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: GACM117864 #8

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

Inspected: January 26, 2017-January 27, 2017

Inspected By: KEVIN MABRY, LEVEL III
TAI Services, Inc.

Reviewed By: _____
TECHNICAL MANAGER, LEVEL III

Table of Contents

Vessel Information

Manufacturer	Model	Style	Serial Number	Type
York	OTT4G2-ZBES	Open Drive	GACM117864 #8	Centrifugal

Condenser	
TestEnd	Outlet End
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	Inlet/Outlet End
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: KEVIN MABRY, 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

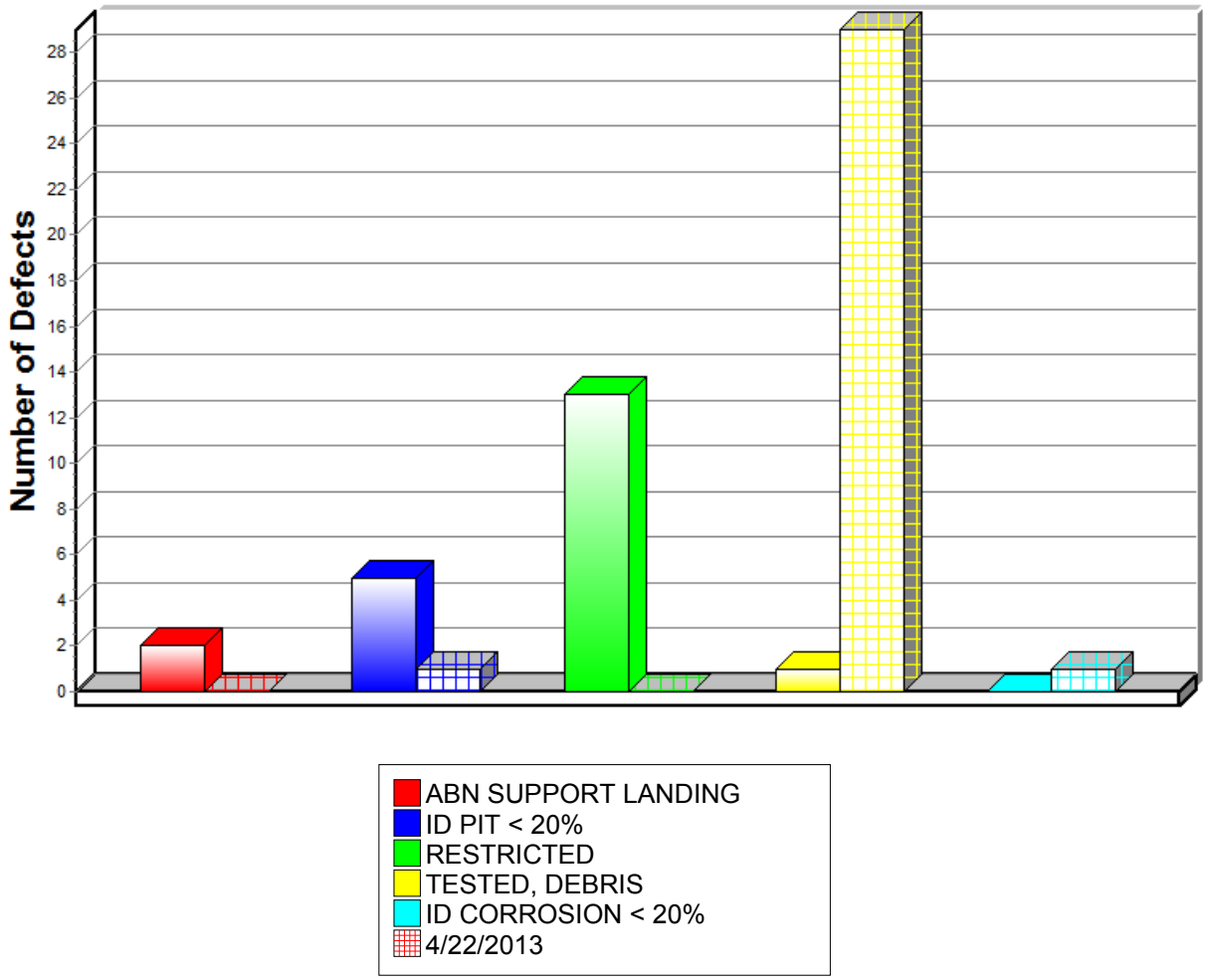
Bay 5	43.00"
Bay 4	29.00"
Bay 3	36.00"
Bay 2	29.00"
Bay 1	43.00"

Defect Summary/Comparison

Comparison of Tests Performed

1/26/2017 4/22/2013

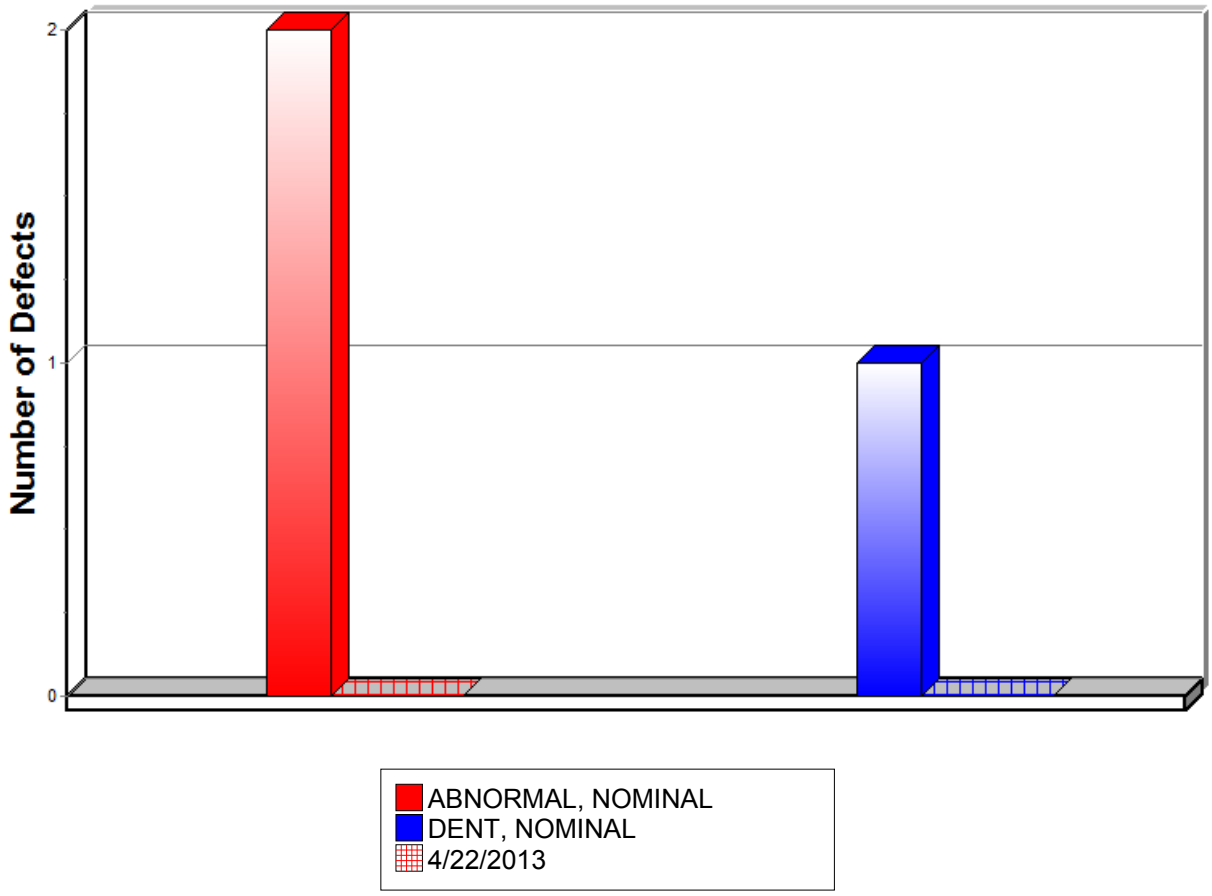
Condenser Defects



Location	Model	Serial Number
DUPONT EXPERIMENTAL STATION	OTT4G2-ZBES	GACM117864 #8

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	GACM117864 #8

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
ABN SUPPORT LANDING	2	.23
ID PIT < 20%	5	.57
RESTRICTED	13	1.47
TESTED, DEBRIS	1	.11
Totals	**21**	**2.38**

NOTE: The tubes in this bundle showed excessive noise believed to be the result of the manufacturing process. Noise is not detrimental to the tubes performance but could mask or distort small tube damage indications.

Evaporator: 699 Tubes		
Tubes Tested: 699 Tubes		
Significant/Measurable Indications	Number of Tubes Marked	Percent of Bundle
ABNORMAL, NOMINAL	2	.29
DENT, NOMINAL	1	.14
Totals	**3**	**.43**

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:

Tubes indicating Abnormal Support Landings require no corrective action at this time.

The ID Pits marked require no immediate corrective action. However, this type damage is usually progressive and should be monitored.

Tubes marked as Restricted contained defects, or foreign material which prevented the inspection probe from passing. As both heads were removed, the tubes were inspected from Opposite Test End side up to the restricted point from that end. No defects were detected.

NOTE: The debris/foreign material appeared to be blue in color and is similiar to what appears to be small Epoxy Coating pieces on tube walls.

The tubes marked as Tested Debris contained foreign material. No damage was detected and no corrective action is required. It should be noted that the tubes in this bundle contained foreign material. This material could possibly mask, or be interpreted as tube damage.

EVAPORATOR:

Tubes indicating Abnormal Nominal Indications require no corrective at this time.

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

RE-INSPECTION RECOMMENDATIONS:

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

Condenser: 26 January 2020

Evaporator: 27 January 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	GACM117864 #8	January 26, 2017
RTE. 141 BETWEEN 52 & 202			
WILMINGTON, DE 19735			

Row	Tube	Description	Area	Action Req.
SET UP CALIBRATE & STARTED				
CONDENSER 1/26/2017 03:15 pm				
CALIBRATION CHECK 1/26/2017 04:50 pm				
CALIBRATION CHECK 1/27/2017 07:25 am				
1	1	ABN SUPPORT LANDING	ALL	
6	16	ID PIT < 20%	B02	
9	18	ID PIT < 20%	B02	
11	9	TESTED, DEBRIS	B02	
12	11	ID PIT < 20%	B04	
12	14	RESTRICTED	B01	
13	8	RESTRICTED	B05	
13	19	ID PIT < 20%	B03	
15	4	RESTRICTED	B05	
15	9	RESTRICTED	B05	
18	25	RESTRICTED	B03	
20	25	RESTRICTED	B01	
21	22	RESTRICTED	B05	
22	1	RESTRICTED	B01	
24	8	RESTRICTED	B05	
25	23	RESTRICTED	B02	
26	25	RESTRICTED	B05	

Row	Tube	Description	Area	Action Req.
29	25	ID PIT < 20%	B03	
35	4	ABN SUPPORT LANDING	ALL	
35	14	RESTRICTED	B05	
37	2	RESTRICTED	B04	
CALIBRATION CHECK & COMPLETED				
CONDENSER 1/27/2017 12:15 pm				
SET UP CALIBRATE & STARTED				
EVAPORATOR 1/27/2017 12:45 pm				
9	23	ABNORMAL, NOMINAL	B03	
13	32	DENT, NOMINAL	B05	
17	25	ABNORMAL, NOMINAL	B02	
CALIBRATION CHECK & COMPLETED				
EVAPORATOR 1/27/2017 04:45 pm				

