APPENDIX C   CHARPY V-NOTCH PLOTS FOR EACH CAPSULE INCLUDING BASELINE DATA USING SYMMETRIC HYPERBOLIC TANGENT CURVE-FITTING METHOD

C.1   METHODOLOGY

Contained in Table C-1 are the upper-shelf energy (USE) values that are used as input for the generation of the Charpy V-notch plots using CVGRAPH, Version 6.02. The definition for USE is given in ASTM E185-82 [C-1], Section 4.18, and reads as follows:

> *upper shelf energy level* – the average energy value for all Charpy specimens (normally three) whose test temperature is above the upper end of the transition region. For specimens tested in sets of three at each test temperature, the set having the highest average may be regarded as defining the upper shelf energy.

Westinghouse reports the average of all Charpy data ($\geq$ 95% shear) as the USE, excluding any values that are deemed outliers using engineering judgment. Hence, the Capsule N USE values reported in Table C-1 were determined by applying this methodology to the Charpy data tabulated in Table 5-1 through Table 5-5 of this report. USE values documented in Table C-1 for the unirradiated material, as well as for Capsules V, P, R, and S, were also determined by applying the methodology described above to the Charpy impact data reported in WCAP-8086 [C-2] and WCAP-14779 [C-3]. The USE values reported in Table C-1 were used in the generation of the Charpy V-notch curves.

The lower-shelf energy values were fixed at 2.2 ft-lb for all cases. The lower-shelf lateral expansion values were fixed at 1.0 mil to be consistent with the previous capsule analysis. Similarly, the upper-shelf energy must also be fixed for curve-fitting the Charpy V-notch (CVN) Energy data using the values reported in Table C-1. However, the upper-shelf lateral expansion is not fixed in CVGRAPH. The only exceptions to this in the following graphs are for the Capsules N and V HAZ material, which did have the upper-shelf lateral expansion set to fixed values, because the CVGRAPH software produced artificially high upper-shelf lateral expansion values without setting the value. The fixed lateral expansion values were based on an average of all the lateral expansion values corresponding to greater than or equal to 95% shear.

Table C-1   Upper-Shelf Energy Values (ft-lb) Fixed in CVGRAPH[1]

Material	Unirradiated (ft-lb)	Capsule V (ft-lb)	Capsule P (ft-lb)	Capsule R (ft-lb)	Capsule S (ft-lb)	Capsule N (ft-lb)
Intermediate Shell Forging C (Tangential Orientation)	158.5	155.1	142.2	145.0	142.5	138.0
Intermediate Shell Forging C (Axial Orientation)	143.1	143.3	136.3	128.7	135.0	119.5
Intermediate Shell to Lower Shell Circumferential Weld - Seam W3 (Heat # 1752)	82.5	90.0	83.2	75.0	84.5	79.0
Heat Affected Zone (HAZ) Material	211.1[2]	---[3]	143.3	97.3	136.0	105.2
Correlation Monitor Material (CMM)	120.4	91.3	84.8	80.7	82.5	56.8

Notes:

1. These values are calculated as an average of all in-family data points with a shear ≥ 95%, consistent with ASTM E185-82 [C-1], unless otherwise noted.
2. One 95% shear data point (145 ft-lb at 80°F) was considered out-of-family and excluded from the USE calculation.
3. Upper shelf impact energy not obtainable due to excessive toughness per WCAP-14779 [C-3].

CVGRAPH, Version 6.02 plots of all surveillance data are provided in this appendix, on the pages following the reference list.

C.2   REFERENCES

C-1   ASTM E185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels," American Society for Testing and Materials, 1982.

C-2   Westinghouse Report WCAP-8086, Rev. 0, "Northern States Power Co. Prairie Island Unit No. 1 Reactor Vessel Radiation Surveillance Program," June 1973.

C-3   Westinghouse Report WCAP-14779, Rev. 2, "Analysis of Capsule S from the Northern States Power Company Prairie Island Unit 1 Reactor Vessel Radiation Surveillance Program," February 1998.

C.3   CVGRAPH VERSION 6.02 INDIVIDUAL PLOTS

Unirradiated Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/29/2021 9:12 AM

A = 80.35 B = 78.15 C = 91.82 T0 = 31.21 D = 0.00

Correlation Coefficient = 0.983

Equation is A + B * [Tanh((T-T0)/(C+DT))]

Upper Shelf Energy = 158.50 (Fixed)   Lower Shelf Energy = 2.20 (Fixed)
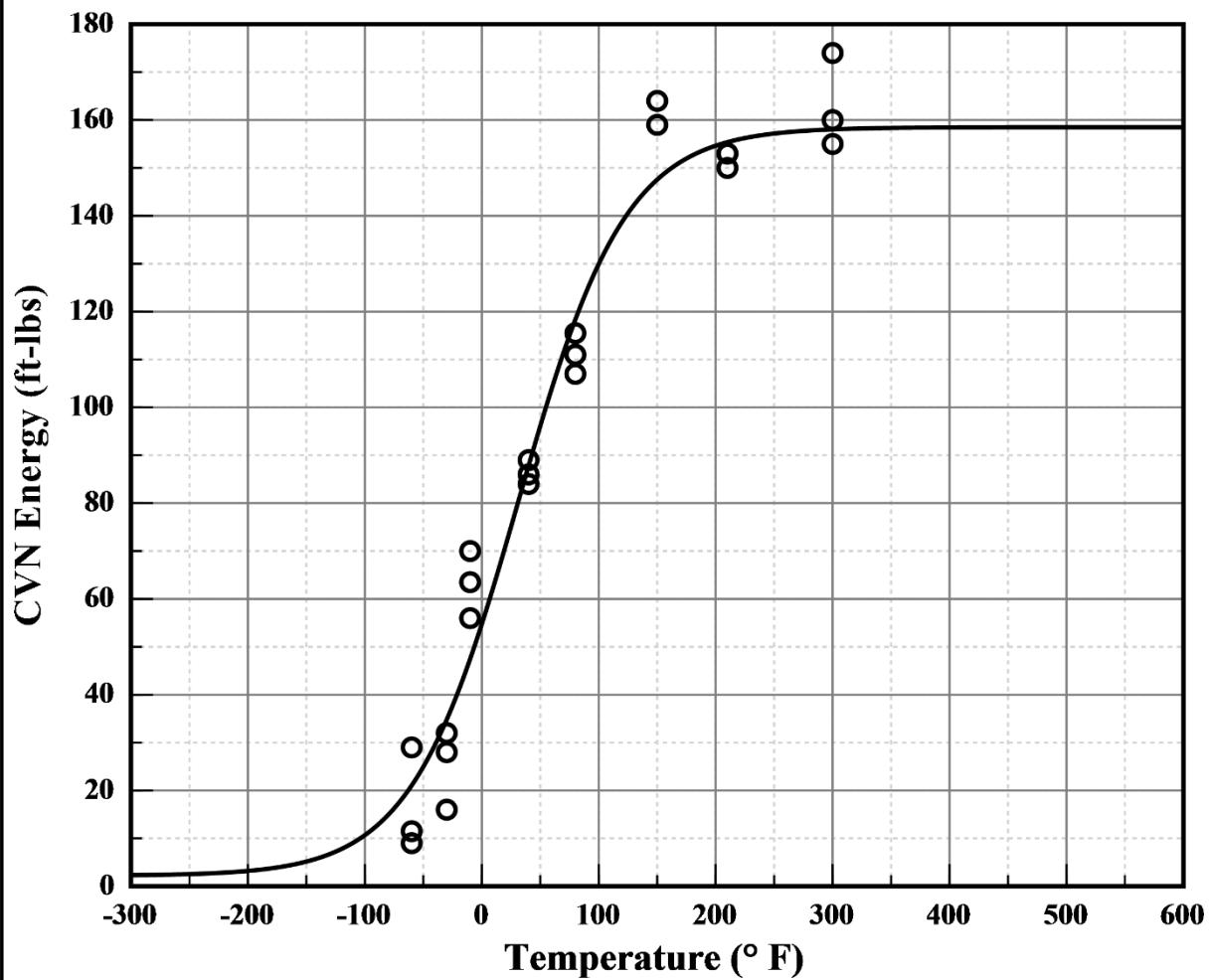
Temp@30 ft-lbs=-39.00° F   Temp@35 ft-lbs=-29.60° F   Temp@50 ft-lbs= -6.40° F

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **Unirrad**   Fluence: **0.00E+000 n/cm²**

CVGraph 6.02   06/29/2021   Page 1/2

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **Unirrad**   Fluence: **0.00E+000 n/cm²**

Unirradiated Intermediate Shell Forging C (Tangential)
Charpy V-Notch Data

Temperature (° F)	Input CVN	Computed CVN	Differential
-60	9.0	21.0	-12.05
-60	29.0	21.0	7.95
-60	11.5	21.0	-9.55
-30	32.0	34.8	-2.81
-30	16.0	34.8	-18.81
-30	28.0	34.8	-6.81
-10	63.5	47.5	16.05
-10	56.0	47.5	8.55
-10	70.0	47.5	22.55
40	89.0	87.8	1.19
40	84.0	87.8	-3.81
40	86.0	87.8	-1.81
80	107.0	118.4	-11.36
80	115.5	118.4	-2.86
80	111.0	118.4	-7.36
150	159.0	147.6	11.43
150	164.0	147.6	16.43
210	150.0	155.4	-5.38
210	153.0	155.4	-2.38
210	153.0	155.4	-2.38
300	160.0	158.1	1.95
300	155.0	158.1	-3.05
300	174.0	158.1	15.95

CVGraph 6.02   06/29/2021   Page 2/2

Capsule V Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/28/2021 2:40 PM

A = 78.65 B = 76.45 C = 76.03 T0 = 50.01 D = 0.00

Correlation Coefficient = 0.975

Equation is A + B * [Tanh((T-T0)/(C+DT))]

