



## PetroTechnical Services

### USI Corrosion Evaluation

Company	XCel Energy Inc
Field	Roundup Storage Unit
Well Name	Roundup 25
UWI	NW SE
Log Date	19-Sep-2013
Analyst	Jim Urdea

Other company, product, and service names are the properties of their respective owners. Copyright © Schlumberger 2009. All rights reserved. 09-DC-0047-C Data and Consulting Services

**Schlumberger**

## Disclaimer

ANY INTERPRETATION, RESEARCH, ANALYSIS, DATA, RESULTS, ESTIMATES, OR RECOMMENDATION FURNISHED WITH THE SERVICES OR OTHERWISE COMMUNICATED BY SCHLUMBERGER TO CUSTOMER AT ANY TIME IN CONNECTION WITH THE SERVICES ARE OPINIONS BASED ON INFERENCES FROM MEASUREMENTS, EMPIRICAL RELATIONSHIPS AND/OR ASSUMPTIONS, WHICH INFERENCES, EMPIRICAL RELATIONSHIPS AND/OR ASSUMPTIONS ARE NOT INFALLIBLE, AND WITH RESPECT TO WHICH PROFESSIONALS IN THE INDUSTRY MAY DIFFER. ACCORDINGLY, SCHLUMBERGER CANNOT AND DOES NOT WARRANT THE ACCURACY, CORRECTNESS OR COMPLETENESS OF ANY SUCH INTERPRETATION, RESEARCH, ANALYSIS, DATA, RESULTS, ESTIMATES OR RECOMMENDATION. CUSTOMER ACKNOWLEDGES THAT IT IS ACCEPTING THE SERVICES "AS IS", THAT SCHLUMBERGER MAKES NO REPRESENTATION OR WARRANTY, EXPRESS OR IMPLIED, OF ANY KIND OR DESCRIPTION IN RESPECT THERETO. SPECIFICALLY, CUSTOMER ACKNOWLEDGES THAT SCHLUMBERGER DOES NOT WARRANT THAT ANY INTERPRETATION, RESEARCH, ANALYSIS, DATA, RESULTS, ESTIMATES, OR RECOMMENDATION IS FIT FOR A PARTICULAR PURPOSE, INCLUDING BUT NOT LIMITED TO COMPLIANCE WITH ANY GOVERNMENT REQUEST OR REGULATORY REQUIREMENT. CUSTOMER FURTHER ACKNOWLEDGES THAT SUCH SERVICES ARE DELIVERED WITH THE EXPLICIT UNDERSTANDING AND AGREEMENT THAT ANY ACTION TAKEN BASED ON THE SERVICES RECEIVED SHALL BE AT ITS OWN RISK AND RESPONSIBILITY AND NO CLAIM SHALL BE MADE AGAINST SCHLUMBERGER AS A CONSEQUENCE THEREOF.

## **Casing Integrity Advisor**

### **Objective:**

What is the quality of the 5.5", 15.5#, J55 casing in Roundup #25?

### **Solution Methodology:**

Survey with the UltraSonic Imager – USIT – to determine the current state of the production casing and review the data with the Casing Integrity Analysis service.

### **Log Quality Control:**

The USI fluid slowness and frequency settings are correct and reproduce the correct average external casing radius and thickness. No USI playbacks are needed.

### **USI Summary of Findings - Wear:**

Casing is seamless with almost every joint having been milled by the manufacturer likely to meet the specification for drift diameter. The milling has used most of the 12.5% safety factor and in combination with minor internal wear and pitting account for the majority of the 20 joints with more than 12.5% penetration. The 'manufacturing anomaly'(s) show up as joints with one side thicker than the other as would happen if the internal wall is not centralized with the external wall.

Joint 132 shows a 10.4% penetration on the main pass at 5188 feet in a zone of high tool eccentricization with multiple processing flags. The repeat run at 0.6 inch sampling unable to detect that same feature leading to the conclusion that the 10.4% is not valid.

The greatest penetration, 17.1% at 4054 ft. was validated by both the radius and thickness and the repeat section

Overall, the casing appears to have been manufactured at the edge of not being able to meet the manufacturing specification and the pitting that has occurred since has pushed it past 12.5% thickness loss in several places.

## Casing Integrity Advisor

Roundup #25  
NWSE, sec 33, T2N, R60W

4770' KB  
4761' GL (?)

Surface casing: existing 8 5/8" 77.00'  
no details

Production cas: K.B. connection 9.00  
168' to 5 1/2", 15.5" K-55 6580.50  
float collar 2.08  
float shoe 1.75  
unbonded connection -1  
6592.33

cemented w/ 1255 slt Howco 260 slt 50/50 per

Tubing: KB connection 6.80  
212' to 2 7/8", 6.5" J-55 6512.50  
sealing nipple 1.10  
6520.40

← whipstock @ 5180

Pipe 6524-6533 4spf

Treated: 1200 gal 7.5% HCL + .5% HF

6520' EOT  
6524-33 perf  
6547' PBD

WELL NAME	Roundup Well #25
API Number	05-087-07082
CURRENT STATUS	Observation
DATE DRILLED/COMPLETED	Drilled 1968. Re-entered 7/80 & comp 8/80.
WELL LOCATION	1980 fsl 1980 fsl NWSE, S33, T2N, R60W
INJ & W/D METER	N/A
Total Depth	6604
PBTD	6547
Perforation Depths	6524 - 6533
Surface Casing	77' of 8-5/8", 24#/ft
Intermediate Casing	N/A
Production Casing	6592' of 5-1/2" 15.5#/ft, K-55 1255 sx HOWCO lite cement and 260 sx of 50-50 POZ. Poor returns to surface.
Production Casing Cement Details	

Plunger Lift ?	NO
Production Casing Insp History	
Tubing Details	6520' of 2-7/8", 6.5#/ft J-55
Well Stimulation History	Acidized in 1980.
Sand/Scale Fillup History	
Bottom Hole Pressure	
Misc (Fluid Level, etc)	
Latitude (Dec. Deg.) NAD83	N40.09347
Longitude (Dec. Deg.) NAD 83	W104.10100
Max. PDOP (<6.0)	2.776
Ground Elev. At Wellhead (SFL)	4763
NAVD99	
GPS Location Date	June 30, 2010
Most Recent Well History (Date Performed/Project Engineer/Work Order)	

## Casing Integrity Advisor

### Schlumberger

Company: **XCel Energy, Inc**

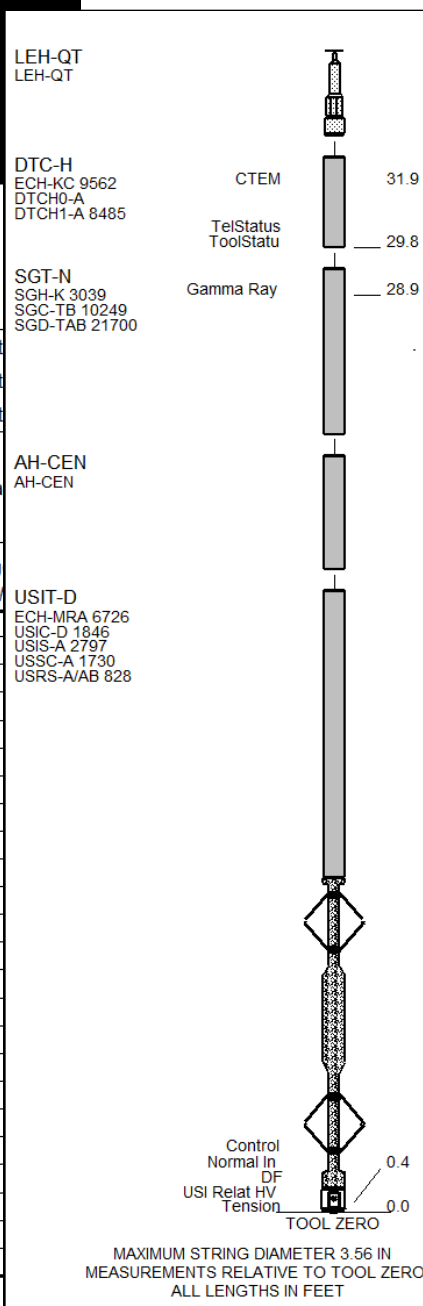
Well: **Roundup 25**

Field: **Roundup Storage Unit**

County: **Morgan**

State: **Colorado**

County: Morgan Field: Roundup Storage Unit Location: NW SE Well: Roundup 25 Company: Xcel Energy, Inc	Corrosion Evaluation			
	Ultrasonic Imager			
	USIT			
	LOCATION	NW SE	Elev.:	K.B. 4769.00 ft G.L. 4760.00 ft D.F. 4768.00 ft
	Permanent Datum: <u>Ground Level</u>		Elev.:	<u>4760.00 ft</u>
Log Measured From: <u>Kelly Bushing</u>		9.00 ft	above Perm. Da	
Drilling Measured From: <u>Kelly Bushing</u>				
API Serial No.		Section 33	Township 2N	Range 60W
Logging Date		19-Sep-2013		
Run Number		One		
Depth Driller		6450 ft		
Schlumberger Depth		6420 ft		
Bottom Log Interval		6420 ft		
Top Log Interval		50 ft		
Casing Fluid Type		Fresh Water with 2% KCL (Brine)		
Salinity				
Density		8.4 lbm/gal		
Fluid Level				
BIT/CASING/TUBING STRING				
Bit Size		7.875 in		
From				
To				
Casing/Tubing Size		5.500 in		
Weight		15.5 lbm/ft		
Grade				
From				
To				
Maximum Recorded Temperatures				
Logger On Bottom	Time	19-Sep-2013	8:15	
Unit Number	Location	3022	Fort Morgan	
Recorded By	Arvin Shi			
Witnessed By	Josh Freed			



