NOTE – This note applies to Section 4.0. Ensure Prerequisites have been completed. MULTIPLE ENTRIES may be performed.

4.0 SPECIFIC WORK INSTRUCTIONS

[✓] 4.1. **ENSURE** Feed and Slurry lines have been deep flushed, Section 5.10 of Procedure TO-650-140 has been performed and Hydrostatic testing of the vessel may be performed per the following steps.

[✓] 4.2. **RECORD** beginning Pump Room Sump level (G12, F7) reading on Data Sheet 1.

[✓] 4.3. **RECORD** FQI-RW-1 BOTTOMS FLUSH TOTALIZR (G15, F10) reading on Data Sheet 1.

[✓] 4.3.1. **START** Slurry Line Flush water flow to the Evaporator Pot by performing the following:

[✓] 4.3.1.1. **SELECT** HV-CA1-2 SLURRY FLUSH VALVES (G15/11, G47/0, F9).

[✓] 4.3.1.2. **IF** HV-CA1-2 is in AUTO mode, **PRESS** AUTO/MAN twice to place HV-CA1-2 in MANUAL.

[✓] 4.3.1.3. **PRESS** CMD 2 twice to place HV-CA1-2 to the EVAP FL position and start flush water flow to the Evaporator.

[✓] 4.3.1.4. **CHECK** that HV-CA1-2 status changes to EVAP FL.

[✓] 4.3.2. **MONITOR** FQI-RW-1 BOTTOMS FLUSH TOTALIZR (G15, F10) as the Evaporator fills.

[✓] 4.3.3. **IF** the Evaporator Vessel volume does not show a volume increase after FQI-RW-1 increases 300 gallons, **SHUT DOWN** Flush Water flow to the Evaporator Pot by performing the following:

[✓] 4.3.3.1. **SELECT** HV-CA1-2 SLURRY FLUSH VALVES (G15/11, G47/0, F9). 9/1/07

[ ] 4.3.3.2. **PRESS** CMD 0 twice to place HV-CA1-2 to the BLOCK position and shut down flush water flow to the Evaporator.

[ ] 4.3.3.3. **CHECK** that HV-CA1-2 status changes to BLOCK.

[ ] 4.3.3.4. **NOTIFY** Shift Manager of possible misrouted water.

[✓] 4.3.4. **MONITOR** LIC-CA1-1 EVAP CA1-1 LEVEL CONTROLR (G10/9, F2) **OR** LIC-CA1-2 EVAP CA1-2 LEVEL CONTROLR (G10/10, F2), TK-102-AW, and the Slurry Receiver Tank liquid levels as the Evaporator vessel fills.

[✓] 4.3.5. **AFTER** the lower of LIC-CA1-1 EVAP CA1-1 LEVEL CONTROLR (G10/9, F2) OR LIC-CA1-2 EVAP CA1-2 LEVEL CONTROLR (G10/10, F2) reads a **MINIMUM** of 26, 500 gallons (not to exceed 27,000 gallons), **SHUT DOWN** flush water flow to the Evaporator Pot by performing the following:

[✓] 4.3.5.1. **SELECT** HV-CA1-2 SLURRY FLUSH VALVES (G15/11, G47/0, F9).

[✓] 4.3.5.2. **PRESS** CMD 0 twice to place HV-CA1-2 to the BLOCK position and shut down flush water flow to the Evaporator.

[✓] 4.3.5.3. **CHECK** that HV-CA1-2 status changes to BLOCK.

[✓] 4.3.6. **SHUT DOWN** PB-1 RECIRC PUMP as follows:

[✓] 4.3.6.1. **SELECT** "PB-1" (G12/6, F5).

[✓] 4.3.6.2. **PRESS** "CMD 0" twice to shut down PB-1.

[✓] 4.3.6.3. **CHECK** PB-1 status changes to CF-OFF.

NOTE - After pump PB-1 is shut down, it is necessary to bypass the PB-1 shut down interlock to prevent the pot from automatically dumping (via Interlock #2) 8 minutes after PB-1 shuts down.

[✓] 4.3.6.4. **ACTIVATE** PB1-BYPAS PB-1 SHUT DOWN BYPASS as follows:

[✓] 4.3.6.5. **SELECT** "PB1-BYPAS" (G12/8, F5).

[✓] 4.3.6.6. **PRESS** "CMD 1" twice to set PB1-BYPAS to BYP ON.

[✓] 4.3.6.7. **CHECK** PB1-BYPAS status changes to BYP ON.

[✓] 4.4. **RECORD** Date/Time and initial level of the pump room sump at the start of the 24 hour hold period as read on LI-SUMP1 and record on Data Sheet 2.

[✓] 4.4.1. **QAT VERIFY** starting level of pump room sump.

9-01-07 / 15:20	[signature]	AR 9-1-07 ~~[illegible]~~ 430.2
Date/ Time	CH2M HILL QAT Signature	Level

NOTE: After the vessel is filled, the vessel must be left at this condition for a minimum of 24 hours. The liquid level should remain constant throughout the 24 hour hold period and no additional liquid should be required to maintain the level. Small erratic up and down variations in liquid level indication may be due to expansion and contraction due to temperature changes. This would not be cause for concern; however, a slow steady downward trend in level is more likely to be indicative of a leak.

[✓] 4.5. **RECORD** date/time and initial level at the start of the 24 hour hold period as read on either LIC-CA1-1 or LIC-CA1-2 and record on Data Sheet 2. Whichever indicator is used to determine the initial level must be used throughout the Integrity Test and **circled** on the data sheet.

[✓] 4.5.1. **QAT VERIFY** starting level of C-A-1.

9-01-07 /15:20 [signature] 26728
Date/ Time CH2M HILL QAT Signature Level

[✓] 4.5.2. **CONDUCT** Visual observations every four hours during the hold period. Results will be recorded on the C-A-1 four hour visual inspections Data Sheet 3.

[✓] 4.5.2.1. Visual Observations are to include jumpers, pipes and pumps visible from the Pump Room viewing window.

[✓] 4.5.3. **OBTAIN** weight factor data reading hourly by monitoring either LIC-CA1-1 or LIC-CA1-2 and RECORD on Data Sheet 2.

[✓] 4.5.3.1. **IF** the liquid level begins to drop noticeably, NOTIFY the 242-A System Engineer so an evaluation of the situation may be performed. The System Engineer shall decide whether to continue with the leak test.

[✓] 4.5.3.2. The 24 hour hold period shall be terminated and the System Engineer notified IF:

- Three successive hourly increases in the sump level totaling 1 inch or more, or a cumulative level rise in the sump of 2 inches or more over the entire 24 hour hold period.
- Any visual evidence of a leak as viewed through the viewing window of the pump room.

[✓] 4.6. **QAT VERIFY** ending level of pump room sump.

9-02-07 /16:06 [signature] 427.3
Date/ Time CH2M HILL QAT Signature Level

[✓] 4.7. **QAT VERIFY** ending level of C-A-1.

9-02-07 /16:06 [signature] 26722
Date/ Time CH2M HILL QAT Signature Level

[✓] 4.8. **REMOVE** C-A-1 vessel dump valve locking screws to allow vessel contents to be emptied.

[✓] 4.9. **ENSURE** Operations is notified that hydrostatic testing activities have been completed and emptying C-A-1 per TO-600-060 may proceed.

[✓] 4.10. **NOTIFY** QA Level II Inspector that visual inspections on WO# WFO-WO-06-002549 may begin AFTER C-A-1 vessel has been emptied.

[✓] 4.11. **COMPLETE** Data Sheet 4 with inspection results.

[✓] 4.11.1. **AFTER** completion of the Test, the 242-A System Engineer shall review the observations, MARK the appropriate evaluation line and SIGN Data Sheet 4.

5.0 POST MAINTENANCE TESTING

N/A

NOTE - Steps in section 6.0 may be worked concurrently.

6.0 RESTORATION ACTIONS

[✓] 6.1. FWS Ensure work documents/Data Sheets are forwarded to Al Friberg (376-1190) OR Jim Castleberry (373-5011).

[✓] 6.2. FWS to review work package for trends and lessons learned. Conduct a Post Job Review on all fieldwork and mark "X" in Feedback block on work record, where appropriate.

[ ] 6.3. Closeout review.

DATA SHEET 1

242-A EVAPORATOR SUMP READING LI-SUMP-1	(G12, F7)	429.9
FQI-RW-1 BOTTOMS FLUSH TOTALIZR	(Gallons) (G15, F10)	8896 (12112) ① after pot fill

1 12001 9-1-07

Operators Signature Time Date

DATA SHEET 2

Date	Time	Pump Room Sump Reading LI-SUMP1 Gallons (Inches)	Tank Indicator Reading LIC-CA1-1 LIC-CA1-2 Gallons	Recorded By
9-01-07	15:20	430.2	26728	QC KYS
9-01-07	15:30	430.0 (34.8)	26729	KYS
9-1-07	16:30	430.4 (34.8)	26729	
9-1-07	17:30	430.2 (34.8)	26728	KYS
9-1-07	1830	430.6 (34.8)	26729	
9-1-07	1930	430.0 (34.8)	26730	
9-1-07	2000	429.7 (34.8)	26731	
9-1-07	2100	429.8 (34.8)	26730	
9-1-07	2200	430.2 (34.8)	26729	
9-1-07	2300	430.3 (34.8)	26730	
9-2-07	0000	429.8 (34.7)	26730	
9-2-07	0100	428.6 (34.7)	26727	
9-2-07	0200	429.2 (34.8)	26727	
9-2-07	0300	428.6 (34.7)	26726	
9-2-07	0400	428.4 (34.7)	26726	
9-2-07	0500	427.5 (34.7)	26723	
9-2-07	0600	427.5 (34.7)	26723	
9-2-07	0700	427.6 (34.6)	26721	
9-2-07	0800	426.8 (34.6)	26718	
9-2-07	0900	426.9 (34.6)	26716	
9-2-07	1000	426.4 (34.6)	26717	
9-2-07	1100	426.5 (34.6)	26719	
9-2-07	1200	426.3 (34.6)	26716	
9-2-07	1300	426.2 (34.5)	26719	
9-2-07	1400	426.9 (34.6)	26720	KYS
9-2-07	1500	426.6 (34.6)	26721	KYS
9-2-07	1600	427.3 (34.6)	26723	
9-2-07	1606	427.3 (34.6)	26722	QC

DATA SHEET 3

Date	Time	Observation	Recorded By
9-1-07	1530	ALL Good No Leaks observed	DJ Dabling
9-1-07	1900	No New Leaks looks like old leak below nozzle E (1)	SD Kelly
9-1-07	2300	No New Leaks	SD Kelly
9-2-07	0300	No New Leaks	SD Kelly
9-2-07	0700	Same old leak under nozzle E - nothing new	DJ Dabling
9-2-07	1100	No New Leaks	DJ Dabling
9-2-07	1500	No New Leaks	DJ Dabling

(1) NOTIFIED ENVIRONMENTAL AND S. RINGO OF APPARENT LEAK FROM NOZZLE E. NB 9/1/07

DATA SHEET 4

EVAPORATOR VESSEL LEAK TEST INSPECTION

Time and date when Vessel was filled: 15:20 9/1/07

Time and Date when inspection began: 15:20 9/1/07

Operations Manager: [signature]

QC Inspectors: [signature]

Comments: Leak during campaign observed during testing. No water observed leaking during actual test.

_____ System is acceptable based on the inspection results. No further evaluation is required.

✓ System requires further evaluation.
Reference: Visual evaluation of pump room discovered a waste leak on the floor below nozzle "E". Nozzle "E" must be evaluated to determine cause of leak & repaired as required.

242-A System Engineer: R.N. DALE [signature] Date 09/04/07

QC Level II Inspector: [signature] Date 9-2-07

RPP WORK RECORD	1. Document Number: WFO-WO-07-1225

2. Work Item Title: 242-A INTEGRITY ASSESSMENT C-A-1 VESSEL

Date	Turnover, Problem Description, Action Taken	Feed Back (X)	Name	Craft/ Resource Type	Hours
7/30/07	Ops pre work release completed. No LHT.		[signature]	OE	
8/31/07	With concurrence of FWS Steve Ringo (per telecon), removed references in work instruction to "applicable process memo" and revised Step 4.3.4 for instruments to be ready for monitoring water levels.		per telecon Steve Ringo Pat Sand	FWS Planner	
9/1/07	Conducted pre job with personnel. Discussed purpose of test and required readings throughout. Test started at 15:20 and should be complete by same time 9/2/07. Locking plates screwed in.		[signature]	FWS	
9/2/07	A leak during campaign was observed. A hardened crust mound of waste was observed leaking from past campaign but was not evident during hold test. The leak appeared to be coming from		[signature]		

Summary by Craft/Resource Type

Craft/Resource Type	Total Hours	Craft/Resource Type	Total Hours

A-6003-243 (11/04)

RPP WORK RECORD

1. Document Number: WFO-WO-07-1225

2. Work Item Title: 242-A INTEGRITY ASSESSMENT C-A-1 VESSEL

Date	Turnover, Problem Description, Action Taken	Feed Back (X)	Name	Craft/ Resource Type	Hours
9/2/07 (cont'd)	Nozzle E. Test was concluded at 1606 on 9/2/07. No leaks observed during actual test (No water observed leaking) Locking plates removed and rotated. SOM to continue with shutdown activities. Notified System Engineer Rob Dale and left message with Project Engineer Al Fleberg. Notified M. Kembel regarding planned entry into pump room to perform visual per WFO-WO-00-2549 planned for 9/3/07. Per direction of McKasty, Operations will continue with dumping of CAI contents to AW102.		[illegible]	FWS	
9/3/07	0124 CAI was emptied to AW102.		[illegible]	FWS	

Summary by Craft/Resource Type

Craft/Resource Type	Total Hours	Craft/Resource Type	Total Hours

A-6003-243 (11/04)

2/2/2007 1:46 PM WORKING COPY TSI Required Data

242-A Evaporator Backside Rounds (Cont.)

Date:	8-27-07		8-28-07		8-29-07		8-30-07		8-31-07		9-01-07		9-02-07	
Day:	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday	
Parameter:	D	N	D	N	D	N	D	N	D	N	D	N	D	N
PUMP ROOM INSPECTIONS (use viewing window in AMU Room for inspection)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Inspect process system for integrity and signs of corrosion. (No leakage from piping, valves, flanges, cabinets, etc. No rust buildup) RCRA	1	1	1	2	1	1	1	1	1	1	1	1	1	1
Inspect room lighting. (No burned out lights, light fixtures intact etc.) SAFETY	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Inspect visible areas within 2 meters of the pump room side of the shielding windows, on the AMU lower and mezzanine levels, for combustible materials. (Report combustibles for removal.) FIRE PROTECTION	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Space for emergency movement of fire, spill and decontamination equipment maintained. (Clear walkways) RCRA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	2	2	2
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
No unsafe conditions exist. Conditions hazardous to personnel and/or equipment. (Wet floors, exposed wiring, housekeeping, belt guards not installed, water leaking onto electrical equipment, etc.) RCI SAFETY	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Conversion 1 Meter = 39.37 inches: 2.0 meters = 78.74 inches (6' 6¼")

DL #	(1) WFO-WO-06-0465	Remarks leak below nozzle E NOTIFIED ENVIRONMENTAL & INTEGRITY ASSESSMENT MGR. 9/2/07
DL #	(2)	RCRA

Inspect Pump Room Sump for overflows. RA

Initials: [illegible] Date: 09/29/20[illegible]

ATTACHMENT 5B

FACTORS POTENTIALLY AFFECTING THE VAPOR-LIQUID SEPARATOR HOLD TEST AND POST TEST ANALYSIS

(52 Pages)

5B.0 FACTORS POTENTIALLY AFFECTING THE VAPOR-LIQUID SEPARATOR HOLD TEST AND POST TEST ANALYSIS

The following sections analyze factors potentially affecting the vapor-liquid separator hold test.

5B.1 INTRODUCTION

In discussions since the preparation of the current IAP (2007), the IQRPE has been alerted to factors that may affect the Evaporator/Reboiler Loop Leak (Hold) test. These factors consist of the following:

1) Level sensor sensitivity.
2) Potential losses from the system by evaporation of the test fluid (water vapor); and
3) Thermal expansion of the text fluid and system components;

The potential impacts of these factors upon the outcome of the Hold Test will be discussed in the following sections, beginning with analysis of previously collected Evaporator/Reboiler Loop Test data.

5B.2 ANALYSIS OF PREVIOUS LEAK TESTS

The Evaporator/Reboiler Loop was previously tested in 1992 and reported in the 1993 IAR (USDOE 1993) and in 1998 and reported in the 1998 IAR (USDOE 1998). Analysis and discussion of results are provided in the following sections.

5B.2.1 1993 Test

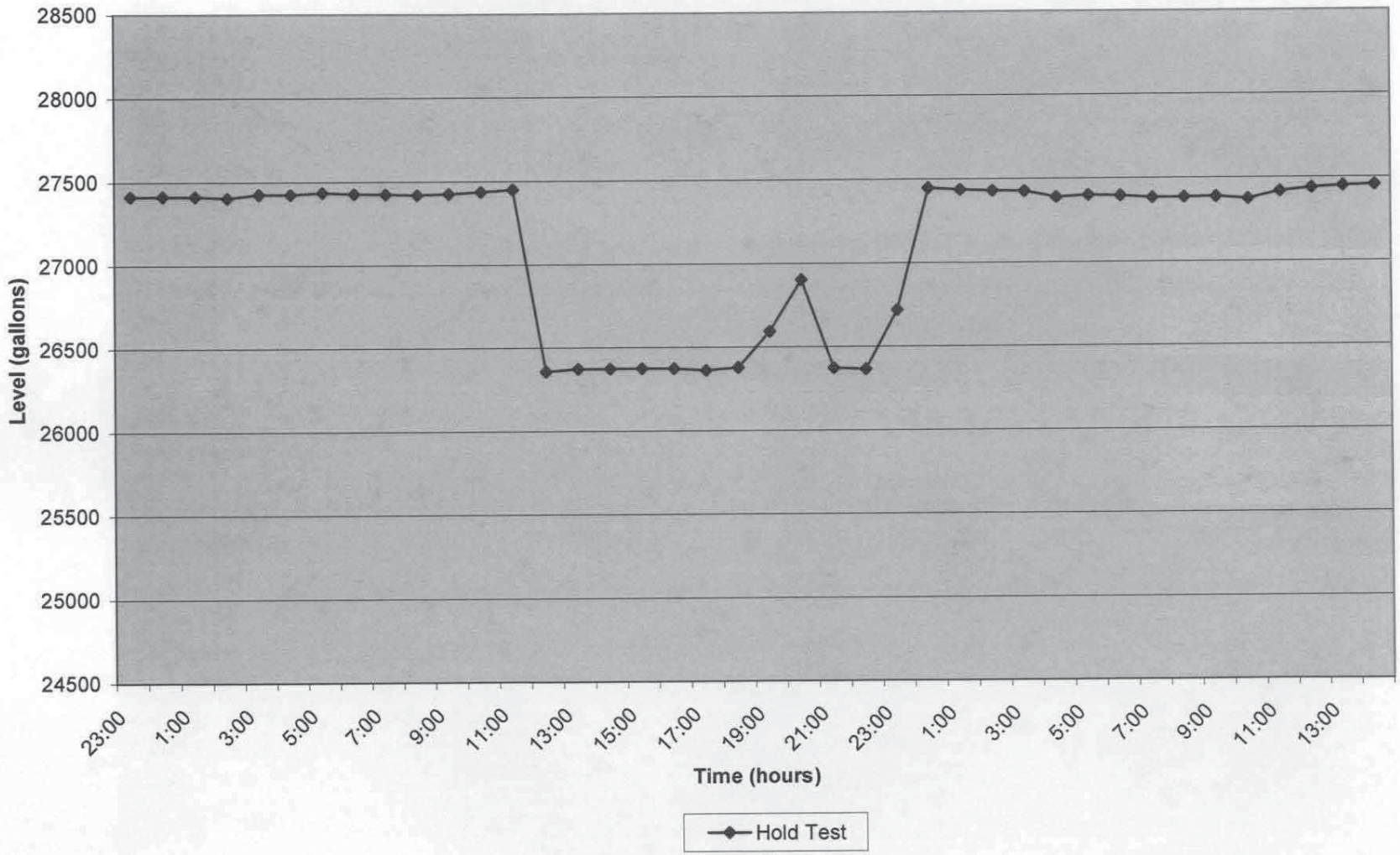
1993 Evaporator hold test data are compiled in Table 5B.2.1 (US and SI units). Figure 5B.2.1 demonstrates that in 1993, the data are relatively flat, maintaining a baseline of approximately 27,400 gallons (103,720 Liters) until the reading taken at 12:00 hours on November 22, 1992 fourteen hours after the test began. At this point, the electronically indicated level dropped approximately 1,000 gallons (3,785 Liters) to a new baseline of approximately 26,400 gallons until 22:00 hours, except for a level spike of up to 26,900 gallons (101,828 Liters) that was recorded between 18:00 and 21:00 hours on November 22, 1992. Level readings resumed the 27,400 gallon (103,720 Liters) baseline at 0:00 hours on November 23, 1992 and maintained this baseline until the termination of the test after 39 hours of testing. In comparing the initial, 27,413 gallons (103,769 Liters), and final levels, 27,454 gallons (103,924 Liters), an apparent gain of 41 gallons (155 Liters) was electronically indicated.

In explanation for the electronically recorded level readings described above, the 1993 IAR postulated that indicated that the 1,000 gallon drop that occurred between 11:00 and 12:00 hours was the result of a change in instrument reference rather than actual liquid leakage. To support this, the 1993 IAR reported that the electronically reported drop between 11:00 and 12:00 hours coincided with the shut down of a cell ventilating fan. It was explained that fan power and liquid level indicator reference leg are on the same electrical motor control center circuit. Further, that the weight factor based level instrument was sensitive to air pressure and that the shutdown of the fan would have

TABLE 5B.2.1
1993 Evaporator Hold Test Data

Date	Time	Level (gallons)	Level (CF)	Level (Liters)	Level (m^3)
11/21/1992	23:00	27413	3664.6	103769	103.77
11/22/1992	0:00	27414	3664.7	103773	103.77
11/22/1992	1:00	27413	3664.6	103769	103.77
11/22/1992	2:00	27403	3663.2	103732	103.73
11/22/1992	3:00	27425	3666.2	103815	103.81
11/22/1992	4:00	27424	3666.1	103811	103.81
11/22/1992	5:00	27435	3667.5	103853	103.85
11/22/1992	6:00	27427	3666.5	103822	103.82
11/22/1992	7:00	27424	3666.1	103811	103.81
11/22/1992	8:00	27419	3665.4	103792	103.79
11/22/1992	9:00	27426	3666.3	103819	103.82
11/22/1992	10:00	27436	3667.7	103857	103.86
11/22/1992	11:00	27450	3669.5	103910	103.91
11/22/1992	12:00	26358	3523.6	99776	99.78
11/22/1992	13:00	26373	3525.6	99833	99.83
11/22/1992	14:00	26373	3525.6	99833	99.83
11/22/1992	15:00	26375	3525.8	99840	99.84
11/22/1992	16:00	26374	3525.7	99836	99.84
11/22/1992	17:00	26363	3524.2	99795	99.79
11/22/1992	18:00	26379	3526.4	99855	99.86
11/22/1992	19:00	26594	3555.1	100669	100.67
11/22/1992	20:00	26903	3596.4	101839	101.84
11/22/1992	21:00	26373	3525.6	99833	99.83
11/22/1992	22:00	26366	3524.6	99806	99.81
11/22/1992	23:00	26721	3572.1	101150	101.15
11/23/1992	0:00	27447	3669.1	103898	103.90
11/23/1992	1:00	27435	3667.5	103853	103.85
11/23/1992	2:00	27429	3666.7	103830	103.83
11/23/1992	3:00	27425	3666.2	103815	103.81
11/23/1992	4:00	27388	3661.2	103675	103.67
11/23/1992	5:00	27399	3662.7	103716	103.72
11/23/1992	6:00	27395	3662.2	103701	103.70
11/23/1992	7:00	27382	3660.4	103652	103.65
11/23/1992	8:00	27383	3660.6	103656	103.66
11/23/1992	9:00	27386	3661.0	103667	103.67
11/23/1992	10:00	27372	3659.1	103614	103.61
11/23/1992	11:00	27417	3665.1	103785	103.78
11/23/1992	12:00	27436	3667.7	103857	103.86
11/23/1992	13:00	27448	3669.3	103902	103.90
11/23/1992	14:00	27454	3670.1	103925	103.92

Figure 5B.2.1 - 1993 Hold Test (Volume vs Time)



affected air pressure in the vessel. However, after establishing the link between the fan shutdown and the drop in level readings, it remained unknown why readings on the level instrument remained low for over 12 hours, when the shutdown of the fan lasted only a few minutes.

However, the 1993 IAR concluded that leakage was unlikely, despite the electronically indicated level fluctuations on the basis of the following:

- No visible leakage was observed during any of the 11 recorded visual inspections during the test;
- No visible leakage was observed during the final VT exam conducted at the conclusion of the test;
- The vapor-liquid separator system is covered by insulation, however, the insulation is not absorbent and the amount of electronically indicated leakage was large (1,000 gallons or 3,785 Liters), which would have been readily observable,
- Boundary drain valves were tested and found to be leak tight prior to testing;
- Sufficient make up water could not have come from the P-B-1 seals,
- No make up water was deliberately added nor could have exactly matched the 1,000 gallon (3,785 Liters) loss electronically indicated.

It was also further explained that the electronically reported level fluctuations in the range of +/- 550 gallons (2082 Liters) were attributable to instrument drift (see Section 5B.3).

5B.2.2 1998 Test

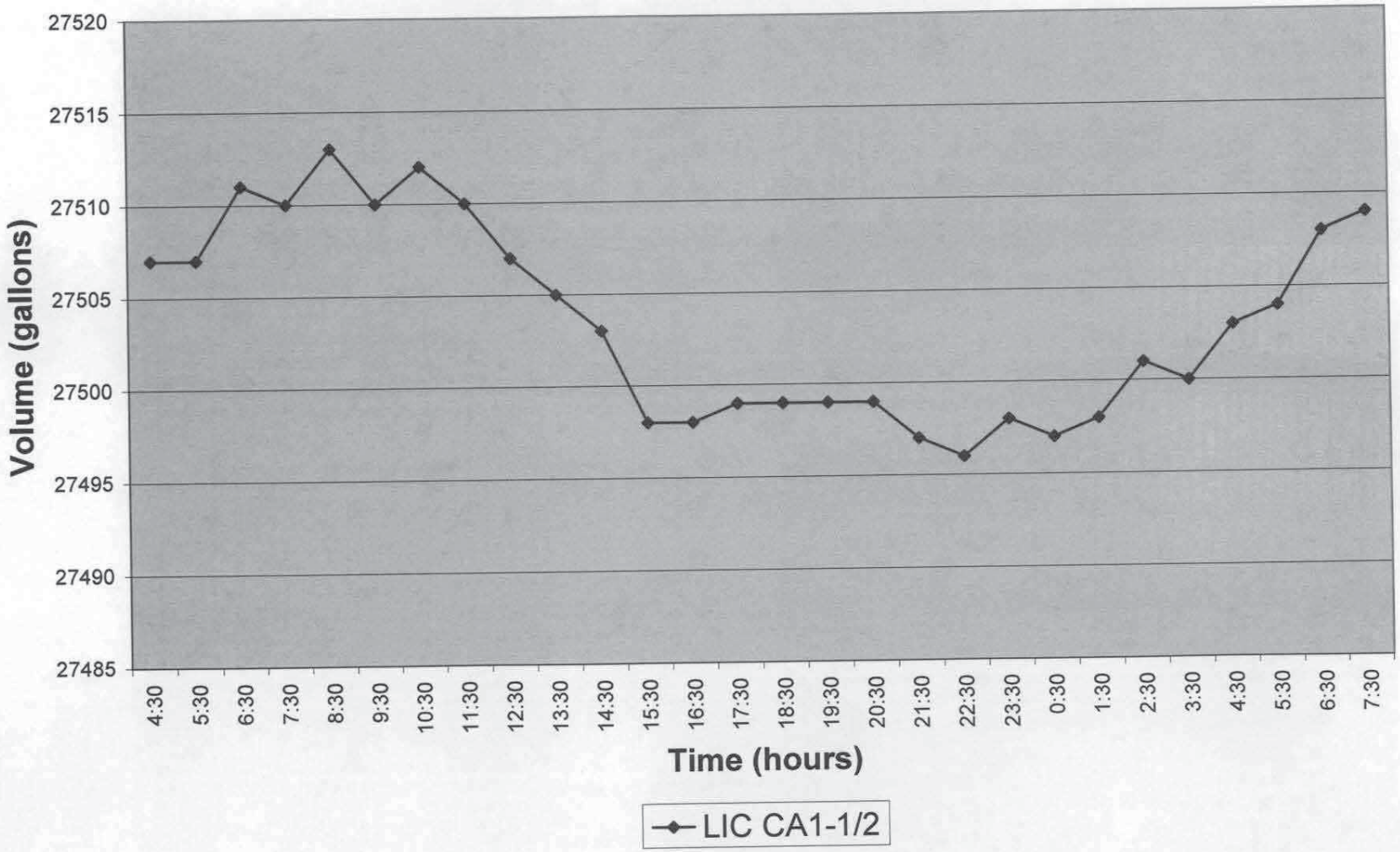
1998 Evaporator hold test data are compiled in Table 5B.2.2 (US and SI units). Figure 5B.2.2 demonstrates that unlike 1993 data, the 1998 data follow a sinusoidal pattern. An analysis of the actual data collected in 1998 (USDOE 1998) shows that the initial volume measurement in 1998 was 27,507 (104,125 liters) at 4:30 hours on June 1st. The maximum volume was 27,513 gallons (104,148 liters) at 8:30 hours and the minimum volume was 27,496 gallons (104,084 liters) at 22:30 hours. The baseline measurement was the reading at 4:30 hours on June 1, 1998, so the greatest positive deviation was 6 gallons (23 liters) at 8:30 hours and the greatest negative deviation was 11 gallons (42 liters) at 22:30 hours on June 1, 1998. For the 6 gallon (23 liters) positive change, this would be approximately a 0.0625 inch (0.159 cm) increase in the apparent height of water in C-A-1. For the 11 gallon (42 liters) negative change, this would be approximately a 0.115 inch (0.291 cm) drop in the apparent height of water in C-A-1.

The 1998 IAR (USDOE 1998) did not detailed analysis of the volume fluctuations observed, however, it acknowledge behavior in the latter half of the explanation for the apparent overall fluctuations of +6 gallons (actually noting this as a change of 5 gallons) and -11 gallons as "...variations within the operating range of the level measuring equipment and the minor temperature fluctuations of the system." Visual inspections during the leak test noted no leaks. During the test, seal water for the recirculation pump P-B1 was routed to tank 241-AW-102, however, the increase in the level of the tank was accounted for by the routing of the seal test water.

TABLE 5B.2.2
1998 Hold Test Data

Date	Time	Level (gallons)	Level (CF)	Level (Liters)	Level (m^3)
6/1/1998	4:30	27507	3677.2	104125	104.1
6/1/1998	5:30	27507	3677.2	104125	104.1
6/1/1998	6:30	27511	3677.7	104140	104.1
6/1/1998	7:30	27510	3677.6	104137	104.1
6/1/1998	8:30	27513	3678.0	104148	104.1
6/1/1998	9:30	27510	3677.6	104137	104.1
6/1/1998	10:30	27512	3677.8	104144	104.1
6/1/1998	11:30	27510	3677.6	104137	104.1
6/1/1998	12:30	27507	3677.2	104125	104.1
6/1/1998	13:30	27505	3676.9	104118	104.1
6/1/1998	14:30	27503	3676.6	104110	104.1
6/1/1998	15:30	27498	3675.9	104091	104.1
6/1/1998	16:30	27498	3675.9	104091	104.1
6/1/1998	17:30	27499	3676.1	104095	104.1
6/1/1998	18:30	27499	3676.1	104095	104.1
6/1/1998	19:30	27499	3676.1	104095	104.1
6/1/1998	20:30	27499	3676.1	104095	104.1
6/1/1998	21:30	27497	3675.8	104087	104.1
6/1/1998	22:30	27496	3675.7	104084	104.1
6/1/1998	23:30	27498	3675.9	104091	104.1
6/2/1998	0:30	27497	3675.8	104087	104.1
6/2/1998	1:30	27498	3675.9	104091	104.1
6/2/1998	2:30	27501	3676.3	104103	104.1
6/2/1998	3:30	27500	3676.2	104099	104.1
6/2/1998	4:30	27503	3676.6	104110	104.1
6/2/1998	5:30	27504	3676.7	104114	104.1
6/2/1998	6:30	27508	3677.3	104129	104.1
6/2/1998	7:30	27509	3677.4	104133	104.1

Figure 5B.2.2 - 1998 Evaporator Hold Test



Variations in instrumentation sensitivity are unlikely to follow a sinusoidal curve but rather to follow small variations around a mean reading. This behavior is more likely attributable to diurnal temperature variations or some other phenomena having a 24 hour cycle or period. For an analysis of level sensor sensitivity, see Section 5B.3 and for an analysis of temperature effects, see Section 5B.5.

5B.2.3 2007 Test – C-A-1 Level

2007 Evaporator hold test data are compiled in Table 5B.2.3 (US and SI units). Figure 5B.2.3 demonstrates the 2007 data follow a similar sinusoidal pattern as the 1998 data, not following a flat or step pattern, as seen in 1993. As in 1998, visual inspections did not indicate leaks. Evidence of an old leak that was attributed to a leak occurring in the previous Evaporator campaign was noted.

An analysis of the actual C-A-1 level data collected in 2007 (Attachment 5A and Table 5B.2.3) shows that the initial volume measurement was 26,728 gallons (101,176 liters) at 15:20 hours on September 1, 2007. The maximum volume was 26,731 gallons (101,188 liters) at 20:00 hours on September 1, 2007 and the minimum volume was 26,716 gallons (101,131 liters) at 9:00 hours on September 2, 2007. The baseline measurement was the reading at 15:20 hours, so the greatest positive deviation was 3 gallons (11 liters) at 20:00 hours on September 1, 2007 and the greatest negative deviation was 12 gallons (45 liters) at 9:00 and 12:00 hours on September 2, 2007. For the 3 gallon positive change, this would be approximately a 0.0313 inch (0.0794 cm) increase in the apparent height of water in C-A-1. For the 12 gallon (45 liter) negative change, this would be approximately a .125 inch (0.318 cm) drop in the apparent height of water in C-A-1.

As noted in Section 5B.2.2, variations in instrumentation sensitivity are unlikely to follow a sinusoidal curve but rather to follow small variations around a mean reading. Instead, this behavior is more likely attributable to diurnal temperature variations or some other phenomena having a 24 hour cycle or period. For an analysis of level sensor sensitivity, see Section 5B.3 and for an analysis of temperature effects, see Section 5B.5.

5B.2.3 2007 Test – L1 Sump Level

L1 Sump level data were also collected in 2007 and are compiled in Table 5B.2.3 (US and SI units) and shown in Figure 5B.2.4. Data are scale corrected to be displayed alongside 242A level data and displayed in Figure 5B.2.5. From observing Figures 5B.2.4 and 5B.2.5, it can be seen that these data demonstrate similar behavior as 1998 and 2007 242A level data, albeit at lesser deviation (i.e. smaller maximums and minimums).

An analysis of the actual L1 Sump level data collected in 2007 (Attachment 5A and Table 5B.2.3) shows that the initial volume measurement was 430.2 gallons (1,628 liters) at 15:20 hours on September 1, 2007. The maximum volume was 430.6 gallons (1,630 liters) at 18:30 hours on September 1, 2007 and the minimum volume was 426.2 gallons (1613 liters) at 13:00 hours on September 2, 2007. The baseline measurement was the reading at 15:20 hours, so the greatest positive deviation was 1 gallon (3 liters) at 18:30 hours on September 1, 2007 and the greatest negative deviation was 4 gallons (13 liters) at 13:00 hours on September 2, 2007. For the 1 gallon positive change, this would be approximately a 0.0662 inch (0.168 cm) increase in the apparent height of water in Sump

TABLE 5B.2.3
2007 Hold Test Data

		242A Level				L1 Sump Level			
Date	Time	(gallons)	(CF)	(Liters)	(m^3)	Gallons	(CF)	(Liters)	(m^3)
9/1/2007	15:20	26728	3573.0	101176	101.2	430.2	57.5	1628	1.6
9/1/2007	15:30	26729	3573.1	101180	101.2	430.0	57.5	1628	1.6
9/1/2007	16:30	26729	3573.1	101180	101.2	430.4	57.5	1629	1.6
9/1/2007	17:30	26728	3573.0	101176	101.2	430.2	57.5	1628	1.6
9/1/2007	18:30	26729	3573.1	101180	101.2	430.6	57.6	1630	1.6
9/1/2007	19:30	26730	3573.3	101184	101.2	430.0	57.5	1628	1.6
9/1/2007	20:00	26731	3573.4	101188	101.2	429.7	57.4	1627	1.6
9/1/2007	21:00	26730	3573.3	101184	101.2	429.8	57.5	1627	1.6
9/1/2007	22:00	26729	3573.1	101180	101.2	430.2	57.5	1628	1.6
9/1/2007	23:00	26730	3573.3	101184	101.2	430.3	57.5	1629	1.6
9/2/2007	0:00	26730	3573.3	101184	101.2	429.8	57.5	1627	1.6
9/2/2007	1:00	26727	3572.9	101173	101.2	428.6	57.3	1622	1.6
9/2/2007	2:00	26727	3572.9	101173	101.2	429.2	57.4	1625	1.6
9/2/2007	3:00	26726	3572.7	101169	101.2	428.6	57.3	1622	1.6
9/2/2007	4:00	26726	3572.7	101169	101.2	428.4	57.3	1622	1.6
9/2/2007	5:00	26723	3572.3	101158	101.2	427.5	57.1	1618	1.6
9/2/2007	6:00	26723	3572.3	101158	101.2	427.5	57.1	1618	1.6
9/2/2007	7:00	26721	3572.1	101150	101.1	427.6	57.2	1619	1.6
9/2/2007	8:00	26718	3571.7	101139	101.1	426.8	57.1	1616	1.6
9/2/2007	9:00	26716	3571.4	101131	101.1	426.9	57.1	1616	1.6
9/2/2007	10:00	26717	3571.5	101135	101.1	426.4	57.0	1614	1.6
9/2/2007	11:00	26719	3571.8	101142	101.1	426.5	57.0	1614	1.6
9/2/2007	12:00	26716	3571.4	101131	101.1	426.3	57.0	1614	1.6
9/2/2007	13:00	26719	3571.8	101142	101.1	426.2	57.0	1613	1.6
9/2/2007	14:00	26720	3571.9	101146	101.1	426.9	57.1	1616	1.6
9/2/2007	15:00	26721	3572.1	101150	101.1	426.6	57.0	1615	1.6
9/2/2007	16:00	26723	3572.3	101158	101.2	427.3	57.1	1618	1.6
9/2/2007	16:06	26722	3572.2	101154	101.2	427.3	57.1	1618	1.6

Figure 5B.2.3 - 2007 Evaporator Hold Test - C-A-1 Level

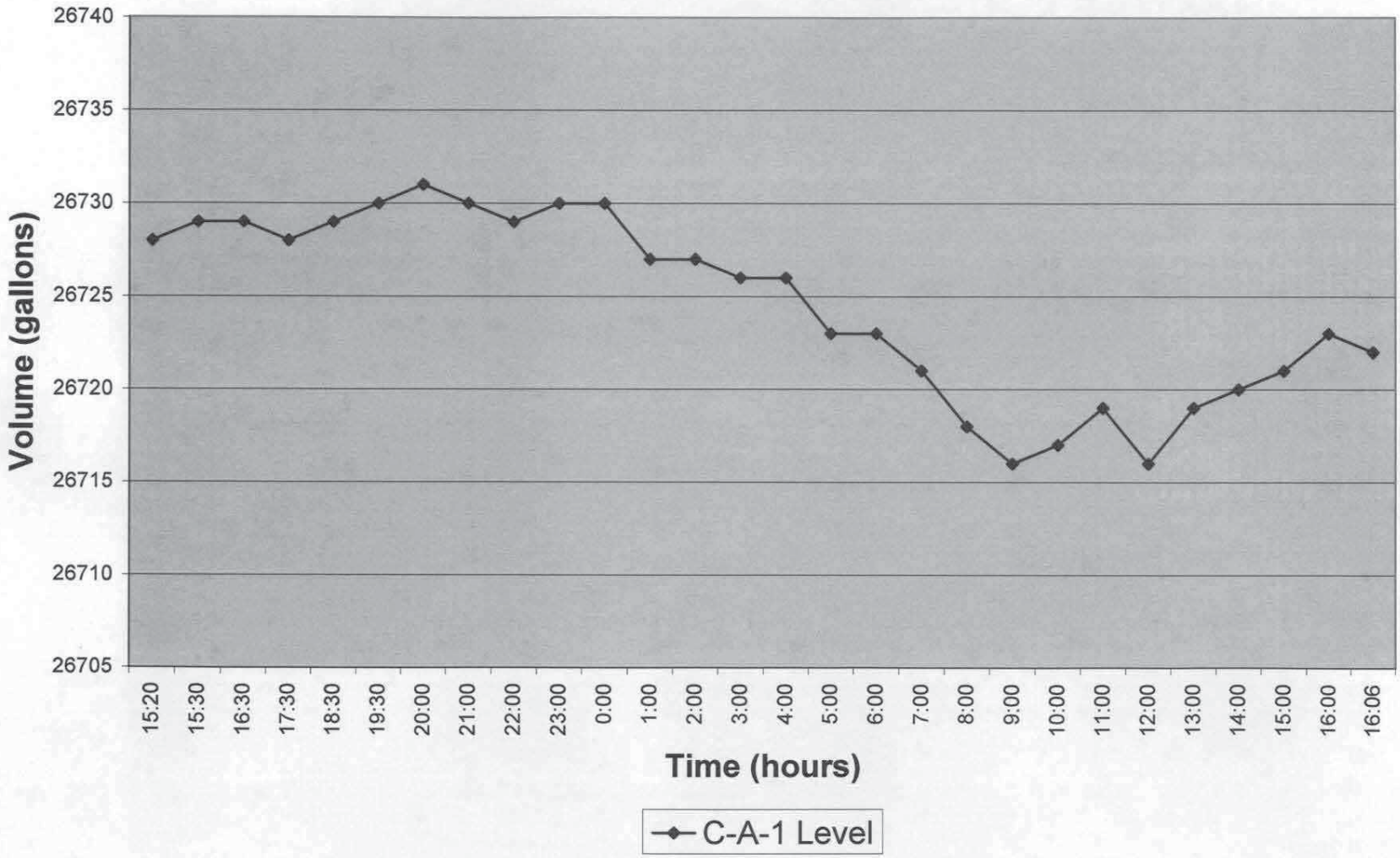


Figure 5B.2.4 - 2007 Evaporator Hold Test - L1 Sump Level

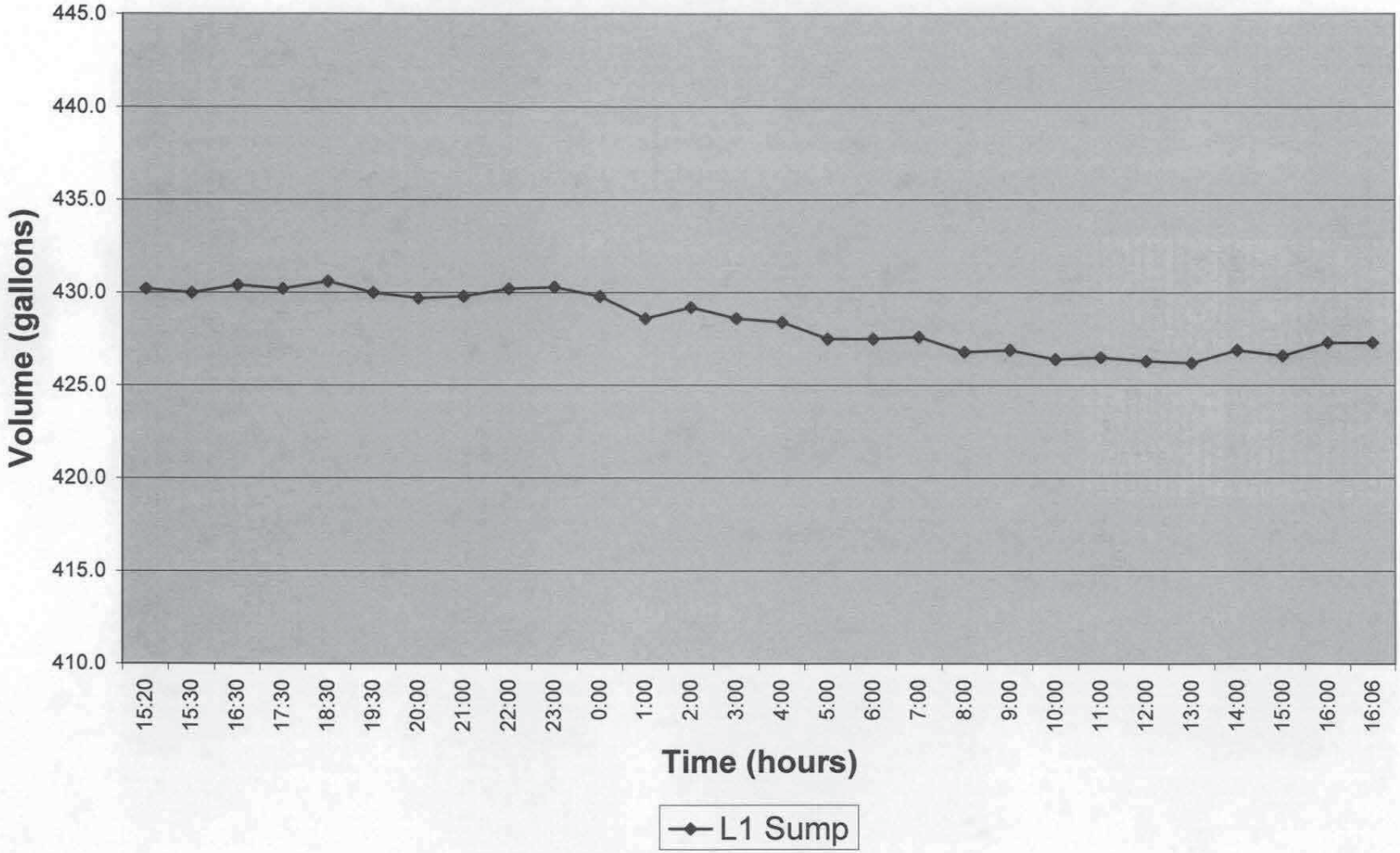


Figure 5B.2.5 - 2007 Evaporator Hold Test - C-A-1 and L1 Sump
Change in Level

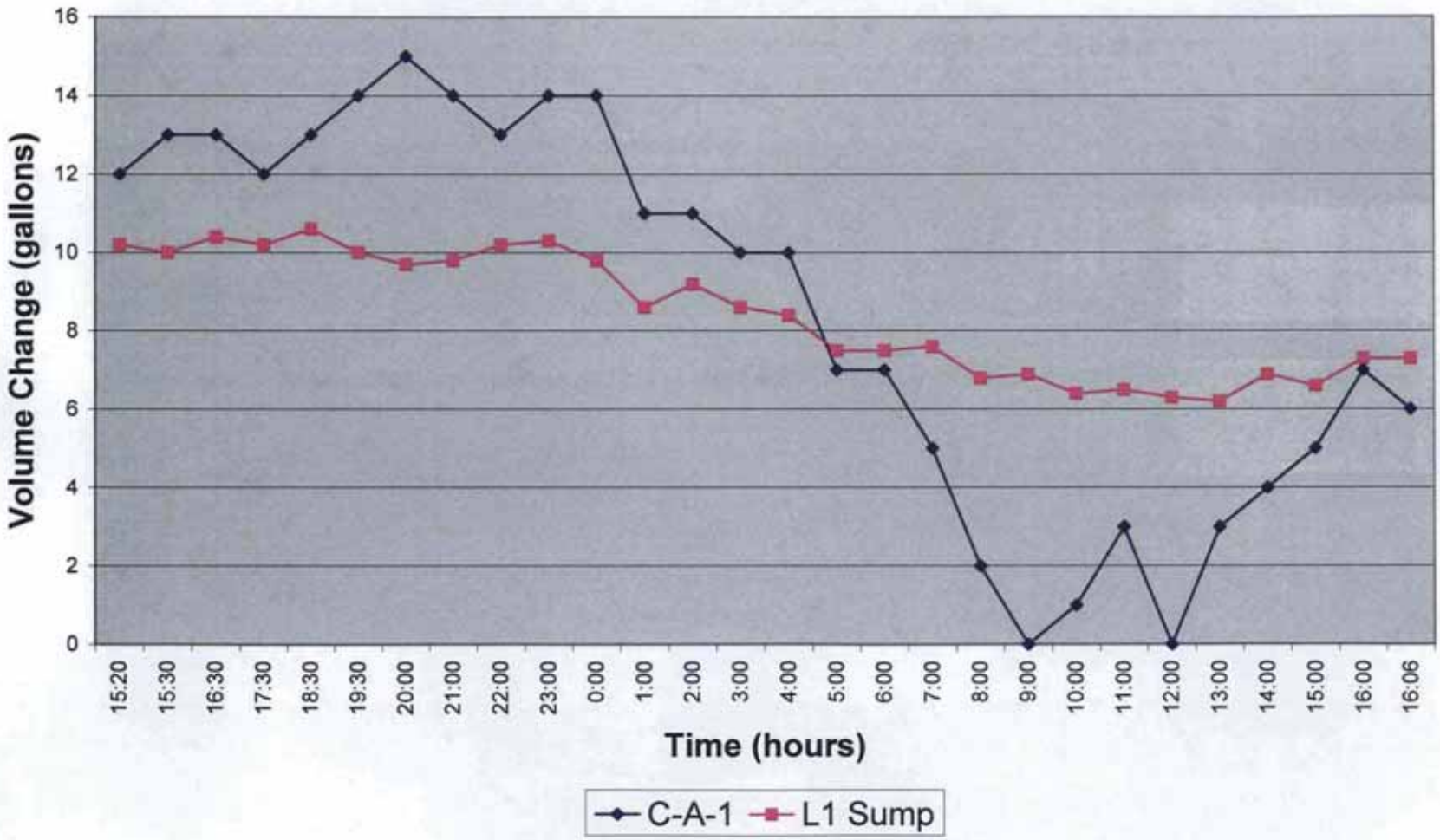
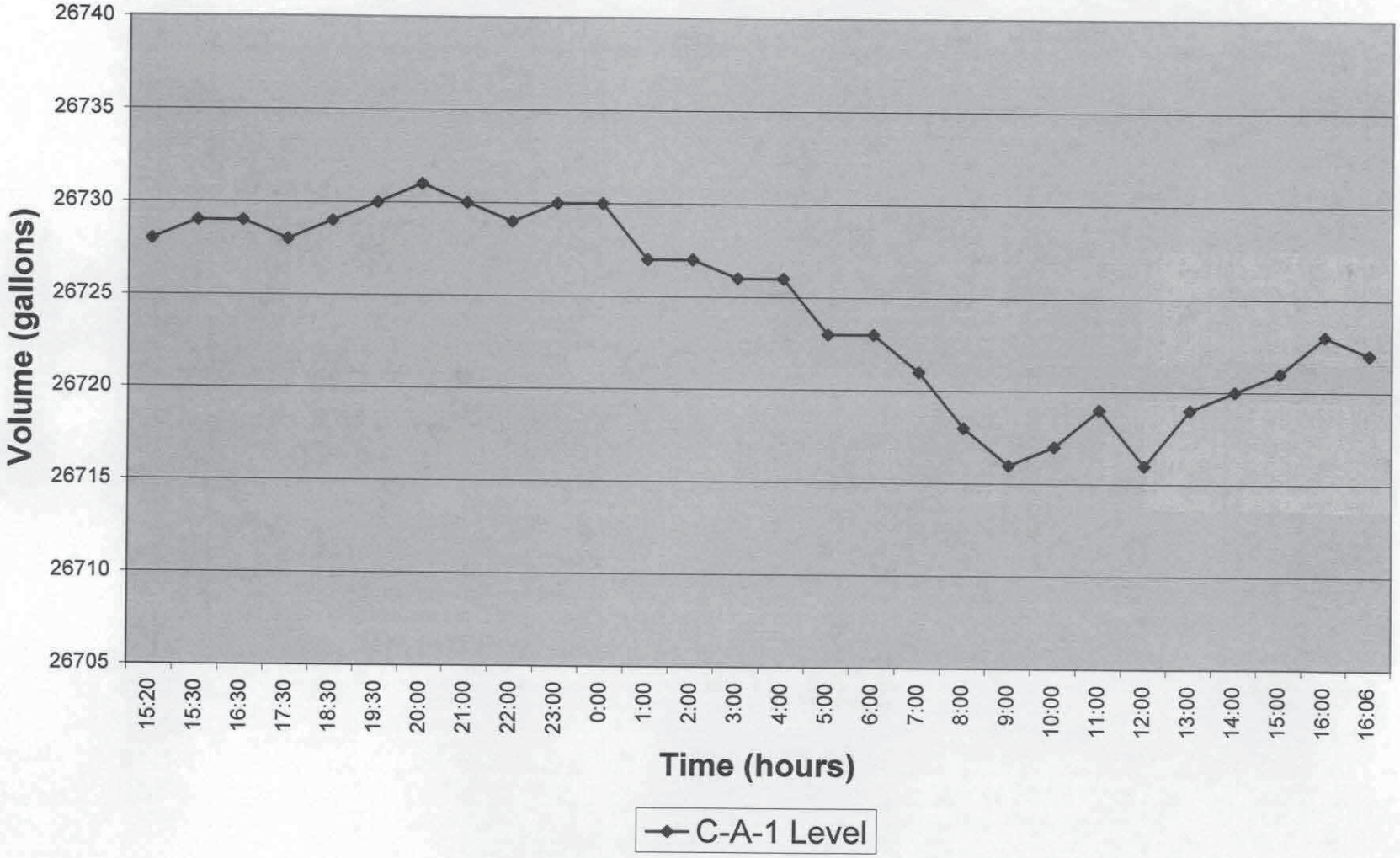


Figure 5B.2.3 - 2007 Evaporator Hold Test - C-A-1 Level



L1. For the 4 gallon (13 liter) negative change, this would be approximately a 0.265 inch (0.673 cm) drop in the apparent height of water in L1.

As noted in Section 5B.2.2 and 5B.2.3, variations in instrumentation sensitivity are unlikely to follow a sinusoidal curve but rather to follow small variations around a mean reading. Instead, this behavior is more likely attributable to diurnal temperature variations or some other phenomena having a 24 hour cycle or period. For an analysis of level sensor sensitivity, see Section 5B.3 and for an analysis of temperature effects, see Section 5B.5.

5B.3 LEVEL SENSOR INSTRUMENTATION

It is desired to determine what effects C-A-1 instrument accuracy may have on determining whether losses from the Vapor-Liquid Separator Loop occur during the hold test.

Level instrument specifications were formally archived in the B100 archive boxes. This information is currently unavailable to the IQRPE. However, two descriptions are provided as being applicable to level sensing instrumentation currently in operation HNF 14755 and CH2 2006 that provide detailed information:

HNF 14755 provides the following:

> WF in vessel C-A-1 is measured using differential pressure information from dip tubes and is controlled to prevent overfilling, prevent tank structural damage, and to preclude the spread of contamination. One dip tube penetrates the bottom of the vessel in the recirculation line and is used for wide-range WF indication. Two dip tubes (to provide redundancy) penetrate to mid-level and are used for narrow range WF indication. Two additional dip tubes (to provide redundancy) are located approximately 100 in. below the narrow range dip tubes. Specific gravity is determined from the differential pressure between these two pairs of dip tubes. A reference tube is located in the vapor space just below the lower deentrainment pad. WF is calculated by measuring the differential pressure between the reference tube and the WF dip tubes. The WF is corrected for density by dividing the height of the WF by specific gravity. This corrected WF is the actual liquid level inches. Vessel calibration data are then used to convert this level from inches to gallons.
>
> The dip tube system is designed and installed to prevent liquid from backflowing into the instrument area. The dip tubes enter the cell 7 m (23 ft) above the operating liquid level in vessel C-A-1. The 242-A Evaporator operates under a vacuum of approximately 6.7 kPa or 50 torr. Assuming that the slurry density is 1.3 g/cc, the pressure in vessel C-A-1 would have to exceed 90 kPa (13 lbf/in.2) above atmospheric pressure to back up liquid into the instrument area. In addition, the dip tubes are slightly pressurized and air flows continuously into the vessel.
>
> High- and low-level vessel C-A-1 alarms signal the operator when the liquid level is approaching liquid levels either below or above the desired range of liquid levels specified by process engineering.
>
> The liquid level in vessel C-A-1 must be controlled to prevent overfilling the vessel and plugging or damaging the deentrainment pads. Vessel C-A-1 overflow

could reach the process condensate tank TK-C-100, which would cause a significant increase in condenser room radiation levels. Operators and RCTs would be unable to enter the room and perform normal surveillance activities until the tank contents were pumped out and the tank and associated lines decontaminated.

A minimum liquid level is maintained in vessel C-A-1 to control scale formation on the reboiler tubes and prevent cavitation in P-B-1 recirculation pump. The liquid level is maintained just above the outlet pipe that exits from the reboiler into the vessel. The level helps prevent vapor bubbles from forming inside the reboiler tubes, which creates a potential for the upper part of the reboiler tubes to become dry and for scale to deposit on the tube walls. High solution velocity through the reboiler tubes also reduces scale formation.

CH2 2006 provides the following:

The liquid level of the vessel is continuously monitored via three dip tube assemblies installed within the vessel. The signals from the dip tubes are received by the Monitoring Control System (MCS) and displayed in both graphical and faceplate format. Weight factors and specific gravities are then converted by the MCS to vessel liquid level. Only one of the two narrow range weight factor indicators (WFI CA1 1 or WFI CA1 2) is required to operate the evaporator. If both WFI CA1 1 and WFI CA1 2 are inoperable, the evaporator liquid level can be monitored using WFI CA1 3 (uncorrected weight factor) if the feed pump, slurry pump, and steam to the reboiler are shut off. Control is accomplished by adjustment of the feed rate, reboiler steam rate, vessel operating pressure, slurry rate, or a combination of these. In the event of a high liquid level alarm, the weight factor transmitters (WFT CA1 1, 2) are hardwired to a switch that turns off the feed pump. A software interlock shuts down the recirculation pump, P B 1, and slurry pump, P B 2, on low liquid level.

Both descriptions are essentially the same. In both cases, level sensors are dip tubes that communicate weight factor and specific gravity data that is used to monitor and control the liquid level in C-A-1.

Indirectly, information regarding the probable accuracy of instrumentation used in 1993 is provided in the 1993 IAR (USDOE 1993). Observations during the leak test of the starting liquid inventory in the system as indicated by the LI-CAI-3G level indicator was 27,413 gallons (103,769 Liters). At the conclusion of the test 39 hours later, the final indicated inventory was 27,454 gallons (103,924 Liters). The difference between starting and ending levels reported electronically was an increase of 41 gallons (155 Liters), with both positive and negative differentials occurring during testing (see Sections 5B.2.2 and 5B.5 below). The testers attributed this discrepancy to electronic instrument drift. Per information received from the instrument engineer, the accuracy of the 242A evaporator/reboiler loop level transmitter (Loop AEIOH-1, instrument number WFT-CAI-3, calibrated for 0-800 inches of water, 4-20 mA) was +/- 2 percent. Out of a total water inventory of 27,454 gallons (approximate) in the evaporator reboiler loop, the accuracy of instrumentation used in the 1993 hold test was therefore approximately +/- 550 gallons (2,082 Liters).

A discussion of instrumentation accuracy is not provided in the 1998 IAR, however, LIC CA1-1 and LIC CA1-2 were used in the 1998 evaporator hold test (US DOE 1998). Since these level sensors remain in use, the descriptions found in HNF 14755 and CH2 2006 are applicable. Specifications for these instruments are not currently available to the IQRPE, however, the system engineer describes LIC-CA1-1/LIC-CA1-2 as being accurate to within approximately 2 percent of scale or the equivalent of ½-inch (1.27 cm) drop in the level of CA1. At typical and maximum operating levels, the diameter of C-A-1 is 14 feet (4.27 m) and has an area of 154 square feet (14.3 m^2). If ½-inch (1.27 cm) is taken as the accuracy of LIC-CA1-1/LIC-CA1-2, a loss of ½ inch (1.27 cm) represents 6.4 cubic feet (0.182 m^3) or 48 gallons (182 Liters), giving these instruments an accuracy of +/- 48 gallons (182 Liters) with respect to reading changes in the volume of CA1.

While instrument sensitivity has an impact regarding quantitative readings, qualitative trends, such as steady, sustained losses should still be observable, provided that instrument response . However, it is also possible that transient changes smaller than instrument sensitivity would go undetected. Potential effects of instrument sensitivity are shown on 1993 data in Figure 5B.3.1 as "Y-bars" of +/- 550 gallons on actual data recorded and on Figure 5B.3.2 as "Y bars" of +/- 48 gallons on actual data recorded. Potential effects of instrument sensitivity are shown on Figures 5B.4.1 and 5B.4.2 (see Section 5B.4 below) by using the larger "error bar" of +/- 550 gallons due to the scale of the figures. Because the instrumentation in effect is as described by the system engineer, Figure 5B.3.3, which depicts the potential effects of instrument sensitivity upon the current hold test, includes "Y bars" of 48 gallons.

5B.4 EVAPORATION

It is desired to determine what effects evaporation may have during the Vapor-Liquid Separator Leak Test/Hold Test. Calculations of this rate could be used to separate any losses from the Loop caused by evaporation from losses caused by leaks during the hold test period.

The following boundary conditions and assumptions are relevant for each of the following calculations:

- The hold test is assumed to be 24 hours in duration;
- Previous hold tests indicate that Evaporator C-A-1 will be filled to at or near the maximum operating level. This is approximately 726'2" (H-2-69328, H-2-69340, and other USDOE drawings);
- Evaporation losses will occur primarily from the surface area of the Evaporator (C-A-1) (if the Evaporator is at the operating level or above, the Reboiler is completely full of fluid, therefore, no evaporation losses can occur from anywhere else in the system);
- Ambient temperature is assumed to be 68 degrees Fahrenheit (°F) or 20 degrees Celsius (°C);
- The test fluid in C-A-1 is assumed to be pure water,
- Humidity at Richland, WA assumed to be 58% (typical) http://weather.msn.com/local.aspx?wealocations=wc:USWA0373; and

Figure 5B.3.1 - 1993 Hold Test Showing Instrument Sensitivity (Volume vs Time)

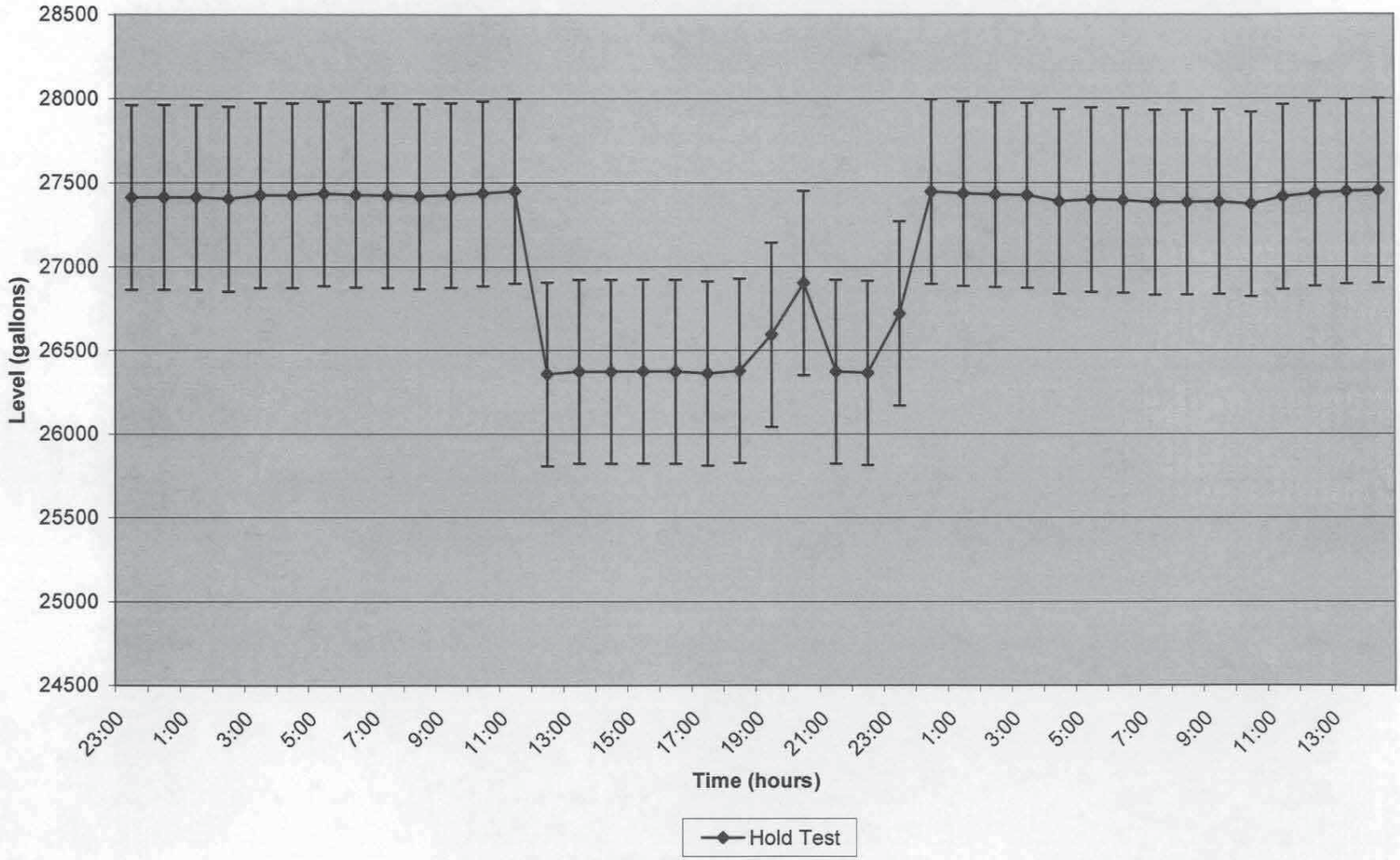


Figure 5B.3.2 - 1998 Evaporator Hold Test Showing Instrument Sensitivity

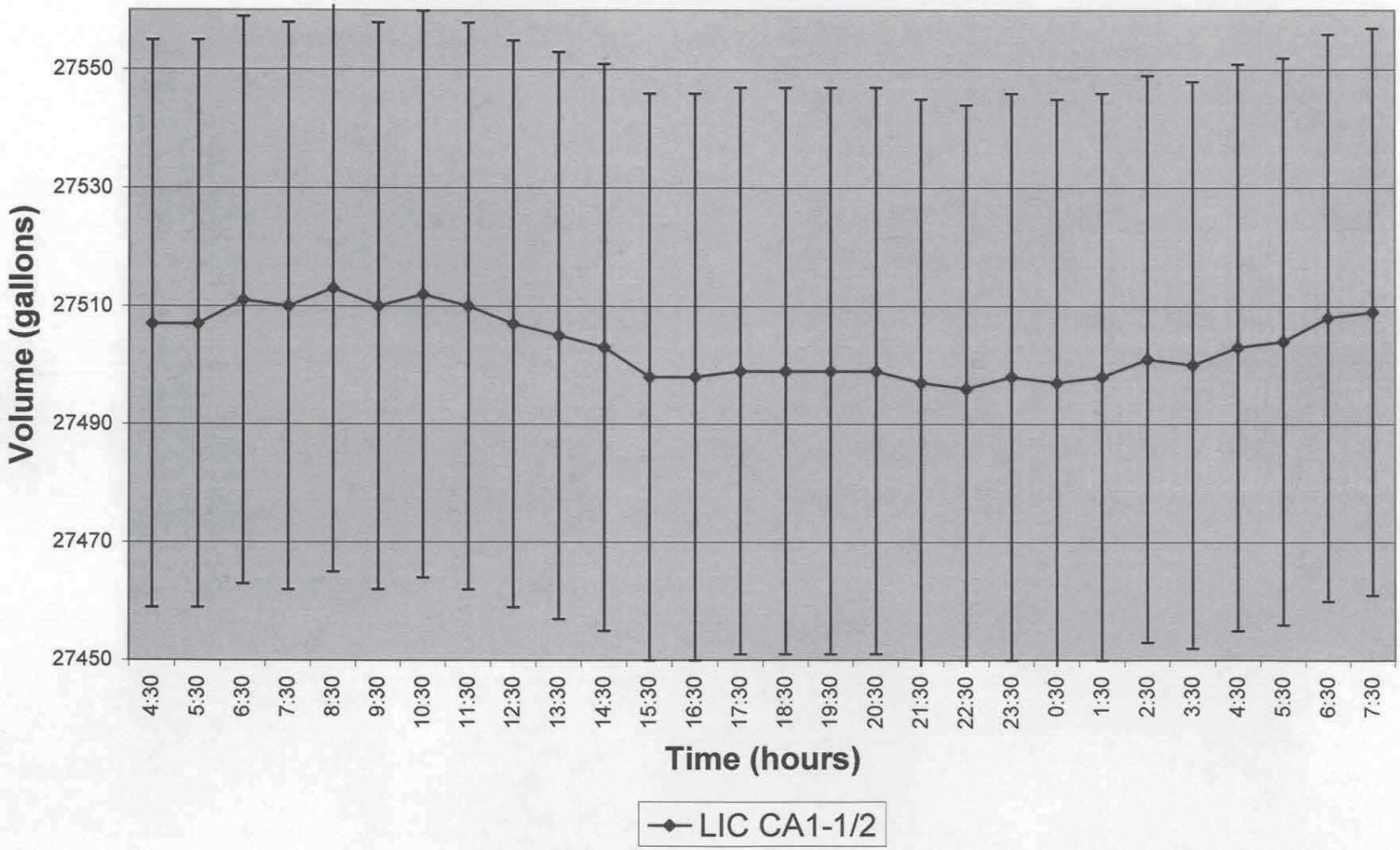
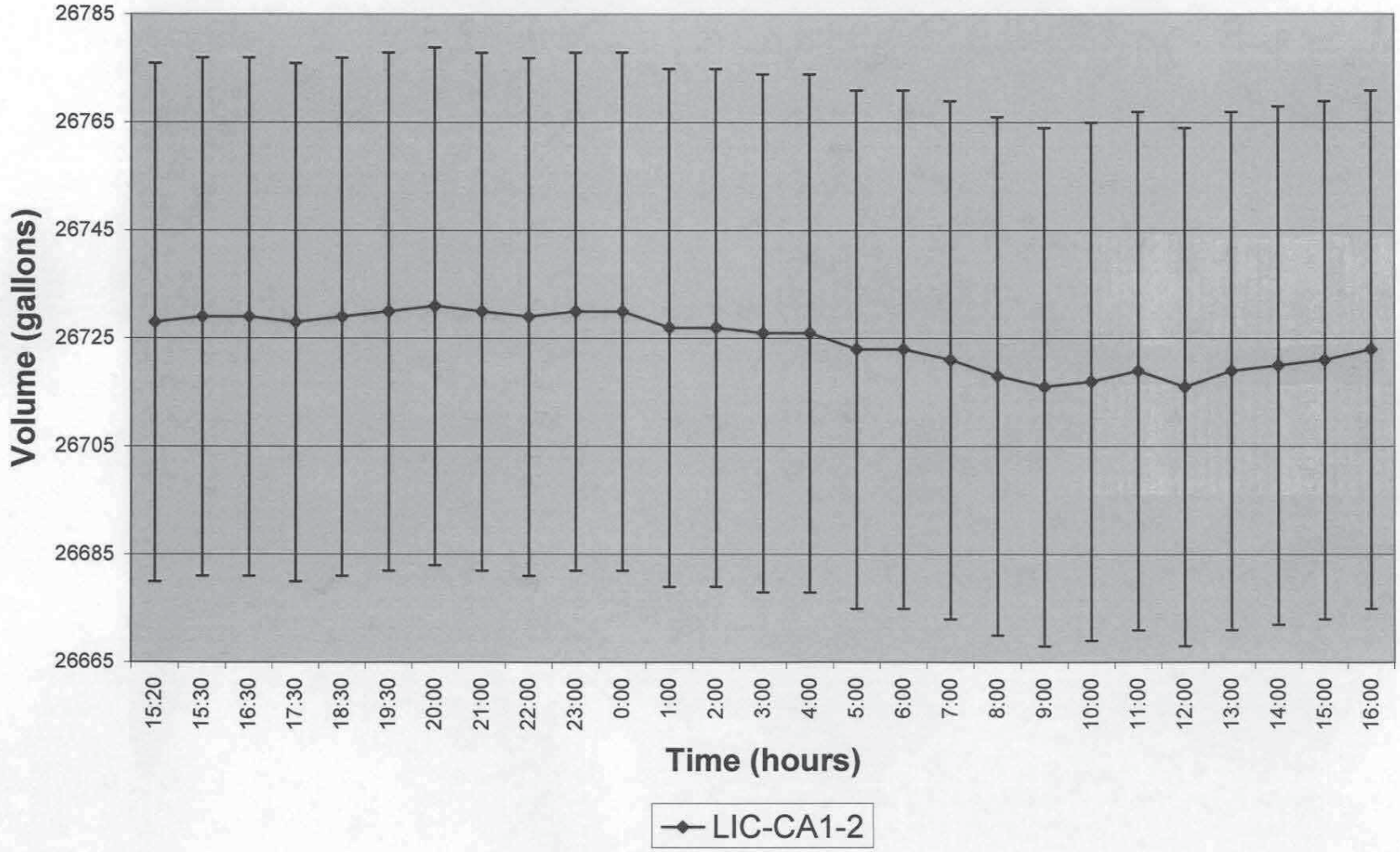


Figure 5B.3.3 - 2007 Evaporator Hold Test Showing Instrument Sensitivity



- Other properties or conditions will be determined by boundary conditions, or determined from physical property tables (i.e. steam tables, etc.), or otherwise calculated in the following sections as needed with results relevant to other sections carried forward or cross-referenced.

Boundary conditions will be changed based on actual field conditions to more accurately estimate evaporation.

Several methods to estimate evaporation losses are presented in the following section, beginning with theoretical methods and progressing through empirical methods.

5B.4.1 Langmuir's Equation

Irving Langmuir developed a way to measure vapor pressure by measuring the evaporation rate. His reasoning is that the rate at which molecules are lost due to evaporation to a gas with no partial pressure of the evaporating substance is the same as the rate at which molecules of the substance would hit the surface if it were in equilibrium with the vapor (because in equilibrium the evaporation rate and re-condensation rate cancel each other out). The theoretical equation developed by Langmuir is:

$$\frac{\Delta m}{A} = \left[P_{vp} \bullet P_a\right]\sqrt{\frac{MW}{2\pi RT}}$$; *Equation 5B.4.1.1* (Zemansky and Dittman 1981)

Where:

$\frac{\Delta m}{A}$ = (mass loss rate) / (unit area)

P_{vp} = vapor pressure of the fluid at temperature T in Pascals (Pa),

P_a = ambient vapor pressure above the fluid in Pa,

MW = molecular weight in kilograms per moles (kg/mol),

T = Temperature of the fluid in Kelvins (K)

R = the gas constant expressed as 8.314 Joules(J)/(mol K)

We be begin to calculate and solve for the values in *Equation 5B.4.1.1* by making use of known values and assumptions.

We assume an ambient temperature, T, of 68°F (20°C) (293.15K) (see boundary conditions in Section 5B.4 above).

The molecular weight, MW, of water (H2O) is 0.018 kg / mol.

The vapor pressure of water, P_{vp} at 68°F (20°C) = $\frac{lb}{ft^2}$ (2,339 Pa) (Lindeburg 1998)

Ambient partial pressure is calculated as follows:

$\phi = \frac{P_w}{P_{sat}}$; or $P_w = \phi P_{sat}$; *Equation 5B.4.1.2* (Lindeburg 1988)

Where:

Φ = Humidity ratio

P_w = Ambient Partial Pressure

P_{sat} = Saturation Pressure

Humidity at Richland, WA assumed to be 58% (typical) (see boundary conditions in Section 5B.4).

P_{sat} = 0.02339 bars (2339 Pa) at 20°C; (Moran and Shapiro 1988). We will retain this result in the following calculations.

Substituting and solving for the above values in *Equation 5B.4.1.2*, gives:

P_w = (0.58)(2339) = 1,356 Pa

We now have all the values we need for *Equation 5B.4.1.1*. By substitution, we write:

$$\frac{\Delta m}{A} = [2{,}339 - 1{,}356]\sqrt{\frac{0.018}{2\pi \cdot 8.314 \cdot 293.15}}$$

Hence, the result of *Equation 5B.4.1.1* gives an evaporation loss rate of 1.07 kg per square meter per second. This is a large rate as will soon be demonstrated. However, Langmuir's equation has the following implicit assumptions: (1) temperature of the fluid is maintained at "*T*," 68°F (20°C) in our case, at the interface and (2) the relative humidity is maintained right up to the interface. Condition (2) carries another third implicit assumption that there must be a high enough air flow rate over the water surface of concern to carry away all of the evaporating water. In a real situation, all three of the implicit assumptions required to correctly use Langmuir's equation are rarely satisfied. In fact, evaporation is a cooling process and condition (1) is actually thermodynamically impossible, so Langmuir's equation is obviously an over simplification.

To get the evaporation rate for the leak test period of 24 hours, we must apply the rate to the surface area exposed. This is assumed to be the operating level of C-A-1, at which level C-A-1 is 14 ft (4.3 m) in diameter (see boundary conditions, Section 5B.4 above):

$A = \frac{1}{4}\pi D^2$, *Equation 5B.4.1.3*

Where D = 14 ft (4.3 m)

Thus, A = 14.3 m^2 (154 ft^2). We will retain this result in the following calculations.

And we now write:

$$Evaporation\ rate\ /\ day = 1.07\frac{kg}{s \cdot m^2} \cdot 14.3m^2 \cdot \frac{3{,}600s}{h} \cdot \frac{24h}{d}$$

Or, 1,318,300 kg per day. The evaporator loops contains between 85,200 to 94,600 liters. Therefore, the predicted loss would exceed 100% (Tables 5B.4.1A [US] and 5B.4.1B [SI]). The potential effects of evaporation on Evaporator system volume and level

TABLE 5B.4.1A
Comparison of Evaporation Rate Calculations (US)

Method	Loss Flux	Flux Units[1]	Surface Area (sq feet)	Loss Flux lb/s	Total Loss (CF / day)	Total Loss (lb/day)	Total Loss in/hr	Total Loss gph	Total Loss gpd	Total Loss (inches/day)
Langmuir	1.07	kg/s*1/m^2	154	33.6	46521	2902883	151	14500	347997	3626
Dalton	108.00	cm/month	154	0.0144	20.0	1247.4952	0.0582	6.26	150	1.4
USAF	0.001	lb/min*1/ft^2	154	0.00286	3.96	247	0.0129	1.23	30	0.309
US EPA	0.944	lb/min	154	0.0157	21.8	1359	0.0708	6.79	163	1.70
US EPA, Area Correction	836	lb/min	154	13.9	19298	1204195	62.7	6015	144359	1504
Stiver and MacKay	1.33E-05	lb/s*1/ft^2	154	0.00206	2.85	178	0.00924	0.887	21	0.222
ASHRAE	0.0693	lb/h*1/ft^2	154	0.00296	4.10	256	0.0133	1.28	30.7	0.320
Boelter	2.28	lb/h	154	0.097	135	8411	0.438	42.0	1008	10.5

Notes[1]

Flux units are units that are native to the corresponding methods utilized and are used in each table, regardless of US or SI units used elsewhere.

TABLE 5B.4.1A
Comparison of Evaporation Rate Calculations (US)

Method	Loss Flux	Flux Units(1)	Surface Area (sq feet)	Loss Flux lb/s	Total Loss (CF / day)	Total Loss (lb/day)	Total Loss in/hr	Total Loss gph	Total Loss gpd	Total Loss (inches/day)
Langmuir	1.07	kg/s*1/m^2	154	33.6	46521	2902883	151	14500	347997	3626
Dalton	108.00	cm/month	154	0.0144	20.0	1247.4952	0.0582	6.26	150	1.4
USAF	0.001	lb/min*1/ft^2	154	0.00286	3.96	247	0.0129	1.23	30	0.309
US EPA	0.944	lb/min	154	0.0157	21.8	1359	0.0708	6.79	163	1.70
US EPA, Area Correction	836	lb/min	154	13.9	19298	1204195	62.7	6015	144359	1504
Stiver and MacKay	1.33E-05	lb/s*1/ft^2	154	0.00206	2.85	178	0.00924	0.887	21	0.222
ASHRAE	0.0693	lb/h*1/ft^2	154	0.00296	4.10	256	0.0133	1.28	30.7	0.320
Boelter	2.28	lb/h	154	0.097	135	8411	0.438	42.0	1008	10.5

Notes[a]

Flux units are units that are native to the corresponding methods utilized and are used in each table, regardless of US or SI units used elsewhere.

predicted by this equation is show in Figures 5B.4.1 and 5B.4.2. Clearly, this is an impossible rate for the physical situation.

Evaporation is created by a humidity gradient between the humidity near the surface of a fluid and the humidity of the surrounding air. However, as the fluid evaporates, a boundary layer of nearly 100 percent humidity air is created just above the surface. This slows down the rate since the rate of evaporation is proportional to the difference between the vapor pressure and the partial pressure of the fluid. The transport mechanism removing the water from the surface of the fluid is diffusion through air, which also limits the rate of evaporation. Further, as the fluid evaporates, the partial pressure of the fluid over the surface is nearly equal to the fluid below and drops off in a gradient away from the surface. The steepness of the gradient depends on air flow rate above the fluid, as well as temperature. These effects, taken together, are non-linear and are not reliably predictable by theoretical equations. Rigorous, complex computer algorithms have been developed that account for these effects (for instance, Lee and Dalpiaz). However, these algorithms can be cumbersome. Further, while more accurate predictions may be made detailed knowledge of multiple parameters (i.e. boundary layer conditions) is required. Several relatively simple empirical equations have been developed, beginning with the earliest, Dalton's Law, which can provide useful estimates of evaporation.

5B.4.2 Dalton's Law

Most empirical equations are in the form of Dalton's Law, who proposed the following simple equation in 1802:

$E = f(u) \cdot (e_s - e_a)$; *Equation 5B.4.2.1*

f(u) is a function of air speed and height of above the water surface. *Equation 5B.3.1* can be estimated as

$E = a \cdot (e_s - e_a)$ *Equation 5B.4.2.2*;

Where

E = Free water surface evaporation (cm per month),

e_s = the saturation vapor pressure at the temperature of the water surface, millibars (mbar) (equivalent to P_s above or 23.39 mbar)

e_a = the vapor pressure in the air; the term e_a is also equal to the saturation vapour pressure at the dew point temperature (equivalent to P_w above or 1,356 mbar).

a = 5 for small, shallow water, and

a =11 for large deep water, Singh and Xu (1997).

However, additional sources (Ohio University 2004) recommend calculating the vapor pressure deficit term (e_s-e_a) in *Equation 5B.4.2.2* above, by estimating saturation vapor pressure e_s, in kilo Pascals (kPa), as follows:

$e_s = e^{\left[\frac{16.78T - 116.9}{T + 237.3}\right]}$; *Equation 5B.4.2.3*

Figure 5B.4.1 - Potential Evaporation Effects (Volumetric)

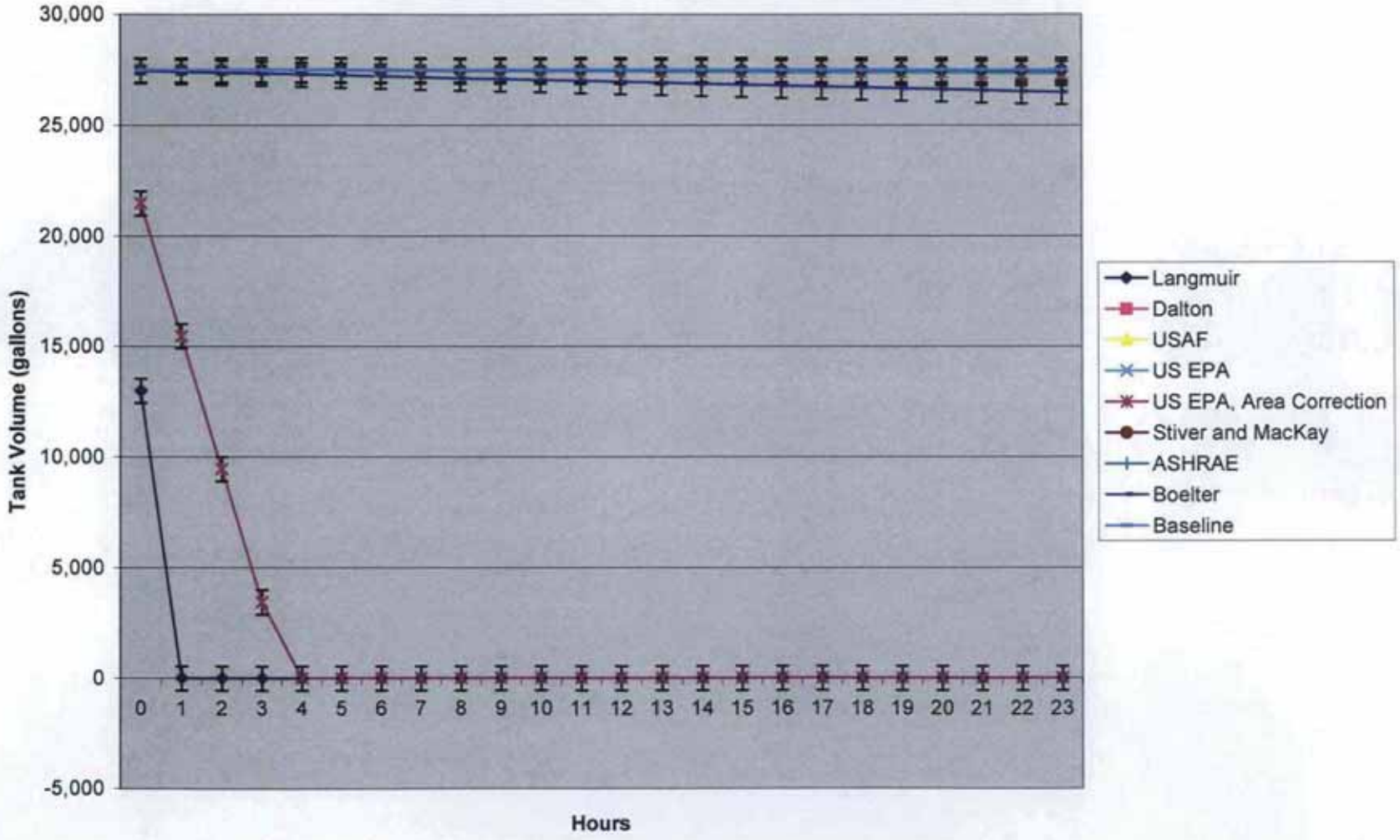
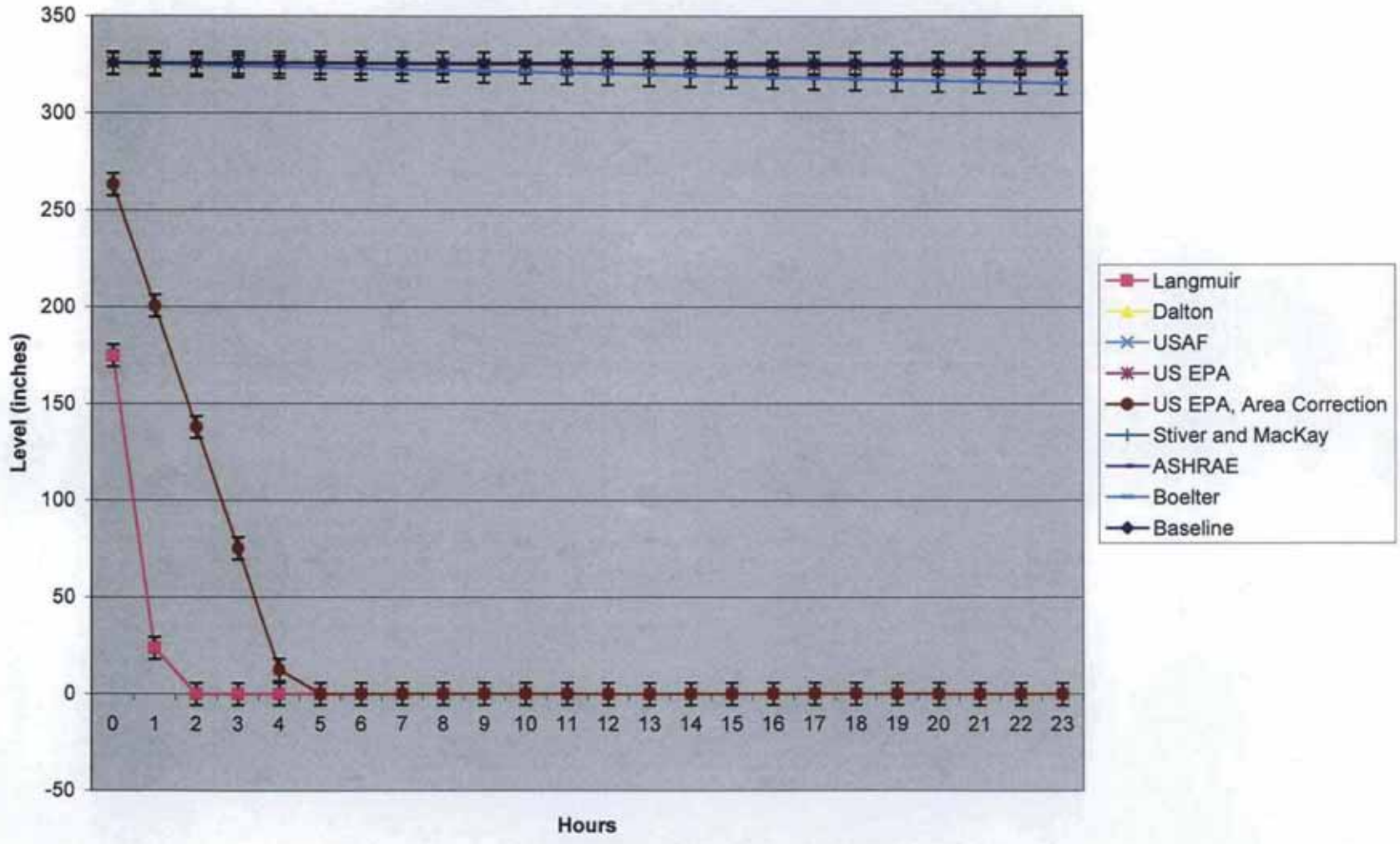


Figure 5B.4.2 - Potential Evaporation Effects (Level)



And estimating actual vapor, e_a, as:

$$e_a = e_s \frac{RH}{100}; \textit{ Equation 5B.4.2.4}$$

And where

T = is the temperature, in Celsius, and

RH = the relative humidity (percent)

For saturation vapor pressure, we solve *Equation 5B.4.2.3* as follows:

$$e_s = e^{\left[\frac{16.78 \cdot 20 - 116.9}{20 + 237.3}\right]}$$

And we solve *Equation 5B.4.2.4* as follows:

$$e_a = e_s \frac{RH}{100}$$

Thus, e_s is 2.34 kPa or 23.4 mbar and e_a is 13.6 mbar. This pressure is essentially identical to what is found by looking up this value in steam tables (see Section 5B.4.1). So, equations ,are, in fact, good estimates.

We have all the terms we need for *Equation 5B.4.2.2*, so we write:

$E = 11 \cdot (23.4 - 13.6)$, assuming that for Dalton's Law (generally concerning large water bodies) that a small value for a is appropriate.

Thus, the evaporation rate, E, is 108 centimeters per month, in the common units of Dalton's equation (Tables 5B.4.1A and 5B.4.1B, US and SI units). The potential effects of evaporation on Evaporator system volume and level predicted by this equation is show in Figures 5B.4.1 and 5B.4.2.

5B.4.3 United States Air Force Empirical Evaporation Equations

The United States Air Force developed the following equations for predicting the rate at which liquid evaporates from the surface of a pool of liquid which is at or near the ambient temperature. The equations were derived from field tests performed by the U.S. Air Force with pools of liquid hydrazine. http://www.air-dispersion.com/usource.html#Non-Boiling%20Liquid%20Pool

$$E = \left(4.66X10^{-6}\right) \cdot U^{0.75} \cdot T_F \cdot MW \cdot \left(\frac{P_S}{P_H}\right); \textit{ Equation 5B.4.3.1}$$

Where

E = evaporation flux, $\frac{lb}{\min}$ per ft^2 of pool surface

u = windspeed just above the liquid surface, $\frac{miles}{hour}$

T_A = ambient temperature, K

T_F = pool liquid temperature correction factor

T_P = pool liquid temperature, °F

MW = pool liquid molecular weight

P_S = pool liquid vapor pressure at ambient temperature, mmHg

P_H = hydrazine vapor pressure at ambient temperature, mmHg

If T_P is 32°F or less, then $T_F = 1.0$

If $T_P > 32$°F, then $T_F = 1.0 + 0.00133\ (T_P - 32)^2$; *Equation 5B.4.3.2*

$$P_H = 760 \cdot e^{\left[65.3319 - \left(\frac{7245}{T_A}\right) - (8.22 \cdot \ln T_A) + (6.1557 X 10^{-3}) T_A\right]}$$; *Equation 5B.4.3.3*

We be begin to calculate and solve for the values in *Equation 5B.4.3.1* by making use of known values and assumptions.

We assume an ambient temperature, T_A, of 68°F (20°C) (293.15K), as before.

The molecular weight, MW, of water (H2O) is 18 grams / mol.

We assume the temperature of the pool is also 68°F.

The vapor pressure of water, P_S at 68°F (20°C) = 17.56 mmHg (Lindeburg 1998).

We must substitute and solve *Equations 5B.4.2.2* and *5B.4.2.3* prior to *5B.4.3.1*, so we write:

For *Equation 5B.3.2.2*, $T_P > 32$°F, then $T_F = 1.0 + 0.00133\ (68 - 32)^2$

So, $T_F = 2.724$°F

For *Equation 5B.4.2.3*,

$$P_H = 760 \cdot e^{\left[65.3319 - \left(\frac{7245}{293.15}\right) - (8.22 \cdot \ln 293.15) + (6.1557 X 10^{-3}) 293.15\right]}$$

So, P_H =10.60 mmHg

However, the airflow over the water in C-A-1 is still needed (i.e. a value for U). The Facility RCRA permit (WA7890008967) states that:

> During waste processing, the airflow is about 20.5 cubic meters per minute, with about 4.3 cubic meters per minute ventilated from tank C-100 and the remainder from the vapor-liquid separator and air inleakage.

This leaves approximately 16.2 cubic meters per minute ventilated from C-A-1. Using the following relationship:

$Q = VA$, or $V = \frac{Q}{A}$; *Equation 5B.4.3.4*

Where

Q = volumetric flow rate (m_3/min)

V = velocity (m/s); and

A = Area (m_2).

The area is already known to be 14.3 m^2 (see Section 5B.4). We write the following,

$$V = \frac{16.2}{14.3m^2} \cdot \frac{m^3}{\min} \cdot \frac{\min}{60s}$$

So, V is 1.888 meters per second or 4.22 mph.

And now, inserting these values into *Equation 5B.4.3.1*, we may write,

$$E = \left(4.66X10^{-6}\right) \cdot 4.22^{0.75} \cdot 2.724 \cdot 18 \cdot \left(\frac{17.56}{10.59}\right)$$

Thus, our evaporation flux, using the USAF formulas, is $1.11X10^{-3} \frac{lb}{\min}$ per ft^2 of fluid surface or 0.1716 pounds per minute from the surface of C-A-1. The total lost over 24 hours is then:

$$Evaporation\ rate\ /\ day = 0.0011 \frac{lb}{\min \cdot ft^2} \cdot 154\, ft^2 \cdot \frac{60 \min}{h} \cdot \frac{24h}{d}$$

Or 247 lb lost per day due to evaporation (Tables 5B.4.1A and 5B.4.1B, US and SI units). The potential effects of evaporation on Evaporator system volume and level predicted by this equation is show in Figures 5B.4.1 and 5B.4.2.

5B.4.4 United States EPA

The following equations are for predicting the rate at which liquid evaporates from the surface of a pool of liquid which is at or near the ambient temperature. The equations were developed by the United States Environmental Protection Agency (U.S. EPA). http://www.air-dispersion.com/usource.html#Non-Boiling%20Liquid%20Pool

$$E = \frac{0.284 \cdot U^{0.78} \cdot MW \cdot A \cdot P}{RT}; \textit{Equation 5B.4.4.1}$$

Where:

E = evaporation rate, lb / minute

U = windspeed just above the pool liquid surface, m / second (calculated as 1.888 m/s above)

MW = molecular weight of the pool liquid (18 g/mol for water)

A = surface area of the pool liquid, ft^2 (154 square feet)

P = vapor pressure of the pool liquid at the pool temperature, mm Hg (17.56 mmHg)

T = pool liquid temperature, K (assumed to be 293.15K)

R = the Universal Gas Law constant expressed as 82.05 (atm * cm^3) / (gmol · °K)

The U.S. EPA also defined the pool depth as 0.033 ft (i.e., 1 cm) so that the surface area of the pool liquid could be calculated as:

A = (cubic feet of pool liquid) / (0.033 ft); *Equation 5B.4.4.2*

However, for deep pools, including the relation in *Equation 5B.4.4.2* predicts large evaporation rates (see below and Tables 5B.4.1A and 5B.4.1B, US and SI units).

