Guide to Good Laboratory Practice

Varian 400-MR

Pub. No. 01-999338-00, Rev. B1106

NOTICE: This document contains references to Varian. Please note that Varian, Inc. is now part of Agilent Technologies. For more information, go to **www.agilent.com/chem.**

Agilent Technologies

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Technical contributors: Iain Green
Technical writes: Mike Miller
Technical editor: Everett Schreiber

3120 Hansen Way, Palo Alto, California 94304
1-800-356-4437
http://www.varianinc.com

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Chapter 1. Introduction

Sections in this chapter:

Good Laboratory Practice (GLP) regulations (see FDA regulation 21 CFR part 58) dictate a system designed to assure the quality and integrity of the safety data attained from "nonclinical laboratory studies that support or are intended to support applications for research or marketing permits for products regulated by the Food and Drug Administration, including food and color additives, animal food additives, human and animal drugs, medical devices for human use, biological products, and electronic products" (Section 58.1 Scope).

Although, for example, certain preliminary pharmacological studies and pharmacokinetic studies are still exempt from FDA regulations, laboratories have extended the reach of GLP to enable greater quality management throughout their processes.

Varian, Inc. is not responsible for compliance to GLP regulations, but the information detailed under the framework of this document, may or may not, depending on any individual customer's internal procedures, be used in conjunction with various SOPs to aid in creating a compliant environment.

1.1 21 CFR Part 58, Subpart D -- Equipment

GLP has several subparts covering the total suite of requirements. Subpart D, Equipment, contains those requirements for which analytical instrument vendors can aid compliance by providing certain capabilities, information, and tools. These areas are generally contained within the 4Q model - Design Qualification, Installation Qualification, Operational Qualification and Performance Qualification.

The definitions used in this manual are as follows (excerpted from "The Development and Application of Guidance on Equipment Qualification of Analytical Instruments", Peter Bedson, Mike Sargent, *Journal of Accreditation and Quality Assurance*, 1996, 1:265-274):

Design Qualification	Defines the functional and operational specifications of the instrument and details the conscious decisions in the selection of the supplier.
Installation Qualification	Establishes that the instrument is received as designed and specified, that it is properly installed in the selected environment and that this environment is suitable for the operation of the instrument.

Operation Qualification	The process of demonstrating that an instrument will function according to a series of predefined operational specifications in the selected environment.
Performance Qualification	The process of demonstrating that an instrument performs according to a specification appropriate for its routine use.

Varian, Inc. has developed this guidance document to:

- Contain important information relating to the 4Q model in one location
- Provide an avenue for aiding the tracking of the various processes that occur during the individual qualification stages

1.2 Yes/No Choice

At several stages in this document, Yes/No choices are to be made. If the choice is **YES**, that criterion has been met. However, if the Customer or Varian Representative decide that a certain criterion has not been met and apply **NO**, then the various appendices at the end of the document allow the tracking of the corrective actions required until all the elements of that criterion have finally been concluded. This approach collects and maintains all of records pertaining to the elements in the document in one place.

1.3 Glossary

The following is a glossary of terms that are used in this manual.

21 CFR Part 11	Code of Federal Regulations, Title 21, Food and Drugs, Part 11 “Electronic Records: Electronic Signatures Final Rule”, Federal Register 62 (54), 13429-12466. www.fda.gov/ora/compliance_ref/part11/Default.htm
21 CFR Part 58	Code of Federal Regulations, Title 21, Food and Drugs, Part 58 “Good Laboratory Practices for Nonclinical Laboratory Studies”, April 1, 2003. www.fda.gov/ora/compliance_ref/glp/default.htm
administrator	The operating system login account that owns the VnmrJ system files. The name of this administrator is selected during installation of VnmrJ for Secure Environments in the User Name: entry field. By default, the name *vnmr1* is used. The password for this account should be kept secure.
Analytical system	A system that combines instrument, computer, and analytical method.
AutoTest	Automated test software used to demonstrate that a Varian NMR instrument functions according to the operation specifications. AutoTest is designed to demonstrate key console and probe performance criteria, measuring the output using NMR data derived from a single sample. In this way, a large series of tests is automatically completed; data from one system is easily compared to similar systems.
Batch	A specific quantity or lot of a test or control article that has been characterized according to Section 58.105(a). (58.3)