#### REMARKS: RUN NUMBER 1

1. Toolstring run as per tool sketch
2. Mainpass was done with 10 Deg 1.5 in Resolution and Repeat pass was done with 10 Deg 0.6 in Resolution
3. Mainpass was pressured up to 500 psi from 500 ft to surface for logging to 50 ft
4. Plug set at 6450 ft

#### REMARKS: RUN NUMBER 2

# Casing Integrity Advisor



**Company Name:** XCel Energy, Inc  
**Well Name:** Roundup 25  
**Field:** Roundup Storage Unit

## Casing Data

Tubular Details	String 1
Top (ft)	52.00
Base (ft)	6420.50
Casing Size (CSIZ) (in)	5.50
Casing Weight (CWEI) (lb/f)	15.50
Casing Grade (CASG)	J-55
Yield Strength (psi)	55000
Casing Nom. ID (CSID) (in)	4.95
Casing Nom. Thk (THNO) (in)	0.28
Good/Bad Threshold (%)	12.5
ECCE Max(in)	0.15
Collapse Pressure	5315
Collapse Multiplier	1

## Pipe Tally Sheet - USI

Reduction in Thickness	List of Joints	Total # of Joints
0% to 12.5%	1, 2, 3, 4, 5, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24, 25, 26, 28, 29, 30, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 43, 44, 45, 46, 48, 49, 50, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 73, 74, 75, 76, 77, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 91, 92, 93, 95, 96, 97, 98, 99, 100, 101, 102, 104, 105, 109, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163	143
12.5% to 40%	6, 11, 23, 27, 31, 40, 47, 51, 72, 78, 90, 94, 103, 106, 107, 108, 110, 124, 125, 136	20
40% to 60%		0
60% to 100%		0
>100%		0
<b>Total</b>		<b>163</b>



# Casing Integrity Advisor



**Company Name:** XCel Energy Inc  
**Well Name:** Roundup 25  
**Field:** Roundup Storage Unit

## Joint Summary - USI

No. (Incl)	Joint Top	Length	Remark	Penetration (Min Thk)	USI Min in min Thick	USI Depth of MT	USI Ave Int. rad.	USI Min Int. rad.	USI Max Int. rad.	USI Depth of Max Int Rad	Min Burst Strength	Collapse Pressure	Min ID	Min ID Depth
	ft	ft		%	in	ft	in	in	in	ft	psig	psig	in	ft
1	52.89	18.99		<div></div> 3.6	0.270	65.25	2.449	2.427	2.467	65.25	5292	3894 (API3)	4.86	69.25
2	71.88	41.94		<div></div> 10.4	0.251	105.38	2.460	2.424	2.493	76.75	4920	3326 (API3)	4.86	76.63
3	113.82	42.93		<div></div> 8.6	0.256	152.88	2.451	2.423	2.476	118.00	5018	3476 (API3)	4.86	117.88
4	156.75	37.75		<div></div> 6.8	0.261	191.00	2.457	2.418	2.477	160.88	5116	3625 (API3)	4.86	160.88
5	194.50	38.14		<div></div> 9.6	0.253	231.13	2.458	2.410	2.493	200.38	4959	3386 (API3)	4.85	200.25
6	232.64	41.11	deep int milling	<div></div> 14.6	0.239	270.50	2.454	2.417	2.481	237.75	4684	2967 (API3)	4.85	237.88
7	273.75	38.75		<div></div> 8.9	0.255	278.50	2.456	2.418	2.499	278.75	4998	3446 (API3)	4.86	289.00
8	312.50	37.88		<div></div> 6.4	0.262	315.13	2.457	2.421	2.505	317.38	5135	3655 (API3)	4.86	315.13
9	350.38	40.62		<div></div> 9.6	0.253	353.25	2.465	2.427	2.509	355.75	4959	3386 (API3)	4.87	362.38
10	391.00	39.25		<div></div> 9.3	0.254	393.63	2.457	2.430	2.493	396.00	4978	3416 (API3)	4.87	428.13
11	430.25	39.88	int. milling & wear	<div></div> 13.9	0.241	433.75	2.463	2.437	2.507	432.88	4724	3027 (API3)	4.89	435.75
12	470.13	38.50		<div></div> 7.9	0.258	477.25	2.457	2.414	2.495	475.25	5057	3536 (API3)	4.86	475.25
13	508.63	36.50		<div></div> 7.5	0.259	509.88	2.458	2.427	2.495	511.25	5076	3566 (API3)	4.86	511.25
14	545.13	36.37	17 ppf joint	<div></div> 0.0	0.281	558.75	2.441	2.416	2.466	555.75	5508	4223 (API3)	4.84	547.75
15	581.50	38.00		<div></div> 10.0	0.252	584.38	2.469	2.426	2.500	600.13	4939	3356 (API3)	4.89	585.75
16	619.50	37.63		<div></div> 4.6	0.267	621.50	2.459	2.428	2.498	624.25	5233	3805 (API3)	4.87	646.13
17	657.13	40.12		<div></div> 10.0	0.252	660.13	2.477	2.450	2.519	659.88	4939	3356 (API3)	4.92	661.50
18	697.25	38.38		<div></div> 7.1	0.260	699.88	2.461	2.432	2.501	702.25	5096	3595 (API3)	4.87	702.25
19	735.63	38.62		<div></div> 6.8	0.261	738.50	2.458	2.433	2.495	738.38	5116	3625 (API3)	4.87	773.00
20	774.25	38.75		<div></div> 5.4	0.265	784.13	2.474	2.432	2.525	776.88	5194	3745 (API3)	4.89	778.75
21	813.00	37.75		<div></div> 7.9	0.258	816.88	2.461	2.428	2.492	817.38	5057	3536 (API3)	4.88	817.38
22	850.75	39.75		<div></div> 9.3	0.254	870.88	2.462	2.430	2.496	853.50	4978	3416 (API3)	4.88	853.38
23	890.50	39.13	int wear & wear	<div></div> 14.3	0.240	893.38	2.473	2.434	2.513	893.13	4704	2997 (API3)	4.90	894.75
24	929.63	38.62		<div></div> 6.4	0.262	938.75	2.473	2.445	2.510	932.25	5135	3655 (API3)	4.91	930.75
25	968.25	39.63		<div></div> 11.4	0.248	971.13	2.471	2.442	2.511	970.63	4861	3237 (API3)	4.91	970.75
26	1007.88	39.87		<div></div> 10.7	0.250	1012.25	2.472	2.444	2.500	1012.13	4900	3296 (API3)	4.90	1010.25
27	1047.75	41.00	int milling & wear	<div></div> 15.7	0.236	1053.75	2.481	2.447	2.517	1053.88	4626	2878 (API3)	4.91	1086.13
28	1088.75	38.75		<div></div> 10.4	0.251	1092.13	2.464	2.434	2.497	1094.13	4920	3326 (API3)	4.87	1118.00
29	1127.50	40.50		<div></div> 11.8	0.247	1130.38	2.470	2.432	2.503	1134.88	4841	3207 (API3)	4.88	1166.38
30	1168.00	36.75	17 ppf joint	<div></div> 2.9	0.272	1194.13	2.456	2.420	2.491	1202.13	5331	3954 (API3)	4.85	1170.00
31	1204.75	41.25	int milling & wear	<div></div> 13.6	0.242	1215.38	2.486	2.453	2.538	1207.38	4743	3057 (API3)	4.91	1209.88
32	1246.00	40.25		<div></div> 12.5	0.245	1249.00	2.484	2.451	2.523	1248.75	4802	3147 (API3)	4.90	1285.25
33	1286.25	40.50		<div></div> 11.4	0.248	1288.88	2.472	2.439	2.512	1290.88	4861	3237 (API3)	4.88	1315.50
34	1326.75	40.25		<div></div> 10.7	0.250	1335.38	2.484	2.450	2.518	1335.38	4900	3296 (API3)	4.91	1365.88
35	1367.00	40.00		<div></div> 10.4	0.251	1370.63	2.477	2.449	2.505	1369.50	4920	3326 (API3)	4.92	1368.00
36	1407.00	37.75		<div></div> 3.6	0.270	1409.50	2.459	2.421	2.499	1409.75	5292	3894 (API3)	4.86	1435.63
37	1444.75	37.63		<div></div> 7.1	0.260	1447.50	2.456	2.435	2.490	1447.38	5096	3595 (API3)	4.88	1457.75
38	1482.38	37.25		<div></div> 1.1	0.277	1486.25	2.458	2.414	2.488	1505.63	5429	4104 (API3)	4.84	1485.00
39	1519.63	41.00		<div></div> 10.7	0.250	1531.75	2.482	2.446	2.534	1522.25	4900	3296 (API3)	4.90	1545.50

