

## I<sup>3</sup>SYSTEM Biometric A-scan Procedure (Software Version 3.30)

- 1) **POWER:** Press the front panel switch and an indicator will light. The I<sup>3</sup> power-up screen will appear after self-test. It does not matter if there is a disk in the floppy or Zip drive.
- 2) **ENTER PATIENT-SPECIFIC DATA:** From the Power Up Screen or the Internal A-Scan Menu press "N" to switch to the New Patient Screen. Enter the patient's last name or chart number, which is used to automatically create file names when storing scans to disk. Press **ENTER** to continue, and then press "D" or "S" to tag the operative eye. Enter the remaining patient-specific IOL calculations input data.
- 3) **SELECT OPERATOR:** The cursor moves automatically into the operator field after all of the patient data has been entered. The default operator, if any, will be present. To select a different operator use either ↑, the arrow keys, or "N" and "P" to scroll through the list of available operators. To add a new operator press "O" to switch to the Operator Database Screen.
- 4) **SELECT SURGEON:** The cursor moves automatically into the surgeon field after the operator name has been entered. Use the arrow keys to select the desired surgeon. To add a new surgeon or modify the IOL data press "S" to switch to the IOL Preferences Database.
- 5) **EXIT TO BIOMETRIC A-SCAN MODE:** After all data has been entered the exit prompts appear at the bottom of the screen. Press "A" to exit to the auto freeze mode or "M" for the manual freeze mode. This is equivalent to pressing the **BIOM AUTO** or **BIOM MAN** mode keys, respectively. Repeated pressing of either mode key will cycle through all biometry eye type modes. The chart below displays all possible eye type modes and the echoes that are required for a valid measurement in each mode.

Biometry Eye Types And Required Echoes	Measurement	Required Echoes		Key To Codes
		MANUAL	AUTO	
Phakic - Type 1	True Phakic	C A P R S	C A P + R S	C = Cornea
Phakic - Type 2		C A P R	C A P R	A = Anterior Lens
Phakic - Average	1550 m/s	C R	C + R S	P = Posterior Lens
Aphakic	1532m/s	C R	C + R S	+ = Retina Shape
Pseudophakic - PMMA	1532m/s +0.4mm	C A R	C A + R S	R = Retina
Pseudophakic - Acrylic	1532m/s +0.2mm	C A R	C A + R S	S = Sclera
Pseudophakic - Silicone	1532m/s -.08mm	C A R	C A + R S	
Pseudophakic - AMO-Si	1532m/s -0.4mm	C A R	C A + R S	

- 6) **AUTO-FREEZE DIAGNOSTICS:** With the Auto-Freeze Diagnostics turned on, the letters CAP+RS will appear in the upper right corner of the display. Each letter indicates an echo that will be required in the current eye type to recognize the scan as valid. A highlighted letter signifies that a valid echo is present. When all required echoes are present, the scan is deemed valid and a measurement is displayed. In Auto-Freeze mode three beeps sound when a scan is frozen automatically.

**RETINA SHAPE:** This Auto-Freeze feature analyzes the rising or leading edge of the retina echo for its smoothness and height. A sharply rising, tall retinal echo indicates sound beam perpendicularity with the retinal surface and is essential for obtaining accurate measurements.

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- 7) **SELECT CALIPER POSITION:** Press **CALIP ON/OFF** to select the desired caliper position: contact, immersion, or child. The caliper (gates) **MUST** be positioned correctly to obtain accurate measurements.
- 8) **BEGIN SCANNING:** Use the foot switch or front panel **SCAN/FREEZE** circle key to activate the probe. The factory-preset gain is 75 dB and may be increased or decreased as needed. Center the probe on the anesthetized cornea to align the sound beam with the patient's visual axis. Occluding the fellow eye may aid fixation on the probe's internal red light.

**SCANNING HINTS:** Even in the automatic mode, it is possible to use the foot switch to freeze any desired scan. Use the auto freeze diagnostics to determine which echoes are not being registered, and adjust your scanning technique accordingly. If it is still difficult to obtain a measurement, manually freeze the scan, move the threshold line up and down, and look for a place where valid scan criteria are met, producing a measurement. If this does not produce a measurement then switch to another similar mode (automatic or manual) to locate one with fewer requirements for a valid scan. Note that manual modes do not include the retina shape or sclera requirements, thus are less restrictive. These techniques may be helpful for patients with various pathologies that reduce the quality of echo pattern.

