	506175	0.9999	0.1356	356371	0.9878	8408	920	1078	1.3575	0.1439	1779	1627	0.0262	0.0251
39	63	0.1171	488743	0.9999	0.1402	342382	0.9862	8245	954	1113	1.3669	0.1533	1825	1672	0.0275	0.0264
40	66	0.1209	479930	0.9999	0.1445	330927	0.9863	8066	984	1145	1.3718	0.1582	1872	1722	0.0286	0.0275
41	64	0.1254	456811	0.9999	0.1493	318742	0.9862	7869	1020	1182	1.3848	0.1712	1911	1759	0.0301	0.0290
42	69	0.1308	437503	1.0000	0.1553	305817	0.9843	7676	1060	1227	1.3960	0.1824	1970	1817	0.0318	0.0307
43	67	0.1362	425346	0.9995	0.1611	294263	0.9827	7441	1099	1269	1.4032	0.1896	2032	1883	0.0334	0.0323
44	71	0.1416	406657	0.9998	0.1669	274788	0.9836	7224	1139	1311	1.4146	0.2010	2083	1933	0.0352	0.0341

Specimen FXY−527

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD $Area_{pl}$ (in−lb)	LL $Area_{pl}$ (in−lb)	Crack Length (in.)	Crack Extension (in.)	J (in−lb/in²)	J Plastic (in−lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	100	0.0025	769261	0.9999	0.0033	576483	0.9991	2037	0	−0	1.2367	0.0038	6	0	0.0000	−0.0000
2	75	0.0048	774217	0.9998	0.0061	572594	0.9982	3779	−0	−1	1.2347	0.0018	18	−1	0.0001	−0.0000
3	61	0.0077	772686	0.9996	0.0099	572959	0.9961	5878	1	−0	1.2353	0.0025	45	0	0.0004	0.0000
4	65	0.0119	772771	0.9997	0.0154	574326	0.9949	7851	13	14	1.2353	0.0024	103	24	0.0010	0.0004
5	63	0.0144	785926	0.9958	0.0186	586905	0.9917	8543	26	31	1.2301	−0.0028	143	52	0.0014	0.0007
6	63	0.0168	770557	0.9999	0.0217	575722	0.9959	8760	46	57	1.2362	0.0033	191	94	0.0019	0.0012
7	62	0.0194	771410	0.9999	0.0248	578276	0.9965	8823	66	81	1.2358	0.0030	231	133	0.0024	0.0017
8	62	0.0219	771666	0.9998	0.0279	578486	0.9972	8972	87	107	1.2357	0.0029	277	175	0.0029	0.0022
9	60	0.0245	771511	0.9998	0.0309	577690	0.9971	9046	110	134	1.2358	0.0029	322	219	0.0035	0.0027
10	61	0.0276	769724	0.9998	0.0344	576262	0.9966	9180	137	164	1.2365	0.0036	375	268	0.0041	0.0034
11	63	0.0297	784663	0.9953	0.0370	584920	0.9924	9274	155	186	1.2306	−0.0023	412	305	0.0045	0.0037
12	62	0.0322	768522	0.9999	0.0400	567833	0.9945	9378	180	215	1.2370	0.0041	462	350	0.0052	0.0043
13	62	0.0348	767687	0.9999	0.0431	566754	0.9937	9403	201	239	1.2373	0.0044	502	390	0.0057	0.0048
14	62	0.0379	766307	0.9998	0.0468	564635	0.9934	9493	230	273	1.2379	0.0050	561	445	0.0063	0.0055
15	63	0.0407	759929	0.9998	0.0503	559084	0.9935	9597	256	304	1.2404	0.0076	613	495	0.0069	0.0061
16	62	0.0436	754385	0.9999	0.0538	557492	0.9936	9569	283	337	1.2427	0.0098	667	547	0.0076	0.0067
17	62	0.0465	750703	0.9999	0.0573	552329	0.9935	9650	309	369	1.2442	0.0113	721	599	0.0082	0.0073
18	62	0.0500	740841	0.9998	0.0615	545634	0.9932	9611	344	409	1.2482	0.0153	786	663	0.0090	0.0081
19	64	0.0533	729987	0.9999	0.0654	537056	0.9925	9680	372	444	1.2527	0.0198	842	716	0.0097	0.0088
20	66	0.0569	721162	0.9999	0.0696	530362	0.9918	9671	406	482	1.2563	0.0234	906	777	0.0105	0.0096
21	65	0.0603	712310	0.9999	0.0737	519002	0.9901	9653	438	520	1.2600	0.0272	967	836	0.0113	0.0103
22	62	0.0637	705574	0.9999	0.0776	506063	0.9867	9527	472	557	1.2629	0.0300	1025	896	0.0121	0.0111
23	62	0.0675	692667	0.9999	0.0819	490165	0.9843	9469	507	595	1.2684	0.0355	1083	954	0.0130	0.0120
24	63	0.0713	681988	0.9998	0.0863	474663	0.9826	9386	542	633	1.2730	0.0401	1141	1011	0.0139	0.0129
25	64	0.0749	667695	0.9998	0.0904	465612	0.9810	9283	576	668	1.2793	0.0464	1195	1064	0.0148	0.0138
26	65	0.0787	676401	0.9907	0.0948	467330	0.9715	9220	609	707	1.2755	0.0426	1264	1137	0.0155	0.0146
27	65	0.0828	645372	0.9997	0.0995	437889	0.9751	9143	650	753	1.2892	0.0564	1326	1193	0.0168	0.0158
28	68	0.0869	633623	0.9996	0.1042	430369	0.9736	9069	683	785	1.2946	0.0617	1376	1242	0.0177	0.0167
29	67	0.0906	620432	0.9995	0.1084	418400	0.9713	8969	716	822	1.3007	0.0678	1430	1296	0.0187	0.0177
30	68	0.0950	602614	0.9994	0.1132	409224	0.9703	8768	756	865	1.3090	0.0761	1489	1357	0.0199	0.0189
31	70	0.0998	578323	0.9993	0.1184	395990	0.9717	8545	797	911	1.3207	0.0878	1551	1418	0.0212	0.0202
32	73	0.1052	554867	0.9994	0.1244	384589	0.9715	8368	841	960	1.3323	0.0994	1615	1482	0.0227	0.0217
33	73	0.1094	537760	0.9995	0.1290	370671	0.9699	8152	874	997	1.3410	0.1081	1669	1533	0.0239	0.0229
34	71	0.1144	538322	0.9993	0.1346	355212	0.9669	7923	915	1042	1.3407	0.1078	1743	1618	0.0250	0.0241
35	73	0.1195	516275	0.9993	0.1401	339399	0.9654	7682	958	1084	1.3521	0.1193	1793	1669	0.0267	0.0257
36	75	0.1250	490548	0.9992	0.1462	327925	0.9676	7384	1000	1129	1.3659	0.1330	1841	1719	0.0284	0.0275
37	75	0.1307	469805	0.9991	0.1524	312749	0.9628	7129	1041	1174	1.3774	0.1445	1898	1778	0.0301	0.0292
38	85	0.1364	448144	0.9982	0.1585	307646	0.9688	6863	1080	1217	1.3898	0.1569	1945	1826	0.0319	0.0310
39	92	0.1421	427147	0.9989	0.1647	298788	0.9687	6703	1116	1260	1.4021	0.1692	1998	1877	0.0336	0.0327
40	93	0.1475	413915	0.9991	0.1706	288158	0.9672	6566	1150	1298	1.4101	0.1772	2052	1932	0.0352	0.0343
41	95	0.1525	403443	0.9990	0.1761	278545	0.9664	6449	1182	1331	1.4165	0.1837	2100	1981	0.0366	0.0357
42	96	0.1579	390261	0.9990	0.1819	265149	0.9623	6302	1216	1367	1.4248	0.1919	2148	2029	0.0383	0.0374
43	96	0.1630	380594	0.9991	0.1874	248904	0.9575	6165	1247	1398	1.4310	0.1981	2192	2073	0.0398	0.0389
44	96	0.1681	370579	0.9991	0.1929	239537	0.9579	6070	1278	1425	1.4375	0.2046	2228	2109	0.0414	0.0405

Specimen FYW-514

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD $Area_{pl}$ (in-lb)	LL $Area_{pl}$ (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	77	0.0020	875748	0.9998	0.0031	515724	0.9900	1809	0	−0	1.1962	0.0081	4	0	0.0000	−0.0000
2	62	0.0047	880222	0.9998	0.0068	546271	0.9877	3942	1	−2	1.1946	0.0065	16	−1	0.0002	0.0001
3	60	0.0079	889104	0.9999	0.0110	537853	0.9806	5698	7	5	1.1914	0.0033	44	9	0.0006	0.0003
4	64	0.0113	888903	0.9999	0.0154	545711	0.9801	6619	22	21	1.1915	0.0033	81	34	0.0013	0.0009
5	61	0.0135	891650	0.9999	0.0183	538040	0.9781	6964	35	38	1.1905	0.0024	112	60	0.0018	0.0013
6	101	0.0155	886840	0.9999	0.0209	580062	0.9880	7228	48	52	1.1922	0.0041	138	82	0.0022	0.0017
7	64	0.0186	891993	0.9999	0.0248	545342	0.9797	7590	67	84	1.1904	0.0022	192	131	0.0028	0.0023
8	59	0.0217	895821	1.0000	0.0286	532704	0.9747	7870	89	104	1.1890	0.0009	22[illegible]	162	0.0035	0.0029
9	61	0.0246	891635	0.9999	0.0324	534782	0.9776	8179	111	127	1.1905	0.0024	26[illegible]	197	0.0042	0.0035
10	62	0.0281	896486	0.9999	0.0367	528752	0.9732	8464	137	160	1.1888	0.0006	32[illegible]	248	0.0049	0.0042
11	59	0.0317	899519	0.9999	0.0412	519899	0.9755	8755	167	193	1.1877	−0.0004	381	300	0.0057	0.0050
12	59	0.0352	886575	0.9999	0.0455	516480	0.9721	8985	196	225	1.1923	0.0042	434	348	0.0065	0.0057
13	54	0.0383	885402	0.9999	0.0494	502420	0.9676	9196	221	257	1.1927	0.0046	487	396	0.0072	0.0064
14	61	0.0418	878031	0.9999	0.0538	506201	0.9718	9376	252	289	1.1954	0.0073	540	445	0.0080	0.0071
15	58	0.0448	869523	0.9999	0.0574	492387	0.9674	9458	279	323	1.1985	0.0104	595	496	0.0087	0.0078
16	64	0.0483	850711	0.9999	0.0617	501677	0.9690	9459	311	359	1.2054	0.0173	649	548	0.0095	0.0086
17	58	0.0516	836200	0.9998	0.0655	482550	0.9621	9453	341	400	1.2108	0.0227	711	608	0.0103	0.0094
18	64	0.0542	819864	0.9998	0.0686	484070	0.9663	9403	365	423	1.2170	0.0289	746	641	0.0110	0.0101
19	57	0.0562	806242	0.9998	0.0709	464066	0.9618	9373	382	446	1.2222	0.0341	779	673	0.0115	0.0105
20	64	0.0595	782863	0.9998	0.0747	460318	0.9630	9241	412	477	1.2313	0.0432	821	714	0.0124	0.0114
21	52	0.0620	768260	0.9998	0.0777	423315	0.9582	9209	434	504	1.2371	0.0490	862	753	0.0130	0.0120
22	54	0.0647	750036	0.9997	0.0807	418745	0.9562	9156	456	517	1.2444	0.0563	87[illegible]	768	0.0137	0.0127
23	53	0.0675	733318	0.9998	0.0840	409600	0.9550	9059	482	548	1.2513	0.0631	923	811	0.0145	0.0135
24	57	0.0701	716758	0.9998	0.0869	408504	0.9549	9016	503	571	1.2582	0.0700	956	842	0.0152	0.0142
25	57	0.0728	701986	0.9998	0.0900	398207	0.9516	8931	527	601	1.2644	0.0763	1000	885	0.0159	0.0149
26	62	0.0759	683774	0.9998	0.0935	399411	0.9579	8826	553	629	1.2722	0.0841	1039	924	0.0168	0.0158
27	66	0.0792	658795	0.9998	0.0972	396705	0.9573	8613	583	668	1.2832	0.0951	1094	976	0.0178	0.0168
28	73	0.0826	636667	0.9998	0.1010	389267	0.9604	8427	610	703	1.2932	0.1051	1137	1023	0.0188	0.0178
29	65	0.0860	614313	0.9998	0.1047	361444	0.9510	8248	637	735	1.3035	0.1154	1180	1065	0.0198	0.0188
30	72	0.0895	590430	0.9999	0.1086	360302	0.9520	8123	664	757	1.3148	0.1267	1204	1086	0.0209	0.0198
31	57	0.0925	576721	0.9998	0.1119	327277	0.9418	7984	686	786	1.3215	0.1333	1246	1130	0.0217	0.0207
32	70	0.0958	553753	0.9998	0.1155	336122	0.9479	7790	713	802	1.3329	0.1447	1256	1139	0.0228	0.0218
33	58	0.0988	539729	0.9997	0.1188	304428	0.9380	7618	734	836	1.3400	0.1518	1306	1191	0.0237	0.0227
34	57	0.1022	518968	0.9997	0.1224	290555	0.9327	7356	761	852	1.3507	0.1626	1315	1202	0.0248	0.0238
35	77	0.1054	494030	0.9996	0.1258	303229	0.9448	7175	783	874	1.3640	0.1759	1333	1218	0.0260	0.0249
36	65	0.1089	477538	0.9997	0.1295	281260	0.9363	6988	806	912	1.3731	0.1849	1389	1275	0.0270	0.0260
37	61	0.1118	461866	0.9996	0.1327	263313	0.9279	6812	825	926	1.3819	0.1937	1397	1285	0.0280	0.0270
38	64	0.1152	444259	0.9996	0.1363	258132	0.9264	6622	848	944	1.3920	0.2039	1412	1300	0.0291	0.0282
39	71	0.1186	427159	0.9996	0.1399	252558	0.9384	6468	869	968	1.4021	0.2140	1440	1328	0.0303	0.0293

Specimen FYW-516

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in-lb)	LL Area (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	166	0.0028	894602	0.9992	0.0039	588892	0.9983	2458	0	-0	1.1894	0.0042	7	0	0.0001	0.0000
2	68	0.0050	895425	0.9998	0.0069	601349	0.9992	4200	1	-0	1.1892	0.0039	20	1	0.0002	0.0001
3	54	0.0083	917595	0.9946	0.0114	600981	0.9935	6024	8	8	1.1813	-0.0040	51	13	0.0007	0.0004
4	67	0.0121	897364	0.9999	0.0163	590905	0.9981	6879	28	31	1.1885	0.0032	98	48	0.0015	0.0011
5	66	0.0145	898551	0.9999	0.0194	586822	0.9979	7153	42	49	1.1880	0.0028	129	75	0.0020	0.0015
6	65	0.0174	897768	0.9999	0.0230	586013	0.9984	7479	60	71	1.1883	0.0030	169	110	0.0026	0.0021
7	65	0.0199	899700	0.9999	0.0263	584186	0.9987	7770	78	92	1.1876	0.0023	206	142	0.0032	0.0026
8	66	0.0225	899097	0.9999	0.0295	586816	0.9976	8000	97	115	1.1878	0.0026	245	178	0.0037	0.0031
9	66	0.0258	899399	0.9999	0.0337	584151	0.9978	8297	121	146	1.1877	0.0025	298	225	0.0045	0.0038
10	65	0.0290	900626	0.9999	0.0377	578045	0.9982	8570	146	175	1.1873	0.0020	348	271	0.0052	0.0045
11	65	0.0321	899744	0.9999	0.0416	578728	0.9984	8825	171	205	1.1876	0.0023	398	316	0.0059	0.0051
12	63	0.0358	896262	0.9999	0.0462	575523	0.9982	9022	203	244	1.1889	0.0036	462	375	0.0067	0.0060
13	64	0.0389	895238	0.9999	0.0501	572731	0.9987	9242	229	275	1.1892	0.0039	515	424	0.0074	0.0066
14	60	0.0430	891565	0.9998	0.0550	568336	0.9992	9414	265	319	1.1905	0.0052	585	490	0.0083	0.0075
15	60	0.0460	886206	0.9998	0.0588	559198	0.9993	9572	292	351	1.1925	0.0072	637	539	0.0090	0.0082
16	59	0.0497	876555	0.9998	0.0634	553647	0.9995	9679	327	391	1.1959	0.0107	700	598	0.0099	0.0090
17	56	0.0521	868330	0.9998	0.0662	547746	0.9994	9700	349	417	1.1989	0.0136	741	637	0.0105	0.0096
18	63	0.0551	858138	0.9998	0.0699	541441	0.9993	9725	377	451	1.2027	0.0174	792	686	0.0112	0.0103
19	60	0.0585	835593	0.9996	0.0739	527277	0.9994	9622	411	490	1.2110	0.0258	848	741	0.0122	0.0112
20	58	0.0607	825500	0.9997	0.0764	519208	0.9998	9615	429	510	1.2149	0.0296	878	769	0.0127	0.0117
21	61	0.0633	808118	0.9997	0.0794	509001	0.9996	9561	454	539	1.2215	0.0362	917	807	0.0134	0.0124
22	60	0.0663	830355	0.9765	0.0829	522351	0.9776	9494	481	570	1.2130	0.0277	971	866	0.0139	0.0129
23	59	0.0693	775263	0.9997	0.0864	489370	0.9995	9439	514	609	1.2343	0.0490	1017	904	0.0151	0.0141
24	62	0.0723	756954	0.9996	0.0898	476841	0.9994	9301	536	632	1.2416	0.0564	1046	933	0.0158	0.0148
25	56	0.0748	741494	0.9996	0.0927	467181	0.9994	9233	558	656	1.2479	0.0626	1080	965	0.0165	0.0154
26	63	0.0776	721347	0.9996	0.0959	458190	0.9984	9161	583	684	1.2563	0.0710	1116	1000	0.0173	0.0162
27	63	0.0801	709616	0.9996	0.0987	451580	0.9979	9117	603	707	1.2612	0.0759	1151	1033	0.0179	0.0169
28	57	0.0829	694724	0.9995	0.1018	439383	0.9977	8970	629	736	1.2675	0.0822	1191	1073	0.0187	0.0177
29	62	0.0855	679013	0.9995	0.1048	434553	0.9966	8904	651	760	1.2743	0.0890	1222	1103	0.0195	0.0184
30	61	0.0888	662689	0.9995	0.1085	423860	0.9945	8764	680	794	1.2815	0.0962	1270	1151	0.0205	0.0194
31	61	0.0927	640332	0.9995	0.1128	415446	0.9942	8576	714	831	1.2915	0.1062	1318	1200	0.0216	0.0206
32	62	0.0977	607277	0.9994	0.1183	399891	0.9933	8266	757	881	1.3068	0.1215	1379	1261	0.0233	0.0222
33	68	0.1031	579297	0.9994	0.1243	389091	0.9927	8093	799	928	1.3202	0.1349	1440	1321	0.0249	0.0238
34	70	0.1083	554410	0.9993	0.1300	371783	0.9912	7880	838	974	1.3325	0.1472	1500	1381	0.0265	0.0254
35	72	0.1135	528390	0.9991	0.1356	357168	0.9918	7608	878	1017	1.3458	0.1605	1552	1433	0.0282	0.0271
36	64	0.1179	505560	0.9990	0.1404	332693	0.9913	7372	910	1052	1.3578	0.1725	1590	1472	0.0296	0.0286
37	69	0.1237	474564	0.9990	0.1466	313877	0.9910	7026	953	1094	1.3747	0.1895	1632	1515	0.0317	0.0307
38	78	0.1302	443035	0.9990	0.1536	298497	0.9914	6733	996	1140	1.3927	0.2074	1678	1561	0.0339	0.0329