No. (Incl)	Joint Top	Length	Remark	Penetration (Min Thk)	USI Min in m in Thick	USI Depth of MT	USI Ave Int. rad.	USI Min Int. rad.	USI Max Int. rad.	USI Depth of Max Int Rad	Min Burst Strength	Collapse Pressure	Min ID	Min ID Depth
	ft	ft		%	in	ft	in	in	in	ft	psig	psig	in	ft
40	1560.63	40.87	int wear	13.9	0.241	1563.38	2.482	2.444	2.519	1586.75	4724	3027 (API3)	4.91	1590.25
41	1601.50	39.13		7.9	0.258	1604.25	2.467	2.425	2.497	1608.13	5057	3536 (API3)	4.87	1638.50
42	1640.63	40.50		10.7	0.250	1644.75	2.479	2.442	2.514	1645.13	4900	3296 (API3)	4.91	1645.25
43	1681.13	41.12		11.4	0.248	1683.38	2.483	2.450	2.517	1683.50	4861	3237 (API3)	4.90	1692.38
44	1722.25	40.13		10.4	0.251	1731.50	2.469	2.439	2.503	1724.63	4920	3326 (API3)	4.89	1759.88
45	1762.38	40.37		9.3	0.254	1764.25	2.470	2.448	2.528	1765.00	4978	3416 (API3)	4.90	1791.13
46	1802.75	40.50		12.5	0.245	1805.75	2.478	2.447	2.520	1840.63	4802	3147 (API3)	4.91	1840.13
47	1843.25	39.00	manufacture anomaly	13.6	0.242	1844.50	2.478	2.431	2.535	1845.50	4743	3057 (API3)	4.88	1875.00
48	1882.25	38.38		9.6	0.253	1885.13	2.470	2.446	2.499	1884.63	4959	3386 (API3)	4.90	1904.00
49	1920.63	34.87	17 ppf joint	0.0	0.287	1923.50	2.431	2.400	2.482	1939.63	5625	4403 (API3)	4.81	1926.25
50	1955.50	40.38		11.8	0.247	1958.50	2.483	2.460	2.517	1969.75	4841	3207 (API3)	4.92	1994.63
51	1995.88	38.37	int wear	12.9	0.244	2031.13	2.468	2.425	2.504	2000.50	4782	3117 (API3)	4.87	2015.63
52	2034.25	39.38		10.4	0.251	2049.25	2.470	2.439	2.527	2036.63	4920	3326 (API3)	4.89	2072.38
53	2073.63	40.25		11.4	0.248	2076.13	2.476	2.451	2.503	2076.00	4861	3237 (API3)	4.90	2074.63
54	2113.88	40.25		10.4	0.251	2122.00	2.480	2.453	2.511	2116.38	4920	3326 (API3)	4.92	2152.50
55	2154.13	40.37		12.1	0.246	2156.75	2.481	2.450	2.509	2157.00	4822	3177 (API3)	4.91	2193.25
56	2194.50	40.00		10.0	0.252	2233.00	2.480	2.451	2.512	2204.38	4939	3356 (API3)	4.91	2232.38
57	2234.50	40.25		10.4	0.251	2240.88	2.476	2.446	2.516	2237.13	4920	3326 (API3)	4.91	2273.13
58	2274.75	39.00		7.9	0.258	2278.75	2.472	2.443	2.504	2277.38	5057	3536 (API3)	4.90	2309.13
59	2313.75	37.50		4.3	0.268	2316.25	2.460	2.416	2.502	2316.25	5253	3835 (API3)	4.86	2342.75
60	2351.25	40.00		8.6	0.256	2355.00	2.466	2.433	2.498	2370.25	5018	3476 (API3)	4.87	2373.75
61	2391.25	41.25		10.0	0.252	2399.75	2.478	2.435	2.505	2404.88	4939	3356 (API3)	4.90	2395.63
62	2432.50	39.38		9.6	0.253	2468.38	2.471	2.434	2.511	2434.75	4959	3386 (API3)	4.88	2434.75
63	2471.88	39.25		6.4	0.262	2474.50	2.466	2.434	2.497	2484.38	5135	3655 (API3)	4.88	2474.25
64	2511.13	37.75		7.1	0.260	2527.13	2.469	2.432	2.523	2513.50	5096	3595 (API3)	4.87	2513.25
65	2548.88	41.00		9.3	0.254	2551.63	2.480	2.447	2.507	2554.25	4978	3416 (API3)	4.90	2551.00
66	2589.88	38.37		6.4	0.262	2596.13	2.473	2.446	2.504	2602.63	5135	3655 (API3)	4.90	2626.00
67	2628.25	40.88		8.2	0.257	2635.38	2.473	2.444	2.516	2630.88	5037	3506 (API3)	4.90	2667.63
68	2669.13	37.75		6.8	0.261	2692.88	2.458	2.421	2.495	2671.63	5116	3625 (API3)	4.85	2671.88
69	2706.88	37.37		3.6	0.270	2710.38	2.457	2.422	2.489	2709.75	5292	3894 (API3)	4.86	2709.38
70	2744.25	40.50		11.8	0.247	2747.25	2.477	2.452	2.515	2746.75	4841	3207 (API3)	4.91	2783.75
71	2784.75	39.75		10.4	0.251	2788.25	2.476	2.446	2.520	2787.25	4920	3326 (API3)	4.89	2823.25
72	2824.50	40.13	wear	12.9	0.244	2827.13	2.472	2.449	2.497	2851.13	4782	3117 (API3)	4.91	2849.13
73	2864.63	41.00		11.4	0.248	2867.38	2.480	2.452	2.507	2878.25	4861	3237 (API3)	4.91	2900.88
74	2905.63	40.25		10.7	0.250	2911.63	2.474	2.448	2.501	2908.25	4900	3296 (API3)	4.90	2944.63
75	2945.88	40.37		11.1	0.249	2948.75	2.470	2.432	2.508	2948.50	4880	3266 (API3)	4.89	2975.25
76	2986.25	38.00		8.6	0.256	2997.13	2.463	2.425	2.506	3020.38	5018	3476 (API3)	4.86	2988.88
77	3024.25	40.50		12.1	0.246	3026.88	2.481	2.445	2.524	3026.88	4822	3177 (API3)	4.91	3030.25
78	3064.75	40.13	ext metal loss	13.9	0.241	3068.00	2.480	2.449	2.508	3067.38	4724	3027 (API3)	4.91	3103.38
79	3104.88	35.25	17 ppf joint	0.0	0.288	3111.25	2.436	2.396	2.474	3107.38	5645	4433 (API3)	4.81	3130.38
80	3140.13	39.62		9.6	0.253	3143.13	2.471	2.443	2.501	3142.75	4959	3386 (API3)	4.91	3166.88
81	3179.75	38.75		10.4	0.251	3182.50	2.472	2.444	2.524	3182.38	4920	3326 (API3)	4.90	3199.50
82	3218.50	38.75		8.9	0.255	3223.75	2.478	2.453	2.509	3221.00	4998	3446 (API3)	4.92	3255.75
83	3257.25	40.50		8.9	0.255	3260.88	2.474	2.444	2.518	3259.88	4998	3446 (API3)	4.90	3293.88
84	3297.75	38.13		7.9	0.258	3300.13	2.464	2.424	2.496	3314.13	5057	3536 (API3)	4.88	3333.38
85	3335.88	40.87		9.6	0.253	3340.25	2.472	2.444	2.502	3348.00	4959	3386 (API3)	4.90	3358.00