- 9) **STORING SCANS:** Evaluate the frozen scan to be sure that all required echoes are present, that the retina echo is tall and perpendicular to the baseline, and that the caliper highlights are positioned on the correct echoes. Press **STORE SCAN** to copy the scan to the internal RAM. Up to twenty scans may be stored in the internal RAM. The assigned number of each scan is shown in the upper left corner.

**NOTE:** A-scans stored in the internal memory will be lost if the unit is turned off. The system will prompt you to save the scans to disk during the new patient process (Step 13).

- 10) **REVIEWING AND DELETING STORED SCANS:** From the A-scan image screen, stored scans may be reviewed by using  $\uparrow$  to cycle through the stored scans. Inferior scans may be deleted using **"D"** while the review prompts are visible in the upper right corner of the display. Press **RECALL CALC** to display the Internal A-Scan Menu in order to view the list of stored scans, view calculations or print reports.
- 11) **HOLLADAY-I IOL CALCULATIONS:** After all required data have been entered in the new patient screen Holladay IOL-I calculations are performed automatically on biometry scans in the Internal A-Scan Menu. You may view the calculation results on screen by selecting the desired scan and pressing **"I"** from the Internal A-Scan Menu. Refer to the prompts at the bottom of the screen for available options.
- 12) **PRINTING AN INDIVIDUAL SCAN AND IOL CALCULATION:** While the IOL calculations results are displayed, press **"P"** to print the currently selected scan with its calcs.
- 13) **SELECT (TAG) ONE OR TWO EYES FOR PRINTING:** While reviewing scans for both eyes, note which ones are to be used to print an IOL calculations report. From either the review mode or the Internal A-Scan Menu press **"T"** to tag the desired biometry scans for printing.
- 14) **PRINTING A REPORT WITH TWO A-SCANS AND CALCULATIONS:** From the Internal A-Scan Menu press **"P"** for print IOL report. The previously tagged scans will be printed on the dot-matrix printer. If unusual values (e.g. a long or short eye) are present a warning is printed on the bottom of the 1<sup>st</sup> page.
- 15) **PREPARING FOR A NEW PATIENT:** Make sure a disk is in the drive to save the previous patient's data. From the Internal A-Scan Menu press **"N"** to begin the New Patient Process. Press **"Y"** in response to the "Save Previous Patient Data?" prompt to store the current patient's scans and associated calcs to disk. Press **"Y"** again in response to the "Clear Previous Patient Data?" prompt to clear the New Patient Screen and reload the default operator and surgeon. Continue from step 2) of this procedure.

## I<sup>3</sup>SYSTEM IOL Preferences Storage (Software Version 3.30)

The IOL Preferences Database is used to store lists of A-Constant/SF data for individual surgeons. Up to twenty surgeons with eight lenses each, or more surgeons with fewer lenses, may be stored. The IOL Preferences Database is reached from either the Biometry Functions Menu or from the New Patient Screen by typing "S", and then "S" again.

### ADDING IOL PREFERENCES DATA FOR A NEW SURGEON:

- 1) Press "A" to add a new surgeon. Enter up to 21 characters in the name field.
- 2) Press "Y" to switch automatically to the Lens Data Edit Menu. The first lens is automatically created and opened for editing. Proceed to entering IOL data, step 2), below.
- 3) Press "T" to 'tag' one of the surgeons as the default. That surgeon and all of the corresponding ACTIVE lenses will be automatically copied into the New Patient Screen during the new patient process.
- 4) If no surgeon is tagged as the default you must manually select a surgeon for each patient in order to complete IOL calculations.

### ENTERING IOL DATA:

- 1) Press "A" to add a new lens. Enter up to twenty-two characters to identify the lens.
- 2) Press **ENTER** to move the cursor to any IOL constant field (A-Constant, SF, or ACD).
- 3) Enter the desired IOL constant. The complementary constants are automatically calculated and filled in.
- 4) Press **ENTER** to step through the remaining constants until the menu prompts re-appear.
- 5) Note that the lens is automatically tagged as ACTIVE upon creation. Press "T" to toggle the active status of the current lens. Only active lenses are automatically copied into the New Patient Screen with the corresponding surgeon data record.

