Birring NDE Center, Inc.
515 Tristar Drive, Webster, TX 77598
Tel: (832) 533-8366
Fax: (281) 488-8485

September 5, 2012

Ultrasonic Inspection Report
HTHA Inspection of Exchangers E 6600 E and E 6600 B

Introduction:	Inspection for detection of High Temperature Hydrogen Attack (HTHA) was performed at selected locations of Exchangers E 6600 E and E 6600 B
Inspection Dates:	August 31, 2012
Client:	US Chemical and Safety Board
Location:	Cleveland, OH
Contact:	Roger Evans
Inspectors:	Anmol Birring, ASNT Level III
Technique:	Ultrasonic inspection for detection of HTHA was conducted using the following techniques: Base Metal: Backscatter for initial scanning. Velocity-ratio for verification, if backscatter is positive
Scope:	Base Metal backscatter ultrasonic data was taken at selected locations in Exchangers E 6600 E and E 6600 B. The locations were selected by Roger Evans. All locations were at least 9 inches away from the welds.
UT Equipment:	Backscatter: USN Go in the RF mode Velocity Ratio: Panametrics Pulser 5052 with the Tektronix 2012 oscilloscope
UT Transducers:	Backscatter: 5 MHz, 10 mm dia Dual L-wave transducer. Velocity ratio: 5 MHz, 12.5 mm dia Single L and S-wave transducers
Calibration:	Base metal calibration performed on step block and HTHA sample. The HTHA signal was set to 80 % FSH at 62 dB as shown in Figure 2. Testing was performed at a gain of 62 dB Velocity ratio calibration was performed on a step block with no HTHA and a sample with HTHA. The readings are given in Table 1.

RESULTS Backscatter measurements were taken at eight selected areas on E 6600 E and about six areas on E 6600 B. Each of the areas is about 4 inches in diameter. Within each area, five backscatter measurements were taken.

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Backscatter was detected at all points. An indication of backscatter can mean base metal HTHA or stringers in steel (inclusions in steel). To determine the cause of backscatter, follow up inspections were done to measure velocity-ratio. This was done on Exchanger E 6600 E and the results are given in Table 2. All of the velocity-ratio measurements turned out to be in the normal range, an indication that the backscatter was caused by stringers in steel.

No follow-up velocity ratio measurements were taken on E 6600 B

CONCLUSIONS

No base metal HTHA was detected at the locations inspected in the exchanger shell. One has to note that all measurements were taken quite far from the weld HAZ.

Table 1. Calibration for Velocity Ratio. Step Block and sample with actual HTHA

Block	Thickness	Backscatter depth	Ratio
Step Block	19.0 mm	0 mm	0.546
HTHA 1 SK	21.5 mm	14 mm	0.560

Table 2. Ultrasonic Data taken on E 6600 E for detection of base metal HTHA.

No.	Location	Thickness	Backscatter	Vel Ratio	Comments
1	E 01	22 mm	Yes	0.546	No HTHA
2	E 02	22 mm	Yes	0.543	No HTHA
3	E 03	22 mm	Yes	0.546	No HTHA
4	E 04	21.6 mm	Yes	0.545	No HTHA
5	E 05	21.7 mm	Yes	0.546	No HTHA
6	E 06	21.6 mm	Yes	0.547	No HTHA
7	E 07	29.8 mm	Yes	0.539	No HTHA
8	EC 01*	22.5 mm	Yes	0.546	No HTHA

* Location with ID clad

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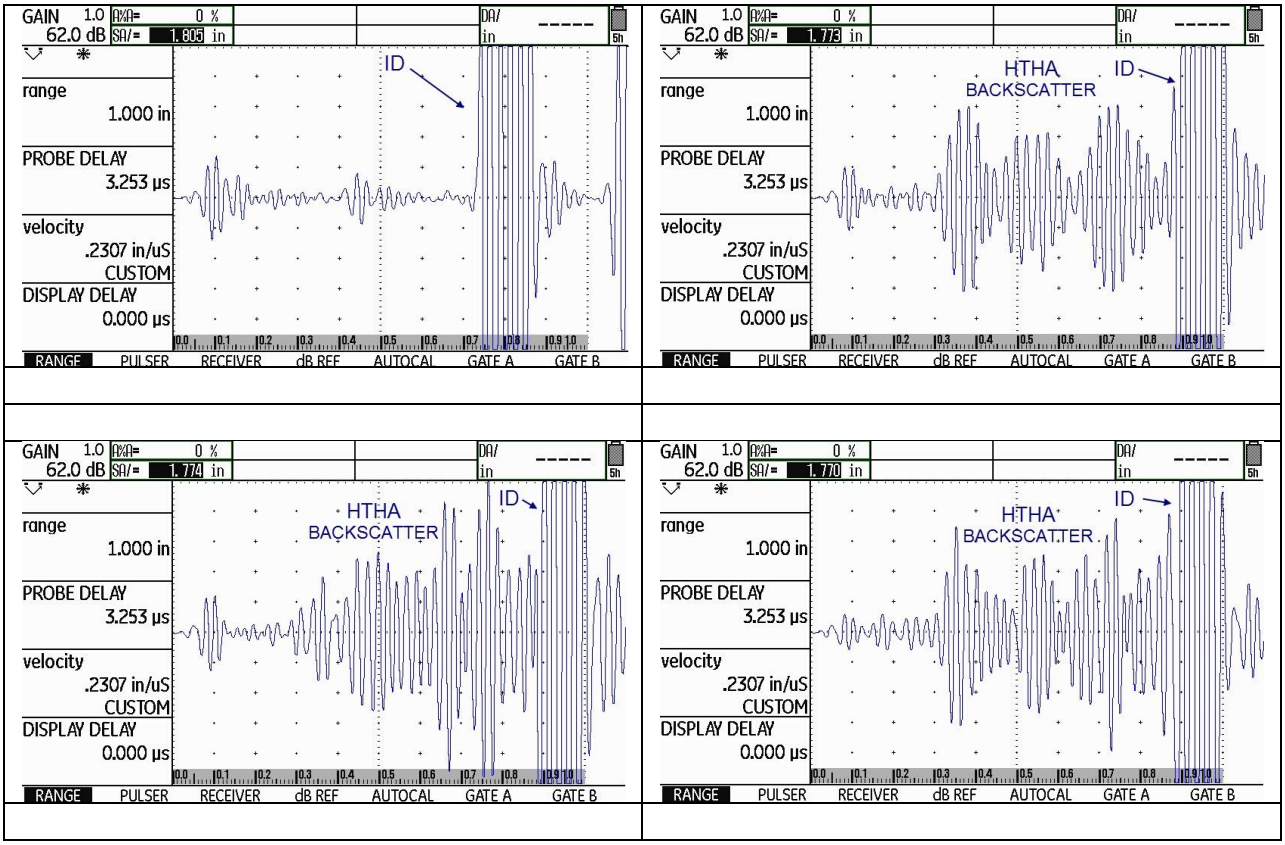

Figure 2. HTHA Backscatter Calibration at 62 dB. Top-left – Step block with no HTHA. Top-right and bottom - Representative HTHA backscatter signals from HTHA 1 SK sample