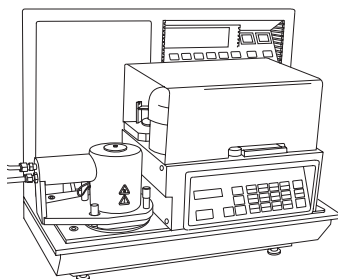


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Thermal Analysis & Rheology

A SUBSIDIARY OF WATERS CORPORATION



# DSC Autosampler

## Operator's Manual

PN 925616.001 Rev. F (Text and Binder)

PN 925616.002 Rev. F (Text Only)

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## Notes, Cautions, and Warnings

This manual uses notes, cautions, and warnings to emphasize important and critical instructions.

***NOTE:***

|| Highlights important information about equipment or procedures.

◆ ***CAUTION:***

|| Emphasizes a procedure that may damage equipment or cause loss of data if not followed correctly.



|| Indicates a procedure that may be hazardous to the operator or the environment if not followed correctly.

---

# Safety

## *Autosampler Safety Labels*



NEVER touch the surface of the metal exterior can covering the DSC cell when the Autosampler is operating. It can become very hot.



NEVER open the Autosampler rear electronics cabinet. Its contents should be serviced by authorized service personnel only. No user-serviceable parts are contained within the electronics enclosure, and hazardous voltages are present within.



NEVER put your fingers in the Autosampler's path when the turret assembly is moving. The gripper fingers are made of fine wire and could scratch or pierce your skin.

---

## *Operation Safety*

- ALWAYS handle the DSC cell lids and sample pans with tweezers; they can become very hot.
- ALWAYS keep your compressed air hoses securely fastened to the lab bench (*e.g.*, use clamps or tape). Sudden increases in pressure can cause the hoses to fly off the counter.
- NEVER leave flammable items (*e.g.*, liquids, paper) around the Autosampler work area, especially during unattended runs. Should a hot lid or pan be dropped accidentally, this could create a fire hazard.
- NEVER open the DSC cell when it is at a temperature of 200°C or higher; this can cause the cell to oxidize.
- NEVER store hot lids (>100°C) on the Autosampler console cover.
- NEVER try to move the turret assembly by pushing it with your hand. This could cause mechanical damage and calibration errors.
- NEVER slide the Autosampler console to the right while the Autosampler is in use.
- Review the safety notes in your instrument *Operator's Manual*.
- Review the safety notes in the *LNCA Operator's Manual* or RCS addendum, if that option is installed.

---

## Using This Manual

<b>Chapter 1</b>	Introduces you to the purpose and features of the DSC Autosampler, lists system requirements, and explains the terminology used in this manual.
<b>Chapter 2</b>	Explains how to prepare the DSC Autosampler system for operation.
<b>Chapter 3</b>	Describes how to use the Autosampler's manual keyboard to move the turret assembly and load and unload the cell.
<b>Chapter 4</b>	Provides the calibration procedures necessary for all new DSC Autosamplers, with guidelines for periodic calibration checks.
<b>Chapter 5</b>	Explains how to install the crimping die, provides guidelines for setting up the Autosampler tray, and describes how to prepare crimped and hermetic pans for Autosampler operation.

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# Using This Manual

*(continued)*

<b>Chapter 6</b>	Describes the diagnostic tests you can run from the DSC Autosampler keyboard and lists controller and Autosampler error messages.
<b>Appendix</b>	Lists the DSC Autosampler part numbers and TA Instruments offices and phone numbers for ordering and service.
<b>Index</b>	Lists the page numbers of important topics for your reference.



# CHAPTER 1: Introducing the DSC Autosampler

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## Introducing the DSC Autosampler



## Overview

Your TA Instruments DSC Autosampler is a four-axis robotic device that automatically loads sample and reference pans to and from the Differential Scanning Calorimeter (DSC) thermal analysis instrument. The Autosampler will detect the presence of a single or dual sample cell and adjust its actions and displays accordingly. Once the Autosampler loads the pans and covers the DSC cell, the controller takes over and runs a preprogrammed thermal analysis experiment on your samples. The Autosampler then uncovers the cell and unloads the pans. You can set up a series of these experiments and leave them to be executed unattended.

## General Features

The following features make the DSC Autosampler a unique and flexible tool:

- The Autosampler makes decisions based on current system status, operator-directed parameters, and computer-directed instructions.
- The mechanical fingers that grip the sample pans and cell lids enable the Autosampler to handle objects weighing from milligrams to tens of grams with more reliability than vacuum-grip systems. Open pans can be handled as safely as closed pans with the Autosampler's tactile-feedback gripper fingers. The tactile-feedback programming also detects improperly gripped or dropped objects and prevents the grippers from puncturing the floor of the DSC cell furnace.
- The Autosampler can be operated automatically through the TA controller or manually through its own keypad. Under manual operation, you can directly control turret movement to calibrate and test the Autosampler, while automatic operation (using *Thermal Solutions/Advantage*) offers the benefits of preprogrammed runs that can be left to execute overnight.
- If you have the multi-instrument option installed on your controller, you are free to run other instruments (*e.g.*, TGA, DMA, TMA) while the Autosampler takes care of DSC operations for you. The Autosampler has no effect on any other instrument

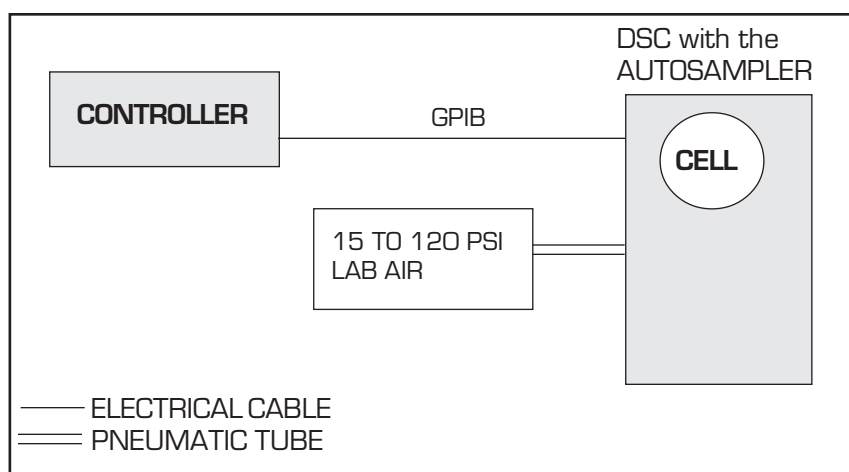
connected to the controller. You can also connect two or more Autosamplers to the controller to work with two or more DSCs.

- The Autosampler can change both reference and sample pans.
- Preprogrammed series of runs, called AS run sequences, can be created easily through the Instrument Control software. Once you have created an AS run sequence, you can edit it and save it on disk. You can even change parts of an AS run sequence as it is being run.
- Up to 62 DSC runs can be preprogrammed on the controller.
- The Autosampler's accuracy of pan placement ( $\pm 0.008$  inches) is more reliable and repeatable than human operation.
- The sample/reference pan storage tray has room for 62 pans and can be removed from the Autosampler for easy loading. A plastic lid is provided for safe carrying. The order of samples used for each experiment is completely up to you and need not follow the order of pans in the Autosampler tray.
- The Autosampler operates with crimped, hermetic, and open pans to support a wide variety of thermal analysis experiments.
- The Autosampler can be used with the full range of thermal analysis temperature profiles currently used in manual experiments (depending upon the cooling accessory installed).

- The AS run sequence ensures that the DSC cell is within a safe load temperature range (10 to 100°C) at the beginning of each run by using compressed ambient air to rapidly cool or warm the DSC cell as needed. You can further narrow this temperature range if you wish when you create your AS run sequence.
- The Autosampler log keeps a record of all controller and Autosampler activities so that you can review operations even after they are performed.
- The Autosampler runs a series of diagnostics tests at power-up and continuously during operation to ensure that all mechanical and electrical components are operating properly.

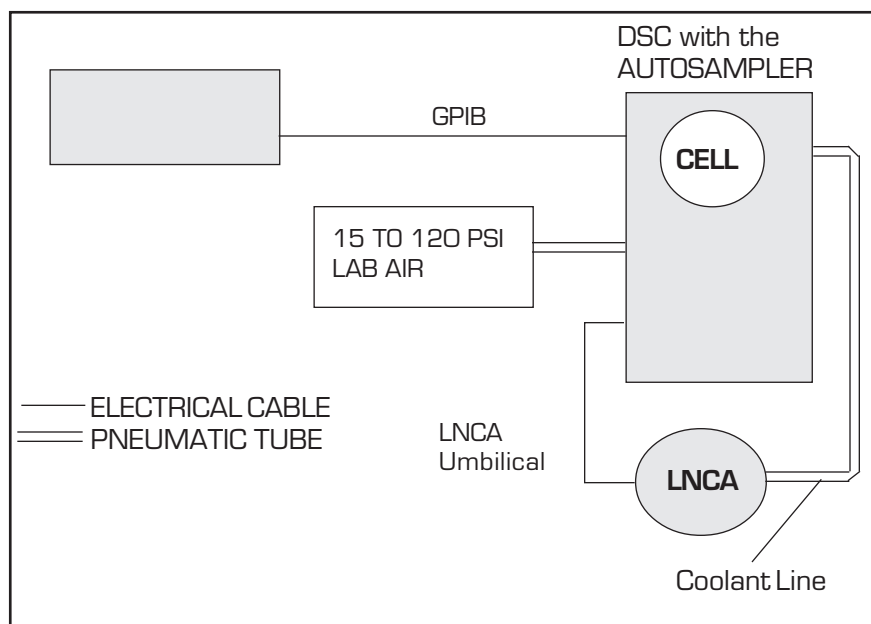
## Relationship to the System

The DSC Autosampler is part of a system consisting of the TA Instruments controller and a 2910 or 2920 DSC instrument (see Figure 1.1).

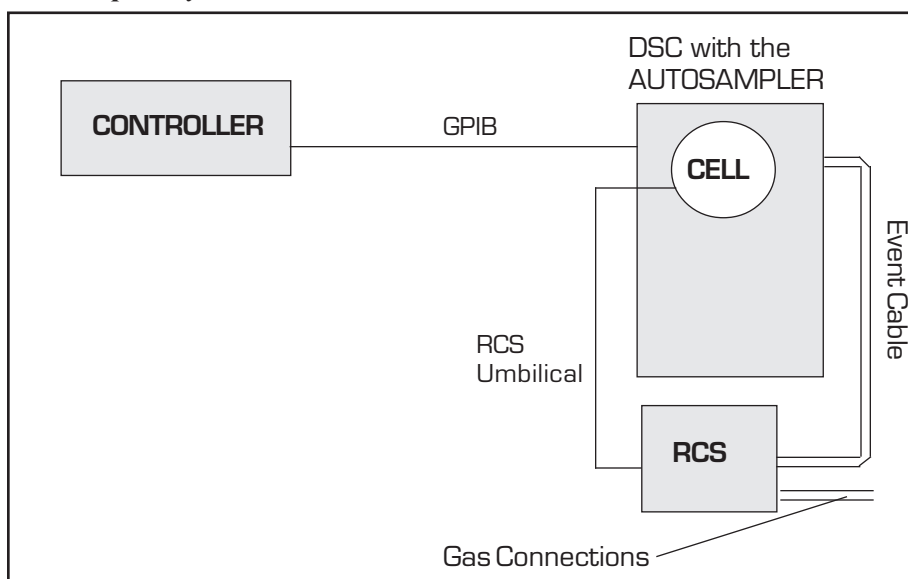


**Figure 1.1**  
*Schematic Diagram of  
the DSC Autosampler System*

The TA Instruments LNCA (Liquid Nitrogen Cooling Accessory) and RCS (Refrigerated Cooling System) can be used for cooling experiments with the Autosampler (see Figures 1.2 and 1.3 on the next page).



**Figure 1.2**  
***Autosampler System with LNCA***



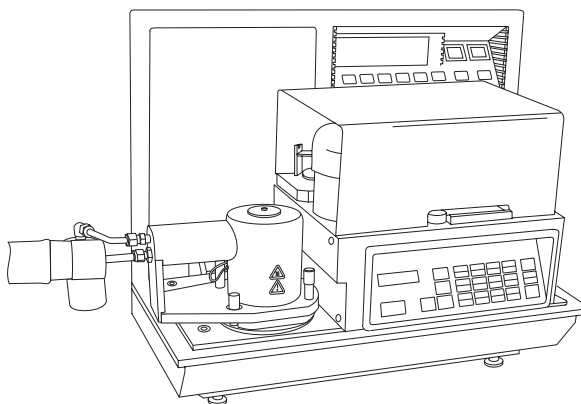
**Figure 1.3**  
***Autosampler System with RCS***

## Description

The DSC Autosampler consists of a turret assembly, a sample tray, an operator's keypad, and a display screen in an assembly that mounts on the instrument (see Figures 1.4 and 1.5).

**NOTE:**

The functions of the DSC instrument keypad and display will not change when the Autosampler is mounted. See the appropriate *DSC Operator's Manual* for information.



