# INSTRUMENT MANUAL

SECTOR® Imager
Models 2400 & 6000

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# Table of Contents

# List of Figures

# List of Tables

**Meso Scale Discovery**

1

# Introduction

# 1  Introduction

MESO SCALE DISCOVERY® (MSD) develops, manufactures, and markets biological assays that provide cost-effective and valuable information to scientists in drug discovery, therapeutic screening, and life science research. MSD's product portfolio is based on MULTI-ARRAY® technology, a proprietary combination of patterned arrays and electrochemiluminescence detection that results in exceptional sensitivity, speed, dynamic range, and convenience.

MSD develops, manufactures, and markets detection instrument systems as well as a line of assay kits for use with these instruments, a proprietary line of reagents, and custom microplate printing and assay development services. MSD MULTI-ARRAY microplates are available in 96-, 384-, and 1536-well formats with standard or high-binding surfaces. MSD plates may be purchased uncoated or coated with proteins such as streptavidin or avidin, with anti-species antibodies such as goat anti-mouse or goat anti-rabbit, or with antibodies against specific analytes. Custom coatings and surface treatments are available.

MSD MULTI-ARRAY plates are available as single spot (single assay) plates and as MULTI-SPOT® plates with patterned spot arrays in each well. MULTI-SPOT plates measure multiple analytes simultaneously in a single well, increasing throughput and enabling novel assay panels.

For more details and information about applications, please visit the MSD website at www.mesoscale.com.

## 1.1   Intended Audience

This manual is for all users of the SECTOR Imagers. Users should understand general computer and Microsoft® Windows terminology, and be familiar with standard laboratory practices. The intended users of the SECTOR Imagers are those conducting research in the life sciences.

The SECTOR Imager 2400/2400A and SECTOR Imager 6000 share many features. Throughout this manual, the reader should assume that a feature is common to all instruments unless otherwise noted. This manual describes how to operate SECTOR Imagers and acquire data. The analysis of this data is treated in a separate manual: DISCOVERY WORKBENCH® User Guide.

## 1.2   How to Use This Manual

This publication is intended as reference and instruction for users of MSD SECTOR Imager 6000 (models 1200 and 1201) and SECTOR Imager 2400/2400A (models 1250/1251). These instruments are designed to read MSD MULTI-ARRAY and MULTI-SPOT plates.

This manual is divided into chapters containing main topics and subsections. Use the hyperlinked Table of Contents to find topics of interest quickly. The List of Figures and List of Tables hyperlink to the images and tables that enhance understanding of written information in this manual. The Appendix contains supplemental information on troubleshooting, instrument specifications, safety symbols, regulatory information, and labels.

The term SECTOR Imager will be used to describe the SECTOR Imager 2400/2400A and the SECTOR Imager 6000 when the feature being described is substantially the same. Differences between SECTOR Imagers will be described explicitly where appropriate.

**Tips**

Symbol  ⤷

Tips provide extra information or details that help users perform functions more efficiently.

**Notes**

Notes provide supplemental information on the proper use of the SECTOR Imager and its software.

**Warnings and Caution Symbols**

**WARNING**

General warnings advise operators of potential hazards and highlight the procedures or information necessary to avoid personal injury during use of the SECTOR Imager.

| Symbol | Explanation |
|--------|-------------|
| ⚠ | Risk exists for a mechanical, chemical, or safety hazard |
| ⚡ | Risk exists for an electrical hazard |

**CAUTION**

A caution note highlights procedures or information necessary to avoid damage to equipment, corruption of software, loss of data, or invalid test results.

⚠ **CAUTION:** Carefully read and understand all information in this document. Failure to read, understand, and follow the instructions in this publication may result in damage to the product, injury to operating personnel or poor instrument performance

# 1.3   Formatting Information

This guide uses the following formatting conventions:

➢ Internal hyperlinks are formatted bold/gray. Click to jump instantly to the referenced section or figure.

➢ Clickstreams are indicated with arrows and always start with a top-level menu item: Select Tools ➔ Plate Data History.

➢ Information to be entered by the user is shown in italics: Enter *5*.

➢ Information that the user chooses based on what is displayed is bracketed: Double-click <experiment name>

➢ When referring to a term as it appears in the software, we capitalize it exactly as it is capitalized on-screen: Select Read from Bar Code from the Plate Type menu.

# 2

# Important Information

# 2 Important Information

## 2.1 General Operation

The SECTOR Imagers are designed to run 24 hours a day. Once initialized, the SECTOR Imager enters standby mode when plates are not running. Standby maintains the CCD detector temperature. The SECTOR Imager requires no additional initialization when left in standby mode.

⚠️ WARNING: The instrument can only be operated with all covers in place. If the unit is operated in any manner not specified in this manual, the protection provided by the equipment may be impaired.

⚠️ CAUTION: Installation of additional software on the computer system used to operate the SECTOR Imager is not supported. Specifically, updating aspects of the operating system or installing any software that changes parameters of the computer environment could interfere with proper operation of the instrument software.

⚠️ CAUTION: Running screen-savers, automated maintenance software, network-security software, and other possible software on the SECTOR Imager computer system could cause conflicts with the operation of the instrument software.

⚠️ CAUTION: The instrument generates files when running. Virus scanning on the instrument computer can interfere with instrument operation. It is suggested that any virus checking software run on the instrument be configured to minimize the scanning of newly generated files while the instrument is operating.

⚠️ CAUTION: Use of other applications while plates are being read may interfere with system performance. Use of operating system power features that disable USB communication, such as Hibernate, will cause the system to stop responding and requires a power off/on cycle of the instrument and PC to restore function.

⚠️ CAUTION: Additional USB devices may *not* be connected to the SECTOR Imager computer system.

⚠️ CAUTION: Changes to the computer clock can cause a system error if the changes are made during a plate read. A system error may also occur if a plate is being read when the time is automatically changed from standard to daylight savings time or vice versa.

NOTE: The SECTOR Imager should be operated in a dust-free environment with an ambient temperature between 20–26°C, and humidity levels between 10–80% (non-condensing). Environments or locations with high levels of vibration should be avoided. See Section 8.2.3 Environmental Specifications for complete environmental specifications.

⚠️ CAUTION: Keep the SECTOR Imager away from direct sources of heat or cold and direct sunlight. Ensure that the rear cooling vents and the CCD camera tower cooling vents on the SECTOR Imager are *not* blocked.

⚠️ CAUTION: Do not place any objects, materials, or liquid containers on top of the SECTOR Imager.

⚠️ CAUTION: Falling objects or splashing liquids, including chemically reactive or infectious reagents, can cause damage to the instrumentation or cause injuries. Avoid handling or storing infectious or radioactive materials near the SECTOR Imager.

## 2.2 Hazards

This section contains notices and warnings that should be read carefully. Before working with the SECTOR Imager, become familiar with all safety precautions and regulations concerning the handling of materials and the instrument's electrical and mechanical components.

Operating this device in a manner not specified by MESO SCALE DISCOVERY may impair the electrical and thermal protection provided by the equipment.

As with most laboratory instruments, the SECTOR Imager presents certain hazards for users. We have identified five key types of hazards:

- Electrical

- Chemical and biological

- Visual

- Mechanical

- ESD sensitivity

Figure 2:1 SECTOR Imager electrical hazards. SECTOR Imager 6000 shown.



⚠ CAUTION:
Do not remove covers. General risk for electrical, visual, and ESD hazards.

⚠ WARNING:
Depending on use. Areas of Chemical or Biohazard Risk.

⚠ WARNING:
Moving components during processing. Areas of Pinch Point Hazard.
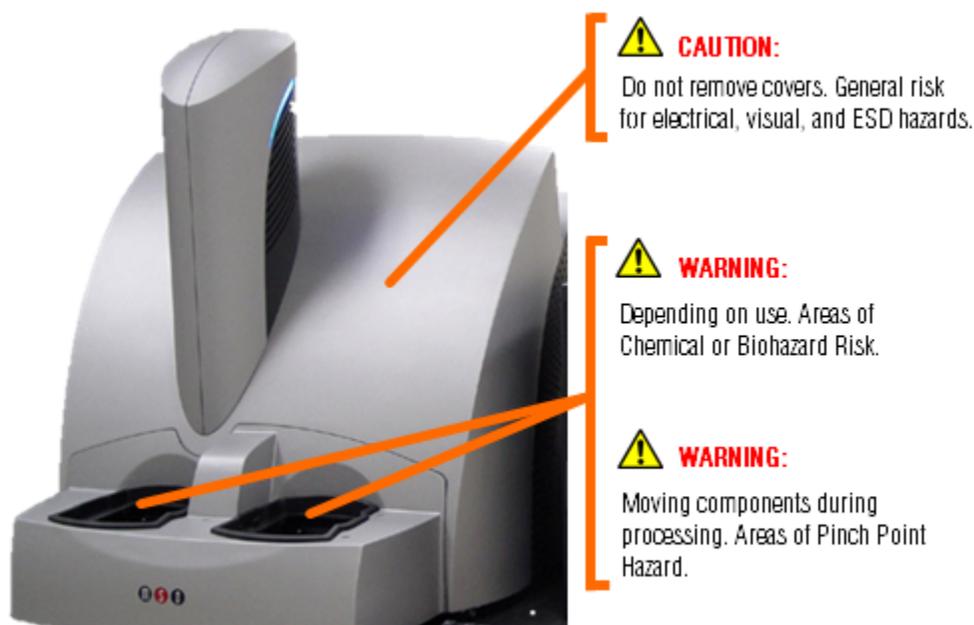
## 2.2.1  Electrical

Do not attempt to open the instrument cover and work with any electronic elements. An electrical shock may occur. The SECTOR Imager was designed and tested in compliance with appropriate electrical safety standards.

⚠ **WARNING:** The SECTOR Imager contains AC voltages. DO NOT ATTEMPT TO SERVICE OR REPAIR THE SECTOR IMAGER. Please contact MSD Instrument Service for all service and repair, including electrical problems.

When the power switch is in the off position, all internal electrical circuits are disconnected from both the live and neutral lines of the electrical power source.

$I_{On} \; O_{Off}$

⚠ **WARNING:** For best performance, remove any sample or reagent spillage from the instrument. For safety, the operator should power down the instrument and disconnect the SECTOR Imager power cable from the wall socket prior to cleaning near moving parts. For significant spills or liquid intrusion into the instrument enclosure (e.g. resulting from a fire protection water sprinkler), contact MSD Instrument Service.

The SECTOR Imager should not be operated in hazardous atmospheres, as defined by the National Fire Protection Association, the National Electric Code, and International Standards.

Although the SECTOR Imager is shielded and grounded, laboratory personnel should never remove any instrument covers that would expose electrical circuits. Only authorized MSD Service personnel should perform repairs to the interior of the SECTOR Imager.

> NOTE: We *strongly* recommend that users of laboratory instruments (such as the SECTOR Imager) follow the Clinical and Laboratory Standards Institute (CLSI) document entitled GP17-A2, Clinical Laboratory Safety; Approved Guideline, Section 19, Instrument Testing.

> ⚠ CAUTION: Grounding and polarity checks should be conducted on all electrical outlets annually, and the results of these tests should be documented. New or incoming equipment should also undergo electrical safety checks before use. Power cords should be inspected annually for integrity.

> ⚠ CAUTION: Do not use a two-prong plug or extension cord to connect primary power to the SECTOR Imager. Use of a two-prong adaptor disconnects utility ground, creating a shock hazard. Always connect the system power cord directly to a three-prong receptacle with a functional ground.

## 2.2.2   Chemical and Biological

Users are responsible for taking all necessary precautions against hazards associated with the use of laboratory chemicals. Running assays on the SECTOR Imager may involve the use of potent chemicals—such as bases and solvents, cleaning and disinfection agents, and assay reagents. Such chemicals should be independently evaluated for chemical or biological hazards.

Laboratory regulations and good laboratory practices concerning the use of such chemicals should be followed at all times. Use personal protective equipment recommended by your facility when handling any of these reagents.

Product labels, package inserts and product information sheets with specific usage recommendations are provided for all plates and reagents used with the SECTOR Imager. Contact MSD Scientific and Technical Support to obtain material safety data sheets (MSDS) for MSD plates and reagents.

Samples, user reagents, or controls used in assays may be infectious or biohazardous. By working with these materials, users may be exposed to biological hazards. Laboratory regulations concerning the handling of potentially infectious material should be followed at all times.

