

Rogers Communications Centre
Computer Acceptance and Maintenance Procedures

Version Final
Date: June 12, 2006
Written by: David Tom

Table of Content

Rogers Communications Centre	1
Computer Acceptance and Maintenance Procedures.....	1
Table of Content	2
1.0 Introduction:.....	3
2.0 Sub-Component Identification and Inventory	3
2.1 Warranty and Financial Information.....	Error! Bookmark not defined.
2.2 Recommended Software for Inventory (Windows Based workstations).....	5
2.3 Recommended Software for Inventory (Apple Based Workstations)	6
3.0 Acceptance Policy for New Workstations	7
3.1 Acceptance Tests:	7
3.1.1 Processor	7
3.1.2 Motherboard.....	7
3.1.3 Memory.....	8
3.1.4 Video Card or chipset	9
3.1.5 Hard Drive	10
3.1.6 Optical Drive.....	11
3.1.7 Card Media Readers.....	12
3.1.8 Floppy Drive	12
3.1.9 Network Interface Card.....	12
3.1.10 Sound Card.....	13
3.1.11 Chassis	13
3.1.12 Other Peripheral Cards.....	14
3.1.13 Monitor	14
4.0 Maintenance Procedures for Workstations	17
4.1 Maintenance Test Procedures:	17
4.1.1 Processor	17
4.1.2 Motherboard.....	17
4.1.3 Memory.....	18
4.1.4 Video Card	18
4.1.5 Hard Drive	19
4.1.6 Optical Drive.....	19
4.1.7 Card Media Readers.....	20
4.1.8 Floppy Drive	20
4.1.9 Network Interface Card.....	20
4.1.10 Sound Card.....	21
4.1.11 Chassis	21
4.1.12 Other Peripheral Cards.....	21
4.1.13 Monitor	22
5.0 Reporting Procedure	23
5.1 Documents	23
5.2 Storage	23
5.2.1 Responsibilities	23
5.2.2 Storage Location	24
5.2.3 Directory Hierarchy	24

5.2.4 File Naming Convention.....	25
Appendix A: Recommended Test Hardware and Software.....	27
Hardware.....	27
Software.....	27
Appendix B: Sample Test Report	29

1.0 Introduction:

In accordance to the Rogers Communication Centre (RCC) Computer Acceptance and Maintenance Policy, this document outlines the procedures and suggested tools used to inventory and test computers.

The purpose for the Computer Acceptance and Maintenance procedure is to have a standard common process within RCC departments for inventory, acceptance testing and maintenance testing.

The procedures in this document are only applicable to PC and Apple based desktops.

2.0 Sub-Component Identification and Inventory

A workstation consist of the following major components that must be identify and recorded:

System Overview

- Manufacturer or Distributor (i.e. Dell, HP, retailer (OTA))
- Model Name (i.e. Opt
- Model Serial #

Processor

- Manufacturer (Intel, AMD, IBM)
- Model Name (i.e. Pentium 4, Pentium Core Duo, AMD Athlon 64, PowerPC)
- Processor Model or Number
- Listed Processor Speed

Motherboard

- Manufacturer (i.e. Asus, Abit, Apple)
- Model Name

Memory

- Type (i.e. DDR-SDRAM, DDR2-SDRAM, RDRAM)
- Speed

- Size
- # of modules

Video Card

- Manufacturer (i.e. Matrox, ATI, Sapphire)
- Model/Chipset (internal) Name
- Memory Size
- Interface (onboard, AGP, PCIe, PCI)

Hard Drive

- Manufacturer
- Model Name
- Capacity
- RPM
- Cache Size
- Interface (IDE, SATA, SCSI)

Optical Drive

- Manufacturer
- Model Name
- Largest Recordable Media Format
- Maximum Write Speed
- Interface

Card Media Readers

- Manufacturer
- Media Format Supported
- External Interface (USB, Firewire 400, Firewire 800)
- Interface

Floppy Drive

- Yes / No

Network Interface Card

- Manufacturer
- Model Name or Chipset
- Media Type (Ethernet, Fibre Channel, Optical)
- Speed Supported
- Interface (onboard, PCI, PCI-x)

Sound Card

- Manufacturer
- Model Name or Chipset
- # of channels supported
- Interface (onboard, PCI, PCI-x)

Other Peripheral Cards

- Manufacturer
- Model Name or Chipset
- Interface

Monitor

- Manufacturer
- Model Name
- Display Technology (i.e. CRT, LCD)
- Display Size
- Interface Supported (HD25, DVI-I, DVI-D, Component)
- Serial #

Battery

- Manufacturer
- Model

2.1 Warranty and Financial Information

For complete system purchases, vendor, date of acquisition, and warranty period must be recorded with the inventory record.

For individual component purchases (components not initially purchase as a complete system), serial #, vendor, date of acquisition and warranty period must be recorded with the inventory record.

2.2 Recommended Software for Inventory (Windows Based workstations)

For windows based PCs, PC Wizard 2006 from CPUID is the current recommended application to be used to collect inventory data for windows based workstations. It is available for free at <http://www.cpubid.com/pcwizard.php>. The tool is periodically updated for support for newer components so it is highly recommended to check the web page for the most recent version of the software before beginning the inventory process of new PCs.

PC Wizard 2006 is available as a zip package or a self-installed package. It is recommended that the zip package be used as it does not need to be installed and can be executed from removable supported storage drives (i.e. CD, USB key).

To save an inventory report from PC Wizard 2006, it is recommended that the user click on the "Save" button or menu item and select the "Selected Category" radio button. This will produce a full report on the hardware inventory of the system. Save the report as a text file.

2.3 Recommended Software for Inventory (Apple Based Workstations)

For Apple based PCs, TechTool Pro v4 from Micromat is the current recommended application to be used to collect inventory data for Apple based workstations. Contact the Rogers Communication Centre's Computer System Technology Group for more information about the software.