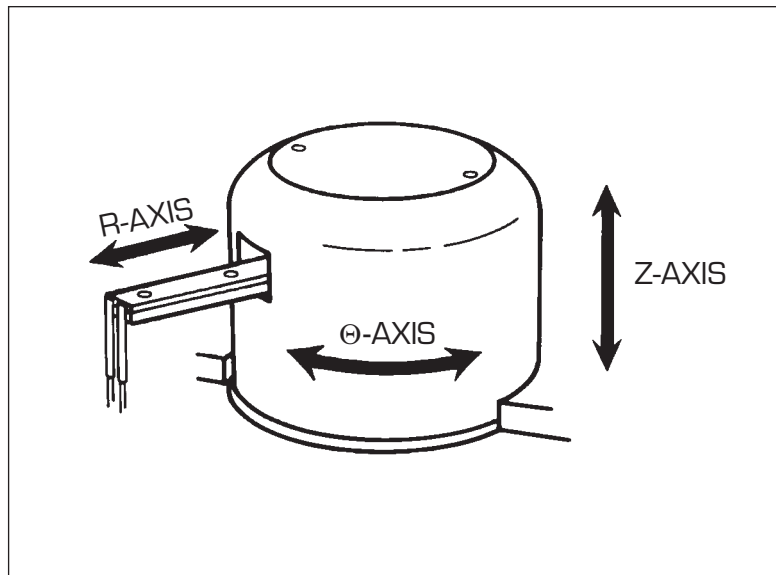
**Figure 1.4**  
*The DSC Autosampler  
with LNCA Heat Exchanger*



**Figure 1.5**  
*DSC Autosampler with  
an RCS Environmental Chamber*

## *The Turret Assembly*

Three stepper motors move the turret assembly through its three major axes of motion (see Figure 1.6). Rotary stepper motors rotate the turret assembly in the clockwise or counter-clockwise direction (along the  $\theta$ -axis) and move the turret arm in and out (along the r-axis). A linear stepper motor moves the turret up or down (along the z-axis). A fourth, linear motor is used to activate the gripper fingers.

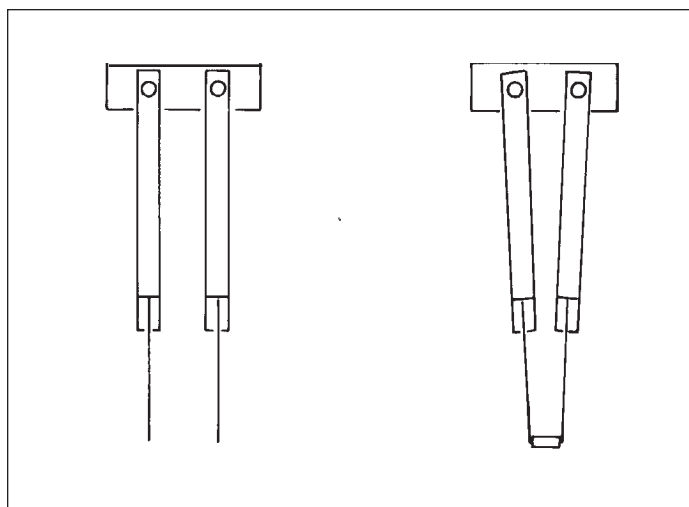


**Figure 1.6**  
***The DSC Autosampler's***  
***Three Major Axes of Motion***



## *The Gripper Fingers*

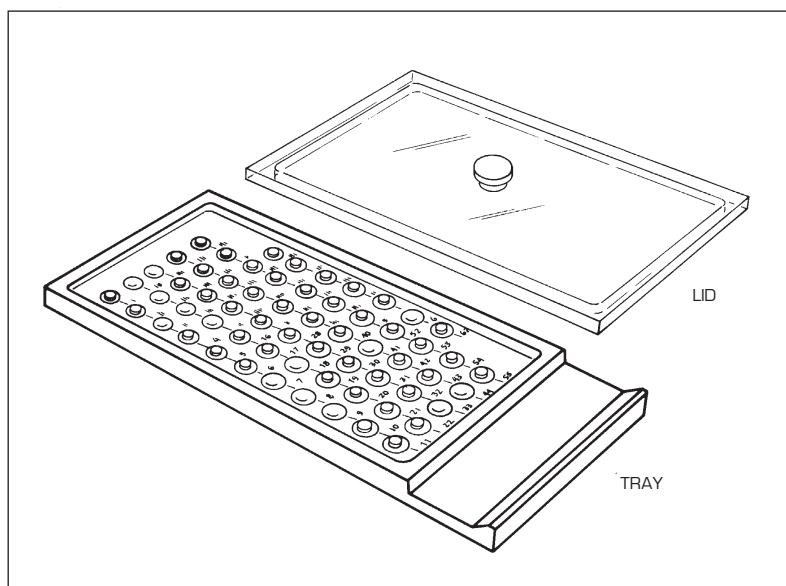
The Autosampler's gripper fingers (see Figure 1.7) open and close to firmly grasp each sample pan while not disturbing the material in the pan. They are made of conductive stainless steel and are controlled by tactile-feedback sensors that detect improperly gripped or dropped objects.



**Figure 1.7**  
**The DSC Autosampler**  
**Gripper Fingers**

## *The Sample Tray*

The sample tray is constructed of anodized aluminum and has a clear acrylic cover (see Figure 1.8). It holds up to 62 pans. Chapter 5 describes how to set up the sample tray.



**Figure 1.8**  
**The DSC Autosampler**  
**Sample Tray**

## The Keypad

The DSC Autosampler keypad operates independently of the DSC keypad (see your *DSC Operator's Manual* for details on its keypad). The Autosampler keypad consists of four types of keys (see Figure 1.9):

- *Autosampler control keys:*

ENTER	MANUAL/AUTOMATIC
ESCAPE/CLEAR	RESET SAMPLER
HALT	RESUME

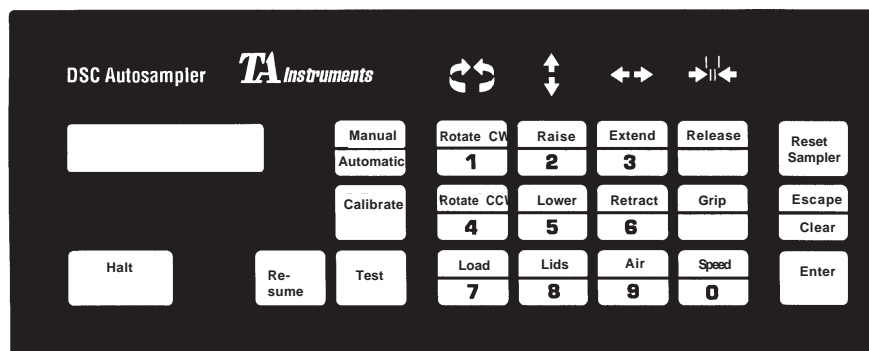
- *Command keys*, which tell the Autosampler to execute a series of movements, run diagnostic tests, and so on:

AIR	LOAD
CALIBRATE	SPEED
LIDS	TEST

- *Motion keys*, which move the turret assembly in the direction indicated on the key:

EXTEND	RETRACT
GRIP	RELEASE
RAISE	LOWER
ROTATE CW	ROTATE CCW

- *Numeric entry keys.*



**Figure 1.9**  
**The DSC**  
**Autosampler Keypad**

Some of the Autosampler keys have dual assignments:

- Commands (white keys) or motion directions (blue keys) are shown on the upper half of the dual-assignment keys.
- Numeric entries are shown on the lower half of the keys.

The current assignment of the dual-assignment keys is determined by the stage of operation of the Autosampler. The numeric entry function is active only when the Autosampler is requesting numeric input; otherwise, the command or direction on the upper half of the key is active.

The DSC Autosampler keys are explained in alphabetical order in Table 1.1 (pages 1-15 to 1-18). The motion keys are grouped into one entry entitled “The Motion Keys.”

**NOTE:**

Except for the HALT and RESET SAMPLER keys, the Autosampler keypad is operable only when the Autosampler is in manual mode (see Chapter 3).

**Table 1.1**  
**The Autosampler Keys**

Key	Description
CALIBRATE	Enables you to calibrate pan, lid, and tray positions on the Autosampler (see Chapter 4).
ENTER	Enters numeric responses, selects items from a menu, and stores calibration positions.
ESCAPE/ CLEAR	<p>Terminates any Autosampler keypad entry or command in progress.</p> <p>The current assignment of this key depends on the stage of operation of the Autosampler:</p> <ul style="list-style-type: none"> <li>When you have selected one of the Autosampler command keys (CALIBRATE, LIDS, LOAD, SPEED, or TEST), you can cancel the command and return to the previous command</li> </ul> <p><i>(table continued)</i></p>

**Table 1.1**  
**The Autosampler Keys**  
*(cont'd)*

Key	Description
	<p>by pressing the ESCAPE/CLEAR key. In this case, the ESCAPE function is active.</p> <ul style="list-style-type: none"><li>• When numeric input is requested (indicated by blinking cursor), you can clear the current entry by pressing the ESCAPE/CLEAR key. In this case, the CLEAR function is active.</li></ul>
HALT	<p>Provides two major functions (see Chapter 3):</p> <ul style="list-style-type: none"><li>• Temporarily stops Autosampler motion without canceling any prior commands.</li><li>• Enables you to switch from automatic to manual mode.</li></ul>
LIDS	<p>Covers or uncovers the DSC cell (see Chapter 3).</p> <p><i>(table continued)</i></p>

**Table 1.1**  
**The Autosampler Keys**  
**(cont'd)**

Key	Description
LOAD	Loads pans from the Autosampler tray to the DSC cell or unloads pans from the cell and returns them to the tray (see Chapter 3).
MANUAL/ AUTOMATIC	Toggles the Autosampler back and forth between manual and automatic modes (see Chapter 3).
Motion Key	Moves the turret assembly in the direction indicated on the key (see Chapter 3).
RESET SAMPLER	Clears all commands and returns the Autosampler to the home position (see Figure 3.2). Also instructs the Autosampler to “forget” the current lid and sample pan locations (see Chapter 3).
RESUME	Resumes the previous command when the Autosampler has been halted with the HALT key (see Chapter 3).

*(table continued)*

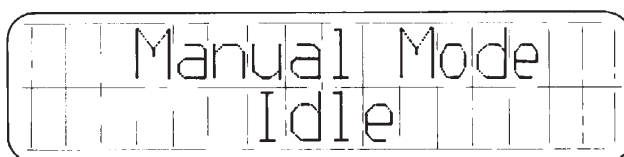
***Table 1.1***  
***The Autosampler Keys***  
***(cont'd)***

Key	Description
SPEED	Enables you to change the speed of manual Autosampler movement (see Chapter 3). In automatic mode, the Autosampler operates at preselected speeds depending on the function being performed.
TEST	Runs diagnostic tests to check the Autosampler's calibration, sensors, keypad, and etc. (see Chapter 6).



## The Display

The Autosampler has a 32-character liquid crystal display (see Figure 1.10). The screen displays a blinking cursor whenever user input is requested. The Autosampler's display is independent of the DSC instrument display (refer to the *DSC Operator's Manual* for details on the instrument display).



**Figure 1.10**  
*Autosampler Screen*

## The GPIB

The GPIB (General Purpose Interface Bus) is a two-way communications network consisting of the controller and the DSC instrument. Through the GPIB, the controller sends commands to control the instrument and Autosampler, then the instrument and Autosampler reply with data and status messages.

## System and Equipment Requirements

The required equipment for the DSC Autosampler includes:

- A TA Instruments controller.
- A source of compressed, dry air (15 psi minimum, 120 psi maximum) for adjusting the DSC cell temperature between runs.
- A DSC 2910 or 2920 thermal analysis instrument (with a DSC Cooling Jacket).
- DSC sample pans (standard-autosampler or hermetic).
- The crimping die (included with the DSC Autosampler).

Optional components that can be included in the Autosampler system are:

- A nitrogen gas purge.
- An additional gas purge controlled by the TA Instruments Gas Switching Accessory.
- The TA Instruments Liquid Nitrogen Cooling Accessory (LNCA) equipped with an adapter for the DSC for cooling experiments or Refrigerated Cooling System (RCS) equipped with environmental chamber.

***NOTE:***

The Autosampler is considered an accessory item for an existing instrument and therefore does not affect the space available for additional instruments on multi-instrument systems.

## Terminology

The terms **manual** and **automatic** are used throughout this book to describe the DSC Autosampler's two modes of operation. In manual mode, the Autosampler does not need to communicate with the controller and is controlled directly through its own keypad. In automatic mode, all Autosampler operations are supervised by the controller (see the *Thermal Solutions/ Advantage User Reference Guide* for information on the automatic mode). Once the Autosampler is in automatic mode, it can be in one of two states:

- **Online** (remote), in which the controller is correctly hooked up to the Autosampler and turned on.
- **Offline** (local), in which the controller is not connected to the Autosampler or is turned off. When the Autosampler is offline, it cannot communicate with the controller.

When the Autosampler is in **manual** mode, you can use the Autosampler keypad to:

- Calibrate the Autosampler
- Load and unload the DSC cell
- Remove and replace the lids on the DSC cell
- Run diagnostic tests.

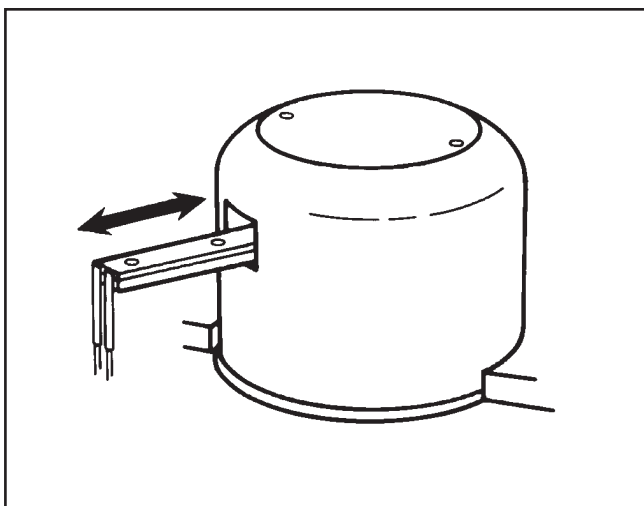
When the Autosampler is in **automatic** mode, you can use the Thermal Analyst controller keyboard to:

- Input experimental parameters
- Create, edit, and execute Autosampler run sequences that automatically load samples, run methods, and unload samples at the end of the experiment
- Maintain a log that records all activities of the Autosampler.