Users should avoid breathing reagent fumes or aerosols. Gloves and goggles should be worn when disposing of used plates. If skin comes in contact with reagents, rinse the exposed area with water immediately and follow appropriate safety protocols as determined by your facility. Dispose of used plates according to federal, state, and local regulations.

> ⚠ WARNING: Wear gloves. Avoid skin contact and inhalation when handling plates that contain or have been exposed to hazardous reagents.

> ⚠ WARNING: The stacker input and output locations are considered susceptible to contamination during normal use. Use of personal protective equipment and good laboratory practices are strongly suggested when working in these areas.

## 2.2.3   Visual

Older versions of the SECTOR Imager 6000 with last 3-digits of serial #'s below 198, and the SECTOR Imager 2400 with last 3-digits of serial #'s below 109 have a scanning bar code reader with a class 2 Laser. Although the laser beam is not visible during normal operation, personnel may be exposed if operating the SECTOR Imager with the light-tight door open or with the covers removed. Laser output power is 1.0 mW maximum. Newer SECTOR Imagers use light emitting diodes (LEDs) to read bar codes.

> ⚠ WARNING: DO NOT STARE INTO THE BEAM. The laser is only directly viewable and accessible by qualified service personnel.

⚠️ **WARNING:** Use of controls, or adjustment or performance of procedures other than those specified herein, may result in hazardous radiation exposure.

## 2.2.4   Mechanical

⚠️ **WARNING:** The SECTOR Imager 6000 weighs 150 lbs (68 kg) and the SECTOR Imager 2400/2400A weighs 140 lbs (64 kg). Be careful to use proper technique when lifting it to minimize the risk of injury. Two or more people should lift from beneath the instrument. Please contact MSD Instrument Service before attempting to move the instrument.

⚠️ **WARNING:** The SECTOR Imager presents potential mechanical hazards. To avoid injury, do not touch any part of the instrument while it is in operation. Do not place fingers in stack tubes or the plate carrier when the instrument is in operation. Labels are affixed to the stack tube platforms indicating a pinch hazard.



⚠️ **CAUTION:** When using robotic plate loaders (robots), ensure that there is nothing present that will obstruct robot movement.

⚠️ **WARNING:** Moving parts of the SECTOR Imager can be damaged or become misaligned when exposed to strong mechanical force. As with any mechanical instrument, you should take certain precautions when operating the SECTOR Imager:

- Do not wear loose garments or jewelry that could catch in moving mechanisms.

- Operate the instrument with the cover intact.

- Keep hands away from pathways of moving parts during operation.

- Do not attempt mechanical repair.

- Do not bump into or lean on the SECTOR Imager, or place any objects on top of it.

- Never operate the instrument unless both stacker ports contain a single plate adaptor (Figure 3:5), a stack tube (Figure 3:4), or the stacker cover plate (Figure 3:5).

## 2.2.5   ESD Sensitivity

The SECTOR Imager has been tested for electrostatic discharge (ESD) sensitivity and complies with the applicable international standards. Standard installation precautions should be taken when stationing the instrument for regular use. Like many instruments of its kind, the SECTOR Imager is sensitive to static discharge in excess of 4.0 kV. In typical laboratory environments, electrostatic discharge should not be a problem.

## 2.2.6   Electromagnetic Interference and Susceptibility

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. The equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference, in which case users will be required to correct the interference at their own expense.

Changes or modifications not expressly approved by MSD may void the warranty. The operator shall use any special accessories provided with the equipment such as the power supply or shielded cables that are necessary for compliance with FCC standards.

⚠️ **CAUTION:** SECTOR Imager 6000 and SECTOR Imager 2400/2400A instruments have been tested for operation in a controlled electromagnetic environment. Transmitters of RF energy such as mobile (cellular) telephones should not be used in close proximity.

⚠️ **CAUTION:** To avoid interference from voltage transients, the computer and instrument should be powered by the same electrical circuit. This may be accomplished using an uninterruptible power supply (UPS), power strip of proper electrical rating, or by verifying the power wall outlets. If one of these is not possible, a ground strap should be used to connect the instrument chassis to the computer chassis. Please contact MSD Scientific and Technical Support if you have questions or need assistance.

## 2.3 Software Compatibility

The Microsoft Windows® Update service can affect the operation of the instrument software. When running, the update application can turn off the database services upon which the instrument relies, causing errors and stopping instrument operation. Updates should not be run during instrument use. Run manually or schedule Windows updates when you are sure that the instrument will not be in use.

Occasionally, Windows Update does not restart the database server after it runs. This will cause the instrument software to run incorrectly. Restarting the computer will restart the database service and restore the instrument to full operation.

The SECTOR Imager system has not been tested for compatibility with all programs. Installation of additional applications, such as anti-virus and security programs may interfere with function.

## 2.4 Decontamination Prior to Shipping or Servicing

The SECTOR Imager may have been used to analyze infectious materials or in an environment where infectious materials were handled. For the protection of future users and service personnel, please follow site safety procedures and the directions of the site safety officer to disinfect the SECTOR Imager before shipping or service. Please contact MSD Instrument Service for details.

⚠️ **WARNING:** Follow site safety procedures and the directions of the site safety officer to determine decontamination requirements for the SECTOR Imager before shipping or service.

**Meso Scale Discovery**

3

# System Description

# 3   System Description

## 3.1   Intended Use

The SECTOR Imager 6000 and SECTOR Imager 2400/2400A are for research use only. The instruments are not for use in diagnostic procedures.

## 3.2   Specifications Overview

The SECTOR Imager offers high sensitivity and six logs of dynamic range. The SECTOR Imager 6000 reads plates at a rate of approximately 70 seconds per plate. The SECTOR Imager 2400/2400A reads plates at a rate of approximately 3 ½ minutes per plate. Using MSD DISCOVERY WORKBENCH software, all models provide the capability to interact with a third party external robotic controller.

## 3.3   Plate Compatibility

The SECTOR Imager 2400A is compatible with:

- 96-well MULTI-ARRAY plates

- 96-well, 4-, 7-, and 10-spot MULTI-SPOT plates

The SECTOR Imager 2400 is compatible with:

- 96- and 384-well MULTI-ARRAY plates

- 96-well, 4-, 7-, and 10-spot MULTI-SPOT plates

The SECTOR Imager 6000 is compatible with:

- 96- and 384-well MULTI-ARRAY plates

- 96-well, 4-, 7-, and 10-spot MULTI-SPOT plates

- 384-well, 4-spot MULTI-SPOT plates

- 1536-well MULTI-ARRAY plates

MULTI-ARRAY and MULTI-SPOT plates are designed to be read only once and may not be reused.

SECTOR Imagers cannot read plates designed for the SECTOR PR® instruments.

## 3.4    System Components

A standard SECTOR Imager system consists of the following (Figure 3:1):

- SECTOR Imager instrument

- Microsoft Windows-compatible workstation

- MSD DISCOVERY WORKBENCH software

- SECTOR Imager demonstration plate

- Cables (SECTOR Imager 6000 [model 1200] and SECTOR Imager 2400/2400A [models 1250/1251]): power, RS-232, USB, and camera serial cable

- Cables (SECTOR Imager 6000 [model 1201]): power and USB

- Uninterruptible power supply (UPS)

- SECTOR Imager 2400 and 6000 Instrument Manual

- DISCOVERY WORKBENCH User Guide

Figure 3:1 SECTOR Imager system. SECTOR Imager 6000 shown.
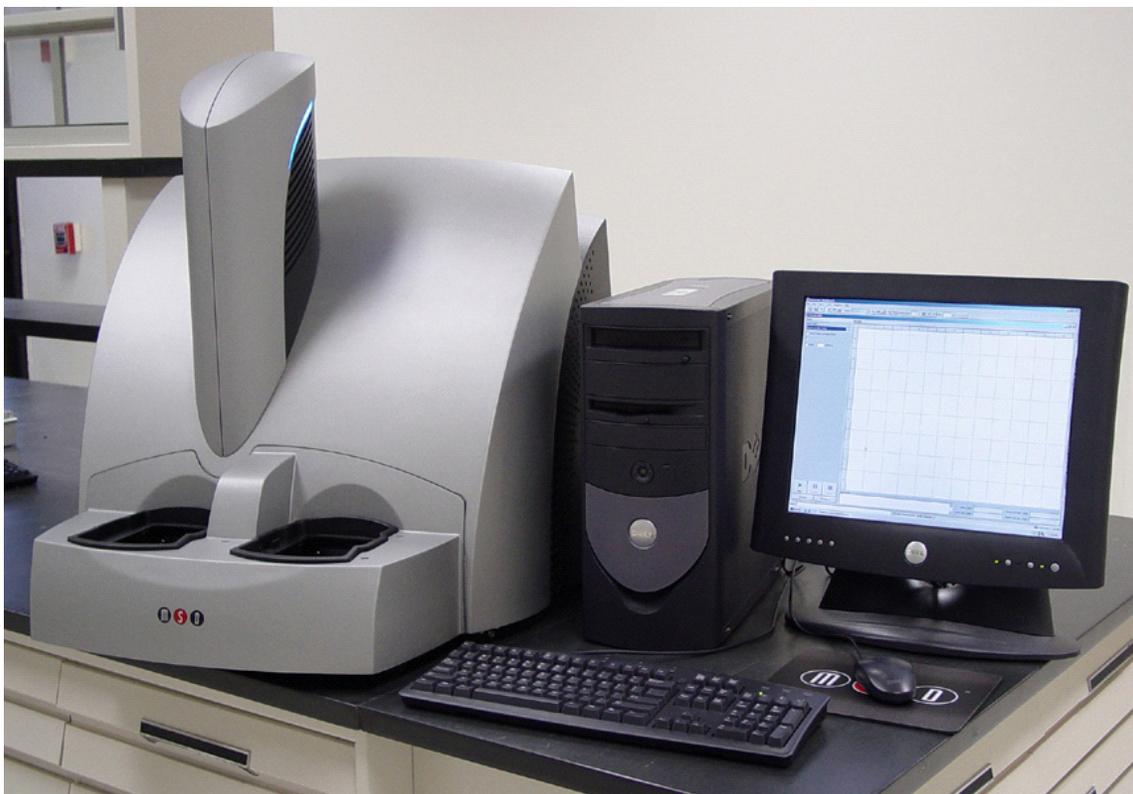


## 3.5    The SECTOR Imager

The main components of the SECTOR Imager include (Figure 3:2):

- CCD camera and telecentric lens

- Motion control system

- Plate barcode readers (short and long side)

- Integrated MULTI-ARRAY plate input/output stack

- Stack tubes (2, standard capacity)

- Single plate adaptor (1, not shown)

- One stacker cover plate (1, not shown)

- Instrument status LEDs

- Power switch and I/O panel (not shown)

- Halt button

  NOTE: The stacker cover plate comes preinstalled on the SECTOR Imager 2400A. This model does **not** use (and does not include) stack tubes or the output stacker mechanism.

Additional stack tubes, single plate adaptors, and stacker cover plates may be purchased from MSD.

