Fabrication of Flaws for Weld Dissimilar Metal Weld Examination Samples Utilizing Hot Iso-Static Pressure (HIP)

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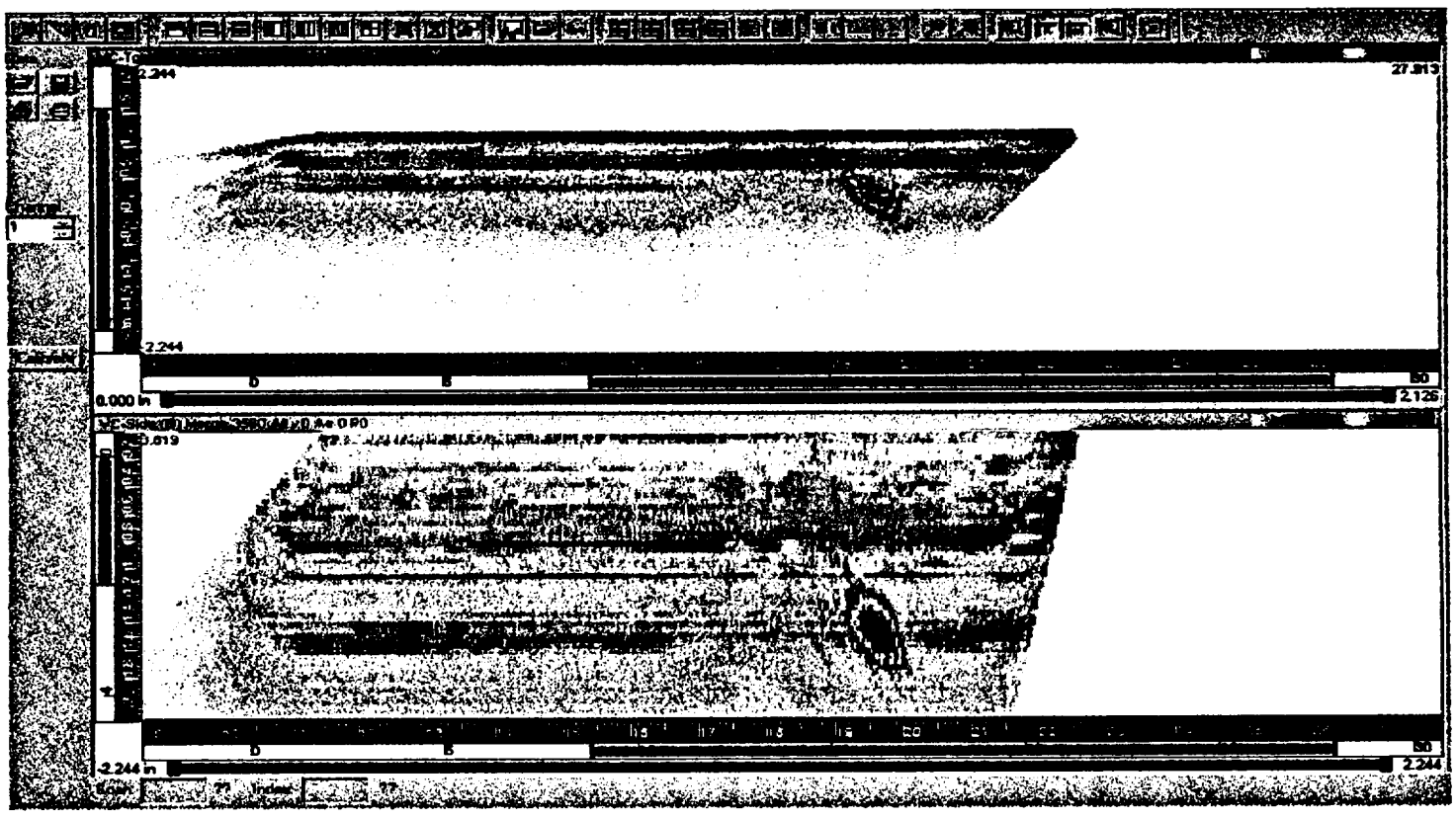
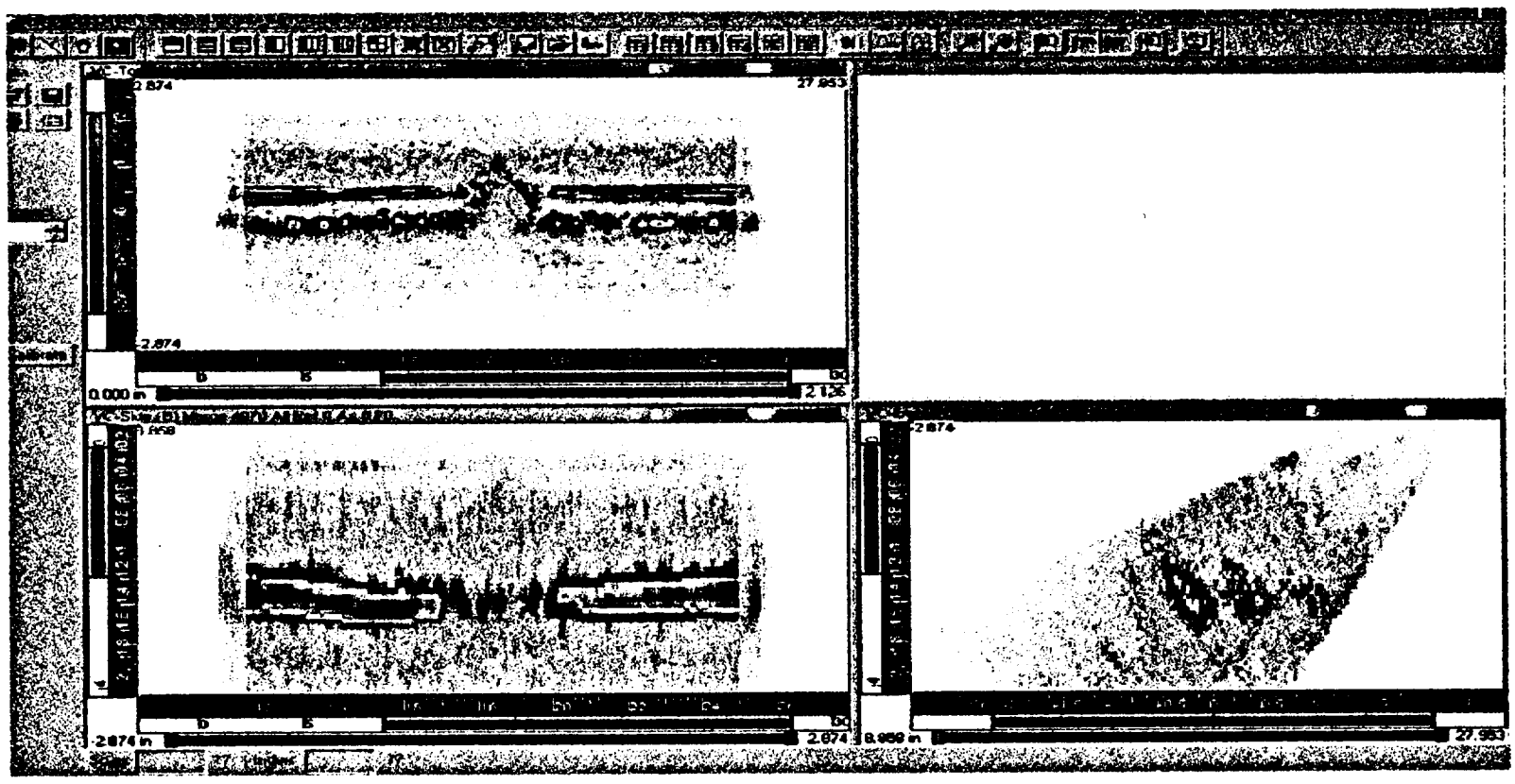
Goals

- To develop flaws that provide a realistic ultrasonic response in dissimilar metal welds
- To develop flaws in which the dimensions are known
- To develop flaws that can be implanted in precise locations in an already fabricated component.
- Avoid complex welding operations which could cause unrealistic ultrasonic responses