Since we know all the values we need for *Equation 5B.4.4.1*, substituting into this equation, we write:

$$E = \frac{0.284 \cdot 1.888^{0.78} \cdot 18 \cdot 154 \cdot 17.56}{82.05 \cdot 293.15}$$

Giving an evaporation flux of 0.944 pounds per minute and 1,359 pounds per day lost by evaporation. (Tables 5B.4.1A and 5B.4.1B, US and SI units).

Returning to *Equation 5B.4.4.2*, the volume of C-A-1, at the typical operating level, is 2,660 cubic feet. Applying the divisor of 0.033 ft as required by *Equation 5B.4.4.2*, the area becomes 81,076 square feet and the resulting evaporative flux is 836 pounds per minute (Tables 5B.4.1A and 5B.4.1B, US and SI units). It is likely that the area correction factor is incorrect or misapplied to the equation. The potential effects of evaporation on Evaporator system volume and level predicted by this equation is show in Figures 5B.4.1 and 5B.4.2.

5B.4.5 Stiver and Mackay

The following equations are for predicting the rate at which liquid evaporates from the surface of a pool of liquid which is at or near the ambient temperature. The equations were developed by Warren Stiver and Dennis Mackay of the Chemical Engineering Department at the University of Toronto. http://www.air-dispersion.com/usource.html#Non-Boiling%20Liquid%20Pool

$$E = \frac{k \cdot P \cdot MW}{RT_A}$$; *Equation 5B.4.5.1*; and

$k = 0.00293\ U$; *Equation 5B.4.5.2*

Where

E = evaporation flux, (lb / s) / ft 2 of pool surface,

k = mass transfer coefficient, ft / s,

T_A = ambient temperature, °R (assumed to be 527.7°R),

MW = pool liquid molecular weight (18 g/mol for water),

P = pool liquid vapor pressure at ambient temperature, mmHg (17.56 mmHg, from above),

R = the Universal Gas Law constant = 555 (mmHg * ft 3) / (lbmol * °R),

U = wind speed just above the liquid surface, miles / hour (4.22 mph, from above),

We have only to calculate k from the simple relationship of *Equation 5B.4.5.2*. However, U is known, so, substituting for k into *Equation 5B.5.1*, we write,

$$E = \frac{0.00293 \cdot 4.22 \cdot 17.56 \cdot 18}{555 \cdot 527.7}$$

Thus, E, our evaporation flux, is $1.33X10^{-5}$ pounds per second per square foot of surface area or 2.06 pounds per second (utilizing the previously calculated surface area of 154 square feet). Thus the total loss by evaporation is 178 pounds per day (Tables 5B.4.1A and 5B.4.1B, US and SI units). The potential effects of evaporation on Evaporator system volume and level predicted by this equation is show in Figures 5B.4.1 and 5B.4.2.

5B.4.6 American Society of Heating, Refrigeration and Air-conditioning Engineers

American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) provides the most commonly used equation for estimating evaporation loss in the following equation:

$$W = \frac{[A + B \cdot V](P_W - P_a)}{H_V}; \textit{Equation 5B.4.6.1}$$

Where

W = water evaporation rate, (lb/hr) per sq.ft. of pond surface area

A = a constant = 95

B = a constant = 37.4

V = air velocity over the pond surface, miles/hr (4.22 mph, from above)

P_w = vapor pressure of water at the pond water temperature, inHg (17.56 mmHg or 0.6913 inHg, from above)

P_a = vapor pressure of water at the air dewpoint temperature, inHg

H_v = heat of vaporization of water at the pond water temperature, Btu/lb

We have only to find P_a and H_v.

We calculate P_a using *Equation 5B.4.1.2* or (*Equation 5B.4.2.4*) with slightly different terms, as in Section 5B.2.1:

$$P_a = \phi P_w; \textit{Equation 5B.4.6.2}$$

And so we write:

$$P_a = 0.58 \cdot 0.6913$$

So, P_a = 0.40095 inHg

H_v is 1,059.6 Btu/lb at 68°F (Moran and Shapiro 1988).

Substituting into *Equation 5B.4.6.1*, we write,

$$W = \frac{[95 + 37.4 \cdot 4.22](0.6913 - 0.40095)}{1{,}059.6}$$

Thus, the water loss rate, W, is 0.0693 pounds per hour per square foot, or 10.7 pounds per hour. A total loss of 256 pounds per day is predicted by the ASHRAE equation (Tables 5B.4.1A and 5B.4.1B, US and SI units). The potential effects of evaporation on Evaporator system volume and level predicted by this equation is show in Figures 5B.4.1 and 5B.4.2.

5B.4.7 Boelter's Equation

Another commonly used equation to predict evaporation rates, especially from tanks, is Boelter's equation. Boelter et al (1946) developed the following equation to predict the amount of the water vapor transferred from a pure water surface to the bulk air based on the experimental data.

$W = 0.00129 \cdot A \cdot (P_i - P_b)^{1.22}$; *Equation 5B.4.7.1*

Where:

W = Amount of water vapor transferred (lb/hr)

A = surface area (ft2), (154 square feet, from above)

P_i = surface water vapor pressure (mm Hg) (17.56 mmHg from above)

P_b = bulk phase water vapor pressure (mm Hg) (10.18 mmHg from above)

We apply these values to the Boelter equation and write:

$$W = 0.00129 \cdot 154 \cdot (17.56 - 10.18)^{1.22}$$

Thus, the evaporation flux rate is 2.28 pounds per hour or a total loss rate of 54.7 pounds through evaporation (Tables 5B.4.1A and 5B.4.1B, US and SI units). The potential effects of evaporation on Evaporator system volume and level predicted by this equation is show in Figures 5B.4.1 and 5B.4.2.

It should be noted that the validity of applying the Boelter equation to large tanks has been questioned, since Boelter et al developed the empirical equation based on experimental data using a small pan (Young and Lee 2003).

5B.5 THERMAL EXPANSION

It is desired to determine what effects thermal expansion and/or contraction may have during the Vapor-Liquid Separator Leak Test/Hold Test. Calculations of this rate could be used to separate any losses from the Loop caused by evaporation from losses caused by leaks during the hold test period.

The following boundary conditions and assumptions are relevant for each of the following calculations and for each test campaign analyzed:

- The level of C-A-1 will initially be at the typical operating level of C-A-1, 721'2" (H-2-69328, H-2-69340, and other USDOE drawings),

- The diameter of C-A-1 is 14 feet (ft) or 4.3 meters (m) at this location (H-2-69328, H-2-69340, other USDOE drawings, and WA7890008967),
- The test fluid in C-A-1 is assumed to be pure water,
- Humidity at Richland, WA assumed to be 58% (typical) http://weather.msn.com/local.aspx?wealocations=wc:USWA0373; and
- Other properties or conditions will be determined by boundary conditions, or determined from physical property tables (i.e. steam tables, etc.), or otherwise calculated in the following sections as needed with results relevant to other sections carried forward or cross-referenced.

Thermal expansion is calculated by the following equation:

$\Delta V = V_0 \beta (T_2 - T_1)$; *Equation 5B.5.1*

Where

ΔV = change in volume,

V_0 = initial volume,

β = Bulk coefficient of thermal expansion,

T_1 = initial temperature, and

T_2 = final temperature

And

$\beta = 3\alpha$

Where

α = Liner coefficient of thermal expansion

The linear thermal coefficient of thermal expansion for stainless steel (α) is commonly $9.6X10^{-6}$/°F, giving a bulk coefficient of expansion (β) of $2.9X10^{-5}$/°F (Perry's 1984).

The bulk thermal coefficient of thermal expansion for water varies significantly by temperature (see Table 5B.5.1, US and SI units).

5B.5.1 1993 Test

There is no apparent sinusoidal pattern in the hold test data collected in 1993. Therefore, attempting to determine whether thermal expansion was a factor in these data was not attempted. Given the disruption of 1993 data by the step drop mid-test (see Figure 5B.2.1 and Section 5B.2.1), it is possible that this effect may have been observed had this not occurred. However, it is indicated that level indicating instrumentation may have been less sensitive in 1993 (sensitive to +/- 550 gallons vs +/- 48 for the 1998 and 2007 tests), so it is also possible, if not probable that small changes observed either would not have been detected during this test or would have been masked by larger variations in level measurement.

5B.5.2 1998 Test

The 1998 IAR (USDOE 1998) described a gain and loss in the volume of the Vapor-Liquid Separator Loop that were described as within the operating range of the level measuring equipment and attributable to minor temperature fluctuations during the test. The system measured a gain of 5 gallons and a loss of 11 gallons during the test (Table 5B.2.2, US and SI units).

The volume fluctuations observed in 1998 are shown in Figure 5B.2.2. These fluctuations most nearly follow a sinusoidal pattern. A likely explanation is thermal expansion and contraction caused by diurnal temperature fluctuations. To test this explanation, the following analysis was performed.

Thermal expansion is largely contingent upon the temperature of the fluid. (Typically, fluid expansion coefficients are much higher than that of the enclosure. Since water is the working fluid of the hold test, the thermal expansion coefficient is much higher than that of the shell of the evaporator and this assumption holds.) However, neither ambient nor C-A-1 temperatures were recorded during the previous hold test. Volume data were recorded hourly as gallons. Concerning water, the volumetric coefficient of expansion is temperature dependent (Table 5B.5.2.1, US and SI units). This material property, together with an iterative approach, was used to determine the most likely conditions of the water in the evaporator loop during the hold test. Tables 5B.5.2.2A and 5B.5.2.2B show initial conditions attempted for loop fill water (50°F and 68°F or 10°C, and 20°C). Figure 5B.5.2.1 shows the various expansion and contraction curves predicted by these initial conditions. It can be seen that the 68°F (20°C) condition best matches actual conditions. From this, an idealized sinusoidal temperature distribution (Table 5B.5.2.3, US and SI units) and inferred CA1 temperature curve (Figure 5B.5.2.2) were predicted. However, using this curve directly resulted in incorrectly predicting volumetric expansion. The best fit to actual volumetric data was another diurnal 6 hours out of phase from the idealized curve (Table 5B.5.2.3) and ("Idealized Curve," Figure 5B.5.2.1). This result was arrived at by matching the volumetric output.

The 68°F (20°C) prediction and idealized curve on Figure 5B.5.2.1 show excellent agreement to actual data, albeit these deviations are small. Arguably, such behavior is, perhaps, attributable to instrument drift, as postulated in the 1993 hold test, however, the above analysis show that the data seem to best fit a 24 hour periodic fluctuation. Such a fluctuation is best explained by external temperature effects (such diurnal temperature cycles) or some other daily phenomena. Therefore, it is most likely that the volume fluctuations observed in 1998 were either caused by diurnal temperature fluctuations or some other daily phenomena associated with a 24 hour period or cycle. However, these affects have been of small magnitude, less than 17 gallons, and therefore within known accuracy of level sensing instrumentation (+/- 48 gallons). Therefore, the actual magnitude of these fluctuations is not likely to be accurately represented by the current sensors due to their small magnitude (i.e. the temperature effects are represented qualitatively rather than quantitatively).

5B.5.3 2007 Test – C-A-1

Analyses similar to those performed in Section 5B.5.2 were performed on 2007 data. Sinusoidal forcing functions presumed to be diurnal temperature fluctuations similar to

TABLE 5B.5.2.1
Coefficients of Thermal Expansion of Water

°C	°F	α (SI) 1μm/(m°C)	β (SI) 1μm³/(m³°C)	α (US) 1/°F	β (US) 1/°F
0	32	-23.1	-69.3	-1.28333E-05	-0.0000385
1	33.8	-50	-150	-2.77778E-05	-8.33333E-05
4	39.2	0	0	0	0
10	50	29.3	88	1.63E-05	4.88E-05
20	68	69	207	3.83E-05	1.15E-04
30	86	101	303	5.61E-05	1.68E-04
40	104	128	385	7.12963E-05	2.14E-04
50	122	153	457	8.50E-05	2.55E-04
100	212	250	750	1.39E-04	4.17E-04

Sources:

CRC Handbook of Chemistry and Physics, David R. Lide, Ed. 79th Edition, CRC Press, Boca Raton, FL, 1998.

CRC Handbook of Chemistry and Physics, Robert C. Weast, Ed. 62 Edition, CRC Press, Boca Raton, FL, 1981.

TABLE 5B.5.2.2A
1998 Hold Test
Modeled and Actual Diurnal Temperatures and Volumetric Expansions (US)

Actual Data					68°F Iteration					50°F Iteration					Idealized					Actual		Predicted	
Date	Time	Level (gal)	Level (CF)	Actual ΔV (gal)	Derived ΔT (°F)	Predicted T (°F)	Recalculated Bulk Coeff (β) (1/°F)	Predicted ΔV (gal)	Predicted Level (gal)	Derived ΔT (°F)	Predicted T (°F)	Recalculated Bulk Coeff (β) (1/°F)	Predicted ΔV (gal)	Predicted Level (gal)	Predicted T (°F)	Bulk Coeff (β) (1/°F)	Predicted ΔV (gal)	Predicted Level (gal)	Heat Change (Btu)	Actual Height in Evap Loop (inches)	Net Rise/Fall C-A-1 (inch)	Predicted Height in Evap Loop (inches)	Net Rise/Fall C-A-1 (inch)
6/1/1998	4:30	27507	3677.2	0	0.0000	68.00	1.15E-04	0.00	27507.0		50.0	4.88E-05	0.00	27507.0	64.72	1.05E-04				286.5	0.00		
6/1/1998	5:30	27507	3677.2	0	0.0000	68.00	1.15E-04	0.00	27507.0	0.0000	50.0	4.88E-05	0.00	27507.0	65.07	1.06E-04	1.02	27508.0	60.83	286.5	0.00	286.6	-0.031
6/1/1998	6:30	27511	3677.7	4	1.2645	69.26	1.19E-04	4.13	27511.1	2.9778	53.0	5.98E-05	4.90	27511.9	65.57	1.08E-04	1.47	27508.5	86.03	286.6	0.04	286.6	-0.035
6/1/1998	7:30	27510	3677.6	3	0.9484	68.95	1.18E-04	3.07	27510.1	2.2334	52.2	5.70E-05	3.50	27510.5	66.17	1.10E-04	1.83	27508.8	105.36	286.6	0.03	286.6	-0.039
6/1/1998	8:30	27513	3678.0	6	1.8968	69.90	1.21E-04	6.29	27513.3	4.4668	54.5	6.53E-05	8.02	27515.0	66.85	1.12E-04	2.07	27509.1	117.51	286.6	0.06	286.6	-0.042
6/1/1998	9:30	27510	3677.6	3	0.9484	68.95	1.18E-04	3.07	27510.1	2.2334	52.2	5.70E-05	3.50	27510.5	67.55	1.14E-04	2.19	27509.2	121.66	286.6	0.03	286.6	-0.043
6/1/1998	10:30	27512	3677.8	5	1.5806	69.58	1.20E-04	5.20	27512.2	3.7223	53.7	6.25E-05	6.40	27513.4	68.23	1.16E-04	2.15	27509.2	117.51	286.6	0.05	286.6	-0.042
6/1/1998	11:30	27510	3677.6	3	0.9484	68.95	1.18E-04	3.07	27510.1	2.2334	52.2	5.70E-05	3.50	27510.5	68.83	1.17E-04	1.96	27509.0	105.36	286.6	0.03	286.6	-0.040
6/1/1998	12:30	27507	3677.2	0	0.0000	68.00	1.15E-04	0.00	27507.0	0.0000	50.0	4.88E-05	0.00	27507.0	69.33	1.19E-04	1.62	27508.6	86.03	286.5	0.00	286.6	-0.037
6/1/1998	13:30	27505	3676.9	-2	-0.6323	67.37	1.13E-04	-1.96	27505.0	-1.4889	48.5	4.21E-05	-1.72	27505.3	69.68	1.20E-04	1.15	27508.2	60.83	286.5	-0.02	286.6	-0.032
6/1/1998	14:30	27503	3676.6	-4	-1.2645	66.74	1.10E-04	-3.84	27503.2	-2.9778	47.0	3.54E-05	-2.90	27504.1	69.86	1.22E-04	0.61	27507.6	31.49	286.5	-0.04	286.6	-0.026
6/1/1998	15:30	27498	3675.9	-9	-2.8451	65.15	1.05E-04	-8.18	27498.8	-6.7001	43.3	1.85E-05	-3.42	27503.6	69.86	1.22E-04	0.00	27507.0	0.00	286.4	-0.09	286.6	-0.020
6/1/1998	16:30	27498	3675.9	-9	-2.8451	65.15	1.05E-04	-8.18	27498.8	-6.7001	43.3	1.85E-05	-3.42	27503.6	69.68	1.21E-04	-0.60	27506.4	-31.49	286.4	-0.09	286.5	-0.014
6/1/1998	17:30	27499	3676.1	-8	-2.5290	65.47	1.06E-04	-7.35	27499.6	-5.9557	44.0	2.19E-05	-3.59	27503.4	69.33	1.20E-04	-1.15	27505.8	-60.83	286.4	-0.08	286.5	-0.008
6/1/1998	18:30	27499	3676.1	-8	-2.5290	65.47	1.06E-04	-7.35	27499.6	-5.9557	44.0	2.19E-05	-3.59	27503.4	68.83	1.18E-04	-1.61	27505.4	-86.03	286.4	-0.08	286.5	-0.003
6/1/1998	19:30	27499	3676.1	-8	-2.5290	65.47	1.06E-04	-7.35	27499.6	-5.9557	44.0	2.19E-05	-3.59	27503.4	68.23	1.16E-04	-1.93	27505.1	-105.36	286.4	-0.08	286.5	0.000
6/1/1998	20:30	27499	3676.1	-8	-2.5290	65.47	1.06E-04	-7.35	27499.6	-5.9557	44.0	2.19E-05	-3.59	27503.4	67.55	1.13E-04	-2.11	27504.9	-117.51	286.4	-0.08	286.5	0.002
6/1/1998	21:30	27497	3675.8	-10	-3.1613	64.84	1.03E-04	-8.99	27498.0	-7.4446	42.6	1.52E-05	-3.11	27503.9	66.85	1.11E-04	-2.13	27504.9	-121.66	286.4	-0.10	286.5	0.002
6/1/1998	22:30	27496	3675.7	-11	-3.4774	64.52	1.02E-04	-9.78	27497.2	-8.1890	41.8	1.18E-05	-2.66	27504.3	66.17	1.08E-04	-2.01	27505.0	-117.51	286.4	-0.11	286.5	0.001
6/1/1998	23:30	27498	3675.9	-9	-2.8451	65.15	1.05E-04	-8.18	27498.8	-6.7001	43.3	1.85E-05	-3.42	27503.6	65.57	1.06E-04	-1.77	27505.2	-105.36	286.4	-0.09	286.5	-0.002
6/2/1998	0:30	27497	3675.8	-10	-3.1613	64.84	1.03E-04	-8.99	27498.0	-7.4446	42.6	1.52E-05	-3.11	27503.9	65.07	1.04E-04	-1.42	27505.6	-86.03	286.4	-0.10	286.5	-0.005
6/2/1998	1:30	27498	3675.9	-9	-2.8451	65.15	1.05E-04	-8.18	27498.8	-6.7001	43.3	1.85E-05	-3.42	27503.6	64.72	1.03E-04	-0.99	27506.0	-60.83	286.4	-0.09	286.5	-0.010
6/2/1998	2:30	27501	3676.3	-6	-1.8968	66.10	1.08E-04	-5.64	27501.4	-4.4668	45.5	2.86E-05	-3.52	27503.5	64.54	1.02E-04	-0.51	27506.5	-31.49	286.5	-0.06	286.5	-0.015
6/2/1998	3:30	27500	3676.2	-7	-2.2129	65.79	1.07E-04	-6.50	27500.5	-5.2112	44.8	2.53E-05	-3.62	27503.4	64.54	1.02E-04	0.00	27507.0	0.00	286.5	-0.07	286.6	-0.020
6/2/1998	4:30	27503	3676.6	-4	-1.2645	66.74	1.10E-04	-3.84	27503.2	-2.9778	47.0	3.54E-05	-2.90	27504.1	64.72	1.05E-04	0.52	27507.5	31.49	286.5	-0.04	286.6	-0.025
6/2/1998	5:30	27504	3676.7	-3	-0.9484	67.05	1.12E-04	-2.91	27504.1	-2.2334	47.8	3.87E-05	-2.38	27504.6	65.07	1.06E-04	1.02	27508.0	60.83	286.5	-0.03	286.6	-0.031
6/2/1998	6:30	27508	3677.3	1	0.3161	68.32	1.16E-04	1.01	27508.0	0.7445	50.7	5.16E-05	1.06	27508.1	65.57	1.08E-04	1.47	27508.5	86.03	286.5	0.01	286.6	-0.035
6/2/1998	7:30	27509	3677.4	2	0.6323	68.63	1.17E-04	2.03	27509.0	1.4889	51.5	5.43E-05	2.22	27509.2	66.17	1.10E-04	1.83	27508.8	105.36	286.6	0.02	286.6	-0.039

TABLE 5B.5.2.2B
1998 Hold Test
Modeled and Actual Diurnal Temperatures and Diurnal Expansions (SI)

Actual Data					20°C Iteration					10°C Iteration					Idealized					Actual		Predicted	
Date	Time	Level (Liters)	Level (m^3)	Actual ΔV (Liters)	Derived ΔT (°C)	Predicted T (°C)	Recalculated Bulk Coeff (β) (1/°C)	Predicted ΔV (Liters)	Predicted Level (Liters)	Derived ΔT (°C)	Predicted T (°C)	Recalculated Bulk Coeff (β) (1/°C)	Predicted ΔV (Liters)	Predicted Level (Liters)	Predicted T (°C)	Bulk Coeff (β) (1/°C)	Predicted ΔV (Liters)	Predicted Level (Liters)	Heat Change (KJ)	Actual Height in Evap Loop (cm)	Net Rise/Fall C-A-1 (cm)	Predicted Height in Evap Loop (cm)	Net Rise/Fall C-A-1 (cm)
6/1/1998	4:30	104125	104.1	0	0.00	20.0	2.07E-04	0.00	104125.3	0.00	10.0	8.79E-05	0.00	104125.3	18.2	1.90E-04				727.8	0.00		
6/1/1998	5:30	104125	104.1	0	0.00	20.0	2.07E-04	0.00	104125.3	0.00	10.0	8.79E-05	0.00	104125.3	18.4	1.91E-04	3.87	104129	64.18	727.8	0.00	728	-0.078
6/1/1998	6:30	104140	104.1	15	0.70	20.7	2.14E-04	15.63	104141.0	1.65	11.7	1.08E-04	18.54	104143.9	18.6	1.94E-04	5.56	104131	90.76	727.9	0.11	728	-0.089
6/1/1998	7:30	104137	104.1	11	0.53	20.5	2.12E-04	11.63	104137.0	1.24	11.2	1.03E-04	13.27	104138.6	19.0	1.97E-04	6.92	104132	111.16	727.9	0.08	728	-0.099
6/1/1998	8:30	104148	104.1	23	1.05	21.1	2.17E-04	23.82	104149.1	2.48	12.5	1.17E-04	30.35	104155.7	19.4	2.01E-04	7.85	104133	123.98	727.9	0.16	728	-0.105
6/1/1998	9:30	104137	104.1	11	0.53	20.5	2.12E-04	11.63	104137.0	1.24	11.2	1.03E-04	13.27	104138.6	19.7	2.05E-04	8.28	104134	128.36	727.9	0.08	728	-0.108
6/1/1998	10:30	104144	104.1	19	0.88	20.9	2.15E-04	19.69	104145.0	2.07	12.1	1.13E-04	24.23	104149.6	20.1	2.08E-04	8.14	104133	123.98	727.9	0.13	728	-0.107
6/1/1998	11:30	104137	104.1	11	0.53	20.5	2.12E-04	11.63	104137.0	1.24	11.2	1.03E-04	13.27	104138.6	20.5	2.11E-04	7.41	104133	111.16	727.9	0.08	728	-0.102
6/1/1998	12:30	104125	104.1	0	0.00	20.0	2.07E-04	0.00	104125.3	0.00	10.0	8.79E-05	0.00	104125.3	20.7	2.14E-04	6.13	104131	90.76	727.8	0.00	728	-0.093
6/1/1998	13:30	104118	104.1	-8	-0.35	19.6	2.03E-04	-7.42	104117.9	-0.83	9.2	7.58E-05	-6.53	104118.8	20.9	2.16E-04	4.37	104130	64.18	727.7	-0.05	728	-0.081
6/1/1998	14:30	104110	104.1	-15	-0.70	19.3	1.99E-04	-14.53	104110.8	-1.65	8.3	6.37E-05	-10.97	104114.4	21.0	2.19E-04	2.30	104128	33.22	727.7	-0.11	728	-0.067
6/1/1998	15:30	104091	104.1	-34	-1.58	18.4	1.88E-04	-30.97	104094.4	-3.72	6.3	3.34E-05	-12.93	104112.4	21.0	2.19E-04	0.00	104125	0.00	727.6	-0.24	728	-0.051
6/1/1998	16:30	104091	104.1	-34	-1.58	18.4	1.88E-04	-30.97	104094.4	-3.72	6.3	3.34E-05	-12.93	104112.4	20.9	2.18E-04	-2.28	104123	-33.22	727.6	-0.24	728	-0.035
6/1/1998	17:30	104095	104.1	-30	-1.41	18.6	1.90E-04	-27.84	104097.5	-3.31	6.7	3.94E-05	-13.58	104111.7	20.7	2.16E-04	-4.37	104121	-64.18	727.6	-0.21	728	-0.020
6/1/1998	18:30	104095	104.1	-30	-1.41	18.6	1.90E-04	-27.84	104097.5	-3.31	6.7	3.94E-05	-13.58	104111.7	20.5	2.13E-04	-6.08	104119	-90.76	727.6	-0.21	728	-0.008
6/1/1998	19:30	104095	104.1	-30	-1.41	18.6	1.90E-04	-27.84	104097.5	-3.31	6.7	3.94E-05	-13.58	104111.7	20.1	2.08E-04	-7.31	104118	-111.16	727.6	-0.21	728	0.000
6/1/1998	20:30	104095	104.1	-30	-1.41	18.6	1.90E-04	-27.84	104097.5	-3.31	6.7	3.94E-05	-13.58	104111.7	19.7	2.04E-04	-7.98	104117	-123.98	727.6	-0.21	728	0.005
6/1/1998	21:30	104087	104.1	-38	-1.76	18.2	1.86E-04	-34.03	104091.3	-4.14	5.9	2.73E-05	-11.76	104113.6	19.4	1.99E-04	-8.07	104117	-128.36	727.5	-0.26	728	0.006
6/1/1998	22:30	104084	104.1	-42	-1.93	18.1	1.84E-04	-37.01	104088.3	-4.55	5.5	2.13E-05	-10.07	104115.3	19.0	1.95E-04	-7.62	104118	-123.98	727.5	-0.29	728	0.003
6/1/1998	23:30	104091	104.1	-34	-1.58	18.4	1.88E-04	-30.97	104094.4	-3.72	6.3	3.34E-05	-12.93	104112.4	18.6	1.91E-04	-6.69	104119	-111.16	727.6	-0.24	728	-0.004
6/2/1998	0:30	104087	104.1	-38	-1.76	18.2	1.86E-04	-34.03	104091.3	-4.14	5.9	2.73E-05	-11.76	104113.6	18.4	1.88E-04	-5.37	104120	-90.76	727.5	-0.26	728	-0.013
6/2/1998	1:30	104091	104.1	-34	-1.58	18.4	1.88E-04	-30.97	104094.4	-3.72	6.3	3.34E-05	-12.93	104112.4	18.2	1.85E-04	-3.75	104122	-64.18	727.6	-0.24	728	-0.024
6/2/1998	2:30	104103	104.1	-23	-1.05	18.9	1.94E-04	-21.34	104104.0	-2.48	7.5	5.15E-05	-13.32	104112.0	18.1	1.84E-04	-1.93	104123	-33.22	727.6	-0.16	728	-0.037
6/2/1998	3:30	104099	104.1	-26	-1.23	18.8	1.92E-04	-24.62	104100.7	-2.90	7.1	4.55E-05	-13.71	104111.6	18.1	1.84E-04	0.00	104125	0.00	727.6	-0.19	728	-0.051
6/2/1998	4:30	104110	104.1	-15	-0.70	19.3	1.99E-04	-14.53	104110.8	-1.65	8.3	6.37E-05	-10.97	104114.4	18.2	1.90E-04	1.99	104127	33.22	727.7	-0.11	728	-0.064
6/2/1998	5:30	104114	104.1	-11	-0.53	19.5	2.01E-04	-11.01	104114.3	-1.24	8.8	6.97E-05	-9.01	104116.3	18.4	1.91E-04	3.88	104129	64.18	727.7	-0.08	728	-0.078
6/2/1998	6:30	104129	104.1	4	0.18	20.2	2.09E-04	3.82	104129.1	0.41	10.4	9.28E-05	4.00	104129.3	18.6	1.94E-04	5.56	104131	90.76	727.8	0.03	728	-0.089
6/2/1998	7:30	104133	104.1	8	0.35	20.4	2.10E-04	7.69	104133.0	0.83	10.8	9.78E-05	8.42	104133.7	19.0	1.97E-04	6.92	104132	111.16	727.8	0.05	728	-0.099

TABLE 5B.5.2.3
1998 Hold Test
Predicted Hold Test Temperatures

Date	Time	Volumetric Predicted Temperature (°F)	Volumetric Predicted Temperature (°C)	Best Fit To Actual Volume Data (°F)	Best Fit To Actual Volume Data (°C)
6/1/1998	4:30	68.23	20.13	64.72	18.18
6/1/1998	5:30	68.83	20.46	65.07	18.37
6/1/1998	6:30	69.33	20.74	65.57	18.65
6/1/1998	7:30	69.68	20.93	66.17	18.99
6/1/1998	8:30	69.86	21.03	66.85	19.36
6/1/1998	9:30	69.86	21.03	67.55	19.75
6/1/1998	10:30	69.68	20.93	68.23	20.13
6/1/1998	11:30	69.33	20.74	68.83	20.46
6/1/1998	12:30	68.83	20.46	69.33	20.74
6/1/1998	13:30	68.23	20.13	69.68	20.93
6/1/1998	14:30	67.55	19.75	69.86	21.03
6/1/1998	15:30	66.85	19.36	69.86	21.03
6/1/1998	16:30	66.17	18.99	69.68	20.93
6/1/1998	17:30	65.57	18.65	69.33	20.74
6/1/1998	18:30	65.07	18.37	68.83	20.46
6/1/1998	19:30	64.72	18.18	68.23	20.13
6/1/1998	20:30	64.54	18.08	67.55	19.75
6/1/1998	21:30	64.54	18.08	66.85	19.36
6/1/1998	22:30	64.72	18.18	66.17	18.99
6/1/1998	23:30	65.07	18.37	65.57	18.65
6/2/1998	0:30	65.57	18.65	65.07	18.37
6/2/1998	1:30	66.17	18.99	64.72	18.18
6/2/1998	2:30	66.85	19.36	64.54	18.08
6/2/1998	3:30	67.55	19.75	64.54	18.08
6/2/1998	4:30	68.23	20.13	64.72	18.18
6/2/1998	5:30	68.83	20.46	65.07	18.37
6/2/1998	6:30	69.33	20.74	65.57	18.65
6/2/1998	7:30	69.68	20.93	66.17	18.99

Figure 5B.5.2.1 - 1998 Hold Test - Actual Volume and Modeled Expansions

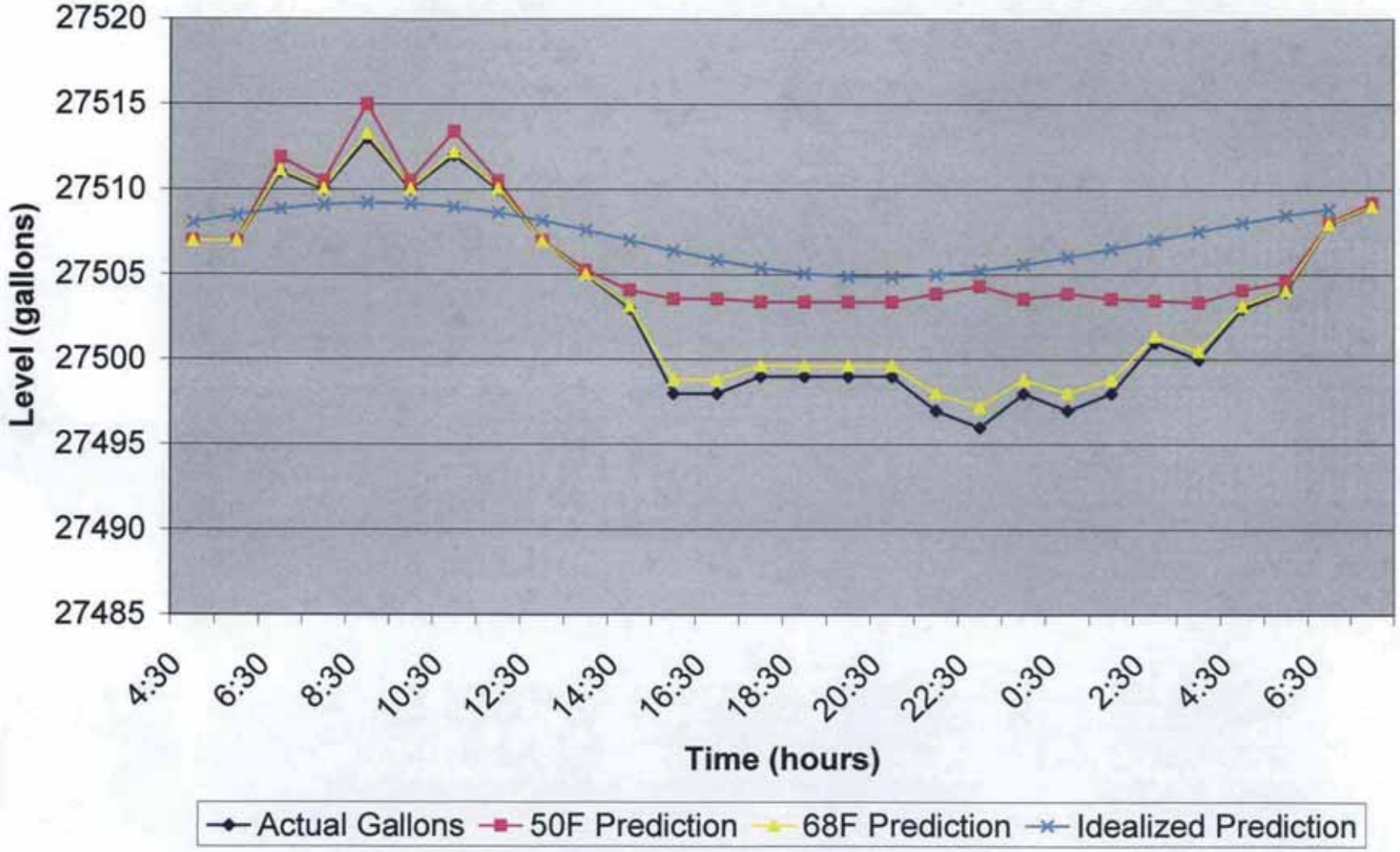
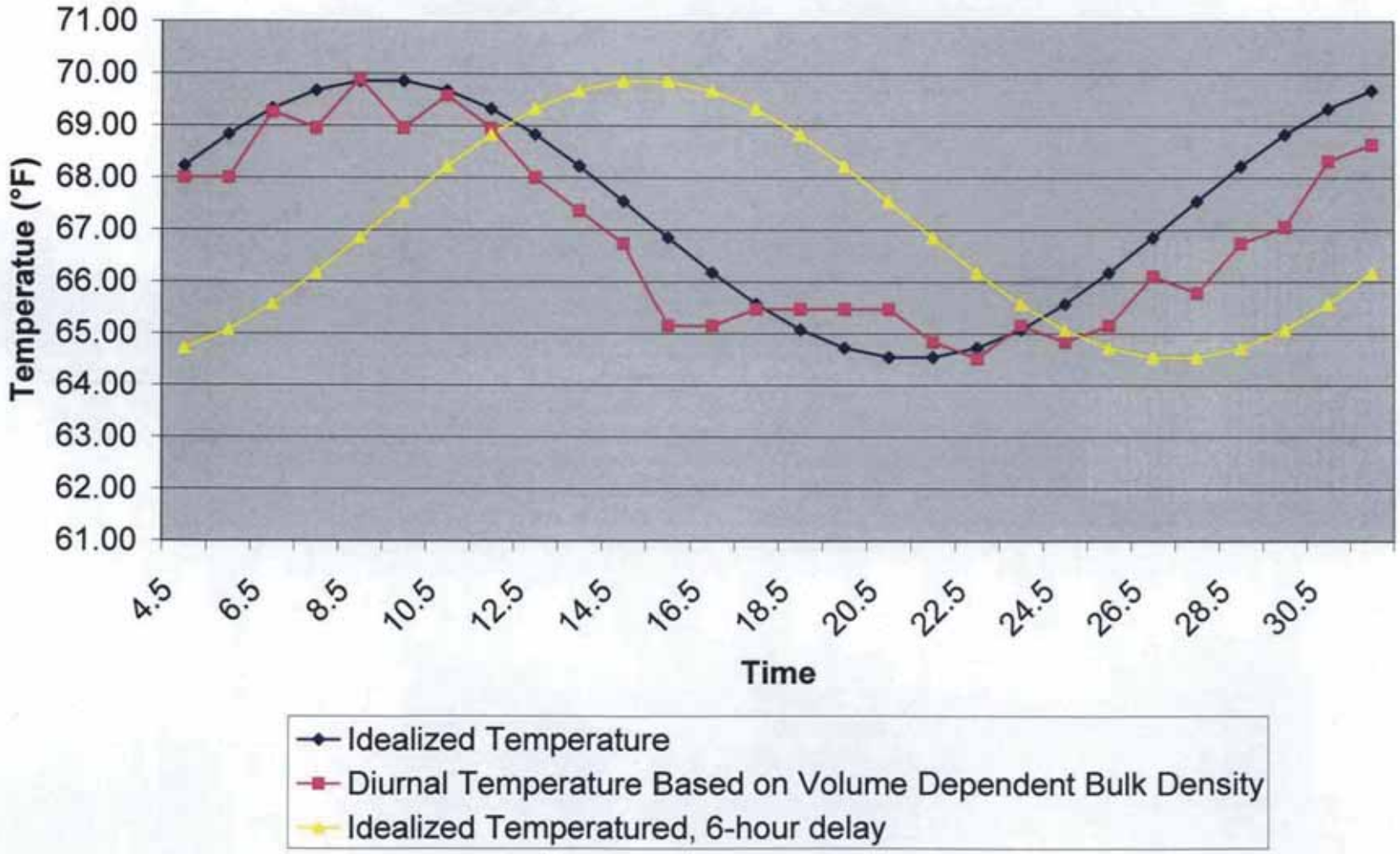


Figure 5B.5.2.2 - 1998 Hold Test - Estimated Temperature Behavior (C-A-1)



the form of $x = F_0 - X\cos(\omega_n t - \beta)$ were attempted as above. As with 1998 data, Tables 5B.5.3.1A and 5B.5.3.1B show initial conditions attempted for loop fill water (50°F and 68°F or 10°C, and 20°C). Figure 5B.5.3.1 shows the various expansion and contraction curves predicted by these initial conditions. It can be seen that the 68°F (20°C) condition best matches actual conditions. From this, an idealized sinusoidal temperature distribution (Table 5B.5.3.2) and inferred CA1 temperature curve (Figure 5B.5.2.2) were predicted. However, as with 1998 C-A-1 level data, using this curve directly resulted in incorrectly predicting volumetric expansion. As with 1998 data, the best fit to actual volumetric data was another diurnal 6 hours out of phase from the idealized curve (Table 5B.5.3.2) and ("Idealized Curve," Figure 5B.5.3.1). This result was arrived at by matching the volumetric output.

The 68°F (20°C) prediction and idealized curve on Figure 5B.5.3.1 show good agreement to actual data, albeit these deviations are small, as seen in the 1998 data. However, in the case of the 2007 analysis, real data show an apparent greater volumetric contraction than the idealized data. This may be caused by Arguably, such behavior is, perhaps, attributable to instrument drift, as postulated in the 1993 hold test, however, the above analysis show that the data seem to best fit a 24 hour periodic fluctuation. Such a fluctuation is best explained by external temperature effects (such diurnal temperature cycles) or some other daily phenomena. Therefore, it is most likely that the C-A-1 volume fluctuations observed in 2007 were also either caused by diurnal temperature fluctuations or some other daily phenomena associated with a 24 hour period or cycle. However, it should be noted that these affects are of small magnitude, less 15 gallons, and therefore within known accuracy of level sensing instrumentation (+/- 48 gallons). Therefore, the actual magnitude of these fluctuations is not likely to be accurately represented by the current sensors due to their small magnitude (i.e. the temperature effects are represented qualitatively rather than quantitatively).

5B.5.4 2007 Test – L1 Sump

L1 Sump level data were also collected in 2007. These data are included in Attachment 5A and tabulated for analysis in Table 5B.2.3. To determine whether the L1 sump might be affected by temperature fluctuations, these data were subjected to the same analyses as 1998 and 2007 Evaporator / Boiler Loop data as measured in C-A-1 (see Tables 5B.5.4.1A, 5B.5.4.2B, and Figure 5B.5.4.1). The same forcing function with adjusted constants was used for the L1 Sump for the idealized expansion shown in Figure 5B.5.4.1. It can be readily seen actual data closely mirror the idealized volumetric expansion/contraction curve developed for the Evaporator/Reboiler Loop. Therefore, whatever is affecting the Evaporator/Reboiler Loop system (most likely temperature) is also affecting the L1 Sump. However, it should also be noted here that these affects have are of small magnitude, less than 5 gallons, and therefore within known accuracy of level sensing instrumentation (+/- 48 gallons). Therefore, the actual magnitude of these fluctuations is not likely to be accurately represented by the current sensors due to their small magnitude.

5B.6 CONCLUSIONS

Analysis of 1993 data indicated that fluctuations observed in electronically indicated level data were most likely caused by either the level instrument being located on the

TABLE 5B.5.3.1A
2007 Hold Test
C-A-1
Modeled and Actual Diurnal Temperatures and Volumetric Expansions (US)

Actual Data					68°F Iteration					50°F Iteration					Idealized					Actual		Predicted	
Date	Time	Level (gal)	Level (CF)	Actual ΔV (gal)	Derived ΔT (°F)	Predicted T (°F)	Recalculated Bulk Coeff (β) (1/°F)	Predicted ΔV (gal)	Predicted Level (gal)	Derived ΔT (°F)	Predicted T (°F)	Recalculated Bulk Coeff (β) (1/°F)	Predicted ΔV (gal)	Predicted Level (gal)	Predicted T (°F)	Bulk Coeff (β) (1/°F)	Predicted ΔV (gal)	Predicted Level (gal)	Heat Change (Btu)	Actual Height in Evap Loop (inches)	Net Rise/Fall C-A-1 (inch)	Predicted Height in Evap Loop (inches)	Net Rise/Fall C-A-1 (inch)
9/1/2007	15:20	26728	3573.0	0	0.0000	68.00	1.15E-04	0.00	26728.0		50.0	4.88E-05	0.00	26728.0	64.21	1.01E-04				278.4	0		
9/1/2007	15:30	26729	3573.1	1	0.3253	68.33	1.16E-04	1.01	26729.0	0.7662	50.77	5.16E-05	1.06	26729.1	64.22	1.01E-04	0.03	26728.0	1.90	278.4	0.01	278.4	-0.020
9/1/2007	16:30	26729	3573.1	1	0.3253	68.33	1.16E-04	1.01	26729.0	0.7662	50.77	5.16E-05	1.06	26729.1	64.38	1.02E-04	0.42	26728.4	27.02	278.4	0.01	278.4	-0.024
9/1/2007	17:30	26728	3573.0	0	0.0000	68.00	1.15E-04	0.00	26728.0	0.0000	50.00	4.88E-05	0.00	26728.0	64.68	1.03E-04	0.82	26728.8	52.20	278.4	0.00	278.4	-0.028
9/1/2007	18:30	26729	3573.1	1	0.3253	68.33	1.16E-04	1.01	26729.0	0.7662	50.77	5.16E-05	1.06	26729.1	65.10	1.04E-04	1.18	26729.2	73.83	278.4	0.01	278.4	-0.032
9/1/2007	19:30	26730	3573.3	2	0.6507	68.65	1.17E-04	2.03	26730.0	1.5323	51.53	5.45E-05	2.23	26730.2	65.62	1.06E-04	1.48	26729.5	90.42	278.4	0.02	278.5	-0.035
9/1/2007	20:00	26731	3573.4	3	0.9760	68.98	1.18E-04	3.07	26731.1	2.2985	52.30	5.73E-05	3.52	26731.5	65.90	1.07E-04	0.82	26728.8	49.54	278.4	0.03	278.4	-0.028
9/1/2007	21:00	26730	3573.3	2	0.6507	68.65	1.17E-04	2.03	26730.0	1.5323	51.53	5.45E-05	2.23	26730.2	66.50	1.09E-04	1.74	26729.7	103.52	278.4	0.02	278.5	-0.038
9/1/2007	22:00	26729	3573.1	1	0.3253	68.33	1.16E-04	1.01	26729.0	0.7662	50.77	5.16E-05	1.06	26729.1	67.10	1.12E-04	1.78	26729.8	103.52	278.4	0.01	278.5	-0.038
9/1/2007	23:00	26730	3573.3	2	0.6507	68.65	1.17E-04	2.03	26730.0	1.5323	51.53	5.45E-05	2.23	26730.2	67.65	1.14E-04	1.69	26729.7	96.46	278.4	0.02	278.5	-0.037
9/2/2007	0:00	26730	3573.3	2	0.6507	68.65	1.17E-04	2.03	26730.0	1.5323	51.53	5.45E-05	2.23	26730.2	68.13	1.15E-04	1.47	26729.5	82.83	278.4	0.02	278.5	-0.035
9/2/2007	1:00	26727	3572.9	-1	-0.3253	67.67	1.14E-04	-0.99	26727.0	-0.7662	49.23	4.54E-05	-0.93	26727.1	68.49	1.17E-04	1.14	26729.1	63.56	278.4	-0.01	278.4	-0.031
9/2/2007	2:00	26727	3572.9	-1	-0.3253	67.67	1.14E-04	-0.99	26727.0	-0.7662	49.23	4.54E-05	-0.93	26727.1	68.72	1.18E-04	0.72	26728.7	39.96	278.4	-0.01	278.4	-0.027
9/2/2007	3:00	26726	3572.7	-2	-0.6507	67.35	1.13E-04	-1.96	26726.0	-1.5323	48.47	4.19E-05	-1.72	26726.3	68.80	1.18E-04	0.25	26728.2	13.63	278.4	-0.02	278.4	-0.022
9/2/2007	4:00	26726	3572.7	-2	-0.6507	67.35	1.13E-04	-1.96	26726.0	-1.5323	48.47	4.19E-05	-1.72	26726.3	68.72	1.18E-04	-0.25	26727.8	-13.63	278.4	-0.02	278.4	-0.017
9/2/2007	5:00	26723	3572.3	-5	-1.6267	66.37	1.09E-04	-4.74	26723.3	-3.8308	46.17	3.15E-05	-3.23	26724.8	68.49	1.17E-04	-0.72	26727.3	-39.96	278.4	-0.05	278.4	-0.012
9/2/2007	6:00	26723	3572.3	-5	-1.6267	66.37	1.09E-04	-4.74	26723.3	-3.8308	46.17	3.15E-05	-3.23	26724.8	68.13	1.15E-04	-1.13	26726.9	-63.56	278.4	-0.05	278.4	-0.008
9/2/2007	7:00	26721	3572.1	-7	-2.2774	65.72	1.07E-04	-6.49	26721.5	-5.3631	44.64	2.46E-05	-3.52	26724.5	67.65	1.14E-04	-1.45	26726.6	-82.83	278.3	-0.07	278.4	-0.004
9/2/2007	8:00	26718	3571.7	-10	-3.2534	64.75	1.03E-04	-8.96	26719.0	-7.6616	42.34	1.42E-05	-2.91	26725.1	67.10	1.12E-04	-1.66	26726.3	-96.46	278.3	-0.10	278.4	-0.002
9/2/2007	9:00	26716	3571.4	-12	-3.9041	64.10	1.01E-04	-10.50	26717.5	-9.1939	40.81	7.26E-06	-1.78	26726.2	66.50	1.09E-04	-1.74	26726.3	-103.52	278.3	-0.12	278.4	-0.001
9/2/2007	10:00	26717	3571.5	-11	-3.5787	64.42	1.02E-04	-9.74	26718.3	-8.4277	41.57	1.07E-05	-2.42	26725.6	65.90	1.07E-04	-1.71	26726.3	-103.52	278.3	-0.11	278.4	-0.002
9/2/2007	11:00	26719	3571.8	-9	-2.9280	65.07	1.04E-04	-8.16	26719.8	-6.8954	43.10	1.77E-05	-3.25	26724.7	65.35	1.05E-04	-1.56	26726.4	-96.46	278.3	-0.09	278.4	-0.003
9/2/2007	12:00	26716	3571.4	-12	-3.9041	64.10	1.01E-04	-10.50	26717.5	-9.1939	40.81	7.26E-06	-1.78	26726.2	64.87	1.04E-04	-1.32	26726.7	-82.83	278.3	-0.12	278.4	-0.006
9/2/2007	13:00	26719	3571.8	-9	-2.9280	65.07	1.04E-04	-8.16	26719.8	-6.8954	43.10	1.77E-05	-3.25	26724.7	64.51	1.02E-04	-1.00	26727.0	-63.56	278.3	-0.09	278.4	-0.009
9/2/2007	14:00	26720	3571.9	-8	-2.6027	65.40	1.05E-04	-7.33	26720.7	-6.1292	43.87	2.11E-05	-3.46	26724.5	64.28	1.01E-04	-0.62	26727.4	-39.96	278.3	-0.08	278.4	-0.013
9/2/2007	15:00	26721	3572.1	-7	-2.2774	65.72	1.07E-04	-6.49	26721.5	-5.3631	44.64	2.46E-05	-3.52	26724.5	64.20	1.01E-04	-0.21	26727.8	-13.63	278.3	-0.07	278.4	-0.017
9/2/2007	16:00	26723	3572.3	-5	-1.6267	66.37	1.09E-04	-4.74	26723.3	-3.8308	46.17	3.15E-05	-3.23	26724.8	64.28	1.01E-04	0.21	26728.2	13.63	278.4	-0.05	278.4	-0.022
9/2/2007	16:06	26722	3572.2	-6	-1.9520	66.05	1.08E-04	-5.63	26722.4	-4.5969	45.40	2.80E-05	-3.45	26724.6	64.29	1.01E-04	0.04	26728.0	2.84	278.4	-0.06	278.4	-0.020

TABLE 5B.5.3.1B
2007 Hold Test
C-A-1
Modeled and Actual Diurnal Temperatures and Volumetric Expansions (SI)

Actual Data					20°C Iteration					10°C Iteration					Idealized					Actual		Predicted	
Date	Time	Level (Liters)	Level (m^3)	Actual ΔV (Liters)	Derived ΔT (°C)	Predicted T (°C)	Recalculated Bulk Coeff (β) (1/°C)	Predicted ΔV (Liters)	Predicted Level (Liters)	Derived ΔT (°C)	Predicted T (°C)	Recalculated Bulk Coeff (β) (1/°C)	Predicted ΔV (Liters)	Predicted Level (Liters)	Predicted T (°C)	Bulk Coeff (β) (1/°C)	Predicted ΔV (Liters)	Predicted Level (Liters)	Heat Change (KJ)	Actual Height in Evap Loop (cm)	Net Rise/Fall C-A-1 (cm)	Predicted Height in Evap Loop (cm)	Net Rise/Fall C-A-1 (cm)
9/1/2007	15:20	101176	101.2	0	0.00	20.0	2.07E-04	0.00	101176.5	0.00	10.0	8.79E-05	0.00	101176.5	17.9	1.82E-04				707	0.000		
9/1/2007	15:30	101180	101.2	4	0.18	20.2	2.09E-04	3.82	101180.3	0.43	10.4	9.30E-05	4.00	101180.5	17.9	1.82E-04	0.11	101177	2.00	707	0.026	707.2	-0.05
9/1/2007	16:30	101180	101.2	4	0.18	20.2	2.09E-04	3.82	101180.3	0.43	10.4	9.30E-05	4.00	101180.5	18.0	1.83E-04	1.60	101178	28.51	707	0.026	707.2	-0.06
9/1/2007	17:30	101176	101.2	0	0.00	20.0	2.07E-04	0.00	101176.5	0.00	10.0	8.79E-05	0.00	101176.5	18.2	1.85E-04	3.12	101180	55.08	707	0.000	707.2	-0.07
9/1/2007	18:30	101180	101.2	4	0.18	20.2	2.09E-04	3.82	101180.3	0.43	10.4	9.30E-05	4.00	101180.5	18.4	1.88E-04	4.48	101181	77.89	707	0.026	707.3	-0.08
9/1/2007	19:30	101184	101.2	8	0.36	20.4	2.10E-04	7.70	101184.2	0.85	10.9	9.80E-05	8.44	101184.9	18.7	1.91E-04	5.59	101182	95.40	707	0.053	707.3	-0.09
9/1/2007	20:00	101188	101.2	11	0.54	20.5	2.12E-04	11.64	101188.1	1.28	11.3	1.03E-04	13.32	101189.8	18.8	1.93E-04	3.09	101180	52.27	707	0.079	707.2	-0.07
9/1/2007	21:00	101184	101.2	8	0.36	20.4	2.10E-04	7.70	101184.2	0.85	10.9	9.80E-05	8.44	101184.9	19.2	1.97E-04	6.59	101183	109.21	707	0.053	707.3	-0.10
9/1/2007	22:00	101180	101.2	4	0.18	20.2	2.09E-04	3.82	101180.3	0.43	10.4	9.30E-05	4.00	101180.5	19.5	2.01E-04	6.73	101183	109.21	707	0.026	707.3	-0.10
9/1/2007	23:00	101184	101.2	8	0.36	20.4	2.10E-04	7.70	101184.2	0.85	10.9	9.80E-05	8.44	101184.9	19.8	2.05E-04	6.38	101183	101.77	707	0.053	707.3	-0.09
9/2/2007	0:00	101184	101.2	8	0.36	20.4	2.10E-04	7.70	101184.2	0.85	10.9	9.80E-05	8.44	101184.9	20.1	2.08E-04	5.56	101182	87.39	707	0.053	707.3	-0.09
9/2/2007	1:00	101173	101.2	-4	-0.18	19.8	2.05E-04	-3.75	101172.7	-0.43	9.6	8.17E-05	-3.52	101173.0	20.3	2.10E-04	4.32	101181	67.06	707	-0.026	707.3	-0.08
9/2/2007	2:00	101173	101.2	-4	-0.18	19.8	2.05E-04	-3.75	101172.7	-0.43	9.6	8.17E-05	-3.52	101173.0	20.4	2.12E-04	2.74	101179	42.16	707	-0.026	707.2	-0.07
9/2/2007	3:00	101169	101.2	-8	-0.36	19.6	2.03E-04	-7.41	101169.1	-0.85	9.1	7.54E-05	-6.50	101170.0	20.4	2.12E-04	0.94	101177	14.38	707	-0.053	707.2	-0.06
9/2/2007	4:00	101169	101.2	-8	-0.36	19.6	2.03E-04	-7.41	101169.1	-0.85	9.1	7.54E-05	-6.50	101170.0	20.4	2.12E-04	-0.93	101176	-14.38	707	-0.053	707.2	-0.04
9/2/2007	5:00	101158	101.2	-19	-0.90	19.1	1.96E-04	-17.94	101158.5	-2.13	7.9	5.67E-05	-12.21	101164.3	20.3	2.10E-04	-2.72	101174	-42.16	707	-0.132	707.2	-0.03
9/2/2007	6:00	101158	101.2	-19	-0.90	19.1	1.96E-04	-17.94	101158.5	-2.13	7.9	5.67E-05	-12.21	101164.3	20.1	2.08E-04	-4.27	101172	-67.06	707	-0.132	707.2	-0.02
9/2/2007	7:00	101150	101.1	-26	-1.27	18.7	1.92E-04	-24.57	101151.9	-2.98	7.0	4.43E-05	-13.34	101163.1	19.8	2.05E-04	-5.48	101171	-87.39	707	-0.185	707.2	-0.01
9/2/2007	8:00	101139	101.1	-38	-1.81	18.2	1.85E-04	-33.92	101142.6	-4.26	5.7	2.55E-05	-11.00	101165.5	19.5	2.01E-04	-6.27	101170	-101.77	707	-0.265	707.2	-0.01
9/2/2007	9:00	101131	101.1	-45	-2.17	17.8	1.81E-04	-39.76	101136.7	-5.11	4.9	1.31E-05	-6.76	101169.7	19.2	1.97E-04	-6.59	101170	-109.21	707	-0.317	707.2	0.00
9/2/2007	10:00	101135	101.1	-42	-1.99	18.0	1.83E-04	-36.88	101139.6	-4.68	5.3	1.93E-05	-9.15	101167.3	18.8	1.93E-04	-6.46	101170	-109.21	707	-0.291	707.2	0.00
9/2/2007	11:00	101142	101.1	-34	-1.63	18.4	1.88E-04	-30.88	101145.6	-3.83	6.2	3.18E-05	-12.32	101164.2	18.5	1.89E-04	-5.91	101171	-101.77	707	-0.238	707.2	-0.01
9/2/2007	12:00	101131	101.1	-45	-2.17	17.8	1.81E-04	-39.76	101136.7	-5.11	4.9	1.31E-05	-6.76	101169.7	18.3	1.86E-04	-4.99	101171	-87.39	707	-0.317	707.2	-0.01
9/2/2007	13:00	101142	101.1	-34	-1.63	18.4	1.88E-04	-30.88	101145.6	-3.83	6.2	3.18E-05	-12.32	101164.2	18.1	1.84E-04	-3.78	101173	-67.06	707	-0.238	707.2	-0.02
9/2/2007	14:00	101146	101.1	-30	-1.45	18.6	1.90E-04	-27.76	101148.7	-3.41	6.6	3.80E-05	-13.10	101163.4	17.9	1.82E-04	-2.36	101174	-42.16	707	-0.212	707.2	-0.03
9/2/2007	15:00	101150	101.1	-26	-1.27	18.7	1.92E-04	-24.57	101151.9	-2.98	7.0	4.43E-05	-13.34	101163.1	17.9	1.82E-04	-0.80	101176	-14.38	707	-0.185	707.2	-0.04
9/2/2007	16:00	101158	101.2	-19	-0.90	19.1	1.96E-04	-17.94	101158.5	-2.13	7.9	5.67E-05	-12.21	101164.3	17.9	1.82E-04	0.80	101177	14.38	707	-0.132	707.2	-0.05
9/2/2007	16:06	101154	101.2	-23	-1.08	18.9	1.94E-04	-21.30	101155.2	-2.55	7.4	5.05E-05	-13.05	101163.4	17.9	1.82E-04	0.17	101177	3.00	707	-0.159	707.2	-0.05

TABLE 5B.5.3.2
2007 Hold Test
Predicted Hold Test Temperatures

Date	Time	Volumetric Predicted Temperature (°F)	Volumetric Predicted Temperature (°C)	Best Fit To Actual Volume Data (°F)	Best Fit To Actual Volume Data (°C)
9/1/2007	15:20	66.70	19.28	64.21	17.89
9/1/2007	15:30	66.80	19.33	64.22	17.90
9/1/2007	16:30	67.38	19.66	64.38	17.99
9/1/2007	17:30	67.90	19.94	64.68	18.15
9/1/2007	18:30	68.32	20.18	65.10	18.39
9/1/2007	19:30	68.62	20.35	65.62	18.68
9/1/2007	20:00	68.72	20.40	65.90	18.84
9/1/2007	21:00	68.80	20.44	66.50	19.17
9/1/2007	22:00	68.72	20.40	67.10	19.50
9/1/2007	23:00	68.49	20.27	67.65	19.81
9/2/2007	0:00	68.13	20.07	68.13	20.07
9/2/2007	1:00	67.65	19.81	68.49	20.27
9/2/2007	2:00	67.10	19.50	68.72	20.40
9/2/2007	3:00	66.50	19.17	68.80	20.44
9/2/2007	4:00	65.90	18.84	68.72	20.40
9/2/2007	5:00	65.35	18.53	68.49	20.27
9/2/2007	6:00	64.87	18.26	68.13	20.07
9/2/2007	7:00	64.51	18.06	67.65	19.81
9/2/2007	8:00	64.28	17.93	67.10	19.50
9/2/2007	9:00	64.20	17.89	66.50	19.17
9/2/2007	10:00	64.28	17.93	65.90	18.84
9/2/2007	11:00	64.51	18.06	65.35	18.53
9/2/2007	12:00	64.87	18.26	64.87	18.26
9/2/2007	13:00	65.35	18.53	64.51	18.06
9/2/2007	14:00	65.90	18.84	64.28	17.93
9/2/2007	15:00	66.50	19.17	64.20	17.89
9/2/2007	16:00	67.10	19.50	64.28	17.93
9/2/2007	16:06	67.15	19.53	64.29	17.94

Figure 5B.5.3.1 - 2007 Hold Test - C-A-1 - Actual Volume and Modeled Expansions

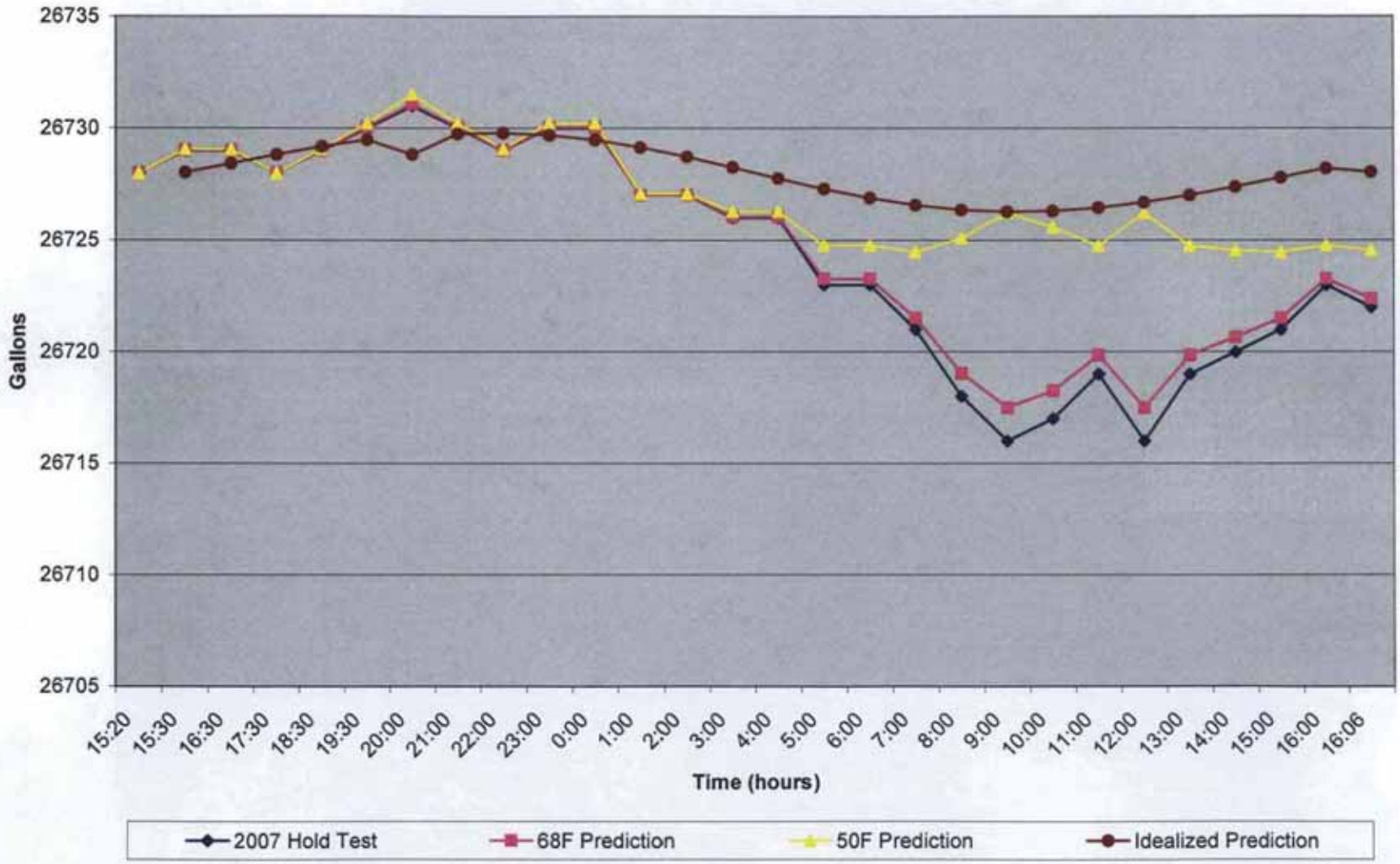


Figure 5B.5.3.2 - Estimated Temperature Behaviour (C-A-1)

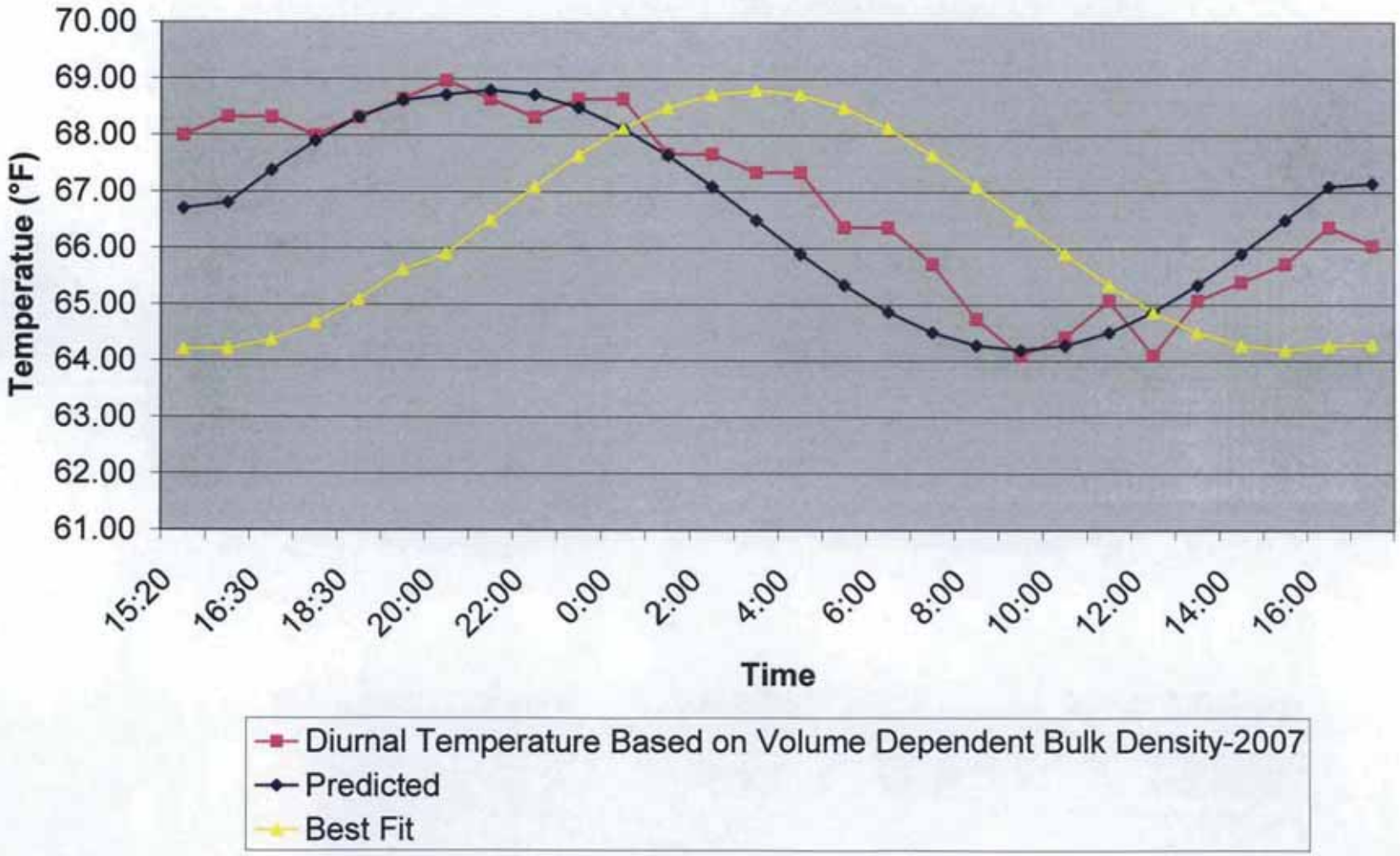


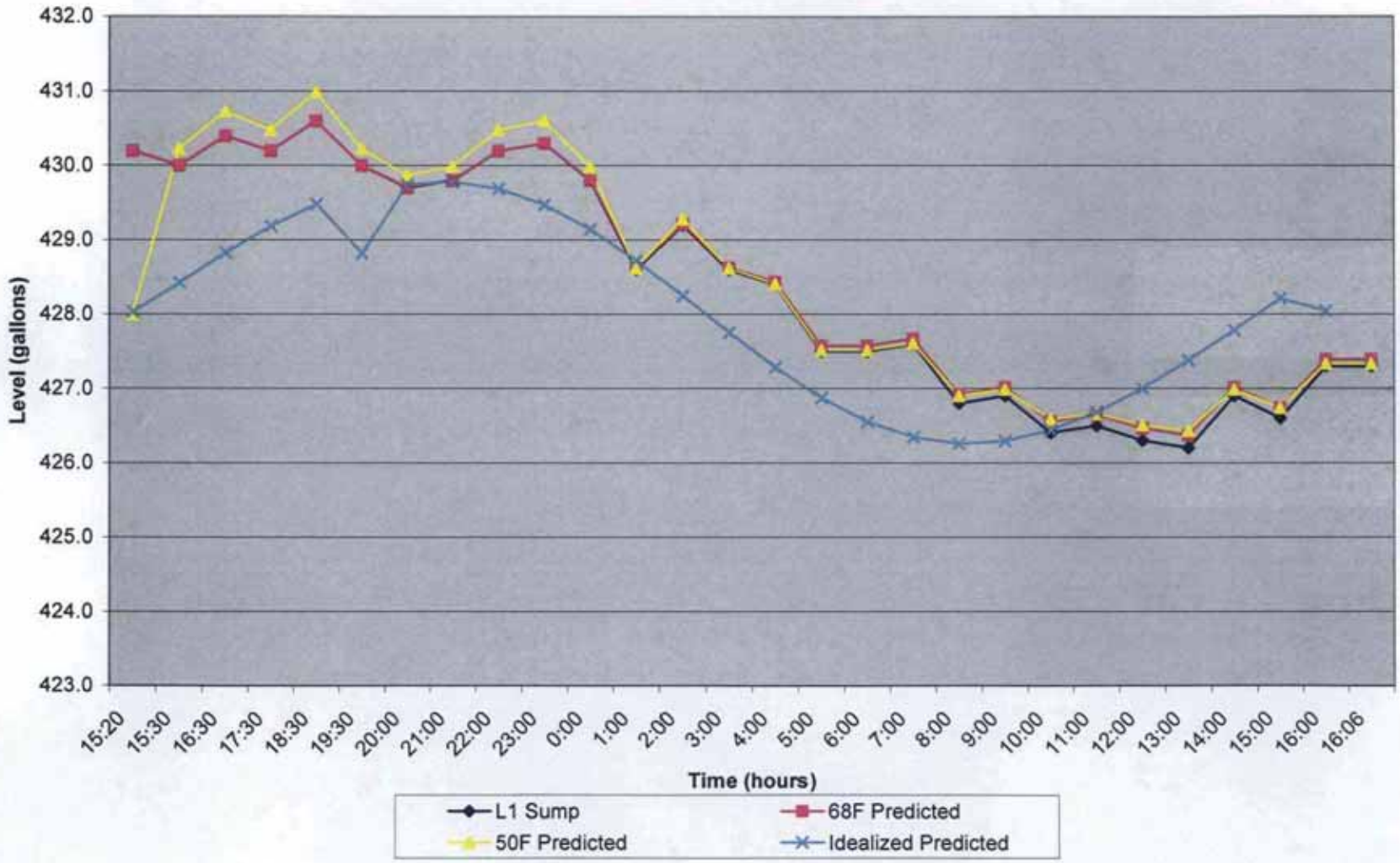
TABLE 5B.5.4.1A
2007 Hold Test
L1 Sump
Modeled and Actual Diurnal Temperatures and Volumetric Expansions (US)

Actual Data					68°F Iteration					50°F Iteration					Idealized					Actual		Predicted	
Date	Time	Actual Level (gallons)	Level (CF)	Actual ΔV (gal)	Derived ΔT (°F)	Predicted T (°F)	Recalculated Bulk Coeff (β) (1/°F)	Predicted ΔV (gal)	Predicted Level (gal)	Derived ΔT (°F)	Predicted T (°F)	Recalculated Bulk Coeff (β) (1/°F)	Predicted ΔV (gal)	Predicted Level (gal)	Predicted T (°F)	Bulk Coeff (β) (1/°F)	Predicted ΔV (gal)	Predicted Level (gal)	Heat Change (Btu)	Actual Height in L1 Sump (inches)	Net Rise/Fall L1 Sump (inch)	Predicted Height in L1 Sump (inches)	Net Rise/Fall L1 Sump (inch)
9/1/2007	15:20	430.2	57.5	0	0.0000	68.00	1.15E-04	0.00	430.20		50.00	4.88E-05	0.00	428.00	64.21	1.01E-04				28.49	0.00		
9/1/2007	15:30	430.0	57.5	0	-0.0651	67.93	1.15E-04	-0.20	430.00	1.5323	51.53	5.45E-05	2.23	430.23	64.22	1.01E-04	0.03	430.23	1.90	28.48	-0.01	28.50	-0.004
9/1/2007	16:30	430.4	57.5	0	0.0651	68.07	1.15E-04	0.20	430.40	1.8388	51.84	5.56E-05	2.73	430.73	64.38	1.02E-04	0.42	430.62	27.02	28.51	0.01	28.52	-0.043
9/1/2007	17:30	430.2	57.5	0	0.0000	68.00	1.15E-04	0.00	430.20	1.6855	51.69	5.50E-05	2.48	430.48	64.68	1.03E-04	0.82	431.02	52.20	28.49	0.00	28.55	-0.043
9/1/2007	18:30	430.6	57.6	0	0.1301	68.13	1.15E-04	0.40	430.60	1.9920	51.99	5.62E-05	2.99	430.99	65.10	1.04E-04	1.18	431.38	73.83	28.52	0.03	28.58	-0.080
9/1/2007	19:30	430.0	57.5	0	-0.0651	67.93	1.15E-04	-0.20	430.00	1.5323	51.53	5.45E-05	2.23	430.23	65.62	1.06E-04	1.48	431.68	90.42	28.48	-0.01	28.59	-0.073
9/1/2007	20:00	429.7	57.4	-1	-0.1627	67.84	1.14E-04	-0.50	429.70	1.3025	51.30	5.36E-05	1.87	429.87	65.90	1.07E-04	0.82	431.02	49.54	28.46	-0.03	28.55	-0.069
9/1/2007	21:00	429.8	57.5	0	-0.1301	67.87	1.15E-04	-0.40	429.80	1.3791	51.38	5.39E-05	1.99	429.99	66.50	1.09E-04	1.74	431.94	103.52	28.47	-0.03	28.61	-0.150
9/1/2007	22:00	430.2	57.5	0	0.0000	68.00	1.15E-04	0.00	430.20	1.6855	51.69	5.50E-05	2.48	430.48	67.10	1.12E-04	1.78	431.98	103.52	28.49	0.00	28.61	-0.146
9/1/2007	23:00	430.3	57.5	0	0.0325	68.03	1.15E-04	0.10	430.30	1.7622	51.76	5.53E-05	2.61	430.61	67.65	1.14E-04	1.69	431.89	96.46	28.50	0.01	28.61	-0.114
9/2/2007	0:00	429.8	57.5	0	-0.1301	67.87	1.15E-04	-0.40	429.80	1.3791	51.38	5.39E-05	1.99	429.99	68.13	1.15E-04	1.47	431.67	82.83	28.47	-0.03	28.59	-0.093
9/2/2007	1:00	428.6	57.3	-2	-0.5205	67.48	1.13E-04	-1.57	428.63	0.4597	50.46	5.05E-05	0.62	428.62	68.49	1.17E-04	1.14	431.34	63.56	28.39	-0.11	28.57	-0.104
9/2/2007	2:00	429.2	57.4	-1	-0.3253	67.67	1.14E-04	-0.99	429.21	0.9194	50.92	5.22E-05	1.28	429.28	68.72	1.18E-04	0.72	430.92	39.96	28.43	-0.07	28.54	-0.156
9/2/2007	3:00	428.6	57.3	-2	-0.5205	67.48	1.13E-04	-1.57	428.63	0.4597	50.46	5.05E-05	0.62	428.62	68.80	1.18E-04	0.25	430.45	13.63	28.39	-0.11	28.51	-0.085
9/2/2007	4:00	428.4	57.3	-2	-0.5856	67.41	1.13E-04	-1.77	428.43	0.3065	50.31	5.00E-05	0.41	428.41	68.72	1.18E-04	-0.25	429.95	-13.63	28.38	-0.12	28.48	-0.092
9/2/2007	5:00	427.5	57.1	-3	-0.8783	67.12	1.12E-04	-2.62	427.58	-0.3831	49.62	4.71E-05	-0.48	427.52	68.49	1.17E-04	-0.72	429.48	-39.96	28.32	-0.18	28.45	-0.074
9/2/2007	6:00	427.5	57.1	-3	-0.8783	67.12	1.12E-04	-2.62	427.58	-0.3831	49.62	4.71E-05	-0.48	427.52	68.13	1.15E-04	-1.13	429.07	-63.56	28.32	-0.18	28.42	-0.106
9/2/2007	7:00	427.6	57.2	-3	-0.8458	67.15	1.12E-04	-2.53	427.67	-0.3065	49.69	4.74E-05	-0.39	427.61	67.65	1.14E-04	-1.45	428.75	-82.83	28.32	-0.17	28.40	-0.085
9/2/2007	8:00	426.8	57.1	-3	-1.1061	66.89	1.11E-04	-3.28	426.92	-0.9194	49.08	4.47E-05	-1.10	426.90	67.10	1.12E-04	-1.66	428.54	-96.46	28.27	-0.23	28.39	-0.065
9/2/2007	9:00	426.9	57.1	-3	-1.0735	66.93	1.11E-04	-3.19	427.01	-0.8428	49.16	4.50E-05	-1.01	426.99	66.50	1.09E-04	-1.74	428.46	-103.52	28.28	-0.22	28.38	-0.112
9/2/2007	10:00	426.4	57.0	-4	-1.2362	66.76	1.10E-04	-3.65	426.55	-1.2258	48.77	4.33E-05	-1.42	426.58	65.90	1.07E-04	-1.71	428.49	-103.52	28.24	-0.25	28.38	-0.107
9/2/2007	11:00	426.5	57.0	-4	-1.2037	66.80	1.11E-04	-3.56	426.64	-1.1492	48.85	4.36E-05	-1.34	426.66	65.35	1.05E-04	-1.56	428.64	-96.46	28.25	-0.25	28.39	-0.150
9/2/2007	12:00	426.3	57.0	-4	-1.2687	66.73	1.10E-04	-3.74	426.46	-1.3025	48.70	4.29E-05	-1.49	426.51	64.87	1.04E-04	-1.32	428.88	-82.83	28.24	-0.26	28.41	-0.160
9/2/2007	13:00	426.2	57.0	-4	-1.3012	66.70	1.10E-04	-3.83	426.37	-1.3791	48.62	4.26E-05	-1.57	426.43	64.51	1.02E-04	-1.00	429.20	-63.56	28.23	-0.26	28.43	-0.194
9/2/2007	14:00	426.9	57.1	-3	-1.0735	66.93	1.11E-04	-3.19	427.01	-0.8428	49.16	4.50E-05	-1.01	426.99	64.28	1.01E-04	-0.62	429.58	-39.96	28.28	-0.22	28.46	-0.226
9/2/2007	15:00	426.6	57.0	-4	-1.1711	66.83	1.11E-04	-3.47	426.73	-1.0726	48.93	4.40E-05	-1.26	426.74	64.20	1.01E-04	-0.21	429.99	-13.63	28.26	-0.24	28.48	-0.207
9/2/2007	16:00	427.3	57.1	-3	-0.9434	67.06	1.12E-04	-2.81	427.39	-0.5363	49.46	4.64E-05	-0.67	427.33	64.28	1.01E-04	0.21	430.41	13.63	28.30	-0.19	28.51	-0.254
9/2/2007	16:06	427.3	57.1	-3	-0.9434	67.06	1.12E-04	-2.81	427.39	-0.5363	49.46	4.64E-05	-0.67	427.33	64.29	1.01E-04	0.04	430.24	2.84	28.30	-0.19	28.50	-0.197

TABLE 5B.5.4.1B
2007 Hold Test
L1 Sump
Modeled and Actual Diurnal Temperatures and Volumetric Expansions (SI)

Actual Data					20°C Iteration					10°C Iteration					Idealized					Actual		Predicted	
Date	Time	Actual Level (Liters)	Level (m^3)	Actual ΔV (Liters)	Derived ΔT (°C)	Predicted T (°C)	Recalculated Bulk Coeff (β) (1/°C)	Predicted ΔV (Liters)	Predicted Level (Liters)	Derived ΔT (°C)	Predicted T (°C)	Recalculated Bulk Coeff (β) (1/°C)	Predicted ΔV (Liters)	Predicted Level (Liters)	Predicted T (°C)	Bulk Coeff (β) (1/°C)	Predicted ΔV (Liters)	Predicted Level (Liters)	Heat Change (KJ)	Actual Height in L1 Sump (cm)	Net Rise/Fall L1 Sump (cm)	Predicted Height in L1 Sump (cm)	Net Rise/Fall L1 Sump (cm)
9/1/2007	15:20	1628	1.628	8	0.00	20.0	2.07E-04	0.00	1620.16	0.00	10.0	8.79E-05	0.00	1620.16	17.9	1.82E-04				72.4	0.00		
9/1/2007	15:30	1628	1.628	8	-0.04	20.0	2.07E-04	-0.76	1619.40	0.85	10.9	9.80E-05	8.44	1628.60	17.9	1.82E-04	0.1118	1628.6	2.004	72.3	-0.03	72.39	-0.010
9/1/2007	16:30	1629	1.629	9	0.04	20.0	2.07E-04	0.76	1620.91	1.02	11.0	1.00E-04	10.34	1630.50	18.0	1.83E-04	1.5986	1630.1	28.511	72.4	0.03	72.45	-0.110
9/1/2007	17:30	1628	1.628	8	0.00	20.0	2.07E-04	0.00	1620.16	0.94	10.9	9.91E-05	9.38	1629.54	18.2	1.85E-04	3.1218	1631.6	55.078	72.4	0.00	72.52	-0.110
9/1/2007	18:30	1630	1.630	10	0.07	20.1	2.08E-04	1.52	1621.68	1.11	11.1	1.01E-04	11.32	1631.47	18.4	1.88E-04	4.4820	1633.0	77.892	72.4	0.07	72.58	-0.204
9/1/2007	19:30	1628	1.628	8	-0.04	20.0	2.07E-04	-0.76	1619.40	0.85	10.9	9.80E-05	8.44	1628.60	18.7	1.91E-04	5.5898	1634.1	95.398	72.3	-0.03	72.63	-0.186
9/1/2007	20:00	1627	1.627	6	-0.09	19.9	2.06E-04	-1.88	1618.27	0.72	10.7	9.65E-05	7.07	1627.22	18.8	1.93E-04	3.0928	1631.6	52.267	72.3	-0.08	72.52	-0.176
9/1/2007	21:00	1627	1.627	7	-0.07	19.9	2.06E-04	-1.51	1618.65	0.77	10.8	9.70E-05	7.52	1627.68	19.2	1.97E-04	6.5942	1635.1	109.214	72.3	-0.07	72.68	-0.382
9/1/2007	22:00	1628	1.628	8	0.00	20.0	2.07E-04	0.00	1620.16	0.94	10.9	9.91E-05	9.38	1629.54	19.5	2.01E-04	6.7260	1635.2	109.214	72.4	0.00	72.68	-0.371
9/1/2007	23:00	1629	1.629	9	0.02	20.0	2.07E-04	0.38	1620.54	0.98	11.0	9.96E-05	9.86	1630.02	19.8	2.05E-04	6.3821	1634.9	101.771	72.4	0.02	72.67	-0.289
9/2/2007	0:00	1627	1.627	7	-0.07	19.9	2.06E-04	-1.51	1618.65	0.77	10.8	9.70E-05	7.52	1627.68	20.1	2.08E-04	5.5648	1634.0	87.393	72.3	-0.07	72.63	-0.236
9/2/2007	1:00	1622	1.622	2	-0.29	19.7	2.04E-04	-5.96	1614.20	0.26	10.3	9.09E-05	2.35	1622.51	20.3	2.10E-04	4.3197	1632.8	67.059	72.1	-0.27	72.57	-0.264
9/2/2007	2:00	1625	1.625	5	-0.18	19.8	2.05E-04	-3.75	1616.41	0.51	10.5	9.40E-05	4.86	1625.01	20.4	2.12E-04	2.7351	1631.2	42.155	72.2	-0.17	72.50	-0.396
9/2/2007	3:00	1622	1.622	2	-0.29	19.7	2.04E-04	-5.96	1614.20	0.26	10.3	9.09E-05	2.35	1622.51	20.4	2.12E-04	0.9352	1629.4	14.378	72.1	-0.27	72.42	-0.215
9/2/2007	4:00	1622	1.622	2	-0.33	19.7	2.03E-04	-6.69	1613.47	0.17	10.2	8.99E-05	1.55	1621.71	20.4	2.12E-04	-0.9329	1627.6	-14.378	72.1	-0.30	72.34	-0.233
9/2/2007	5:00	1618	1.618	-2	-0.49	19.5	2.01E-04	-9.93	1610.22	-0.21	9.8	8.48E-05	-1.83	1618.33	20.3	2.10E-04	-2.7155	1625.8	-42.155	71.9	-0.45	72.26	-0.187
9/2/2007	6:00	1618	1.618	-2	-0.49	19.5	2.01E-04	-9.93	1610.22	-0.21	9.8	8.48E-05	-1.83	1618.33	20.1	2.08E-04	-4.2700	1624.2	-67.059	71.9	-0.45	72.19	-0.269
9/2/2007	7:00	1619	1.619	-2	-0.47	19.5	2.01E-04	-9.58	1610.58	-0.17	9.8	8.54E-05	-1.47	1618.69	19.8	2.05E-04	-5.4804	1623.0	-87.393	71.9	-0.44	72.14	-0.216
9/2/2007	8:00	1616	1.616	-5	-0.61	19.4	2.00E-04	-12.42	1607.74	-0.51	9.5	8.04E-05	-4.16	1616.00	19.5	2.01E-04	-6.2676	1622.2	-101.771	71.8	-0.57	72.10	-0.164
9/2/2007	9:00	1616	1.616	-4	-0.60	19.4	2.00E-04	-12.06	1608.09	-0.47	9.5	8.10E-05	-3.84	1616.32	19.2	1.97E-04	-6.5942	1621.9	-109.214	71.8	-0.56	72.09	-0.284
9/2/2007	10:00	1614	1.614	-6	-0.69	19.3	1.99E-04	-13.82	1606.34	-0.68	9.3	7.79E-05	-5.37	1614.79	18.8	1.93E-04	-6.4624	1622.0	-109.214	71.7	-0.64	72.09	-0.273
9/2/2007	11:00	1614	1.614	-6	-0.67	19.3	1.99E-04	-13.47	1606.69	-0.64	9.4	7.85E-05	-5.07	1615.08	18.5	1.89E-04	-5.9076	1622.6	-101.771	71.8	-0.62	72.12	-0.382
9/2/2007	12:00	1614	1.614	-6	-0.70	19.3	1.99E-04	-14.16	1605.99	-0.72	9.3	7.73E-05	-5.66	1614.50	18.3	1.86E-04	-4.9886	1623.5	-87.393	71.7	-0.66	72.16	-0.406
9/2/2007	13:00	1613	1.613	-7	-0.72	19.3	1.98E-04	-14.51	1605.64	-0.77	9.2	7.67E-05	-5.94	1614.21	18.1	1.84E-04	-3.7782	1624.7	-67.059	71.7	-0.67	72.21	-0.493
9/2/2007	14:00	1616	1.616	-4	-0.60	19.4	2.00E-04	-12.06	1608.09	-0.47	9.5	8.10E-05	-3.84	1616.32	17.9	1.82E-04	-2.3554	1626.1	-42.155	71.8	-0.56	72.28	-0.573
9/2/2007	15:00	1615	1.615	-5	-0.65	19.3	1.99E-04	-13.12	1607.04	-0.60	9.4	7.92E-05	-4.77	1615.38	17.9	1.82E-04	-0.8011	1627.7	-14.378	71.8	-0.61	72.35	-0.525
9/2/2007	16:00	1618	1.618	-3	-0.52	19.5	2.01E-04	-10.65	1609.51	-0.30	9.7	8.35E-05	-2.52	1617.64	17.9	1.82E-04	0.8034	1629.3	14.378	71.9	-0.49	72.42	-0.646
9/2/2007	16:06	1618	1.618	-3	-0.52	19.5	2.01E-04	-10.65	1609.51	-0.30	9.7	8.35E-05	-2.52	1617.64	17.9	1.82E-04	0.1676	1628.7	2.999	71.9	-0.49	72.39	-0.500

Figure 5B.5.4.1 - 2007 Hold Test - L1 Sump - Actual Volume and Modeled Expansions



same circuit as a ventilation fan motor control center or that the weight factor based instrument was impacted by the change in air pressure caused by the shutdown of the fan. It is unknown if the system wiring configuration that existed in 1993 continues to exist, however, if system ventilation changes during testing, level measurement will be impacted, since weight factor based instrumentation is still in use. It should be ensured that system ventilation remain on and constant during testing, if at all possible.

Evaporation losses may also have occurred and may occur in future hold tests. However, evaporation losses, if significant, would take a similar form to leaks from the system (a steady loss over the test period). Based on analysis of data collected in 1993 and 1998, this effect, if it has occurred, does not appear to be significant or detectable with current process instrumentation. Depending on actual test conditions, especially airflow within the vapor-liquid separator, evaporation loss may be too small to be detected. If at all possible, airflow in the system should be quantified to best understand and quantify the potential impact of evaporation, if measurable or significant, during the hold test.

Given the excellent fit between predicted and actual system fluctuations in measured volumes (see Section 5B.5), it is most likely that variations in the vapor-liquid separator system were caused by temperature fluctuations as stated in the 1998 IAR. If not caused by temperature fluctuations, then some other phenomena that occurs in a 24 period or cycle. If temperature data are available in future integrity assessments it might be used to account for volume fluctuations in the Evaporator/Reboiler Loop as well as in Sump L1. In the absence of collecting collaborating temperature data and observing similar sinusoidal volume fluctuations in future integrity assessments, it may be reliably concluded such effects are caused by temperature fluctuations based on the forgoing analysis. However, these affects have been of small magnitude, less than 15 to 17 gallons (or only 5 gallons for the L1 sump), and therefore within known accuracy of level sensing instrumentation (+/- 48 gallons). Therefore, the actual magnitude of these fluctuations is not likely to be accurately represented by the current sensors due to their small magnitude.

5B.7 REFERENCES

Boelter 1946. Boelter, L. M. K., et. al., "Free Evaporation into Air of Water from a Horizontal Quiet Surface,11 Ind. and Eng. Chem., Vol 38, p 596, 1946.

CH2. 2006. OSD-T-151-00012, Revision 1. Operating Specifications for the 242-A Evaporator.

HNF-14755 REV 1-D. Specifications?

Lee and Dalpiaz. 2003. Development of a Computer Code to Predict a Ventilation Requirement for an Underground Radioactive Waste Storage Tank. Proceedings of the 24th DOE/NRC Nuclear Air Cleaning and Treatment Conference.

Lindeburg 1998. Michael R. Lindeburg, PE. Mechanical Engineering Reference Manual for the PE Exam. Tenth ed. Professional Publications, Inc. Belmont, CA.

Moran and Shapiro 1988. Fundamentals of Engineering Thermodynamics. J. Wiley. New York.

Ohio State University. 2004. Environmental Hydrogeology. Accessed via http://streams.osu.edu/book/equation_pdf/Ch4-Equations.pdf.

Perry's. 1984. Perry's Chemical Engineer's Handbook. Sixth ed. McGraw Hill, copyright dates 1984, 1973, 1963, 1959, 1941, 1934.

Singh and Xu. 1997. Evaluation and Generalization of 13 Mass-Transfer Equations for Determining Free Water Evaporation. Hydrological Processes, Vol. 11, pages 311 through 323 (1997).

USDOE 1993. SD-WM-DR-019, Rev 0. Data Package for 242-A Evaporator1 Crystallizer Tank System Integrity Assessment Report.

USDOE 1998. HNF 2905. 1998 Interim 242-A Tank System Integrity Report, HNF-2905, Rev. 0.

World Wide Web. http://www.air-dispersion.com/usource.html#Non-Boiling%20Liquid%20Pool.

Zemansky and Dittman 1981. Heat and Thermodynamics, McGraw Hill, copyright dates from 1937 to 1981.

2005. Permit No. WA7890008967, Attachment 35, Chapter 4.

ATTACHMENT 5C

EVAPORATOR AND PUMP ROOM WALKDOWN WORK INSTRUCTIONS AND RESULTS

(7 Pages)

Work Instruction Record Copy

STEP 002
WFO-WO-06-002549, Walkdown of Evaporator and Pump Rooms

1.0 SCOPE

- Supplemental work instructions to STEP 001 to perform visual inspection of the C-A-1 vessel and associated components **AFTER** a 24 hour leak test has been performed under work package # WFO-WO-07-1225. The intent of this step is visual inspection of equipment and supporting photographs as required, as well as data sheet documentation of the inspection. Entry into the Evaporator/Pump rooms will be as soon as possible after the vessel has been emptied and will be coordinated with Shift Manager and Safety personnel.

- The external portions of the components, piping, flanges, welds, and valves will be examined for evidence of leaks. The walk-downs will be performed by a qualified inspector in accordance with ASME Section XI (VT-2) and overseen by the IQRPE or designated QC Level II inspector.

- If any leaks are observed, follow-up engineering analysis shall be conducted.

- Acceptance Criteria for this visual test is NO DETECTABLE LEAKS.

- Multiple entries may be performed to obtain pictures & data.

2.0 LIMITATIONS & PRECAUTIONS:

[ ] 2.1. **ENSURE** limitations and precautions identified in Step 001 are observed.

[ ] 2.2. **AVOID** disturbing any and all areas where indications of leakage may have occurred until surveyed by HPT.

3.0 PREREQUISITES

[ ] 3.1. **CONDUCT** a Pre-Job Briefing.

[ ] 3.2. **ENSURE** prerequisites stipulated in Step 001 have been performed.

NOTE: Steps in Section 4.0 may be worked repeatedly. Multiple Entries may be performed.

4.0 SPECIFIC WORK INSTRUCTIONS

NOTE: Entry into the Evaporator/Pump rooms will be as soon as possible after the vessel has been emptied and will be coordinated with Shift Manager and Safety personnel.

NOTE: All indications of leakage are considered radiologically uncharacterized and are to be avoided until surveyed by HPT.

[ ] 4.1. ENSURE WO# WFO-WO-07-1225 has completed the leak test and the vessel has been drained prior to any entries into the evaporator/pump rooms.

[ ] 4.2. HPT perform pre-job General Area survey at work locations.

[ ] 4.2.1. Record the Pre-Job Survey RSR (Radiological Survey Report) Number on RSR Log in the work package.

Pen+Ink ok 9/4/07

~~[ ] 4.3. ENSURE Caution tape is installed 6 ft from Pump Room sump prior to performing other work activities in the Pump Room.~~

[ ] 4.4. ENSURE any scaffolding/ladder to be used is inspected by a designated competent person prior to use.

NOTE: Components may be examined in whatever sequence is most convenient to minimize exposure time in the radiation zone. Items to be inspected and photographed are listed in Attachment B-1.

[ ] 4.5. QC Level II Inspector shall examine/photograph the exposed sections of the Evaporator Vessel and Reboiler and all connecting piping, flanges, welds, fittings and valves for signs of leakage.

[ ] 4.5.1. EXAMINE the SPC floor coating for signs of water accumulation.

NOTE: It may not be possible or practical to photograph every piece of equipment.

[ ] 4.5.2. ENSURE items listed in Attachment B-1 are photographed as required.

[ ] 4.5.2.1. ENSURE photographs are taken which clearly show any source of leak and its location.

[ ] 4.6. COMPLETE Data Sheet 1 with visual inspection results.

[ ] 4.7. AFTER completion of the visual examination, the 242-A System Engineer shall review the observations, MARK the appropriate evaluation line and SIGN Data Sheet 1.

5.0 POST MAINTENANCE TESTING

N/A

6.0 RESTORATION ACTIONS

[ ] 6.1. FWS Ensure Data Sheet documentation and picture file is forwarded to Al Friberg (376-1190) OR Jim Castleberry (373-5011).

[ ] 6.2. Restoration Actions will be performed per Step 001.

DATA SHEET 1

EVAPORATOR & COMPONENT LEAK TEST VISUAL INSPECTION RESULTS

Time and Date when inspection began: 8:30 PM 9-4-07

Connections:

From C-A-1: TO PUMP ROOM WALL - NO LEAKAGE OBSERVED

To P-B-1: REFERENCE 9-4-07 WP RECORD - NO

From P-B-1: LEAKAGE OBSERVED

To E-A-1: FROM PUMP WALL TO E-A-1 - NO LEAKAGE OBSERVED

From E-A-1: NO LEAKAGE OBSERVED

To C-A-1: NO LEAKAGE OBSERVED

Operations Manager / Date:

QA Inspector / 9-4-07 Date

Comments:

✓ System and components are acceptable based on the inspection results. No further evaluation is required.