3.0 Acceptance Policy for New Workstations

In order to ensure new workstations are in proper working and have not been damaged due to the effect of manufacturing defects, shipping damage or other possible sources of infant mortality failure (early failure in the span of a component), a “Burn-in” test is performed. This test is done to ensure that all major subcomponents are operating within the device’s specified parameters at the maximum rated operating condition. If a component has been damaged, the test attempts to identify its fault by apply stress. Many electrical components, like semiconductors, are affected by thermal stress so a burn-in test should be executed over a long duration (eight hours is recommended) under load to produce heat.

3.1 Acceptance Tests:

The following tests must be performed on the following components:

3.1.1 Processor

There are many reasons why infant mortality failure can develop in semiconductors, like a CPU. From leakage in the transistors, impurities in the bulk semiconductor material, moisture issues from crack packaging to bond wire damaging due to various stresses. The results can range from improper bits being produce to catastrophic failure. Compounded by the difficulty of isolating the problem from the various other components that work closely with the CPU (i.e. motherboard, memory), it can be a challenging task to identify CPU failure.

A common approach in identifying these possible faults is to place the CPU under various stress (thermal, electrical overstress, environmental) over time. Thermal stress is a common environment that the processor will be exposed to and has an effect on electrical properties of most electronic components.

Tests

- Execute a processor intensive operation where faults can be quantitatively measured. This test should be run for a minimal of eight (8) hours to generate thermal stress and the temperature of the CPU should be monitor.
Requirements to Pass: No Faults must be recorded during the duration of test.
- Compare real processor speed vs. listed processor speed
Requirements to Pass: Real processor speed must match processor speed (with a plus/minus variation of 1%).

3.1.2 Motherboard

The motherboard consists of various ASIC chips, passive electrical components (i.e. capacitors, resistors, inductors), interconnecting slots and sockets, mechanical fans, external I/O ports and the PCB (Printed Circuit Board). All of these subcomponents are

vulnerable to the same problems that processors have including solder joint problems, ESD (electric static discharge), moisture and humidity, vibration and mechanical stress.

Because of the various functions that the motherboard is responsible for, including often now video, audio and networking, the symptoms of motherboard failure can range from errors in the clock, faults in the external ports to complete catastrophic failure.

There are various ASIC controller chips on a motherboard. Various tests found in this procedure may indirectly many of these components (i.e. memory and video tests could test North Bridge chip, hard drive tests SATA controller).

Tests

- For onboard USB and firewire, see tests under “peripherals”
- For onboard audio, see tests under “sound card”
- For onboard network, see tests under “Network Interface Card”
- For onboard video, see tests under “Video Card”
- P/S2 Keyboard Controller Test – Validate communication between keyboard to keyboard controller via P/S2 interface
Requirements to Pass: Keyboard controller must respond to keyboard
- P/S2 Mouse Test - Validate communication between keyboard to keyboard controller via P/S2 interface
Requirements to Pass: Mouse controller must respond to mouse
- Cooling fans (when applicable) – Validate operation of fan and record avg speed.
Requirements to Pass: Fans must spin at specified rate.
- CMOS testing – Enter the BIOS, make a parameter change (i.e. time), save and exit. Verify if changes in parameter persist. Restore parameter.
Requirements to Pass: The changed parameter will remain.
- Other tests – If available, test for CMOS, CTC, DMA, 802.11a/b/g and IRQ controller.
Requirements to Pass: All function should execute without error.

3.1.3 Memory

There are generally two types of memory, SRAM (static RAM) and DRAM (Dynamic RAM). DRAM is the most popular type of RAM with DDR-SDRAM (Double Data Rate Synchronous DRAM) being the current popular variation of DRAM. Each memory cell in a DRAM is a single transistor behaving as a capacitor holding an electrical charge. Although prone to the same issues as any semiconductors (i.e. Processor), the common

problem that occurs is leakage in the memory cell, which produces an incorrect bit in its own cell or neighboring cell. Memory problems can be intermittent.

Symptoms of memory issues are not always obvious, especially if the memory is not being used to hold the OS kernel or application code but user data. If a bit error occurs in the OS kernel or application code, the user may see “blue screen” system crashes or application crashes or odd software behavior. Problems in user data might go unnoticed until reference upon.

Memory testing strategy should try to test as much as the memory as possible. This can be difficult, as the OS kernel requires some memory. Therefore, it is recommended to use a test application that runs under a small OS kernel, like Freedos. Memory testing should test how cells interact with each other as a faulty memory cell can impact other cells instead.

Tests

- Test memory using software that requires a small OS/kernel footprint (i.e. Freedos) and use various test algorithms/patterns. Test with all available algorithms/patterns once minimally.
Requirements to Pass: No errors detected.
- Test memory bandwidth using software that detect/measure memory bandwidth
Requirements to Pass: Expected bandwidth achieved (i.e. DDR-400 memory should achieve 3.2GB with FSB 200MHz)

3.1.4 Video Card or chipset

Computer video can be produced by specialized video card or it can be integrated onto the motherboard. On specialized boards, a video card can be viewed as a processor, a motherboard and memory all integrated as one. All the causes for failure describe under processor, motherboard and memory can be applicable to the video card. In addition, video cards still need to process/transmit analog video signals. This is done through the RAMDAC (Random Access Memory Digital to Analog Converter) chip. With analog signals, failures on the video card could result in a visible degradation of video performance. That is, failure symptoms on a video card may not be measurable or quantifiable but instead must be visually identify.

Video testing should test 2D graphics and 3D graphics. With 3D graphics, DirectX support is normally required which is often only available on Windows OS. The graphic processor should be tested under load and thermal stress over time.

Tests

- Test 2D with graphic application for a minimal duration of 8 hours. Validate results visually.
Requirements to Pass: Picture should look stable on test monitor at the test duration.