## Axis Terms

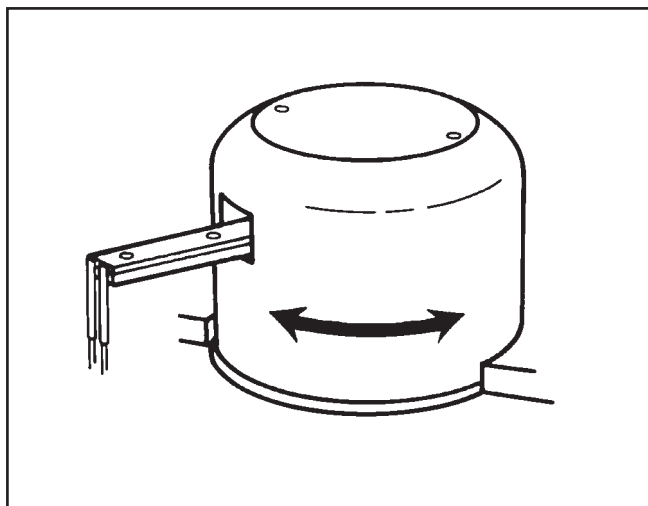
The terms **r-axis**,  **$\theta$ -axis**, and **z-axis** are used to describe the three axes of motion of the Autosampler.

Inward and outward movement of the turret arm occurs along the r-axis:



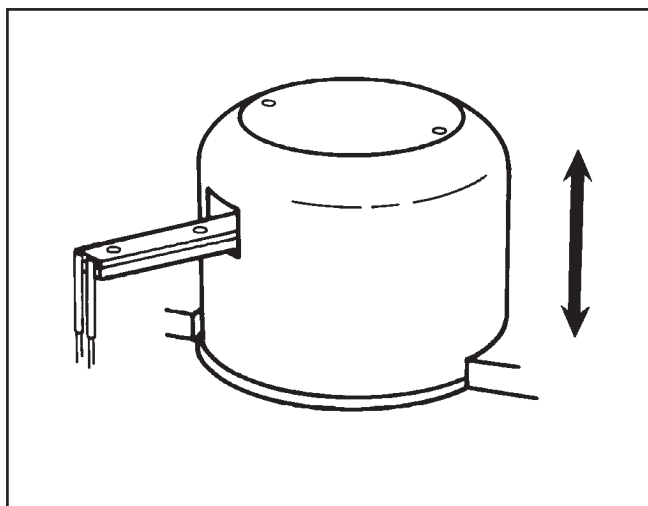
**Figure 1.11**  
**The R-Axis**

Rotational movement (clockwise and counter-clockwise) occurs along the  $\theta$ -axis (theta-axis):



**Figure 1.12**  
**The  $\theta$ -Axis**

Upward and downward movement occurs along the z-axis:



**Figure 1.13**  
**The Z-Axis**

## Testing Terminology

The terms **AS (Autosampler) run sequence** and **run** refer to the experiments that you set up to control the Autosampler motion and running of thermal analysis **methods**.

A **run** is a single TA experiment that consists of the following events:

- Reference and sample pans are loaded into the DSC cell furnace.
- The DSC furnace is covered with three metal lids.
- A standard thermal analysis method is executed.
- The DSC cell is returned to a near-ambient temperature.
- The DSC furnace is uncovered.
- The reference and sample pans are removed from the DSC furnace.

An **AS run sequence** is a series of runs that are executed consecutively. You create these run sequences using the *Thermal Solutions/Advantage* software, see the *User Reference Guide*.

A thermal analysis **method** is a set of segments that you create to control the operation of a thermal analysis instrument (see your *Thermal Solutions/Advantage User Reference Guide* for further details).

## Introducing the DSC Autosampler



## CHAPTER 2: Preparing the Autosampler

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## Preparing the Autosampler

# Introduction

When you purchase your Autosampler, it will be unpacked and set up by a TA Instruments representative. This section contains certain procedures that need to be performed occasionally as part of the Autosampler setup.

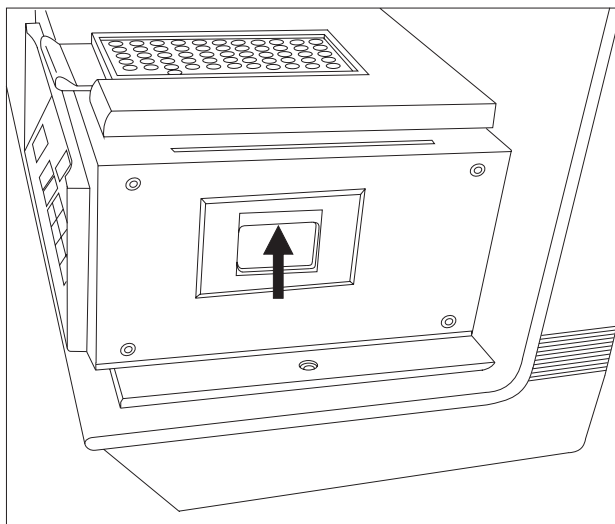
Once you have completed setting up your Autosampler as directed in this chapter, you will need to perform the calibration procedures, which are done while the accessory is in **manual** mode (see Chapter 3 for details on the manual mode).

## Preparing for Operation

### *Connecting the Heat Exchanger Cable*

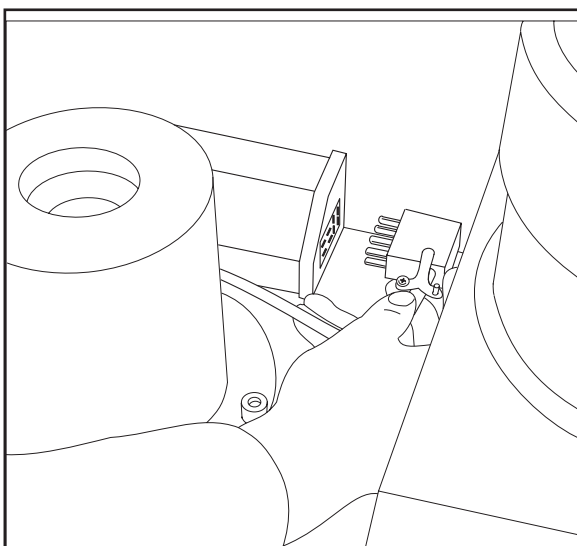
When you place the LNCA heat exchanger on the DSC instrument with an Autosampler, you need to connect the heat exchanger cable to the instrument. The DSC 2920 is not a problem because the Autosampler does not interfere with access to the outlet. However, the DSC 2910 has the power outlet on the side where access is blocked by the Autosampler. (The *LNCA Operator's Manual* contains more details on installing the heat exchanger.) To move the Autosampler out of the way and connect heat exchanger cable to the DSC 2910 instrument, perform the following steps:

1. Make sure that the DSC 2910 POWER switch is in the off position.
2. Locate the release handle on the right side of the Autosampler console and pull up on the handle (see Figure 2.1).
3. Holding onto the release handle, slide the console to the right.



**Figure 2.1**  
***Autosampler Console  
Release Handle***

4. Plug in the end of the heater exchanger cable into the electrical assembly as shown in Figure 2.2.



**Figure 2.2**  
***Plugging in the  
Heat Exchanger Cable***

## Preparing the Autosampler

---

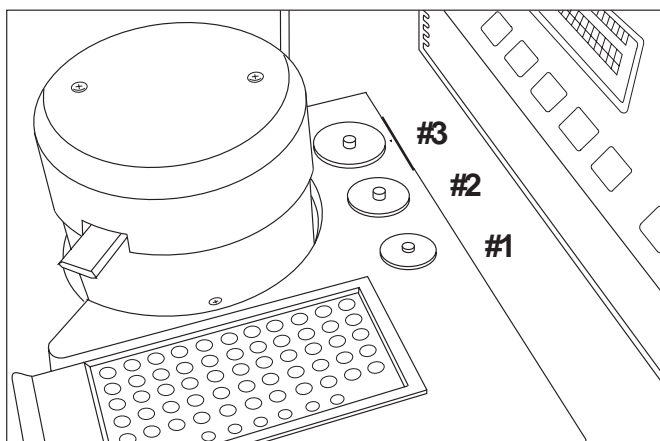
5. When the procedure is complete, slide the console back to the left until you hear it click into place.

## Installing the Autosampler Lids

When your Autosampler is unpacked, there will be three different lids that are to be used when a sample is placed into the cell. The lids are different sizes and made of different materials. In order to ensure that the Autosampler operates correctly while picking up and placing each lid in the appropriate place, you must make sure that they are installed in the proper location on the console. The lids are identified as follows:

Lid Number	Size	Material
#1	Small	Silver (with AS stamped on it)
#2	Medium	Stainless steel
#3	Large	Aluminum

Refer to the figure below (Figure 2.3) and place the lids in their respective positions.



**Figure 2.3**  
**Autosampler**  
**Lid Positions**

## *Installing the Dust Cover*

The plastic dust cover that comes with the Autosampler should be in place whenever you leave the Autosampler to run a series of samples. This will prevent dust and dirt from interfering with your experiments.

To put the dust cover on, simply insert the lip into the slot on the right-hand side of the console and lower it down.

***NOTE:***

|| The dust cover is not used when you are using the RCS with the environmental chamber on the Autosampler.



## After Preparation

Now that your Autosampler has been completely installed and set up, you will need to calibrate it so that it will properly pick up and deposit pans. Calibration is done using the manual mode functions, which are described in the next chapter. If you need information on using the manual mode, turn to Chapter 3. If you are ready to calibrate the Autosampler, turn to Chapter 4.

## Preparing the Autosampler

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## CHAPTER 3: Using the Autosampler in Manual Mode

---

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## Using the Autosampler in the Manual Mode

---

## Overview

Certain procedures must be done with the Autosampler in manual mode. (See page 1-22 for an explanation of the manual and automatic modes.) When the DSC Autosampler is in manual mode, it can be controlled by the Autosampler keypad. This chapter describes the following manual mode procedures:

- Switching to manual mode
- Moving the turret assembly manually
- Covering and uncovering the DSC cell
- Loading and unloading pans
- Stopping Autosampler movement.

Other manual Autosampler operations are described in different chapters of this manual. These include:

- Calibrating the Autosampler (Chapter 4)
- Running diagnostic tests (Chapter 6).

**NOTE:**

For complete information on using the automatic mode, refer to the *Thermal Solutions/Advantage* User Reference Guide.

## Starting the Autosampler

Follow these steps to start up the DSC instrument with the Autosampler:

Turn on the POWER switch on the DSC Autosampler. The Autosampler displays:

Confidence Test  
Version x.x

then:

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TA Instruments, Inc

See page 3-6 for a discussion of the confidence tests. When the confidence tests are complete, the display reads:

Automatic Mode  
Offline

The Autosampler will go into automatic mode upon initial start up. To change to the manual mode follow the procedure on the next page.

## *Switching from Automatic to Manual Mode*

1. Press the HALT key on the Autosampler keypad. The display reads:

Automatic Mode  
Halted

2. Press the MANUAL/AUTOMATIC key. The display reads:

Manual Mode  
Idle

The Autosampler is now in manual mode and is ready for a command from the Autosampler keypad. The display will read “Idle” until you press a key.

## *Understanding the Confidence Tests*

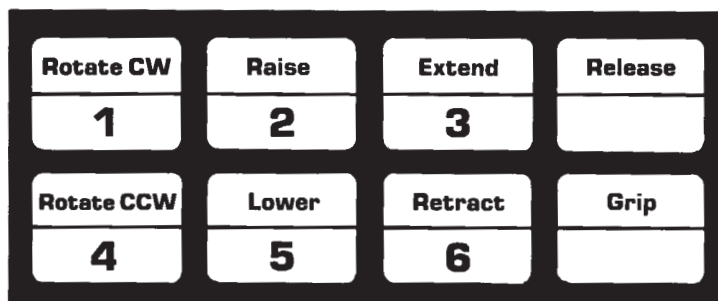
At power-up, the Autosampler runs a set of 13 confidence tests to check its internal electronics and memory, display, keypad, motors, and sensors. If a system that is critical to continued operation fails, the confidence tests stop and the Autosampler shuts down with an error message on the display, unless the display itself fails the test. If the display fails, it may remain blank or display random letters and symbols. If the Autosampler test error is noncritical to the remaining tests, the confidence tests finish but the last error message remains on the display and the Autosampler does not go into an operable mode.

If a confidence test error message is displayed, see the “Error Messages” section in Chapter 6 to determine the problem. If the display is not functional, you can use the confidence test ready light inside the instrument (viewed through the vents on the back of the instrument) to determine which test(s) detected an error (see “Using the Confidence Test Ready Light” on page 6-3).



## Moving the Turret Assembly

The motion keys (see Figure 3.1) are used to move the turret assembly in the direction indicated on the key. You can change the speed of the turret motion with the SPEED key. The motion and SPEED keys are explained on the following pages.

