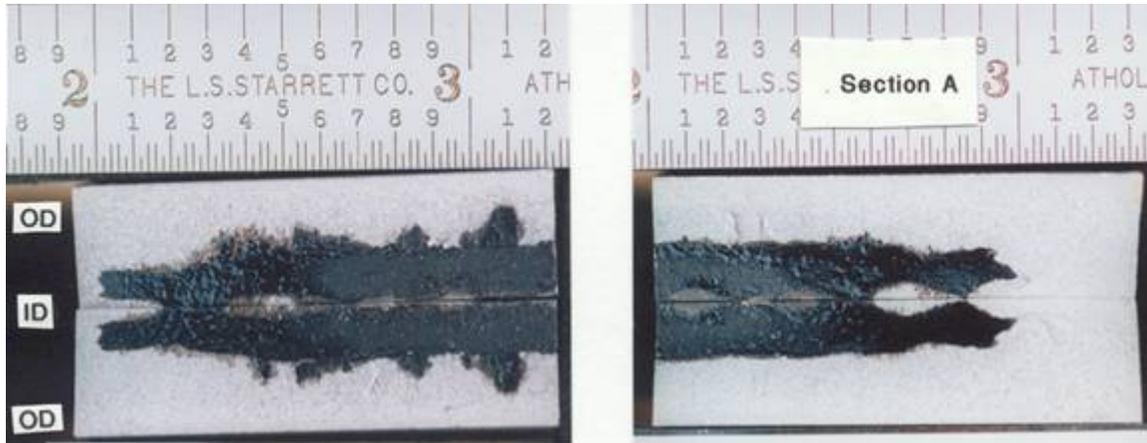


Appendix B – Task 2
Catalog of Seam Weld Defect Types



Photograph of Fracture Surfaces.

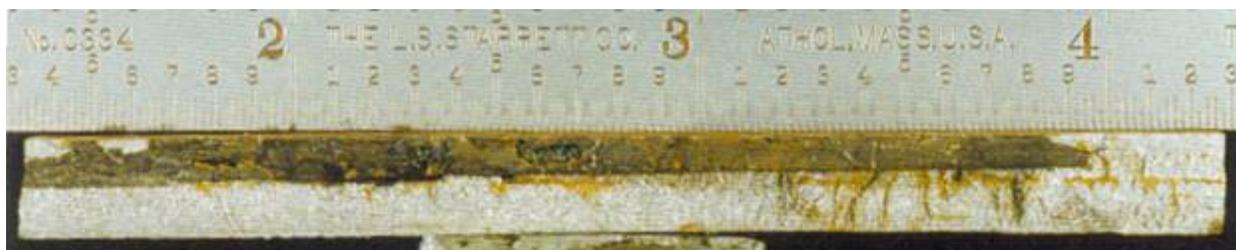
Catalog #: 30
 Report #: 3
 Defect #: 13

Pipe

Vintage: circa 1950
 Manufacturer: Youngstown
 Seam Type: LF-ERW
 Grade: X52
 $D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.312 inch (7.92 mm)
 t_{pipe} : 0.319 inch (8.10 mm)
 Failure: None

Defect

NDE technique(s): UT
 NDE result(s): 60%, 3.5 inch
 (89 mm) ID crack
 Visual: ID Hook Crack
 L
 depth/ t_{weld} : 2.21 inch (56.1 mm)
 71%
 depth: 0.240 inch (6.10 mm)
 t_{weld} : 0.340 inch (8.64 mm)



Photograph of Fracture Surface.

Catalog #: 134
 Report #: 12
 Defect #: 68C

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 99%, 2.25 inch
 (57.2 mm) OD-
 Connected Non-
 Fusion

Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Visual: OD Hook Crack
 L
 $\text{depth}/t_{\text{weld}}$: > 2.7 inch (69 mm)
 52%
 depth: 0.130 inch (3.30 mm)
 t_{weld} : 0.248 inch (6.30 mm)



Photographs of Metallographic Section and Fracture Surface.

Catalog #: 135
 Report #: 12
 Defect #: 71A

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Defect

NDE technique(s): Fast UT, MPI
 NDE result(s): 60%, 8.5 inch
 (216 mm) ID & Mid-wall Non-Fusion
 Mid-wall Void + Laminations + ID
 Hook Crack
 Visual: > 2 inch (51 mm)
 (ID Hook Crack)
 depth/ t_{weld} 48% (ID Hook Crack)
 depth: 0.122 inch (3.10 mm)
 t_{weld} 0.251 inch (6.38 mm)

Seam Type: LF-ERW

Grade: API 5L X42

$D_{nominal}$ 12.75 inch (324 mm)
 $t_{nominal}$ 0.250 inch (6.35 mm)
 t_{pipe} Not Determined
 Failure: N/A



Photograph of Fracture Surface.

Catalog #: 122
 Report #: 12
 Defect #: 58A

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 52%, 8 inch (203 mm)
 OD-Connected Non-Fusion

Visual: OD Hook Crack
 L > 7 inch (178 mm)
 depth/ t_{weld} : 46%
 depth: 0.120 inch (3.05 mm)
 t_{weld} : 0.260 inch (6.60 mm)



Photograph of Fracture Surface.

Catalog #: 142
 Report #: 12
 Defect #: 79A

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 64%, 4.3 inch (109 mm)
 Intermittent Non-Fusion
 Visual: OD Hook Crack
 L
 $\text{depth}/t_{\text{weld}}$: > 6.575 inch (167 mm)
 44%
 depth: 0.108 inch (2.74 mm)
 t_{weld} : 0.248 inch (6.30 mm)



Photograph of Fracture Surfaces.

Catalog #: 22
 Report #: 2
 Defect #: 421

Pipe

Vintage: circa 1950
 Manufacturer: Youngstown

Seam Type: ERW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.326 inch (8.28 mm)
 Failure: Burst test rupture at
 2,200 psig (15.17
 MPa) (136% of SMYS)

Defect

NDE technique(s): UT
 NDE result(s): 50%, 7 inch (178 mm)
 crack like
 Visual: ID Hook crack
 L 5.5 inch (140 mm)
 depth/ t_{weld} : 43%
 depth: 0.150 inch (3.81 mm)
 t_{weld} : 0.344 inch (8.74 mm)



Photograph of Fracture Surface.

Catalog #: 126
 Report #: 12
 Defect #: 67A

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 80%, 6 inch (152 mm)
 ID-Connected Non-Fusion

Visual: OD Hook Crack
 L
 depth/ t_{weld} : 43%
 depth: 0.106 inch (2.69 mm)
 t_{weld} : 0.147 inch (3.73 mm)



Photograph Fracture Surface.

Catalog #: 124
 Report #: 12
 Defect #: 60A

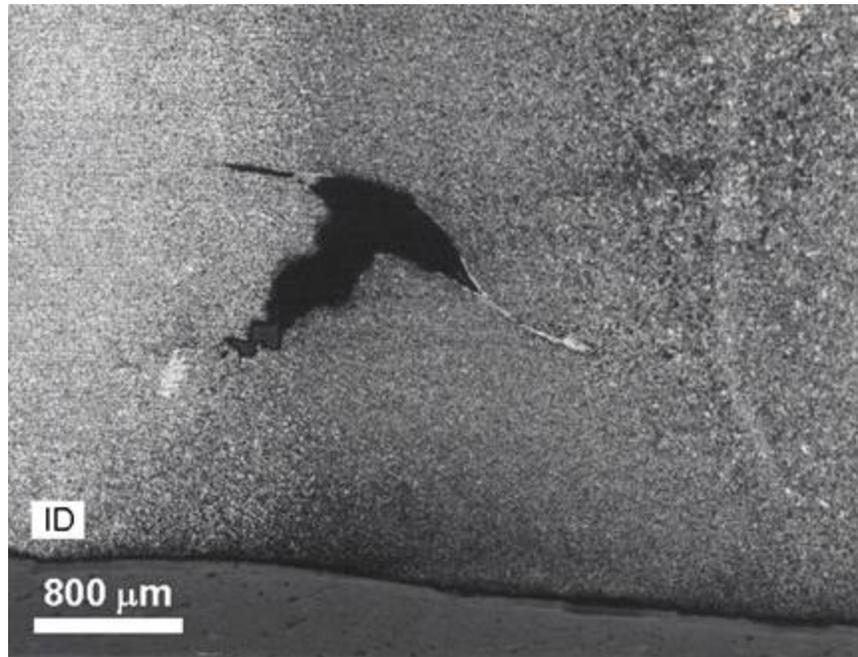
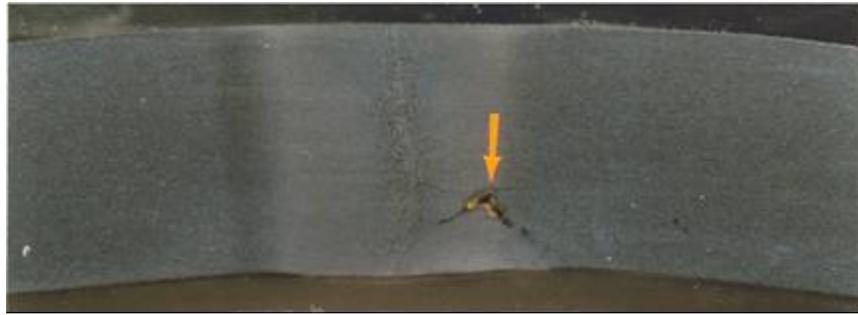
Pipe

Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

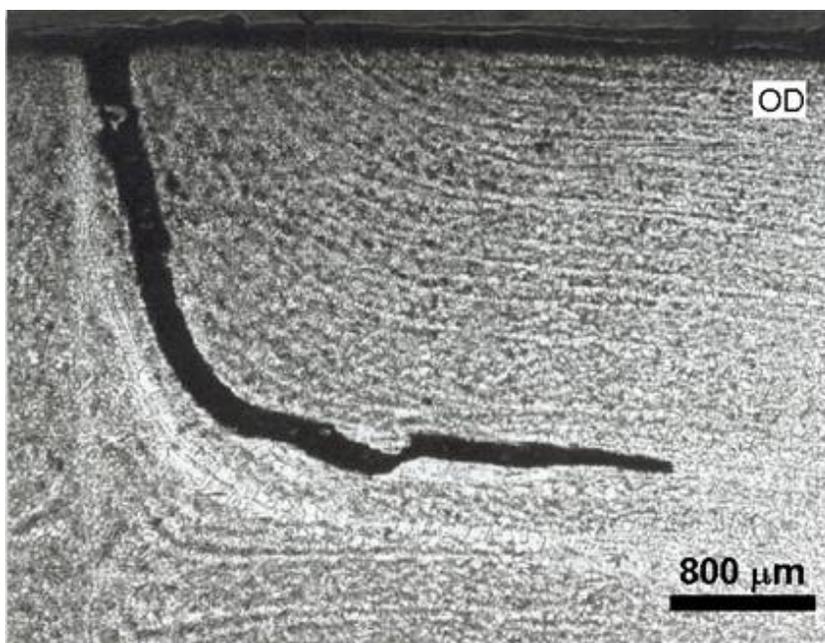
Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 84%, 7 inch (178 mm)
 OD-Connected Non-Fusion
 Visual: OD Hook Crack
 L
 $\text{depth}/t_{\text{weld}}$: > 7.0 inch (178 mm)
 40%
 depth: 0.105 inch (2.67 mm)
 t_{weld} : 0.265 inch (6.73 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #:	104		
Report #:	11		
Defect #:	3B		
<u>Pipe</u>		<u>Defect</u>	
Vintage:	1953	NDE technique(s):	Fast UT
Manufacturer:	Unknown	NDE result(s):	40%, 3 inch (76 mm) ID Crack ID Hook Crack Mid-wall Void
Seam Type:	LF-ERW	Visual:	Not Determined
Grade:	API 5L X42	L	39.6% (ID Hook Crack)
D _{nominal}	12.75 inch (324 mm)	depth/t _{weld}	Not Determined
t _{nominal}	0.250 inch (6.35 mm)	depth:	Not Determined
t _{pipe}	Not Determined	t _{weld}	Not Determined
Failure:	N/A		



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 140
 Report #: 12
 Defect #: 73D

Pipe

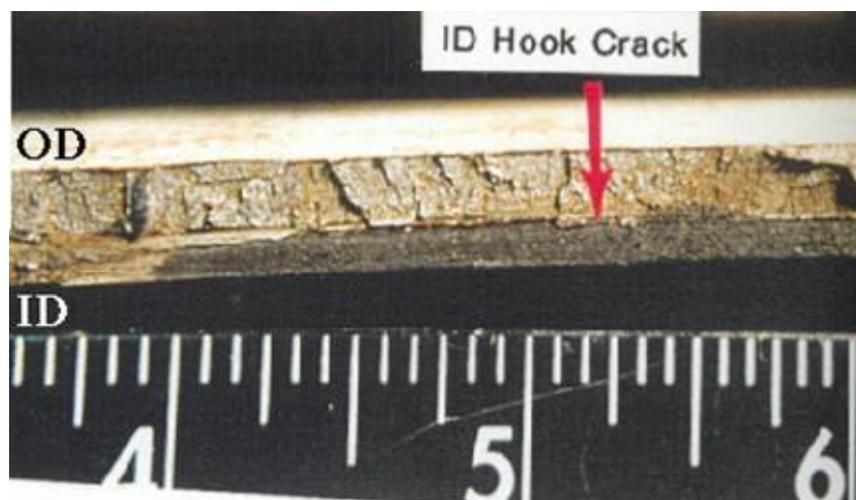
Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 48%, 6.5 inch (165 mm)
 OD-Connected Non-Fusion

Visual: OD Hook Crack
 L: Not Determined
 depth/ t_{weld} : 38%
 depth: 0.090 inch (2.29 mm)
 t_{weld} : 0.236 inch (5.99 mm)



Photographs of Fracture Surfaces.

Catalog #: 23
 Report #: 2
 Defect #: 551-38.8.b

Pipe

Vintage: circa 1950

Manufacturer: Youngstown
 Seam Type: ERW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.332 inch (8.43 mm)
 Failure: Burst test rupture(*) at
 2,200 psig (15.17 MPa)
 (116% of SMYS)

Defect

NDE technique(s): UT
 NDE result(s): 20%, 2.5 inch (64 mm)
 ID crack like
 Visual: ID Hook crack
 L: 6.0 inch (152 mm)
 depth/ t_{weld} : 35%
 depth: 0.120 inch (3.05 mm)
 t_{weld} : 0.346 inch (8.79 mm)

(*) Burst test failed two adjacent hook cracks at one pressure.



Photographs of Fracture Surfaces.

Catalog #: 24
 Report #: 2
 Defect #: 551-39.6.b

Pipe

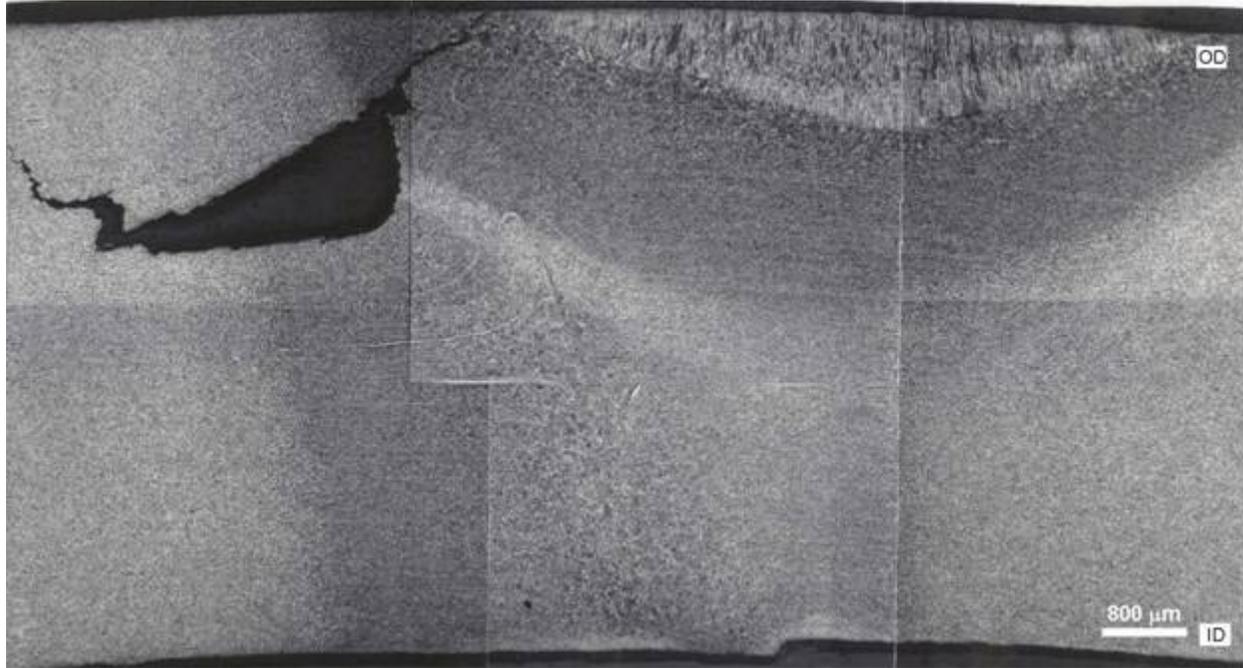
Vintage: circa 1950
 Manufacturer: Youngstown

Seam Type: ERW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.332 inch (8.43 mm)
 Failure: Burst test rupture(*) at
 2,200 psig (15.17 MPa)
 (116% of SMYS)

Defect

NDE technique(s): UT
 NDE result(s): 80%, 5.5 inch (140 mm)
 ID crack like
 Visual: ID Hook crack
 L: 7.0 inch (178 mm)
 $\text{depth}/t_{\text{weld}}$: 35%
 depth: 0.120 inch (3.05 mm)
 t_{weld} : 0.346 inch (8.79 mm)

(*) Burst test failed two adjacent hook cracks at one pressure.



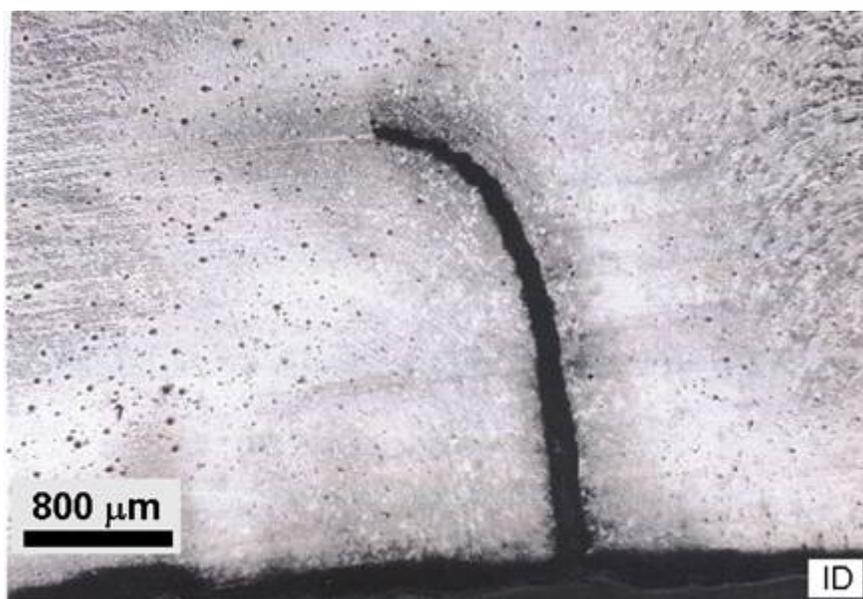
Photograph and Photomicrograph of Metallographic Section.

Catalog #:	108		
Report #:	11		
Defect #:	4A		
<u>Pipe</u>		<u>Defect</u>	
Vintage:	1953	NDE technique(s):	Fast UT
Manufacturer:	Unknown	NDE result(s):	40%, 3.5 inch (89 mm) OD Crack
Seam Type:	LF-ERW	Visual:	OD Hook Crack + Mid-Wall Void + OD Weld Repair
Grade:	API 5L X42	L	Not Determined
D _{nominal}	12.75 inch (324 mm)	depth/t _{weld}	33.5% (OD Hook Crack)
t _{nominal}	0.250 inch (6.35 mm)	depth:	Not Determined
t _{pipe}	Not Determined	t _{weld}	Not Determined
Failure:	N/A		



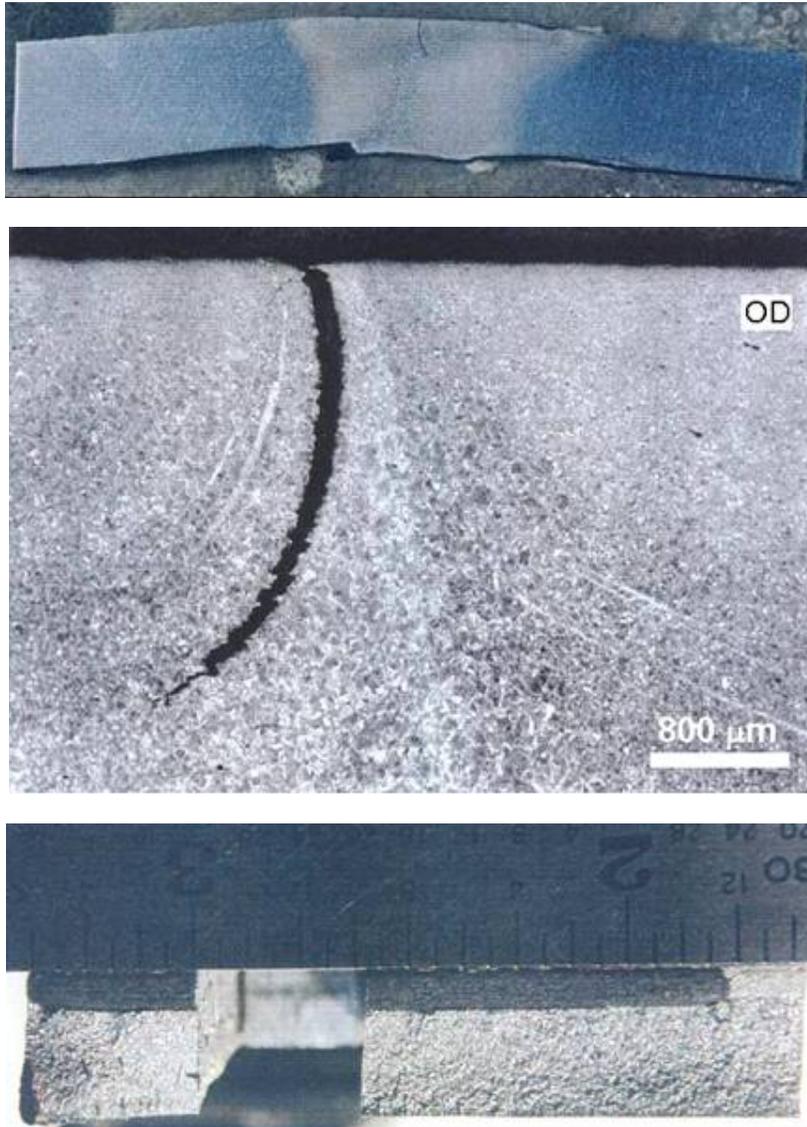
Photograph and Photomicrograph Metallographic Section.

Catalog #:	9		
Report #:	1		
Defect #:	469		
Pipe		Defect	
Vintage:	1950s	NDE technique(s):	UT
Manufacturer:	Youngstown	NDE result(s):	30% x 2.5 inch (63.5 mm) ID crack
Seam Type:	ERW	Visual:	ID hook crack
Grade:	X52	L	N/A
D _{nominal}	20 inch (508 mm)	depth/t _{weld}	29%
t _{nominal}	0.312 inch (7.92 mm)	depth:	0.096 inch (2.44 mm)
t _{pipe}	0.309 inch (7.85 mm)	t _{weld}	0.330 inch (8.38 mm)
Failure:	None at 2,175 psig (15.00 MPa) (134% of SMYS)		



Photograph and Photomicrograph of Metallographic Section.

Catalog #:	7		
Report #:	1		
Defect #:	415		
Pipe		Defect	
Vintage:	1950s	NDE technique(s):	UT
Manufacturer:	Youngstown	NDE result(s):	<10% x 2.4 inch (61 mm) grind area on seam
Seam Type:	ERW	Visual:	ID hook crack
Grade:	X52	L	N/A
D _{nominal}	20 inch (508 mm)	depth/t _{weld}	27.9%
t _{nominal}	0.312 inch (7.92 mm)	depth:	0.092 inch (2.34 mm)
t _{pipe}	0.330 inch (8.38 mm)	t _{weld}	0.330 inch (8.38 mm)
Failure:	Yielding at 2,100 psig (14.48 MPa) (129% of SMYS)		



Photographs and Photomicrograph of Metallographic Section and Fracture Surface.

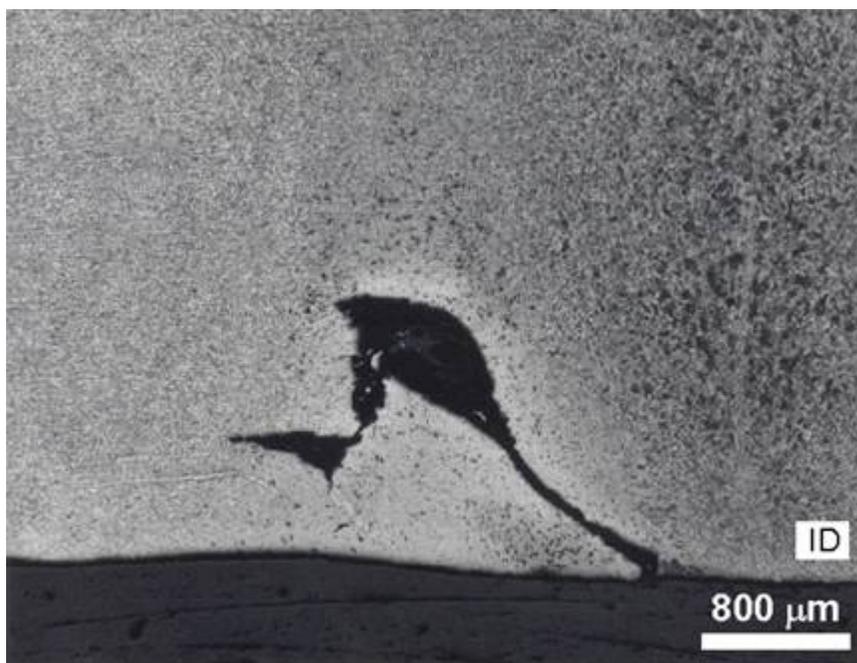
Catalog #: 98
 Report #: 10
 Defect #: CY-7

Pipe

Vintage: circa 1950
 Manufacturer: Youngstown
 Seam Type: ERW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): N/A
 NDE result(s): N/A
 Visual: OD Hook Crack
 L: 1.6 inch (41 mm)
 depth/ t_{weld} : 27.5 %
 depth: 0.100 inch (2.54 mm)
 t_{weld} : 0.363 inch (9.22 mm)



Photograph and Photomicrograph of Metallographic Section.

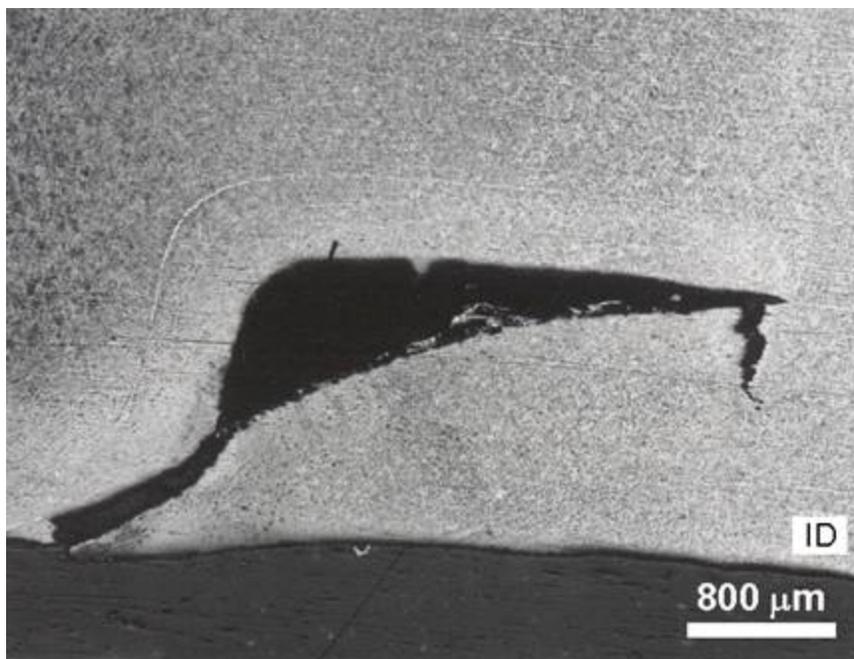
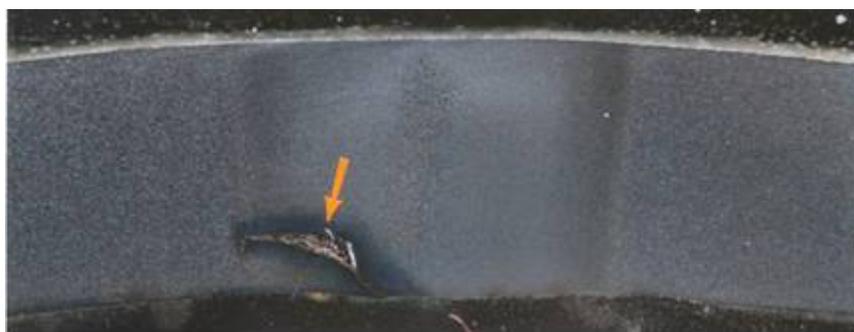
Catalog #: 106
 Report #: 11
 Defect #: 3D

Pipe

Vintage: 1953
 Manufacturer: Unknown
 Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT
 NDE result(s): 30%, 2.5 inch (63 mm) ID Crack
 ID Hook Crack Mid-wall Void
 Visual: Not Determined
 depth/ t_{weld} : 24.2% (ID Hook Crack)
 depth: Not Determined
 t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 103

Report #: 11

Defect #: 3A

Pipe

Vintage: 1953

Manufacturer: Unknown

Seam Type: LF-ERW

Grade: API 5L X42

D_{nominal} : 12.75 inch (324 mm)

t_{nominal} : 0.250 inch (6.35 mm)

t_{pipe} : Not Determined

Failure: N/A

Defect

NDE technique(s): Fast UT

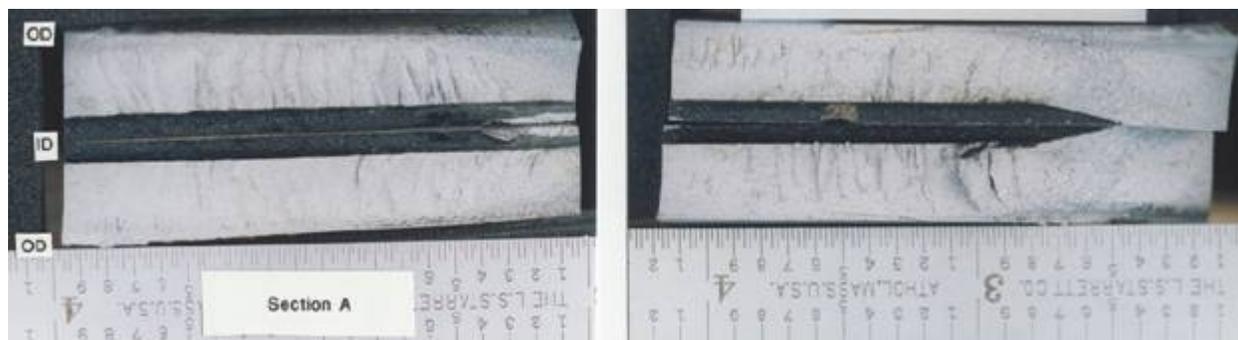
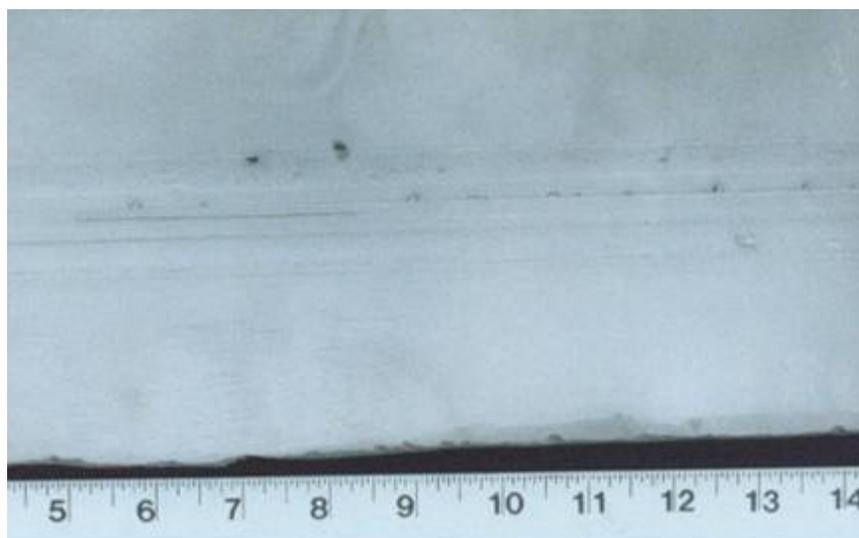
NDE result(s): 25%, 4 inch
(102 mm) ID Crack
ID Hook Crack Mid-
Wall Void

Visual: Not Determined

L depth/ t_{weld} : 24% (ID Hook Crack)

depth: Not Determined

t_{weld} : Not Determined



Photographs of ID Pipe Surface and of Fracture Surfaces.

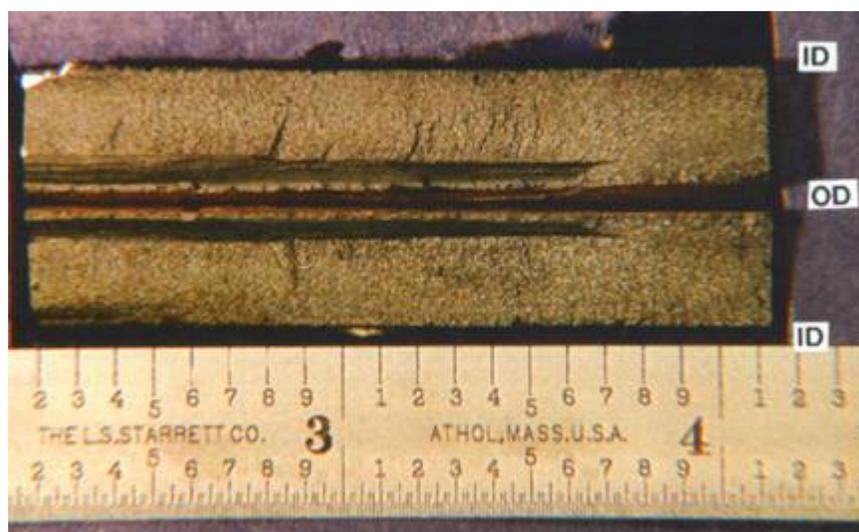
Catalog #: 32
 Report #: 3
 Defect #: 16

Pipe

Vintage: circa 1950
 Manufacturer: Youngstown
 Seam Type: LF-ERW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.335 inch (8.51 mm)
 Failure: None

Defect

NDE technique(s): UT
 NDE result(s): 40%, 4 inch (102 mm)
 ID hook crack
 Visual: ID Hook crack
 >3.64 inch (92.5 mm)
 depth/ t_{weld} : 23%
 depth: 0.083 inch (2.1 mm)
 t_{weld} : 0.365 inch (9.27 mm)



Photograph of Fracture Surfaces.