- Test 3D with windows XP based application for a minimal duration of 8 hours.
Requirements to Pass: Picture should look stable on test monitor at the test duration
- If an onboard MPEG2 decoder or RF Tuner exists on the video card, test the video with windows XP based application.
Requirements to Pass: Picture should look stable on test monitor.
- Set video card to highest resolution and frequency capable for video card (note: test monitor may not support the highest resolution or frequency available on card. If so, use the highest resolution supported by the test monitor and then set the highest frequency supported by the test monitor).
Requirements to Pass: Picture should look stable on test monitor.
- Test VGA / DVI Interface by performing above listed test using all available I/Os
Requirements to Pass: Picture should look stable on test monitor.
- Test composite video / s-video by configuring card to output video to the interface under test.
Requirements to Pass: Video should look as expected.

3.1.5 Hard Drive

The hard drive is an electro-mechanical device that is prone to both electronic failures and mechanical failures. The electronic components on hard drives are subjected to the same causes of early failure as other electronic components describe earlier. However, the mechanical components of a hard drive have a higher chance of failure due to its greater susceptibility to environmental stress (i.e. moisture, impact), which can happen often during shipping.

The result of hard failure could vary from sluggish performance (increase read error and retries), damage or loss data or catastrophic failure. Electronic failure will normally result in a catastrophic failure (although data could be recovered in the magnetic medium isn't damage). Mechanical failure could have various end results.

Because of the mechanical portion of hard drives, symptoms of mechanical failures will often (but not always) exhibit gradual performance degradation. Hard Drive manufacturers are now using this performance degradation to predict potential failures by using Predictive Failure Analysis (PFA) technique like S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology). SMART technology must be supported on the motherboard and normally requires software to access the data. SMART reports on the analog mechanical behavior of a hard drive and does not typically look at the electronic components on a hard drive.

Tests

- Execute a hard drive butterfly seek test. Test should be executed a minimal of one time.
Requirements to Pass: Test should report no error.
- Execute a write test. Test should be executed a minimal of one time.
Requirements to Pass: Test should report no error
- Enable SMART and verify if hard drive is within S.M.A.R.T. tolerance
Requirements to Pass: All parameters within S.M.A.R.T. should be within tolerance specification

3.1.6 Optical Drive

Optical drives, like hard drives, are electro-mechanical devices that are prone to similar causes of failure. Optical drives are significantly less complex than hard drives (drive motor, tracking mechanism and laser lens system vs. multiple spindle, multiple head and tracking system) and are more robust to environmental stress.

Because failures in optical drives will rarely cause any loss to the data (because the data medium is removable) and thus not a critical failure to the system in whole, manufacturers have not implemented any PFA techniques like hard drive manufacturers.

Optical drive failures will normally result in inability to read and/or write to CD/DVD media. Symptoms of potential optical drive failure is sluggish read performance of the media (higher # of read retries) or inability to write data correctly at higher speeds. Note: poor performance or failures could be caused by the media (CD or DVD). It is advisable to retest optical drive in question with different media.

Tests

- Perform a write test (a read test is perform on write validation) on a 700MB CD-RW. The test data should consist of multiple files of various size and should have a total size of approx. 700MB. Fastest write speed that the optical drive will support should be configured. A quick erase should be first done on the CD-RW. Validate the files written. Record the write and read throughput.
Requirements to Pass: Test should report no error
- Perform a write test (a read test is perform on write validation) on a DVD5 RW (+ or -). The test data should consist of multiple files of various size and should have a total size of approx. 4.7 GB. Fastest write speed that the optical drive will support should be configured. A quick erase should be first done on the DVD5 RW. Validate the files written. Record the write and read throughput.
- *Requirements to Pass:* Test should report no error.
- Perform a write test (a read test is perform on write validation) on a DVD9 disc. The test data should consist of multiple files of various size and should have a total size of

- approx. 8.54 GB. Fastest write speed that the optical drive will support should be configured. Validate the files written. Record the write and read throughput.
- *Requirements to Pass:* Test should report no error.

 - (For read-only CD optical drives) Perform a read test with an application that can read a 700MB CD full of files of various sizes. The application should be able to be able to list read errors. Record the read throughput.
Requirements to Pass: Test should report no error.

 - (For read-only DVD optical drives) Perform a read test with an application that can read a 4.7GB CD full of files of various sizes. The application should be able to be able to list read errors. Record the read throughput.
Requirements to Pass: Test should report no error.

3.1.7 Card Media Readers

These devices consist of various card slot ports, small PCB, passive components and ASICs for physical translation. In addition to the common problems that semiconductors and passive components have, other common causes of failures to card readers are from mechanical defects or damage to the pins or electrodes and ESD. This can result in errors in data writing or reading or catastrophic failure.

Tests

- Perform a write and read function with a data file (64MB) on each card slot with the appropriate media. Validate the file.
Requirements to Pass: File should be able transfer without error.

- Test any additional I/O (USB, Firewire, audio) using the corresponding I/O tests

3.1.8 Floppy Drive

Tests

- Perform a write and read test with an empty floppy disc with a data file (1MB). Validate the file.
Requirements to Pass: File should be able transfer without error.

3.1.9 Network Interface Card

Network interface cards (NIC) are expansion cards that provide an interface to either a wired or wireless network. The most common interface to a wired network is through the use of twisted copper cable and a RJ45 plug. Optical interfaces are also available. NICs consist of the physical interface (i.e. RJ45 port), transceiver ASIC, Ethernet controller ASIC or FPGA, host adapter (i.e. PCI interface) and passive components. All these components are susceptible to failures caused by previous mention stresses. Symptoms of failure consist of increase transmit/receive errors, failure to lock to higher speed protocols (i.e. gigE) or catastrophic failure. Because of the need to interface with

external systems and parts (i.e. switch, cabling), symptoms can appear that are caused by failures outside of the NIC. Testing should be done on a test bed that is in a controlled environment (i.e. equipment not in production use) and verify to be operating correctly.