Response From Insitu Crack



Response From Insitu- Crack Implant



First Application

- Implant axial flaws in previously weld overlaid austenitic piping welds

Trials

- 8 flaws have been fabricated in weld overlaid components
- All samples have been scanned ultrasonically and their responses evaluated
- Multiple sections have been taken and their dimensions compared to available samples with laboratory grown IGSCC and In-Situ flaws

Trials

- An additional 4 notches were placed in dissimilar metal weld material and in austenitic base material
- The HIP parameters used were adjusted slightly to compensate for the different materials
- All samples have been scanned ultrasonically and their responses evaluated
- Multiple sections have been taken and ~~their~~ been compared to available field data and data from other implanted flaws

Requirements of Test

- Tip diameter of flaws must be equal to or less than 0.002”
  - Basis for dimension
    - PISC Study
    - ASME Code Case

Results

- Initial Tests
  - ~~The~~ all of the flaws had ~~a~~ tip diameter~~s~~ of less than 0.002" in this exercise
  - The responses from these flaws were good and it would be most difficult to determine ultrasonically which flaw had the larger tip diameter.

Flaw ID	Measurement Number	Description	Tip Diameter Required	Tip Diameter Achieved	Difference
01972 Sample 2A	1	Slanted Circ flaw along HAZ with 0.002" mica	0.002	0.0006	-0.0014
01972 Sample 2B	1	Slanted Circ flaw along HAZ with 0.002" mica	0.002	0.0017	-0.0003
01972 Sample 4C	1	Slanted Circ flaw along HAZ with 0.002" mica	0.002	0.0005	-0.0015
10976 Sample 12-B-1B	1	Radial axial flaw into WOR	0.002	0.0015	-0.0005
10977 Sample 12-B-1B	2	Radial axial flaw into WOR	0.002	0.0005	-0.0015
315/025 Flaw 1	K	Radial Axial Flaw	0.002	0.0003	-0.0017
315/025 Flaw 1	L	Radial Axial Flaw	0.002	0.0001	-0.0019
315/025 Flaw 1	M	Radial Axial Flaw	0.002	0.0001	-0.0019
315/025 Flaw 3	D	Slanted Circ flaw along HAZ	0.002	0.0019	-0.0001
315/025 Flaw 3	E	Slanted Circ flaw along HAZ	0.002	0.0003	-0.0017
315/025 Flaw 3	F	Slanted Circ flaw along HAZ	0.002	0.0017	-0.0003
315/025 Flaw 4	G	Radial Axial Flaw	0.002	0.0043	0.0023
315/025 Flaw 4	H	Radial Axial Flaw	0.002	0.0014	-0.0006
315/025 Flaw 4	J	Radial Axial Flaw	0.002	0.0001	-0.0019
315/025 Flaw 2	A	Slanted Circ flaw along HAZ	0.002	<.0001	
315/025 Flaw 2	B	Slanted Circ flaw along HAZ	0.002	<.0001	
315/025 Flaw 2	C	Slanted Circ flaw along HAZ	0.002	<.0001	
DSM Sample 21 Crack 'A'	F6A	Circ. Fatigue Crack	0.002	0.001	-0.0010
DSM Sample 21 Crack 'A'	F6B	Circ. Fatigue Crack	0.002	0.0022	0.0002
DSM Sample 21 Crack 'A'	F7	Circ. Fatigue Crack	0.002	0.0002	-0.0018
DSM Sample 21 Crack 'A'	F8	Circ. Fatigue Crack	0.002	0.0006	-0.0016
DSM Sample 21 Notch 'K'	A	Axial EDM Notch HIP	0.002	0.0001	-0.0019
DSM Sample 21 Notch 'K'	B	Axial EDM Notch HIP	0.002	0.0001	-0.0019
DSM Sample 21 Notch 'L'	22	Circ. EDM Notch HIP	0.002	0.00004	-0.00196
DSM Sample 21 Notch 'L'	21B	Circ. EDM Notch HIP	0.002	0.0001	-0.0019
DSM Sample 21 Notch 'L'	21A	Circ. EDM Notch HIP	0.002	0.00005	-0.00195
DSM Sample 21 Notch 'L'	20B	Circ. EDM Notch HIP	0.002	0.0002	-0.0018
DSM Sample 21 Notch 'L'	20A	Circ. EDM Notch HIP	0.002	0.00016	-0.00184
DSM Sample 21 Notch 'L'	23B	Circ. EDM Notch HIP	0.002	0.00018	-0.0018
DSM Sample 21 Notch 'L'	23A	Circ. EDM Notch HIP	0.002	0.0002	-0.0018
DSM Sample 21 Notch 'L'	24	Circ. EDM Notch HIP	0.002	0.0002	-0.0018
DSM Sample 21 Notch 'J'	F3	Circ. EDM Notch HIP	0.002	0.0007	-0.0013
DSM Sample 21 Notch 'J'	F1B	Circ. EDM Notch HIP	0.002	0.0005	-0.0015
DSM Sample 21 Notch 'J'	F1A	Circ. EDM Notch HIP	0.002	0.0008	-0.0012
DSM Sample 21 Notch 'J'	F2	Circ. EDM Notch HIP	0.002	[illegible]	[illegible]

