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DESCRIPTION

This document relates to Signa Horizon products, and covers the System Performance Test, Full Test Mode procedure. To run the SPT Head Quick Check, go to the procedure *System Level Procedures: Troubleshooting: SPT Head Quick Check.*

1- INTRODUCTION

The System Performance Test (SPT) provides a means of quickly verifying that all critical parameters that affect image quality are within specification. The data generated by SPT are useful for both local and global trending, and for additional automated interpretation by processes that are not part of SPT.

Notes on Running SPT on an LX System:

The first time you run SPT after loading the MR Advanced Service CD (licensed in-house customers) or MR Restricted Service CD (GE Service) you need to tell the system what kind of nesting plate the LVshim and Body phantom sit in. There are two versions of the SPT Nesting Plate. You can determine whether you have a Short or Long Nesting Plate by checking the following serial numbers:

Nesting Plate = Short	**Nesting Plate = Long**
Part Number = 2172930	Part Number = 2125247
Length = 45 inches (114 cm)	Length = 51.2 inches (130 cm)

If you identify the wrong nesting plate, you will be unable to scan with the body coil. Editing the *_/w/config/spt_nesting_* file will not be sufficient to allow you to scan with the body coil. Remove the *spt_nesting* file and re-run SPT Full and answer the nesting plate question correctly. SPT will recreate the *spt_nesting* file.

IMPORTANT!
WHEN RUNNING SPT ON AN LX SYSTEM FOR THE FIRST TIME, USE THE PATIENT ID "GESERVICE" AND THEN PROCEED TO SAVE SERIES. (AN ACTUAL SCAN IS NOT REQUIRED). THIS STEP IS NOT NECESSARY IF THE "GESERVICE" PATIENT ID HAD BEEN USED BY THE MOST RECENT USER.

Problems with SPT Full Test and Head Quick Check

PROBLEM 1: You cannot have any duplicate exam numbers when running SPT.

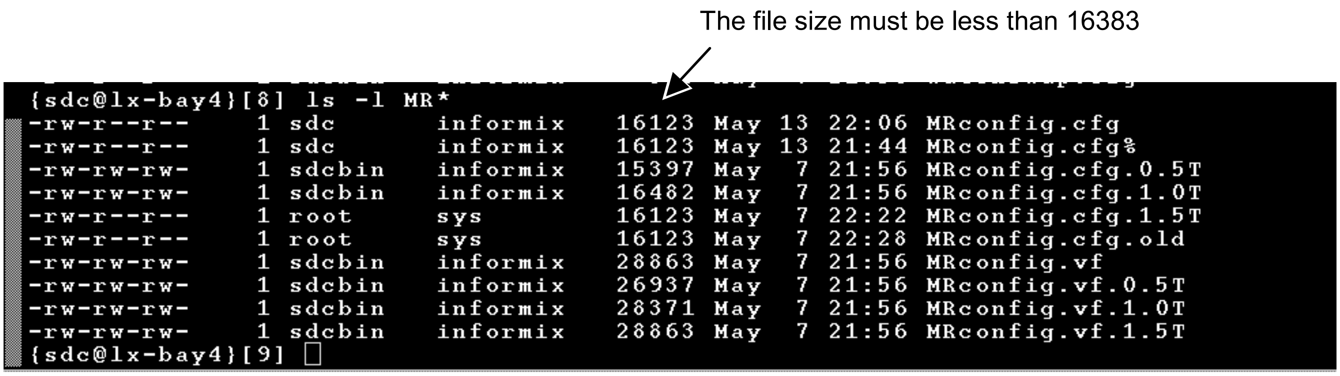
SOLUTION 1: Before running SPT, go to the Browser desktop and remove any duplicate exam numbers.

PROBLEM 2: If the MRConfig file exceeds the file size of 16383, the SPT Head Quick Check will crash (this problem is more likely to occur in mobiles). To verify the file size:

1. From the Service Desktop, open a **[C Shell]** .

2. Type **cd /w/config <Enter>**

3. Type **ls -l MR* <Enter>**. The following is an example of the files:




```
{sdc@lx-bay4}[8] ls -l MR*
-rw-r--r--    1 sdc      informix    16123 May 13 22:06 MRconfig.cfg
-rw-r--r--    1 sdc      informix    16123 May 13 21:44 MRconfig.cfg%
-rw-rw-rw-    1 sdcbin   informix    15397 May  7 21:56 MRconfig.cfg.0.5T
-rw-rw-rw-    1 sdcbin   informix    16482 May  7 21:56 MRconfig.cfg.1.0T
-rw-r--r--    1 root     sys         16123 May  7 22:22 MRconfig.cfg.1.5T
-rw-r--r--    1 root     sys         16123 May  7 22:28 MRconfig.cfg.old
-rw-rw-rw-    1 sdcbin   informix    28863 May  7 21:56 MRconfig.vf
-rw-rw-rw-    1 sdcbin   informix    26937 May  7 21:56 MRconfig.vf.0.5T
-rw-rw-rw-    1 sdcbin   informix    28371 May  7 21:56 MRconfig.vf.1.0T
-rw-rw-rw-    1 sdcbin   informix    28863 May  7 21:56 MRconfig.vf.1.5T
{sdc@lx-bay4}[9]
```

SOLUTION 2: Deleting two lines of comments fixes the problem. Edit the file, remove two "#" lines and save.

To perform the fix:

1. Type **jot MRconfig.cfg** and press **<Enter>**

2. Delete any two lines that begin with "#" (i.e., comment lines).

3. Save and Exit the file using the jot toolbar.

PROBLEM 3: A Host Monitor timeout may occur if multiple passes of SPT FSE stability are performed, or if a single pass is run multiple times due to the generation of many raw files.

SOLUTION 3: The following steps can be performed to avoid or correct the problem:

1. Never run more than two SPT FSE stability passes without a reboot between passes

   or

2. Remove the files from the directory after completing two passes of SPT FSE stability by doing the following:

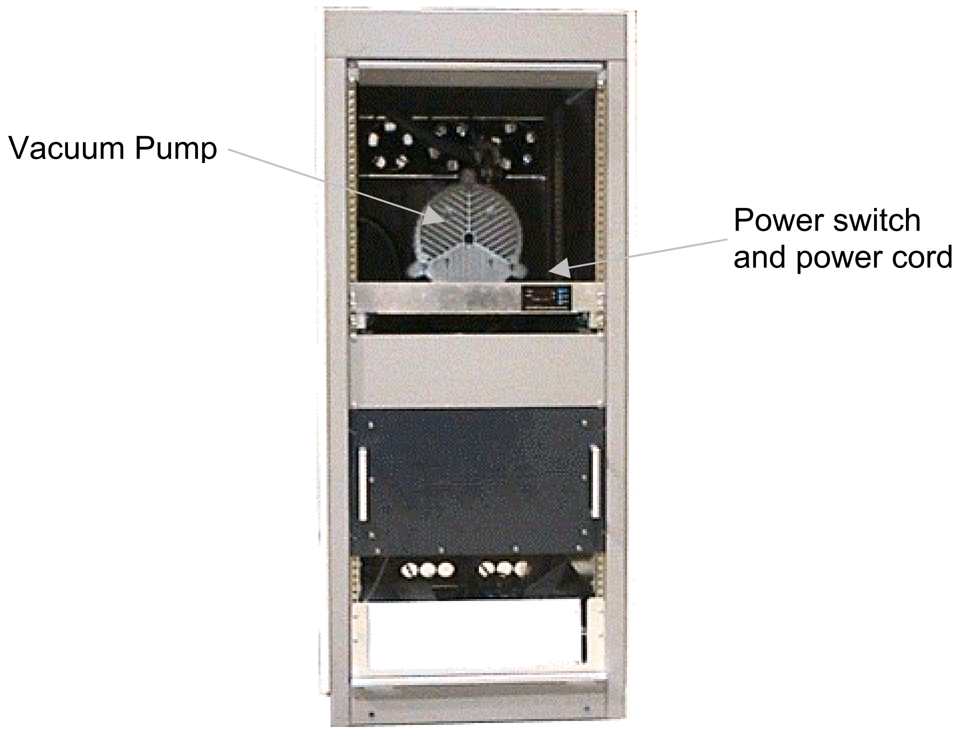
   a. From the Service Desktop, open a **[C Shell]**.
   b. Type **cd /export/home1/sdc_image_pool/reserved <Enter>**
   c. Type **ls -l** and press **<Enter>** *(Used to see the Image directories)*
   d. Type **rm -rf ***and press **<Enter>**
   e. Type **ls -l** and press **<Enter>** *(Used to verify the remove command)*

3. If a timeout occurs, log in as root and remove the files following the procedure in step 2, then re-boot the system.

1-1 SPT Quick Reference Procedure

This section contains a brief summary on how to run SPT Full Test Mode. If you are familiar with SPT, including all cautions and warnings, then use this section. If you are not familiar with SPT, refer to the detailed SPT procedure in Section 10, SPT Full Test Mode Procedure.

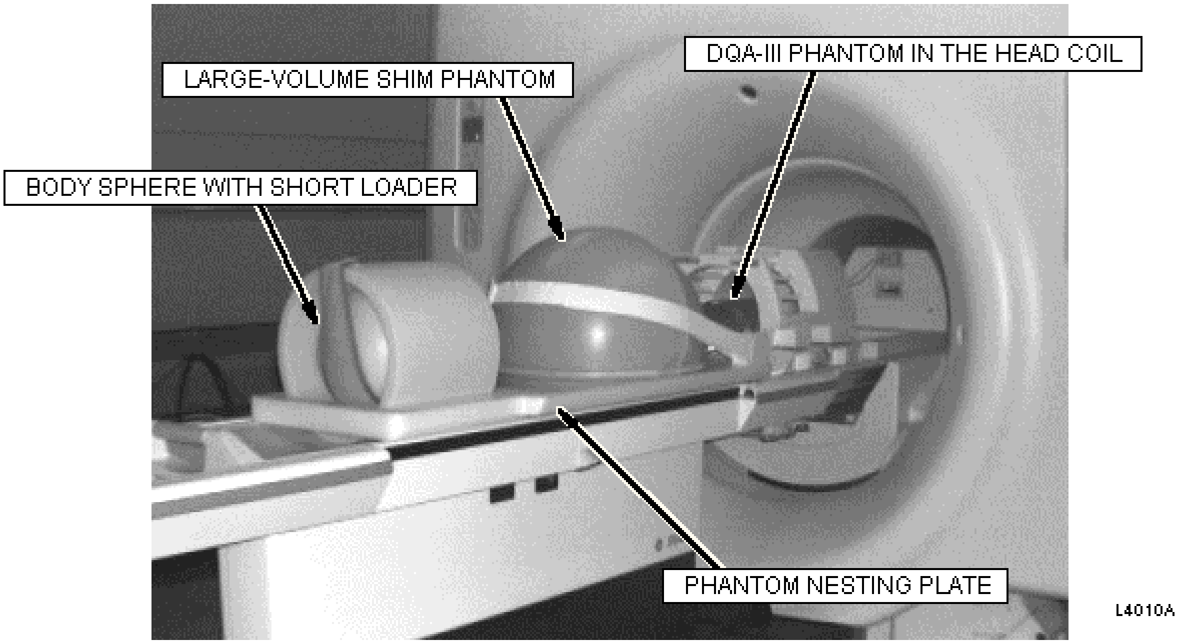
1 **TwinSpeed (TRM) Systems ONLY:** See Illustration 1-1. Remove the front cover from Twinspeed Accessory Cabinet (TAC) and place the power switch on the right side of the vacuum pump (near where the power cord connects) in the OFF position. It is also possible to remove the power cord from the pump.



VACUUM PUMP INSIDE TWINSPEED ACCESSORY CABINET
ILLUSTRATION 1-1

2. Click **[End Exam]** to cancel any previous exam. Then, click on **[New Pt]** so you can set a landmark.

3. Position the phantoms on the nesting plate. See Illustration 1-2. (Due to rear endbell interference, the LVshim phantom cannot be used with Full SPT Test Mode on systems with a CRM Body coil.)



SPT PHANTOM SET WITH NESTING PLATE
ILLUSTRATION 1-2

4. Landmark on the axial line of the DQA-III phantom in the Head Coil.

CAUTION

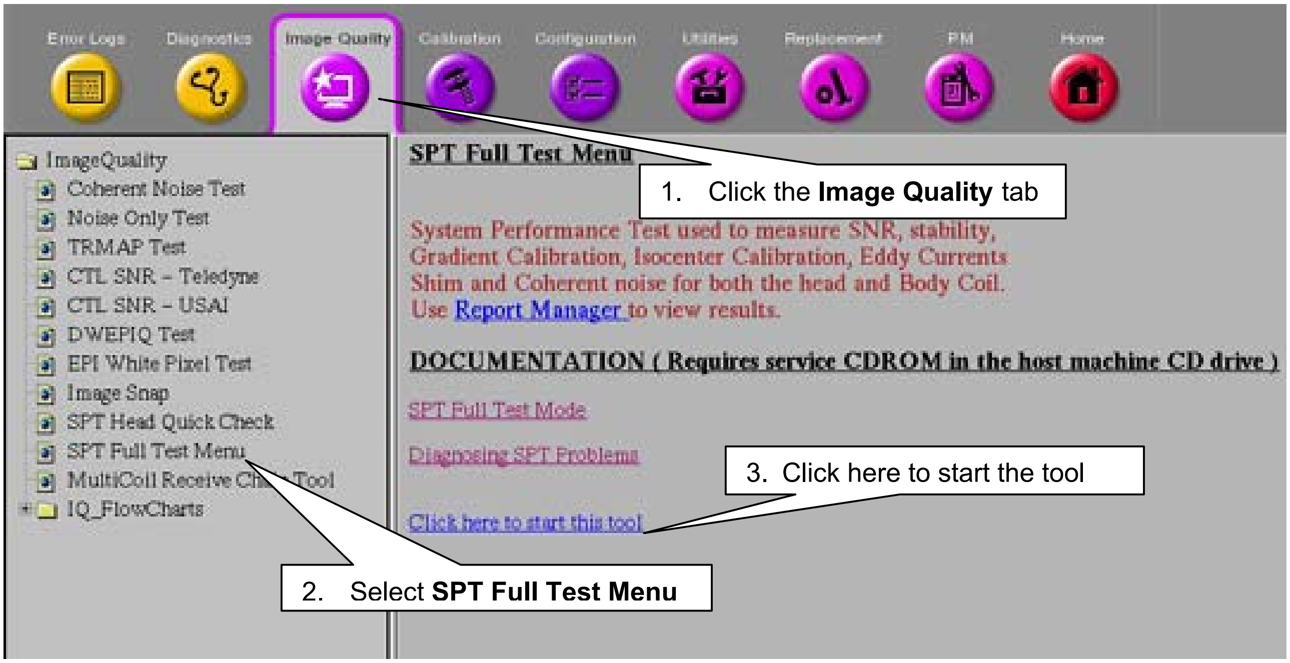
The vacuum pump must be powered off before attempting to bring the area around the TRM to atmospheric pressure. This should already have been done in *Section 10-1 Disable Vacuum Pump – TwinSpeed Systems ONLY*.

Note

The vacuum space inside the magnet bore must be at atmospheric pressure when this test is run. Running this test with the bore under vacuum may result in stability plots that exhibit a sloping, sometimes saw-tooth pattern. As a result, stability failures may occur.

5. **TwinSpeed (TRM) Systems ONLY:** Remove the chain clamp from around the vacuum line at J11 on the rear of the TAC and slowly open the vacuum line connection at J11 so as to equalize the line and vacuum space inside magnet bore to atmospheric pressure. The vacuum pump must be powered off and not run while this is done.

6. To start the SPT Full Test tool, follow the steps on Illustration 1-3, below:



STARTING THE SPT TEST TOOL
ILLUSTRATION 1-3

7. The SPT Head Coil Selection screen appears. See Illustration 1-4.

SELECT HEAD COIL FOR SPT SCREEN
ILLUSTRATION 1-4

8. Click the button corresponding to the head coil currently in use:
   - Old Head Coil and DQA Phantom, or
   - New Head Coil and Phantom

9. Click the **Start** button.

The System Performance Test menu appears. Refer to Illustration 1-5.

SYSTEM PERFORMANCE TEST MENU
ILLUSTRATION 1-5

a. In the **Select All Tests?** field, click **[No]**.

b. To select a reason for the test, click the button to the right of Test Purpose. Select a reason from the list. If desired, enter text in the Comments field.

c. **For systems with a CRM Body Coil**, in the Body section, select Shimming **Off**.

d. Click the **On** button opposite the tests you want to run.

e. For ***TwinSpeed***, select the **GradMode**(s) to be used while running the tests.

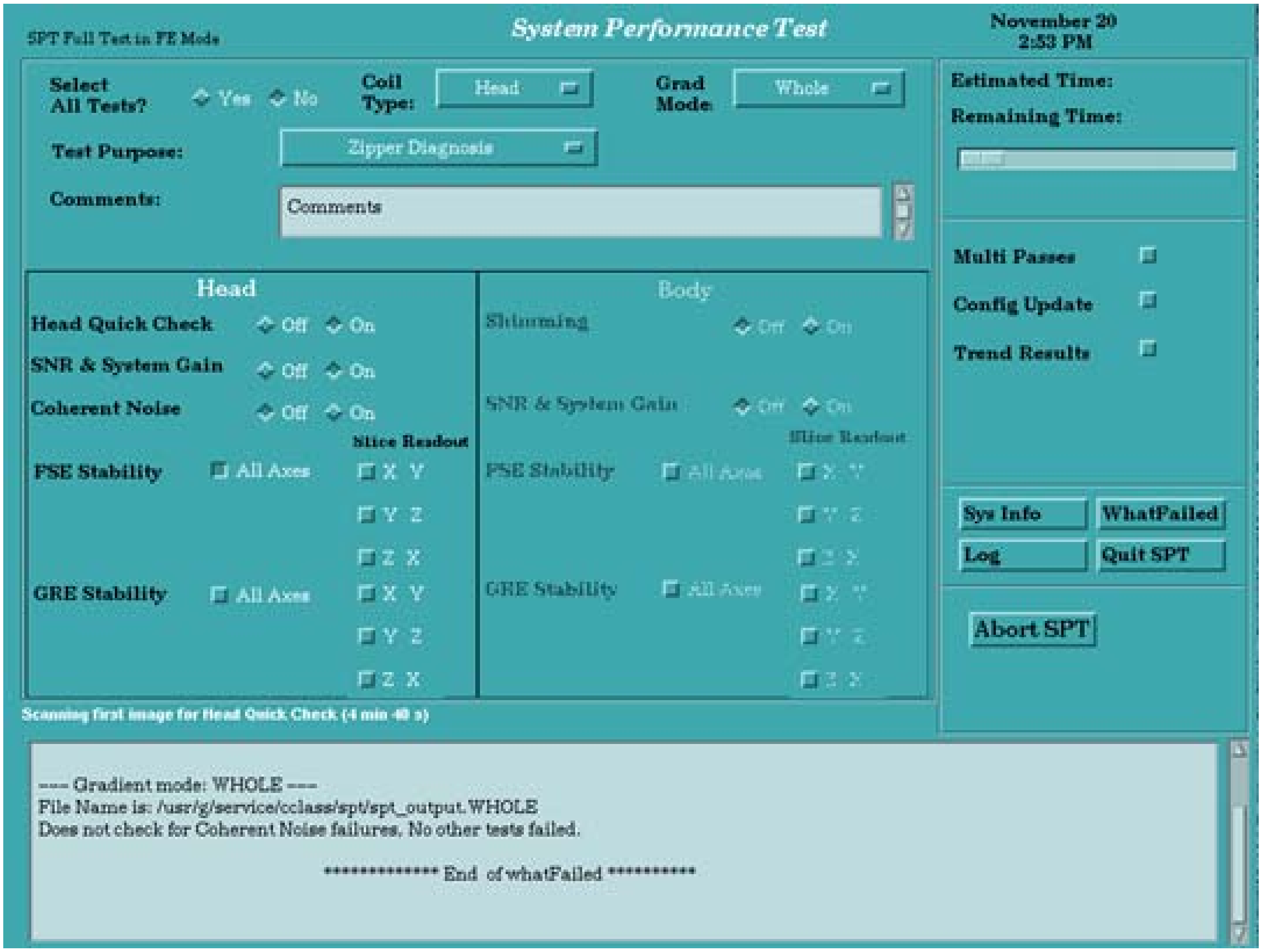
f. To select Multiple Passes of the test(s), select the **Multiple Passes** button, then enter the desired number of passes in the box.

g. Click **[Start SPT]** to begin.

You may be prompted to make additional selections as the test begins.

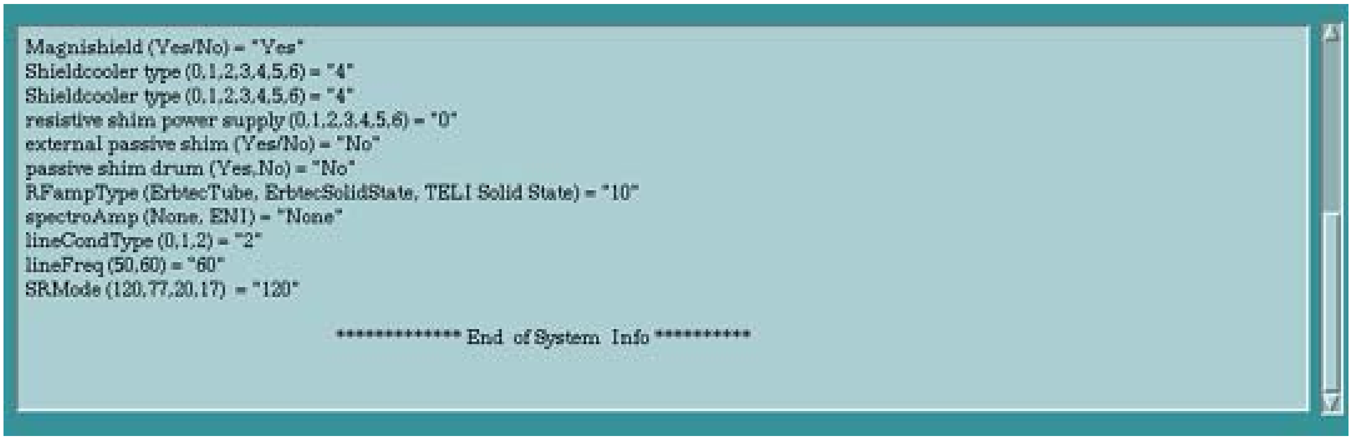
Status messages will appear in the text box below the menu as the tests are run. Use the scroll bar on the right side of the box to move up or down through the messages.

h. If desired, click the **WhatFailed** button. Output will appear in the text window of the System Performance Test screen, as shown in Illustration 1-6.



WHATFAILED LISTING
ILLUSTRATION 1-6

i. If desired, click the **Sys Info** button to display system settings. See an example in Illustration 1-7.