Condenser Section

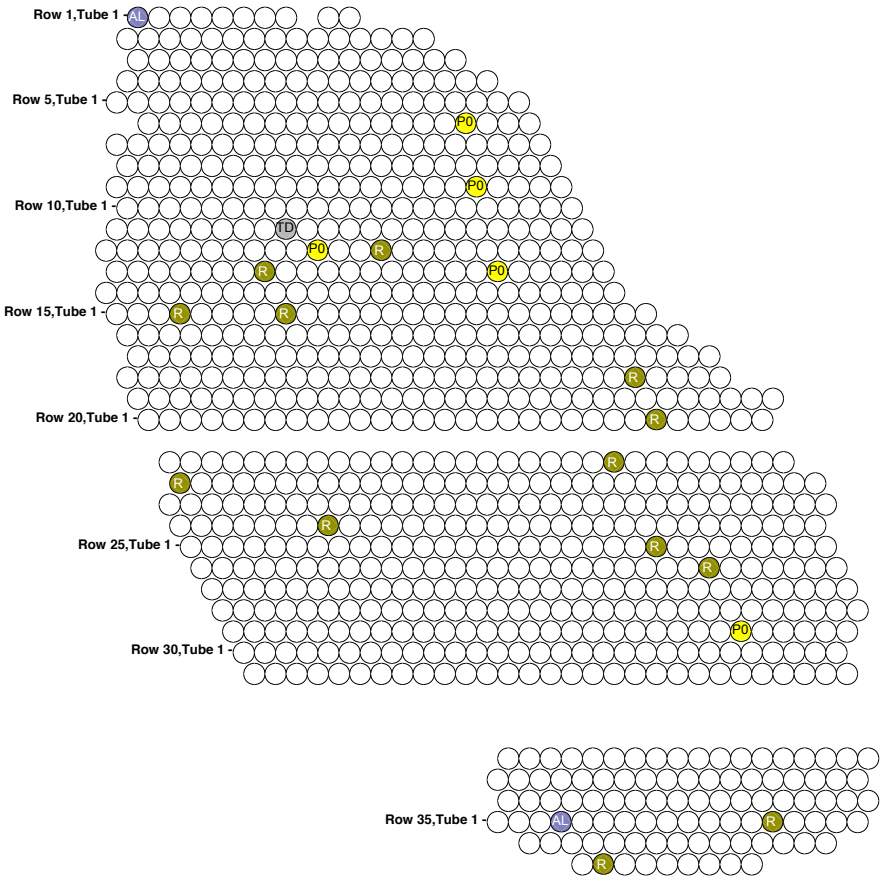
S/N GACM117864 #8

Outlet End

Tubes Numbered
Left to Right

Rows Numbered
Top to Bottom

Top of Vessel



AL = ABN SUPPORT LANDING

P0 = ID PIT < 20%

R = RESTRICTED

TD = TESTED, DEBRIS

Evaporator Section

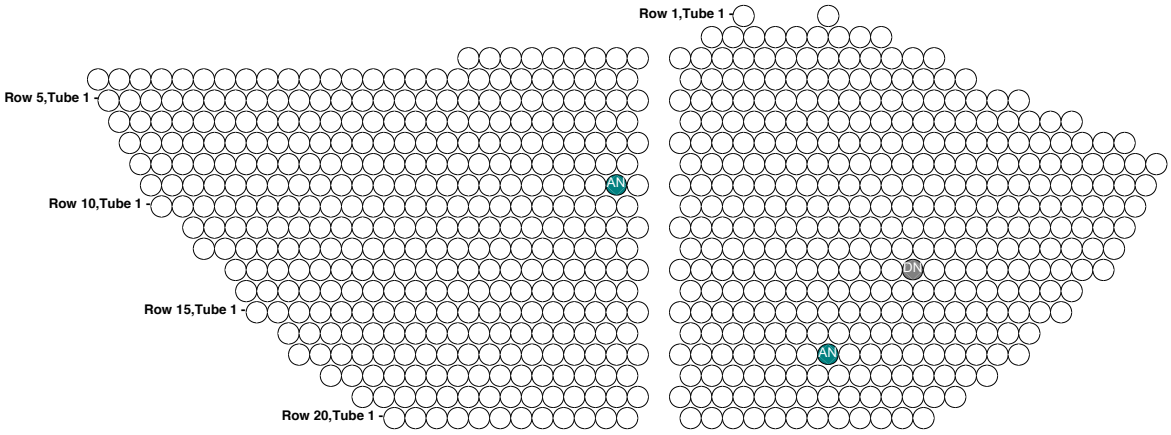
S/N GACM117864 #8

Inlet/Outlet End

Tubes Numbered
Left to Right

Rows Numbered
Top to Bottom

Top of Vessel



AN = ABNORMAL, NOMINAL

DN = DENT, NOMINAL

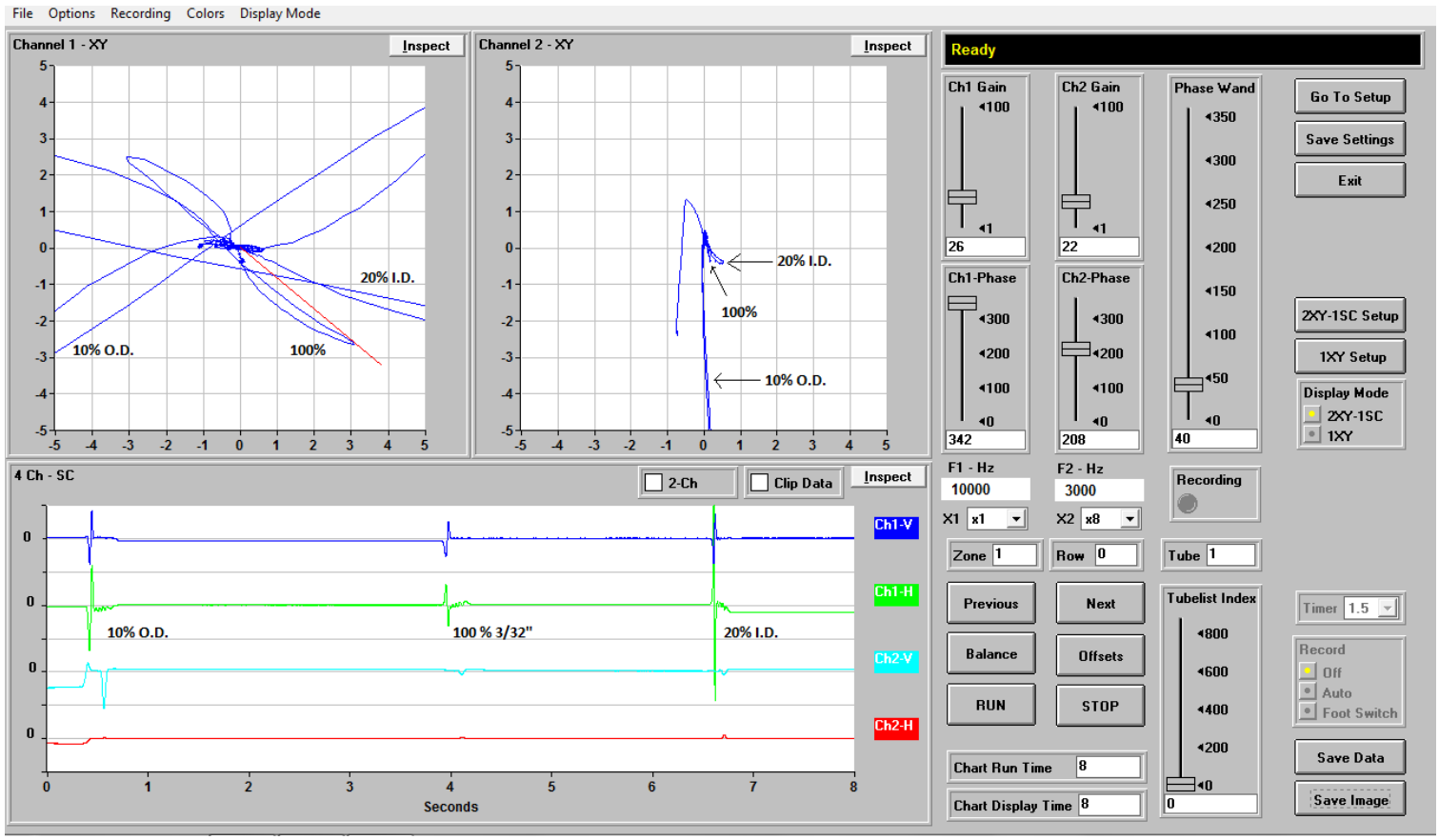
Test Instrument Used
Highline Automation, EC14

S/N GACM117864 #8

Calibration Page

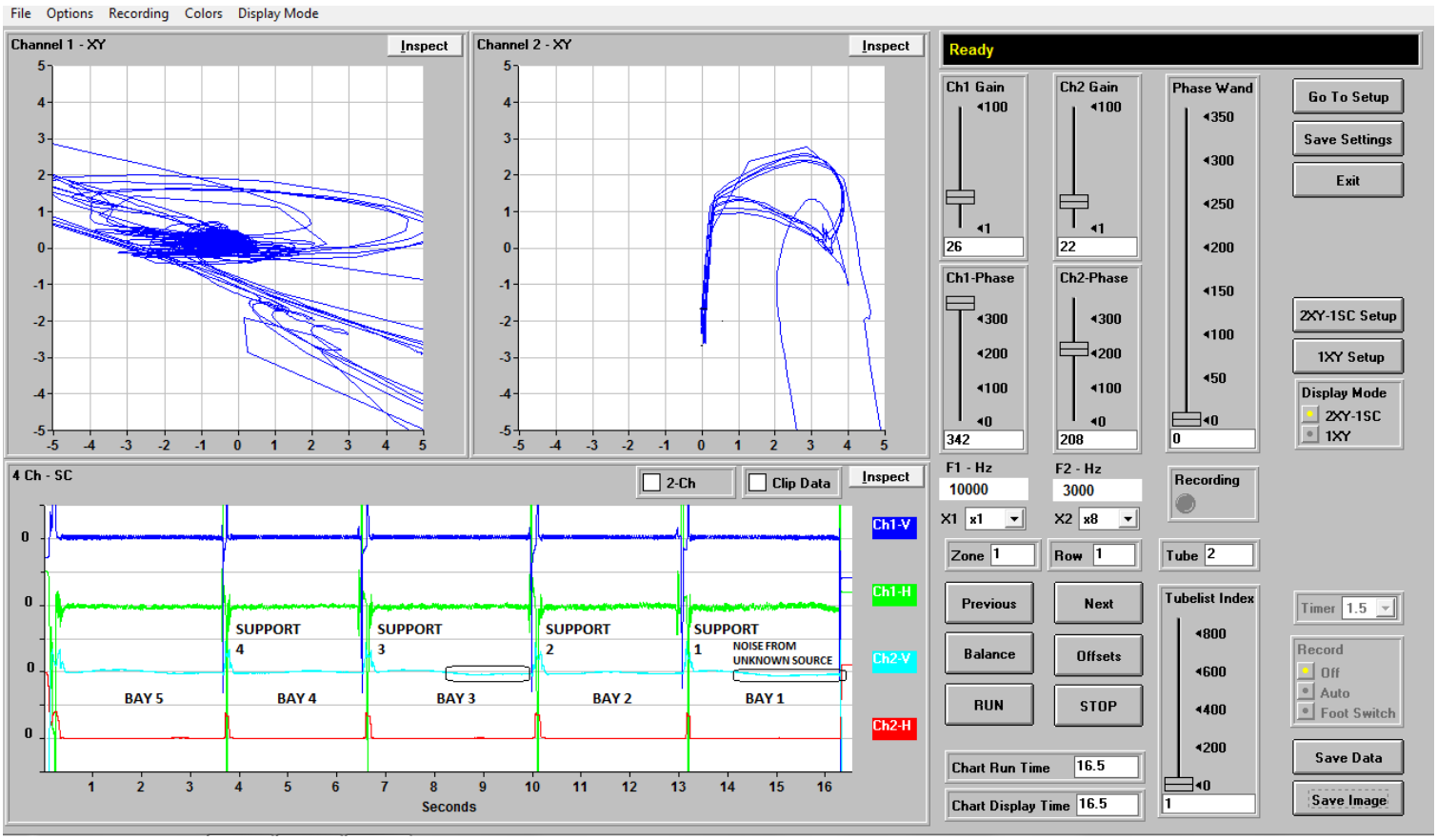
Tube Type	Material	Nom Wall Thick	End Wall Thick	OD	Test Type	Probe Diameter
Skip Fin IE	Copper	.028	.055	.750	Cross/Diff	.500

Condenser



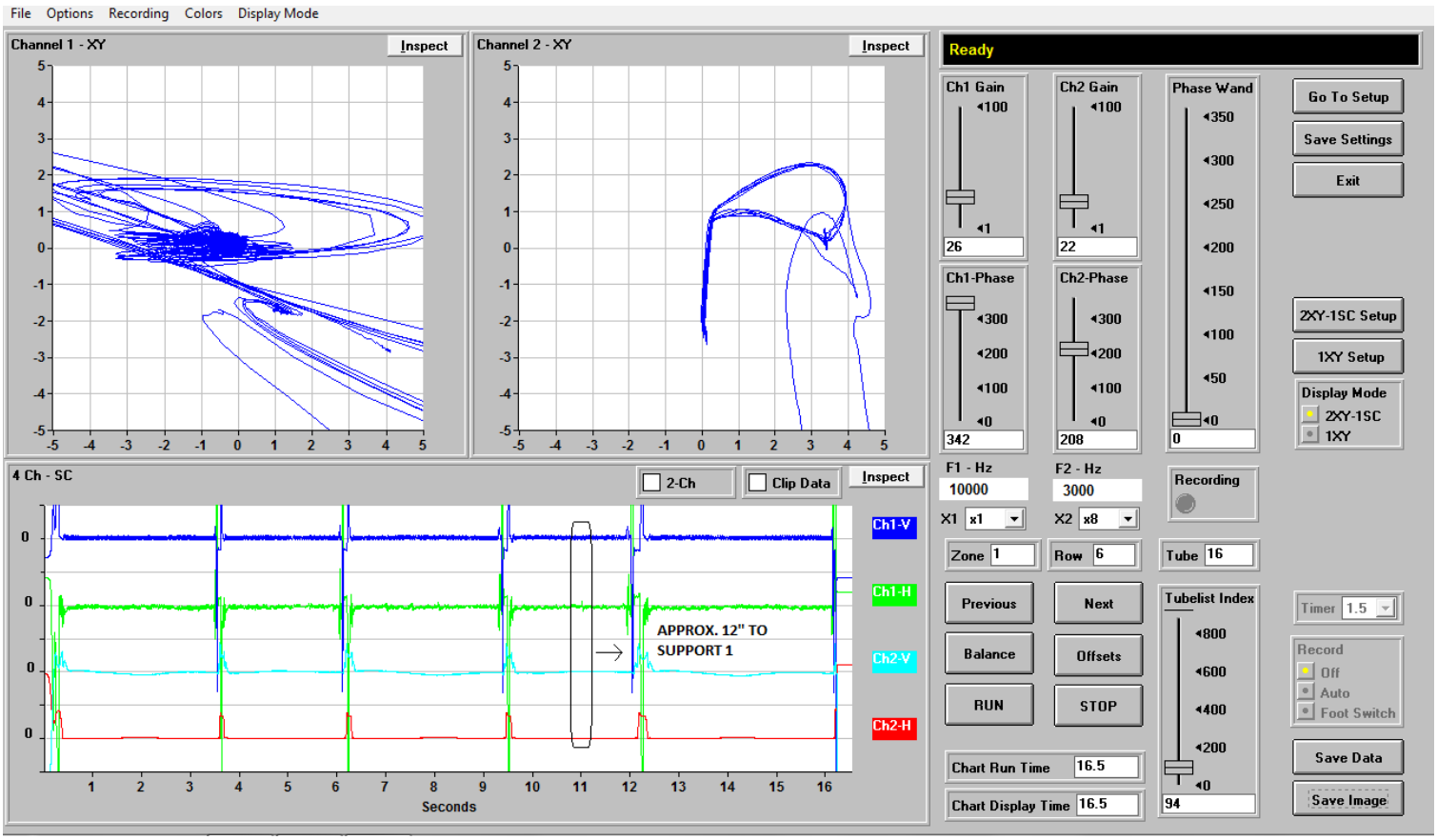
Note: Defects are compared to machined standards.
Actual Defect Geometry may differ.

