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SUMMARY OF FRACTURE TOUGHNESS

304-0-1

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 51%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	397	Stress Ratio	0.1
Final a (in)	0.5379	Kmax (ksi sqrt (in))	8.7
Pf (lbf)	1093.9		

Initial measured crack lengths (in)

0.533	0.534	0.534	0.540	0.537	0.537	0.541	0.542	0.542

Final measured crack lengths (in)

0.702	0.702	0.709	0.716	0.731	0.737	0.739	0.751	0.753

Ave. initial crack length (in)	0.5379	aoq (in)	0.532
Ave. final crack length (in)	0.7265	Compliance Adj. Factor	0.821
Delta a measured (in)	0.1886	Effective Modulus (Msi)	22.2
Delta a predicted (in)	0.068		

Results

JQ (E1820)	730.0 lbf-in/in^2
KJIC(E*JQ)^1/2	147.2 ksi sqrt(in)

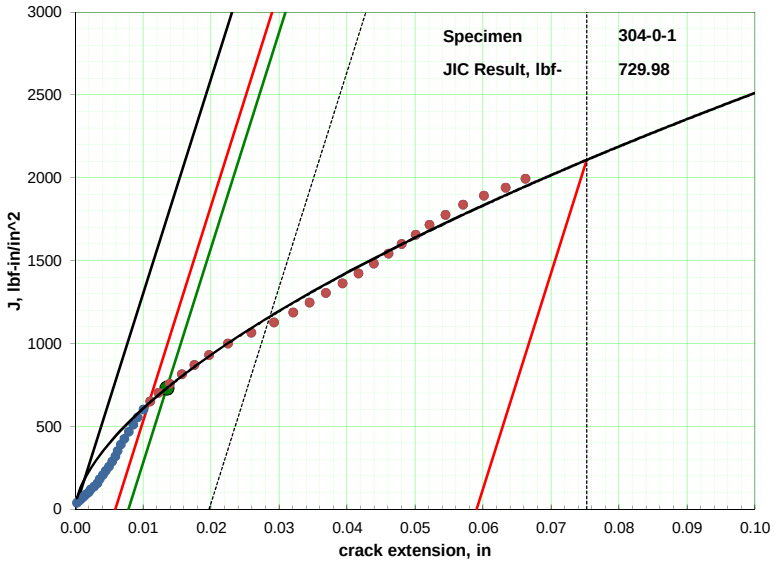
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	valid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	valid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

Approved for release by:

Digitally signed by Tim Esau
Date: 2020.09.30 09:58:31 -04'00'

Tim Esau, Quality Manager

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SUMMARY OF FRACTURE TOUGHNESS

304-0-2

Specimen Type:	CT	Requestor:	Wall
Material:	SS304	Company:	Electric Power Research Institute
Drawing No.:	Fig. 2	P.O. No.:	4700007062
Temperature:	RT	Job No.:	02039-011217
Relative Humidity:	51%	Machining Source:	Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	**Notch Depth (in)**	0.400
Net Thickness (in)	0.4	**Gage Length (in)**	0.300
Width (in)	1	**Alpha Ratio**	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	**Stress Ratio**	0.1
Final a (in)	0.5423	**Kmax (ksi sqrt (in))**	8.7
Pf (lbf)	1071.3		

Initial measured crack lengths (in)

0.553	0.553	0.550	0.545	0.543	0.539	0.536	0.533	0.528

Final measured crack lengths (in)

0.674	0.686	0.692	0.697	0.707	0.701	0.697	0.690	0.673

Ave. initial crack length (in)	0.5423	**aoq (in)**	0.542
Ave. final crack length (in)	0.6928	**Compliance Adj. Factor**	0.899
Delta a measured (in)	0.1505	**Effective Modulus (Msi)**	24.3
Delta a predicted (in)	0.0762		

Results

JQ (E1820)	795.4 lbf-in/in^2
KJIC(E'*JQ)^1/2	153.6 ksi sqrt(in)

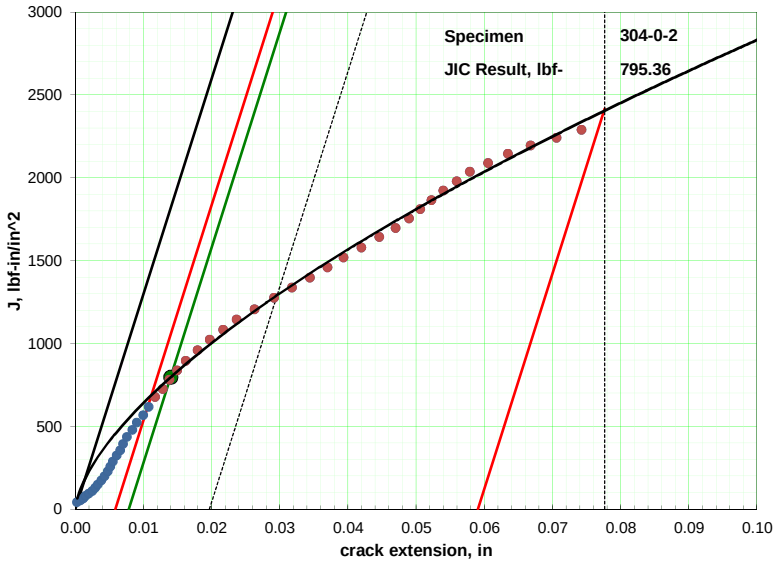
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	valid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	valid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-0-3

Specimen Type:	CT	Requestor:	Wall
Material:	SS304	Company:	Electric Power Research Institute
Drawing No.:	Fig. 2	P.O. No.:	4700007062
Temperature:	RT	Job No.:	02039-011217
Relative Humidity:	51%	Machining Source:	Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	**Notch Depth (in)**	0.400
Net Thickness (in)	0.4	**Gage Length (in)**	0.300
Width (in)	1	**Alpha Ratio**	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	**Stress Ratio**	0.1
Final a (in)	0.539	**Kmax (ksi sqrt (in))**	8.6
Pf (lbf)	1088.1		

Initial measured crack lengths (in)

0.541	0.541	0.541	0.541	0.538	0.538	0.538	0.538	0.536

Final measured crack lengths (in)

0.696	0.710	0.710	0.710	0.710	0.710	0.710	0.710	0.707

Ave. initial crack length (in)	0.539	**aoq (in)**	0.532
Ave. final crack length (in)	0.7085	**Compliance Adj. Factor**	0.808
Delta a measured (in)	0.1695	**Effective Modulus (Msi)**	21.8
Delta a predicted (in)	0.077		

Results

JQ (E1820)	745.0 lbf-in/in^2
KJIC(E*JQ)^1/2	148.7 ksi sqrt(in)

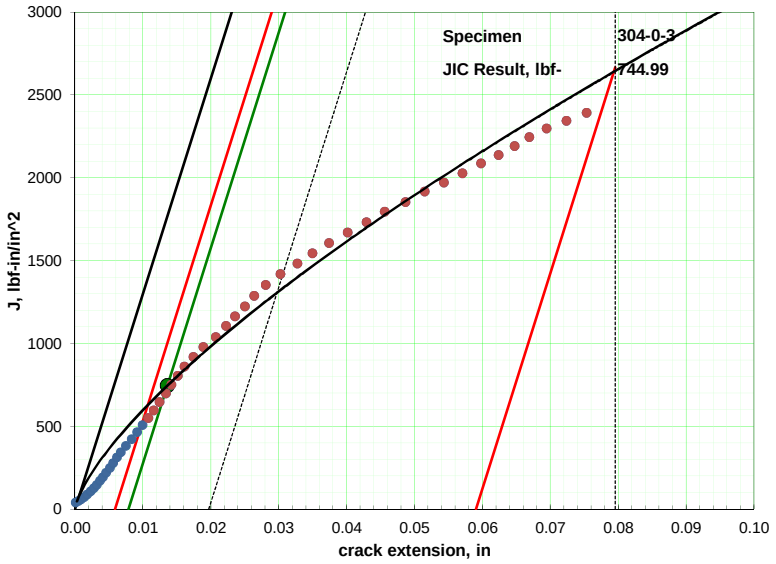
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	valid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	valid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-0-4

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 51%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	Stress Ratio	0.1
Final a (in)	0.5405	Kmax (ksi sqrt (in))	8.7
Pf (lbf)	1080.5		

Initial measured crack lengths (in)

0.543	0.543	0.546	0.546	0.542	0.540	0.536	0.535	0.531

Final measured crack lengths (in)