Upper Shelf Energy = 155.10 (Fixed)   Lower Shelf Energy = 2.20 (Fixed)
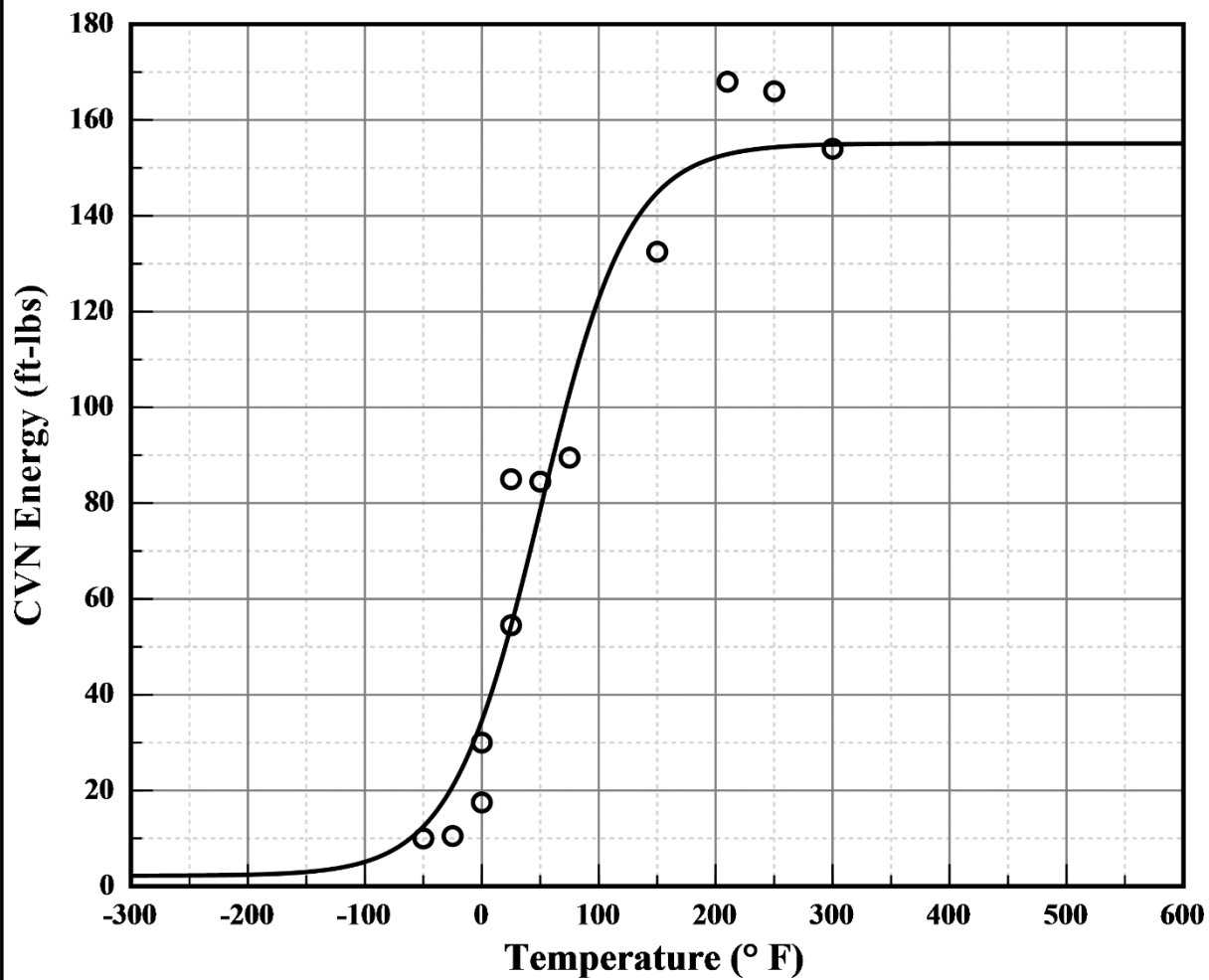
Temp@30 ft-lbs= -7.10° F   Temp@35 ft-lbs= 0.70° F   Temp@50 ft-lbs= 20.10° F

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **V**   Fluence: **6.09E+018 n/cm²**

CVGraph 6.02   06/28/2021   Page 1/2

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **V**   Fluence: **6.09E+018 n/cm²**

Capsule V Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input CVN	Computed CVN	Differential
-50	10.0	12.5	-2.47
-25	10.5	20.9	-10.36
0	30.0	34.5	-4.55
0	17.5	34.5	-17.05
25	85.0	54.4	30.63
25	54.5	54.4	0.13
50	84.5	78.6	5.86
75	89.5	102.9	-13.41
150	132.5	144.8	-12.32
210	168.0	152.9	15.14
250	166.0	154.3	11.69
300	154.0	154.9	-0.89

Capsule P Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/29/2021 7:29 AM

A = 72.20 B = 70.00 C = 89.02 T0 = 46.25 D = 0.00

Correlation Coefficient = 0.989

Equation is A + B * [Tanh((T-T0)/(C+DT))]

Upper Shelf Energy = 142.20 (Fixed)   Lower Shelf Energy = 2.20 (Fixed)
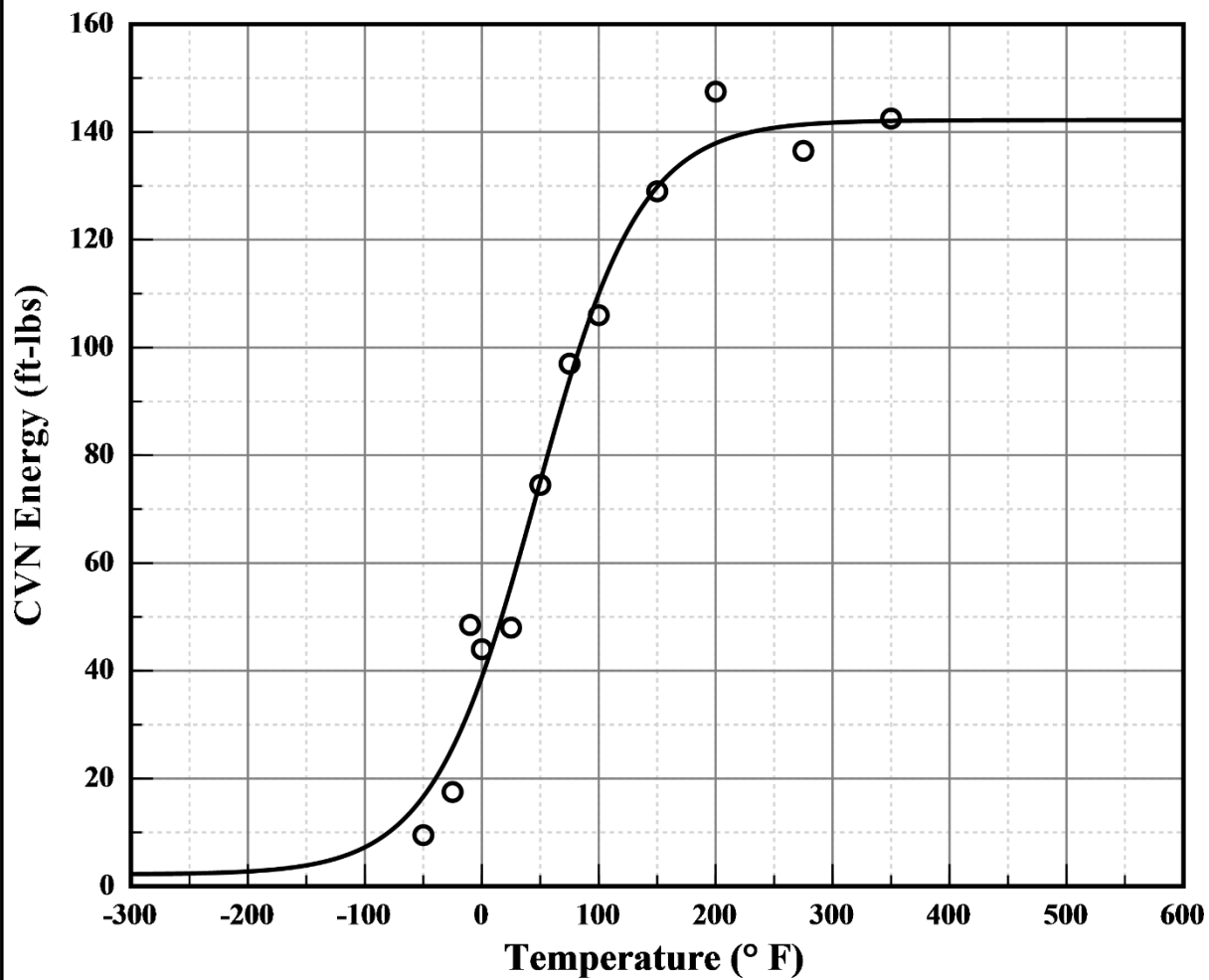
Temp@30 ft-lbs=-15.80° F   Temp@35 ft-lbs= -6.40° F   Temp@50 ft-lbs= 17.10° F

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **P**   Fluence: **1.31E+019 n/cm²**

Plant: **Prairie Island 1** Material: **SA508CL3** Heat: **21918/38566**
Orientation: **Tangential** Capsule: **P** Fluence: **1.31E+019 n/cm²**

Capsule P Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input CVN	Computed CVN	Differential
-50	9.5	16.6	-7.15
-25	17.5	25.7	-8.20
-10	48.5	33.0	15.45
0	44.0	38.8	5.21
25	48.0	55.8	-7.80
50	74.5	75.1	-0.65
75	97.0	94.1	2.95
100	106.0	110.0	-3.98
150	129.0	129.8	-0.80
200	147.5	137.9	9.59
275	136.5	141.4	-4.88
350	142.5	142.0	0.45

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Capsule R Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/29/2021 8:05 AM

A = 73.60 B = 71.40 C = 103.43 T0 = 130.38 D = 0.00

Correlation Coefficient = 0.982

Equation is A + B * [Tanh((T-T0)/(C+DT))]

Upper Shelf Energy = 145.00 (Fixed)   Lower Shelf Energy = 2.20 (Fixed)
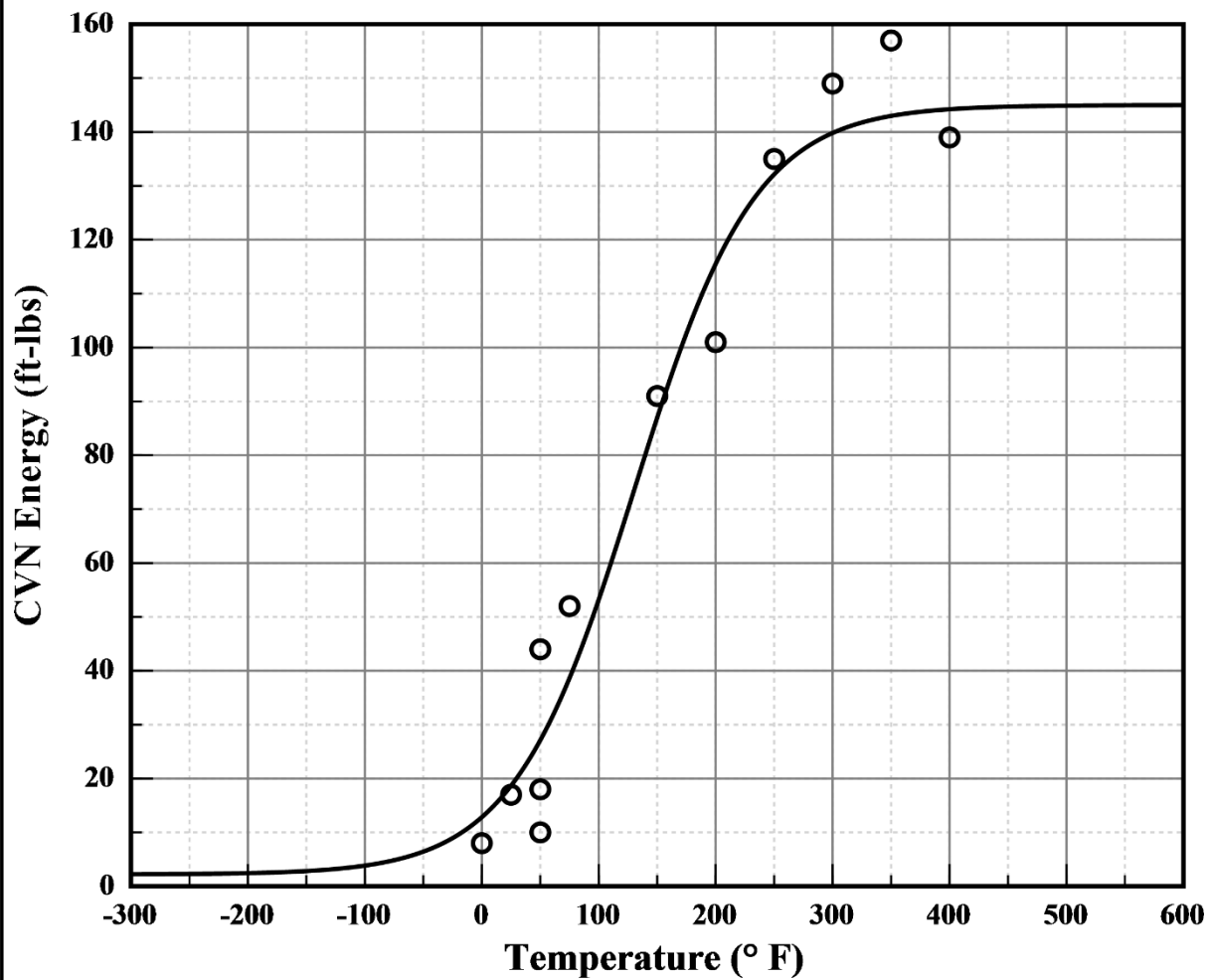
Temp@30 ft-lbs= 57.00° F   Temp@35 ft-lbs= 67.90° F   Temp@50 ft-lbs= 94.90° F