## I<sup>3</sup>SYSTEM Operator Name Storage

Up to eight operator names may be stored in the Operator Database, which is reached from either the Biometry Functions Menu or the from the New Patient Screen by typing "O", "O".

### ENTERING OPERATOR NAMES:

- 1) Press "A" to add an operator name. Enter up to 18 characters.
- 2) Press "T" to 'tag' a default operator. If an operator is tagged as the default, then that name will be automatically copied into the New Patient Screen during the new patient process, otherwise the operator name field will be left blank.

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## **I<sup>3</sup>SYSTEM Holladay-1™ IOL Retrospective Database**

The retrospective database is used to customize the IOL constant in order to obtain the most accurate results possible. Post operative results for a given surgeon/lens combination are entered, resulting in a customized Surgeon Factor.

### **ADDING A NEW LIST OF RETROSPECTIVE CASES:**

- 1) Press "A" to add a new retrospective caselist. Enter the surgeon name and lens description.
- 2) Press "Y" to switch automatically to the case data edit menu. The first case is automatically created and opened for editing. Proceed to Entering Retrospective Data, Step 2), below.

### **ENTERING RETROSPECTIVE CASE DATA:**

- 1) Press "A" to add a new IOL case.
- 2) Enter the preoperative AXL and K's, the stabilized post-operative refraction, and the lens power used.

## **I<sup>3</sup>SYSTEM IOL Data Backup/Restore Command**

The backup database command backs up all user data to a disk file. Saved data includes setup menu default values, IOL preferences data, system operator data, and the Holladay-1™ IOL retrospective data.

### **BACKING UP DATA:**

- 1) Visit the Diskette Menu, and display the contents of the desired disk or folder
- 2) Press "O" to display more commands, then "B", then "B" again, to backup data to the file 'I3SETUP.DAT'.
- 3) In a busy practice it may be desirable to use a separate floppy disk for each surgeon, allowing complete customization of the instrument for each operator and/or surgeon.

### **RESTORING DATA:**

- 1) Visit the Diskette Menu, and display the disk or folder containing the backup file 'I3SETUP.DAT'.
- 2) Press "B", then "R" to invoke the restore database command.
- 3) Press "A" to restore all data, or select an individual database using the menu prompts.

## I<sup>3</sup> SYSTEM 10 MHz B-scan Procedure (Software Version 3.30)

- (1) **POWER:** Press the front panel switch and an indicator will light. The I<sup>3</sup> power-up screen will appear after self-test. It does not matter if there is a diskette in the floppy or Zip drive.
- (2) **SELECT B-SCAN MODE:** B-scans are displayed with a simultaneous Cross Vector A-scan by pressing **B+CV** or without by pressing **B-CV**. The probe will run for a moment. The white alignment mark on the probe corresponds to the top of the screen.
- (3) **ENTER PATIENT NAME AND EYE:** Type the patient's last name or chart number, which is used to create file names when storing scans to disk. Example: KENDALL C. To change the eye notation, press **ENTER** to move the cursor to the "**D**" of the preset **OD** eye field. Type "**S**" for left eye. Press **BACK SPACE** several times to move the cursor into the space next to the patient data to allow entry of probe orientation notes.
- (4) **CLEANING THE PROBE:** After each exam, clean the probe with an alcohol prep. Dried gel may be removed by rinsing the probe tip with warm water. Do not submerge or autoclave.
- (5) **BRIGHTNESS:** Keep background brightness high in order to properly see and photograph vitreous echoes. The cone of B-scan image should always be brighter than the surrounding background.
- (6) **BEGIN SCANNING:** Use the foot switch or front panel **SCAN/FREEZE** circle key to activate the probe. When scanning is complete, freeze the image to stop the probe.
- (7) **IMAGE POST PROCESSING:** The image processor is preset to **LOG**, which provides maximum gray scale. The notation is displayed next to the gain. Repeatedly pressing the **IMAGE PROC** key will cycle the system through the **S-1, S-2, S-3** functions and back to **LOG**. This results in an image with more contrast, which may be useful for muscles, tumor borders, calcium and foreign bodies.
- (8) **IMAGE ADJUSTMENTS:** A frozen or recalled image may be adjusted using **HORIZONTAL, VERTICAL, ZOOM, IMAGE PROC, B+CV, B-CV, or CALIP ON/OFF**.
- (9) **STORING B-SCANS TO DISK:** Pre-formatted disks must be used. Press **STORE SCAN**. The first word of the patient data line is used to create a numbered file name, which increments for each scan stored. After the image has been stored, the notations **↑ NEXT SCAN** and **D=DEL** will appear in the upper right corner of the screen. Naming is different for I<sup>3</sup> and TIFF file formats.  
**I<sup>3</sup> Format:** SCAN.1, SCAN.2, . . . Up to eight characters plus a numeric extension  
**TIFF Format:** SCAN01.TIF, SCAN02.TIF, . . . Up to six characters plus "XX.TIF."
- (10) **RECALLING AND DELETING STORED SCANS:** From the B-scan image screen, scans may be sequentially recalled using the **↑** key and deleted using the "**D**" key when the prompts appear in the upper right corner of the display. This is also possible from the **RECALL/CALC** menu.