Specimen FYW-512

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in-lb)	LL Area (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	88	0.0025	809757	0.9997	0.0035	555422	0.9999	2035	0	-0	1.2209	0.0059	5	0	0.0000	-0.0000
2	60	0.0048	817760	0.9996	0.0065	557922	0.9999	3841	0	-1	1.2178	0.0028	17	-1	0.0002	0.0000
3	63	0.0076	818552	0.9999	0.0103	567056	0.9995	5781	3	1	1.2175	0.0025	42	2	0.0005	0.0001
4	65	0.0098	819822	0.9999	0.0132	568422	0.9992	6271	13	14	1.2170	0.0020	70	23	0.0009	0.0005
5	65	0.0118	820562	0.9999	0.0156	567354	0.9991	6560	23	27	1.2167	0.0017	95	43	0.0013	0.0008
6	62	0.0140	820740	0.9999	0.0184	564211	0.9990	6840	36	43	1.2167	0.0017	124	68	0.0017	0.0012
7	64	0.0164	819385	0.9999	0.0215	564714	0.9992	7100	51	61	1.2172	0.0022	157	98	0.0022	0.0017
8	65	0.0191	821209	0.9998	0.0248	561187	0.9988	7380	68	82	1.2165	0.0015	196	131	0.0028	0.0022
9	67	0.0222	820645	0.9998	0.0287	561633	0.9980	7647	90	107	1.2167	0.0017	240	171	0.0034	0.0028
10	62	0.0253	820056	0.9998	0.0327	562932	0.9984	7926	112	135	1.2169	0.0019	290	215	0.0041	0.0034
11	63	0.0285	816601	0.9999	0.0367	563045	0.9992	8118	136	165	1.2182	0.0032	343	264	0.0048	0.0041
12	63	0.0317	813707	0.9999	0.0406	569019	0.9999	8309	160	195	1.2193	0.0043	393	311	0.0054	0.0047
13	63	0.0348	808261	0.9999	0.0443	568328	1.0000	8474	184	225	1.2214	0.0064	445	358	0.0061	0.0053
14	62	0.0388	798748	0.9998	0.0491	562165	0.9999	8576	218	265	1.2251	0.0101	510	420	0.0070	0.0062
15	61	0.0424	786909	0.9999	0.0531	555403	1.0000	8636	247	298	1.2297	0.0147	564	472	0.0078	0.0070
16	61	0.0455	775165	0.9999	0.0568	549020	1.0000	8655	273	328	1.2344	0.0194	612	517	0.0085	0.0077
17	63	0.0480	766183	0.9999	0.0597	545694	0.9999	8738	292	351	1.2379	0.0229	650	552	0.0091	0.0082
18	63	0.0506	754000	0.9998	0.0627	541288	0.9998	8724	314	377	1.2428	0.0278	691	591	0.0097	0.0088
19	63	0.0537	738776	0.9998	0.0663	531995	0.9997	8680	341	409	1.2490	0.0340	740	638	0.0105	0.0096
20	66	0.0562	725541	0.9997	0.0693	523356	0.9998	8663	361	432	1.2545	0.0395	776	673	0.0111	0.0102
21	63	0.0589	712500	0.9997	0.0724	514998	0.9998	8631	383	458	1.2600	0.0450	815	711	0.0117	0.0108
22	63	0.0615	699073	0.9997	0.0753	506369	0.9999	8524	405	483	1.2657	0.0507	853	748	0.0124	0.0115
23	61	0.0641	683463	0.9996	0.0783	491404	0.9997	8454	426	507	1.2724	0.0574	889	783	0.0131	0.0121
24	61	0.0665	669336	0.9995	0.0811	483197	0.9997	8358	446	529	1.2786	0.0636	919	812	0.0137	0.0128
25	61	0.0693	653350	0.9996	0.0843	472360	0.9997	8287	468	555	1.2857	0.0707	957	850	0.0144	0.0135
26	63	0.0716	646045	0.9992	0.0870	468921	0.9994	8252	485	574	1.2889	0.0739	987	879	0.0150	0.0140
27	66	0.0743	627807	0.9996	0.0900	456363	0.9998	8127	508	601	1.2973	0.0823	1025	916	0.0158	0.0148
28	64	0.0770	610737	0.9996	0.0930	442879	0.9997	8013	529	623	1.3052	0.0902	1054	945	0.0165	0.0156
29	61	0.0794	595149	0.9996	0.0956	430206	0.9994	7906	547	642	1.3126	0.0976	1078	969	0.0172	0.0162
30	64	0.0824	577876	0.9996	0.0990	418625	0.9993	7761	570	667	1.3209	0.1059	1113	1003	0.0181	0.0171
31	66	0.0861	557005	0.9994	0.1030	406415	0.9994	7527	599	699	1.3312	0.1162	1155	1046	0.0192	0.0182
32	63	0.0895	537542	0.9993	0.1067	389567	0.9992	7318	623	726	1.3411	0.1261	1189	1082	0.0202	0.0192
33	68	0.0938	509376	0.9991	0.1113	372765	0.9990	7041	655	760	1.3558	0.1408	1228	1121	0.0216	0.0206
34	69	0.0976	491137	0.9992	0.1154	357377	0.9987	6900	679	786	1.3656	0.1506	1261	1154	0.0226	0.0217
35	70	0.1015	468674	0.9990	0.1196	341909	0.9991	6632	706	815	1.3780	0.1630	1293	1187	0.0239	0.0230
36	71	0.1053	446809	0.9988	0.1237	325655	0.9991	6389	730	841	1.3905	0.1755	1319	1216	0.0251	0.0242
37	77	0.1092	423449	0.9988	0.1278	311329	0.9991	6207	753	865	1.4043	0.1893	1341	1236	0.0264	0.0255
38	96	0.1136	396773	0.9985	0.1326	291713	0.9995	5986	779	893	1.4207	0.2057	1367	1261	0.0279	0.0270
39	86	0.1167	384012	0.9987	0.1358	279044	0.9993	5829	795	908	1.4288	0.2138	1381	1275	0.0288	0.0279

Specimen FYW-518

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area$_{pl}$ (in-lb)	LL Area$_{pl}$ (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in^2)	J Plastic (in-lb/in^2)	CTOD (in.)	CTOD Plastic (in.)
1	161	0.0028	809326	0.9997	0.0037	606610	1.0000	2285	0	-0	1.2210	0.0020	6	0	0.0001	-0.0000
2	76	0.0049	802043	0.9996	0.0064	596026	1.0000	3884	0	0	1.2238	0.0048	19	0	0.0002	0.0000
3	63	0.0072	807067	0.9998	0.0093	589173	0.9999	5493	2	1	1.2219	0.0029	38	1	0.0004	0.0001
4	67	0.0097	808716	0.9998	0.0125	588610	0.9996	5979	13	14	1.2213	0.0022	65	22	0.0009	0.0005
5	73	0.0122	810425	0.9999	0.0155	588316	0.9995	6308	26	29	1.2206	0.0016	94	47	0.0014	0.0010
6	73	0.0146	808861	0.9999	0.0184	589006	0.9996	6611	39	44	1.2212	0.0022	124	71	0.0019	0.0014
7	70	0.0168	811156	0.9999	0.0211	589932	0.9995	6832	53	61	1.2203	0.0013	153	97	0.0023	0.0018
8	70	0.0189	809264	0.9999	0.0236	590172	0.9994	7042	66	76	1.2210	0.0020	181	122	0.0028	0.0022
9	67	0.0214	808820	0.9999	0.0266	592047	0.9994	7243	82	95	1.2212	0.0022	216	153	0.0033	0.0027
10	67	0.0240	808372	0.9999	0.0298	592300	0.9995	7463	100	116	1.2214	0.0024	254	187	0.0038	0.0033
11	68	0.0265	808138	0.9999	0.0327	584342	0.9995	7648	117	137	1.2215	0.0024	290	219	0.0044	0.0037
12	66	0.0290	808558	0.9999	0.0356	583394	0.9990	7840	134	156	1.2213	0.0023	324	250	0.0049	0.0042
13	67	0.0315	806170	0.9999	0.0387	580812	0.9992	7993	153	178	1.2222	0.0032	363	285	0.0054	0.0048
14	67	0.0339	808322	0.9997	0.0416	586624	0.9994	8176	171	199	1.2214	0.0024	399	319	0.0059	0.0052
15	68	0.0361	804829	0.9999	0.0441	585133	0.9996	8301	188	219	1.2228	0.0037	435	351	0.0064	0.0057
16	63	0.0386	802292	0.9999	0.0471	582047	0.9996	8415	208	242	1.2237	0.0047	474	388	0.0070	0.0062
17	63	0.0411	800143	0.9999	0.0500	581024	0.9996	8528	227	265	1.2246	0.0055	513	424	0.0075	0.0067
18	64	0.0435	795337	0.9999	0.0529	579417	0.9994	8614	248	289	1.2264	0.0074	553	462	0.0080	0.0072
19	63	0.0460	790404	0.9999	0.0557	573031	0.9997	8687	268	313	1.2284	0.0093	592	499	0.0086	0.0078
20	64	0.0482	785279	0.9999	0.0584	570092	0.9997	8750	286	333	1.2304	0.0113	627	531	0.0091	0.0082
21	66	0.0505	777432	0.9999	0.0610	567527	0.9997	8808	305	355	1.2335	0.0144	661	564	0.0096	0.0087
22	65	0.0530	768771	0.9999	0.0638	562663	0.9996	8805	326	380	1.2369	0.0179	701	602	0.0102	0.0093
23	66	0.0551	773062	0.9972	0.0663	566173	0.9973	8810	345	401	1.2352	0.0162	736	638	0.0106	0.0098
24	63	0.0575	751087	0.9999	0.0690	551154	0.9997	8798	367	426	1.2440	0.0250	773	671	0.0113	0.0104
25	66	0.0598	742714	0.9999	0.0716	535885	0.9992	8824	384	445	1.2474	0.0284	803	699	0.0118	0.0109
26	66	0.0622	732583	0.9999	0.0743	526884	0.9995	8826	404	465	1.2516	0.0326	835	729	0.0124	0.0115
27	63	0.0648	723467	0.9999	0.0772	528615	0.9998	8816	426	489	1.2554	0.0363	872	766	0.0130	0.0121
28	66	0.0675	713154	0.9998	0.0802	519495	0.9999	8754	449	517	1.2597	0.0407	916	808	0.0137	0.0127
29	69	0.0704	699567	0.9998	0.0835	509267	0.9999	8728	474	544	1.2655	0.0464	956	847	0.0144	0.0135
30	70	0.0730	688478	0.9998	0.0864	501641	0.9999	8689	495	568	1.2702	0.0512	992	882	0.0151	0.0141
31	67	0.0754	677962	0.9998	0.0891	494190	0.9999	8660	515	589	1.2748	0.0557	1026	913	0.0157	0.0147
32	67	0.0780	665759	0.9997	0.0919	486108	0.9999	8603	536	613	1.2801	0.0611	1061	948	0.0164	0.0154
33	67	0.0804	656684	0.9997	0.0947	479307	0.9999	8597	556	635	1.2842	0.0651	1099	980	0.0170	0.0160
34	69	0.0833	647698	0.9997	0.0979	472559	0.9999	8560	580	661	1.2882	0.0692	1137	1021	0.0177	0.0167
35	69	0.0865	634492	0.9997	0.1015	464094	0.9999	8477	607	691	1.2942	0.0752	1181	1064	0.0186	0.0176
36	66	0.0894	621122	0.9997	0.1046	455394	0.9999	8381	631	717	1.3003	0.0813	1218	1101	0.0194	0.0183
37	71	0.0927	608870	0.9984	0.1083	449355	0.9990	8246	658	748	1.3061	0.0870	1263	1147	0.0203	0.0193
38	75	0.0962	584197	0.9995	0.1120	433411	0.9999	8007	688	781	1.3179	0.0988	1302	1186	0.0214	0.0204
39	67	0.0998	561997	0.9994	0.1159	419289	0.9999	7800	716	810	1.3287	0.1097	1336	1222	0.0225	0.0215
40	69	0.1036	543561	0.9994	0.1200	408046	0.9999	7731	742	839	1.3380	0.1190	1375	1258	0.0236	0.0225
41	78	0.1071	526832	0.9994	0.1236	396096	0.9999	7604	767	866	1.3466	0.1276	1411	1292	0.0246	0.0235
42	75	0.1108	513513	0.9995	0.1276	386266	0.9999	7532	793	893	1.3536	0.1346	1450	1331	0.0256	0.0246
43	75	0.1146	497616	0.9994	0.1316	374364	0.9999	7336	822	923	1.3621	0.1431	1490	1371	0.0268	0.0257
44	77	0.1188	477951	0.9992	0.1360	360742	0.9999	7128	853	956	1.3729	0.1538	1529	1411	0.0282	0.0271
45	81	0.1232	460259	0.9991	0.1407	349585	0.9999	6974	882	987	1.3828	0.1638	1568	1450	0.0295	0.0285
46	82	0.1274	444123	0.9989	0.1451	340543	0.9997	6827	910	1017	1.3921	0.1731	1607	1488	0.0308	0.0298
47	85	0.1314	429945	0.9990	0.1493	331730	0.9998	6694	936	1045	1.4004	0.1814	1644	1525	0.0320	0.0310
48	84	0.1356	414492	0.9989	0.1536	320054	0.9998	6502	963	1074	1.4098	0.1907	1680	1562	0.0334	0.0324
49	86	0.1399	396208	0.9988	0.1580	304682	0.9998	6315	990	1102	1.4211	0.2020	1708	1590	0.0349	0.0338
50	90	0.1433	382988	0.9988	0.1616	295406	0.9998	6209	1009	1120	1.4295	0.2104	1726	1607	0.0360	0.0349

Specimen A1

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in-lb)	LL Area (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	64	0.0040	443956	0.9999	0.0054	317948	0.9966	1937	0	-0	1.1918	0.0005	17	0	0.0000	-0.0001
2	70	0.0081	443655	0.9998	0.0106	320639	0.9967	3543	1	0	1.1921	0.0008	57	2	0.0004	0.0000
3	59	0.0125	443314	0.9998	0.0161	319300	0.9950	4865	8	7	1.1923	0.0010	126	23	0.0010	0.0004
4	57	0.0180	441549	0.9997	0.0229	320035	0.9930	5785	26	28	1.1936	0.0023	234	88	0.0021	0.0012
5	64	0.0219	440502	0.9998	0.0276	316628	0.9892	6104	45	50	1.1943	0.0030	319	157	0.0029	0.0019
6	68	0.0260	440599	0.9999	0.0325	314957	0.9897	6313	68	76	1.1943	0.0030	411	237	0.0038	0.0027
7	73	0.0310	439689	0.9998	0.0387	314895	0.9887	6554	97	110	1.1949	0.0036	529	342	0.0049	0.0037
8	71	0.0351	437952	0.9999	0.0436	312317	0.9851	6667	122	140	1.1962	0.0049	629	435	0.0059	0.0046
9	75	0.0400	439108	0.9998	0.0493	311734	0.9846	6772	153	176	1.1953	0.0040	746	547	0.0069	0.0057
10	72	0.0450	436952	0.9998	0.0554	307829	0.9838	6899	186	215	1.1969	0.0056	874	666	0.0081	0.0068
11	75	0.0500	436694	0.9998	0.0614	304870	0.9824	7011	219	252	1.1971	0.0058	997	783	0.0092	0.0079
12	69	0.0550	435408	0.9998	0.0674	297315	0.9783	7093	253	291	1.1980	0.0067	1124	903	0.0104	0.0090
13	69	0.0600	434377	0.9998	0.0732	301281	0.9800	7146	288	328	1.1988	0.0075	1241	1016	0.0116	0.0101
14	72	0.0651	434113	0.9997	0.0792	300495	0.9794	7209	323	372	1.1990	0.0077	1384	1154	0.0127	0.0112
15	70	0.0700	430371	0.9998	0.0849	297496	0.9766	7247	358	413	1.2017	0.0104	1512	1277	0.0139	0.0124
16	74	0.0749	427498	0.9998	0.0908	293014	0.9750	7280	393	453	1.2038	0.0125	1639	1400	0.0151	0.0135
17	74	0.0800	424259	0.9999	0.0967	290543	0.9731	7317	429	492	1.2062	0.0149	1761	1519	0.0163	0.0147
18	75	0.0849	418620	0.9998	0.1024	283138	0.9720	7297	465	534	1.2104	0.0191	1887	1642	0.0175	0.0159
19	76	0.0900	412349	0.9997	0.1083	276437	0.9683	7281	500	573	1.2152	0.0239	2005	1756	0.0188	0.0172
20	82	0.0952	408115	0.9998	0.1144	274109	0.9689	7275	537	613	1.2184	0.0271	2128	1877	0.0200	0.0184
21	64	0.0996	403314	0.9996	0.1195	273068	0.9692	7245	568	650	1.2221	0.0308	2239	1985	0.0211	0.0195
22	62	0.1057	397002	0.9997	0.1265	268277	0.9670	7214	612	702	1.2270	0.0356	2396	2139	0.0227	0.0211
23	60	0.1114	390523	0.9997	0.1332	263682	0.9661	7227	651	746	1.2320	0.0407	2530	2268	0.0241	0.0225
24	63	0.1169	386574	0.9996	0.1395	264101	0.9648	7204	690	790	1.2352	0.0439	2664	2401	0.0255	0.0238
25	62	0.1231	381464	0.9997	0.1466	256787	0.9623	7197	733	842	1.2392	0.0479	2827	2559	0.0271	0.0254
26	67	0.1291	376229	0.9996	0.1535	254093	0.9626	7160	775	887	1.2435	0.0522	2960	2692	0.0286	0.0269
27	66	0.1350	370274	0.9996	0.1603	247125	0.9612	7084	818	936	1.2483	0.0570	3106	2837	0.0302	0.0285
28	70	0.1400	359793	0.9995	0.1658	244456	0.9645	6905	854	975	1.2570	0.0657	3197	2933	0.0317	0.0301
29	73	0.1453	352667	0.9996	0.1720	241892	0.9668	6832	888	1016	1.2630	0.0717	3314	3050	0.0332	0.0315
30	72	0.1501	346412	0.9996	0.1772	240682	0.9652	6752	920	1053	1.2683	0.0770	3415	3150	0.0345	0.0328
31	73	0.1561	338256	0.9996	0.1840	234639	0.9638	6675	960	1100	1.2754	0.0841	3547	3280	0.0362	0.0345
32	75	0.1621	331447	0.9995	0.1907	229540	0.9596	6600	998	1142	1.2814	0.0901	3665	3398	0.0379	0.0362
33	70	0.1680	323984	0.9995	0.1972	221146	0.9524	6492	1037	1185	1.2881	0.0968	3781	3515	0.0397	0.0380
34	71	0.1742	318000	0.9995	0.2041	212997	0.9475	6417	1076	1225	1.2935	0.1022	3895	3628	0.0414	0.0397
35	70	0.1800	309905	0.9994	0.2103	211808	0.9508	6270	1114	1262	1.3010	0.1097	3984	3720	0.0432	0.0415
36	79	0.1864	295699	0.9992	0.2171	209758	0.9620	6057	1155	1310	1.3144	0.1231	4080	3820	0.0455	0.0438
37	67	0.1925	287197	0.9992	0.2237	196370	0.9477	5882	1189	1352	1.3226	0.1313	4155	3929	0.0473	0.0457
38	69	0.1991	274719	0.9989	0.2307	188156	0.9436	5655	1229	1389	1.3350	0.1437	4238	3989	0.0496	0.0480
39	75	0.2053	262937	0.9986	0.2372	185955	0.9552	5428	1263	1425	1.3471	0.1558	4296	4053	0.0518	0.0503
40	71	0.2112	247736	0.9986	0.2436	174614	0.9599	5236	1294	1463	1.3633	0.1720	4337	4094	0.0541	0.0526
41	69	0.2190	235862	0.9985	0.2517	163231	0.9513	5052	1332	1501	1.3763	0.1850	4400	4158	0.0568	0.0552