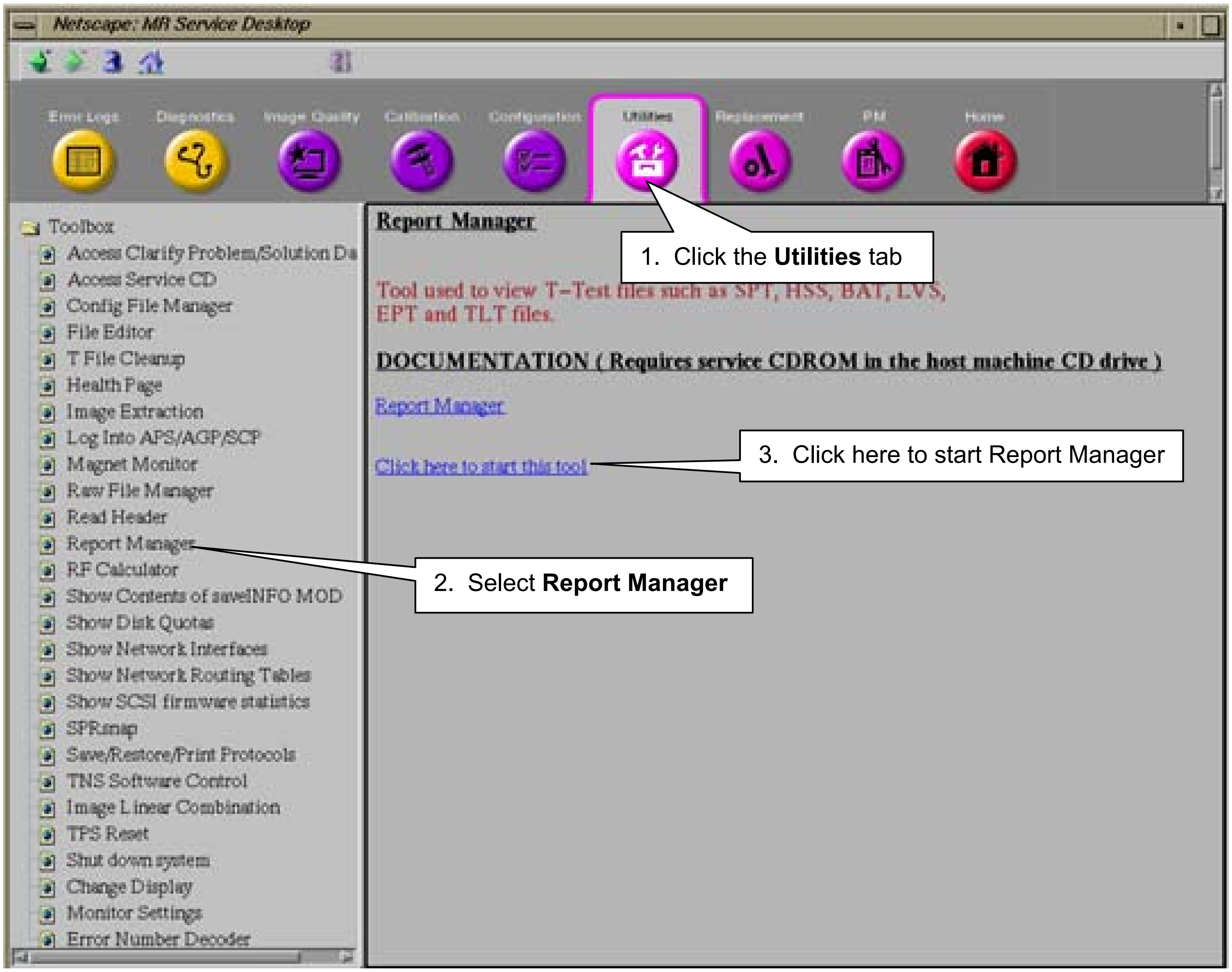


EXAMPLE SYS INFO LISTING
ILLUSTRATION 1-7

Note
This screen will be displayed until you quit SPT, so if you're in a troubleshooting mode, all you need to do is press the **[Start SPT]** button to go again.

10. To exit SPT, click the **[Quit SPT]** button. When prompted “WARNING: Quit SPT?”, click **[Ok]**.

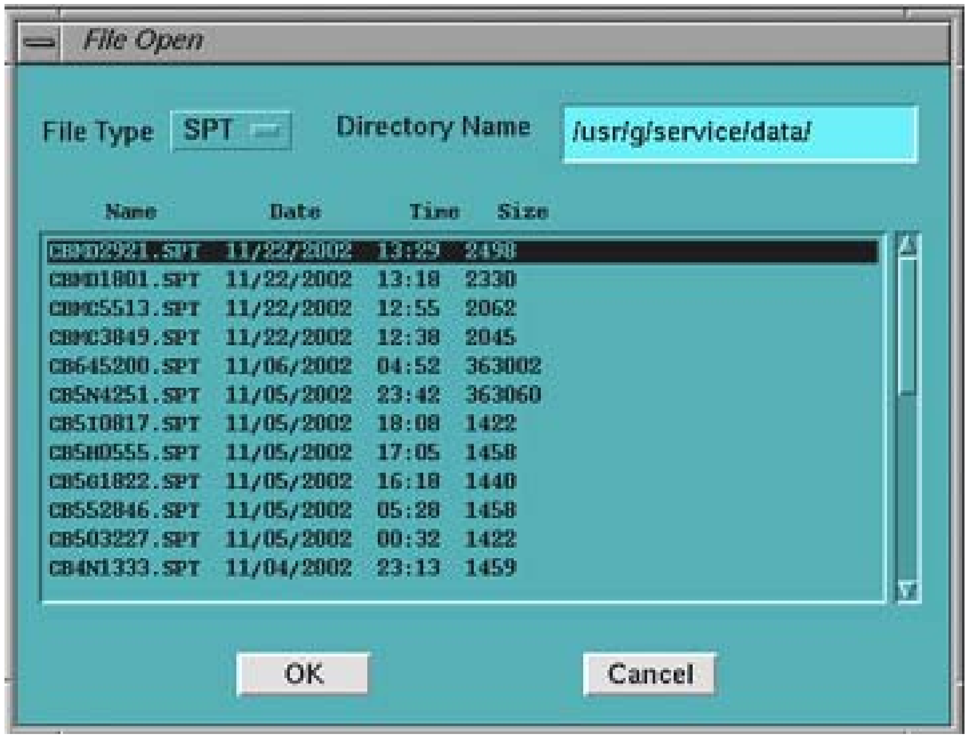
11. To view SPT results, follow the steps on Illustration 1-8 to open the Report Manager.



ACCESSING REPORT MANAGER
ILLUSTRATION 1-8

12. When prompted for a password, enter the same password used for the Service Methods CD-ROM. Press **<Enter>**.

The File Open screen will display available reports. See Illustration 1-9.



ACCESSING SPT REPORTS
ILLUSTRATION 1-9

13. To view an SPT report, first make sure the File Type is **SPT**. (If it is not, click the button following "File Type" and select **SPT** from the list.

14. Select the report you'd like to view, then click **[OK]**.

    Test results will appear in the Report Manager window. Use the **[Previous]** and **[Next]** buttons to view individual pages of the report**.**

15. To print a report, select **File**, then **Print** from the Report Manager menu.

16. To view another report, select **File**, then **Open**. Select the report from the list, then click **[OK]**.

Note

For additional information on Report Manager, select **[Software Utilities]** from the Service Methods CD-ROM, then **[Report Manager Tool]**.

17. **TwinSpeed ONLY:** When finished with SPT place the power switch on the vacuum pump back into the ON position. Replace the cover onto the front of the TAC.

1-2 Critical Parameters

Table 1-1 identifies the parameters SPT evaluates that are critical to image quality, and indicates those parameters that are included in the Full Test Mode and the Head Quick Check.

For ***TwinSpeed***, these tests are repeated for both **GradModes**. The same image quality critical parameters are relevant.

TABLE 1-1
CRITICAL PARAMETERS

PARAMETERS	IN SPT	IN QUICK CHECK
Center Frequency	Yes	Yes
Gradcal	Yes	Yes
Z-isocenter	Yes	Yes
System Gain	Head: Yes Body: Yes	Head: Yes Body: No
SNR	Head: Yes Body: Yes	Head: Yes Body: No
Stability	Yes	Optional
Coherent Noise	Yes	No
Shim	Yes	No
Eddy Currents*	Yes	Optional

**9.1 and 10.x software only*

1-3 Phantom Set

The tests used to determine the critical parameters are performed with three phantoms: the DQA-III phantom in the old head coil or the split head coil phantom in the new head coil, a large-volume shim phantom in the body coil, and a body sphere with a short loader in the body coil (see Illustration 1-1). These phantoms are positioned on the clinical cradle at the same time, with the assistance of a phantom nesting plate that ensures a consistent relative location of the phantoms each time SPT is run.

CAUTION

Systems with the shorter CX or LCC Magnet and smaller CRM Body Coil (55cm) must run SPT Full Test mode without the LVshim phantom due to rear endbell interference. For these systems, leave the LVshim phantom off the nesting plate and de-select LVshim when running Full Test mode.

1-3-1 Phantom for Old Head Coil (DQA-III)

The DQA-III phantom has been modified to improve positioning accuracy and consistency, compared with the Release 5.4 DQA-II phantom. In the coronal plane, the "CI" structure has been removed. In the axial plane, the "A" has been moved to align with the horizontal center of the phantom. The vertical position of the "A" remains unchanged. The DQA-III phantom contains the same solution as the DQA-II phantom.

1-3-2 Phantom for New Split Head Coil

The Split Head Coil Phantom is only for use with the new Split Head Coil. It will not fit inside the old Quadrature Head Coil. The design combines the DQA-III Phantom with an external loader shell and plastic structure so that the assembly can be placed inside the Split Head Coil in only one direction. The addition of the loader shell improves the electrical load characteristics of the Split Head Coil Phantom assembly. The plastic structure that holds the assembly together not only provides one-way placement of the assembly in the coil, but it also provides an end-stop for the front of the SPT Nesting Plate to butt against. The internal structure of the phantom is identical to that of the DQA-III.

1-3-3 Phantom for Shim

A large-volume phantom permits shimming the magnet to spherical diameters as large as 45 cm, and encompasses the volume necessary to collect the data needed for initial shimming during magnet installation. The large-volume phantom is filled with a 0.064 Molar $CuSO_4$ non-ionic solution having a T_1 of approximately 20 milliseconds at 1.5T. SPT does not shim the magnet; it does, however, **check** the homogeneity of the shim.

1-3-4 Phantom for Conventional Body Coil Tests

A 270-mm sphere (the same size as TLT) is used for all tests in the body coil other than shim. A short loader must be used with this phantom so that the phantoms can be positioned properly while maintaining a minimum distance of six inches between the body loader and the shim phantom. The body SPT sphere markings make it readily distinguishable from the body TLT sphere. The body sphere is filled with a 0.014 Molar $NiCl_2$ ionic solution having a T_1 of approximately 109 milliseconds at 1.5T.

1-3-5 Positioning and Handling

Phantoms for SPT are positioned on the cradle using a nesting plate (see Illustration 1-1). The nesting plate consists of a board contoured to fit the cradle. It has cutouts for the two body phantoms, and is positioned in contact with the head coil base during use. Consistent lateral alignment between the nesting plate and clinical cradle is necessary for consistent and accurate SPT test results.

1-3-6 Phantom Storage Considerations

The Large Volume Shim (LVShim) phantom must be stored assembled to minimize deformation of the plastic phantom shells. A storage cabinet on wheels for the LVShim phantom is provided with the SPT phantom set. Phantoms should not be exposed to temperatures below the freezing point of water. Brief exposures to sub-freezing temperatures (not to exceed fifteen minutes) are permitted when moving phantoms from heated storage areas to mobile scanner systems. Storage temperature of the phantoms should be between 50º F to 80º F (10º C to 27º C) for at least two hours prior to use. Brief exposures (not to exceed fifteen minutes) to temperatures outside this range are permitted immediately prior to the use of the phantoms in mobile systems.

1-4 SPT Compared With TLT

1-4-1 Introduction

The System Performance Test (SPT) is the first of a new generation of tools that are being designed to increase automation, simplify user interfaces and improve the reliability of image quality test results. This document is intended to be used by experienced manufacturing technicians, field engineers, and their support personnel to gain a better understanding of the features provided by SPT and how they compare with similar features in Top Level Test (TLT).

1-4-2 Test Control

TLT is typically run by positioning and landmarking the appropriate phantom, initiating a new exam, and selecting a predefined protocol. Test options are controlled by modifying user CVs. Auto prescan must be initiated manually and, if necessary, R1 and R2 must be manually adjusted. The scan is initiated manually and when it is finished, analysis software is automatically started. If the system is InSite-entitled and conditions are met for an automatic transfer of the TLT file after it is created, it is necessary for the file transfer to be completed before control of the scanner is returned to the user. Only one phantom and coil can be used during any single TLT run.

SPT, on the other hand, permits the use of multiple phantoms in multiple coils, and is totally automated. Phantoms are positioned on the cradle with the aid of a phantom nesting plate. The landmark is always on the DQA phantom in the head coil, regardless of test options. After selecting one of the SPT buttons on the MR Tools screen, the user is presented with available test options for selection. These can include tests involving both the head and body coils, if desired. Once test options are selected, all additional activity is automated: protocol selection, cradle motion for proper phantom position, auto prescan, and modification of CVs, if needed. Scanning and data analysis are repeated as many times as necessary to complete all of the selected tests. There is even a feature that permits repeating the tests automatically for up to 24 hours with no additional user input. File transfer is handled automatically in the background for InSite-entitled systems while returning control of the scanner to the user immediately after the test is finished.

1-4-3 Features

Some features in SPT were taken directly from existing tests on the system. In one of its modes, the Gradlong Eddy Current Test can utilize the standard SPT Head setup (the DQA-III phantom) to measure residual eddy currents and produce results that correlate to Grafidy3 (the latest eddy current calibration tool). SPT Z-isocenter and Grad Cal were taken directly from the Daily Quality tests. LVShim data for SPT is acquired and processed by the same PSD and analysis software that is used for adjusting the shim of the magnet. SPT does not provide TRMAP or an equivalent test and, in its current form, does not provide any surface coil testing. Plans are being formulated to create surface coil image quality tests that employ the same control scheme as SPT. Each feature is discussed separately in the following sections.

1-4-4 Z-Isocenter

The axial scan of the Head Quick Check is used for the Z-Isocenter test. Analysis is exactly the same as that used for daily quality except for update limits and error checking. The daily quality version updates the config file for errors > 0.5mm, and no limit is placed on the maximum update allowed. Table 1-2 is an excerpt from the file **cal.spt** showing parameters that control behavior of the Z-Isocenter test in SPT. The update threshold sets the minimum size of the error that is required before the config file is updated. Marginal and severe high change limits cause a test failure to be declared if the size of the update is too large. A marginal fault declares a failure but permits the update to occur. A severe failure inhibits the update and terminates all further SPT processing and scanning.

The example shown is for systems with GE magnets, other than S1, with and without Magnashield. Similar entries exist in **/usr/g/service/cclass/spt/cal.spt** for other configurations.

TABLE 1-2
Z-ISOCENTER TEST CONTROL PARAMETERS

Table 1 - Z-Isocenter Test Control Parameters

#	--------marginal failure limits------						--------severe failure limits--------							
#	-----absolute---			----percent-----			-----absolute---			----percent-----			abs	%
#	low	high	high change	low	high	high change	low	high	high change	low	high	high change	update threshold	
ge_z_iso	11796	13038	30	n/a	n/a	n/a	11175	13659	50	n/a	n/a	n/a	15	n/a
gemshld_z_iso	14412	15929	30	n/a	n/a	n/a	13653	16687	50	n/a	n/a	n/a	15	n/a

1-4-5 Gradcal

The first three scans of the Head Quick Check are used for the Gradcal test. Gradcal is always checked in the frequency encoding direction in SPT. Therefore, the sagittal scan is for the Z axis, coronal for X, and axial for Y. Table 1-3 is an excerpt from the file **cal.spt** showing parameters that control the behavior of the Gradcal test in SPT. The update threshold sets the minimum size of the error that is required before the config file is updated. Marginal and severe high change limits cause a test failure to be declared if the size of the update is too large. A marginal fault declares a failure, but permits the update to occur. A severe failure inhibits the update.

The example shown in Table 1-3 is for Horizon EchoSpeed systems. Similar entries exist in **/usr/g/service/cclass/spt/cal.spt** for other configurations.

TABLE 1-3
GRAD CAL TEST CONTROL PARAMETERS (8645 GRADIENT AMPLIFIERS)

Table 2 - Grad Cal Test Control Parameters

#	--------marginal failure limits------						--------severe failure limits--------							
#	-----absolute---			----percent-----			-----absolute---			----percent-----			abs	%
#	low	high	high change	low	high	high change	low	high	high change	low	high	high change	update threshold	
es_x_gradcal	29945	32766	300	n/a	n/a	n/a	28369	32767	600	n/a	n/a	n/a	150	n/a
es_y_gradcal	29426	32524	300	n/a	n/a	n/a	27878	32767	600	n/a	n/a	n/a	150	n/a
es_z_gradcal	29195	32269	300	n/a	n/a	n/a	27659	32767	600	n/a	n/a	n/a	150	n/a

1-4-6 System Gain

The sagittal scans of the Head Quick Check and Body SNR and System Gain tests are used. System gain is computed by first comparing the mean signal value from the SNR test with the target value. See the nominal signal values in Table 1-4. The result is called "Normalized Signal" in the SPT report. The perfect answer is 1.00. If signal is too high, normalized signal will be greater than one. The current system gain value ("Config Old") is read from the config file, and is divided by the normalized signal to get the new system gain ("Recommended Config New"). Recommended Config New will always be at least slightly different from Config Old, even if the config file is not updated. "Percent Change" is calculated by:

TABLE 1-4
SYSTEM GAIN TEST CONTROL PARAMETERS

Table 3 - System Gain Test Control Parameters

Target signal values example from */usr/g/service/cclass/spt/spt_params.cfg* file on 1.5T systems. "h" prefix is for Horizon systems (regardless of gradient configuration). "a" prefix is for Advantage systems.

```
h_head_nominal_signal 2035.0
h_body_nominal_signal  956.0
a_head_nominal_signal 2114.0
a_body_nominal_signal 1349.0
```

Example from */usr/g/service/cclass/spt/cal.spt* file. "05_h" prefix is for 0.5T head, "15_b" prefix is for 1.5T body, etc.

#	--------marginal failure limits------						--------severe failure limits--------							
#	-----absolute---			----percent-----			-----absolute---			----percent-----			abs	%
#	low	high	high change	low	high	high change	low	high	high change	low	high	high change	update	threshold
05_h_sys_gain	1.40	2.60	n/a	n/a	n/a	12	0.80	3.20	n/a	n/a	n/a	24	n/a	5
05_b_sys_gain	4.81	8.93	n/a	n/a	n/a	12	2.75	10.99	n/a	n/a	n/a	24	n/a	5
10_h_sys_gain	1.05	2.44	n/a	n/a	n/a	12	0.35	3.14	n/a	n/a	n/a	24	n/a	5
10_b_sys_gain	5.58	10.36	n/a	n/a	n/a	12	3.19	12.75	n/a	n/a	n/a	24	n/a	5
15_h_sys_gain	0.95	2.22	n/a	n/a	n/a	12	0.32	2.85	n/a	n/a	n/a	24	n/a	5
15_b_sys_gain	3.14	7.31	n/a	n/a	n/a	12	1.05	9.40	n/a	n/a	n/a	24	n/a	5

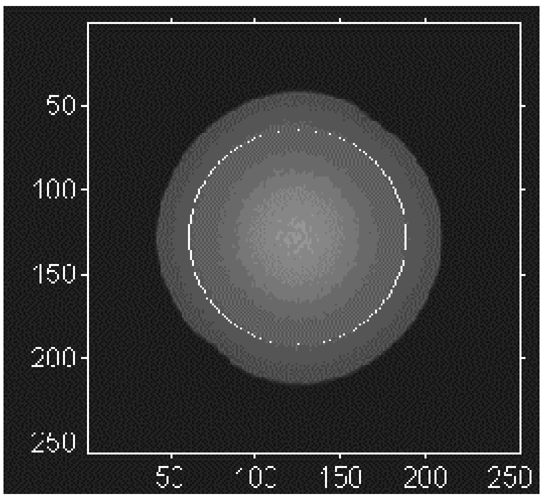
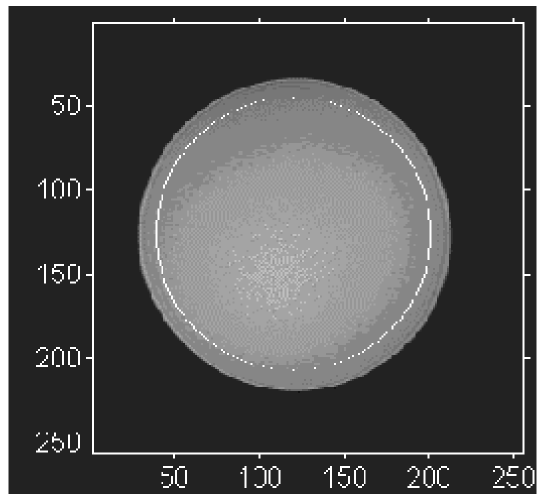
If Percent Change is greater than the update threshold in cal.spt, and automatic config file updates were authorized when SPT was started, system gain in the config file is updated to the Recommended Config New value and "yes" is written to the Updated field in the report. The update threshold sets the minimum absolute value of Percent Change that is required before the config file is updated. Marginal and severe high change limits cause a test failure to be declared if the size of the update is too large. A marginal fault declares a failure, but permits the update to occur. A severe failure inhibits the update.

1-4-7 Signal to Noise

There are significant differences in both data collection and analysis between SPT and TLT. TLT SNR is compared to SPT SNR in two tables:

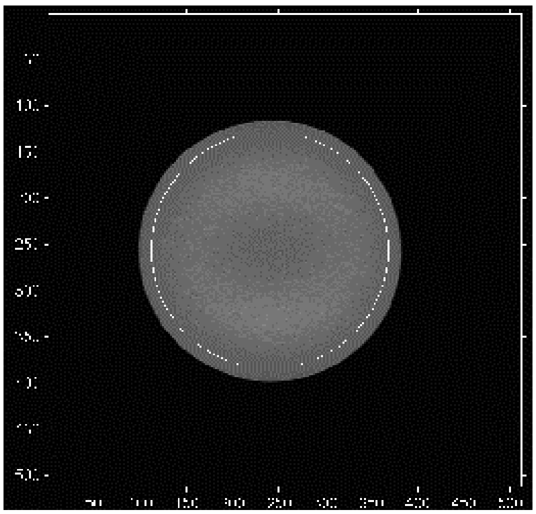
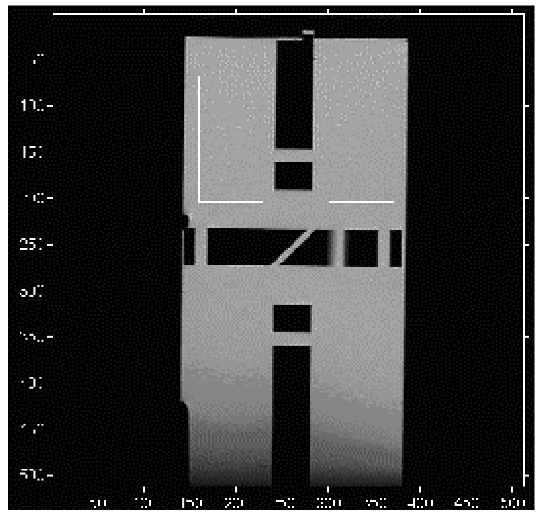
See Table 1-5 for TLT SNR details.

TABLE 1-5
SPT AND TLT SNR TEST CONTROL PARAMETERS COMPARISON – TLT SNR

	Data Collection	**Analysis**
TLT signal	Spin Echo, one 4mm isocenter slice, 4 echoes, T_E 25, T_R 500, FOV (24 head, 48 body), 128x256 with 16 kHz filter.	Fixed diameter (small size for head, large for body) circular ROI is automatically centered on the circular phantom image. The mean signal value is divided by the coil gain factor prior to being used in the SNR calculation. Thus variations in system (coil) gain make it impossible to create meaningful specifications for signal value.
	Body ROI 	Head ROI 
TLT noise	Noise is acquired using a no-RF scan with 30% gradient applied to each axis during data collection. 128x256 with 16 kHz filter.	Noise is mean of the standard deviation of I and Q raw data. Recon scale factor is *not* applied to noise value.

See Table 1-6 for SPT SNR details.

TABLE 1-6
SPT AND TLT SNR TEST CONTROL PARAMETERS COMPARISON – SPT SNR

	Data Collection	**Analysis**
SPT signal	Fast Spin Echo, one 3mm isocenter slice, one echo, 4 echo train, T_E 17, T_R 500, FOV (24 head, 48 body), 256x512. The test control software ensures that R1 and R2 are always set to 6 and 14, respectively, without input from the user. This significantly reduces the risk that operator forgetfulness might corrupt the test results.	Body ROI is same as TLT. Head ROIs are shown below. The mean signal value is *not* divided by the coil gain factor prior to being used in the SNR calculation. Since system gain is taken into account when measuring mean signal, it is possible to create meaningful specifications for the signal value.
	Body ROI 	Head ROI 
SPT noise	Noise is acquired using a no-RF scan with 30% gradient applied to each axis during data collection. 256x512 with 32 kHz filter.	For both head and body, noise is measured in an image, *not* in raw data. Noise is sqrt(pi/2)*mean(noise image). For Gaussian noise this is equivalent to the mean of the standard deviation of I and Q raw data. However, since the measurement is taken from an image, recon scale factor *is* applied to the noise value making it possible to create meaningful specifications for noise.

For SPT SNR test failure limits, refer to Table 11-7, located in Section 11-2, Viewing the Specification Files.