Condenser Section



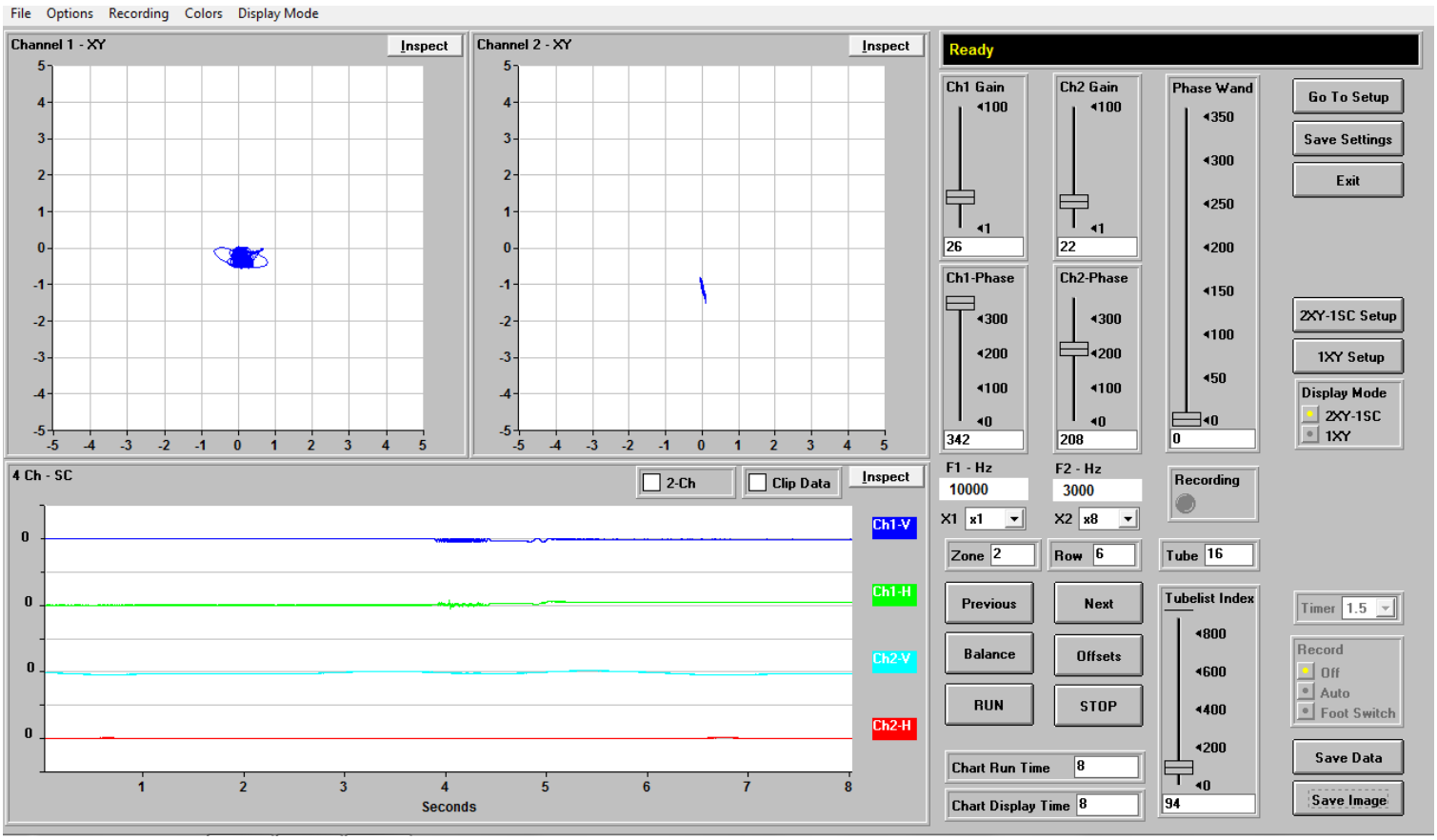
TYPICAL GOOD TUBE (Row 1 Tube 2)

Condenser Section



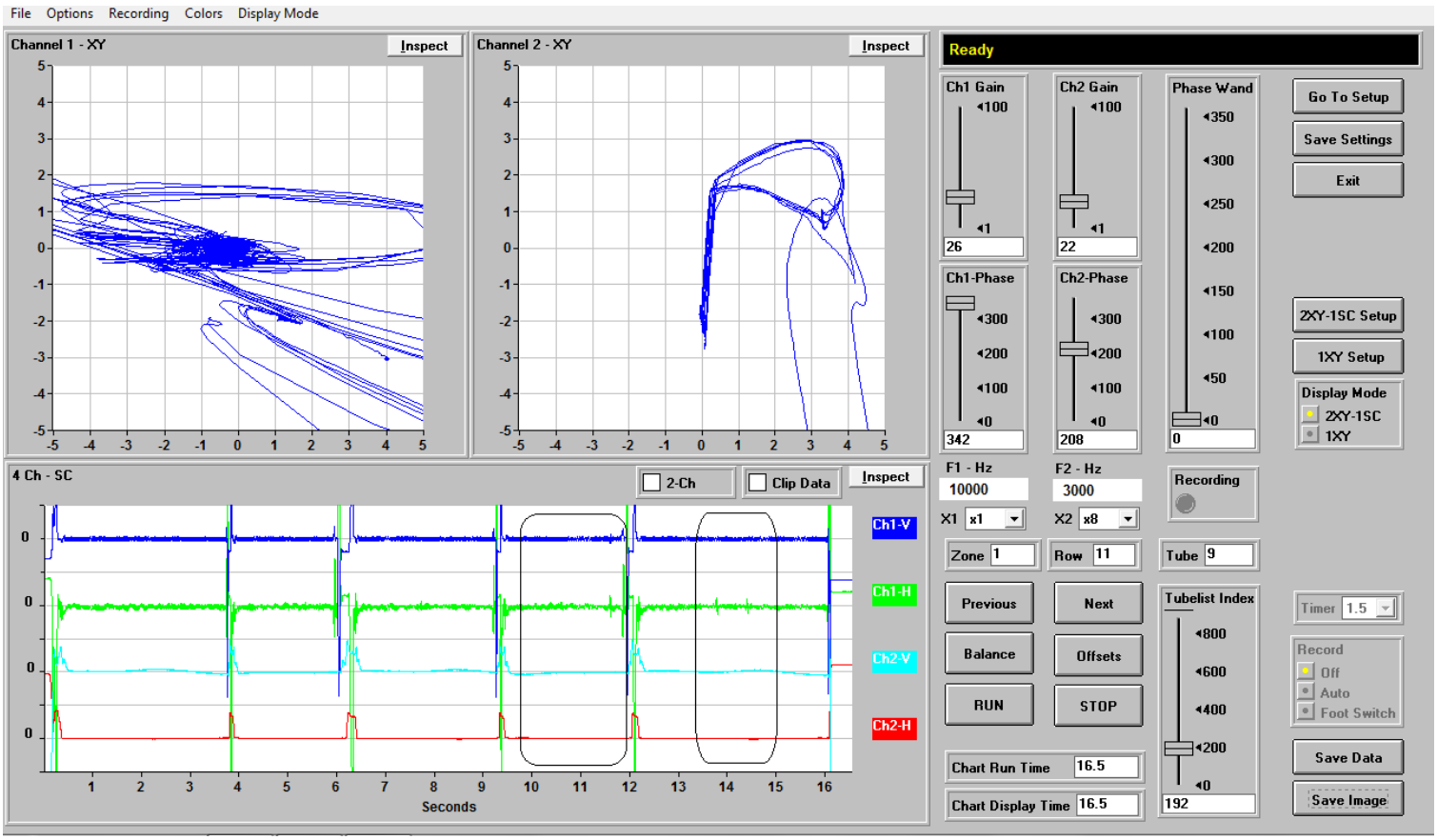
ID PIT < 20% (Row 6 Tube 16)

Condenser Section



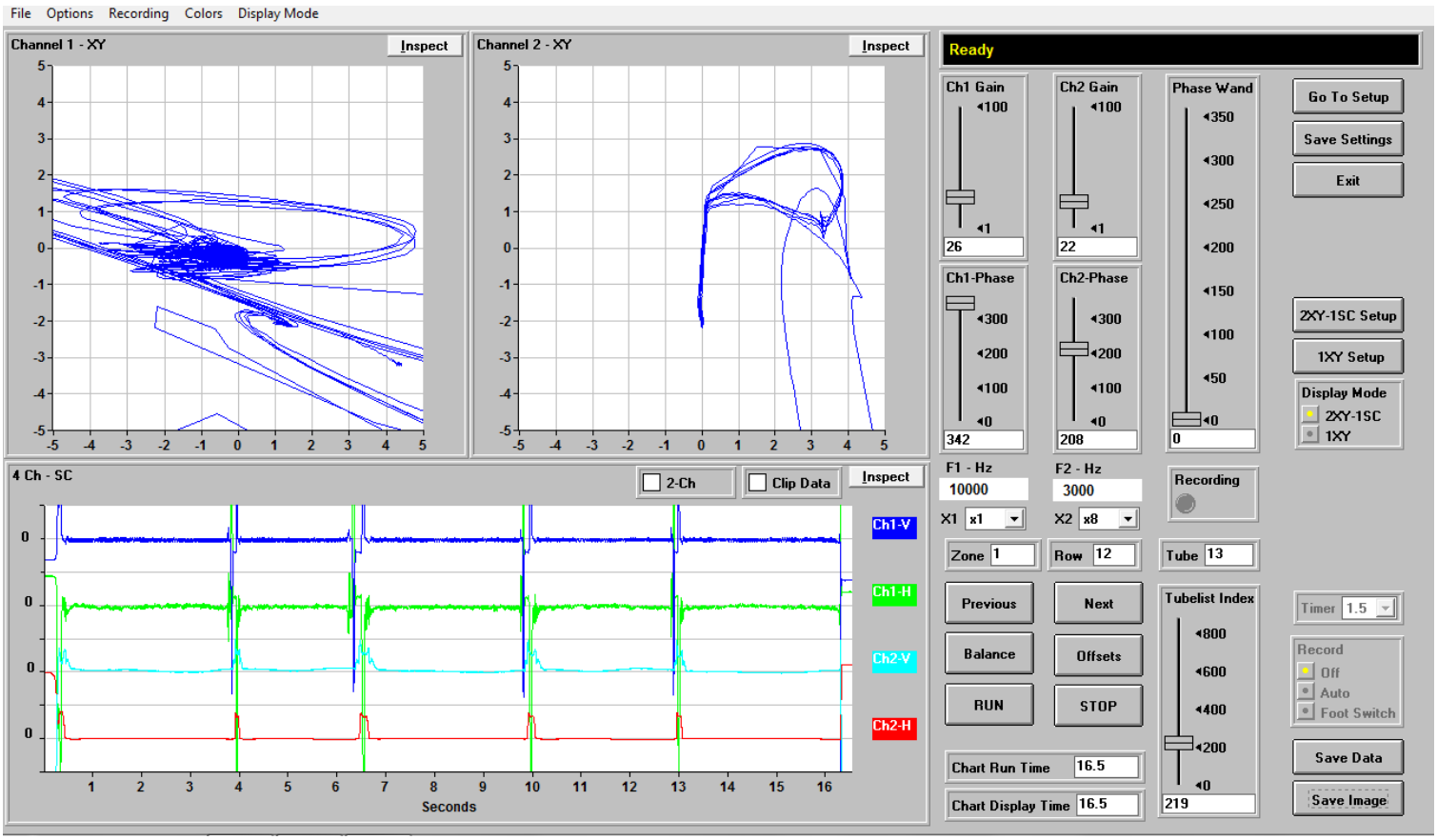
ID PIT < 20% (Row 6 Tube 16)

Condenser Section



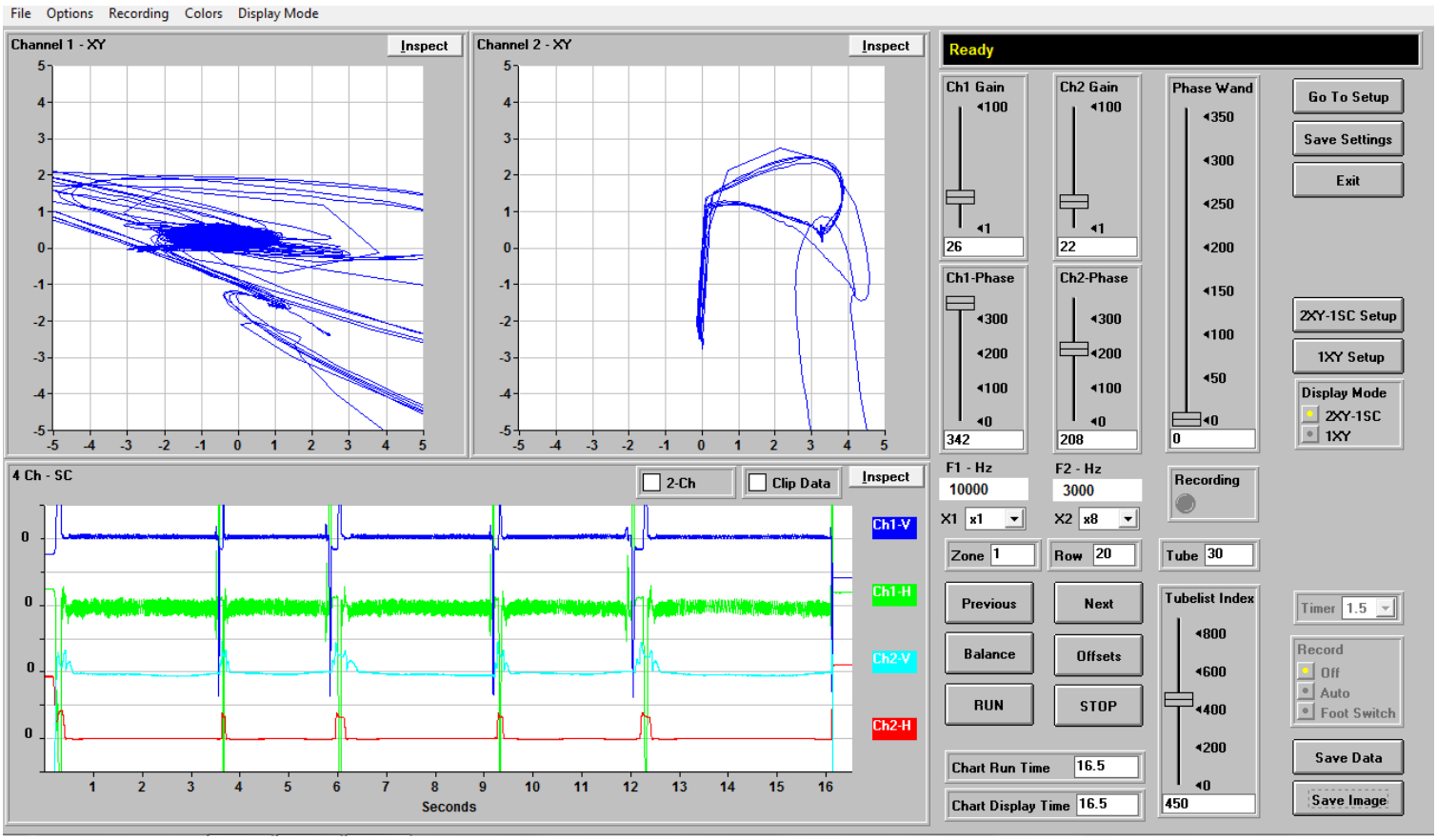
TESTED, DEBRIS (Row 11 Tube 9)

Condenser Section



NO SIGNIFICANT DEFECTS (Row 12 Tube 13)