Specimen A3

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in-lb)	LL Area (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	79	0.0037	456025	0.9999	0.0059	315718	0.9934	1831	0	0	1.1833	0.0027	14	−0	0.0000	−0.0001
2	65	0.0076	456787	0.9998	0.0110	316149	0.9916	3426	1	0	1.1827	0.0022	50	0	0.0003	0.0000
3	64	0.0124	455325	0.9998	0.0171	322404	0.9925	4936	8	6	1.1838	0.0032	120	18	0.0010	0.0004
4	63	0.0186	454310	0.9999	0.0248	320925	0.9915	5955	30	33	1.1845	0.0039	249	100	0.0023	0.0013
5	65	0.0219	474979	0.9770	0.0288	338374	0.9716	6257	46	51	1.1701	−0.0104	313	158	0.0029	0.0019
6	75	0.0227	453505	0.9998	0.0297	325603	0.9936	6324	54	62	1.1850	0.0045	356	188	0.0033	0.0022
7	64	0.0255	453429	0.9998	0.0330	323168	0.9909	6419	66	77	1.1851	0.0045	405	233	0.0038	0.0026
8	64	0.0291	453894	0.9998	0.0374	320159	0.9903	6577	88	102	1.1848	0.0042	490	309	0.0046	0.0034
9	61	0.0332	452947	0.9998	0.0422	318109	0.9893	6709	113	130	1.1854	0.0049	585	396	0.0055	0.0043
10	67	0.0368	452215	0.9998	0.0466	321672	0.9895	6820	136	156	1.1860	0.0054	672	476	0.0063	0.0051
11	57	0.0413	453334	0.9998	0.0519	317666	0.9868	6939	165	193	1.1852	0.0046	788	588	0.0073	0.0061
12	60	0.0452	451164	0.9998	0.0566	319924	0.9871	7041	191	221	1.1867	0.0061	882	674	0.0083	0.0069
13	58	0.0492	453041	0.9998	0.0612	317505	0.9856	7106	218	254	1.1854	0.0048	989	777	0.0092	0.0078
14	59	0.0535	450765	0.9998	0.0663	319148	0.9862	7174	249	288	1.1870	0.0064	1097	879	0.0102	0.0088
15	58	0.0580	450090	0.9998	0.0716	313923	0.9859	7262	280	326	1.1875	0.0069	1218	996	0.0112	0.0098
16	60	0.0627	448038	0.9998	0.0772	314984	0.9842	7342	313	362	1.1889	0.0084	1335	1106	0.0124	0.0109
17	60	0.0674	448121	0.9998	0.0826	310706	0.9810	7397	346	402	1.1889	0.0083	1459	1228	0.0134	0.0119
18	58	0.0723	445947	0.9998	0.0885	304469	0.9755	7481	382	441	1.1904	0.0098	1584	1347	0.0146	0.0131
19	61	0.0772	443396	0.9998	0.0941	306293	0.9768	7495	415	480	1.1922	0.0117	1704	1463	0.0158	0.0142
20	79	0.0822	438639	0.9997	0.0999	312029	0.9846	7552	454	524	1.1957	0.0151	1838	1591	0.0170	0.0154
21	66	0.0863	438490	0.9998	0.1047	304107	0.9778	7577	484	563	1.1958	0.0152	1962	1713	0.0179	0.0163
22	59	0.0904	435379	0.9998	0.1094	295744	0.9733	7555	515	595	1.1980	0.0175	2058	1808	0.0190	0.0174
23	56	0.0945	433145	0.9997	0.1142	294384	0.9718	7552	546	626	1.1997	0.0191	2154	1902	0.0200	0.0183
24	56	0.0991	428108	0.9998	0.1195	289089	0.9675	7552	580	666	1.2034	0.0228	2273	2018	0.0211	0.0195
25	59	0.1042	422307	0.9997	0.1254	286472	0.9674	7475	619	709	1.2077	0.0271	2398	2143	0.0224	0.0208
26	59	0.1087	415061	0.9997	0.1306	279064	0.9631	7414	652	748	1.2131	0.0325	2505	2250	0.0236	0.0220
27	59	0.1121	408975	0.9997	0.1344	272105	0.9584	7340	676	773	1.2177	0.0372	2571	231[illegible]	0.0245	0.0229
28	58	0.1154	402947	0.9997	0.1382	266616	0.9581	7272	700	798	1.2223	0.0418	2637	2383	0.0254	0.0238
29	62	0.1192	390349	0.9995	0.1424	263895	0.9634	7110	728	829	1.2322	0.0517	2703	2450	0.0266	0.0250
30	74	0.1230	380873	0.9994	0.1466	265118	0.9716	6998	753	860	1.2397	0.0591	2779	2528	0.0277	0.0261
31	63	0.1269	370150	0.9997	0.1510	250672	0.9581	6895	780	895	1.2484	0.0678	2867	2612	0.0289	0.0273
32	69	0.1313	363955	0.9997	0.1560	251149	0.9622	6872	807	919	1.2535	0.0730	2934	2677	0.0301	0.0284
33	77	0.1354	358913	0.9996	0.1606	253779	0.9711	6844	833	953	1.2577	0.0772	3034	2774	0.0312	0.0295
34	66	0.1394	356119	0.9997	0.1652	240712	0.9567	6827	859	986	1.2601	0.0795	3139	2878	0.0322	0.0305
35	62	0.1446	349464	0.9997	0.1711	230475	0.9472	6709	896	1020	1.2657	0.0852	3226	2969	0.0338	0.0321
36	72	0.1496	342336	0.9996	0.1767	228987	0.9498	6566	930	1053	1.2719	0.0913	3309	3056	0.0352	0.0336
37	55	0.1552	334646	0.9996	0.1828	205189	0.9253	6410	967	1096	1.2786	0.0980	3427	3178	0.0369	0.0353
38	67	0.1618	319544	0.9994	0.1901	204376	0.9361	6222	1010	1129	1.2921	0.1115	3478	3228	0.0392	0.0376
39	68	0.1682	307356	0.9994	0.1972	195902	0.9317	6034	1048	1177	1.3033	0.1228	3591	3347	0.0411	0.0396
40	60	0.1741	298276	0.9995	0.2037	180857	0.9182	5876	1082	1213	1.3119	0.1313	3676	3435	0.0430	0.0414
41	67	0.1800	287585	0.9994	0.2102	181082	0.9322	5753	1115	1240	1.3222	0.1417	3724	3481	0.0449	0.0434
42	68	0.1861	278073	0.9995	0.2167	177376	0.9304	5648	1148	1282	1.3317	0.1511	3829	3585	0.0469	0.0453
43	63	0.1919	271733	0.9998	0.2233	165731	0.9168	5572	1179	1318	1.3381	0.1575	3930	3685	0.0486	0.0471

Specimen A4

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in-lb)	LL Area (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	65	0.0039	445008	0.9999	0.0053	310547	0.9963	1940	-3	-3	1.2135	0.0008	2	-16	-0.0008	-0.0009
2	65	0.0082	445560	0.9998	0.0108	312042	0.9950	3639	5	4	1.2131	0.0004	73	9	0.0004	0.0000
3	64	0.0124	446108	0.9998	0.0161	311089	0.9950	4880	11	10	1.2127	0.0001	140	25	0.0011	0.0004
4	66	0.0163	444472	0.9998	0.0209	316466	0.9956	5592	24	23	1.2139	0.0012	217	70	0.0019	0.0009
5	63	0.0204	444559	0.9998	0.0256	310627	0.9953	6016	42	44	1.2138	0.0011	308	137	0.0027	0.0016
6	64	0.0250	443261	0.9998	0.0309	319006	0.9959	6286	66	72	1.2147	0.0021	412	227	0.0038	0.0026
7	66	0.0290	441459	0.9997	0.0356	319328	0.9957	6443	90	100	1.2160	0.0033	511	314	0.0047	0.0034
8	66	0.0340	440979	0.9998	0.0413	315504	0.9951	6588	120	135	1.2163	0.0037	631	426	0.0059	0.0045
9	67	0.0390	439959	0.9997	0.0470	316797	0.9957	6717	152	169	1.2171	0.0044	750	535	0.0070	0.0057
10	65	0.0440	438335	0.9997	0.0525	309907	0.9949	6649	184	206	1.2152	0.0055	876	652	0.0082	0.0068
11	65	0.0489	438070	0.9997	0.0583	306390	0.9947	6946	216	239	1.2184	0.0057	988	758	0.0094	0.0079
12	74	0.0536	435390	0.9996	0.0637	307620	0.9944	6993	250	275	1.2204	0.0077	1104	870	0.0105	0.0090
13	67	0.0580	433300	0.9997	0.0685	302980	0.9945	7102	277	306	1.2218	0.0091	1212	970	0.0115	0.0100
14	64	0.0626	432953	0.9996	0.0736	299067	0.9940	7117	310	340	1.2221	0.0094	1324	1079	0.0126	0.0111
15	64	0.0670	430602	0.9996	0.0785	295626	0.9937	7179	340	372	1.2238	0.0111	1427	1176	0.0137	0.0121
16	67	0.0719	425372	0.9995	0.0839	295114	0.9935	7216	375	409	1.2254	0.0127	1550	1294	0.0149	0.0133
17	69	0.0766	426656	0.9997	0.0893	291541	0.9948	7257	409	446	1.2266	0.0139	1678	1413	0.0161	0.0144
18	75	0.0819	422469	0.9996	0.0949	290008	0.9941	7293	445	485	1.2297	0.0170	1798	1533	0.0173	0.0156
19	72	0.0870	417645	0.9996	0.1006	286023	0.9929	7290	483	526	1.2332	0.0205	1925	1657	0.0186	0.0169
20	81	0.0939	410154	0.9996	0.1062	286703	0.9942	7284	532	580	1.2387	0.0261	2097	1823	0.0204	0.0186
21	80	0.0979	408789	0.9995	0.1126	286169	0.9944	7320	558	612	1.2398	0.0271	2202	1925	0.0213	0.0195
22	84	0.1020	405369	0.9996	0.1172	284713	0.9955	7322	568	645	1.2423	0.0296	2309	2028	0.0224	0.0206
23	76	0.1069	403764	0.9997	0.1225	277907	0.9939	7310	623	664	1.2435	0.0309	2434	2153	0.0236	0.0218
24	62	0.1112	399569	0.9994	0.1272	277915	0.9935	7283	655	715	1.2467	0.0340	2531	2247	0.0247	0.0229
25	60	0.1165	393503	0.9994	0.1331	269923	0.9919	7215	694	760	1.2514	0.0387	2666	2382	0.0262	0.0243
26	62	0.1220	384988	0.9994	0.1391	263968	0.9915	7146	733	800	1.2580	0.0453	2780	2494	0.0277	0.0258
27	64	0.1268	378995	0.9994	0.1444	264906	0.9930	7108	766	835	1.2627	0.0500	2884	2596	0.0289	0.0271
28	65	0.1321	372745	0.9994	0.1502	260827	0.9932	7067	802	879	1.2676	0.0550	3016	2726	0.0304	0.0285
29	65	0.1362	366472	0.9994	0.1546	254115	0.9931	6966	831	910	1.2727	0.0600	3099	2812	0.0315	0.0297
30	63	0.1410	359597	0.9993	0.1598	244791	0.9900	6650	865	944	1.2783	0.0656	3194	2910	0.0329	0.0311
31	65	0.1466	350696	0.9993	0.1659	235987	0.9900	6753	902	981	1.2856	0.0730	3294	3008	0.0346	0.0327
32	65	0.1532	341573	0.9991	0.1729	233063	0.9870	6610	947	1026	1.2931	0.0804	3417	3134	0.0365	0.0347
33	67	0.1595	331226	0.9990	0.1800	237548	0.9919	6499	990	1075	1.3022	0.0895	3551	3266	0.0385	0.0367
34	66	0.1660	321302	0.9988	0.1864	231559	0.9942	6347	1029	1124	1.3109	0.0983	3662	3399	0.0404	0.0386
35	69	0.1720	306820	0.9988	0.1927	223727	0.9944	6167	1067	1164	1.3222	0.1095	3769	3499	0.0424	0.0406
36	65	0.1780	298415	0.9991	0.1991	214373	0.9938	6046	1101	1200	1.3318	0.1191	3852	3572	0.0442	0.0424
37	71	0.1838	287254	0.9989	0.2049	215036	0.9885	5879	1136	1234	1.3423	0.1296	3915	3639	0.0462	0.0444
38	73	0.1904	275317	0.9987	0.2115	209630	0.9895	5701	1173	1270	1.3539	0.1412	4024	3747	0.0484	0.0466
39	67	0.1970	266672	0.9987	0.2156	195777	0.9873	5546	1209	1319	1.3623	0.1496	4126	3852	0.0505	0.0487
40	70	0.2048	253630	0.9956	0.2266	188241	0.9866	5369	1253	1361	1.3757	0.1630	4205	3933	0.0532	0.0515

Specimen C1

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in−lb)	LL Area (in−lb)	Crack Length (in.)	Crack Extension (in.)	J (in−lb/in²)	J Plastic (in−lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	83	0.0046	398993	0.9997	0.0064	273563	0.9898	1965	0	−1	1.2254	−0.0007	20	1	0.0001	−0.0001
2	58	0.0088	398538	0.9998	0.0117	270676	0.9872	3411	2	−1	1.2258	−0.0004	59	1	0.0004	0.0001
3	80	0.0150	397762	0.9998	0.0193	275225	0.9883	4821	13	10	1.2264	0.0002	149	34	0.0014	0.0006
4	82	0.0200	396904	0.9999	0.0251	270756	0.9831	5378	32	31	1.2270	0.0009	246	103	0.0023	0.0014
5	75	0.0241	396540	0.9999	0.0300	269956	0.9819	5627	51	51	1.2273	0.0012	323	167	0.0032	0.0022
6	75	0.0279	394649	0.9999	0.0343	271066	0.9806	5770	70	72	1.2288	0.0027	402	237	0.0040	0.0029
7	77	0.0320	394264	0.9998	0.0390	269486	0.9791	5884	92	98	1.2291	0.0030	492	320	0.0048	0.0037
8	76	0.0363	393038	0.9999	0.0440	267085	0.9792	5982	116	125	1.2301	0.0039	585	407	0.0058	0.0046
9	79	0.0399	391538	0.9998	0.0482	266915	0.9768	6049	137	148	1.2312	0.0051	663	480	0.0066	0.0054
10	93	0.0450	388575	0.9998	0.0540	273607	0.9822	6147	167	181	1.2336	0.0074	778	587	0.0077	0.0065
11	68	0.0500	386150	0.9998	0.0596	267018	0.9785	6187	197	219	1.2355	0.0094	906	710	0.0088	0.0075
12	64	0.0552	384935	0.9998	0.0656	259868	0.9752	6266	227	251	1.2365	0.0103	1013	813	0.0099	0.0086
13	61	0.0600	380456	0.9999	0.0710	255177	0.9732	6292	257	281	1.2400	0.0139	1114	908	0.0110	0.0097
14	64	0.0651	377234	0.9998	0.0769	250089	0.9750	6357	287	314	1.2426	0.0165	1224	1013	0.0121	0.0108
15	64	0.0699	374127	0.9998	0.0823	246968	0.9698	6370	317	345	1.2452	0.0190	1327	1112	0.0132	0.0118
16	64	0.0751	370783	0.9998	0.0882	242908	0.9698	6395	349	381	1.2479	0.0218	1445	1226	0.0144	0.0130
17	63	0.0800	369193	0.9998	0.0937	237568	0.9654	6402	380	413	1.2492	0.0231	1557	1332	0.0155	0.0141
18	65	0.0851	364242	0.9999	0.0995	234476	0.9672	6379	413	447	1.2533	0.0272	1661	1435	0.0167	0.0153
19	62	0.0897	359002	0.9999	0.1047	227808	0.9664	6388	441	479	1.2577	0.0315	1762	1535	0.0178	0.0164
20	67	0.0950	352808	0.9999	0.1106	225626	0.9673	6336	474	513	1.2629	0.0367	1867	1639	0.0191	0.0176
21	66	0.1001	343966	0.9999	0.1163	218723	0.9669	6244	506	550	1.2704	0.0443	1976	1747	0.0204	0.0190
22	66	0.1051	336043	0.9999	0.1218	209539	0.9626	6157	536	582	1.2773	0.0512	2068	1840	0.0217	0.0202
23	68	0.1100	327670	0.9998	0.1272	207697	0.9611	6081	566	610	1.2848	0.0586	2148	1918	0.0230	0.0215
24	66	0.1150	318533	0.9999	0.1329	199026	0.9628	6027	594	644	1.2930	0.0669	2249	2014	0.0243	0.0228
25	69	0.1200	312523	0.9999	0.1383	197747	0.9584	5965	623	672	1.2985	0.0724	2332	2097	0.0256	0.0241
26	70	0.1251	309562	0.9999	0.1440	196513	0.9570	5972	650	704	1.3013	0.0751	2443	2204	0.0268	0.0253
27	71	0.1308	305182	0.9999	0.1505	189657	0.9550	5940	685	743	1.3054	0.0792	2571	2331	0.0283	0.0267
28	68	0.1370	299690	0.9999	0.1574	181588	0.9506	5859	722	781	1.3106	0.0844	2688	2448	0.0299	0.0284
29	71	0.1442	290825	0.9999	0.1652	177911	0.9508	5744	764	822	1.3191	0.0930	2807	2568	0.0319	0.0304
30	73	0.1500	281681	0.9998	0.1716	171958	0.9484	5620	796	859	1.3281	0.1019	2906	2668	0.0336	0.0321
31	76	0.1572	266253	0.9998	0.1794	162625	0.9504	5413	837	902	1.3437	0.1175	3004	2766	0.0359	0.0344
32	76	0.1634	255416	0.9997	0.1860	154530	0.9493	5272	867	933	1.3550	0.1289	3072	2834	0.0378	0.0362
33	79	0.1699	246799	0.9997	0.1929	154029	0.9520	5170	899	964	1.3643	0.1381	3153	2914	0.0397	0.0381
34	72	0.1769	236667	0.9995	0.2003	148441	0.9474	5006	935	1007	1.3754	0.1493	3267	3031	0.0419	0.0404
35	75	0.1838	228455	0.9997	0.2077	139839	0.9460	4914	967	1041	1.3847	0.1586	3357	3120	0.0439	0.0424
36	73	0.1901	222585	0.9997	0.2144	133750	0.9420	4817	996	1067	1.3915	0.1653	3429	3192	0.0457	0.0442
37	66	0.1971	215049	0.9996	0.2217	133454	0.9400	4695	1030	1099	1.4004	0.1742	3512	3276	0.0479	0.0464
38	67	0.2042	207249	0.9995	0.2291	129604	0.9367	4568	1063	1138	1.4097	0.1836	3621	3387	0.0502	0.0487
39	72	0.2110	199028	0.9993	0.2361	123310	0.9420	4386	1094	1172	1.4199	0.1938	3697	3470	0.0525	0.0510
40	70	0.2180	187546	0.9992	0.2433	114059	0.9333	4199	1124	1201	1.4346	0.2084	3731	3508	0.0550	0.0536