0.646	0.656	0.662	0.672	0.695	0.673	0.665	0.661	0.623

Ave. initial crack length (in)	0.5405	aoq (in)	0.532
Ave. final crack length (in)	0.6651	Compliance Adj. Factor	0.801
Delta a measured (in)	0.1246	Effective Modulus (Msi)	21.6
Delta a predicted (in)	0.0772		

Results

JQ (E1820)	1107.0 lbf-in/in^2
KJIC(E*JQ)^1/2	181.2 ksi sqrt(in)

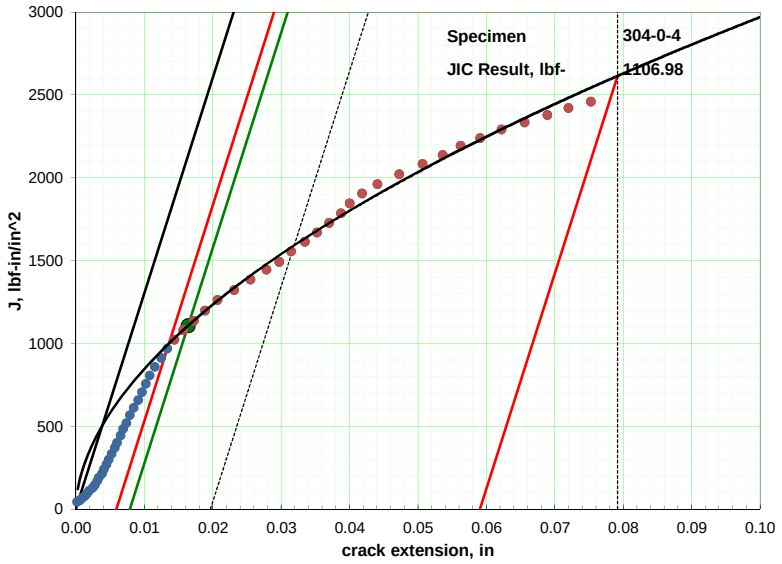
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	valid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	valid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-0-5

Specimen Type:	CT	Requestor:	Wall
Material:	SS304	Company:	Electric Power Research Institute
Drawing No.:	Fig. 2	P.O. No.:	4700007062
Temperature:	RT	Job No.:	02039-011217
Relative Humidity:	51%	Machining Source:	Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	**Notch Depth (in)**	0.400
Net Thickness (in)	0.4	**Gage Length (in)**	0.300
Width (in)	1	**Alpha Ratio**	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	**Stress Ratio**	0.1
Final a (in)	0.5628	**Kmax (ksi sqrt (in))**	9.4
Pf (lbf)	969.44		

Initial measured crack lengths (in)

0.552	0.554	0.556	0.559	0.563	0.567	0.570	0.573	0.572

Final measured crack lengths (in)

0.734	0.728	0.718	0.711	0.706	0.709	0.710	0.713	0.717

Ave. initial crack length (in)	0.5628	**aoq (in)**	0.567
Ave. final crack length (in)	0.7149	**Compliance Adj. Factor**	0.845
Delta a measured (in)	0.1521	**Effective Modulus (Msi)**	22.8
Delta a predicted (in)	0.0719		

Results

JQ (E1820)	1083.8 lbf-in/in^2
KJIC(E'*JQ)^1/2	179.3 ksi sqrt(in)

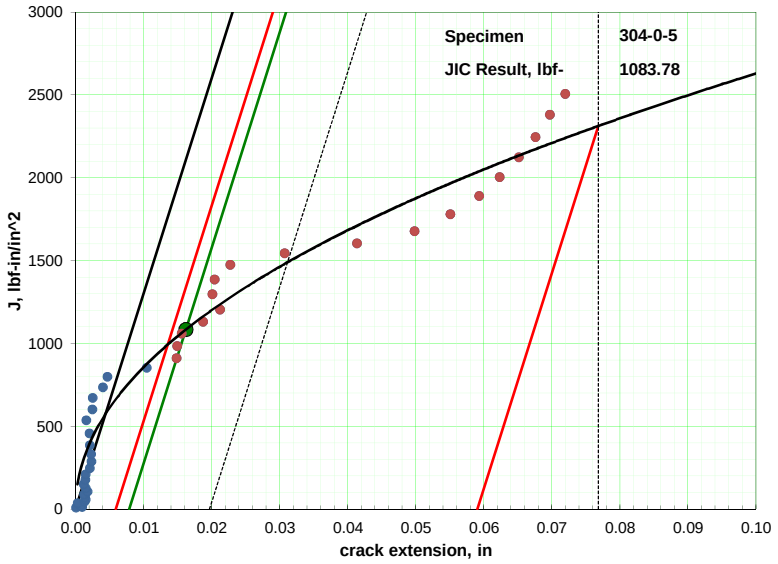
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	valid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	valid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-20-1

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 37%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	Stress Ratio	0.1
Final a (in)	0.5367	Kmax (ksi sqrt (in))	8.6
Pf (lbf)	1099.8		

Initial measured crack lengths (in)

0.560	0.552	0.543	0.534	0.528	0.528	0.530	0.532	0.534

Final measured crack lengths (in)

0.693	0.697	0.701	0.704	0.704	0.700	0.692	0.689	0.688

Ave. initial crack length (in)	0.5367	aoq (in)	0.531
Ave. final crack length (in)	0.6973	Compliance Adj. Factor	0.868
Delta a measured (in)	0.1605	Effective Modulus (Msi)	23.4
Delta a predicted (in)	0.0745		

Results

JQ (E1820)	397.8 lbf-in/in^2
KJIC(E*JQ)^1/2	108.6 ksi sqrt(in)

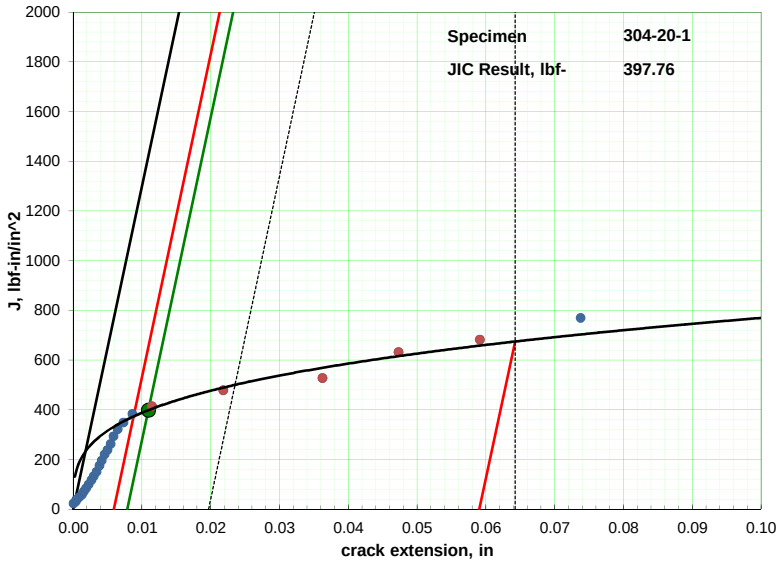
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	valid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-20-2

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 37%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	417	Stress Ratio	0.1
Final a (in)	0.5289	Kmax (ksi sqrt (in))	8.8
Pf (lbf)	1140.9		

Initial measured crack lengths (in)

0.547	0.538	0.527	0.521	0.520	0.522	0.527	0.534	0.535

Final measured crack lengths (in)

0.767	0.778	0.785	0.788	0.789	0.790	0.791	0.791	0.795

Ave. initial crack length (in)	0.5289	aoq (in)	0.525
Ave. final crack length (in)	0.7867	Compliance Adj. Factor	0.837
Delta a measured (in)	0.2578	Effective Modulus (Msi)	22.6
Delta a predicted (in)	0.0542		

Results

JQ (E1820)	410.1 lbf-in/in^2
KJIC(E'*JQ)^1/2	110.3 ksi sqrt(in)