____ System and components require further evaluation. Reference:

242-A System Engineer / Date:

QC Level II Inspector / 9-4-07 Date:

RPP JCS WORK RECORD

Document Number: WFO-WO-06-2549

2. Work Item Title:

Date	Turnover, Problem Description, Action Taken	Feed Back (X)	Name	Craft/ Resource Type	Hours
9/04	Held pre-job, HPT and Operator				
	Entered Evap at 0' 20:26.				
	2 FWS and 1 QC Entered Evap				
	Room on the 4th floor at 20:35.				
	1-FWS Exited HRA, 21:20, QC, Exited				
	HRA 21:26. 1-FWS Exited HRA				
	21:30. Operator Exited HRA At				
	21:32. HPT Exited HRA 21:35				
	All personnel out of HRA and				
	Evaporator Air locks. Verified				
	High rad Doors secured.		[signature]	FWS	
	All waste properly disposed of.		[signature]	FWS	
9/4/07	VERIFIED WITH QC NO NOTICABLE				
	leaks observed.		[signature]	FWS	

Summary by Craft/Resource Type

Craft/Resource Type	Total Hours	Craft/Resource Type	Total Hours

A-6003-243 (12/02)

ATTACHMENT 6

ULTRASONIC TESTING (UT) PROCEDURES, RESULTS, AND ANALYSES

(320 Pages)

ATTACHMENT 6A

UT NARRATIVES

(8 Pages)

UT examination locations points are selected to assess locations of interest, usually where it has been determined increased wear, corrosion, or stress will occur. Key locations include flow transitions, such as bends, tees and reducers, areas where flow disturbance is possible, areas that may be subject to the accumulation of solids or scaling, as well as areas that may be subject to other mechanisms (such as vibration, pipe flexing, joints, welds, flanges, etc.) that may create opportunistic sites for defects to form.

Ultrasonic thickness testing (UTT) or thickness gauging is a manual operation which uses a small ultrasonic probe connected to a hand-held gauge. The main use of thickness gauging is to determine remaining wall thickness particularly in component areas where corrosion/erosion is suspected. For the assessment of component condition 'thickness surveys', as they are often referred to, are carried out. These are usually performed by making a number of 'spot' measurements with the thickness gauge in a grid pattern covering the component surface or the local area of concern. UTT is often performed on a grid that includes the complete circumference of the pipe or vessel in the area of interest.

There are four methods commonly used for determining Non-Destructive Examination (NDE) inspection of piping and vessels and can be used to calculate corrosion or wear in piping components from UT inspection data. These methods are band method, area method, moving blanket method, and point-to-point method. Three of the methods, which are the band, area and blanket methods, estimate the components initial thickness and can be used for evaluation of components with single inspection data. Further, wear or corrosion rates over longer periods can be calculated by using subsequent inspection data. These three methods are effective because the wear caused by wear or corrosion are typically found in a localized area or region. The point-to-point method can be used when data taken at the same grid locations exists from two or more inspection cycles (or baseline data plus data from one or more outages). In such cases, it is possible to obtain a difference in thickness readings for each grid inspection. The wear or corrosion rate at each grid location is the thickness taken at the earlier inspection minus the thickness taken at the later inspection in accordance with ASME Code. The largest of the grid wear values is the component maximum wear between the two outages. The point-to-point method does not estimate the initial component thickness.

Band, area, and blanket methods are methods of calculating wear rates by taking either a band, area, or blanket from around the circumference of the pipe or vessel and subtracting the minimum wall thickness reading in the region from the maximum wall thickness reading in the region.

The point to point method is a method of calculating corrosion or wear rates by subtracting the measurement taken at a grid point during the current outage from the measurement taken at the same grid point during the previous outage.

When employing any of the aforementioned NDE inspection methods, grid patterns or inspection area layout instructions should be documented clearly, for example with drawings and/or inscribed permanently directly on the parts inspected to allow

repeatability and correlation of inspection data for subsequent NDEs. This allows for reliability in the calculation of wear and corrosion rates.

It may occur that points that have been either previously selected are inaccessible or become inaccessible because of equipment changes, changes to operations, or safety concerns. Should this occur, testing at these locations may be abandoned provided that:

1) Sufficient data are collected from a sufficient number of points to make a meaningful statistical analysis of the integrity of areas examined or to determine the existence of flaws or other conditions leading to corrosion, thinning, cracking, wear, or other flaws
2) Grid patterns or other inspection area layout instructions are used and documented clearly, for example with a sketch and/or marking directly on the area of concern, to allow repeatability and correlation of inspection data for subsequent examinations.;
3) Any changes or alterations are clearly documented such that any changes to NDE protocols may be easily employed in the field as well as repeated in future NDE events; and
4) Sufficient data is collected to detect flaws (if present), determine thickness, wear, and corrosion rates.

In 1993, UT thickness data was collected at a total of 2,636 test points at 17 test locations (20 if sub locations such as 9A, 9B, and 8A are included in the total). Of these points, 1,342 were in the Evaporator Room and 1,294 were in the Condenser Room. In 1998, a total of 1,370 test points at 12 locations were evaluated. Of these, 184 were in the Evaporator Room and 1,186 were in the Condenser Room. Appendix E of the 1998 IAR indicated that 7 locations were not evaluated (1, 2S, 2T, 4, 6, 10, and 14), not including in the total locations 8 and 8A, which evaluated the "old" E-C-1, and including 2S and 2T as separate test locations. In addition, multiple test points were not accessible. The 1998 IAR recommended that the next IAP include all accessible equipment and grid points that were tested in 1993 so that a more extensive evaluation of corrosion rates could be completed and a more exhaustive assessment of remaining equipment life could be established. The current IAP (2007), recommended a total of 2,429 test points at 18 test locations, of these locations 1,210 are in the Evaporator Room and 1,219 are in the Condenser Room. The number of test points in the 2007 IAP were reduced to a total of 1,676 test points at 17 locations after reviewing ALARA radiation concerns with the facility, as well as eliminating points that were not accessible in the 1998 IAR, of these locations, 457 are in the Evaporator Room and 1,219 are in the Condenser Room.

To reduce time spent in high radiation areas, the number of test bands were reduced in Locations 1, 2, and 7. In all previous integrity assessments of the 242-A evaporator, 2-inch grids were selected to evaluate evaporator, condenser, and components. In engineering judgment, repeatability criteria would be best satisfied by reducing test points via reducing the number of UT thickness testing bands within a test area while retaining 2-inch grids wherever possible. Other test point reduction strategies, such as eliminating every other point would not retain 2-inch grids, may be difficult to implement

reliably in the field, especially when testers are inhibited by bulky health and safety equipment, and further, if it is desired to evaluate additional areas in future IAPs, it is more difficult to determine what areas have not been evaluated in previous IARs. As described above, wear rates may be calculated taking band of data points around the circumference of a pipe or vessel and subtracting the minimum wall thickness reading in the region from the maximum wall thickness reading in the region. In this way, UT test locations were reduced from areas to bands, however, to best satisfy repeatability criteria, 2-inch grids were retained within these bands.

Evaporator system locations

Locations 1 and 2 are located on the 42-inch vapor line above the evaporator. The line is 5/16-inch stainless steel and carries away vapors from the evaporator to the vacuum condenser system. Corrosion or wear at this location would most likely be the result of condensation; however, and other pitting and other non-uniform defects, including scaling may also occur at unpredictable locations. The locations are hard to accessible for UT inspection; also, they are located in ALARA concern areas. The 1993 IAR evaluated 260 UT points at Location 1 and 245 UT points at Location 2. No evaluation was done in 1998 IAR for Locations 1 and 2. At Location 1, testing was retained in circumferential bands in order to calculate thickness and wear but was reduced to bands A and D, corresponding to the inner and outer areas of the test location. Test points were retained in 2-inch grids and around the circumference of the 42-inch vapor line, reducing the number of points to 65 points per band. The 1993 data indicates little variability between measurements. The total 65 points exceed the minimum of 5 points that should be taken per sample group (ASTM 2005 and Health and Safety Executive [HSE] 2002); and the area to be tested covers the area of concern. Therefore, the alteration to the test design should provide sufficient data to evaluate this section of the vapor line. Subsequent IAPs, to satisfy repeatability criteria, should consider these test points as a new baseline for testing this location.

At Location 2, areas corresponding to bands A, D, and G were retained, corresponding to the outer areas and centerline of the area of concern, retaining the 2-inch grids. 19 data points for each of these columns in test region S and 16 data points for each of these columns in test region T reduced the number of test points to 105 from 245 based on ALARA concern and accessibility problems, while still taking more measurements than required for statistical analysis (ASTM 2005 and HSE 2002). This will provide sufficient test data over the area of concern to evaluate these areas, retaining the ability to calculate corrosion and wear in this area, while reducing the number of data points. Evaluation of these test points at Locations 1 and 2 should allow sufficient evaluation of the 42-inch vapor line in the areas examined. However, if defects are discovered at the test points evaluated, additional testing may be recommended. Subsequent IAPs, to satisfy repeatability criteria, should consider these test points as a new baseline for testing this location.

UT Location 3: In 1993, 456 data points were collected over the entire area (A-L, 1-38). In 1998, only a portion of this area was accessible (A-L, 1-6). It was proposed to repeat

testing in this area since this area was believed to remain accessible for testing. It has since been found that 50 feet of scaffolding are required to re-test the 1998 area. However, an area at the same elevation is available on C-A-1. If the original location is no longer accessible, it is acceptable to test a new area if an old area becomes inaccessible. References indicate that a minimum of 5 test points may be utilized for extreme value distribution analyses (ASTM 2004, ASTM 2005 and Health and Safety Executive [HSE] 2002), however, as a practical matter, predicting the probability of the minimum measurement becomes impractical if the area tested is much less than the total surface area of the equipment evaluated. This is both a function of the range of measurements as well as the ratio between area tested and total surface area. In the case of Location 3, the most defensible testing strategy is to first satisfy the criteria of repeatability. If this cannot be done, than collecting more data to obtain a more statistically stable data set would be the next most defensible action. In evaluating previously collected data from previous IARs, good probability predictions may be obtained from thickness data if thickness data is collected from at least 0.5 to 1 percent of the surface area. This corresponds to testing a minimum of 336 points and up to 660 points (456 were tested in 1993).

Location 5 evaluates the mitered elbow of the 28-inch recirculation line between E-A-1 and P-B-1. The 28-inch line is ¼-inch thick stainless steel and contains a mixture of waste slurry, raw water (RW) and filtered raw water (FRW). Each IAR conducted to date (1993 and 1998) evaluated 52 test points in two 2-inch test grids (Data S and Data T) at Location 5. The current (2007) IAP also recommends 52 test points in the same test grids. ALARA concerns exist at Location 5. Provided that sufficient data may be collected over the area of concern, the number of data points may be reduced. The sample grids for test Location 5 area above this minimum and a reduction could be achieved if safety concerns are sufficiently high. However, the total data points, while higher than those required for statistical analysis, are also lower than at other locations. Further, the location expected to experience wear from contact from the working fluid of the system, is a location of velocity, and pressure change, as well as a low point in the system overall. Finally, there are no accessibility problems indicated for this location. Therefore, at this time it is not recommended to reduce the number of test points at this location since there are no accessibility concerns regarding the location. The current IAP recommends retesting the exiting test grid, replicating the total number of UT points in the existing grid (52 UT points).

UT Location 7: In 1993, 112 data points were tested at Locations S, T, U, and V. In 1998, only 7 U and V were tested for a total of 48 test points. It was proposed to return to the same locations as in 1993 but omit columns A and D from 7S, 7T, 7U, and 7V because of ALARA concerns accessibility problems and noting that little variability in previous thickness measurements existed at this location. It has since been determined by site inspection prior to the 2007 IA that 7T and 7U are not accessible, which is likely to be the reason these test locations at Location 7 were not evaluated in 1998. From that perspective, it would be valid repeat testing of grids 7UV and not collect data from 7ST. However, to maintain a statistically significant data set, it is no longer recommended to

reduce the number of points collected in 7U and 7V (i.e. collect the full number of points from 7UV; do not eliminate columns A and D).

Location 15 evaluates the slurry drain line from the 28-inch recirculation line. The line is 0.134-inch stainless steel and is in contact with waste slurry. The line is in located in an ALARA concern area, however, no access problems are indicated for the test location. The line is stainless steel in direct contact with concentrated waste slurry. The number of test points evaluated in the 1993 IAR was 13 points and 12 points in 1998. The current IAP (2007) proposes to evaluate 12 UT points. Applicable guidance documentation (ASTM 2005 and HSE 2002) recommend evaluating at least 5 points for statistical data analysis. Testing should also be repeated at the same test points to satisfy the repeatability criteria unless test points are inaccessible. The line is in direct contact with concentrated waste slurry. Therefore, it is recommended to retain the currently recommended UT points at Location 15.

Location 18 evaluates the bottom of the 28-inch recirculation line along the mitered elbow to Valve HV CA1-7 between C-A-1 and P-B-1. As previously stated, the 28-inch line is ¼-inch stainless steel, and is in contact with a mixture of waste slurry, RW, and FRW. The location has been added in the current IAP (2007) and was not previously evaluated in the 1993 or 1998 IARs. It is proposed to evaluate 28 UT points in a 2-inch grid along the mitered elbow. The location is in an ALARA concern area, however, no accessibility problems are indicated. Applicable guidance documentation (ASTM 2005 and HSE 2002) recommend evaluating at least 5 points for statistical data analysis. Testing at this location exceeds the number of minimum points recommended, however, the line is in direct contact with concentrated waste slurry. In addition, the location is at a low point in the evaporator system; represents a direction change, as well as a pressure drop in the system. Therefore, while ALARA concerns exist in this location, it is not recommended to reduce the number of UT points in this area.

Condenser Room Locations

Location 9 evaluates the E-C-1 primary condenser shell. The E-C-1 shell is constructed of ½-inch carbon steel. in contact with process condensate and vapor. The 1993 IAR evaluated 603 data points at Location 9. The 1998 evaluated 616 data points. The current IAP (2007) proposes to evaluate 616 data points. No ALARA or accessibility concerns are indicated at this location. The E-C-1 shell is not in contact with concentrated process waste, however, the shell is constructed of carbon steel, which should warrant closer monitoring than a superior material under similar conditions. It is recommended to retain the UT data points evaluated in 1998 and previously recommended in the 2007 IAP (616 points).

Location 11 evaluates the TK-C-100 tank shell. The tank is constructed of 5/16-inch 347 and 304L stainless steel. The tank is in contact with process condensate. No ALARA or accessibility concerns are indicated at this location. The 1993 and 1998 IARs evaluated 432 points at Location 10. The current IAP (2007) proposes to evaluate 432 points. The TK-C-100 shell is not in contact with concentrated process waste and is constructed of

stainless steel. However, the tank represents both a lowpoint and endpoint of the condensate collection system. Given these concerns and the absence of reducing points based on safety concerns or engineering judgment, it is recommended to retain the currently recommended UT points.

Location 12 evaluates the E-C-2 inter condenser shell. The E-C-2 shell is constructed of 5/16-inch carbon steel in contact with process condensate and vapor. The 1993 and 1998 evaluated a similar number of UT points (72 and 75 points, respectively). The current IAP (2007) recommends evaluating 72 UT points. No ALARA or accessibility concerns are indicated at this location. The E-C-2 shell is not in contact with concentrated process waste, however, the shell is constructed of carbon steel, which should warrant closer monitoring than a superior material under similar conditions. It is recommended to retain the UT data points evaluated in 1998 and previously recommended in the 2007 IAP (72 points).

Location 13 evaluates the E-C-3 after condenser shell. The E-C-3 shell is constructed of 5/16-inch carbon steel in contact with process condensate and vapor. The 1993 and 1998 evaluated 39 UT points in a 2-inch grid. The currently IAP (2007) also recommends evaluating 39 UT points in a 2-inch grid. No ALARA or accessibility concerns are indicated at this location. The E-C-2 shell is not in contact with concentrated process waste, however, the shell is constructed of carbon steel, which should warrant closer monitoring than a superior material under similar conditions. Further, the number of UT points per circumferential band is not much higher than the minimum recommended by ASTM for statistical analysis. It is recommended to retain the UT data points evaluated in 1998 and previously recommended in the 2007 IAP (39 points in a 2-inch grid).

Location 16 evaluates the C-100 drain line to the LERF (3"DR-359-M42). The line is 0.216-inch carbon steel. The line drains process condensate from tank C-100. The 1993 and 1998 IARs evaluated 12 UT points in a 2-inch grid. The current IAP (2007) also recommends evaluating 12 UT points in a 2-inch grid. No ALARA or accessibility concerns are indicated at this location. The drain line is not in contact with concentrated process waste, however, the line is constructed of carbon steel, which should warrant closer monitoring than a superior material under similar conditions. Further, the number of UT points per grid is not much higher than the minimum recommended by ASTM for statistical analysis. It is recommended to retain the UT data points evaluated in 1998 and previously recommended in the 2007 IAP (12 points in a 2-inch grid).

Location 17 evaluates the 6-inch vapor line between E-C-1 and E-C-2 (6" VAC-M42). The line is constructed of 0.280-inch carbon steel. The line is in contact with process condensate and vapor. The 1993 and 1998 IARs evaluated 12 UT points in a 2-inch grid. The current IAP (2007) also recommends evaluating 12 UT points in a 2-inch grid. No ALARA or accessibility concerns are indicated at this location. The vapor line is not in contact with concentrated process waste, however, the line is constructed of carbon steel, which should warrant closer monitoring than a superior material under similar conditions. Further, the number of UT points per grid is not much higher than the minimum recommended by ASTM for statistical analysis. It is recommended to retain the UT data

points evaluated in 1998 and previously recommended in the 2007 IAP (12 points in a 2-inch grid).

References

ASTM (2004). ASTM G16-1995 (Reapproved 2004) Standard guide for applying statistics to analysis of corrosion data.

ASTM (2005) G 46(2005) G46-94(2005) Standard Guide for Examination and Evaluation of Pitting Corrosion

Health and Safety Executive (2002). Guidelines for use of statistics for analysis of sample inspection of corrosion

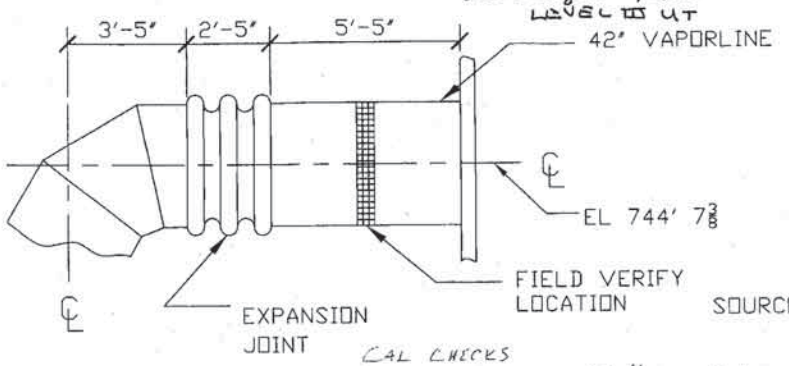
ATTACHMENT 6B

UTRASONIC TESTING RESULTS

2007 INTEGRITY ASSESSMENT

(23 Pages)

Wesley W. Ru
LEVEL III UT



COMPONENT: 42" VAPOR LINE (5/16" Thk SS)
DESCRIPTION: 42" EVAPORATOR LINE DOWNSTREAM OF EXPANSION JOINT
GRID: 6" WIDE X 42" DIA 2" GRID

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: WHC 1993b
DRAWING H-2-69340, SH -0F-, REV 3 (USDOE 1977)

SCALE: 1:40

CAL CHECKS
.200"
.299"
.299"
.198"
.299"
.400"

Date: 9/30/07

	A	B	C	D		A	B	C	D		A	B	C	D		A	B	C	D
1	.316"			.321"	17	.319"			.317"	33	.320"			.320"	49	.320"			.320"
2	.318"			.319"	18	.320"			.320"	34	.320"			.320"	50	.320"			.321"
3	.318"			.322"	19	.318"			.316"	35	.320"			.319"	51	.320"			.323"
4	.317"			.319"	20	.318"			.319"	36	.319"			.319"	52	.320"			.322"
5	.317"			.317"	21	.318"			.318"	37	.319"			.320"	53	.321"			.322"
6	.317"			.319"	22	.318"			.318"	38	.321"			.321"	54	.321"			.321"
7	.316"			.317"	23	.318"			.319"	39	.318"			.320"	55	.319"			.322"
8	.315"			.318"	24	.317"			.318"	40	.318"			.319"	56	.322"			.321"
9	.319"			.321"	25	.303"			.317"	41	.318"			.318"	57	.321"			.320"
10	.321"			.321"	26	.318"			.316"	42	.320"			.318"	58	.321"			.320"
11	.317"			.319"	27	.317"			.318"	43	.317"			.318	59	.320"			.320"
12	.311"			.317"	28	.316"			.318"	44	.318"			.319"	60	.321"			.319"
13	.312"			.317"	29	.317"			.318"	45	.318"			.318"	61	.320"			.320"
14	.317"			.318"	30	.318"			.318"	46	.319"			.320"	62	.319"			.318"
15	.319"			.319"	31	.318"			.318"	47	.320"			.321"	63	.319"			.317"
16	.316"			.317"	32	.320"			.321"	48	.319"			.321"	64	.319"			.318"
															65	.319			.318"

1 MUC 5045

REVISIONS
REV | DATE | DRAWN | CHECK | REMARKS

TechnoGeneral Services Company
Engineering and Construction Management
DESIGNED BY: KP
DRAWN BY: VCAD
CHECKED BY: XX
RE-CHECKED BY: XX
APPROVED BY: XX
DATE: 15 NOVEMBER 2006

242-A Evaporator
Integrity Assessment
Hanford Reservation

LOCATION 1, 42" VAPOR LINE
Downstream of
Expansion Joint

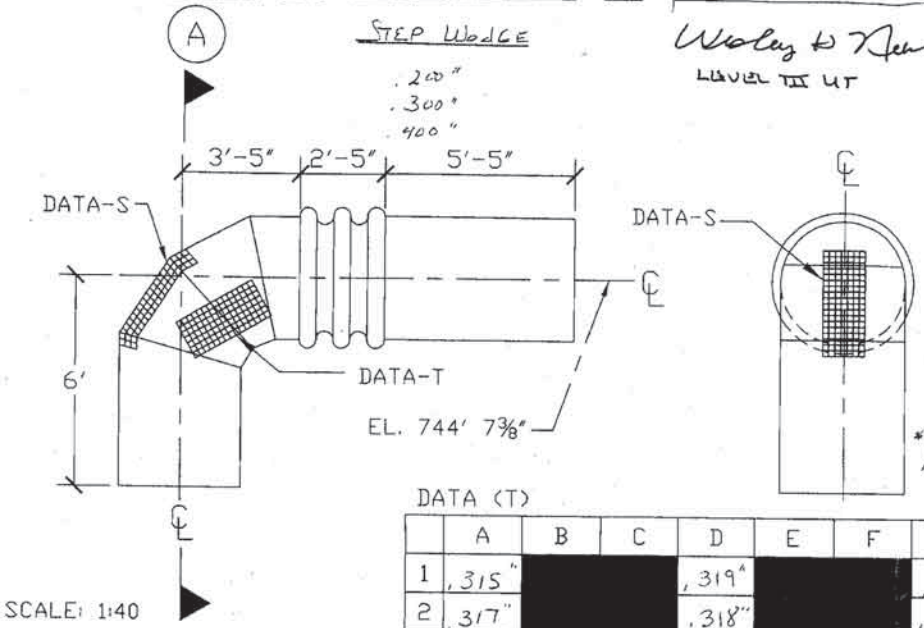
COOPER ZIETZ ENGINEERS, INC.

Drawing Number:
6.3

STEP WEDGE

.200"
.300"
.400"

Wally to Jim
LEVEL III UT



SCALE: 1:40

4/20/07 DATE

CAL IN 2000
.200"
.299"
.400"

CAL OUT 2115
.397"
.300"
.195"

COMPONENT: 42" VAPOR LINE (5/16" Thk SS)
DESCRIPTION: MITERED ELBOW ON 42" EVAPORATOR LINE UPSTREAM OF EXPANSION
GRID: 2" GRID

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: WHC 1993b
DRAWING H-2-69340, SH -0F-, REV 3 (USDOE 1977)

DATA (T)

	A	B	C	D	E	F	G
1	.315"			.319"			.318"
2	.317"			.318"			.317"
3	.315"			.324"			.314"
4	.322"			.323"			.322"
5	.321"			.322"			.322"
6	.320"			.322"			.322"
7	.323"			.323"			.323"
8	.321"			.322"			.322"
9	.322"			.323"			.294"
10	.321"			.323"			.324"
11	.323"			.323"			.324"
12	.321"			.323"			.324"
13	.308"			.323"			.323"
14	.320"			.315"			.321"
15	.320"			.316"			.324"
16	.321"			.318"			.304"

DATA (S)

"C" Weld Interference with "D"

	A	B	C	~~D~~	E	F	G
*1	.291"			.290"			.304"
2	.313"			.317"			.326"
3	.316"			.316"			.326"
4	.315"			.317"			.326"
5	.317"			.318"			.327"
6	.317"			.317"			.326"
7	.318"			.318"			.328"
8	.317"			.318"			.325"
9	.318"			.319"			.327"
10	.318"			.320"			.327"
11	.317"			.319"			.327"
12	.318"			.321"			.327"
13	.317"			.320"			.327"
14	.317"			.319"			.327"
15	.319"			.319"			.328"
16	.317"			.321"			.328"
17	.315"			.319"			.324"
18	.301"			.318"			.322"
19	.329"			.330"			.339"

REVISIONS

REV	DATE	DRWN	CHKD	REMARKS

TechnoGeneral Services Company
Engineering and Construction Management

DESIGNED BY: XX
DRAWN BY: SSG
CHECKED BY: XX
RE-CHECKED BY: XX
APPROVED BY: XX
DATE: 30 NOVEMBER 2006

242-A Evaporator
Integrity Assessment
Hanford Reservation

LOCATION 2, 42" VAPOR LINE

COOPER ZIETZ ENGINEERS, INC.

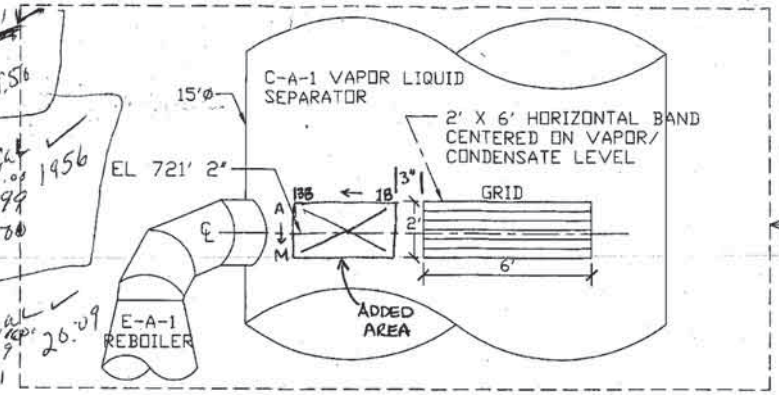
Drawing Number:
6.4

11/28/07 Cal-in: 19.29 100 .100 300 .299 500 .500 / 100 .298 .500 19.56

	1	2	3	4	5	6
A	385	.384	383	382	.380	.381
B	384	.384	.383	.383	.381	.380
C	384	.384	.383	.382	.382	.380
D	385	.385	.384	.384	.381	.380
E	384	.384	.384	.383	.382	.381
F	385	.385	.384	.383	.382	.381
G	385	.385	.384	.384	.381	.382
H	386	.386	.384	.384	.380	.381
I	386	.385	.384	.384	.383	.382
J	386	384	.385	.384	.383	.383
K	386	385	.384	.384	.383	.382
L	385	385	.384	.384	.382	.382

Cal 1956 100 299 500

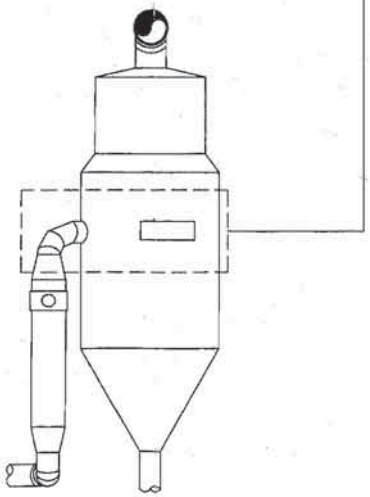
Cal 20.09 279 501



SCALE: 1:50

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	382	.382	.383	.384	386	385	385	380	379	380	380	381		
B	.381	.382	.383	.383	385	384	382	381	380	380	381			
C	.381	.382	.383	.382	385	384	382	380	380	379	381			
D	.382	.384	.382	.383	385	384	382	380	379	381	381			
E	.383	.383	.383	.382	385	384	382	382	380	383	380			
F	.383	.383	.383	384	385	384	382	381	381	379	379			
G	383	.384	.383	382										
H	382	.384	.383	384										
I	384	.384	.383	384										
J	383	.384	.383	384										
K	383	.384	.383	.384										
L	.383	.383	~~.385~~ .377	.383										



SOURCE: WHC 1998b DRAWING H-2-69340, SH -0F-, REV 3 (USDOE 1977)

REVISIONS

TechnoGeneral Services Company
Engineering and Construction Management

242-A Evaporator
Integrity Assessment
Hanford Reservation

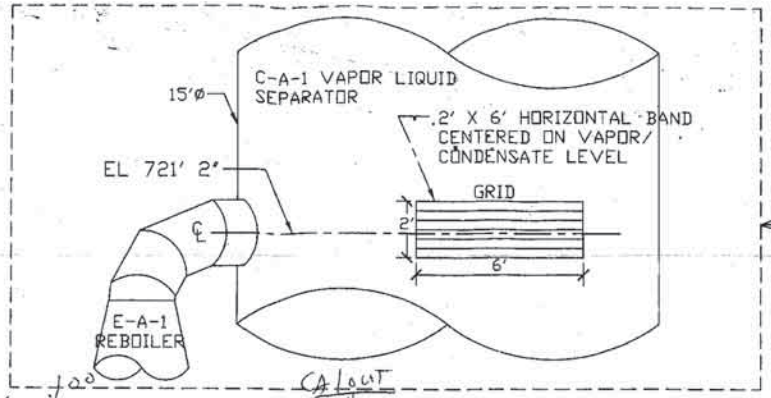
LOCATION 3
C-A-1 EVAPORATOR

COOPER ZIETZ ENGINEERS, INC.

Drawing Number 6.5A

	21	22	23	24	25	26
A			378	378	377	379
B			378	377	378	380
C			378	378	378	378
D			378	378	378	378
E			377	377	378	377
F			378	378	378	378
G						
H						
I						
J						
K						
L						

Time ✓ 20:41



+20 299 501

CA LOWT 2104 100 209 309

Cal ✓ 20:46

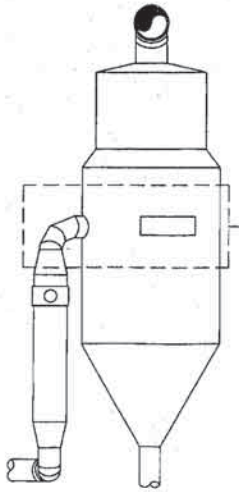
SCALE: 1:50

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

	27	28	29	30	31	32	33	34	35	36	37	38	39	40
A	377	376	377	381	378	377	374	367	370	370	369			
B	373	376	376	377	379	377	373	370	371	370	370			
C	377	376	376	377	377	378	372	371	370	370	372			
D	377	376	377	377	379	376	373	370	369	369	371			
E	375	376	376	377	378	377	369	370	370	370	370			
F	377	376	375	377	378	376	373	370	369	369	372			
G														
H														
I														
J														
K														
L														

Signed 34 35 36 37 38

SKSP 34 PCP 35 CLEAN



SOURCE: WHC 1998b DRAWING H-2-69340, SH -OF-, REV 3 (USDOE 1977)

REVISIONS

REV	DATE	APPROVED	REMARKS

TechnoGeneral Services Company
Engineering and Construction Management

DESIGNED BY: XX
DRAWN BY: VCAD
CHECKED BY: XX
RE-CHECKED BY: XX
APPROVED BY: XX
DATE: 15 NOVEMBER 2000

242-A Evaporator
Integrity Assessment
Hanford Reservation

LOCATION 3
C-A-1 EVAPORATOR

COOPER ZIETZ ENGINEERS, INC.

Drawing Number:
6.5B

CAL ✓ 10:43

12/4/07 10:35

in:

200
299
500

198
298
498

AL Frisbee
313-007
FAX 313-7606

	13B	12B	11B	10B	9B	8B	7B	6B	5B	4B	3B	2B	1B	
	.384	.384	.385	.384	.385	.382	.383	.384	.386	.386	.387	.387	.383	A
	.385	.385	.384	.384	.383	.382	.383	.385	.386	.386	.387	.383	.384	B
	.384	.388	.384	.383	.382	.382	.383	.384	.386	.386	.387	.386	.386	C
	.383	.383	.382	.383	.382	.387	.384	.385	.385	.385	.385	.385	.385	D
	.384	.385	.383	.383	.381	.383	.384	.385	.385	.387	.388	.387	.386	E
	.385	.384	.384	.383	.382	.382	.384	.384	.385	.387	.387	.387	.386	F
	.385	.385	.385	.386	.383	.381	.384	.384	.386	.387	.387	.387	.386	G
	.384	.382	.382	.381	.380	.380	.382	.382	.384	.385	.385	.384	.384	H
	.383	.383	.382	.381	.381	.380	.382	.383	.386	.386	.386	.385	.385	I
	.377	.376 ~~.381~~	.383 ~~.381~~	.381 ~~.384~~	.380 ~~.381~~	.381 ~~.380~~	.383 ~~.380~~	.383	.384 ~~.386~~	.385 ~~.384~~	.385	.385	.385	J
*	.358	.378 ~~.381~~	.382	.381	.380	.381	.384	.384	.384	.386	.386	.386	.386	K
*	.343	.382	.382	.380	.380	.382	.383	.384	.385	.386	.387	.386	.385	L
	.375	.382	.383	.381	.381	.381	.383	.382	.385	.387	.386	.386	.385	M

LOCATION 3
ADDITIONAL UT GRID

PAGE 4 OF 4

DATA (S)

	A	B	C	D
1	.265"	.264"	.265"	.265"
2	.266"	.265"	.265"	.265"
3	.266"	.264"	.261"	.265"

DATA (T)

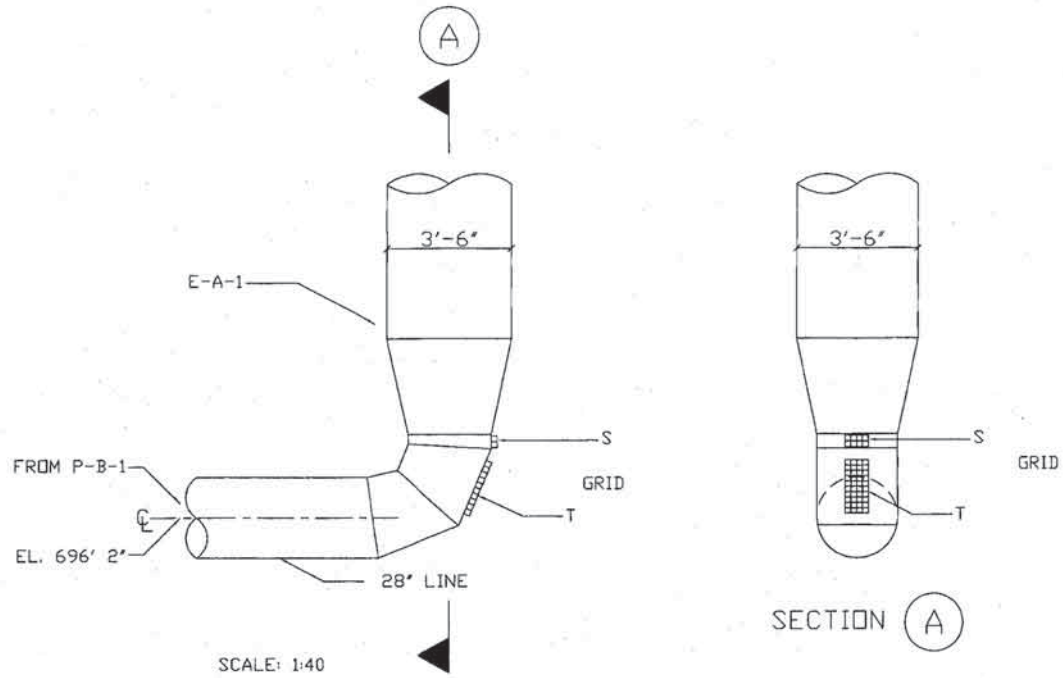
	A	B	C	D
1	.268"	.242"	.254"	.266"
2	.269"	.269"	.255"	.265"
3	.268"	.268"	.260"	.265"
4	.269"	.267"	.258"	.265"
5	.270"	.262"	.262"	.266"
6	.271"	.262"	.262"	.265"
7	.269"	.269"	.260"	.265"
8	.270"	.269"	.264"	.265"
9	.271"	.270"	.264"	.267"
10	.271"	.267"	.266"	.267"

DATE: 5/2/07

CAL. STEP WEDGE
.100"
.400"
.600"

CAL. IN 1410
.100"
.399"
.600"

CAL. OUT 1420
.101"
.399"
.600"



NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

LEVEL III UT

SOURCE: WHC 1993b
DRAWING H-2-69340, SH -0F-, REV 3 (USDOE 1977)

REVISIONS

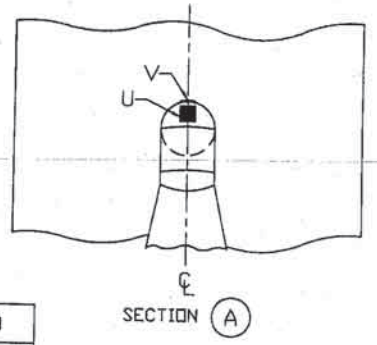
TechnoGeneral Services Company
Engineering and Construction Management

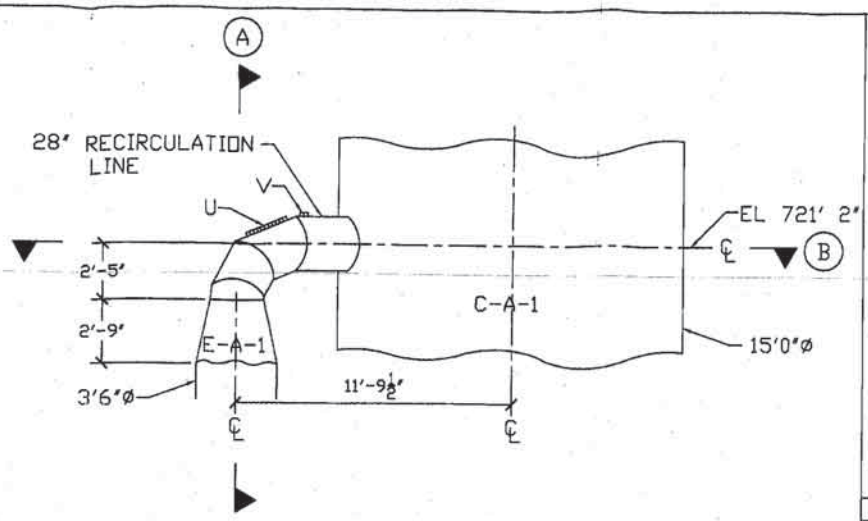
242-A Evaporator
Integrity Assessment
Hanford Reservation

LOCATION 5
28"RECIRC LINE

COOPER ZIETZ ENGINEERS, INC.

Drawing Number:
6.6





DATA (U)

	A	B	C	D
1	250	250	250	245
2	249	250	251	250
3	251	250	250	250
4	249	252	252	253
5	248	250	251	251
6	248	253	252	250
7	250	252	252	250
8	249	250	251	250
9	249	249	250	249
10	249	249	249	248
11	234	235	240	233

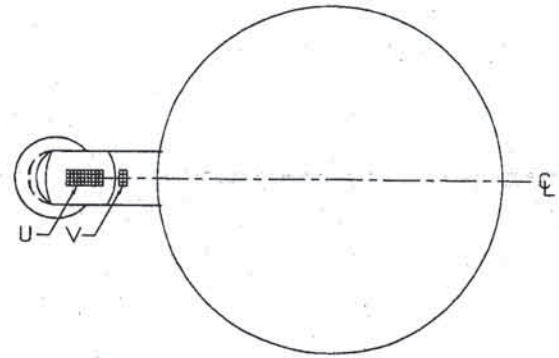
DATA (V)

	A	B	C	D
1	250	249	249	249
2	248	247	248	247
3		WELD		

COMPONENT: LINE 1-1.4 (½" Thk SS)
DESCRIPTION: 6" WIDE ALONG LENGTH OF MITERED ELBOW, TO EXTEND 2" ON EACH SIDE
GRID: 2" GRID

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: LMHC 1998b
DRAWING H-2-69340, SH -OF-, REV 3 (USDOE 1977) AND H-2-99029, SH 1 OF 1, REV 2 (USDOE 1989)



SECTION (B)

REVISIONS

TechnoGeneral Services Company
Engineering and Construction Management

242-A Evaporator
Integrity Assessment
Hanford Reservation

LOCATION 7
28" RECIRC LINE

COOPER ZIETZ ENGINEERS, INC.

Drawing Number:
6.7

DATE: 4/13/01 CAL. STEP WEDGE CAL. IN 1110 CAL. OUT 1123

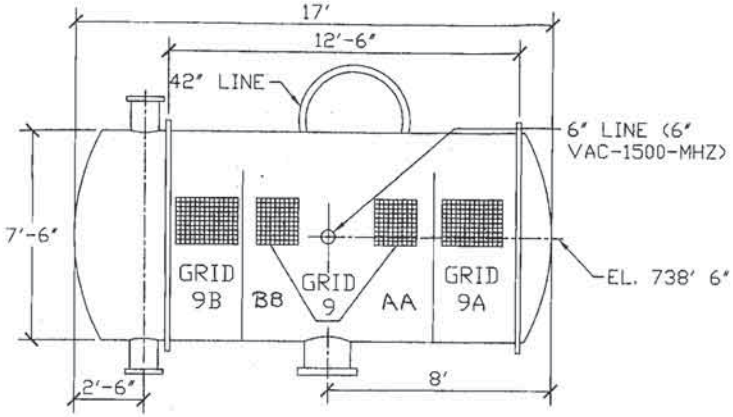
Wolfgang Zu LEVEL III UT

.250"	.250"	.251"
.500"	.500"	.501"
.750"	.750"	.751"

PAGE 2 of 11

GRID 9 AA

	A	B	C	D	E	F	G	H	I
1	.515"	.514"	.515"	.514"	.514"	.516"	.516"	.516"	.518"
2	.519"	.515"	.515"	.519"	.519"	.518"	.517"	.518"	.518"
3	.514"	.514"	.516"	.516"	.518"	.517"	.517"	.518"	.517"
4	.514"	.514"	.516"	.516"	.516"	.516"	.517"	.518"	.520"
5	.515"	.512"	.515"	.514"	.515"	.517"	.519"	.520"	.520"
6	.518"	.514"	.513"	.513"	.515"	.515"	.515"	.518"	.518"
7	.512"	.510"	.516"	.516"	.513"	.515"	.515"	.517"	.519"
8	.512"	.515"	.513"	.513"	.514"	.512"	.514"	.517"	.517"
9	.514"	.513"	.515"	.517"	.515"	.518"	.516"	.517"	.517"
10	.514"	.515"	.515"	.519"	.514"	.518"	.515"	.516"	.514"
11	.512"	.511"	.512"	.514"	.506"	.514"	.516"	.516"	.514"



SCALE: 1:50 E-C-1 PRIMARY CONDENSER

GRID 9A

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	.508"	.509"	.508"	.509"	.510"	.512"	.511"	.511"	.512"	.510"	.512"	.512"	.515"
2	.508"	.510"	.508"	.514"	.512"	.513"	.515"	.515"	.514"	.514"	.514"	.514"	.516"
3	.507"	.508"	.508"	.510"	.512"	.513"	.515"	.517"	.513"	.512"	.513"	.514"	.515"
4	.507"	.510"	.508"	.510"	.511"	.510"	.514"	.514"	.514"	.514"	.513"	.515"	.515"
5	.508"	.510"	.510"	.511"	.512"	.510"	.512"	.515"	.512"	.512"	.515"	.515"	.516"
6	.508"	.509"	.510"	.510"	.512"	.512"	.511"	.513"	.514"	.514"	.516"	.517"	.519"
7	.510"	.510"	.512"	.512"	.513"	.511"	.512"	.515"	.512"	.513"	.513"	.514"	.517"
8	.509"	.510"	.511"	.512"	.513"	.513"	.513"	.515"	.513"	.513"	.513"	.513"	.516"
9	.508"	.510"	.511"	.510"	.511"	.510"	.511"	.512"	.512"	.513"	.511"	.511"	.515"
10	.508"	.508"	.509"	.511"	.510"	.511"	.512"	.514"	.513"	.511"	.512"	.510"	.517"
11	.507"	.509"	.508"	.509"	.513"	.514"	.516"	.517"	.519"	.514"	.512"	.513"	.519"

CAL. IN 1125 CAL. OUT 1145

.250"	.249"
.500"	.499"
.750"	.750"

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: LMHC 1998b
DRAWING H-2-99034, SH 1 OF 1,
REV 2 (USDOE 1989)

REVISIONS

TechnoGeneral Services Company
Engineering and Construction Management

242-A Evaporator
Integrity Assessment
Hanford Reservation

E-C-1 PRIMARY CONDENSER
LOCATION 9A, 9
AND 9B

COOPER ZIETZ ENGINEERS, INC.

Drawing Number:
6.8A

DATE: 4/13/01 CAL. STEP WEDGE CAL. IN 1315 CAL. OUT 1336

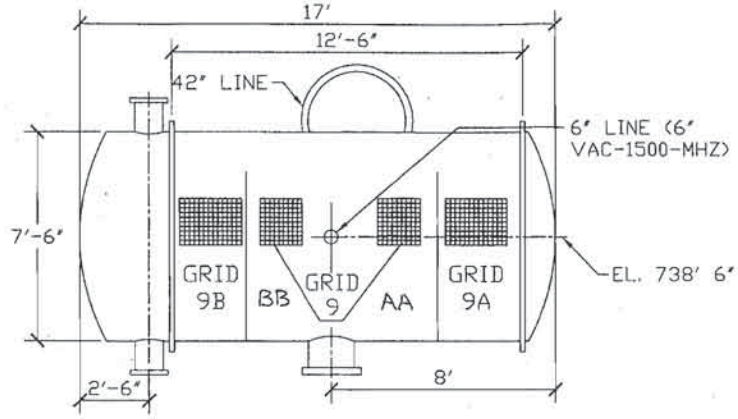
Wesley D. Allen LEVEL III UT

.250"	.250"	.248"
.500"	.500"	.498"
.750"	.750"	.750"

PAGE 3 of 11

GRID 9 BB

	A	B	C	D	E	F	G	H	I
1	.518"	.517"	.519"	.516"	.518"	.517"	.519"	.518"	.520"
2	.519"	.518"	.518"	.517"	.518"	.518"	.514"	.518"	.518"
3	.518"	.520"	.518"	.520"	.519"	.520"	.514"	.519"	.520"
4	.514"	.517"	.518"	.518"	.518"	.517"	.519"	.517"	.516"
5	.520"	.519"	.519"	.516"	.521"	.518"	.521"	.519"	.519"
6	.519"	.521"	.522"	.515"	.520"	.518"	.520"	.521"	.517"
7	.516"	.513"	.516"	.515"	.514"	.514"	.514"	.514"	.516"
8	.513"	.513"	.514"	.513"	.514"	.513"	.513"	.515"	.516"
9	.518"	.516"	.514"	.518"	.517"	.516"	.514"	.516"	.517"
10	.514"	.514"	.515"	.516"	.515"	.517"	.515"	.516"	.517"
11	.515"	.513"	.517"	.516"	.514"	.517"	.514"	.515"	.516"



SCALE: 1:50 E-C-1 PRIMARY CONDENSER

GRID 9B

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	.522"	.520"	.518"	.517"	.517"	.516"	.515"	.513"	.513"	.513"	.512"	.513"	.512"
2	.522"	.518"	.517"	.516"	.516"	.516"	.512"	.513"	.512"	.513"	.511"	.512"	.509"
3	.522"	.522"	.520"	.517"	.519"	.518"	.515"	.515"	.515"	.513"	.515"	.512"	.513"
4	.524"	.520"	.518"	.516"	.516"	.515"	.515"	.514"	.514"	.518"	.514"	.520"	.518"
5	.523"	.521"	.519"	.520"	.518"	.515"	.515"	.515"	.515"	.515"	.514"	.513"	.513"
6	.525"	.521"	.518"	.517"	.517"	.518"	.516"	.515"	.513"	.516"	.516"	.515"	.508"
7	.526"	.521"	.520"	.517"	.520"	.516"	.519"	.514"	.514"	.516"	.515"	.513"	.512"
8	.523"	.518"	.517"	.515"	.517"	.516"	.515"	.515"	.512"	.513"	.515"	.510"	.510"
9	.523"	.520"	.521"	.519"	.518"	.517"	.515"	.515"	.517"	.515"	.513"	.510"	.511"
10	.522"	.522"	.519"	.518"	.518"	.517"	.517"	.518"	.521"	.521"	.517"	.513"	.513"
11	.520"	.518"	.517"	.519"	.516"	.518"	.516"	.516"	.522"	.521"	.516"	.513"	.513"

CAL. IN 1345 CAL. OUT 1403

.250"	.250"
.500"	.500"
.751"	.751"

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: LMHC 1998b
DRAWING H-2-99034, SH 1 OF 1, REV 2 (USDOE 1989)

NOTE: AT two locations an inclusion and/or lamination were found out side the grid point. The two locations are 9-B (.154") and 11-M (.140") on grid 9B.

REVISIONS

TechnoGeneral Services Company
Engineering and Construction Management

242-A Evaporator
Integrity Assessment
Hanford Reservation

E-C-1 PRIMARY CONDENSER
LOCATION 9A, 9 AND 9B

COOPER ZIETZ ENGINEERS, INC.

Drawing Number: 6.8B

PREVIOUS TEST LOCATION IS UNKNOWN. TEST LOCATION SELECTED IS THE SOUTH SIDE OF TK-C-100. ACCESSIBLITY OF THE TEST LOCATION TO BE FIELD VERIFIED.

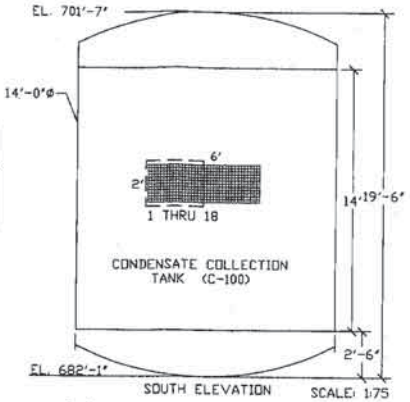
SOURCE: WHC 1993b
DRAWING H-2-69357, SH - OF -, REV 2 (USDOE 1976)

CAL Out: 1739
.100"
.200"
.299"
.399"

PAGE 8 of 11

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	.323"	.321"	.322"	.323"	.322"	.323"	.320"	.322"	.322"	.323"	.328"	.327"	.326"	.325"	.325"	.325"	.324"	.326"
B	.321"	.321"	.320"	.321"	.322"	.322"	.319"	.321"	.321"	.322"	.327"	.326"	.323"	.325"	.324"	.325"	.323"	.326"
C	.320"	.317"	.319"	.318"	.322"	.319"	.318"	.320"	.320"	.320"	.324"	.324"	.323"	.324"	.322"	.322"	.322"	.324"
D	.320"	.318"	.319"	.319"	.322"	.316"	.317"	.319"	.320"	.319"	.322"	.323"	.322"	.322"	.321"	.321"	.322"	.322"
E	.319"	.317"	.318"	.319"	.321"	.316"	.317"	.320"	.320"	.318"	.321"	.322"	.320"	.322"	.320"	.320"	.320"	.322"
F	.321"	.317"	.318"	.317"	.320"	.317"	.315"	.317"	.318"	.318"	.321"	.322"	.324"	.320"	.319"	.320"	.319"	.322"
G	.318"	.318"	.317"	.318"	.320"	.315"	.314"	.317"	.317"	.317"	.321"	.321"	.321"	.321"	.317"	.318"	.319"	.319"
H	.317"	.317"	.318"	.316"	.319"	.314"	.314"	.316"	.315"	.315"	.319"	.319"	.319"	.320"	.317"	.318"	.319"	.320"
I	.319"	.316"	.315"	.316"	.315"	.313"	.313"	.317"	.312"	.316"	.318"	.319"	.317"	.317"	.315"	.317"	.319"	.320"
J	.315"	.314"	.314"	.315"	.316"	.311"	.312"	.316"	.314"	.314"	.318"	.317"	.318"	.317"	.316"	.316"	.319"	.319"
K	.311"	.311"	.312"	.313"	.314"	.310"	.310"	.312"	.313"	.311"	.316"	.315"	.316"	.314"	.315"	.314"	.313"	.316"
L	.309"	.312"	.312"	.312"	.315"	.311"	.308"	.311"	.312"	.311"	.313"	.314"	.313"	.314"	.312"	.313"	.313"	.313"

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A	.326"	.325"	.326"	.326"	.327"	.325"	.325"	.327"	.327"	.326"	.327"	.327"	.327"	.328"	.327"	.327"	.326"	.327"
B	.324"	.324"	.324"	.326"	.324"	.324"	.325"	.327"	.325"	.325"	.326"	.327"	.325"	.329"	.327"	.326"	.325"	.326"
C	.323"	.323"	.323"	.324"	.323"	.323"	.190*	.323"	.322"	.323"	.323"	.323"	.325"	.325"	.324"	.324"	.324"	.326"
D	.320"	.321"	.321"	.322"	.320"	.322"	.323"	.322"	.322"	.322"	.324"	.324"	.326"	.326"	.325"	.324"	.323"	.324"
E	.321"	.320"	.322"	.320"	.319"	.320"	.323"	.322"	.322"	.323"	.325"	.324"	.325"	.324"	.323"	.323"	.321"	.322"
F	.320"	.320"	.320"	.318"	.320"	.320"	.321"	.321"	.320"	.322"	.325"	.325"	.323"	.323"	.321"	.321"	.321"	.321"
G	.321"	.320"	.320"	.317"	.319"	.320"	.321"	.319"	.320"	.322"	.323"	.326"	.323"	.322"	.320"	.319"	.320"	.320"
H	.319"	.320"	.318"	.317"	.319"	.318"	.318"	.317"	.319"	.323"	.322"	.322"	.322"	.321"	.321"	.319"	.319"	.319"
I	.318"	.318"	.317"	.316"	.318"	.317"	.319"	.318"	.317"	.321"	.321"	.322"	.320"	.319"	.319"	.320"	.318"	.320"
J	.318"	.318"	.318"	.315"	.316"	.317"	.319"	.315"	.316"	.320"	.320"	.319"	.319"	.319"	.319"	.319"	.317"	.316"
K	.317"	.314"	.315"	.314"	.314"	.314"	.315"	.317"	.314"	.318"	.318"	.318"	.317"	.319"	.316"	.316"	.314"	.314"
L	.313"	.314"	.313"	.313"	.314"	.313"	.314"	.314"	.312"	.315"	.316"	.316"	.316"	.317"	.316"	.314"	.314"	.314"



Wesley H Rice LEVEL III UT
DATE: 4/17/07

CAL STEP WEDGE: Stainless
.100" .300"
.200" .400"

CAL IN: 1703
.100"
.200"
.299"
.400"

CAL CHECK: Row 11 1707
.99" .397"
.199"
.297"
Re-adjusted & Re-Called

CAL CHECK: Row 26 1731
.100"
.199"
.298"
.398"

REVISIONS

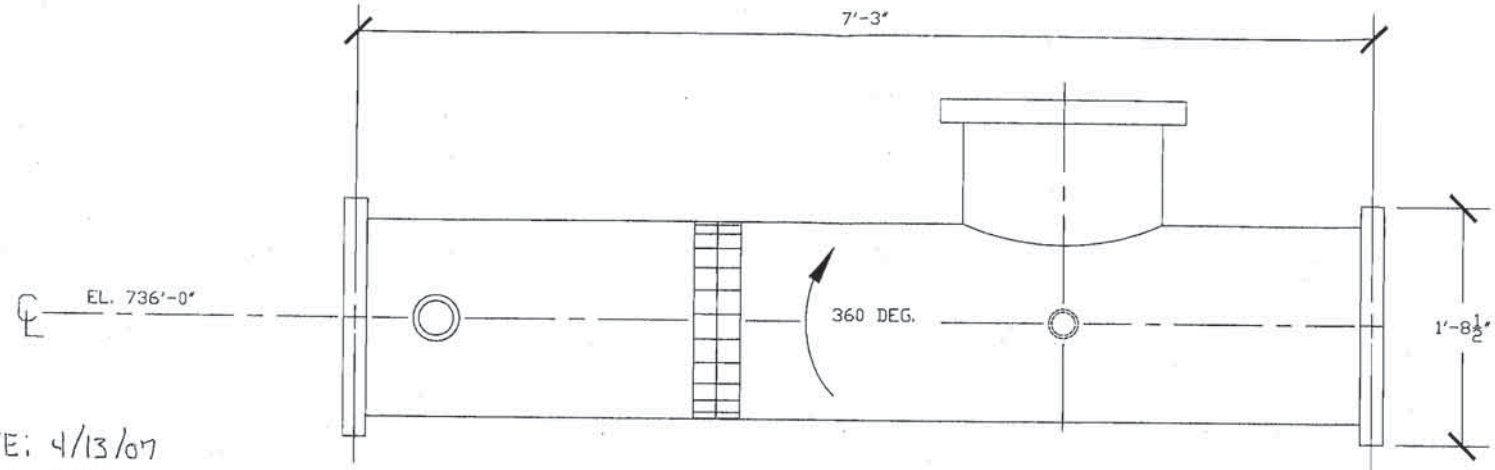
TechnaGeneral Services Company
Engineering and Construction Management

242-A Evaporator
Integrity Assessment
Hanford Reservation

C-100 CONDENSATE COLLECTION TANK LOCATION 11

COOPER ZIETZ ENGINEERS, INC.

Drawing Number:
6.9



DATE: 4/13/07

Wesley D Rau LEVEL III UT

SCALE: 1:10

E-C-2 INTERCONDENSER, 4" BAND 360 DEG.

CAL. STEP WEDGE
.100"
.250"
.500"

CAL. IN 0932
.100"
.250"
.500"

CAL. OUT 0950
.100"
.249"
.500"

NOTE: E-C-2 Covered with thick paint.

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

LOCATIONS ARE APPROXIMATE.

SOURCE: LMHC 1998b
DRAWING H-2-99034, SH 1 OF 1, REV 2
(USDOE 1989)

Grid Points

	1	2	3	4	5	6	7	8	9	10	11	12
C	.312"	.310"	.310"	.311"	.310"	.311"	.322"	.317"	.316"	.317"	.313"	.313"
B	.313"	.311"	.313"	.311"	.311"	.311"	.318"	.317"	.316"	.316"	.314"	.313"
A	.310"	.310"	.312"	.310"	.310"	.310"	.301"	.316"	.316"	.316"	.312"	.311"

	13	14	15	16	17	18	19	20	21	22	23	24	25
C	.309"	.312"	.311"	.312"	.317"	.313"	.315"	.317"	.316"	.316"	.318"	.312"	.307"
B	.312"	.312"	.311"	.312"	.313"	.313"	.314"	.316"	.314"	.314"	.313"	.312"	.310"
A	.311"	.311"	.313"	.312"	.312"	.312"	.314"	.315"	.313"	.314"	.312"	.312"	.311"

REVISIONS

REV. DATE DRAWN CHKD REMARKS

TechnoGeneral Services Company
Engineering and Construction Management

DESIGNED BY: JK RE-CHECKED BY: JK
DRAWN BY: JCAG APPROVED BY: JK
CHECKED BY: KK DATE: 15 NOVEMBER 2006

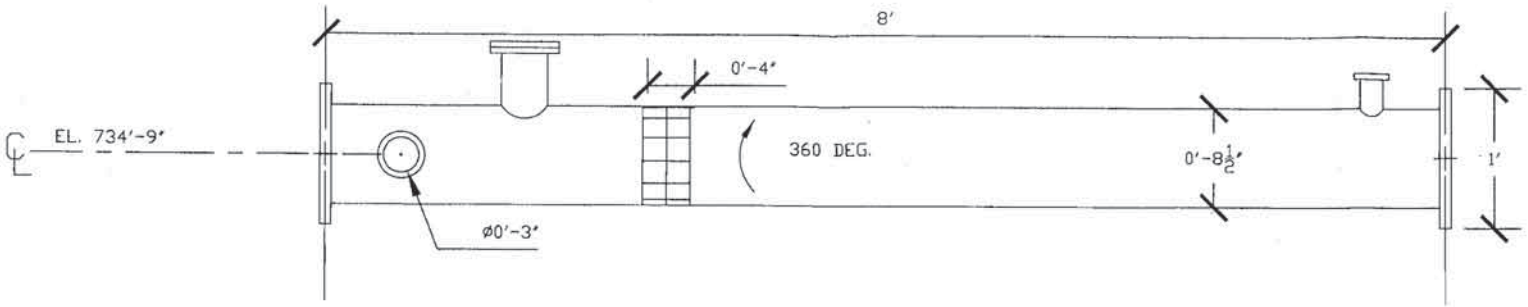
242-A Evaporator
Integrity Assessment
Hanford Reservation

Interecondenser
E-C-2
LOCATION 12

COOPER ZIETZ ENGINEERS, INC.

Drawing Number:
6.10

PAGE 5 of 11



SCALE: 1:10

E-C-3 AFTERCONDENSER 4" BAND 360 DEG.

Grid Points

	1	2	3	4	5	6	7	8	9	10	11	12	13
C	.325"	.326"	.321"	.324"	.336"	.322"	.314"	.323"	.318"	.312"	.319"	.331"	.308"
B	.326"	.324"	.321"	.323"	.335"	.321"	.316"	.325"	.321"	.315"	.321"	.338"	.309"
A	.326"	.322"	.318"	.317"	.337"	.321"	.317"	.327"	.323"	.317"	.325"	.337"	.309"

DATE: 4/13/07 CAL. STEP WEDGE

Wesley D. Rea LEVEL III UT

.100"
.250"
.500"

CAL. IN 1012

.100"
.249"
.499"

CAL. OUT 1019

.101"
.250"
.500"

NOTE: E-C-3 Covered with thick paint.

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

LOCATIONS ARE APPROXIMATE.

SOURCE: LMHC 1998b
DRAWING H-2-99034, SH 1 OF 1, REV 2
(USDOE 1989)

REVISIONS

TechnoGeneral Services Company
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Aftercondenser
E-C-3
LOCATION 13

COOPER ZIETZ ENGINEERS, INC.

Drawing Number:
6.11

PAGE 2 of 4

1 READING EVERY 2" 12 PLACES TOTAL

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

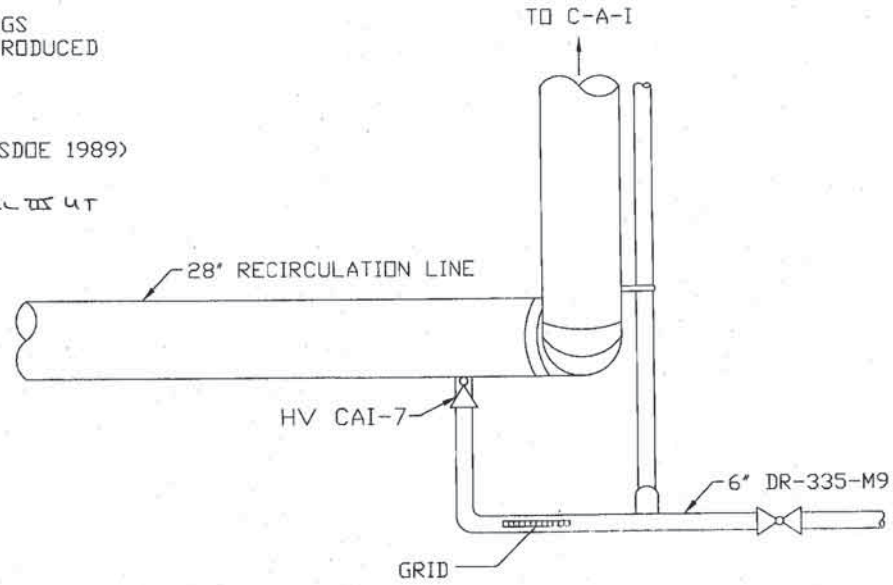
SOURCE: LMHC 1998b
DRAWING H-2-99030, SH 1 OF 1, REV 2 (USDOE 1989)

DATE: 5/2/07 [illegible] LEVEL III UT

CAL. STEP WEDGE
.100"
.400"
.600"

CAL. IN 1345
.100"
.399"
.600"

CAL. OUT 1355
.101"
.400"
.600"



SECT B-B
SCALE: 1:40

Grid Points

	1	2	3	4	5	6	7	8	9	10	11	12
A	.139"	.137"	.138"	.137"	.138"	.138"	.136"	.136"	.136"	.137"	.138"	.138"

REVISIONS

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LOCATION 15
SLURRY DRAIN LINE
LINE 1-3.5

COOPER ZIETZ ENGINEERS, INC.

Drawing Number:
6.12

Date: 4/17/07 Wesley D Nelson LEVEL III UT

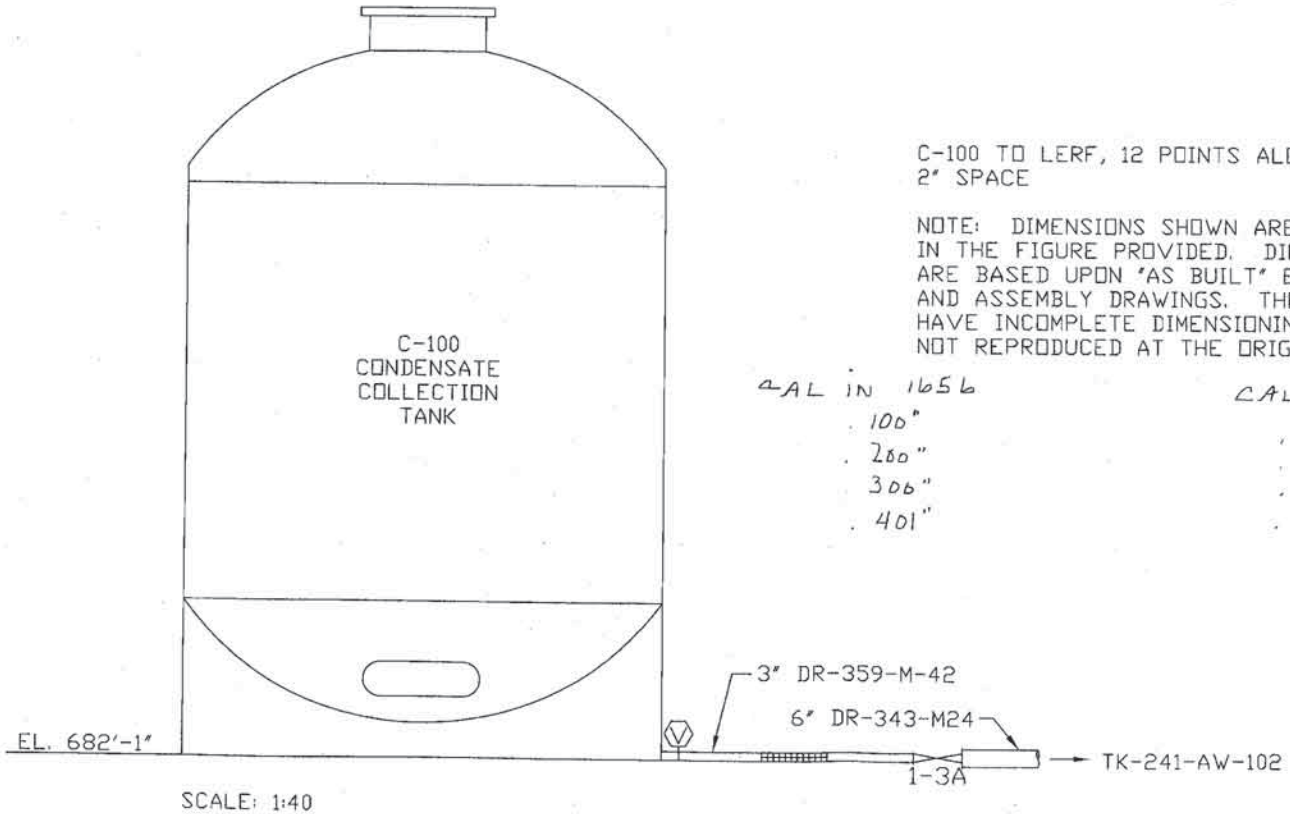
CAL STEP WEDGE Stainless

.100"
.200"
.300"
.400"

PAGE 9 of 11

Grid Points

	1	2	3	4	5	6	7	8	9	10	11	12
A	225"	.223"	.222"	.220"	.218"	.216"	.215"	.215"	.216"	.215"	.216"	.215"



C-100 TO LERF, 12 POINTS ALONG PIPE, 2" SPACE

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

CAL IN 1656
.100"
.200"
.306"
.401"

CAL OUT 1701
.99"
.199"
.299"
.400"

SOURCE: LMHC 1998b
DRAWINGS H-2-69357, SH - OF -, REV 2 (USDOE 1976)
AND H-2-98990, SH 1 OF 2, REV 6 (USDOE 2005)

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PROCESS CONDENSATE
TRANSFER LINE
LOCATION 16

COOPER ZIETZ ENGINEERS, INC.

Drawing Number: 6.13

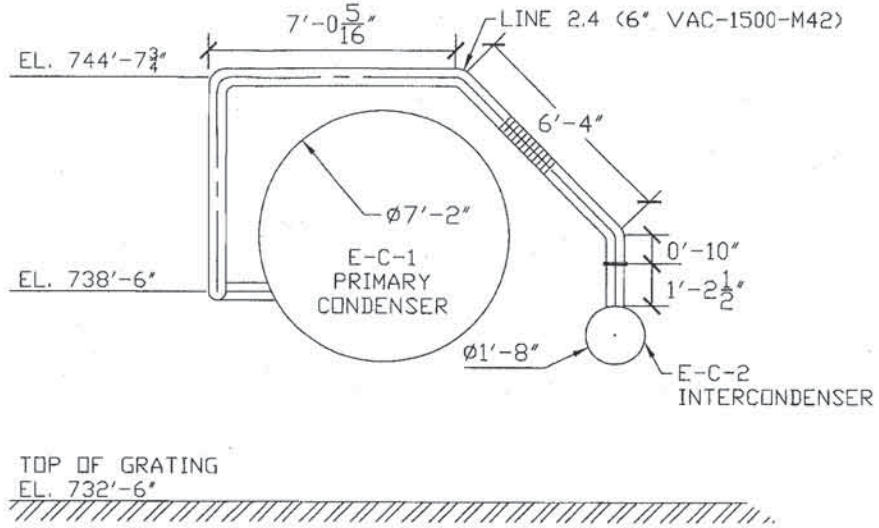
Grid Points

	1	2	3	4	5	6	7	8	9	10	11	12
A	.297"	.310"	.306"	.310"	.306"	.286"	.300"	.303"	.303"	.298"	.300"	.308"

CAL STEP WEDGE CARBON
. 100
. 250
. 500

CAL IN 1756 4/17/07 Wesley H. Nelson LEVEL III UT
. 100"
. 250"
. 500"

CAL out 1758
. 100"
. 251"
. 501"



SCALE: 1:40

12 INDIVIDUAL READINGS ALONG PIPE, 2" SPACE

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: LMHC 1998b
DRAWING H-2-69343, REV 5, SH - OF - (USDOE 1988)

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LOCATION 17
LINE FROM
E-C-1 TO E-C-2

COOPER ZIETZ ENGINEERS, INC.

Drawing Number: 6.14

PAGE 2 OF 2

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: DRAWINGS H-2-69340, SH - OF -, REV (USDOE 1977) AND H-2-99029, SH 1 OF 1, REV 2, (USDOE 1989)

DATA (S)

	A
1	.252"
2	.261"
3	.257"

DATA (T)

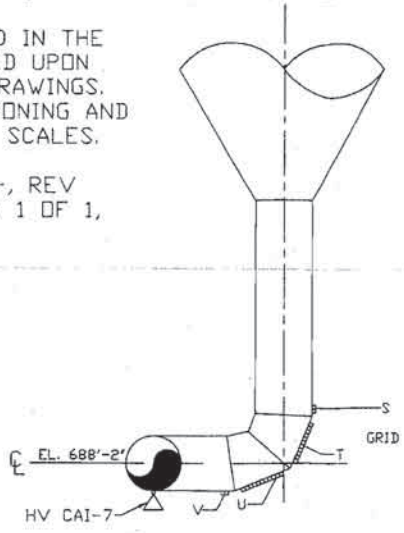
	A
1	.237"
2	.287"
3	.202"
4	.206"
5	.300"
6	.300"
7	.300"
8	.302"
9	.299"
10	.301"
11	.298"

DATA (U)

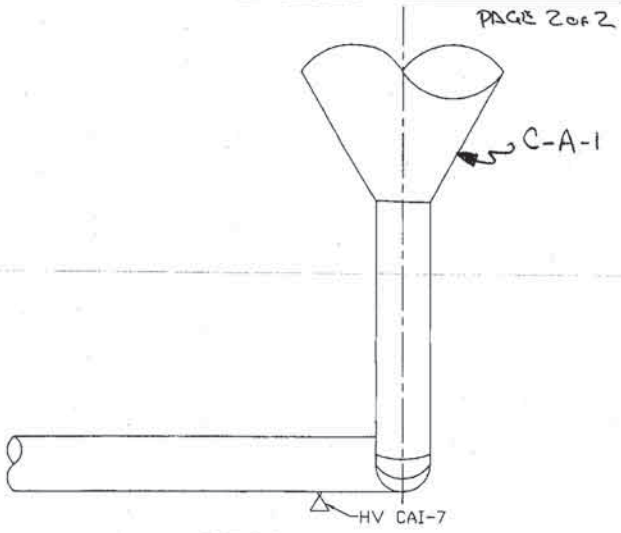
	A
1	.282"
2	.294"
3	.294"
4	.293"
5	.283"
6	.298"
7	.299"
8	.297"
9	.295"
10	N/A
11	N/A

DATA (V)

	A
1	.265"
2	.291"
3	.288"



SECT A-A



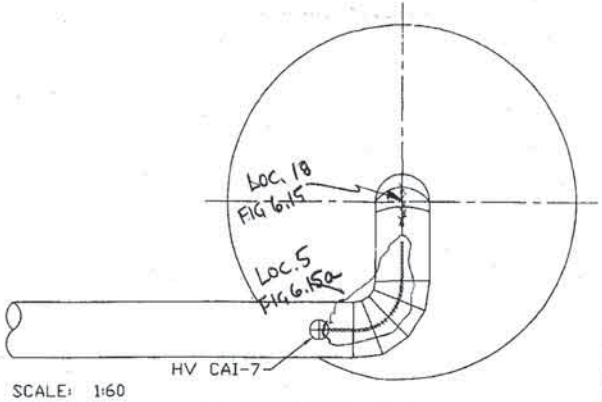
SECT B-B

DATE: 5/4/07 Wesley H. Wilson LEVEL III UT

CAL. STEP WEDGE
.100"
.300"
.400"

CAL. IN 1308
.101"
.300"
.400"

CAL. OUT 1320
.100"
.299"
.399"



SCALE: 1:60

BOTTOM (EXTRAPOLATED) - (FROM H-2-99030 SECTS A-A AND B-B AND H-2-69339)

REVISIONS

TechnoGeneral Services Company
Engineering and Construction Management

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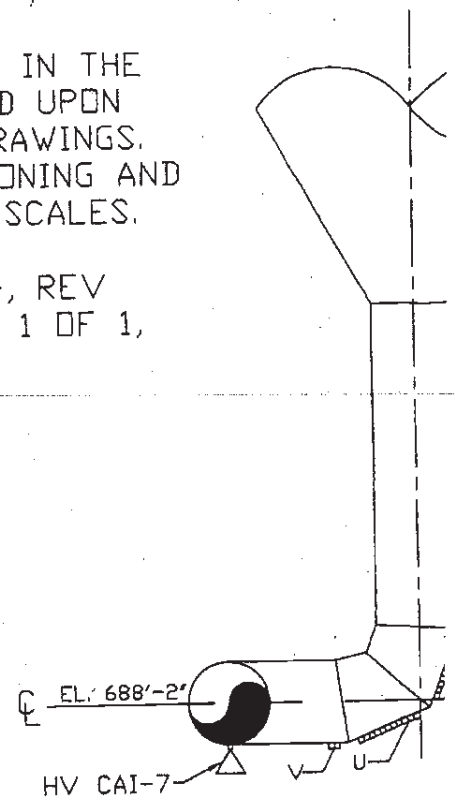
LOCATION 18

COOPER ZIETZ ENGINEERS, INC.

Drawing Number: 6.15

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: DRAWINGS H-2-69340, SH - OF -, REV (USDOE 1977) AND H-2-99029, SH 1 OF 1, REV 2, (USDOE 1989)



SECT A-A

DATE: 5/4/07

CAL. STEP WEDG
.100"
.300"
.400"

CAL. IN 1308
.101"
.300"
.400"

CAL. OUT 1320
.100"
.299"
.399"

DATA (S)

	A
1	.252"
2	.261"
3	.257"

NEW

DATA (T) 11/28/07

	A	
		10.15
1	.237"	.238
2	.287"	.283
3	.202"	.298
4	.206"	.294
5	.300"	.297
6	.300"	.298
7	.300"	.300
8	.302"	.299
9	.299"	.297
10	.301"	.295
11	.298"	.295

DATA (U)

	A
1	.282"
2	.29[illegible]"
3	.29[illegible]4"
4	.2[illegible]3"
5	.[illegible]83"
6	[illegible]8"
7	[illegible]9"
8	.297"
9	.295"
10	N/A
11	N/A

DATA (V)

	A
1	.265"
2	.2[illegible]1"
3	.288"

LOCATION 18
RE-SCAN UT
VALUES

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: DRAWINGS H-2-69343, REV 5, SH - OF - (USDOE 1988) AND H-2-99031, SH 2 OF 3, REV 2 (USDOE 1989)

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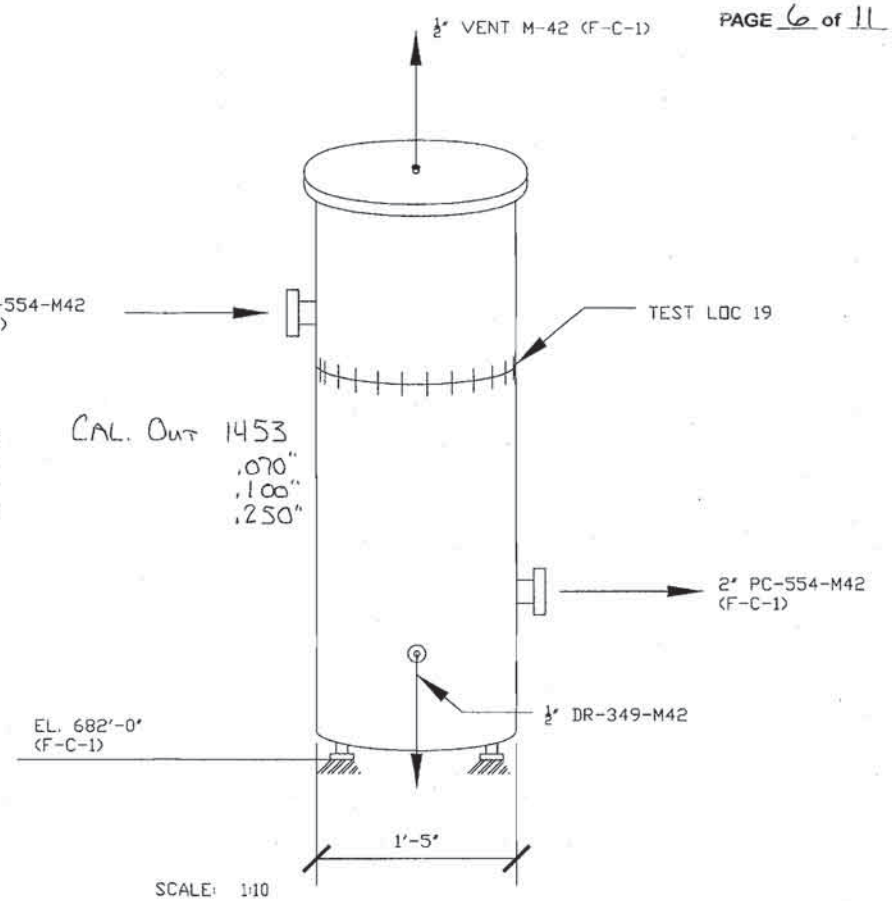

DATE: 4/13/07 CAL. STEP WEDGE CAL. IN 1446 CAL. OUT 1453

Wesley H. Zeller LEVEL IN OUT

.070"	.070"	.070"
.100"	.100"	.100"
.250"	.250"	.250"

Grid Points

	1	2	3	4	5	6	7	8	9	10	11	12
A	.135"	.136"	.134"	.135"	.135"	.135"	.135"	.135"	.135"	.135"	.135"	.135"

	13	14	15	16	17	18	19	20	21	22	23	24	25
B	.135"	.133"	.137"	.135"	.137"	.137"	.136"	.137"	.135"	.136"	.135"	.135"	.134"

REVISIONS

TechnoGeneral Services Company
Engineering and Construction Management

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LOCATION 19
F-C-1

COOPER ZIETZ ENGINEERS, INC.

Drawing Number: 6.16

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: DRAWINGS H-2-69343, REV 5, SH - OF - (USDOE 1988) AND H-2-99031, SH 2 OF 3, REV 2 (USDOE 1989)

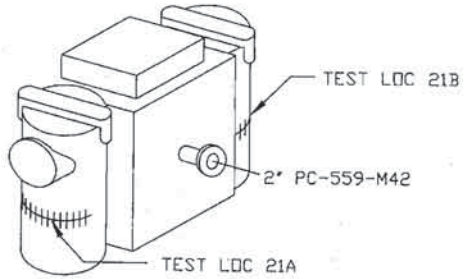
DATE: 4/13/07

Wesley H. [illegible] LEVEL III UT

CAL. STEP WEDGE
.250"
.500"
.750"

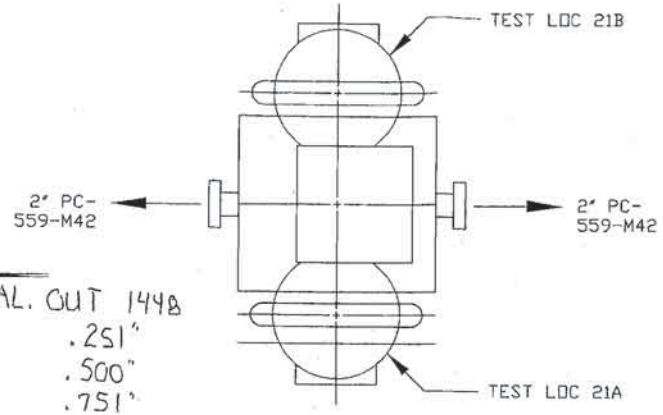
CAL. IN 1415
.250"
.500"
.750"

CAL. OUT 1448
.251"
.500"
.751"



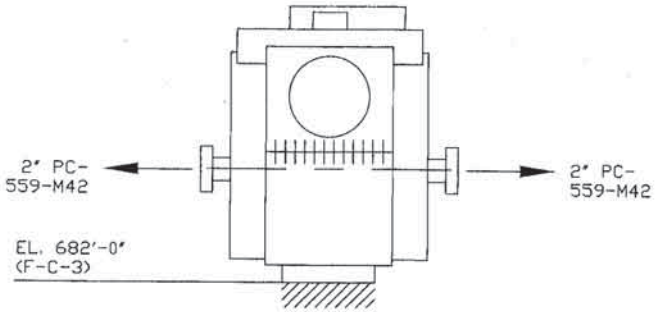
F-C-3

ISOMETRIC F-C-3



PLAN VIEW F-C-3

SCALE: 1:10



SIDE VIEW F-C-3

SCALE: 1:10

Grid Points (21A)

	1	2	3	4	5	6	7	8	9	10	11	12
A	.575"	.490"	.484"	.522"	.699"	.666"	.661"	.564"				

Grid Points (21B)

	1	2	3	4	5	6	7	8	9	10	11	12
B	.674"	.682"	.689"	.612"	.653"	.584"	.564"	.547"				

* Configuration of F-C-3 limited Data Grid to 8 Locations on each side. [illegible] 4/26/07

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LOCATION 21
CONDENSATE FILTER F-C-3

COOPER ZIETZ ENGINEERS, INC.

Drawing Number
6.17

Grid Points

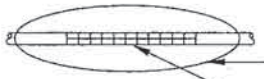
	1	2	3	4	5	6	7	8	9	10	11	12
A	.183"	.182"	.184"	.184"	.179"	.176"	.175"	.180"	.184"	.184"	.184"	.183"

CAL IN 1743 4/17/07 Wesley H Rhen LEVEL III UT
.07"
.100"
.249"

CAL STEP WEDGE: CARBON
.07"
.100"
.250"

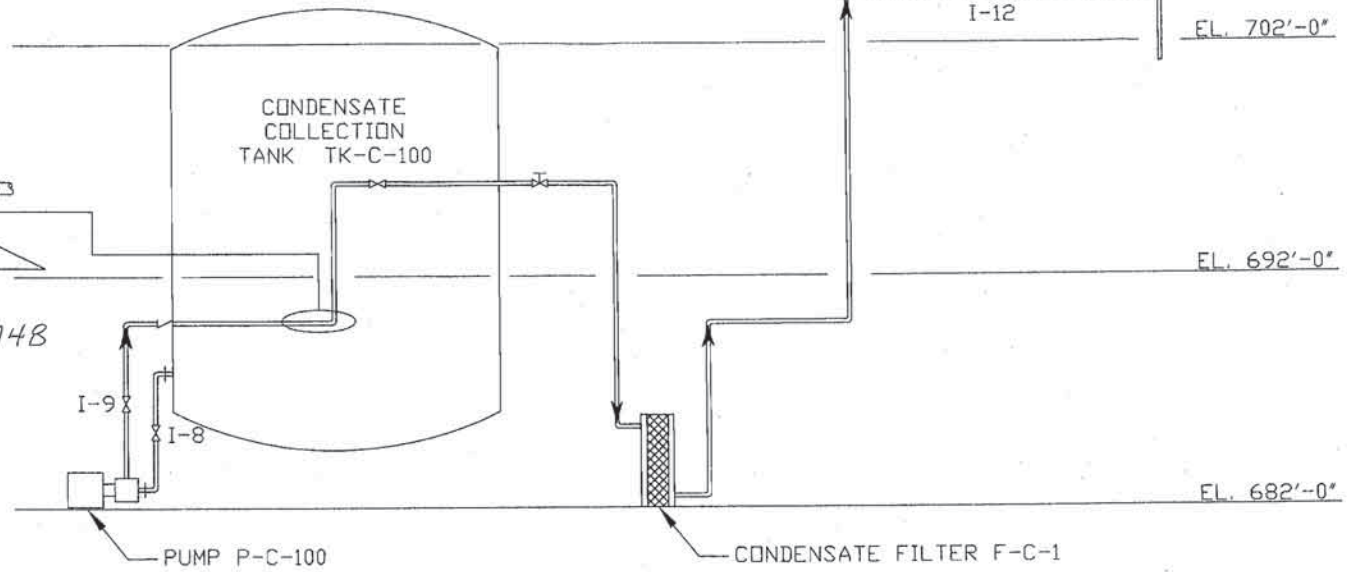
PAGE 11 of 11

LOCATION 22



ON BOTTOM OF PIPE AND AROUND ELBOW

CAL out 1748
.07"
.100"
.249"



SCALE: 1:60

NOTE: SUITABLILITY OF TEST LOCATION TO BE FIELD VERIFIED AND APPROVED BY THE IQRPE.

DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS AND ELEVATIONS ARE BASED UPON AN "AS BUILT" ELEVATION AND A PROCESS HYDRAULIC DRAWING. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

A DRAWING DEPICTING THE TRUE LENGTH OR GEOMETRY OF THE LINE SHOWN IS NOT CURRENTLY AVAILABLE

MINIMUM 12 INDIVIDUAL WALL THICKNESS MEASUREMENTS.

GRID: 2" WIDE BAND ALONG THE LENGTH OF THE LINE, ON THE BOTTOM OF THE LINE.

SOURCE: DRAWING H-2-69328, SH - OF -, REV 1 (USDOE 1976)

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LOCATION 22
CONDENSATE RECIRCULATION LINE, 2" PC-554-M42

COOPER ZIETZ ENGINEERS, INC.

Drawing Number: 6.18

PAGE 3 OF 4

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: DRAWINGS H-2-69340, SH - OF -, REV (USDOE 1977) AND H-2-99029, SH 1 OF 1, REV 2, (USDOE 1989)

DATA (S)

	A
1	.261"
2	.262"
3	.262"

DATA (T)

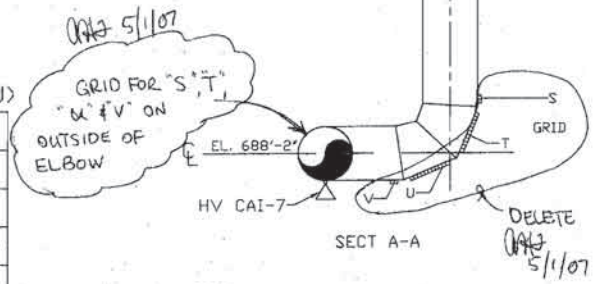
	A
1	.262"
2	.262"
3	.264"
4	.265"
5	.264"
6	.265"
7	.265"
8	.266"
9	.265"
10	.265"
11	.266"

DATA (U)

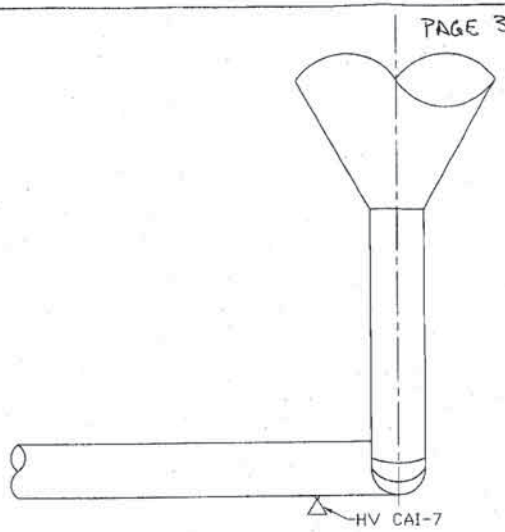
	A
1	.268"
2	.266"
3	.266"
4	.266"
5	.266"
6	.267"
7	.267"
8	.267"
9	.266"
10	.267"
11	.265"

DATA (V)

	A
1	.264"
2	.263"
3	.263"



SECT A-A



SECT B-B

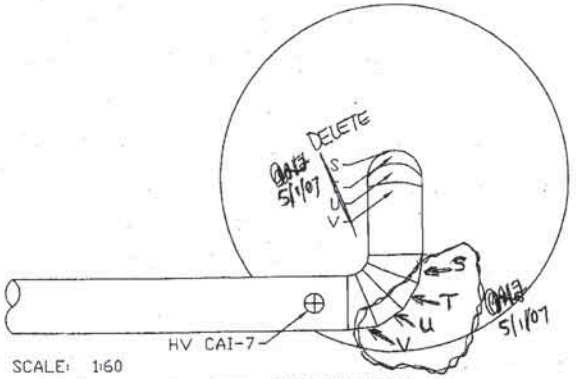
DATE: 5/2/07

CAL. STEP WEDGE
- .100"
- .400"
- .600"

CAL. IN
- .100"
- .399"
- .600"

CAL. OUT
- .99"
- .398"
- .600"

Wesley to Ken LEVEL III UT



SCALE: 1:60

BOTTOM (EXTRAPOLATED) - (FROM H-2-99030 SECTS A-A AND B-B AND H-2-69339)

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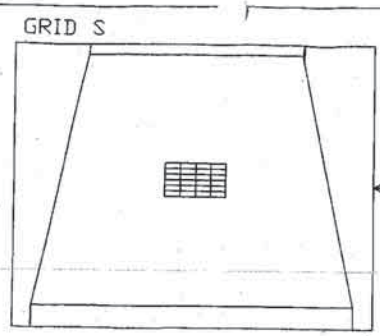
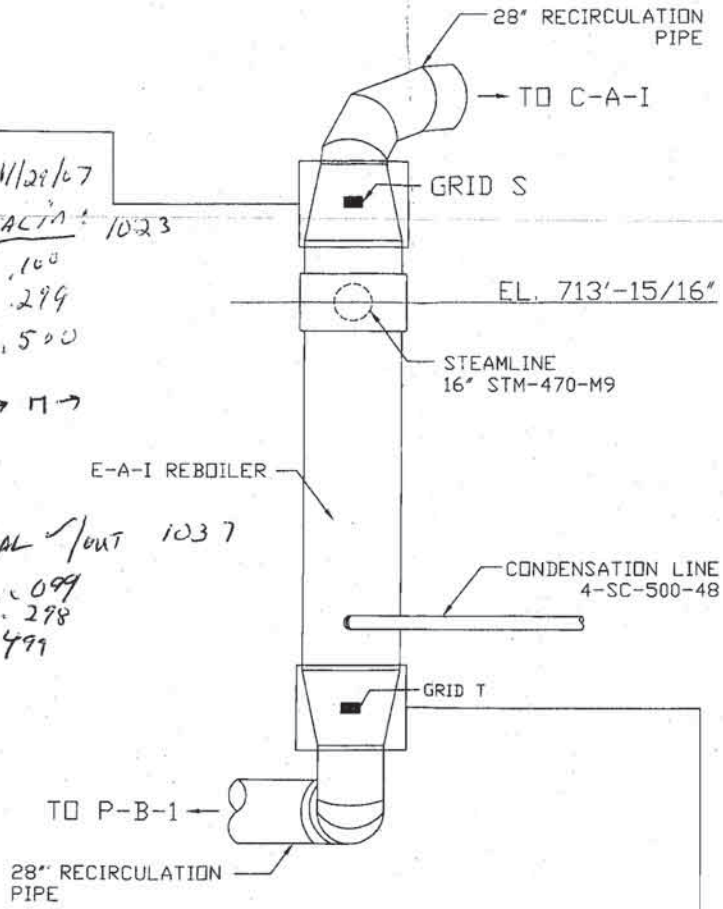
LOCATION

COOPER ZIETZ ENGINEERS, INC.

~~6.15~~ 6.15 a 5/1/07





11/28/07
CALIN: 1023
.100
.299
.500

DATA (S) GRID PATTERN INCHES

	A	B	C	D
1	251	253	251	251
2	252	254	250	252
3	253	252	251	251
4	251	252	252	251
5	252	253	252	251
6	252	254	252	252
7	253	253	252	251

1 → M →
A ↓

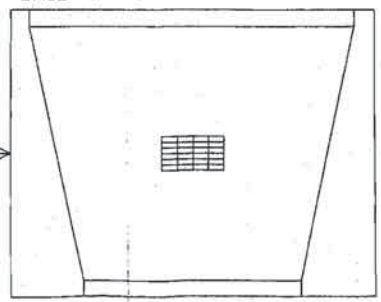
CAL ✓/OUT 1037
.099
.298
.499

.099
.198
.297
.398
CAL ✓

11/28/07 10:30

DATA (T)

	A	B	C	D
1	250	250	249	249
2	250	249	249	250
3	250	250	250	250
4	251	250	250	250
5	250	249	249	249
6	249	248	249	249
7	250	260	304	287



SCALE: 1:50

NOTE: DIMENSIONS SHOWN ARE ESTIMATED IN THE FIGURE PROVIDED. DIMENSIONS ARE BASED UPON "AS BUILT" ELEVATIONS AND ASSEMBLY DRAWINGS. THE DRAWINGS HAVE INCOMPLETE DIMENSIONING AND WERE NOT REPRODUCED AT THE ORIGINAL SCALES.

SOURCE: DRAWINGS H-2-69339, SH - OF -
REV 3, USDOE 1977

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LOCATION 6

COOPER ZIETZ ENGINEERS, INC.