1-4-8 Stability Tests

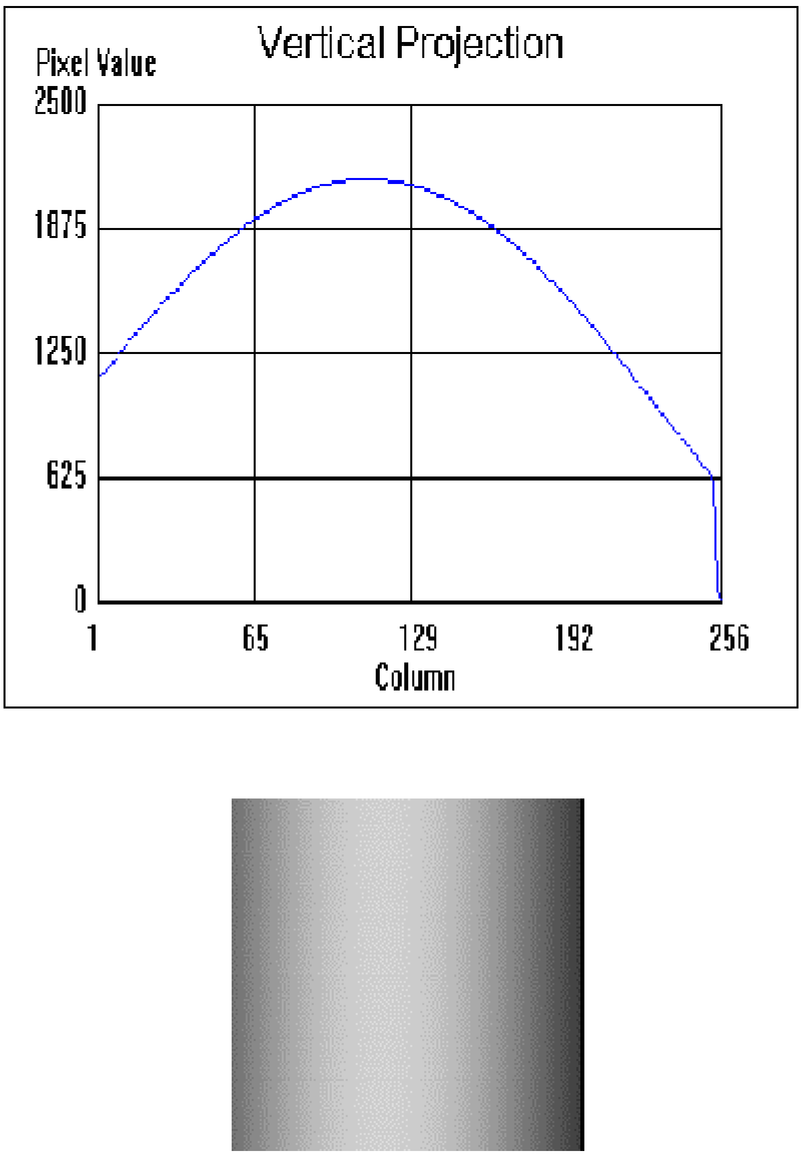
There are significant differences in both data collection and analysis between SPT and TLT. TLT data collection is compared to SPT data collection in two tables:

TLT Data Collection

Spin echo, one 4mm off-isocenter slice (offset 50mm head, 80mm body), 4 echoes, TE 25, TR 500, FOV (24 head, 48 body), 256x256 with 16-kHz filter. Echo 3 data are collected. Only the gradient for the axis being tested is driven. It provides slice selection, a small readout on the slice axis, and an end-of-sequence killer pulse.

TLT Analysis

The first step is to find echo center from magnitude data. Illustration 1-7 is a plot of magnitude raw data from a typical TLT stability run. See Illustration 1-7 to view the vertical projection of the plot in Illustration 1-8.



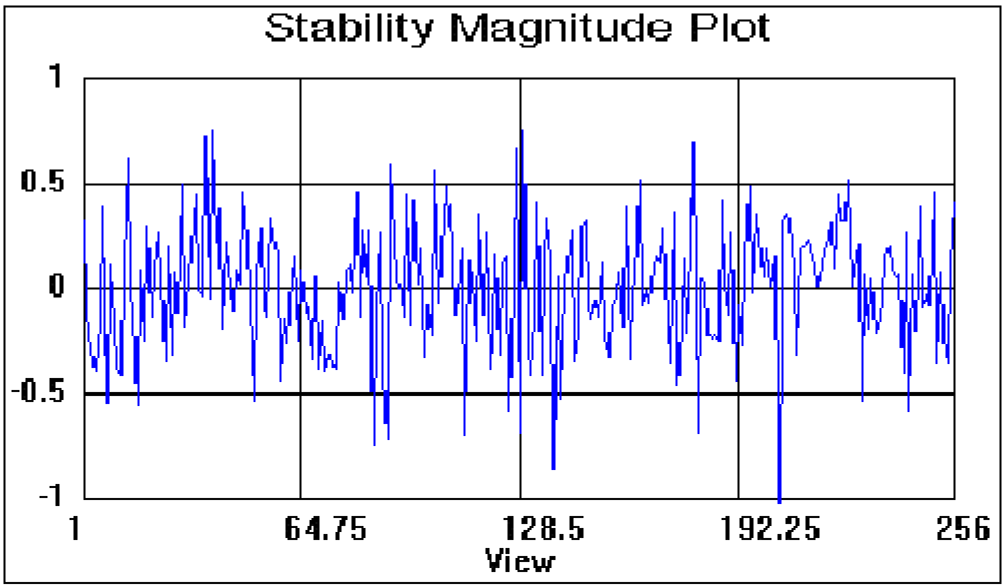
VERTICAL PROJECTION OF MAGNITUDE TLT STABILITY DATA
ILLUSTRATION 1-7

This plot is the mean of all the columns in the magnitude data. Echo center is simply the location of the peak magnitude in milliseconds (msec) from the left edge of the data. The data is 8.192 msec wide so the ideal echo center is 4.096 msec.

Magnitude drift is calculated by averaging the five samples that are centered about echo center in each view. View magnitudes are averaged to get mean magnitude. Magnitude drift in percent of mean magnitude is:

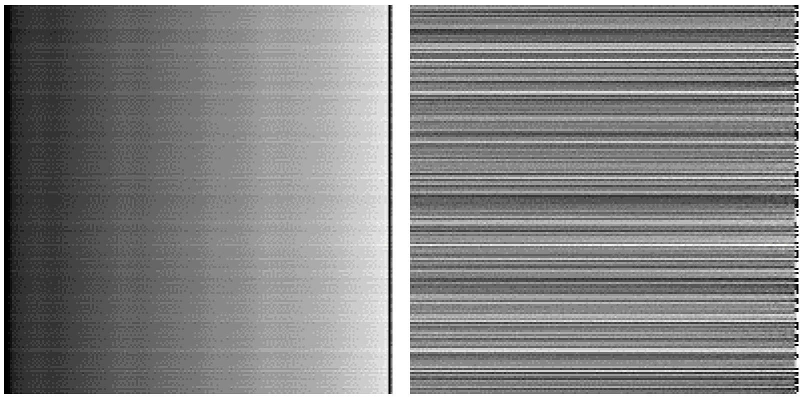
$$mag\_drift = \frac{view\_mag - mean\_mag}{mean\_mag} * 100$$

See Illustration 1-8 to view a magnitude plot.



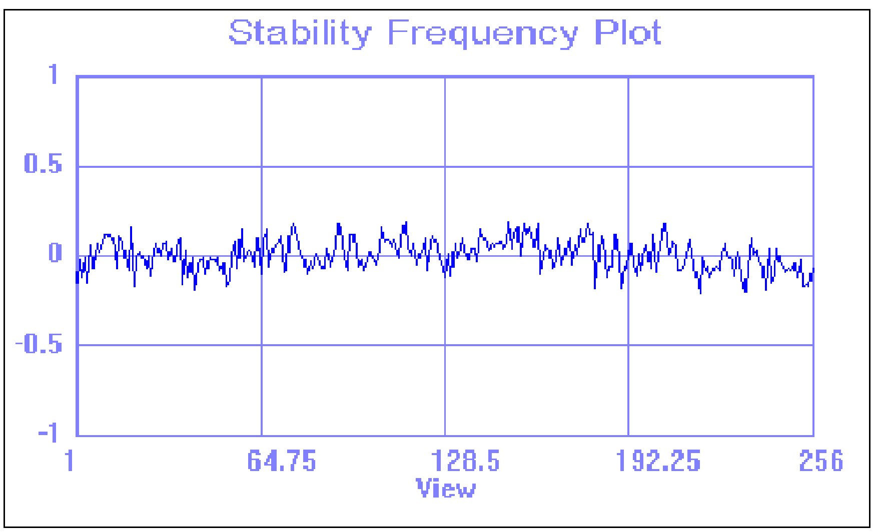
TLT STABILITY MAGNITUDE PLOT
ILLUSTRATION 1-8

Phase and frequency analysis is more involved. See Illustration 1-9. Phase of the raw data is shown on the left. Looking down each column, phase is first unwrapped and then the mean phase in that column is determined and subtracted from each unwrapped phase sample in the column. The process is repeated for each column until all columns have been unwrapped and normalized. The result is the normalized phase matrix shown in Illustration 1-9.

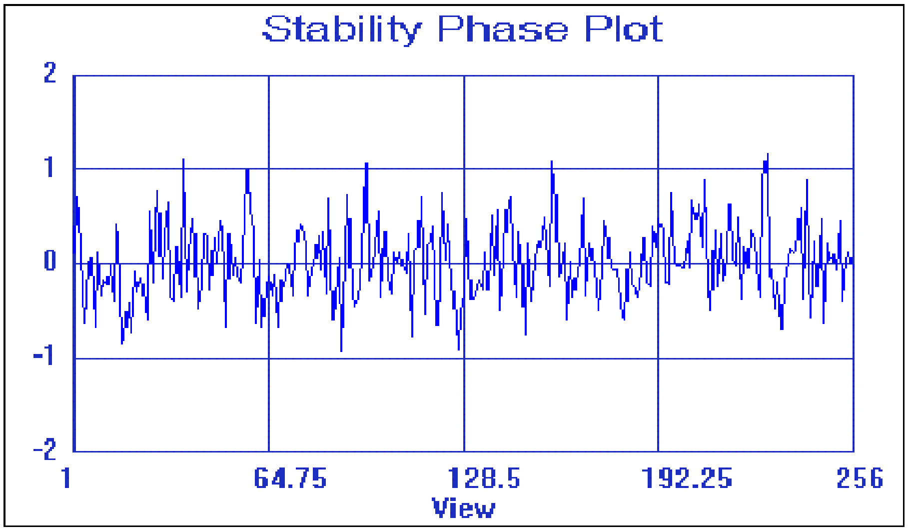


TLT STABILITY - NORMALIZED PHASE
ILLUSTRATION 1-9

Next, a straight line is fitted to each row of normalized phase. The slope of each line is proportional to the frequency drift for that view, and the value of the line where it intersects the echo center is the phase drift value for that view. See Illustrations 1-10 and 1-11.



FREQUENCY PLOT
ILLUSTRATION 1-10



STABILITY PHASE PLOT
ILLUSTRATION 1-11

SPT FGRE Data Collection

Fast Gradient Echo, seven 3mm slices (78mm body, 33mm head), 1 echo, 90 flip, TE 10, TR 200, FOV (24 head, 48 body), 256x256 with 16-kHz filter. Phase-encoding gradient is reduced to zero. Normal amplitude slice selection and readout gradients are used.

SPT FGRE Analysis

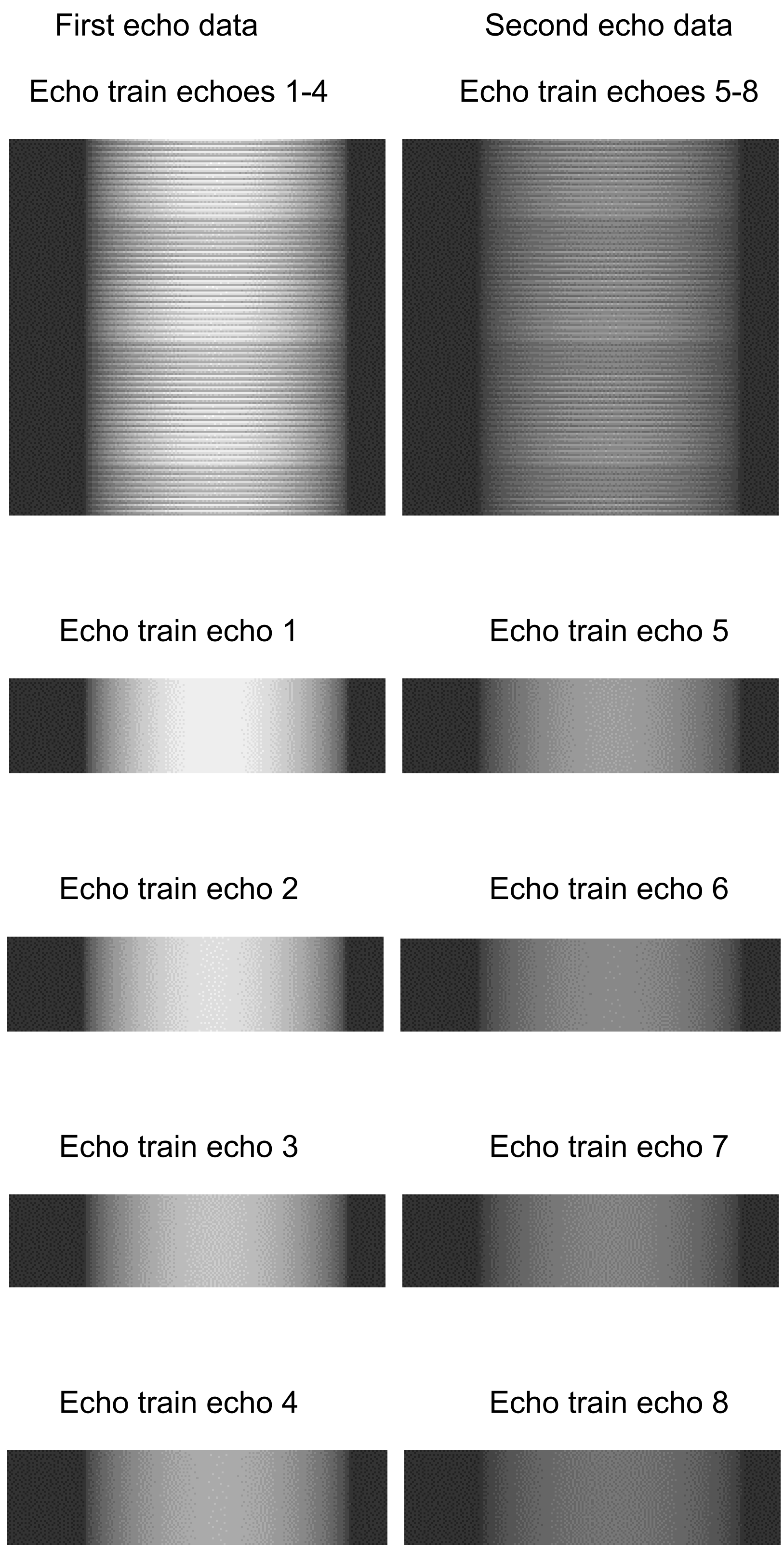
See Section 1-5-8, Stability, for SPT FGRE Analysis examples.

SPT FSE Data Collection

Fast Spin Echo, seven 3mm slices (78mm body, 33mm head), 2 echoes, 8 echo train, TE1 17, TE2 85, TR 1400, FOV (24 head, 48 body), 256x256 with 16-kHz filter. Phase-encoding gradient is reduced to zero. Normal amplitude slice-selection and readout gradients are used. The raw data CV is set to 1 to kill preprocessing and force data to be stored in time order.

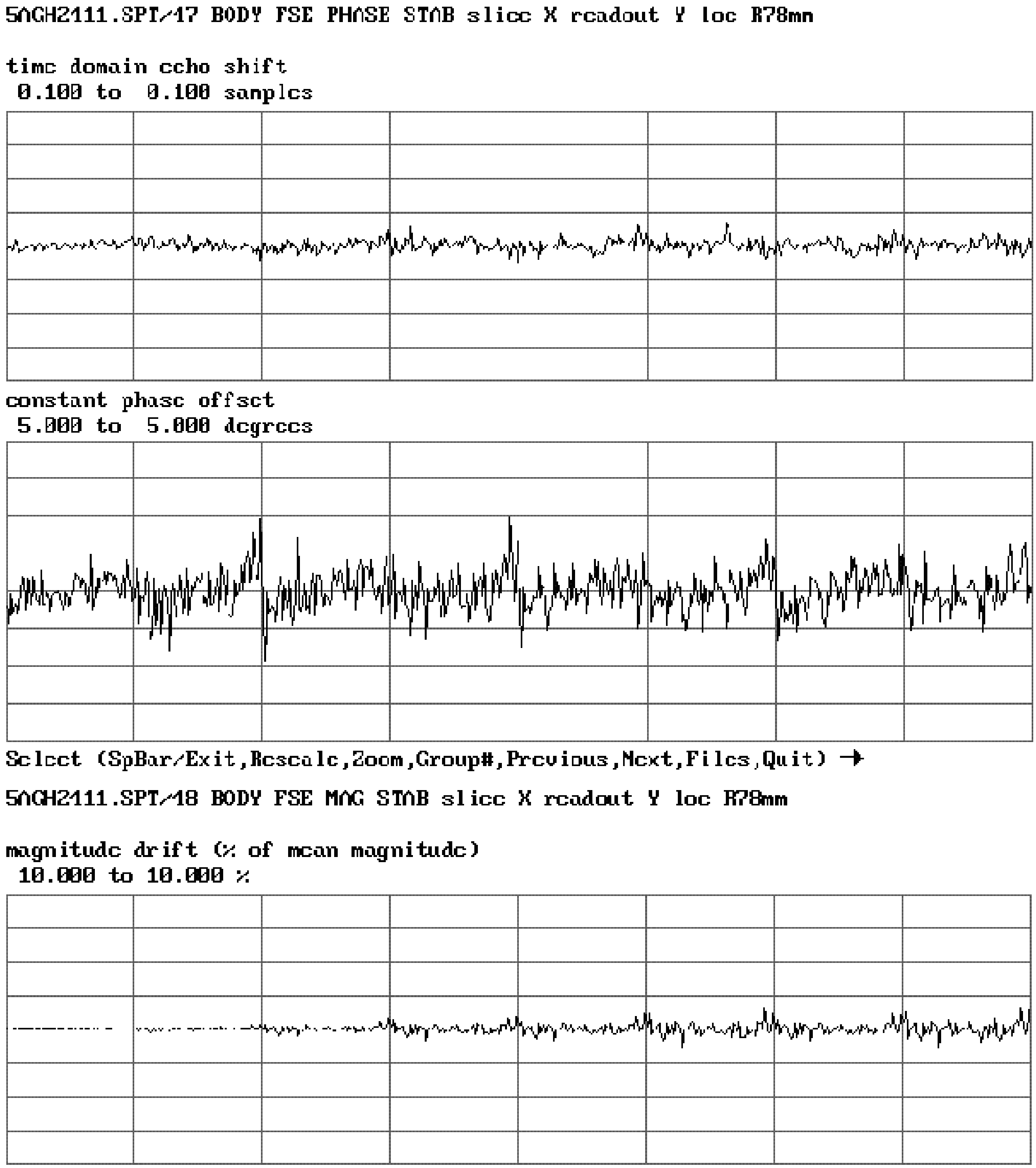
SPT FSE Analysis

See Illustration 1-8 for SPT FSE Analysis. SPT fast spin echo (FSE) stability processing is fundamentally the same as for FGRE except that the raw data is taken apart by echo train echo prior to analysis and then reassembled for plotting at the end.



SPT FSE STABILITY TESTS ANALYSIS
ILLUSTRATION 1-12

Data for each echo in the echo are processed exactly as for FGRE stability, except that linear ramps are not computed and removed. After the processing of each echo train echo is complete, the plots are spliced together in echo train echo order, as shown in the example plots. Next are FSE phase and magnitude plots (see Illustration 1-9).



SPT FSE ECHO TRAIN ECHO ORDER PLOTS
ILLUSTRATION 1-13

1-5 Diagnosing SPT Problems

1-5-1 Introduction

This document is intended to be used by experienced manufacturing technicians, field engineers, and their support personnel as a guide to diagnosing problems detected by the System Performance Test (SPT). For many of the test parameters, the approach to isolating a failure reported by SPT is similar to that followed for TLT, so your experience with TLT will still be useful.

For ***TwinSpeed***, there are two tolerance files, *cal.spt.WHOLE* and *cal.spt.ZOOM*. The use of the correct file is handled by the software automatically, and depends only on the **GradMode** currently being used to run the tests.

1-5-2 Z-Isocenter

If a Z-Isocenter failure is reported, it means that either the measured value was outside allowable absolute limits, the required change was too great, or the image signal is much too small or absent. Failures are always based on the Recommended Config New value in the report. See the file **/usr/g/service/cclass/spt/cal.spt** for limits.

Outside Absolute Limits

The most likely cause is an incorrect magnet or magnet shield type entered in the service config file.

Required Change Too Great

- Bad landmark
- First-time run of SPT after installing new hardware in a bay using config file values restored from previous bay load
- Running SPT on an uncalibrated system may cause this failure. SPT is intended to be used only to "touch up" Z-isocenter calibration.

Low Signal

An abnormally small signal, or noise-only image, will cause Z-isocenter to fail. Such conditions can be caused by:

- Incorrect center frequency
- Power off to resistive shim supply, if present
- Missing phantom or incorrect landmark
- Cradle unlatches from trolley while advancing to scan
- Head coil quick disconnect not plugged in or defective head coil
- Faulty TNS or TNS continuously blanked by oscillating preamplifier(s)
- Other hardware fault that prevents transmitting or receiving properly
- Head only: Split halves of new head coil are not firmly latched together
- Head only: Wrong head coil type was selected

1-5-3 Gradcal Failure

If a gradcal failure is reported, it means that either the measured value was outside the allowable absolute limits, or the required change was too great. Failures are always based on the Recommended Config New values in the report.

See the file **/usr/g/service/cclass/spt/cal.spt** for limits.

Outside Absolute Limits

- Default gradcal entries in config file
- Incorrect config file entries for hardware configuration

Required Change Too Great

- First-time run of SPT after installing new hardware in a bay using config file values restored from previous bay load
- Running SPT on an uncalibrated system will cause this failure. SPT is intended to be used only to "touch up" grad cal calibration.
- Faulty DQA-III phantom (usually Y axis). Compare the thin outside line at the top of the phantom to the wide outside line at the bottom of the phantom. Illustration 1-14 shows that phantom internal structures are improperly centered in the phantom shell.

DQA-III PHANTOM - GRADCAL MEASUREMENT
ILLUSTRATION 1-14

- Faulty gradient driver power module or GRAM
- Faulty gradient coil
- Incorrect bridge/table alignment

1-5-4 System Gain

If a system gain failure is reported, it means that either the measured value was outside the allowable absolute limits or the required change was too great. Failures are always based on the Recommended Config New value in the report.

See the file **/usr/g/service/cclass/spt/cal.spt** for limits.

Outside Absolute Limits

- Faulty TNS
- Head only: Failure to use new style head quick disconnect box with built-in isolation network
- Faulty preamplifier
- Head only: Faulty Quick Disconnect Box
- Faulty cables anywhere between the coil and receiver
- Faulty receiver
- Faulty T/R switch or hybrid splitter
- Faulty dynamic disable bias driver or T/R switch bias driver
- Faulty coil
- Head only: Split halves of new head coil are not firmly latched together

Required Change Too Great

- First-time run of SPT after installing new hardware in a bay using config file values restored from previous bay load
- Running SPT on an uncalibrated system will cause this failure. SPT is intended to be used only to "touch up" system gain calibration.
- Faulty TNS
- Faulty preamplifier
- Head only: Faulty Quick Disconnect Box
- Faulty cables anywhere between the coil and receiver
- Faulty T/R switch or hybrid splitter
- Faulty dynamic disable bias driver or T/R switch bias driver
- Faulty receiver
- Faulty coil
- Head only: Split halves of new head coil are not firmly latched together

1-5-5 Magnet Shim

If a magnet shim failure is reported, it means that the measured value was outside allowable absolute limits. In the **/usr/g/service/cclass/spt** directory, see the files listed below for limits applicable to your magnet type:

ge_s1.spt
ge_s2.spt
ge_s3.spt
ge_s4.spt
ge_s5.spt

ge_sx.spt
ge_sxc.spt
ge_max.spt
ge_cx.spt
ge_lcc.spt, or
ox.spt

Run Grad Shim using LVShim

If only first-order coefficients are out of specification, try running LVShim in Grad Shim mode with all SPT phantoms on the cradle. SPT Magnet Shim should now pass. If it does not pass, but stand-alone LVShim does pass, stand-alone LVShim takes precedence over SPT Magnet Shim. Report the discrepancy and continue.