Tests

- (Wired) Test the auto-sensing and clocking of the 10/100 and/or 1000 Mbps mode by connecting to the Ethernet port the highest rated Ethernet speed network.
Requirements to Pass: Verify that link light on network card is lit and the OS should report the connection at the correct Ethernet speed.

- (Wireless) Test the auto-sensing and clocking of the Wi-Fi interface by connecting to an 802.11a, 802.11b or 802.11g network.
Requirements to Pass: The OS should report the connection at the correct 802.11 network

- Perform a throughput test or bandwidth test to a target PC/server on a quiet network
Requirements to Pass: Bandwidth or throughput should be at least 80% of the theoretical network bandwidth of the Ethernet format (wired or wireless).

- Test on a quiet network for drop packets as the transmitting client and as the receiving client.
Requirements to Pass: No loss packets should be detected

3.1.10 Sound Card

External sound cards are susceptible to similar causes and symptoms as video cards (i.e. environmental, thermal stress, pcb defects). Instead of visually detecting the problems, the output must be analyzed audibly. Problems that occur on sound cards could result in distortion of the audio input/output and low audio sounds output or capture.

Tests

- Test line in / line output via using a loop-back cable and an application that can playout and record simultaneously. Application should compare the capture audio file to the playout for distortion.
Requirements to Pass: Distortion should be minimal.

- Test the surround sound out audibly by playing a multichannel (i.e.5.1) audio file or using an audio application that supports multichannel audio output.
Requirements to Pass: No crackling or significant audio distortion should be heard.

3.1.11 Chassis

The chassis or case for the PC includes the power supply and case fan. For steady, error-free operation of a PC, the power supply must be able to supply a steady voltage regardless of load. Over and under voltage is a source of electrical stress, which could

cause damage to other major components in the PC. Power supply failure are often known as the most common source of computer failure. Power supplies are expose to various environmental, thermal and electrical stresses. Power supply failure can cause memory errors, system crashes, failure to start up and component damage.

Tests

- Check power supply fan and chassis fan are not obstructed and significant airflow is being generated. Check to see if abnormal heat or scent is being produced by the power supply.

Requirements to Pass: Fans should not be producing any odd noise and airflow should be felt. No abnormal scents and heat should be detected.

- If supported on the motherboard, run an application that will display the voltage supply on the various power rails on your motherboard. Execute application(s) that require use of your optical drives, hard drives and CPU. Monitor the voltage supply readings.

Requirements to Pass: Voltage supply readings must not vary more than 5% from the +12 VDC and +5VDC and 4% from the +3.3 VDC.

3.1.12 Other Peripheral Cards

Peripheral cards, like DSP (digital Signal Process) card or I/O cards (USB, firewire) can be treated like sound cards or video cards when looking at causes of failure. When testing for failure, it is recommended to test functionality of the card and all I/O ports.

Tests

- USB 1.1 or 2.0 functionality tests. Test each USB port on the PC for power, USB 1.1 and 2.0 connectivity, transmission and error rate test. No test duration requirements.

Requirements to Pass: All ports must have power, be able to connect to the fastest USB standard and transmit without error at the listed standard.

- Firewire (802.11) 400 and 800 functionality tests. Test each Firewire port on the PC for power, firewire400 and 800 connectivity, transmission and error rate test. No test duration requirements.

Requirements to Pass: All ports must have power, be able to connect to the fastest firewire standard and transmit without error at the listed standard.

3.1.13 Monitor

Consumer monitor technology can be divided into two types of technology: CRT (cathode-ray tubes) and LCD (liquid crystal display). The components of a CRT monitor consist of a vacuum tube with an anode, cathode, electron gun and circuitry (resistors, capacitors, ACIC) that control the electron gun. LCD monitors normally consist of an active-matrix panel, backlight and a driving-circuit unit. Like other electronic components, both technologies are susceptible to various stresses with thermal stress being a common type. Because of the vacuum tube, CRT is less robust to

mechanical stress than LCD. CRT monitors generate significantly more heat than LCD monitors. Heat (thermal stress) will age electronic components faster, which explains why CRT monitors have a shorter MTBF (mean time before failure) than LCD monitors.

CRT generally requires the graphic image to be represented by analog signals while LCD require the graphic image to be represented by digital signals. This will result in different types of symptoms or indicators when a fault occurs on a monitor. CRT failures can range from dark spots, geometric distortion, and blurry images to inability in locking to high resolution/high frequency video signals and catastrophic failure. LCD failures range from dead pixel (always dark or always lit), high-resolution video locking problems and catastrophic failure.

Note: many but not all manufacturers follows ISO standard 13406-2 which outlines the # of acceptable malfunctioning sub-pixels per million pixels. For class II LCD panels (commercial non-critical services), 5 malfunctioning sub-pixels and 2 malfunctioning pixels per million pixels are acceptable. (For 1024x768 native resolution monitor, 4 malfunctioning sub-pixels are allowed).

All monitors should be allowed to warm up for at least ½ hour before and is completely degaussed before any test patterns are displayed. Ensure the monitor is not near any source of electronic magnetic interference.

Tests

- For all monitors, display the following solid colour test patterns (black, white, red, green, blue, yellow, cyan and magenta). For each colour pattern, look to see if the colours of the test pattern are uniform and that there are no dead or dark spots. For LCD monitors, look for constantly dark or lit pixels.
Requirements to Pass: No significant uniformity in the test pattern and no more than 2 bright or dark pixels or 4 malfunctioning sub-pixels should be seen on monitors with native resolutions 1024x768, 3 bright or dark pixels or 4 malfunctioning sub-pixels should be seen on monitors with native resolutions 1280x1024.
- Set the video card resolution and frequency to the highest setting supported for the monitor. Display a picture having complete range of colours and intensity. Look for any movement (i.e. jitter or shimmering) in the picture.
Requirements to Pass: No movement in the picture should be seen.
- For all monitors, display a convergence line test pattern (the pattern will have a black background and white crosshatch pattern lines with white straight lines that converge from each diagonal of the screen to the centre.). Look for colour fringing on the lines and the crosshatch grid pattern should look rectangular. If the grid pattern has a uniform concave or convex distortion, adjust the pincushion setting on the monitor until the lines are vertical.
- *Requirements to Pass:* No colour fringing should be observed on the line and the grid lines should be vertical and horizontal.