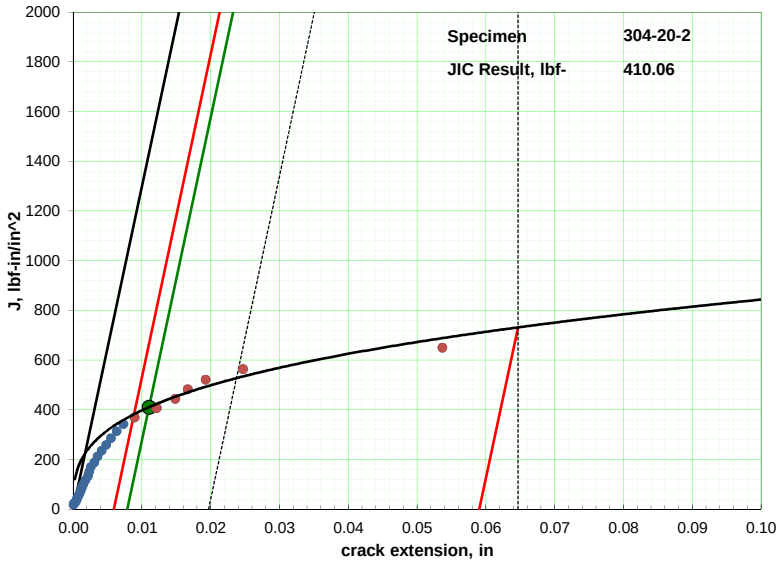
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	valid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-20-3

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 37%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	Stress Ratio	0.1
Final a (in)	0.5408	Kmax (ksi sqrt (in))	8.7
Pf (lbf)	1079		

Initial measured crack lengths (in)

0.573	0.565	0.550	0.538	0.529	0.527	0.528	0.534	0.539

Final measured crack lengths (in)

0.775	0.787	0.791	0.790	0.788	0.780	0.772	0.744	0.696 x

Ave. initial crack length (in)	0.5408	aoq (in)	0.541
Ave. final crack length (in)	0.7737	Compliance Adj. Factor	0.890
Delta a measured (in)	0.2329	Effective Modulus (Msi)	24.0
Delta a predicted (in)	0.0773		

Results

JQ (E1820)	380.8 lbf-in/in^2
KJIC(E*JQ)^1/2	106.3 ksi sqrt(in)

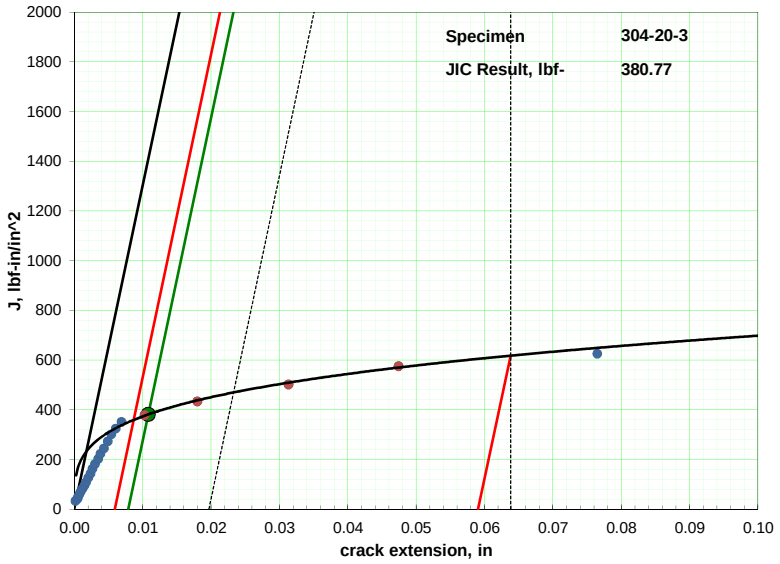
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-20-4

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 37%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	Stress Ratio	0.1
Final a (in)	0.5385	Kmax (ksi sqrt (in))	8.6
Pf (lbf)	1090.7		

Initial measured crack lengths (in)

0.564	0.551	0.540	0.530	0.526	0.527	0.535	0.542	0.547

Final measured crack lengths (in)

0.740	0.735	0.723	0.725	0.721	0.706	0.699	0.676	0.659 x

Ave. initial crack length (in)	0.5385	aoq (in)	0.536
Ave. final crack length (in)	0.7107	Compliance Adj. Factor	0.857
Delta a measured (in)	0.1721	Effective Modulus (Msi)	23.1
Delta a predicted (in)	0.0685		

Results

JQ (E1820)	352.6 lbf-in/in^2
KJIC(E*JQ)^1/2	102.3 ksi sqrt(in)

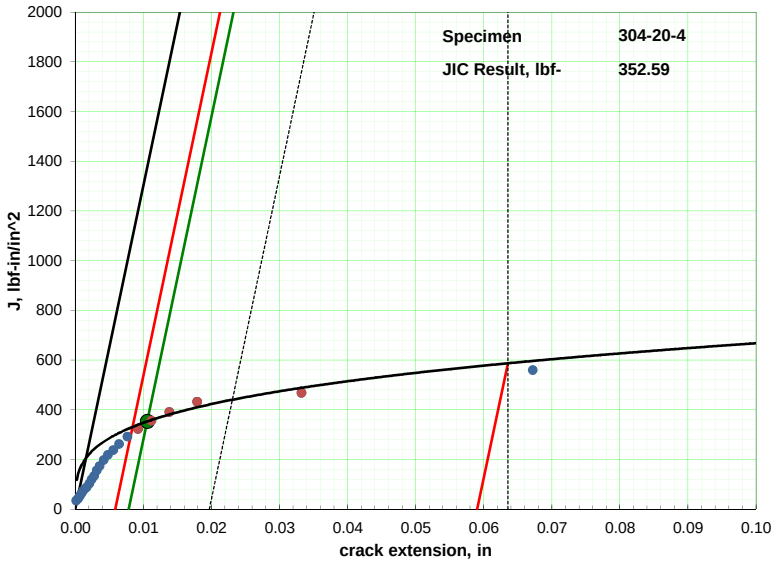
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-20-5

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 37%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	414	Stress Ratio	0.1
Final a (in)	0.5307	Kmax (ksi sqrt (in))	8.8
Pf (lbf)	1131.2		

Initial measured crack lengths (in)

0.557	0.549	0.535	0.523	0.518	0.515	0.521	0.534	0.544

Final measured crack lengths (in)

0.730	0.746	0.752	0.752	0.750	0.744	0.728	0.705	0.685 x

Ave. initial crack length (in)	0.5307	aoq (in)	0.531
Ave. final crack length (in)	0.7355	Compliance Adj. Factor	0.878
Delta a measured (in)	0.2047	Effective Modulus (Msi)	23.7
Delta a predicted (in)	0.0657		

Results

JQ (E1820)	346.5 lbf-in/in^2
KJIC(E*JQ)^1/2	101.4 ksi sqrt(in)

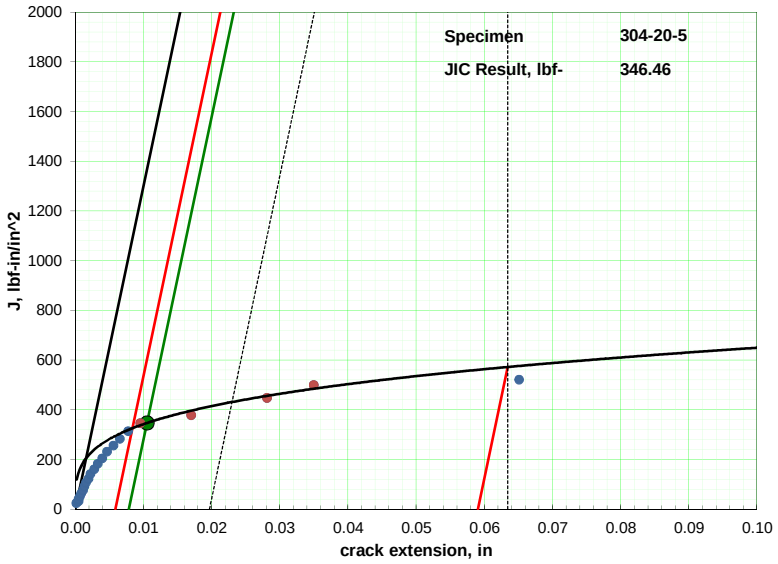
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-40-1

Specimen Type:	CT	Requestor:	Wall
Material:	SS304	Company:	Electric Power Research Institute
Drawing No.:	Fig. 2	P.O. No.:	4700007062
Temperature:	RT	Job No.:	02039-011217
Relative Humidity:	36%	Machining Source:	Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	**Notch Depth (in)**	0.400
Net Thickness (in)	0.4	**Gage Length (in)**	0.300
Width (in)	1	**Alpha Ratio**	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	413	**Stress Ratio**	0.1
Final a (in)	0.5287	**Kmax (ksi sqrt (in))**	8.7
Pf (lbf)	1142.2		

