MAI 3000
Diagnostics and Error Log Manual

MAI BasicFour.
Computers That Mean Business

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PREFACE

This manual provides diagnostics information for the MAI 3000 system . The in
formation is presented as an aid for field service personnel in the use of
diagnostics for locating hardware problems to the board and socketed IC level

The major topics covered in this manual are:

WARNING

**This equipment generates, uses, and can radiate radio
frequency energy, and, if not installed and used in
accordance with the instruction manual, may cause in-
terference to radio communications, as temporarily
permitted by regulation.**

**It has not been tested for compliance with the limits
for Class A Computing Devices pursuant to Subpart J of
Part 15 of FCC Rules, which are designed to provide
reasonable protection against such interference.**

**Operation of this equipment in a residential area is
likely to cause interference, in which case the user,
at his own expense, will be required to take whatever
measures that may be required to correct the interfer-
ence.**

SECTION I

DIAGNOSTICS USER GUIDE

1.1 INTRODUCTION

The scope of this section is limited to a discussion of the various diagnostic
products available for the MAI 3000 system and peripherals. It is intended to
be an introduction to the products and related specifications and to provide a
starting point in using the diagnostics provided for the MAI 3000 system . The
section also tells you how to load and run the diagnostics. Table 1-1 gives
an overview of the diagnostic program set.

Table 1-1. MAI 3000 Diagnostic Program Set Overview

HARDWARE ITEM	DIAGNOSTIC(S) TO USE
CMB	MDS, PIT, SCC, RTC, MMU, FPCP, PORTS, CACHE
MEMORY	MDS, MEMORY
4WAY	FWAY, PWFS
LAN	LAN, LANFS
MCS	MCS, MCSFS
DISK	DISK, DISKFS
MTS	MTS, MTSFS
8WAY	EWAY, EWFS
PERIPHERALS	
Printers	PORTS, PIT
1/2" Streamer	MTS, MTSFS
1/4" Streamer	MCS, MCSFS
Disk Drives	DISK, DISKFS, DUTIL
Terminals	PORTS, FWAY, FWFS, EWAY, EWFS
ENTIRE SYSTEM	SIT

UTILITIES AND GENERAL USE PROGRAMS

EXEC	Diagnostic Executive
SIT	System Interaction Test
DUTIL	To format and verify disk drives
MDS	Micro-Diagnostic System (PROM)
RD	Remote Diagnostics

ON-LINE DIAGNOSTICS

BASS	Basic All-purpose Service System

The diagnostic products for the MAI 3000 are categorized as PROM products, RAM products and support products. The PROM products are those that are contained in PROM on the MAI 3000 Central Microprocessor Board (CMB). RAM products are those that are loaded into memory from diagnostic media. Support products are those that are not specifically diagnostic products but are used in the generation and maintenance of diagnostic programs. Lists of CMB, controller and support diagnostics specifications are provided in tables 1-2 through L-4.

Table 1-2. CMB Diagnostics Specifications

SPEC. #	TITLE	PGM NAME	PRODUCT	HARDWARE
011522	FPCP Test	fpep	RAM	CMB (FPCP)
011523	MMU Test	mmu	RAM	CMB (PMMU/MMB)
	PIT and Printer Test	pit	RAM	CMB (PIT)
011311	SCC Loqic Test	sec	RAM	CMB (SCC)
011521	RTC Loqic Test	rtc	RAM	CMB (RTC)
011509	MAI 3000 Memory Test	memory	RAM	CMB / Memory
011525	CACHE Loqic Test	cache	RAM	CMB cache
011526	MDS Users Guide		PROM	CMB system

Table 1-3. Controller Diagnostics Specifications

SPEC . #	TITLE	PGM NAME	PRODUCT	HARDWARE
011424	**MTS** Loqic Test	mts	RAM	MTS
011425	MTS Function Select	mtsfs	RAM	MTS
011334	Winchester Disk FS	diskfs	RAM	WDC
011363	Disk Loqic Test	disk	RAM	WDC
011336	Disk Utility	dutil	SUPP.	WDC and disk
011165	MCS Function Select		RAM	
011267	MCS Basic Loqic Test	mcsfs		MCS
011178	Four Way F.S.	mfswfs	RAM	MCS
011177	Four Way Loqic Test	fway	RAM	4WAY
011218	LAN Diaq F.S.	lanfs	RAM	LAN
011268	LAN Loqic Test	lan	RAM	LAN
011510	Eight Way F.S.	ewfs	RAM	8WAY
011524	Eiqht Way Loqic Test	eway	RAM	8WAY

Table 1-4. Support Diagnostics Specifications

SPEC. #	TITLE	PGM NAME	PRODUCT	PURPOSE
011339	BASS Users Manual	bass	BASS	system peripherals
011489	Diagnostic EXEC Spec.	exec	RAM	system control
011310	System Interaction	sit	RAM	hardware interaction
011354	Serial Ports Test	ports	RAM	printers test.
011527	SSN User Guide	ssn	SUPP.	nvram serial # write
011270	Remote Diagnostics	rd	SUPP.	multiple systems test

1.2 PROM PRODUCTS

1.2.1 MDS (Micro-Diagnostic System)

MDS consists of the diagnostic boot PROMS that are contained on every MAI 3000 CMB. MDS also includes the first code that is executed at power on, as well as many programs for system support; these are:

- o   bootstrap

- o   system test

- o   debugger

- o   peripheral drivers

- o   system support

- o   NVRAM configuration

Finally, MDS provides feedback (via the hex displays) as to run status and error codes and switch-selectable control.

1.2.2 MDS Test Modules

Module	Description
MEM	Dynamic Random Access Memory tests
EDC	Error Detection and Correction (ECC) tests
WDC (EBUS)	EBUS tests by using the Disk controller
CACH	External instruction/data cache tests
CMB	Tests for PIT, SCC and RTC
MMU	Memory Management Unit (PMMU/MMB)
CTLR	Controllers Test Module (LAN, MCS, MTS, EWAY, FWAY)

1.2.3 MDS Program Modules

Module	Description
CONF	Configure utility for the NVRAM
ALT	Alternate load and bootstrap
SELF	Self test
MDS	MDS test and debugger commands

1.2.4 Envoking Program or Test Modules

MDS is designed to have one module envoked at a time. The modules mentioned in paragraphs 1.2.2 and 1.2.3 are actually a menu of commands to envoke these modules. For a complete description of envoking and running MDS modules, refer to section 1.6.2.