- Test all video input interface (VGA, DVI, composite, s-video, RF Tuner) at max supported resolution and frequency (i.e. max clock frequency).
Requirements to Pass: All input interface should display video without visual distortion or colour distortion

- (If available) Test USB interface by attaching USB storage device and performing data transfer.
Requirements to Pass: All ports must have power, be able to connect to the fastest USB standard and transmit without error at the listed standard.

- (If available) Test audio speakers by plugging in an external audio source (i.e. PC audio out) and listen.
Requirements to Pass: No audio distortion should be heard.

4.0 Maintenance Procedures for Workstations

Components on workstations are prone to failures over time. Some causes of electrical components failures are from corrosion, insulation breakdown, deterioration of encapsulation material, cracking in bond wire due to repeated stress. Mechanical components are more prone to failures because of the increase wear that is present due to moving parts.

For digital components, it is extremely difficult to determine when a component will fail. Little to no early indicators are given before a component fail or provide inaccurate results. We may know, based on the given Mean Time Before Failure (MTBF), when statistically we may start seeing a higher probability of failure but during the useful life span of the component, failures will occur for more or less random reasons. We can describe these events as unpredictable.

For mechanical and electro-mechanical components, many of the mechanical parts will exhibit gradual performance deterioration before failure. This deterioration can be used as indicators of when a catastrophic failure event will likely occur. Manufacturers have developed technology, such as S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) on hard drives, to provide users early warning in order to schedule replacement of failing devices, thus avoiding potentially costly downtime.

Because most PC components fail unpredictably or have a high cost attach to implement a predictable failure analysis technique, RCC's maintenance procedures is design to identify the workstation's health status at a particular time (i.e. between academic terms). This way, any failures of components that have occurred but have not been reported can be identified and the failure corrected. The workstation can then be return back to operation with the knowledge that at the time of when the maintenance test was done, the workstation was fully operational.

4.1 Maintenance Test Procedures:

4.1.1 Processor

Tests

- Execute a processor intensive operation where faults can be quantitatively measured.
Requirements to Pass: No Faults must be recorded during the duration of test.

4.1.2 Motherboard

Tests

- For onboard USB and firewire, see tests under "peripherals"
- For onboard audio, see tests under "sound card"

- For onboard network, see tests under “Network Interface Card”
- For onboard video, see tests under “Video Card”
- P/S2 Keyboard Controller Test – Validate communication between keyboard to keyboard controller via P/S2 interface
Requirements to Pass: Keyboard controller must respond to keyboard
- P/S2 Mouse Test - Validate communication between keyboard to keyboard controller via P/S2 interface
Requirements to Pass: Mouse controller must respond to mouse
- Cooling fans (when applicable) – Validate operation of fan and record avg speed.
Requirements to Pass: Fans must spin at specified rate.
- CMOS testing – Enter the BIOS, make a parameter change (i.e. time), save and exit. Verify if changes in parameter persist. Restore parameter.
Requirements to Pass: The changed parameter will remain.
- Other tests – If available, test for CMOS, CTC, DMA, 802.11a/b/g and IRQ controller.
Requirements to Pass: All function should execute without error.

4.1.3 Memory

Tests

- Test memory using software that requires a small OS/kernel footprint (i.e. Freedos) and use various test algorithms/patterns. Test with all available algorithms/patterns once.
Requirements to Pass: No errors detected.
- Test memory bandwidth using software that detect/measure memory bandwidth
Requirements to Pass: Expected bandwidth achieved (i.e. DDR-400 memory should achieve 3.2GB with FSB 200MHz)

4.1.4 Video Card

Tests

- Test 2D with graphic application. Validate results visually.
Requirements to Pass: Picture should look stable on test monitor at the test duration.
- Test 3D with windows XP based application.
Requirements to Pass: Picture should look stable on test monitor at the test duration

- Set video card to highest resolution and frequency capable for video card (note: test monitor may not support the highest resolution or frequency available on card. If so, use the highest resolution supported by the test monitor and then set the highest frequency supported by the test monitor).
Requirements to Pass: Picture should look stable on test monitor.
- Test composite video / s-video by configuring card to output video to the interface under test.
Requirements to Pass: Video should look as expected.

4.1.5 Hard Drive

Tests

- Execute a read test. Test should be executed a minimal of one time.
Requirements to Pass: Test should report no error
- Enable SMART and verify if hard drive is within S.M.A.R.T. tolerance
Requirements to Pass: All parameters within S.M.A.R.T. should be within tolerance specification

4.1.6 Optical Drive

Tests

- Perform a write test (a read test is perform on write validation) on a 700MB CD-RW. The test data should consist of multiple files of various sizes and should have a total size of approx. 700MB. Fastest write speed that the optical drive will support should be configured. A quick erase should be first done on the CD-RW. Validate the files written. Note the write and read throughput.
Requirements to Pass: Test should report no error. Compare throughputs from previous test results. Note any performance degradation and consider appropriate action.
- Perform a write test (a read test is perform on write validation) on a DVD5 RW (+ or -). The test data should consist of multiple files of various sizes and should have a total size of approx. 4.7 GB. Fastest write speed that the optical drive will support should be configured. A quick erase should be first done on the DVD5 RW. Validate the files written. Note the write and read throughput.
Requirements to Pass: Test should report no error. Compare throughputs from previous test results. Note any performance degradation and consider appropriate action.
- Perform a write test (a read test is perform on write validation) on a DVD9 disc. The test data should consist of multiple files of various sizes and should have a total size of approx. 8.54 GB. Fastest write speed that the optical drive will support should be configured. Validate the files written. Note the write and read throughput.