No. (Incl)	Joint Top	Length	Rem ark	Penetration (Min Thk)	USI Min m in Thick	USI Depth of MT	USI Ave Int. rad.	USI Min Int. rad.	USI Max Int. rad.	USI Depth of Max Int Rad	Min Burst Strength	Collapse Pressure	Min ID	Min ID Depth
	ft	ft		%	in	ft	in	in	in	ft	psig	psig	in	ft
86	3376.75	39.00		<div></div> 10.7	0.250	3378.00	2.464	2.436	2.494	3405.38	4900	3296 (API3)	4.88	3399.13
87	3415.75	38.75		<div></div> 7.1	0.260	3418.75	2.463	2.430	2.498	3418.38	5096	3595 (API3)	4.86	3417.13
88	3454.50	39.75		<div></div> 12.5	0.245	3457.50	2.471	2.440	2.502	3457.50	4802	3147 (API3)	4.89	3463.63
89	3494.25	41.25		<div></div> 11.4	0.248	3502.50	2.476	2.448	2.522	3496.88	4861	3237 (API3)	4.90	3534.38
90	3535.50	40.63	int milling	<div></div> 13.6	0.242	3541.88	2.465	2.440	2.493	3540.25	4743	3057 (API3)	4.89	3573.25
91	3576.13	37.87		<div></div> 7.5	0.259	3578.88	2.459	2.435	2.485	3600.13	5076	3566 (API3)	4.88	3613.13
92	3614.00	38.63		<div></div> 8.6	0.256	3616.63	2.476	2.453	2.519	3616.63	5018	3476 (API3)	4.91	3651.75
93	3652.63	39.62		<div></div> 6.8	0.261	3655.38	2.471	2.438	2.504	3655.25	5116	3625 (API3)	4.90	3655.13
94	3692.25	41.38	int milling	<div></div> 12.9	0.244	3695.13	2.474	2.451	2.499	3699.88	4782	3117 (API3)	4.91	3725.38
95	3733.63	39.37	ext metal loss	<div></div> 11.8	0.247	3737.00	2.467	2.442	2.508	3736.13	4841	3207 (API3)	4.90	3771.25
96	3773.00	37.63		<div></div> 5.7	0.264	3776.13	2.457	2.424	2.498	3775.75	5174	3715 (API3)	4.86	3808.75
97	3810.63	38.12		<div></div> 6.1	0.263	3813.63	2.467	2.444	2.522	3813.13	5155	3685 (API3)	4.89	3813.13
98	3848.75	39.13		<div></div> 8.2	0.257	3855.50	2.466	2.437	2.491	3859.25	5037	3506 (API3)	4.88	3851.25
99	3887.88	42.87		<div></div> 10.4	0.251	3890.63	2.469	2.445	2.501	3911.50	4920	3326 (API3)	4.89	3917.75
100	3930.75	40.63		<div></div> 11.8	0.247	3933.75	2.476	2.446	2.504	3954.50	4841	3207 (API3)	4.90	3969.88
101	3971.38	39.84		<div></div> 10.4	0.251	3974.13	2.465	2.441	2.501	3973.88	4920	3326 (API3)	4.89	4008.50
102	4011.22	41.03		<div></div> 11.4	0.248	4029.25	2.467	2.444	2.512	4013.63	4861	3237 (API3)	4.90	4047.38
103	4052.25	42.25	norm wear & thin joint	<div></div> 17.1	0.232	4054.63	2.485	2.451	2.521	4054.63	4547	2758 (API3)	4.91	4061.00
104	4094.50	39.00		<div></div> 6.1	0.263	4131.63	2.458	2.424	2.485	4127.63	5155	3685 (API3)	4.86	4096.63
105	4133.50	38.13		<div></div> 3.2	0.271	4136.50	2.453	2.422	2.501	4136.13	5312	3924 (API3)	4.86	4168.25
106	4171.63	38.62	int milling & wear	<div></div> 15.4	0.237	4173.75	2.471	2.447	2.511	4173.75	4645	2908 (API3)	4.91	4191.38
107	4210.25	38.50	int milling & wear	<div></div> 13.9	0.241	4213.38	2.471	2.441	2.500	4231.38	4724	3027 (API3)	4.90	4247.00
108	4248.75	38.75	int milling & wear	<div></div> 13.2	0.243	4251.50	2.474	2.440	2.504	4277.88	4763	3087 (API3)	4.89	4262.63
109	4287.50	38.00		<div></div> 7.5	0.259	4290.25	2.472	2.446	2.502	4290.13	5076	3566 (API3)	4.90	4314.38
110	4325.50	39.25	ext metal loss	<div></div> 15.0	0.238	4327.75	2.478	2.449	2.529	4327.75	4665	2938 (API3)	4.91	4347.00
111	4364.75	38.75		<div></div> 6.4	0.262	4371.75	2.467	2.442	2.494	4383.63	5135	3655 (API3)	4.89	4400.88
112	4403.50	37.88		<div></div> 7.1	0.260	4406.00	2.474	2.449	2.521	4405.63	5096	3595 (API3)	4.90	4438.38
113	4441.38	39.25		<div></div> 5.4	0.265	4452.75	2.458	2.425	2.482	4467.25	5194	3745 (API3)	4.85	4466.38
114	4480.63	39.75		<div></div> 9.6	0.253	4483.63	2.462	2.435	2.491	4483.50	4959	3386 (API3)	4.88	4519.38
115	4520.38	39.87		<div></div> 10.7	0.250	4525.50	2.465	2.436	2.493	4527.00	4900	3296 (API3)	4.89	4556.50
116	4560.25	38.38		<div></div> 3.6	0.270	4569.13	2.457	2.429	2.490	4563.00	5292	3894 (API3)	4.87	4597.50
117	4598.63	36.00		<div></div> 5.0	0.266	4601.38	2.449	2.422	2.494	4601.25	5214	3775 (API3)	4.85	4621.00
118	4634.63	38.25		<div></div> 7.1	0.260	4637.00	2.465	2.440	2.500	4637.25	5096	3595 (API3)	4.89	4637.25
119	4672.88	37.12		<div></div> 5.7	0.264	4675.63	2.459	2.432	2.487	4675.13	5174	3715 (API3)	4.88	4675.25
120	4710.00	39.38	ext metal loss	<div></div> 8.9	0.255	4746.38	2.471	2.441	2.514	4712.25	4998	3446 (API3)	4.89	4742.88
121	4749.38	39.62		<div></div> 8.9	0.255	4754.63	2.462	2.429	2.525	4752.00	4998	3446 (API3)	4.88	4766.50
122	4789.00	38.38		<div></div> 5.4	0.265	4802.00	2.456	2.434	2.501	4791.50	5194	3745 (API3)	4.88	4820.63
123	4827.38	40.12		<div></div> 9.3	0.254	4861.25	2.466	2.441	2.490	4830.50	4978	3416 (API3)	4.88	4860.25
124	4867.50	40.63	thin joint & normal wear	<div></div> 12.9	0.244	4870.50	2.480	2.454	2.506	4870.00	4782	3117 (API3)	4.92	4902.38
125	4908.13	41.37	thin joint & normal wear	<div></div> 12.9	0.244	4912.63	2.473	2.452	2.497	4943.00	4782	3117 (API3)	4.91	4930.88
126	4949.50	38.50		<div></div> 8.2	0.257	4952.38	2.455	2.426	2.499	4952.13	5037	3506 (API3)	4.87	4963.63
127	4988.00	37.63		<div></div> 9.3	0.254	4992.63	2.460	2.429	2.492	5010.13	4978	3416 (API3)	4.87	5023.38
128	5025.63	38.37		<div></div> 11.8	0.247	5026.88	2.479	2.442	2.505	5038.38	4841	3207 (API3)	4.89	5028.25
129	5064.00	39.50		<div></div> 12.1	0.246	5066.63	2.467	2.440	2.489	5066.75	4822	3177 (API3)	4.88	5066.63
130	5103.50	40.38		<div></div> 9.6	0.253	5106.38	2.474	2.442	2.540	5106.13	4959	3386 (API3)	4.89	5142.88
131	5143.88	38.87		<div></div> 9.6	0.253	5146.63	2.463	2.434	2.546	5180.38	4959	3386 (API3)	4.87	5170.13

No. (Incl)	Joint Top	Length	Remark	Penetration (Min Thk)	USI Min in Thick	USI Depth of MT	USI Ave Int. rad.	USI Min Int. rad.	USI Max Int. rad.	USI Depth of Max Int Rad	Min Burst Strength	Collapse Pressure	Min ID	Min ID Depth
	ft	ft		%	in	ft	in	in	in	ft	psig	psig	in	ft
132	5182.75	38.50		10.4	0.251	5186.38	2.462	2.420	2.528	5188.00	4920	3326 (API3)	4.86	5187.00
133	5221.25	37.88		5.0	0.266	5223.88	2.461	2.426	2.503	5223.75	5214	3775 (API3)	4.86	5227.75
134	5259.13	40.50		8.6	0.256	5262.13	2.452	2.424	2.493	5261.75	5018	3476 (API3)	4.86	5298.63
135	5299.63	38.62		7.9	0.258	5302.25	2.451	2.424	2.481	5305.75	5057	3536 (API3)	4.86	5326.63
136	5338.25	43.00	thin joint & int wear	14.6	0.239	5342.38	2.476	2.445	2.517	5340.88	4684	2967 (API3)	4.90	5380.13
137	5381.25	38.50		8.6	0.256	5384.25	2.459	2.425	2.484	5383.75	5018	3476 (API3)	4.85	5383.63
138	5419.75	36.00		2.5	0.273	5422.13	2.448	2.419	2.493	5422.00	5351	3984 (API3)	4.85	5454.00
139	5455.75	37.88		3.6	0.270	5492.63	2.439	2.412	2.513	5458.38	5292	3894 (API3)	4.84	5477.38
140	5493.63	38.12		8.6	0.256	5496.25	2.463	2.423	2.509	5495.88	5018	3476 (API3)	4.86	5495.88
141	5531.75	40.88		11.8	0.247	5534.63	2.470	2.428	2.503	5534.38	4841	3207 (API3)	4.87	5563.00
142	5572.63	38.75		10.0	0.252	5580.63	2.464	2.431	2.518	5575.25	4939	3356 (API3)	4.87	5575.13
143	5611.38	39.37		8.9	0.255	5613.75	2.465	2.428	2.496	5629.75	4998	3446 (API3)	4.86	5614.00
144	5650.75	39.25		11.8	0.247	5653.75	2.458	2.428	2.518	5653.38	4841	3207 (API3)	4.86	5683.00
145	5690.00	37.88		8.6	0.256	5692.75	2.460	2.425	2.493	5695.38	5018	3476 (API3)	4.85	5705.25
146	5727.88	37.87		4.6	0.267	5730.50	2.452	2.415	2.497	5730.25	5233	3805 (API3)	4.85	5764.00
147	5765.75	36.38		7.1	0.260	5785.63	2.457	2.434	2.488	5773.63	5096	3595 (API3)	4.87	5797.13
148	5802.13	40.25		10.0	0.252	5804.50	2.464	2.433	2.495	5804.38	4939	3356 (API3)	4.87	5812.63
149	5842.38	39.00		12.1	0.246	5852.25	2.467	2.432	2.528	5844.50	4822	3177 (API3)	4.88	5880.13
150	5881.38	39.00		8.2	0.257	5884.25	2.453	2.426	2.486	5884.13	5037	3506 (API3)	4.87	5901.75
151	5920.38	37.75		3.2	0.271	5935.00	2.451	2.415	2.489	5922.75	5312	3924 (API3)	4.84	5956.75
152	5958.13	38.62		8.2	0.257	5960.63	2.453	2.431	2.519	5960.50	5037	3506 (API3)	4.87	5980.13
153	5996.75	39.13		7.1	0.260	6008.50	2.460	2.429	2.489	6032.88	5096	3595 (API3)	4.87	6013.63
154	6035.88	42.50		12.1	0.246	6038.38	2.476	2.448	2.545	6038.50	4822	3177 (API3)	4.91	6054.38
155	6078.38	39.87		8.2	0.257	6084.88	2.463	2.430	2.497	6097.38	5037	3506 (API3)	4.87	6113.00
156	6118.25	37.50		5.0	0.266	6124.38	2.455	2.431	2.492	6120.63	5214	3775 (API3)	4.87	6154.63
157	6155.75	41.13		10.4	0.251	6159.00	2.472	2.444	2.498	6179.00	4920	3326 (API3)	4.90	6187.88
158	6196.88	39.87		8.2	0.257	6199.63	2.453	2.425	2.512	6199.50	5037	3506 (API3)	4.86	6233.13
159	6236.75	38.88		11.1	0.249	6274.50	2.461	2.429	2.494	6239.13	4880	3266 (API3)	4.88	6273.75
160	6275.63	39.25		6.4	0.262	6280.88	2.459	2.422	2.521	6277.88	5135	3655 (API3)	4.87	6277.63
161	6314.88	38.00		5.0	0.266	6320.25	2.457	2.423	2.484	6349.88	5214	3775 (API3)	4.86	6351.00
162	6352.88	40.37		10.7	0.250	6359.25	2.472	2.445	2.499	6383.63	4900	3296 (API3)	4.90	6366.75
163	6393.25	27.25		6.1	0.263	6397.63	2.466	2.429	2.515	6395.88	5155	3685 (API3)	4.88	6395.88