1-5-6 Gradlong Eddy Currents

Note

Eddy Current Checks are only available in software versions 9.1 and 10.x.

System Performance Test (SPT) originally had an eddy current check portion utilizing the Grafimage test. This method was found to correlate poorly with the Grafidy and ECMT tools used to set eddy current compensation parameters on the Signa scanner, so the test was removed. This left the FE with no quick and easy way to periodically check eddy current compensation efficiency, and removed eddy currents from the trending that SPT offers.

Based on a technique developed by the Haifa MR engineering team, a new eddy current quantification tool was developed. In one of its modes, this tool (Gradlong) can utilize the standard SPT Head setup (the DQA-III phantom) to measure residual eddy currents and produce results that correlate to Grafidy3 (the latest eddy current calibration tool). This reintroduces an eddy current screening capability into SPT.

The new Gradlong eddy current technique is using a different method of checking eddy currents than Grafidy and ECMT use and should be seen as an alternate way of assessing eddy currents on the system. Gradlong is most accurate when run using a small uniform phantom, and a stand-alone version of the tool is included on the scanner (refer to the Gradlong procedure) for running with a 10 cm sphere to aid in more precise troubleshooting. The SPT version is meant to be a quick and easy check to see if a more detailed eddy current check is merited. Stand-alone eddy current measurement tools always take precedence over the SPT Eddy Current Check.

The output of the SPT Eddy Current Check is placed in groups 40-42 of the SPT results file. Each group tabulates data for a different excitation pulse axis (40 - X, 41 - Y and 42 - Z). Each group tabulates maximum residual eddy current in percent of the excitation pulse for three different time intervals (the same time intervals used in Grafidy and ECMT). The data for each time interval also includes the acceptance limit, the difference between the measured data and the limit (to indicate how close to the limit the measured value is) and pass/fail status. Data is presented for both on-axis and cross-terms for linear eddy currents and for on-axis terms for B-zero eddy currents.

If results are outside allowable limits, perform appropriate eddy current and B_0 calibration procedures.

1-5-7 SNR

If an SNR Test failure is reported, it means that at least one of the following was outside allowable limits: signal, noise, SNR, or TG.

See the file **/usr/g/service/cclass/spt/snr.spt** for specifications.

Signal

If the system has previously passed the SNR test, and no calibrations have been performed since the SNR test passed, consider the following:

- If the signal is failing low, the phantom may be warm due to heating from gradients during prior testing. Try using a phantom that has been stored for the last several hours at normal room temperature (not in an unusually warm bay).
- A phantom that is too cold can cause the signal to fail high. This is usually a problem only with mobile systems that have recently had phantoms exposed to winter temperature conditions.
- Low signal can be caused by other system performance parameters that affect imaging physics such as shim, eddy currents, severe instabilities or faulty gradcal. Really bad RF amplifier linearity or exciter rho modulator missing bits could also degrade signal, but this is very rare.
- Oscillating preamplifier(s) can cause the TNS to blank continuously or intermittently.
- Faulty TNS
- Head only: Failure to use new-style head quick disconnect box with built-in isolation network
- Faulty preamplifier
- Head only: Faulty Quick Disconnect Box
- Faulty cables anywhere between the coil and receiver
- Faulty T/R switch or hybrid splitter
- Faulty dynamic disable bias driver or T/R switch bias driver
- Faulty receiver
- Faulty coil
- System gain may be out of calibration, especially if this is a first-time run of SPT after installing new hardware in a bay using config file values restored from a previous bay load, or if the system has not been calibrated at all.
- Head only: Split halves of the new head coil are not firmly latched together
- Head only: Wrong head coil type selected

Noise

If the system has previously passed the SNR test, and no calibrations have been performed since the SNR test passed, consider the following:

- The screen room door is not properly closed or is faulty. The coherent noise test would also likely fail.
- The lighting in the screen room is faulty. The coherent noise test would also likely fail.
- The cover is open or removed from the SRI. The coherent noise test would also likely fail.
- Hardware changes (usually additions) have been made that violate RF shield integrity. These could include special test cables, test equipment, etc. in the screen room without proper filtering or shielding. The coherent noise test would also likely fail.
- Faulty TNS
- Head only: Failure to use the new-style head quick disconnect box with built-in isolation network
- Faulty preamplifier
- Head only: Faulty Quick Disconnect Box
- Faulty cables anywhere between the coil and receiver
- The T/R switch or hybrid splitter is faulty. Try running the PIN diode noise test.
- Faulty dynamic disable bias driver or T/R switch bias driver
- Faulty receiver
- Faulty coil
- System gain may be out of calibration, especially if this is a first-time run of SPT after installing new hardware in a bay using config file values restored from a previous bay load, or if the system has not been calibrated at all.
- Head only: Split halves of the new head coil are not firmly latched together

SNR

Note

Be aware that the specifications used by SPT for the new head coil are different from those used for the old head coil.

If the SNR is failing, either the signal is too low, or the noise is too high. Refer to the signal and noise sections for guidance.

TG

The most likely cause is RF amplifier gain calibration. If RF amplifier gain calibration is verified OK, also consider:

- Head only: Failure to use new-style Head Quick Disconnect Box with built-in isolation network
- Head only: Split halves of the new head coil are not firmly latched together
- Head only: Wrong head coil type selected
- Head only: Faulty Quick Disconnect Box
- Faulty cables anywhere between the coil and RF amplifier output
- Faulty T/R switch or hybrid splitter
- Faulty dynamic disable bias driver or T/R switch bias driver
- Faulty coil

1-5-8 Stability

Note

TwinSpeed Systems <u>ONLY</u>: The vacuum pump should be powered off during SPT FGRE or FSE stability scans or else stability failures may result.

SPT has two stability tests using the clinical fast spin echo (FSE) and fast gradient echo (FGRE) PSDs. As a very loose general rule, FSE stability, with its high RF duty cycle, is more sensitive to RF-related problems while FGRE, which stresses primarily the gradient drivers, is more sensitive to gradient-related problems. It must be stressed, however, that this is by no means a hard and fast rule. If a stability test failure is reported, it means that at least one of the following was outside allowable limits at a slice location: Time Domain Echo Shift, Constant Phase Drift, or Magnitude Drift. In the **/usr/g/service/cclass** directory, see files **fsestb.spt** and **fgrestb.spt** for specifications.

Time Domain Echo Shift

The rate of phase accumulation during the readout window is proportional to the integral of the gradient field from the center of the RF 90° pulse for FSE, or 30° pulse for FGRE to the center of the readout window. If the echo pops up exactly in the center of the readout window, the gradient integral is zero. Phase accumulation rate is positive if the echo is late and negative if it is early. SPT does not report the actual echo position, only how it shifts from view to view. If echo shift errors are similar at isocenter and off-isocenter slices, the problem is most likely to be caused by the readout gradient. RF transmit pulse errors have no appreciable effect on time domain echo position unless the RF errors are really huge. Vibration affects FSE stability much more than FGRE stability.

Constant Phase Drift

Early in each sequence, the spins in a slice are excited by an RF pulse (excitation). At this point the spins are all rotating in synchronism with some absolute phase. At receive time (readout) when the echo is refocused, the spins are again all rotating in synchronism with some absolute phase. Constant phase is the average absolute phase that is left over after the time domain echo shift is removed from each view (i.e., the echoes are moved to the exact center of the readout window). Constant phase drift results when the phase shift between excitation and readout changes from view to view. Basically, anything that changes the magnetic field between excitation and readout can cause constant phase drift. If the drift is small at isocenter but large and opposite in polarity at opposed off-isocenter slices, the problem is most likely to be caused by the slice select gradient. If constant phase drift is similar at isocenter and off-isocenter slices, the problem is most likely to be caused by external factors such as vibration, moving metal, oscillating resistive shim supply, etc. RF transmit pulse errors have no appreciable effect on constant phase drift unless the RF errors are really huge. Vibration affects FSE stability much more than FGRE stability. Constant phase drift is the parameter that is most sensitive to vibration.

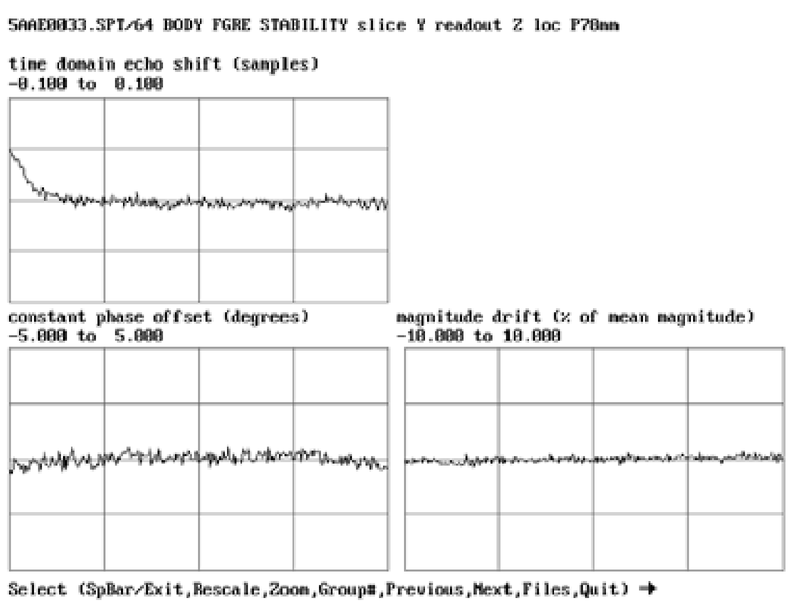
Magnitude Drift

SPT compares mean magnitude of each view to mean magnitude of all views. The result is displayed as a percentage of mean magnitude of all views. In general, magnitude problems are caused by RF transmit or receive faults. There are exceptions, of course. Severe gradient errors can also sometimes cause magnitude drift problems, especially if slice location is changing due to drift of the slice encoding gradient. Vibration affects FSE stability much more than FGRE stability although the impact on magnitude results is not bad enough to impact image quality.

Illustrations Relating to Stability for FGRE and FSE

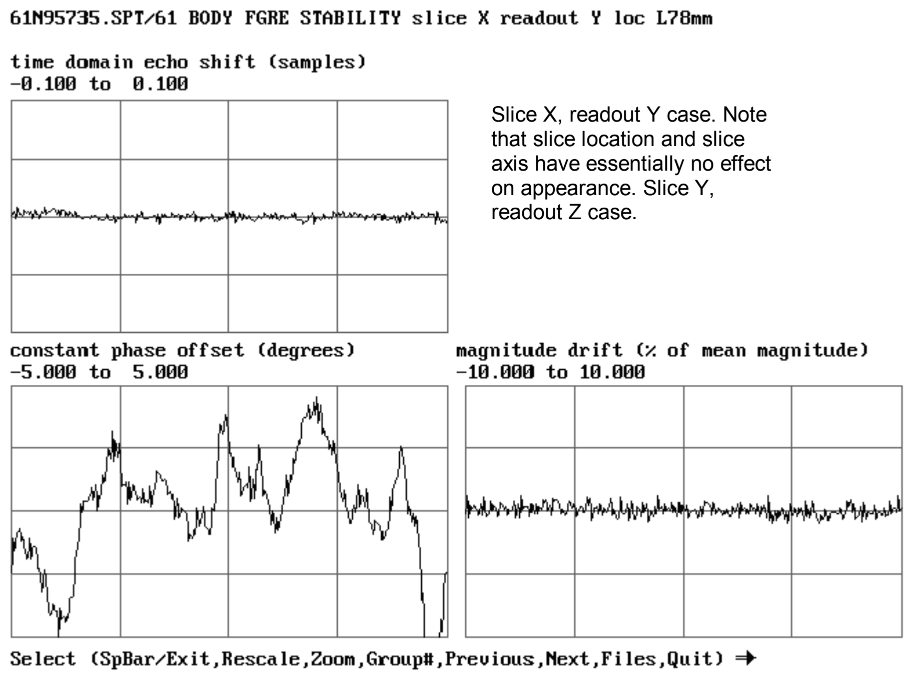
FGRE Stability Example - Inadequately Compensated Long Time Constant Eddy Currents

When Z is used for readout, effect on echo shift is not dependent on slice location (Illustration 1-15).



INADEQUATELY COMPENSATED LONG TIME CONSTANT EDDY CURRENTS
ILLUSTRATION 1-15

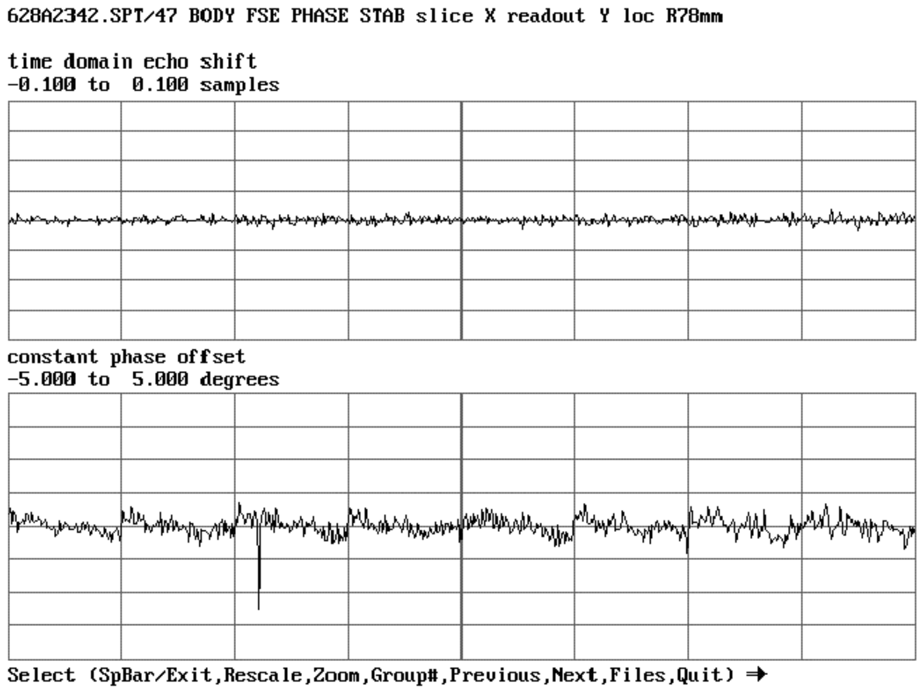
FGRE Stability Example – Environmental magnetic field disturbance (Illustration 1-16).



ENVIRONMENTAL MAGNETIC FIELD DISTURBANCE
ILLUSTRATION 1-16

FSE and FGRE Stability Example – Magnitude and constant phase spikes caused by body preamplifier (Illustration 1-17).

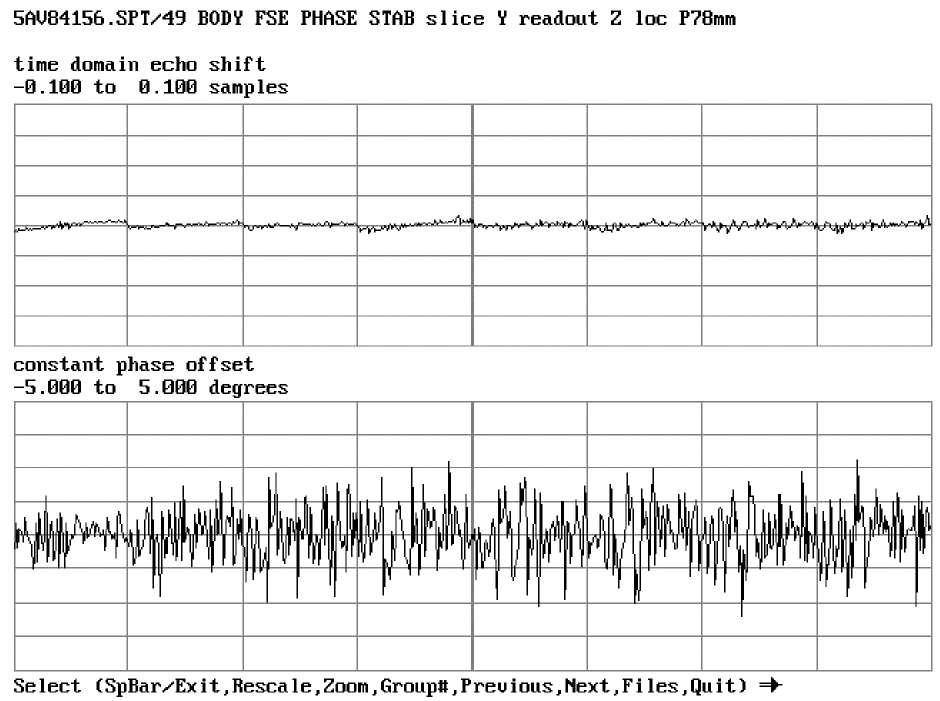
It is **very** important to note that the spikes do **not** propagate in the echo train after the initial event. This means that the event occurred during **receive** time since the "physics" was **not** affected. Therefore, the problem **must be in the receive chain**.



MAGNITUDE & CONSTANT PHASE SPIKES CAUSED BY BODY PREAMPLIFIER
ILLUSTRATION 1-17

FSE Stability Example – High vibration caused by rotating machinery on the floor above the magnet

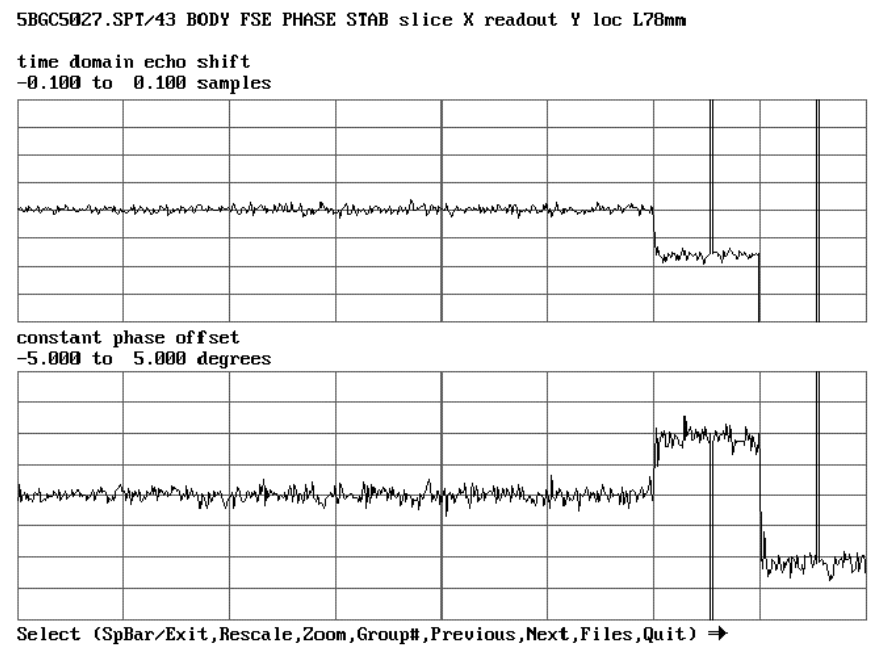
Phase plots from FSE stability test. Results are similar on all planes. Coronal is shown since it was the worst (Illustration 1-18).



HIGH VIBRATION CAUSED BY ROTATING MACHINERY ON FLOOR ABOVE MAGNET
ILLUSTRATION 1-18

FSE & FGRE Stability Example – Spikes caused by defective IPG (Illustration 1-19).

It is **very** important to note that the spikes **do propagate** in the echo train after the initial event. This means that the event occurred during transmit time since the "physics" was affected. The peak-to-peak magnitude error was **100.3 %** which suggests that entire views of data were missing.



SPIKES CAUSED BY DEFECTIVE IPG
ILLUSTRATION 1-19

1-5-9 Coherent Noise

PROBLEM: When performing an SPT coherent noise test, the last 4 or 5 images in each series of SPT coherent noise may have a higher background noise than the first images.

SOLUTION: Normally, the head coil protrudes from the rear of the magnet during data collection. However, values for "table delta" in the protocols controlling the coherent noise test can be modified so that the head coil is placed at isocenter for the coherent noise test. Protocols used for the test should be selected based on magnet field strength and nesting plate style (long or short) just as they were before the change.

All **fixed sites** should run the coherent noise test using default protocols. Fixed systems with good screen room integrity should pass the test using default protocols for the coherent noise test (i.e., with the head coil protruding from the rear of the magnet during data collection). If the coherent noise test fails at a fixed site, run the test stand-alone with protocols modified as described below for mobile systems using the head TLT phantom and loader. If the test then passes AND the customer is not complaining about artifacts (dots or zippers) or degraded image quality (poor SNR), then no further action should be taken to get the site to pass the coherent noise test.

However, if the coherent noise test passes when run stand-alone, as described below for mobile systems, AND the customer IS complaining about artifacts (dots or zippers) or degraded image quality (poor SNR), then steps should be initiated to identify and correct the screen room integrity problem which is causing the coherent noise test to fail when using the default protocols and phantom.

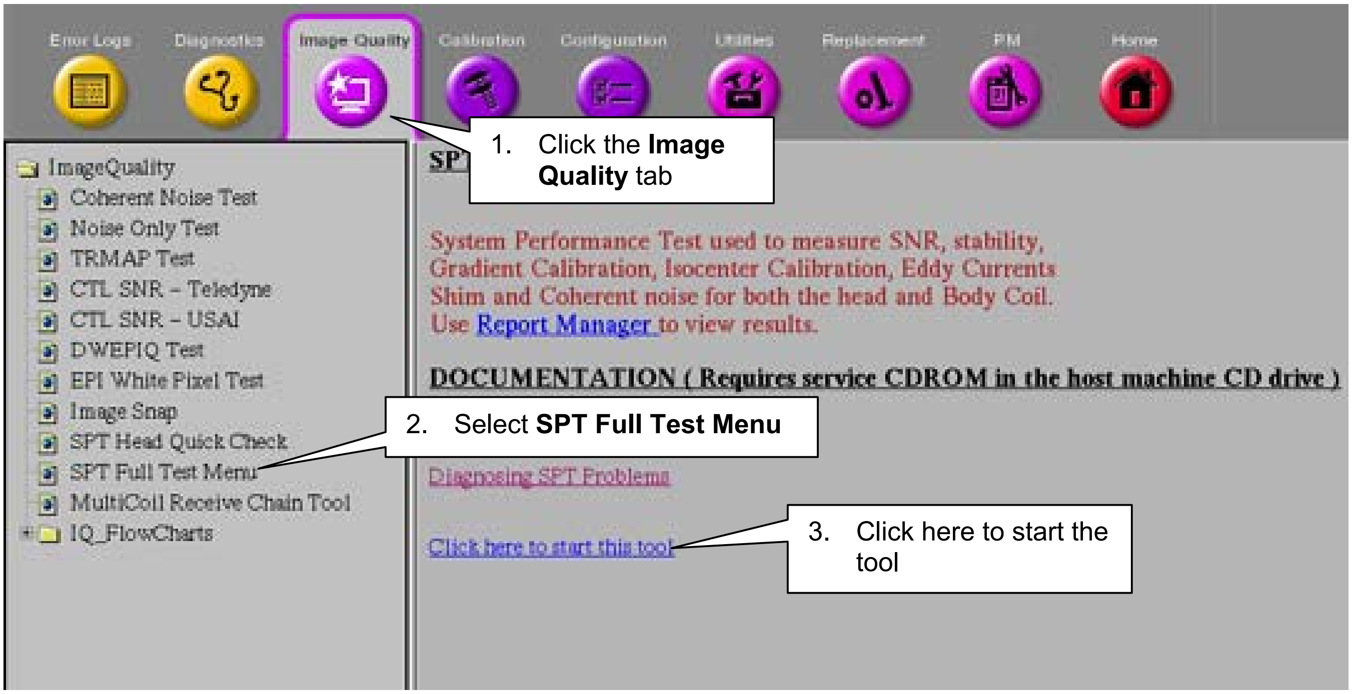
Mobile systems can run the test with protocols modified with "table delta" values for the coherent noise test set to zero, causing the head coil to be positioned at isocenter for data collection. If the protocols are modified, the coherent noise test must be run stand-alone, using the head TLT phantom, without running any other head coil tests. To ensure proper positioning of the head coil for the test:

- Landmark must first be established using the DQA-III phantom in the old head coil or the split head coil phantom in the split head coil.
- With the alignment light still on and WITHOUT moving the cradle, remove the DQA phantom and insert the head TLT phantom and loader, and position the phantom at the alignment light by hand.