Requirements to Pass: Test should report no error. Compare throughputs from previous test results. Note any performance degradation and consider appropriate action.

- (For read-only CD optical drives) Perform a read test with an application that can read a 700MB CD full of files of various sizes. The application should be able to be able to list read errors. Record the read throughput.

Requirements to Pass: Test should report no error. Note any performance degradation and consider appropriate action.

- (For read-only DVD optical drives) Perform a read test with an application that can read a 4.7GB CD full of files of various sizes. The application should be able to be able to list read errors. Record the read throughput.

Requirements to Pass: Test should report no error. Note any performance degradation and consider appropriate action.

4.1.7 Card Media Readers

Tests

- Perform a write and read function with a data file (64MB) on each card slot with the appropriate media. Validate the file.

Requirements to Pass: File should be able transfer without error.

- Test any additional I/O (USB, Firewire, audio) using the corresponding I/O tests

4.1.8 Floppy Drive

Tests

- Perform a write and read test with an empty floppy disc with a data file (1MB). Validate the file.

Requirements to Pass: File should be able transfer without error.

4.1.9 Network Interface Card

Tests

- (Wired) Test the auto-sensing and clocking of the 10/100 and/or 1000 Mbps mode by connecting to the Ethernet port the highest rated Ethernet speed network.

Requirements to Pass: Verify that link light on network card is lit and the OS should report the connection at the correct Ethernet speed.

- (Wireless) Test the auto-sensing and clocking of the Wi-Fi interface by connecting to an 802.11a, 802.11b or 802.11g network.

Requirements to Pass: The OS should report the connection at the correct 802.11 network

4.1.10 Sound Card

Tests

- Test line in / line output via using a loop-back cable and an application that can play out and record simultaneously. Application should compare the capture audio file to the play out for distortion.
Requirements to Pass: Distortion should be minimal.
- Test the surround sound out audibly by playing a multichannel (i.e.5.1) audio file or using an audio application that supports multichannel audio output.
Requirements to Pass: No crackling or significant audio distortion should be heard.

4.1.11 Chassis

Tests

- Check power supply fan and chassis fan is not obstructed and significant airflow is being generated. Check to see if abnormal heat or scent is being produced by the power supply.
Requirements to Pass: Fans should not be producing any odd noise and airflow should be felt. No abnormal scents and heat should be detected.
- If supported on the motherboard, run an application that will display the voltage supply on the various power rails on your motherboard. Execute application(s) that require use of your optical drives, hard drives and CPU. Monitor the voltage supply readings.
Requirements to Pass: Voltage supply readings must not vary more than 5% from the +12 VDC and +5VDC and 4% from the +3.3 VDC.

4.1.12 Other Peripheral Cards

Tests

- USB 1.1 or 2.0 functionality tests. Test each USB port on the PC for power, USB 1.1 and 2.0 connectivity, transmission and error rate test. No test duration requirements.
Requirements to Pass: All ports must have power, be able to connect to the fastest USB standard and transmit without error at the listed standard.
- Firewire (802.11) 400 and 800 functionality tests. Test each Firewire port on the PC for power, firewire400 and 800 connectivity, transmission and error rate test. No test duration requirements.
Requirements to Pass: All ports must have power, be able to connect to the fastest firewire standard and transmit without error at the listed standard.

4.1.13 Monitor

All monitors should be allowed to warm up for at least ½ hour before and is completely degaussed before any test patterns are displayed. Ensure the monitor is not near any source of electronic magnetic interference.

- For all monitors, display the following solid colour test patterns (black, white, red, green, blue, yellow, cyan and magenta). For each colour pattern, look to see if the colours of the test pattern are uniform and that there are no dead or dark spots. For LCD monitors, look for constantly dark or lit pixels.
Requirements to Pass: No significant uniformity in the test pattern and no more than 2 bright or dark pixels or 4 malfunctioning sub-pixels should be seen on monitors with native resolutions 1024x768, 3 bright or dark pixels or 4 malfunctioning sub-pixels should be seen on monitors with native resolutions 1280x1024.
- Set the video card resolution and frequency to the highest setting supported for the monitor. Display a picture having complete range of colours and intensity. Look for any movement (i.e. jitter or shimmering) in the picture.
Requirements to Pass: No movement in the picture should be seen.
- For all monitors, display a convergence line test pattern (the pattern will have a black background and white crosshatch pattern lines with white straight lines that converge from each diagonal of the screen to the centre.). Look for colour fringing on the lines and the crosshatch grid pattern should look rectangular. If the grid pattern has a uniform concave or convex distortion, adjust the pincushion setting on the monitor until the lines are vertical.
- *Requirements to Pass:* No colour fringing should be observed on the line and the grid lines should be vertical and horizontal.

5.0 Reporting Procedure

5.1 Documents

Each PC or Apple workstation should have the following report associated with it:

Workstation Financial and Inventory (including RCC Asset #)

1. Associated Software Specific Inventory Report (when available)
2. Computer Acceptance Test Report (See Appendix B for Test Report Template)
3. Associated Software Specific Acceptance Test Software Reports (when available)
4. Maintenance Report (See Appendix B for Test Report Template)
5. Associated Software Specific Maintenance Test Software Reports (when available)

Each Monitor should have the following report associated with it:

1. Monitor Financial & Warranty Information
 - Manufacturer
 - Model #
 - RCC Asset #
 - Manufacturer Serial #
 - Associated Workstation that Monitor is attach to
 - Warranty Information
2. Monitor Acceptance Test Report (See Appendix B for Test Report Template)
3. Maintenance Report (See Appendix B for Test Report Template)

5.2 Storage

5.2.1 Responsibilities

Each departmental technology group (i.e. Media Systems and Computer Systems) will be responsible for submitting and updating the documents (inventory and test reports) for the workstations under their care.

The Computer Technology Group will be responsible for the physical container (i.e. server) where the documents will be held. This includes any backup and security activity required for the long-term storage and care.

