

FRACTURE TOUGHNESS DATA FOR FERRITIC NUCLEAR PRESSURE VESSEL MATERIALS

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Part II: Appendices 5-8**

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APPENDIX 5

MATERIAL 5

MANUAL METAL ARC (MMA) WELDMENT IN A533B-1 BASE

AND

HEAT AFFECTED ZONE MATERIAL FOR MMA WELD AND A533B-1 BASE

MATERIAL TYPE 5
MMA WELD, HAZ IN A533B-1

INTRODUCTION

Nine heats of manual arc welded A533B-1 steel were studied, namely, ETI heats 9 to 12 (I to L) and CE heats 12 to 16 (L to P). A brief description of the various heats is given in Table 5.1. More details on the ETI heats are given in reference 13, and for the CE heats in reference 12. The test results extracted from the data bank are listed at the end of this section.

TENSILE TESTS RESULTS

The 2-in. gage section tensile test results are illustrated in Figures 5.1 to 5.15 together with plots of the cubic polynomials that were fitted to the data. The curve fit coefficients and the statistical data for each curve are summarized in Table 5.2. The figures are divided as follows: Figures 5.1 to 5.5 correspond to MMA weld longitudinal (direction of weld) properties with J (i.e., property) values ranging from 2 to 6. Figures 5.6 to 5.10 correspond to MMA weld transverse (perpendicular to weld) properties with J again ranging from 2 to 6. Finally Figures 5.11 to 5.15 correspond to heat affected zone (HAZ) properties with J similarly ranging from 2 to 6. Note that the heat-affected zone samples are a combination of weld metal, HAZ, and base metal in the gage section; this combination often means that the property measured is that of the weakest element, generally the base material. Also, the CE samples used a 2-in. gage section while the ETI samples had a 1-in. gage section for this material.

CHARPY V-NOTCH RESULTS

Impact Energy

The Charpy V-notch energy results for material 5 were curve fitted using the tanh analysis and the resultant statistical parameters are given in Table 5.3. The deviations of the various statistical parameters in

Table 5.3 from the mean values are given in Table 5.4. The tanh curve fits for the manual metal arc weld data are shown in Figures 5.16 to 5.25. Note that CE measured the MMA weld impact properties in both the longitudinal and transverse orientation. The tanh curve fits for the MMA heat affected zone (HAZ) data are shown in Figures 5.26 to 5.28. The T_0 values for CE heat M (longitudinal, 231351) is high, and the variance for CE heat L (HAZ, 231253) is large due to one outlying data point in the transition region (Figure 5.26).

Lateral Expansion

The statistical parameters related to the tanh fit of the lateral expansion data are given in Table 5.5, and the associated deviations of these parameters are given in Table 5.6. The lateral expansion data for the MMA welds are plotted in Figures 5.29 to 5.38, and the data for the HAZ are plotted in Figures 5.39 to 5.41. The T_0 value for ETI weld metal heat I (25952) is high as is the C value for CE heat L (231253). Again, the variance is high for CE heat L (231253)

Percent Shear

Table 5.7 summarizes the curve fit parameters obtained from a tanh fit of the percent shear data. The deviation of these parameters from the mean values is given in Table 5.8. The percent shear results are shown graphically for the MMA weld and HAZ materials in Figures 5.42 to 5.51 and Figures 5.52 to 5.54, respectively. ETI heat I (25952) has high values of A and T_0 , and CE heat L (231253) again shows a large variance.

Summary of Charpy Impact Test Data

A review of the variance statistics reveals that data set 231253 (CE heat L, HAZ) exhibited a substantial deviation from the mean values. The CE HAZ heat impact energy data (Table 5.4) had a normalized deviation for variance of 3.14, 2.11 for lateral expansion (Table 5.6) and 2.54 for percent shear (Table 5.8). A check of the corresponding figures (5.26, 5.39, and 5.52) reveals that one of the data points exhibits an exceptionally large deviation from the tanh curve.

A comparison of the transition temperature corresponding to the lower knee of the Charpy curves ($T_0 - C$) with RT_{NDT} and NDTT is given in Table 5.9. There appears to be little correlation between these various measurements of the ductile-brittle transition temperature. Note the large difference between the $T_0 - C$ and RT_{NDT} or NDTT values for data set 251253 (ETI heat L, HAZ).

INSTRUMENTED PRECRACKED CHARPY RESULTS

Dynamic Fracture Toughness K_{Id} , K_d^*

The tanh curve fit coefficients and the statistical parameters for material 5 data are summarized in Table 5.10, and their deviations from mean values are given in Table 5.11. The data sets for the MMA weld are plotted in Figures 5.55 to 5.60. The data sets for the HAZ heats are shown in Figures 5.61 to 5.63.

Normalized Energy, W/A

The statistical parameters obtained by fitting the normalized energy data with the tanh curve are given in Table 5.12. A further analysis of these parameters is given in Table 5.13. The W/A data for the MMA welds are shown in Figures 5.64 to 5.69. The W/A data for the HAZ materials are shown in Figures 5.70 to 5.72.

Summary of Precracked Charpy Results

An examination of the statistics again reveals the large variance associated with CE heat L. The $T_0 - C$ values for the precracked Charpy data are compared with RT_{NDT} and NDTT in Table 5.14. The $T_0 - C$ values from the W/A curves seem to correlate fairly well with the NDTT. The precracked Charpy K_{Id} , K_d^* data for all the heats of material 5 have been summarized and compared to the K_{IR} curve in Figures 5.73 (MMA weld) and 5.74 (HAZ). Note that for manual metal arc weldments in A533B-1, ETI heat K (11) and CE heat M (13) fall below the K_{IR} curve. Also, CE heat N (14) falls right on the lower portion of the K_{IR} curve.

Figures 5.75 and 5.76 summarize the normalized energy data for the MMA welds and HAZ materials, respectively.

STATIC COMPACT AND DYNAMIC ONE-INCH AND FOUR-INCH FRACTURE TOUGHNESS RESULTS

The results for static 1-in. and 2-in. compact fracture tests (test types 5 and 11), dynamic one-inch and four-inch compact tests (test types 8 and 7), and dynamic one-inch bend tests (test type 6) for material 5 are illustrated in Figures 5.77 to 5.85. The number of tests were very limited and tanh curve fits were not made. The static fracture toughness data for the MMA welds and HAZ are summarized and compared to the K_{IR} curve in Figures 5.86 and 5.87, respectively. The static fracture toughness falls well above the K_{IR} curve, as would be expected. The dynamic toughness data from the 1-in. and 4-in. fracture tests are summarized in Figures 5.88 - 5.91 compared to the K_{IR} curve.

EFFECT OF ERROR CODES

The static and dynamic fracture toughness results for material 5 were statistically analyzed with and without the data points which did not meet the EPRI procedures. Tanh curve fits to the total data and acceptable data only are shown in Figures 5.92 - 5.95. The influence of the error code data on shelf properties and variance was determined. Both the overall variance and the variance in the transition temperature region ($T_0 \pm 50^\circ\text{F}$) were compared. A summary of the error code analysis is given in Table 5.15. The variance ratio (F) was calculated for the static and dynamic fracture toughness results. The ratios shown in Table 5.15 had a high probability of occurring by chance, and it is concluded that the effect of the error codes on the data was not significant.

Table 5.1. Summary of MMA Weld and HAZ Materials in A533B-1 (Material 5)

<u>TEST LABORATORY</u>	<u>HEAT CODE</u>	<u>WELDING CONDITIONS</u>	<u>NDTT (^oF)</u>	<u>RT_{NDT} (^oF)</u>	<u>COMMENTS</u>
CE (Weld)	M (13)	(Ref. 12)	-70	-70	{ E8018-C3 Electrode
	N (14)		-70	-70	
	O (15)		-60	-60	
	P (16)		-80	-80	
ETI (Weld)	I (9)	(Ref. 13)	-50	-10	{ E8018-NM Electrode
	K (11)		-50	-40	
CE (HAZ)	L (12)	(Ref. 12)	-70	-40	heat CA base metal
ETI (HAZ)	J (10)	(Ref. 13)	-40	-40	heat EH base metal
	L (12)		-50	-50	heat EF base metal

Table 5.2. Summary of Statistical Parameters for Tensile Data on MMA Welds and HAZ in A533B-1 Base

Property	Material	A	B	C	D	Variance, σ^2	Degrees of Freedom ϕ	Standard Deviation σ
Yield Stress	CE Weld (L)	7.382X10	-5.865X10 ⁻²	5.876X10 ⁻⁵	2.424X10 ⁻⁸	13.99	20	3.74
	ETI Weld (T)	7.842X10	-5.899X10 ⁻²	1.439X10 ⁻⁴	-1.415X10 ⁻⁷	14.01	8	3.74
	CE & ETI HAZ	6.782X10	-6.779X10 ⁻²	1.824X10 ⁻⁴	-1.566X10 ⁻⁷	23.72	14	4.87
Ultimate Tensile Strength	Weld (L)	8.835X10	-6.182X10 ⁻²	9.078X10 ⁻⁵	4.788X10 ⁻⁹	3.01	20	1.73
	Weld (T)	9.349X10	-7.255X10 ⁻²	1.345X10 ⁻⁴	-5.144X10 ⁻⁸	4.95	8	2.22
	HAZ	9.228X10	-7.819X10 ⁻²	1.297X10 ⁻⁴	-1.674X10 ⁻⁸	16.64	14	4.08
Uniform Elongation	Weld (L)	1.287X10	-1.311X10 ⁻²	-9.818X10 ⁻⁶	5.161X10 ⁻⁸	0.49	19	0.7
	Weld (T)	9.596X10	-1.542X10 ⁻²	3.368X10 ⁻⁵	-2.228X10 ⁻⁸	0.60	8	0.77
	HAZ	1.104X10	-1.437X10 ⁻²	-1.455X10 ⁻⁵	5.859X10 ⁻⁸	1.84	13	1.36
Total Elongation	Weld (L)	3.131X10	-1.137X10 ⁻²	-6.387X10 ⁻⁵	1.298X10 ⁻⁷	1.7	20	1.30
	Weld (T)	2.274X10	-1.379X10 ⁻³	7.258X10 ⁻⁵	-9.891X10 ⁻⁸	11.60	8	3.41
	HAZ	2.692X10	-9.375X10 ⁻³	-3.788X10 ⁻⁵	6.898X10 ⁻⁸	4.74	14	2.18
Reduction In Area	Weld (L)	7.374X10	2.111X10 ⁻²	-1.195X10 ⁻⁴	1.191X10 ⁻⁷	6.58	20	2.57
	Weld (T)	6.044X10	-1.370X10 ⁻²	2.086X10 ⁻⁵	-3.058X10 ⁻⁷	111.62	8	10.57
	HAZ	6.771X10	-1.409X10 ⁻²	6.294X10 ⁻⁵	-2.107X10 ⁻⁷	25.63	14	5.06

Table 5.3. Tanh Fit Parameters for Charpy Impact Energy Data (MMA, HAZ, A533B-1)

KEY	J	A	B	T0	C	PHI	VAR
25952	2	59.65	48.31	30.38	64.51	12	241.95
231253	2	75.50	75.50	-9.99	146.17	9	2029.33
231351	2	101.26	101.26	41.10	146.74	4	510.07
231352	2	80.23	79.20	-11.12	54.04	8	560.26
231551	2	94.72	94.72	-4.96	131.68	10	467.60
231552	2	97.50	88.64	-14.11	57.39	8	141.20
231651	2	98.66	94.91	-21.98	69.75	5	68.00
231652	2	99.24	99.24	-19.40	75.49	8	410.85
251053	2	68.00	57.86	-18.80	32.68	10	486.25
251152	2	51.67	50.41	2.17	54.18	8	184.44
251253	2	64.56	57.13	-39.04	70.31	8	365.77
2231451	2	95.81	93.19	-21.15	69.94	6	145.14
2231452	2	78.00	78.00	-7.51	61.81	9	498.53

Table 5.4. Deviation of Charpy Impact Energy Curve Fit Parameters from Mean Values (MMA, HAZ, A533B-1)

<u>A</u>			
TOTAL	1064.8		
MEAN	81.9076923		
ST. DEV	17.12537696		
KEY	VAL	DEV	NORMALIZED DEV
25952	59.65	-22.26	-1.30
231253	75.50	-6.41	-0.37
231351	101.26	19.35	1.13
231352	80.23	-1.68	-0.10
231551	94.72	12.81	0.75
231552	97.50	15.59	0.91
231651	98.66	16.75	0.98
231652	99.24	17.33	1.01
251053	68.00	-13.91	-0.81
251152	51.67	-30.24	-1.77
251253	64.56	-17.35	-1.01
2231451	95.81	13.90	0.81
2231452	78.00	-3.91	-0.23

Table 5.4. (continued)

B

TOTAL	1018.37
MEAN	78.33615385
ST. DEV	19.13051469

KEY	VAL	DEV	NORMALIZED DEV
25952	48.31	-30.03	-1.57
231253	75.50	-2.84	-0.15
231351	101.26	22.92	1.20
231352	79.20	0.86	0.05
231551	94.72	16.38	0.86
231552	88.64	10.30	0.54
231651	94.91	16.57	0.87
231652	99.24	20.90	1.09
251053	57.86	-20.48	-1.07
251152	50.41	-27.93	-1.46
251253	57.13	-21.21	-1.11
2231451	93.19	14.85	0.78
2231452	78.00	-0.34	-0.02

T₀

TOTAL	-94.41
MEAN	-7.262307692
ST. DEV	21.63935772

KEY	VAL	DEV	NORMALIZED DEV
25952	30.38	37.64	1.74
231253	-9.99	-2.73	-0.13
231351	41.10	48.36	2.23
231352	-11.12	-3.86	-0.18
231551	-4.96	2.30	0.11
231552	-14.11	-6.85	-0.32
231651	-21.98	-14.72	-0.68
231652	-19.40	-12.14	-0.56
251053	-18.80	-11.54	-0.53
251152	2.17	9.43	0.44
251253	-39.04	-31.78	-1.47
2231451	-21.15	-13.89	-0.64
2231452	-7.51	-0.25	-0.01

Table 5.4. (continued)

C

TOTAL	1034.69
MEAN	79.59153846
ST. DEV	37.06262377

KEY	VAL	DEV	NORMALIZED DEV
25952	64.51	-15.00	-0.41
231253	146.17	66.58	1.80
231351	146.74	67.15	1.81
231352	54.04	-25.55	-0.69
231551	131.68	52.09	1.41
231552	57.39	-22.20	-0.60
231651	69.75	-9.84	-0.27
231652	75.49	-4.10	-0.11
251053	32.68	-46.91	-1.27
251152	54.18	-25.41	-0.69
251253	70.31	-9.28	-0.25
2231451	69.94	-9.65	-0.26
2231452	61.81	-17.78	-0.48

PHI

TOTAL	104
MEAN	8
ST. DEV	2.121320344

KEY	VAL	DEV	NORMALIZED DEV
25952	12.00	4.00	1.89
231253	8.00	0.00	0.00
231351	4.00	-4.00	-1.89
231352	8.00	0.00	0.00
231551	10.00	2.00	0.94
231552	8.00	0.00	0.00
231651	5.00	-3.00	-1.41
231652	8.00	0.00	0.00
251053	10.00	2.00	0.94
251152	8.00	0.00	0.00
251253	8.00	0.00	0.00
2231451	6.00	-2.00	-0.94
2231452	9.00	1.00	0.47

Table 5.4. (continued)

<u>VARIANCE</u>			
TOTAL	6109.39		
MEAN	469.9530769		
ST. DEV	497.1173291		
KEY	VAL	DEV	NORMALIZED DEV
25952	241.95	-228.00	-0.46
231253	2029.33	1559.38	3.14
231351	510.07	40.12	0.08
231352	560.26	90.31	0.18
231551	467.60	-2.35	-0.00
231552	141.20	-328.75	-0.66
231651	68.00	-401.95	-0.81
231652	410.85	-59.10	-0.12
251053	486.25	16.30	0.03
251152	184.44	-285.51	-0.57
251253	365.77	-104.18	-0.21
2231451	145.14	-324.81	-0.65
2231452	498.53	28.58	0.06

Table 5.5. Tanh Fit Parameters for Charpy Impact Lateral Expansion Data (MMA, HAZ, A533B-1)

KEY	J	A	B	T0	C	PHI	VAR
25952	3	44.24	38.51	25.52	74.04	12	113.28
231253	3	38.84	38.84	-27.83	98.33	8	300.68
231351	3	38.75	38.75	-23.35	45.53	5	78.76
231352	3	40.88	40.88	-23.67	36.99	8	147.26
231551	3	40.44	37.05	-47.42	30.80	4	269.84
231552	3	41.99	38.35	-39.65	30.36	7	47.34
231651	3	39.08	39.08	-53.40	38.49	5	10.85
231652	3	43.03	38.41	-41.37	32.70	7	77.62
251053	3	40.25	36.37	-26.30	34.88	9	136.71
251152	3	39.99	38.78	1.31	41.92	8	96.29
251253	3	40.55	38.27	-40.99	74.29	8	128.32
2231451	3	46.65	39.84	-55.24	20.51	9	116.12
2231452	3	45.51	39.39	-10.46	34.27	6	165.85

Table 5.6. Deviation of Charpy Impact Lateral Expansion Curve Fit Parameters
from Mean value (MMA, HAZ, A533B-1)

A

TOTAL	540.2
MEAN	41.55384615
ST. DEV	2.572306159

KEY	VAL	DEV	NORMALIZED DEV
25952	44.24	2.69	1.04
231253	38.84	-2.71	-1.06
231351	38.75	-2.80	-1.09
231352	40.88	-0.67	-0.26
231551	40.44	-1.11	-0.43
231552	41.99	0.44	0.17
231651	39.08	-2.47	-0.96
231652	43.03	1.48	0.57
251053	40.25	-1.30	-0.51
251152	39.99	-1.56	-0.61
251253	40.55	-1.00	-0.39
2231451	46.65	5.10	1.98
2231452	45.51	3.96	1.54

B

TOTAL	502.52
MEAN	38.65538462
ST. DEV	1.127464822

KEY	VAL	DEV	NORMALIZED DEV
25952	38.51	-0.15	-0.13
231253	38.84	0.18	0.16
231351	38.75	0.09	0.08
231352	40.88	2.22	1.97
231551	37.05	-1.61	-1.42
231552	38.35	-0.31	-0.27
231651	39.08	0.42	0.38
231652	38.41	-0.25	-0.22
251053	36.37	-2.29	-2.03
251152	38.78	0.12	0.11
251253	38.27	-0.39	-0.34
2231451	39.84	1.18	1.05
2231452	39.39	0.73	0.65

Table 5.6. (continued)

<u>T₀</u>			
TOTAL	-362.85		
MEAN	-27.91153846		
ST. DEV	22.95256008		
KEY	VAL	DEV	NORMALIZED DEV
25952	25.52	53.43	2.33
231253	-27.83	0.08	0.00
231351	-23.35	4.56	0.20
231352	-23.67	4.24	0.18
231551	-47.42	-19.51	-0.85
231552	-39.65	-11.74	-0.51
231651	-53.40	-25.49	-1.11
231652	-41.37	-13.46	-0.59
251053	-26.30	1.61	0.07
251152	1.31	29.22	1.27
251253	-40.99	-13.08	-0.57
2231451	-55.24	-27.33	-1.19
2231452	-10.46	17.45	0.76

<u>C</u>			
TOTAL	593.11		
MEAN	45.62384615		
ST. DEV	22.43718957		
KEY	VAL	DEV	NORMALIZED DEV
25952	74.04	28.42	1.27
231253	98.33	52.71	2.35
231351	45.53	-0.09	-0.00
231352	36.99	-8.63	-0.38
231551	30.80	-14.82	-0.66
231552	30.36	-15.26	-0.68
231651	38.49	-7.13	-0.32
231652	32.70	-12.92	-0.58
251053	34.88	-10.74	-0.48
251152	41.92	-3.70	-0.17
251253	74.29	28.67	1.28
2231451	20.51	-25.11	-1.12
2231452	34.27	-11.35	-0.51

Table 5.6. (continued)

<u>PHI</u>			
TOTAL	96		
MEAN	7.384615385		
ST. DEV	2.103111248		
KEY	VAL	DEV	NORMALIZED DEV
25952	12.00	4.62	2.19
231253	8.00	0.62	0.29
231351	5.00	-2.38	-1.13
231352	8.00	0.62	0.29
231551	4.00	-3.38	-1.61
231552	7.00	-0.38	-0.18
231651	5.00	-2.38	-1.13
231652	7.00	-0.38	-0.18
251053	9.00	1.62	0.77
251152	8.00	0.62	0.29
251253	8.00	0.62	0.29
2231451	9.00	1.62	0.77
2231452	6.00	-1.38	-0.66

<u>VARIANCE</u>			
TOTAL	1688.92		
MEAN	129.916923		
ST. DEV	80.79034177		
KEY	VAL	DEV	NORMALIZED DEV
25952	113.28	-16.64	-0.21
231253	300.68	170.76	2.11
231351	78.76	-51.16	-0.63
231352	147.26	17.34	0.21
231551	269.84	139.92	1.73
231552	47.34	-82.58	-1.02
231651	10.85	-119.07	-1.47
231652	77.62	-52.30	-0.65
251053	136.71	6.79	0.08
251152	96.29	-33.63	-0.42
251253	128.32	-1.60	-0.02
2231451	116.12	-13.80	-0.17
2231452	165.85	35.93	0.44

Table 5.7. Tanh Fit Parameters for Charpy Impact Percent Shear Data
(MMA, HAZ, A533B-1)

KEY	J	A	B	T0	C	PH1	VAR
25952	4	54.49	46.22	45.99	64.80	12	87.56
231253	4	52.57	46.50	7.00	56.40	8	366.66
231351	4	50.41	50.41	-5.23	65.06	5	49.38
231352	4	49.77	49.77	-15.96	56.68	8	286.03
231551	4	50.36	47.71	-17.82	71.54	5	173.77
231552	4	51.74	45.55	-16.92	34.82	8	67.49
231651	4	48.94	48.94	-21.19	53.27	5	108.54
231652	4	52.33	46.71	-17.33	34.86	8	90.19
251053	4	50.38	50.38	-8.13	91.61	10	154.65
251152	4	48.62	48.62	7.21	37.84	8	150.25
251253	4	48.71	48.71	-44.99	76.62	8	222.69
2231451	4	50.07	42.84	-36.16	28.57	9	92.74
2231452	4	51.65	44.14	-13.18	42.58	6	40.60

Table 5.8. Deviation of Charpy Impact Percent Shear Curve Fit Parameters from Mean Values (MMA, HAZ, A533B-1)

A

TOTAL 660.04
MEAN 50.77230769
ST. DEV 1.717120429

KEY	VAL	DEV	NORMALIZED DEV
25952	54.49	3.72	2.17
231253	52.57	1.80	1.05
231351	50.41	-0.36	-0.21
231352	49.77	-1.00	-0.58
231551	50.36	-0.41	-0.24
231552	51.74	0.97	0.56
231651	48.94	-1.83	-1.07
231652	52.33	1.56	0.91
251053	50.38	-0.39	-0.23
251152	48.62	-2.15	-1.25
251253	48.71	-2.06	-1.20
2231451	50.07	-0.70	-0.41
2231452	51.65	0.88	0.51

Table 5.8. (continued)

<u>B</u>			
TOTAL	616.5		
MEAN	47.42307692		
ST. DEV	2.358404775		
KEY	VAL	DEV	NORMALIZED DEV
25952	46.22	-1.20	-0.51
231253	46.50	-0.92	-0.39
231351	50.41	2.99	1.27
231352	49.77	2.35	1.00
231551	47.71	0.29	0.12
231552	45.55	-1.87	-0.79
231651	48.94	1.52	0.64
231652	46.71	-0.71	-0.30
251053	50.38	2.96	1.25
251152	48.62	1.20	0.51
251253	48.71	1.29	0.55
2231451	42.84	-4.58	-1.94
2231452	44.14	-3.28	-1.39

<u>T₀</u>			
TOTAL	-136.71		
MEAN	-10.51615385		
ST. DEV	22.33292433		
KEY	VAL	DEV	NORMALIZED DEV
25952	45.99	56.51	2.53
231253	7.00	17.52	0.78
231351	-5.23	5.29	0.24
231352	-15.96	-5.44	-0.24
231551	-17.82	-7.30	-0.33
231552	-16.92	-6.40	-0.29
231651	-21.19	-10.67	-0.48
231652	-17.33	-6.81	-0.31
251053	-8.13	2.39	0.11
251152	7.21	17.73	0.79
251253	-44.99	-34.47	-1.54
2231451	-36.16	-25.64	-1.15
2231452	-13.18	-2.66	-0.12

Table 5.8. (continued)

<u>C</u>			
TOTAL	764.65		
MEAN	58.81923077		
ST. DEV	20.0848224		
KEY	VAL	DEV	NORMALIZED DEV
25952	64.80	5.98	0.30
231253	56.40	-2.42	-0.12
231351	65.06	6.24	0.31
231352	56.68	-2.14	-0.11
231551	71.54	12.72	0.63
231552	34.82	-24.00	-1.19
231651	53.27	-5.55	-0.28
231652	34.86	-23.96	-1.19
251053	91.61	32.79	1.63
251152	87.84	29.02	1.44
251253	76.62	17.80	0.89
2231451	28.57	-30.25	-1.51
2231452	42.58	-16.24	-0.81

<u>PHI</u>			
TOTAL	100		
MEAN	7.692307692		
ST. DEV	2.056883378		
KEY	VAL	DEV	NORMALIZED DEV
25952	12.00	4.31	2.09
231253	8.00	0.31	0.15
231351	5.00	-2.69	-1.31
231352	8.00	0.31	0.15
231551	5.00	-2.69	-1.31
231552	8.00	0.31	0.15
231651	5.00	-2.69	-1.31
231652	8.00	0.31	0.15
251053	10.00	2.31	1.12
251152	8.00	0.31	0.15
251253	8.00	0.31	0.15
2231451	9.00	1.31	0.64
2231452	6.00	-1.69	-0.82

Table 5.8. (continued)

		<u>VARIANCE</u>	
TOTAL		1810.55	
MEAN		139.2730769	
ST. DEV		89.36342208	
KEY	VAL	DEV	NORMALIZED DEV
25952	87.56	-51.71	-0.58
231253	366.66	227.39	2.54
231351	49.38	-89.89	-1.01
231352	206.03	66.76	0.75
231551	173.77	34.50	0.39
231552	67.49	-71.78	-0.80
231651	108.54	-30.73	-0.34
231652	90.19	-49.08	-0.55
251053	154.65	15.38	0.17
251152	150.25	10.98	0.12
251253	222.69	83.42	0.93
2231451	92.74	-46.53	-0.52
2231452	40.60	-98.67	-1.10

Table 5.9. Comparison of $T_0 - C$ from Impact Test Measurements with RT_{NDT} and $NDTT$
(MMA, HAZ, A533B-1)

KEY	$T_0 - C$ ($^{\circ}F$)			RT_{NDT} ($^{\circ}F$)	$NDTT$ ($^{\circ}F$)
	IMPACT ENERGY	LATERAL EXPANSION	PERCENT SHEAR		
25952	-34	-49	-19	-10	-50
231253	-156	-126	-49	-40	-70
231351	-106	-69	-70	---	-70
231352	-65	-61	-73	-70	-70
231551	-137	-78	-89	---	-60
231552	-72	-70	-52	-60	-60
231651	-92	-92	-74	---	-80
231652	-95	-74	-52	-80	-80
251053	-51	-61	-100	-40	-40
251152	-52	-41	-81	-40	-50
251253	-109	-115	-122	-50	-50
2231451	-91	-76	-65	---	-70
2231452	-69	-45	-56	-70	-70

Table 5.10. Tanh Fit Parameters for Precracked Charpy Toughness
Data (MMA, HAZ, A533B-1)

KEY	J	A	B	T0	C	PN1	VAR
35952	2	138.62	111.08	35.88	15.67	5	554.98
331253	2	188.19	148.24	-5.69	58.96	4	9486.86
331352	2	186.51	146.55	38.82	65.68	8	4111.92
331552	2	198.33	151.64	8.93	31.13	5	1833.31
331652	2	187.52	147.92	-2.98	44.64	6	51.88
351853	2	165.89	121.15	4.56	11.21	6	39.72
351152	2	146.88	98.88	72.58	4.88	4	183.73
351253	2	156.87	121.13	-53.74	24.86	4	2282.35
3231452	2	162.88	128.83	15.19	37.41	6	1599.72

Table 5.11. Deviation of Precracked Charpy Fracture Toughness Curve Fit Parameters from Mean Values (MMA, HAZ, A533B-1)

A

TOTAL	1512.41
MEAN	168.0455556
ST. DEV	19.04376743

KEY	VAL	DEV	NORMALIZED DEV
35952	138.62	-29.43	-1.55
331253	180.19	12.14	0.64
331352	186.51	18.46	0.97
331552	190.33	22.28	1.17
331652	187.52	19.47	1.02
351053	165.09	-2.96	-0.16
351153	146.00	-21.97	-1.15
351253	156.07	-11.98	-0.63
3231452	162.00	-6.05	-0.32

B

TOTAL	1158.37
MEAN	128.7077778
ST. DEV	18.64470085

KEY	VAL	DEV	NORMALIZED DEV
35952	111.30	-17.41	-0.93
331253	140.24	11.53	0.62
331352	146.66	17.95	0.96
331552	151.64	22.93	1.23
331652	147.92	19.21	1.03
351053	121.15	-7.56	-0.41
351152	98.00	-30.71	-1.65
351253	121.13	-7.58	-0.41
3231452	120.33	-8.38	-0.45

Table 5.11. (continued)

<u>T₀</u>			
TOTAL	96.59		
MEAN	10.73222222		
ST. DEV	34.61232395		
KEY	VAL	DEV	NORMALIZED DEV
35952	35.80	25.07	0.72
331253	-5.69	-16.42	-0.47
331352	30.02	19.29	0.56
331552	0.93	-9.80	-0.28
331652	-2.98	-13.71	-0.40
351053	4.56	-6.17	-0.18
351152	72.50	61.77	1.78
351253	-53.74	-64.47	-1.86
3231452	15.19	4.46	0.13

<u>C</u>			
TOTAL	304.76		
MEAN	33.86222222		
ST. DEV	19.71783569		
KEY	VAL	DEV	NORMALIZED DEV
35952	45.67	11.81	0.60
331253	50.96	17.10	0.87
331352	65.68	31.82	1.61
331552	31.13	-2.73	-0.14
331652	44.64	10.78	0.55
351053	11.21	-22.65	-1.15
351152	4.00	-29.86	-1.51
351253	24.06	-9.80	-0.50
3231452	27.41	-6.45	-0.33

Table 5.11. (continued)

<u>PHI</u>			
TOTAL	50		
MEAN	5.555555556		
ST. DEV	1.589898669		
KEY	VAL	DEV	NORMALIZED DEV
35952	5.00	-0.56	-0.35
331253	4.00	-1.56	-0.98
331352	8.00	2.44	1.54
331552	5.00	-0.56	-0.35
331652	8.00	2.44	1.54
351053	6.00	0.44	0.28
351152	4.00	-1.56	-0.98
351253	4.00	-1.56	-0.98
3231452	6.00	0.44	0.28

<u>VARIANCE</u>			
TOTAL	19904.31		
MEAN	2211.59		
ST. DEV	3197.955186		
KEY	VAL	DEV	NORMALIZED DEV
35952	554.90	-1656.69	-0.52
331253	9986.86	7775.27	2.43
331352	4111.92	1900.33	0.59
331552	1033.31	-1178.28	-0.37
331652	51.80	-2159.79	-0.68
351053	99.72	-2111.87	-0.66
351152	183.73	-2027.86	-0.63
351253	2282.35	70.76	0.02
3231452	1599.72	-611.87	-0.19

Table 5.12. Tanh Fit Parameters from Precracked Charpy W/A Data
(MMA, HAZ, A533B-1)

KEY	J	A	B	T0	C	PHI	VAR
35952	5	3032.42	2503.00	41.95	74.13	5	1.18E+05
331253	5	3817.32	3817.32	17.80	116.59	6	2.66E+06
331352	5	4460.40	4205.60	20.54	89.42	7	5.26E+05
331552	5	5259.72	4802.85	25.73	73.41	7	4.69E+05
331652	5	4672.25	4366.62	10.02	68.46	7	70113.50
351053	5	3661.90	3229.92	15.01	62.45	3	4.84E+05
351152	5	3135.37	2574.22	49.21	77.80	5	37317.30
351253	5	3832.32	2859.75	-13.84	39.14	4	6.19E+05
3231452	5	3463.42	3108.97	21.49	72.66	6	1.05E+05

Table 5.13. Deviation of Precracked Charpy W/A Curve Fit Parameters from Mean Values
(MMA, HAZ, A533B-1)

<u>A</u>			
TOTAL	35335.12		
MEAN	3926.124444		
ST. DEV	737.3244439		
KEY	VAL	DEV	NORMALIZED DEV
35952	3032.42	-893.70	-1.21
331253	3817.32	-108.80	-0.15
331352	4460.40	534.28	0.72
331552	5259.72	1333.60	1.81
331652	4672.25	746.13	1.01
351053	3661.90	-264.22	-0.36
351152	3135.37	-790.75	-1.07
351253	3832.32	-93.80	-0.13
3231452	3463.42	-462.70	-0.63

Table 5.13. (continued)

B

TOTAL	31468.25
MEAN	3496.472222
ST. DEV	831.6959345

KEY	VAL	DEV	NORMALIZED DEV
35952	2503.00	-993.47	-1.19
331253	3817.32	320.85	0.39
331352	4205.60	709.13	0.85
331552	4802.85	1306.38	1.57
331652	4366.62	870.15	1.05
351053	3229.92	-266.55	-0.32
351152	2574.22	-922.25	-1.11
351253	2859.75	-636.72	-0.77
3231452	3108.97	-387.50	-0.47

T₀

TOTAL	187.91
MEAN	20.87888889
ST. DEV	18.15869382

KEY	VAL	DEV	NORMALIZED DEV
35952	41.95	21.07	1.16
331253	17.80	-3.08	-0.17
331352	20.54	-0.34	-0.02
331552	25.73	4.85	0.27
331652	10.02	-10.86	-0.60
351053	15.01	-5.87	-0.32
351152	49.21	28.33	1.56
351253	-13.84	-34.72	-1.91
3231452	21.49	0.61	0.03

Table 5.13. (continued)

C

TOTAL	674.06
MEAN	74.89555556
ST. DEV	20.73758852

KEY	VAL	DEV	NORMALIZED DEV
35952	74.13	-0.77	-0.04
331253	116.59	41.69	2.01
331352	89.42	14.52	0.70
331552	73.41	-1.49	-0.07
331652	68.46	-6.44	-0.31
351053	62.45	-12.45	-0.60
351152	77.80	2.90	0.14
351253	39.14	-35.76	-1.72
3231452	72.66	-2.24	-0.11

PHI

TOTAL	50
MEAN	5.555555556
ST. DEV	1.424000624

KEY	VAL	DEV	NORMALIZED DEV
35952	5.00	-0.56	-0.39
331253	6.00	0.44	0.31
331352	7.00	1.44	1.01
331552	7.00	1.44	1.01
331652	7.00	1.44	1.01
351053	3.00	-2.56	-1.79
351152	5.00	-0.56	-0.39
351253	4.00	-1.56	-1.09
3231452	6.00	0.44	0.31

VARIANCE

TOTAL	5089226.8
MEAN	565469.6444
ST. DEV	817286.4027

KEY	VAL	DEV	NORMALIZED DEV
35952	1.18E+05	-4.47E+05	-0.55
331253	2.66E+06	2.09E+06	2.56
331352	5.26E+05	-39931.64	-0.05
331552	4.69E+05	-96364.64	-0.12
331652	70113.50	-4.95E+05	-0.61
351053	4.84E+05	-81111.64	-0.10
351152	37817.30	-5.28E+05	-0.65
351253	6.19E+05	53697.36	0.07
3231452	1.05E+05	-4.61E+05	-0.56

Table 5.14. Comparison of Precracked Charpy Transition Behavior with NDTT
and RT_{NDT} (MMA, HAZ, A533B-1)

KEY	$T_O - C \text{ (}^{\circ}\text{F)}$		$RT_{NDT} \text{ (}^{\circ}\text{F)}$	NDTT $\text{(}^{\circ}\text{F)}$
	K_{Id}, K_d^*	W/A		
35952	-10	-32	-10	-50
331253	-57	-99	-40	-70
331352	-36	-69	-70	-70
331552	-30	-48	-60	-60
331652	-48	-58	-80	-80
351053	-6	-47	-40	-40
351152	68	-29	-40	-50
351253	-78	-53	-50	-50
3231452	-12	-51	-70	-70

Table 5.15. Summary of Error Code Analysis for Material 5 (MMA, HAZ, A533B-1)

<u>TEST TYPE</u>	<u>INCLUDES ERROR CODES</u>	<u>NO. OF POINTS</u>	<u>SHELF(Ft-Lb)</u>		<u>VARIANCE</u>		<u>VARIANCE RATIO F</u>	
			<u>LOWER</u>	<u>UPPER</u>	<u>OVERALL</u>	<u>TRANSITION REGION</u>	<u>OVERALL</u>	<u>TRANSITION REGION</u>
Static (5)	Yes	42	7	--	6364	6530	0.85	1.07
	No	34	41	--	7462	6129		
Dynamic (6,7,8)	Yes	42	28	--	7975	16927	1.10	1.31
	No	35	76	--	7222	12957		

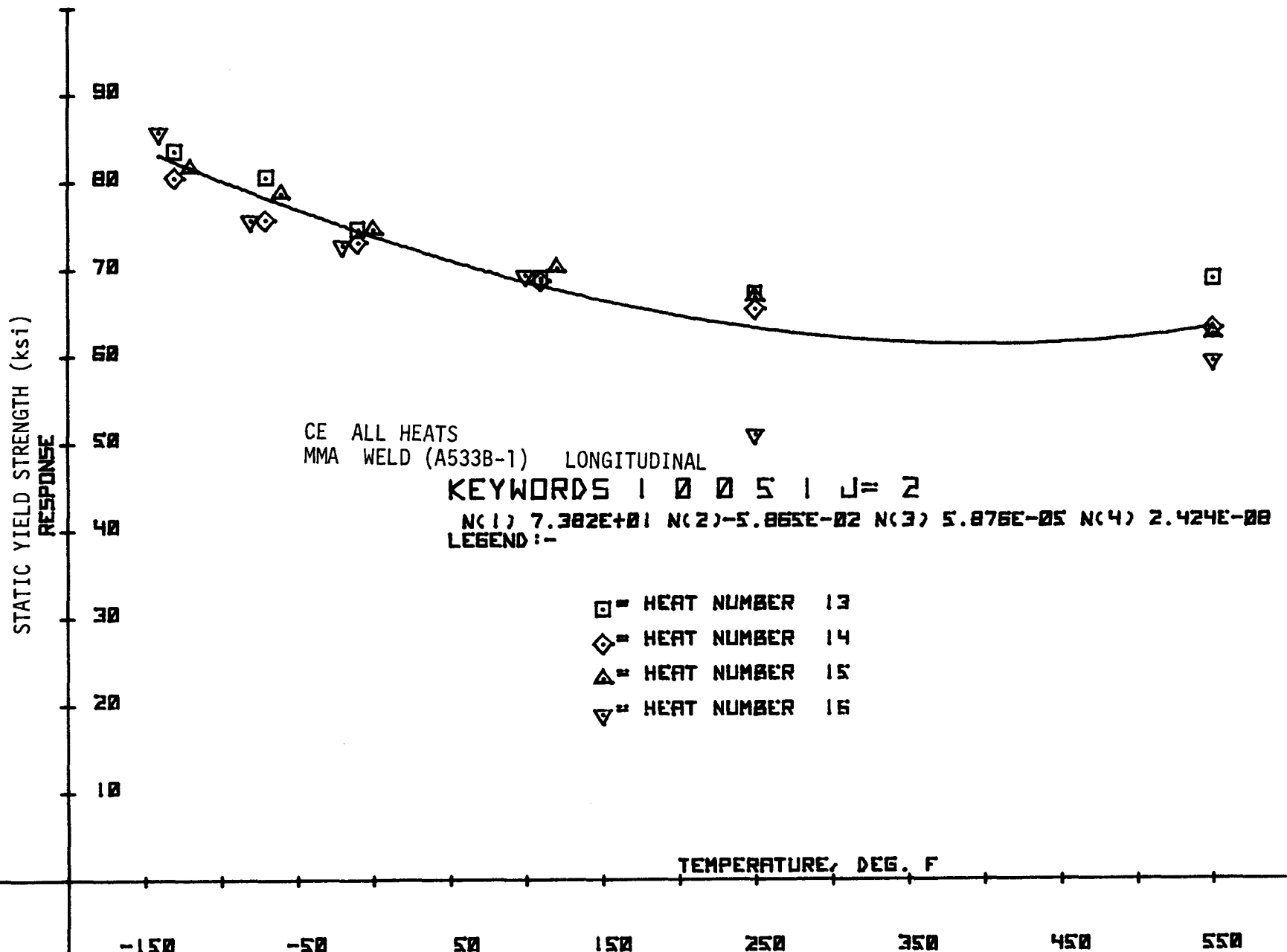


Figure 5.1. Tensile Static Yield Strength for All CE Heats (L)

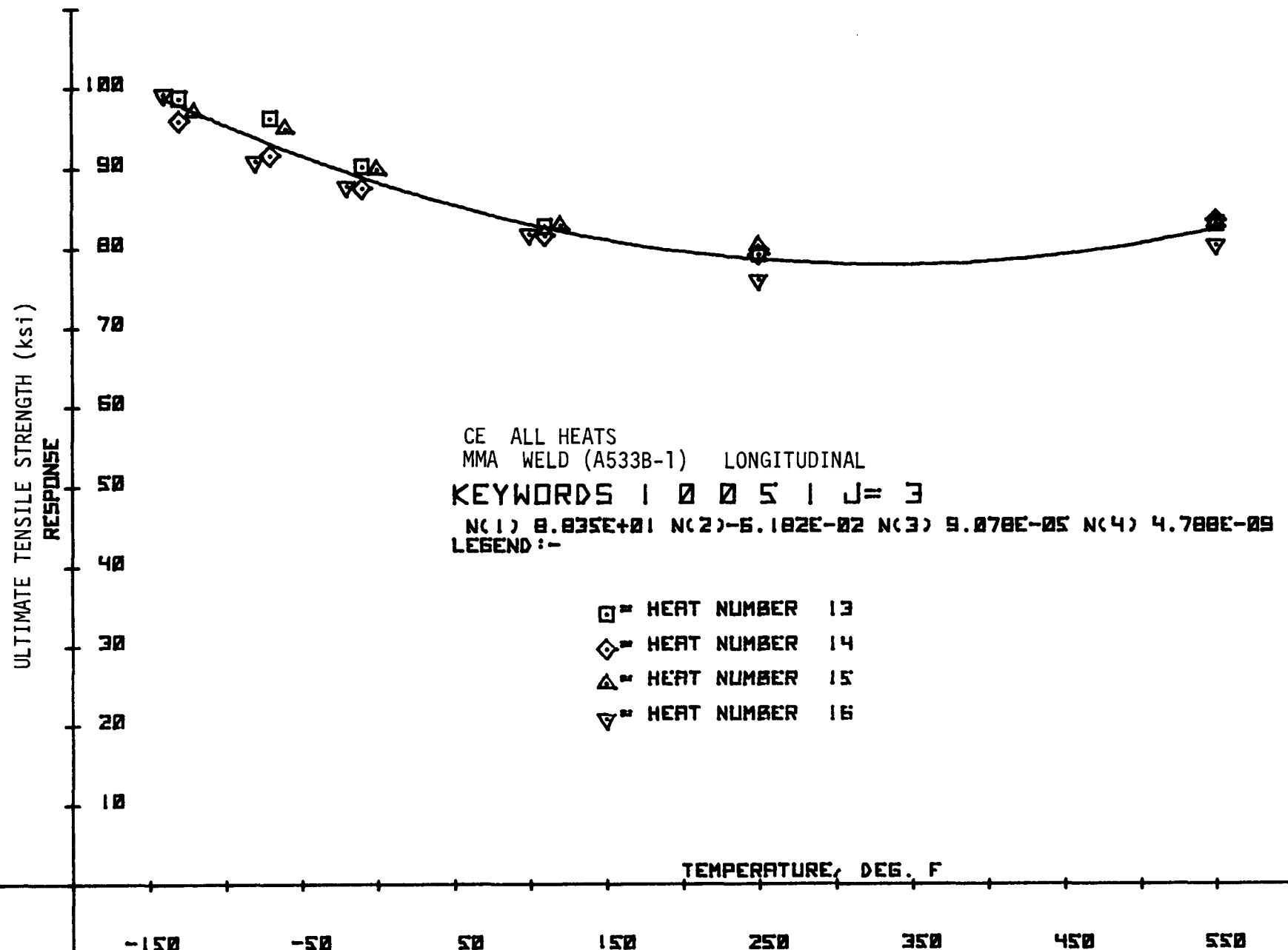
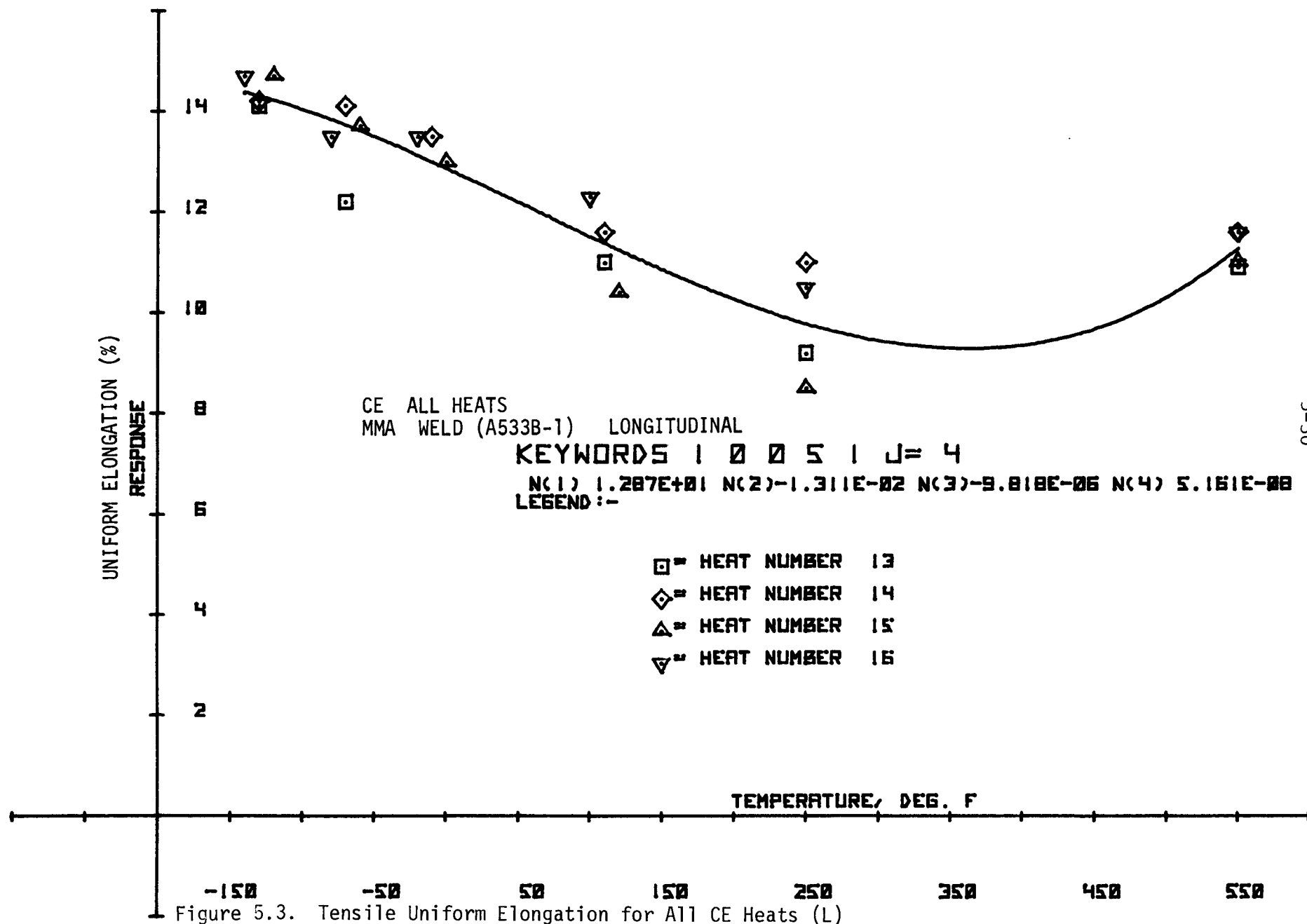


Figure 5.2. Tensile Ultimate Strength for All CE Heats (L)



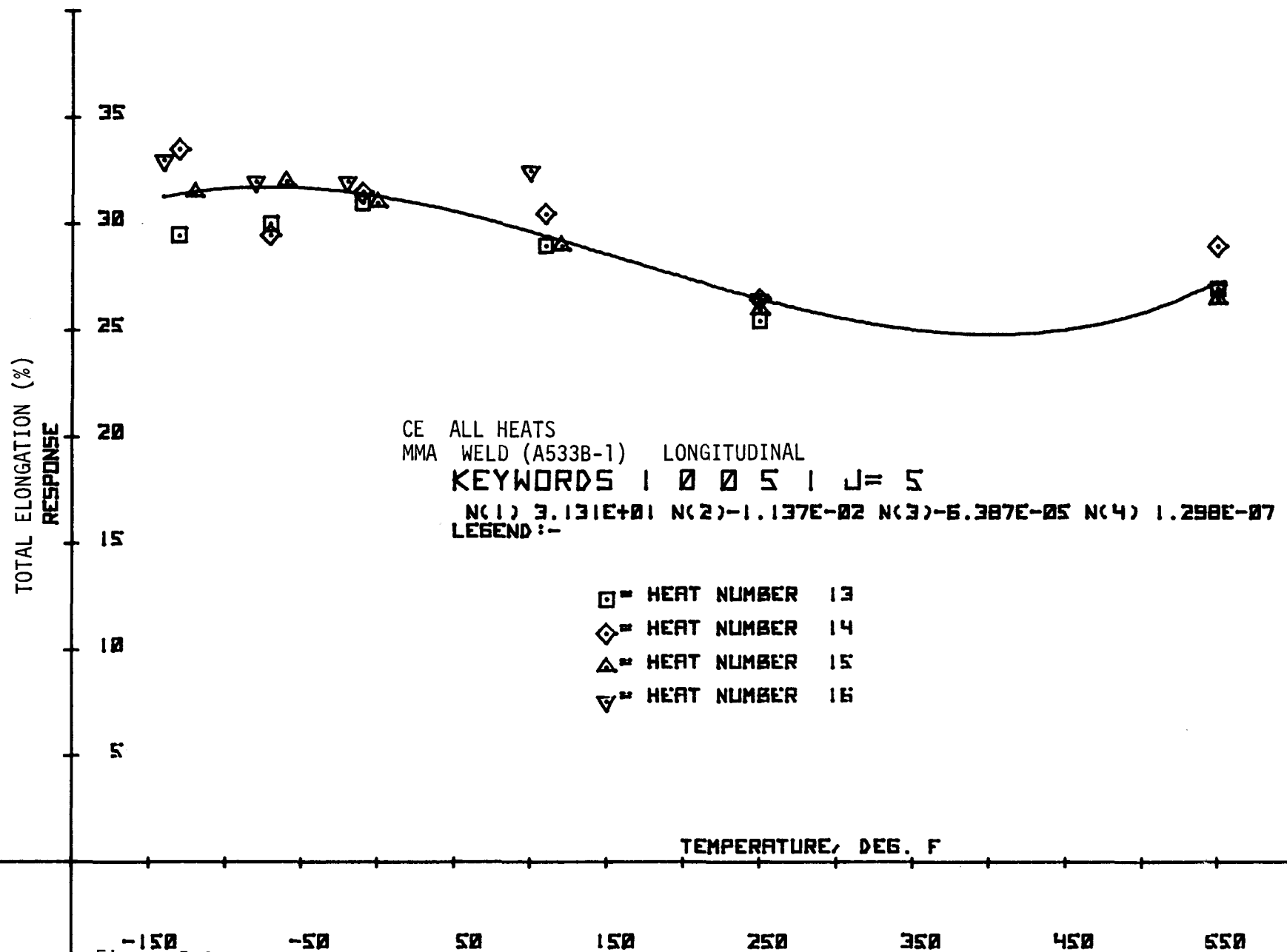


Figure 5.4. Tensile Total Elongation for All CE Heats (L)

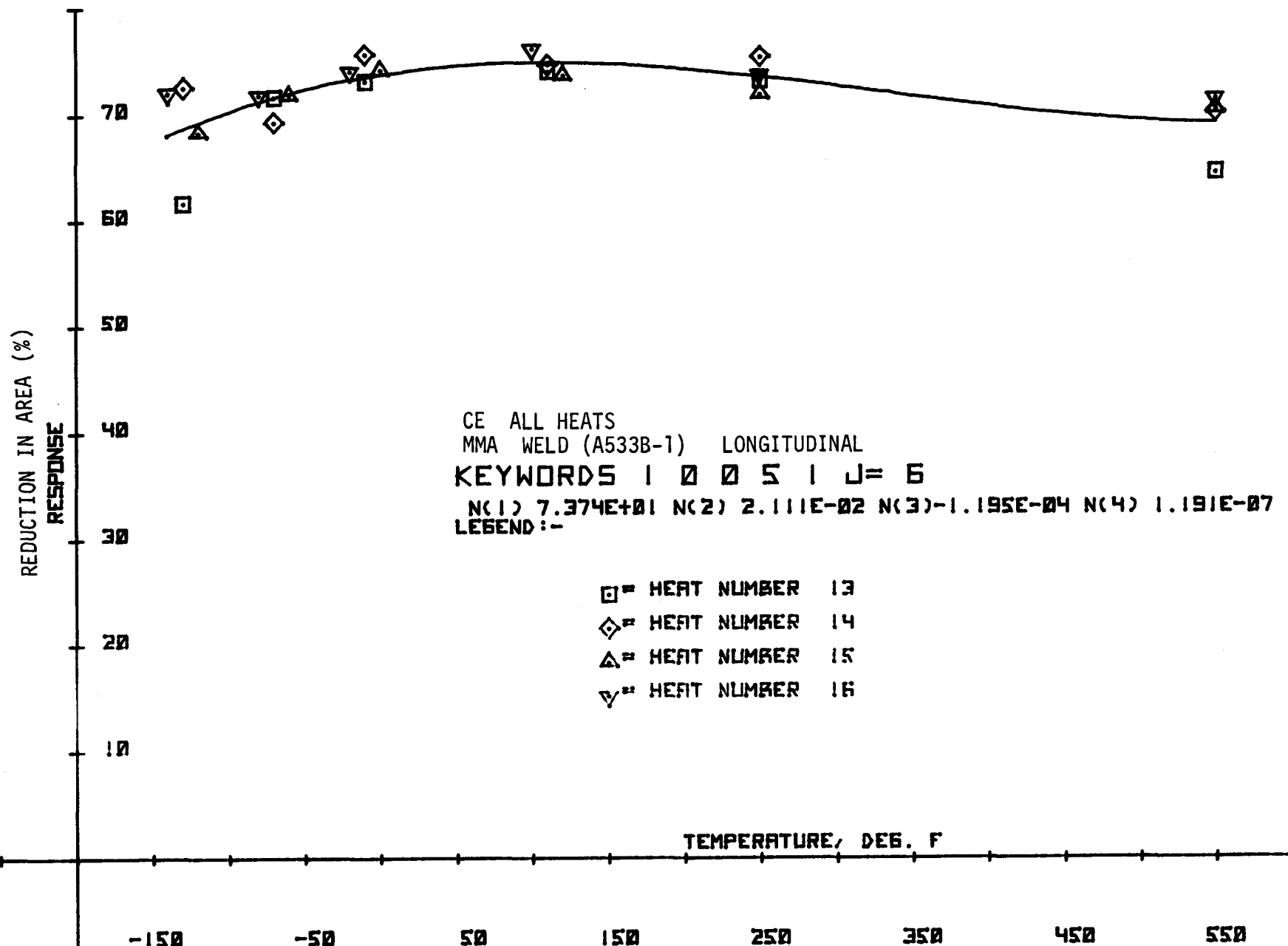
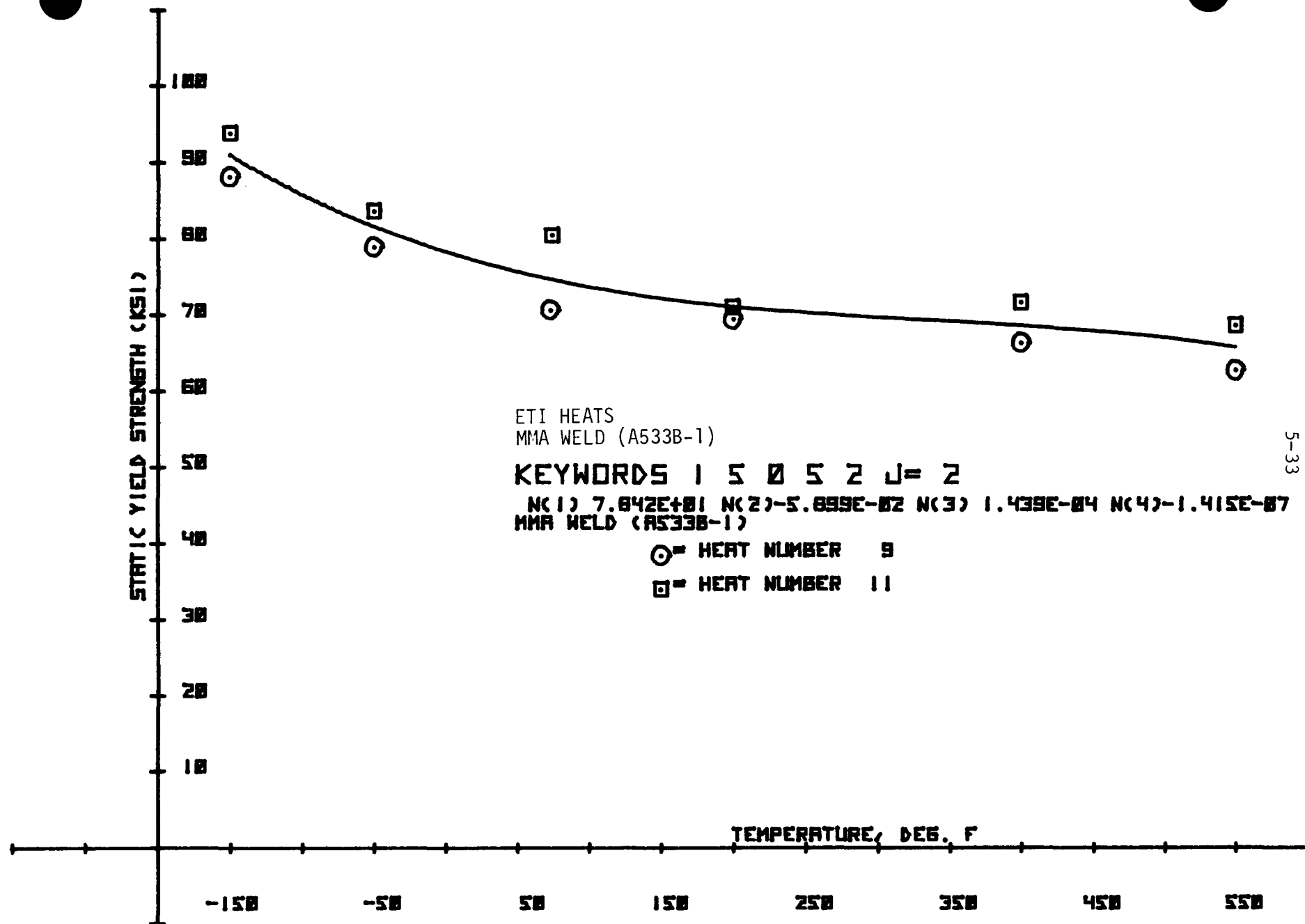


Figure 5.5. Tensile Reduction in Area for All CE Heats (L)



5-33

Figure 5.6 Tensile Static Yield Strength for All ETI Heats (T)

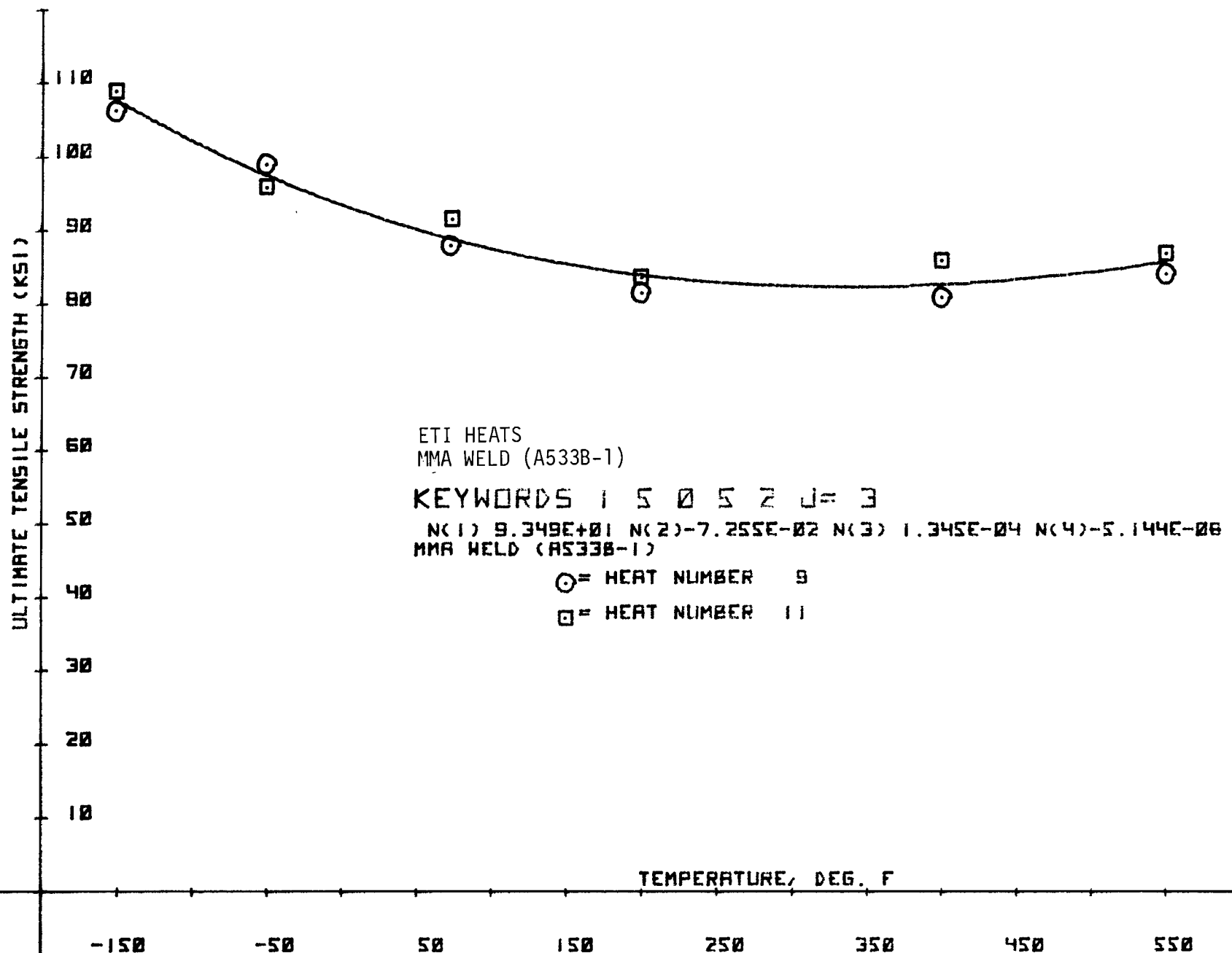
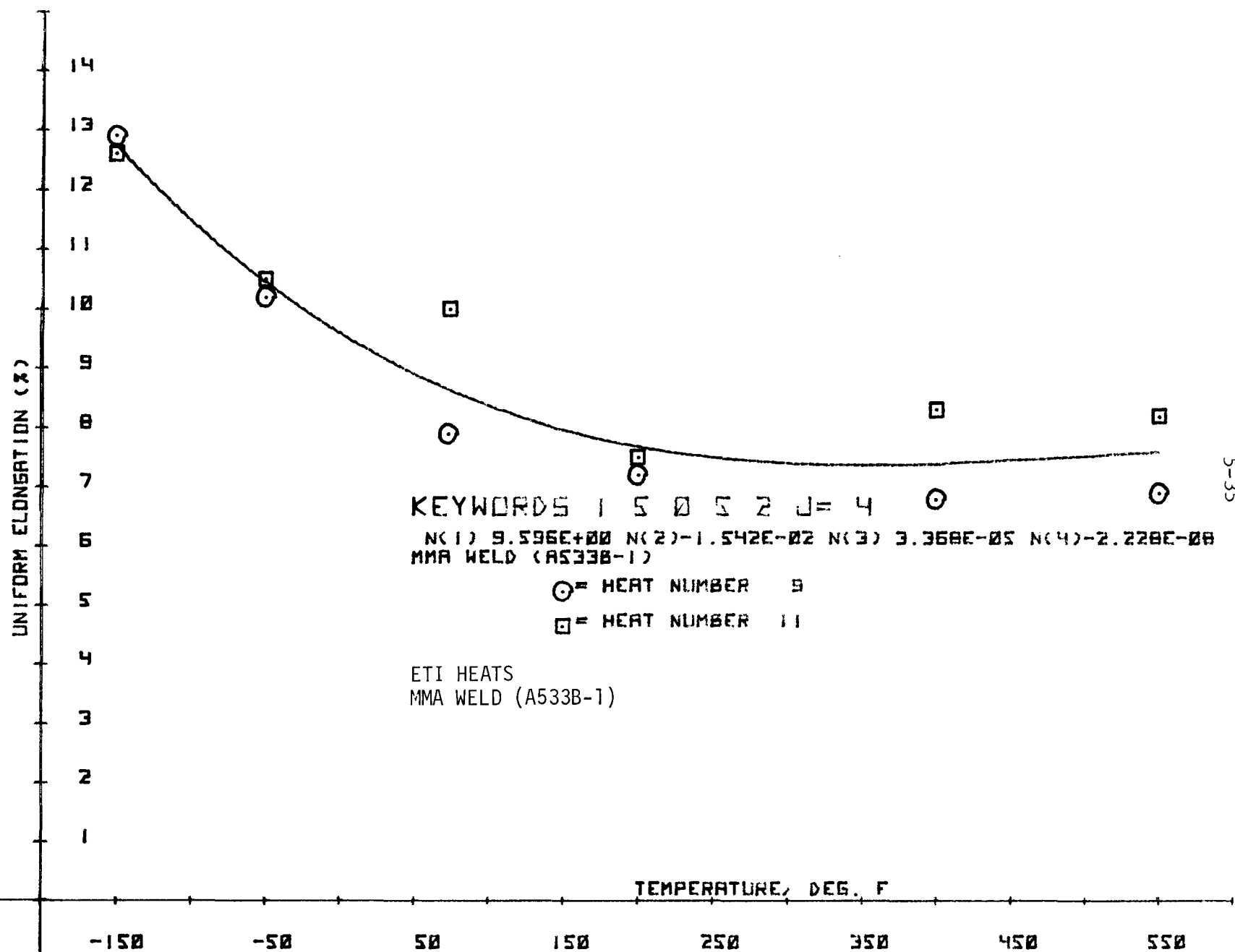


Figure 5.7 Tensile Ultimate Strength for All ETI Heats (T)



5-35

Figure 5.8 Tensile Uniform Elongation for All ETI Heats (T)

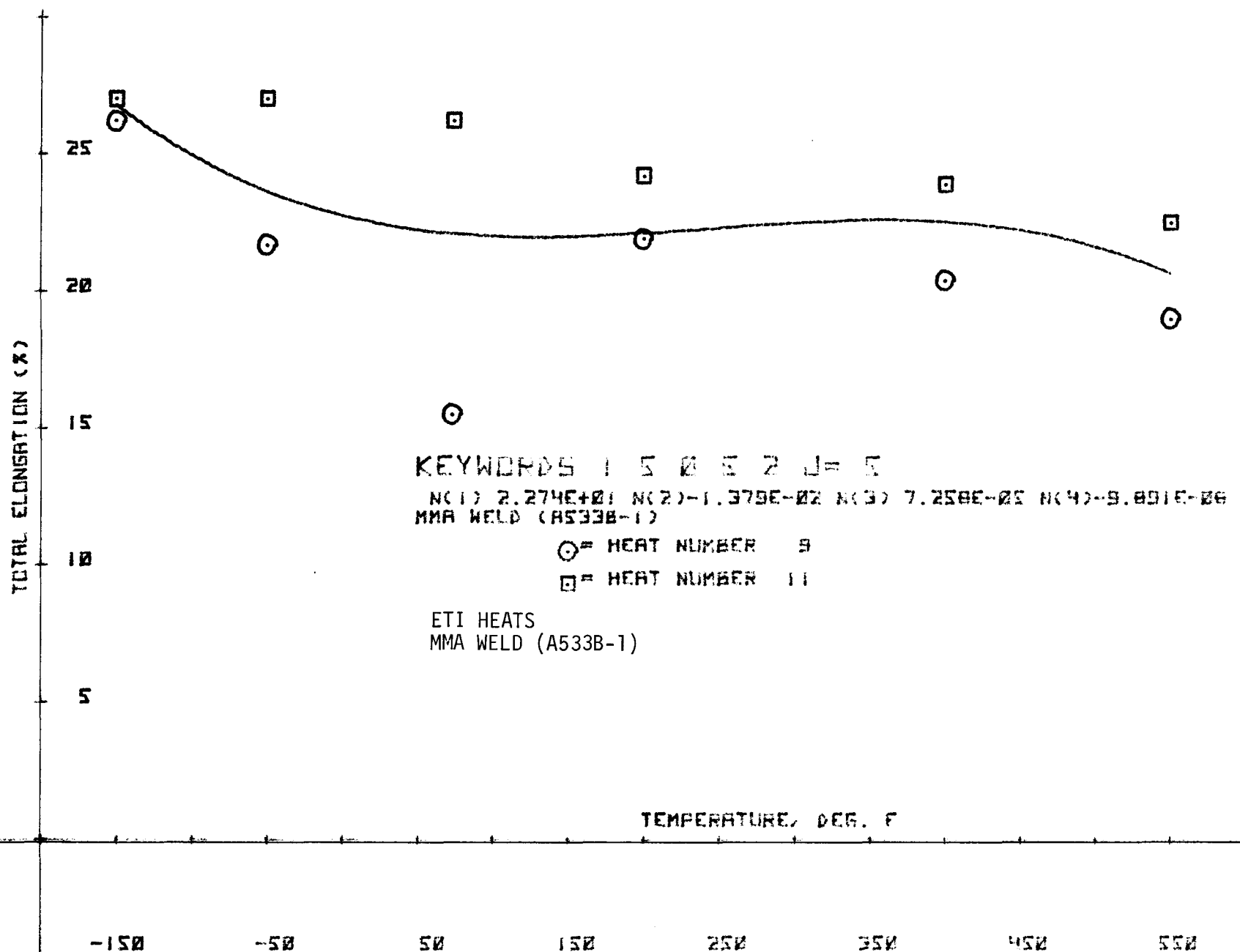


Figure 5.9 Tensile Total Elongation for All ETI Heats (T)

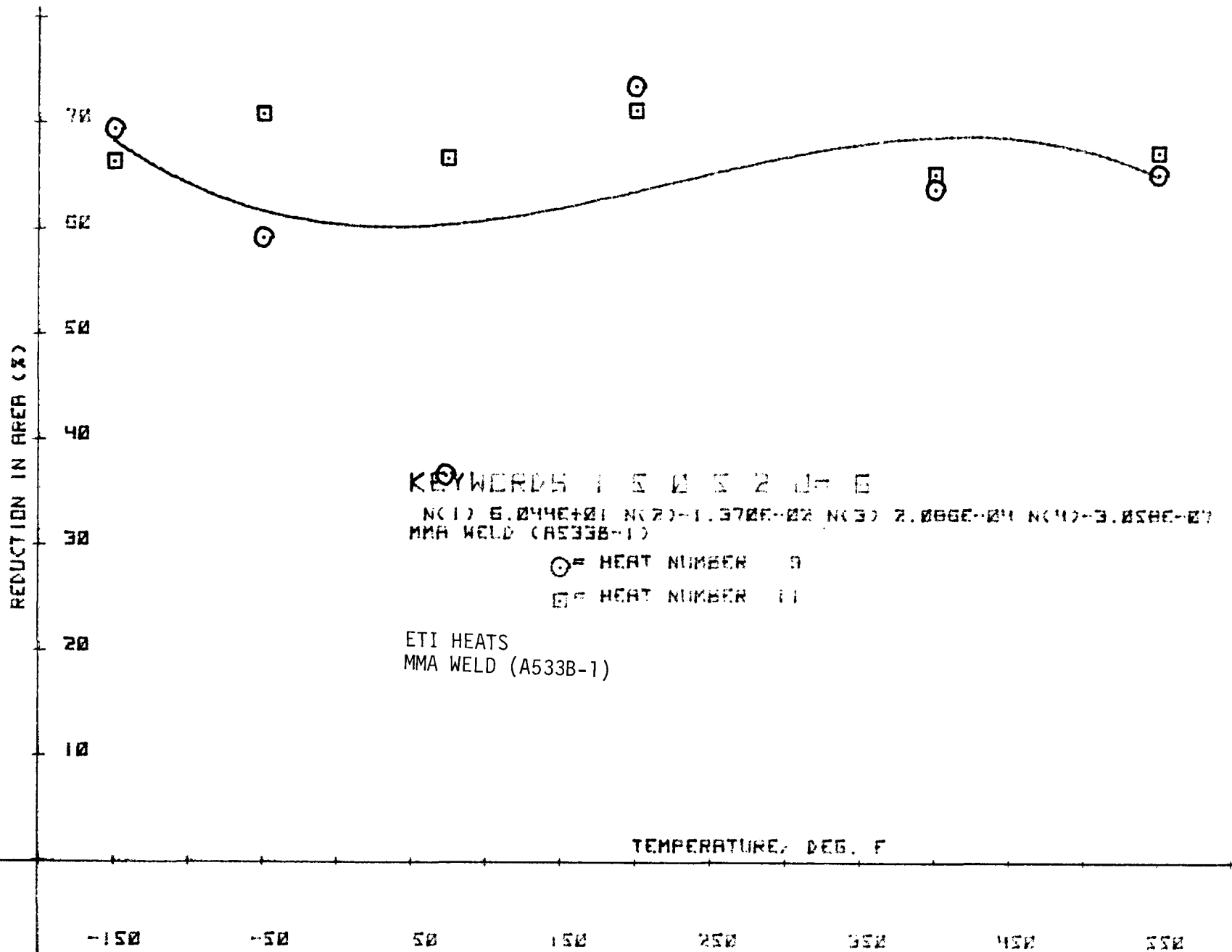


Figure 5.10 Tensile Reducation in Area for All ETI Heats (T)

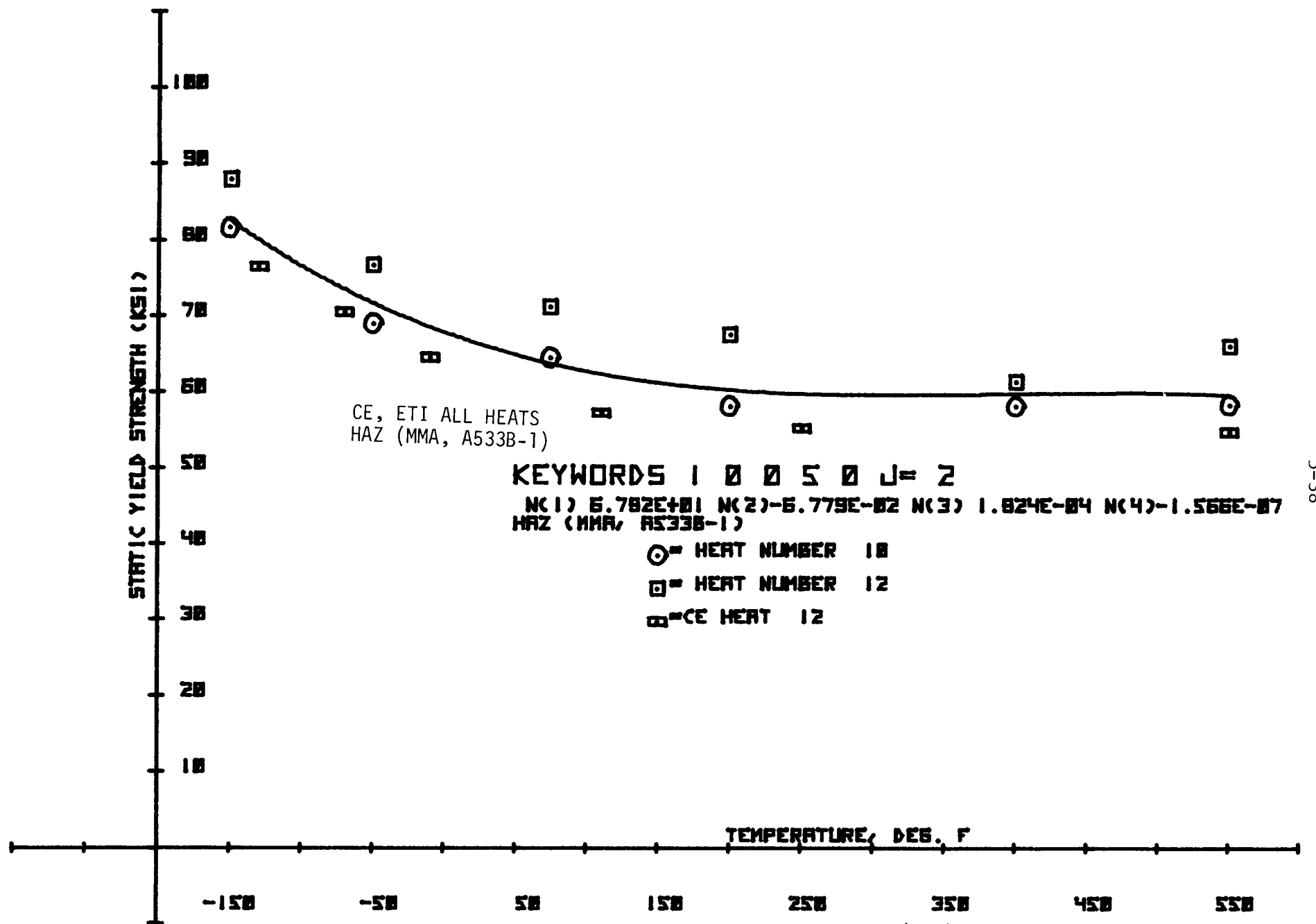


Figure 5.11 Tensile Static Yield Strength for All CE, ETI Heats (HAZ)

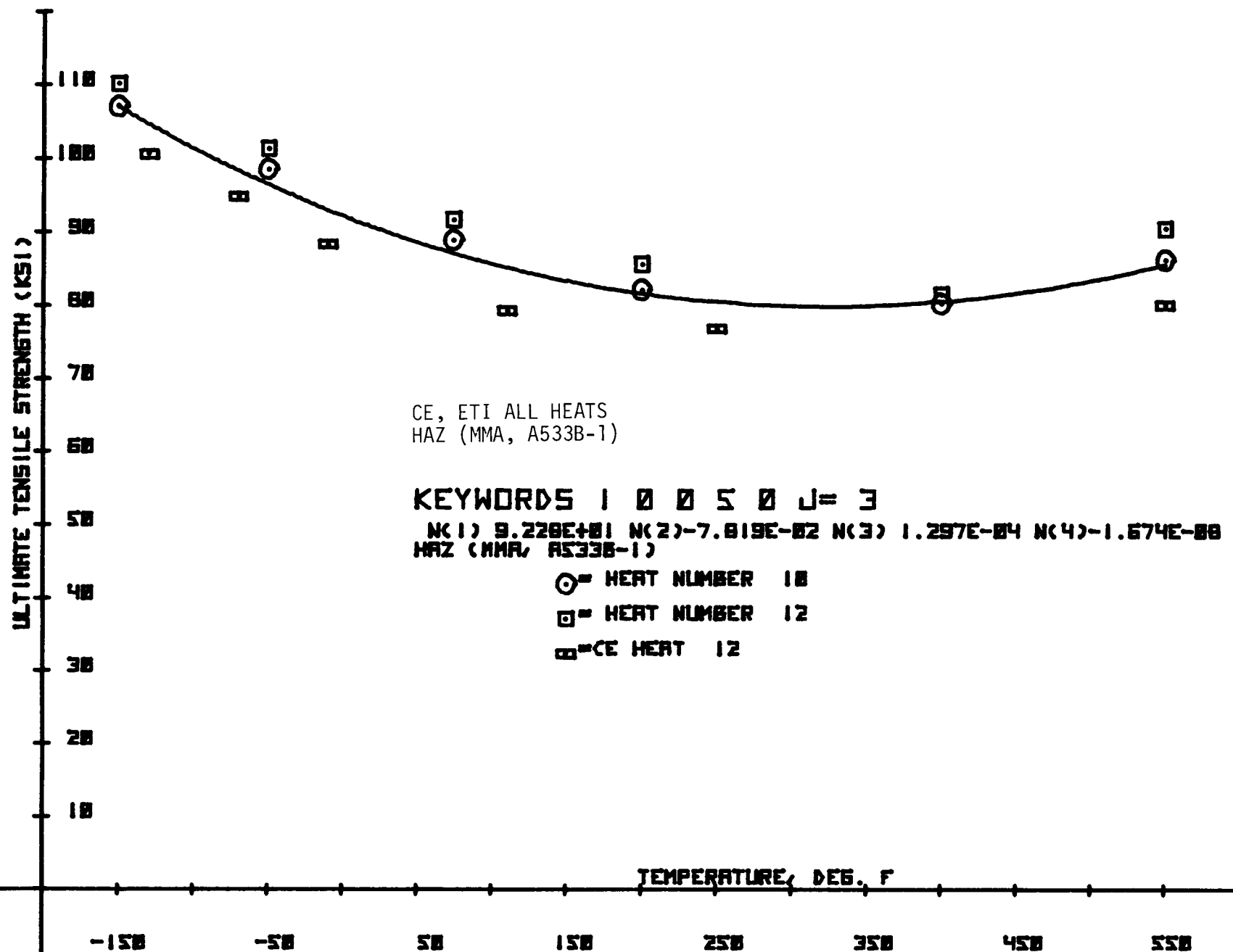


Figure 5.12 Tensile Ultimate Strength for All CE, ETI Heats (HAZ)

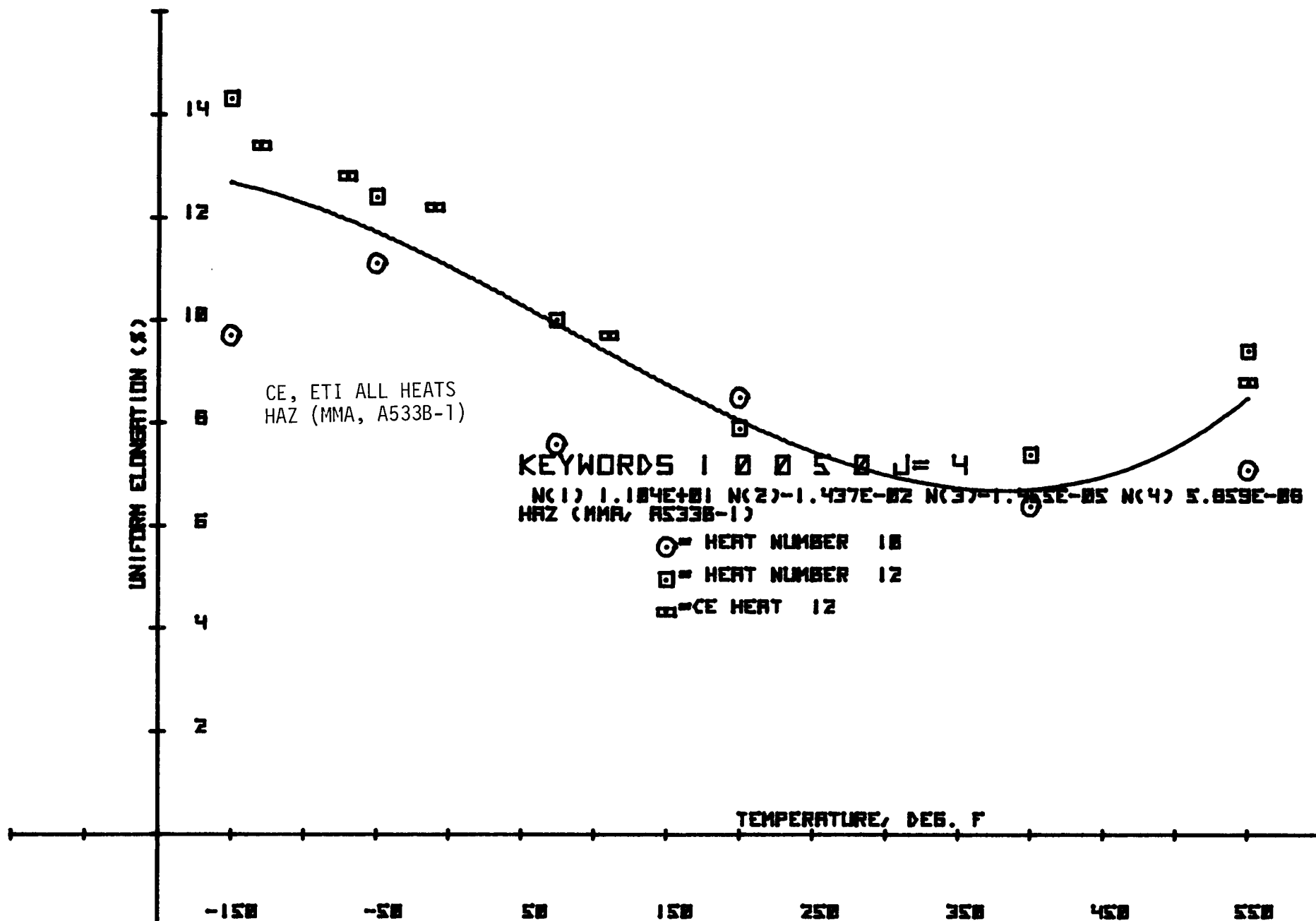


Figure 5.13 Tensile Uniform Elongation for All CE, ETI Heats (HAZ)

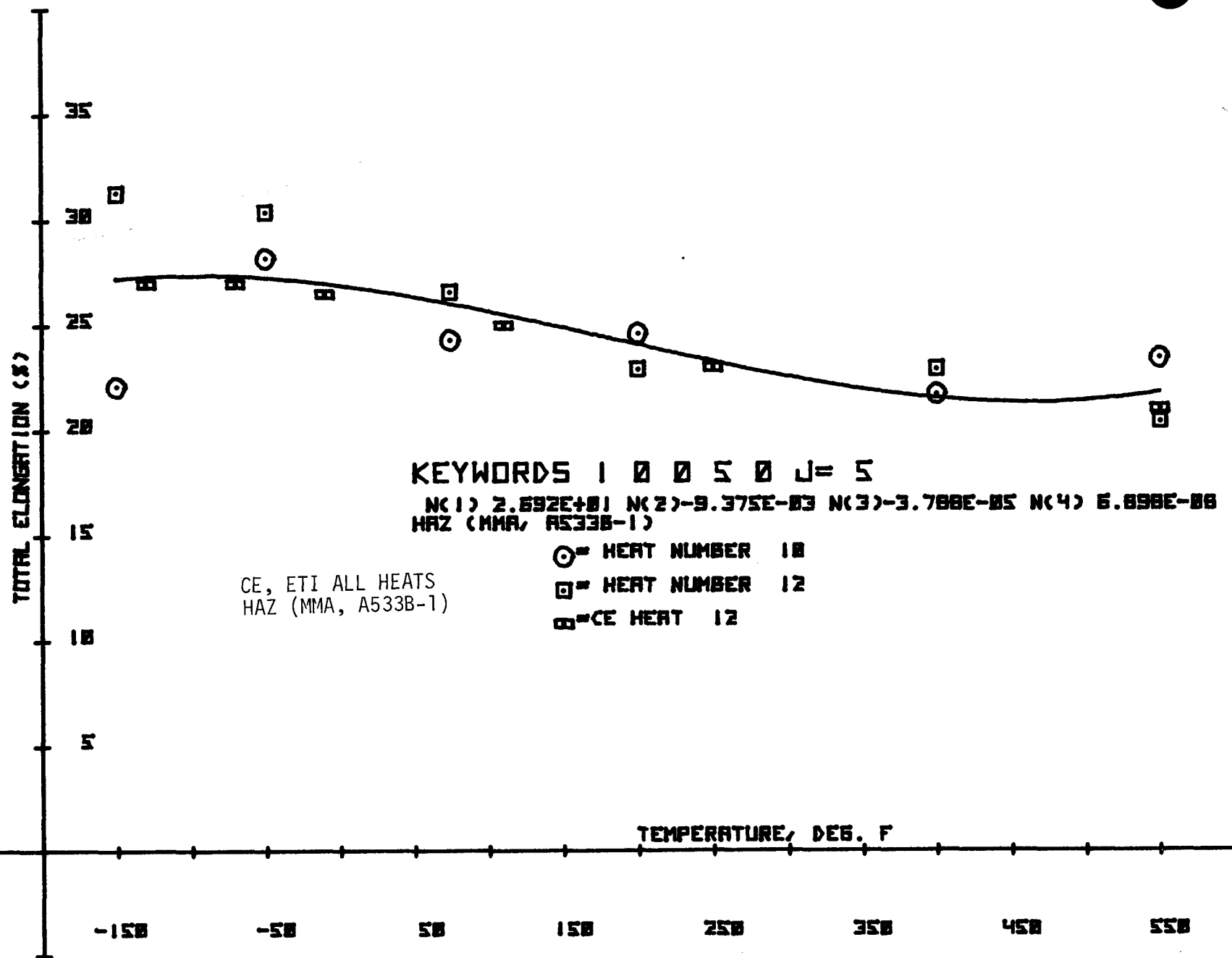


Figure 5.14 Tensile Total Elongation for All CE, ETI Heats (HAZ)

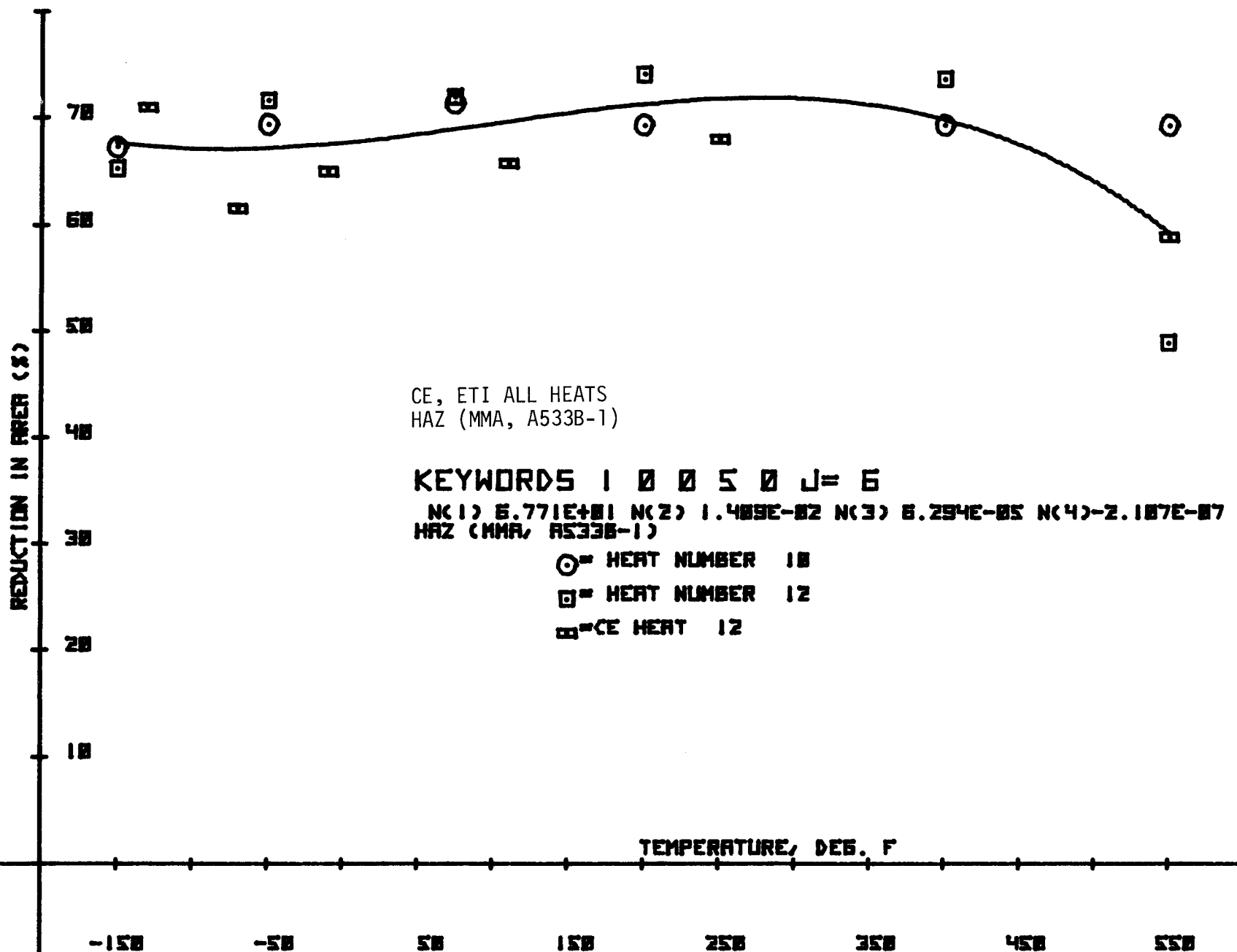


Figure 5.15 Tensile Reduction in Area for All CE, ETI Heats (HAZ)

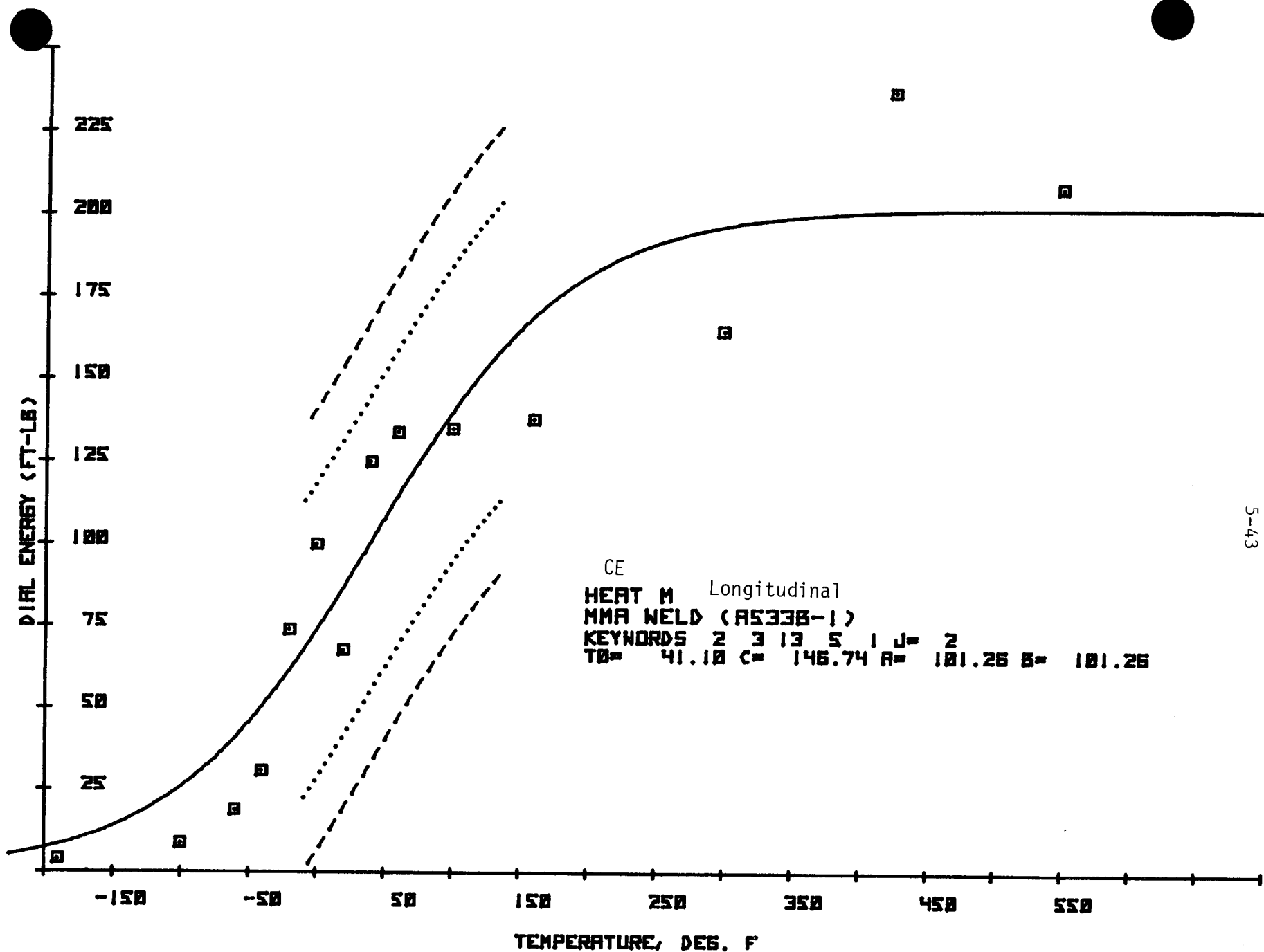
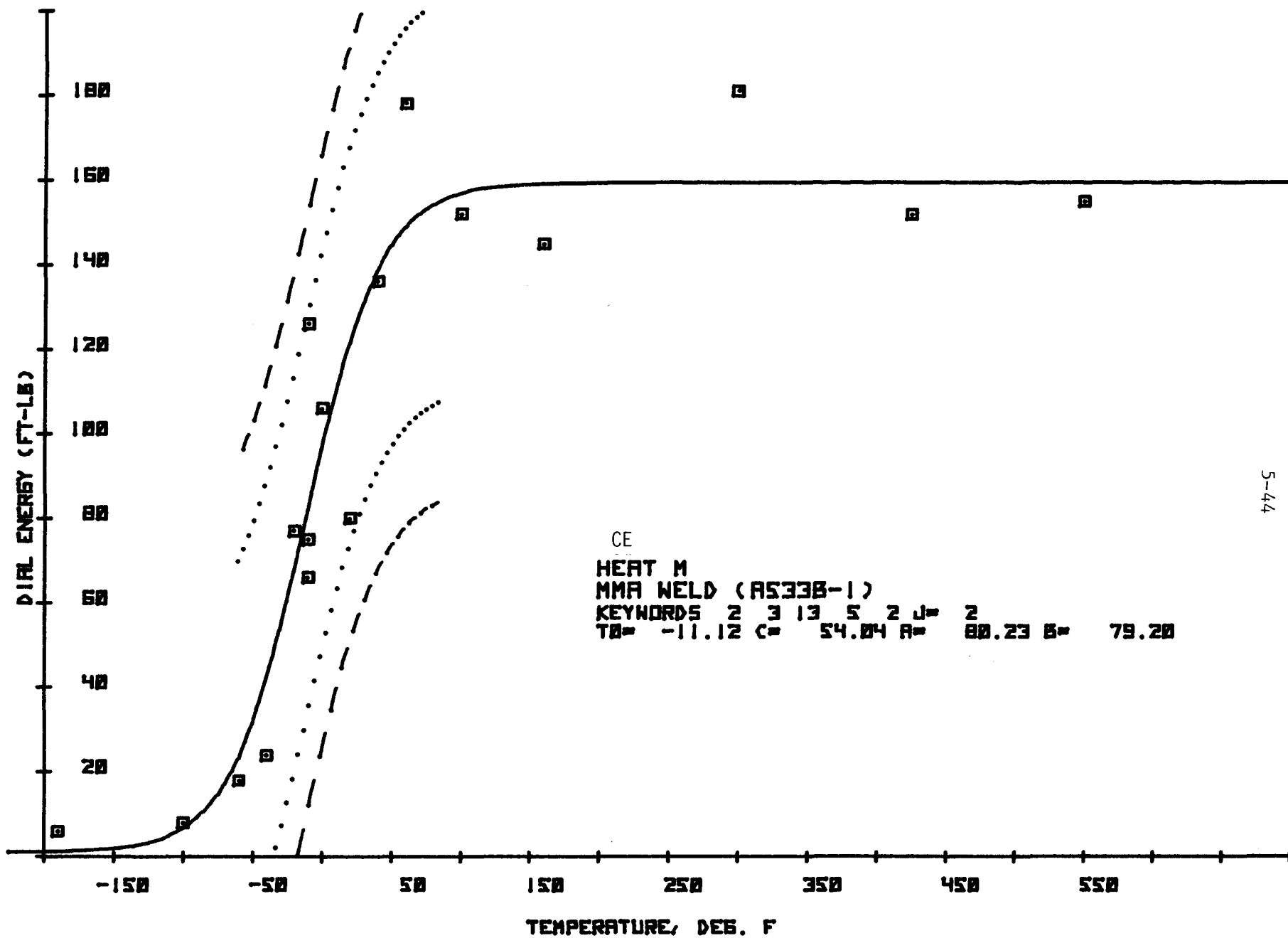


Figure 5.16 Charpy V-Notch Dial Energy for CE Heat M (L)



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Figure 5.17 Charpy V-Notch Dial Energy for CE Heat M (T)

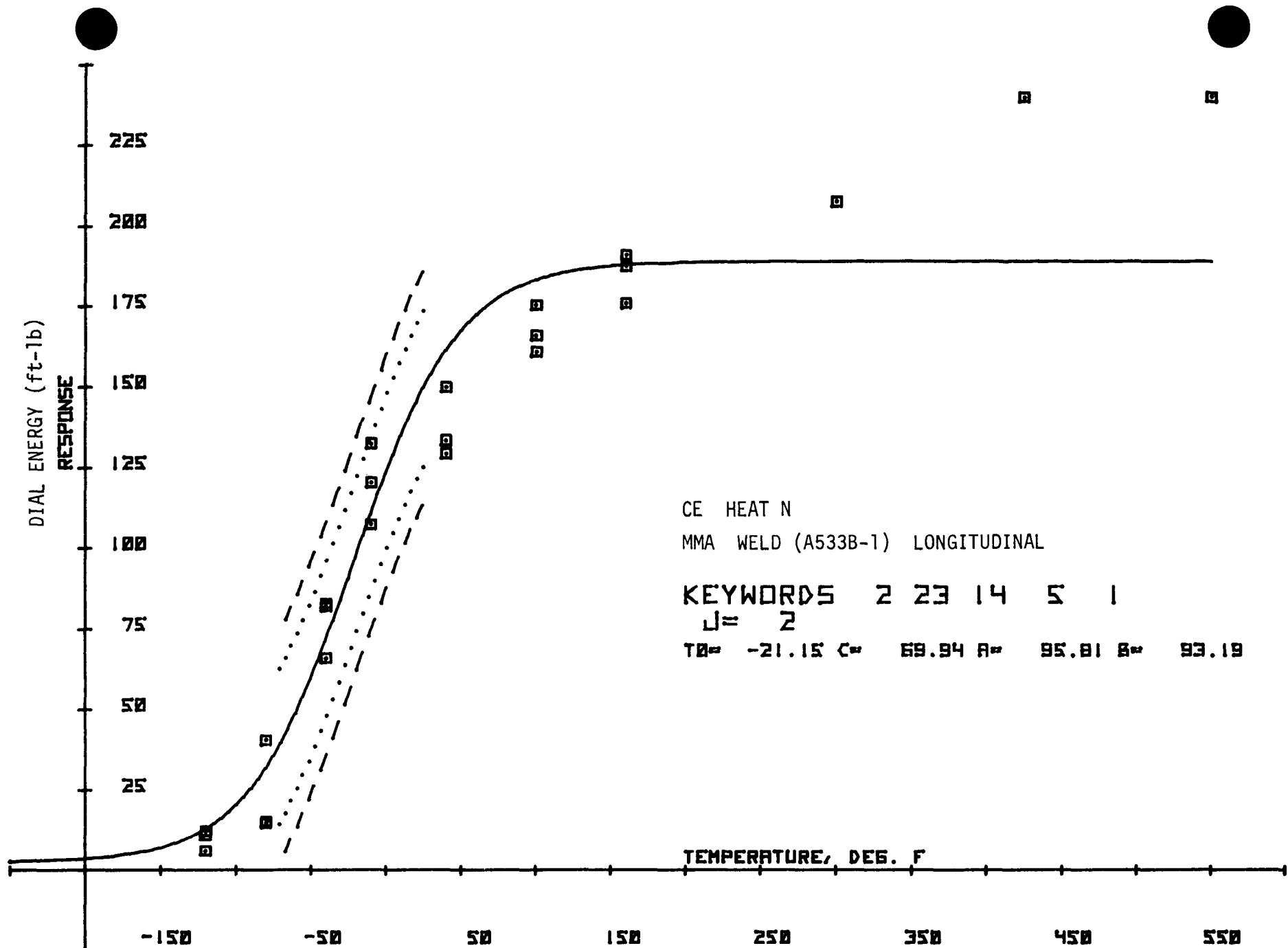
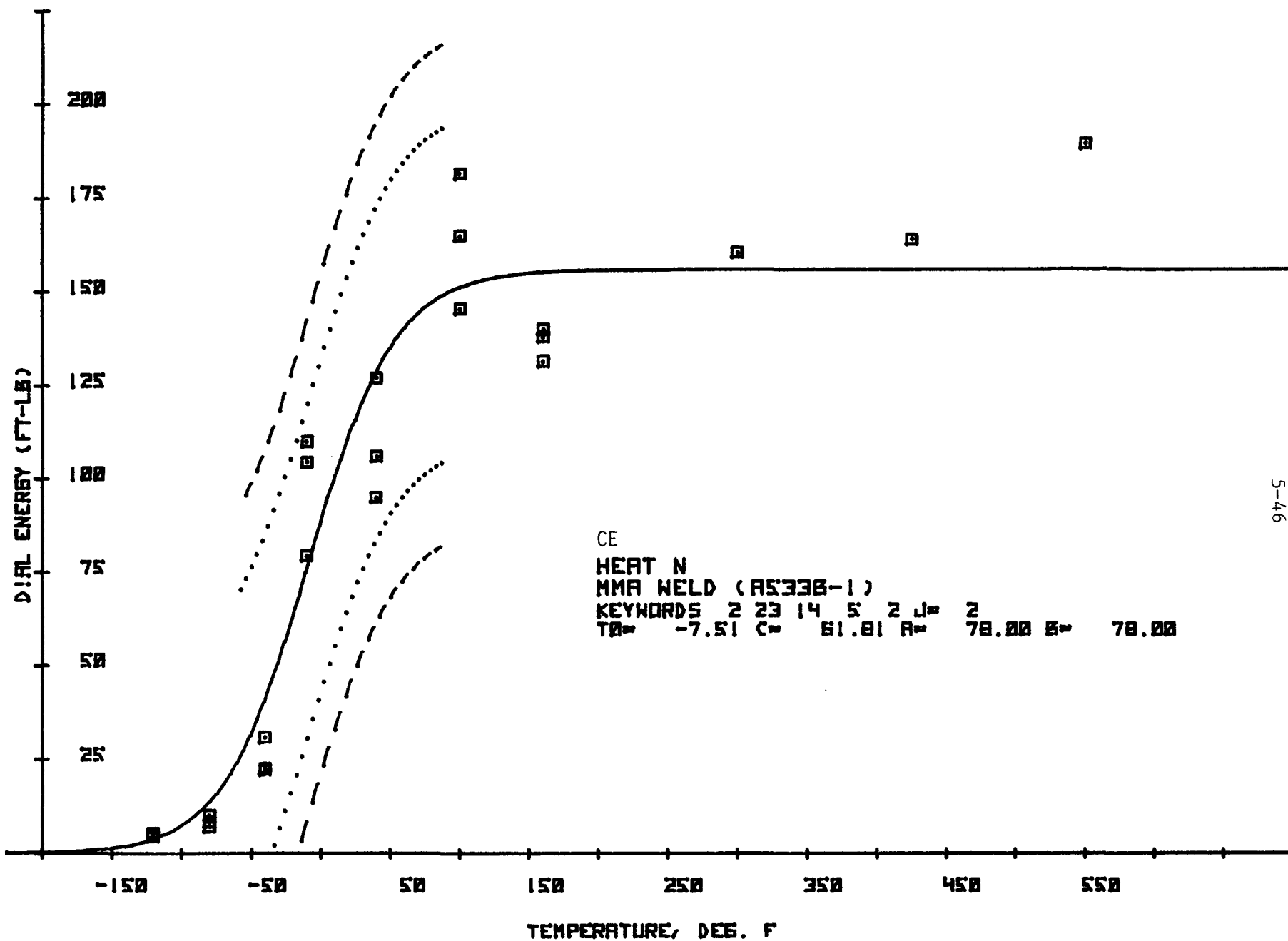


Figure 5.18 Charpy V-Notch Dial Energy for CE Heat N (L)



5-46

Figure 5.19 Charpy V-Notch Dial Energy for CE Heat N (T)

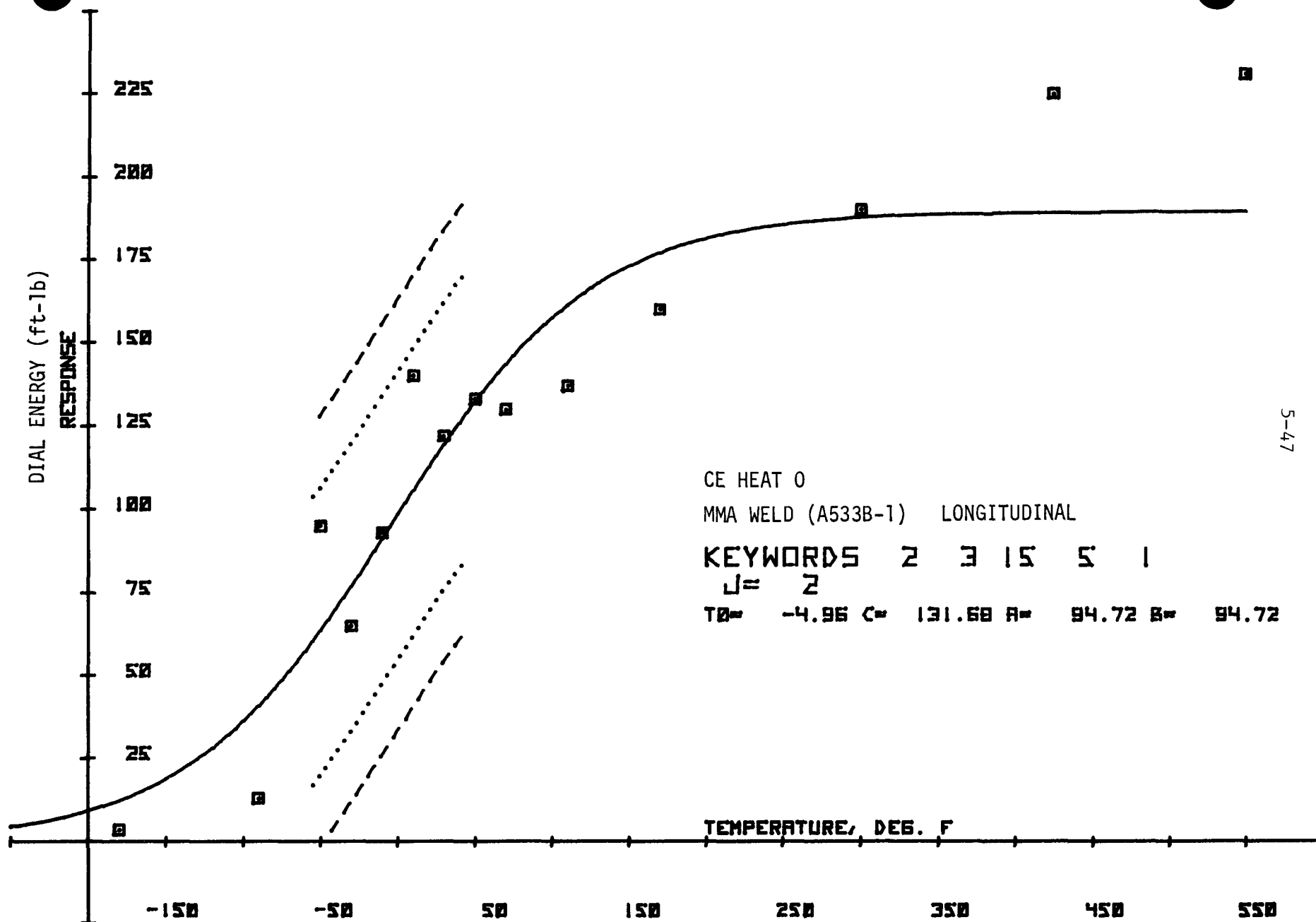


Figure 5.20 Charpy V-Notch Dial Energy for CE Heat 0 (L)

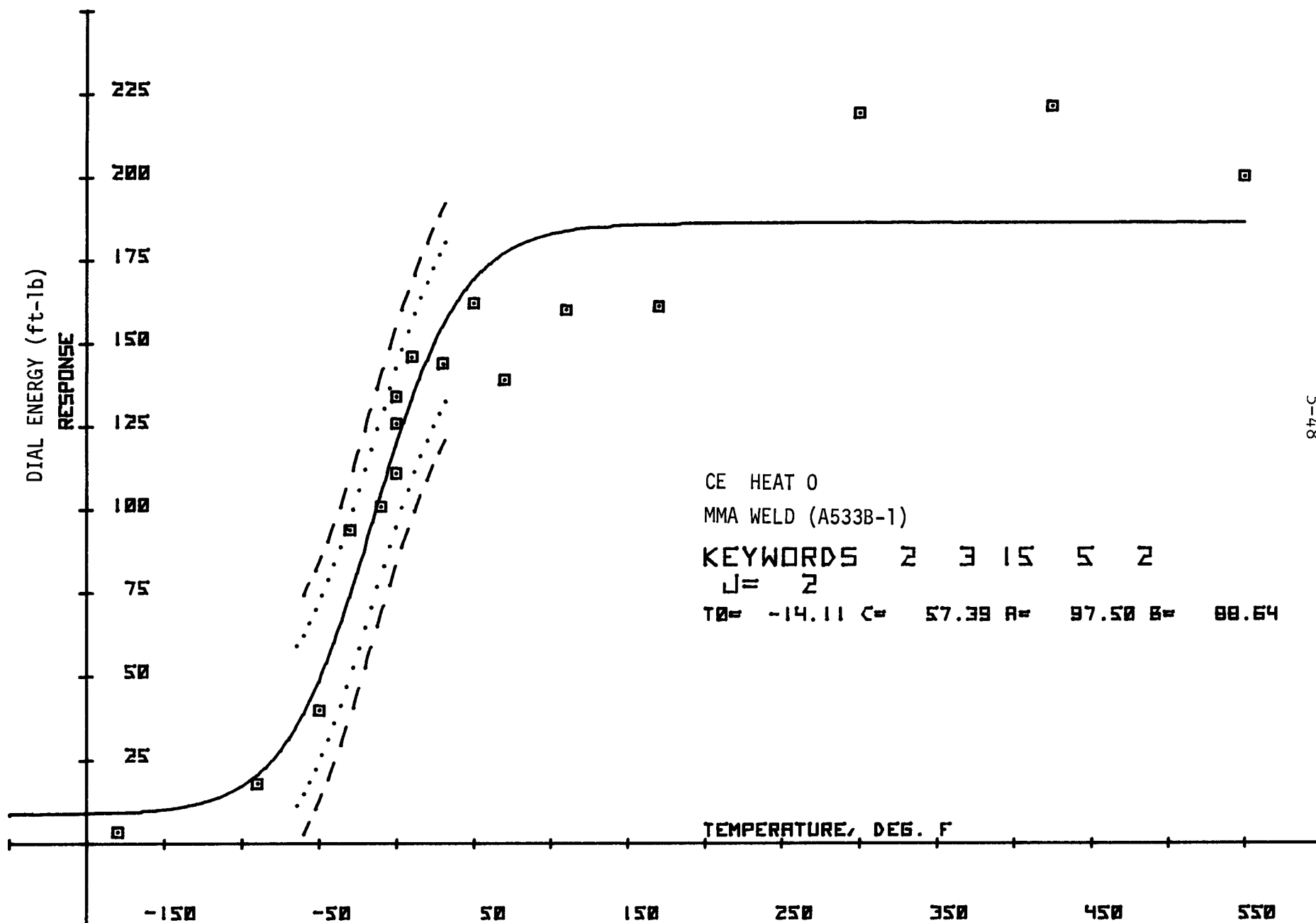


Figure 5.21 Charpy V-Notch Dial Energy for CE Heat 0 (T)

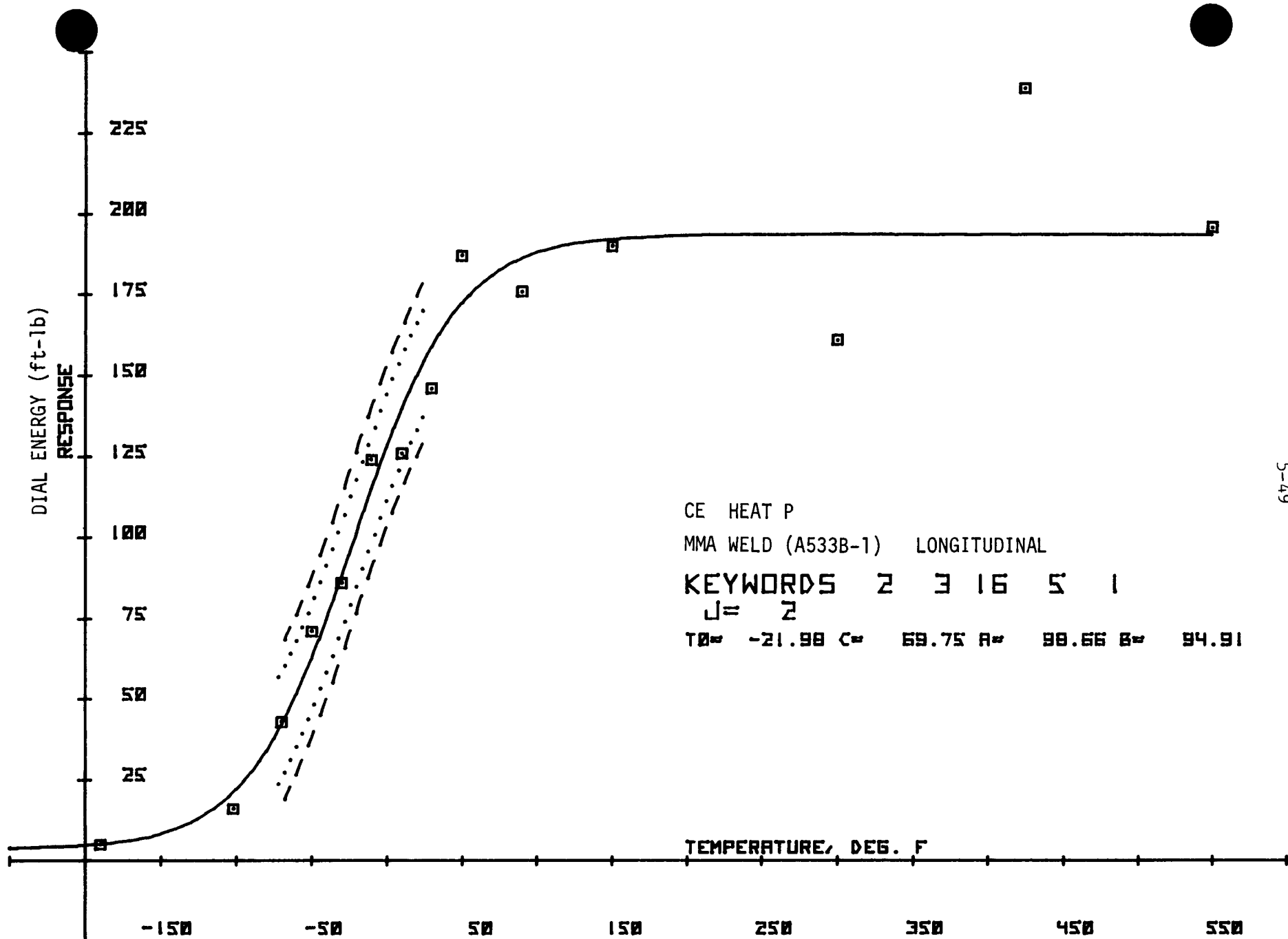


Figure 5.22 Charpy V-Notch Dial Energy for CE Heat P (L)

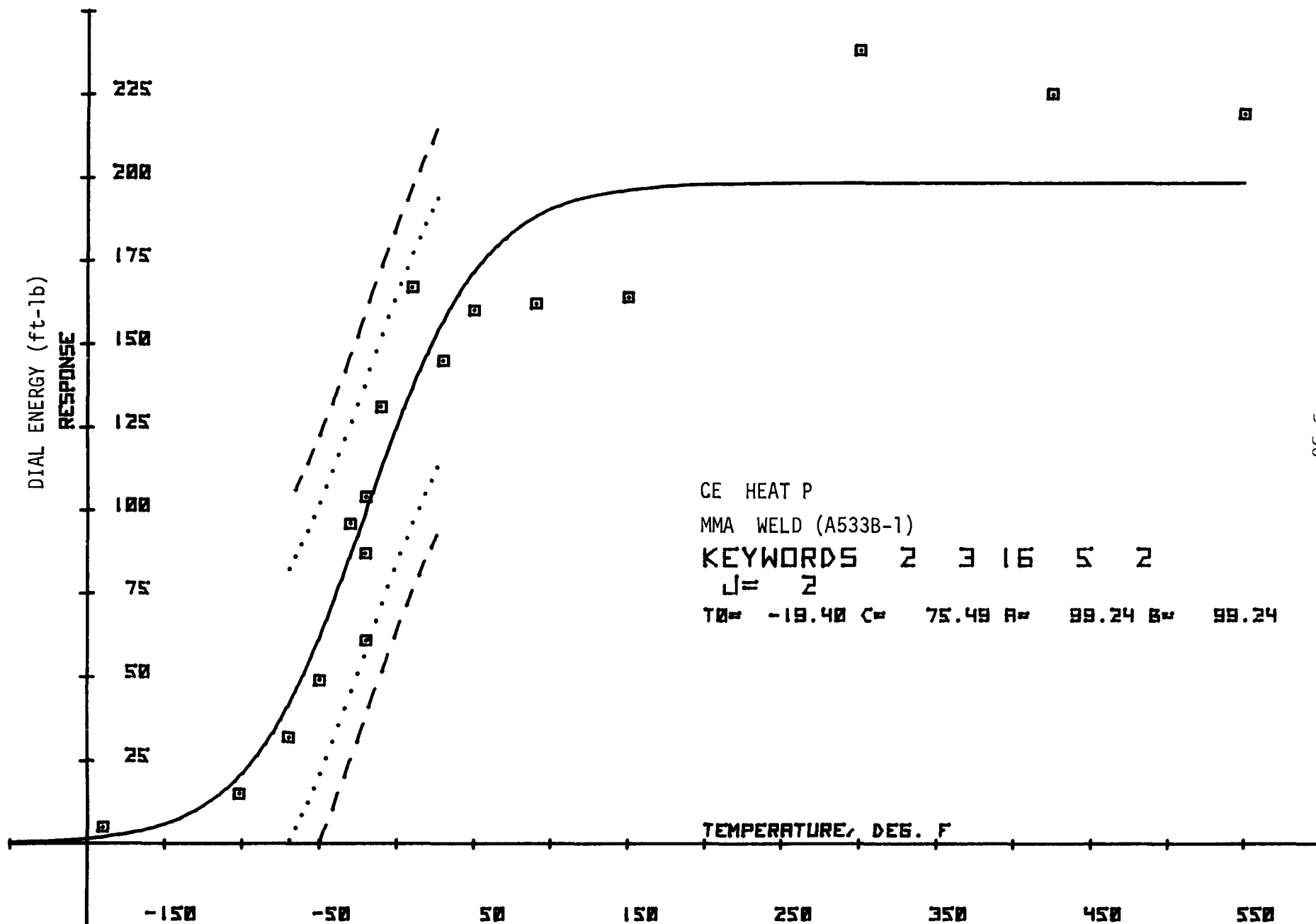
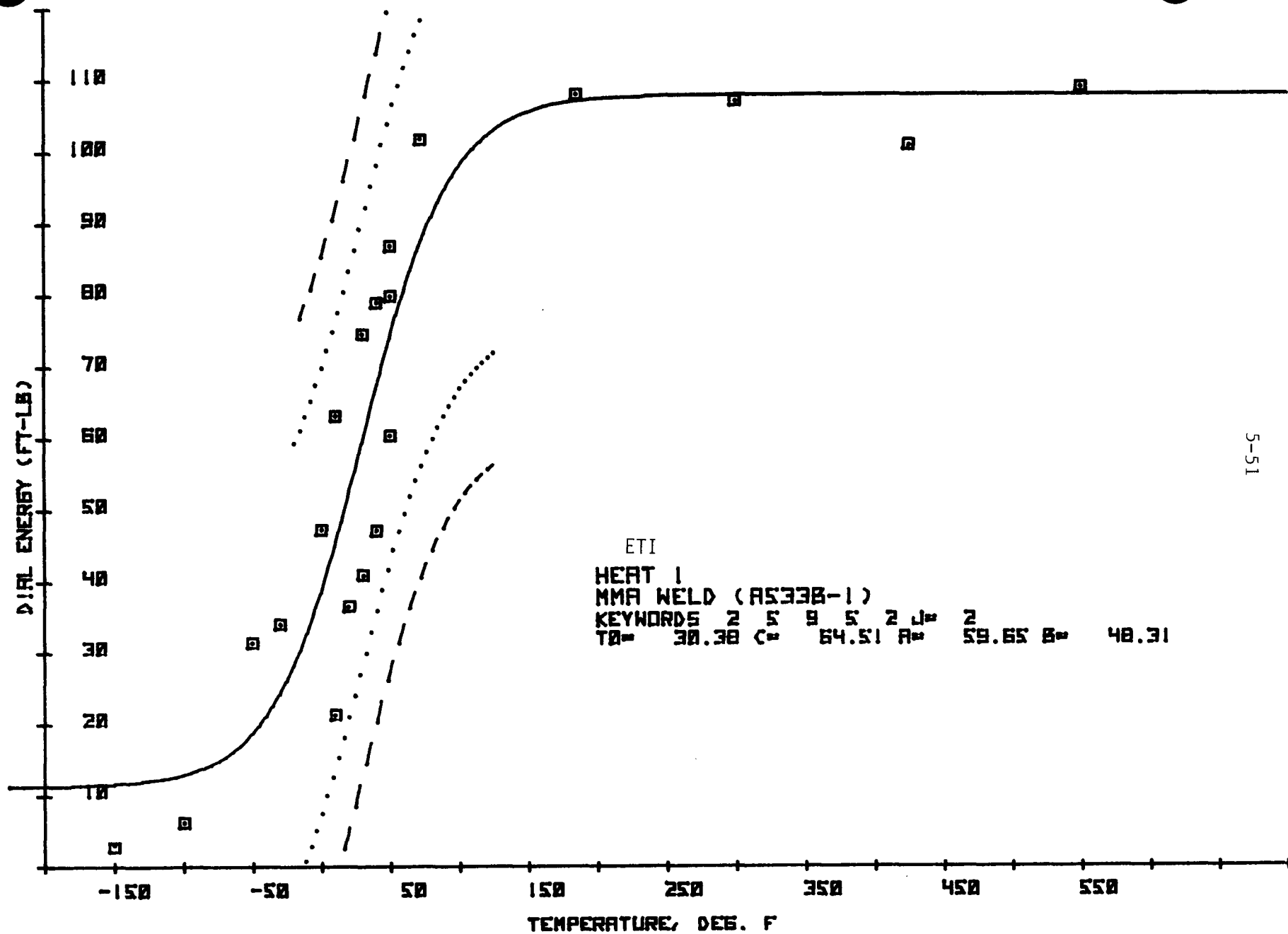


Figure 5.23 Charpy V-Notch Dial Energy for CE Heat P (T)



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Figure 5.24 Charpy V-Notch Dial Energy for ETI Heat I (T)

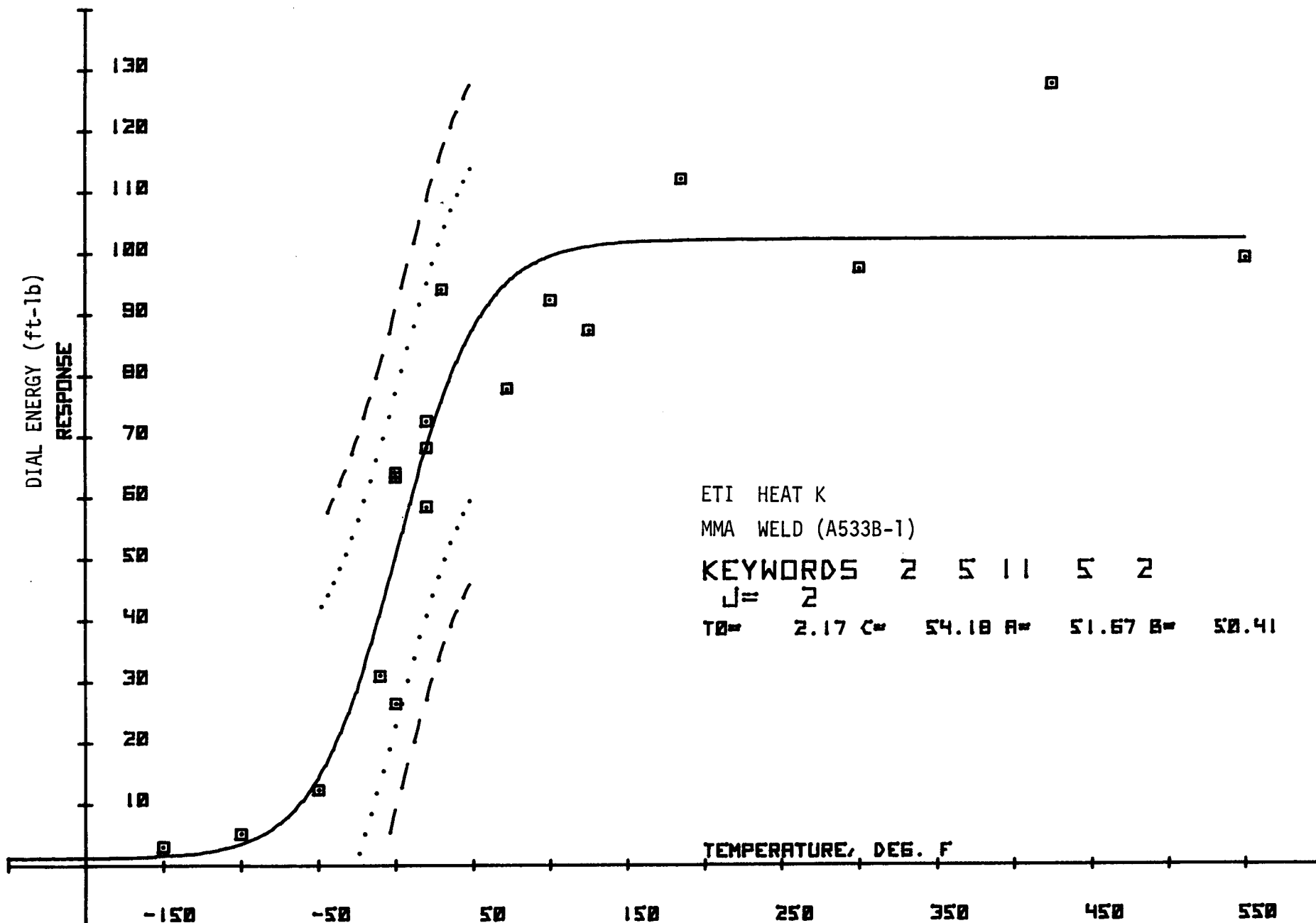


Figure 5.25 Charpy V-Notch Dial Energy for ETI Heat K (T)

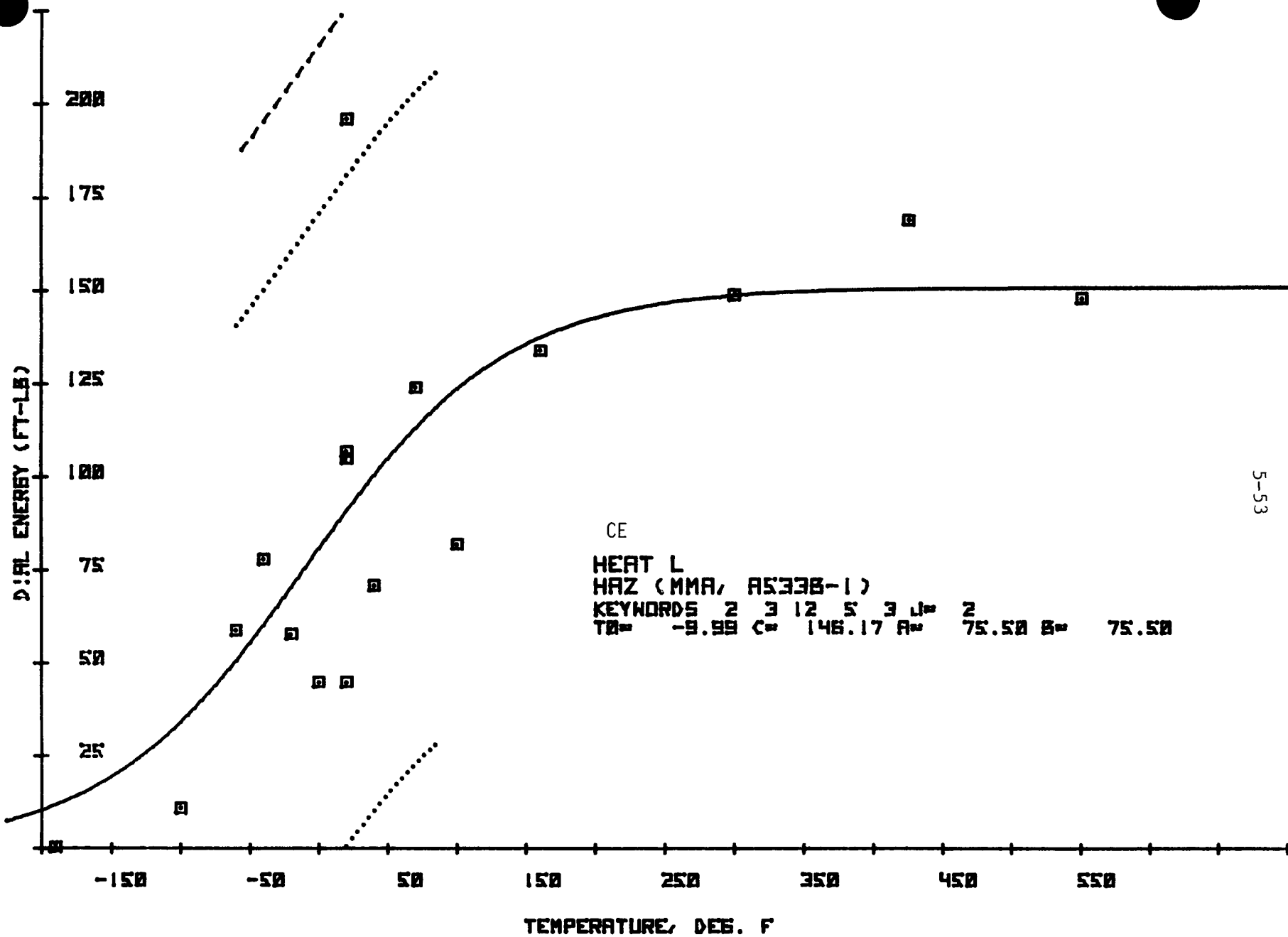


Figure 5.26 Charpy V-Notch Dial Energy for CE Heat L (HAZ)

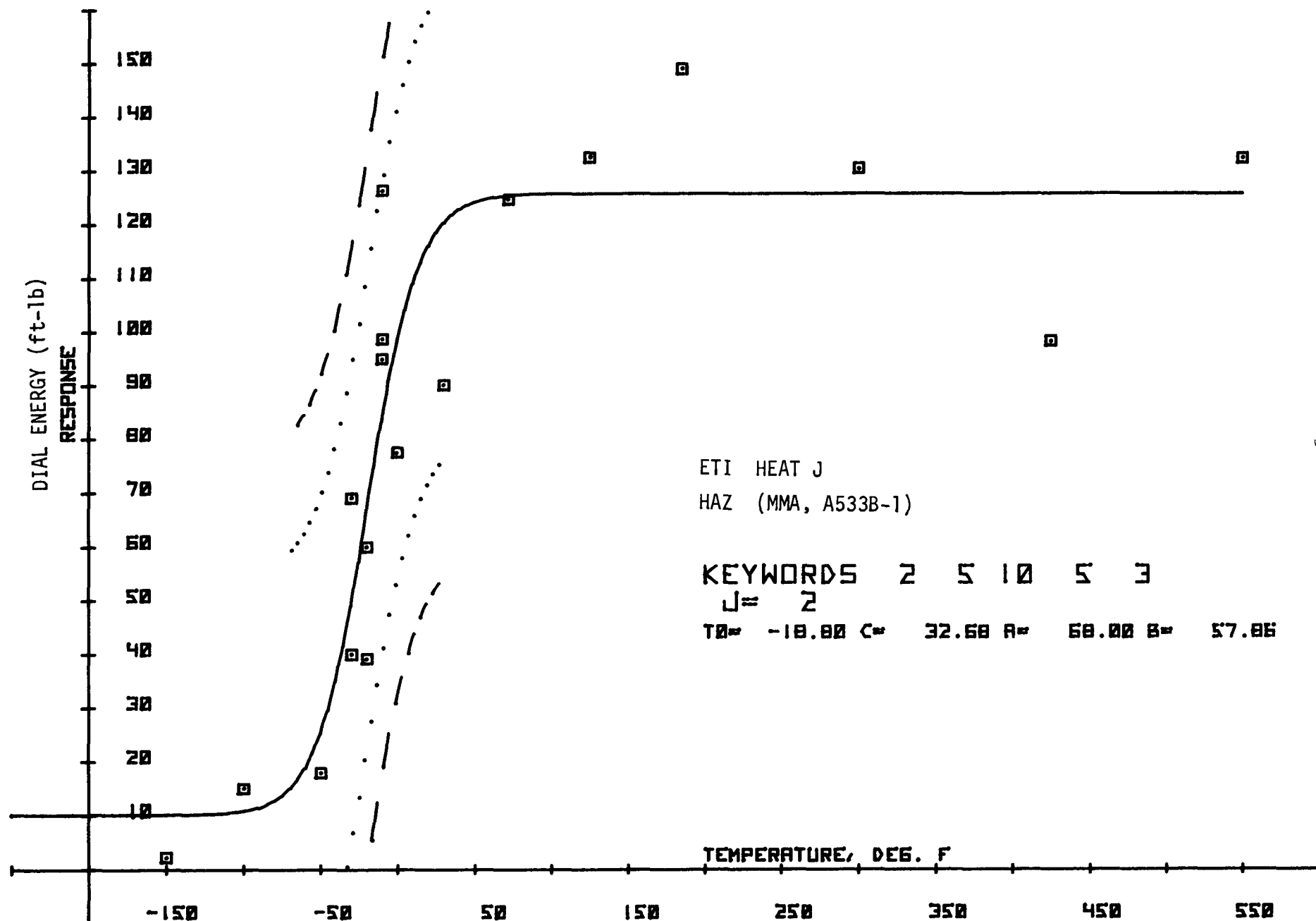


Figure 5.27 Charpy V-Notch Dial Energy for ETI Heat J (HAZ)

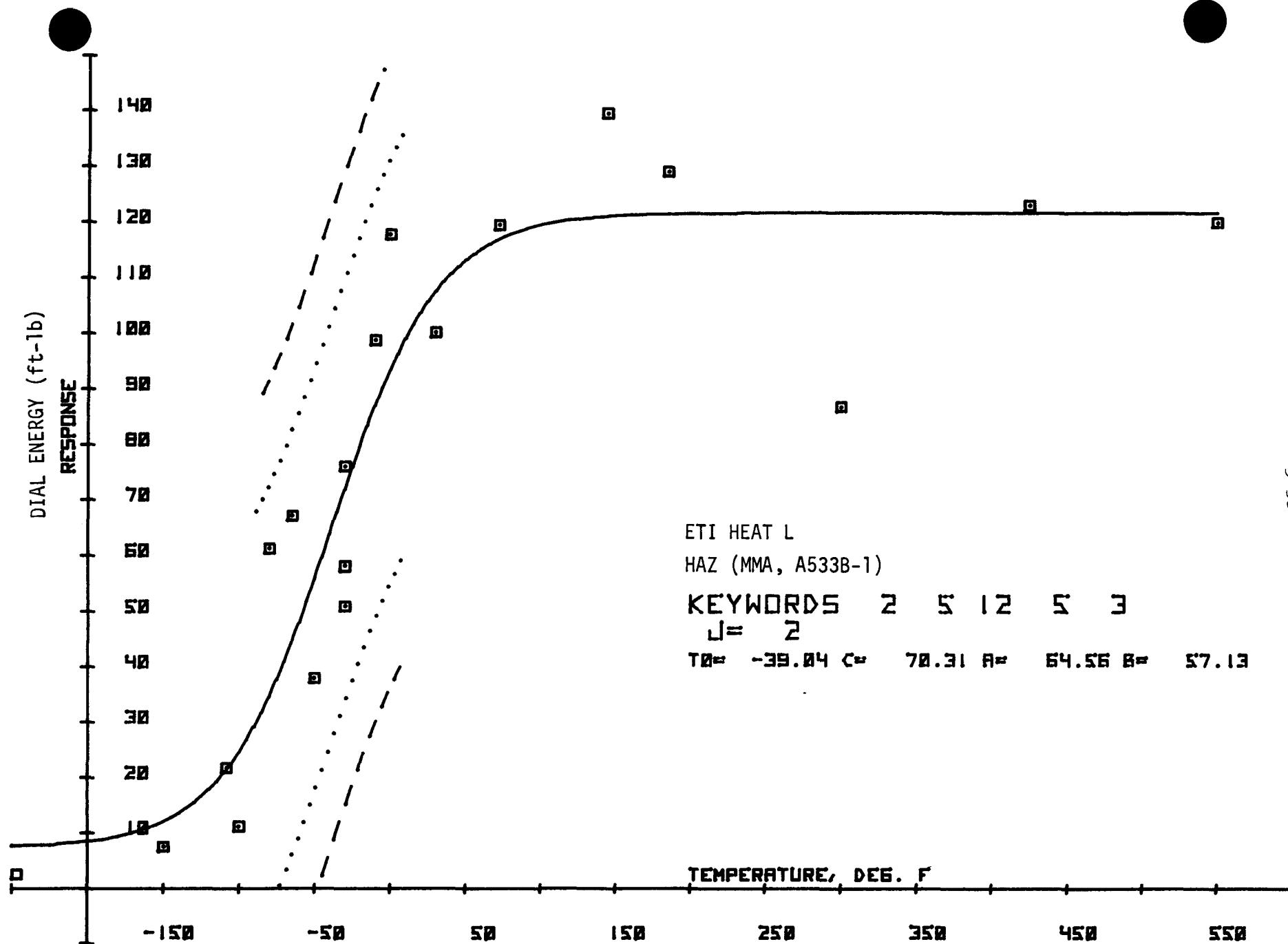
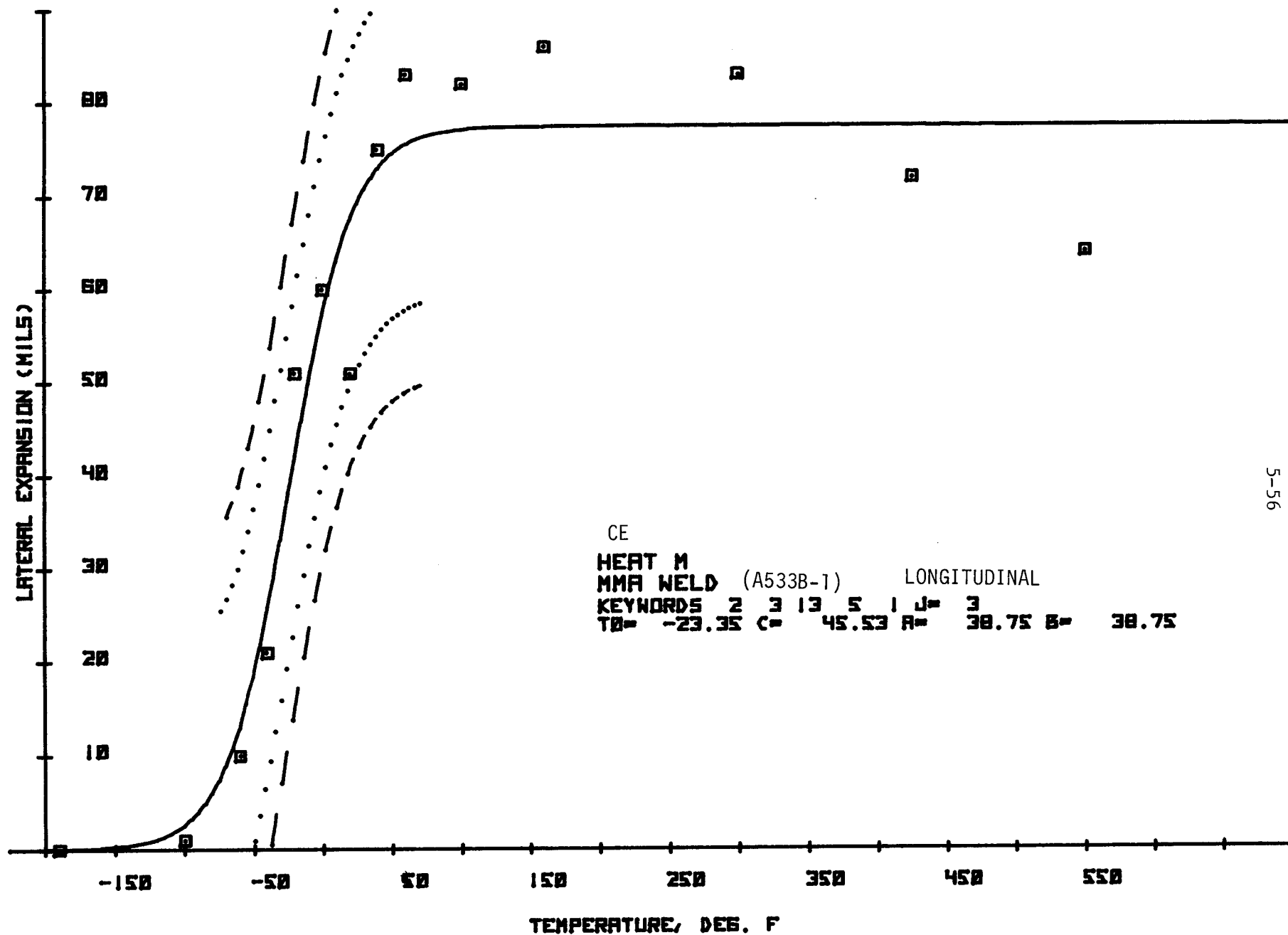
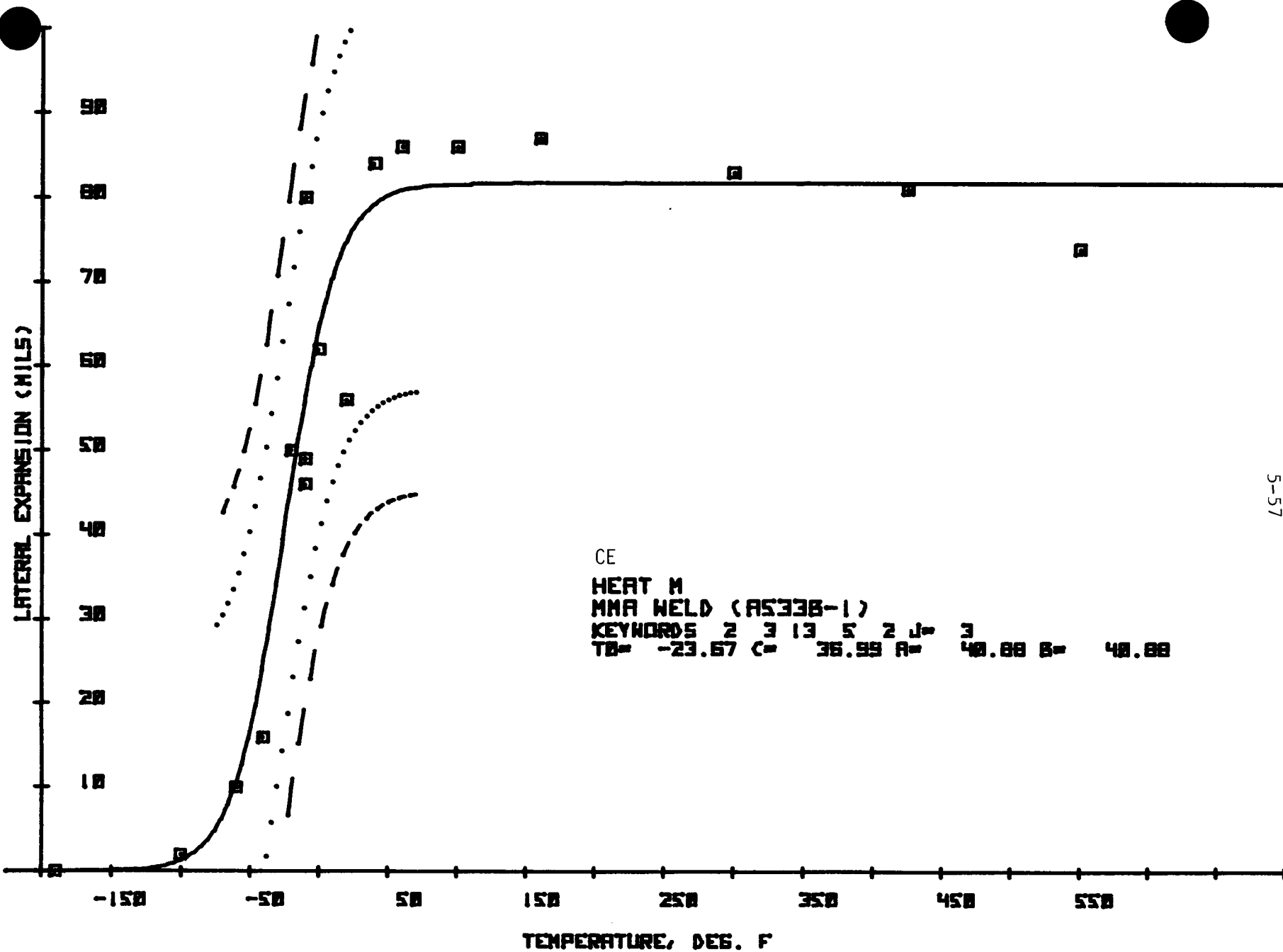


Figure 5.28 Charpy V-Notch Dial Energy for ETI Heat L (HAZ)



5-56

Figure 5.29 Charpy V-Notch Lateral Expansion for CE Heat M (L)



5-57

Figure 5.30 Charpy V-Notch Lateral Expansion for CE Heat M (T)

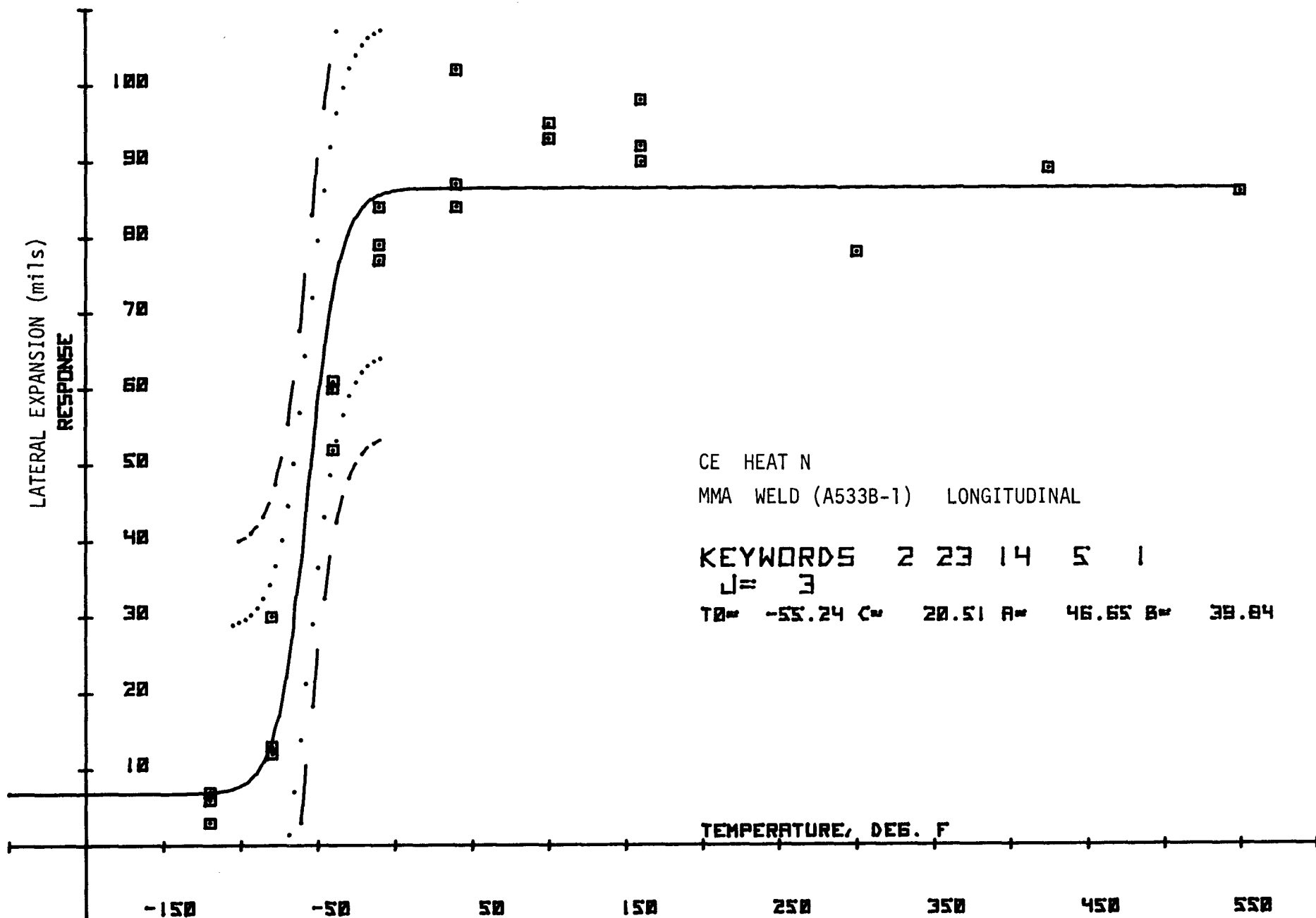


Figure 5.31 Charpy V-Notch Lateral Expansion for CE Heat N (L)

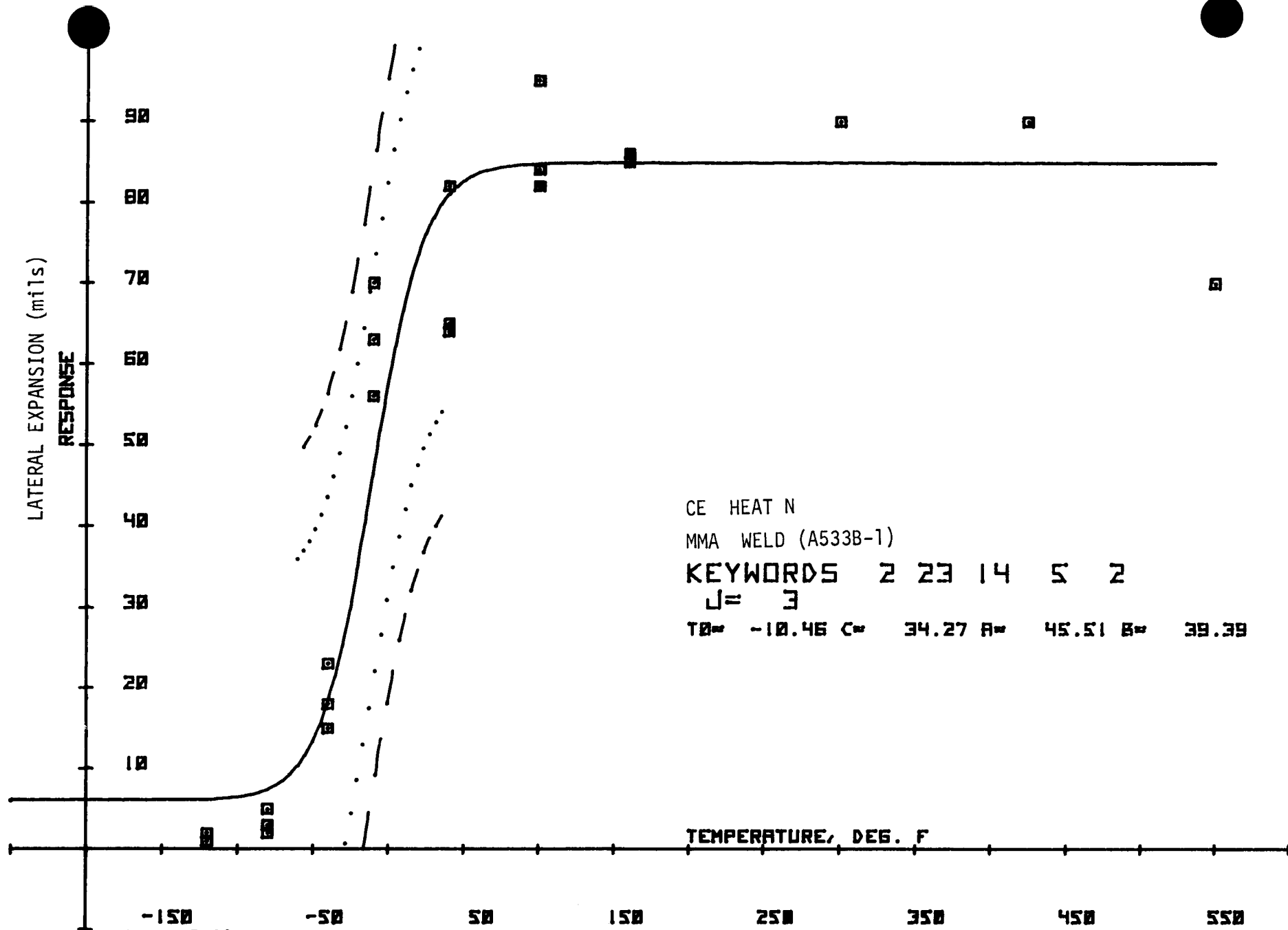


Figure 5.32 Charpy V-Notch Lateral Expansion for CE Heat N (T)

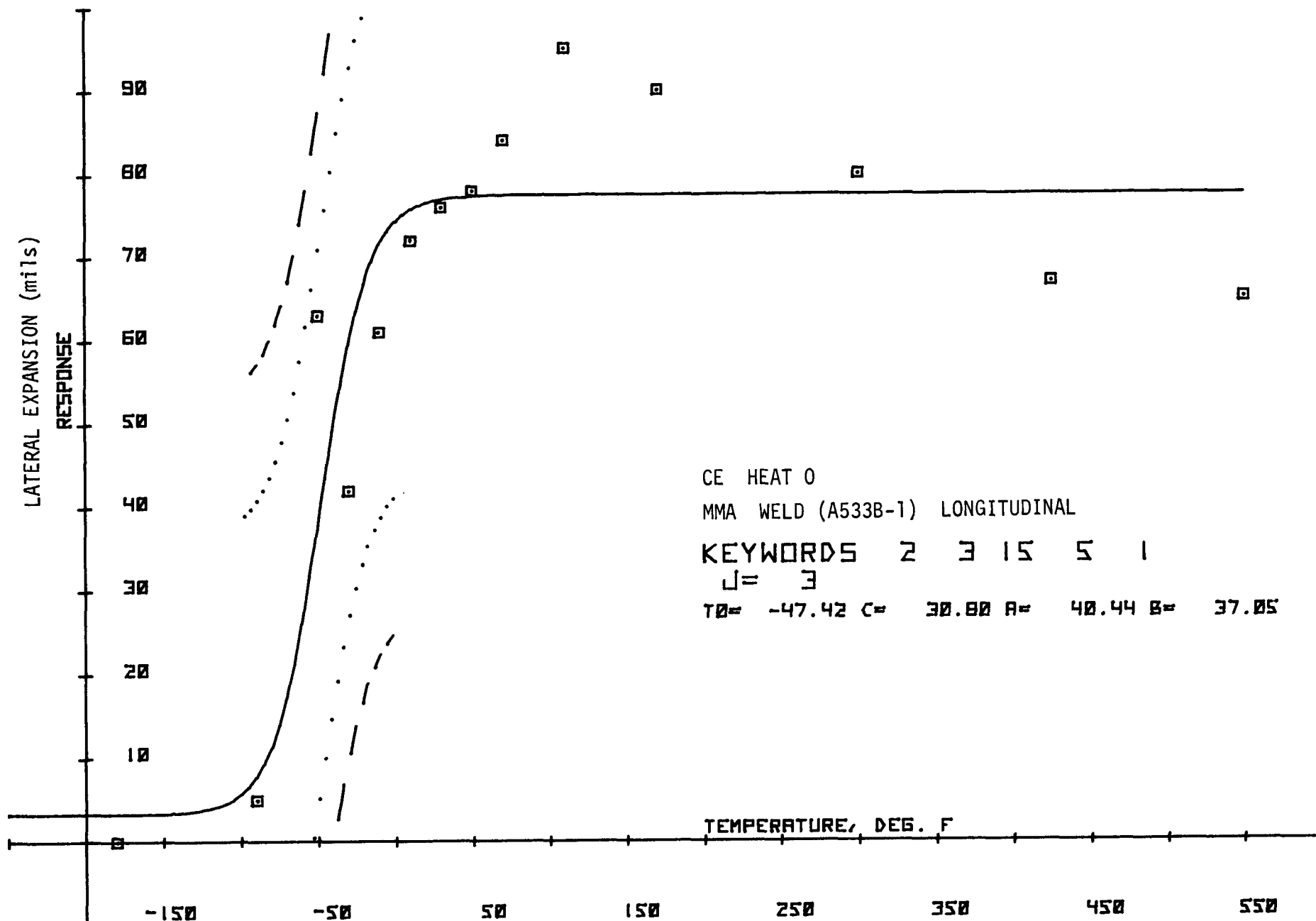


Figure 5.33 Charpy V-Notch Lateral Expansion for CE Heat 0 (L)

