



# CAN-ET-14P001 REVISION 02

## EDDY CURRENT TUBULAR EXAMINATION

ASME V, ARTICLE 8

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**Date:** November 15, 2013

**Notes:**

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**QUALITY "EVERY CLIENT, EVERYWHERE, EVERY DAY"**

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**CAN-ET-14P001 REVISION 02**

Eddy Current Tubular Examination

November 15, 2013

Revision Summary		
Revision No.	Date	Description
01	June 25, 2013	First revision.
02	November 15, 2013	Updated for ASME V 2013. Revised 3.0.

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**APPENDIX G: REQUIREMENTS OF AND EDDY CURRENT EXAMINATION PROCEDURE**

**1.0 SCOPE**

- 1.1 This procedure describes the equipment, set-up, calibration techniques and analysis guidelines to be utilized for the Eddy Current examination of installed tubing in accordance with ASME V, Article 8.
- 1.2 It applies to non-ferromagnetic tubes and slightly magnetic conductive tubes with outside diameters from 0.375" to 3.00" (9.525 to 76.2 mm) and wall thicknesses of 0.022" to 0.220" (0.56 to 5.58 mm).
- 1.3 Where there are specific client requirements or field conditions not dealt with in this procedure a project specific technique shall be applied as well (See APPENDIX F for Sample).

**2.0 PROCEDURE DEMONSTRATION AND QUALIFICATION**

When procedure qualification has been specified by the client or the applicable code or standard, a change in an essential variable (listed in APPENDIX G) from the specified value or range of values shall require re-qualification of this procedure. A change of a requirement identified as a nonessential variable from the specified value, or range of values, does not require requalification of this procedure. All changes of essential or nonessential variables from the value, or range of values, specified by this procedure shall require an addendum to this procedure.

**3.0 REFERENCES**

- 3.1 Acuren Safety Management System
- 3.2 ASME Section V, Article 8 (2013)
- 3.3 CAN-CP-02P001 Acuren Canada SNT-TC-1A Written Practice.

**4.0 PERSONNEL QUALIFICATION AND RESPONSIBILITIES**

- 4.1 Inspection shall be carried out by technicians certified to the requirements of the Acuren written practice CAN-CP-02P001. Note: Certain codes or standards may require the use of additional or alternate certification schemes (e.g. CAN/CGSB-48.9712).
- 4.2 A Level I technician may perform set-up, calibration and acquire data when under the supervision of a Level II or Level III technician.
- 4.3 A Level II or III technician shall perform evaluations, carry out final interpretation and sign the report.
- 4.4 A Level III technician shall approve this procedure.
- 4.5 Personnel performance or procedure qualification demonstrations shall be required when specified by the applicable technique, code or standard.

**5.0 SAFETY**

Personnel shall:

- 5.1 comply with the requirements of the Acuren Safety Management System.
- 5.2 follow all Client and project specific safety requirements.

## **6.0 EQUIPMENT**

### **6.1 Test Instrument**

- 6.1.1 The test instrument shall be capable of running four frequencies in both differential and absolute modes and shall be calibrated annually by the manufacturer or competent calibration lab.
- 6.1.2 Acceptable Eddy Current Testing (ET) instruments include:
  - a) Olympus NDT TC 5700
  - b) Olympus NDT MS 5800

### **6.2 Software and Recording Devices**

- 6.2.1 Olympus NDT (Multiview) software shall be used for analysis of data collected with the TC 5700 and MS5800 Instruments.

### **6.3 Probes - Bobbin Type**

- 6.3.1 Use APPENDIX A to assist in selection of probe type and frequency.
- 6.3.2 Probe size is dependent upon tube diameter. Probes should be of the largest diameter practical for the tube diameter scheduled for examination. Fill factors equal to or greater than 85% for straight length tubing and equal to or greater than 75% for U-bends or tube radius are required. For straight lengths, fill factors less than 85% (but no less than 80%) are allowed in cases where the cleanliness of tubes restricts larger probes from being used.
- 6.3.3 Probe fill factor will be calculated using the following formula.
$$n = d^2 / D^2$$
Where:
  - n = % fill factor
  - d = probe diameter
  - D = inside diameter of tube being inspected
- 6.3.4 Probes shall be capable of operating with differential, absolute or array detectors and demonstrate sensitivity to the anticipated flaw types and sizes.
- 6.3.5 Probe frequency will vary due to wall thickness or conductivity. The frequency used must meet the requirements of calibration as defined in 7.4.

