JOHNSON CONTROLS, INC.
812 First State Blvd
Delmarva Branch N28
Wilmington, DE 19804
(302)996-0275

Report of Eddy Current Inspection

Manufacturer: York

Model: OTT4G2-ZBES

Serial: GACM127698 #9

Location: DUPONT EXPERIMENTAL STATION
RTE. 141 BETWEEN 52 & 202
WILMINGTON, DE 19735

Inspected: February 24, 2017

Inspected By: DAVID H. AMENT, LEVEL III
TAI Services, Inc.

Reviewed By: _____
TECHNICAL MANAGER, LEVEL III

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Vessel Information

Manufacturer	Model	Style	Serial Number	Type
York	OTT4G2-ZBES	Open Drive	GACM127698 #9	Centrifugal

Condenser	
TestEnd	Right Hand Facing Controls
Tube Count	883
Tube Type	Skip Fin IE
Tube Material	Copper
OD	.750
*NWT/Under Fins	.028
*NWT/Bell/Land	.055
#/Type Support	4 Mild Steel
Tube Numbering	Left to Right
Row Numbering	Top to Bottom
Tube Length +- 2	180 Inches

Evaporator	
TestEnd	Left Hand Facing Controls
Tube Count	699
Tube Type	Skip Fin IE
Tube Material	Copper
OD	.750
*NWT/Under Fins	.028
*NWT/Bell/Land	.052
#/Type Support	4 Mild Steel
Tube Numbering	Left to Right
Row Numbering	Top to Bottom
Tube Length +- 2	180 Inches

Analyst: DAVID H. AMENT, LEVEL III

* Nominal Wall Thickness

Vessel Bay Length Information

Condenser (Length = 180 inches)
S = Intermediate Support

Bay 5	43.00"
Bay 4	29.00"
Bay 3	36.00"
Bay 2	29.00"
Bay 1	43.00"

Evaporator (Length = 180 inches)
S = Intermediate Support

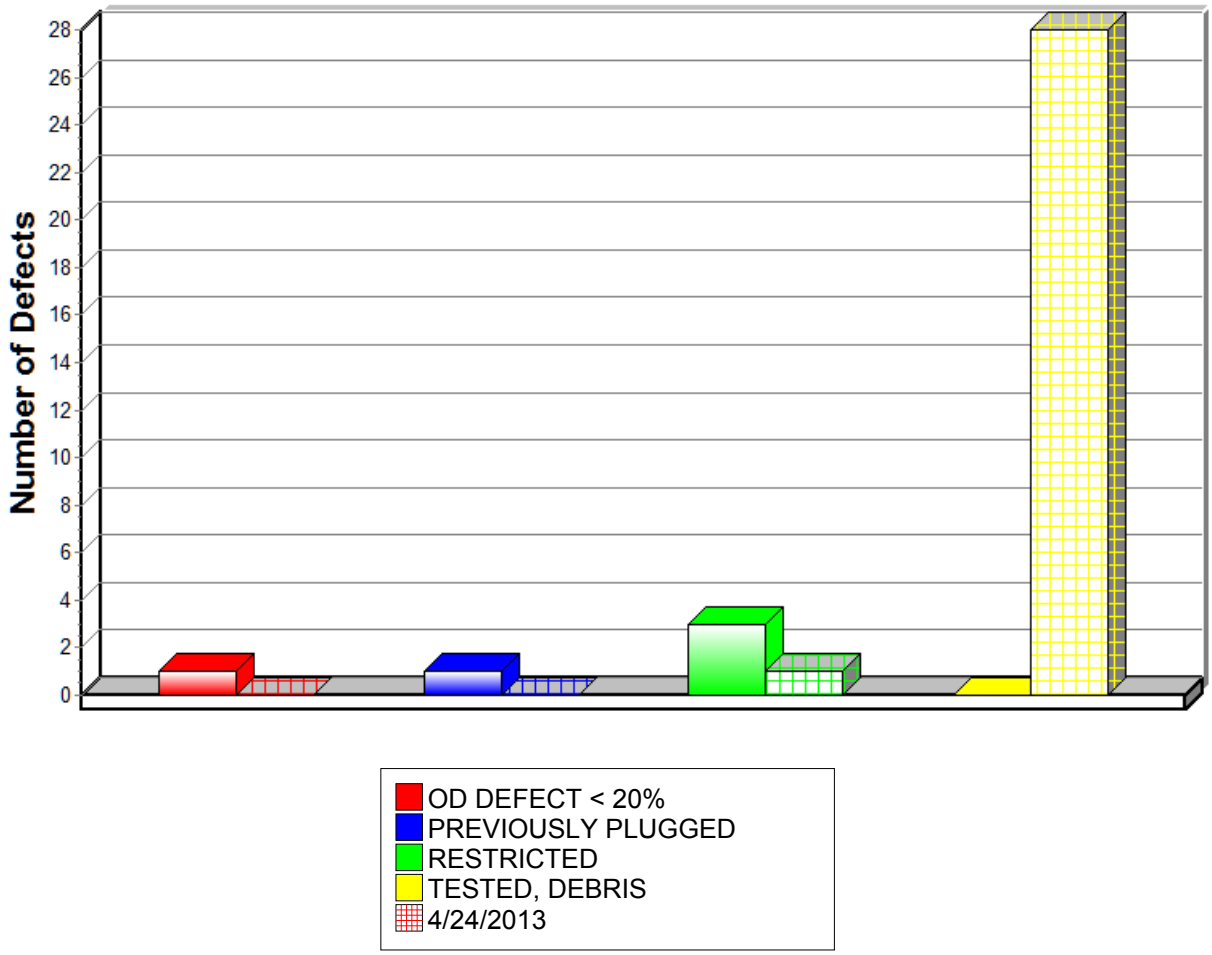
Bay 5	43.00"
Bay 4	29.00"
Bay 3	36.00"
Bay 2	29.00"
Bay 1	43.00"

Defect Summary/Comparison

Comparison of Tests Performed

2/24/2017 4/24/2013

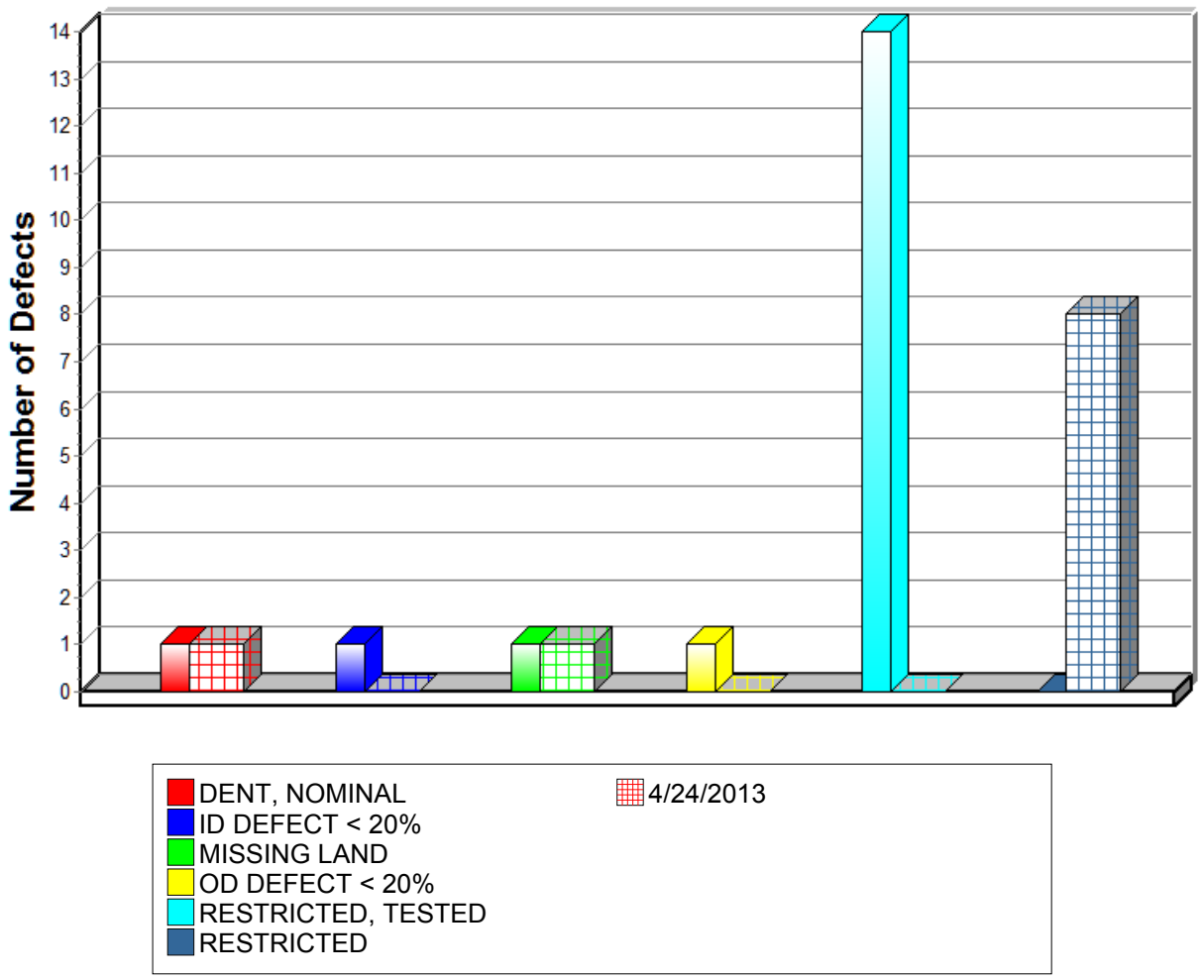
Condenser Defects



Location	Model	Serial Number
DUPONT EXPERIMENTAL STATION	OTT4G2-ZBES	GACM127698 #9

Note: The Graph will indicate a Comparison Analysis when the unit has been previously tested by TAI Services.