Drawing Number: 6.20

ATTACHMENT 6C

DATA EVALUATION AND STATISTICAL ANALYSIS

2007 INTEGRITY ASSESSMENT

(NOTE – AWAITING DATA FROM LOCATIONS 3, 6, AND 7)

(287 Pages)

Table 6C.LOC1.1993.1	
Location 1	
Descriptive Statistics	
Mean	0.317592308
Standard Error	0.000324638
Median	0.316
Mode	0.316
Standard Deviation	0.003701448
Sample Variance	1.37007E-05
Kurtosis	0.78970451
Skewness	1.031080927
Range	0.02
Minimum	0.308
Maximum	0.328
Sum	41.287
Count	130
Largest(1)	0.328
Smallest(1)	0.308
Confidence Level(95.0%)	0.000642305

Table 6C.LOC1.1993.2					
Ordered Readings					
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.308	1	0.316	49	0.319	97
0.311	2	0.316	50	0.319	98
0.312	3	0.316	51	0.319	99
0.313	4	0.316	52	0.319	100
0.313	5	0.316	53	0.32	101
0.314	6	0.316	54	0.32	102
0.314	7	0.316	55	0.32	103
0.314	8	0.316	56	0.32	104
0.314	9	0.316	57	0.32	105
0.314	10	0.316	58	0.321	106
0.314	11	0.316	59	0.321	107
0.314	12	0.316	60	0.321	108
0.314	13	0.316	61	0.321	109
0.314	14	0.316	62	0.322	110
0.314	15	0.316	63	0.322	111
0.315	16	0.316	64	0.322	112
0.315	17	0.316	65	0.323	113
0.315	18	0.316	66	0.323	114
0.315	19	0.316	67	0.323	115
0.315	20	0.316	68	0.324	116
0.315	21	0.316	69	0.324	117
0.315	22	0.316	70	0.324	118
0.315	23	0.316	71	0.324	119
0.315	24	0.317	72	0.325	120
0.315	25	0.317	73	0.325	121
0.315	26	0.317	74	0.325	122
0.315	27	0.317	75	0.325	123
0.315	28	0.317	76	0.325	124
0.315	29	0.317	77	0.326	125
0.315	30	0.317	78	0.327	126
0.315	31	0.317	79	0.327	127
0.315	32	0.317	80	0.327	128
0.315	33	0.317	81	0.327	129
0.316	34	0.317	82	0.328	130
0.316	35	0.317	83		
0.316	36	0.317	84		
0.316	37	0.317	85		
0.316	38	0.317	86		
0.316	39	0.317	87		
0.316	40	0.317	88		
0.316	41	0.317	89		
0.316	42	0.318	90		
0.316	43	0.318	91		
0.316	44	0.318	92		
0.316	45	0.318	93		
0.316	46	0.318	94		
0.316	47	0.319	95		
0.316	48	0.319	96		

Table 6C.LOC1.1993.3						
Location 1						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.308	1	0.007692308	0.00769231	0.9923077	53.29	0.662668041
0.311	1	0.007692308	0.01538462	0.9846154	53.29	0.437724995
0.312	1	0.007692308	0.02307692	0.9769231	53.29	0.288200111
0.313	2	0.015384615	0.03846154	0.9615385	53.29	0.123695047
0.314	10	0.076923077	0.11538462	0.8846154	53.29	0.001454558
0.315	18	0.138461538	0.25384615	0.7461538	53.29	1.67288E-07
0.316	38	0.292307692	0.54615385	0.4538462	53.29	5.22216E-19
0.317	18	0.138461538	0.68461538	0.3153846	53.29	1.97217E-27
0.318	5	0.038461538	0.72307692	0.2769231	53.29	1.92863E-30
0.319	6	0.046153846	0.76923077	0.2307692	53.29	1.164E-34
0.32	5	0.038461538	0.80769231	0.1923077	53.29	7.02523E-39
0.321	4	0.030769231	0.83846154	0.1615385	53.29	6.48284E-43
0.322	3	0.023076923	0.86153846	0.1384615	53.29	1.75551E-46
0.323	3	0.023076923	0.88461538	0.1153846	53.29	1.05952E-50
0.324	4	0.030769231	0.91538462	0.0846154	53.29	7.03862E-58
0.325	5	0.038461538	0.95384615	0.0461538	53.29	6.61093E-72
0.326	1	0.007692308	0.96153846	0.0384615	53.29	3.98996E-76
0.327	4	0.030769231	0.99230769	0.0076923	53.29	2.2661E-113
0.328	1	0.007692308	1	0	53.29	0
Total	130					

Figure 6C.LOC1.1993.1 "Ordered Thickness Readings"

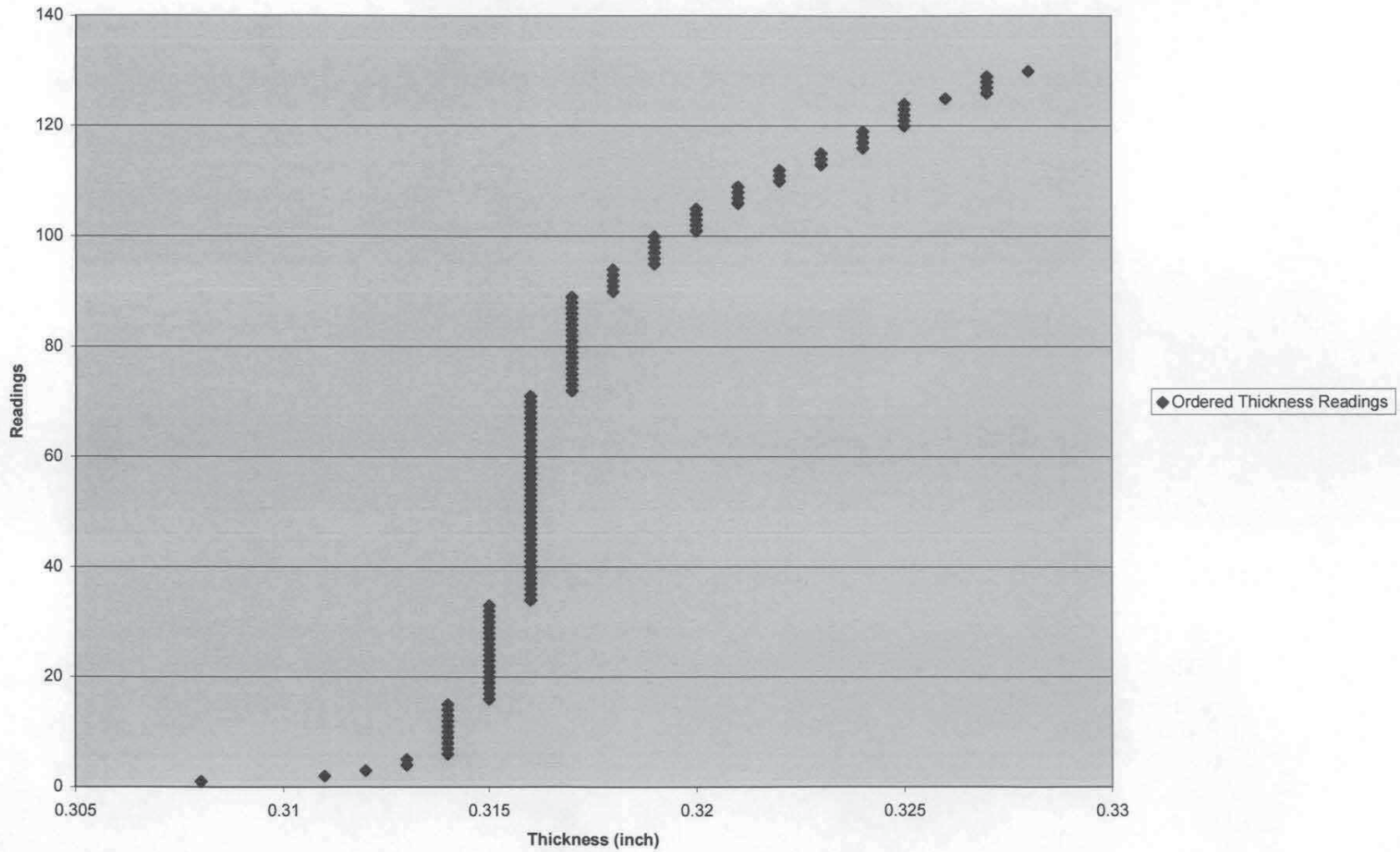

Figure 6C.LOC1.1993.2 "Normalized Frequency Distribution"

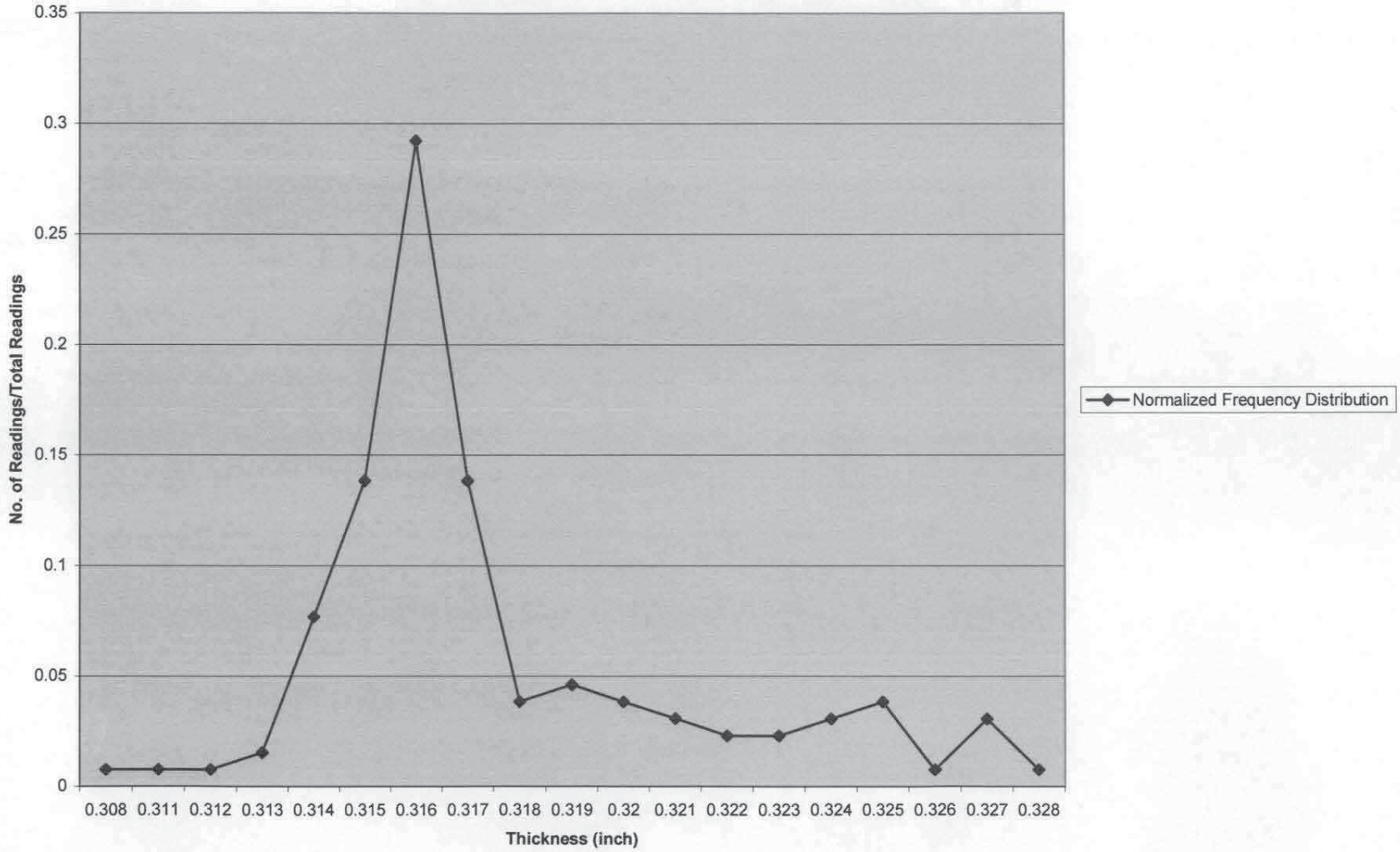

Figure 6C.LOC1.1993.3 "Reliability Function"

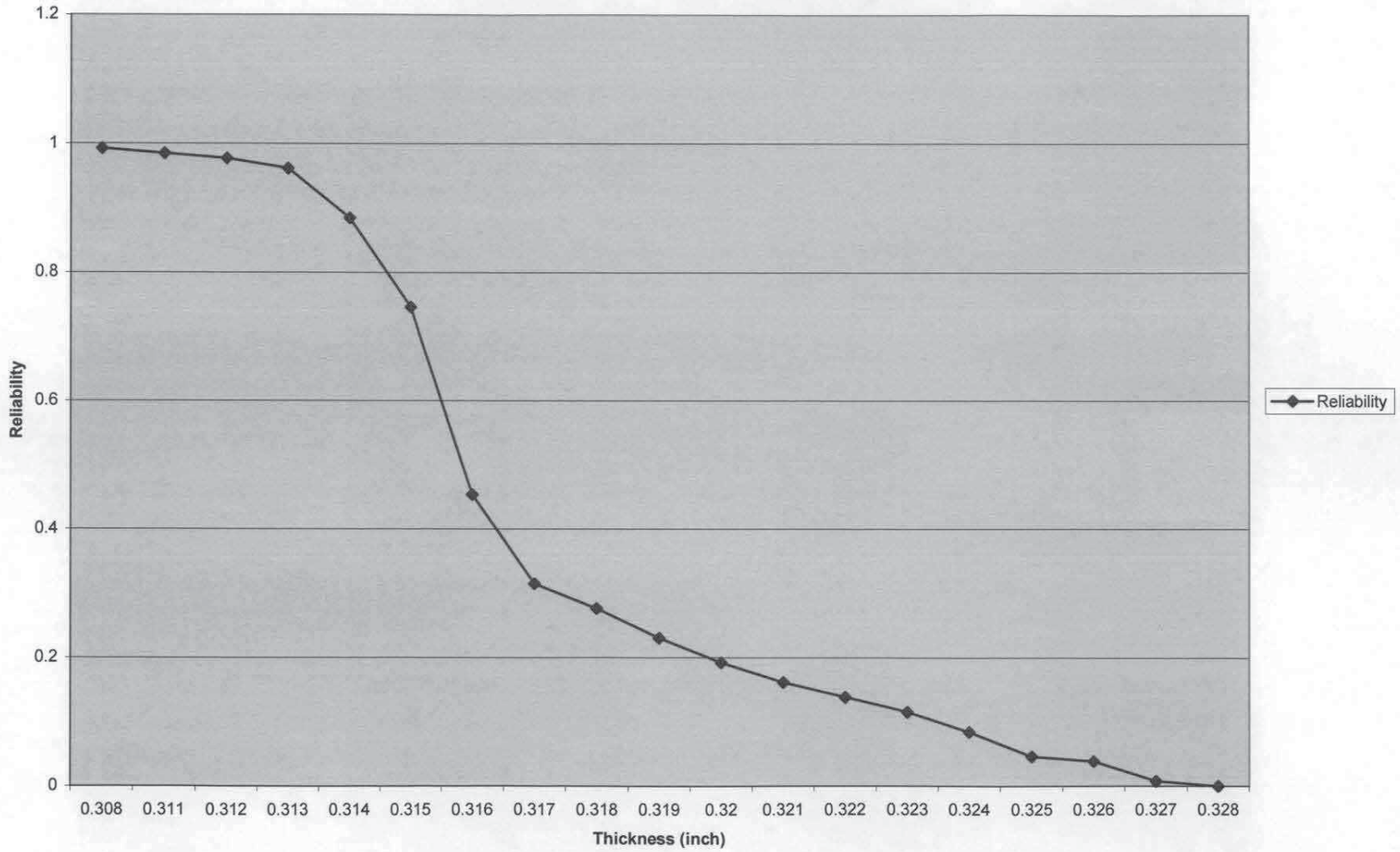

Figure 6C.LOC1.1993.4 "Reliability Function^Area Ratio"

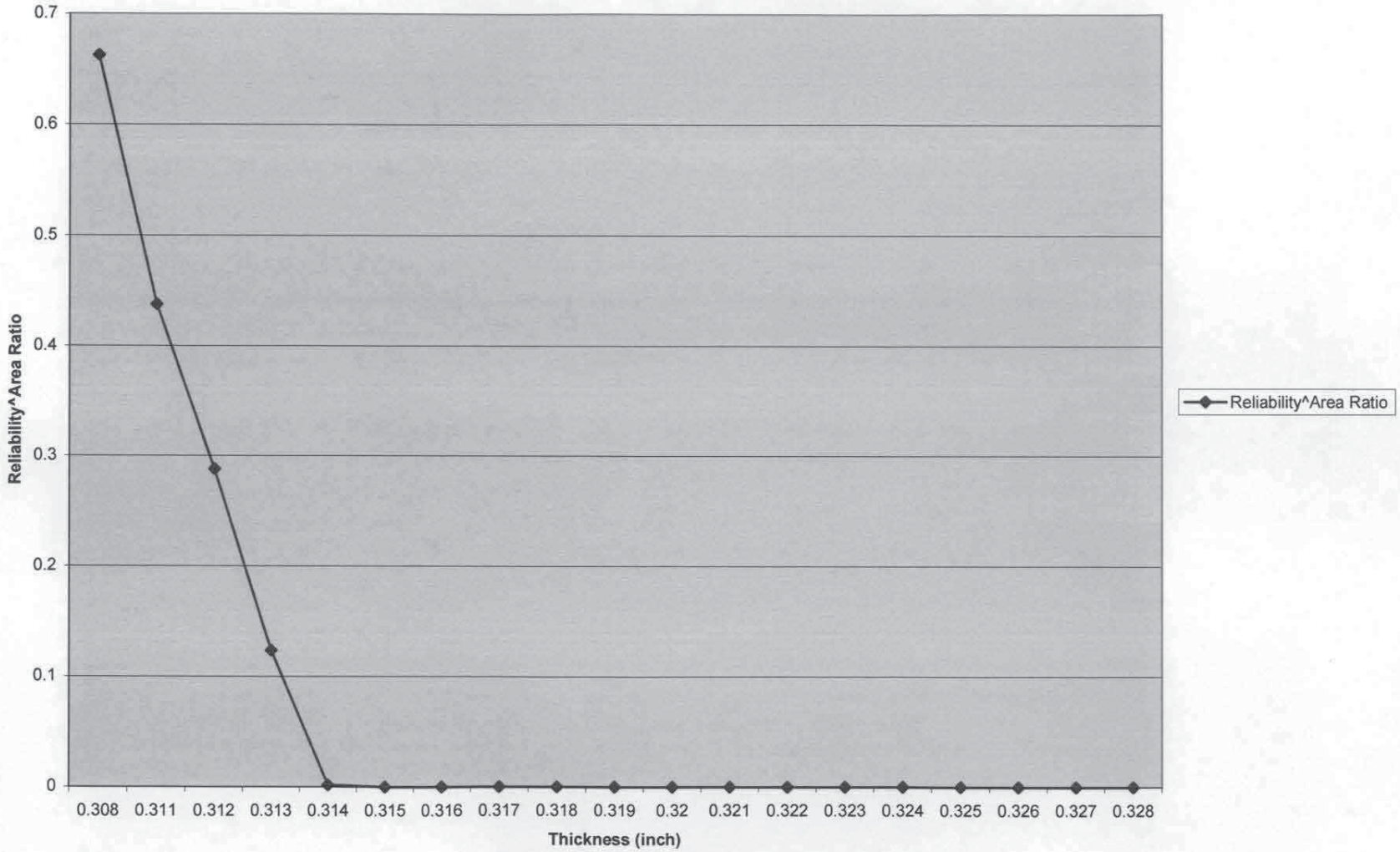

Table 6C.LOC1.2007.1	
Location 1	
Descriptive Statistics	
Mean	0.318676923
Standard Error	0.000201134
Median	0.319
Mode	0.318
Standard Deviation	0.002293284
Sample Variance	5.25915E-06
Kurtosis	16.90119876
Skewness	-2.822680068
Range	0.02
Minimum	0.303
Maximum	0.323
Sum	41.428
Count	130
Largest(1)	0.323
Smallest(1)	0.303
Confidence Level(95.0%)	0.000397949

Table 6C.LOC1.2007.2					
Ordered Readings					
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.303	1	0.318	49	0.32	97
0.311	2	0.318	50	0.32	98
0.312	3	0.318	51	0.32	99
0.315	4	0.318	52	0.32	100
0.316	5	0.318	53	0.32	101
0.316	6	0.318	54	0.32	102
0.316	7	0.318	55	0.32	103
0.316	8	0.318	56	0.32	104
0.316	9	0.318	57	0.32	105
0.316	10	0.318	58	0.32	106
0.317	11	0.318	59	0.32	107
0.317	12	0.319	60	0.321	108
0.317	13	0.319	61	0.321	109
0.317	14	0.319	62	0.321	110
0.317	15	0.319	63	0.321	111
0.317	16	0.319	64	0.321	112
0.317	17	0.319	65	0.321	113
0.317	18	0.319	66	0.321	114
0.317	19	0.319	67	0.321	115
0.317	20	0.319	68	0.321	116
0.317	21	0.319	69	0.321	117
0.317	22	0.319	70	0.321	118
0.317	23	0.319	71	0.321	119
0.317	24	0.319	72	0.321	120
0.317	25	0.319	73	0.321	121
0.317	26	0.319	74	0.321	122
0.317	27	0.319	75	0.321	123
0.318	28	0.319	76	0.321	124
0.318	29	0.319	77	0.322	125
0.318	30	0.319	78	0.322	126
0.318	31	0.319	79	0.322	127
0.318	32	0.319	80	0.322	128
0.318	33	0.319	81	0.322	129
0.318	34	0.319	82	0.323	130
0.318	35	0.319	83		
0.318	36	0.32	84		
0.318	37	0.32	85		
0.318	38	0.32	86		
0.318	39	0.32	87		
0.318	40	0.32	88		
0.318	41	0.32	89		
0.318	42	0.32	90		
0.318	43	0.32	91		
0.318	44	0.32	92		
0.318	45	0.32	93		
0.318	46	0.32	94		
0.318	47	0.32	95		
0.318	48	0.32	96		

Table 6C.LOC1.2007.3						
Location 1						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.303	1	0.007692308	0.00769231	0.9923077	53.29	0.662668041
0.311	1	0.007692308	0.01538462	0.9846154	53.29	0.437724995
0.312	1	0.007692308	0.02307692	0.9769231	53.29	0.288200111
0.315	1	0.007692308	0.03076923	0.9692308	53.29	0.18912637
0.316	6	0.046153846	0.07692308	0.9230769	53.29	0.014049074
0.317	17	0.130769231	0.20769231	0.7923077	53.29	4.09642E-06
0.318	32	0.246153846	0.45384615	0.5461538	53.29	1.0056E-14
0.319	24	0.184615385	0.63846154	0.3615385	53.29	2.85485E-24
0.32	24	0.184615385	0.82307692	0.1769231	53.29	8.26112E-41
0.321	17	0.130769231	0.95384615	0.0461538	53.29	6.61093E-72
0.322	5	0.038461538	0.99230769	0.0076923	53.29	2.2661E-113
0.323	1	0.007692308	1	0	53.29	0
Total	130					

Figure 6C.LOC1.2007.1 "Ordered Thickness Readings"

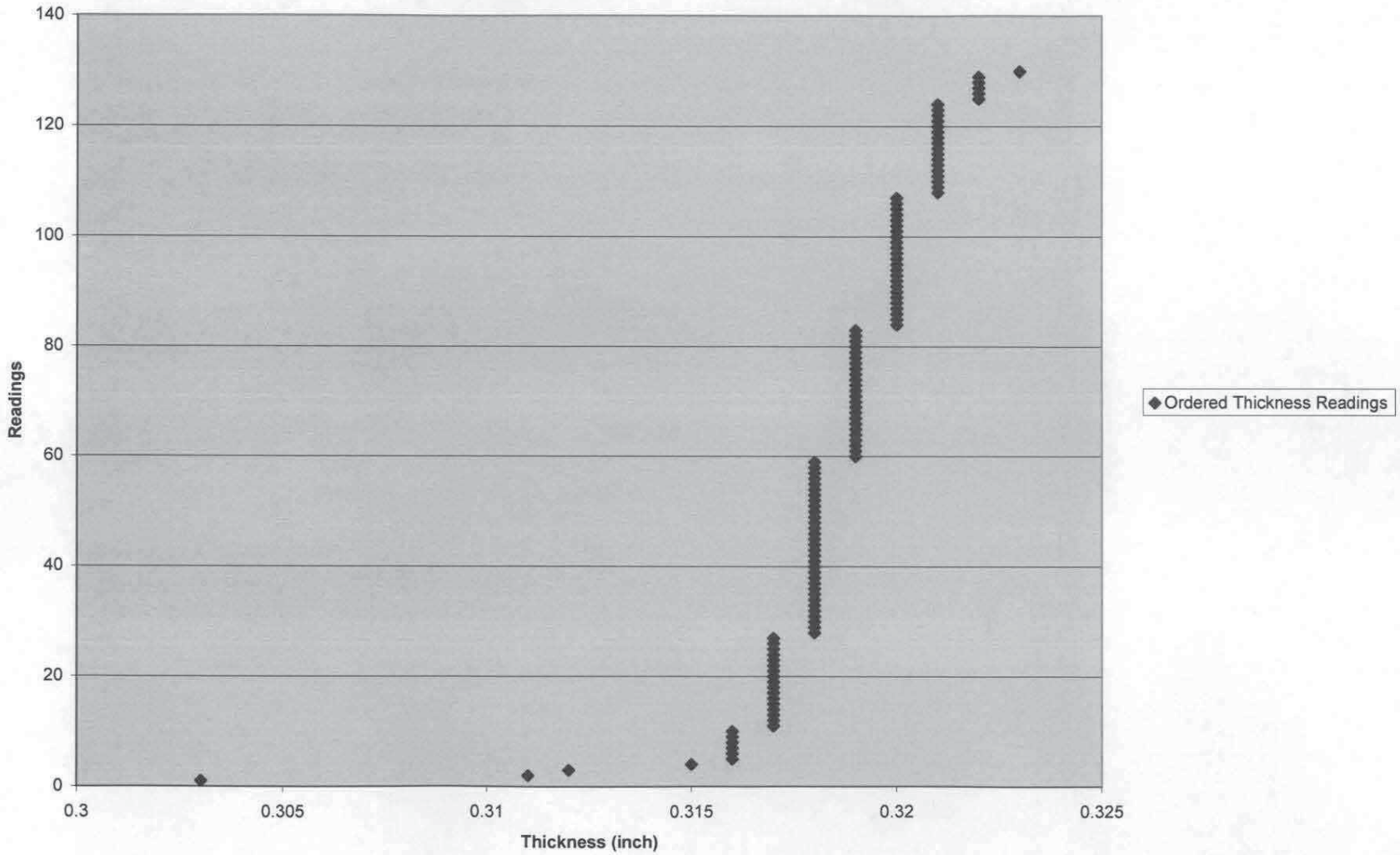

Figure 6C.LOC1.2007.2 "Normalized Frequency Distribution"

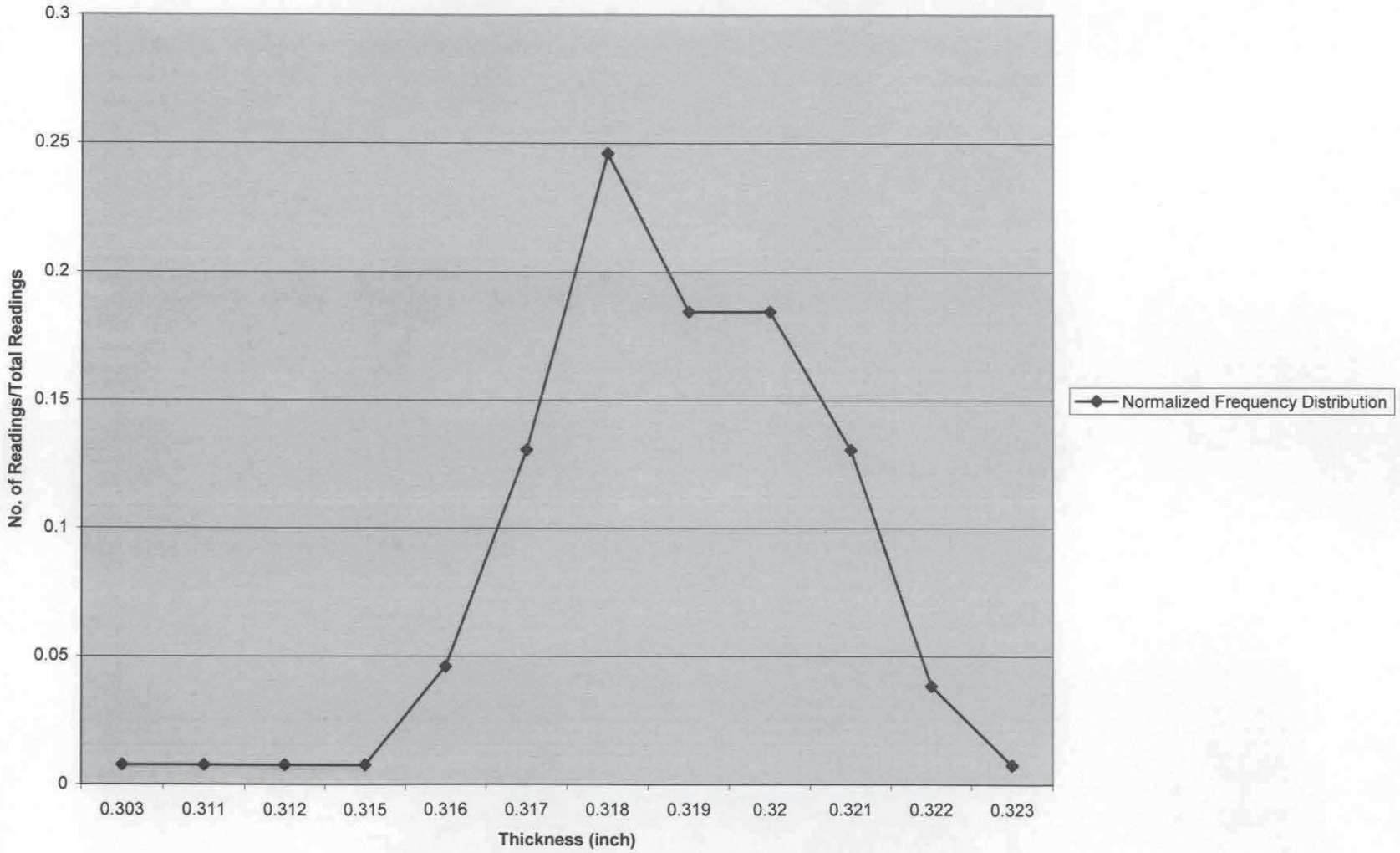

Figure 6C.LOC1.2007.3 "Reliability Function"

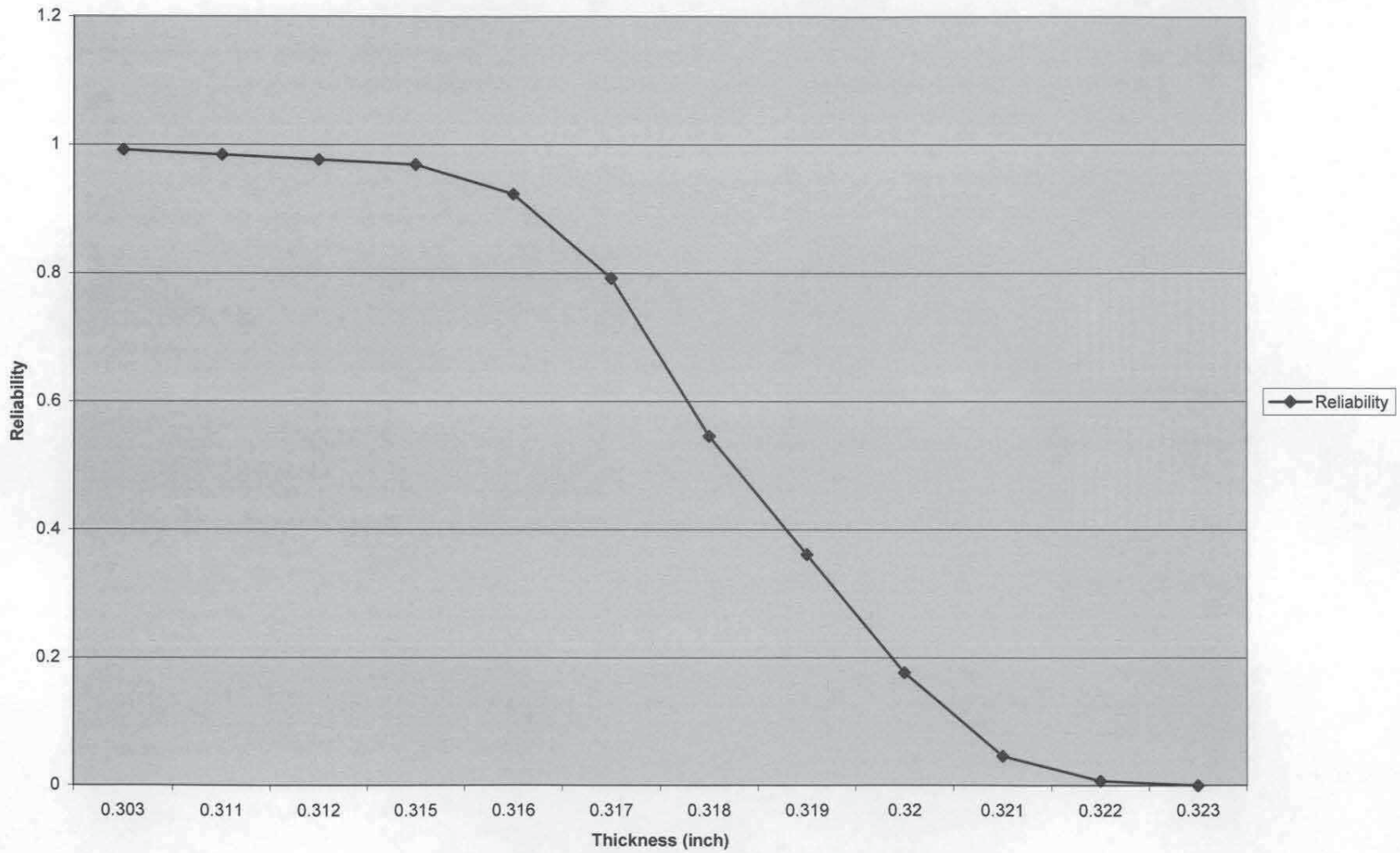

Figure 6C.LOC1.2007.4 "Reliability Function^Area Ratio"

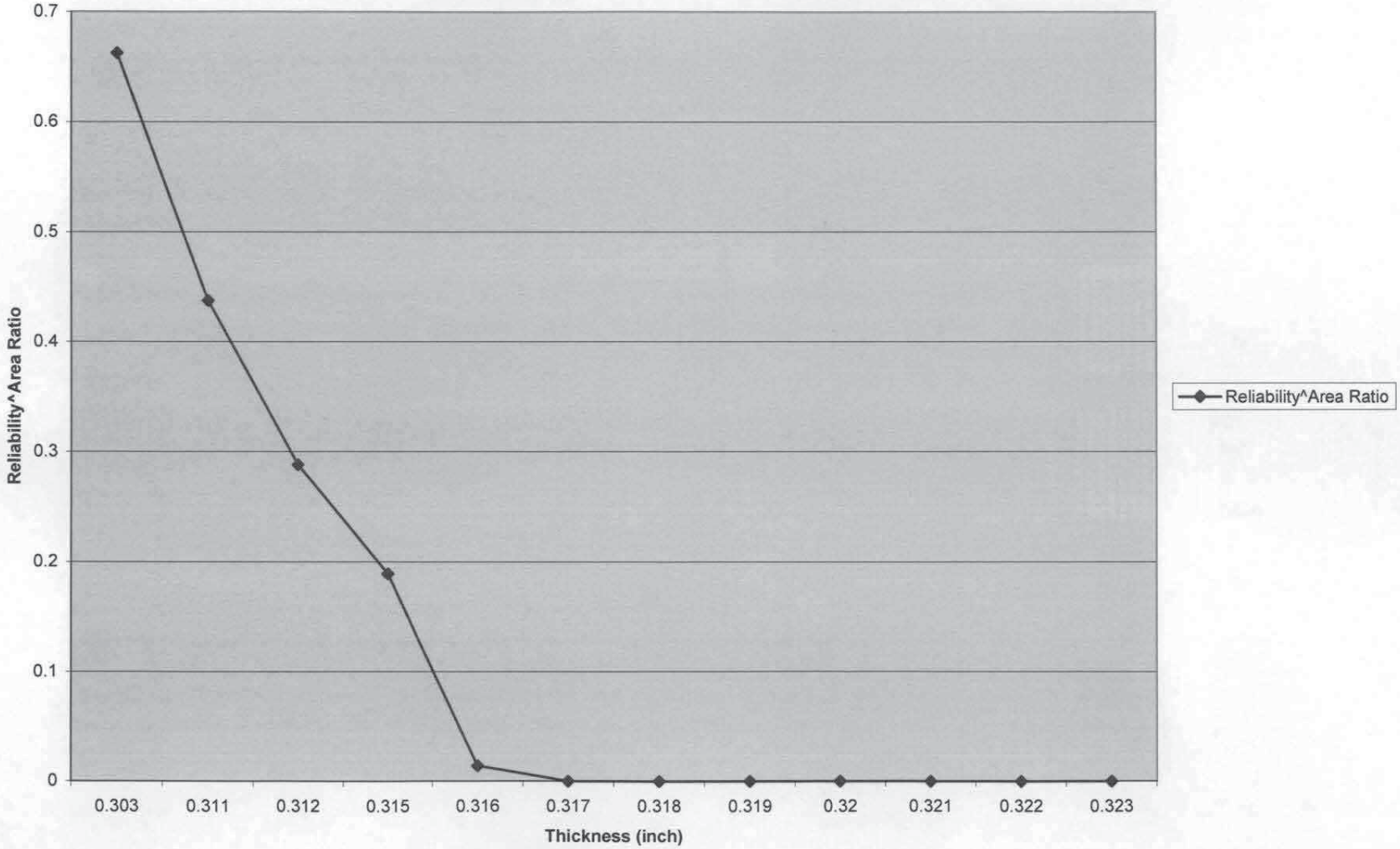

Table 6C.LOC2.1993.1	
Location 2	
Descriptive Statistics	
Mean	0.318952381
Standard Error	0.000666902
Median	0.319
Mode	0.317
Standard Deviation	0.006833713
Sample Variance	4.66996E-05
Kurtosis	5.348598528
Skewness	-1.677435671
Range	0.045
Minimum	0.29
Maximum	0.335
Sum	33.49
Count	105
Largest(1)	0.335
Smallest(1)	0.29
Confidence Level(95.0%)	0.001322492

Table 6C.LOC2.1993.2					
Location 2					
Ordered Readings					
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.29	1	0.319	48	0.326	95
0.292	2	0.319	49	0.326	96
0.299	3	0.319	50	0.327	97
0.299	4	0.319	51	0.327	98
0.302	5	0.319	52	0.327	99
0.306	6	0.319	53	0.328	100
0.313	7	0.319	54	0.328	101
0.313	8	0.32	55	0.328	102
0.313	9	0.32	56	0.328	103
0.314	10	0.32	57	0.328	104
0.314	11	0.32	58	0.335	105
0.315	12	0.32	59		
0.315	13	0.32	60		
0.315	14	0.32	61		
0.315	15	0.32	62		
0.315	16	0.321	63		
0.315	17	0.321	64		
0.315	18	0.321	65		
0.315	19	0.321	66		
0.315	20	0.321	67		
0.315	21	0.321	68		
0.316	22	0.321	69		
0.316	23	0.321	70		
0.316	24	0.321	71		
0.316	25	0.321	72		
0.316	26	0.321	73		
0.317	27	0.321	74		
0.317	28	0.322	75		
0.317	29	0.322	76		
0.317	30	0.322	77		
0.317	31	0.322	78		
0.317	32	0.323	79		
0.317	33	0.323	80		
0.317	34	0.324	81		
0.317	35	0.324	82		
0.317	36	0.325	83		
0.317	37	0.325	84		
0.317	38	0.325	85		
0.318	39	0.325	86		
0.318	40	0.325	87		
0.318	41	0.325	88		
0.318	42	0.325	89		
0.318	43	0.325	90		
0.318	44	0.326	91		
0.318	45	0.326	92		
0.318	46	0.326	93		
0.318	47	0.326	94		

Table 6C.LOC2.1993.3						
Location 2						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.29	1	0.00952381	0.03809524	0.9619048	65.97	0.077118524
0.292	1	0.00952381	0.05714286	0.9428571	65.97	0.020610968
0.299	2	0.019047619	0.06666667	0.9333333	65.97	0.010549017
0.302	1	0.00952381	0.07619048	0.9238095	65.97	0.005362189
0.306	1	0.00952381	0.08571429	0.9142857	65.97	0.002706618
0.313	3	0.028571429	0.13333333	0.8666667	65.97	7.94083E-05
0.314	2	0.019047619	0.16190476	0.8380952	65.97	8.69704E-06
0.315	10	0.095238095	0.27619048	0.7238095	65.97	5.48125E-10
0.316	5	0.047619048	0.38095238	0.6190476	65.97	1.81653E-14
0.317	12	0.114285714	0.44761905	0.552381	65.97	9.87426E-18
0.318	9	0.085714286	0.4952381	0.5047619	65.97	2.57923E-20
0.319	7	0.066666667	0.57142857	0.4285714	65.97	5.28652E-25
0.32	8	0.076190476	0.66666667	0.3333333	65.97	3.33038E-32
0.321	12	0.114285714	0.77142857	0.2285714	65.97	5.15508E-43
0.322	4	0.038095238	0.82857143	0.1714286	65.97	2.94816E-51
0.323	2	0.019047619	0.83809524	0.1619048	65.97	6.78961E-53
0.324	2	0.019047619	0.87619048	0.1238095	65.97	1.39807E-60
0.325	8	0.076190476	0.94285714	0.0571429	65.97	9.81849E-83
0.326	6	0.057142857	0.97142857	0.0285714	65.97	1.355E-102
0.327	3	0.028571429	0.98095238	0.0190476	65.97	3.2699E-114
0.328	5	0.047619048	0.99047619	0.0095238	65.97	4.5128E-134
0.335	1	0.00952381	1	0	65.97	0
Total	105					

Figure 6C.LOC2.1993.1 "Ordered Thickness Readings"

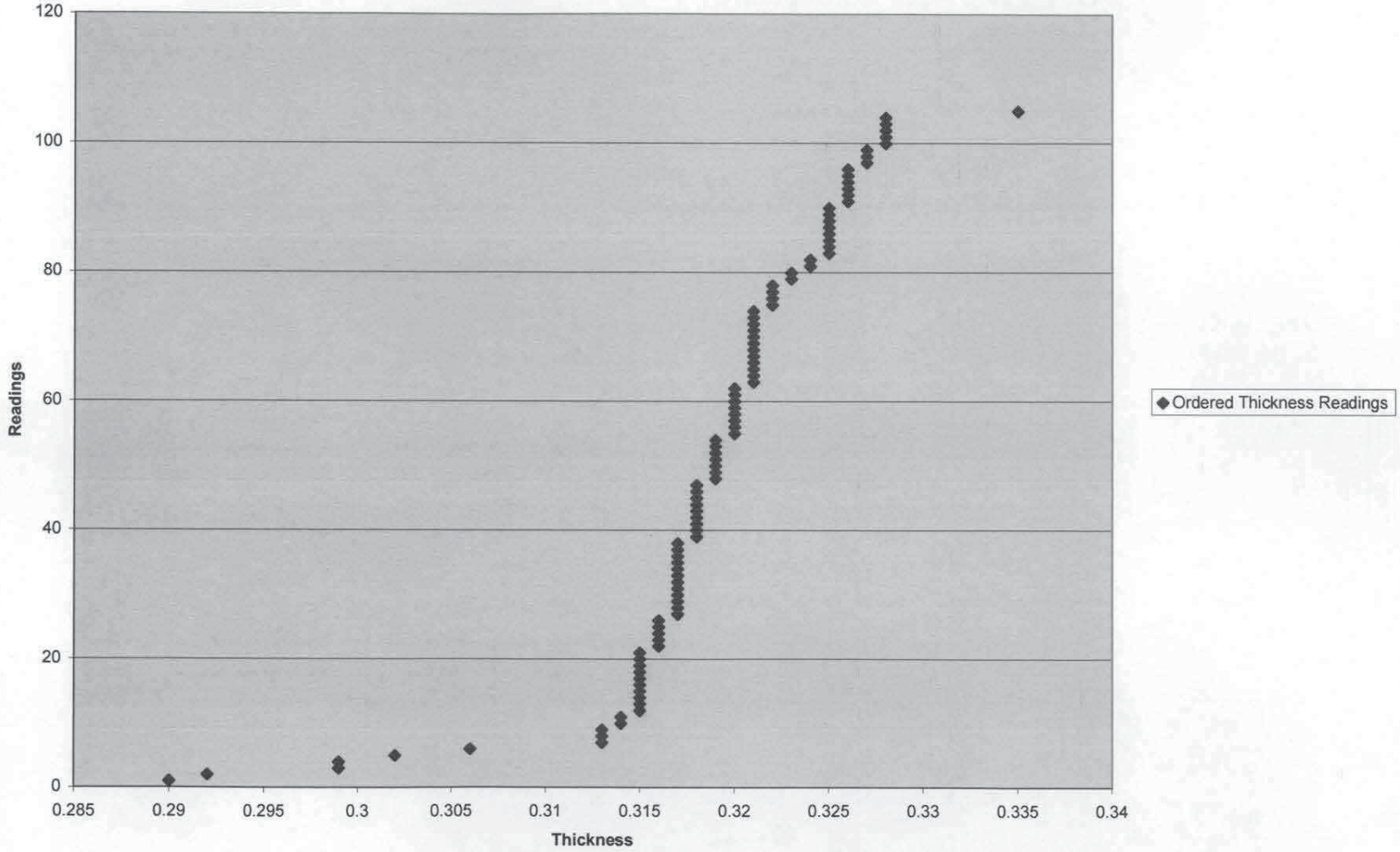

Figure 6C.LOC2.1993.2 "Normalized Frequency Distribution"

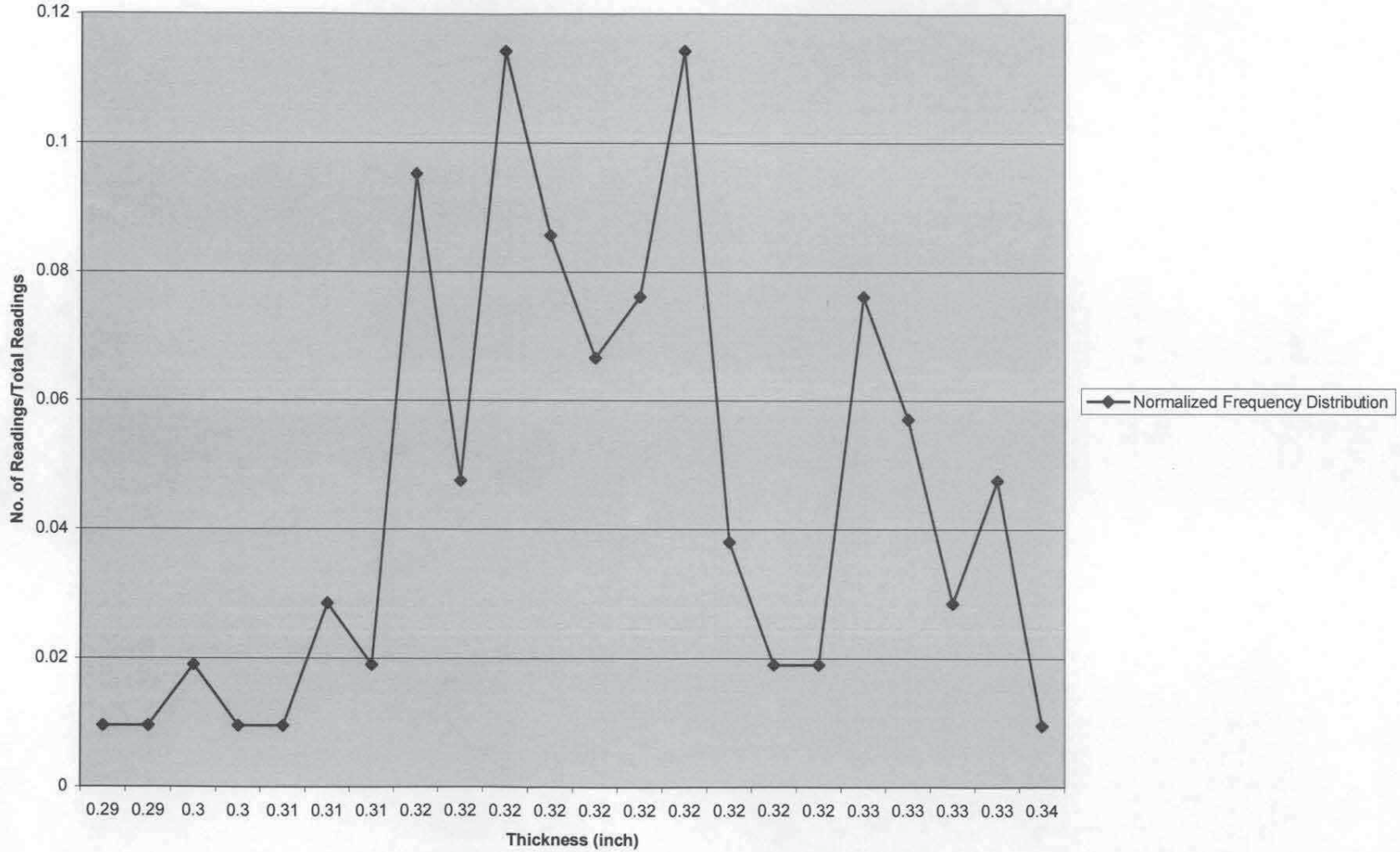

Figure 6C.LOC2.3 "Reliability"

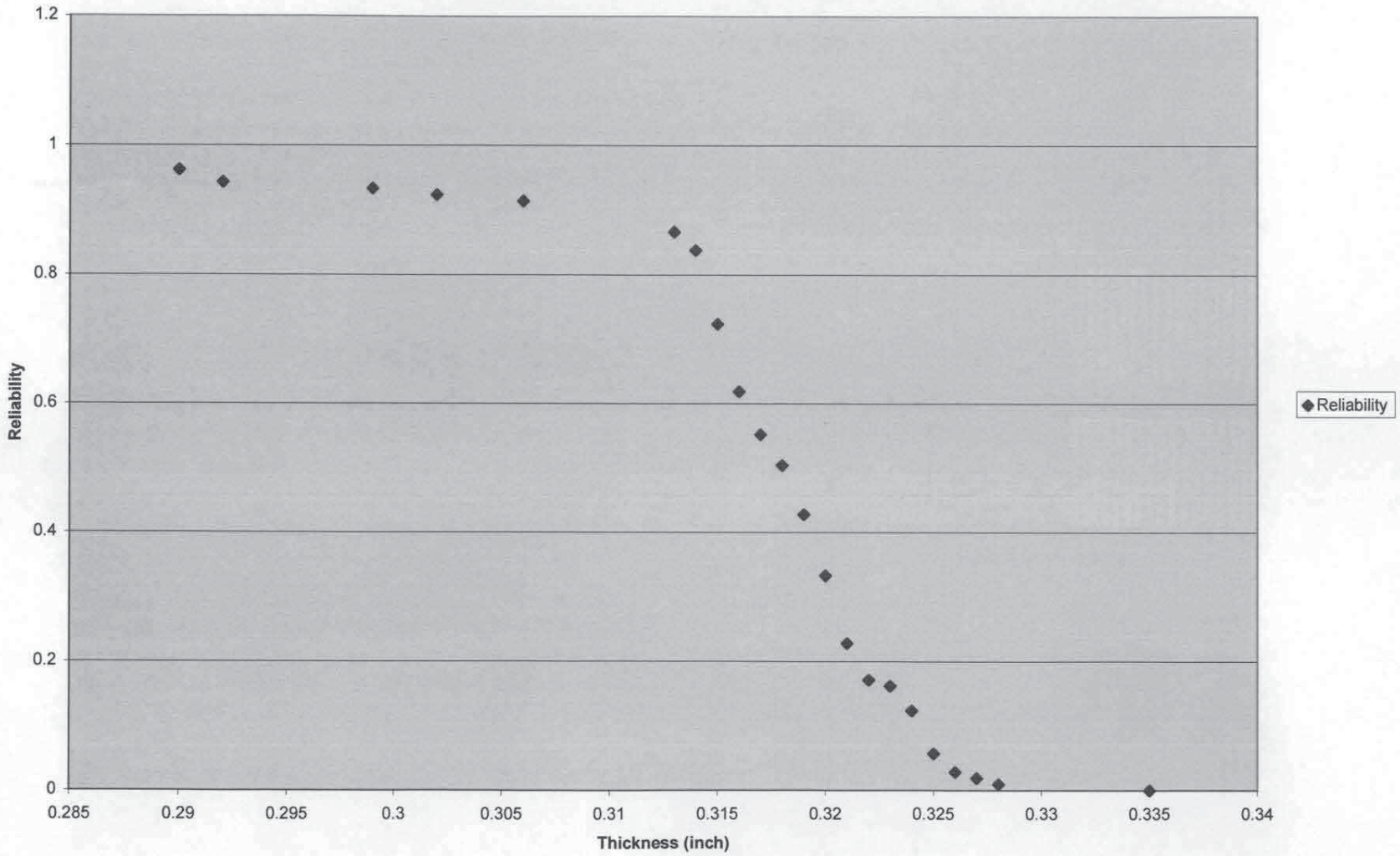

Figure 6C.LOC2.4 "Reliability^Area Ratio"

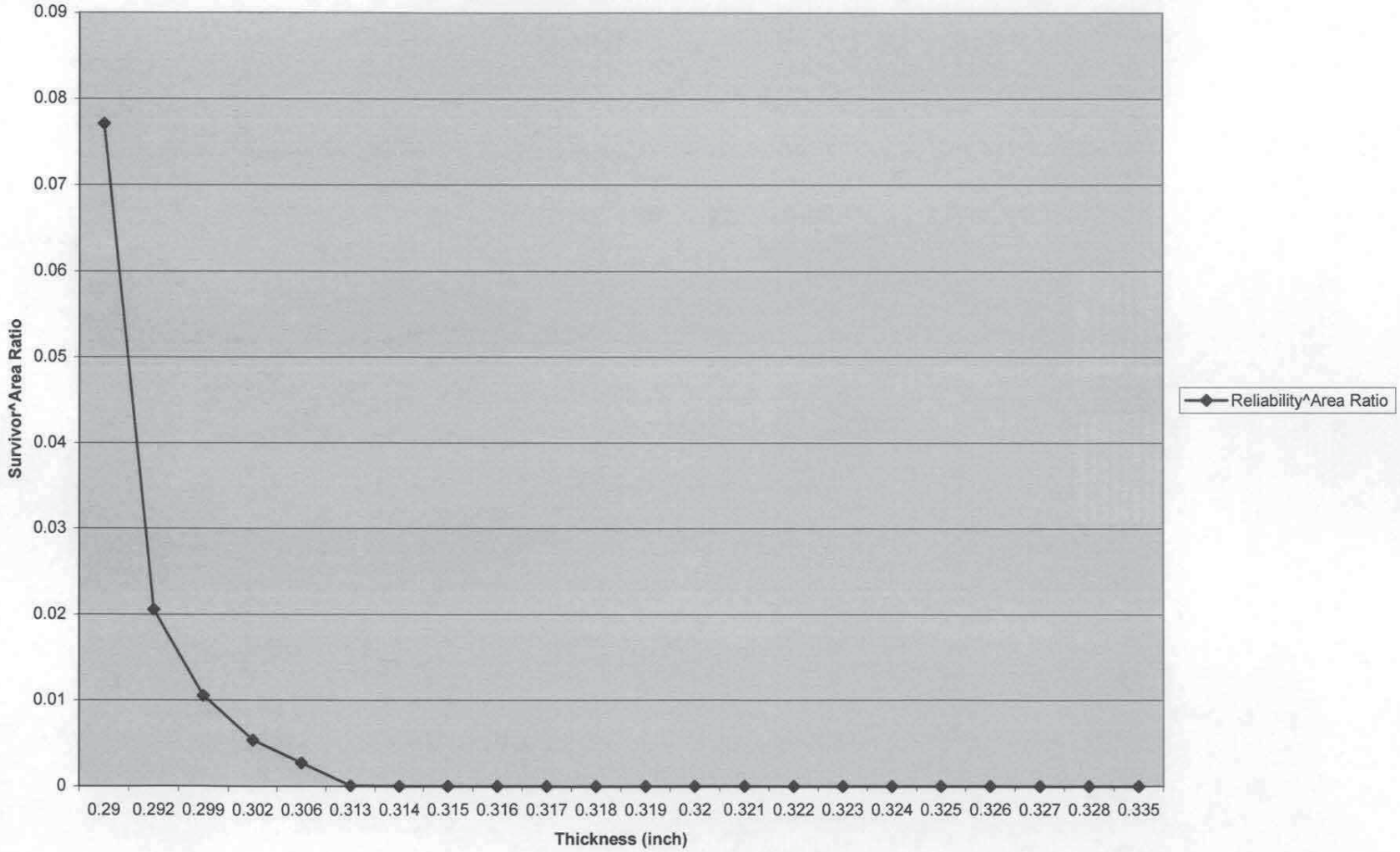

Table 6C.LOC2.2007.1	
Location 2	
Descriptive Statistics	
Mean	0.319638095
Standard Error	0.000698392
Median	0.321
Mode	0.317
Standard Deviation	0.00715639
Sample Variance	5.12139E-05
Kurtosis	6.029128986
Skewness	-1.804413611
Range	0.049
Minimum	0.29
Maximum	0.339
Sum	33.562
Count	105
Largest(1)	0.339
Smallest(1)	0.29
Confidence Level(95.0%)	0.001384938

Table 6C.LOC2.2007.2					
Location 2					
Ordered Readings					
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.29	1	0.32	48	0.327	95
0.291	2	0.32	49	0.327	96
0.294	3	0.32	50	0.327	97
0.301	4	0.32	51	0.327	98
0.304	5	0.32	52	0.327	99
0.304	6	0.321	53	0.328	100
0.308	7	0.321	54	0.328	101
0.313	8	0.321	55	0.328	102
0.314	9	0.321	56	0.329	103
0.315	10	0.321	57	0.33	104
0.315	11	0.321	58	0.339	105
0.315	12	0.321	59		
0.315	13	0.321	60		
0.315	14	0.322	61		
0.316	15	0.322	62		
0.316	16	0.322	63		
0.316	17	0.322	64		
0.317	18	0.322	65		
0.317	19	0.322	66		
0.317	20	0.322	67		
0.317	21	0.322	68		
0.317	22	0.322	69		
0.317	23	0.322	70		
0.317	24	0.323	71		
0.317	25	0.323	72		
0.317	26	0.323	73		
0.317	27	0.323	74		
0.317	28	0.323	75		
0.317	29	0.323	76		
0.318	30	0.323	77		
0.318	31	0.323	78		
0.318	32	0.323	79		
0.318	33	0.323	80		
0.318	34	0.323	81		
0.318	35	0.324	82		
0.318	36	0.324	83		
0.318	37	0.324	84		
0.318	38	0.324	85		
0.318	39	0.324	86		
0.318	40	0.324	87		
0.319	41	0.325	88		
0.319	42	0.326	89		
0.319	43	0.326	90		
0.319	44	0.326	91		
0.319	45	0.326	92		
0.319	46	0.327	93		
0.319	47	0.327	94		

Table 6C.LOC2.2007.3						
Location 2						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.29	1	0.00952381	0.00952381	0.9904762	65.97	0.531882255
0.291	1	0.00952381	0.01904762	0.9809524	65.97	0.281178323
0.294	1	0.00952381	0.02857143	0.9714286	65.97	0.147722726
0.301	1	0.00952381	0.03809524	0.9619048	65.97	0.077118524
0.304	2	0.019047619	0.05714286	0.9428571	65.97	0.020610968
0.308	1	0.00952381	0.06666667	0.9333333	65.97	0.010549017
0.313	1	0.00952381	0.07619048	0.9238095	65.97	0.005362189
0.314	1	0.00952381	0.08571429	0.9142857	65.97	0.002706618
0.315	5	0.047619048	0.13333333	0.8666667	65.97	7.94083E-05
0.316	3	0.028571429	0.16190476	0.8380952	65.97	8.69704E-06
0.317	12	0.114285714	0.27619048	0.7238095	65.97	5.48125E-10
0.318	11	0.104761905	0.38095238	0.6190476	65.97	1.81653E-14
0.319	7	0.066666667	0.44761905	0.552381	65.97	9.87426E-18
0.32	5	0.047619048	0.4952381	0.5047619	65.97	2.57923E-20
0.321	8	0.076190476	0.57142857	0.4285714	65.97	5.28652E-25
0.322	10	0.095238095	0.66666667	0.3333333	65.97	3.33038E-32
0.323	11	0.104761905	0.77142857	0.2285714	65.97	5.15508E-43
0.324	6	0.057142857	0.82857143	0.1714286	65.97	2.94816E-51
0.325	1	0.00952381	0.83809524	0.1619048	65.97	6.78961E-53
0.326	4	0.038095238	0.87619048	0.1238095	65.97	1.39807E-60
0.327	7	0.066666667	0.94285714	0.0571429	65.97	9.81849E-83
0.328	3	0.028571429	0.97142857	0.0285714	65.97	1.355E-102
0.329	1	0.00952381	0.98095238	0.0190476	65.97	3.2699E-114
0.33	1	0.00952381	0.99047619	0.0095238	65.97	4.5128E-134
0.339	1	0.00952381	1	0	65.97	0
Total	105					

Figure 6C.LOC2.2007.1 "Ordered Thickness Readings"

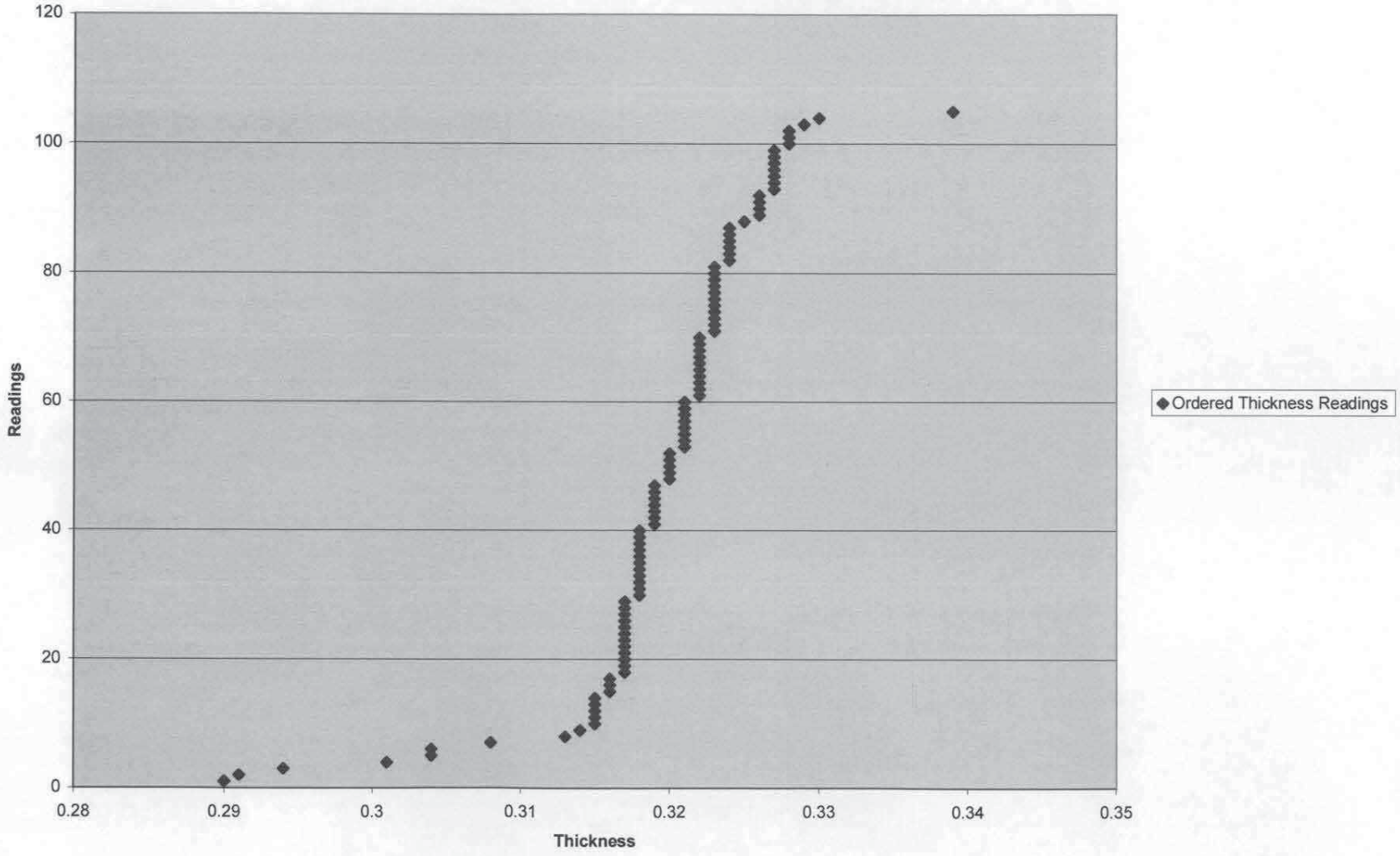

Figure 6C.LOC2.2007.2 "Normalized Frequency Distribution"

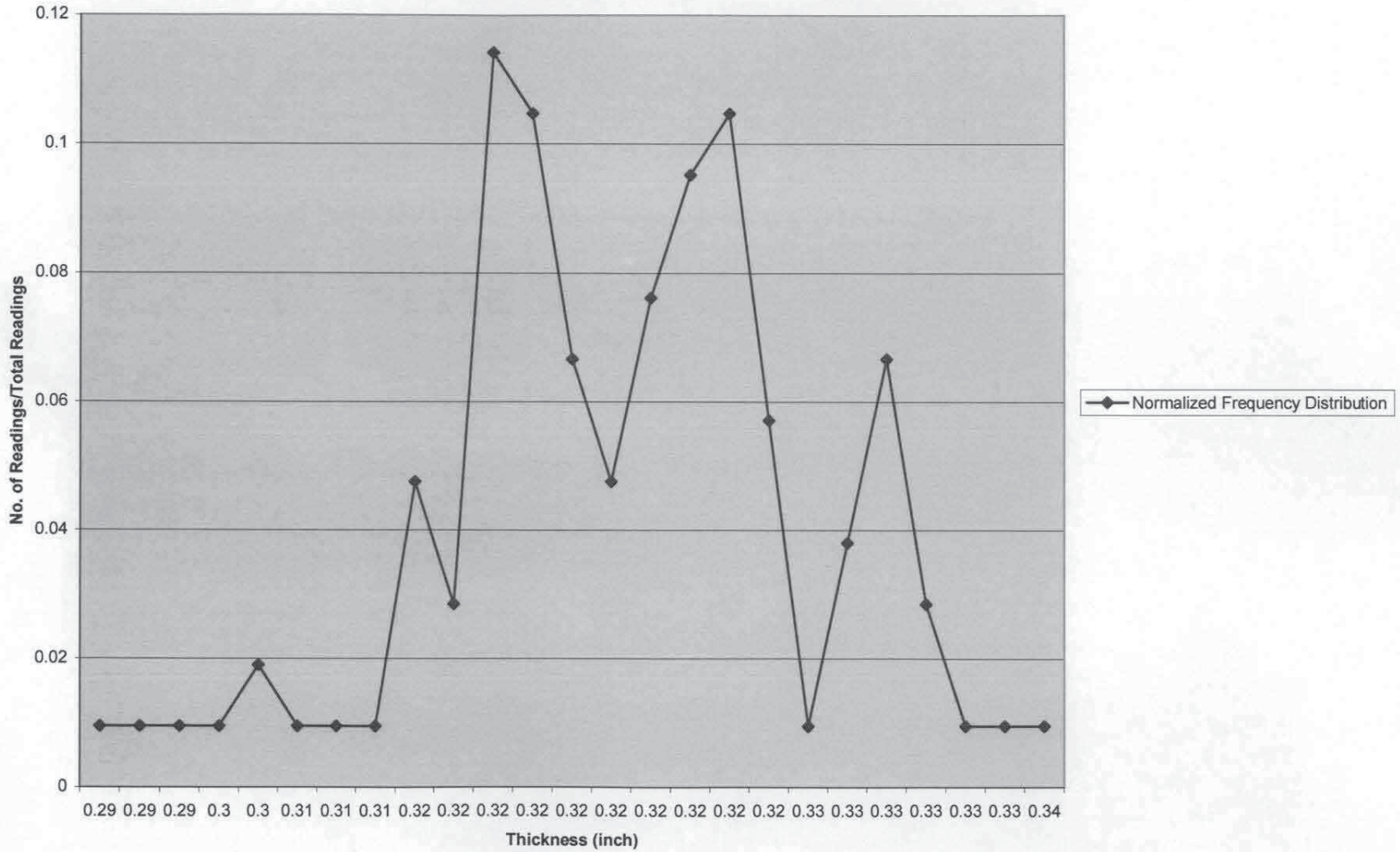

Figure 6C.LOC2.2007.3 "Reliability"

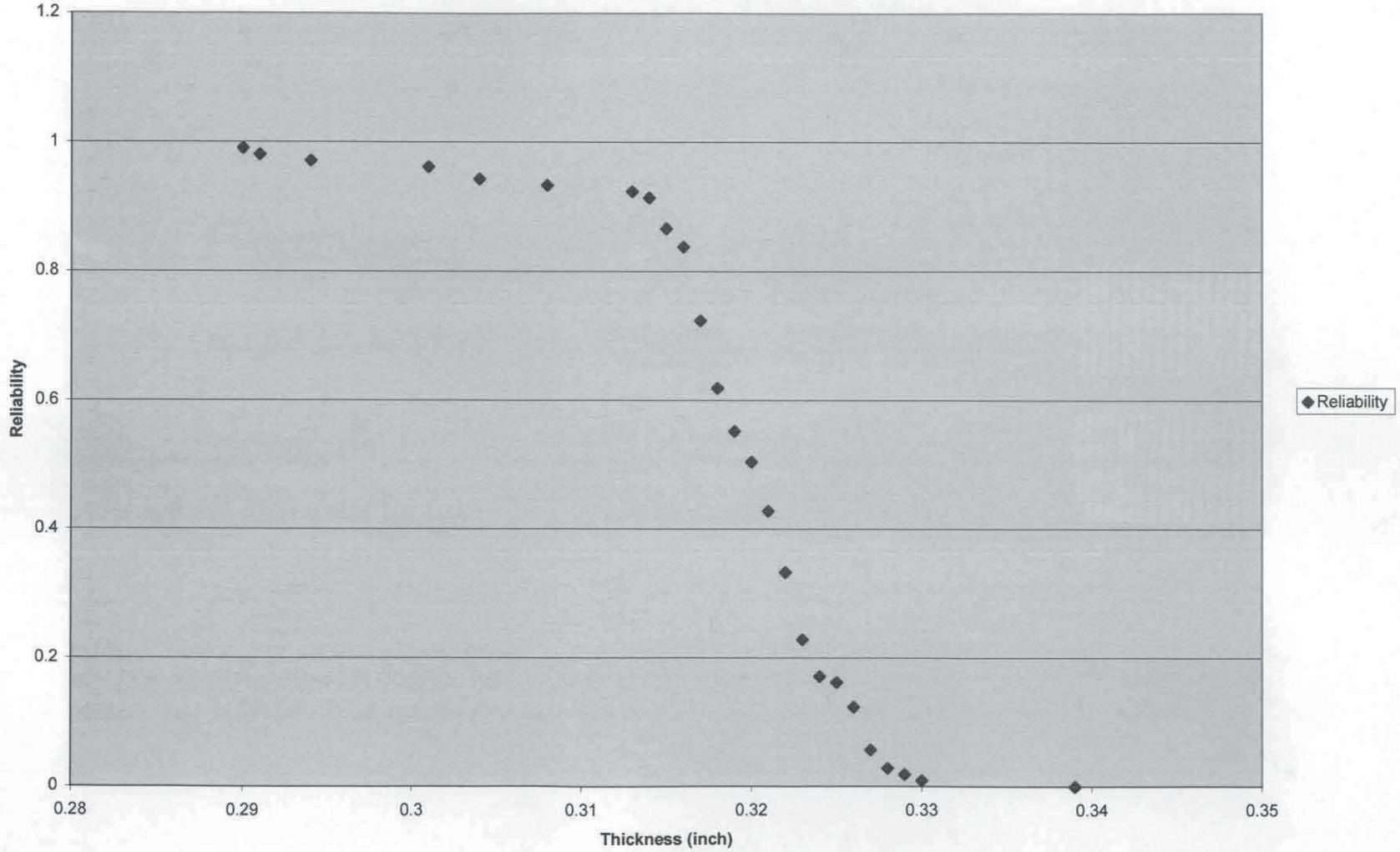

Figure 6C.LOC2.4 "Reliability^Area Ratio"

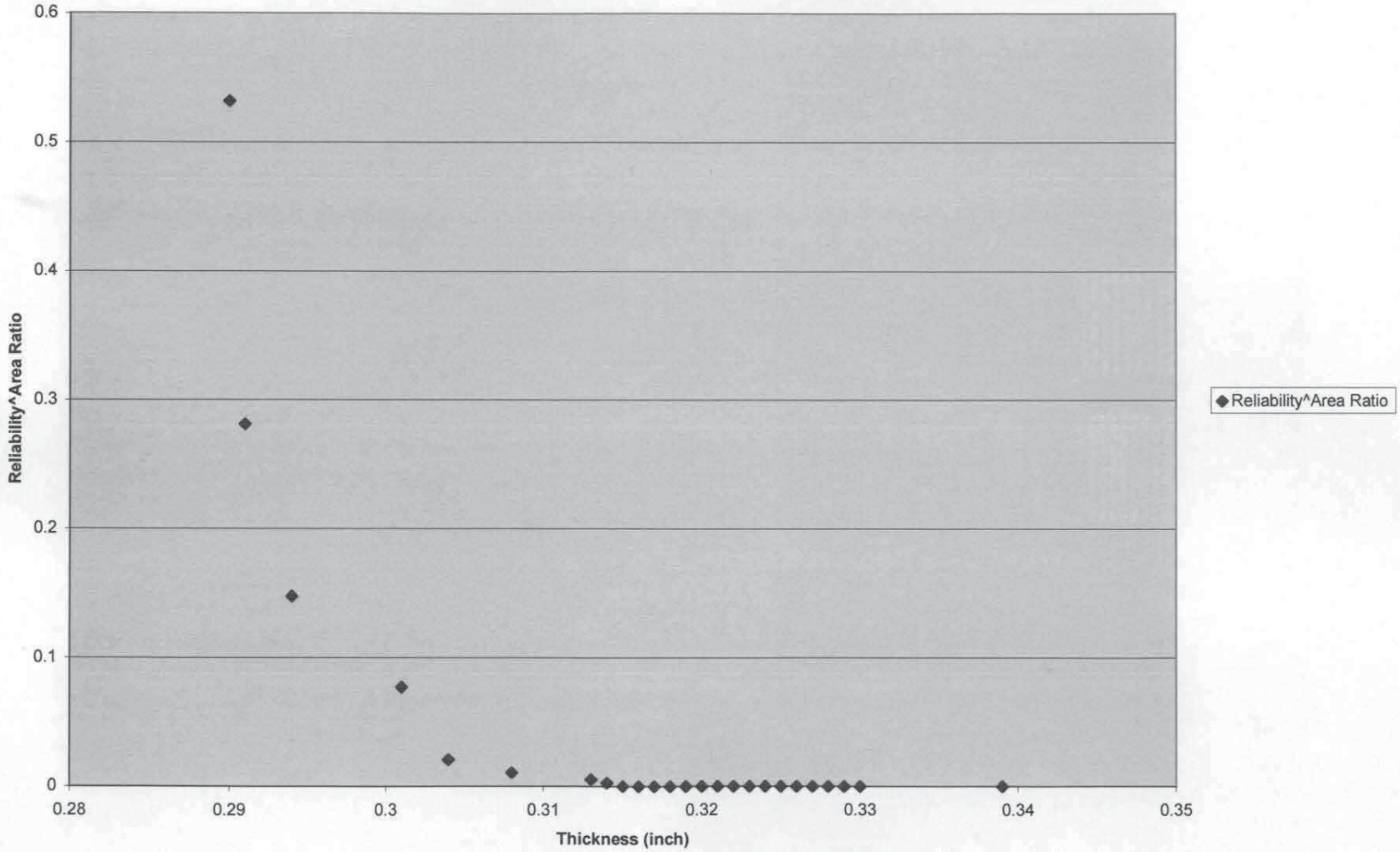

Table 6C.LOC3.1993.1	
Location 3ALL	
Descriptive Statistics	
Mean	0.375138
Standard Error	0.000262
Median	0.376
Mode	0.373
Standard Deviation	0.005601
Sample Variance	3.14E-05
Kurtosis	2.454859
Skewness	-1.187923
Range	0.036
Minimum	0.348
Maximum	0.384
Sum	171.063
Count	456
Largest(1)	0.384
Smallest(1)	0.348
Confidence Level(95.0%)	0.000515

Table 6C.LOC3.1993.2							
Location 3ALL							
Ordered Readings							
Thickness (inch)	Count	*Thickness (inch)*	Count	*Thickness (inch)*	Count	*Thickness (inch)*	Count
0.348	1	0.368	48	0.372	95	0.373	142
0.35	2	0.368	49	0.372	96	0.373	143
0.351	3	0.368	50	0.372	97	0.373	144
0.356	4	0.368	51	0.372	98	0.373	145
0.357	5	0.368	52	0.372	99	0.373	146
0.358	6	0.368	53	0.372	100	0.373	147
0.359	7	0.368	54	0.372	101	0.373	148
0.36	8	0.368	55	0.372	102	0.373	149
0.36	9	0.368	56	0.372	103	0.373	150
0.361	10	0.368	57	0.372	104	0.373	151
0.362	11	0.368	58	0.373	105	0.373	152
0.362	12	0.368	59	0.373	106	0.373	153
0.363	13	0.368	60	0.373	107	0.373	154
0.363	14	0.368	61	0.373	108	0.373	155
0.364	15	0.369	62	0.373	109	0.373	156
0.365	16	0.369	63	0.373	110	0.373	157
0.365	17	0.369	64	0.373	111	0.373	158
0.365	18	0.369	65	0.373	112	0.373	159
0.365	19	0.369	66	0.373	113	0.373	160
0.365	20	0.369	67	0.373	114	0.373	161
0.365	21	0.369	68	0.373	115	0.373	162
0.365	22	0.369	69	0.373	116	0.373	163
0.365	23	0.37	70	0.373	117	0.373	164
0.365	24	0.371	71	0.373	118	0.373	165
0.365	25	0.371	72	0.373	119	0.373	166
0.366	26	0.371	73	0.373	120	0.373	167
0.366	27	0.371	74	0.373	121	0.373	168
0.366	28	0.371	75	0.373	122	0.374	169
0.366	29	0.371	76	0.373	123	0.374	170
0.366	30	0.372	77	0.373	124	0.374	171
0.366	31	0.372	78	0.373	125	0.374	172
0.366	32	0.372	79	0.373	126	0.374	173
0.366	33	0.372	80	0.373	127	0.374	174
0.366	34	0.372	81	0.373	128	0.374	175
0.366	35	0.372	82	0.373	129	0.374	176
0.366	36	0.372	83	0.373	130	0.374	177
0.366	37	0.372	84	0.373	131	0.374	178
0.367	38	0.372	85	0.373	132	0.374	179
0.367	39	0.372	86	0.373	133	0.374	180
0.367	40	0.372	87	0.373	134	0.374	181
0.367	41	0.372	88	0.373	135	0.374	182
0.367	42	0.372	89	0.373	136	0.374	183
0.367	43	0.372	90	0.373	137	0.374	184
0.367	44	0.372	91	0.373	138	0.374	185
0.367	45	0.372	92	0.373	139	0.374	186
0.367	46	0.372	93	0.373	140	0.374	187
0.368	47	0.372	94	0.373	141	0.374	188

Table 6C.LOC3.1993.2							
Location 3ALL							
Ordered Readings							
Thickness (inch)	Count	*Thickness (inch)*	Count	*Thickness (inch)*	Count	*Thickness (inch)*	Count
0.374	189	0.376	236	0.377	283	0.379	330
0.374	190	0.376	237	0.377	284	0.379	331
0.374	191	0.376	238	0.377	285	0.379	332
0.374	192	0.376	239	0.377	286	0.379	333
0.374	193	0.376	240	0.378	287	0.379	334
0.374	194	0.376	241	0.378	288	0.38	335
0.374	195	0.376	242	0.378	289	0.38	336
0.374	196	0.376	243	0.378	290	0.38	337
0.374	197	0.376	244	0.378	291	0.38	338
0.374	198	0.376	245	0.378	292	0.38	339
0.374	199	0.376	246	0.378	293	0.38	340
0.374	200	0.377	247	0.378	294	0.38	341
0.375	201	0.377	248	0.378	295	0.38	342
0.375	202	0.377	249	0.378	296	0.38	343
0.375	203	0.377	250	0.378	297	0.38	344
0.375	204	0.377	251	0.378	298	0.38	345
0.375	205	0.377	252	0.378	299	0.38	346
0.375	206	0.377	253	0.378	300	0.38	347
0.375	207	0.377	254	0.378	301	0.38	348
0.375	208	0.377	255	0.378	302	0.38	349
0.375	209	0.377	256	0.378	303	0.38	350
0.375	210	0.377	257	0.378	304	0.38	351
0.375	211	0.377	258	0.378	305	0.38	352
0.375	212	0.377	259	0.378	306	0.38	353
0.375	213	0.377	260	0.378	307	0.38	354
0.375	214	0.377	261	0.378	308	0.38	355
0.375	215	0.377	262	0.378	309	0.38	356
0.375	216	0.377	263	0.378	310	0.38	357
0.375	217	0.377	264	0.378	311	0.38	358
0.375	218	0.377	265	0.379	312	0.38	359
0.375	219	0.377	266	0.379	313	0.38	360
0.375	220	0.377	267	0.379	314	0.38	361
0.375	221	0.377	268	0.379	315	0.38	362
0.375	222	0.377	269	0.379	316	0.38	363
0.375	223	0.377	270	0.379	317	0.38	364
0.376	224	0.377	271	0.379	318	0.38	365
0.376	225	0.377	272	0.379	319	0.38	366
0.376	226	0.377	273	0.379	320	0.38	367
0.376	227	0.377	274	0.379	321	0.381	368
0.376	228	0.377	275	0.379	322	0.381	369
0.376	229	0.377	276	0.379	323	0.381	370
0.376	230	0.377	277	0.379	324	0.381	371
0.376	231	0.377	278	0.379	325	0.381	372
0.376	232	0.377	279	0.379	326	0.381	373
0.376	233	0.377	280	0.379	327	0.381	374
0.376	234	0.377	281	0.379	328	0.381	375
0.376	235	0.377	282	0.379	329	0.381	376

Table 6C.LOC3.1993.2							
Location 3ALL							
Ordered Readings							
Thickness (inch)	Count	*Thickness (inch)*	Count	*Thickness (inch)*	Count	*Thickness (inch)*	Count
0.381	377	0.382	424				
0.381	378	0.382	425				
0.381	379	0.382	426				
0.381	380	0.382	427				
0.381	381	0.382	428				
0.381	382	0.382	429				
0.381	383	0.382	430				
0.381	384	0.382	431				
0.381	385	0.382	432				
0.381	386	0.382	433				
0.381	387	0.382	434				
0.381	388	0.382	435				
0.381	389	0.382	436				
0.381	390	0.382	437				
0.381	391	0.382	438				
0.381	392	0.382	439				
0.381	393	0.382	440				
0.381	394	0.382	441				
0.381	395	0.382	442				
0.381	396	0.382	443				
0.381	397	0.382	444				
0.381	398	0.382	445				
0.381	399	0.382	446				
0.381	400	0.382	447				
0.381	401	0.382	448				
0.381	402	0.383	449				
0.381	403	0.383	450				
0.381	404	0.383	451				
0.381	405	0.383	452				
0.381	406	0.383	453				
0.381	407	0.384	454				
0.381	408	0.384	455				
0.381	409	0.384	456				
0.381	410						
0.381	411						
0.381	412						
0.381	413						
0.381	414						
0.381	415						
0.381	416						
0.382	417						
0.382	418						
0.382	419						
0.382	420						
0.382	421						
0.382	422						
0.382	423						

Table 6C.LOC3.1993.3						
Location 3ALL						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.348	1	0.002192982	0.00219298	0.997807	142.4	0.731583837
0.35	1	0.002192982	0.00438596	0.995614	142.4	0.534846988
0.351	1	0.002192982	0.00657895	0.9934211	142.4	0.39074645
0.356	1	0.002192982	0.00877193	0.9912281	142.4	0.285272058
0.357	1	0.002192982	0.01096491	0.9890351	142.4	0.208123348
0.358	1	0.002192982	0.01315789	0.9868421	142.4	0.151732426
0.359	1	0.002192982	0.01535088	0.9846491	142.4	0.110542855
0.36	2	0.004385965	0.01973684	0.9802632	142.4	0.058548235
0.361	1	0.002192982	0.02192982	0.9780702	142.4	0.042563948
0.362	2	0.004385965	0.02631579	0.9736842	142.4	0.022447307
0.363	2	0.004385965	0.03070175	0.9692982	142.4	0.011804077
0.364	1	0.002192982	0.03289474	0.9671053	142.4	0.008550509
0.365	10	0.021929825	0.05482456	0.9451754	142.4	0.000326485
0.366	12	0.026315789	0.08114035	0.9188596	142.4	5.86172E-06
0.367	9	0.019736842	0.10087719	0.8991228	142.4	2.66387E-07
0.368	15	0.032894737	0.13377193	0.8662281	142.4	1.32163E-09
0.369	8	0.01754386	0.15131579	0.8486842	142.4	7.17876E-11
0.37	1	0.002192982	0.15350877	0.8464912	142.4	4.96685E-11
0.371	6	0.013157895	0.16666667	0.8333333	142.4	5.33927E-12
0.372	28	0.061403509	0.22807018	0.7719298	142.4	9.88978E-17
0.373	64	0.140350877	0.36842105	0.6315789	142.4	3.87421E-29
0.374	32	0.070175439	0.43859649	0.5614035	142.4	2.0227E-36
0.375	23	0.050438596	0.48903509	0.5109649	142.4	3.0587E-42
0.376	23	0.050438596	0.53947368	0.4605263	142.4	1.14744E-48
0.377	40	0.087719298	0.62719298	0.372807	142.4	9.88506E-62
0.378	25	0.054824561	0.68201754	0.3179825	142.4	1.4467E-71
0.379	23	0.050438596	0.73245614	0.2675439	142.4	3.03357E-82
0.38	33	0.072368421	0.80482456	0.1951754	142.4	9.604E-102
0.381	49	0.10745614	0.9122807	0.0877193	142.4	3.4304E-151
0.382	32	0.070175439	0.98245614	0.0175439	142.4	1.0655E-250
0.383	5	0.010964912	0.99342105	0.0065789	142.4	0
0.384	3	0.006578947	1	0	142.4	0
Total	456					

Figure 6C.LOC3ALL.1993.1.OrderedThickness Readings

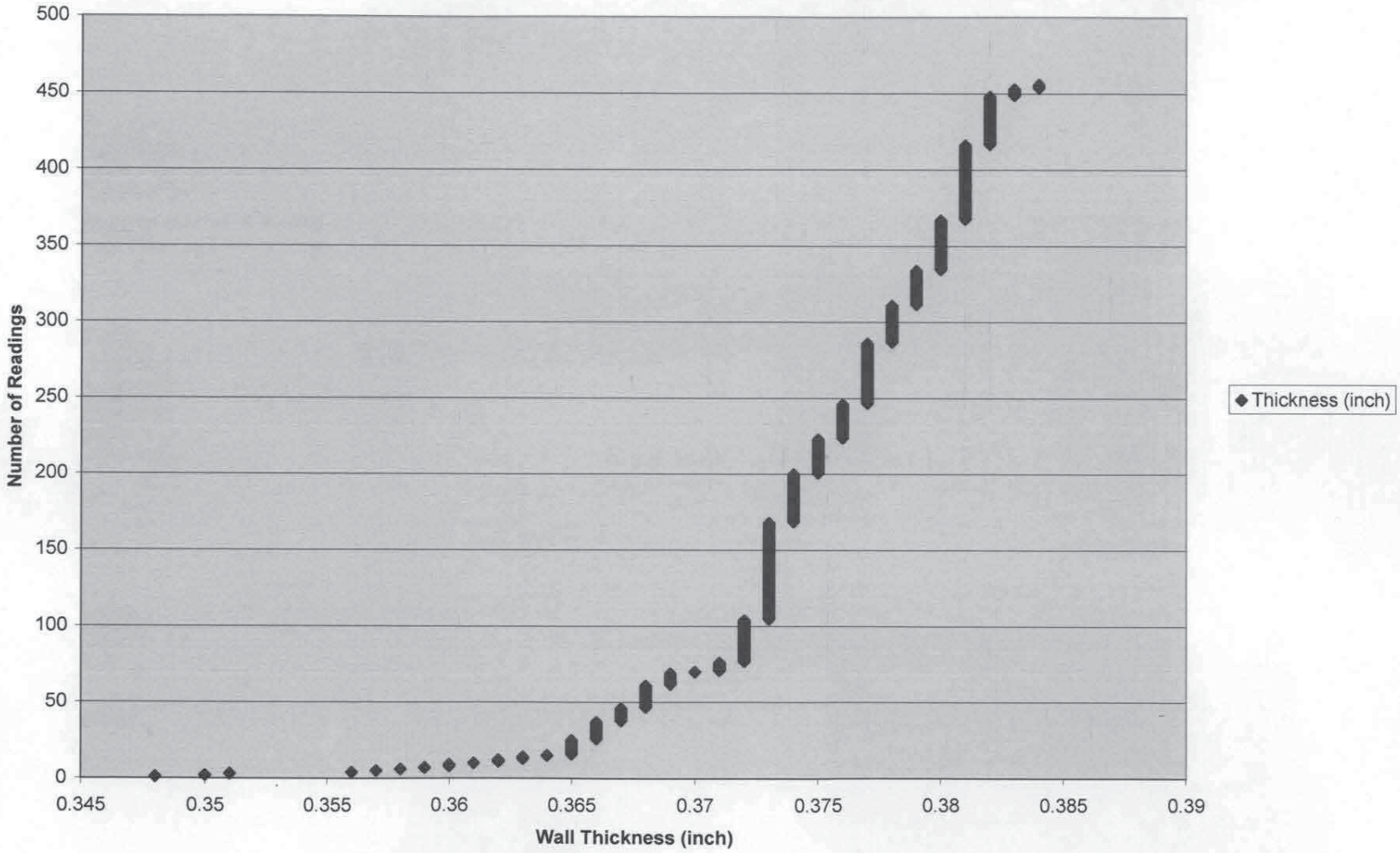

Figure 6C.LOC3ALL.1993.2.Normalized Frequency Distribution

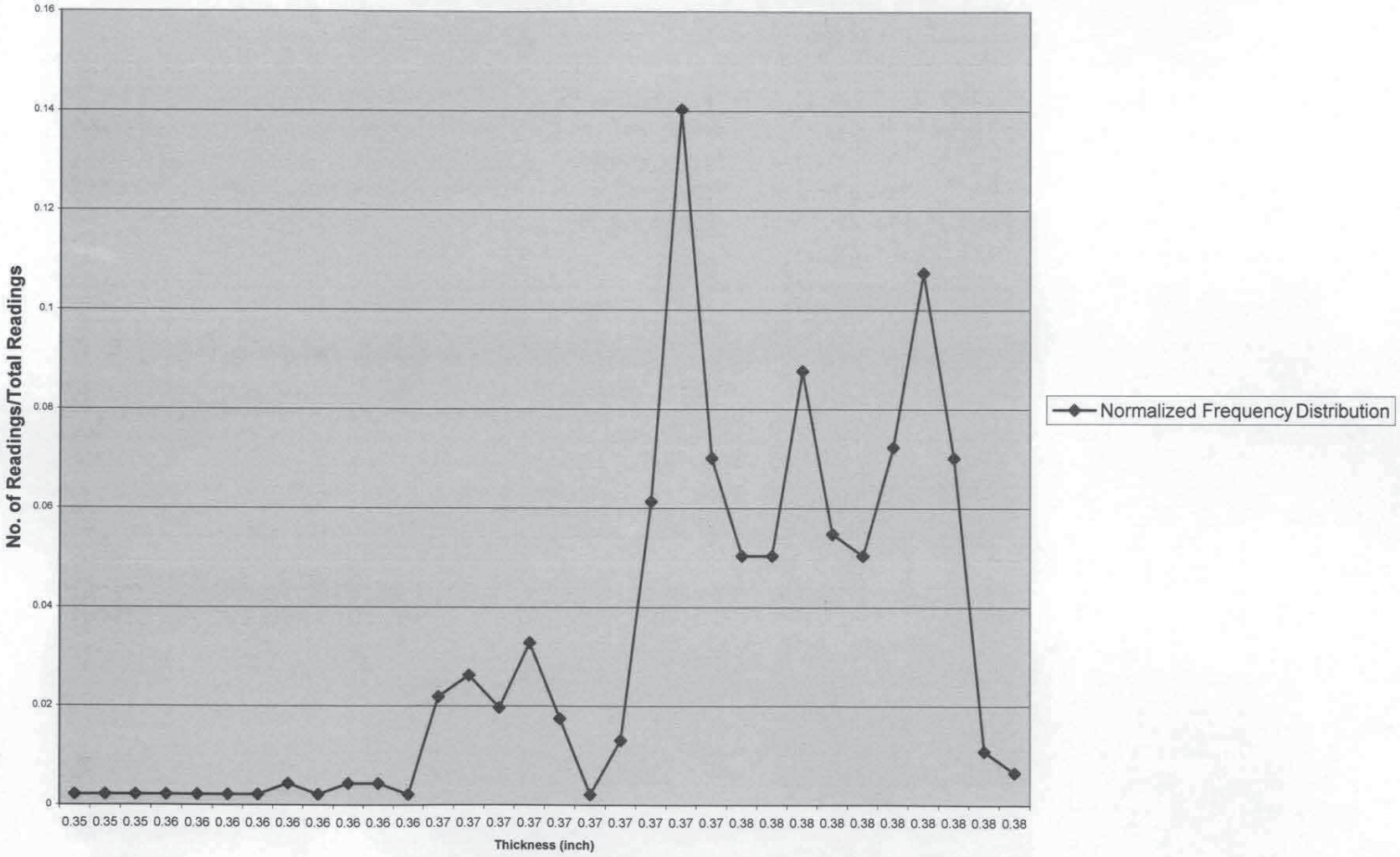

Figure 6C.LOC3ALL.1993.3.Reliability Function

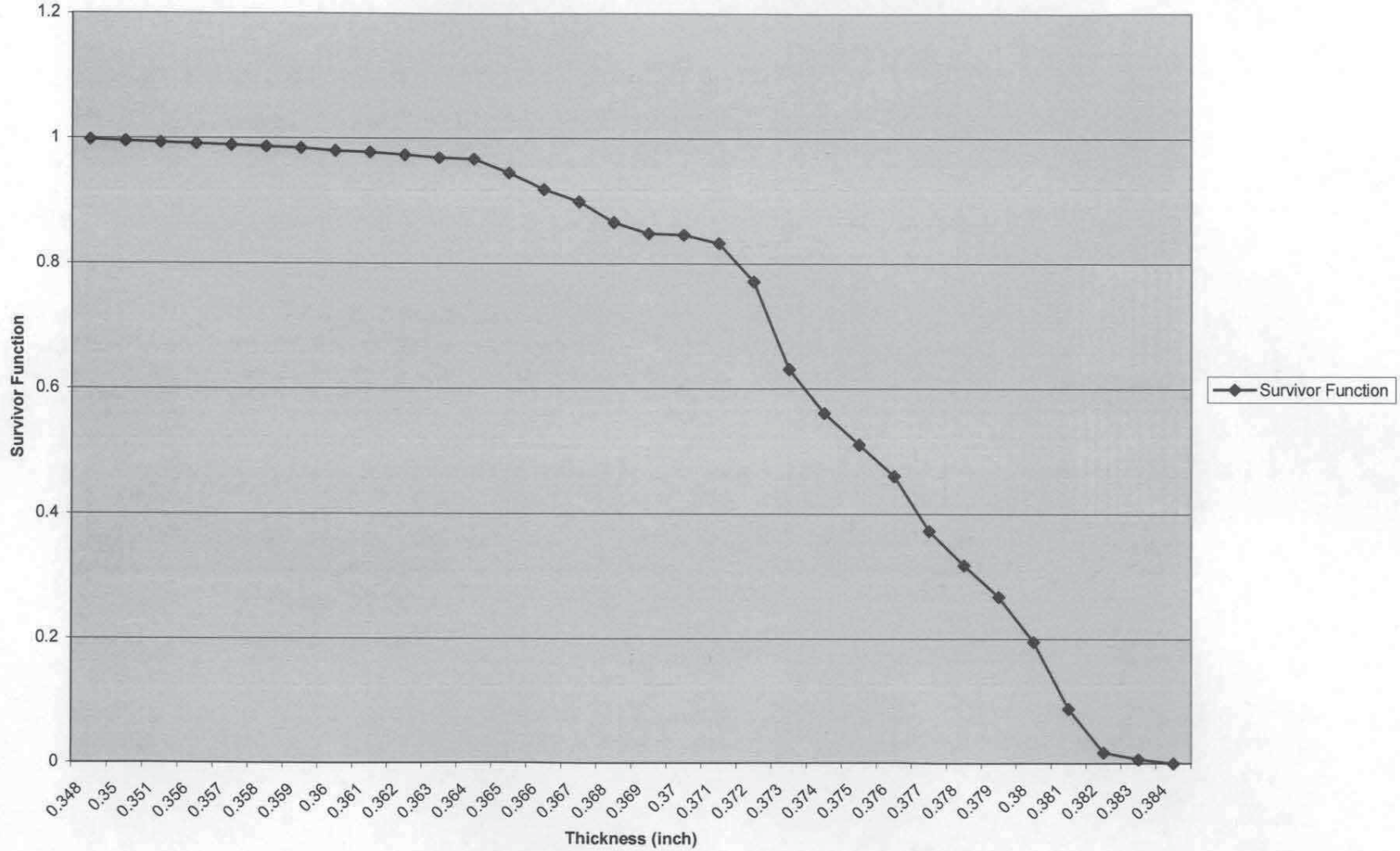

Figure 6C.LOC3ALL.1993.4.Reliablity^Area Ratio

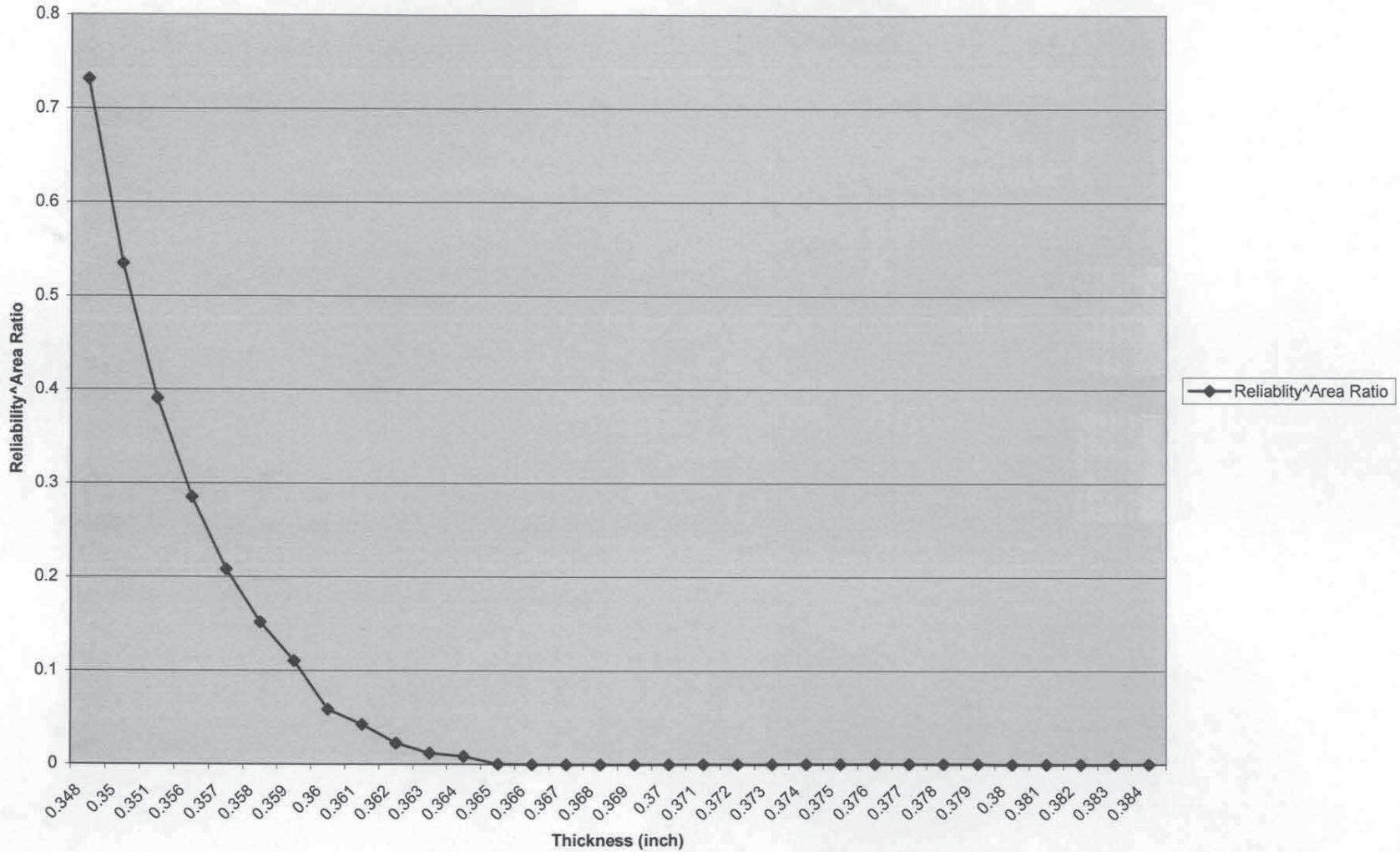

Table 6C.LOC3.1993.1	
Location 3A-L,1-6	
Descriptive Statistics	
Mean	0.380375
Standard Error	0.000183895
Median	0.381
Mode	0.381
Standard Deviation	0.001560404
Sample Variance	2.43486E-06
Kurtosis	-0.660503162
Skewness	-0.355680207
Range	0.006
Minimum	0.377
Maximum	0.383
Sum	27.387
Count	72
Largest(1)	0.383
Smallest(1)	0.377
Confidence Level(95.0%)	0.000366677

