

APR INSPECTION ON HEAT EXCHANGER TUBES IN CHINA

DATE OF INSPECTION	24 July 2021	TOTAL NO. OF TUBES INSPECTED	1,452
LOCATION	Guangzhou, China	CONFIGURATION	Straight tubes
		TUBE OUTER DIAMETER	19mm
		TUBE THICKNESS	2mm
		TUBE LENGTH	9m

THE CHALLENGE

The client had a short turn-around schedule and wanted the heat exchanger tubes inspected within 3 days of cleaning.

THE SOLUTION

Acoustic Pulse Reflectometry Technology Inspection System (APRIS) can identify holes, blockages, and wall loss in a tube of regardless of tube configuration and material. It is quick as it takes only **10 seconds per tube** for measurement and can give the **location and size** of the defects.

THE RESULT

After measurements were taken by APRIS, a report was submitted the next day. One (1) tube had been identified with a 1mm hole and four (4) tubes with more than 60% wall loss. There were several tubes with blockages.

The APRIS software generates insightful information on the condition of the tubes using professional formats such as charts, tables, and images (See graphs, charts and table below).

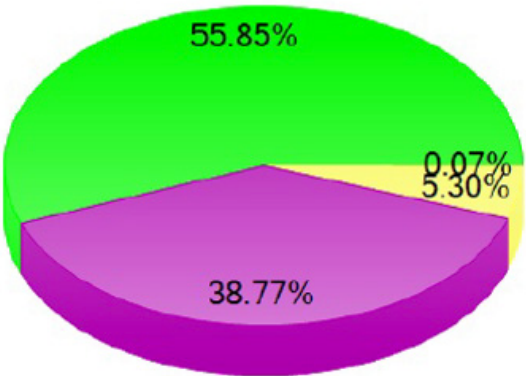
From Report:



Legend

Name	Value
Holes	
Blockages	
Wall loss	
Unknown	
No faults detected	
Not inspected	

Image 1: Tube sheet defects marking.



	Holes (1)	00.07%
	Blockages (77)	05.30%
	Wall loss (563)	38.77%
	No faults detected (811)	55.85%

Chart 1: Defect quantity pie chart

Defect table by tubes:

Defect table by tubes

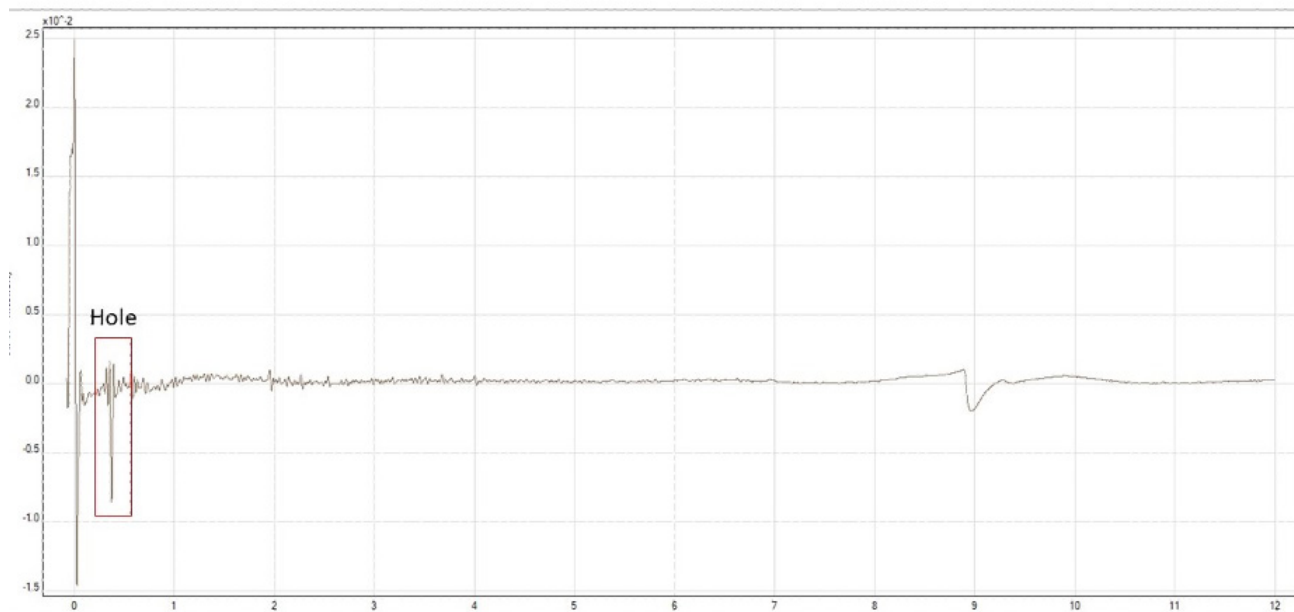
Fault ID	Tube ID	Pos[m]	Type	Size	Comments	Graph
1	R[1]C[1]	1	Blockage	7 %		Link
3	R[1]C[1]	4.64	Wall loss	25 %		
5	R[1]C[2]	1.18	Blockage	5 %		Link
8	R[1]C[2]	4.35	Wall loss	20 %		
12	R[1]C[3]	1.3	Blockage	5 %		Link
10	R[1]C[3]	3.11	Wall loss	20 %		
14	R[1]C[4]	1.05	Wall loss	25 %		
19	R[1]C[4]	4.84	Wall loss	25 %		
21	R[1]C[5]	0.62	Wall loss	10 %		
24	R[1]C[5]	6.17	Wall loss	25 %		
26	R[1]C[6]	1.32	Wall loss	20 %		
33	R[1]C[7]	0.54	Wall loss	20 %		
28	R[1]C[7]	1.06	Wall loss	25 %		