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **R**   Fluence: **4.02E+019 n/cm²**

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **R**   Fluence: **4.02E+019 n/cm²**

Capsule R Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input CVN	Computed CVN	Differential
0	8.0	12.8	-4.82
25	17.0	18.7	-1.67
50	18.0	27.1	-9.12
50	44.0	27.1	16.88
50	10.0	27.1	-17.12
75	52.0	38.7	13.35
150	91.0	87.0	4.01
200	101.0	115.5	-14.52
250	135.0	132.1	2.86
300	149.0	139.8	9.18
350	157.0	143.0	14.01
400	139.0	144.2	-5.23

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Capsule S Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/29/2021 8:26 AM

A = 72.35 B = 70.15 C = 98.27 T0 = 131.23 D = 0.00

Correlation Coefficient = 0.988

Equation is A + B * [Tanh((T-T0)/(C+DT))]

Upper Shelf Energy = 142.50 (Fixed)   Lower Shelf Energy = 2.20 (Fixed)

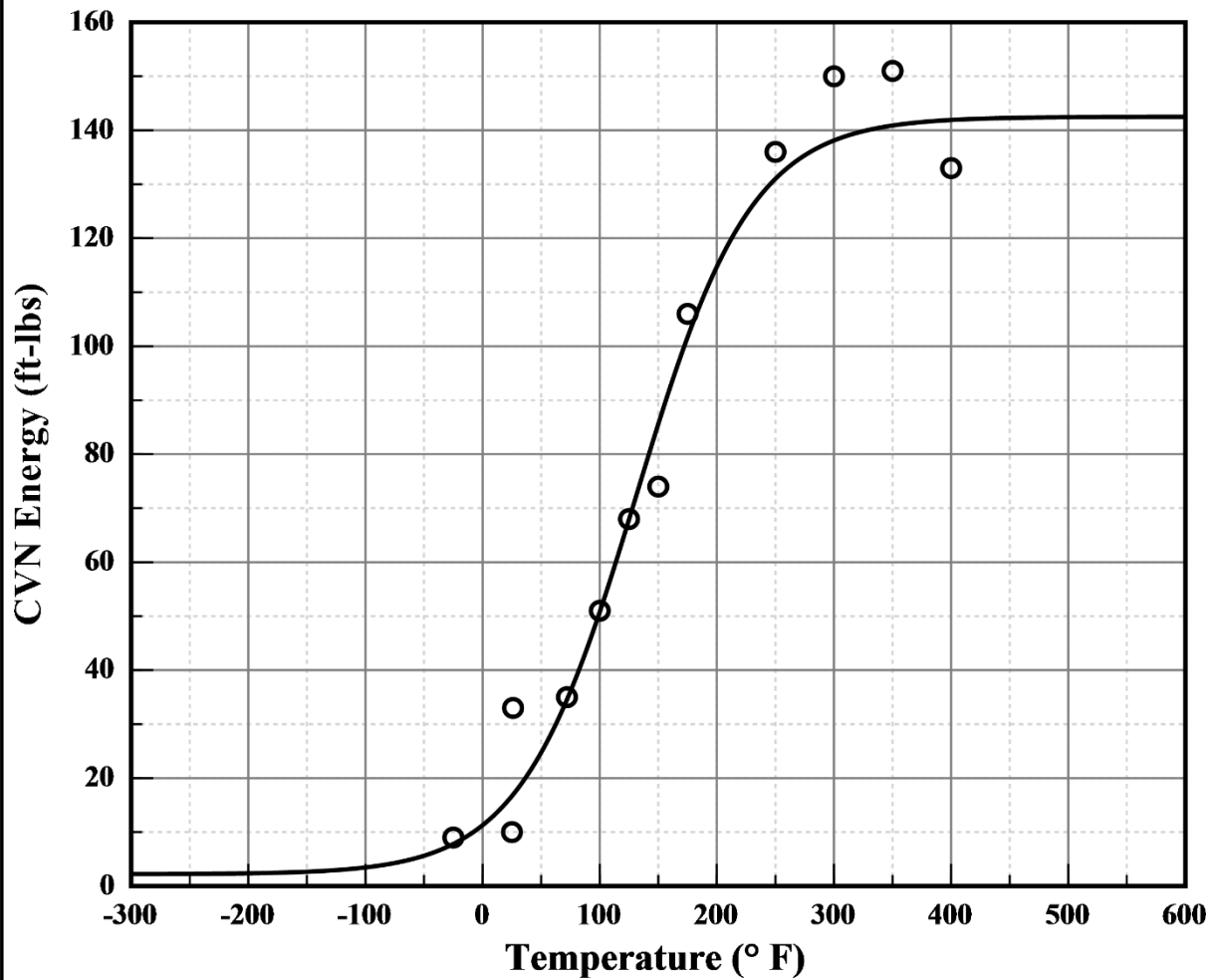Temp@30 ft-lbs= 62.60° F   Temp@35 ft-lbs= 73.00° F   Temp@50 ft-lbs= 98.80° F

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **S**   Fluence: **4.39E+019 n/cm²**

Plant: **Prairie Island 1** Material: **SA508CL3** Heat: **21918/38566**
Orientation: **Tangential** Capsule: **S** Fluence: **4.39E+019 n/cm²**

Capsule S Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input CVN	Computed CVN	Differential
-25	9.0	7.8	1.20
25	10.0	16.7	-6.68
26	33.0	16.9	16.05
72	35.0	34.5	0.46
100	51.0	50.8	0.22
125	68.0	67.9	0.09
150	74.0	85.6	-11.59
175	106.0	101.7	4.32
250	136.0	131.0	4.99
300	150.0	138.1	11.88
350	151.0	140.9	10.12
400	133.0	141.9	-8.91

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Capsule N Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/23/2021 5:38 AM

A = 70.10 B = 67.90 C = 60.89 T0 = 167.72 D = 0.00

Correlation Coefficient = 0.955

Equation is A + B * [Tanh((T-T0)/(C+DT))]

Upper Shelf Energy = 138.00 (Fixed)   Lower Shelf Energy = 2.20 (Fixed)

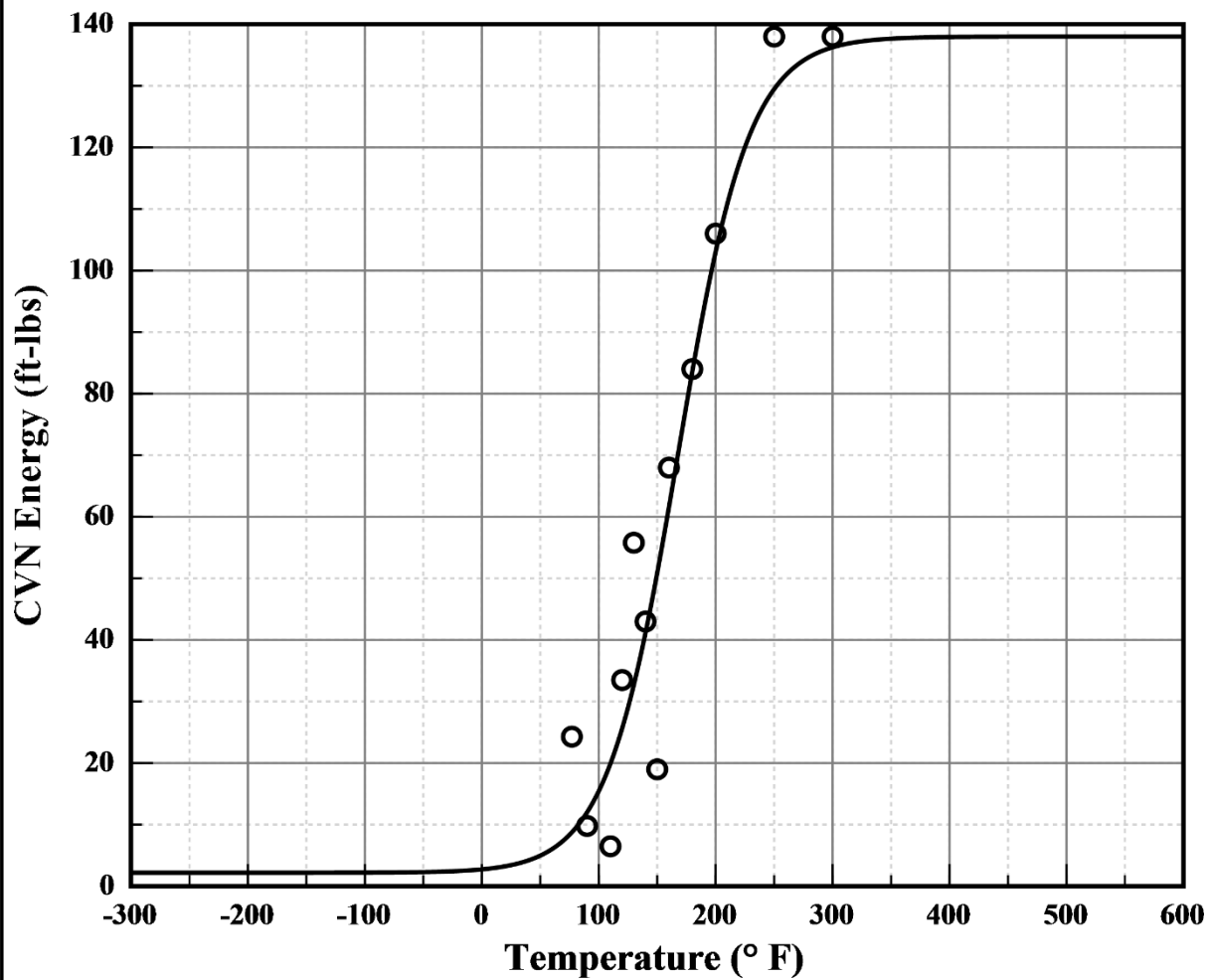Temp@30 ft-lbs=126.50° F   Temp@35 ft-lbs=132.90° F   Temp@50 ft-lbs=149.20° F

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **N**   Fluence: **8.45E+019 n/cm²**