Evaporator Defects



Location	Model	Serial Number
DUPONT EXPERIMENTAL STATION	OTT4G2-ZBES	GACM127698 #9

Note: The Graph will indicate a Comparison Analysis when the unit has been previously tested by TAI Services.

Summary of Inspection

An eddy current tube inspection was performed as part of a preventive maintenance program with the following results.

Condenser: 883 Tubes		
Tubes Tested: 883 Tubes		
Significant/Measurable Indications	Number of Tubes Marked	Percent of Bundle
OD DEFECT < 20%	1	.11
PREVIOUSLY PLUGGED	1	.11
RESTRICTED	3	.34
Totals	**5**	**.56**

Evaporator: 699 Tubes		
Tubes Tested: 699 Tubes		
Significant/Measurable Indications	Number of Tubes Marked	Percent of Bundle
OD DEFECT < 20%	1	.14
ID DEFECT < 20%	1	.14
DENT, NOMINAL	1	.14
MISSING LAND	1	.14
RESTRICTED, TESTED	14	2.00
Totals	**18**	**2.56**

Recommendations

An eddy current inspection was performed on the tubes in this machine. This test was performed using accepted eddy current test methods for the inspection of in-service tubing. It should be noted that Eddy Current is not a leak detection method. The possibility does exist that tubes could contain defects and/or leaks which are not detectable. If leaks are suspected, we recommend a pressure test be used to identify the leaking tubes.

The following suggested repair actions are based on accepted industry standards. After removing sample tubes to confirm the inspection results, a determination of corrective action should be made by the repair agency and end user. Only these parties have knowledge of the critical applications and long-term use of the equipment. If plugging is selected over replacement, both efficiency and capacity should be considered.

CONDENSER:

The tubes marked for OD Defects require no corrective action at this time.

Tubes marked as Previously Plugged, had been plugged prior to this inspection.

Tubes marked as Restricted contained defects, or foreign material which prevented the inspection probe from passing. The condition of these tubes at and beyond the obstruction remains unknown. (NOTE: Many tubes in this bundle had plastic debris from the water tower in them. All effort was made to clean the obstructions to no prevail. The tubes were tested from the opposite side to the obstructions.)

EVAPORATOR:

The tubes marked for OD Defects require no corrective action at this time.

The ID Defects detected appear minor at this time, and require no immediate corrective action. However, the damage mechanism and growth rates are unknown. If leaks are suspected, we recommend these tubes be pressure tested and/or isolated from the system.

Tubes indicated as "Dent, Nominal" require no corrective action at this time.

Tubes missing support landings showed no detectable loss and require no corrective action.

Tubes marked as Restricted/Tested contained foreign material or other obstruction and could not be tested with the size probe normally used. These tubes were tested using a smaller .500 diameter probe. No tube damage was detected. It should be noted that using a smaller probe can increase inspection noise, and reduce sensitivity.

RE-INSPECTION RECOMMENDATIONS:

We recommend that a follow-up inspection be performed on these vessels as follows:

Condenser: 24 February 2020

Evaporator: 24 February 2020

A copy of this report should be retained in your files to be used for comparison at that time.

If you should have any questions concerning this report, or if we may be of further assistance, please feel free to call upon us.

Data Sheet

Location	Model	Serial Number	Date
DUPONT EXPERIMENTAL STATION	OTT4G2-ZBES	GACM127698 #9	February 24, 2017
RTE. 141 BETWEEN 52 & 202			
WILMINGTON, DE 19735			

Row	Tube	Description	Area	Action Req.
SET UP CALIBRATE & STARTED				
CONDENSER 2/24/2017 02:29 pm				
5	8	PREVIOUSLY PLUGGED	TE	
5	13	OD DEFECT < 20%	B01	
26	2	RESTRICTED	B02	
33	7	RESTRICTED	B04	
34	17	RESTRICTED	B04	
CALIBRATION CHECK & COMPLETED				
CONDENSER 2/24/2017 02:35 pm				
SET UP CALIBRATE & STARTED				
EVAPORATOR 2/25/2017 09:54 am				
2	5	DENT, NOMINAL	B04	
6	18	RESTRICTED, TESTED	B01	
6	41	RESTRICTED, TESTED	TE	
7	13	RESTRICTED, TESTED	TE	
7	45	RESTRICTED, TESTED	TE	
8	45	ID DEFECT < 20%	B05	
11	15	OD DEFECT < 20%	B03	
11	35	RESTRICTED, TESTED	B03	
13	6	RESTRICTED, TESTED	B03	
17	8	RESTRICTED, TESTED	TE	

Row	Tube	Description	Area	Action Req.
17	16	RESTRICTED, TESTED	TE	
18	10	MISSING LAND	S02	
18	18	RESTRICTED, TESTED	TE	
18	28	RESTRICTED, TESTED	TE	
19	1	RESTRICTED, TESTED	TE	
19	18	RESTRICTED, TESTED	TE	
20	13	RESTRICTED, TESTED	TE	
20	14	RESTRICTED, TESTED	TE	
CALIBRATION CHECK & COMPLETED				
EVAPORATOR 2/25/2017 09:55 am				