Figure 3:2 SECTOR 6000 Imager components
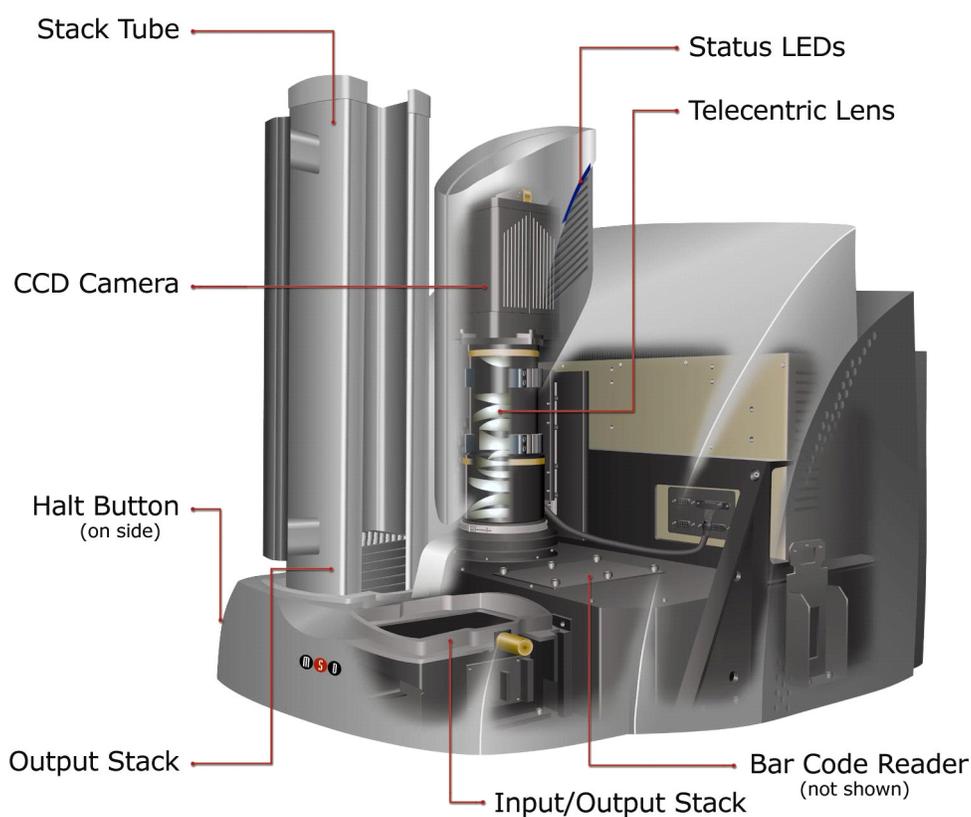


NOTE: The SECTOR Imager 2400/2400A employs a different CCD camera and a different custom lens optimized to read MULTI-ARRAY plates in 24 sectors (not shown).

### 3.5.1   CCD Camera and Telecentric Lens

Each SECTOR Imager uses a sensitive, high-resolution CCD camera and lens system to detect light emitted from MULTI-ARRAY plates. The SECTOR Imager 2400/2400A reads plates using 24 sectors or segments. The SECTOR Imager 6000 reads plates using 6 sectors or segments, yielding higher throughput.

Once the instrument is turned on and the software is started, it takes approximately 45 to 60 minutes for the CCD chip to reach and stabilize at its normal operating temperature of −35 ±1°C (SECTOR Imager 6000) or -25 ±1°C (SECTOR Imager 2400/2400A). The telecentric lens of both SECTOR Imagers provides high efficiency and uniform collection of light from MULTI-ARRAY plates.

### 3.5.2 Motion Control System

The SECTOR Imager uses a precision mechanism for transporting MULTI-ARRAY plates from the input stacker, into the CCD detector's viewing area, and back to either the input or output stacker, depending on selections in the DISCOVERY WORKBENCH Software. (See Section 6 Using the SECTOR Imager) for more information on reading a plate.)

### 3.5.3 Plate Barcode Readers

The SECTOR Imager's two barcode readers read the barcode(s) on the MULTI-ARRAY plates. The MULTI-ARRAY plates come with an MSD barcode label that uniquely identifies the plate and allows the SECTOR Imager to detect the type of plate being run.

If desired, the user may apply a custom barcode label either on the same side of the plate as the MSD barcode or on one of the short sides of the plate. The custom barcode label should be applied at the same height as the MSD barcode label. The custom barcode must be of one of the following formats: **Code 39** or **Code 128**.

To enable custom bar codes, when the SECTOR Imager reader window is open, go to Tools → Instrument Configuration. Select Enable Long-side Custom Bar Code Reader and/or Enable Short-side Custom Bar Code Reader.

Please contact MSD Scientific and Technical Support for additional information regarding the use of custom barcodes on MSD MULTI-ARRAY plates.

### 3.5.4 MULTI-ARRAY Plate Input/Output Stacker

SECTOR Imagers 6000 and 2400 include an integrated mechanism to manipulate multiple MULTI-ARRAY plates arranged vertically (referred to as the "stacker"). The stacker will automatically pull plates from the input (right) side and eject them into the output (left) side. The stacker may be used with two single plate adaptors or two stack tubes or one of each. Stacker cover plates or single plate adaptors containing an empty plate should be used over the stacker interface plates whenever the machine is not in use.

When running single plates, the input (right) stacker interface plate can act as both input and output ports. For safety, place a stacker cover plate over the left stacker interface plate when not in use.

⚠ WARNING: The stacker contains components that may move at any time. Users of the SECTOR Imager should never place their fingers into the stacker for any reason unless the instrument is powered off.

**Note:** The SECTOR Imager 2400A is not equipped with an output stacker mechanism and does not use stack tubes. All plates are returned to the input port after reading.

### 3.5.5 Stack Tubes

MSD offers standard-capacity (standard) and high capacity (extended) stack tubes (Table 3:1) for both the SECTOR Imager 6000 and SECTOR Imager 2400. When using stack tubes, ensure that the stack tube is fully seated on the stacker interface plate (Figure 3:3). The standard tubes are provided with the SECTOR Imager 6000 and SECTOR Imager 2400, and both standard and extended tubes are separately available for purchase (Figure 3:4).

Table 3:1 Lists the capacity of MSD stack tubes for each plate type.

Table 3:1 Stack tube plate capacities

| Stack Tube | Plate Type | Capacity |
|---|---|---|
| **Standard** (Standard Capacity) | 96-well MULTI-ARRAY | 20 plates |
| **Standard (**Standard Capacity) | 384-well MULTI-ARRAY | 30 plates |
| **Extended** (High Capacity) | 96-well MULTI-ARRAY | 50 plates |
| **Extended** (High Capacity) | 384-well MULTI-ARRAY | 75 plates |

Figure 3:3 Input (right) stacker interface plate
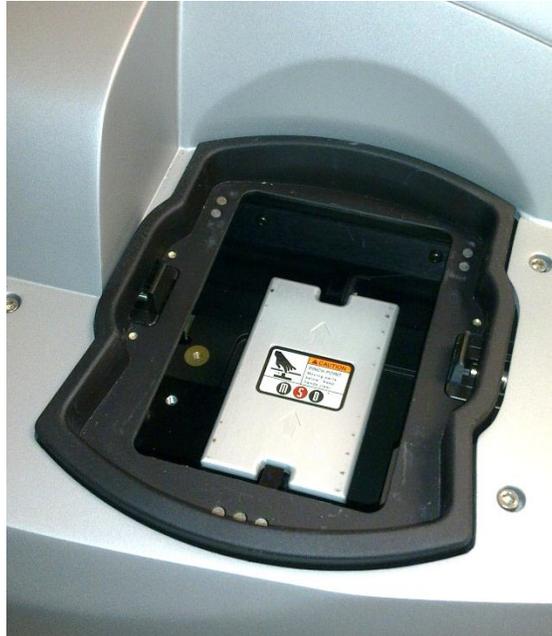


Figure 3:4 Fully loaded standard and high capacity stack tubes



### 3.5.6   Single Plate Adaptor

The SECTOR Imager reads single plates placed manually into the single plate adaptor. When inserting the single plate adaptor into the stacker, ensure that the single plate adaptor is fully seated on the stacker interface plate. Figure 3:5 (right side of image) shows a single plate properly loaded in the single plate adaptor. The single plate adaptor may also be used with laboratory robotics.

### 3.5.7  Stacker Cover Plate

The stacker cover plate (Figure 3:5 left side of image) is used to cover the output (left) stacker interface when the machine is set to return single plates to the input side. Both stacker interface plates should be covered when the machine is not in use.

The SECTOR Imager 2400A comes preconfigured to return plates to the input side. A stacker cover plate is preinstalled on the output port.

**Figure 3:5 SECTOR Imager plate in single plate adaptor**
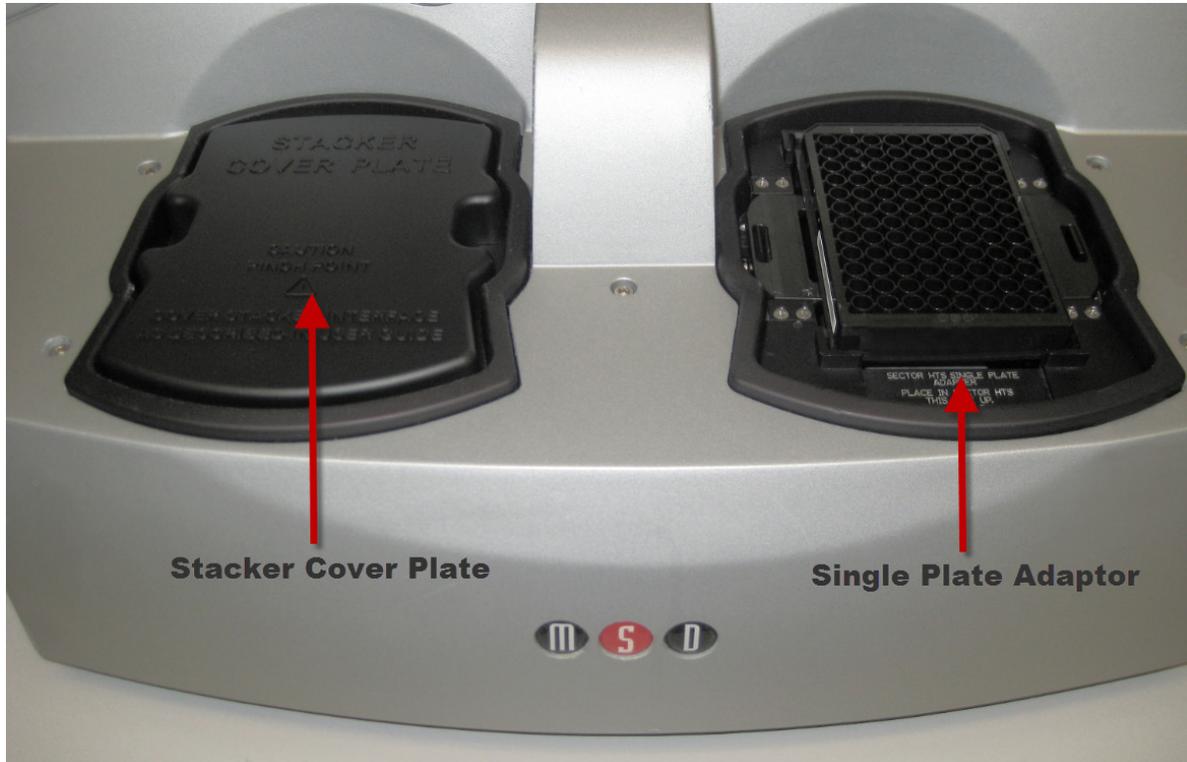


A stacker cover plate should always be in place when no stack tube or single plate adaptor is present.

### 3.5.8  Status LEDs

The status LEDs built into the camera tower indicate the current operational mode of the SECTOR Imager (Figure 3:6).

- **Steady blue:** Instrument is in standby mode
- **Blinking blue:** Instrument is currently reading a plate
- **Steady red:** Instrument is in fault mode or is waiting for the addition of plates

### 3.5.9   Power Switch and Input/Output (I/O) Panel

The I/O panel of the SECTOR Imager, located on the rear right side of the SECTOR Imager, includes the instrument's power switch, power entry module, and connectors for USB, RS-232, camera serial communications, and robotic halt activation cables (Figure 3:7).

The instrument can be powered-on and off via the power switch. Typically, the instrument should be left powered-on to maintain camera temperature.

> NOTE: Only use the communications cables supplied with the SECTOR Imager. Use of cables other than those supplied may degrade instrument performance.

A halt connector is present in order to add an external switch that will de-energize the motion control system. The SECTOR Imager connector receptacle is Hirose Electric Co Ltd HRS, Part #SR30-10R-4S. The mating connector is Hirose Part #SR30-10PE-4P, SR30-10PM-4P, or SR30-10PQ-4P.