Initial measured crack lengths (in)

0.521	0.520	0.520	0.521	0.526	0.531	0.538	0.542	0.544

Final measured crack lengths (in)

0.750	0.748	0.742	0.739	0.737	0.725	0.718	0.713	0.705

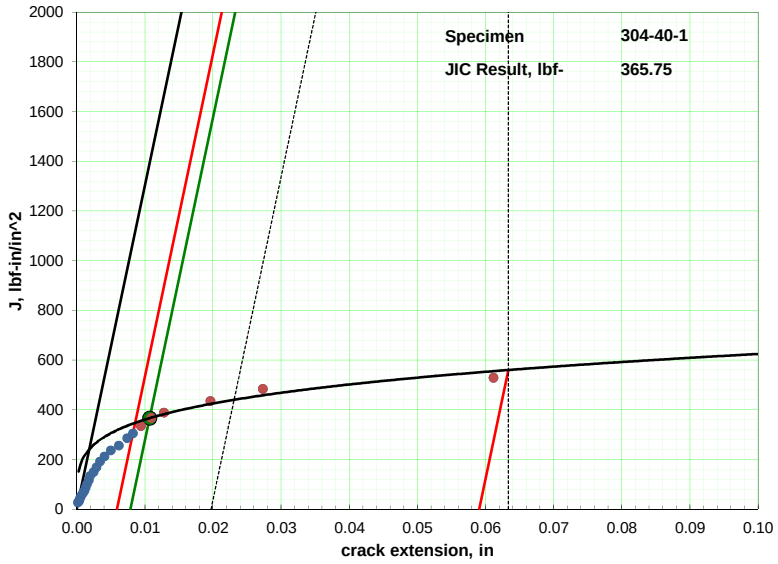
Ave. initial crack length (in)	0.5287	**aoq (in)**	0.526
Ave. final crack length (in)	0.7313	**Compliance Adj. Factor**	0.835
Delta a measured (in)	0.2027	**Effective Modulus (Msi)**	22.6
Delta a predicted (in)	0.0619		

Results

JQ (E1820)	365.8 lbf-in/in^2
KJIC(E*JQ)^1/2	104.2 ksi sqrt(in)

Qualification of Data		**Qualification of JQ as JIC**	
7.4.2: precrack length	valid		
9.1.4.1; precrack	valid	**A9.10.1; thickness**	valid
9.1.4.2; final crack	valid	**A9.10.2; ligament**	valid
9.1.5.1; Da meas	valid	**A9.11; slope**	valid
9.1.5.2; Da pred	invalid		
A9.6.4; # of pnts in reg.A	valid		
A9.6.4; # of pnts in reg.B	valid		
A9.9.1; C2<1	valid		
A9.9.2.1; a0q-a0	valid		
A9.9.2.2; # of pnts for JQ	invalid		
A9.9.2.2; # of pnts < JQ	valid		
A9.9.2.2; correlation	valid		

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-40-2

Specimen Type:	CT	Requestor:	Wall
Material:	SS304	Company:	Electric Power Research Institute
Drawing No.:	Fig. 2	P.O. No.:	4700007062
Temperature:	RT	Job No.:	02039-011217
Relative Humidity:	36%	Machining Source:	Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	**Notch Depth (in)**	0.400
Net Thickness (in)	0.4	**Gage Length (in)**	0.300
Width (in)	1	**Alpha Ratio**	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	**Stress Ratio**	0.1
Final a (in)	0.5401	**Kmax (ksi sqrt (in))**	8.7
Pf (lbf)	1082.7		

Initial measured crack lengths (in)

0.543	0.547	0.546	0.544	0.542	0.538	0.533	0.533	0.532

Final measured crack lengths (in)

0.686	0.705	0.722	0.730	0.737	0.739	0.736	0.737	0.739

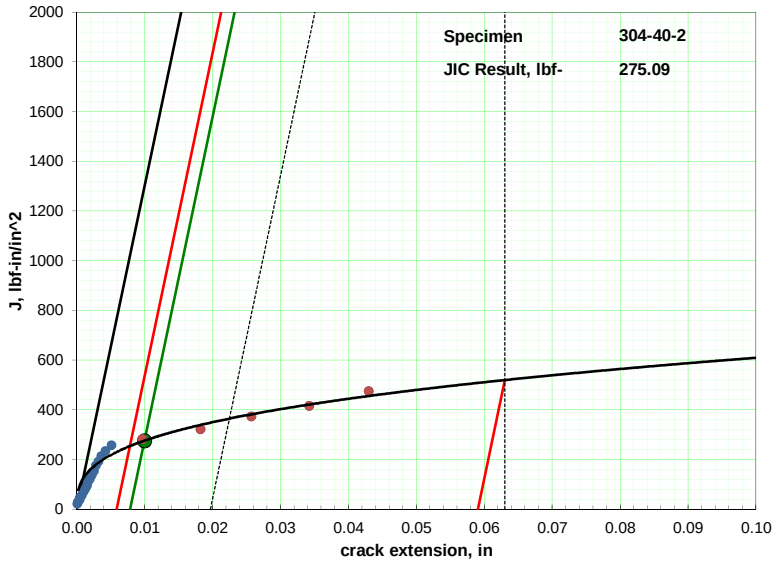
Ave. initial crack length (in)	0.5401	**aoq (in)**	0.541
Ave. final crack length (in)	0.7273	**Compliance Adj. Factor**	1.059
Delta a measured (in)	0.1872	**Effective Modulus (Msi)**	28.6
Delta a predicted (in)	0.0438		

Results

JQ (E1820)	275.1 lbf-in/in^2
KJIC(E'*JQ)^1/2	90.3 ksi sqrt(in)

Qualification of Data		**Qualification of JQ as JIC**	
7.4.2: precrack length	valid		
9.1.4.1; precrack	valid	**A9.10.1; thickness**	valid
9.1.4.2; final crack	valid	**A9.10.2; ligament**	valid
9.1.5.1; Da meas	valid	**A9.11; slope**	valid
9.1.5.2; Da pred	invalid		
A9.6.4; # of pnts in reg.A	valid		
A9.6.4; # of pnts in reg.B	valid		
A9.9.1; C2<1	valid		
A9.9.2.1; a0q-a0	valid		
A9.9.2.2; # of pnts for JQ	invalid		
A9.9.2.2; # of pnts < JQ	valid		
A9.9.2.2; correlation	valid		

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-40-3

Specimen Type:	CT	Requestor:	Wall
Material:	SS304	Company:	Electric Power Research Institute
Drawing No.:	Fig. 2	P.O. No.:	4700007062
Temperature:	RT	Job No.:	02039-011217
Relative Humidity:	36%	Machining Source:	Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	**Notch Depth (in)**	0.400
Net Thickness (in)	0.4	**Gage Length (in)**	0.300
Width (in)	1	**Alpha Ratio**	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	**Stress Ratio**	0.1
Final a (in)	0.5353	**Kmax (ksi sqrt (in))**	8.5
Pf (lbf)	1107.4		

Initial measured crack lengths (in)

0.529	0.528	0.526	0.526	0.528	0.537	0.544	0.551	0.555

Final measured crack lengths (in)

0.724	0.743	0.769	0.796	0.803	0.803	0.798	0.786	0.753
x								

Ave. initial crack length (in)	0.5353	**aoq (in)**	0.536
Ave. final crack length (in)	0.7797	**Compliance Adj. Factor**	0.857
Delta a measured (in)	0.2444	**Effective Modulus (Msi)**	23.1
Delta a predicted (in)	0.0554		

Results

JQ (E1820)	316.6 lbf-in/in^2
KJIC(E*JQ)^1/2	96.9 ksi sqrt(in)