Control article	Any food additive, color additive, drug, biological product, electronic product, medical device for human use, or any article other than a test article, feed, or water that is administered to the test system in the course of a nonclinical laboratory study for the purpose of establishing a basis for comparison with the test article. (58.3)
FDA	United States Food and Drug Administration (www.fda.gov)
FID	An NMR term that stands for Free Induction Decay. A FID is the time-domain data acquired by the NMR spectrometer. The frequency-domain NMR spectrum is then obtained from the FID by Fourier transform.
GAP	Good Auditing Practices
GLP	Good Laboratory Practices
GMP	Good Manufacturing Practices
IQ	Installation Qualification. Applies to new and used equipment that is to be installed. See **IQ, OQ, PQ**.
IQ, OQ, PQ	Installation Qualification, Operational Qualification, and Performance Qualification. Verification of equipment and instruments used for FDA (and other regulatory bodies) and client audits.
NMR	Nuclear Magnetic Resonance. A scientific technique for determining molecular structure.
Nonclinical laboratory study	In vivo or in vitro experiments in which test articles are studied prospectively in test systems under laboratory conditions to determine their safety. The term does not include studies utilizing human subjects or clinical studies or field trials in animals. The term does not include basic exploratory studies carried out to determine whether a test article has any potential utility or to determine physical or chemical characteristics of a test article. (58.3)
noncontrolled	Data and records that are not controlled, monitored, or audited by a regulatory compliant system, or system administrator. See **controlled**.
OQ	Operational Qualification. Verification of equipment or instrument performance to prove operation before and after movement. See **IQ, OQ, PQ**.
Part 11	The Electronic Records; Electronic Signatures section of the Title 21-Food and Drugs regulation.
permissions	Granted in the OS by the system administrator to allow users access to files or resources.
PQ	Performance Qualification or Performance Verification. Operational verification that is performed at least annually for equipment and instruments. See **IQ, OQ, PQ**.
qualify	In terms of electronic records regulations, a company has the SOPs and software in place so that their records qualify as compliant.

raw data	Any laboratory worksheets, records, memoranda, notes, or exact copies thereof, that are the result of original observations and activities of a nonclinical laboratory study and are necessary for the reconstruction and evaluation of the report of that study. In the event that exact transcripts of raw data have been prepared (e.g., tapes which have been transcribed verbatim, dated, and verified accurate by signature), the exact copy or exact transcript may be substituted for the original source as raw data. Raw data may include photographs, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. (58.3)
record	Directories where FID and processed data are saved.
root path	Directory path of a primary directory.
SOP	Standard Operating Procedures. A company or site has SOPs in place for regulatory compliance, among other things.
trusted data	Same as controlled data, which is protected, monitored, and audited under VnmrJ for Secure Environments.
VnmrJ	Data acquisition, processing, and display software for Varian, Inc. NMR spectrometer systems.
XML	The eXtensible Markup Language used for data exchange. VnmrJ uses XML to format data for the Locator database.

Chapter 2. Design Qualifications

Sections in this chapter:

Varian, Inc. is one of the world's leading suppliers of NMR spectrometers and the major provider of research level, high magnetic field functional MRI spectrometers. Innovative design for NMR performance is the trademark of Varian's line of spectrometers. Engineering to the highest standards and using leading-edge technologies has brought to the NMR community spectrometers that support all applications without compromise.

2.1 400-MR and Magnet Specifications

A full suite of specification for the 400-MR is available in Appendix A, “400-MR System Specifications,” and additional information can be requested from Varian, Inc.

Individual probe specification sheets are available upon request and should be appended to this document and summarized in Table 1.

Table 1. Probe Specification List

Probe description and P/N	*Specification sheet attached Yes/No (see next column)*	*Reason for 'No' attachment*	*Customer Signature/Date*

2.2 Standards Compliance

Varian's continuing commitment to the highest standards of design, manufacture, and in-house servicing of NMR spectrometers is confirmed by compliance with:

- ISO 9001 (see Figure 1)
- All applicable directives required for CE conformity (see Figure 2)

ISO Compliance Certificate

ABS Quality Evaluations

CERTIFICATE OF CONFORMANCE

This is to certify that the Quality Management System of:

Varian, Inc. NMR Systems

Principal Office
3120 Hansen Way
Palo Alto, CA
U.S.A.

has been assessed by ABS Quality Evaluations, Inc. and found to be in conformance with the requirements set forth by:

ISO 9001:2000

The Quality Management System is applicable to:

DESIGN, MANUFACTURE, AND IN-HOUSE SERVICING OF NUCLEAR MAGNETIC RESONANCE (NMR) INSTRUMENTS

Further clarifications regarding the scope of the certificate and the applicability of ISO 9001:2000 requirements may be obtained by consulting the organization.