It is the responsibility for each unit (Media Systems and Computer Systems) to run these tests as follows;

1. Upon receipt of all computer technology to verify that the technology that was ordered is contained in the unit and to verify that all components are in operational order.
2. On all lab computers at least twice a year. These tests are normally run in advance of the fall semester and during the Christmas break.

5.2.2 Storage Location

Documents will be stored in electronic format at the following location:

Server: RCC/Luna

5.2.3 Directory Hierarchy

The directory hierarchy on the server where the documents will be stored under will be as following:

Level 1: “Media” and “Computer”

Computers under the responsibility of the Media Systems Technology Group will be stored under the “Media” hierarchy. Computers under the responsibility of the Computer Technology Group will be stored under the “Computer” hierarchy.

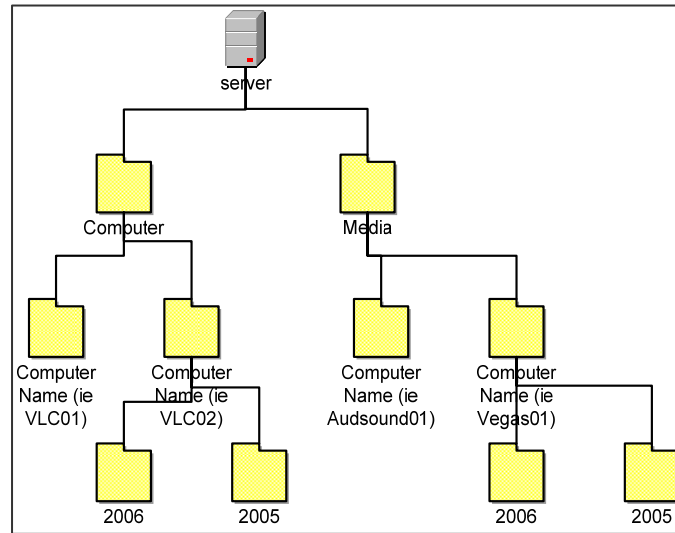
Level 2: Name of workstation.

Directories under this hierarchy level will be named to match the network name of the workstation (i.e. VLC01, Vegas01, Audsound01). Within this directory, workstation financial and inventory records will be held. Note: the folder name reflects the current name of the workstation that the documents are associated with. If the workstation name changes, the folder name must change to reflect the new name. Documents names stored under the new folder name does not have to change.

Level 3: Year of Test

Directories under this hierarchy level will be named to match the year in which the inventory or test was completed (i.e. 2006, 2005, 2004). Within this directory, workstation Acceptance test report, Maintenance reports and any associated test software reports will be stored.

5.2.4



5.2.5 File Naming Convention

Electronic Documents must have the following file naming convention:

“aaaa-bbb-cccc.xxx”

where as:

aaaa is the network name of the workstation that the corresponding document is associated with (i.e. VLC04)

bbb describes what period the inventory or test report was done. Periods are will be divided into two terms: S for spring/summer (Apr-Sept) and W for fall/winter (Oct-Mar). Following the period description, the year will be listed (in two digit format, ie. 05, 06). Examples: S05 means the report was written for the Spring/Summer period of 2005.

cccc describes the document using the following rules:

- “accp” refers to acceptance report
- “maint” refers to maintenance report
- “invent” refers to inventory report
- For Software specific report, use the name of the software. For example, if the document was created by Passmark BurnInTest, the suffix should be “BurnInTest”.

xxx is the standard windows file type prefix

Examples of files using the above listed convention:

“VLC04-S06-iPerf.txt” refers to an iPerf report on computer VLC04 created for spring/summer period in 2006.

“Audsound01-S05-accp.txt” refers to an Acceptance report on Audsound05 created for the spring/summer period of 2005.

Appendix A: Recommended Test Hardware and Software

The following list suggested hardware and software that can be used to perform the listed test found in the RCC Computer Acceptance and Maintenance Procedures.

Hardware

- USB 1.1 and 2.0 Loop-thru or storage device
- Firewire 400 or 800 loop-thru device or storage drive
- Serial and parallel loop-thru device
- High resolution and frequency monitor with VGA, DVI-I, s-video and composite input
- 10/100/1000 Ethernet switch, CAT6 cabling, and a workstation acting as a server
- CD+/-RW media, DVD+/-RW media and DVD + R or DVD – R DL media
- Mini stereo loop-thru cable
- Compact flash I/II, memory stick standard/pro/Duo/Pro-Duo/Magic Gate/ Pro Magic Gate, Secure Digital card, MultiMedia Card I/II, reduce size MultiMedia card, SmartMedia, Mini Secure Digital, xD Picture card, microSD

Software

- PC Wizard 2006 (for inventory) - free
- Memtest86+ (for memory testing) - free
- MicroProbe 2005 (for motherboard, hard drive and memory) - purchased
- Speed Fan (for voltage, temperature, fan and SMART monitoring) - free
- Nero CD-DVD Speed (for DVD+/-R testing) - free
- CheckeMon (for test patterns during monitor testing) – free
- IPerf (for network test)
- Passmark BurnIn Test (for CPU, hard drive, video card, USB, serial, audio, firewire, network, optical drive, floppy) - need to purchase

PC Wizard 2006 is a freeware application that can detect and report on a very comprehensive list of PC components. It runs under Windows XP and can be launch from removable storage or install directly on a PC. The software is updated often and can be found at <http://www.cpubid.com/pcwizard.php>

Memtest86+ is a free application released under the terms of the Gnu Public License. It provides various memory testing algorithms and is a standalone program requiring no OS (bootable images for removable storage can be downloaded). Memtest86+ can be found at: <http://www.memtest86.com/>

MicroProbe 2005 provides a large number of diagnostic tools to test various components on a PC. The most useful tests are the hard drive, memory and motherboard testing. Microprobe can be launch from CD or from floppy. Microprobe 2005 is a standalone application with its own bootable OS that can be launch from CD or floppy disc. Results can be printed via a serial printer or save to a floppy disc (outputting to a USB memory stick occasionally works). Contact the Computer Technology group at RCC for information about the software.