### **6.4 Alternate Probes**

- 6.4.1 Pancake Coils or Array Coils are used for the detection of cracks such as circumferential, axial and/or transverse in the tube sheet area and support structures.
- 6.4.2 Cross-axis coils can be used for the inspection of integral fin tubes (continuous fin and skip fin) in AC chillers, lube oil chillers and condensers for the detection of circumferential, axial and/or transverse cracks as well as wear in the land area of skip fin tubing.
- 6.4.3 Magnetic-Bias Probes, also known as partial saturation probes, are used for the inspection of Monel or material with slight magnetic properties (permeability). 321 stainless steel of .083" thickness or greater should also be inspected with Magnetic-Bias probes. See Appendix A.
- 6.5 Reference Standards
  - 6.5.1 Calibration standards are to be manufactured per ASME Section V Article 8 Appendix II and have the following discontinuities:
    - a) A 100% through wall hole 1.32mm (0.052") diameter for tubing of outer diameter 19mm (0.750") and smaller. A 1.7mm (0.067") diameter 100% through wall hole for tubing greater than 19mm (0.750") in outer diameter.
    - b) An 80% flat bottom hole drilled into the outside diameter (OD), 1.98mm (5/64") diameter.
    - c) A 60% flat bottom hole drilled into the OD, 2.78mm (7/64") diameter.
    - d) A 40% flat bottom hole drilled into the OD, 4.76mm (3/16") diameter.
    - e) Four 20% flat bottom holes 4.76mm (3/16") diameter drilled into the OD spaced 90° apart in a single plane around the circumference.
    - f) An ID 360° circumferential groove with 10% or 20% discontinuity depth with 1.59mm (1/16") width.
  - 6.5.2 Additional or modified calibration standards, if required by site specific conditions, shall be documented and approved by the Level III on the technique sheet (APPENDIX F).

## **7.0 CALIBRATION**

- 7.1 The system shall be calibrated utilizing the:
  - 7.1.1 Calibration standards listed in 6.5.
  - 7.1.2 Appropriate optimum frequency for the material per 7.4.
- 7.2 Pull the probe through the calibration standard and/or standards with the deepest or through wall indication first.

- 7.3 When pulling calibration standards, the operator shall input the exchanger ID, Row and Tube Numbers as follows: At the start of Test: Equip. #, 000, 001 thru 003. At the end of Test: Equip. #, 999 and numbered 001 thru 003 for the three pulls. Additional Row and Tube numbers can be used for more than one calibration standard type.
- 7.4 Frequency and sensitivity setting for the self-comparison Differential Bobbin coil technique:
- 7.4.1 Adjust the ET instrument settings so that the response from the through wall flaw is at approximately 40° @ 1 volt amplitude on all Differential Channels. Gain parameters are considered acceptable if 1 volt is achieved for the through wall hole and the ID groove is not saturated on the prime frequency (F180) channel.
- 7.4.2 The differential phase display for the four 20% FBHs, when the probe is pulled through calibration standard, shall have a motion of down and to the left first followed by an upward motion to the right, followed by a downward motion returning to the point of origin.
- 7.4.3 For the Differential Bobbin Channel (prime frequency), with the hole normalized to 40°, the phase angle separation between the response from the four 20% FBHs and the through wall hole shall be between 110° and 120° degrees. This will result in the phase angles for the 20% flat bottom holes to be between 150° and 160°.
- 7.5 For the Absolute and/or Pancake coil channels, the signal response due to probe motion shall be positioned along the horizontal axis of the display  $\pm 5^\circ$  and defects propagate in the positive or vertically upward direction.
- 7.6 A minimum of three frequencies shall be used, a prime frequency (F180), a half prime frequency (F90) and eighth prime (F90/4). A fourth frequency may be used to include quarter prime (F90/2) when the system set up allows (12Khz and above).
- 7.7 Calibration shall be confirmed by reacquisition of the calibration standard at the beginning of the examination and then:
- at the end of the recording media
  - every 2 hours
  - after an interruption of 30 minutes or more in data acquisition.
  - change of operators
  - at the end of the examination
- 7.8 The initial calibration, subsequent checks and the final calibration shall be recorded on the recording media. Re-calibration shall be made if any of the ET equipment is replaced. This includes changing the probe, extension cables, ET instrumentation, recording instruments or any other hardware associated with the ET system.

If the system is found to be out of calibration, the system shall be re-calibrated and any or all data recorded or analyzed, since the last calibration shall be re-inspected.

## **8.0 PROCESS**

### **8.1 Scope of Work**

8.1.1 The client shall agree with the scope of work prior to the job. A pre-job questionnaire should be completed and signed by the customer and the Acuren representative and retained in the job file (See APPENDIX B for example).

### **8.2 Identification of Examination Area**

8.2.1 Each exchanger tube bundle shall be uniquely identified with a two point coordinate system. The preferred system is row and tube numbering. The system used shall be traceable to the client's drawings or other documentation.