Figure 3:7 Power switch and I/O panel. SECTOR Imager 6000 (model 1200) shown.
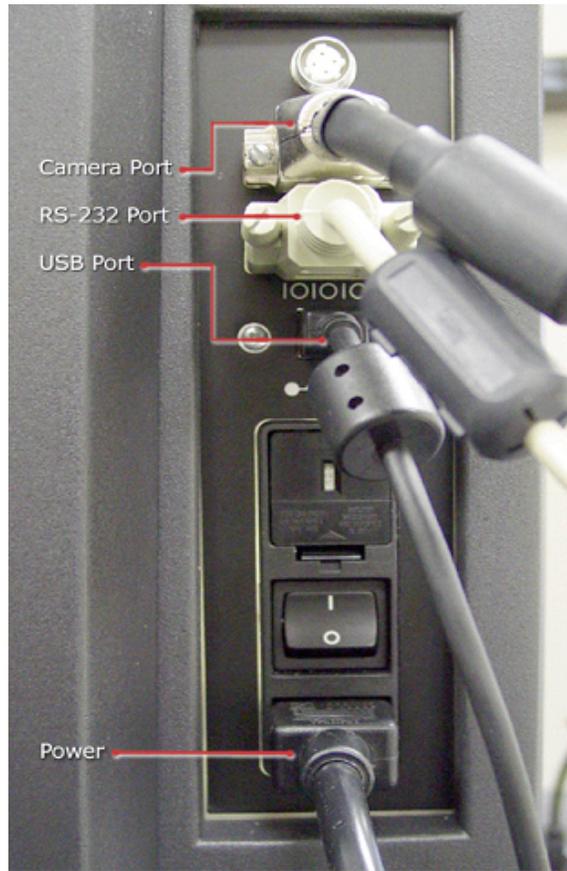


### 3.5.10 Halt Button

The halt button (Figure 3:8) is mounted on the front left side of the SECTOR Imager. It can be pressed to halt movement of the SECTOR Imager abruptly. This button immediately de-energizes the main motion control components in the instrument. However, the remaining electronic components of the instrument remain powered and still pose a shock hazard.

> NOTE: For SECTOR Imager 6000 model 1201, this switch is on/off. If it is pressed for any reason, all motion will halt. It **must** be pressed again before the motion system and software will function. For SECTOR Imager 6000 model 1200 and SECTOR Imager 2400/2400A, the halt switch is a momentary switch, so this not a concern.

> ⚠️The halt switch should never be obstructed or restricted from access.

The halt function can also be accessed through the rear I/O panel to enable external safety devices to halt the motion of the SECTOR Imager. Please contact MSD Scientific and Technical Support for more information on this feature.

Figure 3:8 SECTOR Imager halt button
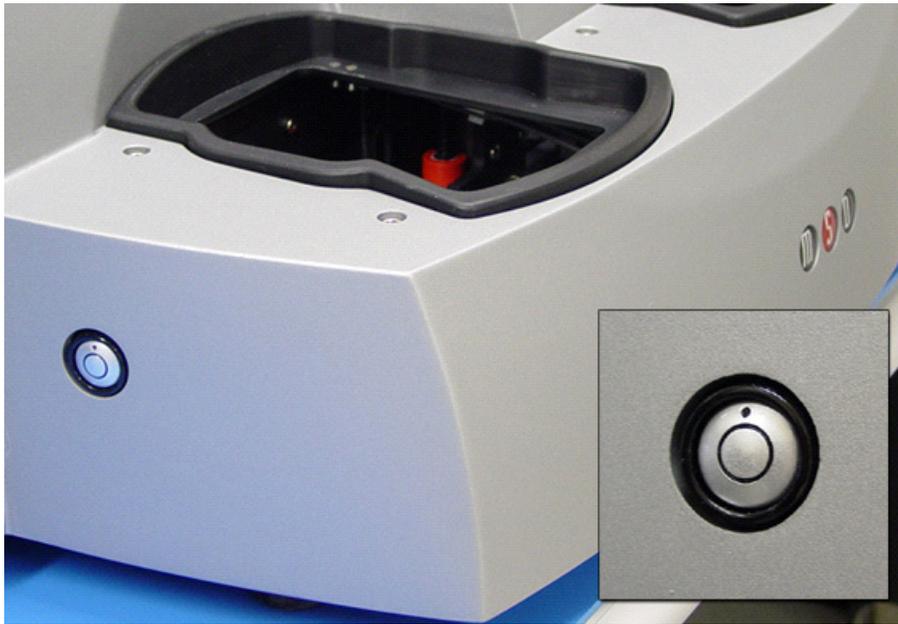


## 3.6    Microsoft Windows-Compatible Workstations

Computer workstations are configured by MSD for use with the SECTOR Imager and come preloaded with MSD DISCOVERY WORKBENCH application software (3.7 MSD DISCOVERY WORKBENCH Software). The workstation includes a personal computer, display, keyboard, and mouse. The instrument computer and its software are an integral part of the system and should only be modified by a MSD service engineer.

I/O connections on the associated computer workstation are shown in Figure 3:9.

Figure 3:9 Cable attachment locations for SECTOR Imager 2400/2400A
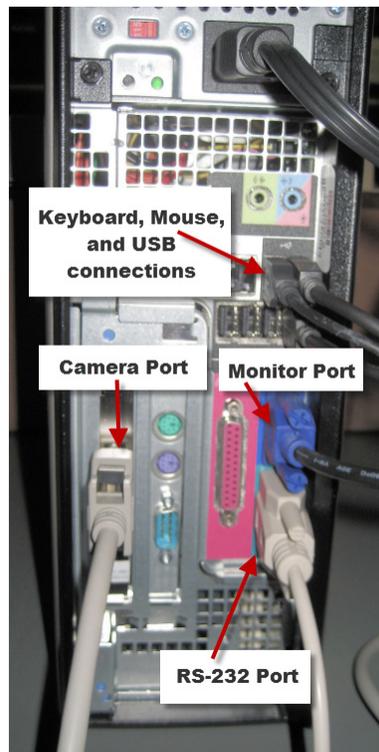
## 3.7    MSD DISCOVERY WORKBENCH Software

DISCOVERY WORKBENCH is a Windows application that supports the operation of SECTOR Imagers, stores both current and historical plate data, and analyzes and presents results. The application has several components: instrument modules, a secure database (the Plate Data History), kit layouts, data integrity features, and data analysis functions. Please refer to the DISCOVERY WORKBENCH User Guide for additional information.

## 3.8    Operational Modes

The SECTOR Imager can be configured as a stand-alone workstation or integrated into robotic systems using the single plate adaptor provided. The single plate adaptor replaces the input stack tube and can serve as the load/unload location when using a robot for loading plates or when loading a single plate manually.

SECTOR Imager 6000 and SECTOR Imager 2400 have four operational modes:

- **The two-stack, stand-alone workstation mode** uses input and output stack tubes for loading and unloading.

- **The one-position, single plate handling mode** uses the single plate adaptor in the input side for both loading and unloading single plates. The plate can be loaded either manually or by robotic plate handling equipment. In this mode, the stacker cover plate should be placed over the interface for safety.

- **The two-position, single plate handling mode** uses a single plate adaptor on the input side for loading, and a second single plate adaptor on the output side for unloading.

- **The single-plate loading and stack-unloading mode** uses the single plate adaptor on the input side for loading and a stack tube on the output side for unloading.

SECTOR Imager 2400A operates exclusively in the one-position, single plate handling mode.

See Section 6.3 Robotics Integration for general information on robotic operational modes.

## 3.9    Image Readout

The SECTOR Imager uses a CCD camera to obtain images of the plate during detection. One advantage of imaging detection is that the time required to read a plate is independent of the format of the plate (i.e., it is independent of the number of wells/plate or spots/well). SECTOR Imagers read plates in sectors to improve sensitivity and optical detection efficiency. The SECTOR Imager 6000 reads plates in 6 sectors at a rate of approximately 70 seconds per plate (Figure 3:10). The SECTOR Imager 2400/2400A reads plates in 24 sectors at a rate of approximately 3 ½ minutes per plate (Figure 3:11).

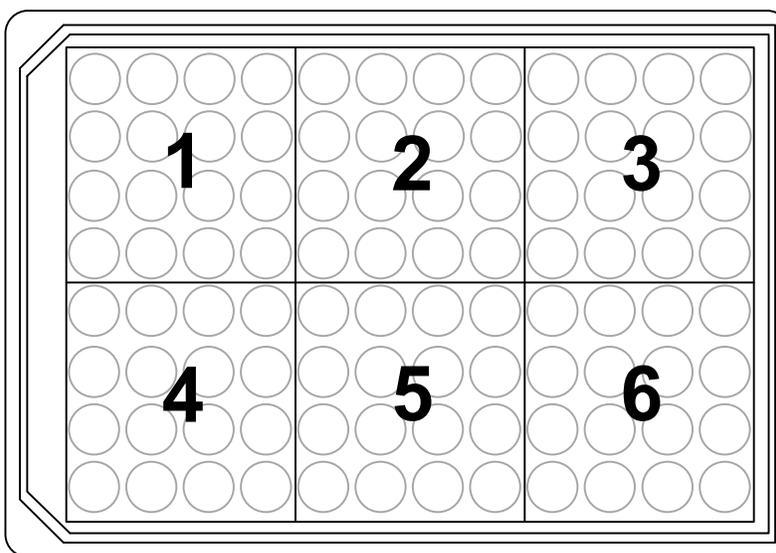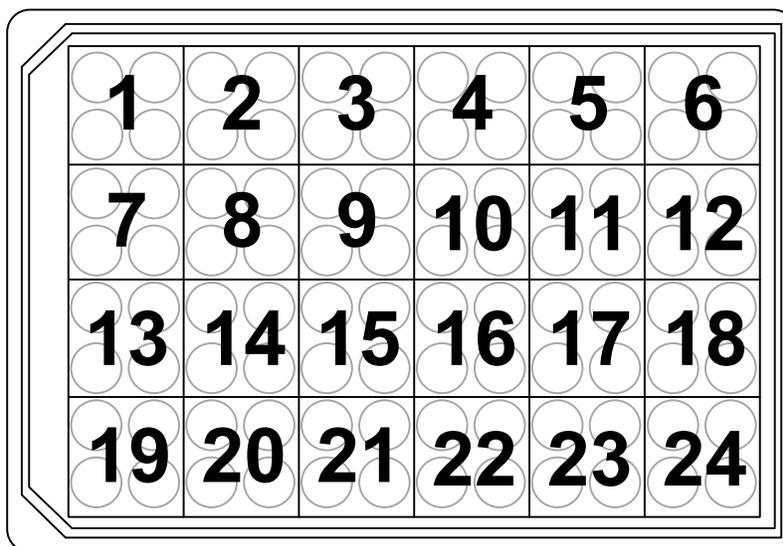### Figure 3:10 The SECTOR 6000 reads 96-well plates in six sectors

Figure 3:11 The SECTOR 2400/2400A reads 96-well plates in 24 sectors



## 3.10 SECTOR Imager Demonstration Test Plate

Each SECTOR Imager is shipped with one demonstration plate. This demonstration plate verifies operation of the system and can be used for operational qualification (OQ). It does not verify performance qualification (PQ) and is not to be used for calibration purposes. It should be used to verify the function of the SECTOR Imager. The demonstration plate consists of an electronic circuit board housed in a plastic carrier in the shape of a standard plate. The circuit board for the SECTOR Imager 6000 has six separate sectors, simulating the structure of MSD MULTI-ARRAY plates (Figure 3:12) as read by the SECTOR Imager 6000. The demonstration plate for the SECTOR Imager 2400/2400A (not shown) uses a different electrode configuration designed to match the SECTOR Imager 2400/2400A.

Figure 3:12 SECTOR Imager 6000 Demonstration Test Plate



For the SECTOR Imager 6000, sectors 3 and 4 of the demonstration plate have LEDs that test the CCD camera in the SECTOR Imager. The remaining four sectors of the plate contain known electronic components for testing the electrical functioning of the instrument across its range of operation. The demonstration plate can be used without any chemical reagents, either to check instrument function at the start of each day or as a tool for demonstrating the instrument and software to new users. The LEDs for the SECTOR Imager 2400/2400A demonstration plate are in sectors 5, 12, 14, and 19.

Store the demonstration plate in its custom case when not in use, and keep the demonstration plate clean and free of dust and debris.

To use, place the demonstration plate in the single plate adaptor with the chamfered corners of the plate facing into the instrument (Figure 3:13). This orientation ensures that the bar code reader can automatically read the bar code label. See Section 5 Quick Start for more details.