If the coherent noise test passes with the modified protocols, then no further effort is required to improve screen room integrity unless the customer is complaining about artifacts (dots or zippers) or degraded image quality (poor SNR). If such complaints are made by the customer for mobile systems, then it will be necessary instead to use clinical scans of volunteers to determine that screen room integrity has been sufficiently improved to the point that the offending artifact or poor SNR is no longer present.

2- SPT USER OPTIONS

Once phantoms are positioned and landmarked, you can access SPT via the Service Browser by following the steps on Illustration 2-1, below.



ACCESSING THE SPT FULL TEST MENU
ILLUSTRATION 2-1

The **SPT Full Test Menu** and **SPT Head Quick Check** selections initiate a hierarchical menu system that guides you through the selection of available test options. Periodic status updates occur while SPT is running to ensure that the test is progressing, and that the system has not hung.

SPT can be aborted at any time. If you abort the test before completion, valid test results that were created prior to the abort are preserved. See Section 13-1, Utilities, for additional information relating to utilities available with SPT for clearing conditions that may be present upon an untimely abort.

The ability to specify multiple passes of SPT is provided to permit extended testing of the system during installation, bay staging, or intermittent problem troubleshooting.

For ***TwinSpeed***, the tests must be repeated for each **GradMode**; in one session by selecting **Whole & Zoom**, and in separate sessions by selecting only one **GradMode**.

2-1 Test Options

Test options for clinical users are limited to: Quick Check, Quick Check with Stability, All Tests except Shim, and All Tests. Field engineers and in-house service engineers have the clinical user's options, plus the choice of logically grouped individual tests (see Table 2-1). Option availability is determined by the presence of valid security keys. See Table 2-2 for details.

TABLE 2-1
SPT TEST OPTIONS

TEST	COIL AND PHANTOM	QUICK CHECK	CALIBRATION CHECK	PERFORMANCE CHECK
Center Frequency	Head and DQA-III or Split Head Coil Phantom	Yes	Yes	No
Gradcal	Head and DQA-III or Split Head Coil Phantom	Yes	Yes	No
Z-Isocenter	Head and DQA-III or Split Head Coil Phantom	Yes	Yes	No
System Gain	Head and DQA-III or Split Head Coil Phantom	Yes	Yes	No
SNR	Head and DQA-III or Split Head Coil Phantom	Yes	No	Yes
Stability	Head and DQA-III or Split Head Coil Phantom	No	No	Yes
Coherent Noise	Head and DQA-III or Split Head Coil Phantom	No	No	Yes
Shim	Body and LVShim	No	Yes	No
Eddy Currents	Body and Sphere	Yes	Yes	No
System Gain	Body and Sphere	No	Yes	No
SNR	Body and Sphere	No	No	Yes
Stability	Body and Sphere	No	No	Yes

TABLE 2-2
SECURITY KEYS AND TEST OPTIONS

INSTALLED KEY	QUICK CHECK	QUICK CHECK & STABILITY	ALL TESTS	ALL TESTS EXCEPT SHIM	SELECTED TESTS
None	No	No	No	No	No
InSite	Yes	Yes	Yes	Yes	No
Service or In-house	Yes	Yes	Yes	No	Yes

After you've chosen options and started the test, data collection and processing proceed without further user input (i.e., you are not required to select protocols, prescan, scan, reposition phantoms, or initiate data analysis processes while SPT is running).

3- SOFTWARE PROPRIETARY CLASSIFICATION

All software required to implement SPT, except the files required to support remote activation of service engineer options for the clinical SPT user, are Proprietary Class C, and are located in the **/usr/g/service/cclass/spt** directory. All output data are saved in the **/usr/g/service/data** directory.

Section 12 of this document, SPT Specification File, shows how system specifications are defined and located.

4- TEST CONTROL

SPT is completely automated and uses a software process to drive the tests. The software process is called *Software Validation and Test* (SVAT). Two selections on the MR Tools screen initiate SPT. If the InSite security key is present, but the field engineer and in-house service engineer keys are not, then only the full set of tests, the full set of tests minus LVShim test, or the SPT Head Quick Check set are available for selection. If the field engineer or in-house service engineer security key is present, a menu is displayed that permits running the full and Quick Check sets, as well as subsets of the tests that are logically grouped together—e.g., the results for some tests are derived from the same scan(s). See Table 3 for Security Keys and Test Options.

Each logically-grouped set of tests has its own protocol(s) that are loaded by SVAT. Protocols include positioning information, which permits the cradle to be driven to the appropriate phantom location for each test based on a single landmark on the DQA-III phantom in the head coil. It is **not** necessary to select **[New Exam]**, select a Service protocol, or modify the scan prescriptions; SVAT scripts do that for you.

When an SPT run is started, a status window is displayed that indicates all selected test options. As each individual test is running, a message is displayed in the window indicating which data are being collected or processed. Start time and estimated completion time are also displayed in the status window. In FE mode, the number of passes selected and the current pass number are displayed. A separate dialog box contains concise instructions and a user interface for terminating SPT prior to completion.

5- RESULT REPORTING

Three types of output files are generated by SPT:

- Result file compatible with the Signa Report Manager tool
- Trend log containing data for use in a customer trend report
- Trend log containing data for use in a field engineer trend report

Each SPT run creates a result file, and appends a new line to each trend log unless the field engineer has elected to exclude results of the current run from the trend log. Trend logs are white-space-delimited ASCII files that can be read by spreadsheet software running on an IBM-compatible personal computer. A utility is provided for the retrospective removal of selected results from trend logs. This utility is called ***Prune***. See Section 13-1, Utilities for SPT, in this document for additional information about utilities available with SPT.

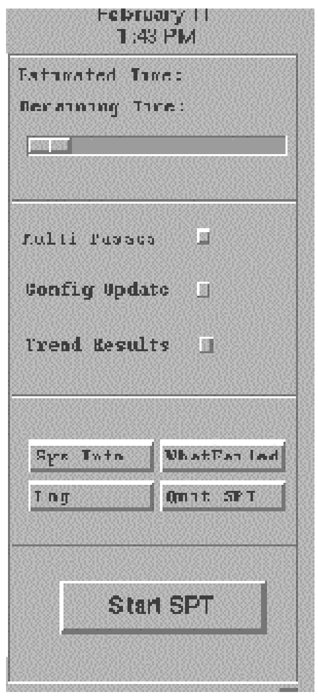
6- SAFETY FEATURES

After you have started SPT, you may stop testing by selecting **[Interrupt SPT]** or **[Quit SPT]**. If you elect to cancel the test at any time during the run, all valid test results created in the current run are assembled into a result file. See Section 13-1, Utilities for SPT, for additional information about utilities available with SPT for clearing conditions that may be present after an untimely abort.

7- CONFIGURATION SENSITIVITY

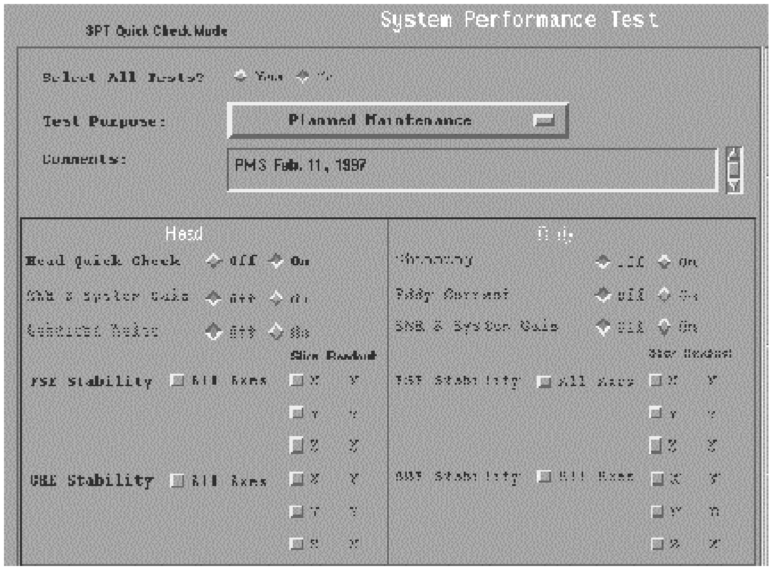
All pulse sequences (PSDs) used by SPT for data collection use interfaces to product system config files to ensure compatibility with all field strengths, slew rates, and product options. Only head and body coils are used for data collection by SPT, so options such as phased array and other surface coils have no impact on test operation.

The following illustrations show the various SPT menus:



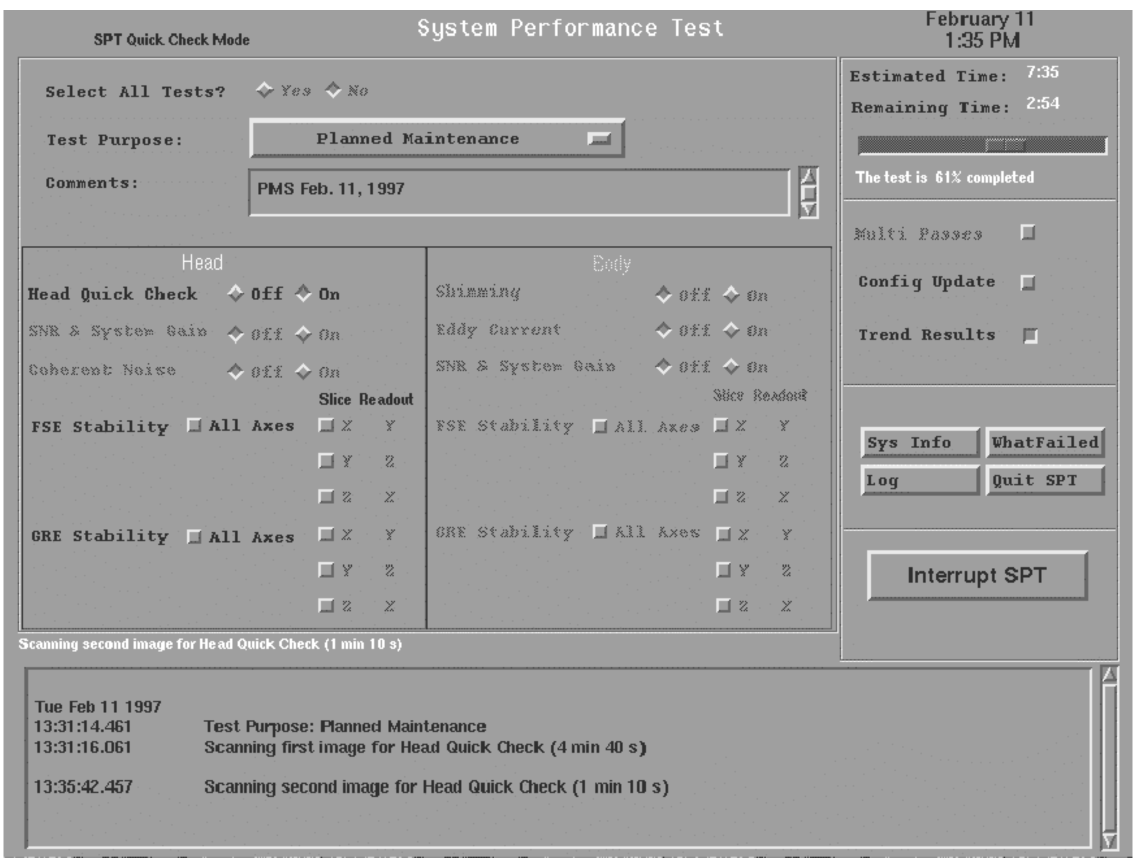
STARTING SPT
ILLUSTRATION 7-1

To run the **Head Quick Check**, click on the **[Head Quick Check]** button.



QUICK CHECK TEST SELECTION
ILLUSTRATION 7-2

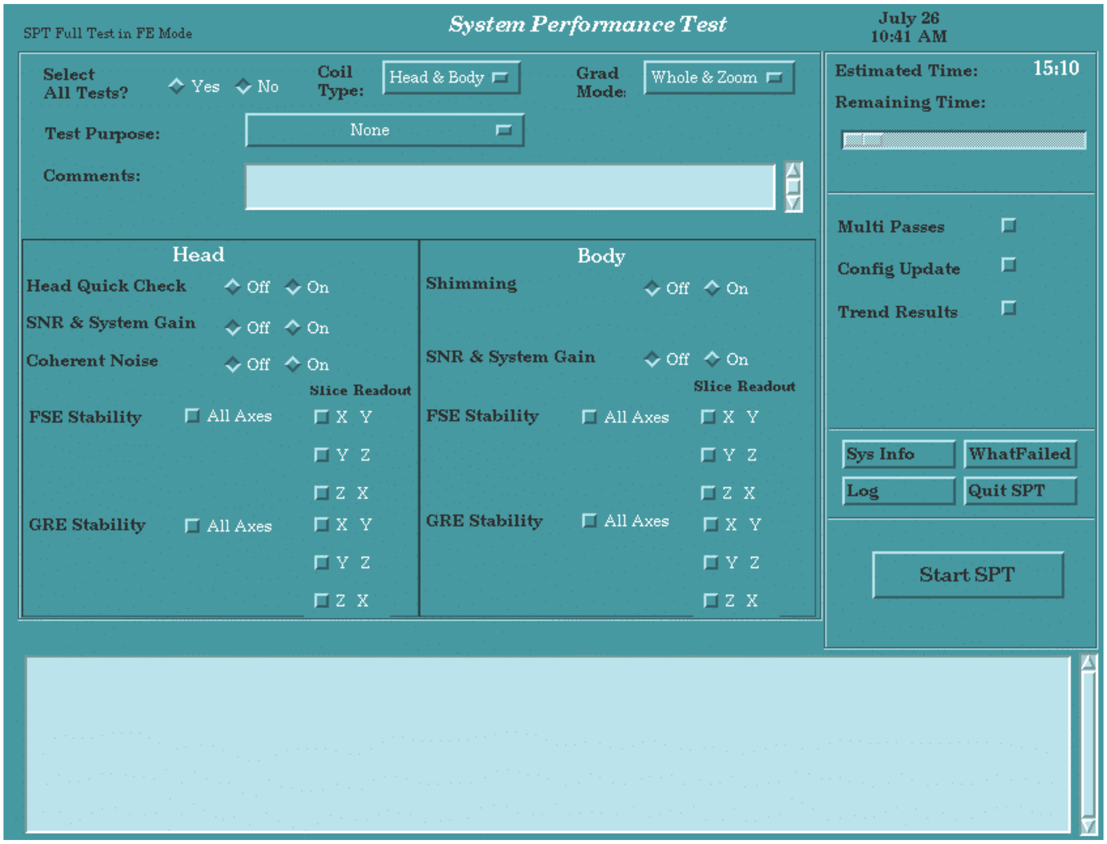
To run the **Full Test**, change the “Select All Tests?” selection to **Yes**.



FULL TEST SELECTION
ILLUSTRATION 7-3

Illustration 7-4 shows **FE Test selection, single test**.

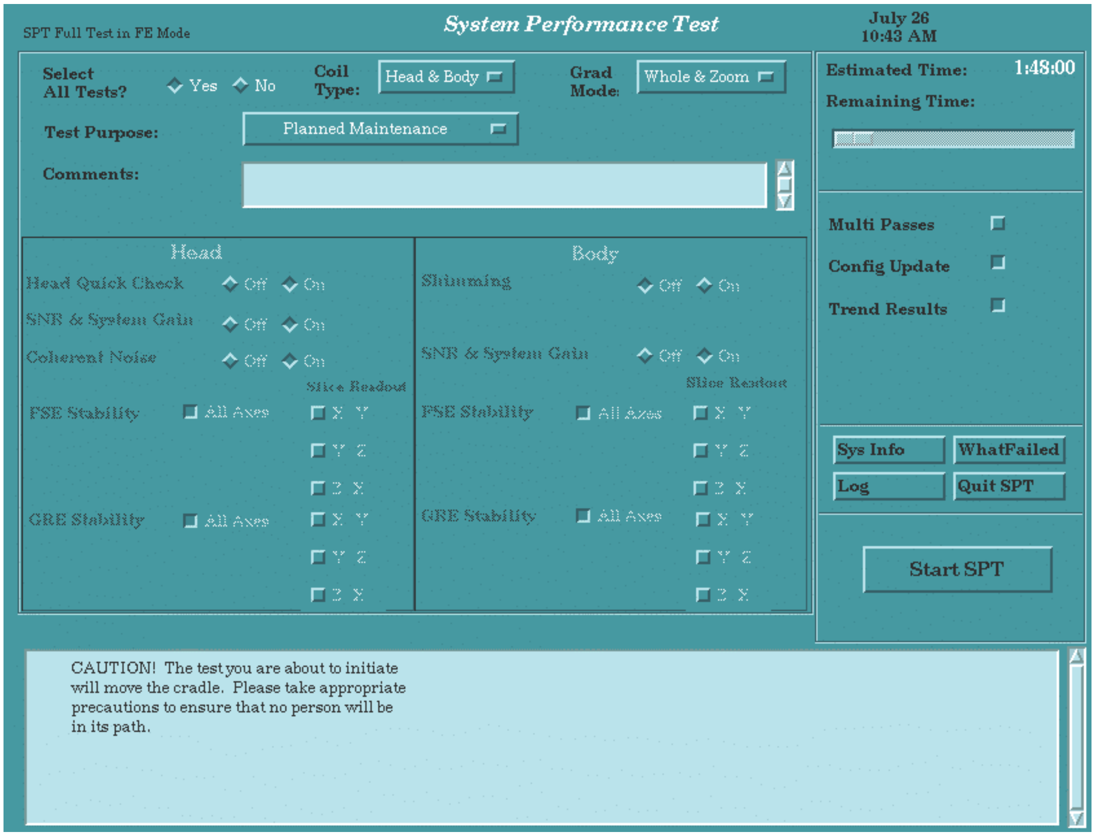
Click on any combination of tests to run. (For ***TwinSpeed***, select the **GradModes** to be used.) Click the **[Start SPT]** button to begin.



FIELD ENGINEER TEST SELECTION - SINGLE TEST EXAMPLE
ILLUSTRATION 7-4

Illustration 7-5 displays **FE Test selection, all tests**.

All tests can be run by selecting **All Tests** and clicking the **[Start SPT**] button to begin.

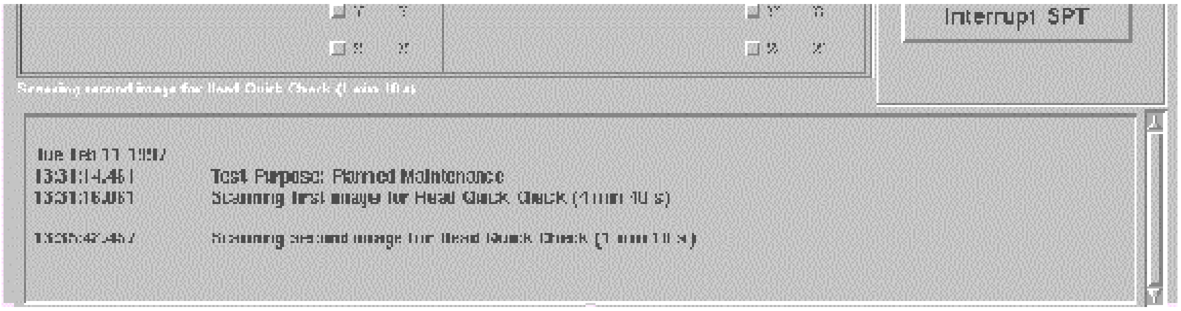


FIELD ENGINEER TEST SELECTION - ALL TESTS EXAMPLE
ILLUSTRATION 7-5

7-1 Test Execution Status

While SPT is running, a status window is displayed for the user. Illustration 7-6 shows an example status window for the "Head Quick Check" case. For other cases, messages applicable to selected tests are shown, including, for the ***TwinSpeed***, the **GradMode** currently being used.

The lower portion of the SPT window contains a scrollable status section to keep the user informed of the test status throughout the test.



SPT STATUS MESSAGE - HEAD QUICK CHECK
ILLUSTRATION 7-6

8- SPT TEST RESULTS DEFINITION

8-1 Z-Isocenter Test

The Z-isocenter check is automated in SPT using SVAT. If you are running SPT (that is, only the InSite security key is present), Z-isocenter is measured and trended, but the config file is not updated. *Trended* means that test results are appended to trend logs.

If the service person authorized automatic config file updates when SPT was initiated, and Z-isocenter is out of specification by the update threshold limit or more, then the config file is automatically updated.

If the Z-isocenter error is greater than the limit for the highest change allowed, a hardware malfunction, not just calibration drift, has probably occurred and an automatic update will not be performed.

If a severe error is detected during the Z-isocenter Test, a message will appear telling the customer that GE advises against scanning any patients until the problem is corrected.

8-2 Gradient Calibration (Gradcal) Test

Analysis for the one-axis-at-a-time automatic gradcal is fully automated with SVAT for SPT.

If the customer is running SPT (that is, only the InSite security key is present), gradcal is measured and trended but the config file is not updated.

If the service person authorized automatic config file updates when SPT was initiated, and gradcal is out of specification by an amount that is equal to or greater than the update threshold, then the config file is automatically updated.

If the error for gradcal is greater than the limit for the highest change allowed, a hardware malfunction (not just a calibration drift) has probably occurred.

8-3 Center Frequency, SNR, and System Gain Tests

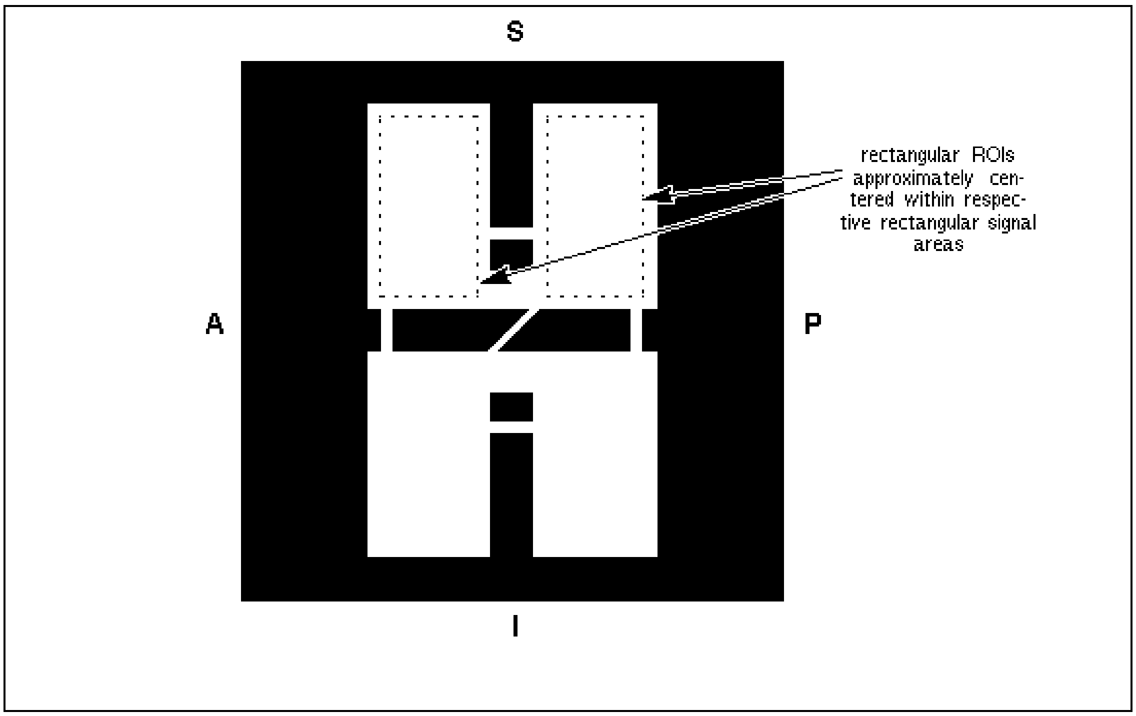
Test results are appended to trend logs.

8-3-1 Center Frequency

This is not really a test, but since the American College of Radiology requires trending of center frequency as part of daily quality checks on an MRI system, the center frequency determined by auto prescan for the sagittal scan of the Quick Check set is reported.