1.3 RAM PRODUCTS

1.3.1 RAM Product Description

RAM products are diagnostic programs that reside on the diagnostic media and are loaded into memory following a diagnostic boot. Diagnostics can be booted from such removable media as MTS tape or MCS cartridge tape. Diagnostic RAM programs can also be loaded in from the system disk, if those programs were installed on the disk. The diagnostic EXEC is used to load and control the running of the diagnostics. The EXEC provides other diagnostic services as well.   The EXEC is the program that is bootstrapped when booting from tape or disk.

1.3.2 Logic Tests

1.3.2.1 Logic Test Description

The Logic tests are characterized as auto-size, auto-run diagnostic tests of logical and functional units of the system. Logic Test programs comprise pre-defined tests that carry out tests of functional areas. These tests are intended to fault isolate to the Field Replaceable Unit, such as a board or a socketed chip. The Logic tests are not generally designed to isolate to the chip level. Logic tests are very simple to load and run. Refer to the following paragraphs for instructions.

1.3.2.2 CMB Logic Tests

The following Logic tests are provided for the MAI 3000:

Test name	Description
MEMORY	Main memory test
MMU	Memory management unit (PMMU/MMB)
FPCP	Floating point co-processor
PIT	Parallel/Interval Timer
SCC	Serial Communications Controller
RTC	Real Time Clock
CACHE	External Instruction/Data Cache

1.3.2.3 Peripherals Logic Tests

The following Logic Tests are used to test the peripherals and controllers which are attached to the controller EBUS stack:

Test name	Description
DISK	Winchester Disk
MTS	Magnetic Tape Streamer (1/2")
MCS	Magnetic Cartridge Streamer (1/4")
LAN	Local Area Network
FWAY	Four Way communications controller
EWAY	Eight Way communications controller

Note that the DISK logic test will not write on the disk unless instructed to do so by the WRITEOK command.

1.3.3 Function Select Tests

1.3.3.1 Function Select Test Description

Function select type programs are characterized by user selectable test sequences or test loops. Function select programs allow the user to select the function desired to be done. Testing of the hardware is carried out by the user first defining the test, by entering the test commands one after the other, or in a loop, to be executed in a string or series. Interpretation of errors and entering of command sequences requires an understanding of the controller logic that is being tested, and the program as well.

1.3.3.2 Function Select tests provided

Test name	Description
DISKFS	Winchester Disk (WDAFS)
MTSFS	Magnetic Tape Streamer (1/2")
MCSFS	Magnetic Cartridge Streamer (1/4")
LANFS	Local Area Network
FWFS	Four Way communications controller
EWFS	Eight Way communications controller

1.3.4 System Interaction Test (SIT)

The System Interaction Test is characterized as an auto-size, auto-run system test that carries out a complete simultaneous system test off-line. This test is designed to emulate the operating system and test system components in a parallel, multi-tasking environment. All test modules are actual user mode tasks, all sharing resources of the system. There is only one system interaction test provided, which is simply called SIT. After loading SIT with the EXEC, control of the system transfers to SIT.

The SIT program carries out sizing and reports the results to the system console. After sizing, SIT automatically enables tasks for the devices present on the system. To begin testing, the user simply enters the RUN command. The user has the option of deleting tasks to be run, prior to entering the RUN command. This test will not destructively write on the disk unless instructed to do so.

1.4 SUPPORT PRODUCTS

1.4.1 Disk UTILITY (DUTIL)

The Disk UTILity is provided to format and support the hard disk on the MAI 3000 system . Formatting the hard disk involves several processes, including: surface analysis; entry of manufacturing defects; actual writing of the disk format on the disk; saving the defect map for future use and reference; and writing the superblock.

DUTIL also provides various support functions, such as read-only utilities that verify the format and scan for soft errors. Other read-only functions include comparing the format data pattern and verifying the ECO codes for the disk, to determine the quality of the data on the disk even after the file system is installed. You can also display the defect map that was last used to format the disk drive. DUTIL is also used to copy disks for backup and restore using MCS tape in binary image.

DUTIL is technically a function select, in that the program has many commands available. DUTIL also has a menu mode of operation, allowing easy selection of utility functions. To begin menu mode, enter the program name DUTIL; the first menu will be displayed.

1.4.2 RD (Remote Diagnostics)

Diagnostics can always be executed remotely, through the use of a modem . Yet
the RD program, which is run on a large system, such as an MPX system, can be
used to test up to 32 systems simultaneously. Status and progress can be de-
termined at any time on any or all of the systems being tested . With the use
of modems, a useful and unique method of field support is provided .

1.4.3 SSN (System Serial Number)

The SSN program is a secure program with limited distribution. This program,
with the support of secure hardware and KEYGEN software is used to install the
system serial number on each system . The system serial number is installed in
Non-Volatile RAM (NVRAM), so that it is always retained.

1.5 BASS ON-LINE DIAGNOSTICS

The Basic All-Purpose Service System (BASS) program is used to test system
components and drivers. This diagnostic package is characterized by testing
specific peripherals while the OS is running other system tasks and customer
programs. As opposed to off line diagnostics, which require shutting down the
system, BASS is designed to exercise the peripheral hardware through the oper-
ating system.