Certificate No: 39480
Original Certification Date: 20 October 1993
Effective Date: 03 January 2004
Expiration Date: 17 October 2008
Issue Date 18 October 2005

Al Escher, President

ABS Quality Evaluations, Inc. * Certification * Management System

ANAB

Validity of this certificate is based on periodic audits of the management system defined by the above scope and is contingent upon prompt, written notification to ABS Quality Evaluations, Inc. of significant changes to the management system or components thereof.

ABS Quality Evaluations, Inc. 16066 Leopold Park Drive, Suite 200 South, Houston, Texas 77044 U.S.A.

Validity of this certificate may be confirmed at www.abs-qe.com/cert_validation

Printed on 2005-03-07 10:52 [GMT]

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Figure 1. ISO Certificate of Conformance

CE Conformity

CE

Declaration of Conformity

VARIAN

NMR Systems

Manufacturer's Address: 3120 Hansen Way, Palo Alto, California 94304, USA

European Representative: Regina Shuck
Alsfelder Strasse 6, 64289 Darmstadt, Germany

Hereby declare that the product:

Spectrometer, Models 400-MR and 400-MRH

to which this declaration relates is in conformity with the following standards:

Low-Voltage Directive, 73/23/EEC, applicable Safety Standards:

EN 61010-1:2001

And EMC Directive, 89/336/EEC, applicable EMC Standards:

EN61326:1997/A1:1998/A2:2001 & 50011:1998, Group II, Class A

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directives and Standards.

September 25, 2006
Date

Tom Ingram, Operations Director

Figure 2. CE Declaration of Conformity

2.3 Instrument Selection Criteria

In many cases, instrument selection is based upon criteria related to specific applications, data management, data processing techniques, or specific site criteria, Table 2. provides a place to record such criteria. This table can be copied so that additional pages can be appended to this document.

Table 2. Instrumentation Selection Criteria.

Selection Criteria	*Description of, name of document or other path that identifies additional criteria. append copies of appropriate pages as necessary.*	*Customer Name/Signature/Date*

Chapter 3. Installation Qualifications

Sections in this chapter:

Various factors pertain to the installation of an instrument in a selected environment.

3.1 Review the Installation Planning Guide

Reviewing the applicable *Pre-Installation Instructions* for the 400-MR will aid determination of site suitability and provide specifications for such requirements as operating temperature, humidity, provision for air and electrical supply.

Pre-Installation Instructions Rev. No.	*Reviewed Yes/No*	*Customer Name/Signature/Date*

Pre-installation Instructions for the 400-MR spectrometer is available from Varian Inc. Sales Representatives or the local Sales Office. A list of sales representatives and local sales offices is located at:
http://www.varianinc.com/cgi-bin/nav?products/nmr/contact_nmr/sales_offices&cid=JKQOKLIJFI.

3.2 Site Survey

A site survey can be purchased for the 400-MR if required. The site survey is performed before the installation to check the site suitability specifically for vibrations, temperature, humidity control, and external rf interference.

Site Survey Required Yes/No	*If Yes, Performed on Date*	*Corrective action? Yes/No and description. If Yes, see "Site Survey Corrective Actions," page 33*	*Varian Representative Name/Signature/Date*	*Customer Name/ Signature/Date*

3.3 Review and Confirmation of Shipped Items

All of the sales orders should be reviewed and checked for accuracy.

Sales Order No.	*Correct? Yes/No and description. If No see "Review and Confirmation of Shipped Items Corrective Actions," page 34*	*Varian Representative Name/Signature/Date*	*Customer Name/ Signature/Date*

3.4 Computer Audit

The computer audit documents information on each computer (please copy and append this chart for additional computers if more than three computers are required for the installation).

The Varian and customer representative's signatures in these forms certify that the information in these forms is accurate and that all computers to be used to run Varian's MR workstation software, VnmrJ, or to run other software to process data obtained on this spectrometer, have been included in the audit (including those previously registered as part of purchases of other Varian NMR spectrometers).

Information about your site (please print):

Company/University _____

Address _____

_____

Principal User _____

Phone _____ Spectrometer type _____

Fax _____ Console S/N _____

Sales Order No. _____ Delivery (month/day) _____

Information on each computer (additional forms are on the back of this page). As required by SOPs, include computers directly attached to the spectrometer, computers (networked or non-networked, on-site or off-site) used to process NMR data using Varian's VnmrJ software, and computers (on-site and off-site) used to process data collected on this spectrometer with software from other vendors.