Figure 3:13 Loading a SECTOR Imager demonstration plate
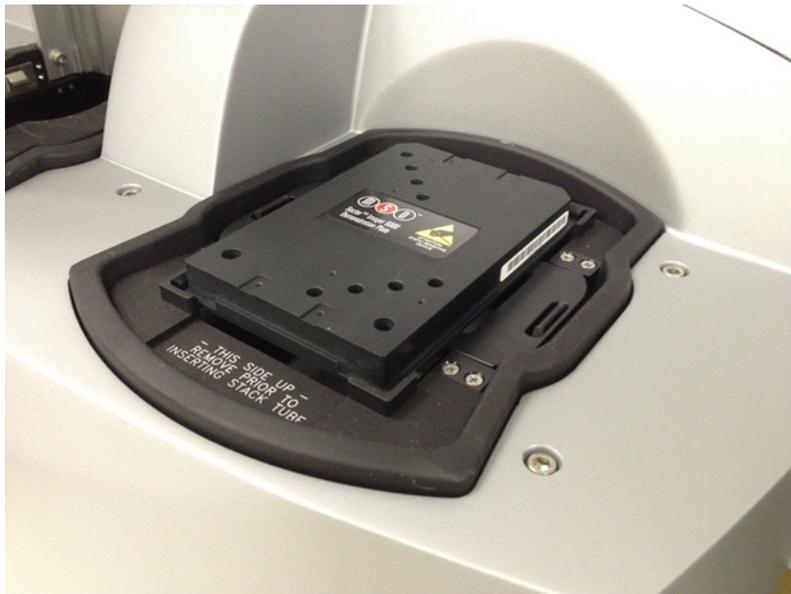


## 3.11  Uninterruptible Power Supply

The SECTOR Imager should be operated with an uninterruptible power supply (UPS) to ensure the integrity of data in the event of power line transients.

The UPS required will depend on the standard operating voltage at your laboratory's location. Please ensure that the proper UPS is employed for the power conditions in your country and local area.

> NOTE: Although the SECTOR Imager has been tested and complies with applicable electrical standards, operation of the system with a UPS is *strongly* encouraged for uninterrupted operation and protection from power line interference.

4

# Installation

# 4 Installation

A qualified MSD service engineer must install and configure the SECTOR Imager before use. Installation includes setup, connection of the instrument to its computer system, and verification that the instrument is functioning properly. Only the computer provided with the instrument and configured by an MSD service engineer should be used to operate the SECTOR Imager.

⚠ CAUTION: Installation of additional software on the computer system used to operate the SECTOR Imager is not supported. Specifically, updating aspects of the operating system or installing any software that changes parameters of the computer environment could interfere with proper operation of the instrument software.

⚠ CAUTION: Running virus-checking software, screen-savers, maintenance software, network-security software, and possibly other software on the SECTOR Imager computer could cause conflicts with the operation of the instrument software.

⚠ CAUTION: Use of other applications while plates are being read may interfere with system performance. Use of operating system power features that disable USB communication, such as Hibernate, will cause the system to stop responding; a power off/on cycle of the instrument and PC is required to restore function.

MSD Instrument Service should be consulted prior to moving the instrument.

5

# Quick Start

# 5  Quick Start

This chapter will guide you through running the SECTOR Imager demonstration plate and verifying that the instrument acquires data and functions properly. Running the SECTOR Imager demonstration plate at the start of each day may be part of standard operation.

The SECTOR Imager has a cooled CCD camera that needs to be brought to operating temperature before plates are read. To initiate the cooling process, the SECTOR Imager must be turned on, the MSD DISCOVERY WORKBENCH software must be started, and the SECTOR Imager Tools must be running (see steps 1–4 below). Simply turning on the instrument will *not* initiate CCD camera cooling. If the instrument has been off, allow at least 45 to 60 minutes for the CCD camera to cool when restarting. Operating temperature, either -25 ±1°C or -35 ±1°C for the SECTOR Imager 2400/2400A and SECTOR Imager 6000, respectively, must be reached before the DISCOVERY WORKBENCH software will allow the processing of any plates.

The Status window displays the temperature of the CCD camera while it is cooling (Figure 5:1). Once the CCD camera has reached its operating temperature, the temperature indicator will disappear, indicating that the instrument is ready for use. (The status window is accessible by selecting Tools from the menu bar in the DISCOVERY WORKBENCH software.)

> NOTE: If the SECTOR Imager has been idle, but has not been shut down (i.e., is in standby mode), then the CCD camera will already be at the proper temperature, and users may skip to Section 5.2 Setup.

**Figure 5:1 Instrument Status window**
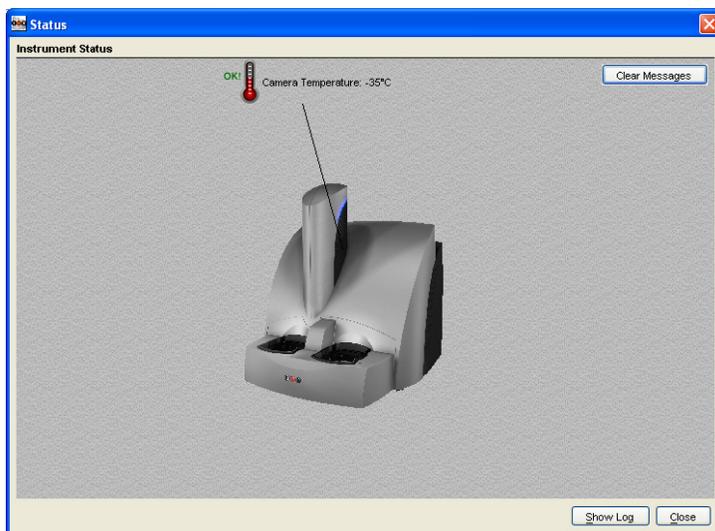


## 5.1   Start-up

To start the system:

1.  Turn on the SECTOR Imager and the computer connected to it. If a robot is connected, the startup sequence is SECTOR Imager, then the robot, then the computer.

2.  Log on to the Windows operating system. To do this, enter *Administrator* as the user login name and *MsdAdmin* as the password. (This is the default login shipped with the system; you may change this login/password or add additional Windows user accounts.)

3.  If DISCOVERY WORKBENCH does not start automatically, double-click the MSD DISCOVERY WORKBENCH icon on the Windows desktop (Figure 5:2).

Figure 5:2 MSD DISCOVERY WORKBENCH desktop icon
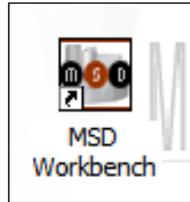


4.  Click the SECTOR Imager icon (Figure 5:3) on the toolbar to connect to the imager and initiate the CCD camera cooling process.

Figure 5:3 SECTOR Imager icon
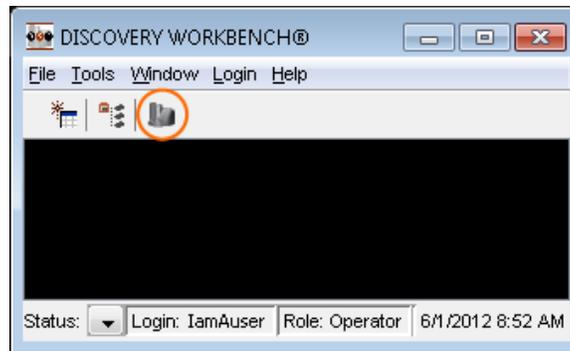


The SECTOR Imager splash screen (Figure 5:4) will display while the instrument is initializing. If the instrument has just been powered-up, the cooling process will take approximately 45 to 60 minutes.
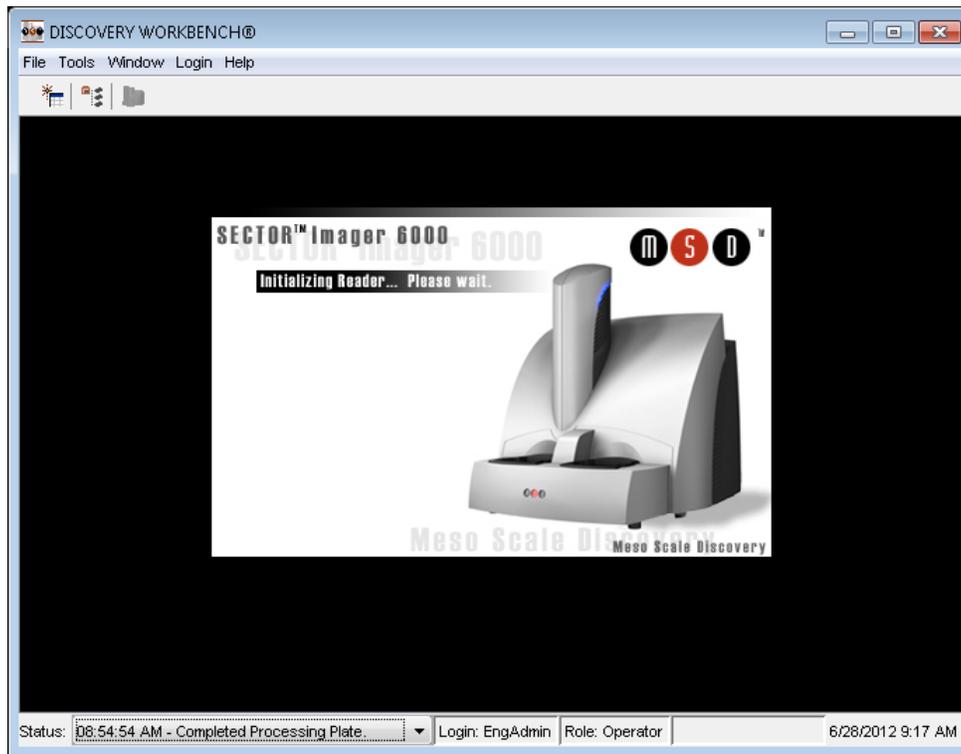
## 5.2   Setup

On the left side of the SECTOR Imager window, users can view and edit the Setup selections for the demonstration plate read (Figure 5:5).

1.  Select Read from Bar Code from the Plate Type menu.

2.  Select the Return Plates to Input Stack checkbox. If left unchecked, the demonstration plate will be placed in the output stack on the left side of the SECTOR Imager after reading. Because the demonstration plate will be run as a single plate, it is most convenient to return it to the input stack after processing.

    NOTE: It is very important to select Return Plates to Input Stack checkbox when the stacker cover plate is on the output stack so that the SECTOR Imager will not attempt to place the plate into the covered interface at the end of the read. (The SECTOR Imager 2400A has a cover plate permanently installed on the output stack and automatically returns plates to the input side.)

3.  Leave the Apply Kit Layout box unchecked. This option is covered in DISCOVERY WORKBENCH User Guide.

4.  Select the Read __ Plate(s) checkbox and enter *1* in the text field.

Figure 5:5 SECTOR Imager Window: Setup, Plate Summary, and Operations areas
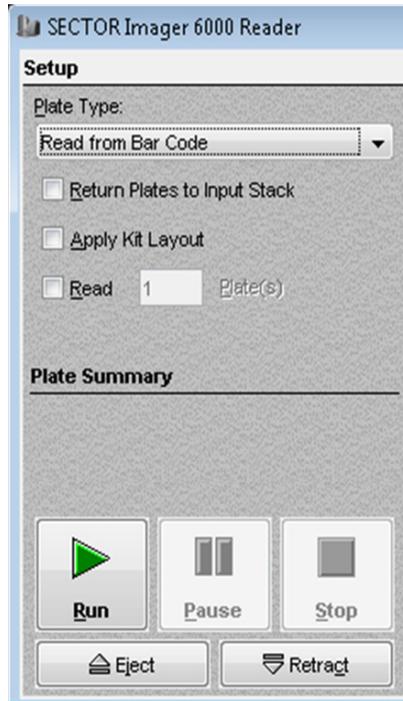


5.   Place the single plate adaptor on the input (right) stacker interface plate (Figure 5:6).

Figure 5:6 Stacker cover over the output port with empty single plate adapter in the input port



6.   Load the SECTOR Imager demonstration plate into the single plate adaptor (Figure 5:7). (Sensors in the instrument will automatically identify the plate orientation and adjust the data acquisition and analysis accordingly.)