BASS is composed of a series of test modules and a monitor program. BASS in-
cludes the following test programs:

  o File System Exerciser (D01) including:

        Disk Dump test   File Integrity Test
        Direct File Exerciser   Free Space Analysis
        File System Check Test

  o MCS (Magnetic Cartridge Streamer) Exerciser (MOD

    mcslabel   mcssave   mcslist
    mcscompare   mcsrestore   Write-Read files

  o MTS (Magnetic Tape Streamer, 1/ 2") Exerciser (TOD

    mtslabel   mtssave   mtslist
    mtscompare   mtsrestore   Write-Read files

  o Printer Exerciser including:

    Printer quality test   (P01)
    Print quality check   (P02)
    Printer Ripple test   (P03)
    Printer Function test   (P04)

o Terminal Exerciser including:

  Keyboard Echo test   (V01)
  General Terminal Exerciser   (V02)
  4308/4309 Multiple VDT   (V03)
  4310 Multiple VDT   (V04)
  4310 Graphics Exerciser   (V05)

o Local Area Network Exerciser including:
                                                            (L01)
  LAN Initialization   (L02)
  LAN Who's There
  LAN Network   (L03)
  LAN Remote Who test   (L04)
  LAN Remote Network test   (L05)
  IAN Topography MAP editor   (L06)

1.6 GENERAL DISCUSSION OF DIAGNOSTIC OPERATIONS

1.6.1 Introduction

The purpose of this section is to give you an idea of a testing approach for the MAI 3000. Testing the MAI 3000 is carried out by a combination of tests in MDS prom, Logic Tests and SIT. Running these tests will give you a complete system test and will locate the majority of failures associated with the hardware.

The following paragraphs give you the brief procedures necessary to load and run the MAI 3000 diagnostics. Complete descriptions are contained in separate specifications.

1.6.2 Micro Diagnostic System (MDS)

1.6.2.1 Power on self tests

The Micro Diagnostic System (MDS) is a set of test programs contained in PROM. MDS carries out the initial testing of the system at power on and provides a command mode of operation for user flexibility.

Self tests are automatically executed at power on or when the reset switch is activated. The self test procedure comprises two steps. The first step carries out necessary "pre-tests" of the system . The second step performs the system self tests and provides feedback of the tests via the system console. The pre-tests test the ability of the processor to access the PROM and the NVRAM correctly. The pre-tests also configure and test the system console controller before any system console output.

When the "pre-tests" execute, no console display results. Any failure in the
pre-tests will cause a flashing error code in the 2-digit hex displays. Refer
to table 1-5 for definitions of these error codes.

After pre-tests pass, the self test will begin. The self tests will start-
automatically when the sense switches at location 17H on the CMB are set to
the default setting (switches si through s8 off). In the default sense switch
setting, the system console display will start after the pre-tests pass. The
running status is displayed , and descriptive error messages are displayed, if
failures are detected.

Table 1-5. Hex Displays

HEX DISPLAY	WHAT IS BEING DONE	ERROR MEANING (WHEN FLASHING)
01	The instructions test is started with cache enabled.	The instructions test failed.
02	Begin the PROM checksum test.	The PROM checksum test failed.
03	Start NVRAM nondestructive test.	
04	Start sizing and initialization of main memory.	A DMA serial controller is configured in NVRAM, and there is no memory-
05	Start CMB SCC internal loopback tests.	The SCC loopback test failed, and the NVRAM specifies the SCC as the serial controller.
06	Start memory test on the first 4K of memory.	The first 4K of memory has failed.
07	Read the sense switches and determine what test or program module to call.	
08	Start to initialize the vector table in RAM. Set VBR to location 0.	Bus error detected with no console to display the error.
09	Start the initialization of the serial controller selected by NVRAM parameter.	
XX	Any other blinking value indicates the unexpected vector received before a system console is read (09 up).	

1.6.2.2 <u>Bootstrap Menu</u>

After the system self tests complete, MDS will automatically boot the system
after the bootstrap menu is displayed:

        1)   Boot
        2)   Alt-load
        3)   Micro-diagnostics
        4)   Power down

        Enter option (1-4) :

o   If the user does not enter anything, the OS will automatically boot
    after a brief delay. This provides the hands-off bootstrap of the
    system at power on. What to do at this point, after display of the boot-
    strap menu, depends on whether you want to boot the OS, load the diag-
    nostics from tape or disk, or run the MDS tests. All menu options
    entered are followed by a carriage return (RETURN). All entries re-
    quiring a RETURN are indicated in the following paragraphs.

o   Entry of "1" and RETURN will cause the boot to start immediately.
    Pressing just RETURN will also cause a bootstrap from the default boot-
    strap device as it is defined in NVRAM. You don't have to wait for the
    timeout.

o   Entry of "2" and RETURN will allow an alternate load. This option al-
    lows you to load the diagnostics from disk or tape or to boot the OS in-
    stallation tape. After selection of option 2, the boot device prompt is
    displayed:

        Boot device:

    Your diagnostics are on either MCS cartridge, MTS tape or the system
    disk. If they are on MCS cartridge, insert the cartridge into the MCS
    drive, slide in the tray, and turn the locking lever up. Then enter :

        cs0

    and RETURN. You will boot from the cartridge tape. If your diagnostics
    are on the hard disk, enter:

        wd0

    and RETURN . Diagnostics will be booted from disk. If your diagnostics
    are on an MTS tape, insert the tape into the tape drive, and load the
    tape. Enter:

        ts0

    and RETURN to boot from the MTS tape. Just pressing RETURN will cause a
    bootstrap from the default bootstrap device, however it is defined in
    NVRAM. When the system file prompt is displayed:

System file:

you can respond as follows. If your diagnostics are on tape, press
RETURN. If your diagnostics are on the system disk, enter the keyword:

diag

and RETURN to tell the system to load in diagnostics from the hard disk.

Diagnostics will now be loaded from the selected device. Refer to para-
graph 1.6.3 for an explanation of how to run the user diagnostics.

o   Option 3 will allow you to start MDS testing or to enter any of the
    debugger commands. After entering MDS, the MDS load prompt is
    displayed:

<mds>

If you have already loaded in the EXEC and have returned to MDS at the
<alt> prompt from the EXEC, not all MDS functions can be done. Some
commands entered will prevent you from returning to the EXEC. If you
plan to return to the EXEC, enter any of the debugger commands, and then
type in:

go

and RETURN to go back to EXEC. If you have entered command mode from
the boot menu by entering "3," the MDS prompt:

<mds>

is displayed. To begin running tests in MDS, you must first initialize
MDS prior to running any MDS tests. This is because MDS has certain run
controls and the program stack in NVRAM, whereas EXEC is all based in
main memory. Thus if you want to run some of the MDS tests, enter:

mds

and RETURN to initialize MDS for testing. You can now enter any MDS
command available.

o   Option 4 will power off your system under software control.