Catalog #: 10
 Report #: 1
 Defect #: 490

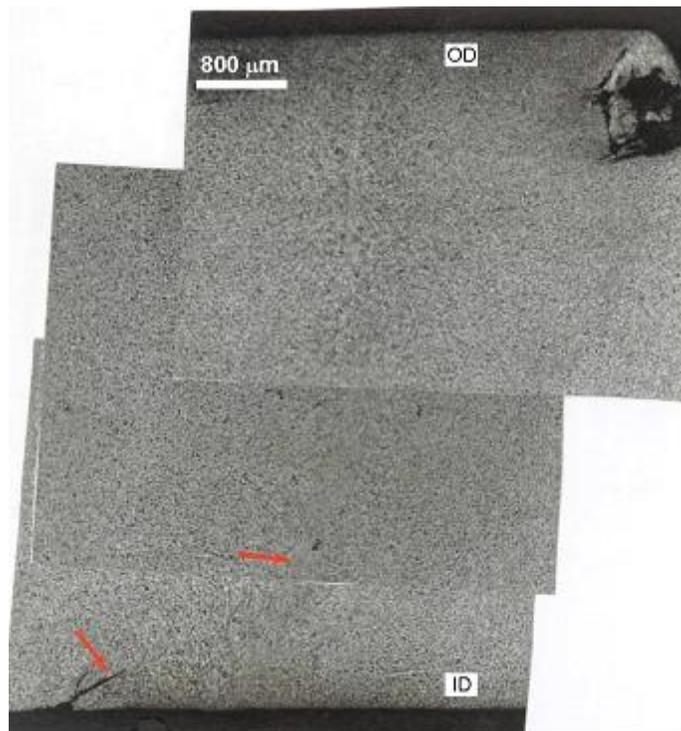
Pipe

Vintage: 1950s
 Manufacturer: Youngstown

Seam Type: ERW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.320 inch (8.13 mm)
 Failure: None at 2,300 psig
 (15.86 MPa) (142%
 of SMYS)

Defect

NDE technique(s): UT
 NDE result(s): 30% x 2.63 inch
 (66.7 mm) OD crack
 OD hook crack
 ~ 3.1 inch (79 mm)
 depth/ t_{weld} : 23%
 depth: 0.096 inch (2.44 mm)
 t_{weld} : 0.340 inch (8.64 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 125
 Report #: 12
 Defect #: 62A

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW

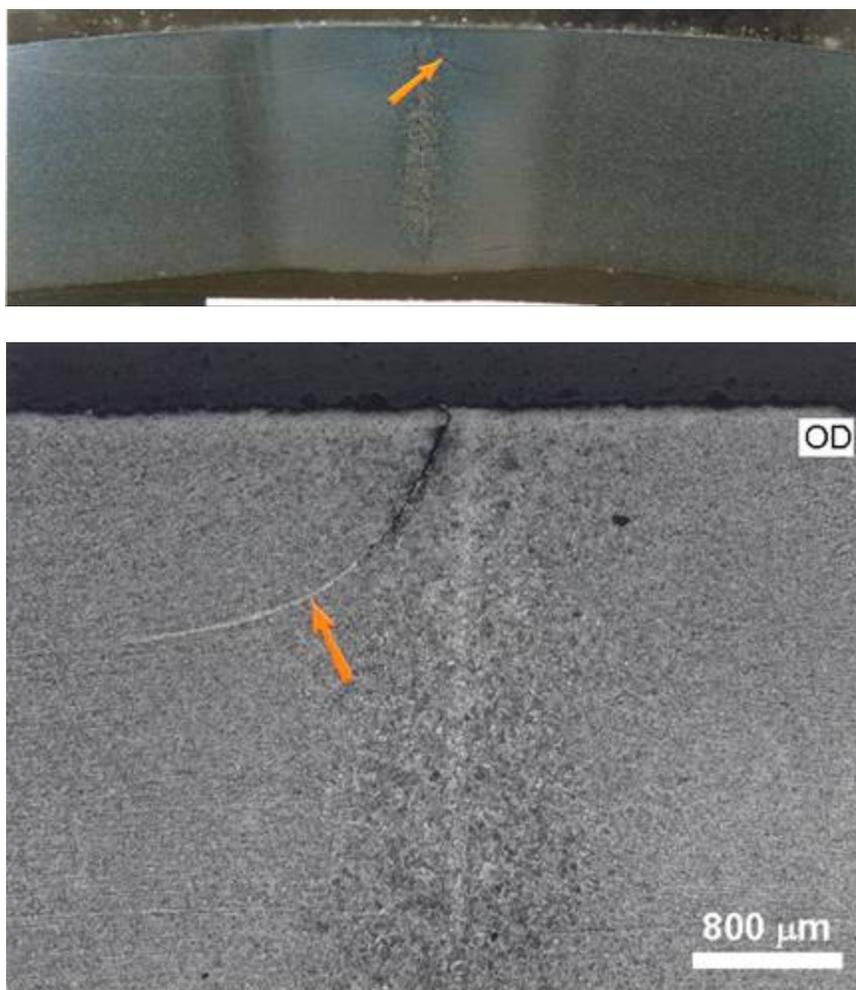
Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 16%, 8 inch (203 mm)

Visual: Non-Fusion or Lamination
 Misalignment + Hook Crack + Alloy Segregation

L
 $\text{depth}/t_{\text{weld}}$: Not Determined
 depth : 19% (Misalignment)
 t_{weld} : 0.049 inch (1.24 mm)
 0.257 inch (6.53 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 105
 Report #: 11
 Defect #: 3C

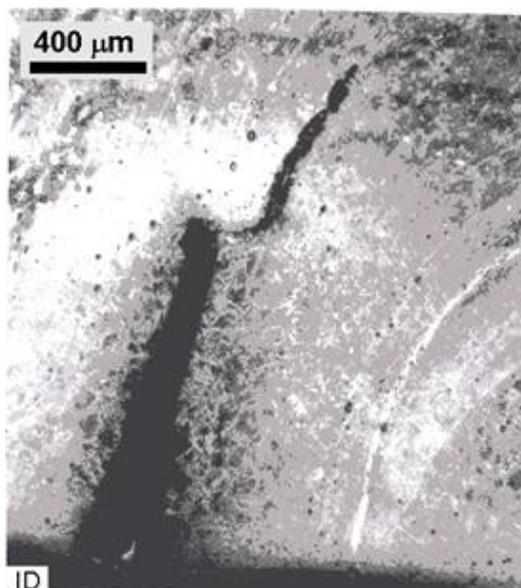
Pipe

Vintage: 1953
 Manufacturer: Unknown

Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT
 NDE result(s): 15%, 2 inch (51 mm)
 OD Crack
 Visual: OD Hook Crack
 L
 2 inch (51 mm)
 depth/ t_{weld} : 16.5%
 depth: Not Determined
 t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 8
 Report #: 1
 Defect #: 451

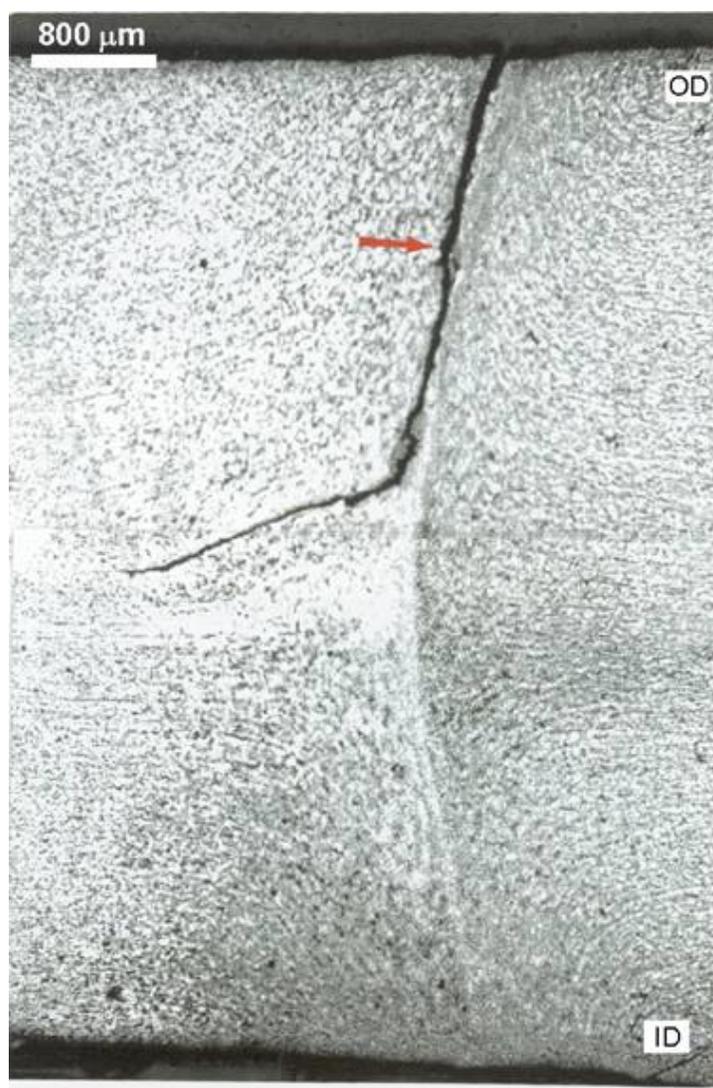
Pipe

Vintage: 1950s
 Manufacturer: Youngstown

Seam Type: ERW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.330 inch (8.38 mm)
 Failure: None at 2,250 psig
 (15.51 MPa) (139% of SMYS)

Defect

NDE technique(s): UT
 NDE result(s): 7% x 2.5 inch
 (63 mm) grind area on seam
 Visual: ID hook crack
 L: N/A
 $\text{depth}/t_{\text{weld}}$: 4.3%
 depth: 0.0136 inch (0.35 mm)
 t_{weld} : 0.319 inch (8.10 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 114
 Report #: 12
 Defect #: 46B-D

Pipe

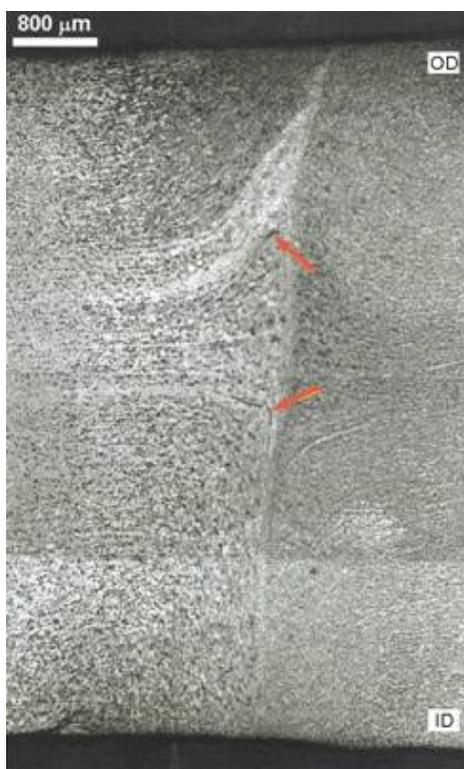
Vintage: Unknown
 Manufacturer: Unknown

Defect

NDE technique(s): Fast UT, MPI
 NDE result(s): 60%, 3.75 inch (95.3 mm)
 ID-Connected Non-Fusion

Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Visual: Hook Crack
 L: Not Determined
 $\text{depth}/t_{\text{weld}}$: Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 112
 Report #: 12
 Defect #: 46B-B

Pipe

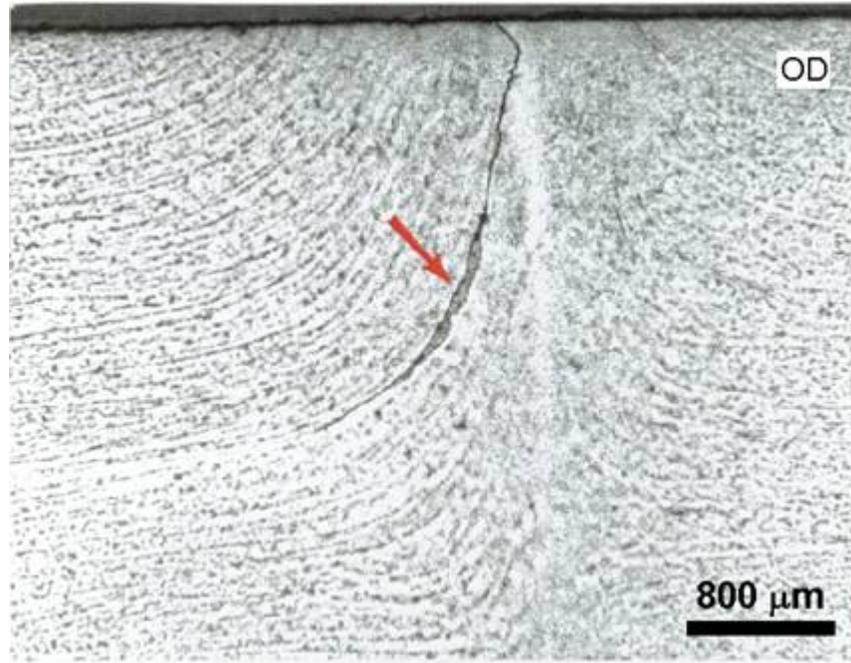
Vintage: Unknown
 Manufacturer: Unknown
 Seam Type: LF-ERW

Defect

NDE technique(s): Fast UT, MPI
 NDE result(s): N/A
 Visual: Hook Crack + Alloy Segregation

Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

L
 depth/ t_{weld} : Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 143
 Report #: 12
 Defect #: 79B

Pipe

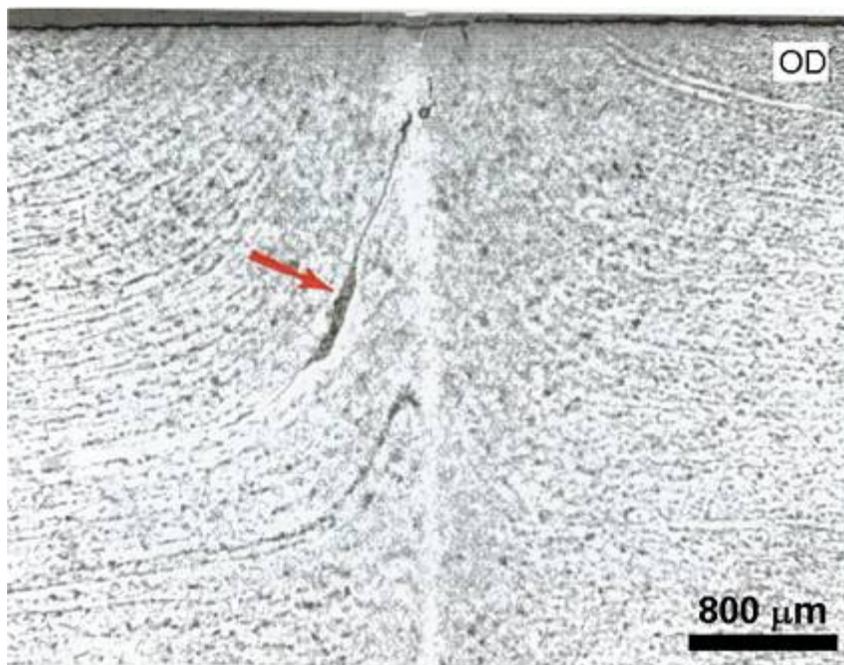
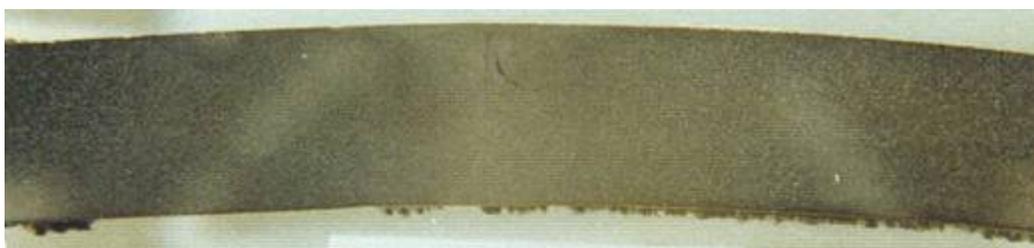
Vintage: Unknown
 Manufacturer: Unknown
 Seam Type: LF-ERW

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): N/A
 Visual: Hook Crack + Alloy Segregation

Grade: API 5L X42
 $D_{nominal}$: 12.75 inch (324 mm)
 $t_{nominal}$: 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

L
 depth/ t_{weld} : Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 144
 Report #: 12
 Defect #: 79C

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW

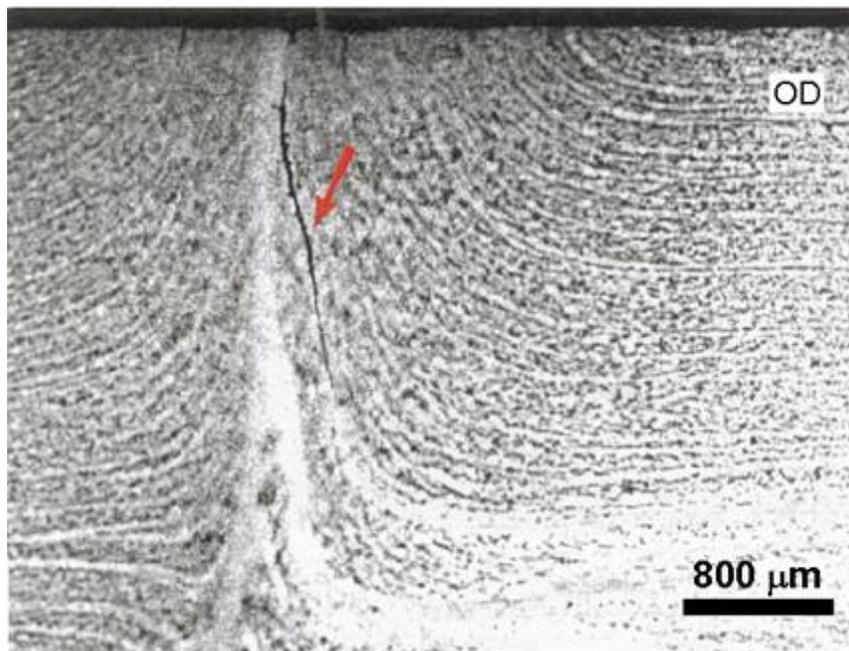
Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 52%, 2.7 inch (69 mm)

Visual: OD Non-Fusion
 Hook Crack + Alloy Segregation

L depth/ t_{weld} : Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 141

Report #: 12

Defect #: 73E

Pipe

Vintage: Unknown

Manufacturer: Unknown

Seam Type: LF-ERW

Grade: API 5L X42

D_{nominal} : 12.75 inch (324 mm)

t_{nominal} : 0.250 inch (6.35 mm)

t_{pipe} : Not Determined

Failure: N/A

Defect

NDE technique(s): TOFD, MPI

NDE result(s): 52%, 2.5 inch (63 mm)
OD-Connected Non-Fusion

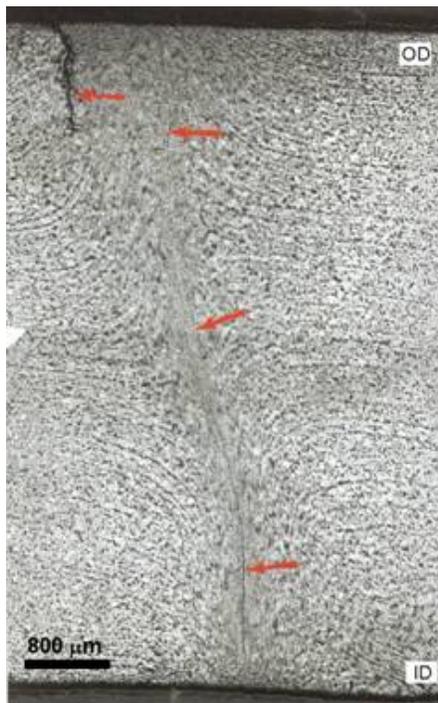
Visual: OD Hook Crack + Alloy Segregation

L: Not Determined

depth/ t_{weld} : Not Determined

depth: Not Determined

t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 145

Report #: 12

Defect #: 80A

Pipe

Vintage: Unknown

Manufacturer: Unknown

Seam Type: LF-ERW

Grade: API 5L X42

D_{nominal} : 12.75 inch (324 mm)

t_{nominal} : 0.250 inch (6.35 mm)

t_{pipe} : Not Determined

Failure: N/A

Defect

NDE technique(s): TOFD, MPI

NDE result(s): 92%, 4.8 inch (122 mm)

Non-Fusion

Visual: Weld Area Crack, Weld

Crack + Misalignment +

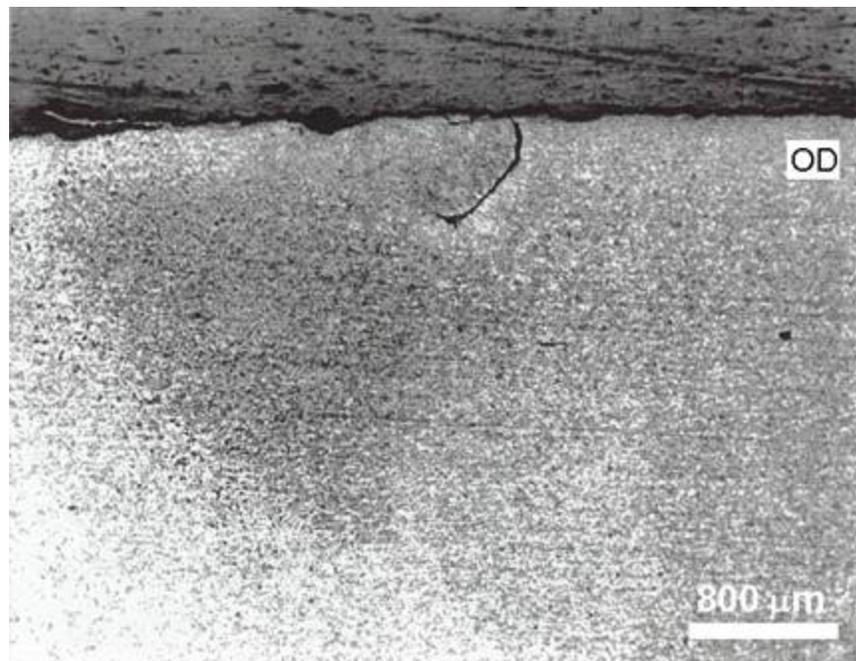
Alloy Segregation

L Not Determined

depth/ t_{weld} Not Determined

depth: Not Determined

t_{weld} Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 100
 Report #: 10
 Defect #: CY-9

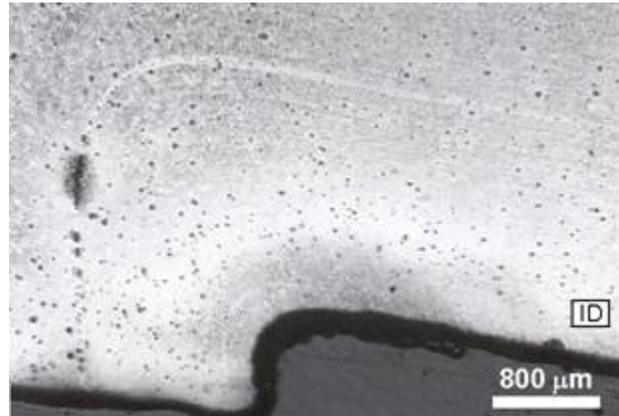
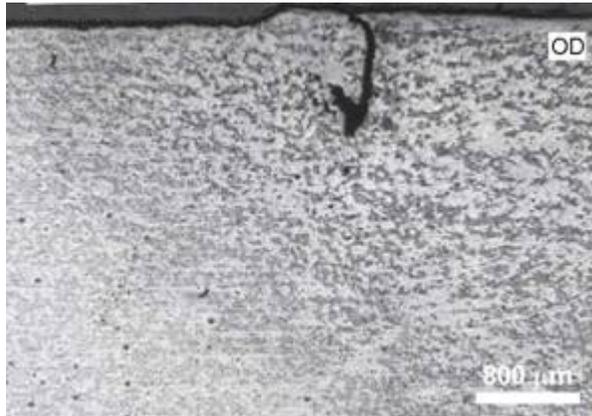
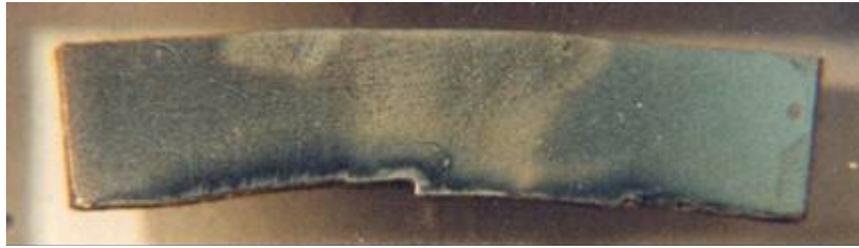
Pipe

Vintage: circa 1950
 Manufacturer: Youngstown
 Seam Type: ERW

Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): N/A
 NDE result(s): N/A
 Visual: OD Crack at Contact Mark + ID Under-trim
 Not Determined
 L
 $\text{depth}/t_{\text{weld}}$: < 7.0% (OD Crack)
 depth: < 0.024 inch (0.61 mm)
 t_{weld} : 0.344 inch (8.74 mm)



Photograph and Photomicrographs of Metallographic Section.

Catalog #: 63
 Report #: 7
 Defect #: 432-4.09

Pipe

Vintage: circa 1950
 Manufacturer: Youngstown

Seam Type: ERW

Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)

t_{pipe} : Not determined
 Failure: N/A

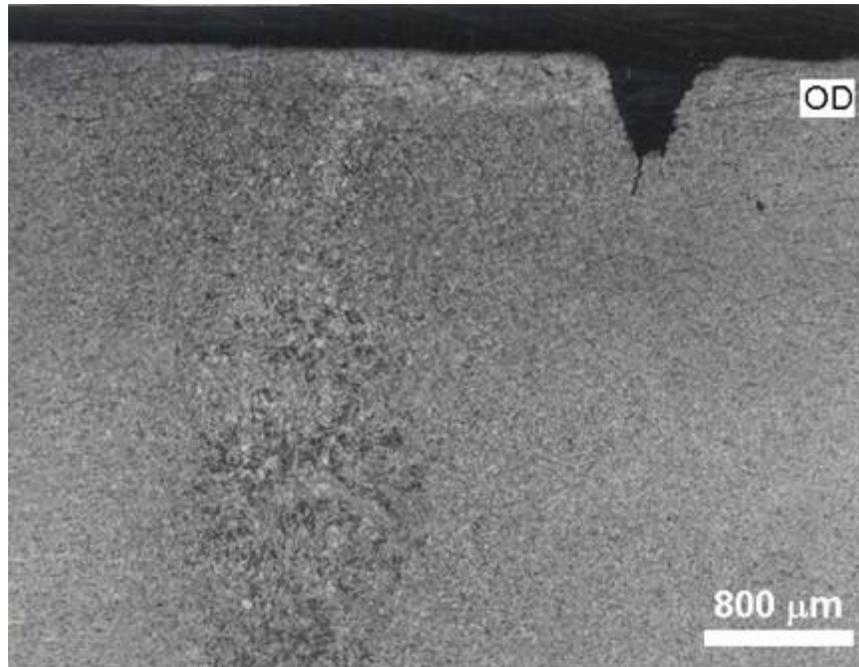
Defect

NDE technique(s): Fast UT
 NDE result(s): No Anomaly Revealed

Visual: OD Crack + ID
 Outbent fiber +
 Contact Marks

Not Determined
 depth/ t_{weld} : 11% (OD Crack)
 depth: 0.036 inch (0.91 mm)
 (OD Crack)

t_{weld} : 0.319 inch (8.10 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 107
 Report #: 11
 Defect #: 3E

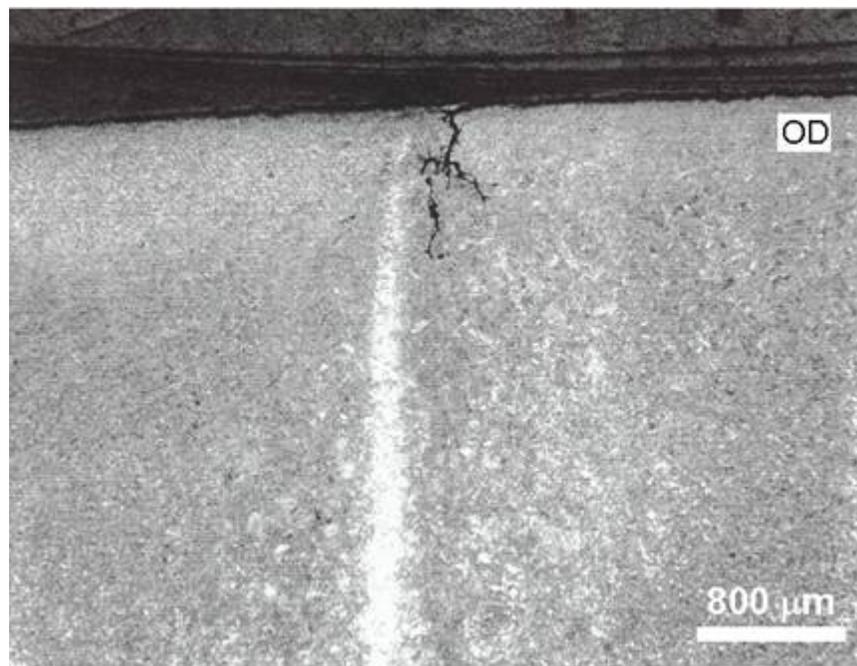
Pipe

Vintage: 1953
 Manufacturer: Unknown

Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT
 NDE result(s): 50%, 5 inch (127 mm)
 OD Crack
 Visual: OD Crack
 L: 5 inch (127 mm)
 depth/ t_{weld} : 9.2%
 depth: Not Determined
 t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

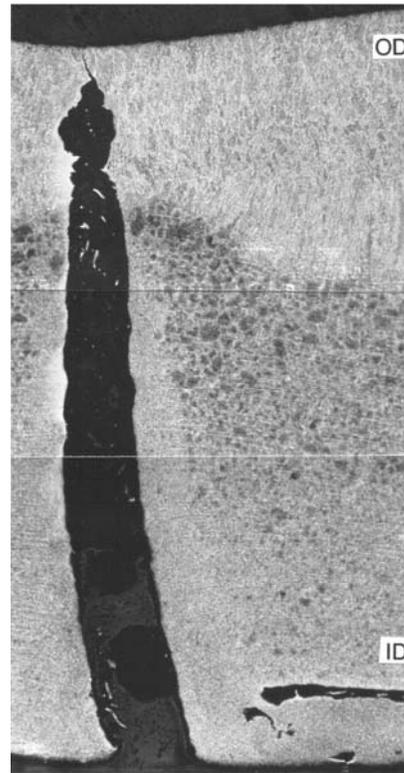
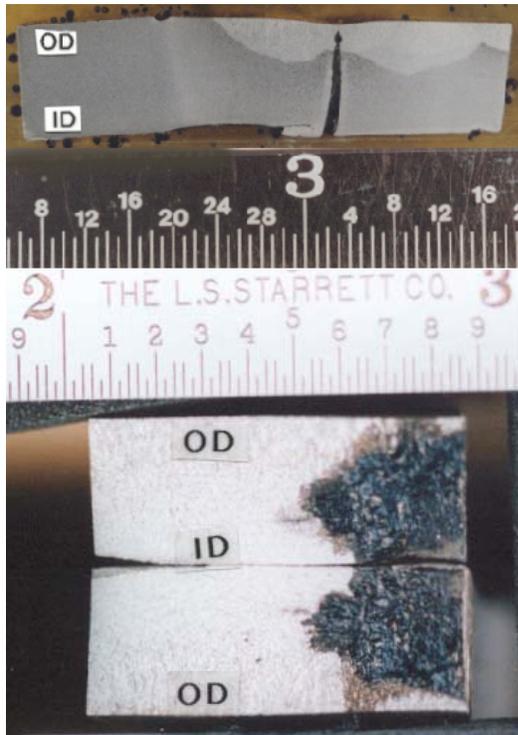
Catalog #: 93
 Report #: 10
 Defect #: CY-2

Pipe

Vintage: circa 1950
 Manufacturer: Youngstown
 Seam Type: ERW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): N/A
 NDE result(s): N/A
 Visual: OD Crack
 L: Not Determined
 $\text{depth}/t_{\text{weld}}$: 8.8%
 depth: 0.031 inch (0.79 mm)
 t_{weld} : 0.353 inch (8.97 mm)



Photographs and Photomicrograph of Metallographic Section, and Fracture Surfaces.

Catalog #: 29
 Report #: 3
 Defect #: 12A

Pipe

Vintage: circa 1950

Manufacturer: Youngstown

Seam Type: LF-ERW
 Grade: X52
 $D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.312 inch (7.92 mm)
 t_{pipe} : 0.320 inch (8.13 mm)
 Failure: None

Defect

NDE technique(s): UT, MT, and Fast UT
 12 x 7 inch (305 x 178 mm)
 OD seam grind area (UT) +
 11 x 1.0 inch (280 x 25.4 mm)
 OD weld repair (UT) +
 0.4 x 0.1 inch (10.2 x 2.5 mm)
 OD grind area (UT) +
 0.25 inch (6.35 mm) OD crack (MT) +
 100%, 1.9 inch (48.3 mm) ID hook crack (Fast UT)
 ID Lack of Fusion & Small crack
 1.9 inch (48 mm)
 99%
 depth: 0.317 inch (8.05 mm)
 t_{weld} : 0.332 inch (8.43 mm)

NDE result(s):

Visual:
 L
 depth/ t_{weld}
 depth:
 t_{weld}



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 139
 Report #: 12
 Defect #: 73B

Pipe

Vintage: Unknown
 Manufacturer: Unknown

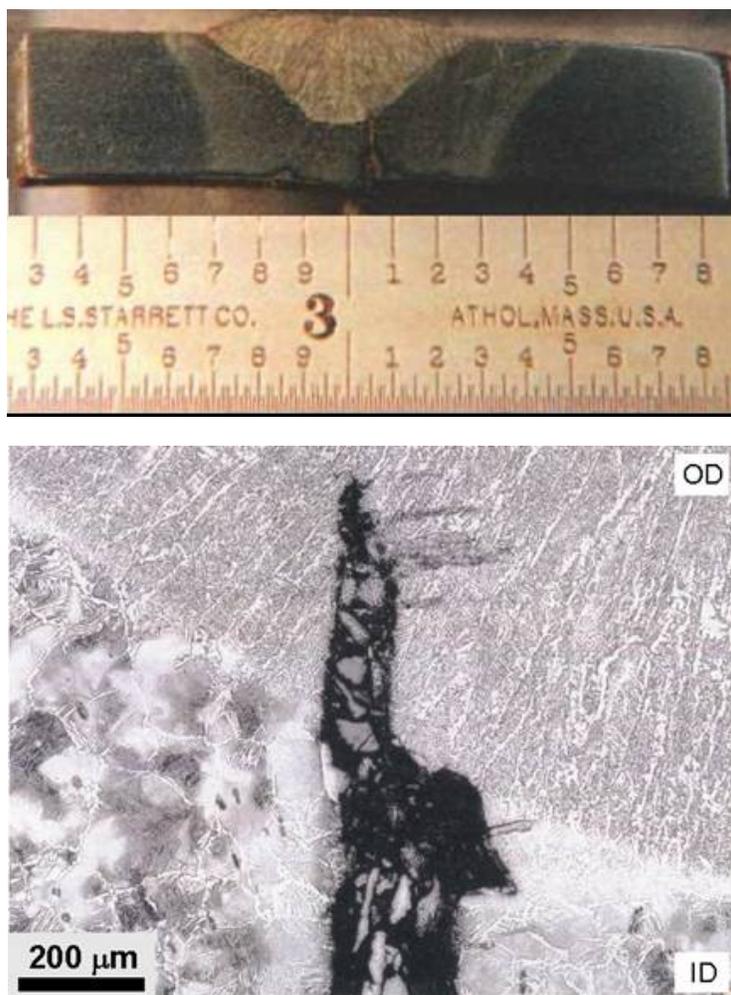
Seam Type: LF-ERW

Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 48%, 2 inch (51 mm)
 Non-Fusion

Visual: ID Extrusion Cracks +
 Alloy Segregation +
 Misalignment
 Not Determined
 L
 $\text{depth}/t_{\text{weld}}$: 16% (Misalignment)
 depth: 0.043 inch (1.1 mm)
 t_{weld} : 0.262 inch (6.65 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 13
 Report #: 1
 Defect #: 574

Pipe

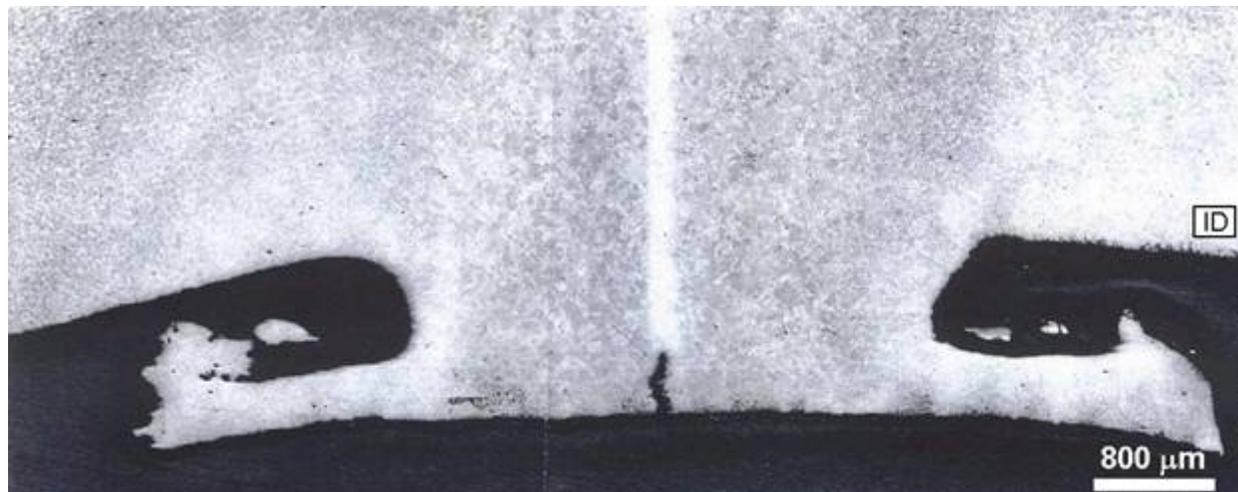
Vintage: 1950s
 Manufacturer: Youngstown

Defect

NDE technique(s): UT
 NDE result(s): 75% x 5.6 inch (142 mm)
 ID crack
 Visual: ID crack + OD repair weld

Seam Type: ERW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.330 inch (8.38 mm)
 Failure: None at 2,300 psig
 (15.86 MPa) (142%
 of SMYS)

L: N/A
 $\text{depth}/t_{\text{weld}}$: 42%
 depth: 0.200 inch (5.08 mm)
 t_{weld} : 0.427 inch (10.9 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 101
 Report #: 10
 Defect #: CY-10

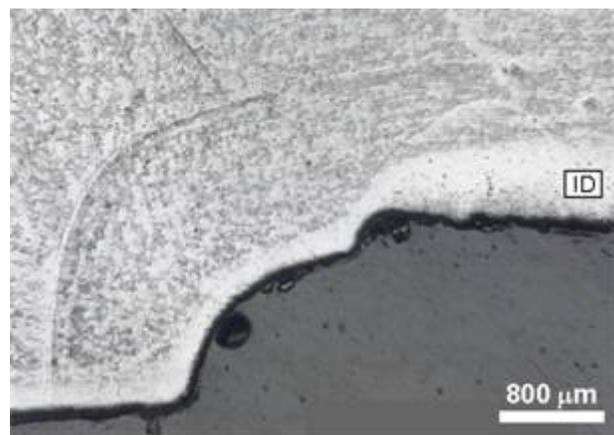
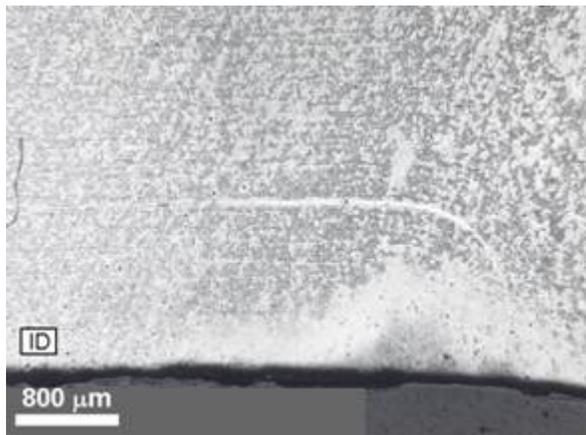
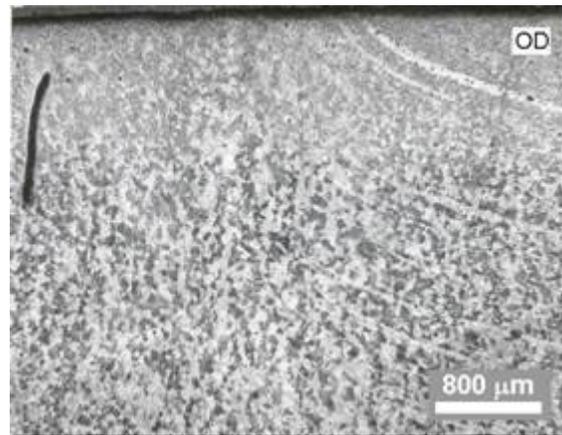
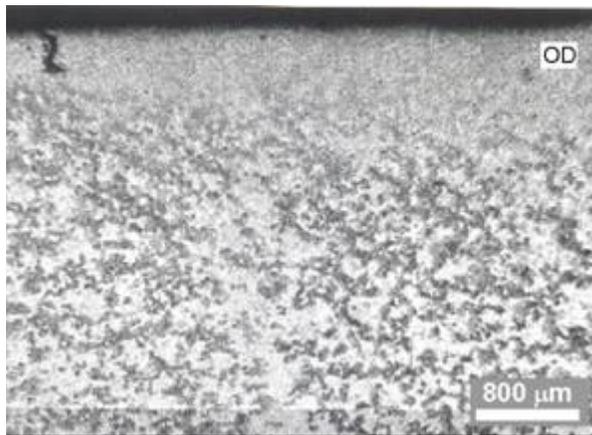
Pipe

Vintage: circa 1950
 Manufacturer: Youngstown
 Seam Type: ERW

Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): N/A
 NDE result(s): N/A
 Visual: ID Crack + ID Under-trim
 L: Not Determined
 $\text{depth}/t_{\text{weld}}$: 4.2% (ID Crack)
 depth: 0.015 inch (0.38 mm)
 t_{weld} : 0.350 inch (8.89 mm)



Photomicrographs of Metallographic Sections.