Condenser Section

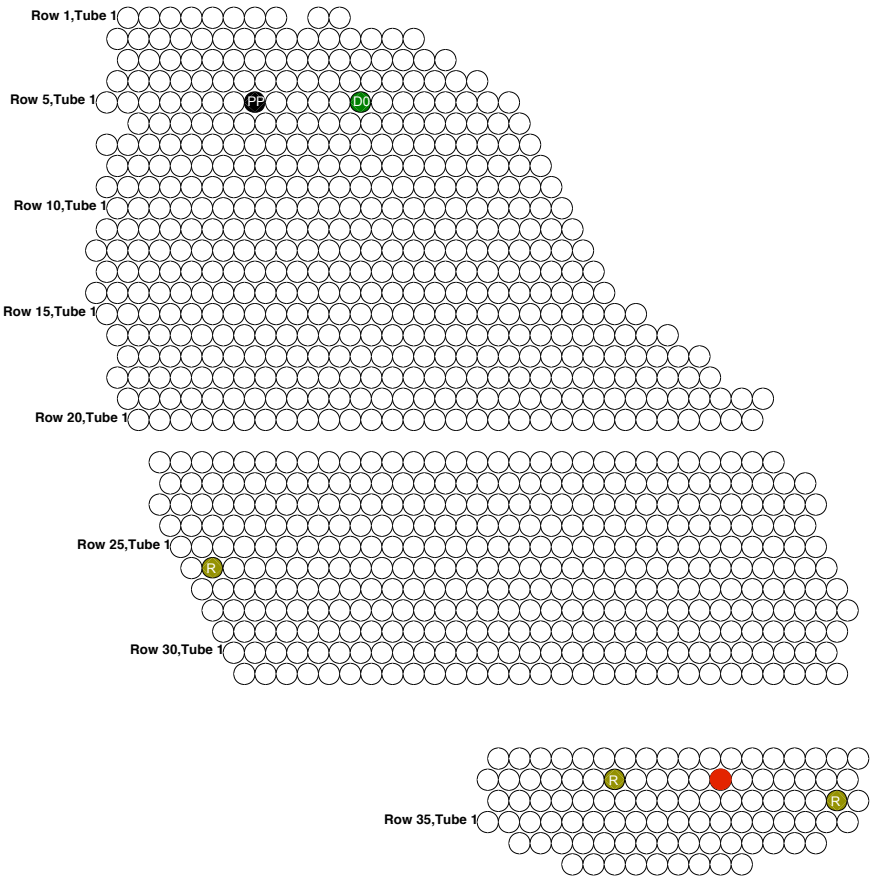
Tubes Numbered
Left to Right

Rows Numbered
Top to Bottom

S/N GACM127698 #9

Right Hand Facing Controls

Top of Vessel

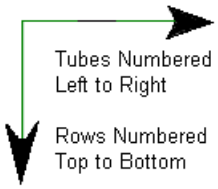


D0 = OD DEFECT < 20%

PP = PREVIOUSLY PLUGGED

R = RESTRICTED

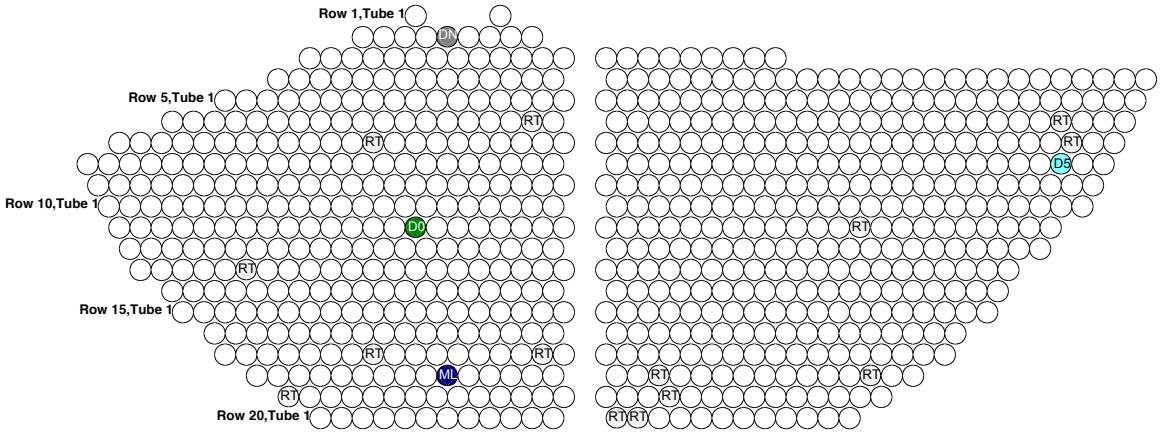
Evaporator Section



S/N GACM127698 #9

Left Hand Facing Controls

Top of Vessel



D0 = OD DEFECT < 20%

D5 = ID DEFECT < 20%

DN = DENT, NOMINAL

ML = MISSING LAND

RT = RESTRICTED, TESTED

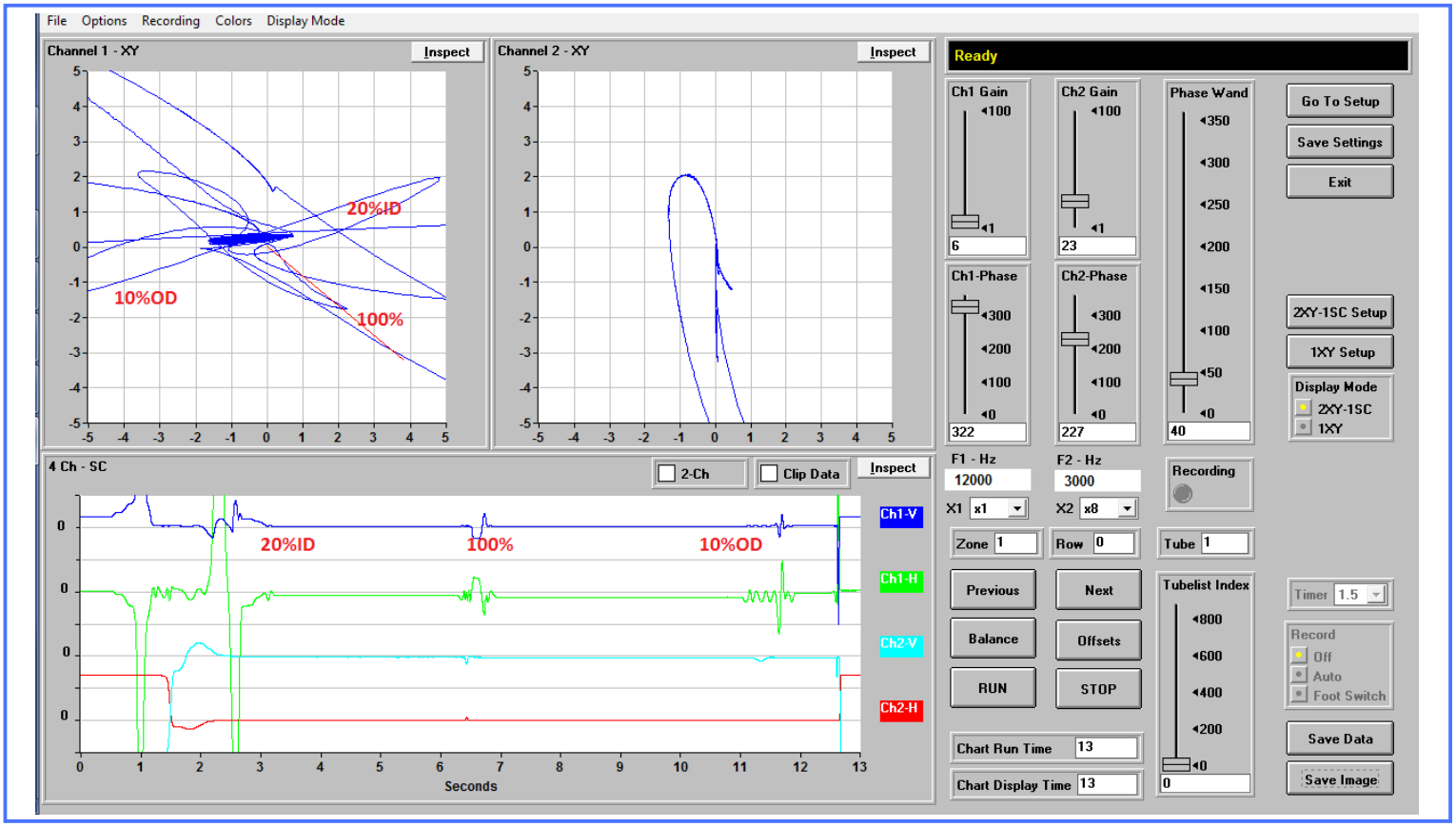
Test Instrument Used
Highline Automation, EC14

S/N GACM127698 #9

Calibration Page

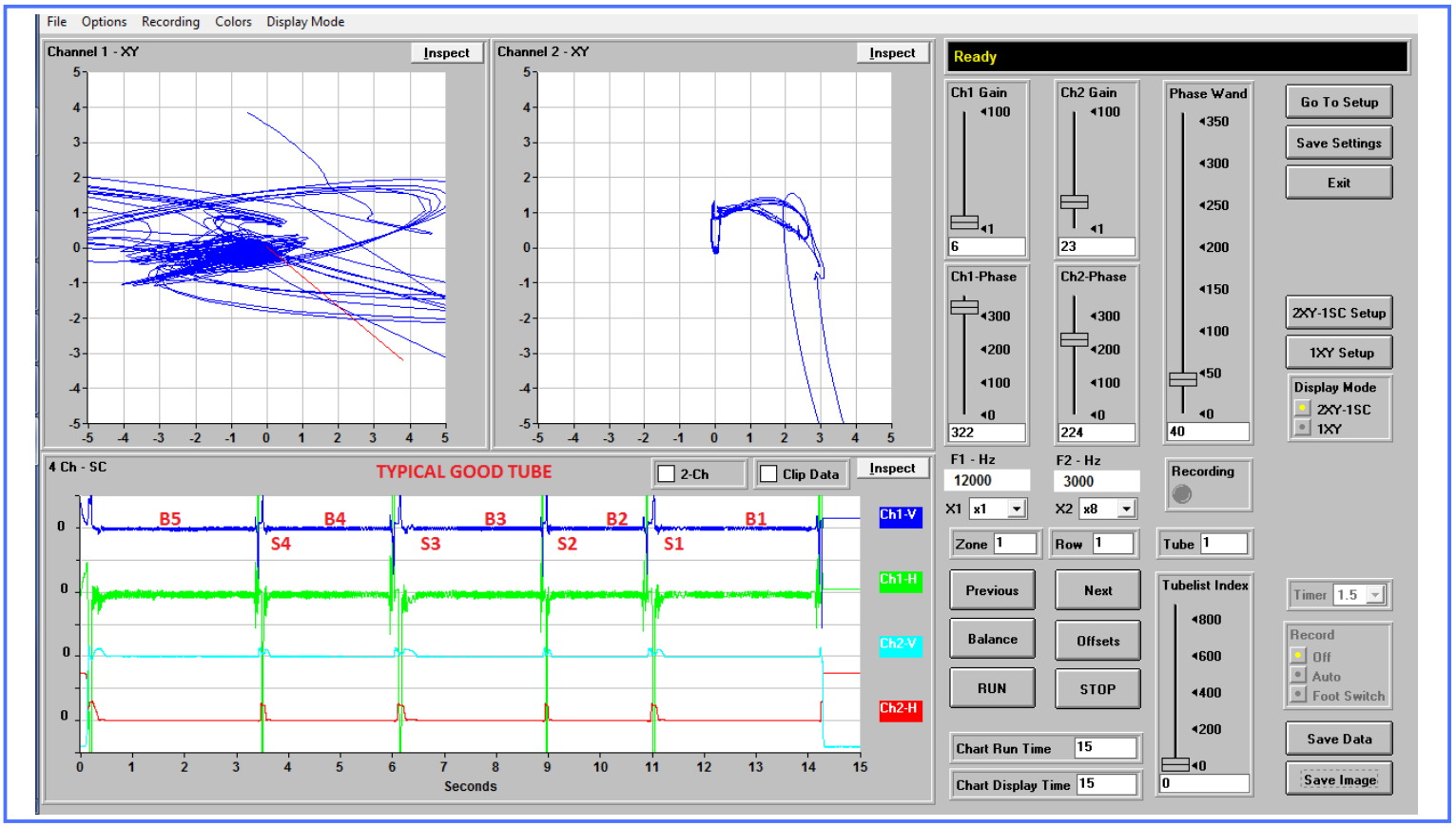
Tube Type	Material	Nom Wall Thick	End Wall Thick	OD	Test Type	Probe Diameter
Skip Fin IE	Copper	.028	.055	.750	Cross/Diff	.500

