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1- OVERVIEW

In this procedure, the strength of the gradient fields are calibrated by modifying the control variables **cfxfull**, **cfyfull**, and **cfzfull**. A separate scan will be taken to calibrate each of the three gradient fields (x, y, and z). For **TwinSpeed**, the whole procedure must be repeated for each gradient mode (**GradMode**) separately, **Whole-Body** (WB) and **Zoom** (ZM) gradients.

For Mobile MR Systems, see Appendix B for the system-specific procedure. This procedure is to be performed after a Mobile MR System move, at the beginning of the day, or any time shim is suspected of affecting image quality.

Note

This procedure must be performed prior to Grafidy and Main Shimming calibrations.

2- SETUP

2-1 Tools Required

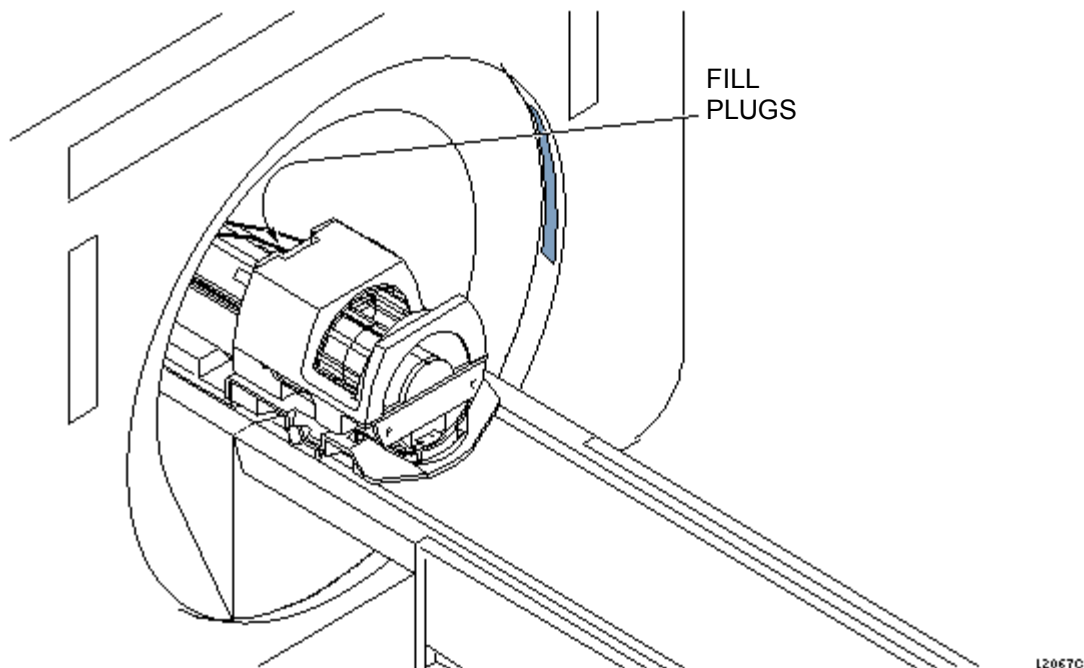
- DQA-III Phantom, 2131027-2

WARNING!

POISON HAZARD! THE PHANTOM CONTAINS NICKEL, A SUSPECT CARCINOGEN. DO NOT INGEST. DISPOSE OF AS A HAZARDOUS WASTE ACCORDING TO STATE AND FEDERAL REGULATIONS.

2-2 Procedure

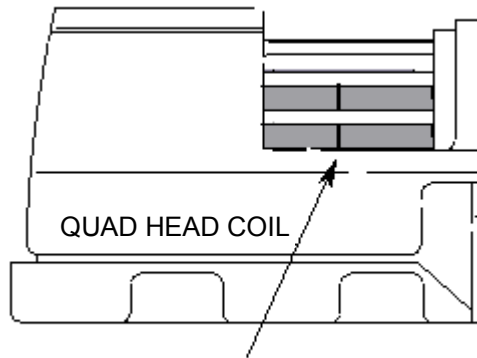
1. Place the DQA-III phantom in the head coil. Position it with the fill plugs up, and toward the rear of the magnet (see Illustration 2-1).