8-3-2 Signal-to-Noise Ratio (SNR)

In the head coil, signal is measured in the sagittal scan of the Head Quick Check set. Signal is the mean value of all pixels within two rectangular regions of interest (ROIs) in the image, as shown in Illustration 8-1. Noise is measured with a no-RF scan with 30% of full scale gradient applied to each axis during data collection. Body SNR and coil gain data are collected using the SPT body sphere in its short loader. Signal is measured as in body TLT SNR. Noise data are collected in the body coil and in the head coil. In both the head and body cases, signal and noise are normalized for coil gain—a significant change from the TLT SNR test.



HEAD SNR & COIL GAIN ROI LOCATION
ILLUSTRATION 8-1

8-3-3 Coil Gain

This test uses the un-normalized signal value measured during the SNR test(s) to compute coil gain for inclusion in the rational image scaling recon scale factor. If the customer is running SPT (that is, only the InSite security key is present), coil gain is measured and trended but the config file is not updated.

If the service person authorized automatic config file updates when SPT was initiated, and coil gain is out of specification by an amount that is equal to or greater than the update threshold, then the config file is automatically updated.

If the error for coil gain is greater than the limit for the highest change allowed, a hardware malfunction (not just calibration drift) probably occurred, and an automatic update won't occur.

8-4 Stability Tests

Stability data for head and body coils is taken on each axis at seven slice locations centered about isocenter. In the body coil case, data from the center and outermost slices are processed. In the head coil case, only data from the outermost slices are processed since there is very little signal-producing material in the axial and coronal isocenter slices of the DQA phantom.

8-4-1 Gradient Recalled Echo

- After auto prescan is completed, CVs are modified to kill the phase encoding gradient. Minimum slice thickness is used to stress the gradient subsystem.
- Time domain echo shift deviation and constant phase deviation and magnitude deviation are plotted.
- A linear ramp is fitted to and then subtracted from the plot data for each parameter prior to computing peak-to-peak values. Peak-to-peak amplitude of each linear ramp is also reported. It is important to note that plots are shown **with** linear ramps included, not subtracted out.

8-4-2 Fast Spin Echo

- Multi-slice stability tests using a fast spin echo clinical pulse sequence are employed by SPT. After auto prescan, CVs are modified to kill the phase-encoding gradient. Minimum slice thickness is used to stress the gradient subsystem.
- Fast spin echo data are acquired with the CV raw data set to **1** to force raw data to be stored in time order with no preprocessing. Because raw data are not preprocessed, the error message "14 images did not successfully reconstruct from Exam E5XXXX, Series X" appears. This is normal and should be ignored.
- Echo shift and constant phase deviation, and magnitude deviation are plotted with data arranged in order by echo (i.e., all echo 1 data, followed by echo 2 data, etc.).

8-5 Shim Test

SPT uses the same version of LVShim that is used to calibrate the magnet. LVShim analysis software command-line arguments permit SVAT to invoke LVShim in SPT mode, and to specify the diameter of the spherical analysis volume. SPT analyzes LVShim at 40 cm for a CRM and 45 cm for other body coils. When LVShim is running in SPT mode, it runs silently. (i.e., the normal LVShim user interface is disabled, and no output to the display is generated. SPT LVShim data are formatted as they are when LVShim is run in the test mode).

8-6 Eddy Currents Test

The TLT version of Grafimage is used to evaluate eddy current effects in the 2 msec to 100 msec range. It is important to note that linear short time constants are not measured with SPT.

Grafidy calibration can be in specification, but SPT may fail due to a problem in Grafimage

ROI. Grafidy results have precedence over Grafimage results whenever a discrepancy is encountered. Use Grafidy to determine if the failure is real.

Note

Systems with Release 8.2.5 or a later release: Short time constants are compensated for using default values that are in the default Grafidy calibration files (these systems no longer run short time constant compensation during Grafidy).

8-7 Coherent Noise Test

The coherent noise protocols are the same as those used for the Class A (non-proprietary) correlated noise test, except they are automated. Two changes have been made to the data collection:

- The Head Coil is driven to near the end of travel outside the rear of the magnet. This permits listening for noise that may be present due to a breach in RF-shielded room integrity.
- Gradwarp is turned off so that any zipper artifacts present in the images will be perfectly straight, improving sensitivity of the analysis. Data reported are the same as those recorded in the data sheets for the Class A Correlated Noise procedure.

9- RESULT FILE ORGANIZATION

The result file is constructed to be compatible with existing report tools.

9-1 Header 0

This contains the customary file header, although it has significantly reduced content compared with older tools such as TLT and SST. SPT data are the result of many scans in multiple coils and, therefore, it would be meaningless to include scan-specific information in the header for the entire result file. Scan-specific data such as prescan and coil information are included with individual test results as needed.

9-2 Groups 1 Through 8: Reserved for Future Use

These groups may be used to display off-line interpretation of SPT results in future releases.

9-3 Group 9 Summary Report

Group 9 contains a summary report showing pass/fail status of all tests that were run. Only the four worst failing stability groups for each coil are identified, in order of descending severity.

9-4 Summary Report Content

The summary report group is completely formatted by the process that creates it, and is designed for human interpretation only. This means that an off-site process is **not** expected to store the information in a database as discrete values, but only as a paragraph. Table 9-1 shows the summary report format.

TABLE 9-1
SUMMARY REPORT FORMAT

OUTPUT/PROMPTS	INPUTS/COMMENTS
`Z Isocenter      <pass/fail> see group    10`	← invalidates all other tests if failing
`Gradcal X        <pass/fail> see group    10`	
`Gradcal Y        <pass/fail> see group    10`	
`Gradcal Z        <pass/fail> see group    10`	
`Head Coil Gain   <pass/fail> see group    10`	
`Head SNR         <pass/fail> see group    10`	
`Head FSE Stab.   <pass/fail> see groups mm,nn,oo,etc.`	← descending failure severity
`Head GRE Stab.   <pass/fail> see groups mm,nn,oo,etc.`	← descending failure severity
`Shim             <pass/fail> see group    30`	
`Eddy Currents X  <pass/fail> see groups   40`	
`Eddy Currents Y  <pass/fail> see groups   41`	
`Eddy Currents Z  <pass/fail> see groups   42`	
`Body Coil Gain   <pass/fail> see group    70`	
`Body SNR         <pass/fail> see group    70`	
`Body FSE Stab.   <pass/fail> see groups mm,nn,oo,etc.`	← descending failure severity
`Body GRE Stab.   <pass/fail> see groups mm,nn,oo,etc.`	← descending failure severity
`Coherent Noise   <pass/fail> see groups xx through yy`	← group numbers depend on magnet field strength

9-5 SPT Evaluates Test Results

In addition to collecting and processing data, and reporting test results like other advanced service tools, SPT also evaluates test results against acceptance criteria, and reports the conclusions of that evaluation. Some parameters are also used to update calibration entries in the system configuration file if it is determined that an adjustment is needed, and the user has authorized automatic configuration file updates during the startup of SPT.

10- SPT FULL TEST MODE PROCEDURE

To set up and run SPT Full Test Mode, four general tasks must be completed:

1. Cancel out of any previous exams. Click on **[End Exam]**.

2. Position phantoms and establish a landmark.

3. Invoke SPT from the Service Desktop's **Image Quality** tab.

4. Remove any patient positioning devices **before** placing the nesting plate or other phantoms on the table. In particular, remove patient restraints or other devices that attach to the tracks along the edges of the cradle.

10-1 Disable Vacuum Pump – TwinSpeed Systems ONLY

The TwinSpeed vacuum pump should be disabled if SPT FSE or FGRE stability scans are going to be run. Failing to disable the vacuum pump may result in SPT stability failures.

Remove the front cover from Twinspeed Accessory Cabinet (TAC) and place the power switch on the right side of the vacuum pump (near where the power cord connects) in the OFF position. It is also possible to remove the power cord from the pump. This is done to prevent

VACUUM PUMP INSIDE TWINSPEED ACCESSORY CABINET
ILLUSTRATION 10-1

10-2 Phantom Positioning for SPT Full Test Mode

If all tests will be run, these elements will be required:

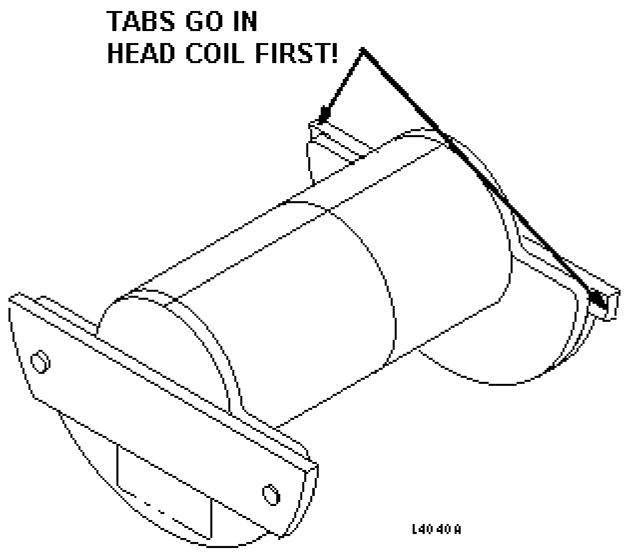
- The nesting plate
- The LVShim phantom
- The body sphere with short loader
- The DQA-III phantom (in the old head coil)
  or
  The new split head coil DQA phantom (2322997-2) for use only with the new split head coil
- The old head coil (46-282118G2)
  or
  The new split head coil (2337543)

10-2-1 DQA-III Phantom and Old Head Coil

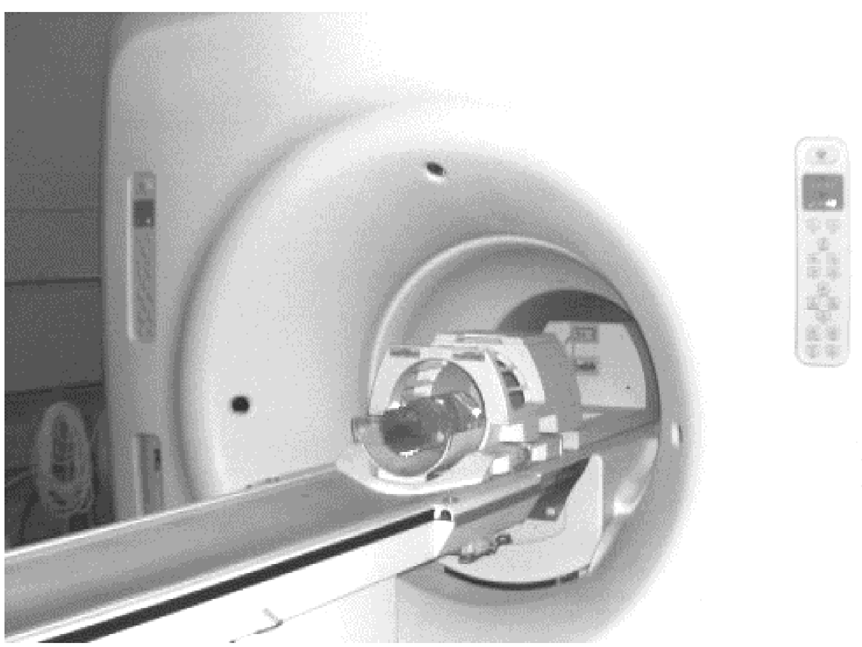
Follow this procedure only if you're using the DQA-III phantom and the old head coil. If you're using the new phantom and new head coil, see Section 10-2-2.

1. Place the head coil on the patient table.

2. The DQA-III phantom fits in the old head coil only one way. Notice the small tabs on one end flange of the DQA-III phantom. These tabs go in the head coil first (see Illustration 10-2). Place the DQA-III phantom in the head coil on the patient table (see Illustration 10-3).

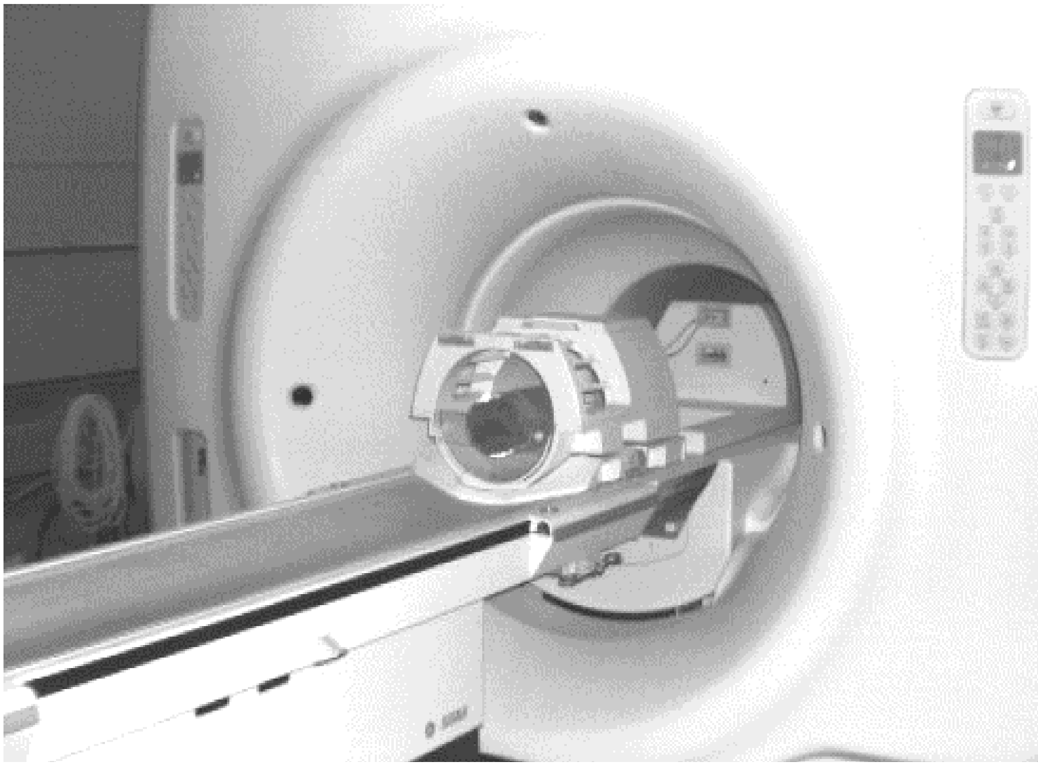


DQA-III PHANTOM ORIENTATION
ILLUSTRATION 10-2



DQA-III PHANTOM POSITION IN THE HEAD COIL
ILLUSTRATION 10-3

3. Pull the head coil all the way out to cover the DQA-III phantom, as shown in Illustration 10-4.



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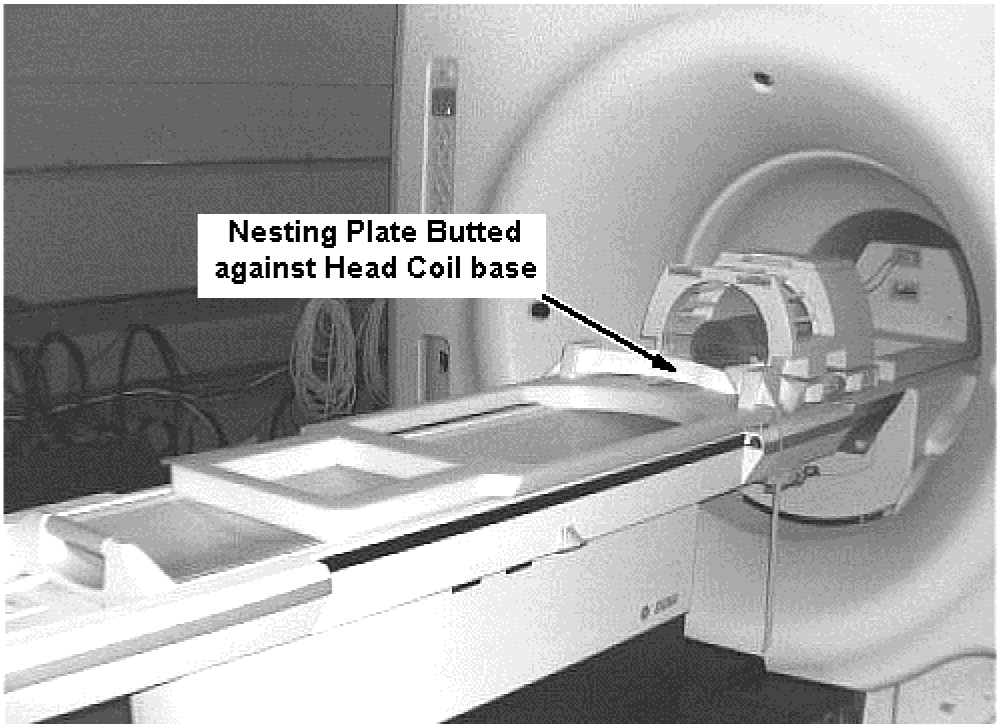
HEAD COIL AND DQA-III PHANTOM CORRECTLY POSITIONED
ILLUSTRATION 10-4

4. Place the nesting plate on the patient table (see Illustration 10-5).

   If the Shim test **will not** be run, go to Section 10-2-3, *Positioning the LVShim Phantom*, step 6.

   If the Shim test **will** be run, continue with Section 10-2-3, *Positioning the LVShim Phantom*.



NESTING PLATE PROPERLY POSITIONED ON PATIENT TABLE
ILLUSTRATION 10-5

10-2-2 New Phantom and New Head Coil

1. Place the split head coil on the patient table.

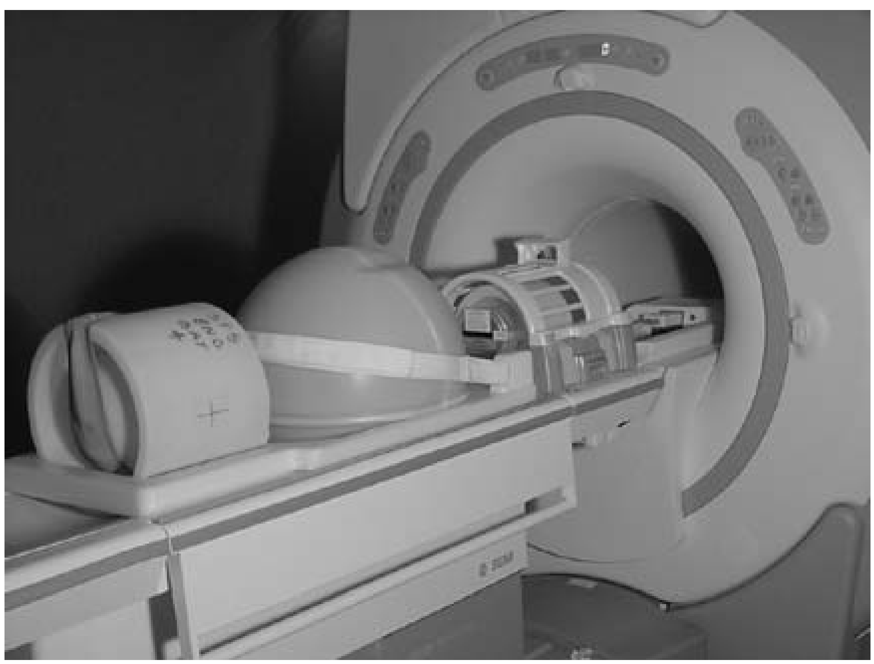
2. The split head coil phantom fits in the new head coil only one way. (See Illustration 10-6).

NEW PHANTOM ORIENTATION
ILLUSTRATION 10-6

3. Place the phantom in the head coil. Refer to Illustration 10-7.

NEW PHANTOM POSITION IN THE HEAD COIL
ILLUSTRATION 10-7

4. Place the nesting plate on the patient table so that it butts flush against the phantom plate (see Illustration 10-8).



NESTING PLATE PROPERLY POSITIONED ON PATIENT TABLE
ILLUSTRATION 10-8

If the Shim test **will not** be run, go to Section 10-2-3, *Positioning the LVShim Phantom*, step 6.

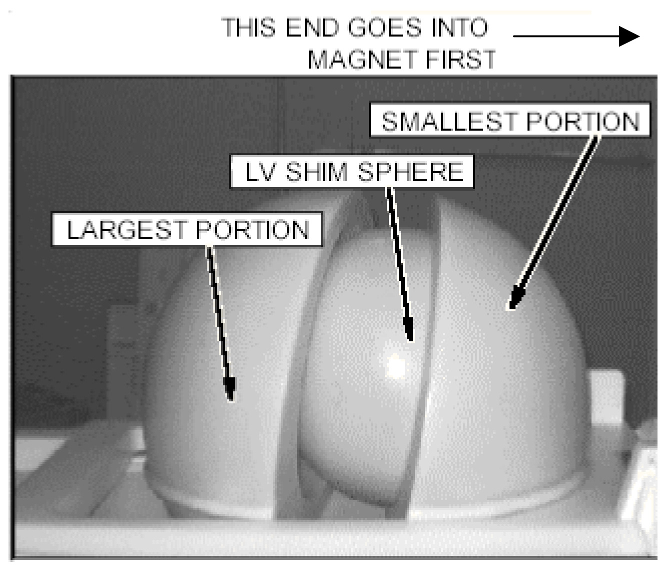
If the Shim test **will** be run, continue with Section 10-2-3, *Positioning the LVShim Phantom*.

10-2-3 Positioning the LVShim Phantom

1. Locate the LVShim phantom, and identify the three parts. (See Illustration 10-9).

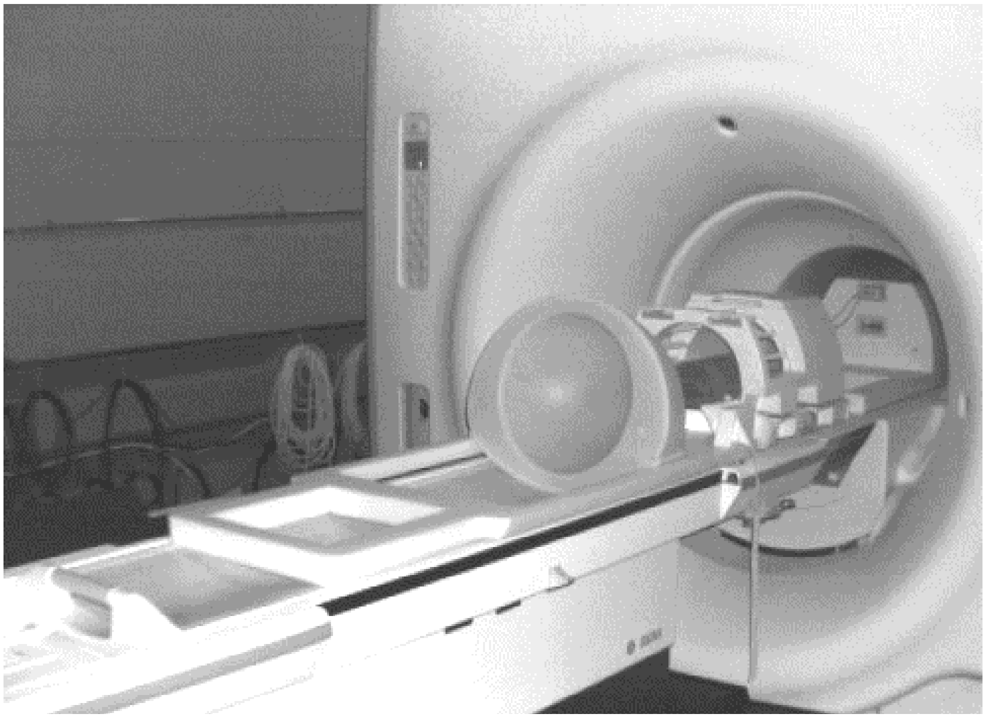
CAUTION

Systems with the shorter CX or LCC Magnet and smaller CRM Body Coil (55cm) must run SPT Full Test mode without the LVshim phantom due to rear endbell interference. For these systems, leave the LVshim phantom off the nesting plate and de-select LVshim when running Full Test mode.