CVGraph 6.02   06/23/2021   Page 1/2

Plant: **Prairie Island 1** Material: **SA508CL3** Heat: **21918/38566**
Orientation: **Tangential** Capsule: **N** Fluence: **8.45E+019 n/cm²**

Capsule N Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input CVN	Computed CVN	Differential
77	24.3	8.8	15.53
90	9.8	12.0	-2.21
110	6.5	19.9	-13.43
120	33.5	25.6	7.86
130	55.8	32.7	23.10
140	43.0	41.2	1.84
150	19.0	50.9	-31.88
160	68.0	61.5	6.46
180	84.0	83.6	0.39
200	106.0	103.1	2.94
250	138.0	129.5	8.53
300	138.0	136.3	1.74

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Unirradiated Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/29/2021 11:14 AM

A = 48.18 B = 47.18 C = 65.16 T0 = -5.22 D = 0.00

Correlation Coefficient = 0.970
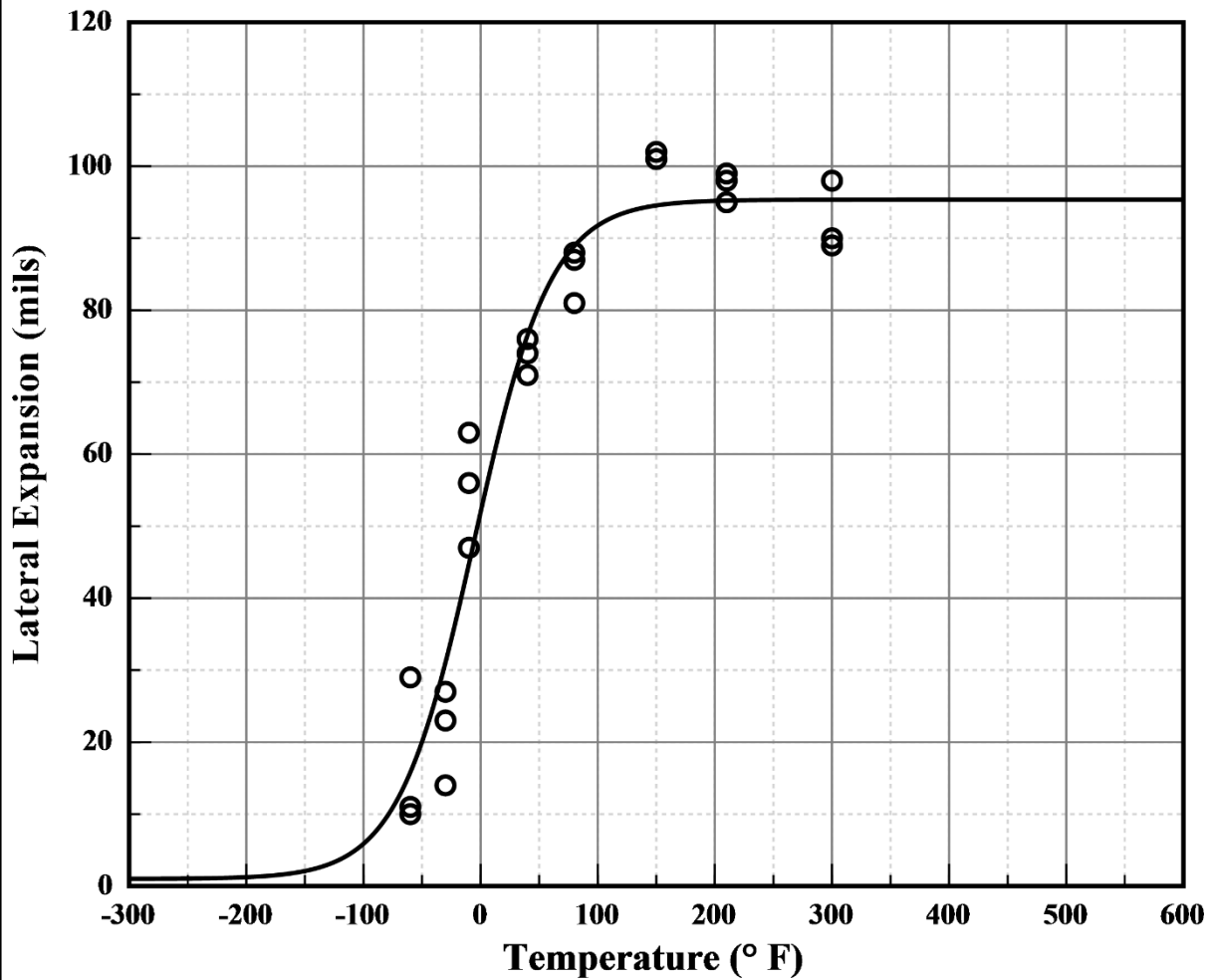
Equation is $A + B * [Tanh((T-T0)/(C+DT))]$

Upper Shelf L.E. = 95.36   Lower Shelf L.E. = 1.00 (Fixed)

Temp@35 mils=-23.90° F

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **Unirrad**   Fluence: **0.00E+000 n/cm²**

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Plant: **Prairie Island 1** Material: **SA508CL3** Heat: **21918/38566**
Orientation: **Tangential** Capsule: **Unirrad** Fluence: **0.00E+000 n/cm²**

Unirradiated Intermediate Shell Forging C (Tangential)
Charpy V-Notch Data

Temperature (° F)	Input L. E.	Computed L. E.	Differential
-60	11.0	15.8	-4.81
-60	29.0	15.8	13.19
-60	10.0	15.8	-5.81
-30	27.0	31.1	-4.06
-30	14.0	31.1	-17.06
-30	23.0	31.1	-8.06
-10	56.0	44.7	11.28
-10	47.0	44.7	2.28
-10	63.0	44.7	18.28
40	76.0	76.5	-0.51
40	71.0	76.5	-5.51
40	74.0	76.5	-2.51
80	81.0	88.9	-7.93
80	88.0	88.9	-0.93
80	87.0	88.9	-1.93
150	102.0	94.6	7.44
150	101.0	94.6	6.44
210	99.0	95.2	3.77
210	98.0	95.2	2.77
210	95.0	95.2	-0.23
300	98.0	95.4	2.65
300	90.0	95.4	-5.35
300	89.0	95.4	-6.35

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Capsule V Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/28/2021 2:45 PM

A = 40.52 B = 39.52 C = 46.30 T0 = 25.46 D = 0.00

Correlation Coefficient = 0.949

Equation is A + B * [Tanh((T-T0)/(C+DT))]

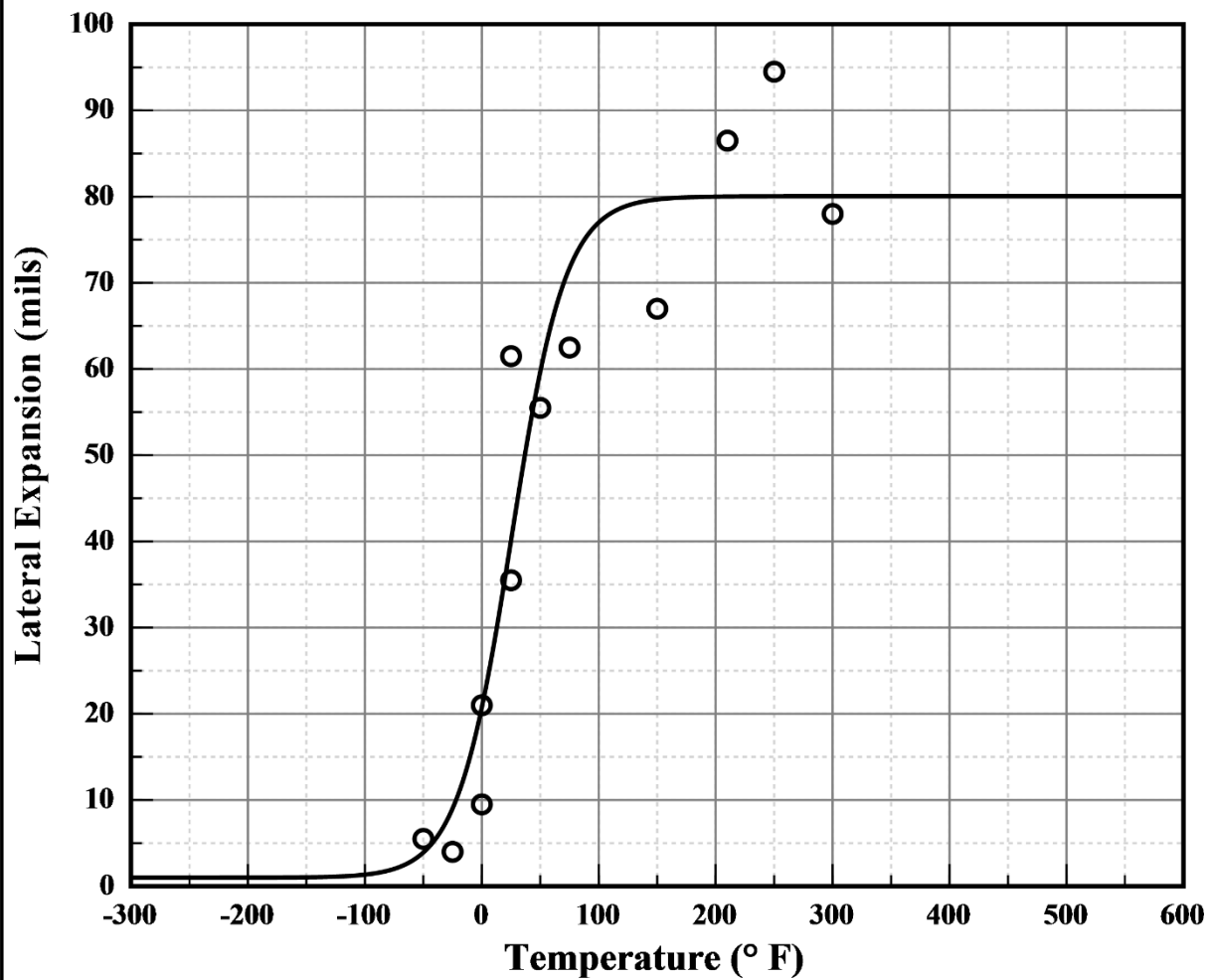Upper Shelf L.E. = 80.04   Lower Shelf L.E. = 1.00 (Fixed)

Temp@35 mils= 19.00° F

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **V**   Fluence: **6.09E+018 n/cm²**

CVGraph 6.02   06/28/2021   Page 1/2

Plant: **Prairie Island 1** Material: **SA508CL3** Heat: **21918/38566**
Orientation: **Tangential** Capsule: **V** Fluence: **6.09E+018 n/cm²**

Capsule V Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input L. E.	Computed L. E.	Differential
-50	5.5	3.9	1.58
-25	4.0	9.0	-5.03
0	21.0	20.7	0.26
0	9.5	20.7	-11.24
25	61.5	40.1	21.37
25	35.5	40.1	-4.63
50	55.5	59.7	-4.20
75	62.5	71.7	-9.22
150	67.0	79.7	-12.68
210	86.5	80.0	6.48
250	94.5	80.0	14.46
300	78.0	80.0	-2.04

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Capsule P Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/28/2021 4:06 PM