DQA-III PHANTOM POSITIONING
ILLUSTRATION 2-1

2. Landmark in the sagittal and axial planes (DQA-III coronal plane is not at isocenter). See Illustration 2-2 for positioning the phantom in the quad head coil.

Position DQA-III Phantom in the Head Coil.



Landmark the DQA-III Phantom on the Landmark Line.

LANDMARKING DQA-III PHANTOM
ILLUSTRATION 2-2

3. At the keypad on the front magnet enclosure, press **LANDMARK** then **MOVE TO SCAN**.

Note

Do not rotate or skew the phantom in the head coil. This will cause errors in the analysis of Gradient Calibration. Landmark errors can also cause errors in the analysis.

4. Click on **[Autoview]**, just below the Autoview image display screen. Your scanned images will be displayed automatically.

3- X-GRADIENT SCAN

1. At the operator workspace, prepare the system for a Gradcal-X scan using the Service Protocols procedure located on the Service Methods CD-ROM, or for the alternate proprietary procedure, see below.

This alternate proprietary procedure is available for GE use, and to sites with a valid Advanced Service Package Limited License.

- a. Click on **[New Pt]**, and press **Enter**.

Id: **geservice**

Name: **gradient calibration**

Weight (lb.): **111**

Set Patient Protocols to **Service**.

- b. In the Protocol field, type **o.32.1** (o=Other, 1=series number).

- c. For **TwinSpeed**, select **GradMode=WHOLE**.

- d. **[Save Series]**, then **[Prepare to Scan]**.

2. Click on **[Scan]** (the system auto prescans first).

3. Perform Section 6, Gradient Calibration Image Analysis. For **TwinSpeed**, highlight **GradMode=WHOLE** and click on **OK**.

4. For **TwinSpeed**, repeat steps 1b to 3 in this section for the **GradMode=ZOOM**.

4- Y-GRADIENT SCAN

1. At the operator workspace, prepare the system for a Gradcal-Y scan using the Service Protocols procedure located on the Service Methods CD-ROM, or for the alternate proprietary procedure, see below.

This alternate proprietary procedure is available for GE use, and to sites with a valid Advanced Service Package Limited License.

- a. Click on **[New Series]**, and press **Enter**.

Id: **geservice**

Name: **gradient calibration**

Weight (lb.): **111**

Set Patient Protocols to **Service**.

- b. In the Protocol field, type **o.32.2** (o=Other, 2=series number).

- c. For **TwinSpeed**, select **GradMode=WHOLE**.

- d. **[Save Series]**, then **[Prepare to Scan]**.

2. Click on **[Scan]** (the system auto prescans first).

3. Perform Section 6, Gradient Calibration Image Analysis. For **TwinSpeed**, highlight **GradMode=WHOLE** and click on **OK**.
4. For **TwinSpeed**, repeat steps 1b to 3 in this section for the **GradMode=ZOOM**.

5- Z-GRADIENT SCAN

1. At the operator workspace, prepare the system for a Gradcal-Z scan using the "Service Protocols" procedure on the service methods CD-ROM, or for the alternate proprietary procedure, see below.

This alternate proprietary procedure is available for GE use, and to sites with a valid Advanced Service Package Limited License.

- a. Click on **[New Series]**, and press **Enter**.
Id: **geservice**
Name: **gradient calibration**
Weight (lb.): **111**
Set Patient Protocols to **Service**.
- b. In the Protocol field, type **o.32.3** (o=Other, 3=series number).
- c. For **TwinSpeed**, select the **GradMode=WHOLE**.
- d. **[Save Series]**, then **[Prepare to Scan]**.
2. Click on **[Scan]** (the system auto prescans first).
3. Perform Section 6, Gradient Calibration Image Analysis. For **TwinSpeed**, highlight **GradMode=WHOLE** and click on **OK**.
4. For **TwinSpeed**, repeat steps 1b to 3 in this section for the **GradMode=ZOOM**.