Catalog #: 64
 Report #: 7
 Defect #: 432-23/32/36/48

Pipe

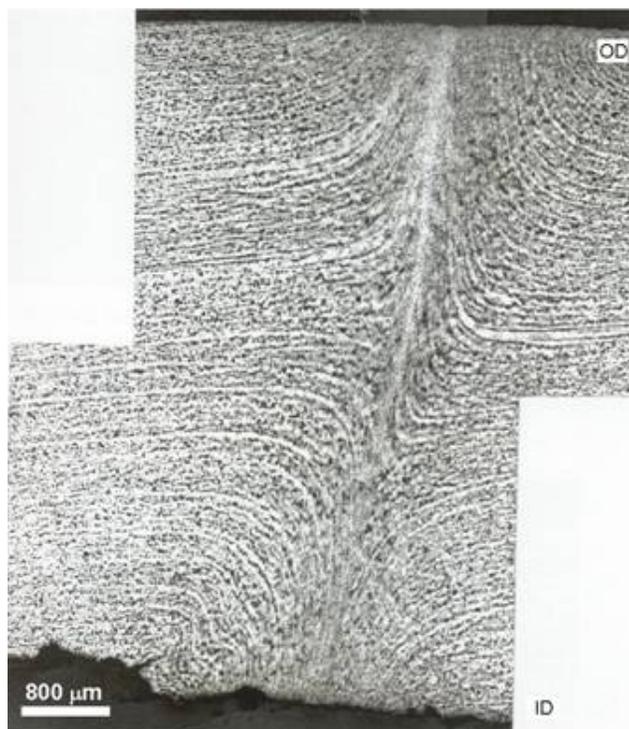
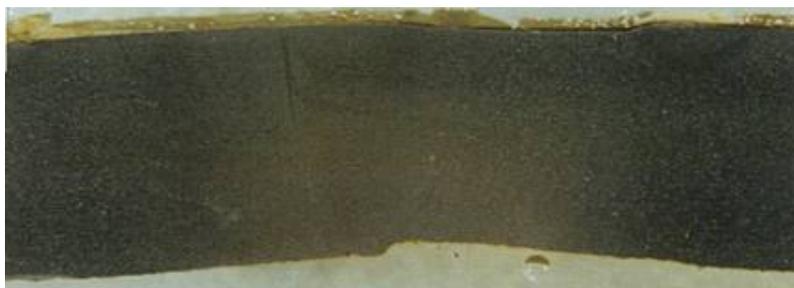
Vintage: circa 1950
 Manufacturer: Youngstown

Seam Type: ERW

Grade: X52
 $D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.312 inch (7.92 mm)
 t_{pipe} : Not determined
 Failure: N/A

Defect

NDE technique(s): Fast UT
 NDE result(s): No Anomaly Revealed
 Visual: ID & OD Outbent fibers + OD Crack + Contact Marks
 L: N/A
 depth/ t_{weld} : N/A
 depth: N/A
 t_{weld} : 0.319 inch (8.1 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 130

Report #: 12

Defect #: 67E

Pipe

Vintage: Unknown

Manufacturer: Unknown

Seam Type: LF-ERW

Grade: API 5L X42

D_{nominal} : 12.75 inch (324 mm)

t_{nominal} : 0.250 inch (6.35 mm)

t_{pipe} : Not Determined

Failure: N/A

Defect

NDE technique(s): TOFD, MPI
NDE result(s): 44%, 3.5 inch (89 mm)

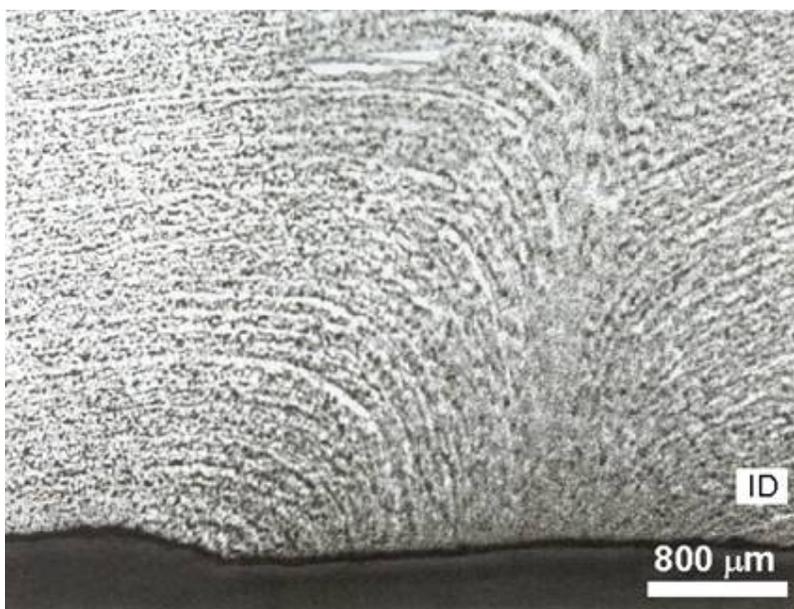
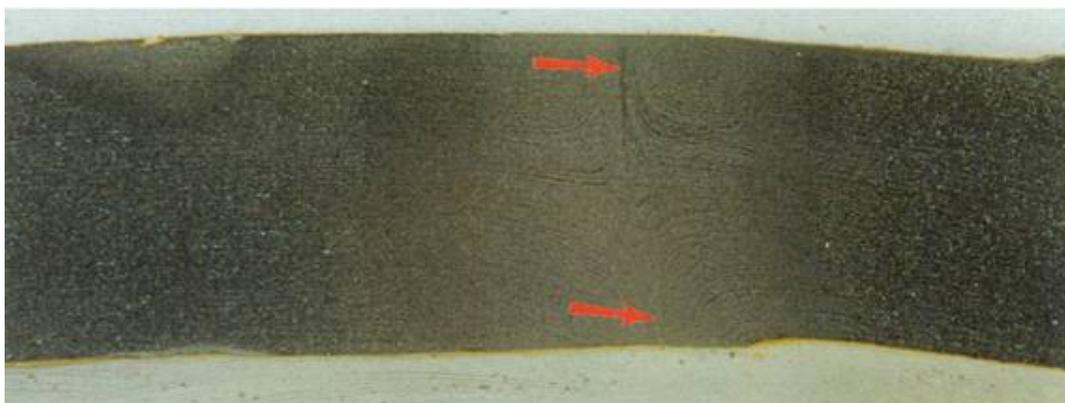
Visual: Mid-Wall Non-Fusion
Misalignment + Alloy
Segregation

L
depth/ t_{weld} : Not Determined

depth: 8.26%

t_{weld} : 0.0195 inch (0.50 mm)

0.236 inch (5.99 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 129

Report #: 12

Defect #: 67D

Pipe

Vintage: Unknown

Manufacturer: Unknown

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 28%, 1 inch (25 mm)
 ID-Connected Non-Fusion

Seam Type: LF-ERW

Visual: Misalignment + Alloy Segregation

Grade: API 5L X42

D_{nominal} : 12.75 inch (324 mm)

t_{nominal} : 0.250 inch (6.35 mm)

t_{pipe} : Not Determined

Failure: N/A

L
 depth/ t_{weld}

depth:

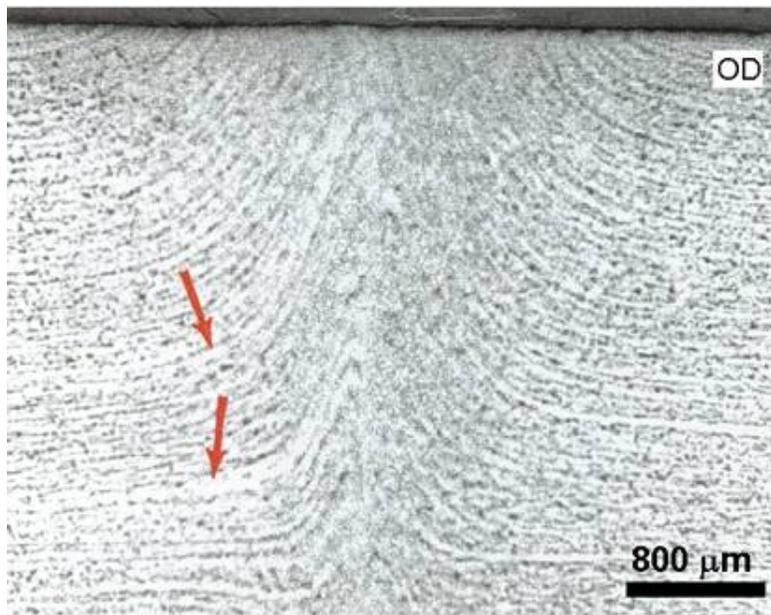
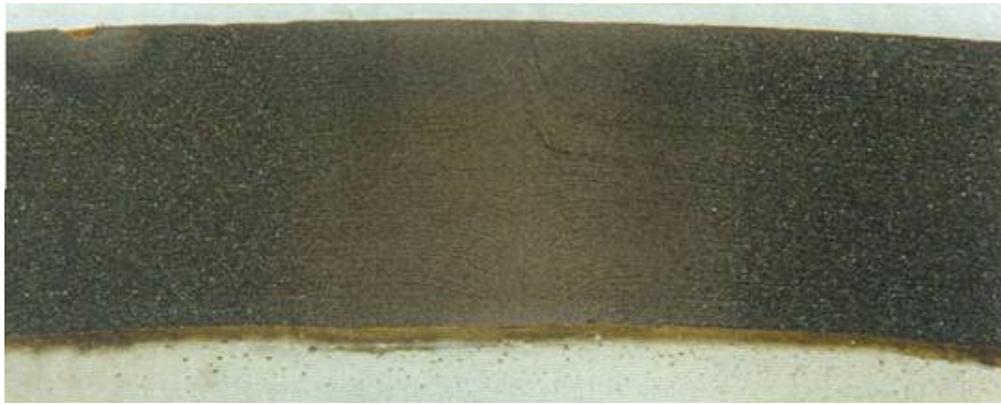
t_{weld}

Not Determined

Not Determined

Not Determined

Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 131
 Report #: 12
 Defect #: 67F

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW

Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 20%, 1.1 inch (28 mm)

Visual:

L
 depth/ t_{weld} : Not Determined
 depth: Not Determined
 t_{weld} : Not Determined

Mid-Wall Non-Fusion
 Misalignment + Alloy
 Segregation



Photograph of Metallographic Section.

Catalog #: 127

Report #: 12

Defect #: 67B

Pipe

Vintage: Unknown

Manufacturer: Unknown

Seam Type: LF-ERW

Grade: API 5L X42

D_{nominal} : 12.75 inch (324 mm)

t_{nominal} : 0.250 inch (6.35 mm)

t_{pipe} : Not Determined

Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 80%, 5.25 inch (133 mm)
 ID-Connected Non-Fusion

Visual: Mid-wall Void +
 Laminations +
 Misalignment + Alloy
 Segregation

L: Not Determined

depth/ t_{weld} : Not Determined

depth: Not Determined

t_{weld} : Not Determined



Photograph of Metallographic Section.

Catalog #: 128
 Report #: 12
 Defect #: 67C

Pipe

Vintage: Unknown

Manufacturer: Unknown

Seam Type: LF-ERW

Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 74%, 4 inch (102 mm)

NDE result(s): ID-Connected Non-Fusion
 Mid-wall Void + Laminations + Misalignment + Alloy Segregation

Visual:

L
 $\text{depth}/t_{\text{weld}}$: Not Determined
 depth : Not Determined
 t_{weld} : Not Determined



Photograph of Metallographic Section.

Catalog #: 132

Report #: 12

Defect #: 68A

Pipe

Vintage: Unknown

Manufacturer: Unknown

Seam Type: LF-ERW

Grade: API 5L X42

D_{nominal} : 12.75 inch (324 mm)

t_{nominal} : 0.250 inch (6.35 mm)

t_{pipe} : Not Determined

Failure: N/A

Defect

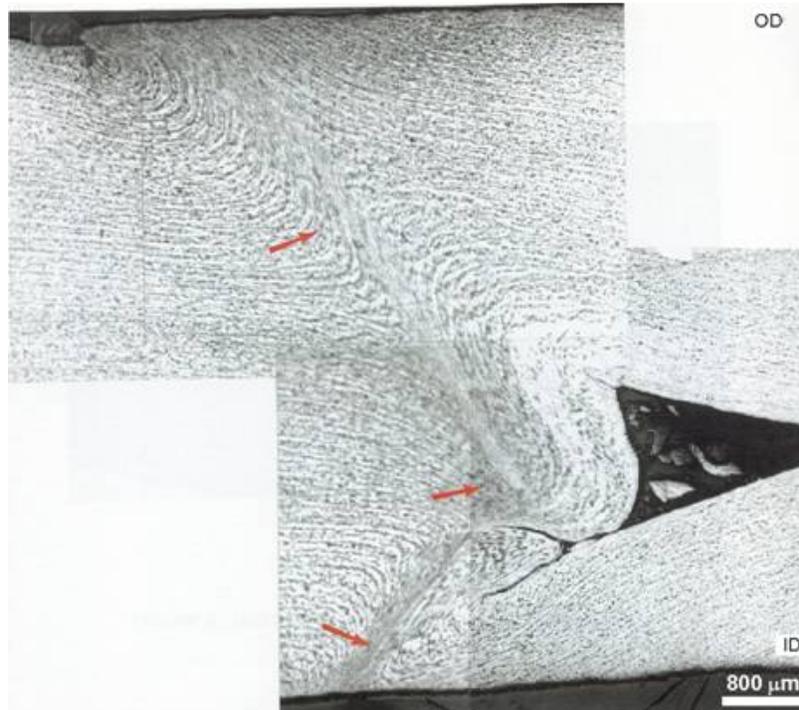
NDE technique(s): TOFD, MPI
 NDE result(s): 72%, 3 inch (76 mm)
 OD-Connected Non-Fusion

Visual: Mid-Wall Void +
 Laminations + Alloy
 Segregation +
 Misalignment

L depth/ t_{weld} : Not Determined

depth: Not Determined

t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 117
 Report #: 12
 Defect #: 52B

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Defect

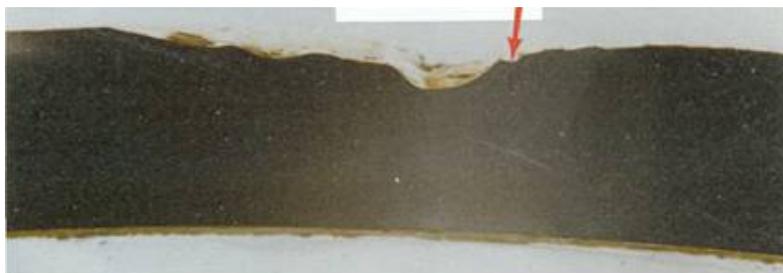
NDE technique(s): Fast UT, MPI
 NDE result(s): 48%, 7.25 inch (184 mm)
 + Non-Fusion (ID to Mid-wall)

Seam Type: LF-ERW

Visual: Mid-wall Non-Fusion +
 Laminations,
 Misalignment, Alloy
 Segregation

Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

L
 $\text{depth}/t_{\text{weld}}$: Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 119
 Report #: 12
 Defect #: 53A

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW

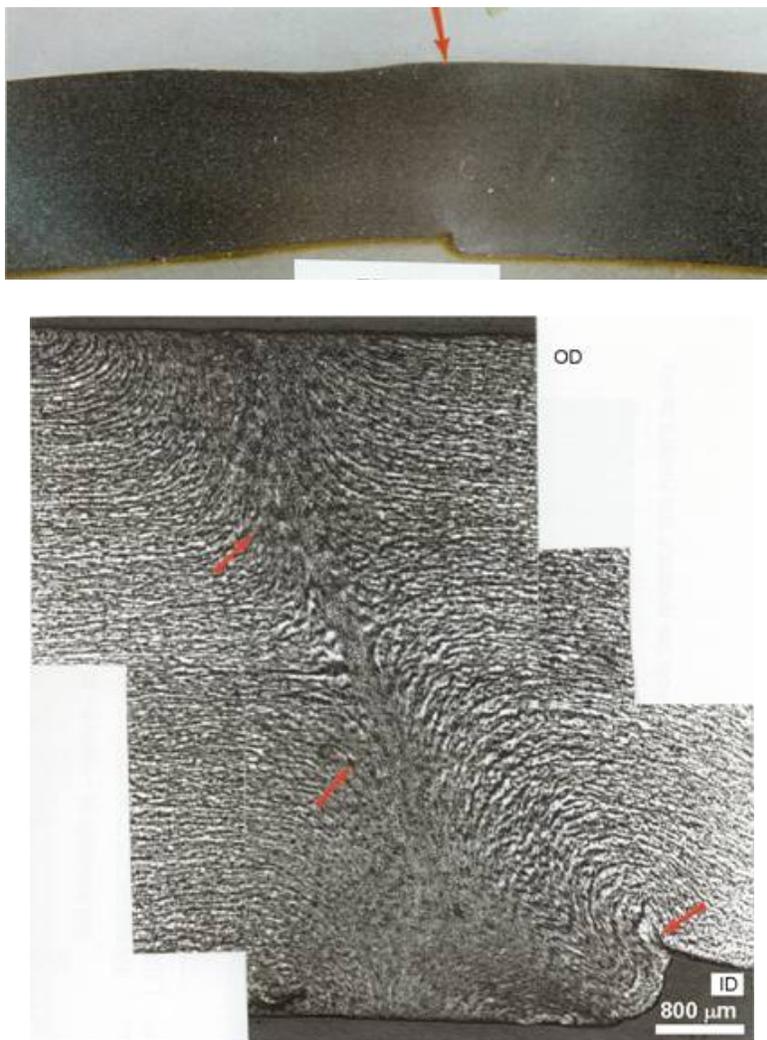
Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT, MPI
 NDE result(s): 30%, 2 inch (51 mm)
 Metal Loss

Visual: External Corrosion on Seam + Alloy Segregation + Misalignment

L
 $\text{depth}/t_{\text{weld}}$: Not Determined
 depth : 29% (Corrosion)
 t_{weld} : 0.075 inch (1.9 mm)
 0.257 inch (6.98 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 121
 Report #: 12
 Defect #: 57B

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW

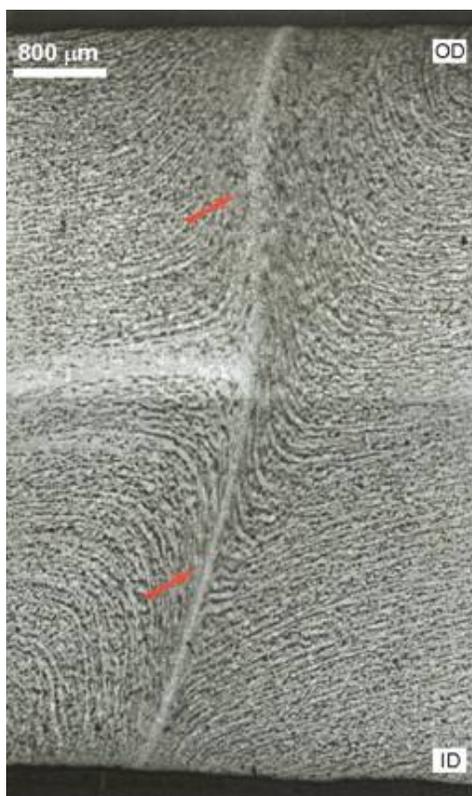
Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 12%, 10 inch (254 mm)

Visual: Gouge (Near Seam)
 Alloy Segregation + Misalignment

L: Not Determined
 $\text{depth}/t_{\text{weld}}$: 14%
 depth: 0.038 inch (0.96 mm)
 t_{weld} : 0.263 inch (6.68 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 116
 Report #: 12
 Defect #: 52A

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Defect

NDE technique(s): Fast UT, MPI
 NDE result(s): 8%, 9 inch (229 mm)
 OD & ID-connected
 Non-Fusion

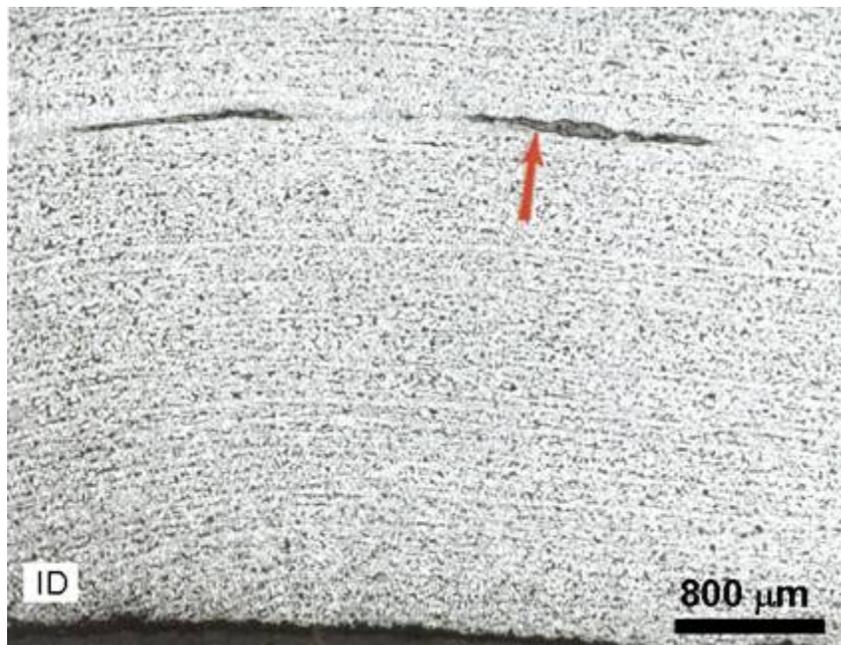
Seam Type: LF-ERW

Visual: Alloy Segregation +
 Misalignment

Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined

L
 depth/ t_{weld} : Not Determined
 depth: Not Determined
 t_{weld} : Not Determined

Failure: N/A



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 133
 Report #: 12
 Defect #: 68B

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW

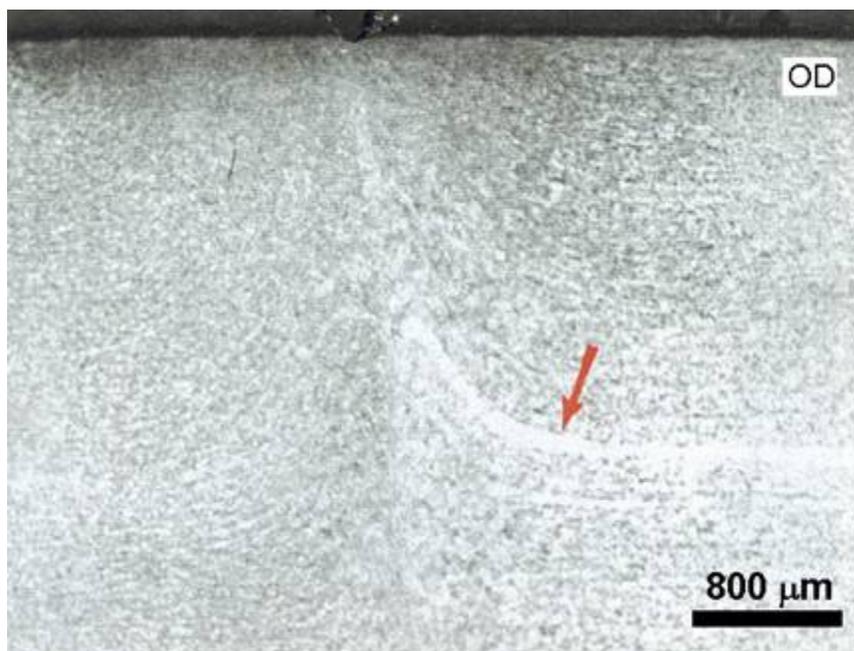
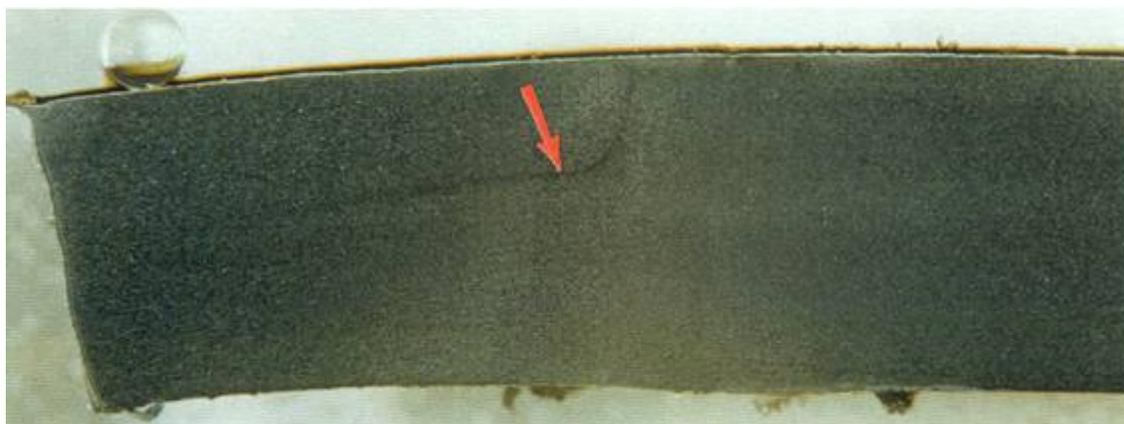
Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 72%, 1.5 inch (38 mm)
 Non-Fusion

Visual: Alloy Segregation +
 Misalignment

L
 depth/ t_{weld} : Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

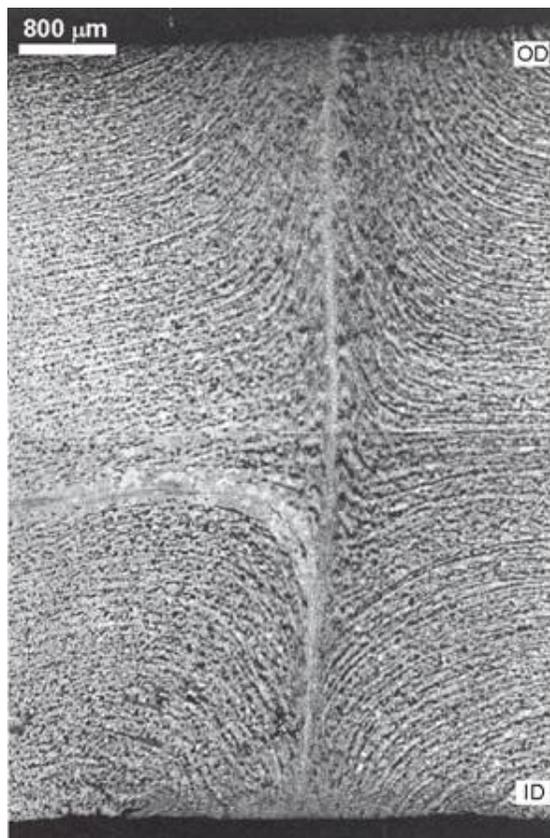
Catalog #: 113
 Report #: 12
 Defect #: 46B-C

Pipe

Vintage: Unknown
 Manufacturer: Unknown
 Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT, MPI
 NDE result(s): N/A
 Visual: Alloy Segregation
 L: Not Determined
 depth/ t_{weld} : Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

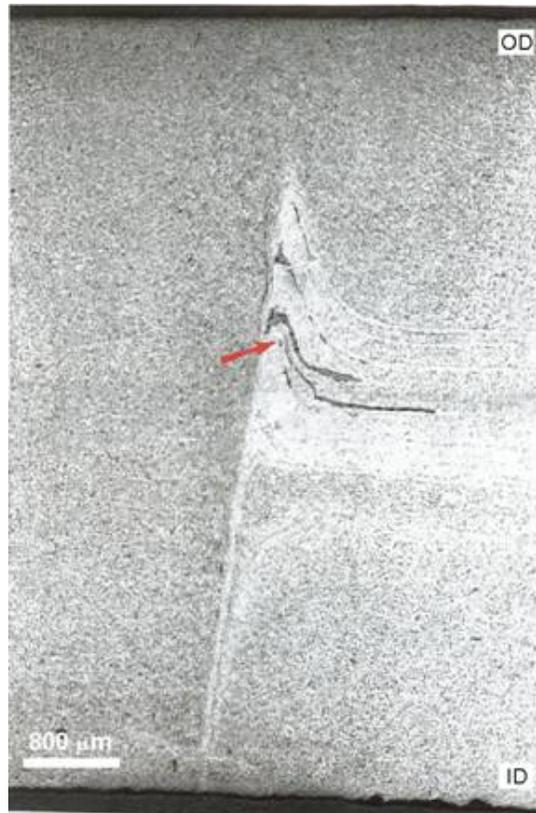
Catalog #: 118
 Report #: 12
 Defect #: 52C

Pipe

Vintage: Unknown
 Manufacturer: Unknown
 Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT, MPI
 NDE result(s): N/A
 Visual: Alloy Segregation
 L: Not Determined
 depth/ t_{weld} : Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 137
 Report #: 12
 Defect #: 72C

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 20%, 4 inch (102 mm)
 ID-Connected Non-Fusion

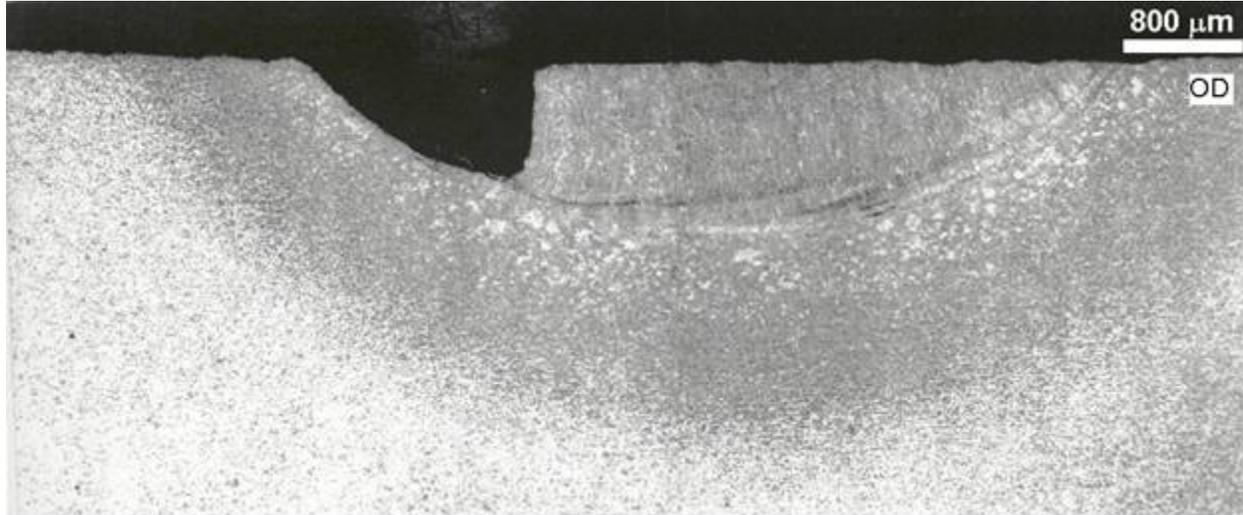
Seam Type: LF-ERW
 Grade: API 5L X42
 $D_{nominal}$: 12.75 inch (324 mm)
 $t_{nominal}$: 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Visual: Alloy Segregation
 L: Not Determined
 depth/ t_{weld} : Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



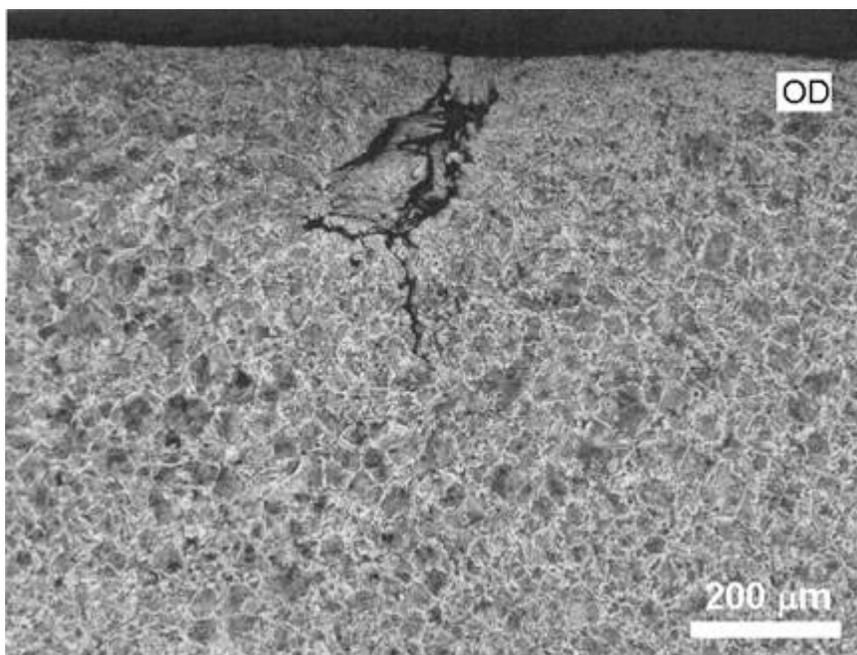
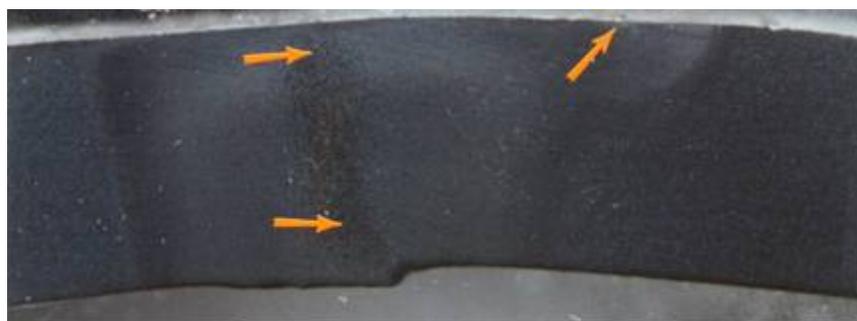
Photograph of Metallographic Section.

Catalog #:	95		
Report #:	10		
Defect #:	CY-4		
<u>Pipe</u>		<u>Defect</u>	
Vintage:	circa 1950	NDE technique(s):	N/A
Manufacturer:	Youngstown	NDE result(s):	N/A
Seam Type:	ERW	Visual:	Offset Plate Edges + OD Notch
Grade:	X52	L	Not Determined
D_{nominal}	20 inch (508 mm)	depth/ t_{weld}	Not Determined
t_{nominal}	0.312 inch (7.92 mm)	depth:	Not Determined
t_{pipe}	0.280 inch (7.11 mm) (at offset)	t_{weld}	Not Determined
Failure:	N/A		



Photograph and Photomicrograph of Metallographic Section.

Catalog #:	96		
Report #:	10		
Defect #:	CY-5		
Pipe		Defect	
Vintage:	circa 1950	NDE technique(s):	N/A
Manufacturer:	Youngstown	NDE result(s):	N/A
Seam Type:	ERW	Visual:	Offset Plate Edges + OD Notch
Grade:	X52	L	Not Determined
D_{nominal}	20 inch (508 mm)	depth/ t_{weld}	Not Determined
t_{nominal}	0.312 inch (7.92 mm)	depth:	Not Determined
t_{pipe}	0.260 inch (6.60 mm) (at offset)	t_{weld}	Not Determined
Failure:	N/A		



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 102

Report #: 11

Defect #: 2A

Pipe

Vintage: 1953

Manufacturer: Unknown

Seam Type: LF-ERW

Grade: API 5L X42

D_{nominal} : 12.75 inch (324 mm)

t_{nominal} : 0.250 inch (6.35 mm)

t_{pipe} : Not Determined

Failure: N/A

Defect

NDE technique(s): Fast UT

NDE result(s): < 10%, 1.5 (38 mm)

inch ID Gouge

Visual: Misalignment

Contact Mark

L

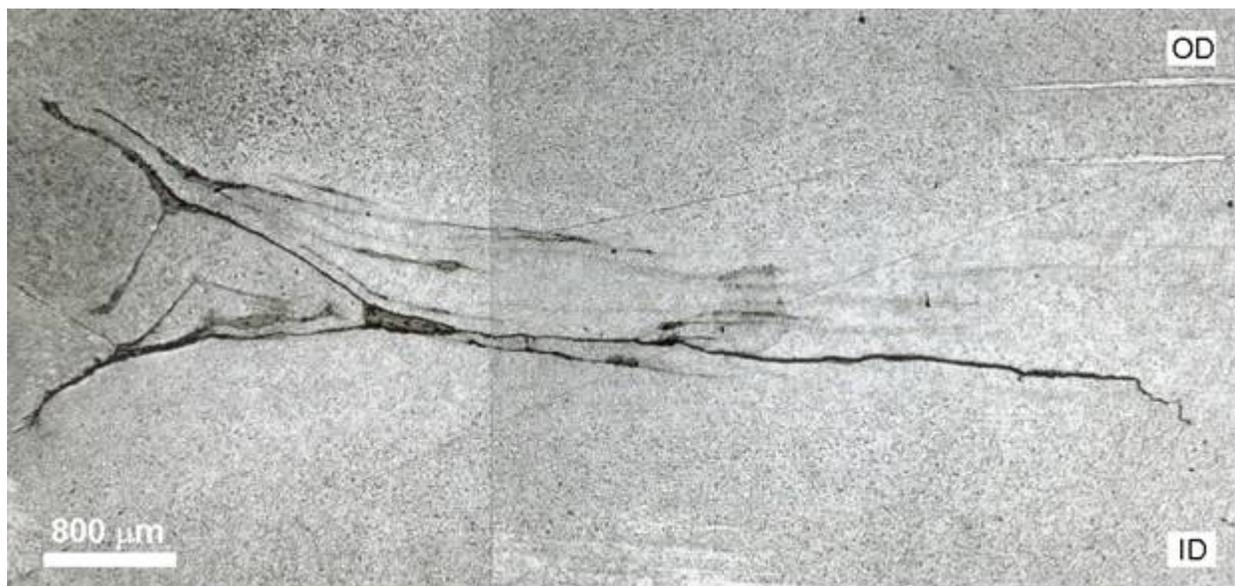
depth/ t_{weld}

Not Determined

depth:

t_{weld}

Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 138

Report #: 12

Defect #: 72D

Pipe

Vintage: Unknown

Manufacturer: Unknown

Seam Type: LF-ERW

Grade: API 5L X42

D_{nominal} : 12.75 inch (324 mm)

t_{nominal} : 0.250 inch (6.35 mm)

t_{pipe} : Not Determined

Failure: N/A

Defect

NDE technique(s): TOFD, MPI
NDE result(s): 72%, 15 inch (381 mm)

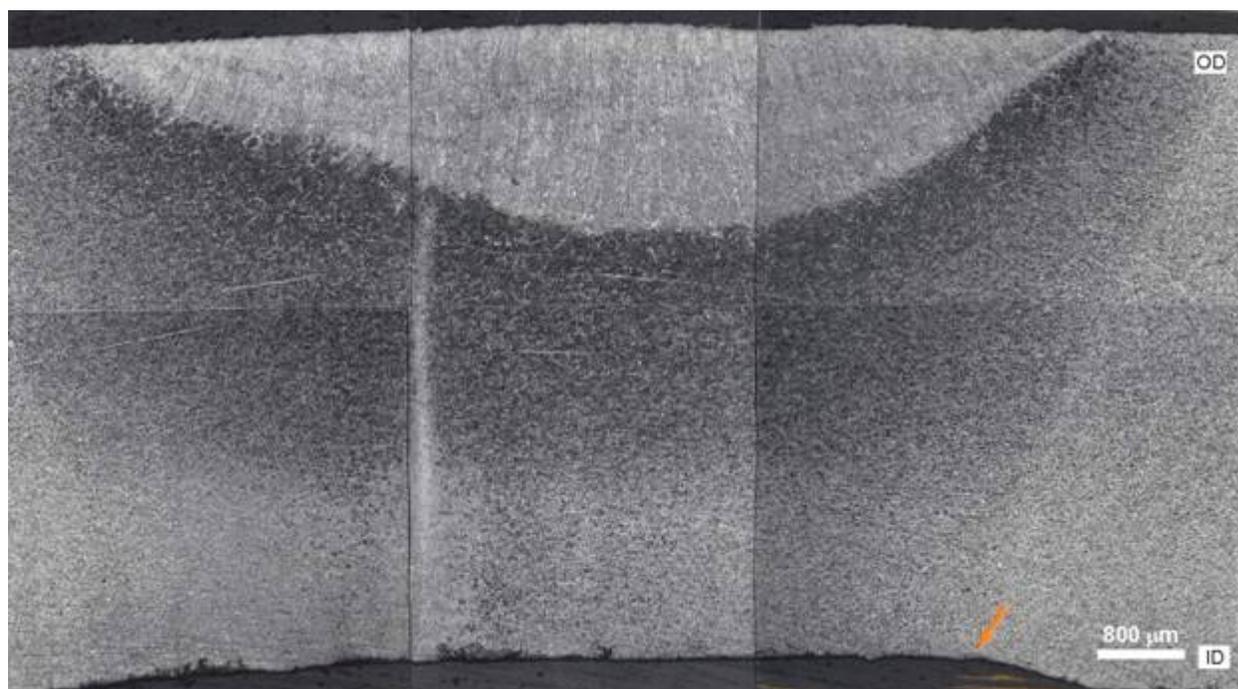
Visual: Mid-Wall Non-Fusion
Mid-wall Void +
Lamination

L: Not Determined

depth/ t_{weld} : Not Determined

depth: Not Determined

t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #:	109		
Report #:	11		
Defect #:	5A		
<u>Pipe</u>		<u>Defect</u>	
Vintage:	1953	NDE technique(s):	Fast UT
Manufacturer:	Unknown	NDE result(s):	15%, 4 inch (102 mm) ID Gouge
Seam Type:	LF-ERW	Visual:	ID Over-trim + OD Weld Repair
Grade:	API 5L X42	L	Not Determined
D _{nominal}	12.75 inch (324 mm)	depth/t _{weld}	8.3% (Over-Trim) + 45% (Weld Repair)
t _{nominal}	0.250 inch (6.35 mm)	depth:	Not Determined
t _{pipe}	Not Determined	t _{weld}	Not Determined
Failure:	N/A		



Photograph of Metallographic Section.

Catalog #: 92
 Report #: 10
 Defect #: CY-1

Pipe

Vintage: circa 1950
 Manufacturer: Youngstown
 Seam Type: ERW

Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): N/A
 NDE result(s): N/A
 Visual: ID Under-trim +
 Weld Repair
 Not Determined
 L
 $\text{depth}/t_{\text{weld}}$: 55% (Weld Repair)
 depth: Not Determined
 t_{weld} : Not Determined



Photograph of Metallographic Section.

Catalog #: 99
 Report #: 10
 Defect #: CY-8

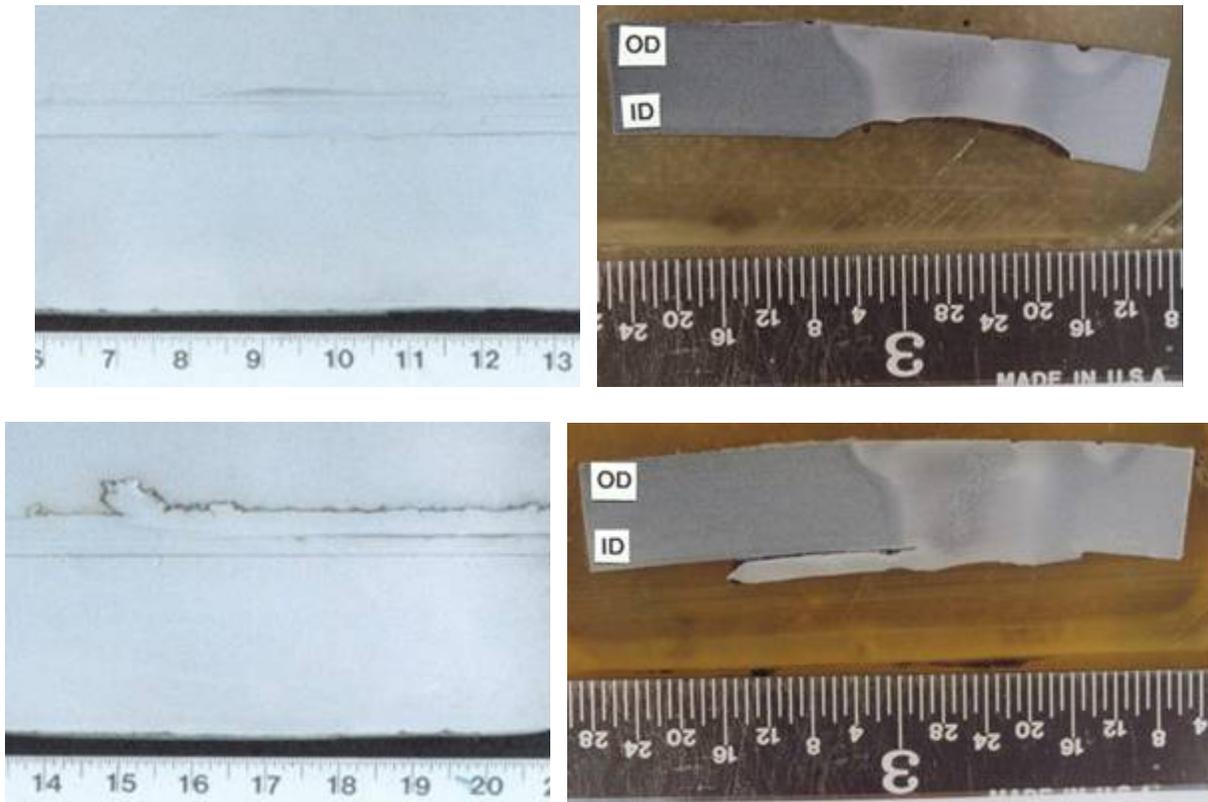
Pipe

Vintage: circa 1950
 Manufacturer: Youngstown
 Seam Type: ERW

Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): N/A
 NDE result(s): N/A
 Visual: ID Under-trim + OD
 Weld Repair
 Not Determined
 $\text{depth}/t_{\text{weld}}$: 45% (Weld Repair)
 depth: Not Determined
 t_{weld} : Not Determined



Photographs of ID Pipe Surface and Metallographic Sections.