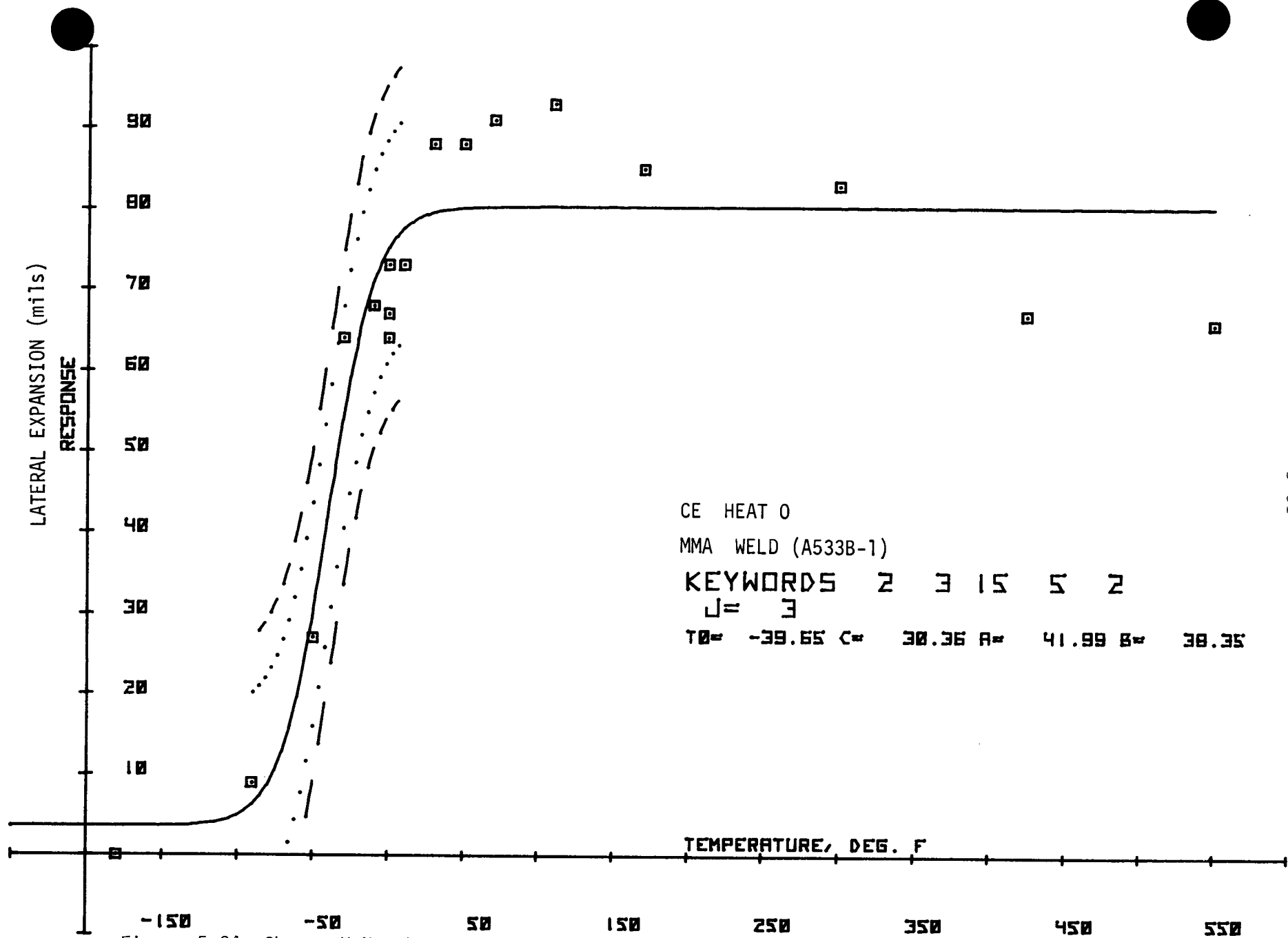


Figure 5.34 Charpy V-Notch Lateral Expansion for CE Heat 0 (T)

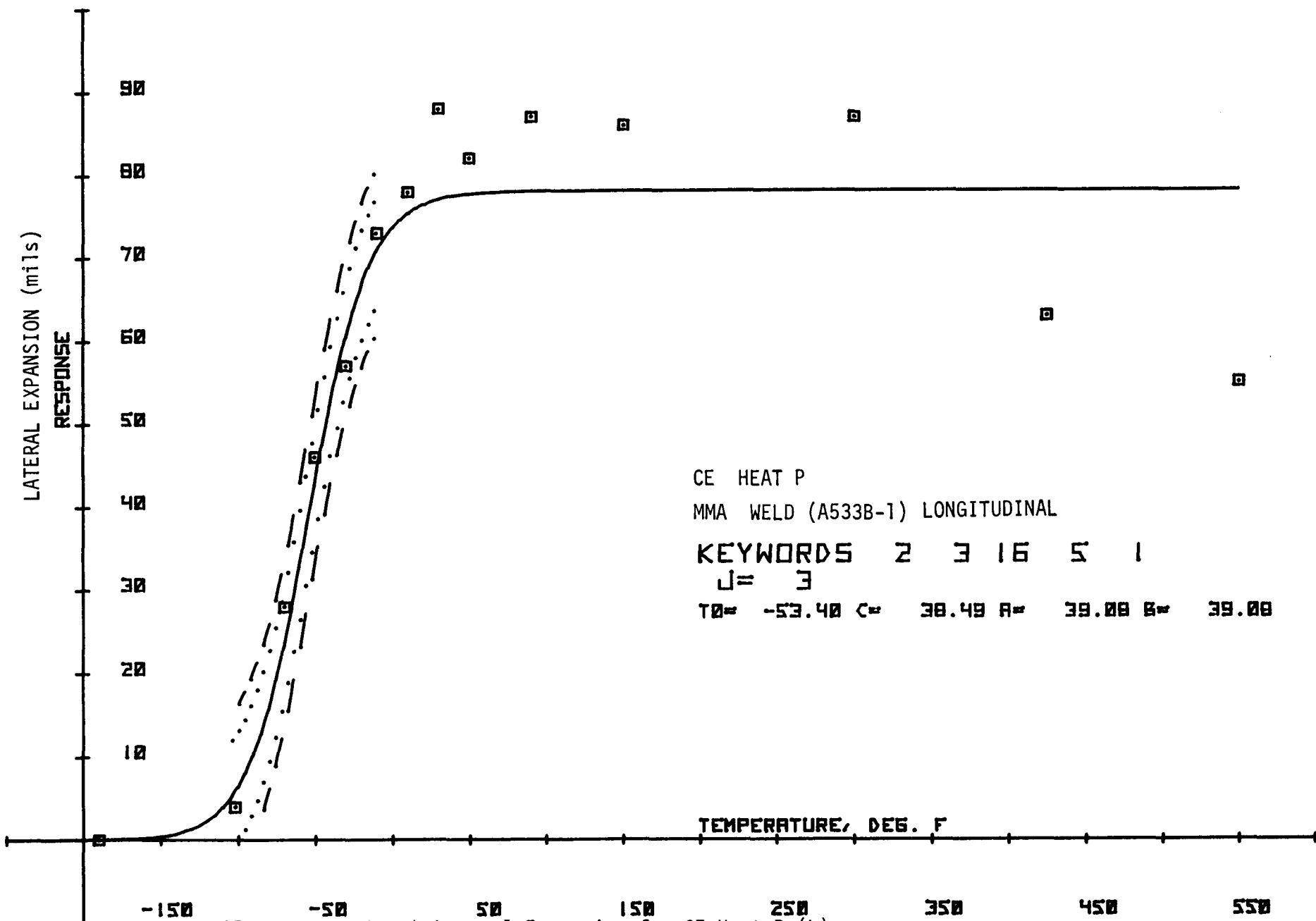


Figure 5.35 Charpy V-Notch Lateral Expansion for CE Heat P (L)

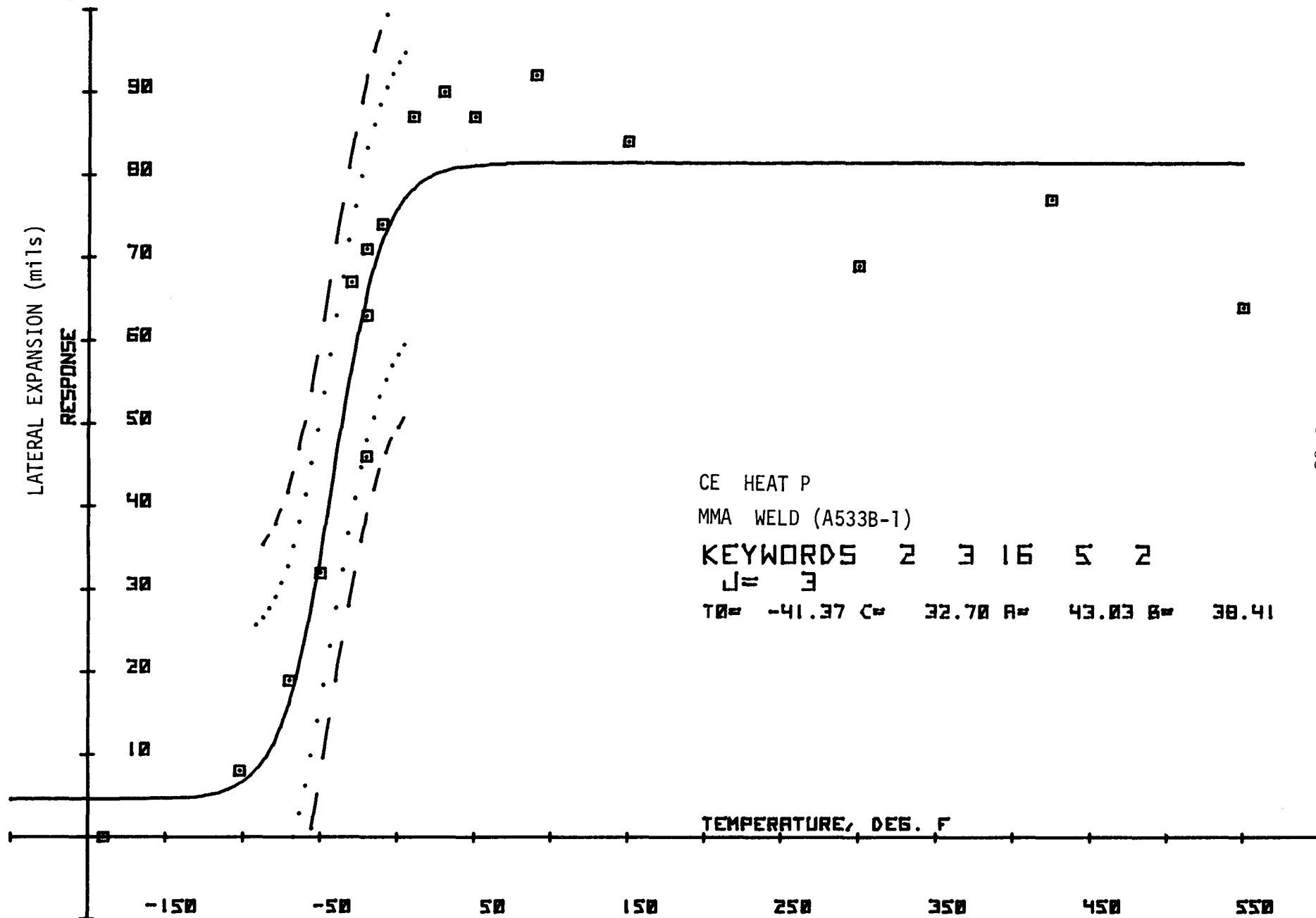
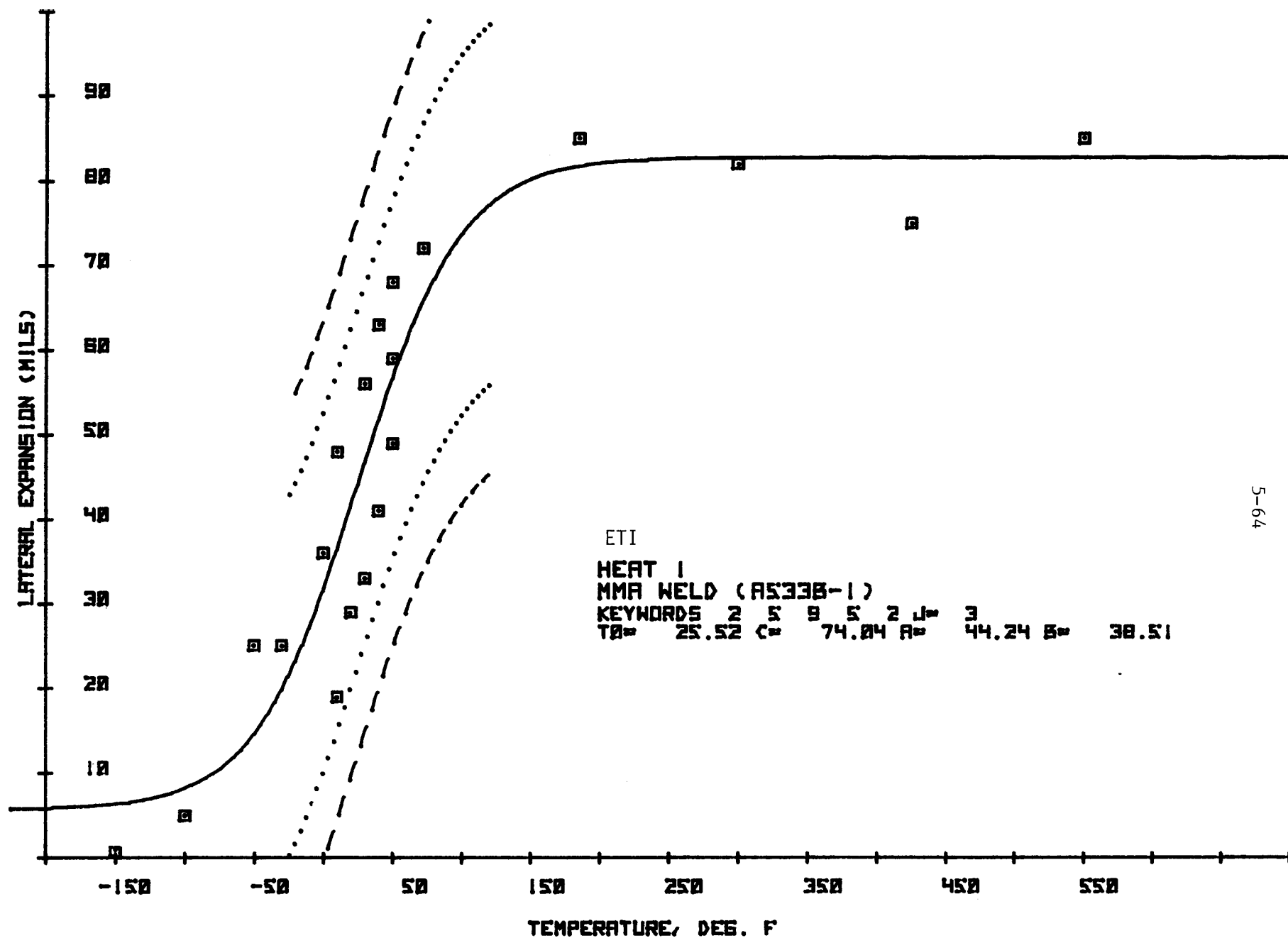


Figure 5.36 Charpy V-Notch Lateral Expansion for CE Heat P (T)



5-64

Figure 5.37 Charpy V-Notch Lateral Expansion for ETI Heat I (T)

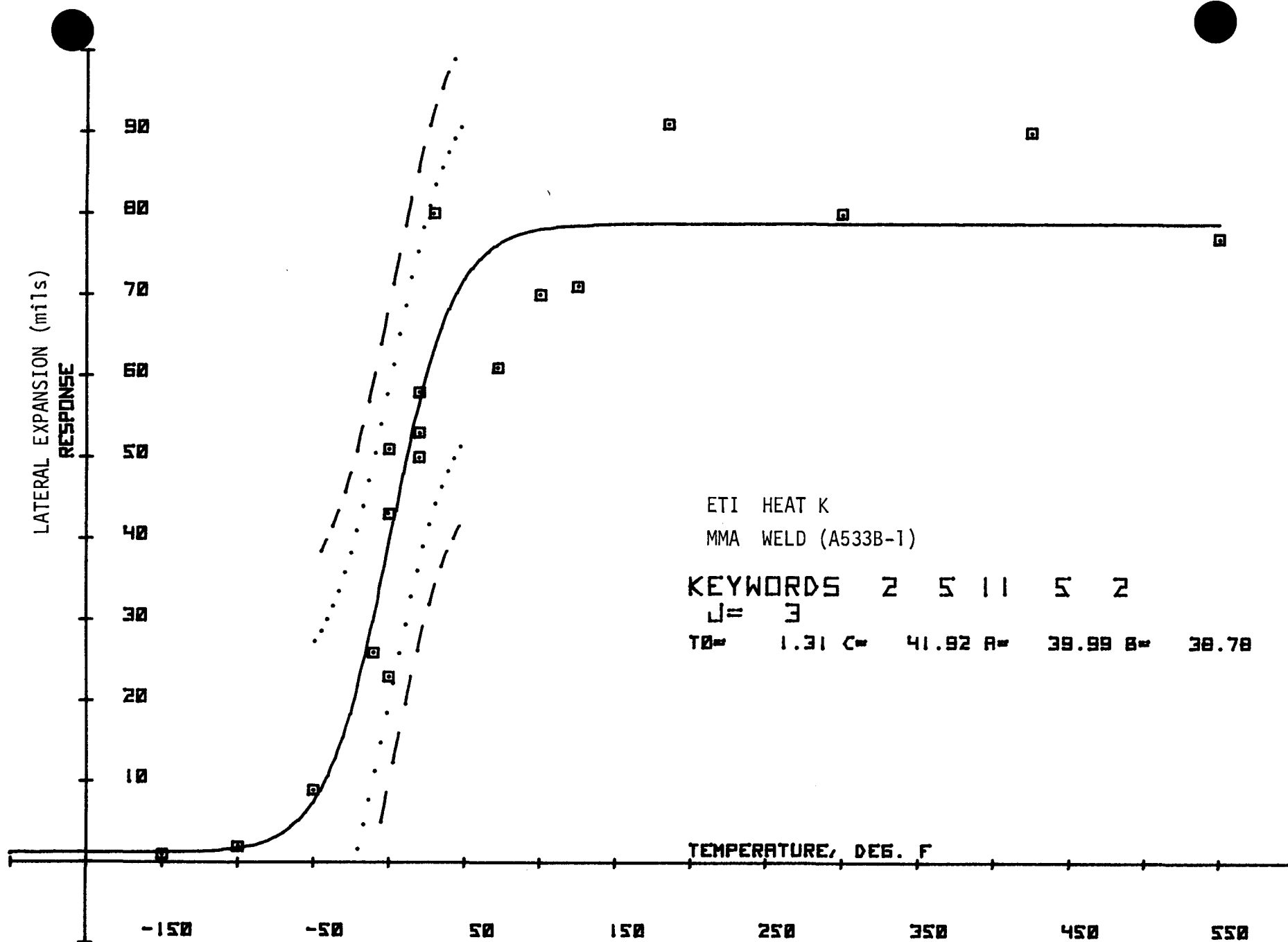
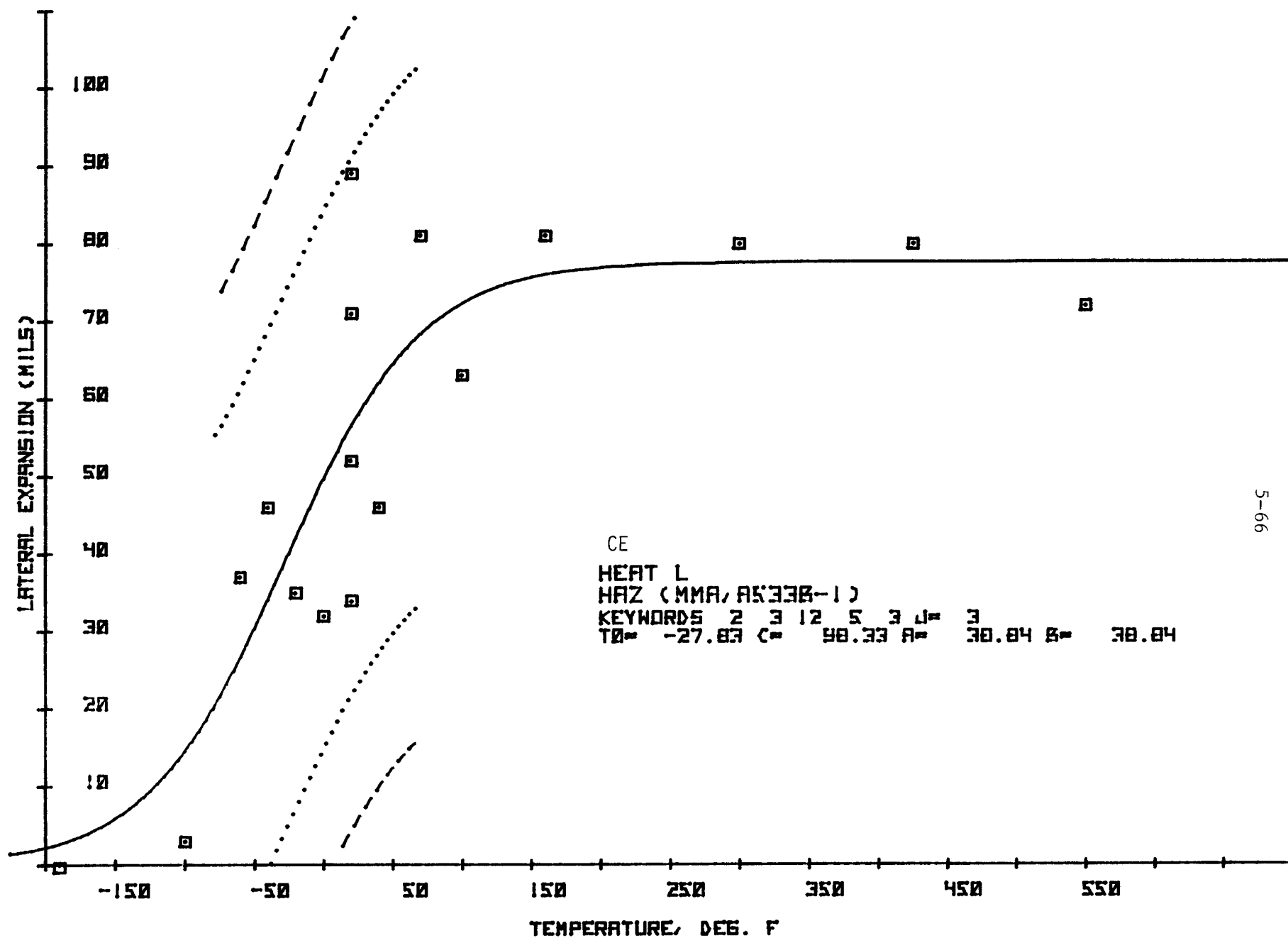


Figure 5.38 Charpy V-Notch Lateral Expansion for ETI Heat K (T)



5-66

Figure 5.39 Charpy V-Notch Lateral Expansion for CE Heat L (HAZ)

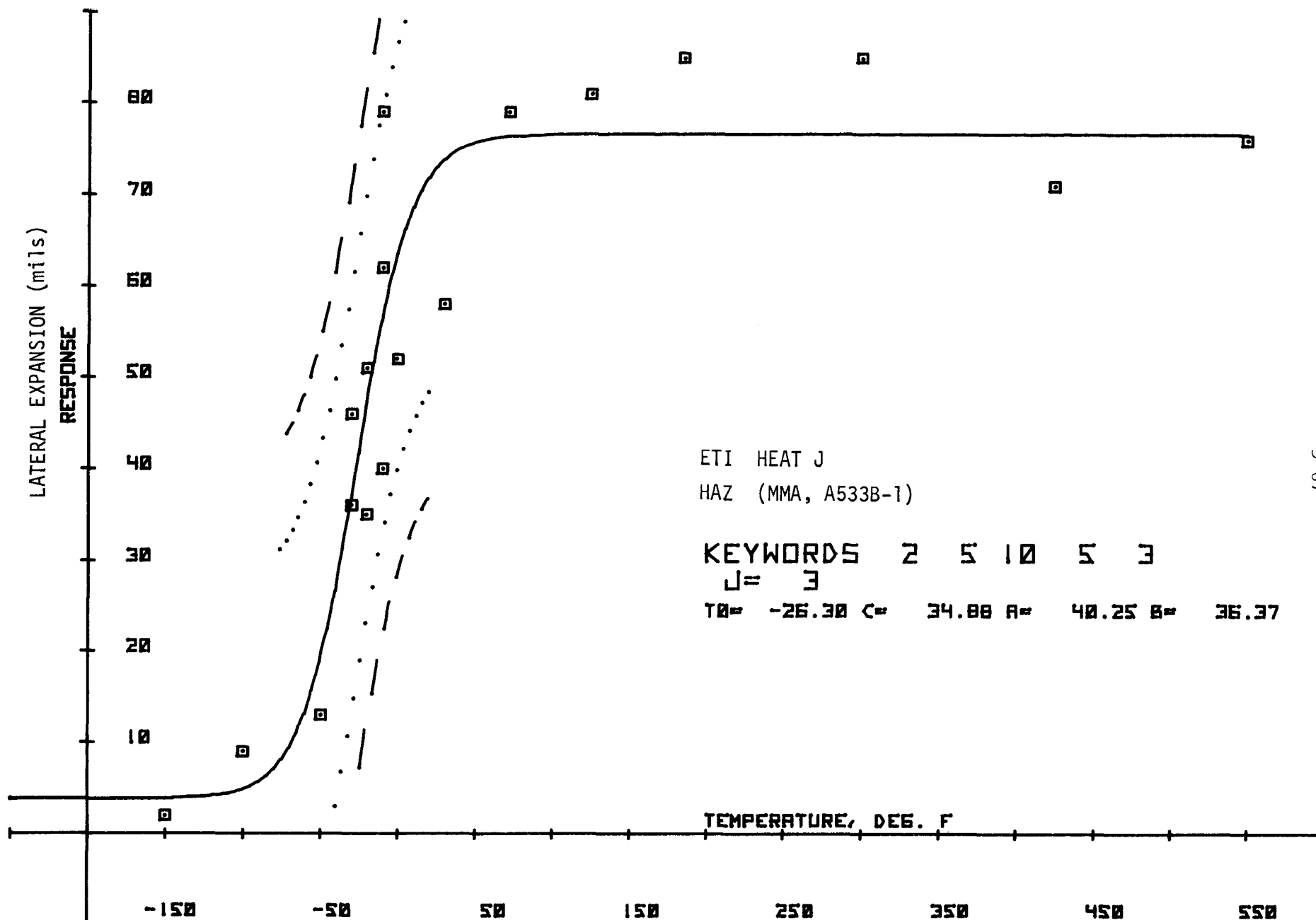


Figure 5.40 Charpy V-Notch Lateral Expansion for ETI Heat J (HAZ)

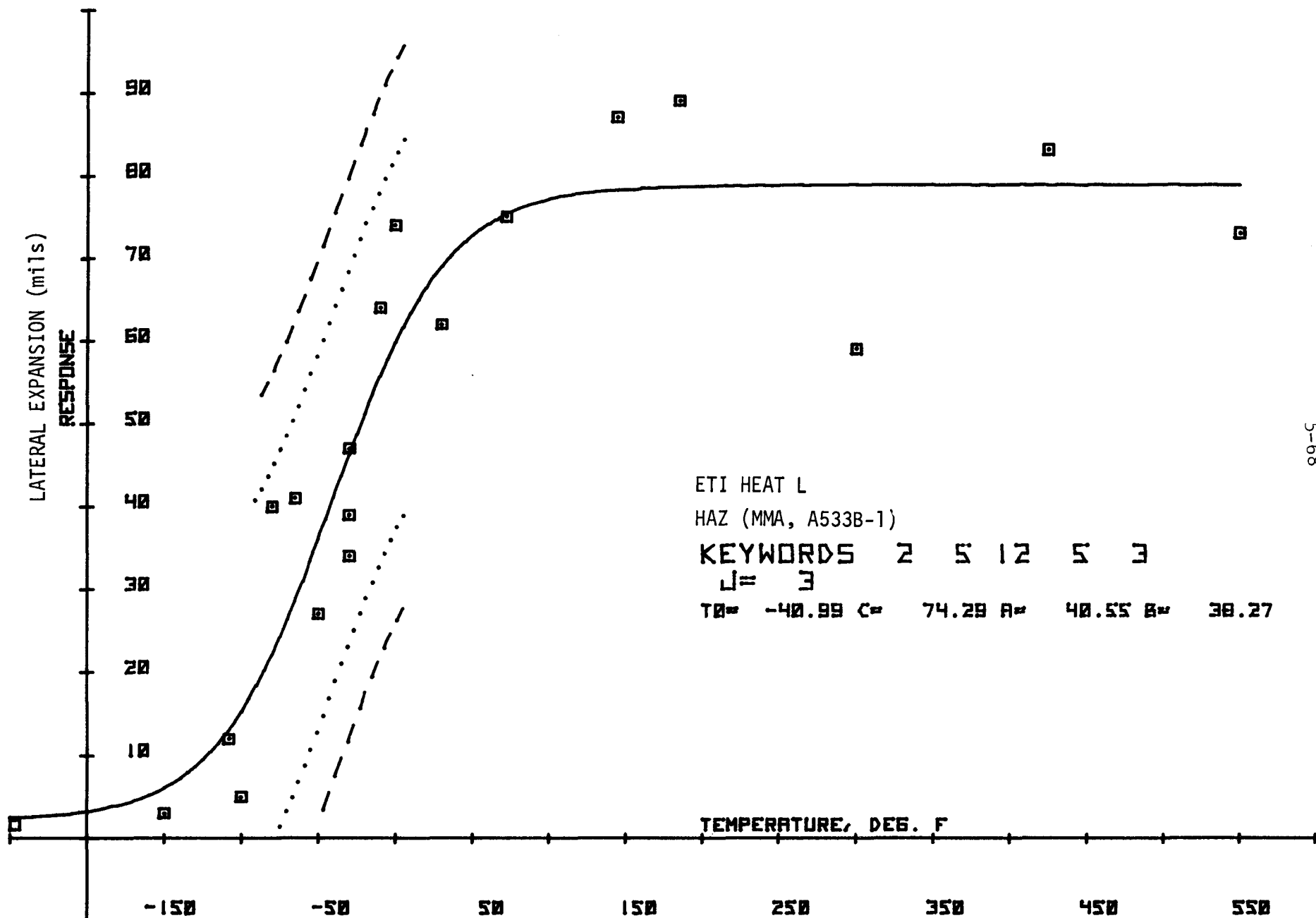


Figure 5.41 Charpy V-Notch Lateral Expansion for ETI Heat L (HAZ)

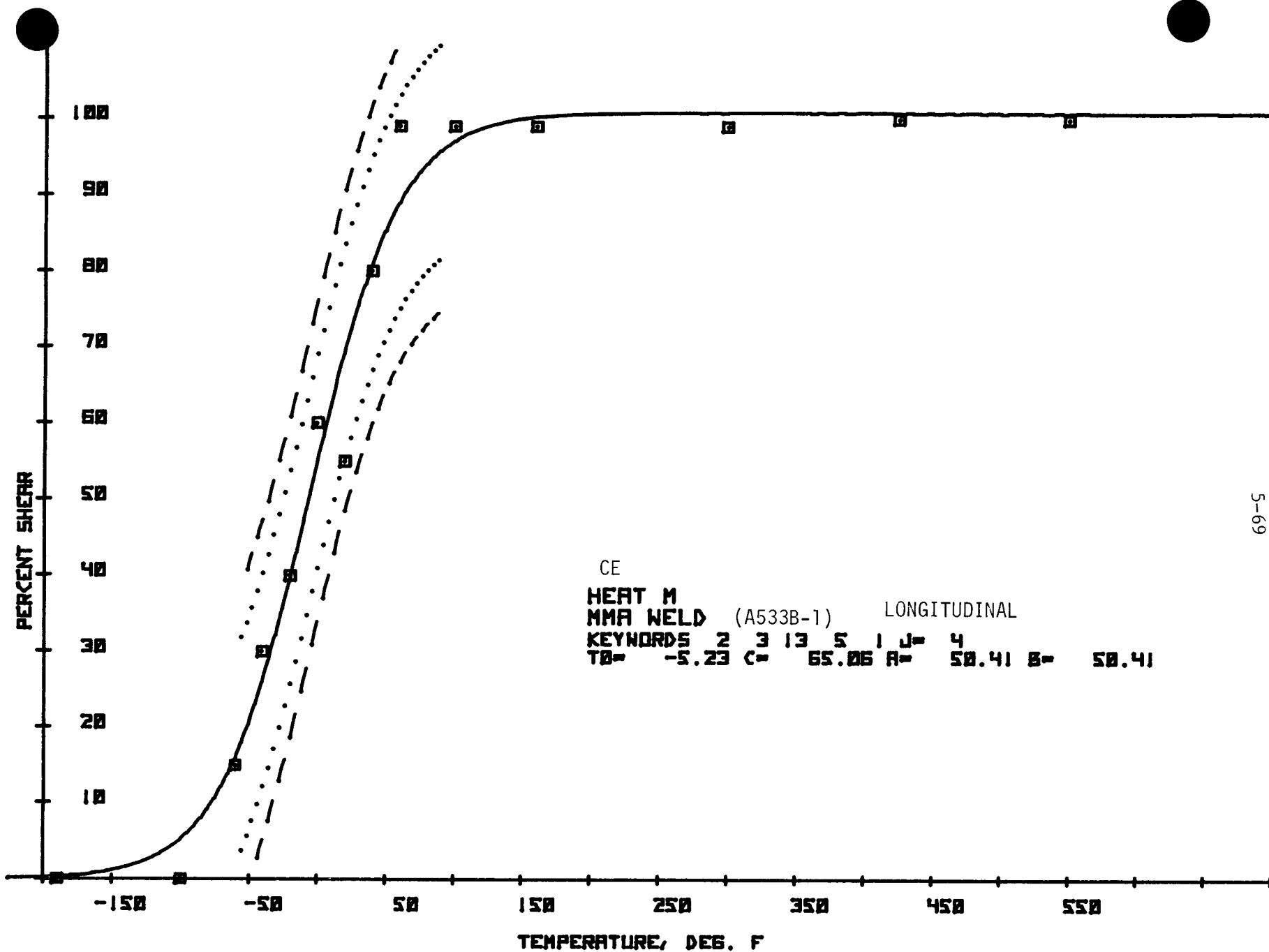
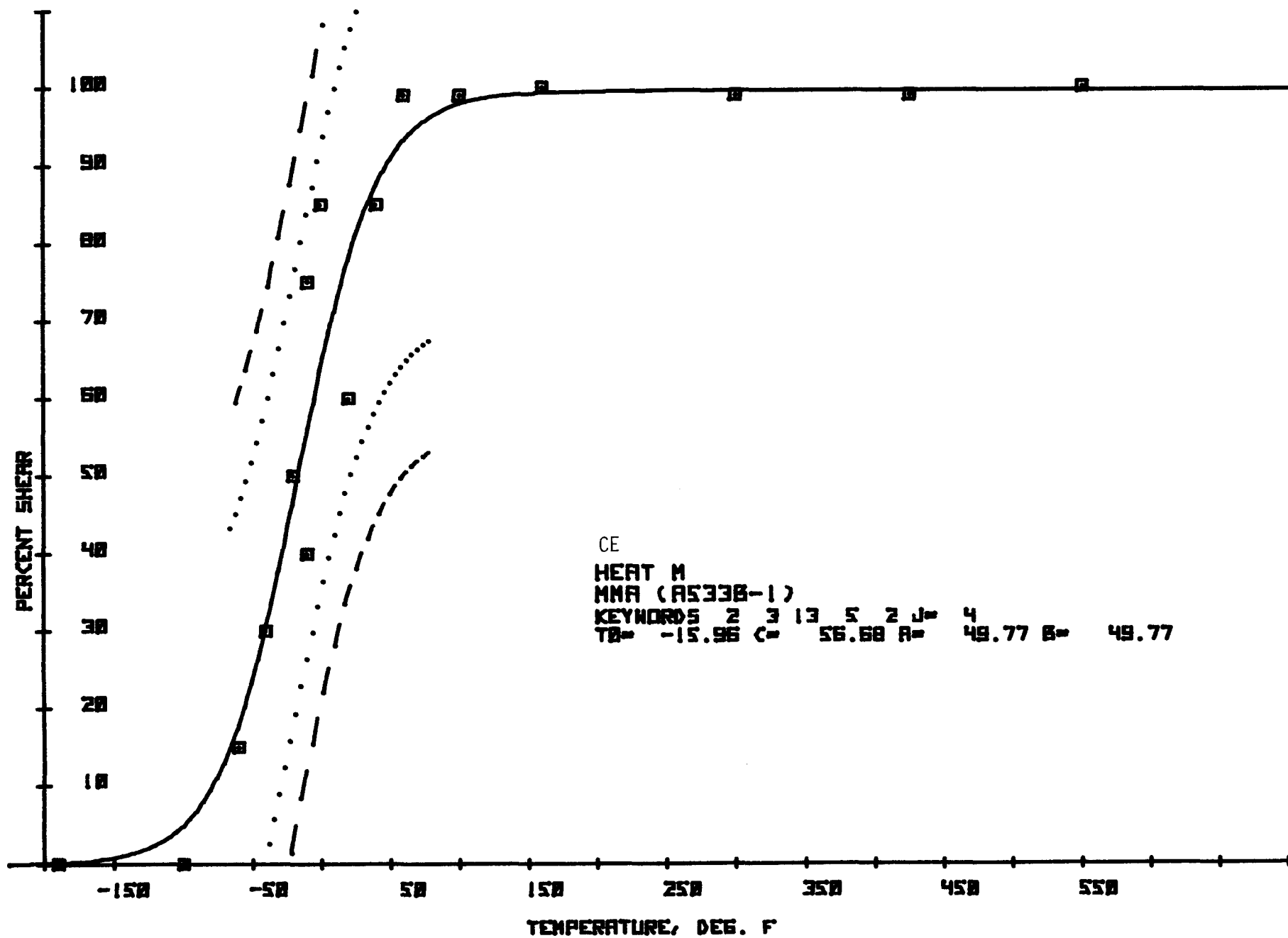


Figure 5.42 Charpy V-Notch Percent Shear for CE Heat M (L)



5-70

Figure 5.43 Charpy V-Notch Percent Shear for CE Heat M (T)

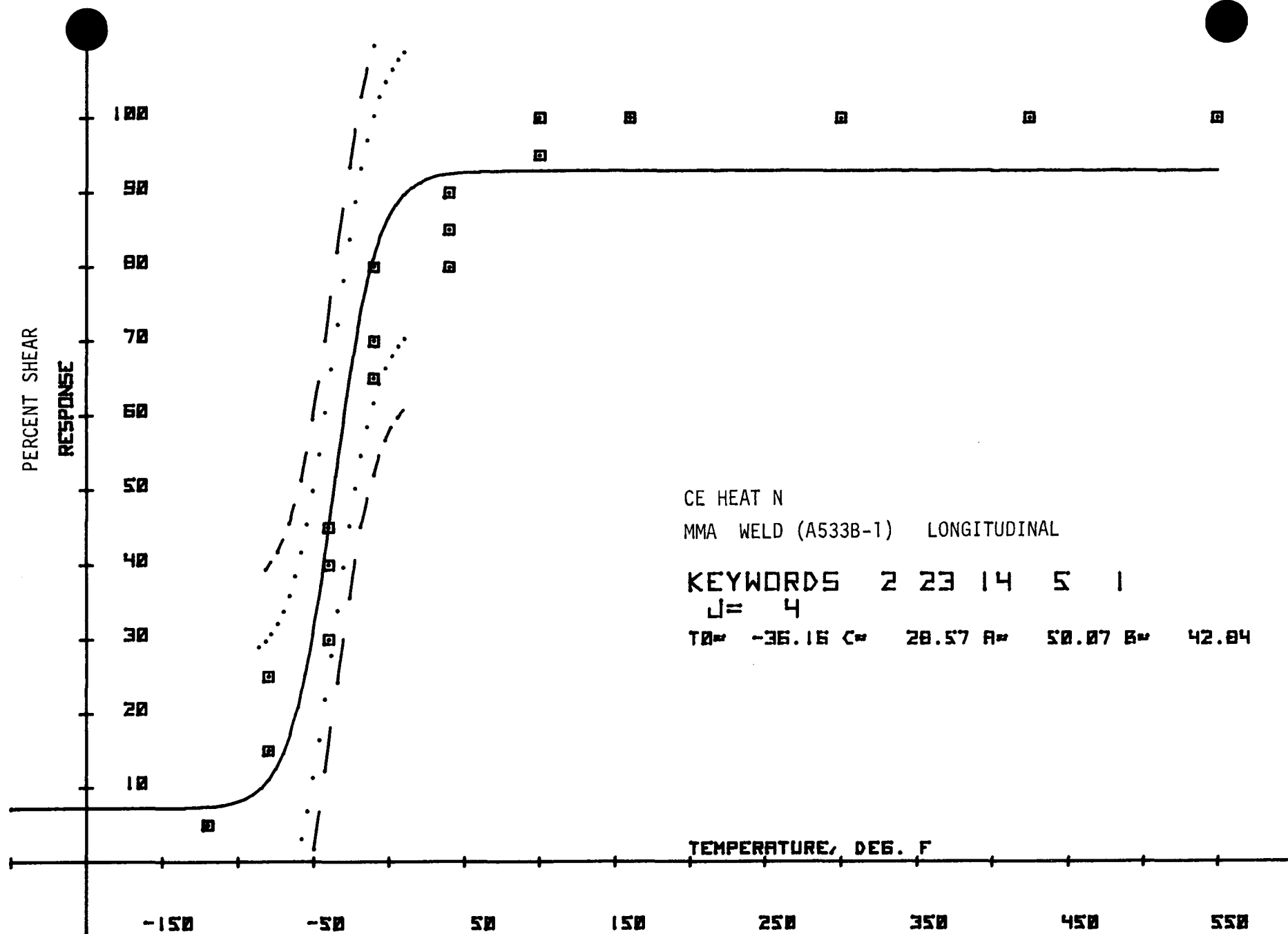


Figure 5.44 Charpy V-Notch Percent Shear for CE Heat N (L)

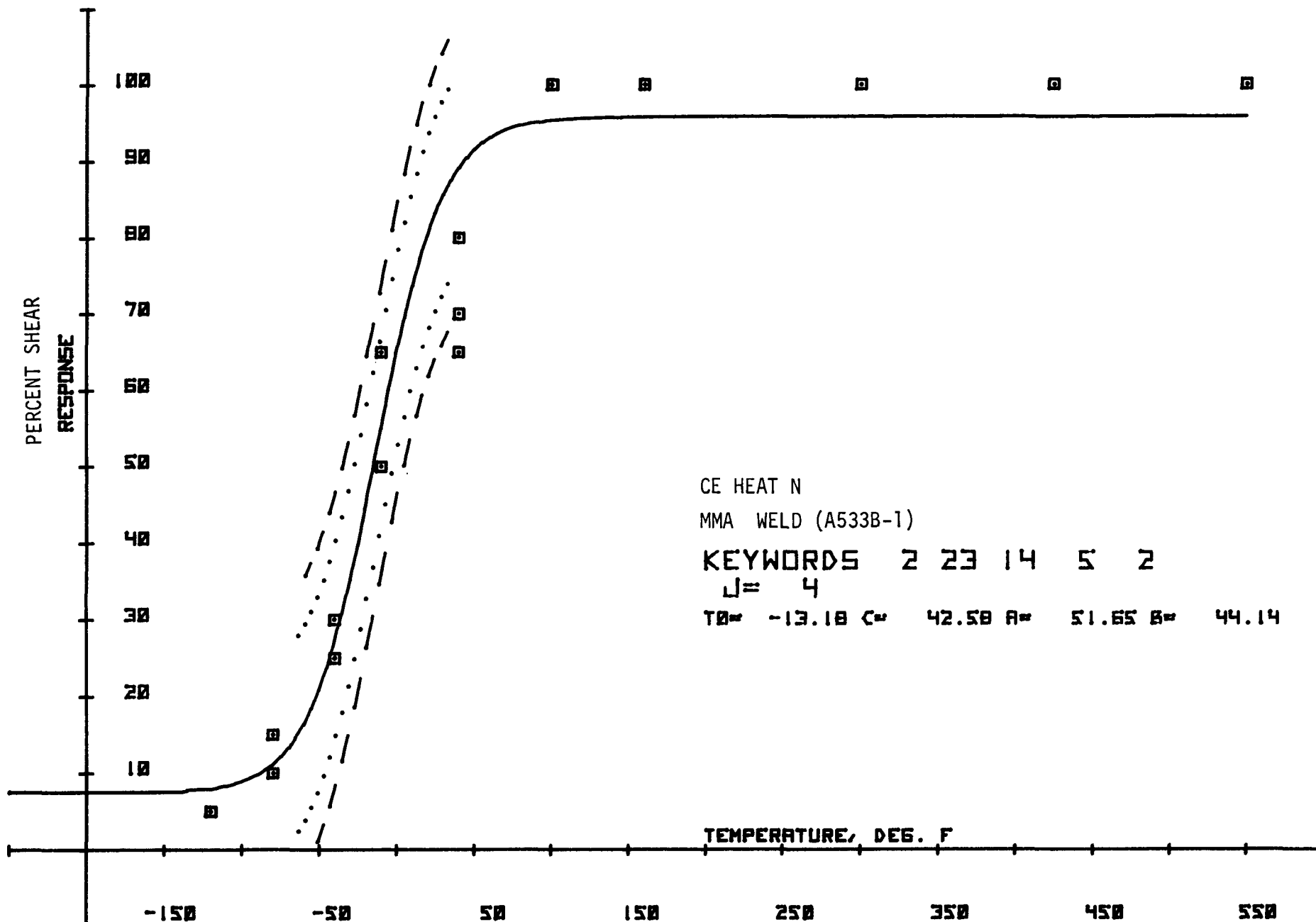


Figure 5.45 Charpy V-Notch Percent Shear for CE Heat N (T)

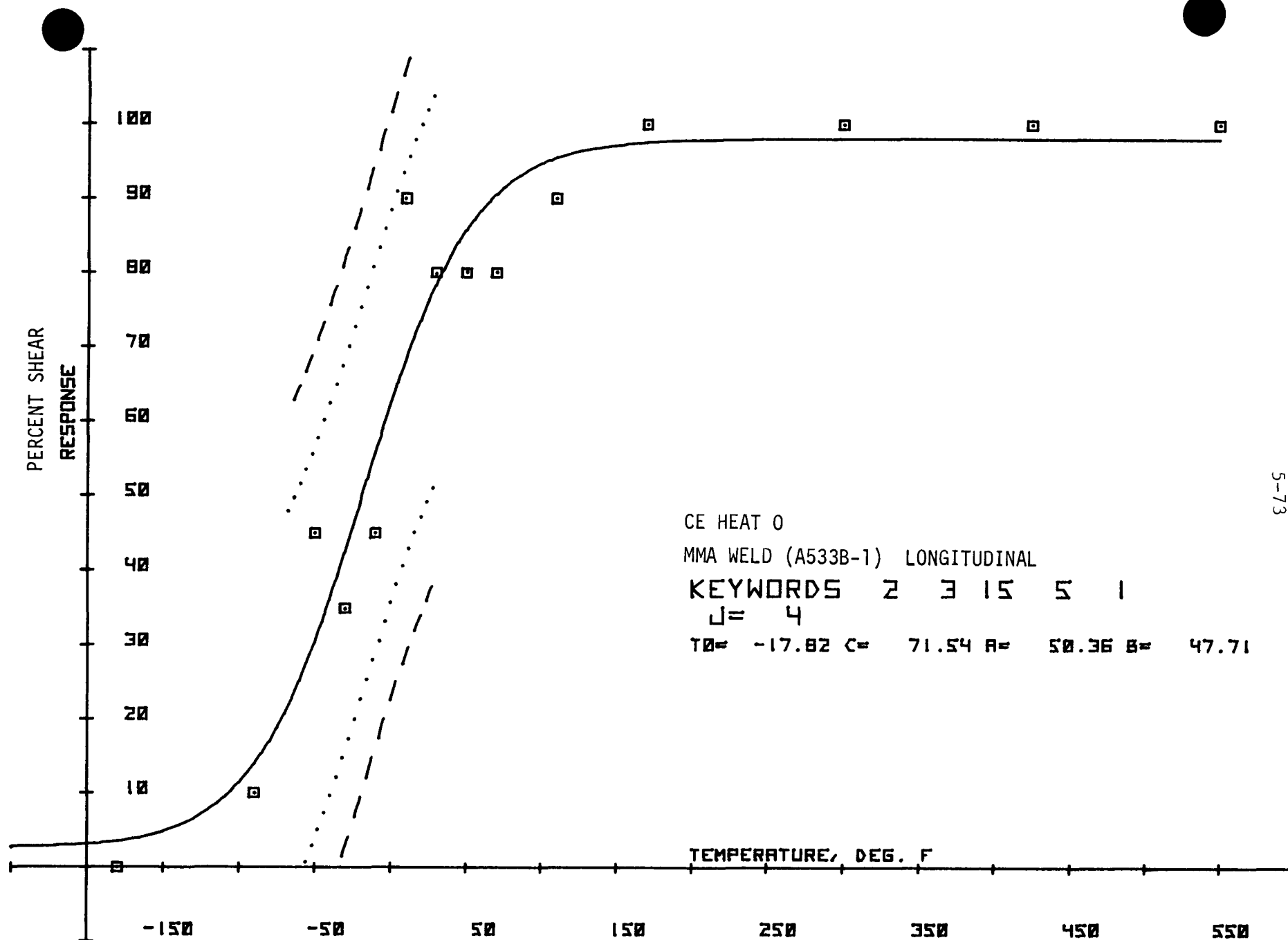


Figure 5.46 Charpy V-Notch Percent Shear for CE Heat 0 (L)

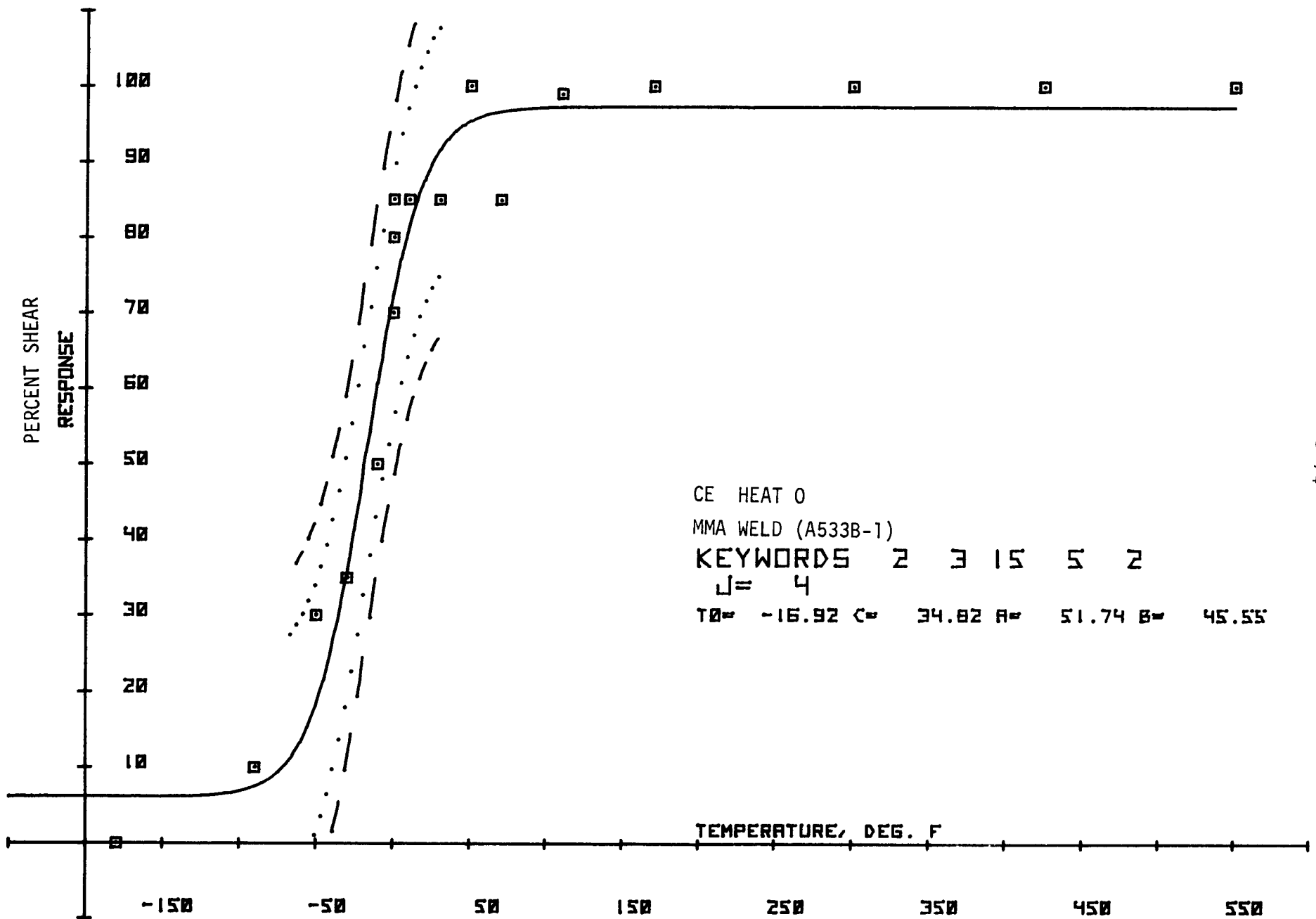


Figure 5.47 Charpy V-Notch Percent Shear for CE Heat 0 (T)

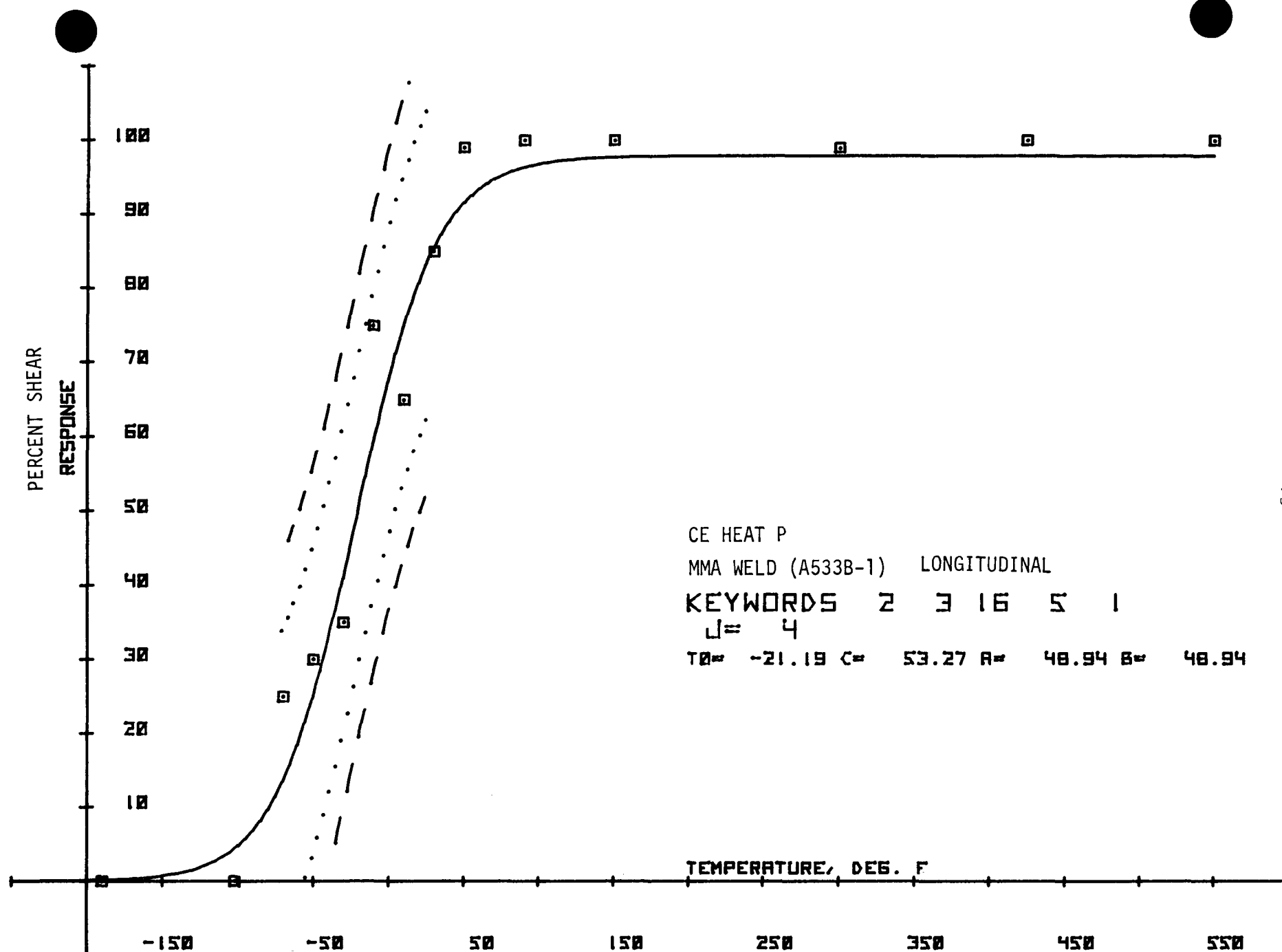


Figure 5.48 Charpy V-Notch Percent Shear for CE Heat P (L)

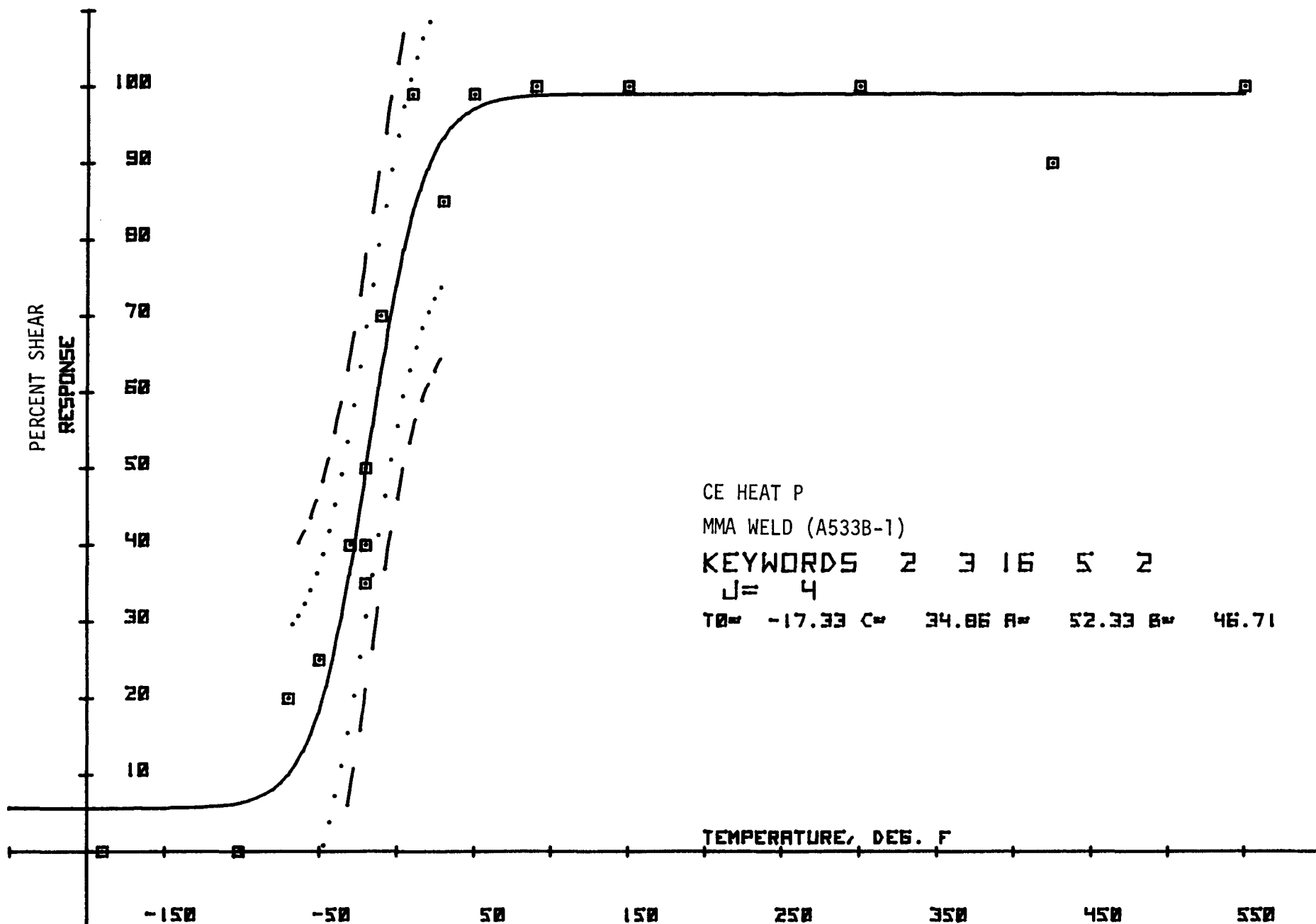
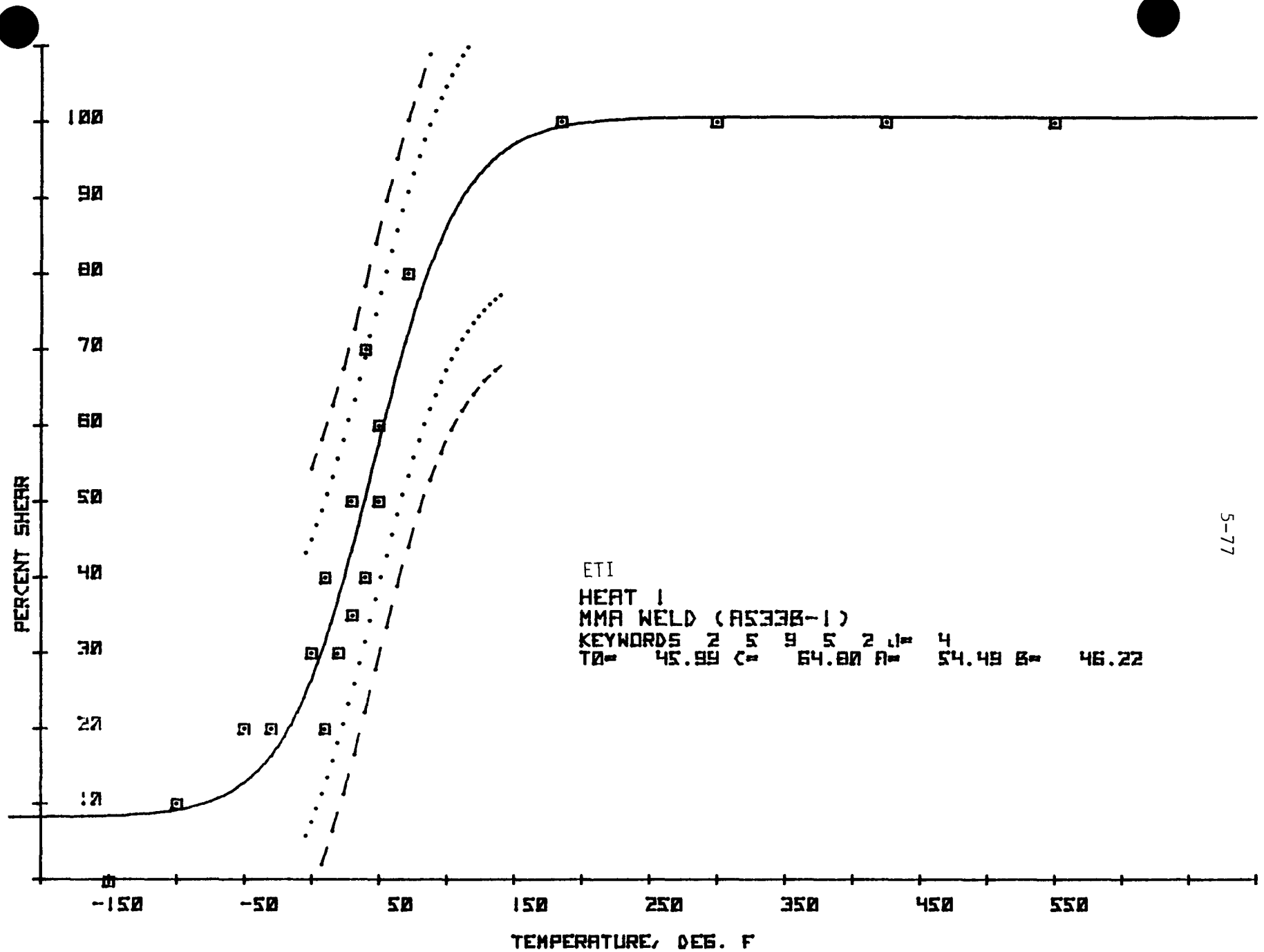
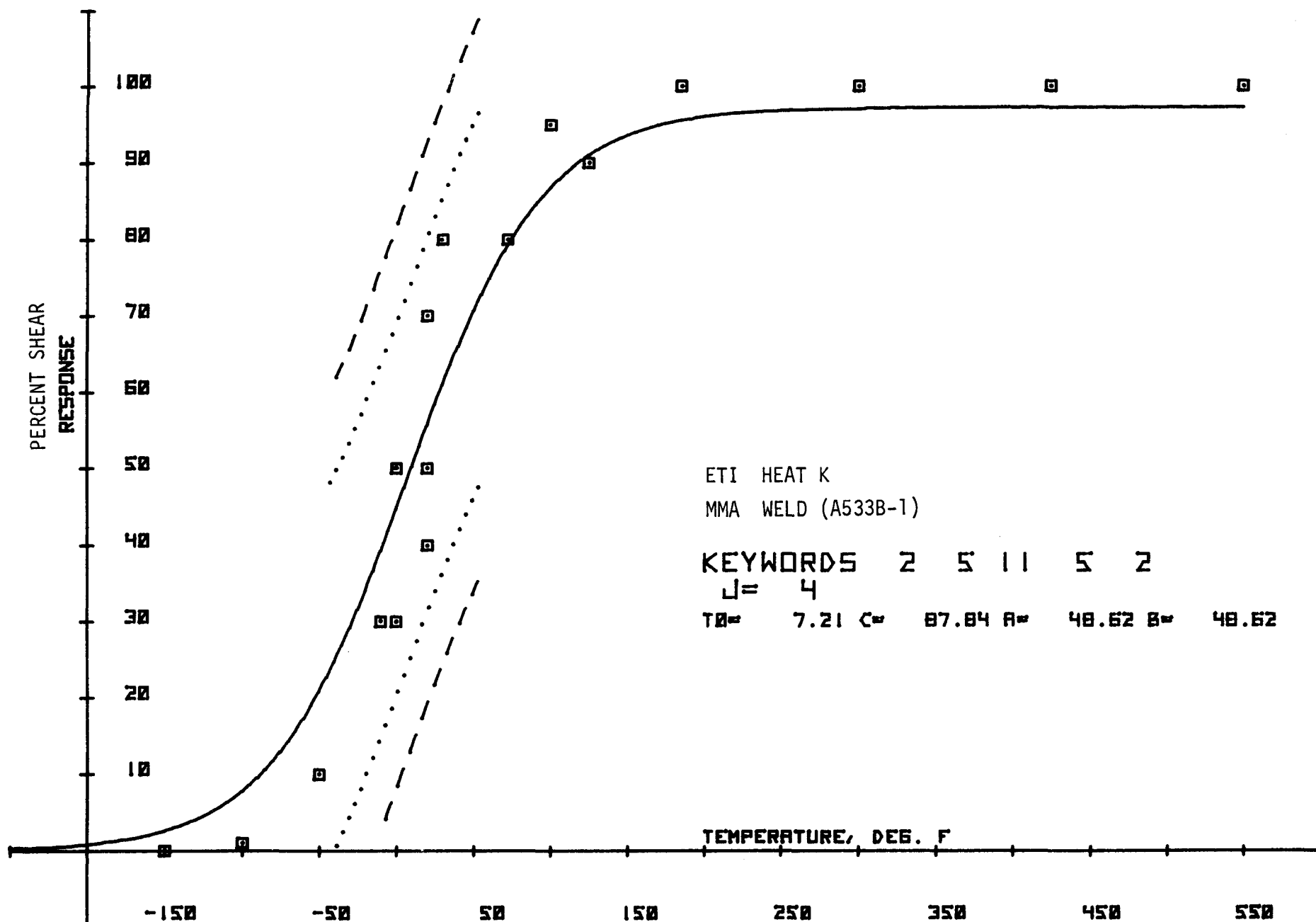


Figure 5.49 Charpy V-Notch Percent Shear for CE Heat P (T)



5-77

Figure 5.50 Charpy V-Notch Percent Shear for ETI Heat I (T)



5-78

Figure 5.51 Charpy V-Notch Percent Shear for ETI Heat K (T)

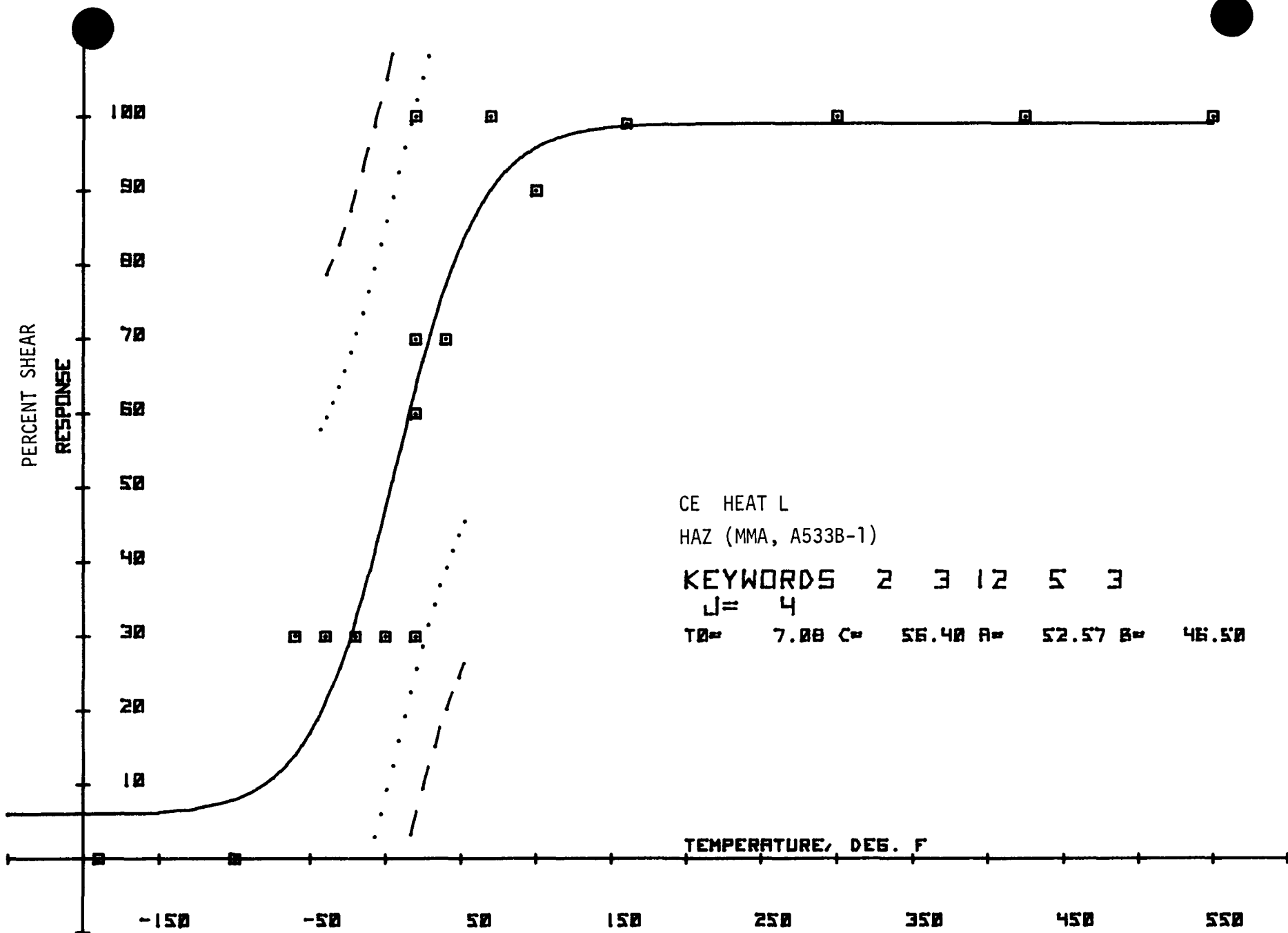
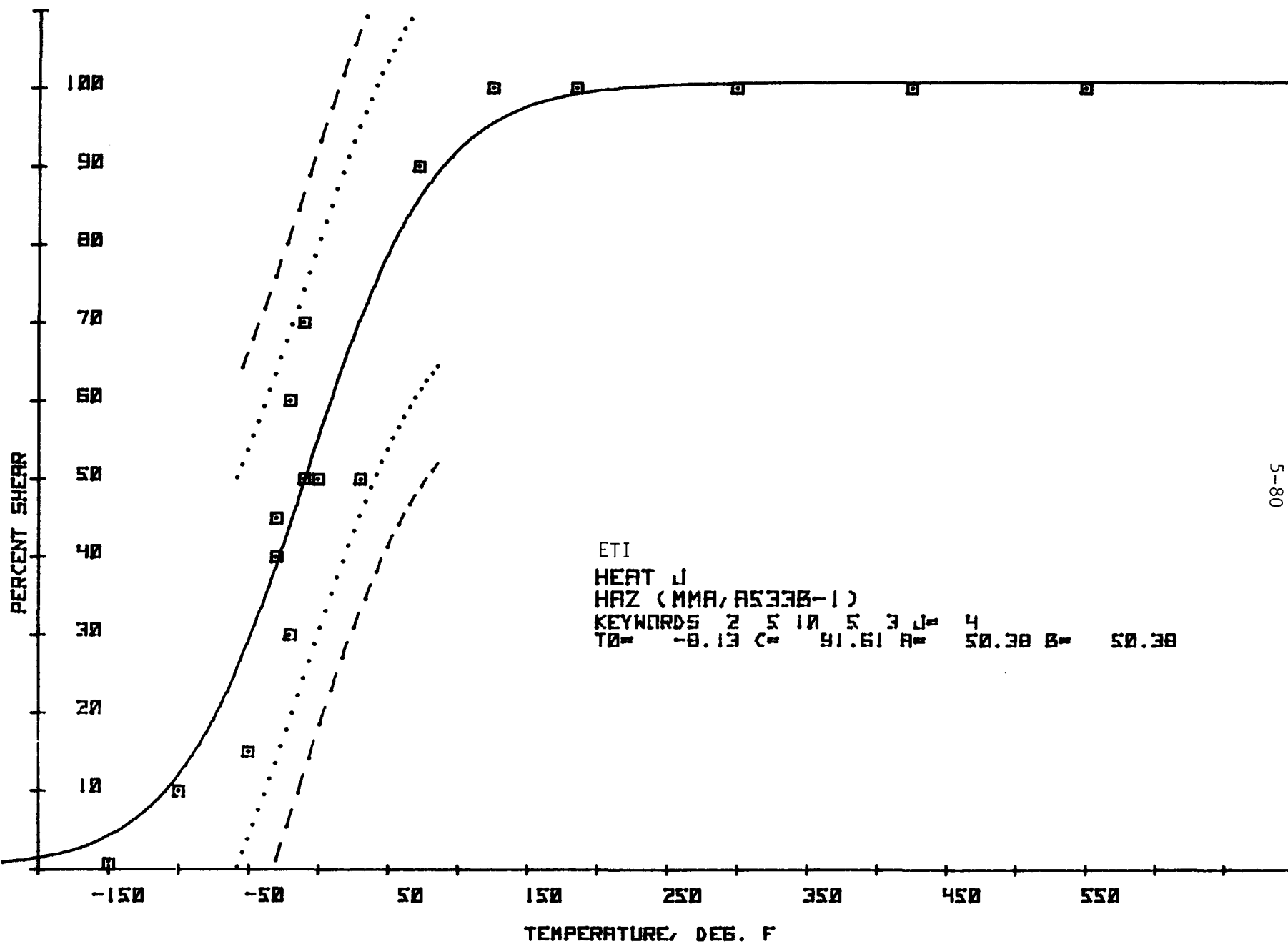


Figure 5.52 Charpy V-Notch Percent Shear for CE Heat L (HAZ)



5-80

Figure 5.53 Charpy V-Notch Percent Shear for ETI Heat J (HAZ)

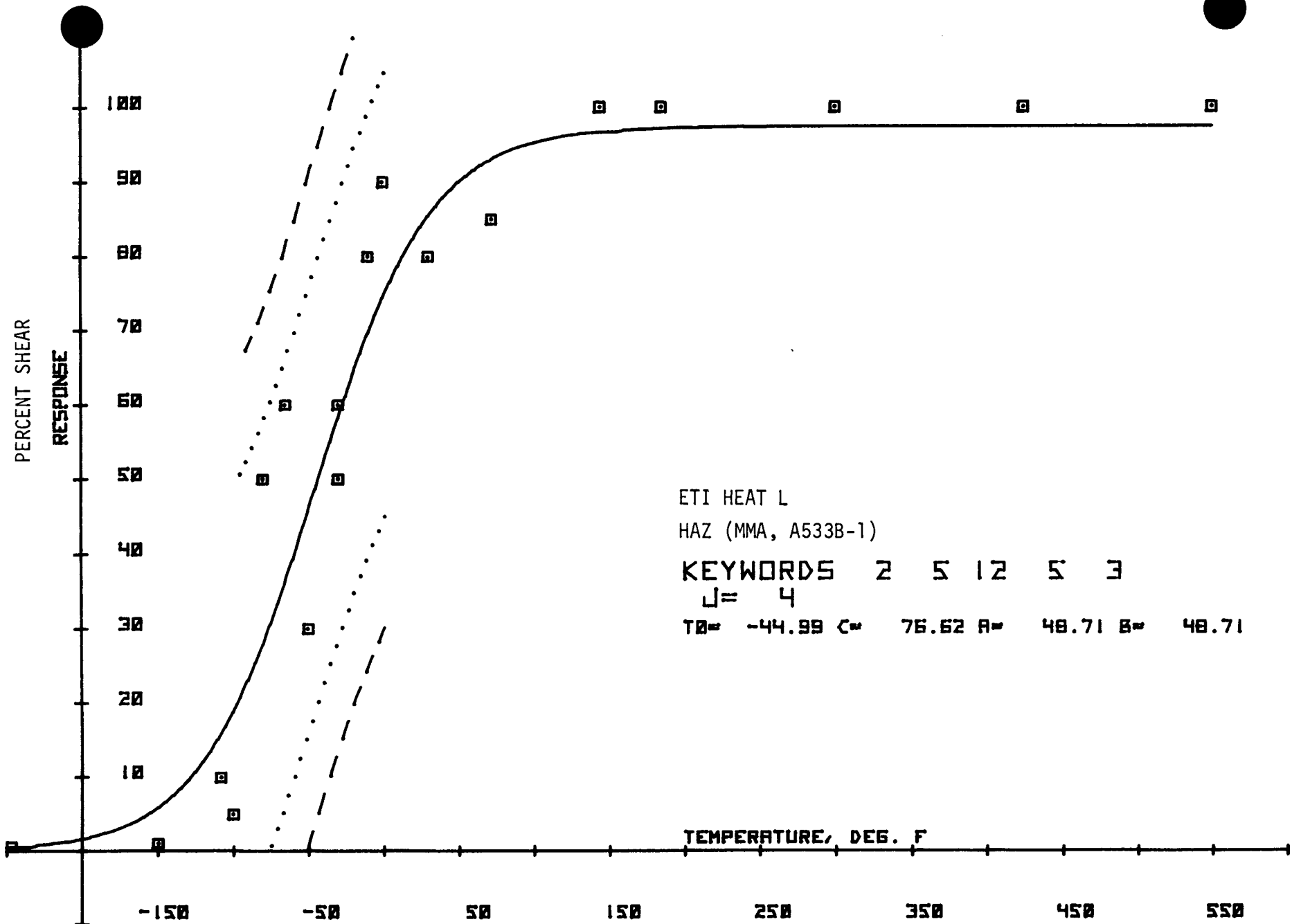


Figure 5.54 Charpy V-Notch Percent Shear for ETI Heat L (HAZ)

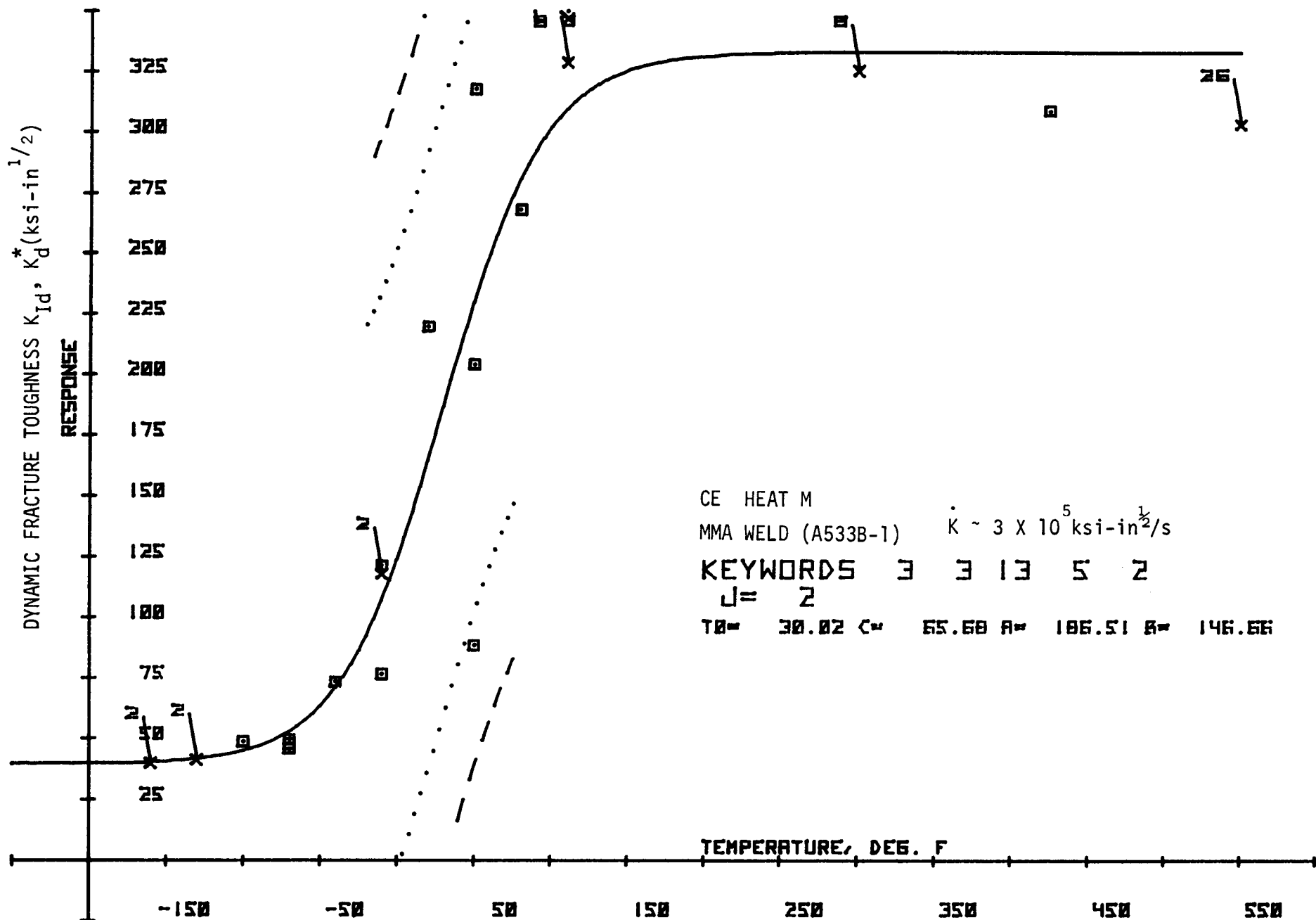


Figure 5.55 Precracked Charpy Fracture Toughness for CE Heat M (T)

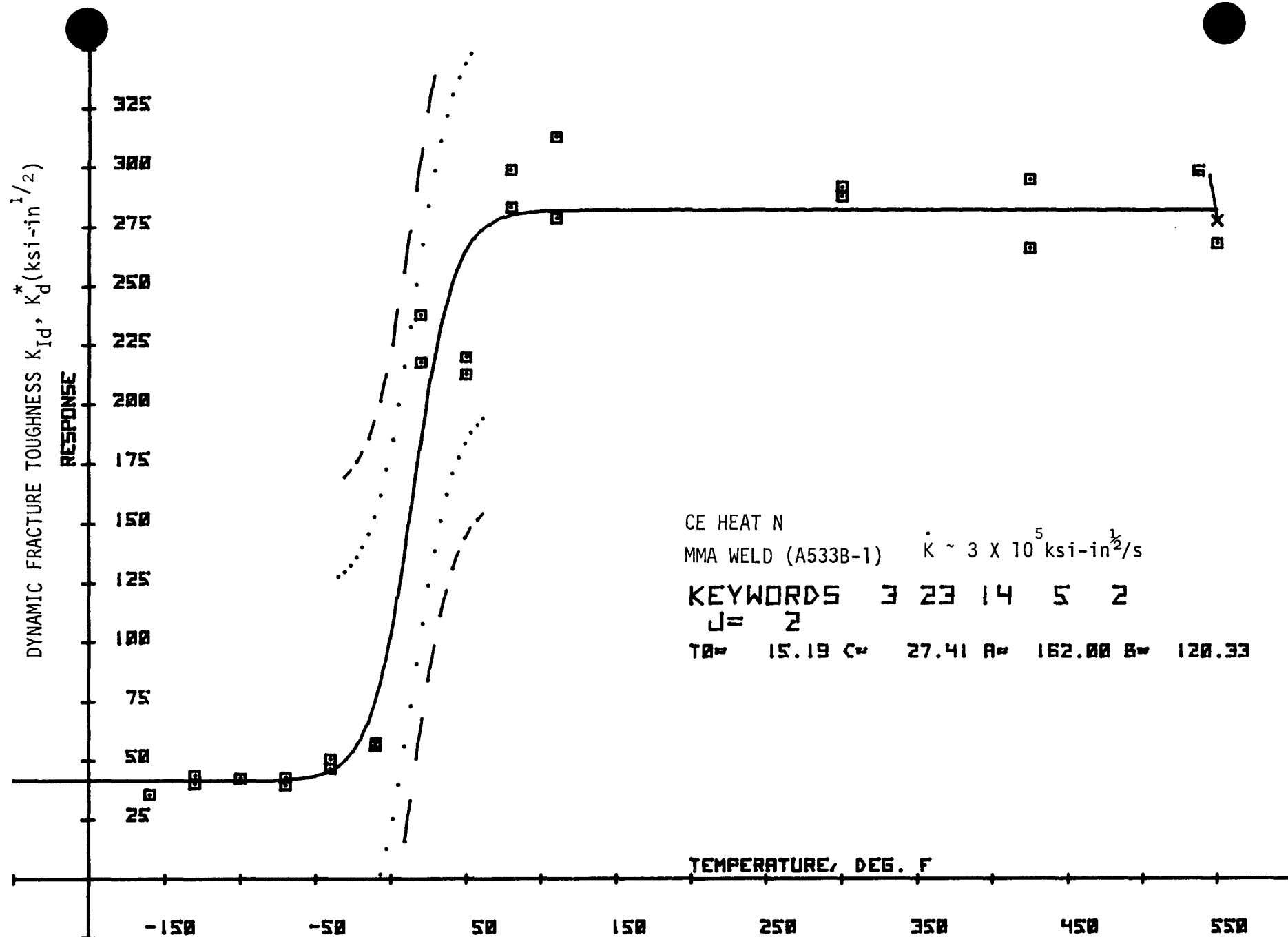


Figure 5.56 Precracked Charpy Fracture Toughness for CE Heat N (T)

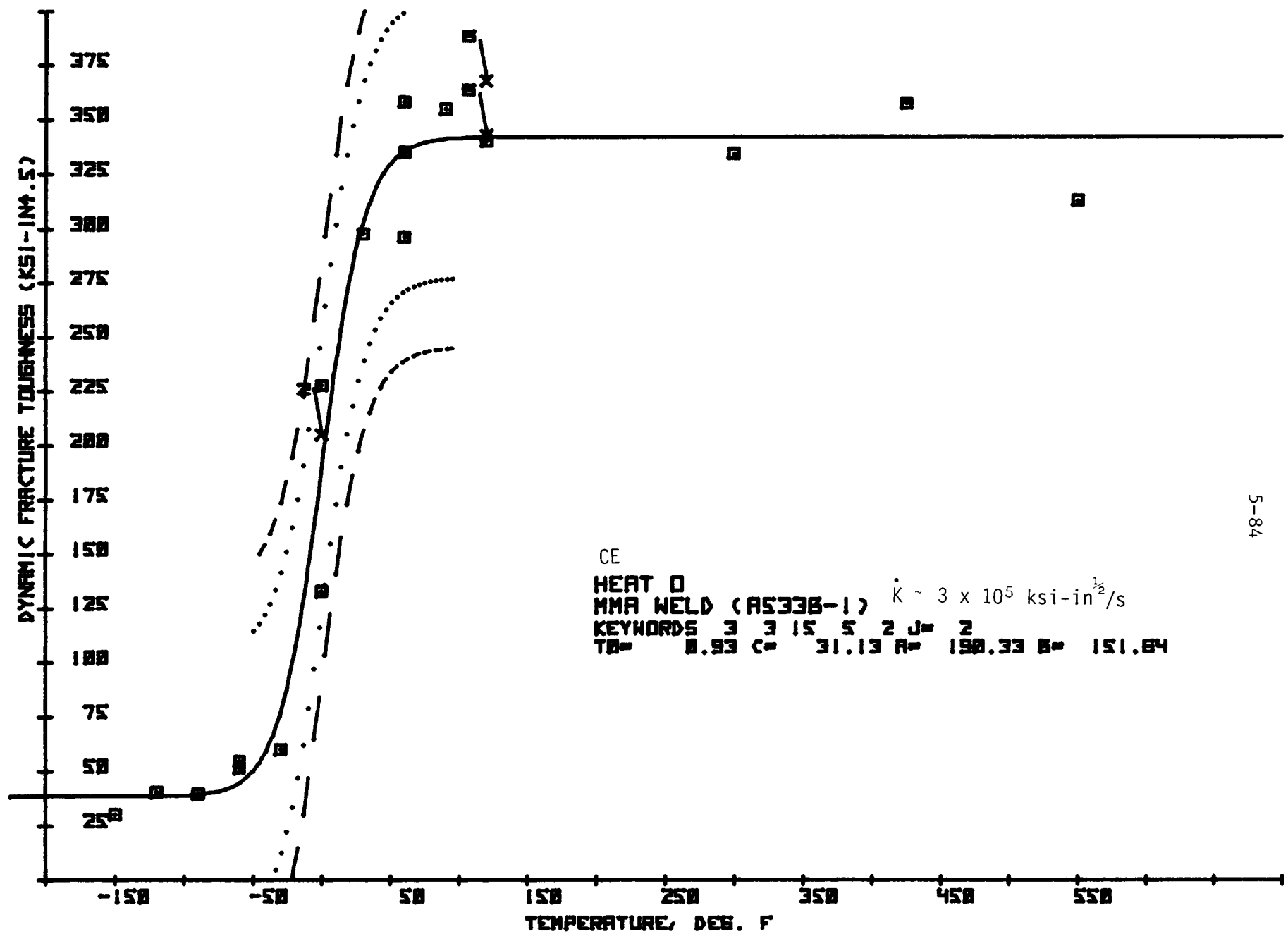


Figure 5.57 Precracked Charpy Fracture Toughness for CE Heat 0 (T)

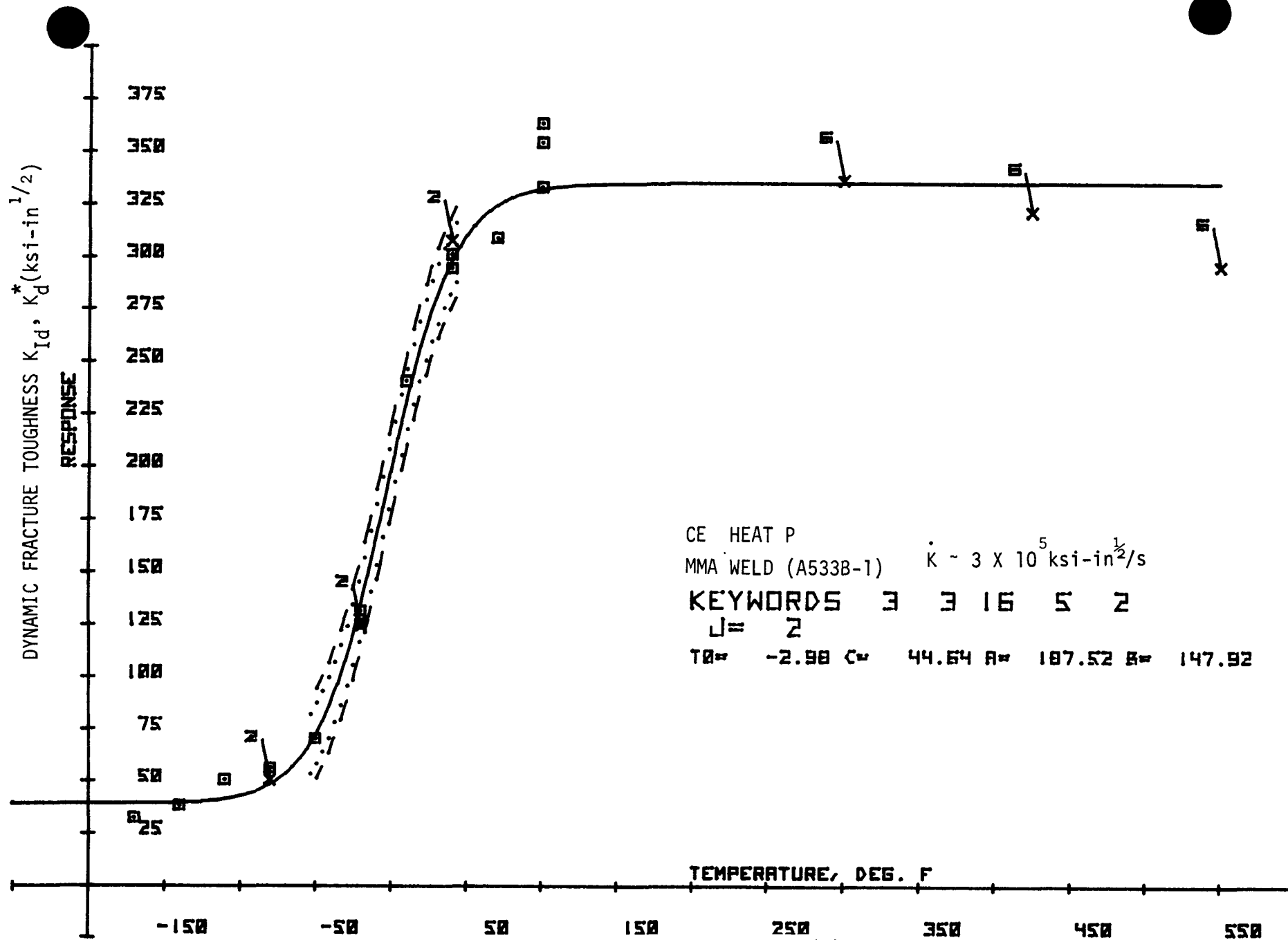


Figure 5.58 Precracked Charpy Fracture Toughness for CE Heat P (T)

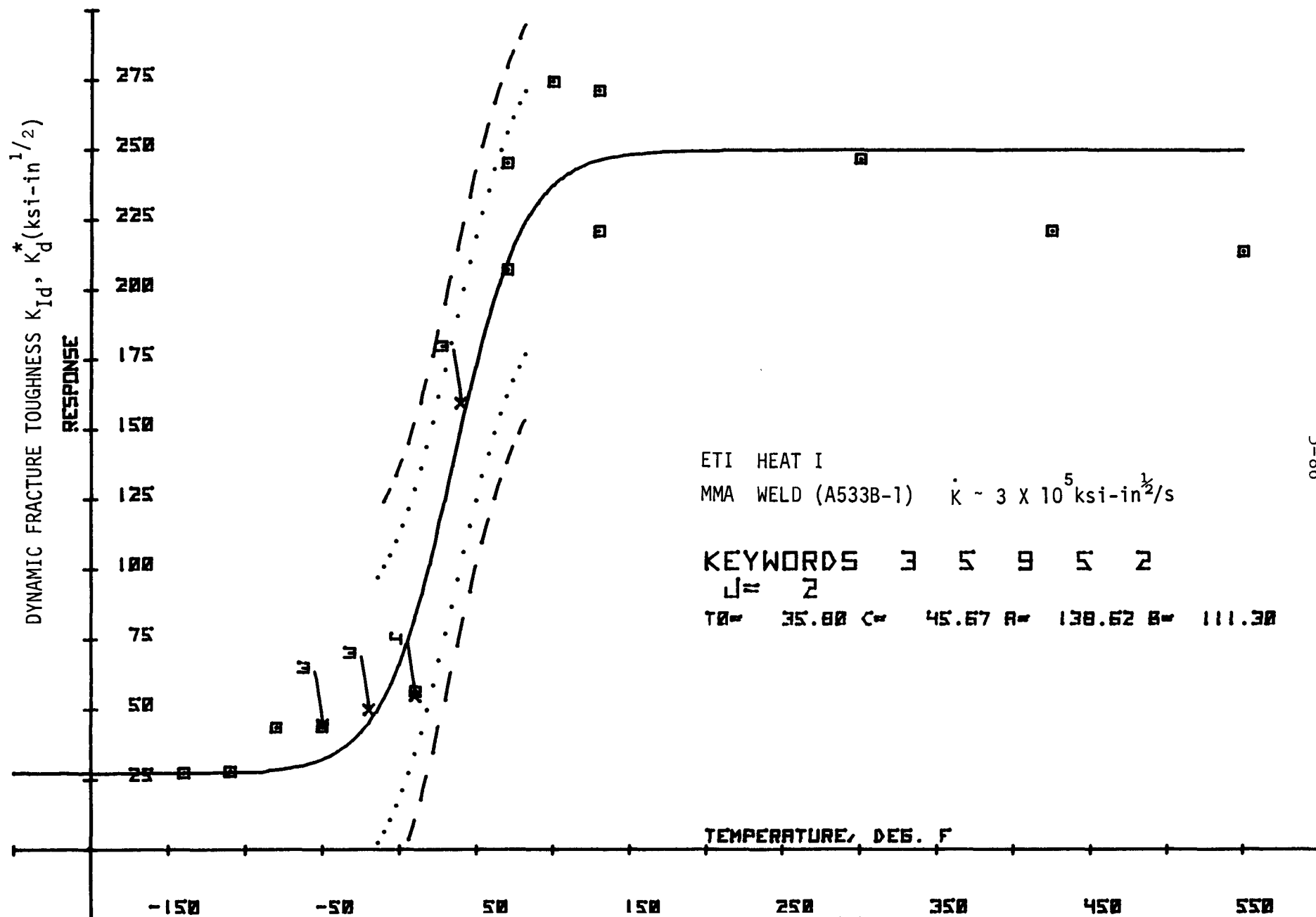
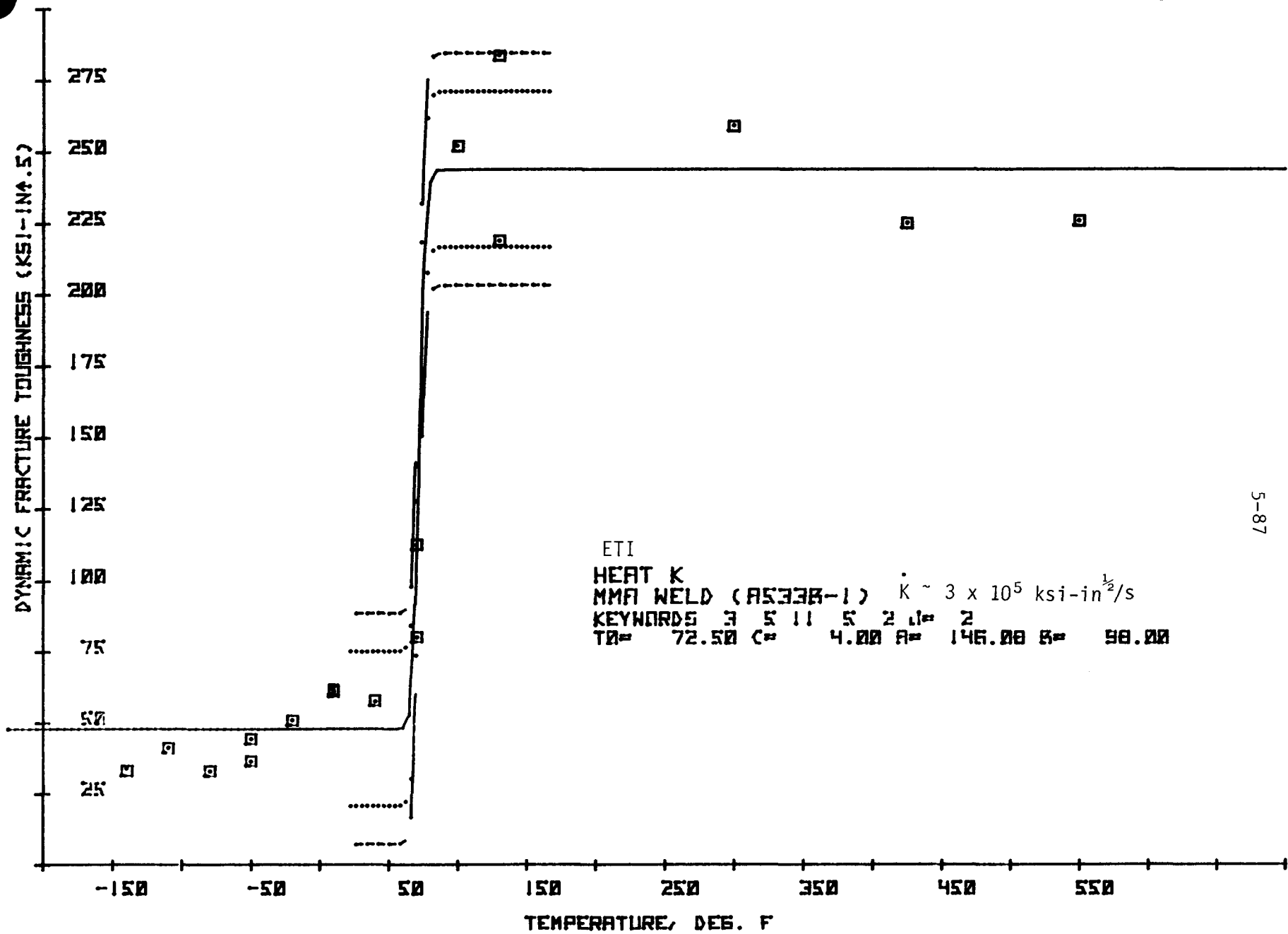


Figure 5.59 Precracked Charpy Fracture Toughness for ETI Heat I (T)



5-87

Figure 5.60 Precracked Charpy Fracture Toughness for ETI Heat K (T)

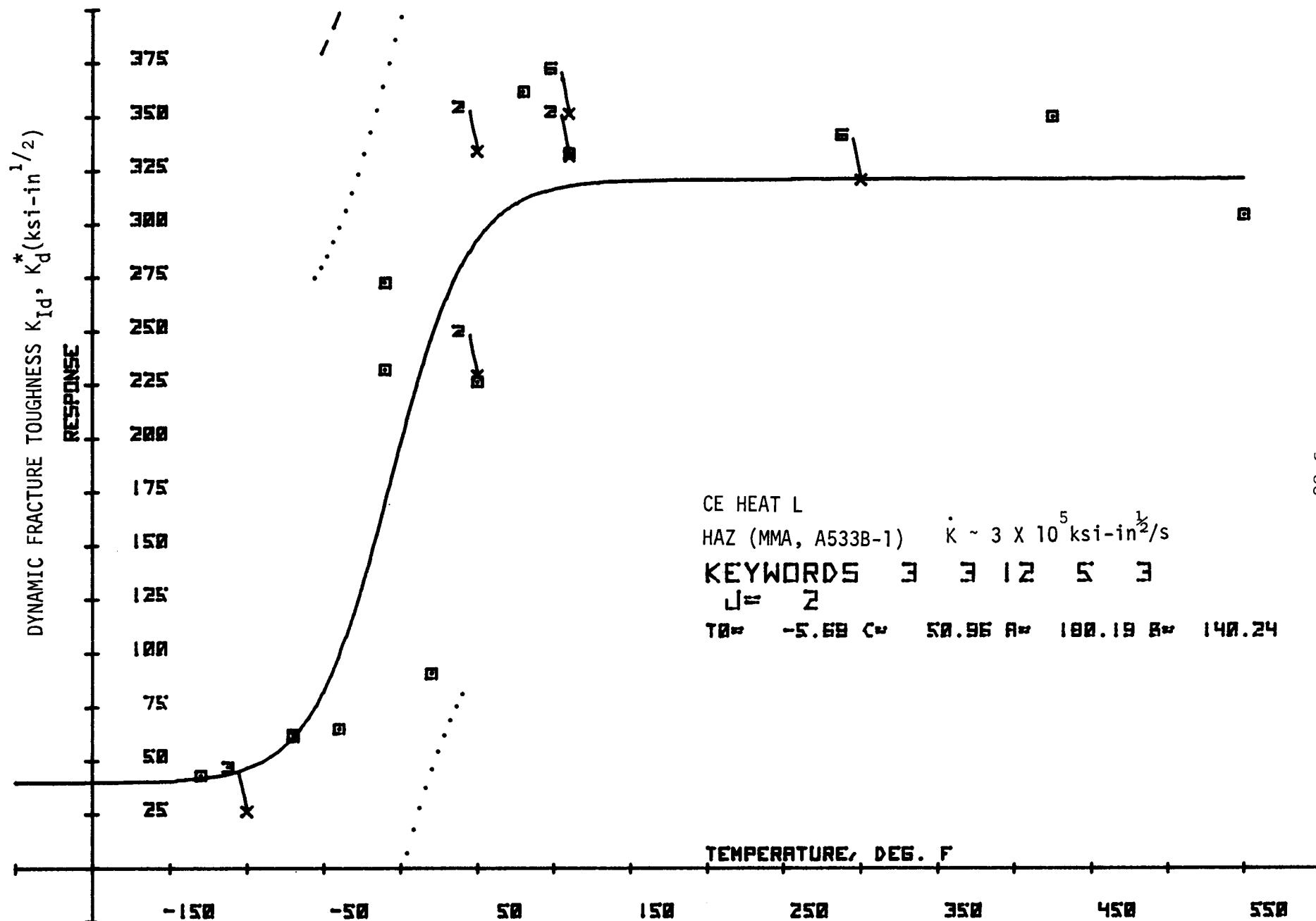


Figure 5.61 Precracked Charpy Fracture Toughness for CE Heat L (HAZ)

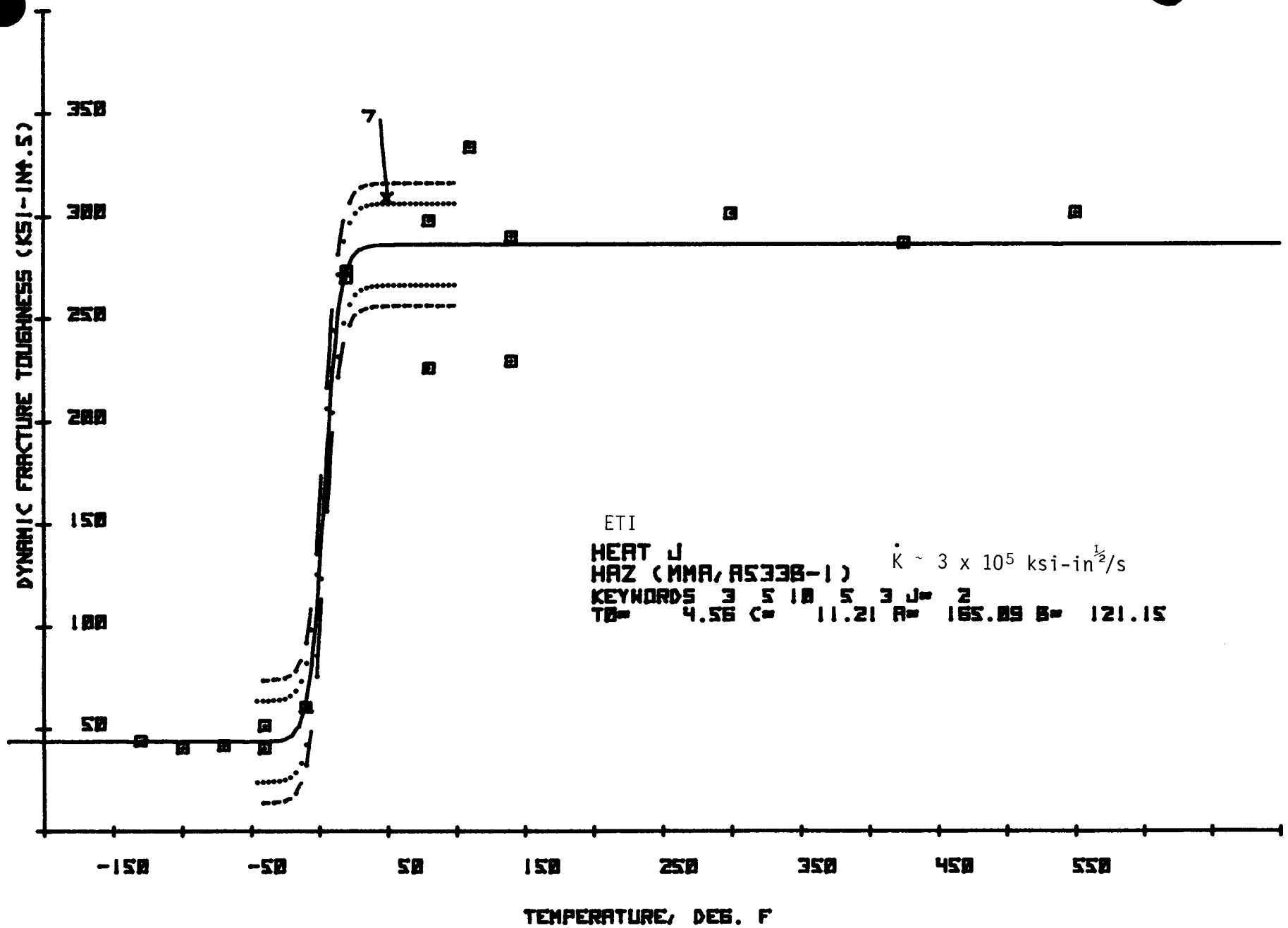
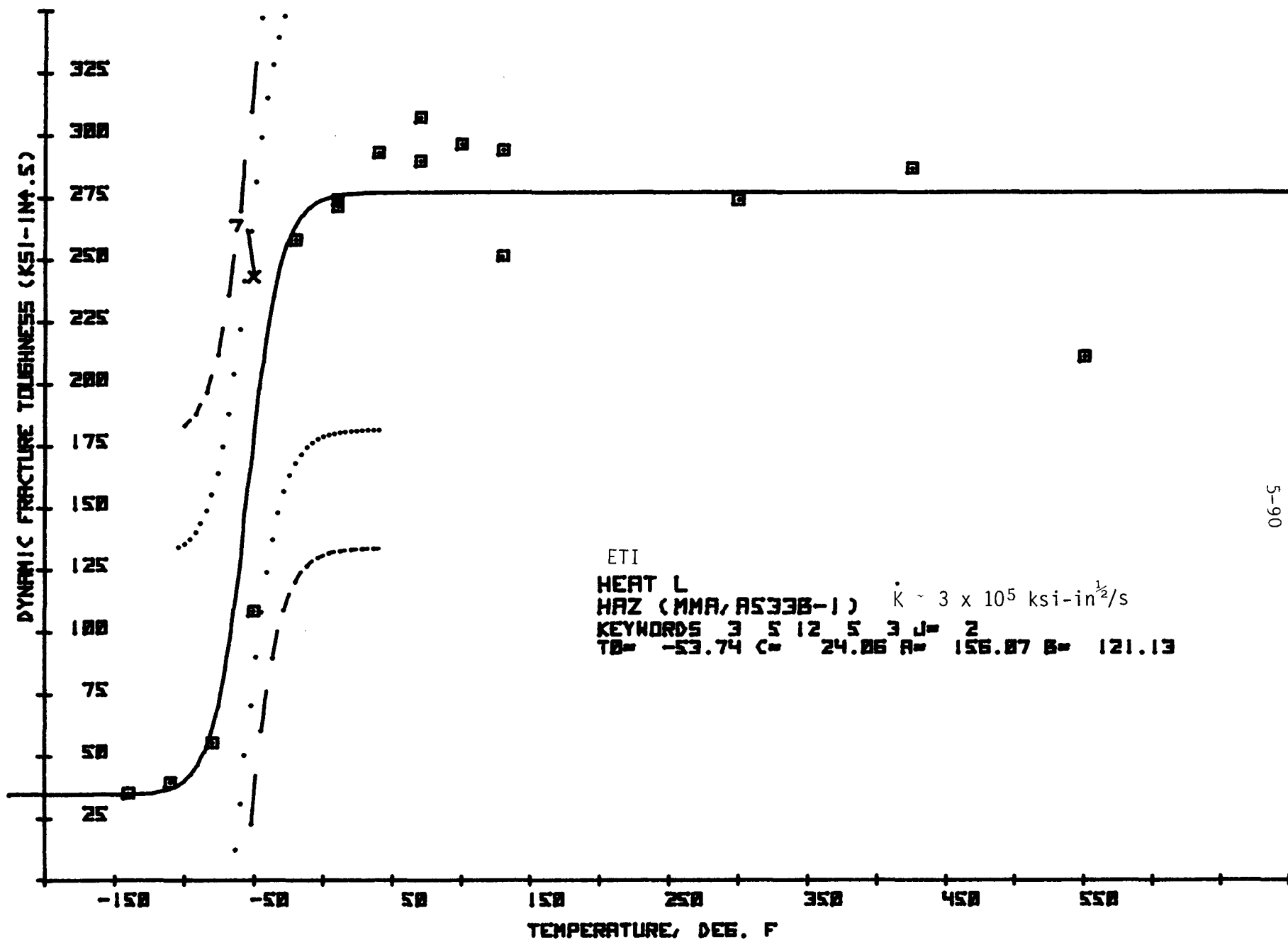


Figure 5.62 Precracked Charpy Fracture Toughness for ETI Heat J (HAZ)



5-90

Figure 5.63 Precracked Charpy Fracture Toughness for ETI Heat L (HAZ)

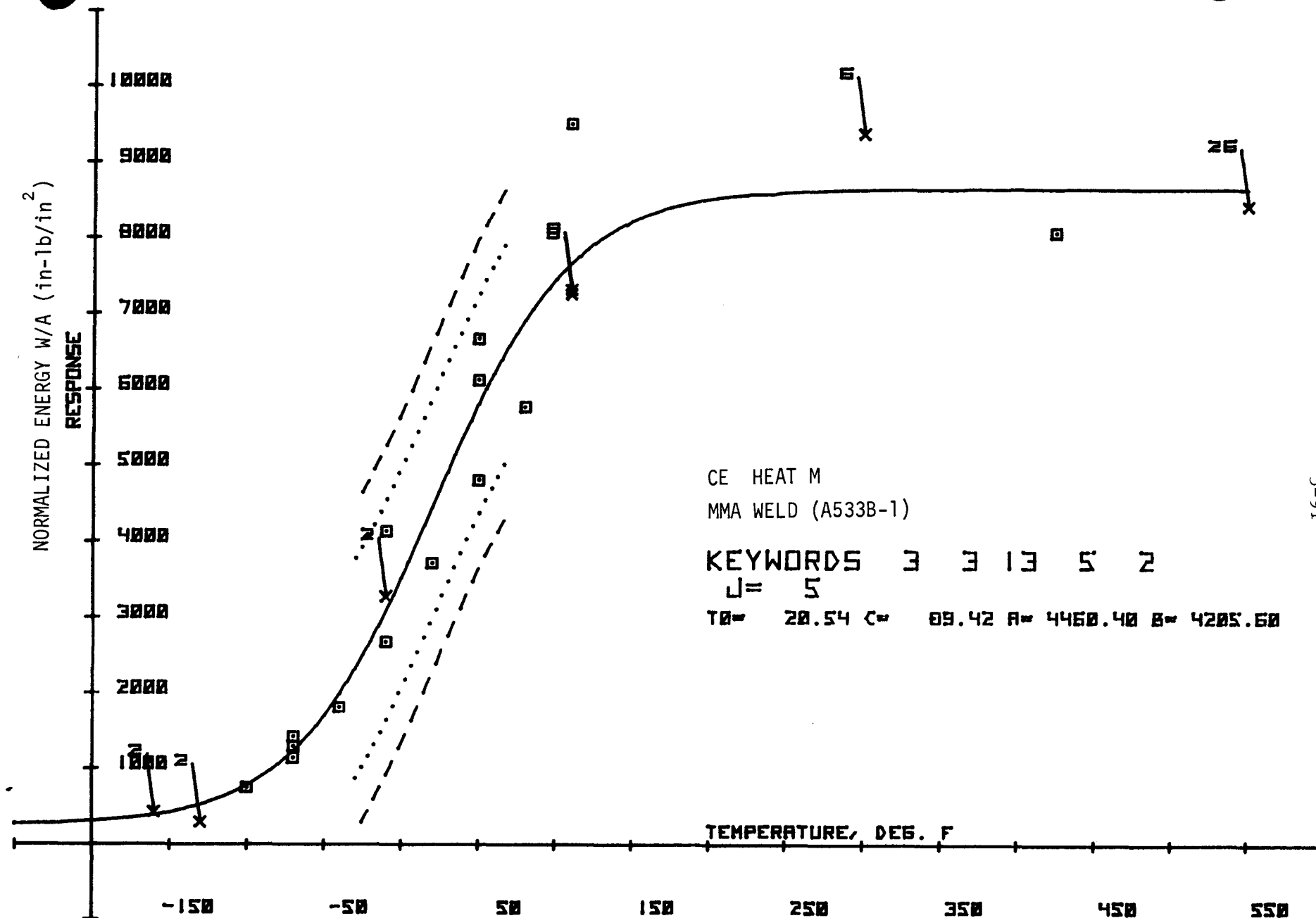


Figure 5.64 Precracked Charpy Normalized Energy for CE Heat M (T)

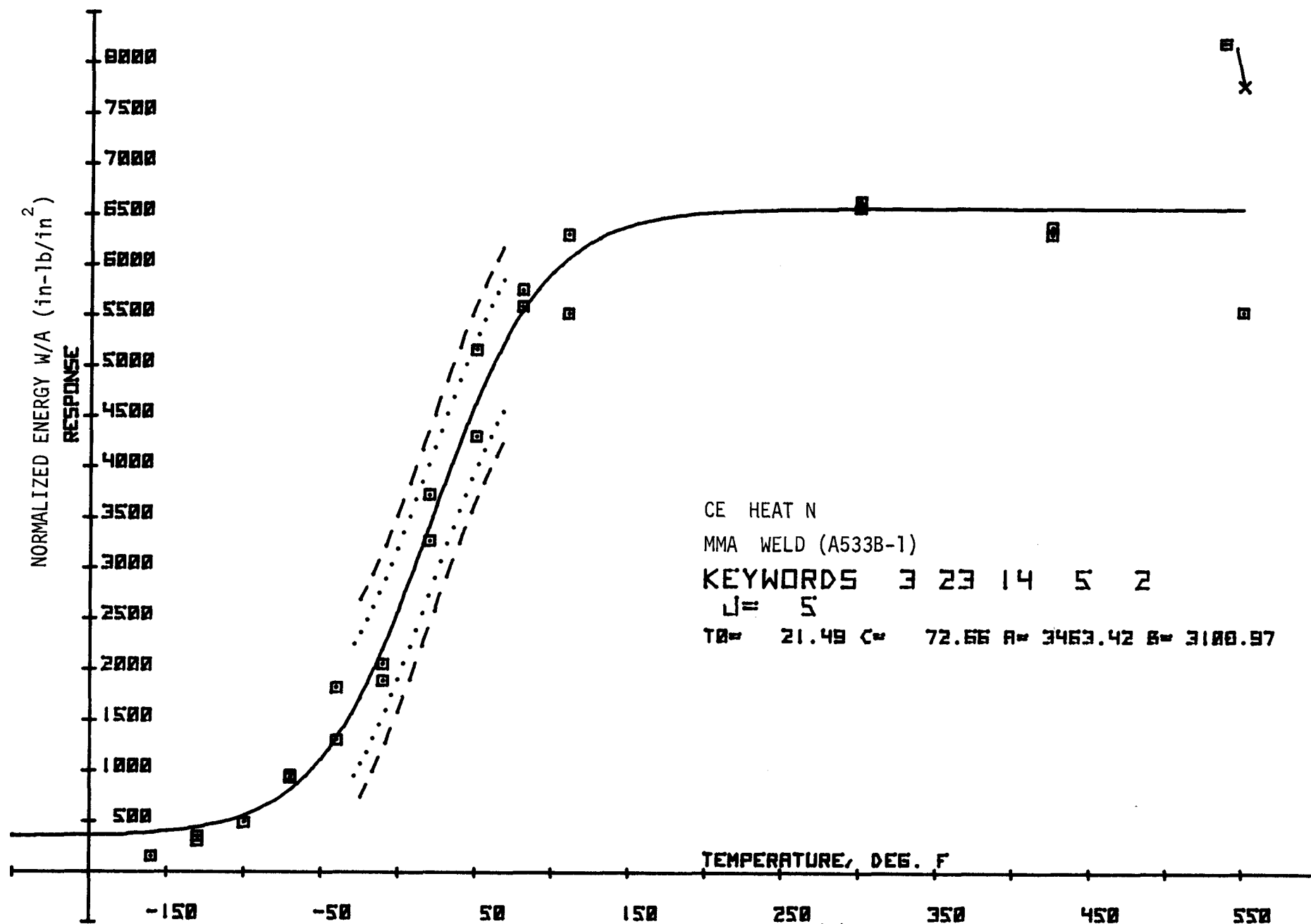


Figure 5.65 Precracked Charpy Normalized Energy for CE Heat N (T)

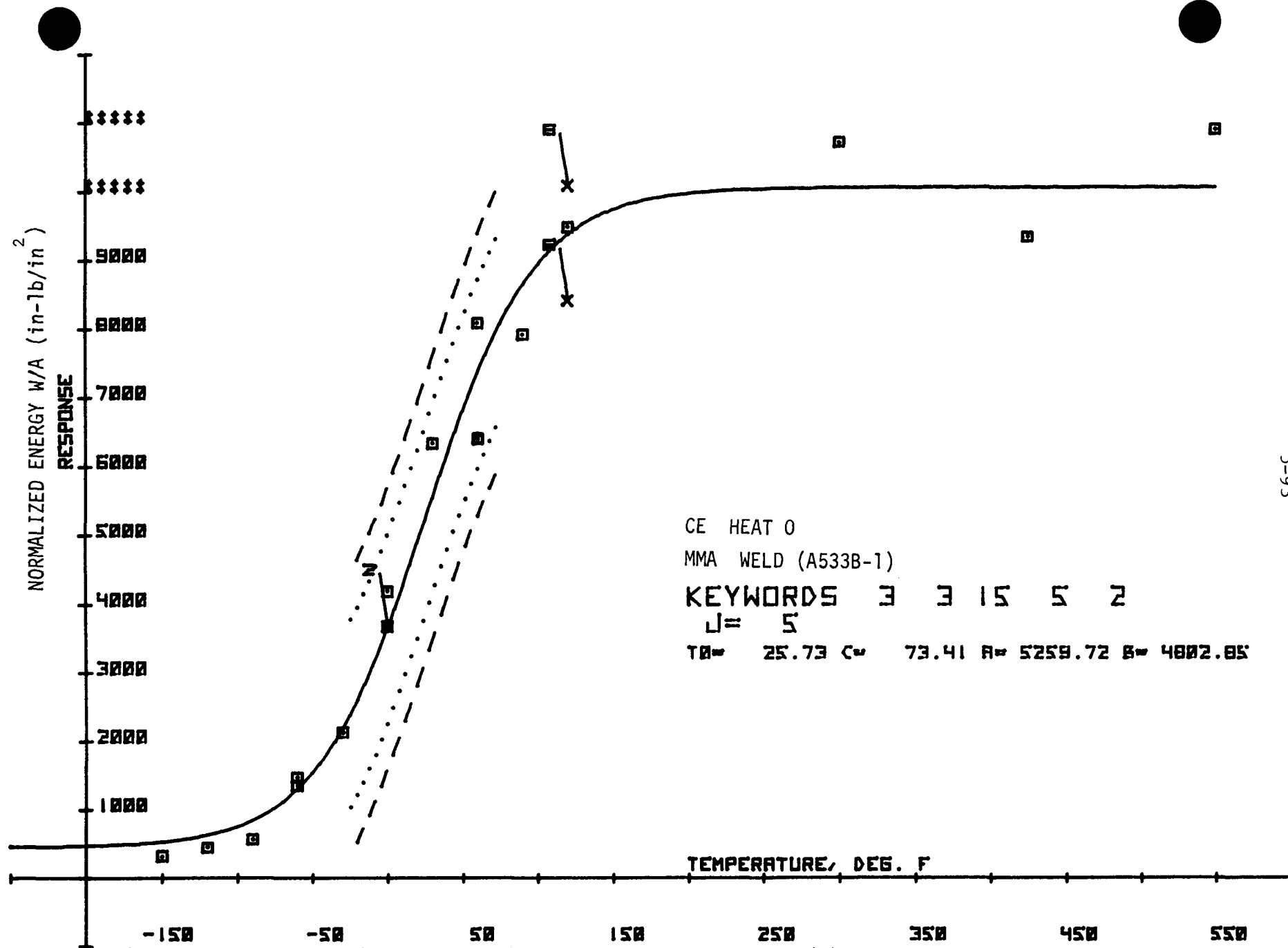


Figure 5.66 Precracked Charpy Normalized Energy for CE Heat 0 (T)

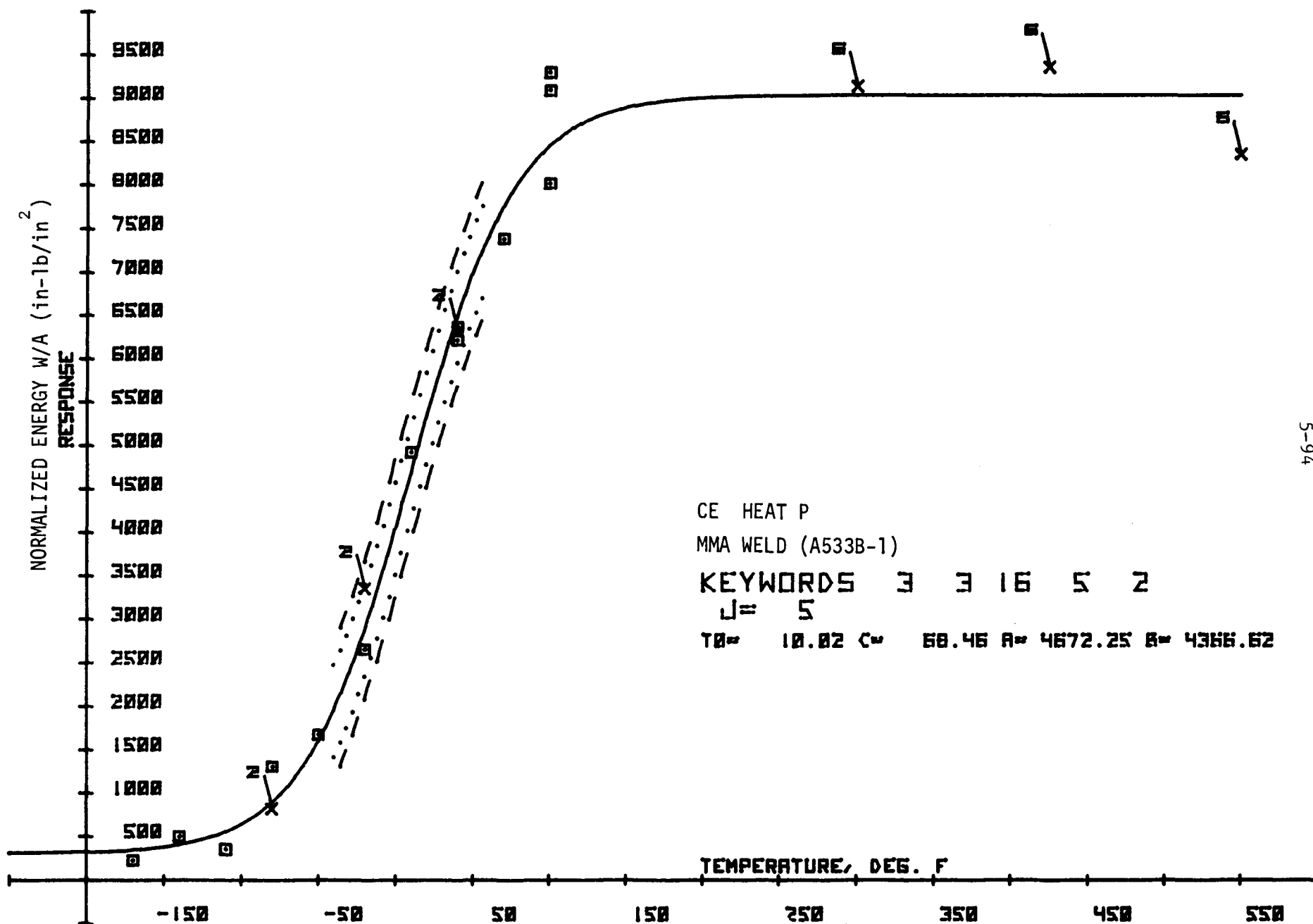


Figure 5.67 Precracked Charpy Normalized Energy for CE Heat P (T)

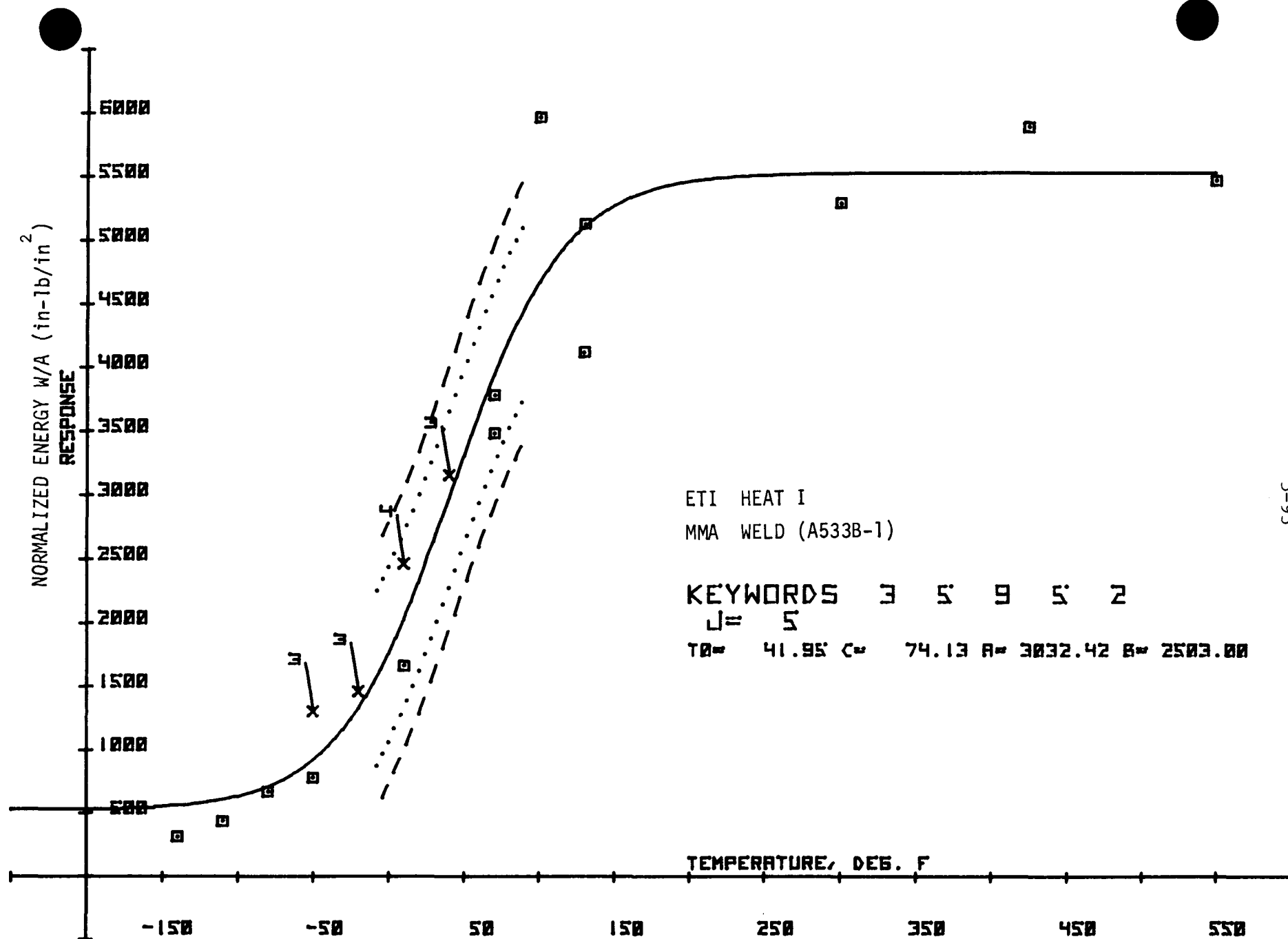


Figure 5.68 Precracked Charpy Normalized Energy for ETI Heat I (T)

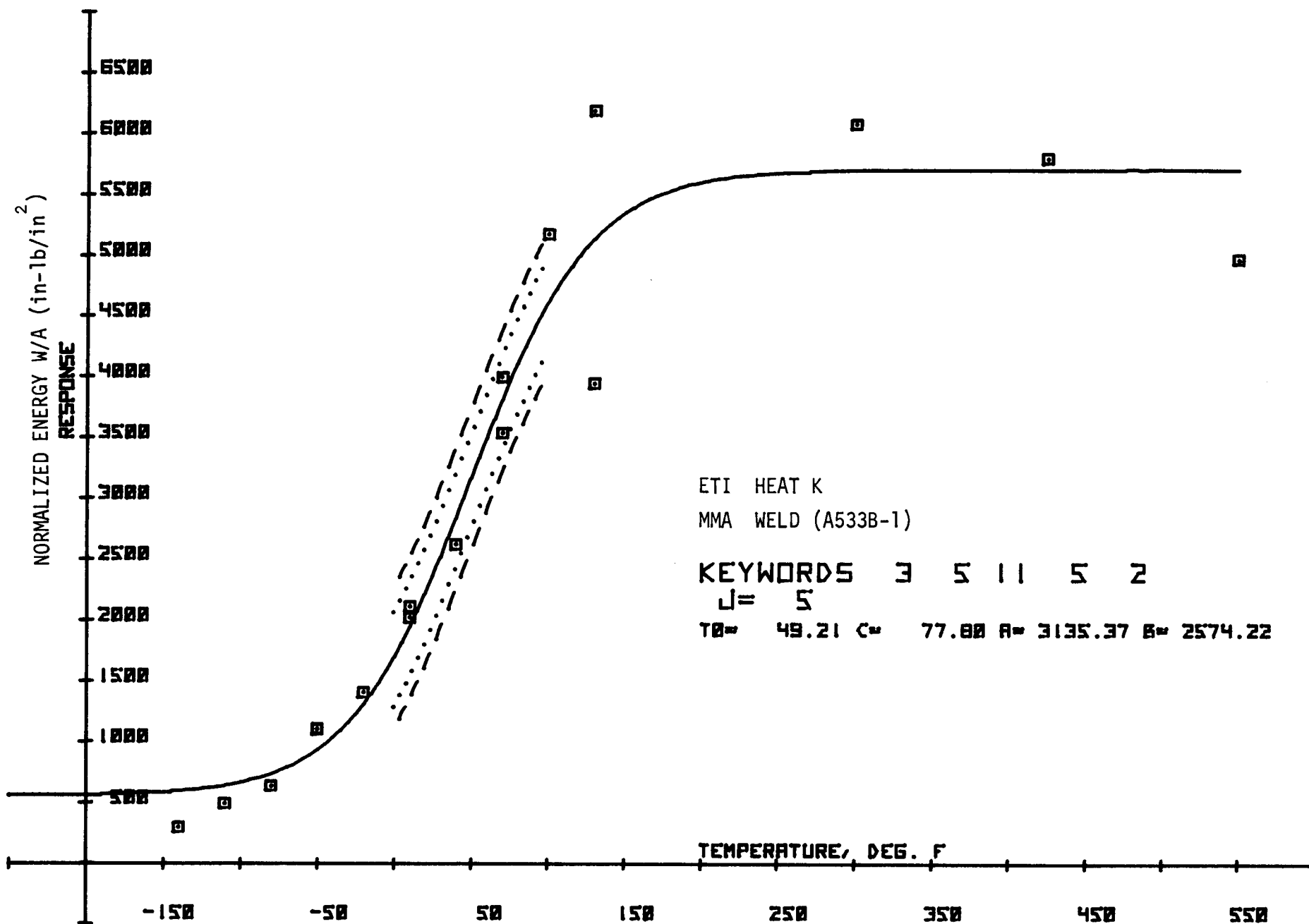


Figure 5.69 Precracked Charpy Normalized Energy for ETI Heat K (T)

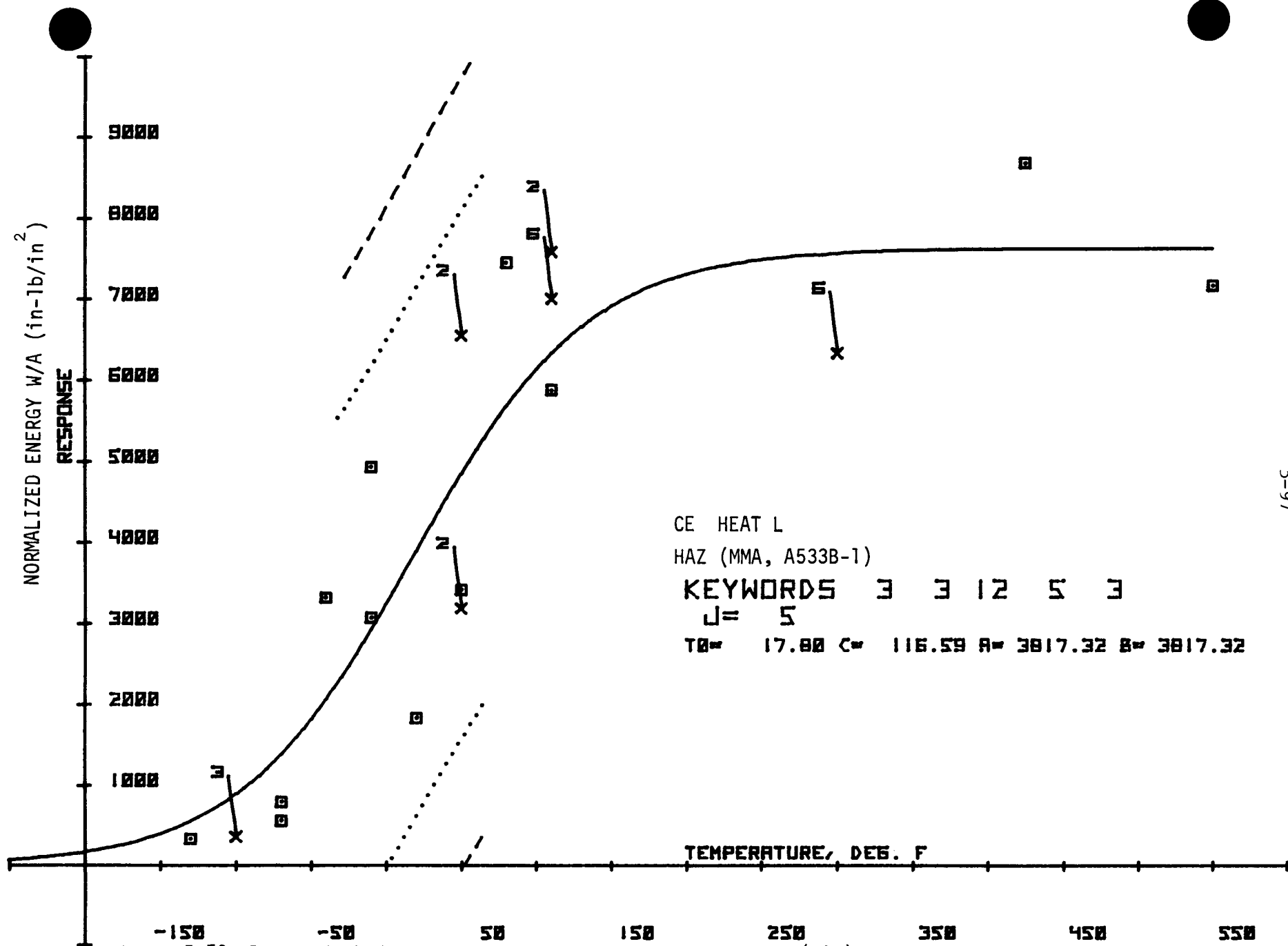


Figure 5.70 Precracked Charpy Normalized Energy for CE Heat L (HAZ)

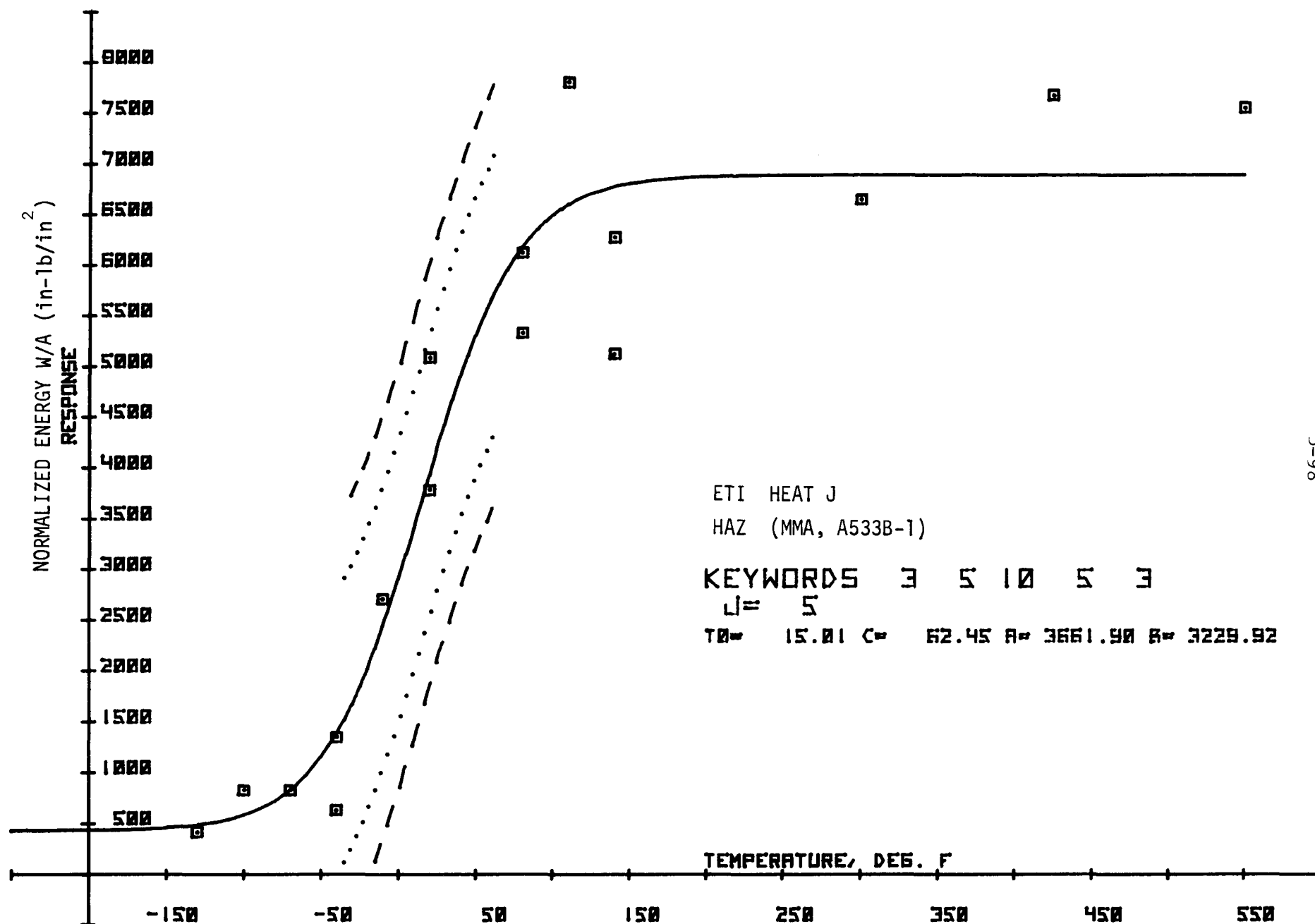


Figure 5.71 Precracked Charpy Normalized Energy for ETI Heat J (HAZ)

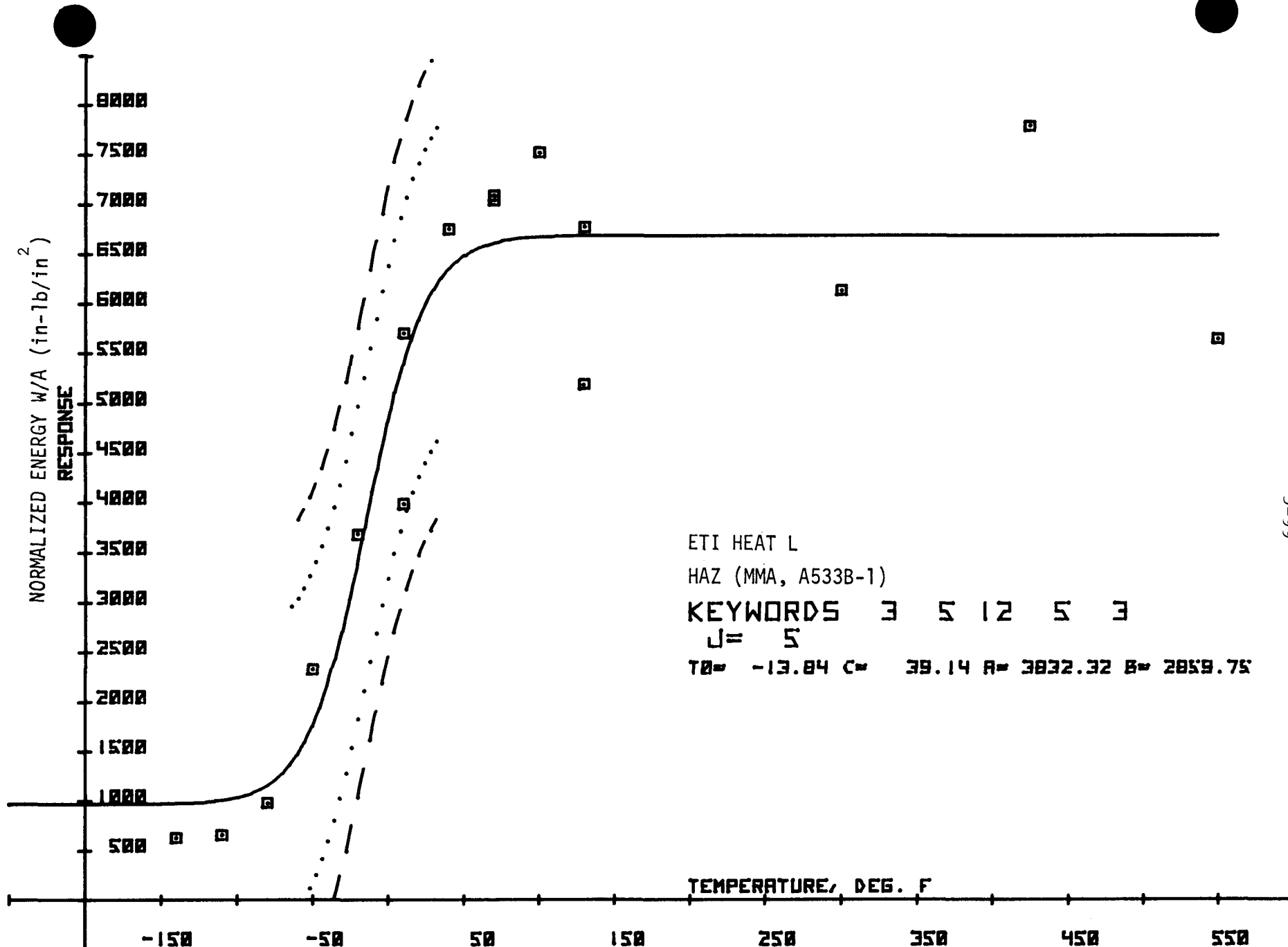


Figure 5.72 Precracked Charpy Normalized Energy for ETI Heat L (HAZ)

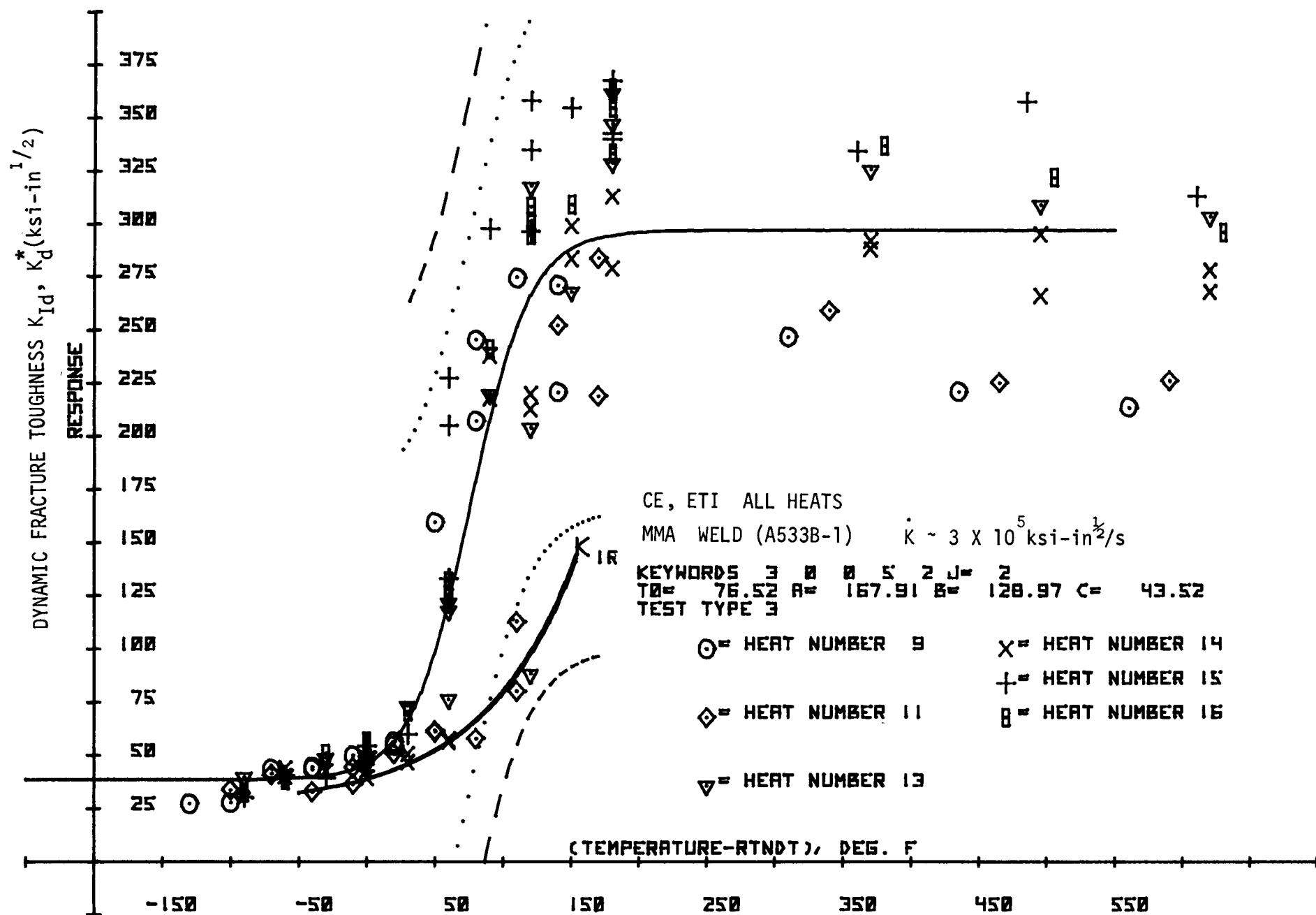


Figure 5.73 Precracked Charpy Fracture Toughness for All CE, ETI Heats

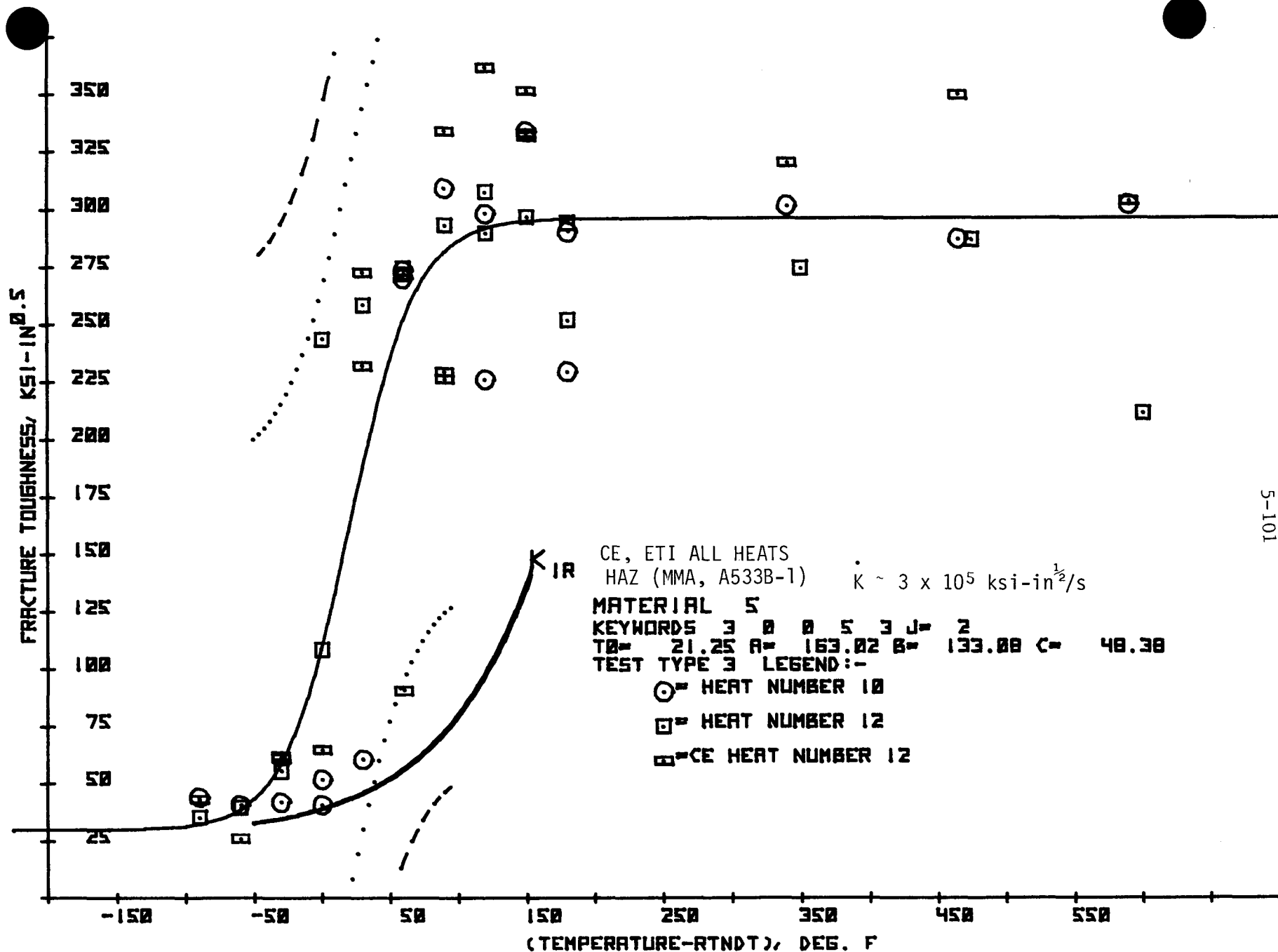


Figure 5.74 Precracked Charpy Fracture Toughness for All CE, ETI Heats (HAZ)

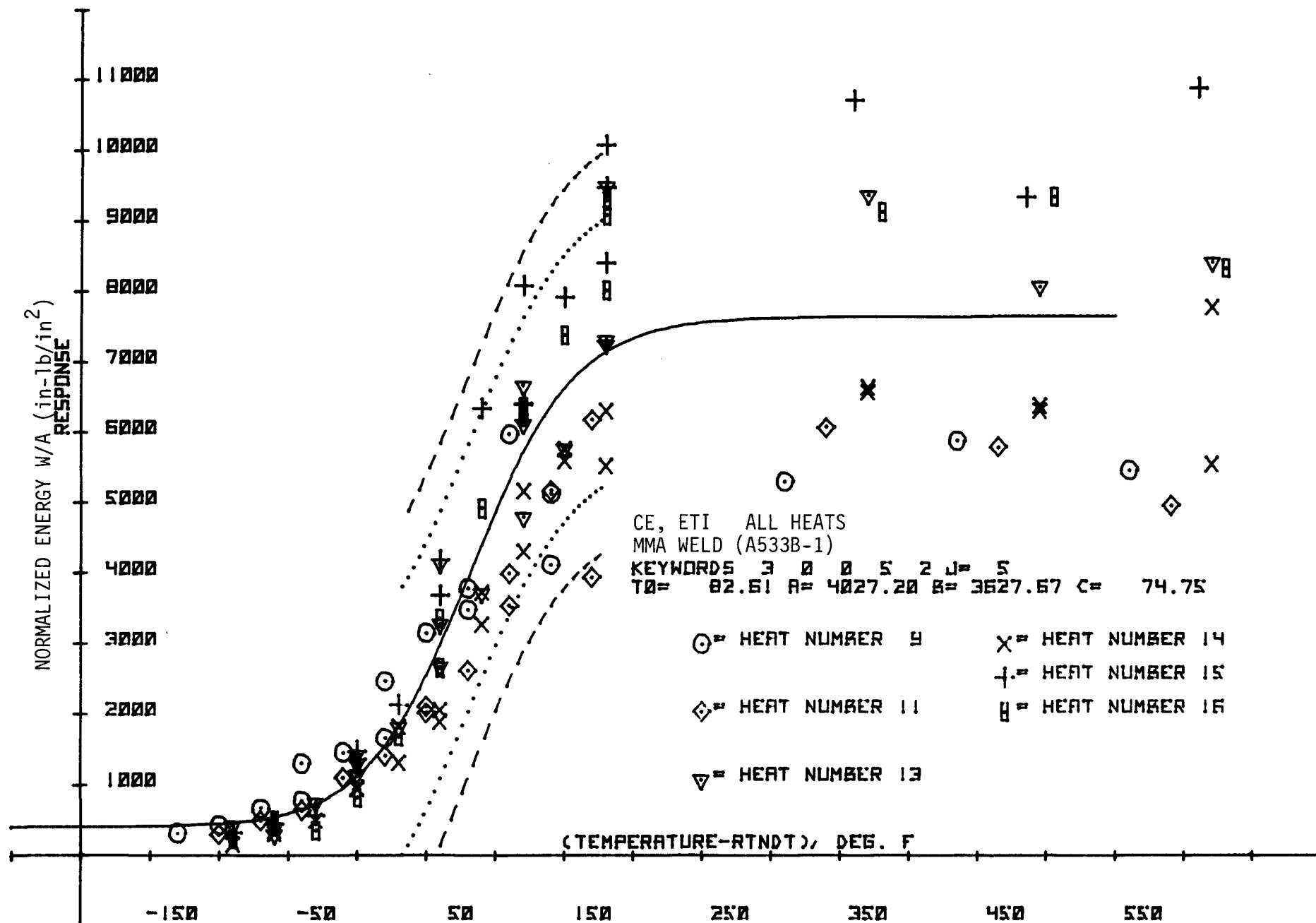


Figure 5.75 Precracked Charpy Normalized Energy for All CE, ETI Heats (T)