Information on computer ____ of ____ (e.g., 1 of 3)

Manufacturer _____ Model no. _____

Computer S/N _____ Purchased from _____

Memory (Gbytes) _____ Screen size (in.) _____

Peripherals: Internal hard disk (Mbytes) _____

CD-ROM drive model _____ Serial no. _____

Printer model _____ Serial no. _____

Plotter model _____ Serial no. _____

Terminal model _____ Serial no. _____

Other peripheral _____ Serial no. _____

Computer function: NMR host _____

Workstation running VnmrJ _____ on-site or off-site

Workstation running other NMR software _____ on-site or off-site

Workstation running VnmrJ and other NMR software _____ on-site or off-site

VnmrJ version _____ **Operating system** _____

The above computer audit was performed during installation of the system.

_____

Varian Representative Date

I certify that the information on this form is accurate and that all computers to be used to run VnmrJ software or to run other software to process data obtained on this spectrometer, have been included, as required, in the audit (including those previously registered as part of purchases of other Varian NMR spectrometers).

_____

Customer Representative Date

Use these forms for additional computers. If more forms are needed, copy this page. Attach all copies to the Computer Audit.

Information on computer ____ of ____ (e.g., 2 of 3)

Manufacturer _____ Model no. _____

Computer S/N _____ Purchased from _____

Memory (Gbytes) _____ Screen size (in.) _____

Peripherals: Internal hard disk (Mbytes) _____

CD-ROM drive model _____ Serial no. _____

Printer model _____ Serial no. _____

Plotter model _____ Serial no. _____

Terminal model _____ Serial no. _____

Other peripheral _____ Serial no. _____

Computer function: NMR host _____

Workstation running VnmrJ _____ on-site or off-site

Workstation running other NMR software _____ on-site or off-site

Workstation running VnmrJ and other NMR software _____ on-site or off-site

VnmrJ version _____ **Operating system** _____

Information on computer ____ of ____ (e.g., 3 of 3)

Manufacturer _____ Model no. _____

Computer S/N _____ Purchased from _____

Memory (Gbytes) _____ Screen size (in.) _____

Peripherals: Internal hard disk (Mbytes) _____

CD-ROM drive model _____ Serial no. _____

Printer model _____ Serial no. _____

Plotter model _____ Serial no. _____

Terminal model _____ Serial no. _____

Other peripheral _____ Serial no. _____

Computer function: NMR host _____

Workstation running VnmrJ _____ on-site or off-site

Workstation running other NMR software _____ on-site or off-site

Workstation running VnmrJ and other NMR software _____ on-site or off-site

VnmrJ version _____ **Operating system** _____

3.5 System Installation Checklist

Fill in the system installation checklist. If corrective action is required (No check box selected), use "System Installation Corrective Actions Checklist," page 34.

Company/University _____

Address _____

_____

Principal User _____

Phone _____ Spectrometer type _____

Fax _____ Console S/N _____

Sales Order No. _____ Magnet S/N _____

Shipment Damage: _____

_____

Preinstallation Preparation:

Line voltage measured (Vac): console _____ accessory _____

Line pressure: air _____ N_2 _____

Air conditioning: _____

Cryogens (liters): LHe _____ LN _____

Testing and Customer Familiarization:

1. Acceptance tests and computer audit

yes	no	Acceptance tests procedures finished
yes	no	Test results forms completed and signed
yes	no	Computer audit completed and signed

2. System documentation review

yes	no	*Software Object Code License Agreement* (acceptance of product constitutes acceptance of object code license regardless of whether agreement is signed or not)
yes	no	Varian and OEM manuals
yes	no	Explanation of warranty and where to telephone for information

3. Magnet demonstration

yes	no	Posting requirements for magnetic field warning signs
yes	no	Warning signs posted
yes	no	Cryogenics handling and safety
yes	no	Magnet refilling
yes	no	Flowmeters
yes	no	Homogeneity disturbances

4. Console and probe demonstration

CAUTION! Avoid possible preamp. damage; make sure probe is connected and tuned to resonance.

yes	no	Loading programs
yes	no	Experiment setup
yes	no	Basic operation to obtain typical spectra

Customer Representative: _____ **Date**

Varian Representative: _____ **Date**

3.6 Supercon Shim Values

Fill in the following information:

Magnet Frequency and Serial Number:

Magnet Frequency _____

Serial Number _____

Measurement in:

_____

Amps _____

Measurement	1. Date:	2. Date:	3. Date:
Z0			
Z1			
Z2			
Z3			
Z4			
X			
Y			
ZX			
ZY			
XY			
X2–Y2			
Drift			
Spacers			
Main Field Current			
Customer Signature:			
Varian Representative Signature:			

Chapter 4. Operation Qualifications

Sections in this chapter:

An NMR spectrometer is a complex instrument, available with a variety of optional items and capable of performing a variety of different experiments. AutoTest (Figure 3) is used to demonstrate that an instrument functions according to a series of operation specifications.