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## Electronic B-mode Cross-Hair Measurements

- (1) **TURN ON CALIPERS:** From either **B-CV** or **B+CV** modes, press **CALIP ON/OFF** to introduce two cross-hair calipers. The left caliper will blink indicating it may be moved. The **THRESHOLD** and **CALIPER** knobs move the caliper up/down and right/left respectively.
- (2) **CALIPER SELECTION:** Press **CALIP SELECT** to make the caliper of choice blink. It will automatically stop blinking after several seconds. Only a blinking caliper may be moved. Position it with the **THRESHOLD** and **CALIPER** knobs. The distance between the center of each cross is continuously displayed under the patient data line.
- (3) **CALIPER COLOR:** When positioned in a dark area of the B-scan, the cross-hair caliper is white. When in an area of bright echoes, it will automatically turn black.
- (4) **VELOCITY:** The preset tissue velocity is 1550 m/s. Another value may be entered by pressing the red **ENTER** key until the cursor moves into the field. Type in a new value and the calculated measurement will automatically appear. The range of valid measurement speeds is from 1 to 2999m/s.

## Cross Vector A-scan Measurements

- (1) **SELECTING AN A-SCAN:** In the **B+CV** mode, the black line in the scan indicates which A-scan has been removed and displayed below. Turn the **CV-A** control to select the desired A-scan. An **IMAGE PROC** function of **S-1**, **S-2**, or **S-3** may enhance the A-mode echoes for easier identification. Use the **VERTICAL** control to superimpose the B-scan image onto the A-scan for verification of which echoes are to be measured.
- (2) **TURN ON CALIPERS:** Pressing **B+CV** will toggle between the B-scan with the vector A-scan and the vector A-scan alone. The A-scan by itself is a fixed image size, not affected by the zoom. A threshold line will be present with the first electronic dot caliper blinking and ready to be positioned on a leading or falling A-scan echo edge.
- (3) **CALIPER SELECTION:** Press the **CALIP SELECT** key to make the caliper of choice blink. It will automatically stop blinking after several seconds. Only a blinking caliper may be moved. Position it at least 2mm below the peak of the echo edge to be measured using the **THRESHOLD** and **CALIPER** knobs. When the first echo edge is detected, **CALIP 1** in the top left of the display will become highlighted. Select the other caliper to make it blink and position it at least 2mm below the peak of the echo to be measured. Calipers should be placed at the same distance from the peak on each echo. When properly positioned **CALIP 2** will highlight and a measurement is displayed. No measurement indicates an improperly positioned caliper.
- (4) **VELOCITY:** The preset tissue velocity is 1550 m/s. Another value may be entered by pressing the red **ENTER** key until the cursor moves into the field. Type in a new value and the calculated measurement will automatically appear. The range of valid measurement speeds is from 1 to 2999m/s.
- (5) **PERFORMING ADDITIONAL B-SCANS:** Press **B-CV** or **B+CV** to return to the B-scan display. Depress the foot switch to activate the probe and continue scanning.