6- GRADIENT CALIBRATION IMAGE ANALYSIS

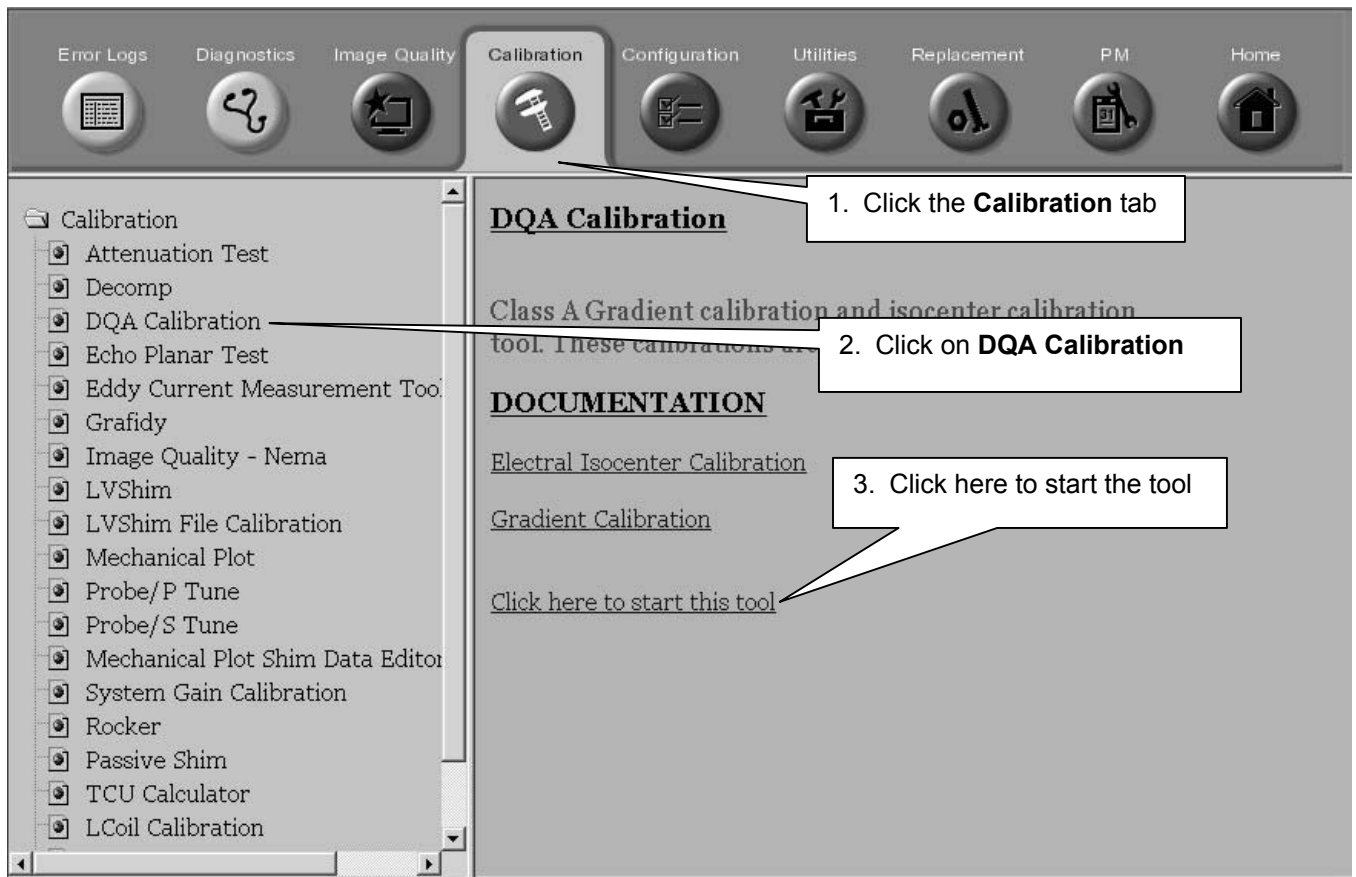
Note

This section describes the procedure for analyzing the x-gradient scan. The procedure for the y-gradient and z-gradient scans is similar.

Note

If the Z measurement is not even close to 100mm, there may be a bubble in the phantom causing the incorrect measurement. Open a C shell and type **setftg** to turn off Fast TG, then rescan the z axis. After the completion of gradcal, type **resetftg** to turn Fast TG back on.