The customer’s representative or a Varian representative can run the Operations Qualifications test. The customer SOP dictates the operator. Operations qualification testing by a Varian Inc. representative is not included in standard installation, warranty, or service contracts. A specific quotation, purchase order, and sales order are required. The sales order number can be recorded in this chapter. Sales Order _____.

4.1 AutoTest

The AutoTest software is designed to demonstrate key console and probe performance criteria, measuring the output using NMR data derived from a single sample. In this way, a large series of tests is automatically completed; data from one system is easily compared to similar systems.

Autotest has a variety of straightforward screens that allow the basic configuration to be set up (operator name, console type etc.) (Figure 3). A library of tests is provided (Figure 4). A history log graphically represents the data over time (Figure 5) and a report page provides a textual output for each test (Figure 6). The report can be printed providing a hard copy record.

Some tests run by AutoTest have specifications attached; some use visual data inspection. For quick reference, all tests are listed in 4.3 “List of Tests Performed by AutoTest,” page 24. System specifications are listed in the *Console Acceptance Tests and Specifications* manual.

For an OQ process, it is recommended that all applicable tests for the instrument are run. This same suite can be run after service calls, probe changes, or other major operations, according to the organization’s SOPs.

4.2 AutoTest Sample

AutoTest uses 0.1% ^{13}C methanol, 0.1% acetonetrile in 1% H_2O/99.8% D_2O.

The sample is doped with gadolinium chloride at a concentration of 0.30 mg/ml, which produces a ^{1}H T1 relaxation time of about 50 to 75 ms. The sample supplied with every spectrometer, has an expiration date of one year and is available for order using Varian P/N 01-901855-06, 5-mm sample.

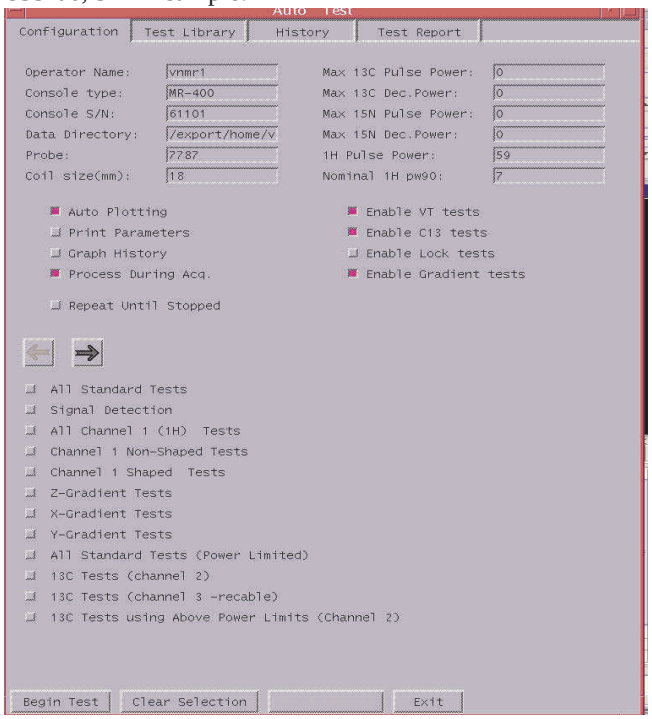

Figure 3. Autotest Configuration Panel with *All Standard Tests* Selected

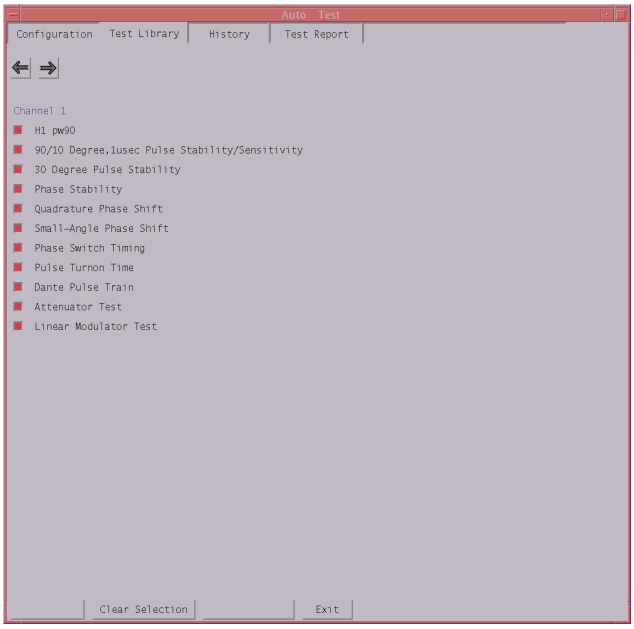

Figure 4. Autotest Test Library Showing the Full List of Available Channel 1 Tests