1.6.2.3 <u>Selecting individual tests in MDS</u>

In addition to the self tests that are executed at power on, you have access
to additional tests that are contained in MDS, but that are not executed at
power on. These tests extend the test capability of the self tests. You can
execute these tests after the self tests complete, when the bootstrap menu is
displayed . Enter a "3" at the bootstrap menu, as described in section
1.6.2.2; MDS will prompt with the MDS load module prompt:

<mds>

Enter the command:

mds

and RETURN to initialize the system for MDS testing. To get an idea of the
ability of MDS, enter the command:

help

and RETURN. The MDS commands will be displayed. To get you started running
the MDS tests, the following description will help.
For a complete description of MDS, including the MDS features and functions,
refer to the MDS User Guide.

There are several ways to execute the MDS tests. One is to execute all of the
tests contained in MDS. You may also select a particular test module, and ex-
ecute only specific tests. The other option is to execute all of the tests of
a specific module. The procedures for executing the MDS tests follows.

1.6.2.4 System "Burn-in"

To carry out system tests automatically, at any MDS prompt, enter the command:

mds

and RETURN. MDS will initialize itself and display the MDS prompt on the
system console:

<mds>

To start up all system tests enter the command:

burn

and RETURN.

The "burn" command will carry out a complete test of the CMB and the control-
lers. Disk controller 0 is also tested. As the tests are executed, the test
title is displayed. Each test of every test module is executed . Any errors
detected are displayed on the system console.

To stop the burn-in cycle, depress the reset button, or press ESCAPE at the system console. This will cause the currently running module prompt to be displayed. Pressing ESCAPE will cause a layout of the errors found for each test module. At this prompt you can enter any of the MDS commands.

1.6.2.5 Running selected MDS test modules

Select a test module. You have the option of running tests specifically for a given portion of your system . To get an idea of the programs contained in MDS, enter the "list programs" command:

> **lisp**

and RETURN. MDS will display the programs contained in the prom. To select a module, enter one of the program names that are displayed. There are program modules and test modules.   Program modules contain no tests.   Test modules can be selected to allow specific tests to be run.

The programs displayed are also a menu, to allow selection of the program you want to run. The commands "conf," "self," and "alt" are program modules that allow you to configure the NVRAM; to execute the self tests again, just like power on; or to perform an alternate load.

To select a test module, enter one of the test modules displayed by the "lisp" command; for example, enter:

> **edc**

and RETURN to select the Error Detection and Correction test module. After the test module is selected , the test module prompt is displayed on the system console. Refer to paragraphs 1.2.2 and 1.2.3 for a list of the MDS modules.

Use of help messages. For any test module selected, there are two commands available to help you. Enter the "list tests" command:

> **list**

and RETURN to display the tests in this test module. Enter the "list com-mands" command :

> **lisc**

and RETURN to display the commands in the test module, if any. You can use the three list commands, "lisp", "list" and "lisc" to help you understand the programs, tests and commands for a particular program or test module.

Run all tests of an MDS test module. There are two ways to run tests in a specific test module. One is to run all the tests in that module, and the other is to run selected tests. To run all of the tests of a particular test module, enter:

> **all**

and RETURN. All of the tests are executed, one after the other.

 Run selected tests. To execute specific tests, enter the command:

> **run**

and RETURN. MDS will ask you for the first test to run:

> **Enter the first test to run :**

Enter the desired test number from the list obtained by the "list" command.
MDS will then prompt for the last test to run:

> **Last:**

Press RETURN if you want to run just the one test, or the number of the last test you want to run, and RETURN. MDS will run the range of tests selected.
After completion, the test module prompt will be displayed.

Each test will run indefinitely when the loop option is on. The indication that looping is on is that the test title is displayed, and the program ap-pears to stop. A particular test can be stopped by depressing ESCAPE. The

next test title will display, and the test will execute.
Entry of two ESCAPE keys will cause the remaining tests to abort, and the test

module prompt will be displayed . To display the options that you have selected, enter the command:

> **ops**

and the selected options will be displayed. To de-select the looping of a test indefinitely, enter:

> **-lp**

and RETURN. When the "run" command is entered , each test is executed once, and the tests will complete and then return to the test module prompt.

MDS has many other run options for the tests including what to do on error detection. Refer to the MDS User Guide for more information on run options of MDS.

1.6.3 Running Diagnostics Under the EXEC

After successful running of the MDS tests, the user can boot diagnostics from either tape or disk. The diagnostics must first be installed on disk in order to boot diagnostics from disk. Refer to paragraph 1.6.5 on how to install diagnostics on disk.

1.6.3.1 <u>Booting diagnostics from tape</u>

When the boot menu is displayed, enter "2" to specify the alternate load. Load diagnostics from tape, as described in paragraph 1.6.2.2. When the Diagnostic Executive is loaded, EXEC will auto-size the system and display its prompt:

<exec>

When the EXEC prompt is displayed, each of the logic tests, or Function Select tests can be run by using the commands "load" and "run." Refer to paragraph 1.7 for an explanation on loading and running diagnostics.

1.6.3.2 <u>Booting diagnostics from disk</u>

When the boot menu is displayed, enter "2" to specify the alternate load. Refer to section 1.6.2.2 for explanation of the alternate load procedure. Load from the disk as normal, except when the system file name is asked for, enter the keyword "diag" in lower case. This will cause MDS to boot in the diagnostics instead of the OS.

EXEC will be loaded and will size the system. After the EXEC prompt each of the logic tests can be loaded and run, just as described in 1.6.3.1. Refer to paragraph 1.7 for an explanation of loading and running diagnostics.

1.6.4 Run SIT System Interaction test

SIT is loaded from tape or disk by the EXEC like a logic test. Once loaded , SIT gains control of the entire system and auto-sizes the system . The auto size results are displayed on the console to provide the user with the information about the tasks that will be run.

Once the System Interaction Test is loaded , you will have to re-boot the Diagnostic Executive. This is because the SIT program is a standalone program that captures the entire system and overwrites the EXEC in memory. Refer to paragraph 1.7.8 for an explanation of how to load and run SIT.