Specimen C3

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp (in.)	Loadline Slope (lb/in)	Loadline Corr	Load (lb.)	COD Area (in-lb)	LL Area (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	91	0.0041	397991	0.9994	0.0057	289042	0.9935	1528	−0	−0	1.2262	0.0010	18	0	−0.0000	−0.0001
2	71	0.0091	399375	0.9999	0.0123	289011	0.9933	3582	2	1	1.2251	−0.0001	68	5	0.0004	0.0000
3	73	0.0140	399015	0.9999	0.0193	289631	0.9940	4732	11	10	1.2254	0.0002	144	34	0.0012	0.0005
4	74	0.0213	396073	0.9999	0.0272	289548	0.9935	5566	38	42	1.2277	0.0025	290	137	0.0026	0.0016
5	65	0.0252	396405	0.9998	0.0319	285912	0.9903	5768	57	65	1.2274	0.0022	375	210	0.0034	0.0023
6	67	0.0292	395493	0.9998	0.0367	285411	0.9903	5894	79	89	1.2281	0.0029	461	289	0.0042	0.0031
7	65	0.0332	395916	0.9999	0.0414	281487	0.9893	6011	101	115	1.2278	0.0026	551	372	0.0051	0.0039
8	65	0.0372	393630	0.9997	0.0461	281967	0.9891	6095	124	140	1.2294	0.0042	638	453	0.0059	0.0048
9	66	0.0411	393022	0.9998	0.0509	279741	0.9884	6208	146	167	1.2301	0.0048	733	541	0.0068	0.0055
10	68	0.0450	391366	0.9997	0.0555	280789	0.9876	6265	170	194	1.2314	0.0062	824	628	0.0076	0.0064
11	64	0.0492	391560	0.9998	0.0604	278753	0.9888	6343	194	224	1.2312	0.0060	927	725	0.0085	0.0072
12	68	0.0533	389551	0.9997	0.0653	277809	0.9893	6416	219	252	1.2328	0.0076	1022	816	0.0094	0.0081
13	65	0.0575	389675	0.9996	0.0702	273606	0.9843	6450	246	283	1.2327	0.0075	1125	916	0.0103	0.0090
14	69	0.0616	387805	0.9996	0.0751	273719	0.9854	6508	272	312	1.2342	0.0090	1221	1007	0.0112	0.0099
15	67	0.0615	388414	0.9997	0.0748	275282	0.9830	6410	272	313	1.2337	0.0085	1227	1012	0.0113	0.0099
16	63	0.0658	386532	0.9997	0.0800	269583	0.9812	6559	298	343	1.2352	0.0100	1326	1108	0.0121	0.0108
17	69	0.0697	387734	0.9982	0.0845	270710	0.9817	6559	324	370	1.2342	0.0090	1416	1198	0.0130	0.0116
18	64	0.0740	380022	0.9997	0.0894	263247	0.9797	6584	352	403	1.2404	0.0152	1521	1296	0.0141	0.0126
19	67	0.0780	375282	0.9997	0.0941	261558	0.9779	6579	376	430	1.2442	0.0190	1605	1377	0.0150	0.0135
20	65	0.0821	372494	0.9997	0.0988	253967	0.9713	6575	402	460	1.2465	0.0213	1702	1473	0.0159	0.0144
21	64	0.0861	369497	0.9997	0.1034	251414	0.9701	6569	428	486	1.2489	0.0237	1785	1554	0.0168	0.0153
22	66	0.0911	362463	0.9998	0.1091	247140	0.9707	6506	461	524	1.2548	0.0295	1900	1668	0.0180	0.0166
23	66	0.0952	358934	0.9997	0.1139	242515	0.9705	6480	486	552	1.2577	0.0325	1990	1757	0.0190	0.0175
24	63	0.0993	351859	0.9996	0.1184	243649	0.9721	6368	514	582	1.2637	0.0385	2074	1842	0.0201	0.0186
25	64	0.1036	343868	0.9996	0.1233	237008	0.9724	6310	540	615	1.2705	0.0453	2171	1938	0.0212	0.0197
26	68	0.1076	336463	0.9988	0.1279	233143	0.9712	6261	564	641	1.2752	0.0500	2247	2013	0.0221	0.0206
27	62	0.1116	333476	0.9996	0.1324	221785	0.9600	6235	588	667	1.2796	0.0544	2330	2092	0.0232	0.0216
28	70	0.1157	328617	0.9996	0.1370	221087	0.9634	6229	611	688	1.2839	0.0587	2392	2151	0.0242	0.0226
29	60	0.1200	325260	0.9997	0.1419	210598	0.9501	6194	637	715	1.2869	0.0617	2490	2249	0.0252	0.0237
30	62	0.1240	319364	0.9996	0.1463	208619	0.9525	6108	663	740	1.2923	0.0670	2547	2308	0.0263	0.0248
31	62	0.1280	313601	0.9996	0.1507	212471	0.9591	6067	686	767	1.2975	0.0723	2626	2384	0.0274	0.0258
32	61	0.1323	308613	0.9995	0.1555	209845	0.9598	5985	712	801	1.3022	0.0769	2733	2492	0.0285	0.0270
33	66	0.1366	302517	0.9996	0.1603	207313	0.9621	5950	736	829	1.3079	0.0827	2813	2571	0.0296	0.0281
34	75	0.1427	295365	0.9995	0.1671	208587	0.9705	5861	772	870	1.3147	0.0895	2936	2694	0.0313	0.0298
35	70	0.1488	289794	0.9996	0.1738	200243	0.9616	5792	807	913	1.3201	0.0949	3073	2828	0.0329	0.0314
36	61	0.1548	282697	0.9996	0.1804	186800	0.9429	5716	841	946	1.3271	0.1018	3166	2922	0.0346	0.0330
37	62	0.1610	276300	0.9996	0.1871	184750	0.9465	5604	876	977	1.3334	0.1082	3248	3006	0.0363	0.0348
38	60	0.1670	266189	0.9996	0.1937	180019	0.9455	5443	910	1016	1.3437	0.1185	3347	3108	0.0382	0.0367
39	69	0.1730	255689	0.9993	0.1999	174877	0.9499	5275	941	1051	1.3547	0.1295	3424	3187	0.0401	0.0386
40	65	0.1788	247203	0.9995	0.2062	166528	0.9465	5156	970	1083	1.3638	0.1386	3499	3264	0.0418	0.0403
41	64	0.1845	239071	0.9995	0.2122	158937	0.9419	5034	999	1110	1.3728	0.1475	3559	3324	0.0436	0.0421
42	68	0.1902	233571	0.9995	0.2153	156733	0.9417	4970	1025	1135	1.3789	0.1537	3629	3393	0.0452	0.0437
43	70	0.1954	228475	0.9994	0.2237	151370	0.9372	4886	1050	1163	1.3847	0.1595	3706	3471	0.0467	0.0452

Specimen FYO-2

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD $Area_{pl}$ (in−lb)	LL $Area_{pl}$ (in−lb)	Crack Length (in.)	Crack Extension (in.)	J (in−lb/in²)	J Plastic (in−lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	71	0.0058	322207	0.9999	0.0078	234585	0.9982	1977	0	−0	1.2897	0.0022	26	1	0.0001	−0.0001
2	61	0.0131	322621	0.9998	0.0170	237751	0.9978	4162	2	−1	1.2893	0.0018	112	0	0.0005	0.0001
3	96	0.0179	323604	0.9999	0.0230	236059	0.9978	5453	6	3	1.2884	0.0009	204	13	0.0010	0.0002
4	126	0.0231	323205	0.9999	0.0294	233785	0.9969	6592	16	11	1.2888	0.0013	320	42	0.0017	0.0005
5	97	0.0327	321423	0.9999	0.0411	232608	0.9957	7985	56	53	1.2904	0.0029	596	187	0.0033	0.0016
6	94	0.0362	321705	0.9999	0.0453	230875	0.9956	8297	75	74	1.2901	0.0026	703	263	0.0039	0.0020
7	99	0.0399	317404	0.9998	0.0496	228149	0.9957	8423	102	103	1.2940	0.0066	825	364	0.0046	0.0027
8	96	0.0434	311023	0.9998	0.0536	222043	0.9955	8469	128	132	1.2999	0.0124	941	463	0.0053	0.0033
9	96	0.0455	307755	0.9998	0.0560	218837	0.9952	8474	142	144	1.3030	0.0155	986	502	0.0057	0.0036
10	94	0.0487	298200	0.9997	0.0594	212215	0.9953	8314	170	173	1.3120	0.0245	1086	602	0.0064	0.0044
11	96	0.0509	287585	0.9997	0.0617	205769	0.9954	8166	185	188	1.3222	0.0348	1137	548	0.0069	0.0048
12	111	0.0520	282814	0.9997	0.0629	204890	0.9952	8121	187	190	1.3269	0.0394	1144	650	0.0070	0.0049
13	95	0.0533	278439	0.9997	0.0642	197677	0.9945	8051	196	203	1.3313	0.0438	1187	692	0.0072	0.0051
14	116	0.0549	273447	0.9997	0.0661	198887	0.9951	8016	206	207	1.3363	0.0488	1204	704	0.0076	0.0054
15	104	0.0570	270088	0.9998	0.0684	194320	0.9951	7978	220	230	1.3397	0.0522	1288	784	0.0080	0.0058
16	95	0.0594	261844	0.9997	0.0709	186105	0.9950	7794	241	249	1.3483	0.0608	1346	847	0.0086	0.0065
17	94	0.0622	250650	0.9997	0.0737	178803	0.9940	7502	265	270	1.3601	0.0726	1403	912	0.0093	0.0072
18	97	0.0648	242433	0.9996	0.0764	173491	0.9931	7337	279	284	1.3690	0.0815	1443	953	0.0098	0.0077
19	92	0.0673	232276	0.9997	0.0789	165123	0.9923	7089	298	303	1.3804	0.0929	1495	1013	0.0104	0.0084
20	93	0.0700	221372	0.9997	0.0816	157465	0.9914	6831	316	319	1.3929	0.1054	1529	1055	0.0111	0.0091
21	92	0.0731	210620	0.9996	0.0847	150719	0.9902	6566	334	337	1.4057	0.1182	1574	1106	0.0118	0.0098
22	93	0.0763	200309	0.9996	0.0879	144398	0.9891	6281	354	358	1.4183	0.1308	1631	1171	0.0126	0.0107
23	94	0.0796	191199	0.9997	0.0912	137650	0.9906	6073	371	376	1.4298	0.1423	1680	1225	0.0134	0.0115
24	94	0.0828	182649	0.9996	0.0945	131350	0.9888	5849	389	393	1.4410	0.1535	1724	1275	0.0142	0.0123
25	94	0.0858	175677	0.9996	0.0976	126453	0.9872	5689	403	406	1.4503	0.1628	1758	1312	0.0149	0.0130
26	96	0.0889	169753	0.9994	0.1008	123980	0.9868	5506	420	423	1.4585	0.1710	1805	1367	0.0157	0.0138
27	93	0.0922	162888	0.9996	0.1042	117845	0.9877	5338	437	444	1.4681	0.1806	1875	1441	0.0166	0.0147
28	96	0.0956	155745	0.9995	0.1075	113720	0.9879	5134	454	459	1.4784	0.1910	1908	1482	0.0175	0.0157
29	110	0.0986	147543	0.9994	0.1105	110217	0.9888	4933	468	475	1.4907	0.2032	1945	1523	0.0184	0.0166
30	97	0.1024	141515	0.9996	0.1144	104066	0.9851	4748	484	495	1.4999	0.2124	2006	1594	0.0193	0.0176
31	96	0.1049	137227	0.9995	0.1169	100402	0.9849	4633	494	500	1.5067	0.2192	2008	1598	0.0199	0.0182
32	102	0.1082	133381	0.9995	0.1204	98383	0.9856	4555	507	512	1.5128	0.2253	2048	1637	0.0207	0.0190

Specimen FYO-6

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD $Area_{pl}$ (in-lb)	LL $Area_{pl}$ (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	79	0.0043	325936	0.9999	0.0063	214401	0.9835	1512	0	−0	1.2863	0.0031	16	1	0.0000	−0.0001
2	74	0.0106	329760	0.9999	0.0145	214380	0.9813	3467	1	−3	1.2829	−0.0003	70	−6	0.0003	0.0000
3	69	0.0156	327851	0.9999	0.0210	216149	0.9801	4896	4	−3	1.2846	0.0014	144	−8	0.0008	0.0002
4	71	0.0202	328100	0.9999	0.0269	218403	0.9787	6029	10	1	1.2844	0.0012	237	7	0.0013	0.0004
5	68	0.0248	328003	0.9998	0.0327	215935	0.9750	6923	22	14	1.2845	0.0013	353	51	0.0020	0.0007
6	60	0.0305	327596	0.9998	0.0399	208824	0.9678	7754	46	36	1.2848	0.0017	507	129	0.0030	0.0014
7	59	0.0344	326518	0.9998	0.0447	201937	0.9643	8155	67	50	1.2858	0.0026	597	179	0.0036	0.0019
8	75	0.0379	323247	0.9998	0.0492	203298	0.9735	8399	89	66	1.2887	0.0056	681	233	0.0043	0.0024
9	76	0.0403	321220	0.9981	0.0519	206774	0.9721	8406	107	91	1.2906	0.0074	773	321	0.0047	0.0028
10	80	0.0427	319081	0.9961	0.0549	203246	0.9711	8464	124	120	1.2925	0.0093	883	421	0.0052	0.0033
11	84	0.0454	310254	0.9998	0.0581	196971	0.9741	8503	144	140	1.3006	0.0175	967	485	0.0058	0.0038
12	79	0.0474	303200	0.9998	0.0604	188582	0.9762	8388	158	153	1.3072	0.0241	1010	527	0.0062	0.0041
13	82	0.0493	293971	0.9997	0.0626	186009	0.9768	8241	173	161	1.3160	0.0329	1034	551	0.0066	0.0045
14	84	0.0506	288845	0.9997	0.0640	183273	0.9787	8170	178	170	1.3210	0.0378	1068	581	0.0067	0.0047
15	85	0.0524	283199	0.9997	0.0659	181150	0.9756	8120	190	184	1.3266	0.0434	1118	626	0.0071	0.0050
16	84	0.0553	277028	0.9997	0.0693	175055	0.9754	8063	211	210	1.3327	0.0495	1215	717	0.0077	0.0056
17	77	0.0574	271849	0.9997	0.0717	167819	0.9721	7966	226	221	1.3379	0.0548	1256	754	0.0082	0.0061
18	82	0.0599	264736	0.9997	0.0744	165005	0.9698	7844	245	233	1.3452	0.0621	1289	789	0.0087	0.0066
19	84	0.0621	257314	0.9997	0.0769	159726	0.9710	7700	260	253	1.3530	0.0698	1355	856	0.0092	0.0071
20	81	0.0645	252661	0.9997	0.0796	155195	0.9679	7610	275	266	1.3580	0.0748	1398	899	0.0096	0.0075
21	86	0.0679	240836	0.9997	0.0833	150349	0.9670	7360	304	295	1.3708	0.0876	1490	995	0.0106	0.0085
22	83	0.0710	225012	0.9996	0.0861	146689	0.9615	6901	330	327	1.3887	0.1055	1568	1092	0.0115	0.0095
23	93	0.0749	212423	0.9996	0.0901	144615	0.9642	6630	350	358	1.4035	0.1203	1667	1193	0.0124	0.0104
24	80	0.0786	204016	0.9996	0.0941	131619	0.9567	6411	370	391	1.4137	0.1305	1776	1308	0.0132	0.0112
25	82	0.0816	193286	0.9995	0.0971	127618	0.9558	6099	391	396	1.4272	0.1440	1756	1302	0.0140	0.0121
26	80	0.0851	184112	0.9995	0.1008	119476	0.9545	5878	408	420	1.4391	0.1559	1826	1378	0.0149	0.0130
27	83	0.0881	176965	0.9995	0.1039	116256	0.9518	5705	422	428	1.4486	0.1654	1834	1389	0.0156	0.0137
28	83	0.0908	170458	0.9995	0.1069	107938	0.9519	5531	435	446	1.4575	0.1743	1883	1446	0.0162	0.0144
29	98	0.0940	162198	0.9994	0.1100	110958	0.9595	5316	453	453	1.4691	0.1859	1882	1450	0.0172	0.0154
30	86	0.0976	156746	0.9994	0.1138	103011	0.9479	5141	470	489	1.4770	0.1938	2019	1596	0.0181	0.0163
31	93	0.1015	154147	0.9802	0.1179	102895	0.9346	4952	490	501	1.4808	0.1976	2043	1641	0.0190	0.0173
32	87	0.1055	143011	0.9994	0.1221	92037	0.9390	4774	512	529	1.4976	0.2144	2136	1724	0.0205	0.0188
33	85	0.1091	136639	0.9994	0.1257	88899	0.9405	4577	525	530	1.5076	0.2244	2095	1693	0.0213	0.0196
34	101	0.1126	128030	0.9992	0.1291	90345	0.9588	4320	542	550	1.5216	0.2384	2134	1745	0.0225	0.0208

Specimen FYO-8

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area$_{pl}$ (in-lb)	LL Area$_{pl}$ (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in^2)	J Plastic (in-lb/in^2)	CTOD (in.)	CTOD Plastic (in.)
1	88	0.0060	322441	0.9999	0.0081	232125	0.9951	2018	0	-0	1.2895	0.0015	27	1	0.0001	-0.0001
2	88	0.0137	322993	0.9999	0.0180	236455	0.9956	4321	2	-0	1.2890	0.0010	122	1	0.0006	0.0001
3	103	0.0194	322783	0.9999	0.0252	238789	0.9965	5804	8	6	1.2892	0.0012	239	23	0.0012	0.0003
4	113	0.0252	321934	0.9999	0.0323	238736	0.9965	6940	22	22	1.2899	0.0020	390	81	0.0020	0.0007
5	89	0.0301	321732	0.9999	0.0383	234605	0.9934	7655	42	45	1.2901	0.0022	535	159	0.0028	0.0012
6	81	0.0324	321833	0.9999	0.0411	232839	0.9916	7930	53	53	1.2900	0.0021	593	190	0.0032	0.0015
7	82	0.0355	322134	0.9999	0.0448	233431	0.9917	8220	71	71	1.2897	0.0018	684	252	0.0038	0.0019
8	87	0.0378	321219	0.9999	0.0476	232972	0.9923	8401	85	89	1.2906	0.0026	766	314	0.0042	0.0023
9	80	0.0411	320488	0.9999	0.0517	230304	0.9909	8592	108	115	1.2912	0.0033	881	408	0.0048	0.0028
10	83	0.0433	318381	0.9999	0.0542	229055	0.9895	8648	125	131	1.2932	0.0052	945	463	0.0052	0.0032
11	83	0.0455	313694	0.9998	0.0567	226340	0.9887	8607	144	153	1.2975	0.0095	1024	537	0.0057	0.0037
12	89	0.0478	308654	0.9998	0.0592	225047	0.9904	8569	161	172	1.3021	0.0142	1095	602	0.0061	0.0041
13	88	0.0496	301764	0.9998	0.0612	220131	0.9901	8463	175	192	1.3086	0.0206	1160	665	0.0065	0.0045
14	80	0.0511	295184	0.9997	0.0629	214292	0.9883	8335	186	203	1.3149	0.0269	1193	700	0.0068	0.0047
15	90	0.0526	287962	0.9997	0.0645	211115	0.9896	8245	196	212	1.3219	0.0339	1224	725	0.0071	0.0050
16	94	0.0545	280251	0.9997	0.0665	208133	0.9897	8114	210	229	1.3295	0.0415	1279	781	0.0075	0.0054
17	82	0.0565	273251	0.9997	0.0686	201262	0.9873	7964	224	247	1.3365	0.0486	1335	839	0.0079	0.0058
18	82	0.0585	266459	0.9997	0.0708	196917	0.9883	7863	237	258	1.3435	0.0555	1371	872	0.0084	0.0063
19	94	0.0607	255527	0.9996	0.0729	193945	0.9911	7606	256	278	1.3549	0.0670	1424	932	0.0089	0.0069
20	81	0.0627	249920	0.9997	0.0752	188556	0.9884	7494	265	295	1.3609	0.0729	1482	990	0.0093	0.0072
21	91	0.0661	238739	0.9997	0.0788	182372	0.9896	7263	293	323	1.3731	0.0852	1569	1080	0.0102	0.0081
22	82	0.0702	225432	0.9996	0.0830	171864	0.9869	6924	322	357	1.3882	0.1002	1668	1189	0.0112	0.0092
23	84	0.0737	213499	0.9995	0.0867	164148	0.9882	6624	343	378	1.4022	0.1143	1716	1246	0.0120	0.0100
24	108	0.0765	200122	0.9995	0.0896	158050	0.9927	6313	360	397	1.4185	0.1306	1756	1292	0.0128	0.0108
25	91	0.0795	192123	0.9996	0.0928	150431	0.9892	6125	372	415	1.4287	0.1407	1804	1345	0.0133	0.0114
26	84	0.0821	184243	0.9996	0.0954	144025	0.9869	5903	387	427	1.4389	0.1509	1824	1375	0.0140	0.0121
27	80	0.0849	174835	0.9995	0.0983	136642	0.9831	5645	403	444	1.4515	0.1635	1857	1417	0.0148	0.0129
28	110	0.0880	165144	0.9995	0.1013	133375	0.9911	5404	419	459	1.4649	0.1770	1888	1453	0.0156	0.0138
29	82	0.0911	155811	0.9995	0.1046	123535	0.9846	5094	436	484	1.4783	0.1904	1947	1528	0.0166	0.0148
30	84	0.0947	146801	0.9995	0.1083	117010	0.9863	4856	452	496	1.4918	0.2039	1951	1546	0.0175	0.0158
31	86	0.0982	138200	0.9995	0.1117	111578	0.9877	4590	468	513	1.5051	0.2172	1987	1589	0.0185	0.0169
32	83	0.1013	130599	0.9994	0.1149	105131	0.9859	4378	480	527	1.5174	0.2294	2007	1618	0.0194	0.0177
33	127	0.1049	119756	0.9993	0.1185	99677	0.9929	4096	496	543	1.5356	0.2476	2018	1637	0.0206	0.0190