1. To start the DQA Calibration tool, refer to the instructions on Illustration 6-1.



STARTING THE DQA CALIBRATION TOOL
ILLUSTRATION 6-1

Output/Prompts	INPUTS/COMMENTS
<pre>***** ** Welcome to Automated DQA calibration tool ** ***** !! Please perform [Phantom Position] test scan !! Press Return when <Proper Phantom Position> is obtained Press Return when the desired scan(s) is completed [Y]: Accessing information from last run number... Last Exam is: ===== Exam number: 50006 Series number: 1 Series Description: dqa xfield cal Image number: 1 ===== Accept the Default: (Y,N) [Y] : <i>If n was entered at the Accept the Default: prompt, the following:</i> Please enter image key manually. Enter Exam Number [50000] : Enter Series Number [1] : Enter image Number [1] : Accessing image, please wait</pre>	<p>Look at the DQA-III phantom image on the Autoview screen. Be sure it is not skewed more than a few degrees. When the phantom is properly positioned, press <ENTER>.</p> <p><ENTER></p> <p>If the correct image data set is displayed, type y <ENTER>. If not, type n <ENTER>.</p> <p>Enter appropriate Exam number. Enter appropriate Series number. Enter appropriate Image number.</p>

6- GRADIENT CALIBRATION IMAGE ANALYSIS (continued)

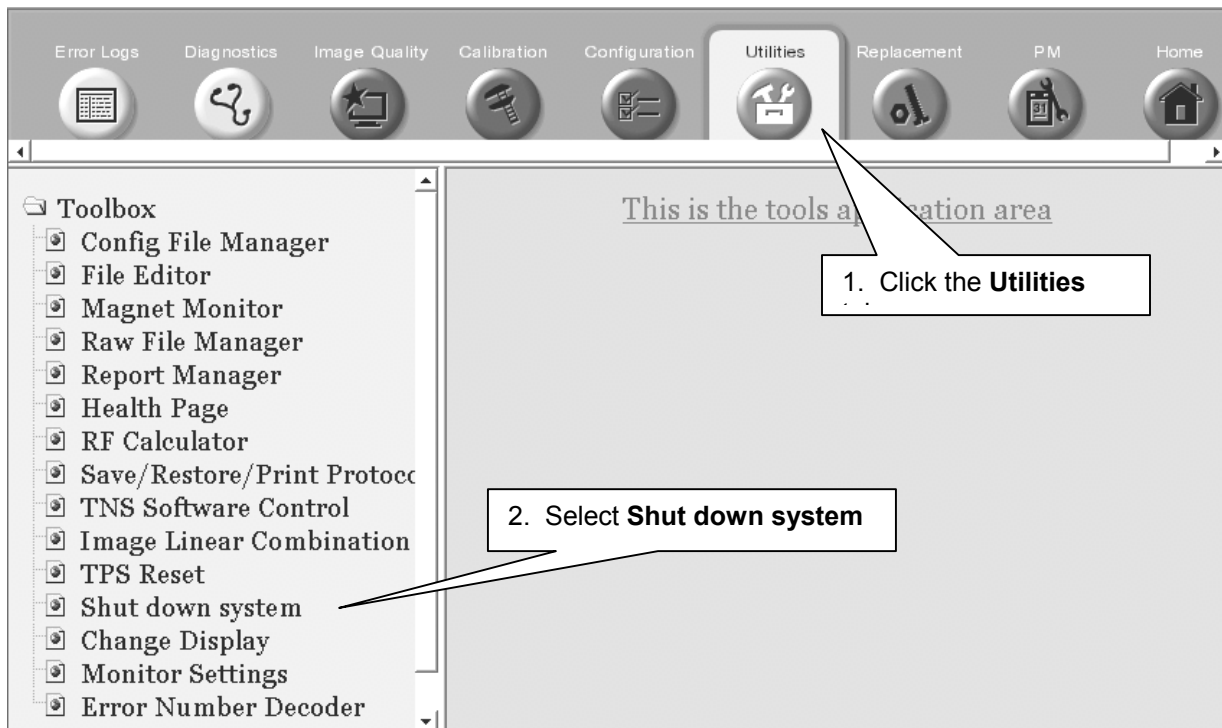
OUTPUT/PROMPTS	INPUTS/COMMENTS
<p><i>If the software does not recognize the "Exam Description," the following is displayed:</i></p> <pre> !!! Unknown Exam Description !!! Please enter test mode manually. Mode 0: Gradient X field Calibration. Mode 1: Gradient Z field Calibration. Mode 2: Gradient Y field Calibration. Mode 3: Isocenter Calibration. Select test mode: (0..6) [0] : ===== == dqa xfield cal analysis in progress == ===== </pre>	<p>Enter 0 for X-Gradient, 1 for Z-Gradient, or 2 for Y-Gradient.</p>
<p><i>If the scan prescription is incorrect for Gradient Calibration, the following is displayed:</i></p> <pre> Wrong imaging parameters for Gradient X Field Calibration <----- </pre>	<p>If this is displayed, check to make sure the scan prescription is correct and that the correct image data set was selected.</p>
<p><i>If Gradient Calibration is OK, the following appears:</i></p> <pre> ***** Calibration results ***** Measured Length: 99.8mm at cfxfull = 29616 X Field Calibration is within 100.0mm +/- 0.5 <<<<<<< No adjustment required >>>>>>> ***** </pre>	<p>If a different gradient mode was highlighted than corresponds to the image selected, this error message will be displayed:</p> <p><i>“Gradient mode of image is not equal to gradient mode selected by user”</i></p> <p>The user will then be prompted for another image.</p>
<p>Note: <i>If the Z measurement is not even close to 100mm, there may be a bubble in the phantom causing the mismeasurement. Open a C shell and type “setftg” to turn off Fast TG, then rescan the z axis. After completion of gradcal, type “resetftg” to turn Fast TG back on.</i></p> <p><i>If Gradient Calibration needs adjustment, the following is displayed:</i></p> <pre> ***** Calibration results ***** Desired Length: 100.0mm +/- 0.5mm Measured Length: 92.4mm at cfxfull = 26472 X Field Calibration adjustment is required. << Try re-scanning with cfxfull set to 28649. >> ***** </pre>	