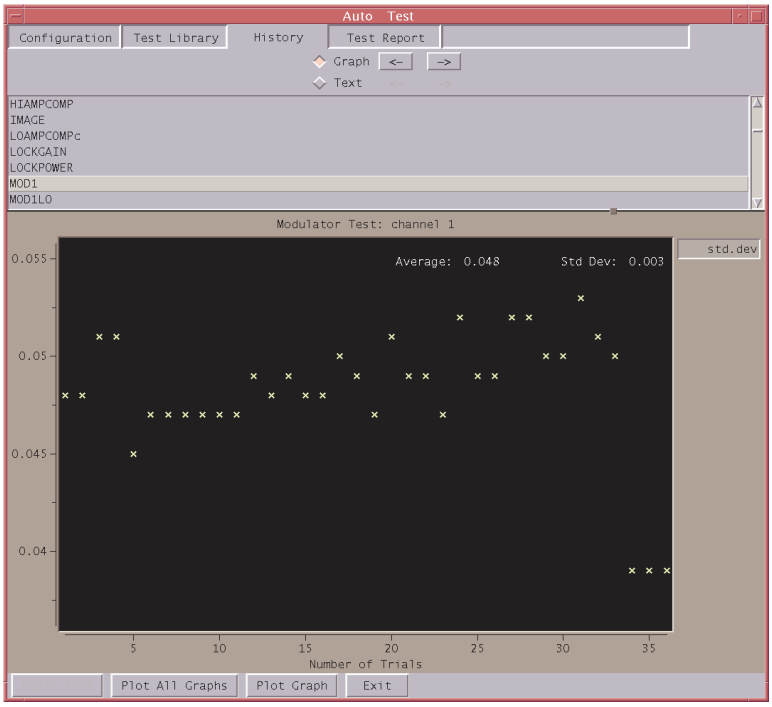

Figure 5. Autotest History Panel Showing the Graphical Output of the MOD1 Test

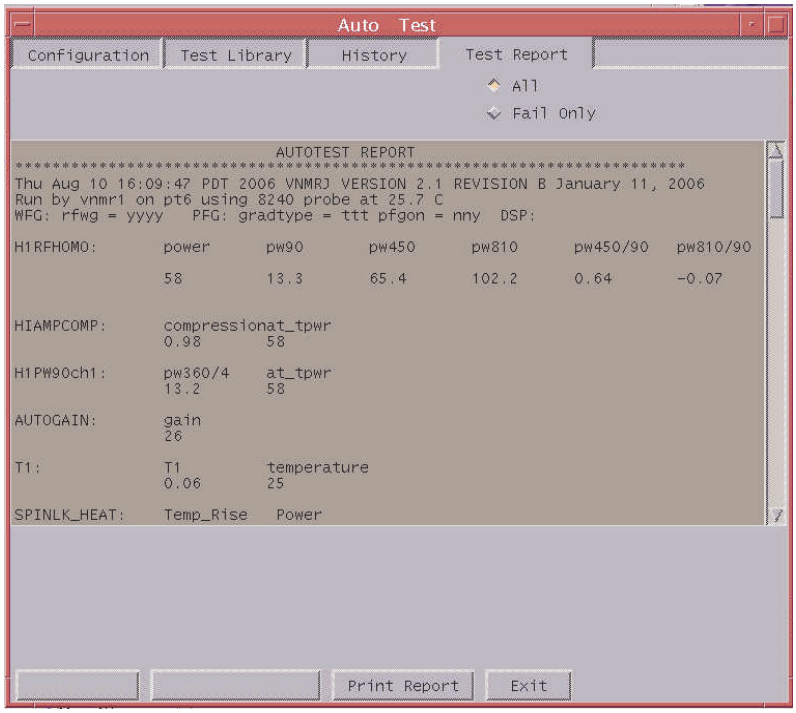

Figure 6. Autotest Test Report Panel Showing the Text of a Completed Report

4.3 List of Tests Performed by AutoTest

For more detail, AutoTest is fully documented in the *AutoTest for VnmrJ*, Pub. No. 01-999247-00.