8.2.2 Each area of the bundle to be examined shall be clearly identified on the final report.

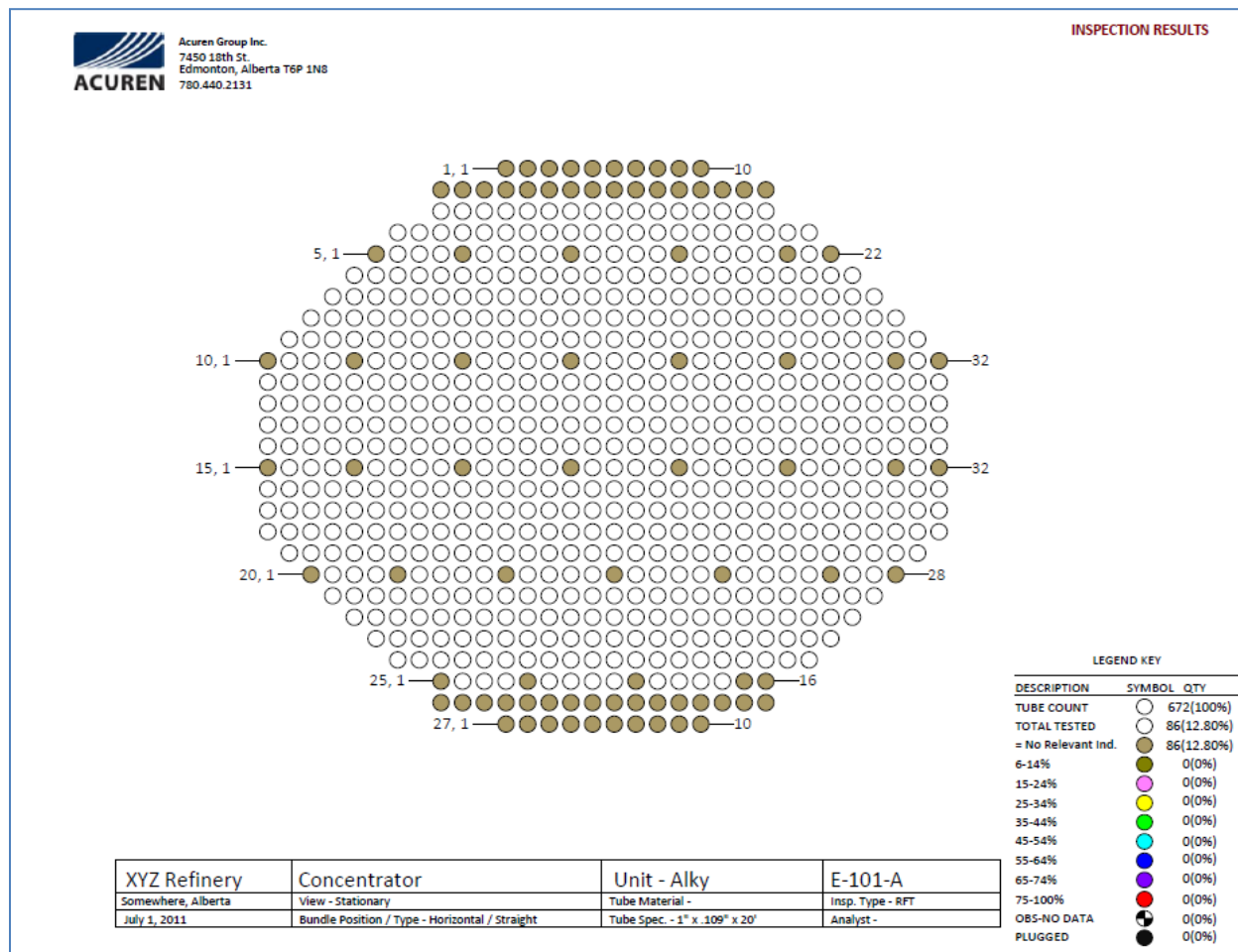
8.2.3 Tube sheet maps, photographs or drawings shall clearly indicate the direction from which the unit is viewed and at least one supplemental direction for orienting the drawing map or photograph.

8.2.4 For units in which the numbering scheme repeats dependent on the area of the tube sheet or drum, the section number for each area shall be included in each reference of its tubes.

For example, a tube in the upper half of a 'U-tube' bundle may be referred to as 'Section 0, Row 1, Tube 1' in a straight section test report. The section information is used to differentiate the tube from its mirrored tube in the bottom half of the bundle in, for example, section "1".