6- GRADIENT CALIBRATION IMAGE ANALYSIS (continued)

OUTPUT/PROMPTS	INPUTS/COMMENTS
<pre> Press Return when the re-scan is completed [Y]:... ***** Calibration Results ***** Measured Length: 99.8mm at cfxfull = 28649 X Field Calibration is within 100.0mm +/- 0.5 <Old cfxfull = 26472 > -- < New cfxfull = 28649 > Update cfxfull in MRconfig.cfg (Y,N): X Field Calibration updated with calibration number 28733 ***** Note: The calibration number used to update the MRconfig file is not the last "new" value displayed (28649 for the example shown). The actual used (28733 for example shown) is the next one the Gradcal program would have recommended you use (i.e, it saves a better calibration value). ***** Would you like to perform another calibration (Y,N) [Y] : ***** * Thank you for using Automated DQA calibration tool * ***** DQA_CAL Exiting! Press [ENTER] to quit --></pre>	<pre> Right click on [Research Operations] and [Display CVs]. Type cfxfull, then <ENTER>, type the recommended value and <ENTER>, then [Accept]. Right- click [Research Operations] and [Download]. It is also necessary to rescan. When the scan is finished, press <ENTER> in the Daily Quality window. Type y then <ENTER> to update the MRconfig.cfg file. Type y or n, as appropriate. Press <ENTER>.</pre>

6- GRADIENT CALIBRATION IMAGE ANALYSIS (continued)

2. Record the final gradient calibration results in Appendix A, Gradcal Data Sheet.
3. When **all three** gradient fields have been calibrated (and for the TwinSpeed, separately for each **GradMode**), the Signa software must be shut down and rebooted to install the changes in the MRconfig.cfg file(s).
 - a. Follow the instructions on Illustration 6-2, below



SYSTEM SHUTDOWN
ILLUSTRATION 6-2

- b. This message will be displayed:

WARNING: System Shutdown?
Please avoid or delay shutdown IF
film composer or archive process
is still active

Click the **Yes** button in the message box.

“Shutting down the system” will appear in the message box.

- c. Wait until Signa logout is complete.

- d. Restart the system software by double-clicking on the **Signa** icon (or type **signa** in the first field), then type the password **adw2.0** and press **<Enter>**. Allow initialization to fully complete before pressing any keys.

4. Store all completed data sheets in *Direction 15403, Signa Advantage/Horizon Data, System tab*, or on floppy disk for future reference.