Speed Fan is a free application that monitors voltages, fan speed and temperature in computers that has a hardware-monitoring chip connected to the System Management Bus (SMBus). Speed Fan also can access S.M.A.R.T. info on hard drives. Speed Fan works with any windows OS and is available for free at:
<http://www.almico.com/speedfan.php>.

Nero CD-DVD Speed is a benchmarking tool used to test the performance of CD-ROM drives, DVD-ROM drives and recorders. CD-DVD Speed can create a test CD/DVD in order to evaluate write performance, scan the disc to determine if any writing issues are detected and read data CD/DVD or perform DAE to evaluate the read performance on the optical drive. Nero CD-DVD Speed can be used in Windows 95/98/ME/NT/2000/XP and is available for free at <http://www.cdspeed2000.com/>.

CheckeMon is a free application that provides a number of test patterns for CRT and LCD monitors. Brief explanations on what to look for are provided with each test pattern. CheckeMon can be used in Windows 95/98/ME/NT/2000/XP and is available for free at <http://www.ykwong.com/checkemon.html>.

Iperf is a free application tool that is design to measure the performance of a network. Iperf can be used to measure maximum TCP bandwidth and UDP delay jitter and packet loss. Iperf has a number of distributions for various OS including MS Windows and OS X. Iperf can be obtain at: <http://dast.nlanr.net/Projects/Iperf/>

Passmark BurnInTest is an application tool that can be used to test most of the major sub-components simultaneously thus stressing the system in order to test for stability and reliability. BurnInTest does a very good job at testing the CPU, Hard Drives, Video Cards, CD and DVD readers and CD writers, stereo audio cards, firewire (via attach external firewire hard drives), serial and parallel ports and USB ports. Passmark BurnInTest is available for 32bit Windows 98, ME, 2000, XP, 2003 and 64bit Windows XP and 2003 and Linux.

Appendix B: Sample Test Report

Computer Acceptance Report

Workstation Name:
 RCC Asset #:
 Test Date:
 Tester:

	Test Procedure	Pass	Test Duration	S/W Tools	Notes and Record
CPU	3.1.1				Processor Speed:
Motherboard	3.1.2				
- Controller					
- Keyboard					
- Mouse					
- USB					
- Firewire					
- Audio					See Sound Card Results
- Network					See Network Card Results
- Cooling Fans					NB Fan: CPU Fan:
Video Card					
- 2D					
- 3D					
- Video					
- VGA DB25					
- DVI					
- baseband video I/O					
Memory					Bandwidth:
Hard Drive (Primary)					
- Butterfly Seek Test					
- Write Test					
- SMART					
Hard Drive (Secondary)					
- Butterfly Seek Test					
- Write Test					
- SMART					
Optical Drive #1					
- Write / Read Test DVD9					Max Write Speed: Max Read Speed:
- Write / Read Test DVD5					Max Write Speed: Max Read Speed:
- Write / Read Test CD					Max Write Speed: Max Read Speed:
Optical Drive #2					
- Write / Read Test DVD9					Max Write Speed: Max Read Speed:
- Write / Read Test DVD5					Max Write Speed: Max Read Speed:
- Write / Read Test CD					Max Write Speed: Max Read Speed:
Floppy Drive					
Chassis					
- Power Supply Fan					Fan Speed:
- Power Supply Voltage					+12VDC Reading: +5VDC Reading: +3.3VDC Reading:
Network Interface Card					Highest Network Speed tested:
Sound Card					
- line in / out					
- centre / s. left / s. right/ bass					
Peripheral Cards (when Applicable)					
- Firewire Card					
- USB Card					
- DSP Card					

Monitor Acceptance Report

Manufacturer
 Model #
 RCC Asset #:
 Serial #
 Workstation attached to:
 Test Date:
 Tester:

	Pass	S/W Tools	Notes and Record
Solid Colour Test			
Convergence Test			
Max Resolution / Frequency Test			
VGA Input			
DVI Input (if applicable)			
baseband video input (if applicable)			
USB Hub test (if applicable)			
Speaker test (if applicable)			

Computer Maintenance Report

Workstation Name:
 RCC Asset #:
 Test Date:
 Tester:

	Test Procedure	Pass	S/W Tools	Notes and Record
CPU	3.1.1			Processor Speed:
Motherboard	3.1.2			See Sound Card Results See Network Card Results NB Fan: CPU Fan:
- Controller - Keyboard - Mouse - USB - Firewire - Audio - Network - Cooling Fans				
Video Card				Bandwidth:
- 2D - 3D - Video				
Memory				
Hard Drive (Primary)				
- Read Test - SMART				
Hard Drive (Secondary)				
- Read Test - SMART				
Optical Drive #1				Max Write Speed: Max Read Speed: Max Write Speed: Max Read Speed: Max Write Speed: Max Read Speed:
- Write / Read Test DVD9 - Write / Read Test DVD5 - Write / Read Test CD				
Optical Drive #2				
- Write / Read Test DVD9 - Write / Read Test DVD5 - Write / Read Test CD				Max Write Speed: Max Read Speed: Max Write Speed: Max Read Speed: Max Write Speed: Max Read Speed:
Floppy Drive				
Chassis				Fan Speed: +12VDC Reading: +5VDC Reading: +3.3VDC Reading:
- Power Supply Fan - Power Supply Voltage				
Network Interface Card				Highest Network Speed tested:
Sound Card				
- line in / out				
Peripheral Cards (when Applicable)				
- Firewire Card - USB Card - DSP Card				

Monitor Acceptance Report

Manufacturer
Model #
RCC Asset #:
Serial #
Workstation attached to:
Test Date:
Tester:

	Pass	S/W Tools	Notes and Record
Solid Colour Test			
Convergence Test			
Max Resolution / Frequency Test			