1.6.5 Installing diagnostics on the disk

1.6.5.1 Introduction

Diagnostic programs for your system may be contained on the system fixed disk.
The installation of all of the diagnostics is optional. Your disk should have
diagnostics installed in order to test the tape subsystem included with your
system.   The purpose of these tape diagnostics is to troubleshoot and test the
tape subsystem when you cannot load diagnostics from the tape subsystem. You
may optionally install all the diagnostic programs on your disk.
The system diagnostics are contained on a dedicated diagnostic partition.

This diagnostic partition is inaccessible to the OS user programs, and is ac-
tually beyond the reach of user disk area. For this reason, the diagnostic
programs cannot be accessed by the OS file system, and are maintained by a
Diagnostic Executive.

When the system is first powered up, or, after the system is shut down, the
user must perform an alternate load sequence in order to load diagnostics from
disk. The system has the logic to either bootstrap the Operating System or
the Diagnostic Executive. The loader programs for each are in different sec-
tions of the disk.

The diagnostic loader and the associated directory of files for the diagnos-
tics are contained in the diagnostic partition. Thus the diagnostic partition
is completely self contained and separate from the OS. The operations of
loading diagnostics from the fixed disk and from the MCS tape are similar.
The only difference is in the alternate load sequence, as discussed in the
previous paragraphs.

The diagnostics contained on your fixed disk cannot be run while the Operating
System is running. The diagnostic programs are all off-line programs and re-
quire you to first shut down your system, regardless whether you load from MCS
tape or from the fixed disk. After running diagnostics, entry of the diagnos-
tic "shutdown" command will allow you to reload the OS. The normal indication
that diagnostics are not on the disk is the error message "invalid loader de-
tected ," displayed when a diagnostic boot is attempted .

To give you an idea of what the following procedure is intended to do, the
following main steps must be performed:

 1. If the OS is already installed, you must first back up the file system.
 2. Reserve a diagnostic partition on the disk.
 3. Install Diagnostics from the diagnostic media.
 4. Restore your file system after the installation is complete

1.6.5.2 Disk diagnostic installation procedure

1.   Back up your disk.

     If your file system has not been installed yet, you will need to in-
     stall the diagnostics first, as indicated in the following steps.
     After the diagnostics are installed, you can install the OS and the
     file system. You do not have to start with a backup.

     The diagnostics can only be installed on a disk that has the diagnos-
     tic partition specified. When you want to create a diagnostic parti-
     tion where it did not exist before, the disk partitions used by the OS
     must also change to reflect a reduction in the disk capacity. For
     this reason, you must back up your disk prior to installing the diag-
     nostics. When your file system is already installed on the disk you
     must do a complete file backup.

     This must be a file-by-file backup, not an image backup. After the
     file backup, you can install the diagnostics. After installing the
     diagnostics, you can restore the file system. The following steps
     specify the diagnostic installation. You may choose not to back up
     your disk, if you want to re-install the OS and file system after in-
     stalling diagnostics.

     Boot diagnostics from tape.

     Insert the diagnostic tape in the tape drive, and perform an alternate
     load to boot the EXEC from the tape as described in section 1.6.2.2.

3.   Enable service mode.

     When the EXEC is loaded , it will auto-size the system and display the
     program prompt:

               <exec>

     Any Exec commands can be entered at this time. To begin the installa-
     tion of diagnostics, you must first enable the service commands.

     At the Exec prompt, enter:

               service

     and RETURN. This will allow use of the service commands. Exec will
     then ask for the service password. Enter the service password and
     RETURN. The <exec> prompt will again be displayed.

4.   Update the superblock on the disk.

The superblock on the disk must be updated to reserve a section of the
disk for the diagnostics. Enter the superblock initialization
command:

              sbinit

and RETURN to initialize the super block for the diagnostic partition.
EXEC will ask you if you want to destroy the existing disk partition
information and the disk directory name. Any (y/n) responses are
single character responses, and do NOT require a RETURN. Entry of the
"sbinit" command will cause EXEC to ask:

              Destroy: "volume ID" (y/n)?

where "volume ID" is the current volume ID contained in the super-
block. A "y" response allows you to initialize the superblock for the
diagnostic partition. Any other response returns you to the <exec>
prompt. Enter :

              y

and EXEC will ask for the number of sectors to reserve on the disk for
the diagnostics:

              Diagnostic Partition size (in sectors)?

Enter the number of sectors desired as follows:

a) To install all available diagnostics, enter: 1200 and RETURN.
b) To install tape diagnostics only, enter: 200 and RETURN.

EXEC will then ask about the directory:

              Destroy : "partition name" (y/n)?

Enter the character "y" to destroy the current disk directory and
diagnostic files and have it initialized for a subsequent install, or
"n" to retain the current partition name and the programs in it.

If you wish to change the name of the disk diagnostic partition,
enter:

              Y

 and EXEC will then ask:

              Disk name :

Enter the new disk name, up to 12 characters in length, and RETURN.
This new name will be displayed every time you display the directory.
EXEC will then display:

Initializing : "disk name"

where "disk name" is the new name you just entered. The diagnostic
partition is now defined.

5.   Copy diagnostics from tape to disk.

Once the diagnostic partition is defined , diagnostics can be installed
on the disk. You can now determine which files to install on the disk
by listing the contents of the tape. This is optional if you are
going to install all of the diagnostics. To obtain a list of file
names on the tape, enter:

ltape

and RETURN to list the MCS tape contents. Enter the command:

mtslist

and RETURN if your diagnostics are on MTS tape. To install the diag-
nostics on the fixed disk, enter:

install

and RETURN to install ALL of the diagnostics. To install a particular
diagnostic enter:

install "file"

and RETURN where "file" is the file name to install on the disk. Use
the list of files obtained by the "ltape" command to determine which
files you want to install. The files EXEC, SIT, MCS and/or MTS are
the minimum diagnostic files to install. When you enter the "install"
command, to install all of the diagnostics, EXEC will prompt:

Destroy : "disk name" (y/n)?

where "disk name" is the name of the disk entered during the "sbinit"
command sequence. Entry of the character "n" will cause the current
directory name to remain and the install process to begin.
Entry of a "y" character will cause EXEC to ask you for the new disk
name as in the "sbinit" command. Maintain the current directory from
the "sbinit" sequence, enter:

n

and the install procedure will begin.