Specimen FYO-J3

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area$_{pl}$ (in-lb)	LL Area$_{pl}$ (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in^2)	J Plastic (in-lb/in^2)	CTOD (in.)	CTOD Plastic (in.)
1	38	0.0034	381288	0.9994	0.0041	283937	0.9960	1380	0	-0	1.2394	-0.0035	11	1	0.0000	-0.0000
2	60	0.0063	380264	0.9994	0.0078	284039	0.9971	2437	0	-0	1.2402	-0.0026	33	0	0.0001	-0.0000
3	60	0.0094	379712	0.9985	0.0117	289199	0.9969	3563	1	-0	1.2406	-0.0022	68	-0	0.0003	0.0000
4	39	0.0133	376562	0.9957	0.0166	283751	0.9890	4899	3	1	1.2432	0.0003	135	5	0.0007	0.0001
5	52	0.0168	375206	0.9977	0.0210	287766	0.9931	6007	5	2	1.2443	0.0014	202	7	0.0010	0.0002
6	49	0.0211	376065	0.9971	0.0263	288428	0.9933	7180	13	11	1.2436	0.0007	316	39	0.0016	0.0004
7	43	0.0273	372672	0.9969	0.0338	285287	0.9906	8425	36	37	1.2464	0.0035	504	123	0.0027	0.0011
8	46	0.0328	365676	0.9974	0.0403	282954	0.9899	9074	68	72	1.2521	0.0093	692	238	0.0038	0.0019
9	37	0.0366	359212	0.9952	0.0446	273219	0.9886	9273	93	102	1.2575	0.0146	821	338	0.0045	0.0025
10	36	0.0404	342034	0.9957	0.0489	264952	0.9872	9318	124	131	1.2721	0.0293	944	427	0.0054	0.0032
11	30	0.0435	333408	0.9946	0.0523	250619	0.9798	9225	143	156	1.2797	0.0368	1029	508	0.0059	0.0037
12	41	0.0469	320943	0.9969	0.0561	249817	0.9896	9146	170	175	1.2908	0.0480	1103	568	0.0067	0.0044
13	51	0.0500	310431	0.9980	0.0593	243624	0.9940	9000	192	209	1.3005	0.0576	1219	679	0.0073	0.0050
14	47	0.0545	296668	0.9976	0.0642	234055	0.9908	8760	232	253	1.3134	0.0706	1366	824	0.0084	0.0061
15	40	0.0574	279780	0.9964	0.0670	220813	0.9875	8315	258	281	1.3300	0.0871	1432	906	0.0092	0.0070
16	49	0.0602	266139	0.9979	0.0698	214757	0.9931	8040	275	297	1.3438	0.1010	1470	945	0.0098	0.0076
17	54	0.0641	249883	0.9978	0.0738	204009	0.9942	7708	303	332	1.3609	0.1181	1572	1053	0.0108	0.0086
18	52	0.0671	230295	0.9967	0.0769	187271	0.9889	7311	323	354	1.3826	0.1398	1607	1103	0.0116	0.0095
19	52	0.0719	216986	0.9975	0.0815	180933	0.9932	6856	354	383	1.3981	0.1552	1686	1193	0.0128	0.0107
20	46	0.0761	200440	0.9972	0.0857	168924	0.9919	6446	383	418	1.4181	0.1753	1780	1294	0.0141	0.0121
21	62	0.0789	192308	0.9981	0.0886	163293	0.9958	6291	390	426	1.4284	0.1856	1792	1307	0.0145	0.0125
22	68	0.0825	182044	0.9982	0.0922	156130	0.9970	5999	412	451	1.4418	0.1989	1856	1384	0.0156	0.0136
23	74	0.0853	174788	0.9985	0.0951	150355	0.9970	5794	426	466	1.4515	0.2087	1883	1426	0.0163	0.0144
24	71	0.0883	166497	0.9983	0.0978	144765	0.9970	5537	443	483	1.4630	0.2202	1929	1473	0.0173	0.0153
25	62	0.0923	156960	0.9979	0.1019	136441	0.9966	5233	466	509	1.4767	0.2338	1994	1555	0.0185	0.0167
26	56	0.0954	147395	0.9979	0.1049	127218	0.9953	4920	482	524	1.4909	0.2480	2004	1584	0.0196	0.0178
27	55	0.1001	137107	0.9975	0.1095	119331	0.9954	4652	504	544	1.5069	0.2640	2048	1632	0.0210	0.0193
28	61	0.1042	129840	0.9981	0.1137	115013	0.9968	4489	517	558	1.5186	0.2758	2079	1666	0.0221	0.0203
29	63	0.1074	124312	0.9982	0.1169	109493	0.9969	4334	528	572	1.5278	0.2850	2111	1703	0.0229	0.0212
30	71	0.1107	118715	0.9983	0.1200	106253	0.9972	4175	542	584	1.5374	0.2945	2135	1731	0.0240	0.0223
31	74	0.1142	113382	0.9984	0.1235	102119	0.9973	4011	555	600	1.5468	0.3039	2178	1780	0.0251	0.0234
32	75	0.1171	108441	0.9984	0.1263	97835	0.9978	3843	566	611	1.5557	0.3129	2197	1808	0.0260	0.0244
33	55	0.1209	106500	0.9984	0.1303	94917	0.9958	3770	578	623	1.5593	0.3164	2243	1860	0.0269	0.0253
34	58	0.1253	100667	0.9983	0.1344	91072	0.9955	3580	598	641	1.5703	0.3275	2288	1916	0.0287	0.0271
35	63	0.1305	94895	0.9985	0.1396	85739	0.9958	3403	615	661	1.5816	0.3387	2342	1977	0.0304	0.0288
36	55	0.1357	91392	0.9984	0.1446	81713	0.9945	3259	631	676	1.5886	0.3458	2387	2033	0.0319	0.0304
37	66	0.1399	85089	0.9982	0.1488	78645	0.9969	3083	646	689	1.6017	0.3589	2396	2050	0.0336	0.0322
38	74	0.1458	79565	0.9985	0.1546	73479	0.9976	2935	662	708	1.6137	0.3708	2449	2105	0.0354	0.0340
39	66	0.1515	75202	0.9985	0.1602	69393	0.9964	2789	676	723	1.6235	0.3806	2477	2142	0.0372	0.0358
40	72	0.1571	70509	0.9988	0.1658	65242	0.9968	2655	691	737	1.6344	0.3916	2504	2174	0.0391	0.0377
41	74	0.1623	66800	0.9989	0.1708	62731	0.9980	2556	702	748	1.6433	0.4005	2522	2191	0.0407	0.0393
42	83	0.1684	62712	0.9989	0.1766	59150	0.9986	2423	717	764	1.6535	0.4107	2563	2240	0.0428	0.0415
43	89	0.1743	59708	0.9990	0.1824	56492	0.9984	2323	730	776	1.6613	0.4184	2595	2277	0.0447	0.0433
44	64	0.1798	57331	0.9992	0.1877	54015	0.9967	2193	743	789	1.6676	0.4247	2633	2330	0.0466	0.0453
45	62	0.1872	52288	0.9989	0.1947	49612	0.9975	2030	761	807	1.6814	0.4386	2655	2361	0.0498	0.0485
46	63	0.1938	48114	0.9989	0.2012	45717	0.9972	1875	773	818	1.6935	0.4506	2641	2361	0.0520	0.0509
47	70	0.2047	42763	0.9987	0.2117	41128	0.9978	1690	794	839	1.7099	0.4670	2663	2393	0.0564	0.0552
48	74	0.2108	40400	0.9989	0.2175	38903	0.9977	1612	799	845	1.7175	0.4746	2645	2379	0.0578	0.0566
49	80	0.2157	38741	0.9991	0.2221	37295	0.9980	1555	806	851	1.7229	0.4801	2651	2387	0.0593	0.0582
50	82	0.2217	36856	0.9990	0.2278	35774	0.9983	1485	816	860	1.7293	0.4865	2668	2411	0.0615	0.0605
51	80	0.2281	34950	0.9992	0.2341	33923	0.9979	1415	825	869	1.7360	0.4931	2689	2438	0.0638	0.0628

Specimen FYO−J4

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD $Area_{pl}$ (in−lb)	LL $Area_{pl}$ (in−lb)	Crack Length (in.)	Crack Extension (in.)	J (in−lb/in²)	J Plastic (in−lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	50	0.0038	389770	0.9996	0.0060	297008	0.9981	1652	0	0	1.2326	−0.0021	14	−0	−0.0000	−0.0001
2	59	0.0074	389668	0.9992	0.0105	295299	0.9975	3009	0	0	1.2327	−0.0020	48	−0	0.0001	−0.0001
3	45	0.0105	385685	0.9987	0.0145	297500	0.9954	4145	1	−0	1.2359	0.0011	89	−1	0.0004	−0.0000
4	46	0.0133	385983	0.9986	0.0180	296684	0.9955	5102	2	2	1.2356	0.0009	140	5	0.0006	0.0000
5	52	0.0170	386995	0.9991	0.0226	299105	0.9966	6293	6	4	1.2348	0.0001	218	14	0.0010	0.0002
6	45	0.0224	384435	0.9990	0.0293	297142	0.9941	7724	19	19	1.2369	0.0021	372	62	0.0019	0.0005
7	32	0.0280	383408	0.9983	0.0360	290124	0.9857	8742	42	45	1.2377	0.0029	543	147	0.0028	0.0012
8	31	0.0329	374197	0.9987	0.0417	281022	0.9866	9261	74	74	1.2451	0.0104	698	241	0.0039	0.0019
9	31	0.0361	364663	0.9983	0.0453	279593	0.9866	9371	95	95	1.2529	0.0182	792	308	0.0045	0.0025
10	47	0.0392	353699	0.9990	0.0489	274601	0.9960	9457	116	124	1.2621	0.0274	910	402	0.0051	0.0030
11	54	0.0416	342698	0.9993	0.0515	267169	0.9961	9328	134	147	1.2715	0.0368	987	474	0.0056	0.0034
12	52	0.0442	334217	0.9990	0.0543	260094	0.9955	9250	154	168	1.2790	0.0442	1062	540	0.0061	0.0039
13	57	0.0467	323322	0.9992	0.0570	257405	0.9956	9119	174	189	1.2887	0.0539	1134	606	0.0067	0.0045
14	56	0.0494	313501	0.9993	0.0600	245993	0.9953	8973	194	218	1.2976	0.0629	1232	701	0.0073	0.0051
15	60	0.0525	301121	0.9991	0.0632	237930	0.9960	8755	220	240	1.3092	0.0745	1301	767	0.0081	0.0058
16	56	0.0556	291601	0.9991	0.0667	235565	0.9952	8615	241	265	1.3183	0.0836	1382	846	0.0087	0.0064
17	53	0.0585	282217	0.9991	0.0698	228805	0.9937	8446	263	295	1.3275	0.0928	1479	945	0.0094	0.0071
18	50	0.0618	267988	0.9991	0.0730	216505	0.9908	8070	293	326	1.3419	0.1072	1563	1042	0.0103	0.0081
19	50	0.0647	256049	0.9992	0.0763	207483	0.9917	7840	311	344	1.3543	0.1196	1608	1089	0.0110	0.0088
20	50	0.0670	246376	0.9990	0.0784	201333	0.9922	7607	326	358	1.3647	0.1300	1643	1125	0.0115	0.0093
21	49	0.0698	236716	0.9990	0.0814	194022	0.9917	7397	344	380	1.3754	0.1406	1706	1190	0.0122	0.0101
22	46	0.0718	227683	0.9988	0.0836	185073	0.9921	7118	359	396	1.3856	0.1509	1736	1236	0.0128	0.0107
23	41	0.0744	215506	0.9986	0.0862	177114	0.9912	6794	378	414	1.3998	0.1651	1767	1279	0.0136	0.0116
24	47	0.0768	207560	0.9989	0.0885	174006	0.9920	6607	389	426	1.4094	0.1746	1796	1308	0.0142	0.0121
25	52	0.0790	200840	0.9989	0.0909	167252	0.9936	6462	401	443	1.4176	0.1829	1847	1362	0.0147	0.0127
26	54	0.0826	193912	0.9990	0.0948	162352	0.9932	6297	422	465	1.4264	0.1916	1917	1435	0.0157	0.0136
27	56	0.0854	187326	0.9989	0.0978	156658	0.9931	6138	437	482	1.4349	0.2001	1965	1488	0.0164	0.0144
28	51	0.0879	180641	0.9991	0.1002	152791	0.9928	5936	452	496	1.4437	0.2089	1992	1526	0.0171	0.0152
29	46	0.0911	172467	0.9988	0.1035	146400	0.9905	5704	472	519	1.4547	0.2200	2060	1599	0.0182	0.0163
30	52	0.0927	168987	0.9988	0.1051	143141	0.9926	5584	476	524	1.4595	0.2248	2060	1606	0.0185	0.0165
31	51	0.0954	160269	0.9986	0.1076	140246	0.9922	5346	495	542	1.4719	0.2371	2098	1652	0.0196	0.0177
32	49	0.0982	153739	0.9987	0.1106	132809	0.9920	5168	507	560	1.4814	0.2467	2149	1708	0.0203	0.0184
33	45	0.1010	146823	0.9984	0.1134	127444	0.9873	4970	521	571	1.4918	0.2570	2161	1728	0.0212	0.0194
34	46	0.1042	137537	0.9988	0.1166	120352	0.9899	4666	539	590	1.5062	0.2714	2190	1773	0.0224	0.0207
35	50	0.1074	131103	0.9987	0.1198	114715	0.9907	4463	550	603	1.5165	0.2818	2207	1800	0.0233	0.0216
36	50	0.1110	126461	0.9987	0.1236	109975	0.9902	4341	563	617	1.5242	0.2895	2245	1842	0.0242	0.0225
37	55	0.1159	119010	0.9986	0.1285	106164	0.9920	4112	587	639	1.5369	0.3021	2299	1907	0.0260	0.0244
38	58	0.1200	113597	0.9985	0.1327	101159	0.9929	3937	601	657	1.5464	0.3116	2350	1965	0.0272	0.0256
39	61	0.1245	107877	0.9987	0.1373	95924	0.9922	3762	618	675	1.5568	0.3220	2395	2016	0.0287	0.0271
40	65	0.1287	103351	0.9988	0.1415	93585	0.9941	3643	631	688	1.5652	0.3304	2423	2051	0.0299	0.0283
41	70	0.1328	98148	0.9987	0.1454	88987	0.9952	3472	646	704	1.5752	0.3404	2461	2097	0.0314	0.0298
42	67	0.1367	93494	0.9989	0.1494	85769	0.9945	3326	659	718	1.5844	0.3496	2483	2129	0.0326	0.0311
43	74	0.1417	87544	0.9987	0.1543	81085	0.9959	3123	676	737	1.5966	0.3618	2519	2178	0.0345	0.0331
44	64	0.1470	81353	0.9986	0.1594	75815	0.9953	2949	691	752	1.6098	0.3750	2534	2199	0.0363	0.0349
45	64	0.1525	76579	0.9985	0.1649	72054	0.9962	2797	705	767	1.6204	0.3856	2559	2231	0.0381	0.0367
46	55	0.1586	71518	0.9985	0.1707	67289	0.9936	2622	722	784	1.6320	0.3973	2593	2275	0.0403	0.0389
47	50	0.1649	67281	0.9987	0.1772	63393	0.9948	2508	736	798	1.6422	0.4074	2624	2308	0.0423	0.0409
48	50	0.1710	63559	0.9987	0.1831	60652	0.9945	2376	750	812	1.6514	0.4167	2648	2342	0.0443	0.0430
49	51	0.1785	58648	0.9985	0.1903	56476	0.9952	2210	769	831	1.6641	0.4293	2689	2391	0.0472	0.0460
50	58	0.1856	54289	0.9989	0.1972	52726	0.9968	2072	783	845	1.6758	0.4411	2698	2409	0.0497	0.0484
51	53	0.1933	50263	0.9988	0.2045	49185	0.9951	1925	798	860	1.6872	0.4525	2718	2438	0.0524	0.0513
52	59	0.2010	46296	0.9988	0.2119	45730	0.9962	1793	812	874	1.6989	0.4642	2726	2454	0.0552	0.0541
53	62	0.2081	43336	0.9988	0.2189	42961	0.9970	1698	822	885	1.7080	0.4733	2735	2468	0.0575	0.0564
54	56	0.2141	41873	0.9992	0.2246	41501	0.9951	1634	831	893	1.7127	0.4779	2760	2499	0.0593	0.0582
55	64	0.2211	39048	0.9989	0.2314	38845	0.9970	1544	843	905	1.7219	0.4872	2777	2520	0.0622	0.0611
56	63	0.2277	36592	0.9990	0.2376	36457	0.9972	1441	853	915	1.7302	0.4955	2773	2527	0.0647	0.0636