LV SHIM PHANTOM COMPONENTS
ILLUSTRATION 10-9

2. Place the smallest portion of the LVShim phantom on the nesting plate (see Illustration 10-10).



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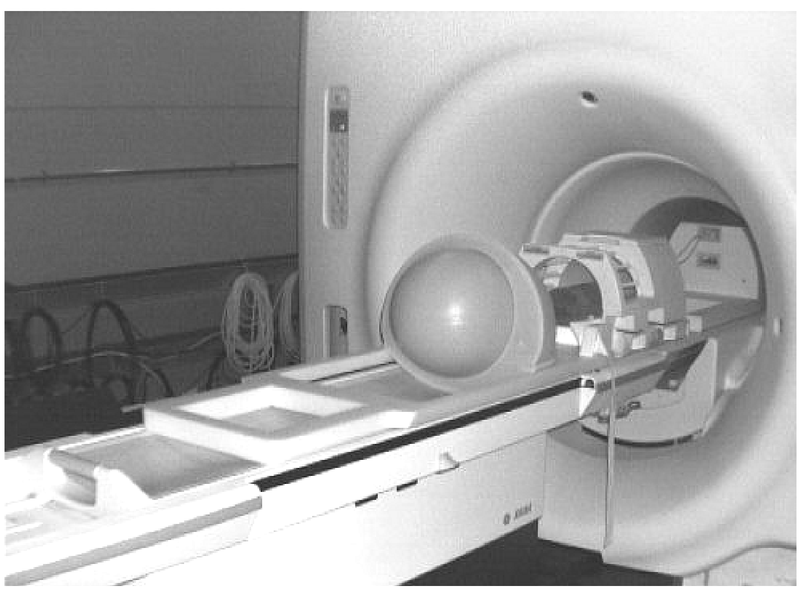
FIRST SECTION OF LVSHIM PHANTOM POSITIONED ON NESTING PLATE
ILLUSTRATION 10-10

3. Place the LVShim sphere in the smallest portion of the LVShim phantom (see Illustration 10-11).



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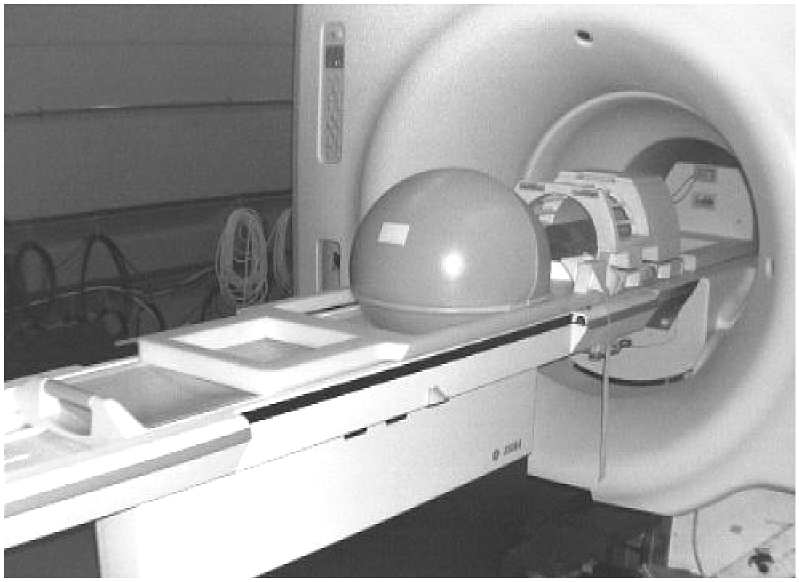
LV SHIM SPHERE POSITIONED IN FIRST LVSHIM SEGMENT
ILLUSTRATION 10-11

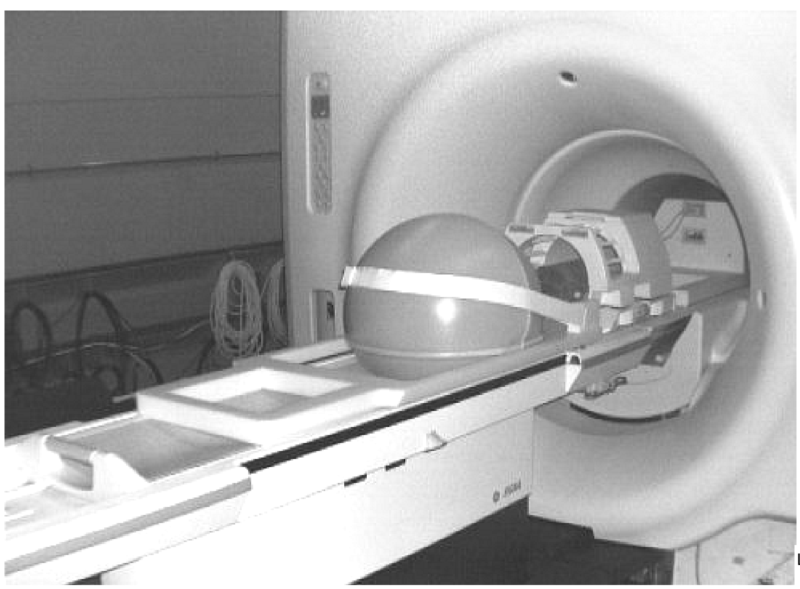
4. Place the largest portion of the LVShim phantom on the combined LVShim phantom on the nesting plate (see Illustration 10-12).



L4010G

POSITIONED THIRD SEGMENT OF THE LVSHIM PHANTOM
ILLUSTRATION 10-12

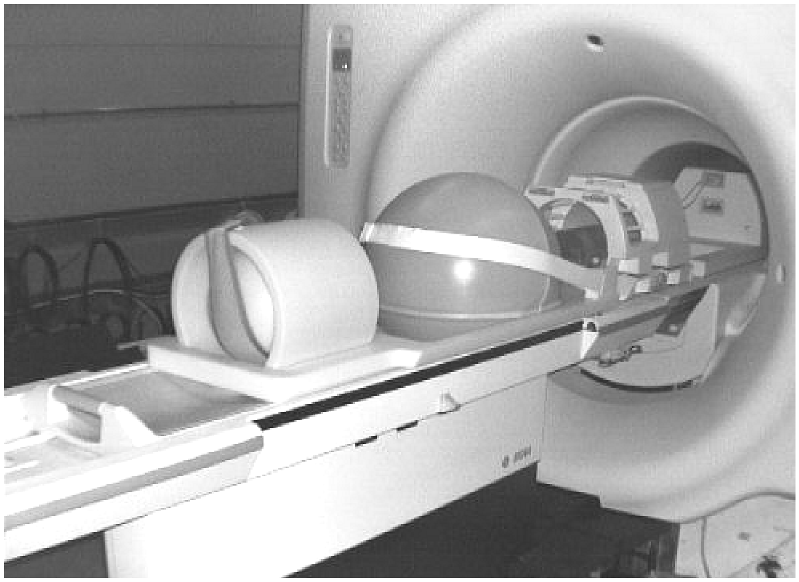
5. Place the strap for the LVShim phantom around the phantom and cinch it tightly, attaching the Velcro® hooks on the strap to the Velcro loops mounted on the outside of the largest portion of the LVShim phantom (see Illustration 10-13).



L4010H

STRAP CINCHING THE LVSHIM PHANTOM
ILLUSTRATION 10-13

6. Place the short loader with the body sphere inside on the nesting plate (see Illustration 10-14). Note the position of the short loader. The label on the top of the short loader indicates the correct orientation.



SHORT BODY LOADER WITH BODY SPHERE POSITIONED ON NESTING PLATE
ILLUSTRATION 10-14

7. Landmark on the axial line of the DQA-III phantom in the head coil.

8. As a final positioning check, ensure that:

   a. The head coil is all the way in position.
   b. The DQA-III is all the way in the head coil.
   c. The nesting plate is up against the head coil holder.

10-3 Bring Vacuum Space Around TRM to Atmospheric Pressure (TwinSpeed ONLY)

CAUTION

The vacuum pump must be powered off before attempting to bring the area around the TRM to atmospheric pressure. This should already have been done in *Section 10-1 Disable Vacuum Pump – TwinSpeed Systems ONLY.*

Note

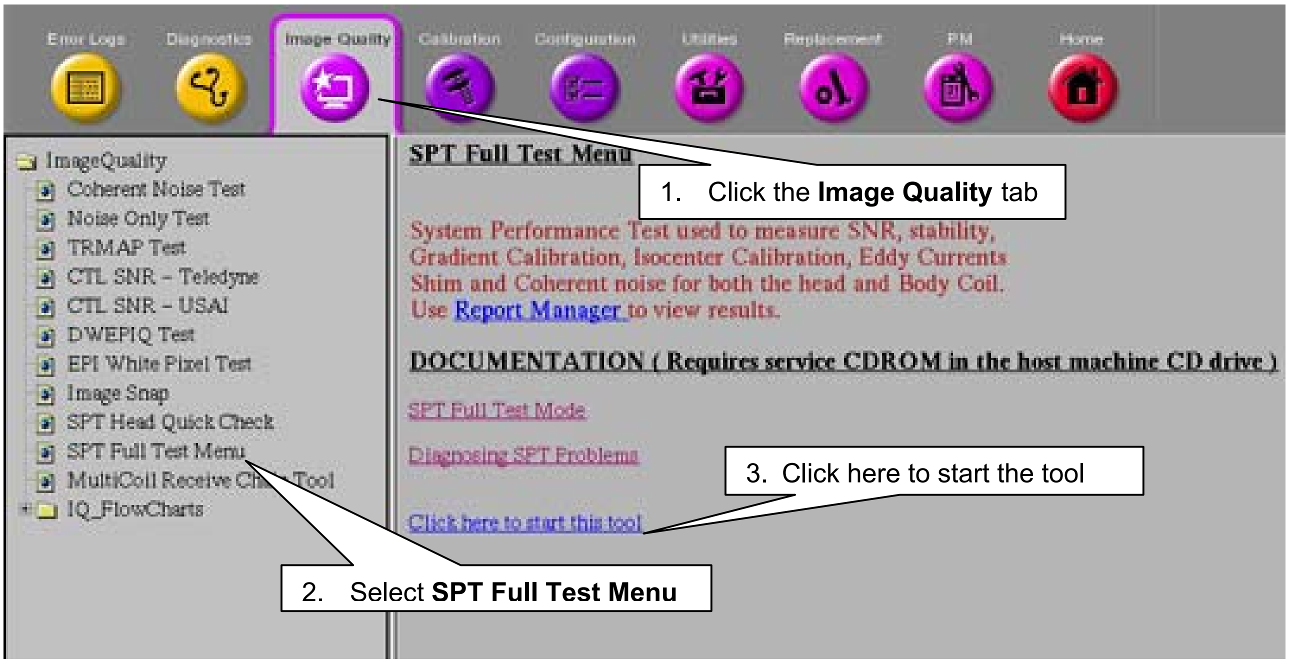
The vacuum space inside the magnet bore must be at atmospheric pressure when this test is run. Running this test with the bore under vacuum may result in stability plots that exhibit a sloping, sometimes saw-tooth pattern. As a result, stability failures may occur.

TwinSpeed (TRM) Systems ONLY: Remove the chain clamp from around the vacuum line at J11 on the rear of the TAC and slowly open the vacuum line connection at J11 so as to equalize the line and vacuum space inside magnet bore to atmospheric pressure. The vacuum pump must be powered off and not run while this is done.

10-4 Invoking SPT Full Test Mode

CAUTION

Test functionality and system functionality may be adversely affected if the previous exam is not terminated. Click on [End Exam] to terminate any previous exam. It is not necessary to click on [New Pt] as SPT automatically enters the scan protocol when it is invoked via the MR Tools menu.



1. To start the SPT Full Test tool from the Service Browser, follow the steps on Illustration 10-15, below.

STARTING THE SPT TEST TOOL
ILLUSTRATION 10-15

2. The SPT Head Coil Selection screen appears. See Illustration 10-16.

SELECT HEAD COIL FOR SPT SCREEN
ILLUSTRATION 10-16

3. Select the head coil currently in use, then click on **[Start]**. An SPT Test menu appears in a window on the desktop. The Field Engineer should always use the Full Test Mode (see Illustration 10-17).

FIELD ENGINEER TEST SELECTION - FULL TEST EXAMPLE
ILLUSTRATION 10-17

a In the **Select All tests** field, click **[No]**.

b. To select a reason for the test, click the button to the right of Test Purpose. Select a reason from the list. If desired, enter text in the Comments field.

c. **For systems with a CRM Body Coil**, in the Body section, select Shimming **Off**.

d. Click the **On** button opposite the tests you want to run.

e. For ***TwinSpeed***, select the **GradMode**(s) to be used while running the tests.

f. To select Multiple Passes of the test(s), select the **Multi Passes** button, then enter the desired number of passes in the box that appears to the right.

g. Click **[Start SPT]** to begin.

You may be prompted to make additional selections as the test begins.

Status messages will appear in the text box below the menu as the tests are run. Use the scroll bar on the right side of the box to move up or down through the messages.

h. If desired, click the **WhatFailed** button. An example of WhatFailed output can be found in Illustration 1-6.

Note

This screen will be displayed until you quit SPT, so if you're in a troubleshooting mode, all you need to do is press the **[Start SPT]** button to go again.

4. To exit SPT, click the **[Quit SPT]** button.

5. **TwinSpeed ONLY:** When finished with SPT place the power switch on the vacuum pump back into the ON position. Replace the cover onto the front of the TAC.

6. To view SPT results, select the **[Utilities]** tab on the Service Browser, then select **[Report Manager]**.

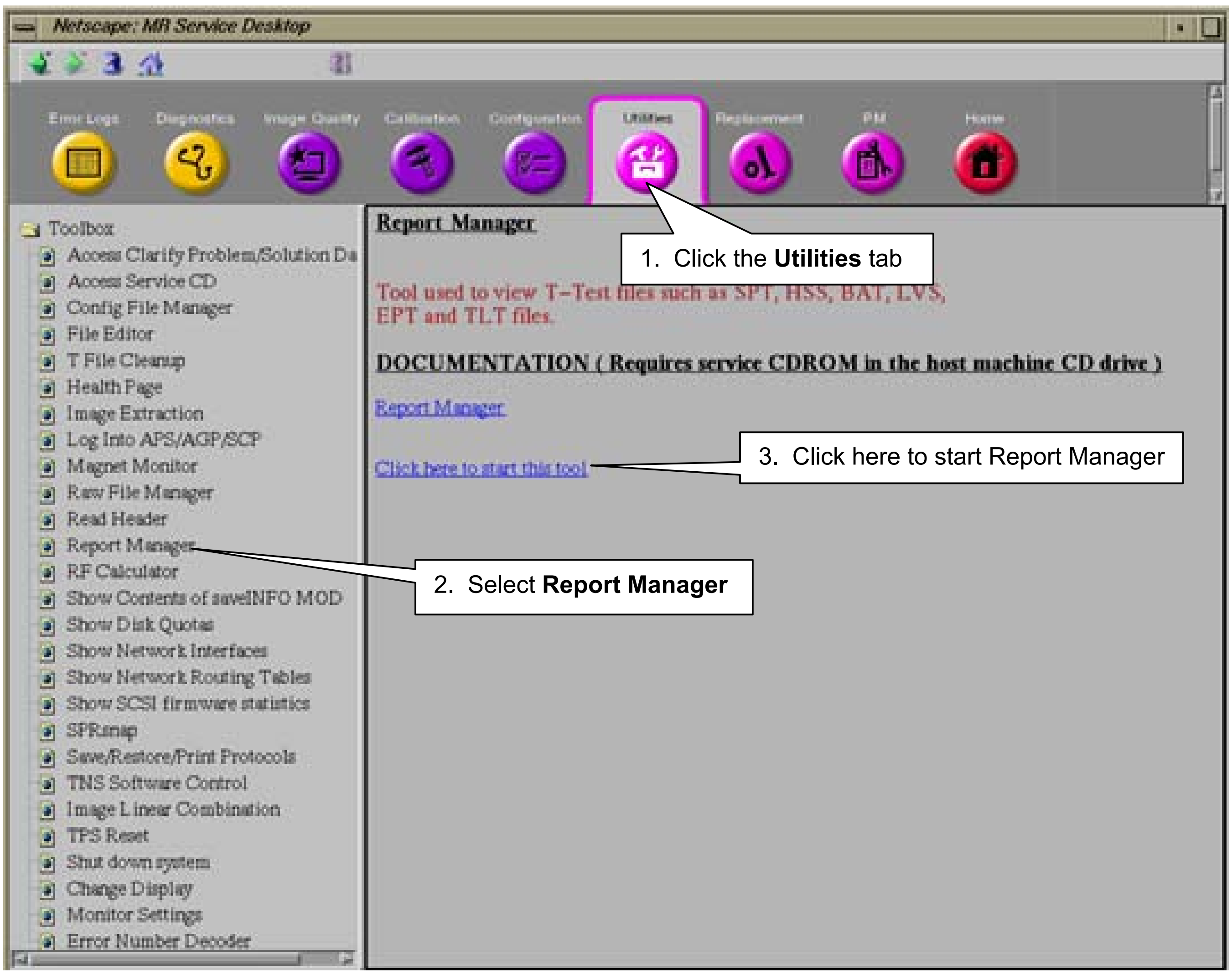
7. Enter the Report Manager password (the same password used for the Service Methods CD-ROM) and press **<Enter>**.

11- VIEWING RESULTS AND CALIBRATION FILES

After SPT has finished the analysis, the data files can be viewed using the Report Manager Tool. The specification files can also be viewed to compare the results against the specifications.

11-1 Viewing Results - Report Manager Tool

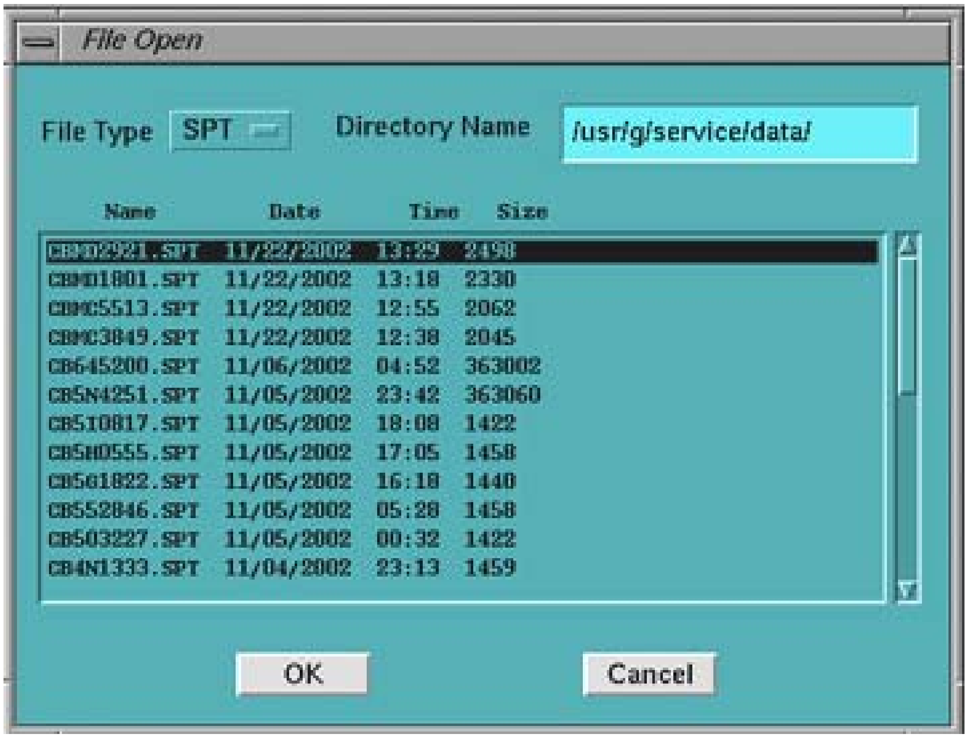
1. To view SPT results, follow the steps on Illustration 11-1 to open the Report Manager.



ACCESSING REPORT MANAGER
ILLUSTRATION 11-1

2. When prompted for a password, enter the same password used for the Service Methods CD-ROM. Press **<Enter>**.

The File Open screen will display available reports. See Illustration 11-2.



ACCESSING SPT REPORTS
ILLUSTRATION 11-2

3. To view an SPT report, first make sure the File Type is **SPT**. (If it is not, click the button following "File Type" and select **SPT** from the list.)

4. Select the report you'd like to view, then click **[OK]**.

   Test results will appear in the Report Manager window. Use the **[Previous]** and **[Next]** buttons to view individual pages of the report**.**

5. To print a report, select **File**, then **Print** from the Report Manager menu.

6. To view another report, select **File**, then **Open**. Select the report from the list, then click **[OK]**.

Note

For additional information on Report Manager, select **[Software Utilities]** from the Service Methods CD-ROM, then **[Report Manager Tool]**.

11-2 Viewing the Specification Files

CAUTION

The specification file contents change based on whether the user selected the old or new head coil at the start of SPT. The file names do not change.

The specification files can be viewed using the **more** command, or the **jot** editor. For definitions of each specification file, go to Section 12, SPT Specification File Definition. For ***TwinSpeed***, refer to the file with a **GradMode** extension, hence as **cal.spt.WHOLE** and **cal.spt.ZOOM**, rather than the original file **cal.spt**.

11-2-1 MORE Method

1. On the Service Desktop, click on **[C Shell]**.
2. View the specification files. Type: **cd /usr/g/service/cclass/spt** and press **<Enter>.**
3. To view the specification file of interest, type **more *filename*.** Press **<Enter>**. Use the filenames from Table 11-1.

11-2-2 JOT Method

1. On the Service Desktop, click on **[C Shell]**. Type: **cd /usr/g/service/cclass/spt** and press **<Enter>**.
2. Type **jot** and press **<Enter>**. A jot window will appear on the desktop.
3. Select **Open** from the **File** pull-down menu. Select the **specification file** of interest from the browser list, and click on **[Accept].** Refer to the file list from Table 11-1.
4. To exit JOT, select **File**, then **Exit**.

11-2-3 Both Methods

Compare the results from the Signa Report Manager tool with the values in the correct specification files to determine the parameter that is out of specification.

CAUTION

The limits shown for Specification Files in this System Performance Test Procedure are for illustration purposes only! Actual specifications are contained within the files on the system.

TABLE 11-1
SPT SPECIFICATION FILES

PARAMETERS	FILE NAME	TABLE NUMBER
Calibration Specification File	cal.spt.	Table 11-2
Eddy Current Specification File	eddyl.spt	Table 11-3
Large Volume Shim Specification Files:		
GE S1 Magnets	ge_s1.spt	Table 11-4
GE S2 Magnets	ge_s2.spt	Table 11-4
GE S3 Magnets	ge_s3.spt	Table 11-4
GE S-IV Magnets	ge_s4.spt	Table 11-4
GE S-V Magnets	ge_s5.spt	Table 11-4
GE S-X Magnets	ge_sx.spt	Table 11-4
GE S-XC Magnets	ge_sxc.spt	Table 11-4
Oxford Magnets	ox.spt	Table 11-4
GE Cx Magnets	ge_cx.spt	Table 11-5
Fast Recalled Echo (FSE) Stability Specification File	fsestb.spt	Table 11-6
Gradient Recalled Echo (GRE) Stability Specification File	grestb.spt	Table 11-6
Signal to Noise (SNR) File	snr.spt	Table 11-7
Control Parameters File	spt_params.cfg	Table 11-8

CAUTION

The limits shown are for illustration purposes only! The following file is for a system with a GRAM (SGD and CRM version specs are different for Gradcal parameters). Actual specifications are contained within the files on the system.