## Joint Summary Reference Table

Column	Unit	Explanation
No. (Incl)		Joint Number
Joint Top	ft	Top of joint. Measured to center of collar above.
Joint Length	ft	Length of joint. Difference of Base and Top.
Remark		General interpreters remarks.
Penetration	%	Penetration. % of total wall thickness lost. Method dependant on the source of min. thickness measurement. -Minimum thickness: Used where direct thickness measurement is available. The single azimuthal point with the minimum thickness in the joint. $\%pen = (1 - (minTHK / CTHK)) * 100$ .  -minTHK = Measured thickness. -CTHK = Casing Nominal thickness
USI Min in Thick	in	Minimum minimum thickness. Single azimuthal measurement with the minimum thickness in the joint. Minimum of all level by level minimums. Same as minimum value of THMN channel within the joint.
USI Depth of MT	ft	Depth of Min Min Thickness.

Column	Unit	Explanation
USI Ave Int. rad.	in	Average Internal Radius. Average of all level by level average internal radius measurements in the joint. Same as average value of IRAV channel within the joint.
USI Min Int. rad.	in	Minimum Internal Radius. Minimum of all minimum radii at each level within the joint. Same as minimum value of IRMN channel within the joint.
USI Max Int. rad.	in	Maximum Internal Radius. Maximum of all maximum radii at each level within the joint. Same as maximum value of IRMX channel within the joint.
USI Depth of Max Int Rad	ft	Depth of Maximum Internal Radius. Depth of event IRMX_C_U
Min Burst Strength	psig	<p>Minimum Burst strength. Burst is computed using the computed minimum thickness in the joint. The source for the thickness measurement is:</p> <p>USI thickness: THK=Min thickness from USI.</p> $\text{Burst} = \text{burstSafetyFactor} * \text{YS} * 2 * \text{THK} / \text{COD}$ <p>-burst safety factor = 0.98          -YS = Yield Strength for casing (current joint)          -THK = computed remaining thickness from above method          -COD = Casing Nominal Diameter.</p>
Collapse Pressure	psig	Collapse pressure. API computation for collapse pressure given by API 1, API 3 API 5 Or API 7. All are based on ratio of Diameter to thickness and Yield Strength, where thickness is measured by one of the above methods. The user can select to have to the program select the best method depending on range of D/thickness or can select one of the API equations.
Min ID	in	Minimum Internal Diameter. Computed from pair of 180 degree apart calipers radius readings that produce the smallest sum or diameter.
Min ID Depth	ft	Depth of the Minimum Internal Diameter value.

## Casing Integrity Advisor

### Repeat Sections

0.6 inch sampling

No. (Incl)	Joint Top	Length	Comment	Remark	Penetration (Min Thk)	USI Min min Thick	USI Depth of MT	USI Ave Int. rad.	USI Min Int. rad.	USI Max Int. rad.	USI Depth of Max Int Rad	Min Burst Strength	Collapse Pressure	Min ID	Min ID Depth
	ft	ft			%	in	ft	in	in	in	ft	psig	psig	in	ft
✓49	1920.60	34.75			0.0	0.284	1923.50	2.444	2.410	2.499	1927.95	5566	4313 (API3)	4.83	1953.95

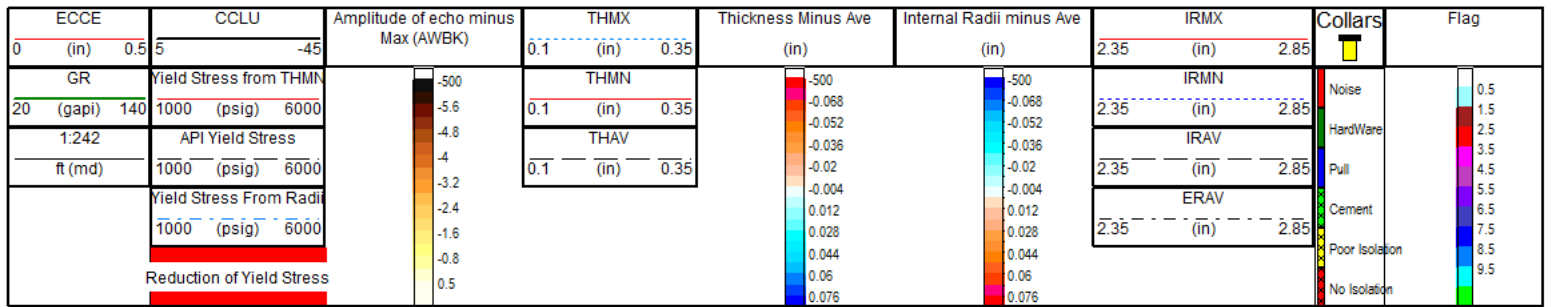
No. (Incl)	Joint Top	Length	Comment	Remark	Penetration (Min Thk)	USI Min min Thick	USI Depth of MT	USI Ave Int. rad.	USI Min Int. rad.	USI Max Int. rad.	USI Depth of Max Int Rad	Min Burst Strength	Collapse Pressure	Min ID	Min ID Depth
	ft	ft			%	in	ft	in	in	in	ft	psig	psig	in	ft
✓95	3733.99	39.21		external	12.1	0.246	3736.70	2.467	2.440	2.502	3736.60	4822	3177 (API3)	4.89	3770.60

No. (Incl)	Joint Top	Length	Comment	Remark	Penetration (Min Thk)	USI Min min Thick	USI Depth of MT	USI Ave Int. rad.	USI Min Int. rad.	USI Max Int. rad.	USI Depth of Max Int Rad	Min Burst Strength	Collapse Pressure	Min ID	Min ID Depth
	ft	ft			%	in	ft	in	in	in	ft	psig	psig	in	ft
✓103	4051.95	42.65		Thin Joint	17.1	0.232	4054.80	2.486	2.444	2.543	4054.80	4547	2758 (API3)	4.91	4059.10

No. (Incl)	Joint Top	Length	Comment	Remark	Penetration (Min Thk)	USI Min min Thick	USI Depth of MT	USI Ave Int. rad.	USI Min Int. rad.	USI Max Int. rad.	USI Depth of Max Int Rad	Min Burst Strength	Collapse Pressure	Min ID	Min ID Depth
	ft	ft			%	in	ft	in	in	in	ft	psig	psig	in	ft
✓110	4324.63	40.17		ext wear	15.0	0.238	4327.95	2.479	2.450	2.514	4327.90	4665	2938 (API3)	4.91	4355.90

No. (Incl)	Joint Top	Length	Comment	Remark	Penetration (Min Thk)	USI Min min Thick	USI Depth of MT	USI Ave Int. rad.	USI Min Int. rad.	USI Max Int. rad.	USI Depth of Max Int Rad	Min Burst Strength	Collapse Pressure	Min ID	Min ID Depth
	ft	ft			%	in	ft	in	in	in	ft	psig	psig	in	ft
✓131	5144.40	38.40			0.0	0.252	5146.05	2.465	2.440	2.494	5146.85	4939	3356 (API3)	4.89	5145.90
✓132	5182.80	38.50			5.4	0.262	5192.65	2.461	2.436	2.488	5203.95	5135	3655 (API3)	4.87	5191.95
✓133	5221.30	38.05			5.4	0.265	5224.10	2.459	2.427	2.491	5223.65	5194	3745 (API3)	4.86	5227.60