weld qualifying

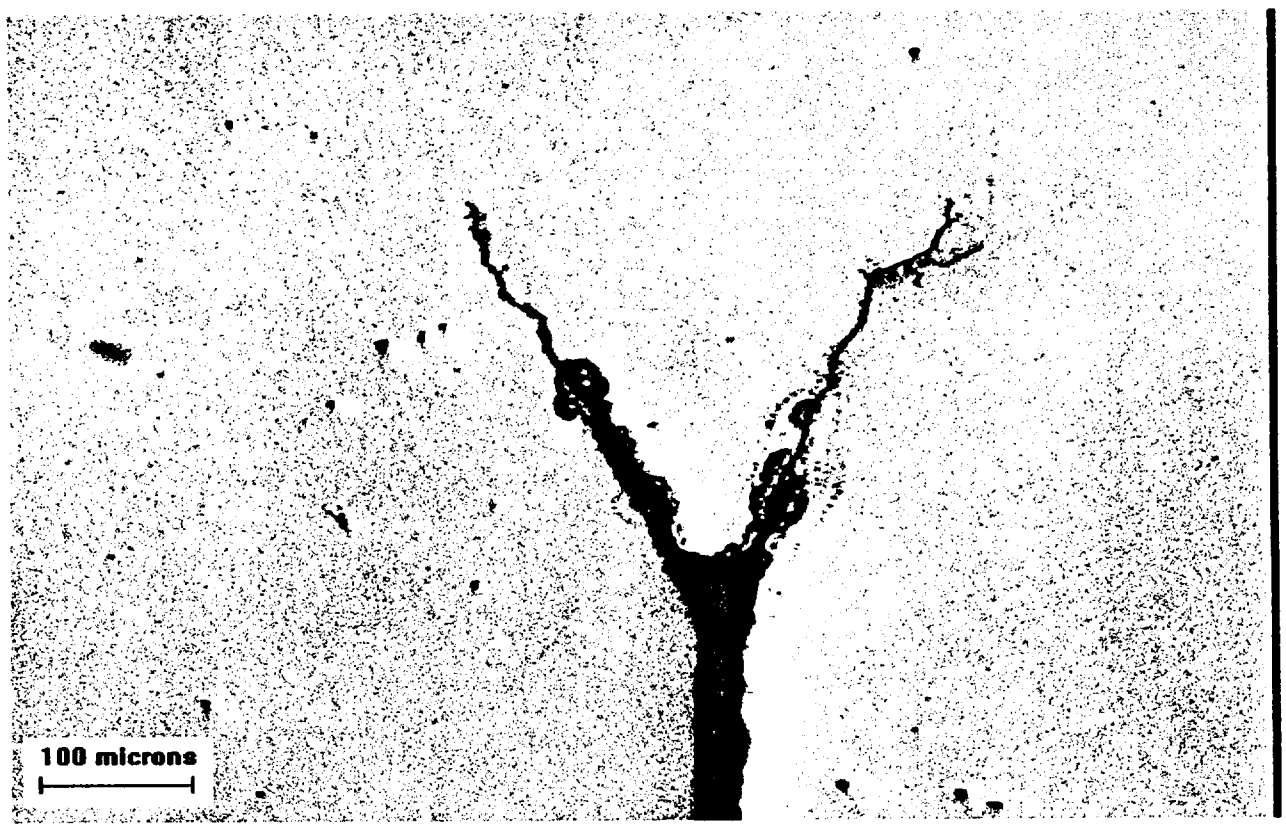
real crack

DWM

2 measurement on the fatigue crack

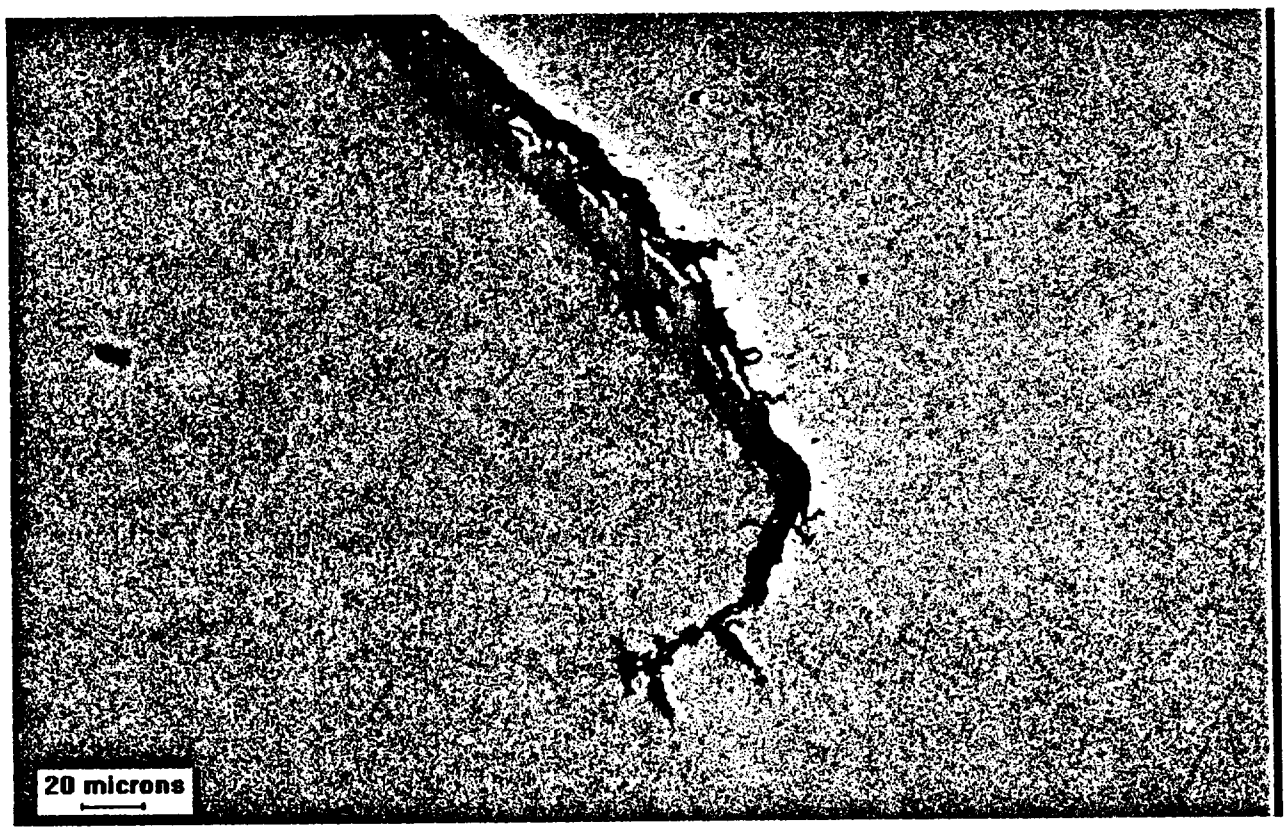
Notch Tip J

Notch Tip K