TABLE 11-2
CAL.SPT SPECIFICATION FILE

```
# Rev 0.0 created on 8/16/95
# File cal.spt sets failure limits and update thresholds for all config file parameters that can be
# automatically updated by SPT.  All change limits and update thresholds are absolute values.  All
# gradcal limits are absolute values.
#
# Rev 0.0 created on 8/16/95
# File cal.spt sets failure limits and update thresholds for all config file parameters that can be
# automatically updated by SPT.  All change limits and update thresholds are absolute values.  All
# gradcal limits are absolute values.
#
#                  --------marginal failure limits------  --------severe failure limits--------
#                    low  high   high   low  high   high    low  high   high   low  high   high     update
#                               change              change              change              change  threshold
# parameter          abs   abs    abs     %     %      %    abs   abs    abs     %     %      %    abs   %
o_z_iso            11796 13038     30   n/a   n/a    n/a  11175 13659     50   n/a   n/a    n/a     15 n/a
ges1_z_iso         11796 13038     30   n/a   n/a    n/a  11175 13659     50   n/a   n/a    n/a     15 n/a
ge_z_iso           11796 13038     30   n/a   n/a    n/a  11175 13659     50   n/a   n/a    n/a     15 n/a
gemshld_z_iso      14412 15929     30   n/a   n/a    n/a  13653 16687     50   n/a   n/a    n/a     15 n/a
a_o_z_iso          11796 13038     30   n/a   n/a    n/a  11175 13659     50   n/a   n/a    n/a     15 n/a
a_ges1_z_iso       11796 13038     30   n/a   n/a    n/a  11175 13659     50   n/a   n/a    n/a     15 n/a
a_ge_z_iso         11796 13038     30   n/a   n/a    n/a  11175 13659     50   n/a   n/a    n/a     15 n/a
a_gemshld_z_iso    14412 15929     30   n/a   n/a    n/a  13653 16687     50   n/a   n/a    n/a     15 n/a
05_h_sys_gain       1.40  2.60    n/a   n/a   n/a     12   0.80  3.20    n/a   n/a   n/a     24    n/a   5
05_b_sys_gain       4.81  8.93    n/a   n/a   n/a     12   2.75 10.99    n/a   n/a   n/a     24    n/a   5
10_h_sys_gain       1.18  2.20    n/a   n/a   n/a     12   0.68  2.70    n/a   n/a   n/a     24    n/a   5
10_b_sys_gain       5.58 10.36    n/a   n/a   n/a     12   3.19 12.75    n/a   n/a   n/a     24    n/a   5
15_h_sys_gain       1.27  2.37    n/a   n/a   n/a     12   0.73  2.91    n/a   n/a   n/a     24    n/a   5
15_b_sys_gain       4.18  7.76    n/a   n/a   n/a     12   2.39  9.55    n/a   n/a   n/a     24    n/a   5
es_x_gradcal       29945 32766    300   n/a   n/a    n/a  28369 32767    600   n/a   n/a    n/a    150 n/a
es_y_gradcal       29426 32524    300   n/a   n/a    n/a  27878 32767    600   n/a   n/a    n/a    150 n/a
es_z_gradcal       29195 32269    300   n/a   n/a    n/a  27659 32767    600   n/a   n/a    n/a    150 n/a
hs_x_gradcal       29945 32766    300   n/a   n/a    n/a  28369 32767    600   n/a   n/a    n/a    150 n/a
hs_y_gradcal       29426 32524    300   n/a   n/a    n/a  27878 32767    600   n/a   n/a    n/a    150 n/a
hs_z_gradcal       29195 32269    300   n/a   n/a    n/a  27659 32767    600   n/a   n/a    n/a    150 n/a
h_x_gradcal        29945 32766    300   n/a   n/a    n/a  28369 32767    600   n/a   n/a    n/a    150 n/a
h_y_gradcal        29426 32524    300   n/a   n/a    n/a  27878 32767    600   n/a   n/a    n/a    150 n/a
h_z_gradcal        29195 32269    300   n/a   n/a    n/a  27659 32767    600   n/a   n/a    n/a    150 n/a
a_x_gradcal        27355 30234    300   n/a   n/a    n/a  25916 31675    600   n/a   n/a    n/a    150 n/a
a_y_gradcal        26878 29708    300   n/a   n/a    n/a  25464 31122    600   n/a   n/a    n/a    150 n/a
a_z_gradcal        27120 29974    300   n/a   n/a    n/a  25692 31402    600   n/a   n/a    n/a    150 n/a
#
# Parameter prefix legend
#
# o = all Oxford magnets                                10 = 1.0 Tesla
# ges1 = GE S-I magnet                                  a = Signa Advantage gradient driver & coil
# ge = GE SII,SIII,SIV,SV,SX,SXc and max magnets        h = Signa Horizon gradient driver & coil
# gemshld = GE SIII with Magnashield                    hs = Signa Horizon HighSpeed gradient driver & coil
# 05 = 0.5 Tesla                                        es = Signa Horizon EchoSpeed gradient driver & coil
# 10 = 1.0 Tesla
```

For ***TwinSpeed***, this file has the **GradMode** extension.

TABLE 11-3
EDDY CURRENT SPECIFICATION FILE

Caution! The limits shown are for illustration purposes only! Actual specifications are contained within the files on the system.

```
# Rev 0.0 created on 8/17/95
    # File eddyl.spt sets failure limits for the long eddy current test in
    SPT.

#
# Legend
# b0 = zeroth order (main field) eddy current effects
# g1 = first order linear eddy current effects
# g2 = first order cross term eddy current effects
# suffix _1 = 2.3-11.3 msec interval
# suffix _2 = 21-30 msec interval
# suffix _3 = 41-50 msec interval
# suffix _4 = 91-100 msec interval

#
# 1.5T Echo Speed Long Eddy Current Limits
#        marginal      severe
#       low  high  lowlow  highhigh
es_b0_1 n/a    .2    n/a      .4
es_b0_2 n/a    .2    n/a      .4
es_b0_3 n/a    .2    n/a      .4
es_b0_4 n/a    .2    n/a      .4
es_g1_1 n/a   .15    n/a      .3
es_g1_2 n/a   .08    n/a     .16
es_g1_3 n/a   .08    n/a     .16
es_g1_4 n/a   .08    n/a     .16
es_g2_1 n/a  10.0    n/a    10.0
es_g2_2 n/a  10.0    n/a    10.0
es_g2_3 n/a  10.0    n/a    10.0
es_g2_4 n/a  10.0    n/a    10.0
#
# 1.5T High Speed Long Eddy Current Limits   -
#        marginal      severe                 |
#       low  high  lowlow  highhigh           |
hs_b0_1 n/a    .2    n/a      .4              |
hs_b0_2 n/a    .2    n/a      .4              |
hs_b0_3 n/a    .2    n/a      .4              |
hs_b0_4 n/a    .2    n/a      .4              |
hs_g1_1  n/a    .15     n/a        .3                >Same specs for 1.0T
                                                      High Speed.
hs_g1_2 n/a   .08    n/a     .16              |
hs_g1_3 n/a   .08    n/a     .16              |
```

```
hs_g1_4 n/a   .08    n/a     .16              |
hs_g2_1 n/a  10.0    n/a    10.0              |
hs_g2_2 n/a  10.0    n/a    10.0              |
hs_g2_3 n/a  10.0    n/a    10.0              |
hs_g2_4 n/a  10.0    n/a    10.0             -
#
# 1.5T Horizon Long Eddy Current Limits      -
#        marginal      severe                 |
#       low  high  lowlow  highhigh           |
```

(Same limits as 1.5T High Speed.)

>**Same specs for 1.0T Horizon.**

TABLE 11-4
LVSHIM SPECIFICATION FILE FOR GE S1-S5, SX, Sxc, & OXFORD MAGNETS

Caution! The limits shown are for illustration purposes only! Actual specifications are contained within the files on the system.

```
# Rev 1.0 created on 9/21/95
# <Magnet Type> Magnet SPT LVshim Limits
#             marginal          severe
#           low     high    lowlow  highhigh
planes        5        7        5        7
bw          499      501      499      501
fov          59       61       59       61
dsv          44       46       44       46
std_dev     n/a       60      n/a       90
z1          n/a       10      n/a       15
z2          n/a       50      n/a       75
z3          n/a     1000      n/a     1500
z4          n/a     1000      n/a     1500
z5          n/a     1000      n/a     1500
z6          n/a     1000      n/a     1500
x           n/a       10      n/a       15
y           n/a       10      n/a       15
zx          n/a       50      n/a       75
zy          n/a       50      n/a       75
xy          n/a       50      n/a       75
x2-y2       n/a       50      n/a       75
z2x         n/a     1000      n/a     1500
z2y         n/a     1000      n/a     1500
zxy         n/a     1000      n/a     1500
z(x2-y2)    n/a     1000      n/a     1500
x3          n/a     1000      n/a     1500
y3          n/a     1000      n/a     1500
```

Note
LVshim specs are the same for S1-S5, Sx, Sxc, and Oxford Magnets.

TABLE 11-5
LVSHIM SPECIFICATION FILE FOR CX MAGNETS

CAUTION

The limits shown are for illustration purposes only! Actual specifications are contained within the files on the system.

```
# Rev 1.0 created on 9/21/95
# GE Conquest Magnet SPT LVshim Limits
#            marginal          severe
#           low     high    lowlow  highhigh
planes        5        7       5        7
bw          499      501     499      501
fov          59       61      59       61
dsv          44       46      44       46
std_dev     n/a       65     n/a       80
z1          n/a      8       n/a       10
z2          n/a       35     n/a       50
z3          n/a       35     n/a       50
z4          n/a       675    n/a      1000
z5          n/a       675    n/a      1000
z6          n/a       675    n/a      1000
x           n/a      8       n/a       10
y           n/a      8       n/a       10
zx          n/a       35     n/a       50
zy          n/a       35     n/a       50
xy          n/a       35     n/a       50
x2-y2       n/a       35     n/a       50
z2x         n/a       35     n/a       50
z2y         n/a       35     n/a       50
zxy         n/a       35     n/a       50
z(x2-y2)    n/a       35     n/a       50
x3          n/a       35     n/a       50
y3          n/a       35     n/a       50
```

TABLE 11-6
SPT SPECIFICATIONS FOR FSE & GRE STABILITY

CAUTION

The limits shown are for illustration purposes only! Actual specifications are contained within the files on the system.

```
# Rev 1.0 created on 11/7/97
# <1.5T, 1.0T; FSE and GRE> Stability Limits
#                                      marginal         severe
#                                   low    high   lowlow highhigh
head_off_iso_echo_shift_pp          n/a   .0600     n/a   .120
head_off_iso_echo_shift_rms         n/a   .0110     n/a   .022
head_off_iso_phase_drift_pp         n/a    4.75     n/a   9.50
head_off_iso_phase_drift_rms        n/a    0.84     n/a   1.68
head_off_iso_mag_drift_pp           n/a    8.00     n/a   16.0
head_off_iso_mag_drift_rms          n/a    1.41     n/a   2.82
#
body_off_iso_echo_shift_pp          n/a   .0600     n/a   .120
body_off_iso_echo_shift_rms         n/a   .0110     n/a   .022
body_off_iso_phase_drift_pp         n/a    4.75     n/a   9.50
body_off_iso_phase_drift_rms        n/a    0.84     n/a   1.68
body_off_iso_mag_drift_pp           n/a    8.00     n/a   16.0
body_off_iso_mag_drift_rms          n/a    1.41     n/a   2.82
#
body_iso_echo_shift_pp              n/a   .0600     n/a   .120
body_iso_echo_shift_rms             n/a   .0110     n/a   .022
body_iso_phase_drift_pp             n/a    4.75     n/a   9.50
body_iso_phase_drift_rms            n/a    0.84     n/a   1.68
body_iso_mag_drift_pp               n/a    8.00     n/a   16.0
body_iso_mag_drift_rms              n/a    1.41     n/a   2.82
#
sum_of_exp_echo_shift_rms           n/a    .029     n/a   .058
sum_of_exp_phase_drift_rms          n/a    2.90     n/a   5.80
sum_of_exp_mag_drift_rms            n/a    4.64     n/a   9.28
#
```

TABLE 11-7
SPT SPECIFICATIONS FOR SNR

CAUTION

The limits shown for Specification Files in this System Performance Test Procedure are for illustration purposes only! Actual specifications are contained within the files on the system.

1.5T SNR.SPT FILE CONTENTS:

```
# Rev 1.3 created on 02/20/98
# 1.5T Echo Speed, High Speed & Horizon SNR Limits
#                      marginal          severe
#                    low     high    lowlow  highhigh
h_head_signal          0  10000.0         0  10000.0
h_head_noise         n/a  10000.0       n/a  10000.0
h_head_snr          42.7      n/a      40.4      n/a
h_head_tg             55       85        40      100
h_body_signal          0  10000.0         0  10000.0
h_body_noise         n/a  10000.0       n/a  10000.0
h_body_snr         24.37      n/a     23.09      n/a
h_body_tg            116      146       101      161
```

1.0T SNR.SPT FILE CONTENTS:

```
# Rev 1.2 created on 05/03/96
# 1.0T Echo Speed, High Speed & Horizon SNR Limits
#                      marginal          severe
#                    low     high    lowlow  highhigh
h_head_signal          0  10000.0         0  10000.0
h_head_noise         n/a  10000.0       n/a  10000.0
# next line with baluns
h_head_snr          27.8      n/a      27.7      n/a
# next line without baluns
#h_head_snr          26.8      n/a      25.2      n/a
h_head_tg             57       87        42      102
h_body_signal          0  10000.0       961  10000.0
h_body_noise         n/a  10000.0       n/a  10000.0
h_body_snr          14.1      n/a      13.4      n/a
h_body_tg            121      151       106      166
```

TABLE 11-8
ANNOTATED COPY OF SPT_PARAMS.CFG

CAUTION

The limits shown are for illustration purposes only! Actual specifications are contained within the files on the system.

1.5T SYSTEMS	1.0T SYSTEMS
h_geom_threshold 1400.0	h_geom_threshold 1275.0
min_clipped_pixels_ge 900	min_clipped_pixels_ge 900
min_clipped_pixels_comb 470	min_clipped_pixels_comb 470
min_clipped_pixels_cs 770	min_clipped_pixels_cs 770
h_ax_ge_threshold 4207304.0	h_ax_ge_threshold 3808000.0
h_ax_comb_threshold 2043548.0	h_ax_comb_threshold 1849600.0
h_co_cs_threshold 2404174.0	h_co_cs_threshold 2176000.0
h_co_comb_threshold 2043548.0	h_co_comb_threshold 1849600.0
c_of_mass_threshold 300.0	c_of_mass_threshold 300.0
body_roi_radius 120.7	body_roi_radius 120.7
head_roi_top 66	head_roi_top 66
head_roi_bottom 203	head_roi_bottom 203
head_roi1_left -106.0	head_roi1_left -106.0
head_roi1_right -36.0	head_roi1_right -36.0
head_roi2_left 36.0	head_roi2_left 36.0
head_roi2_right 106.0	head_roi2_right 106.0
head_nominal_gain 1.0	head_nominal_gain 1.0
body_nominal_gain 1.0	body_nominal_gain 1.0
h_head_nominal_signal 2035.0	h_head_nominal_signal 1853.0
h_body_nominal_signal 956.0	h_body_nominal_signal 1068.0
h_head_m 0.00648195	h_head_m 0.00413298
h_head_b 0.35251801	h_head_b 0.58504881
h_body_m 0.01278402	h_body_m 0.005916955
h_body_b -0.28914058	h_body_b 0.39398547

Parameter explanations:

`h_geom_threshold` = image clipping threshold

`h_ax_ge_threshold` = minimum brightest pixel in GE logo convolution result

`h_ax_comb_threshold` = minimum brightest pixel in axial comb convolution result

`h_co_cs_threshold` = minimum brightest pixel in coronal CS convolution result

`h_co_comb_threshold` = minimum brightest pixel in coronal comb convolution result

`c_of_mass_threshold` = minimum pixel intensity to consider in the center of mass calculation to locate signal ROI for SNR and system gain

`body_roi_radius` = radius of body signal for SNR and system gain

The following apply to head signal ROIs for SNR and system gain:

`head_roi_top` = row number for top row of pixels

`head_roi_bottom` = row number for bottom row of pixels

`head_roi1_left` = column offset from center of mass for left edge of left ROI

`head_roi1_right` = column offset from center of mass for right edge of left ROI

`head_roi2_left` = column offset from center of mass for left edge of right ROI

`head_roi2_right` = column offset from center of mass for right edge of right ROI

`h_head_nominal_signal` = target mean signal value for head system gain calculation

`h_body_nominal_signal` = target mean signal value for body system gain calculation

12- SPT SPECIFICATION FILE DEFINITION

CAUTION

The specification file contents change based on whether the user selected the old or new head coil at the start of SPT. The file names do not change.

Table 11-1 identifies example specification files for all results generated by SPT. These files are in the **/usr/g/service/cclass/spt** directory.

Important

The limits shown for the specification file in this SPT procedure are for illustration purposes only. Actual specifications are contained within the files on the system.

12-1 Calibration Specification File

File **cal.spt** sets failure limits and updates thresholds for all config file parameters that can be automatically updated by SPT. There are three versions of this file after a new Host software load:

- **cal.spt** (Initially contains specifications for systems with 8645 Gradient Amps.)
- **cal.spt.sgd** (Specs for systems with SGD Gradients and BRM Body Coil.)
- **cal.spt.sgd_crm** (Specs for systems with SGD Gradients and CRM Body Coil.)
- **cal.spt.TWINSPEED_ACGD.WHOLE** (Specs for TwinSpeed Whole-Body gradient with ACGD)
- **cal.spt.TWINSPEED_ACGD.ZOOM** (Specs for TwinSpeed Zoom Gradient with ACGD)

The first time SPT is run, it checks the system configuration. If the system contains an SGD and BRM, it copies the contents of file cal.spt.sgd into cal.spt. If the system contains an SGD and CRM (i.e., GradCoil = 6 in MRconfig.cfg, or GCoilType = 6 in GradientConfig.cfg), it copies the contents of file cal.spt.sgd_crm into cal.spt. For ***TwinSpeed***, the software installation will have copied over the correct **cal.spt** files for each **GradMode**.

12-2 Eddy Current Specification File

File **eddy.spt** sets failure limits for the long eddy current test in SPT. The version of this file appropriate for the field strength of the scanner is selected the first time SPT is run following a new Host software load.

12-3 Large FOV Shim Specification Files

The magnet files set magnet failure limits for the LVShim test in SPT:

ge_max.spt

ge_s1.spt

ge_s2.spt

ge_s3.spt

ge_s4.spt

ge_s5.spt

ge_sx.spt

ge_sxc.spt

ge_cx.spt, and

ox.spt

12-4 Fast Spin Echo Stability Specification File

The file **fsestb.spt** sets failure limits for the fast spin echo stability test in SPT. The version of this file appropriate for the field strength of the scanner is selected the first time SPT is run following a new Host software load.

12-5 Gradient Recalled Echo Stability Specification Files

The file **grestb.spt** sets failure limits for the fast gradient echo stability test in SPT. The version of this file appropriate for the field strength of the scanner is selected the first time SPT is run following a new Host software load.

12-6 Signal to Noise Specification Files

The file **snr.spt** sets failure limits for the head and body SNR and system gain tests in SPT. The version of this file appropriate for the field strength of the scanner is selected the first time SPT is run following a new Host software load.

It is important to note that even if the Summary Report shows that one of the SNR parameters has failed, it does not necessarily mean that there is an SNR failure. There could be a gain adjustment necessary. Look at the SNR section of the report for that SPT run and view **all** parameters in that section, **not** just the SNR value.

12-7 Control Parameters

The file **spt_params.cfg** contains control parameters that affect the operation of the geometry test, and the head and body SNR and system gain tests in SPT. This file should **not** be modified in the field without explicit instructions from the MR Advanced Test Methods Engineering SPT development team. The version of this file appropriate for the field strength of the scanner is selected the first time SPT is run following a new Host software load.

13- TROUBLESHOOTING

If there is a stop scan condition (such as a hardware error) during a run of SPT, then it is recommended that the system be rebooted. This condition may be caused by the test software being out of sync with the scan software. The only way to clear this condition is to reboot. Follow these instructions:

1. Right-click on the desktop wallpaper area and select **Service Tools** from the root menu, then select **System Shutdown**. Click **Yes** to confirm.

2. When the message "Okay to power off the system now. Press any key to restart" appears, double-click on the **Signa** icon (or type **Signa** in the Login name field), then click the **Log In** button. Enter the password **adw2.0** and click **Log In** again. Allow initialization to fully complete before any user interaction.

3. Continue with the SPT test.

13-1 Utilities for SPT

There are five utilities that are useful when you use SPT. To view a short description of them, refer to the following:

- **Sptreset -** If a problem occurs when exiting SPT in an unusual manner, and the system seems to be in an unusual configuration, type the following in a **[C-Shell]**:

  cd /usr/g/service/cclass/spt <Enter>

  sptreset <Enter>. This puts all the files and configuration values back in their correct condition.
- **PRUNE -** Prune is used to take out trend file entries.
- **"T" File Cleanup -** "T" File Cleanup is a file space management tool. It cleans up the /usr/g/service/data directory. See the procedure for "T" File Cleanup for more information on how to use it.
- **"whatFailed" -** This utility scans through user-selected SPT result files and reports what portion of the test failed, and the actual result and test spec for that test.

To run the "**whatFailed**" utility, you can either

- Open a C-shell from the Service Desktop, then type **whatFailed** and press **<Enter>**

  or
- Select the **whatFailed** button from the System Performance Test GUI.

A menu of all the SPT files for that system will pop up. Select one of the tests displayed (or quit). The utility will then read through the file comparing each test (except for Coherent Noise) against its limits. If there are no failing values in the file, you'll see the following message:

"This utility does not check for Coherent Noise failures."

Press **<Enter>** to continue. For each failure it finds, it will print out each failure one at a time. Press **<Enter>** to move through each listed failure. See Illustration 13-1 for a **whatFailed** example:

```
{sdc lx} [1] whatFailed

Index      Name           Size          Last modified
 =====  ============     =======    ========================
    1. 642M5026.SPT      303045    Mon Apr 15 16:37:40 1996
    2. 64432616.SPT      367539    Mon Apr 15 16:37:44 1996

Enter command or the number of the desired data file
(N)ext (P)revious (S)top (Q)uit :2

FSE Body Stability Phase Drift Slice Y Readout Z at P78 with a value of
6.068
Fails MARGINALLY
This parameter must be less than 4.000 to pass
Greater than 8.000 is a severe failure

Press ENTER to continue ->ENTER

FSE Body Stability Phase Drift Slice X Readout Y at Iso-center with a
value of 5.927
Fails MARGINALLY
This parameter must be less than 4.000 to pass
Greater than 8.000 is a severe failure

Press ENTER to continue ->ENTER

FSE Body Stability Phase Drift Slice Y Readout Z at A78 with a value of
5.026
Fails MARGINALLY
This parameter must be less than 4.000 to pass
Greater than 8.000 is a severe failure

Press ENTER to continue ->ENTER

Body TG with a value of 71.000
Fails MARGINALLY
This parameter must be between 74.000 and 104.000 to pass
Outside of 59.000 to 119.000 is a severe failure

Press ENTER to continue ->ENTER

This utility does not check for Coherent Noise failures

Press ENTER to continue....
```

WHATFAILED EXAMPLE
ILLUSTRATION 13-1

REVISION HISTORY

REV	DATE	AUTHOR	PRIMARY REASONS FOR CHANGE
0	Apr 02, 1998	L. Loehrer	Converted Toolbook document to MS Word 7.0.
1	July 8, 1998	M. Keber	Updated for Release 8.2 and Release CV1 differences, added “Quick Reference” procedure, and “Problems with SPT...” to section 1, removed Release 8.0 information and duplicate spec tables, updated other spec files, and cleaned up illustration/table number references.
2	Oct 15, 1998	M. Keber	Updated for Release 8.2.5 references; removed obsolete 8.1 info.
3	May 20, 1999	S.M.Atladottir	Updated Procedure References for New GUI
4	Sept. 27, 1999	G. Boerner	Minor corrections (pg. 5) per 8.3 bay validation.
5	Oct 14, 1999	M. Keber	Added correct proprietary heading to document.
6	Jan 26, 2000	J. Wolak	Corrected pathname for nesting plate file
7	Sep 10, 2000	J.Gerber	Updated for TwinSpeed
8	July 25, 2001	J.Gerber	Updated for TwinSpeed scanner for 9.0 release.
9	Aug. 13, 2001	J. Wolak	Merged in updates from Milwaukee’s previously published revs 7, 8 & 9. This included M. Jones changes as follows: Deleted obsolete GUI info in Introduction, changed “PCReport” references to “Report Manager”, changed “start” to “Start SPT” in sec. 10-2, added steps 3 and 4 to sec 10-2. Reversed Illustration 10-5 so spatial orientation agrees w/ other photos in section. Sec. 1- :Changed “Service Tape” references to “Service CD”. Sec. 1-1: Deleted old “what’s new” information. Added notes that Eddy Current Test applies only to 8.3 and ASP1 software. Deleted reference to “Exit SPT Window” from Section 13-1.
10	Aug. 1, 2002	K. Keshena	Updated the SPT screen in section 1-1, SPT Screens (Overview). Added information on Gradlong Eddy Current checks in sections 1.4-3 Features and 1-5-6 Gradlong Eddy Currents. Updated Table 1-1 to reflect the Eddy Current check and version of software, 9.1 & 10.x in note.
11	Nov. 5, 2002	C. MacDonald	Added Desktop browser interface illustration 1-2 and 10-11, plus SPT Head Coil Selection screen. Minor style and syntax changes.
12	Jan. 13, 2003	C. MacDonald	Added new head coil and phantom photos.
13	Apr. 29, 2003	D. Thome’	Added reminder to turn TwinSpeed vacuum pump off during scanning. Corrected errors.
14	June 5, 2003	D. Thome’	Added Sections advising FE to open TwinSpeed vacuum line.