Condenser



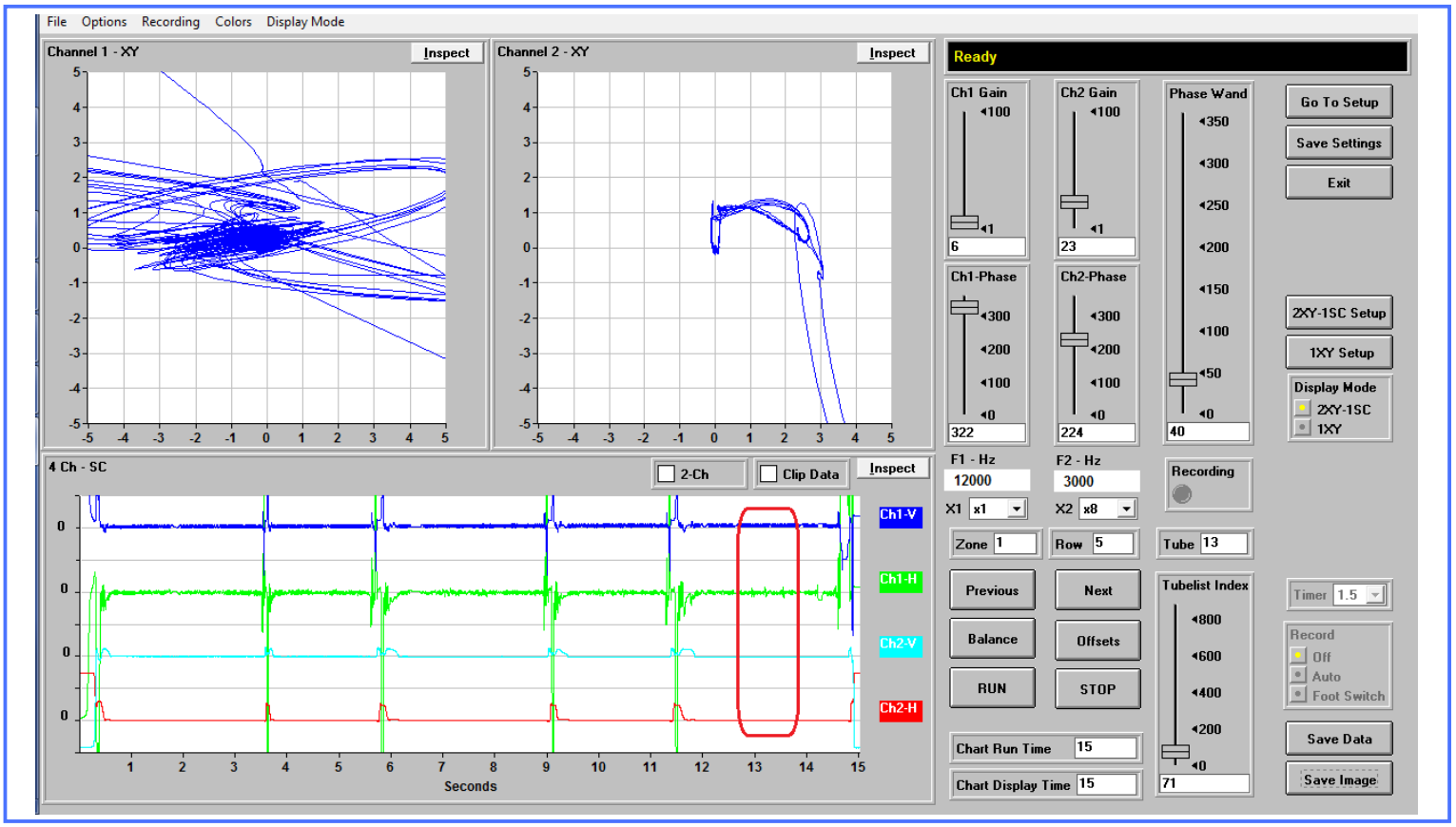
Note: Defects are compared to machined standards.
Actual Defect Geometry may differ.

Condenser Section



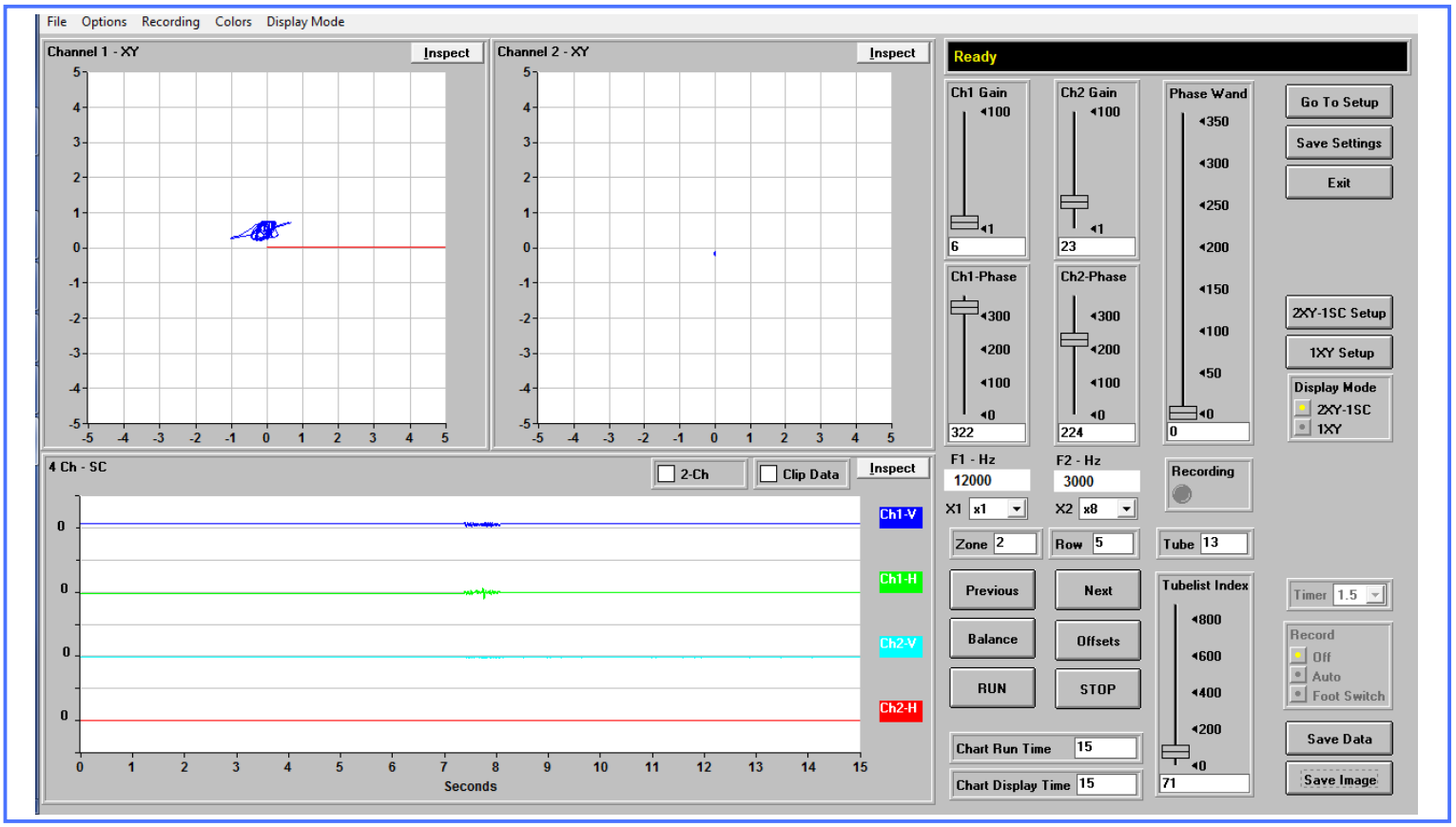
NO SIGNIFICANT DEFECTS (Row 1 Tube 1)

Condenser Section



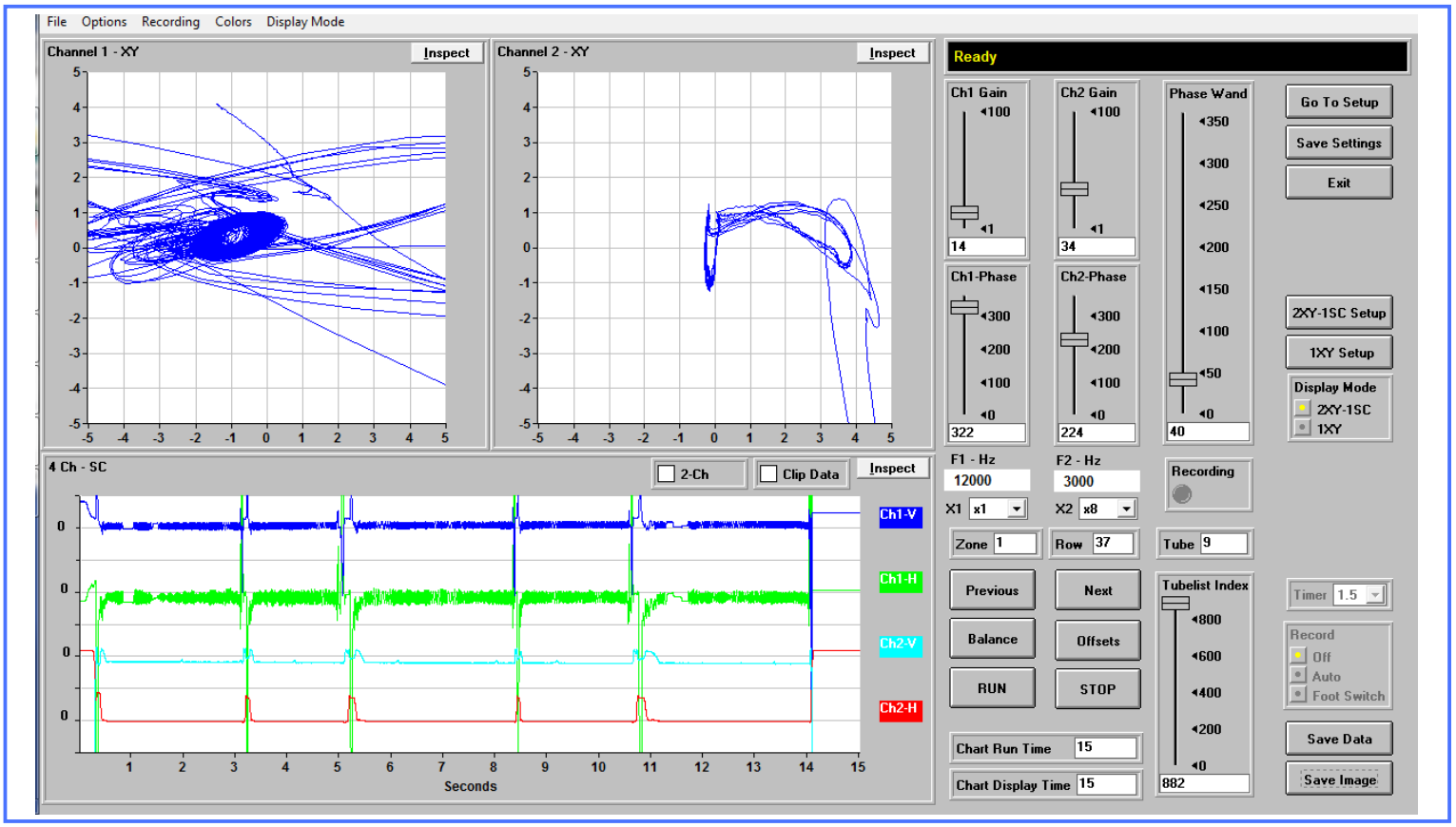
OD DEFECT < 20% (Row 5 Tube 13)