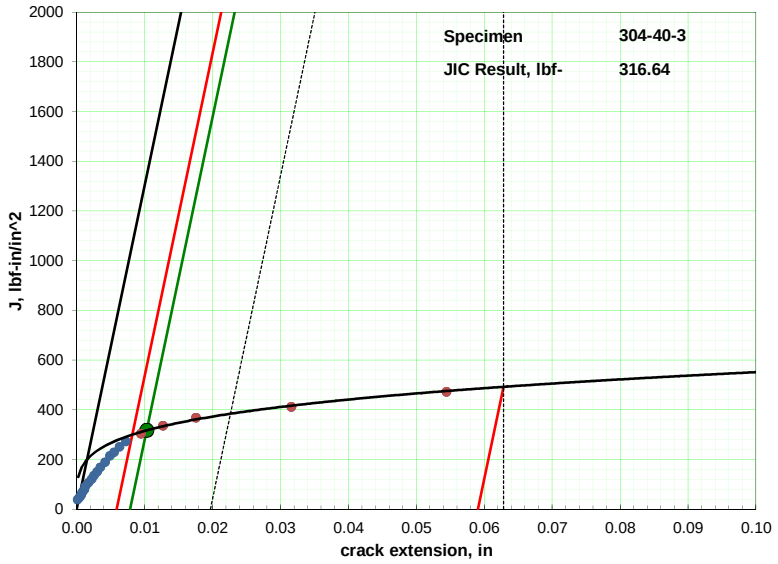
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-40-4

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 36%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	Stress Ratio	0.1
Final a (in)	0.5369	Kmax (ksi sqrt (in))	8.6
Pf (lbf)	1099.2		

Initial measured crack lengths (in)

0.572	0.534	0.532	0.528	0.526	0.528	0.536	0.547	0.557

Final measured crack lengths (in)

0.778	0.797	0.807	0.815	0.820	0.819	0.816	0.791	0.742 x

Ave. initial crack length (in)	0.5368	aoq (in)	0.536
Ave. final crack length (in)	0.8032	Compliance Adj. Factor	0.882
Delta a measured (in)	0.2664	Effective Modulus (Msi)	23.8
Delta a predicted (in)	0.0857		

Results

JQ (E1820)	404.7 lbf-in/in^2
KJIC(E*JQ)^1/2	109.6 ksi sqrt(in)

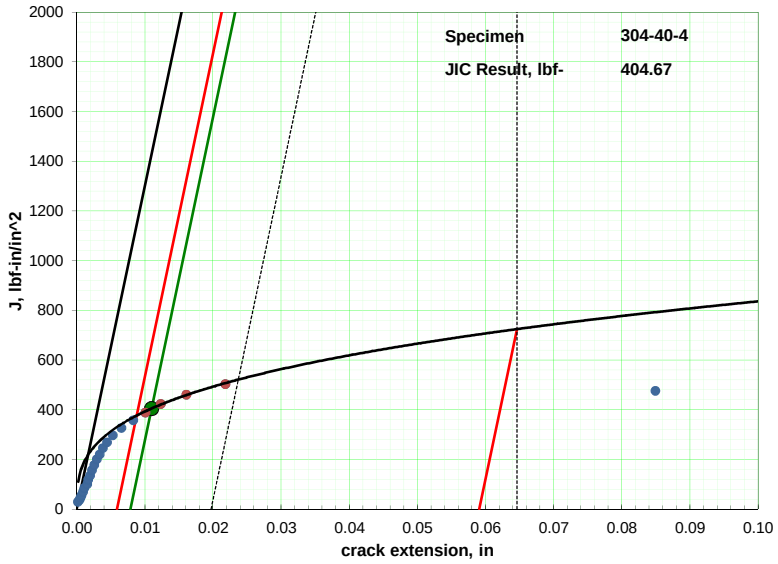
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	invalid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-40-5

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 36%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	Stress Ratio	0.1
Final a (in)	0.5372	Kmax (ksi sqrt (in))	8.6
Pf (lbf)	1097.7		

Initial measured crack lengths (in)

0.575	0.564	0.550	0.537	0.529	0.524	0.524	0.524	0.520

Final measured crack lengths (in)

0.780	0.818	0.841	0.842	0.843	0.843	0.840	0.831	0.766
x								x

Ave. initial crack length (in)	0.5372	aoq (in)	0.536
Ave. final crack length (in)	0.8292	Compliance Adj. Factor	0.928
Delta a measured (in)	0.292	Effective Modulus (Msi)	25.1
Delta a predicted (in)	0.1516		

Results

JQ (E1820)	354.0 lbf-in/in^2
KJIC(E*JQ)^1/2	102.5 ksi sqrt(in)

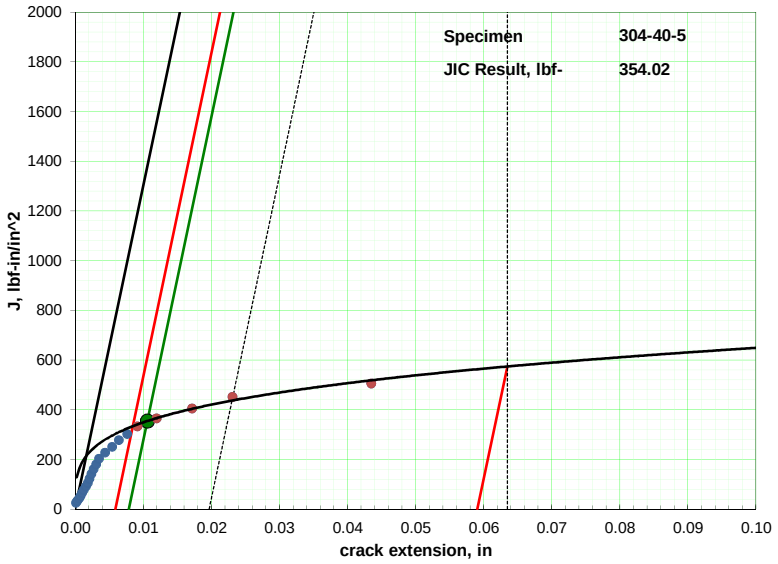
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-60-1

Specimen Type:	CT	Requestor:	Wall
Material:	SS304	Company:	Electric Power Research Institute
Drawing No.:	Fig. 2	P.O. No.:	4700007062
Temperature:	RT	Job No.:	02039-011217
Relative Humidity:	37%	Machining Source:	Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	**Notch Depth (in)**	0.400
Net Thickness (in)	0.4	**Gage Length (in)**	0.300
Width (in)	1	**Alpha Ratio**	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	**Stress Ratio**	0.1
Final a (in)	0.5342	**Kmax (ksi sqrt (in))**	8.5
Pf (lbf)	1113.1		

Initial measured crack lengths (in)

0.548	0.539	0.537	0.538	0.537	0.533	0.528	0.524	0.525

Final measured crack lengths (in)

0.754	0.808	0.818	0.824	0.817	0.805	0.788	0.765	0.731 x

Ave. initial crack length (in)	0.5342	**aoq (in)**	0.531
Ave. final crack length (in)	0.7959	**Compliance Adj. Factor**	0.859
Delta a measured (in)	0.2617	**Effective Modulus (Msi)**	23.2
Delta a predicted (in)	0.1721		

Results

JQ (E1820)	289.3 lbf-in/in^2
KJIC(E*JQ)^1/2	92.6 ksi sqrt(in)

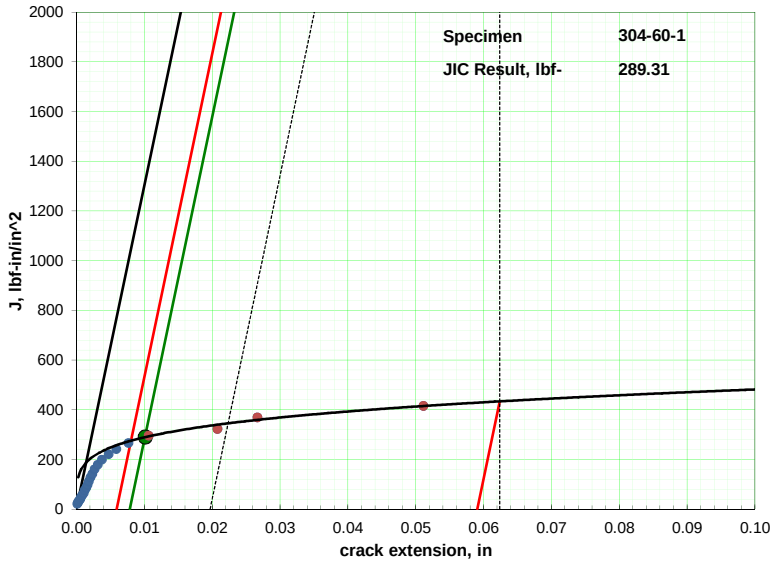
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-60-2