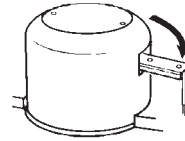


*Figure 3.1*  
*The DSC Autosampler*  
*Motion Keys*

## *The Motion Keys*

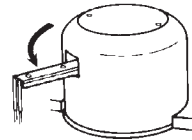
ROTATE  
CW

(Rotate Clockwise)  
Moves the turret clockwise until the clockwise limit is reached.



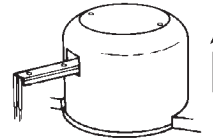
ROTATE  
CCW

(Rotate Counter-clockwise) Moves the turret counterclockwise until the counterclockwise limit is reached.



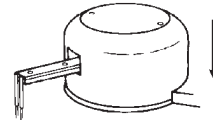
RAISE

Raises the turret until the upper limit is reached.



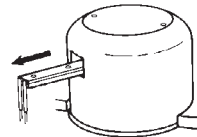
LOWER

Lowers the turret until the lower limit is reached.



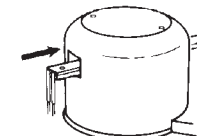
EXTEND

Extends the turret arm outward until the outer limit is reached.



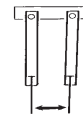
RETRACT

Retracts the turret arm inward until the inner limit is reached.



RELEASE

Opens the grippers to release an object.



GRIP

Closes the grippers to grasp an object.



## *Changing the Motor Speed*

The SPEED key enables you to change the speed of manual Autosampler movement. The speed you select applies only to the motion keys; when the Autosampler is executing commands from the controller or one of the Autosampler command keys (LOAD, LIDS), the speed is preset and is not affected by your selection.

1. Press the SPEED key. The Autosampler displays the current speed. For example:

Motor Speed 7 Selected
---------------------------

2. Select a new speed by pressing a numeric key from 0 to 9 then pressing ENTER. The lowest speed is 0, 9 is highest, and 7 is default (automatically selected when you turn on the Autosampler).

## Covering and Uncovering the DSC Cell

The LIDS key covers or uncovers the DSC cell when the Autosampler is in manual mode.

◆ **CAUTION:**

Do not remove lids exceeding 100°C from the DSC cell; they may damage the console.

1. Press the LIDS key. You are prompted to select option 1 (Uncover) or 2 (Cover):

Uncover (1) or  
Cover (2) ? 1

2. Select an option by pressing a numeric key then pressing ENTER.

If you select option 1, the Autosampler uncovers the cell and returns all cell lids to their storage positions. If you select option 2, the Autosampler removes all lids from their storage positions and places them on the cell.

**NOTE:**

If you select option 1 (Uncover) when all lids are in their storage positions or option 2 (Cover) when the lids are already on the cell, the Autosampler ignores the command and goes back to idle mode.

## Loading and Unloading Sample Pans

The LOAD key loads and unloads sample pans to and from the DSC cell when the Autosampler is in manual mode. If the lids are on the DSC cell, the Autosampler first removes them, then performs the load or unload function.

◆ **CAUTION:**

Do not unload the DSC cell when its temperature is above 100°C.

### Loading Pans

To load sample pans to the DSC cell in manual mode, follow these steps:

1. Press the LOAD key. You are prompted to select option 1 (Load) or 2 (Unload):

Load (1) or  
Unload (2) ? 1

2. Select the Load option by pressing ENTER. You are then prompted to select which cell position to load:

Load Ref (1) or  
Sample (2) ? 1

3. Select a cell position (reference or sample) by pressing a numeric key then pressing ENTER. You are then prompted to select the tray position to load from:

Sample Pan  
Number ? 1

4. Type a number between 1 and 62 then press ENTER. The Autosampler loads the pan to the cell position you chose in step 3. If there is already a pan in the cell position you selected, the Autosampler first returns that pan to its original tray position, then loads the new pan.

## Unloading Pans

The LOAD key unloads pans that have been loaded in automatic mode, manual mode, or with tweezers.

**NOTE:**

The Autosampler does not keep track of the pans in the sample tray. Be careful not to unload a pan on top of another pan in the tray.

1. Press the LOAD key. You are prompted to select option 1 (Load) or 2 (Unload):

Load (1) or  
Unload (2) ? 1

2. Select the Unload option by pressing the 2 key then pressing ENTER. You are then prompted to select which cell position to unload:

Unload Ref (1) or  
Sample (2) ? 1

3. Select a cell position (reference or sample) by pressing a numeric key then pressing ENTER. You are then prompted to select the destination tray position:

Sample Pan  
Number ? 0

4. Select a tray position:

- Press ENTER to select sample pan 0, and the Autosampler will unload the selected pan back to the tray position from which it was originally loaded.

OR

- Type a number between 1 and 62 to select a different tray position, then press ENTER.

**NOTE:**

If you load pans into the DSC cell by hand or press RESET SAMPLER after loading them with the LOAD key, you must enter a returning pan number (you cannot use sample pan number 0).

**NOTE:**

Press RESET SAMPLER to clear the Autosampler's memory whenever you remove a pan from the DSC cell with tweezers. If you do not, the Autosampler assumes that the pan is still in the cell, and if you later start a run on the controller, the Autosampler attempts to remove the pan and halts when it cannot find the pan.



## Stopping the Autosampler

Three keys on the Autosampler keypad enable you to suspend and resume Autosampler motion: the HALT key, the RESUME key, and the RESET SAMPLER key.

### *The HALT Key*

The HALT key affects only the motion of the Autosampler turret assembly; any currently running heating or cooling method on the controller continues. After you press the HALT key, you can resume action with the Autosampler RESUME key. The Autosampler then completes the task that was interrupted.

When the Autosampler is in manual mode, you can use the motion keys to move the turret assembly while it is halted without canceling the previous command. However, if you press any of the following keys while the Autosampler is halted, the previous command is forgotten:

- ESCAPE/CLEAR
- MANUAL/AUTOMATIC
- RESET SAMPLER

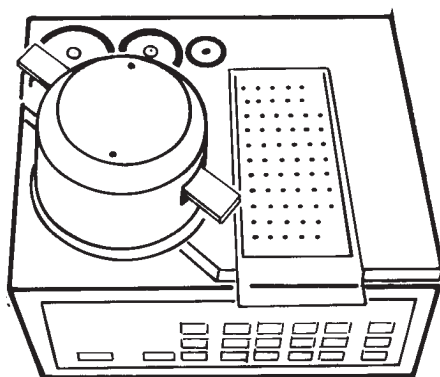
If you press ESCAPE/CLEAR after halting the Autosampler then enter a new command before pressing the RESUME key, the new command is executed when you press RESUME.

## *The RESUME Key*

The RESUME key resumes the last command after the Autosampler has been halted with the HALT key. This key does not resume the previous command after you press the RESET SAMPLER key.

## *The RESET SAMPLER Key*

In manual mode, the RESET SAMPLER key clears all commands, assumes that the cell is empty and all pans are in the tray, and returns the Autosampler to the home position (see Figure 3.2).



**Figure 3.2**  
**The DSC Autosampler**  
**in Home Position**

When you press the RESET SAMPLER key, the Autosampler displays:

Enter to Reset  
Escape to Cancel

To execute the Reset Sampler command, press ENTER. To cancel the Reset Sampler command and return to the previous operation, press ESCAPE/CLEAR.

If you press ENTER to continue the reset, the display shows:

Manual Mode  
Resetting

When the Autosampler reaches home position, the display displays:

Manual Mode  
Idle

and the Autosampler is ready for a command.

**NOTE:**

When the Autosampler is in automatic mode, the RESET SAMPLER key stops the AS run sequence and method currently being executed from the controller.

## Conditions When Resetting

The Autosampler assumes that the DSC cell is empty when you press RESET SAMPLER, so you should check that this is true whenever you press this key. If there are any pans in the cell after you press RESET SAMPLER, you must remove them manually with tweezers or the Autosampler motion keys. The Autosampler does check that all lids are in their storage positions and displays an error message if they are not.

**NOTE:**

If you press RESET SAMPLER when a pan is still in the DSC cell, then use the LOAD key to load a pan into the same position, the Autosampler will not know that the first pan is there and will attempt to load the second pan onto the first. This could cause damage to the pans. Always check that the cell is empty after you press RESET SAMPLER.

## CHAPTER 4: Calibrating the Autosampler

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## Calibrating the Autosampler

---

# Overview

**NOTE:**

The calibration procedures described in this chapter are critical to proper operation of the Autosampler.

In order for the Autosampler to accurately pick up, load, and unload sample pans, it must be correctly calibrated. There are four different calibration procedures for the Autosampler:

- Cell lid positions
- Cell pan positions
- Lid storage positions
- Sample tray positions.

The display that is used to calibrate the positions, and a brief description of each one are listed and illustrated in Table 4.1 beginning on the next page.

You will need to calibrate the cell lid and cell pan positions using the procedures described on pages 4-11 to 4-19. The lid storage and sample tray calibrations described on pages 4-20 to 4-25 are performed at the factory; however, these procedures are provided in case calibration of these positions becomes necessary.

After you calibrate the Autosampler, check your calibration by following the guidelines in “Checking Your Calibration” (pages 4-26 to 4-31).

Once the Autosampler is correctly calibrated, you may need to recalibrate it only when you replace the DSC cell. Periodic checks are the best way of determining when the Autosampler needs recalibration.

**Table 4.1**  
**Autosampler**  
**Calibration Position**

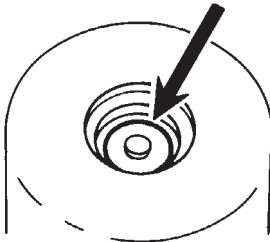
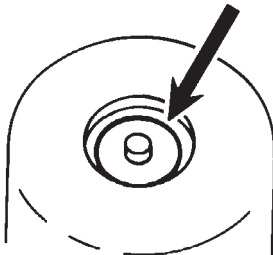
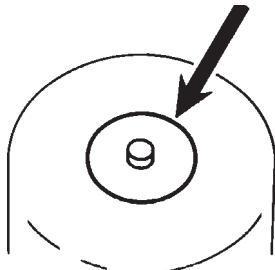
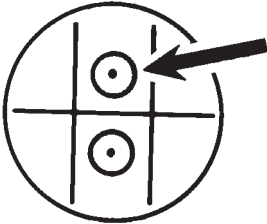
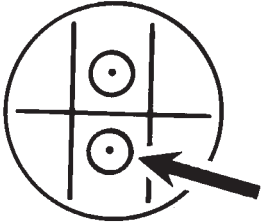
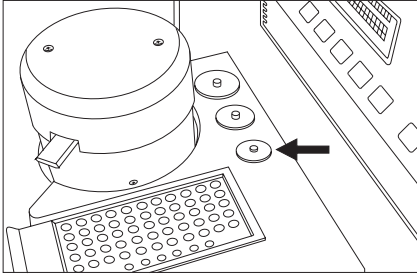
Screen Display	Autosampler Position
<div>Calibrate/Verify Lid #1 Cell</div>	<p>The small, silver lid's position on the DSC cell.</p> 
<div>Calibrate/Verify Lid #2 Cell</div>	<p>The medium-sized, stainless-steel lid's position on the DSC cell.</p> 
<div>Calibrate/Verify Lid #3 Cell</div>	<p>The large, aluminum lid's position on the DSC cell.</p>  <p><i>(table continued)</i></p>



Table 4.1 (continued)

Screen Display	Autosampler Position
<div style="border: 1px solid black; padding: 5px; text-align: center;"> <b>Calibrate/Verify Cell Ref. Pos.</b> </div>	<p>The dimple in the DSC cell where the reference pan is placed (the rear position).</p> 
<div style="border: 1px solid black; padding: 5px; text-align: center;"> <b>Calibrate/Verify Sample Pos.</b> </div> <p>Single Sample Cell Display</p>	<p>The dimple in a DSC cell where the sample pan is placed. (For dual sample cells, choose side A or B.)</p>
<div style="border: 1px solid black; padding: 5px; text-align: center;"> <b>Calibrate/Verify Sample A/B</b> </div> <p>Dual Sample Cell Display</p>	 <p>Single Sample DSC Cell</p>
<div style="border: 1px solid black; padding: 5px; text-align: center;"> <b>Calibrate/Verify Lid #1 Storage</b> </div>	<p>The small, silver lid's storage position.</p>  <p style="text-align: right;"><i>(table continued)</i></p>

**Table 4.1 (continued)**

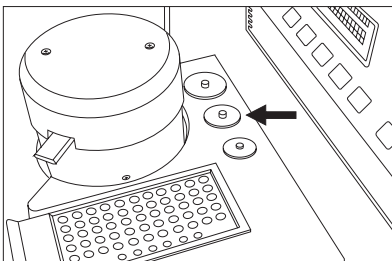
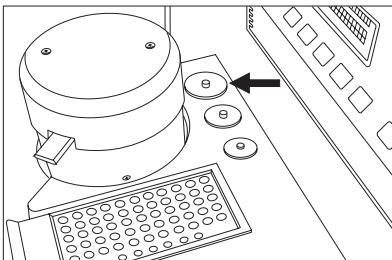
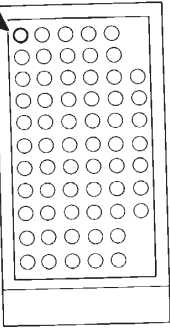
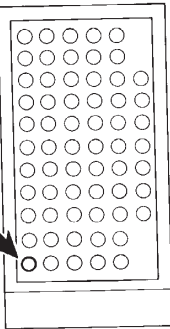
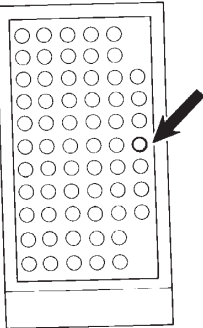
Screen Display	Autosampler Position
<div>Calibrate/Verify Lid #2 Storage</div>	<p>The medium-sized, stainless-steel lid's storage position.</p> 
<div>Calibrate/Verify Lid #3 Storage</div>	<p>The large, aluminum lid's storage position.</p>  <p><i>(table continued)</i></p>

Table 4.1 (continued)

Screen Display	Autosampler Position
<div>Calibrate/Verify Tray Pos. #1</div>	<p>Position 1 on the sample tray.</p> 
<div>Calibrate/Verify Tray Pos. #11</div>	<p>Position 11 on the sample tray.</p> 
<div>Calibrate/Verify Tray Pos. #59</div>	<p>Position 59 on the sample tray.</p> 

## *Precalibration Checklist*

Use the checklist below to make sure your Autosampler system is set up properly and ready to be calibrated.