RF homogeneity test: ^{1}H
RF homogeneity test: ^{13}C
Water resonance frequency
T_1
^{1}H PW90 determination
^{13}C PW90 determination
High-band amplifier compression
Low-band amplifier compression
^{13}C phase modulation decoupling profile
    GARP-1 modulation
    WALTZ-16 modulation
    XY-32 modulation
    MLEV-16 modulation
^{13}C adiabatic decoupling profiles
    STUD modulation
    WURST modulation
Receiver gain tests
Small-angle phase test
90° pulse stability (see Note 1)
Phase cycle cancellation – 2 scans (see Note 2)
Phase cycle cancellation – 4 scans (see Note 2)
30° amplitude stability (see Note 1)
Pulse turnon time
Attenuator linearity tests
    400 MHz systems and above
Attenuator linearity test (reduced power)
    400 MHz systems and above
Modulator linearity (`tpwr` = 40)
Modulator linearity (`tpwr` = –16)
Phase stability error
Gradient level for 10 G/cm along Z
X-gradient echo stability (10 G/cm)
Z-gradient recovery stability (10 G/cm)
Z-axis signal recovery (rect)
Z-axis signal recovery (sine)
Gradient phase cycle cancellation – 4 scans (see note 2)
Gaussian 90° stability
Gaussian 13° phase error
GaussianSLP 13° phase error
Temperature rise in spinlock test
Lock power test: corr. coef.
Lock gain test: corr. coef.

Chapter 5. Performance Qualifications

Sections in this chapter:

Autotest can also be used for routine maintenance testing. The customer’s representative or the Varian representative can run the performance qualifications test. The customer SOP dictates the operator. Performance qualification by a Varian Inc. representative is not included in standard installation, warranty, or service contracts. A specific quotation, purchase order, and sales order are required. The sales order number can be recorded in this chapter.

5.1 AutoTest for Maintenance Testing

The AutoTest software is designed to demonstrate key console and probe performance criteria. However, for PQ, rather than run a full suite, individual tests should be chosen to best represent some of the more important criteria for the organization (see Figure 7). These tests can be run as required by the organization SOPs. The value of each selected test can be compared against earlier tests over time and against the values measured for the same test run during an OQ operation.

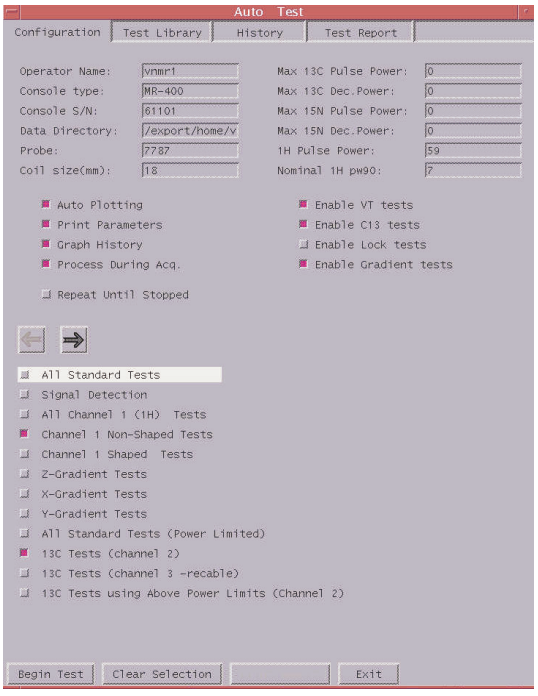

Figure 7. AutoTest Configuration panel showing a minimized selection of tests, potentially suitable for a PQ operation

5.2 AutoTest Sample

AutoTest uses 0.1% ^{13}C methanol, 0.1% ^{15}N acetonitrile in 1% H_2O/99.8% D_2O.

The sample is doped with gadolinium chloride at a concentration of 0.30 mg/ml, which produces a ^{1}H T1 relaxation time of about 50 to 75 ms. The sample supplied with every spectrometer, has an expiration date of one year and is available for order using Varian P/N 01-901855-06, 5-mm sample.

5.3 Additional Performance Qualification Tests

Additional tests using a particular sample with a documented result can be applied to an SOP. These tests can be documented in Table 3.

Note: A Varian Inc. quotation for performance qualification services may include sample preparation and validation.:

Table 3. Additional Performance Qualification Tests

Test	*Sample*	*Result*	*Customer Representative* Signature	*Varian Sales Order* (if applicable)

Appendix A. 400-MR System Specifications

Sections in this chapter:

Compact, high performance 2 channel NMR spectrometer

Frequency Sources

Frequency ranges: 18 5 - 245 MHz & 370 - 425 MHz

Frequency resolution of 0.1 Hz (not including phase continuous frequency shifting)

High Band Linear Amplifier

For 1H & 19F, 50 watts pulsed power

Lowband, Linear Amplifier

For ^{109}Ag - ^{31}P, 300 watts pulsed power, 18.5-245 MHz

RF Controller

Power PC & FPGA

64MB RAM & 32MB Flash

> 30 MB controller memory per RF channel for waveform definition:

Phase Shift Generation

50 ns minimum event time and 12.5 ns timing resolution

50 ns settling time

0.044° phase resolution

0.04° phase accuracy

Coarse amplitude control

79 dB in 1 dB steps

Fine amplitude control

60 dB in 4096 linear steps

50 ns minimum event time and 12.5ns timing resolution

50 ns settling time

Phase Coherent and Phase Continuous Frequency Shifting

50 ns minimum event

50 ns settling time

Infinitesimally fine resolution for infinitely long pulse

PFG Controller

Power PC & FPGA

64MB RAM & 32MB Flash

> 30 MB controller memory for PFG channel for waveform definition:

Gradient Shaping

12.5 ns timing resolution

Gradient amplitude control in ±32,768 linear steps

Minimum gradient pulse length 2.4 ms

Preamplifiers

High band (^{19}F and ^{1}H) GaAs FET preamplifier.

Active (linear) transmit/receive switch.

1 µs recovery, 1 µs switching time.

Lowband (^{109}Ag - ^{31}P) preamplifier

Active (linear) transmit/receive switch.

1 µs recovery, 1.5 µs switching time.

DDR Controller

Power PC & FPGA

64MB RAM & 32MB Flash

DirectDigital™ Receiver

Digitizer/ Max over sampling rate, 14 bit at 80 MHz, (eff. 20 bit, 10 KHz)

Maximum spectral width, 5 MHz

Maximum spectral width with no quadrature images, 5 MHz

On-the-fly Digital filtering

Lock Controller

Power PC & FPGA

64MB RAM & 32MB Flash

Adaptive 2H Lock

2H frequency +/- 1 MHz

Quadrature detection with simultaneous sampling during lock capture.

Continuous field correction for short-term field fluctuations.

Synchronization with External Events

3 TTL output line per RF channel for user programming

1 additional Ethernet connection

Broadband (^{109}Ag - ^{31}P) preamplifier

Active (linear) transmit/receive switch.

1 µs recovery, 1.5 µs switching time.

High dynamic range, low noise and fast recovery.

Note: Nuclei using frequency ranges 61 to 72 MHz and 130 to 143 MHz are not supported and cannot be viewed.

Note: Deuterium observe uses the lock channel.

High band Linear Amplifier

Nominal power	50 W
Nuclei	^{1}H, ^{19}F
Max pulsed power (W)	50
Max CW power (W)	15
Full power duty cycle (%)	10
Full power pulse length (ms)	250
Rise time (ns)	200
Droop (%)	5
Unblank/Blank time (µs)	1

Broadband Linear Amplifier

Nominal power	300 W
Frequency (MHz)	185 - 245
Nuclei	^{109}Ag - ^{31}P
Max pulsed power (W)	300 (full range)
Max CW power (W)	30
Full power duty cycle (%)	10
Full power pulse length (ms)	100
Rise time (ns)	200
Droop (%)	5
Unblank/Blank time (µs)	1

Additional Optional Modules

Hardware Accessories	
Low Temperature Sample Management	
Software Accessories	
NMRAnalyst	Analyzes data from the carbon-carbon connectivity experiment, revealing carbon connectivities at previously unattainable levels of sensitivity
DOSY	Analyzes data from Diffusion Ordered Spectroscopy experiments

Varian 400 MHz Magnet

Drift	< 8 Hz/hr
Superconducting shim coils	Z1, Z2, Z3, X, Y, ZX, ZY, XY, X2-Y2
Radial 5G Stray Field from Magnet Center	55 cm/21.7 inches
Axial 5G Stray Field from Magnet Center	100 cm/39.4 inches
Axial 5 G height above floor	208 cm/81.9 inches
Axial 5 G depth below floor	N/A
System weight, operational 650 kg	650 kg/1433 lbs
Min. ceiling height	294 cm/115.7 inches
Min. ceiling height (optional transfer)	260.5 cm/102.6 inches
Liquid helium refill volume	95 L
Liquid helium hold time	< 270 days (9 months)
Liquid nitrogen refill volume	51 L
Liquid nitrogen hold time	< 14 days

Appendix B. Corrective Actions

Site Survey Corrective Actions

Action Required (from description)	*Completed Yes/No*	*Customer Name/Signature/Date*

Review and Confirmation of Shipped Items Corrective Actions

Action Required (from description)	*Completed Yes/No*	*Customer Name/Signature/Date*

System Installation Corrective Actions Checklist

Action Required (from description)	*Completed Yes/No*	*Customer Name/Signature/Date*

Numerics

A

B

C

D

F

G

I

N

O

P

Q

R

S

T

V

W

X

Y