Specimen Type:	CT	Requestor:	Wall
Material:	SS304	Company:	Electric Power Research Institute
Drawing No.:	Fig. 2	P.O. No.:	4700007062
Temperature:	RT	Job No.:	02039-011217
Relative Humidity:	37%	Machining Source:	Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	**Notch Depth (in)**	0.400
Net Thickness (in)	0.4	**Gage Length (in)**	0.300
Width (in)	1	**Alpha Ratio**	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	**Stress Ratio**	0.1
Final a (in)	0.5349	**Kmax (ksi sqrt (in))**	8.5
Pf (lbf)	1109.6		

Initial measured crack lengths (in)

0.533	0.534	0.535	0.537	0.537	0.535	0.533	0.534	0.536

Final measured crack lengths (in)

0.791	0.822	0.835	0.838	0.833	0.821	0.808	0.799	0.726 x

Ave. initial crack length (in)	0.5349	**aoq (in)**	0.531
Ave. final crack length (in)	0.8143	**Compliance Adj. Factor**	0.942
Delta a measured (in)	0.2794	**Effective Modulus (Msi)**	25.4
Delta a predicted (in)	0.1318		

Results

JQ (E1820)	323.2 lbf-in/in^2
KJIC(E'*JQ)^1/2	97.9 ksi sqrt(in)

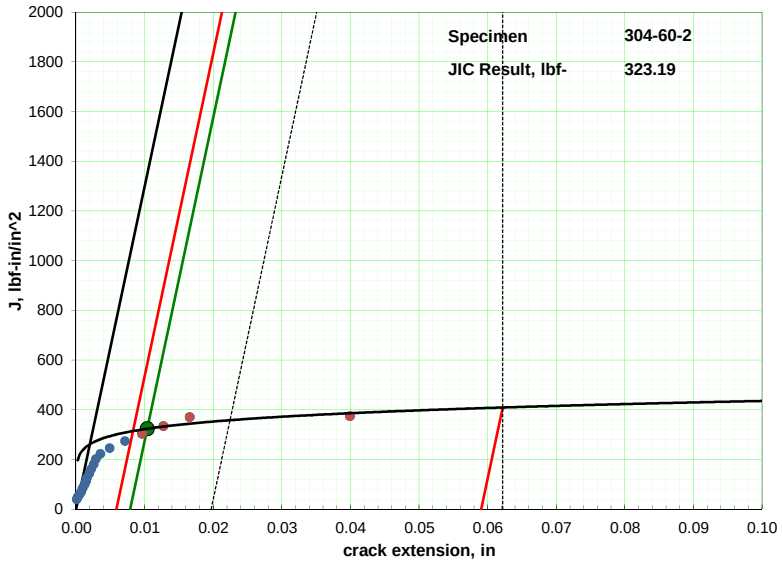
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	invalid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-60-3

Specimen Type:	CT	Requestor:	Wall
Material:	SS304	Company:	Electric Power Research Institute
Drawing No.:	Fig. 2	P.O. No.:	4700007062
Temperature:	RT	Job No.:	02039-011217
Relative Humidity:	37%	Machining Source:	Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	**Notch Depth (in)**	0.400
Net Thickness (in)	0.4	**Gage Length (in)**	0.300
Width (in)	1	**Alpha Ratio**	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	**Stress Ratio**	0.1
Final a (in)	0.5415	**Kmax (ksi sqrt (in))**	8.7
Pf (lbf)	1075.3		

Initial measured crack lengths (in)

0.533	0.536	0.539	0.544	0.546	0.545	0.544	0.542	0.540

Final measured crack lengths (in)

0.604	0.654	0.704	0.723	0.725	0.727	0.709	0.669	0.603
x								x

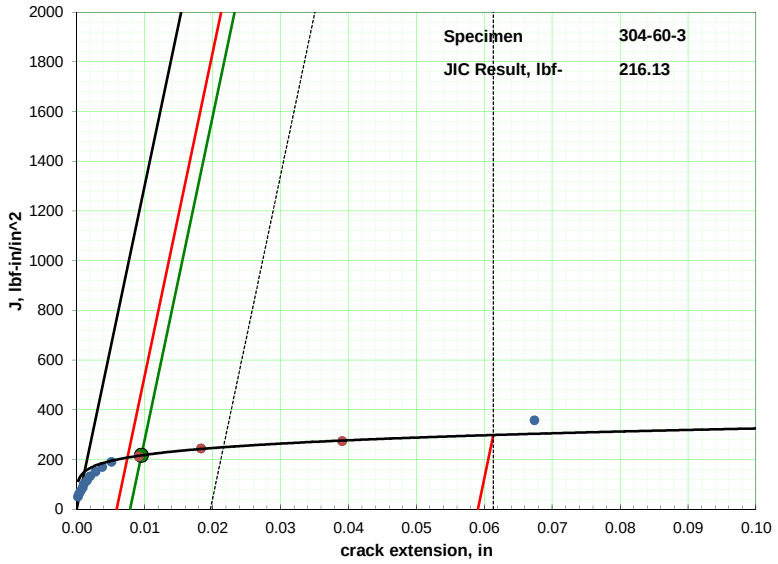
Ave. initial crack length (in)	0.5415	**aoq (in)**	0.541
Ave. final crack length (in)	0.6894	**Compliance Adj. Factor**	1.007
Delta a measured (in)	0.1479	**Effective Modulus (Msi)**	27.2
Delta a predicted (in)	0.0686		

Results

JQ (E1820)	216.1 lbf-in/in^2
KJIC(E*JQ)^1/2	80.1 ksi sqrt(in)

Qualification of Data		**Qualification of JQ as JIC**	
7.4.2: precrack length	valid		
9.1.4.1; precrack	valid	**A9.10.1; thickness**	valid
9.1.4.2; final crack	invalid	**A9.10.2; ligament**	valid
9.1.5.1; Da meas	invalid	**A9.11; slope**	valid
9.1.5.2; Da pred	invalid		
A9.6.4; # of pnts in reg.A	valid		
A9.6.4; # of pnts in reg.B	valid		
A9.9.1; C2<1	valid		
A9.9.2.1; a0q-a0	valid		
A9.9.2.2; # of pnts for JQ	invalid		
A9.9.2.2; # of pnts < JQ	valid		
A9.9.2.2; correlation	valid		

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-60-4

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 37%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	Stress Ratio	0.1
Final a (in)	0.5385	Kmax (ksi sqrt (in))	8.6
Pf (lbf)	1090.6		

Initial measured crack lengths (in)

0.537	0.535	0.534	0.536	0.538	0.542	0.542	0.541	0.543

Final measured crack lengths (in)

0.781	0.813	0.832	0.835	0.841	0.847	0.845	0.825	0.801

Ave. initial crack length (in)	0.5385	aoq (in)	0.536
Ave. final crack length (in)	0.8286	Compliance Adj. Factor	0.881
Delta a measured (in)	0.29	Effective Modulus (Msi)	23.8
Delta a predicted (in)	0.0537		

Results

JQ (E1820)	341.3 lbf-in/in^2
KJIC(E*JQ)^1/2	100.6 ksi sqrt(in)

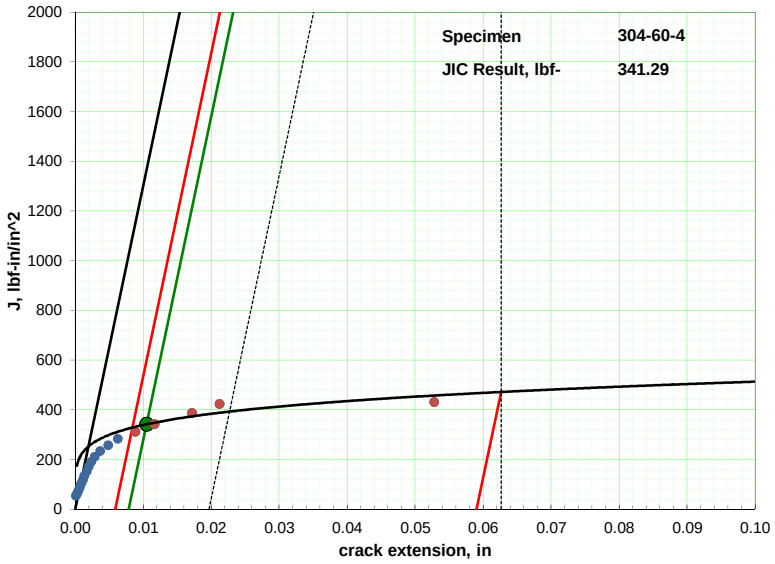
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	valid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	invalid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-60-5

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 37%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	Stress Ratio	0.1
Final a (in)	0.5401	Kmax (ksi sqrt (in))	8.7
Pf (lbf)	1082.6		