Ensure that:

- ☐ You have two properly crimped, empty pans to use in the calibration procedure (see Chapter 5 for pan crimping instructions). Hermetic or open pans are not recommended for calibration. When you have finished and checked your calibration, you can cycle hermetic or open pans for further verification.
- ☐ The DSC cell is level and properly installed.
- ☐ Air lines and optional cell purge nitrogen gas lines are connected.
- ☐ The Autosampler is on and has passed the confidence tests.
- ☐ The DSC cell has been calibrated for temperature, cell constant, and baseline (see your *Thermal Solutions/Advantage—User Reference Guide* for instructions).
- ☐ The DSC cell is clean and free of corrosion or boiled-out material from previous experiments.

## Performing the Calibration

Please read the following cautions and notes before calibrating the Autosampler. They are numbered for easy reference.

### CAUTIONS

◆ **CAUTION:**

1) Each time you select the Verify function or move the turret with the LIDS or LOAD key, hold your finger over the HALT key so that you can stop the Autosampler if it looks as if the grippers are going to run into something. After halting the Autosampler, take one of the following actions:

- If the Autosampler was performing a Verify function, press RESET SAMPLER and repeat the Verify operation to recheck the position. If it is incorrect, HALT the Autosampler again, press ESCAPE/CLEAR to cancel the Verify function, press RESUME, then recalibrate the position.
- If the Autosampler was performing a LIDS or LOAD function, press ESCAPE/CLEAR to cancel the LIDS command, then press RESUME to continue with the calibration.

◆ **CAUTION:**

2) During calibration, the Autosampler does not keep track of lid and pan locations. When you use the Verify function, watch carefully to ensure that the Autosampler does not attempt to stack lids or pans on top of each other.

## NOTES

- NOTE:** 1) Calibrate the Autosampler in the order shown in this manual.
- NOTE:** 2) The Autosampler must be in manual mode during calibration (see Chapter 3).
- NOTE:** 3) You should be familiar with how the motion keys work before you calibrate the Autosampler. For a review of motion key operation, please see Chapter 3.
- NOTE:** 4) You can change the speed of the motion keys at any point in the calibration procedures by pressing the SPEED key and entering a new speed (number from 0 to 9). The default speed is 7 at Autosampler power-up. Lower speeds are recommended for fine control, but you may want to change to higher speeds when you are moving the turret for longer distances. For more information on the SPEED key, please see Chapter 3.
- NOTE:** 5) If the grippers, either empty or holding a pan or lid, contact the DSC cell furnace, the Autosampler displays a "Contact Error" message and freezes operation of all motion keys except the RAISE key. This is a safety feature that prevents the grippers from being bent or puncturing the floor of the DSC cell furnace. To correct the condition, simply press the RAISE key to clear the grippers from the obstacle, then reposition the grippers with the other motion keys (ROTATE, EXTEND, RETRACT) and try again.
- NOTE:** 6) If the Autosampler screen displays any step-error messages during the calibration procedure, press RESET SAMPLER, then recalibrate the position. Positions calibrated during a step-error condition may not be reliable.

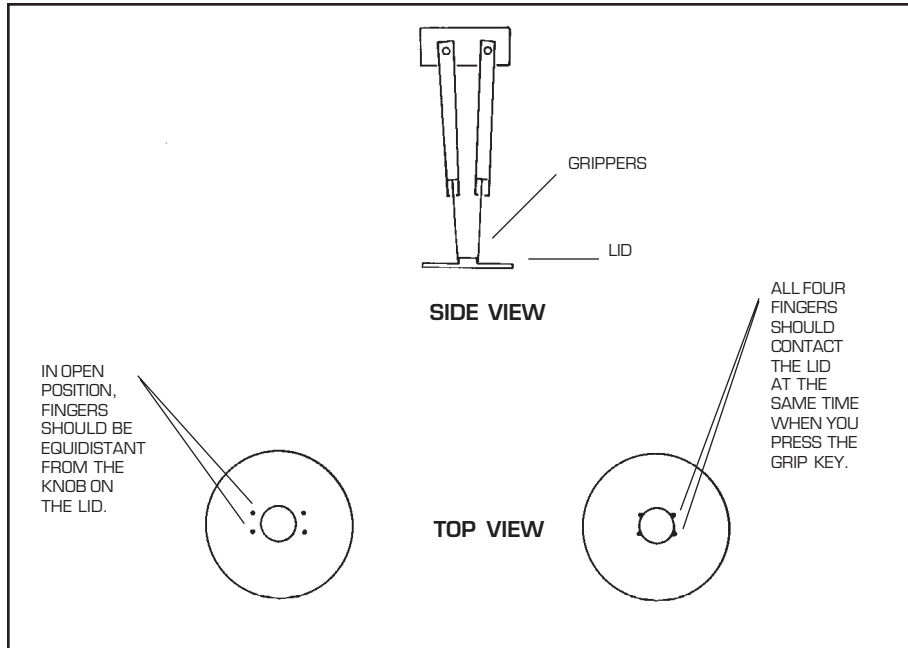
## *Calibrating the Cell Lid Positions*

Because each DSC cell is custom made, the cell lid positions cannot be calibrated at the factory and must be calibrated on newly installed Autosamplers.

1. Press RESET SAMPLER and press ENTER to bring the Autosampler to home position.
2. Make sure all lids are in their storage positions (see Table 4.1).
3. Press the LIDS key. The screen displays:

Uncover [1] or Cover [2] ? 1
---------------------------------

4. Select option 2 (Cover) by pressing the 2 key then pressing ENTER. The Autosampler picks up a lid and begins moving toward the cell.
5. Press the ESCAPE/CLEAR key when the Autosampler reaches the DSC cell area.
6. Use the motion keys to position the lid in its correct cell calibration position (see Table 4.1). Press the RELEASE and GRIP keys repeatedly to ensure that the fingers can firmly grasp the lid, and watch carefully to ensure that each finger contacts the lid at the same time (see Figure 4.1).



**Figure 4.1**  
**Calibrating a**  
**Cell Lid Position**

7. When you are satisfied that the lid is properly positioned, press the CALIBRATE key until you see the correct cell lid position on the display:

Calibrate/Verify  
Lid #1 Cell

8. Press ENTER. The screen displays:

Verify (1) or  
Store (2) ? 1



9. Select option 2 (Store) to store the calibration position (press the 2 key then press ENTER). The screen displays:

Lid #1 Cell  
Calibrated

10. Release the lid (press the RELEASE key). Press RESET SAMPLER and ENTER to bring the Autosampler to the home position. Disregard the message “Error Lid #1 not stored.” Press the CALIBRATE key until you see the correct cell lid position on the display:

Calibrate/Verify  
Lid #1 Cell

11. Press ENTER. The screen displays:

Verify (1) or  
Store (2) ? 1

12. Press ENTER to select default option 1 (Verify).
13. When the turret stops moving, close and open the grippers again and check your calibration against the criteria in Figure 4.1. Remember to release the lid. If the position is correctly calibrated, go on to step 14. If it is not, repeat steps 3 through 13 with lid #1.

14. Repeat steps 3 through 13 with lids 2 and 3 (the medium-sized and large lids). The screen displays in steps 7, 9, and 10 are the same except for the lid numbers:

Steps 7 and 10:

Calibrate/Verify  
Lid #2 Cell

or

Calibrate/Verify  
Lid #3 Cell

Step 9:

Lid #2 Cell  
Calibrated

or

Lid #3 Cell  
Calibrated

15. When you have calibrated all three cell lid positions, use the LIDS key to return the lids to their storage positions (select option 1 Uncover).
16. Press ESCAPE/CLEAR to exit the calibration procedure.
17. If you are calibrating a newly installed Autosampler, go on to “Calibrating the Cell Pan Positions” (pages 4-15 to 4-19). Otherwise, go on to the section entitled “Checking Your Calibration” (page 4-26).

## Calibrating the Cell Pan Positions

Because each DSC cell is custom made, the cell pan positions cannot be calibrated at the factory and must be calibrated on newly installed Autosamplers.

1. Press RESET SAMPLER and press ENTER to bring the Autosampler to the home position.
2. Make sure the cell lids are in their storage positions (see Table 4.1), and place empty crimped pans in tray positions 1 and 2.
3. Press the LOAD key. The screen displays:

Load {1} or  
Unload {2} ? 1

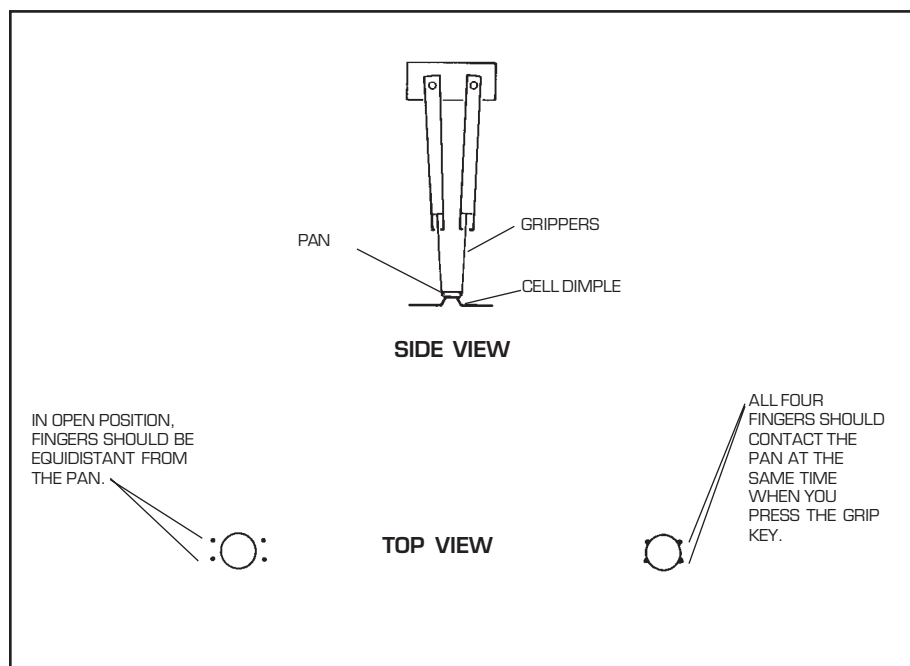
4. Select option 1 (Load) by pressing ENTER. The screen displays:

Load Ref {1}  
Sample {2} ? 1

5. Select option 1 (Load Ref) by pressing ENTER. The screen displays:

Sample Pan  
Number ? 1

6. Select tray position 1 by pressing ENTER. The Autosampler picks up the pan in tray position 1 and begins moving toward the cell.
7. Press ESCAPE/CLEAR when the Autosampler reaches the DSC cell area.
8. Use the motion keys to position the pan in its correct calibration position (see Table 4.1). Press the RELEASE and GRIP keys repeatedly to ensure that the fingers can firmly grasp the pan, and watch carefully to ensure that each finger contacts the pan at the same time (see Figure 4.2).



**Figure 4.2**  
**Calibrating a**  
**Cell Pan Position**

9. When you are satisfied that the pan is properly positioned, press the CALIBRATE key repeatedly until you see the correct cell pan position on the display:

Calibrate/Verify  
Cell Ref. Pos.

10. Press ENTER. The screen displays:

Verify (1) or  
Store (2) ? 1

11. Select option 2 (Store) to store the calibration position (press the 2 key then press ENTER). The screen displays:

Cell Ref. Pos.  
Calibrated

12. Release the pan (press the RELEASE key). Press RESET SAMPLER and ENTER to bring the Autosampler to the home position. Press the CALIBRATE key until you see the correct cell lid position on the display:

Calibrate/Verify  
Cell Ref. Pos.

13. Press ENTER. The screen displays:

Verify (1) or  
Store (2) ? 1

14. Press ENTER to select default option 1 (Verify).

15. When the turret stops moving, close and open the grippers again and check your calibration against the criteria in Figure 4.2. Remember to release the pan. If the position is correctly calibrated, go on to step 16. If it is not, repeat steps 3 through 15.

16. Press the LOAD key. The screen displays:

Load (1) or  
Unload (2) ? 1

17. Select option 1 (Load) by pressing ENTER. The screen displays:

Load Ref (1) or  
Sample (2) ? 1

18. Select option 2 (Sample) by pressing 2 then ENTER. The screen displays:

Sample Pan  
Number ? 1

19. Select tray position 2 (press the 2 key then press ENTER). The Autosampler picks up the pan in tray position 2 and begins moving toward the cell.