Table 1: Defects table by tubes.

1551	R[38]C[24]	2.58	30	0.6		
1553	R[10]C[26]	0.32	20	0.4		
1555	R[17]C[30]	0.3	60	1.2	建议插拔	Link
1558	R[22]C[30]	0.14	62.5	1.25	建议插拔	Link
1560	R[23]C[8]	0.11	63.4	1.27	建议插拔	Link
1562	R[36]C[1]	0.13	60	1.2	建议插拔	Link
1564	R[36]C[1]	0.95	30	0.6		

Table 2: Defects table by wall loss.

From Software:



Graph 1: Signal of tube with 1mm hole.

Review	Defects Table	Final report		
Fault ID	Tube ID	Pos[m]	Cross Section Reduction[%]	Cross Section Reduction[mm]
1	R[1]C[1]	1	7	1.05
5	R[1]C[2]	1.18	5	0.75
12	R[1]C[3]	1.3	5	0.75
112	R[2]C[21]	4.24	12	1.8
124	R[2]C[25]	4.16	18	2.7
128	R[2]C[27]	0.78	10	1.5
131	R[3]C[1]	1.03	10	1.5
173	R[3]C[23]	4.26	10	1.5
179	R[3]C[24]	3.65	15	2.25
189	R[3]C[29]	3.64	15	2.25
194	R[4]C[1]	1.27	15	2.25
208	R[4]C[8]	3.97	18	2.7
254	R[5]C[1]	1.02	12	1.8
271	R[5]C[8]	1.89	10	1.5
273	R[5]C[9]	2.79	10	1.5
277	R[5]C[12]	0.91	8	1.2
289	R[5]C[19]	1.49	8	1.2
303	R[5]C[28]	1.97	10	1.5
315	R[5]C[31]	1.48	15	2.25
319	R[5]C[32]	1.78	10	1.5
328	R[5]C[33]	3.62	20	3
330	R[6]C[1]	1.34	7	1.05
343	R[6]C[6]	0.56	7	1.05
347	R[6]C[7]	0.65	12	1.8
385	R[6]C[33]	0.79	10	1.5
406	R[7]C[18]	1.27	10	1.5
410	R[7]C[30]	1.69	8	1.2
414	R[7]C[36]	2.05	12	1.8
441	R[8]C[39]	3.66	13	1.95
469	R[9]C[32]	1.97	10	1.5
496	R[10]C[7]	2.75	10	1.5
510	R[10]C[17]	1.87	5	0.75
560	R[10]C[41]	3.75	15	2.25
591	R[12]C[7]	1.76	17	2.55
599	R[12]C[10]	0.73	8	1.2
640	R[13]C[10]	1.3	12	1.8
667	R[13]C[33]	1.71	5	0.75
708	R[15]C[1]	1.02	10	1.5

< > Holes Wall loss Blockages Unknown

Table 1: Defect table of Blockage in Software.

CONCLUSION

The advantages of APRIS were demonstrated by the following:

- 1. Speed of measurement** : APRIS was able to quickly assess the condition of the tubes in a fraction of the time as compared to other technologies.
- 2. U-bend defect detection** : APRIS was able to detect holes, blockages and wall loss.
- 3. Sizing and location indicated** : APRIS indicated the size and location of the defects.

APRIS is recommended as the **initial non-destructive testing method** for applications such as condensers, reboilers and heat exchangers, which have defects originating from the inner diameter of the tubes.

APRIS was proven to be useful in quickly detecting inner diameter surface defects.



ACOUSTIC PULSE REFLECTOMETRY
INSPECTION SYSTEM