Initial measured crack lengths (in)

0.528	0.535	0.550	0.558	0.558	0.552	0.537	0.514	0.507

Final measured crack lengths (in)

0.643	0.665	0.683	0.693	0.694	0.683	0.660	0.621	0.594 x

Ave. initial crack length (in)	0.5401	aoq (in)	0.541
Ave. final crack length (in)	0.6647	Compliance Adj. Factor	0.859
Delta a measured (in)	0.1246	Effective Modulus (Msi)	23.2
Delta a predicted (in)	0.0442		

Results

JQ (E1820)	245.7 lbf-in/in^2
KJIC(E*JQ)^1/2	85.4 ksi sqrt(in)

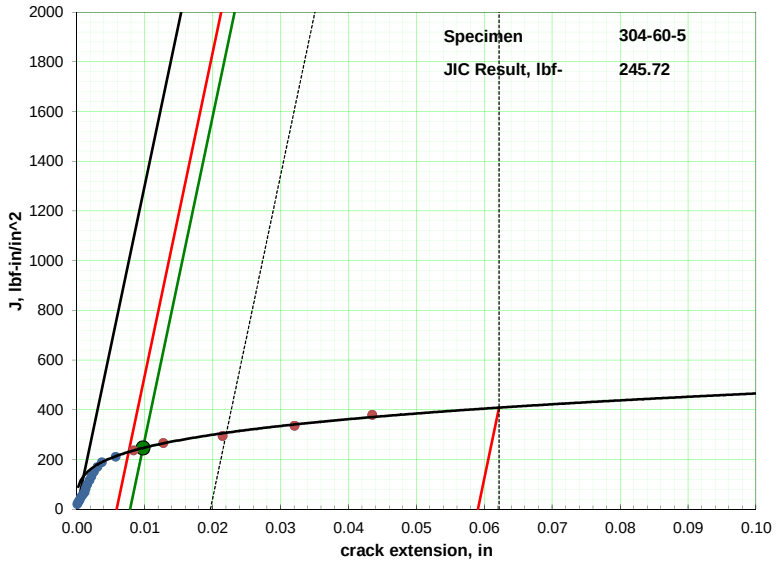
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-80-1

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 54%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	Stress Ratio	0.1
Final a (in)	0.552	Kmax (ksi sqrt (in))	9.0
Pf (lbf)	1022.4		

Initial measured crack lengths (in)

0.520	0.539	0.559	0.567	0.568	0.567	0.559	0.541	0.511

Final measured crack lengths (in)

0.617	0.640	0.654	0.668	0.673	0.663	0.645	0.630	0.613

Ave. initial crack length (in)	0.552	aoq (in)	0.550
Ave. final crack length (in)	0.6485	Compliance Adj. Factor	0.948
Delta a measured (in)	0.0965	Effective Modulus (Msi)	25.6
Delta a predicted (in)	0.0682		

Results

JQ (E1820)	57.2 lbf-in/in^2
KJIC(E'*JQ)^1/2	41.2 ksi sqrt(in)

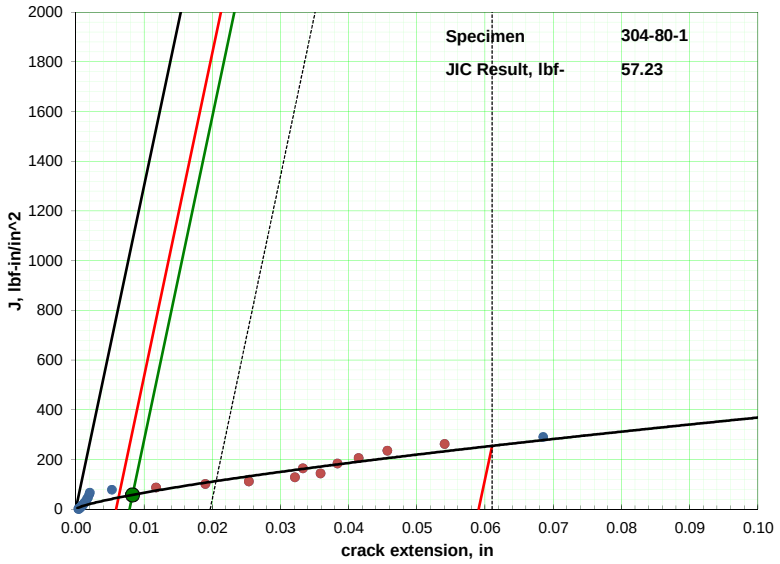
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	valid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	valid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-80-2

Specimen Type:	CT	Requestor:	Wall
Material:	SS304	Company:	Electric Power Research Institute
Drawing No.:	Fig. 2	P.O. No.:	4700007062
Temperature:	RT	Job No.:	02039-011217
Relative Humidity:	54%	Machining Source:	Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	**Notch Depth (in)**	0.400
Net Thickness (in)	0.4	**Gage Length (in)**	0.300
Width (in)	1	**Alpha Ratio**	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	**Stress Ratio**	0.1
Final a (in)	0.5434	**Kmax (ksi sqrt (in))**	8.8
Pf (lbf)	1065.7		

Initial measured crack lengths (in)

0.573	0.577	0.577	0.568	0.551	0.530	0.513	0.501	0.490 x

Final measured crack lengths (in)

0.590	0.599	0.608	0.617	0.626	0.612	0.593	0.562	0.520 x

Ave. initial crack length (in)	0.5434	**aoq (in)**	0.555
Ave. final crack length (in)	0.5963	**Compliance Adj. Factor**	0.932
Delta a measured (in)	0.0529	**Effective Modulus (Msi)**	25.2
Delta a predicted (in)	0.0319		

Results

JQ (E1820)	0.0 lbf-in/in^2
KJIC(E'*JQ)^1/2	0.0 ksi sqrt(in)

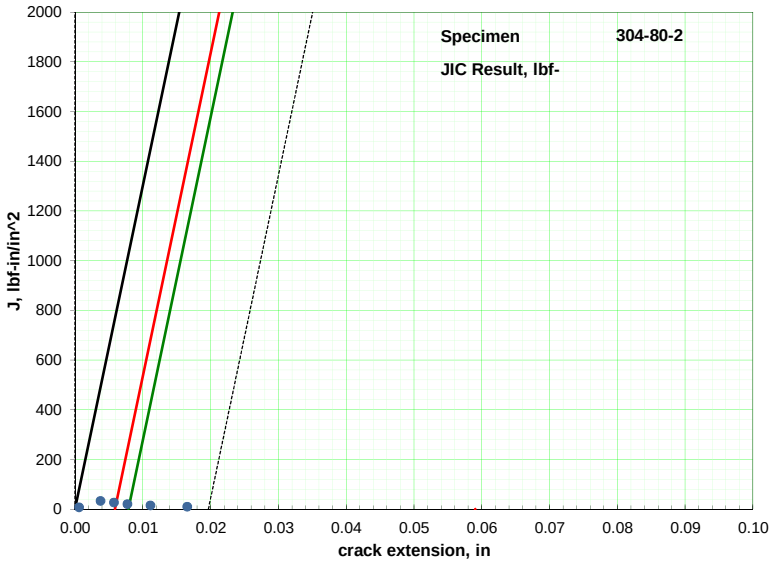
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	invalid
9.1.4.2; final crack	invalid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	invalid
A9.6.4; # of pnts in reg.B	invalid
A9.9.1; C2<1	invalid
A9.9.2.1; a0q-a0	invalid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	invalid
A9.9.2.2; correlation	invalid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

No valid J1C could be determined.