20. Press ESCAPE/CLEAR when the Autosampler reaches the DSC cell area.

21. Use the motion keys to position the pan in its correct calibration position (see Table 4.1). Press the RELEASE and GRIP keys repeatedly to ensure that the fingers can firmly grasp the pan, and watch carefully to ensure that each finger contacts the pan at the same time (see Figure 4.2).

22. When you are satisfied that the pan is properly positioned, press the CALIBRATE key repeatedly until you see the correct cell pan position on the display:

Calibrate/Verify  
Sample Pos.

23. Press ENTER. The screen displays:

Verify (1) or  
Store (2) ? 1

24. Select option 2 (Store) to store the calibration position (press the 2 key then press ENTER). The screen displays:

Sample Pos.  
Calibrated

25. Release the pan (press the RELEASE key). Press RESET SAMPLER and ENTER to bring the Autosampler to the home position. Press the CALIBRATE key until you see the correct cell lid position on the display:

Calibrate/Verify  
Sample Pos.

26. Press ENTER. The screen displays:

Verify (1) or  
Store (2) ? 1

27. Press ENTER to select default option 1 (Verify).

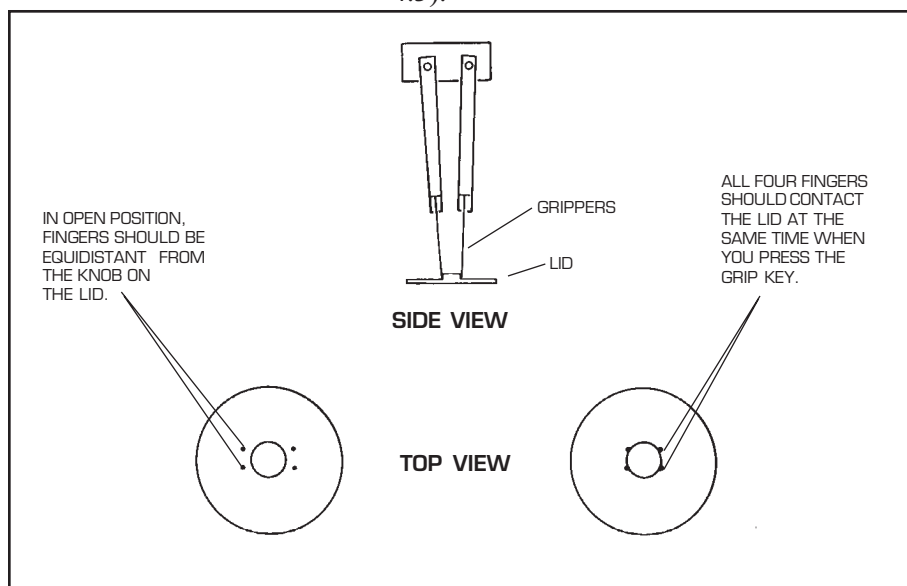
28. When the turret stops moving, close and open the grippers again and check your calibration against the criteria in Figure 4.2. Remember to release the pan and raise the turret out of the cell with the RAISE key.
29. Use the LOAD key to remove the pans from the cell.
30. Press ESCAPE/CLEAR to end the calibration procedure. Go on to the section entitled “Checking Your Calibration” (page 4-26).



## Calibrating the Lid Storage Positions

To calibrate the lid storage positions, follow the steps below:

1. Press RESET SAMPLER and press ENTER to bring the Autosampler to home position.
2. Check that the three cell lids are in their storage positions (see Table 4.1).
3. Use the motion keys to position the grippers over lid #1 (the small lid). Press the GRIP and RELEASE keys repeatedly to ensure that the fingers can firmly grasp the lid, and watch carefully to ensure that each finger contacts the lid at the same time (see Figure 4.3).



**Figure 4.3**  
**Calibrating a Lid**  
**Storage Position**

4. Press the CALIBRATE key repeatedly until you see the correct lid storage position on the display:

Calibrate/Verify  
Lid #1 Storage

5. Press ENTER. The screen displays:

Verify (1) or  
Store (2) ? 1

6. Select option 2 (Store) to store the calibration position (press the 2 key then press ENTER). The screen displays:

Lid #1 Storage  
Calibrated

7. Release the lid (press the RELEASE key). Press RESET SAMPLER and ENTER to bring the Autosampler to the home position. Press the CALIBRATE key until you see the correct cell lid position on the display:

Calibrate/Verify  
Lid #1 Storage

8. Press ENTER. The screen displays:

Verify (1) or  
Store (2) ? 1

9. Press ENTER to select default option 1 (Verify).

10. When the turret stops moving, close and open the grippers again and check your calibration against the criteria in Figure 4.3. Remember to release the lid. If the position is correctly calibrated, go on to step 11. If it is not, repeat steps 3 through 10 with lid #1.
11. Repeat steps 3 through 10 to calibrate the storage positions for lids 2 and 3 (the medium-sized and large lids). The screen displays in steps 4, 6, and 7 are the same except for the lid numbers:

Steps 4 and 7:

Calibrate/Verify  
Lid #2 Storage

or

Calibrate/Verify  
Lid #3 Storage

Step 6:

Lid #2 Storage  
Calibrated

or

Lid #3 Storage  
Calibrated

12. Press **ESCAPE/CLEAR** to exit the calibration procedure.

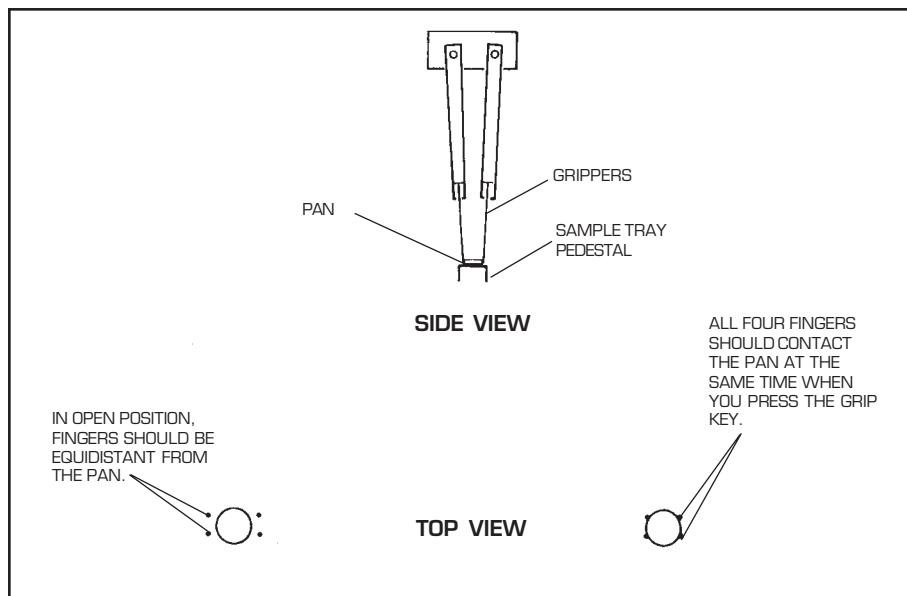
## *Calibrating the Sample Tray*

To calibrate the sample tray positions, use the following procedures:

**NOTE:**

The Autosampler uses the calibrated tray positions 1, 11, and 59 to calculate all other tray positions. Be sure to verify each of these positions as described below.

1. Press RESET SAMPLER and press ENTER to bring the Autosampler to the home position.
2. Make sure the sample tray is fully inserted.
3. Place empty crimped pans in tray positions 1, 11, and 59.
4. Use the motion keys to position the grippers over the pan in tray position #1. Press the GRIP and RELEASE keys to ensure that the fingers can firmly grasp the pan, and watch carefully to ensure that each finger contacts the pan at the same time (see Figure 4.4).



**Figure 4.4**  
**Calibrating a Tray Position**

5. Press the CALIBRATE key repeatedly until you see the correct tray position on the display:

Calibrate/Verify  
Tray Pos. #1

6. Press ENTER. The screen displays:

Verify (1) or  
Store (2) ? 1

7. Select option 2 (Store) to store the calibration position (press the 2 key then press ENTER). The screen displays:

Tray Pos. #1  
Calibrated

8. Release the pan (press the RELEASE key). Press RESET SAMPLER and ENTER to bring the Autosampler to the home position. Press the CALIBRATE key until you see the correct cell lid position on the display:

Calibrate/Verify  
Tray Pos. #1

9. Press ENTER. The screen displays:

Verify (1) or  
Store (2) ? 1

10. Press ENTER to select default option 1 (Verify).
11. When the turret stops moving, close and open the grippers again and check your calibration against the criteria in Figure 4.4. Remember to release the pan. If the position is correctly calibrated, go on to step 12. If it is not, repeat steps 4 through 11 for tray position 1.
12. Repeat steps 4 through 11 for tray positions 11 and 59. The screen displays in steps 5, 7, and 8 are the same except for the tray position numbers:

Steps 5 and 8:

Calibrate/Verify  
Tray Pos. #11

or

Calibrate/Verify  
Tray Pos. #59

Step 7:

Tray Pos. #11  
Calibrated

or

Tray Pos. #59  
Calibrated

13. Press ESCAPE/CLEAR to exit the calibration procedure.

## Checking Your Calibration

This section recommends three methods to check the accuracy of your Autosampler calibrations:

- The LOAD/LIDS test
- The Verify test
- The Cycle Pans test.

We recommend that you use the LOAD/LIDS test to check your first calibration. The Verify test is ideal for quick checks after you make small adjustments. The Cycle Pans test is useful for long-term cycling tests that check the Autosampler's ability to continuously load and unload samples and lids. Whatever method you use, always be ready to press the HALT key if the Autosampler turret arm starts to run into something.

If the Autosampler has trouble completing any of the tests or displays any error messages, note the position(s) showing a problem, then stop the test. You do not need to recalibrate the entire Autosampler; recalibrate only the incorrect positions by following the appropriate steps on pages 4-11 to 4-25. If you need to recalibrate any of the sample tray positions, however, you must verify all three. The Autosampler uses the calibration values for positions 1, 11, and 59 to determine the locations of all pans on the tray.

After correcting a calibration, run the Verify test again.

**NOTE:**

Make sure the DSC cell is empty before you run the following tests.



## *The LOAD/LIDS Test*

The LOAD/LIDS test is recommended for comprehensive testing of all calibration positions.

### **Step A:**

**Use the **LOAD** key to test the Autosampler's ability to load and unload pans from the tray to the DSC cell.**

1. Press RESET SAMPLER and press ENTER to bring the Autosampler to home position.
2. Place empty crimped pans in tray positions 6, 45, and 55.
3. Press the LOAD key. The Autosampler screen displays:

Load (1) or  
Unload (2) ? 1

4. Select option 1 (Load) by pressing ENTER. The screen displays:

Load Ref (1) or  
Sample (2) ? 1

5. Select option 1 (Ref) by pressing ENTER. The screen displays:

Sample Pan  
Number ? 1

6. Select tray position 6 (press the 6 key then press ENTER). The Auto-sampler loads the pan in tray position 6 into the cell reference position.
7. Press the LOAD key again.
8. Select option 1 (Load) by pressing ENTER.
9. Select option 2 (Sample) by pressing the 2 key then pressing ENTER.
10. Select tray position 45 (press 45 then ENTER). The Autosampler loads the pan in tray position 45 into the cell sample (or sample A) position.
11. Press the LOAD key again.
12. Select option 1 (Load) by pressing ENTER.
13. Select option 1 (Ref) by pressing ENTER.
14. Select tray position 55 (press 55 then ENTER). The Autosampler loads the pan in tray position 55 into the cell reference position. The Autosampler first unloads pan 6 from the reference position.
15. Press the LOAD key again. The screen displays:

Load [1] or  
Unload [2] ? 1

16. Select option 2 (Unload) by pressing the 2 key then pressing ENTER. The screen displays:

Unload Ref[1] or  
Sample[2] ? 1

17. Select option 1 (Ref) by pressing ENTER. The screen displays:

Sample Pan  
Number ? 0

18. Select default tray position 0 by pressing ENTER (tray position zero tells the Autosampler to return the pan to the tray position from which it was loaded).

19. Press the LOAD key again.

20. Select option 2 (Unload) by pressing the 2 key then pressing ENTER.

21. Select option 2 (Sample) by pressing the 2 key then pressing ENTER.

22. Select default tray position 0 by pressing ENTER.

**Step B:**

**Use the LIDS key to test the Autosampler's ability to cover the DSC cell.**

1. Press RESET SAMPLER and press ENTER to bring the Autosampler to home position.
2. Press the LIDS key. The Autosampler screen displays:

Uncover (1) or  
Cover (2) ? 1

3. Select option 2 (Cover) by pressing the 2 key then pressing ENTER. The Autosampler removes all lids from their storage positions and places them on the cell.
4. Press the LIDS key again. The screen displays:

Uncover (1) or  
Cover (2) ? 1

5. Select default option 1 (Uncover) by pressing ENTER. The Autosampler removes all lids from the cell and returns them to their storage positions.

## *The Verify Test*

The Verify function is best for testing individual pan or lid positions.

1. Press RESET SAMPLER and press ENTER to bring the Autosampler to home position.
2. Press the CALIBRATE key repeatedly until the screen displays the position you want to check.
3. Press ENTER. The screen displays:

Verify {1} or Store {2} ? 1
--------------------------------

4. Select option 1 (Verify) by pressing ENTER. The Autosampler should move to the position you selected in step 2.
5. Use Table 4.1 to determine whether the turret is in the correct position when it stops moving. Press the GRIP and RELEASE keys to test the grippers' ability to firmly grasp the object.
6. To test another position, go back to step 2. Press ESCAPE/CLEAR when you are finished with the Verify test.