A = 44.52 B = 43.52 C = 88.50 T0 = 29.08 D = 0.00

Correlation Coefficient = 0.967

Equation is A + B * [Tanh((T-T0)/(C+DT))]

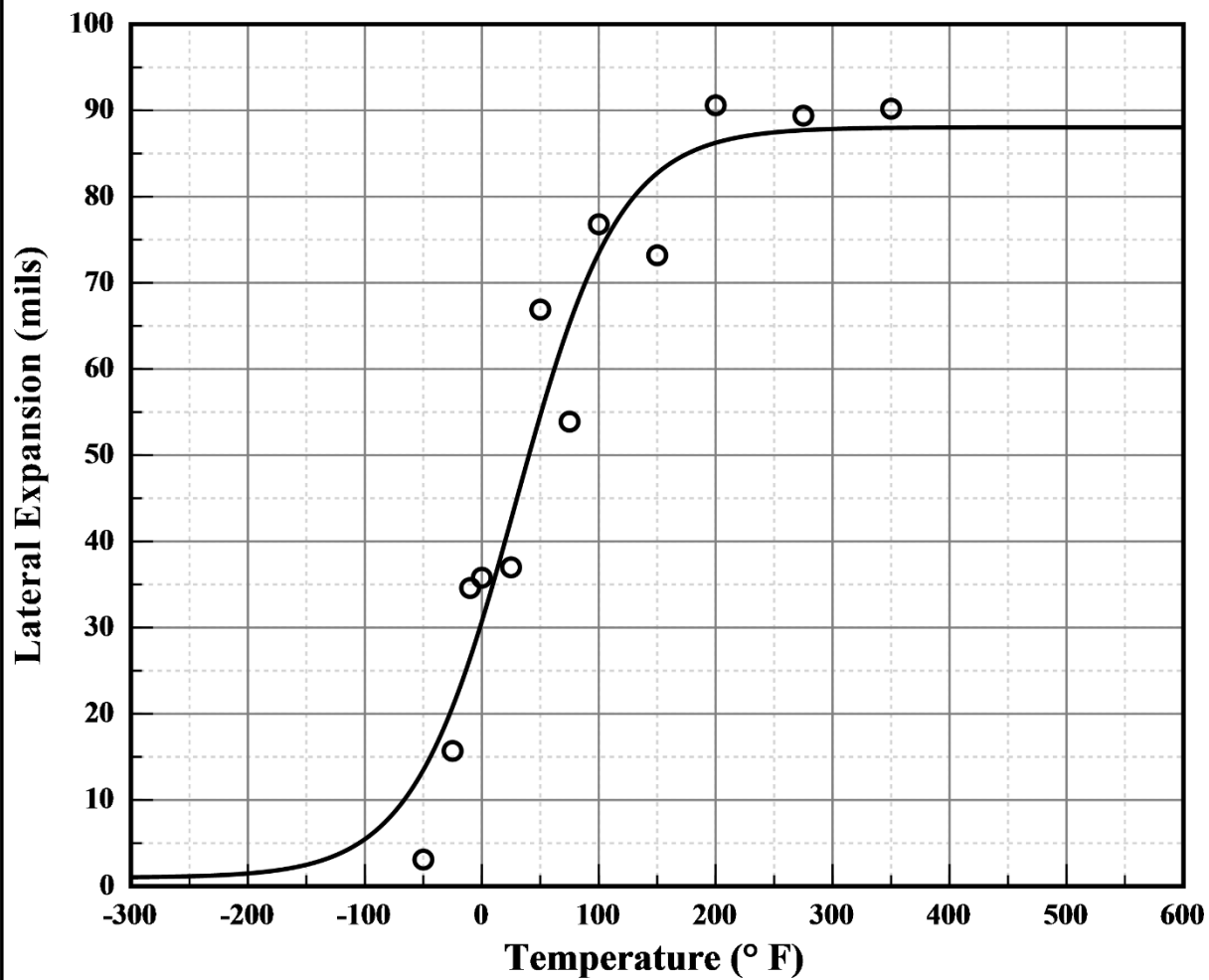Upper Shelf L.E. = 88.04   Lower Shelf L.E. = 1.00 (Fixed)

Temp@35 mils= 9.50° F

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **P**   Fluence: **1.31E+019 n/cm²**

Plant: **Prairie Island 1**　　　　　Material: **SA508CL3**　　　　　Heat: **21918/38566**
Orientation: **Tangential**　　　　　Capsule: **P**　　　　　Fluence: **1.31E+019 n/cm²**

Capsule P Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input L. E.	Computed L. E.	Differential
-50	3.1	13.5	-10.39
-25	15.7	20.8	-5.11
-10	34.6	26.5	8.14
0	35.8	30.7	5.08
25	37.0	42.5	-5.52
50	66.9	54.6	12.28
75	53.9	65.3	-11.37
100	76.8	73.5	3.35
150	73.2	82.7	-9.53
200	90.6	86.3	4.35
275	89.4	87.7	1.69
350	90.2	88.0	2.22

CVGraph 6.02　　　　　06/28/2021　　　　　Page 2/2

Capsule R Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/29/2021 8:07 AM

A = 40.14 B = 39.14 C = 88.29 T0 = 92.60 D = 0.00

Correlation Coefficient = 0.978

Equation is A + B * [Tanh((T-T0)/(C+DT))]

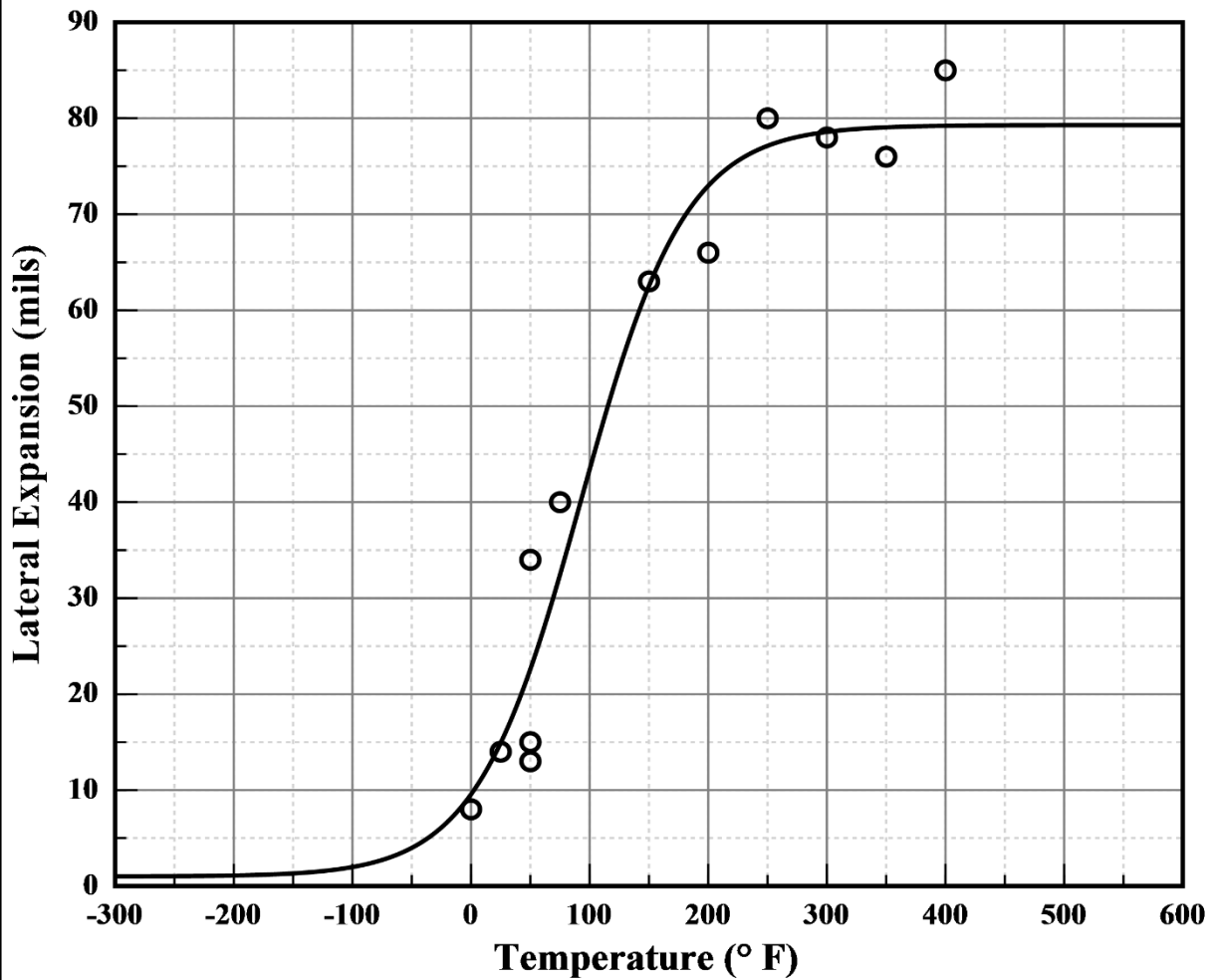Upper Shelf L.E. = 79.29   Lower Shelf L.E. = 1.00 (Fixed)

Temp@35 mils= 81.00° F

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **R**   Fluence: **4.02E+019 n/cm²**

CVGraph 6.02   06/29/2021   Page 1/2

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **R**   Fluence: **4.02E+019 n/cm²**

Capsule R Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input L. E.	Computed L. E.	Differential
0	8.0	9.6	-1.56
25	14.0	14.9	-0.92
50	15.0	22.6	-7.60
50	34.0	22.6	11.40
50	13.0	22.6	-9.60
75	40.0	32.4	7.55
150	63.0	62.5	0.47
200	66.0	73.0	-6.97
250	80.0	77.1	2.86
300	78.0	78.6	-0.58
350	76.0	79.1	-3.06
400	85.0	79.2	5.78

CVGraph 6.02   06/29/2021   Page 2/2

Capsule S Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/29/2021 8:28 AM

A = 46.43 B = 45.43 C = 104.38 T0 = 115.05 D = 0.00

Correlation Coefficient = 0.982

Equation is A + B * [Tanh((T-T0)/(C+DT))]