Figure 5:7 SECTOR Imager demonstration plate in the single plate adaptor



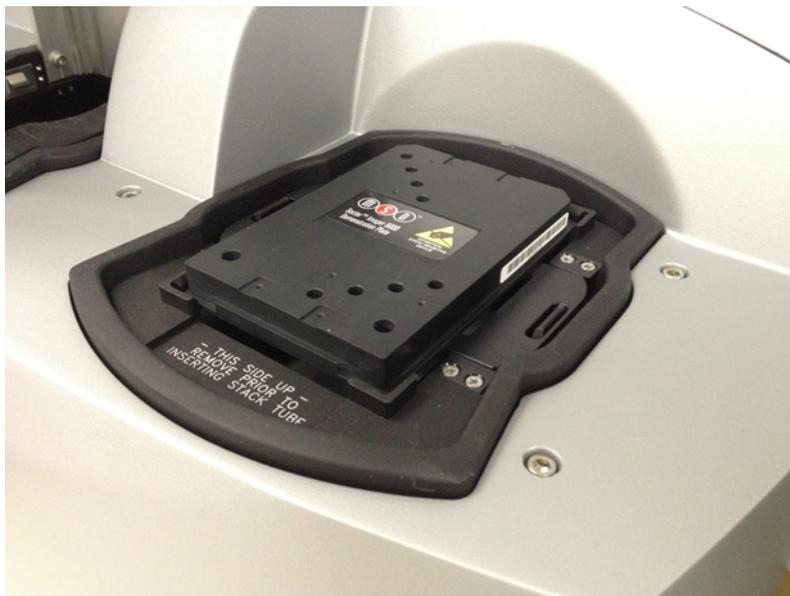NOTE: If the SECTOR Imager is unable to read the barcode on the demonstration plate (or if no barcode label is present), the plate will be skipped and ejected from the instrument. Please contact MSD Scientific and Technical Support for assistance.

## 5.3 Run

When the camera reaches proper operating temperature, the Instrument Log (click Show Log in the Status window) will indicate that the temperature is locked. At that point, the instrument is ready.

Click Run in the SECTOR Imager window. The Run Options dialog window will open (Figure 5:8).

1. Verify Setup Selections. If changes are necessary, click Cancel, make changes in the area (5.2 Setup) of the SECTOR Imager window, and re-verify Setup Selections.

2. Run name is optional, but one can be entered in the second section.

3. Verify the Export information and make changes if necessary. (Refer to the DISCOVERY WORKBENCH User Guide for additional details.) The export selections control the format and the location of the exported text data file that will be created when the demonstration plate is read.

4. Click OK. The plate read starts. View the status in the lower left region (Status bar) of the DISCOVERY WORKBENCH software to monitor progress. When the plate read is complete, the demonstration plate is returned to the stacker and Run is enabled again.

### 5.3.1 Operations

The Pause, Stop, Eject, and Retract buttons operate the motion control system that moves plates through the instrument.

- **Pause.** Pauses the plate read. Selecting Pause again resumes the read.

- **Stop.** Stops the current run and ejects any plate inside the instrument.

- **Eject.** Transfers a plate from inside the instrument (but not being read) to the stacker output port where it may be retrieved. This function is disabled during a plate run.

- **Retract.** Moves a plate from the input port into the instrument. No further action is taken without input from the operator. This function is disabled during a plate run.

Figure 5:8 SECTOR Imager window, Run Options dialog box

## 5.4 Results

The software provides several options for viewing results. Select View → Layer Views from the menu or select a layer from the Layer menu on the toolbar. Refer to the DISCOVERY WORKBENCH User Guide for details on data viewing options. If you observe the data as it is acquired in Color Map view, bright wells should display numbers above 2000 and dark wells should display numbers below 200.

Figure 5:9 shows a Color Map view of the data from the demonstration plate.

Figure 5:9 Demonstration plate results, Color Map layer
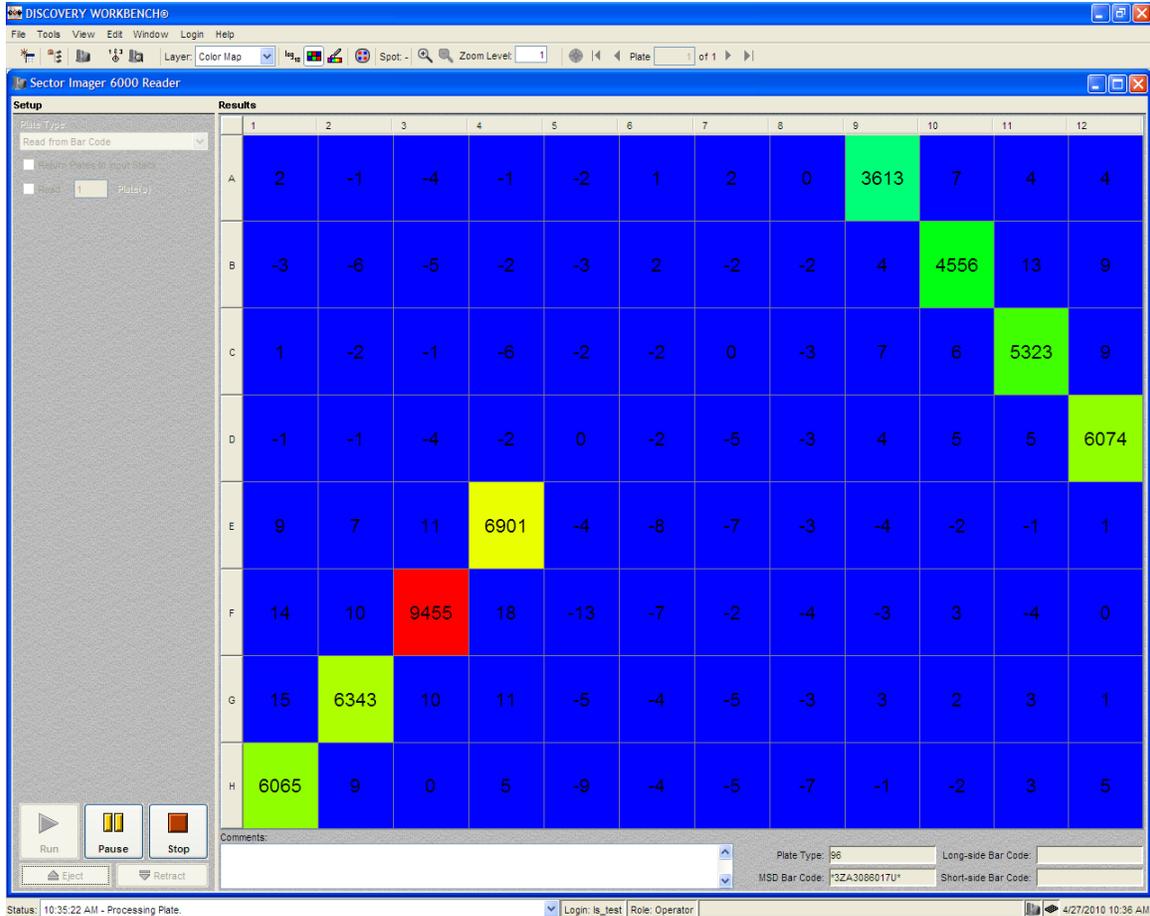


When using the SECTOR Imager 6000 demonstration plate sectors 3 and 4 (Figure 3:10) should display four bright wells each, as shown in Figure 5:9. Sectors 1, 2, 5, and 6 should have uniform, low signal levels corresponding to instrument background. The demonstration plate provided for the 2400/2400A (Figure 3:11) functions similarly, with sectors 5, 12, 14 and 19 displaying bright wells.

# Using the SECTOR Imager

# 6   Using the SECTOR Imager

This chapter explains how to prepare and load single or multiple MULTI-ARRAY plates for typical use with SECTOR Imagers. Additional information is provided to integrate the instrument with an external, third-party robotic system. Please refer to the DISCOVERY WORKBENCH User Guide for detailed instructions on running MULTI-ARRAY plates on the SECTOR Imager system.

> **NOTE:** This section assumes that a qualified MSD service engineer has installed and configured the instrument, and that the user has run a demonstration plate as described in the previous section.

## 6.1   Single Plate Run

To run a single MULTI-ARRAY plate, place the single plate adaptor in the right stacker interface (Section 3.5 SECTOR Imager Instrument).

The right stacker interface can act as both input and output locations. If not using the output (left) interface, place the stacker cover plate over it. The SECTOR Imager will pull and eject plates from/to the input (right) interface. The SECTOR Imager 2400A has a stacker cover plate preinstalled on the output side and is configured to automatically pull and eject plates from/to the input (right) interface.

If using the output side, install a second single plate adaptor or a stack tube on the output (left) stacker interface plate. The SECTOR Imager (except the SECTOR Imager 2400A) will automatically pull plates from the right side and eject plates into the left side.

> If the stacker cover plate is present on the output stack, remember to select the Return Plates to Input Stack checkbox so that the SECTOR Imager will not attempt to place the plate into the covered stack at the end of the read. (The SECTOR Imager 2400A is configured to automatically Return Plates to the input stacker port.)

Prepare the MULTI-ARRAY plate using the required reagents per the assay protocol. Place the plate into the single plate adapter. Sensors within the instrument will automatically identify the plate orientation and compensate the data acquisition and analysis accordingly. Per the detailed instructions in the DISCOVERY WORKBENCH User Guide, configure the options in DISCOVERY WORKBENCH and run the plate.

## 6.2   Stack Run—Multiple Plates

Multiple plates may be loaded into SECTOR Imager 6000 and SECTOR Imager 2400 instruments using the standard or high-capacity stack tubes (Figure 3:4). SECTOR Imagers read plates from the bottom of the stack tube. (The SECTOR Imager 2400A does not use stack tubes.)

### 6.2.1   Loading the Stack Tube

Prepare MULTI-ARRAY plates using the required reagents per the assay protocol.

To load prepared plates into the stack tube:

1. Stack plates on a stable surface.

2. Place the stack of plates on top of an extra, standard 96-well MULTI-ARRAY plate. This extra plate serves as a spacer for loading (Figure 6:1).

3.  Orient the stack tube so that the chamfers of the plates are toward the back of the instrument and the bar code labels are to the left.

    **NOTE:** A label on the inside of the stack tube reminds users of the correct orientation for loading plates. The stack tube itself will only fit on the interface plate in one orientation.

4.  Slide the stack tube carefully over the top of the stack of plates such that the plates slide into the tube. Once the stack tube base is flush with the stable surface, all but the extra plate will be loaded into the stack tube (Figure 6:1).

5.  Remove the single plate adaptor if it is present on the stacker.

6.  Place the full stack tube on the input (right) stacker interface plate.

7.  Place an empty stack tube of the same size on the output (left) stacker interface plate.

Figure 6:1 Loading MULTI-ARRAY plates into stack tube



If the stack of plates to be run is too tall for the above procedure, you can insert the additional plates through the top of the stack tube (up to the stack tube capacity) during the run. Be careful to not to add more plates than can be accommodated in the output stack tube.

⚠ **CAUTION:** When reading multiple plates in a run, ensure that the stack tube is not overloaded. See Table 3:1 Stack Tube plate capacities.

⚠ **WARNING:** Loading a tall stack of plates could lead to spilling potentially harmful chemical reagents. Use caution when loading the stack tubes.

### 6.2.2   Unloading the Stack Tube

After running a stack of plates, the consumed plates will be located in the output stack tube. These plates should be unloaded and properly disposed of prior to running additional plate stacks to prevent the possibility of overfilling the output stack tube.

⚠️ **CAUTION:** Not removing the completed plates from the output stack may cause spills if the number of completed plates exceeds the capacity of the output stack.

The plates should be removed manually by sliding them up and out the top of the stack tube. The last few plates can be accessed by pushing the last plate up from the bottom of the stack tube.

## 6.3    Robotics Integration

All SECTOR Imagers can be integrated with a robotics system for loading and unloading plates using the Remote Instrument Mode, which allows the instrument to be used as a component through its remote interface. A Remote Instrument Manual that provides descriptions of the commands recognized by the MSD software is available upon request. Contact Scientific and Technical Support for more information on robotics integration.

7

Maintenance

# 7  Maintenance

This chapter contains basic maintenance instructions for the SECTOR Imager and some components. A qualified MSD service engineer should perform all other maintenance procedures not described in this section.

⚠ WARNING: Opening the instrument to perform maintenance incurs risk of mechanical, electrical, and laser harm.

The SECTOR Imager requires proper care, including occasional preventive maintenance. Only MSD service engineers should perform standard preventive maintenance on the instrument. The schedule for these procedures depends on the usage of the instrument.