## Basic Examination Protocol for Diagnostic B-scan

(See back for schematic showing labeling system)

- Position #1**
- (1) Horizontal Transverse – Probe Marker Nasal
  - (2) Place probe at 6:00 limbus with the patient looking up
  - (3) Locate the optic nerve void (shadow)
  - (4) Top of screen is NASAL, bottom of screen is TEMPORAL
  - (5) Slowly sweep the probe inferiorly, thereby sweeping the acoustic section superiorly
  - (6) Scans are labeled 12:00, with notation of exact position (e.g. posterior, equator, ora serrata, etc. – see diagram on next page)
- Position #2**
- (1) Vertical Transverse – Probe Marker Superior
  - (2) Place probe at temporal limbus with the patient looking nasally
  - (3) Locate the optic nerve void
  - (4) Top of screen is SUPERIOR, bottom of screen is INFERIOR
  - (5) Slowly sweep the probe temporally, sweeping the acoustic section nasally
  - (6) OD scans are labeled 3:00 with notation of exact position;  
OS scans are labeled 9:00 with notation of exact position (see diagram)
- Position #3**
- (1) Horizontal Transverse – Probe Marker Nasal
  - (2) Place probe at 12:00 limbus with the patient looking down
  - (3) Locate the optic nerve void
  - (4) Top of screen is NASAL, bottom of screen is TEMPORAL
  - (5) Slowly sweep the probe superiorly, sweeping the acoustic section inferiorly
  - (6) Scans are labeled 6:00 with notation of exact position (see diagram)
- Position #4**
- (1) Vertical Transverse – Probe Marker Superior
  - (2) Place the probe at nasal limbus with the patient looking temporally
  - (3) Locate the optic nerve void
  - (4) Top of screen is SUPERIOR, bottom of screen is INFERIOR
  - (5) Slowly sweep the probe nasally, sweeping the acoustic section temporally
  - (6) OD scans are labeled 9:00 with notation of exact position;  
OS scans are labeled 3:00 with notation of exact position (see diagram)
- Position #5**
- (1) Longitudinal of the Macula – Probe Marker Toward the Cornea
  - (2) Place probe nasally with patient looking temporally
  - (3) Locate optic nerve void at bottom of screen, and lateral rectus muscle
  - (4) Top of screen is ANTERIOR PERIPHERY, bottom of screen is OPTIC NERVE
  - (5) OD – Marker toward 9:00 • OD scans are labeled L9 MAC  
OS – Marker toward 3:00 • OS scans are labeled L3 MAC

### Additional Longitudinal Scans

Each clock hour may be scanned longitudinally in order to determine the anterior / posterior extent of a lesion or detachment, and to look for the insertions of membranes. This position allows the acoustic section to be better aligned with many membranes than with transverse scans. Each meridian is scanned by having the patient look to the clock hour to be examined and the probe is placed opposite with the marker directed toward that meridian. The image is displayed with the optic nerve at the bottom of the screen and the anterior periphery at the top of the screen.

### Additional Transverse Scans – Oblique

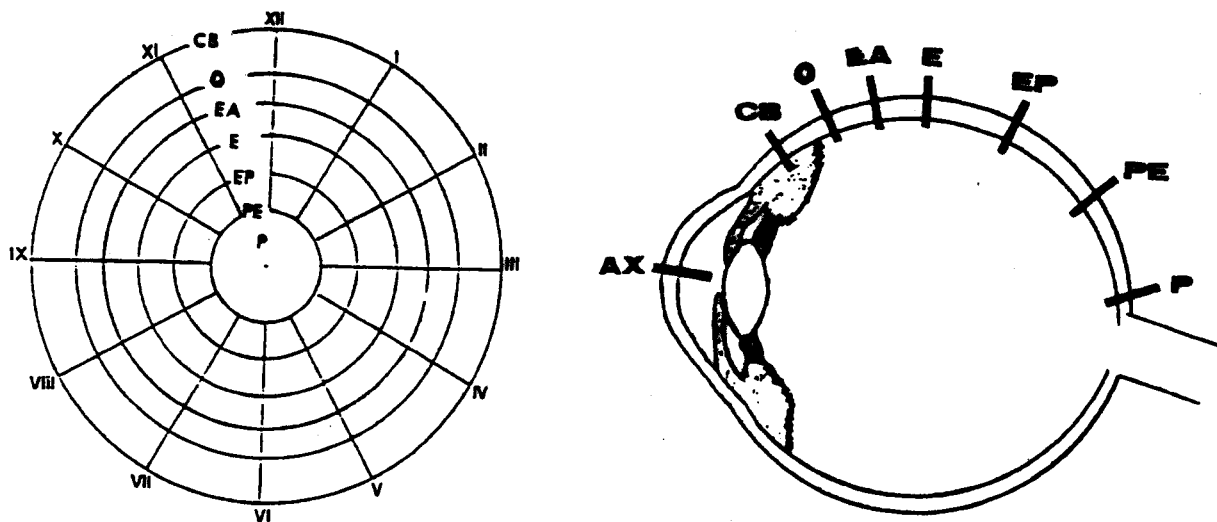
These scans are used to center a lesion within the acoustic section when located away from 12:00, 3:00, 6:00, and 9:00. For optimal imaging and measurement, lesions should always be centered in the image.