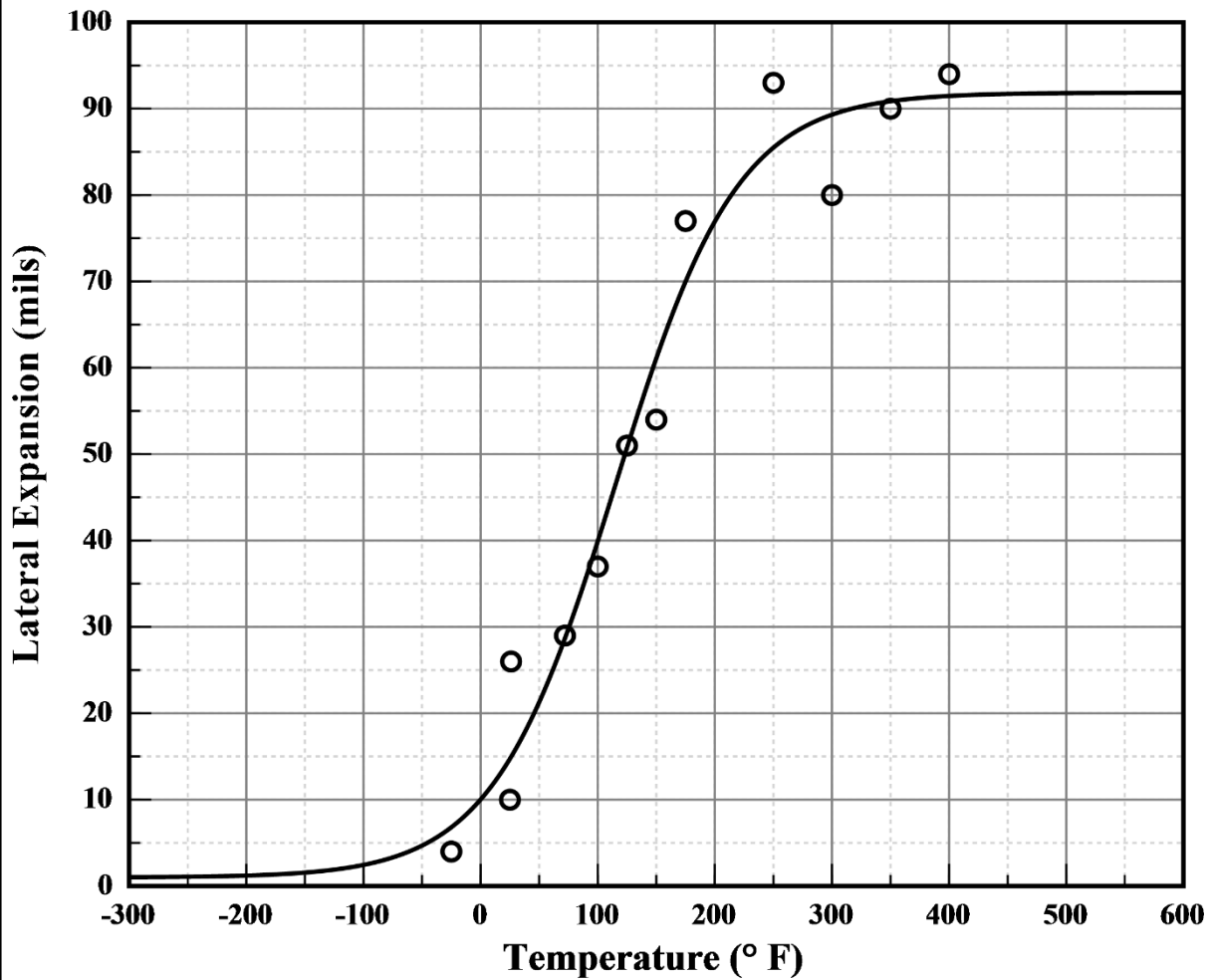Upper Shelf L.E. = 91.86   Lower Shelf L.E. = 1.00 (Fixed)

Temp@35 mils= 88.30° F

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **S**   Fluence: **4.39E+019 n/cm²**

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Plant: **Prairie Island 1** Material: **SA508CL3** Heat: **21918/38566**
Orientation: **Tangential** Capsule: **S** Fluence: **4.39E+019 n/cm²**

Capsule S Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input L. E.	Computed L. E.	Differential
-25	4.0	6.8	-2.81
25	10.0	14.7	-4.74
26	26.0	15.0	11.04
72	29.0	28.7	0.31
100	37.0	39.9	-2.93
125	51.0	50.7	0.25
150	54.0	61.1	-7.10
175	77.0	70.0	7.01
250	93.0	85.5	7.50
300	80.0	89.3	-9.31
350	90.0	90.9	-0.86
400	94.0	91.5	2.52

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Capsule N Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/23/2021 5:54 AM

A = 50.85 B = 49.85 C = 79.67 T0 = 167.12 D = 0.00

Correlation Coefficient = 0.955

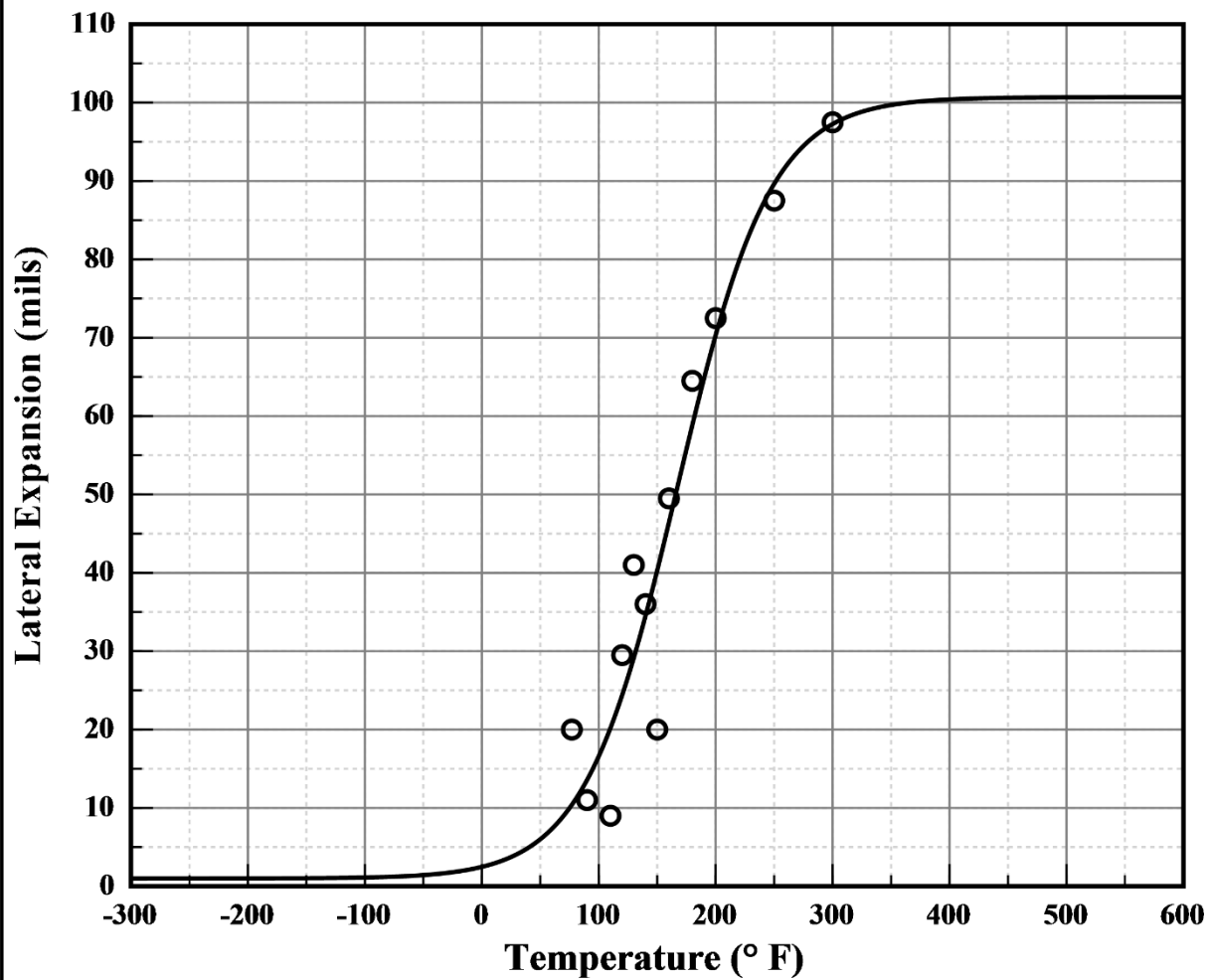Equation is A + B * [Tanh((T-T0)/(C+DT))]

Upper Shelf L.E. = 100.69   Lower Shelf L.E. = 1.00 (Fixed)

Temp@35 mils=140.90° F

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **N**   Fluence: **8.45E+019 n/cm²**

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Plant: **Prairie Island 1** Material: **SA508CL3** Heat: **21918/38566**
Orientation: **Tangential** Capsule: **N** Fluence: **8.45E+019 n/cm²**

Capsule N Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input L. E.	Computed L. E.	Differential
77	20.0	10.4	9.60
90	11.0	13.6	-2.57
110	9.0	20.2	-11.19
120	29.5	24.4	5.12
130	41.0	29.2	11.83
140	36.0	34.5	1.49
150	20.0	40.3	-20.30
160	49.5	46.4	3.09
180	64.5	58.8	5.66
200	72.5	70.3	2.17
250	87.5	89.6	-2.13
300	97.5	97.3	0.23

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Unirradiated Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/29/2021 9:13 AM

A = 50.00 B = 50.00 C = 93.52 T0 = 35.80 D = 0.00

Correlation Coefficient = 0.987

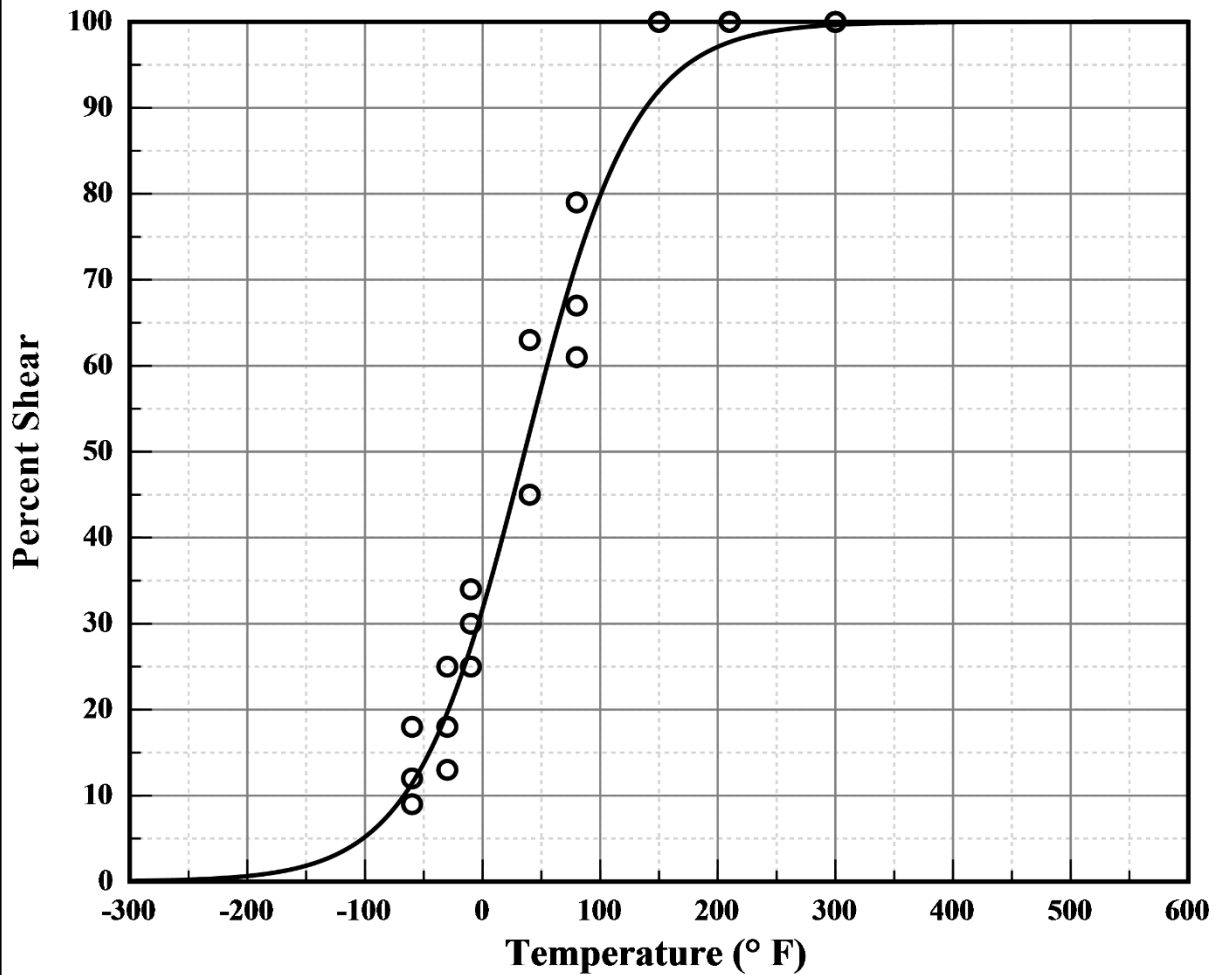Equation is A + B * [Tanh((T-T0)/(C+DT))]