Specimen FYO−150

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD $Area_{pl}$ (in−lb)	LL $Area_{pl}$ (in−lb)	Crack Length (in.)	Crack Extension (in.)	J (in−lb/in²)	J Plastic (in−lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	69	0.0105	404457	0.9998	0.0138	300900	0.9985	4380	0	−1	1.2212	0.0006	96	2	0.0003	−0.0001
2	62	0.0158	403788	0.9998	0.0205	300114	0.9985	6262	4	2	1.2217	0.0011	205	13	0.0009	0.0001
3	59	0.0201	403777	0.9998	0.0258	298475	0.9983	7530	11	9	1.2217	0.0011	313	34	0.0015	0.0003
4	65	0.0247	400926	0.9998	0.0314	298487	0.9987	8569	29	24	1.2239	0.0033	448	83	0.0023	0.0008
5	66	0.0272	397815	0.9998	0.0343	297727	0.9989	8974	41	38	1.2263	0.0057	527	128	0.0028	0.0011
6	65	0.0293	395094	0.9997	0.0367	295615	0.9985	9278	51	50	1.2284	0.0078	599	167	0.0032	0.0014
7	65	0.0313	393350	0.9997	0.0390	293290	0.9984	9530	62	61	1.2298	0.0092	661	203	0.0035	0.0016
8	65	0.0331	390220	0.9997	0.0411	292643	0.9986	9722	73	73	1.2323	0.0117	720	241	0.0039	0.0019
9	63	0.0347	386785	0.9997	0.0429	290474	0.9984	9775	87	88	1.2350	0.0144	780	287	0.0043	0.0022
10	64	0.0366	382233	0.9997	0.0450	287856	0.9985	9883	100	102	1.2386	0.0180	840	332	0.0046	0.0025
11	63	0.0384	377009	0.9996	0.0469	283127	0.9984	9908	114	119	1.2428	0.0222	901	384	0.0050	0.0028
12	65	0.0403	371532	0.9996	0.0491	279772	0.9982	9929	129	133	1.2473	0.0267	965	431	0.0054	0.0032
13	64	0.0421	367808	0.9996	0.0511	277678	0.9982	9952	143	149	1.2503	0.0297	1024	481	0.0058	0.0035
14	66	0.0439	362504	0.9996	0.0532	273962	0.9985	9936	160	167	1.2547	0.0341	1087	540	0.0062	0.0039
15	64	0.0455	358225	0.9996	0.0550	270864	0.9983	9924	172	181	1.2583	0.0377	1134	581	0.0065	0.0042
16	67	0.0475	349814	0.9995	0.0570	265620	0.9985	9807	191	201	1.2654	0.0448	1200	646	0.0070	0.0047
17	64	0.0496	342933	0.9994	0.0594	261952	0.9984	9700	209	221	1.2713	0.0507	1265	708	0.0075	0.0051
18	63	0.0512	334885	0.9994	0.0610	255642	0.9985	9522	224	239	1.2784	0.0578	1318	762	0.0079	0.0056
19	66	0.0532	327816	0.9993	0.0632	251913	0.9986	9420	240	255	1.2846	0.0640	1366	810	0.0083	0.0060
20	68	0.0550	322354	0.9993	0.0650	248815	0.9987	9350	253	270	1.2895	0.0689	1418	858	0.0087	0.0063
21	66	0.0570	311668	0.9992	0.0670	240490	0.9987	9093	274	294	1.2993	0.0787	1479	930	0.0093	0.0070
22	65	0.0591	296122	0.9989	0.0691	231775	0.9987	8787	294	313	1.3140	0.0934	1524	977	0.0099	0.0076
23	65	0.0610	287097	0.9990	0.0710	225127	0.9987	8603	303	324	1.3227	0.1021	1554	1007	0.0102	0.0079
24	67	0.0628	280771	0.9992	0.0728	220078	0.9986	8432	316	337	1.3290	0.1084	1589	1045	0.0106	0.0083

Specimen FYO-151

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area$_{pl}$ (in-lb)	LL Area$_{pl}$ (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in^2)	J Plastic (in-lb/in^2)	CTOD (in.)	CTOD Plastic (in.)
1	48	0.0109	395296	0.9997	0.0140	291578	0.9916	4417	0	-3	1.2283	-0.0009	106	5	0.0004	-0.0000
2	68	0.0185	393265	0.9998	0.0233	298645	0.9962	6864	9	3	1.2299	0.0007	264	22	0.0013	0.0003
3	71	0.0212	391777	0.9998	0.0264	298994	0.9965	7539	15	13	1.2310	0.0019	347	56	0.0017	0.0005
4	74	0.0241	391048	0.9998	0.0299	299765	0.9965	8167	24	24	1.2316	0.0024	429	92	0.0021	0.0007
5	78	0.0271	387601	0.9997	0.0334	295761	0.9965	8660	40	40	1.2343	0.0052	528	144	0.0027	0.0011
6	75	0.0288	385827	0.9998	0.0354	293910	0.9960	8915	48	47	1.2358	0.0066	576	165	0.0031	0.0013
7	77	0.0308	383961	0.9998	0.0376	291224	0.9965	9157	58	58	1.2372	0.0081	636	200	0.0034	0.0016
8	77	0.0329	381469	0.9997	0.0399	289482	0.9963	9346	73	71	1.2392	0.0101	699	243	0.0038	0.0019
9	77	0.0352	376215	0.9997	0.0426	285782	0.9962	9492	90	89	1.2435	0.0143	783	303	0.0043	0.0023
10	73	0.0372	372963	0.9997	0.0448	282636	0.9949	9601	103	103	1.2461	0.0169	845	348	0.0047	0.0026
11	72	0.0394	368079	0.9997	0.0473	280174	0.9950	9665	120	121	1.2501	0.0209	915	406	0.0052	0.0030
12	69	0.0412	365237	0.9996	0.0493	277577	0.9940	9688	134	137	1.2525	0.0233	974	457	0.0055	0.0034
13	70	0.0428	361031	0.9996	0.0511	274664	0.9939	9690	148	151	1.2560	0.0268	1027	503	0.0059	0.0037
14	71	0.0444	357690	0.9996	0.0528	273489	0.9940	9685	160	165	1.2588	0.0296	1079	545	0.0062	0.0040
15	73	0.0463	352966	0.9996	0.0550	269021	0.9943	9704	174	185	1.2627	0.0336	1144	609	0.0066	0.0043
16	73	0.0487	345346	0.9996	0.0576	263828	0.9945	9580	199	208	1.2693	0.0401	1221	685	0.0072	0.0050
17	76	0.0505	339148	0.9995	0.0596	260907	0.9950	9498	213	223	1.2746	0.0455	1271	731	0.0076	0.0053
18	77	0.0524	335163	0.9995	0.0616	257449	0.9948	9438	228	241	1.2781	0.0489	1333	788	0.0080	0.0057
19	75	0.0543	326610	0.9995	0.0637	251706	0.9946	9307	247	261	1.2857	0.0565	1394	849	0.0085	0.0062
20	73	0.0560	317402	0.9994	0.0654	244993	0.9944	9047	263	278	1.2940	0.0649	1432	900	0.0089	0.0067
21	74	0.0583	307189	0.9993	0.0678	238584	0.9944	8902	280	297	1.3035	0.0743	1491	953	0.0095	0.0072
22	77	0.0604	298708	0.9993	0.0701	232949	0.9950	8752	295	314	1.3115	0.0823	1540	1003	0.0099	0.0077
23	75	0.0623	293634	0.9993	0.0721	229199	0.9945	8639	309	328	1.3164	0.0872	1587	1049	0.0104	0.0081
24	78	0.0647	286152	0.9993	0.0746	224150	0.9954	8520	327	349	1.3237	0.0945	1649	1115	0.0109	0.0087
25	78	0.0671	279040	0.9993	0.0772	220315	0.9950	8406	344	368	1.3307	0.1015	1712	1172	0.0115	0.0092

Specimen GFF-42

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in-lb)	LL Area (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	119	0.0121	234425	0.9998	0.0121	234425	0.9998	3016	0	0	1.3912	0.0010	78	-1	0.0003	-0.0002
2	90	0.0183	235416	0.9996	0.0183	235416	0.9996	4072	7	7	1.3900	-0.0001	172	28	0.0011	0.0002
3	84	0.0252	234684	0.9996	0.0252	234684	0.9996	4729	25	25	1.3909	0.0007	305	111	0.0022	0.0010
4	86	0.0324	233393	0.9996	0.0324	233393	0.9996	5021	54	54	1.3923	0.0022	458	237	0.0035	0.0022
5	89	0.0439	231682	0.9997	0.0439	231682	0.9997	5138	110	110	1.3943	0.0041	720	486	0.0058	0.0044
6	99	0.0571	230074	0.9997	0.0571	230074	0.9997	5303	175	175	1.3962	0.0060	1023	772	0.0084	0.0068
7	100	0.0687	228679	0.9998	0.0687	228679	0.9998	5410	234	234	1.3978	0.0076	1296	1033	0.0106	0.0090
8	92	0.0818	226949	0.9997	0.0818	226949	0.9997	5516	303	303	1.3998	0.0096	1612	1336	0.0132	0.0115
9	97	0.0983	224407	0.9997	0.0983	224407	0.9997	5613	392	392	1.4028	0.0126	2019	1727	0.0165	0.0147
10	100	0.1143	221777	0.9998	0.1143	221777	0.9998	5683	479	479	1.4059	0.0157	2412	2108	0.0197	0.0179
11	91	0.1308	217777	0.9999	0.1308	217777	0.9999	5706	571	571	1.4106	0.0204	2819	2505	0.0231	0.0212
12	87	0.1489	213479	0.9999	0.1489	213479	0.9999	5722	672	672	1.4158	0.0256	3264	2939	0.0269	0.0249
13	87	0.1683	209155	0.9999	0.1683	209155	0.9999	5737	781	781	1.4210	0.0309	3740	3404	0.0309	0.0288
14	89	0.1866	204505	0.9999	0.1866	204505	0.9999	5713	884	884	1.4267	0.0366	4184	3840	0.0348	0.0326
15	93	0.2053	198289	0.9999	0.2053	198289	0.9999	5630	989	989	1.4345	0.0443	4614	4265	0.0388	0.0367
16	91	0.2241	191389	0.9998	0.2241	191389	0.9998	5544	1092	1092	1.4433	0.0531	5026	4671	0.0430	0.0408
17	81	0.2421	185058	0.9997	0.2421	185058	0.9997	5442	1189	1189	1.4515	0.0614	5411	5051	0.0470	0.0448
18	61	0.2630	176475	0.9998	0.2630	176475	0.9998	5285	1300	1300	1.4630	0.0728	5827	5464	0.0519	0.0497
19	70	0.2827	168380	0.9998	0.2827	168380	0.9998	5113	1402	1402	1.4740	0.0839	6192	5829	0.0566	0.0543
20	74	0.2921	165270	0.9998	0.2921	165270	0.9998	5063	1445	1445	1.4784	0.0882	6352	5987	0.0586	0.0563
21	77	0.3032	161220	0.9998	0.3032	161220	0.9998	4952	1501	1501	1.4841	0.0939	6557	6194	0.0613	0.0590
22	77	0.3140	156789	0.9998	0.3140	156789	0.9998	4851	1554	1554	1.4904	0.1003	6737	6375	0.0639	0.0617
23	71	0.3234	152649	0.9998	0.3234	152649	0.9998	4750	1599	1599	1.4965	0.1063	6878	6518	0.0663	0.0640
24	79	0.3351	147552	0.9997	0.3351	147552	0.9997	4661	1652	1652	1.5040	0.1138	7046	6682	0.0692	0.0669
25	82	0.3492	141471	0.9998	0.3492	141471	0.9998	4542	1716	1716	1.5132	0.1231	7241	6874	0.0728	0.0706
26	85	0.3646	136811	0.9998	0.3646	136811	0.9998	4417	1784	1784	1.5204	0.1303	7487	7123	0.0766	0.0743
27	86	0.3810	130115	0.9998	0.3810	130115	0.9998	4285	1856	1856	1.5311	0.1409	7693	7325	0.0809	0.0787
28	78	0.3985	125784	0.9999	0.3985	125784	0.9999	4167	1927	1927	1.5381	0.1479	7959	7594	0.0852	0.0829

Specimen GFF-44

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD $Area_{pl}$ (in-lb)	LL $Area_{pl}$ (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	113	0.0120	244719	0.9998	0.0120	244719	0.9998	2994	0	0	1.3795	0.0007	72	-1	0.0004	-0.0001
2	104	0.0168	245581	0.9996	0.0168	245581	0.9996	3949	4	4	1.3786	-0.0003	141	14	0.0009	0.0001
3	110	0.0249	244315	0.9996	0.0249	244315	0.9996	4891	23	23	1.3800	0.0012	296	100	0.0022	0.0010
4	91	0.0366	242828	0.9995	0.0366	242828	0.9995	5275	75	75	1.3817	0.0028	556	326	0.0045	0.0030
5	97	0.0480	241104	0.9996	0.0480	241104	0.9996	5414	133	133	1.3836	0.0048	822	577	0.0067	0.0052
6	94	0.0597	239831	0.9996	0.0597	239831	0.9996	5545	194	194	1.3850	0.0062	1098	840	0.0090	0.0074
7	91	0.0717	238103	0.9997	0.0717	238103	0.9997	5662	258	258	1.3870	0.0081	1391	1119	0.0115	0.0098
8	82	0.0826	236136	0.9997	0.0826	236136	0.9997	5733	318	318	1.3892	0.0104	1660	1377	0.0137	0.0119
9	87	0.0928	234655	0.9997	0.0928	234655	0.9997	5796	374	374	1.3909	0.0121	1914	1622	0.0157	0.0139
10	96	0.1030	232727	0.9998	0.1030	232727	0.9998	5864	431	431	1.3931	0.0143	2169	1867	0.0178	0.0159
11	88	0.1141	230578	0.9998	0.1141	230578	0.9998	5909	495	495	1.3956	0.0167	2449	2139	0.0201	0.0182
12	89	0.1272	228297	0.9999	0.1272	228297	0.9999	5940	570	570	1.3982	0.0194	2783	2465	0.0228	0.0208
13	86	0.1404	224499	0.9998	0.1404	224499	0.9998	5947	648	648	1.4027	0.0238	3115	2788	0.0256	0.0236
14	86	0.1543	220878	0.9998	0.1543	220878	0.9998	5950	728	728	1.4069	0.0281	3459	3124	0.0285	0.0265
15	91	0.1671	216906	0.9999	0.1671	216906	0.9999	5922	803	803	1.4116	0.0328	3773	3433	0.0313	0.0292
16	101	0.1808	211526	0.9998	0.1808	211526	0.9998	5907	881	881	1.4181	0.0393	4095	3745	0.0343	0.0321
17	91	0.1952	207796	0.9998	0.1952	207796	0.9998	5847	964	964	1.4227	0.0438	4441	4089	0.0374	0.0352
18	91	0.2092	202928	0.9999	0.2092	202928	0.9999	5784	1045	1045	1.4287	0.0499	4767	4411	0.0405	0.0383
19	84	0.2238	196944	0.9998	0.2238	196944	0.9998	5688	1128	1128	1.4362	0.0574	5091	4731	0.0439	0.0417
20	92	0.2396	190701	0.9998	0.2396	190701	0.9998	5613	1215	1215	1.4442	0.0653	5428	5061	0.0475	0.0453
21	90	0.2543	185840	0.9999	0.2543	185840	0.9999	5532	1294	1294	1.4505	0.0717	5741	5371	0.0508	0.0486
22	69	0.2697	179646	0.9997	0.2697	179646	0.9997	5413	1379	1379	1.4587	0.0799	6054	5683	0.0545	0.0523
23	74	0.2862	174347	0.9998	0.2862	174347	0.9998	5311	1465	1465	1.4658	0.0870	6391	6018	0.0584	0.0561
24	67	0.3043	167528	0.9998	0.3043	167528	0.9998	5167	1560	1560	1.4752	0.0964	6735	6361	0.0628	0.0605
25	63	0.3198	160719	0.9997	0.3198	160719	0.9997	5015	1638	1638	1.4848	0.1060	6987	6614	0.0667	0.0644
26	67	0.3350	154122	0.9997	0.3350	154122	0.9997	4845	1713	1713	1.4943	0.1155	7222	6852	0.0706	0.0683
27	70	0.3542	145455	0.9996	0.3542	145455	0.9996	4669	1804	1804	1.5072	0.1283	7489	7117	0.0757	0.0734
28	76	0.3677	141490	0.9998	0.3677	141490	0.9998	4577	1862	1862	1.5132	0.1344	7695	7322	0.0788	0.0765
29	79	0.3838	136994	0.9997	0.3838	136994	0.9997	4470	1934	1934	1.5202	0.1413	7965	7592	0.0829	0.0806
30	86	0.3989	131674	0.9997	0.3989	131674	0.9997	4341	2001	2001	1.5286	0.1497	8170	7799	0.0869	0.0846

Specimen GFF-33

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in-lb)	LL Area (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	301	0.0044	272772	0.9990	0.0044	272772	0.9990	1465	-0	-0	1.3493	-0.0107	17	2	-0.0002	-0.0002
2	248	0.0062	268203	0.9995	0.0062	268203	0.9995	1957	0	0	1.3541	-0.0059	31	3	-0.0000	-0.0002
3	149	0.0101	266270	0.9994	0.0101	266270	0.9994	2908	1	1	1.3561	-0.0039	67	6	0.0002	-0.0001
4	133	0.0152	264351	0.9990	0.0152	264351	0.9990	4025	4	4	1.3582	-0.0018	137	18	0.0008	0.0000
5	127	0.0206	264583	0.9996	0.0206	264583	0.9996	4944	12	12	1.3579	-0.0021	233	53	0.0015	0.0004
6	123	0.0253	264193	0.9995	0.0253	264193	0.9995	5463	26	26	1.3583	-0.0016	332	112	0.0023	0.0010
7	107	0.0349	258051	0.9994	0.0349	258051	0.9994	5889	72	72	1.3649	0.0049	568	305	0.0043	0.0027
8	98	0.0501	259785	0.9994	0.0501	259785	0.9994	6099	156	156	1.3631	0.0031	945	665	0.0074	0.0056
9	96	0.0701	253014	0.9996	0.0701	253014	0.9996	6281	277	277	1.3704	0.0104	1476	1168	0.0117	0.0098
10	96	0.0870	249332	0.9994	0.0870	249332	0.9994	6377	378	378	1.3744	0.0144	1916	1592	0.0152	0.0132
11	93	0.1088	245059	0.9996	0.1088	245059	0.9996	6406	515	515	1.3792	0.0192	2502	2167	0.0199	0.0179
12	98	0.1328	234929	0.9996	0.1328	234929	0.9996	6390	668	668	1.3906	0.0306	3133	2779	0.0254	0.0232
13	100	0.1569	226385	0.9996	0.1569	226385	0.9996	6361	817	817	1.4004	0.0405	3747	3378	0.0308	0.0285
14	102	0.1785	216105	0.9991	0.1785	216105	0.9991	6254	950	950	1.4126	0.0526	4269	3887	0.0358	0.0334
15	92	0.2001	206645	0.9997	0.2001	206645	0.9997	6127	1080	1080	1.4241	0.0641	4776	4386	0.0409	0.0385
16	91	0.2242	195639	0.9995	0.2242	195639	0.9995	5932	1224	1224	1.4379	0.0779	5316	4921	0.0467	0.0443
17	93	0.2486	187979	0.9997	0.2486	187979	0.9997	5846	1362	1362	1.4477	0.0877	5875	5469	0.0525	0.0500
18	94	0.2769	177403	0.9997	0.2769	177403	0.9997	5610	1526	1526	1.4617	0.1017	6493	6087	0.0596	0.0571
19	87	0.3031	163821	0.9997	0.3031	163821	0.9997	5302	1669	1669	1.4804	0.1204	6938	6532	0.0666	0.0641
20	104	0.3346	151509	0.9995	0.3346	151509	0.9995	5019	1829	1829	1.4981	0.1382	7475	7068	0.0748	0.0723
21	109	0.3590	144124	0.9996	0.3590	144124	0.9996	4857	1943	1943	1.5092	0.1492	7892	7483	0.0810	0.0784
22	116	0.3885	132409	0.9992	0.3885	132409	0.9992	4564	2085	2085	1.5274	0.1674	8310	7902	0.0893	0.0868
23	119	0.4128	124735	0.9995	0.4128	124735	0.9995	4363	2188	2188	1.5398	0.1798	8632	8226	0.0958	0.0933
24	125	0.4402	116891	0.9996	0.4402	116891	0.9996	4152	2304	2304	1.5530	0.1930	9009	8606	0.1034	0.1009
25	130	0.4695	108561	0.9996	0.4695	108561	0.9996	3913	2421	2421	1.5675	0.2076	9354	8957	0.1117	0.1092
26	136	0.4960	103167	0.9997	0.4960	103167	0.9997	3742	2520	2520	1.5773	0.2173	9705	9314	0.1189	0.1165
27	143	0.5231	95455	0.9996	0.5231	95455	0.9996	3529	2619	2619	1.5918	0.2318	9936	9548	0.1270	0.1246
28	149	0.5481	89206	0.9994	0.5481	89206	0.9994	3312	2703	2703	1.6040	0.2440	10122	9744	0.1343	0.1320
29	156	0.5749	82486	0.9994	0.5749	82486	0.9994	3135	2789	2789	1.6177	0.2578	10286	9907	0.1424	0.1401
30	162	0.6093	77645	0.9994	0.6093	77645	0.9994	2979	2891	2891	1.6280	0.2680	10665	10293	0.1520	0.1497
31	170	0.6382	72996	0.9995	0.6382	72996	0.9995	2821	2974	2974	1.6383	0.2783	10911	10546	0.1606	0.1583