Table 6C.LOC3.1993.2			
Location 3A-L,1-6			
Ordered Readings			
Thickness (inch)	Count	*Thickness (inch)*	Count
0.377	1	0.381	48
0.377	2	0.381	49
0.377	3	0.381	50
0.378	4	0.381	51
0.378	5	0.381	52
0.378	6	0.382	53
0.378	7	0.382	54
0.378	8	0.382	55
0.378	9	0.382	56
0.378	10	0.382	57
0.379	11	0.382	58
0.379	12	0.382	59
0.379	13	0.382	60
0.379	14	0.382	61
0.379	15	0.382	62
0.379	16	0.382	63
0.379	17	0.382	64
0.379	18	0.382	65
0.379	19	0.382	66
0.379	20	0.382	67
0.379	21	0.382	68
0.38	22	0.383	69
0.38	23	0.383	70
0.38	24	0.383	71
0.38	25	0.383	72
0.38	26		
0.38	27		
0.38	28		
0.38	29		
0.38	30		
0.38	31		
0.38	32		
0.38	33		
0.38	34		
0.38	35		
0.381	36		
0.381	37		
0.381	38		
0.381	39		
0.381	40		
0.381	41		
0.381	42		
0.381	43		
0.381	44		
0.381	45		
0.381	46		
0.381	47		

Table 6C.LOC3.1993.3						
Location 3A-L,1-6						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.377	3	0.041666667	0.04166667	0.9583333	901.6	2.16126E-17
0.378	7	0.097222222	0.13888889	0.8611111	901.6	2.79942E-59
0.379	11	0.152777778	0.29166667	0.7083333	901.6	9.3108E-136
0.38	14	0.194444444	0.48611111	0.5138889	901.6	2.0392E-261
0.381	17	0.236111111	0.72222222	0.2777778	901.6	0
0.382	16	0.222222222	0.94444444	0.0555556	901.6	0
0.383	4	0.055555556	1	0	901.6	0
Total	72					

Figure 6C.LOC3A-L.1-6.1.Ordered Thickness Readings

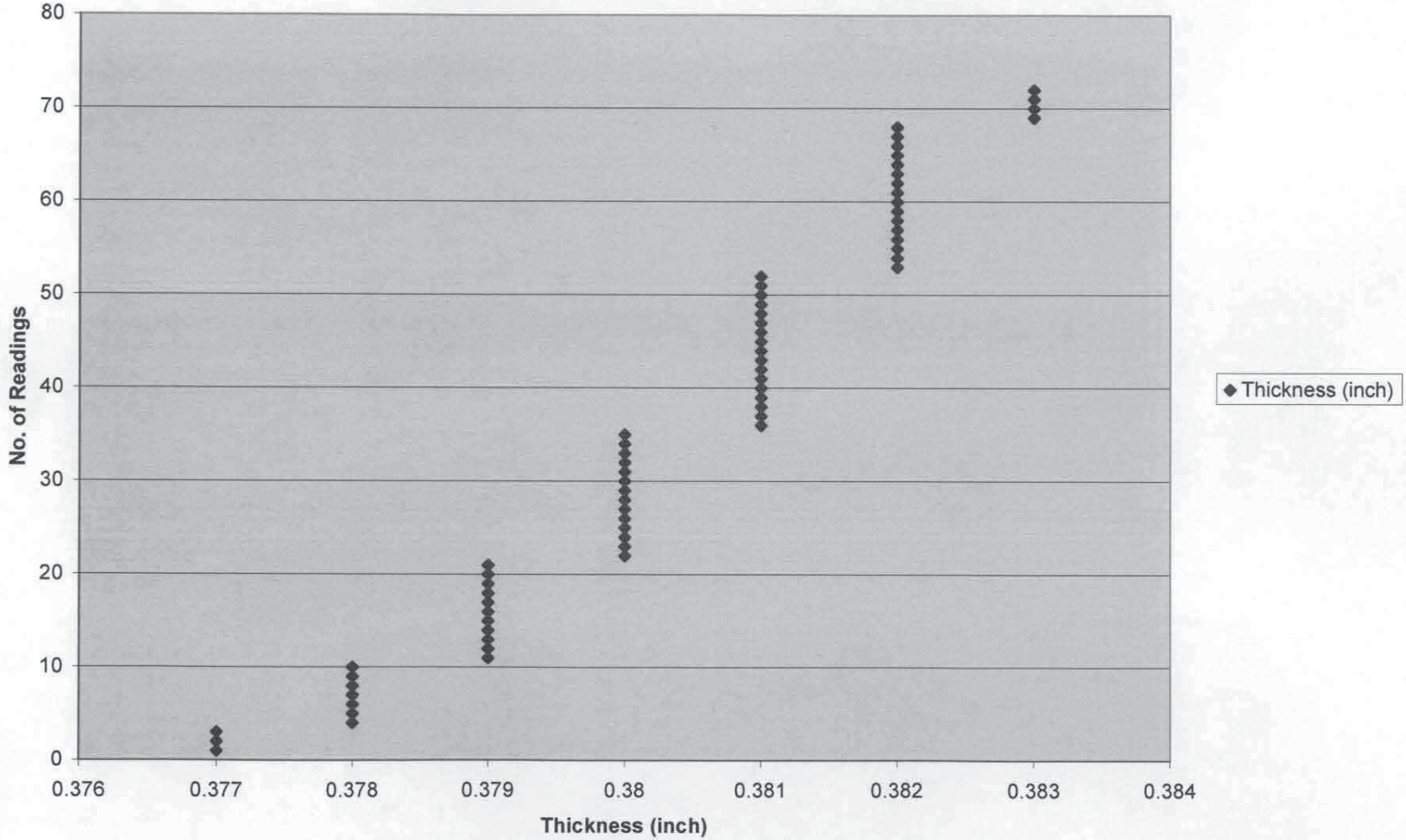

Figure 6C.LOC3A-L.1-6.1993.2.Normalized Frequency Distribution

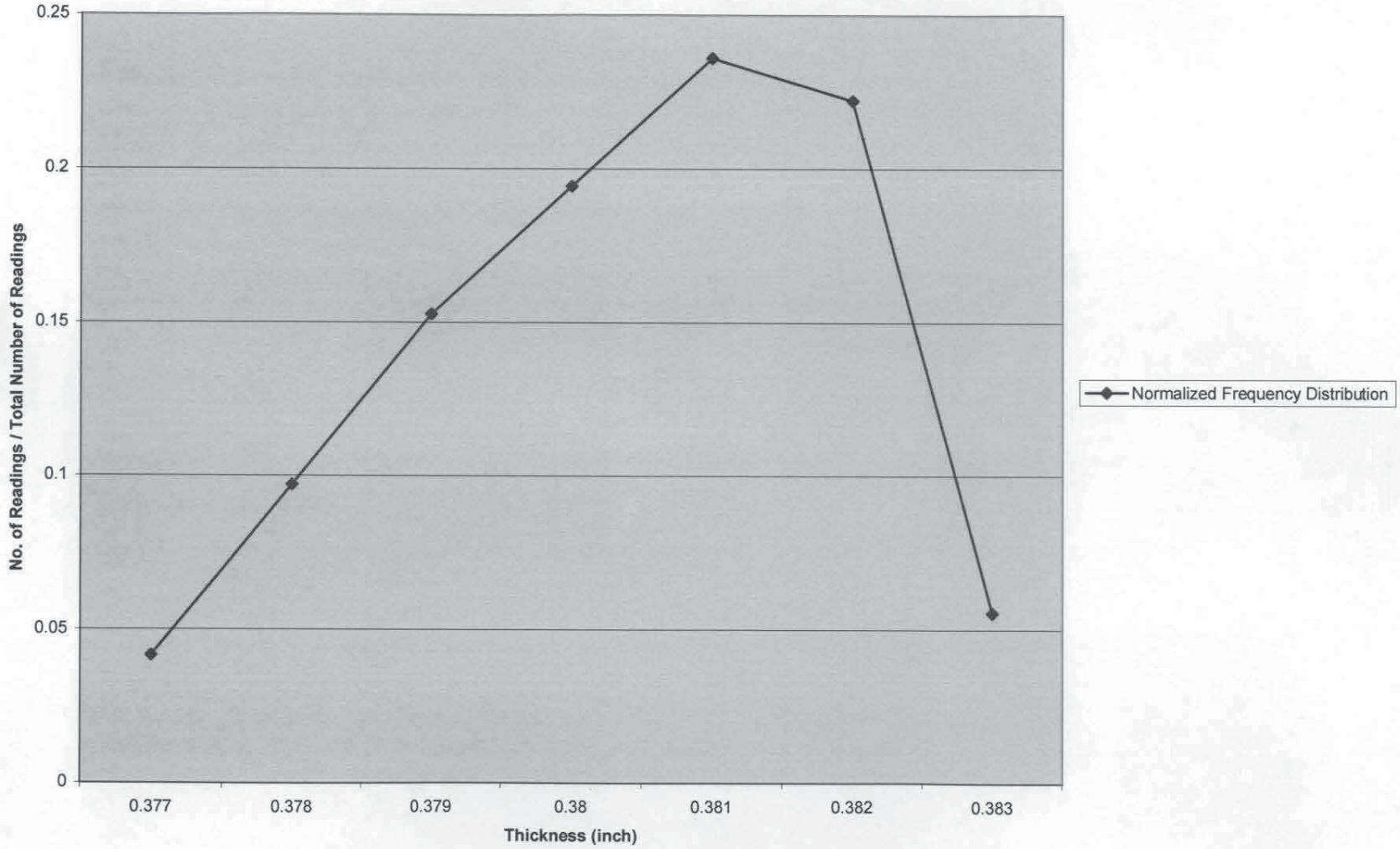

Figure 6C.LOC3A-L.1-6.1993.3.Reliability Function

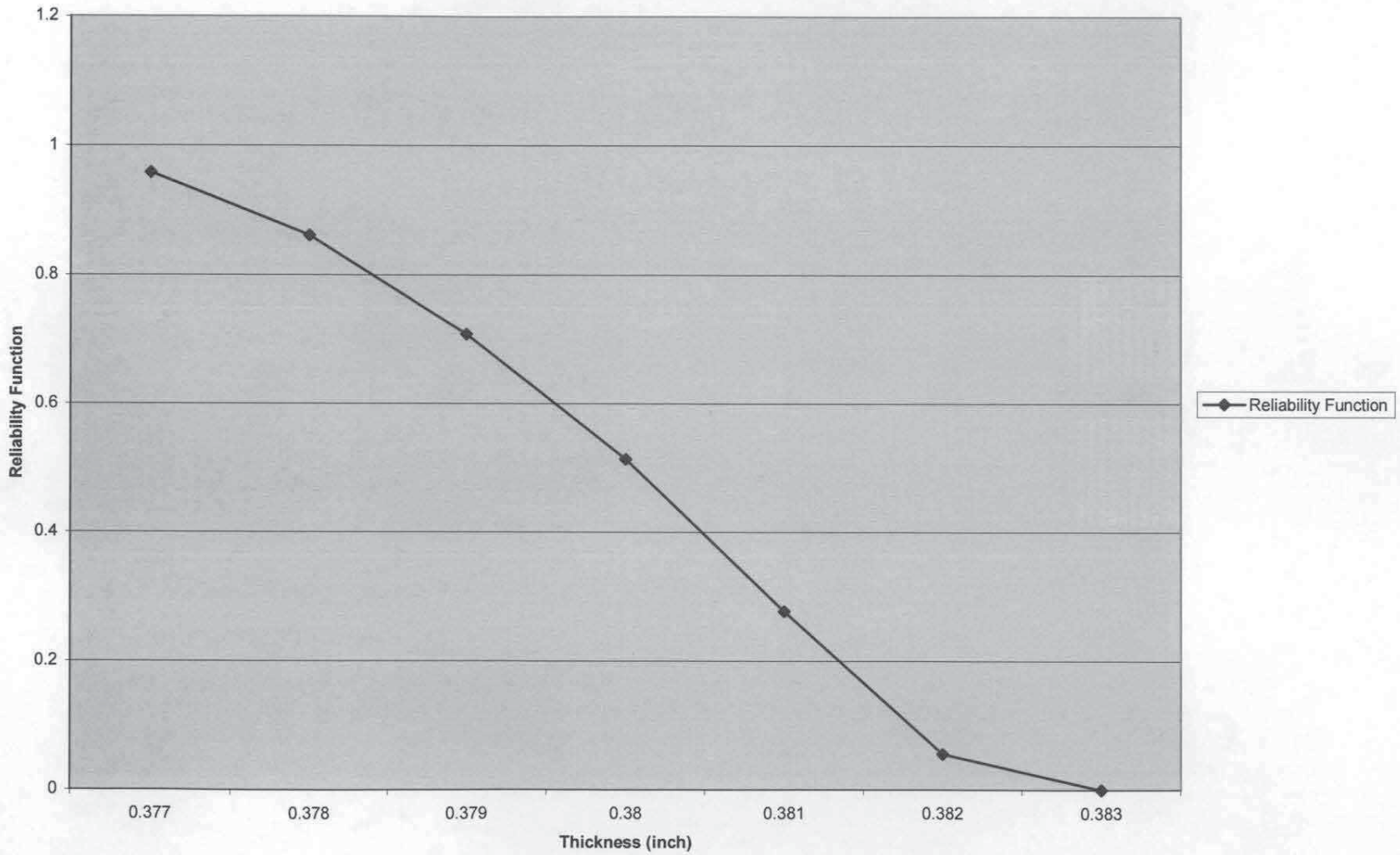

Figure 6C.LOC3A-L.1-6.4.Reliability^Area Ratio

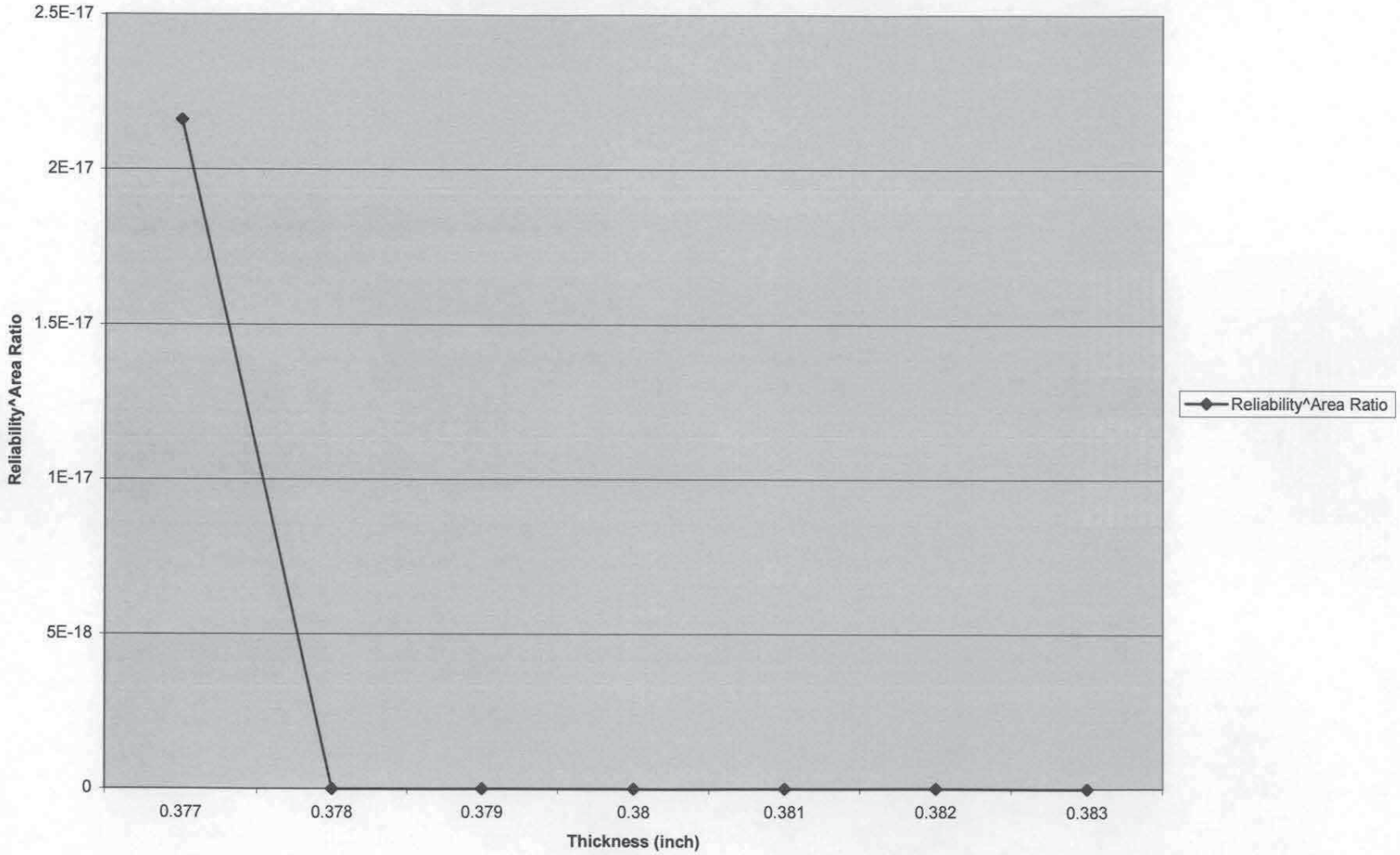

Table 6C.LOC3.1998.1	
Location 3	
Descriptive Statistics	
Mean	0.383569444
Standard Error	0.000274665
Median	0.383
Mode	0.381
Standard Deviation	0.002330607
Sample Variance	5.43173E-06
Kurtosis	9.999803857
Skewness	2.161591687
Range	0.015
Minimum	0.381
Maximum	0.396
Sum	27.617
Count	72
Largest(1)	0.396
Smallest(1)	0.381
Confidence Level(95.0%)	0.000547666

Table 6C.LOC3.1998.2			
Location 3			
Ordered Readings			
Thickness (inch)	Count	*Thickness (inch)*	Count
0.381	1	0.384	48
0.381	2	0.384	49
0.381	3	0.385	50
0.381	4	0.385	51
0.381	5	0.385	52
0.381	6	0.385	53
0.381	7	0.385	54
0.381	8	0.385	55
0.381	9	0.385	56
0.381	10	0.385	57
0.381	11	0.385	58
0.381	12	0.385	59
0.381	13	0.385	60
0.381	14	0.385	61
0.382	15	0.386	62
0.382	16	0.386	63
0.382	17	0.386	64
0.382	18	0.386	65
0.382	19	0.386	66
0.382	20	0.386	67
0.382	21	0.386	68
0.382	22	0.387	69
0.382	23	0.387	70
0.382	24	0.387	71
0.382	25	0.396	72
0.382	26		
0.382	27		
0.383	28		
0.383	29		
0.383	30		
0.383	31		
0.383	32		
0.383	33		
0.383	34		
0.383	35		
0.383	36		
0.383	37		
0.384	38		
0.384	39		
0.384	40		
0.384	41		
0.384	42		
0.384	43		
0.384	44		
0.384	45		
0.384	46		
0.384	47		

Table 6C.LOC3.1998.3						
Location 3						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.381	14	0.194444444	0.19444444	0.8055556	901.6	2.14968E-85
0.382	13	0.180555556	0.375	0.625	901.6	9.0823E-185
0.383	10	0.138888889	0.51388889	0.4861111	901.6	3.5455E-283
0.384	12	0.166666667	0.68055556	0.3194444	901.6	0
0.385	12	0.166666667	0.84722222	0.1527778	901.6	0
0.386	7	0.097222222	0.94444444	0.0555556	901.6	0
0.387	3	0.041666667	0.98611111	0.0138889	901.6	0
0.396	1	0.013888889	1	0	901.6	0
Total	72					

Figure 6C.LOC3.1998.1.Ordered Thickness Readings

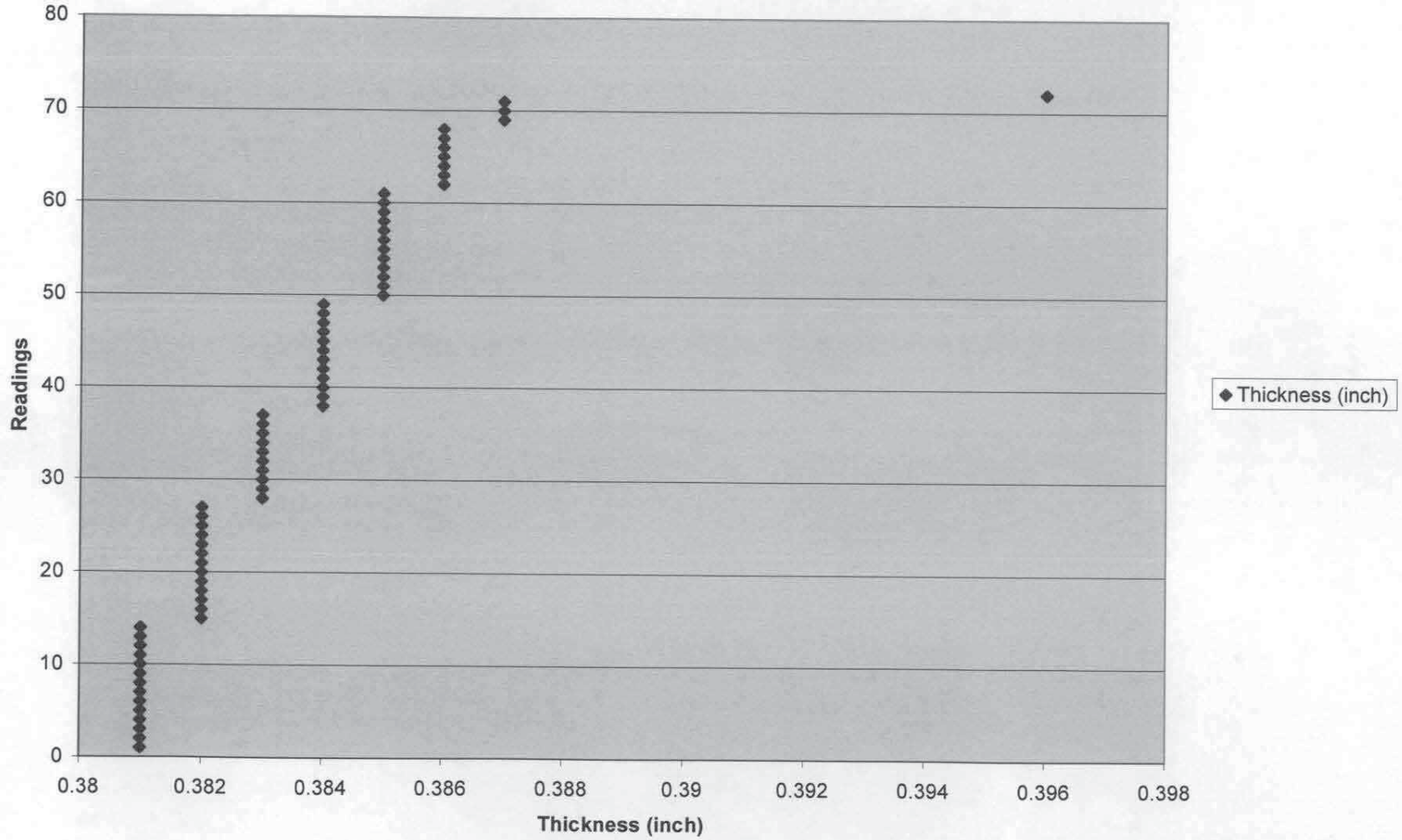

Figure 6C.LOC3.1998.2.Normalized Frequency Distribution

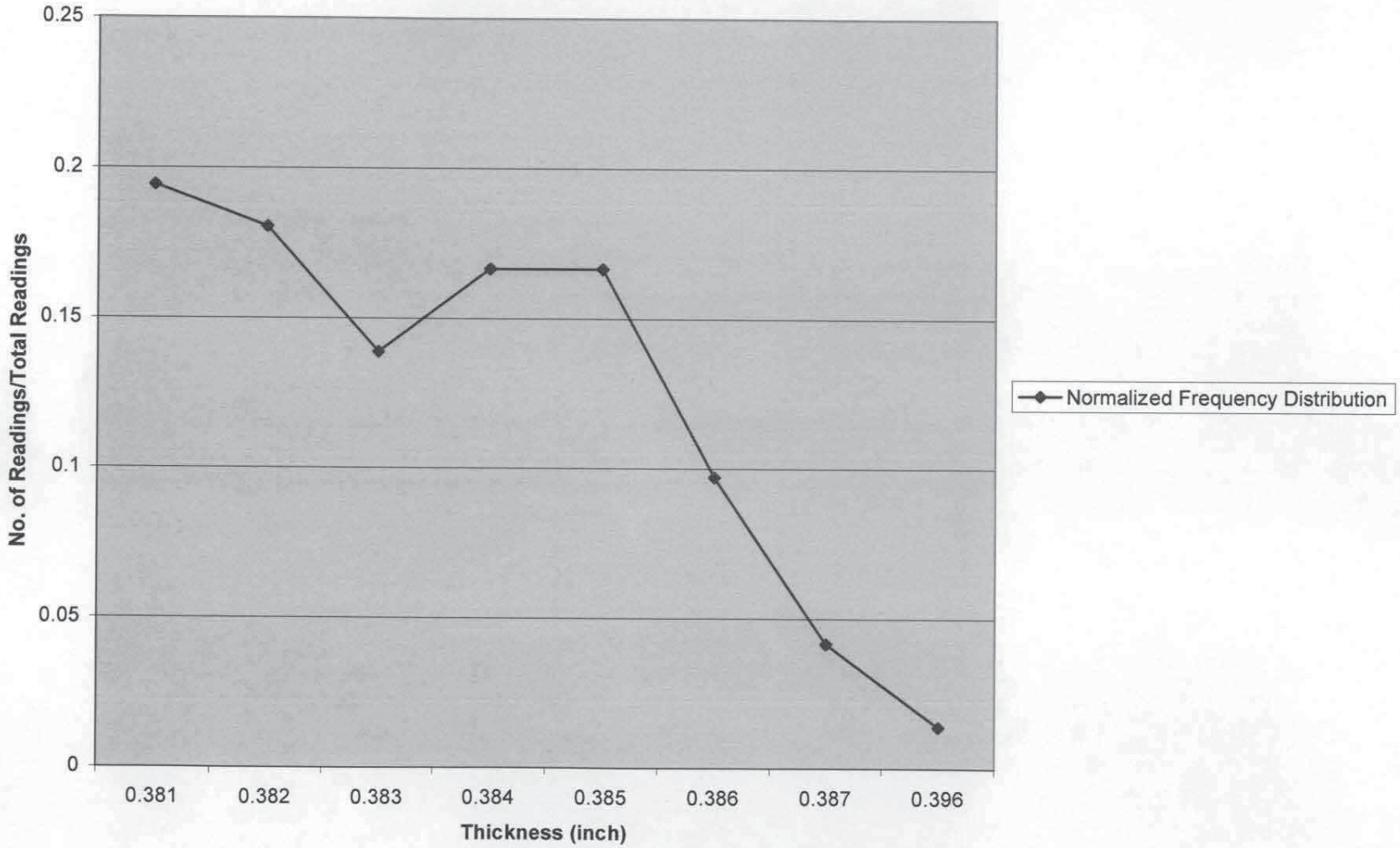

Figure 6C.LOC3.1998.3.Reliability Function

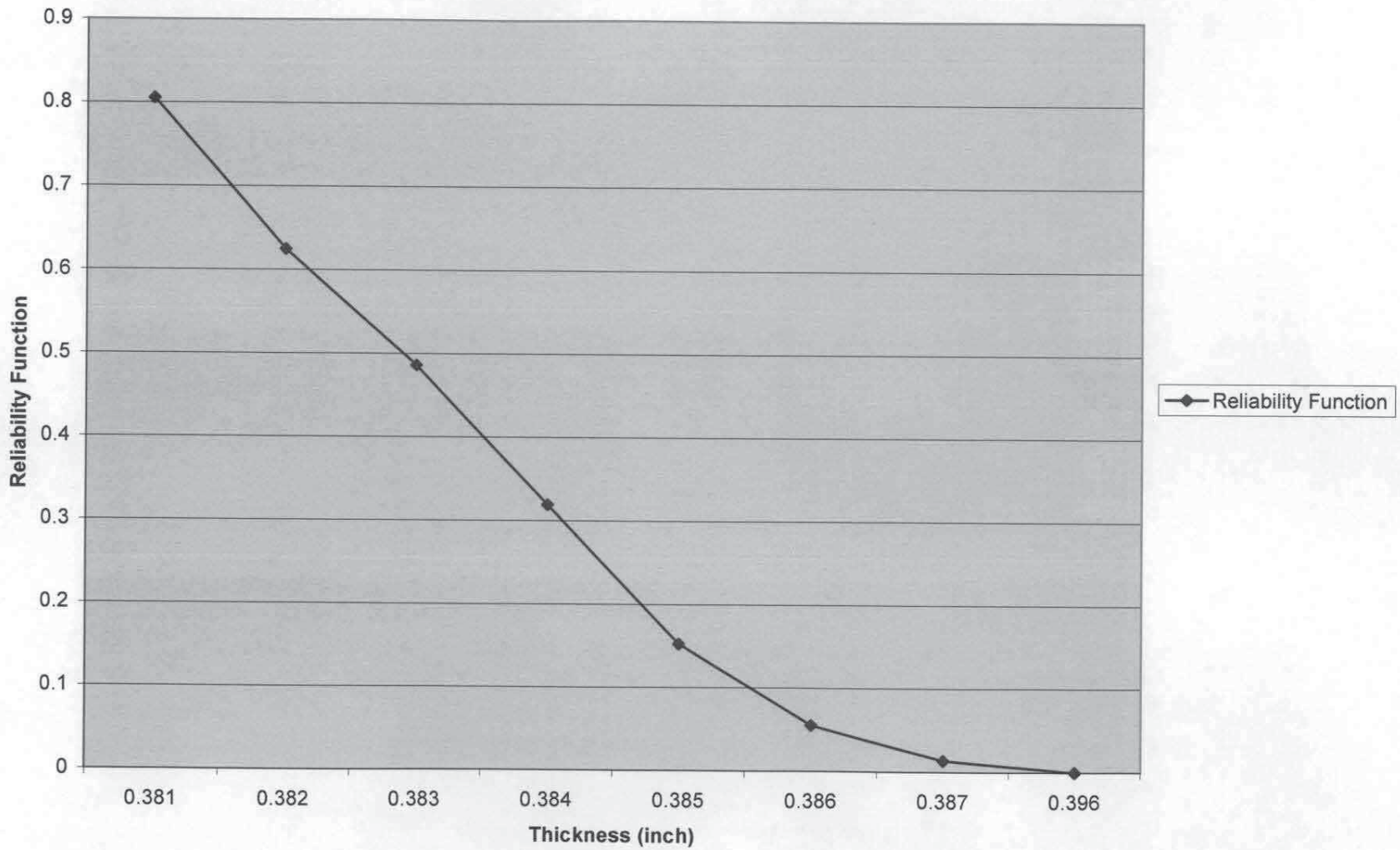

Figure 6C.LOC3.1998.4.Reliability^Area Ratio

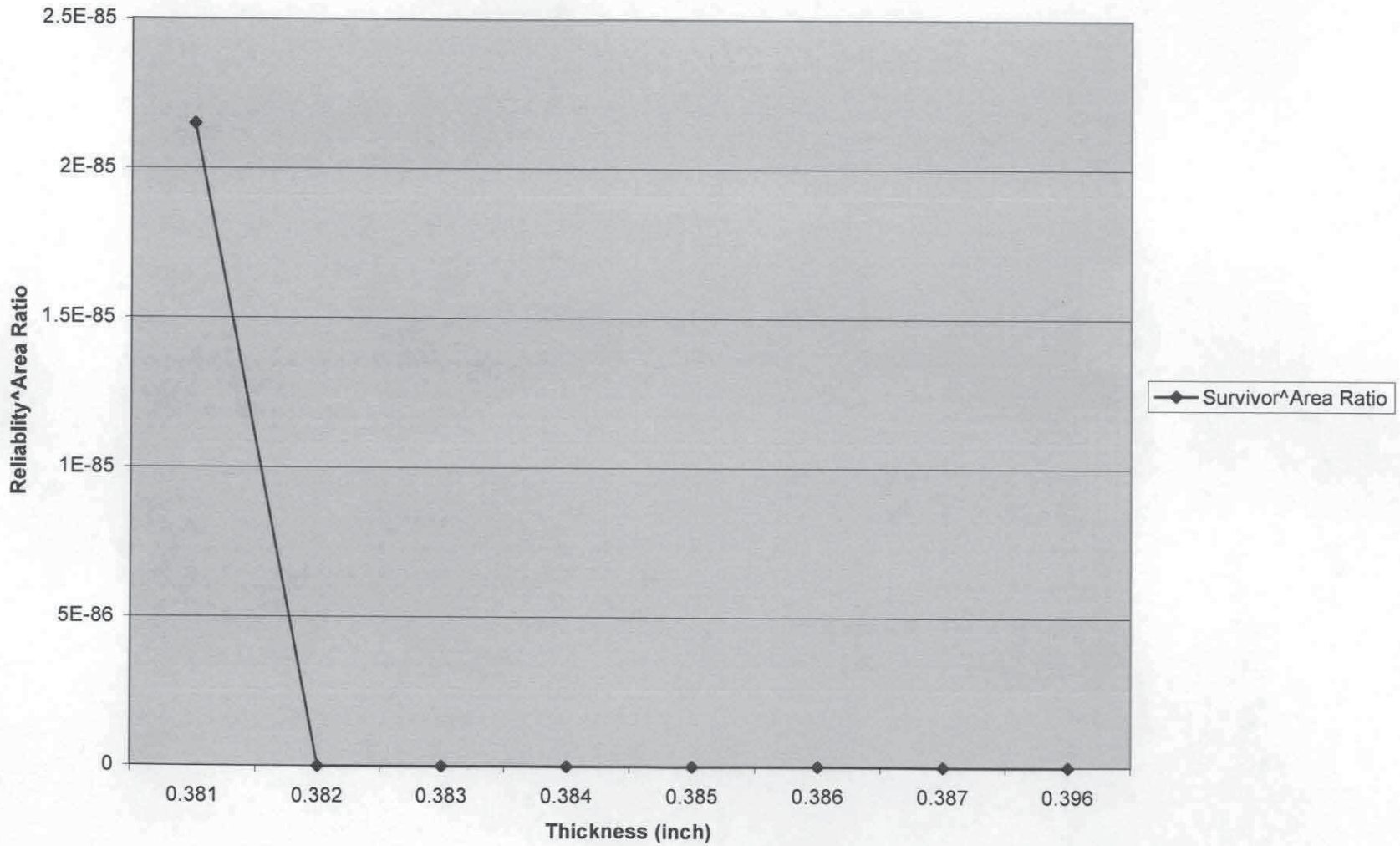

Table 6C.LOC4.1993.1	
Location 4	
Descriptive Statistics	
Mean	0.26275
Standard Error	0.000564902
Median	0.2635
Mode	0.264
Standard Deviation	0.002989178
Sample Variance	8.93519E-06
Kurtosis	6.237408158
Skewness	-1.379308022
Range	0.018
Minimum	0.252
Maximum	0.27
Sum	7.357
Count	28
Largest(1)	0.27
Smallest(1)	0.252
Confidence Level(95.0%)	0.001159082

Table 6C.LOC4.1993.2	
Location 4	
Ordered Readings	
Thickness (inch)	Count
0.252	1
0.259	2
0.26	3
0.26	4
0.261	5
0.261	6
0.261	7
0.261	8
0.262	9
0.263	10
0.263	11
0.263	12
0.263	13
0.263	14
0.264	15
0.264	16
0.264	17
0.264	18
0.264	19
0.264	20
0.264	21
0.264	22
0.264	23
0.264	24
0.265	25
0.265	26
0.265	27
0.27	28

Table 6C.LOC4.1993.3						
Location 4						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.252	1	0.035714286	0.03571429	0.9642857	942.5	1.30072E-15
0.259	1	0.035714286	0.07142857	0.9285714	942.5	4.63992E-31
0.26	2	0.071428571	0.14285714	0.8571429	942.5	8.01394E-64
0.261	4	0.142857143	0.28571429	0.7142857	942.5	1.8921E-138
0.262	1	0.035714286	0.32142857	0.6785714	942.5	1.9135E-159
0.263	5	0.178571429	0.5	0.5	942.5	1.9258E-284
0.264	10	0.357142857	0.85714286	0.1428571	942.5	0
0.265	3	0.107142857	0.96428571	0.0357143	942.5	0
0.27	1	0.035714286	1	0	942.5	0
Total	28					

Figure 6C.LOC4.1993.1.Ordered Thickness Readings

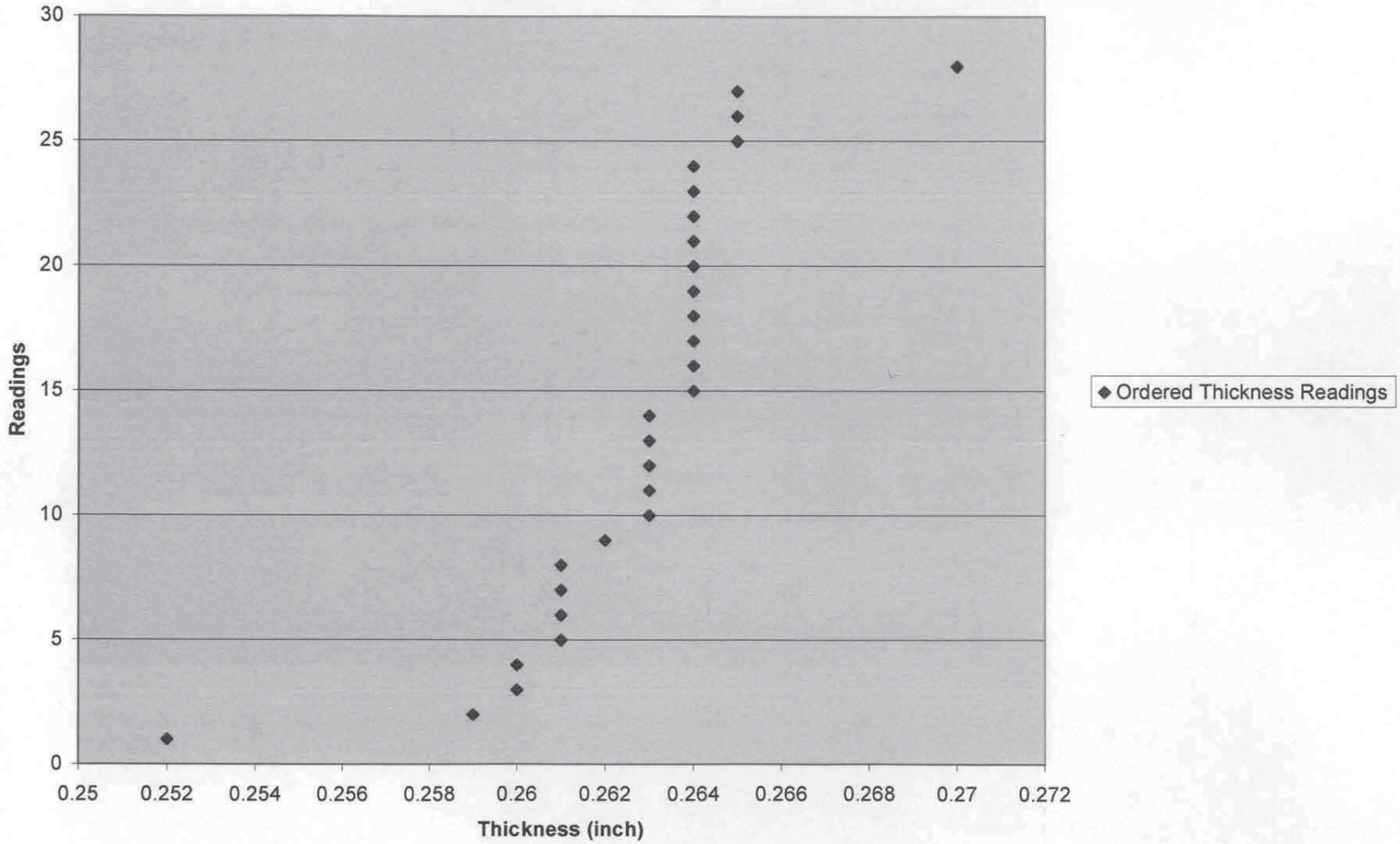

Figure 6C.LOC4.1993.2 "Normalized Frequency Distribution"

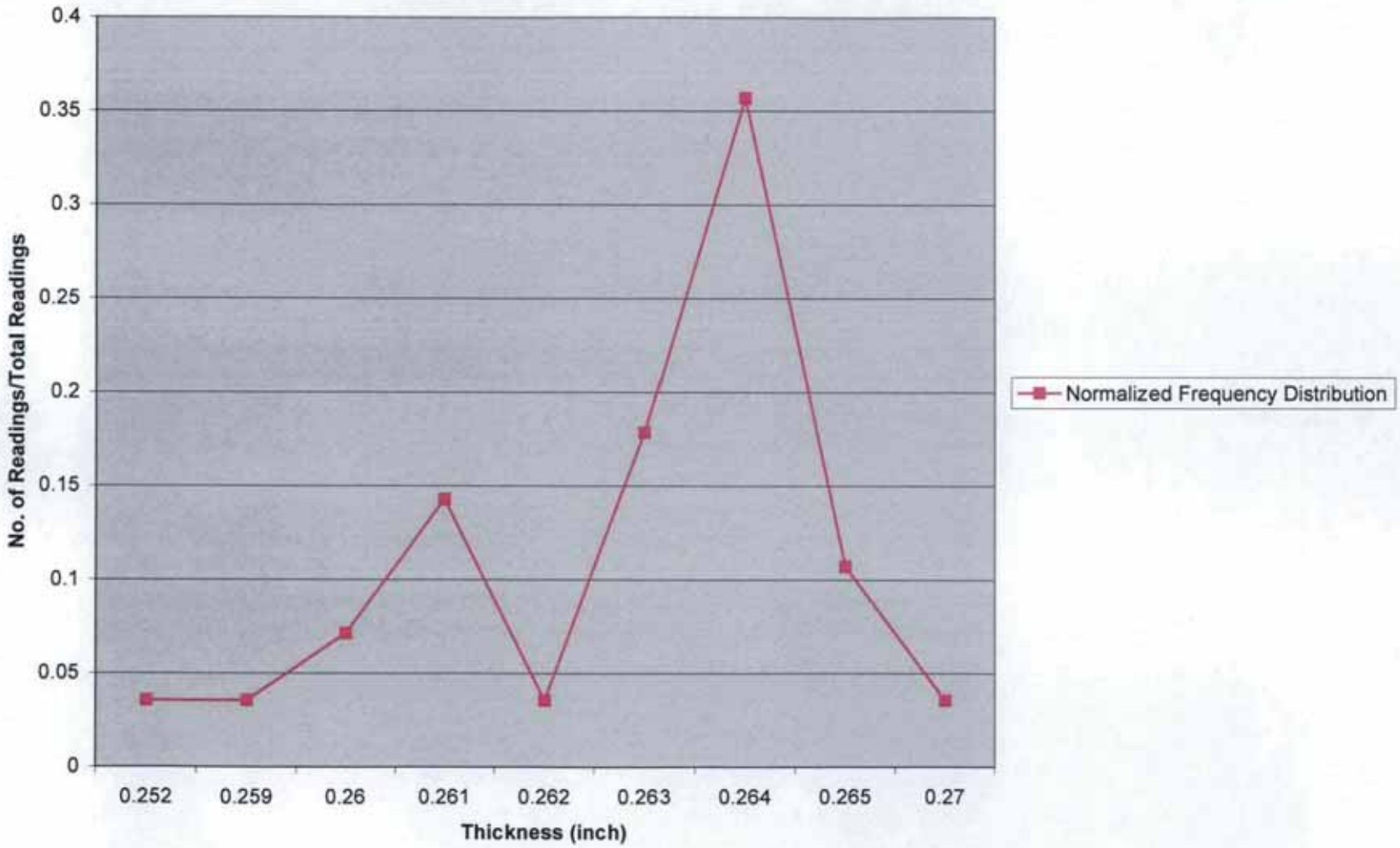

Figure 6C.LOC4.1993.3.Relibilty Function

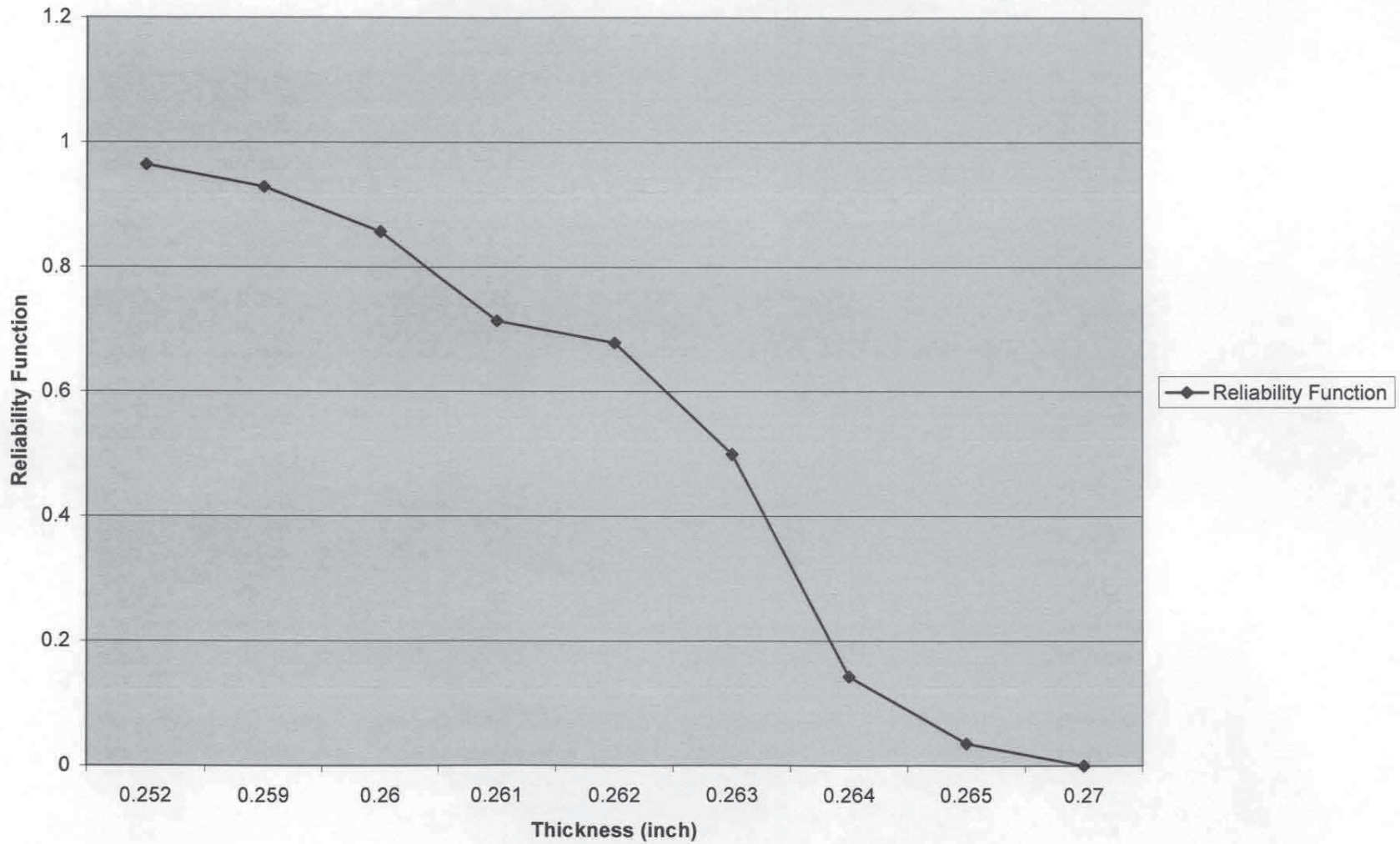

Figure 6C.LOC4.1993.4.Reliability^Area Ratio

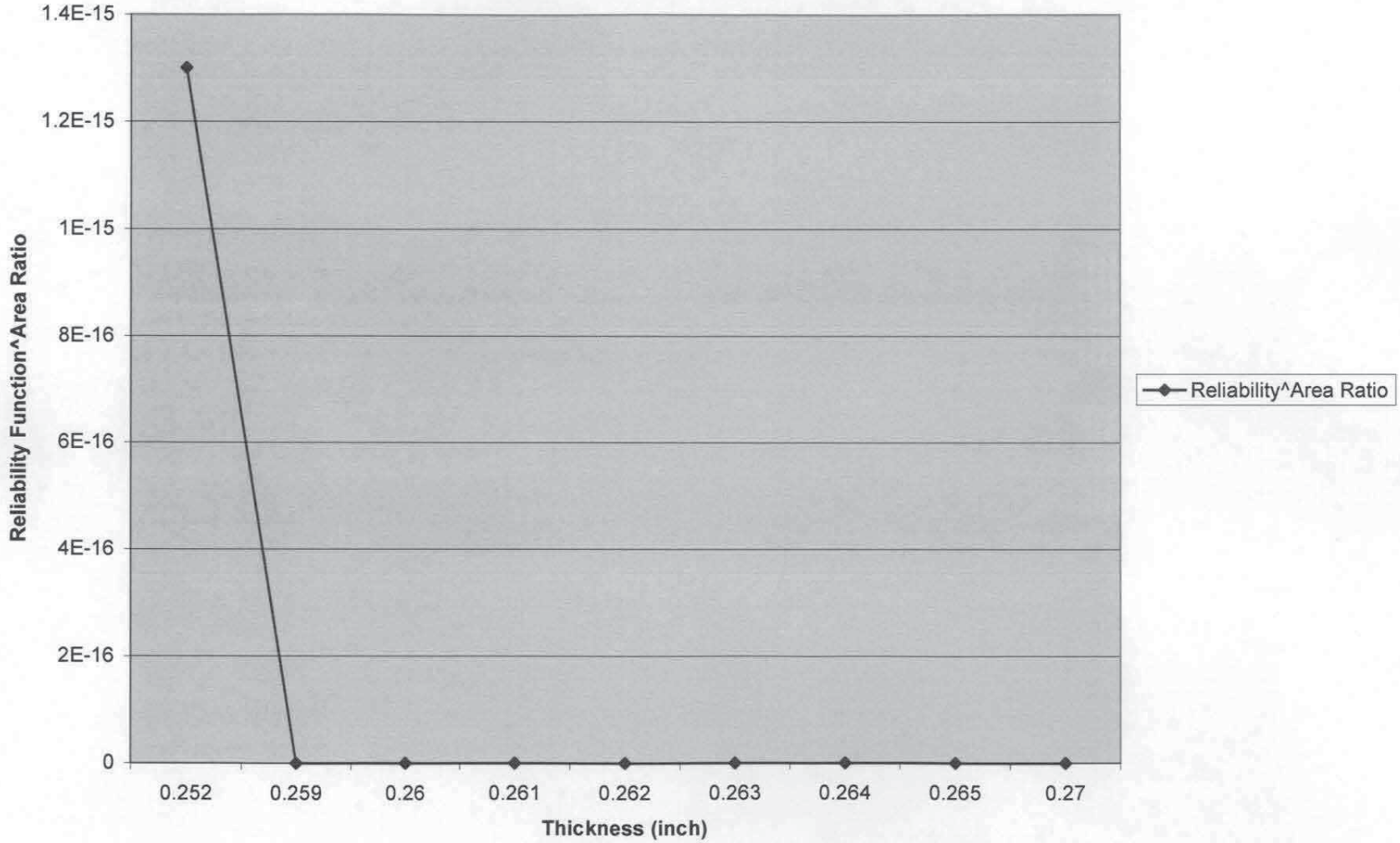

Table 6C.LOC4.2007.1	
Location 4	
Descriptive Statistics	
Mean	0.26275
Standard Error	0.000564902
Mean	0.264821429
Standard Error	0.000352818
Median	0.265
Mode	0.266
Standard Deviation	0.001866936
Sample Variance	3.48545E-06
Kurtosis	-0.714597906
Skewness	-0.456202311
Range	0.007
Minimum	0.261
Maximum	0.268
Sum	7.415
Count	28
Largest(1)	0.268
Smallest(1)	0.261
Confidence Level(95.0%)	0.000723922

Table 6C.LOC4.2007.2	
Location 4	
Ordered Readings	
Thickness (inch)	Count
0.261	1
0.262	2
0.262	3
0.262	4
0.262	5
0.263	6
0.263	7
0.264	8
0.264	9
0.264	10
0.265	11
0.265	12
0.265	13
0.265	14
0.265	15
0.265	16
0.266	17
0.266	18
0.266	19
0.266	20
0.266	21
0.266	22
0.266	23
0.267	24
0.267	25
0.267	26
0.267	27
0.268	28

Table 6C.LOC4.2007.3						
Location 4						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.261	1	0.035714286	0.03571429	0.9642857	942.5	1.30072E-15
0.262	4	0.142857143	0.17857143	0.8214286	942.5	3.04485E-81
0.263	2	0.071428571	0.25	0.75	942.5	1.768E-118
0.264	3	0.107142857	0.35714286	0.6428571	942.5	1.4168E-181
0.265	6	0.214285714	0.57142857	0.4285714	942.5	0
0.266	7	0.25	0.82142857	0.1785714	942.5	0
0.267	4	0.142857143	0.96428571	0.0357143	942.5	0
0.268	1	0.035714286	1	0	942.5	0
Total	28					

Figure 6C.LOC4.2007.1.Ordered Thickness Readings

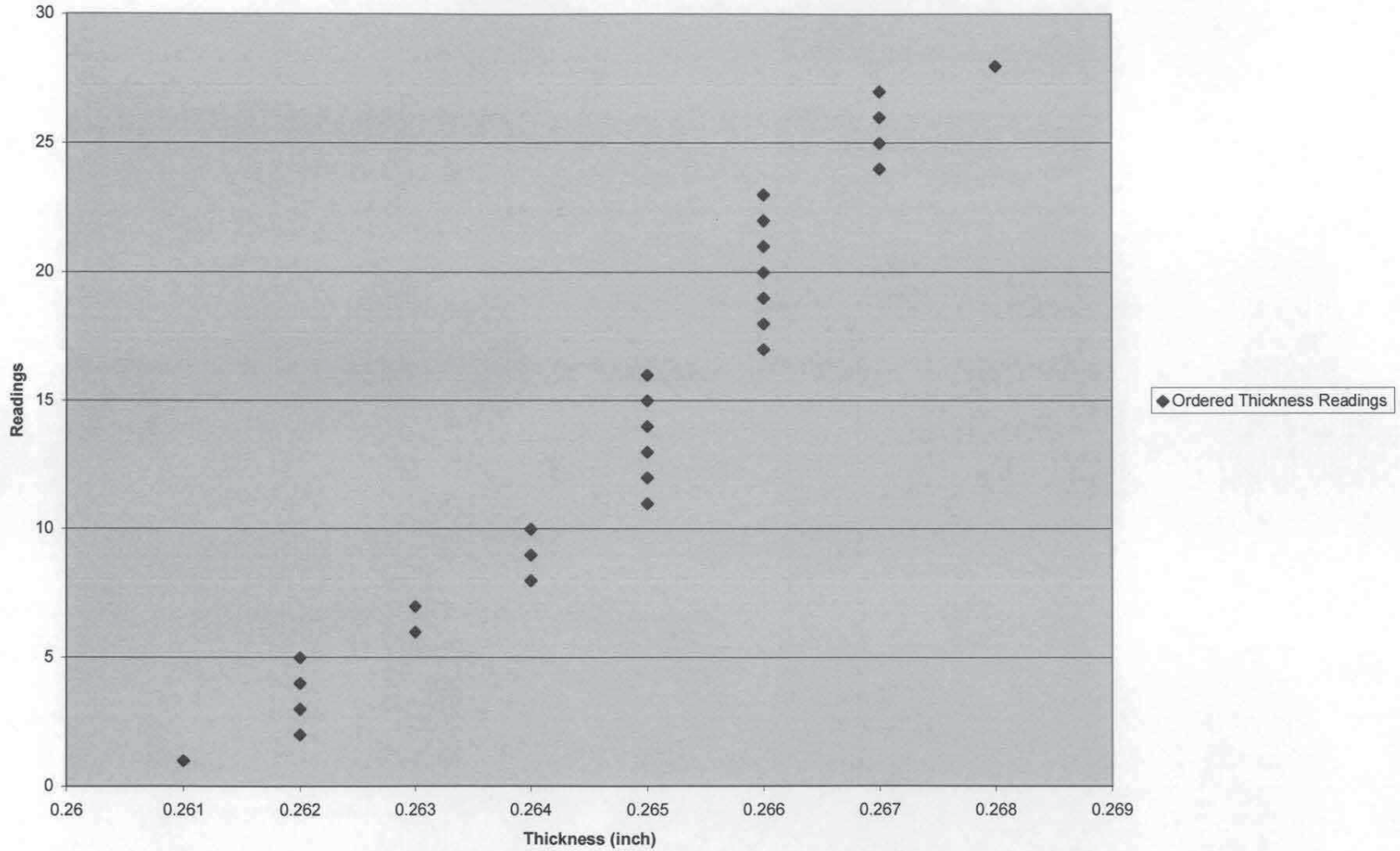

Figure 6C.LOC4.2007.2.Normalized Frequency Distribution

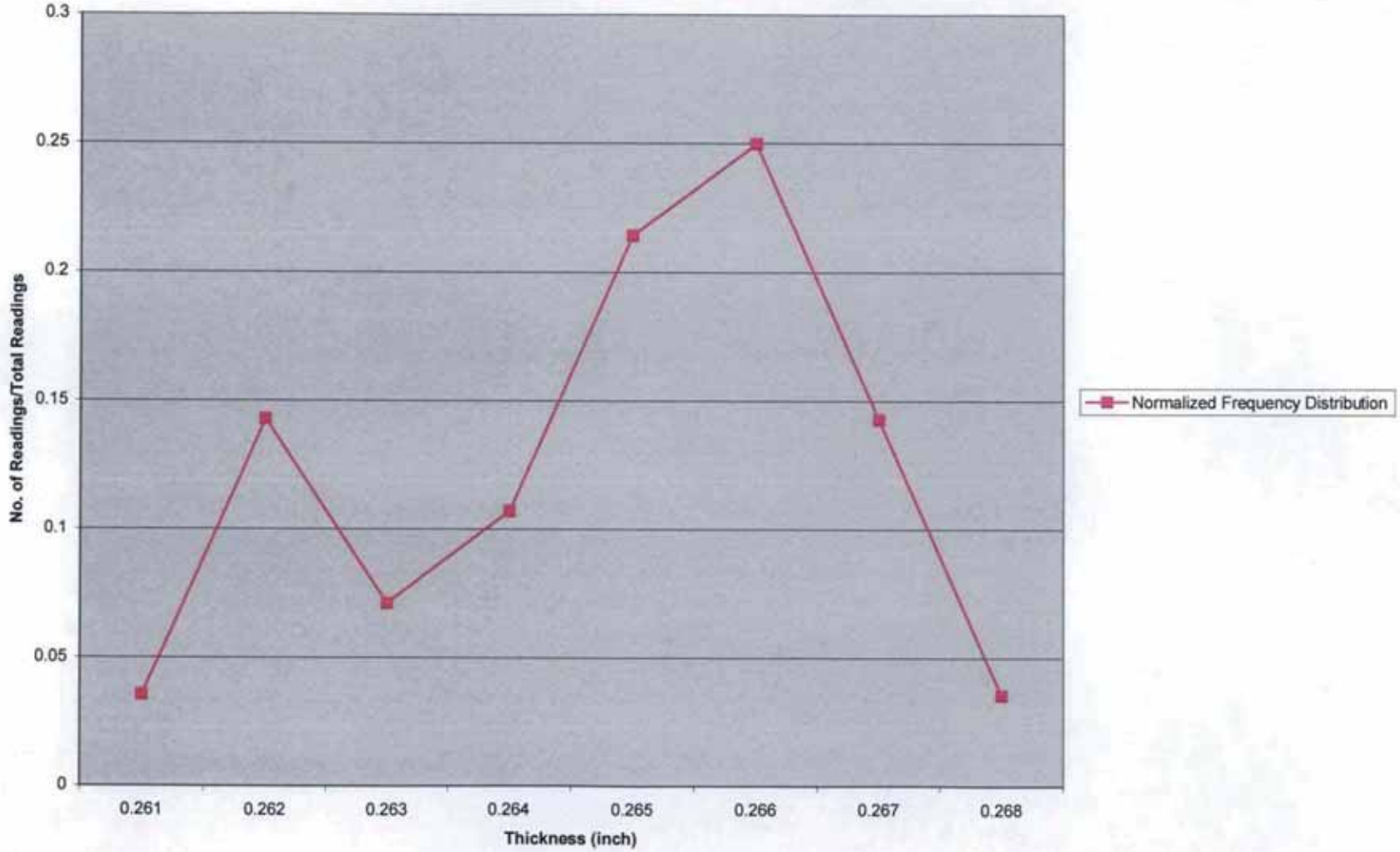

Figure 6C.LOC4.2007.3.Reliability Function

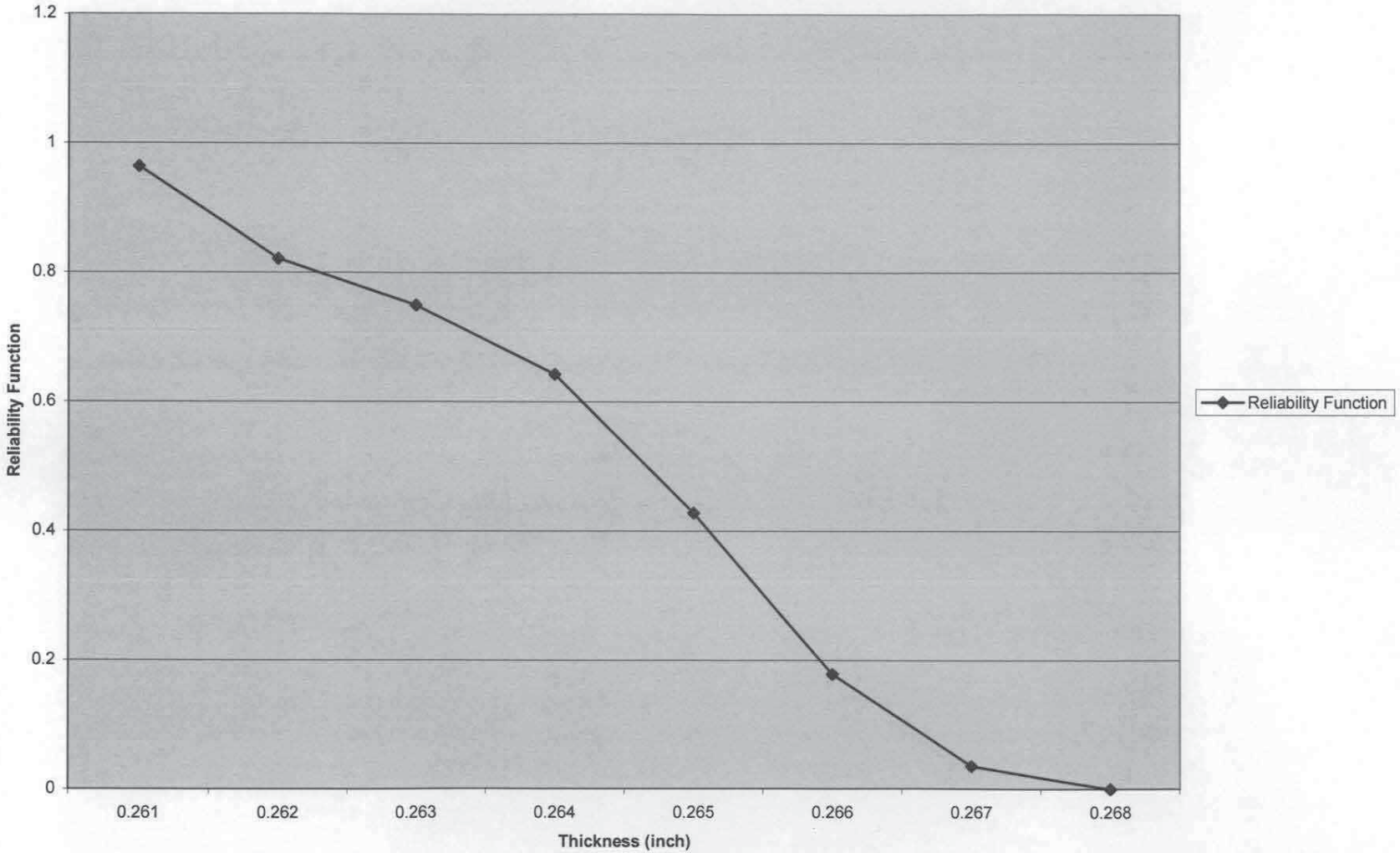

Figure 6C.2007.4.Reliability^Area Ratio

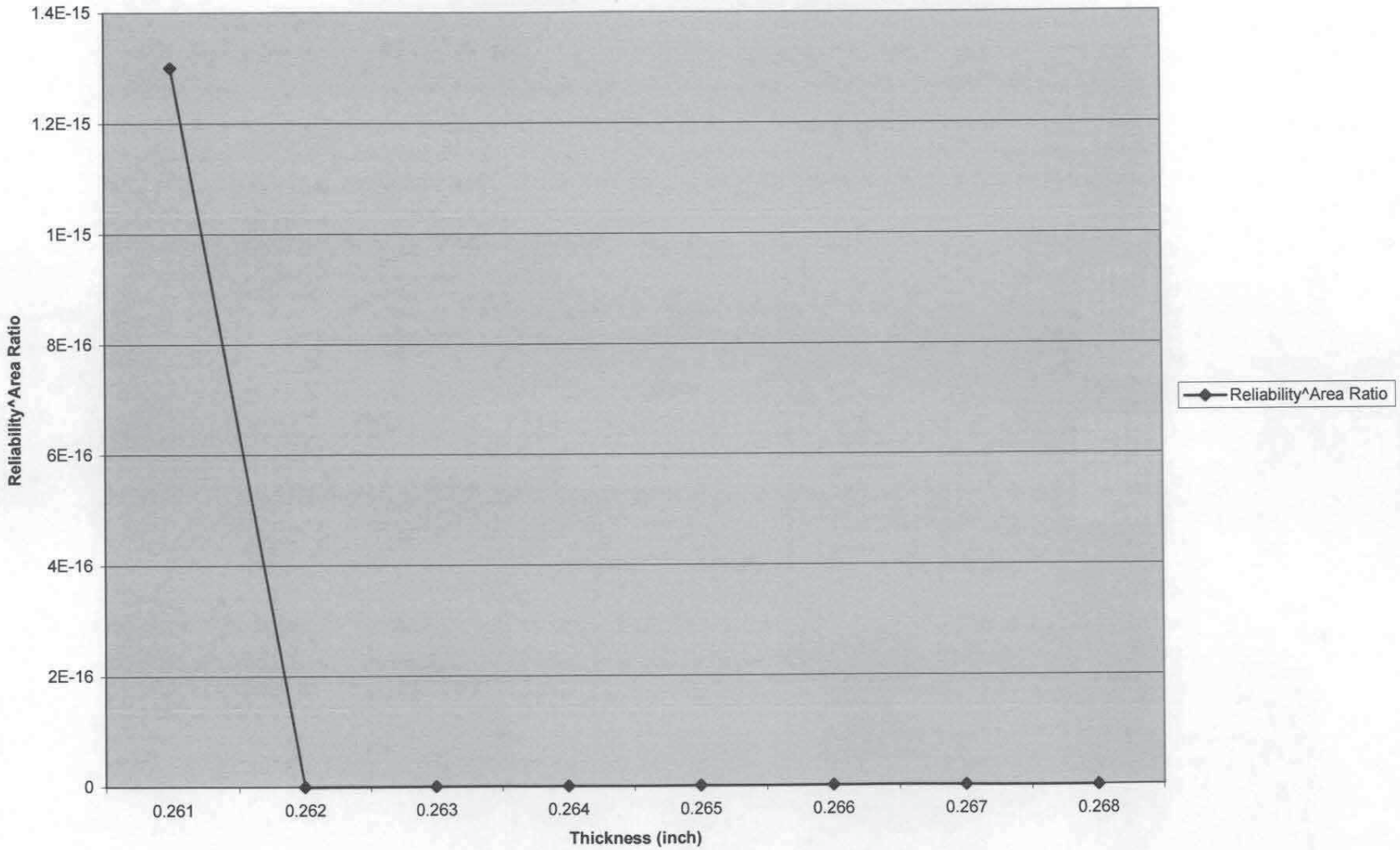

Table 6C.LOC5.1998.1	
Location 5	
Descriptive Statistics	
Mean	0.264423077
Standard Error	0.000756244
Median	0.264
Mode	0.264
Standard Deviation	0.005453354
Sample Variance	2.97391E-05
Kurtosis	2.441757018
Skewness	0.411298072
Range	0.032
Minimum	0.252
Maximum	0.284
Sum	13.75
Count	52
Largest(1)	0.284
Smallest(1)	0.252
Confidence Level(95.0%)	0.001518223

Table 6C.LOC5.1998.2			
Location 5			
Ordered Readings			
Thickness (inch)	Count	*Thickness (inch)*	Count
0.252	1	0.27	48
0.253	2	0.271	49
0.254	3	0.271	50
0.257	4	0.272	51
0.257	5	0.284	52
0.257	6		
0.258	7		
0.259	8		
0.26	9		
0.26	10		
0.261	11		
0.261	12		
0.262	13		
0.262	14		
0.262	15		
0.263	16		
0.263	17		
0.263	18		
0.263	19		
0.263	20		
0.264	21		
0.264	22		
0.264	23		
0.264	24		
0.264	25		
0.264	26		
0.264	27		
0.264	28		
0.264	29		
0.265	30		
0.265	31		
0.265	32		
0.265	33		
0.266	34		
0.266	35		
0.266	36		
0.267	37		
0.268	38		
0.269	39		
0.269	40		
0.269	41		
0.269	42		
0.269	43		
0.269	44		
0.269	45		
0.27	46		
0.27	47		

Table 6C.LOC5.1998.3						
Location 5						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.252	1	0.019230769	0.01923077	0.9807692	507.5	5.25108E-05
0.253	1	0.019230769	0.03846154	0.9615385	507.5	2.26853E-09
0.254	1	0.019230769	0.05769231	0.9423077	507.5	7.99948E-14
0.257	3	0.057692308	0.11538462	0.8846154	507.5	9.51513E-28
0.258	1	0.019230769	0.13461538	0.8653846	507.5	1.36225E-32
0.259	1	0.019230769	0.15384615	0.8461538	507.5	1.51787E-37
0.26	2	0.038461538	0.19230769	0.8076923	507.5	8.47637E-48
0.261	2	0.038461538	0.23076923	0.7692308	507.5	1.4957E-58
0.262	3	0.057692308	0.28846154	0.7115385	507.5	9.81972E-76
0.263	5	0.096153846	0.38461538	0.6153846	507.5	9.8615E-108
0.264	9	0.173076923	0.55769231	0.4423077	507.5	1.6165E-180
0.265	4	0.076923077	0.63461538	0.3653846	507.5	1.2588E-222
0.266	3	0.057692308	0.69230769	0.3076923	507.5	1.6754E-260
0.267	1	0.019230769	0.71153846	0.2884615	507.5	9.9956E-275
0.268	1	0.019230769	0.73076923	0.2692308	507.5	6.2196E-290
0.269	7	0.134615385	0.86538462	0.1346154	507.5	0
0.27	3	0.057692308	0.92307692	0.0769231	507.5	0
0.271	2	0.038461538	0.96153846	0.0384615	507.5	0
0.272	1	0.019230769	0.98076923	0.0192308	507.5	0
0.284	1	0.019230769	1	0	507.5	0
Total	52					

Figure 6C.LOC5.1998.1.Ordered Thickness Readings

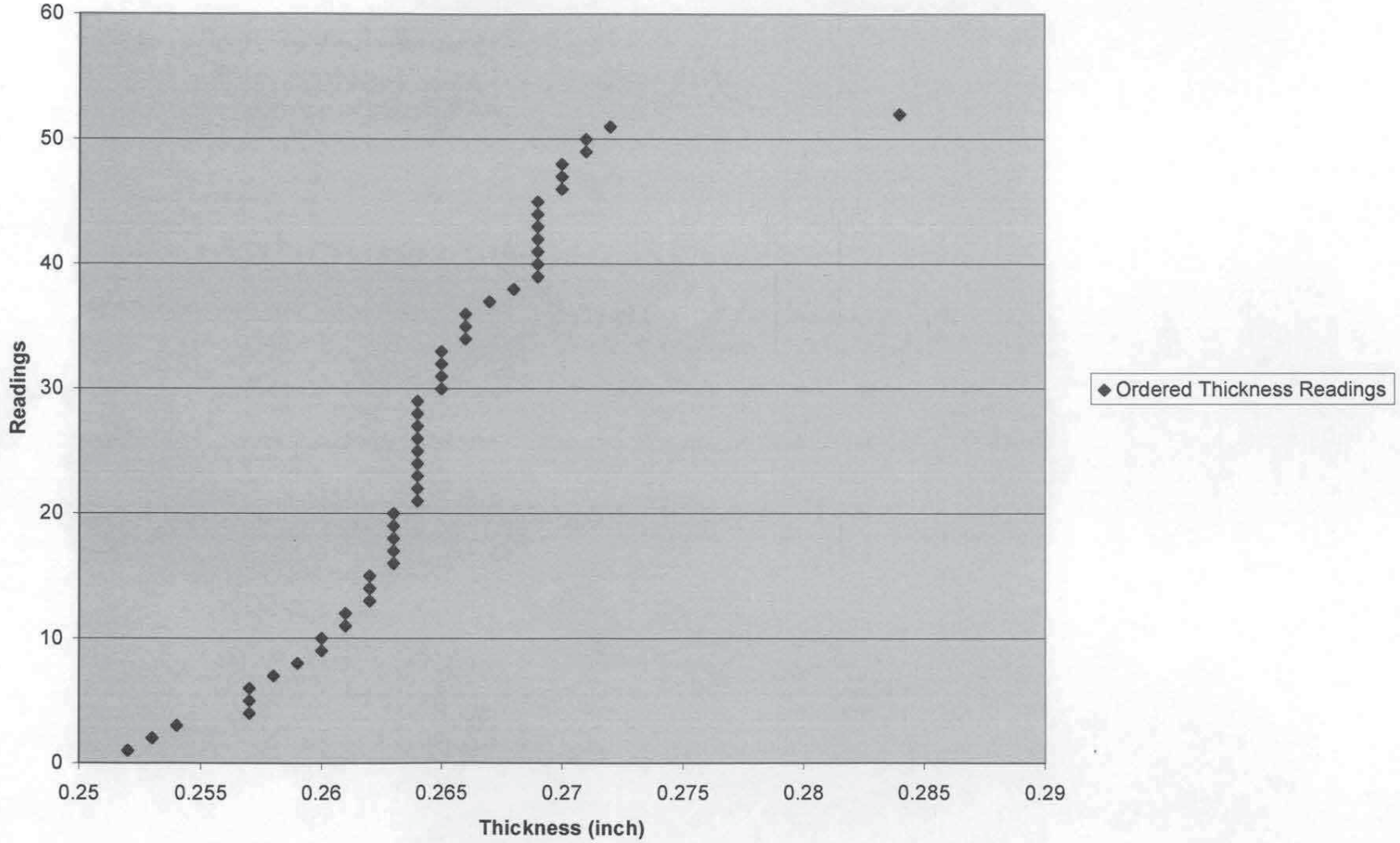

Figure 6C.1998.2.Normalized Frequency Distribution

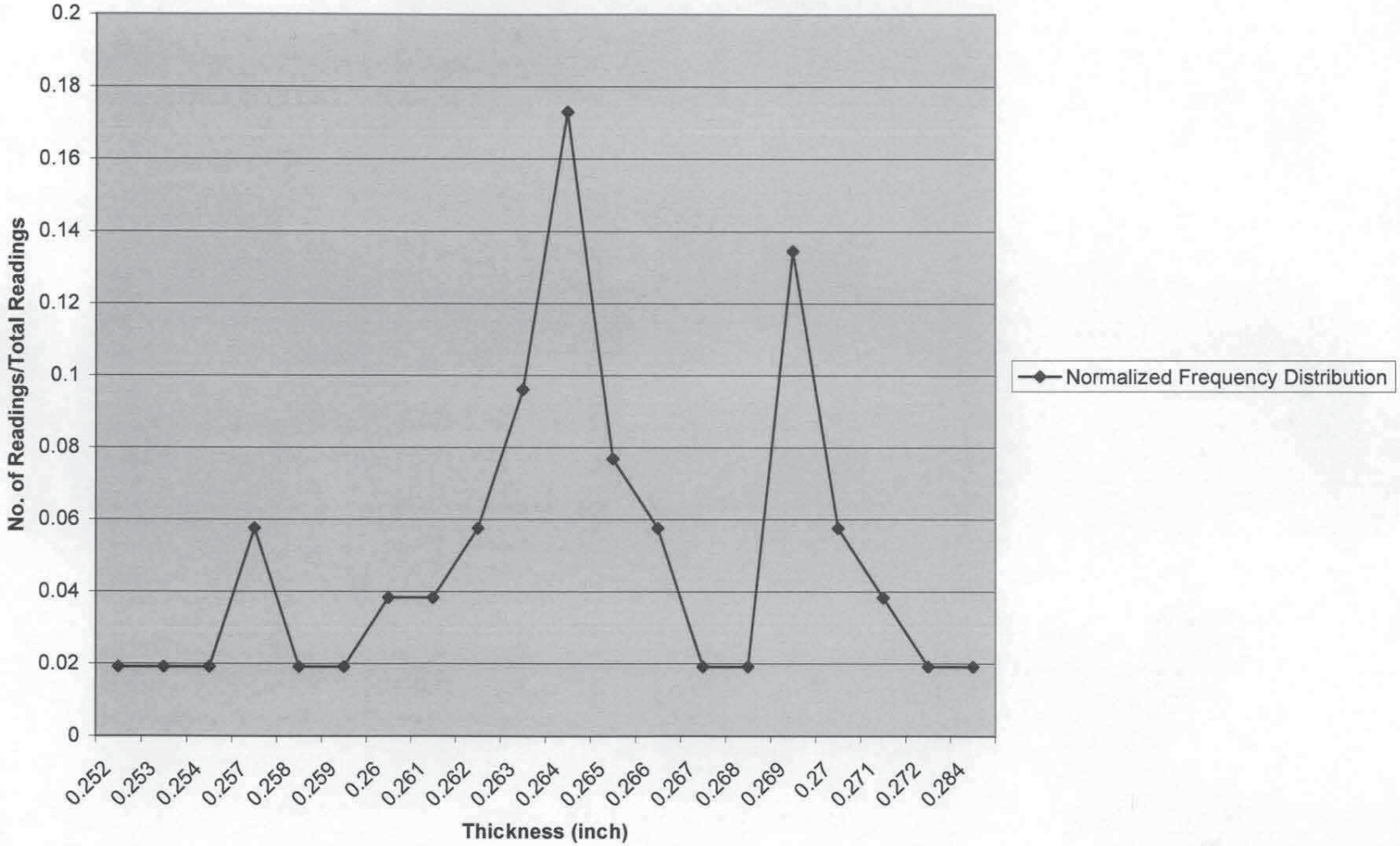

Figure 6C.LOC5.1998.3.Reliability Function

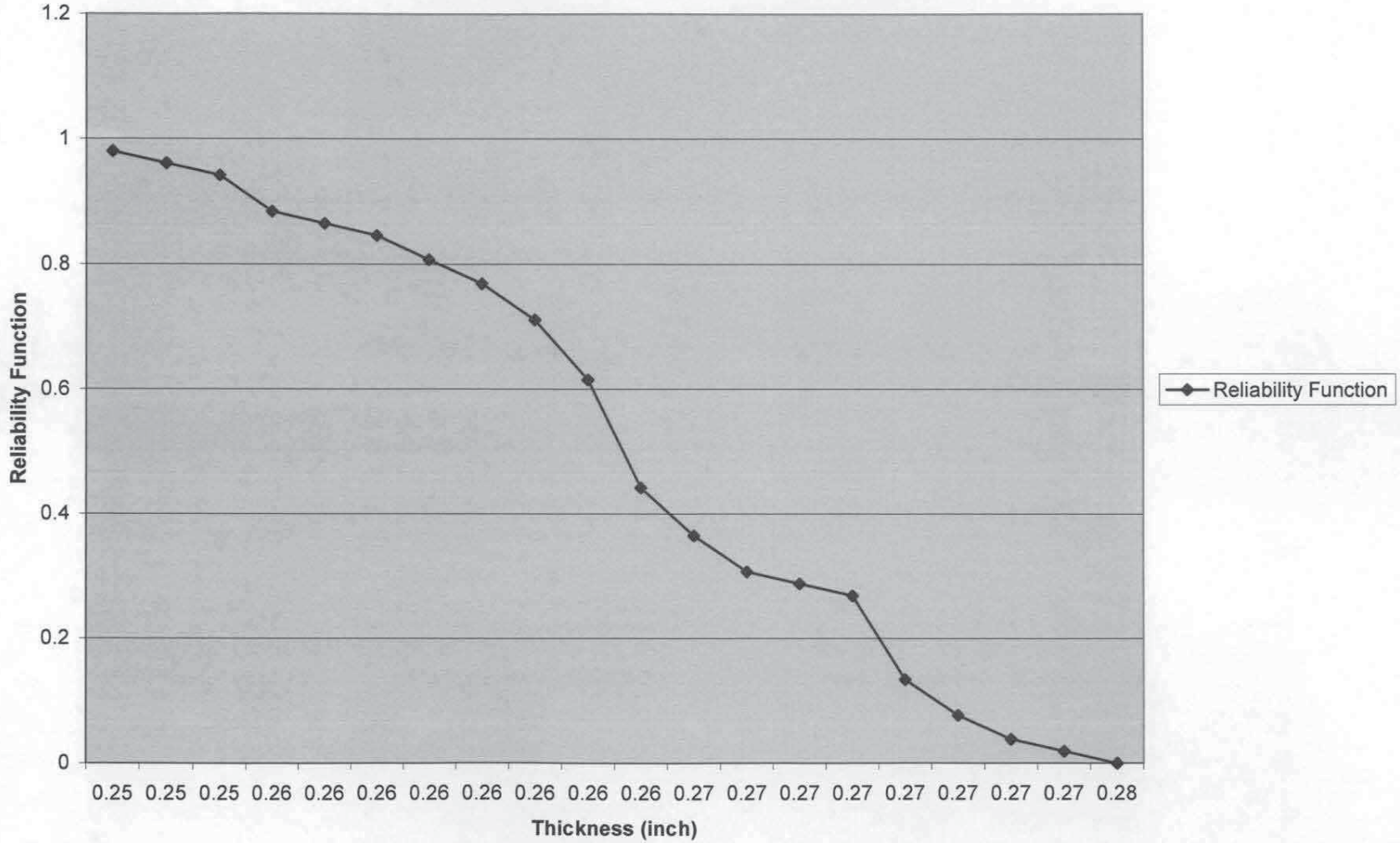

Figure 6C.LOC5.1998.4.Reliability^Area Ratio

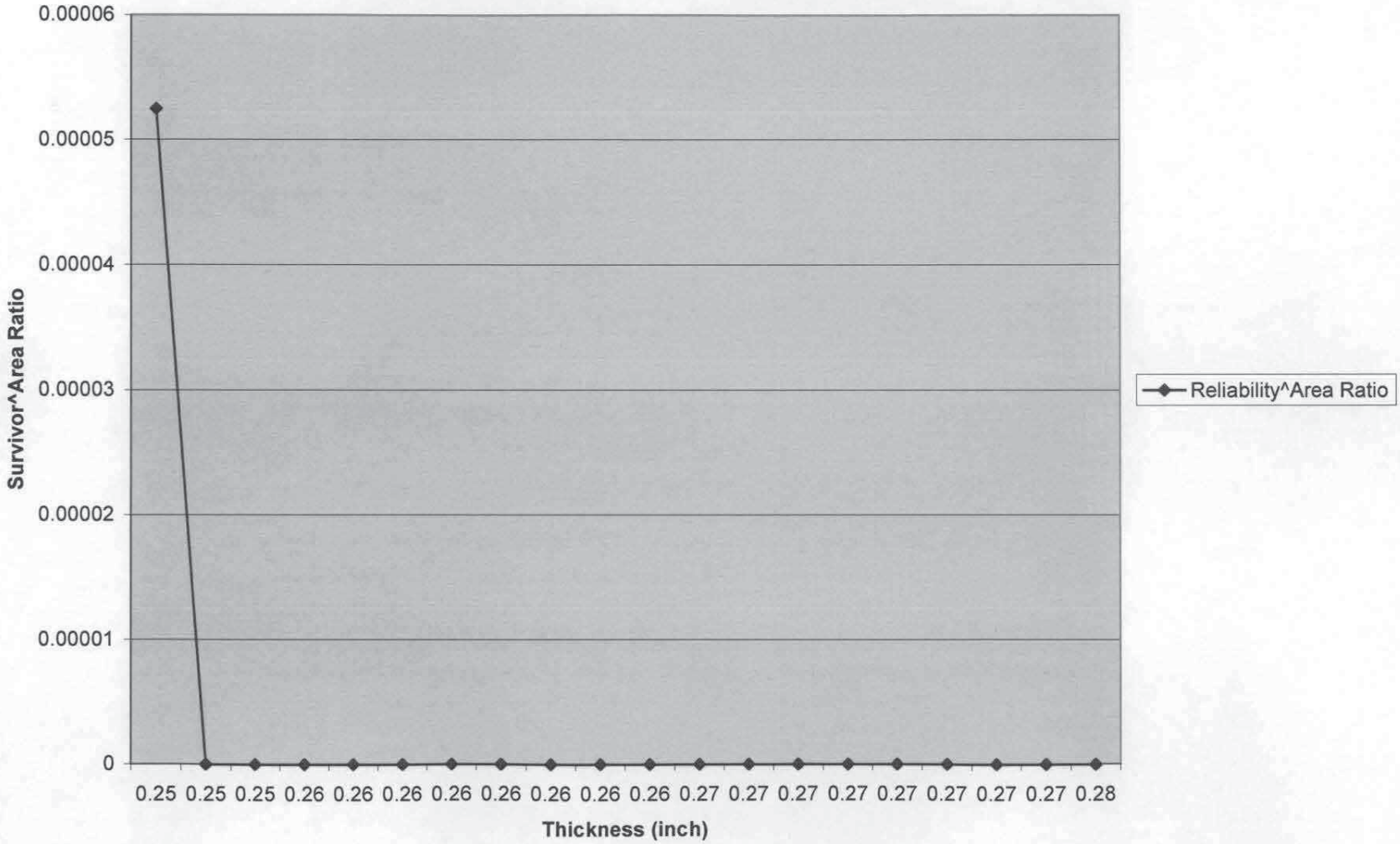

Table 6C.LOC5.2007.1	
Location 5	
Descriptive Statistics	
Mean	0.264961538
Standard Error	0.000681561
Median	0.265
Mode	0.265
Standard Deviation	0.00491481
Sample Variance	2.41554E-05
Kurtosis	8.693464011
Skewness	-2.336023599
Range	0.029
Minimum	0.242
Maximum	0.271
Sum	13.778
Count	52
Largest(1)	0.271
Smallest(1)	0.242
Confidence Level(95.0%)	0.001368292

Table 6C.LOC5.2007.2			
Location 5			
Ordered Readings			
Thickness (inch)	Count	*Thickness (inch)*	Count
0.242	1	0.27	48
0.254	2	0.27	49
0.255	3	0.271	50
0.258	4	0.271	51
0.26	5	0.271	52
0.26	6		
0.261	7		
0.262	8		
0.262	9		
0.262	10		
0.262	11		
0.264	12		
0.264	13		
0.264	14		
0.264	15		
0.265	16		
0.265	17		
0.265	18		
0.265	19		
0.265	20		
0.265	21		
0.265	22		
0.265	23		
0.265	24		
0.265	25		
0.265	26		
0.265	27		
0.265	28		
0.266	29		
0.266	30		
0.266	31		
0.266	32		
0.266	33		
0.267	34		
0.267	35		
0.267	36		
0.267	37		
0.268	38		
0.268	39		
0.268	40		
0.269	41		
0.269	42		
0.269	43		
0.269	44		
0.269	45		
0.269	46		
0.27	47		

Table 6C.LOC5.2007.3						
Location 5						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.242	1	0.019230769	0.01923077	0.9807692	507.5	5.25108E-05
0.254	1	0.019230769	0.03846154	0.9615385	507.5	2.26853E-09
0.255	1	0.019230769	0.05769231	0.9423077	507.5	7.99948E-14
0.258	1	0.019230769	0.07692308	0.9230769	507.5	2.28331E-18
0.26	2	0.038461538	0.11538462	0.8846154	507.5	9.51513E-28
0.261	1	0.019230769	0.13461538	0.8653846	507.5	1.36225E-32
0.262	4	0.076923077	0.21153846	0.7884615	507.5	4.14098E-53
0.264	4	0.076923077	0.28846154	0.7115385	507.5	9.81972E-76
0.265	13	0.25	0.53846154	0.4615385	507.5	3.8792E-171
0.266	5	0.096153846	0.63461538	0.3653846	507.5	1.2588E-222
0.267	4	0.076923077	0.71153846	0.2884615	507.5	9.9956E-275
0.268	3	0.057692308	0.76923077	0.2307692	507.5	0
0.269	6	0.115384615	0.88461538	0.1153846	507.5	0
0.27	3	0.057692308	0.94230769	0.0576923	507.5	0
0.271	3	0.057692308	1	0	507.5	0
Total	52					