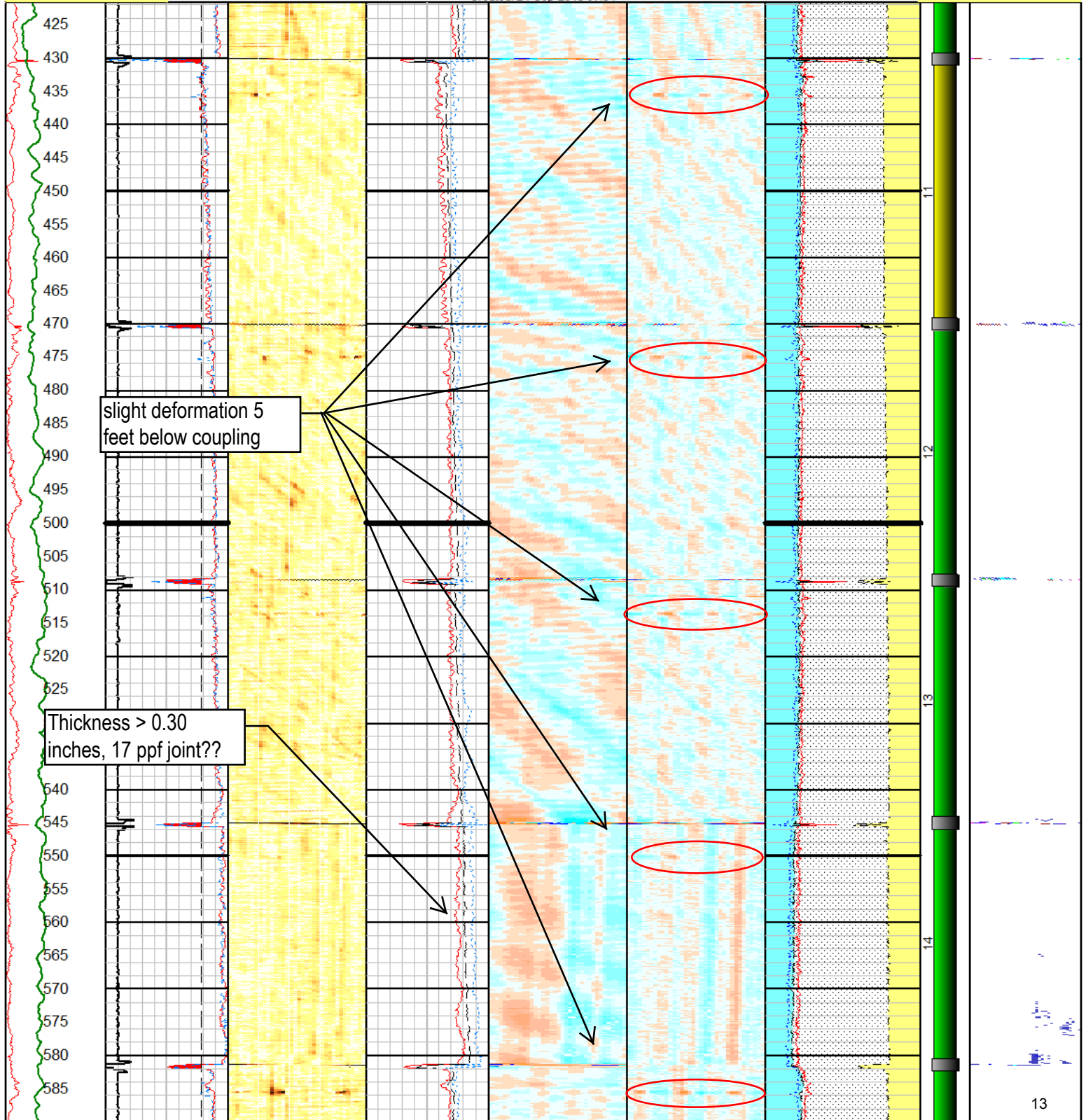




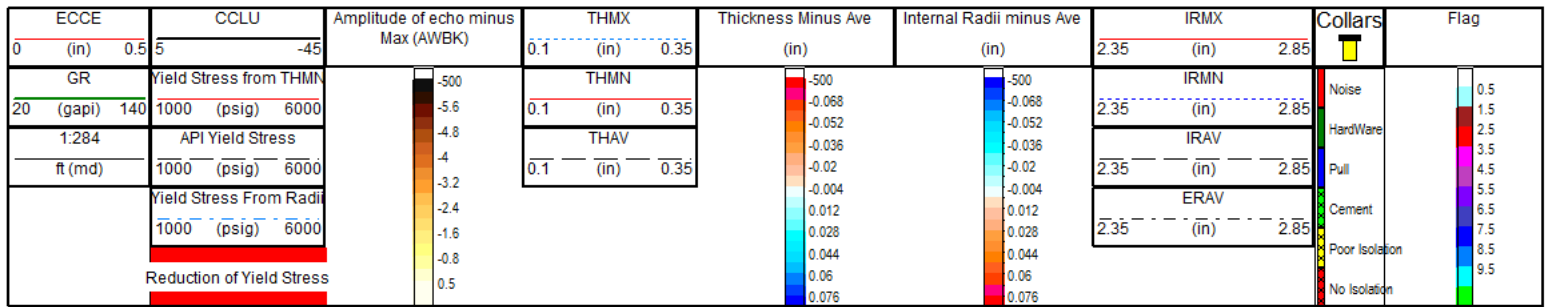
Triangular deformation

USI Log  
Roundup 25 (UWID: Lic: )  
Created: 24-Sep-2013 07:54

Triangular deformation



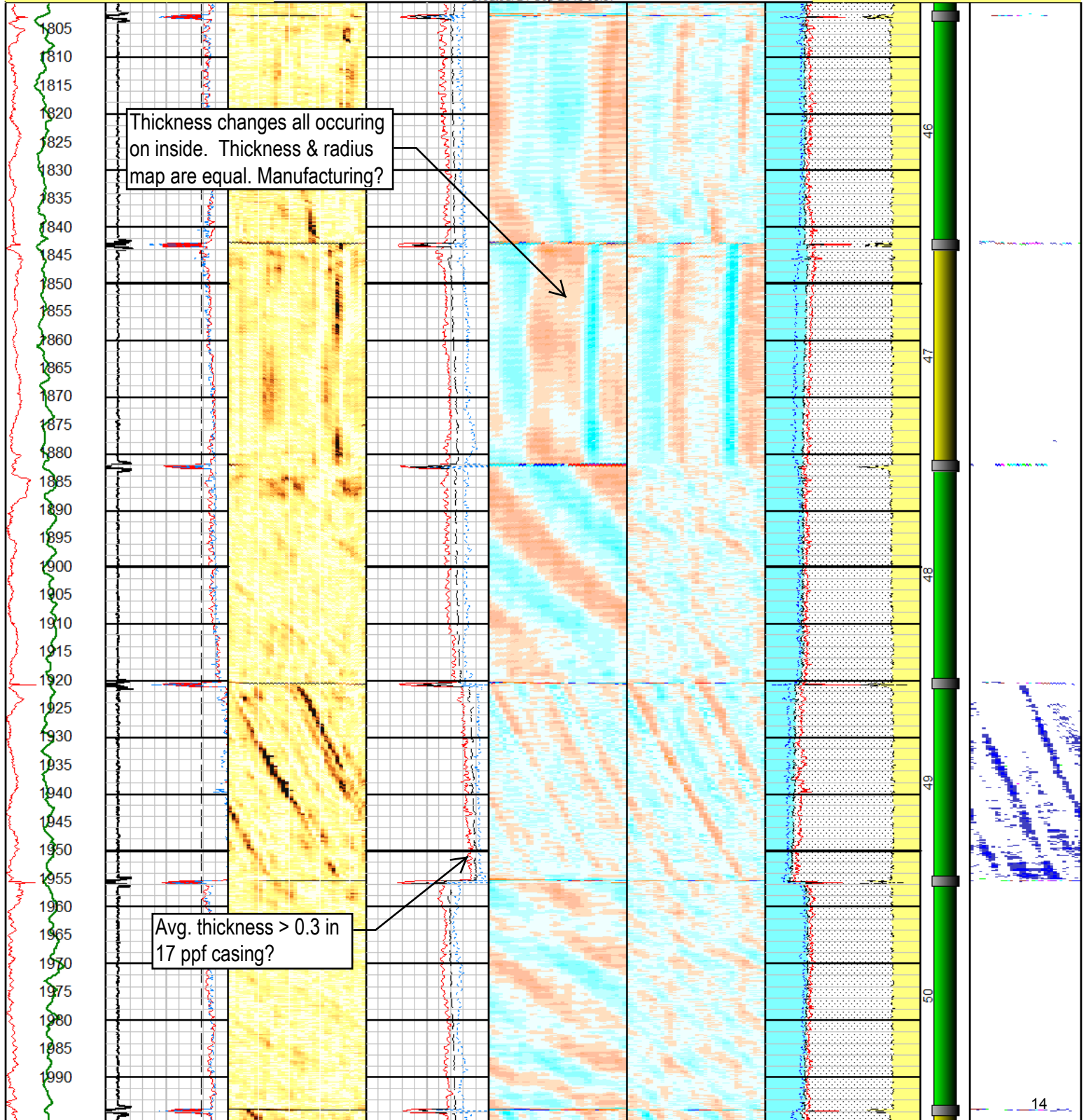


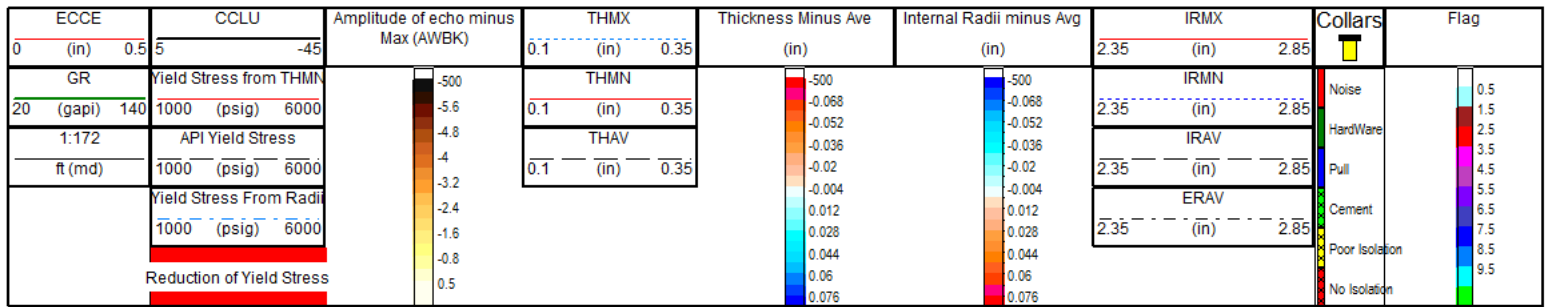


Manufacture anomaly & 17 ppf casing