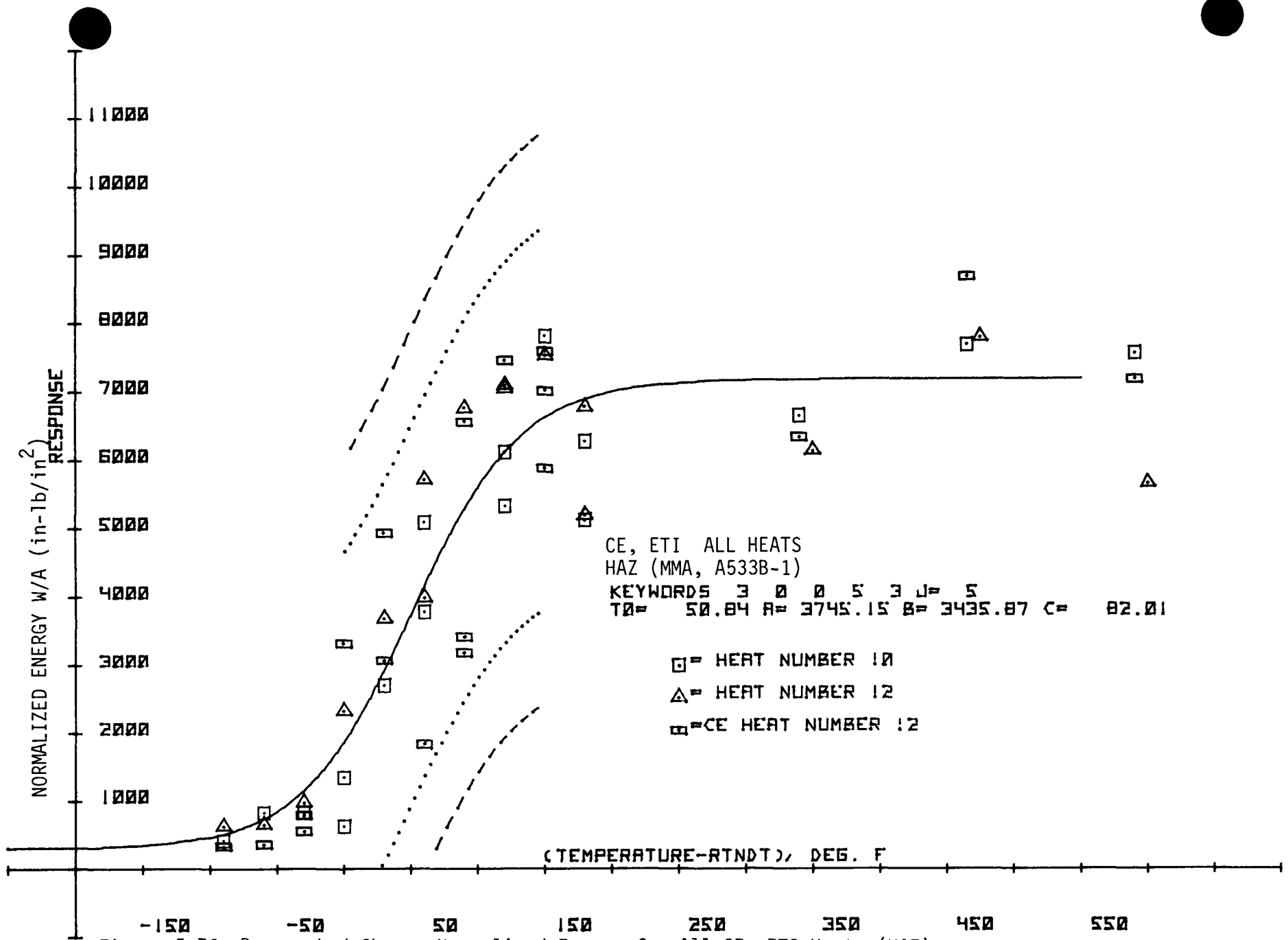


Figure 5.76 Precracked Charpy Normalized Energy for All CE, ETI Heats (HAZ)

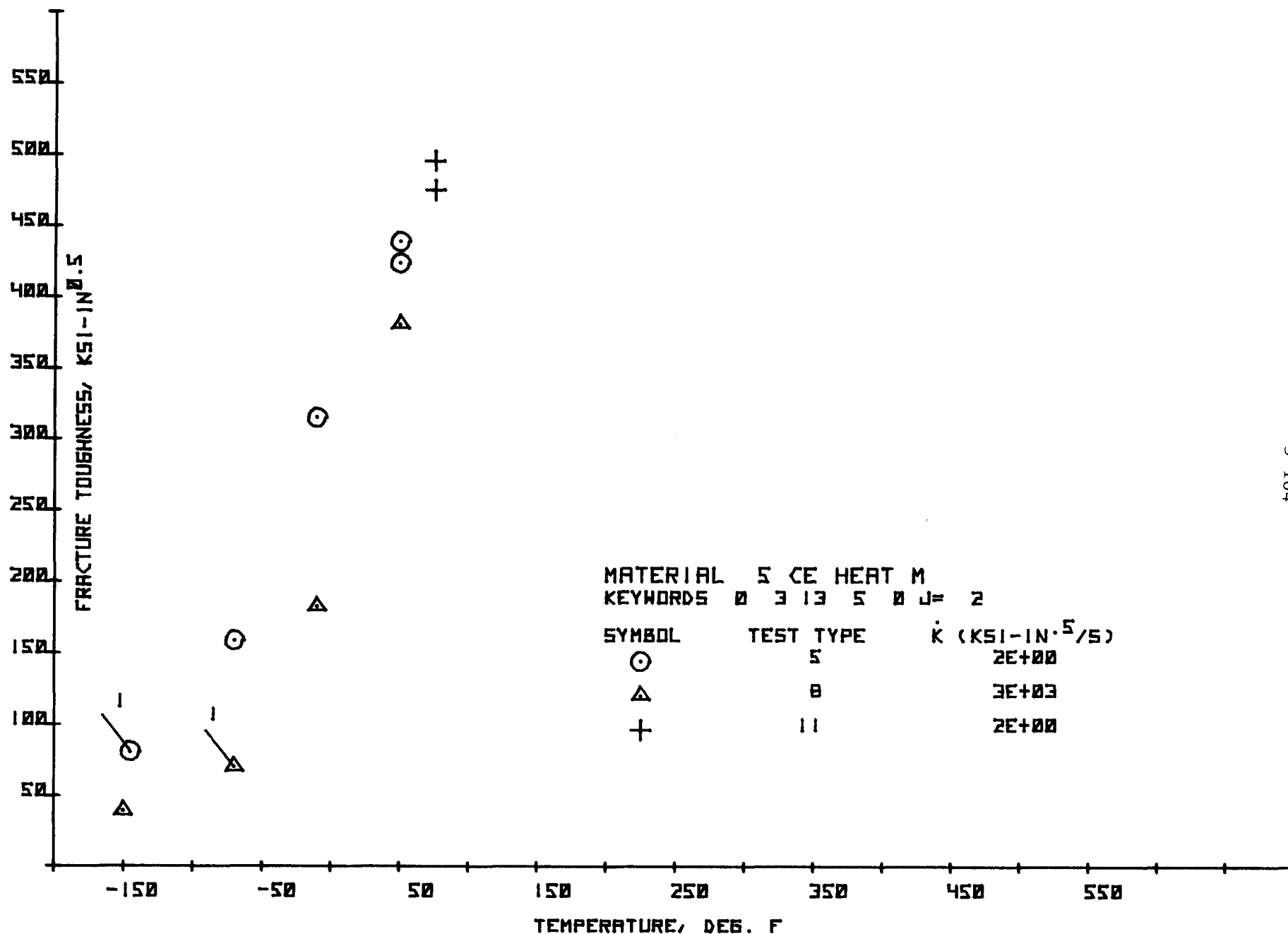


Figure 5.77. Static and Dynamic Fracture Toughness Data for CE Heat M

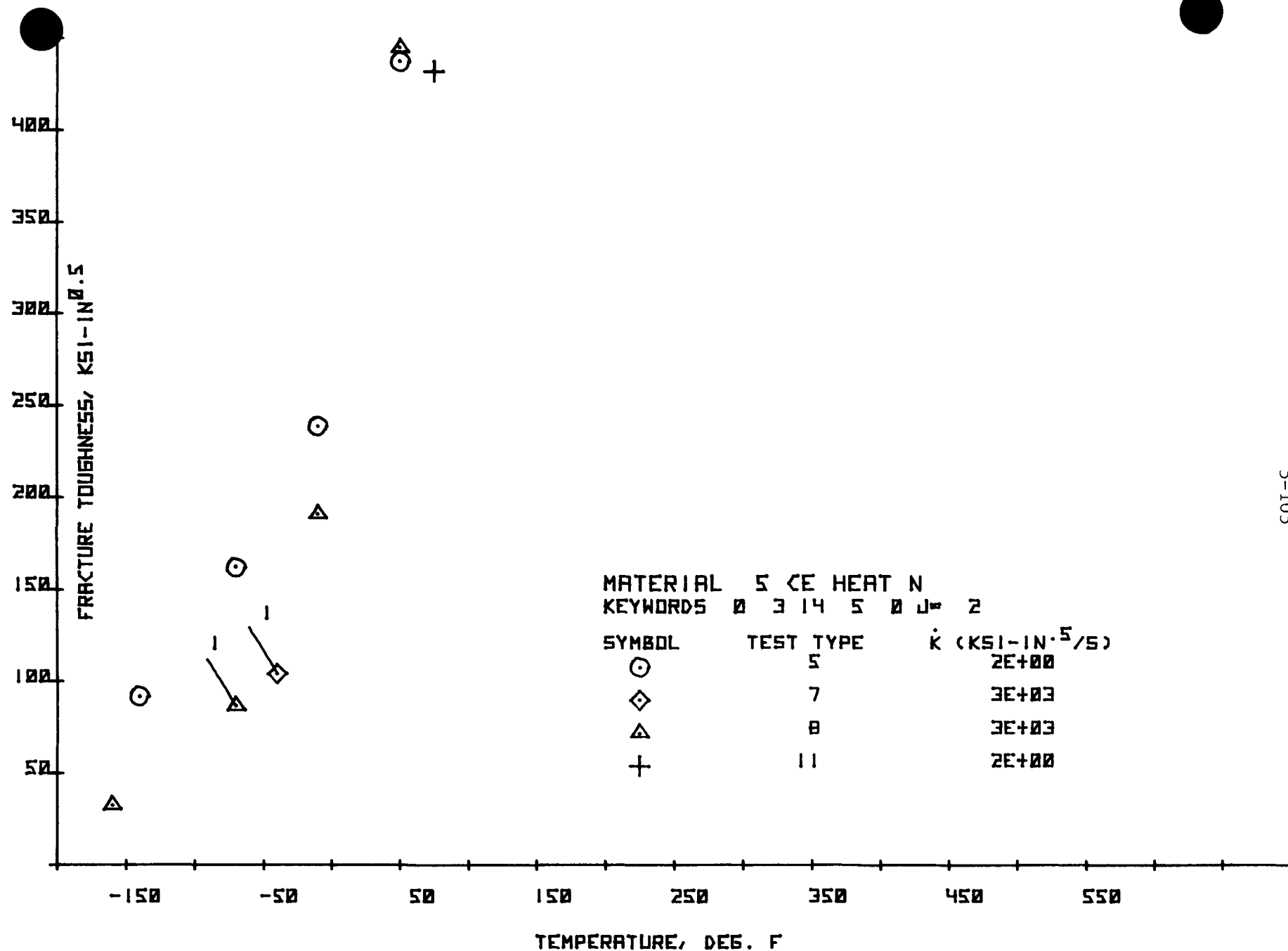


Figure 5.78. Static and Dynamic Fracture Toughness Data for CE Heat N

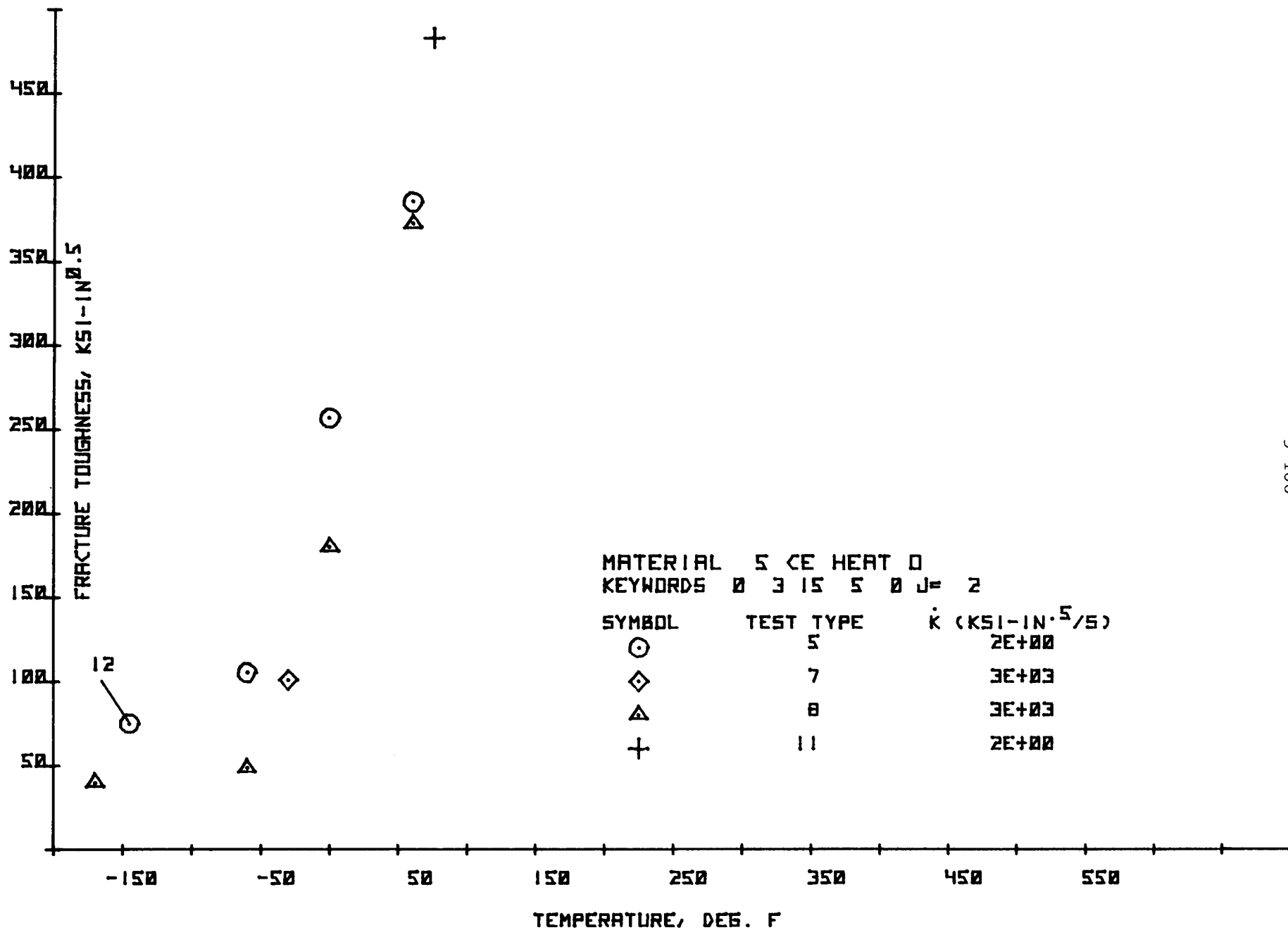


Figure 5.79. Static and Dynamic Fracture Toughness Data for CE Heat 0

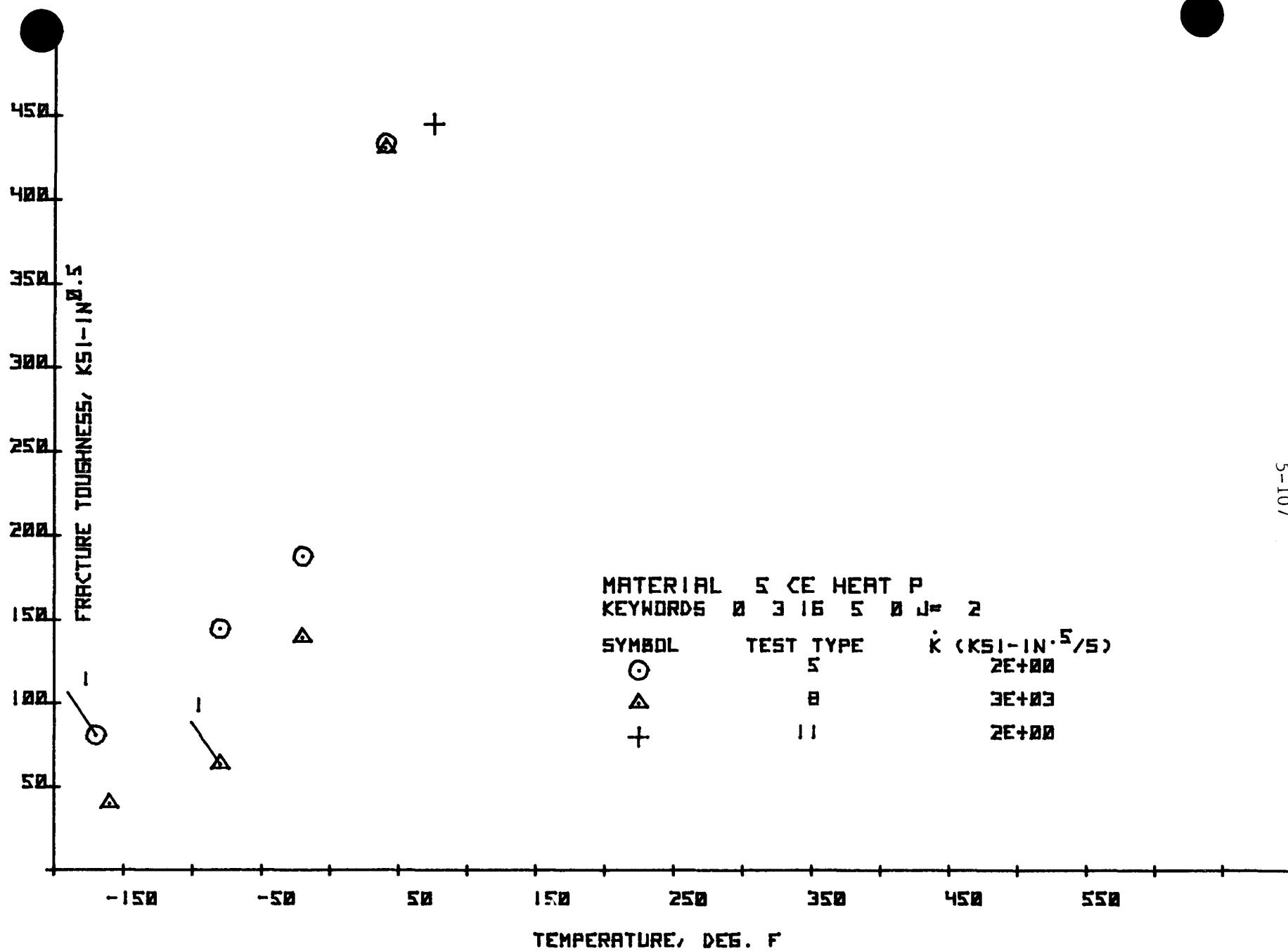


Figure 5.80. Static and Dynamic Fracture Toughness Data for CE Heat P

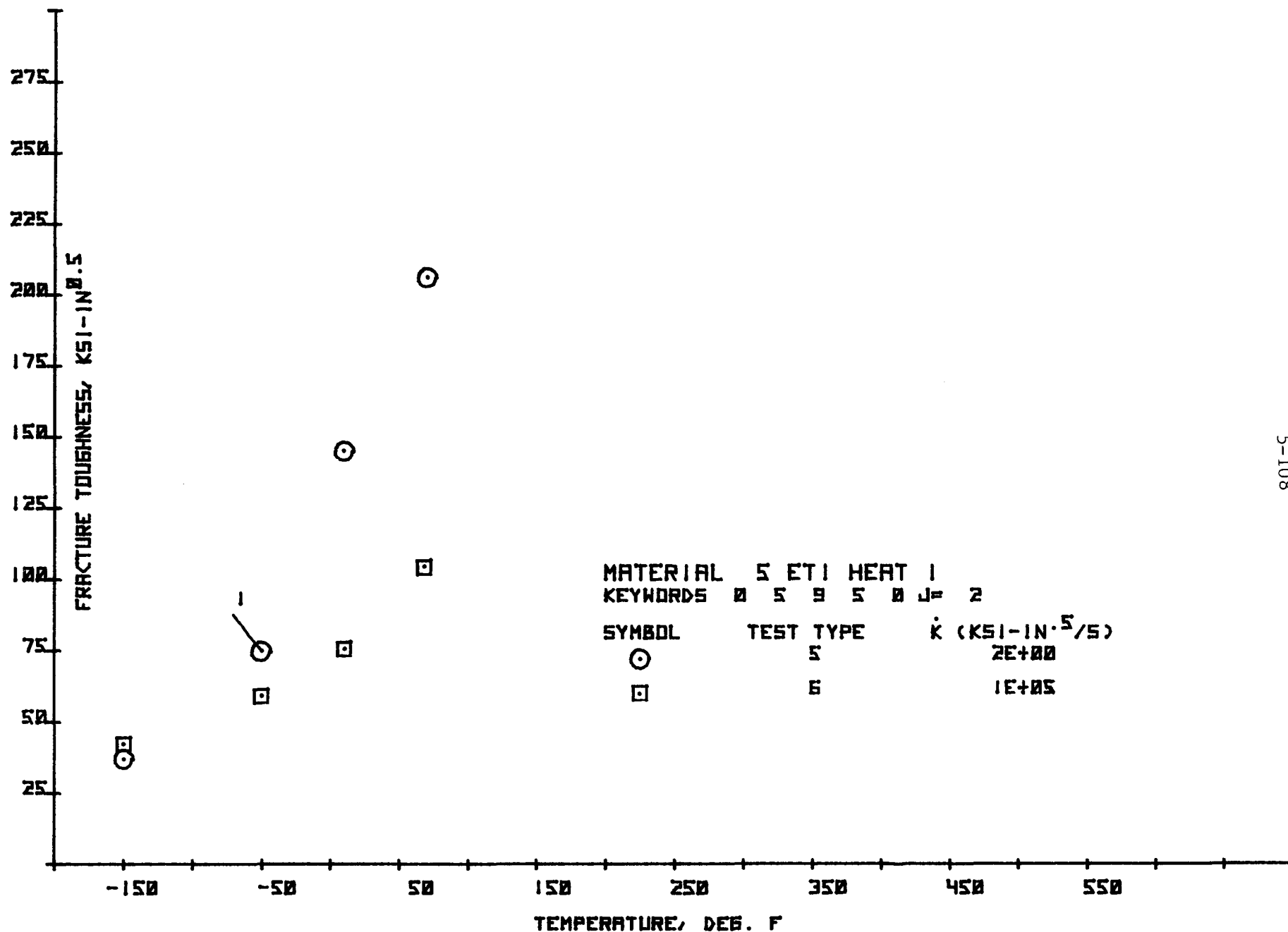


Figure 5.81. Static and Dynamic Fracture Toughness Data for ETI Heat I

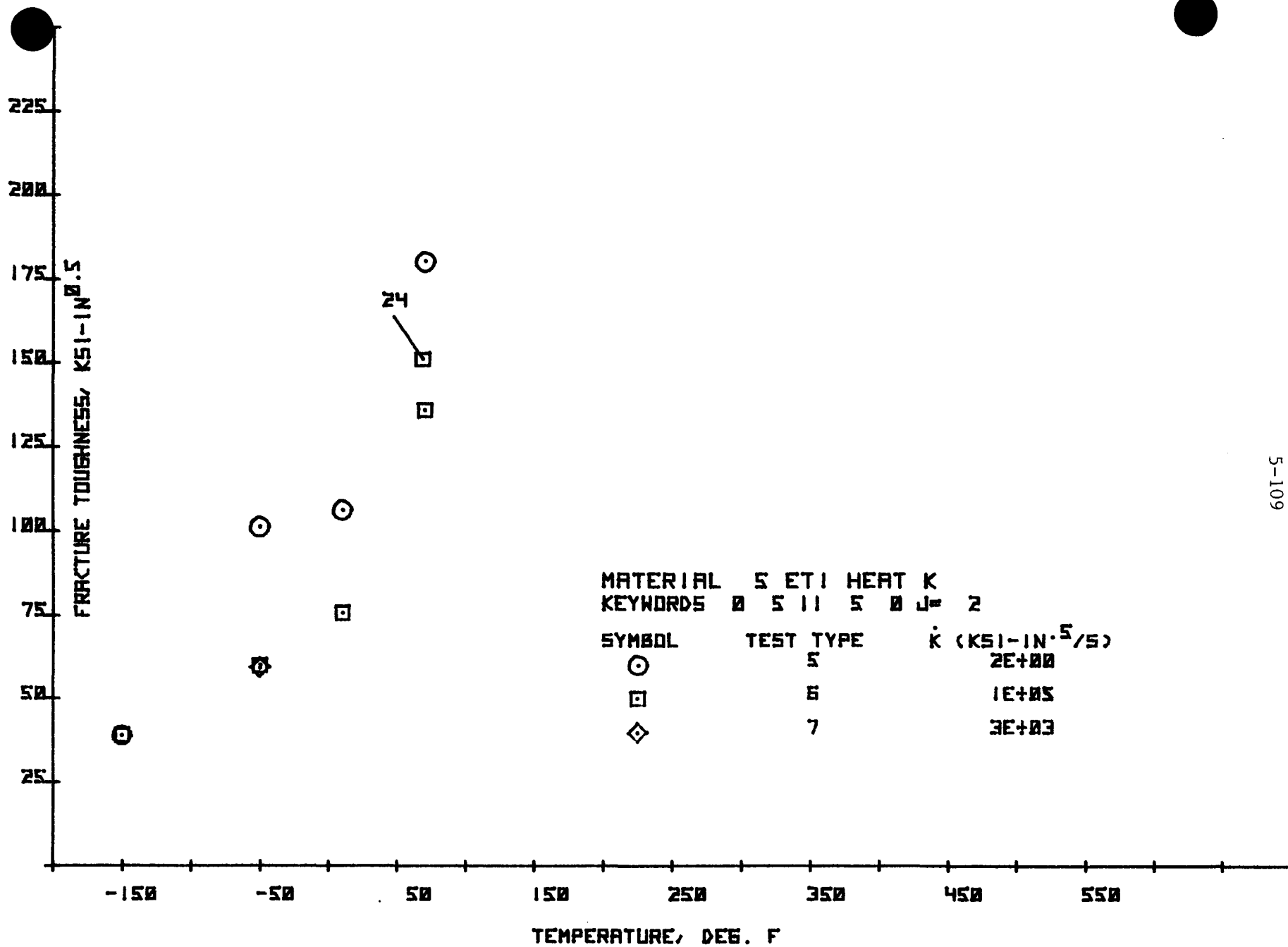


Figure 5.82. Static and Dynamic Fracture Toughness Data for ETI Heat K

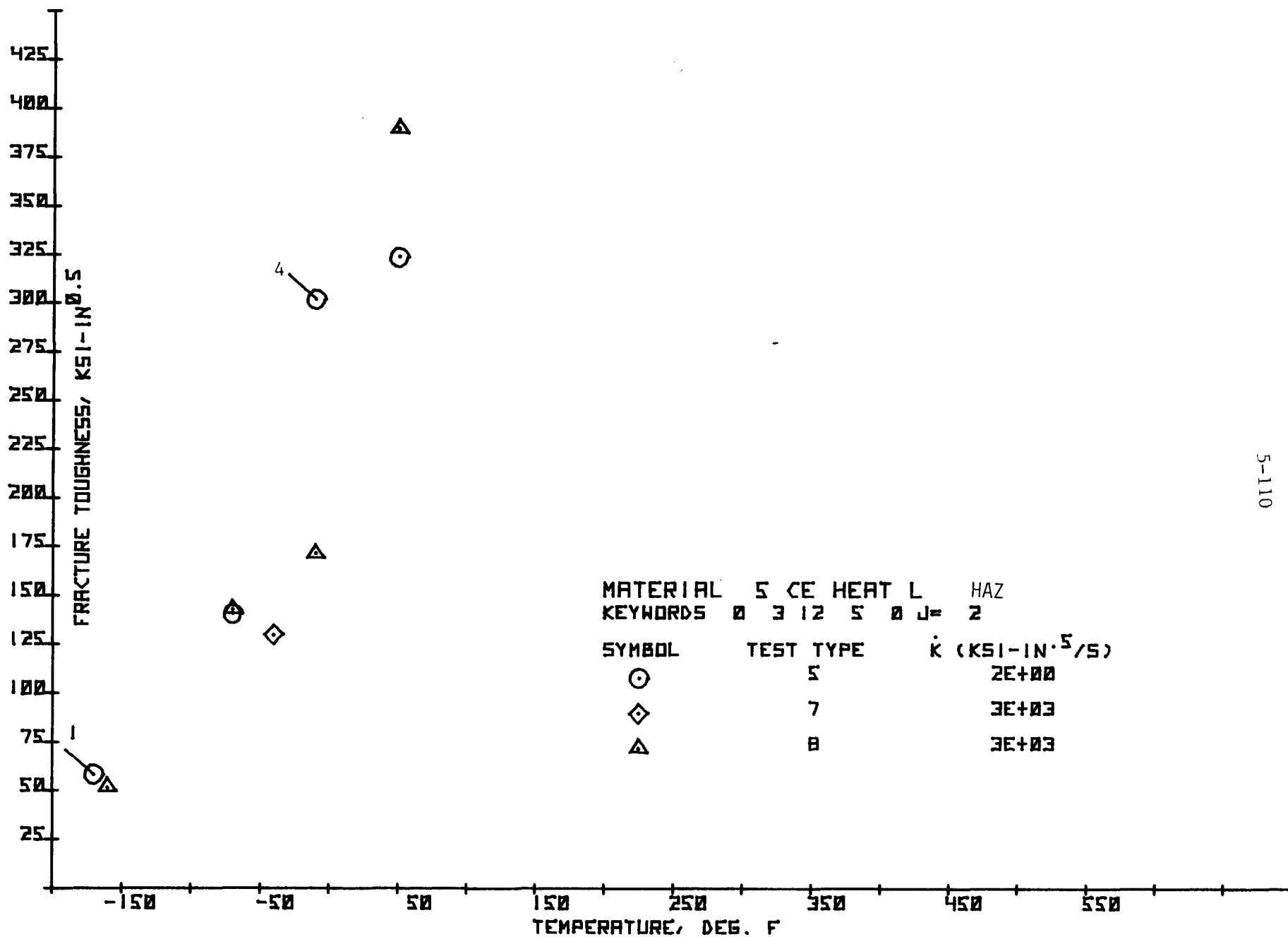


Figure 5.83. Static and Dynamic Fracture Toughness Data for CE Heat L (HAZ)

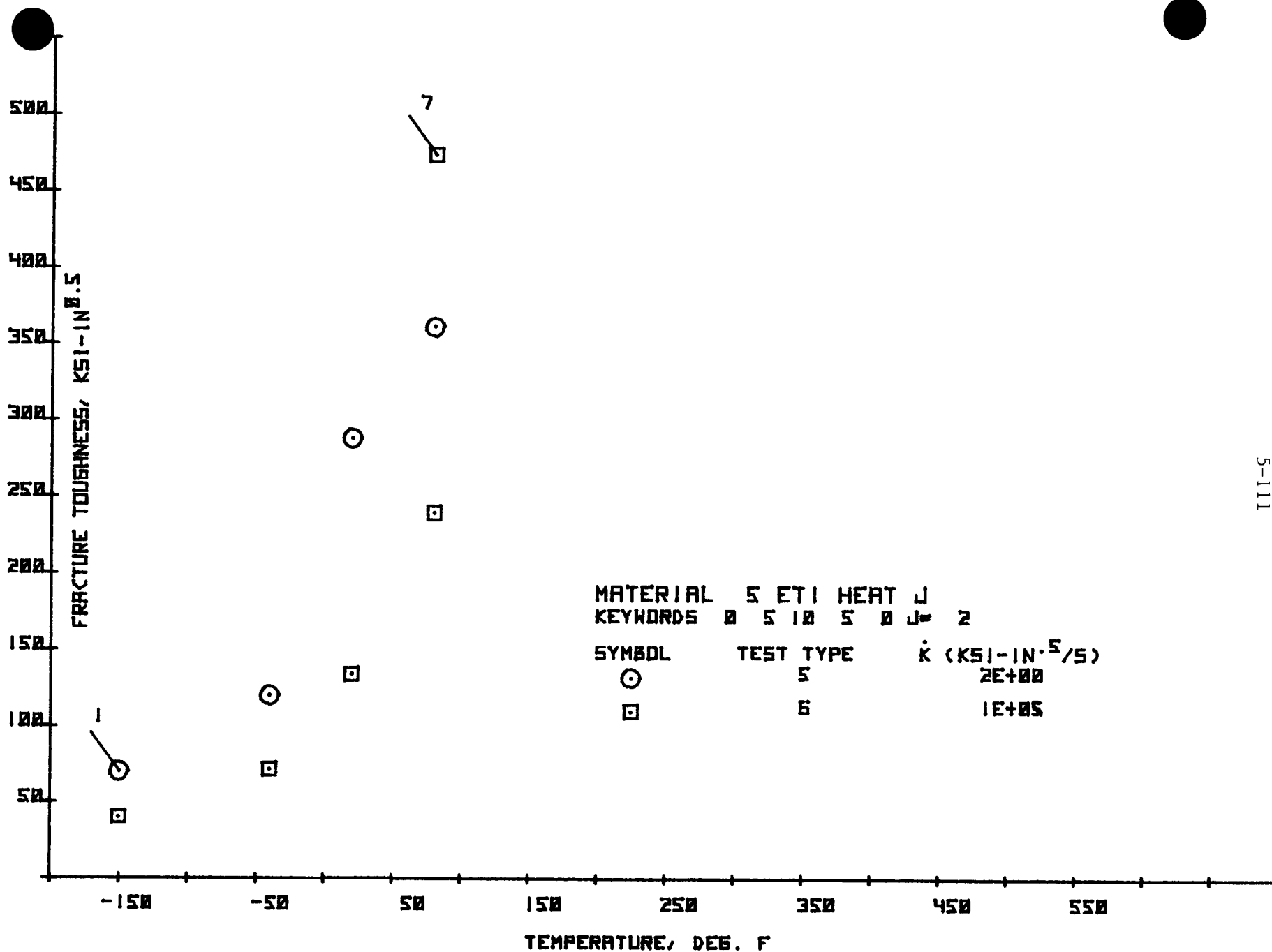
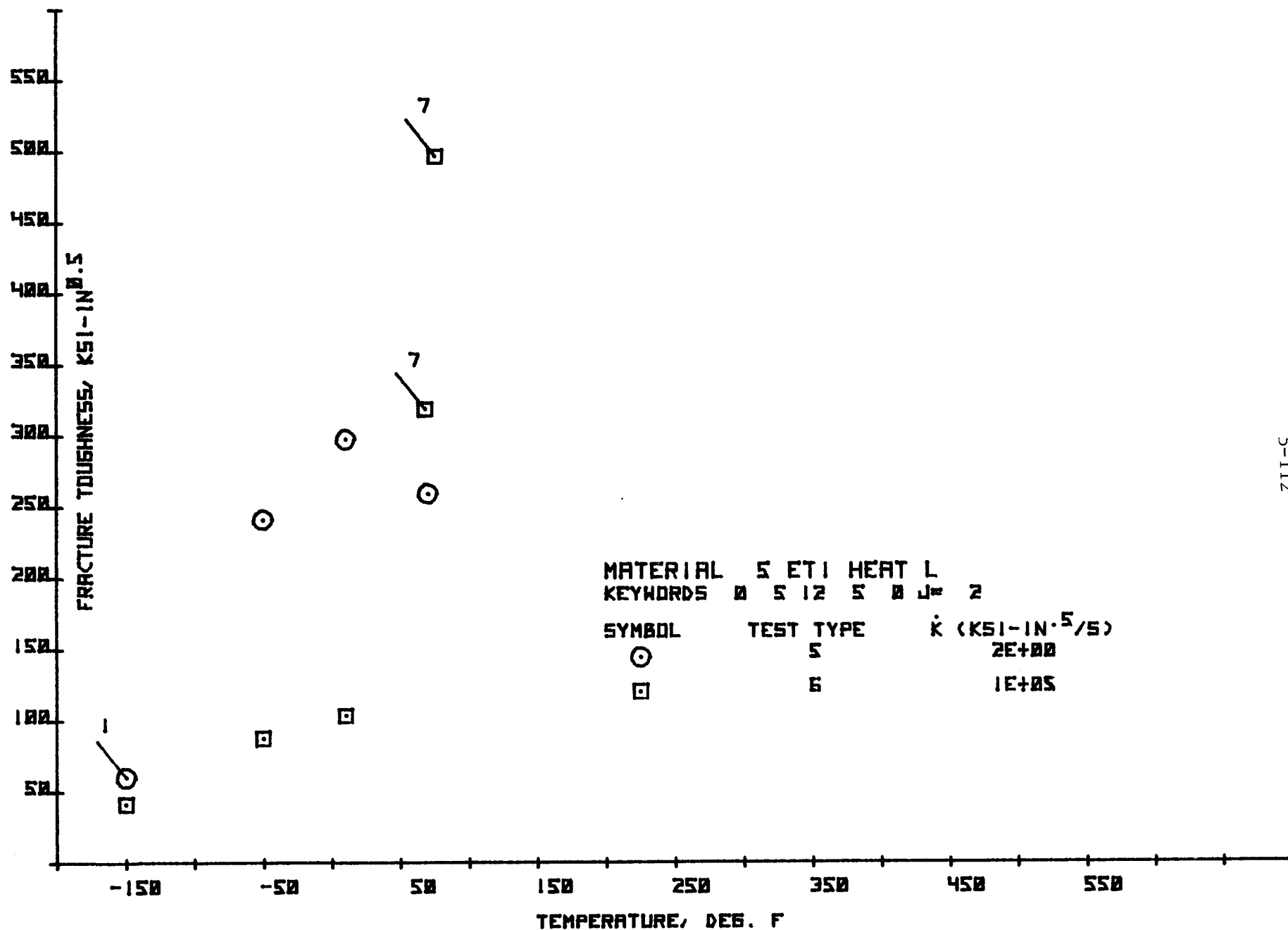


Figure 5.84. Static and Dynamic Fracture Toughness Data for ETI Heat J



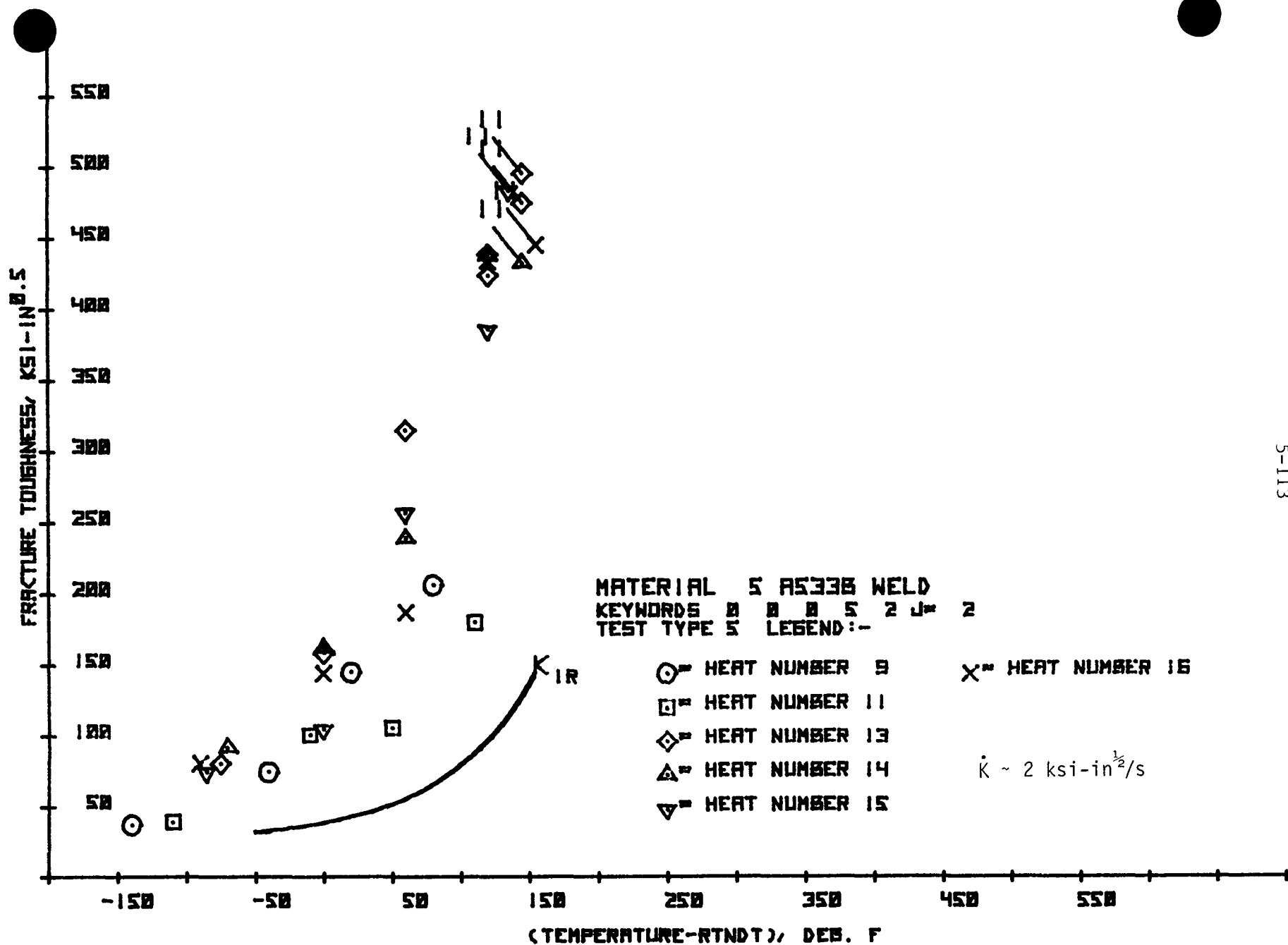


Figure 5.86. All Static Fracture Toughness Data (Weld Metal)

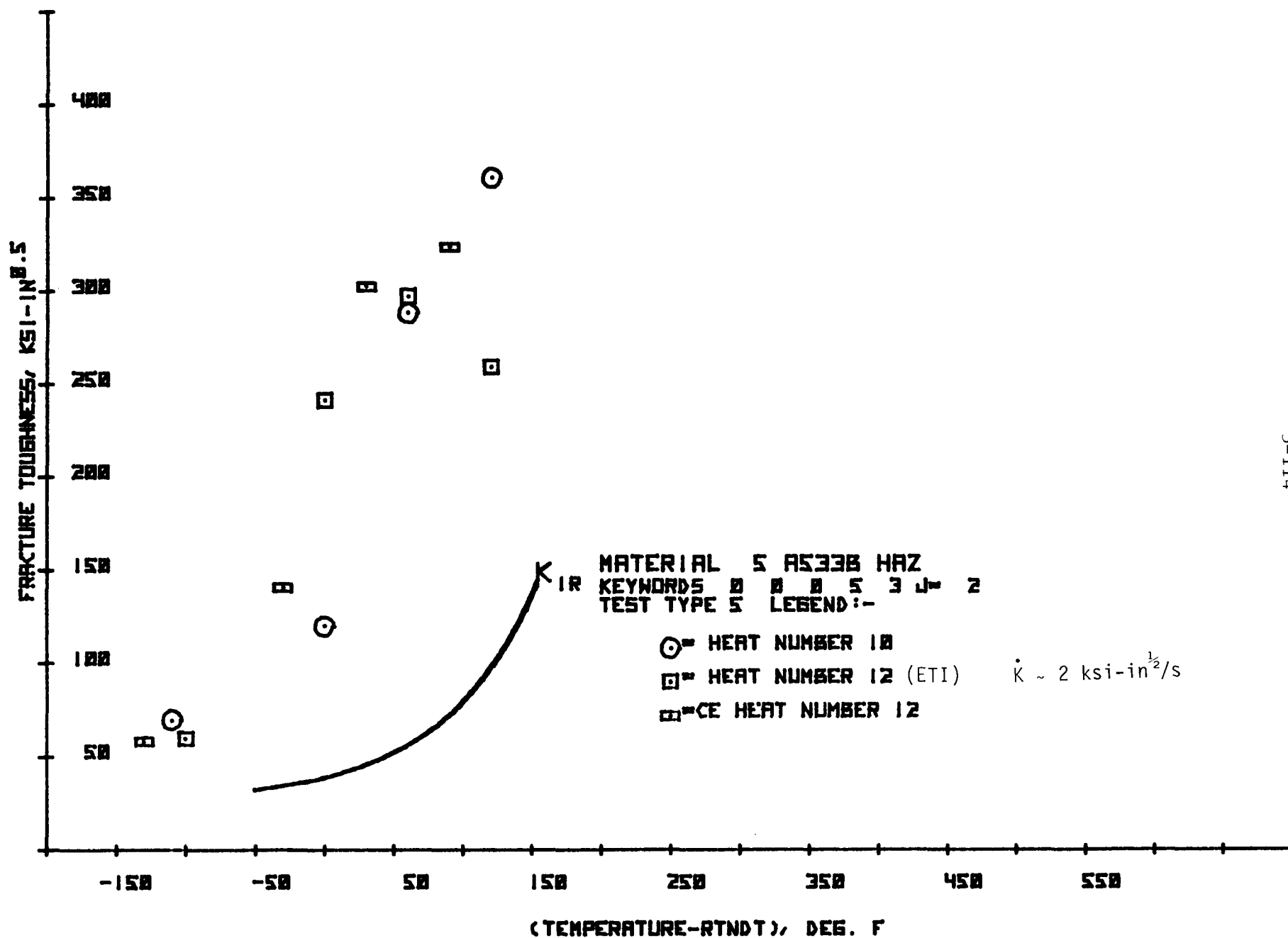


Figure 5.87. All Static Fracture Toughness Data (HAZ)

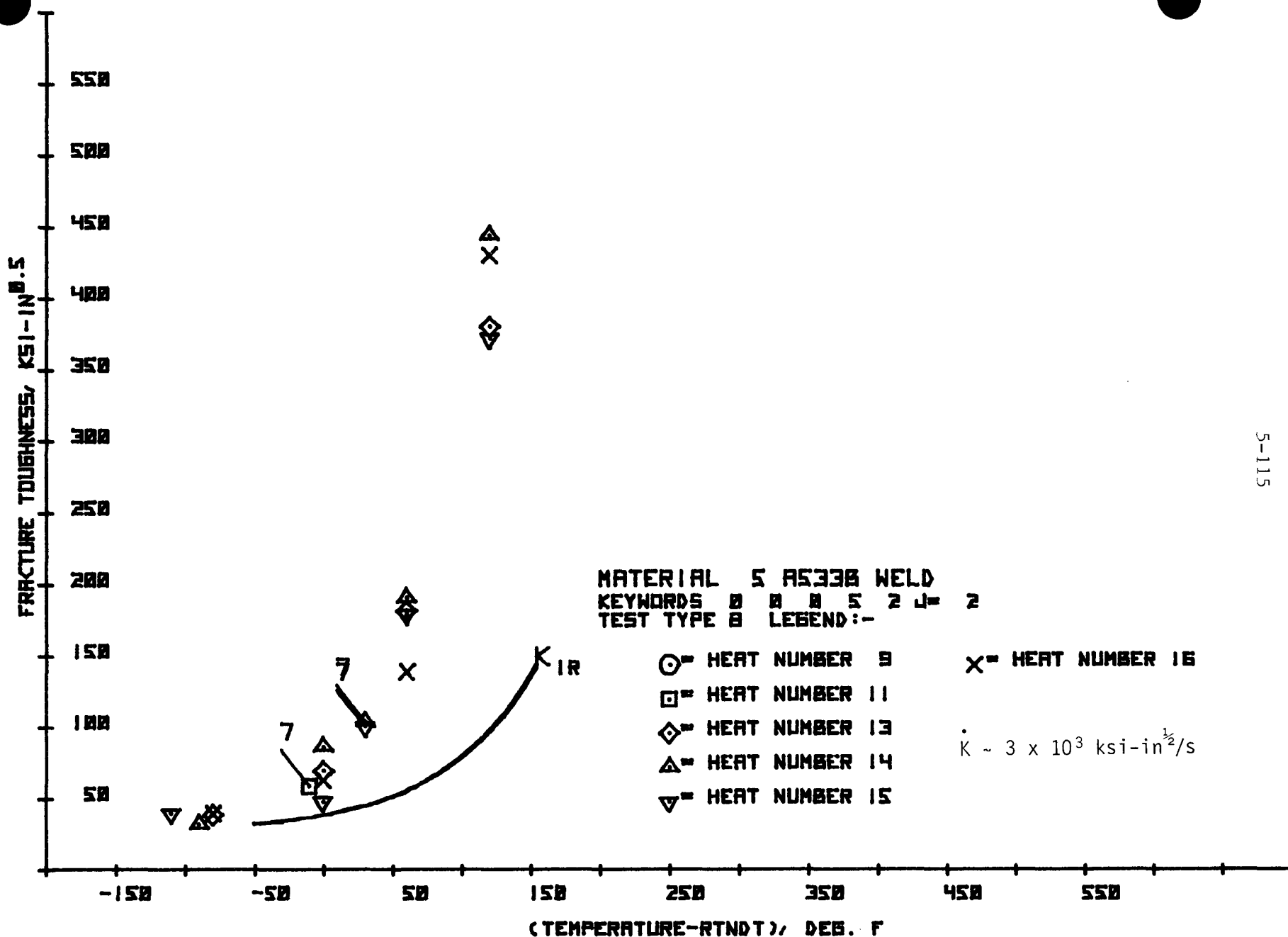


Figure 5.88. All Dynamic Compact Fracture Toughness Data for Weld Metal

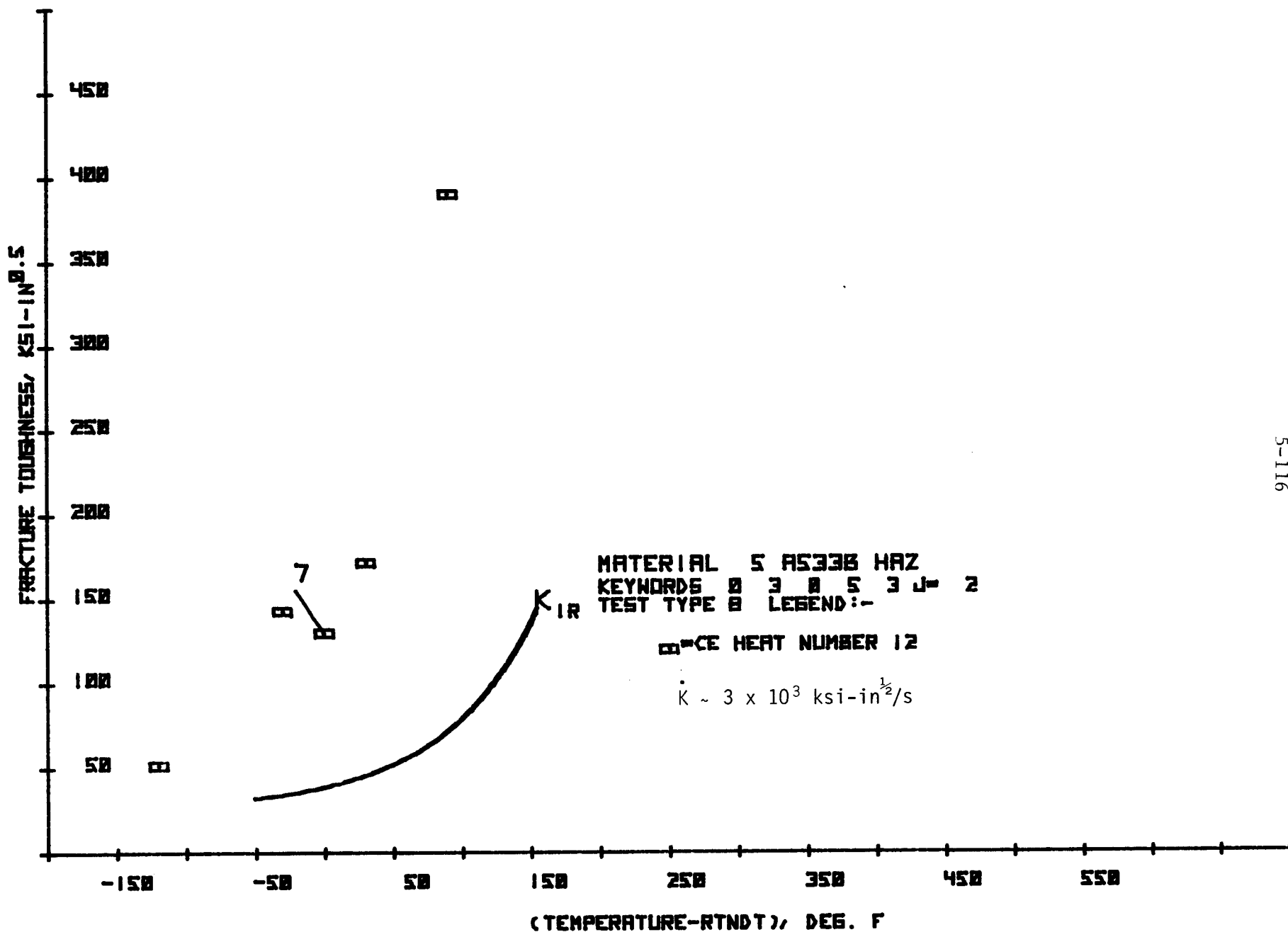


Figure 5.89. All Dynamic Compact Fracture Toughness Data (HAZ)

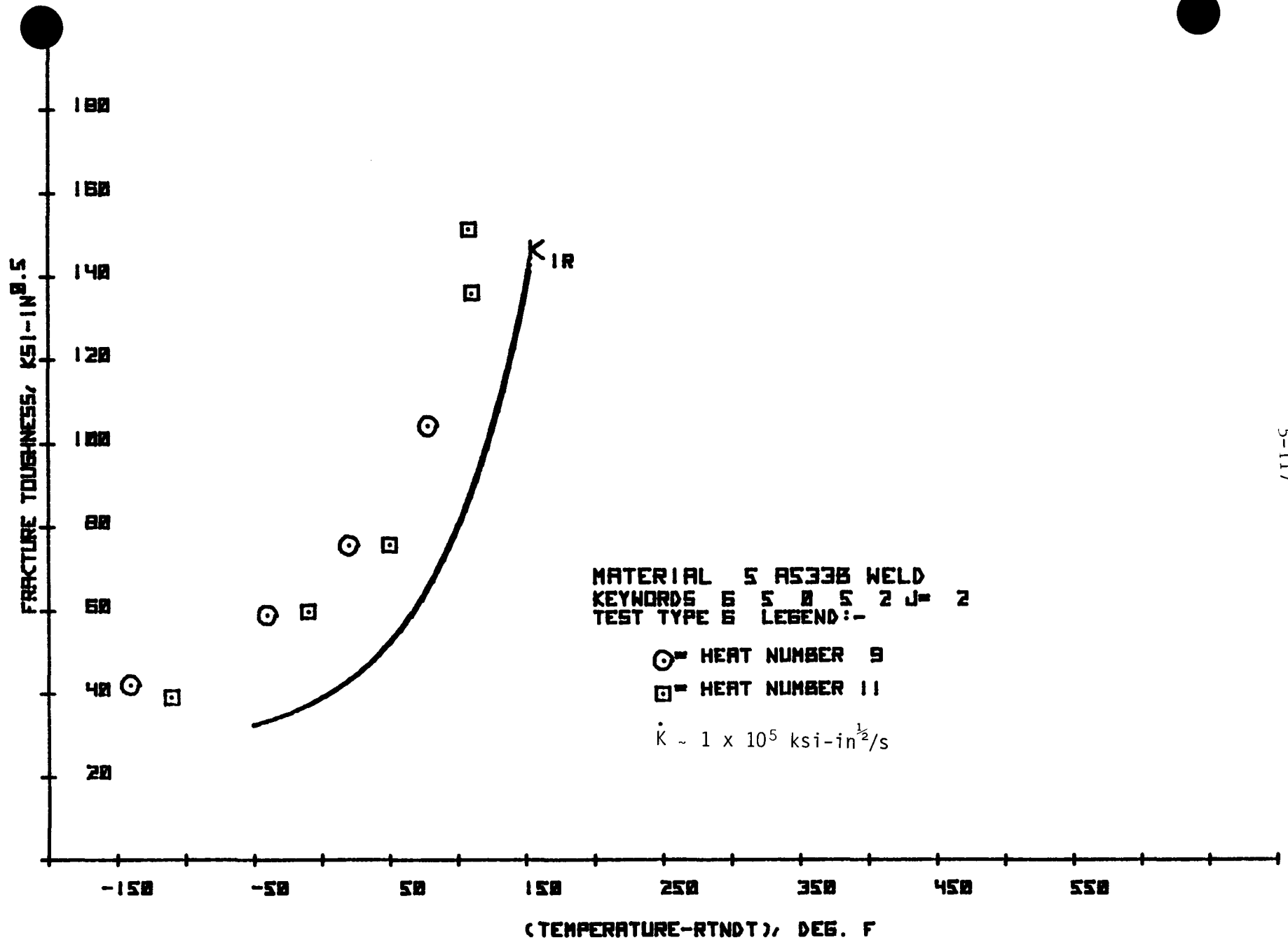


Figure 5.90. Dynamic 1T Bend Specimen Fracture Toughness Data for Weld Metal

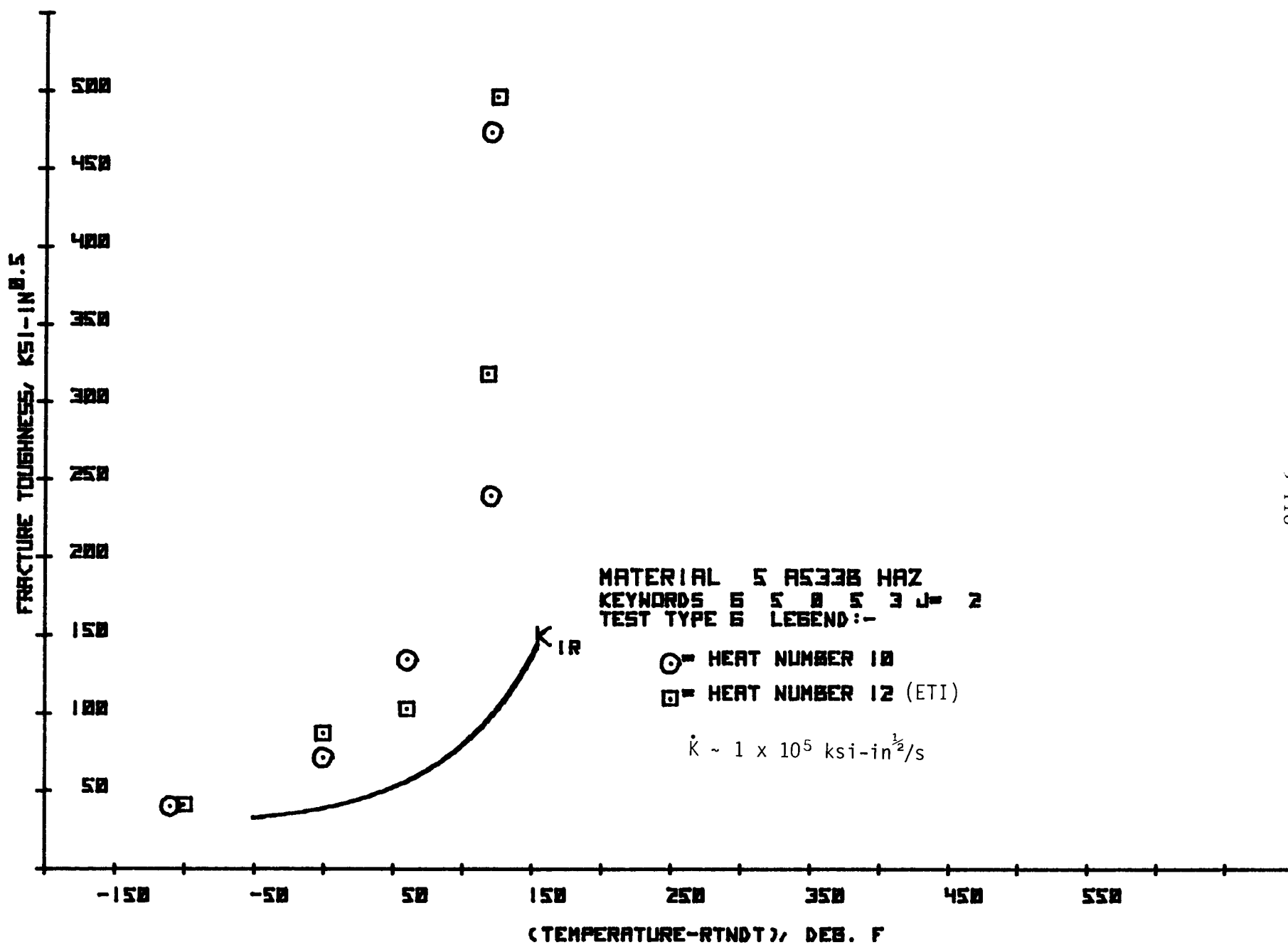
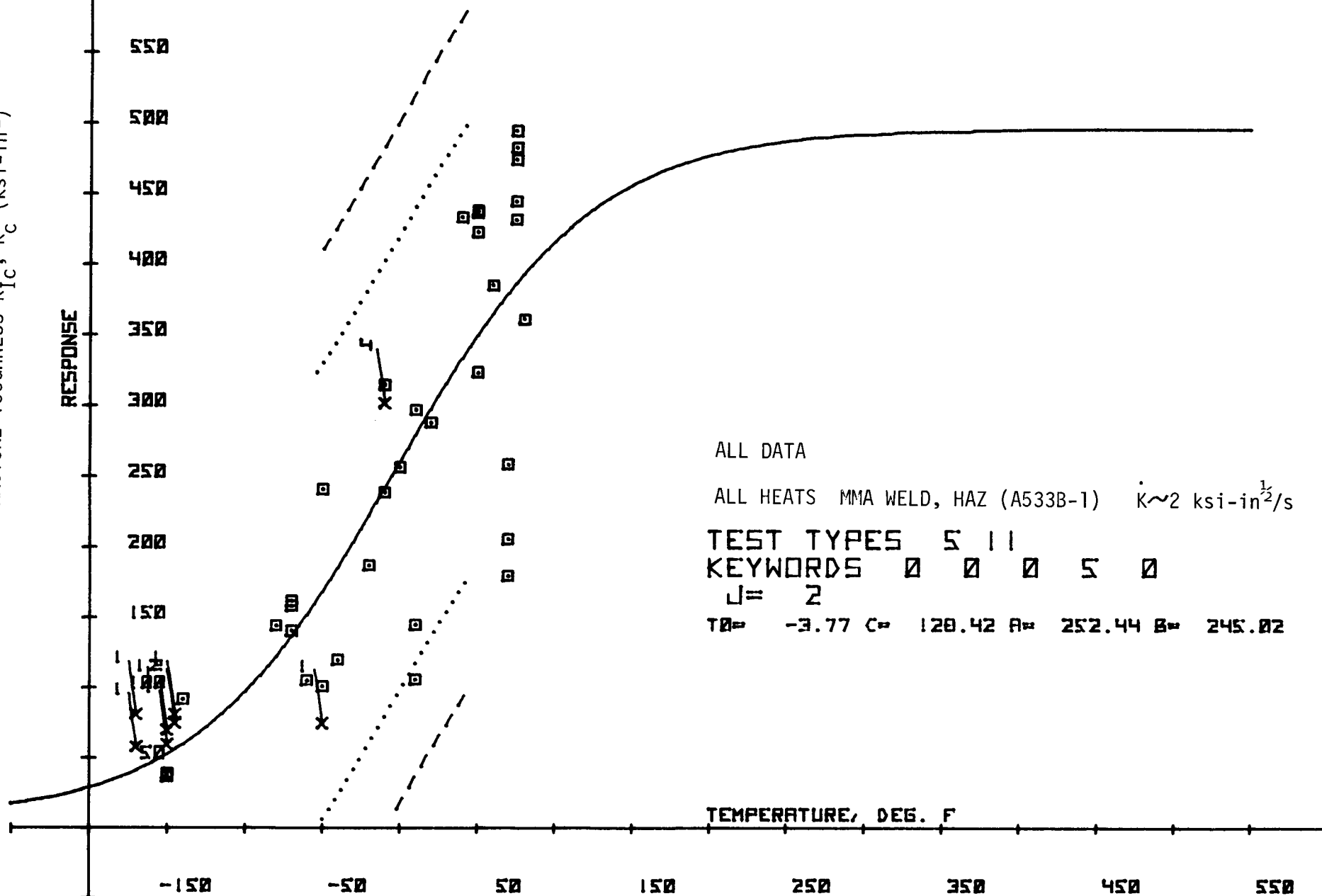


Figure 5.91. Dynamic 1T Bend Specimen Fracture Toughness Data (HAZ)

STATIC FRACTURE TOUGHNESS K_{IC} , K_C^* ($\text{ksi-in}^{\frac{1}{2}}$)

RESPONSE



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Figure 5.92 All Static Fracture Toughness Data

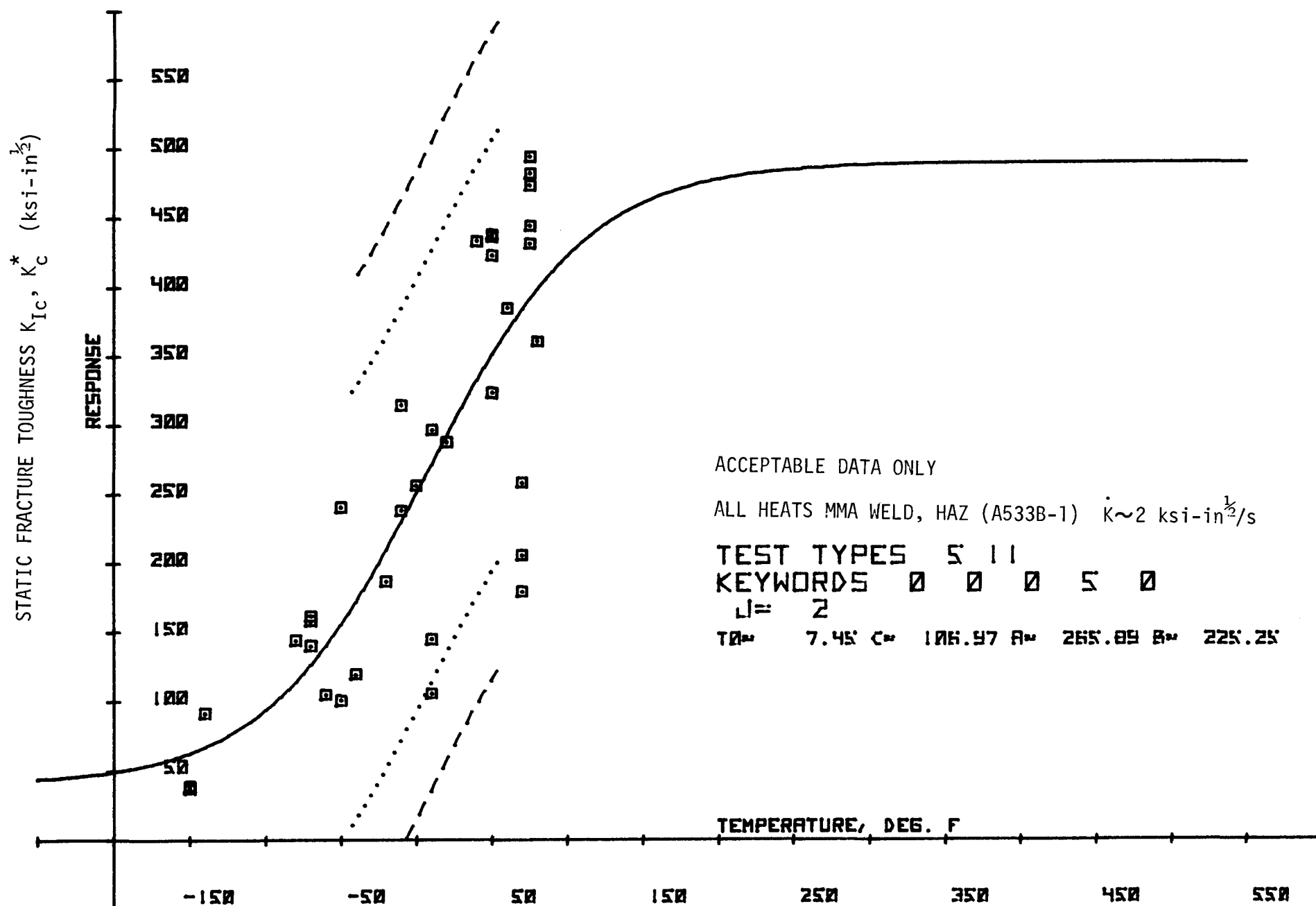


Figure 5.93 Acceptable Static Fracture Toughness Data

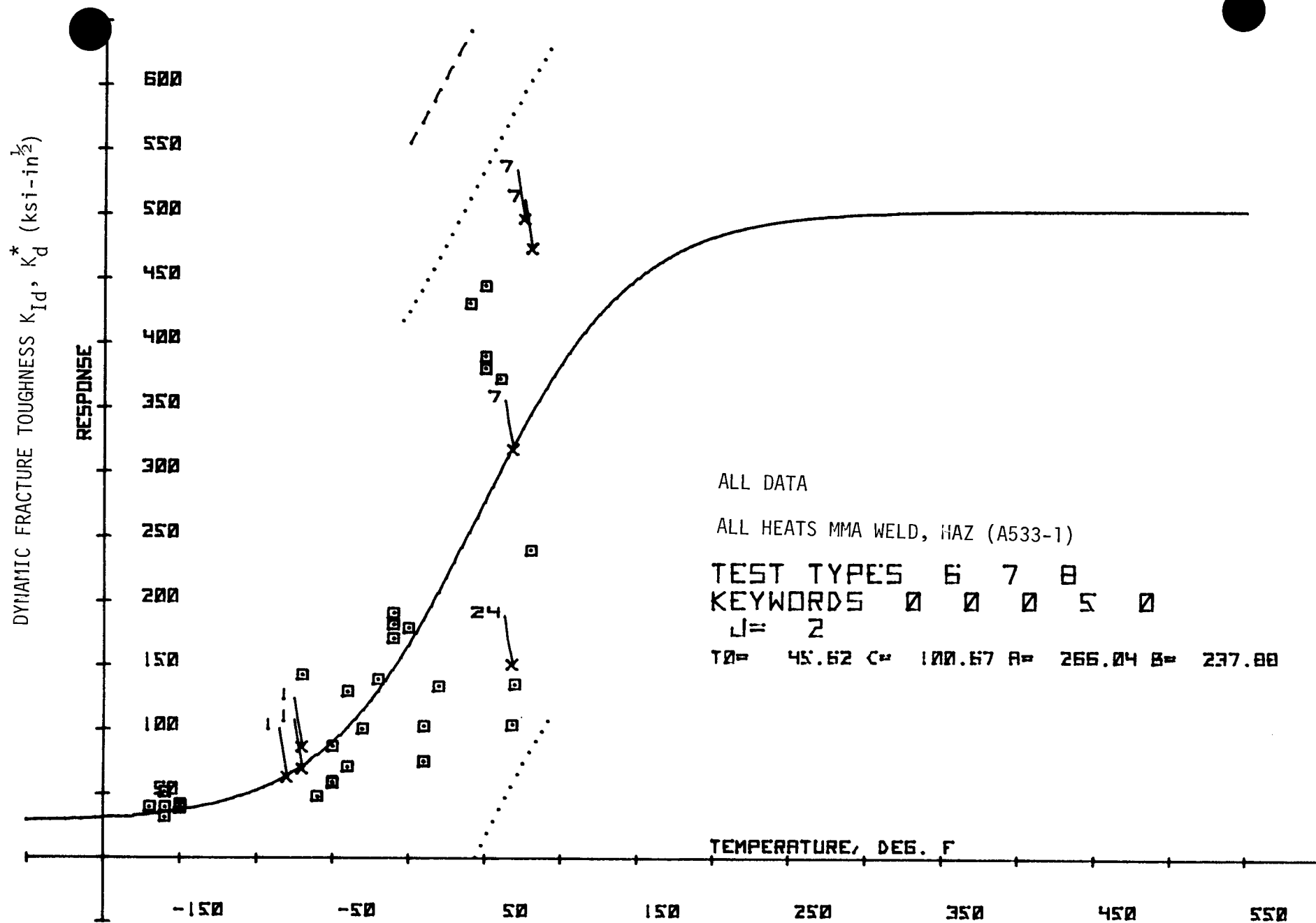


Figure 5.94 All Dynamic Fracture Toughness Data

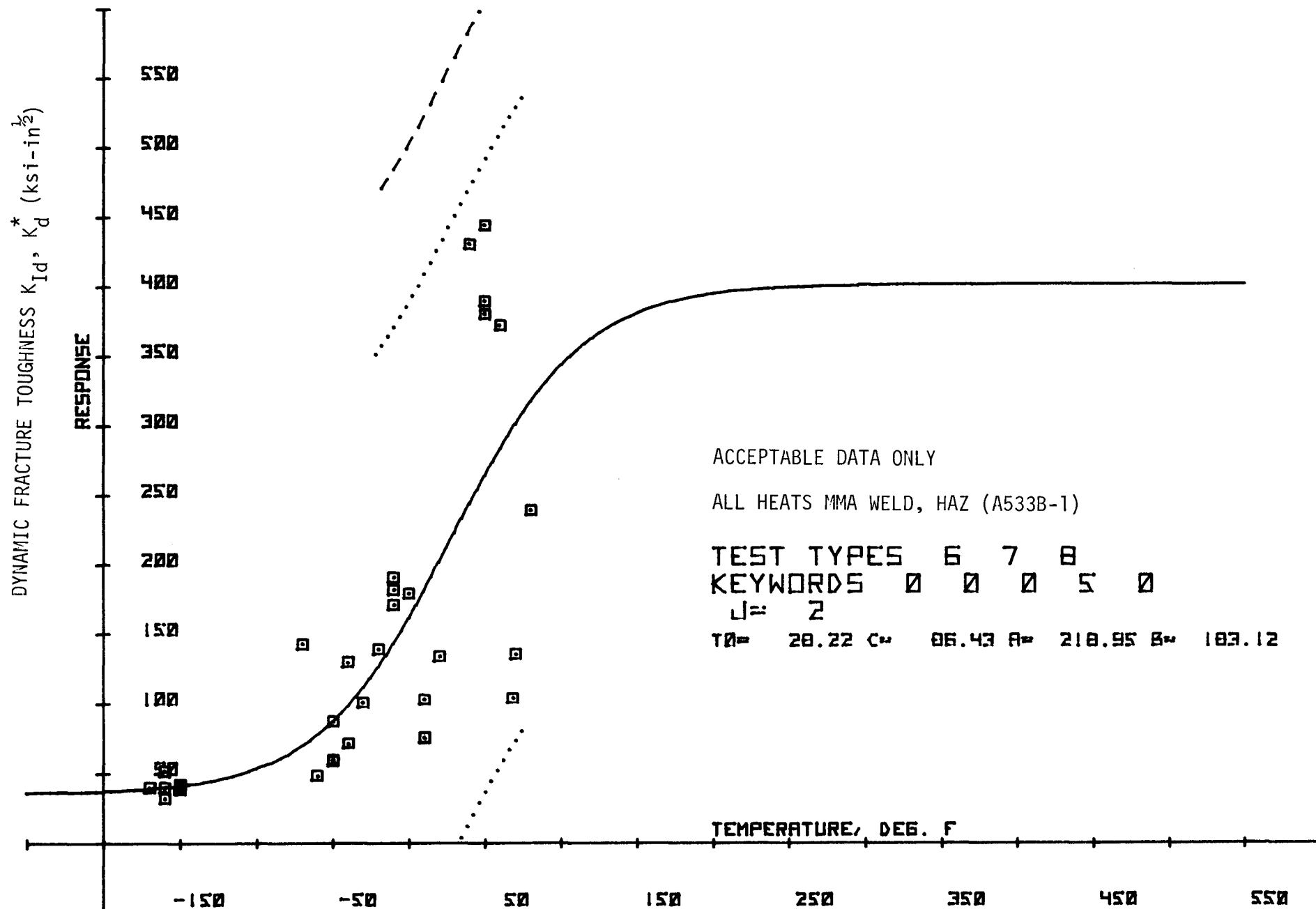


Figure 5.95 Acceptable Dynamic Fracture Toughness Data

KEYWORDS 0-0-0-5-0

MATERIAL 5 DATA BANK (MMA, HAZ, A533B-1)

(6)	1-5-9-5-2-1-0	-150.00	88.20	106.10	12.90	26.20	69.40
(7)	1-5-9-5-2-2-0	-50.00	79.00	99.00	10.20	21.70	59.20
(8)	1-5-9-5-2-3-0	73.00	70.80	88.00	7.90	15.50	36.70
(9)	1-5-9-5-2-4-0	200.00	69.60	81.60	7.20	21.90	73.50
(10)	1-5-9-5-2-5-0	400.00	66.50	81.00	6.80	20.40	63.90
(11)	1-5-9-5-2-6-0	550.00	62.90	84.10	6.30	19.00	65.30
(12)	1-5-10-5-3-1-0	-150.00	81.60	107.10	9.70	22.10	67.30
(13)	1-5-10-5-3-2-0	-50.00	69.00	98.60	11.10	28.20	69.40
(14)	1-5-10-5-3-3-0	74.00	64.50	89.80	7.60	24.30	71.40
(15)	1-5-10-5-3-4-0	200.00	58.20	82.20	8.50	24.60	69.40
(16)	1-5-10-5-3-5-0	400.00	58.20	80.40	6.40	21.70	69.40
(17)	1-5-10-5-3-6-0	550.00	58.40	86.30	7.10	23.40	69.40
(18)	1-5-11-5-2-1-0	-150.00	93.90	108.80	12.60	27.00	66.30
(19)	1-5-11-5-2-2-0	-50.00	83.70	95.90	10.50	27.00	70.80
(20)	1-5-11-5-2-3-0	74.00	80.60	91.60	10.00	26.20	66.70
(21)	1-5-11-5-2-4-0	200.00	71.20	83.70	7.50	24.20	71.20
(22)	1-5-11-5-2-5-0	400.00	71.00	85.90	8.30	23.90	65.30
(23)	1-5-11-5-2-6-0	550.00	68.80	86.90	8.20	22.50	67.30
(24)	1-5-12-5-3-1-0	-150.00	88.00	110.20	14.30	31.30	65.30
(25)	1-5-12-5-3-2-0	-50.00	76.70	101.40	12.40	30.40	71.60
(26)	1-5-12-5-3-3-0	74.00	71.20	91.30	10.00	26.60	72.00
(27)	1-5-12-5-3-4-0	200.00	67.60	85.70	7.90	22.90	74.10
(28)	1-5-12-5-3-5-0	400.00	61.40	81.60	7.40	22.90	73.70
(29)	1-5-12-5-3-6-0	550.00	66.10	90.60	9.40	20.40	49.00
(30)	2-5-9-5-2-30-0	-150.00	3.20	1.00	0.00	---	---
(31)	2-5-9-5-2-28-0	-100.00	6.30	5.00	10.00	---	---
(32)	2-5-9-5-2-27-0	-50.00	31.50	25.00	20.00	---	---
(33)	2-5-9-5-2-26-0	-30.00	34.10	25.00	20.00	---	---
(34)	2-5-9-5-2-23-0	0.00	47.30	36.00	30.00	---	---
(35)	2-5-9-5-2-31-0	10.00	21.40	19.00	20.00	---	---
(36)	2-5-9-5-2-29-0	10.00	63.20	48.00	40.00	---	---
(37)	2-5-9-5-2-32-0	20.00	36.60	29.00	30.00	---	---
(38)	2-5-9-5-2-22-0	30.00	74.60	56.00	50.00	---	---
(39)	2-5-9-5-2-30-0	30.00	41.00	33.00	35.00	---	---
(40)	2-5-9-5-2-40-0	40.00	47.20	41.00	40.00	---	---
(41)	2-5-9-5-2-37-0	40.00	79.00	63.00	70.00	---	---
(42)	2-5-9-5-2-39-0	50.00	60.50	49.00	50.00	---	---
(43)	2-5-9-5-2-33-0	50.00	86.90	68.00	60.00	---	---
(44)	2-5-9-5-2-34-0	50.00	79.90	59.00	50.00	---	---
(45)	2-5-9-5-2-21-0	72.00	101.80	72.00	80.00	---	---
(46)	2-5-9-5-2-38-0	185.00	108.00	85.00	100.00	---	---
(47)	2-5-9-5-2-26-0	300.00	107.10	82.00	100.00	---	---
(48)	2-5-9-5-2-24-0	425.00	101.00	75.00	100.00	---	---
(49)	2-5-9-5-2-25-0	550.00	109.00	85.00	100.00	---	---
(100)	2-5-10-5-3-32-0	-150.00	2.20	2.00	1.00	---	---
(101)	2-5-10-5-3-23-0	-100.00	15.00	9.00	10.00	---	---
(102)	2-5-10-5-3-27-0	-50.00	17.90	13.00	15.00	---	---
(103)	2-5-10-5-3-31-0	-30.00	40.00	36.00	40.00	---	---
(104)	2-5-10-5-3-33-0	-30.00	69.10	46.00	45.00	---	---

(105)	2-5-10-5-3-36-0	-20.00	39.20	35.00	30.00	---	---
(106)	2-5-10-5-3-35-0	-20.00	60.00	51.00	60.00	---	---
(107)	2-5-10-5-3-30-0	-10.00	126.40	79.00	70.00	---	---
(108)	2-5-10-5-3-37-0	-10.00	95.00	62.00	50.00	---	---
(109)	2-5-10-5-3-34-0	-10.00	98.70	40.00	50.00	---	---
(110)	2-5-10-5-3-23-0	0.00	77.50	52.00	50.00	---	---
(111)	2-5-10-5-3-22-0	30.00	90.10	58.00	50.00	---	---
(112)	2-5-10-5-3-21-0	72.00	124.70	79.00	90.00	---	---
(113)	2-5-10-5-3-38-0	125.00	132.50	81.00	100.00	---	---
(114)	2-5-10-5-3-29-0	185.00	149.00	85.00	100.00	---	---
(115)	2-5-10-5-3-26-0	300.00	130.50	85.00	100.00	---	---
(116)	2-5-10-5-3-24-0	425.00	98.30	71.00	100.00	---	---
(117)	2-5-10-5-3-25-0	550.00	132.30	76.00	100.00	---	---
(118)	2-5-11-5-2-37-0	-150.00	3.10	1.00	0.00	---	---
(119)	2-5-11-5-2-32-0	-100.00	5.10	2.00	1.00	---	---
(120)	2-5-11-5-2-31-0	-50.00	12.30	9.00	10.00	---	---
(121)	2-5-11-5-2-34-0	-10.00	30.90	26.00	30.00	---	---
(122)	2-5-11-5-2-30-0	0.00	64.00	43.00	50.00	---	---
(123)	2-5-11-5-2-26-0	0.00	26.40	23.00	30.00	---	---
(124)	2-5-11-5-2-25-0	0.00	63.30	51.00	50.00	---	---
(125)	2-5-11-5-2-35-0	20.00	68.10	53.00	50.00	---	---
(126)	2-5-11-5-2-28-0	20.00	72.50	58.00	70.00	---	---
(127)	2-5-11-5-2-27-0	20.00	58.50	50.00	40.00	---	---
(128)	2-5-11-5-2-29-0	30.00	94.00	80.00	80.00	---	---
(129)	2-5-11-5-2-24-0	72.00	77.80	61.00	80.00	---	---
(130)	2-5-11-5-2-36-0	100.00	92.20	70.00	95.00	---	---
(131)	2-5-11-5-2-39-0	125.00	87.30	71.00	90.00	---	---
(132)	2-5-11-5-2-33-0	185.00	111.90	91.00	100.00	---	---
(133)	2-5-11-5-2-23-0	300.00	97.30	80.00	100.00	---	---
(134)	2-5-11-5-2-21-0	425.00	127.30	90.00	100.00	---	---
(135)	2-5-11-5-2-22-0	550.00	98.90	77.00	100.00	---	---
(136)	2-5-12-5-3-39-0	-320.00	1.70	1.00	0.00	---	---
(137)	2-5-12-5-3-26-0	-150.00	7.50	3.00	1.00	---	---
(138)	2-5-12-5-3-38-0	-100.00	21.80	12.00	10.00	---	---
(139)	2-5-12-5-3-32-0	-100.00	11.20	5.00	5.00	---	---
(140)	2-5-12-5-3-37-0	-80.00	61.30	40.00	50.00	---	---
(141)	2-5-12-5-3-35-0	-65.00	67.20	41.00	60.00	---	---
(142)	2-5-12-5-3-24-0	-50.00	38.00	27.00	30.00	---	---
(143)	2-5-12-5-3-28-0	-30.00	51.00	34.00	50.00	---	---
(144)	2-5-12-5-3-27-0	-30.00	58.20	39.00	50.00	---	---
(145)	2-5-12-5-3-25-0	-30.00	76.10	47.00	60.00	---	---
(146)	2-5-12-5-3-34-0	-10.00	98.80	64.00	80.00	---	---
(147)	2-5-12-5-3-31-0	0.00	117.80	74.00	90.00	---	---
(148)	2-5-12-5-3-30-0	30.00	100.20	62.00	80.00	---	---
(149)	2-5-12-5-3-29-0	72.00	119.50	75.00	85.00	---	---
(150)	2-5-12-5-3-36-0	144.00	139.50	87.00	100.00	---	---
(151)	2-5-12-5-3-33-0	185.00	129.00	89.00	100.00	---	---
(152)	2-5-12-5-3-23-0	300.00	86.80	59.00	100.00	---	---
(153)	2-5-12-5-3-21-0	425.00	123.00	83.00	100.00	---	---
(154)	2-5-12-5-3-22-0	550.00	120.00	73.00	100.00	---	---
(208)	3-5-9-5-2-17-0	-140.00	27.40	--	--	312.00	1.90E+05

(209)	3-5-9-5-2-13-0	-110.00	27.90	--	--	433.00	1.50E+05
(210)	3-5-9-5-2-12-0	-80.00	43.60	--	--	667.00	1.82E+05
(211)	3-5-9-5-2-9-3	-50.00	44.60	--	--	1303.00	1.86E+05
(212)	3-5-9-5-2-8-0	-50.00	43.80	--	--	779.00	1.82E+05
(213)	3-5-9-5-2-6-3	-20.00	49.90	--	--	1460.00	2.63E+05
(214)	3-5-9-5-2-2-0	10.00	56.50	--	--	1660.00	5.23E+05
(215)	3-5-9-5-2-1-4	10.00	--	54.80	55.00	2465.00	3.81E+05
(216)	3-5-9-5-2-7-3	40.00	--	159.50	162.60	3157.00	3.17E+05
(217)	3-5-9-5-2-4-0	70.00	--	245.30	246.70	3784.00	4.09E+05
(218)	3-5-9-5-2-3-0	70.00	--	207.20	208.70	3485.00	4.21E+05
(219)	3-5-9-5-2-5-0	100.00	--	274.40	276.40	5970.00	4.16E+05
(220)	3-5-9-5-2-11-0	130.00	--	220.90	220.30	4123.00	4.37E+05
(221)	3-5-9-5-2-10-0	130.00	--	271.10	273.40	5131.00	4.30E+05
(222)	3-5-9-5-2-14-0	300.00	--	246.70	250.80	5302.00	3.74E+05
(223)	3-5-9-5-2-15-0	425.00	--	221.10	224.90	5895.00	3.68E+05
(224)	3-5-9-5-2-16-0	550.00	--	213.80	216.80	5474.00	3.56E+05
(225)	3-5-10-5-3-15-0	-130.00	44.20	--	--	420.00	1.94E+05
(226)	3-5-10-5-3-13-0	-100.00	40.80	--	--	829.00	2.43E+05
(227)	3-5-10-5-3-2-0	-70.00	42.00	--	--	829.00	2.19E+05
(228)	3-5-10-5-3-8-0	-40.00	51.80	--	--	1347.00	2.46E+05
(229)	3-5-10-5-3-7-0	-40.00	40.70	--	--	632.00	2.34E+05
(230)	3-5-10-5-3-4-0	-10.00	60.70	--	--	2703.00	3.37E+05
(231)	3-5-10-5-3-10-0	20.00	--	269.90	273.50	3782.00	4.02E+05
(232)	3-5-10-5-3-9-0	20.00	--	273.30	276.60	5086.00	4.07E+05
(233)	3-5-10-5-3-5-7	50.00	--	309.00	313.30	--	2.71E+05
(234)	3-5-10-5-3-3-0	80.00	--	225.90	227.40	5330.00	4.38E+05
(235)	3-5-10-5-3-1-0	80.00	--	297.90	300.40	6121.00	4.14E+05
(236)	3-5-10-5-3-6-0	110.00	--	333.40	338.80	7805.00	4.03E+05
(237)	3-5-10-5-3-12-0	140.00	--	229.30	232.80	5124.00	3.82E+05
(238)	3-5-10-5-3-11-0	140.00	--	290.10	291.60	6276.00	4.39E+05
(239)	3-5-10-5-3-14-0	300.00	--	301.40	303.90	6646.00	3.59E+05
(240)	3-5-10-5-3-17-0	425.00	--	287.00	287.30	7678.00	2.90E+05
(241)	3-5-10-5-3-16-0	550.00	--	301.80	306.50	7557.00	2.96E+05
(242)	3-5-11-5-2-2-0	-140.00	34.10	--	--	297.00	1.89E+05
(243)	3-5-11-5-2-19-0	-110.00	41.30	--	--	494.00	2.75E+05
(244)	3-5-11-5-2-10-0	-80.00	33.10	--	--	638.00	2.12E+05
(245)	3-5-11-5-2-17-0	-50.00	44.50	--	--	1108.00	2.39E+05
(246)	3-5-11-5-2-8-0	-50.00	36.70	--	--	1102.00	2.27E+05
(247)	3-5-11-5-2-6-0	-20.00	51.10	--	--	1407.00	3.28E+05
(248)	3-5-11-5-2-14-0	10.00	61.10	--	--	2021.00	4.24E+05
(249)	3-5-11-5-2-13-0	10.00	61.80	--	--	2111.00	5.72E+05
(250)	3-5-11-5-2-7-0	40.00	--	58.00	58.90	2623.00	2.04E+05
(251)	3-5-11-5-2-16-0	70.00	--	112.70	114.30	3994.00	4.70E+05
(252)	3-5-11-5-2-15-0	70.00	--	80.30	81.40	3536.00	3.72E+05
(253)	3-5-11-5-2-5-0	100.00	--	252.20	255.30	5173.00	3.39E+05
(254)	3-5-11-5-2-9-0	130.00	--	283.90	284.30	6187.00	2.10E+05
(255)	3-5-11-5-2-4-0	130.00	--	219.20	219.70	3945.00	4.35E+05
(256)	3-5-11-5-2-11-0	300.00	--	259.10	261.30	6076.00	3.40E+05
(257)	3-5-11-5-2-3-0	425.00	--	225.30	228.10	5801.00	3.03E+05
(258)	3-5-11-5-2-12-0	550.00	--	226.20	228.70	4973.00	3.37E+05
(259)	3-5-12-5-3-14-0	-140.00	35.40	--	--	630.00	2.11E+05

(260)	3-5-12-5-3-19-0	-110.00	39.60	--	--	657.00	2.64E+05
(261)	3-5-12-5-3-9-0	-80.00	55.60	--	--	982.00	2.21E+05
(262)	3-5-12-5-3-12-0	-50.00	--	108.60	109.60	2329.00	3.77E+05
(263)	3-5-12-5-3-1-7	-50.00	--	243.40	247.30	--	1.83E+05
(264)	3-5-12-5-3-7-0	-20.00	--	258.30	261.60	3684.00	2.15E+05
(265)	3-5-12-5-3-5-0	10.00	--	271.70	276.30	3990.00	4.53E+05
(266)	3-5-12-5-3-2-0	10.00	--	274.30	273.70	5709.00	4.56E+05
(267)	3-5-12-5-3-8-0	40.00	--	293.00	298.10	6751.00	3.94E+05
(268)	3-5-12-5-3-17-0	70.00	--	289.60	291.30	7040.00	3.86E+05
(269)	3-5-12-5-3-4-0	70.00	--	307.40	310.30	7087.00	4.00E+05
(270)	3-5-12-5-3-6-0	100.00	--	296.50	300.90	7521.00	3.92E+05
(271)	3-5-12-5-3-11-0	130.00	--	251.60	255.50	5195.00	4.19E+05
(272)	3-5-12-5-3-10-0	130.00	--	294.00	296.10	6773.00	3.92E+05
(273)	3-5-12-5-3-3-0	300.00	--	274.30	278.30	6134.00	3.57E+05
(274)	3-5-12-5-3-13-0	425.00	--	286.60	287.50	7787.00	3.41E+05
(275)	3-5-12-5-3-15-0	550.00	--	211.20	212.60	5650.00	3.20E+05
(315)	4-5-9-5-2-2-0	-70.00	1.00	--	--	--	--
(316)	4-5-9-5-2-4-0	-60.00	1.00	--	--	--	--
(317)	4-5-9-5-2-5-0	-50.00	1.00	--	--	--	--
(318)	4-5-9-5-2-3-0	-50.00	2.00	--	--	--	--
(319)	4-5-9-5-2-7-0	-40.00	2.00	--	--	--	--
(320)	4-5-9-5-2-6-0	-40.00	2.00	--	--	--	--
(321)	4-5-9-5-2-1-0	-30.00	2.00	--	--	--	--
(322)	4-5-10-5-3-2-0	-70.00	1.00	--	--	--	--
(323)	4-5-10-5-3-5-0	-60.00	1.00	--	--	--	--
(324)	4-5-10-5-3-4-0	-50.00	1.00	--	--	--	--
(325)	4-5-10-5-3-3-0	-50.00	2.00	--	--	--	--
(326)	4-5-10-5-3-6-0	-40.00	1.00	--	--	--	--
(327)	4-5-10-5-3-7-0	-30.00	2.00	--	--	--	--
(328)	4-5-10-5-3-1-0	-30.00	2.00	--	--	--	--
(329)	4-5-11-5-2-2-0	-70.00	1.00	--	--	--	--
(330)	4-5-11-5-2-3-0	-50.00	1.00	--	--	--	--
(331)	4-5-11-5-2-5-0	-40.00	2.00	--	--	--	--
(332)	4-5-11-5-2-4-0	-40.00	2.00	--	--	--	--
(333)	4-5-11-5-2-1-0	-30.00	2.00	--	--	--	--
(334)	4-5-12-5-3-2-0	-70.00	1.00	--	--	--	--
(335)	4-5-12-5-3-3-0	-50.00	1.00	--	--	--	--
(336)	4-5-12-5-3-5-0	-40.00	2.00	--	--	--	--
(337)	4-5-12-5-3-4-0	-40.00	2.00	--	--	--	--
(338)	4-5-12-5-3-1-0	-30.00	2.00	--	--	--	--
(351)	5-5-9-5-2-3-0	-150.00	37.00	--	--	--	3.10
(352)	5-5-9-5-2-2-1	-50.00	74.80	--	--	--	2.70
(353)	5-5-9-5-2-1-0	10.00	--	145.00	124.00	--	3.30
(354)	5-5-9-5-2-5-0	70.00	--	206.00	180.00	--	4.00
(355)	5-5-10-5-3-2-1	-150.00	70.10	--	--	--	3.50
(356)	5-5-10-5-3-5-0	-40.00	--	120.00	103.00	--	3.10
(357)	5-5-10-5-3-3-0	20.00	--	288.00	251.00	--	4.50
(358)	5-5-10-5-3-6-0	80.00	--	361.00	302.00	--	5.00
(359)	5-5-11-5-2-6-0	-150.00	39.10	--	--	--	3.00
(360)	5-5-11-5-2-1-0	-50.00	--	101.00	82.80	--	3.30
(361)	5-5-11-5-2-4-0	10.00	--	106.00	91.70	--	2.90

(362)	5-5-11-5-2-5-0	70.00	--	180.00	155.00	--	4.30
(363)	5-5-12-5-3-5-1	-150.00	59.90	--	--	--	3.20
(364)	5-5-12-5-3-2-0	-50.00	--	241.00	183.00	--	4.80
(365)	5-5-12-5-3-1-0	10.00	--	297.00	258.00	--	3.90
(366)	5-5-12-5-3-6-0	70.00	--	259.00	226.00	--	5.90
(380)	6-5-9-5-2-6-0	-150.00	42.30	--	--	85.00	74000.00
(381)	6-5-9-5-2-4-0	-50.00	59.10	--	--	--	1.16E+05
(382)	6-5-9-5-2-2-0	10.00	75.60	--	--	1599.00	1.48E+05
(383)	6-5-9-5-2-1-0	68.00	104.10	--	--	--	2.04E+05
(384)	6-5-10-5-3-5-0	-150.00	40.20	--	--	71.00	67000.00
(385)	6-5-10-5-3-4-0	-40.00	71.60	--	--	607.00	1.40E+05
(386)	6-5-10-5-3-1-0	20.00	134.10	--	--	--	1.79E+05
(387)	6-5-10-5-3-6-0	80.00	--	239.40	239.80	--	2.28E+05
(388)	6-5-10-5-3-2-7	80.00	--	473.70	473.30	--	1.16E+05
(389)	6-5-11-5-2-4-0	-150.00	39.20	--	--	80.00	65000.00
(390)	6-5-11-5-2-3-0	-50.00	59.90	--	--	722.00	1.17E+05
(391)	6-5-11-5-2-2-0	10.00	75.70	--	--	--	1.40E+05
(392)	6-5-11-5-2-1-24	68.00	151.10	--	--	--	2.01E+05
(393)	6-5-11-5-2-6-0	70.00	135.80	--	--	--	1.89E+05
(394)	6-5-12-5-3-4-0	-150.00	41.20	--	--	82.00	78000.00
(395)	6-5-12-5-3-3-0	-50.00	87.30	--	--	--	1.10E+05
(396)	6-5-12-5-3-2-0	10.00	103.10	--	--	--	2.02E+05
(397)	6-5-12-5-3-1-7	68.00	--	317.90	318.00	--	1.32E+05
(398)	6-5-12-5-3-5-7	75.00	--	496.40	496.60	--	1.22E+05
(409)	7-5-11-5-2-1-0	-50.00	59.40	--	--	--	2000.00
(364)	2-3-12-5-3-1-0	-190.00	1.00	0.00	0.00	--	--
(365)	2-3-12-5-3-2-0	-100.00	11.00	3.00	0.00	--	--
(366)	2-3-12-5-3-3-0	-60.00	59.00	37.00	30.00	--	--
(367)	2-3-12-5-3-4-0	-40.00	78.00	46.00	30.00	--	--
(368)	2-3-12-5-3-5-0	-20.00	58.00	35.00	30.00	--	--
(369)	2-3-12-5-3-6-0	0.00	45.00	32.00	30.00	--	--
(370)	2-3-12-5-3-14-0	20.00	105.00	52.00	60.00	--	--
(371)	2-3-12-5-3-13-0	20.00	107.00	71.00	70.00	--	--
(372)	2-3-12-5-3-12-0	20.00	196.00	89.00	100.00	--	--
(373)	2-3-12-5-3-7-0	20.00	45.00	34.00	30.00	--	--
(374)	2-3-12-5-3-8-0	40.00	71.00	46.00	70.00	--	--
(375)	2-3-12-5-3-18-0	70.00	124.00	81.00	100.00	--	--
(376)	2-3-12-5-3-10-0	100.00	82.00	63.00	90.00	--	--
(377)	2-3-12-5-3-11-0	160.00	134.00	81.00	99.00	--	--
(378)	2-3-12-5-3-15-0	300.00	149.00	80.00	100.00	--	--
(379)	2-3-12-5-3-16-0	425.00	169.00	80.00	100.00	--	--
(380)	2-3-12-5-3-17-0	550.00	148.00	72.00	100.00	--	--
(381)	2-23-14-5-1-21-0	-120.00	12.20	7.00	5.00	--	--
(382)	2-23-14-5-1-9-0	-120.00	6.00	3.00	5.00	--	--
(383)	2-23-14-5-1-9-0	-120.00	11.00	6.00	5.00	--	--
(384)	2-23-14-5-1-25-0	-80.00	40.50	30.00	25.00	--	--
(385)	2-23-14-5-1-24-0	-80.00	14.80	13.00	15.00	--	--
(386)	2-23-14-5-1-23-0	-80.00	15.20	12.00	15.00	--	--
(387)	2-23-14-5-1-32-0	-40.00	66.00	52.00	30.00	--	--
(388)	2-23-14-5-1-13-0	-40.00	83.00	61.00	40.00	--	--
(389)	2-23-14-5-1-10-0	-40.00	82.00	60.00	45.00	--	--

(390)	2-23-14-3-1-5-0	-10.00	132.50	84.00	80.00	--	----
(391)	2-23-14-3-1-4-0	-10.00	120.50	77.00	70.00	--	----
(392)	2-23-14-3-1-3-0	-10.00	107.50	79.00	65.00	--	----
(393)	2-23-14-3-1-14-0	40.00	133.50	87.00	85.00	--	----
(394)	2-23-14-3-1-15-0	40.00	150.00	102.00	90.00	--	----
(395)	2-23-14-3-1-6-0	40.00	129.50	84.00	80.00	--	----
(396)	2-23-14-3-1-11-0	100.00	166.00	95.00	100.00	--	----
(397)	2-23-14-3-1-12-0	100.00	175.50	93.00	100.00	--	----
(398)	2-23-14-3-1-1-0	100.00	161.00	93.00	95.00	--	----
(399)	2-23-14-3-1-10-0	160.00	176.00	98.00	100.00	--	----
(400)	2-23-14-3-1-7-0	160.00	187.50	92.00	100.00	--	----
(401)	2-23-14-3-1-8-0	160.00	191.00	90.00	100.00	--	----
(402)	2-23-14-3-1-19-0	300.00	207.50	78.00	100.00	--	----
(403)	2-23-14-3-1-20-0	425.00	240.00	89.00	100.00	--	----
(404)	2-23-14-3-1-18-0	550.00	240.00	86.00	100.00	--	----
(405)	2-23-14-3-2-12-0	-120.00	5.20	1.00	5.00	--	----
(406)	2-23-14-3-2-4-0	-120.00	5.50	2.00	5.00	--	----
(407)	2-23-14-3-2-10-0	-120.00	4.70	1.00	5.00	--	----
(408)	2-23-14-3-2-8-0	-80.00	7.10	2.00	10.00	--	----
(457)	4-23-12-5-3-7-0	-80.00	1.00	--	--	--	----
(458)	4-23-12-5-3-2-0	-70.00	1.00	--	--	--	----
(459)	4-23-12-5-3-0-0	-70.00	2.00	--	--	--	----
(460)	4-23-12-5-3-5-0	-60.00	2.00	--	--	--	----
(461)	4-23-12-5-3-1-0	-60.00	2.00	--	--	--	----
(462)	4-23-12-5-3-6-0	-30.00	2.00	--	--	--	----
(463)	4-23-12-5-3-3-0	-10.00	2.00	--	--	--	----
(464)	4-23-13-5-2-3-0	-70.00	1.00	--	--	--	----
(465)	4-23-13-5-2-8-0	-60.00	2.00	--	--	--	----
(466)	4-23-13-5-2-7-0	-60.00	2.00	--	--	--	----
(467)	4-23-13-5-2-5-0	-50.00	2.00	--	--	--	----
(468)	4-23-14-5-2-2-0	-70.00	1.00	--	--	--	----
(469)	4-23-14-5-2-1-0	-60.00	2.00	--	--	--	----
(470)	4-23-14-5-2-3-0	-60.00	2.00	--	--	--	----
(471)	4-23-14-5-2-6-0	-50.00	2.00	--	--	--	----
(472)	4-23-15-5-2-2-0	-70.00	1.00	--	--	--	----
(473)	4-23-15-5-2-1-0	-60.00	2.00	--	--	--	----
(474)	4-23-15-5-2-4-0	-60.00	1.00	--	--	--	----
(475)	4-23-15-5-2-5-0	-50.00	2.00	--	--	--	----
(476)	4-23-15-5-2-3-0	-50.00	2.00	--	--	--	----
(477)	4-23-16-5-2-1-0	-100.00	1.00	--	--	--	----
(478)	4-23-16-5-2-3-0	-90.00	1.00	--	--	--	----
(479)	4-23-16-5-2-5-0	-80.00	1.00	--	--	--	----
(480)	4-23-16-5-2-7-0	-80.00	2.00	--	--	--	----
(481)	4-23-16-5-2-4-0	-70.00	2.00	--	--	--	----
(482)	4-23-16-5-2-2-0	-70.00	2.00	--	--	--	----
(483)	4-23-16-5-2-6-0	-60.00	2.00	--	--	--	----
(546)	8-3-12-5-3-25-0	-160.00	51.60	--	--	--	4900.00
(547)	8-3-12-5-3-16-0	-70.00	--	142.80	127.20	--	5200.00
(548)	8-3-12-5-3-12-0	-10.00	--	171.30	161.50	--	5600.00
(549)	8-3-12-5-3-21-0	50.00	--	389.60	368.00	--	4800.00
(550)	8-3-13-5-2-6-0	-150.00	38.80	--	--	--	4700.00

(551)	8-3-13-5-2-3-1	-70.00	65.90	--	--	--	7000.00
(552)	8-3-13-5-2-18-0	-10.00	--	182.10	172.40	--	2700.00
(553)	8-3-13-5-2-19-0	50.00	--	380.30	359.80	--	2700.00
(554)	8-3-14-5-2-2-0	-160.00	32.20	--	--	--	5200.00
(555)	8-3-14-5-2-7-1	-70.00	86.70	--	--	--	5000.00
(556)	8-3-14-5-2-10-0	-10.00	--	191.10	179.50	--	2200.00
(557)	8-3-14-5-2-19-0	50.00	--	444.40	420.00	--	1900.00
(558)	8-3-15-5-2-11-0	-170.00	40.00	--	--	--	4300.00
(559)	8-3-15-5-2-7-0	-60.00	--	48.60	92.80	--	5300.00
(560)	8-3-15-5-2-22-0	0.00	--	179.50	168.90	--	5100.00
(561)	8-3-15-5-2-21-0	60.00	--	372.20	351.40	--	4600.00
(562)	8-3-16-5-2-15-0	-160.00	39.90	--	--	--	4700.00
(563)	8-3-16-5-2-4-1	-80.00	63.50	--	--	--	4900.00
(564)	8-3-16-5-2-1-0	-20.00	--	139.30	130.50	--	4900.00
(565)	8-3-16-5-2-27-0	40.00	--	430.60	403.70	--	2000.00
60	1-23-12-5-3-1-0	-130.00	76.50	100.60	13.40	27.00	71.80
61	1-23-12-5-3-2-0	-70.00	70.50	94.90	12.80	27.00	61.60
62	1-23-12-5-3-3-0	-10.00	64.50	88.40	12.20	26.50	65.00
63	1-23-12-5-3-4-0	110.00	57.30	79.40	9.70	25.00	65.80
64	1-23-12-5-3-5-0	250.00	55.30	76.90	--	23.00	68.10
65	1-23-12-5-3-6-0	550.00	54.80	80.20	8.80	21.00	59.80
(66)	1-23-13-5-1-1-0	-130.00	83.60	98.80	14.10	29.50	61.70
(67)	1-23-13-5-1-2-0	-70.00	80.60	96.30	12.20	30.00	71.60
(68)	1-23-13-5-1-3-0	-10.00	74.60	90.30	--	31.00	73.10
(69)	1-23-13-5-1-4-0	110.00	69.00	82.80	11.00	29.00	74.00
(70)	1-23-13-5-1-5-0	250.00	67.20	79.30	9.20	25.50	73.10
(71)	1-23-13-5-1-6-0	550.00	68.80	83.10	10.90	27.00	64.40
(72)	1-23-14-5-1-1-0	-130.00	80.60	96.00	14.20	33.50	72.60
(73)	1-23-14-5-1-2-0	-70.00	75.70	91.70	14.10	29.50	69.30
(74)	1-23-14-5-1-3-0	-10.00	73.10	87.60	13.50	31.50	75.60
(75)	1-23-14-5-1-4-0	110.00	68.70	81.70	11.60	30.50	74.60
(76)	1-23-14-5-1-5-0	250.00	65.40	79.30	11.00	26.50	75.30
(77)	1-23-14-5-1-6-0	550.00	63.10	83.60	11.60	29.00	70.10
(78)	1-23-15-5-1-1-0	-120.00	81.70	97.10	14.70	31.50	68.30
(79)	1-23-15-5-1-2-0	-60.00	78.70	95.00	13.70	32.00	71.80
(80)	1-23-15-5-1-3-0	0.00	74.60	89.90	13.00	31.00	74.10
(81)	1-23-15-5-1-4-0	120.00	70.20	82.90	10.40	29.00	73.60
(82)	1-23-15-5-1-5-0	250.00	66.80	80.40	8.50	26.00	71.80
(83)	1-23-15-5-1-6-0	550.00	62.40	83.20	11.00	26.50	70.30
(84)	1-23-16-5-1-1-0	-140.00	85.80	99.40	14.70	33.00	72.10
(85)	1-23-16-5-1-2-0	-80.00	75.70	91.00	13.50	32.00	71.30
(86)	1-23-16-5-1-3-0	-20.00	72.80	87.90	13.50	32.00	74.00
(87)	1-23-16-5-1-4-0	100.00	69.40	81.90	12.30	32.50	76.10
(88)	1-23-16-5-1-5-0	250.00	51.00	76.10	10.50	26.50	73.60
(89)	1-23-16-5-1-6-0	550.00	59.40	80.50	11.60	27.00	71.20
(91)	2-23-14-5-2-25-0	-80.00	8.30	3.00	15.00	--	--
(92)	2-23-14-5-2-2-0	-80.00	10.10	5.00	15.00	--	--
(93)	2-23-14-5-2-21-0	-40.00	31.00	23.00	30.00	--	--
(94)	2-23-14-5-2-6-0	-40.00	22.70	18.00	25.00	--	--
(95)	2-23-14-5-2-23-0	-40.00	22.20	15.00	25.00	--	--
(96)	2-23-14-5-2-1-0	-10.00	110.00	70.00	65.00	--	--

(97)	2-23-14-5-2-3-0	-10.00	104.50	63.00	65.00
(98)	2-23-14-5-2-5-0	-10.00	79.50	56.00	50.00
(99)	2-23-14-5-2-22-0	40.00	127.00	82.00	80.00
(100)	2-23-14-5-2-19-0	40.00	106.00	65.00	70.00
(101)	2-23-14-5-2-21-0	40.00	95.00	64.00	65.00
(102)	2-23-14-5-2-17-0	100.00	181.50	84.00	100.00
(103)	2-23-14-5-2-15-0	100.00	165.00	95.00	100.00
(104)	2-23-14-5-2-13-0	100.00	145.50	82.00	100.00
(105)	2-23-14-5-2-7-0	160.00	140.00	86.00	100.00
(106)	2-23-14-5-2-11-0	160.00	138.00	85.00	100.00
(107)	2-23-14-5-2-9-0	160.00	131.50	86.00	100.00
(108)	2-23-14-5-2-14-0	300.00	160.50	90.00	100.00
(109)	2-23-14-5-2-16-0	425.00	164.00	90.00	100.00
(110)	2-23-14-5-2-19-0	550.00	189.50	70.00	100.00
(111)	2-3-15-5-1-1-0	-180.00	3.50	0.00	0.00
(112)	2-3-15-5-1-2-0	-90.00	13.00	5.00	10.00
(113)	2-3-15-5-1-3-0	-50.00	95.00	63.00	45.00
(114)	2-3-15-5-1-4-0	-30.00	65.00	42.00	35.00
(115)	2-3-15-5-1-5-0	-10.00	93.00	61.00	45.00
(116)	2-3-15-5-1-6-0	10.00	140.00	72.00	90.00
(117)	2-3-15-5-1-7-0	30.00	122.00	76.00	80.00
(118)	2-3-15-5-1-8-0	50.00	133.00	78.00	80.00
(119)	2-3-15-5-1-9-0	70.00	130.00	84.00	80.00
(120)	2-3-15-5-1-10-0	110.00	137.00	95.00	90.00
(121)	2-3-15-5-1-11-0	170.00	160.00	90.00	100.00
(122)	2-3-15-5-1-12-0	300.00	190.00	80.00	100.00
(123)	2-3-15-5-1-13-0	425.00	225.00	67.00	100.00
(124)	2-3-15-5-1-14-0	550.00	231.00	65.00	100.00
(125)	2-3-15-5-2-1-0	-180.00	3.50	0.00	0.00
(126)	2-3-15-5-2-2-0	-90.00	18.00	9.00	10.00
(127)	2-3-15-5-2-3-0	-50.00	40.00	27.00	30.00
(128)	2-3-15-5-2-4-0	-30.00	94.00	64.00	35.00
(129)	2-3-15-5-2-5-0	-10.00	101.00	68.00	50.00
(130)	2-3-15-5-2-17-0	0.00	134.00	73.00	85.00
(131)	2-3-15-5-2-16-0	0.00	126.00	67.00	80.00
(132)	2-3-15-5-2-15-0	0.00	111.00	64.00	70.00
(133)	2-3-15-5-2-6-0	10.00	146.00	73.00	85.00
(134)	2-3-15-5-2-7-0	30.00	144.00	88.00	85.00
(135)	2-3-15-5-2-8-0	50.00	162.00	88.00	100.00
(136)	2-3-15-5-2-9-0	70.00	139.00	91.00	85.00
(137)	2-3-15-5-2-10-0	110.00	160.00	93.00	99.00
(138)	2-3-15-5-2-11-0	170.00	161.00	85.00	100.00
(139)	2-3-15-5-2-12-0	300.00	219.00	83.00	100.00
(140)	2-3-15-5-2-13-0	425.00	221.00	67.00	100.00
(141)	2-3-15-5-2-14-0	550.00	200.00	66.00	100.00
(142)	2-3-16-5-1-1-0	-190.00	5.00	0.00	0.00
(143)	2-3-16-5-1-2-0	-102.00	16.00	4.00	0.00
(144)	2-3-16-5-1-3-0	-70.00	43.00	28.00	25.00
(145)	2-3-16-5-1-4-0	-50.00	71.00	46.00	30.00
(146)	2-3-16-5-1-5-0	-30.00	86.00	57.00	35.00
(147)	2-3-16-5-1-6-0	-10.00	124.00	73.00	75.00

(148)	2-3-16-5-1-7-0	10.00	126.00	78.00	65.00	---	---
(149)	2-3-16-5-1-8-0	30.00	146.00	88.00	85.00	---	---
(150)	2-3-16-5-1-9-0	50.00	137.00	82.00	99.00	---	---
(151)	2-3-16-5-1-10-0	90.00	176.00	87.00	100.00	---	---
(152)	2-3-16-5-1-11-0	150.00	190.00	86.00	100.00	---	---
(153)	2-3-16-5-1-12-0	300.00	161.00	87.00	99.00	---	---
(154)	2-3-16-5-1-13-0	425.00	239.00	63.00	100.00	---	---
(155)	2-3-16-5-1-14-0	550.00	196.00	55.00	100.00	---	---
(156)	2-3-16-5-2-1-0	-190.00	5.00	0.00	0.00	---	---
(157)	2-3-16-5-2-2-0	-102.00	15.00	8.00	0.00	---	---
(158)	2-3-16-5-2-3-0	-70.00	32.00	19.00	20.00	---	---
(159)	2-3-16-5-2-4-0	-50.00	49.00	32.00	25.00	---	---
(160)	2-3-16-5-2-5-0	-30.00	95.00	67.00	40.00	---	---
(161)	2-3-16-5-2-17-0	-20.00	104.00	71.00	50.00	---	---
(162)	2-3-16-5-2-16-0	-20.00	61.00	46.00	35.00	---	---
(163)	2-3-16-5-2-15-0	-20.00	87.00	63.00	40.00	---	---
(164)	2-3-16-5-2-6-0	-10.00	131.00	74.00	70.00	---	---
(165)	2-3-16-5-2-7-0	10.00	167.00	87.00	99.00	---	---
(166)	2-3-16-5-2-8-0	30.00	145.00	90.00	85.00	---	---
(167)	2-3-16-5-2-9-0	50.00	160.00	87.00	99.00	---	---
(168)	2-3-16-5-2-10-0	90.00	162.00	92.00	100.00	---	---
(169)	2-3-16-5-2-11-0	150.00	164.00	84.00	100.00	---	---
(170)	2-3-16-5-2-12-0	300.00	238.00	69.00	100.00	---	---
(171)	2-3-16-5-2-13-0	425.00	225.00	77.00	90.00	---	---
(172)	2-3-16-5-2-14-0	550.00	219.00	64.00	100.00	---	---
(372)	3-3-12-5-3-2-0	-130.00	43.20	---	---	335.00	1.70E+05
(373)	3-3-12-5-3-5-0	-70.00	62.30	---	---	561.00	2.20E+05
(374)	3-3-12-5-3-4-0	-70.00	61.30	---	---	794.00	3.30E+05
(375)	3-3-12-5-3-7-0	-40.00	64.90	---	---	3324.00	4.70E+05
(376)	3-3-12-5-3-10-0	-10.00	---	231.90	230.90	4933.00	4.50E+05
(377)	3-3-12-5-3-9-0	-10.00	---	272.50	270.40	3077.00	1.70E+05
(378)	3-3-12-5-3-14-0	50.00	---	226.20	224.60	3420.00	3.60E+05
(379)	3-3-12-5-3-13-2	50.00	---	229.20	225.40	3190.00	4.00E+05
(380)	3-3-12-5-3-12-2	50.00	---	333.60	328.70	6552.00	4.10E+05
(381)	3-3-12-5-3-15-0	80.00	---	361.30	357.90	7455.00	3.80E+05
(382)	3-3-12-5-3-18-6	110.00	---	351.20	347.80	7009.00	6.90E+05
(383)	3-3-12-5-3-17-2	110.00	---	331.40	326.20	7588.00	5.00E+05
(384)	3-3-12-5-3-16-0	110.00	---	332.60	328.10	5882.00	4.70E+05
(385)	3-3-12-5-3-19-6	300.00	---	320.10	316.40	6336.00	8.10E+05
(386)	3-3-12-5-3-20-0	425.00	---	349.40	344.60	8682.00	4.90E+05
(387)	3-3-12-5-3-21-0	550.00	---	303.40	299.50	7171.00	4.30E+05
(388)	3-3-13-5-2-1-2	-160.00	40.00	---	---	432.00	1.60E+05
(389)	3-3-13-5-2-2-2	-130.00	41.40	---	---	297.00	2.00E+05
(390)	3-3-13-5-2-3-0	-100.00	48.90	---	---	754.00	2.30E+05
(391)	3-3-13-5-2-23-0	-70.00	46.00	---	---	1428.00	2.80E+05
(392)	3-3-13-5-2-6-0	-70.00	47.90	---	---	1298.00	3.40E+05
(393)	3-3-13-5-2-5-0	-70.00	49.80	---	---	1146.00	3.60E+05
(394)	3-3-13-5-2-7-0	-40.00	---	73.40	72.90	1813.00	4.40E+05
(395)	3-3-13-5-2-9-0	-10.00	---	121.50	119.60	4135.00	4.80E+05
(396)	3-3-13-5-2-8-2	-10.00	---	118.00	115.20	3284.00	4.30E+05
(397)	3-3-13-5-2-11-0	20.00	---	219.90	218.20	3719.00	4.90E+05

(398)	3-3-13-5-2-13-0	50.00	--	317.80	317.20	6667.00	3.60E+05
(399)	3-3-13-5-2-12-0	50.00	--	204.10	204.70	6122.00	4.00E+05
(400)	3-3-13-5-2-15-0	80.00	--	268.20	264.00	5773.00	4.50E+05
(401)	3-3-13-5-2-18-6	110.00	--	328.80	324.60	7318.00	8.60E+05
(402)	3-3-13-5-2-17-6	110.00	--	347.20	343.90	7260.00	6.60E+05
(403)	3-3-13-5-2-16-0	110.00	--	361.70	360.60	9504.00	3.00E+05
(404)	3-3-13-5-2-19-6	300.00	--	325.50	320.40	9380.00	7.30E+05
(405)	3-3-13-5-2-20-0	425.00	--	309.00	306.00	8081.00	2.00E+05
(406)	3-3-13-5-2-21-26	550.00	--	393.50	298.20	8437.00	3.80E+05
(407)	3-23-14-5-2-12-0	-150.00	35.70	--	--	158.00	1.90E+05
(408)	3-23-14-5-2-1-0	-130.00	40.30	--	--	352.00	2.00E+05
(409)	3-23-14-5-2-14-0	-130.00	43.90	--	--	308.00	2.20E+05
(410)	3-23-14-5-2-10-0	-100.00	42.60	--	--	492.00	2.10E+05
(411)	3-23-14-5-2-2-0	-70.00	39.70	--	--	940.00	2.80E+05
(412)	3-23-14-5-2-0-0	-70.00	42.90	--	--	960.00	2.40E+05
(413)	3-23-14-5-2-26-0	-40.00	46.30	--	--	1823.00	3.60E+05
(414)	3-23-14-5-2-6-0	-40.00	50.60	--	--	1309.00	3.50E+05
(415)	3-23-14-5-2-27-0	-10.00	56.30	--	--	2057.00	2.90E+05
(416)	3-23-14-5-2-21-0	-10.00	57.50	--	--	1892.00	4.10E+05
(417)	3-23-14-5-2-5-0	20.00	--	217.80	219.50	3730.00	3.00E+05
(418)	3-23-14-5-2-4-0	20.00	--	238.00	240.00	3273.00	3.00E+05
(419)	3-23-14-5-2-3-0	50.00	--	212.70	215.00	5165.00	3.30E+05
(420)	3-23-14-5-2-20-0	50.00	--	220.00	221.00	4308.00	3.70E+05
(421)	3-23-14-5-2-7-0	80.00	--	283.50	281.30	5595.00	3.50E+05
(422)	3-23-14-5-2-23-0	80.00	--	299.00	301.80	5760.00	3.00E+05
(423)	3-23-14-5-2-18-0	110.00	--	313.00	314.00	6308.00	3.10E+05
(424)	3-23-14-5-2-19-0	110.00	--	279.00	277.50	5526.00	3.50E+05
(425)	3-23-14-5-2-22-0	300.00	--	288.00	289.00	6640.00	3.20E+05
(426)	3-23-14-5-2-24-0	300.00	--	292.00	292.70	6575.00	2.90E+05
(427)	3-23-14-5-2-13-0	425.00	--	266.00	267.70	6316.00	3.00E+05
(428)	3-23-14-5-2-8-0	425.00	--	295.00	294.00	6390.00	3.00E+05
(429)	3-23-14-5-2-16-6	550.00	--	277.90	277.20	7792.00	2.80E+05
(430)	3-23-14-5-2-11-0	550.00	--	268.00	270.00	5556.00	3.40E+05
(431)	3-3-15-5-2-1-0	-150.00	30.40	--	--	319.00	1.60E+05
(432)	3-3-15-5-2-2-0	-120.00	40.50	--	--	444.00	1.70E+05
(433)	3-3-15-5-2-3-0	-90.00	39.70	--	--	565.00	1.90E+05
(434)	3-3-15-5-2-23-0	-60.00	51.40	--	--	1477.00	1.40E+05
(435)	3-3-15-5-2-4-0	-60.00	54.60	--	--	1353.00	2.90E+05
(436)	3-3-15-5-2-7-0	-30.00	60.00	--	--	2135.00	2.90E+05
(437)	3-3-15-5-2-10-0	0.00	--	227.50	224.50	4191.00	3.70E+05
(438)	3-3-15-5-2-9-0	0.00	--	132.80	131.30	3685.00	6.50E+05
(439)	3-3-15-5-2-8-2	0.00	--	205.10	201.10	3691.00	2.80E+05
(440)	3-3-15-5-2-11-0	30.00	--	297.70	297.00	6346.00	4.00E+05
(441)	3-3-15-5-2-14-0	60.00	--	296.20	292.20	6411.00	3.80E+05
(442)	3-3-15-5-2-13-0	60.00	--	334.90	331.60	6398.00	5.70E+05
(443)	3-3-15-5-2-12-0	60.00	--	358.00	354.40	8087.00	3.70E+05
(444)	3-3-15-5-2-15-0	90.00	--	354.70	352.30	7922.00	2.80E+05
(445)	3-3-15-5-2-18-6	120.00	--	367.60	365.10	10088.00	6.90E+05
(446)	3-3-15-5-2-17-0	120.00	--	340.00	336.50	9483.00	3.30E+05
(447)	3-3-15-5-2-16-6	120.00	--	342.60	340.00	8415.00	6.90E+05
(448)	3-3-15-5-2-22-0	300.00	--	334.20	331.40	10721.00	4.70E+05

(449)	3-3-15-5-2-20-0	425.00	--	357.30	352.40	9349.00	2.40E+05
(450)	3-3-15-5-2-21-0	550.00	--	313.00	303.60	10707.00	2.36E+05
(451)	3-3-16-5-2-1-0	-170.00	32.60	--	--	223.00	1.40E+05
(452)	3-3-16-5-2-2-0	-140.00	38.60	--	--	500.00	2.10E+05
(453)	3-3-16-5-2-3-0	-110.00	51.30	--	--	354.00	1.60E+05
(454)	3-3-16-5-2-4-0	-80.00	50.80	--	--	320.00	3.00E+05
(455)	3-3-16-5-2-5-0	-80.00	56.50	--	--	1307.00	3.00E+05
(456)	3-3-16-5-2-6-0	-50.00	70.70	--	--	1680.00	3.40E+05
(457)	3-3-16-5-2-8-2	-20.00	--	124.80	122.60	3354.00	5.20E+05
(458)	3-3-16-5-2-8-0	-20.00	--	125.40	123.20	2657.00	4.90E+05
(459)	3-3-16-5-2-11-0	10.00	--	241.00	236.10	4521.00	4.00E+05
(460)	3-3-16-5-2-14-0	40.00	--	301.40	296.60	6211.00	3.60E+05
(461)	3-3-16-5-2-13-2	40.00	--	303.00	300.90	6312.00	4.70E+05
(462)	3-3-16-5-2-12-0	40.00	--	294.30	289.80	6306.00	4.70E+05
(463)	3-3-16-5-2-15-0	70.00	--	309.20	305.80	7382.00	3.00E+05
(464)	3-3-16-5-2-16-0	100.00	--	363.90	358.20	9091.00	2.80E+05
(526)	5-3-12-5-3-11-1	-170.00	58.20	--	--	--	1.00
(527)	5-3-12-5-3-3-0	-70.00	--	140.60	131.90	--	1.30
(528)	5-3-12-5-3-24-4	-10.00	--	302.10	286.10	--	2.70
(529)	5-3-12-5-3-26-0	50.00	--	323.60	303.50	--	2.60
(530)	5-3-13-5-2-5-1	-145.00	81.00	--	--	--	1.10
(531)	5-3-13-5-2-2-0	-70.00	--	158.60	150.10	--	1.40
(532)	5-3-13-5-2-14-0	-10.00	--	314.60	297.00	--	2.30
(533)	5-3-13-5-2-16-0	50.00	--	423.40	402.90	--	2.60
(534)	5-3-13-5-2-15-0	50.00	--	438.50	414.60	--	3.50
(535)	5-3-14-5-2-4-0	-140.00	--	92.00	84.80	--	1.20
(536)	5-3-14-5-2-1-0	-70.00	--	162.00	153.30	--	1.40
(537)	5-3-14-5-2-11-0	-10.00	--	238.60	224.20	--	1.50
(538)	5-3-14-5-2-18-0	50.00	--	437.10	412.50	--	2.50
(539)	5-3-15-5-2-9-12	-145.00	75.20	--	--	--	1.20
(540)	5-3-15-5-2-1-0	-60.00	--	105.30	96.80	--	1.10
(541)	5-3-15-5-2-25-0	0.00	--	256.50	240.40	--	2.10
(542)	5-3-15-5-2-26-0	60.00	--	385.30	362.70	--	3.10
(543)	5-3-16-5-2-5-1	-170.00	81.00	--	--	--	1.00
(544)	5-3-16-5-2-9-0	-80.00	--	144.50	135.70	--	1.30
(545)	5-3-16-5-2-22-0	-20.00	--	187.30	176.10	--	1.60
(546)	5-3-16-5-2-3-0	40.00	--	433.70	408.10	--	3.40
(553)	7-3-14-5-2-1-1	-40.00	104.40	--	--	--	2005.00
(566)	11-3-13-5-2-2-0	75.00	--	495.00	449.90	--	5.40
(567)	11-3-13-5-2-1-0	75.00	--	474.40	423.90	--	5.10
(568)	11-3-14-5-2-2-0	75.00	--	432.00	390.10	--	4.60
(569)	11-3-15-5-2-2-0	75.00	--	483.00	435.00	--	5.00
(570)	11-3-16-5-2-1-0	75.00	--	445.00	400.00	--	4.70
(0)	3-3-16-5-2-17-0	100.00	--	354.70	350.60	9290.00	3.70E+05
(1)	3-3-16-5-2-18-0	100.00	--	333.40	330.00	8621.00	4.30E+05
(2)	3-3-16-5-2-19-0	300.00	--	336.80	332.00	9139.00	5.40E+05
(3)	3-3-16-5-2-20-0	425.00	--	321.90	317.00	9359.00	7.60E+05
(4)	3-3-16-5-2-21-0	550.00	--	296.00	292.10	8352.00	1.50E+05
(9)	7-3-12-5-3-1-0	-40.00	130.00	--	--	--	1200.00
(10)	7-3-15-5-2-1-0	-30.00	101.00	--	--	--	--
(15)	3-3-12-5-3-3-3	-100.00	26.30	--	--	364.00	1.40E+05
(16)	3-3-12-5-3-11-0	20.00	--	90.60	90.00	1036.00	5.60E+05

20	2-3-13-5-1-1-0	-190.00	4.00	0.00	0.00	---	---
21	2-3-13-5-1-2-0	-100.00	9.00	1.00	0.00	---	---
22	2-3-13-5-1-3-0	-60.00	19.00	10.00	15.00	---	---
23	2-3-13-5-1-4-0	-40.00	31.00	21.00	30.00	---	---
24	2-3-13-5-1-5-0	-20.00	74.00	51.00	40.00	---	---
25	2-3-13-5-1-6-0	0.00	100.00	60.00	60.00	---	---
26	2-3-13-5-1-7-0	20.00	68.00	51.00	55.00	---	---
27	2-3-13-5-1-8-0	40.00	125.00	75.00	80.00	---	---
28	2-3-13-5-1-9-0	60.00	134.00	83.00	99.00	---	---
29	2-3-13-5-1-10-0	100.00	135.00	82.00	99.00	---	---
30	2-3-13-5-1-11-0	160.00	138.00	86.00	99.00	---	---
31	2-3-13-5-1-12-0	300.00	165.00	83.00	99.00	---	---
32	2-3-13-5-1-13-0	425.00	238.00	72.00	100.00	---	---
33	2-3-13-5-1-14-0	550.00	209.00	64.00	100.00	---	---
34	2-3-13-5-2-1-0	-190.00	6.00	0.00	0.00	---	---
35	2-3-13-5-2-2-0	-100.00	8.00	2.00	0.00	---	---
36	2-3-13-5-2-3-0	-60.00	18.00	10.00	15.00	---	---
37	2-3-13-5-2-4-0	-40.00	24.00	16.00	30.00	---	---
38	2-3-13-5-2-5-0	-20.00	77.00	50.00	50.00	---	---
39	2-3-13-5-2-15-0	-10.00	66.00	46.00	40.00	---	---
40	2-3-13-5-2-16-0	-10.00	75.00	49.00	40.00	---	---
41	2-3-13-5-2-17-0	-10.00	126.00	80.00	75.00	---	---
42	2-3-13-5-2-6-0	0.00	106.00	62.00	85.00	---	---
43	2-3-13-5-2-7-0	20.00	80.00	56.00	60.00	---	---
44	2-3-13-5-2-8-0	40.00	136.00	84.00	85.00	---	---
45	2-3-13-5-2-9-0	60.00	178.00	86.00	99.00	---	---
46	2-3-13-5-2-10-0	100.00	152.00	86.00	99.00	---	---
47	2-3-13-5-2-11-0	160.00	145.00	87.00	100.00	---	---
48	2-3-13-5-2-12-0	300.00	181.00	83.00	99.00	---	---
49	2-3-13-5-2-13-0	425.00	152.00	81.00	99.00	---	---
50	2-3-13-5-2-14-0	550.00	155.00	74.00	100.00	---	---

APPENDIX 6

MATERIAL 6

MANUAL METAL ARC WELDMENT IN A508-2 BASE METAL

MATERIAL TYPE 6
MMA WELD IN A508-2

INTRODUCTION

Five heats of manual metal arc welded A508-2, (heats A-D and K) were studied by Babcock and Wilcox. A description of each heat is given in Table 6.1. The results are encoded in the data bank extract shown at the end of this section. A complete description of the test program performed on material 6 is given in reference 11.

TENSILE TESTS RESULTS

The 1.25-in. gage section tensile test results on the MMA weld in A508-2 are shown graphically in Figures 6.1 to 6.5. Cubic polynomial equations were fitted to the data. The statistical data and curve fit coefficients are summarized in Table 6.2. Heat K (11) had generally lower yield and ultimate tensile strengths than the other heats.

CHARPY V-NOTCH RESULTS

Impact Energy

The impact energy results for material 6 are shown graphically in Figures 6.6 to 6.15. A tanh curve was fitted to each set of data; the coefficients and statistics are summarized in Table 6.3. Each quantity shown in Table 6.3 was examined separately. The results are shown in Table 6.4. The EPRI test matrix required the determination of the Charpy V-notch properties of the base metal and heat affected zone associated with each weld. The A508-2 base metal was characterized as material 2. The properties of the HAZ material are included here.

The HAZ material for heat C (data set 22363) had an abnormally high variance in the transition temperature range. This high variance was due to the odd behavior of this material in the upper shelf region. The fitted curve passed through the center of the shelf data, at a position in good

agreement with the other curves. However, other points scattered in a range of about ± 60 ft-lb about this level. One high point was included in the end portion of the transition range. The A and B values for HAZ material heat K (221163) were abnormal as indicated in Figure 6.15. Heat B HAZ material (22263) had a significantly higher T_0 than the mean value.

Lateral Expansion

The data were analyzed as described above. The statistics are summarized in Tables 6.5 and 6.6, and the data are shown graphically in Figures 6.16 to 6.25. The main feature of note is the high A value for data set 221163 (HAZ for heat K), indicating (since B was in line with the other heats) that the lower shelf, $A - B$, was high. As before, the T_0 value for heat B, HAZ (data set 22263) was appreciably higher than the other heats.

Percent Shear

The percent shear results are shown in Figures 6.26 to 6.35. The data are summarized as before in Tables 6.7 and 6.8. The lower shelf was high (high A value and low B), again due to the paucity of data points, for heat K HAZ (data set 221163). The only other noteworthy feature was the unusual property scatter of heat C HAZ (data set 22363), as shown by the exceptionally high variance value, Table 6.8.

Summary of Charpy Impact Test Data

The ductile-brittle transition temperature estimated from the Charpy V-notch curves, $T_0 - C$, is shown compared to RT_{NDT} and $NDTT$ in Table 6.9. There is reasonable agreement between the percent shear values and RT_{NDT} .

INSTRUMENTED PRECRACKED CHARPY RESULTS

Dynamic Fracture Toughness, K_{Id} , K_d^*

The elastic and elastic-plastic fracture toughness results for material 6 are shown in Figures 6.36 to 6.40. The properties of the curves are summarized in Table 6.10, and analyzed in detail in Table 6.11. None of the heats were significantly different from the others.

Normalized Energy, W/A

The W/A results are shown in Figures 6.41 to 6.45. The curve-fit statistics are summarized in Tables 6.12 and 6.13. As for the K values, none of the data sets differed significantly from the mean for all of the heats.

Summary of Precracked Charpy Results

Table 6.14 shows the $T_0 - C$ values for the fracture toughness and the W/A curves, compared to RT_{NDT} and NDTT. In contrast to the percent shear data, there was poor correlation. The $T_0 - C$ results for W/A were in slightly better agreement with RT_{NDT} and NDTT than those for K.

The instrumented precracked Charpy data are summarized in Figures 6.46 and 6.47. The fracture toughness results are compared to the K_{IR} curve in Figure 6.46. There were some points below the K_{IR} curve in the lower shelf region, but in the transition range the data were well above K_{IR} . The W/A data are shown in Figure 6.47.

STATIC AND DYNAMIC COMPACT FRACTURE TOUGHNESS RESULTS

The static one-inch compact data (test type 5) and the dynamic one-inch and four-inch compact data (test types 8 and 7, respectively) are shown in Figures 6.48 to 6.52. The large dynamic compact specimen for heat D was three inches thick (test type 10) rather than four inches. As before the data is shown without a tanh curve fit due to the limited data for each heat. The static test data are summarized in Figure 6.53, and the dynamic compact data are summarized in Figure 6.54. Note the one point to the right of the K_{IR} curve in Figure 6.54.

EFFECT OF ERROR CODES

The static and dynamic fracture toughness results for material 6 were statistically analyzed with and without the data points which did not meet the EPRI procedures. Tanh curve fits to the total data and acceptable data only are shown in Figures 6.55 to 6.58. The influence of the error code

data on shelf properties and variance was determined. Both the overall variance and the variance in the transition temperature region ($T_0 \pm 50^\circ\text{F}$) were compared. A summary of the error code analysis is given in Table 6.15. The variance ratio (F) was calculated for the static and dynamic fracture toughness results. The ratios shown in Table 6.15 had a high probability of occurring by chance, and it is concluded that the effect of the error codes on the data was not significant.