Condenser Section



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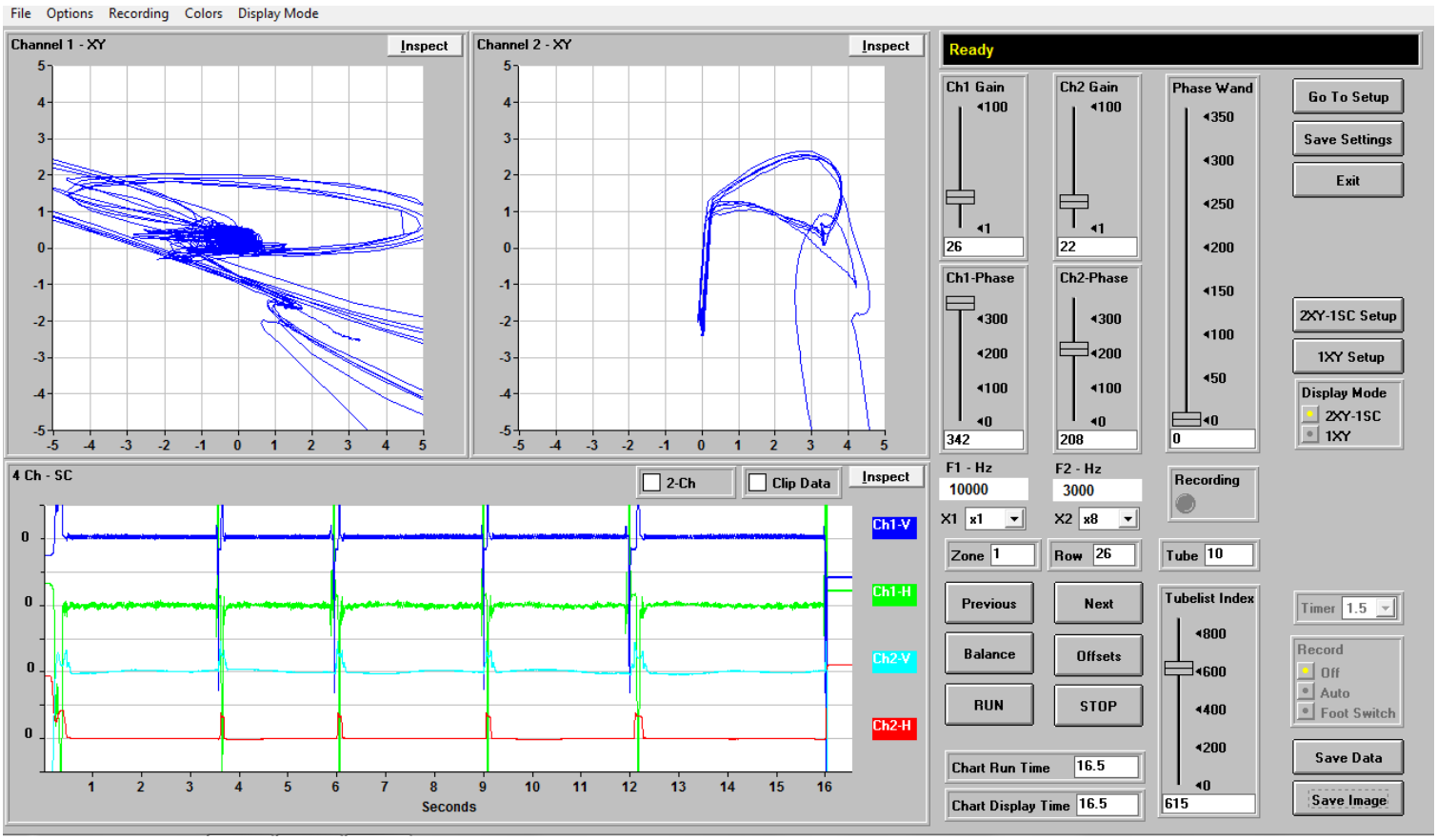

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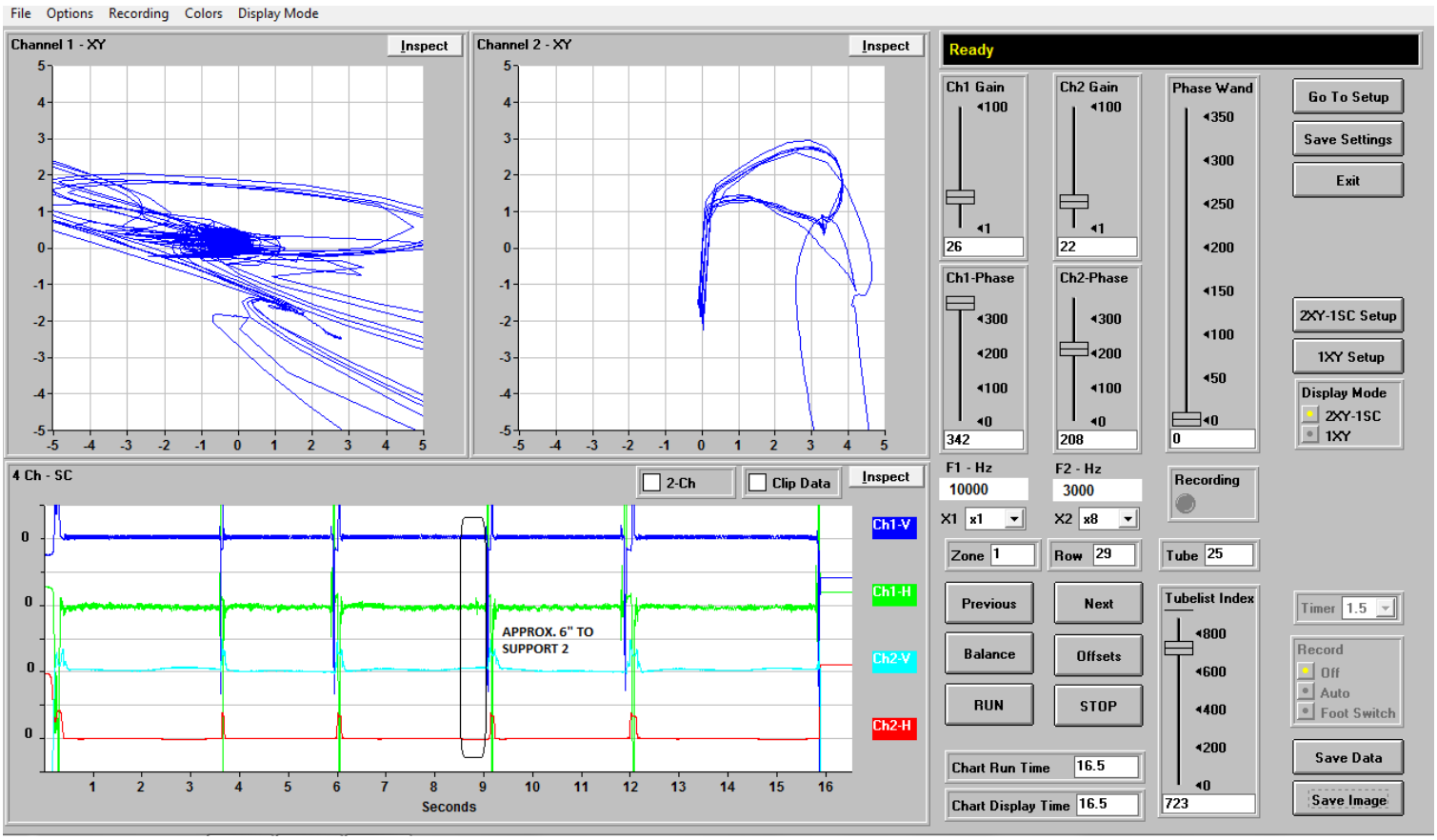
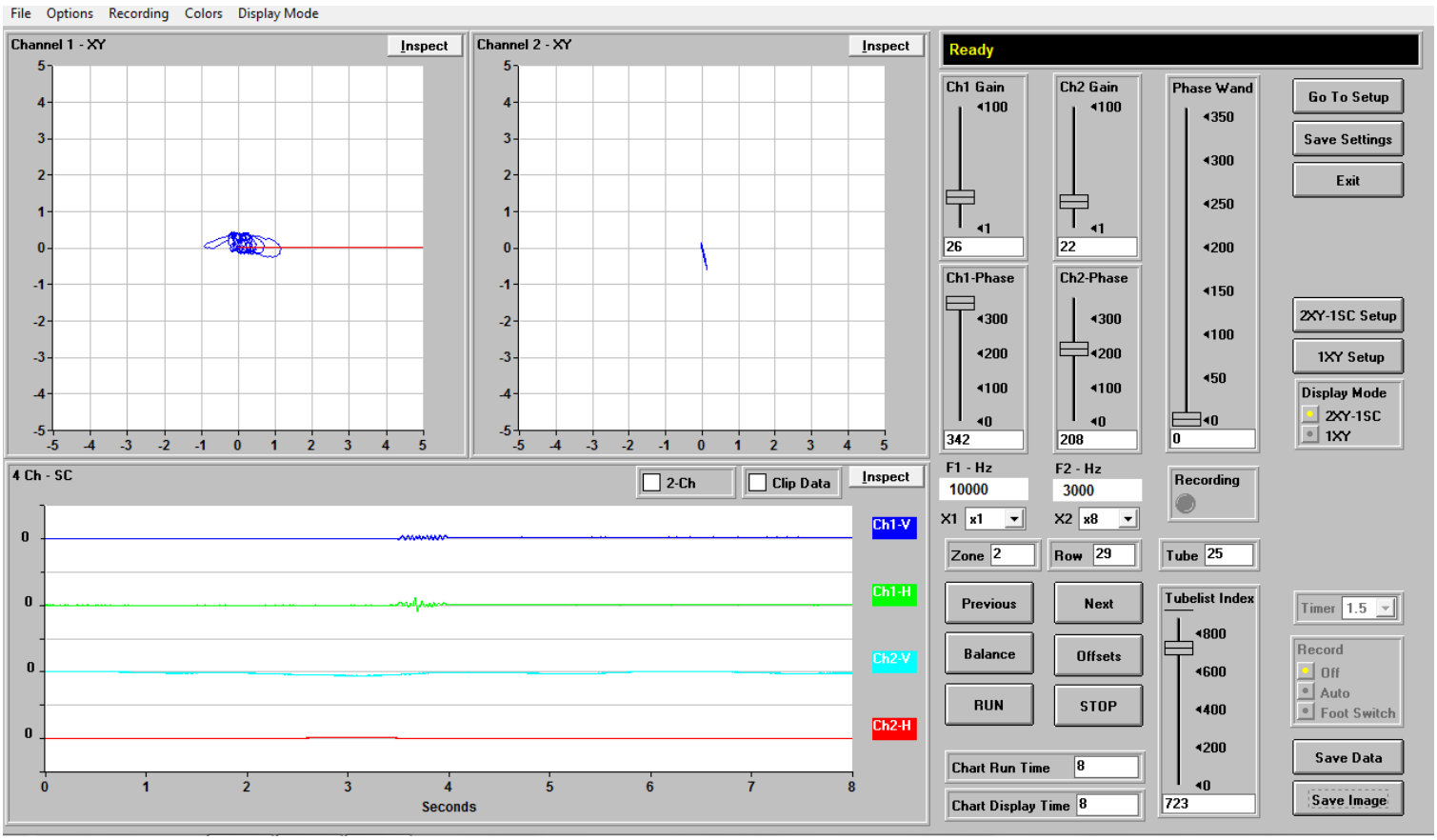


ID PIT < 20% (Row 29 Tube 25)

Condenser Section



ID PIT < 20% (Row 29 Tube 25)

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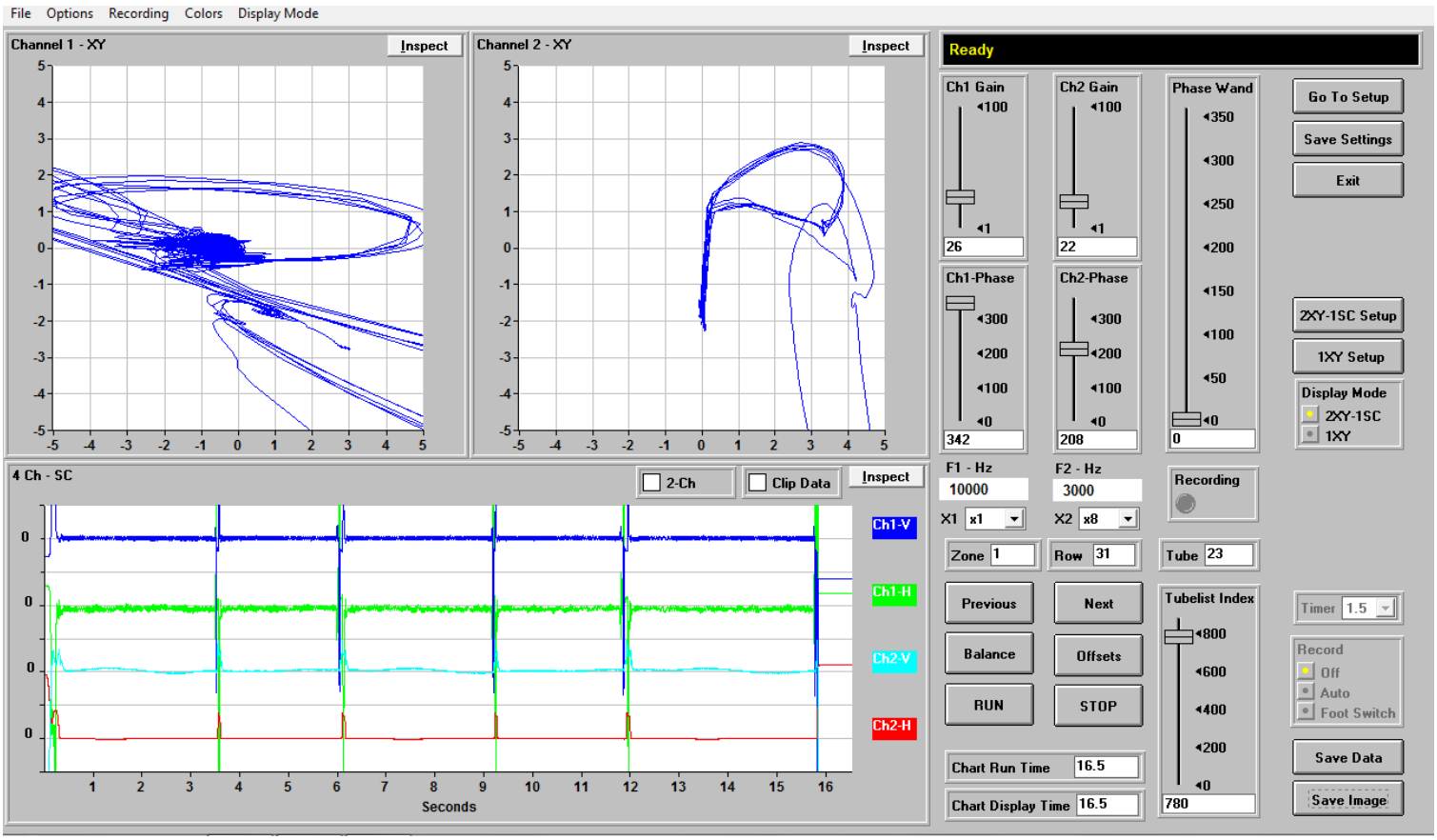
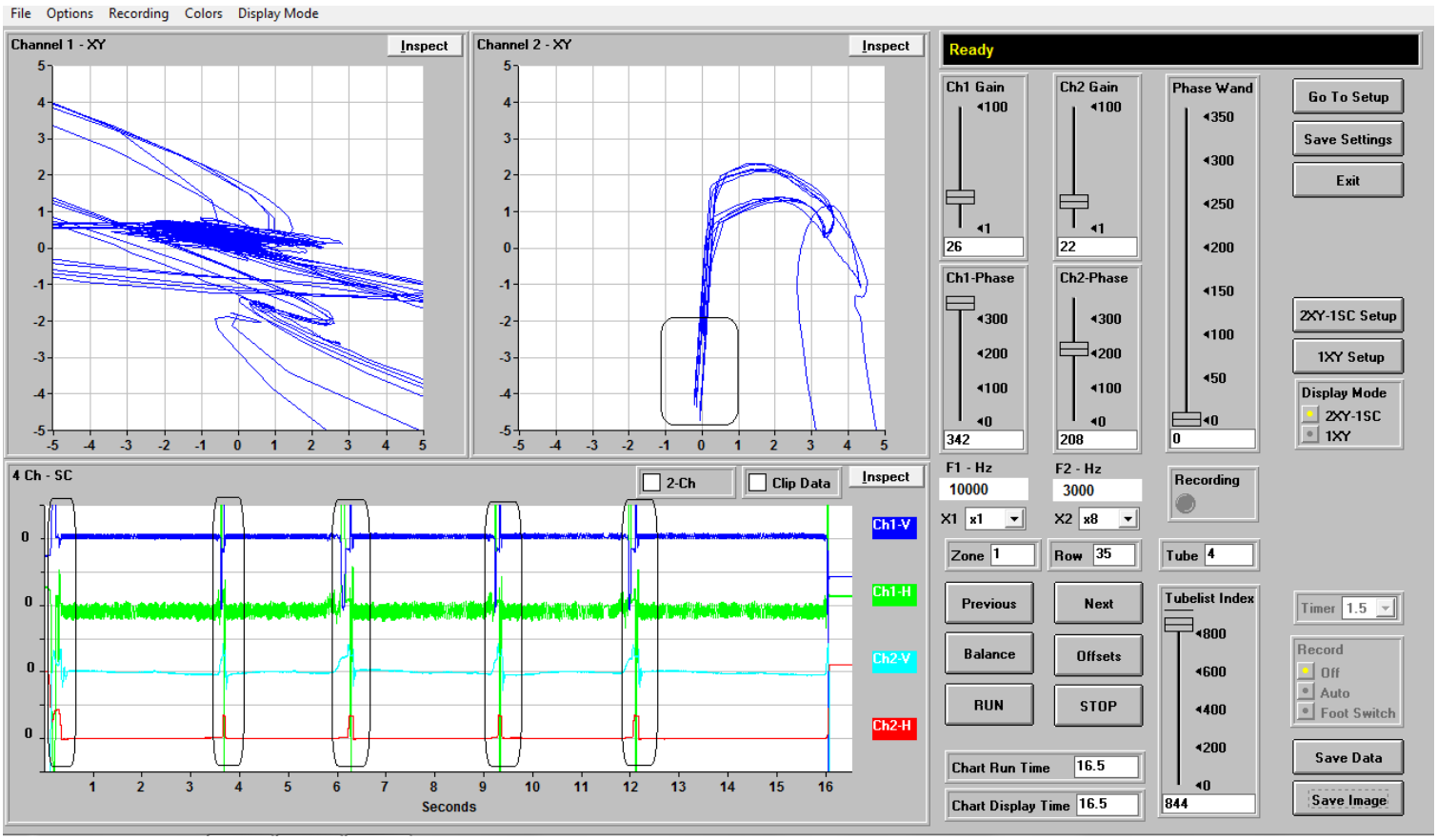