8.2.5 Where a percentage of the tubes are to be examined all the tubes in the first two rows and last two rows of the inspection area shall be examined as well as every fifth row and every fifth tube in the row as well as the last tube in each row as a minimum.





### 8.3 Examination Process

8.3.1 A Field Log shall be established detailing the information as shown in APPENDIX C and as required for completion of the examination report (see Section 14.0 Reports). Other details shall include:

- a) Owner or Customer
- b) Plant Location
- c) Unit Name
- d) Service Name
- e) Equipment Number
- f) Examination Frequencies
- g) Previously Plugged Tubes
- h) Obstructed Tubes or Restrictions

- 8.3.2 Initialize the recording media in accordance with the manufacturer's instructions.
- 8.3.3 The probe shall be inserted into the tube and the probe cable marked to indicate the insertion length for subsequent tubes.
- 8.3.4 The probe should be inserted into each tube in a manner and speed ensuring personnel safety and minimum damage to tube and probe surfaces.
- 8.3.5 Verbal communication of the row and tube currently under test shall be relayed between the acquisition technicians and assistant every ten tubes as a minimum.
- 8.3.6 Tubes recorded with the incorrect row and tube information shall be accompanied with a log entry to disregard the incorrectly encoded data.
- 8.3.7 All incorrectly identified tubes shall be reacquired with correct encoded data.
- 8.3.8 Where tubes are restricted they shall be scanned to the extent that they can be and the restriction identified on the report.
- 8.3.9 Examination data for all tubes shall be stored for analysis and archival in the following manner.  
  
Customer\Unit\Exchanger Name (Date(mm-dd-yy))\Exchanger Name ET DATA\  
  
e.g. ABC Company\100 Area\E-101-C (11-02-10)\E-101-C ET DATA\
- 8.3.10 All applicable documentation including, but not limited to: raw data, pictures, mapping software files and final reports shall be stored in these files.
- 8.4 Interpretation and Reporting
  - 8.4.1 Ensure the tube sheet diagram is accurately representative of the test unit.
  - 8.4.2 Assess data for the following:
    - a) Pull speed consistency
    - b) Absence of data saturation
    - c) Acceptable signal to noise ratio
    - d) Desired examination extent
    - e) Sensitivity to anticipated degradation
    - f) Expected responses from baffles
  - 8.4.3 Data with unacceptable quality shall be identified and the affected tubes reexamined.
  - 8.4.4 Further evaluate the data by identifying all signals of potential defect indications and classifying signals into two classes:
    - a) Defect indication types accurately sized by analysis curves.

- b) Defect indications not represented or reliably sized by the reference standard flaws.
- 8.4.5 For all signals represented by the calibration standard flaws assess their depth and report the deepest with amplitude, phase, depth and axial position information.
- 8.4.6 For all defect indication types in this class, depth shall be reported as a percentage loss from the reported nominal wall thickness.
- 8.4.7 For all potential defect indications not reliably sized by reference standard comparison, report the amplitude, phase and axial position with a defect code indicating the analyst's opinion of the defect indication type.
- 8.4.8 No depth estimate shall be provided for flaws not represented by the calibration standard until a linear correlation exists between complimentary test results using alternate inspection method and the ET examination data.
- 8.4.9 Ensure all entries are included in the final report database for the test unit.

## **9.0 DATA ACQUISITION**

- 9.1 Project information should be entered prior to the start of the examination, see APPENDIX D. As a minimum, the information should include the following:
  - 9.1.1 The equipment identification number.
  - 9.1.2 Before the scan is made for each tube, the tube number shall be entered on a tube list. For tube locations, tube sheet map or data check-off sheets may be available.
- 9.2 During the scan, the operator will monitor all recording equipment. The setup per APPENDIX E should be used to monitor probe performance.

## **10.0 PROBE MANIPULATION**

- 10.1 The probe will be manually inserted into the tube to be tested, taking care not to damage the probe.
- 10.2 The probe speed shall remain as consistent as achievable during the recording phase as the probe is being removed
- 10.3 The traverse speed shall not exceed that which provides adequate frequency response and sensitivity to the applicable calibration discontinuities. Digitization rates must be maintained in order to resolve all defect indications at the pull speed used.

## **11.0 DATA INTERPRETATION**

- 11.1 All tubes showing signals that indicate discontinuities of 10% through wall or greater shall be reported, unless otherwise requested by the customer.

- 11.2 ET signals that have a phase angle between 0° and the through wall hole (40°) on all channels shall be considered discontinuities originating from the inside diameter of the tube.
- 11.3 ET signals that have a phase angle between the 100% through wall hole (40°) and the degree value of the 20% FBHs, on all channels, shall be considered as originating from the outside of the tube.
- 11.4 At any time the ET signals originate from the ID side, review the rotation of the defect signal on other frequencies, especially frequency eighth prime (F90/4). If the indication on this channel rotates out of phase (clockwise) into the OD plane, this would be considered non-relevant (metallic deposit or unknown anomaly).