Table 6.1. Summary of MMA Weld Materials in A508-2 (Material 6)

<u>TEST LABORATORY</u>	<u>HEAT CODE</u>	<u>WELDING CONDITIONS</u>	<u>NDTT (°F)</u>	<u>RT_{NDT} (°F)</u>	<u>COMMENTS</u>
B & W	A (1)	(Ref. 11)	-100	-100	E8015-C3 Electrode
	B (2)		-40	-40	E8018-C3 "
	C (3)		-80	-80	E8015-C3 "
	D (4)		-90	-90	E8018-C3 "
	K (11)		-80	-80	E8015-C3 "

Table 6.2. Summary of the Regression Analysis of the Tensile Test Data (MMA Weld, A508-2)

Property	A	B	C	D	Variance, σ^2	Degrees of Freedom σ	Standard Deviation σ
Yield Stress	7.938X10	-6.512X10 ⁻²	1.74 X10 ⁻⁴	-1.932X10 ⁻⁷	26.73	26	5.45
Ultimate Tensile Stress	9.284X10	-6.67 X10 ⁻²	1.119X10 ⁻⁴	-4.739X10 ⁻⁸	35.49	26	5.96
Uniform Elongation	1.367X10	-1.457X10 ⁻²	-9.151X10 ⁻⁶	4.391X10 ⁻⁸	1.30	26	1.14
Reduction In Area	2.81 X10	-1.363X10 ⁻²	-1.055X10 ⁻⁵	3.261X10 ⁻⁸	2.22	26	1.49

Table 6.3. Tanh Fit Parameters for Charpy Impact Energy Data (MMA, HAZ, A508-2)

KEY	J	A	B	T0	C	PHI	VAR
22162	2	67.93	66.03	-33.56	84.98	6	93.18
22163	2	76.98	76.98	-26.36	89.53	2	61.58
22262	2	68.85	68.44	-21.60	61.87	5	301.92
22263	2	62.01	58.64	55.79	77.02	2	44.32
22362	2	75.22	75.22	-34.57	92.63	6	98.94
22363	2	65.13	63.70	-90.00	43.99	3	1898.07
22462	2	65.65	65.65	-24.32	57.36	5	335.01
22463	2	78.13	74.37	-77.70	78.32	2	741.56
221162	2	71.44	71.37	-24.88	97.76	5	129.47
221163	2	97.59	43.80	1.10	24.00	2	478.25

Table 6.4. Deviation of Charpy Impact Energy Curve Fit Parameters from Mean Values (MMA, HAZ, A508-2)

A

TOTAL 728.93
 MEAN 72.893
 ST. DEV 10.18571882

KEY	VAL	DEV	NORMALIZED DEV
22162	67.93	-4.96	-0.49
22163	76.98	4.09	0.40
22262	68.85	-4.04	-0.40
22263	62.01	-10.88	-1.07
22362	75.22	2.33	0.23
22363	65.13	-7.76	-0.76
22462	65.65	-7.24	-0.71
22463	78.13	5.24	0.51
221162	71.44	-1.45	-0.14
221163	97.59	24.70	2.42

Table 6.4. (continued)

B

TOTAL	664.2
MEAN	66.42
ST. DEV	9.781360960

KEY	VAL	DEV	NORMALIZED DEV
22162	66.03	-0.39	-0.04
22163	76.98	10.56	1.08
22262	68.44	2.02	0.21
22263	58.64	-7.78	-0.80
22362	75.22	8.80	0.90
22363	63.70	-2.72	-0.28
22462	65.65	-0.77	-0.08
22463	74.37	7.95	0.81
221162	71.37	4.95	0.51
1163	43.80	-22.62	-2.31

T₀

TOTAL	-276.1
MEAN	-27.61
ST. DEV	39.89033300

KEY	VAL	DEV	NORMALIZED DEV
22162	-33.56	-5.95	-0.15
22163	-26.36	1.25	0.03
22262	-21.60	6.01	0.15
22263	55.79	83.40	2.09
22362	-34.57	-6.96	-0.17
22363	-90.00	-62.39	-1.56
22462	-24.32	3.29	0.08
22463	-77.70	-50.09	-1.26
221162	-24.88	2.73	0.07
221163	1.10	28.71	0.72

Table 6.4. (continued)

C

TOTAL 707.46
 MEAN 70.746
 ST. DEV 23.61703726

KEY	VAL	DEV	NORMALIZED DEV
22162	84.98	14.23	0.60
22163	89.53	18.78	0.80
22262	61.87	-8.88	-0.38
22263	77.02	6.27	0.27
22362	92.63	21.88	0.93
22363	43.99	-26.76	-1.13
22462	57.36	-13.39	-0.57
22463	78.32	7.57	0.32
221162	97.76	27.01	1.14
221163	24.00	-46.75	-1.98

PHI

TOTAL 38
 MEAN 3.8
 ST. DEV 1.751190072

KEY	VAL	DEV	NORMALIZED DEV
22162	6.00	2.20	1.26
22163	2.00	-1.80	-1.03
22262	5.00	1.20	0.69
22263	2.00	-1.80	-1.03
22362	6.00	2.20	1.26
22363	3.00	-0.80	-0.46
22462	5.00	1.20	0.69
22463	2.00	-1.80	-1.03
221162	5.00	1.20	0.69
221163	2.00	-1.80	-1.03

Table 6.4. (continued)

<u>VARIANCE</u>			
TOTAL	4182.3		
MEAN	418.23		
ST. DEV	565.3434113		
KEY	VAL	DEV	NORMALIZED DEV
22162	93.18	-325.05	-0.57
22163	61.58	-356.65	-0.63
22262	301.92	-116.31	-0.21
22263	44.32	-373.91	-0.66
22362	98.94	-319.29	-0.56
22363	1898.07	1479.84	2.62
22462	335.01	-83.22	-0.15
22463	741.56	323.33	0.57
221162	129.47	-288.76	-0.51
221163	478.25	60.02	0.11

Table 6.5. Tanh Fit Parameters for Charpy Impact Lateral Expansion Data (MMA, HAZ, A508-2)

KEY	J	A	B	T0	C	PHI	VAR
22162	3	44.71	44.71	-55.39	87.74	6	51.51
22163	3	46.31	41.84	-40.05	40.20	2	123.12
22262	3	48.23	45.73	-21.02	49.63	5	173.49
22263	3	46.58	43.70	41.39	79.26	2	48.96
22362	3	46.00	40.51	-50.06	49.48	6	83.95
22363	3	41.44	37.55	-84.61	33.16	3	180.76
22462	3	46.43	42.43	-29.49	33.70	5	154.45
22463	3	40.09	40.09	-122.00	68.33	2	238.24
221162	3	50.33	37.01	-41.67	44.14	5	40.72
221163	3	55.09	35.21	-80.17	88.00	2	81.67

Table 6.6. Deviation of Charpy Impact Lateral Expansion Curve Fit Parameters
From Mean Values (MMA, HAZ, A508-2)

A

TOTAL	465.21
MEAN	46.521
ST. DEV	4.237906847

KEY	VAL	DEV	NORMALIZED DEV
22162	44.71	-1.81	-0.43
22163	46.31	-0.21	-0.05
22262	48.23	1.71	0.40
22263	46.58	0.06	0.01
22362	46.00	-0.52	-0.12
22363	41.44	-5.08	-1.20
22462	46.43	-0.09	-0.02
22463	40.09	-6.43	-1.52
221162	50.33	3.81	0.90
221163	55.09	8.57	2.02

B

TOTAL	408.78
MEAN	40.878
ST. DEV	3.471207923

KEY	VAL	DEV	NORMALIZED DEV
22162	44.71	3.83	1.10
22163	41.84	0.96	0.28
22262	45.73	4.85	1.40
22263	43.70	2.82	0.81
22362	40.51	-0.37	-0.11
22363	37.55	-3.33	-0.96
22462	42.43	1.55	0.45
22463	40.09	-0.79	-0.23
221162	37.01	-3.87	-1.11
221163	35.21	-5.67	-1.63

Table 6.6. (continued)

T₀

TOTAL -483.07
 MEAN -48.307
 ST. DEV 43.55519896

KEY	VAL	DEV	NORMALIZED DEV
22162	-55.39	-7.08	-0.16
22163	-40.05	8.26	0.19
22262	-21.02	27.29	0.63
22263	41.39	89.70	2.06
22362	-50.06	-1.75	-0.04
22363	-84.61	-36.30	-0.83
22462	-29.49	18.82	0.43
22463	-122.00	-73.69	-1.69
221162	-41.67	6.64	0.15
221163	-80.17	-31.86	-0.73

C

TOTAL 573.64
 MEAN 57.364
 ST. DEV 21.59789506

KEY	VAL	DEV	NORMALIZED DEV
22162	87.74	30.38	1.41
22163	40.20	-17.16	-0.79
22262	49.63	-7.73	-0.36
22263	79.26	21.90	1.01
22362	49.48	-7.88	-0.37
22363	33.16	-24.20	-1.12
22462	33.70	-23.66	-1.10
22463	68.33	10.97	0.51
221162	44.14	-13.22	-0.61
221163	88.00	30.64	1.42

Table 6.6. (continued)

PHI

TOTAL	38
MEAN	3.8
ST. DEV	1.751190072

KEY	VAL	DEV	NORMALIZED DEV
22162	6.00	2.20	1.26
22163	2.00	-1.80	-1.03
22262	5.00	1.20	0.69
22263	2.00	-1.80	-1.03
22362	6.00	2.20	1.26
22363	3.00	-0.80	-0.46
22462	5.00	1.20	0.69
22463	2.00	-1.80	-1.03
221162	5.00	1.20	0.69
221163	2.00	-1.80	-1.03

VARIANCE

TOTAL	1176.84
MEAN	117.684
ST. DEV	67.05925111

KEY	VAL	DEV	NORMALIZED DEV
22162	51.51	-66.17	-0.99
22163	123.12	5.44	0.08
22262	173.49	55.81	0.83
22263	48.93	-68.75	-1.03
22362	83.95	-33.73	-0.50
22363	180.76	63.08	0.94
22462	154.45	36.77	0.55
22463	238.24	120.56	1.80
221162	40.72	-76.96	-1.15
221163	81.67	-36.01	-0.54

Table 6.7. Tanh Fit Parameters for Charpy Impact Percent Shear Data
(MMA, HAZ, A508-2)

KEY	J	A	B	T0	C	PHI	VAR
22162	4	50.98	47.63	-33.30	38.43	6	98.60
22163	4	55.26	49.27	70.21	110.01	2	21.35
22262	4	51.98	47.73	11.30	46.96	4	111.83
22263	4	50.60	49.31	63.22	74.01	2	93.27
22362	4	53.37	46.33	-36.19	41.63	6	39.48
22363	4	45.47	41.76	-77.60	37.28	3	408.22
22462	4	50.58	44.91	-25.75	24.02	5	145.32
22463	4	49.18	49.18	-75.70	101.40	2	188.18
221162	4	52.59	43.75	-33.13	24.75	5	171.20
221163	4	61.77	37.51	-30.50	35.71	2	7.30

Table 6.8. Deviation of Charpy Impact Percent Shear Curve Fit Parameters
From Mean Values (MMA, HAZ, A508-2)

<u>A</u>			
TOTAL	521.78		
MEAN	52.178		
ST. DEV	4.263529576.		
KEY	VAL	DEV	NORMALIZED DEV
22162	50.98	-1.20	-0.28
22163	55.26	3.08	0.72
22262	51.98	-0.20	-0.05
22263	50.60	-1.58	-0.37
22362	53.37	1.19	0.28
22363	45.47	-6.71	-1.57
22462	50.58	-1.60	-0.37
22463	49.18	-3.00	-0.70
221162	52.59	0.41	0.10
221163	61.77	9.59	2.25

Table 6.8. (continued)

B

TOTAL	457.38
MEAN	45.738
ST. DEV	3.846238567

KEY	VAL	DEV	NORMALIZED DEV
22162	47.63	1.89	0.49
22163	49.27	3.53	0.92
22262	47.73	1.99	0.52
22263	49.31	3.57	0.93
22362	46.33	0.59	0.15
22363	41.76	-3.98	-1.03
22462	44.91	-0.83	-0.22
22463	49.18	3.44	0.89
221162	43.75	-1.99	-0.52
221163	37.51	-8.23	-2.14

T₀

TOTAL	-167.44
MEAN	-16.744
ST. DEV	50.67549555

KEY	VAL	DEV	NORMALIZED DEV
22162	-33.30	-16.56	-0.33
22163	70.21	86.95	1.72
22262	11.30	28.04	0.55
22263	63.22	79.96	1.58
22362	-36.19	-19.45	-0.38
22363	-77.60	-60.86	-1.20
22462	-25.75	-9.01	-0.18
22463	-75.70	-58.96	-1.16
221162	-33.13	-16.39	-0.32
221163	-30.50	-13.76	-0.27

Table 6.8. (continued)

C

TOTAL	534.2
MEAN	53.42
ST. DEV	30.90193270

KEY	VAL	DEV	NORMALIZED DEV
22162	38.43	-14.99	-0.49
22163	110.01	56.59	1.83
22262	46.96	-6.46	-0.21
22263	74.01	20.59	0.67
22362	41.63	-11.79	-0.38
22363	37.28	-16.14	-0.52
22462	24.02	-29.40	-0.95
22463	101.40	47.98	1.55
221162	24.75	-28.67	-0.93
221163	35.71	-17.71	-0.57

PHI

TOTAL	37
MEAN	3.7
ST. DEV	1.702938637

KEY	VAL	DEV	NORMALIZED DEV
22162	6.00	2.30	1.35
22163	2.00	-1.70	-1.00
22262	4.00	0.30	0.18
22263	2.00	-1.70	-1.00
22362	6.00	2.30	1.35
22363	3.00	-0.70	-0.41
22462	5.00	1.30	0.76
22463	2.00	-1.70	-1.00
221162	5.00	1.30	0.76
221163	2.00	-1.70	-1.00

Table 6.8. (continued)

<u>VARIANCE</u>			
TOTAL	1284.75		
MEAN	128.475		
ST. DEV	115.6716385		
KEY	VAL	DEV	NORMALIZED DEV
22162	98.60	-29.88	-0.26
22163	21.35	-107.13	-0.93
22262	111.83	-16.65	-0.14
22263	93.27	-35.21	-0.30
22362	39.48	-89.00	-0.77
22363	408.22	279.75	2.42
22462	145.32	16.85	0.15
22463	138.18	59.71	0.52
221162	171.20	42.73	0.37
221163	7.30	-121.18	-1.05

Table 6.9. Comparison of $T_0 - C$ from Impact Test Measurements with RT_{NDT} and $NDTT_0$ (MMA, HAZ. A508-2)

KEY	$T_0 - C (^{\circ}F)$			$RT_{NDT} (^{\circ}F)$	$NDTT (^{\circ}F)$
	IMPACT ENERGY	LATERAL EXPANSION	PERCENT SHEAR		
22162	-119	-143	-72	-100	-100
22163	-116	-80	-40		
22262	-83	-71	-36	-40	-40
22263	-21	-38	-11		
22362	-127	-100	-78	-80	-80
22363	-134	-118	-115		
22462	-82	-63	-50	-60	-90
22463	-156	-190	-177		
221162	-123	-86	-66	-80	-80
221163	-23	-168	-54		

Table 6.10. Tanh Fit Parameters for Precracked Charpy Toughness Data
(MMA, HAZ, A508-2)

KEY	J	A	B	T0	C	PHI	VAR
32162	2	141.63	99.60	-58.02	14.77	6	1497.94
32262	2	161.44	114.15	46.53	13.63	5	221.66
32362	2	175.62	140.18	5.26	51.61	5	2897.71
32462	2	150.84	109.50	2.97	29.81	5	3457.61
321162	2	146.23	101.01	-33.86	10.78	6	1120.80

Table 6.11. Deviation of Precracked Charpy Fracture Toughness Curve Fit Parameters
From Mean Values (MMA, A508-2)

A

TOTAL 775.76
MEAN 155.152
ST. DEV 13.59703902

KEY	VAL	DEV	NORMALIZED DEV
32162	141.63	-13.52	-0.99
32262	161.44	6.29	0.46
32362	175.62	20.47	1.51
32462	150.84	-4.31	-0.32
321162	146.23	-8.92	-0.66

B

TOTAL 564.44
MEAN 112.888
ST. DEV 16.39803555

KEY	VAL	DEV	NORMALIZED DEV
32162	99.60	-13.29	-0.81
32262	114.15	1.26	0.08
32362	140.18	27.29	1.66
32462	109.50	-3.39	-0.21
321162	101.01	-11.88	-0.72

Table 6.11 (continued)

T₀

TOTAL	-37.12
MEAN	-7.424
ST. DEV	40.12097494

KEY	VAL	DEV	NORMALIZED DEV
32162	-58.02	-50.60	-1.26
32262	46.53	53.95	1.34
32362	5.26	12.68	0.32
32462	2.97	10.39	0.26
321162	-33.86	-26.44	-0.66

C

TOTAL	120.6
MEAN	24.12
ST. DEV	17.05501686

KEY	VAL	DEV	NORMALIZED DEV
32162	14.77	-9.35	-0.55
32262	13.63	-10.49	-0.62
32362	51.61	27.49	1.61
32462	29.81	5.69	0.33
321162	10.78	-13.34	-0.78

Table 6.11 (continued)

PHI

TOTAL	27
MEAN	5.4
ST. DEV	0.547722558

KEY	VAL	DEV	NORMALIZED DEV
32162	6.00	0.60	1.10
32262	5.00	-0.40	-0.73
32362	5.00	-0.40	-0.73
32462	5.00	-0.40	-0.73
31162	6.00	0.60	1.10

VARIANCE

TOTAL	9195.74
MEAN	1839.148
ST. DEV	1321.80012

KEY	VAL	DEV	NORMALIZED DEV
32162	1497.94	-341.21	-0.26
32262	221.68	-1617.47	-1.22
32362	2897.71	1058.56	0.80
32462	3457.61	1618.46	1.22
321162	1120.80	-718.35	-0.54

Table 6.12. Tanh Fit Parameters for Precracked Charpy W/A Data (MMA, A508-2)

KEY	J	A	B	T0	C	PHI	VAR
32162	5	3355.27	2771.60	-30.82	40.07	4	89484.10
32262	5	4026.65	3378.72	33.95	49.13	6	2.84E+05
32362	5	3366.52	3181.42	-66.26	19.69	6	5.75E+05
32462	5	4037.37	4018.45	21.97	92.92	4	25039.80
321162	5	3422.42	3422.42	-19.53	102.55	4	1.99E+05

Table 6.13. Deviation of Precracked Charpy W/A Curve Fit Parameters From Mean Values (MMA A508-2)

A

TOTAL 18208.28
 MEAN 3641.646
 ST. DEV 357.2782993

KEY	VAL	DEV	NORMALIZED DEV
32162	3355.27	-286.38	-0.80
32262	4026.65	385.00	1.08
32362	3366.52	-275.13	-0.77
32462	4037.37	395.72	1.11
321162	3422.42	-219.23	-0.61

B

TOTAL 16772.61
 MEAN 3354.522
 ST. DEV 451.5967314

KEY	VAL	DEV	NORMALIZED DEV
32162	2771.60	-582.92	-1.29
32262	3378.72	24.20	0.05
32362	3181.42	-173.10	-0.38
32462	4018.45	663.93	1.47
321162	3422.42	67.90	0.15

Table 6.13. (continued)

T₀

TOTAL	-60.69
MEAN	-12.138
ST. DEV	40.68264089

KEY	VAL	DEV	NORMALIZED DEV
32162	-30.82	-18.68	-0.46
32262	33.95	46.09	1.13
32362	-66.26	-54.12	-1.33
32462	21.97	34.11	0.84
321162	-19.53	-7.39	-0.18

C

TOTAL	304.36
MEAN	60.872
ST. DEV	35.46366056

KEY	VAL	DEV	NORMALIZED DEV
32162	40.07	-20.80	-0.59
32262	49.13	-11.74	-0.33
32362	19.69	-41.18	-1.16
32462	92.92	32.05	0.90
321162	102.55	41.68	1.18

Table 6.13. (continued)

PHI

TOTAL	24
MEAN	4.8
ST. DEV	1.095445115

KEY	VAL	DEV	NORMALIZED DEV
32162	4.00	-0.80	-0.73
32262	6.00	1.20	1.10
32362	6.00	1.20	1.10
32462	4.00	-0.80	-0.73
321162	4.00	-0.80	-0.73

VARIANCE

TOTAL	1171800.9
MEAN	234360.18
ST. DEV	214772.5023

KEY	VAL	DEV	NORMALIZED DEV
32162	89484.10	-1.45E+05	-0.67
32262	2.84E+05	49412.82	0.23
32362	5.75E+05	3.41E+05	1.59
32462	25039.80	-2.09E+05	-0.97
321162	1.99E+05	-35779.18	-0.17

Table 6.14. Comparison of Precracked Charpy Transition Behavior with NDTT and RT_{NDT} (MMA, HAZ, A508-2)

KEY	$T_0 - C (^{\circ}F)$		$RT_{NDT} (^{\circ}F)$	NDTT ($^{\circ}F$)
	K_{Id}, K_d^*	W/A		
32162	-73	-71	-100	-100
32262	33	-15	-40	-70
32362	-46	-86	-80	-80
32462	-27	-71	-60	-90
321162	-45	-122	-80	-80

Table 6.15. Summary of Error Code Analysis for Material 6 (MMA, A508-2)

<u>TEST TYPE</u>	<u>INCLUDES ERROR CODES</u>	<u>NO. OF POINTS</u>	<u>SHELF(Ft-Lb)</u>		<u>OVERALL</u>	<u>VARIANCE TRANSITION REGION</u>		<u>VARIANCE RATIO F</u>	
			<u>LOWER</u>	<u>UPPER</u>				<u>OVERALL</u>	<u>TRANSITION REGION</u>
Static (5)	Yes	25	67	306	3503	6235		0.987	1.163
	No	17	48	312	3548	5361			
Dynamic (7,8,10)	Yes	30	59	258	3818	3750		1.450	1.383
	No	25	13	320	2634	2712			

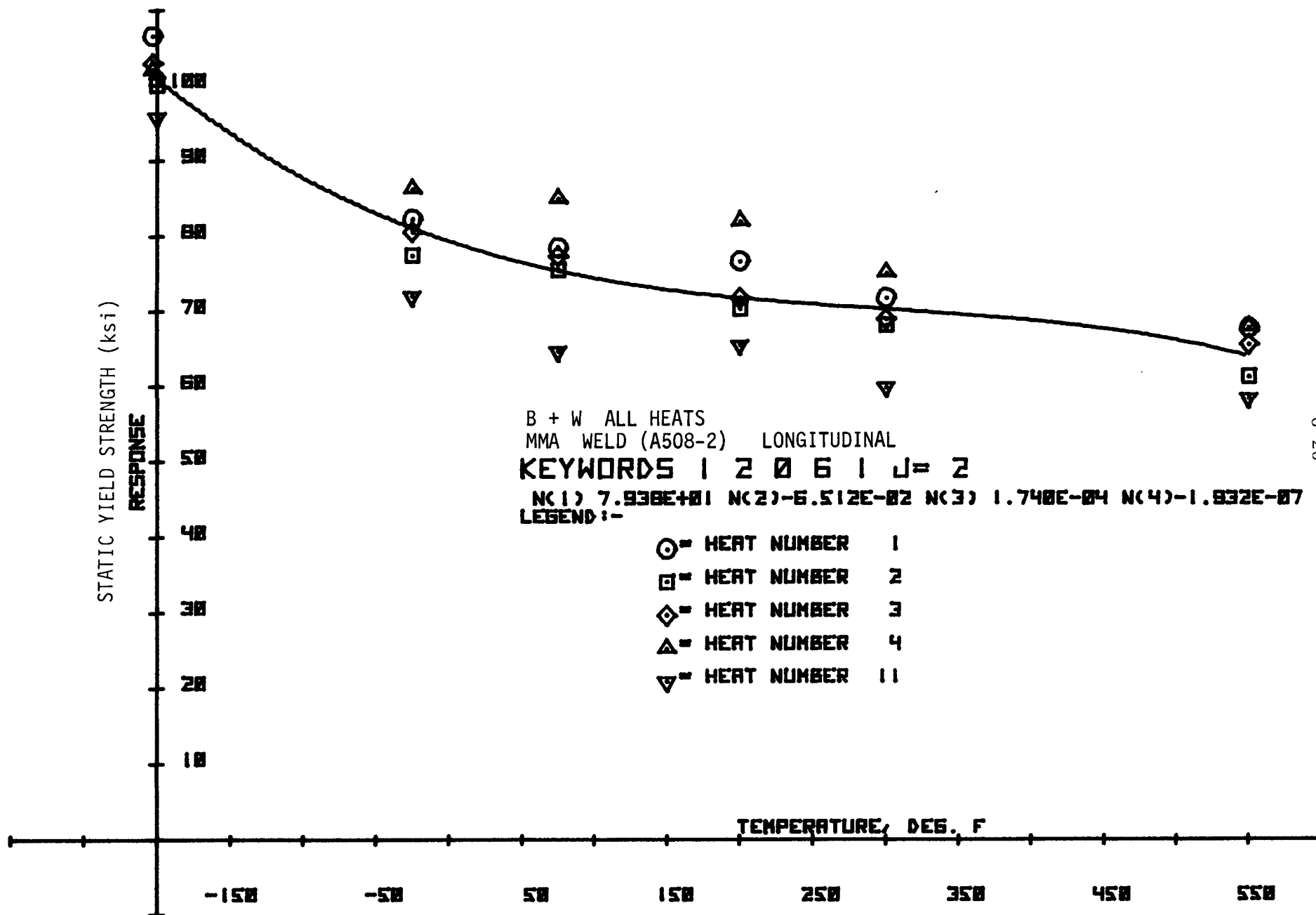


Figure 6.1. Tensile Static Yield Strength for All B&W Heats (L)

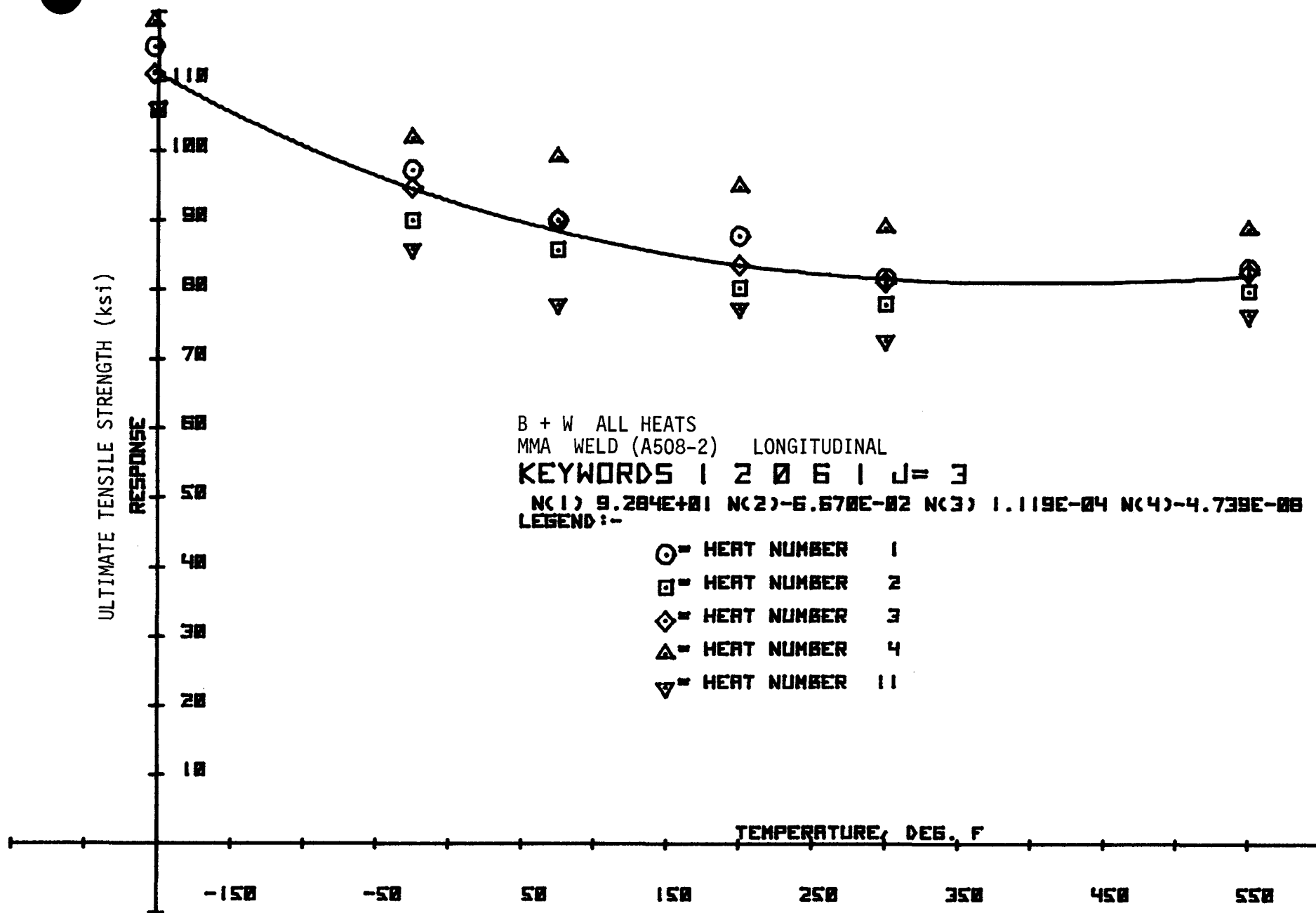
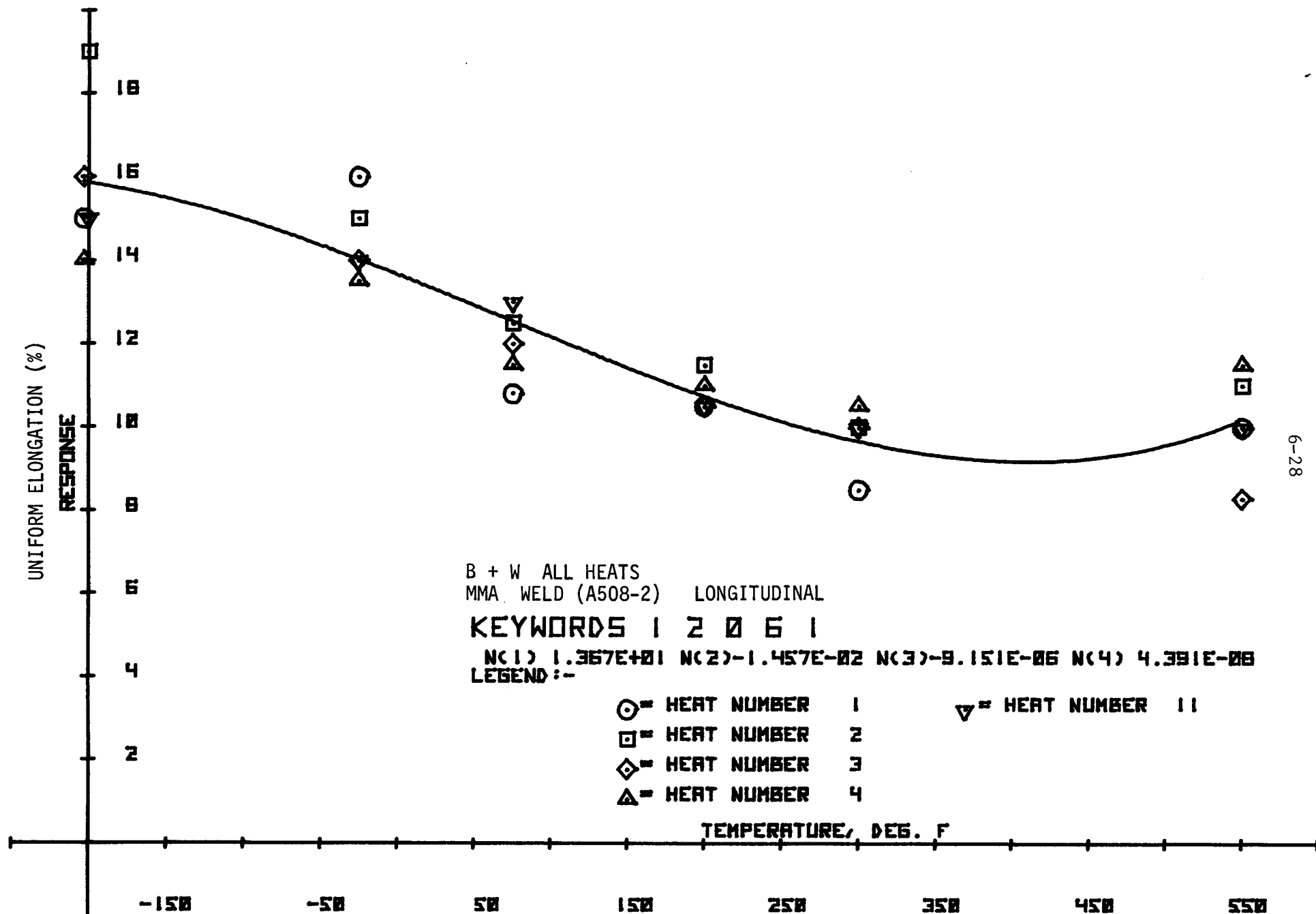


Figure 6.2. Tensile Ultimate Strength for All B&W Heats (L)



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Figure 6.3. Tensile Uniform Elongation for All B&W Heats (L)

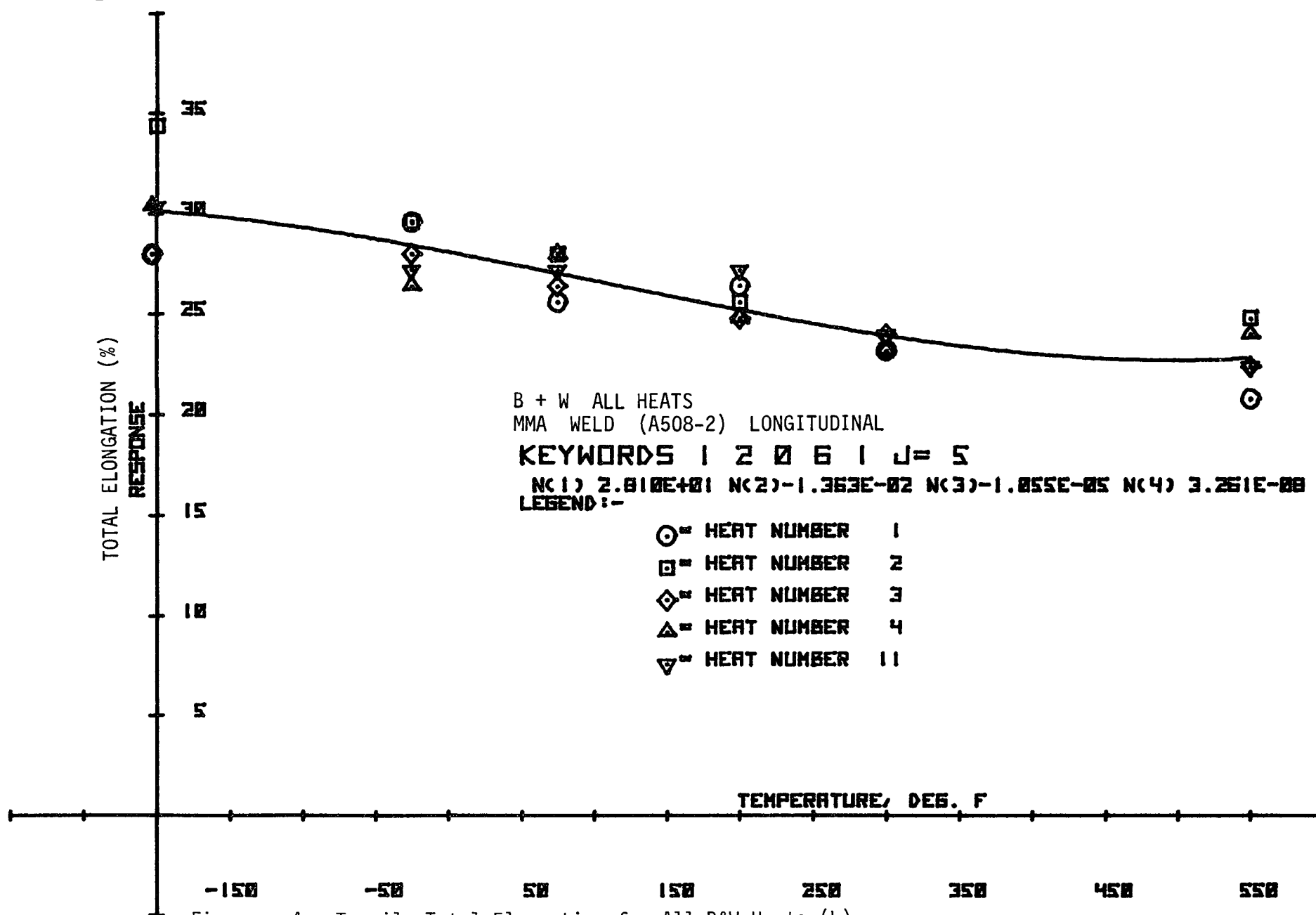


Figure 6.4. Tensile Total Elongation for All B&W Heats (L)

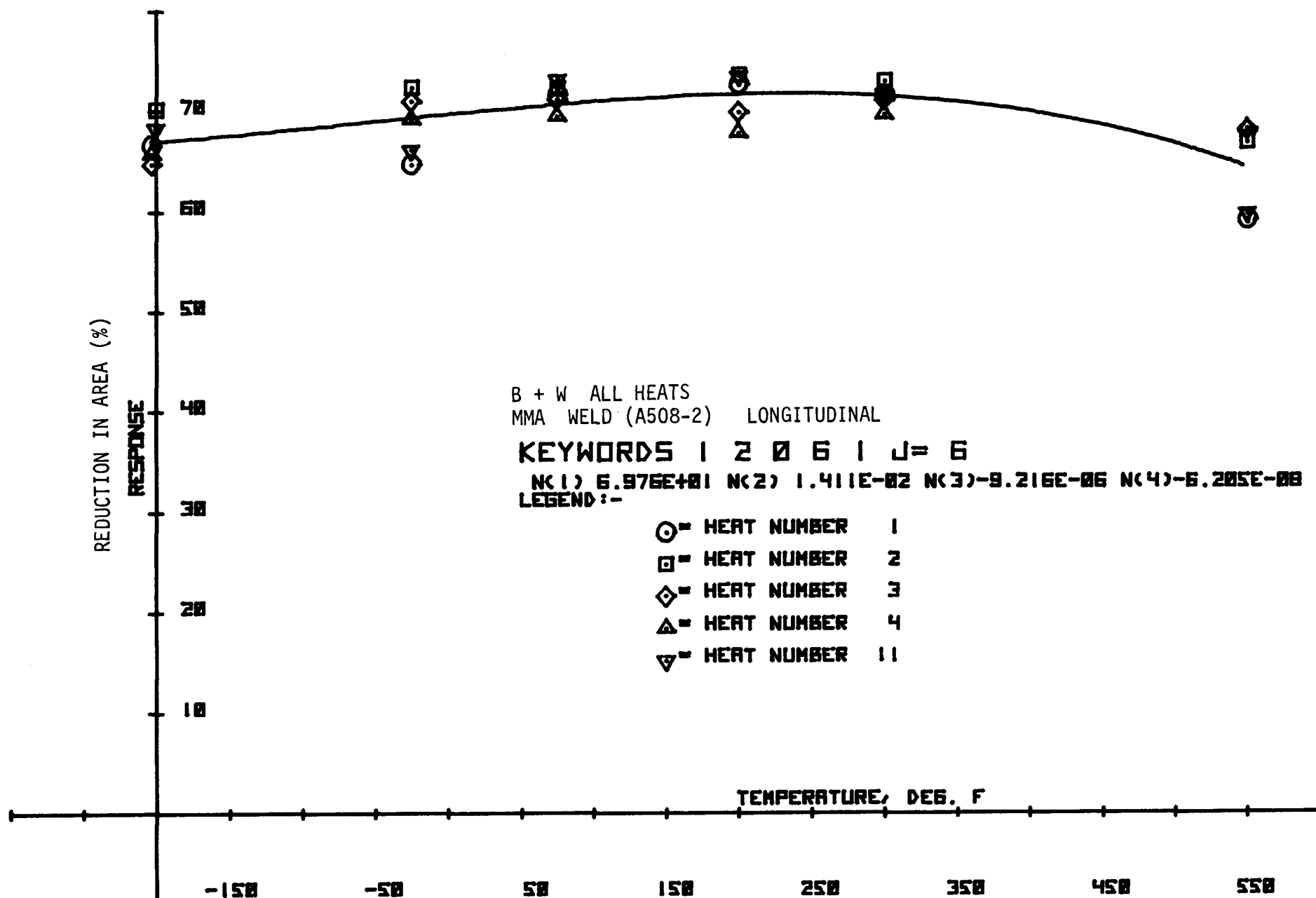


Figure 6.5. Tensile Reduction in Area for All B&W Heats (L)

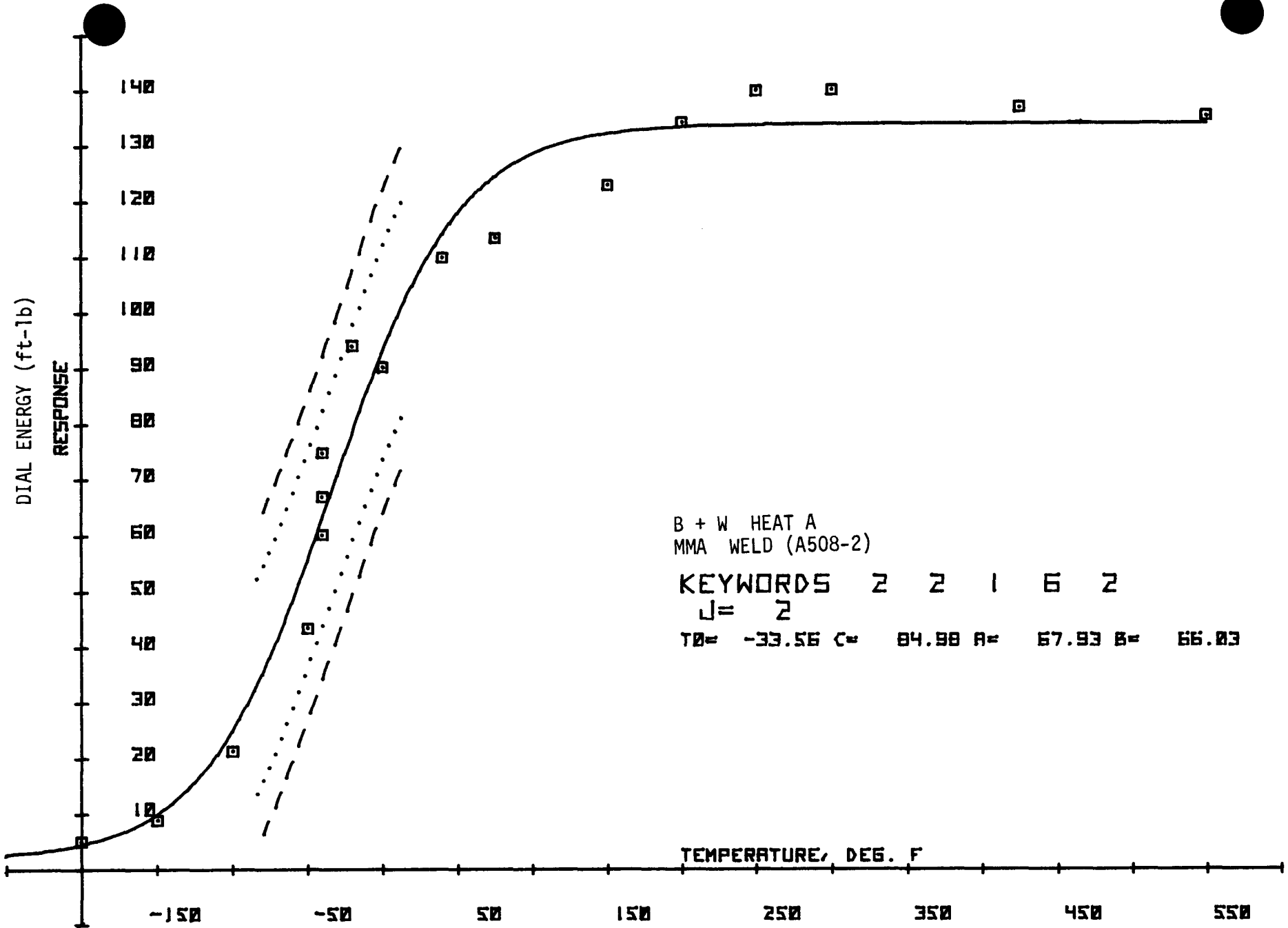


Figure 6.6. Charpy V-Notch Dial Energy for B&W Heat A (T)

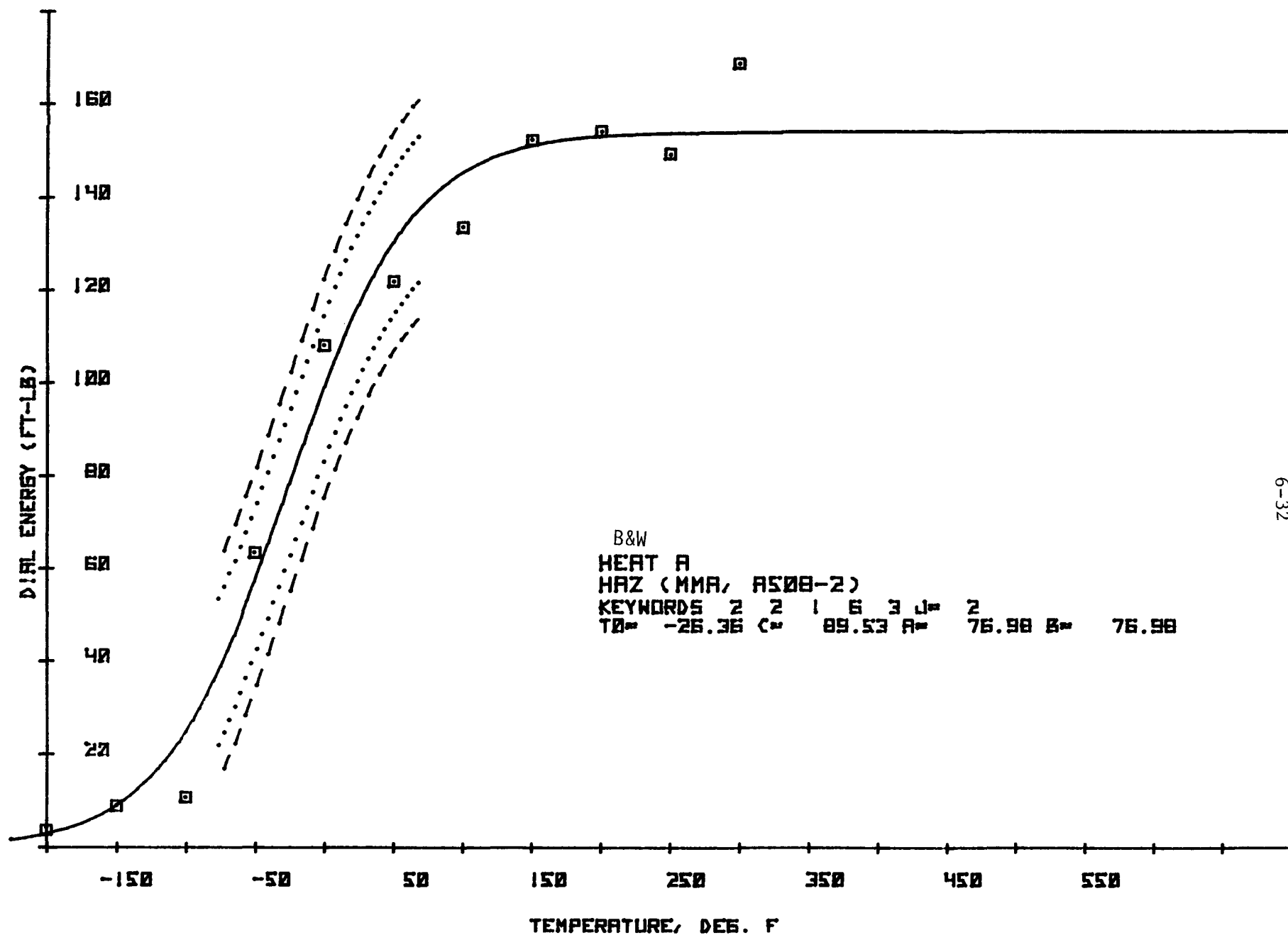
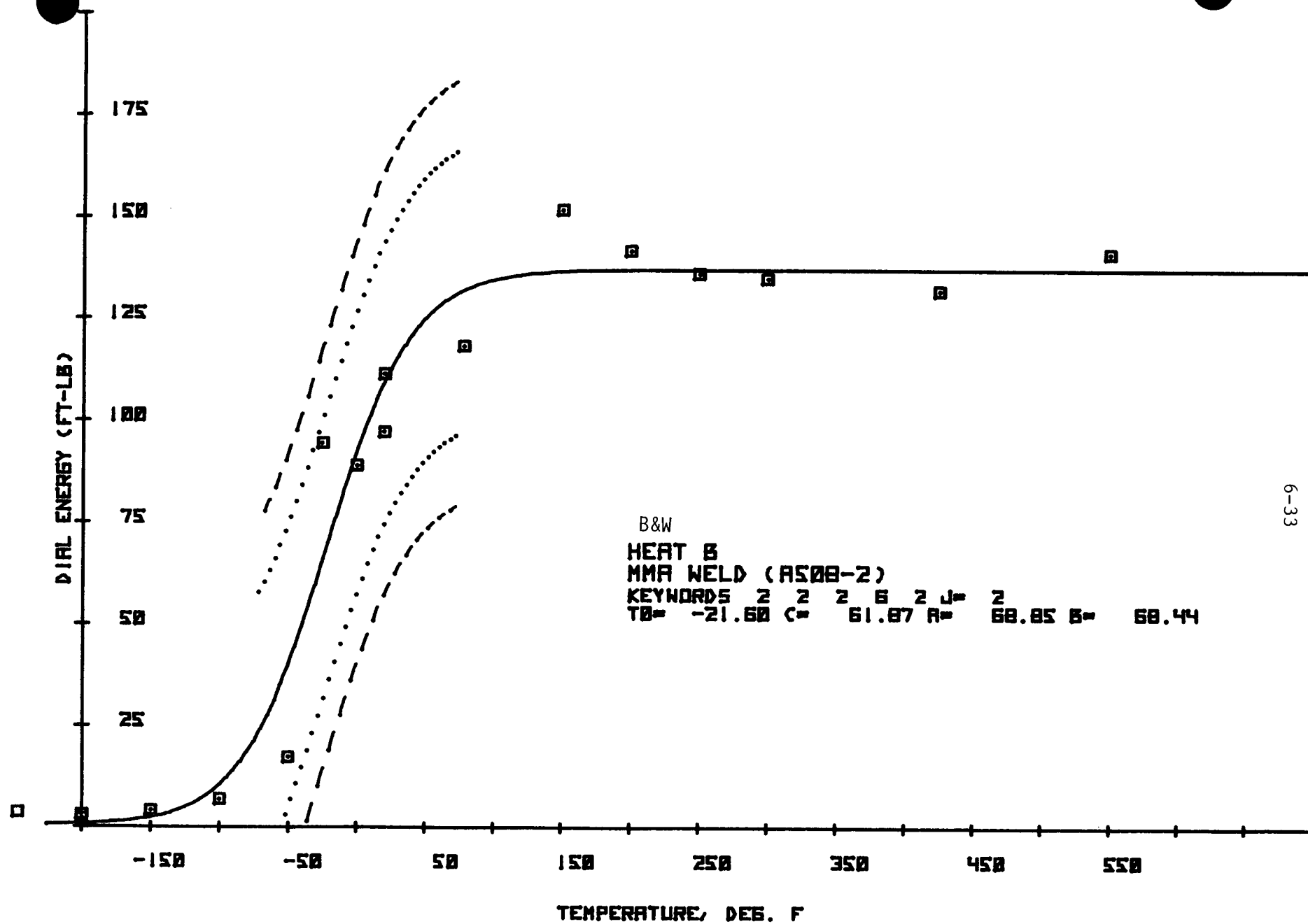


Figure 6.7. Charpy V-Notch Dial Energy for B&W Heat A (HAZ)



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Figure 6.8. Charpy V-Notch Dial Energy for B&W Heat B (T)

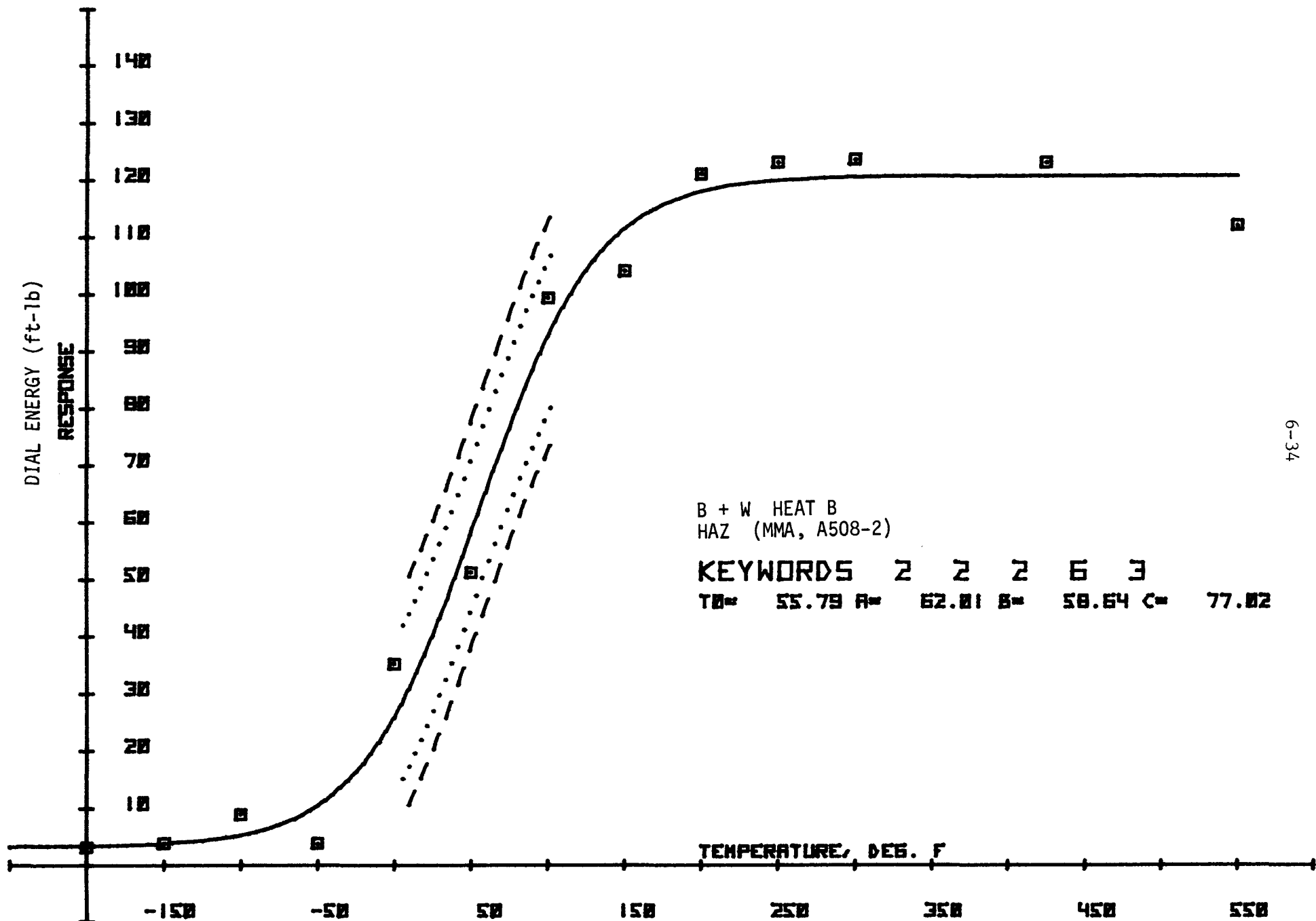
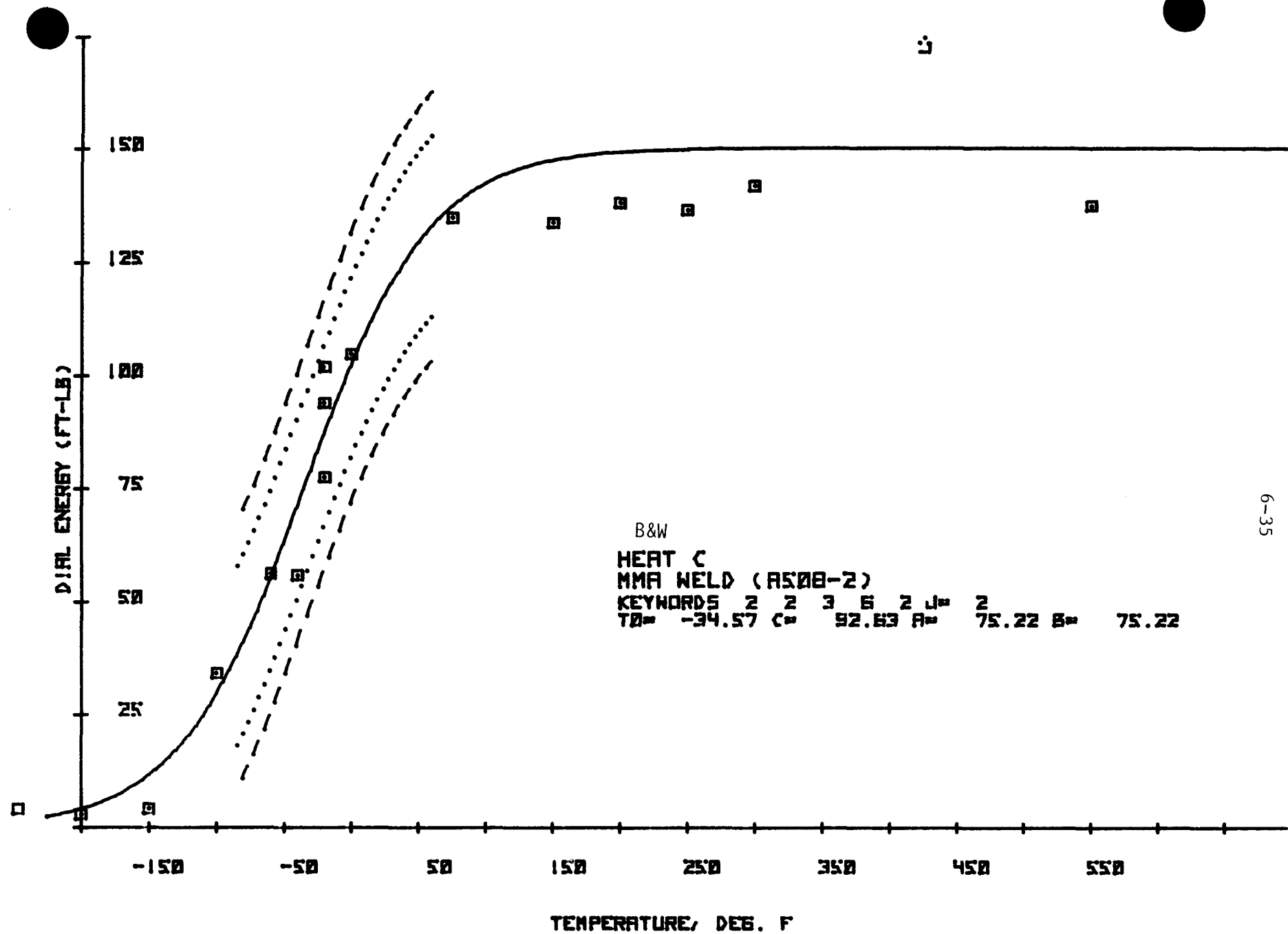


Figure 6.9. Charpy V-Notch Dial Energy for B&W Heat B (HAZ)



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Figure 6.10. Charpy V-Notch Dial Energy for B&W Heat C (T)

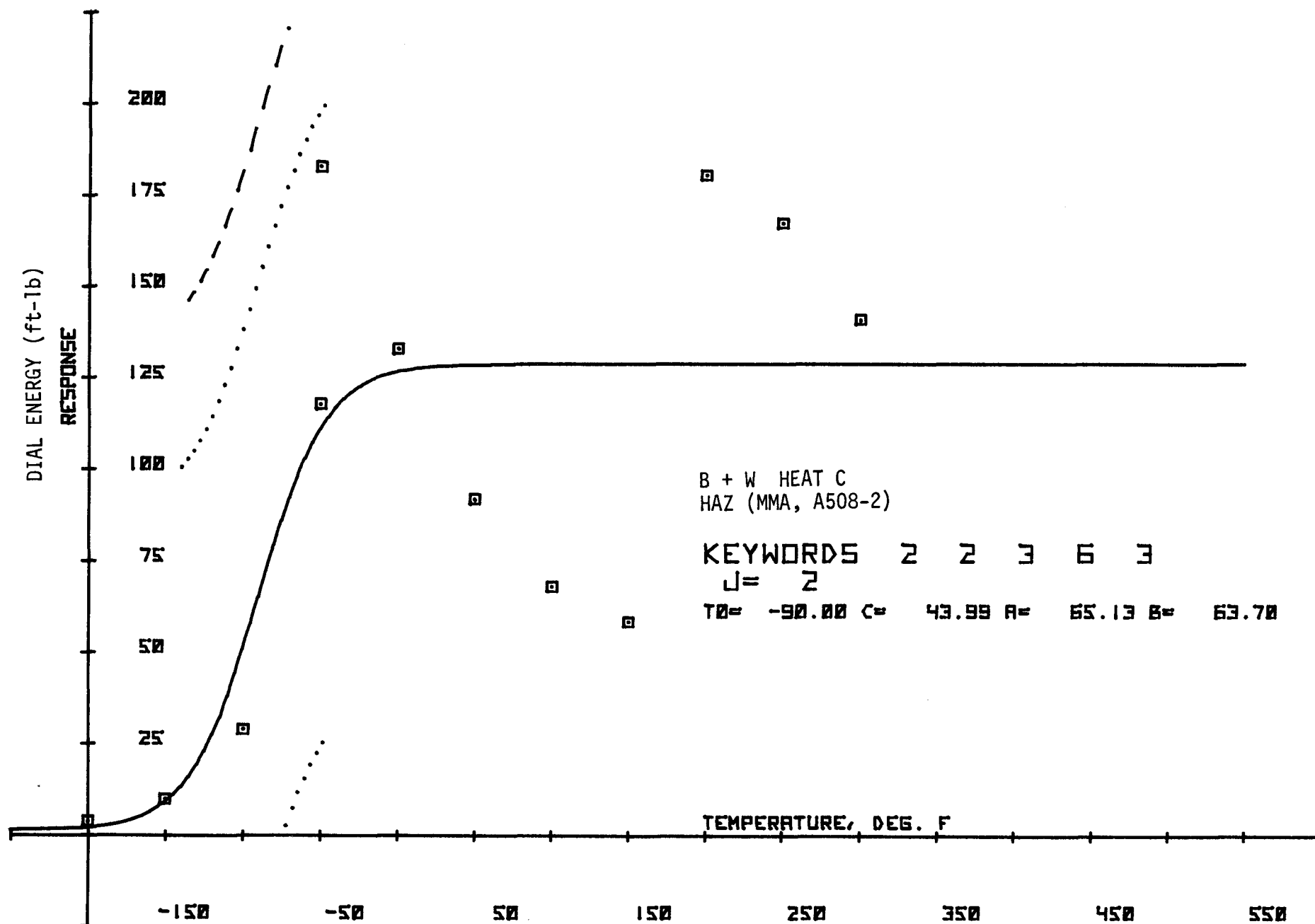


Figure 6.11. Charpy V-Notch Dial Energy for B&W Heat C (HAZ)

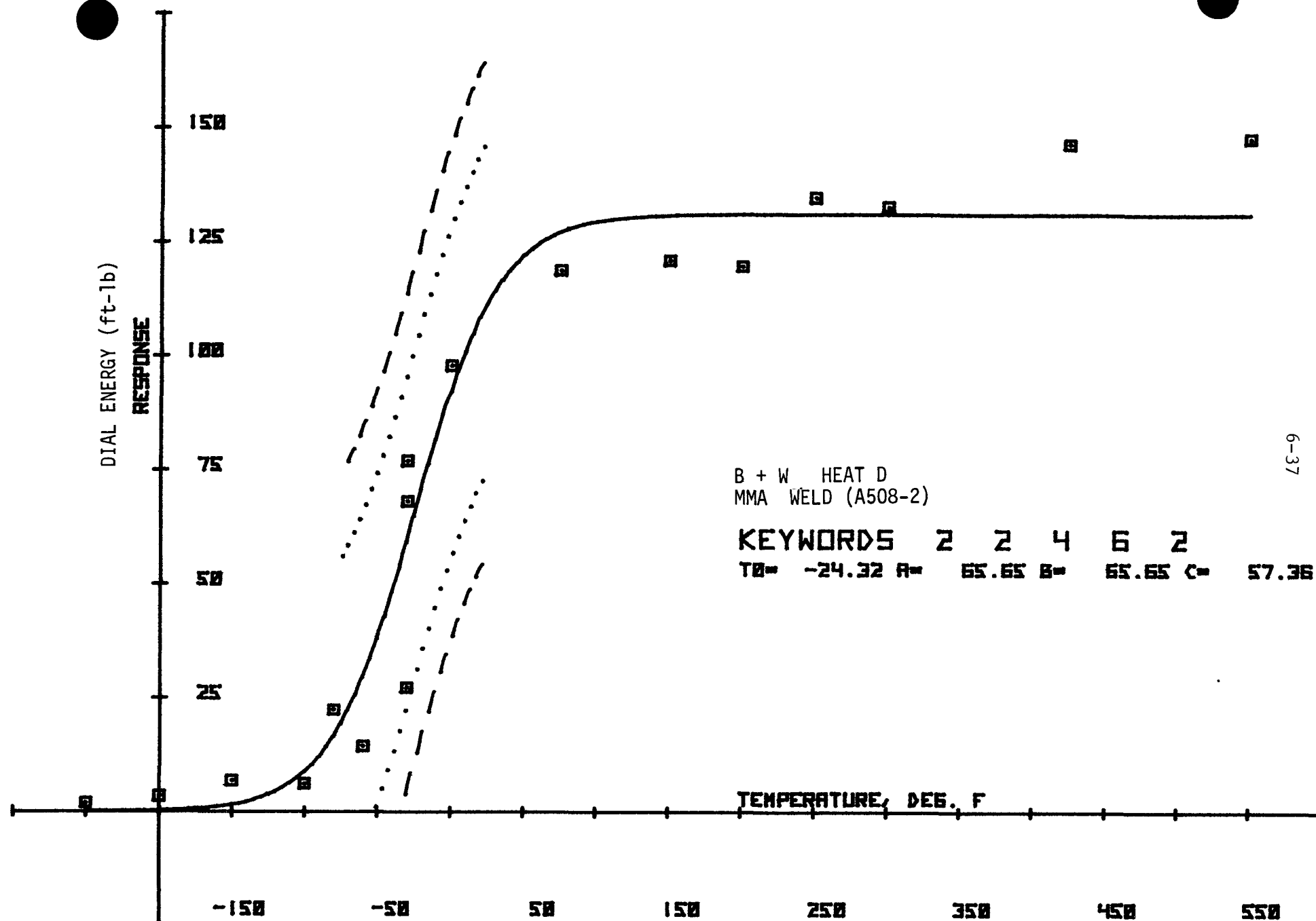


Figure 6.12. Charpy V-Notch Dial Energy for B&W Heat D (T)

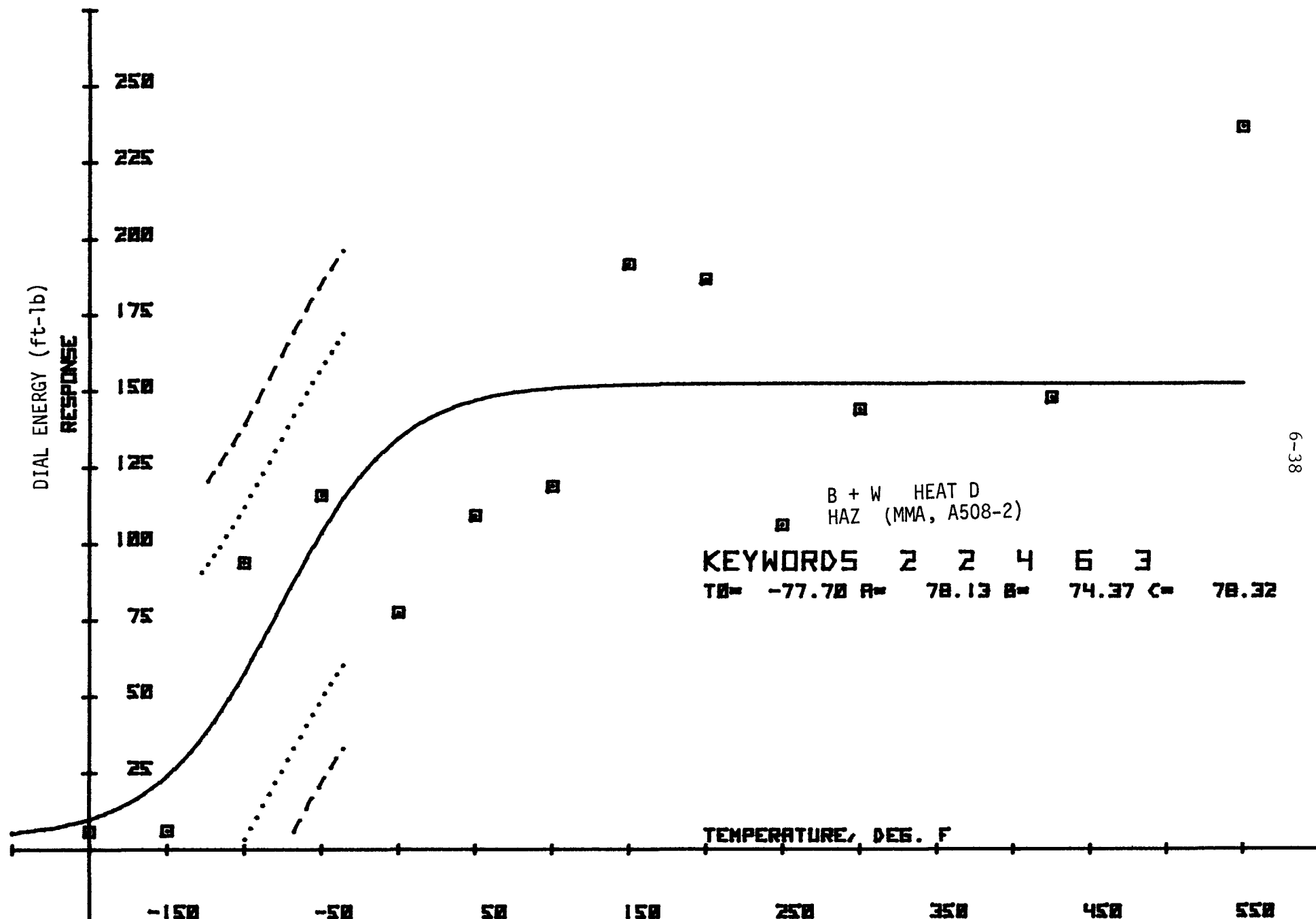


Figure 6.13. Charpy V-Notch Dial Energy for B&W Heat D (HAZ)

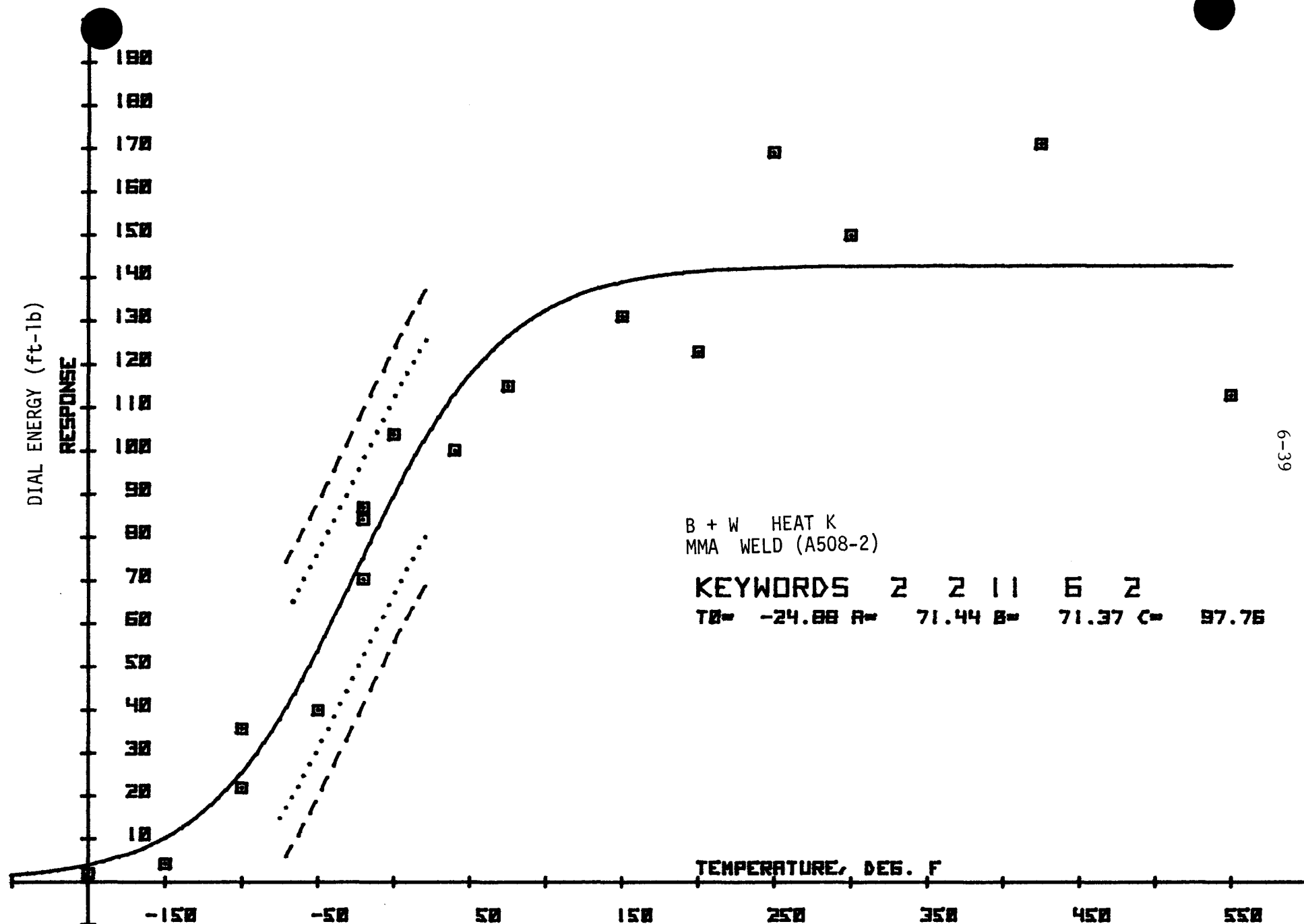


Figure 6.14. Charpy V-Notch Dial Energy for B&W Heat K (T)

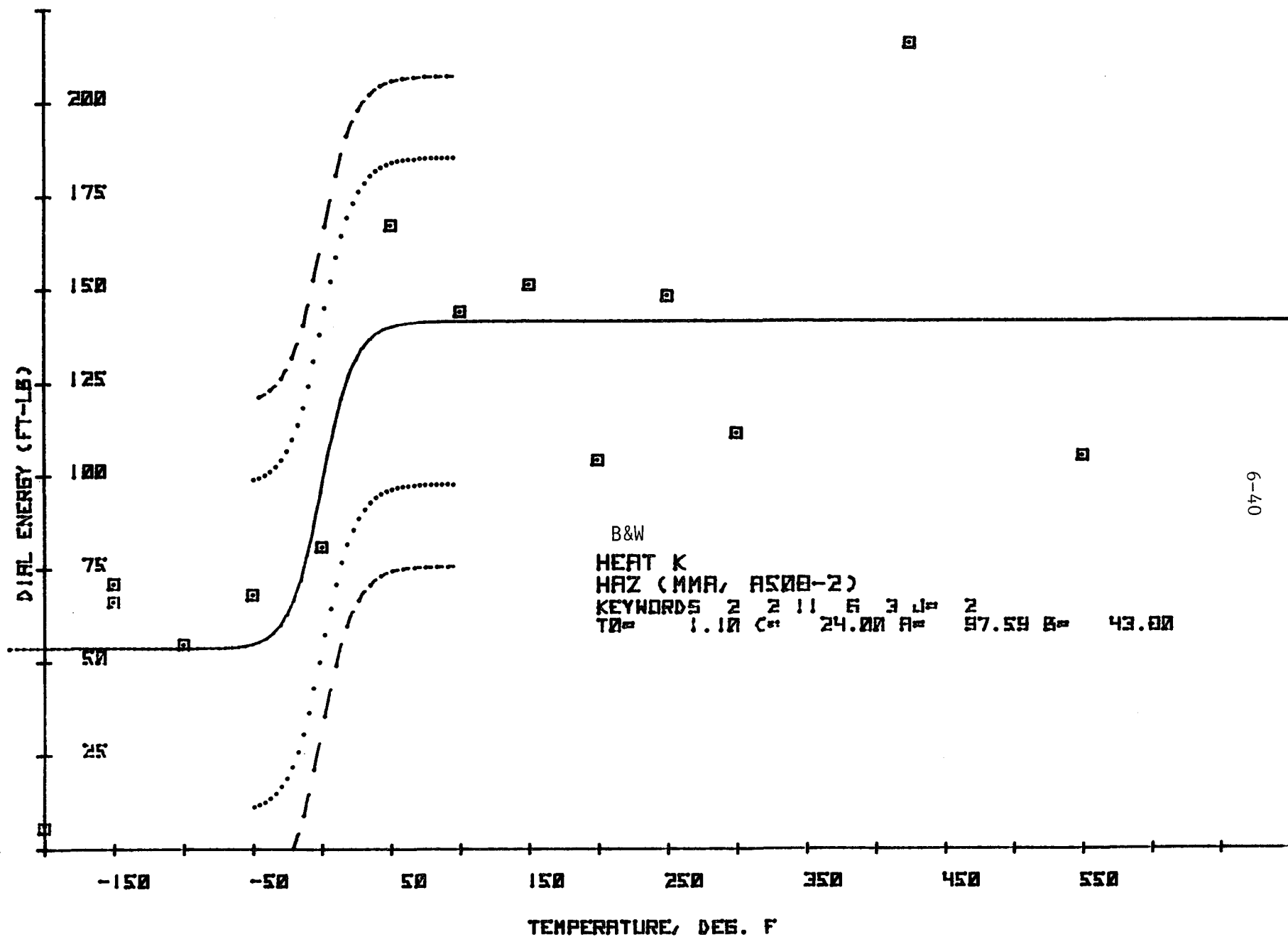


Figure 6.15. Charpy V-Notch Dial Energy for B&W Heat K (HAZ)

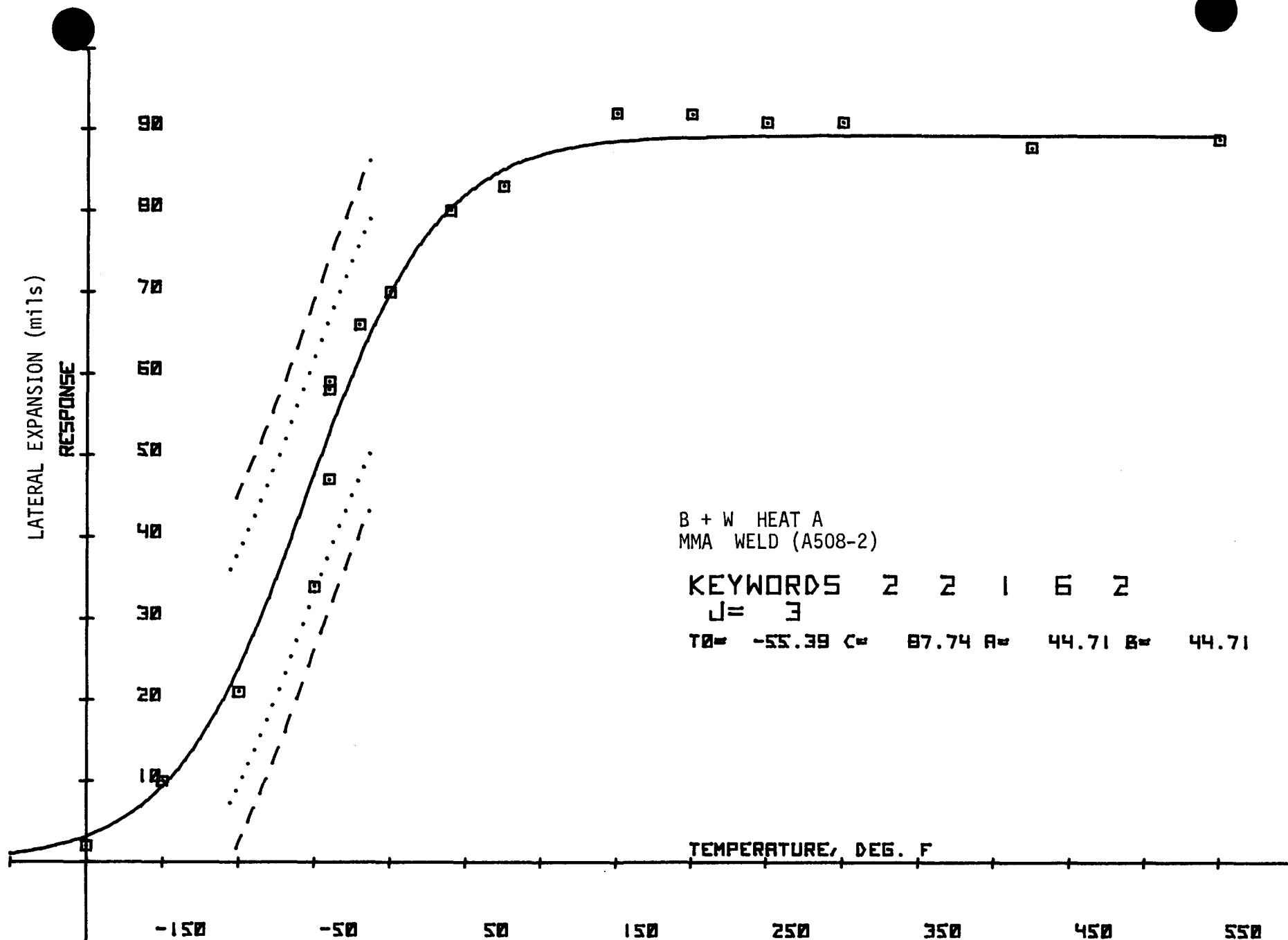


Figure 6.16. Charpy V-Notch Lateral Expansion for B&W Heat A (T)

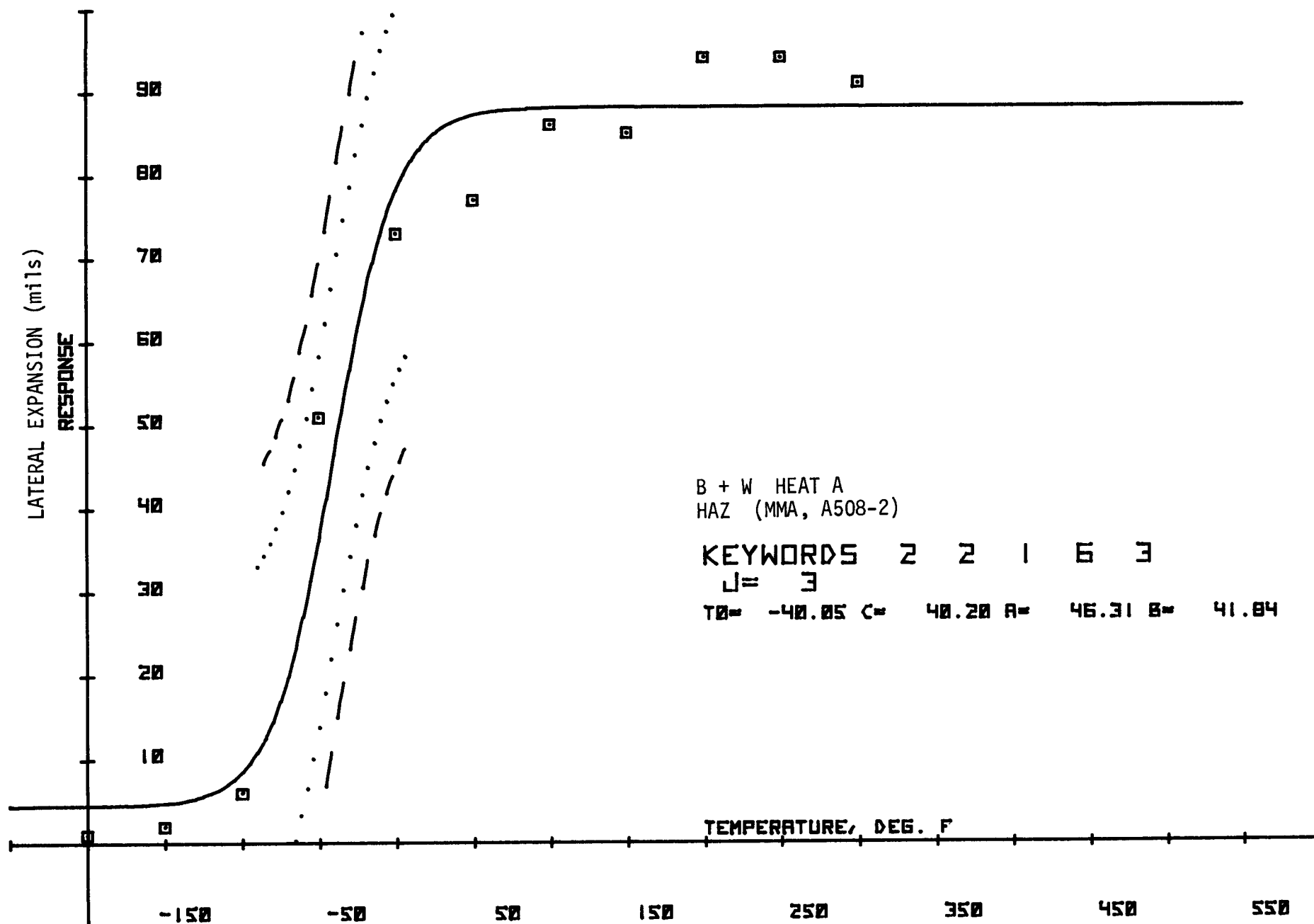
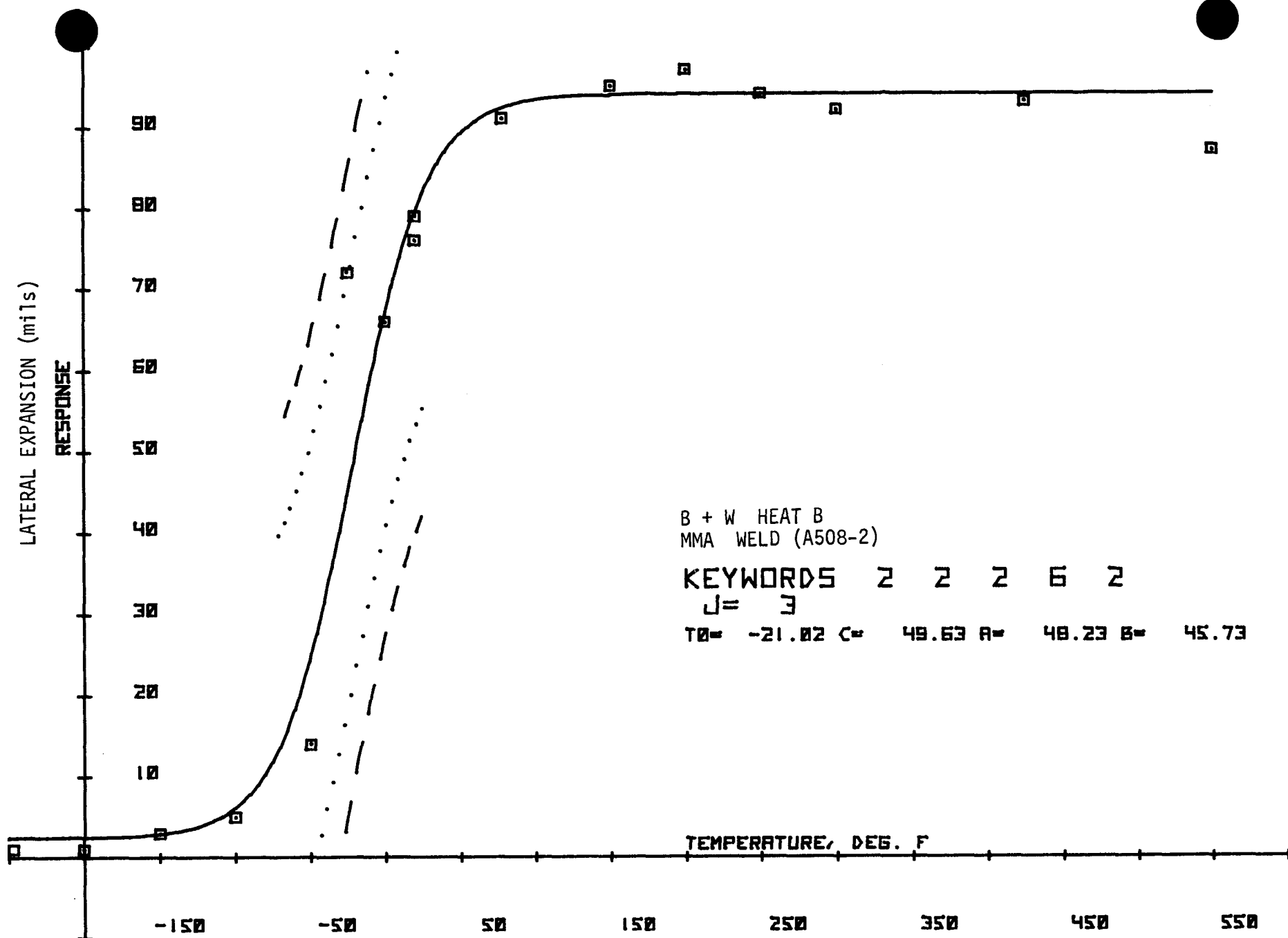


Figure 6.17. Charpy V-Notch Lateral Expansion for B&W Heat A (HAZ)



B + W HEAT B
MMA WELD (A508-2)

KEYWORDS 2 2 2 6 2
J= 3

T0= -21.02 C= 49.63 A= 48.23 B= 45.73

Figure 6.18. Charpy V-Notch Lateral Expansion for B&W Heat B (T)

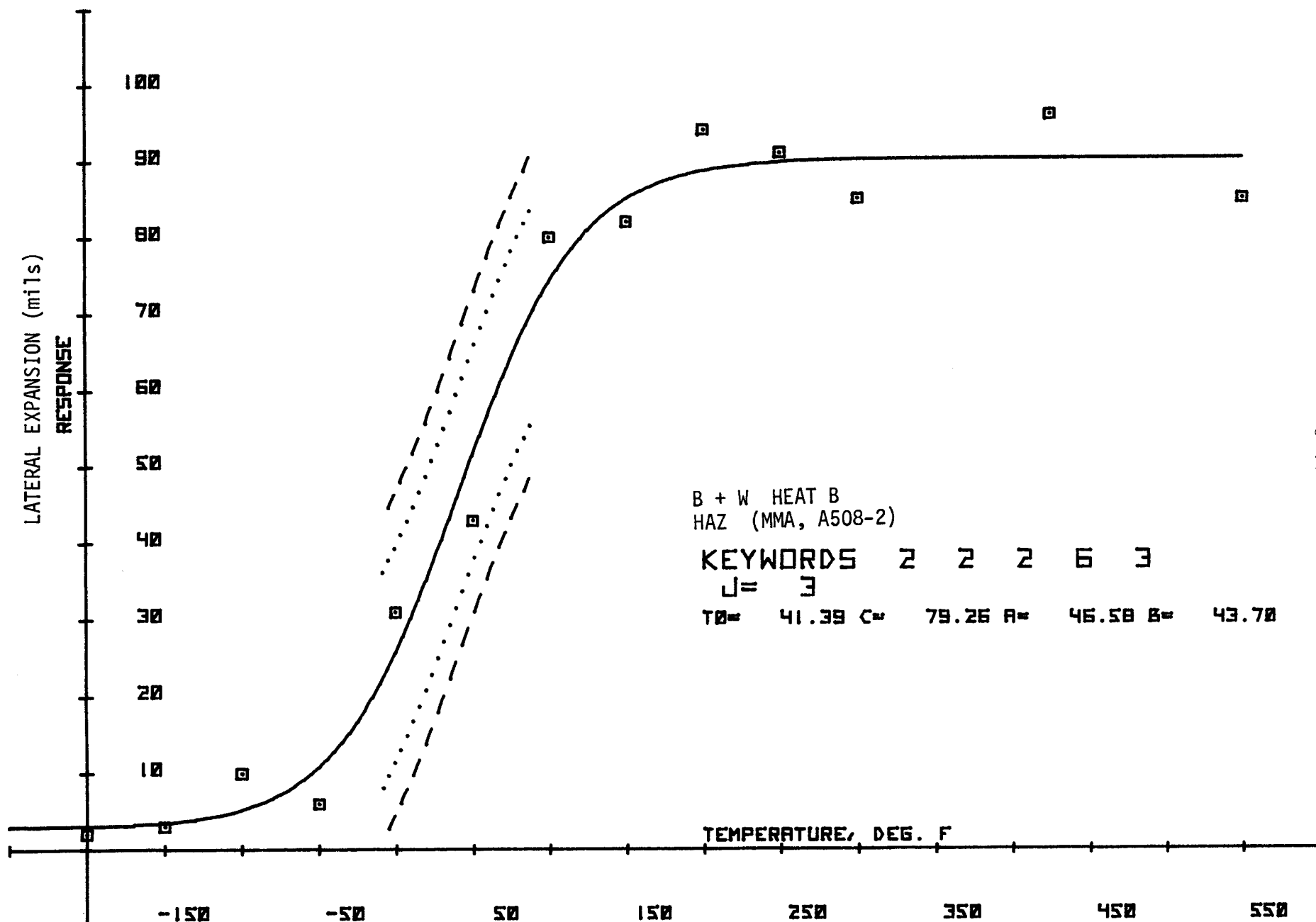


Figure 6.19. Charpy V-Notch Lateral Expansion for B&W Heat B (HAZ)

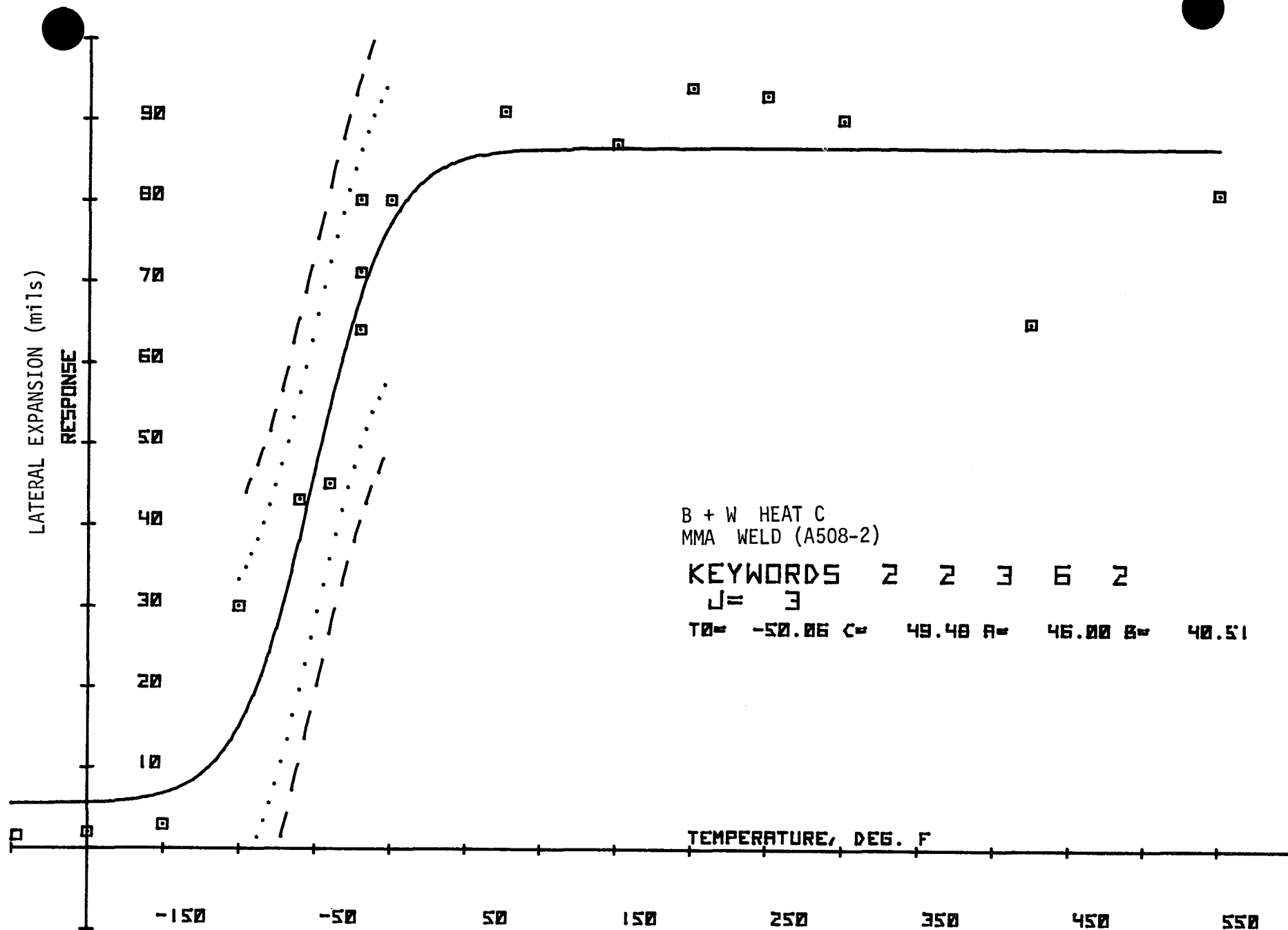


Figure 6.20. Charpy V-Notch Lateral Expansion for B&W Heat C (T)

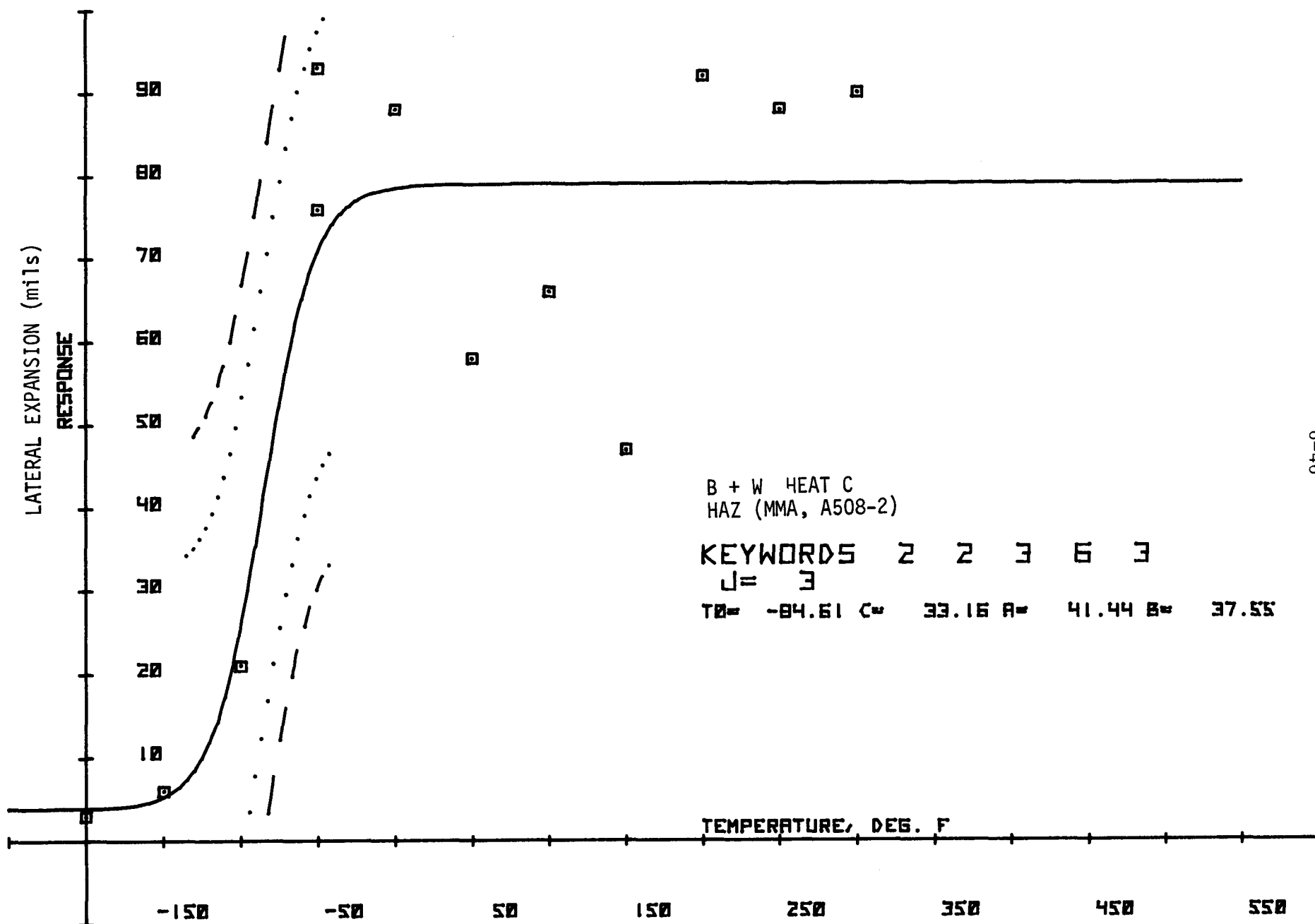


Figure 6.21. Charpy V-Notch Lateral Expansion for B&W Heat C (HAZ)

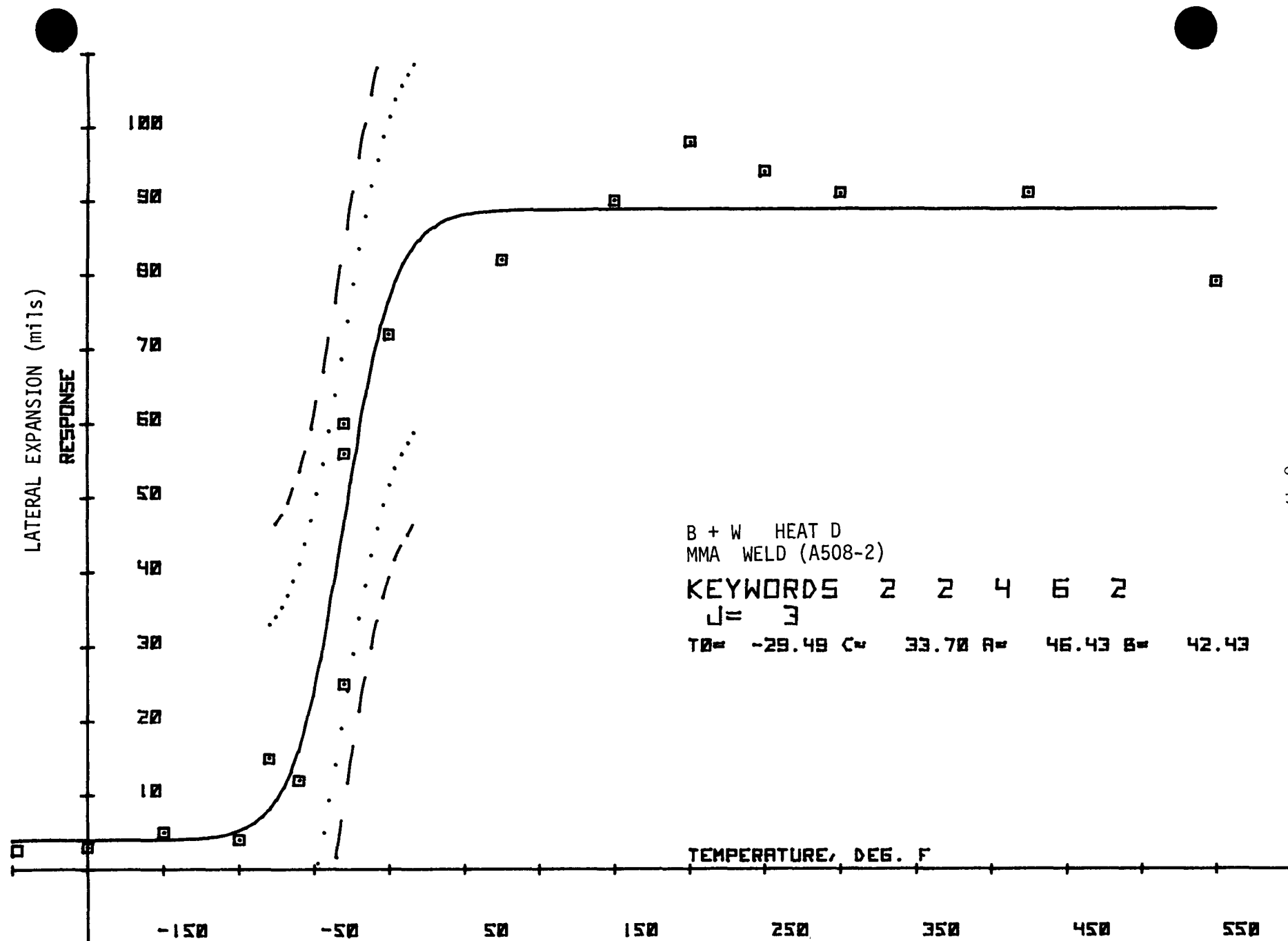


Figure 6.22. Charpy V-Notch Lateral Expansion for B&W Heat D (T)

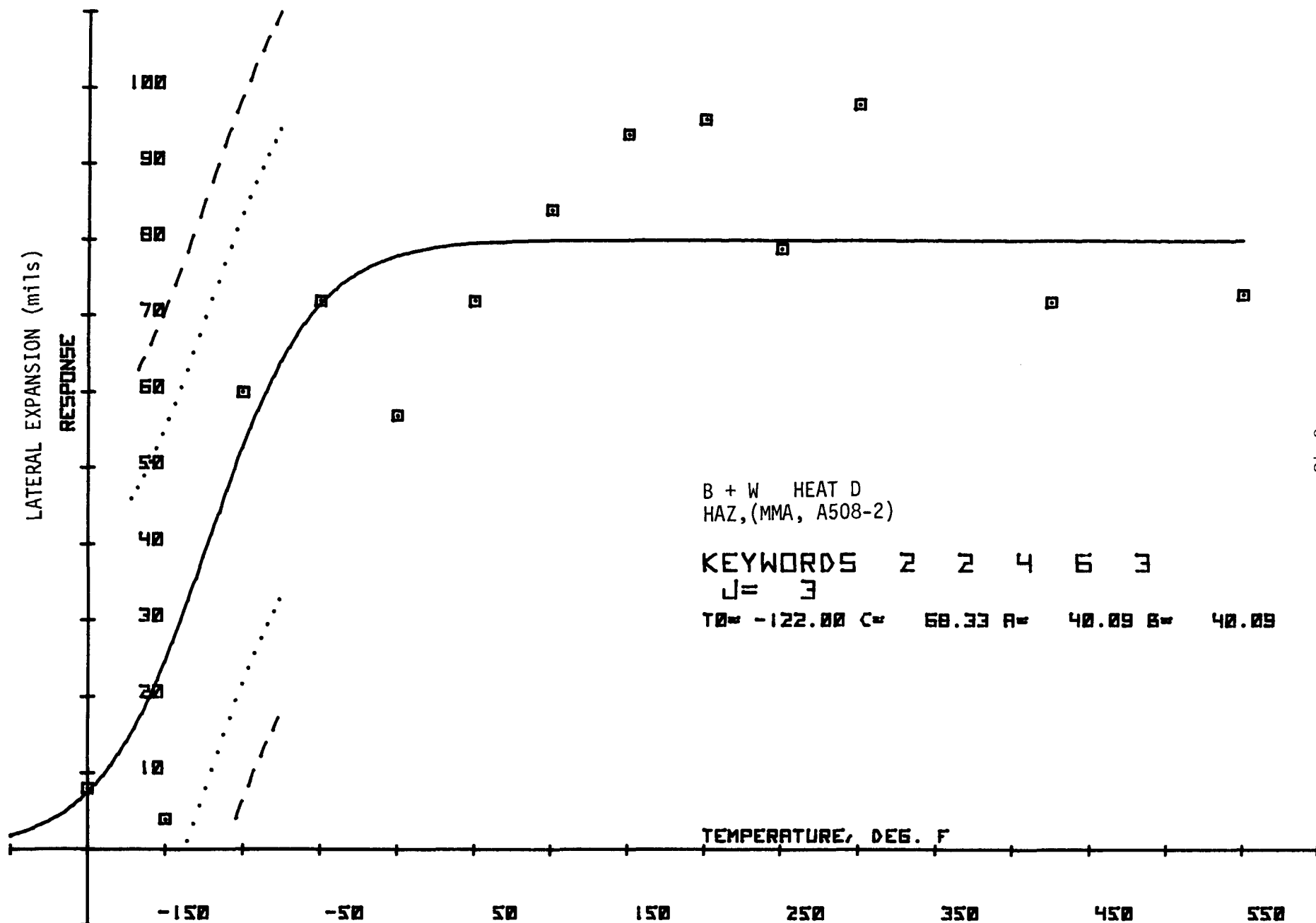


Figure 6.23. Charpy V-Notch Lateral Expansion for B&W Heat D (HAZ)

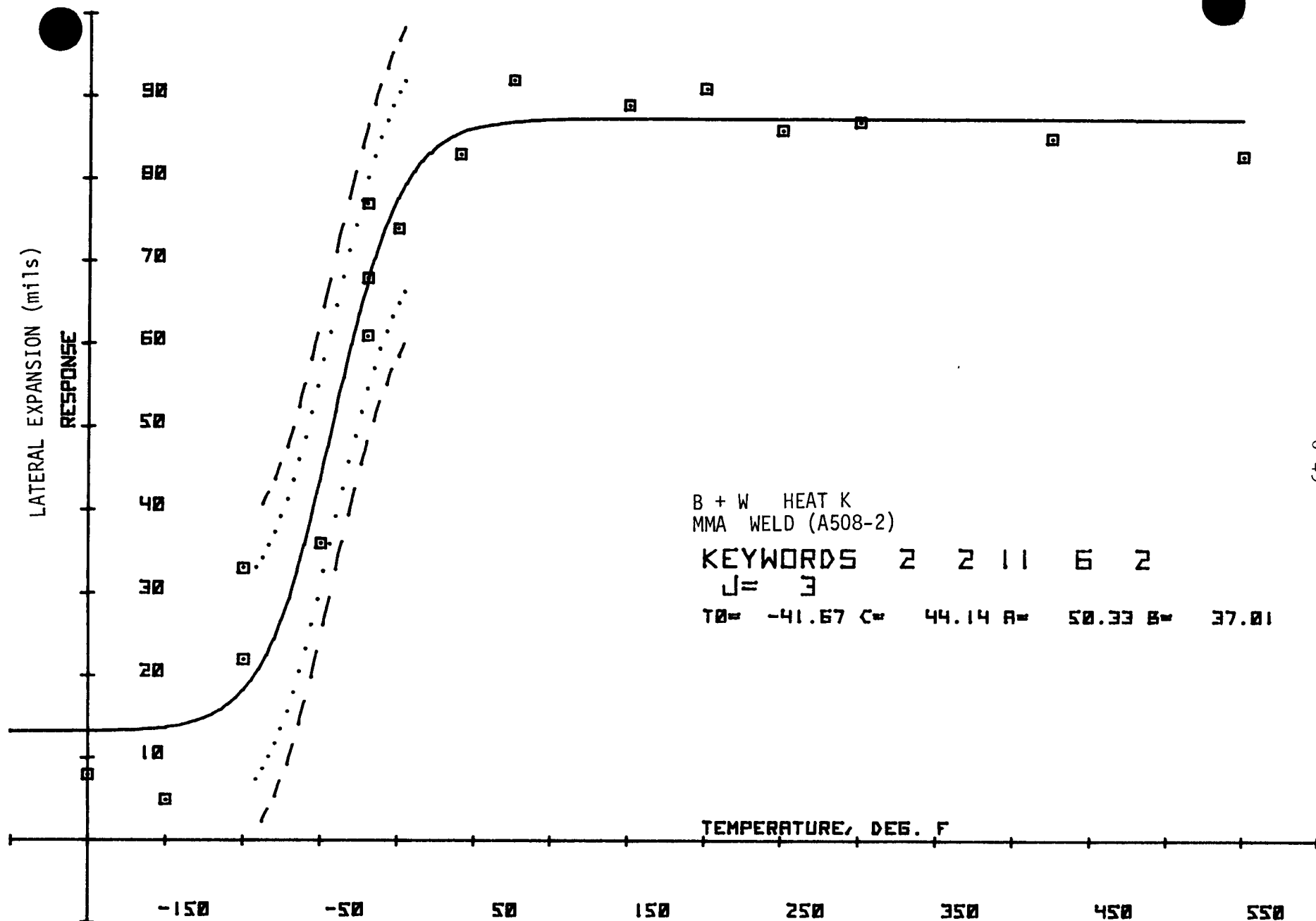


Figure 6.24. Charpy V-Notch Lateral Expansion for B&W Heat K (T)

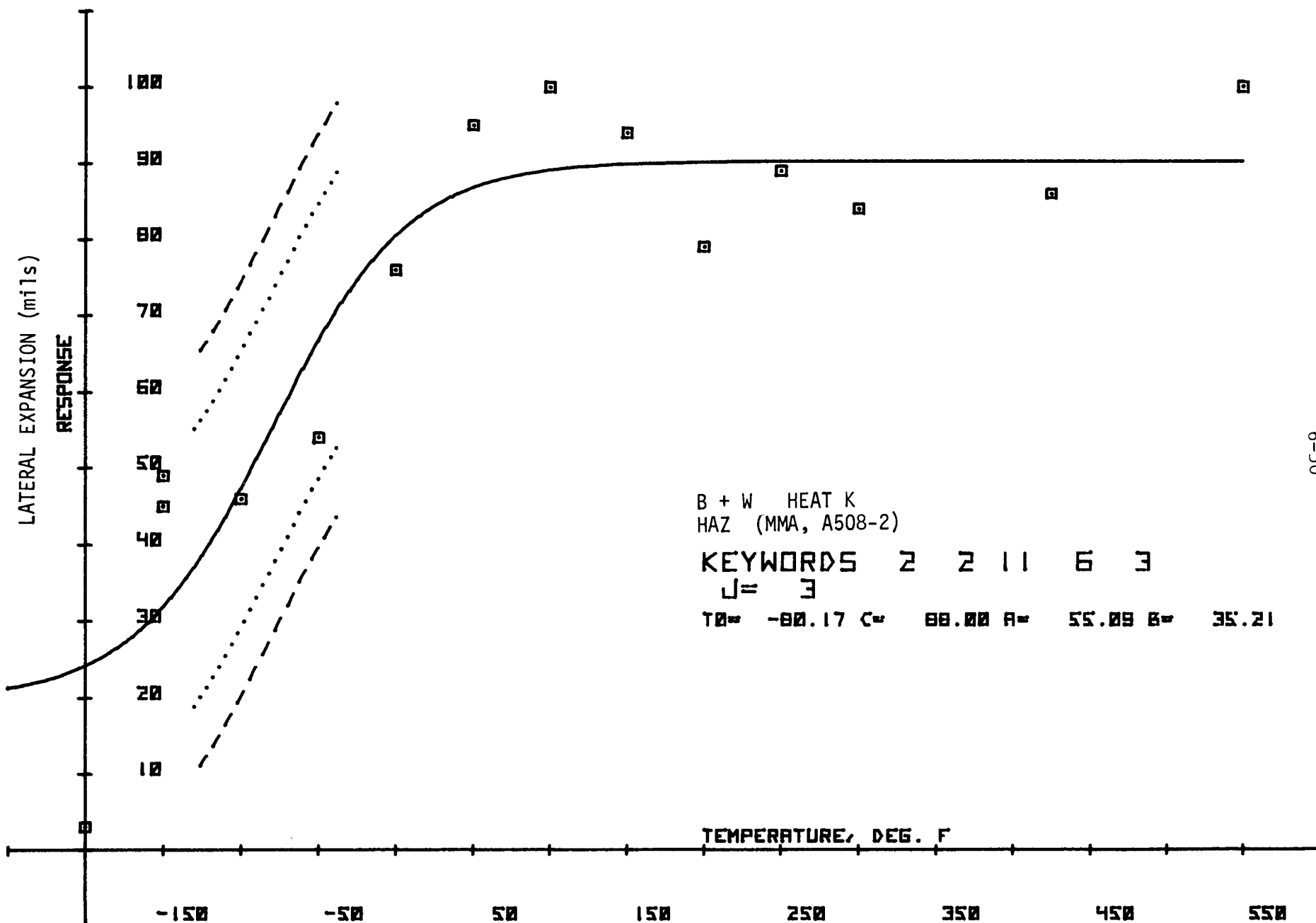


Figure 6.25. Charpy V-Notch Lateral Expansion for B&W Heat K (HAZ)

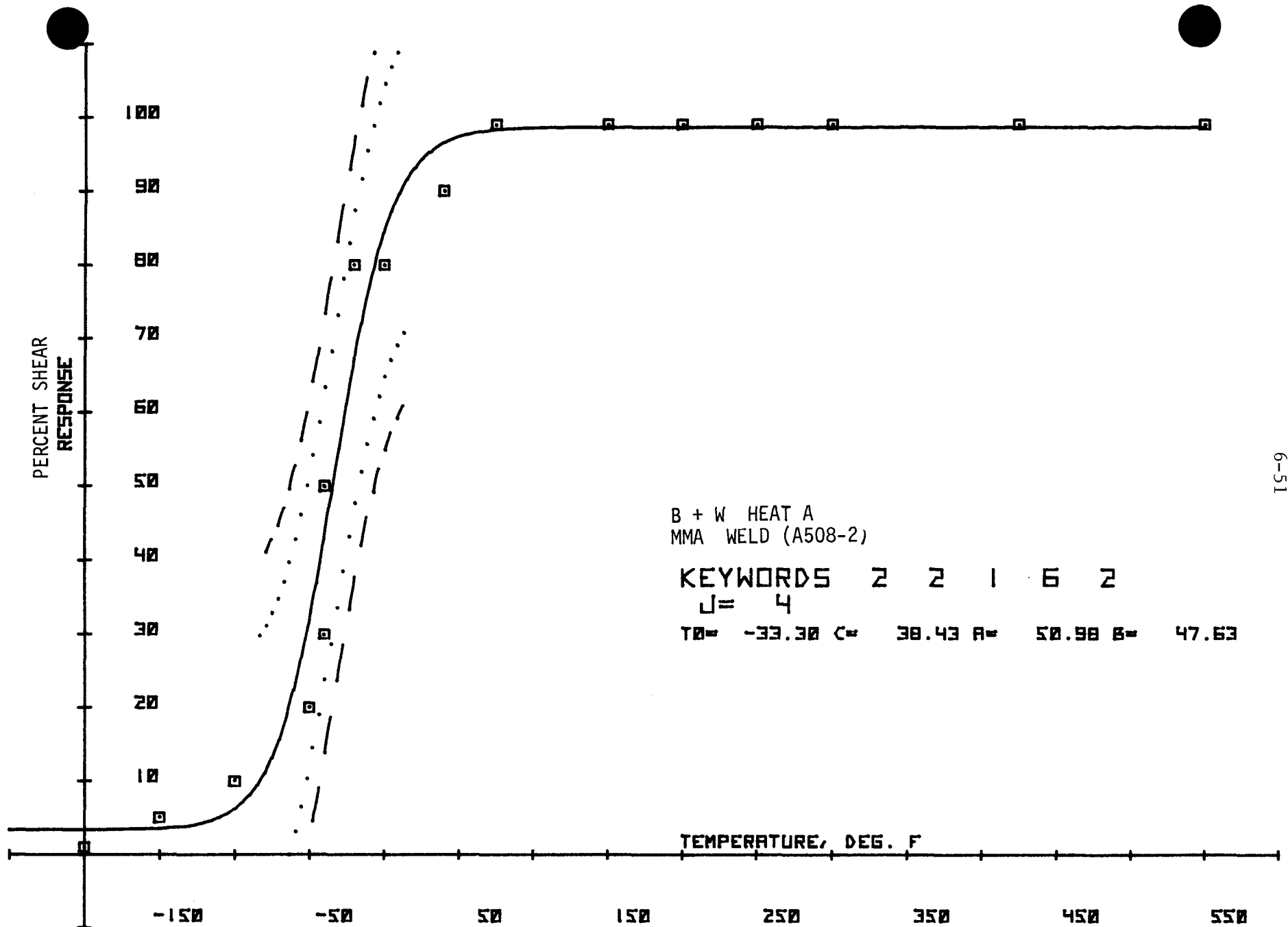


Figure 6.26. Charpy V-Notch Percent Shear for B&W Heat A (T)

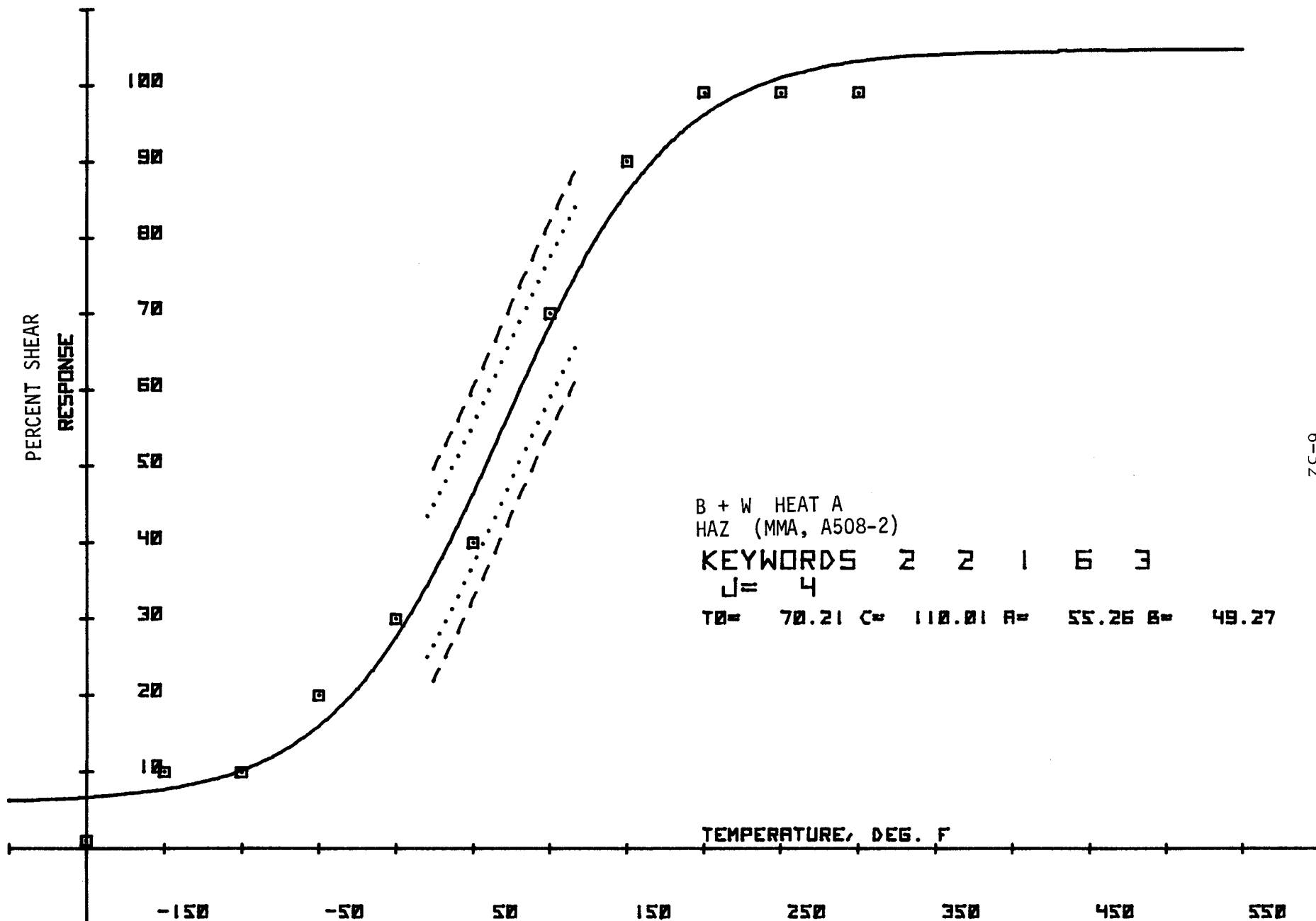


Figure 6.27. Charpy V-Notch Percent Shear for B&W Heat A (HAZ)

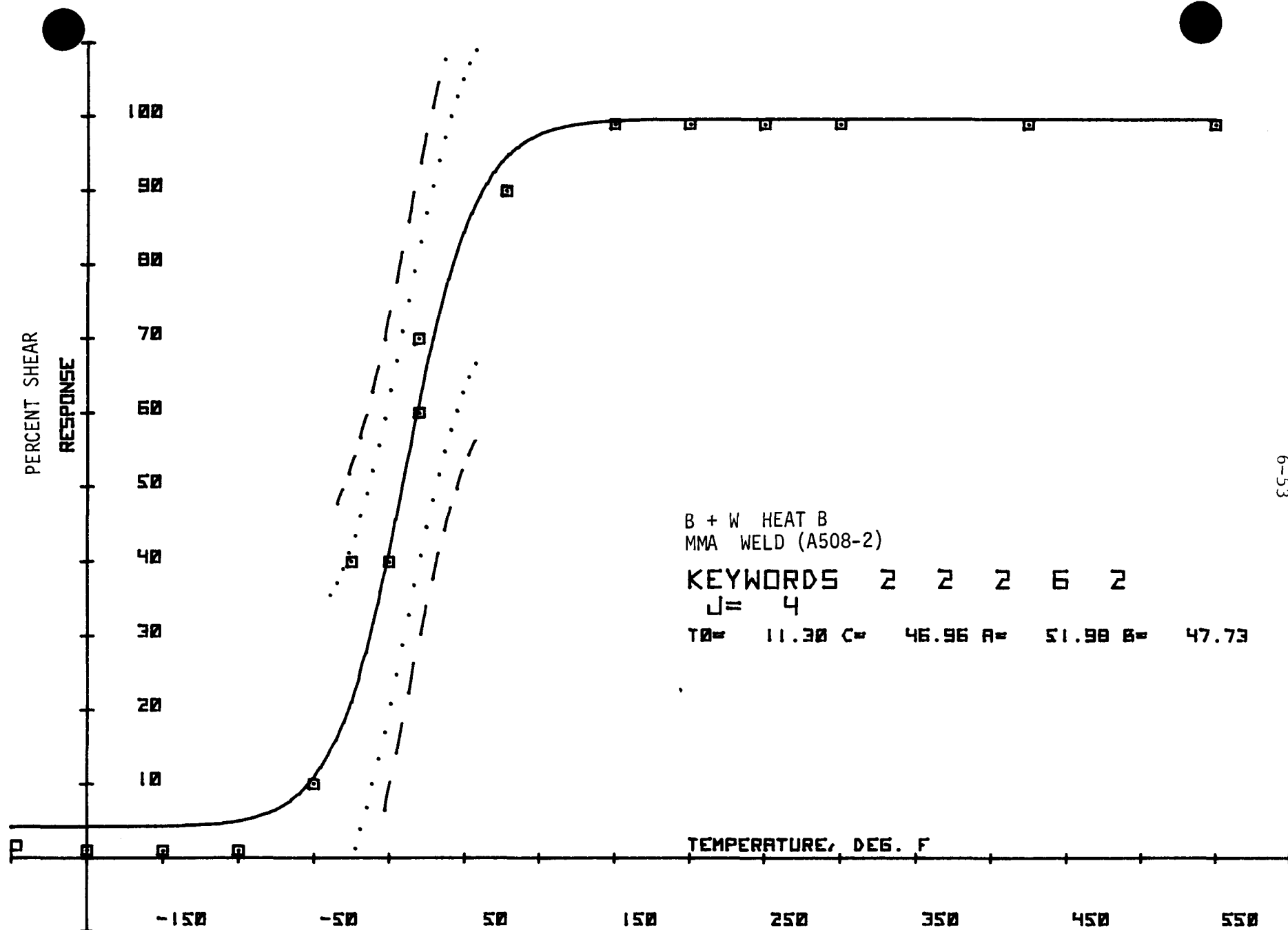


Figure 6.28. Charpy V-Notch Percent Shear for B&W Heat B (T)

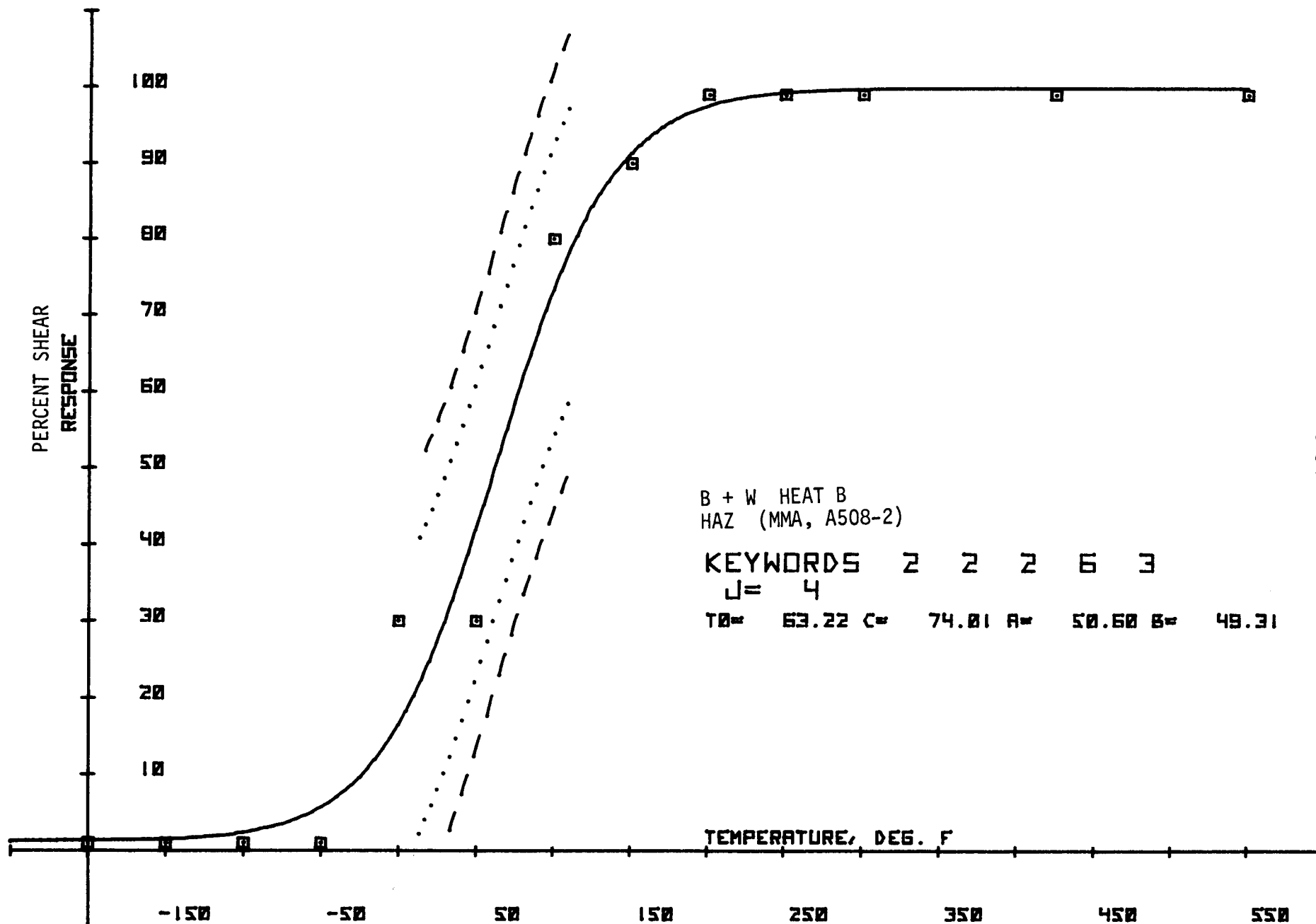


Figure 6.29. Charpy V-Notch Percent Shear for B&W Heat B (HAZ)

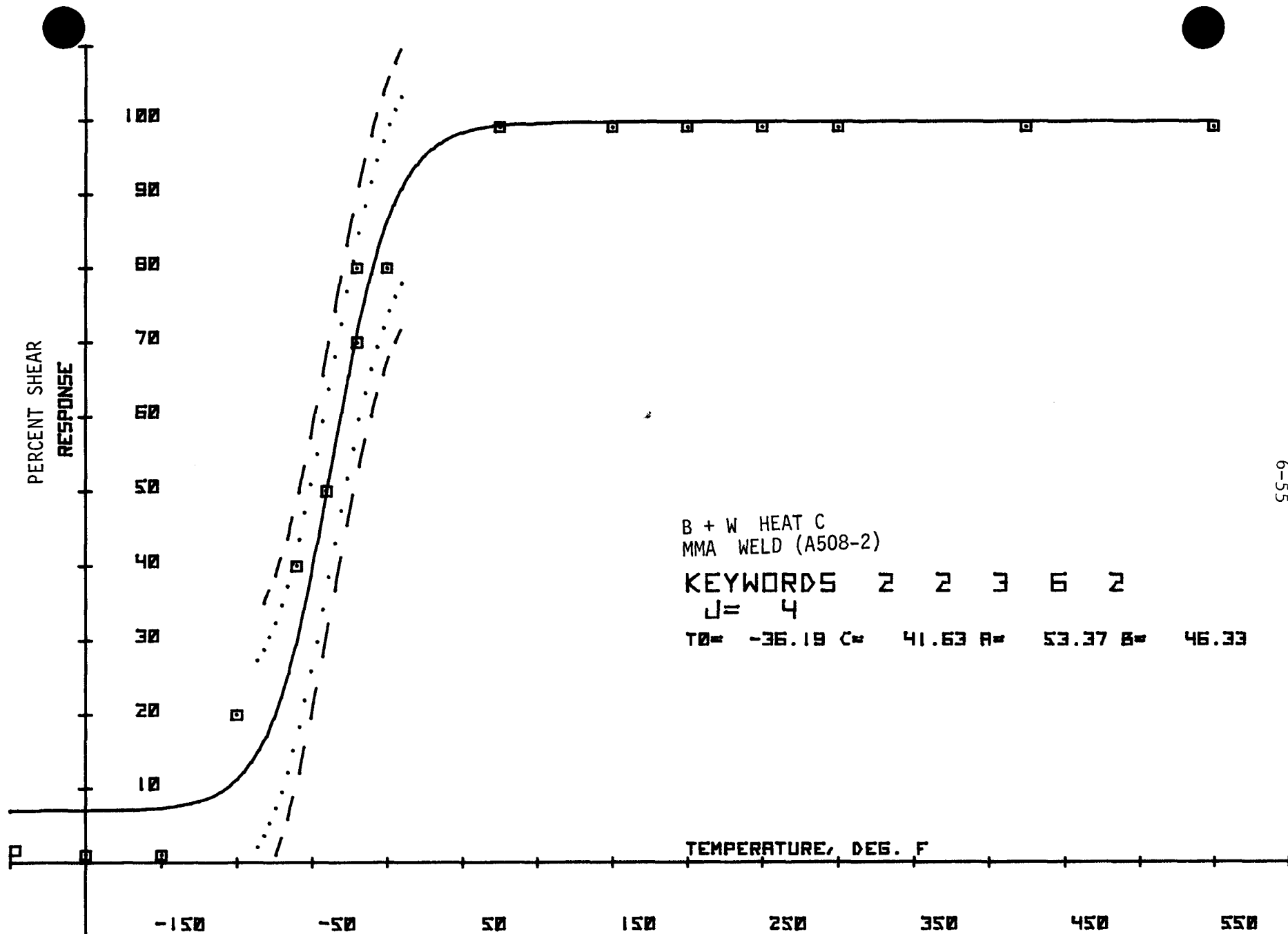


Figure 6.30. Charpy V-Notch Percent Shear for B&W Heat C (T)

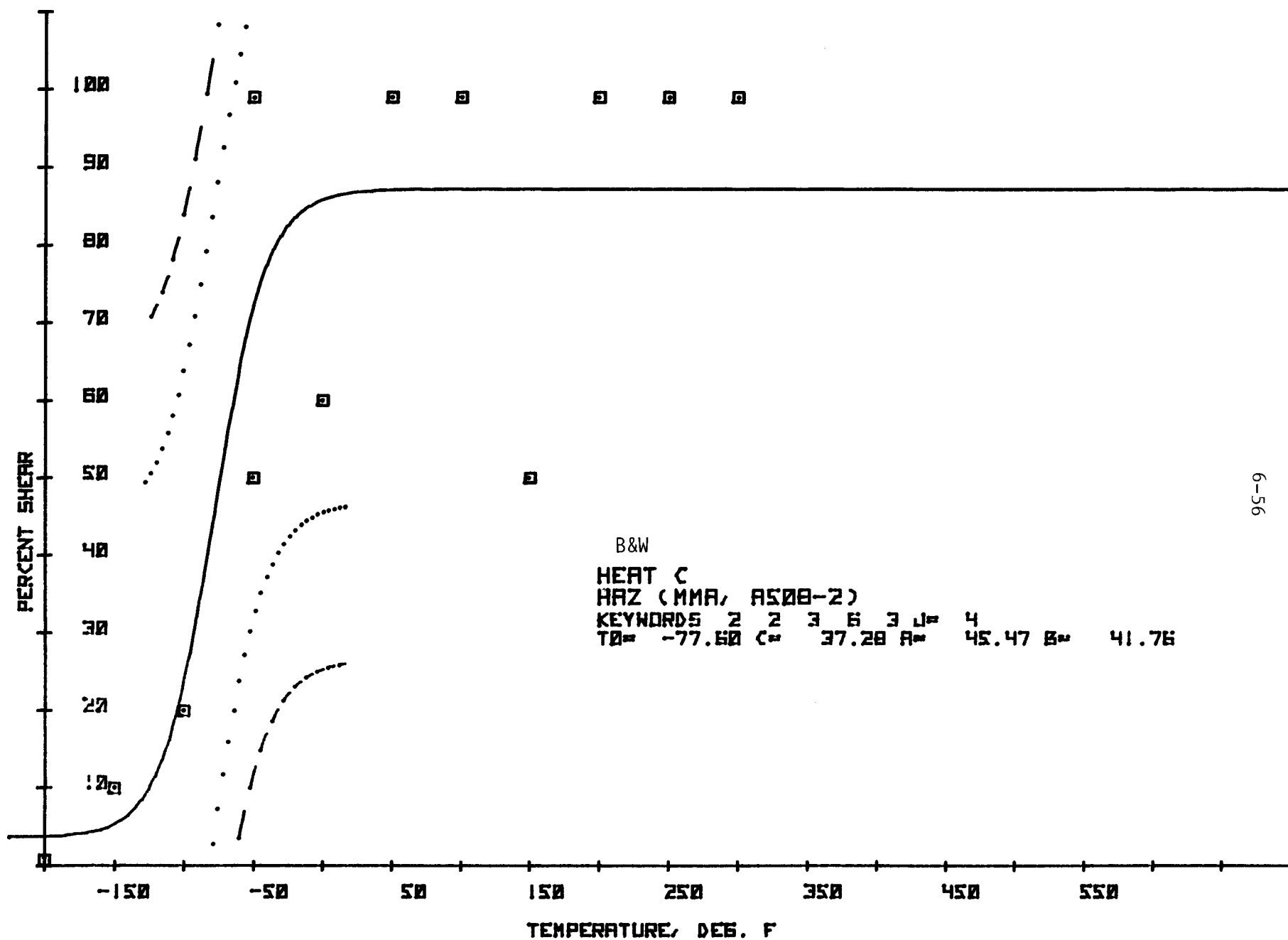


Figure 6.31. Charpy V-Notch Percent Shear for B&W Heat C (HAZ)

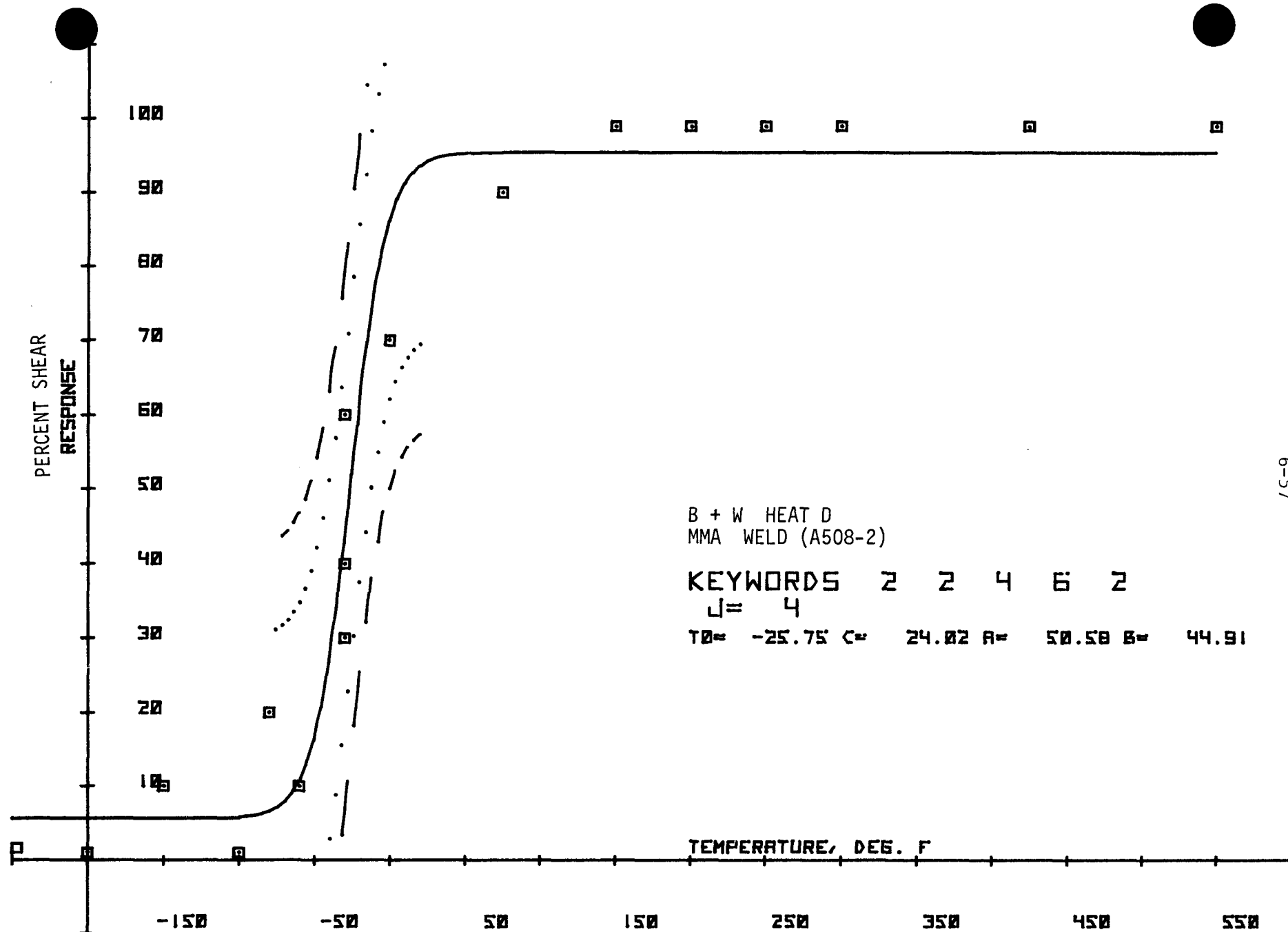
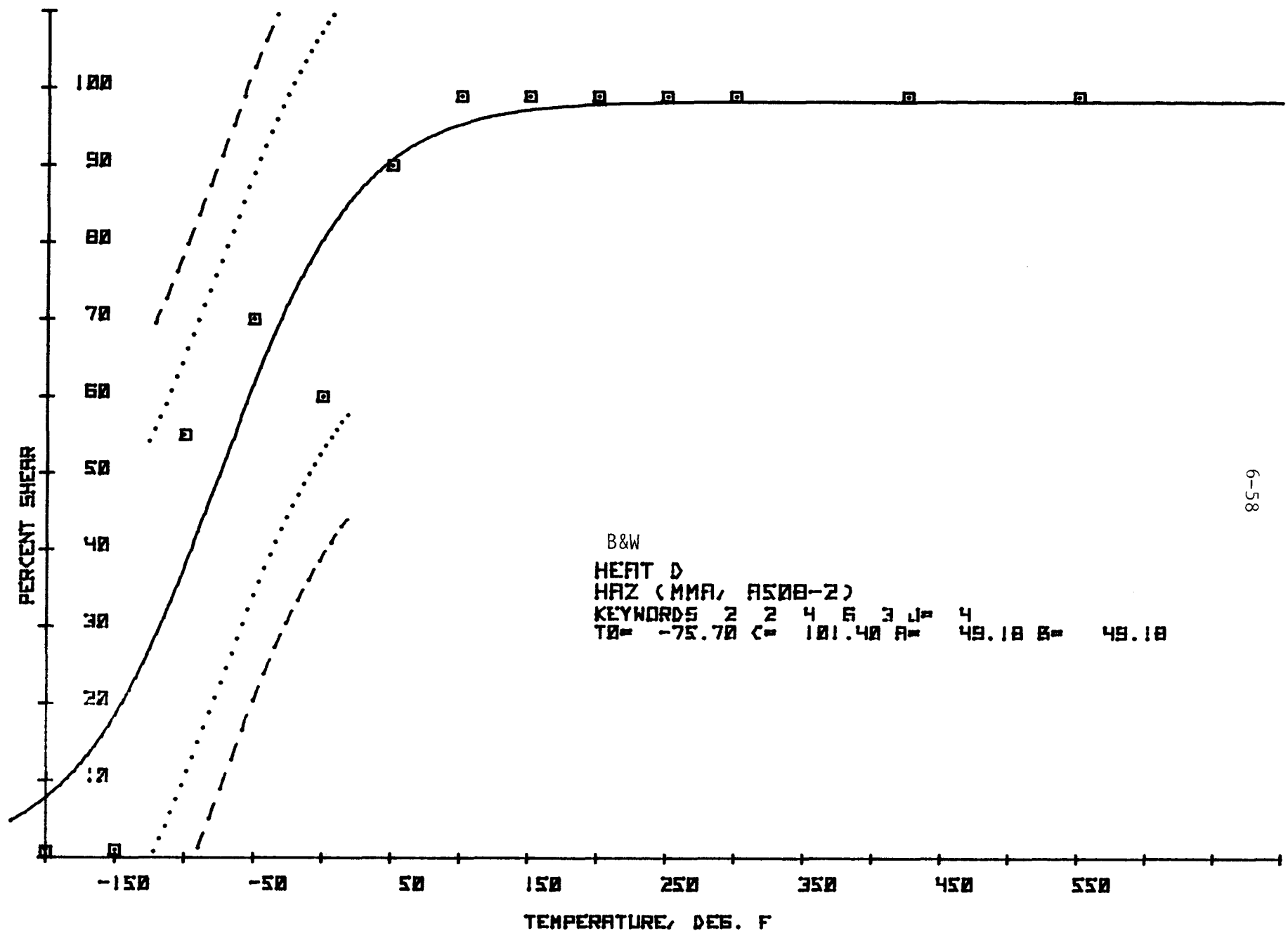


Figure 6.32. Charpy V-Notch Percent Shear for B&W Heat D (T)



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Figure 6.33. Charpy V-Notch Percent Shear for B&W Heat D (HAZ)

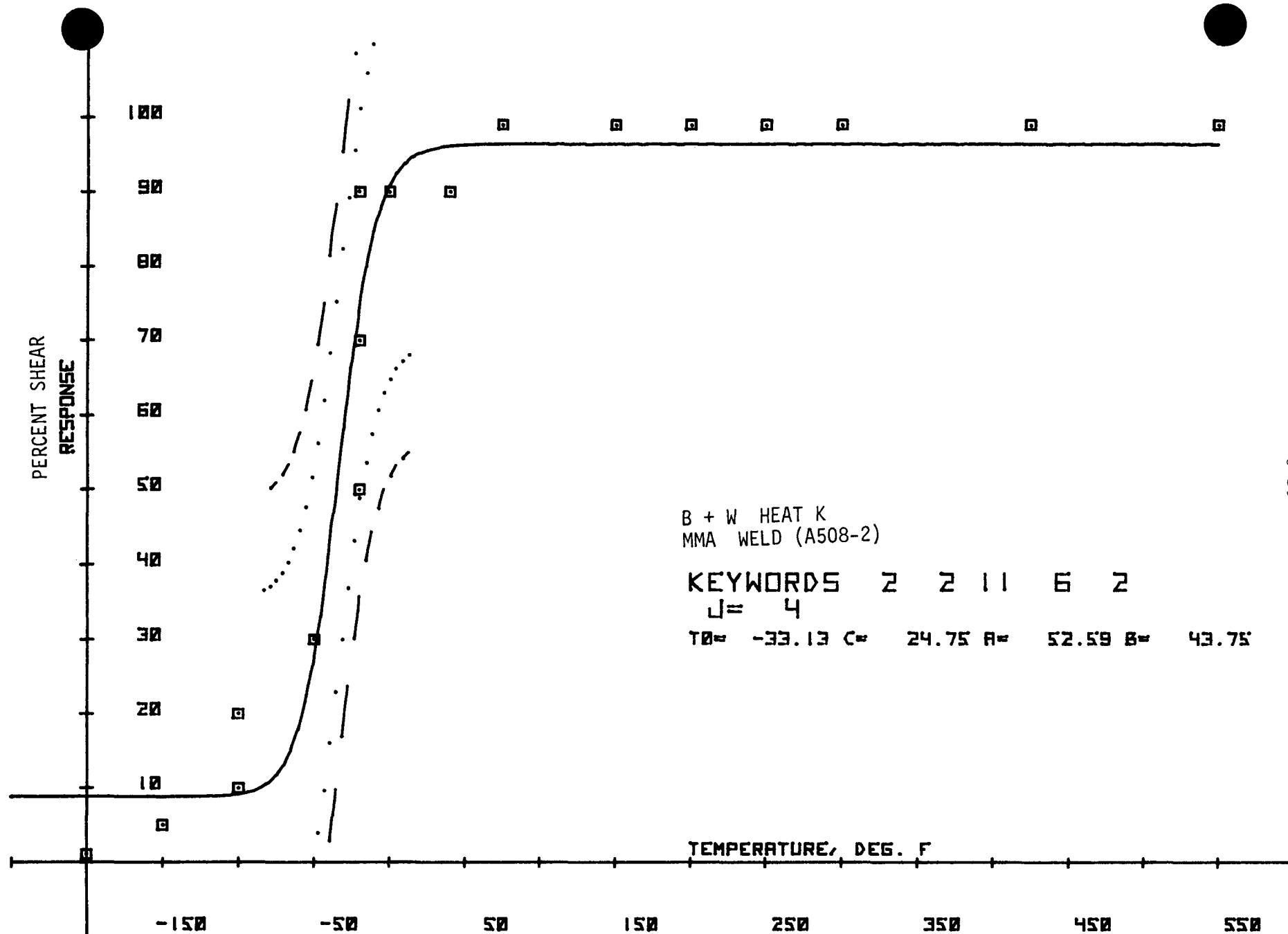


Figure 6.34. Charpy V-Notch Percent Shear for B&W Heat K (T)

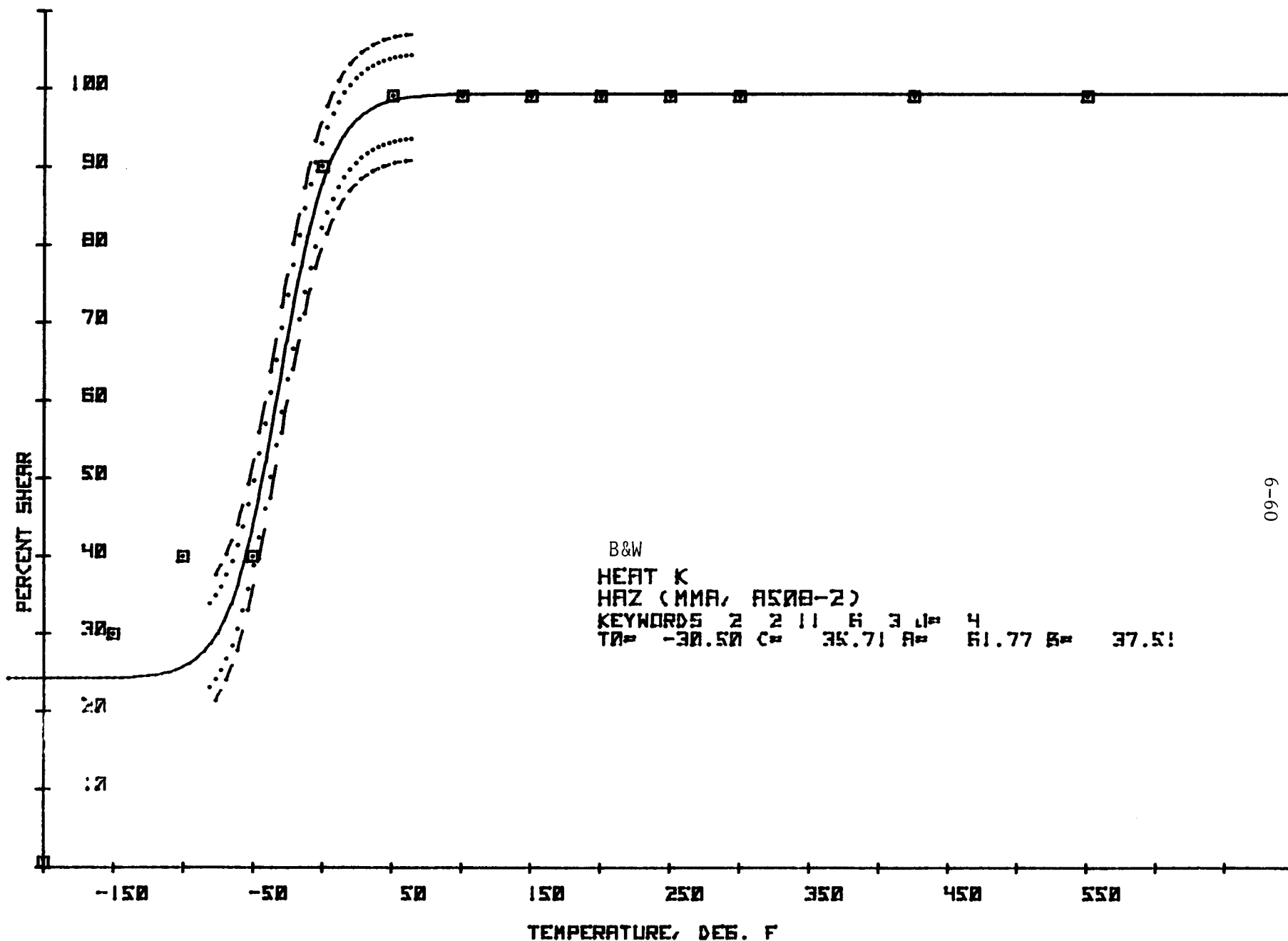


Figure 6.35. Charpy V-Notch Percent Shear for B&W Heat K (HAZ)

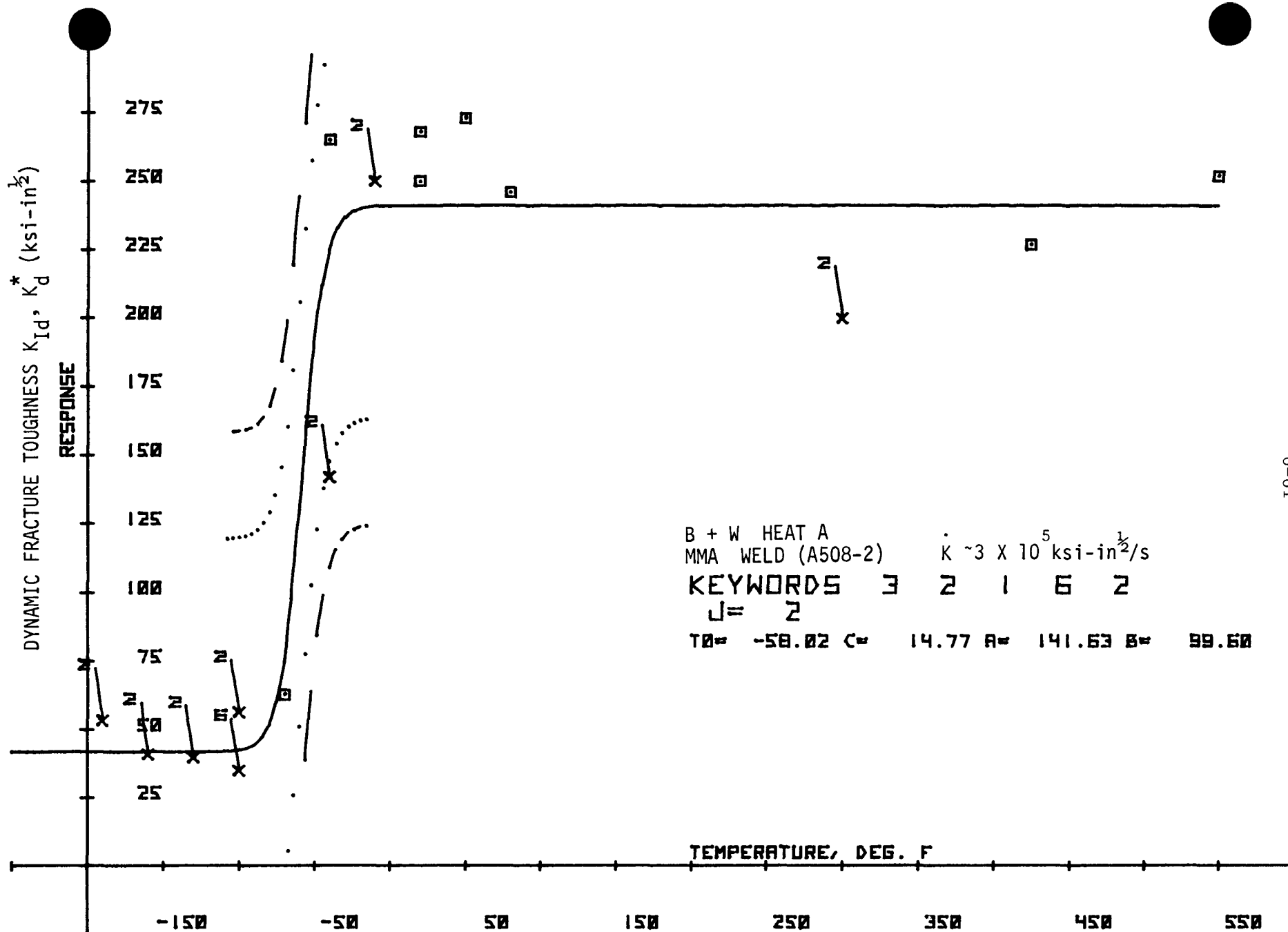


Figure 6.36. Precracked Charpy Fracture Toughness for B&W Heat A

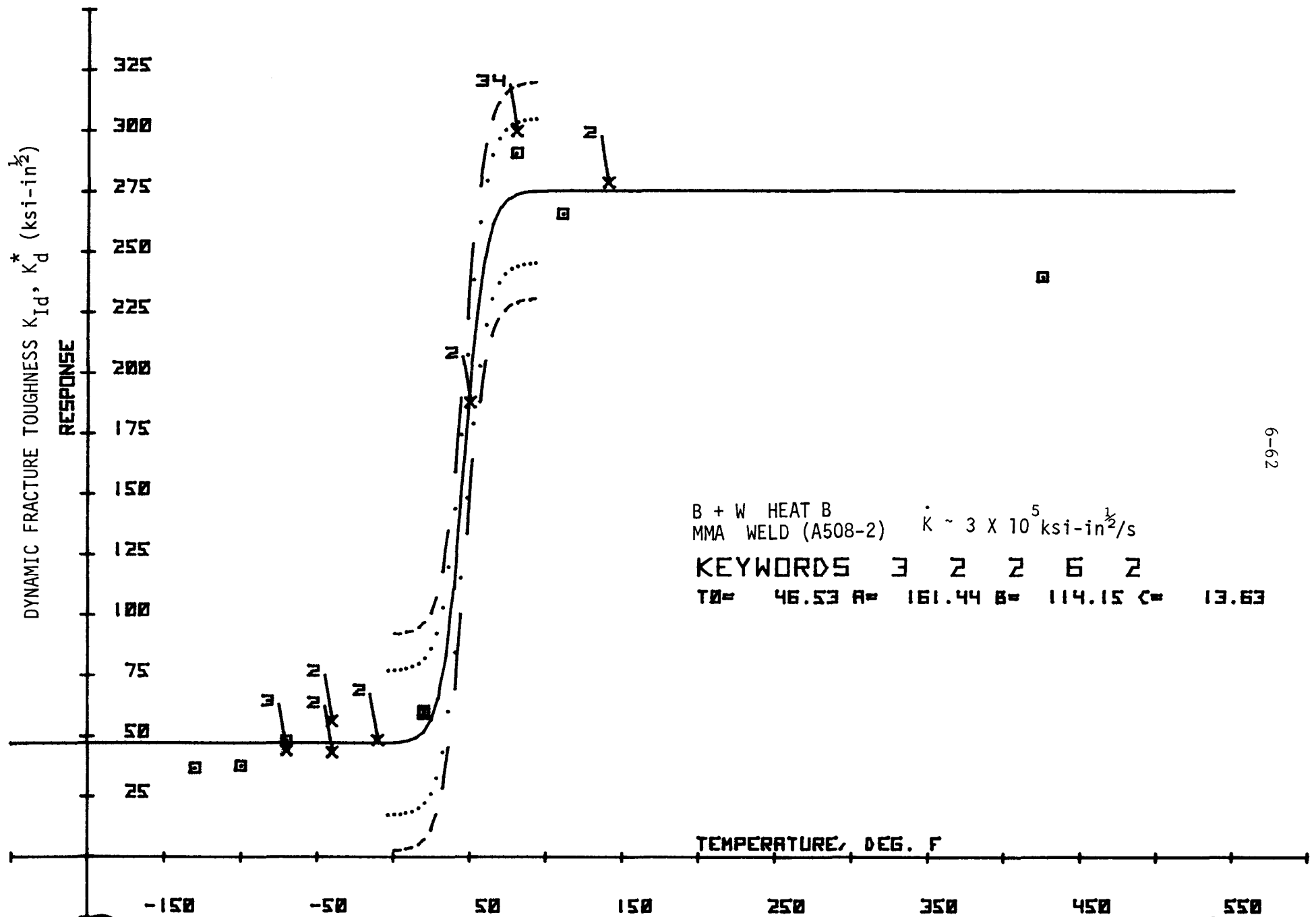


Figure 6.37. Precracked Charpy Fracture Toughness for B&W Heat B

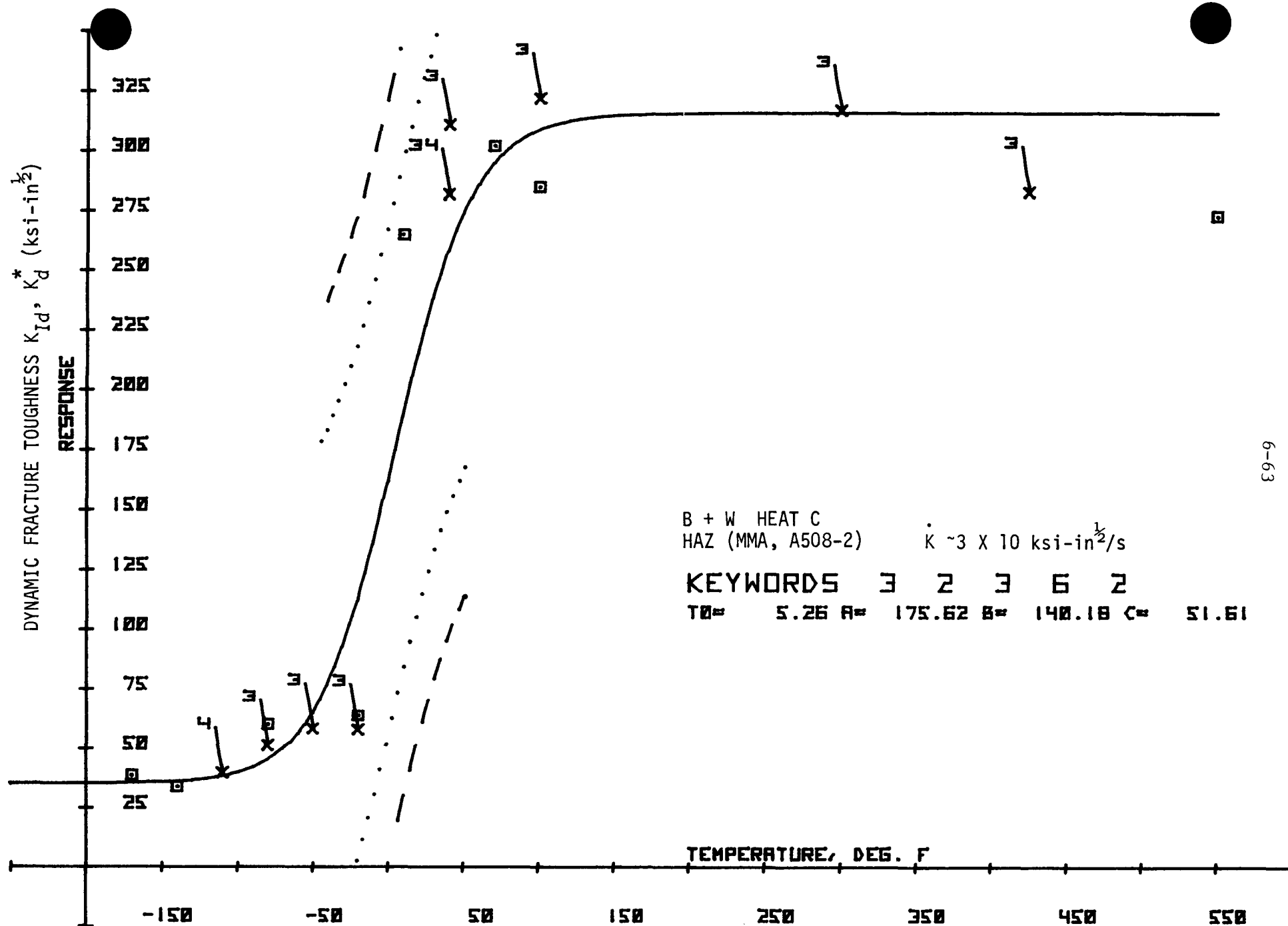
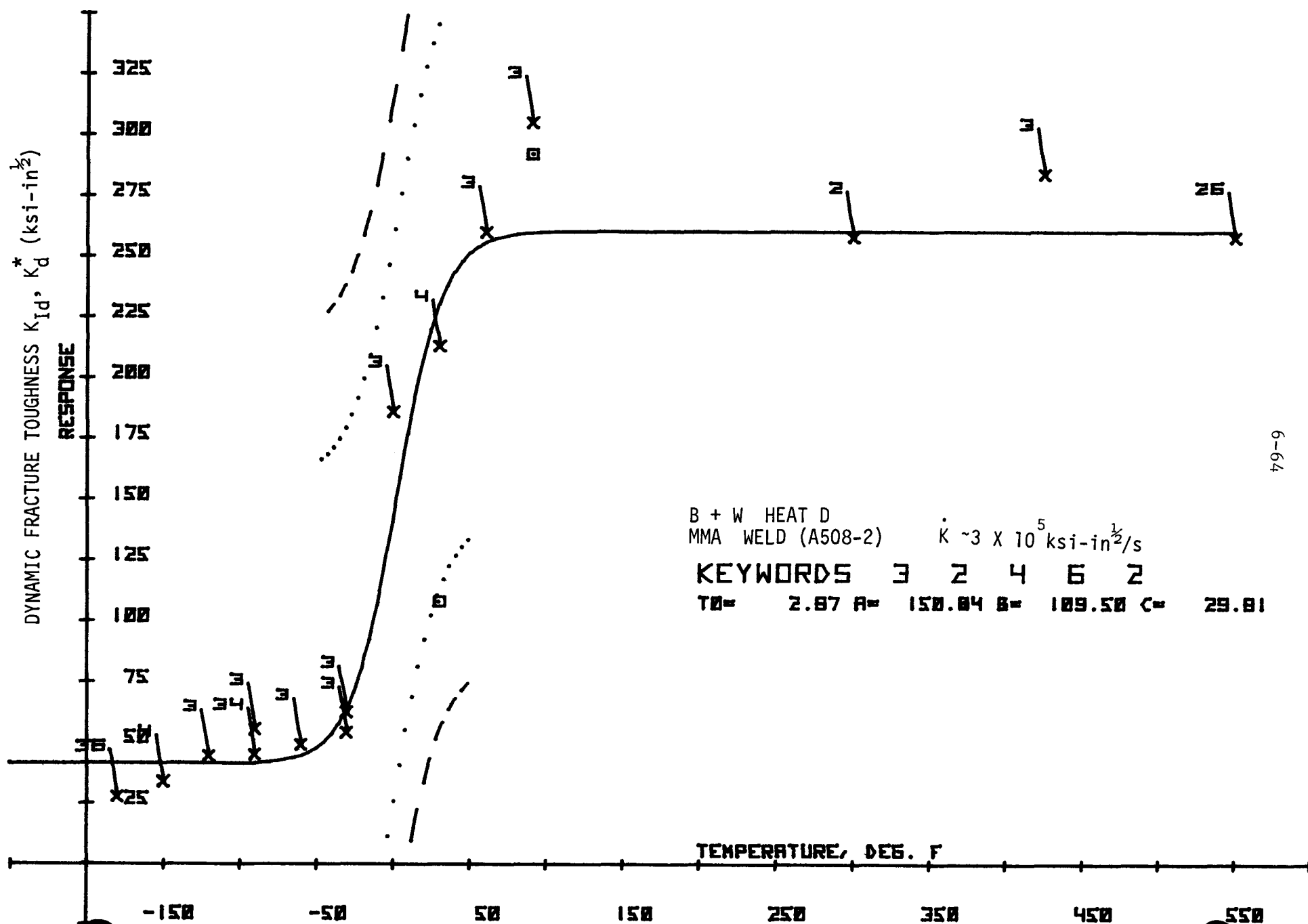


Figure 6.38. Precracked Charpy Fracture Toughness for B&W Heat C



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Figure 6.39. Precracked Charpy Fracture Toughness for B&W Heat D