USI Log  
Roundup 25 (UWID: Lic: )  
Created: 24-Sep-2013 08:57

Manufacture anomaly & 17 ppf casing

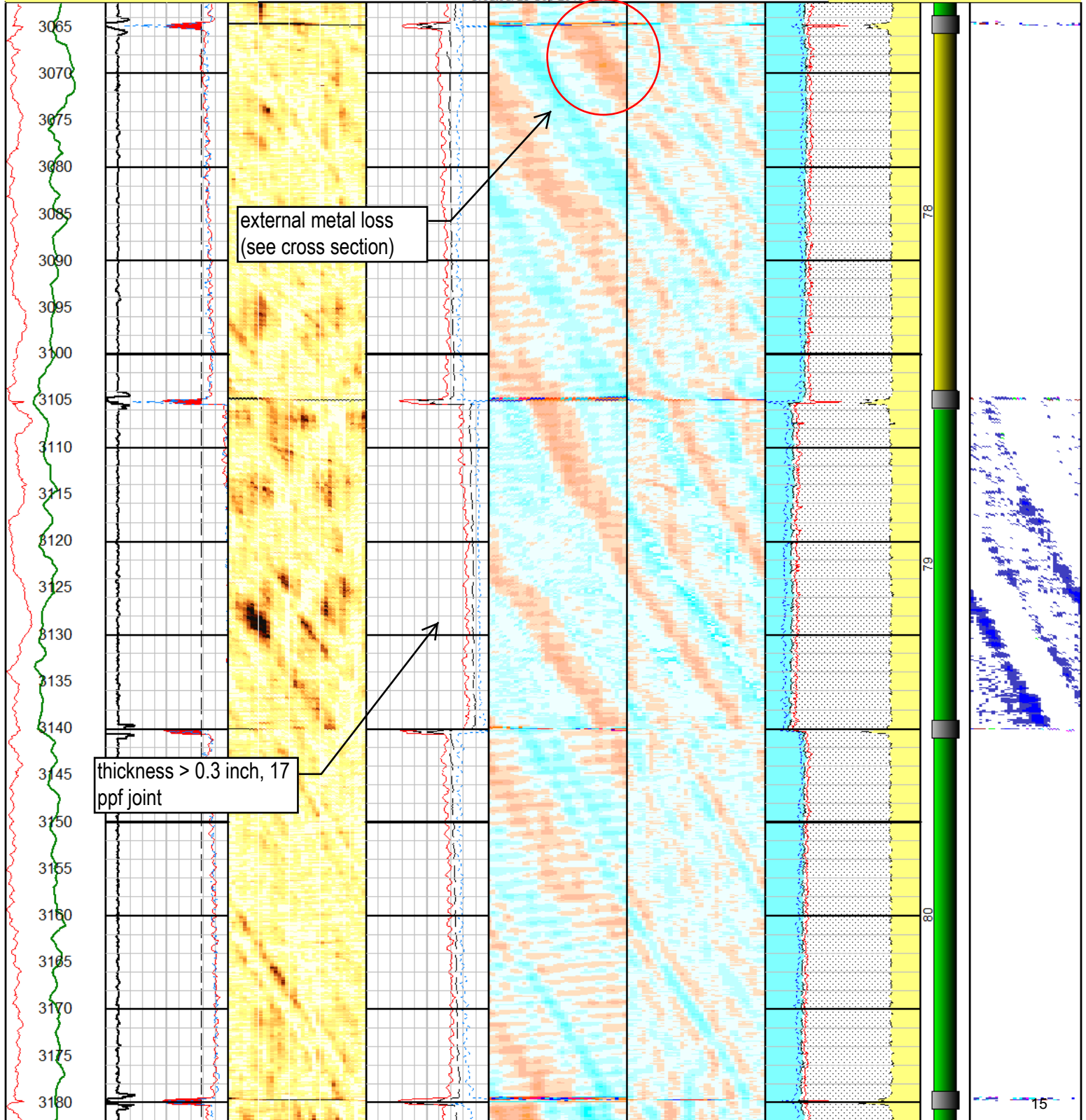




Jt 78 - External loss, Jt 70 - 17 ppf?

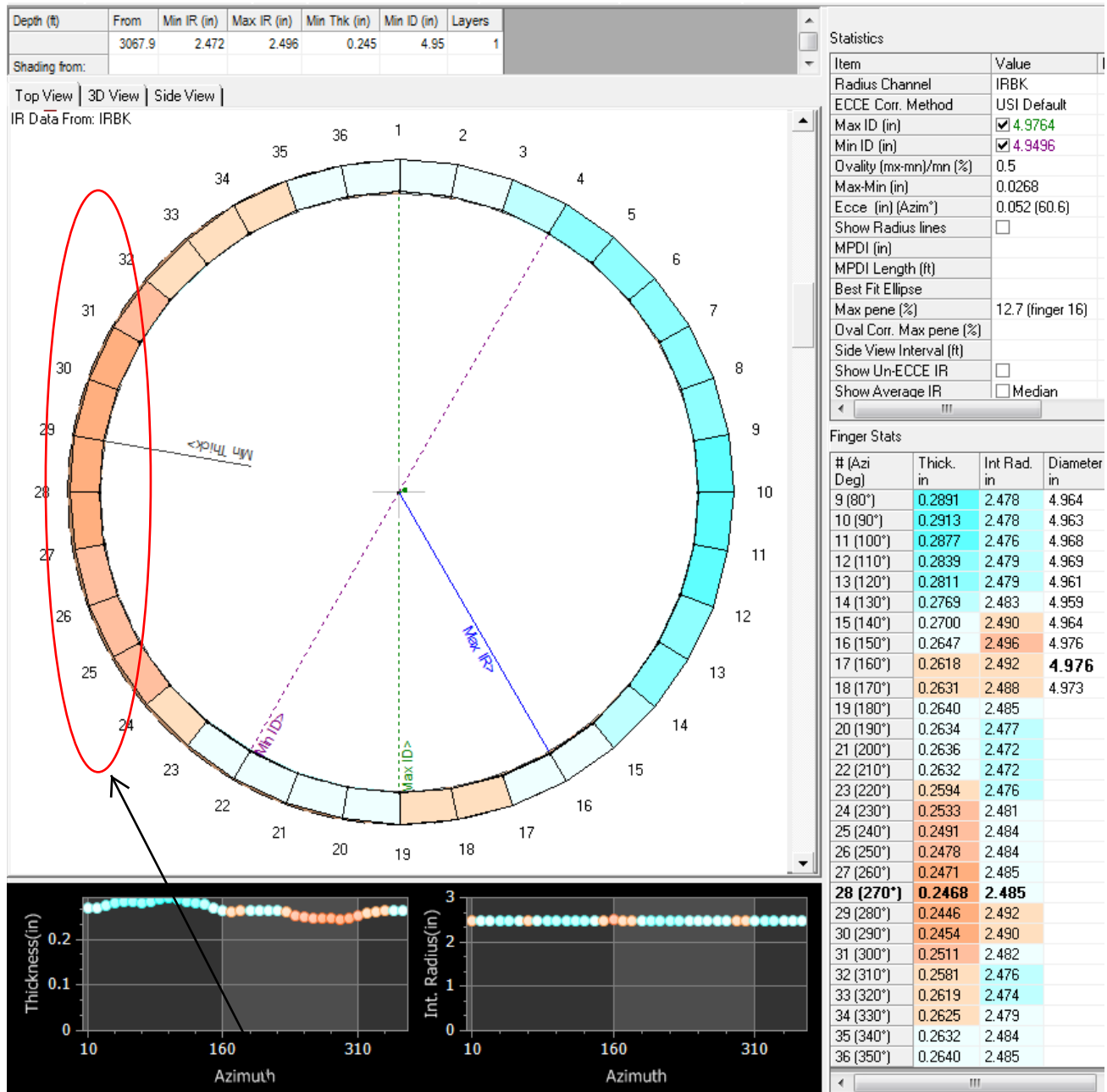
USI Log  
Roundup 25 (UWID: Lic: )  
Created: 25-Sep-2013 09:01

Jt 78 - External loss, Jt 70 - 17 ppf?