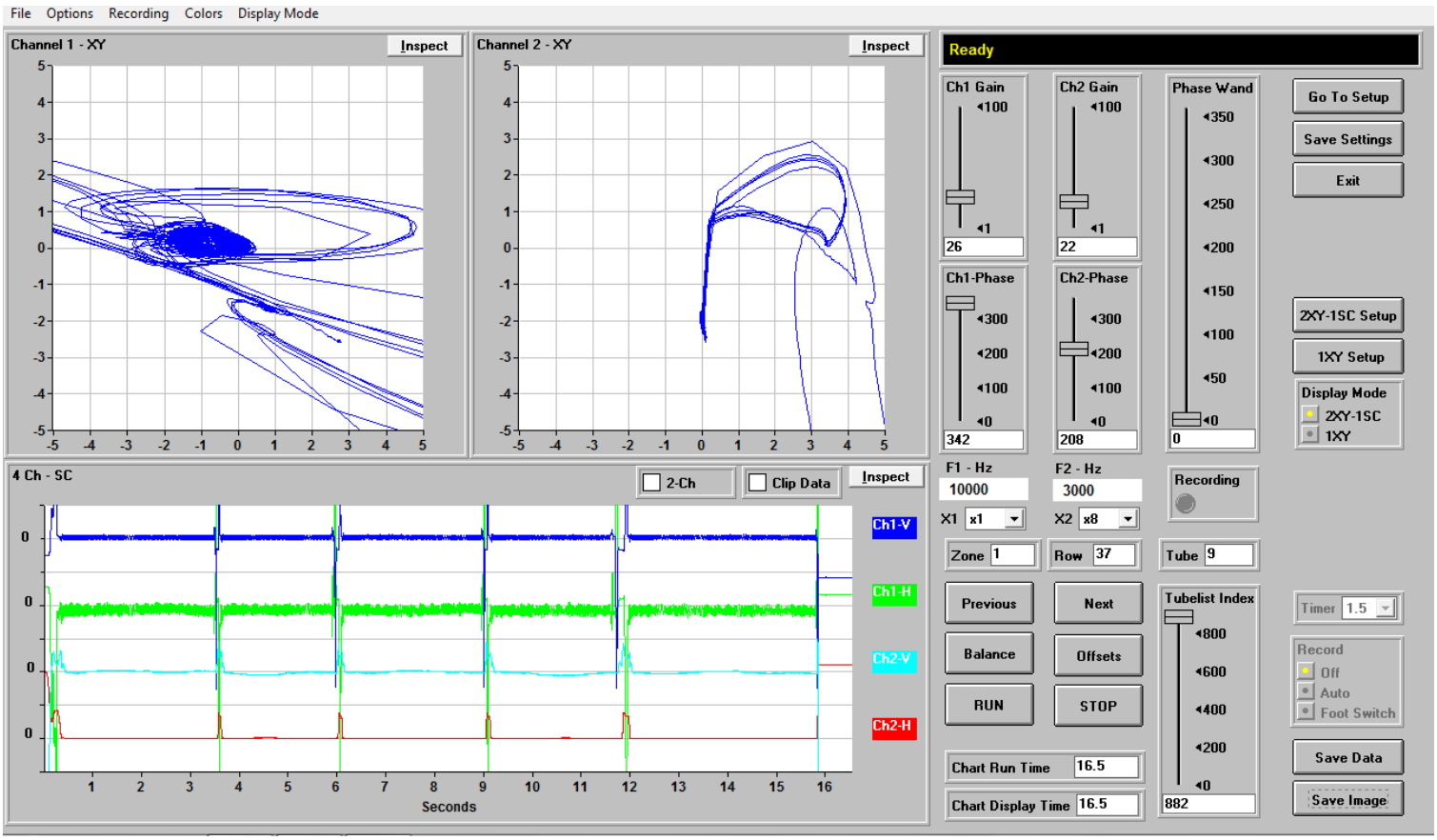
NO SIGNIFICANT DEFECTS (Row 31 Tube 23)

Condenser Section



ABN SUPPORT LANDING (Row 35 Tube 4)

Condenser Section



NO SIGNIFICANT DEFECTS (Row 37 Tube 9)

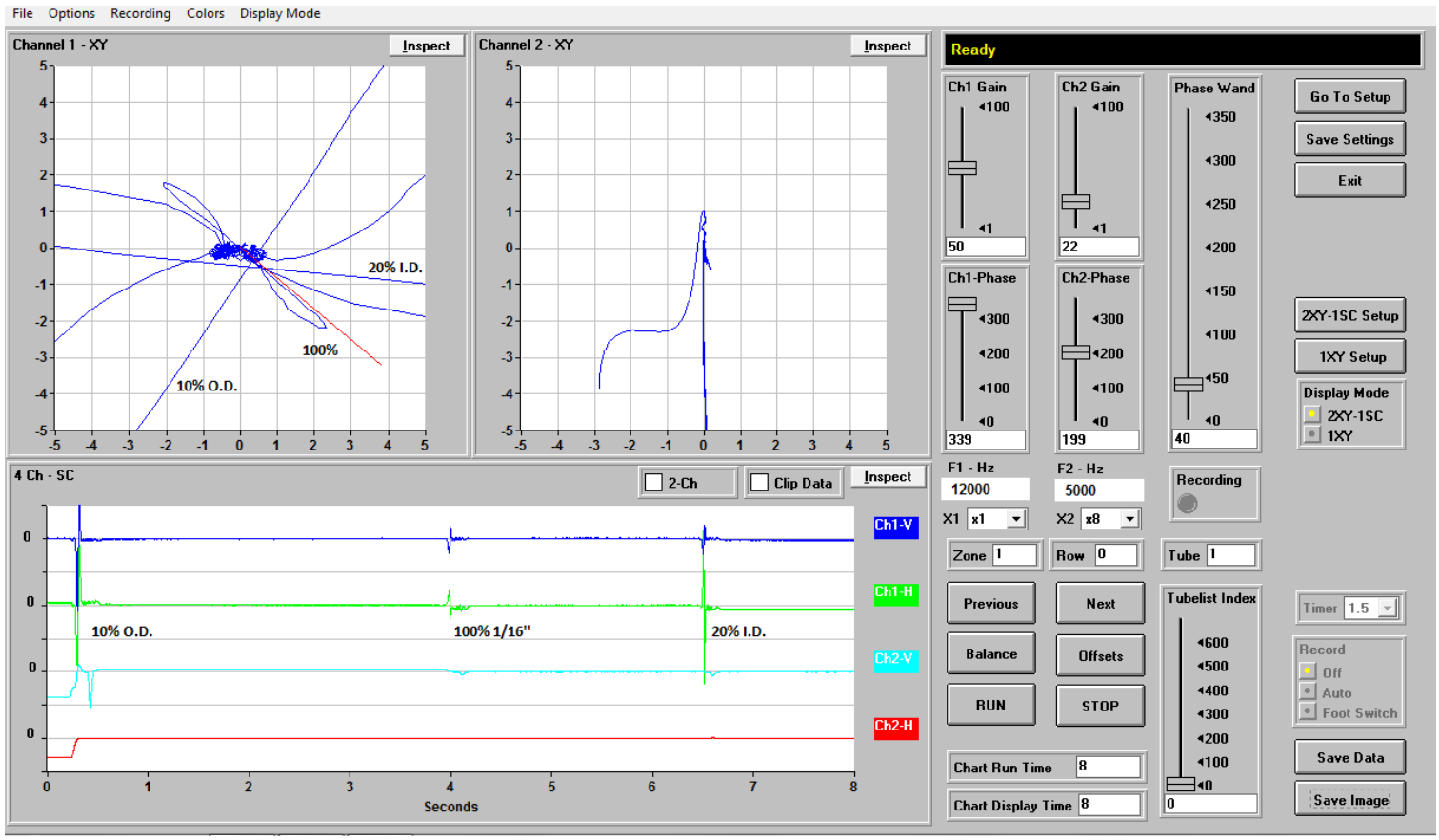
Test Instrument Used
Highline Automation, EC14

S/N GACM117864 #8

Calibration Page

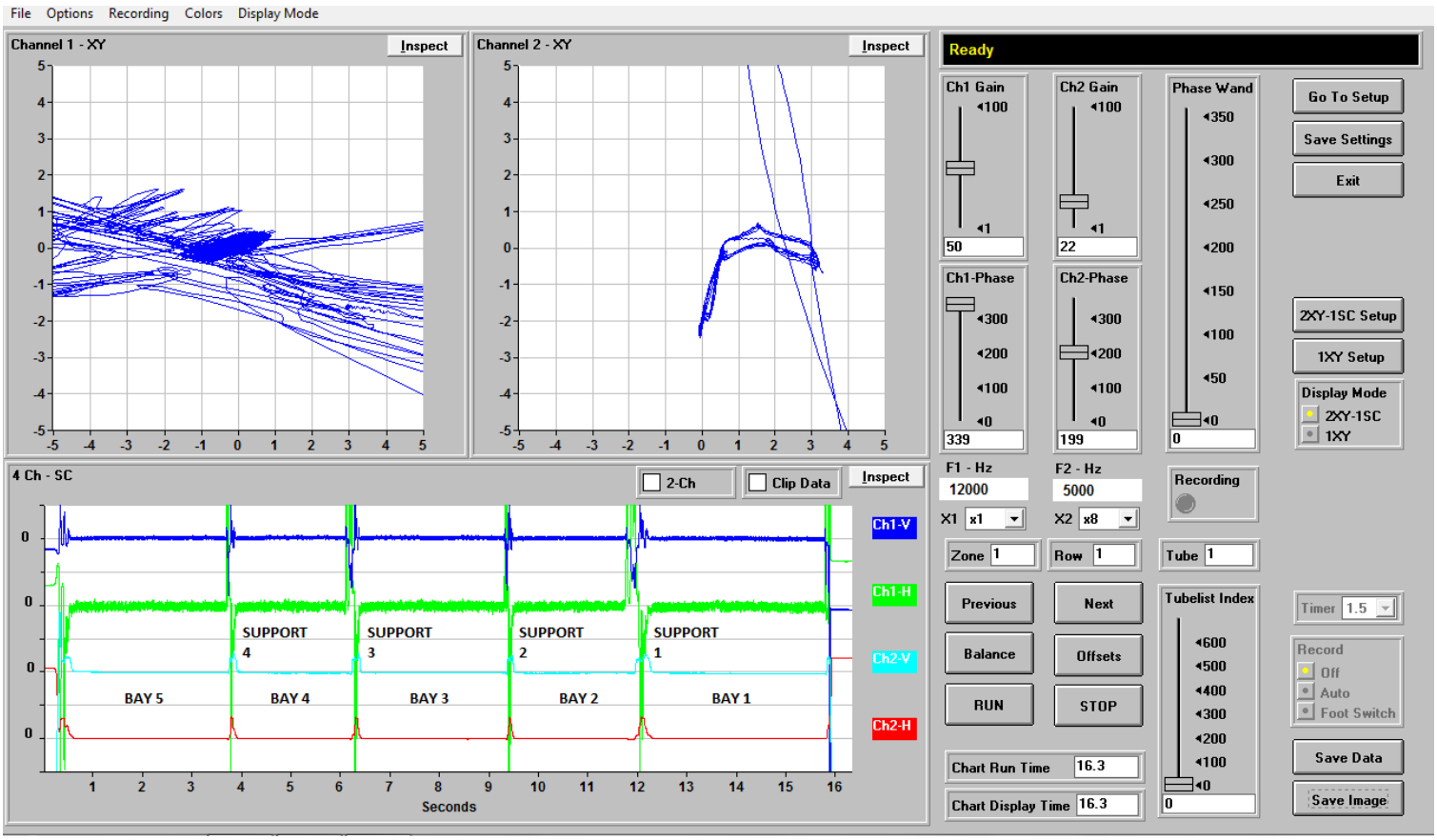
Tube Type	Material	Nom Wall Thick	End Wall Thick	OD	Test Type	Probe Diameter
Skip Fin IE	Copper	.028	.052	.750	Cross/Diff	.5625