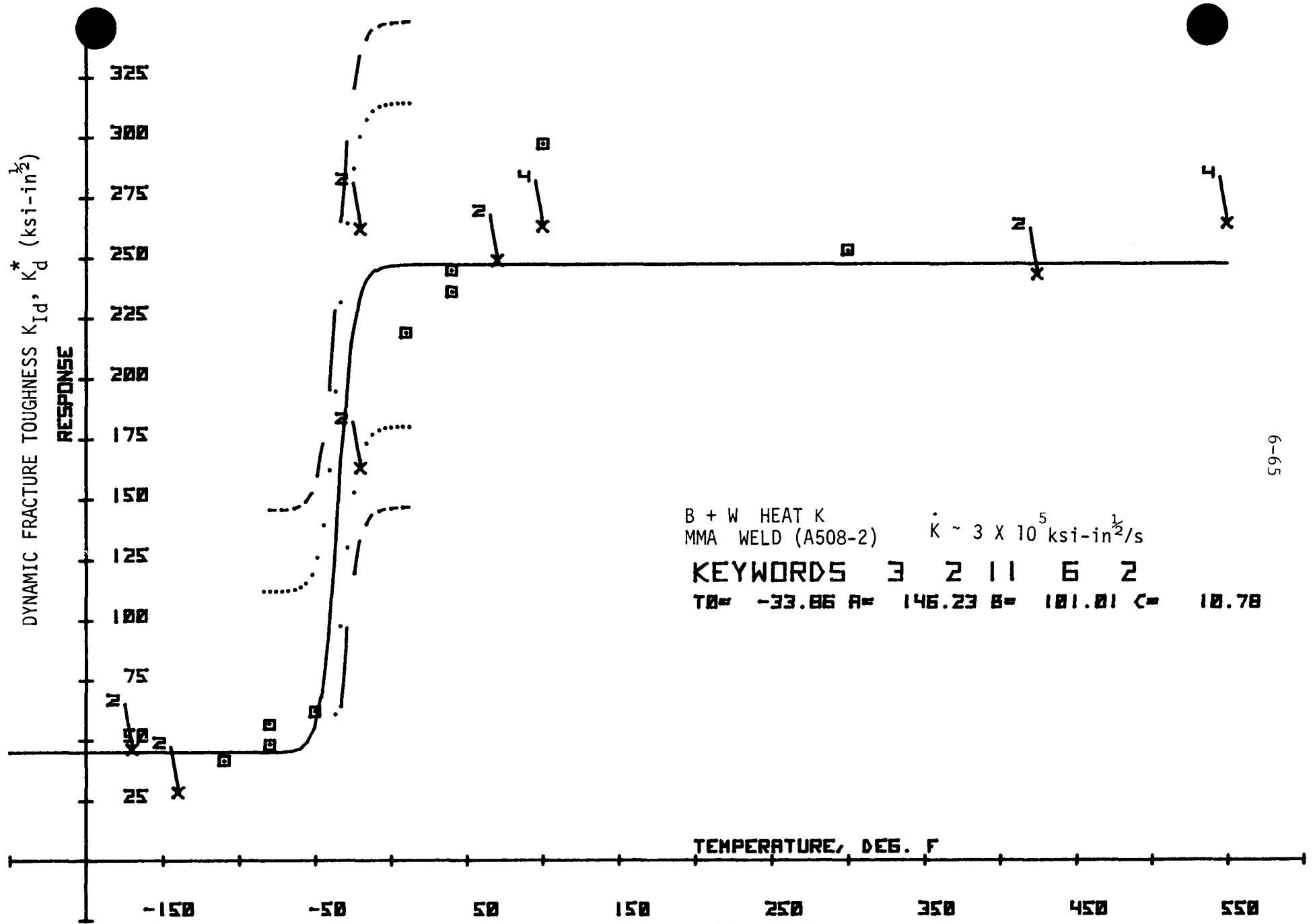


Figure 6.40. Precracked Charpy Fracture Toughness for B&W Heat K

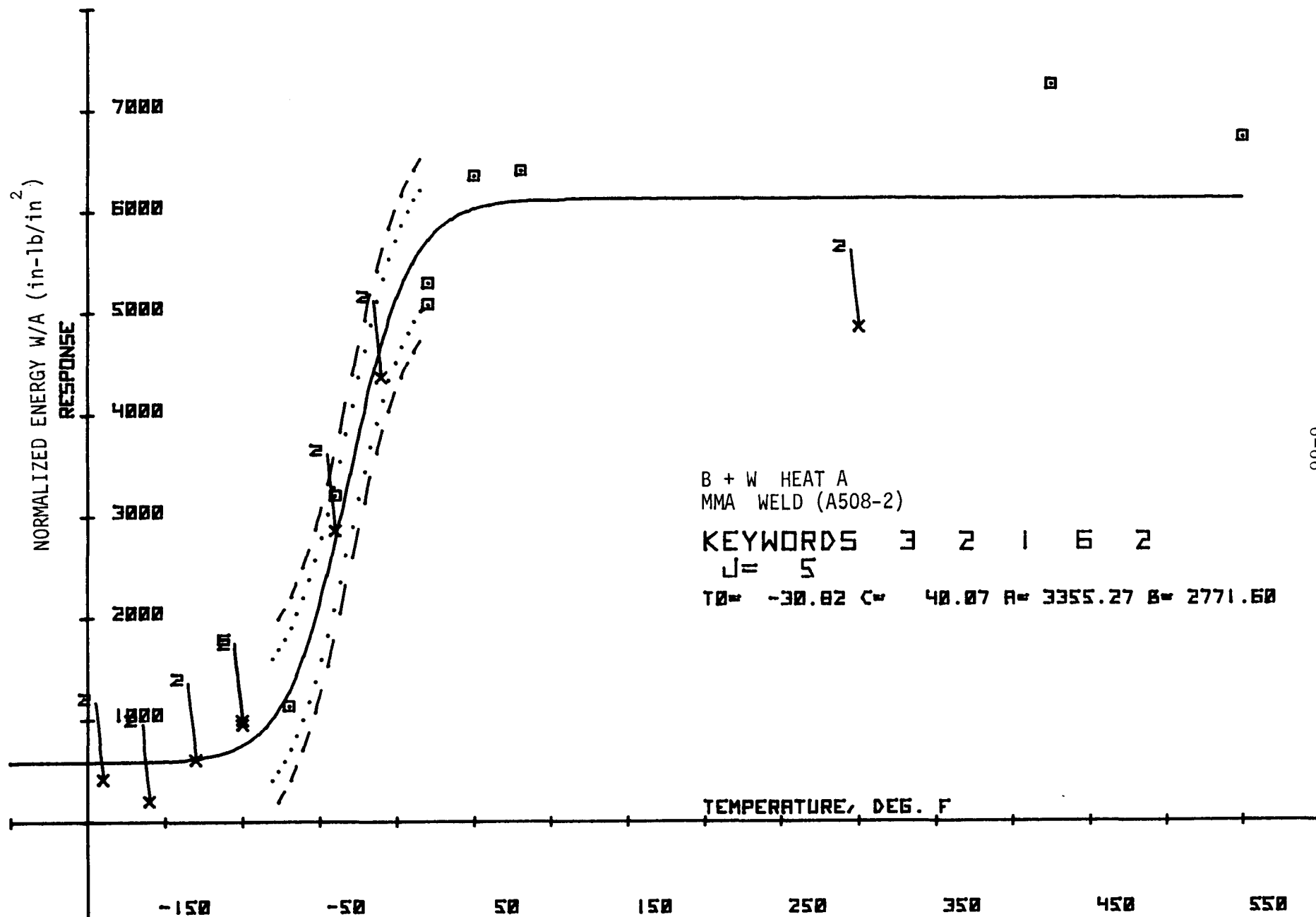


Figure 6.41. Precracked Charpy Normalized Energy for B&W Heat A

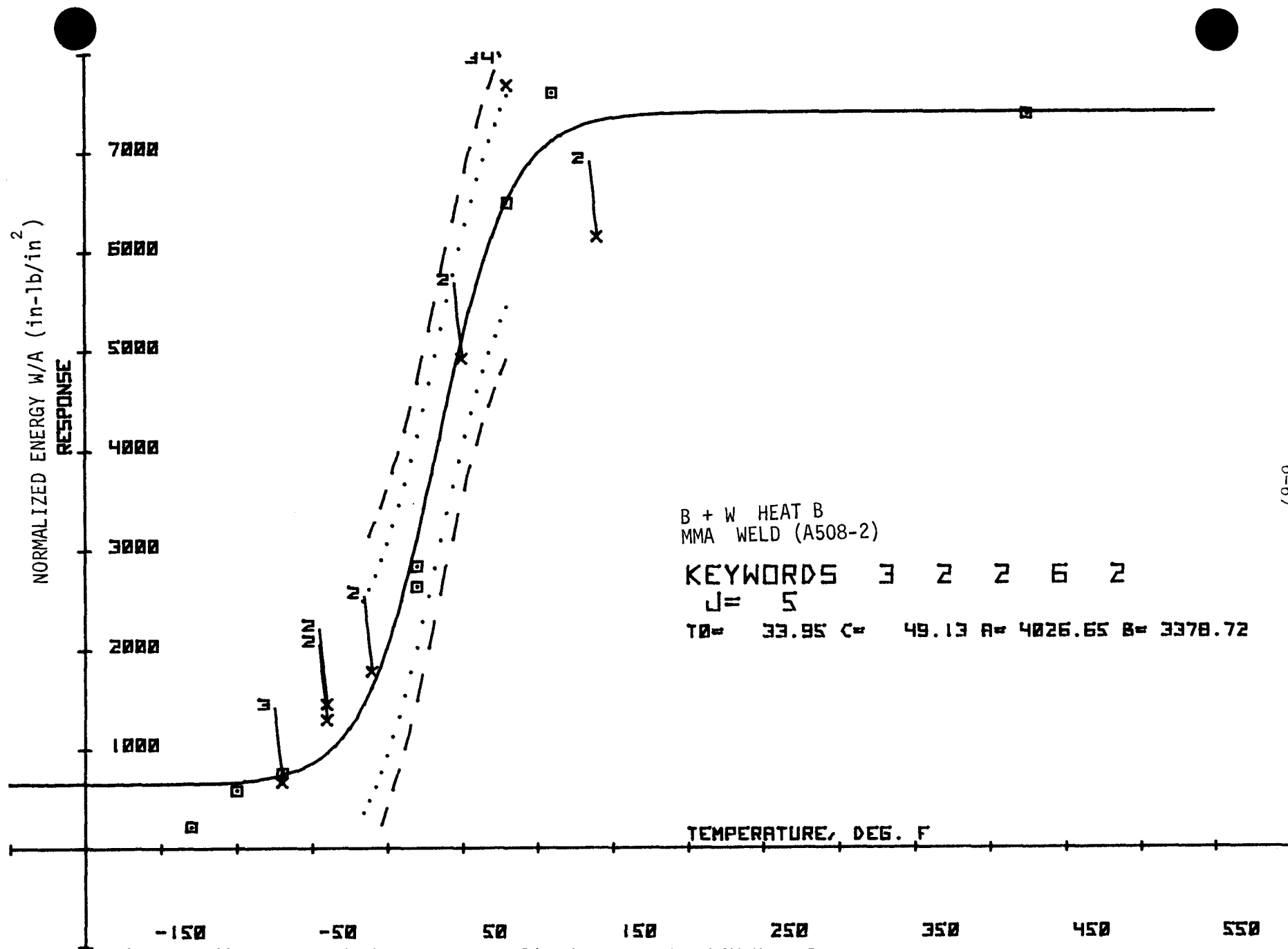


Figure 6.42. Precracked Charpy Normalized Energy for B&W Heat B

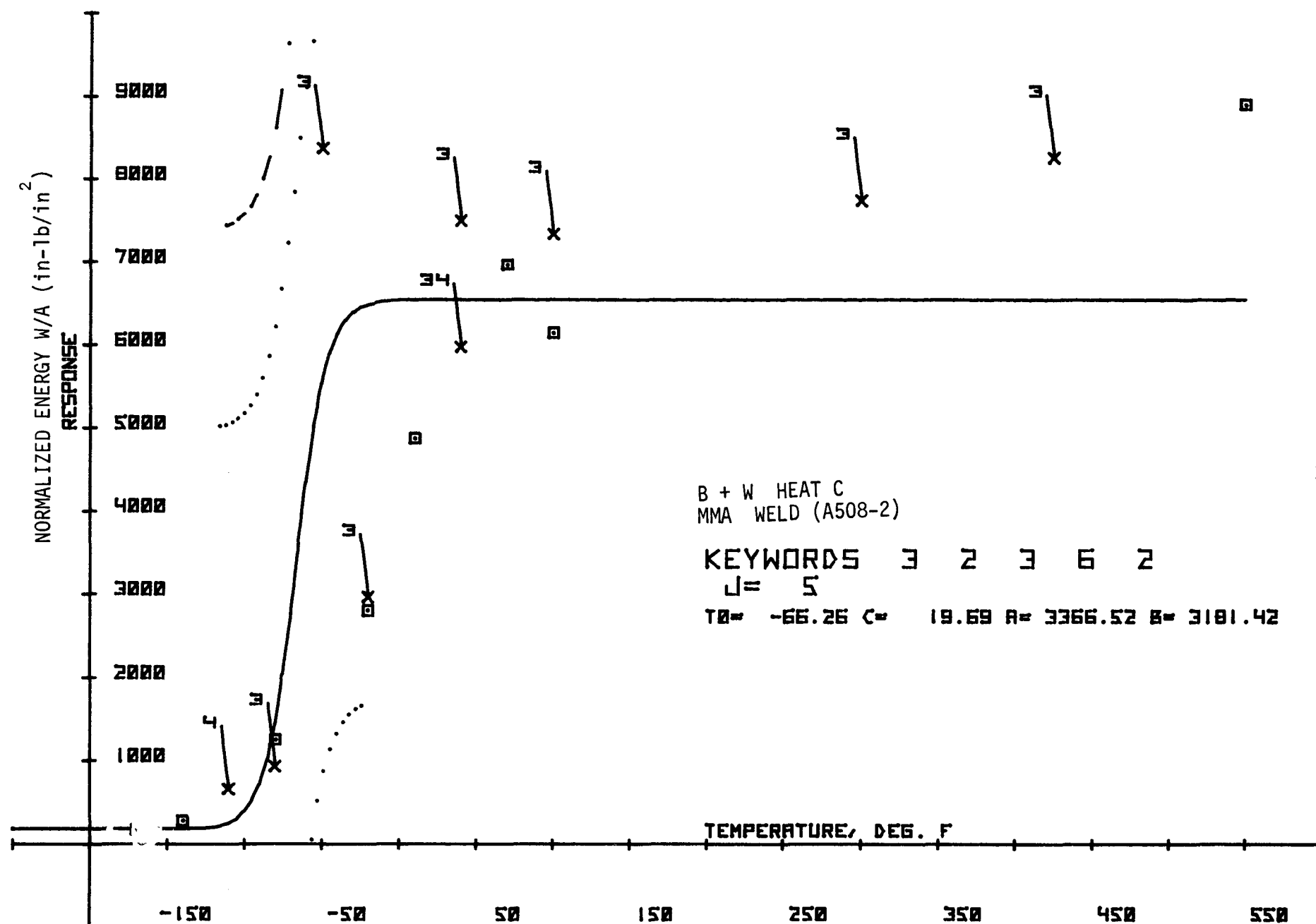


Figure 6.43. Precracked Charpy Normalized Energy for B&W Heat C

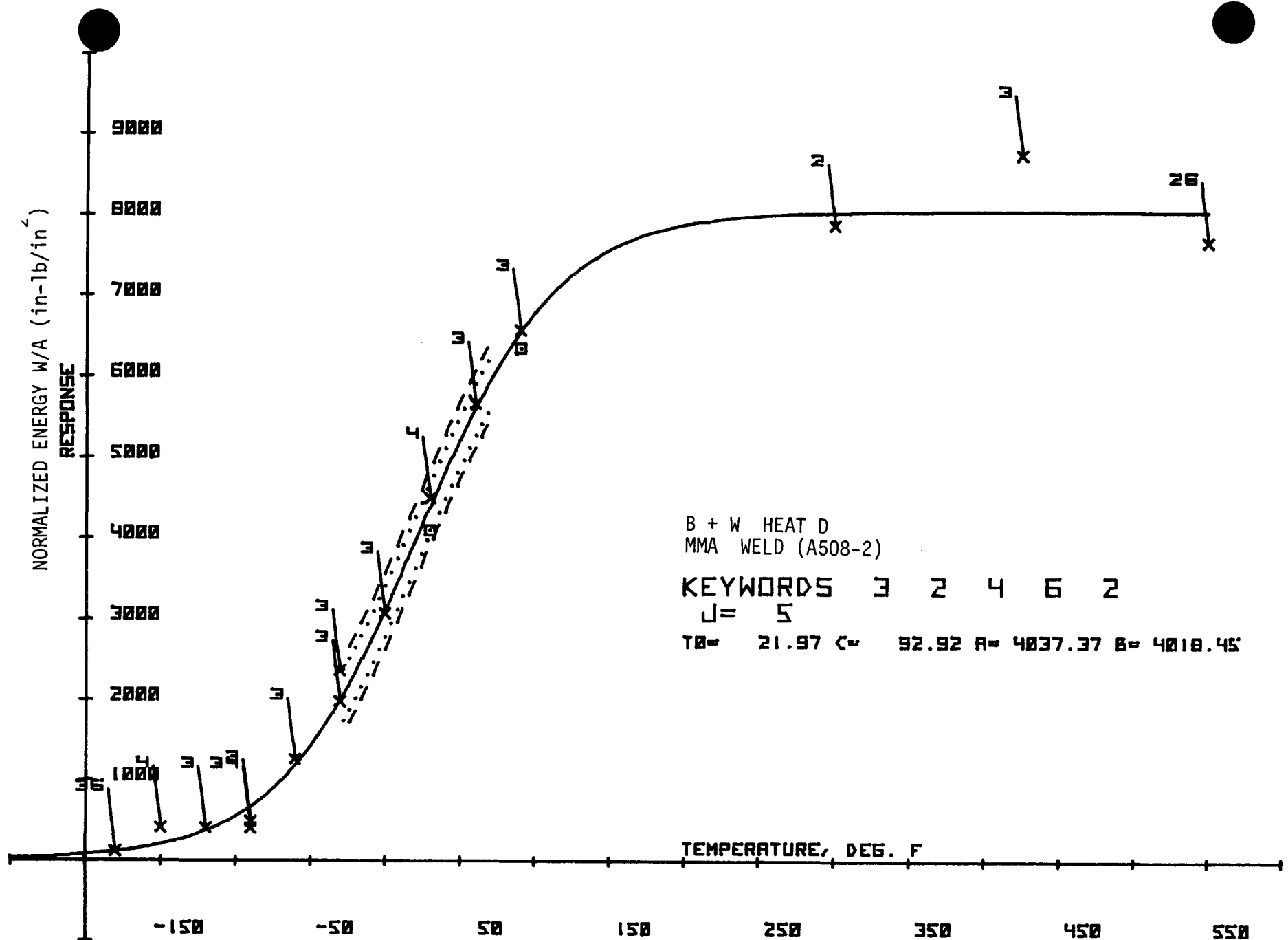


Figure 6.44. Precracked Charpy Normalized Energy for B&W Heat D

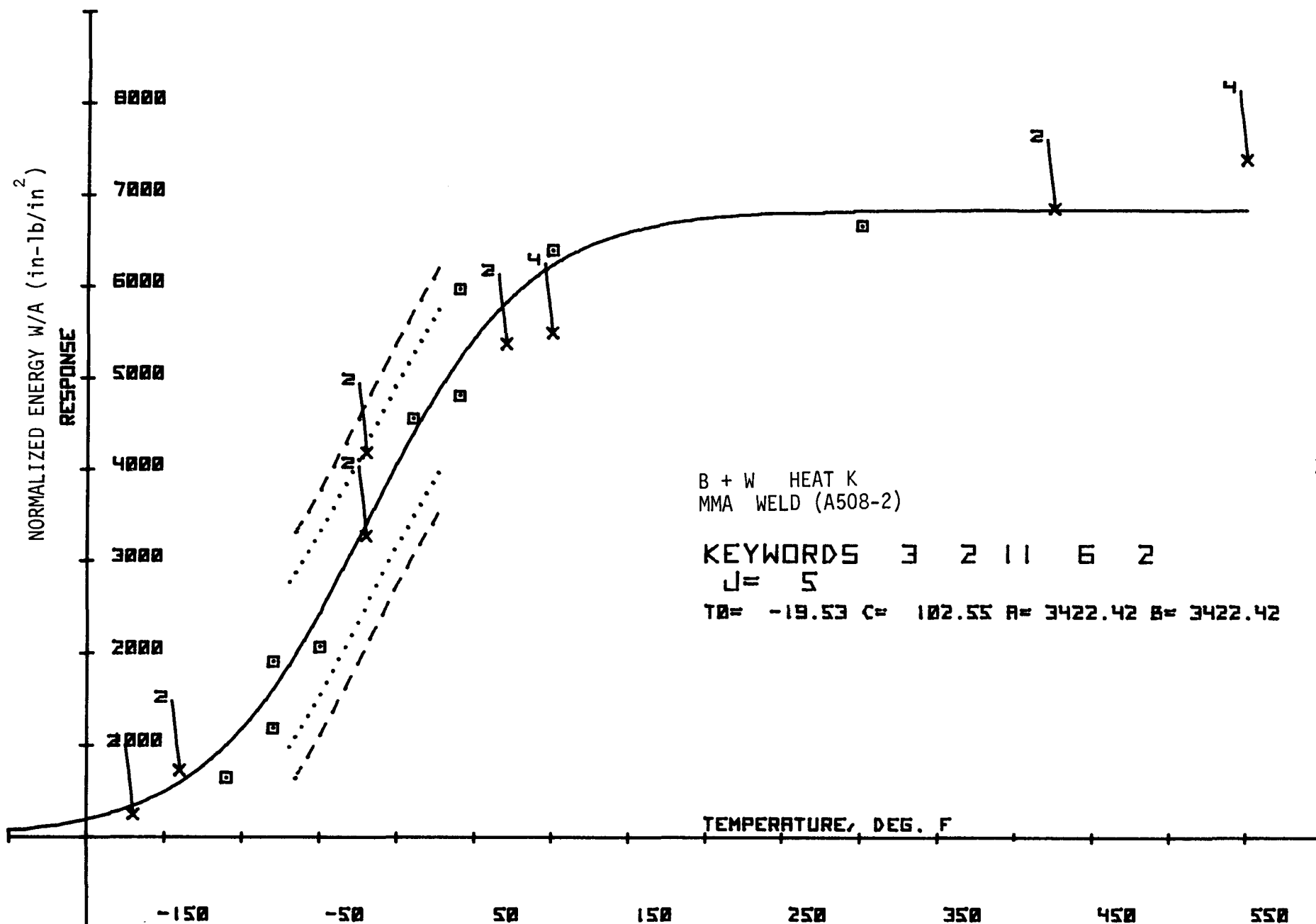


Figure 6.45. Precracked Charpy Normalized Energy for B&W Heat K

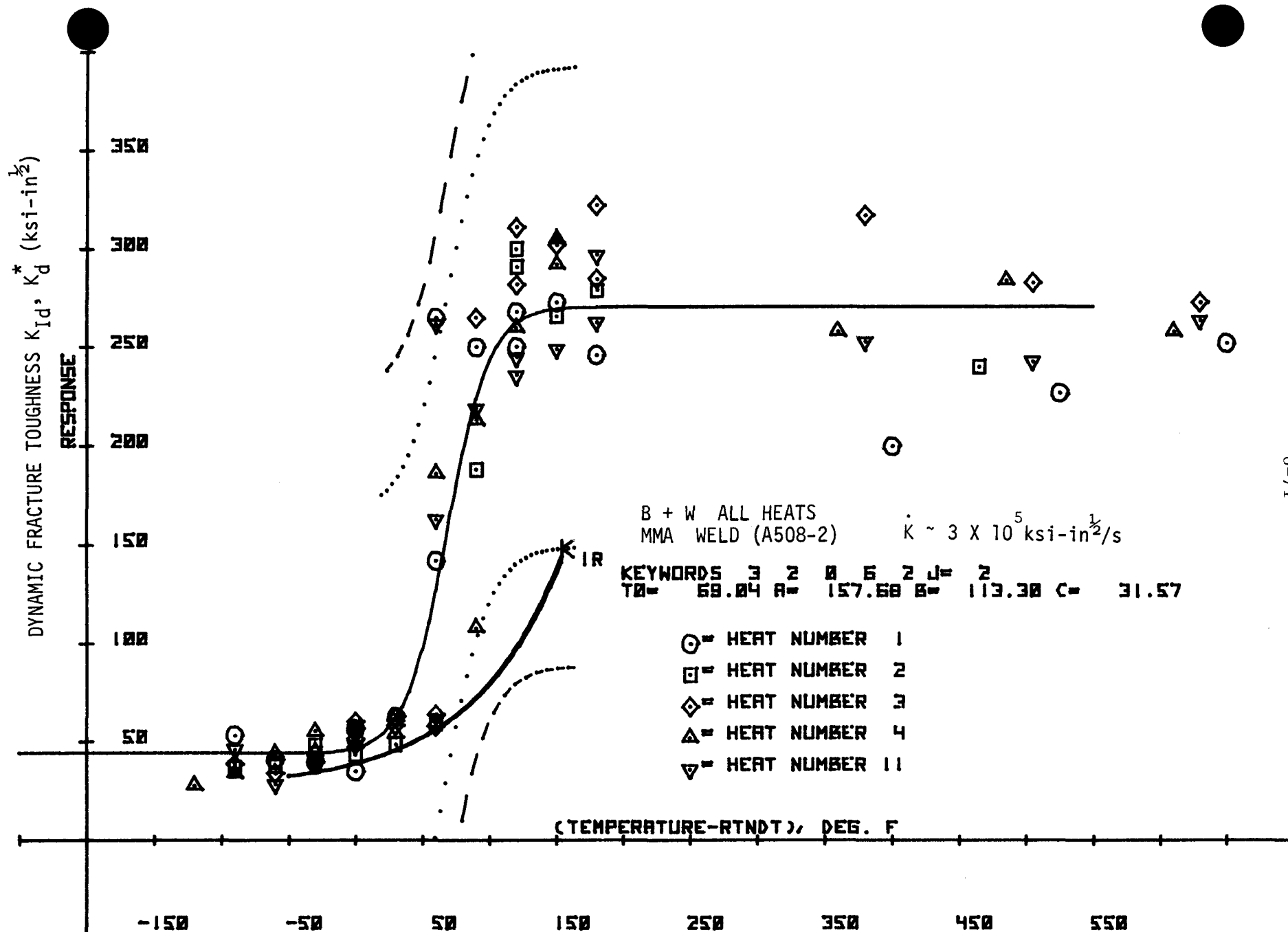


Figure 6.46. Precracked Charpy Fracture Toughness Data for All B&W Heats

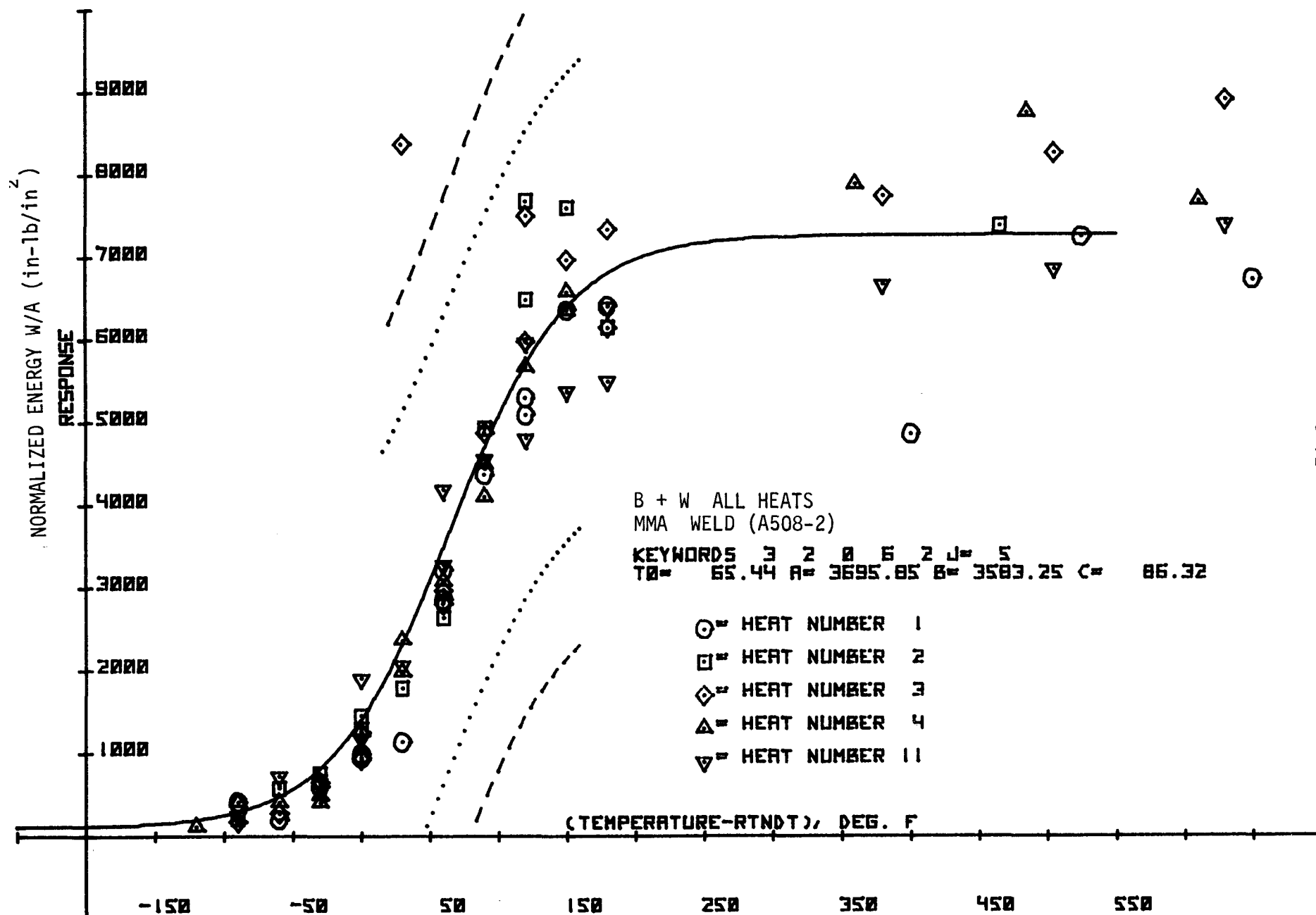


Figure 6.47. Precracked Charpy Normalized Energy for All B&W Heats

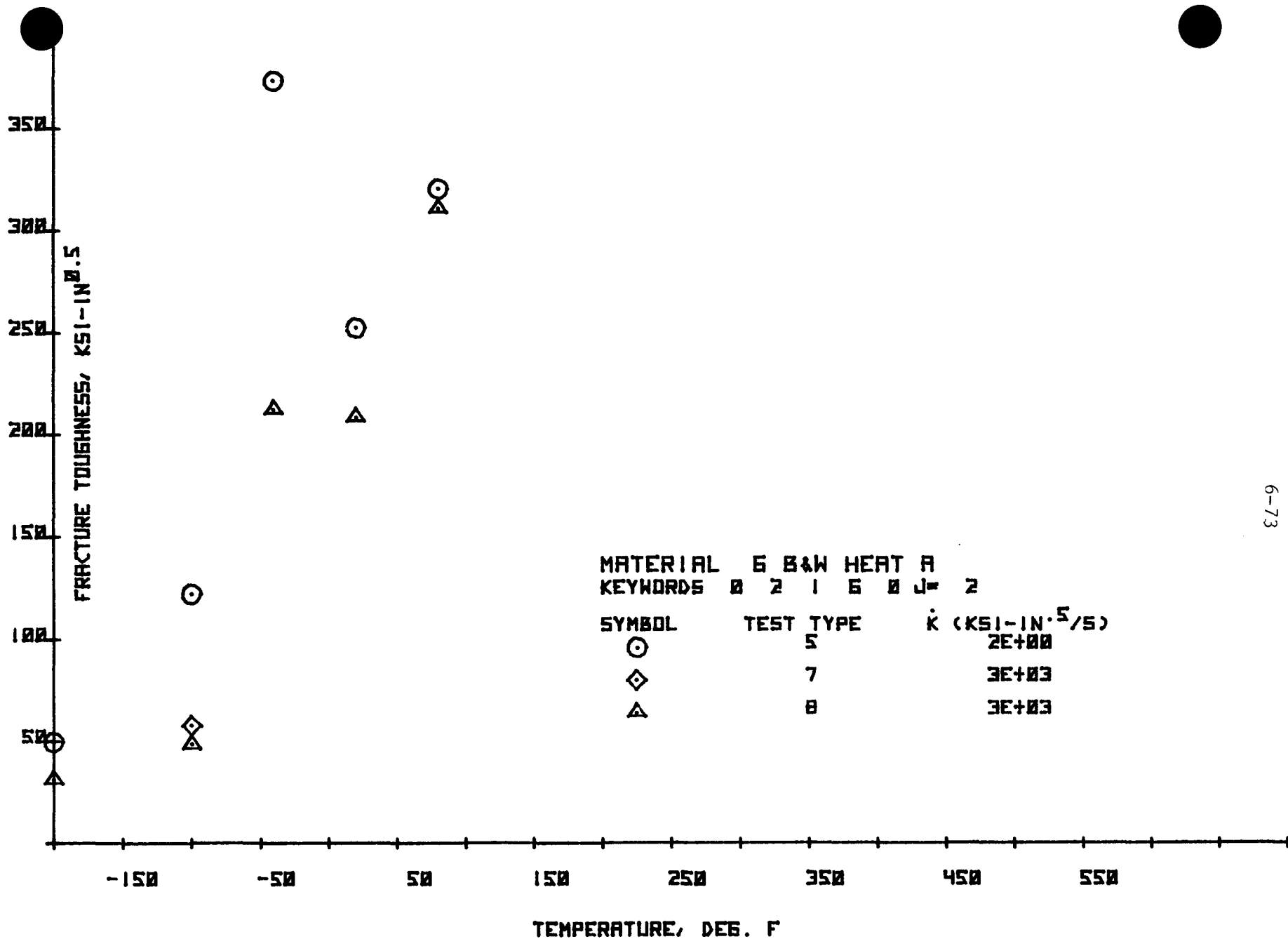


Figure 6.48. Static and Dynamic Fracture Toughness for B&W Heat A

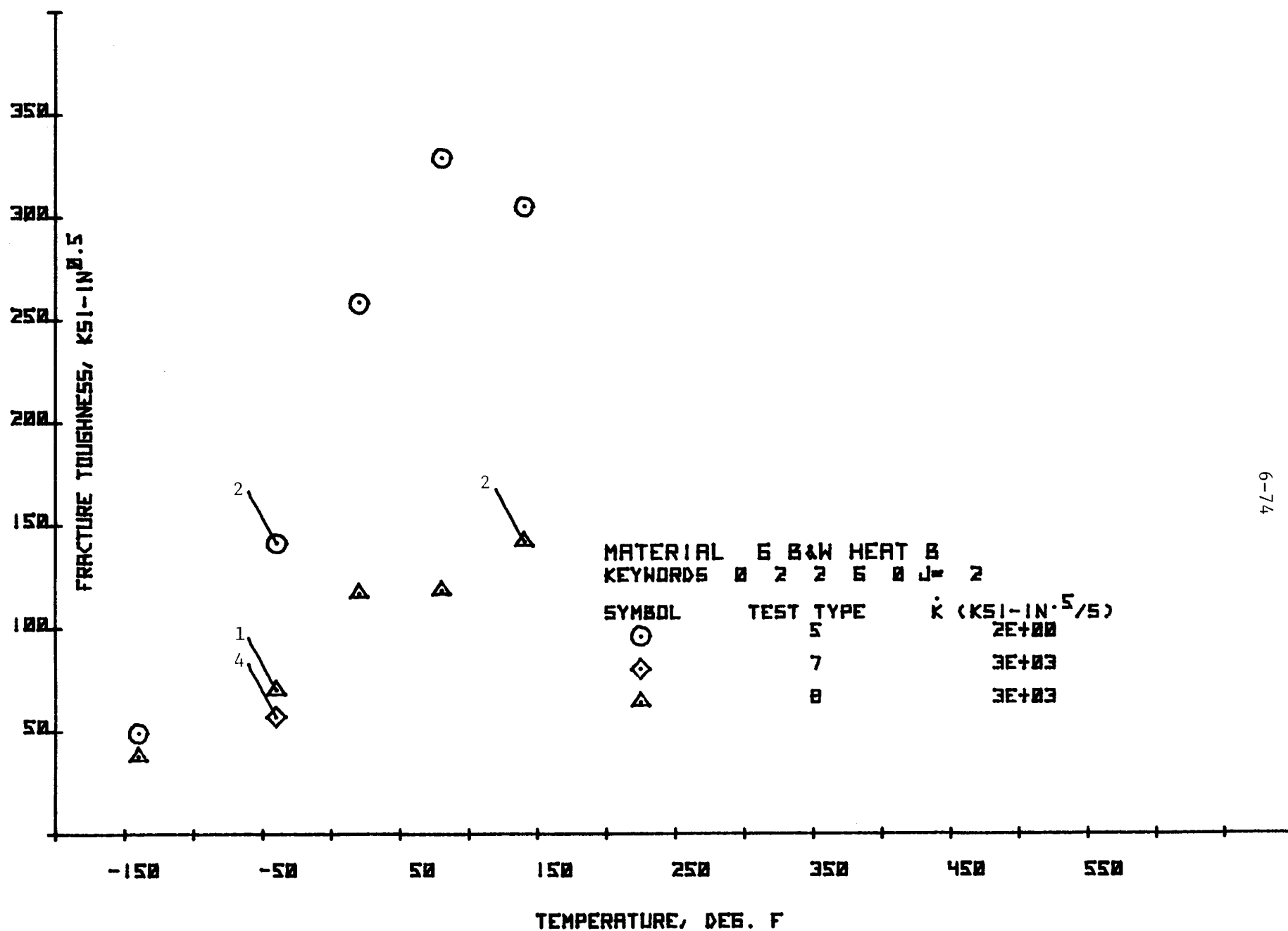


Figure 6.49. Static and Dynamic Fracture Toughness for B&W Heat B

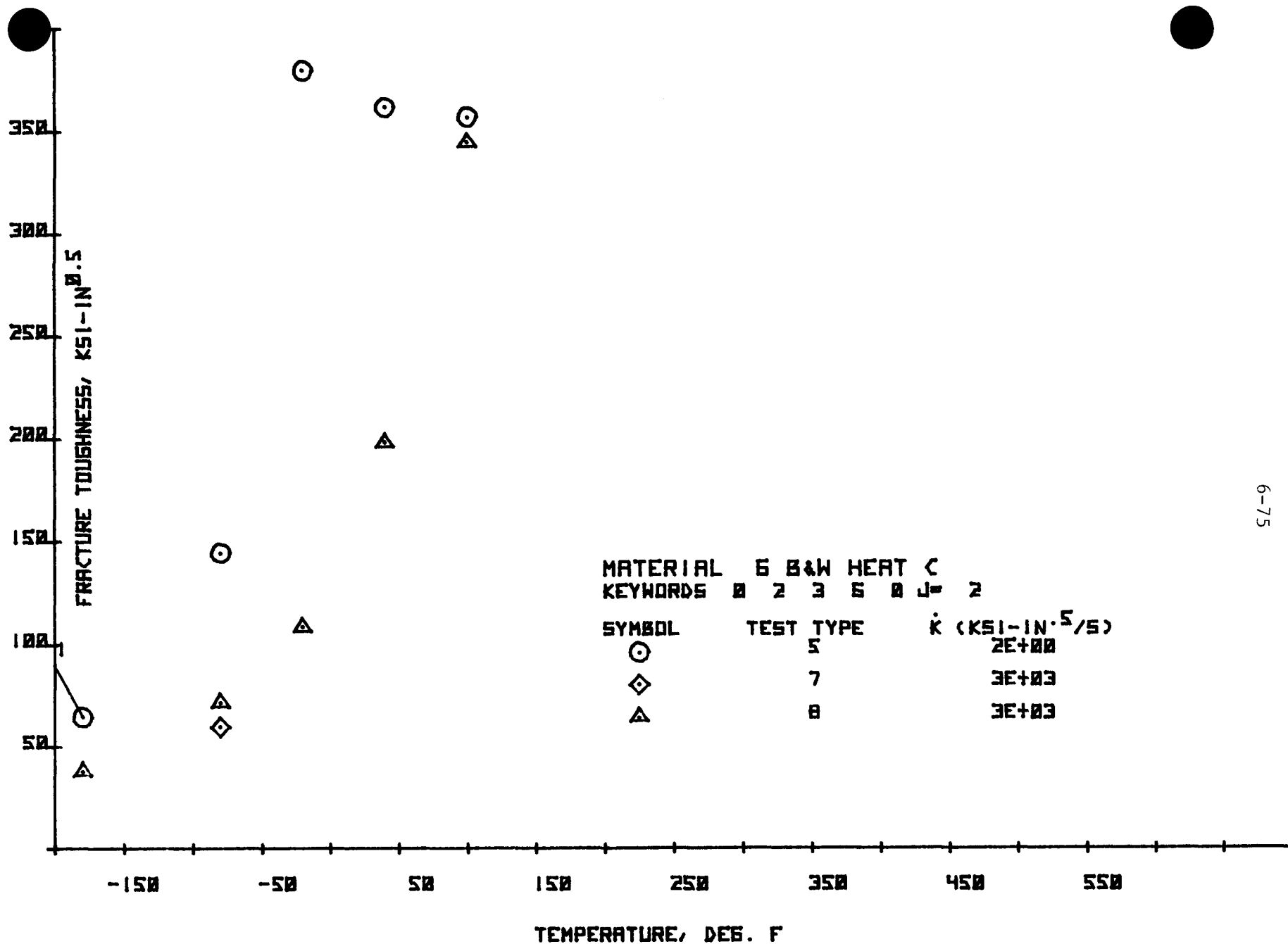


Figure 6.50. Static and Dynamic Fracture Toughness for B&W Heat C

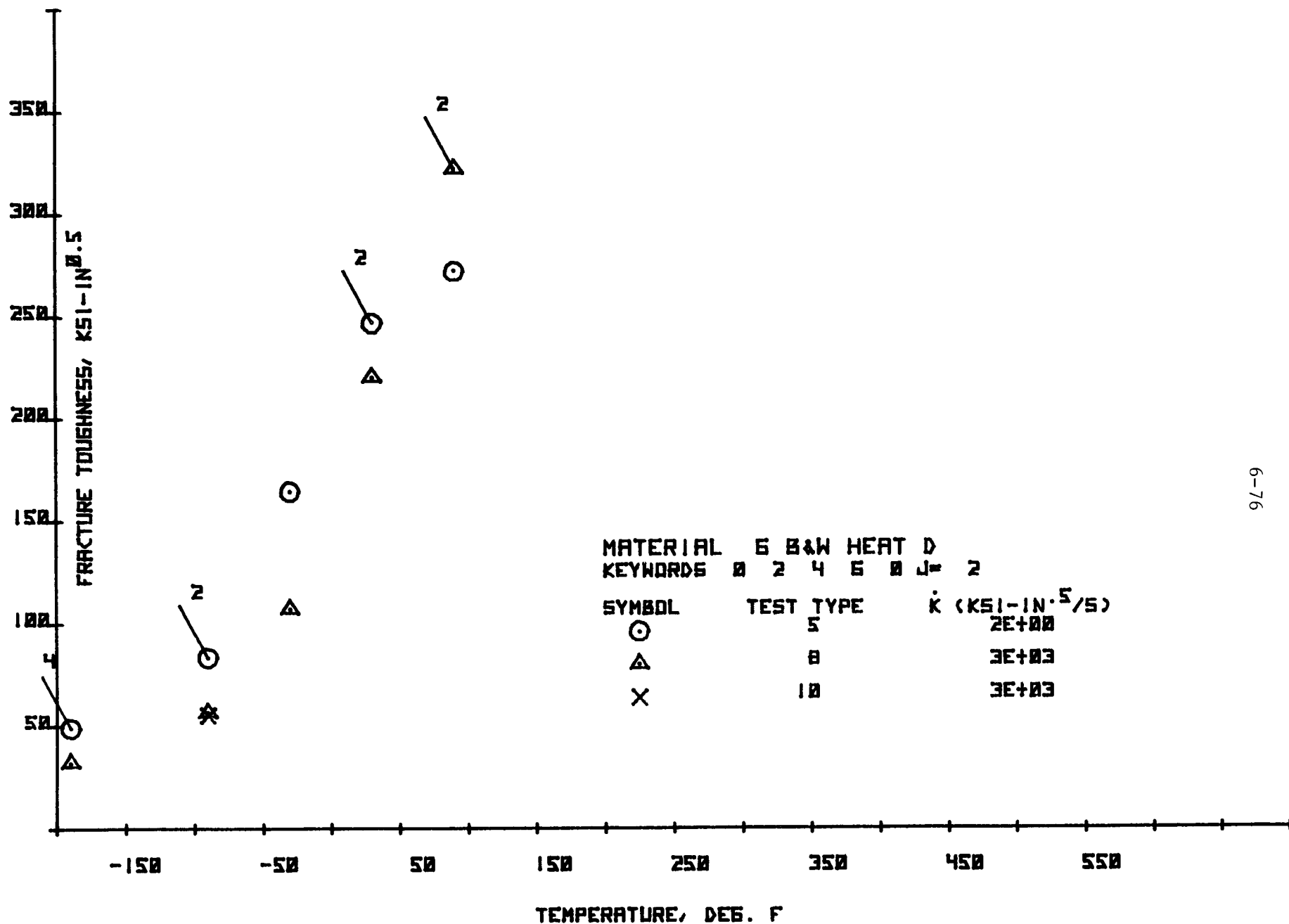


Figure 6.51. Static and Dynamic Fracture Toughness for B&W Heat D

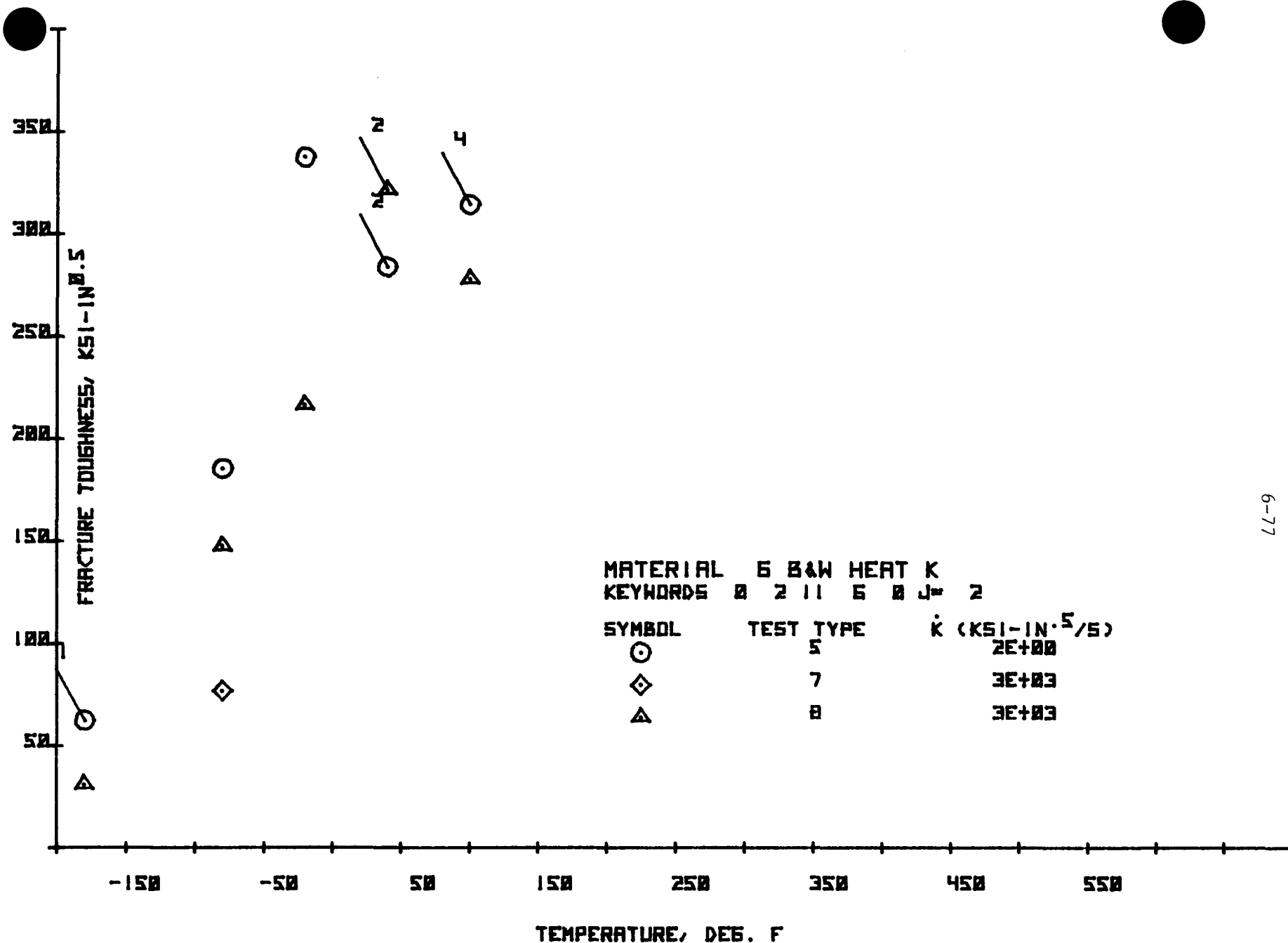


Figure 6.52. Static and Dynamic Fracture Toughness for B&W Heat K

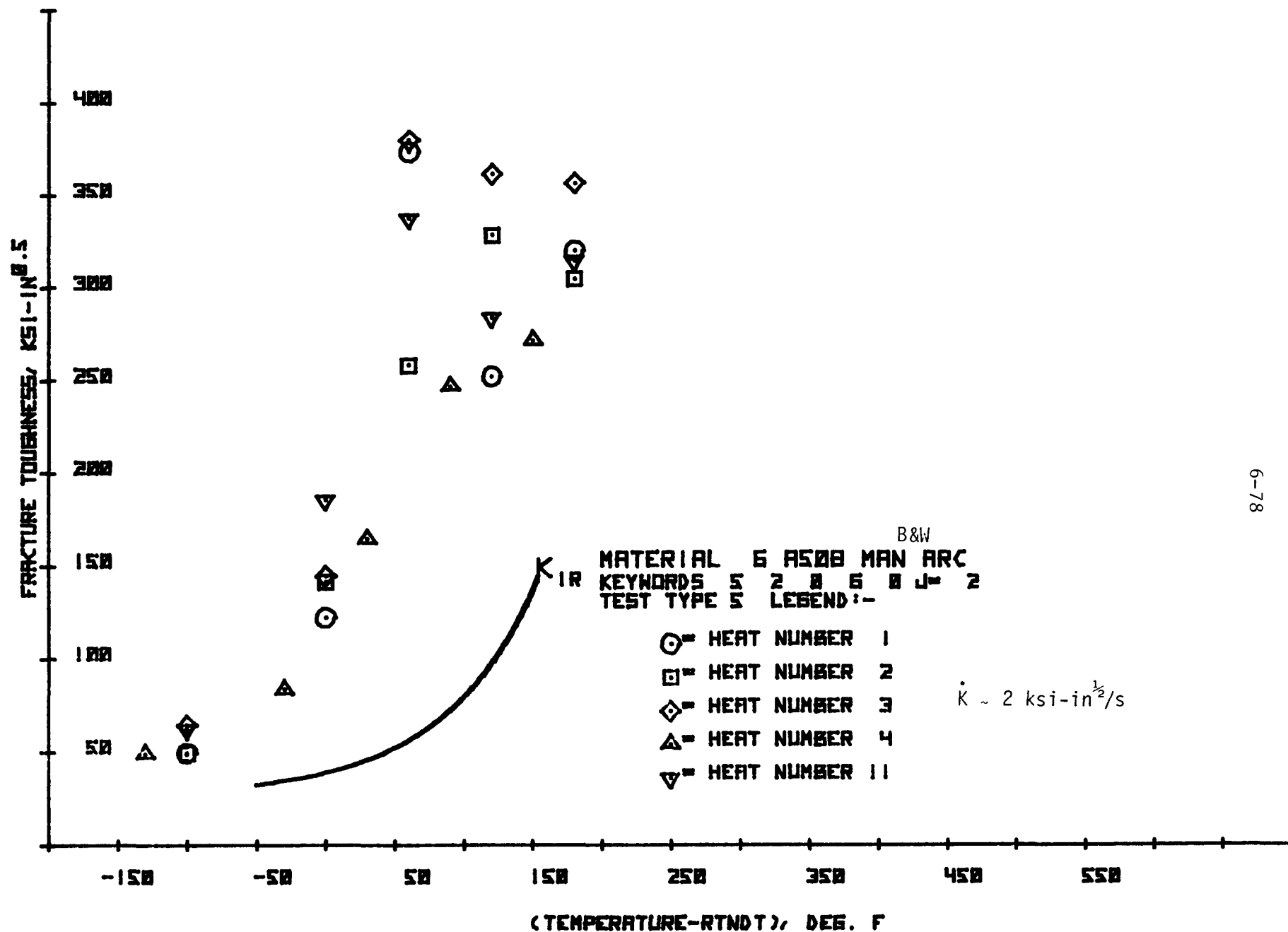


Figure 6.53. Static Fracture Toughness Data for All B&W Heats

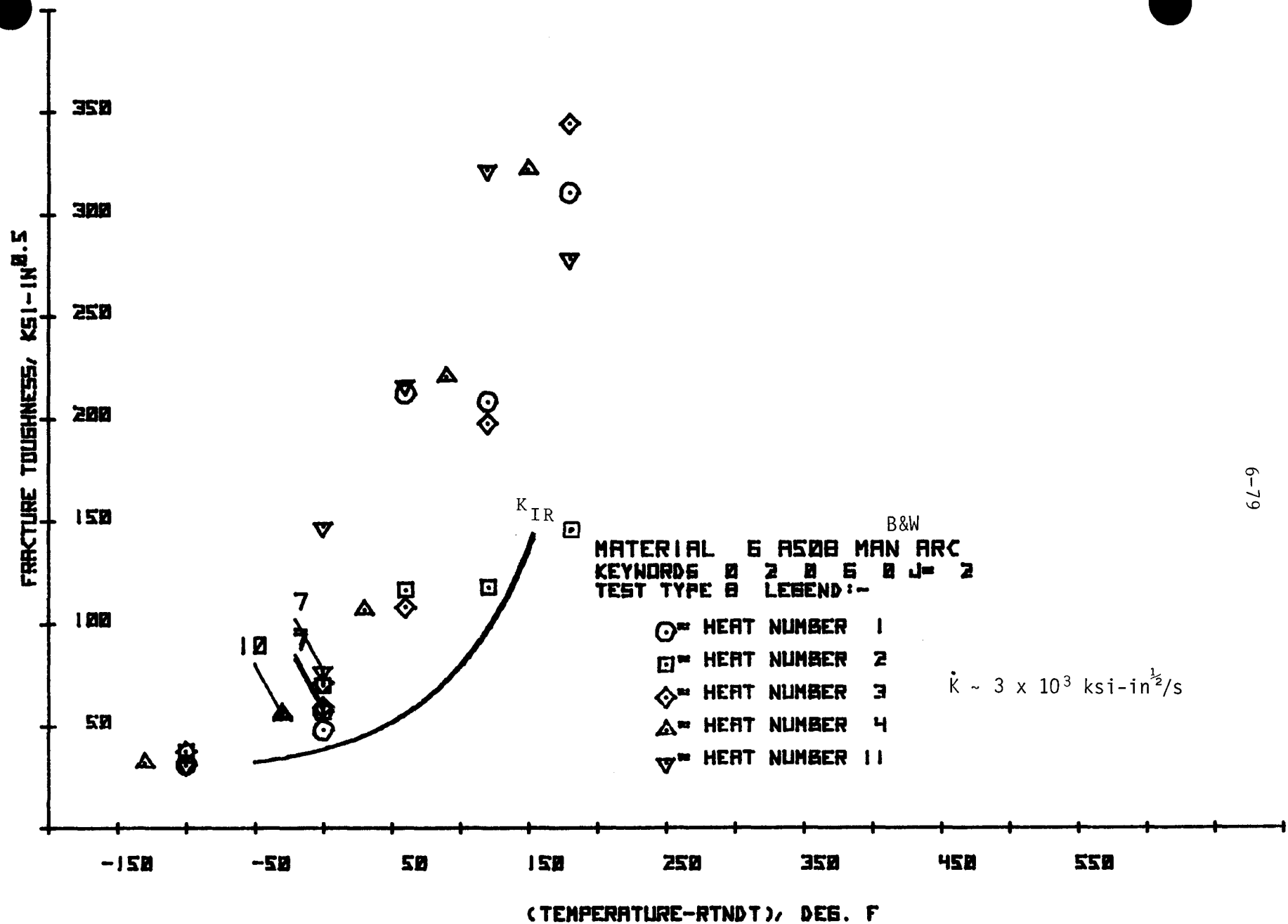


Figure 6.54. Dynamic Compact Specimen Fracture Toughness Data for All B&W Heats

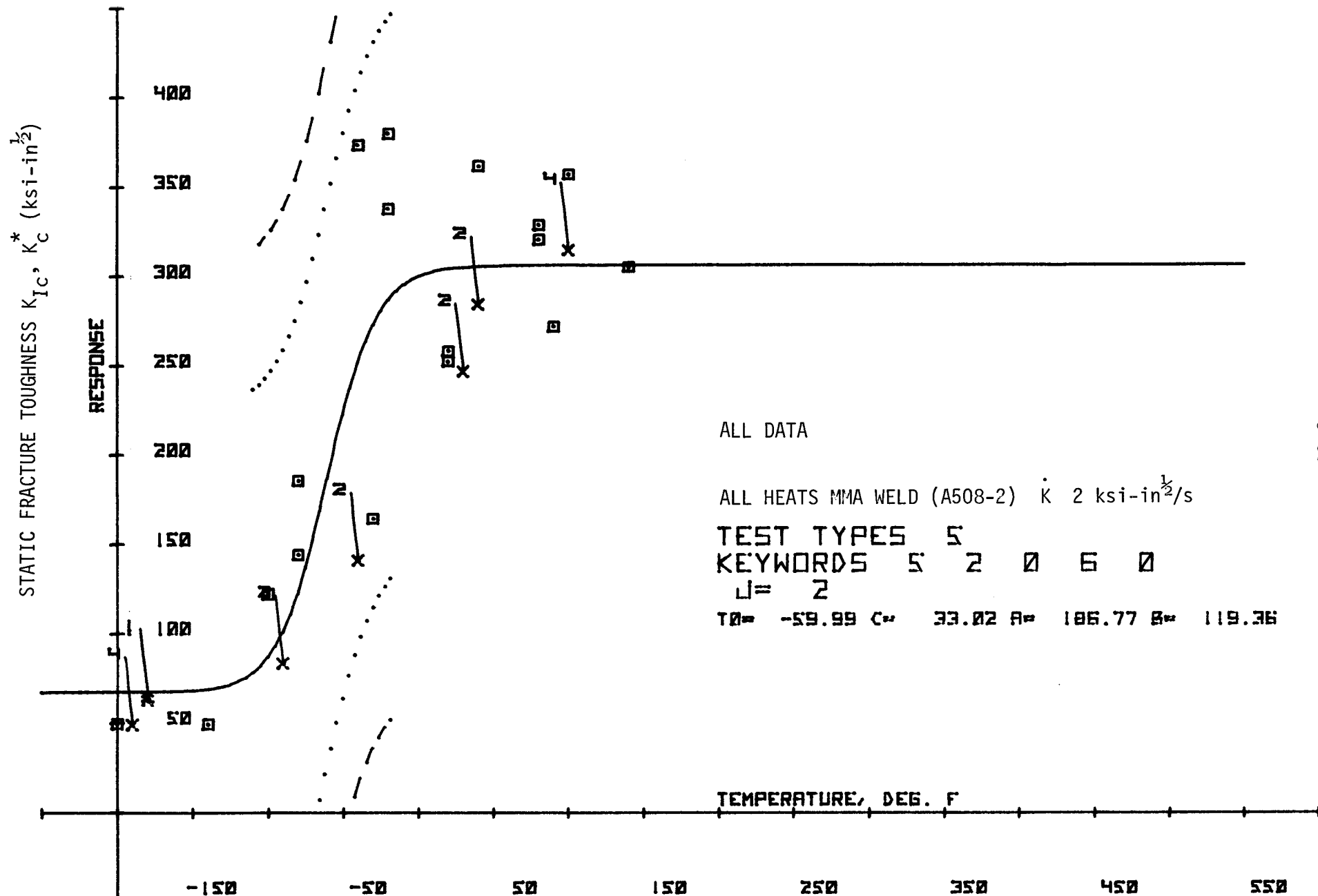


Figure 6.55. All Static Fracture Toughness Data for B&W Heats

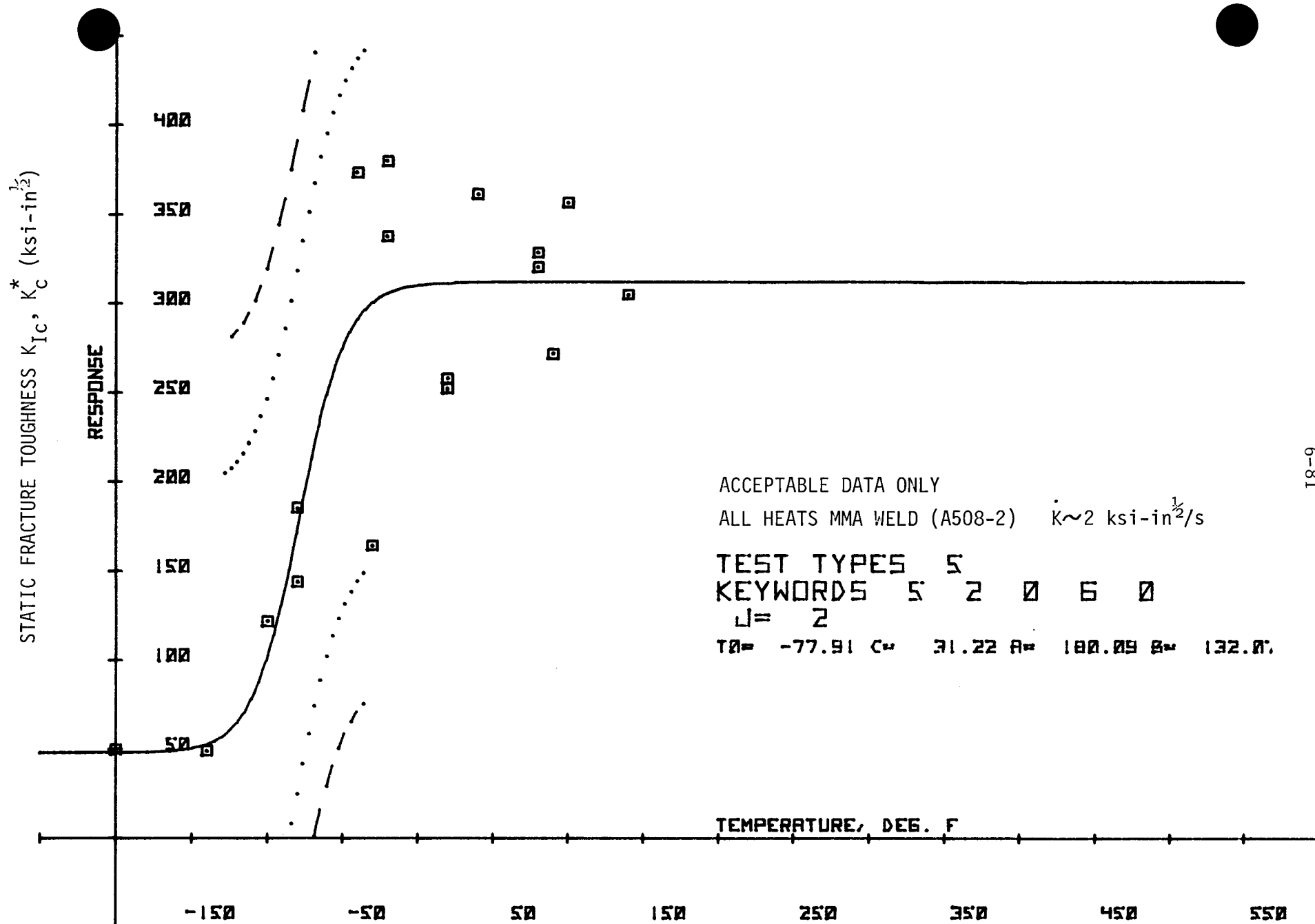


Figure 6.56. Acceptable Static Fracture Toughness Data for All B&W Heats

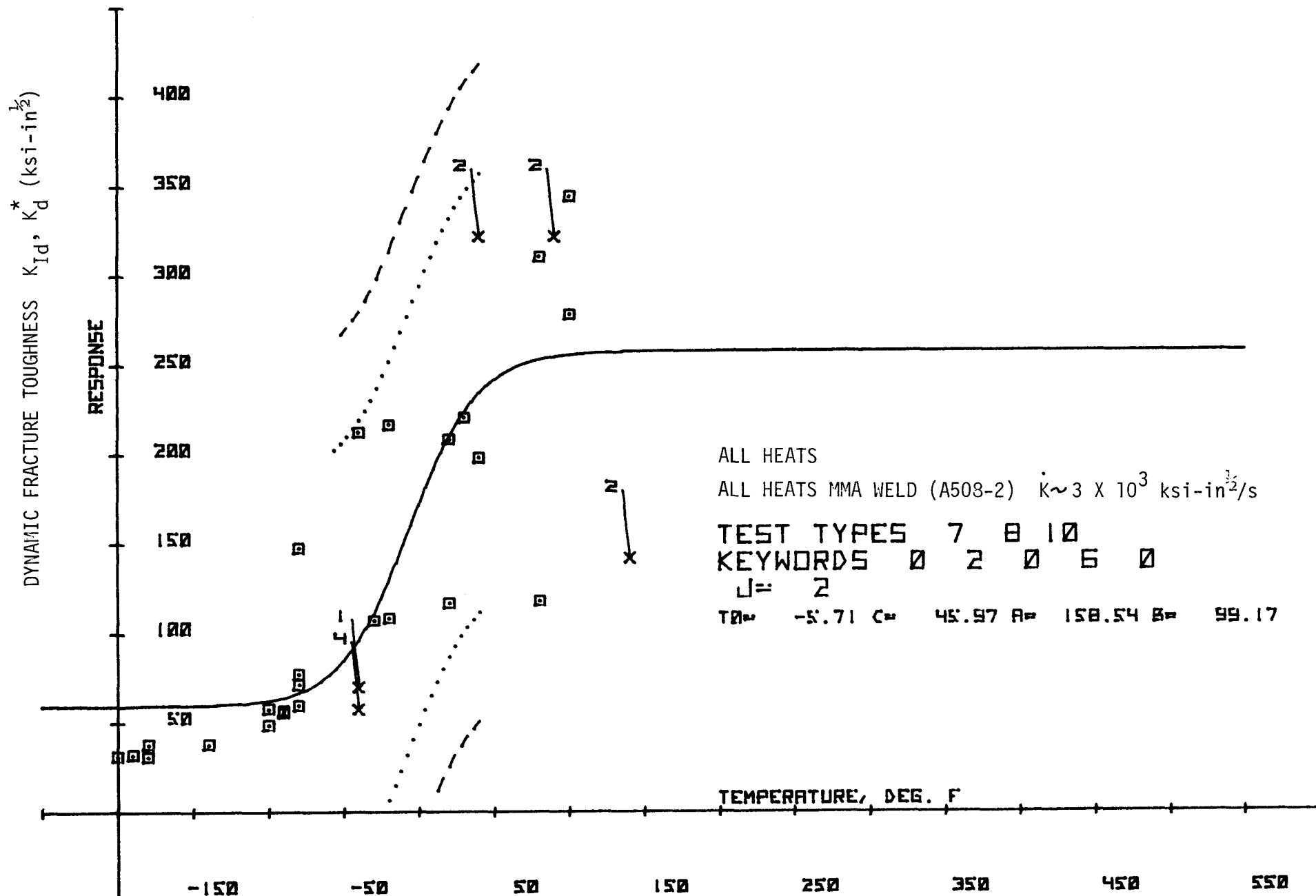
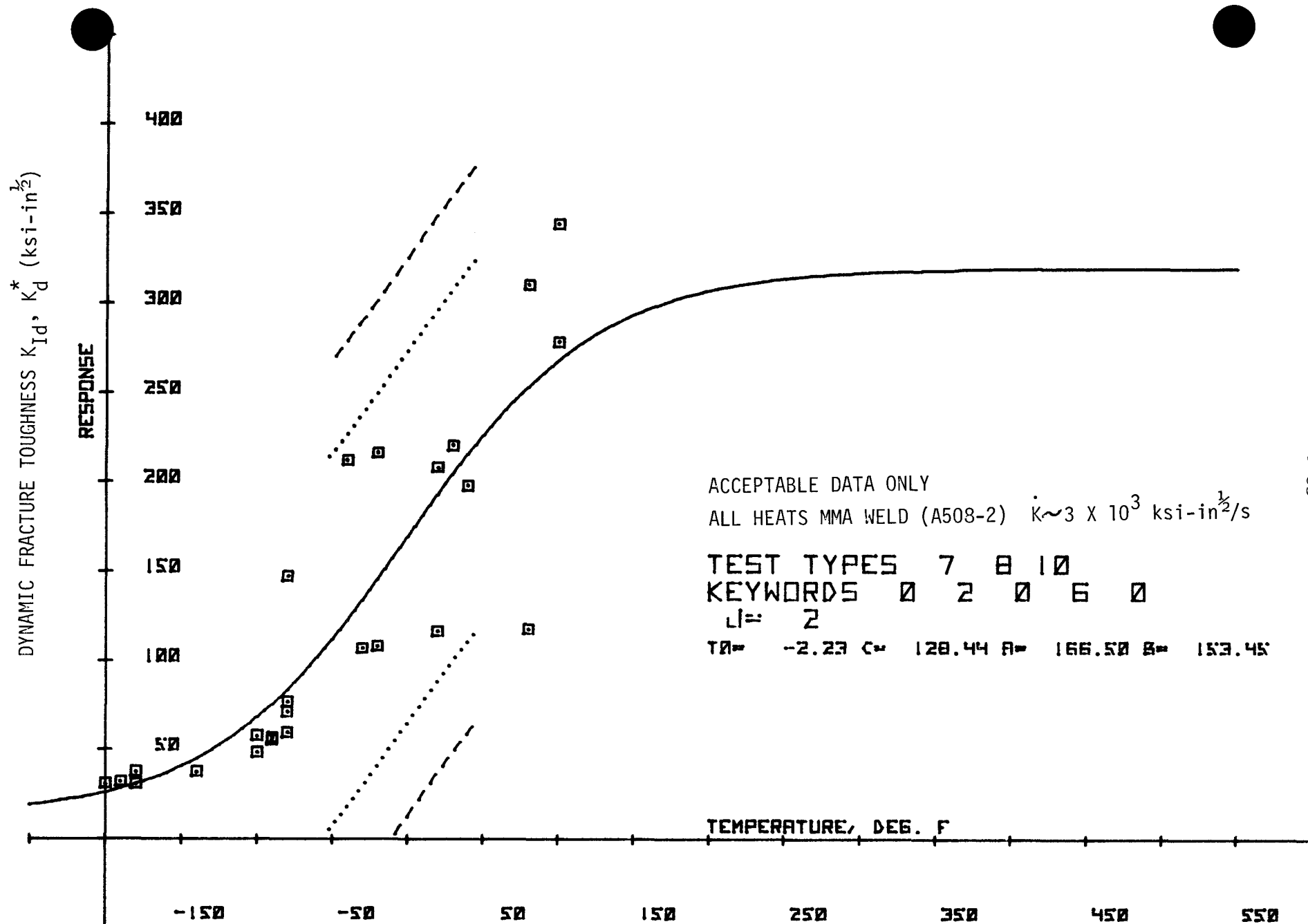


Figure 6.57. All Dynamic Compact Specimen Fracture Toughness Data for B&W Heats



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Figure 6.58. Acceptable Dynamic Compact Specimen Fracture Toughness Data for B&W Heats

KEYWORDS 0-0-0-0-0

MATERIAL 6 DATA BANK (MMA, HAZ, A508-2)

(5)	4-2-1-6-2-4-0	-100.00	1.00	---	---	---	---
(6)	4-2-1-6-2-5-0	-90.00	2.00	---	---	---	---
(7)	4-2-1-6-2-6-0	-90.00	2.00	---	---	---	---
(8)	4-2-1-6-2-3-0	-60.00	2.00	---	---	---	---
(9)	4-2-1-6-2-2-0	-40.00	2.00	---	---	---	---
(10)	4-2-1-6-2-1-0	0.00	2.00	---	---	---	---
(22)	4-2-2-6-2-4-0	-40.00	1.00	---	---	---	---
(23)	4-2-2-6-2-5-0	-30.00	2.00	---	---	---	---
(24)	4-2-2-6-2-6-0	-30.00	2.00	---	---	---	---
(38)	4-2-3-6-2-4-0	-90.00	1.00	---	---	---	---
(39)	4-2-3-6-2-5-0	-80.00	1.00	---	---	---	---
(40)	4-2-3-6-2-3-0	-80.00	2.00	---	---	---	---
(41)	4-2-3-6-2-6-0	-70.00	2.00	---	---	---	---
(42)	4-2-3-6-2-7-0	-70.00	2.00	---	---	---	---
(43)	4-2-3-6-2-2-0	-40.00	2.00	---	---	---	---
(44)	4-2-3-6-2-1-0	0.00	2.00	---	---	---	---
(58)	4-2-4-6-2-4-0	-90.00	1.00	---	---	---	---
(59)	4-2-4-6-2-3-0	-80.00	2.00	---	---	---	---
(60)	4-2-4-6-2-5-0	-60.00	2.00	---	---	---	---
(61)	4-2-4-6-2-2-0	-40.00	2.00	---	---	---	---
(62)	4-2-4-6-2-1-0	0.00	2.00	---	---	---	---
(100)	4-2-11-6-2-4-0	-100.00	1.00	---	---	---	---
(101)	4-2-11-6-2-5-0	-80.00	1.00	---	---	---	---
(102)	4-2-11-6-2-6-0	-70.00	2.00	---	---	---	---
(103)	4-2-11-6-2-7-0	-70.00	2.00	---	---	---	---
(104)	4-2-11-6-2-3-0	-60.00	2.00	---	---	---	---
(105)	4-2-11-6-2-2-0	-40.00	2.00	---	---	---	---
(106)	4-2-11-6-2-1-0	0.00	2.00	---	---	---	---
(131)	3-2-1-6-2-18-2	-190.00	53.50	---	---	417.00	2.50E+05
(132)	3-2-1-6-2-19-2	-160.00	41.00	---	---	202.00	2.10E+05
(133)	3-2-1-6-2-20-2	-130.00	39.00	---	---	609.00	1.60E+05
(134)	3-2-1-6-2-21-2	-100.00	56.50	---	---	955.00	1.70E+05
(135)	3-2-1-6-2-22-6	-100.00	35.00	---	---	999.00	3.70E+05
(136)	3-2-1-6-2-23-0	-70.00	62.80	---	---	1140.00	4.10E+05
(137)	3-2-1-6-2-24-2	-40.00	---	142.00	162.00	2860.00	2.80E+05
(138)	3-2-1-6-2-26-0	-40.00	---	265.00	264.00	3210.00	3.80E+05
(139)	3-2-1-6-2-27-2	-10.00	---	250.00	249.00	4370.00	3.40E+05
(140)	3-2-1-6-2-28-0	20.00	---	268.00	269.00	5300.00	3.60E+05
(141)	3-2-1-6-2-29-0	20.00	---	250.00	250.00	5090.00	3.90E+05
(142)	3-2-1-6-2-30-0	50.00	---	273.00	274.00	6360.00	3.50E+05
(143)	3-2-1-6-2-31-0	80.00	---	246.00	246.00	6410.00	3.30E+05
(144)	3-2-1-6-2-33-2	300.00	---	200.00	207.00	4860.00	2.40E+05
(145)	3-2-1-6-2-34-0	425.00	---	227.00	226.00	7250.00	2.80E+05
(146)	3-2-1-6-2-35-0	550.00	---	252.00	252.00	6730.00	2.40E+05
(180)	3-2-2-6-2-15-0	-130.00	36.90	---	---	218.00	1.40E+05
(181)	3-2-2-6-2-16-0	-100.00	37.80	---	---	582.00	2.50E+05

(182)	3-2-2-6-2-25-0	-70.00	40.20	--	--	759.00	3.60E+05
(183)	3-2-2-6-2-26-0	-70.00	44.20	--	--	666.00	3.30E+05
(184)	3-2-2-6-2-18-2	-40.00	56.40	--	--	1460.00	3.60E+05
(185)	3-2-2-6-2-19-2	-40.00	43.50	--	--	1300.00	2.20E+05
(186)	3-2-2-6-2-20-2	-10.00	48.50	--	--	1790.00	2.90E+05
(187)	3-2-2-6-2-21-0	20.00	60.60	--	--	2640.00	2.00E+05
(188)	3-2-2-6-2-22-0	20.00	59.40	--	--	2240.00	1.20E+05
(189)	3-2-2-6-2-31-2	50.00	--	188.00	197.00	4930.00	2.60E+05
(190)	3-2-2-6-2-24-34	80.00	--	390.00	387.00	7680.00	2.60E+05
(191)	3-2-3-6-2-25-0	80.00	--	291.00	291.00	6490.00	2.60E+05
(192)	3-2-3-6-2-26-0	110.00	--	266.00	268.00	7600.00	2.50E+05
(193)	3-2-3-6-2-27-2	140.00	--	279.00	277.00	6150.00	2.40E+05
(194)	3-2-3-6-2-29-0	425.00	--	240.00	239.00	7380.00	2.40E+05
(226)	3-2-3-6-2-18-0	-170.00	38.80	--	--	177.00	2.00E+05
(227)	3-2-3-6-2-19-0	-140.00	34.10	--	--	279.00	2.60E+05
(228)	3-2-3-6-2-20-4	-110.00	39.90	--	--	661.00	3.20E+05
(229)	3-2-3-6-2-21-0	-80.00	60.20	--	--	1260.00	3.30E+05
(230)	3-2-3-6-2-22-3	-80.00	51.40	--	--	936.00	2.80E+05
(231)	3-2-3-6-2-23-3	-50.00	58.40	--	--	8370.00	2.20E+05
(232)	3-2-3-6-2-24-0	-20.00	63.90	--	--	2810.00	4.20E+05
(233)	3-2-3-6-2-25-3	-20.00	58.00	--	--	2970.00	4.20E+05
(234)	3-2-3-6-2-26-0	10.00	--	265.00	264.00	4680.00	3.20E+05
(235)	3-2-3-6-2-27-34	40.00	--	282.00	289.00	5980.00	3.10E+05
(236)	3-2-3-6-2-28-3	40.00	--	311.00	319.00	7500.00	3.10E+05
(237)	3-2-3-6-2-29-0	70.00	--	302.00	307.00	6970.00	3.40E+05
(238)	3-2-3-6-2-30-0	100.00	--	285.00	285.00	6150.00	3.10E+05
(239)	3-2-3-6-2-31-3	100.00	--	322.00	328.00	7340.00	3.10E+05
(240)	3-2-3-6-2-32-3	300.00	--	317.00	327.00	7740.00	2.60E+05
(241)	3-2-3-6-2-33-3	425.00	--	283.00	292.00	8260.00	3.80E+05
(242)	3-2-3-6-2-34-0	550.00	--	273.00	273.00	8900.00	3.60E+05
(277)	3-2-4-6-2-39-36	-180.00	27.70	--	--	118.00	2.90E+05
(278)	3-2-4-6-2-19-4	-150.00	33.90	--	--	414.00	2.00E+05
(279)	3-2-4-6-2-20-3	-120.00	44.30	--	--	412.00	2.00E+05
(280)	3-2-4-6-2-21-34	-90.00	45.00	--	--	410.00	1.90E+05
(281)	3-2-4-6-2-22-3	-90.00	55.30	--	--	496.00	2.30E+05
(282)	3-2-4-6-2-23-3	-60.00	49.90	--	--	1270.00	3.30E+05
(283)	3-2-4-6-2-24-3	-30.00	62.50	--	--	1990.00	3.80E+05
(284)	3-2-4-6-2-25-3	-30.00	54.00	--	--	2370.00	4.10E+05
(285)	3-2-4-6-2-26-3	0.00	--	186.00	189.00	3080.00	4.60E+05
(286)	3-2-4-6-2-27-4	30.00	--	213.00	216.00	4500.00	3.60E+05
(287)	3-2-4-6-2-28-0	30.00	--	108.00	108.00	4100.00	3.90E+05
(288)	3-2-4-6-2-29-3	60.00	--	260.00	260.00	5670.00	3.40E+05
(289)	3-2-4-6-2-30-0	90.00	--	292.00	292.00	6350.00	3.20E+05
(290)	3-2-4-6-2-31-3	90.00	--	305.00	312.00	6580.00	3.30E+05
(291)	3-2-4-6-2-32-2	300.00	--	258.00	256.00	7880.00	3.80E+05
(292)	3-2-4-6-2-34-3	425.00	--	284.00	290.00	8750.00	3.80E+05
(293)	3-2-4-6-2-18-26	550.00	--	258.00	259.00	7680.00	3.90E+05
(381)	3-2-11-6-2-29-2	-170.00	46.50	--	--	249.00	2.40E+05
(382)	3-2-11-6-2-27-2	-140.00	28.60	--	--	732.00	1.20E+05
(383)	3-2-11-6-2-18-0	-110.00	41.70	--	--	651.00	2.80E+05

(384)	3-2-11-6-2-19-0	-80.00	48.40	--	--	1190.00	2.20E+05
(385)	3-2-11-6-2-20-0	-80.00	56.80	--	--	1910.00	1.30E+05
(386)	3-2-11-6-2-21-0	-50.00	62.10	--	--	2070.00	3.80E+05
(387)	3-2-11-6-2-22-2	-20.00	--	262.00	260.00	4190.00	3.40E+05
(388)	3-2-11-6-2-23-2	-20.00	--	163.00	162.00	3280.00	3.90E+05
(389)	3-2-11-6-2-24-0	10.00	--	219.00	218.00	4560.00	3.50E+05
(390)	3-2-11-6-2-25-0	40.00	--	236.00	236.00	4810.00	3.00E+05
(391)	3-2-11-6-2-26-0	40.00	--	245.00	245.00	5970.00	2.90E+05
(392)	3-2-11-6-2-28-2	70.00	--	249.00	248.00	5380.00	3.20E+05
(393)	3-2-11-6-2-30-0	100.00	--	297.00	297.00	6400.00	2.80E+05
(394)	3-2-11-6-2-31-4	100.00	--	263.00	265.00	5500.00	2.70E+05
(395)	3-2-11-6-2-32-0	300.00	--	253.00	253.00	6670.00	2.60E+05
(396)	3-2-11-6-2-33-2	425.00	--	243.00	241.00	6860.00	1.20E+05
(397)	3-2-11-6-2-34-4	550.00	--	264.00	264.00	7400.00	2.40E+05
(451)	2-2-1-6-2-1-0	-200.00	5.00	2.00	1.00	--	--
(452)	2-2-1-6-2-2-0	-150.00	8.90	10.00	5.00	--	--
(453)	2-2-1-6-2-3-0	-100.00	21.30	21.00	10.00	--	--
(454)	2-2-1-6-2-4-0	-50.00	43.50	34.00	20.00	--	--
(455)	2-2-1-6-2-14-0	-40.00	67.00	58.00	50.00	--	--
(456)	2-2-1-6-2-15-0	-40.00	74.90	59.00	50.00	--	--
(457)	2-2-1-6-2-16-0	-40.00	60.30	47.00	30.00	--	--
(458)	2-2-1-6-2-17-0	-20.00	94.10	66.00	80.00	--	--
(459)	2-2-1-6-2-5-0	0.00	90.30	70.00	80.00	--	--
(460)	2-2-1-6-2-6-0	40.00	110.00	80.00	90.00	--	--
(461)	2-2-1-6-2-7-0	75.00	113.50	93.00	99.00	--	--
(462)	2-2-1-6-2-8-0	150.00	122.90	92.00	99.00	--	--
(463)	2-2-1-6-2-9-0	200.00	134.20	92.00	99.00	--	--
(464)	2-2-1-6-2-10-0	250.00	139.90	91.00	99.00	--	--
(465)	2-2-1-6-2-11-0	300.00	140.00	91.00	99.00	--	--
(466)	2-2-1-6-2-12-0	425.00	136.90	88.00	99.00	--	--
(467)	2-2-1-6-2-13-0	550.00	135.40	89.00	99.00	--	--
(468)	2-2-1-6-3-1-0	-200.00	4.30	1.00	1.00	--	--
(469)	2-2-1-6-3-2-0	-150.00	9.60	2.00	10.00	--	--
(470)	2-2-1-6-3-3-0	-100.00	10.90	6.00	10.00	--	--
(471)	2-2-1-6-3-4-0	-50.00	63.50	51.00	20.00	--	--
(472)	2-2-1-6-3-5-0	0.00	108.10	73.00	30.00	--	--
(473)	2-2-1-6-3-6-0	50.00	121.90	77.00	40.00	--	--
(474)	2-2-1-6-3-7-0	100.00	133.50	86.00	70.00	--	--
(475)	2-2-1-6-3-8-0	150.00	152.10	85.00	90.00	--	--
(476)	2-2-1-6-3-9-0	200.00	154.00	94.00	99.00	--	--
(477)	2-2-1-6-3-10-0	250.00	149.20	94.00	99.00	--	--
(478)	2-2-1-6-3-11-0	300.00	168.60	91.00	99.00	--	--
(541)	2-2-2-6-2-1-0	-250.00	2.40	0.50	1.00	--	--
(542)	2-2-2-6-2-2-0	-200.00	3.00	1.00	1.00	--	--
(543)	2-2-2-6-2-14-0	-200.00	2.10	1.00	1.00	--	--
(544)	2-2-2-6-2-3-0	-150.00	4.20	3.00	1.00	--	--
(545)	2-2-2-6-2-4-0	-100.00	7.00	5.00	1.00	--	--
(546)	2-2-2-6-2-5-0	-50.00	17.30	14.00	10.00	--	--
(547)	2-2-2-6-2-34-0	-25.00	94.50	72.00	40.00	--	--
(548)	2-2-2-6-2-6-0	0.00	89.00	66.00	40.00	--	--

(549)	2-2-2-6-2-32-0	20.00	111.50	79.00	70.00	---	---
(550)	2-2-2-6-2-33-0	20.00	97.20	75.00	60.00	---	---
(551)	2-2-2-6-2-7-0	78.00	118.30	91.00	90.00	---	---
(552)	2-2-2-6-2-8-0	150.00	151.90	95.00	99.00	---	---
(553)	2-2-2-6-2-9-0	200.00	141.90	97.00	99.00	---	---
(554)	2-2-2-6-3-10-0	250.00	136.30	94.00	99.00	---	---
(555)	2-2-2-6-3-11-0	300.00	135.00	92.00	99.00	---	---
(556)	2-2-2-6-3-12-0	425.00	132.00	93.00	99.00	---	---
(557)	2-2-2-6-3-13-0	550.00	141.30	87.00	99.00	---	---
(558)	2-2-2-6-3-1-0	-200.00	3.20	2.00	1.00	---	---
(559)	2-2-2-6-3-2-0	-150.00	3.90	3.00	1.00	---	---
(560)	2-2-2-6-3-3-0	-100.00	9.00	10.00	1.00	---	---
(561)	2-2-2-6-3-4-0	-50.00	3.90	6.00	1.00	---	---
(562)	2-2-2-6-3-5-0	0.00	25.20	31.00	30.00	---	---
(563)	2-2-2-6-3-6-0	50.00	51.20	43.00	30.00	---	---
(564)	2-2-2-6-3-7-0	100.00	99.30	80.00	80.00	---	---
(565)	2-2-2-6-3-8-0	150.00	104.00	82.00	90.00	---	---
(566)	2-2-2-6-3-9-0	200.00	121.00	94.00	99.00	---	---
(567)	2-2-2-6-3-10-0	250.00	123.00	91.00	99.00	---	---
(568)	2-2-2-6-3-11-0	300.00	123.50	85.00	99.00	---	---
(569)	2-2-2-6-3-12-0	425.00	123.00	96.00	99.00	---	---
(570)	2-2-2-6-3-13-0	550.00	112.00	85.00	99.00	---	---
(62)	2-2-3-6-2-1-0	-250.00	3.00	1.00	1.00	---	---
(63)	2-2-3-6-2-2-0	-200.00	2.00	2.00	1.00	---	---
(64)	2-2-3-6-2-3-0	-150.00	4.10	3.00	1.00	---	---
(65)	2-2-3-6-2-4-0	-100.00	34.20	30.00	20.00	---	---
(66)	2-2-3-6-2-5-0	-60.00	56.40	43.00	40.00	---	---
(67)	2-2-3-6-2-6-0	-40.00	56.00	45.00	50.00	---	---
(68)	2-2-3-6-2-7-0	-20.00	77.00	64.00	70.00	---	---
(69)	2-2-3-6-2-8-0	-20.00	94.10	71.00	70.00	---	---
(70)	2-2-3-6-2-9-0	-20.00	102.00	80.00	80.00	---	---
(71)	2-2-3-6-2-10-0	0.00	104.80	80.00	80.00	---	---
(72)	2-2-3-6-2-11-0	75.00	135.00	91.00	99.00	---	---
(73)	2-2-3-6-2-12-0	150.00	133.90	87.00	99.00	---	---
(74)	2-2-3-6-2-13-0	200.00	138.30	94.00	99.00	---	---
(75)	2-2-3-6-2-14-0	250.00	136.80	93.00	99.00	---	---
(76)	2-2-3-6-2-15-0	300.00	142.10	90.00	99.00	---	---
(77)	2-2-3-6-2-16-0	425.00	208.50	65.00	99.00	---	---
(78)	2-2-3-6-2-17-0	550.00	137.80	81.00	99.00	---	---
(79)	2-2-3-6-3-1-0	-200.00	3.90	3.00	1.00	---	---
(80)	2-2-3-6-3-2-0	-150.00	10.00	6.00	10.00	---	---
(81)	2-2-3-6-3-3-0	-100.00	28.90	21.00	20.00	---	---
(82)	2-2-3-6-3-4-0	-50.00	182.90	93.00	99.00	---	---
(83)	2-2-3-6-3-14-0	-50.00	117.90	76.00	50.00	---	---
(84)	2-2-3-6-3-5-0	0.00	132.90	88.00	60.00	---	---
(85)	2-2-3-6-3-6-0	50.00	92.00	56.00	99.00	---	---
(86)	2-2-3-6-3-7-0	100.00	66.00	66.00	99.00	---	---
(87)	2-2-3-6-3-8-0	150.00	58.50	47.00	50.00	---	---
(88)	2-2-3-6-3-9-0	200.00	180.60	92.00	99.00	---	---
(89)	2-2-3-6-3-10-0	250.00	167.50	88.00	99.00	---	---

(90)	2-2-3-6-3-11-0	300.00	141.10	90.00	99.00	---	---
(155)	2-2-4-5-3-2-0	-200.00	5.90	8.00	1.00	---	---
(156)	2-2-4-6-3-3-0	-150.00	6.10	4.00	1.00	---	---
(157)	2-2-4-6-3-5-0	-100.00	93.90	60.00	55.00	---	---
(158)	2-2-4-6-3-6-0	-50.00	116.00	72.00	70.00	---	---
(159)	2-2-4-6-3-7-0	0.00	77.00	57.00	60.00	---	---
(160)	2-2-4-6-3-8-0	50.00	100.30	72.00	90.00	---	---
(161)	2-2-4-6-3-9-0	100.00	118.90	84.00	99.00	---	---
(162)	2-2-4-6-3-10-0	150.00	191.80	94.00	99.00	---	---
(163)	2-2-4-6-3-11-0	200.00	186.70	96.00	99.00	---	---
(164)	2-2-4-6-3-12-0	250.00	106.10	79.00	99.00	---	---
(165)	2-2-4-6-3-13-0	300.00	144.00	98.00	99.00	---	---
(166)	2-2-4-6-3-14-0	425.00	147.90	72.00	99.00	---	---
(167)	2-2-4-6-3-15-0	550.00	236.60	73.00	99.00	---	---
(168)	2-2-4-6-2-1-0	-250.00	1.90	2.00	1.00	---	---
(169)	2-2-4-6-2-2-0	-200.00	3.40	3.00	1.00	---	---
(170)	2-2-4-6-2-3-0	-150.00	6.80	5.00	10.00	---	---
(171)	2-2-4-6-2-4-0	-100.00	6.10	4.00	1.00	---	---
(172)	2-2-4-6-2-5-0	-80.00	22.40	15.00	20.00	---	---
(173)	2-2-4-6-2-6-0	-60.00	14.40	12.00	10.00	---	---
(174)	2-2-4-6-2-7-0	-30.00	27.30	35.00	30.00	---	---
(175)	2-2-4-6-2-8-0	-30.00	68.20	56.00	60.00	---	---
(176)	2-2-4-6-2-9-0	-30.00	77.00	60.00	40.00	---	---
(177)	2-2-4-6-2-10-0	0.00	97.90	72.00	70.00	---	---
(178)	2-2-4-6-2-11-0	75.00	118.80	82.00	90.00	---	---
(179)	2-2-4-6-2-12-0	150.00	121.10	90.00	99.00	---	---
(180)	2-2-4-6-2-13-0	200.00	119.90	98.00	99.00	---	---
(181)	2-2-4-6-2-14-0	250.00	135.00	94.00	99.00	---	---
(182)	2-2-4-6-2-15-0	300.00	133.00	91.00	99.00	---	---
(183)	2-2-4-6-2-16-0	425.00	146.80	91.00	99.00	---	---
(184)	2-2-4-6-2-17-0	550.00	148.10	79.00	99.00	---	---
(315)	2-2-11-6-2-1-0	-200.00	1.90	8.00	1.00	---	---
(316)	2-2-11-6-2-2-0	-150.00	4.20	5.00	5.00	---	---
(317)	2-2-11-6-2-3-0	-100.00	35.70	33.00	20.00	---	---
(318)	2-2-11-6-2-4-0	-100.00	22.00	22.00	10.00	---	---
(319)	2-2-11-6-2-5-0	-50.00	40.00	36.00	30.00	---	---
(320)	2-2-11-6-2-6-0	-20.00	84.20	77.00	90.00	---	---
(321)	2-2-11-6-2-7-0	-20.00	87.00	68.00	50.00	---	---
(322)	2-2-11-6-2-8-0	-20.00	70.40	61.00	70.00	---	---
(323)	2-2-11-6-2-9-0	0.00	103.90	74.00	90.00	---	---
(324)	2-2-11-6-2-10-0	40.00	100.20	83.00	90.00	---	---
(325)	2-2-11-6-2-11-0	75.00	115.00	92.00	99.00	---	---
(326)	2-2-11-6-2-12-0	150.00	131.10	89.00	99.00	---	---
(327)	2-2-11-6-2-13-0	200.00	122.90	91.00	99.00	---	---
(328)	2-2-11-6-2-14-0	250.00	169.00	86.00	99.00	---	---
(329)	2-2-11-6-2-15-0	300.00	149.90	87.00	99.00	---	---
(330)	2-2-11-6-2-16-0	425.00	171.00	85.00	99.00	---	---
(331)	2-2-11-6-2-17-0	550.00	112.90	83.00	99.00	---	---
(332)	2-2-11-6-3-1-0	-200.00	6.30	3.00	1.00	---	---
(333)	2-2-11-6-3-2-0	-150.00	71.20	45.00	30.00	---	---

(334)	2-2-11-6-3-13-0	-150.00	66.40	49.00	30.00	--	--
(335)	2-2-11-6-3-3-0	-100.00	54.90	46.00	40.00	--	--
(336)	2-2-11-6-3-4-0	-50.00	62.30	54.00	40.00	--	--
(337)	2-2-11-6-3-5-0	0.00	81.00	76.00	90.00	--	--
(338)	2-2-11-6-3-6-0	50.00	167.20	95.00	99.00	--	--
(339)	2-2-11-6-3-7-0	100.00	144.00	100.00	99.00	--	--
(340)	2-2-11-6-3-8-0	150.00	151.20	94.00	99.00	--	--
(341)	2-2-11-6-3-9-0	200.00	104.20	79.00	99.00	--	--
(342)	2-2-11-6-3-10-0	250.00	148.20	89.00	99.00	--	--
(343)	2-2-11-6-3-11-0	300.00	111.40	84.00	99.00	--	--
(344)	2-2-11-6-3-12-0	425.00	215.00	96.00	99.00	--	--
(345)	2-2-11-6-3-14-0	550.00	105.30	100.00	99.00	--	--
(386)	1-2-1-6-1-1-0	-203.00	106.60	115.00	15.00	28.00	66.70
(387)	1-2-1-6-1-2-0	-25.00	82.30	97.30	15.00	29.60	64.80
(388)	1-2-1-6-1-3-0	75.00	78.50	90.00	10.00	25.60	71.70
(389)	1-2-1-6-1-4-0	200.00	76.70	87.00	10.50	26.40	72.70
(390)	1-2-1-6-1-5-0	300.00	71.80	81.00	9.50	23.20	71.60
(391)	1-2-1-6-1-6-0	550.00	67.80	83.20	10.00	20.80	59.20
(404)	1-2-2-6-1-1-0	-200.00	100.10	105.90	19.00	34.40	70.20
(405)	1-2-2-6-1-2-0	-25.00	77.50	90.00	15.00	29.60	72.40
(406)	1-2-2-6-1-3-0	75.00	75.50	85.00	12.50	28.00	72.30
(407)	1-2-2-6-1-4-0	200.00	70.40	80.30	11.50	25.60	73.60
(408)	1-2-2-6-1-5-0	300.00	68.20	78.00	10.00	23.20	73.00
(409)	1-2-2-6-1-6-0	550.00	61.40	79.90	11.00	24.80	66.90
(422)	1-2-3-6-1-1-0	-203.00	102.90	111.10	16.00	28.00	64.80
(423)	1-2-3-6-1-2-0	-25.00	80.60	94.70	14.00	28.00	71.00
(424)	1-2-3-6-1-3-0	75.00	77.40	90.20	12.00	26.40	71.20
(425)	1-2-3-6-1-4-0	200.00	71.80	83.60	10.50	24.80	69.90
(426)	1-2-3-6-1-5-0	300.00	69.00	81.20	10.00	24.00	71.10
(427)	1-2-3-6-1-6-0	550.00	65.60	82.60	9.50	22.40	68.10
(440)	1-2-4-6-1-1-0	-203.00	102.00	118.60	14.00	30.40	65.00
(441)	1-2-4-6-1-2-0	-25.00	96.30	101.80	13.50	26.40	69.20
(442)	1-2-4-6-1-3-0	75.00	85.00	99.10	11.50	28.00	69.50
(443)	1-2-4-6-1-4-0	200.00	82.00	94.90	11.00	24.80	67.70
(444)	1-2-4-6-1-5-0	300.00	75.10	89.00	10.50	23.20	69.70
(445)	1-2-4-6-1-6-0	550.00	67.90	88.80	11.50	24.00	66.20
(482)	1-2-11-6-1-1-0	-200.00	95.80	106.20	15.00	30.40	68.40
(483)	1-2-11-6-1-2-0	-25.00	72.10	86.00	14.00	27.20	66.20
(484)	1-2-11-6-1-3-0	75.00	64.00	78.00	13.00	27.20	73.20
(485)	1-2-11-6-1-4-0	200.00	65.60	77.50	10.50	27.20	73.50
(486)	1-2-11-6-1-5-0	300.00	60.00	72.90	10.00	24.00	71.70
(487)	1-2-11-6-1-6-0	550.00	58.50	76.60	10.00	22.40	59.80
(499)	5-2-1-6-2-7-0	-200.00	49.60	--	--	--	3.40
(500)	5-2-1-6-2-11-0	-100.00	--	122.20	116.20	--	3.90
(501)	5-2-1-6-2-3-0	-40.00	--	373.40	361.30	--	3.60
(502)	5-2-1-6-2-9-0	20.00	--	252.30	291.60	--	2.90
(503)	5-2-1-6-2-10-0	80.00	--	320.30	316.50	--	3.60
(513)	5-2-2-6-2-3-0	-140.00	49.20	--	--	--	3.50
(514)	5-2-2-6-2-5-2	-40.00	--	141.10	131.90	--	--
(515)	5-2-2-6-2-4-0	20.00	--	258.00	253.00	--	1.70

(516)	5-2-2-6-2-11-0	80.00	--	328.60	310.50	--	1.60
(517)	5-2-2-6-2-8-0	140.00	--	305.00	292.00	--	1.60
(528)	5-2-3-6-2-6-1	-180.00	64.70	--	--	--	3.80
(529)	5-2-3-6-2-3-0	-80.00	--	144.30	140.60	--	3.40
(530)	5-2-3-6-2-4-0	-20.00	--	379.70	377.30	--	3.10
(531)	5-2-3-6-2-11-0	40.00	--	361.60	361.60	--	3.20
(532)	5-2-3-6-2-7-0	100.00	--	356.30	361.60	--	3.40
(543)	5-2-4-6-2-9-4	-190.00	49.10	--	--	--	3.40
(544)	5-2-4-6-2-3-2	-90.00	--	33.60	75.90	--	4.10
(545)	5-2-4-6-2-5-0	-30.00	--	164.30	157.70	--	3.70
(546)	5-2-4-6-2-6-2	30.00	--	246.70	253.20	--	3.70
(547)	5-2-4-6-2-11-0	90.00	--	271.70	246.50	--	3.60
(11)	5-2-11-6-2-10-1	-180.00	62.50	--	--	--	3.40
(12)	5-2-11-6-2-12-0	-80.00	--	185.60	185.30	--	3.60
(13)	5-2-11-6-2-11-0	-20.00	--	337.60	340.90	--	3.40
(14)	5-2-11-6-2-6-2	40.00	--	384.20	389.50	--	3.20
(15)	5-2-11-6-2-6-4	100.00	--	314.60	347.80	--	3700.00
(23)	7-2-1-6-2-1-0	-100.00	57.30	--	--	--	2500.00
(26)	7-2-2-6-2-1-4	-40.00	57.40	--	--	--	2400.00
(28)	7-2-3-6-2-1-0	-80.00	59.70	--	--	--	2600.00
(33)	7-2-11-6-2-1-0	-80.00	77.20	--	--	--	2500.00
(39)	10-2-4-6-2-1-0	-90.00	55.50	--	--	--	3600.00
(45)	8-2-1-6-2-2-0	-200.00	31.20	--	--	--	1800.00
(46)	8-2-1-6-2-6-0	-100.00	43.50	--	--	--	4700.00
(47)	8-2-1-6-2-6-0	-40.00	--	212.10	213.00	--	5200.00
(48)	8-2-1-6-2-4-0	20.00	--	208.30	193.00	--	5600.00
(49)	8-2-1-6-2-5-0	80.00	--	310.40	389.30	--	4200.00
(60)	8-2-2-6-2-7-0	-140.00	37.00	--	--	--	1700.00
(61)	8-2-2-6-2-9-1	-40.00	70.10	--	--	--	3200.00
(62)	8-2-2-6-2-10-0	20.00	--	116.30	106.50	--	3100.00
(63)	8-2-2-6-2-0-0	80.00	--	118.10	108.90	--	3100.00
(64)	8-2-2-6-2-2-2	140.00	--	141.70	127.10	--	3100.00
(75)	9-2-3-6-2-9-0	-180.00	37.80	--	--	--	2100.00
(76)	8-2-3-6-2-2-0	-80.00	--	71.40	60.30	--	5300.00
(77)	8-2-3-6-2-5-0	-20.00	--	103.30	103.30	--	5400.00
(78)	8-2-3-6-2-8-0	40.00	--	197.80	198.90	--	5400.00
(79)	8-2-3-6-2-10-0	100.00	--	344.10	334.90	--	5200.00
(90)	8-2-4-6-2-2-0	-190.00	32.20	--	--	--	1700.00
(91)	8-2-4-6-2-8-0	-90.00	56.80	--	--	--	5800.00
(92)	8-2-4-6-2-7-0	-30.00	--	107.10	101.10	--	5000.00
(93)	8-2-4-6-2-10-0	30.00	--	220.30	182.40	--	6200.00
(94)	8-2-4-6-2-4-2	90.00	--	321.60	320.40	--	5300.00
(124)	8-2-11-6-2-5-0	-100.00	31.00	--	--	--	1700.00
(125)	8-2-11-6-2-9-0	-80.00	--	147.40	146.10	--	5600.00
(126)	8-2-11-6-2-3-0	-20.00	--	216.30	182.60	--	5600.00
(127)	8-2-11-6-2-2-2	40.00	--	321.60	296.30	--	5400.00
(128)	8-2-11-6-2-7-0	100.00	--	278.10	312.70	--	5200.00

APPENDIX 7

MATERIAL 7

SUBMERGED ARC WELDMENT (SA) IN A533B-1 BASE METAL

AND

HEAT AFFECTED ZONE MATERIAL FOR SA WELD AND A533B-1 BASE

MATERIAL TYPE 7
SA WELD, HAZ IN A533B-1

INTRODUCTION

Five heats of submerged arc welded A533B-1 were studied by Combustion Engineering, Inc. at their Windsor and Chattanooga laboratories. A brief description of the heats is given in Table 7.1. The extracted data bank entries for this material are appended to this section. More details on Material 7 can be found in reference 12.

TENSILE TESTS RESULTS

The 2-in. gage section tensile test results are shown in Figures 7.1 to 7.10. The coefficients for the cubic polynomials fitted to the test data are summarized in Table 7.2. Note that the heat affected zone material, heat I (9), exhibited substantially less strength and ductility than the submerged arc weldments. In fact, the HAZ properties are almost identical to the base metal properties (see material 1, CE heat A). This behavior is most likely due to the fact that the two-inch gage section of the tensile samples was a combination of weld metal, HAZ, and base metal; the samples broke at the weakest link -- the base metal.

CHARPY V-NOTCH RESULTS

Impact Energy

The impact energy test results for the SA weld and HAZ material are summarized in Figures 7.11 to 7.19. The curve-fit results are extracted and analyzed in Tables 7.3 and 7.4, respectively. The data set 223772 (CE Windsor, heat G transverse) had an abnormally high B value, indicating that the upper shelf was high (159 ft-lb compared to the mean of 131 ft-lb). The same heat had an unusually low T_0 . Heat I (23973) had a high variance probably indicative of HAZ material.

Lateral Expansion

The statistical parameters related to the tanh fit of the lateral

expansion data are given in Table 7.5, and the associated deviations of these parameters from the mean values are given in Table 7.6. The curve fits are shown in Figures 7.20 to 7.28. The results for heat I HAZ material (data 23973) had an abnormally low B value, indicating a low upper shelf (75 mils compared to 83 mils, the mean for all results). The T_0 value for heat G (data set 223772) was again low, agreeing with the impact energy data set. Heat H (data set 23871) had a high variance, shown in Table 7.6. This was caused by a single outlying data point, Figure 7.22.

Percent Shear

The results are shown in Figures 7.29 to 7.37. The results of the curve fitting procedure are summarized in Table 7.7. Each parameter has been analyzed in Table 7.8. The only significant feature noted in this analysis was that heat I HAZ material (data set 23973) had an abnormally high variance. This was again caused by a single outlying data point, Figure 7.37.

Summary of Charpy Impact Test Data

The quantity $T_0 - C$ for the impact energy, lateral expansion, and percent shear results is compared to RT_{NDT} and $NDTT$ in Table 7.9. Apart from the heat I HAZ material (data set 23973), the $T_0 - C$ results for impact energy and lateral expansion agreed quite well. There was little agreement between any of the $T_0 - C$ quantities and RT_{NDT} or $NDTT$.

INSTRUMENTED PRECRACKED CHARPY RESULTS

Dynamic Fracture Toughness, K_{Id} , K_d^*

The dynamic fracture toughness test measurements for the precracked Charpy test are shown in Figures 7.38 to 7.42. The results of the curve fit procedure are shown in Table 7.10 and analyzed in detail in Table 7.11. There were no outlying results.

Normalized Energy, W/A

Figures 7.43 to 7.47 summarize the test results. The curve parameters are listed in Table 7.12 and analyzed in Table 7.13. Again, there were no significant outlying sets.

Summary of Precracked Charpy Results

The precracked Charpy toughness results are summarized in Figure 7.48. Temperatures were normalized by RT_{NDT} and the K_{IR} curve was added. The K_{IR} curve falls inside the 3σ limit for the transition data. The W/A data points are plotted together in Figure 7.49, normalized to RT_{NDT} . The values of $T_0 - C$ are compared to RT_{NDT} and NDTT in Table 7.14. There was fair agreement between the W/A results for $T_0 - C$ and RT_{NDT} or NDTT.

STATIC AND DYNAMIC COMPACT FRACTURE TOUGHNESS RESULTS

The static one-inch and two-inch compact (test types 5 and 11) and the dynamic compact (test types 7 and 8) results for the SA weld and HAZ materials are shown in Figures 7.50 to 7.54. Because there were few data points, the data are shown without curve-fitting. All the results are summarized by loading rate in Figures 7.55 and 7.56 and compared to the K_{IR} curve. The K_{IR} curve lies below the data for both static and dynamic loading rates.

EFFECT OF ERROR CODES

The static and dynamic fracture toughness results for material 7 were statistically analyzed with and without the data points which did not meet the EPRI procedures. Tanh curve fits to the total data and acceptable data only are shown in Figures 7.57 to 7.60. The influence of the error code data on shelf properties and variance was determined. Both the overall variance and the variance in the transition temperature region ($T_0 \pm 50^\circ\text{F}$) were compared. A summary of the error code analysis is given in Table 7.15. The variance ratio (F) was calculated for the static and dynamic fracture

toughness results. The ratios shown in Table 7.15 had a high probability of occurring by chance, and it is concluded that the effect of the error codes on the data was not significant.

Table 7.1. Summary of SA Weld and HAZ Materials in A533B-1 (Material 7)

<u>TEST LABORATORY</u>	<u>HEAT CODE</u>	<u>WELDING CONDITIONS</u>	<u>NDTT (^oF)</u>	<u>RT_{NDT} (^oF)</u>	<u>COMMENTS</u>
CE (Weld)	G (7)	(Ref. 12)	-70	-70	{ Linde 0091 Flux
	H (8)		-70	-70	
	J (10)		-70	-70	
	K (11)		-70	-70	
CE (HAZ)	I (9)		-40	-40	Heat CA base metal

Table 7.2. Summary of the Regression Analysis of the Tensile Test Data (SA, HAZ, A533B-1)

<u>Property</u>	<u>Material</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>Variance</u> σ^2	<u>Degrees of Freedom</u> ϕ	<u>Standard Deviation</u> σ
Yield Stress	Weld (L)	8.187X10	-6.137X10 ⁻²	1.760X10 ⁻⁴	-1.995X10 ⁻⁷	4.07	20	2.02
	HAZ	6.607X10	-8.092X10 ⁻²	2.346X10 ⁻⁴	-2.118X10 ⁻⁷	0.14	2	0.37
Ultimate Tensile Stress	Weld (L)	9.585X10	-6.821X10 ⁻²	1.271X10 ⁻⁴	6.257X10 ⁻⁸	2.60	20	1.61
	HAZ	9.059X10	-9.104X10 ⁻²	1.728X10 ⁻⁴	-4.309X10 ⁻⁸	0.27	2	0.52
Uniform Elongation	Weld (L)	1.037X10	-1.511X10 ⁻²	2.685X10 ⁻⁵	-7.526X10 ⁻⁹	0.24	20	0.49
	HAZ	8.874X10	-1.976X10 ⁻²	2.093X10 ⁻⁵	2.322X10 ⁻⁸	0.02	1	0.14
Total Elongation	Weld (L)	2.756X10	-2.145X10 ⁻²	2.698X10 ⁻⁶	4.374X10 ⁻⁸	0.70	20	0.84
	HAZ	2.161X10	-1.224X10 ⁻²	8.846X10 ⁻⁵	-1.181X10 ⁻⁷	2.09	2	1.45
Reduction In Area	Weld (L)	6.844X10	1.915X10 ⁻²	-6.563X10 ⁻⁵	3.594X10 ⁻⁸	7.22	20	2.69
	HAZ	5.576X10	1.351X10 ⁻²	2.777X10 ⁻⁴	-5.132X10 ⁻⁷	6.16	2	2.48

Table 7.3. Tanh Fit Parameters for Charpy Impact Energy Data
(SA, HAZ, A533B-1)

KEY	J	A	B	T0	C	PHI	VAR
23871	2	61.90	57.29	-12.86	59.79	5	121.08
23872	2	65.76	65.76	-28.52	65.96	8	96.12
23973	2	65.19	65.19	-3.54	102.40	7	985.29
223771	2	80.34	67.36	-20.44	34.64	6	341.54
223772	2	79.42	79.42	-50.22	87.97	9	92.67
231071	2	60.47	60.42	-10.87	69.26	5	66.13
231072	2	66.70	62.31	0.50	71.43	8	117.54
231171	2	60.18	56.95	-1.19	52.24	5	12.61
231172	2	61.41	61.41	-6.99	78.22	8	61.00

Table 7.4. Deviation of Charpy Impact Energy Curve Fit Parameters from Mean
Values (SA, HAZ, A533B-1)

<u>A</u>			
TOTAL	601.37		
MEAN	66.81888889		
ST. DEV	7.772000136		
KEY	VAL	DEV	NORMALIZED DEV
23871	61.90	-4.92	-0.63
23872	65.76	-1.06	-0.14
23973	65.19	-1.63	-0.21
223771	80.34	13.52	1.74
223772	79.42	12.60	1.62
231071	60.47	-6.35	-0.82
231072	66.70	-0.12	-0.02
231171	60.18	-6.64	-0.85
231172	61.41	-5.41	-0.70

Table 7.4. (continued)

<u>VARIANCE</u>			
TOTAL	1893.98		
MEAN	210.4422222		
ST. DEV	304.8418824		
KEY	VAL	DEV	NORMALIZED DEV
23871	121.08	-89.36	-0.29
23872	96.12	-114.32	-0.38
23973	985.29	774.85	2.54
223771	341.54	131.10	0.43
223772	92.67	-117.77	-0.39
231071	66.13	-144.31	-0.47
231072	117.54	-92.90	-0.30
231171	12.61	-197.83	-0.65
231172	61.00	-149.44	-0.49

Table 7.5. Tanh Fit Parameters for Charpy Impact Lateral Expansion Data
(SA. HAZ, A533B-1)

KEY	J	A	B	T0	C	PHI	VAR
23871	3	45.79	37.80	-10.23	36.51	5	336.67
23872	3	40.82	40.82	-34.16	51.20	7	76.78
23973	3	40.90	34.37	10.22	47.45	8	100.68
223771	3	46.81	40.15	-28.07	29.21	6	101.76
223772	3	42.92	42.92	-73.75	68.90	9	66.26
231071	3	42.40	42.40	-5.52	81.27	5	51.34
231072	3	41.45	41.45	-12.74	68.72	8	39.60
231171	3	41.23	41.00	-1.63	56.17	5	13.26
231172	3	41.53	41.46	-8.19	75.90	8	32.45

Table 7.6. Deviation of Charpy Impact Lateral Expansion Curve Fit Parameters
From Mean Values (SA, HAZ, A533B-1)

A

TOTAL	383.85
MEAN	42.65
ST. DEV	2.191540554

KEY	VAL	DEV	NORMALIZED DEV
23871	45.79	3.14	1.43
23872	40.82	-1.83	-0.84
23973	40.90	-1.75	-0.80
223771	46.81	4.16	1.90
223772	42.92	0.27	0.12
231071	42.40	-0.25	-0.11
231072	41.45	-1.20	-0.55
231171	41.23	-1.42	-0.65
231172	41.53	-1.12	-0.51

B

TOTAL	362.37
MEAN	40.26333333
ST. DEV	2.64877802

KEY	VAL	DEV	NORMALIZED DEV
23871	37.80	-2.46	-0.93
23872	40.82	0.56	0.21
23973	34.37	-5.89	-2.22
223771	40.15	-0.11	-0.04
223772	42.92	2.66	1.00
231071	42.40	2.14	0.81
231072	41.45	1.19	0.45
231171	41.00	0.74	0.28
231172	41.46	1.20	0.45

Table 7.6. (continued)

T₀

TOTAL	-164.07
MEAN	-18.23
ST. DEV	24.68427941

KEY	VAL	DEV	NORMALIZED DEV
23871	-10.23	8.00	0.32
23872	-34.16	-15.93	-0.65
23973	10.22	28.45	1.15
223771	-28.07	-9.84	-0.40
223772	-73.75	-55.52	-2.25
231071	-5.52	12.71	0.51
231072	-12.74	5.49	0.22
231171	-1.63	16.60	0.67
231172	-8.19	10.04	0.41

C

TOTAL	515.33
MEAN	57.25888889
ST. DEV	17.82646799

KEY	VAL	DEV	NORMALIZED DEV
23871	36.51	-20.75	-1.16
23872	51.20	-6.06	-0.34
23973	47.45	-9.81	-0.55
223771	29.21	-28.05	-1.57
223772	68.90	11.64	0.65
231071	81.27	24.01	1.35
231072	68.72	11.46	0.64
231171	56.17	-1.09	-0.06
231172	75.90	18.64	1.05

Table 7.6. (continued)

PHI

TOTAL	61
MEAN	6.777777778
ST. DEV	1.563471928

KEY	VAL	DEV	NORMALIZED DEV
23871	5.00	-1.78	-1.14
23872	7.00	0.22	0.14
23973	8.00	1.22	0.78
223771	6.00	-0.78	-0.50
223772	9.00	2.22	1.42
231071	5.00	-1.78	-1.14
231072	8.00	1.22	0.78
231171	5.00	-1.78	-1.14
231172	8.00	1.22	0.78

VARIANCE

TOTAL	818.8
MEAN	90.97777778
ST. DEV	96.86587774

KEY	VAL	DEV	NORMALIZED DEV
23871	336.67	245.69	2.54
23872	76.78	-14.20	-0.15
23973	100.68	9.70	0.10
223771	101.76	10.78	0.11
223772	66.26	-24.72	-0.26
231071	51.34	-39.64	-0.41
231072	39.60	-51.38	-0.53
231171	13.26	-77.72	-0.80
231172	32.45	-58.53	-0.60

Table 7.7. Tanh Fit Parameters for Charpy Impact Percent Shear Data
(SA, HAZ A533B-1)

KEY	J	A	B	T0	C	PHI	VAR
23871	4	45.59	45.59	-29.53	68.92	5	94.86
23872	4	49.37	49.37	-25.18	81.03	8	122.07
23973	4	52.53	48.62	26.16	43.86	8	245.54
223771	4	52.86	45.44	-34.28	37.14	9	45.56
223772	4	49.03	49.03	-58.96	56.15	9	33.75
231071	4	48.82	48.82	-9.56	86.72	5	28.52
231072	4	51.25	45.86	-8.03	51.86	8	35.92
231171	4	49.44	49.44	6.57	96.62	5	59.81
231172	4	55.72	45.88	17.85	73.37	8	112.35

Table 7.8. Deviation of Charpy Impact Percent Shear Curve Fit Parameters from
From Mean Values (SA, HAZ, A533B-1)

A

TOTAL 454.61
MEAN 50.51222222
ST. DEV 2.936663830

KEY	VAL	DEV	NORMALIZED DEV
23871	45.59	-4.92	-1.68
23872	49.37	-1.14	-0.39
23973	52.53	2.02	0.69
223771	52.86	2.35	0.80
223772	49.03	-1.48	-0.50
231071	48.82	-1.69	-0.58
231072	51.25	0.74	0.25
231171	49.44	-1.07	-0.37
231172	55.72	5.21	1.77

Table 7.8. (continued)

B

TOTAL	427.97
MEAN	47.55222222
ST. DEV	1.804333520

KEY	VAL	DEV	NORMALIZED DEV
23871	45.59	-1.96	-1.00
23872	49.37	1.82	1.01
23973	48.62	1.07	0.59
223771	45.44	-2.11	-1.17
223772	49.03	1.48	0.82
231071	48.82	1.27	0.70
231072	45.36	-1.69	-0.94
231171	49.44	1.89	1.05
231172	45.80	-1.75	-0.97

T₀

TOTAL	-106.93
MEAN	-11.88111111
ST. DEV	27.43291064

KEY	VAL	DEV	NORMALIZED DEV
23871	-29.53	-17.65	-0.64
23872	-25.10	-13.22	-0.48
23973	26.16	38.04	1.39
223771	-34.28	-22.40	-0.82
223772	-58.96	-47.08	-1.72
231071	-9.56	2.32	0.08
231072	-0.08	11.80	0.43
231171	6.57	18.45	0.67
231172	17.85	29.73	1.08

Table 7.8. (continued)

C

TOTAL	587.67
MEAN	65.29666667
ST. DEV	20.27472626

KEY	VAL	DEV	NORMALIZED DEV
23871	60.92	-4.38	-0.22
23872	81.03	15.73	0.78
23973	43.86	-21.44	-1.06
223771	37.14	-28.16	-1.39
223772	56.15	-9.15	-0.45
231071	86.72	21.42	1.06
231072	51.86	-13.44	-0.66
231171	96.62	31.32	1.54
231172	73.37	8.07	0.40

PHI

TOTAL	65
MEAN	7.222222222
ST. DEV	1.715938357

KEY	VAL	DEV	NORMALIZED DEV
23871	5.00	-2.22	-1.30
23872	8.00	0.78	0.45
23973	8.00	0.78	0.45
223771	9.00	1.78	1.04
223772	9.00	1.78	1.04
231071	5.00	-2.22	-1.30
231072	8.00	0.78	0.45
231171	5.00	-2.22	-1.30
231172	8.00	0.78	0.45

Table 7.8. (continued)

<u>VARIANCE</u>			
TOTAL	770.38		
MEAN	85.59777778		
ST. DEV	70.15378781		
KEY	VAL	DEV	NORMALIZED DEV
23871	94.86	9.26	0.13
23872	122.07	36.47	0.52
23973	245.54	159.94	2.28
223771	45.56	-40.04	-0.57
223772	33.75	-51.85	-0.74
231071	20.52	-65.08	-0.93
231072	35.92	-49.68	-0.71
231171	59.81	-25.79	-0.37
231172	112.35	26.75	0.38

Table 7.9. Comparison of $T_0 - C$ from Impact Test Measurements with RT_{NDT} and $NDTT$ (SA, HAZ, A533B-1)

<u>KEY</u>	<u>$T_0 - C$ ($^{\circ}F$)</u>			<u>RT_{NDT} ($^{\circ}F$)</u>	<u>$NDTT$ ($^{\circ}F$)</u>
	<u>IMPACT ENERGY</u>	<u>LATERAL EXPANSION</u>	<u>PERCENT SHEAR</u>		
23871	-73	-47	-90		
23872	-94	-85	-106	-70	-70
223771	-55	-57	-71		
223772	-138	-143	-115	-40	-40
231071	-80	-87	-96		
231072	-71	-81	-52	-40	-40
231171	-53	-58	-90		
231172	-85	-84	-56	-70	-70
23973	-106	-37	-18	-70	-70

Table 7.10. Tanh Fit Parameters for Precracked Charpy Toughness Data
(SA, HAZ, A533B-1)

KEY	J	A	B	T0	C	PHI	VAR
33872	2	153.15	124.78	-27.43	43.49	7	525.17
33973	2	173.01	122.57	-10.71	43.41	7	2965.32
323772	2	168.32	117.01	-11.78	9.20	6	1251.04
331072	2	161.53	110.49	18.65	27.50	6	110.79
331172	2	173.79	120.73	36.42	21.05	8	334.05

Table 7.11. Deviation of Precracked Charpy Fracture Toughness Curve Fit Parameters
From Mean Values (SA, HAZ, A533B-1)

<u>A</u>			
TOTAL	829.8		
MEAN	165.96		
ST. DEV	8.664611936		
KEY	VAL	DEV	NORMALIZED DEV
33872	153.15	-12.81	-1.48
33973	173.01	7.05	0.81
323772	168.32	2.36	0.27
331072	161.53	-4.43	-0.51
331172	173.79	7.83	0.90

Table 7.11 (continued)

B

TOTAL	595.58
MEAN	119.116
ST. DEV	5.600426769

KEY	VAL	DEV	NORMALIZED DEV
33872	124.78	5.66	1.01
33973	122.57	3.45	0.62
323772	117.01	-2.11	-0.38
331072	110.49	-8.63	-1.54
331172	120.73	1.61	0.29

T₀

TOTAL	5.15
MEAN	1.03
ST. DEV	25.85929137

KEY	VAL	DEV	NORMALIZED DEV
33872	-27.43	-28.46	-1.10
33973	-10.71	-11.74	-0.45
323772	-11.78	-12.81	-0.50
331072	18.65	17.62	0.68
331172	36.42	35.39	1.37

Table 7.11. (continued)

C

TOTAL	144.65
MEAN	28.93
ST. DEV	14.79084345

KEY	VAL	DEV	NORMALIZED DEV
33872	43.49	14.56	0.98
33973	43.41	14.48	0.98
323772	9.20	-19.73	-1.33
331072	27.50	-1.43	-0.10
331172	21.05	-7.88	-0.53

PHI

TOTAL	34
MEAN	6.8
ST. DEV	0.836660027

KEY	VAL	DEV	NORMALIZED DEV
33872	7.00	0.20	0.24
33973	7.00	0.20	0.24
323772	6.00	-0.80	-0.96
331072	6.00	-0.80	-0.96
331172	8.00	1.20	1.43

Table 7.11. (continued)

<u>VARIANCE</u>			
TOTAL	5194.37		
MEAN	1038.874		
ST. DEV	1157.954213		
KEY	VAL	DEV	NORMALIZED DEV
33872	525.17	-513.70	-0.44
33973	2965.32	1926.45	1.66
323772	1251.04	212.17	0.18
331072	110.79	-920.08	-0.79
331172	334.05	-704.82	-0.61

Table 7.12. Tanh Fit Parameters for Precracked Charpy W/A Data (SA,HAZ, A533B-1)

KEY	J	A	B	T0	C	PHI	VAR
33872	5	3452.95	3404.55	-8.26	60.80	4	5.06E+05
33973	5	3574.00	3368.20	-1.03	57.21	7	2.33E+06
323772	5	3753.42	3349.57	-0.63	55.63	6	2.09E+05
331072	5	3205.75	2928.02	-7.43	42.83	5	4.00E+35
331172	5	3860.90	3636.17	37.16	67.26	5	68633.50

Table 7.13. Deviation of Precracked Charpy W/A Curve Fit Parameters from Mean Values (SA, HAZ, A533B-1)

A

TOTAL	17847.02
MEAN	3569.404
ST. DEV	257.2249480

KEY	VAL	DEV	NORMALIZED DEV
33872	3452.95	-116.45	-0.45
33973	3574.00	4.60	0.02
323772	3753.42	184.02	0.72
331072	3205.75	-363.65	-1.41
331172	3860.90	291.50	1.13

B

TOTAL	16706.51
MEAN	3341.302
ST. DEV	256.9130401

KEY	VAL	DEV	NORMALIZED DEV
33872	3404.55	63.25	0.25
33973	3388.20	46.90	0.18
323772	3349.57	8.27	0.03
331072	2928.02	-413.28	-1.61
331172	3636.17	294.87	1.15

Table 7.13. (continued)

T₀

TOTAL	19.81
MEAN	3.962
ST. DEV	18.88960481

KEY	VAL	DEV	NORMALIZED DEV
33872	-8.26	-12.22	-0.65
33973	-1.03	-4.99	-0.26
323772	-0.63	-4.59	-0.24
331072	-7.43	-11.39	-0.60
331172	37.16	33.20	1.76

C

TOTAL	283.73
MEAN	56.746
ST. DEV	8.973501546

KEY	VAL	DEV	NORMALIZED DEV
33872	60.80	4.05	0.45
33973	57.21	0.46	0.05
323772	55.63	-1.12	-0.12
331072	42.83	-13.92	-1.55
331172	67.26	10.51	1.17

Table 7.13. (continued)

<u>PHI</u>			
TOTAL	30		
MEAN	6		
ST. DEV	1.58113883		
KEY	VAL	DEV	NORMALIZED DEV
33872	4.00	-2.00	-1.26
33973	7.00	1.00	0.63
323772	6.00	0.00	0.00
331072	5.00	-1.00	-0.63
331172	8.00	2.00	1.26

<u>VARIANCE</u>			
TOTAL	3516487.5		
MEAN	703297.5		
ST. DEV	926446.7093		
KEY	VAL	DEV	NORMALIZED DEV
33872	5.06E+05	-1.97E+05	-0.21
33973	2.33E+06	1.63E+06	1.76
323772	2.09E+05	-4.94E+05	-0.53
331072	4.00E+05	-3.03E+05	-0.33
331172	68633.50	-6.35E+05	-0.69

Table 7.14 Comparison of Precracked Charpy Transition Behavior with NDTT and RT_{NDT} (SA, HAZ, A533B-1)

KEY	$T_0 - C (^{\circ}F)$		$RT_{NDT} (^{\circ}F)$	NDTT ($^{\circ}F$)
	K_{Id}, K_d^*	W/A		
33872	-71	-69	-70	-70
323772	-21	-56	-70	-70
331072	-9	-50	-70	-70
331172	15	-30	-70	-70
33973	-54	-58	-40	-40

Table 7.15. Summary of Error Code Analysis for Material 7 (SA, HAZ, A533B-1)

<u>TEST TYPE</u>	<u>INCLUDES ERROR CODES</u>	<u>NO. OF POINTS</u>	<u>SHELF (Ft-Lb)</u>		<u>OVERALL</u>	<u>VARIANCE TRANSITION REGION</u>	<u>VARIANCE RATIO F</u>	
			<u>LOWER</u>	<u>UPPER</u>			<u>OVERALL</u>	<u>TRANSITION REGION</u>
Static (5,11)	Yes	30	48	--	1884	3919	0.774	1.434
	No	24	71	--	2433	2732		
Dynamic (7, 8)	Yes	32	72	--	1919	2506	0.901	0.959
	No	25	57	--	2131	2614		

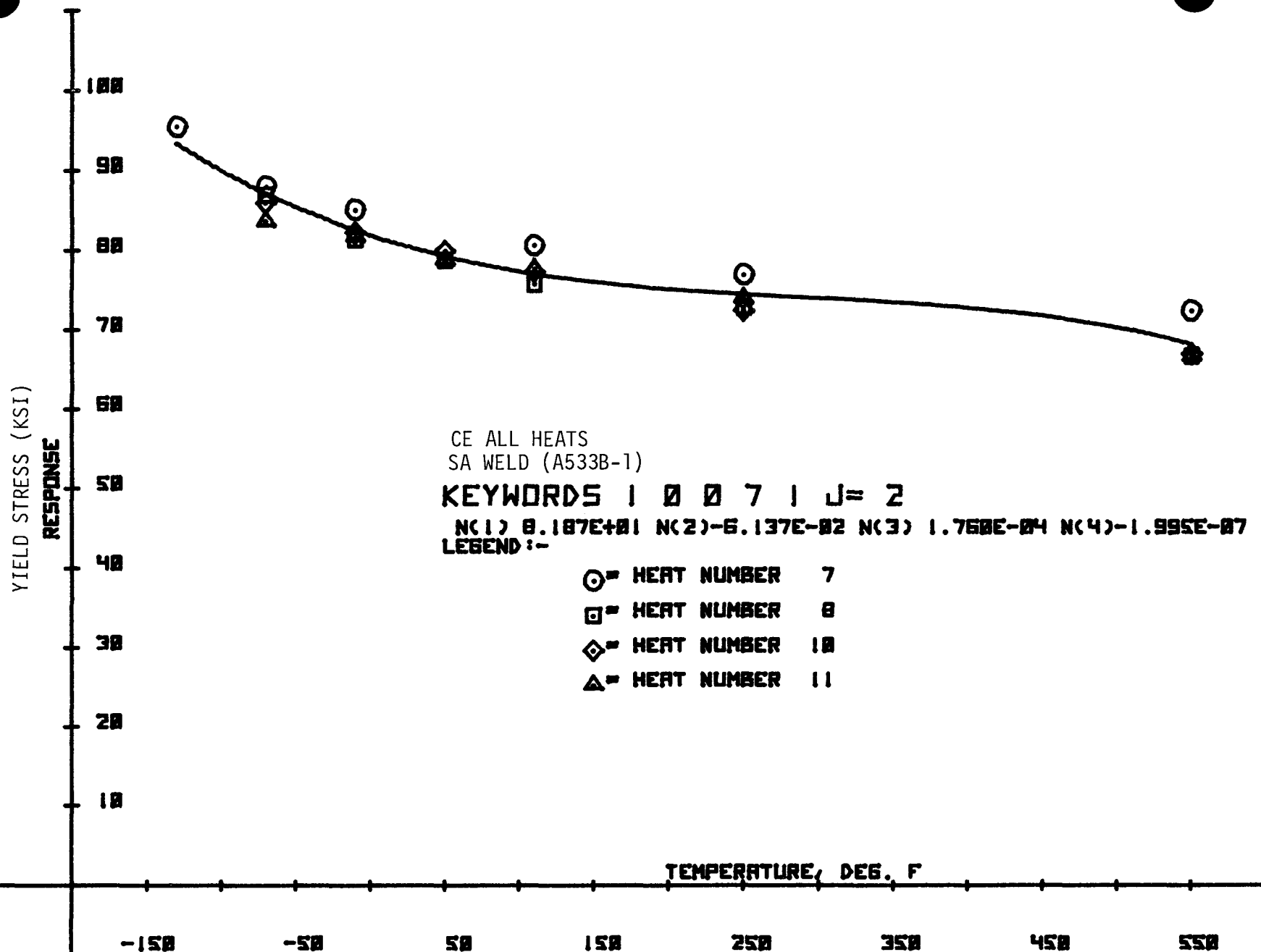


Figure 7.1. Tensile Yield Stress for All CE Weld Metal Heats

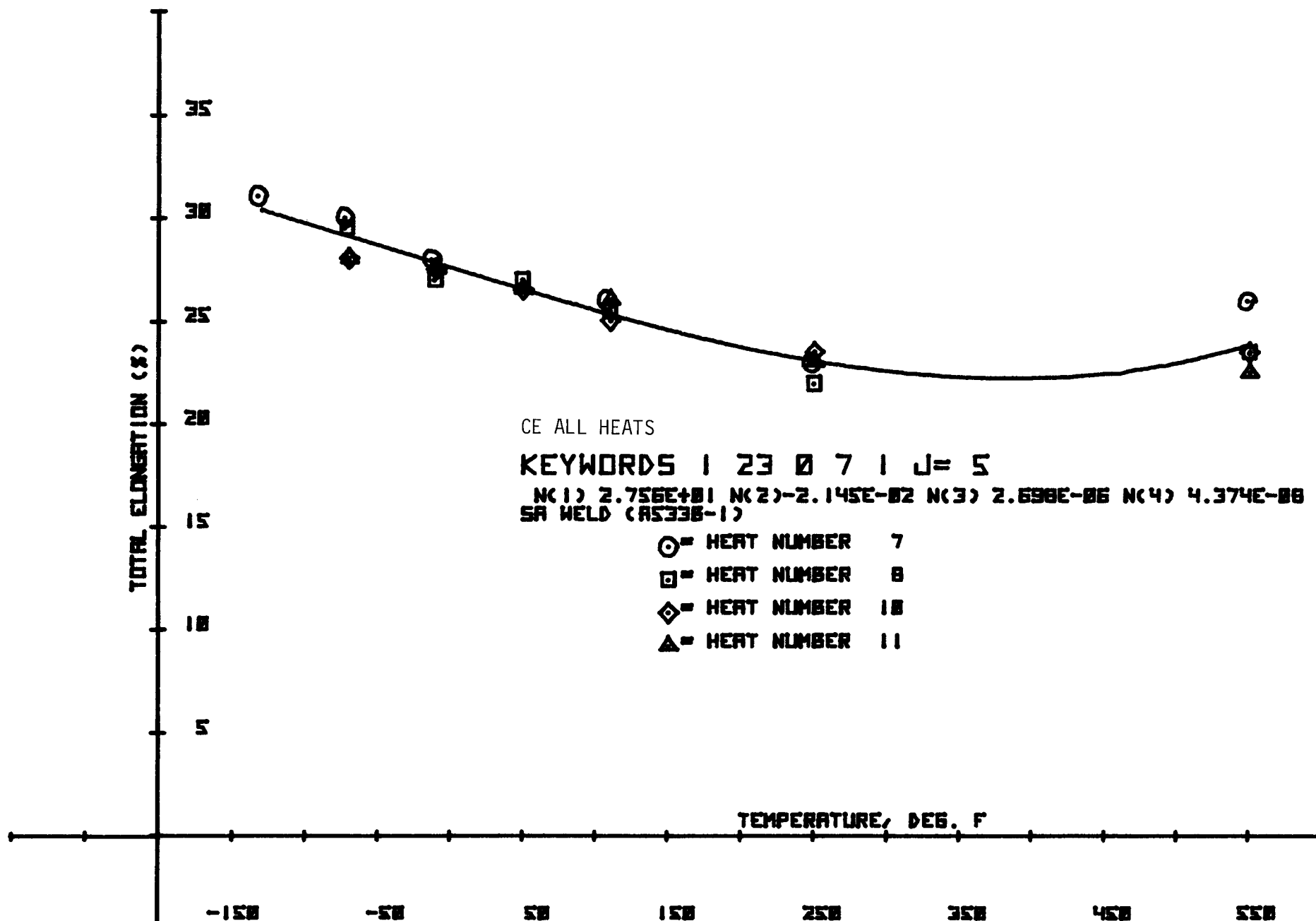


Figure 7.4. Tensile Total Elongation for All CE Weld Metal Heats

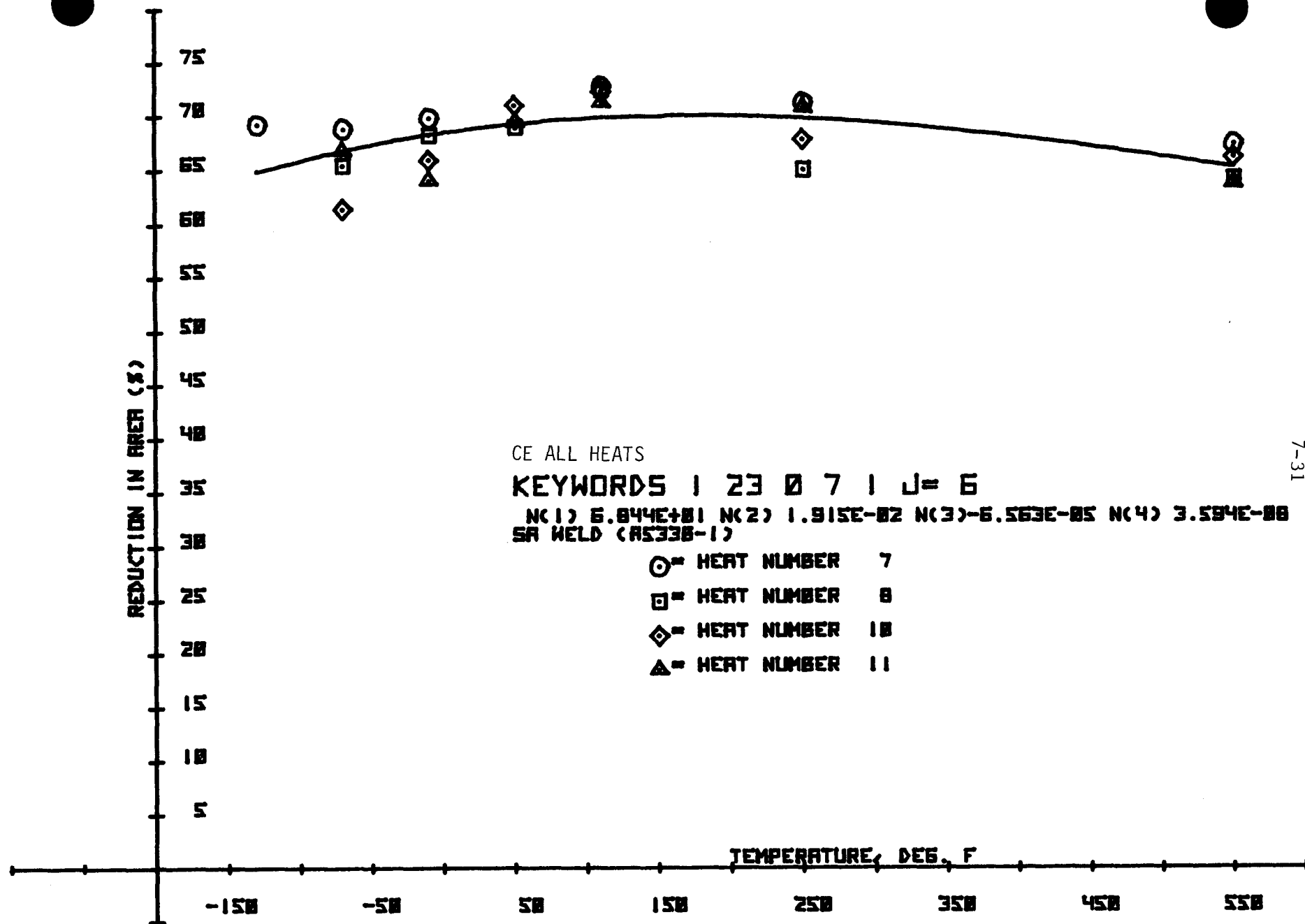


Figure 7.5. Tensile Reduction in Area for All CE Weld Metal Heats

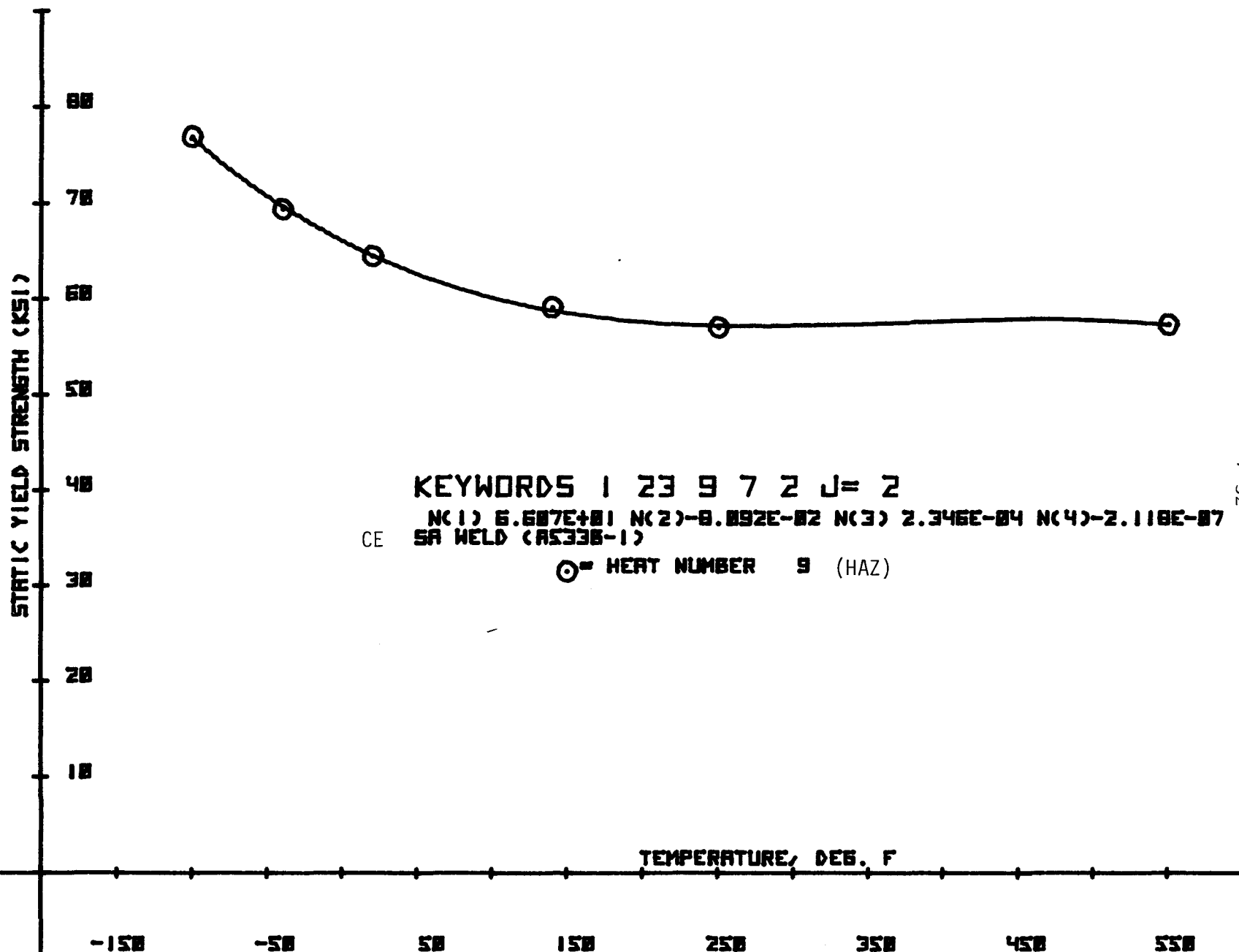


Figure 7.6. Tensile Static Yield Strength for CE SA Weld (HAZ)

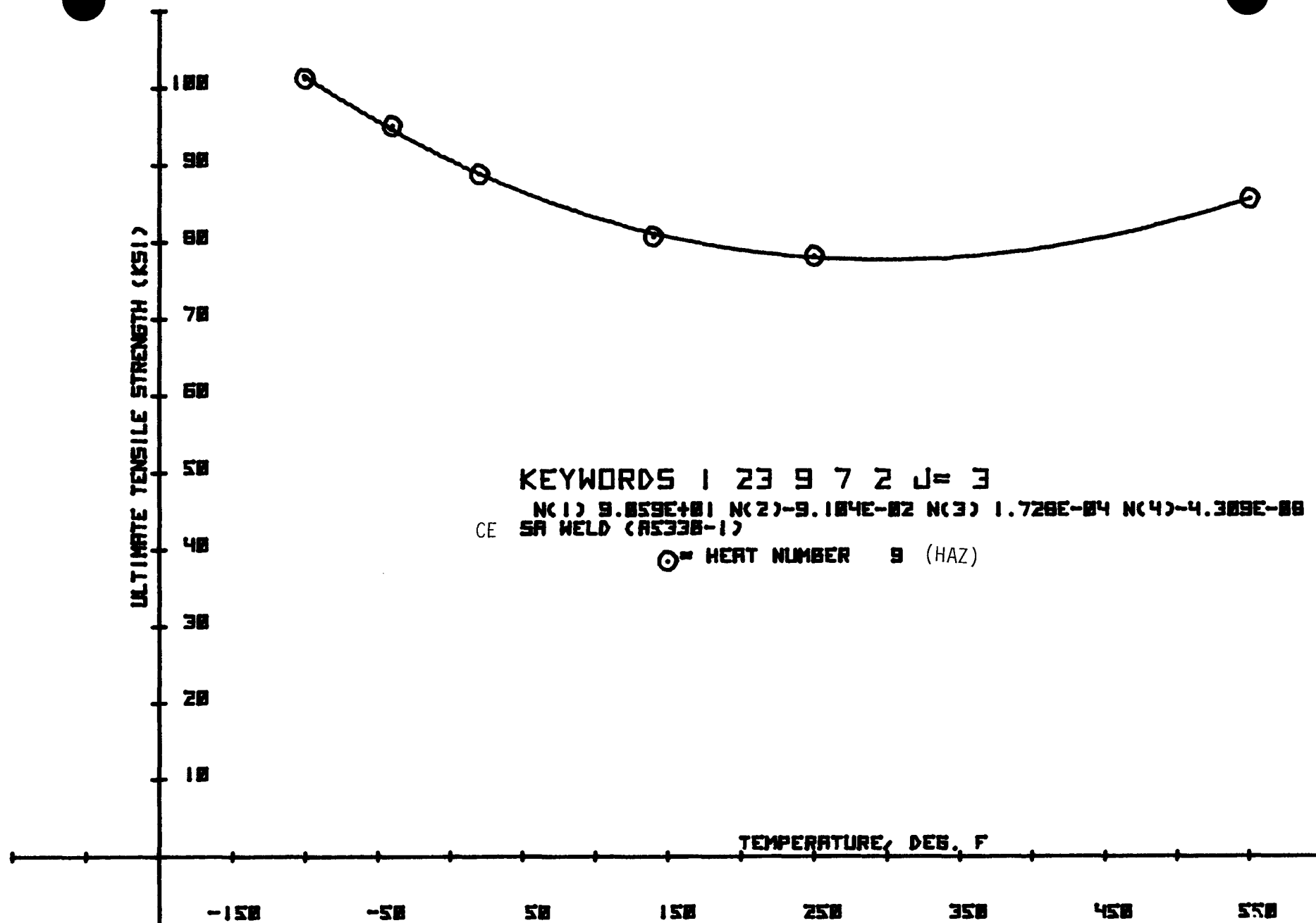


Figure 7.7. Tensile Ultimate Strength for CE SA Weld (HAZ)

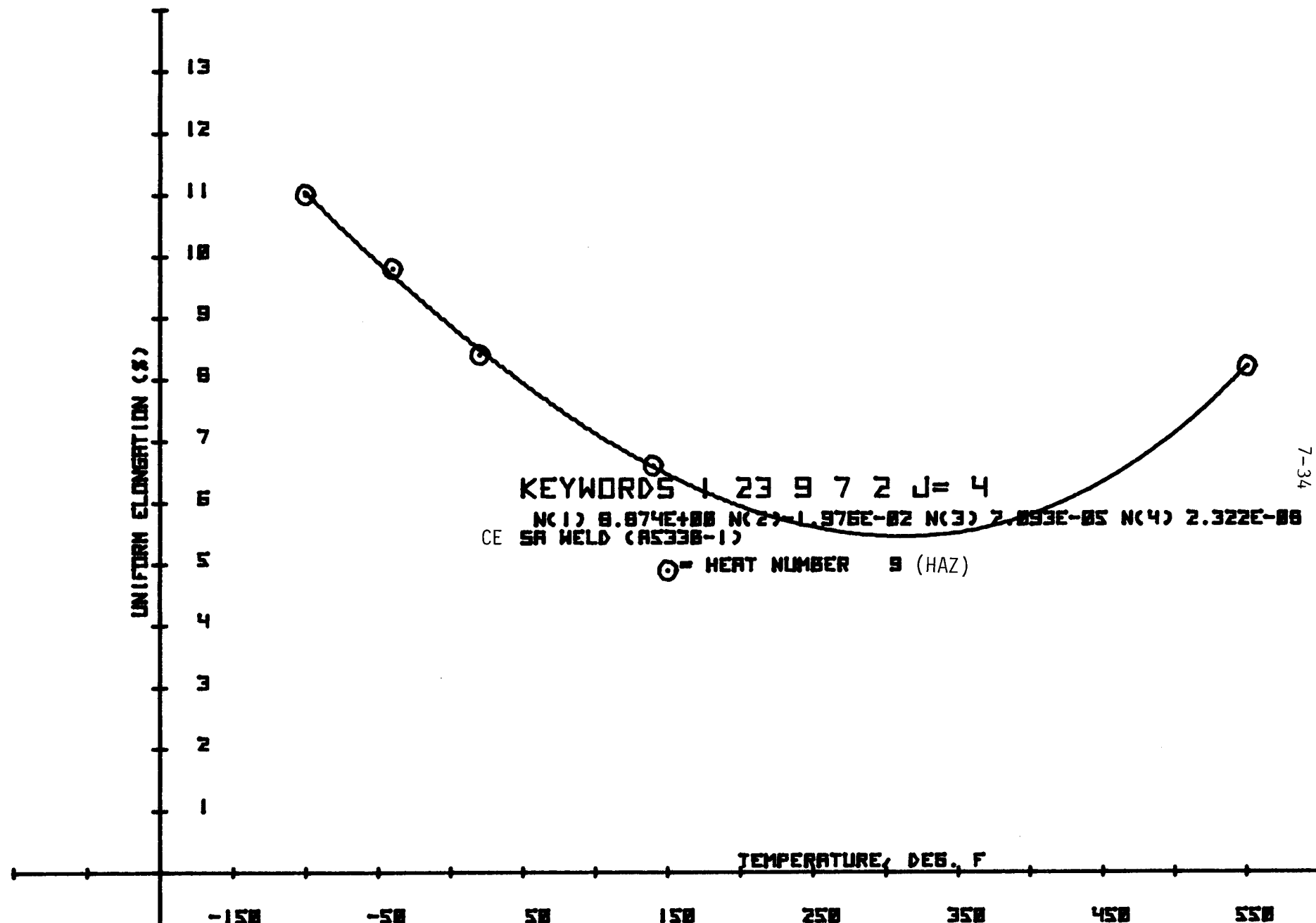


Figure 7.8. Tensile Uniform Elongation for CE SA Weld (HAZ)

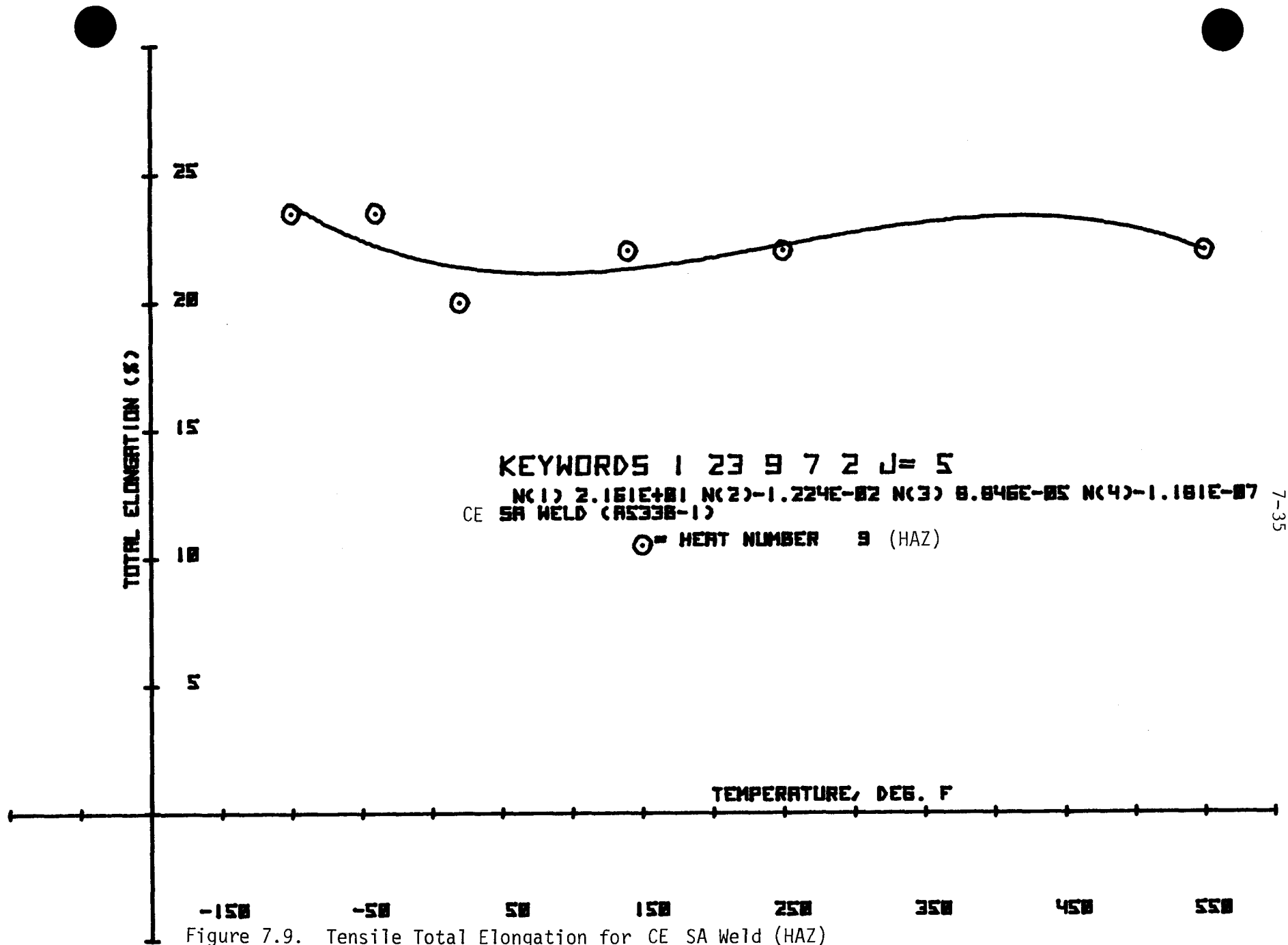


Figure 7.9. Tensile Total Elongation for CE SA Weld (HAZ)

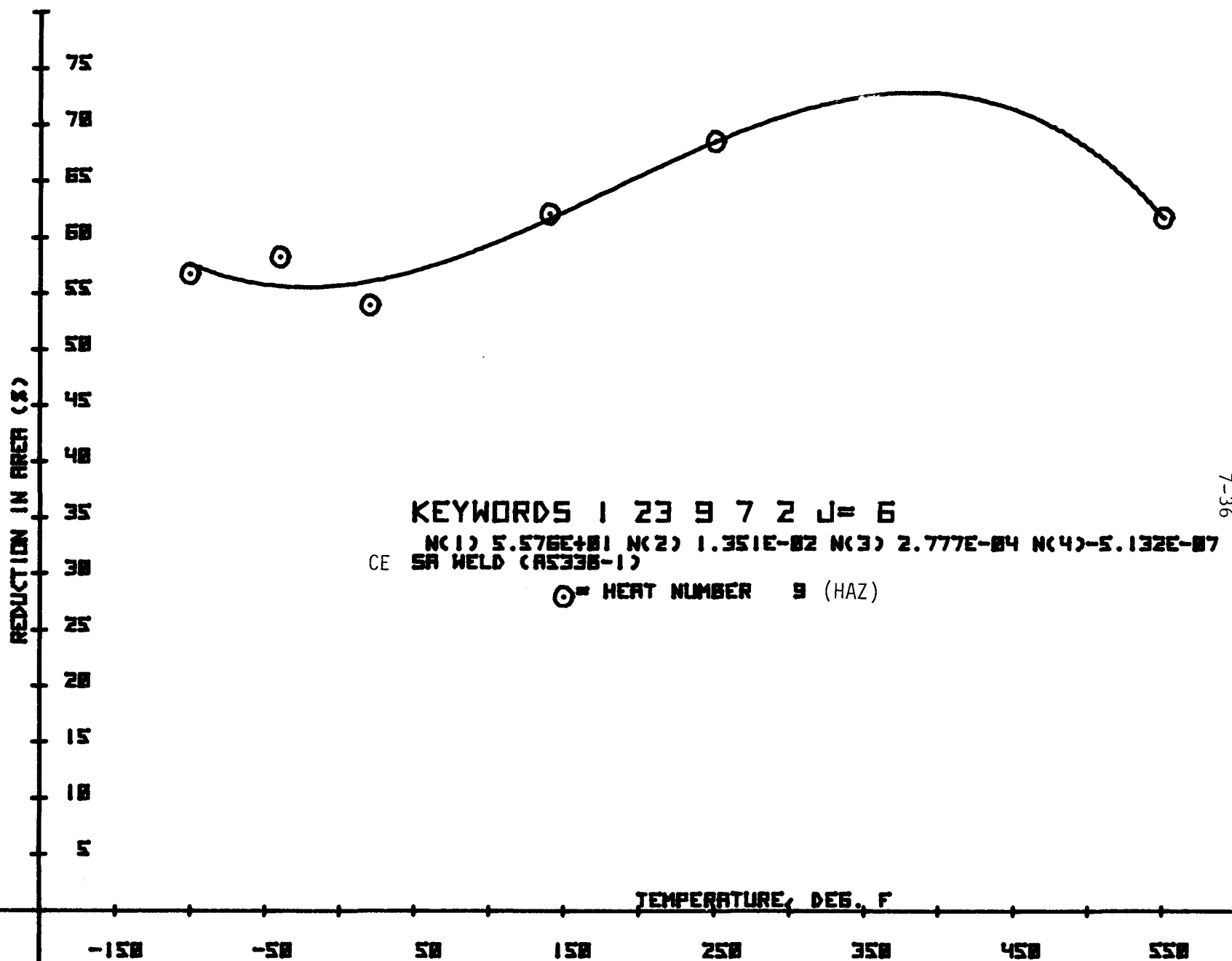


Figure 7.10. Tensile Reduction in Area for CE SA Weld (HAZ)

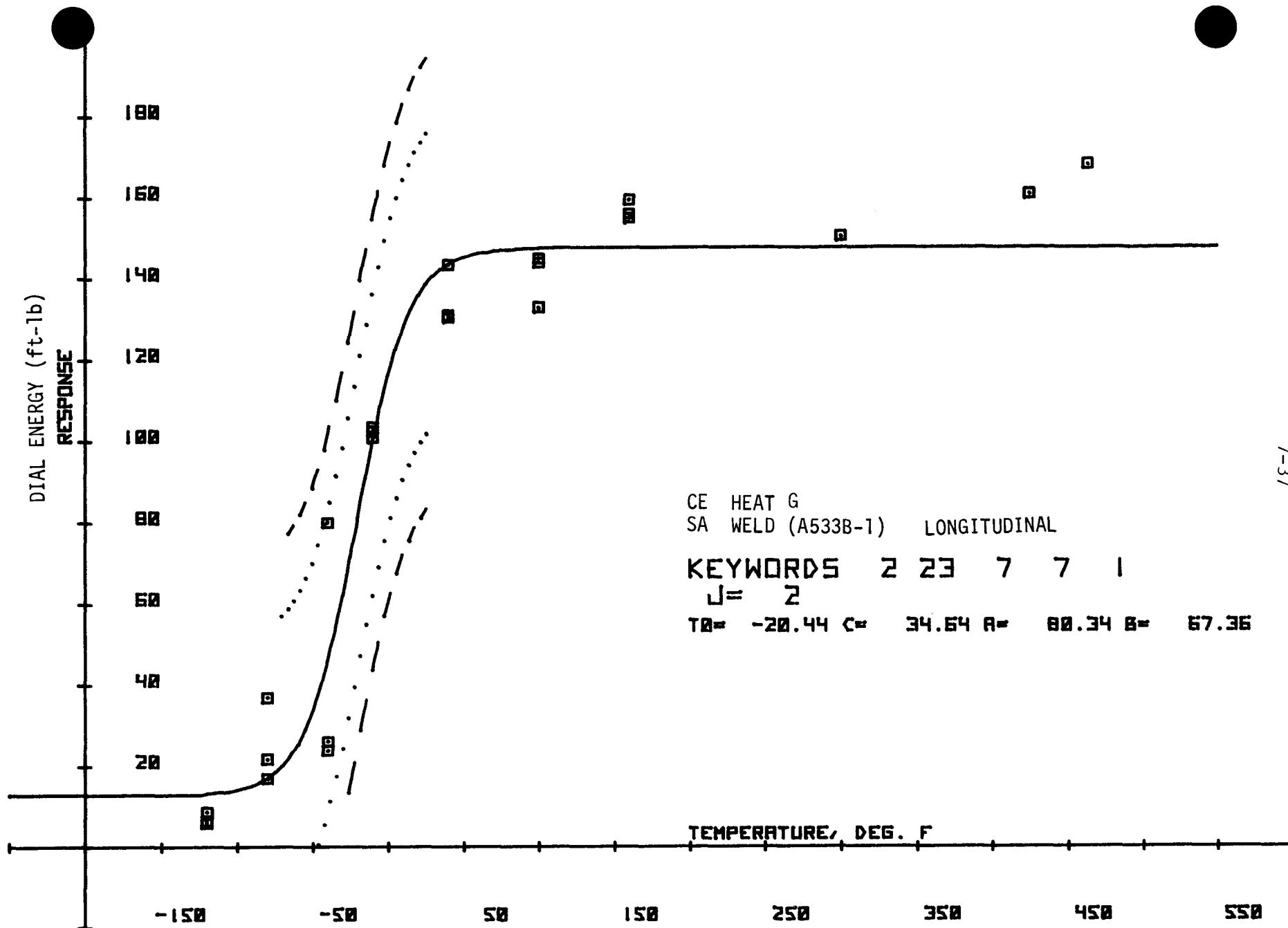


Figure 7.11. Charpy V-Notch Dial Energy for CE Heat G (L)

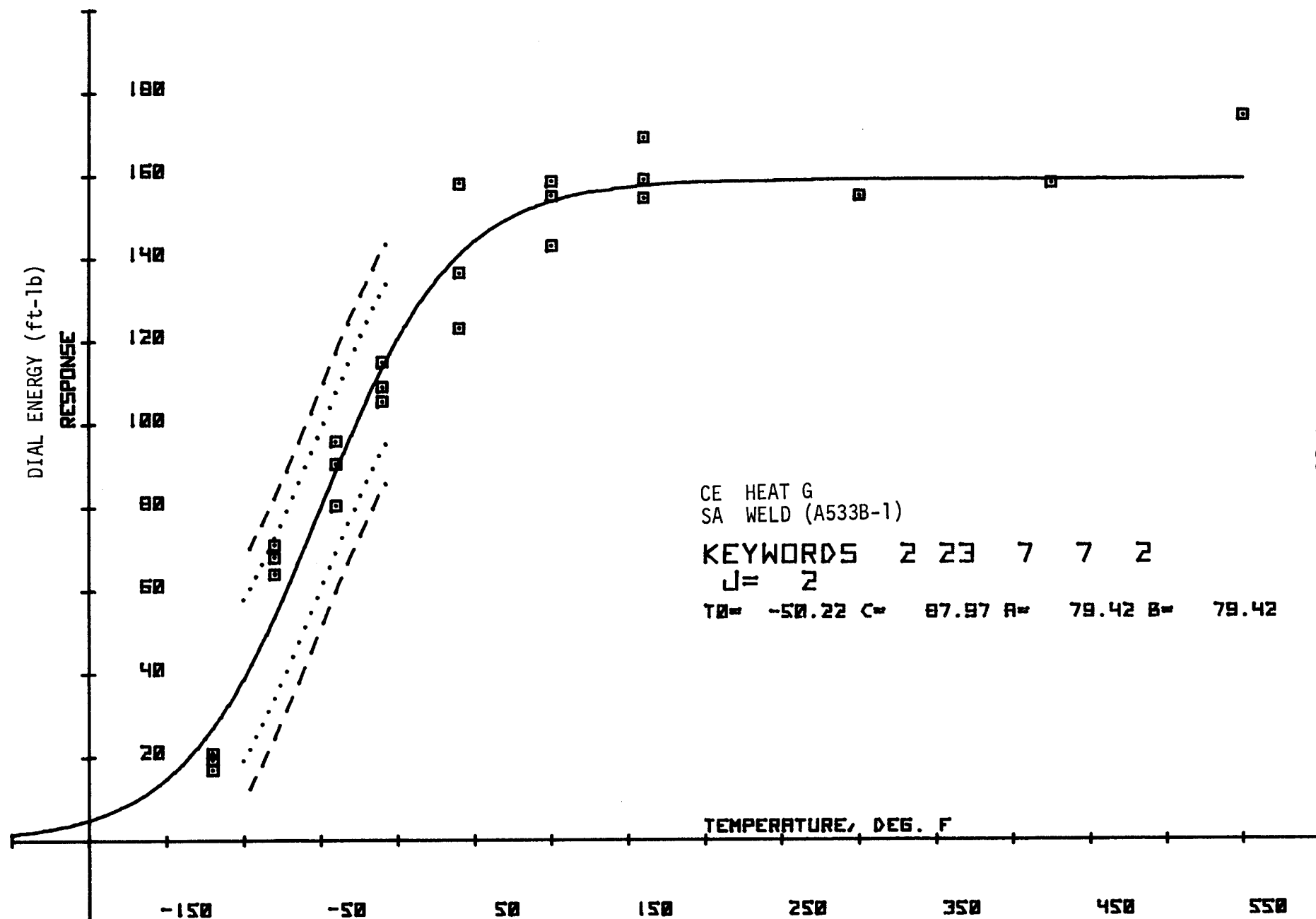


Figure 7.12. Charpy V-Notch Dial Energy for CE Heat G (T)

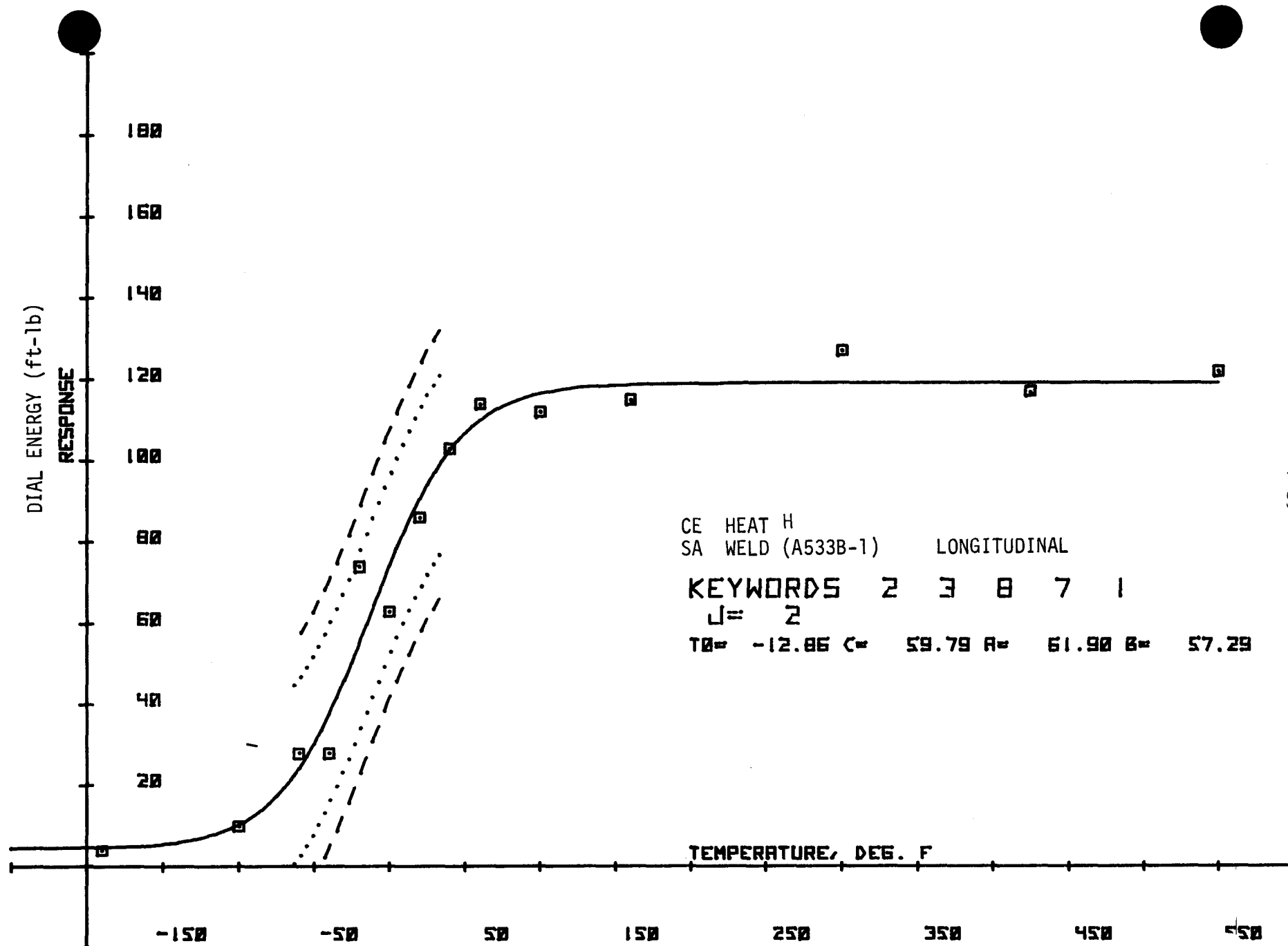
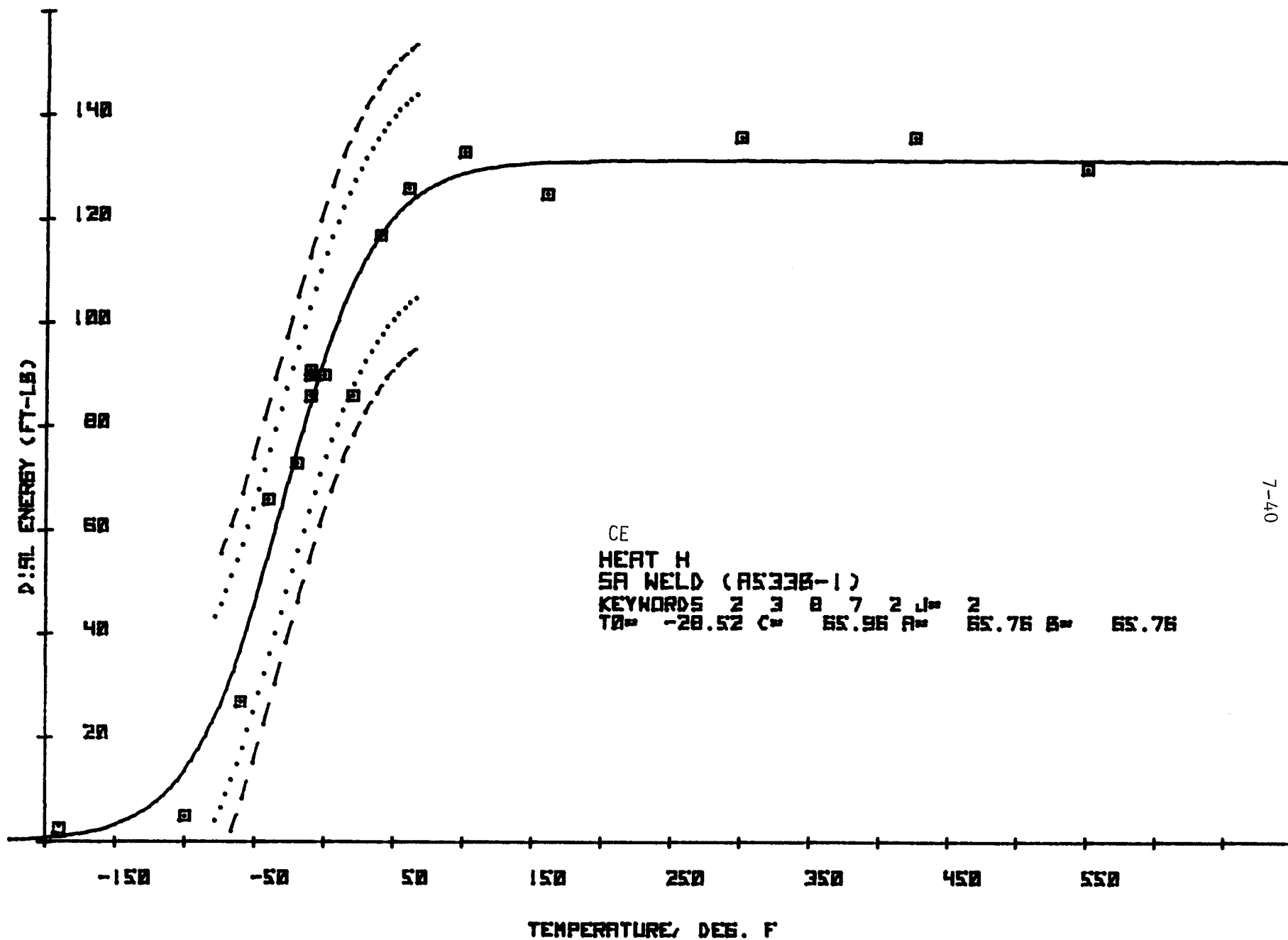