As the diagnostics are installed on the disk, EXEC will display the current program being copied from the tape, and the size in sectors. After the sector size display, the file is written to the disk and the directory updated. When all the files are installed, EXEC will again display the prompt:

<exec>

6. After the diagnostics are installed on the disk, you may want to list the diagnostics on the disk; enter:

    ldisk

    and RETURN to obtain the list of the diagnostic files on disk. You should test the bootstrap capability now, to see that you can boot diagnostics from the disk. Enter:

    shutdown

    and RETURN to obtain the re-boot menu. Refer to section 1.6.2.2 for an explanation of the re-boot menu to perform an alternate load sequence to boot the diagnostics from disk.

7. Install the file system on the disk. Note that installing diagnostics on the disk has taken disk space away from the user available disk space. The device capacity is reduced to provide room for the diagnostics.

1.6.5.3 Changing the load device for EXEC

Once diagnostics are installed, diagnostics can be loaded from disk quite easily by the procedure noted in section 1.6.2.2, by performing the alternate load sequence. The alternate load procedure will load the Diagnostic EXEC from the disk, and diagnostics can be loaded from the disk. Yet you do not have to re-boot the EXEC to start loading diagnostics from the disk after the diagnostics are installed. To allow loading the diagnostics from the just-created disk, enter the command:

device wd0

and RETURN to tell EXEC that it is to load diagnostics from the disk. Now the "load" command will cause diagnostics to be loaded from the disk. For example, enter:

load memory

and RETURN, and EXEC will load the memory diagnostic from the disk. Refer to section 1.7.7.2 for a description of loading and running specific tests. To change back to loading from the tape devices, enter:

device cs0

and RETURN to load from the MCS tape or

device ts0

and RETURN to cause loading from the MTS half-inch tape.

1.6.6 OS-Detected Errors

While the BOSS/IX Operating System is running, many errors that are detected are logged in an error log on the disk. This error log can be displayed to determine the quantity and type of errors that are being detected.

If necessary, you can shut down the system and load the appropriate diagnostics in order to determine whether the error can be duplicated by the diagnostics or to further identify the cause of the error, to facilitate repair.

1.7 LOADING AND RUNNING LOGIC TESTS AND SIT

1.7.1 Introduction

The following paragraphs describe the procedures for running the Logic Tests and the System Interaction Test in their automatic modes. These instructions are provided to assist you in running these diagnostics and to give a practical step-by-step approach. The full set of diagnostics is contained on a separate MCS cartridge or on MTS half inch tape. Diagnostics may also be installed on your disk.

The procedures covered here are as follows:

o   Booting the diagnostic Executive
    – From MCS cartridge tape
    – From MTS tape
    – From the system disk

o   Running the Logic Tests in the auto-run mode

o   Loading and running specific Logic tests

o   Loading and running the System Interaction test

The reports produced by the tests are briefly explained, to help you in fault
isolation, or to determine how effectively your system is running.

1.7.2 Fixed Disk Resident Diagnostics

Diagnostic programs for your system may be contained on the system fixed disk.
The installation of all of the diagnostics is optional. Your disk should have
diagnostics installed in order to test the tape subsystem included with your
system. The purpose of these tape diagnostics is to troubleshoot and test
your tape subsystem when you cannot load diagnostics from the tape subsystem.
You may optionally install all of the diagnostics programs on your disk.
Refer to section 1.6.5 for more information on disk-resident diagnostics.

1.7.3 Loading Diagnostics

To run the Logic Tests or the System Interaction Test, you need to perform an
alternate system load from the diagnostic MCS cartridge, MTS tape or system
hard disk.   This will load the Diagnostic Executive.

1.7.3.1 <u>Starting from the shutdown menu</u>

It is assumed that your system is currently shut down and is either powered
off or displaying the reboot menu:

   1.   Boot
   2.   Alt-Load
   3.   Micro-Diagnostics
   4.   Power down

   Enter option (1-4) :

Enter a "2" and RETURN to start the alternate load procedure. Note that if you don't enter anything at the boot menu, the system will automatically boot after a brief timeout. Entering a "3" at the boot menu will begin the command mode of operation with the Micro Diagnostic System. To return to the re-boot menu, enter the command at the system console:

self

and RETURN. The normal self test will begin. To avoid the self test, if they have already been run, enter:

shut

and RETURN, and the normal shutdown and re-boot menu will again be displayed. To perform an alternate load while you are in command mode, enter the command:

alt

and RETURN. The system will then prompt for the alternate load device.

1.7.3.2 Starting from power off

If your system is currently powered off, turn it on. While the self-tests are being performed, the status is displayed on the system console. To abort the system self tests, press the ESCAPE key until the reboot menu is displayed. It is advisable to let the self tests complete, so that any errors can be detected . Self tests will ensure a reliable load of the diagnostics. When the self tests complete, the boot menu will be displayed . If you pressed the ESCAPE key during the running of the self tests, the boot menu will also be displayed .

1.7.3.3 Alternate load device entry

The boot device prompt is displayed after the alternate load procedure is selected from the boot menu:

Boot device:

Your diagnostics are on either MCS cartridge, MTS tape or the system disk. If your diagnostics are on MCS cartridge, insert the cartridge into the MCS drive, slide in the tray, and turn the locking lever up. Then enter :

cs0

and RETURN. Diagnostics will be loaded from tape. If your diagnostics are on MTS tape, insert the tape into the tape drive, and make it ready. Then enter:

ts0

and RETURN. Diagnostics will be loaded from tape. If your diagnostics are on the hard disk, enter:

wd0

and RETURN. Diagnostics will be loaded from disk.

Pressing just RETURN to the "boot device" prompt will cause the alternate load to be done from the default boot device that is programmed into the NVRAM. This is usually the system fixed disk.

1.7.3.4 <u>System file prompt</u>

The system file prompt is displayed as:

System file:

If your diagnostics are on tape, press RETURN. If your diagnostics are on the system disk, enter the keyword:

diag

and RETURN to tell the system to load in diagnostics from the hard disk.