Catalog #: 31
 Report #: 3
 Defect #: 15A/B

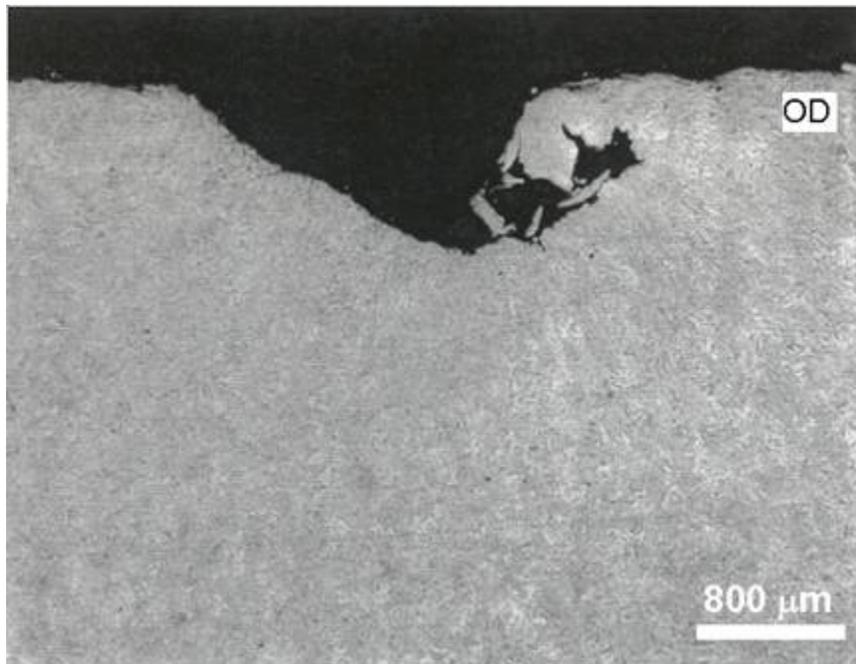
Pipe

Vintage: circa 1950
 Manufacturer: Youngstown

Seam Type: LF-ERW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.318 inch (8.08 mm)
 Failure: None

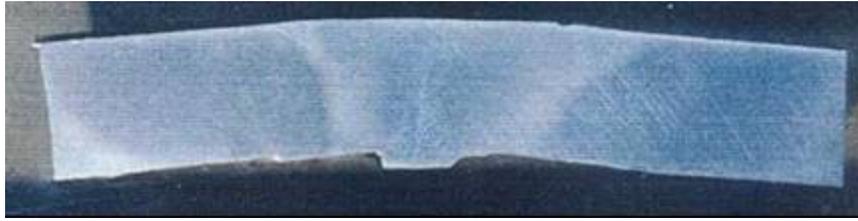
Defect

NDE technique(s): UT & HiLo MT
 NDE result(s): 5.5 x 0.5 inch (140 x 12.7 mm) ID Gouge from Overtrim (UT) + 12 inch OD (HiLo MT)
 Visual: ID gouge (Overtrim)
 L: 5.5 inch (140 mm)
 Width: 0.5 inch (12.7 mm)
 depth/ t_{weld} : 26%
 depth: 0.084 inch (2.13 mm)
 t_{weld} : 0.234 inch (5.94 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #:	94		
Report #:	10		
Defect #:	CY-3		
<u>Pipe</u>		<u>Defect</u>	
Vintage:	circa 1950	NDE technique(s):	N/A
Manufacturer:	Youngstown	NDE result(s):	N/A
Seam Type:	ERW	Visual:	ID Under-trim + OD Notch at Contact mark
Grade:	X52	L	Not Determined
D_{nominal}	20 inch (508 mm)	depth/ t_{weld}	Not Determined
t_{nominal}	0.312 inch (7.92 mm)	depth:	Not Determined
t_{pipe}	Not Determined	t_{weld}	Not Determined
Failure:	N/A		



Photograph of Metallographic Section.

Catalog #: 97
 Report #: 10
 Defect #: CY-6

Pipe

Vintage: circa 1950
 Manufacturer: Youngstown
 Seam Type: ERW

Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): N/A
 NDE result(s): N/A
 Visual: ID Under-trim + OD Notch
 L: Not Determined
 $\text{depth}/t_{\text{weld}}$: Not Determined
 depth: 0.031 inch (0.79 mm)
 t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #:	12		
Report #:	1		
Defect #:	573-14.8		
<u>Pipe</u>		<u>Defect</u>	
Vintage:	1950s	NDE technique(s):	UT
Manufacturer:	Youngstown	NDE result(s):	30% x 0.7 inch (17.8 mm) OD crack
Seam Type:	ERW	Visual:	OD lack of fusion + OD repair weld
Grade:	X52	L	N/A
D _{nominal}	20 inch (508 mm)	depth/t _{weld}	37.2%
t _{nominal}	0.312 inch (7.92 mm)	depth:	0.128 inch (3.25 mm)
t _{pipe}	0.311 inch (7.9 mm)	t _{weld}	0.344 inch (8.74 mm)
Failure:	None at 2,275 psig (15.69 MPa) (140% of SMYS)		



Photograph of Metallographic Section.

Catalog #: 11
 Report #: 1
 Defect #: 573-5.1

Pipe

Vintage: 1950s
 Manufacturer: Youngstown

Seam Type: ERW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.330 inch (8.38 mm)
 Failure: None at 2,275 psig
 (15.69 MPa) (140%
 of SMYS)

Defect

NDE technique(s): UT
 NDE result(s): 10% x 2 inch (51 mm)
 grind area on seam
 OD repair weld
 Visual: OD repair weld
 L: N/A
 depth/ t_{weld} : N/A
 depth: N/A
 t_{weld} : 0.330 inch (8.38 mm)



Photograph of Metallographic Section.

Catalog #: 14
 Report #: 1
 Defect #: 598

Pipe

Vintage: 1950s
 Manufacturer: Youngstown

Seam Type: ERW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.330 inch (8.38 mm)

Failure: None at 2,100 psig
 (14.48 MPa) (129%
 of SMYS)

Defect

NDE technique(s): UT
 NDE result(s): <10% multiple minor
 cracks at weld toe

Visual: OD repair weld
 L N/A
 depth/ t_{weld} N/A
 depth: N/A
 t_{weld} 0.330 inch (8.38 mm)



Photograph of ID Pipe Surface Near Seam Weld.

Catalog #: 111
 Report #: 12
 Defect #: 45A

Pipe

Vintage: Unknown
 Manufacturer: Unknown
 Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT, MPI
 NDE result(s): 24%, 1.25 inch (31.7 mm)
 ID Gouge (Metal Loss)
 ID Pit
 Visual: 1.15 inch (29.2 mm)
 L
 depth/ t_{weld} : 28%
 depth: 0.068 inch (1.73 mm)
 t_{weld} : 0.245 inch (6.22 mm)



Photograph of ID Pipe Surface Near Seam Weld.

Catalog #: 115
 Report #: 12
 Defect #: 49A

Pipe

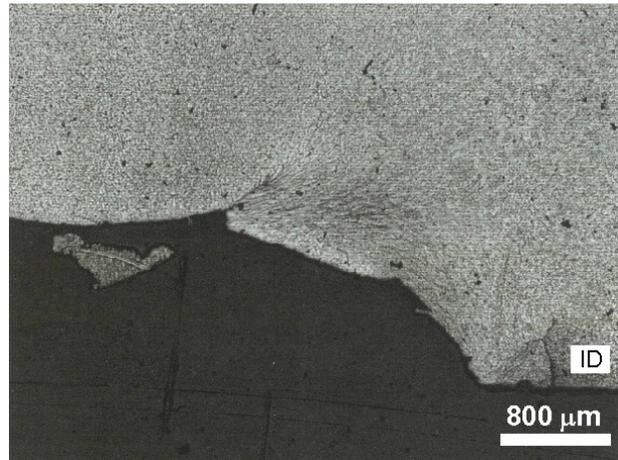
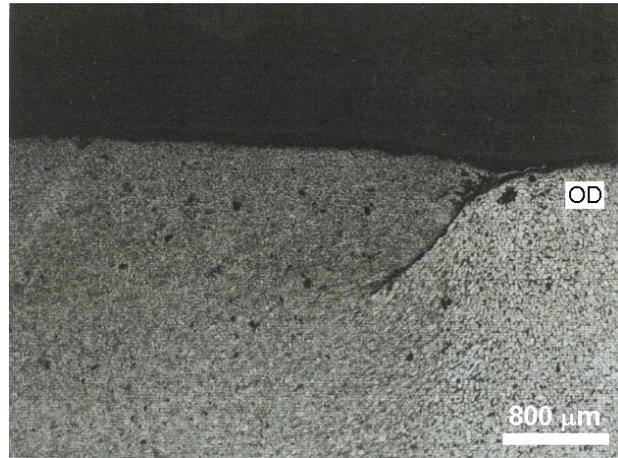
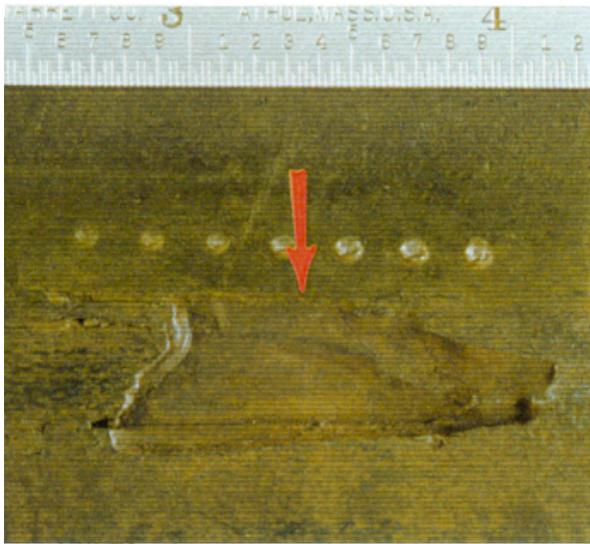
Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT, MPI
 NDE result(s): 24%, 0.6 inch (15.2 mm)
 ID Gouge (Metal Loss)

Visual: ID Pit
 L: 1 inch (25.4 mm)
 depth/ t_{weld} : 22%
 depth: 0.058 inch (1.47 mm)
 t_{weld} : 0.258 inch (6.55 mm)



Photographs and Photomicrographs of Pipe Seam ID Surface and Metallographic Sections.

Catalog #: 110
 Report #: 12
 Defect #: 43A

Pipe

Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW
 Grade: API 5L X42
 $D_{nominal}$: 12.75 inch (324 mm)
 $t_{nominal}$: 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT, MPI
 NDE result(s): 88%, 3 inch (76 mm)
 ID & OD-Connected
 Non-Fusion
 ID Pit
 1.72 inch (43.7 mm)
 17%
 depth/ t_{weld} : 0.046 inch (1.17 mm)
 depth: 0.266 inch (6.76 mm)
 t_{weld} : 0.266 inch (6.76 mm)



Photographs of Pipe Seam ID Surface and Metallographic Section.

Catalog #: 123
 Report #: 12
 Defect #: 59A

Pipe

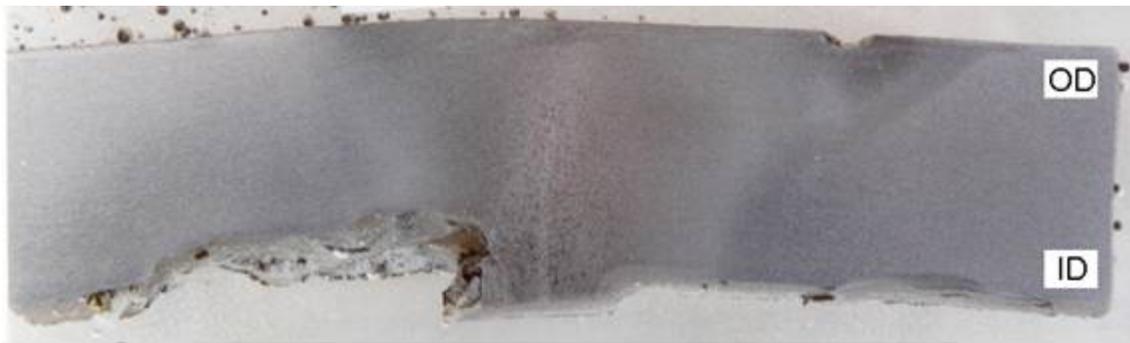
Vintage: Unknown
 Manufacturer: Unknown

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 44%, 2 inch (51 mm)
 ID-Connected Non-Fusion

Seam Type: LF-ERW
 Grade: API 5L X42
 $D_{nominal}$: 12.75 inch (324 mm)
 $t_{nominal}$: 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Visual: ID Pit
 L: 1 inch (25.4 mm)
 depth/ t_{weld} : 15%
 depth: 0.037 inch (0.94 mm)
 t_{weld} : 0.252 inch (6.4 mm)



Photographs of Weld Seam ID Surface and Metallographic Section.

Catalog #: 73
 Report #: 7
 Defect #: 1084

Pipe

Vintage: circa 1950
 Manufacturer: Youngstown
 Seam Type: ERW

Defect

NDE technique(s): Fast UT
 NDE result(s): ID Gouges
 Visual: ID Plate Edge Defect (Roll-in) + Contact Location Arc

Grade: X52
 $D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

L
 $depth/t_{weld}$: Not Determined
 $depth$: Not Determined
 t_{weld} : 0.349 inch (8.86 mm)



Photograph of Metallographic Section.

Catalog #: 136
 Report #: 12
 Defect #: 72B

Pipe

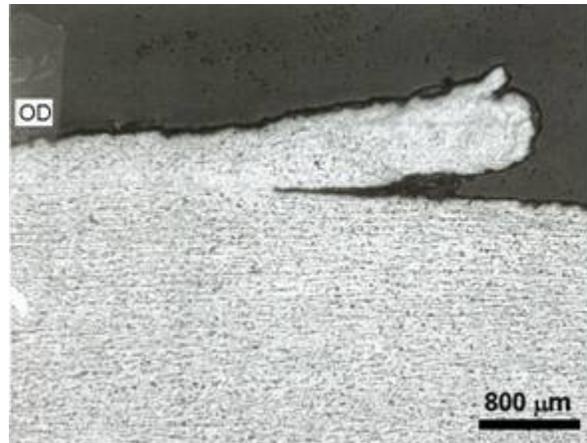
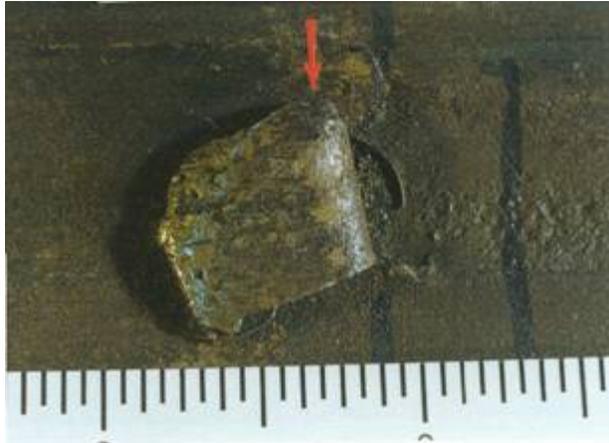
Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 48%, 1.25 inch (31.7 mm)
 OD Hook Crack

Visual: Roll-in
 L: Not Determined
 $\text{depth}/t_{\text{weld}}$: 6%
 depth: 0.017 inch (0.43 mm)
 t_{weld} : 0.262 inch (6.65 mm)



Photograph and Photomicrograph of Pipe Seam ID Surface and Metallographic Section.

Catalog #: 120
 Report #: 12
 Defect #: 54B

Pipe

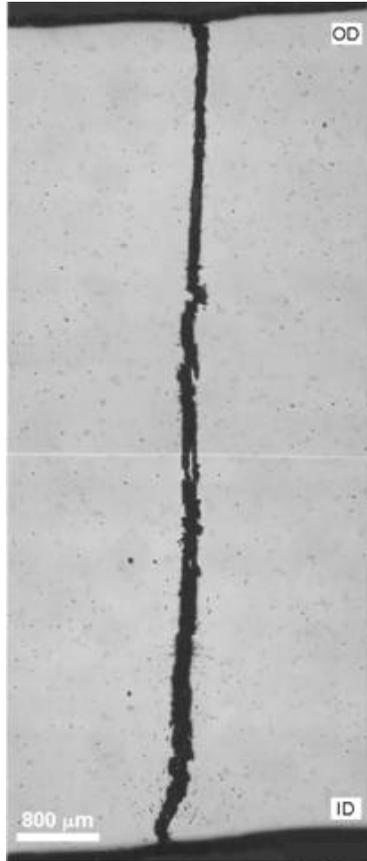
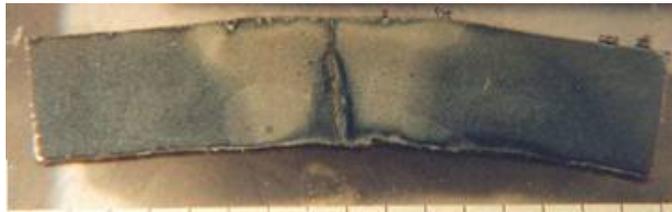
Vintage: Unknown
 Manufacturer: Unknown

Seam Type: LF-ERW
 Grade: API 5L X42
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): TOFD, MPI
 NDE result(s): 24%, 2 inch (51 mm)

Visual: ID Gouge
 ID Scab
 L: Not Determined
 depth/ t_{weld} : Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 65
 Report #: 7
 Defect #: 553

Pipe

Vintage: circa 1950
 Manufacturer: Youngstown

Defect

NDE technique(s): Seeper found during dig
 NDE result(s): 100%, 0.25 inch (6.35 mm)
 (Seeper)

Seam Type: ERW
 Grade: X52
 $D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Visual: Lack of Fusion
 L: Not Determined
 $depth/t_{weld}$: 100%
 $depth$: 0.330 inch (8.38 mm)
 t_{weld} : 0.330 inch (8.38 mm)



Photograph of Weld Seam ID Surface.

Catalog #: 82
 Report #: 7
 Defect #: 1640

Pipe

Vintage: circa 1950
 Manufacturer: Youngstown

Defect

NDE technique(s): Fast UT
 NDE result(s): 20% ID Non-Fusion
 + Irregular weld root
 geometry along
 entire joint

Seam Type: ERW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Visual: Not Determined
 L: Not Determined
 $\text{depth}/t_{\text{weld}}$: Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



Photograph of Weld Seam ID Surface.

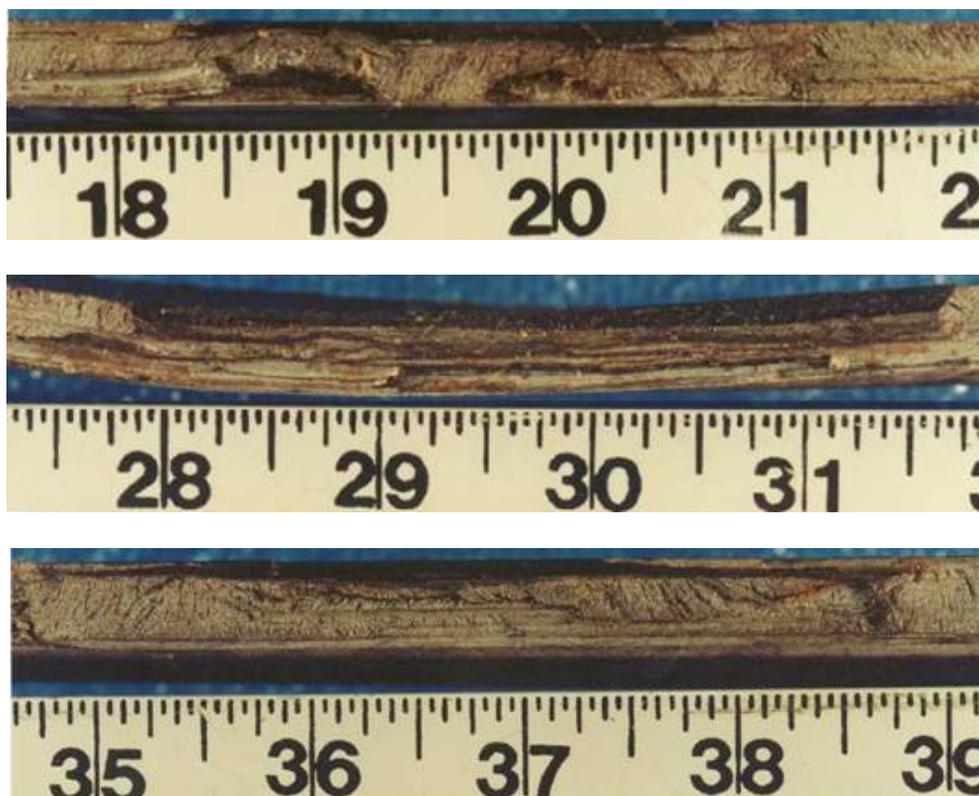
Catalog #: 83
Report #: 7
Defect #: 1668

Pipe

Vintage: circa 1950
Manufacturer: Youngstown
Seam Type: ERW
Grade: X52
 $D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
Failure: N/A

Defect

NDE technique(s): Fast UT
NDE result(s): 25% ID Gouge
Visual: Not Determined
L: Not Determined
depth/ t_{weld} : Not Determined
depth: Not Determined
 t_{weld} : Not Determined



Photographs of Fracture Surfaces.

Catalog #: 61
 Report #: 6
 Defect #: 1012

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52

Defect

NDE technique(s): Fast UT
 NDE result(s): 50% ID + 20% OD Crack
 Visual: 3 ID + 1 OD Hook Cracks
 L > 2 inch (51 mm) (ID Crack #1)
 + > 4 inch (102 mm) (ID Crack #2)
 + > 4 inch (ID Crack #3)
 43% (ID Crack #1) + 31% (ID Crack #2) + 31% (ID Crack #3) + 11% (OD Crack)
 depth: 0.171 inch (4.34 mm) (ID Crack #1)
 + 0.125 inch (3.17 mm) (ID Crack #2) + 0.125 inch (ID Crack #3)
 + 0.044 inch (1.19 mm) (OD Crack)
 t_{weld} 0.397 inch (10.1 mm)

D_{nominal} 20 inch (508 mm)

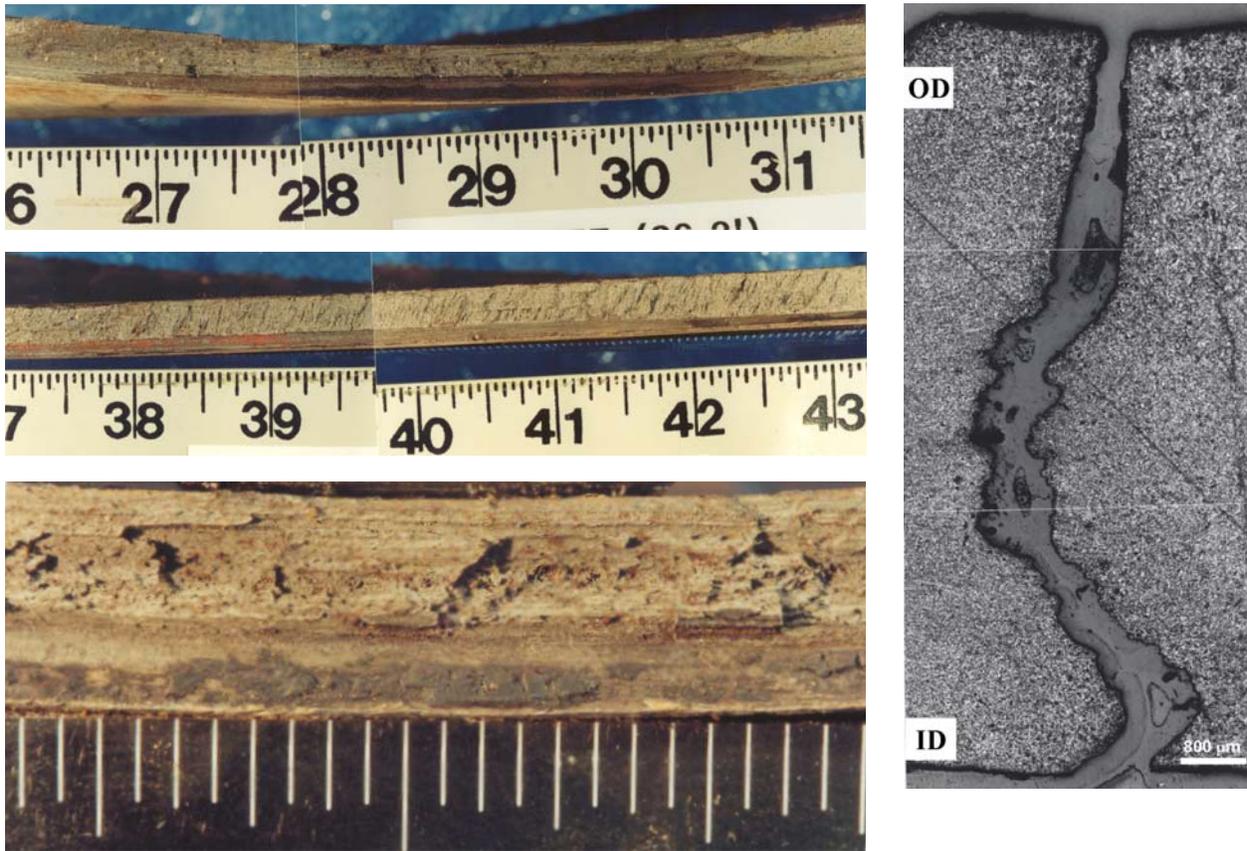
depth/ t_{weld}

t_{nominal} 0.312 inch (7.92 mm)

depth:

t_{pipe} Not Determined
 Failure: Burst test failure at
 1,825 psig (12.58
 MPa) (112% of
 SMYS)

t_{weld}



Photographs of Fracture Surface and Photomicrograph of Metallographic Section.

Catalog #: 56
 Report #: 6
 Defect #: 757

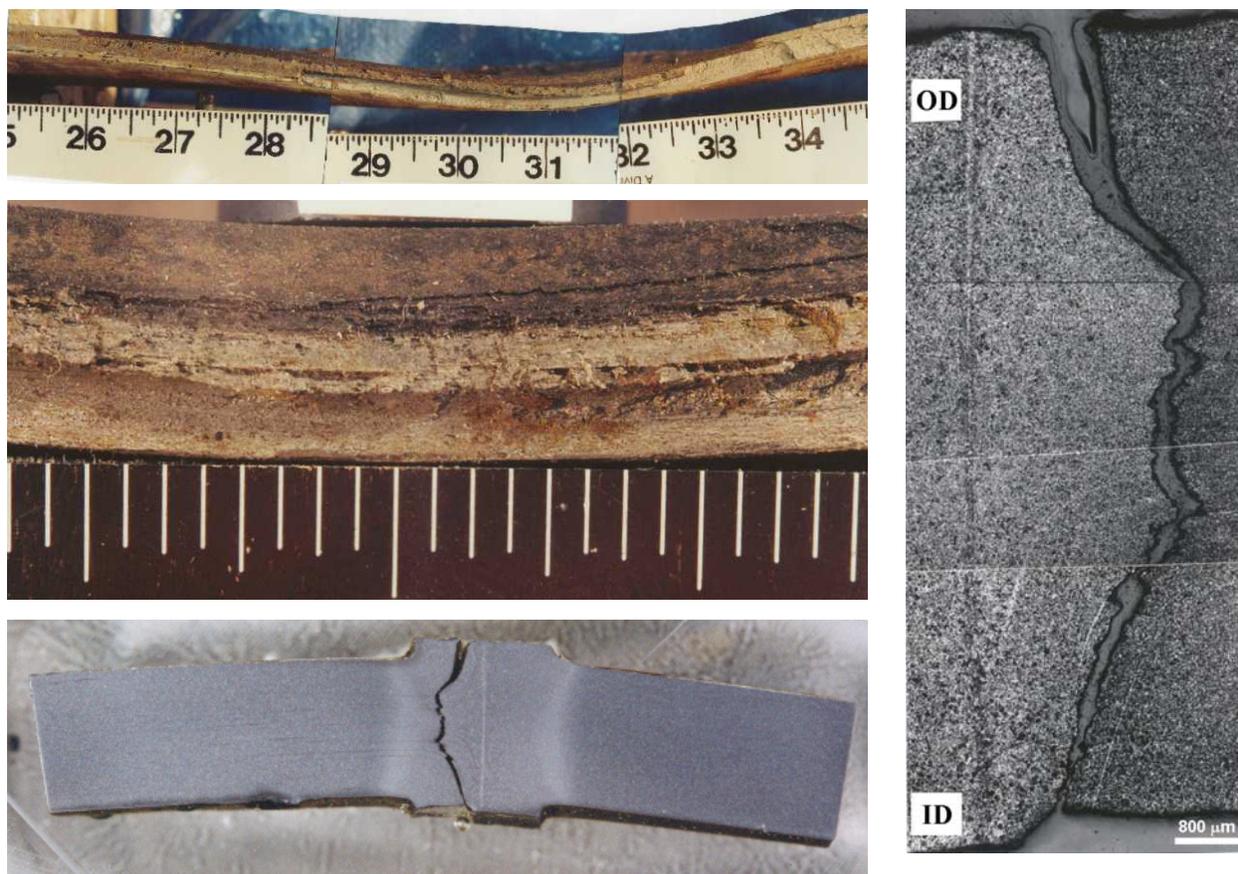
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52

Defect

NDE technique(s): Fast UT
 NDE result(s): 65% OD Crack
 Visual: Two OD Hook cracks
 L 4.5 inch (114 mm)
 (Crack #1) + 12 inch
 (305 mm) (Crack #2)
 40% (Crack #1) (incl.
 5% fatigue growth)
 + 28% (Crack #2)
 depth/t_{weld} 0.156 inch (3.96 mm)
 depth: (Crack #1) (incl. 0.020
 inch (0.51 mm)
 fatigue) + 0.109 inch
 (2.77 mm) (Crack #2)
 t_{weld} 0.390 inch (9.91 mm)

D_{nominal} 20 inch (508 mm)
 t_{nominal} 0.312 inch (7.92 mm)
 t_{pipe} Not Determined
 Failure: Burst test failure at
 1,875 psig (12.93
 MPa) (116% of SMYS)



Photographs and Photomicrograph of Metallographic Section and Fracture Surfaces.

Catalog #: 59
 Report #: 6
 Defect #: 939

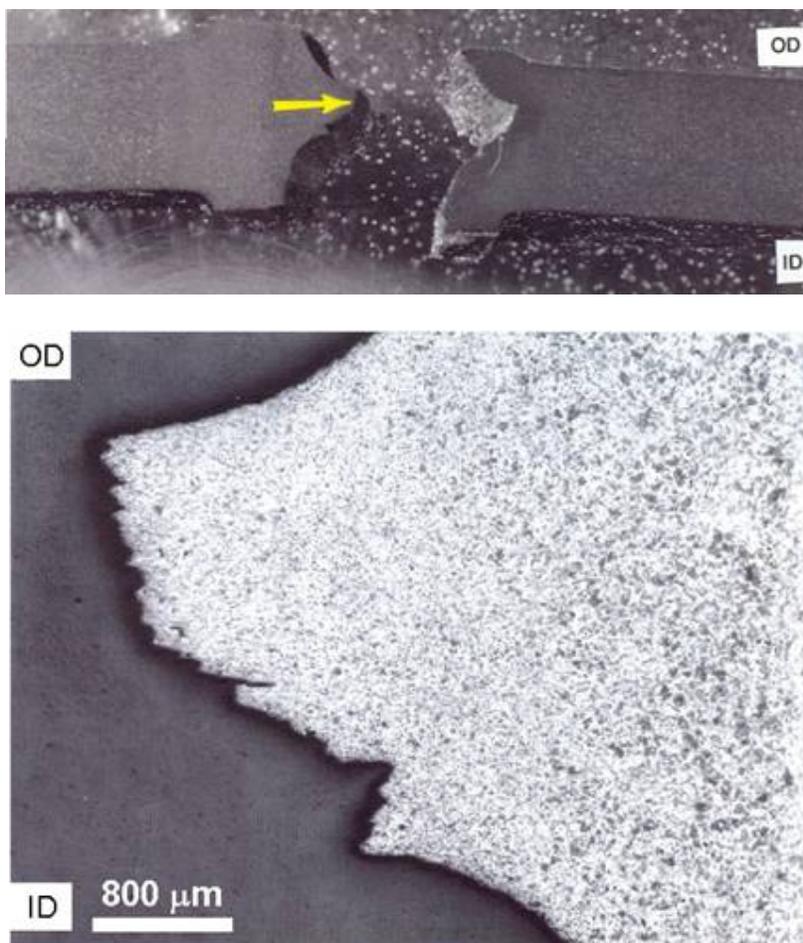
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52

Defect

NDE technique(s): Fast UT
 NDE result(s): 40% ID Crack
 Visual: Two ID Hook Cracks
 L 4 inch (102 mm)
 (Crack #1) + > 8 inch
 (203 mm) (Crack #2)
 depth/ t_{weld} 24% (Crack #1)
 + 40% (Crack #2)
 depth: 0.093 inch (2.36 mm)
 (Crack #1) + 0.156 inch
 (3.96 mm) (Crack #2)
 t_{weld} 0.388 inch (9.85 mm)

$D_{nominal}$ 20 inch (508 mm)
 $t_{nominal}$ 0.312 inch (7.92 mm)
 t_{pipe} Not Determined
 Failure: Burst test failure at
 2,050 psig (14.13 MPa)
 (126% of SMYS)



Photographs and Photomicrograph of Metallographic Section and Fracture Surfaces.

Catalog #: 44
 Report #: 5
 Defect #: 22

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Defect

NDE technique(s): Fast UT
 NDE result(s): 2 overlapping cracks: 85%,
 10.5 inch
 (267 mm) total length

Seam Type: FW
 Grade: X52
 $D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.312 inch (7.92 mm)

Visual: ID & OD hook cracks
 L: 14 to 19 inch (356 to 483 mm)
 depth/ t_{weld} : 75% (33% OD + 42% ID)
 depth: 0.129 inch (3.28 mm) (OD) +
 0.164 inch
 (4.17 mm) (ID)
 t_{weld} : 0.390 inch (9.91 mm)

t_{pipe} : 0.309 inch (7.85 mm)
 Failure: Burst Test Failure at
 2,050 psig (14.13
 MPa) (126% of SMYS)



Photographs/Micrographs of Weld Seam OD Surface and Fracture Surface.

Catalog #: 62
 Report #: 6
 Defect #: 1450

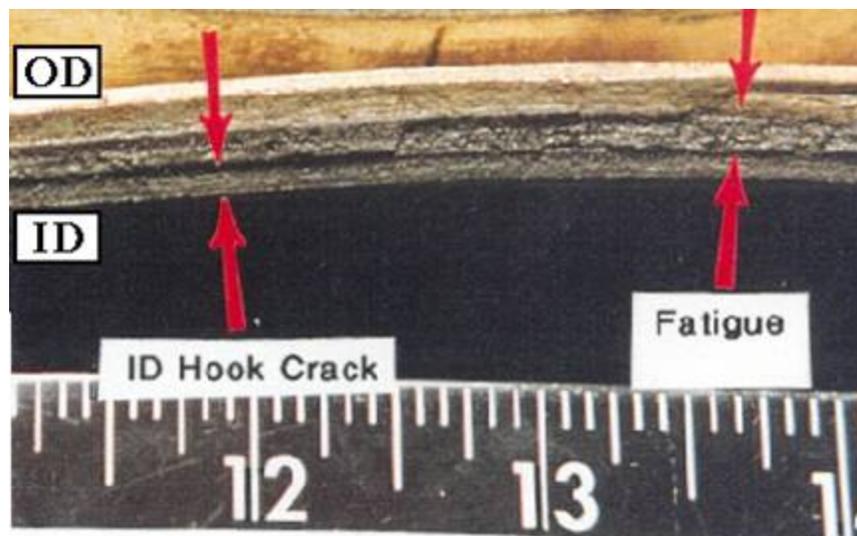
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Defect

NDE technique(s): Fast UT
 NDE result(s): 0.300 inch (7.62 mm)
 RDI Mechanical
 Damage + 70%, 1 inch
 (25.4 mm) OD Crack
 Dent and Hook Crack
 1 inch (25.4 mm)
 Visual:
 L
 depth/ t_{weld} 70%
 depth: 0.312 inch (7.92 mm)
 t_{weld} 0.445 inch (11.3 mm)

Seam Type: FW
 Grade: X52
 $D_{nominal}$ 20 inch (508 mm)
 $t_{nominal}$ 0.312 inch (7.92 mm)
 t_{pipe} Not Determined
 Failure: Leak at 2,250 psig (15.51
 MPa) (138% of SMYS)



Photographs of Fracture Surfaces.

Catalog #: 26
 Report #: 2
 Defect #: 640

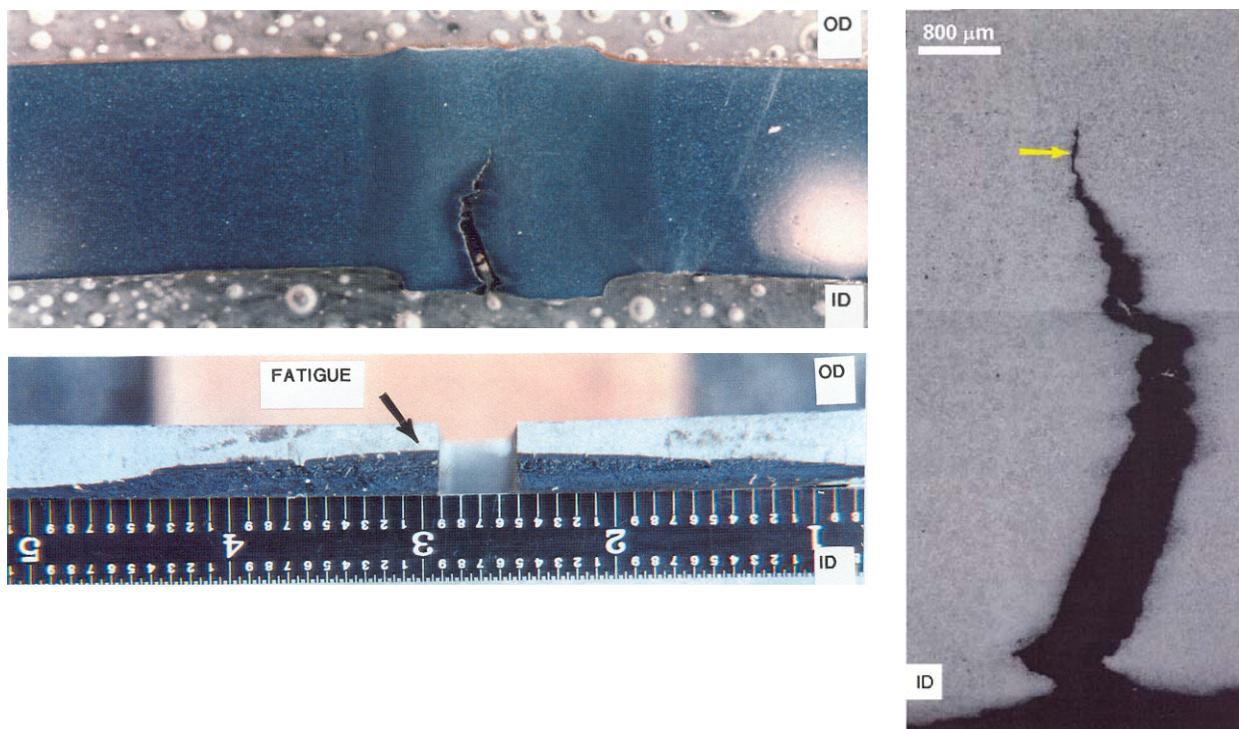
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)

t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.315 inch
 Failure: Burst test rupture at
 1,550 psig (10.69 MPa)
 (95% of SMYS)

Defect

NDE technique(s): UT
 NDE result(s): 50% ID Crack like
 Visual: ID Hook crack
 L: 12.0 inch (305 mm)
 $\text{depth}/t_{\text{weld}}$: 63% (30% hook +
 33% fatigue)
 depth: 0.250 inch (6.35 mm)
 t_{weld} : 0.394 inch (10.1 mm)



Photographs and Photomicrograph of Metallographic Section and Fracture Surfaces.