## *The Cycle Pans Test*

The Cycle Pans test exercises all of the Autosampler's loading and unloading functions, but requires only a few simple keystrokes. It is recommended as a double check after the LOAD/LIDS test or as a quick verification for experienced users.

1. Press RESET SAMPLER and press ENTER to bring the Autosampler to home position.
2. Load the sample tray with at least five empty crimped pans. Use sample tray positions 1 through 5.
3. Press the TEST key two times. The screen displays:

Test  
Cycle Pans

4. Press ENTER to select the Cycle Pans test. This test causes the Autosampler to continuously load and unload pans into the DSC cell reference and sample positions. (See "Testing Autosampler Functions" in Chapter 6 for further explanation of the Cycle Pans test.)
5. Allow the Autosampler to complete at least one full cycle of the test:
  - Two pans are removed from their tray positions and placed in the cell.

- The lids are placed on the cell.
- The lids are removed.
- The pans are returned to their storage positions.

If you must stop the test because of calibration errors, press the **ESCAPE/CLEAR** key.

6. Press **ESCAPE/CLEAR** to stop the Cycle Pans test after the Autosampler completes at least one cycle of the test.

## Calibrating the Autosampler

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## CHAPTER 5: Preparing Samples

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Installing the Crimping Die .....	5-4
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Autosampler Run Capacity .....	5-10
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Preparing Sample Pans .....	5-14
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## Preparing Samples

# Overview

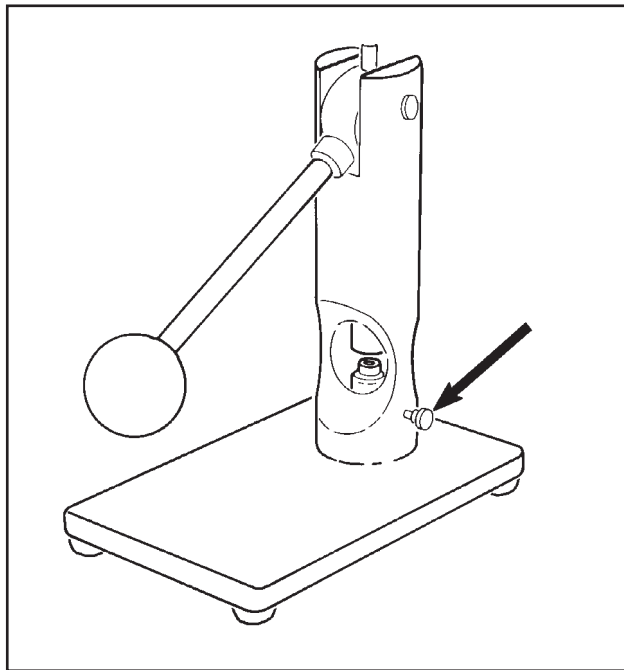
This chapter explains how to:

- Install the TA Instruments crimping die in the sample encapsulating press
- Set up the sample tray
- Prepare crimped and hermetic pans for Autosampler use.

## Installing the Crimping Die

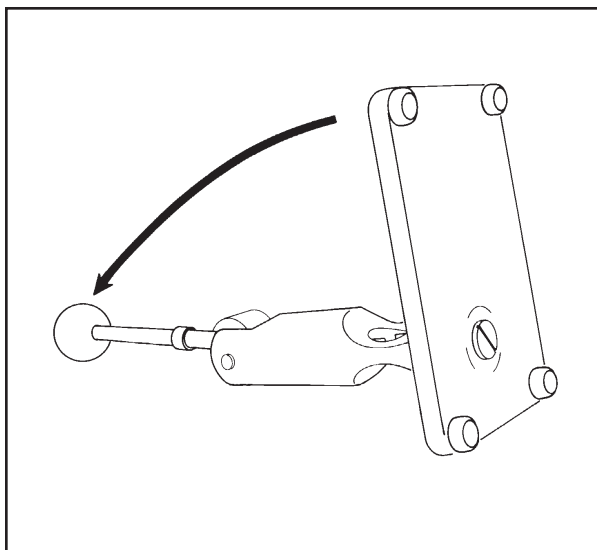
The Autosampler comes equipped with a crimping die designed to work with the TA Instruments Autosampler crimped pans. Follow the steps below to install the crimping die in the sample encapsulating press before preparing crimped pans for Autosampler use.

1. Loosen the lower die holder thumbscrew on the sample encapsulating press.



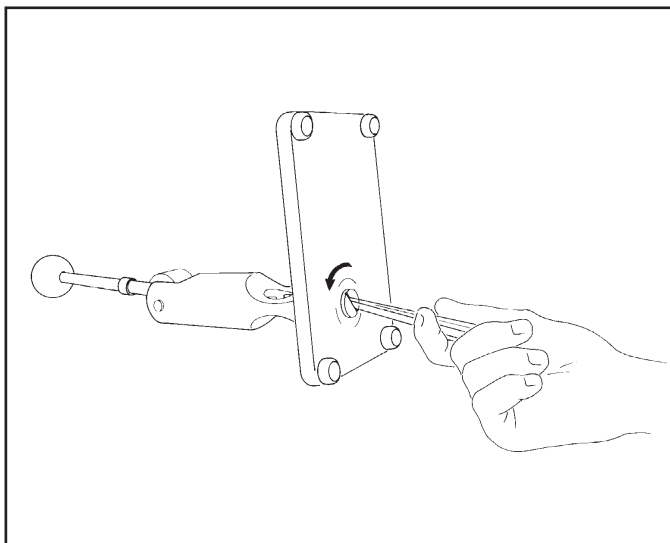
**Figure 5.1**  
**The Lower Die**  
**Holder Thumbscrew**

2. Turn the sample press on its back.



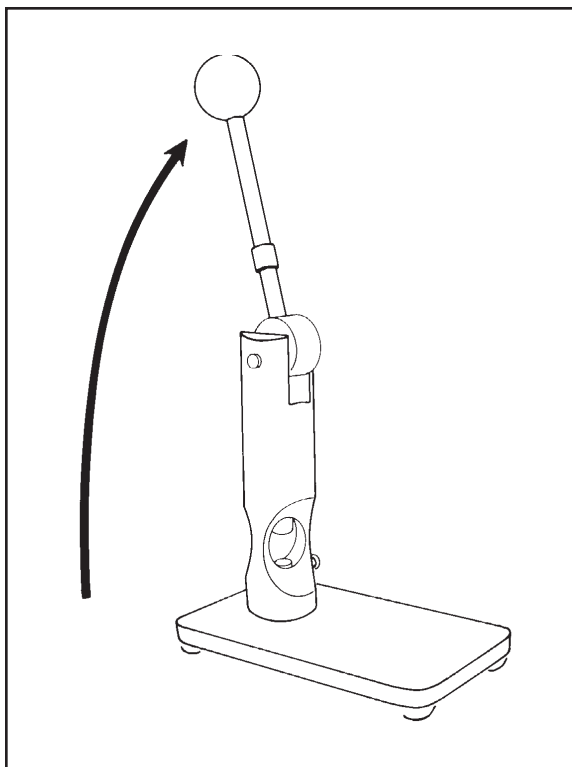
**Figure 5.2**  
**Turning the**  
**Sample Encapsulating**  
**Press on its Back**

3. Turn the base screw counterclockwise to lower the height of the lower die.



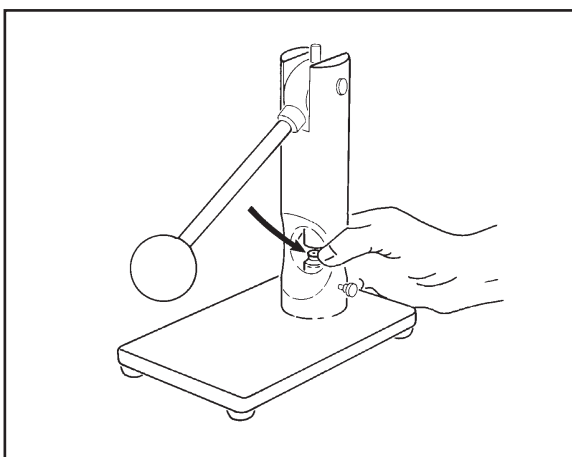
**Figure 5.3**  
**Lowering the**  
**Base Screw**

4. Set the sample press upright.



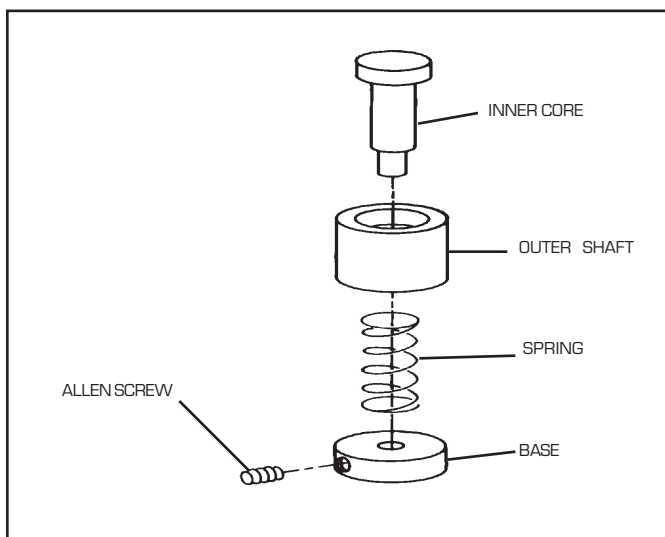
**Figure 5.4**  
***Setting the Sample  
Encapsulating  
Press Upright***

5. Lift the lower die out of the sample press.



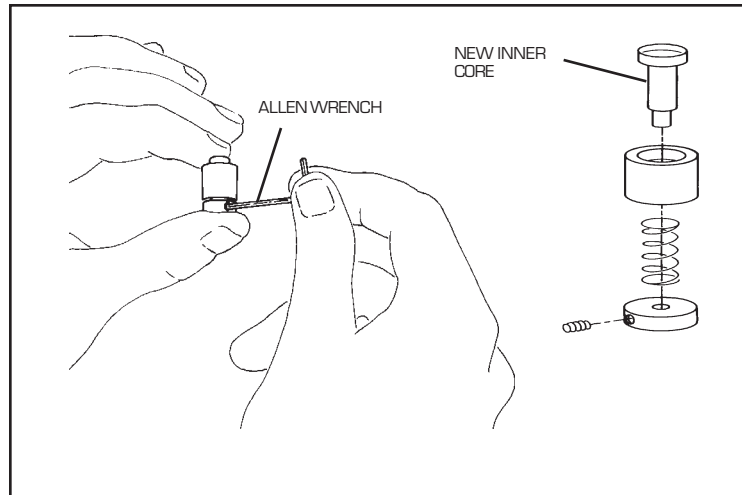
**Figure 5.5**  
***Removing  
the Lower Die***

6. Loosen the allen screw on the lower die (see Figure 5.6), then lift the inner core out of the die.



**Figure 5.6**  
**Removing the**  
**Inner Core from**  
**the Lower Die**

7. Insert the new inner core (included with the Autosampler; see Figure 5.7) into the die. Retighten the allen screw.



**Figure 5.7**  
**Installing the**  
**New Inner Core**

8. Insert the modified die into the sample press.
9. Tilt the sample press on its back again and turn the base screw clockwise to adjust the height of the lower die.
10. Tilt the sample press back up and bring the lever down to test the height of the lower die. The upper die should just touch the lower die when the lever is fully down.
11. Repeat steps 9 and 10 until the height of the lower die is satisfactory. Then tighten the lower die holder thumbscrew to hold the lower die in place.
12. Crimp a few empty pans to verify that the die is at an acceptable height (see pages 5-19 to 5-23).



## Setting Up the Sample Tray

Before you prepare your sample pans and set up the sample tray, you should consider the following:

- Sample and run capacity
- Reuse of pans
- Order of runs
- Pan metal and type.

Each of these considerations is explained on the following pages.

## *Autosampler Run Capacity*

When you use the Autosampler and controller to automate sample loading and unloading, you must create an **Autosampler (AS) run sequence** for each tray of samples. An AS run sequence is composed of a series of **runs**, each of which requires a reference pan and sample pan in the cell (see “Terminology” in Chapter 1 for explanations of the terms **AS run sequence** and **run**). When you set up your tray, you must consider the maximum number of runs that can be set up in an AS run sequence, known as the Autosampler’s **run capacity**.

If you are using the LNCA for cooling experiments, the maximum number of cooling runs in an AS run sequence is limited by the amount of liquid nitrogen in the LNCA tank. The rate at which the liquid nitrogen is used up depends, of course, on your method: the temperature you use, how long you hold the cell at a particular temperature, the rate of change in temperature, and so on. In general, you can expect to get approximately 10 to 15 cooling runs with one LNCA tank-full of liquid nitrogen when your method cools to the lower limit of -150°C. If you have an autofill LNCA, you will need to allow sufficient delay times between runs for the LNCA to refill from the bulk storage tank. You are encouraged to experiment using your own thermal methods to determine what you can expect from your system.

The maximum number of runs in an AS run sequence is 62 (the number of positions in the Autosampler tray). Thus, you can run 62 samples in an AS run sequence if you manually

load the reference pan and place only pans that actually contain samples in the tray. (This run capacity also applies to the Autosampler with an RCS used for cooling.)