APPENDIX A - GRADCAL DATA SHEET

MEASUREMENT (GradMode=_____)	FINAL MEASUREMENT (mm) Spec = 99 to 101	FINAL CV VALUE
X GRADIENT		(cfxfull)
Y GRADIENT		(cfyfull)
Z GRADIENT		(cfzfull)

MEASUREMENT (GradMode=_____)	FINAL MEASUREMENT (mm) Spec = 99 to 101	FINAL CV VALUE
X GRADIENT		(cfxfull)
Y GRADIENT		(cfyfull)
Z GRADIENT		(cfzfull)

CORRECTION FORMULA

$$\frac{100 \text{ (Desired Distance)}}{\text{Calculated Distance}} \times \text{Current Value} = \text{Corrected Value}$$

APPENDIX B - SIMPLIFIED GRADIENT SHIM PROCEDURE FOR MOBILE MRs

B-1 Overview

This procedure is intended to be performed after a Mobile MR System move, at the beginning of the day, or any other time shim is suspected of affecting image quality.

B-2 Setup

B-2-1 Tools Required

- LVshim Phantom Assembly, 2125245
- Nesting Plate Assembly, 2125247

Note

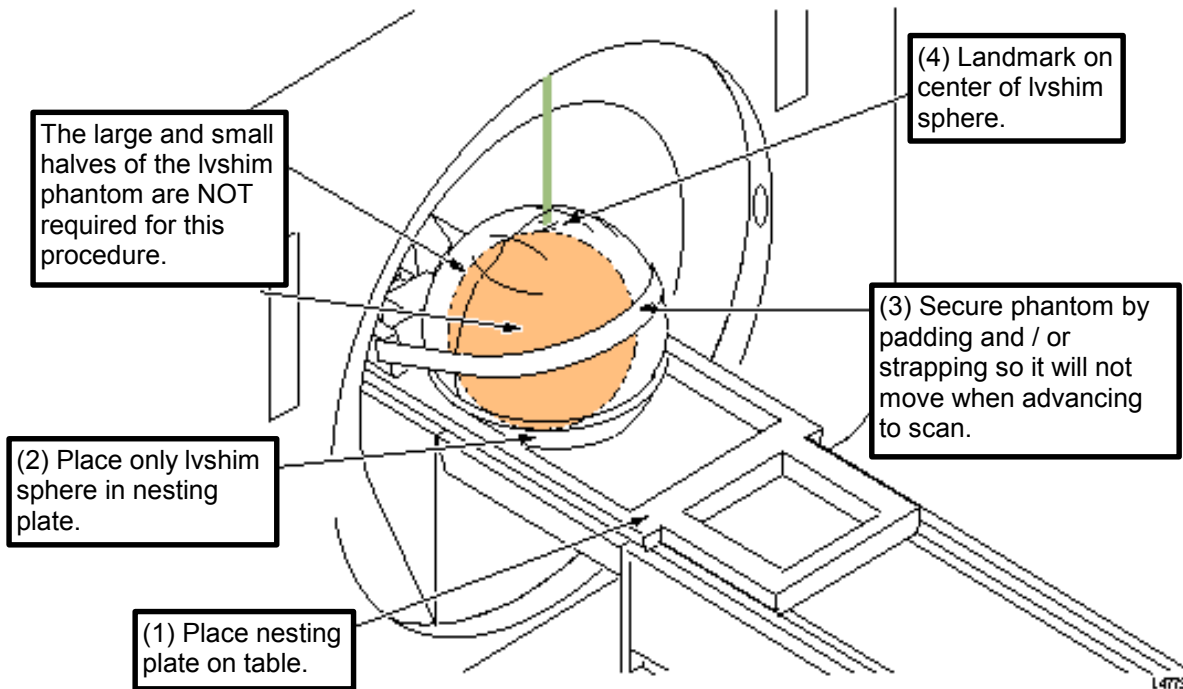
Foreign material (such as staples, metal filings, dirt, etc.) on the LVshim phantom or nesting plate will alter shim harmonics, resulting in shim divergence. Therefore, before using the phantom and nesting plate, be sure that all foreign material has been cleaned off.

B-2-2 Phantom Setup



Completely remove the Quad Head Coil from the cradle before performing any body scans. Failure to do this may damage the Head Coil T/R network.