1.7.4 What if your diagnostics are not on the fixed disk?

If the diagnostics are not installed on the disk, the system will display the message, "Invalid loader detected," which indicates that the diagnostic loader is not on the disk. The load device prompt will then be displayed.

Installing the diagnostics on the disk is optional. The installation of the tape diagnostics is the normal minimum in order to carry out tests on the tape drive when it is malfunctioning. Refer to section 1.6.5 to install diag-nostics on the disk.

You may want to install all of the diagnostics on the disk, to allow quick loading and running of the tests, as opposed to loading from MCS tape cart-ridge. Installing all of the diagnostics on your disk will take up approxi-mately 1200 sectors.

1.7.5 After the Diagnostic Executive is loaded

When the boot is completed from either the tape or disk, the Diagnostic Execu-
tive prompt is displayed.

<exec>

You are now ready to load and run the Logic tests or the System Interaction
Test. You may wish to run either or both, depending upon the expected fail-
ure. You may run individual Logic Tests, or an automatic sequence. But first
you may want to have output to a line printer to list any errors that may be
detected, or to have a list of the tests performed and the favorable test re-
sults printed.

1.7.6 Starting Printer Output

If you have a parallel printer or a serial printer with an MAI Basic Four or
industry standard interface configured as the system printer, you can have the
diagnostics print the test and error messages on the printer, as well as the
system console. To print messages to the serial printer, at the <exec>
prompt, enter:

option sp

and RETURN. For a parallel printer, enter:

option lp

and RETURN. Make sure that your printer is on line and ready. To test the
printer ready, press RETURN a few times; the <exec> prompt will be printed on
the printer.   Now proceed with the tests.

1.7.7 Running the Logic Tests

1.7.7.1 <u>Automatic Mode</u>

Once you have performed the alternate load from the diagnostic cartridge or
disk, you are ready to run the Logic Tests. The automatic test mode is de-
scribed first, followed by the manual mode. At the diagnostics <exec> prompt,
enter:

auto

and RETURN. The program then displays this warning and asks you to verify
that you want to continue:

**WARNING: ALL NON-WRITE-PRDTECTED MEDIA IS SUBJECT TO
CORRUPTION (WINCHESTER DISK EXEMPT)...Continue (y/n)?**

The "auto" testing sequence is designed to load and run all the Logic Tests, including the MCS and MTS, which will use the tape drives and the media installed . All unprotected media will **be written on**.

To prevent writing on the diagnostic media, remove this media. Write protect your diagnostic media if it is not already done. You should insert a non-write-protected scratch tape into your tape drive if you wish to execute the MCS and MTS write tests. If you do not wish to run the write tests, insert your write-protected diagnostic tape, make the drive ready and the write tests will be skipped. After you verify tape write-protection, enter:

Y

and testing will begin. No further intervention is required until the tests are complete. Note that the memory tests take a long time to run, some tests lasting several minutes with no apparent activity.

At each step of its execution, the program displays a message to indicate what the Diagnostic Executive is doing. First, it loads a particular diagnostic, and then it runs it. As the individual tests are executed, the titles are displayed on the system console first, and then the test is executed. When the specific Logic Test is completed, a message indicating the number of errors that occurred is displayed. The next Logic Test is then loaded and run, and so on until all the Logic Tests have been run. The last test to be run will finish and display the Logic Test program prompt for that program. Unless you are printing the test results, the tests need to be monitored. So, if any errors occur, the Logic test and the subtest that gave the error can be noted. When an error occurs, the program will halt on the error. Enter a SPACE to continue with the testing. If the errors seem to be endless, press the ESCAPE key, and abort the test. The total errors for each Logic test should also be noted . These results should be recorded for evaluation by a cognizant engineer.

Some apparent errors only indicate that the MCS cartridge is write protected , and these errors can be ignored. Similarly for the disk diagnostics, some sub-tests are not optioned to run.

If in doubt of the relevance of an error, write it down for future reference by a cognizant engineer.

1.7.7.2 Loading and running specific logic tests

When the diagnostic Executive is running the logic tests, the user may press
the ESCAPE key to cause the test to stop and the current program that is run-
ning will display the program prompt in "< >" characters (angle brackets).
If you have just loaded the Executive, then the <exec> prompt will be dis-
played.

<exec>

When the <exec> prompt is displayed, the user may enter commands to carry out
different tests. Described here is the technique to load and run a specific
Logic Test. Another Logic test can be loaded when any Logic Test prompt is
displayed, as well as the <exec> prompt. At the <exec> prompt, the user can
display the names of the tests which can be loaded . If the diagnostics are
booted from the MCS tape, enter :

ltape

and RETURN to display the contents of the tape. If booting diagnostics from
MTS tape, enter the command:

mtslist

and RETURN. If the diagnostics are loaded from disk, enter:

ldisk

and RETURN to display the programs contained on the disk.

In response to either the "ltape" or "ldisk" commands, the Diagnostic Execu-
tive will display, on the system console, the names of the Logic Tests that
are available to the user. The Logic Tests must first be loaded into memory
and then executed. The program names are used to indicate the tests available
to load. To load a specific Logic Test, enter the following:

load program

and RETURN, where "program" is the name of the logic test obtained from the
list of the contents of the tape or disk.

When the program is loaded , the user can run the sub-tests in the Logic test,
after the Logic Test displays the program title and the prompt. The prompt is
always displayed with the "< >" characters enclosing the program name. Prior
to the program prompt, the Logic test will size the system, if necessary, to
determine test variables. When the program prompt is displayed, enter:

run

and RETURN; the testing will begin. The test titles will be displayed on the
system console, along with any errors that are detected.

When the diagnostic completes, the program prompt will be displayed , as well
as an error count indicating the number of errors that were encountered. To
load another Logic Test, simply enter the "load" command with the name of the
next Logic Test, and that program will be loaded . Enter the "run" command
again, and this next program will begin testing.

This method of loading and running specific Logic Tests will save you time, so
long as you have an idea of where your problem is. For instance, if you

suspect the memory is the problem, you can load and run the memory diagnostics
alone and not run an "auto" sequence.