Figure 7.13. Charpy V-Notch Dial Energy for CE Heat H (L)



7-40

Figure 7.14. Charpy V-Notch Dial Energy for CE Heat H (T)

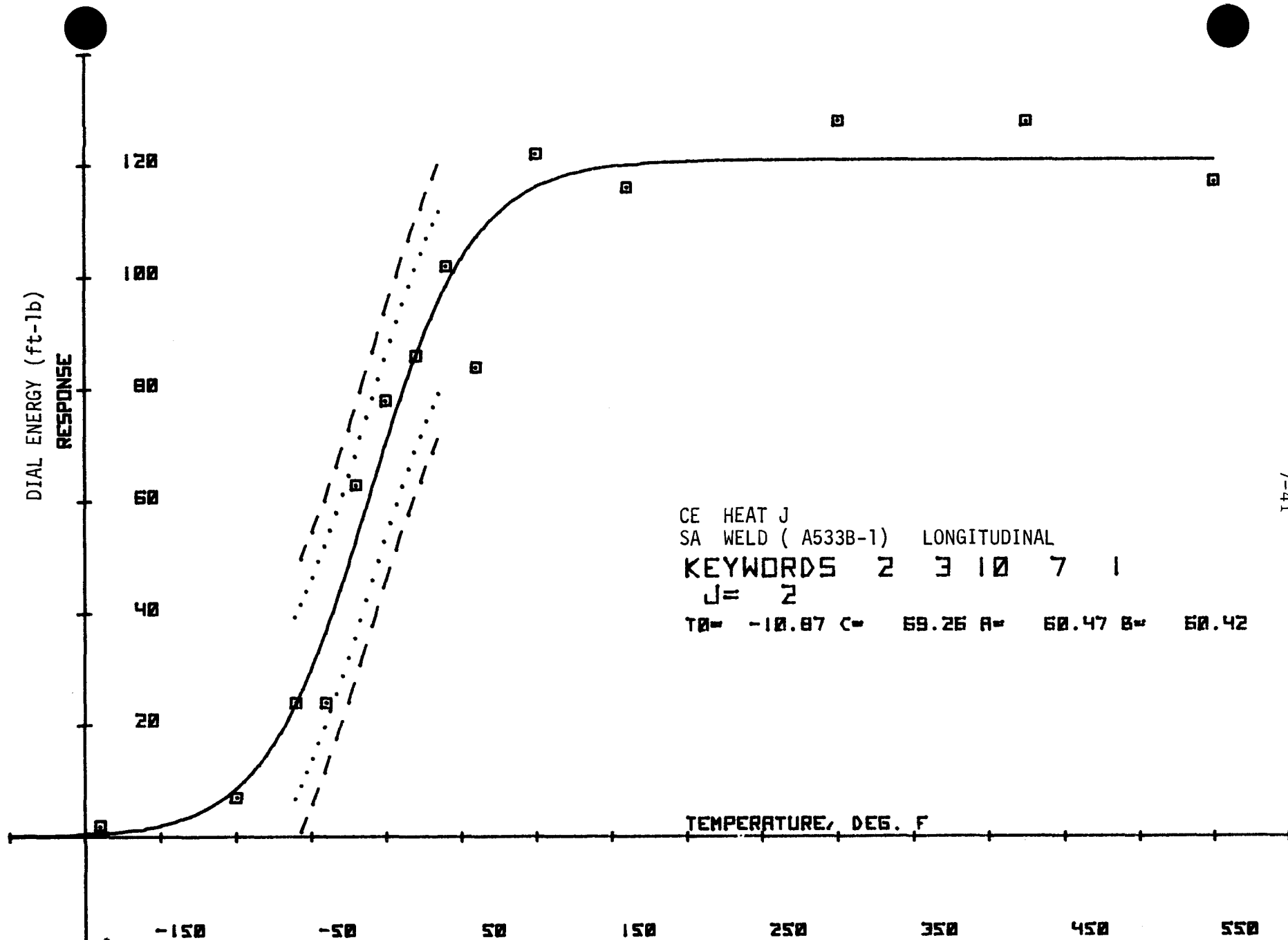


Figure 7.15. Charpy V-Notch Dial Energy for CE Heat J (L)

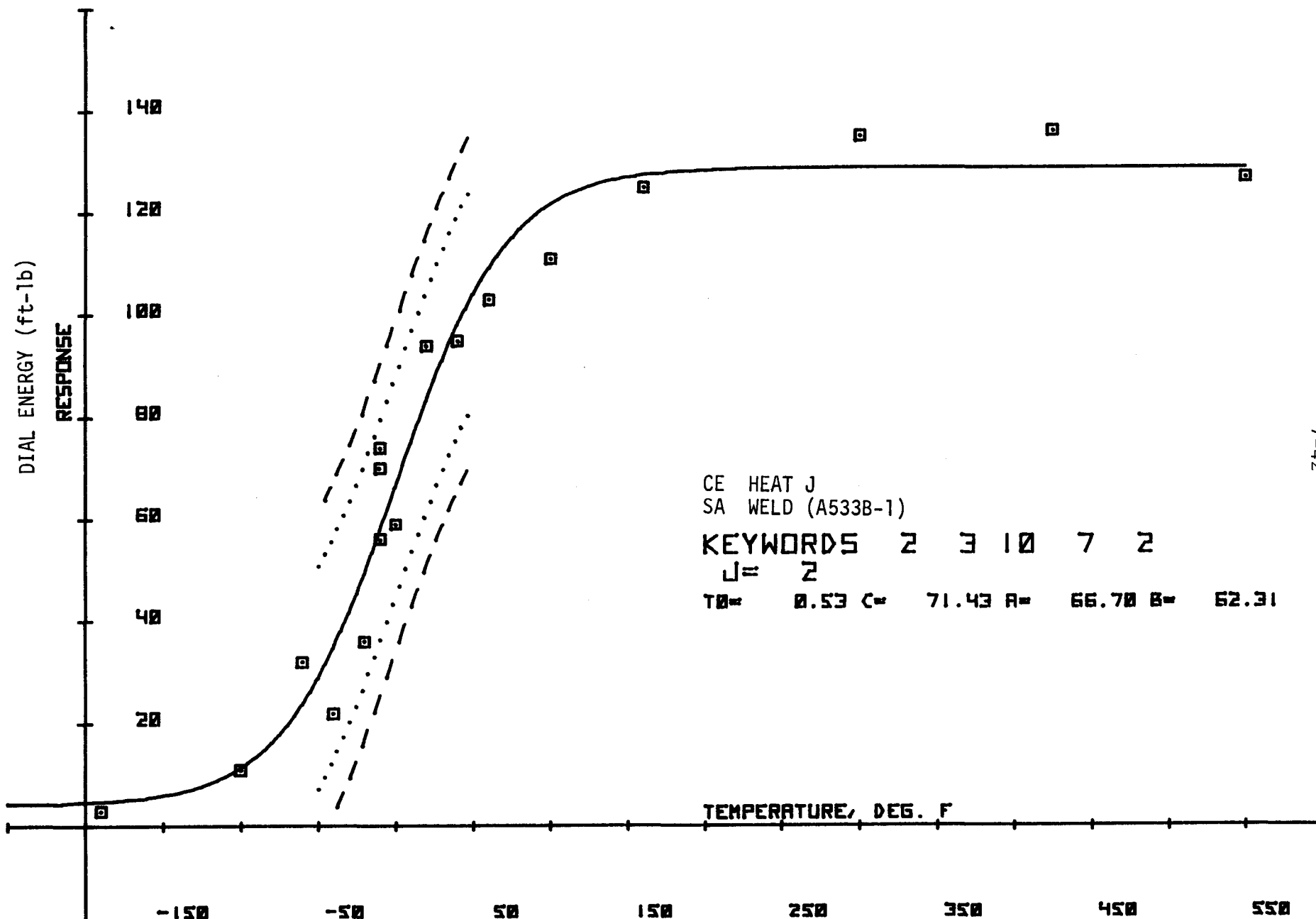


Figure 7.16. Charpy V-Notch Dial Energy for CE Heat H (T)

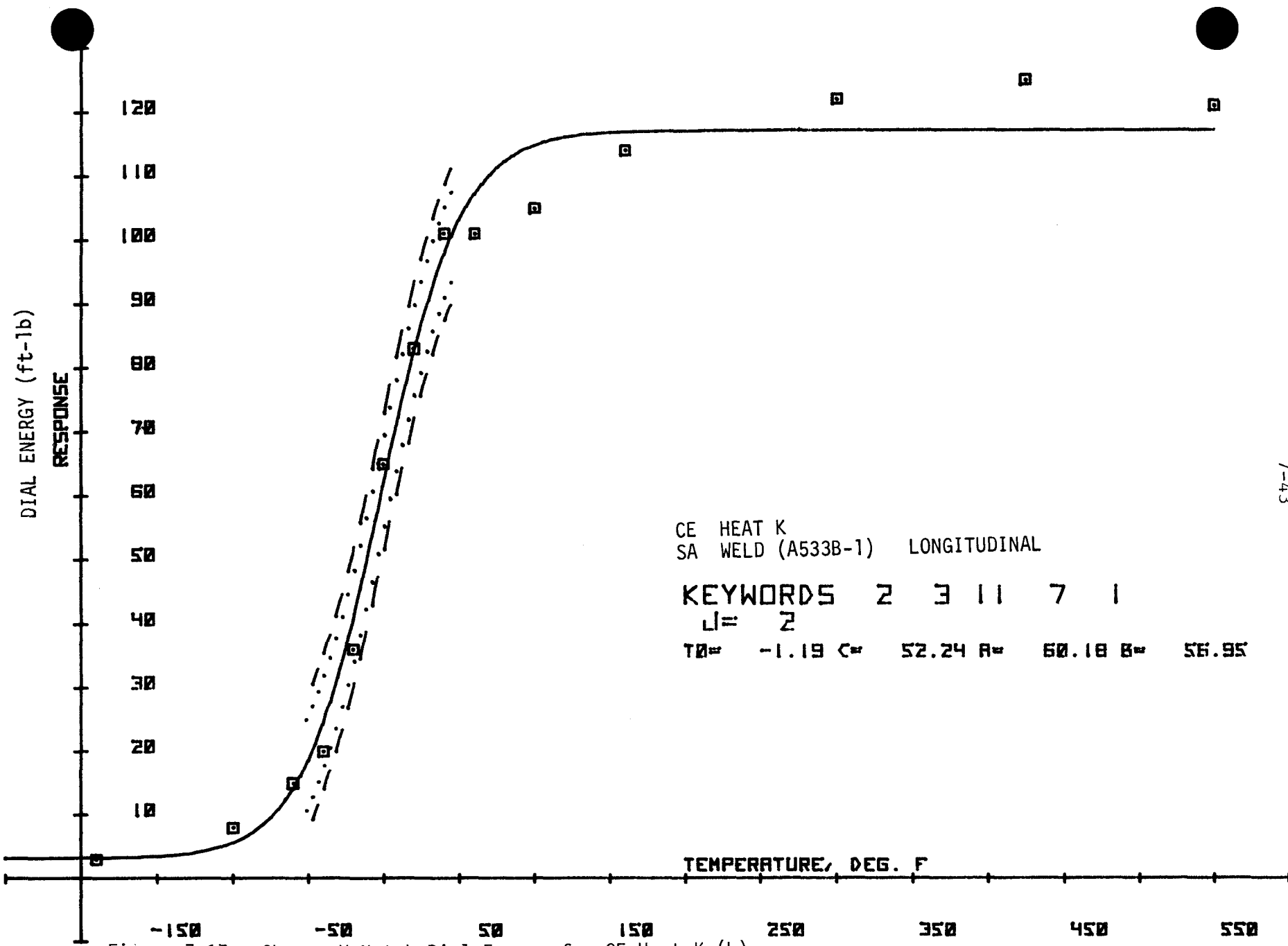
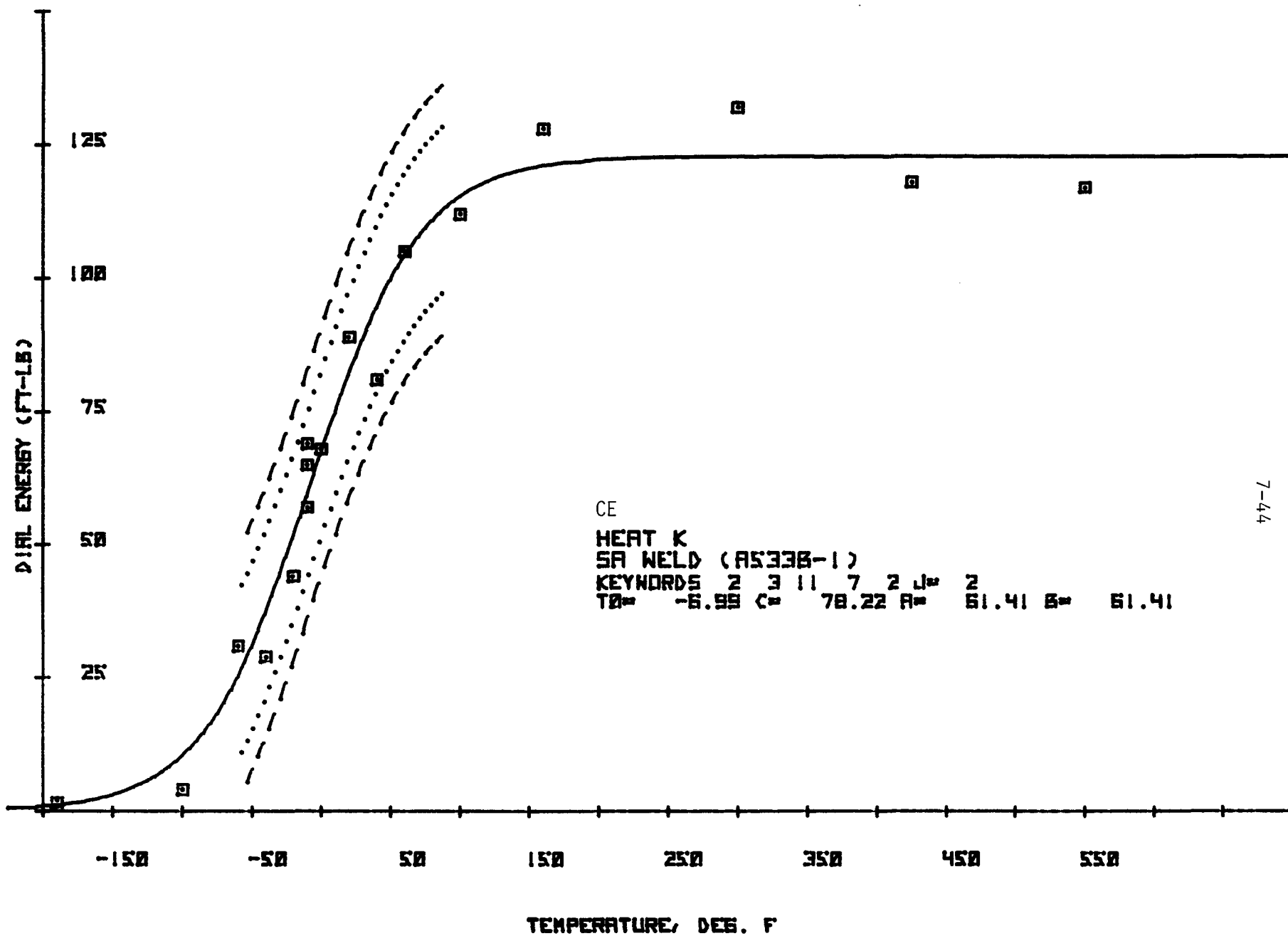
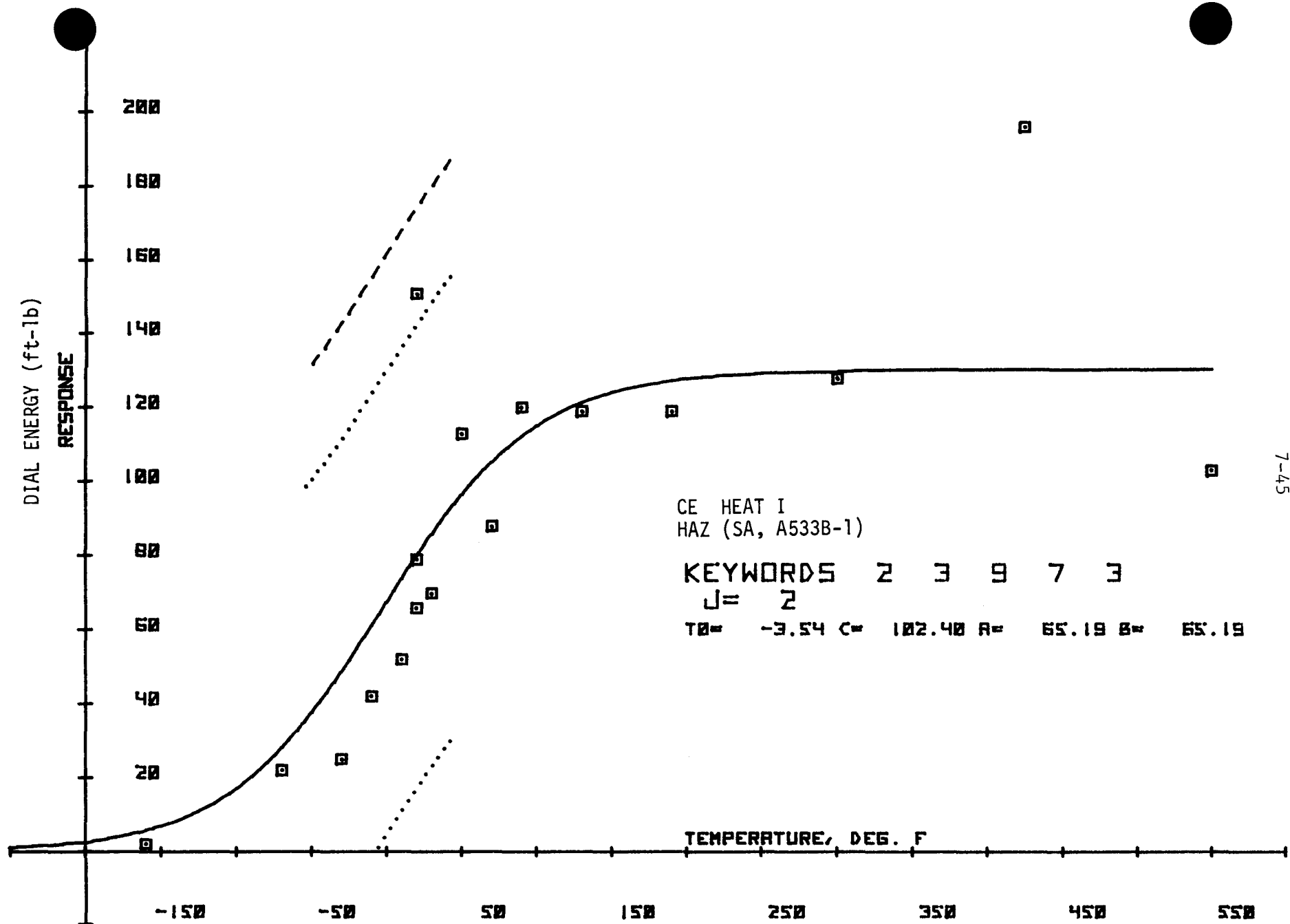


Figure 7.17. Charpy V-Notch Dial Energy for CE Heat K (L)



7-44

Figure 7.18. Charpy V-Notch Dial Energy for CE Heat K (T)



7-45

Figure 7.19. Charpy V-Notch Dial Energy for CE Heat I (HAZ)

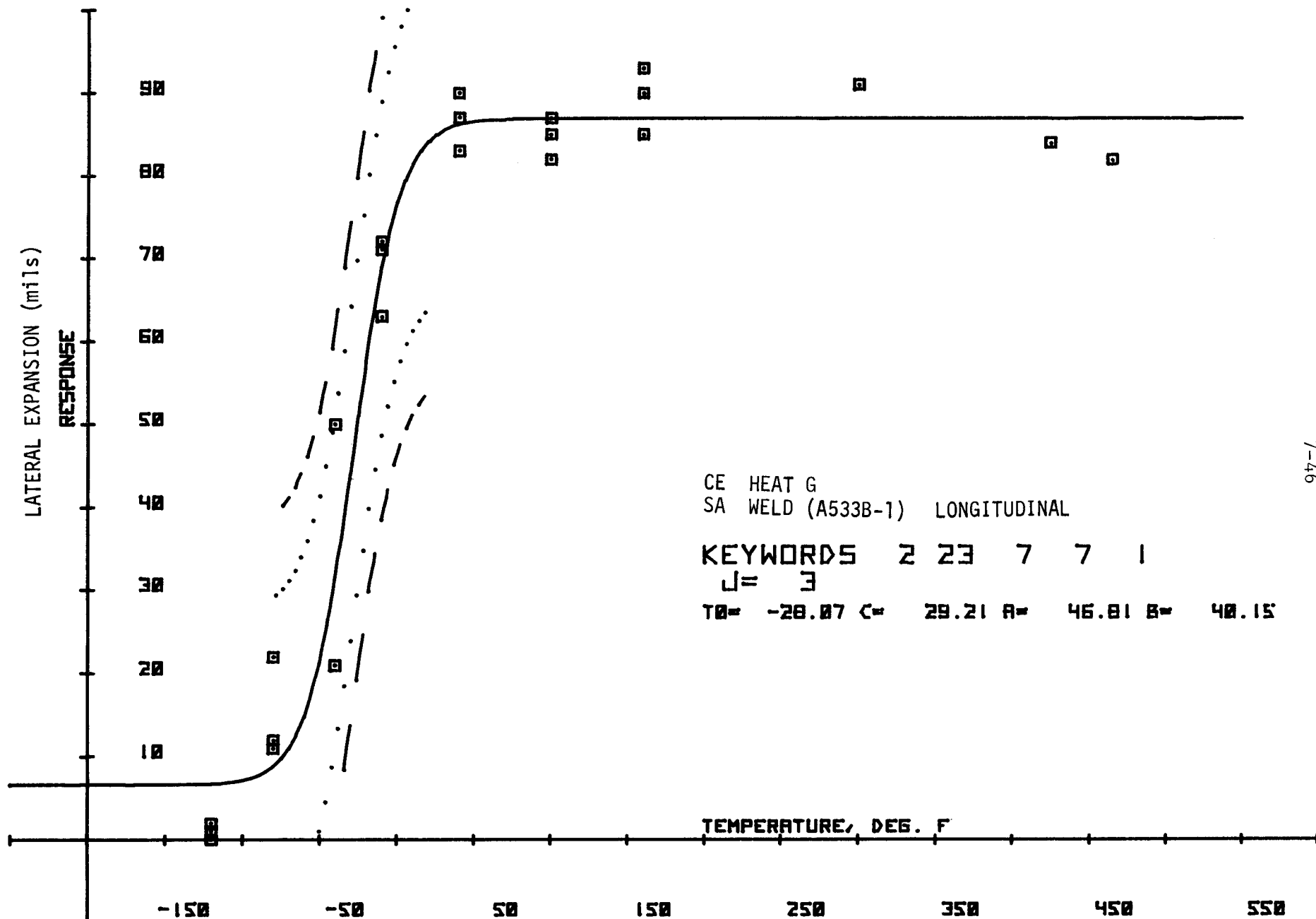


Figure 7.20. Charpy V-Notch Lateral Expansion for CE Heat G (L)

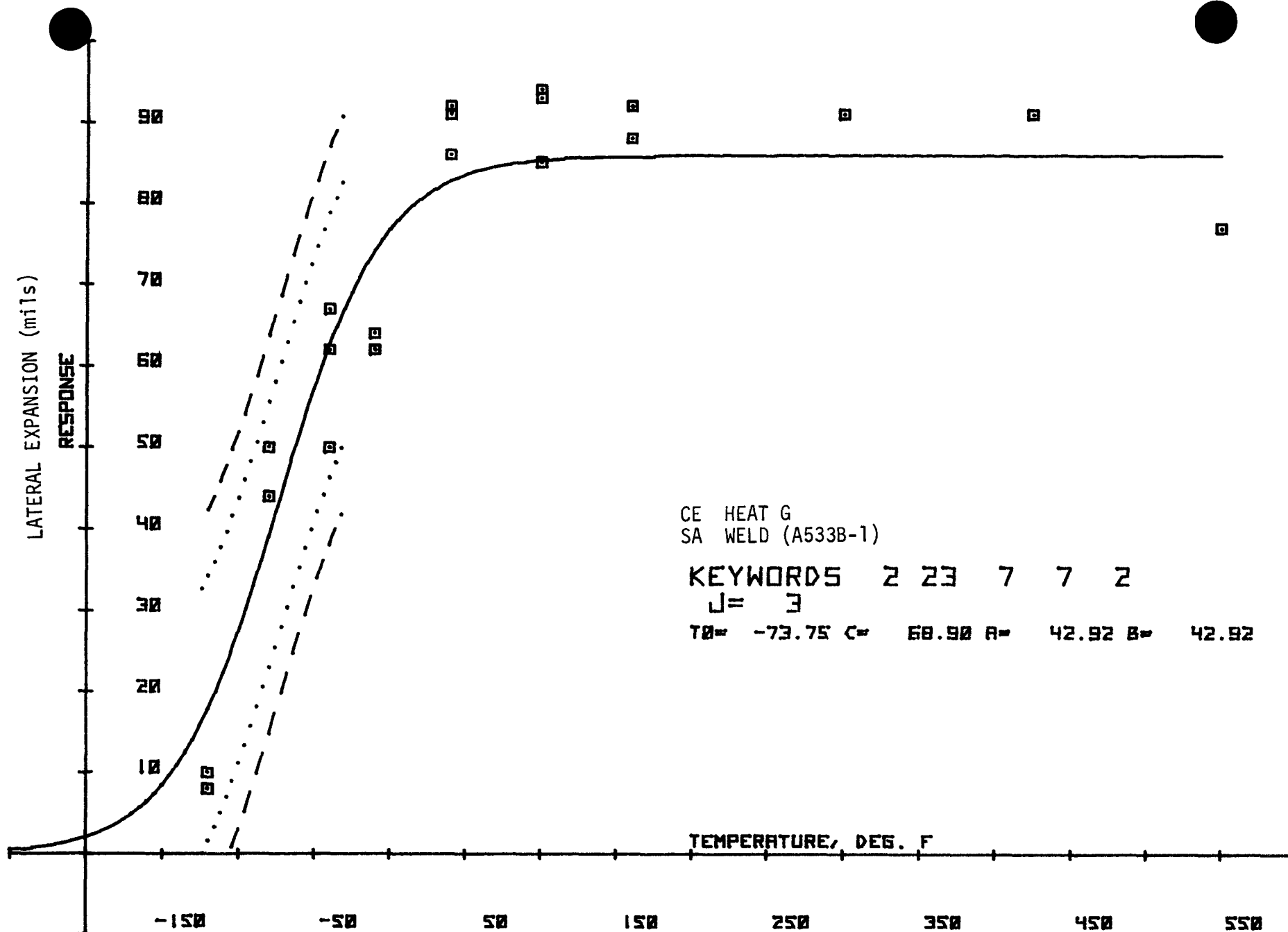


Figure 7.21. Charpy V-Notch Lateral Expansion for CE Heat G (T)

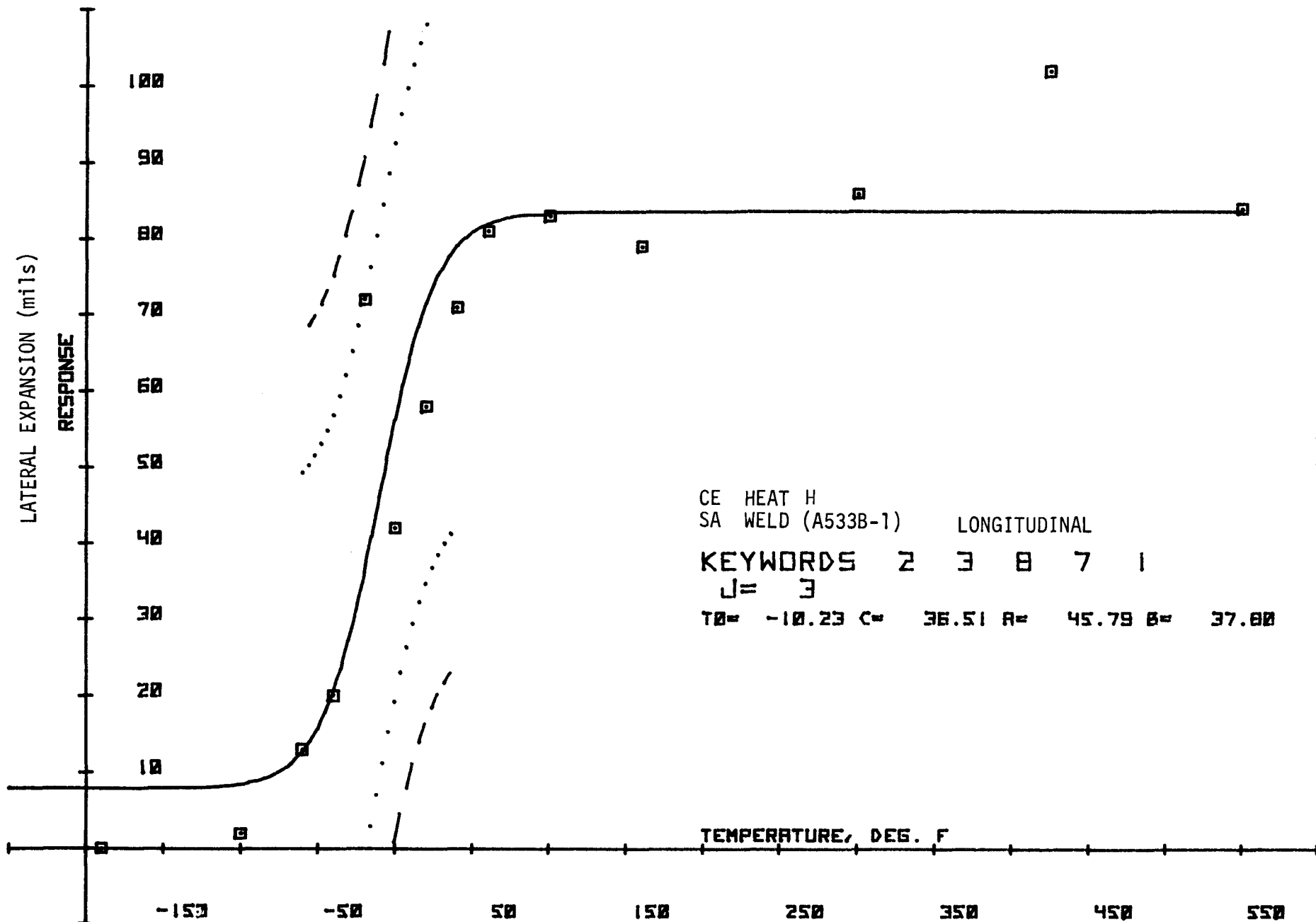


Figure 7.22. Charpy V-Notch Lateral Expansion for CE Heat H (L)

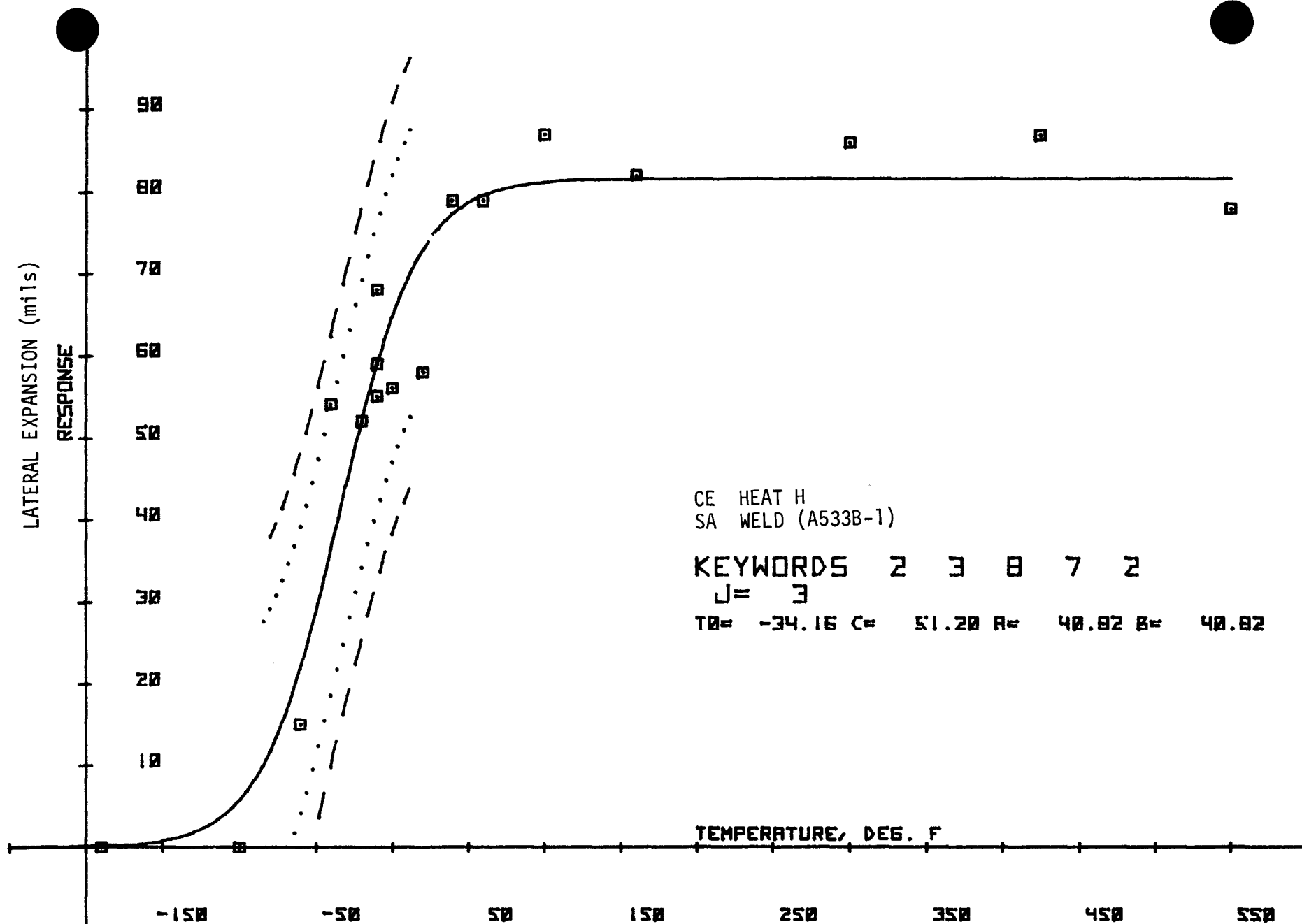
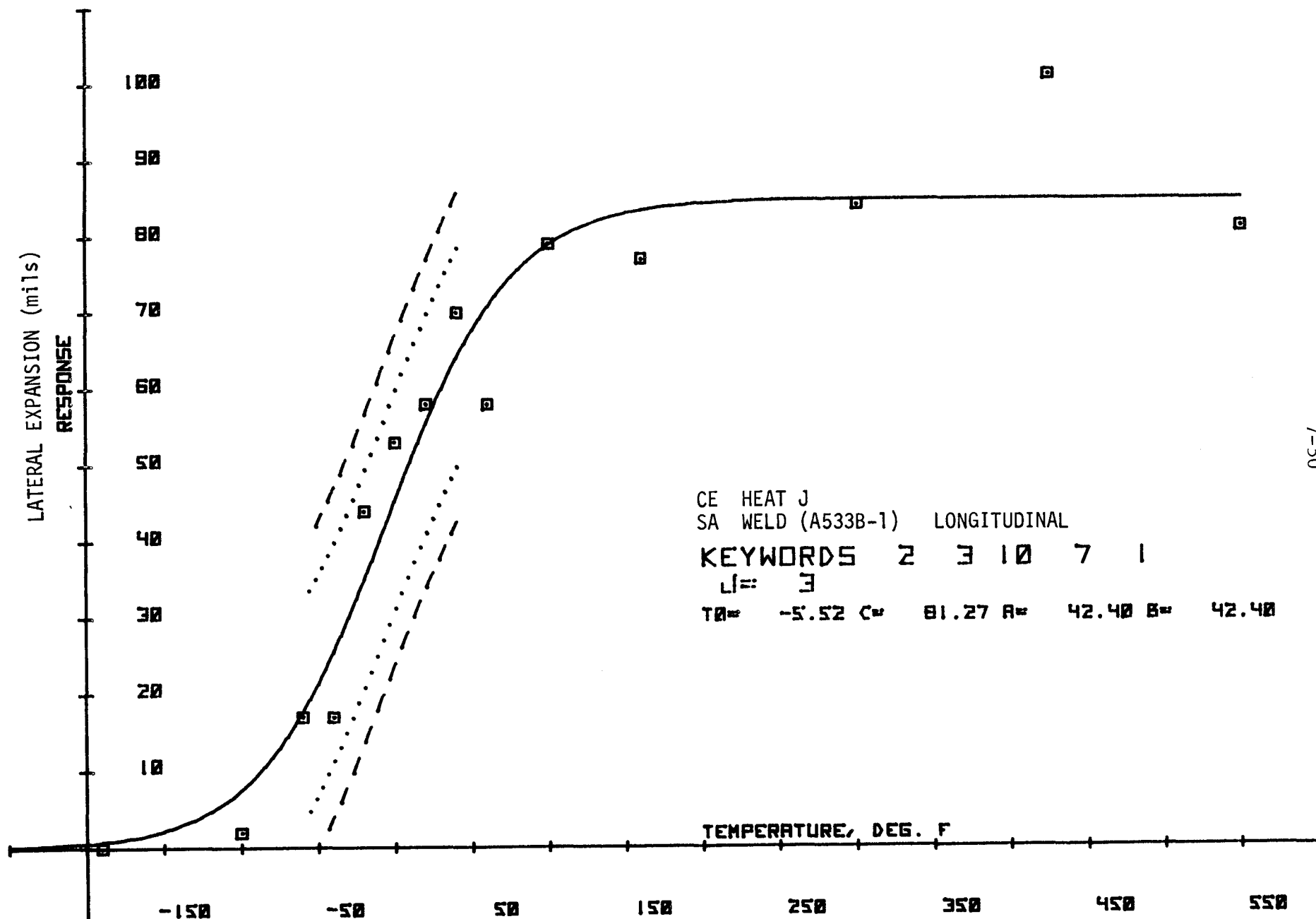


Figure 7.23. Charpy V-Notch Lateral Expansion for CE Heat H (T)



7-50

Figure 7.24. Charpy V-Notch Lateral Expansion for CE Heat J (L)

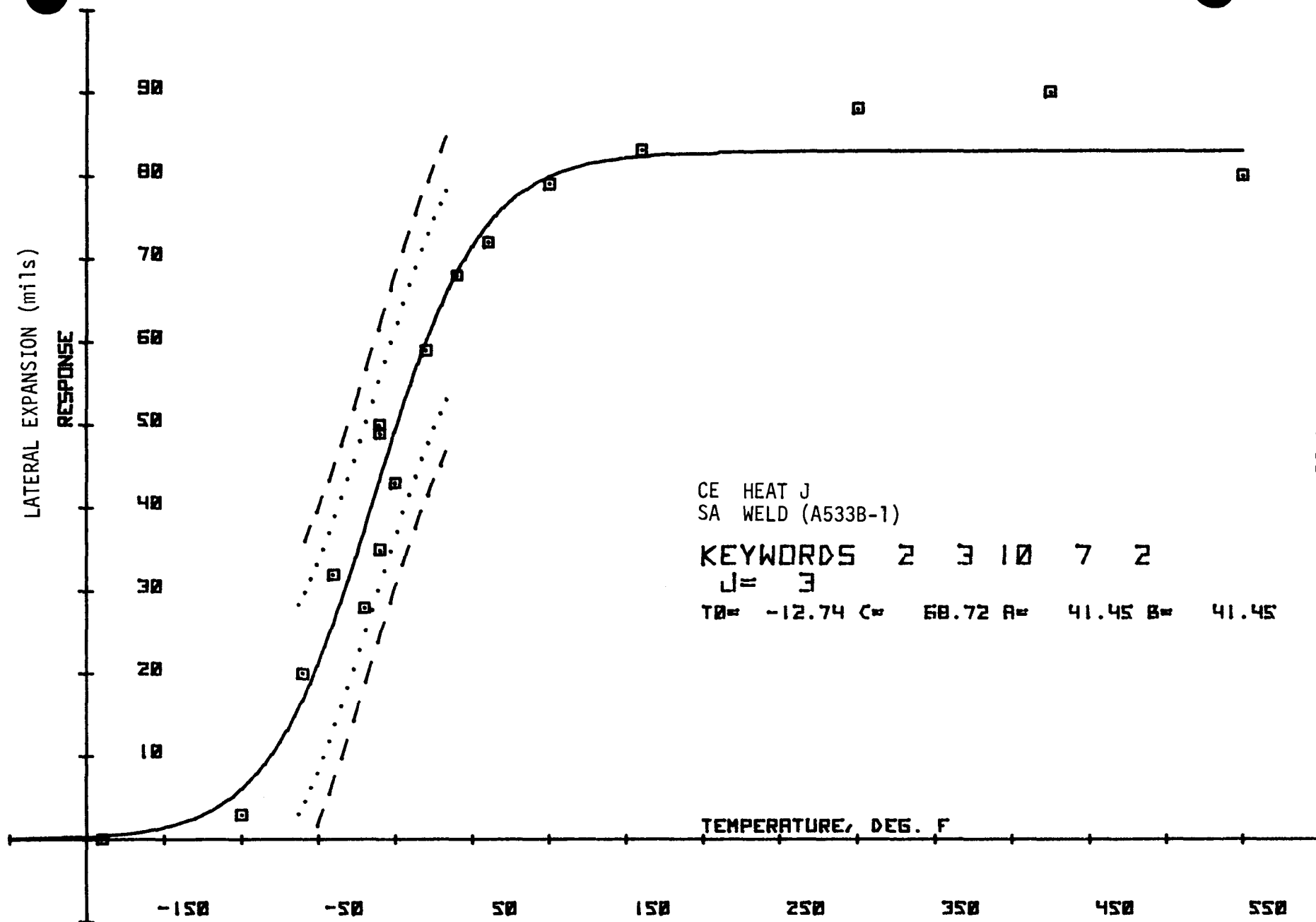


Figure 7.25. Charpy V-Notch Lateral Expansion for CE Heat J (T)

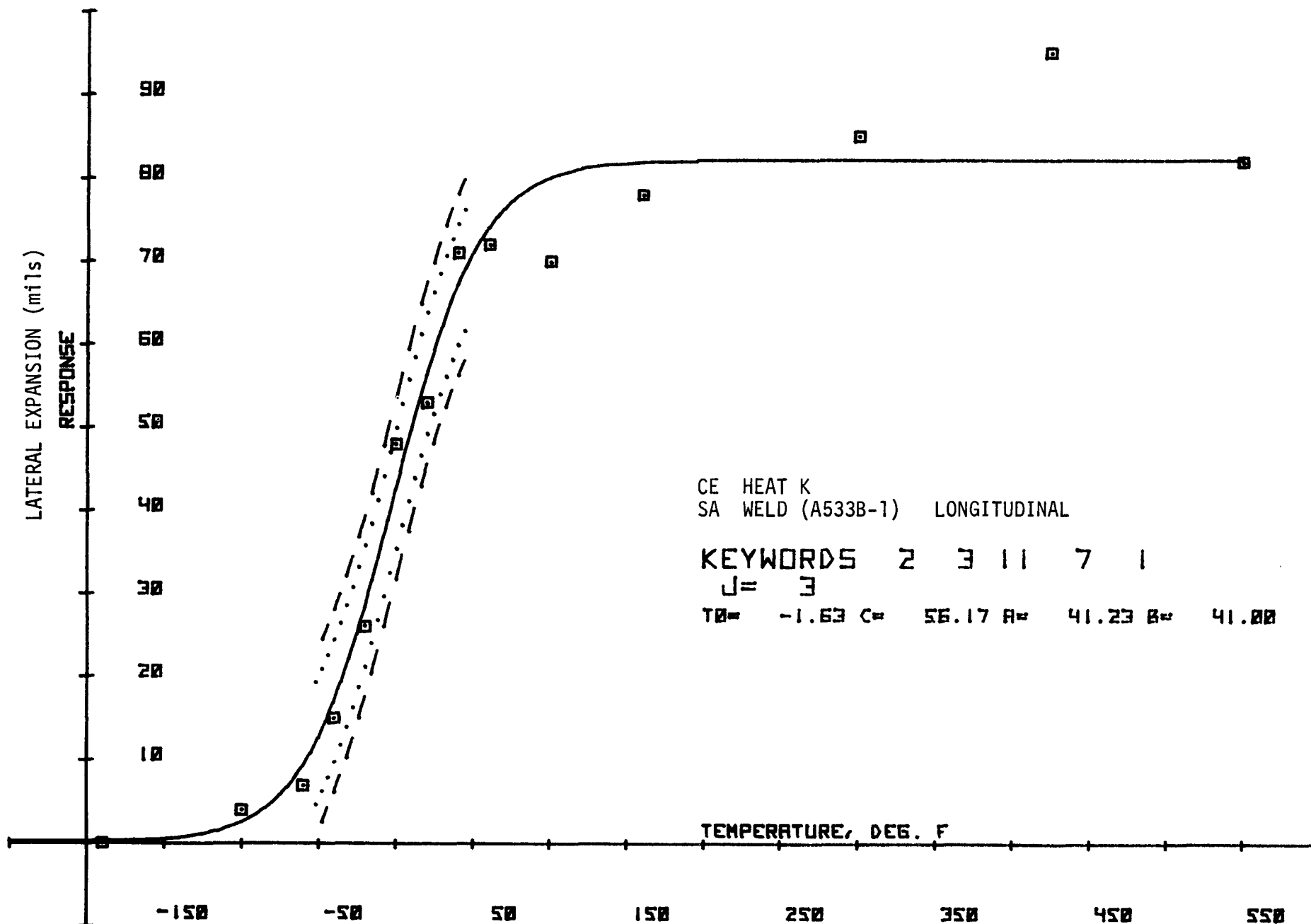


Figure 7.26. Charpy V-Notch Lateral Expansion for CE Heat K (L)

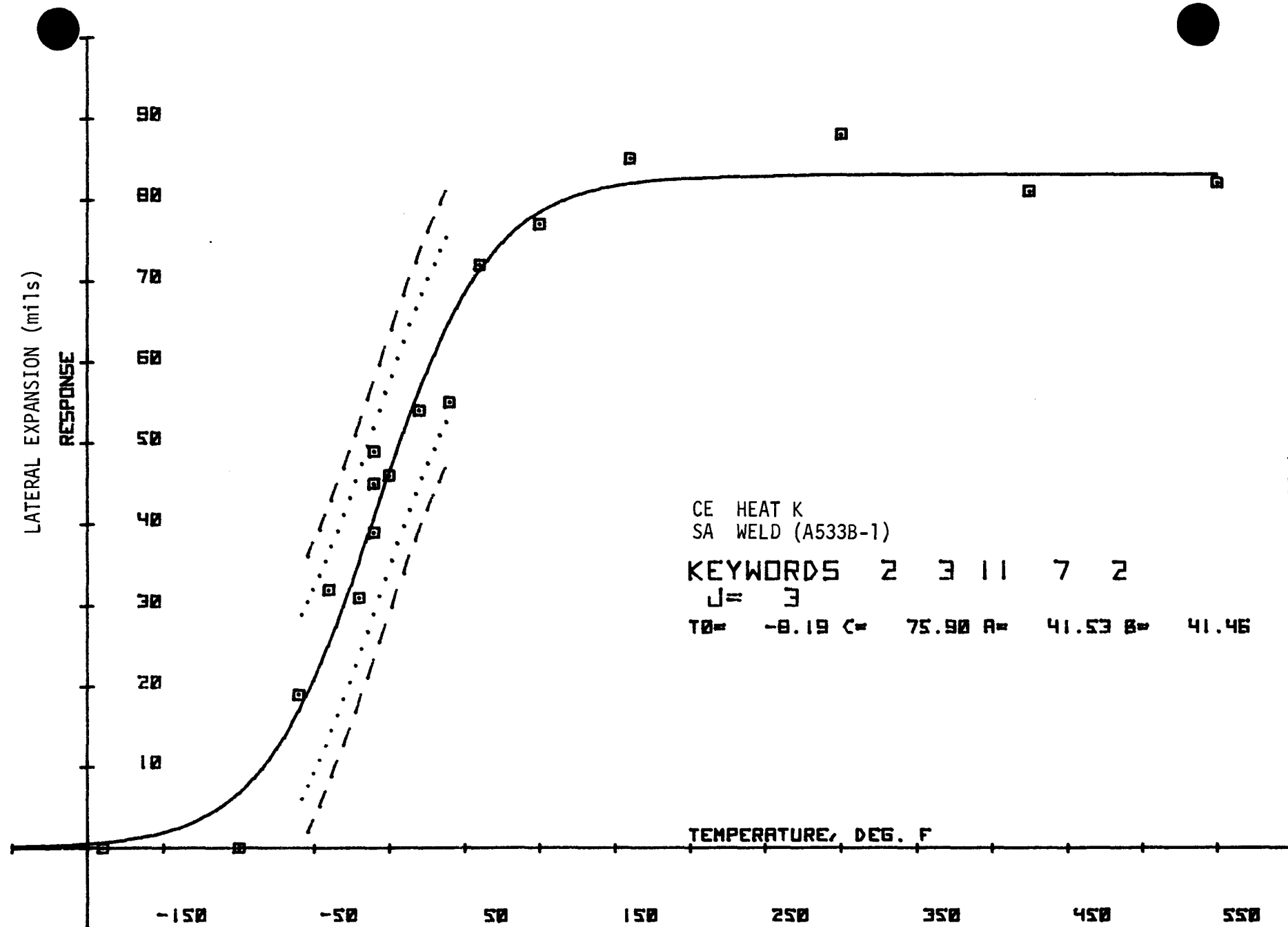


Figure 7.27. Charpy V-Notch Lateral Expansion for CE Heat K (T)

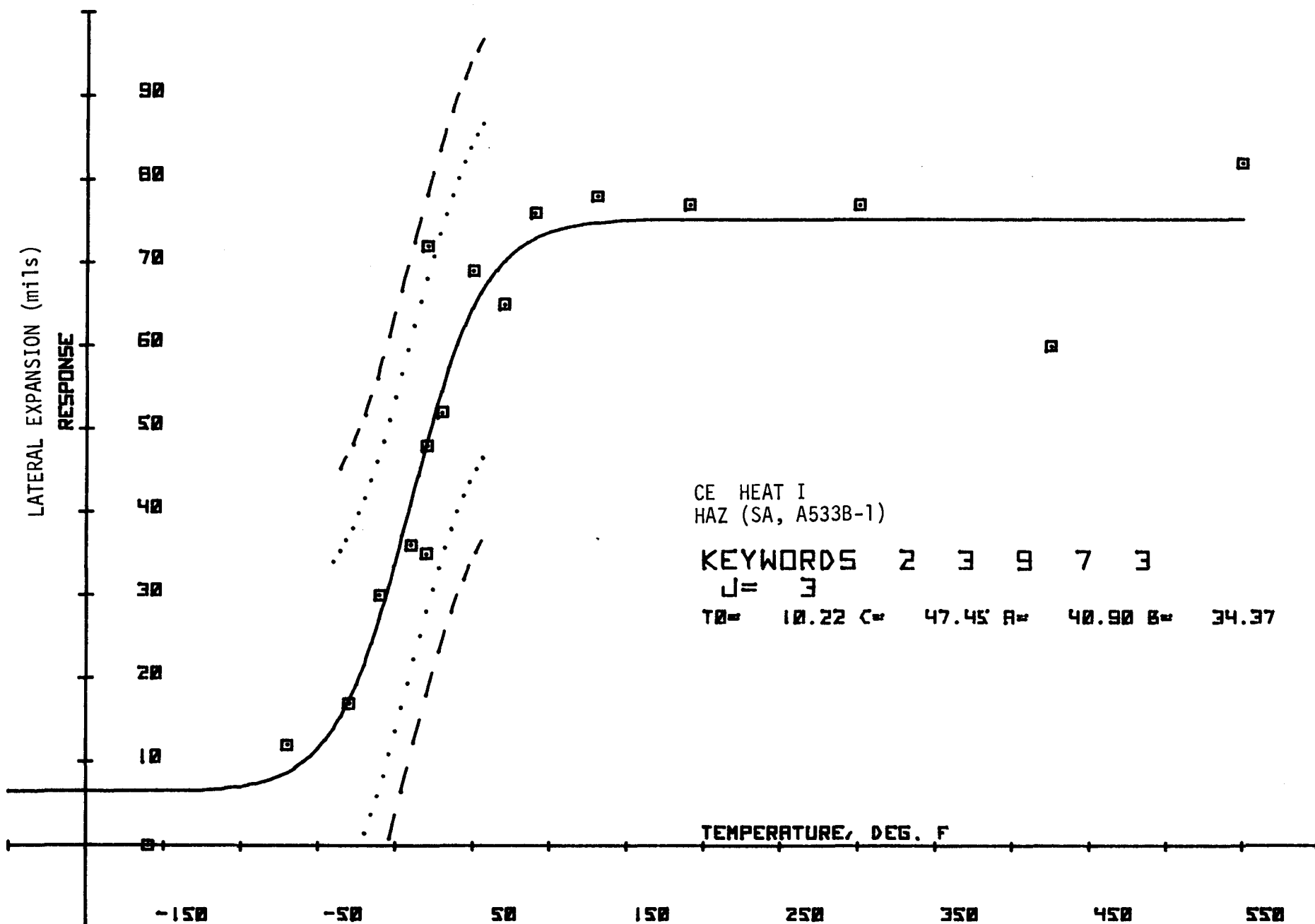


Figure 7.28. Charpy V-Notch Lateral Expansion for CE Heat I (HAZ)

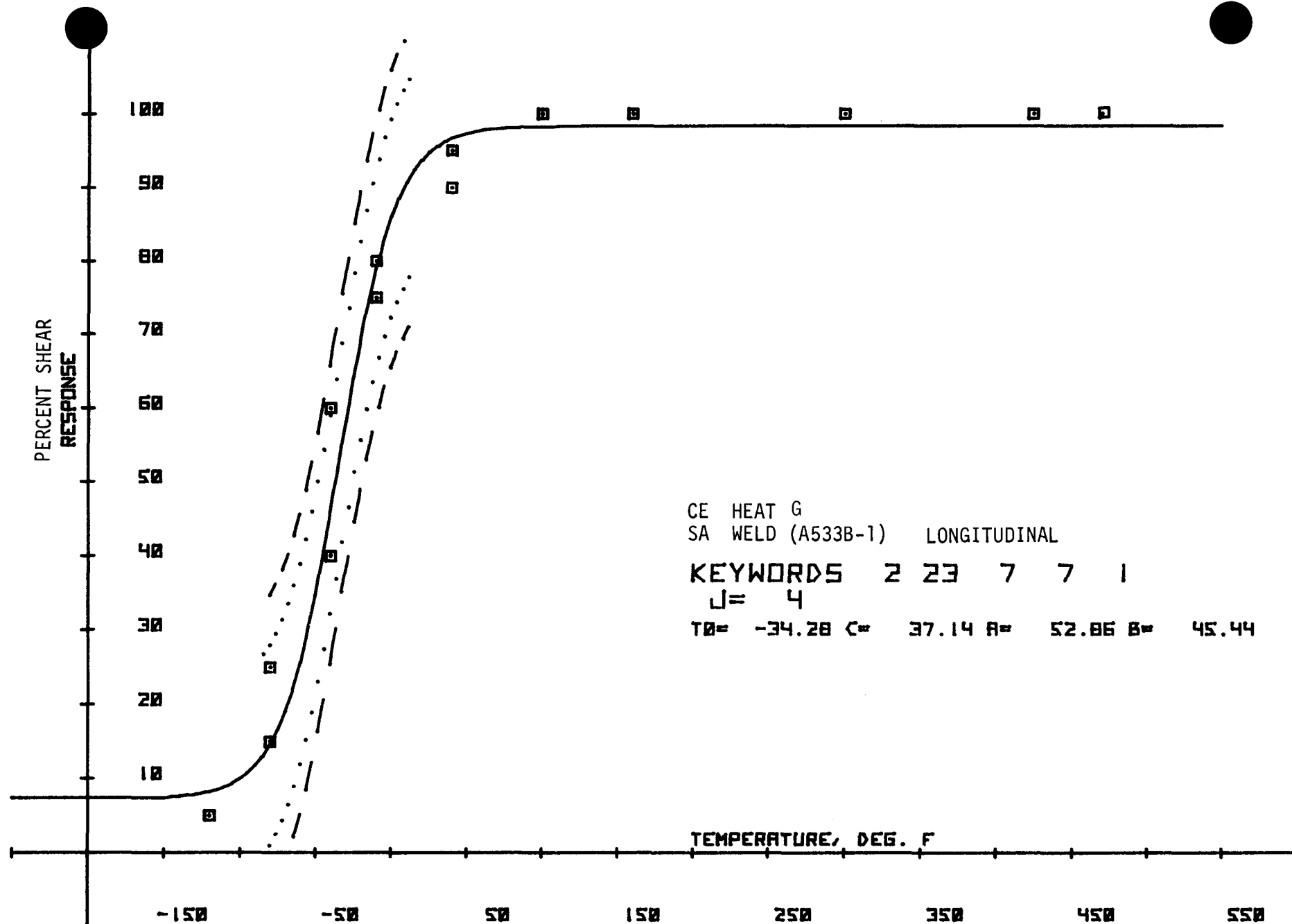


Figure 7.29. Charpy V-Notch Percent Shear for CE Heat G (L)

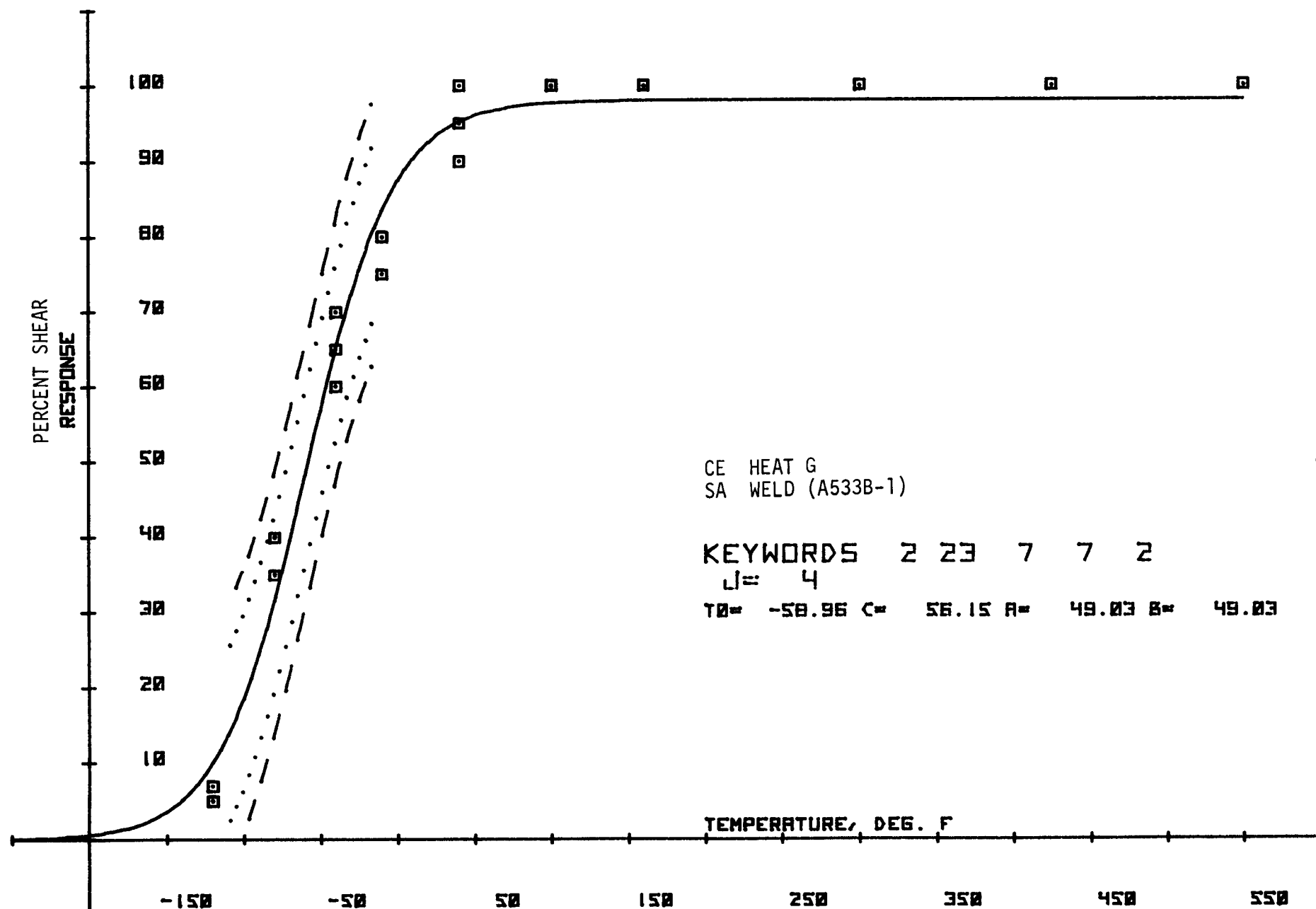


Figure 7.30. Charpy V-Notch Percent Shear for CE Heat G (T)

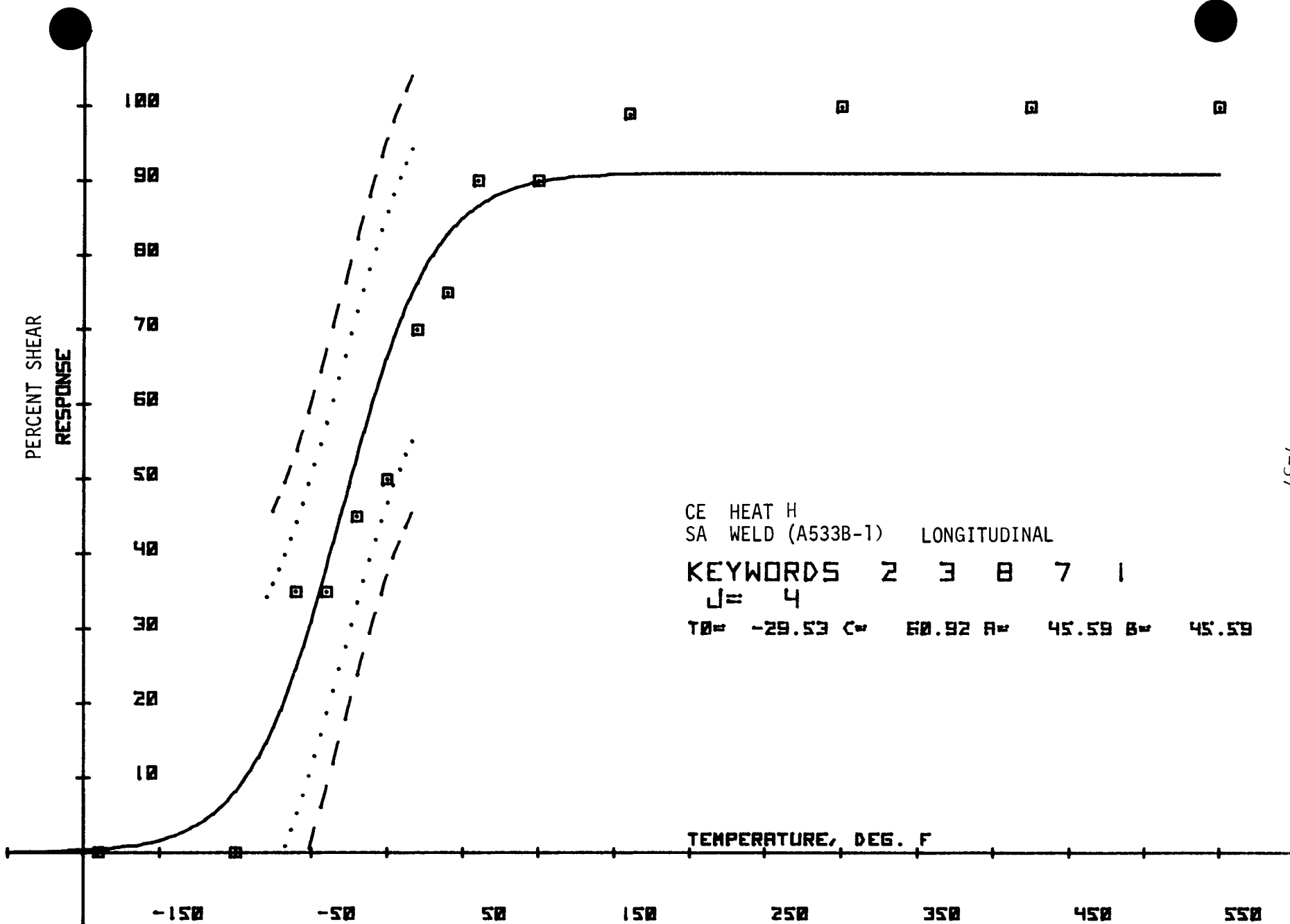


Figure 7.31. Charpy V-Notch Percent Shear for CE Heat H (L)

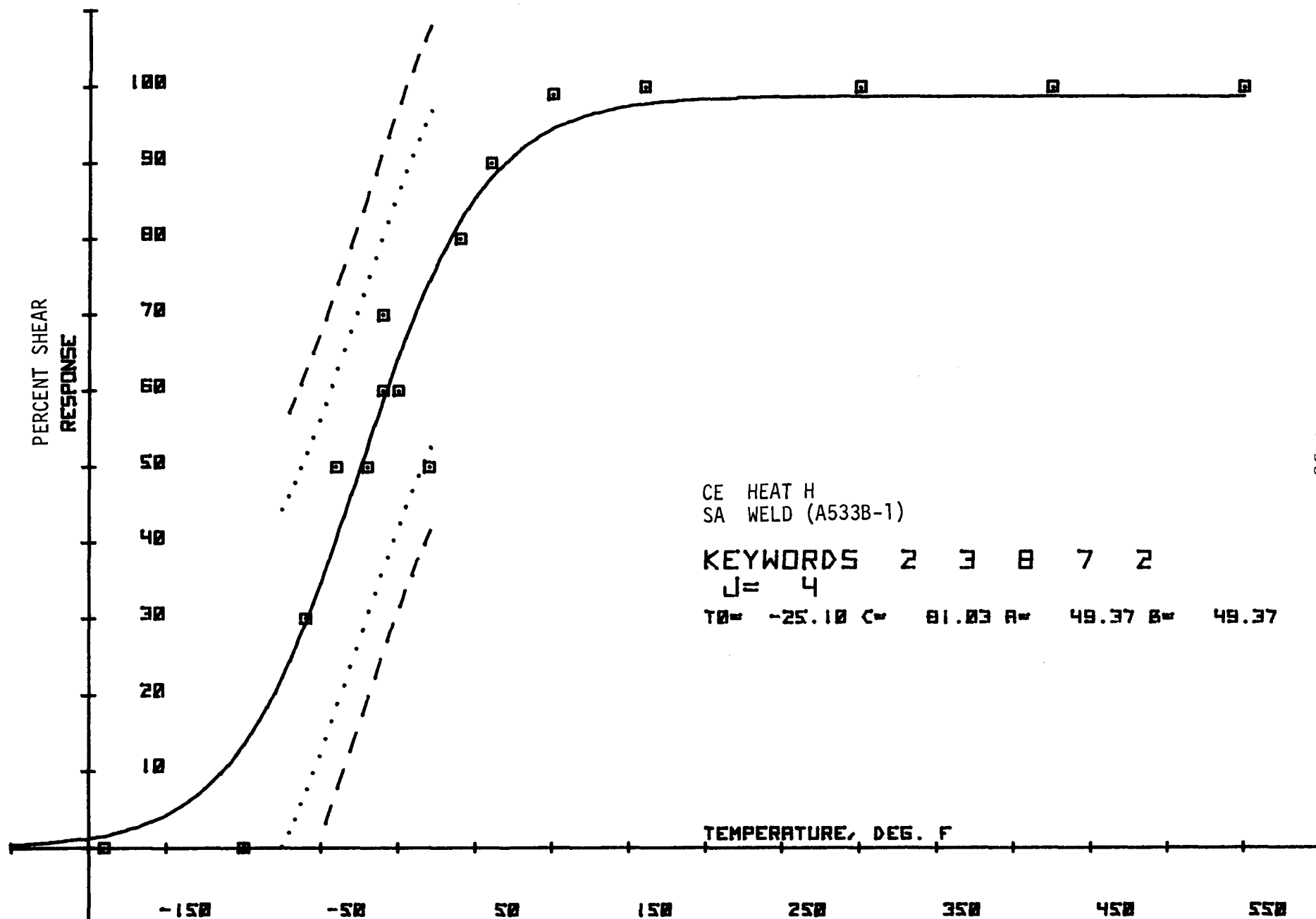


Figure 7.32. Charpy V-Notch Percent Shear for CE Heat H (T)

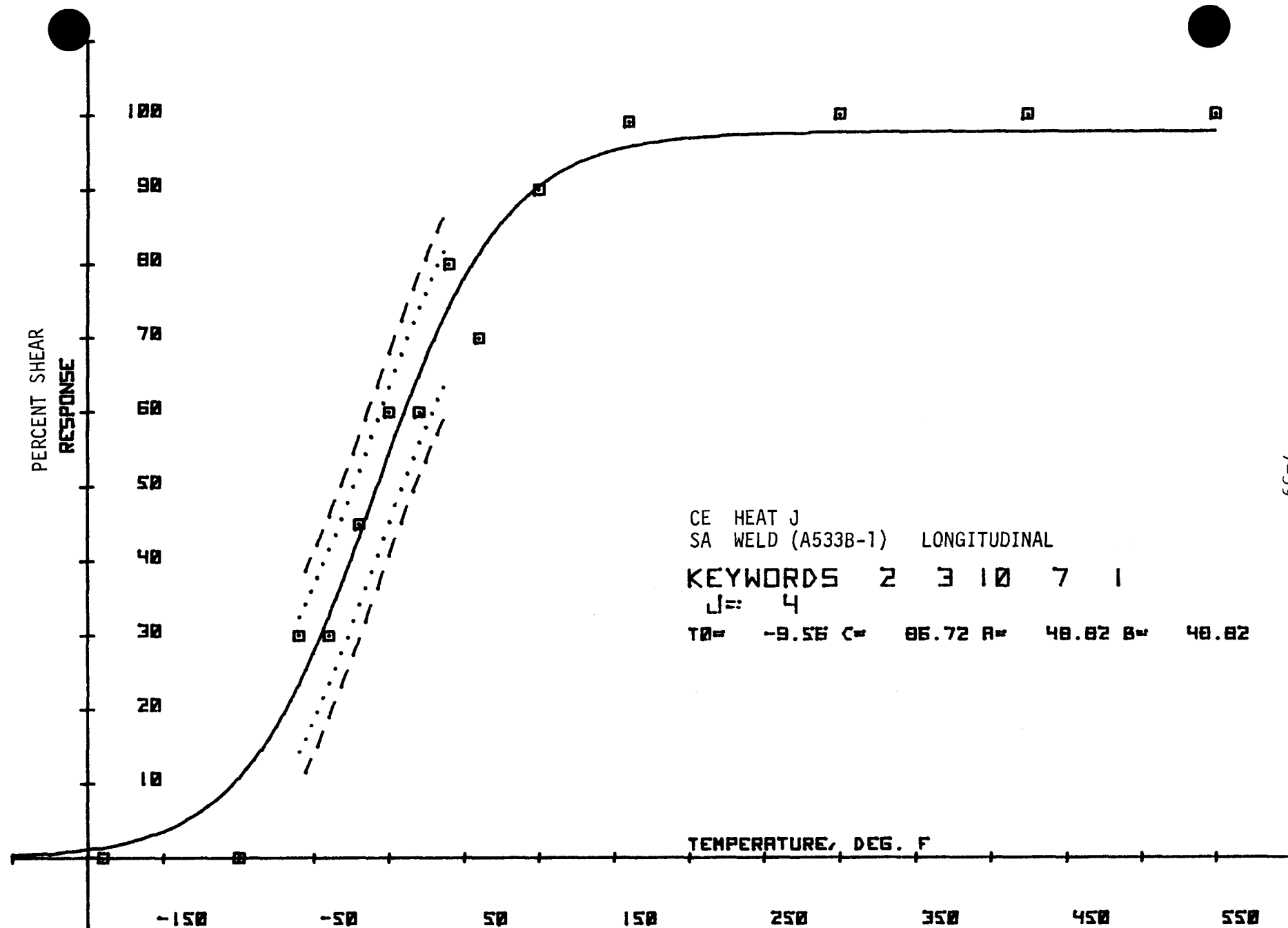


Figure 7.33. Charpy V-Notch Percent Shear for CE Heat J (L)

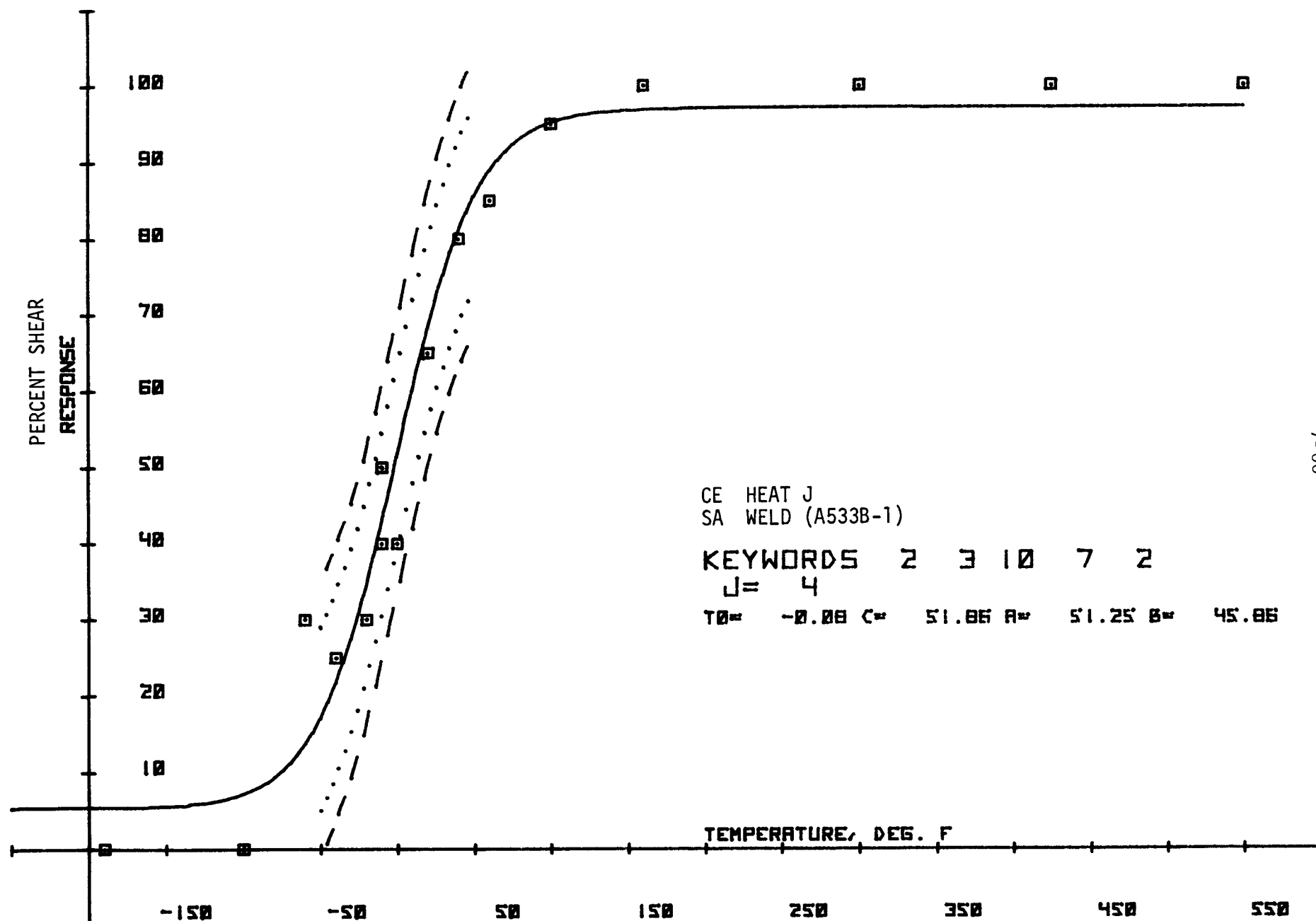


Figure 7.34. Charpy V-Notch Percent Shear for CE Heat J (T)

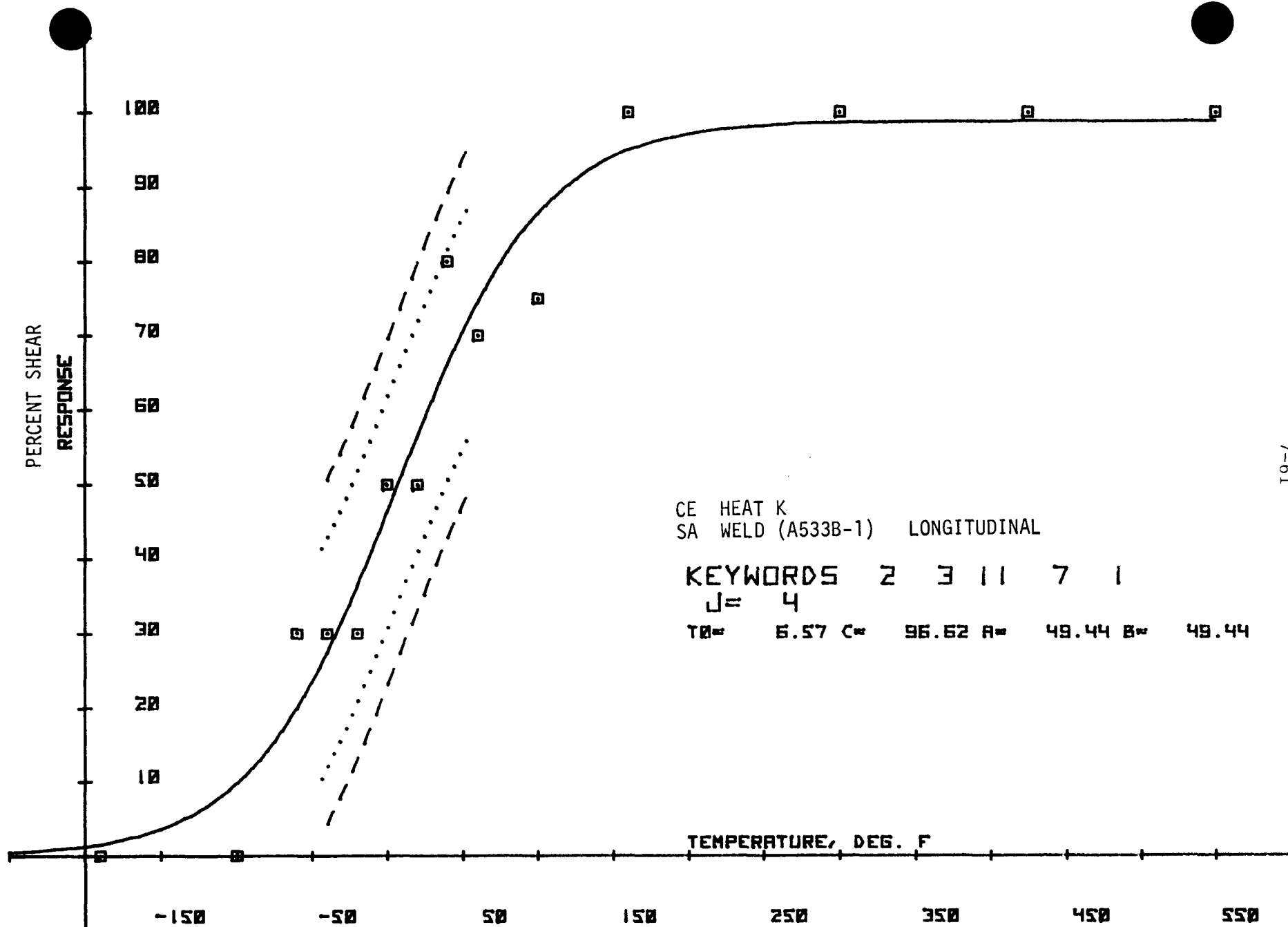


Figure 7.35. Charpy V-Notch Percent Shear for CE Heat K (L)

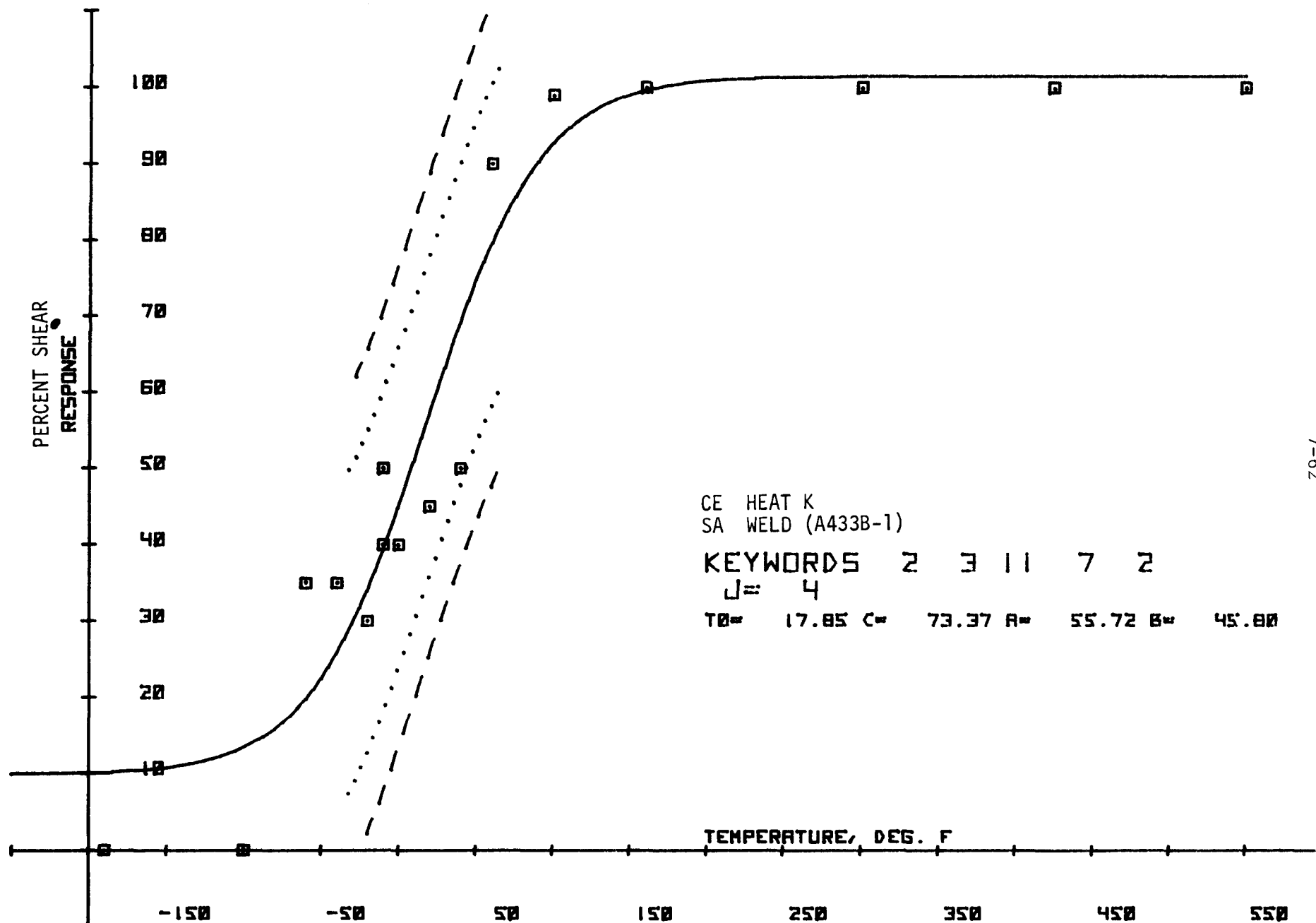


Figure 7.36. Charpy V-Notch Percent Shear for CE Heat K (T)

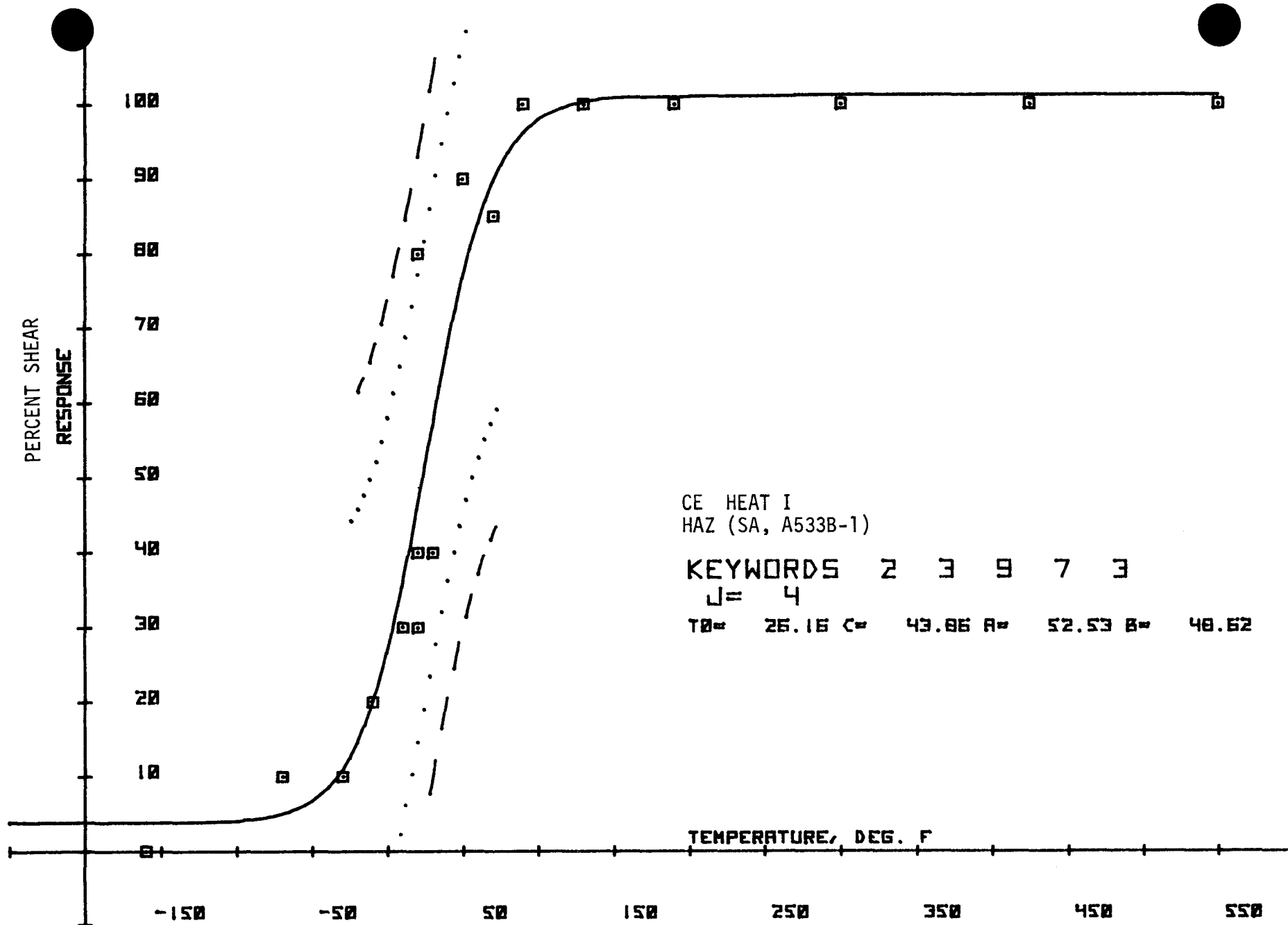


Figure 7.37. Charpy V-Notch Percent Shear for CE Heat I (HAZ)

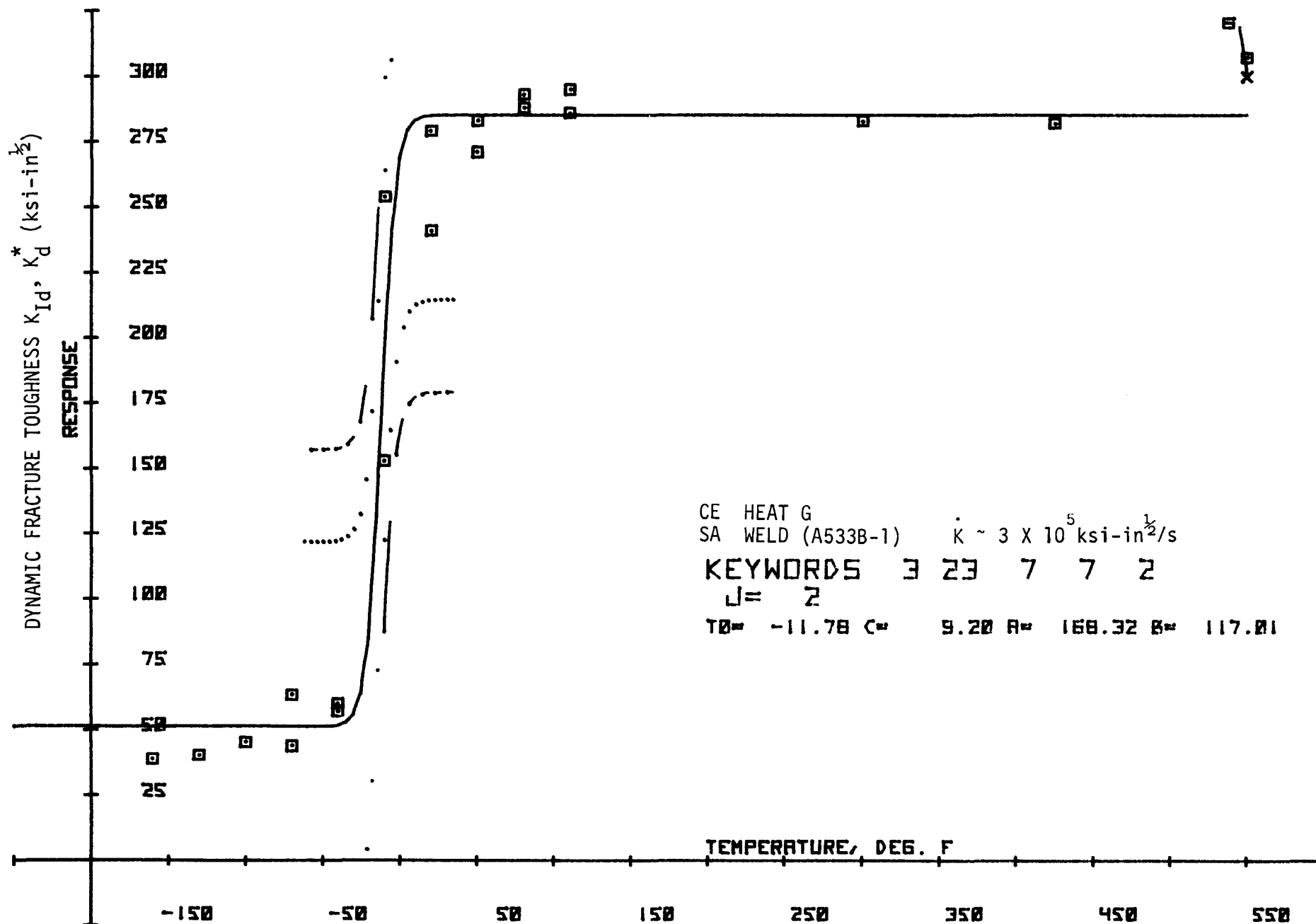


Figure 7.38. Precracked Charpy Fracture Toughness for CE Heat G

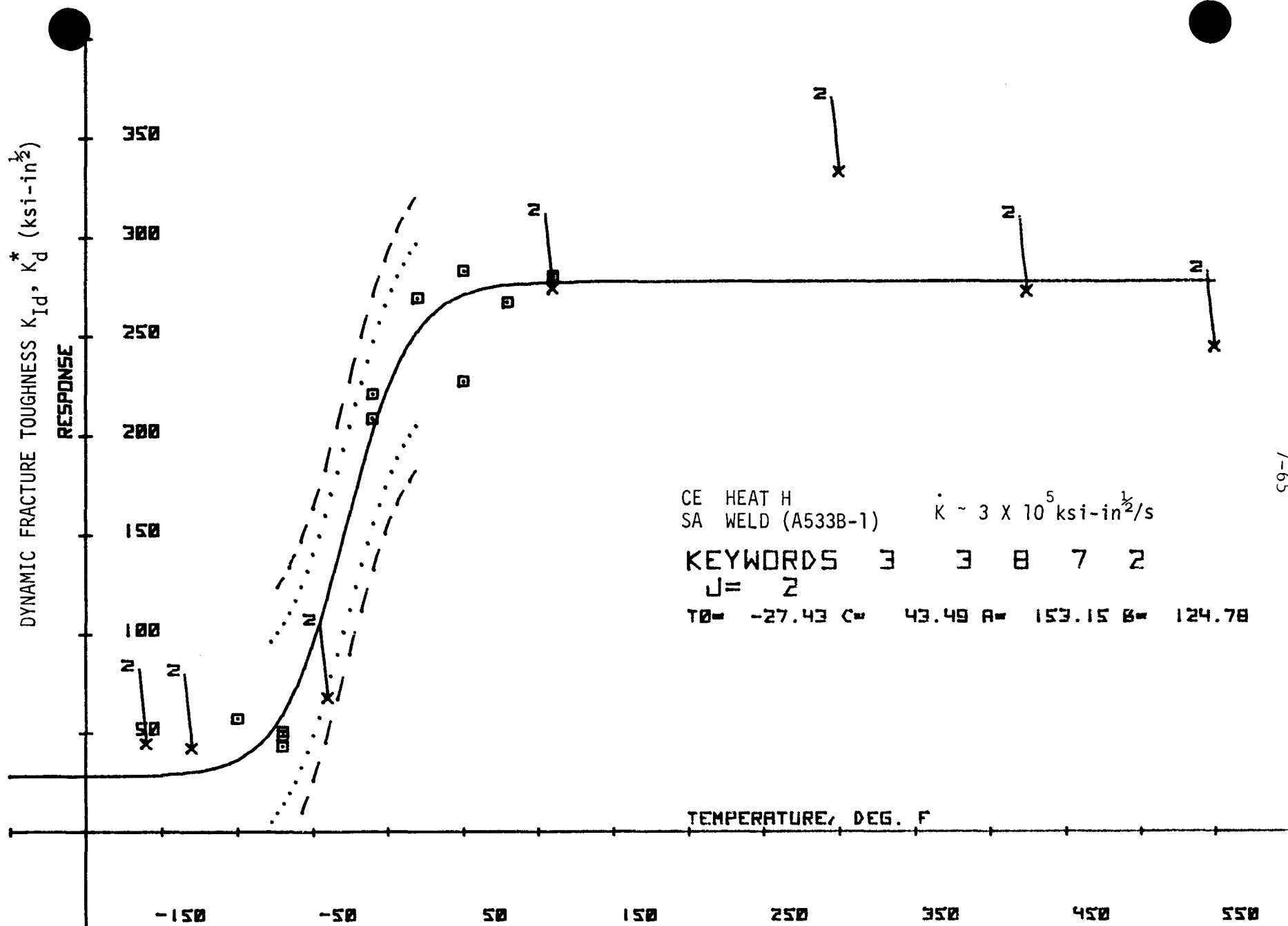


Figure 7.39. Precracked Charpy Fracture Toughness for CE Heat H

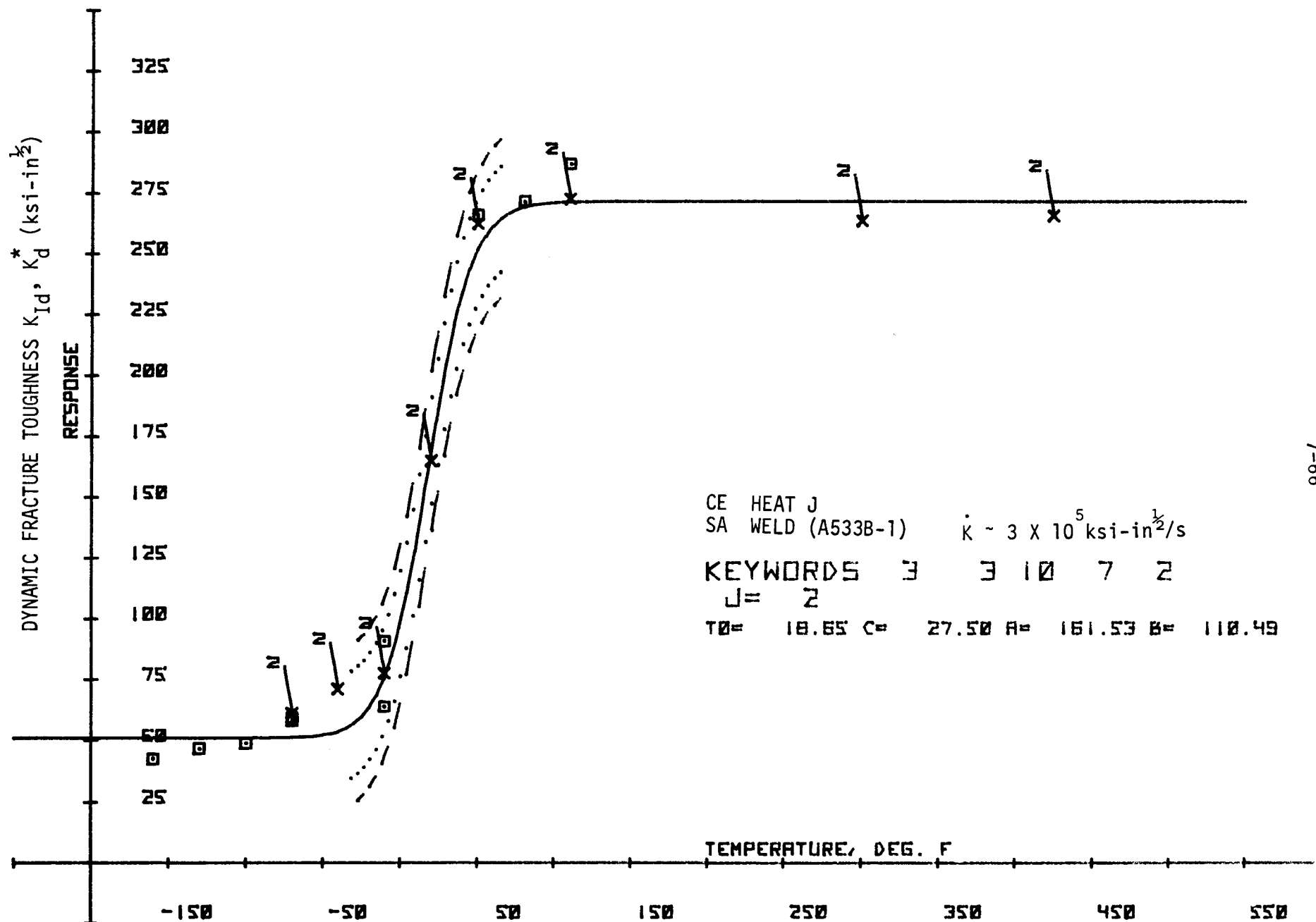


Figure 7.40. Precracked Charpy Fracture Toughness for CE Heat J

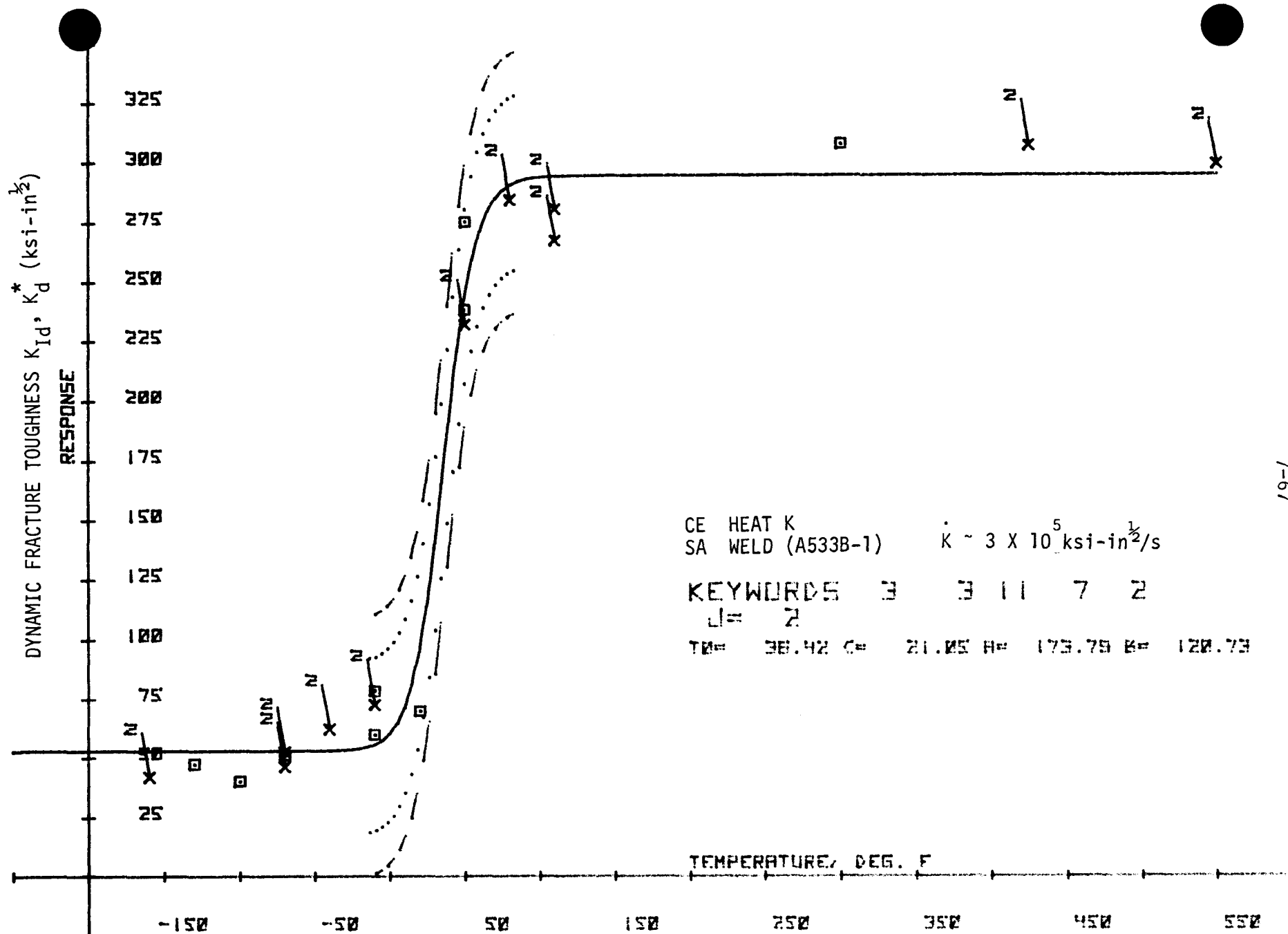


Figure 7.41. Precracked Charpy Fracture Toughness for CE Heat K

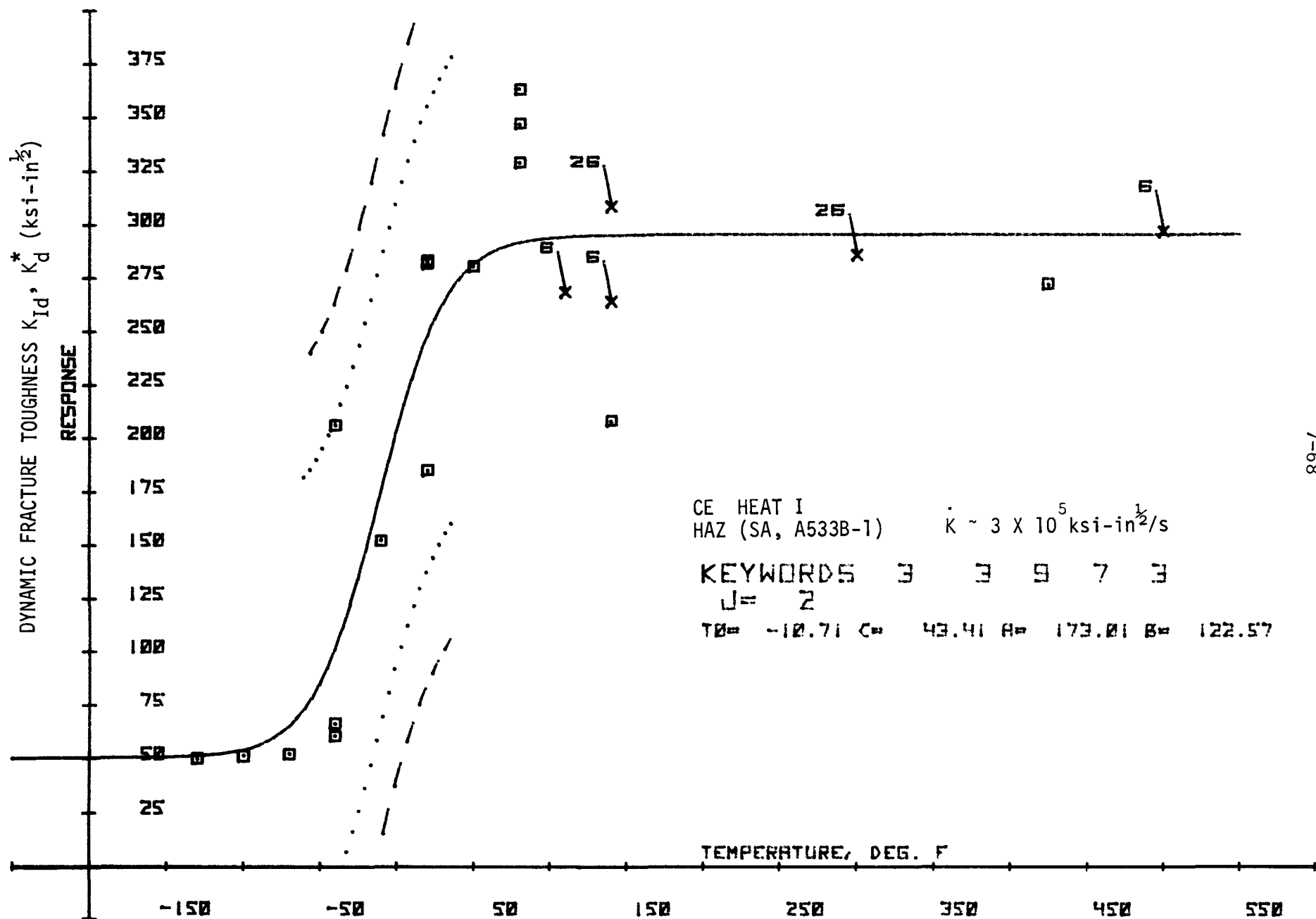


Figure 7.42. Precracked Charpy Fracture Toughness for CE Heat I (HAZ)

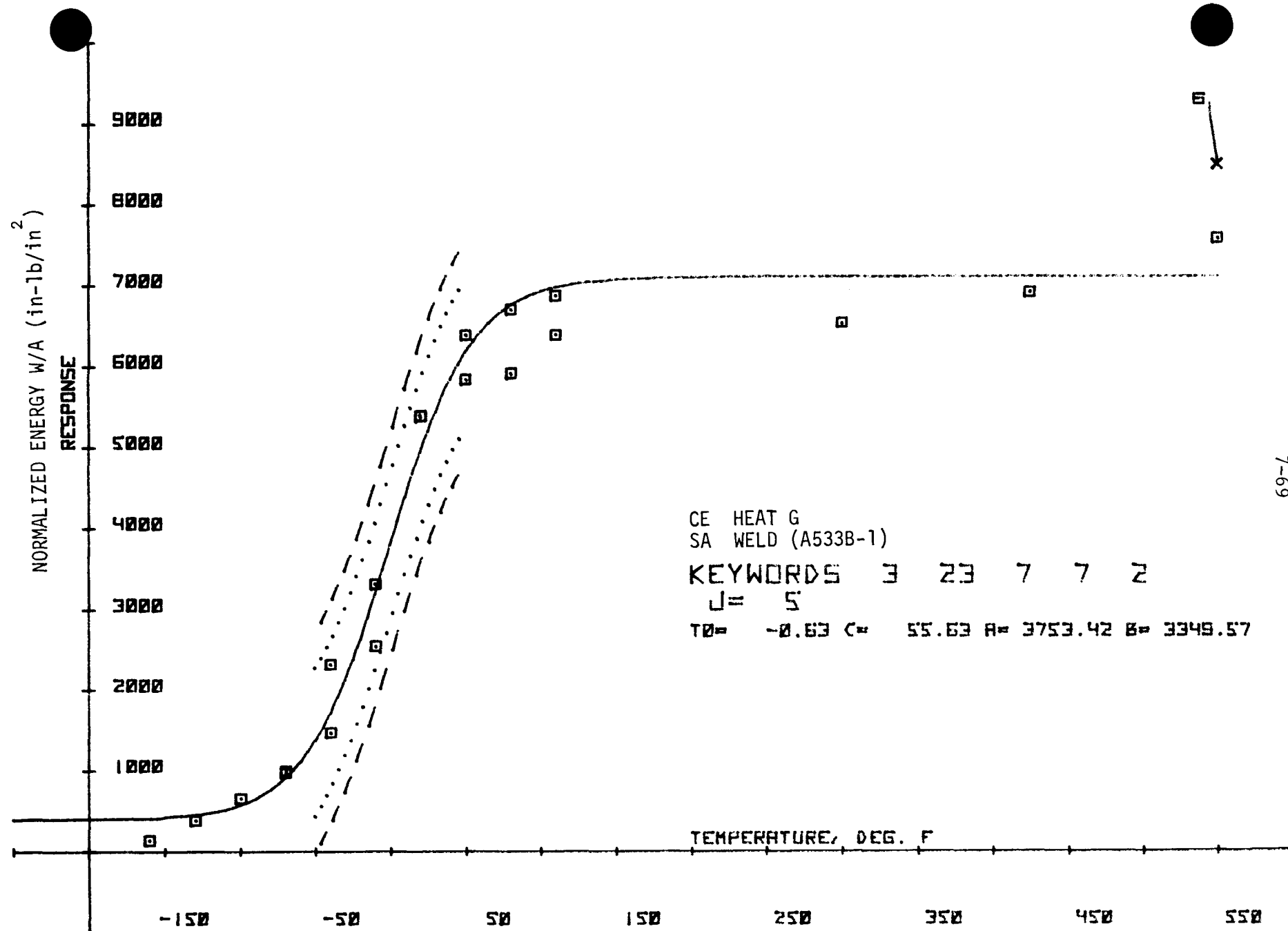


Figure 7.43. Precracked Charpy Normalized Energy for CE Heat G

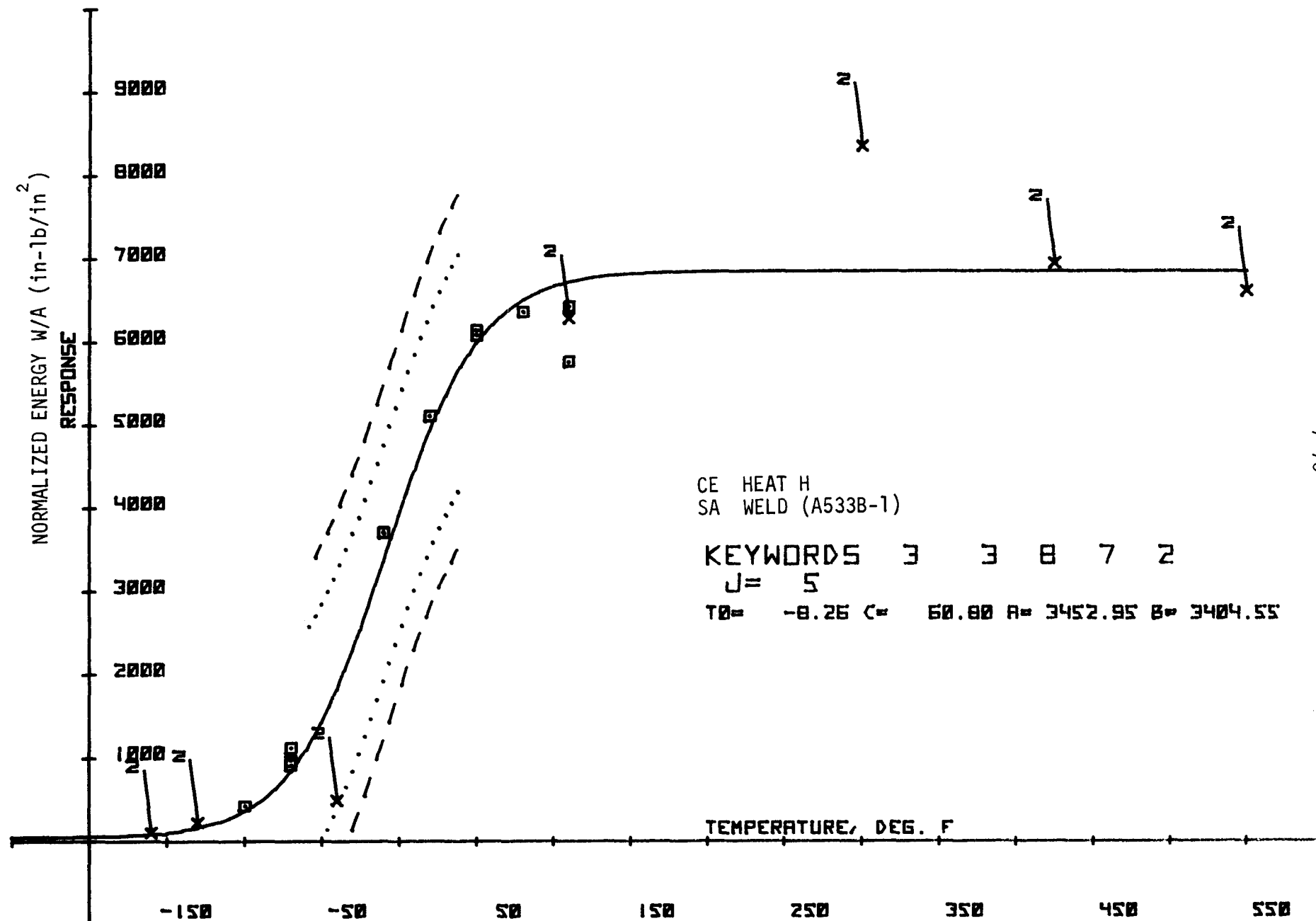


Figure 7.44. Precracked Charpy Normalized Energy for CE Heat H

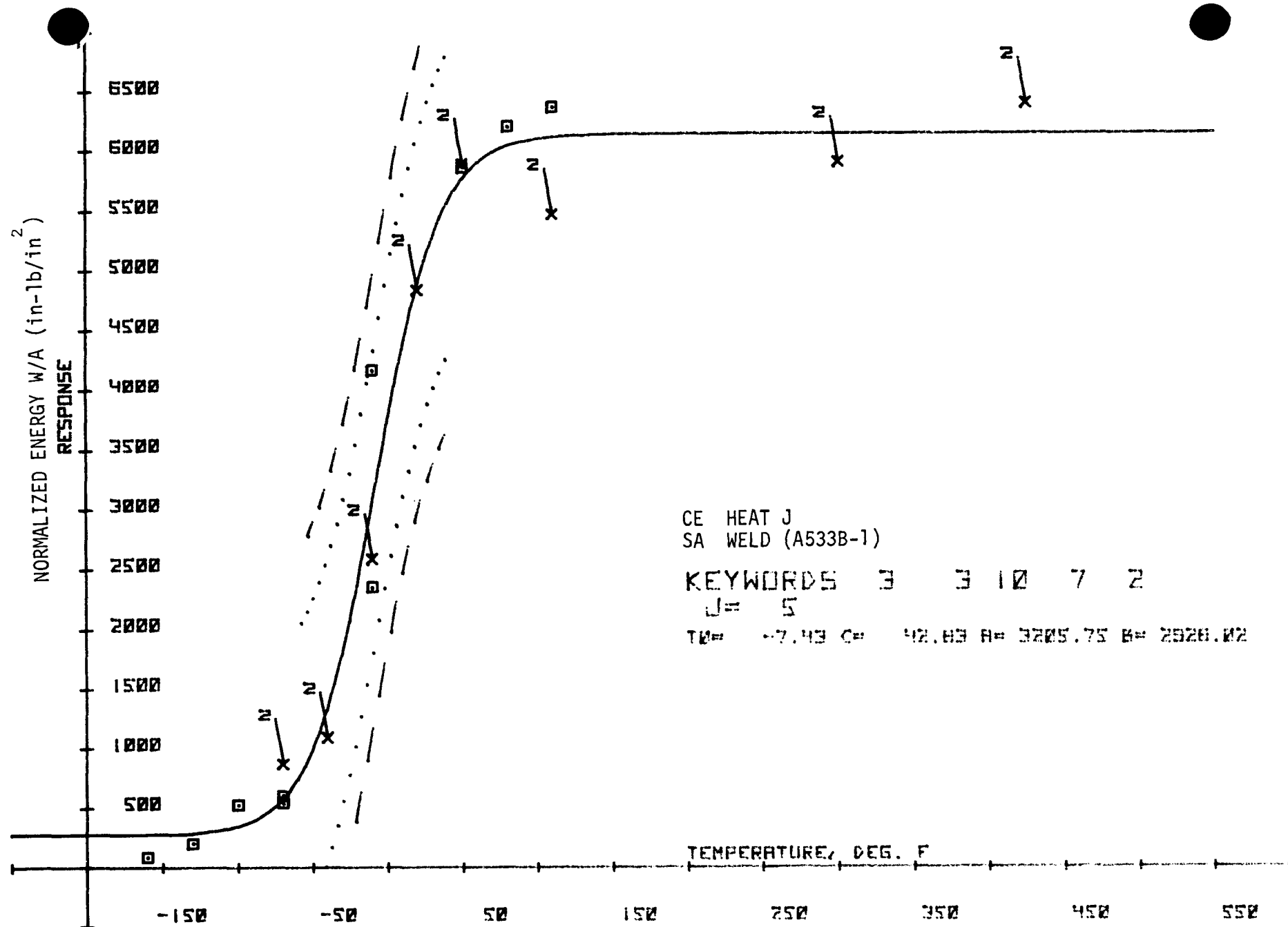


Figure 7.45. Precracked Charpy Normalized Energy for CE Heat J

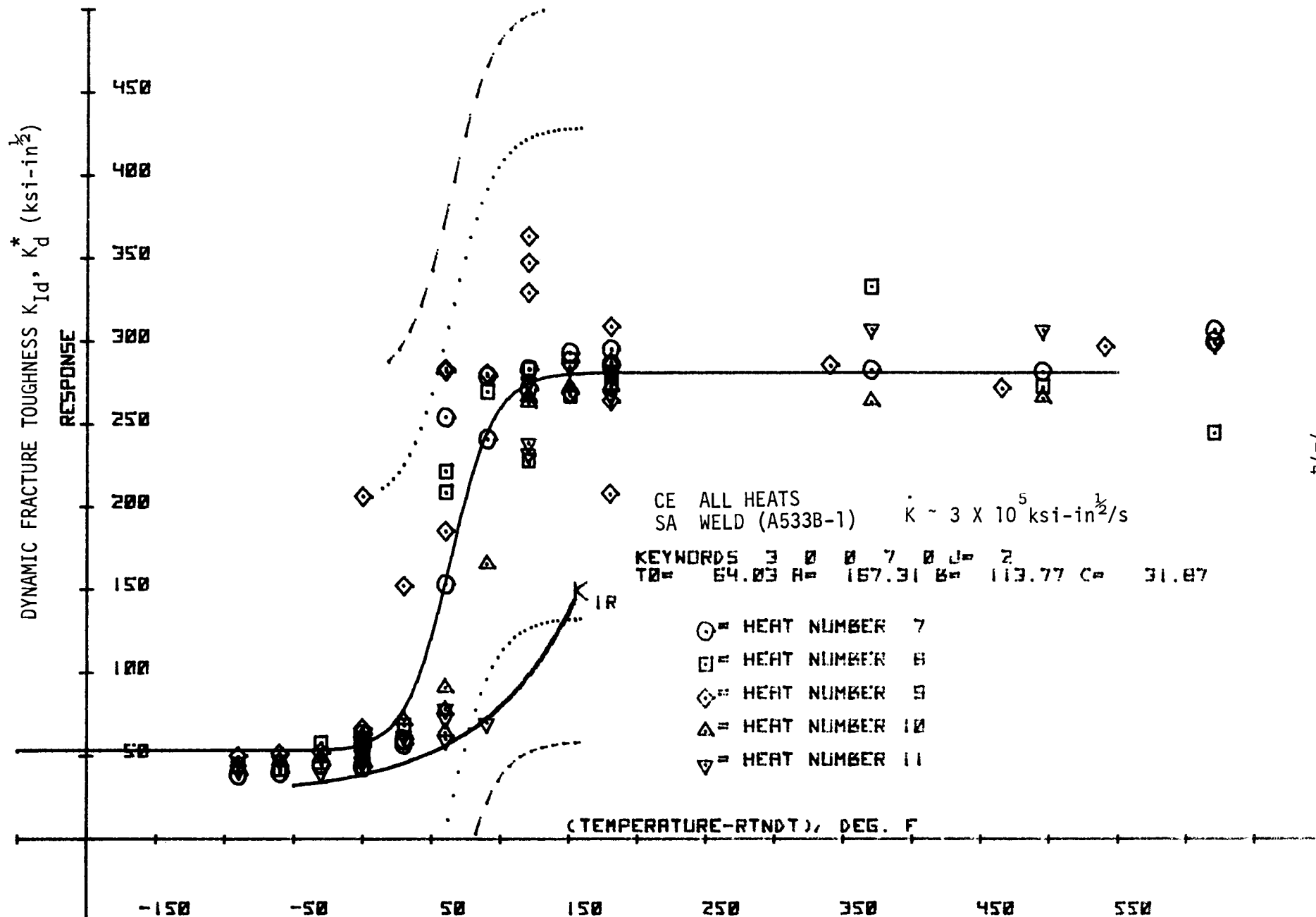


Figure 7.48. Precracked Charpy Fracture Toughness for All CE Heats

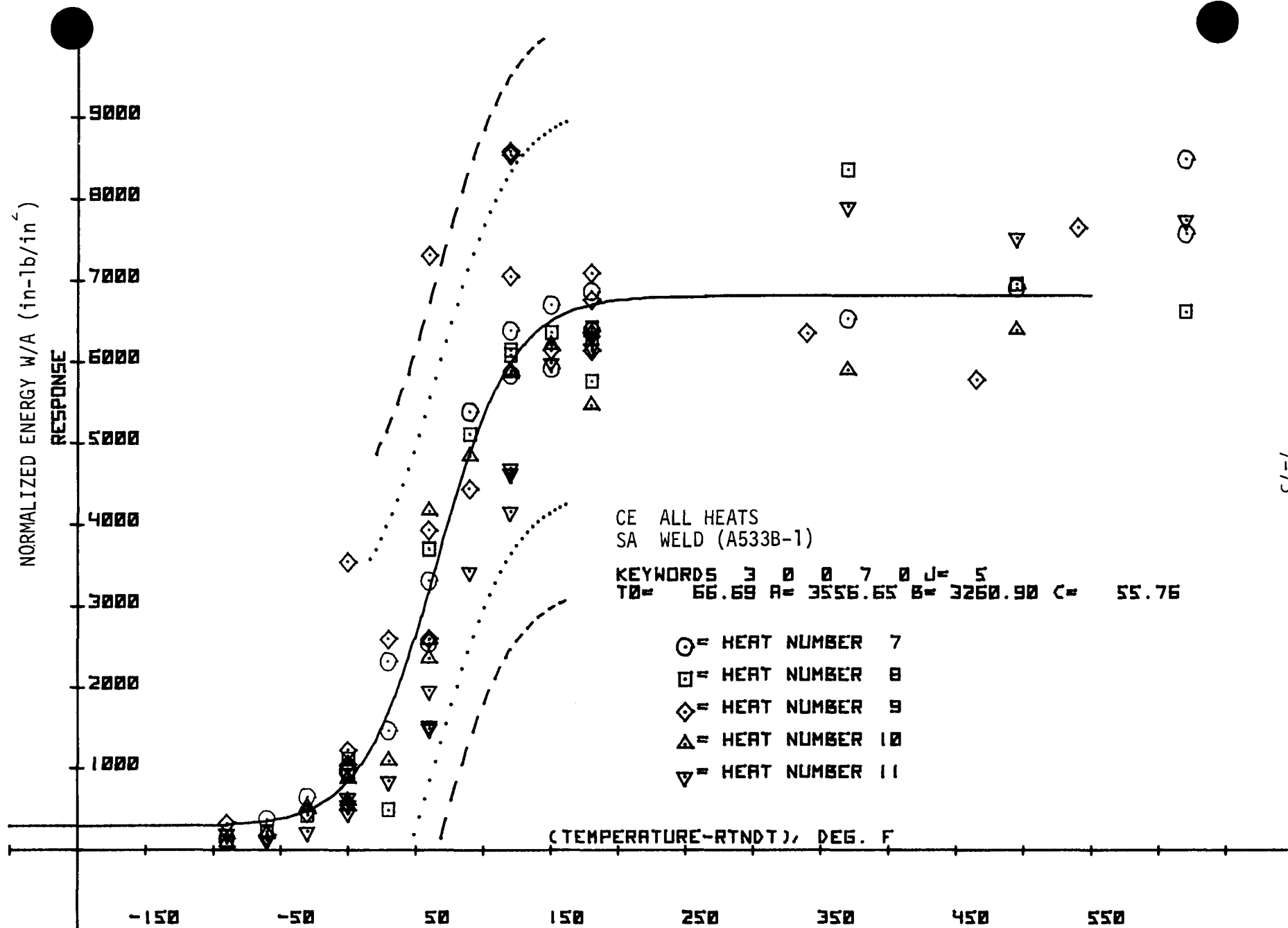


Figure 7.49. Precracked Charpy Normalized Energy for All CE Heats

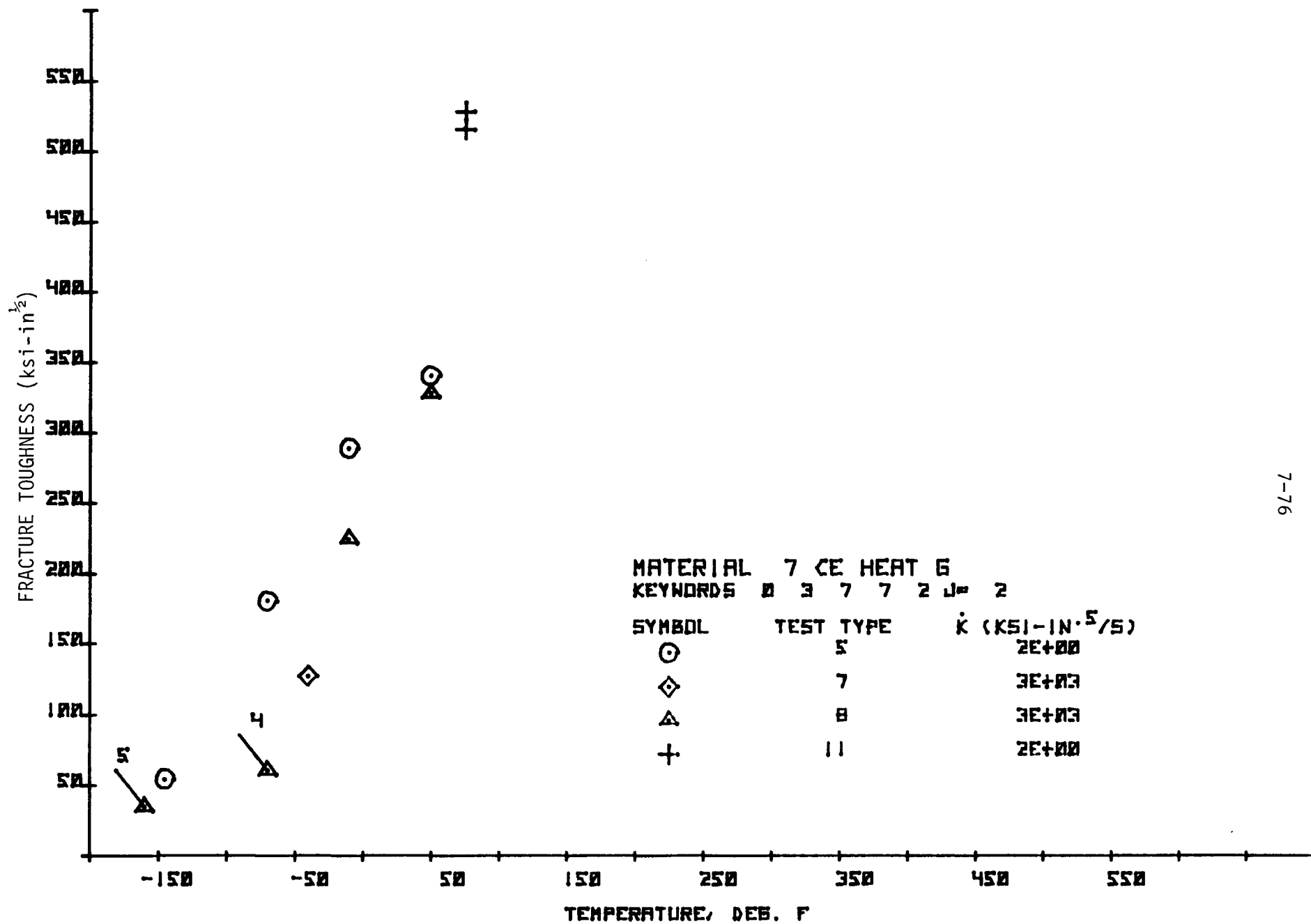


Figure 7.50. Static and Dynamic Fracture Toughness for CE Heat G

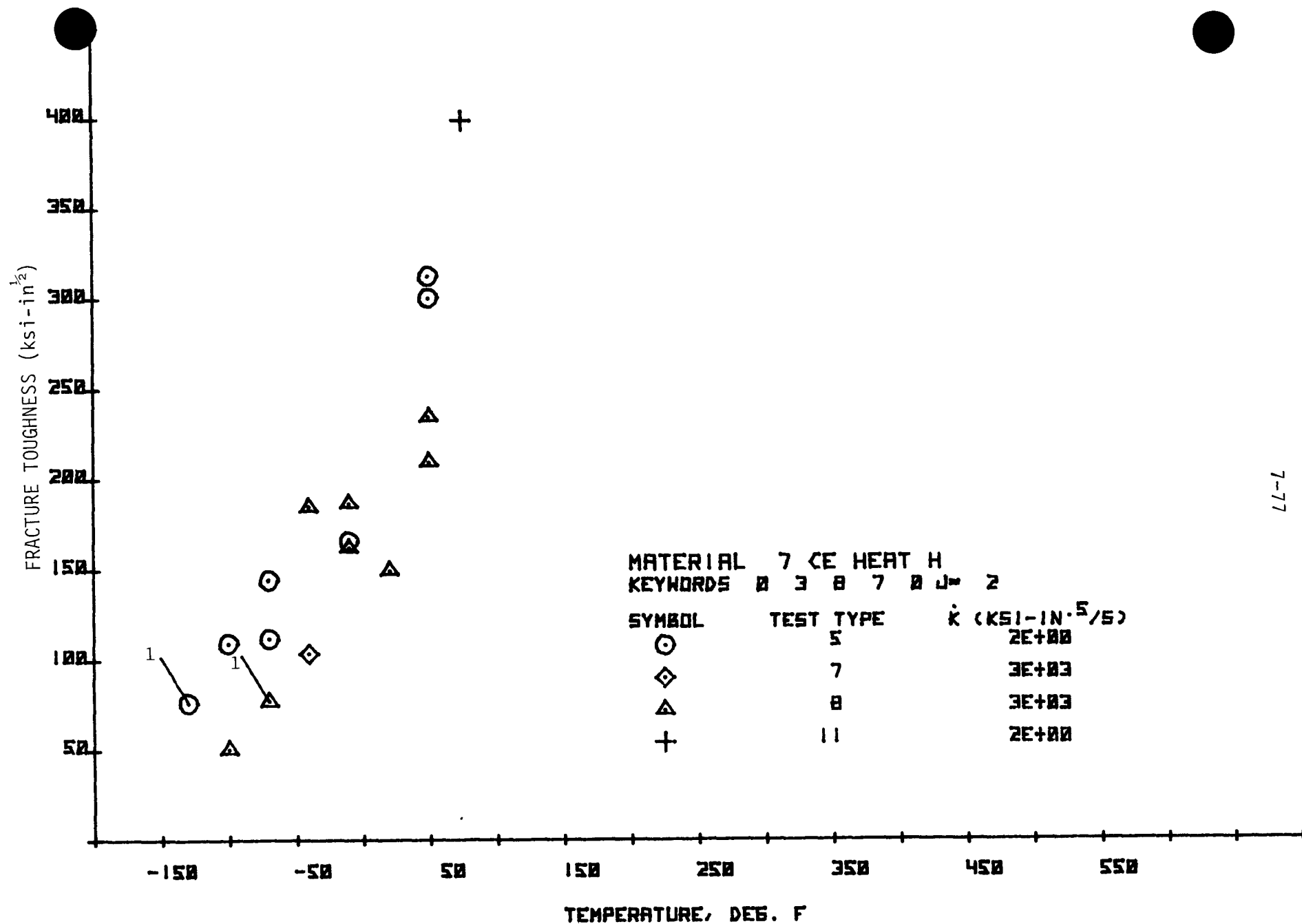


Figure 7.51. Static and Dynamic Fracture Toughness for CE Heat H

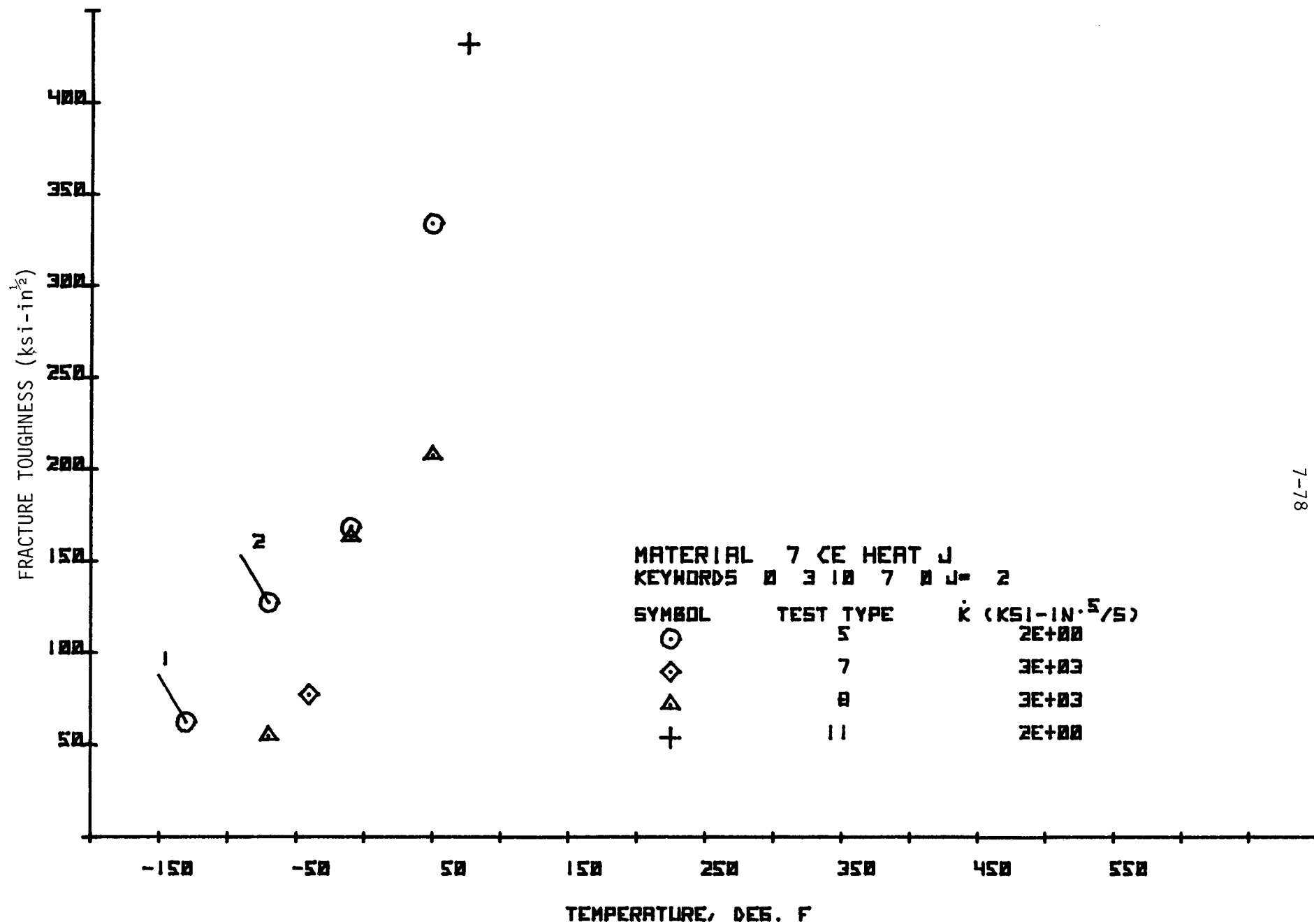


Figure 7.52. Static and Dynamic Fracture Toughness for CE Heat J

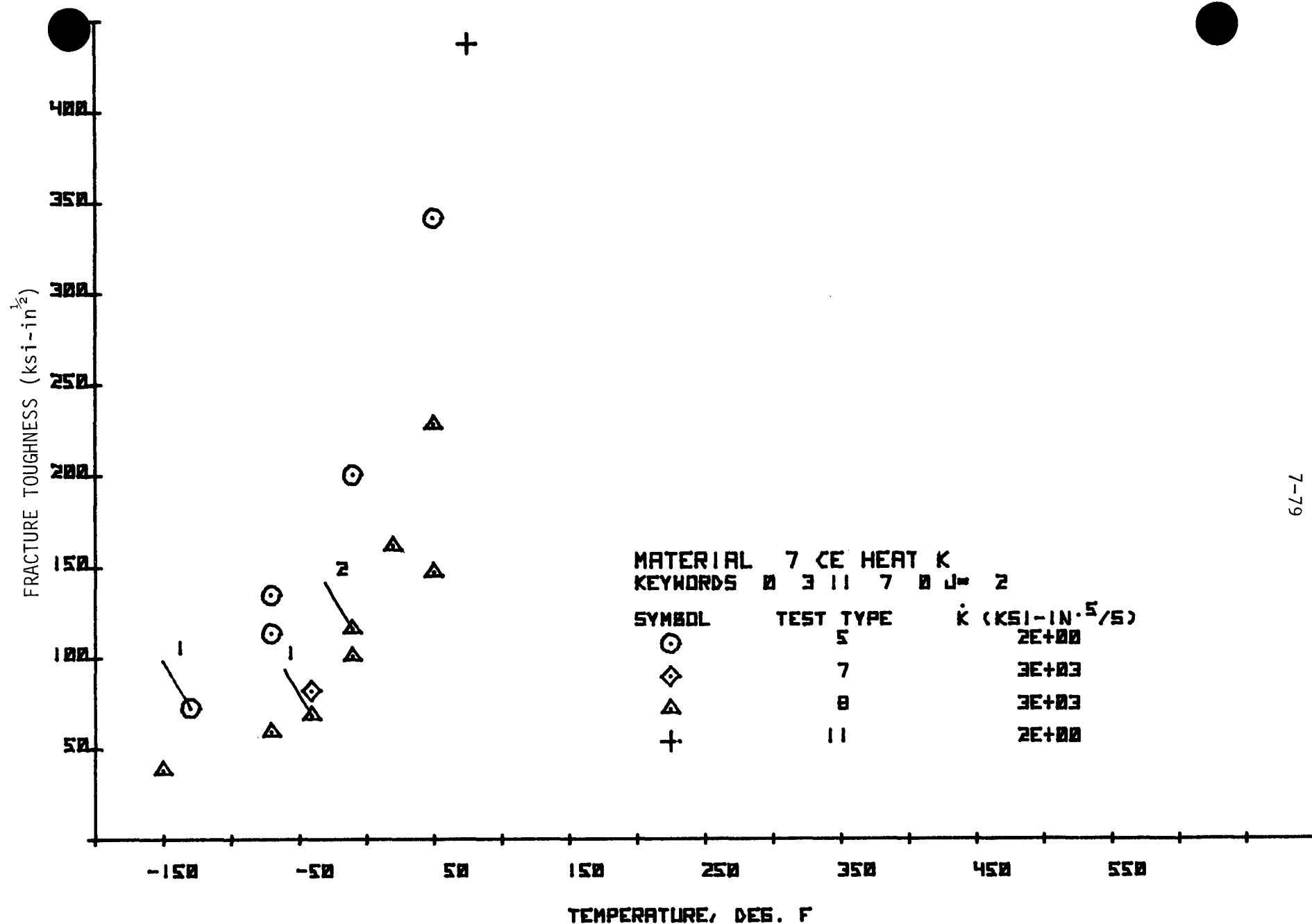


Figure 7.53. Static and Dynamic Fracture Toughness for CE Heat K

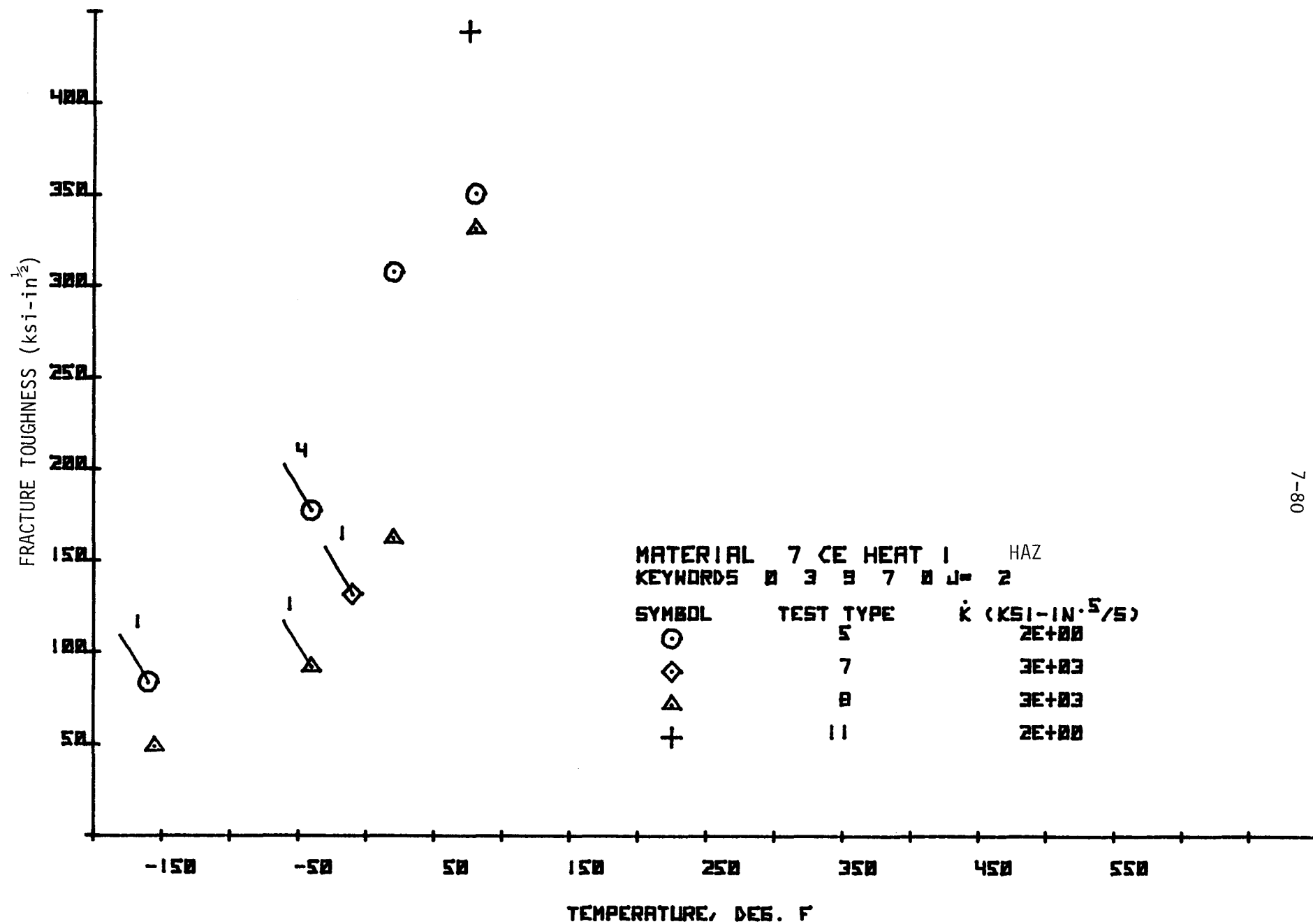


Figure 7.54. Static and Dynamic Fracture Toughness for CE Heat I (HAZ)

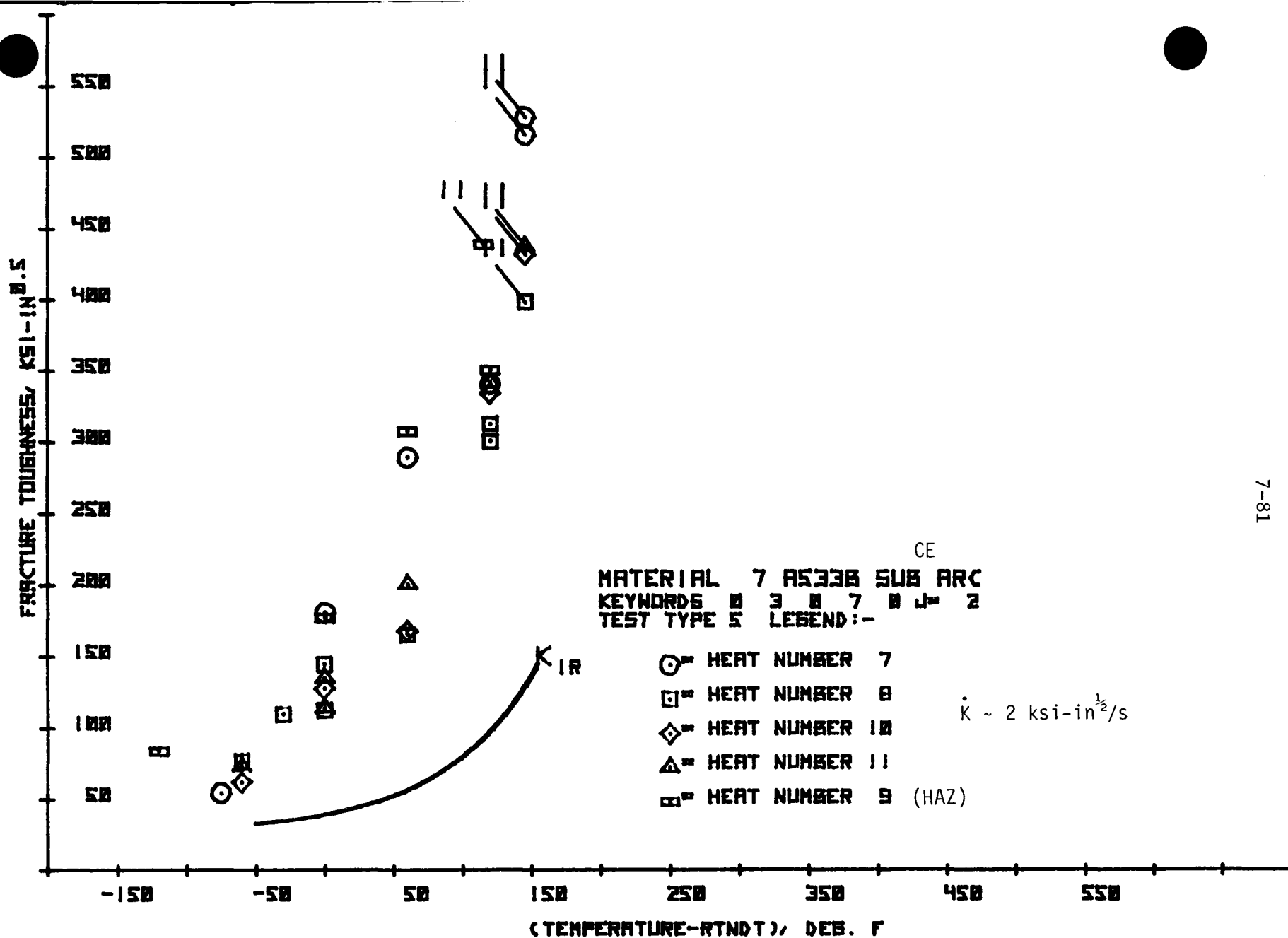


Figure 7.55. Static Fracture Toughness for All CE Heats

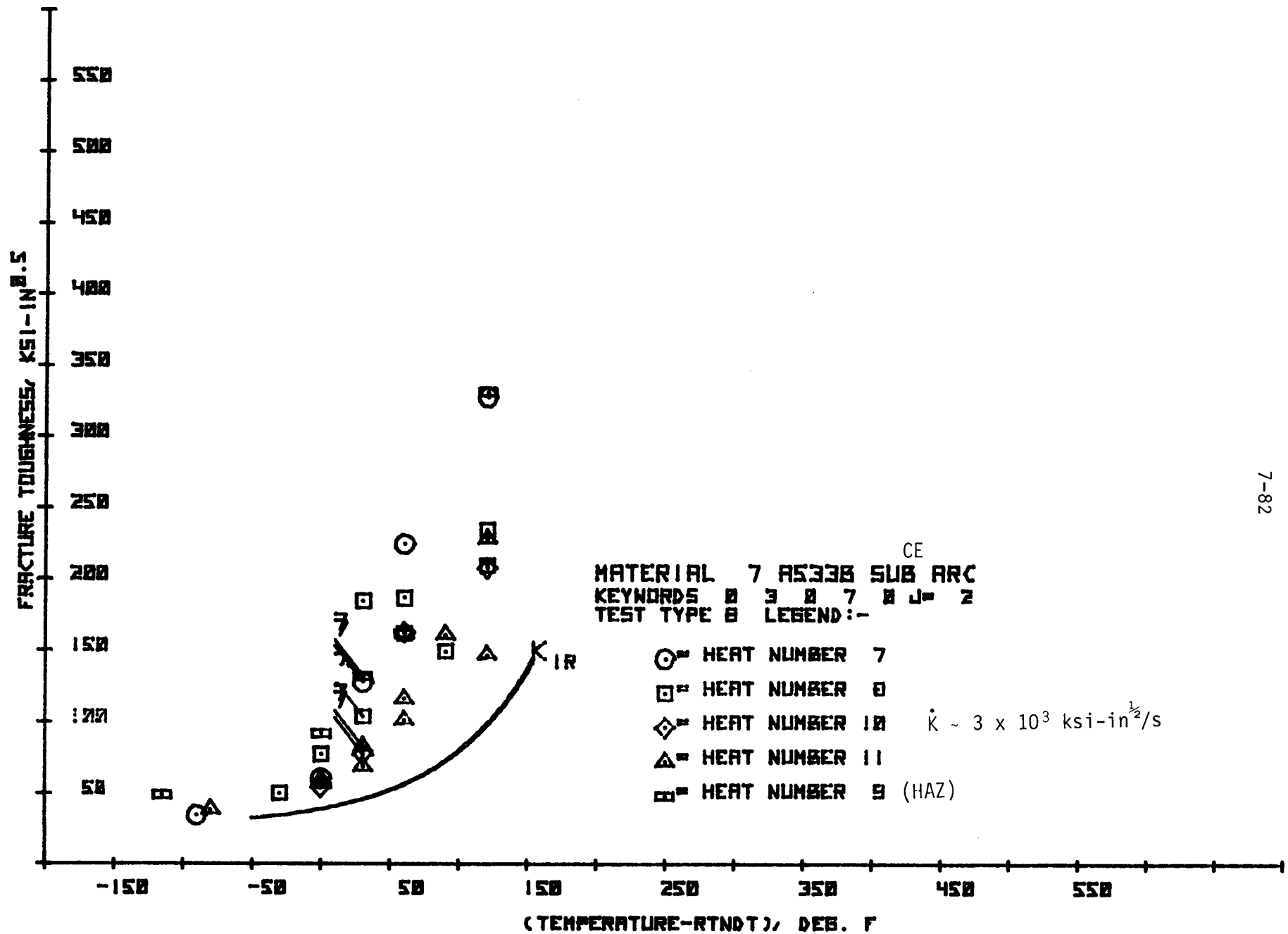


Figure 7.56. Dynamic Compact Specimen Fracture Toughness for All CE Heats

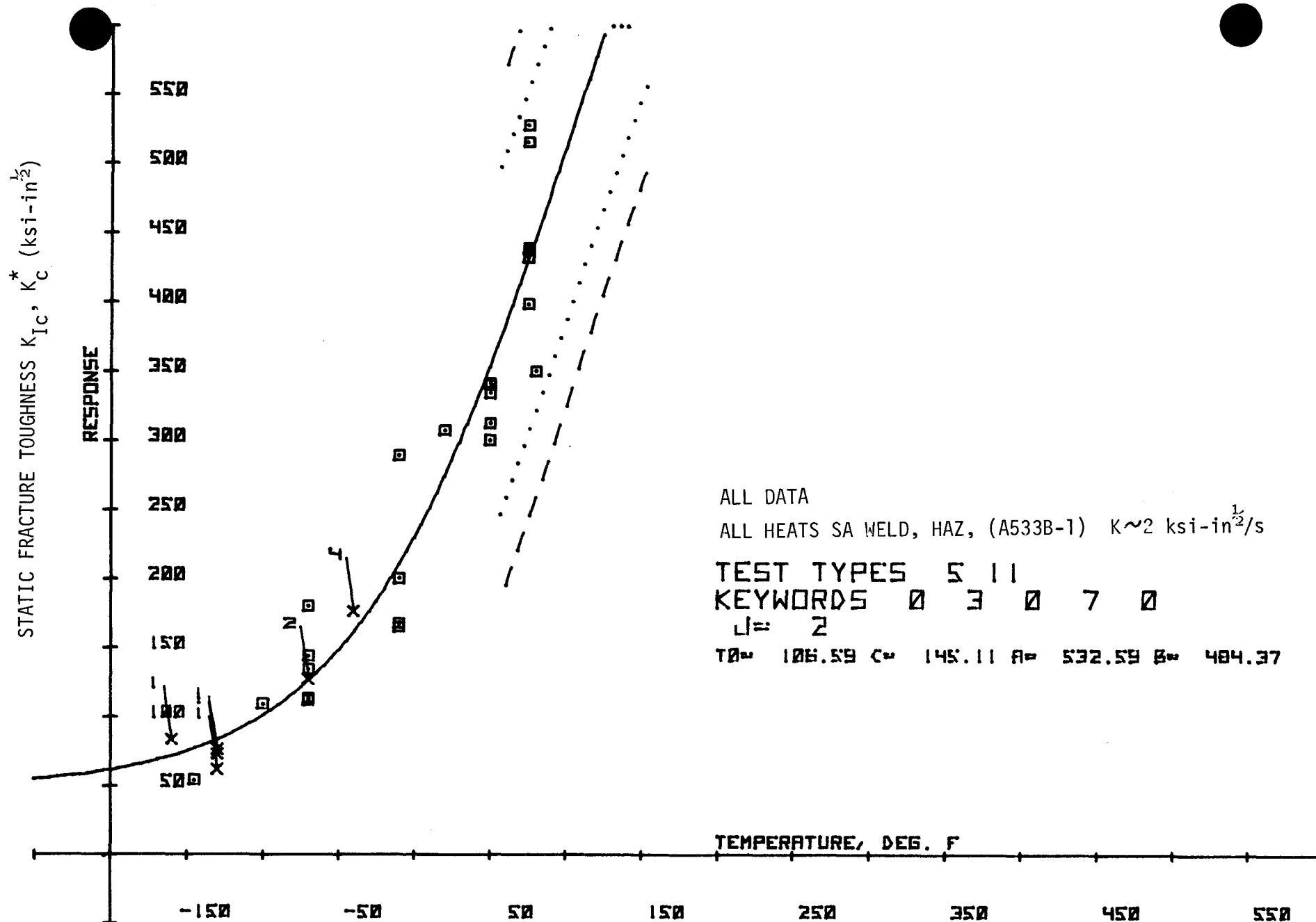


Figure 7.57 All Static Fracture Toughness Data for CE Heats

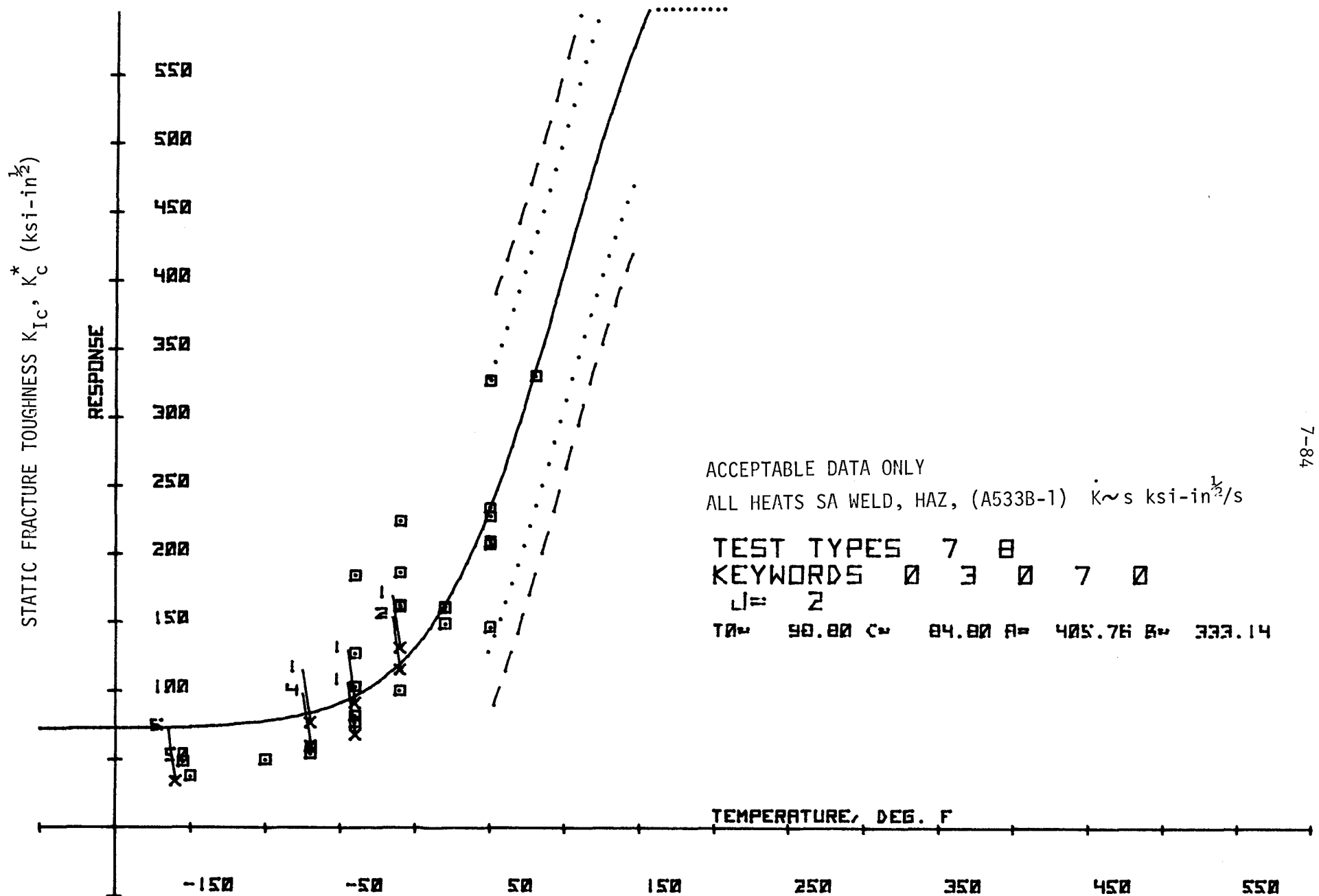


Figure 7.58. Acceptable Static Fracture Toughness Data for A11 CE Heats

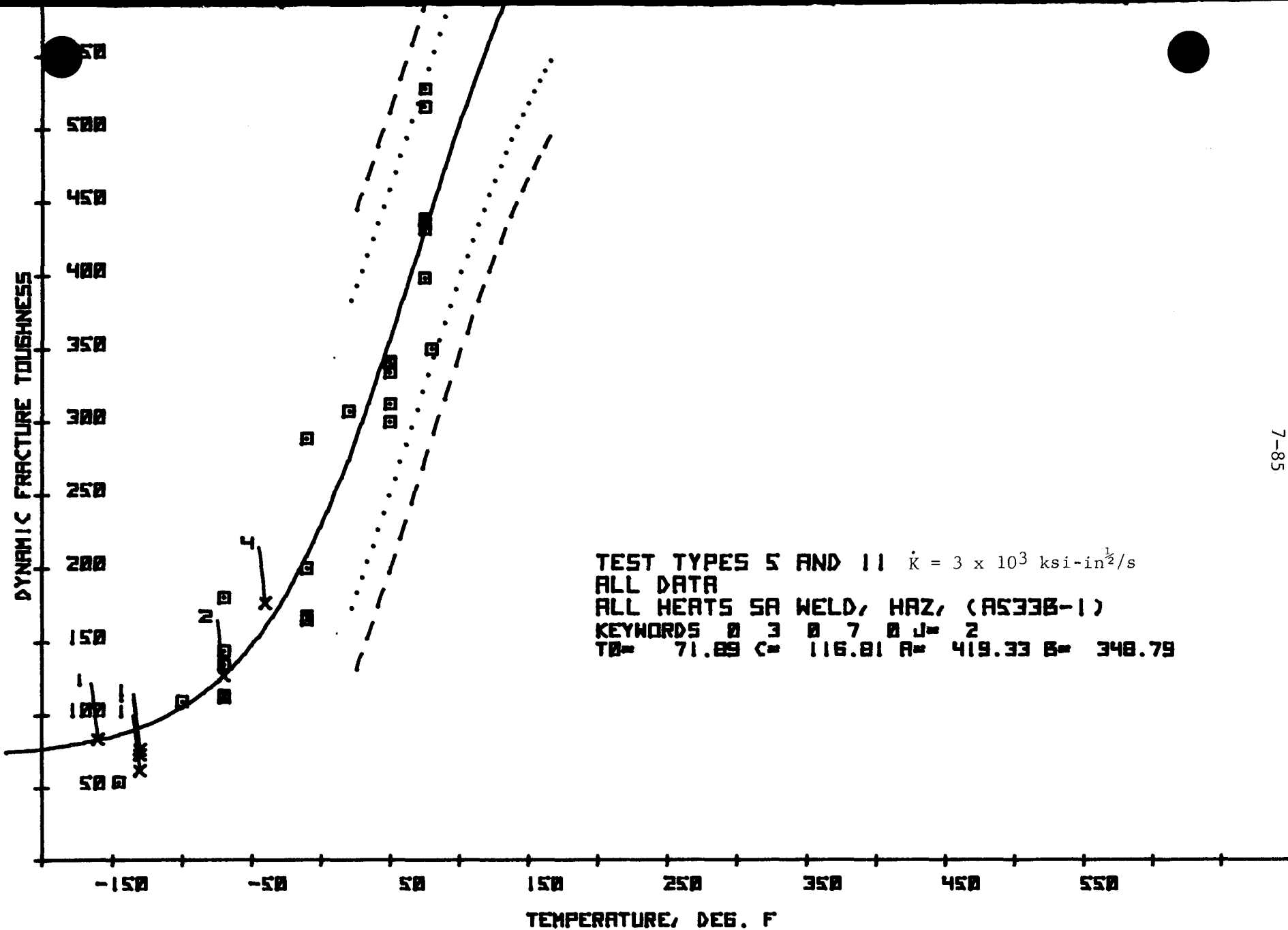


Figure 7.59 All Dynamic Fracture Toughness Data for CE Heats

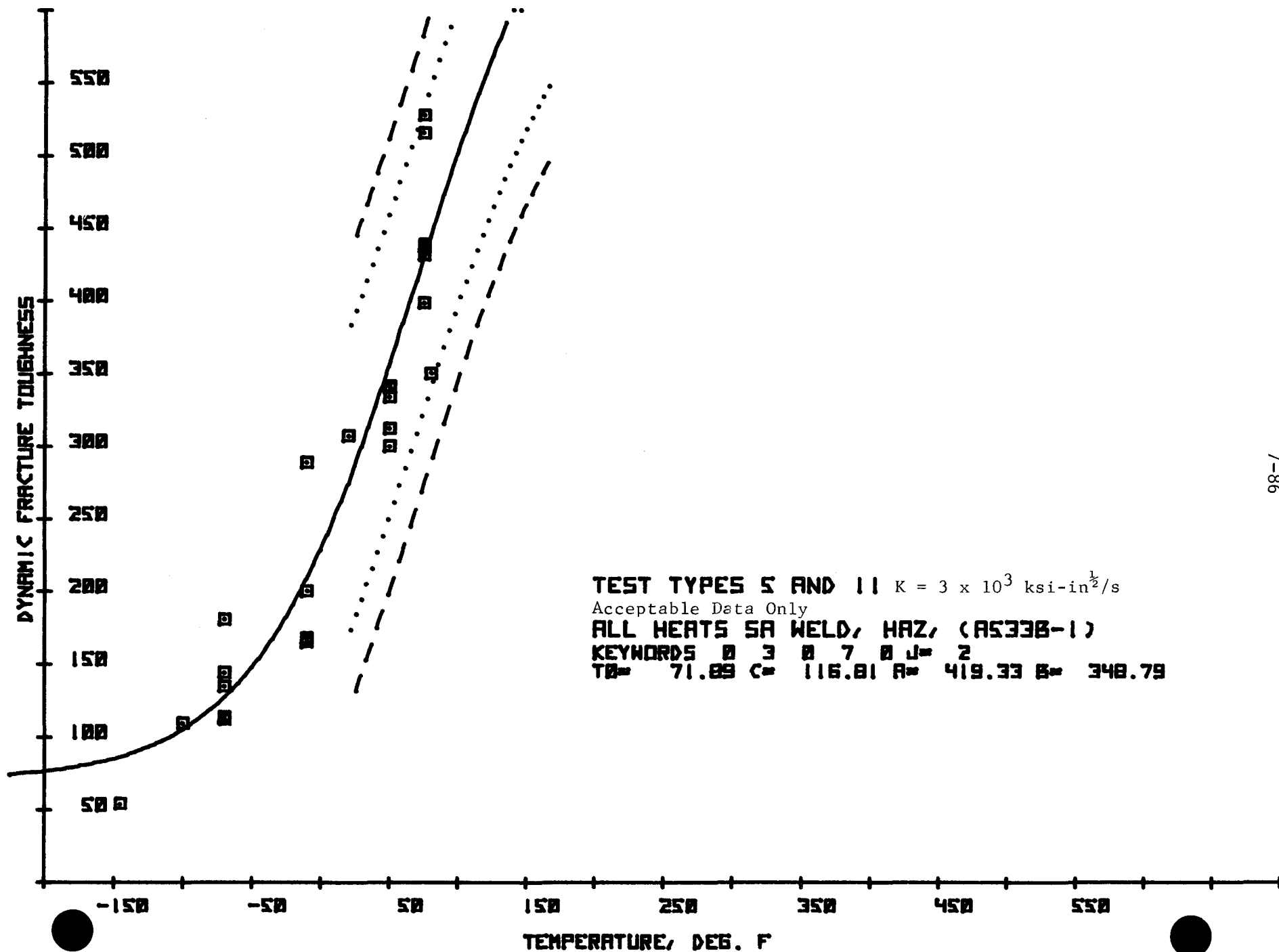


Figure 7.60 Acceptable Dynamic Fracture Toughness Data for CE Heats

MATERIAL 7 DATA BANK (SA, HAZ, A533B-1)