Specimen GFF-34

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in-lb)	LL Area (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	181	0.0046	274206	0.9992	0.0046	274206	0.9992	1471	−0	−0	1.3478	−0.0040	17	1	−0.0001	−0.0002
2	123	0.0082	270642	0.9992	0.0082	270642	0.9992	2445	0	0	1.3515	−0.0003	45	3	0.0001	−0.0001
3	100	0.0124	271711	0.9987	0.0124	271711	0.9987	3430	1	1	1.3504	−0.0014	90	7	0.0005	−0.0001
4	96	0.0169	270418	0.9989	0.0169	270418	0.9989	4373	6	6	1.3518	−0.0001	162	26	0.0010	0.0002
5	91	0.0227	269066	0.9993	0.0227	269066	0.9993	5224	18	18	1.3532	0.0014	273	78	0.0019	0.0007
6	88	0.0297	268696	0.9991	0.0297	268696	0.9991	5796	45	45	1.3536	0.0017	430	189	0.0032	0.0017
7	93	0.0378	266324	0.9992	0.0378	266324	0.9992	5956	89	89	1.3561	0.0042	631	373	0.0049	0.0034
8	84	0.0529	263926	0.9994	0.0529	263926	0.9994	6160	175	175	1.3586	0.0068	1014	735	0.0081	0.0064
9	87	0.0692	258764	0.9992	0.0692	258764	0.9992	6316	273	273	1.3642	0.0123	1438	1136	0.0116	0.0098
10	87	0.0849	257729	0.9995	0.0849	257729	0.9995	6343	368	368	1.3653	0.0134	1848	1542	0.0149	0.0131
11	85	0.1013	247632	0.9996	0.1013	247632	0.9996	6403	472	472	1.3763	0.0245	2277	1947	0.0187	0.0167
12	92	0.1200	241612	0.9997	0.1200	241612	0.9997	6410	585	585	1.3830	0.0312	2752	2409	0.0228	0.0207
13	85	0.1345	232983	0.9994	0.1345	232983	0.9994	6363	676	676	1.3928	0.0410	3111	2756	0.0262	0.0240
14	87	0.1464	231552	0.9997	0.1464	231552	0.9997	6321	747	747	1.3945	0.0426	3417	3063	0.0286	0.0265
15	87	0.1625	224295	0.9997	0.1625	224295	0.9997	6253	850	850	1.4029	0.0511	3828	3466	0.0325	0.0303
16	87	0.1769	216862	0.9995	0.1769	216862	0.9995	6210	935	935	1.4117	0.0599	4160	3786	0.0359	0.0336
17	90	0.1886	212558	0.9997	0.1886	212558	0.9997	6159	1004	1004	1.4169	0.0650	4439	4060	0.0386	0.0362
18	90	0.2000	209435	0.9995	0.2000	209435	0.9995	6096	1073	1073	1.4207	0.0688	4724	4345	0.0412	0.0389
19	303	0.2129	188629	0.9979	0.2129	188629	0.9979	6018	1151	1151	1.4469	0.0950	4881	4453	0.0454	0.0427
20	92	0.2305	195465	0.9996	0.2305	195465	0.9996	5917	1241	1241	1.4381	0.0863	5366	4973	0.0483	0.0458
21	95	0.2463	190712	0.9997	0.2463	190712	0.9997	5764	1345	1345	1.4442	0.0923	5792	5405	0.0526	0.0502
22	98	0.2664	181394	0.9997	0.2664	181394	0.9997	5674	1459	1459	1.4564	0.1045	6206	5804	0.0578	0.0553
23	99	0.2842	174952	0.9997	0.2842	174952	0.9997	5511	1556	1556	1.4650	0.1132	6564	6165	0.0622	0.0597
24	86	0.3002	169219	0.9997	0.3002	169219	0.9997	5296	1643	1643	1.4729	0.1210	6875	6489	0.0663	0.0639
25	107	0.3175	158453	0.9997	0.3175	158453	0.9997	5128	1733	1733	1.4880	0.1362	7111	6713	0.0713	0.0688
26	108	0.3357	152506	0.9997	0.3357	152506	0.9997	4990	1820	1820	1.4967	0.1448	7424	7026	0.0758	0.0734
27	110	0.3549	147047	0.9997	0.3549	147047	0.9997	4835	1914	1914	1.5048	0.1529	7779	7385	0.0809	0.0785
28	114	0.3723	138481	0.9996	0.3723	138481	0.9996	4675	1997	1997	1.5178	0.1660	7990	7589	0.0859	0.0835
29	115	0.3880	134900	0.9997	0.3880	134900	0.9997	4532	2065	2065	1.5234	0.1716	8248	7857	0.0899	0.0875
30	120	0.4064	128573	0.9994	0.4064	128573	0.9994	4393	2148	2148	1.5335	0.1817	8511	8118	0.0951	0.0927
31	116	0.4246	121265	0.9998	0.4246	121265	0.9998	4175	2227	2227	1.5456	0.1938	8698	8311	0.1005	0.0981
32	282	0.4406	106919	0.9970	0.4406	106919	0.9970	4078	2288	2288	1.5705	0.2187	8544	8103	0.1064	0.1036
33	123	0.4581	111312	0.9997	0.4581	111312	0.9997	3924	2346	2346	1.5627	0.2108	9014	8628	0.1091	0.1067
34	114	0.4782	106229	0.9997	0.4782	106229	0.9997	3764	2435	2435	1.5717	0.2199	9329	8950	0.1156	0.1133
35	114	0.4979	101463	0.9996	0.4979	101463	0.9996	3639	2507	2507	1.5805	0.2286	9554	9176	0.1212	0.1189
36	118	0.5168	96460	0.9997	0.5168	96460	0.9997	3499	2574	2574	1.5899	0.2380	9729	9352	0.1268	0.1245
37	123	0.5338	92669	0.9998	0.5338	92669	0.9998	3397	2630	2630	1.5972	0.2454	9893	9517	0.1317	0.1293
38	118	0.5528	87951	0.9996	0.5528	87951	0.9996	3277	2694	2694	1.6065	0.2547	10044	9668	0.1374	0.1350
39	122	0.5727	83674	0.9996	0.5727	83674	0.9996	3132	2757	2757	1.6153	0.2634	10208	9838	0.1433	0.1410
40	122	0.5920	79731	0.9998	0.5920	79731	0.9998	3043	2815	2815	1.6236	0.2717	10356	9983	0.1490	0.1467
41	120	0.6138	76653	0.9997	0.6138	76653	0.9997	2934	2879	2879	1.6302	0.2784	10589	10221	0.1553	0.1530
42	117	0.6342	73727	0.9995	0.6342	73727	0.9995	2836	2937	2937	1.6366	0.2848	10794	10431	0.1613	0.1591

Specimen FGN-10

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area$_{pl}$ (in-lb)	LL Area$_{pl}$ (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in^2)	J Plastic (in-lb/in^2)	CTOD (in.)	CTOD Plastic (in.)
1	115	0.0053	156552	0.9999	0.0053	156552	0.9999	1018	-0	-0	1.2213	-0.0001	11	1	-0.0002	-0.0003
2	102	0.0085	156078	0.9999	0.0085	156078	0.9999	1491	0	0	1.2223	0.0009	24	1	-0.0000	-0.0003
3	93	0.0122	156113	0.9999	0.0122	156113	0.9999	2022	1	1	1.2223	0.0008	45	3	0.0003	-0.0002
4	89	0.0159	155914	0.9999	0.0159	155914	0.9999	2516	2	2	1.2227	0.0013	73	8	0.0006	-0.0000
5	86	0.0199	156010	0.9999	0.0199	156010	0.9999	2988	4	4	1.2225	0.0010	109	17	0.0012	0.0002
6	96	0.0235	155799	1.0000	0.0235	155799	1.0000	3348	8	8	1.2229	0.0015	147	31	0.0018	0.0005
7	92	0.0261	155528	1.0000	0.0261	155528	1.0000	3584	12	12	1.2235	0.0021	177	44	0.0022	0.0008
8	93	0.0292	155424	1.0000	0.0292	155424	1.0000	3823	18	18	1.2237	0.0023	216	64	0.0028	0.0012
9	101	0.0324	155285	1.0000	0.0324	155285	1.0000	4036	25	25	1.2240	0.0026	259	90	0.0035	0.0017
10	97	0.0359	155018	1.0000	0.0359	155018	1.0000	4230	34	34	1.2246	0.0032	309	123	0.0043	0.0023
11	94	0.0400	154237	1.0000	0.0400	154237	1.0000	4415	47	47	1.2263	0.0048	371	167	0.0052	0.0031
12	83	0.0443	152759	1.0000	0.0443	152759	1.0000	4541	62	62	1.2295	0.0080	439	220	0.0063	0.0040
13	77	0.0463	150693	1.0000	0.0463	150693	1.0000	4550	69	69	1.2340	0.0125	468	244	0.0068	0.0044
14	92	0.0478	149132	1.0000	0.0478	149132	1.0000	4550	74	74	1.2374	0.0159	488	261	0.0071	0.0047
15	87	0.0493	1470[illegible]	1.0000	0.0493	147000	1.0000	4522	81	81	1.2421	0.0207	511	282	0.0075	0.0051
16	100	0.0509	144265	1.0000	0.0509	144265	1.0000	4475	87	87	1.2482	0.0268	532	302	0.0079	0.0055
17	78	0.0519	142318	1.0000	0.0519	142318	1.0000	4449	9[illegible]	90	1.2526	0.0311	541	310	0.0081	0.0057
18	95	0.0532	140613	1.0000	0.0532	140613	1.0000	4416	9[illegible]	95	1.2564	0.0350	558	327	0.0085	0.0060
19	96	0.0547	138185	1.0000	0.0547	138185	1.0000	4381	101	101	1.2620	0.0406	580	346	0.0089	0.0064
20	94	0.0562	135368	1.0000	0.0562	135368	1.0000	4309	107	107	1.2686	0.0471	596	364	0.0093	0.0068
21	83	0.0569	133518	1.0000	0.0569	133518	1.0000	4266	109	109	1.2729	0.0515	601	369	0.0094	0.0070
22	99	0.0587	130348	1.0000	0.0587	130348	1.0000	4208	117	117	1.2804	0.0590	625	391	0.0099	0.0075
23	106	0.0604	127470	1.0000	0.0604	127470	1.0000	4136	123	123	1.2873	0.0659	643	410	0.0104	0.0079
24	93	0.0616	125284	1.0000	0.0616	125284	1.0000	4094	126	126	1.2927	0.0713	652	419	0.0106	0.0082
25	91	0.0630	122538	1.0000	0.0630	122538	1.0000	4022	132	132	1.2995	0.0780	668	436	0.0111	0.0086
26	97	0.0643	119049	1.0000	0.0643	119049	1.0000	3916	138	138	1.3082	0.0868	681	452	0.0115	0.0091
27	98	0.0661	114386	1.0000	0.0661	114386	1.0000	3804	145	145	1.3201	0.0987	698	469	0.0121	0.0097
28	103	0.0674	111958	1.0000	0.0674	111958	1.0000	3743	147	147	1.3265	0.1050	700	472	0.0123	0.0099
29	103	0.0694	107452	1.0000	0.0694	107452	1.0000	3594	156	156	1.3384	0.1170	723	500	0.0130	0.0107
30	100	0.0715	103562	1.0000	0.0715	103562	1.0000	3491	162	162	1.3490	0.1276	734	513	0.0136	0.0112
31	83	0.0732	100267	0.9999	0.0732	100267	0.9999	3392	167	167	1.3582	0.1368	744	525	0.0140	0.0117
32	82	0.0750	96915	0.9999	0.0750	96915	0.9999	3295	173	173	1.3677	0.1463	756	540	0.0146	0.0123
33	94	0.0772	92895	1.0000	0.0772	92895	1.0000	3174	181	181	1.3793	0.1579	772	559	0.0153	0.0131
34	104	0.0797	89595	1.0000	0.0797	89595	1.0000	3077	187	187	1.3891	0.1677	786	576	0.0160	0.0138
35	120	0.0820	85964	1.0000	0.0820	85964	1.0000	2982	193	193	1.4002	0.1787	801	591	0.0167	0.0145
36	122	0.0840	82769	0.9999	0.0840	82769	0.9999	2872	199	199	1.4101	0.1887	809	604	0.0173	0.0151
37	135	0.0863	79810	0.9999	0.0863	79810	0.9999	2799	204	204	1.4195	0.1981	821	616	0.0179	0.0158

Specimen FGN-12

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in-lb)	LL Area (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	124	0.0075	155438	0.9999	0.0075	155438	0.9999	1338	−0	−0	1.2237	0.0024	19	1	−0.0001	−0.0003
2	103	0.0119	155751	0.9999	0.0119	155751	0.9999	1987	0	0	1.2230	0.0017	43	2	0.0002	−0.0002
3	96	0.0157	155885	0.9999	0.0157	155885	0.9999	2492	1	1	1.2227	0.0014	71	6	0.0006	−0.0001
4	86	0.0197	156027	0.9999	0.0197	156027	0.9999	2971	4	4	1.2224	0.0011	107	16	0.0011	0.0002
5	86	0.0229	155672	0.9999	0.0229	155672	0.9999	3306	7	7	1.2232	0.0019	141	27	0.0016	0.0005
6	85	0.0258	155670	0.9999	0.0258	155670	0.9999	3584	11	11	1.2232	0.0019	174	41	0.0021	0.0007
7	81	0.0281	155574	0.9999	0.0281	155574	0.9999	3770	15	15	1.2234	0.0021	203	56	0.0026	0.0010
8	86	0.0307	155459	0.9999	0.0307	155459	0.9999	3963	20	20	1.2236	0.0023	236	73	0.0031	0.0014
9	96	0.0330	155292	0.9999	0.0330	155292	0.9999	4115	26	26	1.2240	0.0027	269	93	0.0036	0.0017
10	95	0.0356	154910	1.0000	0.0356	154910	1.0000	4262	33	33	1.2248	0.0035	306	116	0.0042	0.0022
11	87	0.0380	154191	1.0000	0.0380	154191	1.0000	4380	39	39	1.2264	0.0050	341	140	0.0047	0.0026
12	103	0.0405	154330	1.0000	0.0405	154330	1.0000	4482	47	47	1.2261	0.0047	378	167	0.0052	0.0030
13	86	0.0430	153320	1.0000	0.0430	153320	1.0000	4570	56	56	1.2282	0.0069	419	198	0.0059	0.0036
14	93	0.0453	152632	1.0000	0.0453	152632	1.0000	4636	63	63	1.2297	0.0084	454	225	0.0064	0.0040
15	86	0.0470	151195	1.0000	0.0470	151195	1.0000	4646	70	70	1.2329	0.0115	481	248	0.0068	0.0044
16	79	0.0487	149799	1.0000	0.0487	149799	1.0000	4654	77	77	1.2359	0.0146	507	271	0.0073	0.0048
17	79	0.0505	147377	0.9999	0.0505	147377	0.9999	4629	85	85	1.2412	0.0199	534	296	0.0078	0.0053
18	77	0.0520	144808	1.0000	0.0520	144808	1.0000	4595	91	91	1.2470	0.0256	555	314	0.0082	0.0056
19	88	0.0538	140865	1.0000	0.0538	140865	1.0000	4503	99	99	1.2559	0.0345	581	340	0.0087	0.0062
20	79	0.0550	138654	0.9999	0.0550	138654	0.9999	4464	102	102	1.2609	0.0396	589	348	0.0089	0.0064
21	80	0.0566	135759	1.0000	0.0566	135759	1.0000	4408	108	108	1.2676	0.0463	610	368	0.0093	0.0068
22	80	0.0592	130909	0.9999	0.0592	130909	0.9999	4302	120	120	1.2791	0.0577	647	405	0.0101	0.0076
23	90	0.0604	128086	0.9999	0.0604	128086	0.9999	4226	123	123	1.2859	0.0645	650	409	0.0103	0.0078
24	109	0.0617	125505	1.0000	0.0617	125505	1.0000	4168	127	127	1.2921	0.0708	662	421	0.0106	0.0081
25	111	0.0631	122822	1.0000	0.0631	122822	1.0000	4081	133	133	1.2987	0.0774	677	438	0.0110	0.0085
26	87	0.0649	119211	1.0000	0.0649	119211	1.0000	3971	141	141	1.3078	0.0864	698	463	0.0116	0.0092
27	91	0.0666	115890	0.9999	0.0666	115890	0.9999	3895	146	146	1.3163	0.0949	710	475	0.0120	0.0096
28	84	0.0694	108410	0.9999	0.0694	108410	0.9999	3698	160	160	1.3359	0.1145	743	511	0.0132	0.0107
29	81	0.0704	106366	0.9999	0.0704	106366	0.9999	3636	157	157	1.3414	0.1200	727	496	0.0130	0.0106
30	120	0.0722	102424	0.9999	0.0722	102424	0.9999	3542	164	164	1.3522	0.1308	746	515	0.0136	0.0112
31	72	0.0739	98123	0.9999	0.0739	98123	0.9999	3396	171	171	1.3642	0.1429	755	530	0.0142	0.0119
32	84	0.0761	94713	0.9999	0.0761	94713	0.9999	3322	176	176	1.3740	0.1527	767	540	0.0147	0.0124
33	74	0.0784	90931	0.9999	0.0784	90931	0.9999	3180	184	184	1.3851	0.1638	784	564	0.0155	0.0132
34	90	0.0803	86828	0.9999	0.0803	86828	0.9999	3054	190	190	1.3975	0.1762	793	577	0.0162	0.0139
35	96	0.0824	82706	0.9999	0.0824	82706	0.9999	2929	196	196	1.4103	0.1889	799	586	0.0168	0.0145
36	95	0.0843	79416	0.9999	0.0843	79416	0.9999	2845	199	199	1.4208	0.1994	802	589	0.0172	0.0150
37	91	0.0855	77740	0.9999	0.0855	77740	0.9999	2794	201	201	1.4262	0.2048	800	588	0.0174	0.0152