## 12.0 DATA ANALYSIS PROCEDURE

- 12.1 Retrieve the calibration standard and tube data from storage disk or device.
- 12.2 If the data is considered unfit for analysis the analyst shall require the data to be reacquired.
- 12.3 Input data file (Tube List) into the analysis file.
- 12.4 Retrieve calibration run and setup the parameters, configuration and calibration curve and save the settings.
- 12.5 Review the entire tube length for indications and extent of test.
- 12.6 Review data to determine if indications are relevant or non-relevant.
- 12.7 If an indication is detected, find the location as follows:
  - 12.7.1 The distance scale (Landmarks) should be checked or setup in the analysis software and/or set prior to reporting the indication. The scale should be set between the two tube ends or between two baffles.
  - 12.7.2 Evaluate and report indications as specified by Section 11.0. The report section of the data file shall include the following information as applicable to the type of indication:
    - a) Row Number
    - b) Tube and/or Column Number
    - c) Voltage Amplitude
    - d) Phase Angle
    - e) Characterization of the type defect or indication
    - f) Orientation of the defect (ID or OD)
    - g) Location (axial location or length)
    - h) The channel that the indication was called from

- 12.8 Every tube tested shall be included in the data section of the report file. This entry shall include the extent tested, any reportable indications and comments as required.
- 12.9 Only the deepest flaw in each tube will be identified. Additional flaws may be reported at the discretion of the analyst.
- 12.10 Ensure that every tube entry reflects the actual extent tested. Exceptions are allowed when requested by the client but details must be documented on the report
- 12.11 When the analysis is complete, edit the final report:
  - 12.11.1 correct any errors.
  - 12.11.2 ensure that all tubes reported have been examined
  - 12.11.3 ensure that all tubes examined have been reported.

### **13.0 ACCEPTANCE CRITERIA**

- 13.1 ET data analyses shall be provided for information only and shall not be subject to acceptance or rejection criteria.
- 13.2 Upon request, ET data evaluation maps may display flaw depth graduations in parallel with the client's stated repair criteria.

### **14.0 REPORTS**

- 14.1 Reporting
  - 14.1.1 Complete all fields of the Acuren supplied report form in either the electronic or hard copy format.
  - 14.1.2 For each examination the following information shall be recorded as a minimum. Where the item is not applicable to the examination the field shall be completed as N/A:
    - a) Owner, location, type, serial number, and identification of component examined.
    - b) Size, wall thickness, material type, and configuration of installed tubes.
    - c) Tube numbering system.
    - d) Extent of examination or tubes examined and length of tubes scanned.
    - e) Personnel performing the examination;
    - f) Personnel qualification level.
    - g) Date of examination.
    - h) Models, types, and serial numbers of components of the ET system.
    - i) Probe model/type and extension length.
    - j) All relevant instrument settings (e.g. test frequencies and modes).

- k) Serial number(s) of reference tube(s).
- l) Procedure used – Identification and revision.
- m) Acceptance criteria used.
- n) Identification of tubes or specific regions of tubes where limited sensitivity and other areas of reduced sensitivity or other problems.
- o) Results of the examination and related sketches or maps of the examined area.
- p) Complementary tests used to further investigate or confirm test results.

14.2 Archival

- 14.2.1 In addition to the Client supplied examination report, all field notes, sketches, drawing, photos and examination data shall be retained and archived in the Acuren job file for future reference.

14.3 Marking

- 14.3.1 If utilized, marking products shall not be detrimental to the material being examined. Consult the product data to ensure material compatibility.

**APPENDIX A: EDDY CURRENT FREQUENCY AND PROBE SELECTION**

Note: All frequency values are in kHz. Listed frequencies are Prime Frequencies (F180)

## EDDY CURRENT FREQUENCY CHART

GUIDELINES FOR FREQUENCY AND PROBE SELECTION										
BWG	WALL THK.	COPPER	ADM. BRASS	70/30 CU/NI	90/10 CU/NI	HAST. B/C	INCOLOY 800	INCOLOY 825	INCONEL 600	ALLOY20
22 GA	.028"	21	92	489	226	11,691	1,293	1,466	1,293	1,288
21 GA	.032"	16	70	374	172	1,295	990	1,122	990	895
20 GA	.035"	14	59	312	145	1,082	828	938	828	823
19 GA	.042"	9	41	217	100	751	575	652	575	570
18 GA	.049"	7	30	160	74	552	422	479	422	417
17 GA	.058"	5	21	114	53	394	301	342	301	296
16 GA	.065"	4	17	91	42	314	240	272	240	235
15 GA	.072"	3	14	74	34	256	196	222	196	191
14 GA	.083"	2	10	56	26	193	147	167	147	142
13 GA	.095"	2	8	42	20	147	112	127	112	107
12 GA	.109"	1	6	32	15	112	85	97	85	80
11 GA	.120"	< 1	5	27	12	92	70	80	70	65
10 GA	.134"	< 1	4	21	10	74	56	64	56	51