KEYWORDS 0-0-0-7-0

(35)	8-3-7-7-2-14-5	-160.00	34.70	--	--	--	4500.00
(36)	8-3-7-7-2-2-4	-70.00	60.60	--	--	--	4800.00
(37)	8-3-7-7-2-8-0	-10.00	--	224.50	210.30	--	1400.00
(38)	8-3-7-7-2-18-0	50.00	--	327.60	307.40	--	1100.00
(39)	8-3-8-7-2-7-0	-100.00	50.40	--	--	--	2400.00
(40)	8-3-8-7-2-28-1	-70.00	77.50	--	--	--	2700.00
(41)	8-3-8-7-2-22-0	-40.00	--	184.80	170.20	--	2100.00
(42)	8-3-8-7-2-21-0	-10.00	--	186.80	176.10	--	1400.00
(43)	8-3-8-7-2-26-0	-10.00	--	162.00	153.90	--	2700.00
(44)	8-3-8-7-2-19-0	20.00	--	149.50	139.70	--	4600.00
(45)	8-3-8-7-2-18-0	50.00	--	209.60	198.70	--	1400.00
(46)	8-3-8-7-2-20-0	50.00	--	234.30	220.80	--	1800.00
(47)	8-3-9-7-3-16-0	-155.00	48.90	--	--	--	4800.00
(48)	8-3-9-7-3-24-1	-40.00	92.00	--	--	--	4600.00
(49)	8-3-9-7-3-9-0	20.00	--	161.80	152.90	--	5300.00
(50)	8-3-9-7-3-4-0	80.00	--	331.00	311.70	--	5500.00
(51)	8-3-10-7-2-2-0	-70.00	54.70	--	--	--	5100.00
(52)	8-3-10-7-2-25-0	-10.00	--	163.00	154.80	--	2500.00
(53)	8-3-10-7-2-22-0	50.00	--	207.70	197.90	--	2600.00
(54)	8-3-11-7-2-11-0	-150.00	38.40	--	--	--	5100.00
(55)	8-3-11-7-2-5-0	-70.00	59.50	--	--	--	4800.00
(56)	8-3-11-7-2-22-1	-40.00	68.80	--	--	--	2700.00
(57)	8-3-11-7-2-21-0	-10.00	--	101.10	96.80	--	2800.00
(58)	8-3-11-7-2-23-2	-10.00	--	116.30	110.30	--	3100.00
(59)	8-3-11-7-2-20-0	20.00	--	161.10	153.50	--	4500.00
(60)	8-3-11-7-2-18-0	50.00	--	228.00	216.70	--	2800.00
(61)	8-3-11-7-2-19-0	50.00	--	147.00	140.10	--	4500.00
(104)	4-23-7-7-2-5-0	-80.00	1.00	--	--	--	--
(105)	4-23-7-7-2-4-0	-70.00	1.00	--	--	--	--
(106)	4-23-7-7-2-7-0	-70.00	2.00	--	--	--	--
(107)	4-23-7-7-2-2-0	-60.00	2.00	--	--	--	--
(108)	4-23-7-7-2-3-0	-60.00	2.00	--	--	--	--
(109)	4-23-8-7-2-5-0	-80.00	1.00	--	--	--	--
(110)	4-23-8-7-2-7-0	-70.00	1.00	--	--	--	--
(111)	4-23-8-7-2-2-0	-70.00	2.00	--	--	--	--
(112)	4-23-8-7-2-8-0	-60.00	2.00	--	--	--	--
(113)	4-23-8-7-2-3-0	-60.00	2.00	--	--	--	--
(114)	4-23-9-7-3-4-0	-50.00	1.00	--	--	--	--
(115)	4-23-9-7-3-7-0	-40.00	1.00	--	--	--	--
(116)	4-23-9-7-3-3-0	-30.00	2.00	--	--	--	--
(117)	4-23-9-7-3-1-0	-30.00	2.00	--	--	--	--
(118)	4-23-10-7-2-8-0	-70.00	1.00	--	--	--	--
(119)	4-23-10-7-2-2-0	-60.00	2.00	--	--	--	--
(120)	4-23-10-7-2-4-0	-60.00	2.00	--	--	--	--
(121)	4-23-10-7-2-1-0	-50.00	2.00	--	--	--	--
(122)	4-23-11-7-2-3-0	-90.00	1.00	--	--	--	--

(123)	4-23-11-7-2-2-0	-80.00	3.00	--	--	--	--
(124)	4-23-11-7-2-1-0	-80.00	1.00	--	--	--	--
(125)	4-23-11-7-2-6-0	-70.00	2.00	--	--	--	--
(126)	4-23-11-7-2-5-0	-70.00	1.00	--	--	--	--
(127)	4-23-11-7-2-8-0	-60.00	2.00	--	--	--	--
(128)	4-23-11-7-2-4-0	-60.00	2.00	--	--	--	--
(129)	4-23-11-7-2-7-0	-50.00	2.00	--	--	--	--
(364)	2-23-7-7-1-1-0	-120.00	6.00	0.00	5.00	--	--
(365)	2-23-7-7-1-16-0	-120.00	6.50	1.00	5.00	--	--
(366)	2-23-7-7-1-23-0	-120.00	8.70	2.00	5.00	--	--
(367)	2-23-7-7-1-14-0	-80.00	17.00	12.00	15.00	--	--
(368)	2-23-7-7-1-8-0	-80.00	21.80	11.00	15.00	--	--
(369)	2-23-7-7-1-12-0	-80.00	37.00	22.00	25.00	--	--
(370)	2-23-7-7-1-4-0	-40.00	24.00	21.00	40.00	--	--
(371)	2-23-7-7-1-24-0	-40.00	26.20	21.00	40.00	--	--
(372)	2-23-7-7-1-10-0	-40.00	80.00	50.00	60.00	--	--
(373)	2-23-7-7-1-20-0	-10.00	101.00	71.00	75.00	--	--
(374)	2-23-7-7-1-22-0	-10.00	102.50	72.00	80.00	--	--
(375)	2-23-7-7-1-15-0	-10.00	103.50	63.00	75.00	--	--
(376)	2-23-7-7-1-5-0	40.00	130.50	90.00	95.00	--	--
(377)	2-23-7-7-1-19-0	40.00	131.00	87.00	90.00	--	--
(378)	2-23-7-7-1-25-0	40.00	143.50	83.00	95.00	--	--
(379)	2-23-7-7-1-13-0	100.00	133.00	82.00	100.00	--	--
(380)	2-23-7-7-1-21-0	100.00	144.00	87.00	100.00	--	--
(381)	2-23-7-7-1-3-0	100.00	145.00	85.00	100.00	--	--
(382)	2-23-7-7-1-7-0	160.00	156.00	90.00	100.00	--	--
(383)	2-23-7-7-1-6-0	160.00	155.00	93.00	100.00	--	--
(384)	2-23-7-7-1-9-0	160.00	159.50	85.00	100.00	--	--
(385)	2-23-7-7-1-11-0	300.00	150.50	91.00	100.00	--	--
(386)	2-23-7-7-1-2-0	425.00	161.00	84.00	100.00	--	--
(387)	2-23-7-7-2-11-0	-120.00	19.50	8.00	5.00	--	--
(388)	2-23-7-7-2-23-0	-120.00	17.00	8.00	5.00	--	--
(389)	2-23-7-7-2-7-0	-120.00	21.00	10.00	7.00	--	--
(390)	2-23-7-7-2-9-0	-80.00	64.00	44.00	35.00	--	--
(391)	2-23-7-7-2-12-0	-80.00	71.00	50.00	40.00	--	--
(392)	2-23-7-7-2-13-0	-80.00	68.00	44.00	40.00	--	--
(393)	2-23-7-7-2-6-0	-40.00	80.50	50.00	60.00	--	--
(394)	2-23-7-7-2-2-0	-40.00	90.50	62.00	65.00	--	--
(395)	2-23-7-7-2-3-0	-40.00	96.00	67.00	70.00	--	--
(396)	2-23-7-7-2-24-0	-10.00	109.00	62.00	80.00	--	--
(397)	2-23-7-7-2-25-0	-10.00	105.50	62.00	80.00	--	--
(398)	2-23-7-7-2-19-0	-10.00	115.00	64.00	75.00	--	--
(399)	2-23-7-7-2-26-0	40.00	123.00	85.00	90.00	--	--
(400)	2-23-7-7-2-4-0	40.00	136.50	91.00	95.00	--	--
(401)	2-23-7-7-2-8-0	40.00	158.00	92.00	100.00	--	--
(402)	2-23-7-7-2-5-0	100.00	158.50	94.00	100.00	--	--
(403)	2-23-7-7-2-22-0	100.00	155.00	93.00	100.00	--	--
(404)	2-23-7-7-2-21-0	100.00	143.00	85.00	100.00	--	--
(405)	2-23-7-7-2-15-0	160.00	154.50	92.00	100.00	--	--
(406)	2-23-7-7-2-14-0	160.00	159.00	92.00	100.00	--	--
(407)	2-23-7-7-2-10-0	160.00	169.00	88.00	100.00	--	--

(408)	2-23-7-7-2-20-0	300.00	155.00	91.00	100.00	--	--
(409)	2-23-7-7-2-16-0	425.00	158.00	91.00	100.00	--	--
(410)	2-23-7-7-2-18-0	550.00	174.00	77.00	100.00	--	--
(411)	2-3-8-7-2-1-0	-190.00	3.00	0.00	0.00	--	--
(412)	2-3-8-7-2-2-0	-100.00	5.00	0.00	0.00	--	--
(413)	2-3-8-7-2-3-0	-60.00	27.00	15.00	30.00	--	--
(414)	2-3-8-7-2-4-0	-40.00	66.00	54.00	50.00	--	--
(415)	2-3-8-7-2-5-0	-20.00	73.00	52.00	50.00	--	--
(416)	2-3-8-7-2-15-0	-10.00	90.00	68.00	70.00	--	--
(417)	2-3-8-7-2-16-0	-10.00	91.00	55.00	70.00	--	--
(418)	2-3-8-7-2-17-0	-10.00	86.00	59.00	60.00	--	--
(419)	2-3-8-7-2-6-0	0.00	90.00	56.00	60.00	--	--
(420)	2-3-8-7-2-7-0	20.00	86.00	58.00	50.00	--	--
(421)	2-3-8-7-2-18-0	40.00	117.00	79.00	80.00	--	--
(422)	2-3-8-7-2-9-0	60.00	126.00	79.00	90.00	--	--
(423)	2-3-8-7-2-10-0	100.00	133.00	87.00	99.00	--	--
(424)	2-3-8-7-2-11-0	160.00	125.00	82.00	100.00	--	--
(425)	2-3-8-7-2-12-0	300.00	136.00	86.00	100.00	--	--
(426)	2-3-8-7-2-13-0	425.00	136.00	87.00	100.00	--	--
(427)	2-3-8-7-2-14-0	550.00	130.00	78.00	100.00	--	--
(428)	2-3-8-7-1-1-0	-190.00	4.00	0.00	0.00	--	--
(429)	2-3-8-7-1-2-0	-100.00	10.00	2.00	0.00	--	--
(430)	2-3-8-7-1-3-0	-60.00	28.00	13.00	35.00	--	--
(431)	2-3-8-7-1-4-0	-40.00	29.00	20.00	35.00	--	--
(432)	2-3-8-7-1-5-0	-20.00	74.00	72.00	45.00	--	--
(433)	2-3-8-7-1-6-0	0.00	63.00	42.00	50.00	--	--
(434)	2-3-8-7-1-7-0	20.00	86.00	50.00	70.00	--	--
(435)	2-3-8-7-1-8-0	40.00	103.00	71.00	75.00	--	--
(436)	2-3-8-7-1-9-0	60.00	114.00	81.00	90.00	--	--
(437)	2-3-8-7-1-10-0	100.00	112.00	83.00	90.00	--	--
(438)	2-3-8-7-1-11-0	160.00	115.00	79.00	99.00	--	--
(439)	2-3-8-7-1-12-0	300.00	127.00	86.00	100.00	--	--
(440)	2-3-8-7-1-13-0	425.00	117.00	102.00	100.00	--	--
(441)	2-3-8-7-1-14-0	550.00	122.00	84.00	100.00	--	--
(442)	2-3-9-7-3-1-0	-160.00	2.00	0.00	0.00	--	--
(443)	2-3-9-7-3-2-0	-70.00	22.00	12.00	10.00	--	--
(444)	2-3-9-7-3-3-0	-30.00	25.00	17.00	10.00	--	--
(445)	2-3-9-7-3-4-0	-10.00	42.00	30.00	20.00	--	--
(446)	2-3-9-7-3-5-0	10.00	52.00	36.00	30.00	--	--
(447)	2-3-9-7-3-12-0	20.00	66.00	35.00	30.00	--	--
(448)	2-3-9-7-3-13-0	20.00	79.00	48.00	40.00	--	--
(449)	2-3-9-7-3-14-0	20.00	151.00	72.00	80.00	--	--
(450)	2-3-9-7-3-6-0	30.00	70.00	52.00	40.00	--	--
(451)	2-3-9-7-3-7-0	50.00	113.00	69.00	90.00	--	--
(452)	2-3-9-7-3-18-0	70.00	80.00	65.00	85.00	--	--
(453)	2-3-9-7-3-9-0	90.00	120.00	76.00	100.00	--	--
(454)	2-3-9-7-3-10-0	130.00	119.00	78.00	100.00	--	--
(455)	2-3-9-7-3-11-0	190.00	119.00	77.00	100.00	--	--
(456)	2-3-9-7-3-15-0	300.00	128.00	77.00	100.00	--	--
(457)	2-3-9-7-3-16-0	425.00	196.00	60.00	100.00	--	--
(458)	2-3-9-7-3-17-0	550.00	103.00	82.00	100.00	--	--

(459)	2-3-10-7-2-1-0	-190.00	3.00	0.00	0.00	--	--
(460)	2-3-10-7-2-2-0	-100.00	11.00	3.00	0.00	--	--
(461)	2-3-10-7-2-3-0	-60.00	32.00	20.00	30.00	--	--
(462)	2-3-10-7-2-4-0	-40.00	22.00	32.00	25.00	--	--
(463)	2-3-10-7-2-5-0	-20.00	36.00	28.00	30.00	--	--
(464)	2-3-10-7-2-15-0	-10.00	70.00	50.00	50.00	--	--
(465)	2-3-10-7-2-16-0	-10.00	74.00	49.00	50.00	--	--
(466)	2-3-10-7-2-17-0	-10.00	56.00	35.00	40.00	--	--
(467)	2-3-10-7-2-6-0	0.00	59.00	43.00	40.00	--	--
(468)	2-3-10-7-2-7-0	20.00	94.00	59.00	65.00	--	--
(469)	2-3-10-7-2-8-0	40.00	95.00	68.00	80.00	--	--
(470)	2-3-10-7-2-9-0	60.00	103.00	72.00	85.00	--	--
(471)	2-3-10-7-2-10-0	100.00	111.00	79.00	95.00	--	--
(472)	2-3-10-7-2-11-0	160.00	125.00	83.00	100.00	--	--
(473)	2-3-10-7-2-12-0	300.00	135.00	88.00	100.00	--	--
(474)	2-3-10-7-2-13-0	425.00	136.00	90.00	100.00	--	--
(475)	2-3-10-7-2-14-0	550.00	127.00	80.00	100.00	--	--
(476)	2-3-10-7-1-1-0	-190.00	2.00	0.00	0.00	--	--
(477)	2-3-10-7-1-2-0	-100.00	7.00	2.00	0.00	--	--
(478)	2-3-10-7-1-3-0	-60.00	24.00	17.00	30.00	--	--
(479)	2-3-10-7-1-4-0	-40.00	24.00	17.00	30.00	--	--
(480)	2-3-10-7-1-5-0	-20.00	63.00	44.00	45.00	--	--
(481)	2-3-10-7-1-6-0	0.00	78.00	53.00	60.00	--	--
(482)	2-3-10-7-1-7-0	20.00	86.00	58.00	60.00	--	--
(483)	2-3-10-7-1-8-0	40.00	102.00	70.00	80.00	--	--
(484)	2-3-10-7-1-15-0	60.00	84.00	50.00	70.00	--	--
(485)	2-3-10-7-1-10-0	100.00	122.00	79.00	90.00	--	--
(486)	2-3-10-7-1-11-0	160.00	116.00	77.00	99.00	--	--
(487)	2-3-10-7-1-12-0	300.00	128.00	84.00	100.00	--	--
(488)	2-3-10-7-1-13-0	425.00	128.00	101.00	100.00	--	--
(489)	2-3-10-7-1-14-0	550.00	117.00	81.00	100.00	--	--
(490)	2-3-11-7-1-1-0	-190.00	3.00	0.00	0.00	--	--
(491)	2-3-11-7-1-2-0	-100.00	8.00	4.00	0.00	--	--
(492)	2-3-11-7-1-3-0	-60.00	15.00	7.00	30.00	--	--
(493)	2-3-11-7-1-4-0	-40.00	20.00	15.00	30.00	--	--
(494)	2-3-11-7-1-5-0	-20.00	36.00	26.00	30.00	--	--
(495)	2-3-11-7-1-6-0	0.00	65.00	48.00	50.00	--	--
(496)	2-3-11-7-1-7-0	20.00	83.00	53.00	50.00	--	--
(497)	2-3-11-7-1-8-0	40.00	101.00	71.00	80.00	--	--
(498)	2-3-11-7-1-9-0	60.00	101.00	72.00	70.00	--	--
(499)	2-3-11-7-1-10-0	100.00	105.00	70.00	75.00	--	--
(500)	2-3-11-7-1-11-0	160.00	114.00	78.00	100.00	--	--
(501)	2-3-11-7-1-12-0	300.00	122.00	85.00	100.00	--	--
(502)	2-3-11-7-1-13-0	425.00	125.00	95.00	100.00	--	--
(503)	2-3-11-7-1-14-0	550.00	121.00	82.00	100.00	--	--
(504)	2-3-11-7-2-1-0	-190.00	2.00	0.00	0.00	--	--
(505)	2-3-11-7-2-2-0	-100.00	4.00	0.00	0.00	--	--
(506)	2-3-11-7-2-3-0	-60.00	31.00	19.00	35.00	--	--
(507)	2-3-11-7-2-4-0	-40.00	29.00	32.00	35.00	--	--
(508)	2-3-11-7-2-5-0	-20.00	44.00	31.00	30.00	--	--
(509)	2-3-11-7-2-15-0	-10.00	57.00	39.00	40.00	--	--

(510)	2-3-11-7-2-16-0	-10.00	69.00	49.00	50.00	--	--
(511)	2-3-11-7-2-17-0	-10.00	65.00	45.00	50.00	--	--
(512)	2-3-11-7-2-6-0	0.00	68.00	46.00	40.00	--	--
(513)	2-3-11-7-2-7-0	20.00	89.00	54.00	45.00	--	--
(514)	2-3-11-7-2-8-0	40.00	81.00	55.00	50.00	--	--
(515)	2-3-11-7-2-9-0	60.00	105.00	72.00	90.00	--	--
(516)	2-3-11-7-2-10-0	100.00	112.00	77.00	99.00	--	--
(517)	2-3-11-7-2-11-0	160.00	128.00	85.00	100.00	--	--
(518)	2-3-11-7-2-12-0	300.00	132.00	88.00	100.00	--	--
(519)	2-3-11-7-2-13-0	425.00	118.00	81.00	100.00	--	--
(520)	2-3-11-7-2-14-0	550.00	117.00	82.00	100.00	--	--
(119)	5-3-7-7-2-4-0	-145.00	54.60	--	--	--	1.10
(120)	5-3-7-7-2-5-0	-70.00	--	180.80	171.30	--	1.50
(121)	5-3-7-7-2-9-0	-10.00	--	289.20	271.60	--	2.10
(122)	5-3-7-7-2-15-0	50.00	--	340.40	320.20	--	2.50
(123)	5-3-8-7-2-3-1	-130.00	76.70	--	--	--	1.00
(124)	5-3-8-7-2-6-0	-100.00	--	109.80	102.90	--	1.10
(125)	5-3-8-7-2-27-0	-70.00	--	144.40	138.70	--	1.20
(126)	5-3-8-7-2-2-0	-70.00	--	112.30	108.10	--	1.10
(127)	5-3-8-7-2-1-0	-10.00	--	165.60	155.60	--	1.30
(128)	5-3-8-7-2-13-0	50.00	--	300.40	286.20	--	2.40
(129)	5-3-8-7-2-14-0	50.00	--	312.50	297.00	--	2.40
(130)	5-3-9-7-3-20-1	-160.00	83.90	--	--	--	1.00
(131)	5-3-9-7-3-25-4	-40.00	--	177.30	166.20	--	1.50
(132)	5-3-9-7-3-3-0	20.00	--	307.50	287.20	--	2.40
(133)	5-3-9-7-3-14-0	80.00	--	350.30	330.40	--	2.80
(134)	5-3-10-7-2-7-1	-130.00	62.40	--	--	--	1.00
(135)	5-3-10-7-2-1-2	-70.00	--	127.60	121.80	--	1.30
(136)	5-3-10-7-2-21-0	-10.00	--	168.30	160.00	--	1.30
(137)	5-3-10-7-2-23-0	50.00	--	334.10	317.00	--	2.70
(138)	5-3-11-7-2-10-1	-130.00	73.20	--	--	--	1.10
(139)	5-3-11-7-2-2-0	-70.00	--	134.80	128.40	--	1.20
(140)	5-3-11-7-2-9-0	-70.00	--	113.80	109.10	--	1.10
(141)	5-3-11-7-2-24-0	-10.00	--	200.50	187.70	--	1.50
(142)	5-3-11-7-2-13-0	50.00	--	341.50	324.40	--	2.60
(171)	11-3-7-7-2-1-0	75.00	--	528.00	466.00	--	5.20
(172)	11-3-7-7-2-2-0	75.00	--	515.70	468.80	--	5.10
(173)	11-3-8-7-2-2-0	75.00	--	398.60	361.50	--	4.10
(174)	11-3-9-7-3-2-0	75.00	--	439.00	399.00	--	4.70
(175)	11-3-10-7-2-2-0	75.00	--	432.00	391.00	--	3.80
(176)	11-3-11-7-2-1-0	75.00	--	437.50	397.30	--	4.40
(184)	7-3-8-7-2-1-0	-40.00	104.00	--	--	--	1900.00
(185)	7-3-10-7-2-1-0	-40.00	77.60	--	--	--	2.20
(186)	7-3-11-7-2-1-0	-40.00	82.60	--	--	--	2.20
(218)	1-23-7-7-1-1-0	-130.00	95.50	106.70	12.80	31.00	69.10
(219)	1-23-7-7-1-2-0	-70.00	88.00	101.90	11.60	30.00	68.70
(220)	1-23-7-7-1-3-0	-10.00	85.10	97.50	10.40	28.00	69.70
(221)	1-23-7-7-1-4-0	110.00	80.60	91.40	8.50	26.00	72.60
(222)	1-23-7-7-1-5-0	250.00	76.90	87.80	7.20	23.00	71.10
(223)	1-23-7-7-1-6-0	550.00	72.40	90.20	9.20	26.00	67.20

(224)	1-23-8-7-1-1-0	-70.00	86.90	102.20	11.60	29.50	65.30
(225)	1-23-8-7-1-2-0	-10.00	81.30	95.10	10.40	27.00	68.10
(226)	1-23-8-7-1-3-0	50.00	78.70	92.30	10.30	27.00	68.80
(227)	1-23-8-7-1-4-0	110.00	75.70	88.40	9.10	25.50	72.30
(228)	1-23-8-7-1-5-0	250.00	72.80	84.50	9.10	22.00	64.90
(229)	1-23-8-7-1-5-0	550.00	66.70	82.00	8.40	23.50	64.00
(230)	1-23-9-7-2-1-0	-100.00	76.90	101.20	11.00	23.50	56.80
(231)	1-23-9-7-2-2-0	-40.00	69.40	95.00	9.80	23.50	58.30
(232)	1-23-9-7-2-3-0	20.00	64.50	88.80	8.40	20.00	54.00
(233)	1-23-9-7-2-4-0	140.00	59.10	80.70	6.60	22.00	62.10
(234)	1-23-9-7-2-5-0	250.00	57.00	78.20	--	22.00	68.50
(235)	1-23-9-7-2-6-0	550.00	57.30	85.60	8.20	22.00	61.80
(236)	1-23-10-7-1-1-0	-70.00	85.90	101.60	11.60	28.00	61.30
(237)	1-23-10-7-1-2-0	-10.00	82.20	96.70	11.00	27.50	65.80
(238)	1-23-10-7-1-3-0	50.00	79.90	92.40	9.70	26.50	70.90
(239)	1-23-10-7-1-4-0	110.00	77.30	89.40	9.10	25.00	72.20
(240)	1-23-10-7-1-5-0	250.00	72.40	85.00	8.50	23.50	67.70
(241)	1-23-10-7-1-6-0	550.00	67.00	86.20	8.40	23.50	66.00
(242)	1-23-11-7-1-1-0	-70.00	83.60	100.00	11.60	28.00	66.70
(243)	1-23-11-7-1-2-0	-10.00	81.70	96.80	9.70	27.50	63.90
(244)	1-23-11-7-1-3-0	50.00	78.70	93.00	9.70	26.50	69.30
(245)	1-23-11-7-1-4-0	110.00	77.60	90.20	9.10	26.00	71.10
(246)	1-23-11-7-1-5-0	250.00	73.90	85.80	7.80	23.00	70.60
(247)	1-23-11-7-1-6-0	550.00	66.70	87.10	9.70	22.50	63.60
(278)	2-23-7-7-1-18-0	550.00	168.00	82.00	100.00	--	--
(379)	3-23-7-7-2-11-0	-160.00	39.00	--	--	140.00	2.20E+05
(380)	3-23-7-7-2-1-0	-130.00	40.40	--	--	385.00	2.20E+05
(381)	3-23-7-7-2-3-0	-100.00	45.10	--	--	658.00	3.20E+05
(382)	3-23-7-7-2-13-0	-70.00	43.80	--	--	1000.00	3.70E+05
(383)	3-23-7-7-2-2-0	-70.00	63.40	--	--	975.00	3.70E+05
(384)	3-23-7-7-2-16-0	-40.00	57.30	--	--	2320.00	3.60E+05
(385)	3-23-7-7-2-7-0	-40.00	60.10	--	--	1474.00	3.80E+05
(386)	3-23-7-7-2-21-0	-10.00	--	254.00	253.00	2316.00	3.30E+05
(387)	3-23-7-7-2-18-0	-10.00	--	153.00	156.00	2550.00	4.80E+05
(388)	3-23-7-7-2-6-0	20.00	--	279.00	281.00	5392.00	3.50E+05
(389)	3-23-7-7-2-15-0	20.00	--	241.00	243.00	5385.00	3.40E+05
(390)	3-23-7-7-2-12-0	50.00	--	271.00	270.10	5842.00	3.90E+05
(391)	3-23-7-7-2-10-0	50.00	--	283.00	287.00	6385.00	4.10E+05
(392)	3-23-7-7-2-4-0	80.00	--	288.00	287.00	6701.00	3.80E+05
(393)	3-23-7-7-2-5-0	80.00	--	293.00	291.00	5921.00	4.20E+05
(394)	3-23-7-7-2-8-0	110.00	--	295.00	295.00	6268.00	3.70E+05
(395)	3-23-7-7-2-14-0	110.00	--	286.00	294.00	6385.00	3.20E+05
(396)	3-23-7-7-2-19-0	300.00	--	283.00	281.00	6532.00	3.10E+05
(397)	3-23-7-7-2-20-0	425.00	--	282.00	284.00	6911.00	3.50E+05
(398)	3-23-7-7-2-9-0	550.00	--	307.00	307.00	7579.00	3.10E+05
(399)	3-23-7-7-2-17-6	550.00	--	300.00	298.00	8486.00	3.00E+05
(400)	3-3-8-7-2-1-2	-160.00	45.00	--	--	110.00	2.30E+05
(401)	3-3-8-7-2-2-2	-130.00	42.50	--	--	229.00	1.20E+05
(402)	3-3-8-7-2-3-0	-100.00	57.80	--	--	428.00	2.30E+05
(403)	3-3-8-7-2-4-0	-70.00	49.10	--	--	922.00	2.60E+05

(404)	3-3-8-7-2-5-0	-70.00	51.00	--	--	971.00	2.40E+05
(405)	3-3-8-7-2-6-0	-70.00	43.50	--	--	1123.00	2.30E+05
(406)	3-3-8-7-2-7-2	-40.00	68.30	--	--	500.00	3.70E+05
(407)	3-3-8-7-2-9-0	-10.00	--	208.80	205.90	3709.00	3.30E+05
(408)	3-3-8-7-2-10-0	-10.00	--	221.30	217.60	3701.00	2.50E+05
(409)	3-3-8-7-2-11-0	20.00	--	269.60	266.30	5114.00	2.70E+05
(410)	3-3-8-7-2-12-0	50.00	--	283.20	279.40	6145.00	4.70E+05
(411)	3-3-8-7-2-13-0	50.00	--	227.90	224.90	6086.00	3.30E+05
(412)	3-3-8-7-2-15-0	80.00	--	267.30	265.80	6363.00	3.00E+05
(413)	3-3-8-7-2-16-2	110.00	--	274.50	269.60	6291.00	4.00E+05
(414)	3-3-8-7-2-17-0	110.00	--	280.50	276.00	5768.00	4.80E+05
(415)	3-3-8-7-2-18-0	110.00	--	279.50	275.40	6424.00	3.40E+05
(416)	3-3-8-7-2-19-2	300.00	--	333.00	327.00	9358.00	2.70E+05
(417)	3-3-8-7-2-20-2	425.00	--	273.00	267.00	6959.00	3.00E+05
(418)	3-3-8-7-2-21-2	550.00	--	245.00	249.00	6619.00	4.20E+05
(419)	3-3-9-7-3-1-0	-130.00	50.10	--	--	328.00	2.60E+05
(420)	3-3-9-7-3-2-0	-100.00	51.40	--	--	183.00	3.00E+05
(421)	3-3-9-7-3-3-0	-70.00	52.30	--	--	460.00	3.50E+05
(422)	3-3-9-7-3-4-0	-40.00	--	206.30	203.50	3547.00	3.20E+05
(423)	3-3-9-7-3-5-0	-40.00	66.70	--	--	1053.00	7.20E+05
(424)	3-3-9-7-3-6-0	-40.00	60.70	--	--	1231.00	5.20E+05
(425)	3-3-9-7-3-7-0	-10.00	--	152.20	150.40	2601.00	3.30E+05
(426)	3-3-9-7-3-8-0	20.00	--	283.30	279.90	3934.00	2.80E+05
(427)	3-3-9-7-3-9-0	20.00	--	281.90	278.80	7309.00	4.20E+05
(428)	3-3-9-7-3-10-0	20.00	--	185.20	182.80	2604.00	3.90E+05
(429)	3-3-9-7-3-11-0	50.00	--	280.50	277.60	4442.00	4.10E+05
(430)	3-3-9-7-3-12-0	80.00	--	363.30	359.90	8583.00	3.90E+05
(431)	3-3-9-7-3-13-0	80.00	--	347.20	343.80	8541.00	3.50E+05
(432)	3-3-9-7-3-14-0	80.00	--	329.20	325.80	7058.00	4.50E+05
(433)	3-3-9-7-3-15-6	110.00	--	268.60	265.00	6149.00	1.30E+05
(434)	3-3-9-7-3-16-0	140.00	--	208.40	206.20	7098.00	5.40E+05
(435)	3-3-9-7-3-17-6	140.00	--	264.20	260.40	6145.00	8.30E+05
(436)	3-3-9-7-3-18-26	140.00	--	300.70	302.30	6766.00	9.50E+05
(437)	3-3-9-7-3-19-26	300.00	--	286.10	280.30	6357.00	5.80E+05
(438)	3-3-9-7-3-20-0	425.00	--	272.30	269.10	5786.00	3.90E+05
(439)	3-3-9-7-3-21-6	500.00	--	297.20	293.70	7652.00	5.90E+05
(440)	3-3-10-7-2-1-0	-160.00	42.60	--	--	88.00	1.90E+05
(441)	3-3-10-7-2-2-0	-130.00	40.80	--	--	705.00	2.10E+05
(442)	3-3-10-7-2-3-0	-100.00	40.90	--	--	522.00	1.80E+05
(443)	3-3-10-7-2-4-0	-70.00	36.30	--	--	706.60	2.80E+05
(444)	3-3-10-7-2-5-0	-70.00	59.50	--	--	947.80	3.70E+05
(445)	3-3-10-7-2-6-2	-70.00	67.50	--	--	874.00	2.90E+05
(446)	3-3-10-7-2-7-2	-40.00	71.30	--	--	1698.00	3.10E+05
(447)	3-3-10-7-2-8-2	-10.00	77.70	--	--	2389.00	4.30E+05
(448)	3-3-10-7-2-9-0	-10.00	64.10	--	--	2356.00	3.10E+05
(449)	3-3-10-7-2-10-0	-10.00	--	90.80	88.40	4169.00	4.20E+05
(450)	3-3-10-7-2-11-2	20.00	--	165.20	161.80	4838.00	6.20E+05
(451)	3-3-10-7-2-13-0	50.00	--	266.20	262.90	5858.00	4.20E+05
(452)	3-3-10-7-2-14-2	50.00	--	262.70	257.40	5888.00	4.10E+05
(453)	3-3-10-7-2-15-0	80.00	--	271.90	268.00	6203.00	3.00E+05

(454)	3-3-10-7-2-17-0	110.00	--	287.30	283.10	6362.00	4.60E+05
(455)	3-3-10-7-2-18-2	110.00	--	273.00	267.60	5467.00	1.10E+05
(456)	3-3-10-7-2-19-2	300.00	--	264.00	257.00	5897.00	3.80E+05
(457)	3-3-10-7-2-20-2	425.00	--	266.00	260.00	6387.00	3.10E+05
(458)	3-3-11-7-2-1-2	-160.00	42.10	--	--	207.00	1.60E+05
(459)	3-3-11-7-2-2-0	-130.00	47.60	--	--	124.00	1.80E+05
(460)	3-3-11-7-2-3-0	-100.00	40.30	--	--	228.00	1.10E+05
(461)	3-3-11-7-2-4-0	-70.00	51.20	--	--	465.00	2.20E+05
(462)	3-3-11-7-2-5-2	-70.00	52.80	--	--	564.00	1.90E+05
(463)	3-3-11-7-2-6-2	-70.00	46.50	--	--	653.00	2.00E+05
(464)	3-3-11-7-2-7-2	-40.00	62.30	--	--	853.00	2.10E+05
(465)	3-3-11-7-2-8-0	-10.00	60.00	--	--	1499.00	5.20E+05
(466)	3-3-11-7-2-9-0	-10.00	78.40	--	--	1531.00	2.50E+05
(467)	3-3-11-7-2-10-2	-10.00	72.70	--	--	1966.00	4.30E+05
(468)	3-3-11-7-2-11-0	20.00	69.90	--	--	3435.00	3.80E+05
(469)	3-3-11-7-2-12-0	50.00	--	238.50	235.50	4169.00	3.90E+05
(470)	3-3-11-7-2-13-0	50.00	--	275.40	272.50	4637.00	3.30E+05
(471)	3-3-11-7-2-14-2	50.00	--	232.30	228.90	4697.00	4.00E+05
(472)	3-3-11-7-2-15-2	80.00	--	284.70	280.10	5992.00	4.10E+05
(473)	3-3-11-7-2-16-2	110.00	--	267.50	262.40	6316.00	3.50E+05
(474)	3-3-11-7-2-18-2	110.00	--	280.80	275.20	6172.00	4.00E+05
(475)	3-3-11-7-2-23-0	300.00	--	307.80	303.50	7906.00	2.20E+05
(476)	3-3-11-7-2-20-2	425.00	--	307.00	302.00	7529.00	2.50E+05
(477)	3-3-11-7-2-21-2	550.00	--	299.00	294.00	7744.00	3.10E+05
(7)	7-3-7-7-2-1-0	-40.00	128.00	--	--	--	1900.00
	7-3-9-7-3-1-1	-10.00	132.00	--	--	--	1300.00

APPENDIX 8

MATERIAL 8

SUBMERGED ARC WELDMENT IN A508-2 BASE METAL

MATERIAL TYPE 8
SA WELD IN A508-2

INTRODUCTION

Five heats of submerged arc weldments in A508-2, (heats A - D and K) were studied by Babcock and Wilcox. The various heats are described in Table 8.1. The results were encoded in the data bank, and the listing for material type 8 is given at the end of this section. The test program performed on material 8 is described in reference 11.

TENSILE TESTS RESULTS

The 1.25-inch gage section results are shown graphically in Figures 8.1 to 8.5. The statistical data and curve fit coefficients for cubic polynomial equations fitted to the data are shown in Table 8.2.

CHARPY V-NOTCH RESULTS

Impact Energy

The impact energy results for the submerged arc weldments and associated HAZ materials are shown graphically in Figures 8.6 to 8.15. The results of tanh curve fits to each data set are summarized in Table 8.3 and examined in detail in Table 8.4. Note the high T_0 for heat K (HAZ) and the high variance for heat A (HAZ).

Lateral Expansion

The data are summarized in the curves shown in Figures 8.16 to 8.25. The curve fit properties are summarized in Table 8.5. Each property has been analyzed in detail in Table 8.6. There were no deviant data sets.

Percent Shear

Figures 8.26 to 8.35 show the percent shear data. The curve fit results are summarized in Tables 8.7 and 8.8. Apart from heat K weld material (data set 221182), which had a somewhat larger than normal PHI

value (and heat D weld had a high value of variance), none of the results differed noticeably from the others.

Summary of Charpy Impact Test Data

The $T_0 - C$ values from the various Charpy measurements are compared to RT_{NDT} and NDTT in Table 8.9. There was no evidence of a correlation between $T_0 - C$ obtained from Charpy V-notch data and RT_{NDT} or NDTT.

INSTRUMENTED PRECRACKED CHARPY RESULTS

Dynamic Fracture Toughness, K_{Id} , K_d^*

The data sets are shown in Figures 8.36 to 8.40. The results for the curve fit procedure are summarized in Table 8.10. Each parameter has been examined in detail, and the results are summarized in Table 8.11. There were no outlying results.

Normalized Energy, W/A

The normalized energy data are shown in Figures 8.41 to 8.45. Results of the curve fit analysis are summarized in Table 8.12, and reviewed in detail in Table 8.13. As before, there were no outlying data sets.

Summary of Precracked Charpy Results

The RT_{NDT} and NDTT data, and the $T_0 - C$ results are summarized in Table 8.14. Again there is little agreement between the various measurements. The fracture toughness data are combined in Figure 8.46. The data fall close to the K_{IR} curve with one point lying slightly below the limit. The W/A data are combined and referenced to RT_{NDT} in Figure 8.47.

STATIC AND DYNAMIC COMPACT FRACTURE TOUGHNESS RESULTS

The test type 5, 7, 8, and 10 data are shown graphically in Figures 8.48 to 8.52. There were too few data points to perform a curve fit. The compact fracture test data are summarized by rate in Figures 8.53 and 8.54. There was considerable scatter in the data.

EFFECT OF ERROR CODES

The static and dynamic fracture toughness results for material 8 were statistically analyzed with and without the data points which did not meet the EPRI procedures. Tanh curve fits to the total data and acceptable data only are shown in Figures 8.55 to 8.58. The influence of the error code data on shelf properties and variance was determined. Both the overall variance and the variance in the transition temperature region ($T_0 \pm 50^\circ\text{F}$) were compared. A summary of the error code analysis is given in Table 8.15. The variance ratio (F) was calculated for the static and dynamic fracture toughness results. The ratios shown in Table 8.15 had a high probability of occurring by chance, and it is concluded that the effect of the error codes on the data was not significant.

Table 8.1. Summary of SA Weld Materials in A508-2 (Material 8)

<u>TEST LABORATORY</u>	<u>HEAT CODE</u>	<u>WELDING CONDITIONS</u>	<u>NDTT (^oF)</u>	<u>RT_{NDT} (^oF)</u>	<u>COMMENTS</u>
B & W	A (1)	(Ref. 11)	-30	15	Linde 80 Flux
	B (2)		-80	-80	Linde 0091 Flux
	C (3)		-60	-60	Linde 0091 Flux
	D (4)		0	0	Linde 80 Flux
	K (11)		-50	0	Linde 80 Flux

Table 8.2. Summary of the Regression Analysis of the Tensile Test Data (SA, A508-2)

Property	A	B	C	D	Variance, σ^2	Degrees of Freedom ϕ	Standard Deviation σ
Yield Stress	7.679X10	-6.257X10 ⁻²	1.542X10 ⁻⁴	-1.579X10 ⁻⁷	43.8	26	6.62
Ultimate Tensile Stress	9.411X10	-6.716X10 ⁻²	8.844X10 ⁻⁵	-1.692X10 ⁻⁸	20.82	26	4.56
Uniform Elongation	1.29X10	-1.483X10 ⁻²	-1.141X10 ⁻⁶	3.104X10 ⁻⁸	1.95	26	1.4
Total Elongation	2.672X10	-1.6X10 ⁻²	-8.155X10 ⁻⁶	3.308X10 ⁻⁸	2.27	26	1.51
Reduction In Area	6.67X10	7.76X10 ⁻³	-6.127X10 ⁻⁵	5.975X10 ⁻⁸	23.68	26	4.87

Table 8.3. Tanh Fit Parameters for Charpy Impact Energy Data (SA, A508-2)

KEY	J	A	B	T0	C	PHI	VAR
22182	2	39.66	37.37	19.41	130.90	5	156.79
22183	2	105.34	89.39	-59.53	62.10	2	419.08
22282	2	67.92	63.62	-21.60	56.78	6	64.16
22283	2	100.69	100.69	-44.51	85.21	2	98.67
22382	2	100.79	100.79	-18.47	115.14	5	283.19
22383	2	92.89	92.89	-54.51	72.83	2	98.20
22482	2	42.59	42.59	-13.08	120.77	2	34.78
22483	2	86.62	77.10	-34.53	30.21	2	2.66
221182	2	41.99	35.35	16.00	68.88	10	101.53
221183	2	121.48	119.76	97.55	150.16	2	4.13

Table 8.4. Deviation of Charpy Impact Energy Curve Fit Parameters from Mean Values (SA, A508-2)

<u>A</u>			
TOTAL	799.97		
MEAN	79.997		
ST. DEV	29.9081795		
KEY	VAL	DEV	NORMALIZED DEV
22182	39.66	-40.34	-1.35
22183	105.34	25.34	0.85
22282	67.92	-12.08	-0.40
22283	100.69	20.69	0.69
22382	100.79	20.79	0.70
22383	92.89	12.89	0.43
22482	42.59	-37.41	-1.25
22483	86.62	6.62	0.22
221182	41.99	-38.01	-1.27
221183	121.48	41.48	1.39

Table 8.4. (continued)

B

TOTAL	759.55
MEAN	75.955
ST. DEV	29.84966713

KEY	VAL	DEV	NORMALIZED DEV
22182	37.37	-38.59	-1.29
22183	89.39	13.44	0.45
22282	63.62	-12.34	-0.41
22283	100.69	24.74	0.83
22382	100.79	24.84	0.83
22383	92.89	16.94	0.57
22482	42.59	-33.37	-1.12
22483	77.10	1.15	0.04
221182	35.35	-40.61	-1.36
221183	119.76	43.81	1.47

T₀

TOTAL	-173.27
MEAN	-17.327
ST. DEV	53.28905517

KEY	VAL	DEV	NORMALIZED DEV
22182	19.41	36.74	0.69
22183	-59.53	-42.20	-0.79
22282	-21.60	-4.27	-0.08
22283	-44.51	-27.18	-0.51
22382	-18.47	-1.14	-0.02
22383	-54.51	-37.18	-0.70
22482	-13.08	4.25	0.08
22483	-94.53	-77.20	-1.45
221182	16.00	33.33	0.63
221183	97.55	114.88	2.16

Table 8.4. (continued)

C

TOTAL	894.98
MEAN	89.498
ST. DEV	37.94744606

KEY	VAL	DEV	NORMALIZED DEV
22182	130.90	41.40	1.09
22183	62.10	-27.40	-0.72
22282	58.78	-30.72	-0.81
22283	85.21	-4.29	-0.11
22382	115.14	25.64	0.68
22383	72.83	-16.67	-0.44
22482	120.77	31.27	0.82
22483	30.21	-59.29	-1.56
221182	68.88	-20.62	-0.54
221183	150.16	60.66	1.60

PHI

TOTAL	38
MEAN	3.8
ST. DEV	2.69979423

KEY	VAL	DEV	NORMALIZED DEV
22182	5.00	1.20	0.44
22183	2.00	-1.80	-0.67
22282	6.00	2.20	0.81
22283	2.00	-1.80	-0.67
22382	5.00	1.20	0.44
22383	2.00	-1.80	-0.67
22482	2.00	-1.80	-0.67
22483	2.00	-1.80	-0.67
221182	10.00	6.20	2.30
221183	2.00	-1.80	-0.67

Table 8.4. (continued)

<u>VARIANCE</u>			
TOTAL	1263.19		
MEAN	126.319		
ST. DEV	131.6056674		
KEY	VAL	DEV	NORMALIZED DEV
22182	156.79	30.47	0.23
22183	419.08	292.76	2.22
22282	64.16	-62.16	-0.47
22283	98.67	-27.65	-0.21
22382	283.19	156.87	1.19
22383	98.20	-28.12	-0.21
22482	34.78	-91.54	-0.70
22483	2.66	-123.66	-0.94
221182	101.53	-24.79	-0.19
221183	4.13	-122.19	-0.93

Table 8.5. Tanh Fit Parameters for Charpy Impact Lateral Expansion Data
(SA, A508-2)

KEY	J	A	B	T0	C	PH1	VAR
22182	3	39.61	35.88	27.79	124.60	5	60.35
22183	3	47.64	40.34	-92.67	36.83	2	41.02
22282	3	48.58	39.32	-25.52	26.95	6	46.42
22283	3	45.77	39.27	-69.96	38.16	2	8.55
22382	3	44.58	38.68	-77.14	10.95	6	119.63
22383	3	48.64	41.74	-65.57	24.14	2	13.84
22482	3	38.74	38.74	5.84	116.62	1	1.43
22483	3	45.64	40.99	-101.80	34.21	2	3.09
221182	3	37.11	36.11	8.39	98.31	7	119.12
221183	3	50.62	41.61	-3.26	73.21	2	23.48

Table 8.6. Deviation of Charpy Impact Lateral Expansion Curve Fit Parameters from Mean Values (SA, A508-2)

A

TOTAL	446.93
MEAN	44.693
ST. DEV	4.65890088

KEY	VAL	DEV	NORMALIZED DEV
22182	39.61	-5.08	-1.09
22183	47.64	2.95	0.63
22282	48.58	3.89	0.83
22283	45.77	1.08	0.23
22382	44.58	-0.11	-0.02
22383	48.64	3.95	0.85
22482	38.74	-5.95	-1.28
22483	45.64	0.95	0.20
221182	37.11	-7.58	-1.63
21183	50.62	5.93	1.27

B

TOTAL	392.68
MEAN	39.268
ST. DEV	2.049090855

KEY	VAL	DEV	NORMALIZED DEV
22182	35.88	-3.39	-1.65
22183	40.34	1.07	0.52
22282	39.32	0.05	0.03
22283	39.27	0.00	0.00
22382	38.68	-0.59	-0.29
22383	41.74	2.47	1.21
22482	38.74	-0.53	-0.26
22483	40.99	1.72	0.84
221182	36.11	-3.16	-1.54
21183	41.61	2.34	1.14

Table 8.6. (continued)

<u>T₀</u>			
TOTAL	-393.9		
MEAN	-39.39		
ST. DEV	47.27970413		
KEY	VAL	DEV	NORMALIZED DEV
22182	27.79	67.18	1.42
22183	-92.67	-53.28	-1.13
22282	-25.52	13.87	0.29
22283	-69.96	-30.57	-0.65
22382	-77.14	-37.75	-0.80
22383	-65.57	-26.18	-0.55
22482	5.84	45.23	0.96
22483	-101.80	-62.41	-1.32
221182	8.39	47.78	1.01
221183	-3.26	36.13	0.76

<u>C</u>			
TOTAL	583.98		
MEAN	58.398		
ST. DEV	41.44418437		
KEY	VAL	DEV	NORMALIZED DEV
22182	124.60	66.20	1.60
22183	36.83	-21.57	-0.52
22282	26.95	-31.45	-0.76
22283	38.16	-20.24	-0.49
22382	10.95	-47.45	-1.14
22383	24.14	-34.26	-0.83
22482	116.62	58.22	1.40
22483	34.21	-24.19	-0.58
221182	98.31	39.91	0.96
221183	73.21	14.81	0.36

Table 8.6. (continued)

PHI

TOTAL	35
MEAN	3.5
ST. DEV	2.223610677

KEY	VAL	DEV	NORMALIZED DEV
22182	5.00	1.50	0.67
22183	2.00	-1.50	-0.67
22282	6.00	2.50	1.12
22283	2.00	-1.50	-0.67
22382	6.00	2.50	1.12
22383	2.00	-1.50	-0.67
22482	1.00	-2.50	-1.12
22483	2.00	-1.50	-0.67
221182	7.00	3.50	1.57
221183	2.00	-1.50	-0.67

VARIANCE

TOTAL	428.93
MEAN	42.893
ST. DEV	45.13824150

KEY	VAL	DEV	NORMALIZED DEV
22182	60.35	17.46	0.39
22183	41.02	-1.87	-0.04
22282	46.42	3.53	0.08
22283	0.55	-42.34	-0.94
22382	119.63	76.74	1.70
22383	13.84	-29.05	-0.64
22482	1.43	-41.46	-0.92
22483	3.09	-39.80	-0.88
221182	119.12	76.23	1.69
221183	23.48	-19.41	-0.43

Table 8.7. Tanh Fit Parameters for Charpy Impact Percent Shear Data (SA, A508-2)

KEY	J	A	B	T0	C	PHI	VAR
22182	4	51.47	50.60	45.98	114.11	4	177.44
22183	4	50.34	47.58	-65.08	22.15	2	6.66
22282	4	51.48	46.78	-28.66	44.26	6	14.79
22283	4	53.49	45.49	-40.04	43.73	2	10.29
22382	4	47.46	47.46	-54.27	41.51	6	120.05
22383	4	50.05	46.26	-53.87	17.88	2	16.12
22482	4	50.06	47.34	39.02	51.76	5	653.93
22483	4	49.60	45.61	-86.37	22.63	1	94.60
221182	4	51.46	49.00	29.19	49.33	11	157.01
221183	4	52.18	50.30	34.52	108.70	2	191.59

Table 8.8. Deviation of Charpy Impact Percent Shear Curve Fit Parameters from Mean Values (SA, A508-2)

<u>A</u>			
TOTAL	507.59		
MEAN	50.759		
ST. DEV	1.646136554		
KEY	VAL	DEV	NORMALIZED DEV
22182	51.47	0.71	0.43
22183	50.34	-0.42	-0.25
22282	51.48	0.72	0.44
22283	53.49	2.73	1.66
22382	47.46	-3.30	-2.00
22383	50.05	-0.71	-0.43
22482	50.06	-0.70	-0.42
22483	49.60	-1.16	-0.70
221182	51.46	0.70	0.43
221183	52.18	1.42	0.86

Table 8.8.(continued)

B

TOTAL	477.92
MEAN	47.792
ST. DEV	1.633304762

KEY	VAL	DEV	NORMALIZED DEV
22182	50.60	2.81	1.72
22183	47.58	-0.21	-0.13
22282	46.78	-1.01	-0.62
22283	45.99	-1.80	-1.10
22382	47.46	-0.33	-0.20
22383	46.26	-1.53	-0.94
22482	47.34	-0.45	-0.28
22483	46.61	-1.18	-0.72
221182	49.00	1.21	0.74
221183	50.30	2.51	1.54

T₀

TOTAL	-171.58
MEAN	-17.158
ST. DEV	49.78717814

KEY	VAL	DEV	NORMALIZED DEV
22182	45.98	63.14	1.27
22183	-65.08	-47.92	-0.96
22282	-20.66	-3.50	-0.07
22283	-40.04	-22.88	-0.46
22382	-54.27	-37.11	-0.75
22383	-53.87	-36.71	-0.74
22482	39.02	56.18	1.13
22483	-86.37	-69.21	-1.39
221182	29.19	46.35	0.93
221183	34.52	51.68	1.04

Table 8.8. (continued)

C

TOTAL	516.06
MEAN	51.606
ST. DEV	33.72158992

KEY	VAL	DEV	NORMALIZED DEV
22182	114.11	62.50	1.85
22183	22.15	-29.46	-0.87
22282	44.26	-7.35	-0.22
22283	43.73	-7.88	-0.23
22382	41.51	-10.10	-0.30
22383	17.88	-33.73	-1.00
22482	51.76	0.15	0.00
22483	22.63	-28.98	-0.86
221182	49.33	-2.28	-0.07
221183	108.70	57.09	1.69

PHI

TOTAL	42
MEAN	4.2
ST. DEV	2.936362073

KEY	VAL	DEV	NORMALIZED DEV
22182	4.00	-0.20	-0.07
22183	2.00	-2.20	-0.75
22282	6.00	1.80	0.61
22283	2.00	-2.20	-0.75
22382	6.00	1.80	0.61
22383	2.00	-2.20	-0.75
22482	5.00	0.80	0.27
22483	2.00	-2.20	-0.75
221182	11.00	6.80	2.32
21183	2.00	-2.20	-0.75

Table 8.8. (continued)

<u>VARIANCE</u>			
TOTAL	1442.49		
MEAN	144.249		
ST. DEV	193.3277294		
KEY	VAL	DEV	NORMALIZED DEV
22182	177.44	33.19	0.17
22183	6.68	-137.57	-0.71
22282	14.78	-129.47	-0.67
22283	10.29	-133.96	-0.69
22382	120.05	-24.20	-0.13
22383	16.12	-128.13	-0.66
22482	653.93	509.68	2.64
22483	94.60	-49.65	-0.26
221182	157.01	12.76	0.07
221183	191.59	47.34	0.24

Table 8.9. Comparison of $T_0 - C$ from Impact Test Measurements with RT_{NDT} and NDTT (SA, A508-2)

<u>KEY</u>	<u>$T_0 - C$ ($^{\circ}F$)</u>				<u>RT_{NDT} ($^{\circ}F$)</u>	<u>NDTT ($^{\circ}F$)</u>
	<u>IMPACT ENERGY</u>	<u>LATERAL EXPANSION</u>	<u>PERCENT SHEAR</u>			
22182	-150	-97	-68		15	-30
22183	-122	-130	-87			
22282	-80	-52	-65		-80	-80
22283	-130	-108	-84			
22382	-134	-88	-96		-60	-60
22383	-127	-90	-72			
22482	-134	-111	-13		0	0
22483	-125	-136	-109			
221182	-53	-90	-20		0	-50
221183	-53	-76	-74			

Table 8.10. Tanh Fit Parameters for Precracked Charpy Toughness Data
(SA, A508-2)

KEY	J	A	B	T0	C	PHI	VAR
32182	2	133.03	82.75	58.38	1.51	5	154.26
32282	2	149.41	104.18	-7.48	10.55	6	787.91
32382	2	162.02	112.02	-40.06	9.67	6	127.02
32482	2	127.35	88.61	41.46	7.41	6	238.62
321182	2	129.38	77.79	2.29	41.91	4	1620.16

Table 8.11. Deviation of Precracked Charpy Fracture Toughness Curve Fit Parameters
from Mean Values (SA, A508-2)

<u>A</u>			
TOTAL	701.19		
MEAN	140.238		
ST. DEV	14.95437294		
KEY	VAL	DEV	NORMALIZED DEV
32182	133.03	-7.21	-0.48
32282	149.41	9.17	0.61
32382	162.02	21.78	1.46
32482	127.35	-12.89	-0.86
321182	129.38	-10.86	-0.73

Table 8.11. (continued)

B

TOTAL	466.15
MEAN	93.23
ST. DEV	14.77530880

KEY	VAL	DEV	NORMALIZED DEV
32182	82.75	-10.48	-0.71
32282	104.18	10.95	0.74
32382	112.82	19.59	1.33
32482	88.61	-4.62	-0.31
321182	77.79	-15.44	-1.04

T₀

TOTAL	54.56
MEAN	10.912
ST. DEV	39.35514160

KEY	VAL	DEV	NORMALIZED DEV
32182	58.38	47.47	1.21
32282	-7.48	-18.39	-0.47
32382	-40.06	-50.97	-1.30
32482	41.43	30.52	0.78
321182	2.29	-8.62	-0.22

Table 8.11. (continued)

C

TOTAL	71.05
MEAN	14.21
ST. DEV	15.88102012

KEY	VAL	DEV	NORMALIZED DEV
32182	1.51	-12.70	-0.80
32282	10.55	-3.66	-0.23
32382	9.67	-4.54	-0.29
32482	7.41	-6.80	-0.43
21182	41.91	27.70	1.74

PHI

TOTAL	27
MEAN	5.4
ST. DEV	0.894427191

KEY	VAL	DEV	NORMALIZED DEV
32182	5.00	-0.40	-0.45
32282	6.00	0.60	0.67
32382	6.00	0.60	0.67
32482	6.00	0.60	0.67
1182	4.00	-1.40	-1.57

Table 8.13. (continued)

T₀

TOTAL	92.43
MEAN	18.486
ST. DEV	23.54187609

KEY	VAL	DEV	NORMALIZED DEV
32182	31.71	13.22	0.56
32282	29.16	10.67	0.45
32382	-20.55	-39.04	-1.66
32482	38.09	19.60	0.83
321182	14.02	-4.47	-0.19

C

TOTAL	389.44
MEAN	77.888
ST. DEV	23.06589192

KEY	VAL	DEV	NORMALIZED DEV
32182	114.46	36.57	1.59
32282	86.46	8.57	0.37
32382	67.29	-10.60	-0.46
32482	58.60	-19.29	-0.84
321182	62.63	-15.26	-0.66

Table 8.13. (continued)

PHI

TOTAL	24
MEAN	4.8
ST. DEV	0.836660027

KEY	VAL	DEV	NORMALIZED DEV
32182	4.00	-0.80	-0.96
32282	6.00	1.20	1.43
32382	5.00	0.20	0.24
32482	5.00	0.20	0.24
31182	4.00	-0.80	-0.96

VARIANCE

TOTAL	710220.3
MEAN	142044.06
ST. DEV	177437.4219

KEY	VAL	DEV	NORMALIZED DEV
32182	1.27E+05	-14790.06	-0.08
32282	4.52E+05	3.10E+05	1.75
32382	53998.00	-88046.06	-0.50
32482	27211.60	-1.15E+05	-0.65
31182	49521.70	-92522.36	-0.52

Table 8.14. Comparison of Precracked Charpy Transition Behavior with NDTT and RT_{NDT} (SA, A508-2)

<u>KEY</u>	<u>$T_0 - C (^{\circ}F)$</u>		<u>$RT_{NDT} (^{\circ}F)$</u>	<u>NDTT ($^{\circ}F$)</u>
	<u>K_{Id}, K_d^*</u>	<u>W/A</u>		
32182	57	-83	15	-30
32282	-18	-57	-80	-80
32382	-50	-88	-60	-60
32482	34	-21	0	0
321182	-40	-49	0	-50

Table 8.15. Summary of Error Code Analysis for Material 8 (SA, A508-2)

<u>TEST TYPE</u>	<u>INCLUDES ERROR CODES</u>	<u>NO. OF POINTS</u>	<u>SHELF(Ft-Lb)</u>		<u>VARIANCE</u>		<u>VARIANCE RATIO F</u>	
			<u>LOWER</u>	<u>UPPER</u>	<u>OVERALL</u>	<u>TRANSITION REGION</u>	<u>OVERALL</u>	<u>TRANSITION REGION</u>
Static (5)	Yes	25	3	--	5666	8200	0.85	1.64
	No	20	19	--	6660	4992		
Dynamic (7,8,10)	Yes	30	9	--	5664	12511	0.94	1.17
	No	25	37	--	5995	10668		

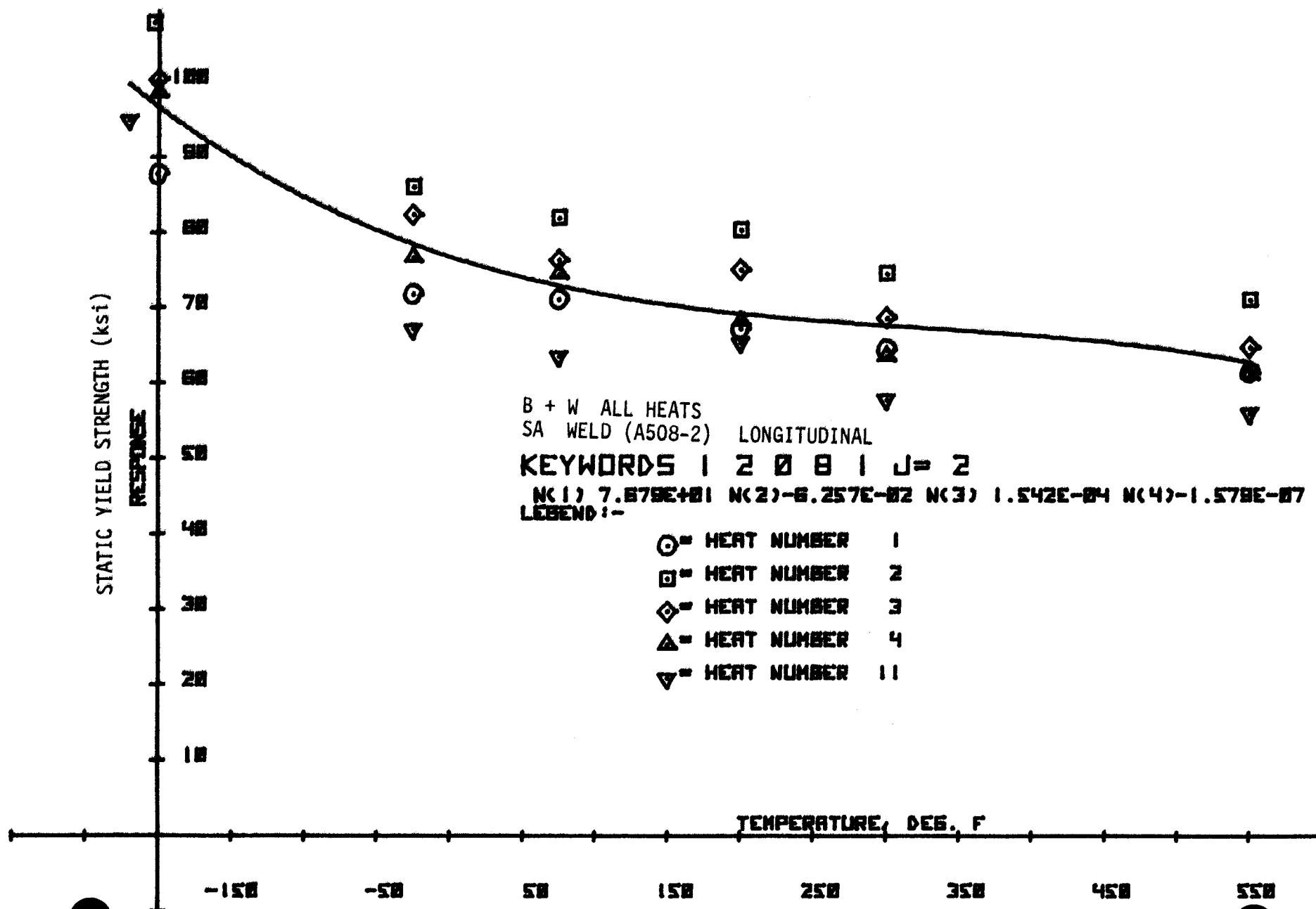


Figure 8.1. Tensile Static Yield Strength for All B&W Heats (L)

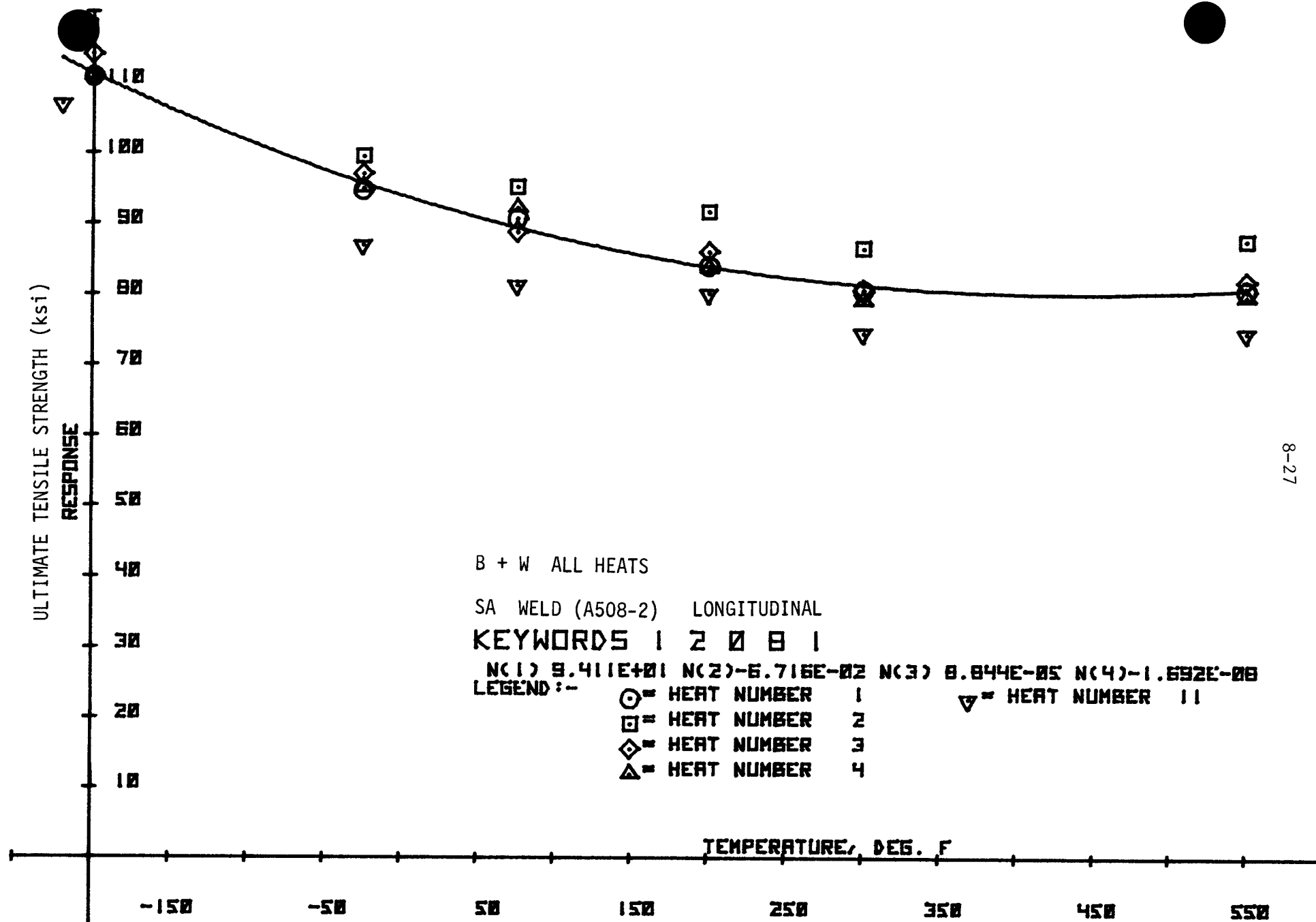


Figure 8.2. Tensile Ultimate Strength for All B&W Heats (L)

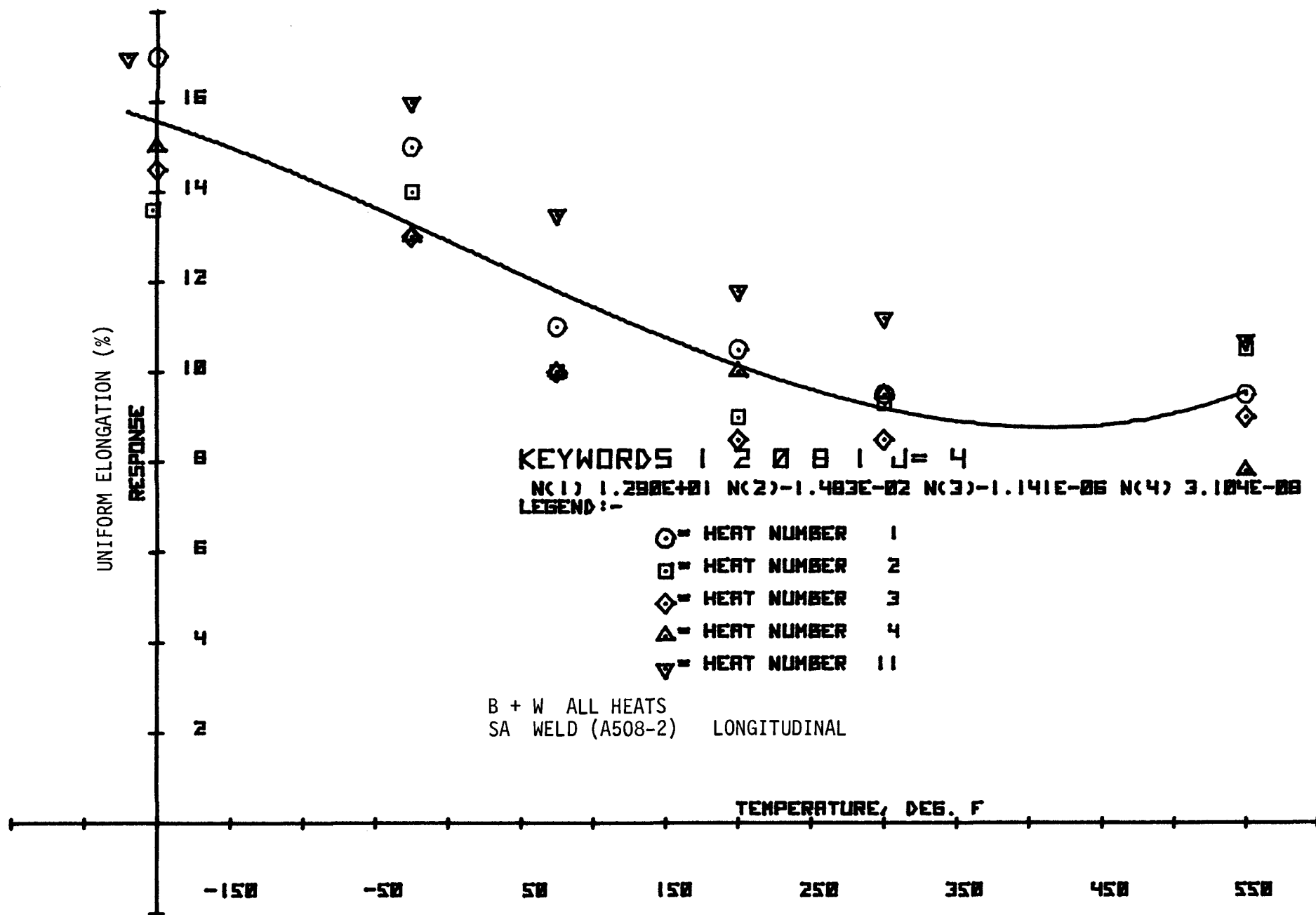


Figure 8.3. Tensile Uniform Elongation for All B&W Heats (L)

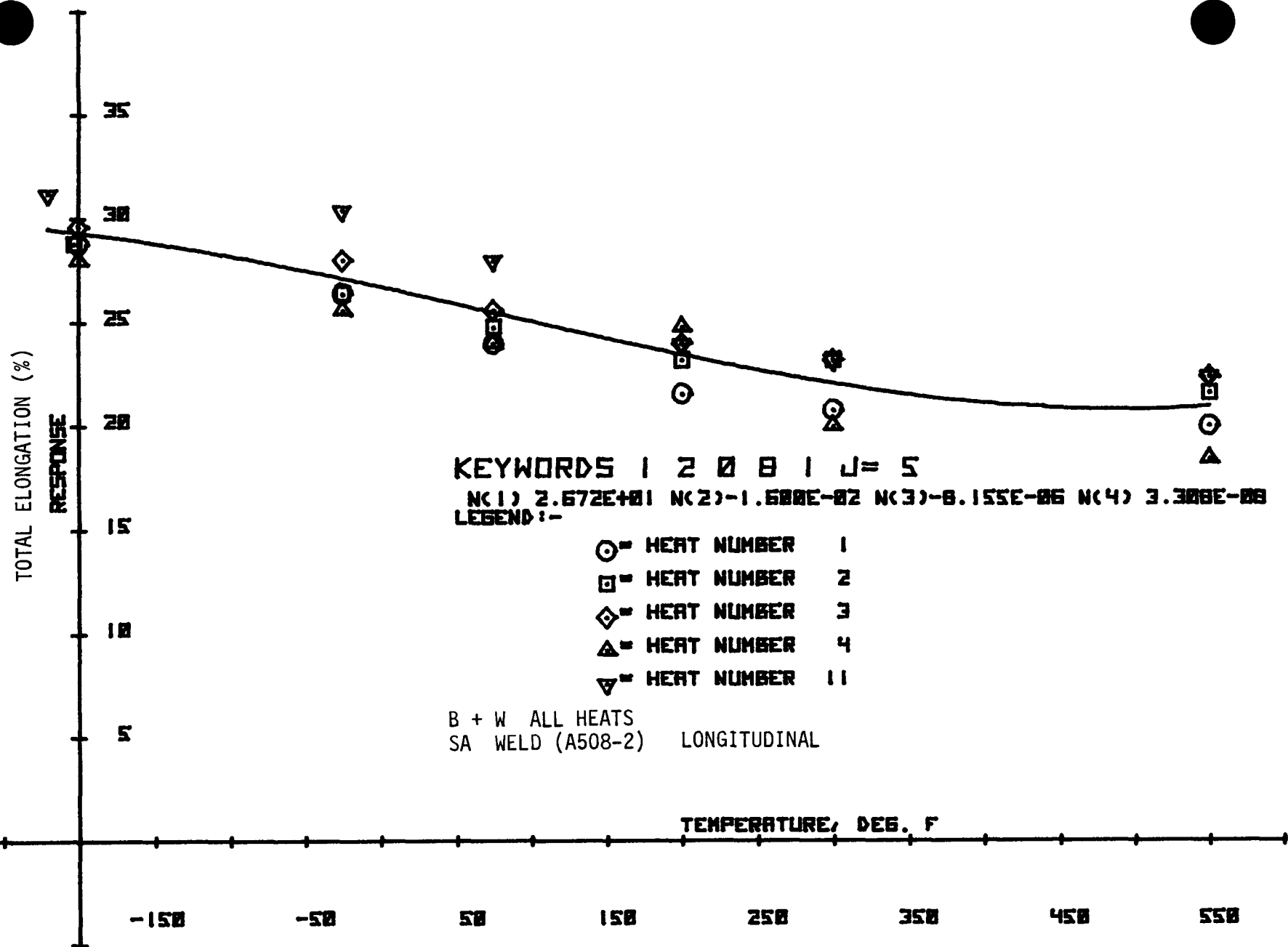


Figure 8.4. Tensile Total Elongation for All B&W Heats (L)

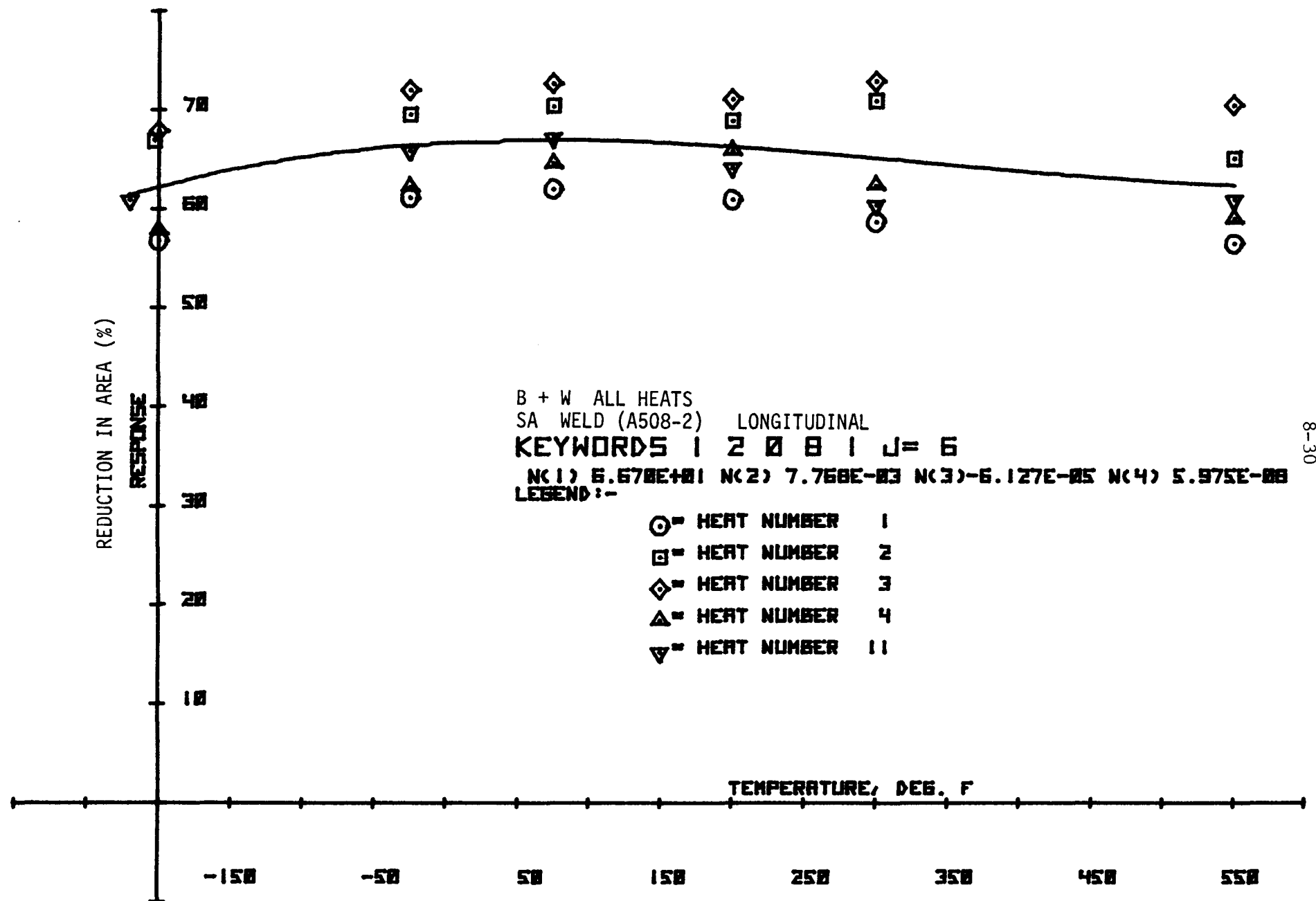


Figure 8.5. Tensile Reduction in Area for All B&W Heats (L)

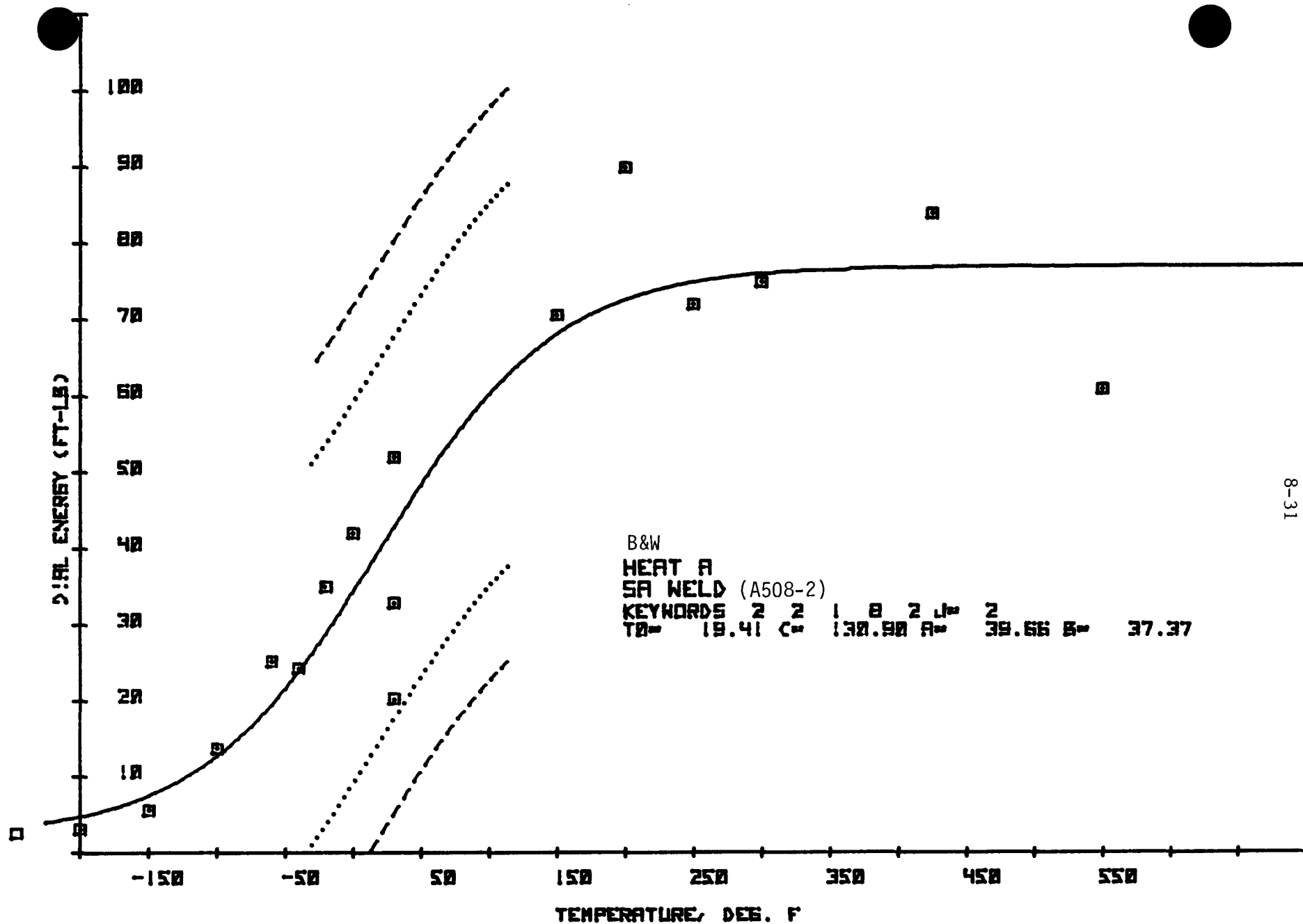


Figure 8.6. Charpy V-Notch Dial Energy for B&W Heat A

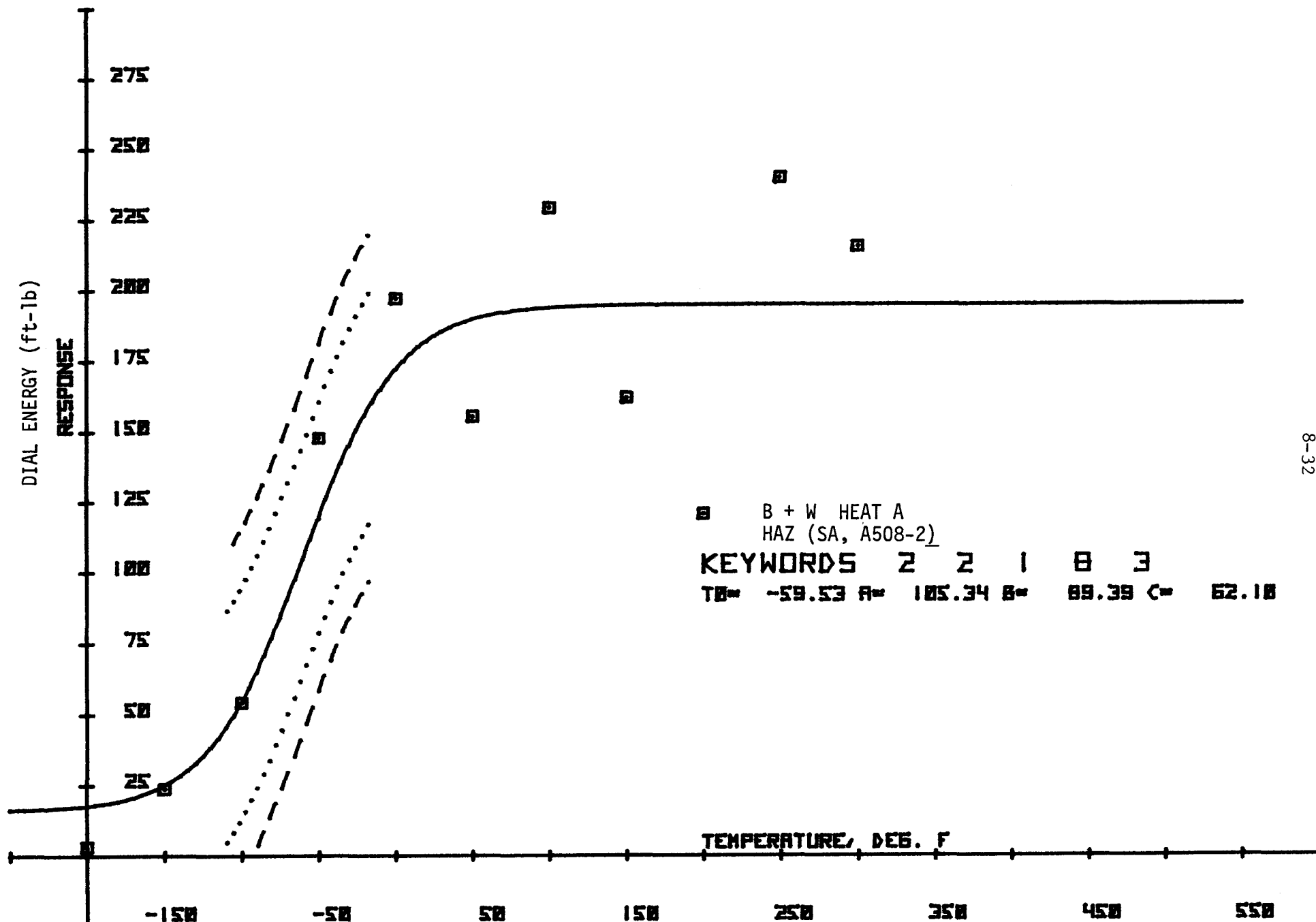


Figure 8.7. Charpy V-Notch Dial Energy for B&W Heat A (HAZ)

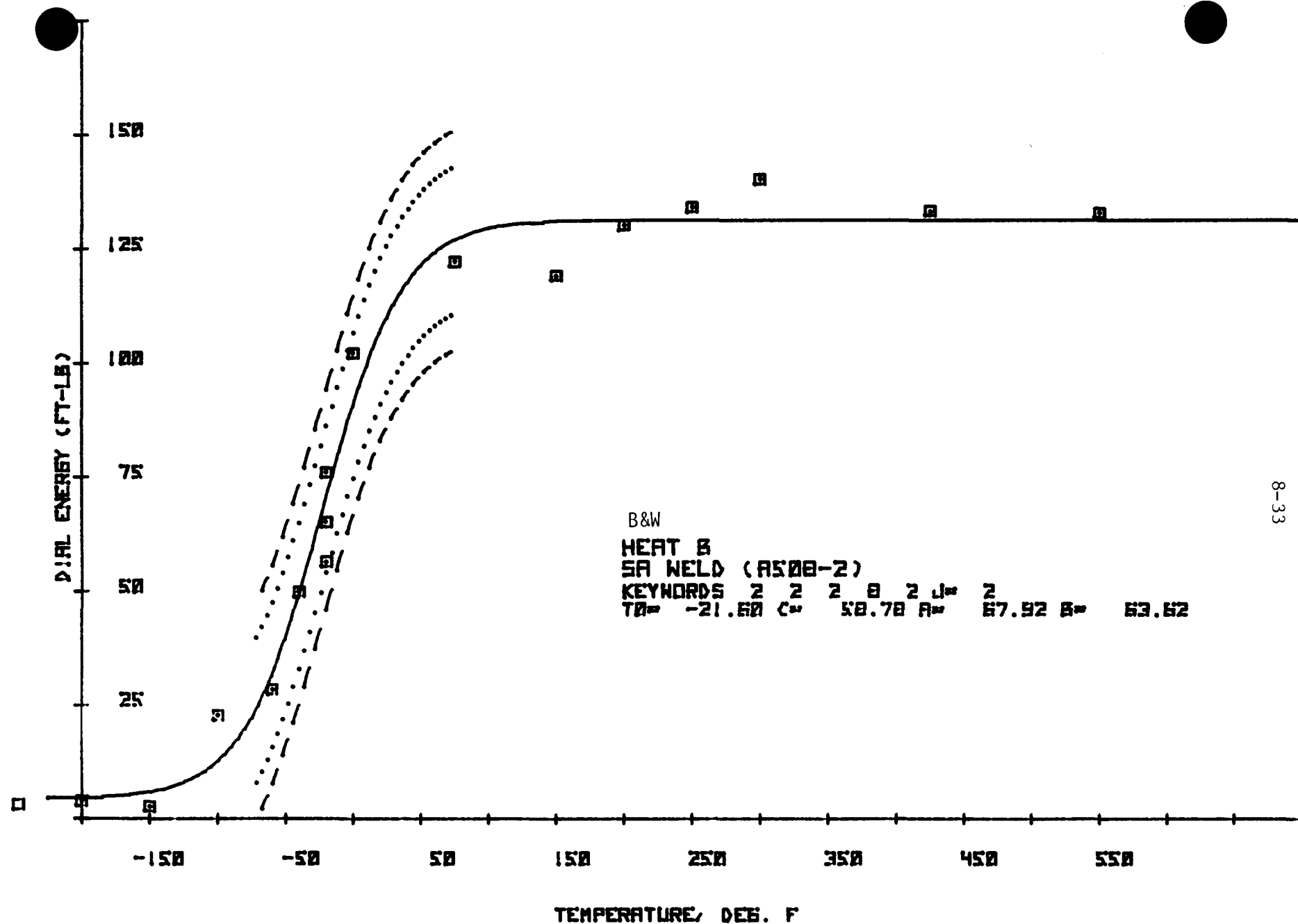
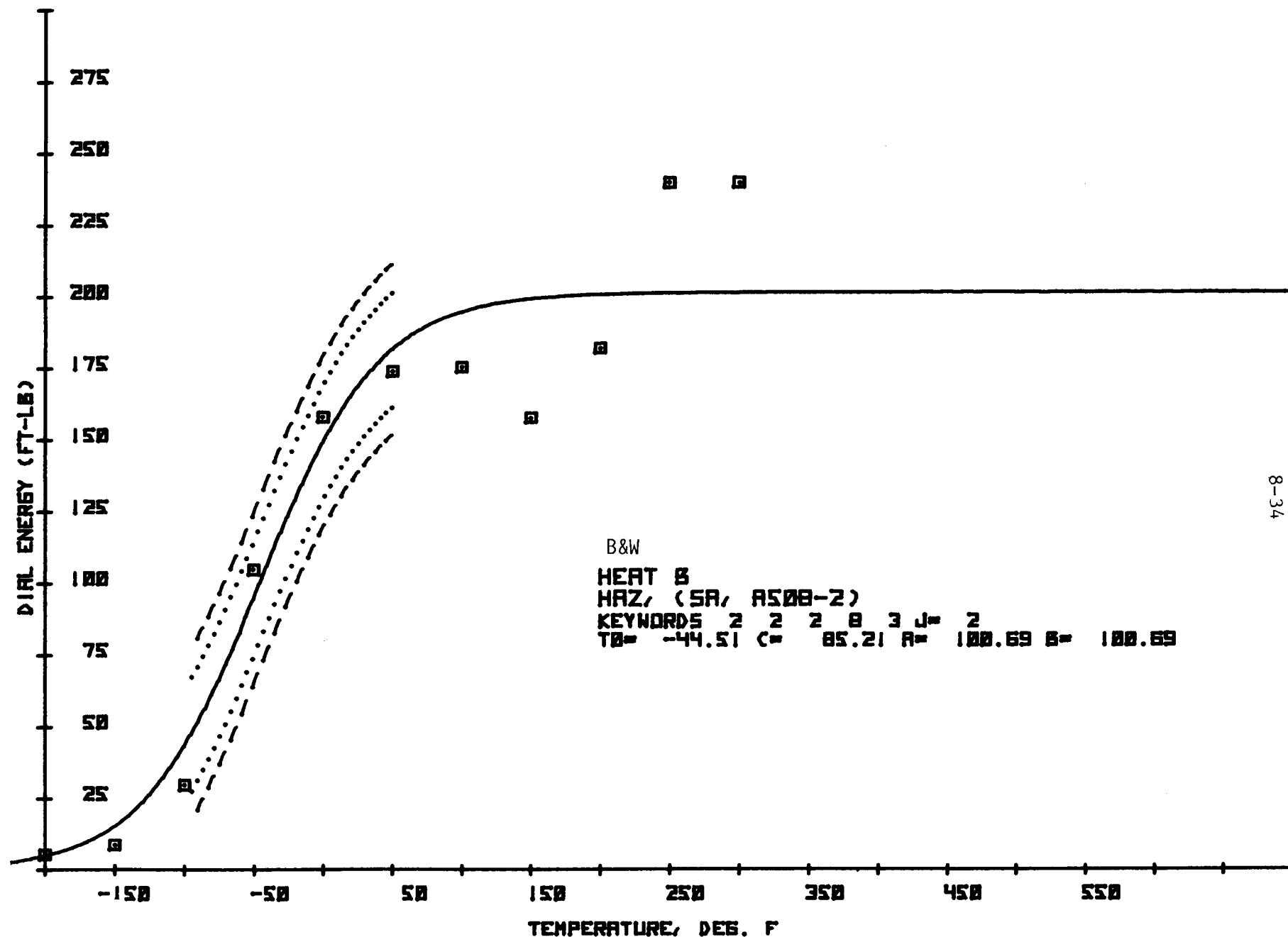


Figure 8.8. Charpy V-Notch Dial Energy for B&W Heat B



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Figure 8.9. Charpy V-Notch Dial Energy for B&W Heat B (HAZ)

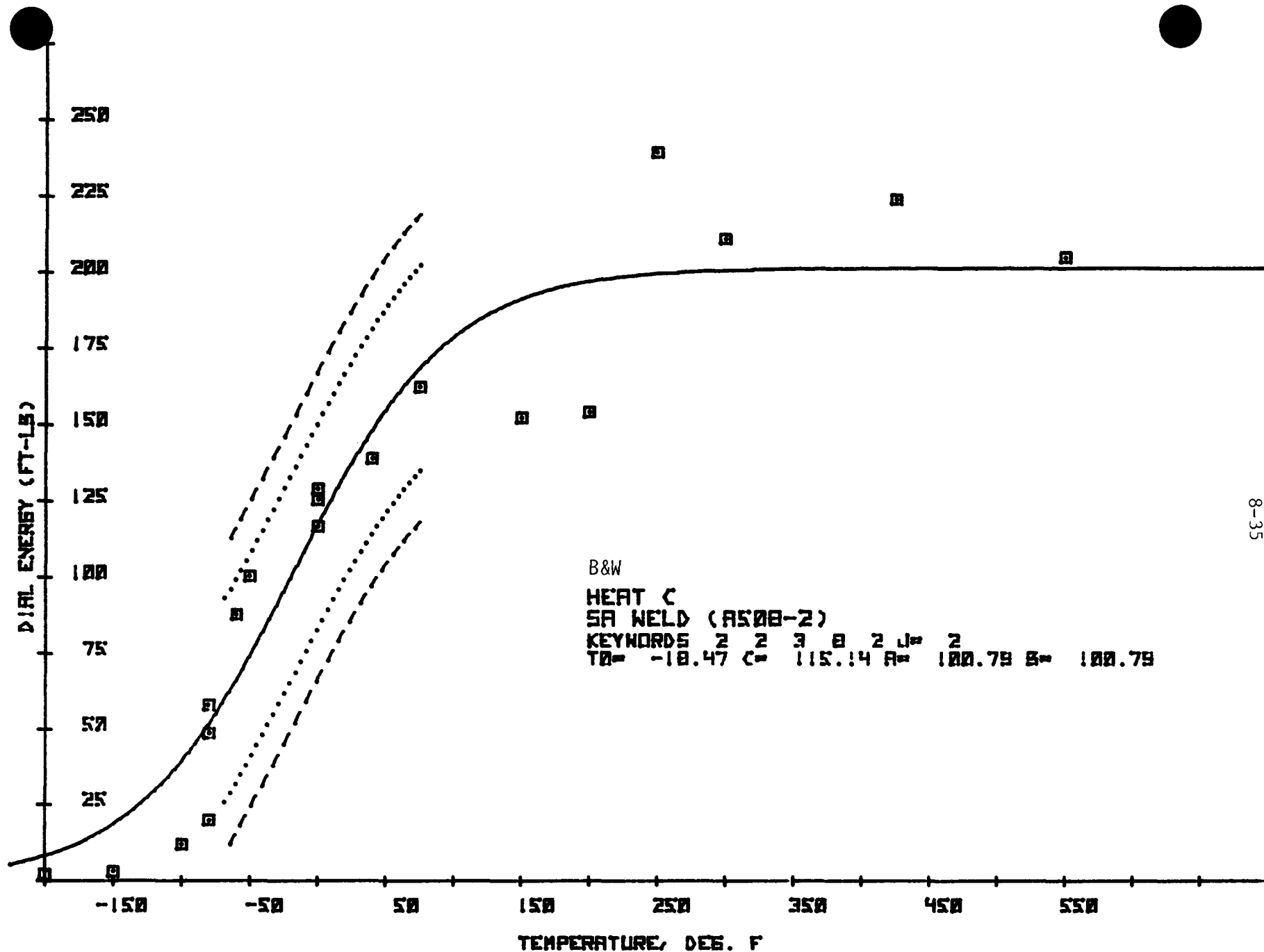


Figure 8.10. Charpy V-Notch Dial Energy for B&W Heat C

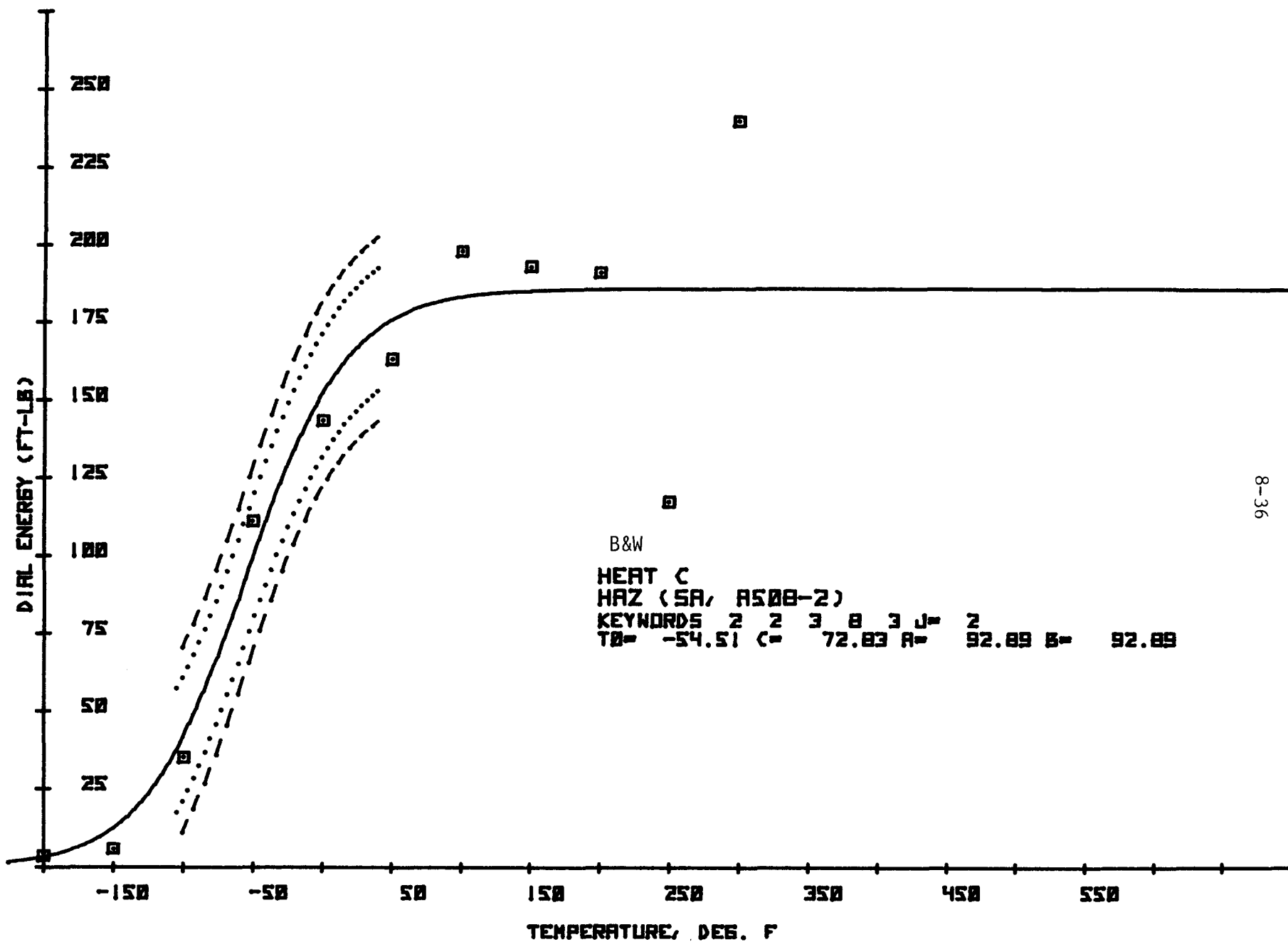


Figure 8.11. Charpy V-Notch Dial Energy for B&W Heat C (HAZ)

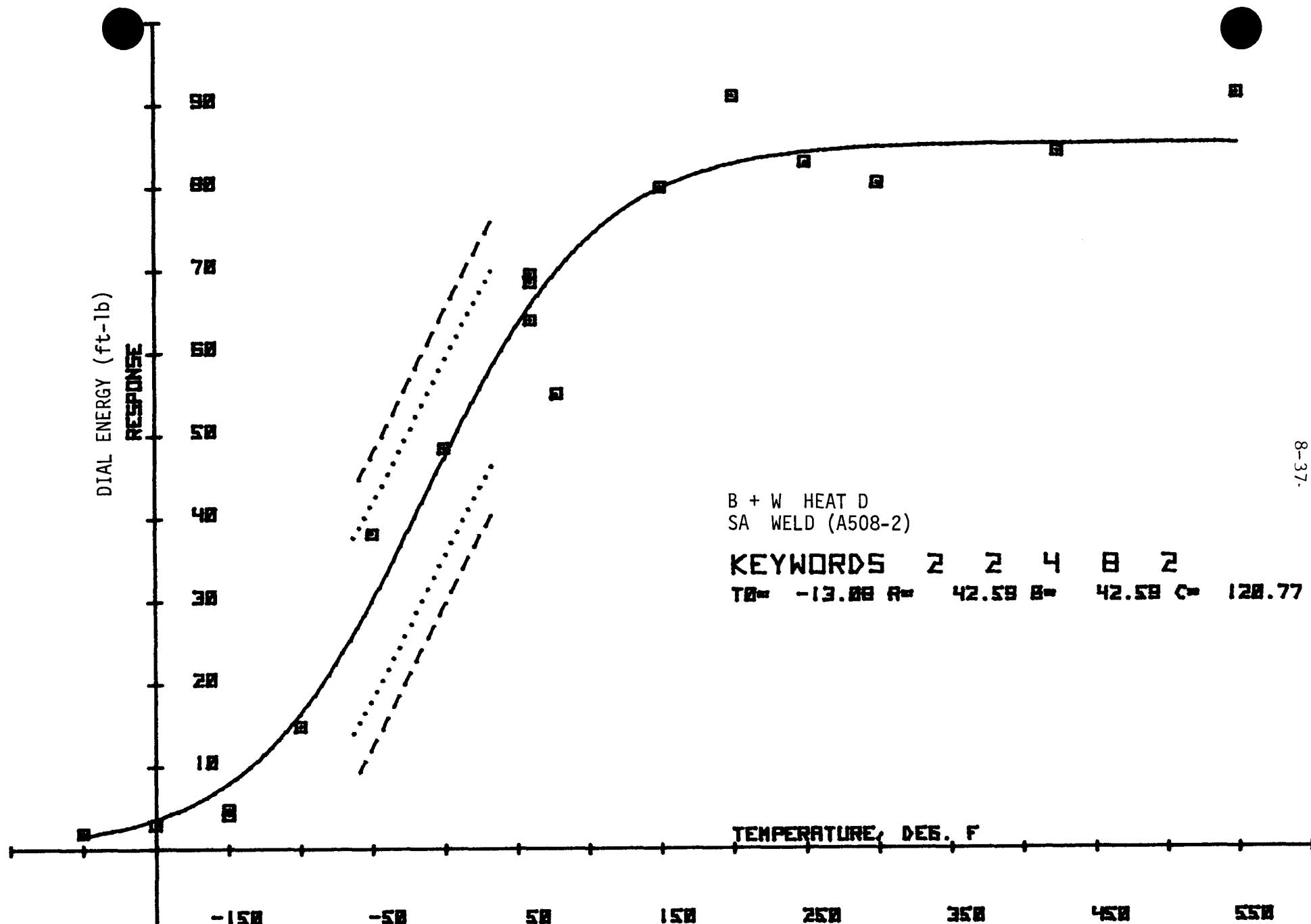


Figure 8.12. Charpy V-Notch Dial Energy for B&W Heat D

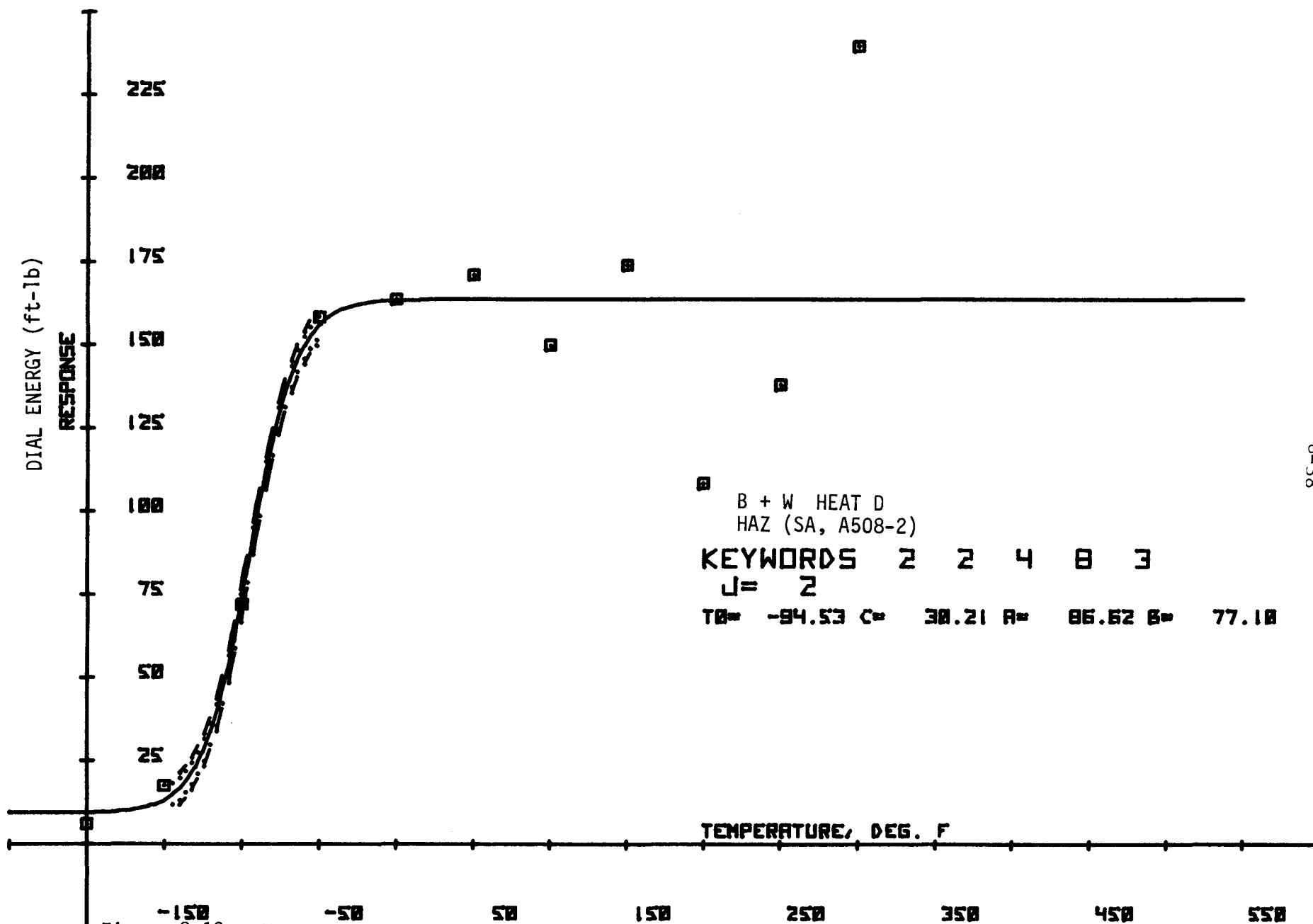


Figure 8.13. Charpy V-Notch Dial Energy for B&W Heat D (HAZ)

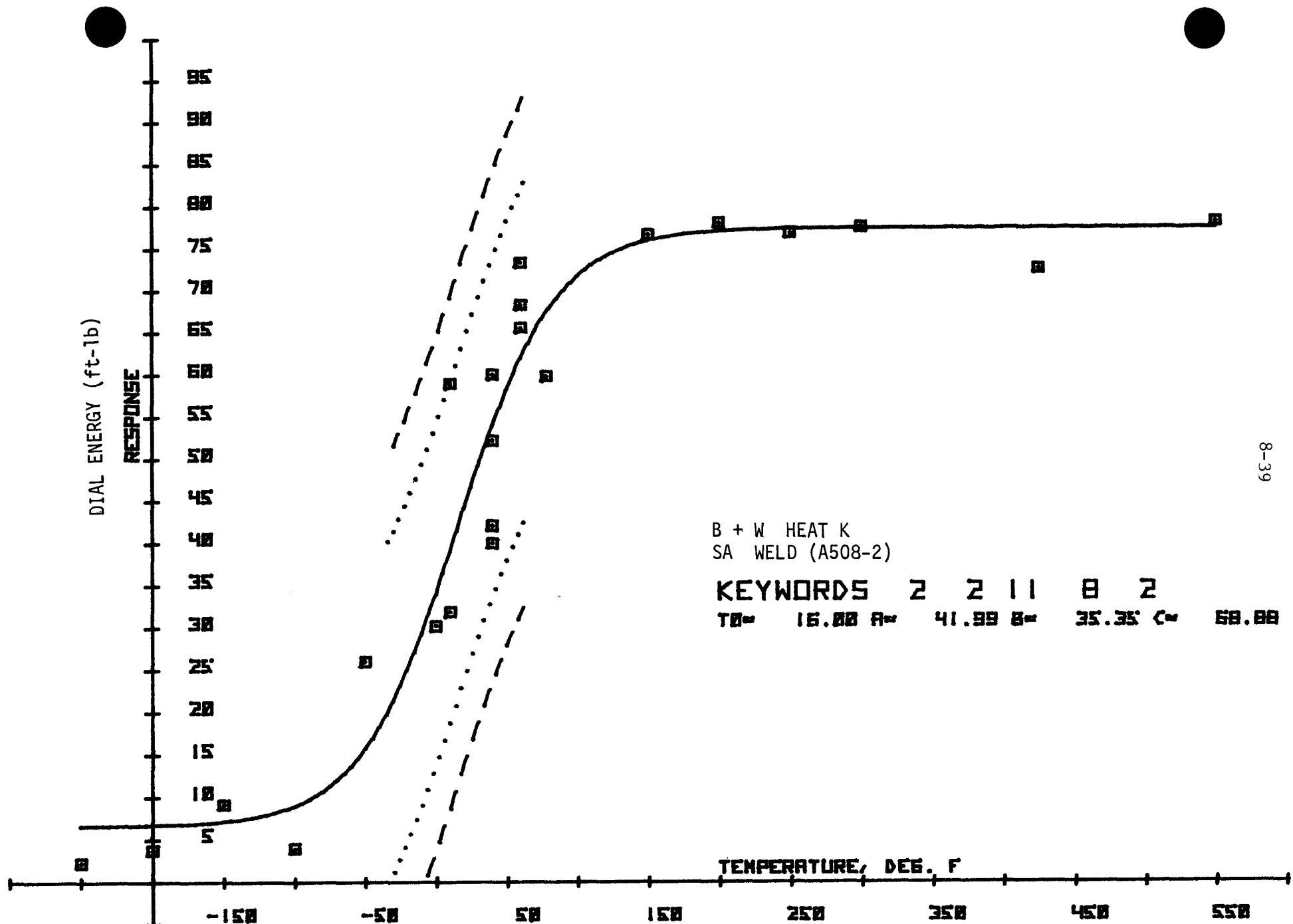
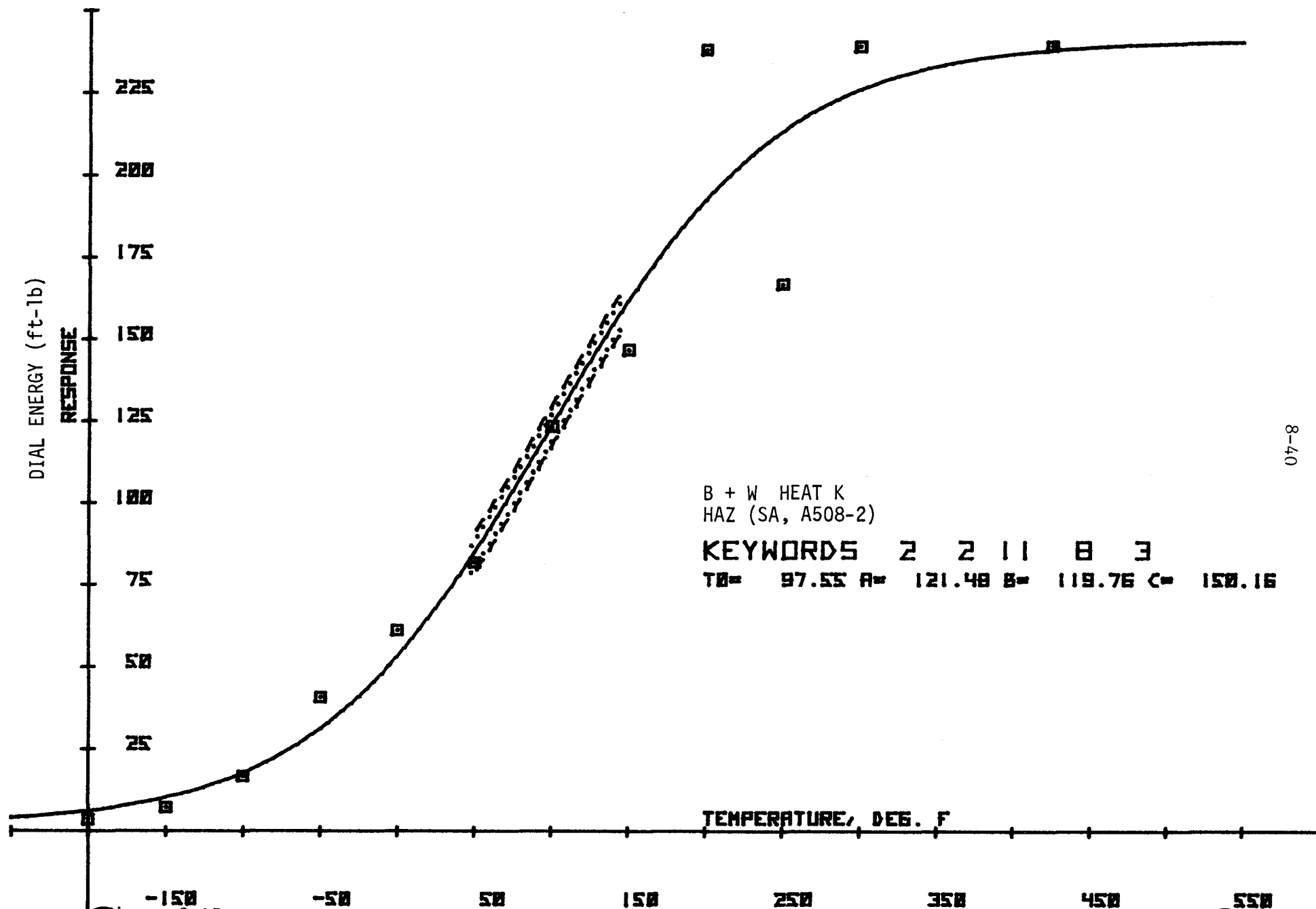


Figure 8.14. Charpy V-Notch Dial Energy for B&W Heat K



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Figure 8.15. Charpy V-Notch Dial Energy for B&W Heat K (HAZ)

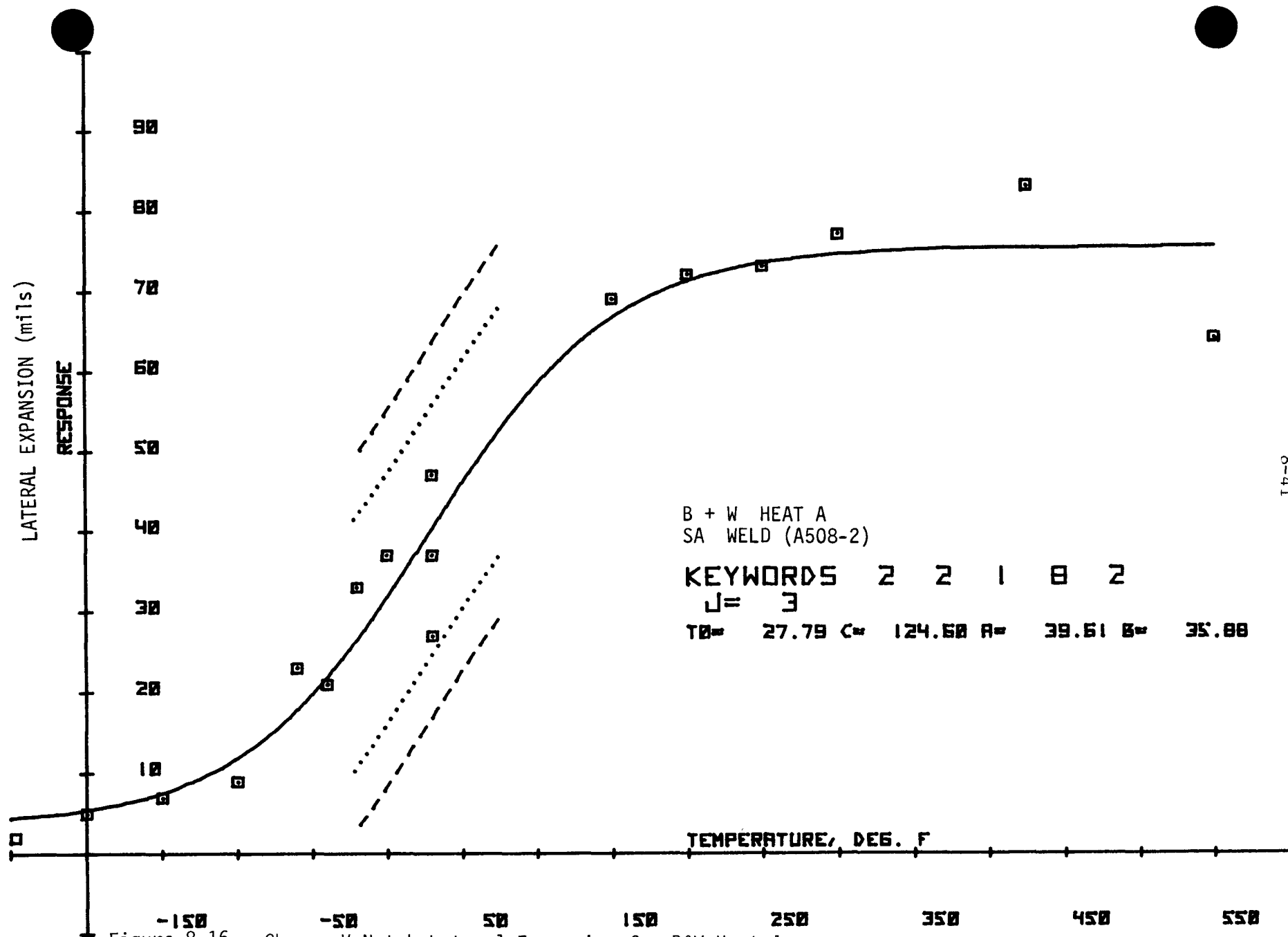


Figure 8.16. Charpy V-Notch Lateral Expansion for B&W Heat A

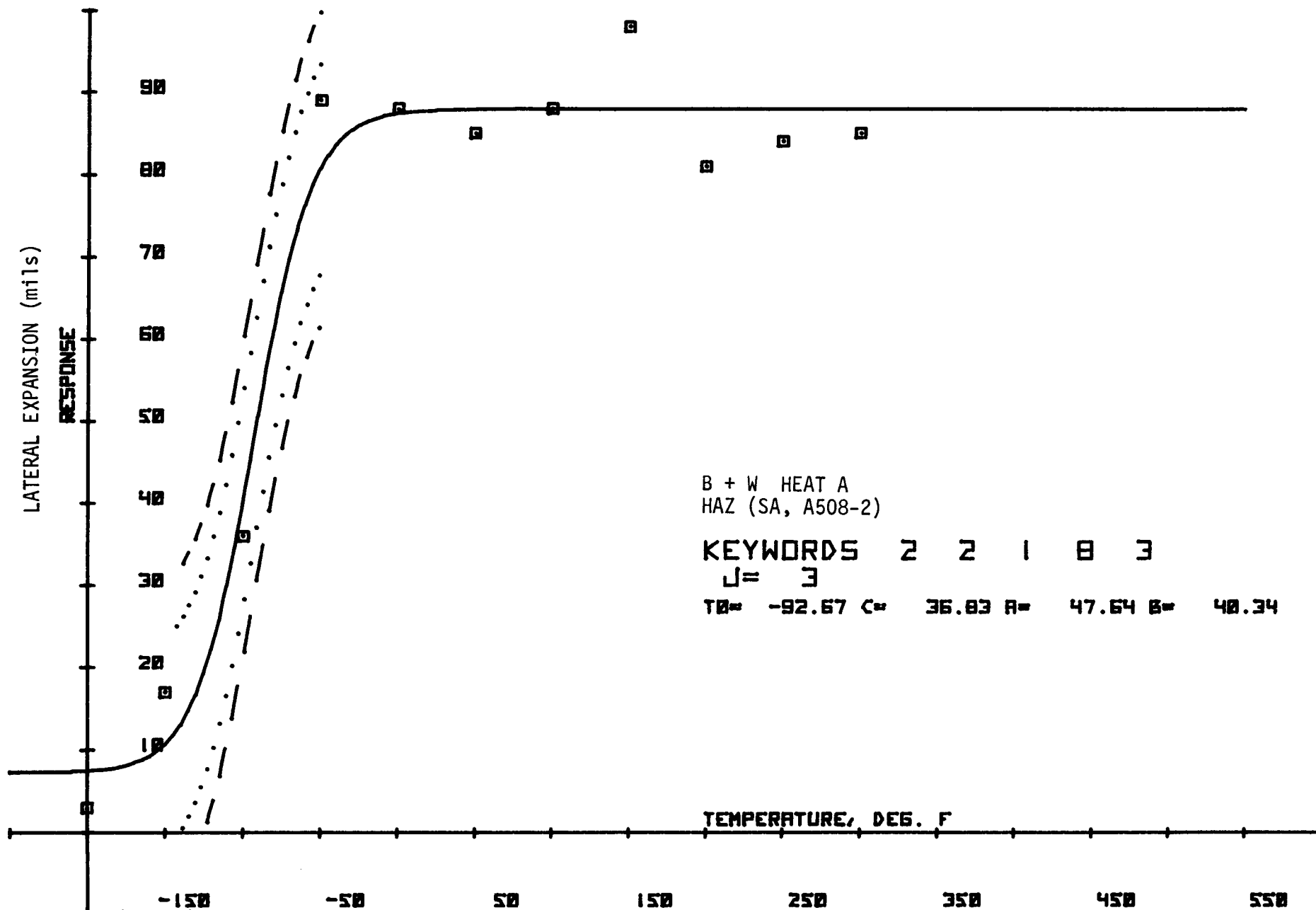


Figure 8.17. Charpy V-Notch Lateral Expansion for B&W Heat A (HAZ)

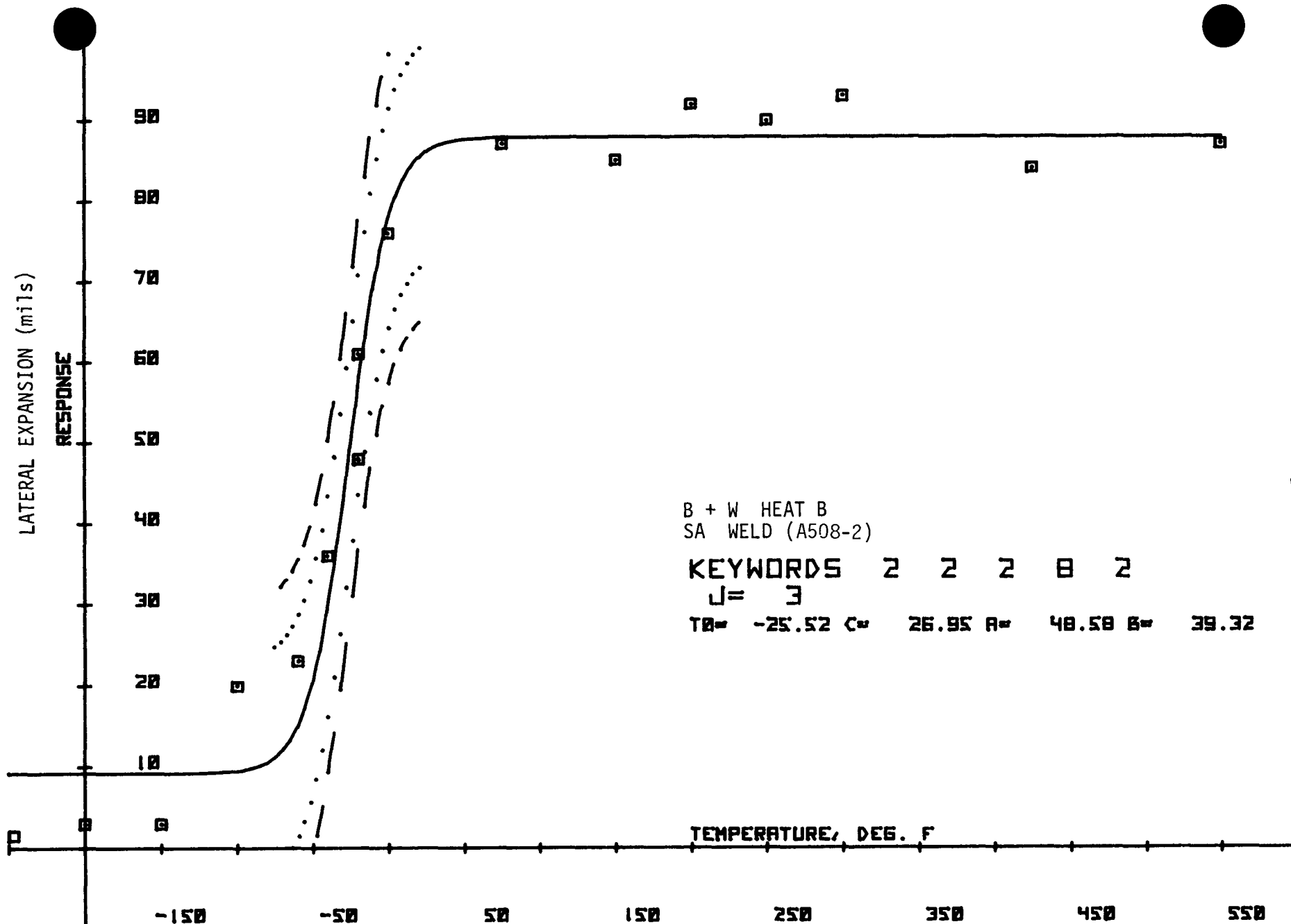


Figure 8.18. Charpy V-Notch Lateral Expansion for B&W Heat B

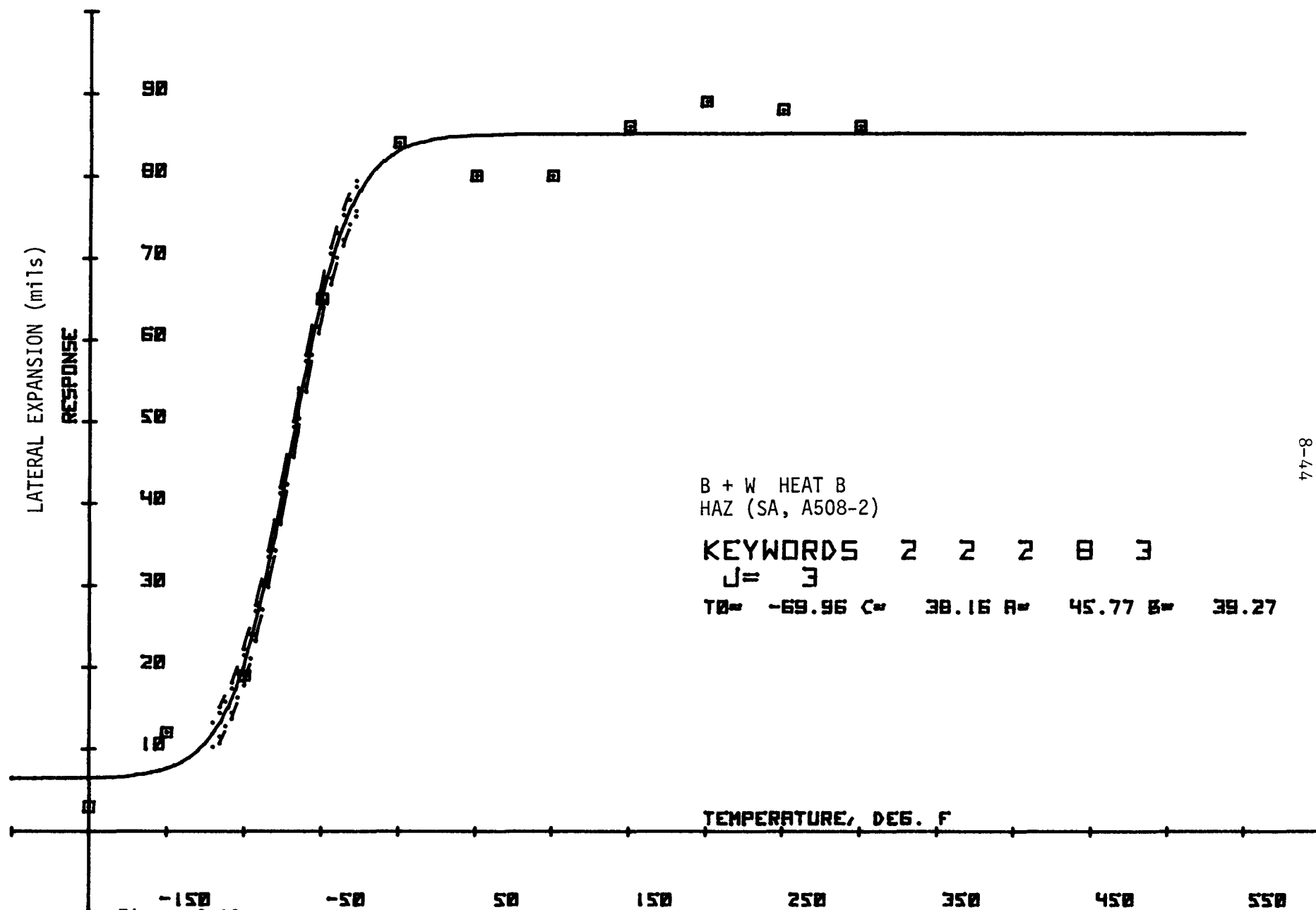


Figure 8.19. Charpy V-Notch Lateral Expansion for B&W Heat B (HAZ)

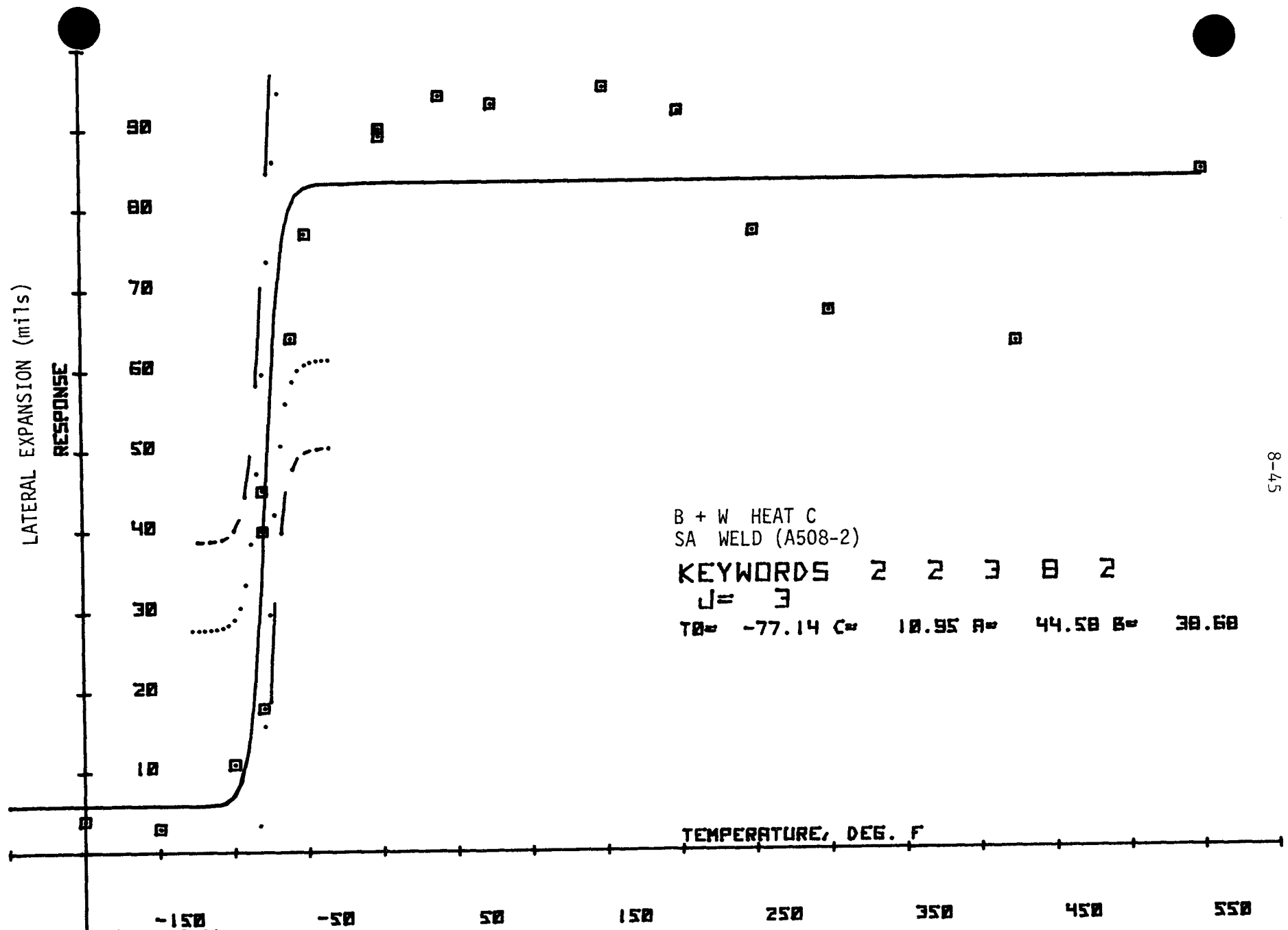


Figure 8.20. Charpy V-Notch Lateral Expansion for B&W Heat C

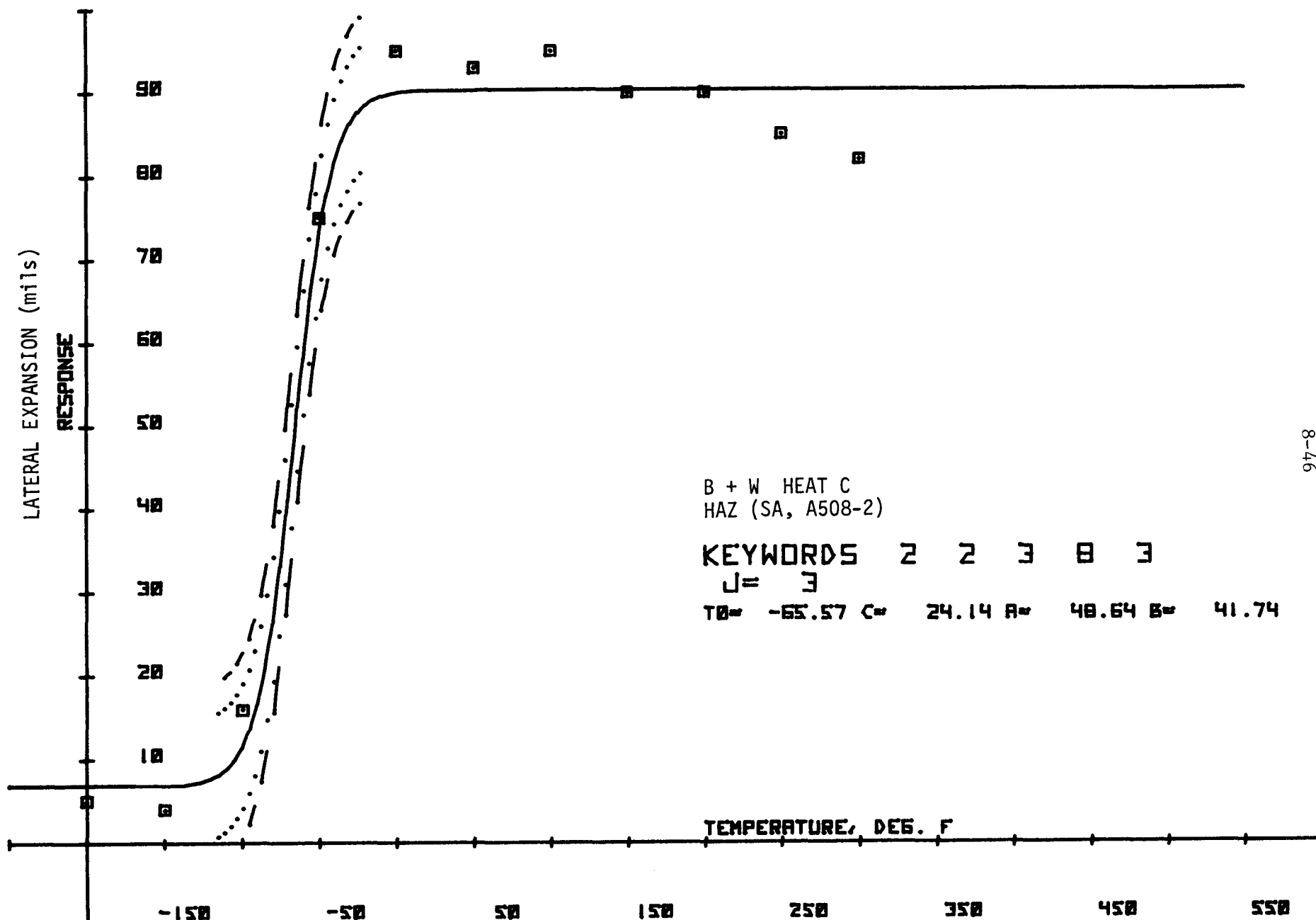


Figure 8.21. Charpy V-Notch Lateral Expansion for B&W Heat C (HAZ)

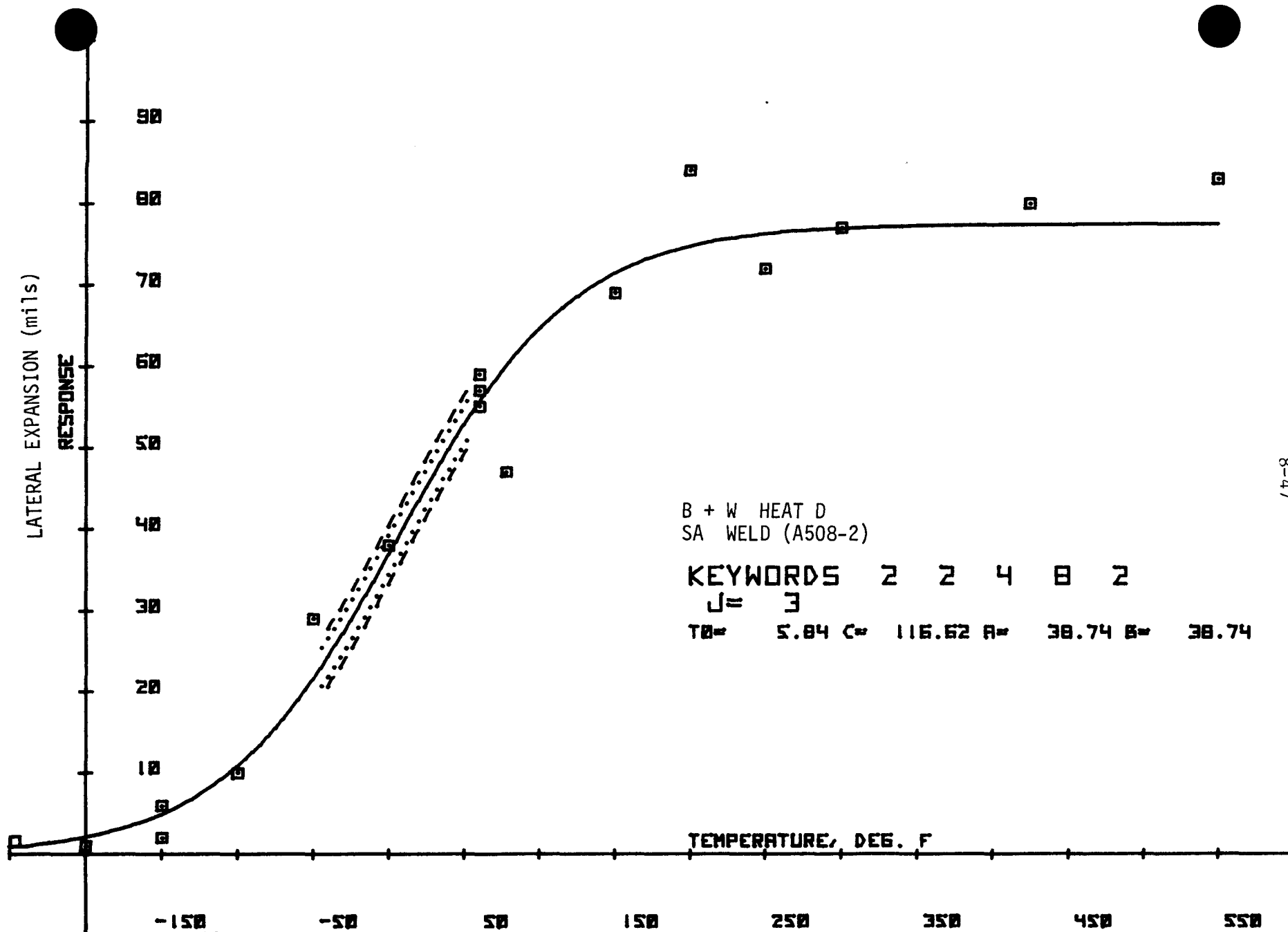


Figure 8.22. Charpy V-Notch Lateral Expansion for B&W Heat D

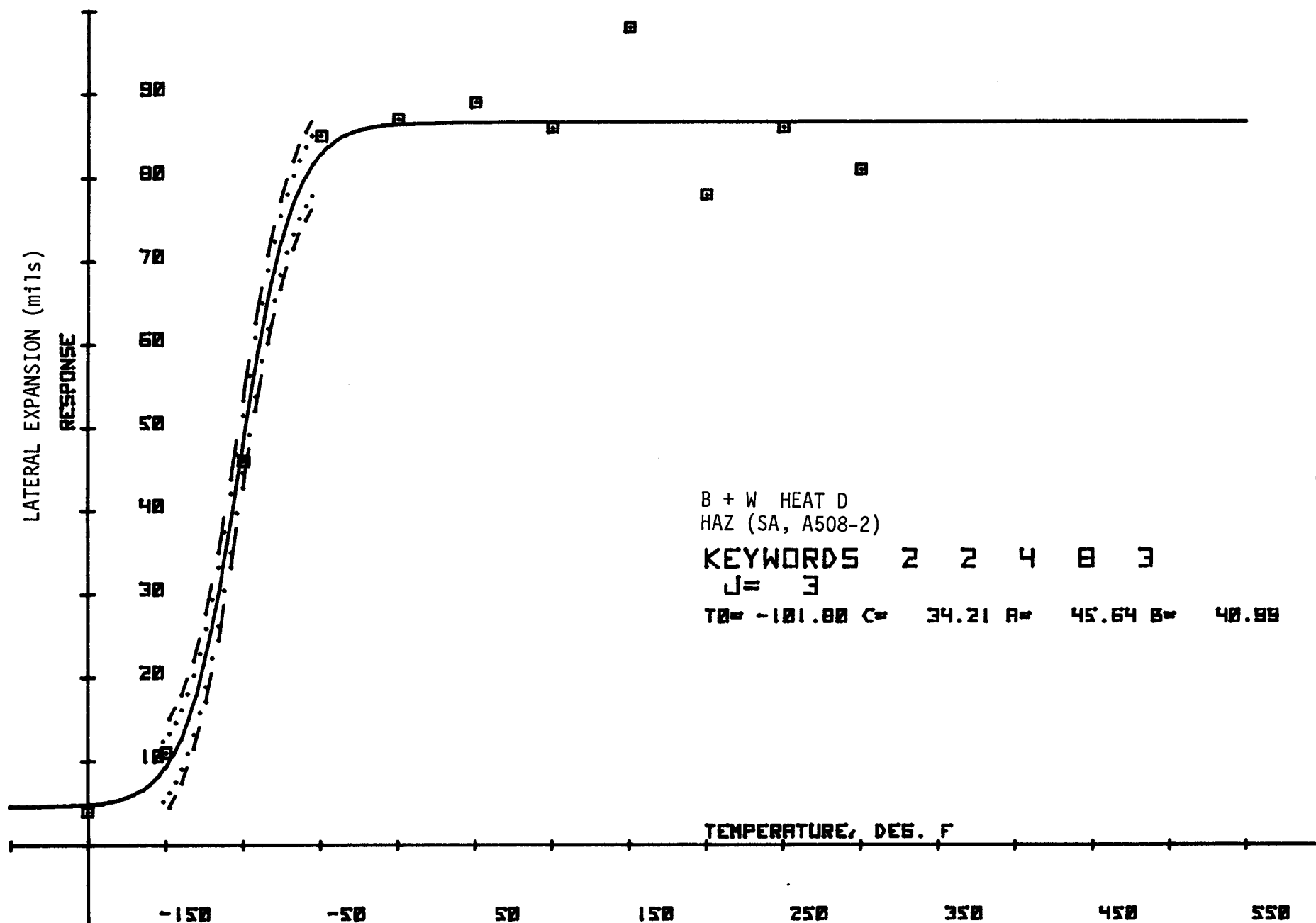


Figure 8.23. Charpy V-Notch Lateral Expansion for B&W Heat D (HAZ)

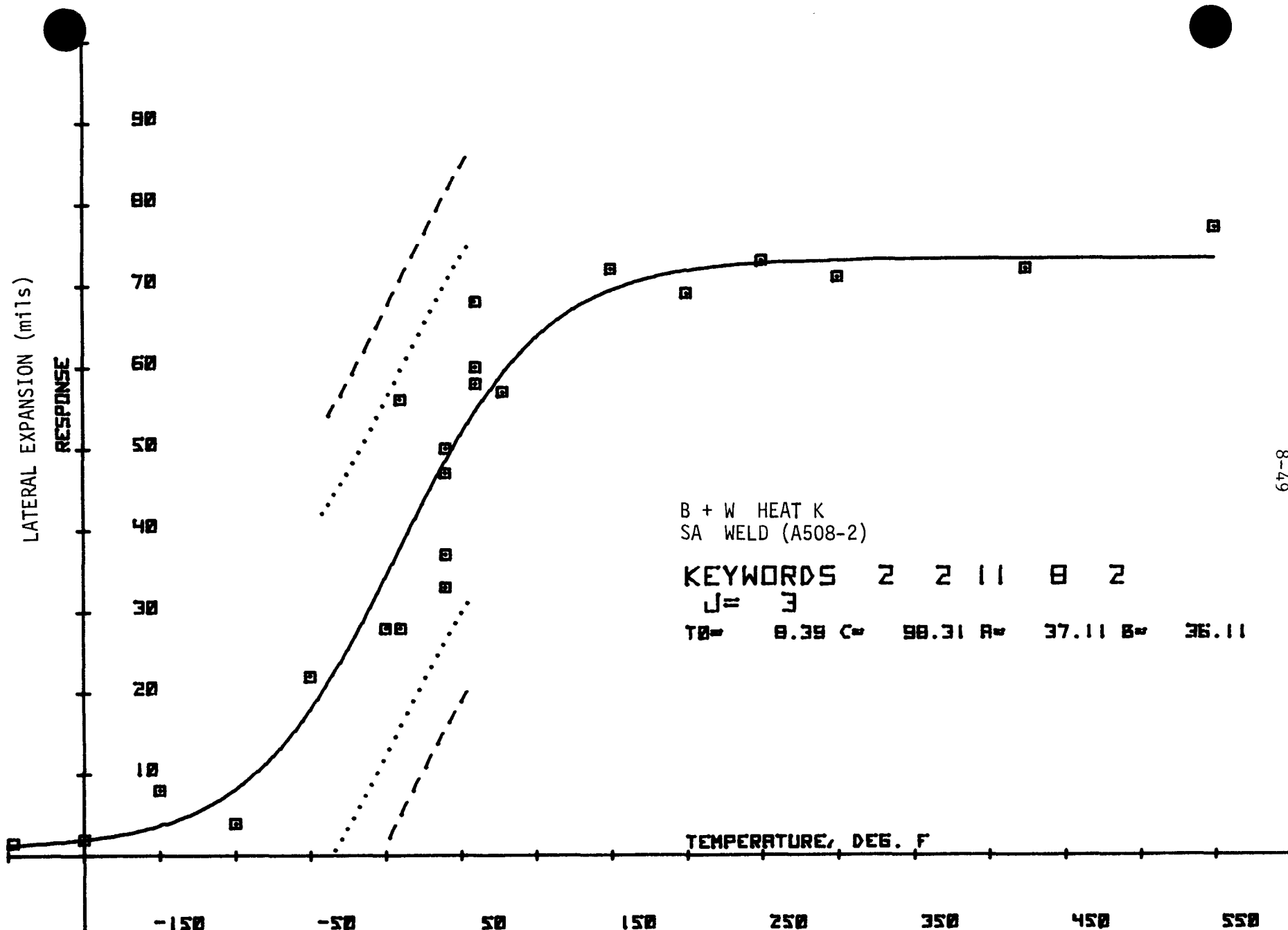


Figure 8.24. Charpy V-Notch Lateral Expansion for B&W Heat K

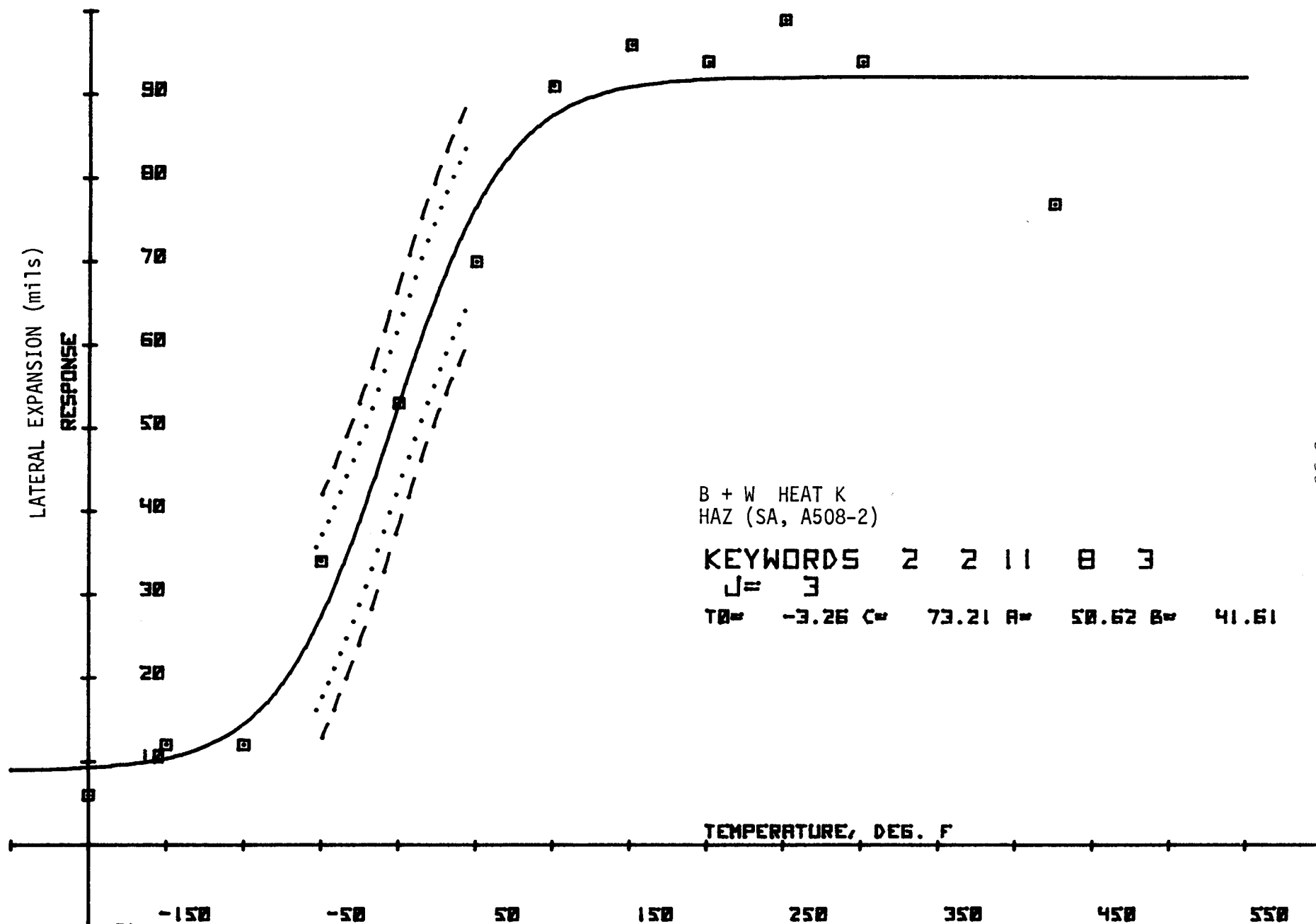


Figure 8.25. Charpy V-Notch Lateral Expansion for B&W Heat K (HAZ)