Evaporator



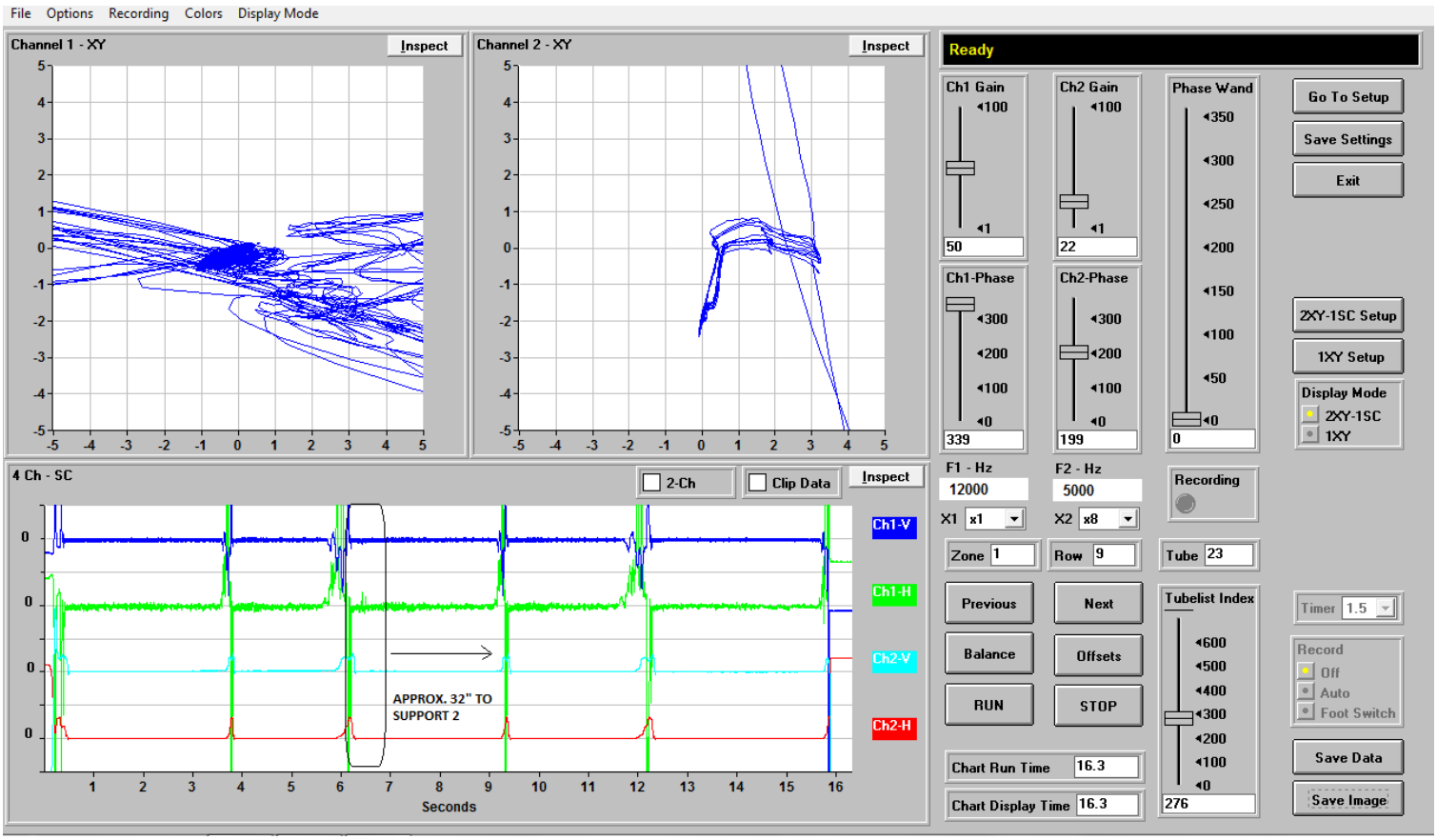
Note: Defects are compared to machined standards.
Actual Defect Geometry may differ.

Evaporator Section



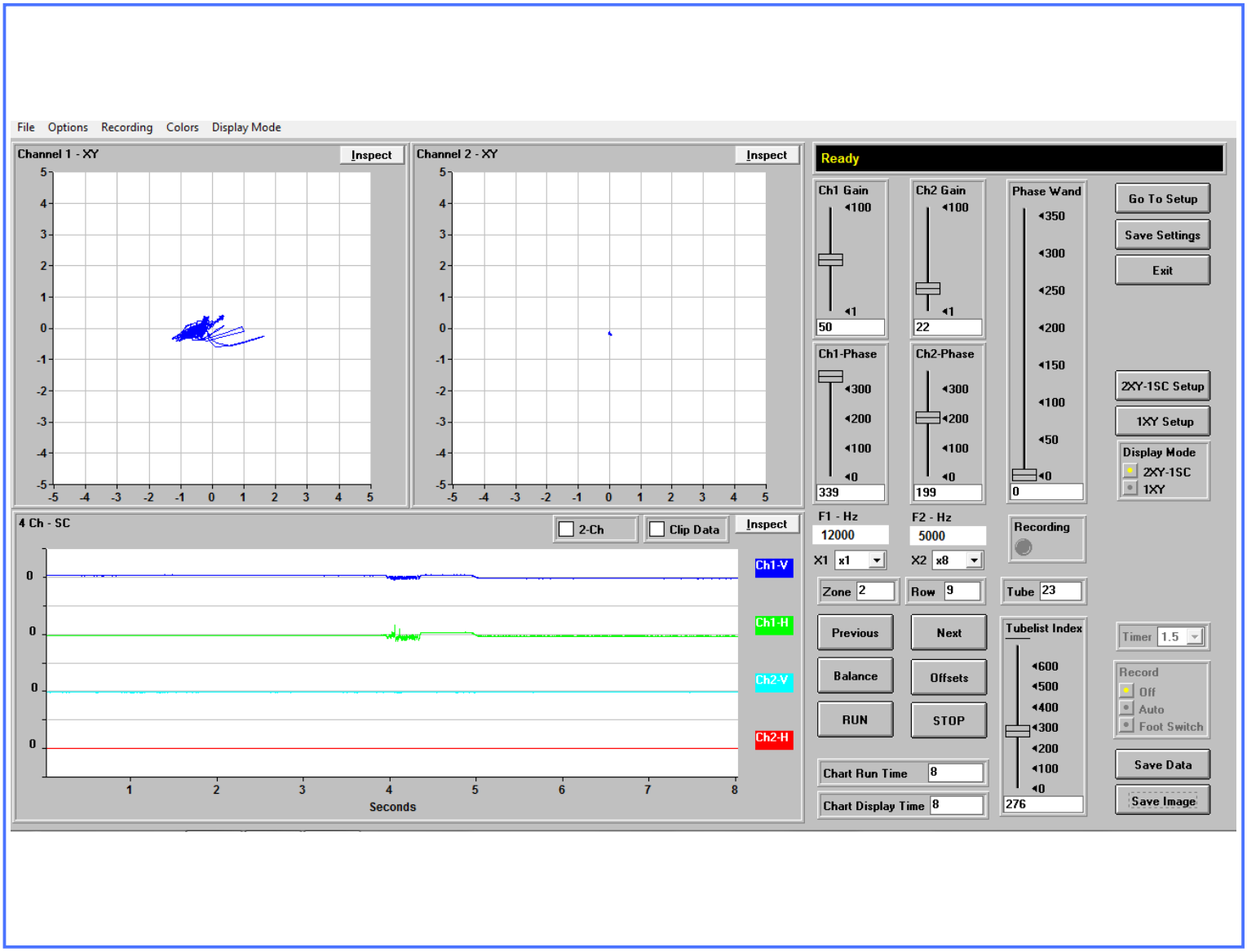
TYPICAL GOOD TUBE (Row 1 Tube 1)

Evaporator Section



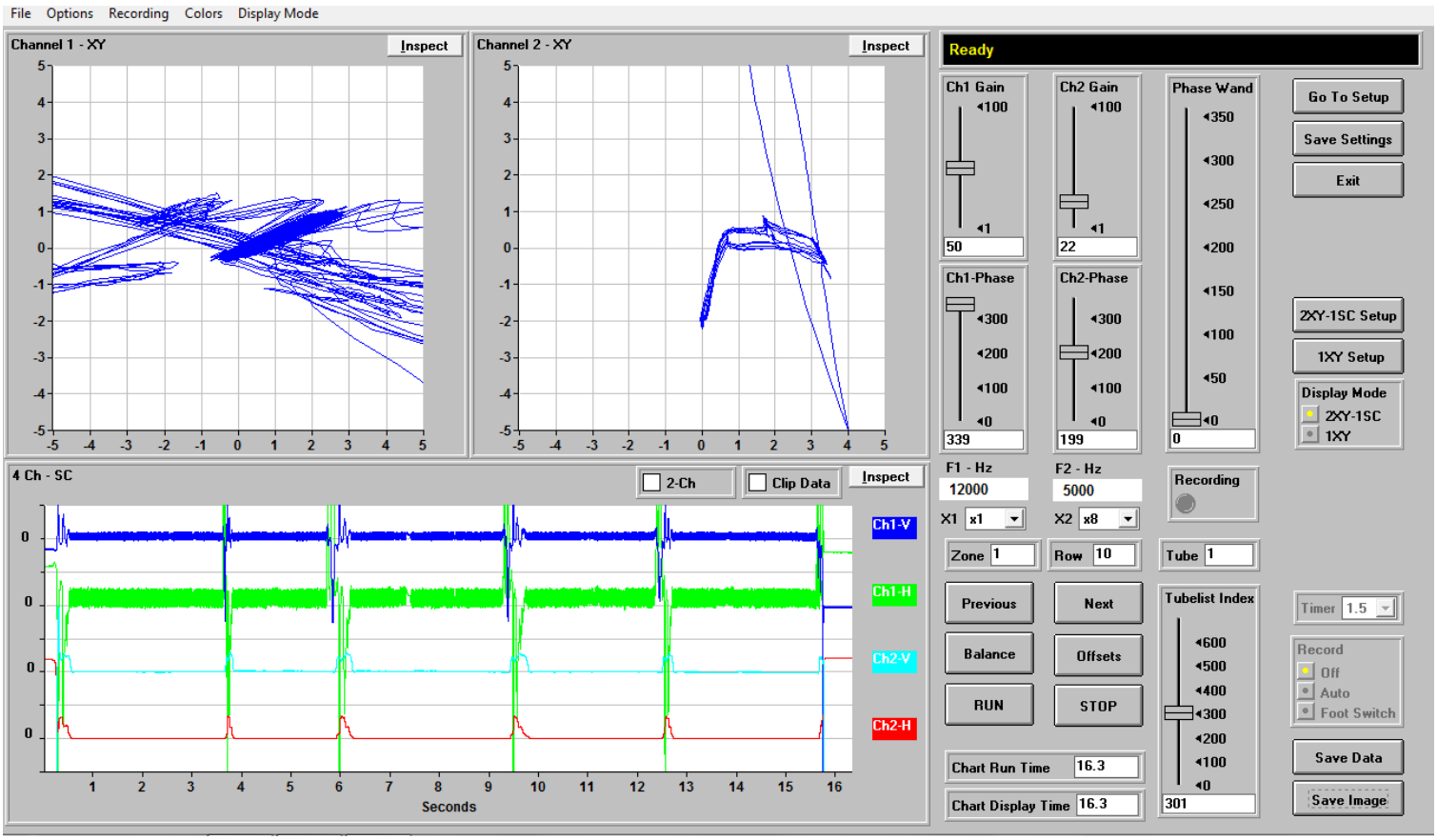
ABNORMAL, NOMINAL (Row 9 Tube 23)

Evaporator Section



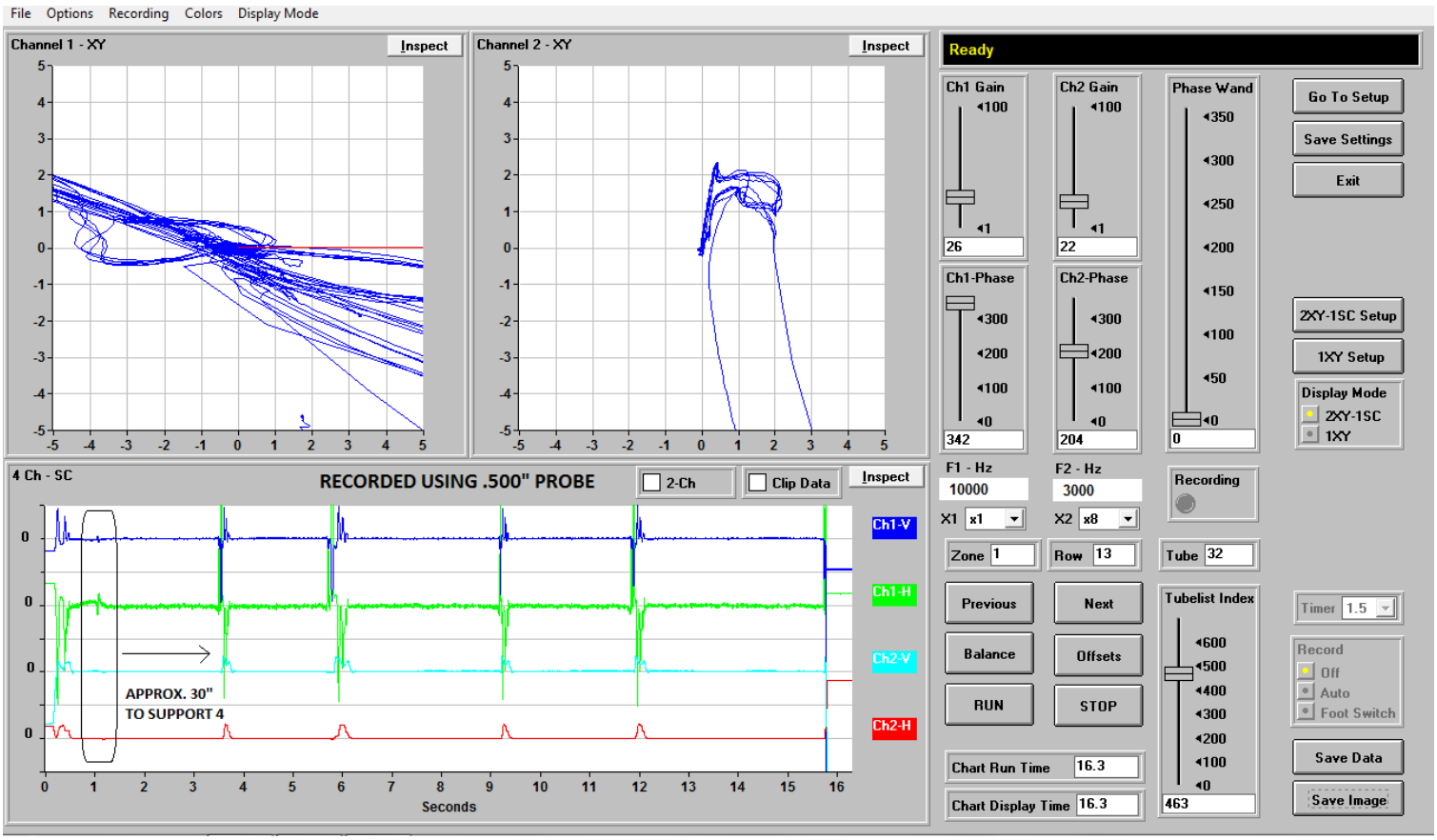
ABNORMAL, NOMINAL (Row 9 Tube 23)