Catalog #: 37
 Report #: 5
 Defect #: C9

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Defect

NDE technique(s): UT, MT, and Fast UT
 NDE result(s): ID-connected crack-like (UT) + Intermittently dispersed minor inclusions (UT) + Crack-like (UT) + OD Sub-surface crack-like (MT) + NF with associated crack-like (Fast UT)
 ID hook crack (with crack extension)
 > 4.25 inch (108 mm)
 62%
 0.227 inch (5.77 mm) (incl. 0.020 inch (0.51 mm) crack extension)
 0.366 inch (9.3 mm)

Seam Type: FW

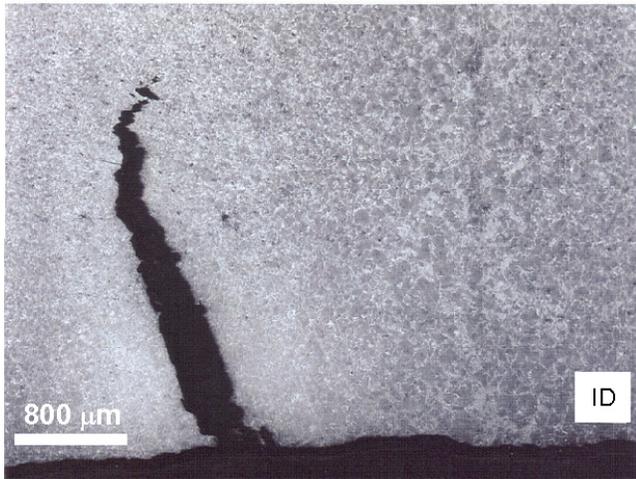
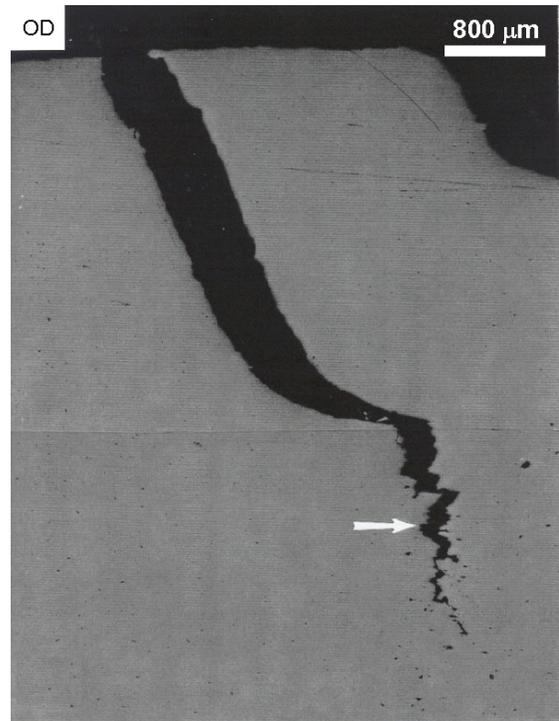
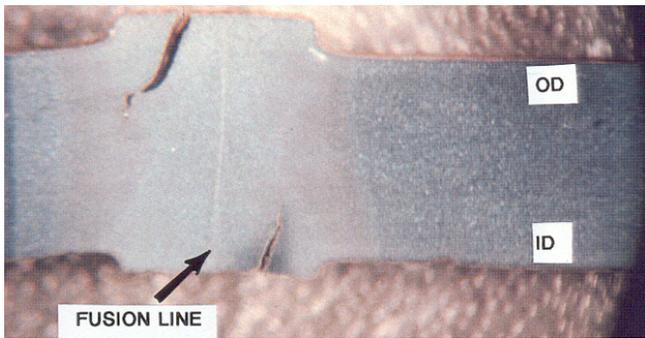
Visual:

Grade: X52
 $D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.312 inch (7.92 mm)

L
 depth/ t_{weld}
 depth:

t_{pipe} : 0.320 inch (8.13 mm)
 Failure: None

t_{weld}



Photographs and Photomicrograph of Metallographic Section and Fracture Surfaces.

Catalog #: 35
 Report #: 5
 Defect #: C5A

Pipe

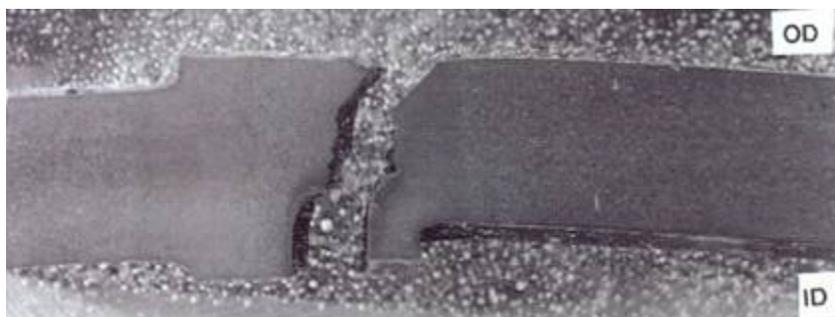
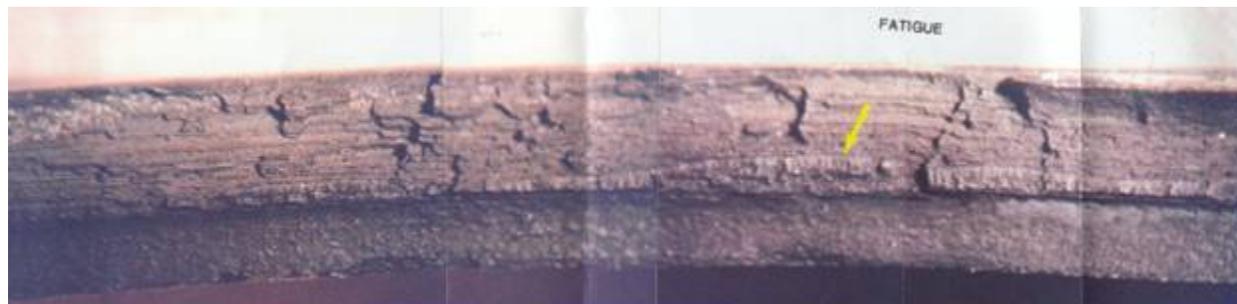
Vintage: circa 1950
 Manufacturer: AO Smith

Seam Type: FW
 Grade: X52
 $D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.312 inch (7.92 mm)

t_{pipe} : 0.320 inch (8.13 mm)
 Failure: Burst Test: No failure at 2,000 psig (13.79 MPa) (123% of SMYS)

Defect

NDE technique(s): UT, MT, and Fast UT
 NDE result(s): ID Connected, Crack like (UT) + OD Crack-like (MT) + ID Connected, Crack-like + Some LOF (Fast UT)
 Visual: ID & OD Hook Cracks
 L: N/A
 depth/ t_{weld} : 57% (32 + 25%)
 depth: 0.204 inch (5.18 mm) (0.115 + 0.089 inch) (2.92 mm + 2.26 mm)
 t_{weld} : 0.358 inch (9.09 mm)



Photographs of Fracture Surface and Metallographic Section.

Catalog #: 51

Report #: 5

Defect #: 49

Pipe

Vintage: circa 1950

Manufacturer: AO Smith

Defect

NDE technique(s): Fast UT

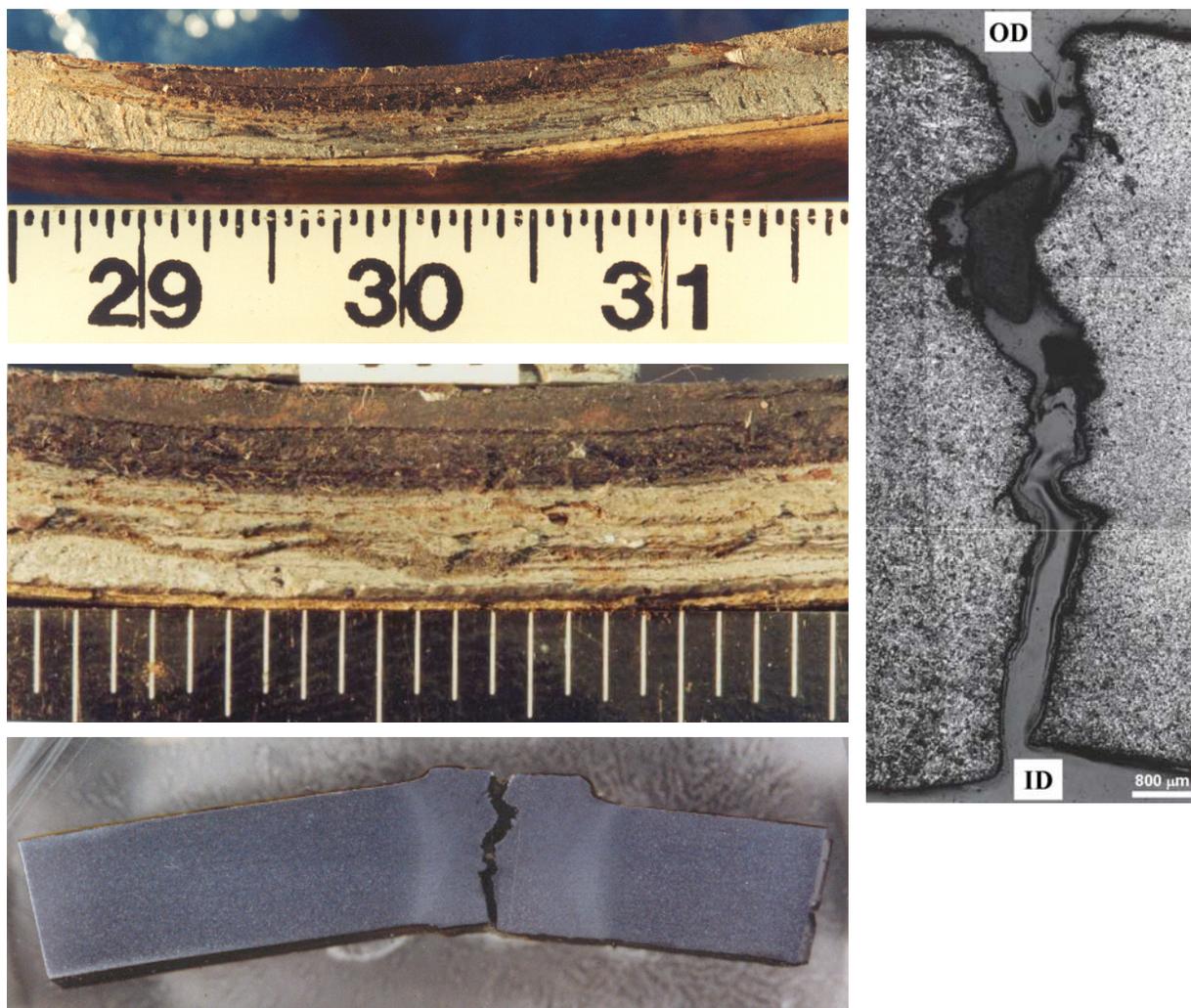
NDE result(s): 35%, 8 inch (203 mm),
ID-connected crack-like +

Seam Type: FW

Visual: ID Hook Crack + Crack
extension

Grade: X52

 D_{nominal} 20 inch (508 mm) t_{nominal} 0.312 inch (7.92 mm)L > 19.5 inch (495 mm)
depth/ t_{weld} 54% (incl. 15% fatigue)
depth: < 0.218 inch (5.54 mm) t_{pipe} 0.306 inch (7.77 mm)Failure: Burst test rupture at
1,750 psig (12.07 MPa)
(108% of SMYS) t_{weld} 0.404 inch (10.3 mm)



Photographs of Weld Seam ID Surface and Metallographic Section.

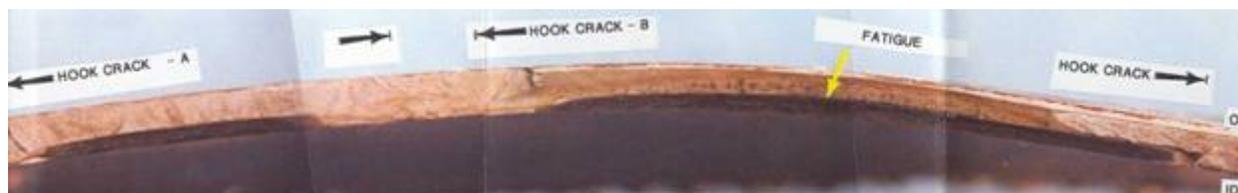
Catalog #: 58
 Report #: 6
 Defect #: 858

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: Burst test failure at
 2,275 psig (15.69 MPa)
 (140% of SMYS)

Defect

NDE technique(s): Fast UT
 NDE result(s): 75% ID Crack
 Visual: ID Hook Crack
 L: 2.25 inch (57.1 mm)
 depth/ t_{weld} : 50%
 depth: 0.187 inch (4.75 mm)
 t_{weld} : 0.377 inch (9.58 mm)



Photograph of Fracture Surface.

Catalog #: 48

Report #: 5

Defect #: 44

Pipe

Vintage: circa 1950

Manufacturer: AO Smith

Defect

NDE technique(s):

NDE result(s):

Fast UT

13.5 inch (343 mm)
intermittent NF
2(1.6)5.3(.5)4.1 inch
(gap)

Seam Type: FW

Visual:

ID Hook Crack
(evidence of crack
extension)

Grade: X52

L

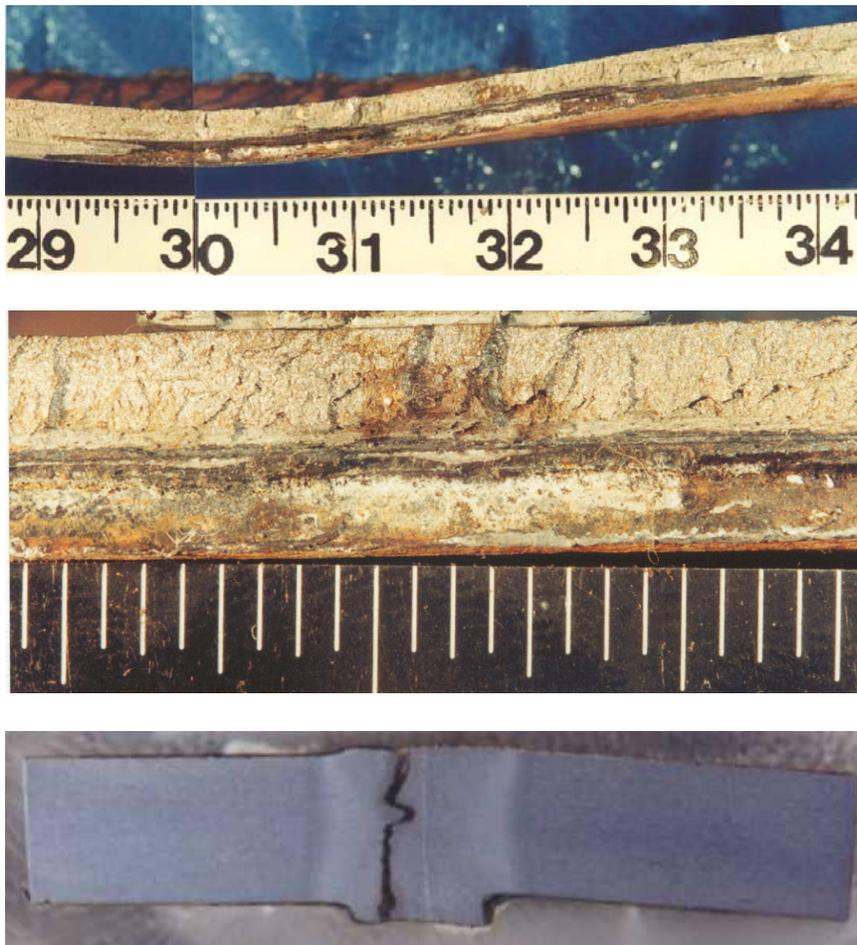
 D_{nominal} 20 inch (508 mm)depth/ t_{weld} > 12 inch (305 mm)
48% (incl. 11% crack
extension) t_{nominal} 0.312 inch (7.92 mm)

depth:

0.189 inch (4.8 mm)
(incl. 0.043 inch
(1.09 mm) crack
extension) t_{pipe} 0.312 inch (7.92 mm) t_{weld}

0.394 inch (10.1 mm)

Failure: Burst test failure at
1,950 psig (13.44 MPa)
(120% of SMYS)



Photographs and Photomicrograph of Fracture Surface and Metallographic Section.

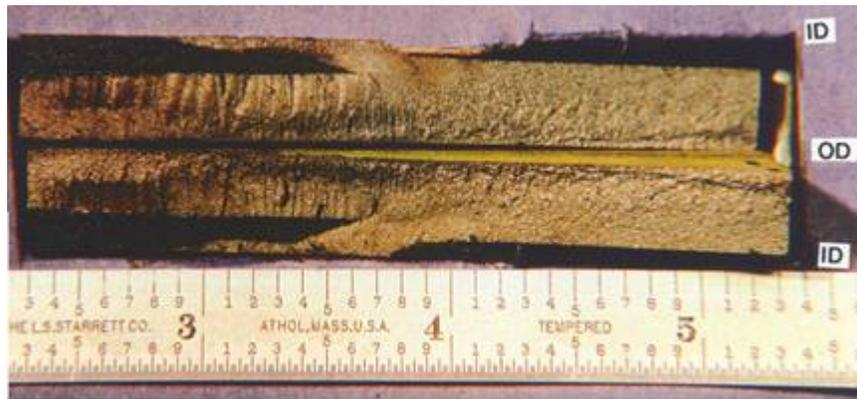
Catalog #: 55
 Report #: 6
 Defect #: 707

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: Burst test failure at
 1,675 psig (11.55 MPa)
 (103% of SMYS)

Defect

NDE technique(s): Fast UT
 NDE result(s): 75% OD Crack
 Visual: OD Hook Crack
 L: > 5 inch (127 mm)
 depth/ t_{weld} : 47%
 depth: 0.187 inch (4.75 mm)
 t_{weld} : 0.400 inch (10.2 mm)



Photograph of Fracture Surfaces.

Catalog #:	6		
Report #:	1		
Defect #:	299		
Pipe		Defect	
Vintage:	1950s	NDE technique(s):	UT
Manufacturer:	AO Smith	NDE result(s):	60% x 6.0 inch (152 mm) ID crack
Seam Type:	FW	Visual:	ID hook crack
Grade:	X52	L	> 2.8 inch (71 mm)
D_{nominal}	20 inch (508 mm)	depth/ t_{weld}	43%
t_{nominal}	0.344 inch (8.74 mm)	depth:	0.1875 (3/16 inch) (4.76 mm)
t_{pipe}	0.345 inch (8.76 mm)	t_{weld}	0.435 inch (11.1 mm)
Failure:	None at 2,300 psig (15.86 MPa) (129% of SMYS)		



Photograph of Fracture Surface.

Catalog #: 45
 Report #: 5
 Defect #: 24

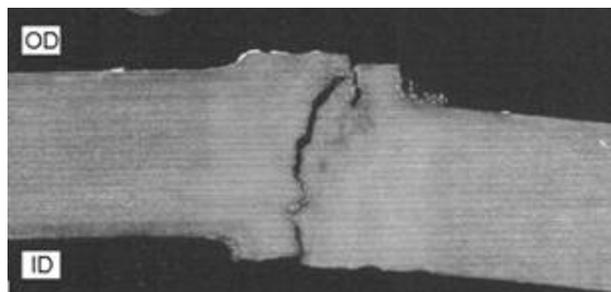
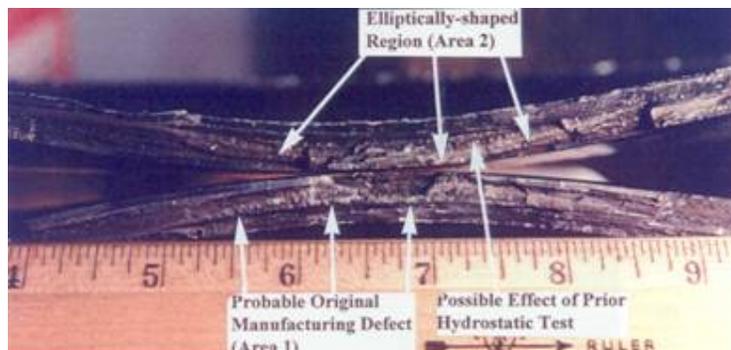
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.310 inch (7.87 mm)
 Failure: Burst Test: No failure at
 2,200 psig (15.17 MPa)
 (136% of SMYS) +
 Yielding at 2,175 psig
 (15.00 MPa) (134% of
 SMYS)

Defect

NDE technique(s): Fast UT
 NDE result(s): 2.4 inch (61 mm)
 long, 50% crack-like
 ID Hook Crack
 Visual: > 5 inch (127 mm)
 L
 depth/ t_{weld} : 40%
 depth: 0.158 inch (4.01 mm)
 t_{weld} : 0.394 inch (10.1 mm)



Photographs of Fracture Surfaces and Metallographic Section.

Catalog #: 84
 Report #: 4
 Defect #: 964+53

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW

Grade: X52

D_{nominal} 20 inch (508 mm)
 t_{nominal} 0.312 inch (7.92 mm)
 t_{pipe} 0.321 inch (8.15 mm)
 Failure: In-Service rupture at 897 psig (6.18 MPa) (55% of SMYS) Hydrotested at 1,460 psig (10.07 MPa) (90% of SMYS) 32 to 35 years earlier

Defect

NDE technique(s): N/A
 NDE result(s): N/A
 Visual: ID Overtrim + ID Hook Crack + Fatigue Crack
 L 11 feet long, 5.875 inch (149 mm) wide
 depth/ t_{weld} 40% (Hook Crack)
 depth: 0.162 inch (4.11 mm)
 t_{weld} 0.405 inch (10.3 mm)



Photograph of Fracture Surface.

Catalog #: 49
 Report #: 5
 Defect #: 45B

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.308 inch (7.82 mm)
 Failure: Burst test rupture at
 2,150 psig(*) (14.82 MPa)
 (133% of SMYS)

Defect

NDE technique(s): Fast UT
 NDE result(s): 65%, 14 inch (356 mm)
 crack-like
 Visual: OD Hook crack
 L: 6.63 inch (168 mm)
 depth/ t_{weld} : 40%
 depth: 0.156 inch (3.96 mm)
 t_{weld} : 0.390 inch (9.91 mm)

(*) This and a nearby hook crack together produced the failure at this pressure.



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 76
 Report #: 7
 Defect #: 1328

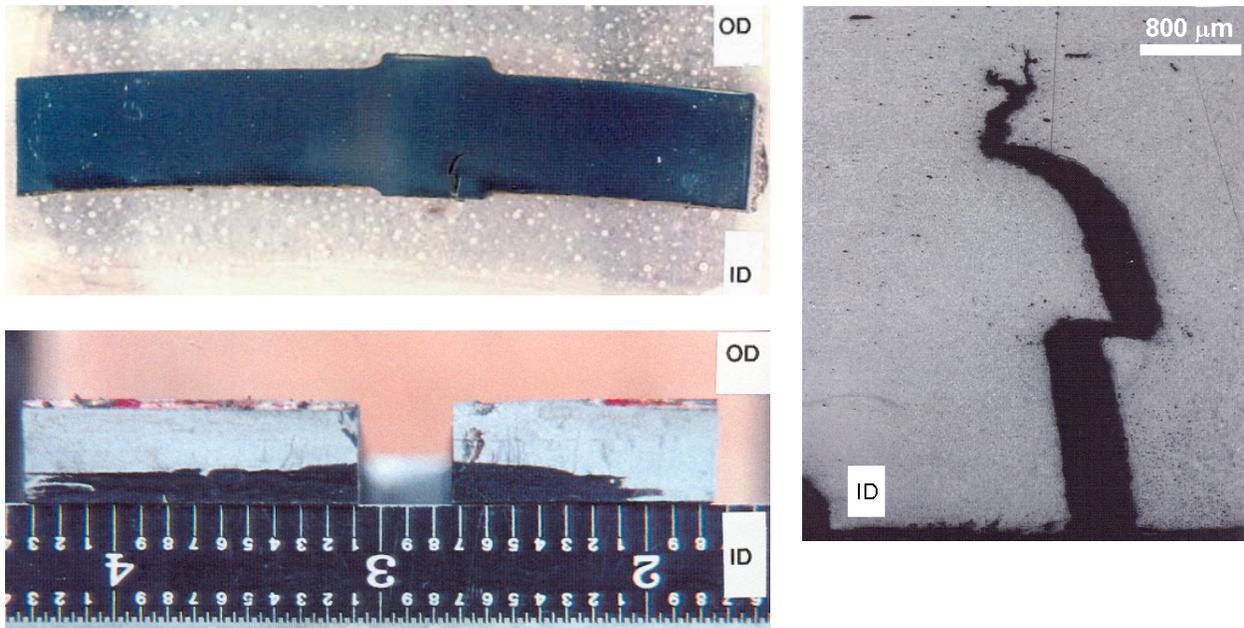
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.318 inch (8.08 mm)
 Failure: N/A

Defect

NDE technique(s): Fast UT
 NDE result(s): 40% (0.158 inch (4.01 mm))
 OD Crack
 Visual: OD Hook Crack
 L: Not Determined
 $\text{depth}/t_{\text{weld}}$: 39%
 depth: 0.155 inch (3.94 mm)
 t_{weld} : 0.398 inch (10.1 mm)



Photographs and Photomicrograph of Metallographic Section and Fracture Surfaces.

Catalog #: 38
 Report #: 5
 Defect #: C10

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Defect

NDE technique(s): UT & Fast UT
 NDE result(s): Minor Inclusions (UT)
 + Minor Inclusions (Fast UT) + Crack-like (Fast UT)

Seam Type: FW

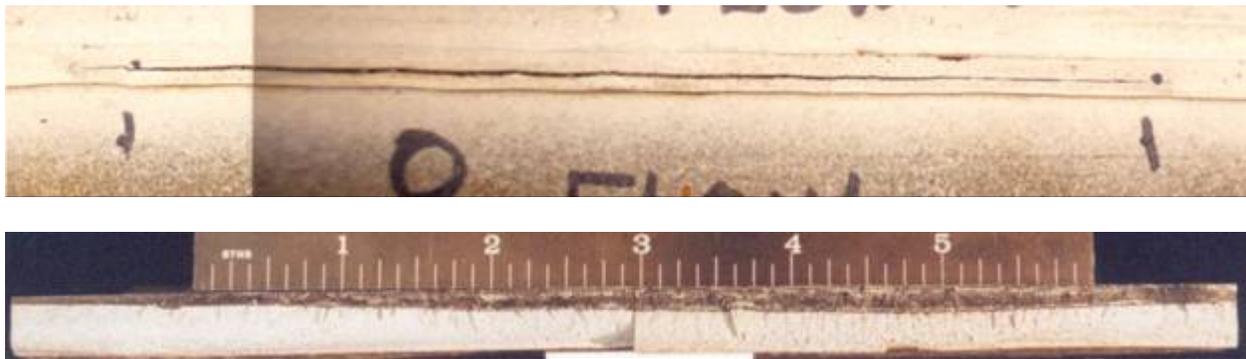
Visual: ID hook crack (with crack extension)
 > 2.5 inch (63 mm)

Grade: X52
 $D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.312 inch (7.92 mm)

L depth/ t_{weld} : 38%
 depth: 0.148 inch (3.76 mm)
 (incl. 0.028 inch (0.71 mm) crack extension)

t_{pipe} : 0.321 inch (8.15 mm)
 Failure: None t_{weld}

0.390 inch (9.91 mm)



Photographs of Weld Seam ID Surface and Fracture Surface.

Catalog #: 67
 Report #: 7
 Defect #: 841

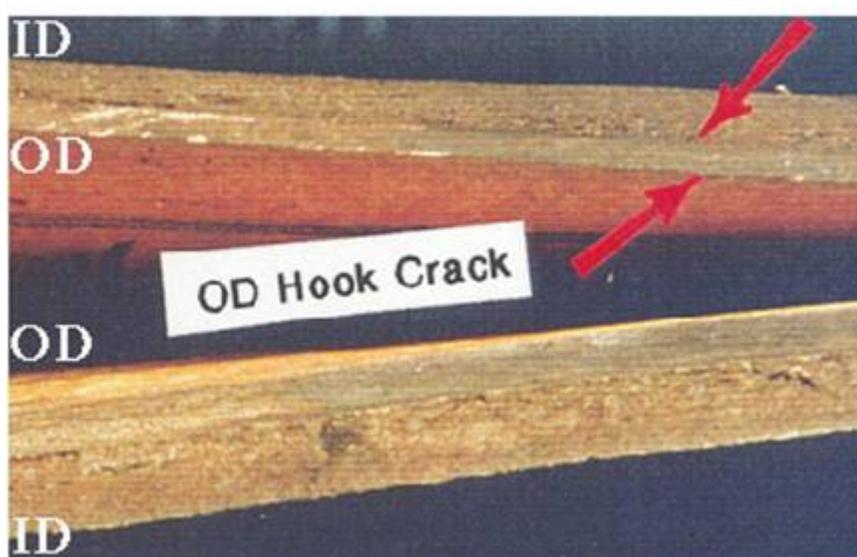
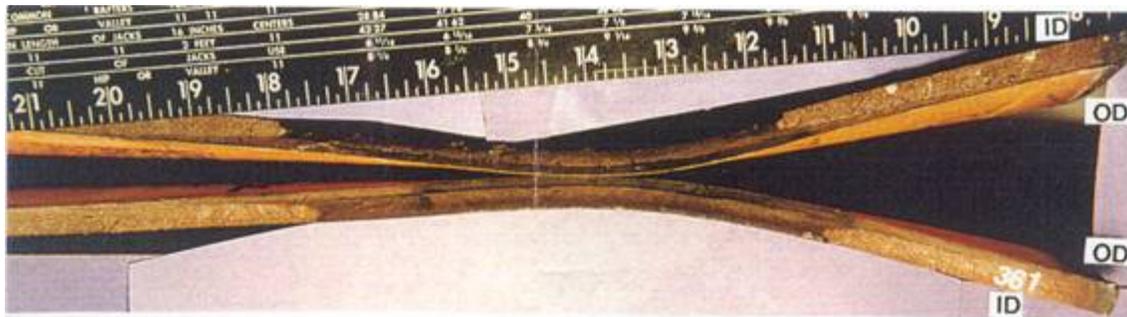
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT
 NDE result(s): 40% (0.170 inch (4.32 mm)) ID Crack
 ID Hook Crack
 > 8 inch (203 mm)
 Visual: ID Hook Crack
 L
 $\text{depth}/t_{\text{weld}}$: 37%
 depth: 0.156 inch (3.96 mm)
 t_{weld} : 0.425 inch (10.8 mm)



Photographs of Fracture Surfaces.

Catalog #: 21
 Report #: 2
 Defect #: 361

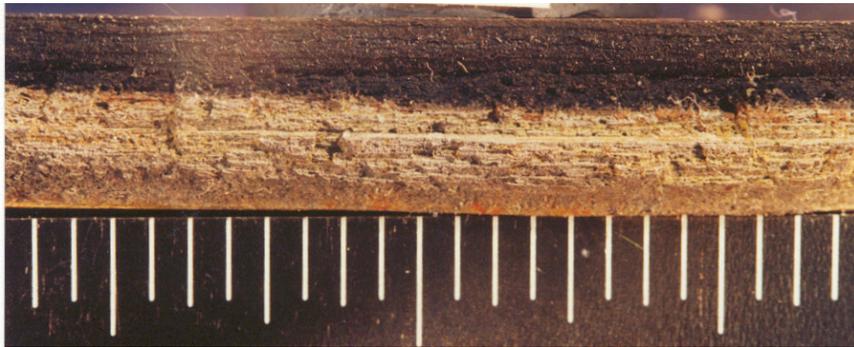
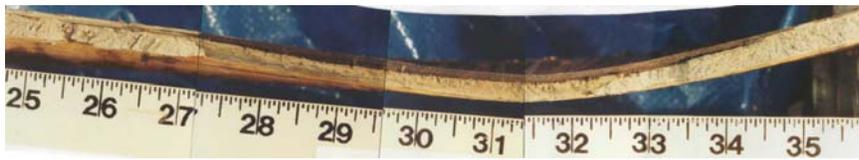
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.303 inch (7.7 mm)
 Failure: Burst test rupture at
 1,925 psig (13.27 MPa)
 (119% of SMYS)

Defect

NDE technique(s): UT
 NDE result(s): 30%, 8.5 inch (216 mm)
 OD crack like
 Visual: OD Hook crack
 L: 10.5 inch (267 mm)
 depth/ t_{weld} : 36%
 depth: 0.140 inch (3.56 mm)
 t_{weld} : 0.389 inch (9.88 mm)



Photographs and Photomicrograph of Metallographic Section and Fracture Surfaces.

Catalog #: 60
 Report #: 6
 Defect #: 968

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: Burst test failure at
 1,950 psig (13.44 MPa)
 (120% of SMYS)

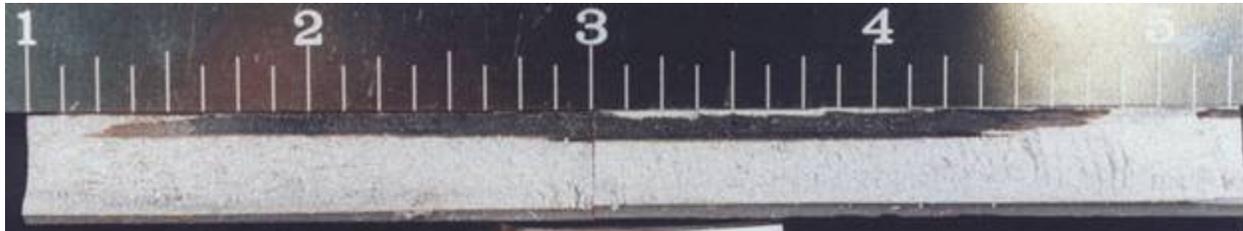
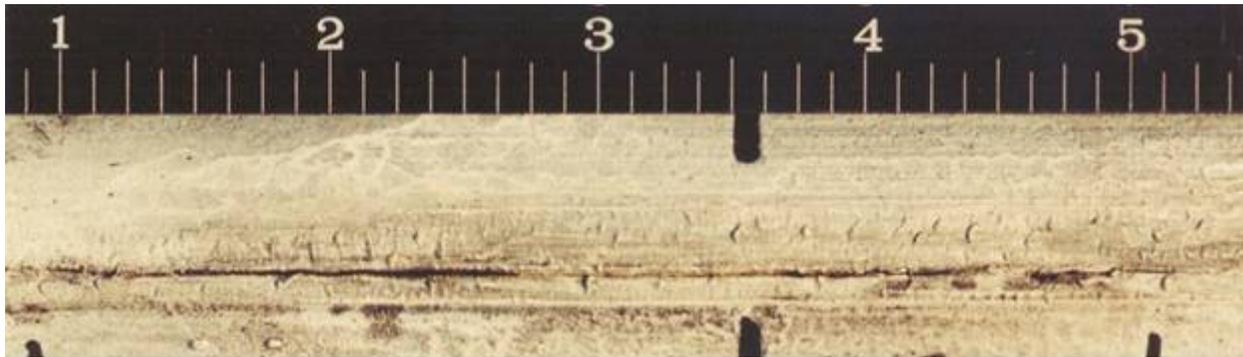
Defect

NDE technique(s): Fast UT
 NDE result(s): 65% ID Crack
 Visual: ID Hook Crack
 L: 8.25 inch (210 mm)
 depth/ t_{weld} : 34%
 depth: 0.125 inch (3.17 mm)
 t_{weld} : 0.371 inch (9.42 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #:	78		
Report #:	7		
Defect #:	1381		
Pipe		Defect	
Vintage:	circa 1950	NDE technique(s):	Fast UT
Manufacturer:	AO Smith	NDE result(s):	30% (0.128 inch (3.25 mm)) OD Crack-Like
Seam Type:	FW	Visual:	OD Hook Crack
Grade:	X52	L	Not Determined
D_{nominal}	20 inch (508 mm)	depth/ t_{weld}	34%
t_{nominal}	0.312 inch (7.92 mm)	depth:	0.145 inch (3.68 mm)
t_{pipe}	0.306 inch (7.77 mm)	t_{weld}	0.425 inch (10.8 mm)
Failure:	N/A		



Photographs of Weld Seam ID Surface and Fracture Surface.

Catalog #: 72
 Report #: 7
 Defect #: 1017

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT
 NDE result(s): 30% ID Crack
 Visual: ID Hook Crack
 L: 3.5 inch (89 mm)
 $\text{depth}/t_{\text{weld}}$: 32%
 depth: 0.116 inch (2.95 mm)
 t_{weld} : 0.365 inch (9.27 mm)



Photographs of Fracture Surface.

Catalog #: 57
 Report #: 6
 Defect #: 808

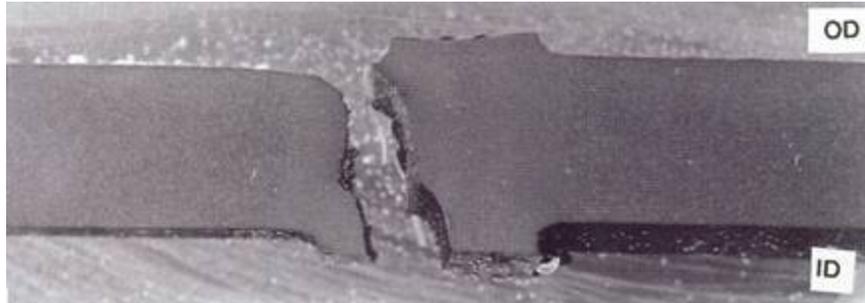
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW

Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: Burst test failure at
 1,900 psig (13.10 MPa)
 (117% of SMYS)

Defect

NDE technique(s): Fast UT
 NDE result(s): 65% OD Crack
 Visual: OD Hook Crack +
 inclusions
 L: 5 inch (127 mm)
 $\text{depth}/t_{\text{weld}}$: 32%
 depth: 0.125 inch (3.17 mm)
 t_{weld} : 0.385 inch (9.78 mm)



Photographs of Fracture Surface and Metallographic Section.