Figure 6C.LOC5.2007.1.Ordered Thickness Readings

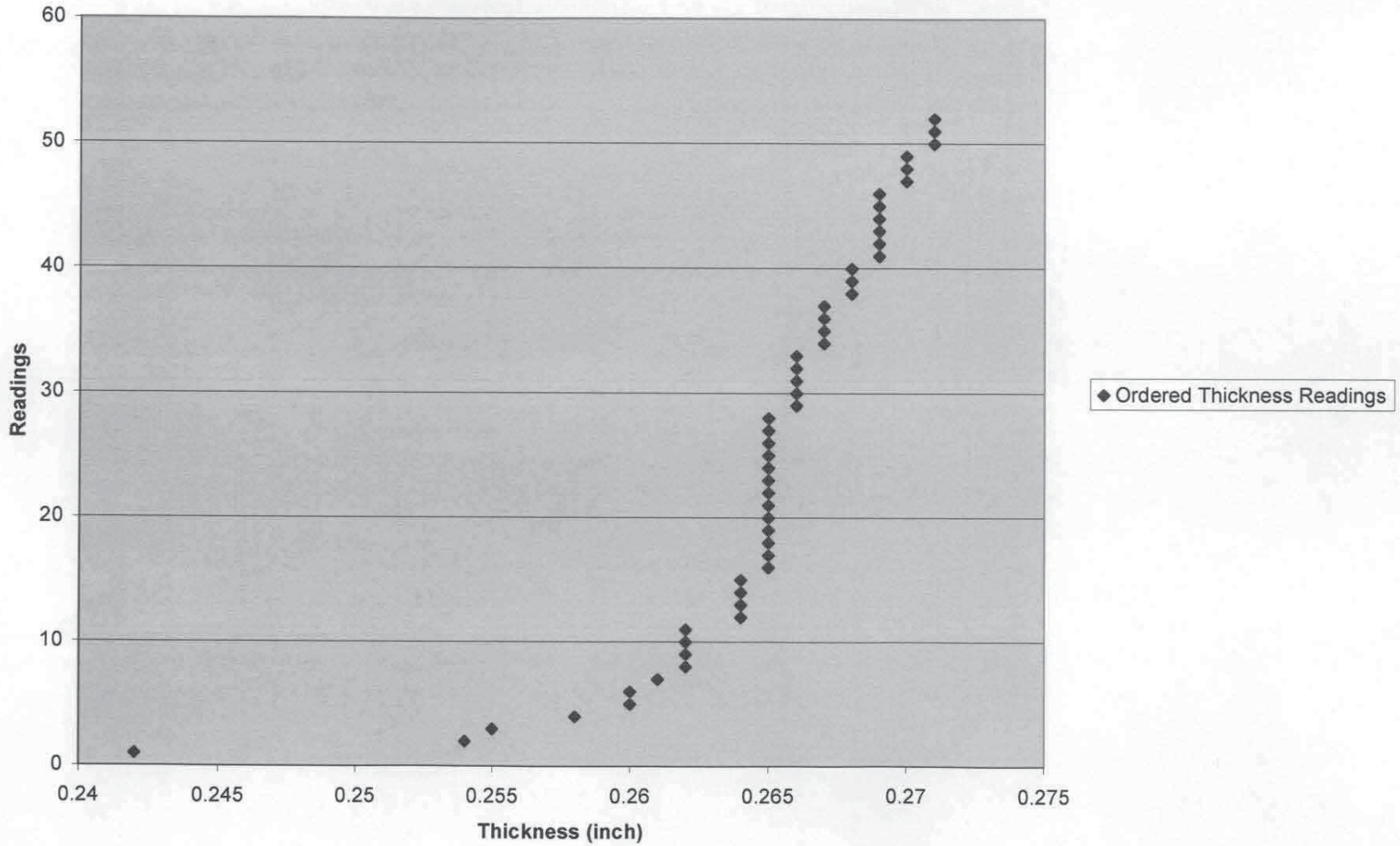

Figure 6C.LOC5.2007.2.Normalized Frequency Distribution

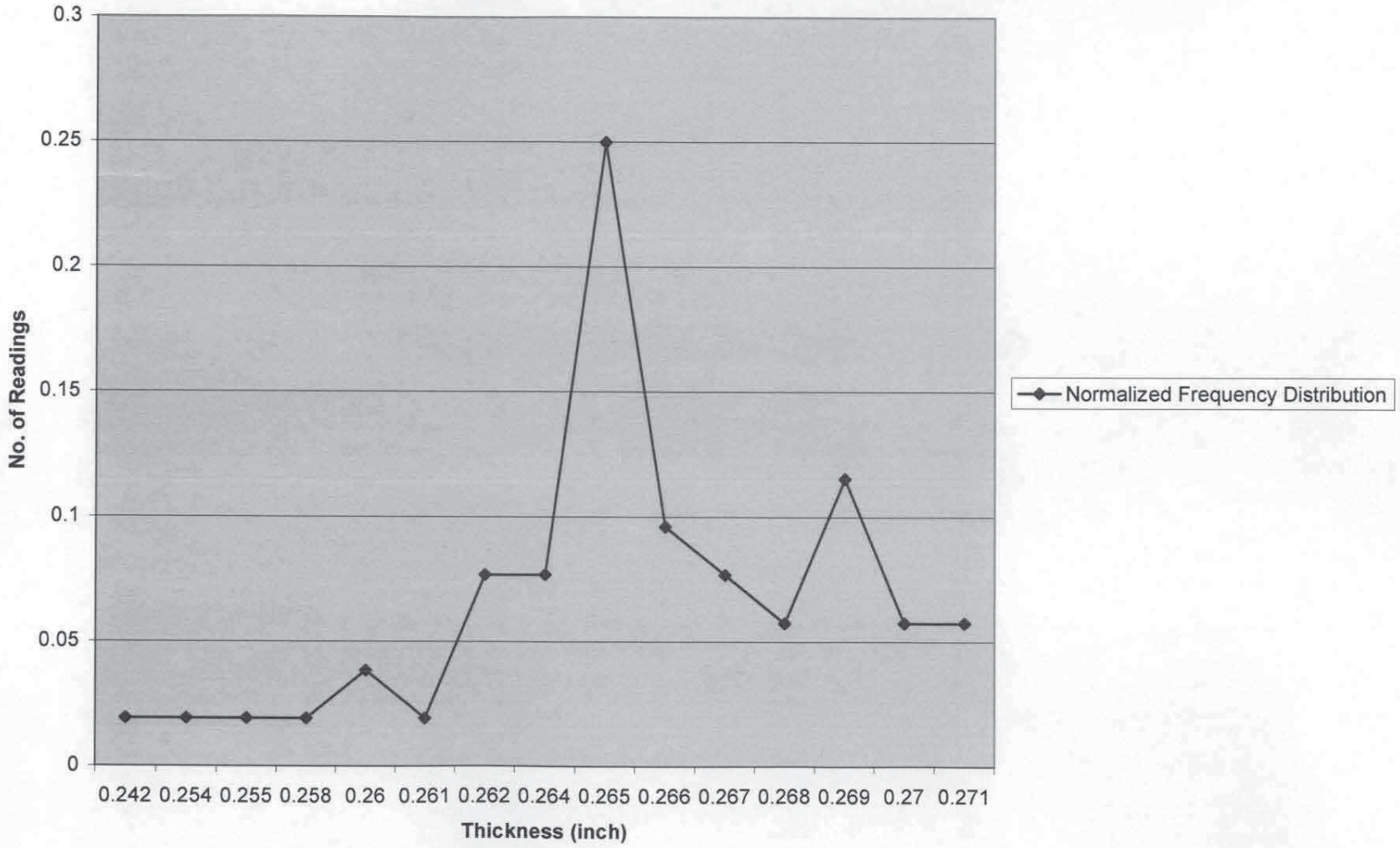

Figure 6C.LOC5.2007.3.Reliability Function

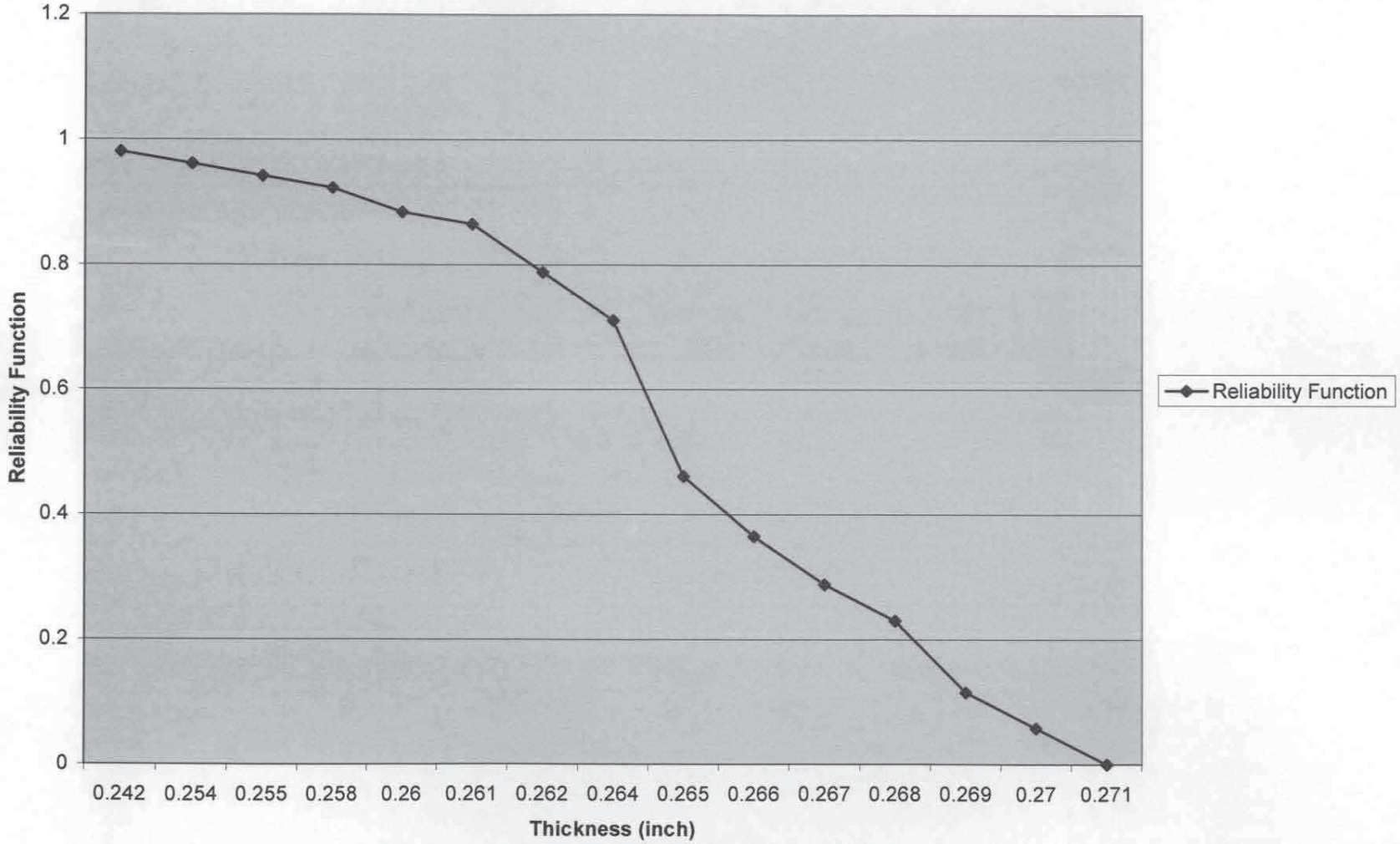

Figure 6C.LOC5.2007.4.Reliability^Area Ratio

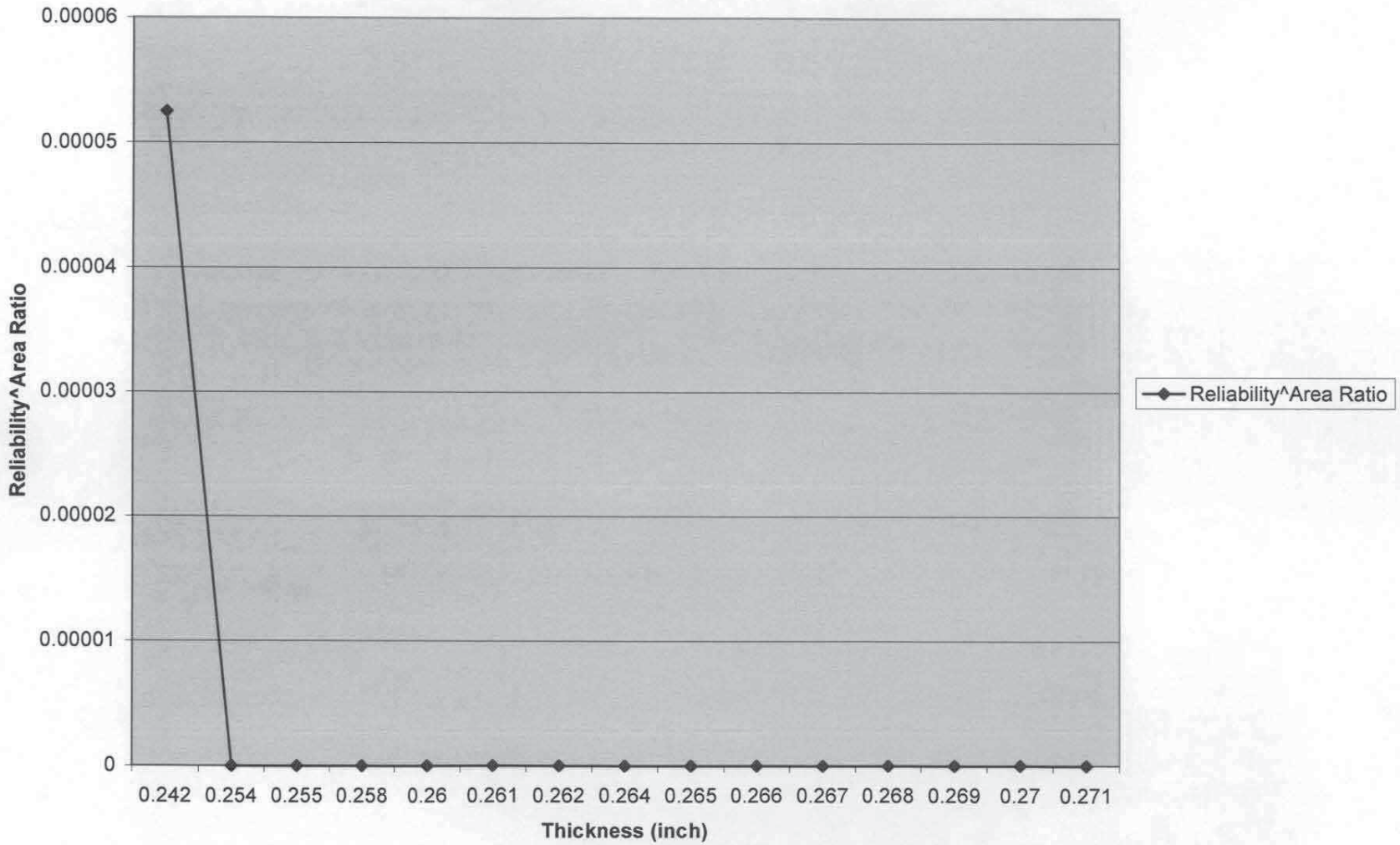

Table 6C.LOC6.1993.1	
Location 6	
Descriptive Statistics	
Mean	0.249142857
Standard Error	0.000244987
Median	0.249
Mode	0.25
Standard Deviation	0.001833314
Sample Variance	3.36104E-06
Kurtosis	-0.505696394
Skewness	0.056953447
Range	0.008
Minimum	0.245
Maximum	0.253
Sum	13.952
Count	56
Largest(1)	0.253
Smallest(1)	0.245
Confidence Level(95.0%)	0.000490965

Table 6C.LOC6.1993.2			
Location 6			
Ordered Readings			
Thickness (inch)	Count	*Thickness (inch)*	Count
0.245	1	0.251	48
0.246	2	0.251	49
0.246	3	0.251	50
0.247	4	0.252	51
0.247	5	0.252	52
0.247	6	0.252	53
0.247	7	0.252	54
0.247	8	0.253	55
0.247	9	0.253	56
0.247	10		
0.247	11		
0.247	12		
0.248	13		
0.248	14		
0.248	15		
0.248	16		
0.248	17		
0.248	18		
0.248	19		
0.248	20		
0.248	21		
0.248	22		
0.249	23		
0.249	24		
0.249	25		
0.249	26		
0.249	27		
0.249	28		
0.249	29		
0.249	30		
0.25	31		
0.25	32		
0.25	33		
0.25	34		
0.25	35		
0.25	36		
0.25	37		
0.25	38		
0.25	39		
0.25	40		
0.25	41		
0.25	42		
0.25	43		
0.25	44		
0.251	45		
0.251	46		
0.251	47		

Table 6C.LOC6.1993.3						
Location 6						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.245	1	0.017857143	0.01785714	0.9821429	210.4	0.022581075
0.246	2	0.035714286	0.05357143	0.9464286	210.4	9.32137E-06
0.247	9	0.160714286	0.21428571	0.7857143	210.4	9.25339E-23
0.248	10	0.178571429	0.39285714	0.6071429	210.4	2.56934E-46
0.249	8	0.142857143	0.53571429	0.4642857	210.4	7.94259E-71
0.25	14	0.25	0.78571429	0.2142857	210.4	1.8101E-141
0.251	6	0.107142857	0.89285714	0.1071429	210.4	8.4823E-205
0.252	4	0.071428571	0.96428571	0.0357143	210.4	3.582E-305
0.253	2	0.035714286	1	0	210.4	0
Total	56					

Figure 6C.LOC6.1993.1.Ordered Thickness Readings

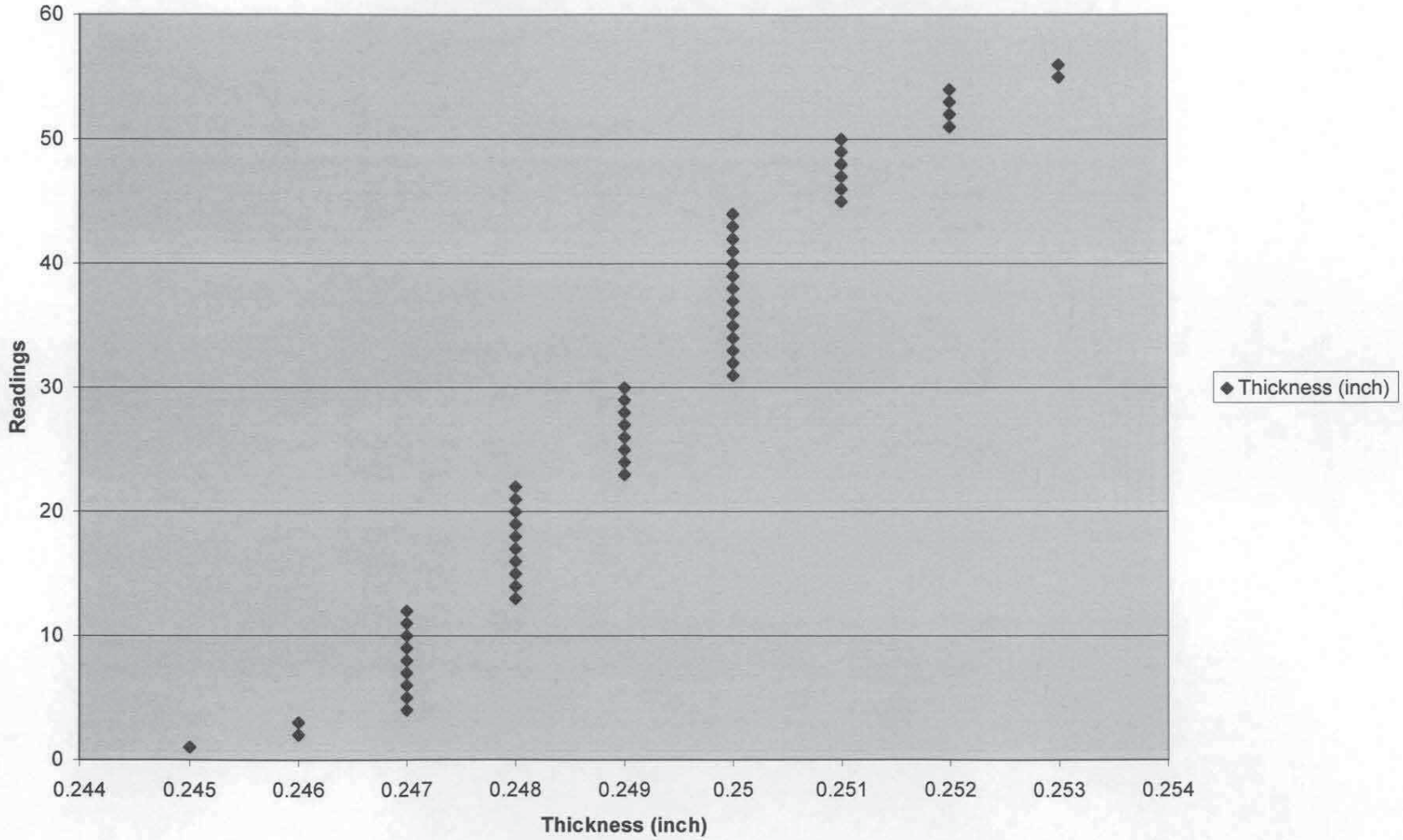

Figure 6C.LOC6.1993.2.Normalized Frequency Distribution

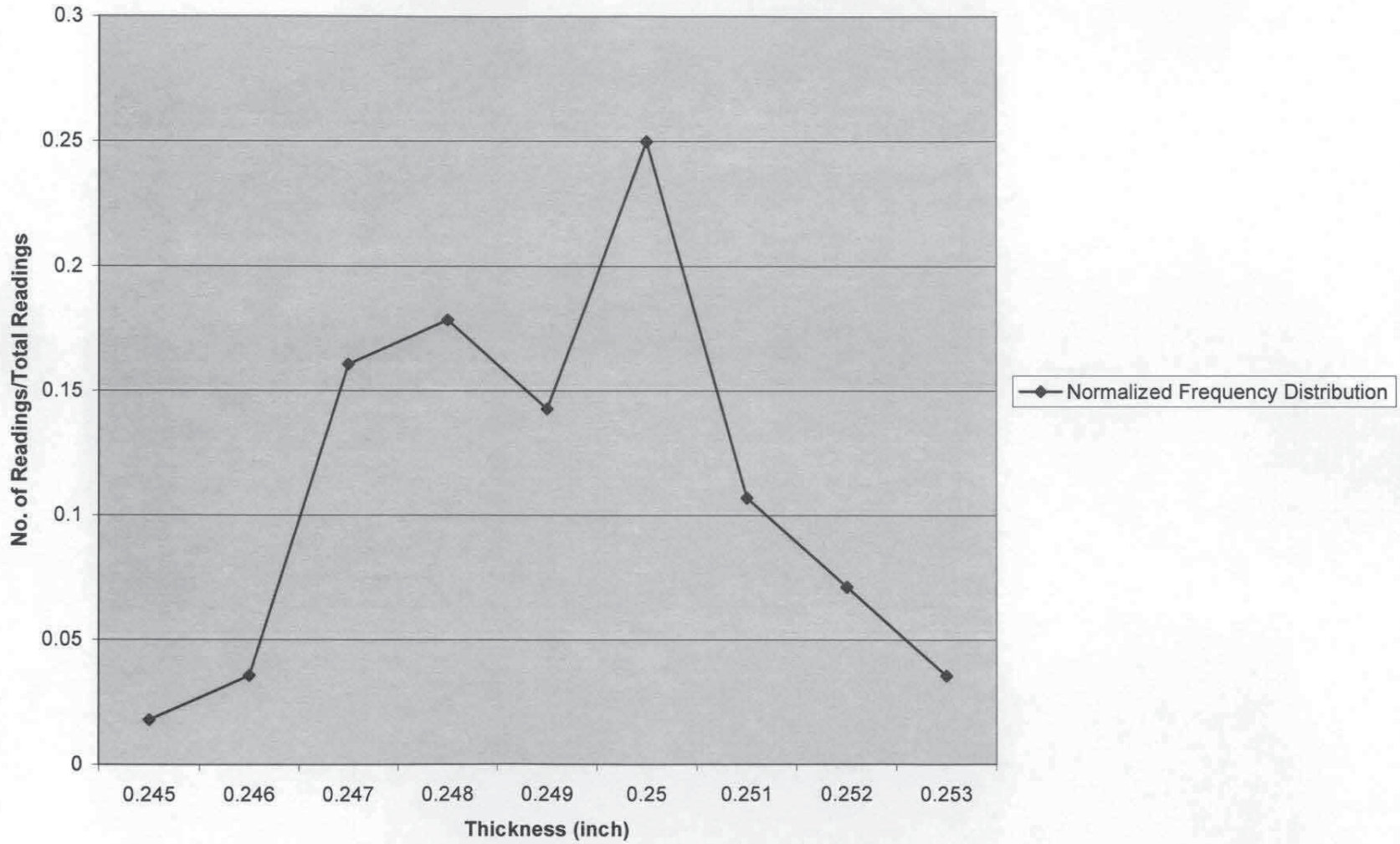

Figure 6C.LOC6.1993.3.Reliability Function

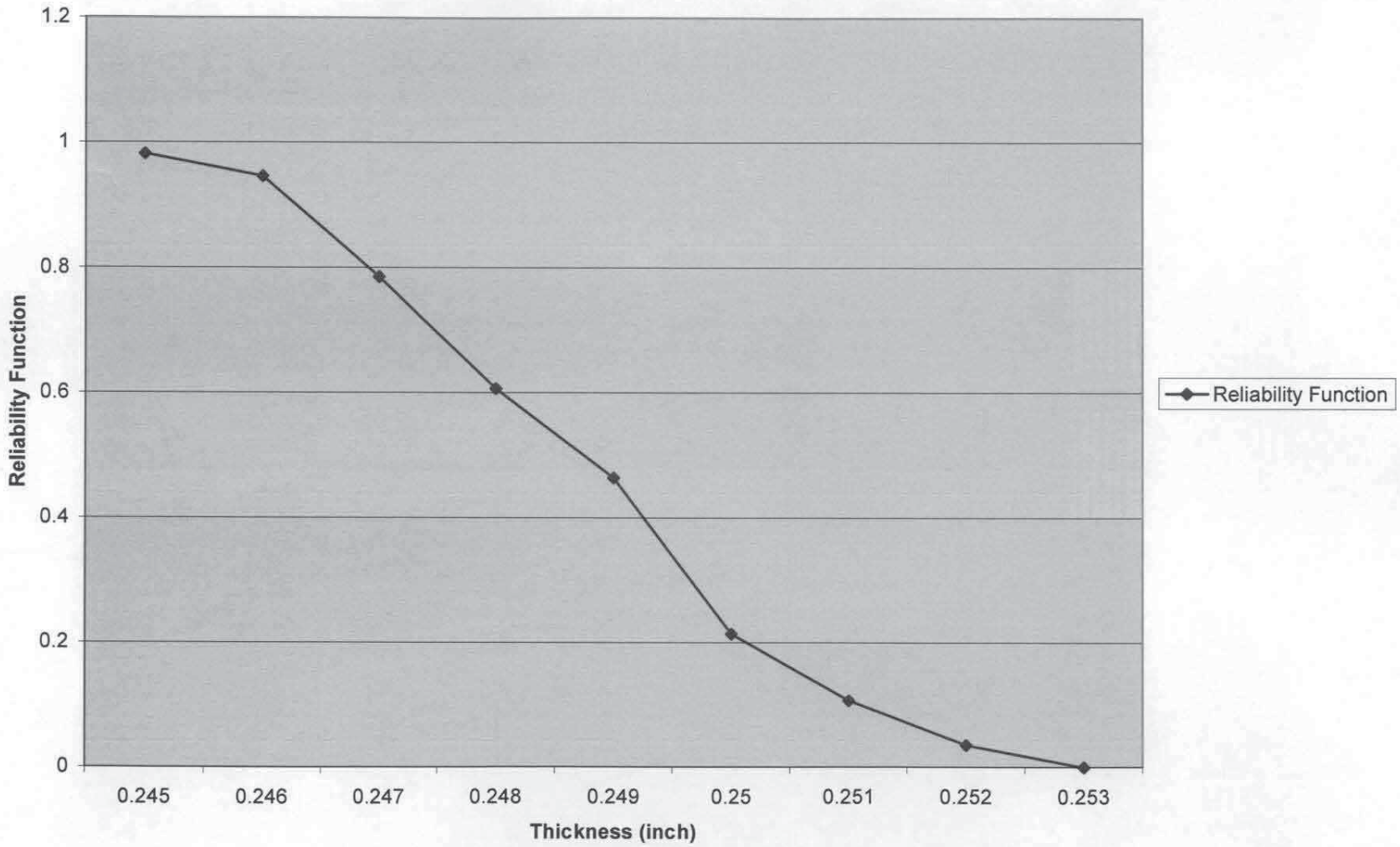

Figure 6C.LOC6.1993.4.Reliability^Area Ratio

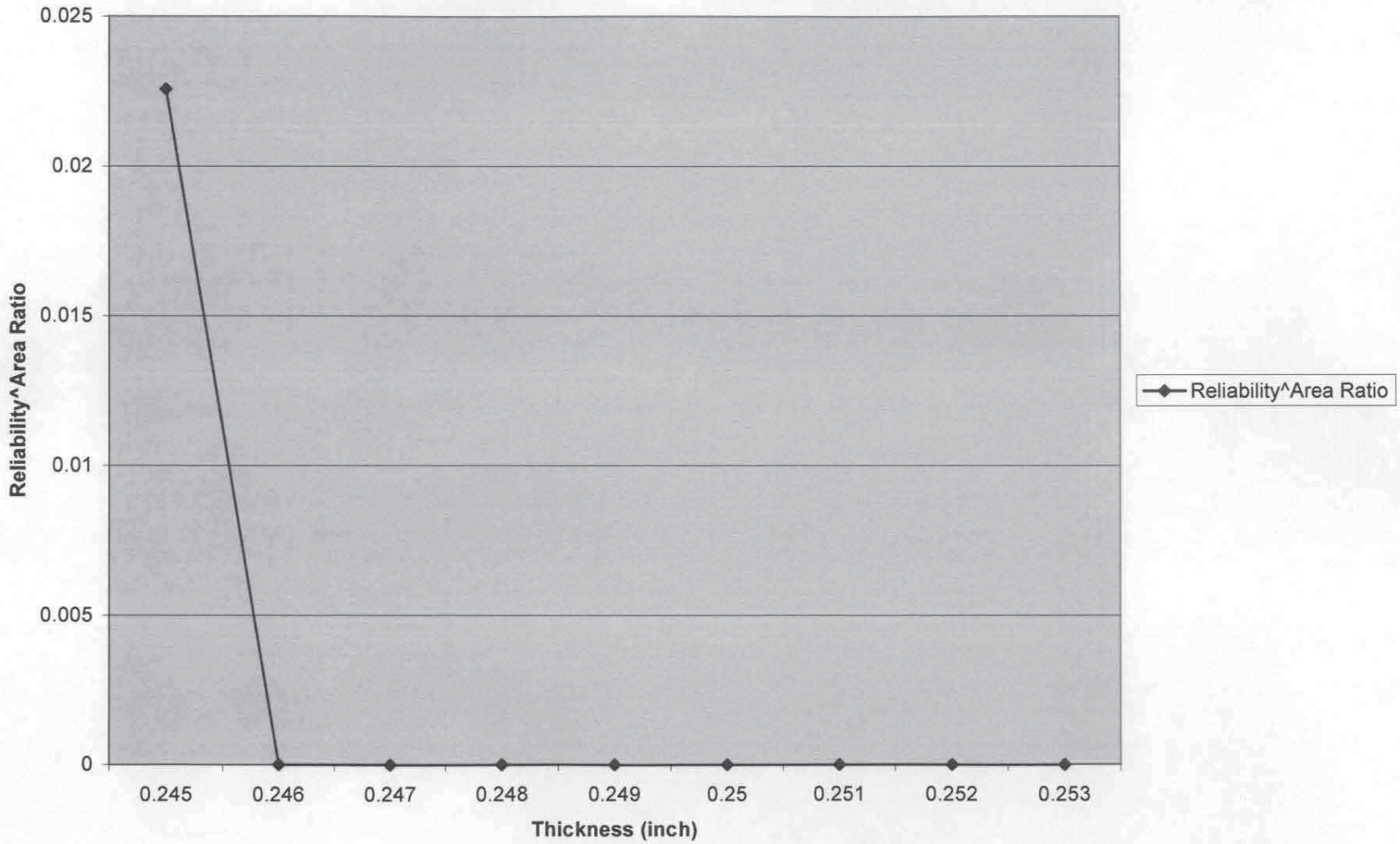

Table 6C.LOC7.1993.1	
Location 7	
Descriptive Statistics	
Mean	0.249232143
Standard Error	0.000887866
Median	0.249
Mode	0.249
Standard Deviation	0.00664418
Sample Variance	4.41451E-05
Kurtosis	5.347222415
Skewness	0.436710363
Range	0.045
Minimum	0.229
Maximum	0.274
Sum	13.957
Count	56
Largest(1)	0.274
Smallest(1)	0.229
Confidence Level(95.0%)	0.001779323

Table 6C.LOC7.1993.2			
Location 7			
Ordered Readings			
Thickness (inch)	Count	*Thickness (inch)*	Count
0.229	1	0.251	48
0.234	2	0.251	49
0.235	3	0.251	50
0.236	4	0.252	51
0.24	5	0.252	52
0.246	6	0.262	53
0.247	7	0.263	54
0.247	8	0.266	55
0.247	9	0.274	56
0.247	10		
0.248	11		
0.248	12		
0.248	13		
0.249	14		
0.249	15		
0.249	16		
0.249	17		
0.249	18		
0.249	19		
0.249	20		
0.249	21		
0.249	22		
0.249	23		
0.249	24		
0.249	25		
0.249	26		
0.249	27		
0.249	28		
0.249	29		
0.249	30		
0.249	31		
0.249	32		
0.249	33		
0.25	34		
0.25	35		
0.25	36		
0.25	37		
0.25	38		
0.25	39		
0.25	40		
0.25	41		
0.25	42		
0.25	43		
0.25	44		
0.251	45		
0.251	46		
0.251	47		

Table 6C.LOC7.1993.3						
Location 7						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.229	1	0.017857143	0.01785714	0.9821429	471.2	0.000205296
0.234	1	0.017857143	0.03571429	0.9642857	471.2	3.60656E-08
0.235	1	0.017857143	0.05357143	0.9464286	471.2	5.39026E-12
0.236	1	0.017857143	0.07142857	0.9285714	471.2	6.8117E-16
0.24	1	0.017857143	0.08928571	0.9107143	471.2	7.23103E-20
0.246	1	0.017857143	0.10714286	0.8928571	471.2	6.40393E-24
0.247	4	0.071428571	0.17857143	0.8214286	471.2	5.51802E-41
0.248	3	0.053571429	0.23214286	0.7678571	471.2	8.69814E-55
0.249	20	0.357142857	0.58928571	0.4107143	471.2	7.6575E-183
0.25	11	0.196428571	0.78571429	0.2142857	471.2	0
0.251	6	0.107142857	0.89285714	0.1071429	471.2	0
0.252	2	0.035714286	0.92857143	0.0714286	471.2	0
0.262	1	0.017857143	0.94642857	0.0535714	471.2	0
0.263	1	0.017857143	0.96428571	0.0357143	471.2	0
0.266	1	0.017857143	0.98214286	0.0178571	471.2	0
0.274	1	0.017857143	1	0	471.2	0
Total	56					

Figure 6C.LOC7.1993.1.Ordered Thickness Readings

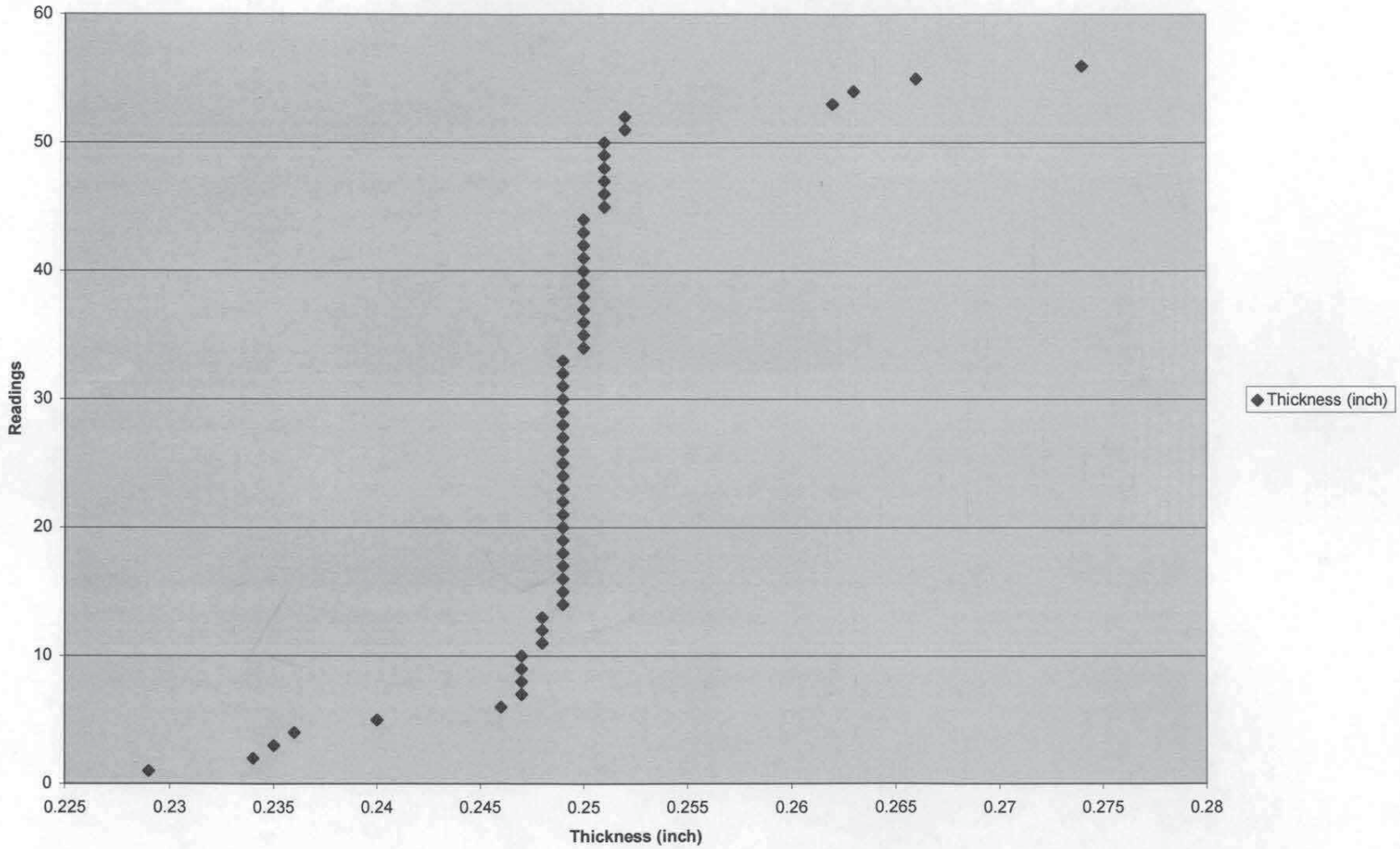

Figure 6C.LOC7.1993.2.Normalized Frequency Distribution

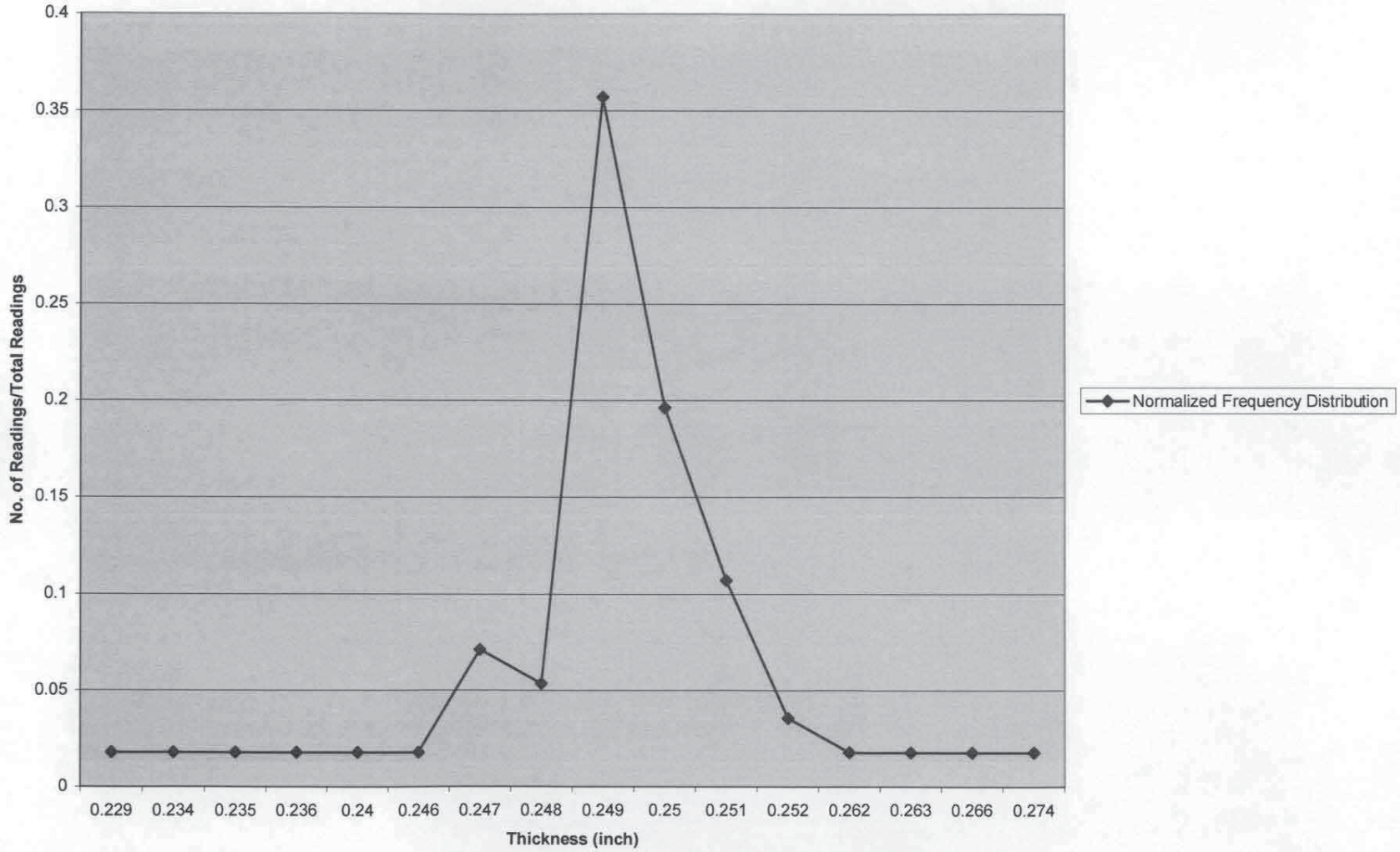

Figure 6C.LOC7.1993.3.Reliability Function

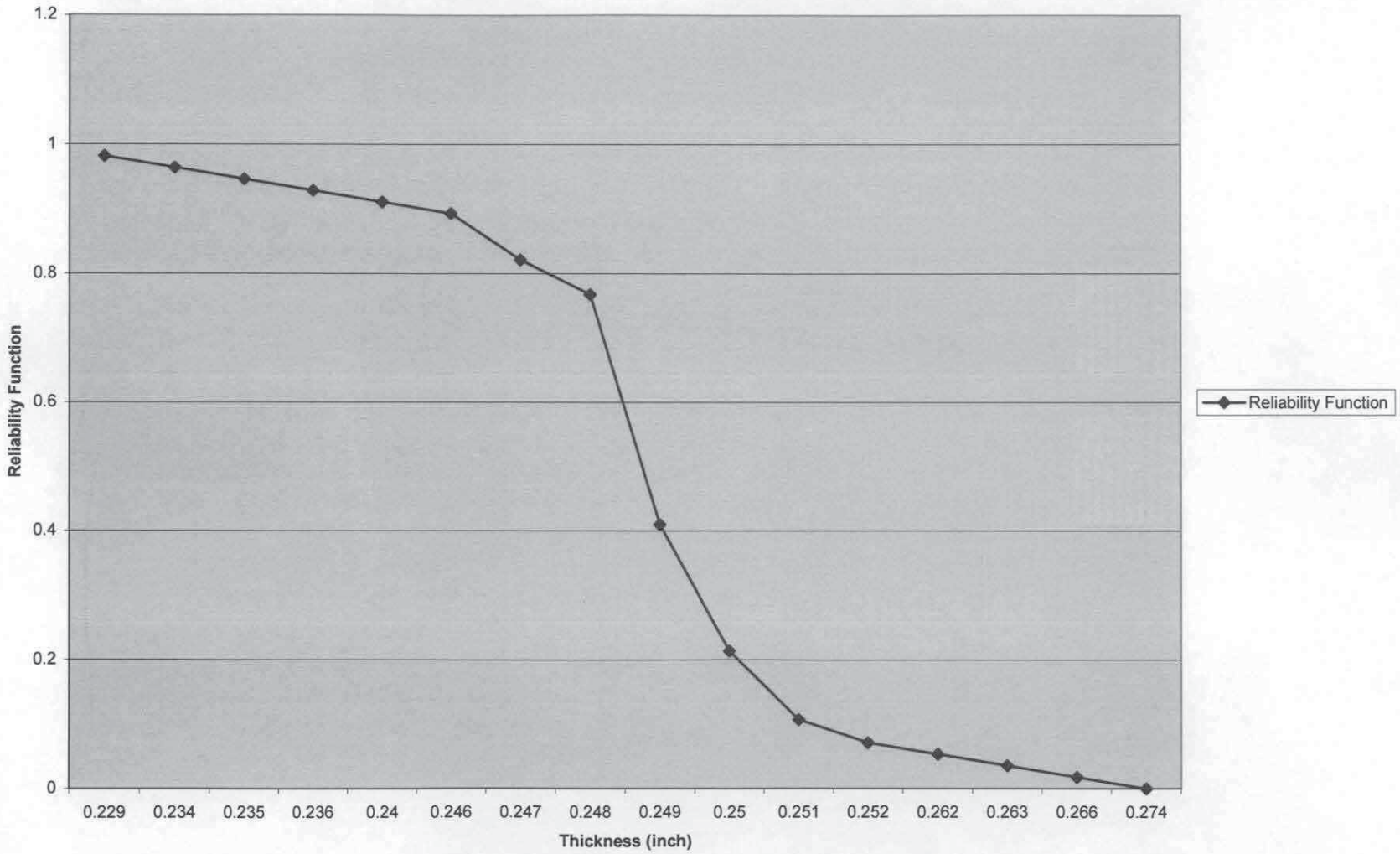

Figure 6C.LOC7.1993.4.Reliability^Area Ratio

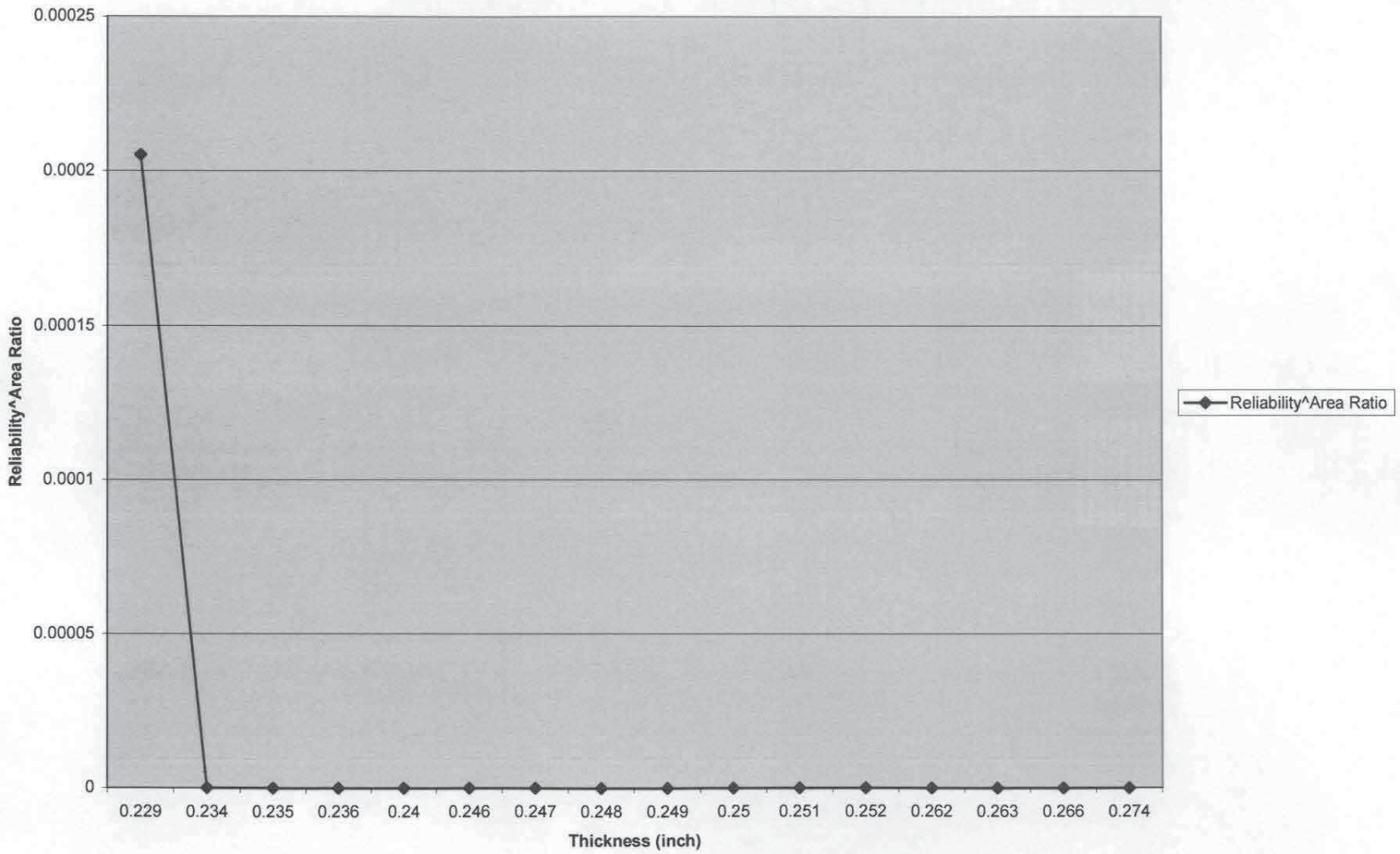

Table 6C.LOC7.1998.1	
Location 7	
Descriptive Statistics	
Mean	0.250833333
Standard Error	0.000571434
Median	0.251
Mode	0.252
Standard Deviation	0.00395901
Sample Variance	1.56738E-05
Kurtosis	1.114212578
Skewness	-0.532189817
Range	0.02
Minimum	0.239
Maximum	0.259
Sum	12.04
Count	48
Largest(1)	0.259
Smallest(1)	0.239
Confidence Level(95.0%)	0.001149577

Table 6C.LOC7.1998.2	
Location 7	
Ordered Readings	
Thickness (inch)	Count
0.239	1
0.241	2
0.245	3
0.246	4
0.246	5
0.246	6
0.247	7
0.248	8
0.248	9
0.248	10
0.248	11
0.248	12
0.249	13
0.249	14
0.249	15
0.25	16
0.25	17
0.25	18
0.25	19
0.25	20
0.25	21
0.251	22
0.251	23
0.251	24
0.251	25
0.251	26
0.251	27
0.252	28
0.252	29
0.252	30
0.252	31
0.252	32
0.252	33
0.252	34
0.253	35
0.253	36
0.253	37
0.253	38
0.254	39
0.254	40
0.255	41
0.256	42
0.256	43
0.256	44
0.257	45
0.257	46
0.257	47
0.259	48

Table 6C.LOC7.1998.3						
Location 7						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.239	1	0.020833333	0.02083333	0.9791667	549.8	9.40029E-06
0.241	1	0.020833333	0.04166667	0.9583333	549.8	6.88922E-11
0.245	1	0.020833333	0.0625	0.9375	549.8	3.89344E-16
0.246	3	0.0625	0.125	0.875	549.8	1.30953E-32
0.247	1	0.020833333	0.14583333	0.8541667	549.8	2.30896E-38
0.248	5	0.104166667	0.25	0.75	549.8	2.04656E-69
0.249	3	0.0625	0.3125	0.6875	549.8	3.43228E-90
0.25	6	0.125	0.4375	0.5625	549.8	4.1884E-138
0.251	6	0.125	0.5625	0.4375	549.8	4.1349E-198
0.252	7	0.145833333	0.70833333	0.2916667	549.8	6.3796E-295
0.253	4	0.083333333	0.79166667	0.2083333	549.8	0
0.254	2	0.041666667	0.83333333	0.1666667	549.8	0
0.255	1	0.020833333	0.85416667	0.1458333	549.8	0
0.256	3	0.0625	0.91666667	0.0833333	549.8	0
0.257	3	0.0625	0.97916667	0.0208333	549.8	0
0.259	1	0.020833333	1	0	549.8	0
Total	48					

Figure 6C.LOC7.1998.1.Ordered Thickness Readings

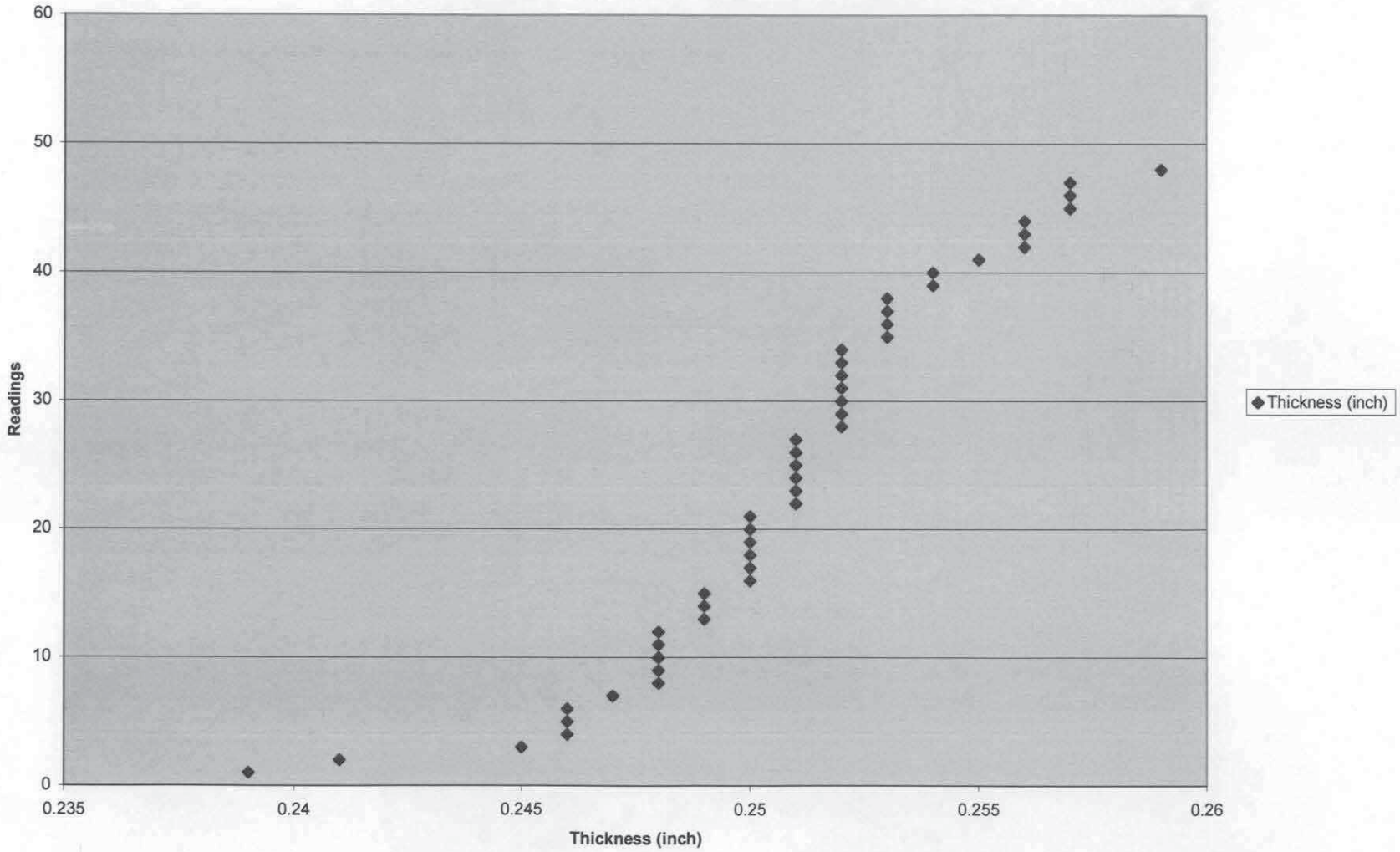

Figure 6C.LOC7.1998.2.Normalized Frequency Distribution

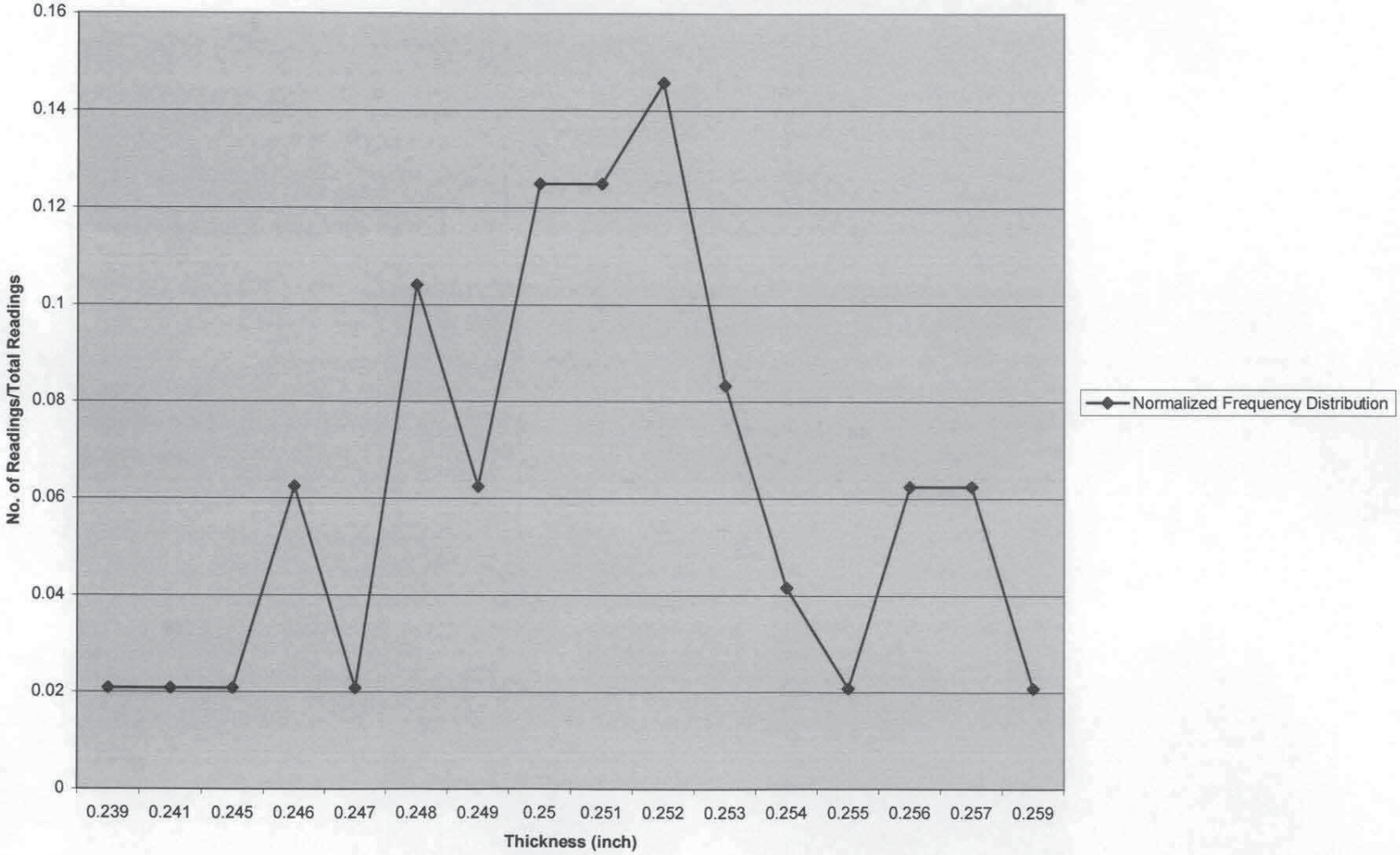

Figure 6C.LOC7.1998.3.Reliability Function

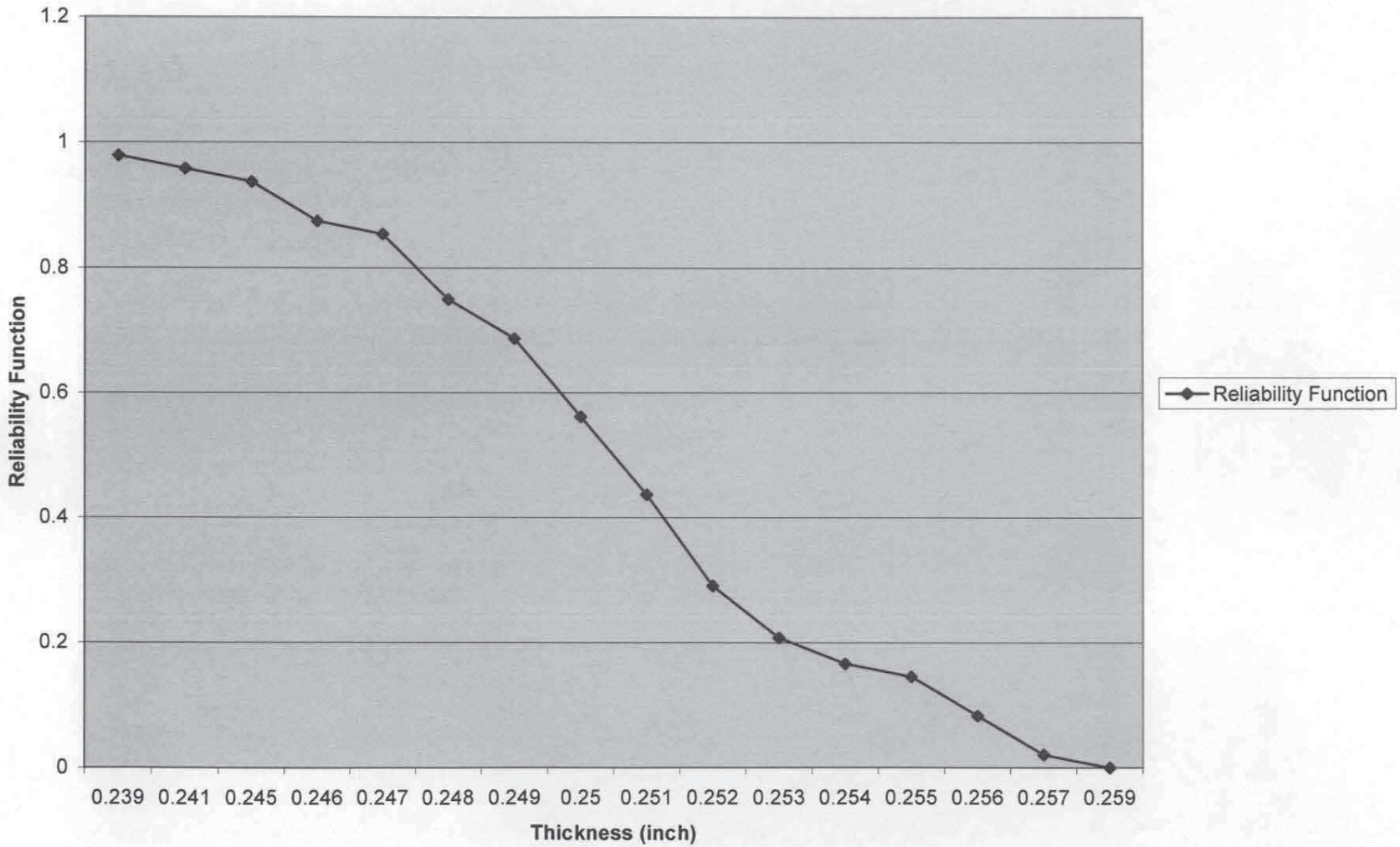

Figure 6C.LOC7.1998.4.Reliability^Area Ratio

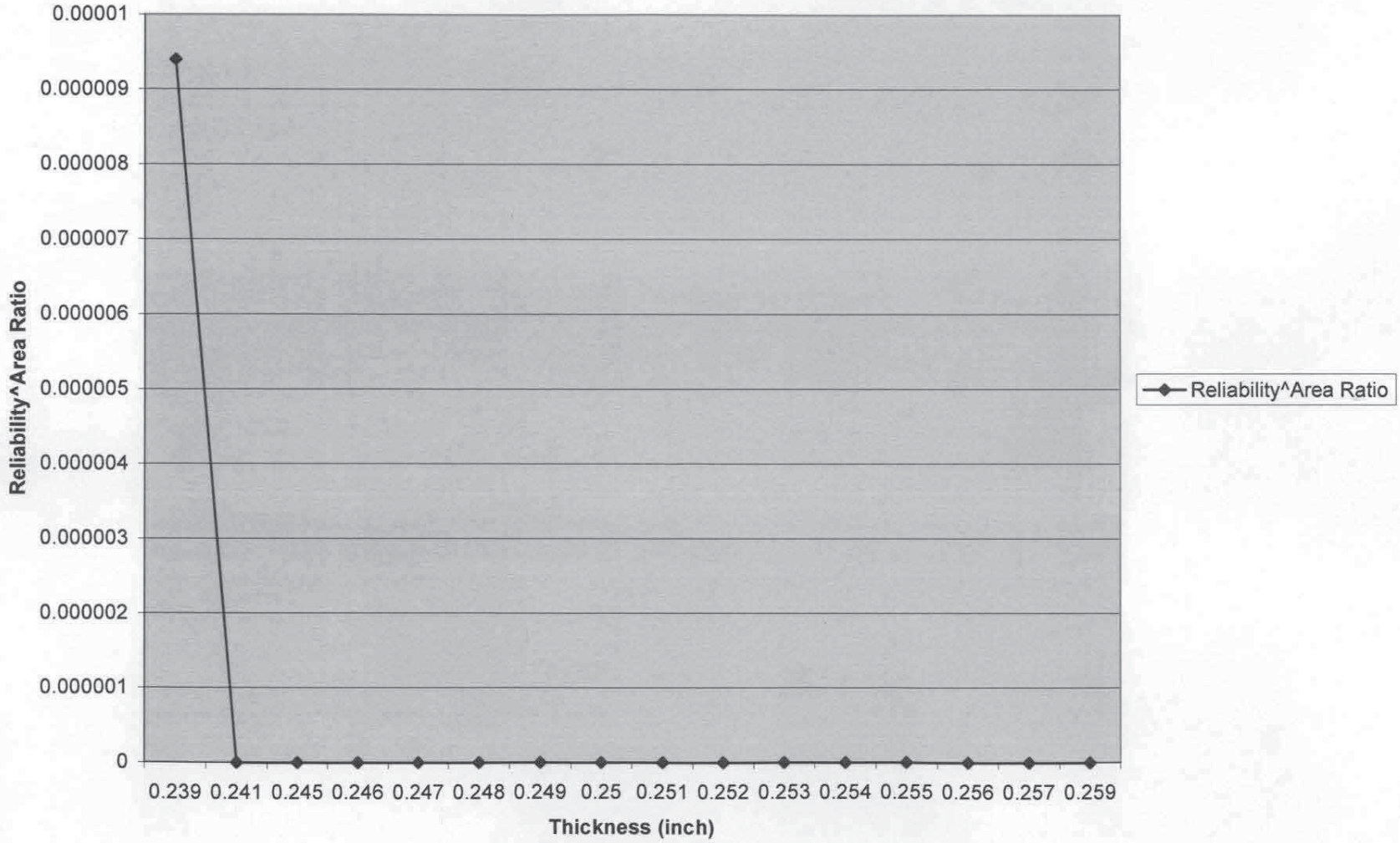

Table 6C.LOC9.1993.1	
Location 9	
Descriptive Statistics	
Mean	0.520568823
Standard Error	0.000273934
Median	0.519
Mode	0.517
Standard Deviation	0.006726737
Sample Variance	4.5249E-05
Kurtosis	3.95089052
Skewness	1.450633112
Range	0.059
Minimum	0.489
Maximum	0.548
Sum	313.903
Count	603
Largest(1)	0.548
Smallest(1)	0.489
Confidence Level(95.0%)	0.000537982

Table 6C.LOC9.1993.2							
Location 9							
Ordered Readings							
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.489	1	0.514	51	0.515	101	0.516	151
0.507	2	0.514	52	0.515	102	0.516	152
0.508	3	0.514	53	0.515	103	0.516	153
0.51	4	0.514	54	0.515	104	0.516	154
0.511	5	0.514	55	0.515	105	0.516	155
0.511	6	0.514	56	0.515	106	0.516	156
0.511	7	0.514	57	0.515	107	0.516	157
0.511	8	0.514	58	0.515	108	0.516	158
0.511	9	0.514	59	0.515	109	0.516	159
0.512	10	0.514	60	0.515	110	0.516	160
0.512	11	0.514	61	0.515	111	0.516	161
0.512	12	0.514	62	0.516	112	0.516	162
0.512	13	0.514	63	0.516	113	0.517	163
0.512	14	0.514	64	0.516	114	0.517	164
0.512	15	0.514	65	0.516	115	0.517	165
0.512	16	0.514	66	0.516	116	0.517	166
0.512	17	0.515	67	0.516	117	0.517	167
0.512	18	0.515	68	0.516	118	0.517	168
0.512	19	0.515	69	0.516	119	0.517	169
0.513	20	0.515	70	0.516	120	0.517	170
0.513	21	0.515	71	0.516	121	0.517	171
0.513	22	0.515	72	0.516	122	0.517	172
0.513	23	0.515	73	0.516	123	0.517	173
0.513	24	0.515	74	0.516	124	0.517	174
0.513	25	0.515	75	0.516	125	0.517	175
0.513	26	0.515	76	0.516	126	0.517	176
0.513	27	0.515	77	0.516	127	0.517	177
0.513	28	0.515	78	0.516	128	0.517	178
0.513	29	0.515	79	0.516	129	0.517	179
0.513	30	0.515	80	0.516	130	0.517	180
0.513	31	0.515	81	0.516	131	0.517	181
0.513	32	0.515	82	0.516	132	0.517	182
0.513	33	0.515	83	0.516	133	0.517	183
0.513	34	0.515	84	0.516	134	0.517	184
0.513	35	0.515	85	0.516	135	0.517	185
0.513	36	0.515	86	0.516	136	0.517	186
0.513	37	0.515	87	0.516	137	0.517	187
0.513	38	0.515	88	0.516	138	0.517	188
0.514	39	0.515	89	0.516	139	0.517	189
0.514	40	0.515	90	0.516	140	0.517	190
0.514	41	0.515	91	0.516	141	0.517	191
0.514	42	0.515	92	0.516	142	0.517	192
0.514	43	0.515	93	0.516	143	0.517	193
0.514	44	0.515	94	0.516	144	0.517	194
0.514	45	0.515	95	0.516	145	0.517	195
0.514	46	0.515	96	0.516	146	0.517	196
0.514	47	0.515	97	0.516	147	0.517	197
0.514	48	0.515	98	0.516	148	0.517	198
0.514	49	0.515	99	0.516	149	0.517	199
0.514	50	0.515	100	0.516	150	0.517	200

Table 6C.LOC9.1993.2							
Location 9							
Ordered Readings							
0.517	201	0.518	252	0.519	303	0.521	354
0.517	202	0.518	253	0.519	304	0.521	355
0.517	203	0.518	254	0.519	305	0.521	356
0.517	204	0.518	255	0.519	306	0.521	357
0.517	205	0.518	256	0.52	307	0.521	358
0.517	206	0.518	257	0.52	308	0.521	359
0.517	207	0.518	258	0.52	309	0.521	360
0.517	208	0.518	259	0.52	310	0.521	361
0.517	209	0.518	260	0.52	311	0.521	362
0.517	210	0.518	261	0.52	312	0.521	363
0.517	211	0.518	262	0.52	313	0.521	364
0.517	212	0.518	263	0.52	314	0.521	365
0.517	213	0.519	264	0.52	315	0.521	366
0.517	214	0.519	265	0.52	316	0.521	367
0.517	215	0.519	266	0.52	317	0.521	368
0.517	216	0.519	267	0.52	318	0.521	369
0.517	217	0.519	268	0.52	319	0.521	370
0.517	218	0.519	269	0.52	320	0.521	371
0.517	219	0.519	270	0.52	321	0.521	372
0.517	220	0.519	271	0.52	322	0.521	373
0.517	221	0.519	272	0.52	323	0.521	374
0.518	222	0.519	273	0.52	324	0.521	375
0.518	223	0.519	274	0.52	325	0.521	376
0.518	224	0.519	275	0.52	326	0.521	377
0.518	225	0.519	276	0.52	327	0.521	378
0.518	226	0.519	277	0.52	328	0.521	379
0.518	227	0.519	278	0.52	329	0.521	380
0.518	228	0.519	279	0.52	330	0.521	381
0.518	229	0.519	280	0.52	331	0.521	382
0.518	230	0.519	281	0.52	332	0.521	383
0.518	231	0.519	282	0.52	333	0.522	384
0.518	232	0.519	283	0.52	334	0.522	385
0.518	233	0.519	284	0.52	335	0.522	386
0.518	234	0.519	285	0.52	336	0.522	387
0.518	235	0.519	286	0.52	337	0.522	388
0.518	236	0.519	287	0.52	338	0.522	389
0.518	237	0.519	288	0.52	339	0.522	390
0.518	238	0.519	289	0.52	340	0.522	391
0.518	239	0.519	290	0.52	341	0.522	392
0.518	240	0.519	291	0.52	342	0.522	393
0.518	241	0.519	292	0.52	343	0.522	394
0.518	242	0.519	293	0.52	344	0.522	395
0.518	243	0.519	294	0.52	345	0.522	396
0.518	244	0.519	295	0.52	346	0.522	397
0.518	245	0.519	296	0.52	347	0.522	398
0.518	246	0.519	297	0.52	348	0.522	399
0.518	247	0.519	298	0.52	349	0.522	400
0.518	248	0.519	299	0.52	350	0.522	401
0.518	249	0.519	300	0.521	351	0.522	402
0.518	250	0.519	301	0.521	352	0.522	403
0.518	251	0.519	302	0.521	353	0.522	404

Table 6C.LOC9.1993.2							
Location 9							
Ordered Readings							
0.522	405	0.523	456	0.525	507	0.529	558
0.522	406	0.523	457	0.525	508	0.53	559
0.522	407	0.523	458	0.525	509	0.53	560
0.522	408	0.523	459	0.525	510	0.53	561
0.522	409	0.523	460	0.525	511	0.53	562
0.522	410	0.523	461	0.525	512	0.53	563
0.522	411	0.523	462	0.525	513	0.531	564
0.522	412	0.523	463	0.525	514	0.531	565
0.522	413	0.523	464	0.525	515	0.531	566
0.522	414	0.523	465	0.525	516	0.531	567
0.522	415	0.523	466	0.525	517	0.533	568
0.522	416	0.523	467	0.525	518	0.533	569
0.522	417	0.523	468	0.525	519	0.534	570
0.522	418	0.523	469	0.525	520	0.535	571
0.522	419	0.523	470	0.525	521	0.535	572
0.522	420	0.523	471	0.525	522	0.536	573
0.522	421	0.523	472	0.525	523	0.538	574
0.522	422	0.523	473	0.526	524	0.539	575
0.522	423	0.523	474	0.526	525	0.54	576
0.522	424	0.523	475	0.526	526	0.54	577
0.522	425	0.524	476	0.526	527	0.54	578
0.522	426	0.524	477	0.526	528	0.54	579
0.522	427	0.524	478	0.526	529	0.54	580
0.522	428	0.524	479	0.526	530	0.54	581
0.522	429	0.524	480	0.526	531	0.541	582
0.522	430	0.524	481	0.526	532	0.541	583
0.522	431	0.524	482	0.526	533	0.541	584
0.522	432	0.524	483	0.526	534	0.541	585
0.522	433	0.524	484	0.526	535	0.542	586
0.522	434	0.524	485	0.527	536	0.542	587
0.523	435	0.524	486	0.527	537	0.542	588
0.523	436	0.524	487	0.527	538	0.542	589
0.523	437	0.524	488	0.527	539	0.542	590
0.523	438	0.524	489	0.527	540	0.542	591
0.523	439	0.524	490	0.527	541	0.542	592
0.523	440	0.524	491	0.527	542	0.542	593
0.523	441	0.524	492	0.527	543	0.543	594
0.523	442	0.524	493	0.527	544	0.543	595
0.523	443	0.524	494	0.528	545	0.544	596
0.523	444	0.524	495	0.528	546	0.544	597
0.523	445	0.524	496	0.528	547	0.544	598
0.523	446	0.524	497	0.528	548	0.544	599
0.523	447	0.524	498	0.528	549	0.544	600
0.523	448	0.524	499	0.528	550	0.545	601
0.523	449	0.524	500	0.529	551	0.545	602
0.523	450	0.524	501	0.529	552	0.548	603
0.523	451	0.525	502	0.529	553		
0.523	452	0.525	503	0.529	554		
0.523	453	0.525	504	0.529	555		
0.523	454	0.525	505	0.529	556		
0.523	455	0.525	506	0.529	557		

Table 6C.LOC9.1993.3						
Location 9						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.489	1	0.001658375	0.00165837	0.9983416	29.19	0.952708832
0.507	1	0.001658375	0.00331675	0.9966833	29.19	0.907581017
0.508	1	0.001658375	0.00497512	0.9950249	29.19	0.864520948
0.51	1	0.001658375	0.0066335	0.9933665	29.19	0.823437091
0.511	5	0.008291874	0.01492537	0.9850746	29.19	0.644722195
0.512	10	0.016583748	0.03150912	0.9684909	29.19	0.392777903
0.513	19	0.031509121	0.06301824	0.9369818	29.19	0.149578516
0.514	28	0.046434494	0.10945274	0.8905473	29.19	0.033927637
0.515	45	0.074626866	0.1840796	0.8159204	29.19	0.002637034
0.516	51	0.084577114	0.26865672	0.7313433	29.19	0.000108113
0.517	59	0.097844113	0.36650083	0.6334992	29.19	1.63391E-06
0.518	42	0.069651741	0.43615257	0.5638474	29.19	5.45426E-08
0.519	43	0.071310116	0.50746269	0.4925373	29.19	1.05367E-09
0.52	44	0.072968491	0.58043118	0.4195688	29.19	9.77517E-12
0.521	33	0.054726368	0.63515755	0.3648425	29.19	1.65362E-13
0.522	51	0.084577114	0.71973466	0.2802653	29.19	7.50379E-17
0.523	41	0.067993367	0.78772803	0.212272	29.19	2.25365E-20
0.524	26	0.043117745	0.83084577	0.1691542	29.19	2.98261E-23
0.525	22	0.036484245	0.86733002	0.13267	29.19	2.48253E-26
0.526	12	0.019900498	0.88723051	0.1127695	29.19	2.16135E-28
0.527	9	0.014925373	0.90215589	0.0978441	29.19	3.42801E-30
0.528	6	0.009950249	0.91210614	0.0878939	29.19	1.49812E-31
0.529	8	0.013266998	0.92537313	0.0746269	29.19	1.2627E-33
0.53	5	0.008291874	0.93366501	0.066335	29.19	4.0572E-35
0.531	4	0.006633499	0.94029851	0.0597015	29.19	1.87338E-36
0.533	2	0.00331675	0.94361526	0.0563847	29.19	3.5323E-37
0.534	1	0.001658375	0.94527363	0.0547264	29.19	1.47784E-37
0.535	2	0.00331675	0.94859038	0.0514096	29.19	2.38281E-38
0.536	1	0.001658375	0.95024876	0.0497512	29.19	9.15019E-39
0.538	1	0.001658375	0.95190713	0.0480929	29.19	3.40155E-39
0.539	1	0.001658375	0.95356551	0.0464345	29.19	1.22136E-39
0.54	6	0.009950249	0.96351575	0.0364842	29.19	1.07092E-42
0.541	4	0.006633499	0.97014925	0.0298507	29.19	3.06167E-45
0.542	8	0.013266998	0.98341625	0.0165837	29.19	1.08366E-52
0.543	2	0.00331675	0.986733	0.013267	29.19	1.60774E-55
0.544	5	0.008291874	0.99502488	0.0049751	29.19	5.92587E-68
0.545	2	0.00331675	0.99834163	0.0016584	29.19	7.018E-82
0.548	1	0.001658375	1	0	29.19	0
Total	603					

Figure 6C.LOC9.1993.1 Ordered Thickness Readings

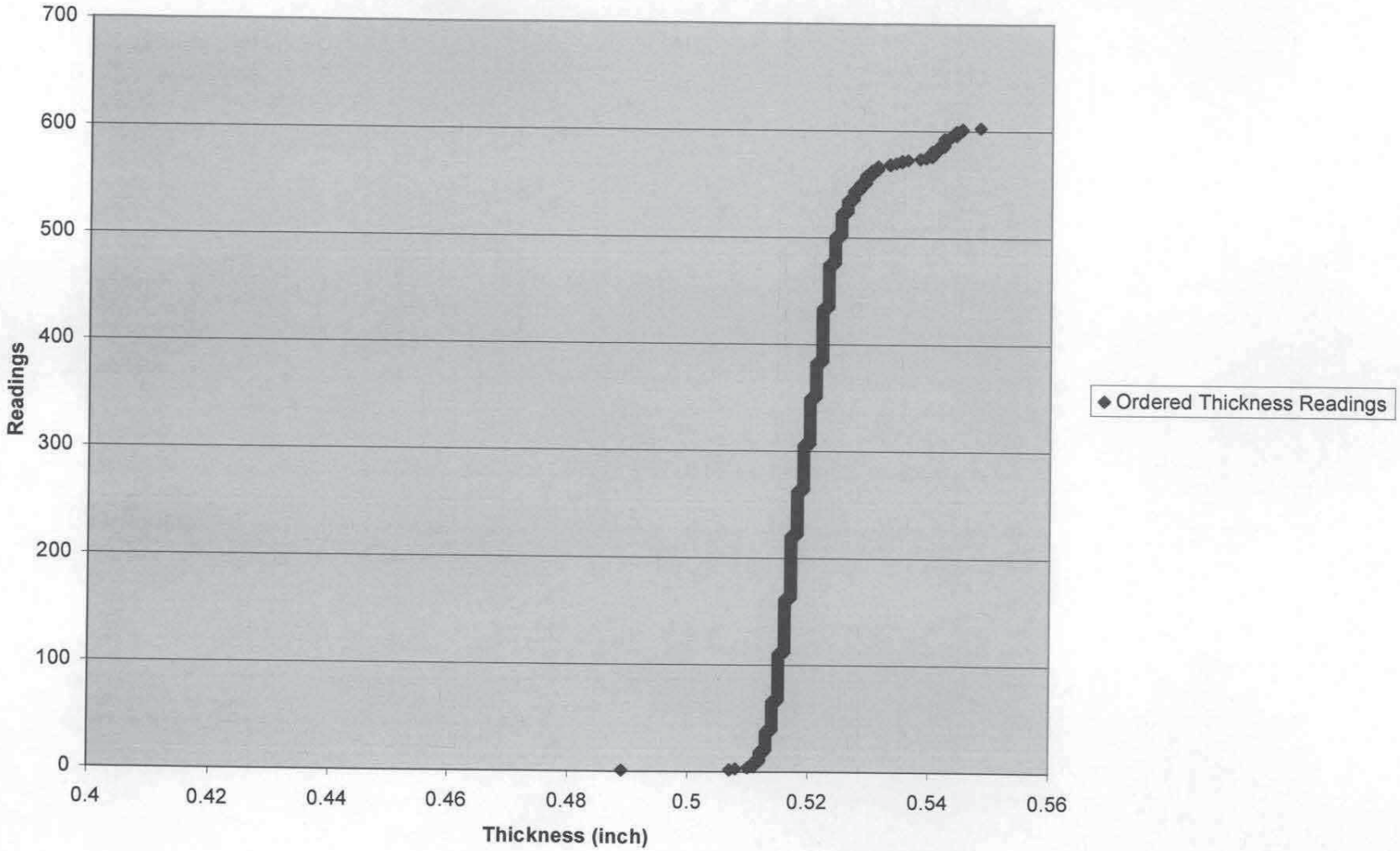

Figure 6C.LOC9.1993.2.Normalized Frequency Distribution

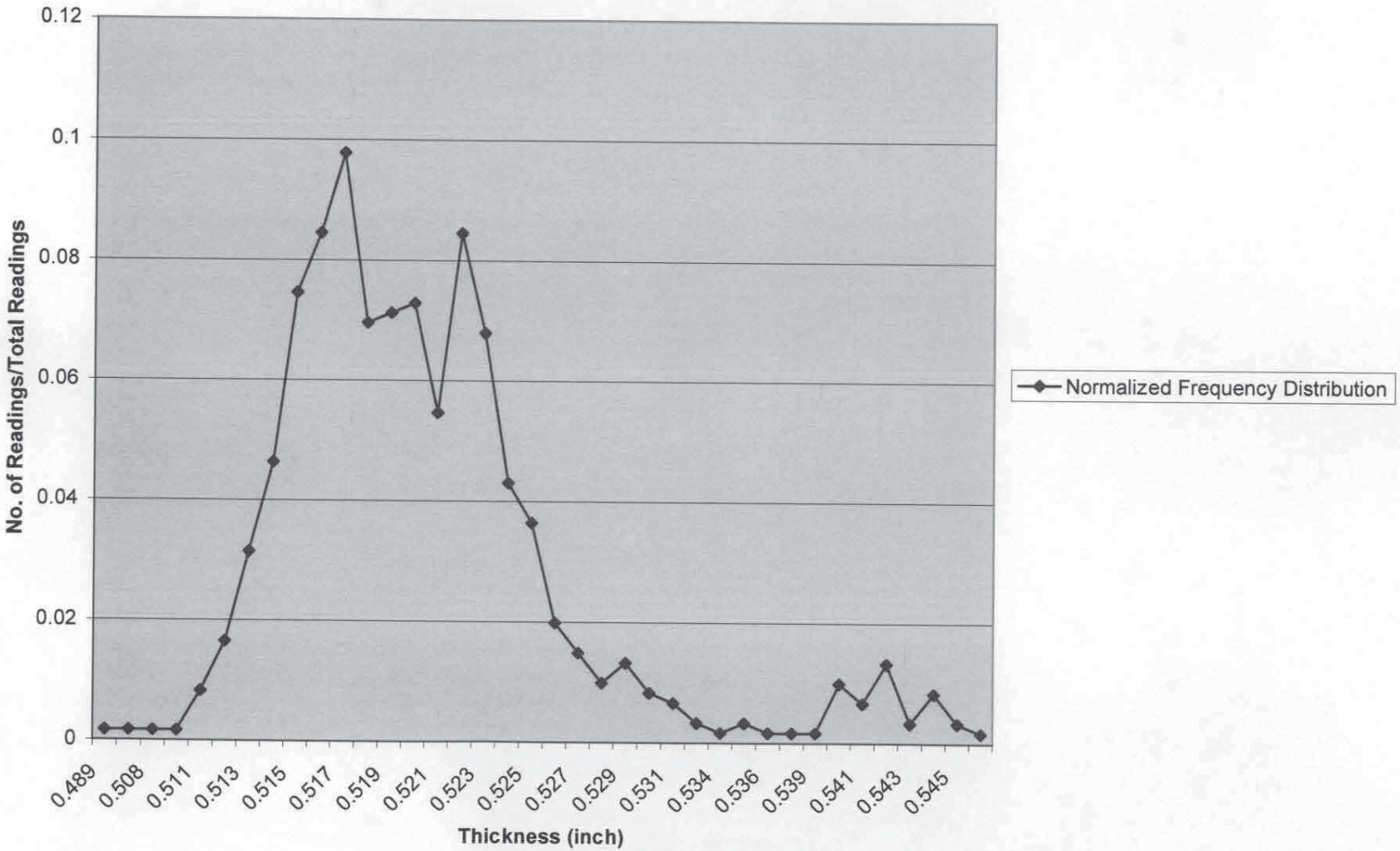

Figure 6C.LOC9.1993.3.Reliability Function

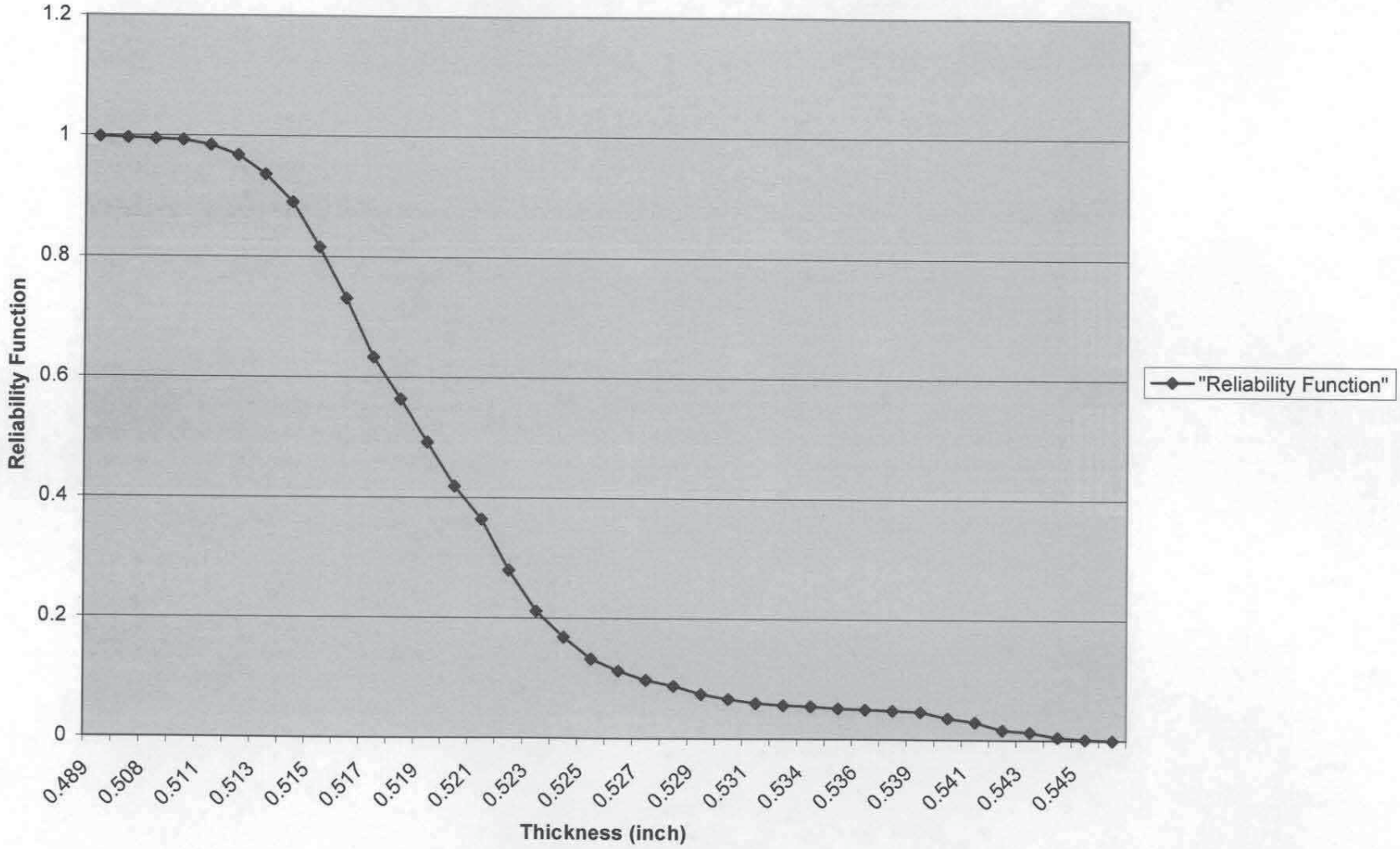

Figure 6C.LOC9.1998.4.Reliability^Area Ratio

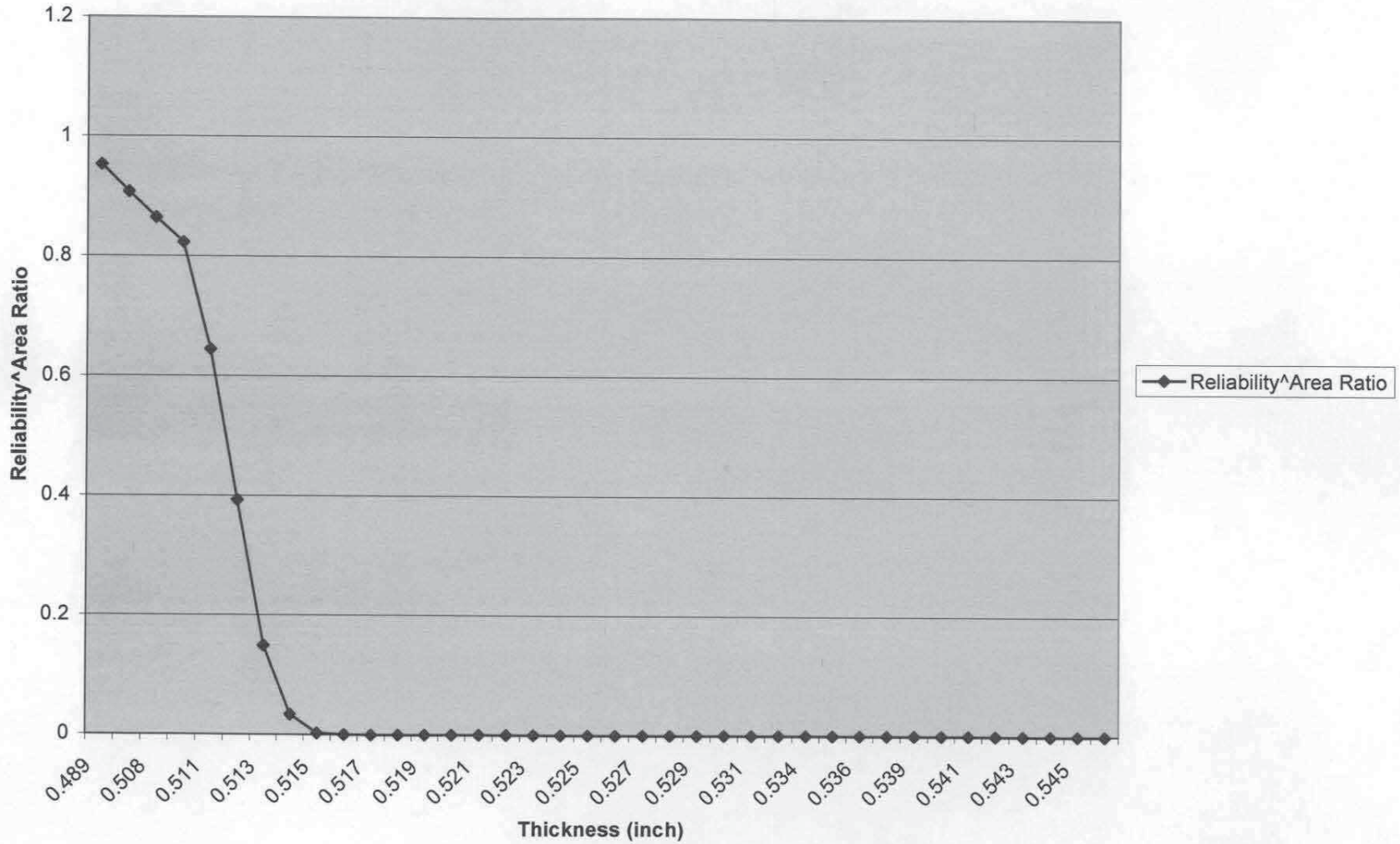

Table 6C.LOC9.1998.1	
Location 9	
Descriptive Statistics	
Mean	0.514893357
Standard Error	0.000231702
Median	0.515
Mode	0.515
Standard Deviation	0.005541516
Sample Variance	3.07084E-05
Kurtosis	193.6200472
Skewness	10.70659553
Range	0.112
Minimum	0.504
Maximum	0.616
Sum	294.519
Count	572
Largest(1)	0.616
Smallest(1)	0.504
Confidence Level(95.0%)	0.000455093

Table 6C.LOC9.1998.2							
Location 9							
Ordered Readings							
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.504	1	0.51	51	0.511	101	0.512	151
0.506	2	0.51	52	0.511	102	0.512	152
0.506	3	0.51	53	0.511	103	0.512	153
0.507	4	0.51	54	0.511	104	0.512	154
0.507	5	0.51	55	0.511	105	0.512	155
0.507	6	0.51	56	0.511	106	0.512	156
0.507	7	0.51	57	0.512	107	0.512	157
0.508	8	0.51	58	0.512	108	0.513	158
0.508	9	0.51	59	0.512	109	0.513	159
0.508	10	0.51	60	0.512	110	0.513	160
0.508	11	0.51	61	0.512	111	0.513	161
0.508	12	0.51	62	0.512	112	0.513	162
0.508	13	0.51	63	0.512	113	0.513	163
0.508	14	0.511	64	0.512	114	0.513	164
0.508	15	0.511	65	0.512	115	0.513	165
0.508	16	0.511	66	0.512	116	0.513	166
0.508	17	0.511	67	0.512	117	0.513	167
0.509	18	0.511	68	0.512	118	0.513	168
0.509	19	0.511	69	0.512	119	0.513	169
0.509	20	0.511	70	0.512	120	0.513	170
0.509	21	0.511	71	0.512	121	0.513	171
0.509	22	0.511	72	0.512	122	0.513	172
0.509	23	0.511	73	0.512	123	0.513	173
0.509	24	0.511	74	0.512	124	0.513	174
0.509	25	0.511	75	0.512	125	0.513	175
0.509	26	0.511	76	0.512	126	0.513	176
0.509	27	0.511	77	0.512	127	0.513	177
0.509	28	0.511	78	0.512	128	0.513	178
0.509	29	0.511	79	0.512	129	0.513	179
0.509	30	0.511	80	0.512	130	0.513	180
0.509	31	0.511	81	0.512	131	0.513	181
0.509	32	0.511	82	0.512	132	0.513	182
0.509	33	0.511	83	0.512	133	0.513	183
0.509	34	0.511	84	0.512	134	0.513	184
0.51	35	0.511	85	0.512	135	0.513	185
0.51	36	0.511	86	0.512	136	0.513	186
0.51	37	0.511	87	0.512	137	0.513	187
0.51	38	0.511	88	0.512	138	0.513	188
0.51	39	0.511	89	0.512	139	0.513	189
0.51	40	0.511	90	0.512	140	0.513	190
0.51	41	0.511	91	0.512	141	0.513	191
0.51	42	0.511	92	0.512	142	0.513	192
0.51	43	0.511	93	0.512	143	0.513	193
0.51	44	0.511	94	0.512	144	0.513	194
0.51	45	0.511	95	0.512	145	0.513	195
0.51	46	0.511	96	0.512	146	0.513	196
0.51	47	0.511	97	0.512	147	0.513	197
0.51	48	0.511	98	0.512	148	0.513	198
0.51	49	0.511	99	0.512	149	0.513	199
0.51	50	0.511	100	0.512	150	0.513	200

Table 6C.LOC9.1998.2							
Location 9							
Ordered Readings							
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.513	201	0.514	251	0.515	301	0.515	351
0.513	202	0.514	252	0.515	302	0.515	352
0.513	203	0.514	253	0.515	303	0.515	353
0.513	204	0.514	254	0.515	304	0.515	354
0.513	205	0.514	255	0.515	305	0.515	355
0.513	206	0.514	256	0.515	306	0.516	356
0.513	207	0.514	257	0.515	307	0.516	357
0.513	208	0.514	258	0.515	308	0.516	358
0.513	209	0.514	259	0.515	309	0.516	359
0.513	210	0.514	260	0.515	310	0.516	360
0.513	211	0.514	261	0.515	311	0.516	361
0.513	212	0.514	262	0.515	312	0.516	362
0.513	213	0.514	263	0.515	313	0.516	363
0.513	214	0.514	264	0.515	314	0.516	364
0.513	215	0.514	265	0.515	315	0.516	365
0.513	216	0.514	266	0.515	316	0.516	366
0.513	217	0.514	267	0.515	317	0.516	367
0.513	218	0.514	268	0.515	318	0.516	368
0.513	219	0.514	269	0.515	319	0.516	369
0.513	220	0.514	270	0.515	320	0.516	370
0.513	221	0.514	271	0.515	321	0.516	371
0.513	222	0.514	272	0.515	322	0.516	372
0.513	223	0.514	273	0.515	323	0.516	373
0.513	224	0.514	274	0.515	324	0.516	374
0.514	225	0.514	275	0.515	325	0.516	375
0.514	226	0.514	276	0.515	326	0.516	376
0.514	227	0.514	277	0.515	327	0.516	377
0.514	228	0.514	278	0.515	328	0.516	378
0.514	229	0.514	279	0.515	329	0.516	379
0.514	230	0.514	280	0.515	330	0.516	380
0.514	231	0.514	281	0.515	331	0.516	381
0.514	232	0.515	282	0.515	332	0.516	382
0.514	233	0.515	283	0.515	333	0.516	383
0.514	234	0.515	284	0.515	334	0.516	384
0.514	235	0.515	285	0.515	335	0.516	385
0.514	236	0.515	286	0.515	336	0.516	386
0.514	237	0.515	287	0.515	337	0.516	387
0.514	238	0.515	288	0.515	338	0.516	388
0.514	239	0.515	289	0.515	339	0.516	389
0.514	240	0.515	290	0.515	340	0.516	390
0.514	241	0.515	291	0.515	341	0.516	391
0.514	242	0.515	292	0.515	342	0.516	392
0.514	243	0.515	293	0.515	343	0.516	393
0.514	244	0.515	294	0.515	344	0.516	394
0.514	245	0.515	295	0.515	345	0.516	395
0.514	246	0.515	296	0.515	346	0.516	396
0.514	247	0.515	297	0.515	347	0.516	397
0.514	248	0.515	298	0.515	348	0.516	398
0.514	249	0.515	299	0.515	349	0.516	399
0.514	250	0.515	300	0.515	350	0.517	400