Upper Shelf %Shear = 100.00 (Fixed)   Lower Shelf %Shear = 0.00 (Fixed)

Temperature at 50% Shear = 35.90

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **Unirrad**   Fluence: **0.00E+000 n/cm²**

CVGraph 6.02   06/29/2021   Page 1/2

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **Unirrad**   Fluence: **0.00E+000 n/cm²**

Unirradiated Intermediate Shell Forging C (Tangential)
Charpy V-Notch Data

Temperature (° F)	Input %Shear	Computed %Shear	Differential
-60	9.0	11.4	-2.42
-60	18.0	11.4	6.58
-60	12.0	11.4	0.58
-30	25.0	19.7	5.33
-30	13.0	19.7	-6.67
-30	18.0	19.7	-1.67
-10	34.0	27.3	6.70
-10	25.0	27.3	-2.30
-10	30.0	27.3	2.70
40	63.0	52.2	10.75
40	45.0	52.2	-7.25
40	45.0	52.2	-7.25
80	79.0	72.0	6.98
80	67.0	72.0	-5.02
80	61.0	72.0	-11.02
150	100.0	92.0	8.00
150	100.0	92.0	8.00
210	100.0	97.6	2.35
210	100.0	97.6	2.35
210	100.0	97.6	2.35
300	100.0	99.6	0.35
300	100.0	99.6	0.35
300	100.0	99.6	0.35

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Capsule V Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/28/2021 2:44 PM

A = 50.00 B = 50.00 C = 71.38 T0 = 75.91 D = 0.00

Correlation Coefficient = 0.989

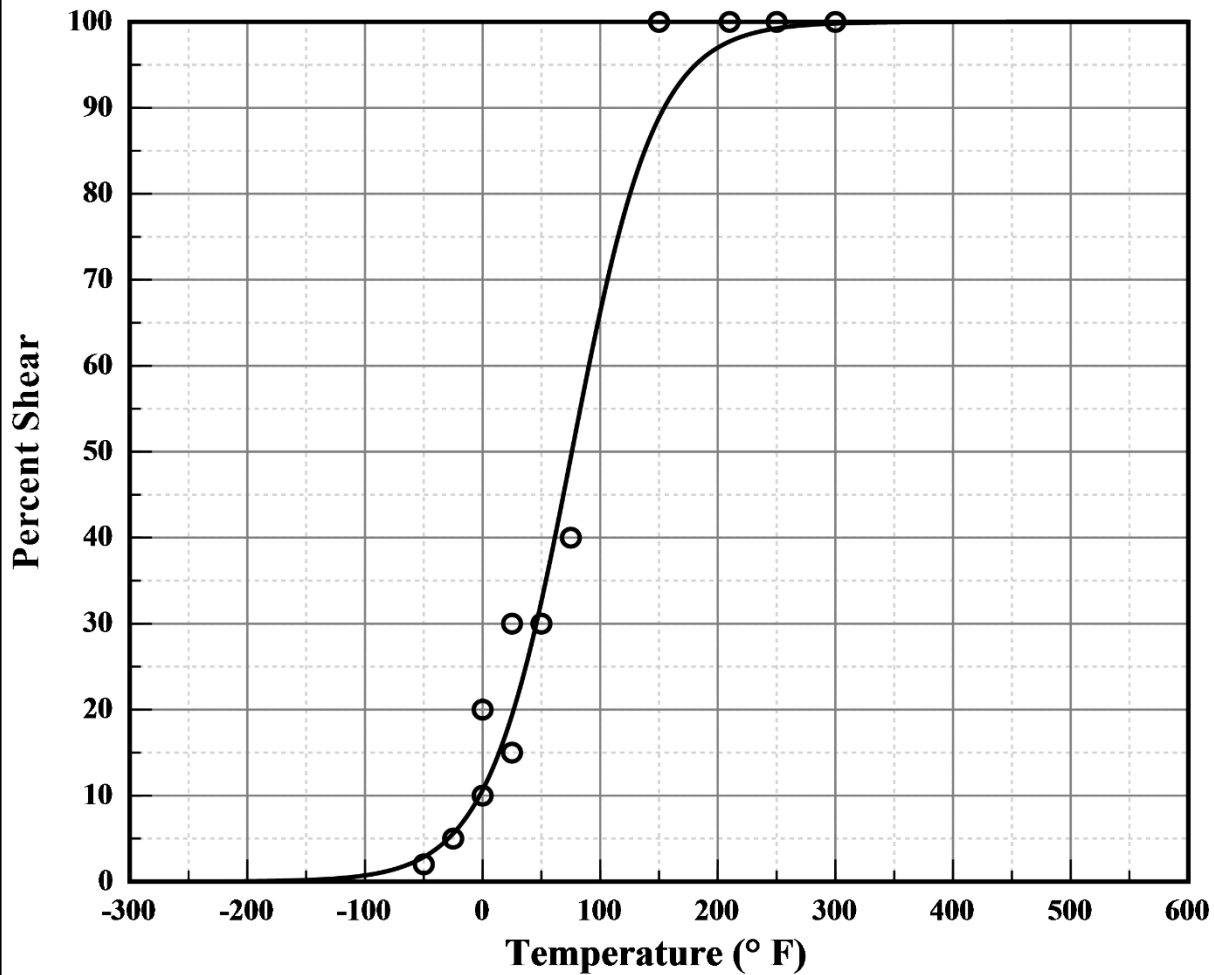Equation is $A + B * [Tanh((T-T0)/(C+DT))]$

Upper Shelf %Shear = 100.00 (Fixed)   Lower Shelf %Shear = 0.00 (Fixed)

Temperature at 50% Shear = 76.00

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **V**   Fluence: **6.09E+018 n/cm²**

CVGraph 6.02   06/28/2021   Page 1/2

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **V**   Fluence: **6.09E+018 n/cm²**

Capsule V Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input %Shear	Computed %Shear	Differential
-50	2.0	2.9	-0.85
-25	5.0	5.6	-0.59
0	10.0	10.6	-0.65
0	20.0	10.6	9.35
25	30.0	19.4	10.64
25	15.0	19.4	-4.36
50	30.0	32.6	-2.61
75	40.0	49.4	-9.36
150	100.0	88.9	11.14
210	100.0	97.7	2.28
250	100.0	99.2	0.76
300	100.0	99.8	0.19

CVGraph 6.02   06/28/2021   Page 2/2

Capsule P Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/28/2021 4:04 PM

A = 50.00 B = 50.00 C = 92.34 T0 = 74.14 D = 0.00

Correlation Coefficient = 0.996

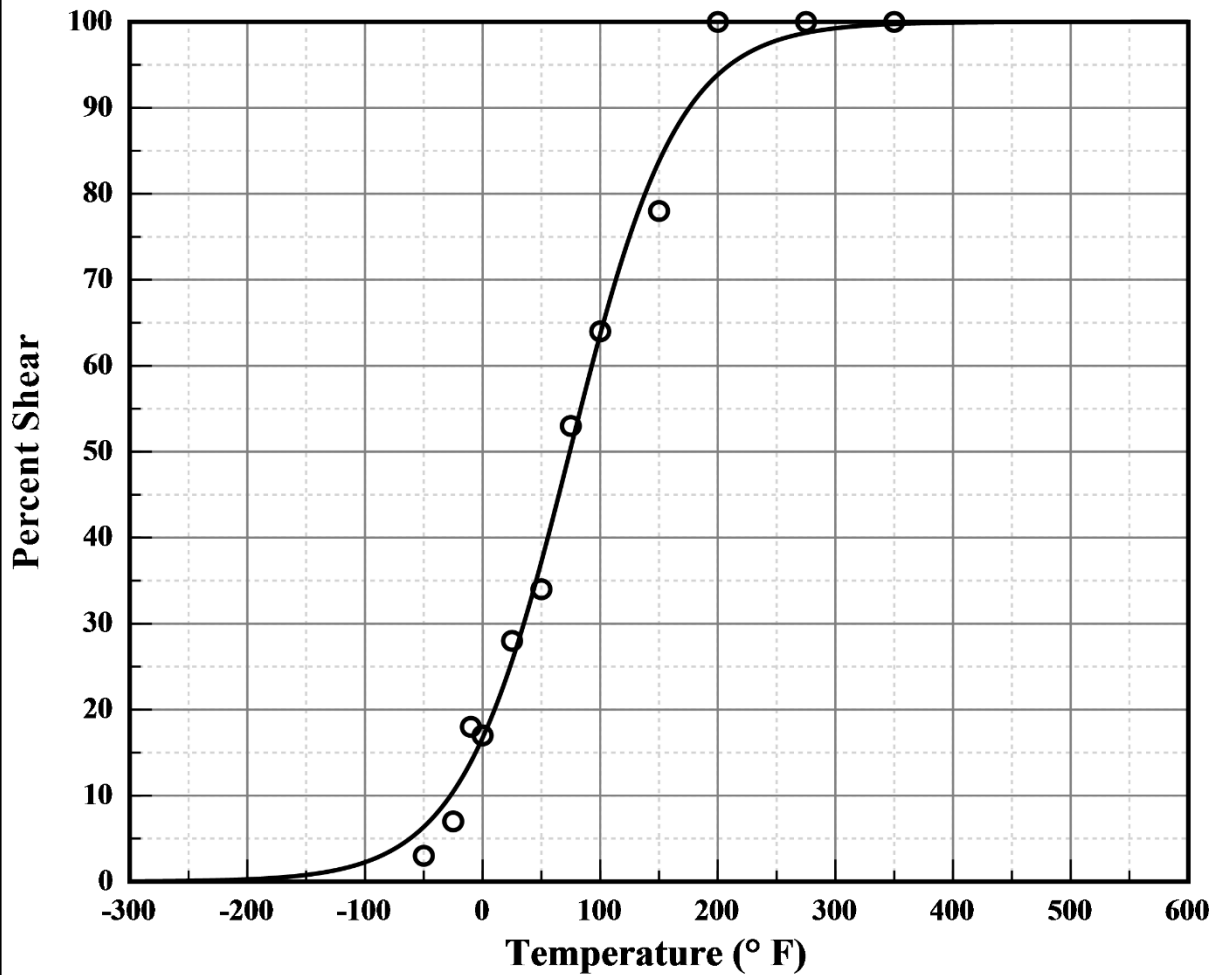Equation is A + B * [Tanh((T-T0)/(C+DT))]