Catalog #:	50		
Report #:	5		
Defect #:	46		
<u>Pipe</u>		<u>Defect</u>	
Vintage:	circa 1950	NDE technique(s):	Fast UT
Manufacturer:	AO Smith	NDE result(s):	4.8 inch (122 mm) crack-like, ID connected
Seam Type:	FW	Visual:	ID Hook crack
Grade:	X52	L	> 9 inch (229 mm)
D_{nominal}	20 inch (508 mm)	depth/ t_{weld}	31%
t_{nominal}	0.312 inch (7.92 mm)	depth:	0.124 inch (3.15 mm)
t_{pipe}	0.314 inch (7.98 mm)	t_{weld}	0.400 inch (10.2 mm)
Failure:	Burst test rupture at 2,250 psig (15.51 MPa) (139% of SMYS)		



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 77
 Report #: 7
 Defect #: 1339

Pipe

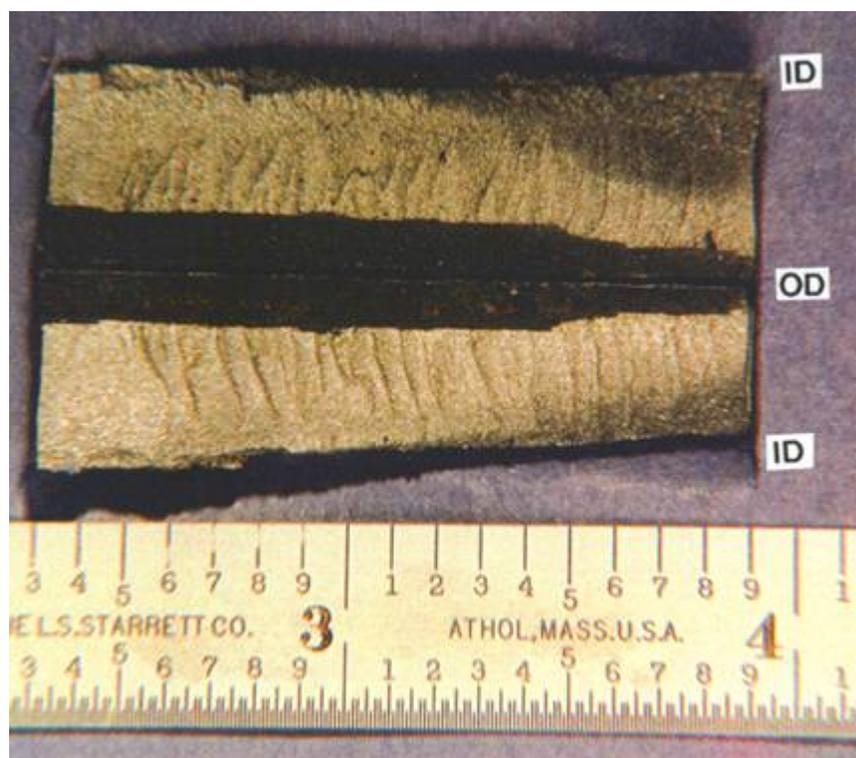
Vintage: circa 1950
 Manufacturer: AO Smith

Defect

NDE technique(s): Fast UT
 NDE result(s): 30% (0.105 inch (2.67 mm)) OD
 Crack-like

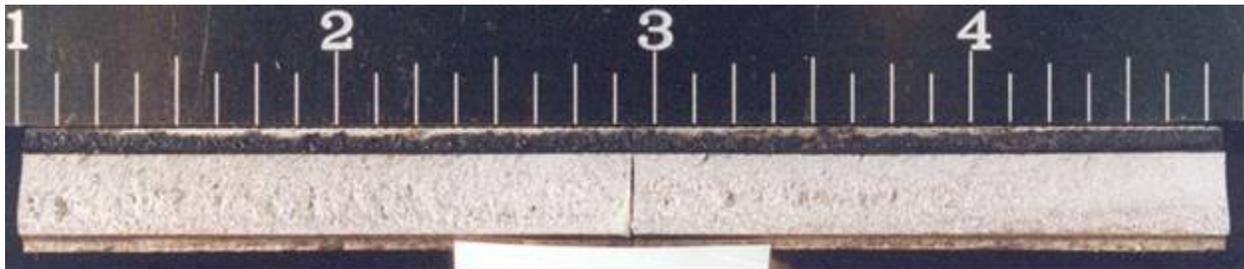
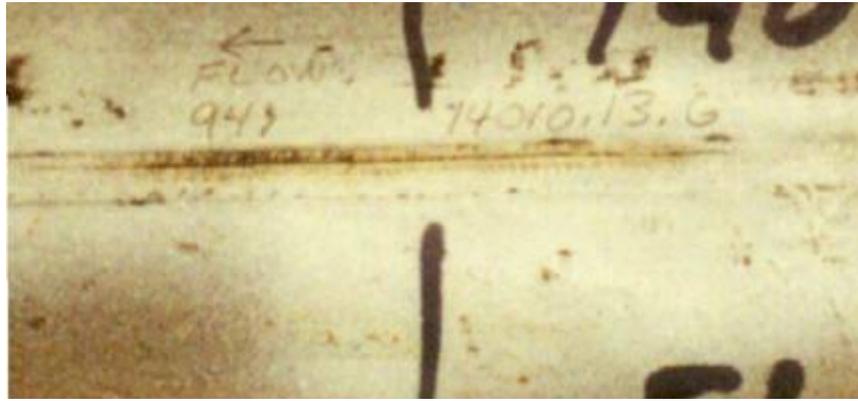
Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.306 inch (7.77 mm)
 Failure: N/A

Visual: OD Hook Crack
 L: Not Determined
 $\text{depth}/t_{\text{weld}}$: 29%
 depth: 0.100 inch (2.54 mm)
 t_{weld} : 0.349 inch (8.86 mm)



Photograph of Fracture Surfaces.

Catalog #:	5		
Report #:	1		
Defect #:	282		
<u>Pipe</u>		<u>Defect</u>	
Vintage:	1950s	NDE technique(s):	UT
Manufacturer:	AO Smith	NDE result(s):	66% x 3.5 inch (89 mm) OD crack
Seam Type:	FW	Visual:	OD hook crack
Grade:	X52	L	~ 3.4 inch (86 mm)
D_{nominal}	20 inch (508 mm)	depth/ t_{weld}	27.7%
t_{nominal}	0.344 inch (8.74 mm)	depth:	0.125 (1/8 inch (3.17 mm))
t_{pipe}	0.341 inch (8.66 mm)	t_{weld}	0.450 inch (11.4 mm)
Failure:	None at 2,300 psig (15.86 MPa) (129% of SMYS)		



Photographs of Weld Seam ID Surface and Fracture Surface.

Catalog #: 69
 Report #: 7
 Defect #: 941

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT
 NDE result(s): 20% ID Crack
 Visual: ID Hook Crack
 L: > 5 inch (127 mm)
 depth/ t_{weld} : 25%
 depth: 0.086 inch (2.18 mm)
 t_{weld} : 0.344 inch (8.74 mm)



Photograph of Fracture Surfaces.

Catalog #: 4
 Report #: 1
 Defect #: 169

Pipe

Vintage: 1950s
 Manufacturer: AO Smith

Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)

t_{pipe} : 0.310 inch (7.87 mm)
 Failure: None at 2,275 psig
 (15.69 MPa) (140% of
 SMYS)

Defect

NDE technique(s): UT
 NDE result(s): 40% x 5.5 inch (140 mm)
 crack

Visual: ID hook crack
 L > 6 inch (152 mm)
 depth/ t_{weld} : 24.4%
 depth: 0.09375 (3/32 inch (2.38
 mm))

t_{weld} : 0.384 inch (9.75 mm)



Photograph of Fracture Surfaces.

Catalog #: 16
 Report #: 1
 Defect #: 643

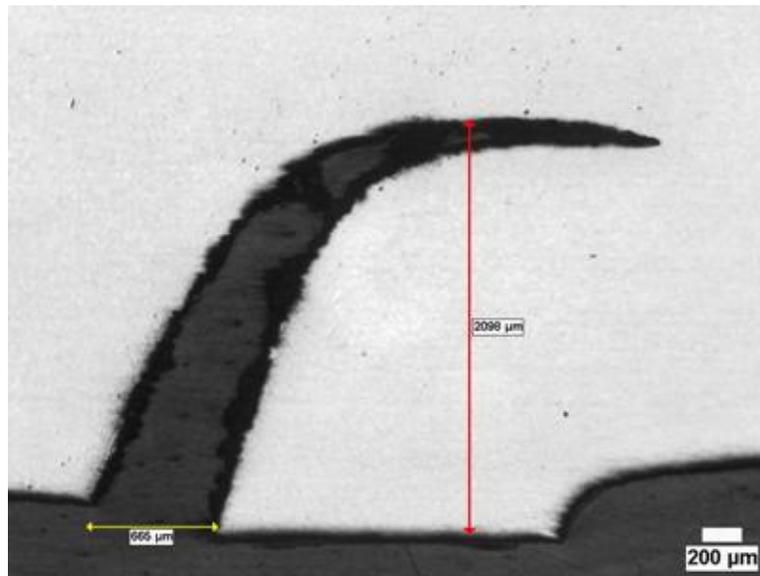
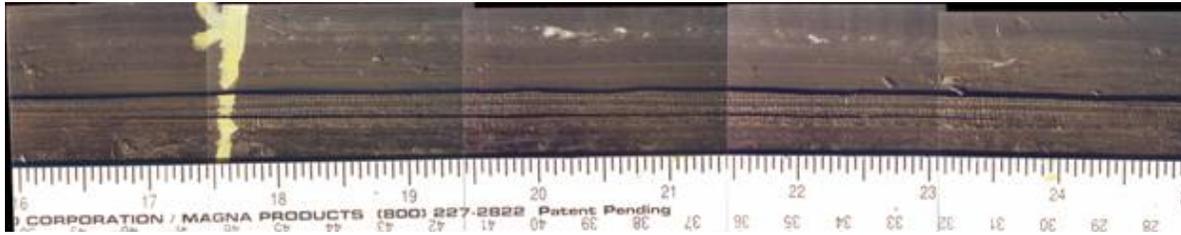
Pipe

Vintage: 1950s
 Manufacturer: AO Smith

Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.315 inch (8.00 mm)
 Failure: None at 2,300 psig
 (15.86 MPa) (140%
 of SMYS)

Defect

NDE technique(s): UT
 NDE result(s): 50% x 5.0 inch (127 mm) ID
 crack
 Visual: ID hook crack
 L ~ 3.4 inch (86 mm)
 depth/ t_{weld} : 23.4%
 depth: 0.09375 inch (3/32) (2.38 mm)
 t_{weld} : 0.400 inch (10.2 mm)



Photographs and Photomicrograph of Pipe ID Surface and Metallographic Section.

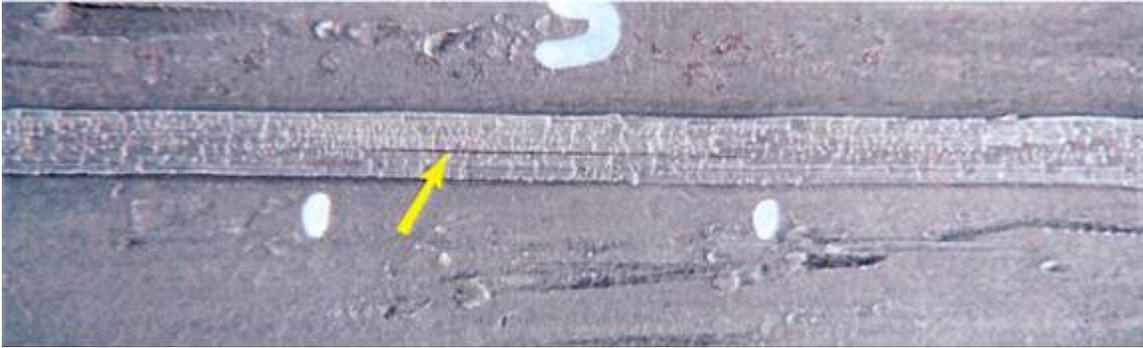
Catalog #: 17
 Report #: 13
 Defect #: 1

Pipe

Vintage: 1954
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: API 5L X52
 D_{nominal} : 26 inch (660 mm)
 t_{nominal} : 0.281 inch (7.14 mm)
 t_{pipe} : 0.275 inch (6.98 mm)
 Failure: N/A
 MOP: 809 psig (5.58 MPa)

Defect

NDE technique(s): Shear wave UT
 NDE result(s): 30% x 8.1 inch (206 mm)
 ID-connected crack
 Visual: ID hook crack
 L: ~ 7 inch (178 mm)
 Width: 0.026 inch (0.66 mm)
 depth/ t_{weld} : 22.6%
 depth: 0.083 inch (2.1 mm)
 t_{weld} : 0.365 inch (9.27 mm)



Photograph of Weld Seam ID Surface.

Catalog #: 40
 Report #: 5
 Defect #: 3

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Defect

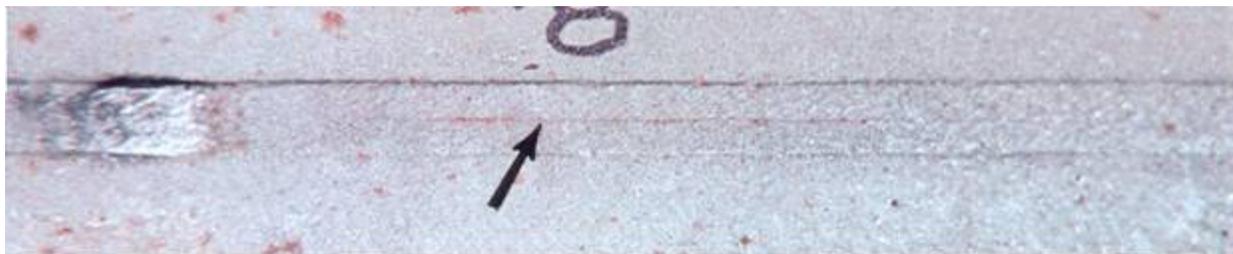
NDE technique(s): Fast UT
 NDE result(s): 2 interacting, ID-connected crack-like indications: combined L = 3.6 inch (91 mm), 25% radial extent

Visual: ID hook crack (surmised, defect not exposed)

L: Not Determined
 depth/ t_{weld} : Not Determined
 depth: Not Determined
 t_{weld} : 0.380 inch (9.65 mm)

Seam Type: FW

Grade: X52
 $D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.312 inch (7.92 mm)
 t_{pipe} : 0.309 inch (7.85 mm)
 Failure: Burst test: No failure at 2,250 psig (15.51 MPa) (139% of SMYS) + Yielding at 2,175 psig (15.00 MPa) (134% of SMYS)



Photograph of Weld Seam OD Surface.

Catalog #: 41

Report #: 5

Defect #: 8

Pipe

Vintage: circa 1950

Manufacturer: AO Smith

Defect

NDE technique(s): Fast UT
 NDE result(s): 50%, 3.7 inch (94 mm)
 crack-like, OD-
 connected

Seam Type: FW

Visual: OD hook crack
 (surmised, defect not
 exposed)

Grade: X52

$D_{nominal}$: 20 inch (508 mm)

$t_{nominal}$: 0.312 inch (7.92 mm)

t_{pipe} : 0.327 inch (8.31 mm)

Failure: Burst Test: No failure at
 2,300 psig (15.86 MPa)
 (142% of SMYS) +
 Yielding at 2,250 psig
 (15.51 MPa) (139% of
 SMYS)

L

depth/ t_{weld}

depth:

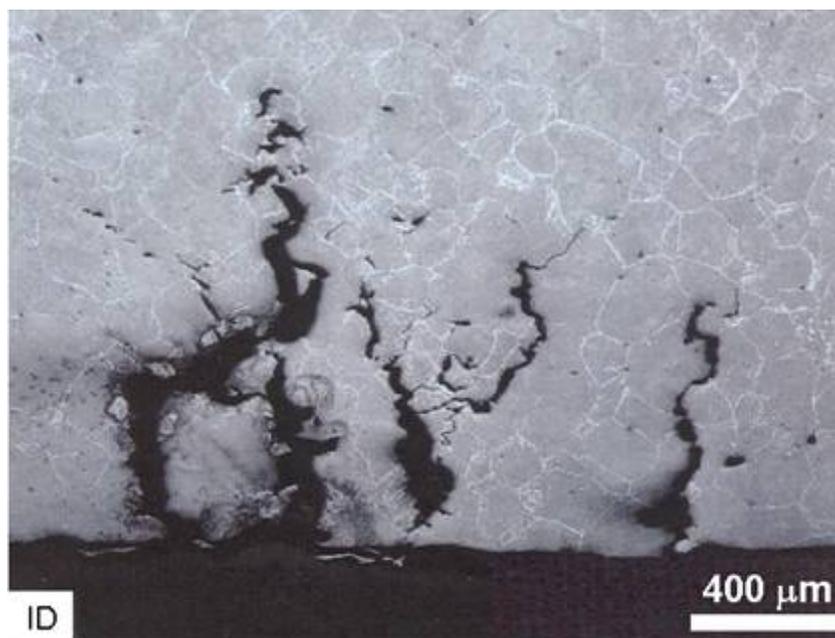
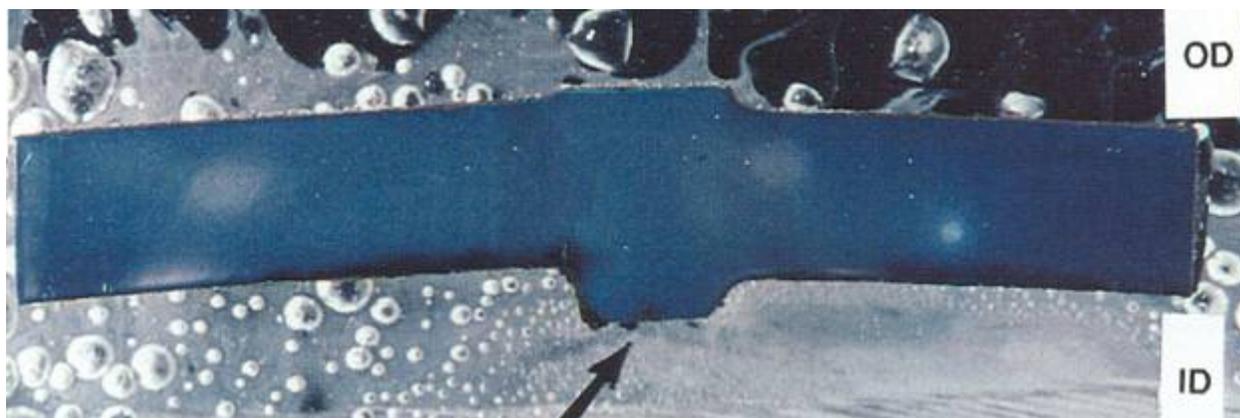
t_{weld}

Not Determined

Not Determined

Not Determined

0.404 inch (10.3 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 36

Report #: 5

Defect #: C7

Pipe

Vintage: circa 1950

Manufacturer: AO Smith

Defect

NDE technique(s):

UT & Fast UT

NDE result(s):

No anomaly revealed
(UT) + Minor inclusions
(Fast UT)

Seam Type: FW

Grade: X52

D_{nominal} : 20 inch (508 mm)

t_{nominal} : 0.312 inch (7.92 mm)

t_{pipe} : 0.312 inch (7.92 mm)

Failure: None

Visual:

ID Shrinkage Crack

L

N/A

depth/ t_{weld}

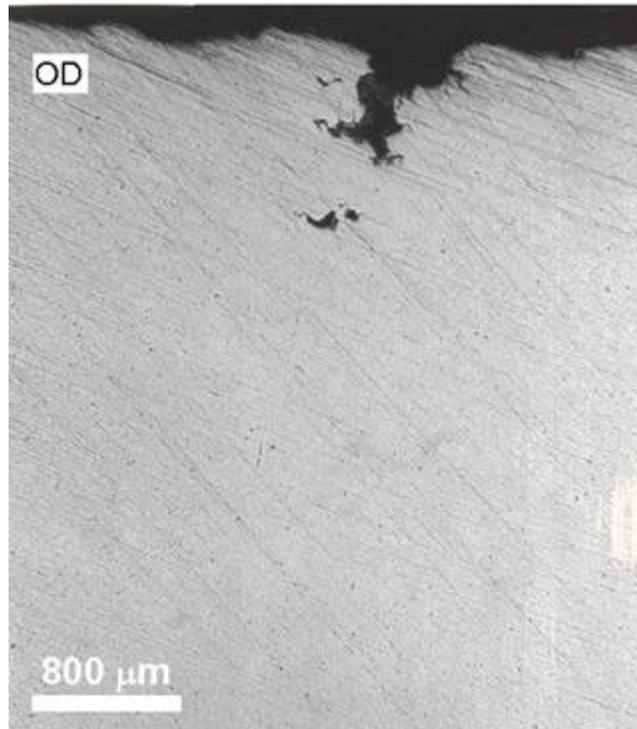
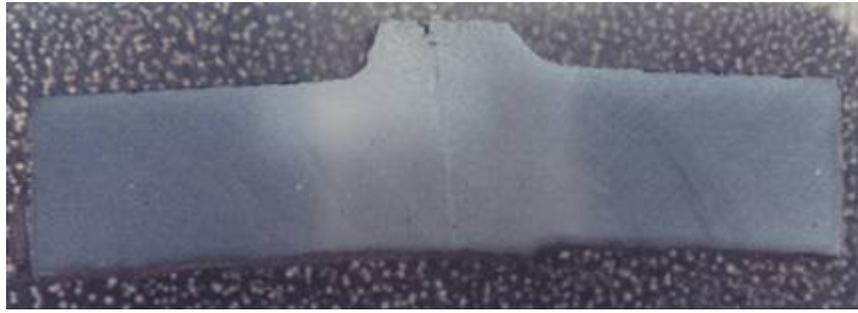
< 12%

depth:

< 0.052 inch (1.32 mm)

t_{weld}

0.436 inch (11 mm)



Photograph and Photomicrograph of Metallographic Section.

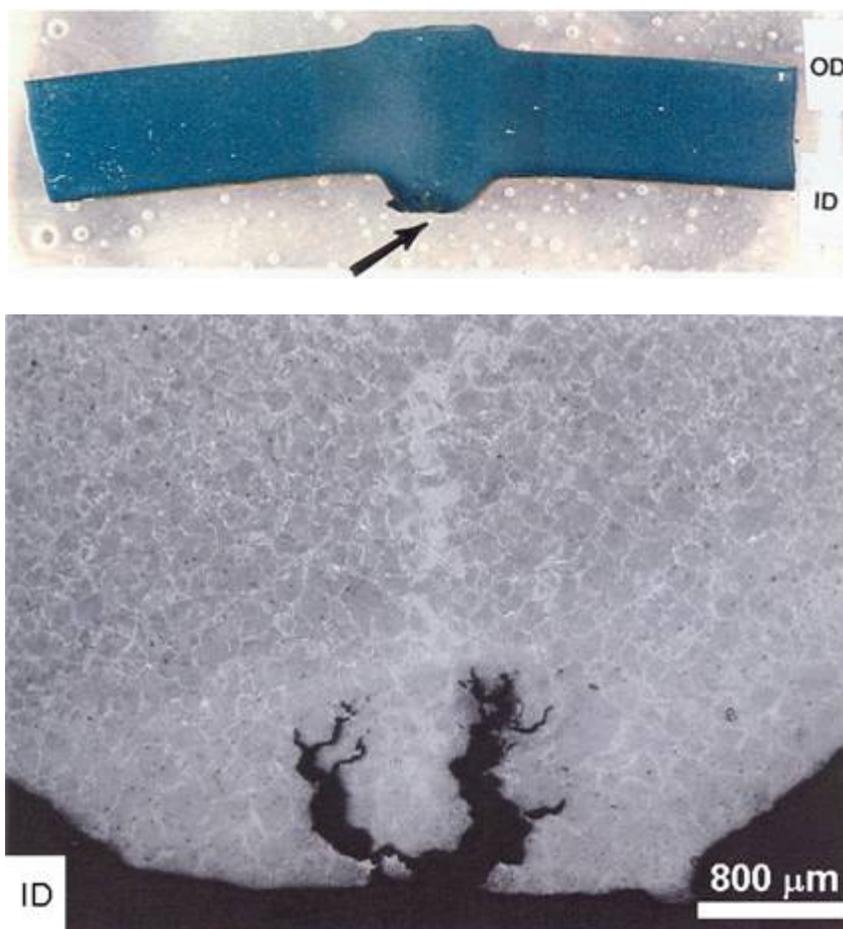
Catalog #: 68
 Report #: 7
 Defect #: 904

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT
 NDE result(s): 20% OD Crack-Like
 Visual: OD Shrinkage Crack
 L: Not Determined
 $\text{depth}/t_{\text{weld}}$: 10%
 depth: 0.040 inch (1.02 mm)
 t_{weld} : 0.396 inch (10.1 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 33

Report #: 5

Defect #: C1

Pipe

Vintage: circa 1950

Manufacturer: AO Smith

Seam Type: FW

Grade: X52

D_{nominal} : 20 inch (508 mm)

t_{nominal} : 0.312 inch (7.92 mm)

t_{pipe} : 0.306 inch (7.77 mm)

Failure: None

Defect

NDE technique(s): UT

NDE result(s): Minor indication from ID surface

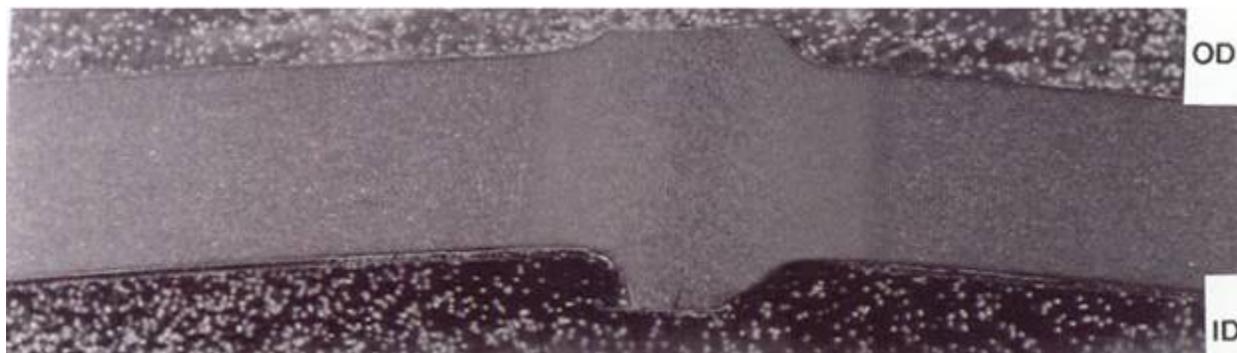
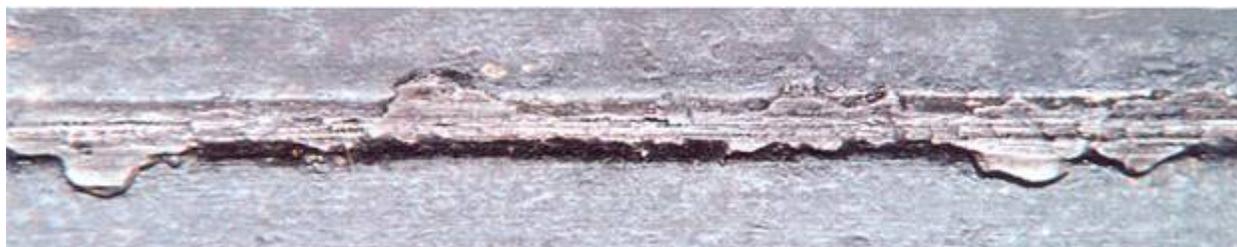
Visual: Shrinkage Crack (Weld trim defect)

L: > 9 inch (229 mm)

depth/ t_{weld} : < 10%

depth: < 0.047 inch (1.19 mm)

t_{weld} : 0.475 inch (12.1 mm)



Photographs of Weld Seam ID Surface and Metallographic Section.

Catalog #: 39

Report #: 5

Defect #: 1

Pipe

Vintage: circa 1950

Manufacturer: AO Smith

Defect

NDE technique(s): Fast UT
 NDE result(s): 1.0 (25.4 mm) and 1.5 inch (38.1 mm) (long, 30% radial extent NF at Mid-wall

Seam Type: FW

Visual: ID Shrinkage Crack (Under-trim)

Grade: X52

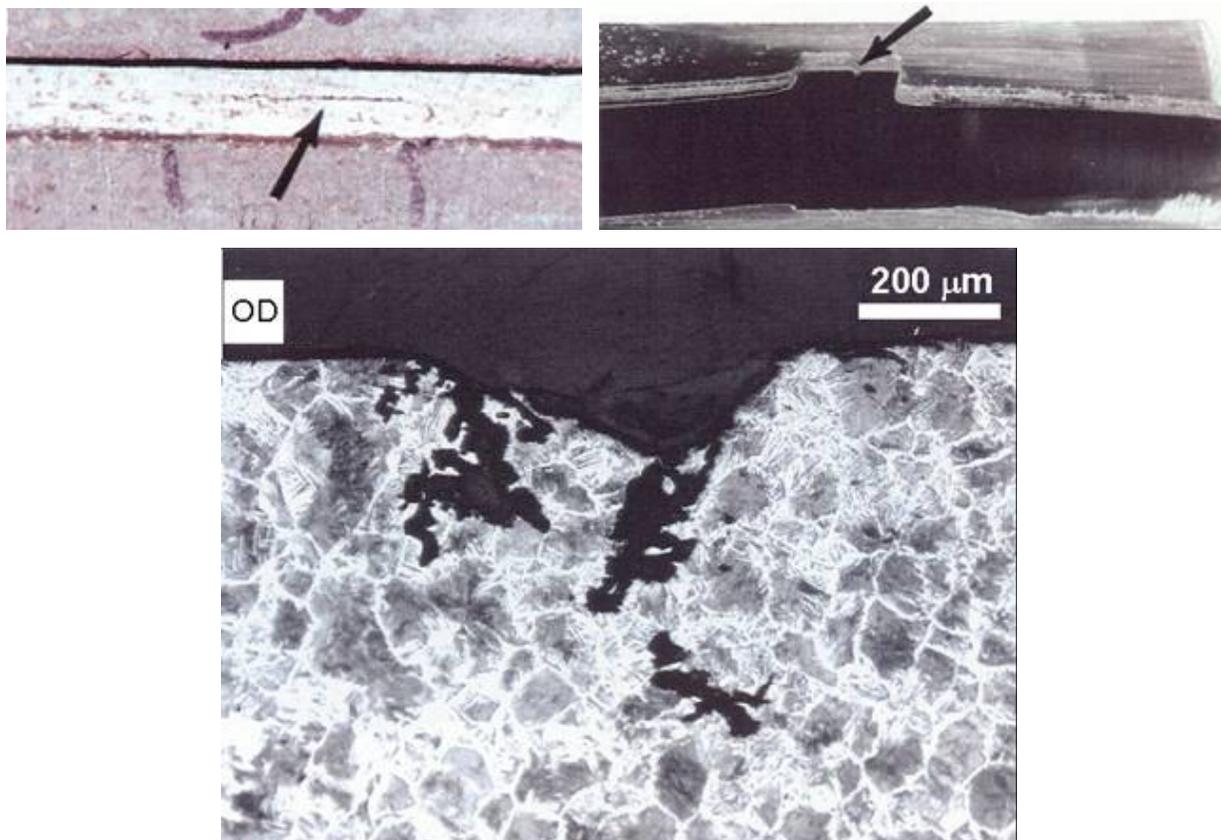
L
 depth/ t_{weld} N/A
 depth: < 7%
 t_{weld} < 0.033 inch (8.38 mm)
 0.470 inch (11.9 mm)

$D_{nominal}$ 20 inch (508 mm)

$t_{nominal}$ 0.312 inch (7.92 mm)

t_{pipe} 0.313 inch (7.95 mm)

Failure: Burst test: No failure at 2,250 psig (15.51 MPa)
 + Yielding at 2,250 psig (15.51 MPa) (139% of SMYS)



Photographs/Micrographs of Weld Seam OD Surface and Metallographic Section.

Catalog #: 47
 Report #: 5
 Defect #: 26

Pipe

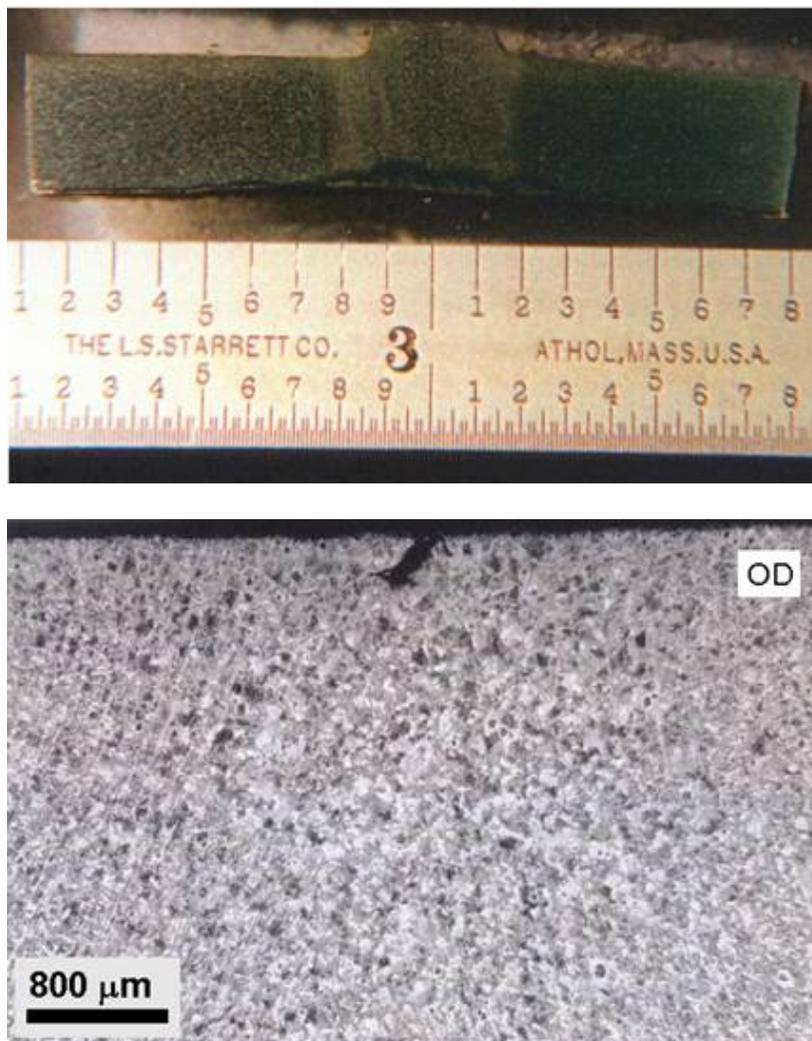
Vintage: circa 1950
 Manufacturer: AO Smith

Seam Type: FW

Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.316 inch (8.03 mm)
 Failure: Burst test: No failure at 2,200 psig (15.17 MPa) (136% of SMYS) + Yielding at 2,000 psig (13.79 MPa) (123% of SMYS)

Defect

NDE technique(s): Fast UT
 NDE result(s): <10%, 3.75 inch (95 mm) crack-like, OD-connected OD shrinkage crack (inadequate trim)
 Visual: N/A
 L: N/A
 $\text{depth}/t_{\text{weld}}$: < 5%
 depth: 0.020 inch (0.51 mm)
 t_{weld} : 0.390 inch (9.91 mm)



Photograph and Photomicrograph of Metallographic Section.

Catalog #:	15		
Report #:	1		
Defect #:	624		
Pipe		Defect	
Vintage:	1950s	NDE technique(s):	UT
Manufacturer:	AO Smith	NDE result(s):	<10% x 5.5 inch (140 mm) crack
Seam Type:	FW	Visual:	OD crack
Grade:	X52	L	N/A
D_{nominal}	20 inch (508 mm)	depth/ t_{weld}	3.1%
t_{nominal}	0.312 inch (7.92 mm)	depth:	0.012 inch (0.31 mm)
t_{pipe}	0.303 inch (7.7 mm)	t_{weld}	0.385 inch (9.78 mm)
Failure:	None at 2,300 psig (15.86 MPa) (142% of SMYS)		



Photograph of Weld Seam OD Surface.

Catalog #: 79
 Report #: 7
 Defect #: 1422

Pipe

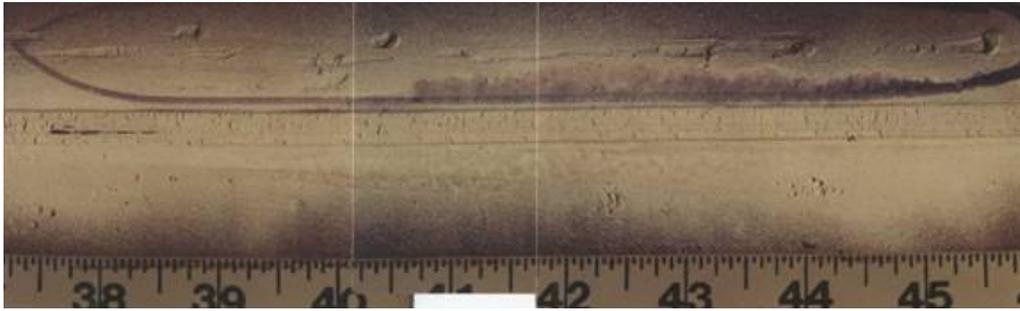
Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW

Defect

NDE technique(s): Visual
 NDE result(s): OD Weld repair
 Visual: OD Weld repair + No
 cracking visible from
 ID surface

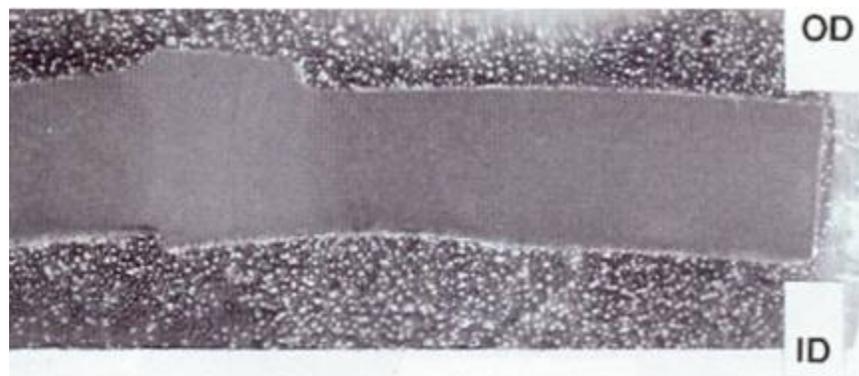
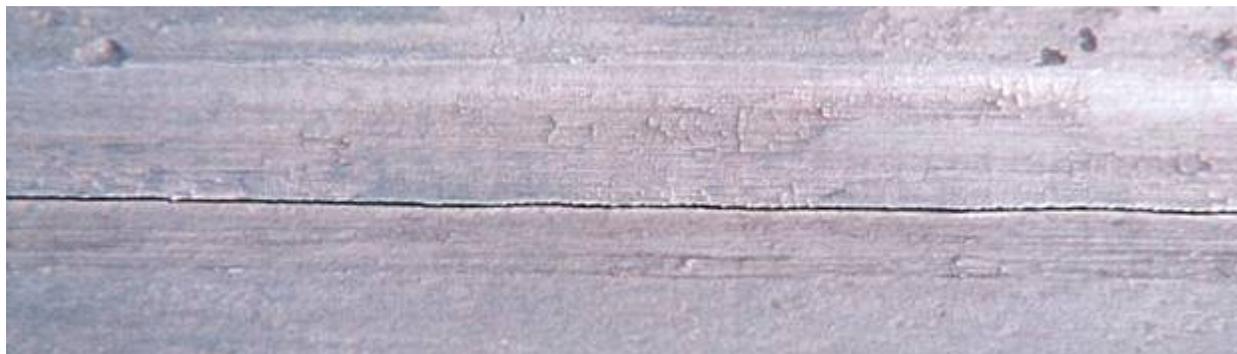
Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

L
 $\text{depth}/t_{\text{weld}}$: N/A
 depth: N/A
 t_{weld} : N/A



Photographs of Weld Seam ID Surface and Metallographic Section.

Catalog #:	71		
Report #:	7		
Defect #:	1003		
Pipe		Defect	
Vintage:	circa 1950	NDE technique(s):	Fast UT
Manufacturer:	AO Smith	NDE result(s):	< 10% ID Gouge + < 0.060 inch (1.52 mm) RDI Dent
Seam Type:	FW	Visual:	3 ID Gouges + Weld Over-trim
Grade:	X52	L	5 inch, 7 inch, 8 inch (127, 178, 203 mm)
D _{nominal}	20 inch (508 mm)	depth/t _{weld}	Not Determined
t _{nominal}	0.312 inch (7.92 mm)	depth:	Not Determined
t _{pipe}	Not Determined	t _{weld}	Not Determined
Failure:	N/A		



Photographs of Weld Seam ID Surface and Metallographic Section.

Catalog #: 52

Report #: 5

Defect #: 53

Pipe

Vintage: circa 1950

Manufacturer: AO Smith

Defect

NDE technique(s): MT

NDE result(s): 9.2 inch (234 mm)
linear indications + < 5% two small cracks
0.1"(1.6")0.3" (1.54 mm(41 mm)7.6mm)

Seam Type: FW

Grade: X52

$D_{nominal}$: 20 inch (508 mm)

$t_{nominal}$: 0.312 inch (7.92 mm)

t_{pipe} : 0.307 inch (7.8 mm)

Failure: Burst test: No failure at 2,300 psig (15.86 MPa) (142% of SMYS) +
Yielding at 2,000 psig (13.79 MPa) (123% of SMYS)

Visual:

L

depth/ t_{weld}

depth:

t_{weld}

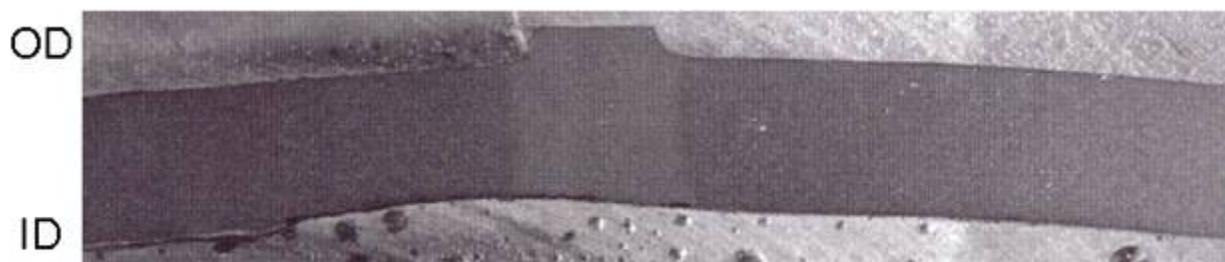
ID Over-trim (scrape)

N/A

N/A

N/A

0.383 inch (9.73 mm)



Photographs of Weld Seam ID Surface and Metallographic Section.