PROBE STYLE:	BS	BS	BS	BS	MBS	MBS	MBS	BS	MBS
	CBS	CBS	CBS	CBS	CMBS	CMBS	CMBS	CBS	CMBS

GUIDELINES FOR FREQUENCY AND PROBE SELECTION										
BWG	WALL THK.	MONEL 400	304 S/S	316 S/S	310 S/S	321 S/S	347 S/S	TITANIUM G2	TITANIUM	ZIRCONIUM
22 GA	.028"	698	879	955	955	920	916	709	999	647
21 GA	.032"	534	673	732	761	704	701	543	765	495
20 GA	.035"	447	562	611	637	589	586	454	640	413
19 GA	.042"	310	390	425	442	409	407	345	444	287
18 GA	.049"	228	287	312	325	300	299	231	326	211
17 GA	.058"	163	205	223	232	214	213	165	233	151
16 GA	.065"	130	163	177	184	170	170	132	185	120
15 GA	.072"	106	133	147	150	139	138	107	151	98
14 GA	.083"	80	100	108	113	104	104	80	114	74
13 GA	.095"	61	76	83	86	80	80	62	87	56
12 GA	.109"	47	58	63	66	61	60	47	66	43
11 GA	.120"	38	48	52	54	50	50	39	54	35
10 GA	.134"	30	38	42	43	40	40	31	44	28

PROBE STYLE:	BS	BS	BS	BS	MBS	MBS	BS	BS	BS
	CBS	CBS	CBS	CBS	CMBS	CMBS	CBS	CBS	CBS

BS= Barnicle scraper Mid range 50-500 Khz	/ LF= Low Frequency 1-50 Khz.
CBS= Chamfered Barnicle Scraper Mid range (same as "BS" Only the head is Chamfered)	/ HF= High Frequency 500Khz.- 2Mhz.
MBS= Magnetic Bias Barnicle Scraper Mid range	
CMBS= Chamfered Magnetic Bias Barnicle Scraper Mid range	

**APPENDIX B: SAMPLE PRE-JOB QUESTIONNAIRE**


Please Return Completed to:

**Eric Holtz**
[eholtz@acuren.com](mailto:eholtz@acuren.com)
**Ph No. (780) 490-2552**
**Cell No. (780) 886-1597**

<b>Client Name:</b>		<b>P.O. #</b>		<b>Start Date</b>	
<b>Billing Contact:</b>		<b>Field Contact</b>			
<b>Telephone No.</b>		<b>Email:</b>			
<b>Billing Address:</b>					
<b>Safety Requirments:</b>					
<b>Directions to Site:</b>					

Remote Field Testing (RFT) is used on tubes that are ferromagnetic. RFT has nearly equal sensitivity to ID and OD forms of volumetric tube degradation. The accuracy for heat exchanger tubes is generally +/-10%. The accuracy for boiler tubes is generally +/-20%. Accuracy becomes compromised in the presence of deposits, bends, geometry changes, residual stress, work hardening, and embrittlement due to flame impingement for example. The accurate sizing of boiler tube data in bends requires supporting data from a complementary method. Flow sizing is enhanced by using complementary methods and with knowledge of flow shape and past history. RFT has very low sensitivity to non-volumetric forms of tube degradation such as cracking. Because of the possibility of magnetic deposits, material property variations, and different damage mechanisms within the same bundle, it is highly recommended that RFT data be verified by examining a small sample of the tubes using IRIS, conventional UT, or direct inspection of an extracted tube. This important step allows for the fine-tuning of the RFT calibration curve to ensure that these parameters are accounted for during analysis and to provide the highest degree of accuracy in the assessment. Acuren cannot warranty the accuracy of RFT data (within the +/- ranges identified above) that has not been verified by IRIS, conventional UT or direct inspection of an extracted tube. Pit sizing, without a complimentary method for verification, is not recommended.