Upper Shelf %Shear = 100.00 (Fixed) Lower Shelf %Shear = 0.00 (Fixed)

Temperature at 50% Shear = 74.20

Plant: **Prairie Island 1** Material: **SA508CL3** Heat: **21918/38566**
Orientation: **Tangential** Capsule: **P** Fluence: **1.31E+019 n/cm²**

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Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **P**   Fluence: **1.31E+019 n/cm²**

Capsule P Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input %Shear	Computed %Shear	Differential
-50	3.0	6.4	-3.36
-25	7.0	10.5	-3.46
-10	18.0	13.9	4.09
0	17.0	16.7	0.28
25	28.0	25.6	2.35
50	34.0	37.2	-3.22
75	53.0	50.5	2.53
100	64.0	63.6	0.35
150	78.0	83.8	-5.79
200	100.0	93.9	6.15
275	100.0	98.7	1.27
350	100.0	99.7	0.25

CVGraph 6.02   06/28/2021   Page 2/2

Capsule R Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/29/2021 8:06 AM

A = 50.00 B = 50.00 C = 90.55 T0 = 131.34 D = 0.00

Correlation Coefficient = 0.995

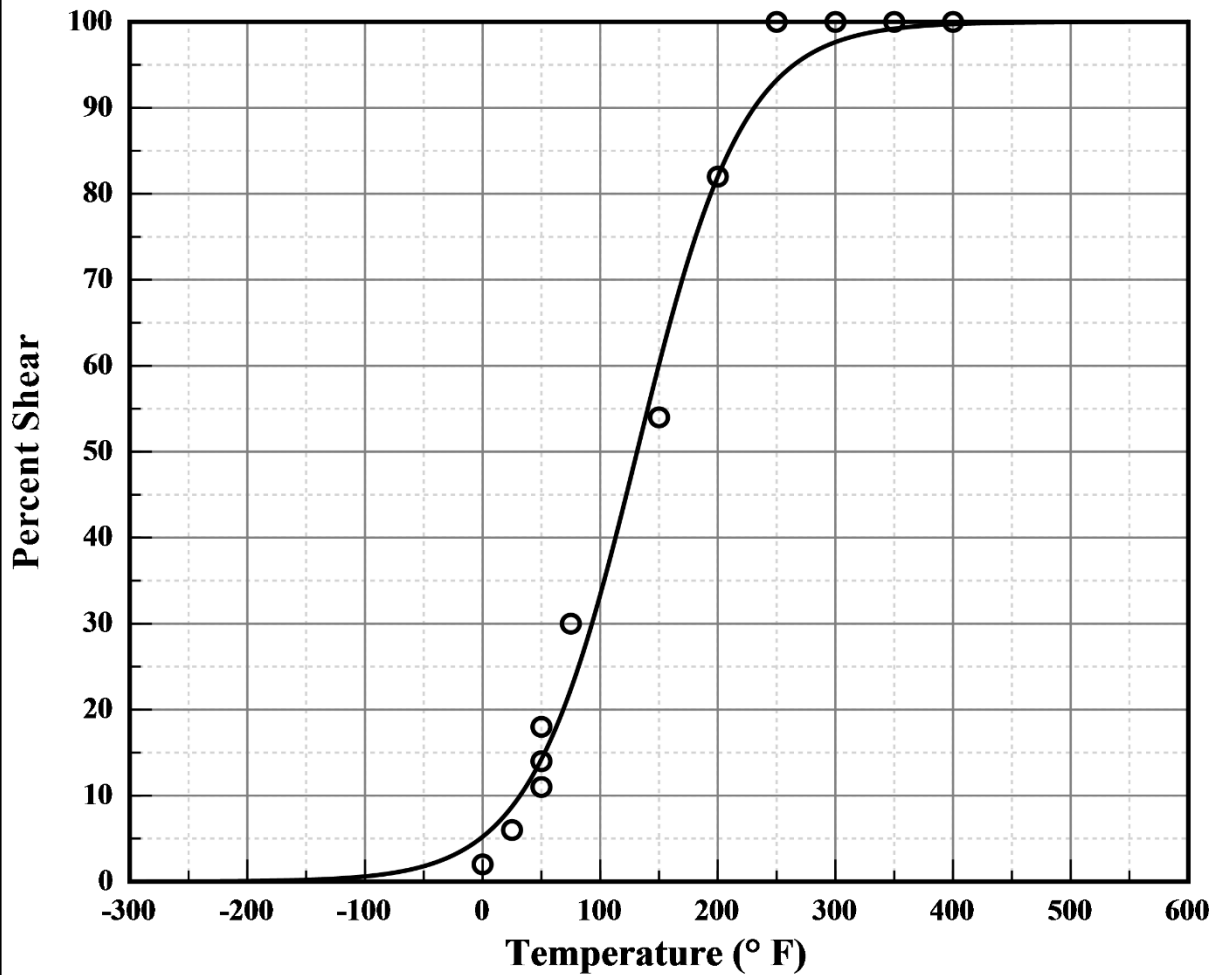Equation is A + B * [Tanh((T-T0)/(C+DT))]

Upper Shelf %Shear = 100.00 (Fixed)   Lower Shelf %Shear = 0.00 (Fixed)

Temperature at 50% Shear = 131.40

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **R**   Fluence: **4.02E+019 n/cm²**

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Plant: **Prairie Island 1**　　　　Material: **SA508CL3**　　　　Heat: **21918/38566**
Orientation: **Tangential**　　　　Capsule: **R**　　　　Fluence: **4.02E+019 n/cm²**

Capsule R Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input % Shear	Computed % Shear	Differential
0	2.0	5.2	-3.21
25	6.0	8.7	-2.72
50	14.0	14.2	-0.23
50	18.0	14.2	3.77
50	11.0	14.2	-3.23
75	30.0	22.4	7.63
150	54.0	60.2	-6.16
200	82.0	82.0	0.00
250	100.0	93.2	6.78
300	100.0	97.6	2.35
350	100.0	99.2	0.79
400	100.0	99.7	0.26

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Capsule S Intermediate Shell Forging C (Tangential)

CVGraph 6.02: Hyperbolic Tangent Curve Printed on 6/29/2021 8:27 AM

A = 50.00 B = 50.00 C = 71.03 T0 = 161.20 D = 0.00

Correlation Coefficient = 0.996

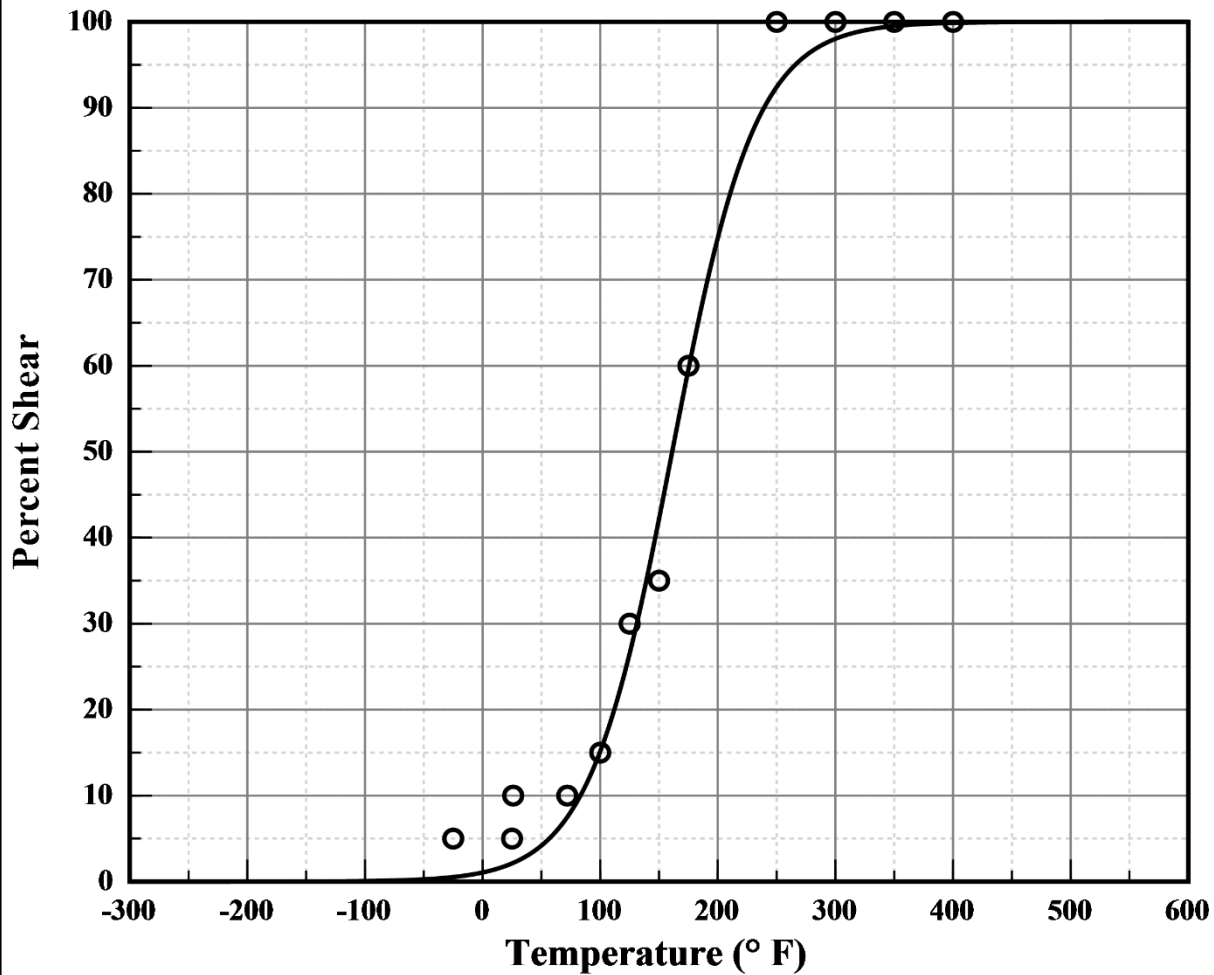Equation is A + B * [Tanh((T-T0)/(C+DT))]

Upper Shelf %Shear = 100.00 (Fixed)   Lower Shelf %Shear = 0.00 (Fixed)

Temperature at 50% Shear = 161.20

Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **S**   Fluence: **4.39E+019 n/cm²**

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Plant: **Prairie Island 1**   Material: **SA508CL3**   Heat: **21918/38566**
Orientation: **Tangential**   Capsule: **S**   Fluence: **4.39E+019 n/cm²**

Capsule S Intermediate Shell Forging C (Tangential)

Charpy V-Notch Data

Temperature (° F)	Input %Shear	Computed %Shear	Differential
-25	5.0	0.5	4.47
25	5.0	2.1	2.89
26	10.0	2.2	7.83
72	10.0	7.5	2.50
100	15.0	15.1	-0.15
125	30.0	26.5	3.48
150	35.0	42.2	-7.18
175	60.0	59.6	0.41
250	100.0	92.4	7.58
300	100.0	98.0	1.97
350	100.0	99.5	0.49
400	100.0	99.9	0.12

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