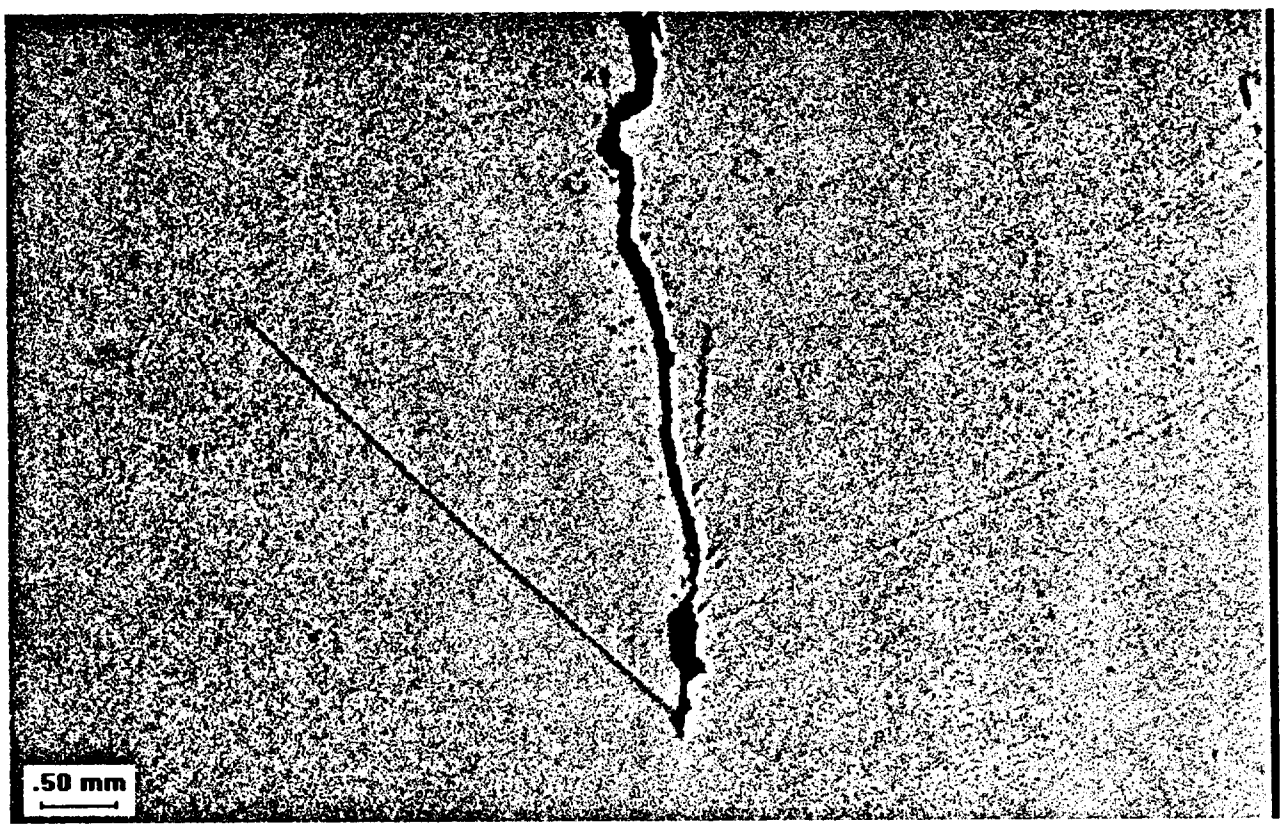


Notch Tip L

Insitu Crack Tip



Insitu Crack



Summary

- The initial trials were quite successful and it is believed that the process will prove to be an effective way to produce a realistic flaw for performance demonstrations
- Additional tests are underway to improve the process and to ensure that the minimum diameter is achieved repeatedly