Evaporator Section



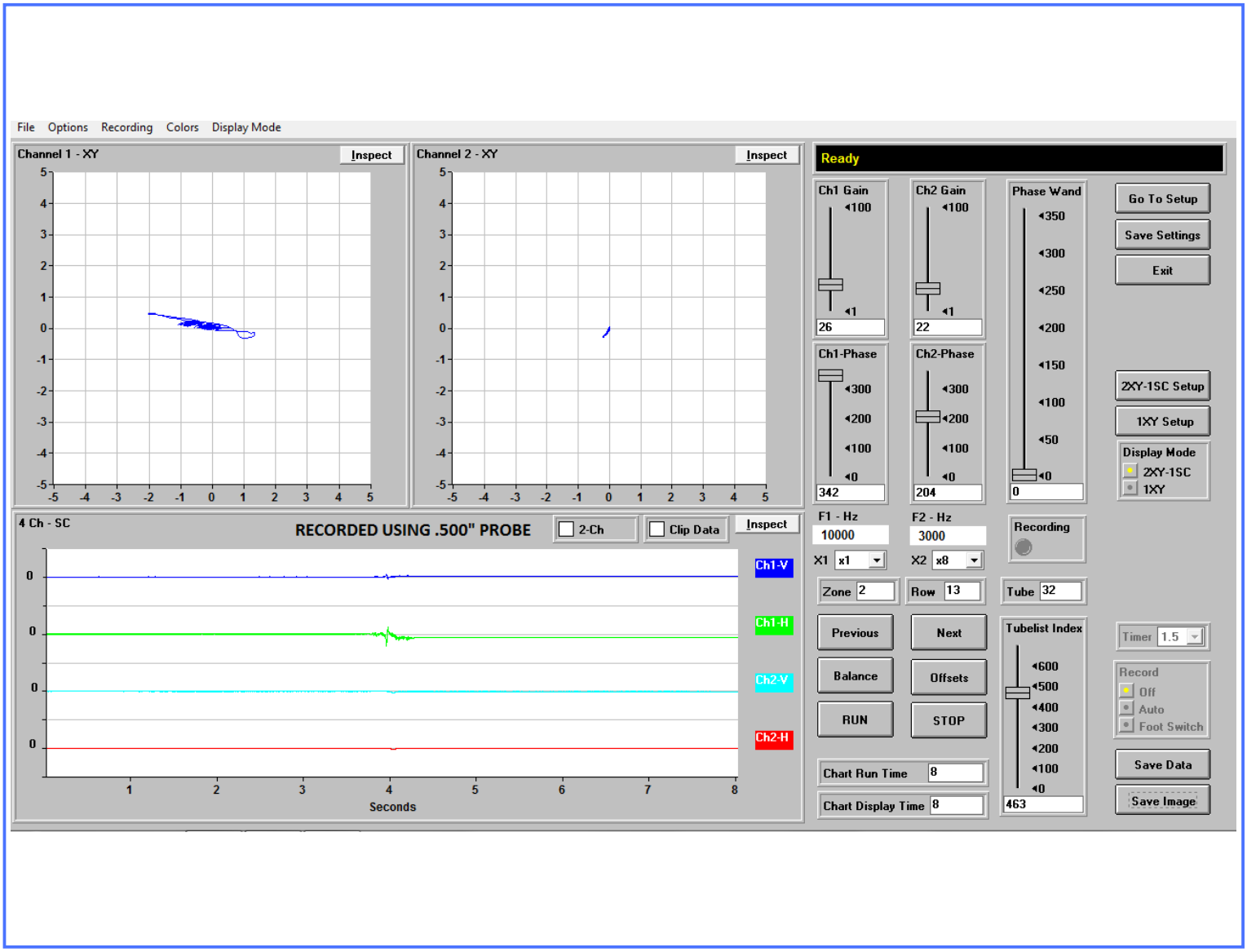
NO SIGNIFICANT DEFECTS (Row 10 Tube 1)

Evaporator Section



DENT, NOMINAL (Row 13 Tube 32)

Evaporator Section



DENT, NOMINAL (Row 13 Tube 32)

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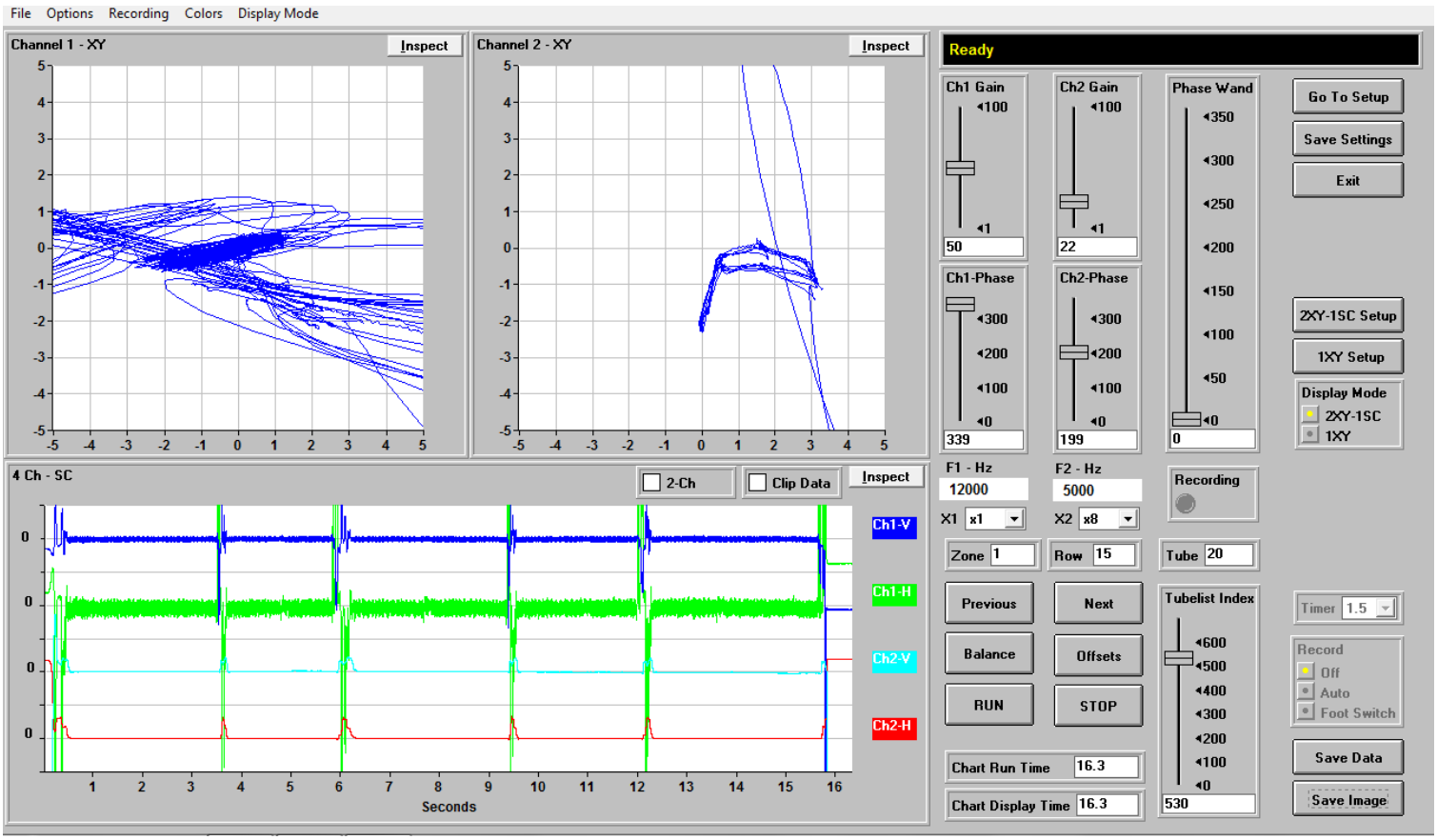
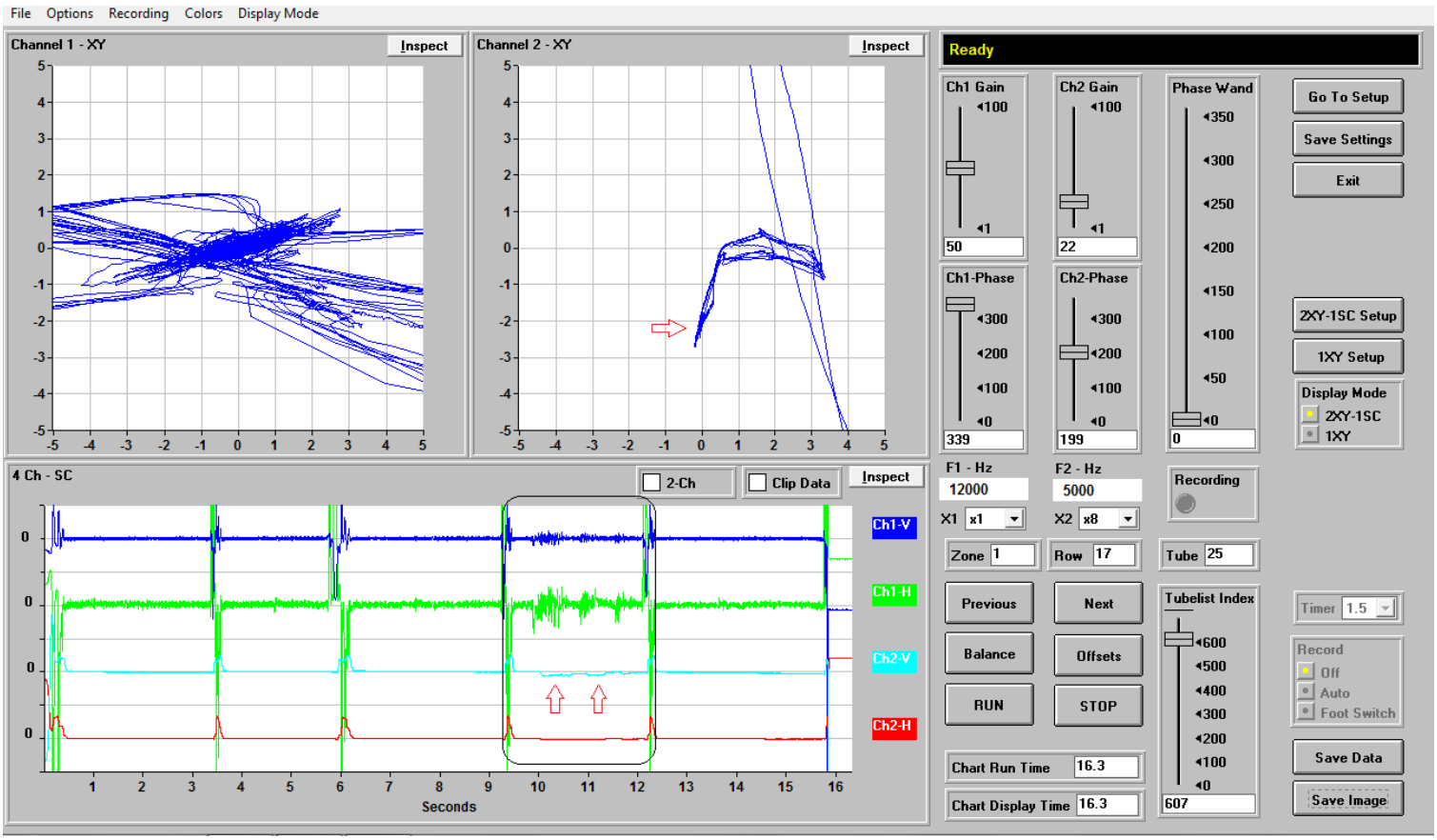


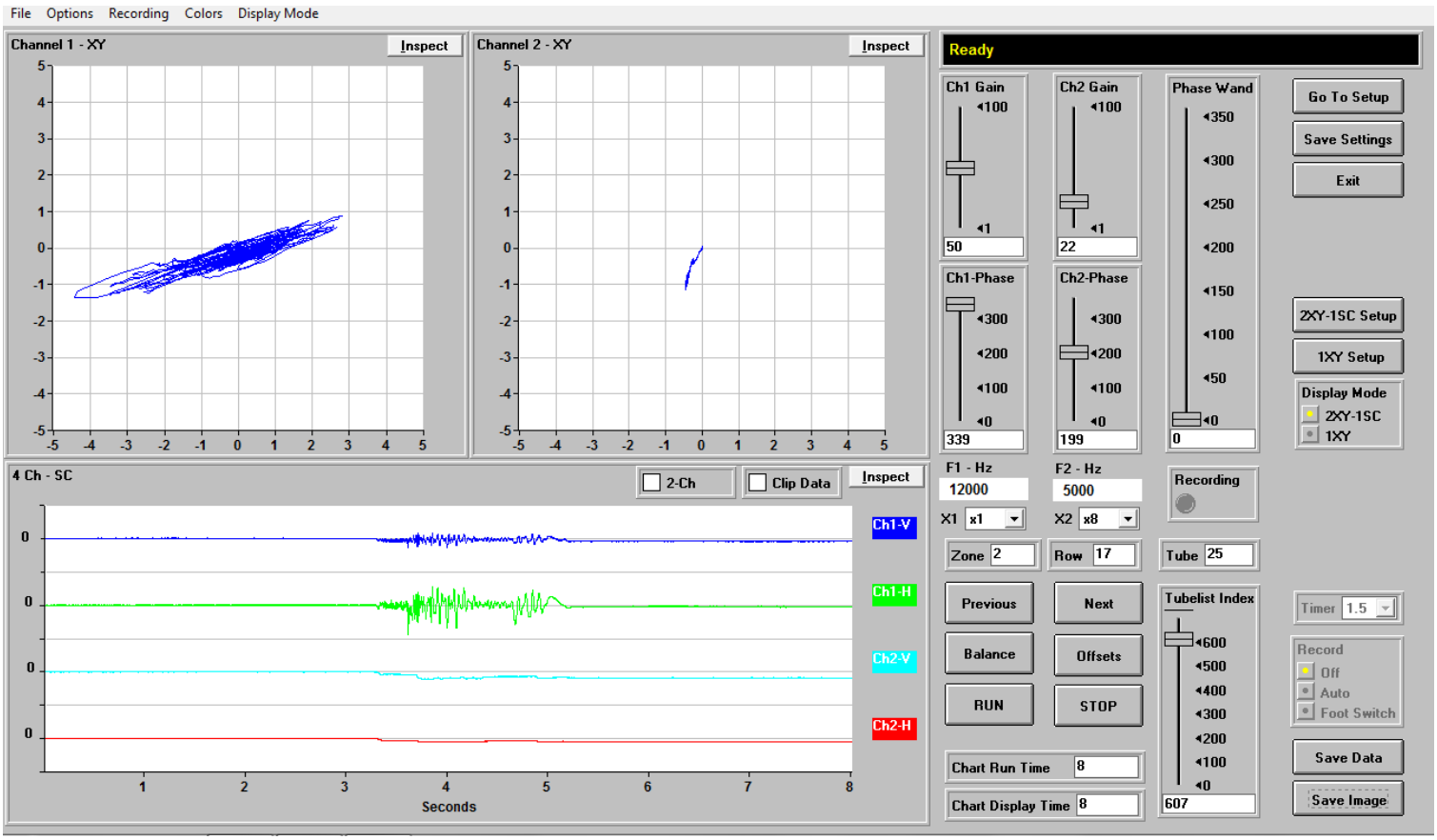
NO SIGNIFICANT DEFECTS (Row 15 Tube 20)