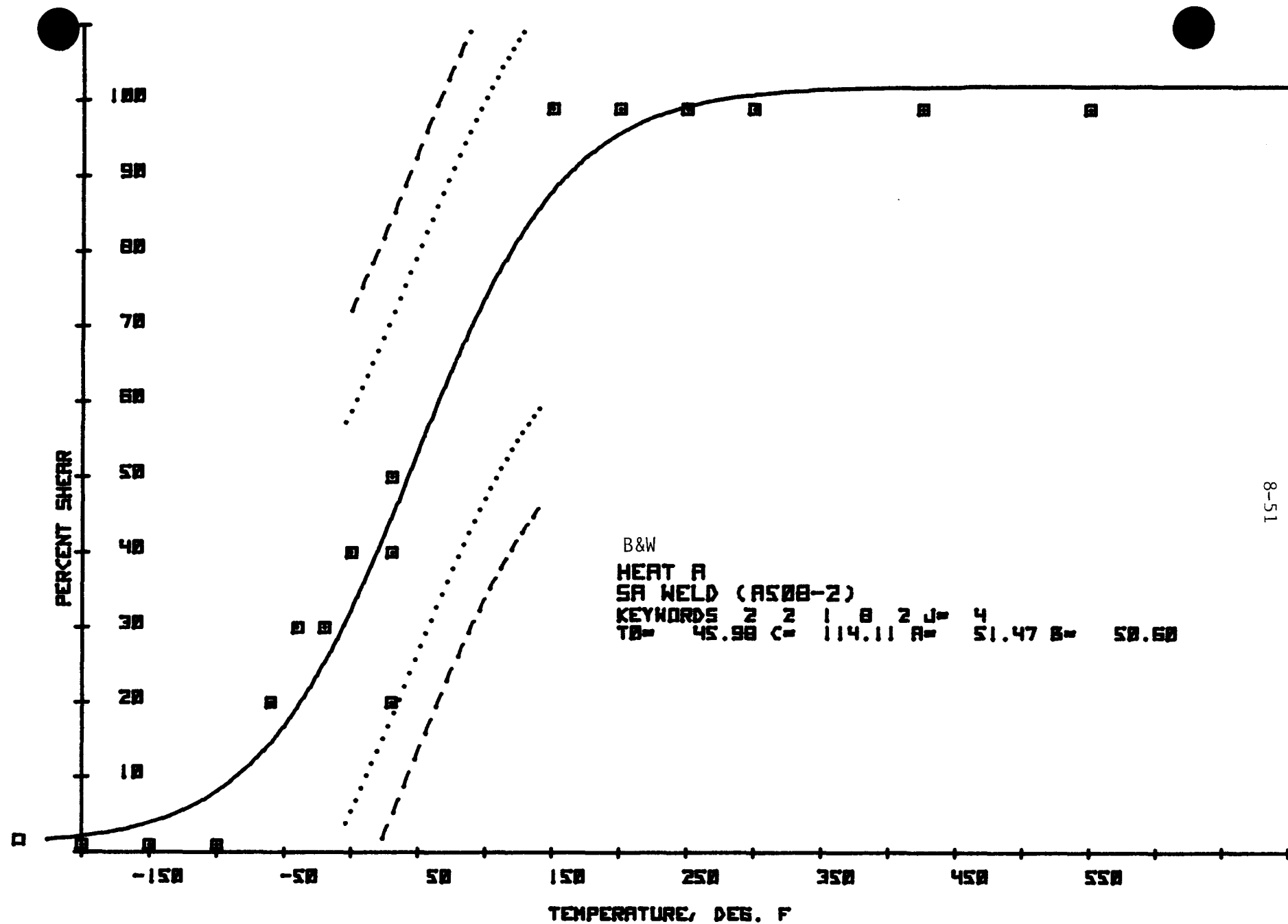


Figure 8.26. Charpy V-Notch Percent Shear for B&W Heat A

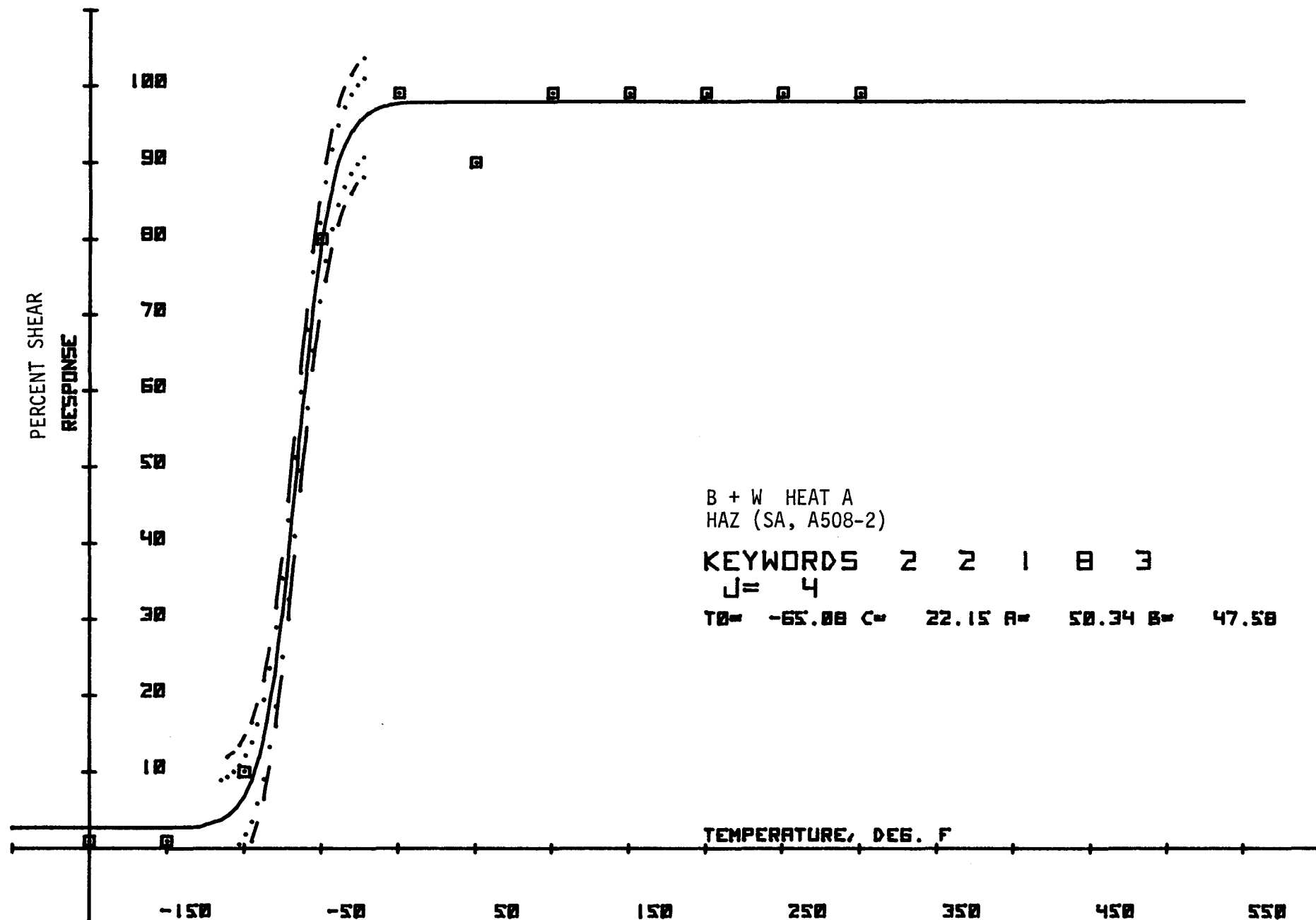


Figure 8.27. Charpy V-Notch Percent Shear for B&W Heat A (HAZ)

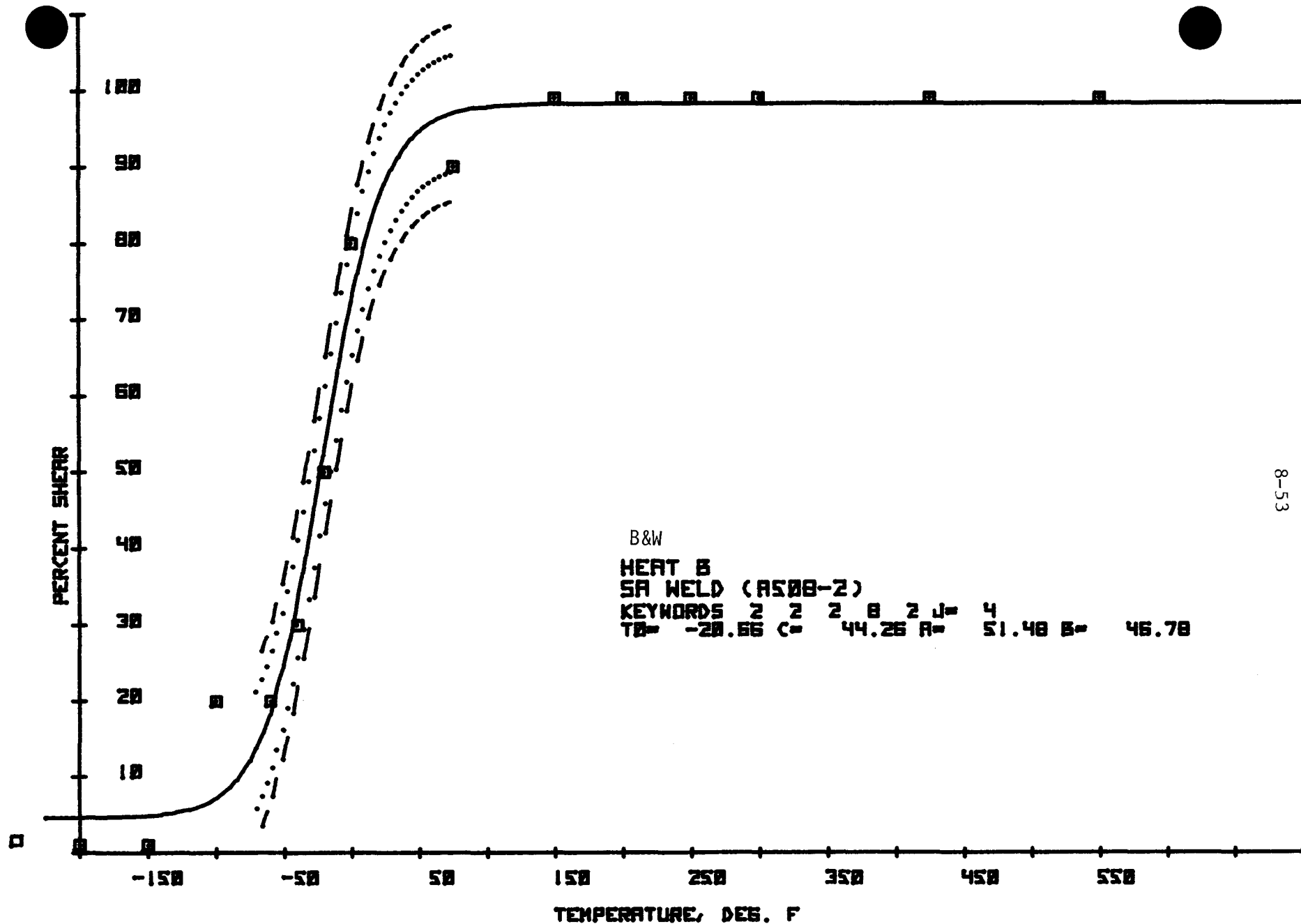


Figure 8.28. Charpy V-Notch Percent Shear for B&W Heat B

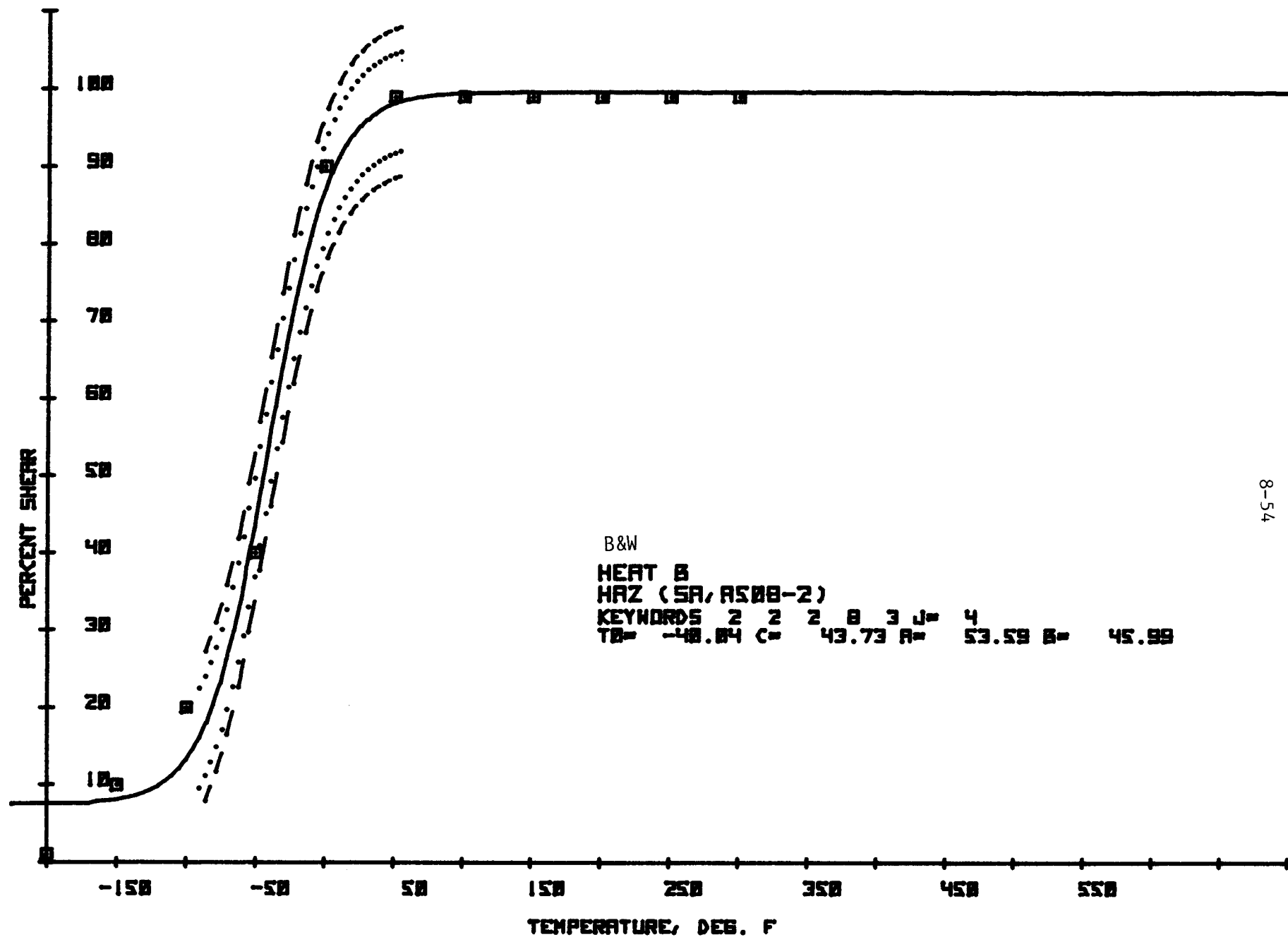


Figure 8.29. Charpy V-Notch Percent Shear for B&W Heat B (HAZ)

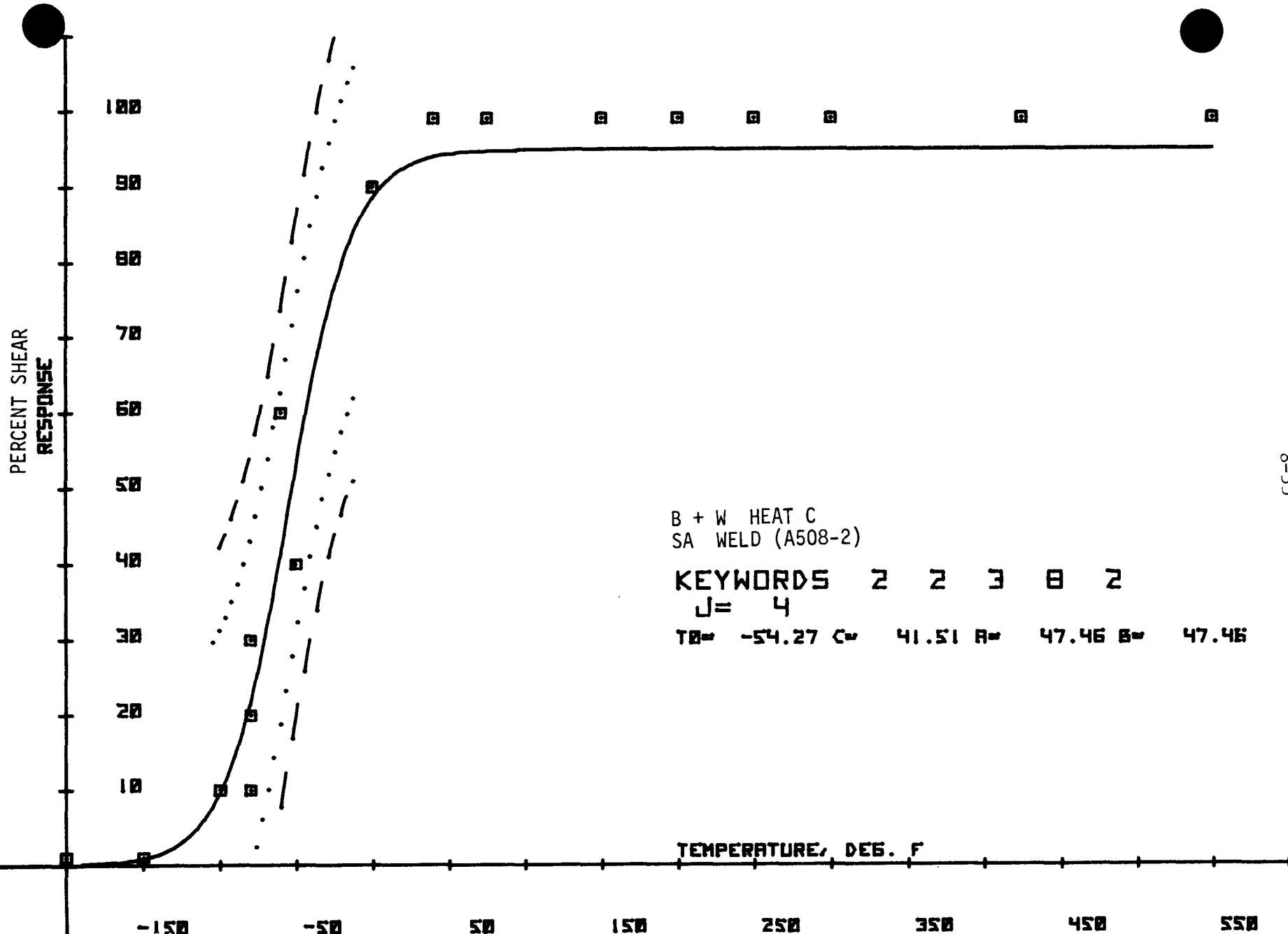


Figure 8.30. Charpy V-Notch Percent Shear for B&W Heat C

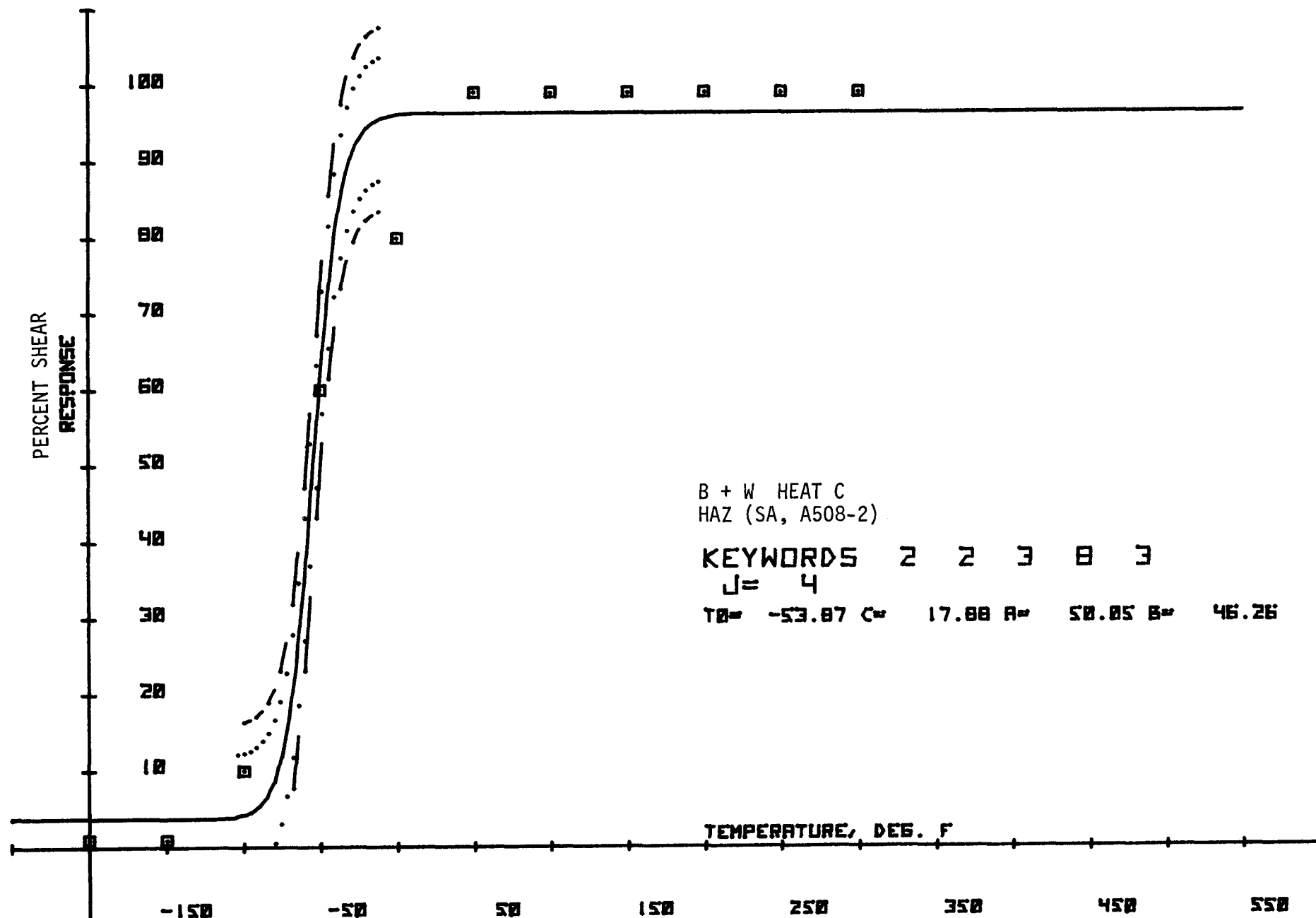


Figure 8.31. Charpy V-Notch Percent Shear for B&W Heat C (HAZ)

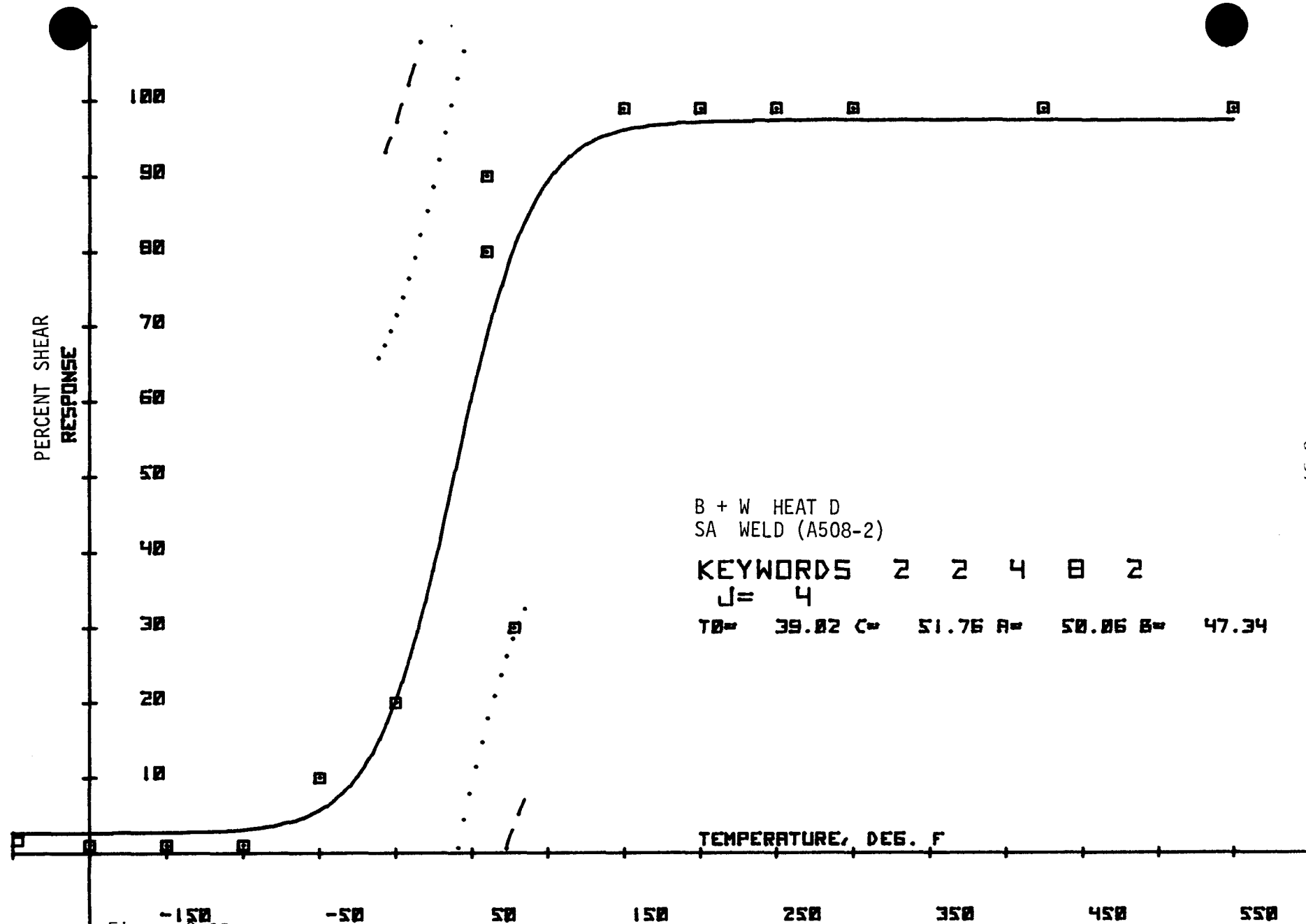


Figure 8.32. Charpy V-Notch Percent Shear for B&W Heat D

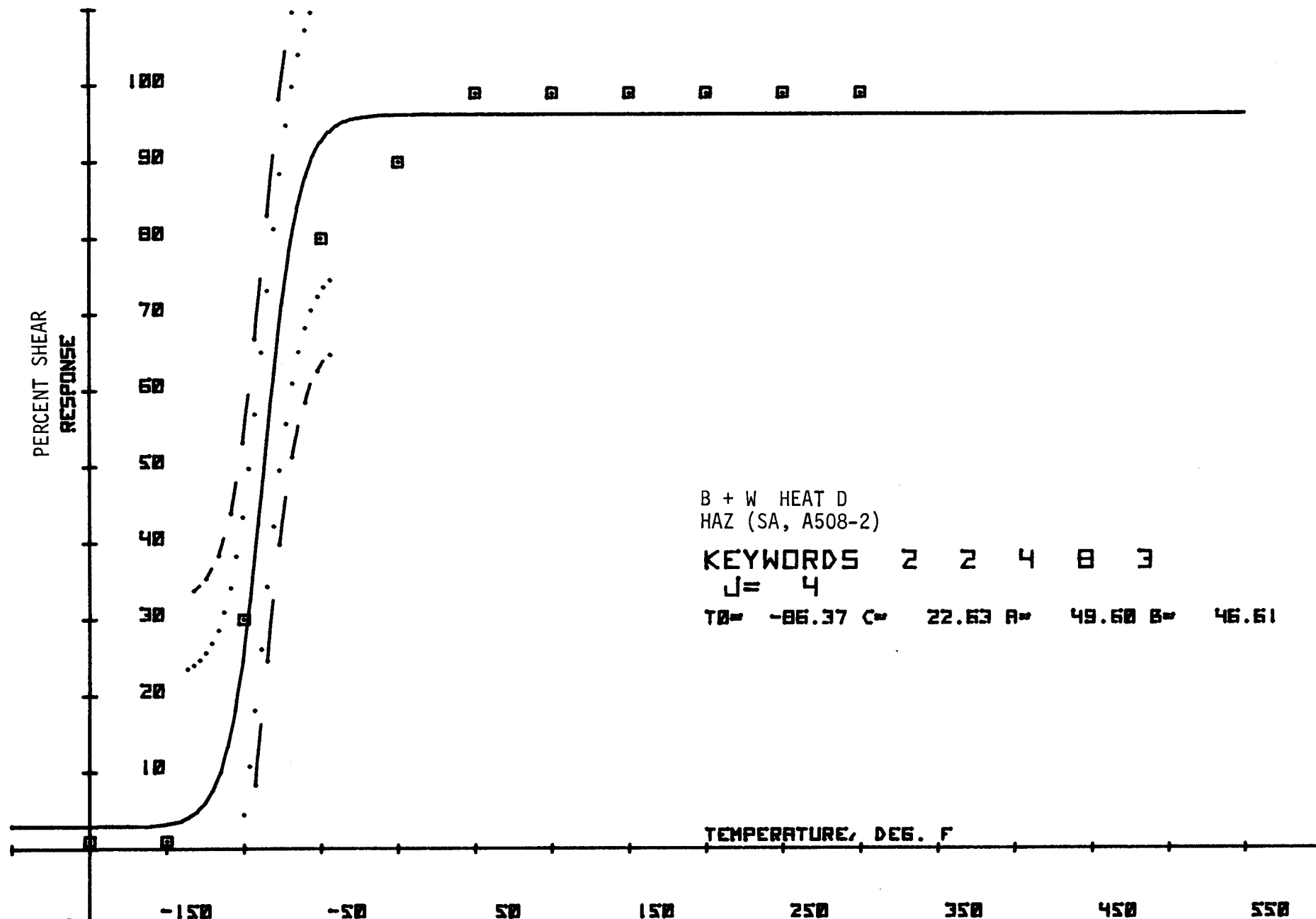


Figure 8.33. Charpy V-Notch Percent Shear for B&W Heat D (HAZ)

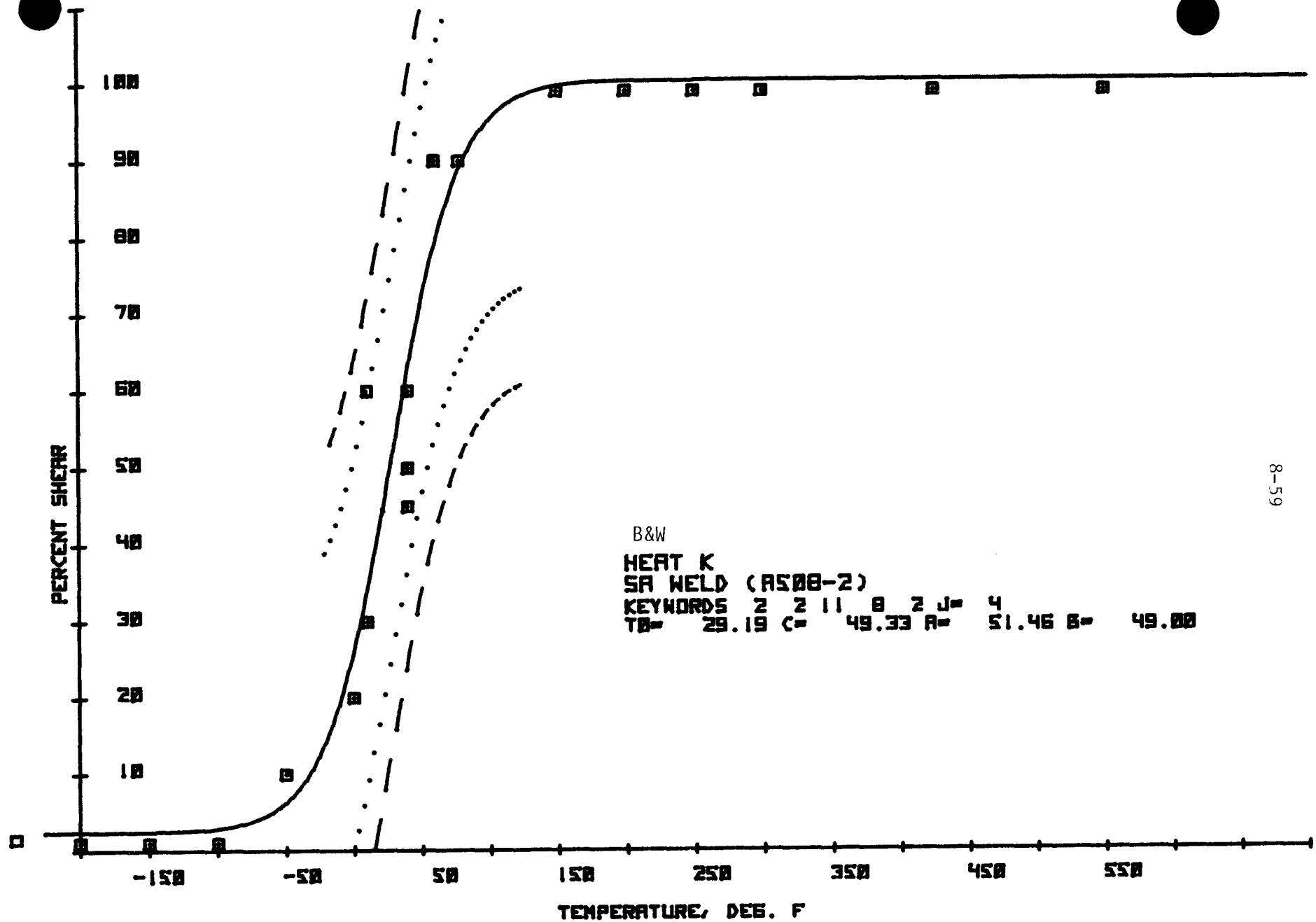
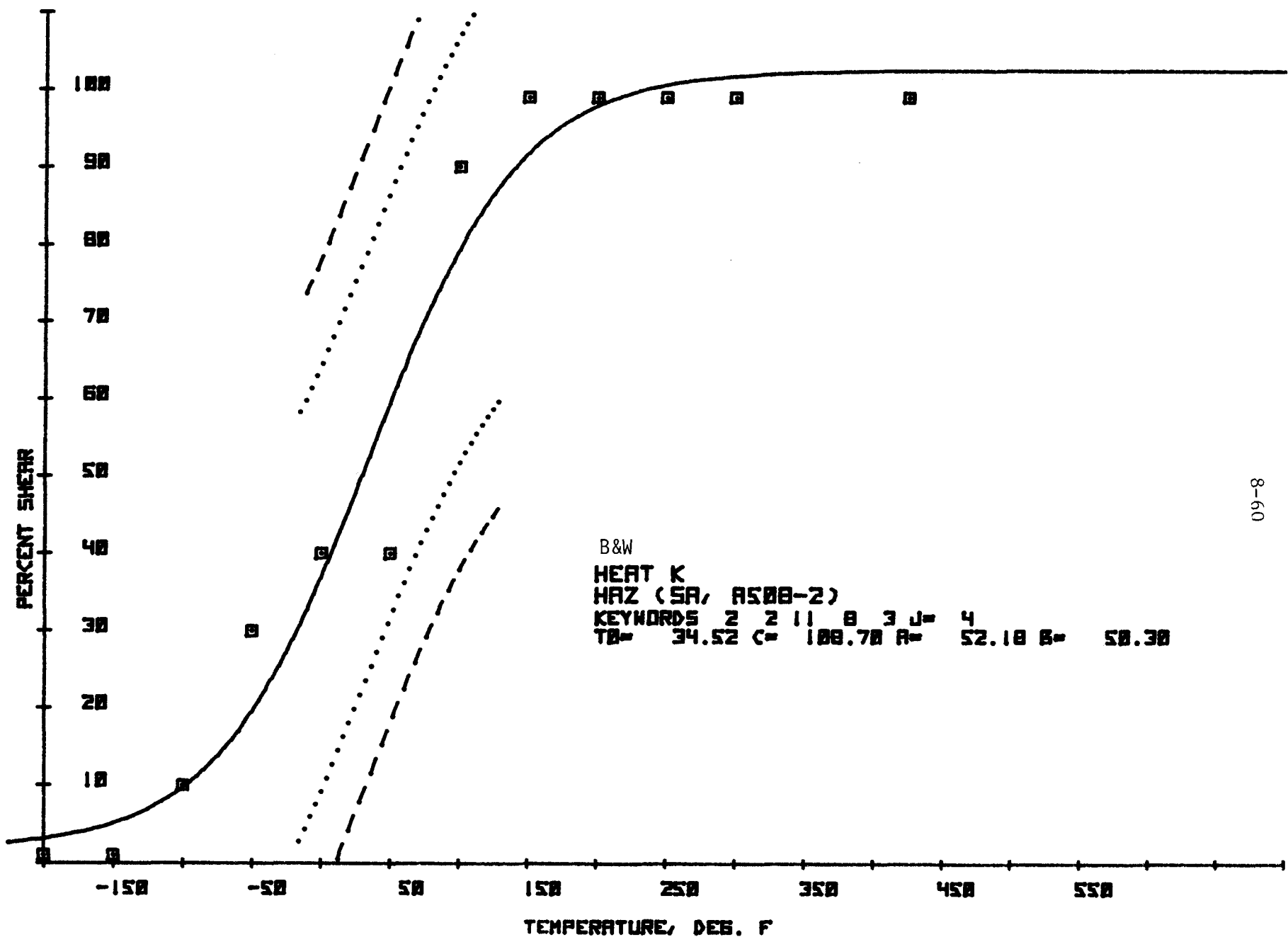


Figure 8.34. Charpy V-Notch Percent Shear for B&W Heat K



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Figure 8.35. Charpy V-Notch Percent Shear for B&W Heat K (HAZ)

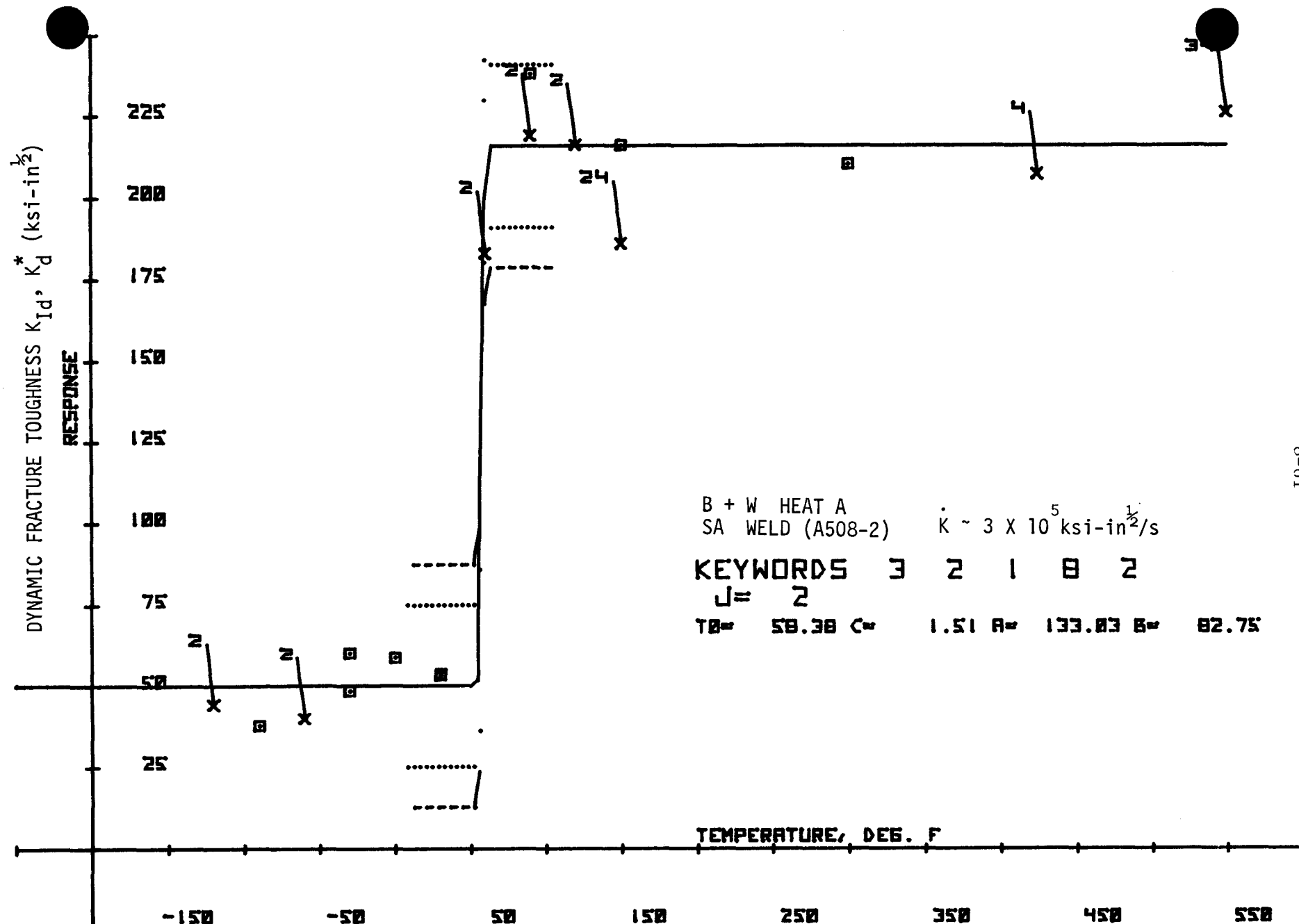


Figure 8.36. Precracked Charpy Fracture Toughness for B&W Heat A

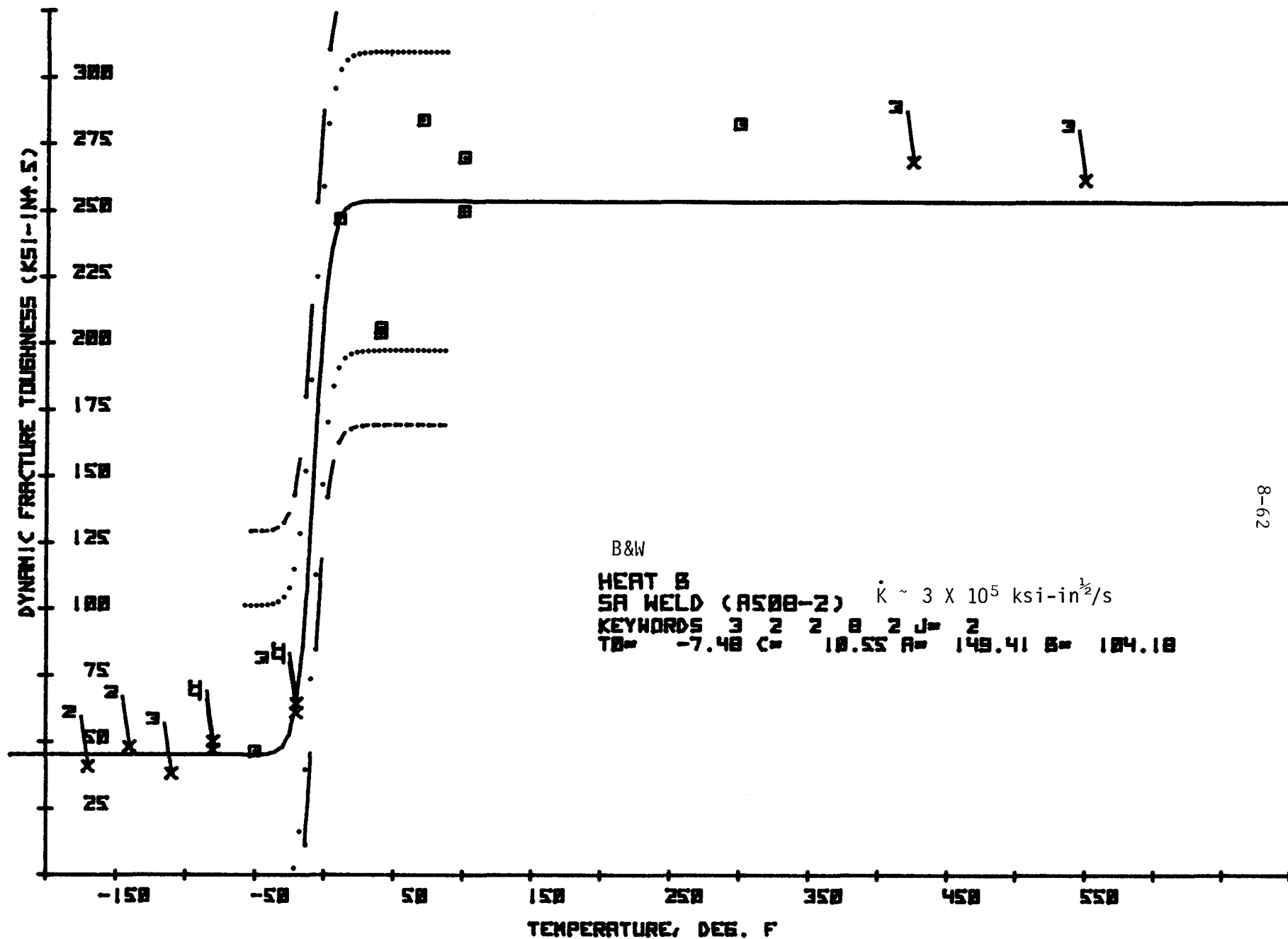


Figure 8.37. Precracked Charpy Fracture Toughness for B&W Heat B

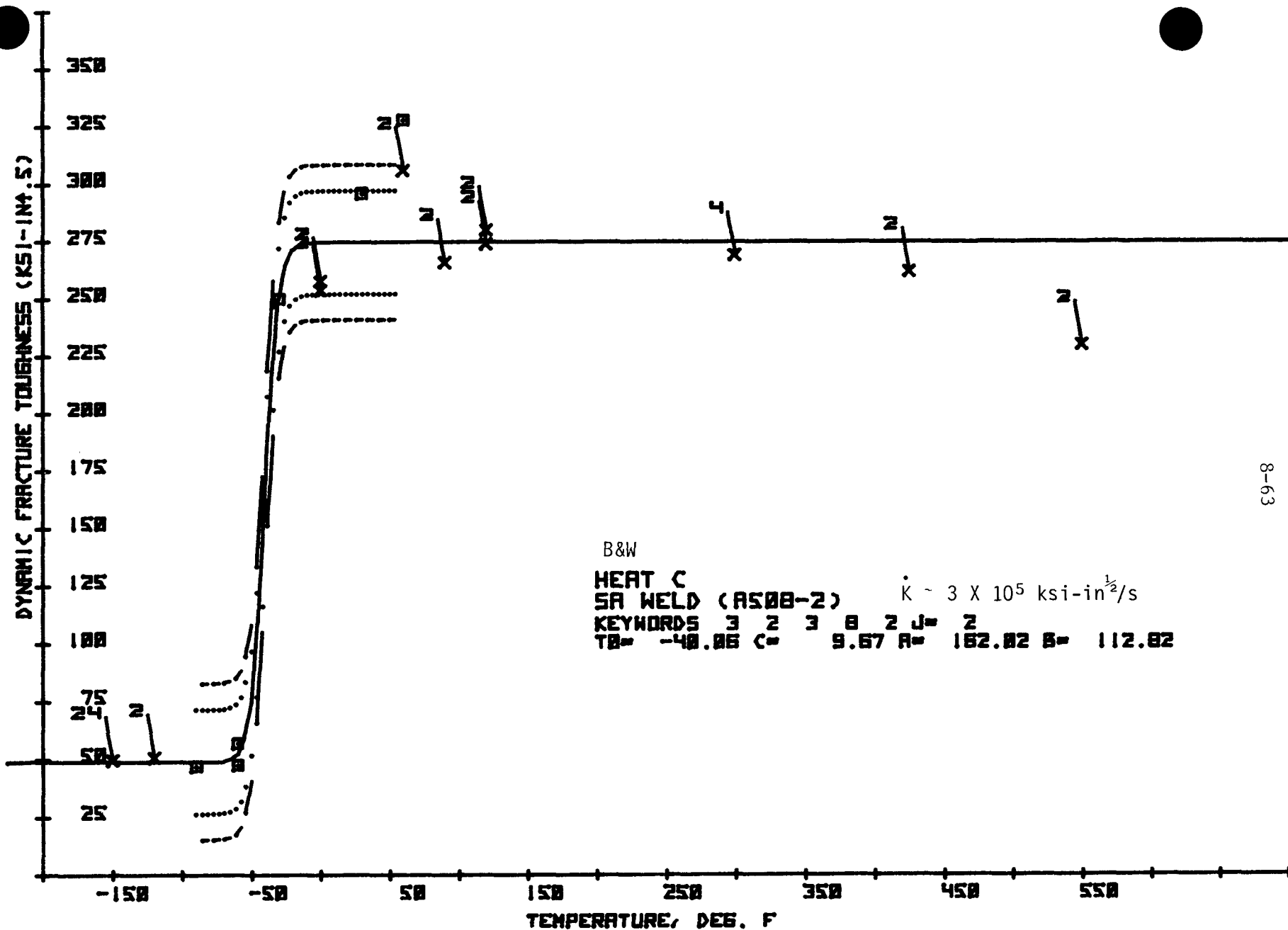


Figure 8.38. Precracked Charpy Fracture Toughness for B&W Heat C

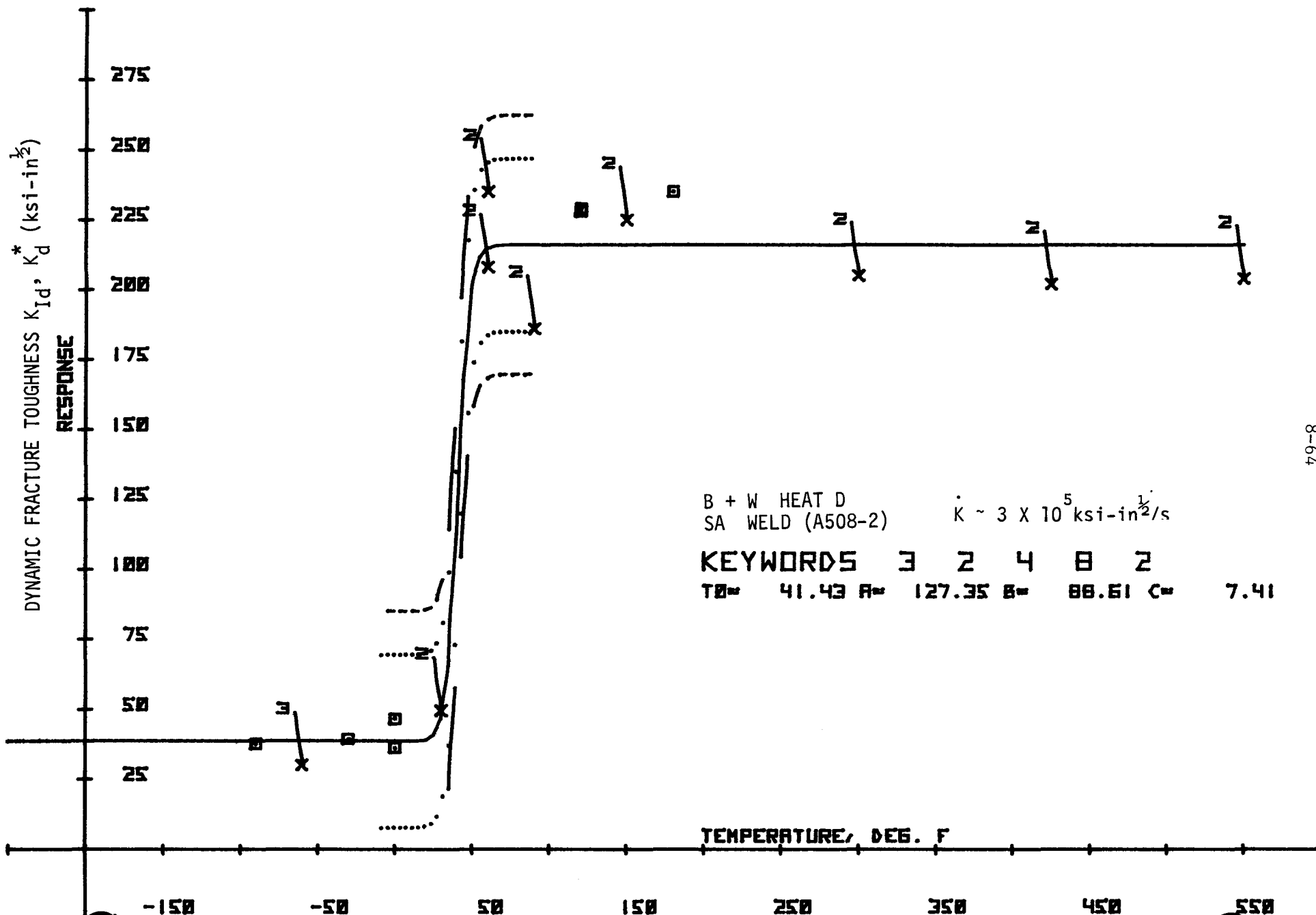


Figure 8.39. Precracked Charpy Fracture Toughness for B&W Heat D

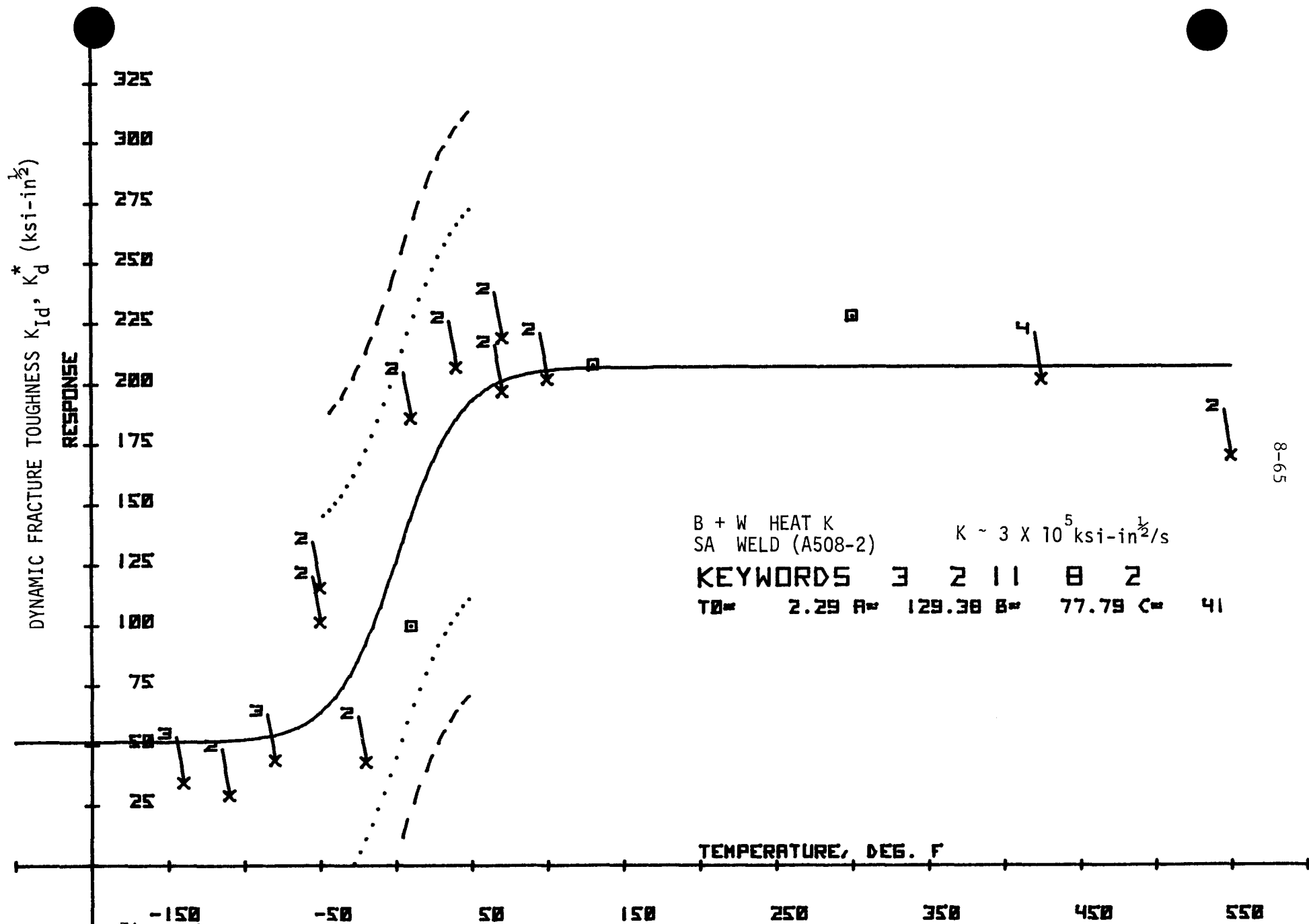


Figure 8.40. Precracked Charpy Fracture Toughness for B&W Heat K

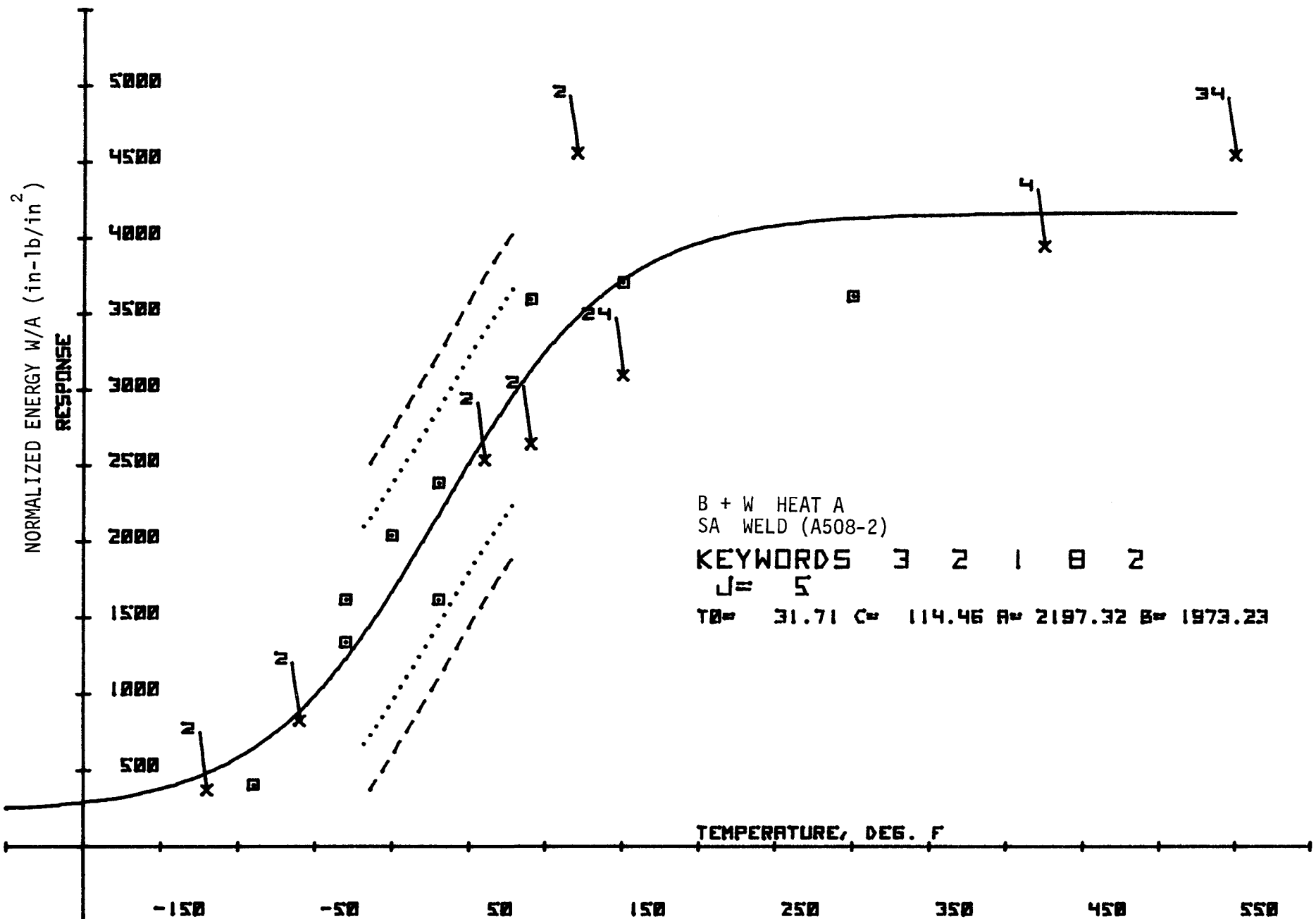


Figure 8.41. Precracked Charpy Normalized Energy for B&W Heat A

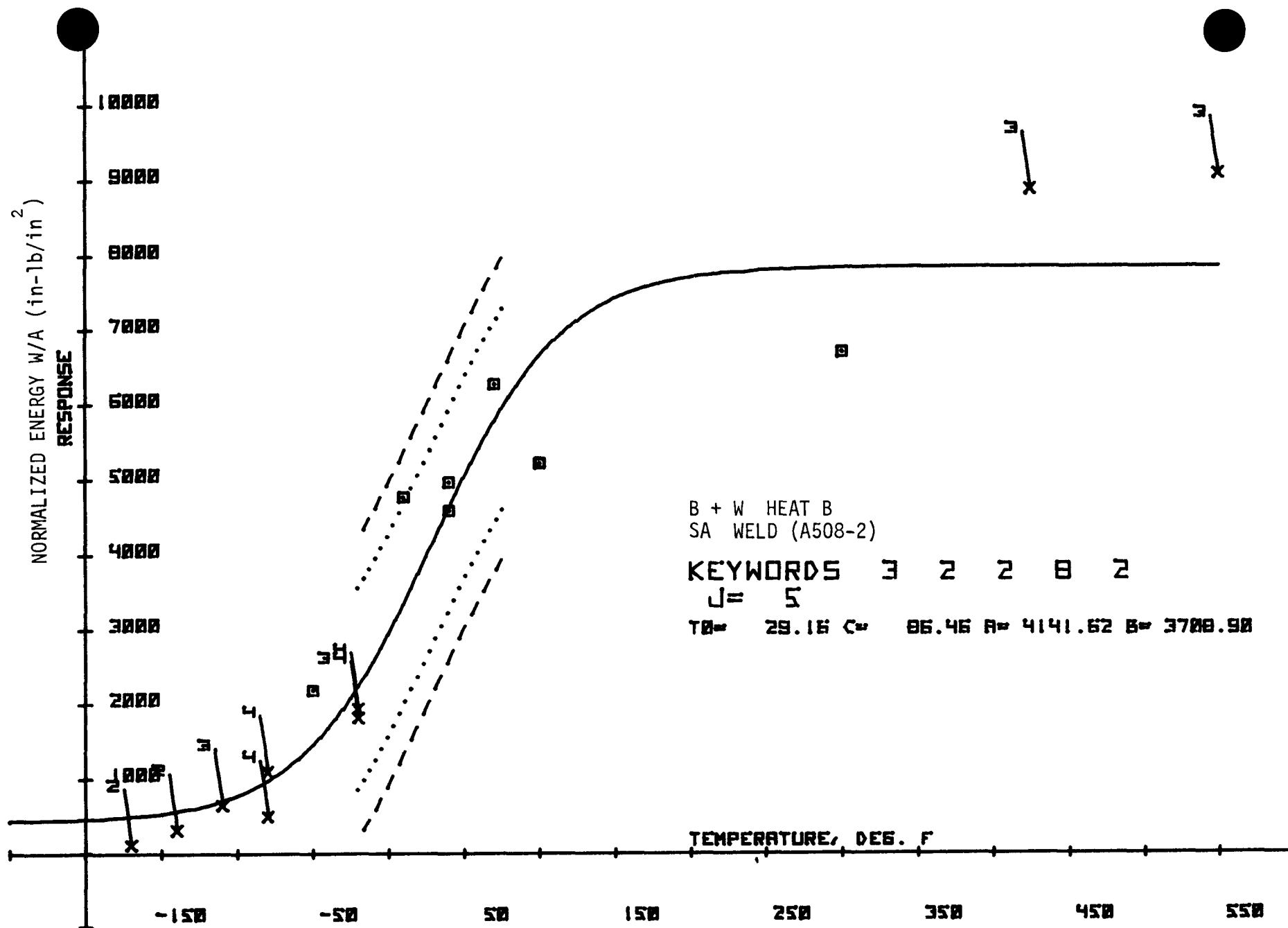


Figure 8.42. Precracked Charpy Normalized Energy for B&W Heat B

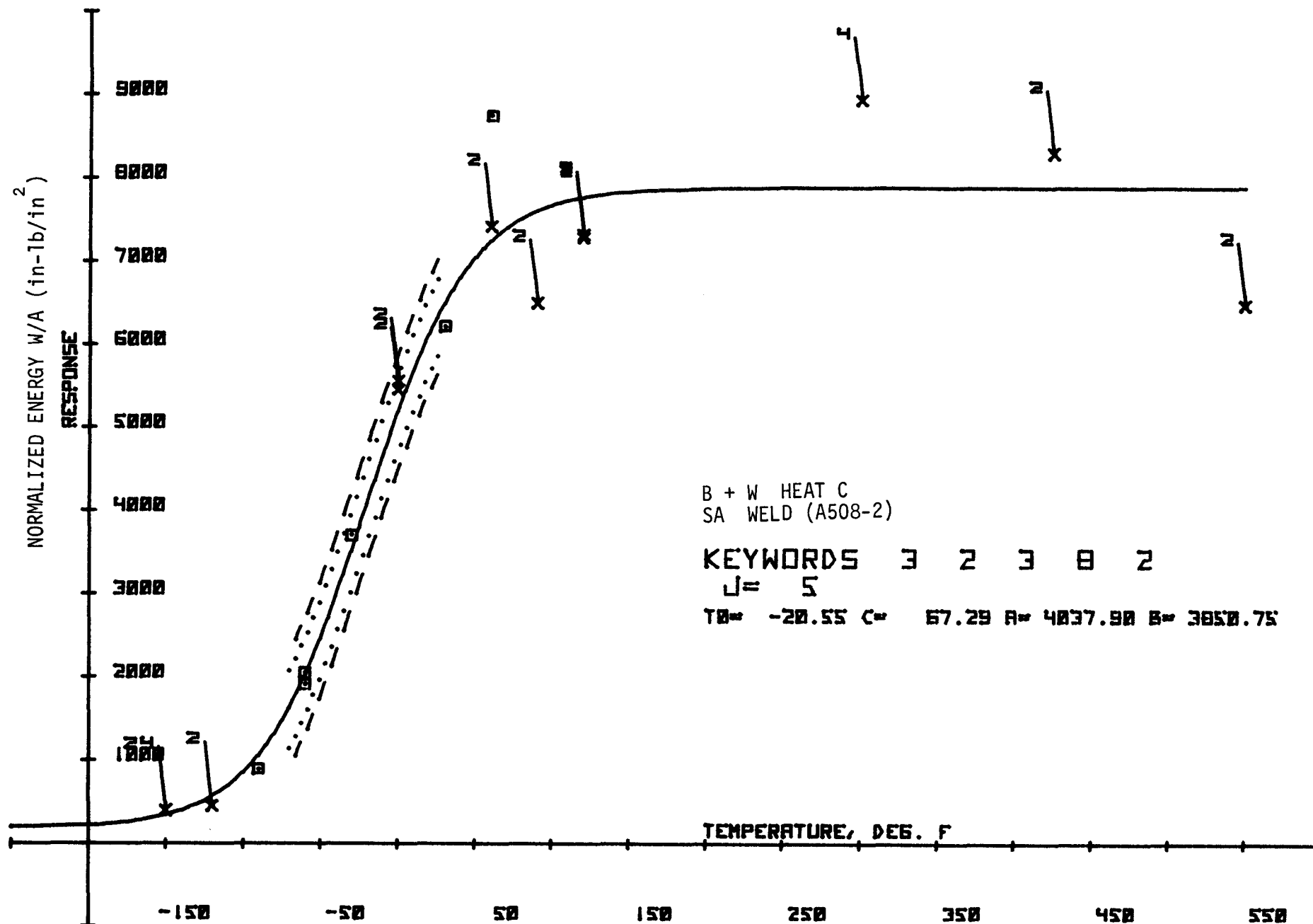


Figure 8.43. Precracked Charpy Normalized Energy for B&W Heat C

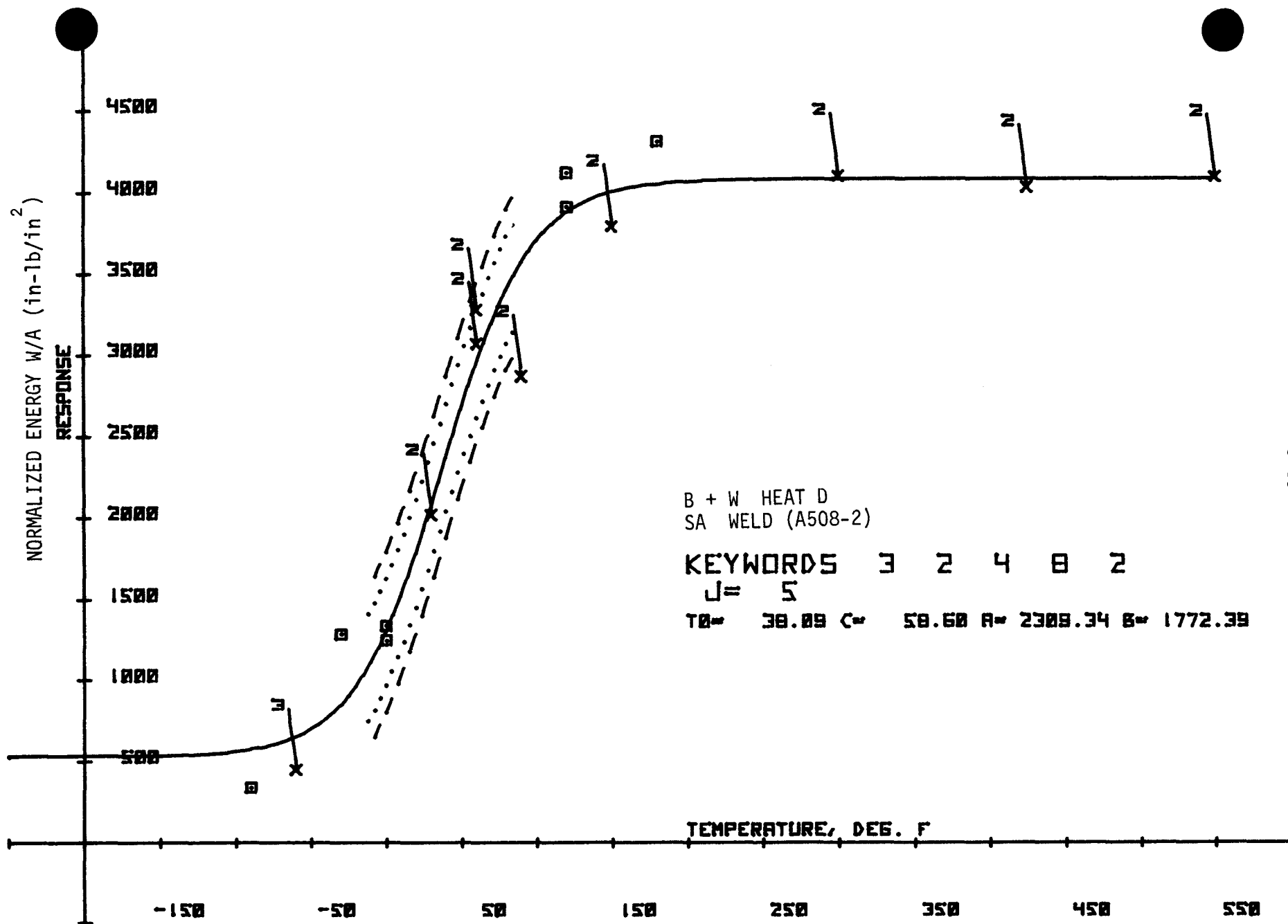


Figure 8.44. Precracked Charpy Normalized Energy for B&W Heat D

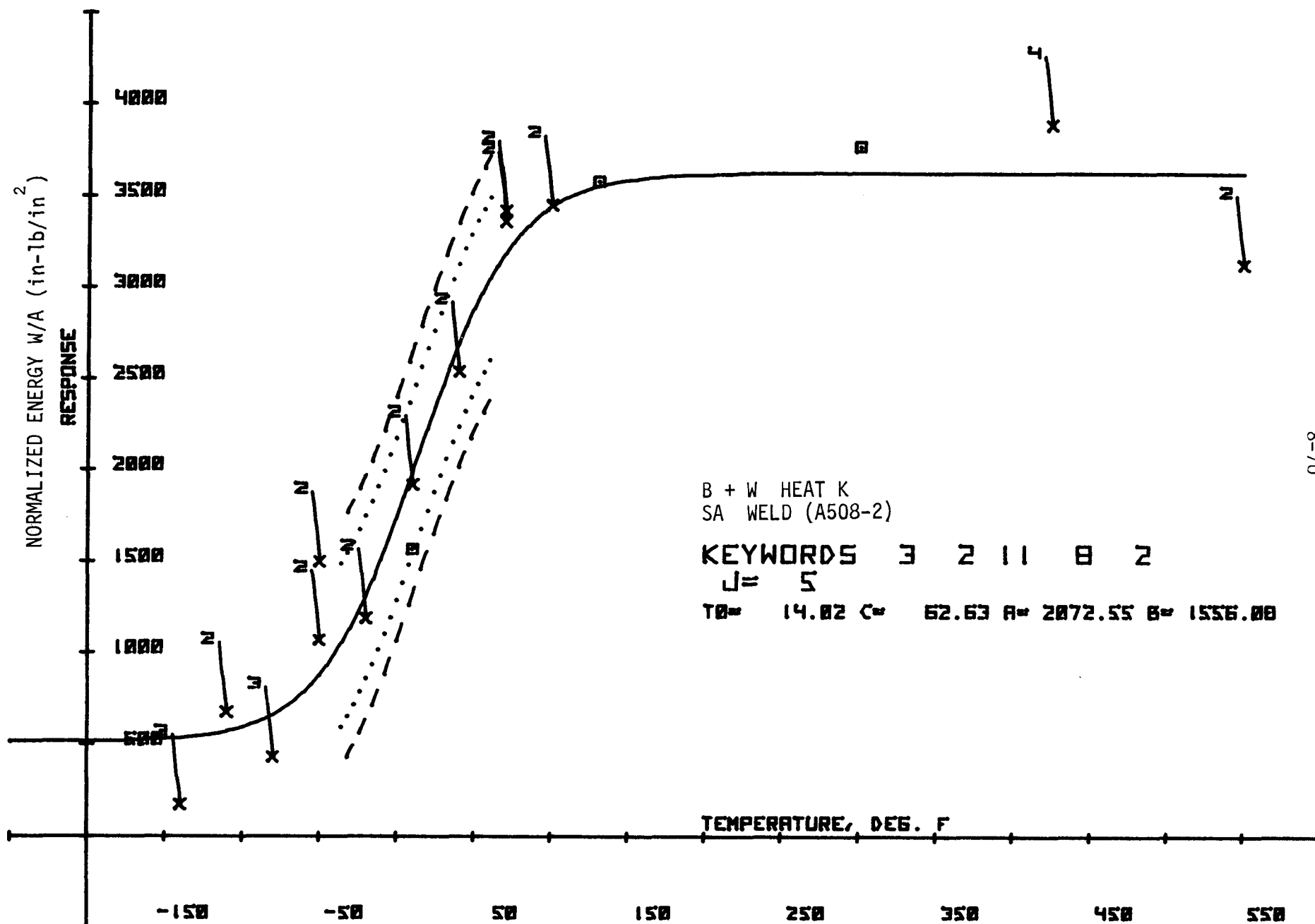


Figure 8.45 Precracked Charpy Normalized Energy for B&W Heat K

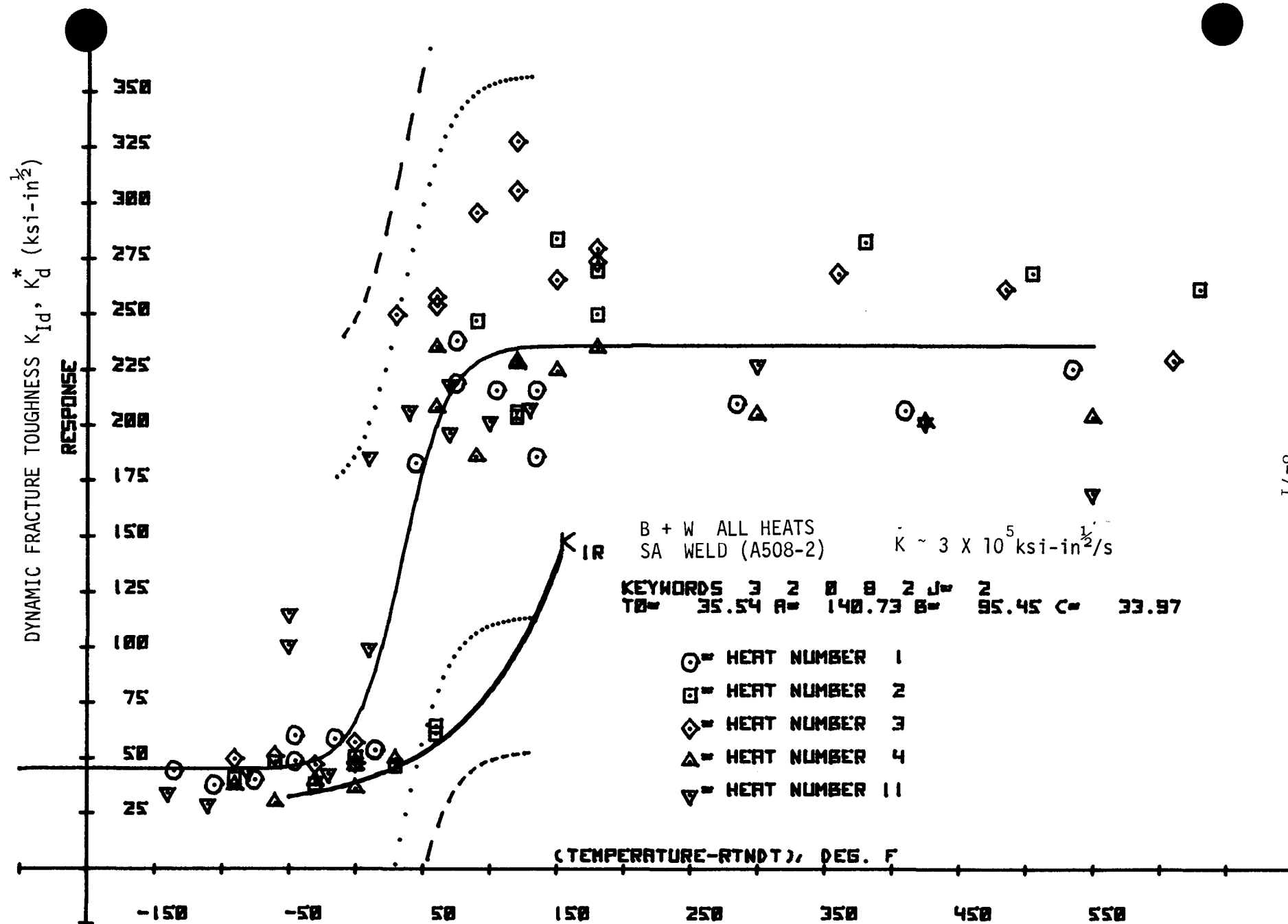


Figure 8.46 Precracked Charpy Fracture Toughness for All B&W Heats

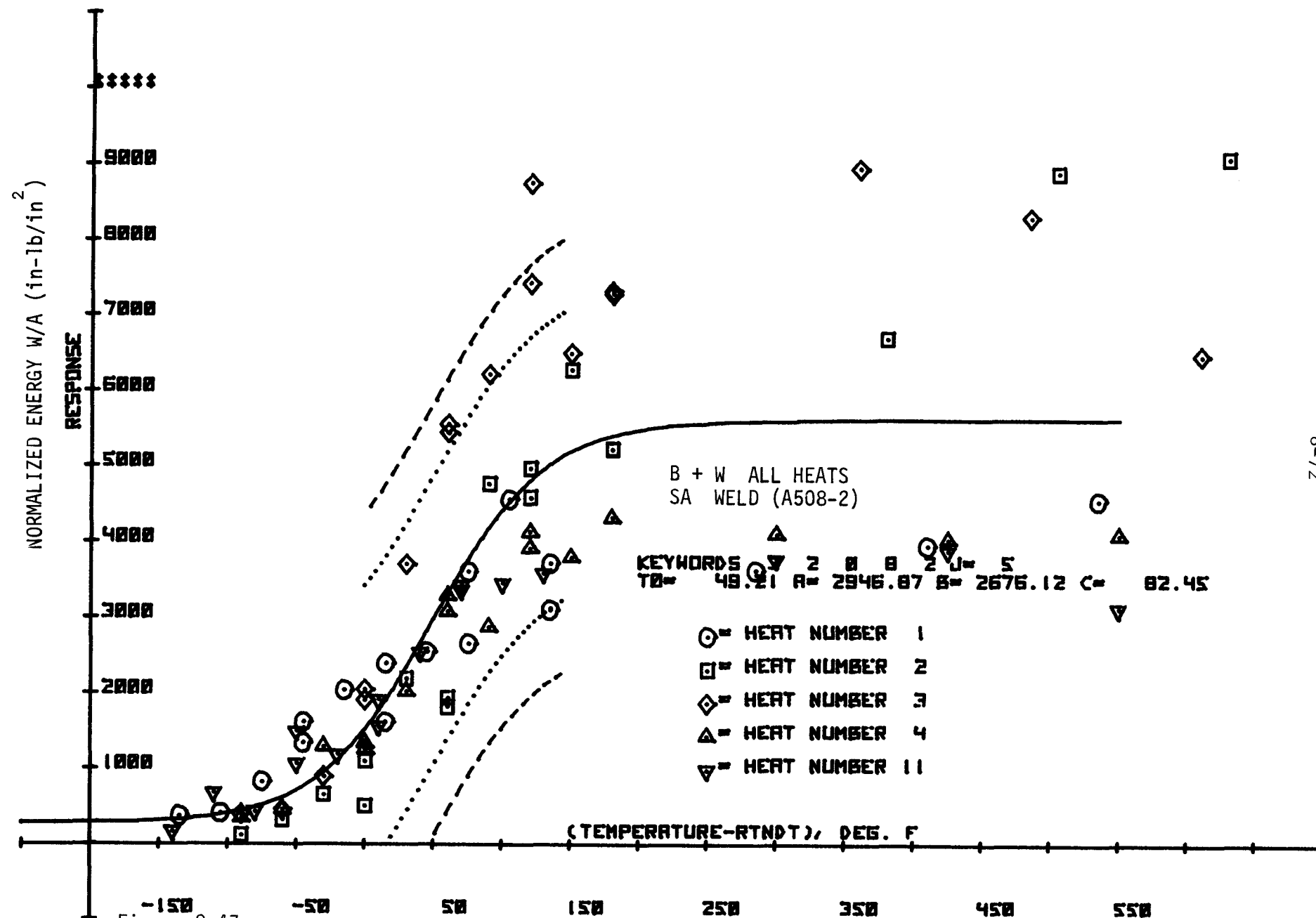


Figure 8.47. Precracked Charpy Normalized Energy for All B&W Heats

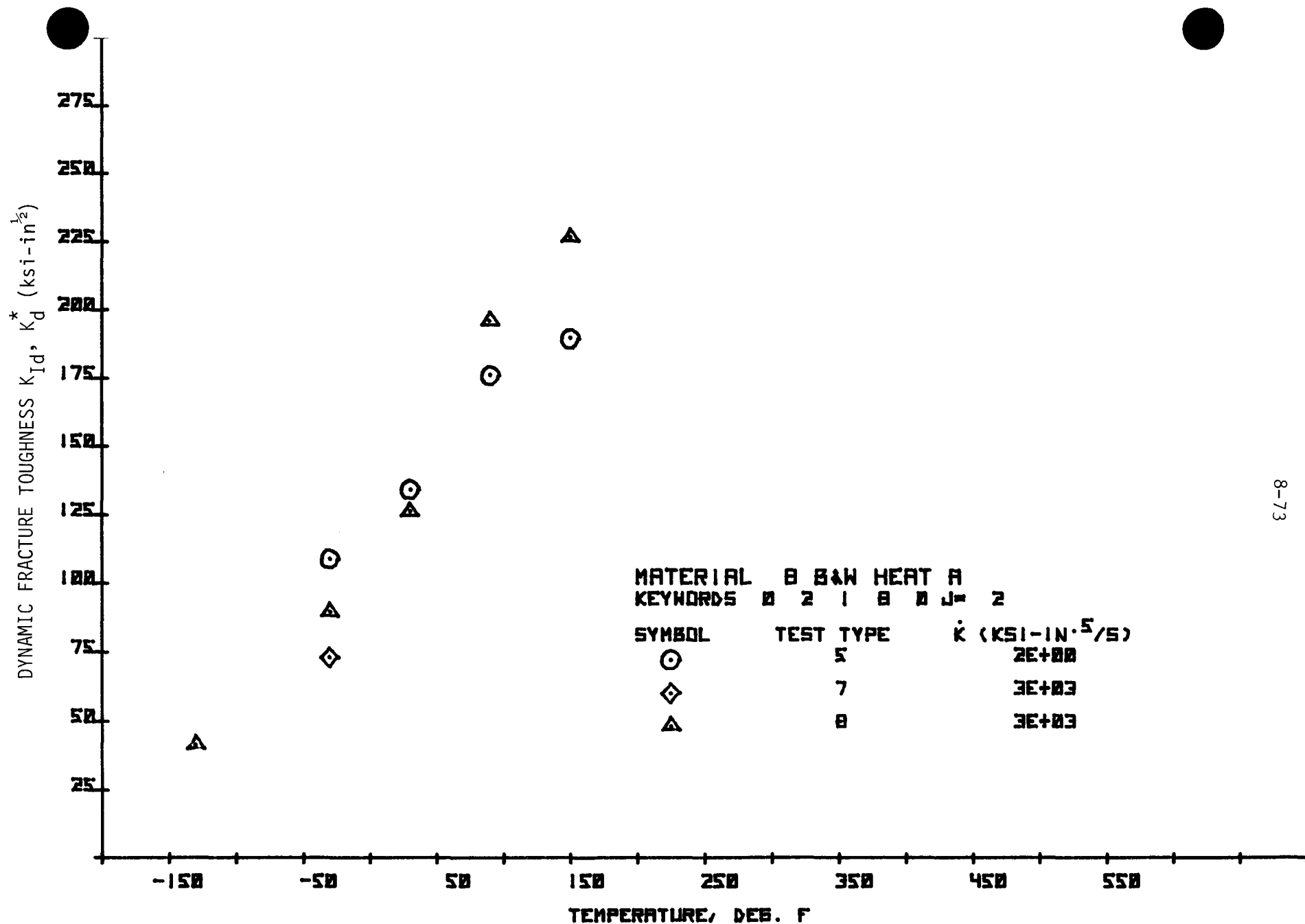


Figure 8.48. Static and Dynamic Fracture Toughness for B&W Heat A

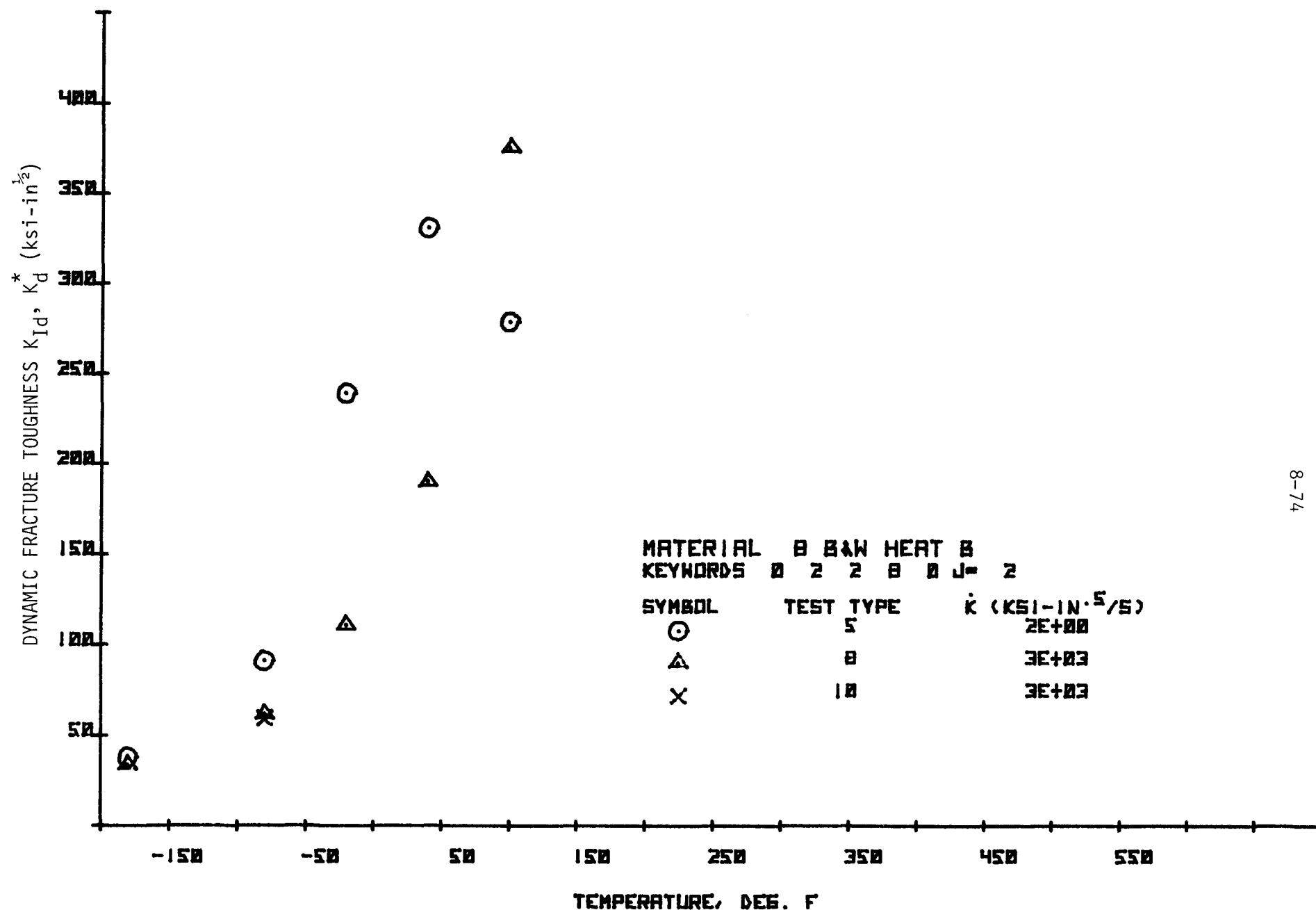


Figure 8.49. Static and Dynamic Fracture Toughness for B&W Heat B

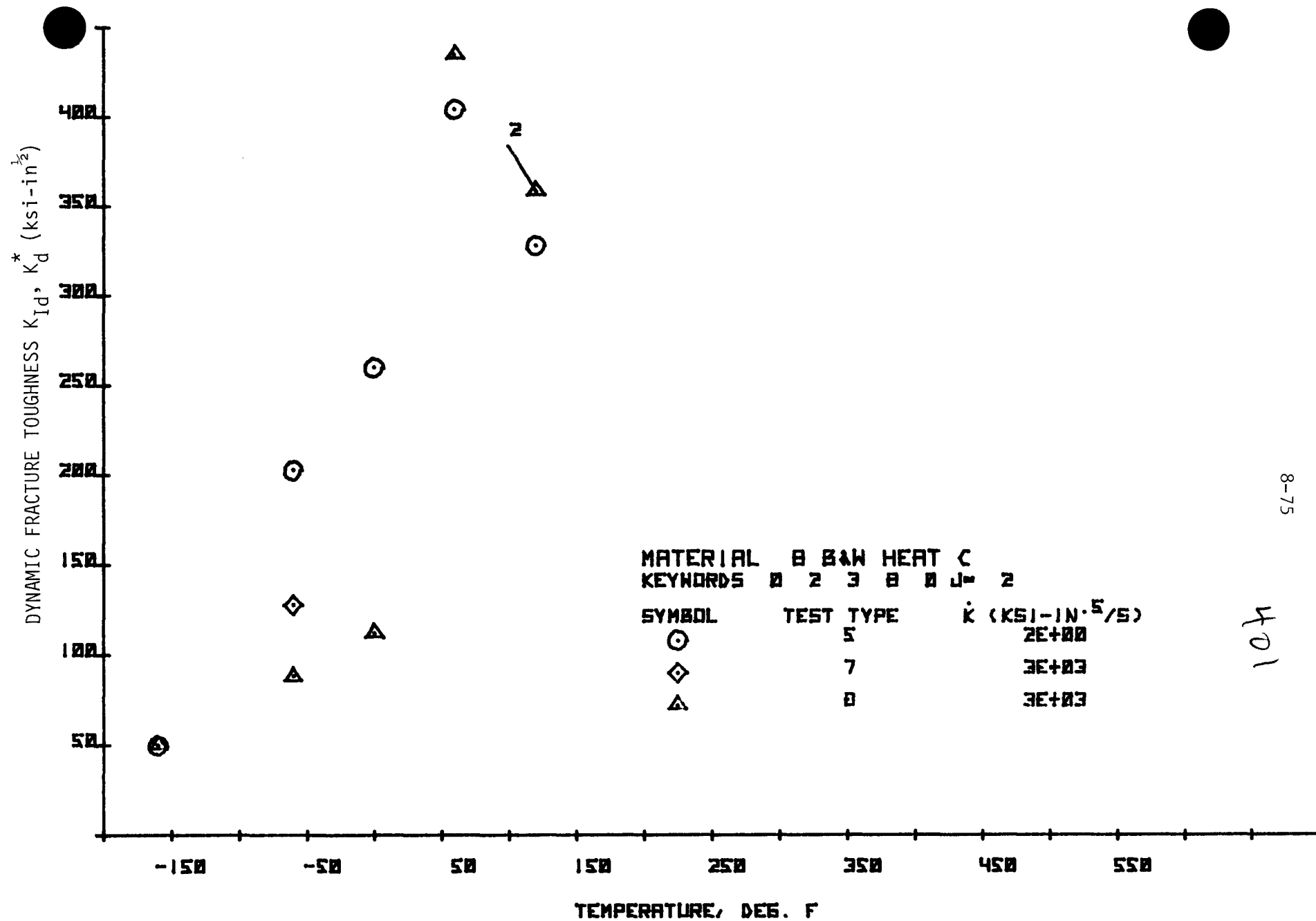


Figure 8.50. Static and Dynamic Fracture Toughness for B&W Heat C

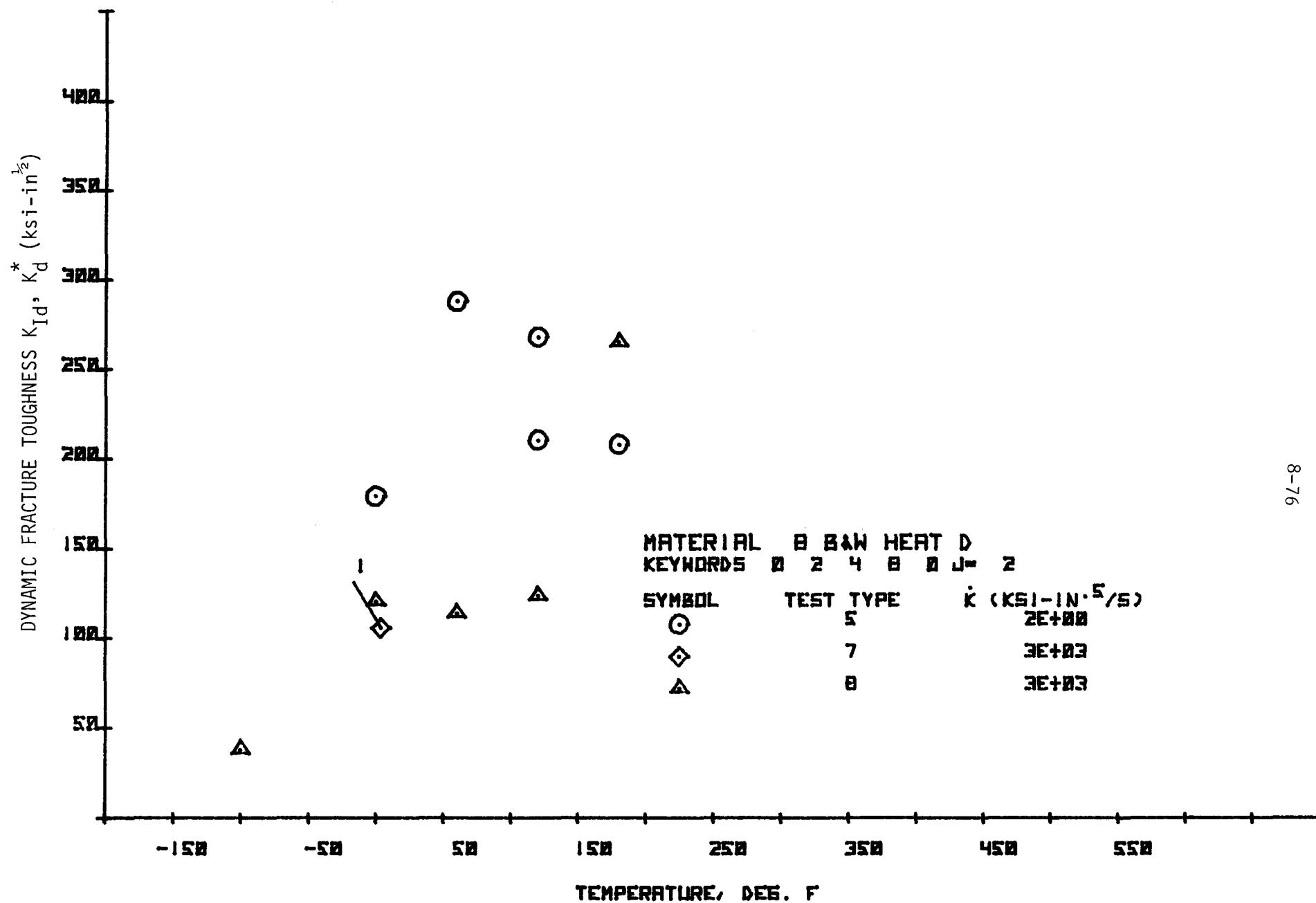


Figure 8.51. Static and Dynamic Fracture Toughness for B&W Heat D

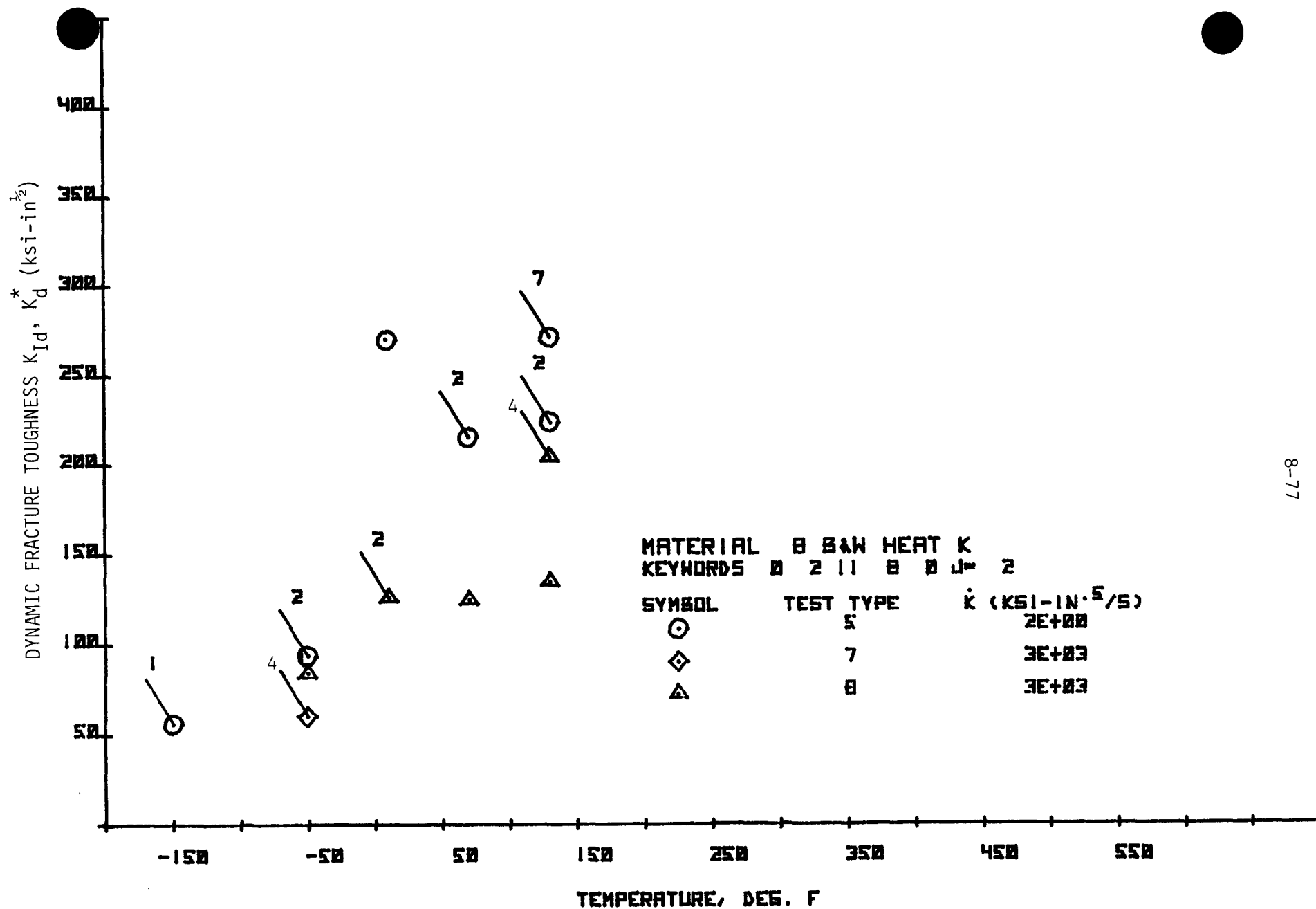


Figure 8.52. Static and Dynamic Fracture Toughness for B&W Heat K

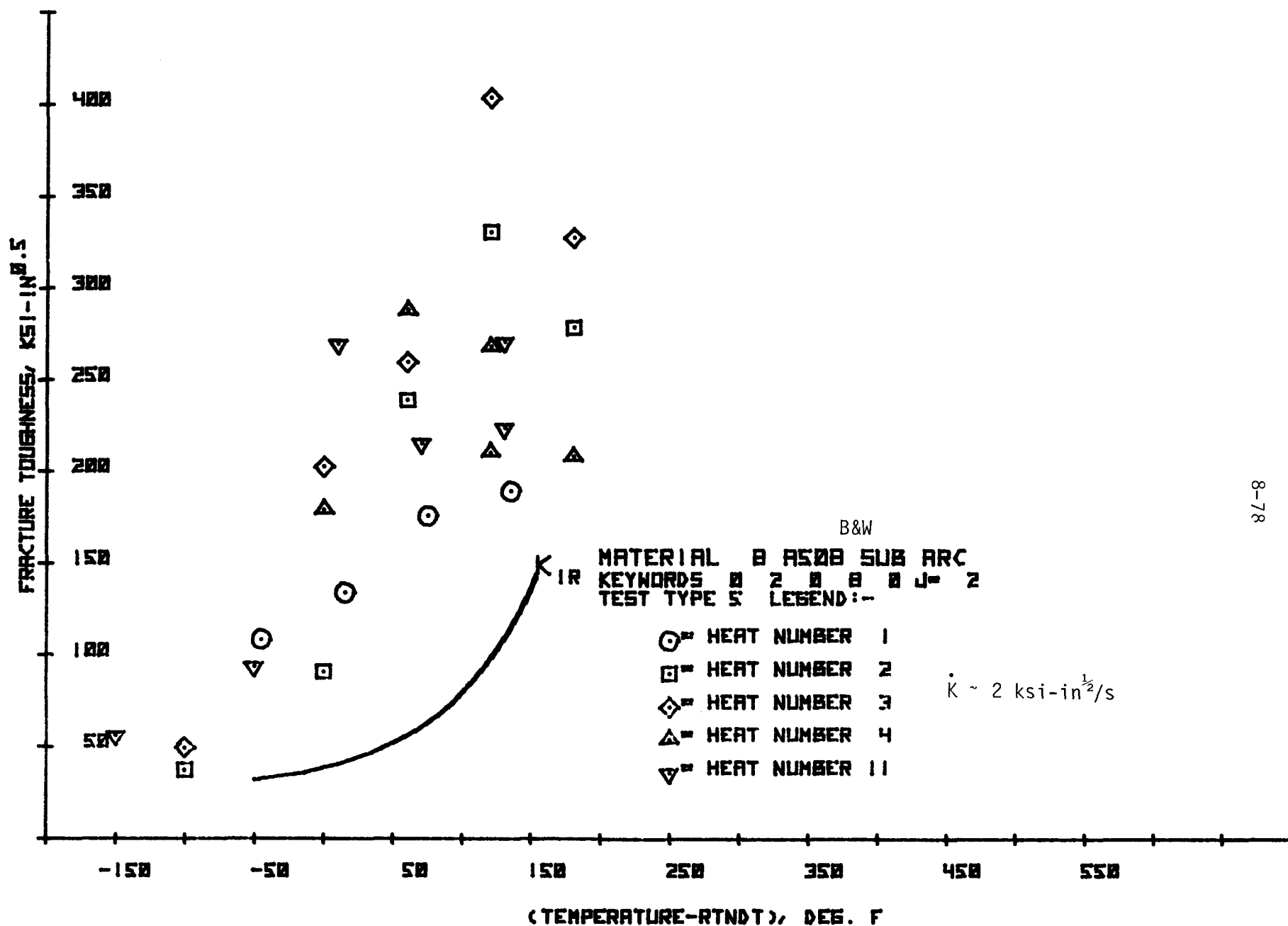


Figure 8.53. All Static Fracture Toughness Data for B&W Heats

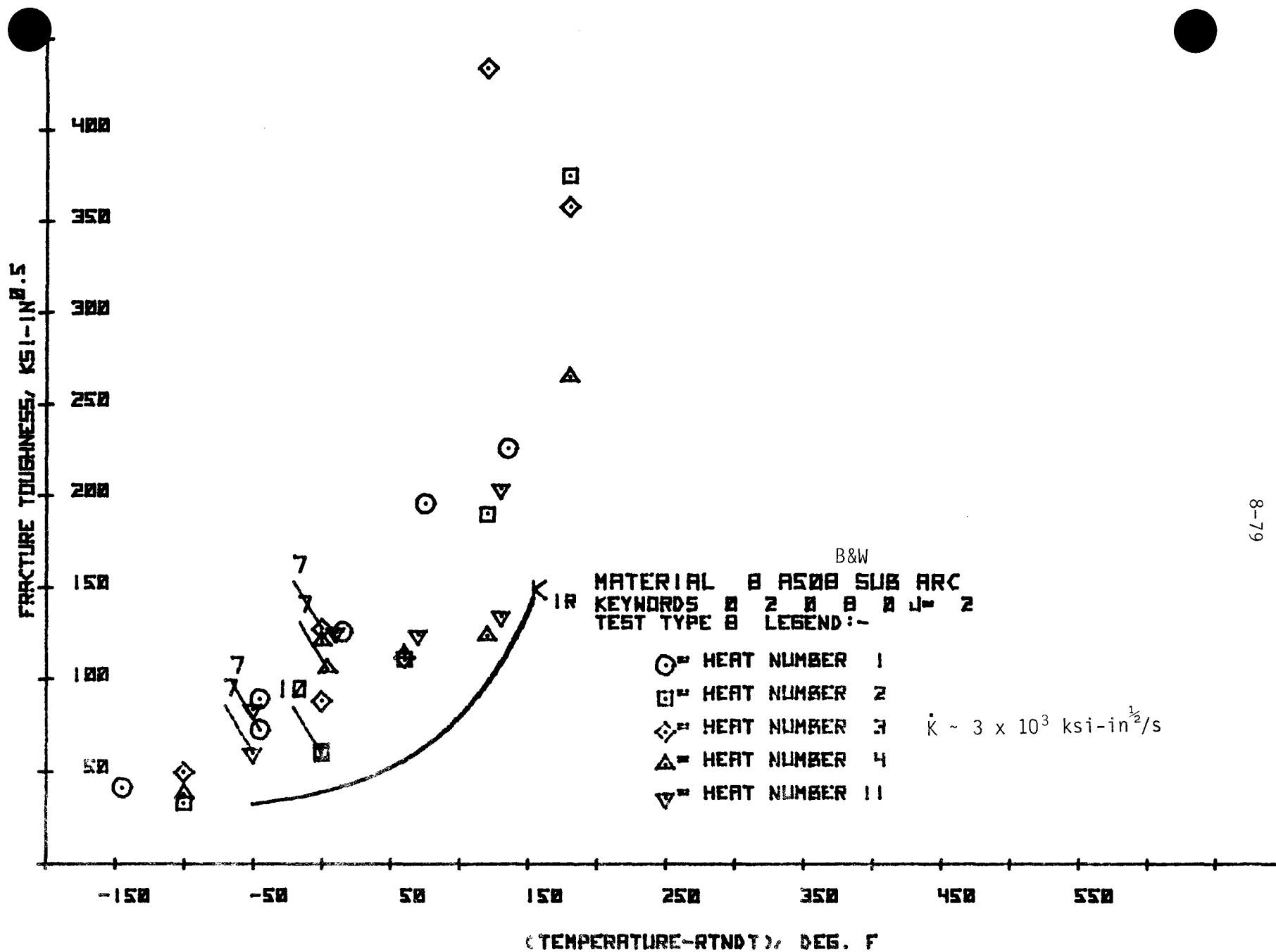


Figure 8.54. All Dynamic Compact Specimen Fracture Toughness Data for B&W Heats

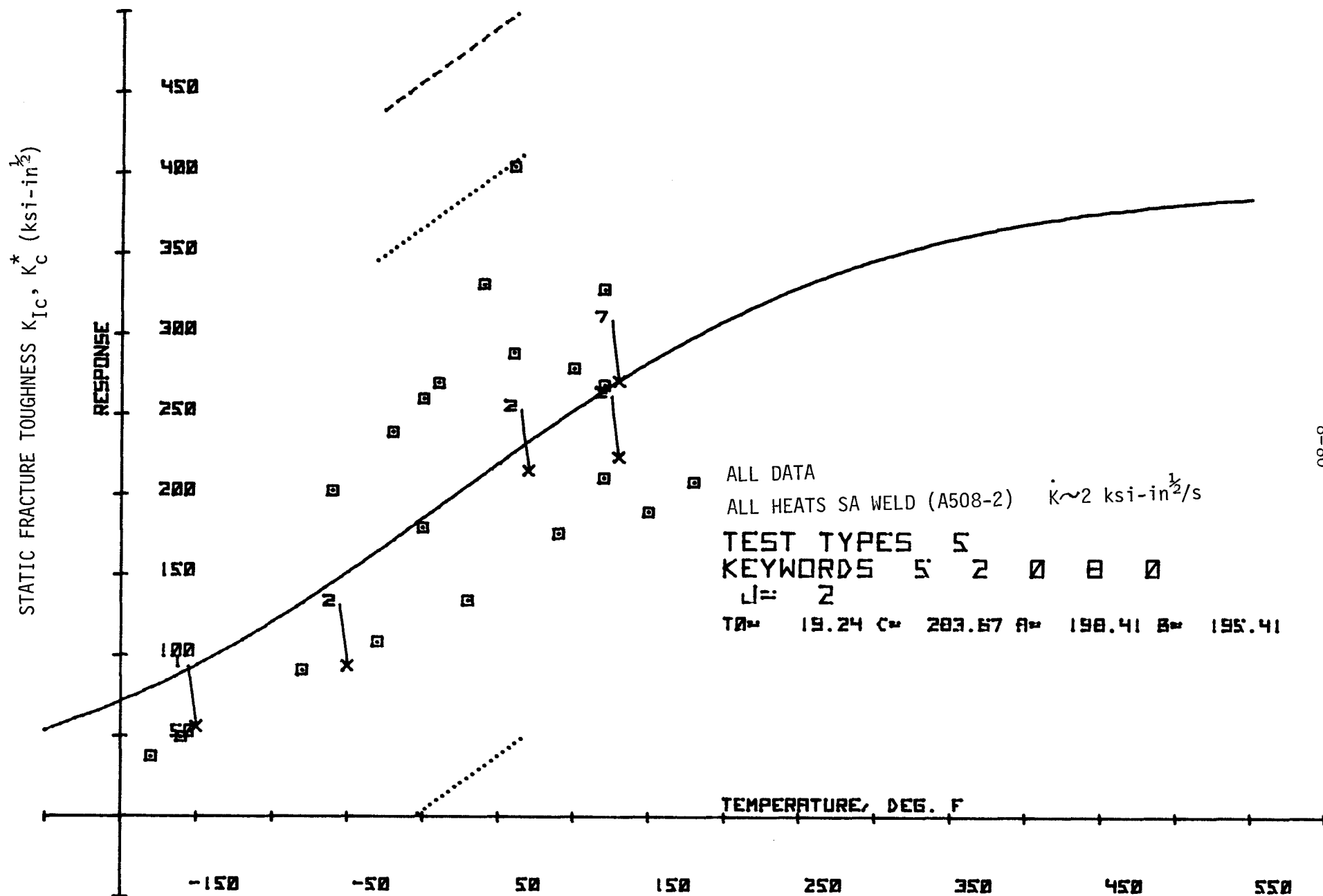


Figure 8.55. All Static Fracture Toughness Data for B&W Heats

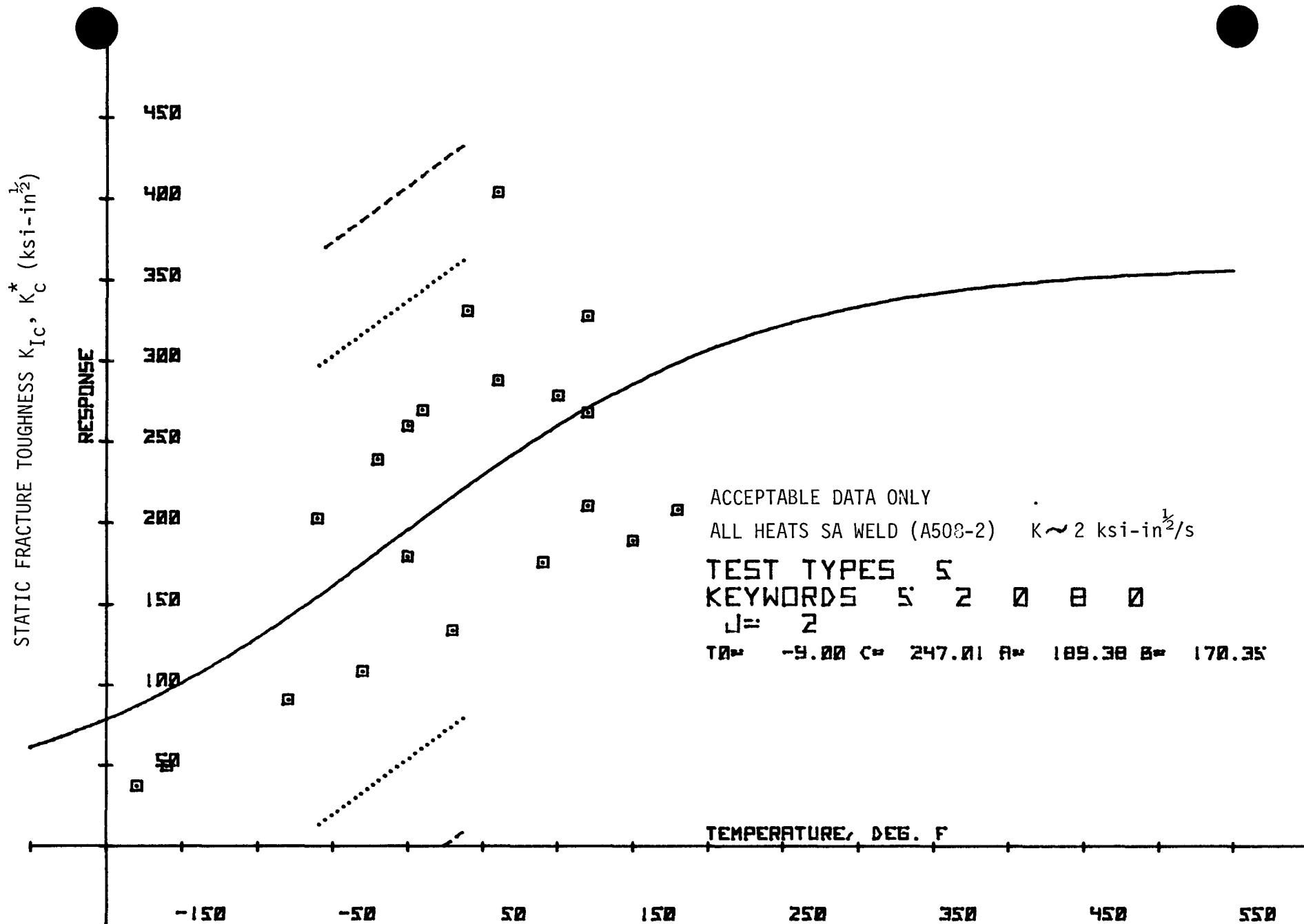


Figure 8.56. Acceptable Static Fracture Toughness for B&W Heats

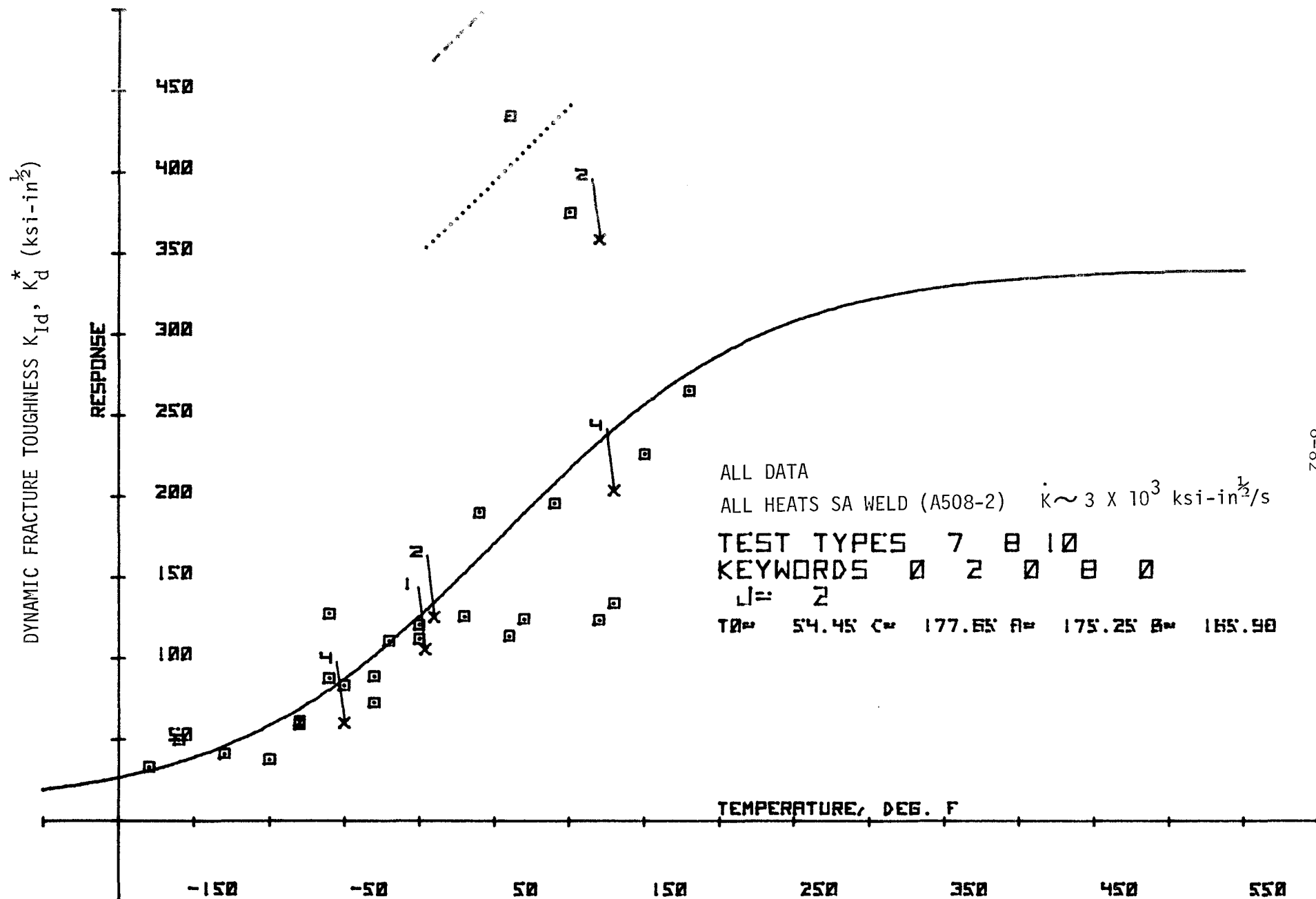


Figure 8.57. All Dynamic Fracture Toughness Data for B&W Heats

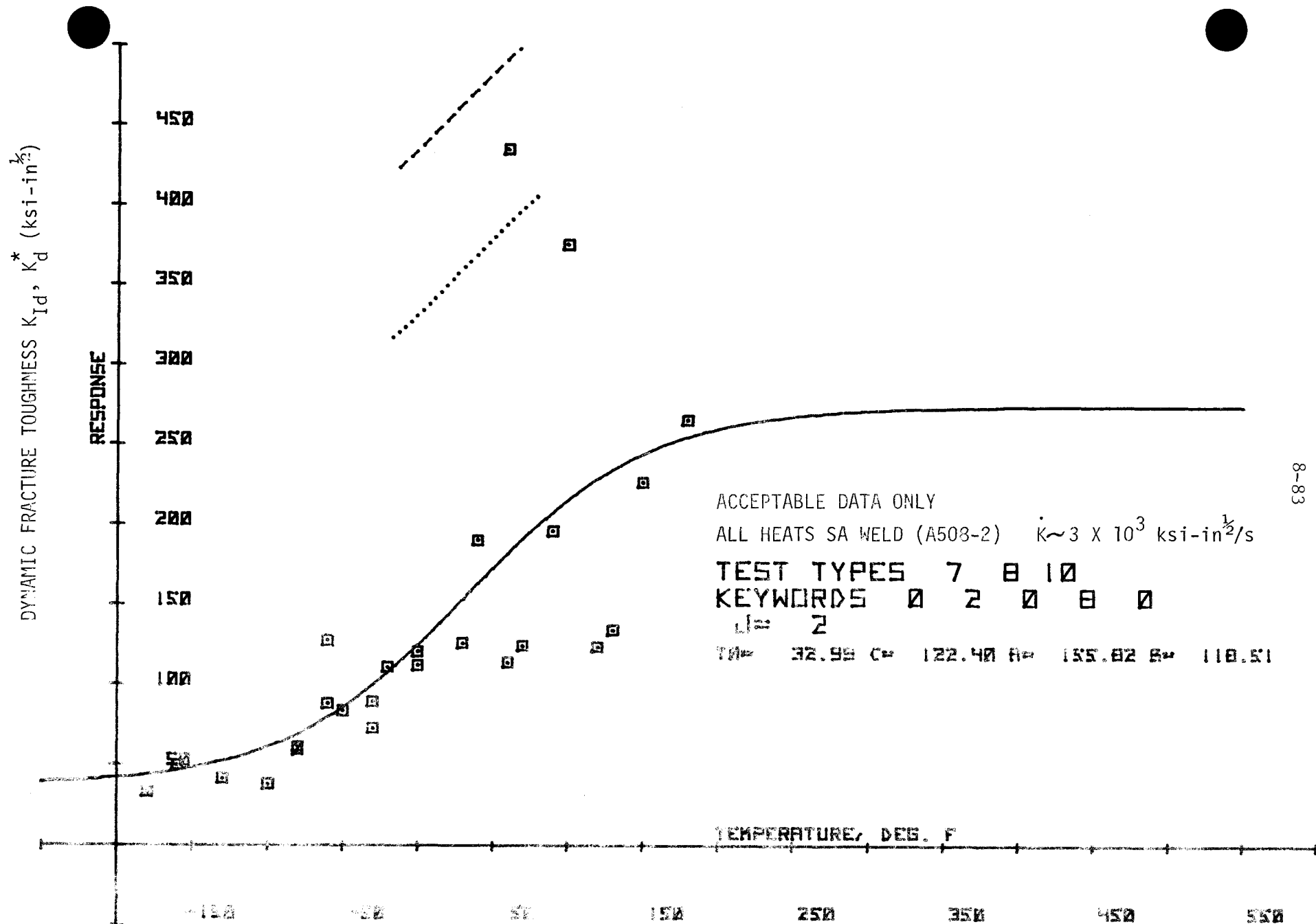


Figure 8.58. Acceptable Dynamic Fracture Toughness Data for B&W Heats

MATERIAL 8 DATA BANK (SA, A508-2)

RECORDS 0-4-0-0

(11)	4-2-1-8-2-2-0	-40.00	1.00	---	---	---	---
(12)	4-2-1-8-2-3-0	-30.00	1.00	---	---	---	---
(13)	4-2-1-8-2-5-0	-20.00	2.00	---	---	---	---
(14)	4-2-1-8-2-6-0	-20.00	2.00	---	---	---	---
(15)	4-2-1-8-2-4-0	-10.00	2.00	---	---	---	---
(16)	4-2-1-8-2-1-0	0.00	2.00	---	---	---	---
(25)	4-2-2-8-2-5-0	-100.00	1.00	---	---	---	---
(26)	4-2-2-8-2-4-0	-90.00	2.00	---	---	---	---
(27)	4-2-2-8-2-6-0	-90.00	1.00	---	---	---	---
(28)	4-2-2-8-2-3-0	-90.00	1.00	---	---	---	---
(29)	4-2-2-8-2-8-0	-70.00	2.00	---	---	---	---
(30)	4-2-2-8-2-7-0	-70.00	2.00	---	---	---	---
(31)	4-2-2-8-2-2-0	-40.00	2.00	---	---	---	---
(32)	4-2-2-8-2-1-0	0.00	2.00	---	---	---	---
(45)	4-2-3-8-2-4-0	-70.00	1.00	---	---	---	---
(46)	4-2-3-8-2-3-0	-60.00	1.00	---	---	---	---
(47)	4-2-3-8-2-3-0	-60.00	2.00	---	---	---	---
(48)	4-2-3-8-2-7-0	-50.00	2.00	---	---	---	---
(49)	4-2-3-8-2-6-0	-50.00	2.00	---	---	---	---
(50)	4-2-3-8-2-2-0	-40.00	2.00	---	---	---	---
(51)	4-2-3-8-2-1-0	0.00	2.00	---	---	---	---
(63)	4-2-4-8-2-1-0	0.00	1.00	---	---	---	---
(64)	4-2-4-8-2-5-0	10.00	2.00	---	---	---	---
(65)	4-2-4-8-2-4-0	10.00	2.00	---	---	---	---
(66)	4-2-4-8-2-2-0	20.00	2.00	---	---	---	---
(67)	4-2-4-8-2-2-0	40.00	2.00	---	---	---	---
(107)	4-2-11-8-2-3-0	-80.00	1.00	---	---	---	---
(108)	4-2-11-8-2-5-0	-70.00	1.00	---	---	---	---
(109)	4-2-11-8-2-8-0	-60.00	1.00	---	---	---	---
(110)	4-2-11-8-2-4-0	-60.00	2.00	---	---	---	---
(111)	4-2-11-8-2-7-0	-50.00	1.00	---	---	---	---
(112)	4-2-11-8-2-2-0	-40.00	2.00	---	---	---	---
(113)	4-2-11-8-2-8-0	-40.00	2.00	---	---	---	---
(114)	4-2-11-8-2-1-0	0.00	2.00	---	---	---	---
(147)	3-2-1-8-2-18-2	-120.00	44.40	---	---	373.00	2.40E+05
(148)	3-2-1-8-2-19-0	-90.00	38.00	---	---	408.00	1.90E+05
(149)	3-2-1-8-2-2-2	-60.00	40.20	---	---	829.00	2.90E+05
(150)	3-2-1-8-2-21-0	-30.00	48.70	---	---	1620.00	4.60E+05
(151)	3-2-1-8-2-22-0	-30.00	60.40	---	---	1340.00	4.50E+05
(152)	3-2-1-8-2-23-0	0.00	59.00	---	---	2040.00	3.10E+05
(153)	3-2-1-8-2-24-0	30.00	53.60	---	---	2390.00	2.80E+05
(154)	3-2-1-8-2-20-0	30.00	54.00	---	---	1620.00	4.20E+05
(155)	3-2-1-8-2-25-2	60.00	---	183.00	182.00	2540.00	3.30E+05
(156)	3-2-1-8-2-27-2	90.00	---	219.00	218.00	2650.00	3.30E+05
(157)	3-2-1-8-2-28-0	90.00	---	238.00	241.00	3600.00	3.70E+05

(158)	3-2-1-8-2-28-2	120.00	--	216.00	216.00	4560.00	2.90E+05
(159)	3-2-1-8-2-30-0	150.00	--	216.00	230.00	3710.00	3.40E+05
(160)	3-2-1-8-2-31-34	150.00	--	186.00	184.00	3100.00	3.30E+05
(161)	3-2-1-8-2-32-0	300.00	--	210.00	210.00	3620.00	3.10E+05
(162)	3-2-1-8-2-33-4	425.00	--	207.00	210.00	3950.00	4.20E+05
(163)	3-2-1-8-2-34-34	550.00	--	226.00	232.00	4550.00	4.60E+05
(195)	3-2-2-8-2-18-2	-170.00	40.90	--	--	110.00	2.20E+05
(196)	3-2-2-8-2-19-2	-140.00	48.30	--	--	222.00	2.30E+05
(197)	3-2-2-8-2-20-3	-110.00	38.30	--	--	654.00	2.40E+05
(198)	3-2-2-8-2-21-4	-80.00	50.30	--	--	503.00	3.20E+05
(199)	3-2-2-8-2-22-4	-80.00	47.20	--	--	1100.00	1.40E+06
(200)	3-2-2-8-2-23-0	-50.00	46.60	--	--	2190.00	1.90E+05
(201)	3-2-2-8-2-24-4	-20.00	64.60	--	--	1540.00	4.20E+05
(202)	3-2-2-8-2-25-34	-20.00	61.20	--	--	1800.00	4.20E+05
(203)	3-2-2-8-2-26-0	10.00	--	247.00	248.00	4770.00	3.90E+05
(204)	3-2-2-8-2-27-0	40.00	--	204.00	206.00	4090.00	3.60E+05
(205)	3-2-2-8-2-28-0	40.00	--	206.00	207.00	4070.00	3.60E+05
(206)	3-2-2-8-2-29-0	70.00	--	204.00	205.00	6280.00	3.40E+05
(207)	3-2-2-8-2-30-0	100.00	--	250.00	249.00	5230.00	3.30E+05
(208)	3-2-2-8-2-31-0	100.00	--	270.00	270.00	5220.00	3.30E+05
(209)	3-2-2-8-2-32-0	300.00	--	283.00	287.00	6700.00	2.80E+05
(210)	3-2-2-8-2-33-3	425.00	--	269.00	276.00	8800.00	4.10E+05
(211)	3-2-2-8-2-34-3	550.00	--	262.00	270.00	4080.00	4.00E+05
(243)	3-2-3-8-2-26-24	-150.00	49.90	--	--	396.00	2.60E+05
(244)	3-2-3-8-2-21-2	-120.00	51.10	--	--	458.00	2.50E+05
(245)	3-2-3-8-2-22-0	-90.00	47.20	--	--	896.00	4.40E+05
(246)	3-2-3-8-2-24-0	-60.00	47.80	--	--	2050.00	4.50E+05
(247)	3-2-3-8-2-25-0	-60.00	57.20	--	--	1910.00	4.50E+05
(248)	3-2-3-8-2-26-0	-30.00	--	250.00	250.00	3700.00	3.80E+05
(249)	3-2-3-8-2-27-2	0.00	--	254.00	254.00	5560.00	3.60E+05
(250)	3-2-3-8-2-28-2	0.00	--	258.00	256.00	5450.00	3.60E+05
(251)	3-2-3-8-2-29-3	30.00	--	296.00	296.00	6220.00	3.00E+05
(252)	3-2-3-8-2-30-2	60.00	--	306.00	305.00	7420.00	2.90E+05
(253)	3-2-3-8-2-31-0	60.00	--	328.00	331.00	8740.00	3.00E+05
(254)	3-2-3-8-2-32-2	90.00	--	266.00	264.00	6500.00	2.80E+05
(255)	3-2-3-8-2-33-2	120.00	--	274.00	272.00	7280.00	2.90E+05
(256)	3-2-3-8-2-34-2	120.00	--	280.00	279.00	7320.00	2.90E+05
(257)	3-2-3-8-2-35-4	300.00	--	269.00	271.00	8940.00	2.10E+05
(258)	3-2-3-8-2-36-2	425.00	--	262.00	260.00	8300.00	2.40E+05
(259)	3-2-3-8-2-23-2	550.00	--	230.00	232.00	6480.00	2.20E+05
(294)	3-2-4-8-2-15-0	-90.00	37.70	--	--	341.00	2.00E+05
(295)	3-2-4-8-2-16-3	-60.00	30.10	--	--	452.00	3.30E+05
(296)	3-2-4-8-2-17-0	-30.00	39.50	--	--	1290.00	3.40E+05
(297)	3-2-4-8-2-18-0	0.00	36.30	--	--	1250.00	2.80E+05
(298)	3-2-4-8-2-19-0	0.00	46.70	--	--	1340.00	1.80E+05
(299)	3-2-4-8-2-20-2	30.00	49.70	--	--	2020.00	3.60E+05
(300)	3-2-4-8-2-21-2	60.00	--	208.00	207.00	3070.00	2.70E+05
(301)	3-2-4-8-2-22-2	60.00	--	235.00	233.00	3280.00	2.80E+05
(302)	3-2-4-8-2-23-2	90.00	--	186.00	152.00	2370.00	2.50E+05
(303)	3-2-4-8-2-24-0	120.00	--	229.00	229.00	4120.00	2.70E+05

(304)	3-2-4-8-2-25-0	120.00	--	228.00	227.00	3910.00	2.90E+05
(305)	3-2-4-8-2-26-2	150.00	--	225.00	223.00	3790.00	2.60E+05
(306)	3-2-4-8-2-27-0	180.00	--	235.00	237.00	4310.00	3.20E+05
(307)	3-2-4-8-2-28-2	300.00	--	205.00	204.00	4100.00	2.30E+05
(308)	3-2-4-8-2-29-2	425.00	--	202.00	202.00	4030.00	2.40E+05
(309)	3-2-4-8-2-30-2	550.00	--	204.00	203.00	4090.00	2.50E+05
(398)	3-2-11-8-2-15-3	-140.00	34.70	--	--	174.00	1.60E+05
(399)	3-2-11-8-2-16-2	-110.00	29.50	--	--	678.00	1.50E+05
(400)	3-2-11-8-2-17-3	-80.00	44.00	--	--	433.00	2.60E+05
(401)	3-2-11-8-2-18-2	-50.00	--	115.70	116.20	1500.00	3.60E+05
(402)	3-2-11-8-2-19-2	-50.00	--	101.50	100.80	1070.00	4.20E+05
(403)	3-2-11-8-2-20-2	-20.00	43.20	--	--	1190.00	3.80E+05
(404)	3-2-11-8-2-21-2	10.00	--	186.00	186.00	1920.00	3.30E+05
(405)	3-2-11-8-2-22-0	10.00	--	100.00	100.00	1570.00	3.70E+05
(406)	3-2-11-8-2-23-2	40.00	--	207.00	209.00	2540.00	3.60E+05
(408)	3-2-11-8-2-24-2	70.00	--	219.00	218.00	3420.00	2.90E+05
(409)	3-2-11-8-2-25-2	70.00	--	197.00	196.00	3360.00	3.10E+05
(410)	3-2-11-8-2-26-2	100.00	--	202.00	201.00	3450.00	2.70E+05
(411)	3-2-11-8-2-27-0	130.00	--	203.00	203.00	3580.00	3.00E+05
(412)	3-2-11-8-2-28-0	300.00	--	223.00	229.00	3770.00	2.60E+05
(413)	3-2-11-8-2-29-4	425.00	--	202.00	203.00	3890.00	2.60E+05
(414)	3-2-11-8-2-30-2	550.00	--	170.00	160.00	3130.00	2.30E+05
(479)	2-2-1-8-2-1-0	-250.00	2.00	1.50	1.00	--	--
(480)	2-2-1-8-2-2-0	-200.00	3.10	5.00	1.00	--	--
(481)	2-2-1-8-2-3-0	-150.00	5.60	7.00	1.00	--	--
(482)	2-2-1-8-2-4-0	-100.00	13.70	9.00	1.00	--	--
(483)	2-2-1-8-2-5-0	-60.00	25.20	23.00	20.00	--	--
(484)	2-2-1-8-2-6-0	-40.00	24.30	21.00	30.00	--	--
(485)	2-2-1-8-2-7-0	-20.00	35.00	33.00	30.00	--	--
(486)	2-2-1-8-2-8-0	0.00	42.00	37.00	40.00	--	--
(487)	2-2-1-8-2-9-0	30.00	20.30	27.00	20.00	--	--
(488)	2-2-1-8-2-10-0	30.00	52.00	47.00	50.00	--	--
(489)	2-2-1-8-2-11-0	30.00	32.90	37.00	40.00	--	--
(490)	2-2-1-8-2-12-0	150.00	70.60	69.00	99.00	--	--
(491)	2-2-1-8-2-13-0	200.00	89.90	72.00	99.00	--	--
(492)	2-2-1-8-2-14-0	250.00	72.00	73.00	99.00	--	--
(493)	2-2-1-8-2-15-0	300.00	74.90	77.00	99.00	--	--
(494)	2-2-1-8-2-16-0	425.00	83.90	83.00	99.00	--	--
(495)	2-2-1-8-2-17-0	550.00	60.90	64.00	99.00	--	--
(496)	2-2-1-8-3-1-0	-200.00	3.20	3.00	1.00	--	--
(497)	2-2-1-8-3-2-0	-150.00	23.80	17.00	1.00	--	--
(498)	2-2-1-8-3-3-0	-100.00	54.20	36.00	10.00	--	--
(499)	2-2-1-8-3-4-0	-50.00	147.90	89.00	80.00	--	--
(500)	2-2-1-8-3-5-0	0.00	197.10	88.00	99.00	--	--
(501)	2-2-1-8-3-6-0	50.00	155.50	85.00	90.00	--	--
(502)	2-2-1-8-3-7-0	100.00	229.10	88.00	99.00	--	--
(503)	2-2-1-8-3-8-0	150.00	162.00	98.00	99.00	--	--
(504)	2-2-1-8-3-9-0	200.00	120.90	81.00	99.00	--	--
(505)	2-2-1-8-3-10-0	250.00	239.60	84.00	99.00	--	--
(506)	2-2-1-8-3-11-0	300.00	215.20	85.00	99.00	--	--
(0)	2-2-2-8-2-1-0	-250.00	2.00	1.00	1.00	--	--

(1)	2-2-2-8-2-3-0	-200.00	3.80	3.00	1.00	---	---
(2)	2-2-2-8-2-3-0	-150.00	2.60	3.00	1.00	---	---
(3)	2-2-2-8-2-4-0	-100.00	22.80	20.00	20.00	---	---
(4)	2-2-2-8-2-5-0	-60.00	28.50	22.00	20.00	---	---
(5)	2-2-2-8-2-6-0	-40.00	50.00	36.00	30.00	---	---
(6)	2-2-2-8-2-7-0	-20.00	56.50	48.00	50.00	---	---
(7)	2-2-2-8-2-8-0	-20.00	76.00	61.00	50.00	---	---
(8)	2-2-2-8-2-9-0	-20.00	65.20	48.00	50.00	---	---
(9)	2-2-2-8-2-10-0	0.00	102.20	76.00	80.00	---	---
(10)	2-2-2-8-2-11-0	75.00	122.20	87.00	90.00	---	---
(11)	2-2-2-8-2-12-0	150.00	119.20	85.00	99.00	---	---
(12)	2-2-2-8-2-13-0	200.00	130.30	92.00	99.00	---	---
(13)	2-2-2-8-2-14-0	250.00	134.30	90.00	99.00	---	---
(14)	2-2-2-8-2-15-0	300.00	140.30	93.00	99.00	---	---
(15)	2-2-2-8-2-16-0	425.00	152.50	84.00	99.00	---	---
(16)	2-2-2-8-2-17-0	550.00	130.00	87.00	99.00	---	---
(17)	2-2-2-8-3-1-0	-200.00	6.30	3.00	1.00	---	---
(18)	2-2-2-8-3-2-0	-150.00	9.00	12.00	10.00	---	---
(19)	2-2-2-8-3-3-0	-100.00	29.70	19.00	20.00	---	---
(20)	2-2-2-8-3-4-0	-50.00	104.00	65.00	40.00	---	---
(21)	2-2-2-8-3-5-0	0.00	158.20	84.00	90.00	---	---
(22)	2-2-2-8-3-6-0	50.00	174.00	80.00	94.00	---	---
(23)	2-2-2-8-3-7-0	100.00	175.40	80.00	99.00	---	---
(24)	2-2-2-8-3-8-0	150.00	157.90	86.00	99.00	---	---
(25)	2-2-2-8-3-9-0	200.00	181.90	89.00	99.00	---	---
(26)	2-2-2-8-3-10-0	250.00	239.70	88.00	95.00	---	---
(27)	2-2-2-8-3-11-0	300.00	239.80	86.00	99.00	---	---
(28)	2-2-2-8-3-12-0	-200.00	2.90	4.00	1.00	---	---
(29)	2-2-3-8-2-2-0	-150.00	3.00	3.00	1.00	---	---
(30)	2-2-3-8-2-3-0	-100.00	12.00	11.00	10.00	---	---
(31)	2-2-3-8-2-4-0	-80.00	48.00	40.00	20.00	---	---
(32)	2-2-3-8-2-5-0	-80.00	20.00	18.00	10.00	---	---
(33)	2-2-3-8-2-6-0	-50.00	58.00	45.00	30.00	---	---
(34)	2-2-3-8-2-7-0	-50.00	87.90	64.00	60.00	---	---
(35)	2-2-3-8-2-8-0	-50.00	100.50	77.00	40.00	---	---
(36)	2-2-3-8-2-9-0	0.00	116.00	89.00	90.00	---	---
(37)	2-2-3-8-2-10-0	0.00	129.00	90.00	90.00	---	---
(38)	2-2-3-8-2-11-0	0.00	125.50	90.00	90.00	---	---
(39)	2-2-3-8-2-12-0	40.00	139.00	94.00	99.00	---	---
(40)	2-2-3-8-2-13-0	75.00	162.40	93.00	99.00	---	---
(41)	2-2-3-8-2-14-0	150.00	152.30	95.00	99.00	---	---
(42)	2-2-3-8-2-15-0	200.00	154.10	92.00	99.00	---	---
(43)	2-2-3-8-2-16-0	250.00	239.40	77.00	99.00	---	---
(44)	2-2-3-8-2-17-0	300.00	211.20	67.00	99.00	---	---
(45)	2-2-3-8-2-18-0	425.00	224.00	63.00	99.00	---	---
(46)	2-2-3-8-2-19-0	550.00	205.20	84.00	99.00	---	---
(47)	2-2-3-8-3-1-0	-200.00	4.50	5.00	1.00	---	---
(48)	2-2-3-8-3-2-0	-150.00	6.00	4.00	1.00	---	---
(49)	2-2-3-8-3-3-0	-100.00	35.20	16.00	10.00	---	---
(50)	2-2-3-8-3-4-0	-50.00	111.20	75.00	60.00	---	---
(51)	2-2-3-8-3-5-0	0.00	148.40	95.00	80.00	---	---

(115)	2-2-3-3-3-0-0	50.00	163.30	93.00	39.00	--	--
(116)	2-2-3-3-3-7-0	100.00	197.90	95.00	99.00	--	--
(117)	2-2-3-3-3-5-0	150.00	193.10	90.00	90.00	--	--
(118)	2-2-3-3-3-9-0	200.00	191.10	90.00	99.00	--	--
(119)	2-2-3-3-3-10-0	250.00	137.50	85.00	99.00	--	--
(120)	2-2-3-3-3-11-0	300.00	239.50	82.00	99.00	--	--
(121)	2-2-4-3-2-1-0	-250.00	2.00	1.00	1.00	--	--
(122)	2-2-4-3-2-2-0	-200.00	3.00	1.00	1.00	--	--
(123)	2-2-4-3-2-3-0	-150.00	4.20	2.00	1.00	--	--
(124)	2-2-4-3-2-4-0	-100.00	14.90	10.00	1.00	--	--
(125)	2-2-4-3-2-14-0	-150.00	4.90	6.00	1.00	--	--
(126)	2-2-4-3-2-5-0	-50.00	30.20	29.00	10.00	--	--
(127)	2-2-4-3-2-6-0	0.00	48.50	38.00	20.00	--	--
(128)	2-2-4-3-2-32-0	60.00	63.90	55.00	80.00	--	--
(129)	2-2-4-3-2-33-0	60.00	68.50	59.00	80.00	--	--
(130)	2-2-4-3-2-35-0	60.00	69.50	57.00	90.00	--	--
(131)	2-2-4-3-2-7-0	78.00	55.00	47.00	80.00	--	--
(132)	2-2-4-3-2-9-0	150.00	80.00	69.00	90.00	--	--
(133)	2-2-4-3-2-0-0	200.00	91.00	84.00	99.00	--	--
(134)	2-2-4-3-2-10-0	250.00	82.90	72.00	90.00	--	--
(135)	2-2-4-3-2-11-0	300.00	80.50	77.00	99.00	--	--
(136)	2-2-4-3-2-12-0	425.00	84.20	80.00	99.00	--	--
(137)	2-2-4-3-2-13-0	550.00	91.30	83.00	93.00	--	--
(138)	2-2-4-3-3-1-0	-200.00	6.00	4.00	1.00	--	--
(139)	2-2-4-3-3-2-0	-150.00	17.50	11.00	1.00	--	--
(140)	2-2-4-3-3-3-0	-100.00	72.00	46.00	30.00	--	--
(141)	2-2-4-3-3-4-0	-50.00	156.20	85.00	80.00	--	--
(142)	2-2-4-3-3-5-0	0.00	163.50	87.00	90.00	--	--
(143)	2-2-4-3-3-6-0	50.00	170.90	89.00	99.00	--	--
(144)	2-2-4-3-3-7-0	100.00	149.80	86.00	99.00	--	--
(145)	2-2-4-3-3-8-0	150.00	173.90	98.00	99.00	--	--
(146)	2-2-4-3-3-9-0	200.00	108.40	78.00	99.00	--	--
(147)	2-2-4-3-3-10-0	250.00	137.90	86.00	99.00	--	--
(148)	2-2-4-3-3-11-0	300.00	239.50	81.00	99.00	--	--
(149)	2-2-11-3-1-1-0	-250.00	2.30	1.00	1.00	--	--
(150)	2-2-11-3-2-2-0	-200.00	3.80	2.00	1.00	--	--
(151)	2-2-11-3-3-3-0	-150.00	9.20	8.00	1.00	--	--
(152)	2-2-11-3-2-4-0	-100.00	4.00	4.00	1.00	--	--
(153)	2-2-11-3-2-5-0	-50.00	26.00	22.00	10.00	--	--
(154)	2-2-11-3-2-6-0	0.00	30.20	28.00	20.00	--	--
(155)	2-2-11-3-2-14-0	10.00	31.90	28.00	30.00	--	--
(156)	2-2-11-3-2-32-0	10.00	58.90	56.00	60.00	--	--
(157)	2-2-11-3-2-33-0	40.00	60.00	50.00	60.00	--	--
(158)	2-2-11-3-2-35-0	40.00	52.20	47.00	50.00	--	--
(159)	2-2-11-3-2-36-0	40.00	42.10	37.00	50.00	--	--
(160)	2-2-11-3-2-38-0	40.00	40.00	33.00	45.00	--	--
(161)	2-2-11-3-2-34-0	60.00	73.30	68.00	90.00	--	--
(162)	2-2-11-3-2-37-0	60.00	68.30	60.00	90.00	--	--
(163)	2-2-11-3-2-7-0	78.00	59.80	57.00	90.00	--	--
(164)	2-2-11-3-2-8-0	150.00	76.60	72.00	99.00	--	--
(165)	2-2-11-3-2-9-0	200.00	78.00	69.00	99.00	--	--

(510)	5-2-2-3-2-11-0	-180.00	37.60	--	--	--	2.80
(512)	5-2-2-3-2-10-0	-80.00	--	91.10	87.00	--	3.80
(520)	5-2-2-3-2-2-0	-20.00	--	239.00	233.20	--	--
(521)	5-2-2-3-2-1-0	40.00	--	330.90	324.80	--	3.60
(532)	5-2-3-3-2-2-0	100.00	--	273.30	290.50	--	3.50
(533)	5-2-3-3-2-1-0	-100.00	49.73	--	--	--	3.30
(534)	5-2-3-3-2-0-0	-60.00	--	202.60	202.00	--	3.30
(535)	5-2-3-3-2-11-0	0.00	--	259.70	258.10	--	0.50
(536)	5-2-3-3-2-2-0	60.00	--	400.00	400.50	--	3.00
(537)	5-2-3-3-2-1-0	120.00	--	327.90	325.90	--	4.10
(548)	5-2-4-3-2-5-0	0.00	--	179.40	167.70	--	1.70
(549)	5-2-4-3-2-0-0	60.00	--	288.00	257.60	--	1.80
(550)	5-2-4-3-2-0-0	120.00	--	210.50	233.90	--	3.10
(551)	5-2-4-3-2-11-0	120.00	--	268.20	247.20	--	1.70
(552)	5-2-4-3-2-0-0	180.00	--	208.10	232.10	--	--
(16)	5-2-11-3-2-9-1	-150.00	33.80	--	--	--	5.10
(17)	5-2-11-3-2-4-2	-50.00	--	93.90	95.10	--	1.80
(18)	5-2-11-3-2-2-0	10.00	--	269.30	249.40	--	1.60
(19)	5-2-11-3-2-1-0	70.00	--	215.00	204.10	--	1.60
(20)	5-2-11-3-2-0-0	130.00	--	272.90	245.30	--	1.60
(21)	5-2-11-3-2-7-0	130.00	--	223.70	249.60	--	--
(24)	7-2-1-3-2-1-0	-30.00	73.10	--	--	--	2680.00
(29)	7-2-3-3-2-1-0	-60.00	--	127.60	110.30	--	2100.00
(31)	7-2-4-3-2-1-1	4.00	105.90	--	--	--	2200.00
(34)	7-2-11-3-2-1-4	-50.00	60.50	--	--	--	2500.00
(38)	10-2-2-3-2-1-0	-80.00	59.70	--	--	--	3700.00
(50)	5-2-1-3-2-4-0	-130.00	41.50	--	--	--	2100.00
(51)	5-2-1-3-2-3-0	-30.00	--	89.50	86.00	--	5300.00
(52)	5-2-1-3-2-2-0	30.00	--	126.00	117.10	--	5900.00
(53)	5-2-1-3-2-1-0	90.00	--	195.80	176.60	--	5200.00
(54)	5-2-1-3-2-0-0	150.00	--	226.20	228.10	--	4400.00
(65)	8-2-2-3-2-5-0	-180.00	33.40	--	--	--	1500.00
(66)	8-2-2-3-2-4-0	-80.00	61.50	--	--	--	5600.00
(67)	8-2-2-3-2-3-0	-20.00	--	110.90	104.90	--	5900.00
(68)	8-2-2-3-2-2-0	40.00	--	189.90	182.90	--	5700.00
(69)	8-2-2-3-2-1-0	100.00	--	375.10	311.40	--	4700.00
(70)	8-2-3-3-2-4-0	-150.00	56.60	--	--	--	2300.00
(81)	8-2-3-3-2-3-0	-60.00	--	89.30	82.60	--	5100.00
(82)	8-2-3-3-2-2-0	0.00	--	112.00	109.00	--	5100.00
(83)	8-2-3-3-2-1-0	60.00	--	434.70	414.30	--	5300.00
(84)	8-2-3-3-2-0-0	120.00	--	358.30	372.40	--	4900.00
(95)	8-2-4-3-2-4-0	-100.00	38.10	--	--	--	4500.00
(96)	8-2-4-3-2-3-0	0.00	--	120.60	111.70	--	3100.00
(97)	8-2-4-3-2-2-0	60.00	--	114.00	100.70	--	3100.00
(98)	8-2-4-3-2-1-0	120.00	--	123.70	112.20	--	3000.00
(99)	8-2-4-3-2-0-0	180.00	--	265.10	267.00	--	4000.00
(129)	8-2-11-3-2-7-0	-50.00	--	84.10	76.40	--	3300.00
(130)	8-2-11-3-2-6-2	10.00	--	125.60	115.10	--	3200.00
(131)	8-2-11-3-2-5-0	70.00	--	124.40	113.90	--	3000.00
(132)	8-2-11-3-2-4-0	130.00	--	134.40	123.00	--	3200.00
(133)	8-2-11-3-2-3-4	130.00	--	203.90	211.70	--	4700.00

(363)	2-2-11-8-2-10-0	250.00	76.80	73.00	99.00	--	--
(364)	2-2-11-8-2-11-0	300.00	77.50	71.00	99.00	--	--
(365)	2-2-11-8-2-12-0	425.00	72.50	72.00	99.00	--	--
(366)	2-2-11-8-2-13-0	550.00	78.00	77.00	99.30	--	--
(367)	2-2-11-8-2-39-0	60.00	65.60	58.00	90.00	--	--
(368)	2-2-11-8-3-1-0	-200.00	3.60	6.00	1.00	--	--
(369)	2-2-11-8-3-2-0	-150.00	7.20	12.00	1.00	--	--
(370)	2-2-11-8-3-3-0	-100.00	16.90	12.00	10.00	--	--
(371)	2-2-11-8-3-4-0	-50.00	40.80	34.00	30.00	--	--
(372)	2-2-11-8-3-5-0	0.00	61.20	53.00	40.00	--	--
(373)	2-2-11-8-3-6-0	50.00	81.90	70.00	40.00	--	--
(374)	2-2-11-8-3-7-0	100.00	123.50	91.00	90.00	--	--
(375)	2-2-11-8-3-8-0	150.00	148.90	96.00	98.00	--	--
(376)	2-2-11-8-3-9-0	200.00	208.20	94.00	99.00	--	--
(377)	2-2-11-8-3-10-0	250.00	166.90	99.00	99.00	--	--
(378)	2-2-11-8-3-11-0	300.00	239.30	94.00	99.00	--	--
(379)	2-2-11-8-3-12-0	425.00	239.50	77.00	99.00	--	--
(392)	1-2-1-0-1-1-0	-200.00	87.80	110.80	17.00	28.80	56.00
(393)	1-2-1-0-1-2-0	-25.00	71.80	94.90	15.00	26.40	61.10
(394)	1-2-1-0-1-3-0	75.00	71.10	90.80	11.00	24.00	62.00
(395)	1-2-1-0-1-4-0	200.00	67.20	84.20	10.50	21.60	60.90
(396)	1-2-1-0-1-5-0	300.00	64.50	80.70	9.50	20.80	58.70
(397)	1-2-1-0-1-6-0	550.00	61.50	80.90	9.50	20.00	56.50
(410)	1-2-2-0-1-1-0	-203.00	107.80	117.80	13.60	28.80	66.20
(411)	1-2-2-0-1-2-0	-25.00	86.10	99.70	14.00	26.40	69.50
(412)	1-2-2-0-1-3-0	75.00	82.00	95.40	10.00	24.80	70.40
(413)	1-2-2-0-1-4-0	200.00	80.40	91.90	9.00	23.20	68.90
(414)	1-2-2-0-1-5-0	300.00	74.60	86.80	9.30	23.20	70.90
(415)	1-2-2-0-1-6-0	550.00	71.10	80.00	10.50	21.60	65.10
(428)	1-2-3-0-1-1-0	-200.00	100.30	114.00	14.50	29.60	67.90
(429)	1-2-3-0-1-2-0	-25.00	82.40	97.30	10.00	28.00	72.00
(430)	1-2-3-0-1-3-0	75.00	76.40	89.00	10.00	25.60	72.7
(431)	1-2-3-0-1-4-0	200.00	75.10	80.30	8.50	24.00	71.10
(432)	1-2-3-0-1-5-0	300.00	68.70	80.90	8.50	23.20	72.30
(433)	1-2-3-0-1-6-0	550.00	64.00	82.20	9.00	22.40	70.00
(446)	1-2-4-0-1-1-0	-200.00	98.50	111.00	15.00	28.00	57.90
(447)	1-2-4-0-1-2-0	-25.00	76.70	95.20	13.00	25.60	62.20
(448)	1-2-4-0-1-3-0	75.00	74.50	92.40	10.00	24.00	64.60
(449)	1-2-4-0-1-4-0	200.00	69.20	83.90	10.00	24.80	65.90
(450)	1-2-4-0-1-5-0	300.00	63.60	79.30	9.50	20.00	62.40
(451)	1-2-4-0-1-6-0	550.00	61.20	80.00	7.80	18.40	59.00
(488)	1-2-11-8-1-1-0	-220.00	95.00	106.90	17.00	31.20	60.90
(489)	1-2-11-8-1-2-0	-25.00	67.20	87.10	10.00	30.40	65.90
(490)	1-2-11-8-1-3-0	75.00	63.60	81.40	10.50	28.00	67.20
(491)	1-2-11-8-1-4-0	200.00	65.40	80.30	11.80	24.00	64.20
(492)	1-2-11-8-1-5-0	300.00	57.90	74.80	11.20	23.20	60.40
(493)	1-2-11-8-1-6-0	550.00	56.10	74.90	10.70	22.40	60.90
(504)	5-2-1-0-2-0-0	-30.00	--	108.70	102.00	--	3.60
(505)	5-2-1-0-2-11-0	30.00	--	134.10	132.70	--	3.70
(506)	5-2-1-0-2-18-0	90.00	--	175.80	195.20	--	3.60
(507)	5-2-1-0-2-5-0	150.00	--	189.20	190.30	--	3.80