Please perform periodic system maintenance on the computer in order to maintain high performance. This includes running the defragmentation program included with the operating system on a regular basis. A performance qualification kit containing plates, reagents, and a protocol for verifying instrument performance, is available for purchase (MSD catalog #R31QQ-3). MSD Scientific and Technical Support can provide more details on the performance qualification kit.

> Inspect the SECTOR Imager before and after each use to ensure that there is no debris (liquid, dirt, plastic items, etc.) on or near the stacker interface plate. Clean the SECTOR Imager after each use as described below.

## 7.1  Preventive Maintenance

Scheduled maintenance should include the cleaning and lubrication of all appropriate internal components. Only MSD service engineers should perform this maintenance, usually once every 6 months.

Contact MSD Customer Service to ask about our service contracts.

## 7.2  Instrument Cleaning

Reasonable care should be taken to prevent unnecessary fluid spills onto and into the SECTOR Imager. Any spills onto the instrument should be promptly cleaned using either water, 70% ethanol, 1% bleach in water, or a mild detergent. Choose a cleaning solvent that is appropriate for the nature of the spill. Lint-free cleaning wipes are recommended for this cleaning.

⚠ CAUTION: The instrument should be turned off and unplugged for all cleaning processes.

Any of the outside surfaces of the SECTOR Imager can be cleaned. In addition, accessible regions of the stackers and elevators can be cleaned. The stackers should only be cleaned when the power is disconnected.

⚠ WARNING: When the stack tubes are removed, the plate elevator and doors to the instrument pose a pinch hazard. Do not put hands into these regions while the instrument is powered-up.

If chemical reagents are spilled inside the light tight enclosure of the SECTOR Imager, contact MSD Instrument Service for instructions.

### 7.2.1  Adapter and Stack Tube Cleaning

Spills on single plate adapters or stack tubes should be promptly cleaned to prevent a build-up of crystalline debris or dried salts that could interfere with their operation. In particular, plates may not load correctly if the latch movement of these devices is compromised.

Clean dirty latch mechanisms by soaking the latches in warm water (approximately 104°F/40°C) with a small amount of residue-free detergent for 15 minutes. Rinse the latches thoroughly with running water, tip and/or shake gently to remove excess liquid, and allow

to fully air dry. If there is any residue remaining, soak the latches in a 70% alcohol solution (isopropanol or ethanol in water) for 15 minutes; shake out the excess, and allow to air dry completely. If plate-loading problems persist, contact Scientific and Technical Support.

## 7.3    Instrument Decontamination

Contact MSD Scientific and Technical Support for a detailed protocol for instrument decontamination.

> NOTE: The SECTOR Imager must be decontaminated prior to shipping the instrument back to MSD. Contact MSD Scientific and Technical Support prior to shipping for instructions and requirements.

8

Appendix

# 8 Appendix

## 8.1 Troubleshooting Guide

Refer to Table 8:1 below to troubleshoot hardware and operating errors. The software version may be found in Help → About Workbench.

Table 8:1: Troubleshooting guide

| Symptom/Error message on screen | Possible Cause | Corrective Action |
|---|---|---|
| Instrument or computer does not power on | Loose or disconnected power cable(s) | Ensure that the cables connecting the instrument and/or computer to the external power source are plugged in properly. |
| | No voltage at outlet | Test the outlet by connecting a different electrical device to the outlet. |
| | One or more fuses activated | Fuse locations and specifications for the instrument are shown in Section 8.2.4: Power Requirements. |
| The plate passes through the instrument without being read. The status window jumps from 1% to 100%. | The instrument was unable to read the barcode on the plate. The bar code may be damaged, smudged, marked, or otherwise unreadable. | Verify a bar code is smoothly affixed to the side of the plate. Then, select the appropriate plate type from the pull-down menu, and read the plate again. |
| **Error 515** General error<br><br>The instrument failed to read the plate after clicking the Run button. | Windows security settings, networking parameters, or the instrument name has changed. | Click OK to continue.<br><br>Determine whether your IT department has made any changes to the instrument computer recently. |
| | Incompatible anti-virus software has been installed on the instrument computer. | Disable the antivirus program temporarily to see if that is the issue. There are several methods:<br>1) Exclude the file: C:\Program Files\MSD Discovery Workbench\lib\prefs.properties from scanning.<br>2) Disable real-time scanning.<br>3) Uninstall the antivirus program and use a different one. |
| **Error 515** General error<br><br>The instrument failed to initialize after clicking the instrument icon. | The Windows theme has changed. | Click OK to continue.<br><br>Restore the default Windows theme. Please check whether your IT department has made any changes to the instrument computer recently.<br><br>The MsdDebug file (DISCOVERY WORKBENCH v3) or sysinfo file (DISCOVERY WORKBENCH v4) contains a software log that can be used to diagnose the problem. The log will contain errors such as .JCodedException: Error creating plugin: unknown and CreatePluginAction$1 doWork:-1 and lifesci.usersrv.ipr.IPRReader$iprReaderVetoCloseController vetoClose:-1. |
| **Error 515** General error<br><br>The error was noted while reading a plate, or during data collection, the instrument read a partial plate as a full plate. | The Plate Data History (database) is in an inconsistent state.<br><br>DISCOVERY WORKBENCH v3 only | Click OK to continue.<br><br>1)The software log will contain an error similar to: .ProcessView$PartialPlateSelectListener itemStateChanged:-1. For assistance, contact Scientific and Technical Support. |

| Symptom/Error message on screen | Possible Cause | Corrective Action |
|---|---|---|
| **Error 515** General error<br><br>The error was noted while reading a plate or during data analysis. | The Plate Data History (database) is full. | Click OK to continue.<br><br>Backup and clear the database. For DISCOVERY WORKBENCH v3, contact Instrument Service for instructions on backing up and clearing the database. For DISCOVERY WORKBENCH v4, instructions on backing up and clearing the database may be found in the DISCOVERY WORKBENCH User Guide.<br><br>The software log will contain a message such as: Could not allocate space for object 'PIDTable' .....in database 'LCPRSchema' because the 'PRIMARY' filegroup is full. |
| **Error 515** General error<br><br>The PDF generator failed to create the report. | The PDF generator is overburdened by large amounts of data, such as when reading 10-spot plates or analyzing multiplex plates in an experiment.<br><br>DISCOVERY WORKBENCH v3 only | Click OK to continue.<br><br>Print the PDF file in parts using the Report Selection Mode. To access this mode:<br>1) Open the experiment.<br>2) Right-click the experiment name.<br>3) Select Report Selection Mode. A check box will appear next to each element in the analysis.<br>4) Deselect a subset of elements to be included in the PDF report. |
| **Error 515** General error<br><br>The error was noted during data analysis or while saving information to the Plate Data History (database). | Several situations can generate Error 515 during data analysis. For example:<br><br>A process was cancelled before completion, or<br><br>The text in the note section of the plate layout is too long, or<br><br>Sample or plot curve names are too long or contain too many numbers.<br><br>DISCOVERY WORKBENCH v3 only | Click OK to continue.<br><br>As long as the plate was read, you can retrieve the data with the following actions:<br>• Reduce the text in the note section of the plate layout.<br>• Ensure that each text field does not contain more than 9 numbers. For example, shorten Sx379 2012-04-24 1638400 to Sx379 16384.<br>• Avoid using invalid characters (#, ?, \, etc.) in text fields. |
| **Error 5216** Unable to locate file | An inventory file has become corrupted.<br><br>DISCOVERY WORKBENCH v3 only | Perform the following steps:<br>1) Completely close DISCOVERY WORKBENCH.<br>2) Go to C:\Program Files\MSD DISCOVERY WORKBENCH\Data and look for a file called SECTORHTSInventory.ini (SECTOR Imager 6000) or SECTORHTS24Inventory.ini (SECTOR Imager 2400/2400A).<br>3) If the file does not exist look for SECTORHTSInventory.ini.bak (SECTOR Imager 6000) or SECTORHTS24Inventory.ini.bak (SECTOR Imager 2400/2400A).Once you locate this file remove the .bak extension<br>4) Restart DISCOVERY WORKBENCH.<br><br>If the problem persists, contact Scientific and Technical Support. |
| **Error 5451** Unable to read serial device | The instrument serial cable is disconnected or attached to the incorrect COM port. | A beige, 9-pin cable should be plugged into the COM port 1 on the back of the computer. The COM port 2 should be vacant. The SECTOR Imager 6000 has a black cable and a beige cable. The SECTOR Imager 2400/2400A has two beige cables. Please verify that the thinner beige cable is in SECTOR 2400 COM port 1. |
| **Error 6106** Instrument initialization failed | The instrument or computer has experienced a communications failure. | Perform the following steps:<br>1) Shut down the computer<br>2) Shut down the SECTOR Imager<br>3) Restart the computer<br>4) Restart the SECTOR Imager. |
| **Error 7254** Hardware fault | A fault was detected in the camera or camera controller. This error can be caused by a blown fuse internal to the camera power supply, a fault with the PCI card, or a disconnected taxi cable. | Check that all connections are tight, particularly the thick cable that runs from the SECTOR Imager to the PCI card in the back of the computer. If no loose cables can be found and the instrument still fails to function after restarting, contact Instrument Service for assistance. |

| Symptom/Error message on screen | Possible Cause | Corrective Action |
|---|---|---|
| **Error 7460** Instrument Operation Timed Out | A Windows service has not started or has been interrupted.<br><br>DISCOVERY WORKBENCH v3 only | Perform the following steps:<br>1) Close DISCOVERY WORKBENCH.<br>2) Right click My Computer on the Desktop and select Manage.<br>3) In the Computer Management dialog box under services and Applications, click Services.<br>4) Find MSSQL$MESOSCALE1 in the Services list.<br>5) Right click MSSQL$MESOSCALE1 and then click Start or Restart.<br>6) If Startup type is not Automatic, then select Automatic.<br>Restart DISCOVERY WORKBENCH.<br><br>If the problem persists:<br>1) Shut down the computer.<br>2) Shut down the SECTOR Imager<br>3) Restart the computer<br>4) Restart the SECTOR Imager.<br>5) Restart DISCOVERY WORKBENCH.<br><br>If the issue is still not resolved, contact Instrument Service. We may need the instrument log files that are in the following locations:<br>1) Event log: Go to C:\Program Files\MSD Discovery Workbench\log. Send the file with the word "Events" in it.<br>2) Software log: Go to C:\Program Files\MSD Discovery Workbench\log. Send all the files beginning with the word "Workbench." |
| **Error 7461** Instrument not ready when starting a plate run. | The camera has not reached the proper temperature for operation. The SECTOR Imager 2400/2400A and SECTOR Imager 6000 cameras will cool to -25°C and -35°C, respectively, before the instrument becomes operational. | Check the camera cooling status (Tools → Status) The temperature should be dropping toward the operating temperature.<br><br>Wait up to 60 minutes for the camera to stabilize at the correct temperature. This is a normal function of turning on the instrument.<br><br>Restart the software. Check the temperature again. Contact MSD Scientific and Technical Support if the camera temperature is not dropping. |
| **Error 8605** ERR_EL_CACHE_SAVE_FAILED | One or more files could not be written to the log.<br><br>DISCOVERY WORKBENCH v3 only | Generally, this error can be resolved by restarting the system:<br>1) Shut down the SECTOR Imager and the instrument computer for 30 seconds.<br>2) Start the computer and then start the SECTOR Imager.<br>3) Wait for five minutes and then launch DISCOVERY WORKBENCH.<br><br>If the problem persists:<br>1) Click Start and select Settings then Control Panel.<br>2) Go to Administrative Tools and click Event Viewer.<br>3) Right-click Application and select Properties. A dialog window will appear.<br>4) Increase the log size 2-fold.<br>5) Log off and then log back into Windows. |
| **Error 8704** The MSSQL$Mesoscale1 or SQL Server (MESOSCALE2) service has not started | The Windows service has not started. | It may take up to five minutes for this service to start after the computer is started. If the error is caused because DISCOVERY WORKBENCH was launched before the service started, then restarting the software will resolve it.<br><br>If the service has been interrupted:<br>1) Right-click My Computer on the desktop and select Manage. In the Computer Management window under Services and Applications, click Services.<br>2) In the alphabetical list of services, right-click MSSQL$MESOSCALE1 for DISCOVERY WORKBENCH v3 or SQL Server (MESOSCALE2) for DISCOVERY WORKBENCH v4 and select Restart. |
| **Error 8906** Invalid Plate Type | The software failed to recognize the barcode on the MSD plate.<br><br>DISCOVERY WORKBENCH v3 only | Check to see if Bar Code Update for MSD DISCOVERY WORKBENCH has been installed at the following location: START Menu → Settings → Control Panel → Add or Remove Programs. If it has not, contact Scientific and Technical Support to obtain the Bar Code Update program. |
|  | A discontinued plate or a plate configuration exclusive to another instrument was used. | Discontinued plates cannot be run. In addition, plates made for SECTOR PR instruments are incompatible with SECTOR Imager instruments, and older SECTOR Imager 6000 plates are incompatible with the SECTOR Imager 2400. |
| **Error 9460** Instrument timed out | Communication between the instrument and the computer has been interrupted. | Check the cables attached to the instrument and computer to make sure they are correct and seated securely.<br><br>Contact Instrument Service. Customers may be asked to provide log files from the folder C:\Program Files\MSD DISCOVERY WORKBENCH\log |