Evaporator Section



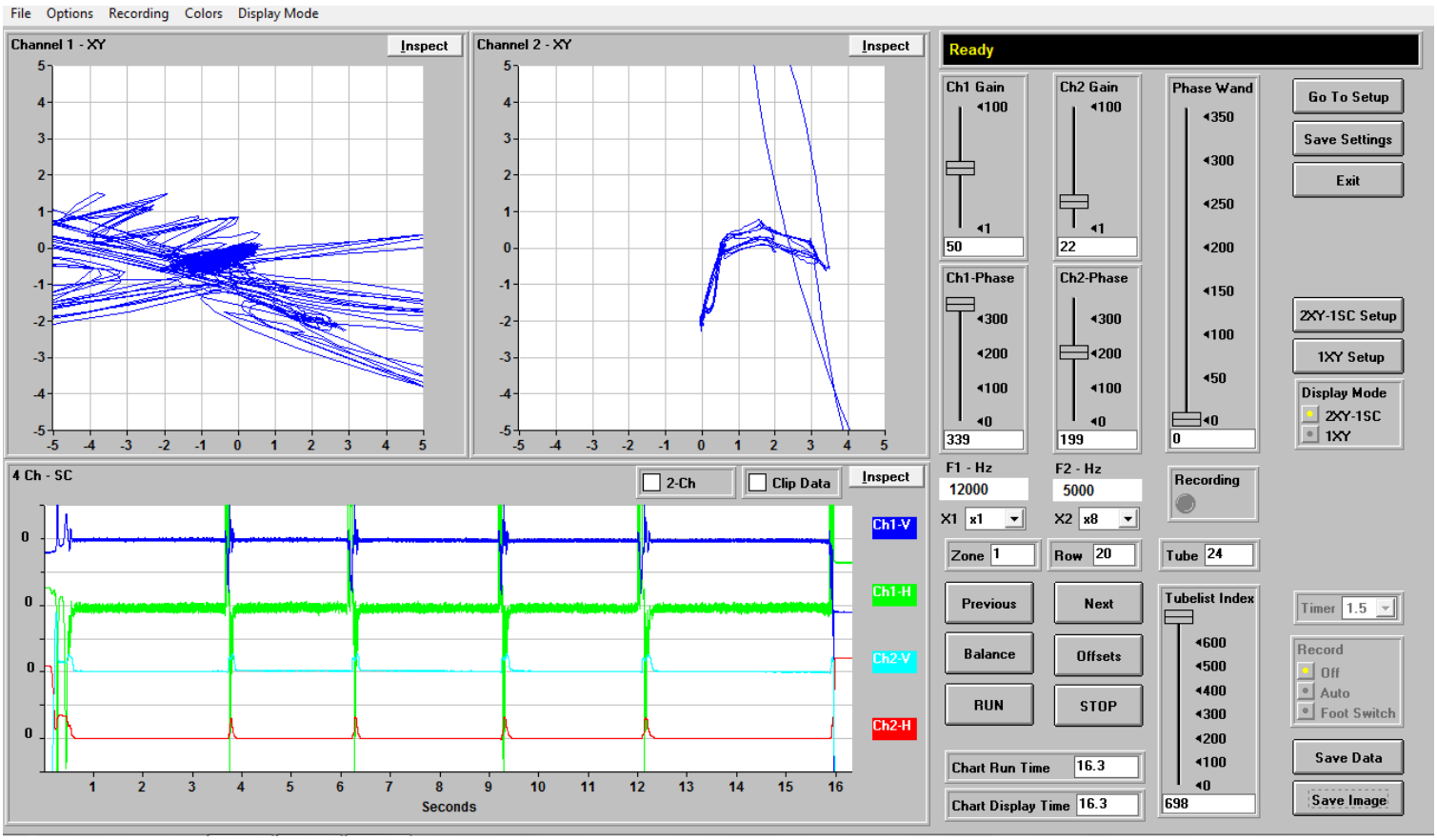
ABNORMAL, NOMINAL (Row 17 Tube 25)

Evaporator Section



ABNORMAL, NOMINAL (Row 17 Tube 25)

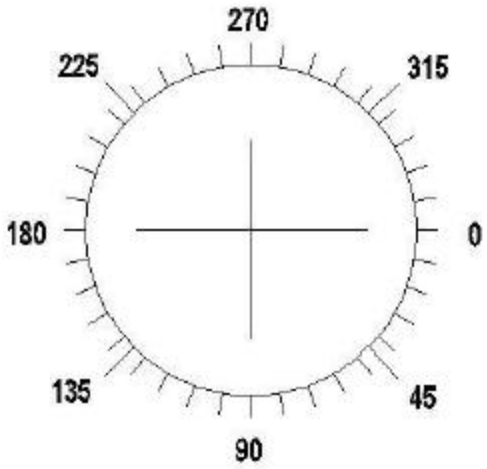
Evaporator Section

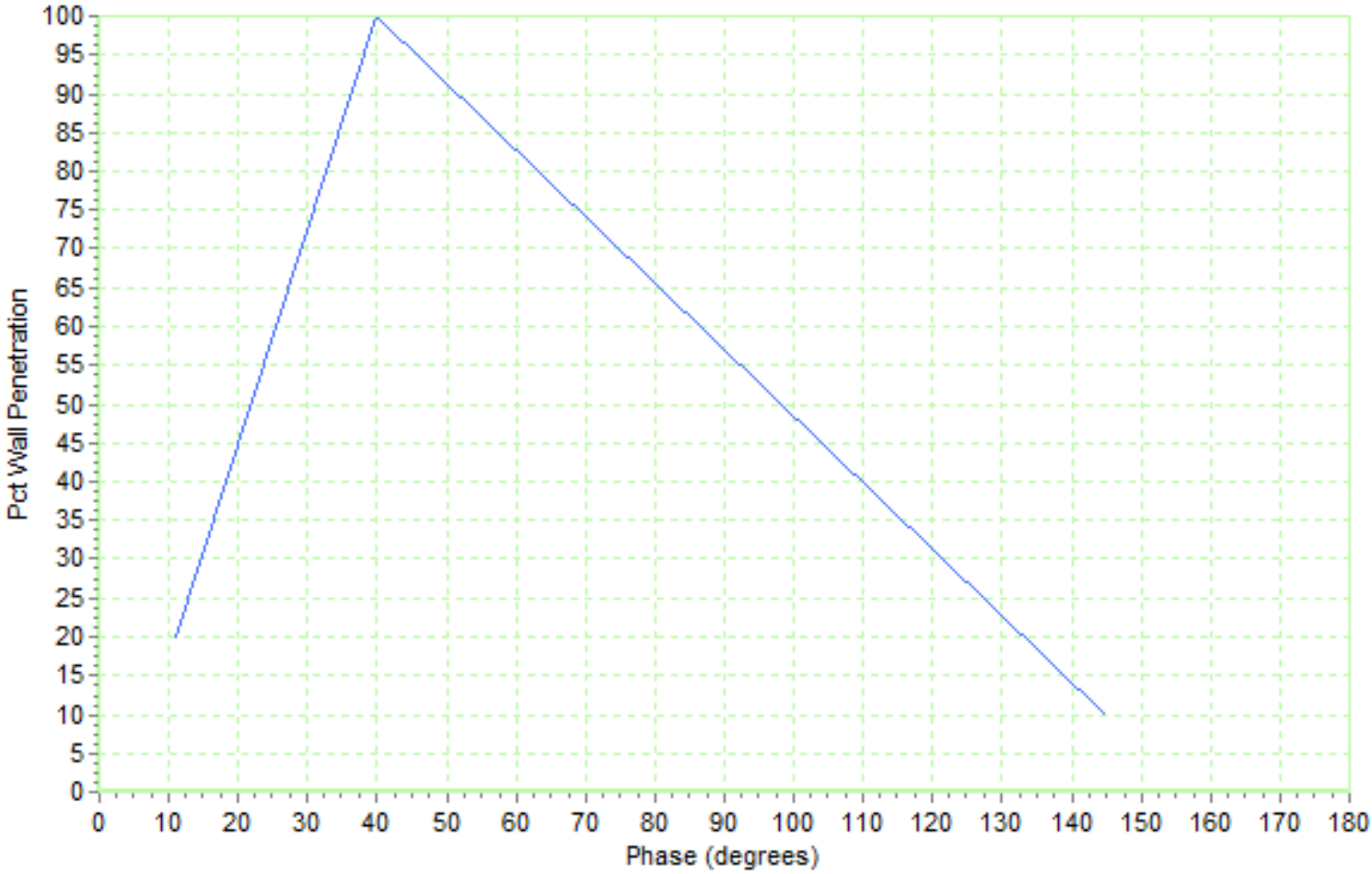


NO SIGNIFICANT DEFECTS (Row 20 Tube 24)

Phase Chart - Condenser

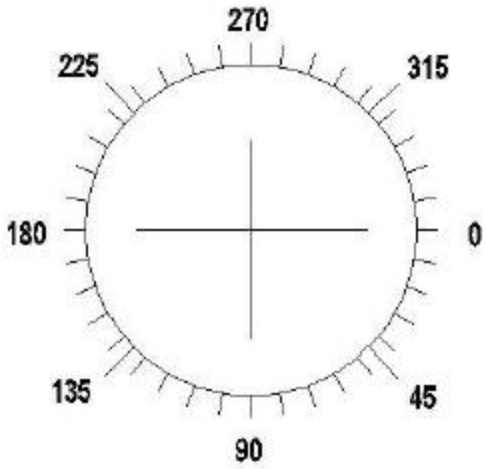
Material	Tube Type	OD	Wall	Test Type	Frequency	Probe Diameter
Copper	Skip Fin IE	.750	.035	CROSS/DIFF	10000	.500

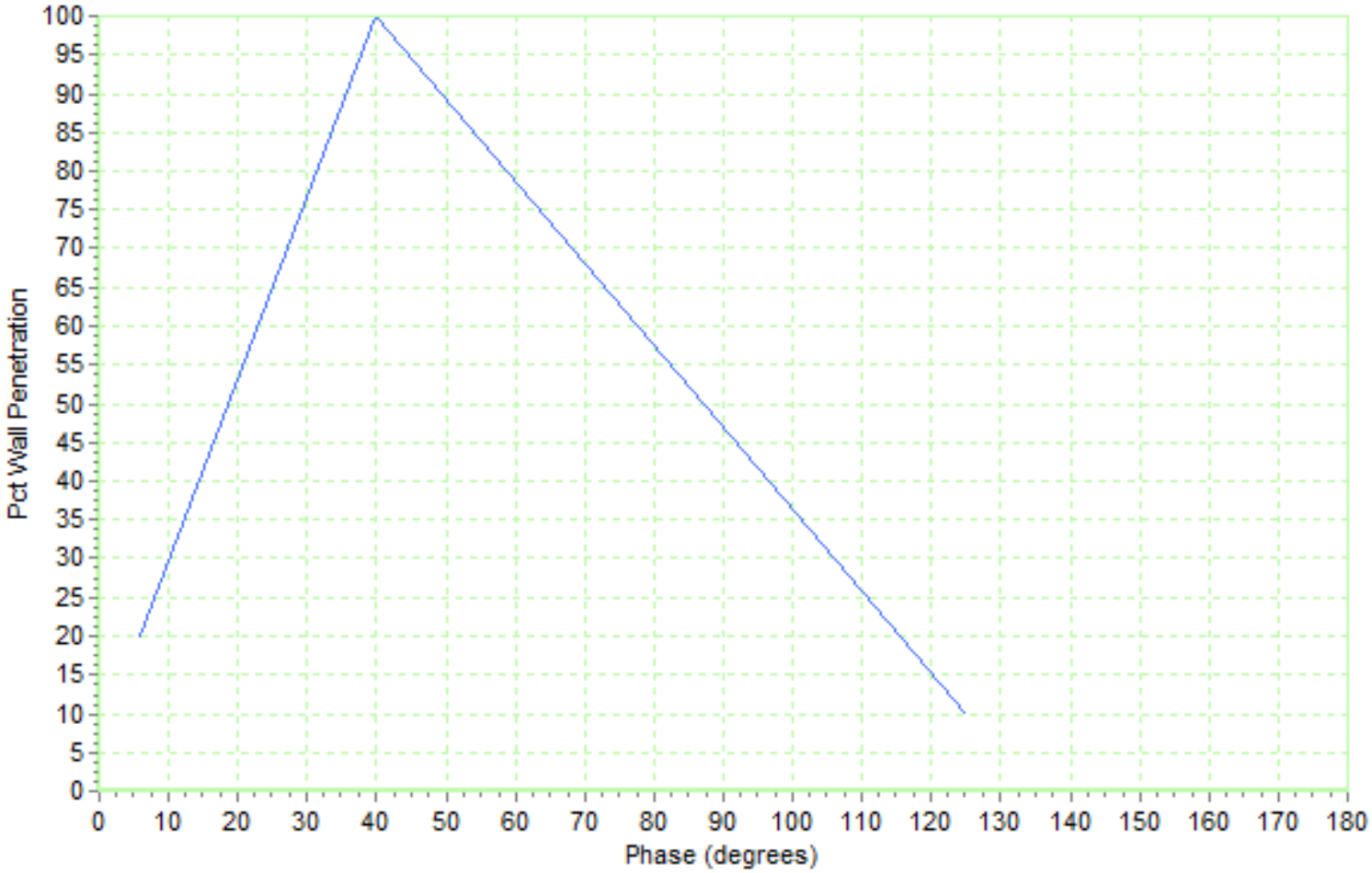




Phase Chart - Evaporator

Material	Tube Type	OD	Wall	Test Type	Frequency	Probe Diameter
Copper	Skip Fin IE	.750	.028	CROSS/DIFF	12000	.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