Specimen FGN-16

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in-lb)	LL Area (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	103	0.0080	156919	0.9999	0.0080	156919	0.9999	1462	−7	−7	1.1828	0.0006	−15	−34	−0.0026	−0.0028
2	93	0.0118	156720	0.9999	0.0118	156720	0.9999	2029	7	7	1.1833	0.0010	51	15	0.0001	−0.0003
3	83	0.0151	156717	0.9999	0.0151	156717	0.9999	2472	8	8	1.1833	0.0010	73	19	0.0004	−0.0002
4	83	0.0187	156761	0.9999	0.0187	156761	0.9999	2895	11	11	1.1832	0.0009	101	27	0.0008	0.0001
5	89	0.0222	156727	0.9999	0.0222	156727	0.9999	3264	14	14	1.1833	0.0010	133	39	0.0014	0.0004
6	75	0.0244	156438	0.9999	0.0244	156438	0.9999	3474	17	17	1.1839	0.0017	156	49	0.0017	0.0006
7	89	0.0284	156115	1.0000	0.0284	156115	1.0000	3789	24	24	1.1846	0.0024	200	72	0.0024	0.0011
8	73	0.0312	156006	0.9999	0.0312	156006	0.9999	3986	30	30	1.1849	0.0026	234	92	0.0030	0.0015
9	74	0.0343	155548	0.9999	0.0343	155548	0.9999	4164	38	38	1.1859	0.0036	274	119	0.0036	0.0020
10	64	0.0373	155325	0.9999	0.0373	155325	0.9999	4305	46	46	1.1864	0.0041	313	148	0.0042	0.0025
11	81	0.0404	153970	1.0000	0.0404	153970	1.0000	4407	57	57	1.1894	0.0072	359	183	0.0050	0.0031
12	80	0.0420	153197	0.9999	0.0420	153197	0.9999	4452	62	62	1.1911	0.0089	380	199	0.0053	0.0034
13	80	0.0438	151447	1.0000	0.0438	151447	1.0000	4467	69	69	1.1951	0.0128	406	221	0.0058	0.0038
14	69	0.0453	149750	0.9999	0.0453	149750	0.9999	4440	75	75	1.1989	0.0167	425	240	0.0061	0.0042
15	78	0.0469	148083	1.0000	0.0469	148083	1.0000	4462	80	80	1.2027	0.0205	446	256	0.0065	0.0045
16	94	0.0485	145408	1.0000	0.0485	145408	1.0000	4410	87	87	1.2089	0.0267	469	279	0.0069	0.0049
17	78	0.0503	142594	1.0000	0.0503	142594	1.0000	4358	94	94	1.2155	0.0333	491	300	0.0074	0.0054
18	83	0.0523	138935	1.0000	0.0523	138935	1.0000	4294	102	102	1.2242	0.0420	515	323	0.0079	0.0059
19	92	0.0535	136674	1.0000	0.0535	136674	1.0000	4259	105	105	1.2296	0.0474	523	331	0.0081	0.0061
20	95	0.0552	133884	1.0000	0.0552	133884	1.0000	4202	112	112	1.2364	0.0542	544	351	0.0086	0.0066
21	99	0.0566	130853	1.0000	0.0566	130853	1.0000	4118	118	118	1.2439	0.0617	559	368	0.0090	0.0070
22	105	0.0584	127198	1.0000	0.0584	127198	1.0000	4033	124	124	1.2531	0.0708	577	387	0.0095	0.0075
23	93	0.0597	124830	1.0000	0.0597	124830	1.0000	3984	128	128	1.2591	0.0769	586	395	0.0097	0.0078
24	97	0.0621	119578	1.0000	0.0621	119578	1.0000	3813	140	140	1.2727	0.0905	616	431	0.0106	0.0087
25	81	0.0633	117081	0.9999	0.0633	117081	0.9999	3730	143	143	1.2794	0.0971	617	434	0.0108	0.0089
26	91	0.0652	114734	1.0000	0.0652	114734	1.0000	3686	149	149	1.2857	0.1034	636	452	0.0113	0.0094
27	108	0.0668	112873	1.0000	0.0668	112873	1.0000	3653	153	153	1.2907	0.1085	649	465	0.0117	0.0097
28	90	0.0687	108884	0.9999	0.0687	108884	0.9999	3537	162	162	1.3017	0.1195	670	489	0.0124	0.0105
29	75	0.0720	104126	0.9999	0.0720	104126	0.9999	3369	174	174	1.3151	0.1329	701	526	0.0135	0.0116
30	79	0.0732	101754	0.9999	0.0732	101754	0.9999	3299	176	176	1.3220	0.1398	699	526	0.0136	0.0118
31	99	0.0758	97586	0.9999	0.0758	97586	0.9999	3202	185	185	1.3343	0.1520	723	550	0.0145	0.0127
32	93	0.0779	95610	0.9999	0.0779	95610	0.9999	3164	189	189	1.3402	0.1579	733	559	0.0149	0.0131
33	90	0.0796	93056	0.9999	0.0796	93056	0.9999	3060	195	195	1.3480	0.1657	746	578	0.0155	0.0138
34	98	0.0819	88597	0.9999	0.0819	88597	0.9999	2950	203	203	1.3618	0.1796	762	594	0.0164	0.0146
35	81	0.0848	85209	0.9999	0.0848	85209	0.9999	2855	210	210	1.3727	0.1904	777	611	0.0172	0.0154
36	73	0.0870	81202	0.9999	0.0870	81202	0.9999	2752	216	216	1.3858	0.2036	784	619	0.0179	0.0162
37	76	0.0897	77603	0.9999	0.0897	77603	0.9999	2654	222	222	1.3979	0.2157	795	631	0.0187	0.0170

Specimen FGN-31

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area (in-lb)	LL Area (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in²)	J Plastic (in-lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	49	0.0076	56723	0.9999	0.0076	56723	0.9999	508	−0	−0	1.5010	0.0010	13	2	−0.0001	−0.0002
2	55	0.0124	56614	1.0000	0.0124	56614	1.0000	779	−0	−0	1.5015	0.0014	28	2	0.0001	−0.0002
3	35	0.0182	56861	0.9999	0.0182	56861	0.9999	1082	0	0	1.5005	0.0005	54	5	0.0004	−0.0001
4	47	0.0256	56690	1.0000	0.0256	56690	1.0000	1396	3	3	1.5012	0.0011	101	18	0.0011	0.0002
5	45	0.0287	56249	1.0000	0.0287	56249	1.0000	1483	5	5	1.5029	0.0029	124	29	0.0014	0.0004
6	43	0.0316	55461	0.9999	0.0316	55461	0.9999	1536	8	8	1.5060	0.0060	146	43	0.0018	0.0007
7	49	0.0351	54305	1.0000	0.0351	54305	1.0000	1579	11	11	1.5106	0.0106	175	62	0.0023	0.0011
8	47	0.0381	53082	1.0000	0.0381	53082	1.0000	1592	15	15	1.5156	0.0155	199	81	0.0027	0.0014
9	46	0.0407	51829	1.0000	0.0407	51829	1.0000	1586	18	18	1.5207	0.0207	219	97	0.0031	0.0018
10	47	0.0428	49969	1.0000	0.0428	49969	1.0000	1564	21	21	1.5285	0.0284	235	111	0.0034	0.0021
11	56	0.0456	47461	0.9999	0.0456	47461	0.9999	1518	25	25	1.5392	0.0391	256	130	0.0039	0.0025
12	52	0.0485	44448	0.9999	0.0485	44448	0.9999	1439	29	29	1.5525	0.0525	276	151	0.0044	0.0031
13	52	0.0510	42626	0.9999	0.0510	42626	0.9999	1415	31	31	1.5608	0.0608	283	155	0.0046	0.0033
14	63	0.0537	40744	0.9999	0.0537	40744	0.9999	1377	34	34	1.5696	0.0696	299	170	0.0050	0.0037
15	60	0.0578	37118	0.9999	0.0578	37118	0.9999	1274	41	41	1.5872	0.0872	329	203	0.0060	0.0047
16	67	0.0611	35119	0.9999	0.0611	35119	0.9999	1229	42	42	1.5974	0.0973	336	209	0.0063	0.0050
17	54	0.0645	31953	0.9999	0.0645	31953	0.9999	1120	48	48	1.6141	0.1141	355	234	0.0072	0.0059
18	59	0.0682	29094	0.9999	0.0682	29094	0.9999	1035	51	51	1.6301	0.1300	363	245	0.0078	0.0066
19	66	0.0704	27175	0.9999	0.0704	27175	0.9999	979	52	52	1.6413	0.1413	359	243	0.0081	0.0069
20	58	0.0730	25417	0.9999	0.0730	25417	0.9999	921	54	54	1.6520	0.1520	363	250	0.0086	0.0074
21	64	0.0759	23867	0.9999	0.0759	23867	0.9999	883	56	56	1.6618	0.1617	369	255	0.0090	0.0078
22	47	0.0789	21852	0.9998	0.0789	21852	0.9998	802	60	60	1.6750	0.1750	377	271	0.0099	0.0087
23	60	0.0821	20186	0.9998	0.0821	20186	0.9998	757	61	61	1.6865	0.1865	379	272	0.0104	0.0093
24	64	0.0860	18701	0.9999	0.0860	18701	0.9999	716	63	63	1.6973	0.1972	386	280	0.0111	0.0100
25	67	0.0897	17289	0.9999	0.0897	17289	0.9999	665	66	66	1.7079	0.2079	392	290	0.0119	0.0106
26	73	0.0935	16214	0.9999	0.0935	16214	0.9999	631	68	68	1.7163	0.2163	396	295	0.0125	0.0114
27	71	0.0971	15147	0.9998	0.0971	15147	0.9998	595	70	70	1.7251	0.2250	404	304	0.0132	0.0122
28	68	0.0984	14600	0.9998	0.0984	14600	0.9998	575	70	70	1.7296	0.2296	397	299	0.0133	0.0123
29	73	0.1015	13888	0.9999	0.1015	13888	0.9999	556	71	71	1.7358	0.2357	406	308	0.0140	0.0130
30	76	0.1053	12998	0.9999	0.1053	12998	0.9999	524	74	74	1.7437	0.2437	414	319	0.0149	0.0139
31	74	0.1090	12154	0.9998	0.1090	12154	0.9998	488	76	76	1.7515	0.2515	419	327	0.0157	0.0148
32	69	0.1132	11252	0.9998	0.1132	11252	0.9998	460	77	77	1.7602	0.2601	424	333	0.0166	0.0157
33	67	0.1183	10360	0.9998	0.1183	10360	0.9998	424	80	80	1.7691	0.2691	430	343	0.0178	0.0169
34	61	0.1227	9594	0.9998	0.1227	9594	0.9998	394	81	81	1.7772	0.2772	432	348	0.0188	0.0179
35	54	0.1271	8892	0.9997	0.1271	8892	0.9997	363	83	83	1.7849	0.2849	434	355	0.0198	0.0190
36	49	0.1310	8303	0.9996	0.1310	8303	0.9996	343	84	84	1.7917	0.2916	433	355	0.0206	0.0198
37	61	0.1352	7671	0.9995	0.1352	7671	0.9995	322	86	86	1.7992	0.2992	434	357	0.0216	0.0208
38	66	0.1400	7127	0.9996	0.1400	7127	0.9996	304	87	87	1.8060	0.3059	436	359	0.0225	0.0217
39	70	0.1440	6750	0.9996	0.1440	6750	0.9996	290	88	88	1.8108	0.3108	435	360	0.0232	0.0225
40	51	0.1481	6421	0.9994	0.1481	6421	0.9994	276	89	89	1.8152	0.3152	440	367	0.0242	0.0234

Specimen FGN−57

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD $Area_{pl}$ (in−lb)	LL $Area_{pl}$ (in−lb)	Crack Length (in.)	Crack Extension (in.)	J (in−lb/in²)	J Plastic (in−lb/in²)	CTOD (in.)	CTOD Plastic (in.)
1	101	0.0060	154663	0.9997	0.0060	154663	0.9997	979	0	0	1.2254	0.0004	10	−0	0.0000	−0.0001
2	76	0.0093	154801	0.9996	0.0093	154801	0.9996	1468	0	0	1.2251	0.0001	23	1	0.0002	−0.0000
3	64	0.0128	154331	0.9994	0.0128	154331	0.9994	1969	1	1	1.2261	0.0011	43	2	0.0005	0.0000
4	58	0.0164	154978	0.9992	0.0164	154978	0.9992	2457	2	2	1.2247	−0.0003	69	6	0.0008	0.0002
5	84	0.0188	154098	0.9996	0.0188	154098	0.9996	2753	3	3	1.2266	0.0016	90	11	0.0011	0.0003
6	70	0.0204	154484	0.9994	0.0204	154484	0.9994	2949	4	4	1.2257	0.0008	105	14	0.0013	0.0004
7	94	0.0233	153692	0.9996	0.0233	153692	0.9996	3251	7	7	1.2274	0.0025	135	24	0.0018	0.0006
8	72	0.0248	153226	0.9995	0.0248	153226	0.9995	3390	9	9	1.2284	0.0035	152	31	0.0020	0.0007
9	74	0.0262	152047	0.9996	0.0262	152047	0.9996	3499	11	11	1.2310	0.0060	169	38	0.0023	0.0009
10	72	0.0276	150254	0.9994	0.0276	150254	0.9994	3574	13	13	1.2349	0.0100	185	47	0.0026	0.0011
11	68	0.0288	148461	0.9994	0.0288	148461	0.9994	3636	15	15	1.2388	0.0139	199	53	0.0028	0.0012
12	66	0.0303	145926	0.9994	0.0303	145926	0.9994	3687	18	18	1.2445	0.0195	217	63	0.0031	0.0015
13	65	0.0311	144263	0.9992	0.0311	144263	0.9992	3718	19	19	1.2482	0.0232	225	66	0.0032	0.0015
14	61	0.0323	143049	0.9993	0.0323	143049	0.9993	3736	22	22	1.2509	0.0260	238	76	0.0034	0.0017
15	60	0.0334	139637	0.9992	0.0334	139637	0.9992	3728	25	25	1.2587	0.0337	255	88	0.0037	0.0020
16	60	0.0348	134897	0.9993	0.0348	134897	0.9993	3668	30	30	1.2697	0.0447	272	102	0.0041	0.0023
17	78	0.0357	131433	0.9995	0.0357	131433	0.9995	3647	30	30	1.2778	0.0529	277	104	0.0042	0.0024
18	89	0.0371	126647	0.9996	0.0371	126647	0.9996	3563	35	35	1.2893	0.0644	293	119	0.0046	0.0028
19	97	0.0385	121789	0.9996	0.0385	121789	0.9996	3504	38	38	1.3013	0.0764	305	128	0.0049	0.0030
20	87	0.0398	118960	0.9995	0.0398	118960	0.9995	3481	39	39	1.3084	0.0835	312	131	0.0050	0.0031
21	96	0.0416	112824	0.9996	0.0416	112824	0.9996	3362	47	47	1.3242	0.0992	337	155	0.0057	0.0038
22	92	0.0434	107149	0.9996	0.0434	107149	0.9996	3240	51	51	1.3393	0.1143	350	169	0.0061	0.0042
23	80	0.0468	96480	0.9994	0.0468	96480	0.9994	2981	64	64	1.3689	0.1440	390	212	0.0074	0.0055
24	103	0.0487	90566	0.9996	0.0487	90566	0.9996	2869	64	64	1.3862	0.1613	384	204	0.0075	0.0056
25	90	0.0506	85601	0.9994	0.0506	85601	0.9994	2718	69	69	1.4013	0.1763	393	218	0.0080	0.0061

Specimen FGN-60

Unload No.	No. of Data Points	COD (in.)	COD Slope (lb/in)	COD Corr.	Loadline Disp. (in.)	Loadline Slope (lb/in)	Loadline Corr.	Load (lb.)	COD Area$_{pl}$ (in-lb)	LL Area$_{pl}$ (in-lb)	Crack Length (in.)	Crack Extension (in.)	J (in-lb/in^2)	J Plastic (in-lb/in^2)	CTOD (in.)	CTOD Plastic (in.)
1	92	0.0035	149526	0.9996	0.0035	149526	0.9996	596	-0	-0	1.2365	0.0070	4	0	-0.0001	-0.0001
2	77	0.0051	149879	0.9994	0.0051	149879	0.9994	826	-0	-0	1.2357	0.0062	7	-0	-0.0000	-0.0001
3	80	0.0076	150596	0.9995	0.0076	150596	0.9995	1189	0	0	1.2342	0.0047	16	0	0.0001	-0.0001
4	76	0.0103	151472	0.9994	0.0103	151472	0.9994	1582	0	0	1.2323	0.0028	28	1	0.0002	-0.0000
5	63	0.0133	152160	0.9991	0.0133	152160	0.9991	1987	1	1	1.2308	0.0013	46	3	0.0005	0.0000
6	67	0.0161	152288	0.9993	0.0161	152288	0.9993	2357	2	2	1.2305	0.0010	66	7	0.0008	0.0002
7	72	0.0188	152526	0.9992	0.0188	152526	0.9992	2684	3	3	1.2300	0.0005	89	12	0.0011	0.0003
8	76	0.0210	152486	0.9994	0.0210	152486	0.9994	2929	5	5	1.2301	0.0006	110	18	0.0014	0.0005
9	60	0.0234	151426	0.9991	0.0234	151426	0.9991	3173	8	8	1.2324	0.0029	136	27	0.0018	0.0007
10	73	0.0260	150567	0.9993	0.0260	150567	0.9993	3393	11	11	1.2342	0.0047	163	38	0.0022	0.0009
11	74	0.0277	149546	0.9995	0.0277	149546	0.9995	3525	13	13	1.2365	0.0070	183	47	0.0026	0.0011
12	76	0.0293	147617	0.9992	0.0293	147617	0.9992	3602	16	16	1.2407	0.0112	203	58	0.0029	0.0014
13	83	0.0311	145480	0.9994	0.0311	145480	0.9994	3698	20	20	1.2455	0.0160	224	69	0.0032	0.0016
14	65	0.0326	143247	0.9992	0.0326	143247	0.9992	3729	23	23	1.2505	0.0210	242	81	0.0035	0.0018
15	66	0.0340	140624	0.9993	0.0340	140624	0.9993	3756	26	26	1.2564	0.0269	260	92	0.0038	0.0021
16	64	0.0356	137327	0.9992	0.0356	137327	0.9992	3740	31	31	1.2640	0.0345	279	107	0.0042	0.0024
17	58	0.0371	131739	0.9991	0.0371	131739	0.9991	3670	36	36	1.2771	0.0476	299	124	0.0046	0.0028
18	75	0.0380	129879	0.9994	0.0380	129879	0.9994	3644	36	36	1.2815	0.0520	299	123	0.0047	0.0028
19	79	0.0392	127136	0.9994	0.0392	127136	0.9994	3649	39	39	1.2882	0.0587	313	131	0.0049	0.0030
20	70	0.0402	124607	0.9992	0.0402	124607	0.9992	3584	42	42	1.2943	0.0648	323	143	0.0052	0.0033
21	80	0.0420	116684	0.9992	0.0420	116684	0.9992	3430	51	51	1.3142	0.0847	352	171	0.0059	0.0040
22	83	0.0435	111294	0.9992	0.0435	111294	0.9992	3348	52	52	1.3282	0.0987	354	171	0.0061	0.0041
23	81	0.0443	109165	0.9994	0.0443	109165	0.9994	3310	51	51	1.3339	0.1044	350	165	0.0060	0.0041
24	97	0.0456	105912	0.9995	0.0456	105912	0.9995	3254	55	55	1.3426	0.1131	365	179	0.0064	0.0044
25	75	0.0475	99770	0.9994	0.0475	99770	0.9994	3077	63	63	1.3596	0.1301	388	207	0.0071	0.0052
26	72	0.0495	93146	0.9992	0.0495	93146	0.9992	2895	69	69	1.3786	0.1491	400	224	0.0078	0.0059
27	78	0.0516	87233	0.9994	0.0516	87233	0.9994	2747	73	73	1.3963	0.1668	409	235	0.0083	0.0064
28	101	0.0527	84404	0.9996	0.0527	84404	0.9996	2695	72	72	1.4050	0.1755	402	226	0.0082	0.0064
29	86	0.0555	75930	0.9988	0.0555	75930	0.9988	2456	84	84	1.4321	0.2026	435	265	0.0096	0.0079

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