### Axial Scans

Axial scans are used primarily to document the presence of a lesion relative to the lens and optic nerve. Axial scans may be horizontal, vertical, or oblique. However, both a crystalline and an intraocular lens will interfere with the transmission of sound causing artifacts in the echogram. The natural lens may cause pseudo elevations of the peripheral retina due to refraction of the sound beam. An IOL will cause significant reverberation artifacts (multiple signals) throughout the vitreous cavity. Therefore, most diagnostic B-scans are performed using transverse and longitudinal scans, thus avoiding the lens.

Horizontal – probe marker nasal, placed on center of cornea with the patient in primary gaze. Center posterior lens capsule and optic nerve. Macula is just below (temporal) to the optic nerve. The scan is labeled HAX.

Vertical – probe marker superior, placed on the center of the cornea with the patient in primary gaze. Center the posterior lens capsule and optic nerve. Macula is not in this scan plane. The scan is labeled VAX. Shifting sound plane slightly temporally produces a vertical macula scan without optic nerve and is labeled VMAC.



Acoustic Section Labeling Diagram Courtesy of: Sandra Frazier Byrne, Director of COMS Echography Center

For a more detailed description of these techniques, refer to the book:

Ultrasound of the Eye and Orbit by Sandra Frazier Byrne and Ronald L. Green, MD – Mosby Year-Book Inc. – St. Louis, MO (800) 426-4545  
Ophthalmic Echography by Cynthia Kendall, BMET, RDMS, ROUB – Slack Inc. – Thorofare, NJ (800) 257-8290



## HOLLADAY IOL CALCULATION FORMULA

### IOL CALCULATION CONVERSION TABLE

A-Constant SRK I, II, T	S-Factor Holladay	Postop ACD Binkhorst	A-Constant SRK I, II, T	S-Factor Holladay	Postop ACD Binkhorst
114	-1.04	2.63	117.6	1.00	4.73
114.1	-.98	2.69	117.7	1.05	4.79
114.2	-.93	2.75	117.8	1.11	4.85
114.3	-.87	2.81	117.9	1.17	4.91
114.4	-.82	2.86	118	1.22	4.96
114.5	-.76	2.92	118.1	1.28	5.02
114.6	-.70	2.98	118.2	1.34	5.08
114.7	-.64	3.04	118.3	1.39	5.14
114.8	-.59	3.10	118.4	1.45	5.20
114.9	-.53	3.16	118.5	1.51	5.26
115	-.48	3.21	118.6	1.56	5.32
115.1	-.42	3.27	118.7	1.62	5.37
115.2	-.36	3.33	118.8	1.68	5.43
115.3	-.31	3.39	118.9	1.73	5.49
115.4	-.25	3.45	119	1.79	5.55
115.5	-.19	3.51	119.1	1.85	5.61
115.6	-.14	3.56	119.2	1.90	5.66
115.7	-.08	3.62	119.3	1.96	5.72
115.8	-.02	3.68	119.4	2.02	5.78
115.9	.03	3.74	119.5	2.07	5.84
116	.09	3.80	119.6	2.13	5.90
116.1	.15	3.86	119.7	2.19	5.96
116.2	.20	3.91	119.8	2.24	6.02
116.3	.26	3.97	119.9	2.30	6.07
116.4	.32	4.03	120	2.36	6.13
116.5	.37	4.09			
116.6	.43	4.15			
116.7	.49	4.21			
116.8	.54	4.26			
116.9	.60	4.32			
117	.66	4.38			
117.1	.71	4.44			
117.2	.77	4.50			
117.3	.83	4.56			
117.4	.88	4.62			
117.5	.94	4.67			