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SUMMARY OF FRACTURE TOUGHNESS

304-80-3

Specimen Type:	CT	Requestor:	Wall
Material:	SS304	Company:	Electric Power Research Institute
Drawing No.:	Fig. 2	P.O. No.:	4700007062
Temperature:	RT	Job No.:	02039-011217
Relative Humidity:	54%	Machining Source:	Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	**Notch Depth (in)**	0.400
Net Thickness (in)	0.4	**Gage Length (in)**	0.300
Width (in)	1	**Alpha Ratio**	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	**Stress Ratio**	0.1
Final a (in)	0.5434	**Kmax (ksi sqrt (in))**	8.8
Pf (lbf)	1065.6		

Initial measured crack lengths (in)

0.534	0.547	0.560	0.563	0.562	0.555	0.539	0.512	0.485 x

Final measured crack lengths (in)

0.663	0.694	0.715	0.732	0.757 x	0.731	0.705	0.673	0.629 x

Ave. initial crack length (in)	0.5434	**aoq (in)**	0.541
Ave. final crack length (in)	0.7066	**Compliance Adj. Factor**	0.907
Delta a measured (in)	0.1632	**Effective Modulus (Msi)**	24.5
Delta a predicted (in)	0.0897		

Results

JQ (E1820)	233.1 lbf-in/in^2
KJIC(E*JQ)^1/2	83.2 ksi sqrt(in)

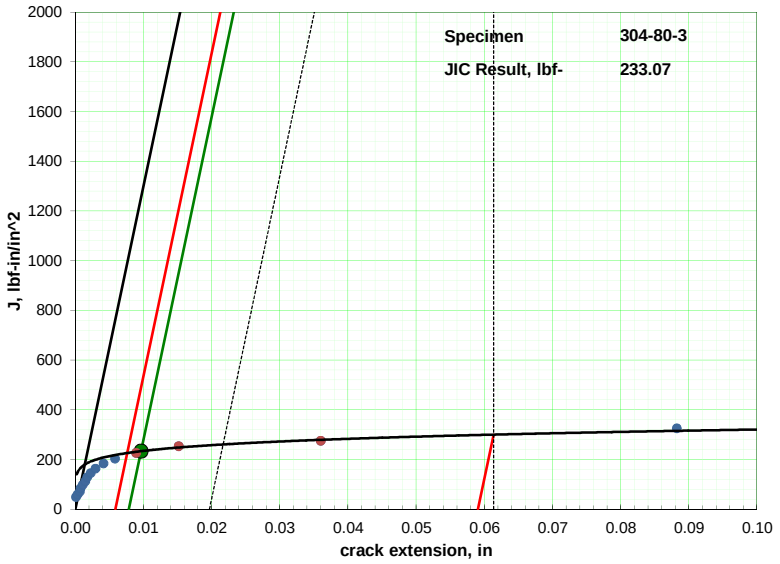
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	invalid
9.1.4.2; final crack	invalid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	invalid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-80-4

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 54%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	Stress Ratio	0.1
Final a (in)	0.5514	Kmax (ksi sqrt (in))	9.0
Pf (lbf)	1025.2		

Initial measured crack lengths (in)

0.569	0.574	0.576	0.573	0.568	0.557	0.536	0.500 x	0.484 x

Final measured crack lengths (in)

0.660	0.682	0.684	0.684	0.671	0.657	0.631	0.590 x	0.554 x

Ave. initial crack length (in)	0.5514	aoq (in)	0.551
Ave. final crack length (in)	0.6509	Compliance Adj. Factor	0.885
Delta a measured (in)	0.0995	Effective Modulus (Msi)	23.9
Delta a predicted (in)	0.0423		

Results

JQ (E1820)	268.1 lbf-in/in^2
KJIC(E'*JQ)^1/2	89.2 ksi sqrt(in)

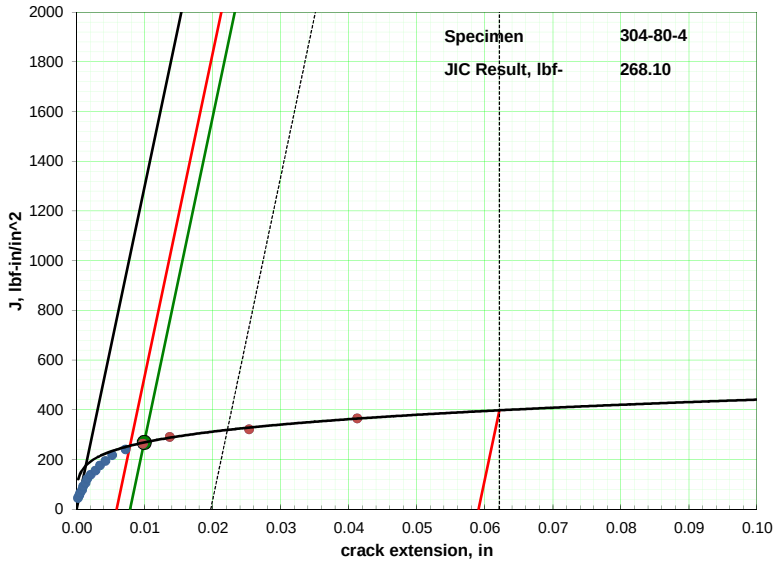
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	invalid
9.1.4.2; final crack	invalid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



All results are reported For Information Only

Applicable Specification: ASTM E1820-20

Customer: Electric Power Research Institute, Inc. 3420 Hillview Ave, Palo Alto CA 94304

Additional customer nos.: SOW: Compact Tension Testing of Cold-Worked Stainless Steel Alloys;
EPRI Task ID: 1-110095-01-02;

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SUMMARY OF FRACTURE TOUGHNESS

304-80-5

Specimen Type: CT
Material: SS304
Drawing No.: Fig. 2
Temperature: RT
Relative Humidity: 54%

Requestor: Wall
Company: Electric Power Research Institute
P.O. No.: 4700007062
Job No.: 02039-011217
Machining Source: Customer

Material Properties

Yield (ksi)	40
Tensile (ksi)	90
Modulus (Msi)	27

Specimen Dimensions

Thickness (in)	0.5	Notch Depth (in)	0.400
Net Thickness (in)	0.4	Gage Length (in)	0.300
Width (in)	1	Alpha Ratio	1.25
Pin Spacing (in)	0.55		

Precrack Parameters

Pmax (lbf)	394	Stress Ratio	0.1
Final a (in)	0.5416	Kmax (ksi sqrt (in))	8.7
Pf (lbf)	1074.8		

Initial measured crack lengths (in)

0.526	0.526	0.535	0.541	0.543	0.543	0.549	0.553	0.558

Final measured crack lengths (in)

0.629	0.713	0.764	0.784	0.798	0.803	0.803	0.789	0.683
x	x							x

Ave. initial crack length (in)	0.5416	aoq (in)	0.541
Ave. final crack length (in)	0.7637	Compliance Adj. Factor	0.835
Delta a measured (in)	0.2221	Effective Modulus (Msi)	22.6
Delta a predicted (in)	0.1032		

Results

JQ (E1820)	240.5 lbf-in/in^2
KJIC(E*JQ)^1/2	84.5 ksi sqrt(in)

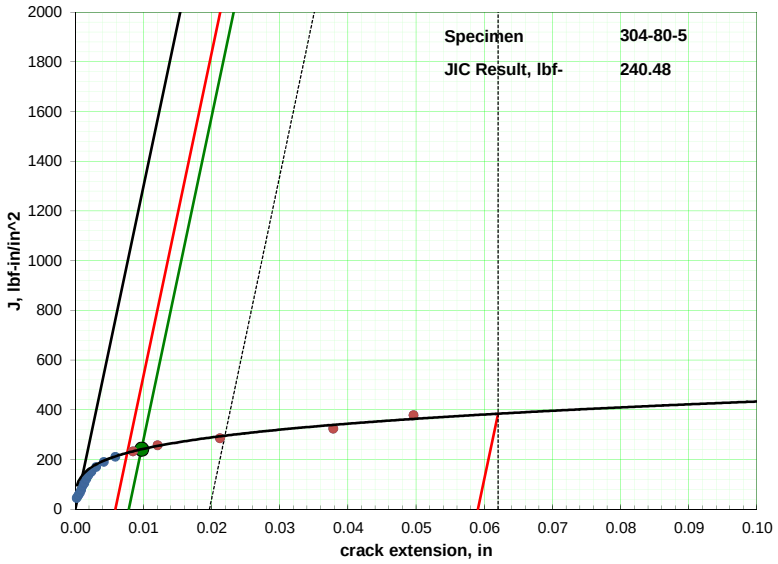
Qualification of Data

7.4.2: precrack length	valid
9.1.4.1; precrack	valid
9.1.4.2; final crack	invalid
9.1.5.1; Da meas	valid
9.1.5.2; Da pred	invalid
A9.6.4; # of pnts in reg.A	valid
A9.6.4; # of pnts in reg.B	valid
A9.9.1; C2<1	valid
A9.9.2.1; a0q-a0	valid
A9.9.2.2; # of pnts for JQ	invalid
A9.9.2.2; # of pnts < JQ	valid
A9.9.2.2; correlation	valid

Qualification of JQ as JIC

A9.10.1; thickness	valid
A9.10.2; ligament	valid
A9.11; slope	valid

ASTM E1820-20 Standard Test



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