1. Remove the Quad Head Coil from the cradle and remove any other phantoms from the bore.
2. Set up and align the LVshim Phantom as indicated in Illustration B-1.



ALIGNING LVSHIM PHANTOM ON PATIENT TABLE
ILLUSTRATION B-1

B-3 Gradient Shim Procedure

For the setup with only the LVshim sphere phantom, refer to section B-2, *Phantom Setup*.

IMPORTANT

The LVshim sphere should be padded and/or strapped to prevent it from moving when advancing to scan.

1. Enter the following RX:

PATIENT INFO:

Patient Id **geservice**
Weight (lb) **300 lbs**
Landmark **Sternal Notch**

PATIENT POSITION:

Patient Position [>] **Supine**
Patient Entry [>] **Head First**
Coil [...] **Body**

IMAGING PARAMS:

Plane [>] **Axial**
Mode [>] **2D**
Pulse Seq. [...] **Spin Echo [Accept]**
GradMode (Twin) [...] **WHOLE or ZOOM [Accept]**
Imaging Options [...] **Variable Bandwidth [Accept]**

SCAN TIMING:

TE **(Type) 18**
TR **(Type) 75**
Bandwidth [...] **15.63**

SCANNING RANGE:

FOV **(Type) 22**
Slice Thickness **10**
Spacing **10**
Start **0**
End **0**
Slices **1**
L/R Center **0**
P/A Center **0**

ACQUISITION TIMING:

Freq **256**
Phase **128**
NEX **1**
Phase FOV **1**
Freq DIR **R/L**
Auto CF **Water**
Autoshim **ON**

Note

For all imaging protocols the autoshim feature must be turned on before scanning patients. The Autoshim button is located on the right side of the screen.

2. Landmark at the center of the phantom (see Illustration B-1) and advance to scan.
3. **[Save RX]**.
4. **[Save Series]**, then **[Prepare to Scan]**.
5. **[Auto prescan]** (APS).
- 6 **[Manual prescan]** (MPS).
 - a. Record gradient settings x, y, and z on the data sheet in section B-4.
 - b. Save gradient setting by selecting; **File -> Save**
 - c. Press **DONE**
7. Repeat steps 4 and 5 until gradient setting x, y, and z do not change or toggle between +/- 1 count. For **TwinSpeed**, repeat steps 1 to 6 for each **GradMode**.

B-4 Gradient Shim Data Sheet

Enter Van Number:							
Enter Date →	Date:	Date:	Date:	Date:	Date:	Date:	Date:
Enter Gradient Offset Value							
X							
Y							
Z							
GradMode							
Vessel Pressure CX-K4 only							
Comment							

Enter Date→	Date:	Date:	Date:	Date:	Date:	Date:	Date:
Enter Gradient Offset Value							
X							
Y							
Z							
GradMode							
Vessel Pressure CX-K4 only							
Comment							

REVISION HISTORY

REV	DATE	AUTHOR	PRIMARY REASONS FOR CHANGE
0	June 15, 1998	M. Keber	Initial version converted from Toolbook to Microsoft Word.
1	Nov 4, 1998	M. Keber	Removed obsolete Release 8.1 information; added data sheet.
2	Feb. 15, 1999	K. Keshena	Updated per Engineering Bay Validation.
3	April 15, 1999	K. Keshena	Added Appendix B - Simplified Shim Procedure for Mobile MR.
4	Oct 18, 1999	J. Wolak	Updated per Release 8.3 validation
5	Sep 7, 2000	J.Gerber	Updated for TwinSpeed
6	July 17, 2001	J.Gerber	Updated for TwinSpeed scanner for 9.0 release.
7	Aug. 8, 2001	J. Wolak	Merged in changes from Milwaukee published rev 5 & 6 version which included. K. Keshena's changes: Corrected references to Daily Quality to DQA Calibrations. Changed paragraph for Mobile specific procedure to be clearer, changed cf-full value to reflect real value on pg 7 and placed the X gradient data to first row on data sheet in Appendix A for consistency. <i>and</i> M. Jones changes: Sec 6-, step 3a: added reference to System Shutdown button.
8	Oct. 22, 2002	C. MacDonald	Added new interface for DQA Calibration. Added footer. Replaced Section 6, step 3 with shutdown procedure from CSD.