Catalog #: 53

Report #: 5

Defect #: 56

Pipe

Vintage: circa 1950

Manufacturer: AO Smith

Defect

NDE technique(s): Fast UT
 NDE result(s): < 5%, 3.1 inch (79 mm)
 OD crack-like + 1.4
 inch (36 mm) NF +
 10%, 7.8 inch (198
 mm) linear indications
 (over 9.5 inches (241
 mm))

Seam Type: FW

Grade: X52

D_{nominal} : 20 inch (508 mm)

t_{nominal} : 0.312 inch (7.92 mm)

t_{pipe} : 0.316 inch (8.03 mm)

Failure: Burst test: No failure at
 2,300 psig (15.86 MPa)
 (142% of SMYS)

Visual:

L

depth/ t_{weld}

depth:

t_{weld}

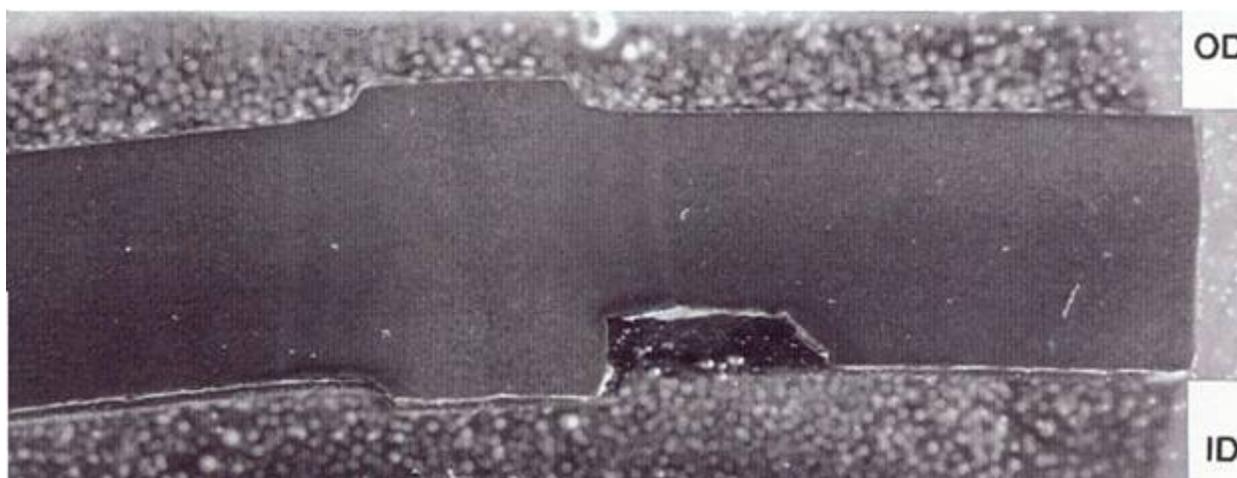
ID Over-trim (scrape)

N/A

N/A

N/A

0.411 inch (10.4 mm)



Photographs of Weld Seam ID Surface and Metallographic Section.

Catalog #: 46
 Report #: 5
 Defect #: 26

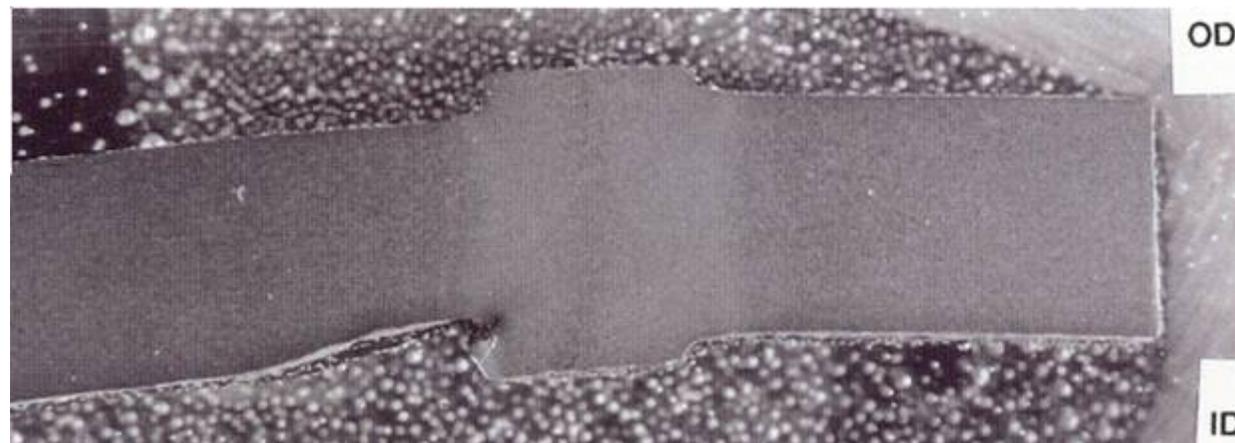
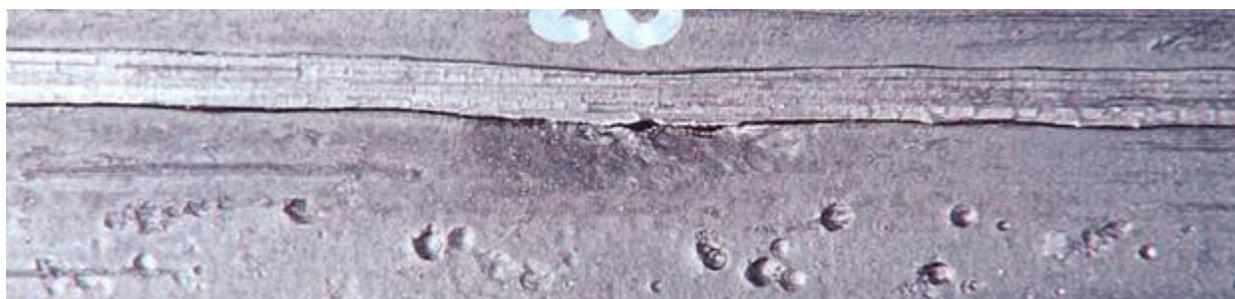
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.319 inch (8.1 mm)
 Failure: Burst test: No failure at
 2,300 psig (15.86 MPa)
 (142% of SMYS) +
 Yielding at 2,175 psig
 (15.00 MPa) (134% of
 SMYS)

Defect

NDE technique(s): Fast UT
 NDE result(s): 50%, 1.25 inch (31.7 mm)
 ID-connected
 Visual: Plate roll-in
 L: N/A
 $\text{depth}/t_{\text{weld}}$: 40%
 depth: 0.167 inch (4.24 mm)
 t_{weld} : 0.417 inch (10.6 mm)



Photographs of Weld Seam ID Surface and Metallographic Section.

Catalog #: 43
 Report #: 5
 Defect #: 20

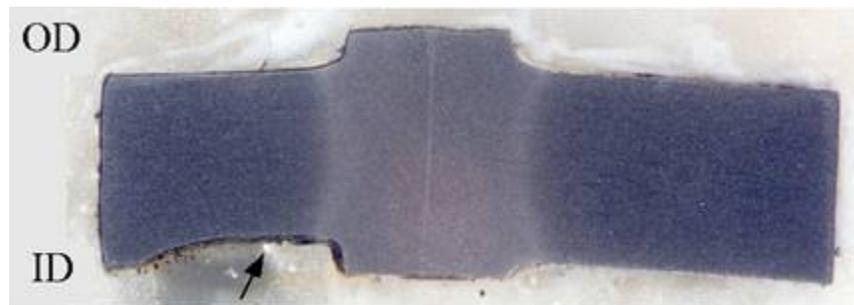
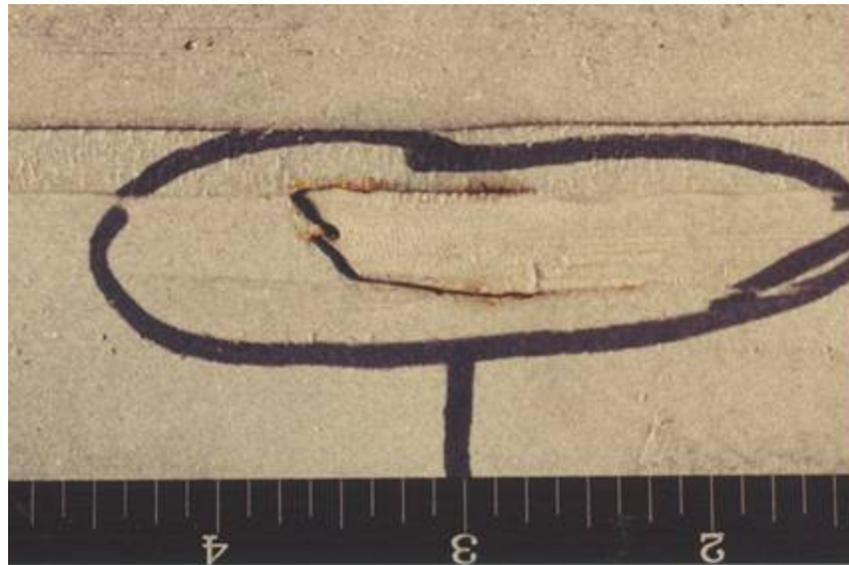
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.312 inch (7.92 mm)
 Failure: Burst Test: No failure at 2,250 psig (51.51 MPa) (139% of SMYS) + Yielding at 2,200 psig (15.17 MPa) (136% of SMYS)

Defect

NDE technique(s): Fast UT
 NDE result(s): 5%, 2.4 inch (61 mm) NF
 Visual: Plate roll-in
 L: N/A
 $\text{depth}/t_{\text{weld}}$: 33%
 depth: 0.129 inch (3.28 mm)
 t_{weld} : 0.394 inch (10.1 mm)



Photographs of Weld Seam ID Surface and Metallographic Section.

Catalog #: 70
 Report #: 7
 Defect #: 981

Pipe

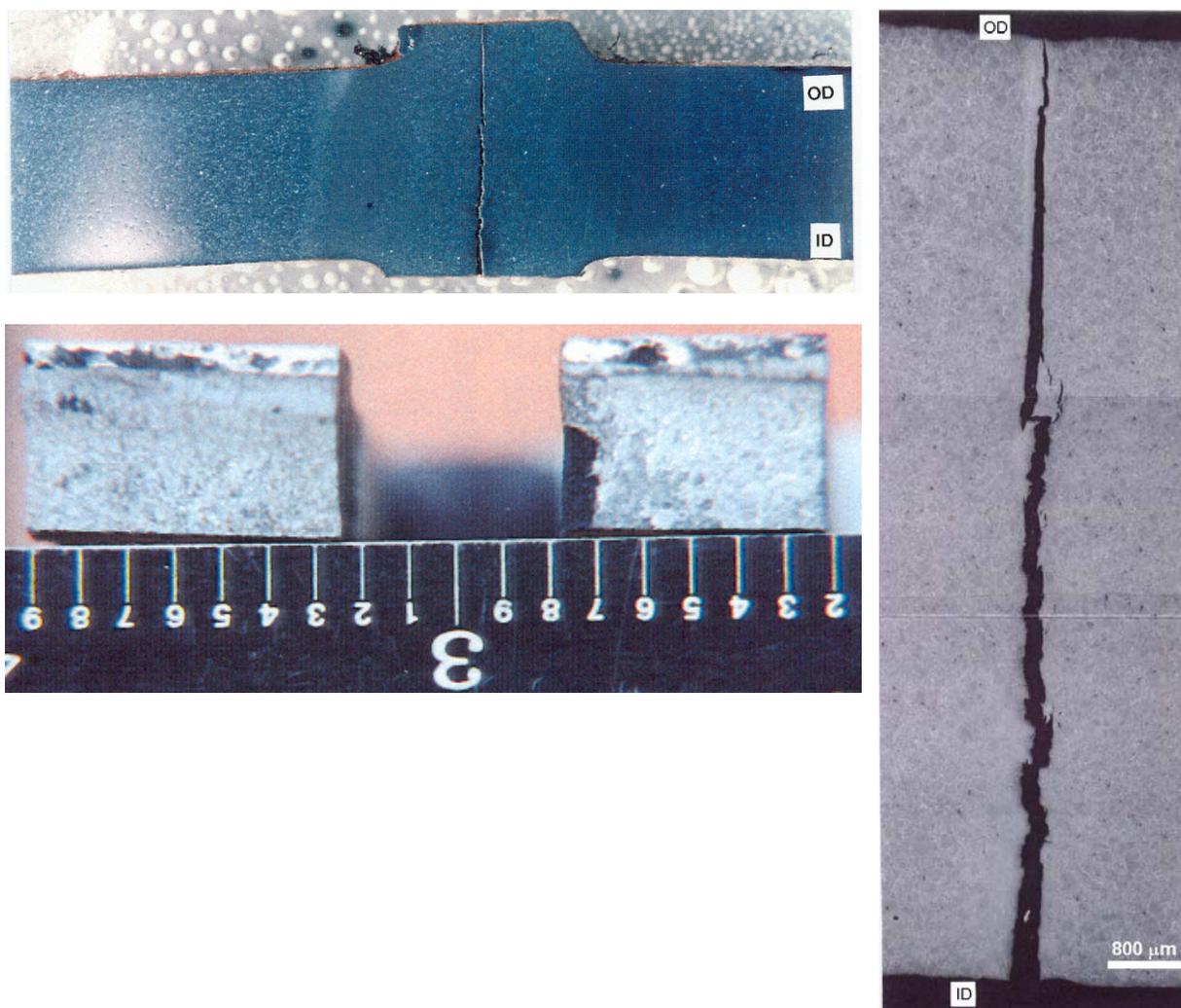
Vintage: circa 1950
 Manufacturer: AO Smith

Seam Type: FW

Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT
 NDE result(s): 20% Mid-Wall Crack
 + < 10% ID Gouge
 ID Plate Edge Defect
 (Roll-in)
 Visual: 1.1 inch (27.9 mm)
 L
 depth/ t_{weld} : Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



Photographs and Photomicrograph of Metallographic Section and Fracture Surfaces.

Catalog #: 34
 Report #: 5
 Defect #: C5

Pipe

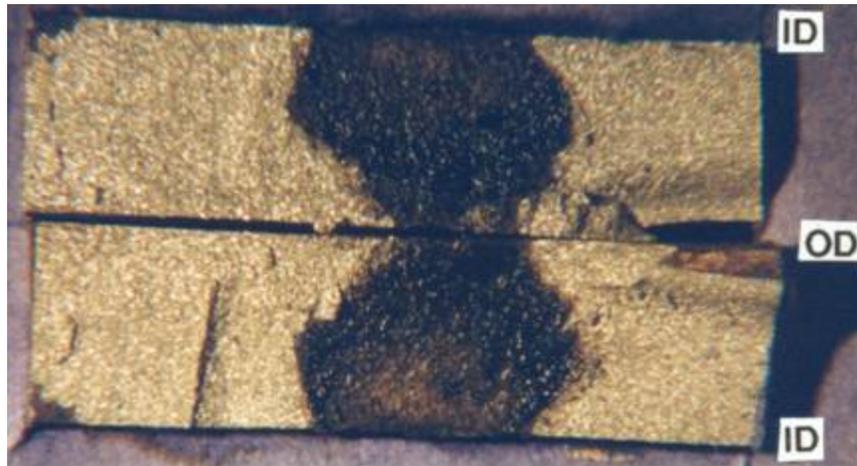
Vintage: circa 1950
 Manufacturer: AO Smith

Defect

NDE technique(s): UT & Fast UT
 NDE result(s): ID connected crack-like (UT)
 + NF with associated crack-like (Fast UT) + Narrow band of NF (Fast UT)

Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.312 inch (7.92 mm)
 Failure: No leak

Visual: Lack of Fusion
 L
 depth/ t_{weld} : 100%
 depth: 0.422 inch (10.7 mm)
 t_{weld} : 0.422 inch (10.7 mm)



Photograph of Fracture Surface.

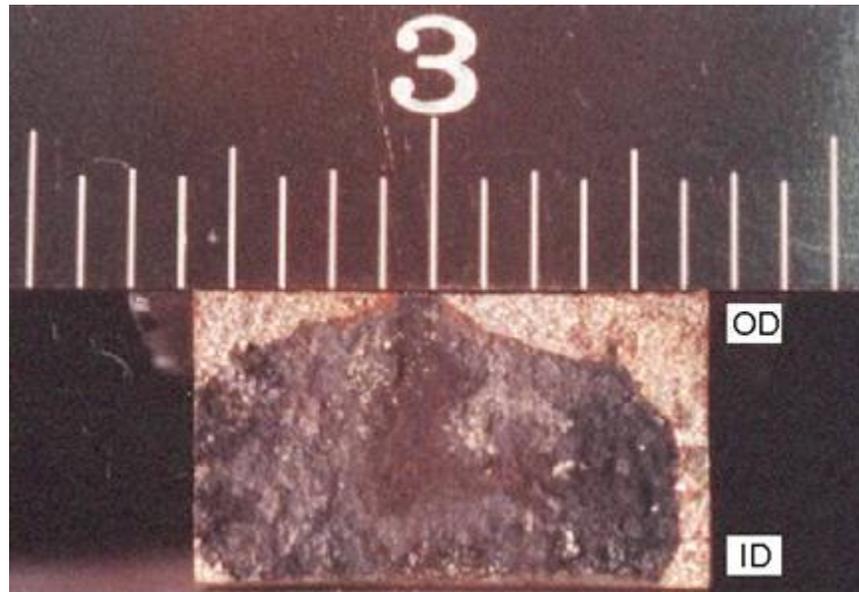
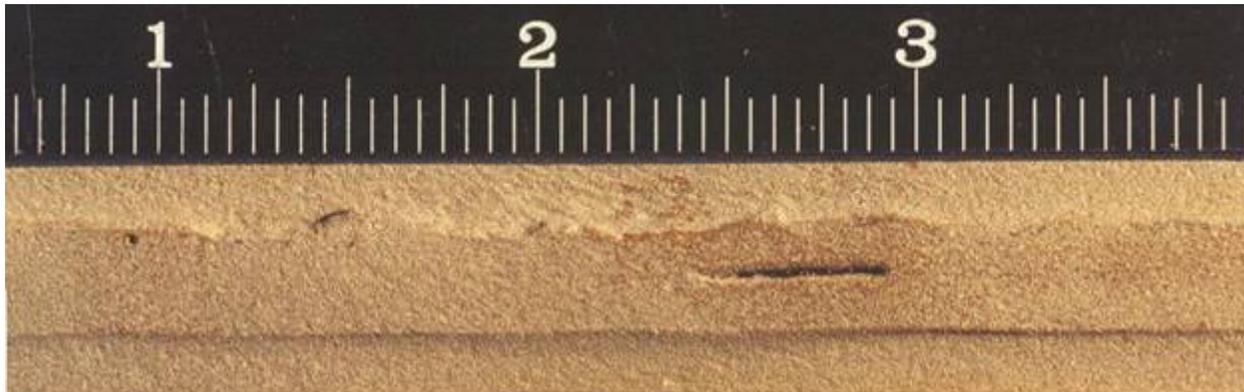
Catalog #: 66
 Report #: 7
 Defect #: 831

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

Defect

NDE technique(s): Fast UT
 NDE result(s): 100% (Seeper)
 Visual: Lack of Fusion
 L: 0.55 inch (13.8 mm)
 depth/ t_{weld} : 100%
 depth: 0.400 inch (10.2 mm)
 t_{weld} : 0.400 inch (10.2 mm)



Photographs of Weld Seam OD Surface and Fracture Surface.

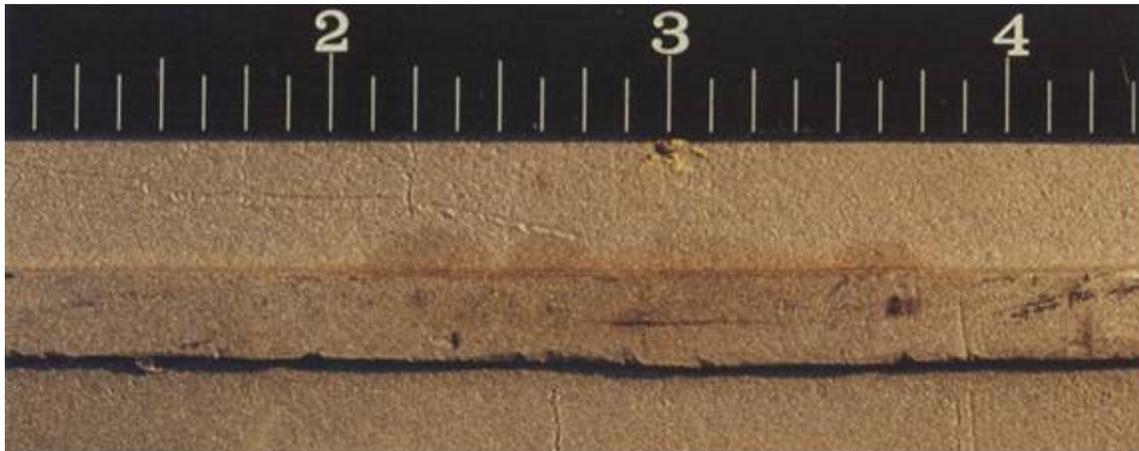
Catalog #: 80
 Report #: 7
 Defect #: 1573.1

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52
 $D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.312 inch (7.92 mm)
 t_{pipe} : Not Determined
 Failure: N/A

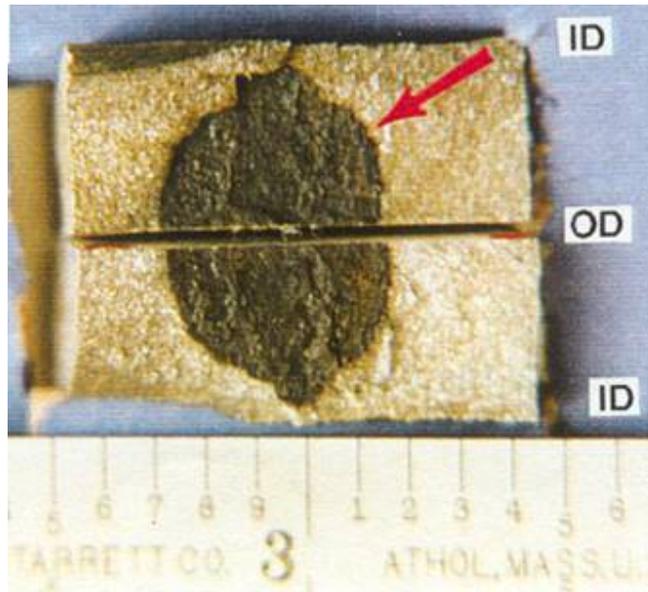
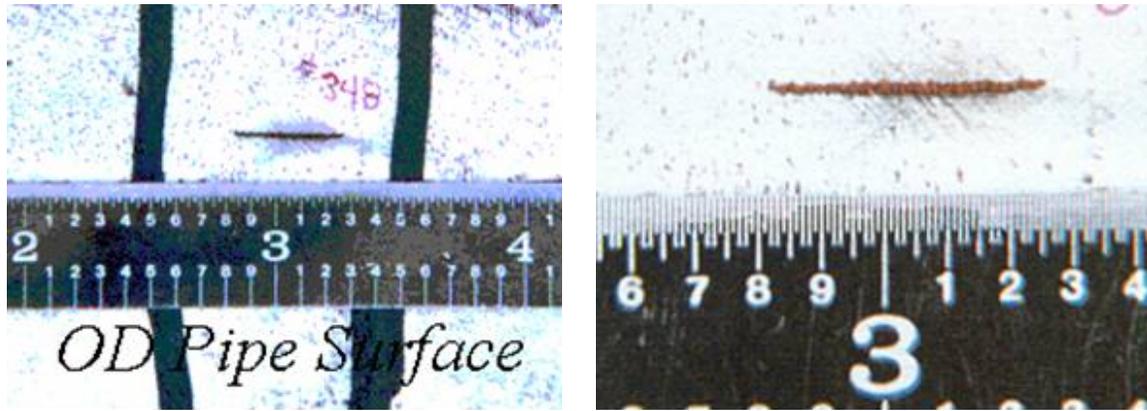
Defect

NDE technique(s): Visual
 NDE result(s): 100% (Seeper)
 Visual: Lack of Fusion
 L: 0.63 inch (16 mm)
 depth/ t_{weld} : 100%
 depth: Not Determined
 t_{weld} : Not Determined



Photographs of Weld Seam OD Surface and Fracture Surface.

Catalog #:	81		
Report #:	7		
Defect #:	1577.1		
<u>Pipe</u>		<u>Defect</u>	
Vintage:	circa 1950	NDE technique(s):	Visual
Manufacturer:	AO Smith	NDE result(s):	100% (Seeper)
Seam Type:	FW	Visual:	Lack of Fusion
Grade:	X52	L	0.66 inch (16.8 mm)
D_{nominal}	20 inch (508 mm)	depth/ t_{weld}	100%
t_{nominal}	0.312 inch (7.92 mm)	depth:	Not Determined
t_{pipe}	Not Determined	t_{weld}	Not Determined
Failure:	N/A		



Photographs of Magnetic Particle Indication on Pipe OD Surface and of Fracture Surfaces.

Catalog #: 19
 Report #: 2
 Defect #: 348

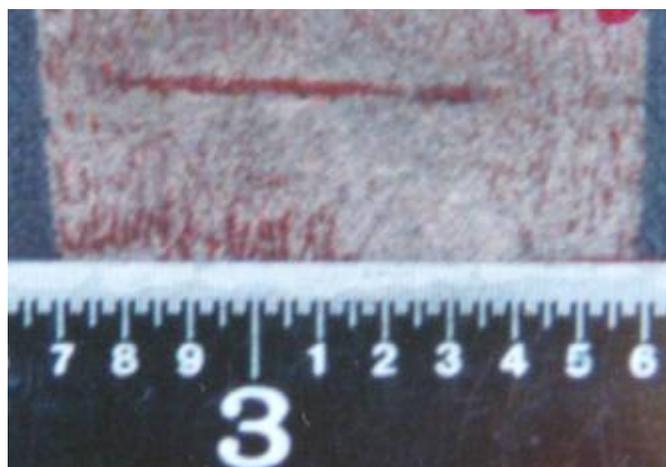
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Defect

NDE technique(s): MPI / UT
 NDE result(s): Through-wall, 1 inch (25.4 mm) long non-fusion / crack
 Visual: OD Lack of Fusion
 L 0.42 inch (10.7 mm)
 depth/ t_{weld} 91%
 depth: 0.320 inch (8.13 mm)
 t_{weld} 0.350 inch (8.89 mm)

Seam Type: FW
 Grade: X52
 $D_{nominal}$ 20 inch (508 mm)
 $t_{nominal}$ 0.312 inch (7.92 mm)
 t_{pipe} 0.312 inch (7.92 mm)
 Failure: No burst test done



Photograph of Magnetic Particle Indication on Pipe OD Surface and of Fracture Surfaces.

Catalog #: 20
 Report #: 2
 Defect #: 356

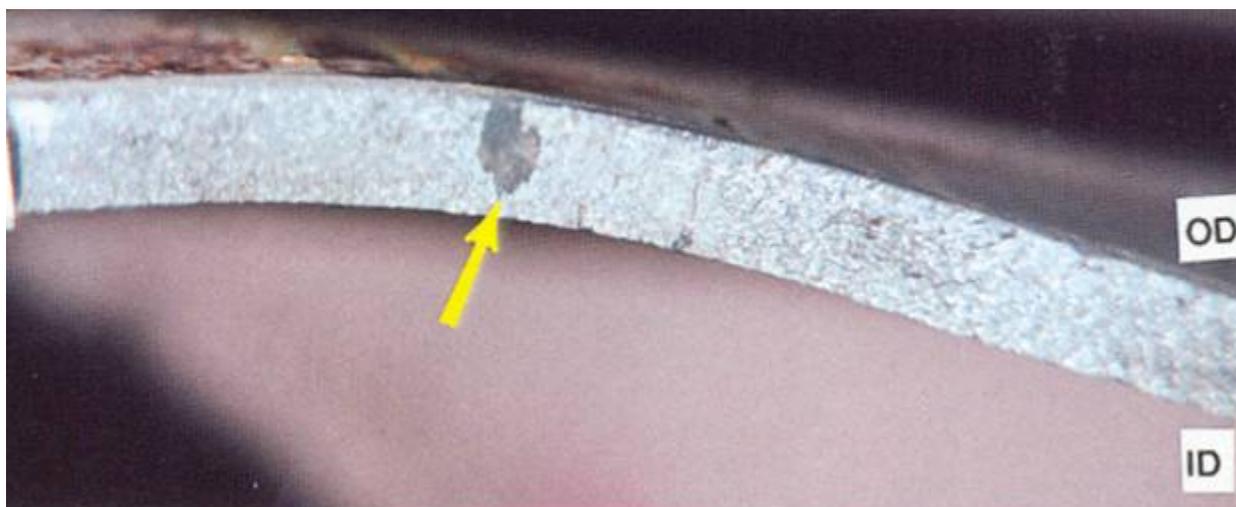
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.312 inch (7.92 mm)
 Failure: No burst test done

Defect

NDE technique(s): MPI / UT
 NDE result(s): 1 inch long ID crack like
 Visual: OD Lack of Fusion
 L: 0.53 inch (13.5 mm)
 $\text{depth}/t_{\text{weld}}$: 91%
 depth: 0.320 inch (8.13 mm)
 t_{weld} : 0.350 inch (8.89 mm)



Photograph of Fracture Surface.

Catalog #: 42
 Report #: 5
 Defect #: 16

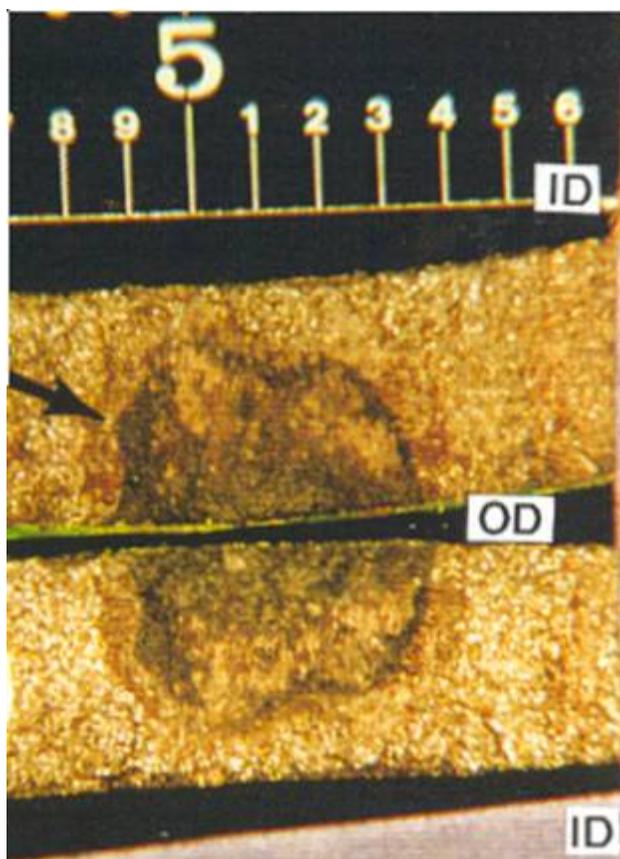
Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

Defect

NDE technique(s): Fast UT
 NDE result(s): 3 NF indications: 10%,
 1.5 inch (38 mm) +
 10%, 2.0 inch (51
 mm) + 30%, 0.75 inch
 OD Lack of Fusion
 < 0.25 inch (6.3 mm)
 84%
 Visual: L
 depth/ t_{weld} 84%
 depth: 0.312 inch (7.92 mm)
 t_{weld} 0.372 inch (9.45 mm)

Seam Type: FW
 Grade: X52
 $D_{nominal}$ 20 inch (508 mm)
 $t_{nominal}$ 0.312 inch (7.92 mm)
 t_{pipe} 0.308 inch (7.82 mm)
 Failure: Burst Test Failure at
 2,125 psig (14.65 MPa)
 (131% of SMYS)



Photograph of Fracture Surfaces.

Catalog #: 18
 Report #: 2
 Defect #: 220

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith

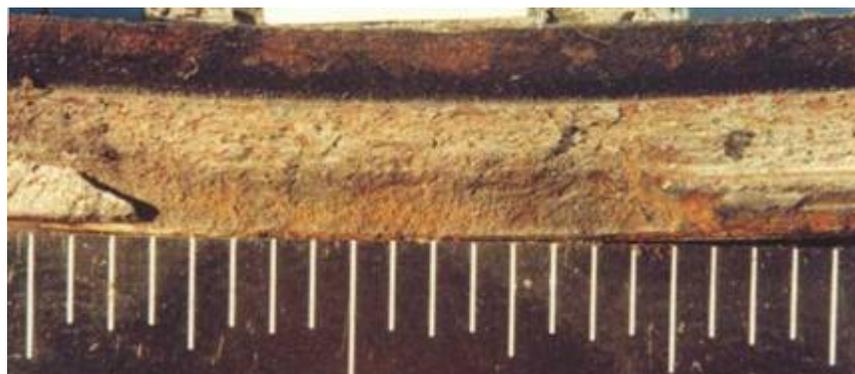
Seam Type: FW
 Grade: X52
 $D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.312 inch (7.92 mm)
 t_{pipe} : 0.312 inch (7.92 mm)
 Failure: Burst test rupture at
 2,225 psig (15.34 MPa)
 (137% of SMYS)

MAOP: 400 psig (2.76 MPa)
 Coating: Coal tar + paper wrap
 CP: Yes

Defect

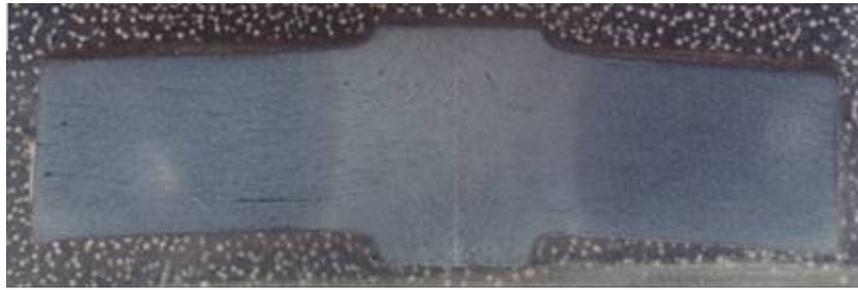
NDE technique(s): UT
 NDE result(s): >80%, 1 inch (25.4 mm)
 long crack like

Visual: OD Lack of Fusion
 L: 0.52 inch (13.2 mm)
 Width: N/A
 depth/ t_{weld} : 75%
 depth: 0.300 inch (7.62 mm)
 t_{weld} : 0.396 inch (10.1 mm)



Photographs of Fracture Surface.

Catalog #:	54		
Report #:	6		
Defect #:	685		
<u>Pipe</u>		<u>Defect</u>	
Vintage:	circa 1950	NDE technique(s):	Fast UT
Manufacturer:	AO Smith	NDE result(s):	70% (0.300 inch (7.62 mm)) ID Crack + 30% (0.128 inch (3.25 mm)) OD Crack
Seam Type:	FW	Visual:	ID & Hook Cracks + Lack of Fusion
Grade:	X52	L	8.5 inch (216 mm) (ID Crack) + 4.0 inch (102 mm) (OD Crack)
D_{nominal}	20 inch (508 mm)	depth/ t_{weld}	44% (22% ID + 22% OD)
t_{nominal}	0.312 inch (7.92 mm)	depth:	0.094 inch (23.9 mm) (ID Crack) + 0.094 inch (23.9 mm) (OD Crack)
t_{pipe}	Not determined	t_{weld}	0.428 inch (10.9 mm)
Failure:	Burst test failure at 2,050 psig (14.13 MPa) (126% of SMYS)		



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 74
 Report #: 7
 Defect #: 1097

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : Not determined
 Failure: N/A

Defect

NDE technique(s): Fast UT
 NDE result(s): 30% OD Crack-like
 Visual: OD Outbent Fiber
 L: N/A
 $\text{depth}/t_{\text{weld}}$: 33%
 depth: 0.145 inch (3.68 mm)
 t_{weld} : 0.433 inch (11 mm)



Photograph of Metallographic Section.

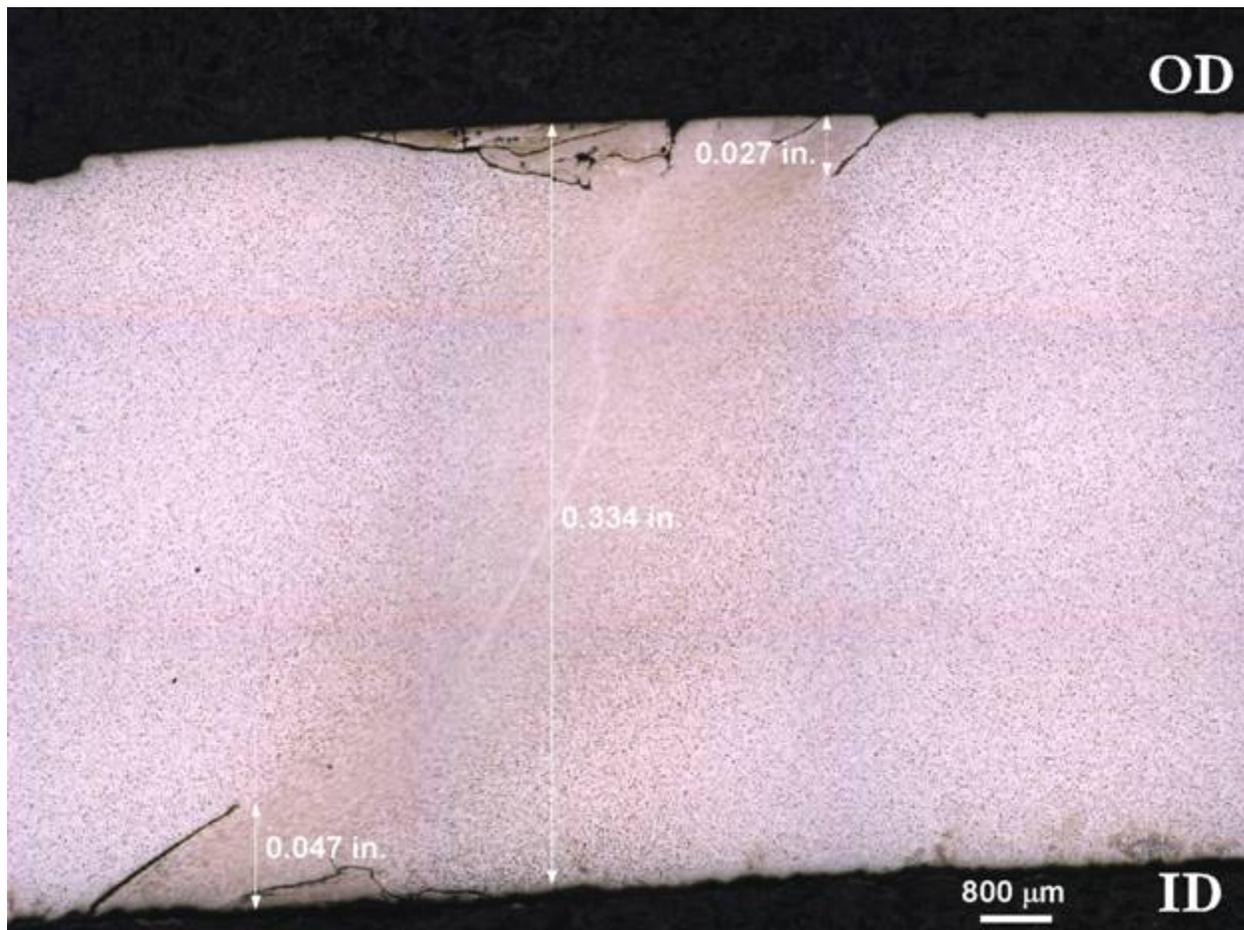
Catalog #: 75
 Report #: 7
 Defect #: 1105

Pipe

Vintage: circa 1950
 Manufacturer: AO Smith
 Seam Type: FW
 Grade: X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.312 inch (7.92 mm)
 t_{pipe} : 0.336 inch (8.53 mm)
 Failure: N/A

Defect

NDE technique(s): Fast UT
 NDE result(s): <10% OD Crack-like
 Visual: No Anomaly Revealed
 L: N/A
 $\text{depth}/t_{\text{weld}}$: N/A
 depth: N/A
 t_{weld} : 0.468 inch (11.9 mm)



Photomicrograph of Metallographic Section.