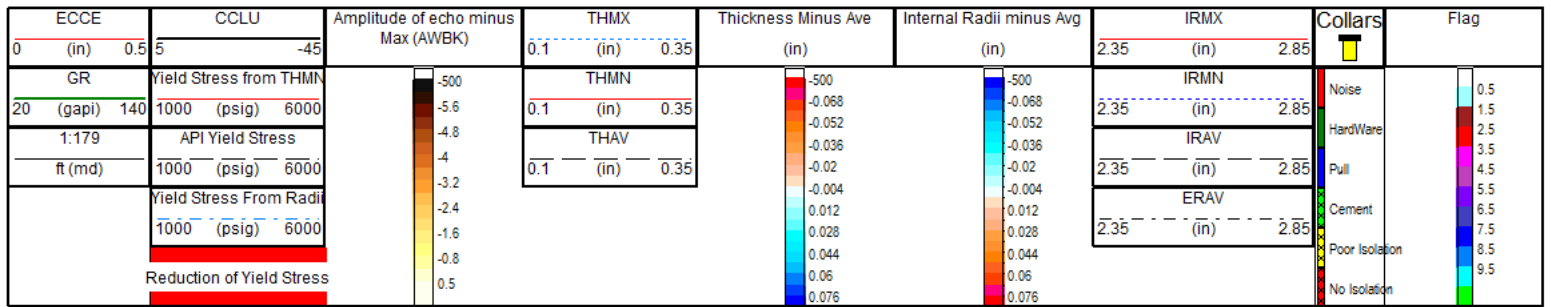


# Casing Integrity Advisor

## Joint 78 X-Section @ 3068 ft



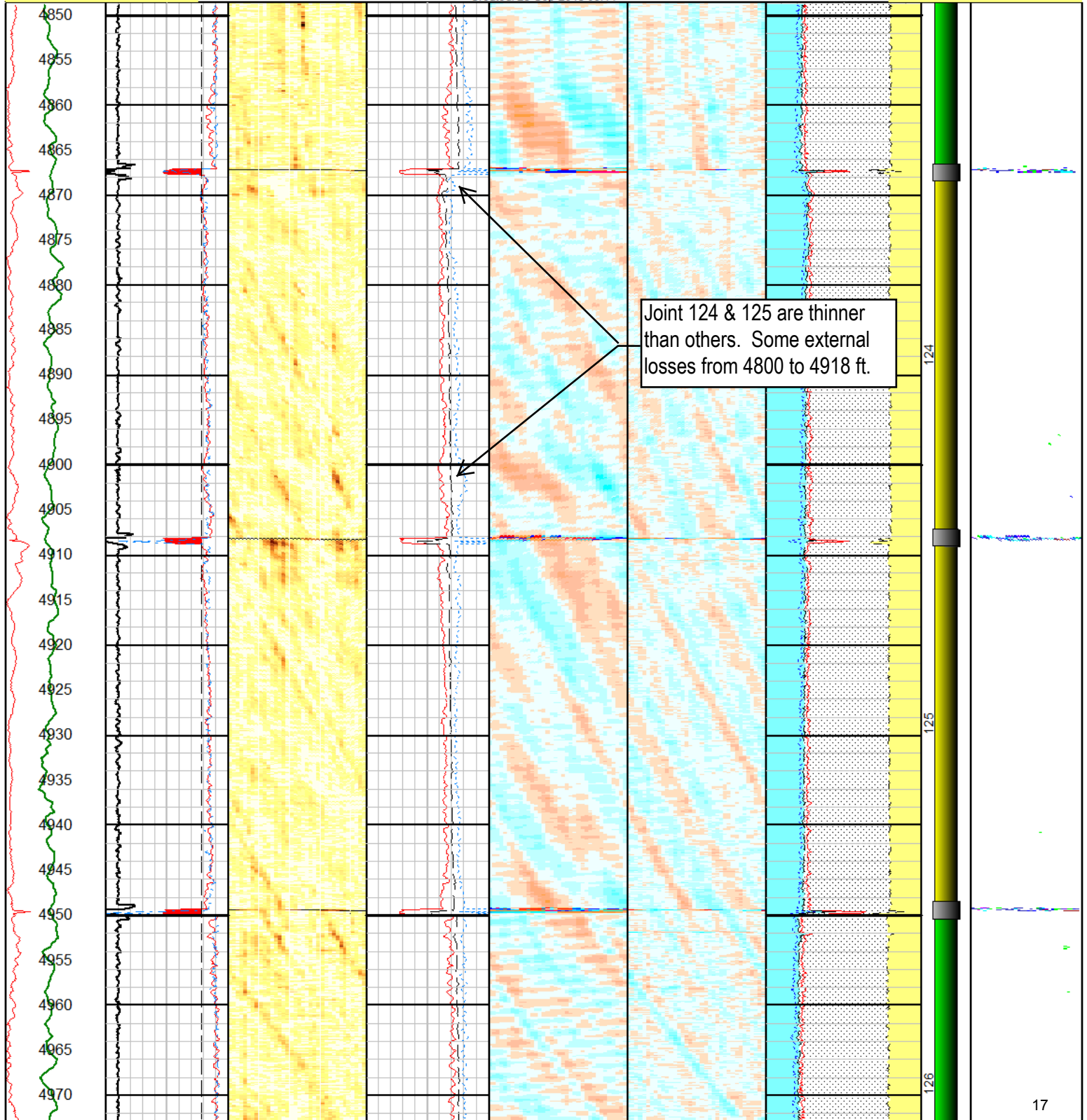




Thinner than average joints

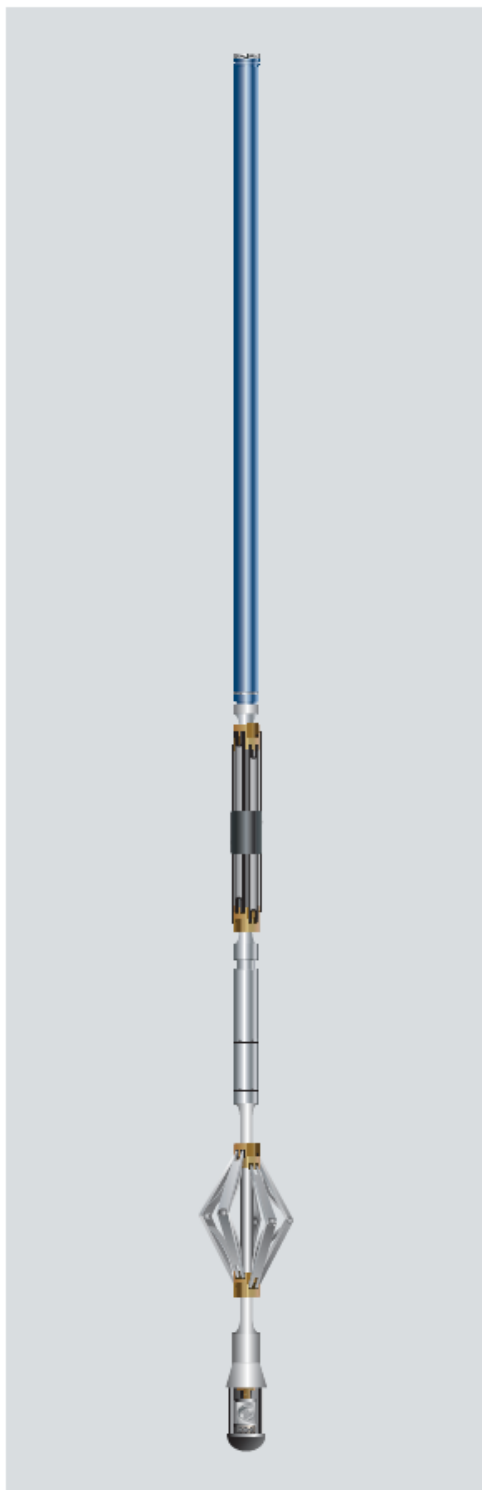
USI Log  
Roundup 25 (UWID: Lic.)  
Created: 25-Sep-2013 09:14

Thinner than average joints



# USI UltraSonic Imager Tool

**Schlumberger**



The USI\* UltraSonic Imager tool (USIT) uses a single transducer mounted on an Ultrasonic Rotating Sub (USRS) on the bottom of the tool. The transmitter emits ultrasonic pulses between 200 and 700 kHz and measures the received ultrasonic waveforms reflected from the internal and external casing interfaces. The rate of decay of the waveforms received indicates the quality of the cement bond at the cement/casing interface, and the resonant frequency of the casing provides the casing wall thickness required for pipe inspection. Because the transducer is mounted on the rotating sub, the entire circumference of the casing is scanned. This 360° data coverage enables the evaluation of the quality of the cement bond as well as the determination of the internal and external casing condition. The very high angular and vertical resolutions can detect channels as narrow as 1.2 in. [3.05 cm]. Cement bond, thickness, internal and external radii, and self-explanatory maps are generated in real time at the wellsite.

## Applications

- Cement evaluation
- Casing inspection
  - Corrosion detection and monitoring
  - Detection of internal and external damage or deformation
  - Casing thickness analysis for collapse and burst pressure calculations

## Measurement Specifications

	USIT
Output	Acoustic impedance, cement bonding to casing, internal radius, casing thickness
Logging speed	1,800 ft/hr [549 m/h]
Range of measurement	Acoustic impedance: 0 to 10 MRayl [0 to 10 MPa.s/m]
Vertical resolution	Standard: 6 in. [15.24 cm]
Accuracy	Less than 3.3 MRayl: ±0.5 MRayl
Depth of investigation	Casing-to-cement interface
Mud type or weight limitations <sup>†</sup>	Water-base mud: Up to 15.9 lbm/gal Oil-base mud: Up to 11.2 lbm/gal
Combinability	Bottom-only tool, combinable with most tools
Special applications	Identification and orientation of narrow channels

<sup>†</sup>Exact value depends on the type of mud system and casing size.

## Mechanical Specifications

	USIT
Temperature rating	350°F [177°C]
Pressure rating	20,000 psi [138 MPa]
Casing size—min.	4½ in. [11.43 cm]
Casing size—max.	13¾ in. [33.97 cm]
Outer diameter <sup>†</sup>	3.375 in. [8.57 cm]
Length <sup>†</sup>	19.75 ft [6.02 m]
Weight <sup>†</sup>	333 lbm [151 kg]
Tension	40,000 lbf [177,930 N]
Compression	4,000 lbf [17,790 N]

<sup>†</sup>Excluding the rotating sub