Condenser Section



OD DEFECT < 20% (Row 5 Tube 13)

Condenser Section



NO SIGNIFICANT DEFECTS (Row 37 Tube 9)

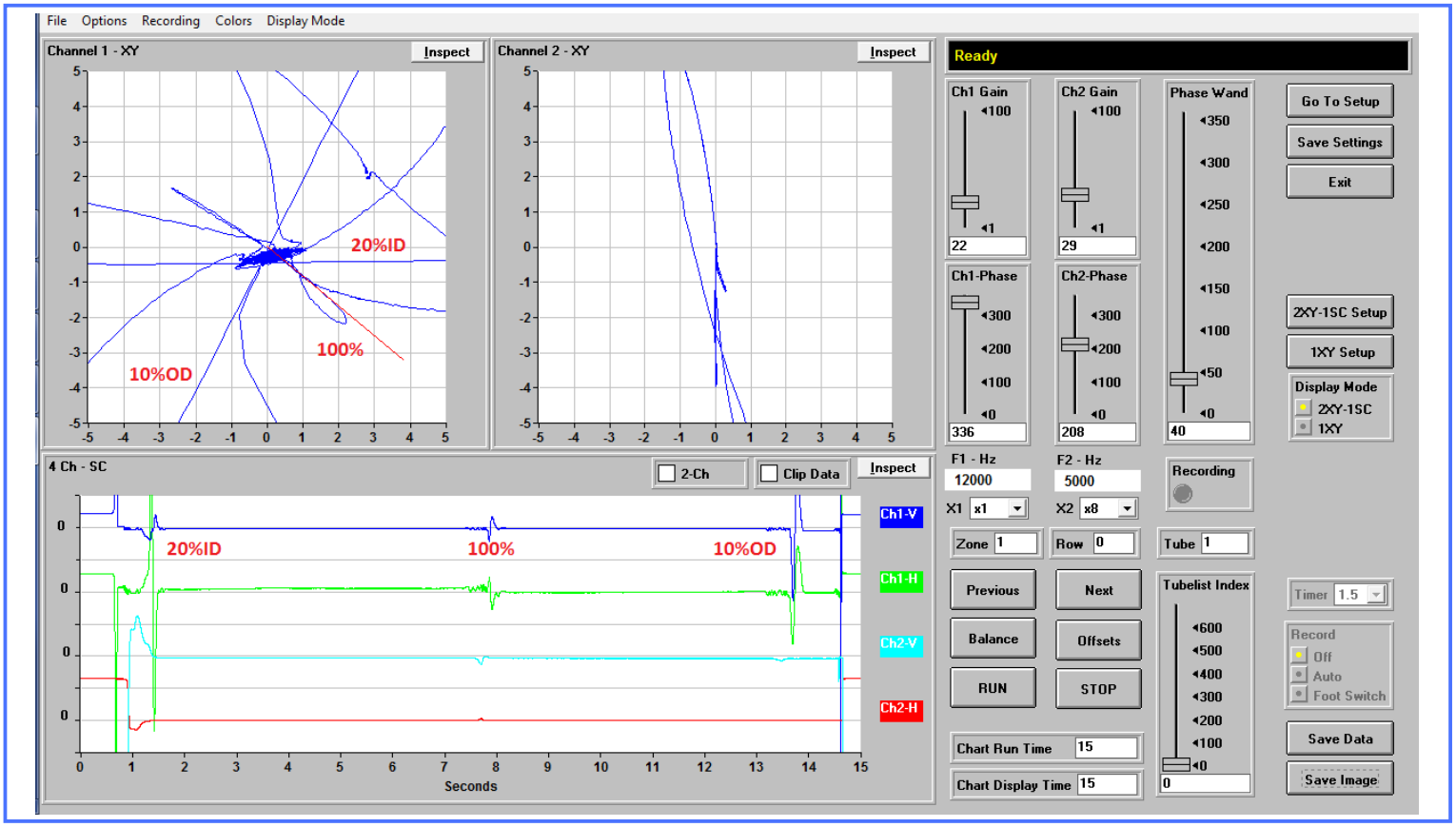
Test Instrument Used
Highline Automation, EC14

S/N GACM127698 #9

Calibration Page

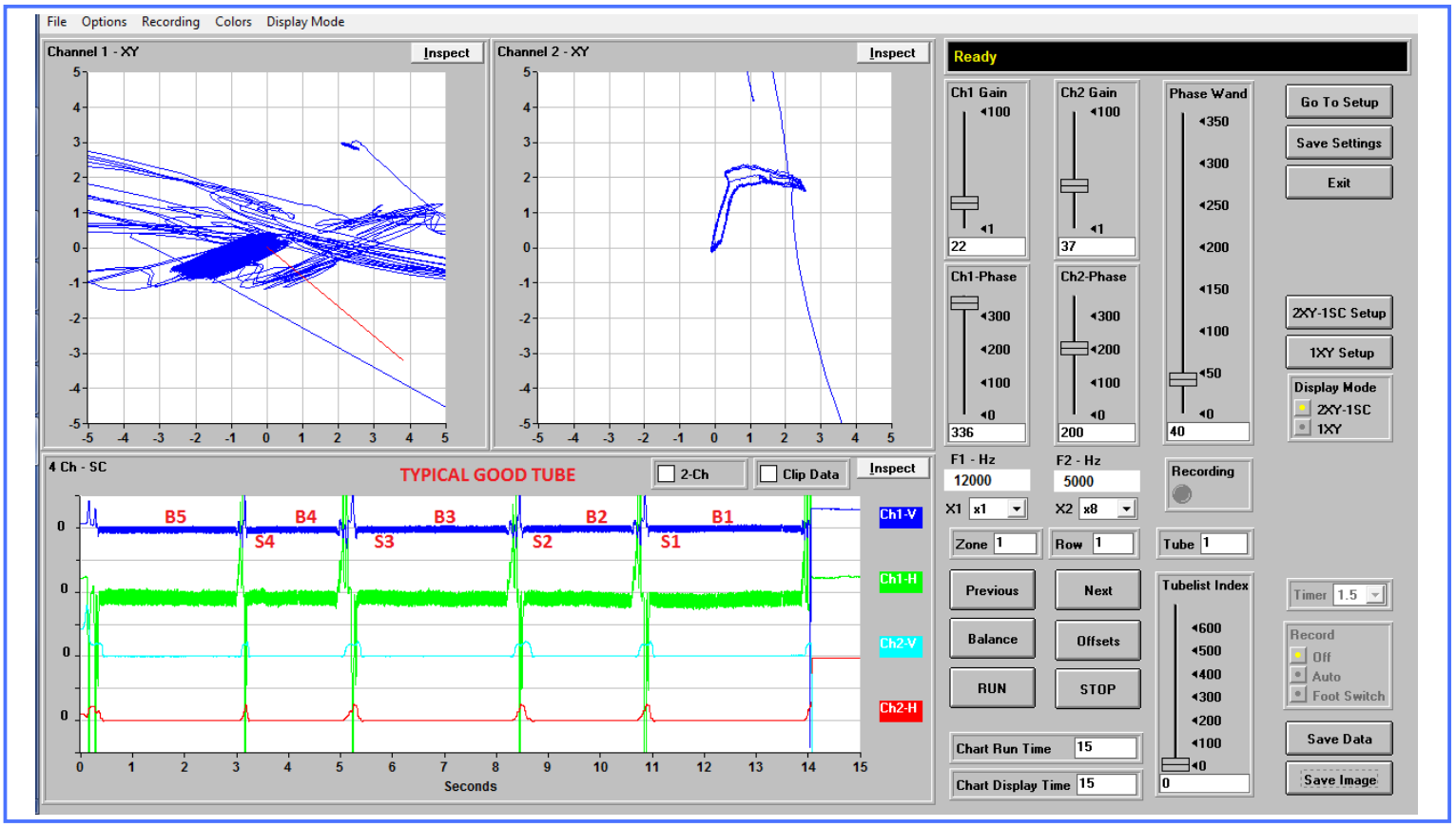
Tube Type	Material	Nom Wall Thick	End Wall Thick	OD	Test Type	Probe Diameter
Skip Fin IE	Copper	.028	.052	.750	Cross/Diff	.5625