Eddy Current Testing (ET) is used on tubes that are non-ferromagnetic. ET is very sensitive to a great number of variables making it a powerful examination tool. ET can be as accurate as +/-5%. The presence of non-relevant variables needs to be controlled in order to minimize their effect on flaw signals. These non-relevant variables include magnetic and non-magnetic deposits on the ID and OD, and geometry changes. Unlike RFT, ET is used on tube material types which are not as susceptible to the variables which affect RFT signals. However, flow sizing is further enhanced by using complementary methods and with knowledge of flow shape and past history.

Internal Rotary Inspection System (IRIS) is sensitive to both ID and OD forms of volumetric wall loss. Predictions can be as accurate as +/-0.005 inches. IRIS accuracy and sensitivity are seriously compromised in the presence of ID or OD deposits, bends and geometry changes. Tube cleanliness is critical for this method. If areas of geometry changes require examination, complementary methods must be employed. IRIS is not sensitive to non-volumetric forms of degradation such as cracking.

Accuscan is limited to near drum inspection. The maximum scan length is 5'. It is limited to tube size (2" to 3" OD) The Accuscan is not sensitive to internal diameter pitting or non-volumetric forms of degradation such as cracking. Predictions can be as accurate as +/-0.005 inches. Tube cleanliness is critical for this method.

Tube cleanliness requirements are the following are as follows. All internal deposits restricting probe passage should be removed. All internal or external conductive or magnetic structures or metallic deposits such as iron, copper, zinc etc. should be removed. A high pressure water wash (>10,000 psi to 30,000 psi) is recommended for achieving the best signal to noise ratio. Grit blasting to remove scale and deposits has been a viable tool for cleaning cooling water tube side exchangers and/or air coolers.

Tube numbering convention shall be established and agreed upon prior to the start of the examination.

\_\_\_\_\_  
**Client Representative**

\_\_\_\_\_  
**Signature**

\_\_\_\_\_  
**Date**





Please Return Completed to:

Eric Holtz

[eholtz@acuren.com](mailto:eholtz@acuren.com)

Ph No. (780) 490-2552

Cell No. (780) 886-1597

**Component Information (1)**

Exchanger Name:			Exchanger No.			
Method of inspection (ET/RFT/IRIS/Accuscan)			i.e. RFT with IRIS back up.			
Mat'l Specification	Diameter	Gauge	Length	# Tubes	# to Test	Baffle Thickness
Vertical/Horizontal	U-Bend or Straight	Finned	Tube Side Service		Shell Side Service	
Air Cooler or Fin Fan	Tema Type	Year Built	Last Inspection		Last Retube	
Is there any information about the equipment's service history that might assist us in determining flaw mechanisms? What type of wall losses do you expect us to find? Did any failure occur during service? Do you have a previous report available?						
Comments:						

**Component Information (2)**


Exchanger Name:			Exchanger No.			
Method of inspection (ET/RFT/IRIS/Accuscan)			i.e. RFT with IRIS back up.			
Mat'l Specification	Diameter	Gauge	Length	# Tubes	# to Test	Baffle Thickness
Vertical or Horizontal	U-Bend or Straight	Finned	Tube Side Service		Shell Side Service	
Air Cooler or Fin Fan	Tema Type	Year Built	Last Inspection		Last Retube	
Is there any information about the equipment's service history that might assist us in determining flaw mechanisms? What type of wall losses do you expect us to find? Did any failure occur during service? Do you have a previous report available?						
Comments:						

Client Representative

Signature

Date

**APPENDIX C: SAMPLE FIELD LOGS / DATA SHEETS**

		<b>Acuren Group Inc.</b> 7450 18th St Edmonton, AB T6P 1N8 Office: 780.440.2131 Fax: 780.490.2426 <b>Materials Engineering and Testing</b> a Rockwood Company	
<b>Inspection Information Sheet</b>			
<b>Site Information</b>			
Customer:		Facility:	
Date of Insp:		Unit:	
Exchanger #:		Test End:	
Tube Type:		Bundle Type:	
Joint Type:		Position:	
Tube Material #1		Tube Material #2	
OD	Gauge	Length	# Tubes
Tube Side:		Shell Side:	
Year Built:		Last Inspection:	
Last- Retube:		Baffle/Support:	
<b>Equipment Information</b>			
Instrument:		Manufacturer:	
Serial#:		Cal Due Date:	
Cal Std.#1 S/N:		Cal Std.#2 S/N:	
Material	OD	Gauge	
Probe Size #1:		Probe Size #2:	
Type:		Type:	
Manufacturer:		Manufacturer:	
Serial No.:		Serial No.:	
Fill Factor:		Fill Factor:	
<b>Inspection Parameters for Material #1</b>			
	Diff-1	Abs-1	Diff-2
Frequency:			
Probe Drive:	Volts	5 Volts	5 Volts
Raw Gain:	dB	dB	dB
Software Gain:			
Rotation:			
Bandwidth:			
<b>Mix Channel</b>			
Frequency Mix:		Pre Amp Gain:	
Software Gain:		Samples/Sec.:	
Rotation:		Low Pass Filter:	
<b>Acquisition Technician(s)</b>			
Name #1:		Acq. Tech #1 Level:	
Name #2:		Acq. Tech #2 Level:	