1.7.8   Load and run System Interaction Test (SIT)

1.7.8.1 <u>Loading SIT through the Diagnostic EXEC</u>

After you have performed the alternate load, and you see the Diagnostic Execu-
tive prompt, <exec >, you are ready to load and run the SIT program. You may
want to run this test first, prior to running the Logic tests, to get a quick
picture of the stability of your system. You may also run this test after you
have run the Logic Tests, to detect errors associated with interactions be-
tween controllers and other system components.

SIT is designed to emulate the operating system by causing many I/O tasks to
be done in parallel, as well as carrying out other system tests. Although the
tests that are done on individual system components are not as exhaustive as
the Logic tests, SIT will locate errors associated with interactions between
system components, which Logic tests are not designed to locate. At the Exec-
utive prompt:

> **<exec>**

 or from the last Logic test prompt, enter :

> **load sit**

and RETURN. This will load in the SIT program from the diagnostic media.
When SIT finishes loading, it displays:

> **SYSTEM INTERACTION TEST (SIT) REV. XX**
> **Wait 30 seconds for auto sizing**

The SIT program will automatically size the system for the amount of memory in
your system, as well as the controllers found in the system. The program
searches for the devices that are ready to be used for a test sequence. SIT
then builds the required tables in memory for the tasks associated with the
devices found. The auto-size results are then displayed on the system con-
sole.

SIT will configure the MCS tape for testing only if there is a non-write-
protected cartridge in the drive, the lock lever is in the up position, and
the drive is ready. SIT also configures the disk tests to be non-destructive,
so that you don't have to worry about the disk data being written over.

1.7.8.2 SIT Auto-size results

The auto-size results are displayed on the system console to allow you to determine the devices found by SIT. The status of the controllers and attached devices are displayed to tell you what SIT found. Write down the auto-size results for reference or evaluation. List the controllers and the status found.

You might compare this list with your expected system configuration, as to the types of controllers present in your system and the number of attached peripherals. When the auto-size results are displayed, SIT will display the program prompt:

<sit>

To begin an auto test of the system, enter:

run

and RETURN. SIT will automatically begin the system test by starting each of the tasks associated with the auto-size results.

While SIT runs, a "news update" will be displayed on the system console, giving you up to date information on the test run. The number of transactions completed and the number and types of errors detected will be displayed . The counts will be accumulated, so you do not have to write down the errors that occur. The "news updates" will continue to display as long as SIT is running.

The System Interaction test will run as long as it is left to run. The longer you let SIT run, the better the actual test is, due to the fact that some errors may be intermittent. You may want to run the test overnight, to get a good test result. During the test, the program should not be stopped. SIT will run indefinitely until you press ESCAPE to get the <sit> prompt back. At the <sit> prompt you may enter other SIT commands to modify the test sequence.

1.7.9 Diagnostic Shutdown

The shutdown procedure is similar both for the Logic Tests and for the System
Interaction Test.

If a Logic test is currently running, you can stop testing at any time by
pressing ESCAPE; the program prompt will be displayed on the system console.
Some Logic Tests may continue until a normal stopping point, which will pro-
duce a delay before the program prompt.

When you are running the Logic tests, at the <exec> prompt or any program
prompt, you can allow a re-boot of the system by entering the diagnostic com-
mand:

shutdown

and press RETURN. This will cause the system to display the usual re-boot
menu.
To shutdown SIT, press the ESCAPE key. SIT will display the <sit> prompt.
Enter:

shutdown

and RETURN. SIT will then pass control of the system to the normal shutdown
menu, to allow reboot of your system .

SECTION II

PROM—BASED DIAGNOSTICS

The PROM—based diagnostics consist of the MDS, or Micro-Diagnostic System, which is included on every MAI 3000 CMB (Central Microprocessor Board). The document describing in detail the MDS is the **MDS Users Guide**, specification number 011526.

Title	Spec. #
MDS Users Guide	011526

SECTION III

RAM—BASED DIAGNOSTICS

The RAM-based diagnostics are diagnostic programs that reside on the diagnostic media and are loaded into system memory following a diagnostic boot. The diagnostic EXEC is used to load and control the running of these diagnostics. The RAM-based diagnostics consist of the tests listed below. The documents describing in detail these tests are also listed.

Title	Spec. #
FPCP Test	011522
MMU Test	011523
PIT Test	011221
SCC Logic Test	011311
RTC Logic Test	011521
Memory Test	011509
CACHE Logic Test	011525
MTS Logic Test	011424
MTS Function Select	011425
Winchester Disk F.S.	011334
Disk Logic Test	011363
MCS Function Select	011165
MCS Basic Logic Test	011267
Four-Way F.S.	011178
Four-Way Logic Test	011177
LAN Diag. F.S.	011218
LAN Logic Test	011268
Eight-Way F.S.	011510
Eight-Way Logic Test	011524
Diagnostic EXEC.	011489
System Interaction	011310
Serial Ports Test	011354

SECTION IV

SUPPORT DIAGNOSTICS

The support diagnostics are diagnostic programs that reside on the diagnostic media and are loaded into system memory following a diagnostic boot. These consist of the Disk UTILITY (DUTIL), RD (Remote Diagnostics) and SSN (System Serial Number). The documents describing these tests in detail are listed below.

Title	Spec. #
Disk Utility	011336
SSN User Guide	011527
Remote Diagnostics	011270
bass	011339
Diagnostic Exec.	011989
SIT	011310

BASS ON-LINE DIAGNOSTICS

The Basic All-Purpose Service System, or BASS, is used to test system components and drivers. BASS is characterized by testing specific peripherals while the OS is running system tasks and applications programs. BASS is composed of a series of test modules and a monitor program . The document describing BASS in detail is the **BASS User Manual**, specification number 011339.

Title	Spec. #
BASS User Manual	011339

SECTION VI

ERROR-LOGGING FACILITY

The MAI 3000 Error-Logging Facility is contained in the operating system and is continually in operation. The document describing the Error-Logging Facility in detail is titled **Error-Logging Facility,** and the specification number is 011364.

Title	**Spec. #**
Error Logging Facility	011364