Evaporator



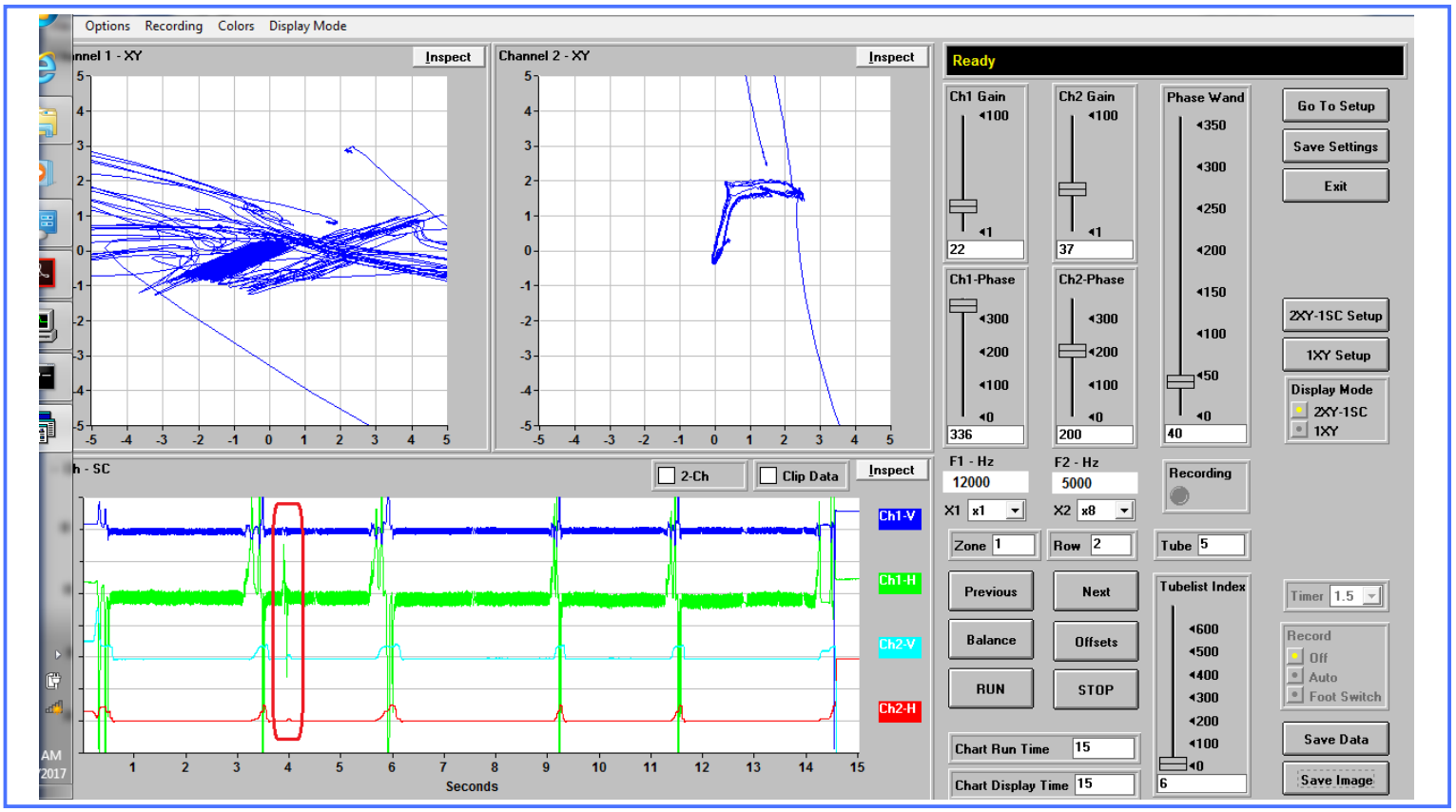
Note: Defects are compared to machined standards.
Actual Defect Geometry may differ.

Evaporator Section



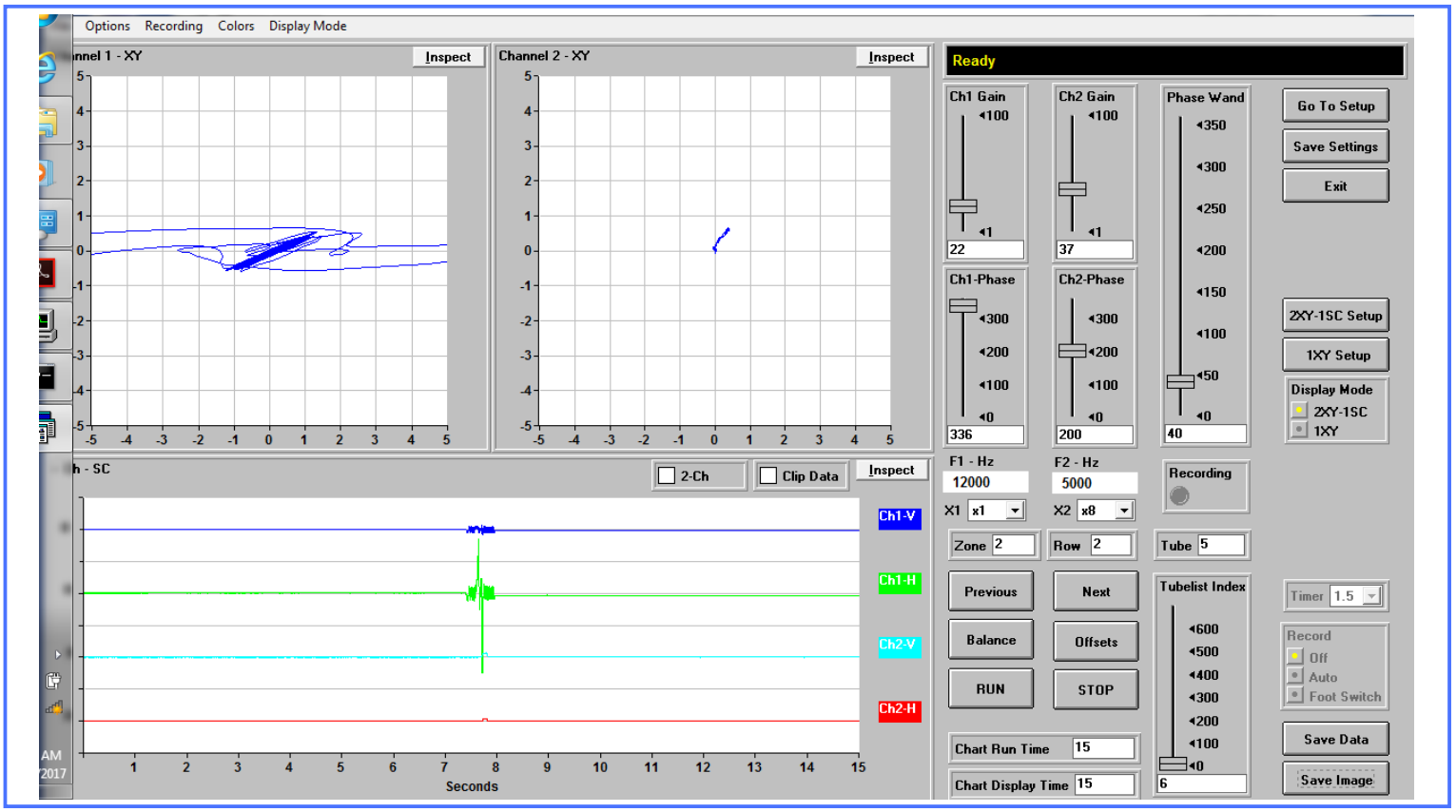
NO SIGNIFICANT DEFECTS (Row 1 Tube 1)

Evaporator Section



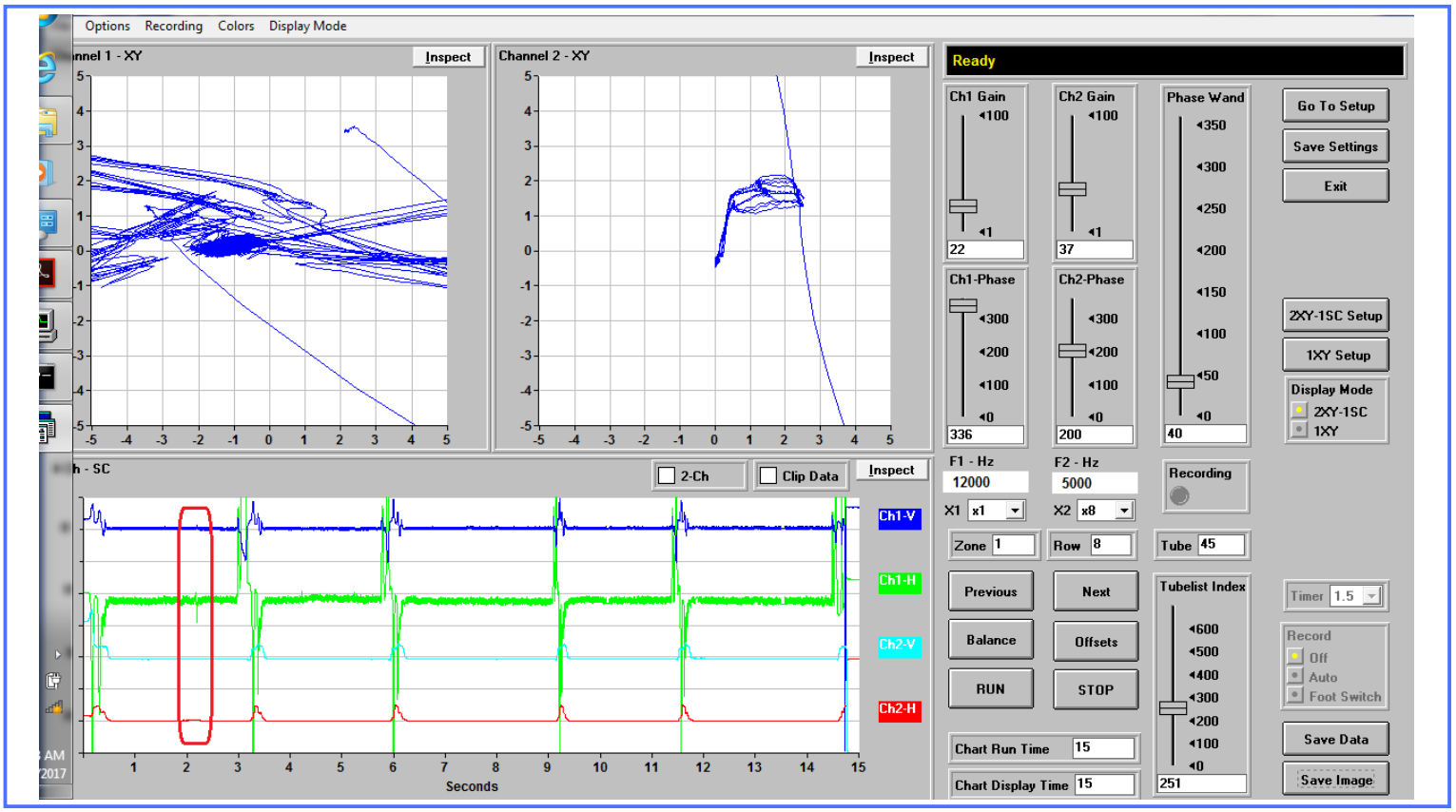
DENT, NOMINAL (Row 2 Tube 5)