Catalog #: 3
 Report #: 8
 Defect #: TS95

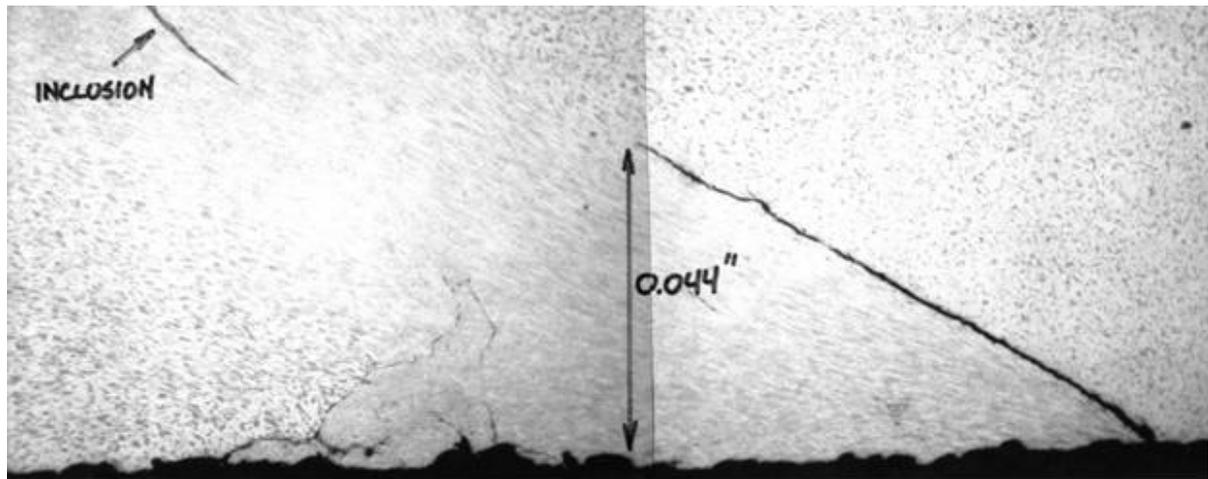
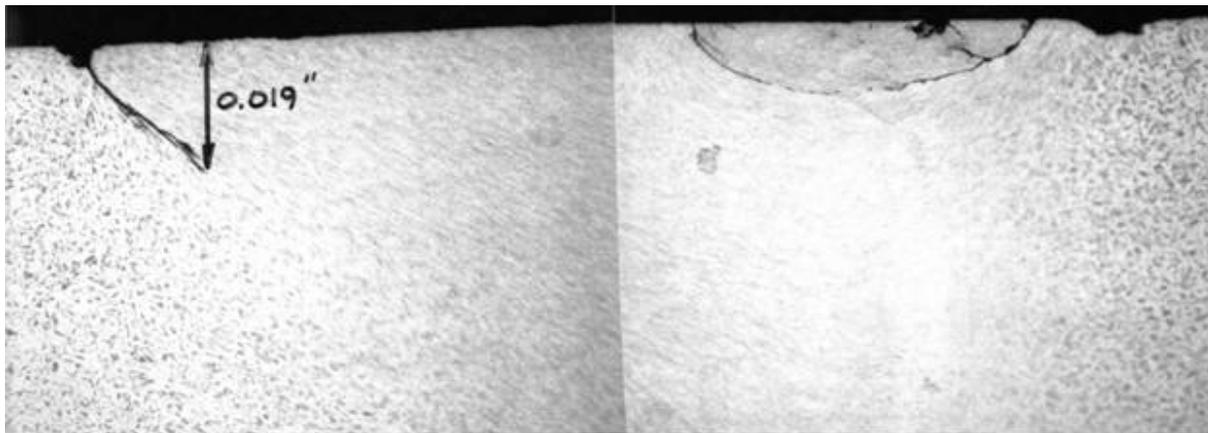
Pipe

Vintage: 1932
 Manufacturer: Republic Steel
 Seam Type: Lap Weld
 Grade: A25
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : 0.259 inch (6.58 mm)

Failure: No failure history
 MAOP: 400 psig (2.76 MPa)
 Coating: Coal tar + paper wrap
 CP: Yes

Defect

NDE technique(s): MPI on OD surface
 NDE result(s): Crack visible
 Visual: OD & ID Lack of Fusion
 L: N/A
 Width: N/A
 depth/ t_{weld} : 22.2% (LOF combined)
 depth: 0.027 inch (0.69 mm) (OD)
 + 0.047 inch (1.19 mm) (ID)
 t_{weld} : 0.334 inch (8.48 mm)



Photomicrographs of Lack of Fusion at OD and ID Surfaces and Near Mid-Wall.

Catalog #: 1
 Report #: 8
 Defect #: Not Specified

Pipe

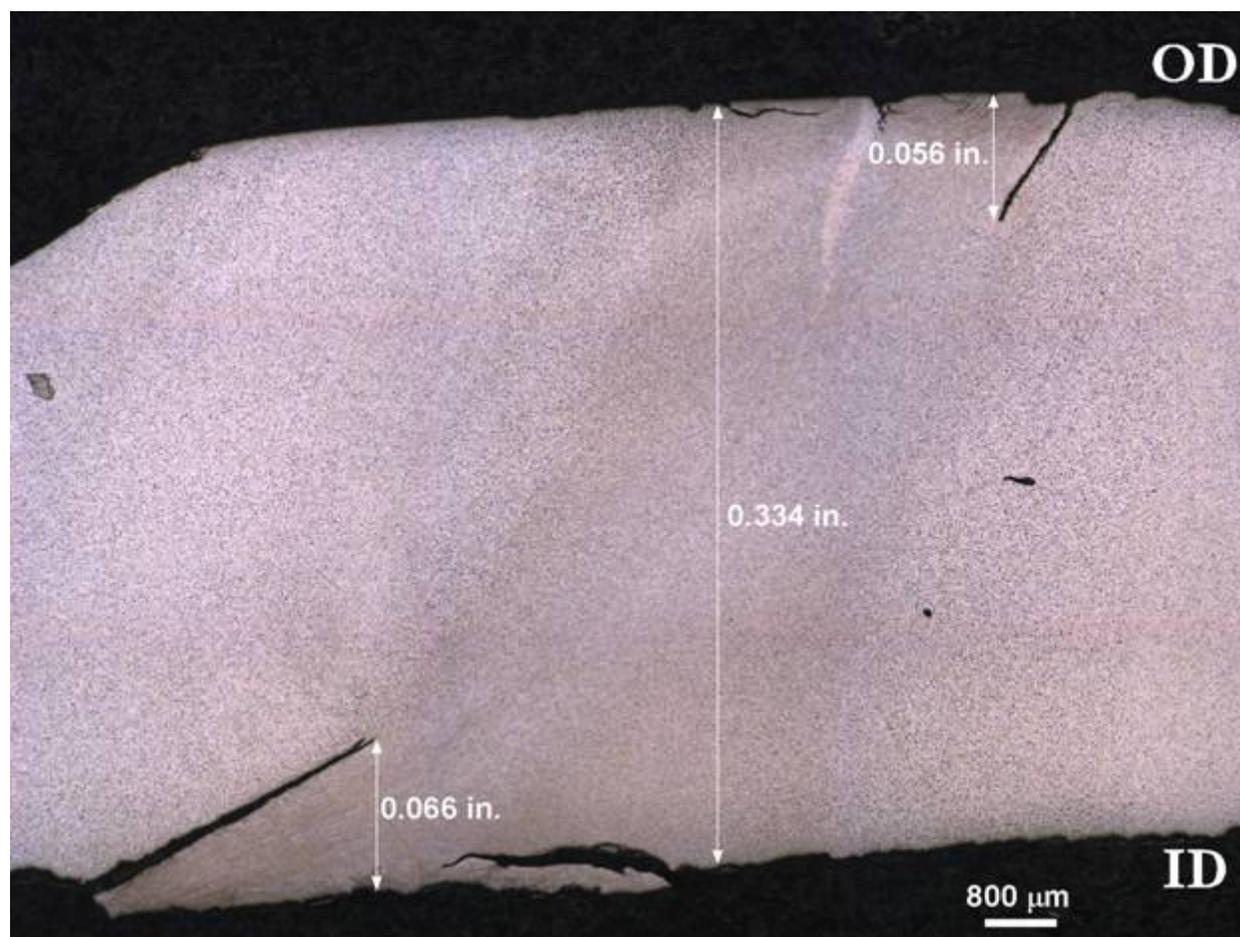
Vintage: 1932
 Manufacturer: Republic Steel
 Seam Type: Lap Weld

Defect

NDE technique(s): MPI on OD surface
 NDE result(s): Crack visible
 Visual: OD, Mid-wall & ID Lack of Fusion
 L: N/A
 Width: N/A
 depth/ t_{weld} : 30.8% (all LOF combined)
 depth: OD: 0.019 inch (0.48 mm) +
 Mid-wall: 0.017 inch (0.43 mm)
 + ID: 0.044 inch (1.12 mm)
 t_{weld} : 0.259 inch (6.58 mm)

Grade: A25
 $D_{nominal}$: 12.75 inch (324 mm)
 $t_{nominal}$: 0.250 inch (6.35 mm)
 t_{pipe} : 0.259 inch (6.58 mm)

Failure: No failure history
 MAOP: 400 psig (2.76 MPa)
 Coating: Coal tar + paper wrap
 CP: Yes



Photomicrograph of Metallographic Section.

Catalog #: 2
 Report #: 8
 Defect #: L1026

Pipe

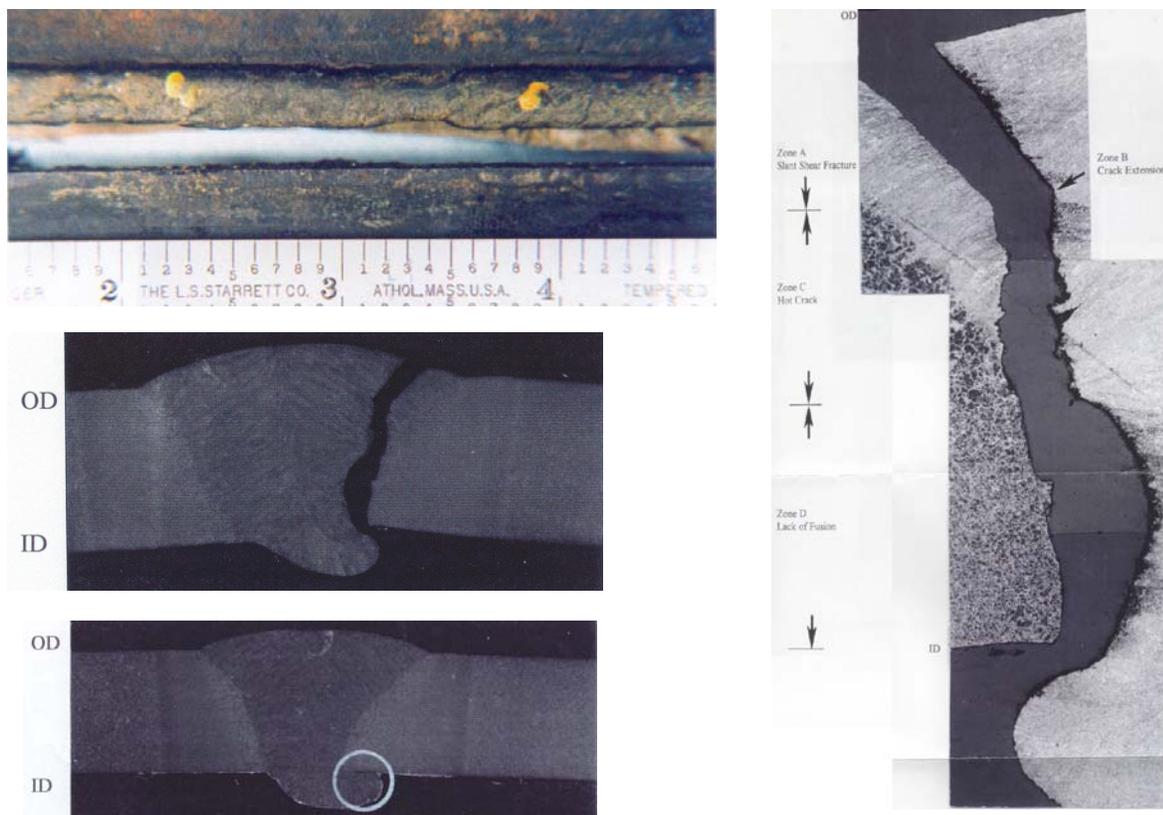
Vintage: 1932
 Manufacturer: Republic Steel
 Seam Type: Lap Weld

Grade: A25
 D_{nominal} : 12.75 inch (324 mm)
 t_{nominal} : 0.250 inch (6.35 mm)
 t_{pipe} : 0.259 inch (6.58 mm)

Failure: No failure history
 MAOP: 400 psig (2.76 MPa)
 Coating: Coal tar + paper wrap
 CP: Yes

Defect

NDE technique(s): MPI on OD surface
 NDE result(s): Crack visible
 Visual: OD, Mid-wall & ID Lack of Fusion
 L: N/A
 Width: N/A
 depth/ t_{weld} : 36.5%
 depth: 0.056 inch (1.42 mm) (OD)
 + 0.066 inch (1.68 mm) (ID)
 t_{weld} : 0.334 inch (8.48 mm)



Photographs and Photomicrograph of Pipe Seam OD Surface and Metallographic Sections.

Catalog #: 85
 Report #: 9
 Defect #: 4-1

Pipe

Vintage: circa 1952
 Manufacturer: Kaiser
 Seam Type: SSAW

Grade: API 5L X52

D_{nominal} 20 inch (508 mm)

t_{nominal} 0.344 inch (8.74 mm)

t_{pipe} 0.354 inch (8.99 mm)

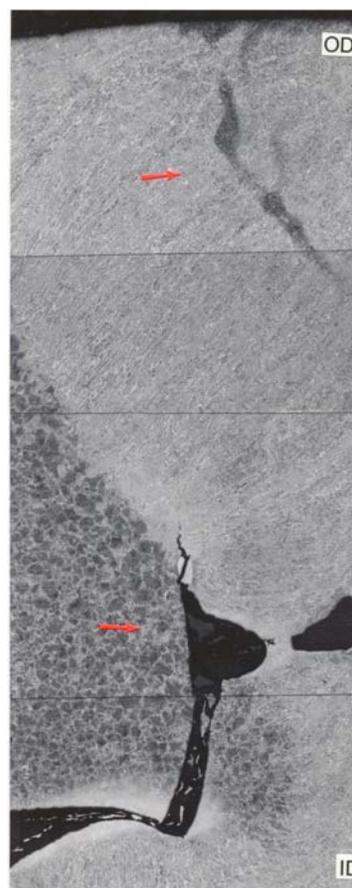
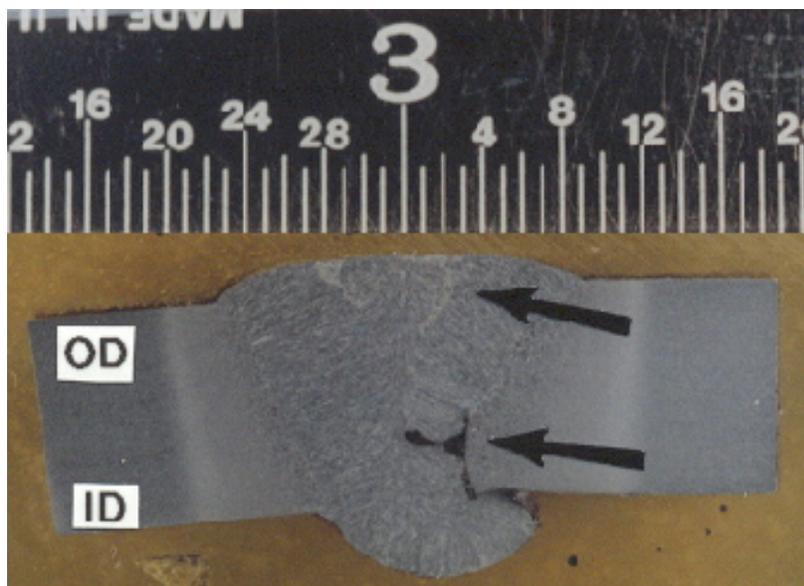
Failure: Hydrotest Rupture at
 1,520 psig (10.48
 MPa) (85% of SMYS)

Defect

NDE technique(s): N/A

NDE result(s): N/A

Visual: Weld Penetration + Lack
 of Fusion + Hot Crack
 5 ft-9 inch (1.8 m) long
 Seam split
 50% (LOF) + 30% (Hot
 crack)
 depth: 0.177 inch (4.5 mm) (LOF)
 + 0.106 inch (2.69 mm)
 (Hot crack)
 t_{weld} 0.354 inch (8.99 mm) (At
 crack location)



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 27
 Report #: 3
 Defect #: 11A

Pipe

Vintage: circa 1950
 Manufacturer: Kaiser

Defect

NDE technique(s): Shearwave UT
 NDE result(s): 1.5 inch (38 mm) Linear
 Inclusion at 0.235 to 0.291 inch
 depth

Seam Type: SSAW

Visual: ID Lack of Fusion + ID Crack +
 OD Slag Inclusion

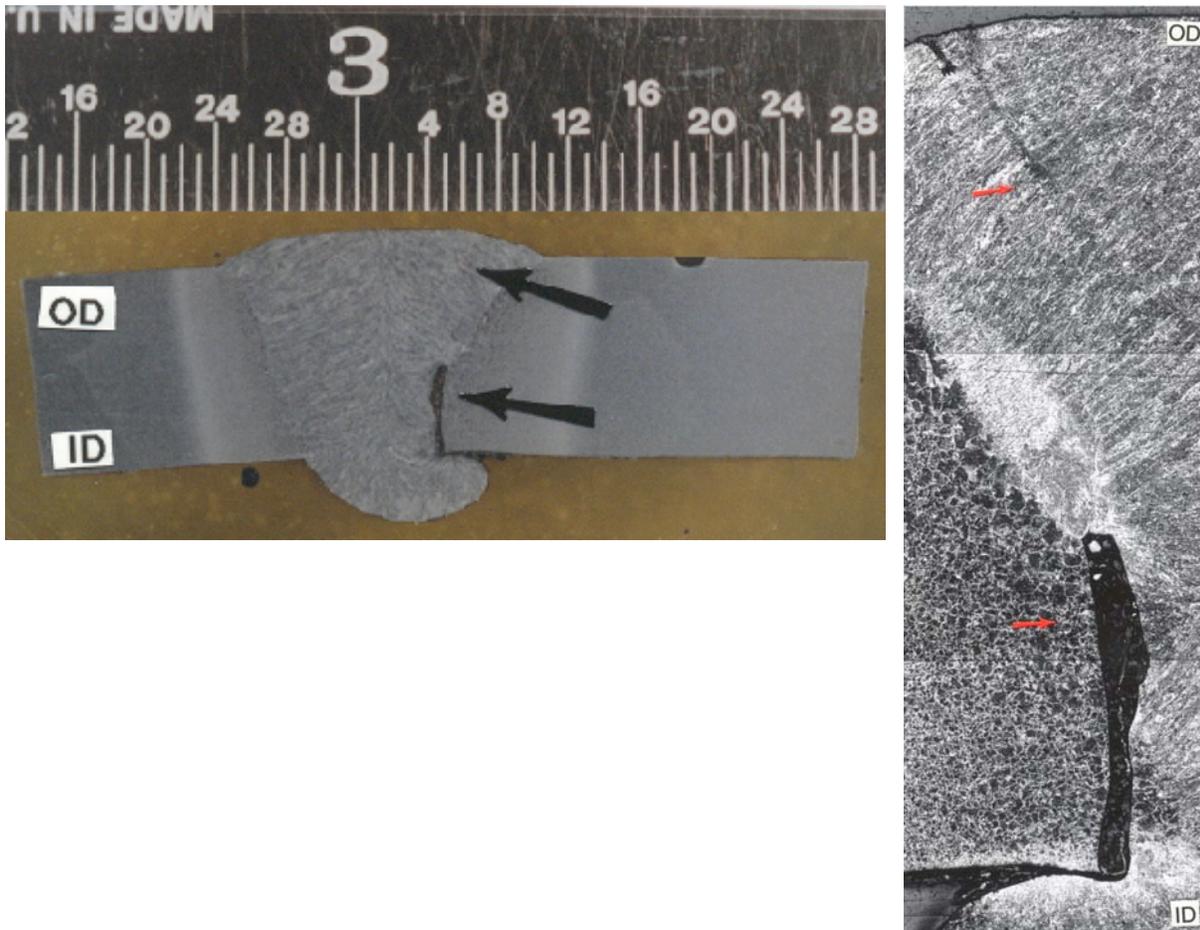
Grade: X52
 D_{nominal} : 20 inch (508 mm)

L
 $\text{depth}/t_{\text{weld}}$

t_{nominal} : 0.344 inch (8.74 mm)

depth: 21% ID Lack of Fusion + 6% ID
 Crack + 24% OD Slag Inclusion
 0.106 inch (2.69 mm) ID Lack of
 Fusion + 0.030 inch (0.76 mm)
 ID Crack + 0.124 inch (3.15
 mm) OD Slag Inclusion

t_{pipe} : 0.344 inch (8.74 mm) t_{weld}
 Failure: None



Photograph and Photomicrograph of Metallographic Section.

Catalog #: 28
 Report #: 3
 Defect #: 11C

Pipe

Vintage: circa 1950
 Manufacturer: Kaiser

Defect

NDE technique(s): Shearwave UT
 NDE result(s): 5 inch Linear inclusion at
 0.290 (7.37 mm) to 0.308
 inch (7.82 mm) depth +
 suspected ID LOF

Seam Type: SSAW

Visual: ID Lack of Fusion + OD Slag
 Inclusion

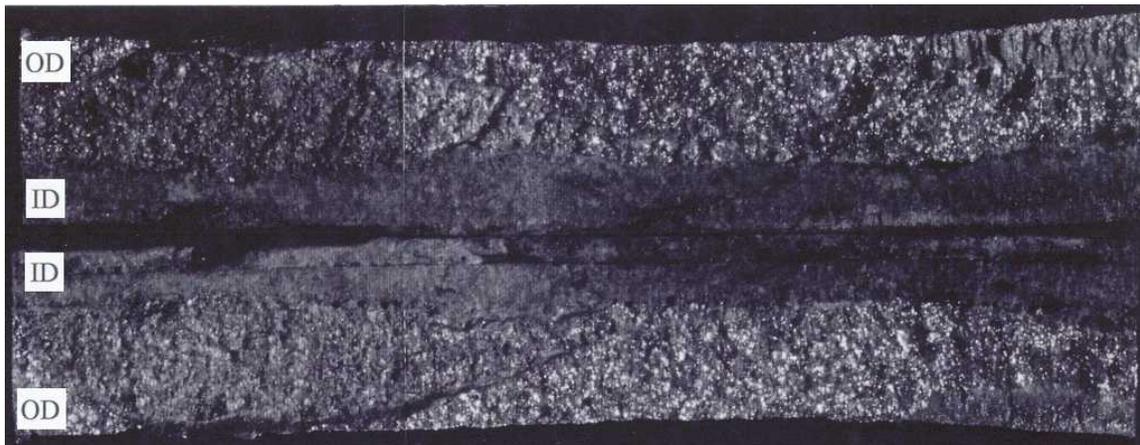
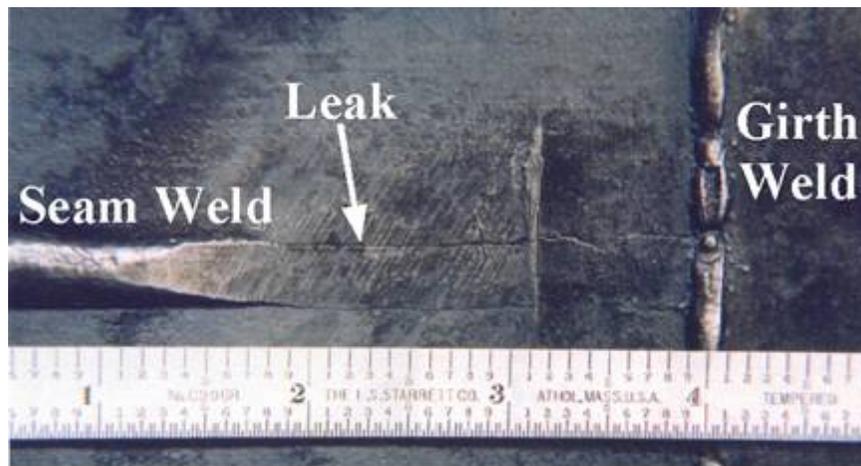
Grade: X52
 D_{nominal} 20 inch (508 mm)

L
 $\text{depth}/t_{\text{weld}}$ N/A
 29% ID Lack of Fusion +
 29% OD Slag Inclusion

t_{nominal} 0.344 inch (8.74 mm) depth :

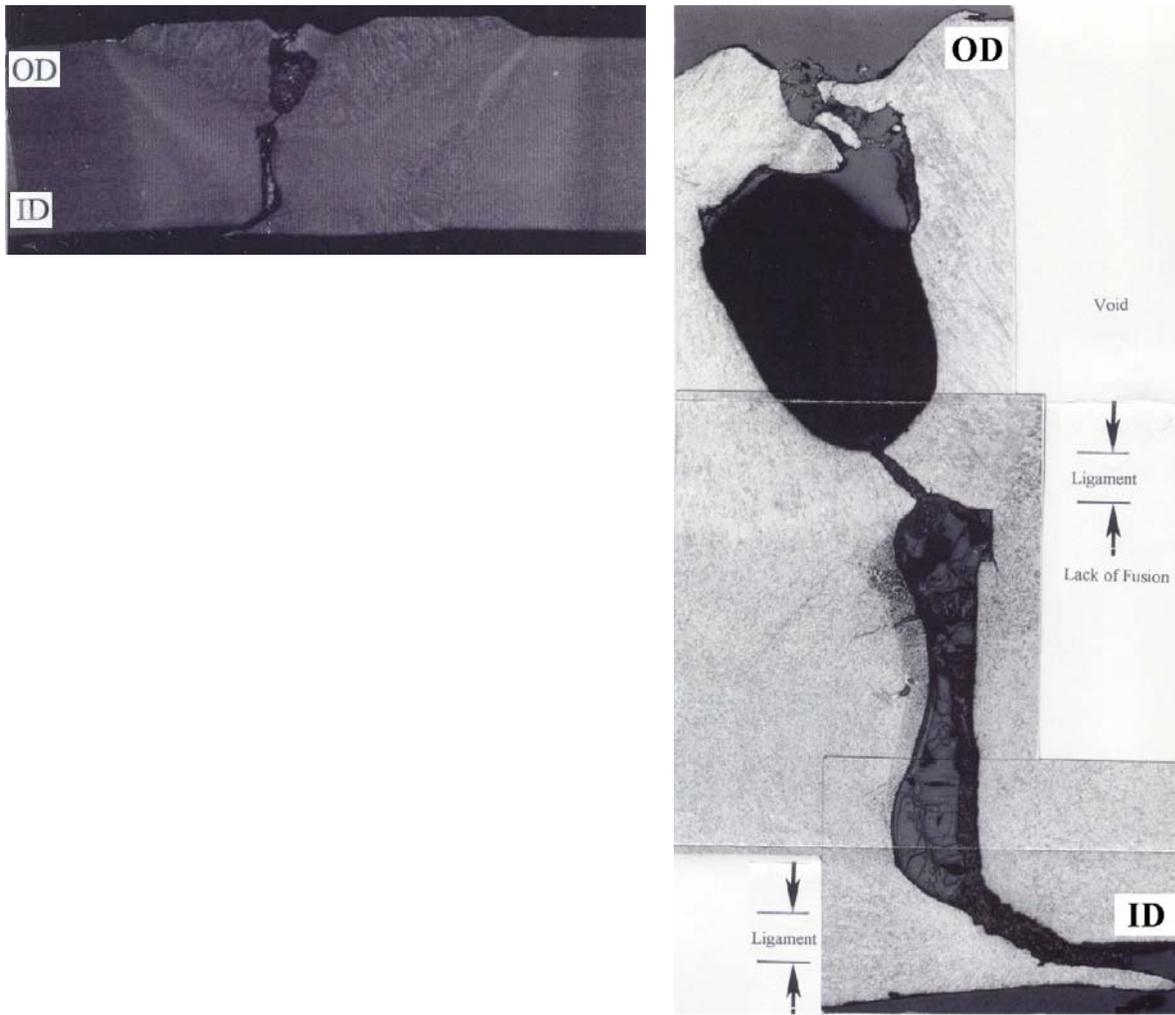
0.154 inch (3.91 mm) ID
 Lack of Fusion + 0.154 inch
 (3.91 mm) OD Slag Inclusion
 0.525 inch (13.3 mm)

t_{pipe} 0.344 inch (8.74 mm) t_{weld}
 Failure: None



Photographs of Pipe Seam ID Surface and Fracture Surfaces.

Catalog #:	88		
Report #:	9		
Defect #:	4-3		
Pipe		Defect	
Vintage:	circa 1952	NDE technique(s):	N/A
Manufacturer:	Kaiser	NDE result(s):	N/A
Seam Type:	SSAW	Visual:	Through-wall flaw + ID seam ground flush + Lack of fusion
Grade:	API 5L X52	L	N/A
D_{nominal}	20 inch (508 mm)	depth/ t_{weld}	100% (Leak) + 30% (LOF)
t_{nominal}	0.344 inch (8.74 mm)	depth:	Not Determined
t_{pipe}	Not Determined	t_{weld}	Not Determined
Failure:	Hydrotest Leak at 1,517 psig (10.46 MPa) (85% of SMYS)		



Photograph and Photomicrograph of Metallographic Section.

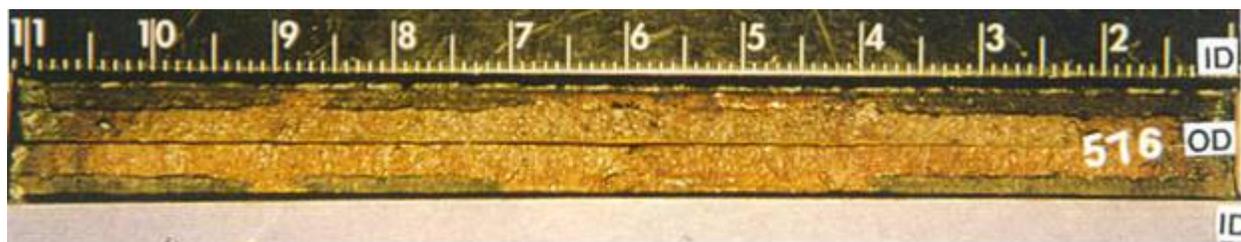
Catalog #: 89
 Report #: 9
 Defect #: 5-4

Pipe

Vintage: circa 1952
 Manufacturer: Kaiser
 Seam Type: SSAW
 Grade: API 5L X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.344 inch (8.74 mm)
 t_{pipe} : Not Determined
 Failure: Hydrotest Leak at
 1,559 psig (10.75 MPa)
 (87% of SMYS)

Defect

NDE technique(s): N/A
 NDE result(s): N/A
 Visual: Lack of fusion + Void
 L: N/A
 $\text{depth}/t_{\text{weld}}$: 85%
 depth: 45% (LOF) + 40%
 (Void)
 t_{weld} : Not Determined



Photograph of Fracture Surfaces.

Catalog #: 25
 Report #: 2
 Defect #: 576

Pipe

Vintage: circa 1950
 Manufacturer: Kaiser

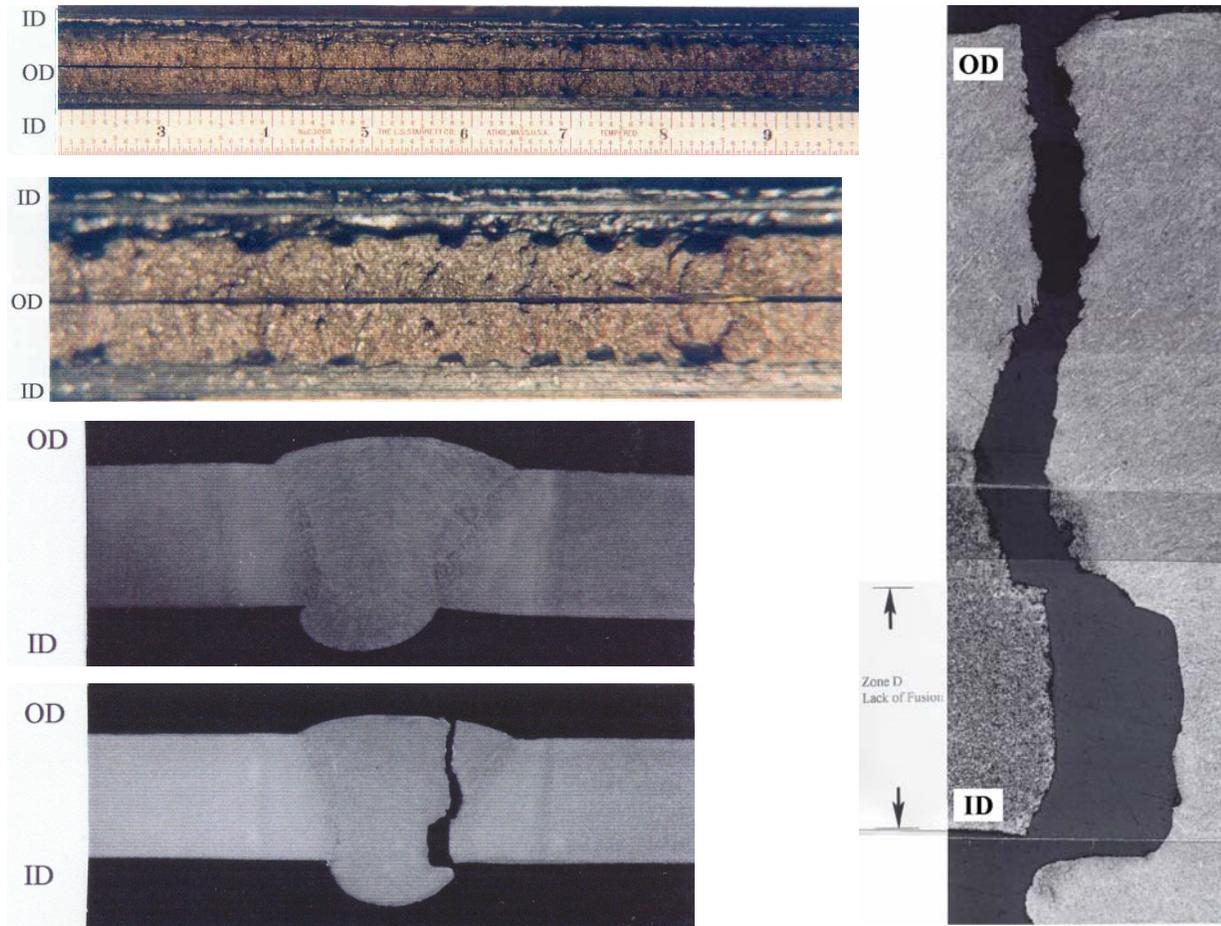
Seam Type: SSAW

Grade: X52

D_{nominal} 20 inch (508 mm)
 t_{nominal} 0.344 inch (8.74 mm)
 t_{pipe} 0.342 inch (8.69 mm)
 Failure: Burst test rupture at
 2,075 psig (14.31 MPa)
 (116% of SMYS)

Defect

NDE technique(s): UT
 NDE result(s): 20%, 9.4 feet long (2.9 m)
 ID crack like
 Visual: Intermittent ID Lack of
 Fusion
 L Entire joint, in photo: 2.0,
 1.75 & 2.9 inch
 (51, 44.5 & 74 mm)
 $\text{depth}/t_{\text{weld}}$ 45%
 depth : 0.150 inch (38 mm)
 t_{weld} N/A



Photographs and Photomicrograph of Fracture Surfaces and Metallographic Section.

Catalog #:	86		
Report #:	9		
Defect #:	5-1		
<u>Pipe</u>		<u>Defect</u>	
Vintage:	circa 1952	NDE technique(s):	N/A
Manufacturer:	Kaiser	NDE result(s):	N/A
Seam Type:	SSAW	Visual:	Weld Penetration + Lack of Fusion
Grade:	API 5L X52	L	15 ft-4 inch (4.7 m) long Seam split
D_{nominal}	20 inch (508 mm)	depth/ t_{weld}	44% (LOF)
t_{nominal}	0.344 inch (8.74 mm)	depth:	0.150 inch (38 mm) (LOF)
t_{pipe}	Not Determined	t_{weld}	0.341 inch (8.66 mm) (At crack location)
Failure:	Hydrotest Rupture at 1,483 psig (10.22 MPa) (83% of SMYS)		



Photograph of Pipe Outside Surface.

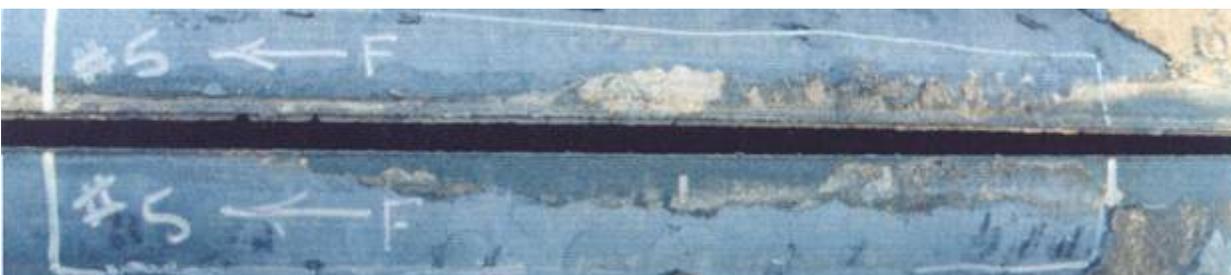
Catalog #: 90
 Report #: 9
 Defect #: 5-2

Pipe

Vintage: circa 1952
 Manufacturer: Kaiser
 Seam Type: SSAW
 Grade: API 5L X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.344 inch (8.74 mm)
 t_{pipe} : Not Determined
 Failure: Hydrotest Leak at 1,570
 psig (10.82 MPa) (88%
 of SMYS)

Defect

NDE technique(s): N/A
 NDE result(s): N/A
 Visual: Seam Split
 L: 19 ft-5 inch (5.9 m)
 depth/ t_{weld} : Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



Photographs of Pipe Outside Surface.

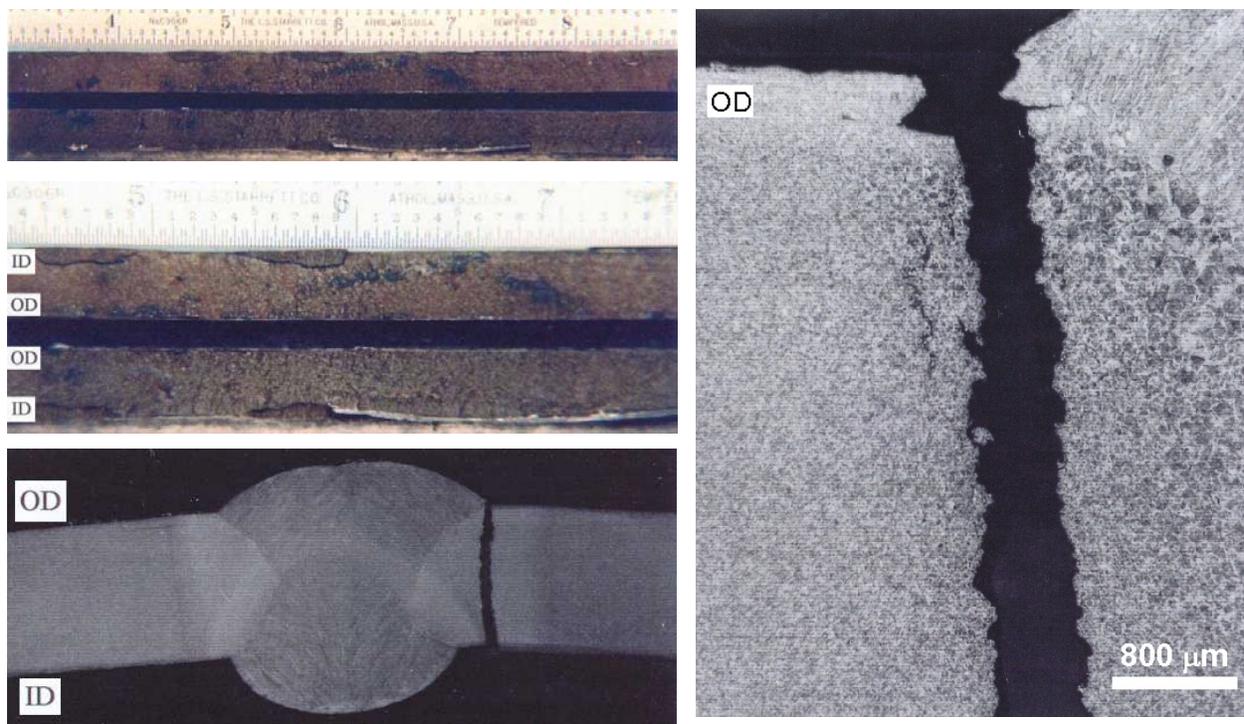
Catalog #: 91
 Report #: 9
 Defect #: 5-5

Pipe

Vintage: circa 1952
 Manufacturer: Kaiser
 Seam Type: SSAW
 Grade: API 5L X52
 D_{nominal} : 20 inch (508 mm)
 t_{nominal} : 0.344 inch (8.74 mm)
 t_{pipe} : Not Determined
 Failure: Hydrotest Leak at
 1,615 psig (11.14 MPa)
 (90% of SMYS)

Defect

NDE technique(s): N/A
 NDE result(s): N/A
 Visual: Seam split
 L: 12 ft-8 inch (3.9 m)
 $\text{depth}/t_{\text{weld}}$: Not Determined
 depth: Not Determined
 t_{weld} : Not Determined



Photographs and Photomicrograph of Fracture Surfaces and Metallographic Section.

Catalog #: 87
 Report #: 9
 Defect #: 5-3

Pipe

Vintage: circa 1952
 Manufacturer: Kaiser
 Seam Type: DSAW

Defect

NDE technique(s): N/A
 NDE result(s): N/A
 Visual: Initiation at toe of OD weld bead + Small OD cracks parallel to main fracture

Grade: API 5L X52

L
 39 ft-3 inch (12 m)
 long Seam split

$D_{nominal}$: 20 inch (508 mm)
 $t_{nominal}$: 0.344 inch (8.74 mm)
 t_{pipe} : Not Determined
 Failure: Hydrotest Rupture at 1,538 psig (10.60 MPa) (86% of SMYS)

depth/ t_{weld} : 100%
 depth: Not Determined
 t_{weld} : Not Determined