| Symptom/Error message on screen | Possible Cause | Corrective Action |
| --- | --- | --- |
| **Error 9706** Client already has a session | Multiple sessions of DISCOVERY WORKBENCH are running at the same time.<br><br>DISCOVERY WORKBENCH v3 only | Close all instances of DISCOVERY WORKBENCH software. This could take up to a minute if the Windows Task Manager is used to close the program. Restart the software. |
| **Error 9711** Unable to connect to the instrument server | Loose cables prevent communication between the instrument and computer. | Check the integrity of all cables going into the SECTOR instrument and the desktop computer. |
| | Communication between the instrument and computer has been interrupted. | Restart the computer.<br><br>Restart the communication service by navigating in Windows to Control Panel → Administrative Tools → Services. Right-click the service MSSQL$Mesoscale1 for DISCOVERY WORKBENCH v3 or SQL Server (MESOSCALE2) for DISCOVERY WORKBENCH v4 and select either Restart or Start. |
| **Error 9901, 9902** Communications failure | The instrument lost communication with the computer. | Ensure that both the instrument and computer are powered on and all power and communications cables connected and secure.<br><br>Close DISCOVERY WORKBENCH and restart the computer.<br><br>If restarting does not correct the problem, then switch the location of the instrument-to-computer USB cable by plugging the USB cable into a different USB port on the instrument computer.<br><br>1) Turn off the SECTOR Imager.<br>2) Wait 30 seconds.<br>3) Turn on the SECTOR Imager.<br>4) Restart the computer.<br>5) Wait five minutes before starting the MSD DISCOVERY WORKBENCH software.<br><br>If the problem is not resolved, contact Scientific and Technical Support. |
| **Error 11668** Audit Event Issue | The software was unable to add an event to the Windows event log.<br><br>DISCOVERY WORKBENCH v3 only | Perform the following steps:<br>1) Right-click My Computer, select Manage and then click Event Viewer.<br>2) Right-click Application.<br>3) Select Properties to open the System Properties window. Check either Overwrite events as needed or Overwrite events older than *<xx>* days (enter the maximum number of days for keeping older events).<br>NOTE: Setting the system log to overwrite will result in a loss of data. MSD recommends archiving the log periodically.<br>4) Click OK.<br>5) Right-click System and repeat the Properties settings in step 3.<br>6) Click OK.<br>7) Log off and then log back into Windows. |
| | Date and time setting on instrument is incorrect.<br><br>DISCOVERY WORKBENCH v3 only | Change the date and time setting on the instrument computer to the current date and time. |
| **Error 11685** Audit Event Issue | The instrument session manager is unable to write to the Windows event log.<br><br>DISCOVERY WORKBENCH v3 only | Perform the following steps:<br>1) Right-click My Computer, select Manage, and click Event Viewer.<br>2) Right-click Application.<br>3) Select Properties to open the System Properties window. Check either Overwrite events as needed or Overwrite events older than *<xx>* days (enter the maximum number of days for keeping older events).<br>NOTE: Setting the system log to overwrite will result in a loss of data. MSD recommends archiving the log periodically.<br>4) Click OK.<br>5) Right-click System and then repeat the Properties settings in step 3.<br>6) Click OK.<br>7) Log off and then log back into Windows. |

## 8.2   Specifications

### 8.2.1   SECTOR Imager

NOTE: All performance information including standard signal levels, detection limits, dynamic range, and instrument noise is based on 150 μL read volumes in 96-well MULTI-ARRAY plates using standard plate read parameters.

Unless noted, specifications apply to all models of the SECTOR Imager 2400/2400A and the SECTOR Imager 6000.

### 8.2.2   Scientific Performance

Table 8:2 Scientific performance

|  | SECTOR Imager 6000 | SECTOR Imager 2400/2400A |
|---|---|---|
| **Standard Signal Levels**<br>Signals generated by Free TAG, 15,000 [Cat # R94AA]<br>Signals generated by PQ Low Control [Cat # R92TE-2] | 12,000–18,000 counts<br>25–100 counts | 12,000–18,000 counts<br>25–100 counts |
| **Dynamic Range** | $10^6$ | $10^6$ |
| **Electronic Noise**<br>Standard Deviation Dark Noise (depends on plate type) | 0–16 counts | 0–16 counts |

### 8.2.3   Environmental Specifications

Suggested Operational Temperature Range           20–26 °C (68–78 °F)

Suggested Operational Humidity Range              10–80% non-condensing

Storage Temperature Range                         5–40°C (41–104 °F)

Storage Humidity Range                            5–85% non-condensing

Ambient Light                                     <2000 Lux

### 8.2.4   Power Requirements

SECTOR Imager 2400/2400A (models 1250/1251)

    Voltage                   100–240 V~ 50/60 Hz

    Current                   3.7–2.0 A

SECTOR Imager 6000 (model 1200)

    Voltage                   100 / 120 / 220 / 240 V~ 50/60 Hz

    Current                   3.3 / 2.7 / 1.5 / 1.4 A

SECTOR Imager 6000 (model 1201)

    Voltage                   100–240 V~ 50/60 Hz

    Current                   3.5A–2.8A @ 100–240 V~

Class I, Installation (Overvoltage) Category II Device

⚠️ Fuses

Electrical fuses are only accessible by MSD service engineers and are not user-serviceable. The information below is provided for reference.

**Main Fuses F1 and F2:**

SECTOR Imager 6000 (model 1201) and SECTOR Imager 2400/2400A (models 1250/1251)

T4.0 A, 250 V, 100–240 V~

SECTOR Imager 6000 (model 1200)

T4.0 A, 250 V, 100/120 V~

T2.5 A, 250 V, 220/240 V~

**Internal Fuse F3:**

SECTOR Imager 6000 (model 1200 only)

T0.8 A, 250 V

### 8.2.5   SECTOR Imager Physical Dimensions

| | |
|---|---|
| Size | 26.8 in x 30.5 in x 33.9 in (68.1 cm x 77.5 cm x 86.1 cm) |
| Weight for SECTOR Imager 2400/2400A: | 140 lbs (64 kg) |
| Weight for SECTOR Imager 6000: | 150 lbs (68 kg) |

### 8.2.6   Plate Standard Read Volume (per Well)

| | |
|---|---|
| 96-well MULTI-ARRAY Plates | 150 $\mu$L |
| 384-well, MULTI-ARRAY Plates | 40 $\mu$L |
| 1536-well, MULTI-ARRAY Plates | 4–6 $\mu$L |

### 8.2.7   Custom Bar Code Compatibility*

Code 39
Code 128

*Contact MSD Scientific and Technical Support for information on proper label, font size, and location of custom bar code on plate. Recognition of additional codes is possible but has not been tested.

### 8.2.8   Plate Specifications

MSD MULTI-ARRAY and MULTI-SPOT plates are designed to comply with the mechanical dimensions of the proposed standards of the Society of Biomolecular Screening. Contact MSD Scientific and Technical Support for further details.

The MULTI-ARRAY and MULTI-SPOT plate bar code labels conform to the ANSI/AIM BC1—1995: Uniform Symbology Specification—Code 39 format.

## 8.3   Regulatory and Safety Certifications

The SECTOR Imager 6000 and the SECTOR Imager 2400/2400A have been tested to comply with applicable regulatory standards: TUV (Canada, US), TUV-GS, CE approved, CB Certification.

Regarding EN61326 Electrical Equipment for Measurement, Control, and Laboratory Use—EMC Requirements. (EMCD) Annex B:

- SECTOR Imager 6000 (model 1200 only) and SECTOR Imager 2400/2400A: These units are designed for operation in a controlled electromagnetic environment. Transmitters of RF energy such as mobile (cellular) telephones should not be used in close proximity.

Regarding FCC Rules, Part 15, Subpart B, as a Class A digital device:

- This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. The equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case, users will be required to correct the interference at their own expense.

Regarding Industry Canada Interference-Causing Equipment Standard:

- This Class A digital apparatus complies with Canadian ICES-003.

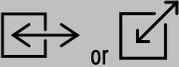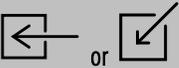- Cet appareil numérique de la Classe A est conforme à la norme NMB-003 du Canada.

Contact MSD Scientific and Technical Support with inquiries about the regulatory compliance of MSD instrumentation.

### 8.3.1 WEEE Compliance

For all inquiries regarding recycling of shipping materials, instrument disposal, and WEEE-related issues, please contact an MSD instrument service specialist at 301.947.2057 or instrumentservice@mesoscale.com.

## 8.4    Symbols and Labels

Table 8:3 Symbols and labels

| Symbol/Label | Description |
|---|---|
| ⚠️ | Consult accompanying documentation/written warning |
| ⚡ | Device contains high voltages |
| ✋ | Pinch Hazard Warning |
| ▭ | Accessible fuse with rating |
| ☀ | Class 2 Laser Warning |
| ⚠ | Electrostatic Sensitive Device |
| V | Volts |
| A | Amps |
| ~ | Alternating Current |
| I | On |
| O | Off |
| Ȯ | Halt plate motion system |
| C€ | European Compliance Mark Indicates that the device complies with applicable European Directives |
| ⟜ | USB I/O Port Symbol and Reference Designation |
| ⇆ or ↗ | Camera Controller Serial I/O Port Symbol and Reference Designation |
| IOIOI | Bar Code Reader RS-232 I/O Port Symbol and Reference Designation |
| ⇐ or ↙ | External Stop or Pause Control I/O Port Symbol |

9

# Technical Support

# 9 Technical Support

MSD provides excellent and timely support for all authorized users of SECTOR Imagers. We welcome and carefully consider all bug reports and suggestions for improvements to future versions. We will work with you to resolve any problems you may encounter.

## 9.1 Bug Reports and Suggestions

Please send comments or feedback on the software—including bug reports, unresolved error codes, feature requests, or design change requests—to an MSD Scientific and Technical Support specialist.

## 9.2 Problems Running SECTOR Imagers

If you encounter an error report that you cannot resolve, please provide us with as much of the following information as possible:

- The error code and text in the error dialog box

- What you were doing when the error occurred

- How can the error be reproduced?

- If requested by MSD Scientific Support, a copy of the SysInfoOutput.txt file located in C:\sysinfo

  To generate the report file, first run the SysInfo.exe diagnostic tool located in:

  | | |
  |---|---|
  | (WinXP/Win7-32 bit) | C:\Program Files\MSD DISCOVERY WORKBENCH\bin |
  | (Win7-64 bit) | C:\Program Files (x86)\MSD DISCOVERY WORKBENCH\bin |

Email this information to scientificsupport@mesoscale.com. Someone will contact you within two business days. If the error is affecting your work, please mark it URGENT and we will respond as quickly as possible.

## 9.3 How to Contact Us

Meso Scale Diagnostics, LLC, company headquarters is located at:

1601 Research Boulevard
Rockville, Maryland 20850 USA
+1 240-314-2600

Our website is www.mesoscale.com.

| Customer Service | Scientific and Technical Support | Instrument Service |
|---|---|---|
| +1 240-314-2795 | +1 240-314-2798 | +1 301-947-2057 |
| customerservice@mesoscale.com | scientificsupport@mesoscale.com | instrumentservice@mesoscale.com |

**MSD**

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