Evaporator Section



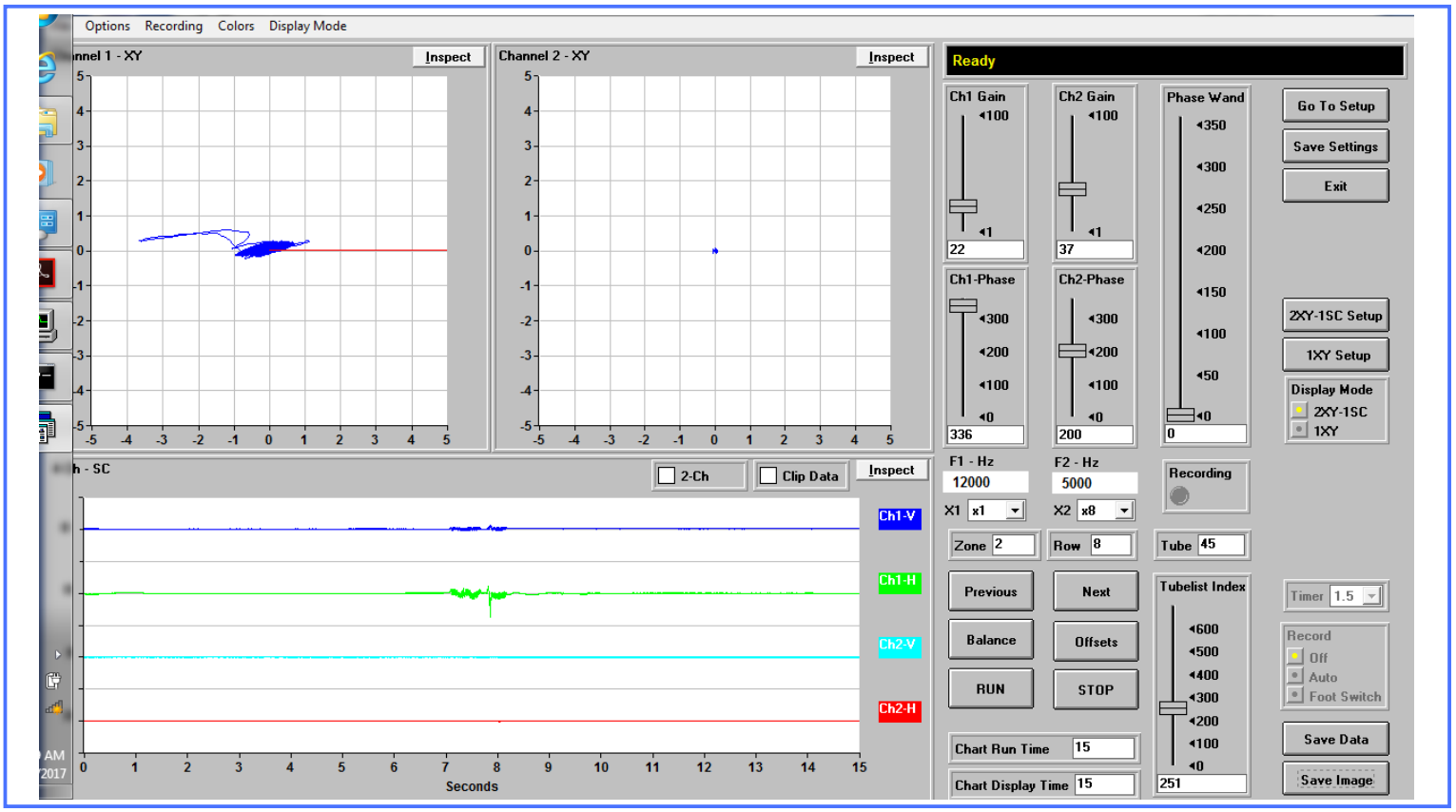
DENT, NOMINAL (Row 2 Tube 5)

Evaporator Section



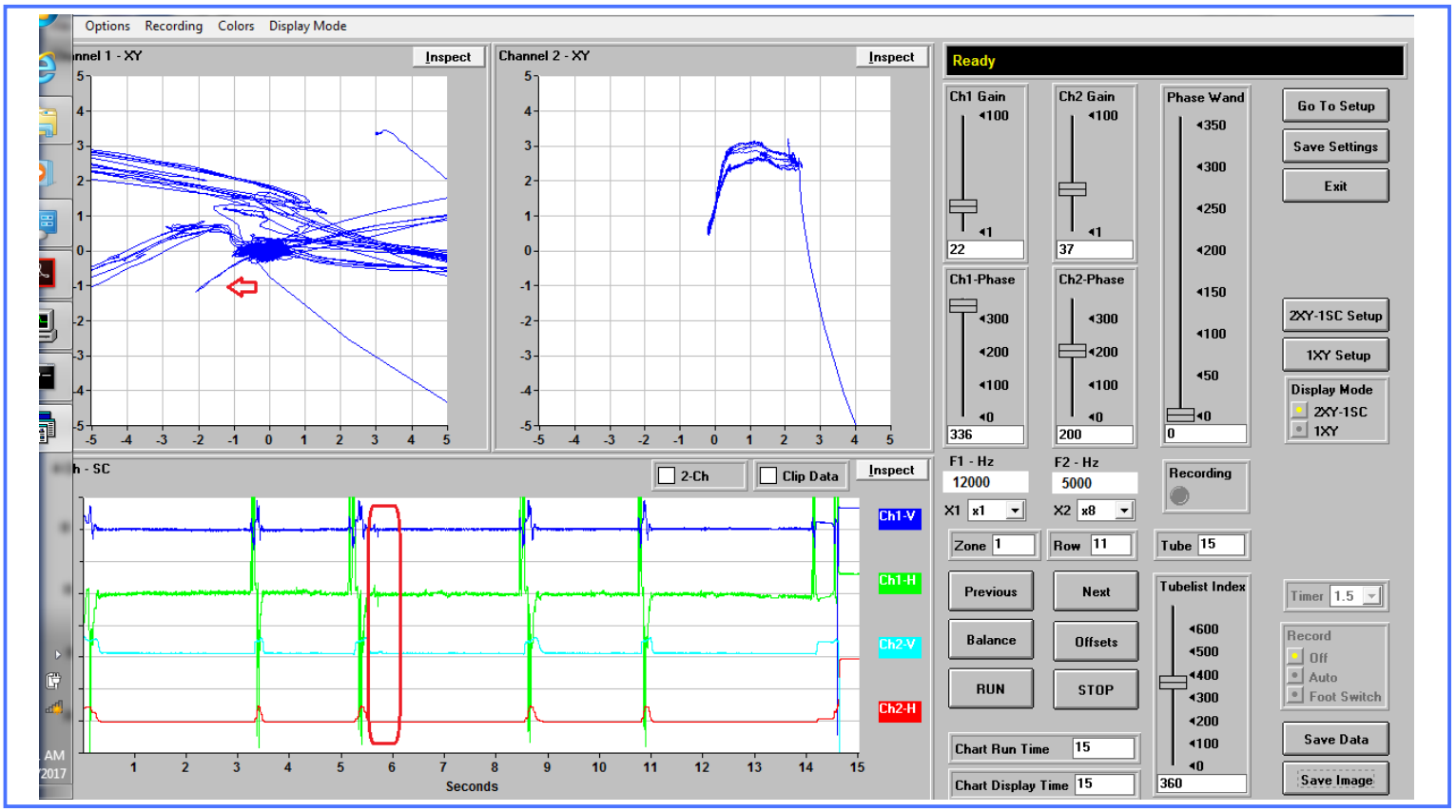
ID DEFECT < 20% (Row 8 Tube 45)

Evaporator Section



ID DEFECT < 20% (Row 8 Tube 45)