Table 6C.LOC9.1998.2							
Location 9							
Ordered Readings							
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.517	401	0.518	451	0.519	501	0.522	551
0.517	402	0.518	452	0.519	502	0.522	552
0.517	403	0.518	453	0.519	503	0.522	553
0.517	404	0.518	454	0.519	504	0.522	554
0.517	405	0.518	455	0.519	505	0.522	555
0.517	406	0.518	456	0.519	506	0.522	556
0.517	407	0.518	457	0.519	507	0.522	557
0.517	408	0.518	458	0.519	508	0.522	558
0.517	409	0.518	459	0.519	509	0.522	559
0.517	410	0.518	460	0.519	510	0.523	560
0.517	411	0.518	461	0.519	511	0.523	561
0.517	412	0.518	462	0.519	512	0.523	562
0.517	413	0.518	463	0.519	513	0.523	563
0.517	414	0.518	464	0.519	514	0.523	564
0.517	415	0.518	465	0.519	515	0.523	565
0.517	416	0.518	466	0.519	516	0.524	566
0.517	417	0.518	467	0.52	517	0.524	567
0.517	418	0.518	468	0.52	518	0.524	568
0.517	419	0.518	469	0.52	519	0.525	569
0.517	420	0.518	470	0.52	520	0.525	570
0.517	421	0.518	471	0.52	521	0.526	571
0.517	422	0.518	472	0.52	522	0.616	572
0.517	423	0.518	473	0.52	523		
0.517	424	0.518	474	0.52	524		
0.517	425	0.518	475	0.52	525		
0.517	426	0.518	476	0.52	526		
0.517	427	0.518	477	0.52	527		
0.517	428	0.518	478	0.52	528		
0.517	429	0.518	479	0.52	529		
0.517	430	0.518	480	0.52	530		
0.517	431	0.518	481	0.52	531		
0.517	432	0.518	482	0.52	532		
0.517	433	0.518	483	0.52	533		
0.517	434	0.518	484	0.52	534		
0.517	435	0.518	485	0.521	535		
0.517	436	0.518	486	0.521	536		
0.517	437	0.518	487	0.521	537		
0.517	438	0.518	488	0.521	538		
0.517	439	0.519	489	0.521	539		
0.517	440	0.519	490	0.521	540		
0.517	441	0.519	491	0.521	541		
0.517	442	0.519	492	0.521	542		
0.517	443	0.519	493	0.521	543		
0.517	444	0.519	494	0.521	544		
0.517	445	0.519	495	0.521	545		
0.517	446	0.519	496	0.521	546		
0.517	447	0.519	497	0.521	547		
0.517	448	0.519	498	0.522	548		
0.518	449	0.519	499	0.522	549		
0.518	450	0.519	500	0.522	550		

Table 6C.LOC9.1998.3						
Location 9						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.504	1	0.001748252	0.00174825	0.9982517	29.19	0.950208528
0.506	2	0.003496503	0.00524476	0.9947552	29.19	0.857709054
0.507	4	0.006993007	0.01223776	0.9877622	29.19	0.698089621
0.508	10	0.017482517	0.02972028	0.9702797	29.19	0.414514206
0.509	17	0.02972028	0.05944056	0.9405594	29.19	0.167178232
0.51	29	0.050699301	0.11013986	0.8898601	29.19	0.033171796
0.511	43	0.075174825	0.18531469	0.8146853	29.19	0.002522972
0.512	51	0.089160839	0.27447552	0.7255245	29.19	8.56284E-05
0.513	67	0.117132867	0.39160839	0.6083916	29.19	5.01872E-07
0.514	57	0.09965035	0.49125874	0.5087413	29.19	2.71041E-09
0.515	74	0.129370629	0.62062937	0.3793706	29.19	5.16923E-13
0.516	44	0.076923077	0.69755245	0.3024476	29.19	6.93206E-16
0.517	49	0.085664336	0.78321678	0.2167832	29.19	4.16358E-20
0.518	40	0.06993007	0.85314685	0.1468531	29.19	4.81309E-25
0.519	28	0.048951049	0.9020979	0.0979021	29.19	3.48781E-30
0.52	18	0.031468531	0.93356643	0.0664336	29.19	4.23692E-35
0.521	13	0.022727273	0.95629371	0.0437063	29.19	2.08582E-40
0.522	12	0.020979021	0.97727273	0.0227273	29.19	1.071E-48
0.523	6	0.01048951	0.98776224	0.0122378	29.19	1.52247E-56
0.524	3	0.005244755	0.99300699	0.006993	29.19	1.22628E-63
0.525	2	0.003496503	0.9965035	0.0034965	29.19	2.00412E-72
0.526	1	0.001748252	0.99825175	0.0017483	29.19	3.27533E-81
0.616	1	0.001748252	1	0	29.19	0
Total	572					

Figure 6C.LOC9.1998.1.Ordered Thickness Readings

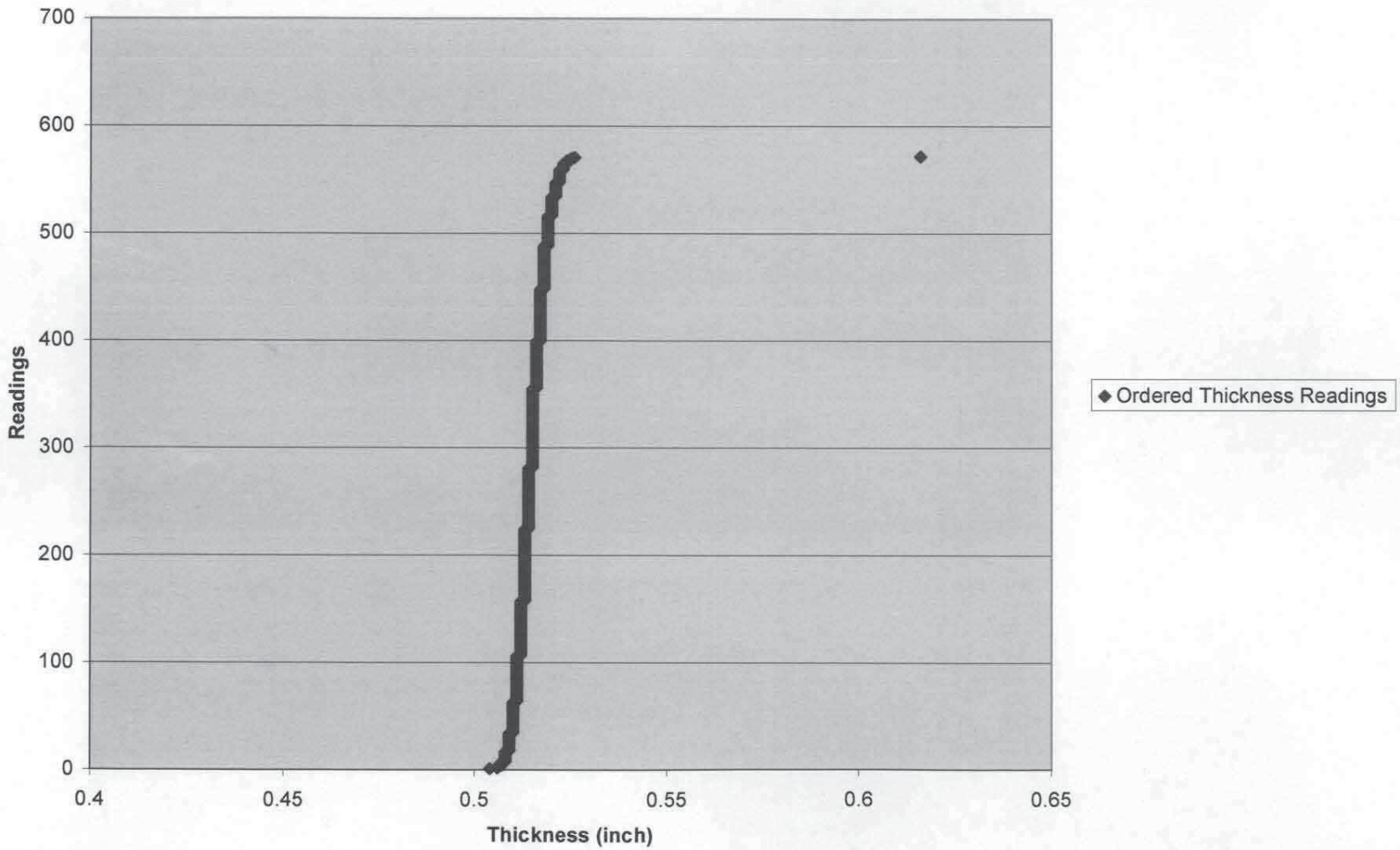

Figure 6C.LOC9.1998.2.Normalized Frequency Distribution

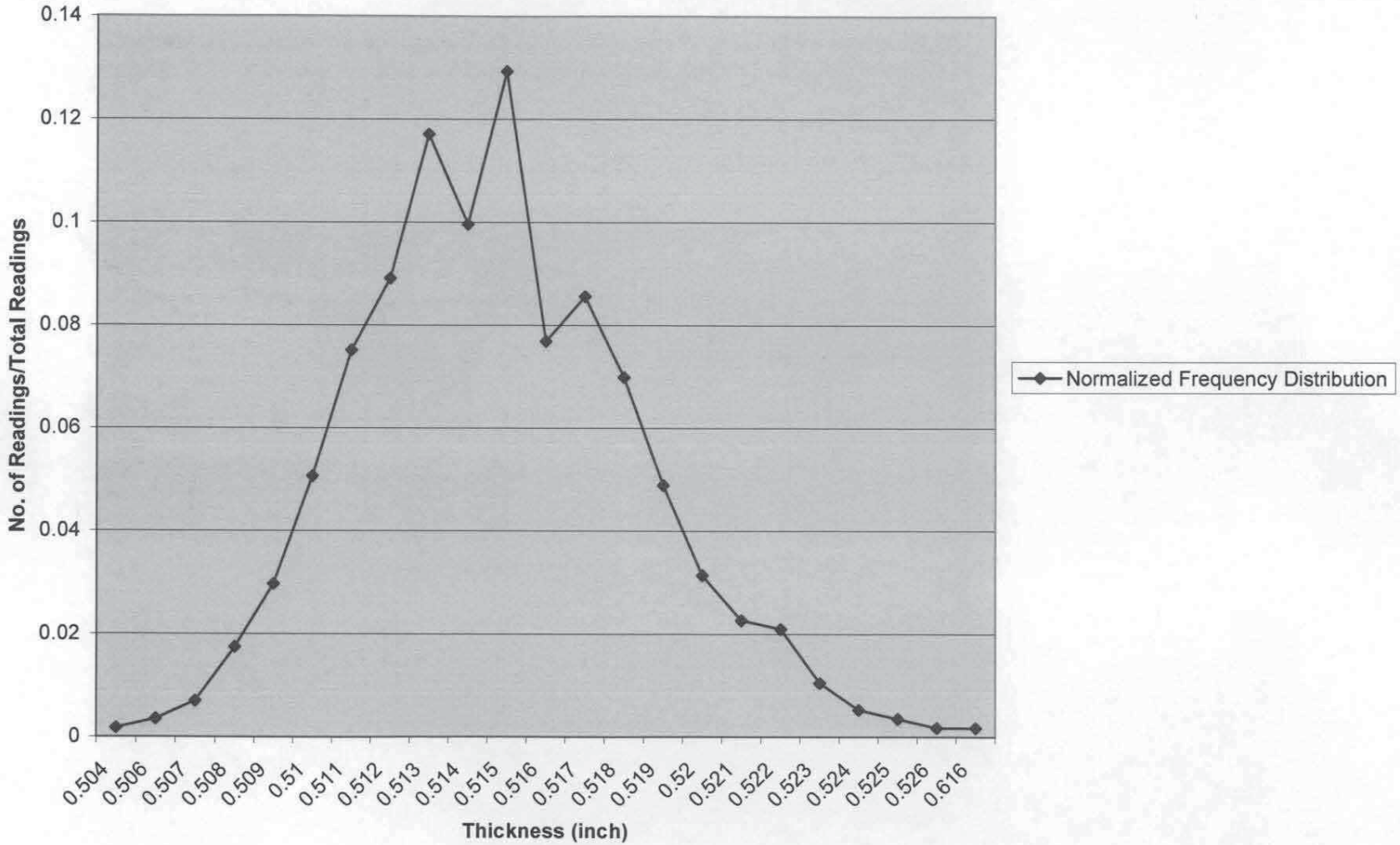

Figure 6C.LOC9.1998.3.Reliability Function

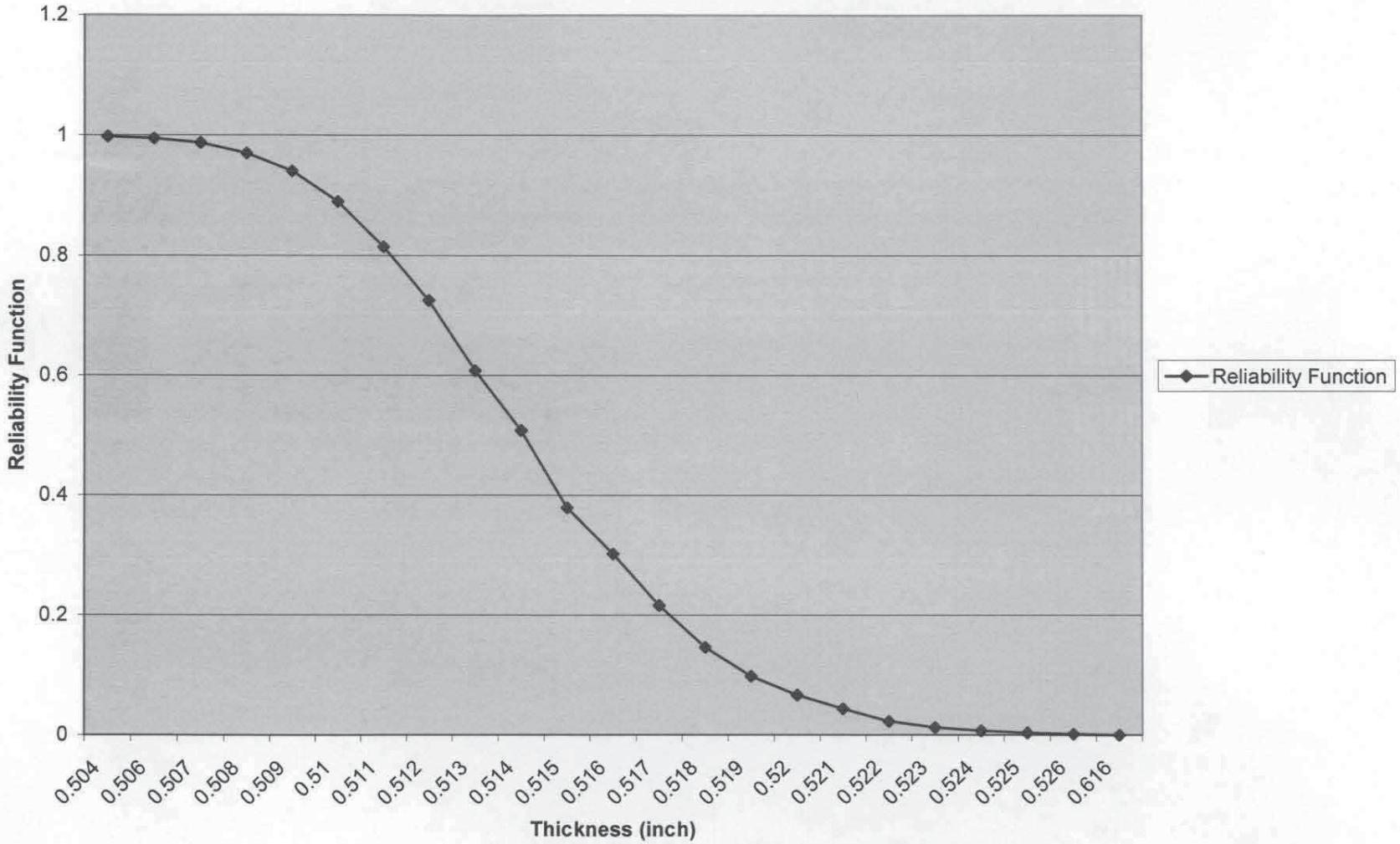

Figure 6C.LOC9.1998.4.Reliability^Area Ratio

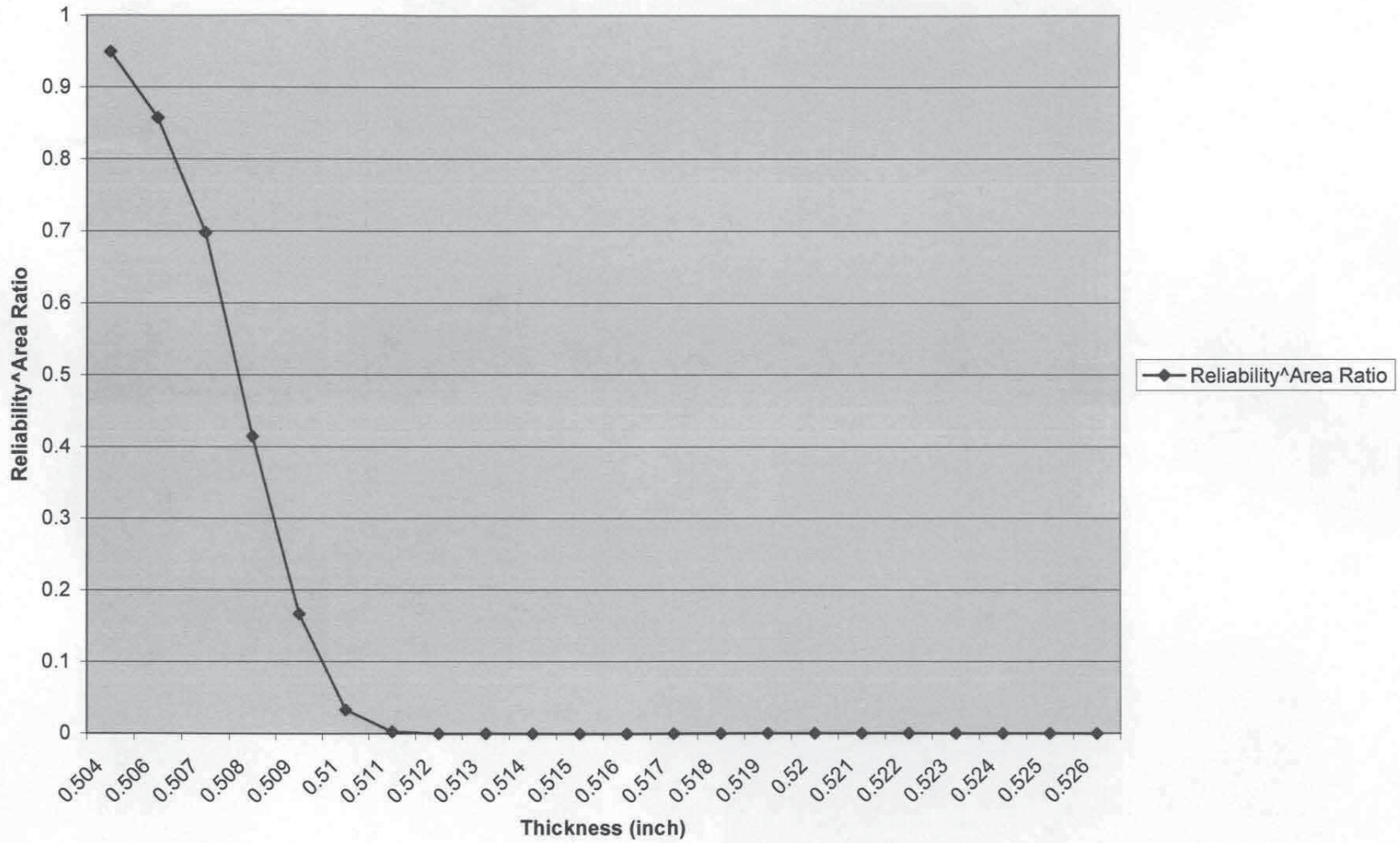

Table 6C.LOC9.2007.1	
Location 9	
Descriptive Statistics	
Mean	0.51502686
Standard Error	0.000154728
Median	0.515
Mode	0.515
Standard Deviation	0.003404008
Sample Variance	1.15873E-05
Kurtosis	-0.081864155
Skewness	0.024036113
Range	0.02
Minimum	0.506
Maximum	0.526
Sum	249.273
Count	484
Largest(1)	0.526
Smallest(1)	0.506
Confidence Level(95.0%)	0.000304022

Table 6C.LOC9.2007.2							
Location 9							
Ordered Readings							
Thickness (inch)	Count	*Thickness (inch)*	Count	*Thickness (inch)*	Count	*Thickness (inch)*	Count
0.506	1	0.51	51	0.512	101	0.513	151
0.507	2	0.511	52	0.512	102	0.513	152
0.507	3	0.511	53	0.512	103	0.513	153
0.507	4	0.511	54	0.512	104	0.513	154
0.508	5	0.511	55	0.512	105	0.513	155
0.508	6	0.511	56	0.512	106	0.513	156
0.508	7	0.511	57	0.513	107	0.514	157
0.508	8	0.511	58	0.513	108	0.514	158
0.508	9	0.511	59	0.513	109	0.514	159
0.508	10	0.511	60	0.513	110	0.514	160
0.508	11	0.511	61	0.513	111	0.514	161
0.508	12	0.511	62	0.513	112	0.514	162
0.508	13	0.511	63	0.513	113	0.514	163
0.508	14	0.511	64	0.513	114	0.514	164
0.508	15	0.511	65	0.513	115	0.514	165
0.508	16	0.511	66	0.513	116	0.514	166
0.508	17	0.511	67	0.513	117	0.514	167
0.508	18	0.511	68	0.513	118	0.514	168
0.509	19	0.511	69	0.513	119	0.514	169
0.509	20	0.512	70	0.513	120	0.514	170
0.509	21	0.512	71	0.513	121	0.514	171
0.509	22	0.512	72	0.513	122	0.514	172
0.509	23	0.512	73	0.513	123	0.514	173
0.509	24	0.512	74	0.513	124	0.514	174
0.509	25	0.512	75	0.513	125	0.514	175
0.509	26	0.512	76	0.513	126	0.514	176
0.509	27	0.512	77	0.513	127	0.514	177
0.51	28	0.512	78	0.513	128	0.514	178
0.51	29	0.512	79	0.513	129	0.514	179
0.51	30	0.512	80	0.513	130	0.514	180
0.51	31	0.512	81	0.513	131	0.514	181
0.51	32	0.512	82	0.513	132	0.514	182
0.51	33	0.512	83	0.513	133	0.514	183
0.51	34	0.512	84	0.513	134	0.514	184
0.51	35	0.512	85	0.513	135	0.514	185
0.51	36	0.512	86	0.513	136	0.514	186
0.51	37	0.512	87	0.513	137	0.514	187
0.51	38	0.512	88	0.513	138	0.514	188
0.51	39	0.512	89	0.513	139	0.514	189
0.51	40	0.512	90	0.513	140	0.514	190
0.51	41	0.512	91	0.513	141	0.514	191
0.51	42	0.512	92	0.513	142	0.514	192
0.51	43	0.512	93	0.513	143	0.514	193
0.51	44	0.512	94	0.513	144	0.514	194
0.51	45	0.512	95	0.513	145	0.514	195
0.51	46	0.512	96	0.513	146	0.514	196
0.51	47	0.512	97	0.513	147	0.514	197
0.51	48	0.512	98	0.513	148	0.514	198
0.51	49	0.512	99	0.513	149	0.514	199
0.51	50	0.512	100	0.513	150	0.514	200

Table 6C.LOC9.2007.2							
Location 9							
Ordered Readings							
Thickness (inch)	Count	*Thickness (inch)*	Count	*Thickness (inch)*	Count	*Thickness (inch)*	Count
0.514	201	0.515	251	0.516	301	0.517	351
0.514	202	0.515	252	0.516	302	0.517	352
0.514	203	0.515	253	0.516	303	0.517	353
0.514	204	0.515	254	0.516	304	0.517	354
0.514	205	0.515	255	0.516	305	0.517	355
0.514	206	0.515	256	0.516	306	0.517	356
0.514	207	0.515	257	0.516	307	0.517	357
0.514	208	0.515	258	0.516	308	0.517	358
0.514	209	0.515	259	0.516	309	0.517	359
0.514	210	0.515	260	0.516	310	0.517	360
0.514	211	0.515	261	0.516	311	0.517	361
0.515	212	0.515	262	0.516	312	0.517	362
0.515	213	0.515	263	0.516	313	0.517	363
0.515	214	0.515	264	0.516	314	0.517	364
0.515	215	0.515	265	0.516	315	0.517	365
0.515	216	0.515	266	0.516	316	0.517	366
0.515	217	0.515	267	0.516	317	0.517	367
0.515	218	0.515	268	0.516	318	0.518	368
0.515	219	0.515	269	0.516	319	0.518	369
0.515	220	0.515	270	0.516	320	0.518	370
0.515	221	0.515	271	0.516	321	0.518	371
0.515	222	0.515	272	0.516	322	0.518	372
0.515	223	0.515	273	0.516	323	0.518	373
0.515	224	0.516	274	0.517	324	0.518	374
0.515	225	0.516	275	0.517	325	0.518	375
0.515	226	0.516	276	0.517	326	0.518	376
0.515	227	0.516	277	0.517	327	0.518	377
0.515	228	0.516	278	0.517	328	0.518	378
0.515	229	0.516	279	0.517	329	0.518	379
0.515	230	0.516	280	0.517	330	0.518	380
0.515	231	0.516	281	0.517	331	0.518	381
0.515	232	0.516	282	0.517	332	0.518	382
0.515	233	0.516	283	0.517	333	0.518	383
0.515	234	0.516	284	0.517	334	0.518	384
0.515	235	0.516	285	0.517	335	0.518	385
0.515	236	0.516	286	0.517	336	0.518	386
0.515	237	0.516	287	0.517	337	0.518	387
0.515	238	0.516	288	0.517	338	0.518	388
0.515	239	0.516	289	0.517	339	0.518	389
0.515	240	0.516	290	0.517	340	0.518	390
0.515	241	0.516	291	0.517	341	0.518	391
0.515	242	0.516	292	0.517	342	0.518	392
0.515	243	0.516	293	0.517	343	0.518	393
0.515	244	0.516	294	0.517	344	0.518	394
0.515	245	0.516	295	0.517	345	0.518	395
0.515	246	0.516	296	0.517	346	0.518	396
0.515	247	0.516	297	0.517	347	0.518	397
0.515	248	0.516	298	0.517	348	0.518	398
0.515	249	0.516	299	0.517	349	0.518	399
0.515	250	0.516	300	0.517	350	0.518	400

Table 6C.LOC9.2007.2							
Location 9							
Ordered Readings							
Thickness (inch)	Count	*Thickness (inch)*	Count	*Thickness (inch)*	Count	*Thickness (inch)*	Count
0.518	401	0.52	451				
0.518	402	0.52	452				
0.518	403	0.52	453				
0.518	404	0.52	454				
0.518	405	0.52	455				
0.518	406	0.52	456				
0.518	407	0.52	457				
0.518	408	0.52	458				
0.518	409	0.52	459				
0.518	410	0.521	460				
0.518	411	0.521	461				
0.518	412	0.521	462				
0.518	413	0.521	463				
0.519	414	0.521	464				
0.519	415	0.521	465				
0.519	416	0.521	466				
0.519	417	0.521	467				
0.519	418	0.521	468				
0.519	419	0.521	469				
0.519	420	0.521	470				
0.519	421	0.522	471				
0.519	422	0.522	472				
0.519	423	0.522	473				
0.519	424	0.522	474				
0.519	425	0.522	475				
0.519	426	0.522	476				
0.519	427	0.522	477				
0.519	428	0.522	478				
0.519	429	0.523	479				
0.519	430	0.523	480				
0.519	431	0.523	481				
0.519	432	0.524	482				
0.519	433	0.525	483				
0.519	434	0.526	484				
0.519	435						
0.519	436						
0.519	437						
0.519	438						
0.519	439						
0.52	440						
0.52	441						
0.52	442						
0.52	443						
0.52	444						
0.52	445						
0.52	446						
0.52	447						
0.52	448						
0.52	449						
0.52	450						

Table 6C.LOC9.2007.3						
Location 9						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.506	1	0.002066116	0.00206612	0.9979339	36.37	0.927546357
0.507	3	0.006198347	0.00826446	0.9917355	36.37	0.739494896
0.508	14	0.02892562	0.03719008	0.9628099	36.37	0.252027799
0.509	9	0.018595041	0.05578512	0.9442149	36.37	0.124006722
0.51	24	0.049586777	0.1053719	0.8946281	36.37	0.017436909
0.511	18	0.037190083	0.14256198	0.857438	36.37	0.003723076
0.512	37	0.076446281	0.21900826	0.7809917	36.37	0.000124756
0.513	50	0.103305785	0.32231405	0.677686	36.37	7.16657E-07
0.514	55	0.113636364	0.43595041	0.5640496	36.37	9.04889E-10
0.515	62	0.128099174	0.56404959	0.4359504	36.37	7.72762E-14
0.516	50	0.103305785	0.66735537	0.3326446	36.37	4.13723E-18
0.517	44	0.090909091	0.75826446	0.2417355	36.37	3.75866E-23
0.518	46	0.095041322	0.85330579	0.1466942	36.37	4.85751E-31
0.519	26	0.053719008	0.90702479	0.0929752	36.37	3.05092E-38
0.52	20	0.041322314	0.94834711	0.0516529	36.37	1.58996E-47
0.521	11	0.022727273	0.97107438	0.0289256	36.37	1.1071E-56
0.522	8	0.016528926	0.98760331	0.0123967	36.37	4.59858E-70
0.523	3	0.006198347	0.99380165	0.0061983	36.37	5.19515E-81
0.524	1	0.002066116	0.99586777	0.0041322	36.37	2.05115E-87
0.525	1	0.002066116	0.99793388	0.0020661	36.37	2.31725E-98
0.526	1	0.002066116	1	0	36.37	0
Total	484					

Figure 6C.LOC9.2007.1.Ordered Thickness Readings

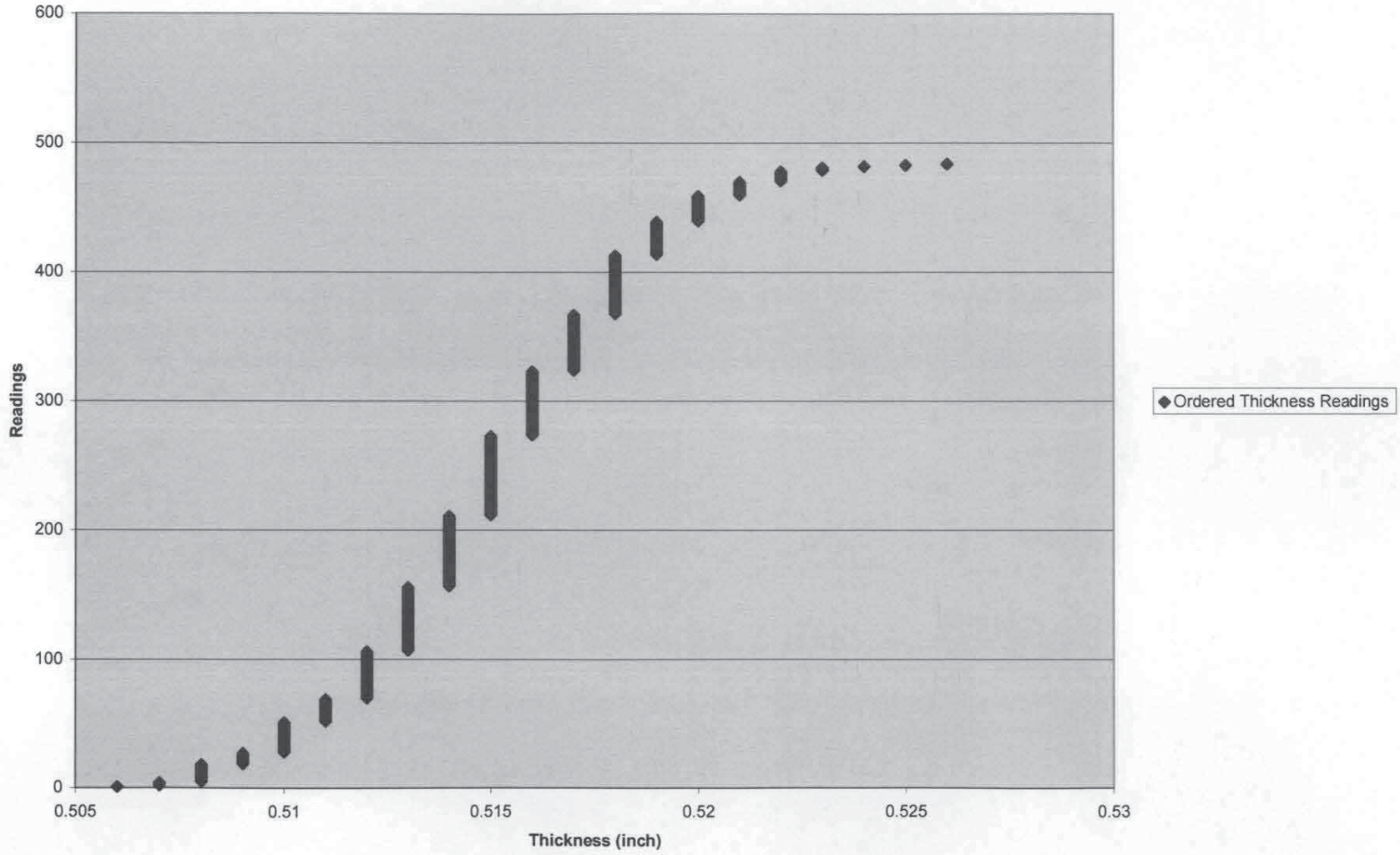

Figure 6C.LOC9.2007.2.Normalized Frequency Distribution

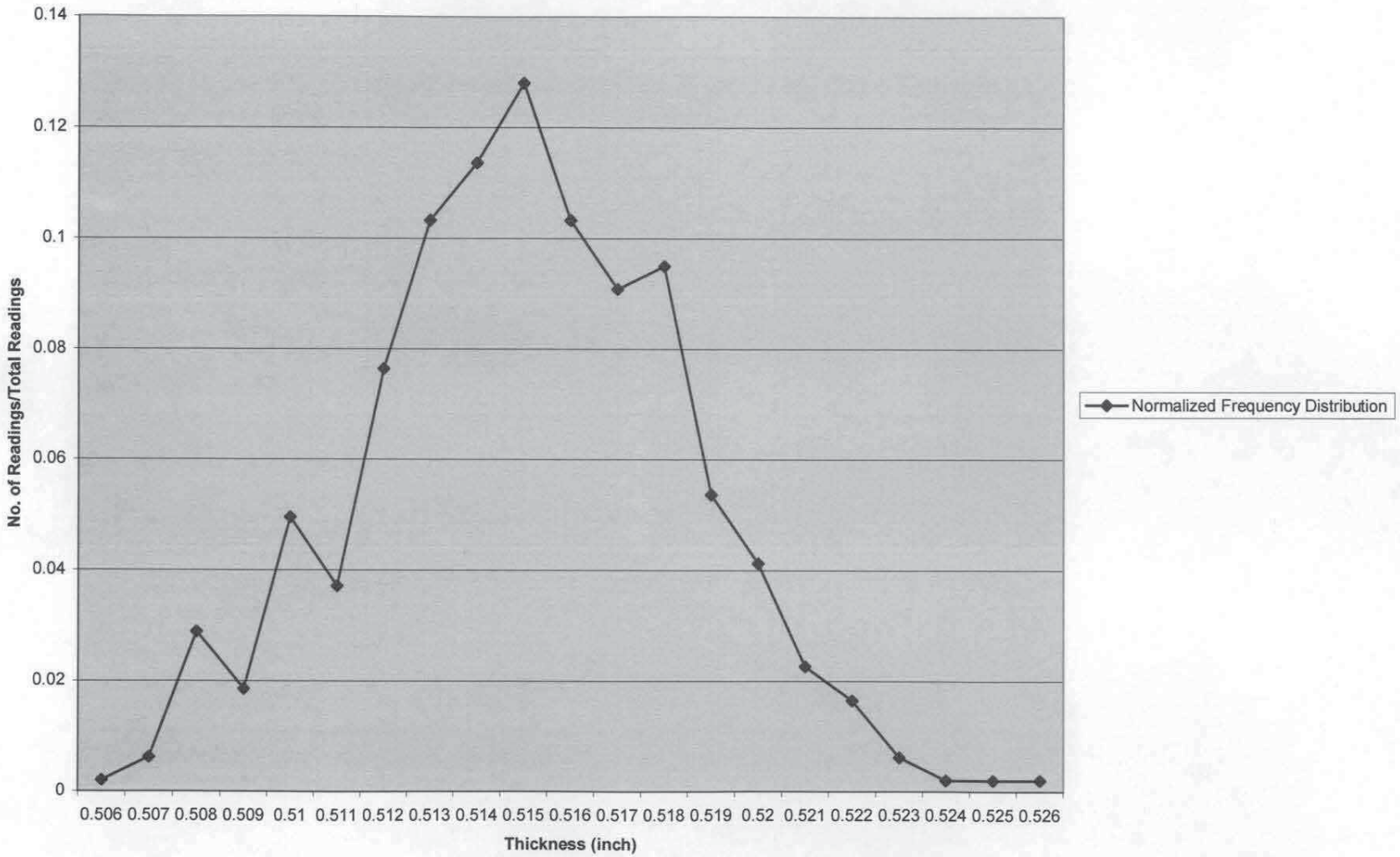

Figure 6C.LOC9.2007.3.Reliability Function

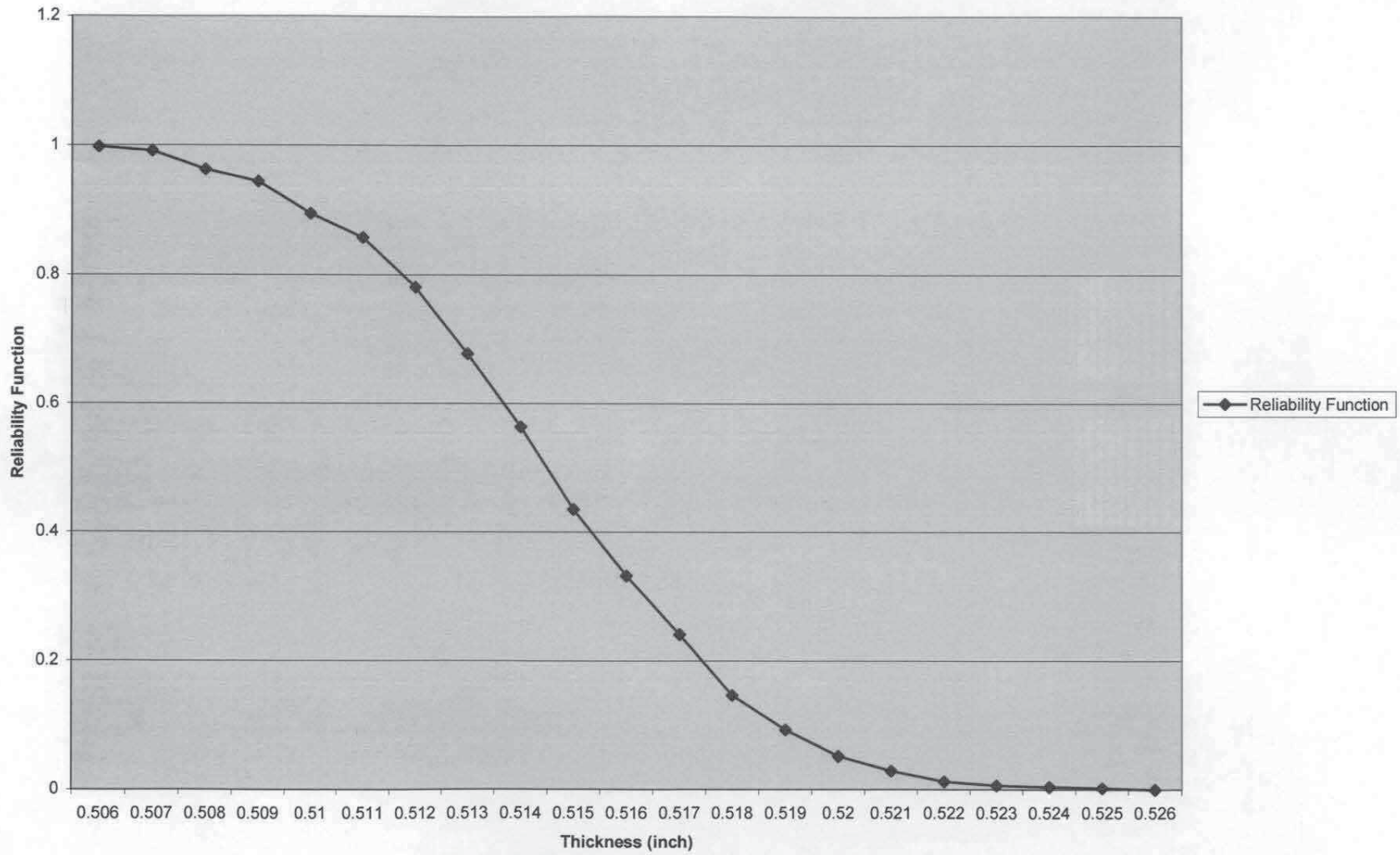

Figure 6C.LOC9.2007.4.Reliability^Area Ratio

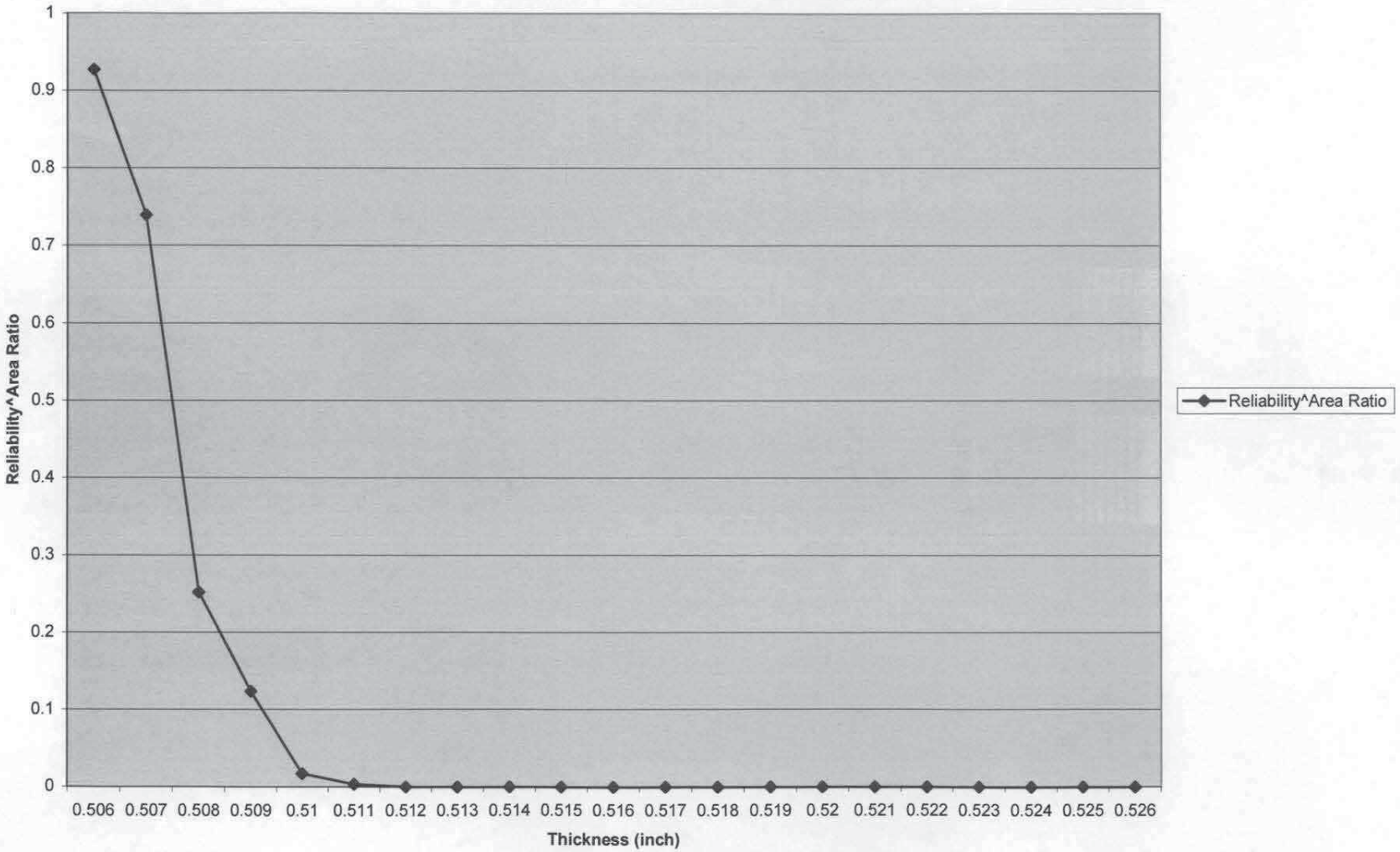

Table 6C.LOC11.1993.1	
Location 11	
Descriptive Statistics	
Mean	0.317553241
Standard Error	0.000187456
Median	0.318
Mode	0.32
Standard Deviation	0.00389621
Sample Variance	1.51805E-05
Kurtosis	-0.616460093
Skewness	-0.157773324
Range	0.02
Minimum	0.309
Maximum	0.329
Sum	137.183
Count	432
Largest(1)	0.329
Smallest(1)	0.309
Confidence Level(95.0%)	0.000368443

Table 6C.LOC11.1993.2							
Location 11							
Ordered Readings							
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.309	1	0.312	51	0.315	101	0.316	151
0.309	2	0.312	52	0.315	102	0.316	152
0.309	3	0.312	53	0.315	103	0.316	153
0.309	4	0.312	54	0.315	104	0.316	154
0.31	5	0.312	55	0.315	105	0.316	155
0.31	6	0.312	56	0.315	106	0.316	156
0.31	7	0.312	57	0.315	107	0.316	157
0.31	8	0.313	58	0.315	108	0.316	158
0.31	9	0.313	59	0.315	109	0.316	159
0.31	10	0.313	60	0.315	110	0.316	160
0.31	11	0.313	61	0.315	111	0.316	161
0.31	12	0.313	62	0.315	112	0.316	162
0.31	13	0.313	63	0.315	113	0.316	163
0.31	14	0.313	64	0.315	114	0.316	164
0.31	15	0.313	65	0.315	115	0.316	165
0.31	16	0.313	66	0.315	116	0.316	166
0.31	17	0.313	67	0.315	117	0.316	167
0.31	18	0.313	68	0.315	118	0.316	168
0.31	19	0.314	69	0.315	119	0.317	169
0.31	20	0.314	70	0.315	120	0.317	170
0.31	21	0.314	71	0.315	121	0.317	171
0.311	22	0.314	72	0.315	122	0.317	172
0.311	23	0.314	73	0.315	123	0.317	173
0.311	24	0.314	74	0.315	124	0.317	174
0.311	25	0.314	75	0.315	125	0.317	175
0.311	26	0.314	76	0.315	126	0.317	176
0.311	27	0.314	77	0.315	127	0.317	177
0.311	28	0.314	78	0.315	128	0.317	178
0.311	29	0.314	79	0.315	129	0.317	179
0.311	30	0.314	80	0.315	130	0.317	180
0.311	31	0.314	81	0.315	131	0.317	181
0.311	32	0.314	82	0.315	132	0.317	182
0.311	33	0.314	83	0.315	133	0.317	183
0.311	34	0.314	84	0.315	134	0.317	184
0.312	35	0.314	85	0.316	135	0.317	185
0.312	36	0.314	86	0.316	136	0.317	186
0.312	37	0.314	87	0.316	137	0.317	187
0.312	38	0.314	88	0.316	138	0.317	188
0.312	39	0.314	89	0.316	139	0.317	189
0.312	40	0.314	90	0.316	140	0.317	190
0.312	41	0.314	91	0.316	141	0.317	191
0.312	42	0.314	92	0.316	142	0.317	192
0.312	43	0.314	93	0.316	143	0.317	193
0.312	44	0.314	94	0.316	144	0.317	194
0.312	45	0.314	95	0.316	145	0.317	195
0.312	46	0.314	96	0.316	146	0.317	196
0.312	47	0.314	97	0.316	147	0.317	197
0.312	48	0.315	98	0.316	148	0.317	198
0.312	49	0.315	99	0.316	149	0.317	199
0.312	50	0.315	100	0.316	150	0.317	200

Table 6C.LOC11.1993.2							
Location 11							
Ordered Readings							
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.317	201	0.319	251	0.32	301	0.321	351
0.317	202	0.319	252	0.32	302	0.321	352
0.317	203	0.319	253	0.32	303	0.321	353
0.317	204	0.319	254	0.32	304	0.321	354
0.317	205	0.319	255	0.32	305	0.321	355
0.317	206	0.319	256	0.32	306	0.321	356
0.317	207	0.319	257	0.32	307	0.321	357
0.317	208	0.319	258	0.32	308	0.321	358
0.318	209	0.319	259	0.32	309	0.321	359
0.318	210	0.319	260	0.32	310	0.321	360
0.318	211	0.319	261	0.32	311	0.321	361
0.318	212	0.319	262	0.32	312	0.321	362
0.318	213	0.319	263	0.32	313	0.322	363
0.318	214	0.319	264	0.32	314	0.322	364
0.318	215	0.319	265	0.32	315	0.322	365
0.318	216	0.319	266	0.32	316	0.322	366
0.318	217	0.319	267	0.32	317	0.322	367
0.318	218	0.319	268	0.32	318	0.322	368
0.318	219	0.319	269	0.32	319	0.322	369
0.318	220	0.319	270	0.32	320	0.322	370
0.318	221	0.319	271	0.32	321	0.322	371
0.318	222	0.319	272	0.32	322	0.322	372
0.318	223	0.319	273	0.32	323	0.322	373
0.318	224	0.319	274	0.32	324	0.322	374
0.318	225	0.319	275	0.32	325	0.322	375
0.318	226	0.319	276	0.32	326	0.322	376
0.318	227	0.319	277	0.321	327	0.322	377
0.318	228	0.319	278	0.321	328	0.322	378
0.318	229	0.319	279	0.321	329	0.322	379
0.318	230	0.319	280	0.321	330	0.322	380
0.318	231	0.32	281	0.321	331	0.322	381
0.318	232	0.32	282	0.321	332	0.322	382
0.318	233	0.32	283	0.321	333	0.322	383
0.318	234	0.32	284	0.321	334	0.322	384
0.318	235	0.32	285	0.321	335	0.322	385
0.318	236	0.32	286	0.321	336	0.322	386
0.318	237	0.32	287	0.321	337	0.322	387
0.318	238	0.32	288	0.321	338	0.323	388
0.318	239	0.32	289	0.321	339	0.323	389
0.318	240	0.32	290	0.321	340	0.323	390
0.318	241	0.32	291	0.321	341	0.323	391
0.318	242	0.32	292	0.321	342	0.323	392
0.319	243	0.32	293	0.321	343	0.323	393
0.319	244	0.32	294	0.321	344	0.323	394
0.319	245	0.32	295	0.321	345	0.323	395
0.319	246	0.32	296	0.321	346	0.323	396
0.319	247	0.32	297	0.321	347	0.323	397
0.319	248	0.32	298	0.321	348	0.323	398
0.319	249	0.32	299	0.321	349	0.323	399
0.319	250	0.32	300	0.321	350	0.323	400

Table 6C.LOC11.1993.2							
Location 11							
Ordered Readings							
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.323	401						
0.323	402						
0.323	403						
0.323	404						
0.323	405						
0.323	406						
0.323	407						
0.323	408						
0.323	409						
0.323	410						
0.324	411						
0.324	412						
0.324	413						
0.324	414						
0.324	415						
0.324	416						
0.324	417						
0.324	418						
0.324	419						
0.324	420						
0.324	421						
0.324	422						
0.324	423						
0.324	424						
0.325	425						
0.325	426						
0.325	427						
0.325	428						
0.325	429						
0.325	430						
0.326	431						
0.329	432						

Table 6C.LOC11.1993.3						
Location 11						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.309	4	0.009259259	0.00925926	0.9907407	41	0.682924668
0.31	17	0.039351852	0.04861111	0.9513889	41	0.129641716
0.311	13	0.030092593	0.0787037	0.9212963	41	0.034711798
0.312	23	0.053240741	0.13194444	0.8680556	41	0.00302433
0.313	11	0.025462963	0.15740741	0.8425926	41	0.000892364
0.314	29	0.06712963	0.22453704	0.775463	41	2.96707E-05
0.315	37	0.085648148	0.31018519	0.6898148	41	2.44629E-07
0.316	34	0.078703704	0.38888889	0.6111111	41	1.70434E-09
0.317	40	0.092592593	0.48148148	0.5185185	41	2.02383E-12
0.318	34	0.078703704	0.56018519	0.4398148	41	2.372E-15
0.319	38	0.087962963	0.64814815	0.3518519	41	2.524E-19
0.32	46	0.106481481	0.75462963	0.2453704	41	9.64945E-26
0.321	36	0.083333333	0.83796296	0.162037	41	3.94923E-33
0.322	25	0.05787037	0.89583333	0.1041667	41	5.36748E-41
0.323	23	0.053240741	0.94907407	0.0509259	41	9.73424E-54
0.324	14	0.032407407	0.98148148	0.0185185	41	9.48319E-72
0.325	6	0.013888889	0.99537037	0.0046296	41	1.9691E-96
0.326	1	0.002314815	0.99768519	0.0023148	41	8.9727E-109
0.329	1	0.002314815	1	0	41	0
Total	432					

Figure 6C.LOC11.1993.1.Ordered Thickness Readings

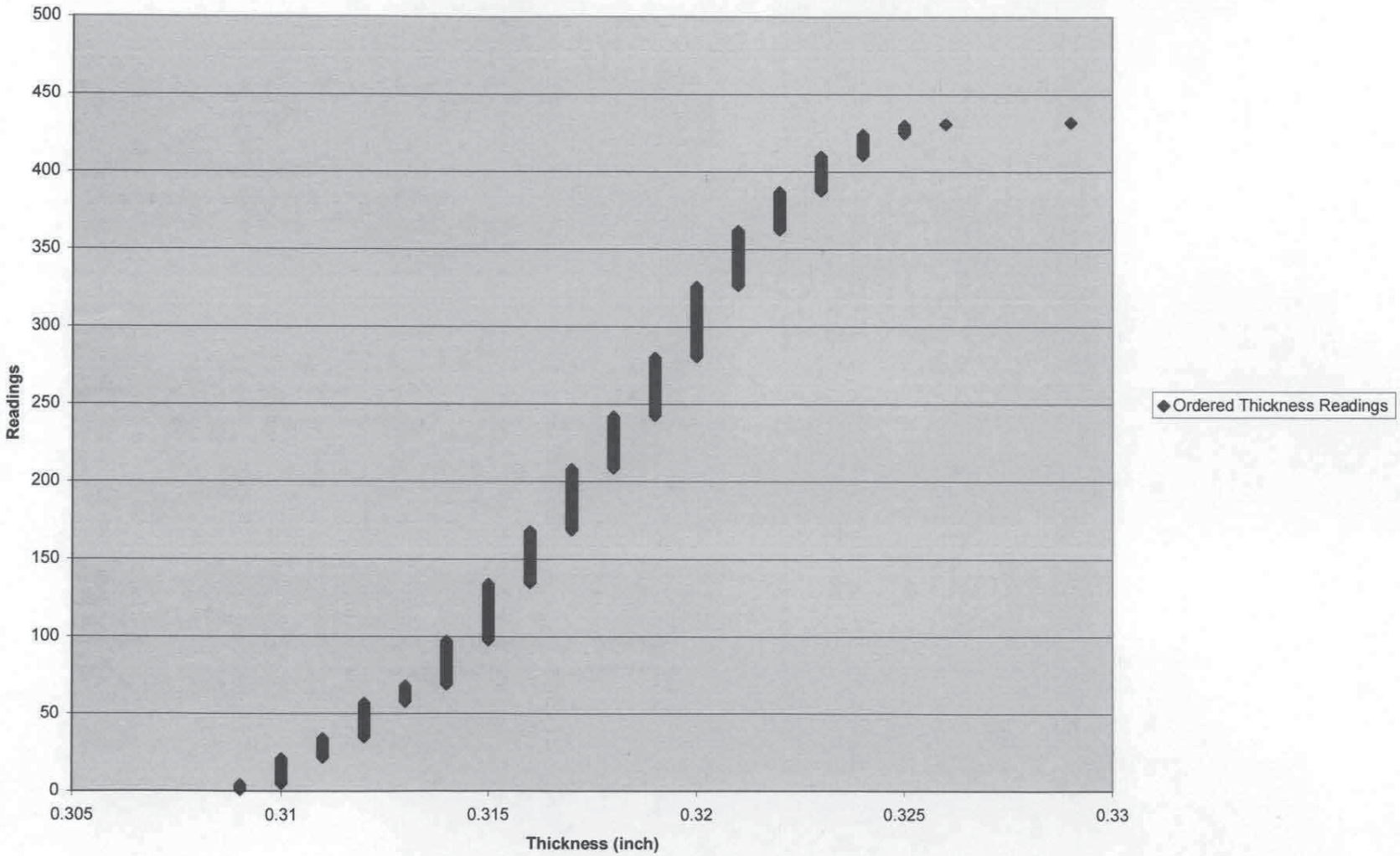

Figure 6C.LOC11.1993.2.Normal Frequency Distribution

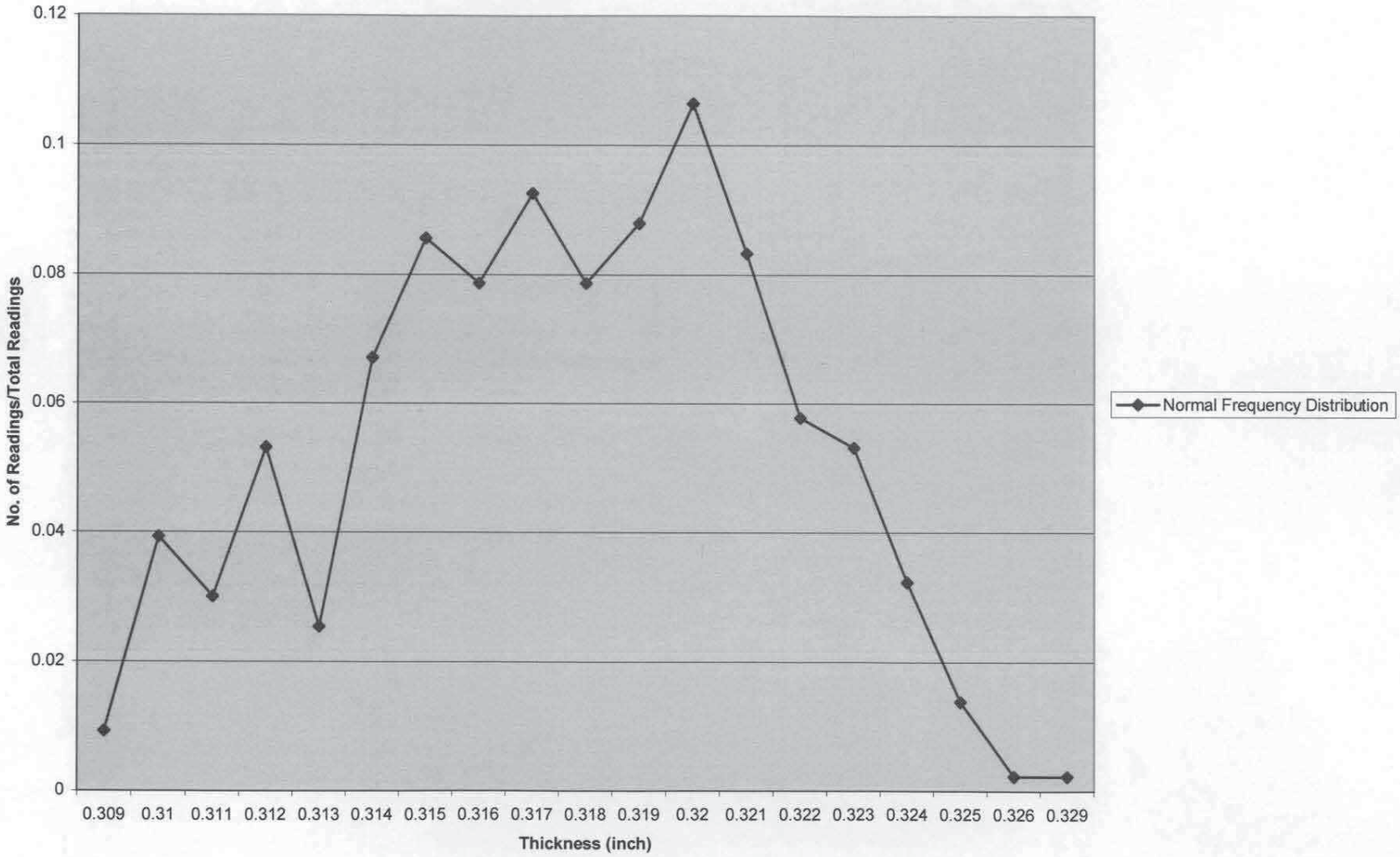

Figure 6C.LOC11.1993.3.Reliability Function

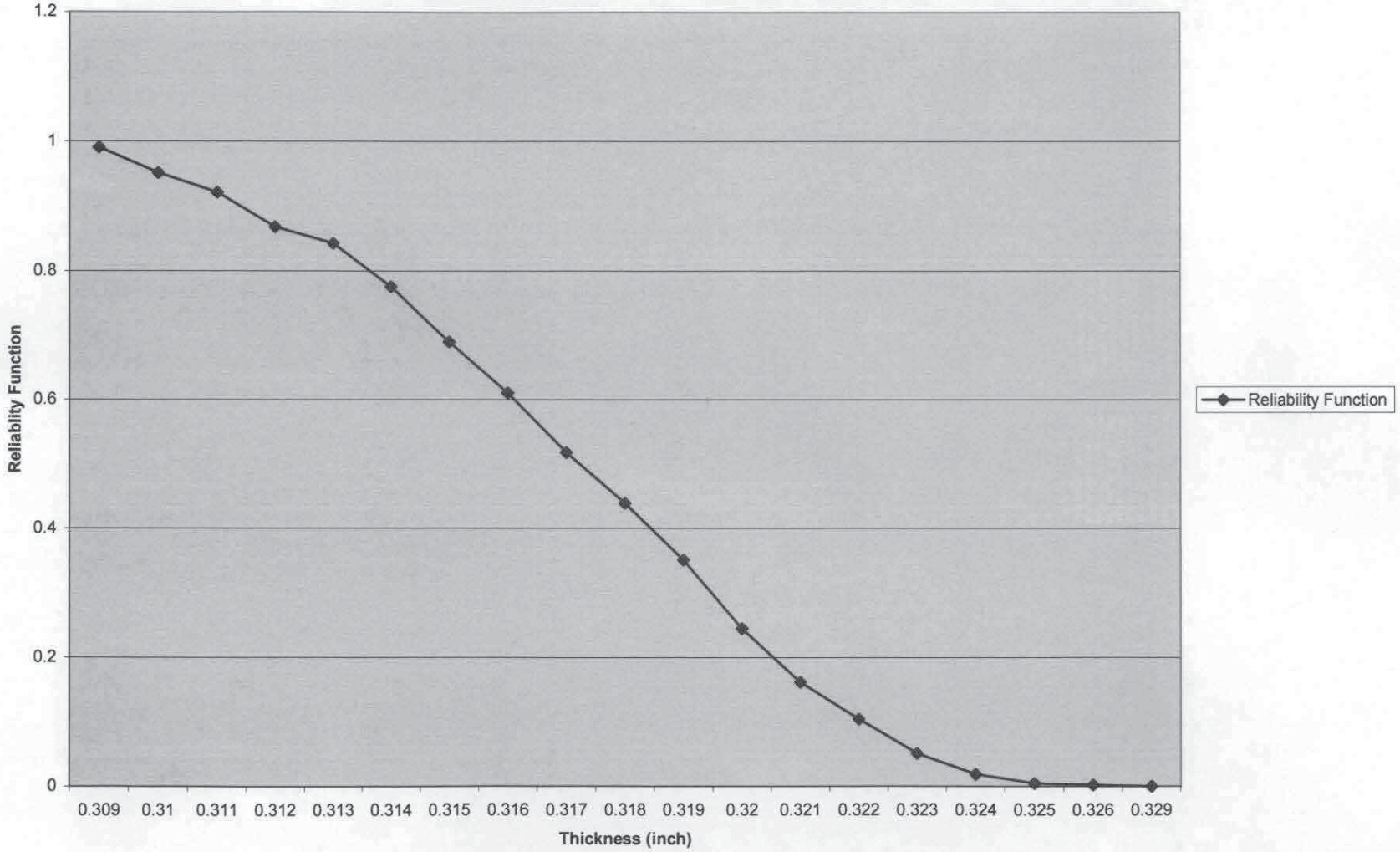

Figure 6C.LOC11.1993.4.Reliability^Area Ratio

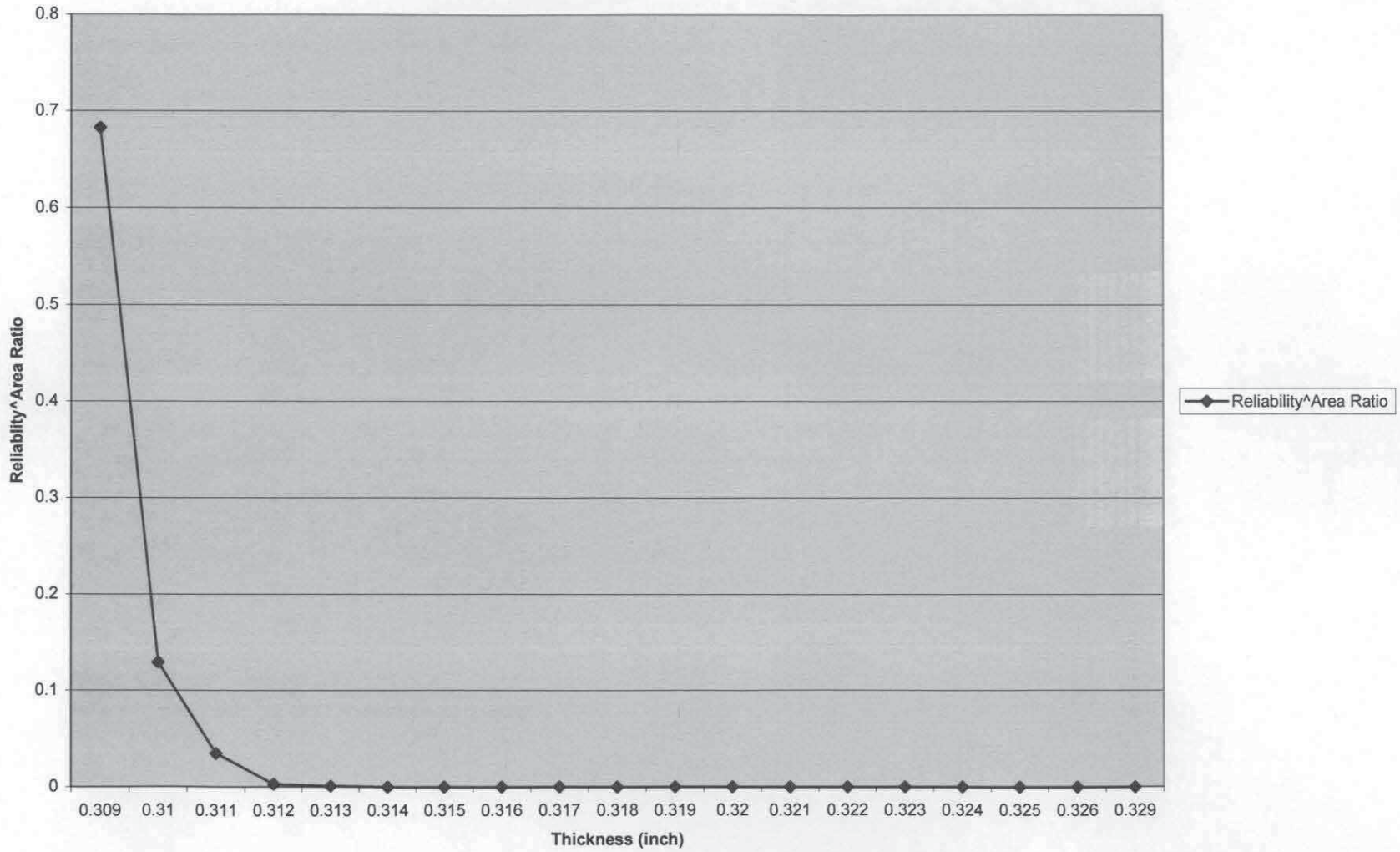

Table 6C.LOC11.1998.1	
Location 11	
Descriptive Statistics	
Mean	0.320087963
Standard Error	0.000186219
Median	0.32
Mode	0.322
Standard Deviation	0.003870484
Sample Variance	1.49806E-05
Kurtosis	-0.322706077
Skewness	0.017442059
Range	0.023
Minimum	0.31
Maximum	0.333
Sum	138.278
Count	432
Largest(1)	0.333
Smallest(1)	0.31
Confidence Level(95.0%)	0.00036601

Table 6C.LOC11.1998.2							
Location 11							
Ordered Readings							
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.31	1	0.315	51	0.317	101	0.319	151
0.312	2	0.315	52	0.317	102	0.319	152
0.312	3	0.315	53	0.317	103	0.319	153
0.312	4	0.315	54	0.317	104	0.319	154
0.312	5	0.315	55	0.317	105	0.319	155
0.312	6	0.315	56	0.317	106	0.319	156
0.313	7	0.315	57	0.317	107	0.319	157
0.313	8	0.315	58	0.317	108	0.319	158
0.313	9	0.315	59	0.318	109	0.319	159
0.313	10	0.315	60	0.318	110	0.319	160
0.313	11	0.315	61	0.318	111	0.319	161
0.313	12	0.315	62	0.318	112	0.319	162
0.313	13	0.316	63	0.318	113	0.319	163
0.313	14	0.316	64	0.318	114	0.319	164
0.313	15	0.316	65	0.318	115	0.319	165
0.313	16	0.316	66	0.318	116	0.319	166
0.313	17	0.316	67	0.318	117	0.319	167
0.313	18	0.316	68	0.318	118	0.319	168
0.313	19	0.316	69	0.318	119	0.319	169
0.313	20	0.316	70	0.318	120	0.319	170
0.314	21	0.316	71	0.318	121	0.319	171
0.314	22	0.316	72	0.318	122	0.319	172
0.314	23	0.316	73	0.318	123	0.319	173
0.314	24	0.316	74	0.318	124	0.319	174
0.314	25	0.316	75	0.318	125	0.319	175
0.314	26	0.316	76	0.318	126	0.319	176
0.314	27	0.316	77	0.318	127	0.319	177
0.314	28	0.316	78	0.318	128	0.319	178
0.314	29	0.316	79	0.318	129	0.319	179
0.314	30	0.316	80	0.318	130	0.319	180
0.314	31	0.316	81	0.318	131	0.319	181
0.314	32	0.316	82	0.318	132	0.319	182
0.314	33	0.316	83	0.318	133	0.319	183
0.314	34	0.316	84	0.318	134	0.319	184
0.314	35	0.316	85	0.318	135	0.319	185
0.314	36	0.316	86	0.318	136	0.319	186
0.314	37	0.317	87	0.318	137	0.319	187
0.314	38	0.317	88	0.318	138	0.319	188
0.314	39	0.317	89	0.318	139	0.319	189
0.314	40	0.317	90	0.318	140	0.319	190
0.315	41	0.317	91	0.318	141	0.32	191
0.315	42	0.317	92	0.318	142	0.32	192
0.315	43	0.317	93	0.318	143	0.32	193
0.315	44	0.317	94	0.318	144	0.32	194
0.315	45	0.317	95	0.318	145	0.32	195
0.315	46	0.317	96	0.318	146	0.32	196
0.315	47	0.317	97	0.319	147	0.32	197
0.315	48	0.317	98	0.319	148	0.32	198
0.315	49	0.317	99	0.319	149	0.32	199
0.315	50	0.317	100	0.319	150	0.32	200

Table 6C.LOC11.1998.2							
Location 11							
Ordered Readings							
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.32	201	0.321	251	0.322	301	0.324	351
0.32	202	0.321	252	0.322	302	0.324	352
0.32	203	0.321	253	0.322	303	0.324	353
0.32	204	0.321	254	0.322	304	0.324	354
0.32	205	0.321	255	0.322	305	0.324	355
0.32	206	0.321	256	0.322	306	0.324	356
0.32	207	0.321	257	0.322	307	0.324	357
0.32	208	0.321	258	0.322	308	0.324	358
0.32	209	0.321	259	0.322	309	0.324	359
0.32	210	0.321	260	0.322	310	0.324	360
0.32	211	0.321	261	0.322	311	0.324	361
0.32	212	0.321	262	0.322	312	0.324	362
0.32	213	0.321	263	0.322	313	0.324	363
0.32	214	0.321	264	0.322	314	0.324	364
0.32	215	0.322	265	0.322	315	0.324	365
0.32	216	0.322	266	0.322	316	0.324	366
0.32	217	0.322	267	0.322	317	0.324	367
0.32	218	0.322	268	0.322	318	0.324	368
0.32	219	0.322	269	0.323	319	0.324	369
0.32	220	0.322	270	0.323	320	0.324	370
0.32	221	0.322	271	0.323	321	0.324	371
0.32	222	0.322	272	0.323	322	0.324	372
0.32	223	0.322	273	0.323	323	0.324	373
0.32	224	0.322	274	0.323	324	0.324	374
0.321	225	0.322	275	0.323	325	0.324	375
0.321	226	0.322	276	0.323	326	0.324	376
0.321	227	0.322	277	0.323	327	0.324	377
0.321	228	0.322	278	0.323	328	0.324	378
0.321	229	0.322	279	0.323	329	0.324	379
0.321	230	0.322	280	0.323	330	0.324	380
0.321	231	0.322	281	0.323	331	0.324	381
0.321	232	0.322	282	0.323	332	0.325	382
0.321	233	0.322	283	0.323	333	0.325	383
0.321	234	0.322	284	0.323	334	0.325	384
0.321	235	0.322	285	0.323	335	0.325	385
0.321	236	0.322	286	0.323	336	0.325	386
0.321	237	0.322	287	0.323	337	0.325	387
0.321	238	0.322	288	0.323	338	0.325	388
0.321	239	0.322	289	0.323	339	0.325	389
0.321	240	0.322	290	0.323	340	0.325	390
0.321	241	0.322	291	0.323	341	0.325	391
0.321	242	0.322	292	0.323	342	0.325	392
0.321	243	0.322	293	0.323	343	0.325	393
0.321	244	0.322	294	0.323	344	0.325	394
0.321	245	0.322	295	0.323	345	0.325	395
0.321	246	0.322	296	0.323	346	0.325	396
0.321	247	0.322	297	0.323	347	0.325	397
0.321	248	0.322	298	0.323	348	0.325	398
0.321	249	0.322	299	0.323	349	0.325	399
0.321	250	0.322	300	0.324	350	0.326	400

Table 6C.LOC11.1998.2							
Location 11							
Ordered Readings							
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.326	401						
0.326	402						
0.326	403						
0.326	404						
0.326	405						
0.326	406						
0.326	407						
0.326	408						
0.326	409						
0.326	410						
0.326	411						
0.326	412						
0.326	413						
0.327	414						
0.327	415						
0.327	416						
0.327	417						
0.327	418						
0.327	419						
0.327	420						
0.327	421						
0.328	422						
0.328	423						
0.328	424						
0.328	425						
0.328	426						
0.329	427						
0.329	428						
0.329	429						
0.329	430						
0.33	431						
0.333	432						

Table 6C.LOC11.1998.3						
Location 11						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.31	1	0.002314815	0.00231481	0.9976852	41	0.909363292
0.312	5	0.011574074	0.01388889	0.9861111	41	0.563608872
0.313	14	0.032407407	0.0462963	0.9537037	41	0.14322302
0.314	20	0.046296296	0.09259259	0.9074074	41	0.0186217
0.315	22	0.050925926	0.14351852	0.8564815	41	0.001744356
0.316	24	0.055555556	0.19907407	0.8009259	41	0.000111576
0.317	22	0.050925926	0.25	0.75	41	7.54883E-06
0.318	38	0.087962963	0.33796296	0.662037	41	4.53629E-08
0.319	44	0.101851852	0.43981481	0.5601852	41	4.81213E-11
0.32	34	0.078703704	0.51851852	0.4814815	41	9.69834E-14
0.321	40	0.092592593	0.61111111	0.3888889	41	1.52776E-17
0.322	54	0.125	0.73611111	0.2638889	41	1.90532E-24
0.323	31	0.071759259	0.80787037	0.1921296	41	4.26066E-30
0.324	32	0.074074074	0.88194444	0.1180556	41	9.08395E-39
0.325	18	0.041666667	0.92361111	0.0763889	41	1.61259E-46
0.326	14	0.032407407	0.95601852	0.0439815	41	2.38812E-56
0.327	8	0.018518519	0.97453704	0.025463	41	4.43566E-66
0.328	5	0.011574074	0.98611111	0.0138889	41	7.1587E-77
0.329	4	0.009259259	0.99537037	0.0046296	41	1.9691E-96
0.33	1	0.002314815	0.99768519	0.0023148	41	8.9727E-109
0.333	1	0.002314815	1	0	41	0
Total	432					

Figure 6C.LOC11.1998.1.Ordered Thickness Readings

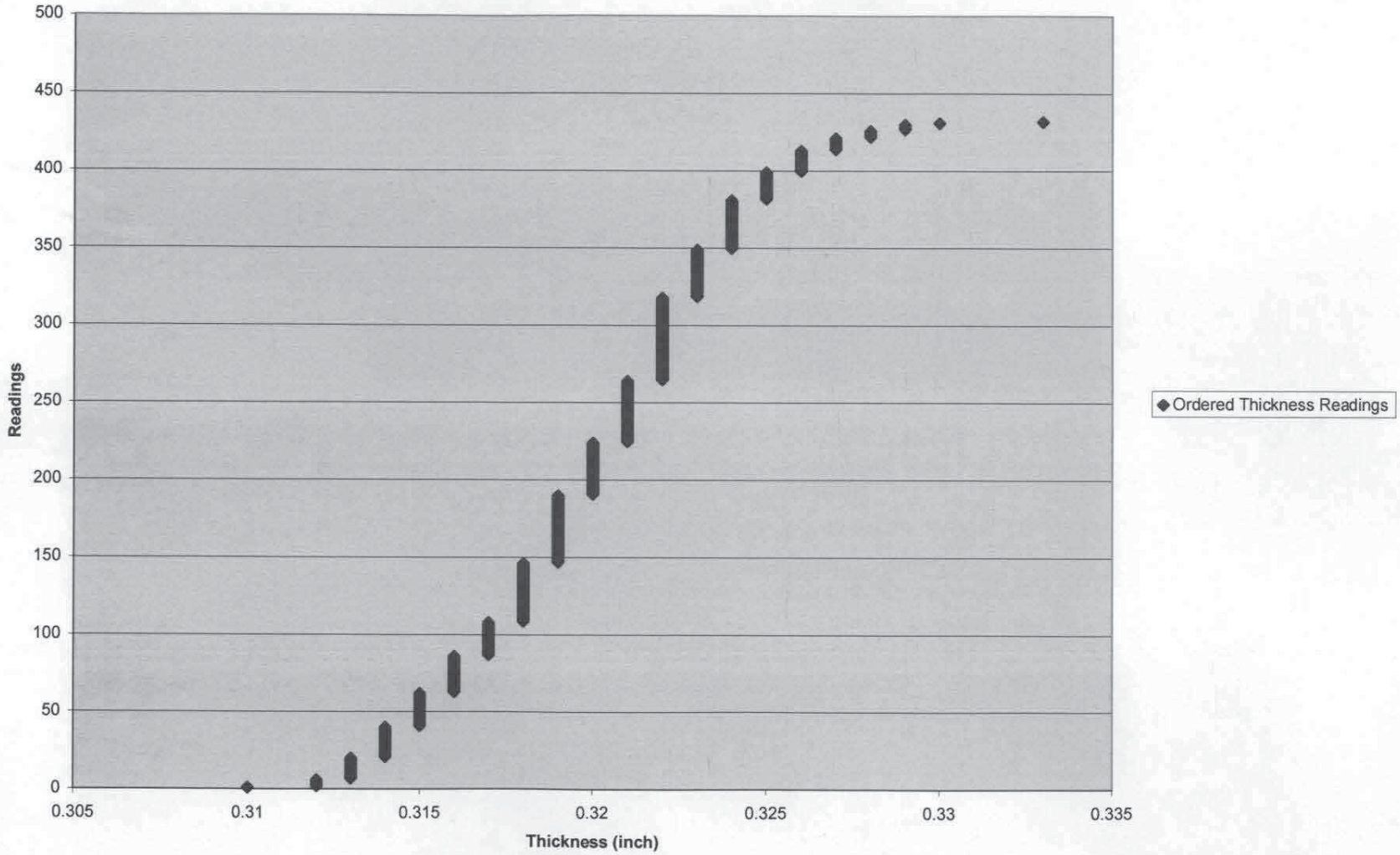

Figure 6C.LOC11.1998.2.Normalized Frequency Distribution

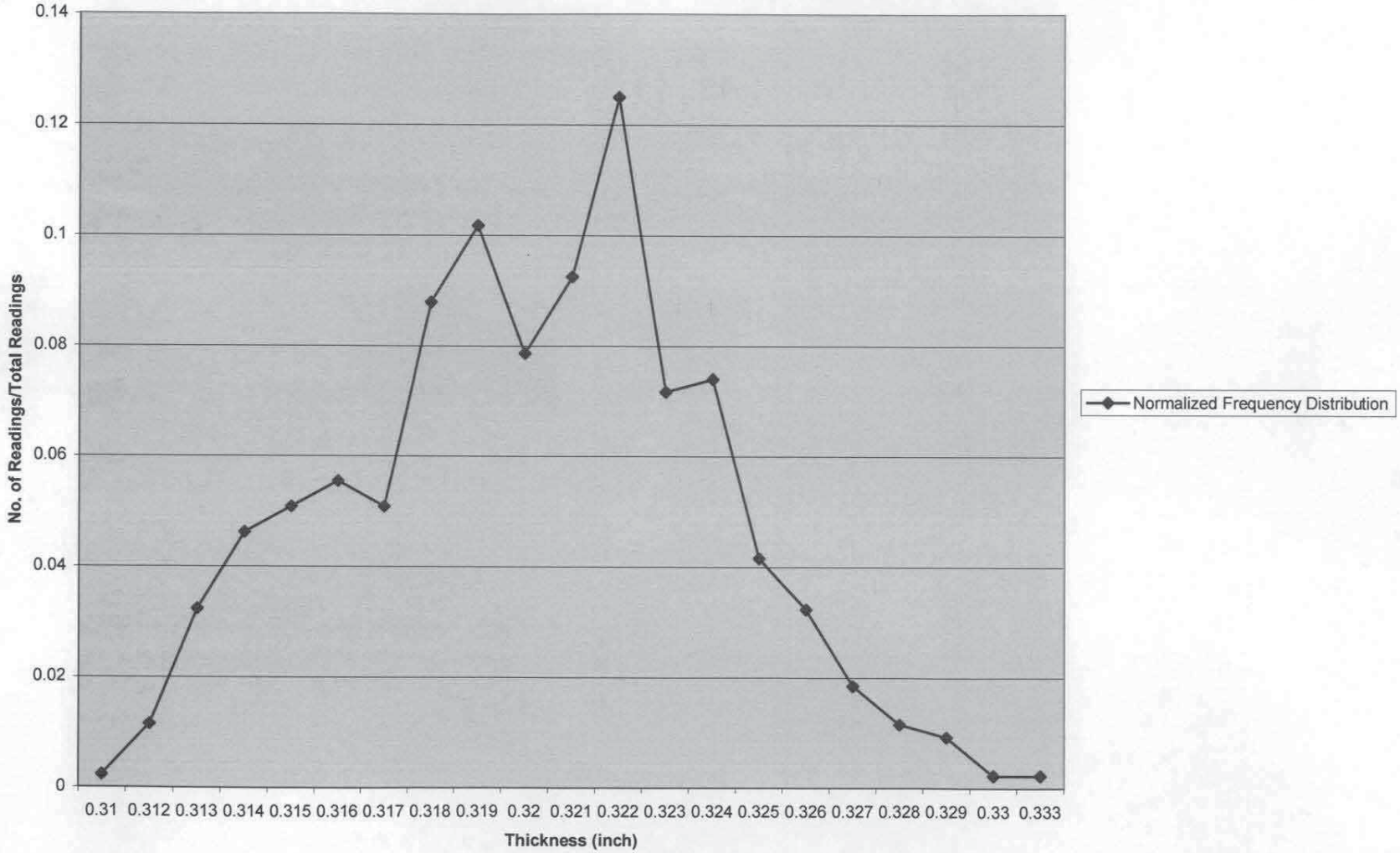

Figure 6C.LOC11.3.Reliability Function

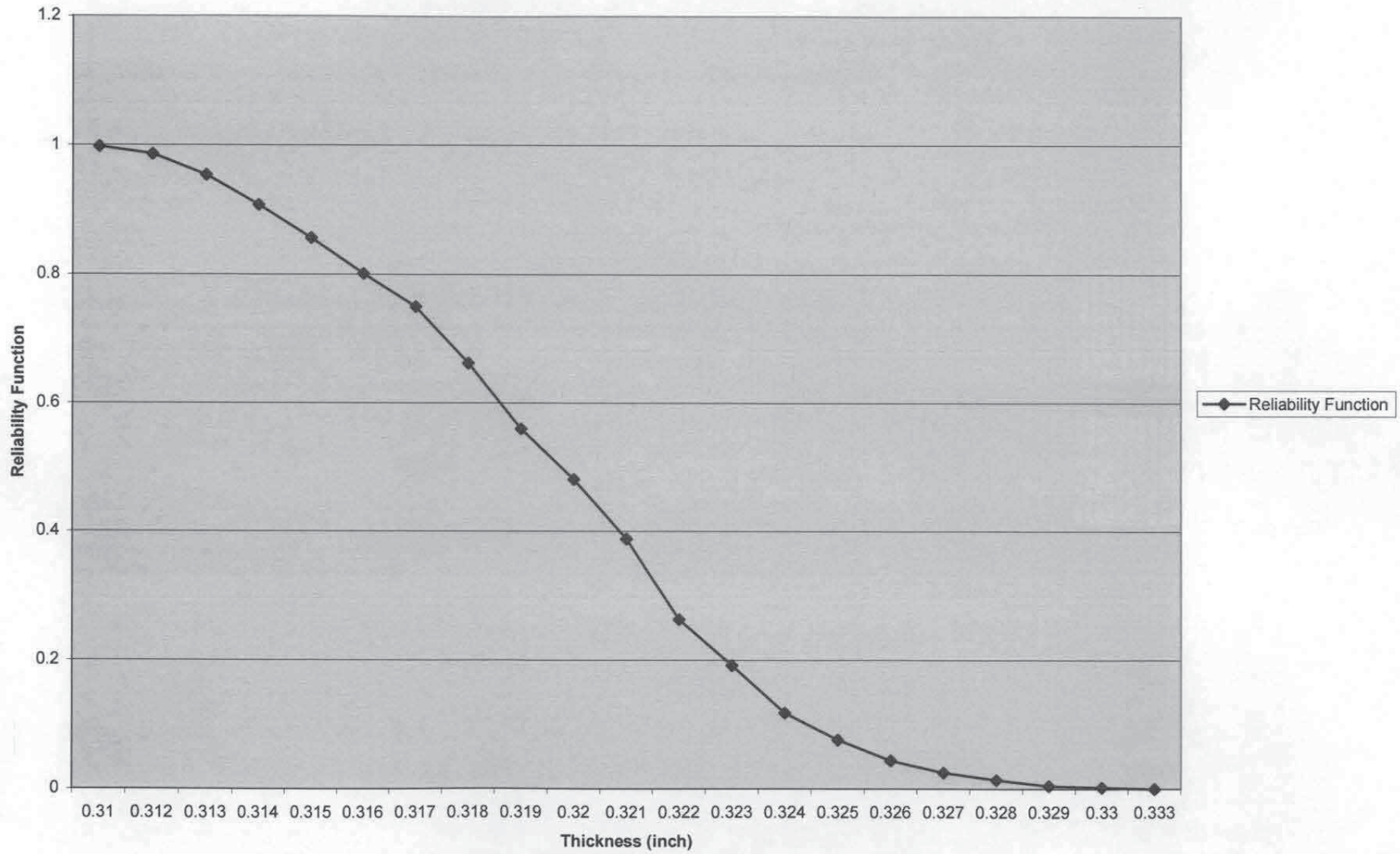

Figure 6C.LOC11.1998.4.Reliability^Area Ratio

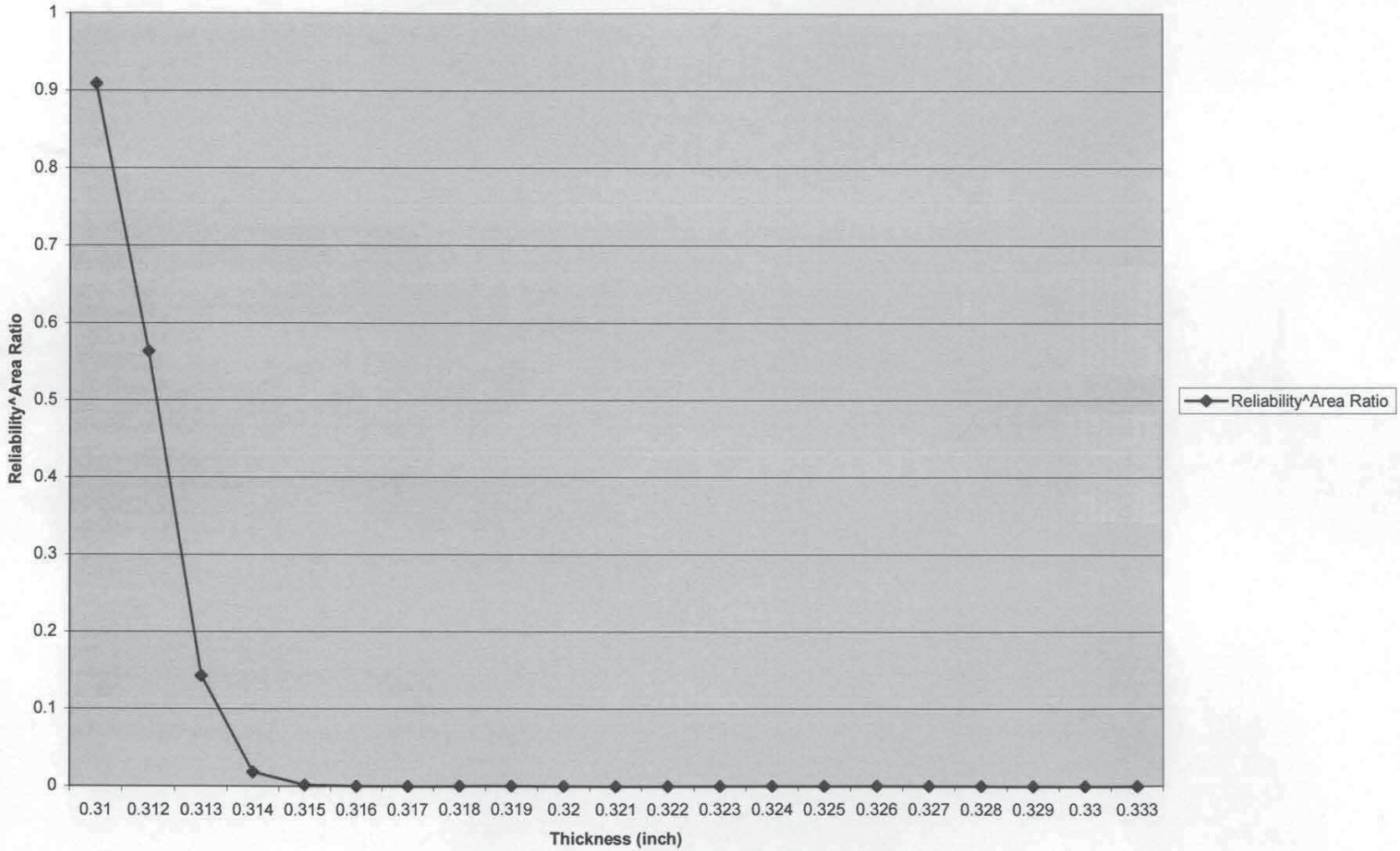

Table 6C.LOC11.2007.1	
Location 11	
Descriptive Statistics	
Mean	0.319180556
Standard Error	0.00035901
Median	0.32
Mode	0.32
Standard Deviation	0.007461878
Sample Variance	5.56796E-05
Kurtosis	208.5387275
Skewness	-12.08014704
Range	0.139
Minimum	0.19
Maximum	0.329
Sum	137.886
Count	432
Largest(1)	0.329
Smallest(1)	0.19
Confidence Level(95.0%)	0.000705628

Table 6C.LOC11.2007.2							
Location 11							
Ordered Readings							
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.19	1	0.314	51	0.316	101	0.318	151
0.308	2	0.314	52	0.316	102	0.318	152
0.309	3	0.314	53	0.316	103	0.318	153
0.31	4	0.314	54	0.317	104	0.318	154
0.31	5	0.314	55	0.317	105	0.318	155
0.311	6	0.314	56	0.317	106	0.318	156
0.311	7	0.314	57	0.317	107	0.318	157
0.311	8	0.314	58	0.317	108	0.318	158
0.311	9	0.314	59	0.317	109	0.318	159
0.311	10	0.314	60	0.317	110	0.318	160
0.311	11	0.314	61	0.317	111	0.318	161
0.311	12	0.314	62	0.317	112	0.318	162
0.312	13	0.315	63	0.317	113	0.318	163
0.312	14	0.315	64	0.317	114	0.318	164
0.312	15	0.315	65	0.317	115	0.318	165
0.312	16	0.315	66	0.317	116	0.318	166
0.312	17	0.315	67	0.317	117	0.318	167
0.312	18	0.315	68	0.317	118	0.318	168
0.312	19	0.315	69	0.317	119	0.318	169
0.312	20	0.315	70	0.317	120	0.319	170
0.312	21	0.315	71	0.317	121	0.319	171
0.312	22	0.315	72	0.317	122	0.319	172
0.313	23	0.315	73	0.317	123	0.319	173
0.313	24	0.315	74	0.317	124	0.319	174
0.313	25	0.315	75	0.317	125	0.319	175
0.313	26	0.315	76	0.317	126	0.319	176
0.313	27	0.315	77	0.317	127	0.319	177
0.313	28	0.315	78	0.317	128	0.319	178
0.313	29	0.315	79	0.317	129	0.319	179
0.313	30	0.315	80	0.317	130	0.319	180
0.313	31	0.316	81	0.317	131	0.319	181
0.313	32	0.316	82	0.317	132	0.319	182
0.313	33	0.316	83	0.317	133	0.319	183
0.313	34	0.316	84	0.317	134	0.319	184
0.313	35	0.316	85	0.317	135	0.319	185
0.313	36	0.316	86	0.317	136	0.319	186
0.314	37	0.316	87	0.317	137	0.319	187
0.314	38	0.316	88	0.318	138	0.319	188
0.314	39	0.316	89	0.318	139	0.319	189
0.314	40	0.316	90	0.318	140	0.319	190
0.314	41	0.316	91	0.318	141	0.319	191
0.314	42	0.316	92	0.318	142	0.319	192
0.314	43	0.316	93	0.318	143	0.319	193
0.314	44	0.316	94	0.318	144	0.319	194
0.314	45	0.316	95	0.318	145	0.319	195
0.314	46	0.316	96	0.318	146	0.319	196
0.314	47	0.316	97	0.318	147	0.319	197
0.314	48	0.316	98	0.318	148	0.319	198
0.314	49	0.316	99	0.318	149	0.319	199
0.314	50	0.316	100	0.318	150	0.319	200