## APPENDIX D: FIELD INFORMATION SHEETS

## Acuren Detailed Data Sheet

[illegible]

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**APPENDIX E: CALIBRATION STANDARD AND SOFTWARE SET UP**

<b>ASME Standard Setup</b>					
Channel	Diff/Abs	Phase	Cal Std.	Curve	Volts
Diff1 / F180	Differential	40 Deg	100%	Phase	100% - 1 Volt
Abs 1 / F180	Absolute	Horizontal	n/a	Voltage	
Diff3 / F90	Differential	40 Deg	100%	Phase	100% - 1 Volt
Abs 3 / F90	Absolute	Horizontal	n/a	Voltage	
Diff5 / F90/2	Differential	40 Deg	100%	Phase	100% - 1 Volt
Abs5 / F90/2	Absolute	Horizontal	n/a	Voltage	
Diff7 / F90/4	Differential	40 Deg	100%	Phase	100% - 1 Volt
Abs7 / F90/4	Absolute	Horizontal	n/a	Voltage	
Mix	Differential	40 Deg	100%	Phase	100% - 1 Volt

<b>Analysis Software Set Up</b>	
Spans	Set all Differential channels so that the 20% flat bottom holes are of 75% screen height. All Absolute channels should display the discontinuities upward at 30% of screen height. Data may be screened at a more sensitive level.
Mix Channels	Adjust window around a good support plate, create Mix channel 1 from channels 1 and 3. Rotate Mix channel so that any probe motion is horizontal and the through-wall drilled hole is between 35 and 40 degrees.
Additional Channels	Additional mix channels may be utilized to aid in signal interpretation or detection.
Screening	Suggested screening will be done from the ASME standard setup using 4 to 8 windows: At a minimum prime (F180), half prime (F90), mix, and the lowest frequency absolute channel should be displayed.
Strip Chart Display	Suggest screening as a minimum 2-strip chart display, the mix channel and the lowest frequency absolute, unless other channels provide a higher degree of detection.
Reporting / Analysis	Flaws in free span areas should be called off raw channels where possible. Flaws that are influenced by or associated with support structures or deposits should be called off the appropriate mix channel.



APPENDIX F: TUBULAR PROJECT SPECIFIC TECHNIQUE

ACUREN TUBULAR PROJECT SPECIFIC TECHNIQUE SHEET

Site Information									
Customer:					Facility:				
Date of Insp:					Unit:				
Exchanger #:					Test End:				
Tube Type:					Bundle Type:				
Tube Material #1:					Tube Material #2:				
OD		Gauge	Length	# Tubes	OD		Gauge	Length	# Tubes
Reason for procedure deviation:									
Defects for Technique Calibration					Resultant Curve 1				
	Type	% Depth	Phase	Voltage	Instructions: Use these windows to display the curves, defects and technique used for analysis with the application. Send completed sheet with data and calibration standard drawing to SME or Level III for review.				
1									
2									
3									
4									
5									
6									
7									
Resultant Curve					Resultant Curve 3				
Explanation of Technique:									

Acuren Level II: \_\_\_\_\_ Date: \_\_\_\_\_

Acuren Level III or SME: \_\_\_\_\_ Date: \_\_\_\_\_

**APPENDIX G: REQUIREMENTS OF AND EDDY CURRENT EXAMINATION PROCEDURE**
**REQUIREMENTS OF AN EDDY CURRENT EXAMINATION PROCEDURE**

(Table T-821 from ASME V, Article 8)

Requirement	Essential Variable	Nonessential Variable
Tube material, size (outside diameter), wall thickness and grade/temper	X	...
Mode of inspection – differential and/or absolute	X	...
Probe type	X	...
Probe manufacturer, part or serial number, and description	X	...
Examination frequencies, drive voltage, and gain settings	X	...
Manufacturer and model of eddy current equipment	X	...
Maximum scanning speed	X	...
Scanning mode – manual, mechanized probe driver, remote controlled fixture	X	...
Identity of calibration reference standard(s) including drawing	X	...
Minimum digitization rate/sample per second	X	...
Procedure qualification	X	...
Personnel qualifications	...	X
Data recording equipment manufacturer and model	...	X
Data analysis parameters	...	X
Tube numbering	...	X
Tube examination surface preparation	...	X
Scanning equipment, extension cable, and fixtures	...	X