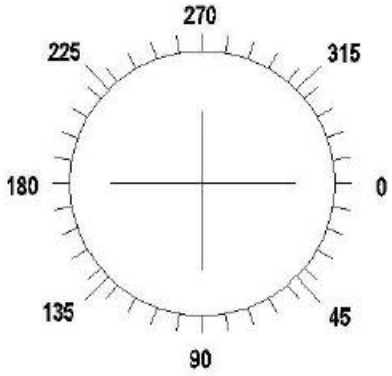
Evaporator Section

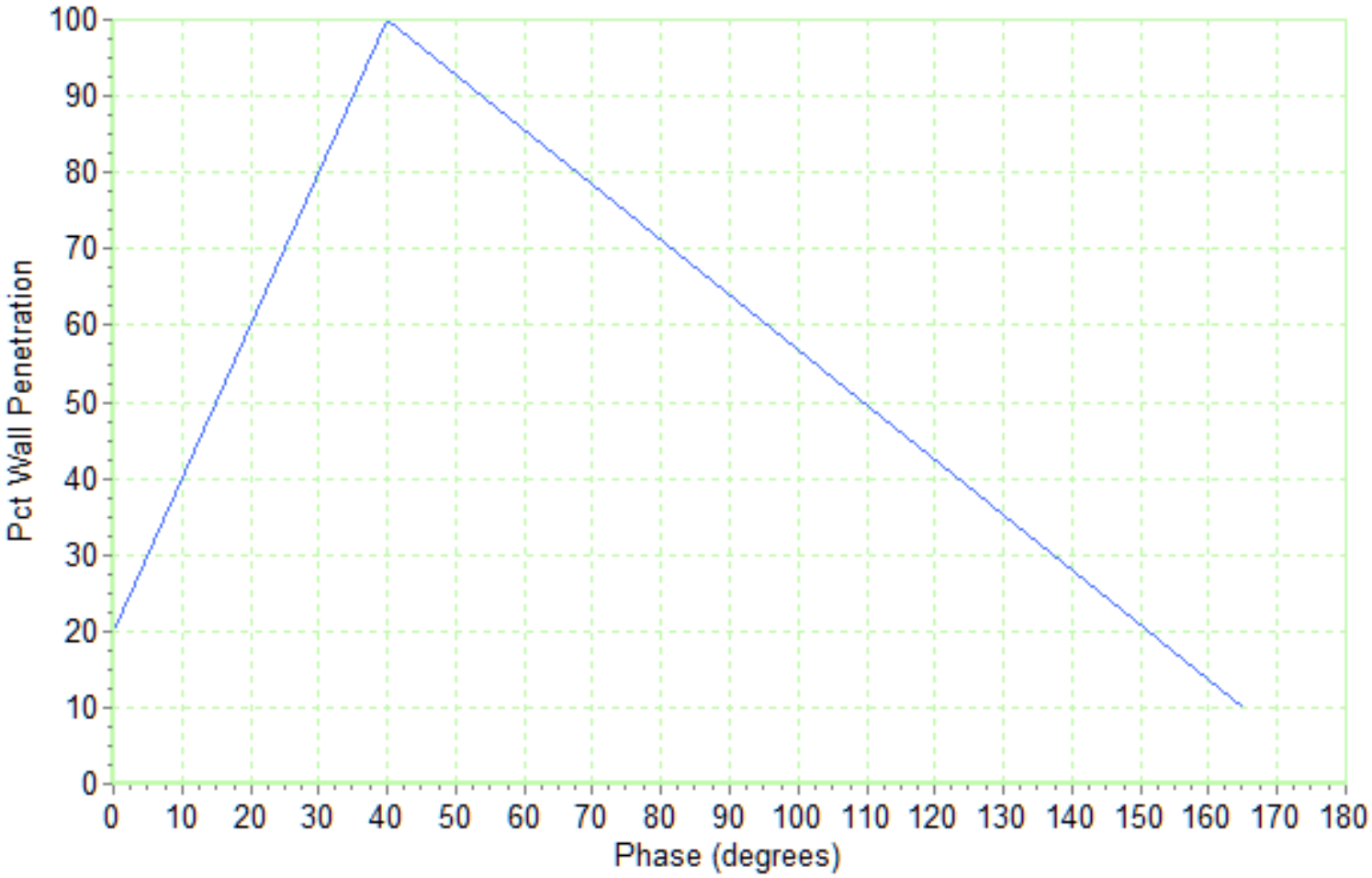


OD DEFECT < 20% (Row 11 Tube 15)

Phase Chart - Condenser

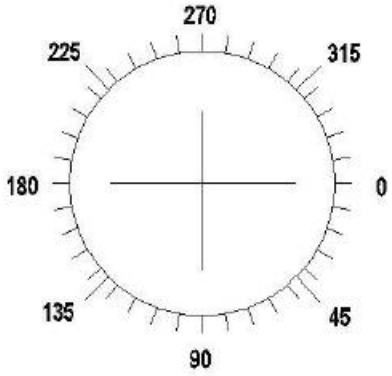
Material	Tube Type	OD	Wall	Test Type	Frequency	Probe Diameter
Copper	Skip Fin IE	.750	.055	CROSS/DIFF	12000/30	.500

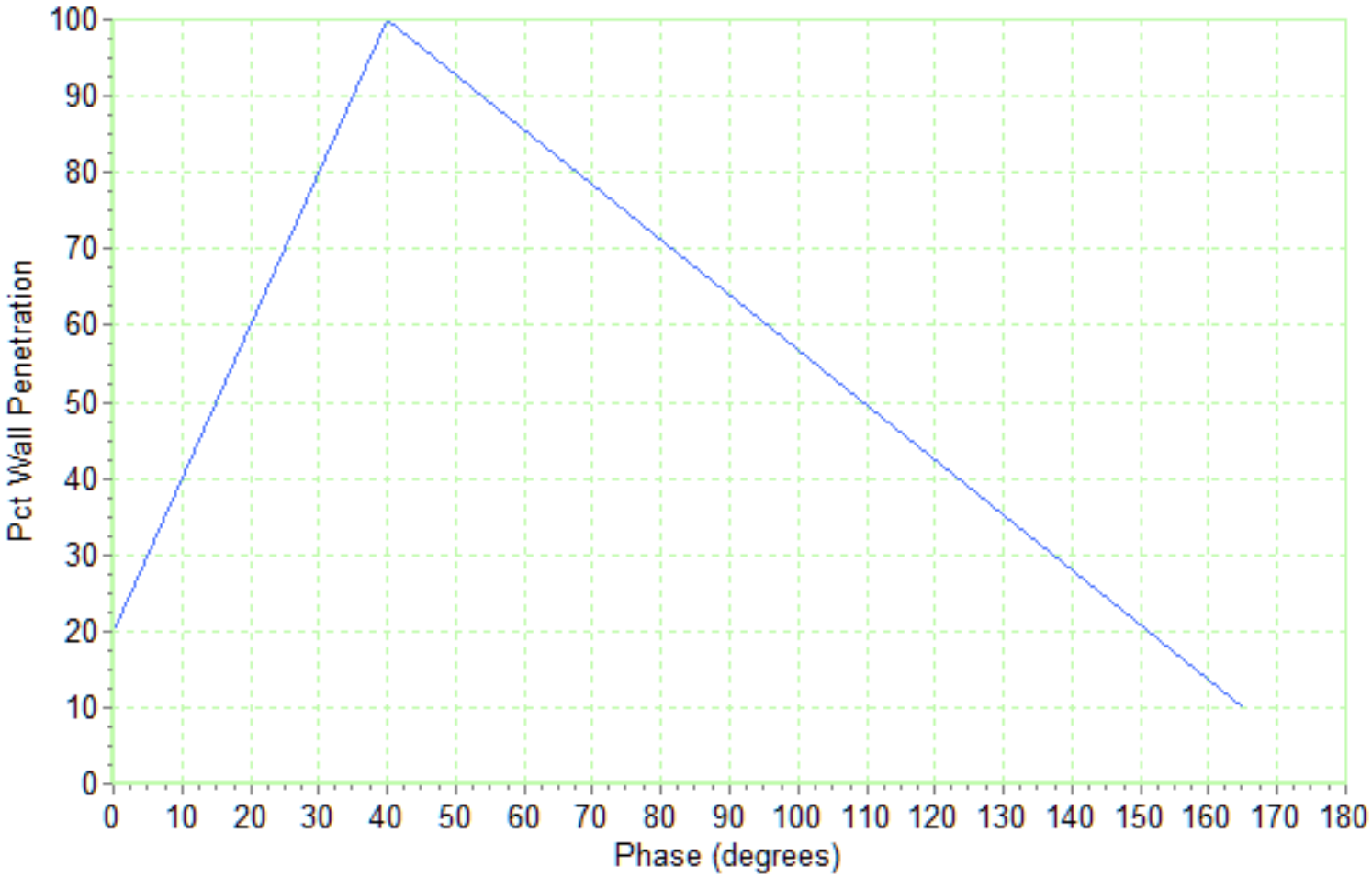




Phase Chart - Evaporator

Material	Tube Type	OD	Wall	Test Type	Frequency	Probe Diameter
Copper	Skip Fin IE	.750	.052	CROSS/DIFF	12000/50	.5625





Calibration Procedure

A calibration procedure is performed prior to an inspection, and is repeated every 2 hours, or whenever improper operation of the test instrument is suspected. Test frequencies are selected prior to an inspection through experimentation to achieve optimum phase separation, and amplitude response for the tube type and alloy being inspected. An appropriate inspection probe is selected based on tube type, wall thickness, and alloy. The inspection probe will have a minimum fill factor of 80% through the smallest areas of the tubes being inspected. Instrument sensitivity is set high enough to determine background noise inherent in the tube and to produce a .05 Volt deflection for a .031 through wall hole at .25 V/Div.

Calibration Reference Standard

A Calibration Reference Standard representing a typical production run tube of the same alloy, tube type and nominal wall thickness is used to adjust test system response. The calibration reference standard used for the inspection of finned and internally enhanced tubing, has been milled in accordance with the American Society for Testing and Materials (ASTM). Standard Recommended Practices, E-243-80, E-426-76, and E571-76. The depth of the grooves and notches used for establishing instrument response are calculated to compensate for the influence of the fins and/or internal enhancements used on finned tubes. Where applicable, calibration reference standards are milled in accordance with the American Society of Mechanical Engineers (ASME), Section V, Article 8, Appendix I.

A strip chart recording of each calibration reference standard used for the inspection has been included in this report. Each artificial discontinuity has been identified on the strip chart recording.

Explanation of Abbreviations

Abbreviation	Explanation
ABN IND	Abnormal Indication
B	Bay
FB	Freeze Bulge
FBH	Flat Bottom Hole
FM	Foreign Material
ID	Internal Diameter
ID CORROSION	Internal Diameter, Corrosion
ID DEPOSIT	Internal Diameter, Deposit
ID PIT	Internal Diameter, Pit
IDML	Internal Diameter, Metal Loss
IE	Internally Enhanced
OD	Outside Diameter
ODML	Outside Diameter, Metal Loss
ODML@S	Outside Diameter Metal Loss at Support
OD DEPOSIT	Outside Diameter, Deposit
PLF	Possible Longitudinal Flaw
PRF	Possible Radial Flaw
PSC	Possible Stress Corrosion
S	Support
WAS	Wear at Support
>	Greater Than
<	Less Than
OTE	Opposite Test End
TE	Test End