Table 6C.LOC11.2007.2							
Location 11							
Ordered Readings							
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.319	201	0.32	251	0.322	301	0.323	351
0.319	202	0.32	252	0.322	302	0.323	352
0.319	203	0.32	253	0.322	303	0.323	353
0.319	204	0.32	254	0.322	304	0.323	354
0.319	205	0.32	255	0.322	305	0.323	355
0.319	206	0.32	256	0.322	306	0.323	356
0.319	207	0.32	257	0.322	307	0.324	357
0.319	208	0.321	258	0.322	308	0.324	358
0.319	209	0.321	259	0.322	309	0.324	359
0.319	210	0.321	260	0.322	310	0.324	360
0.319	211	0.321	261	0.322	311	0.324	361
0.319	212	0.321	262	0.322	312	0.324	362
0.32	213	0.321	263	0.322	313	0.324	363
0.32	214	0.321	264	0.322	314	0.324	364
0.32	215	0.321	265	0.322	315	0.324	365
0.32	216	0.321	266	0.322	316	0.324	366
0.32	217	0.321	267	0.322	317	0.324	367
0.32	218	0.321	268	0.322	318	0.324	368
0.32	219	0.321	269	0.322	319	0.324	369
0.32	220	0.321	270	0.322	320	0.324	370
0.32	221	0.321	271	0.322	321	0.324	371
0.32	222	0.321	272	0.322	322	0.324	372
0.32	223	0.321	273	0.322	323	0.324	373
0.32	224	0.321	274	0.322	324	0.324	374
0.32	225	0.321	275	0.322	325	0.324	375
0.32	226	0.321	276	0.322	326	0.324	376
0.32	227	0.321	277	0.322	327	0.324	377
0.32	228	0.321	278	0.322	328	0.324	378
0.32	229	0.321	279	0.323	329	0.325	379
0.32	230	0.321	280	0.323	330	0.325	380
0.32	231	0.321	281	0.323	331	0.325	381
0.32	232	0.321	282	0.323	332	0.325	382
0.32	233	0.321	283	0.323	333	0.325	383
0.32	234	0.321	284	0.323	334	0.325	384
0.32	235	0.321	285	0.323	335	0.325	385
0.32	236	0.321	286	0.323	336	0.325	386
0.32	237	0.321	287	0.323	337	0.325	387
0.32	238	0.321	288	0.323	338	0.325	388
0.32	239	0.321	289	0.323	339	0.325	389
0.32	240	0.322	290	0.323	340	0.325	390
0.32	241	0.322	291	0.323	341	0.325	391
0.32	242	0.322	292	0.323	342	0.325	392
0.32	243	0.322	293	0.323	343	0.325	393
0.32	244	0.322	294	0.323	344	0.325	394
0.32	245	0.322	295	0.323	345	0.325	395
0.32	246	0.322	296	0.323	346	0.325	396
0.32	247	0.322	297	0.323	347	0.325	397
0.32	248	0.322	298	0.323	348	0.325	398
0.32	249	0.322	299	0.323	349	0.326	399
0.32	250	0.322	300	0.323	350	0.326	400

Table 6C.LOC11.2007.2							
Location 11							
Ordered Readings							
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*	*Thickness (inch)*	*Count*
0.326	401						
0.326	402						
0.326	403						
0.326	404						
0.326	405						
0.326	406						
0.326	407						
0.326	408						
0.326	409						
0.326	410						
0.326	411						
0.326	412						
0.326	413						
0.326	414						
0.326	415						
0.327	416						
0.327	417						
0.327	418						
0.327	419						
0.327	420						
0.327	421						
0.327	422						
0.327	423						
0.327	424						
0.327	425						
0.327	426						
0.327	427						
0.327	428						
0.327	429						
0.328	430						
0.328	431						
0.329	432						

Table 6C.LOC11.2007.3						
Location 11						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.19	1	0.002314815	0.00231481	0.9976852	41	0.909363292
0.308	1	0.002314815	0.00462963	0.9953704	41	0.826759113
0.309	1	0.002314815	0.00694444	0.9930556	41	0.751491837
0.31	2	0.00462963	0.01157407	0.9884259	41	0.620474784
0.311	7	0.016203704	0.02777778	0.9722222	41	0.315081783
0.312	10	0.023148148	0.05092593	0.9490741	41	0.1173198
0.313	14	0.032407407	0.08333333	0.9166667	41	0.028234508
0.314	26	0.060185185	0.14351852	0.8564815	41	0.001744356
0.315	18	0.041666667	0.18518519	0.8148148	41	0.000225776
0.316	23	0.053240741	0.23842593	0.7615741	41	1.41432E-05
0.317	34	0.078703704	0.31712963	0.6828704	41	1.61568E-07
0.318	32	0.074074074	0.3912037	0.6087963	41	1.45877E-09
0.319	43	0.099537037	0.49074074	0.5092593	41	9.66849E-13
0.32	45	0.104166667	0.59490741	0.4050926	41	8.14482E-17
0.321	32	0.074074074	0.66898148	0.3310185	41	2.06708E-20
0.322	39	0.090277778	0.75925926	0.2407407	41	4.4193E-26
0.323	28	0.064814815	0.82407407	0.1759259	41	1.15012E-31
0.324	22	0.050925926	0.875	0.125	41	9.46168E-38
0.325	20	0.046296296	0.9212963	0.0787037	41	5.48342E-46
0.326	17	0.039351852	0.96064815	0.0393519	41	2.49866E-58
0.327	14	0.032407407	0.99305556	0.0069444	41	3.26205E-89
0.328	2	0.00462963	0.99768519	0.0023148	41	8.9727E-109
0.329	1	0.002314815	1	0	41	0
Total	432					

Figure 6C.LOC11.2007.1.Ordered Thickness Readings

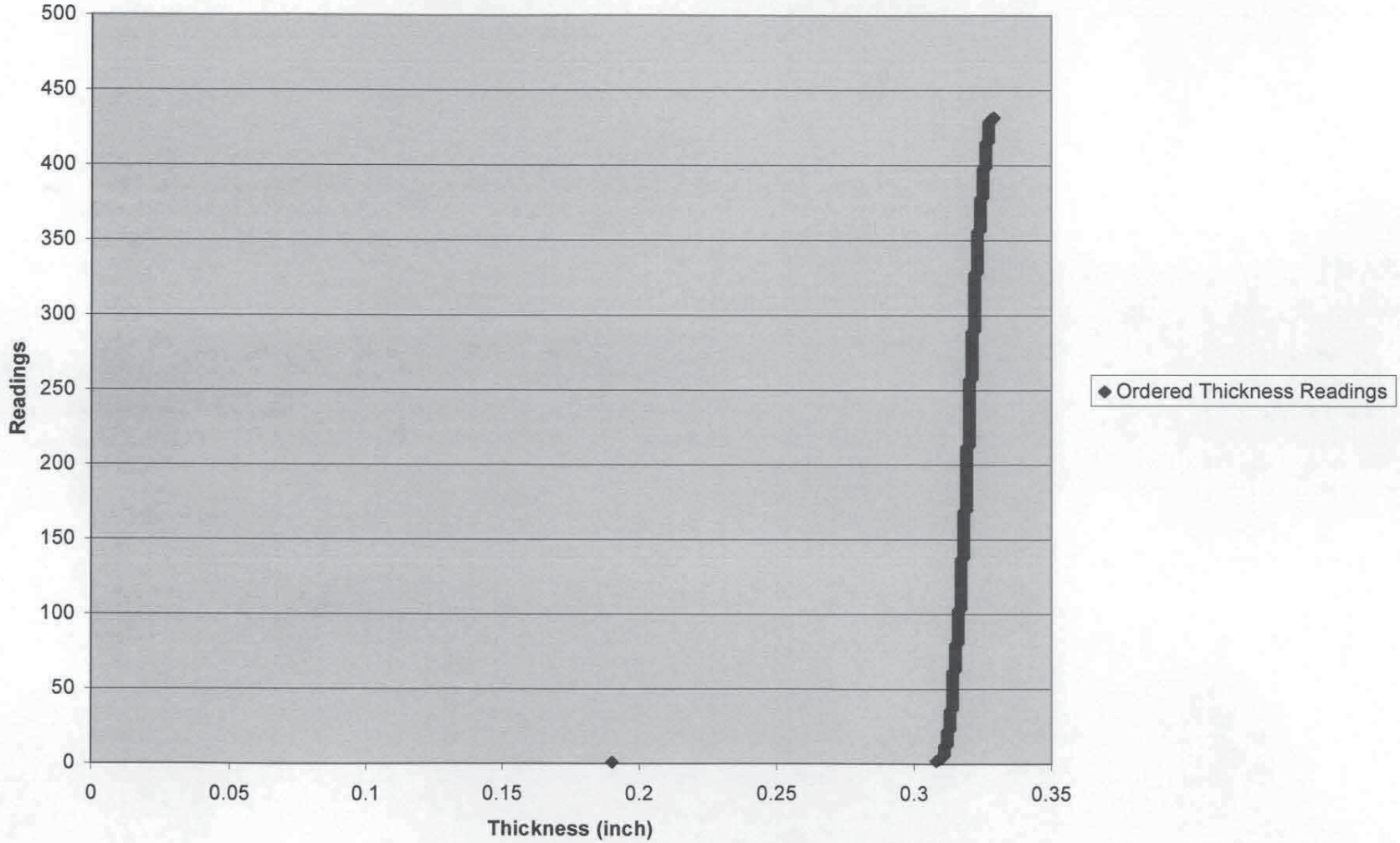

Figure 6C.LOC11.2007.2.Normalized Frequency Distribution

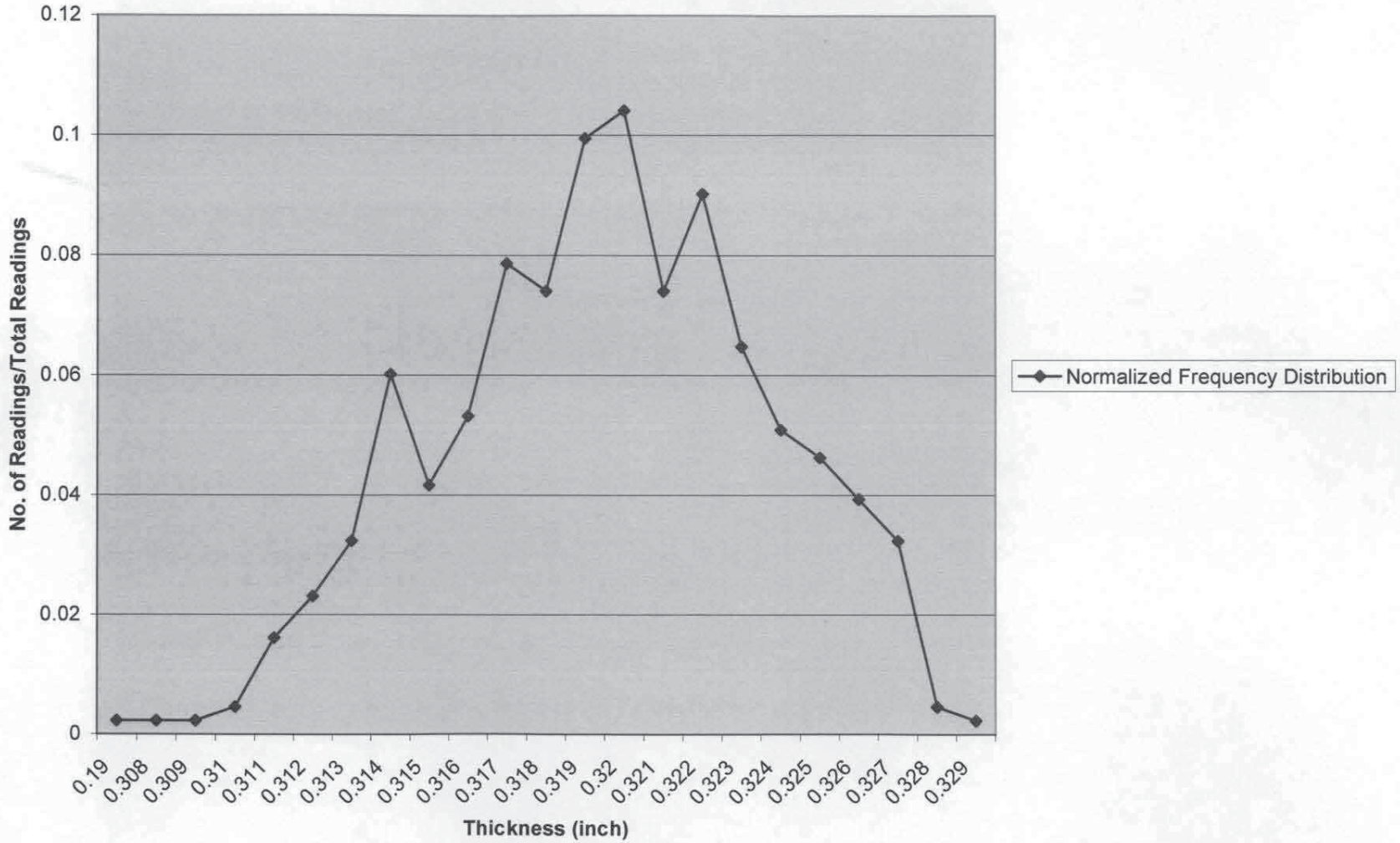

Figure 6C.LOC11.2007.3.Reliability Function

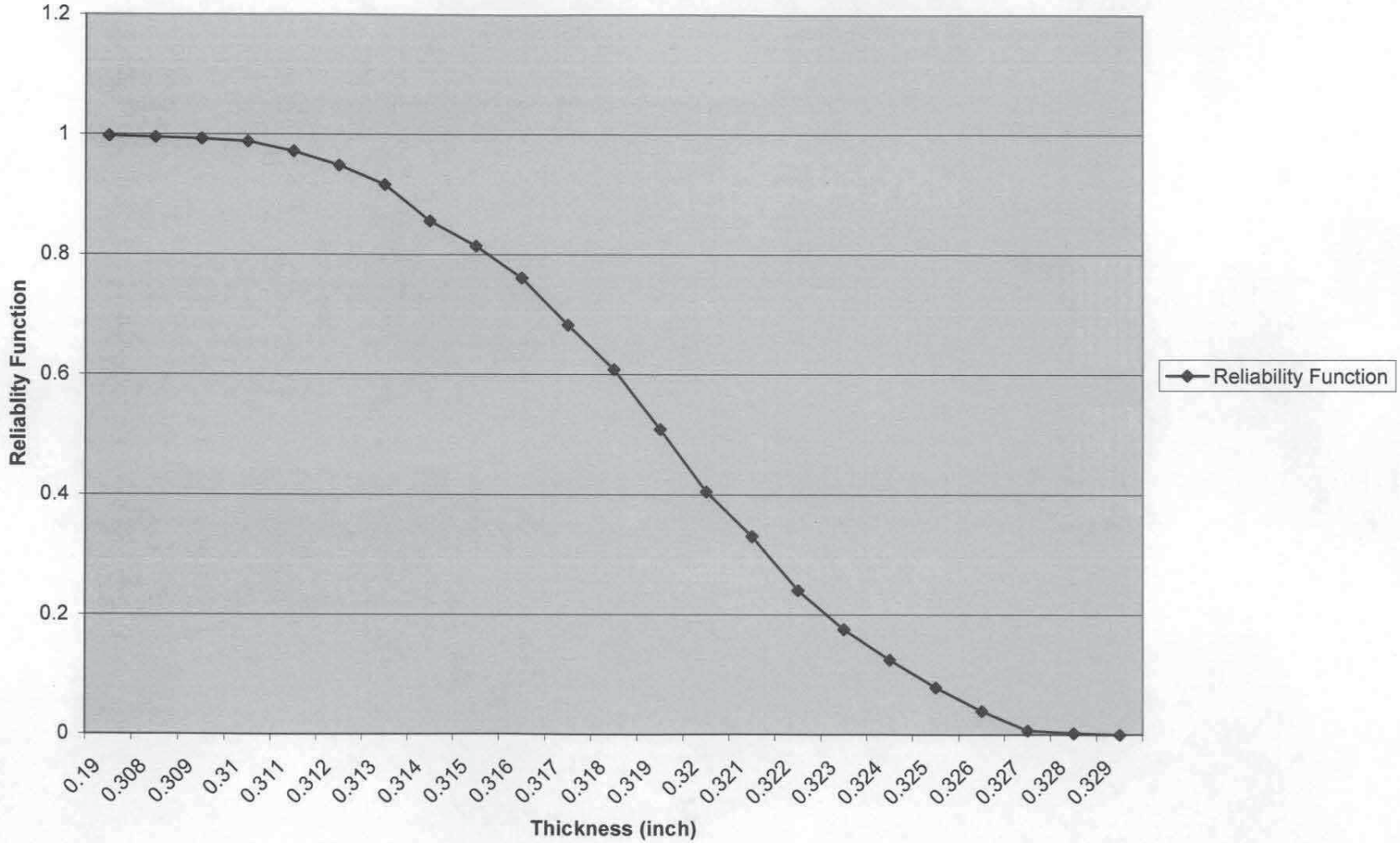

Figure 6C.LOC11.2007.4.Reliability^Area Ratio

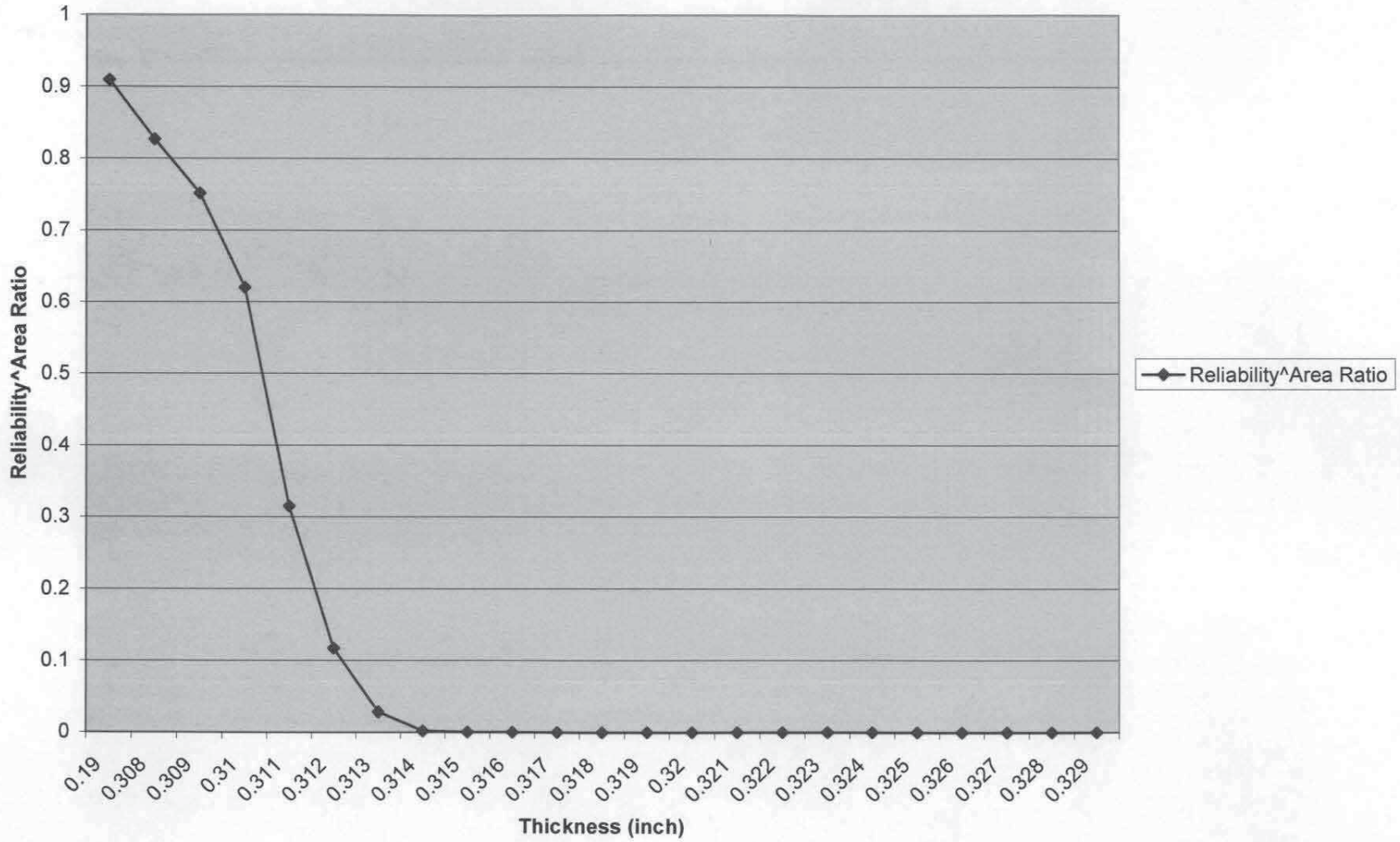

Table 6C.LOC12.1993.1	
Location 12	
Descriptive Statistics	
Mean	0.333139
Standard Error	0.001218
Median	0.333
Mode	0.335
Standard Deviation	0.010332
Sample Variance	0.000107
Kurtosis	-0.761391
Skewness	0.364092
Range	0.043
Minimum	0.314
Maximum	0.357
Sum	23.986
Count	72
Largest(1)	0.357
Smallest(1)	0.314
Confidence Level(95.0%)	0.002428

Table 6C.LOC12.1993.2			
Location 12			
Ordered Readings			
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*
0.314	1	0.336	48
0.316	2	0.336	49
0.319	3	0.337	50
0.319	4	0.339	51
0.319	5	0.339	52
0.32	6	0.34	53
0.321	7	0.341	54
0.322	8	0.341	55
0.322	9	0.342	56
0.322	10	0.343	57
0.322	11	0.343	58
0.322	12	0.344	59
0.323	13	0.345	60
0.323	14	0.345	61
0.323	15	0.345	62
0.324	16	0.346	63
0.324	17	0.347	64
0.324	18	0.348	65
0.324	19	0.348	66
0.326	20	0.35	67
0.326	21	0.352	68
0.326	22	0.352	69
0.326	23	0.352	70
0.327	24	0.353	71
0.327	25	0.357	72
0.327	26		
0.327	27		
0.327	28		
0.327	29		
0.329	30		
0.329	31		
0.329	32		
0.33	33		
0.331	34		
0.332	35		
0.332	36		
0.334	37		
0.334	38		
0.334	39		
0.335	40		
0.335	41		
0.335	42		
0.335	43		
0.335	44		
0.335	45		
0.336	46		
0.336	47		

Table 6C.LOC12.1993.3						
Location 12						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.314	1	0.013888889	0.01388889	0.9861111	21.75	0.737742925
0.316	1	0.013888889	0.02777778	0.9722222	21.75	0.541921469
0.319	3	0.041666667	0.06944444	0.9305556	21.75	0.20904346
0.32	1	0.013888889	0.08333333	0.9166667	21.75	0.150733341
0.321	1	0.013888889	0.09722222	0.9027778	21.75	0.108146788
0.322	5	0.069444444	0.16666667	0.8333333	21.75	0.018968784
0.323	3	0.041666667	0.20833333	0.7916667	21.75	0.006217175
0.324	4	0.055555556	0.26388889	0.7361111	21.75	0.001277637
0.326	4	0.055555556	0.31944444	0.6805556	21.75	0.000231885
0.327	6	0.083333333	0.40277778	0.5972222	21.75	1.35398E-05
0.329	3	0.041666667	0.44444444	0.5555556	21.75	2.80912E-06
0.33	1	0.013888889	0.45833333	0.5416667	21.75	1.61977E-06
0.331	1	0.013888889	0.47222222	0.5277778	21.75	9.20711E-07
0.332	2	0.027777778	0.5	0.5	21.75	2.84104E-07
0.334	3	0.041666667	0.54166667	0.4583333	21.75	4.2824E-08
0.335	6	0.083333333	0.625	0.375	21.75	5.45037E-10
0.336	4	0.055555556	0.68055556	0.3194444	21.75	1.66743E-11
0.337	1	0.013888889	0.69444444	0.3055556	21.75	6.34187E-12
0.339	2	0.027777778	0.72222222	0.2777778	21.75	7.98082E-13
0.34	1	0.013888889	0.73611111	0.2638889	21.75	2.61578E-13
0.341	2	0.027777778	0.76388889	0.2361111	21.75	2.32871E-14
0.342	1	0.013888889	0.77777778	0.2222222	21.75	6.23072E-15
0.343	2	0.027777778	0.80555556	0.1944444	21.75	3.41494E-16
0.344	1	0.013888889	0.81944444	0.1805556	21.75	6.81491E-17
0.345	3	0.041666667	0.86111111	0.1388889	21.75	2.26739E-19
0.346	1	0.013888889	0.875	0.125	21.75	2.29316E-20
0.347	1	0.013888889	0.88888889	0.1111111	21.75	1.77018E-21
0.348	2	0.027777778	0.91666667	0.0833333	21.75	3.39597E-24
0.35	1	0.013888889	0.93055556	0.0694444	21.75	6.44175E-26
0.352	3	0.041666667	0.97222222	0.0277778	21.75	1.4288E-34
0.353	1	0.013888889	0.98611111	0.0138889	21.75	4.05929E-41
0.357	1	0.013888889	1	0	21.75	0
Total	72					

Figure 6C.LOC12.1993.1.Ordered Thickness Readings

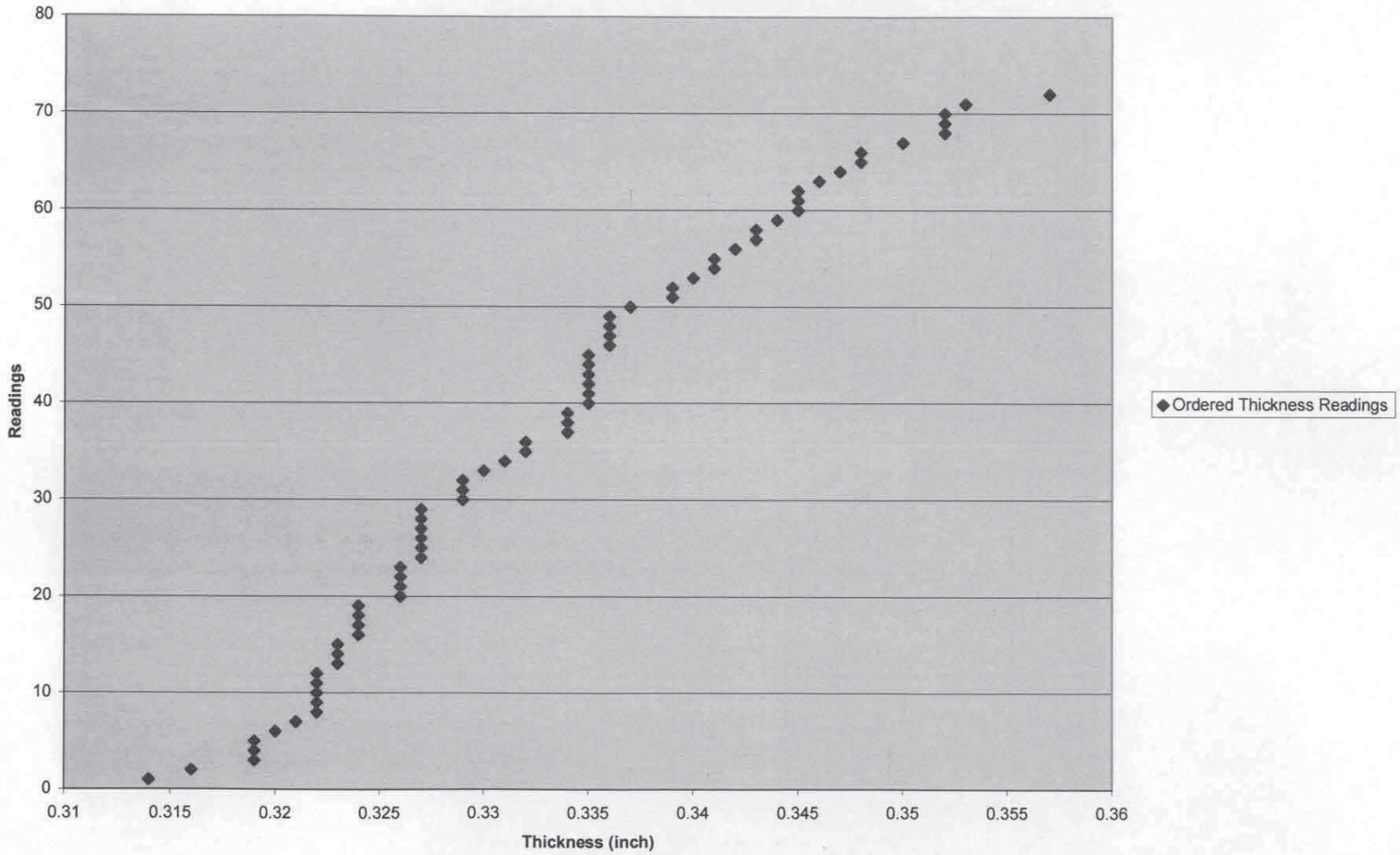

Figure 6C.LOC12.1993.2.Normalized Frequency Distribution

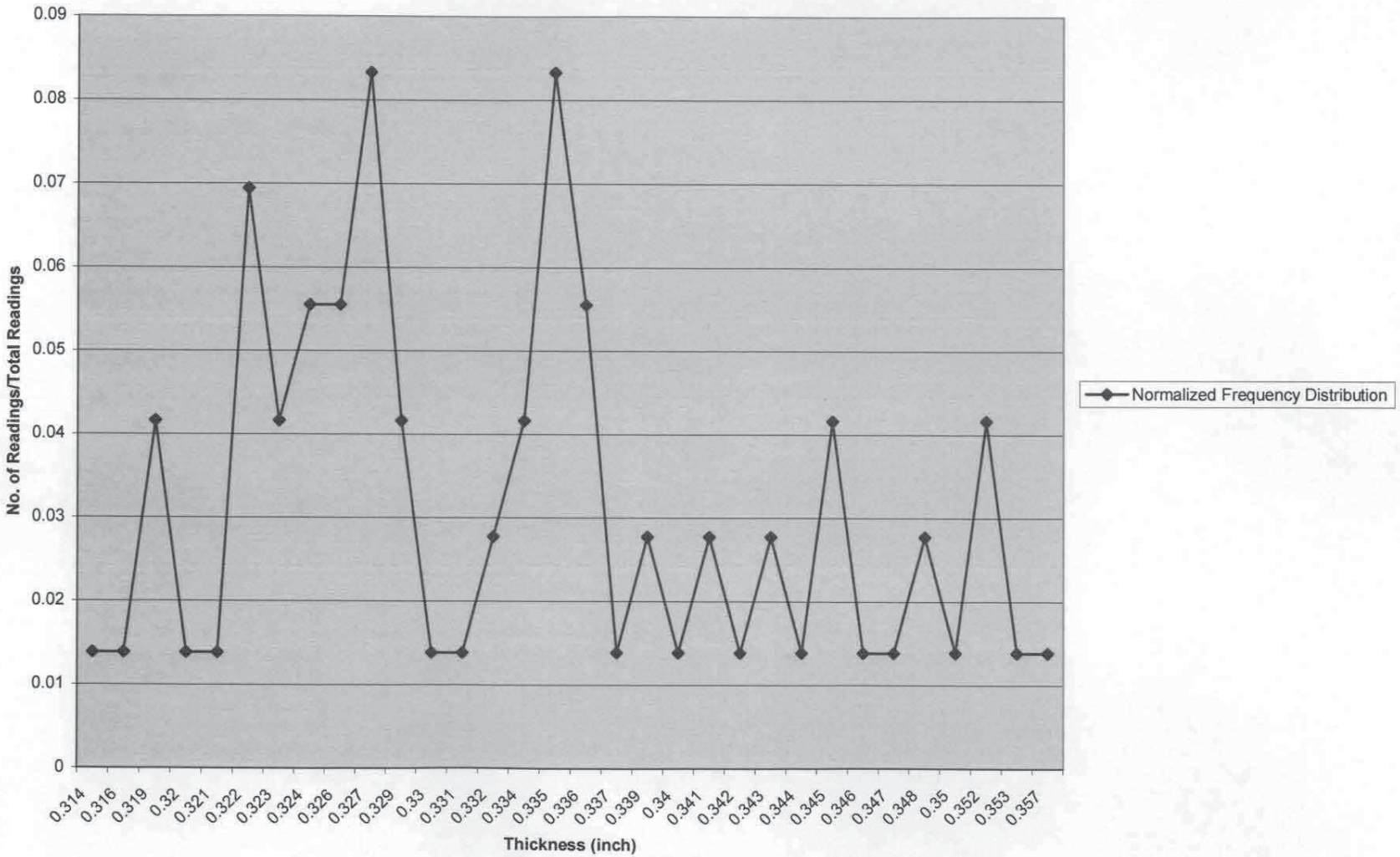

Figure 6C.LOC12.1993.3.Reliability Function

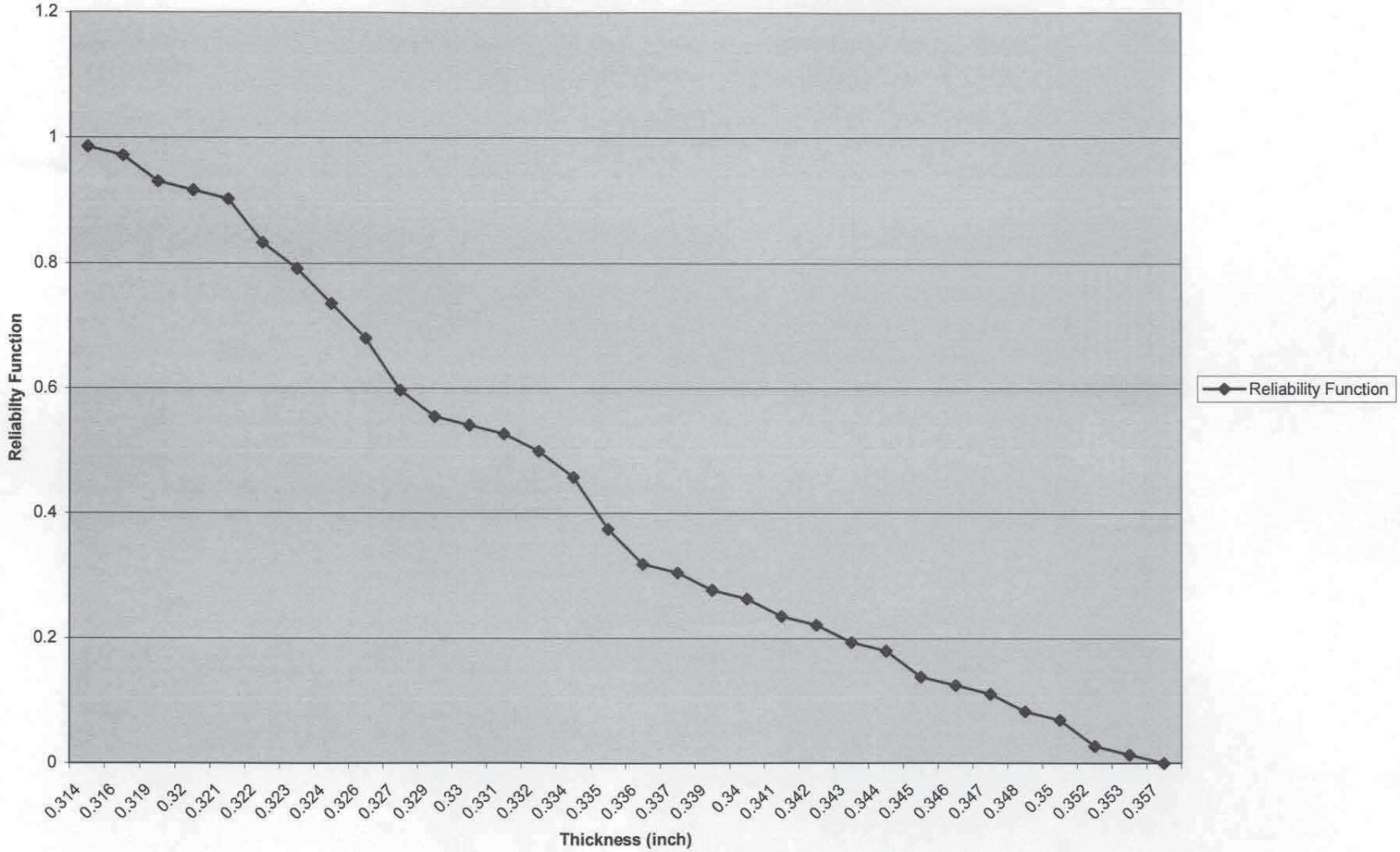

Figure 6C.LOC12.1993.4.Reliability^Area Ratio

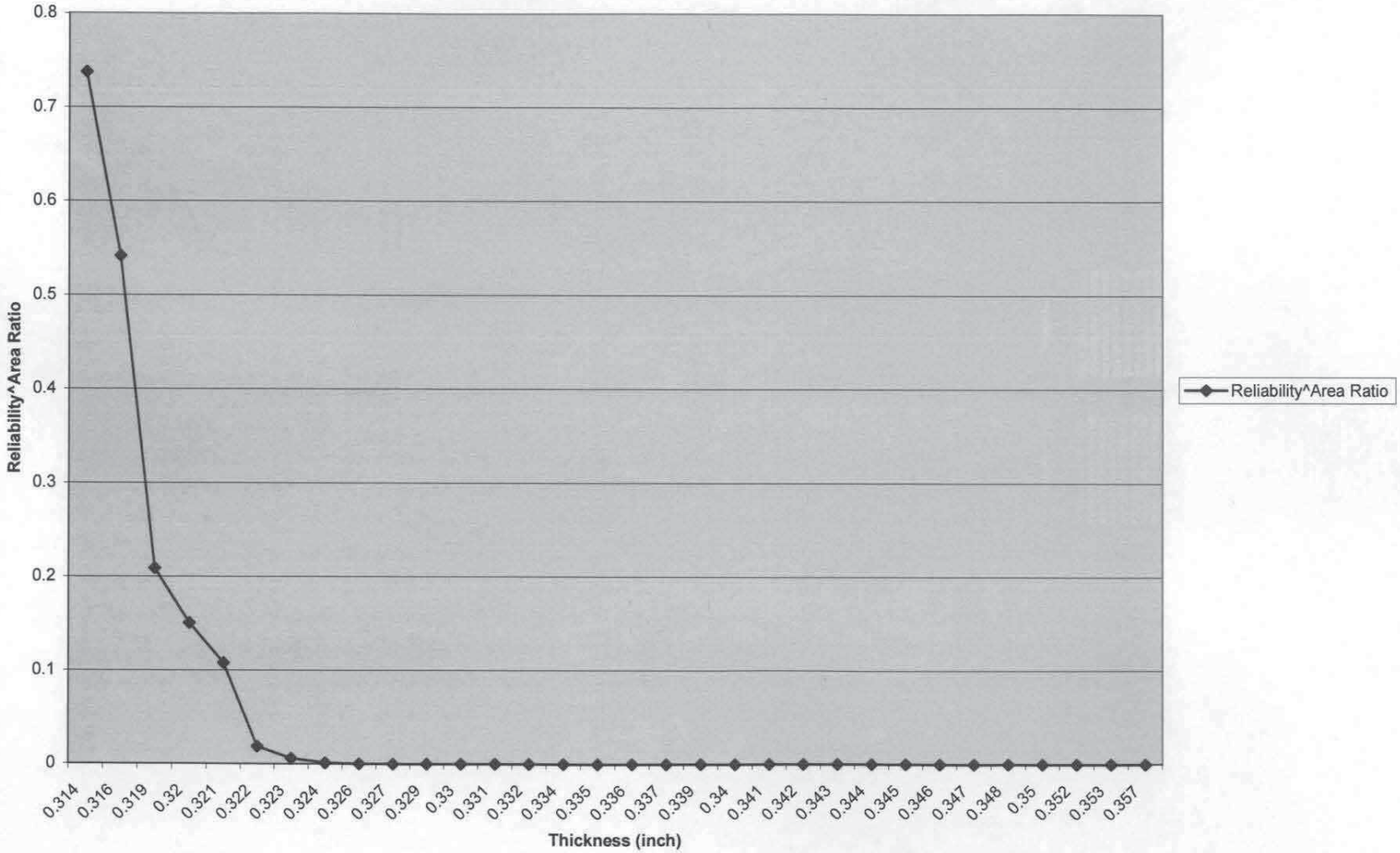

Table 6C.LOC12.1998.1	
Location 12	
Descriptive Statistics	
Mean	0.32616
Standard Error	0.001153926
Median	0.326
Mode	0.336
Standard Deviation	0.009993295
Sample Variance	9.98659E-05
Kurtosis	-0.635621207
Skewness	0.358232885
Range	0.042
Minimum	0.31
Maximum	0.352
Sum	24.462
Count	75
Largest(1)	0.352
Smallest(1)	0.31
Confidence Level(95.0%)	0.002299248

Table 6C.LOC12.1998.2			
Location 12			
Ordered Readings			
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*
0.31	1	0.329	48
0.31	2	0.33	49
0.311	3	0.33	50
0.312	4	0.33	51
0.313	5	0.331	52
0.313	6	0.331	53
0.313	7	0.331	54
0.314	8	0.332	55
0.314	9	0.333	56
0.314	10	0.333	57
0.314	11	0.335	58
0.315	12	0.336	59
0.315	13	0.336	60
0.315	14	0.336	61
0.315	15	0.336	62
0.316	16	0.337	63
0.317	17	0.338	64
0.318	18	0.338	65
0.319	19	0.34	66
0.319	20	0.34	67
0.319	21	0.34	68
0.319	22	0.34	69
0.32	23	0.341	70
0.32	24	0.341	71
0.32	25	0.344	72
0.321	26	0.344	73
0.321	27	0.347	74
0.322	28	0.352	75
0.322	29		
0.322	30		
0.322	31		
0.323	32		
0.323	33		
0.323	34		
0.323	35		
0.324	36		
0.325	37		
0.326	38		
0.326	39		
0.327	40		
0.327	41		
0.327	42		
0.328	43		
0.328	44		
0.328	45		
0.329	46		
0.329	47		

Table 6C.LOC12.1998.3						
Location 12						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.31	2	0.026666667	0.02666667	0.9733333	20.88	0.568767928
0.311	1	0.013333333	0.04	0.96	20.88	0.426454916
0.312	1	0.013333333	0.05333333	0.9466667	20.88	0.318465195
0.313	3	0.04	0.09333333	0.9066667	20.88	0.129308298
0.314	4	0.053333333	0.14666667	0.8533333	20.88	0.036471371
0.315	4	0.053333333	0.2	0.8	20.88	0.009479622
0.316	1	0.013333333	0.21333333	0.7866667	20.88	0.006674265
0.317	1	0.013333333	0.22666667	0.7733333	20.88	0.00467101
0.318	1	0.013333333	0.24	0.76	20.88	0.003248796
0.319	4	0.053333333	0.29333333	0.7066667	20.88	0.000711253
0.32	3	0.04	0.33333333	0.6666667	20.88	0.000210722
0.321	2	0.026666667	0.36	0.64	20.88	8.98632E-05
0.322	4	0.053333333	0.41333333	0.5866667	20.88	1.46104E-05
0.323	4	0.053333333	0.46666667	0.5333333	20.88	1.99756E-06
0.324	1	0.013333333	0.48	0.52	20.88	1.17746E-06
0.325	1	0.013333333	0.49333333	0.5066667	20.88	6.84591E-07
0.326	2	0.026666667	0.52	0.48	20.88	2.21418E-07
0.327	3	0.04	0.56	0.44	20.88	3.59992E-08
0.328	3	0.04	0.6	0.4	20.88	4.92187E-09
0.329	3	0.04	0.64	0.36	20.88	5.45559E-10
0.33	3	0.04	0.68	0.32	20.88	4.66574E-11
0.331	3	0.04	0.72	0.28	20.88	2.87218E-12
0.332	1	0.013333333	0.73333333	0.2666667	20.88	1.03714E-12
0.333	2	0.026666667	0.76	0.24	20.88	1.14961E-13
0.335	1	0.013333333	0.77333333	0.2266667	20.88	3.48581E-14
0.336	4	0.053333333	0.82666667	0.1733333	20.88	1.28824E-16
0.337	1	0.013333333	0.84	0.16	20.88	2.42248E-17
0.338	2	0.026666667	0.86666667	0.1333333	20.88	5.3849E-19
0.34	4	0.053333333	0.92	0.08	20.88	1.25776E-23
0.341	2	0.026666667	0.94666667	0.0533333	20.88	2.65038E-27
0.344	2	0.026666667	0.97333333	0.0266667	20.88	1.37609E-33
0.347	1	0.013333333	0.98666667	0.0133333	20.88	7.14473E-40
0.352	1	0.013333333	1	0	20.88	0
Total	75					

Figure 6C.LOC12.1998.1.Ordered Thickness Readings

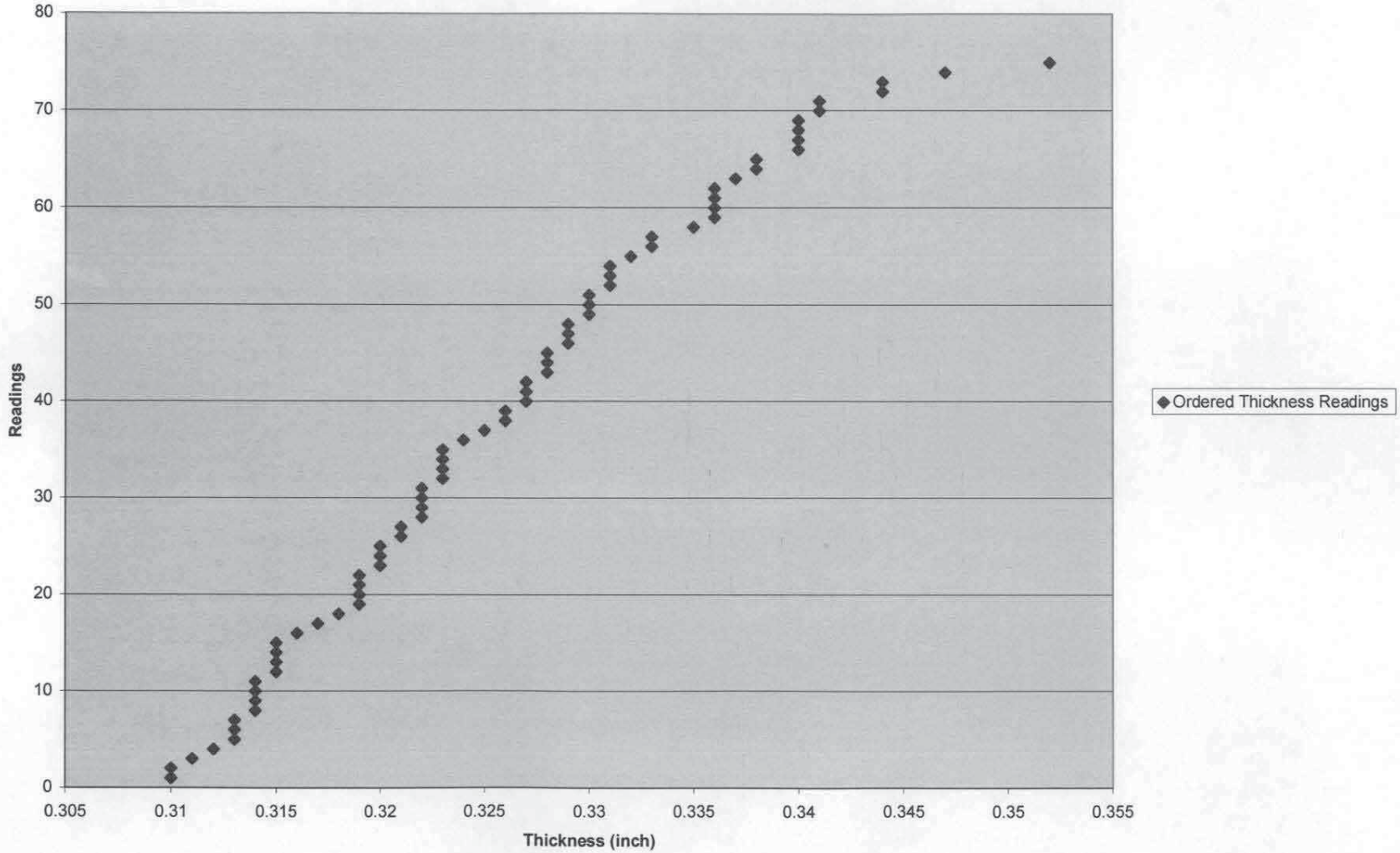

Figure 6C.LOC12.1998.2.Normalized Frequency Distribution

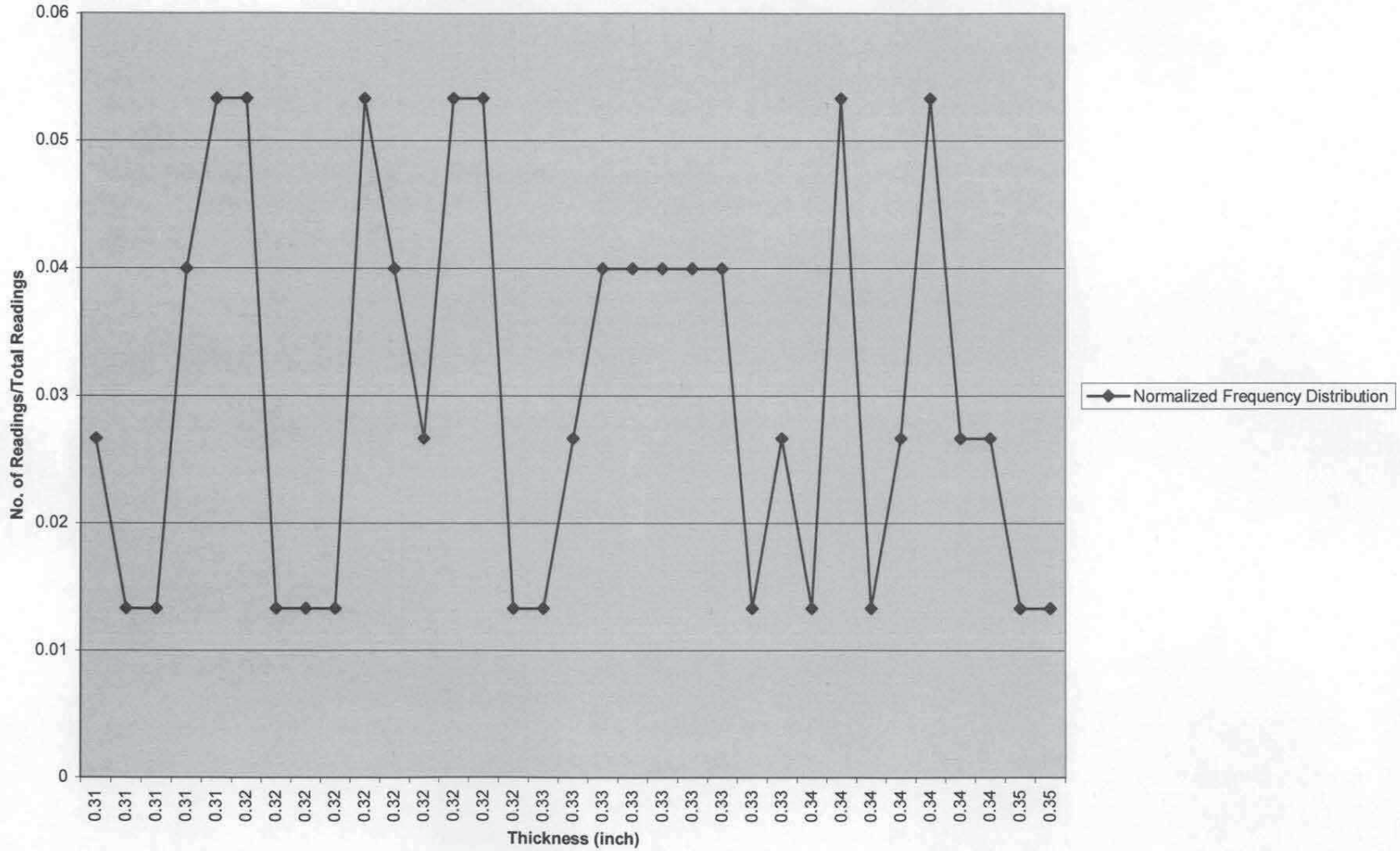

Figure 6C.LOC12.1998.3.Reliability Function

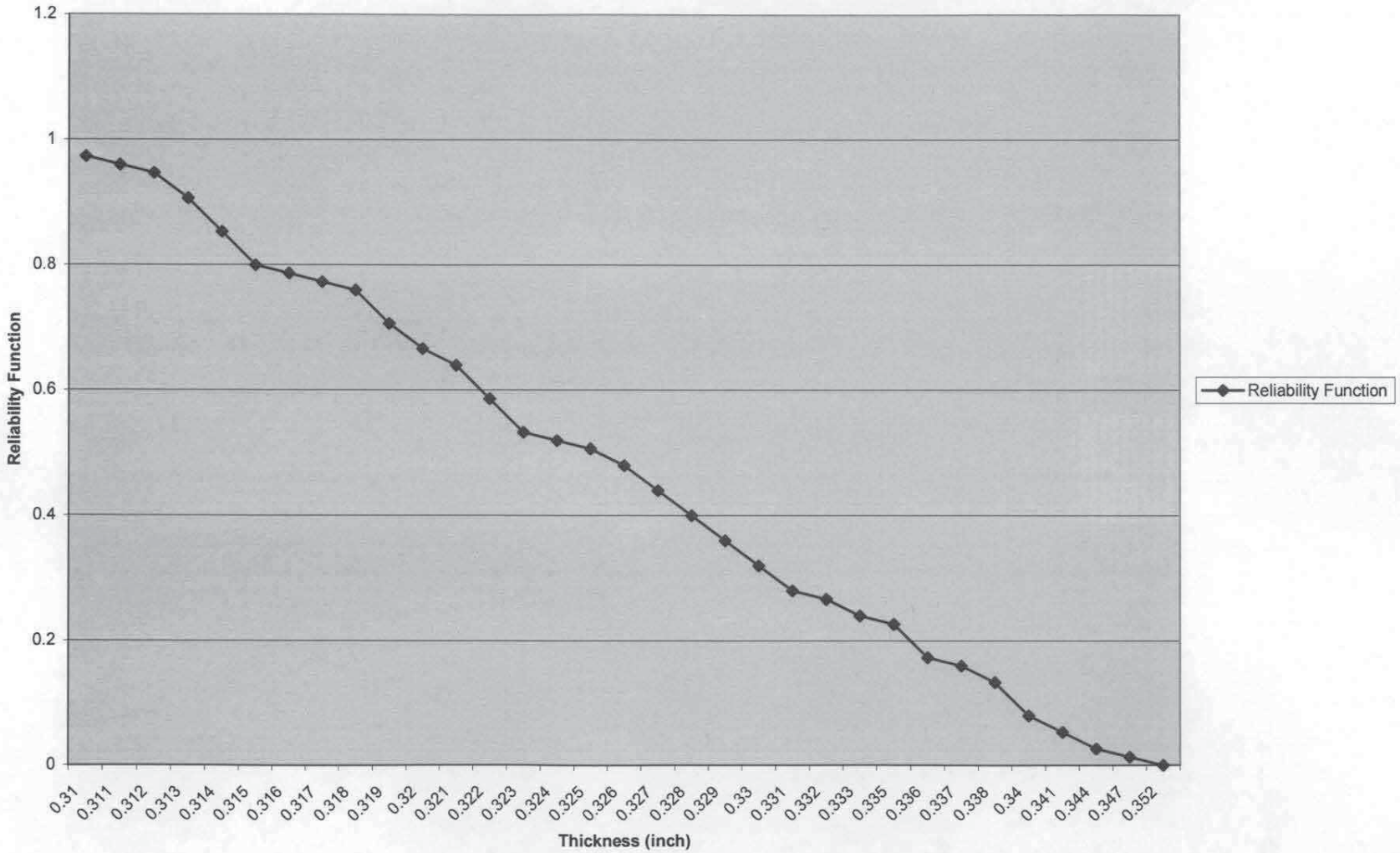

Figure 6C.LOC12.1998.4.Reliability^Area Ratio

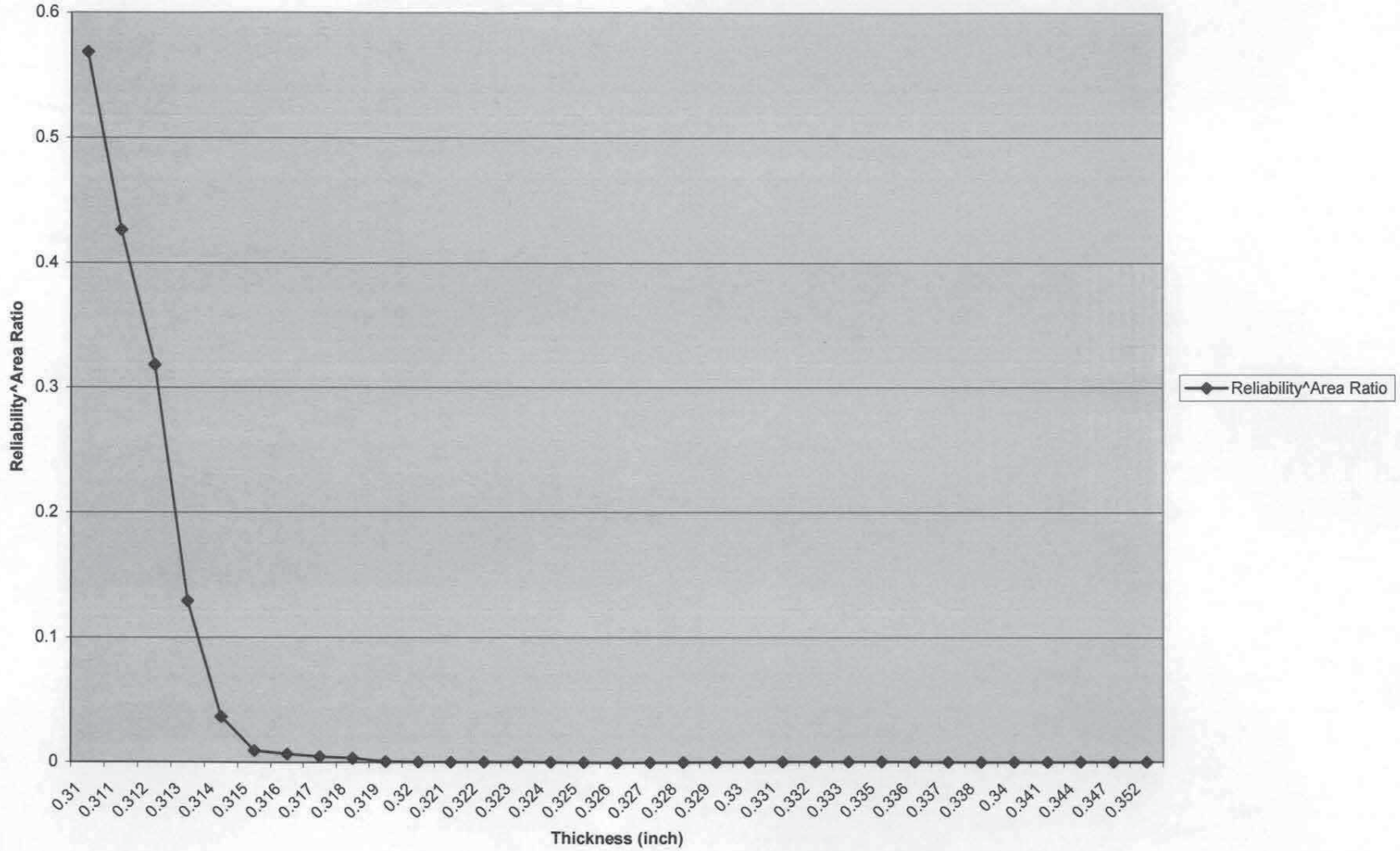

Table 6C.LOC12.2007.1	
Location 12	
Descriptive Statistics	
Mean	0.313106667
Standard Error	0.000319105
Median	0.312
Mode	0.312
Standard Deviation	0.002763533
Sample Variance	7.63712E-06
Kurtosis	0.860809383
Skewness	0.829562214
Range	0.015
Minimum	0.307
Maximum	0.322
Sum	23.483
Count	75
Largest(1)	0.322
Smallest(1)	0.307
Confidence Level(95.0%)	0.000635831

Table 6C.LOC12.2007.2			
Location 12			
Ordered Readings			
Thickness (inch)	*Count*	*Thickness (inch)*	*Count*
0.307	1	0.313	48
0.309	2	0.313	49
0.31	3	0.314	50
0.31	4	0.314	51
0.31	5	0.314	52
0.31	6	0.314	53
0.31	7	0.314	54
0.31	8	0.314	55
0.31	9	0.315	56
0.31	10	0.315	57
0.31	11	0.316	58
0.311	12	0.316	59
0.311	13	0.316	60
0.311	14	0.316	61
0.311	15	0.316	62
0.311	16	0.316	63
0.311	17	0.316	64
0.311	18	0.316	65
0.311	19	0.316	66
0.311	20	0.317	67
0.311	21	0.317	68
0.311	22	0.317	69
0.311	23	0.317	70
0.312	24	0.317	71
0.312	25	0.318	72
0.312	26	0.318	73
0.312	27	0.321	74
0.312	28	0.322	75
0.312	29		
0.312	30		
0.312	31		
0.312	32		
0.312	33		
0.312	34		
0.312	35		
0.312	36		
0.312	37		
0.312	38		
0.313	39		
0.313	40		
0.313	41		
0.313	42		
0.313	43		
0.313	44		
0.313	45		
0.313	46		
0.313	47		

Table 6C.LOC12.2007.3						
Location 12						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.307	1	0.013333333	0.01333333	0.9866667	20.88	0.755606172
0.309	1	0.013333333	0.02666667	0.9733333	20.88	0.568767928
0.31	9	0.12	0.14666667	0.8533333	20.88	0.036471371
0.311	12	0.16	0.30666667	0.6933333	20.88	0.000477878
0.312	15	0.2	0.50666667	0.4933333	20.88	3.92315E-07
0.313	11	0.146666667	0.65333333	0.3466667	20.88	2.48117E-10
0.314	6	0.08	0.73333333	0.2666667	20.88	1.03714E-12
0.315	2	0.026666667	0.76	0.24	20.88	1.14961E-13
0.316	9	0.12	0.88	0.12	20.88	5.96884E-20
0.317	5	0.066666667	0.94666667	0.0533333	20.88	2.65038E-27
0.318	2	0.026666667	0.97333333	0.0266667	20.88	1.37609E-33
0.321	1	0.013333333	0.98666667	0.0133333	20.88	7.14473E-40
0.322	1	0.013333333	1	0	20.88	0
Total	75					

Figure 6C.LOC12.2007.1.Ordered Thickness Readings

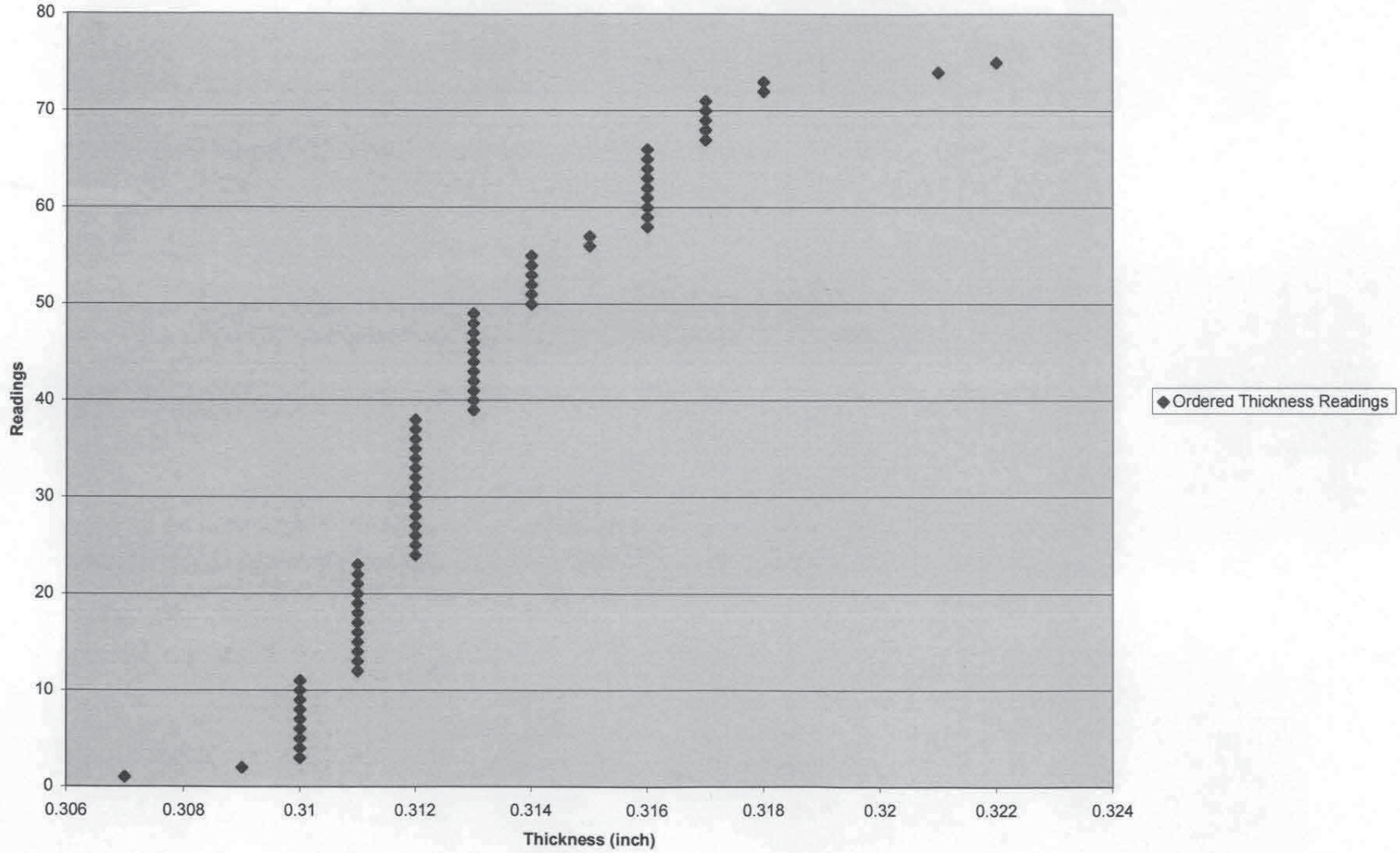

Figure 6C.LOC12.2007.2.Normalized Frequency Distribution

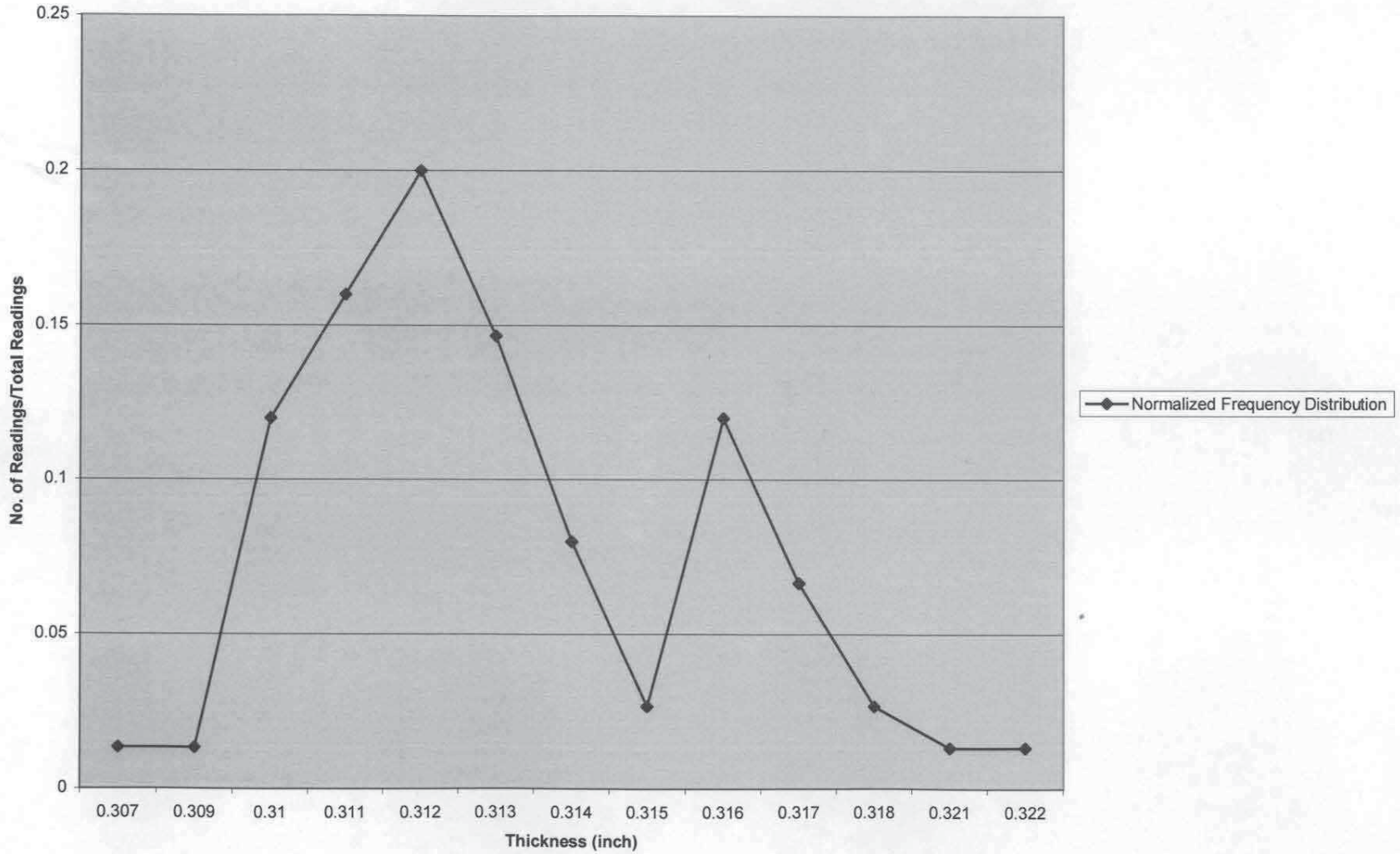

Figure 6C.LOC12.2007.3.Reliability Function

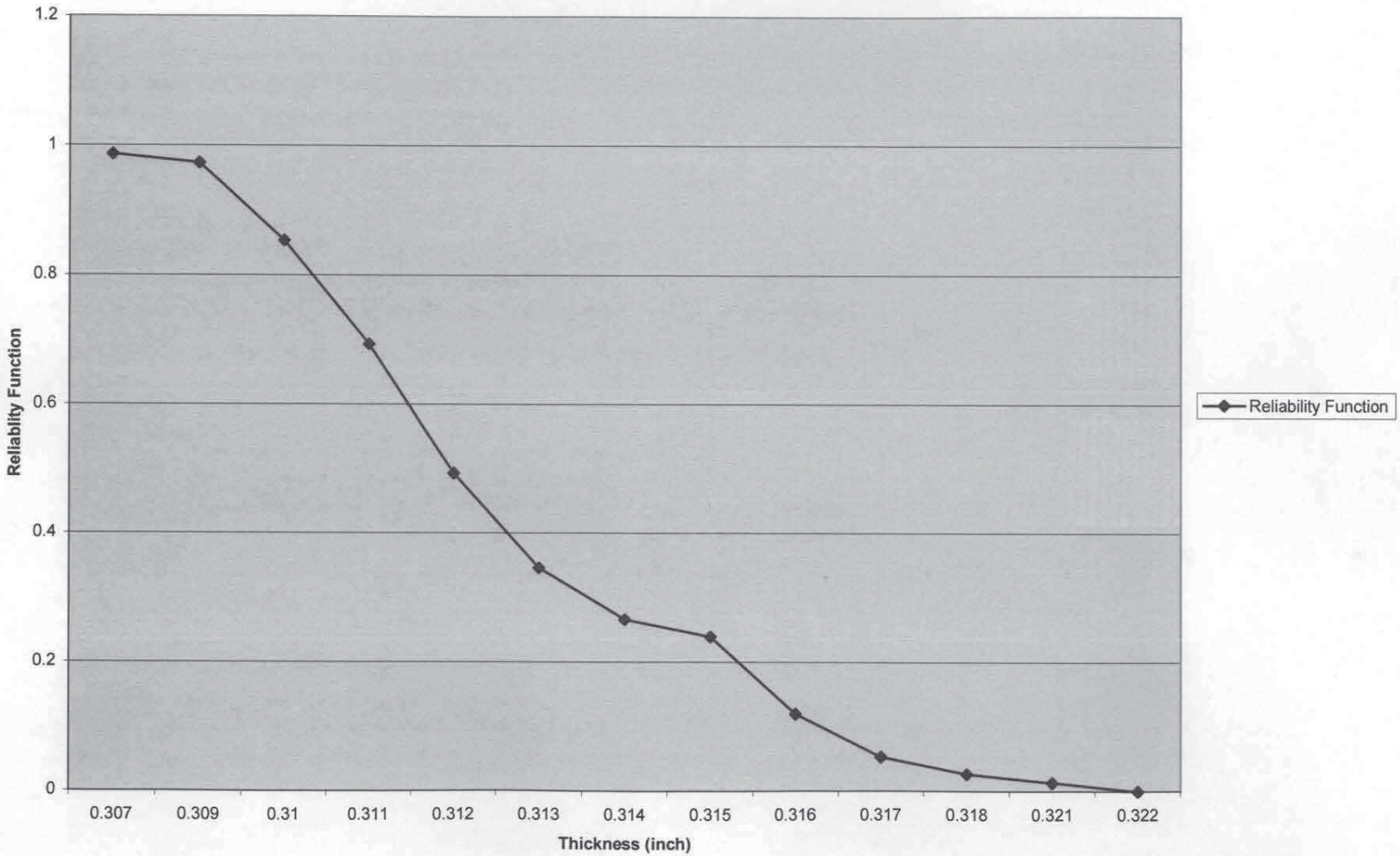

Figure 6C.LOC12.2007.4.Reliability^Area Ratio

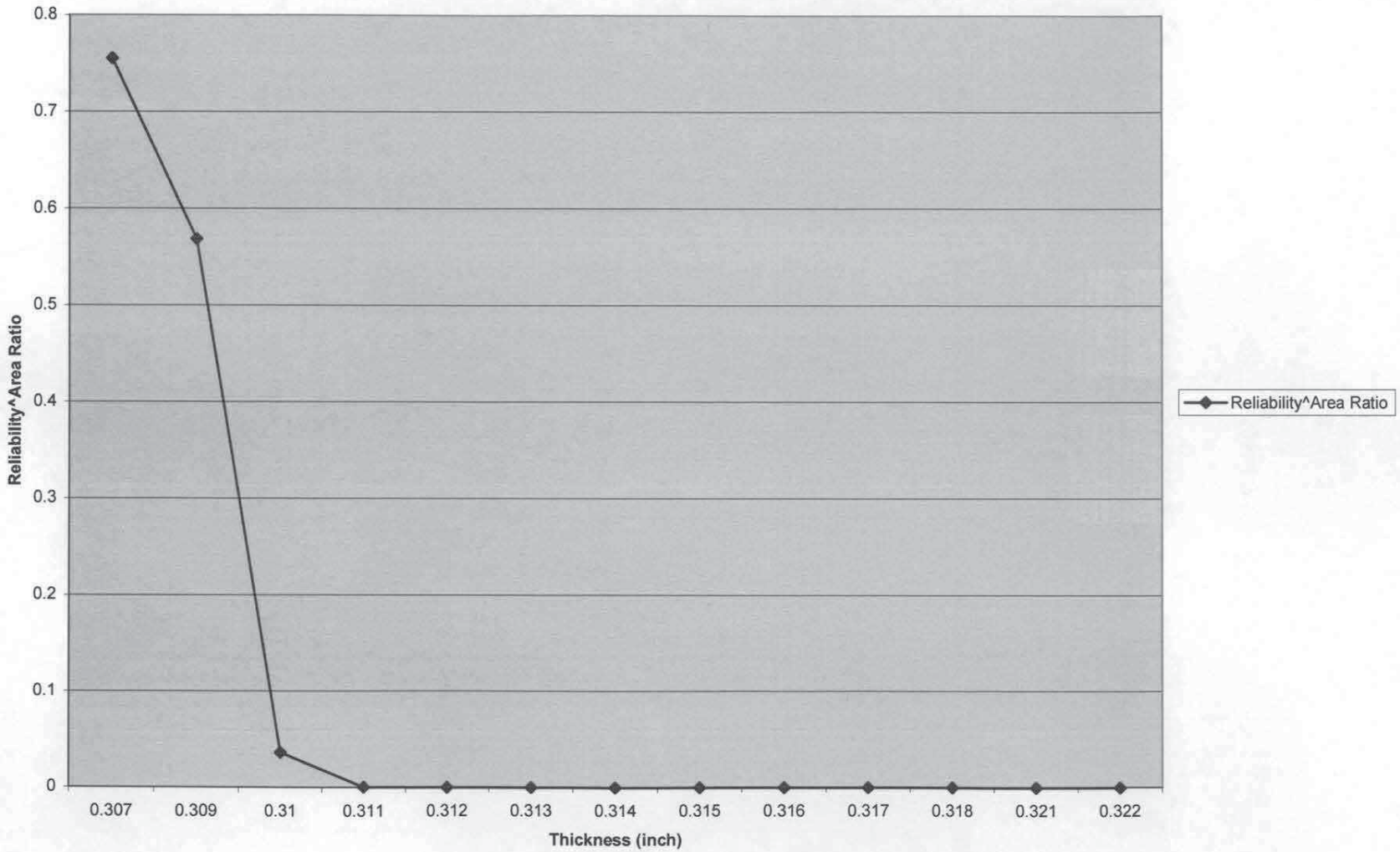

Table 6C.LOC13.1993.1	
Location 13	
Descriptive Statistics	
Mean	0.345358974
Standard Error	0.001170076
Median	0.344
Mode	0.344
Standard Deviation	0.007307124
Sample Variance	5.33941E-05
Kurtosis	0.597913796
Skewness	0.859052861
Range	0.032
Minimum	0.334
Maximum	0.366
Sum	13.469
Count	39
Largest(1)	0.366
Smallest(1)	0.334
Confidence Level(95.0%)	0.002368696

Table 6C.LOC13.1993.2	
Location 13	
Ordered Readings	
Thickness (inch)	*Count*
0.334	1
0.336	2
0.336	3
0.336	4
0.337	5
0.338	6
0.338	7
0.339	8
0.34	9
0.34	10
0.34	11
0.341	12
0.342	13
0.342	14
0.342	15
0.343	16
0.344	17
0.344	18
0.344	19
0.344	20
0.344	21
0.345	22
0.345	23
0.346	24
0.346	25
0.346	26
0.347	27
0.348	28
0.349	29
0.349	30
0.35	31
0.351	32
0.352	33
0.355	34
0.355	35
0.356	36
0.358	37
0.361	38
0.366	39

Table 6C.LOC13.1993.3						
Location 13						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.334	1	0.025641026	0.02564103	0.974359	40.15	0.352439809
0.336	3	0.076923077	0.1025641	0.8974359	40.15	0.012976603
0.337	1	0.025641026	0.12820513	0.8717949	40.15	0.004052538
0.338	2	0.051282051	0.17948718	0.8205128	40.15	0.000355354
0.339	1	0.025641026	0.20512821	0.7948718	40.15	9.93306E-05
0.34	3	0.076923077	0.28205128	0.7179487	40.15	1.66869E-06
0.341	1	0.025641026	0.30769231	0.6923077	40.15	3.87489E-07
0.342	3	0.076923077	0.38461538	0.6153846	40.15	3.42425E-09
0.343	1	0.025641026	0.41025641	0.5897436	40.15	6.20133E-10
0.344	5	0.128205128	0.53846154	0.4615385	40.15	3.29966E-14
0.345	2	0.051282051	0.58974359	0.4102564	40.15	2.91591E-16
0.346	3	0.076923077	0.66666667	0.3333333	40.15	6.98752E-20
0.347	1	0.025641026	0.69230769	0.3076923	40.15	2.80982E-21
0.348	1	0.025641026	0.71794872	0.2820513	40.15	8.54134E-23
0.349	2	0.051282051	0.76923077	0.2307692	40.15	2.70758E-26
0.35	1	0.025641026	0.79487179	0.2051282	40.15	2.3927E-28
0.351	1	0.025641026	0.82051282	0.1794872	40.15	1.12357E-30
0.352	1	0.025641026	0.84615385	0.1538462	40.15	2.30564E-33
0.355	2	0.051282051	0.8974359	0.1025641	40.15	1.96337E-40
0.356	1	0.025641026	0.92307692	0.0769231	40.15	1.89193E-45
0.358	1	0.025641026	0.94871795	0.0512821	40.15	1.61107E-52
0.361	1	0.025641026	0.97435897	0.025641	40.15	1.32199E-64
0.366	1	0.025641026	1	0	40.15	0
Total	39					

Figure 6C.LOC13.1993.1.Ordered Thickness Readiings

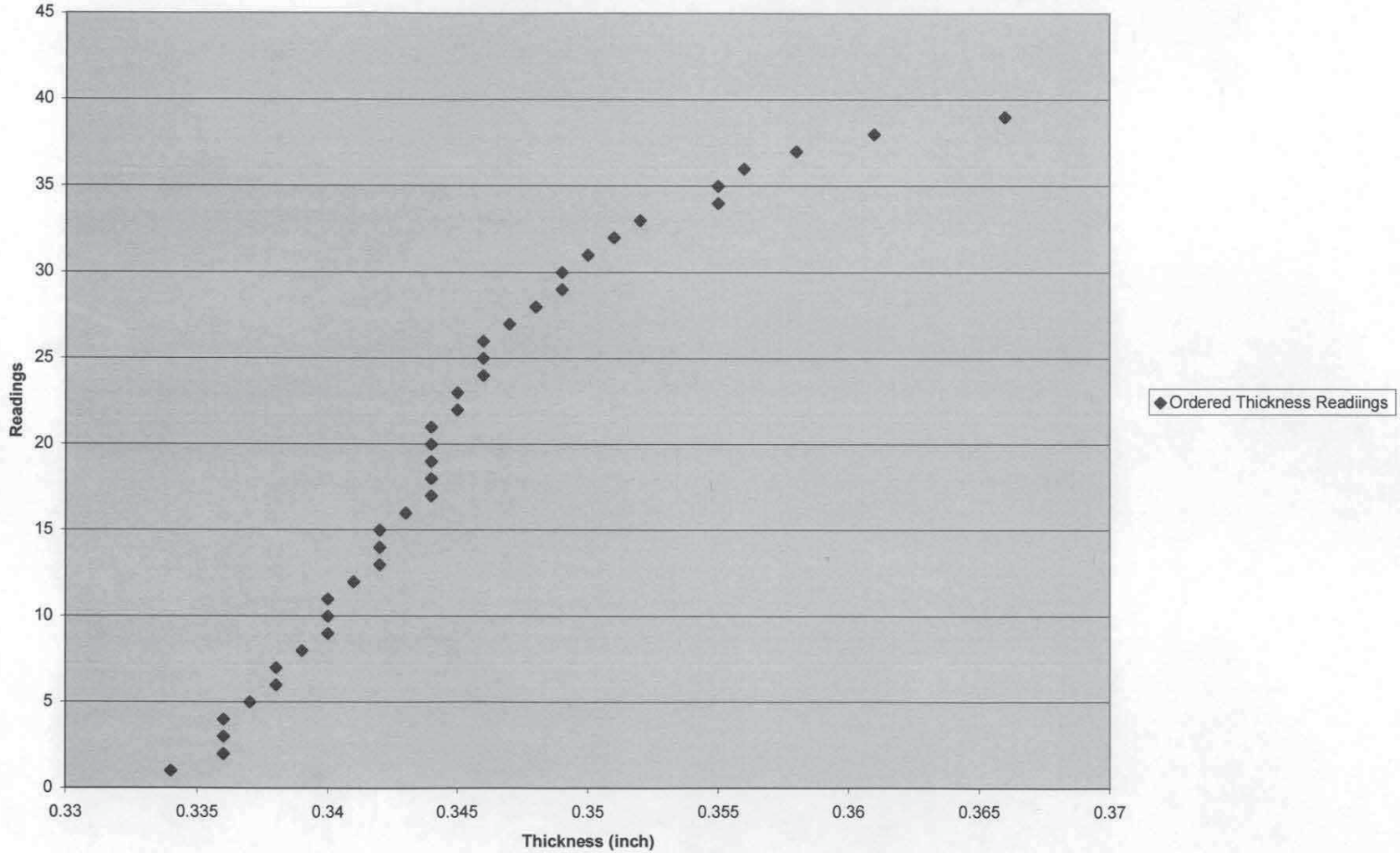

Figure 6C.LOC13.1993.2.Normalized Frequency Distribution

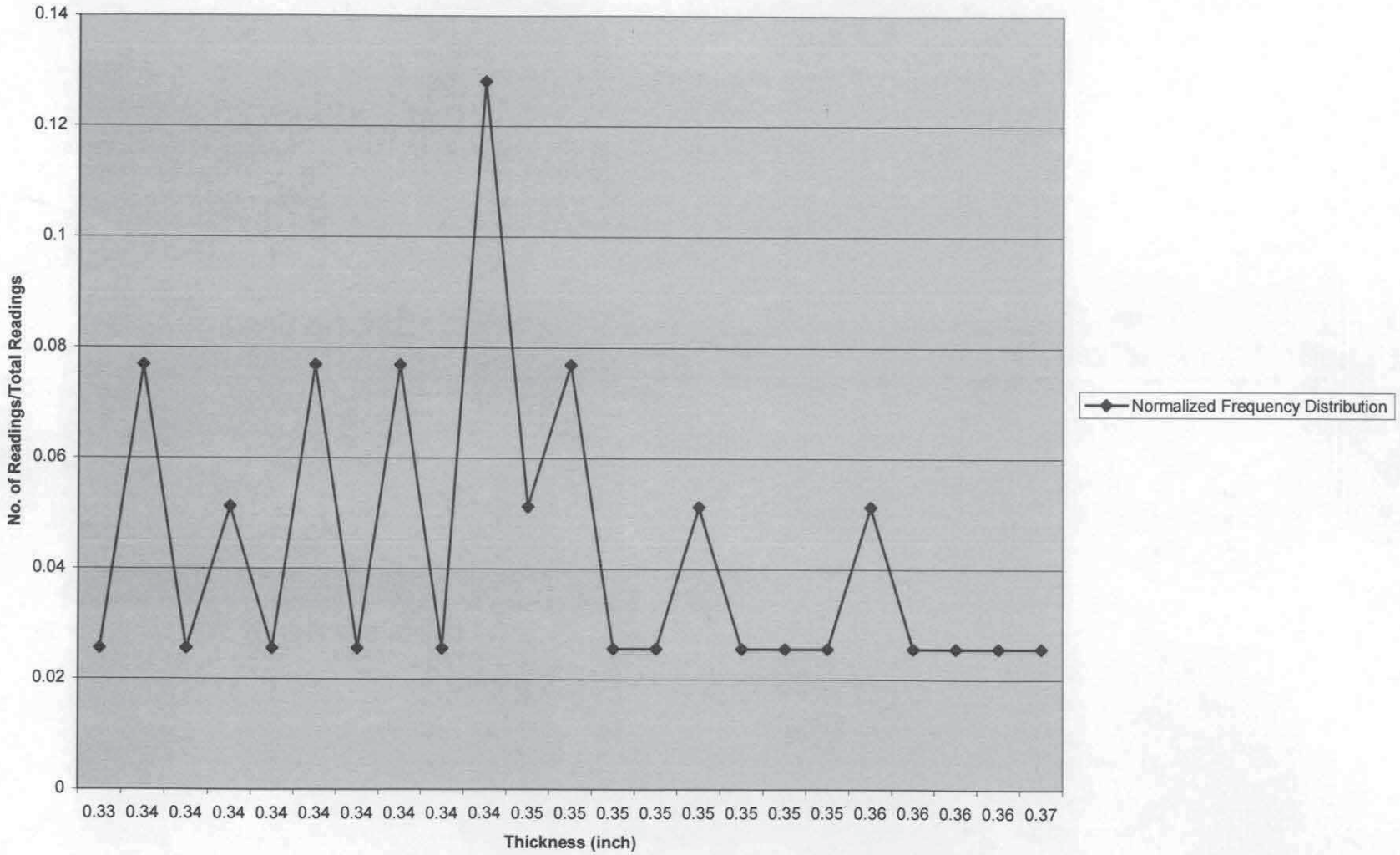

Figure 6C.LOC13.1993.3.Reliability Function

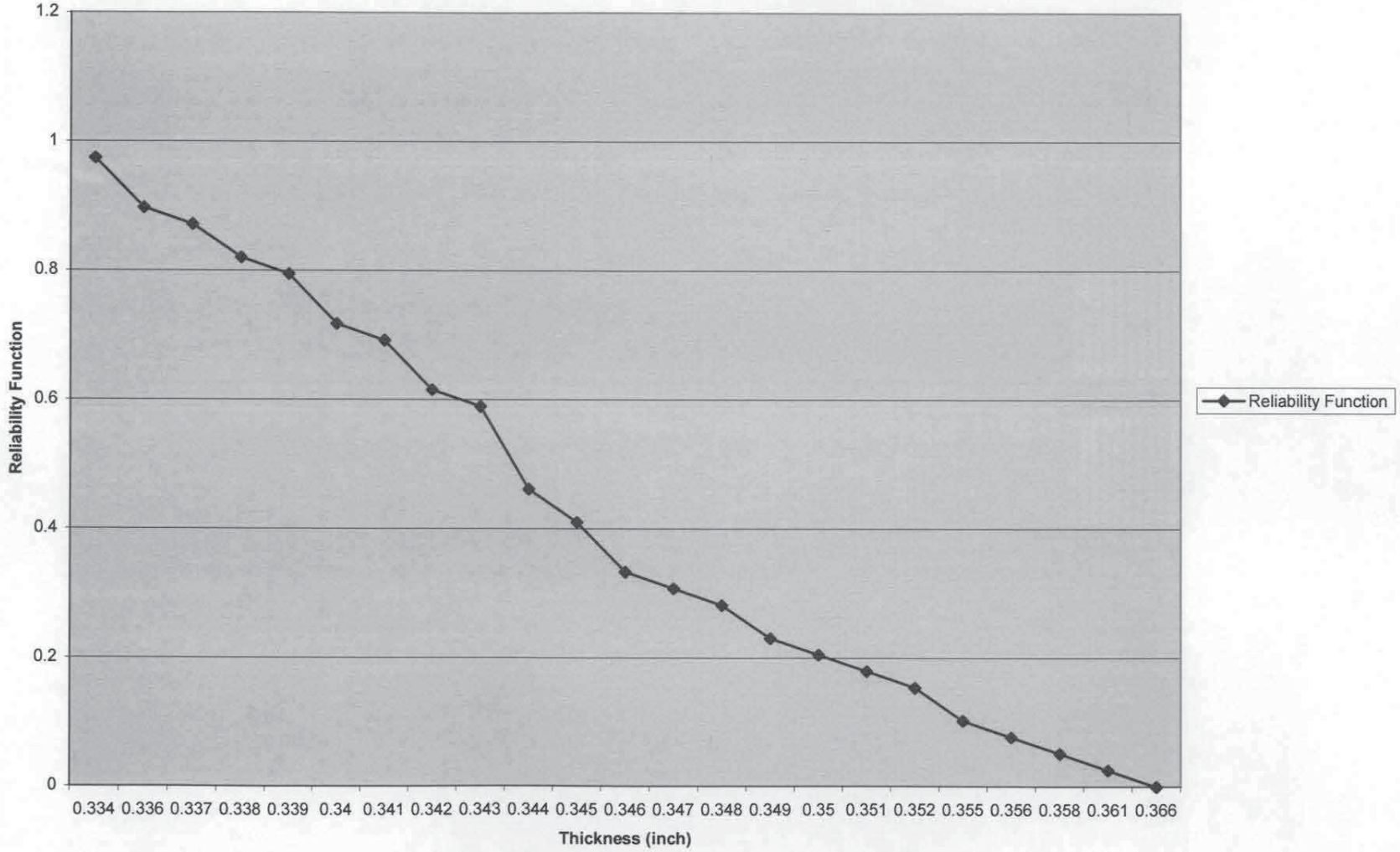

Figure 6C.LOC13.1993.4.Reliability^Area Ratio

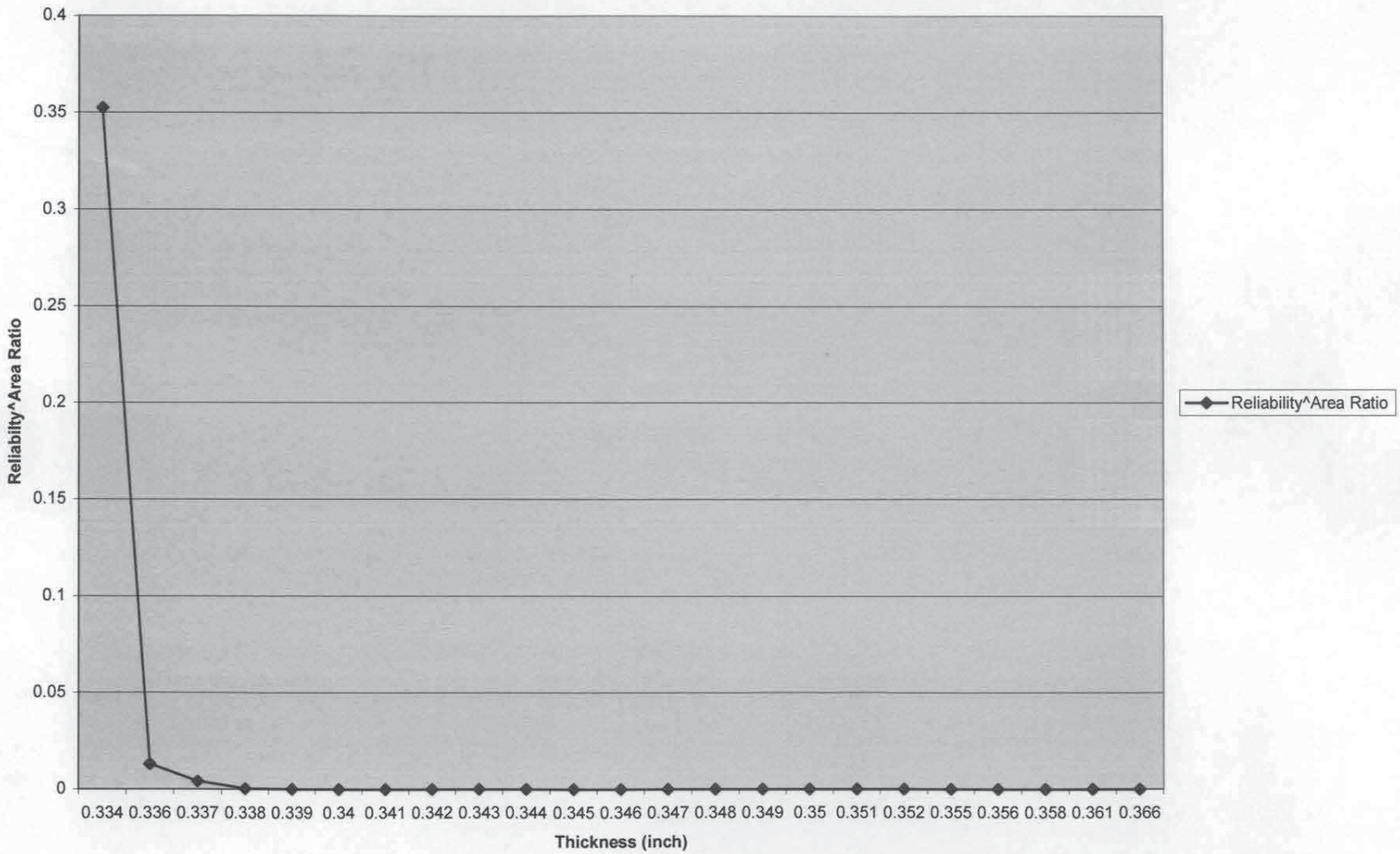

Table 6C.LOC13.1998.1	
Location 13	
Descriptive Statistics	
Mean	0.340820513
Standard Error	0.001309094
Median	0.339
Mode	0.341
Standard Deviation	0.008175289
Sample Variance	6.68354E-05
Kurtosis	-0.798551498
Skewness	0.380071171
Range	0.032
Minimum	0.328
Maximum	0.36
Sum	13.292
Count	39
Largest(1)	0.36
Smallest(1)	0.328
Confidence Level(95.0%)	0.002650122

Table 6C.LOC13.1998.2	
Location 13	
Ordered Readings	
Thickness (inch)	*Count*
0.328	1
0.328	2
0.33	3
0.331	4
0.332	5
0.332	6
0.332	7
0.333	8
0.334	9
0.334	10
0.334	11
0.336	12
0.336	13
0.336	14
0.337	15
0.338	16
0.338	17
0.338	18
0.339	19
0.339	20
0.34	21
0.34	22
0.341	23
0.341	24
0.341	25
0.343	26
0.347	27
0.348	28
0.348	29
0.349	30
0.349	31
0.35	32
0.35	33
0.351	34
0.351	35
0.352	36
0.352	37
0.354	38
0.36	39

Table 6C.LOC13.1998.3						
Location 13						
Frequency and Reliability Statistical Analysis						
Thickness (inch)	*Frequency Distribution*	*Normalized Frequency Distribution*	*Cumulative Distribution*	*Reliability Function*	*Area Ratio*	*Reliability Function^Area Ratio*
0.328	2	0.051282051	0.05128205	0.9487179	40.15	0.120806629
0.33	1	0.025641026	0.07692308	0.9230769	40.15	0.040211978
0.331	1	0.025641026	0.1025641	0.8974359	40.15	0.012976603
0.332	3	0.076923077	0.17948718	0.8205128	40.15	0.000355354
0.333	1	0.025641026	0.20512821	0.7948718	40.15	9.93306E-05
0.334	3	0.076923077	0.28205128	0.7179487	40.15	1.66869E-06
0.336	3	0.076923077	0.35897436	0.6410256	40.15	1.76339E-08
0.337	1	0.025641026	0.38461538	0.6153846	40.15	3.42425E-09
0.338	3	0.076923077	0.46153846	0.5384615	40.15	1.60797E-11
0.339	2	0.051282051	0.51282051	0.4871795	40.15	2.892E-13
0.34	2	0.051282051	0.56410256	0.4358974	40.15	3.32537E-15
0.341	3	0.076923077	0.64102564	0.3589744	40.15	1.36927E-18
0.343	1	0.025641026	0.66666667	0.3333333	40.15	6.98752E-20
0.347	1	0.025641026	0.69230769	0.3076923	40.15	2.80982E-21
0.348	2	0.051282051	0.74358974	0.2564103	40.15	1.86069E-24
0.349	2	0.051282051	0.79487179	0.2051282	40.15	2.3927E-28
0.35	2	0.051282051	0.84615385	0.1538462	40.15	2.30564E-33
0.351	2	0.051282051	0.8974359	0.1025641	40.15	1.96337E-40
0.352	2	0.051282051	0.94871795	0.0512821	40.15	1.61107E-52
0.354	1	0.025641026	0.97435897	0.025641	40.15	1.32199E-64
0.36	1	0.025641026	1	0	40.15	0
Total	39					