You should use the same pan type (*e.g.*, crimped, hermetic) and metal (*e.g.*, aluminum, copper) for the reference pan as you do for your sample pans. Thus, if you are using more than one pan type or metal in one AS run sequence, you will need to include a corresponding reference pan for each type or metal used. This will decrease the number of actual samples in the AS run sequence.

## *Reuse of Pans*

Because thermal analysis experiments can sometimes deform the pans or cause the sample material to boil out, we do not recommend that you reload pans in the Autosampler once they have been unloaded from the DSC cell. Thus, if you want to run a sample through more than one thermal method during your AS run sequence, do one of the following:

1. Run several methods on one sample pan consecutively. The Autosampler does not unload a pan at the completion of a run if the next run calls for the same pan.
2. If you prefer not to run consecutive methods on one sample, prepare several pans containing the same material.

## *Order of Runs*

To avoid mistakes, we suggest that you place the pans in the sample tray in the order in which you intend to run them. The following paragraphs suggest some guidelines for determining the order of your runs.

**Perform cooling methods before heating methods.** Unlike the electricity that supplies the cell heater, the LNCA's supply of liquid nitrogen is limited. Thus, you can keep the amount of liquid nitrogen needed to do a cooling method at a minimum by putting all cooling-only runs at the beginning of the AS run sequence. If you plan to run combination cooling/ heating methods, these methods should come next, followed finally by any heating-only methods.

**Keep runs of a similar method together.** For example, if you plan to run some of your samples through a cooling method with the LNCA or RCS and some through heating methods, you should run all of the cooled samples consecutively to prevent unnecessary waste of your liquid nitrogen supply. If you alternate heating and cooling runs, the cell heater will have to work harder to bring the cell up to temperature and the LNCA or RCS will have to work harder to bring the temperature down again.

## *Pan Metal and Type*

The metal (*e.g.*, aluminum, copper) and type (*e.g.*, crimped, hermetic) of your reference pans must always match the metal and type of sample pan. Thus, when you are setting up the tray, remember to include a new reference pan for each new sample pan type used.

The DSC Autosampler operates using the following types of TA Instruments pans:

- Autosampler crimped pans
- Hermetic pans
- Open pans

The above pans are available in a variety of metals. Any pan metal can be used with the Autosampler, as long as it is conductive. However, do not use aluminum pans at temperatures above 600°C.

Operation of the Autosampler with pans other than those listed above is not recommended. Autosampler performance is not guaranteed with pans that are not provided by TA Instruments.

## Preparing Sample Pans

Follow the steps on the following pages to prepare sample pans and set up the Autosampler tray. Keep these tips in mind when preparing sample pans:

- The oils on your finger can affect the results of thermal analysis experiments. Thus, always use tweezers when handling pans and sample material.
- If you overfill a pan, the heating or cooling method may cause the sample to boil out, buckle, or explode the pan. If the Autosampler cannot remove a pan from the cell because of deformation or boiled-out material, operation is halted until the problem is corrected. Thus, before you use the Autosampler for unattended runs, you should be reasonably familiar with the effects of experimental heating and cooling methods on your samples and pans.
- Use the Sample Information Chart to keep a record of sample weights and identifications while you prepare your pans. You will need this information later when you program AS run sequences on the controller. Make several copies of the chart before beginning. You are authorized to copy pages 5-17 and 5-18 only, but no other part of the manual.

- If this is the first time you have used the DSC sample encapsulating press, we recommend that you practice the following procedures with empty pans before attempting to seal a sample.
- If you wish to prepare additional trays of samples while a tray is being run on the Autosampler, you can purchase additional trays and covers from TA Instruments.

## Preparing Samples

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Tray Position	Cell Position	Reference Pan	Sample Name or Reference Pan Type	Sample Weight	Method File
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
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31					

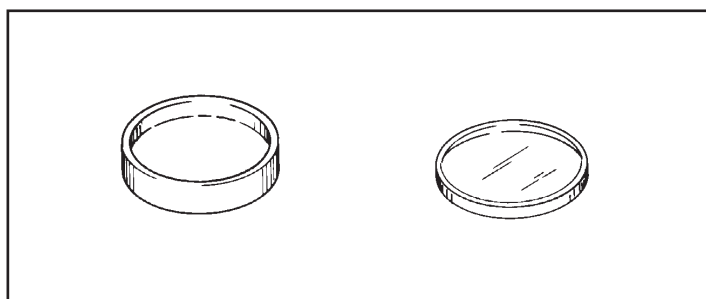
Tray Position	Cell Position	Reference Pan	Sample Name or Reference Pan Type	Sample Weight	Method File
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					
61					
62					

## Preparing Crimped Pans

**NOTE:**

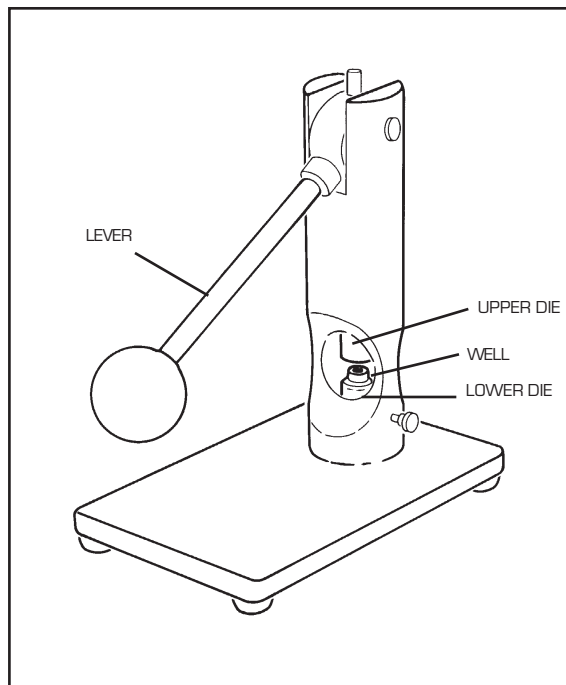
Make sure the crimping die is properly installed (see page 5-4) before you perform the following.

1. Place a pan and cover (see Figure 5.8) in a milligram balance (measuring accuracy of the balance must be  $\pm 0.0001$  gram) and record the weight.



**Figure 5.8**  
**TA Instruments**  
**Crimped Pan**

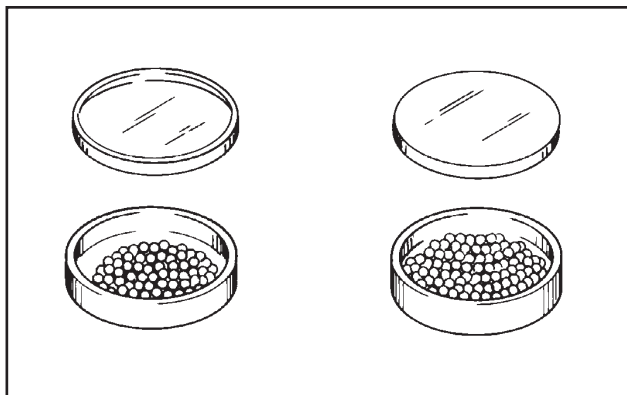
2. Leave the pan and cover in the balance and place your sample in the pan. Record the weight.
3. Subtract the weight you obtained in step 1 from the weight you obtained in step 2 and enter the result in the sample weight column of the Sample Information Chart.
4. Place the pan in the well of the lower die of the sample encapsulating press (see Figure 5.9).



**Figure 5.9**  
***Sample Encapsulating***  
***Press Set Up for***  
***Nonhermetic Crimping***

5. Place the cover over the pan:

- If the sample is small or thin, align the cover with the pan (see Figure 5.10).
- If the sample is large, invert the cover and place it in the pan (see Figure 5.10).

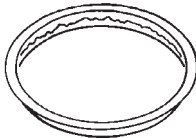
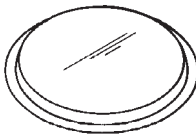
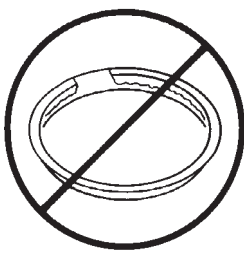
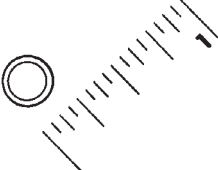


**Figure 5.10**  
**Placing the**  
**Cover over**  
**the Crimped Pan**

6. Pull the sample press lever forward and push down gently until the lever stops moving.
7. Raise the lever and remove the pan from the well. Check the pan to ensure that it meets the specifications outlined in Table 5.1 (next page).

If the pan does not meet the specifications in the table, you may need to adjust the height of the lower die. To adjust the lower die, loosen the lower die thumbscrew (see Figure 5.1) and follow steps 9 through 11 on page 5-8.

**Table 5.1**  
**Specifications for**  
**Properly Crimped Pans**

Description	Illustration
Uniform folding of lid around circumference	
Flat surface on the bottom of the pan; no ridge around circumference	
No visible gaps between lid and pan	
Diameter of pan slightly greater than 1/4 inch (0.270 to 0.275 inches)	

8. Place the pan in the Autosampler tray and record the cell position, corresponding reference pan number, and sample name in the Sample Information Chart (see example in Figure 5.11). A column is also provided in this chart for the thermal method file.

Tray Position	Cell Position	Reference Pan	Sample Name or Reference Pan Type	Sample Weight	Method File
1	<i>Ref.</i>		<i>(Aluminum Crimped)</i>		
2	<i>Samp. A</i>	<i>1</i>	<i>Indium</i>	<i>0.35</i>	<i>Indium.mth</i>
3	<i>Samp. B</i>	<i>1</i>	<i>Epoxy Resin</i>	<i>0.29</i>	<i>Epoxy.mth</i>
4	<i>Samp. A</i>	<i>1</i>	<i>Indium</i>	<i>0.67</i>	<i>Indium.mth</i>
5	<i>Samp. B</i>	<i>1</i>	<i>Epoxy Resin</i>	<i>0.71</i>	<i>Epoxy.mth</i>
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
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24					
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28					
29					
30					
31					

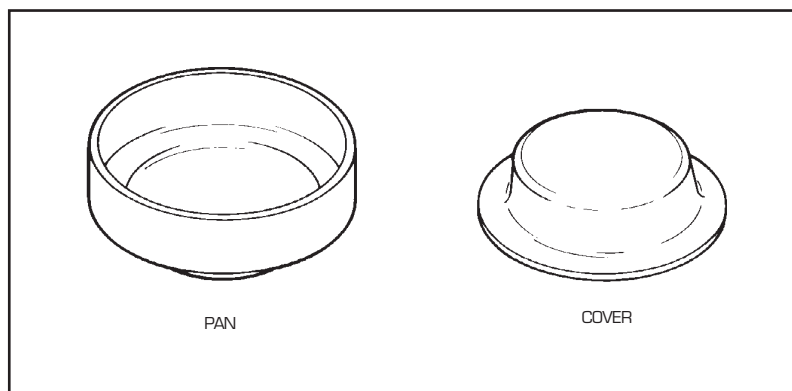
**Figure 5.11**  
Using the Sample  
Information Chart

## Preparing Hermetic Pans

**NOTE:**

Make sure your sample press is set up for hermetic sealing (see Appendix A in the *DSC Operator's Manual*) before you perform the following procedure.

1. Place the hermetic pan and cover (see Figure 5.12) in a milligram balance (measuring accuracy of the balance must be  $\pm 0.0001$  gram) and record the weight.

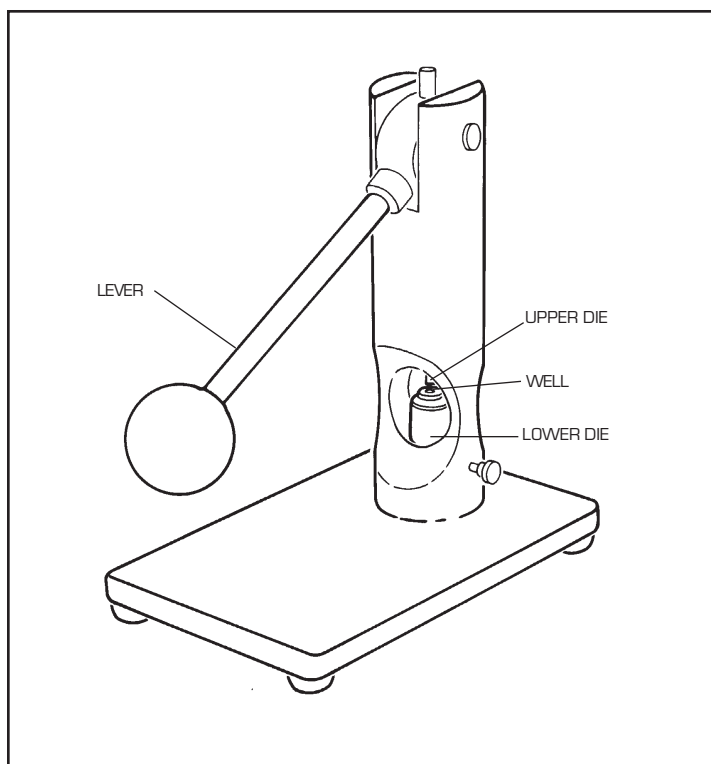


**Figure 5.12**  
**TA Instruments**  
**Hermetic Pan**

2. Leave the pan and cover in the balance and place your sample in the pan. Record the weight.
3. Subtract the weight you obtained in step 1 from the weight you obtained in step 2 and enter the result in the sample weight column of the Sample Information Chart.

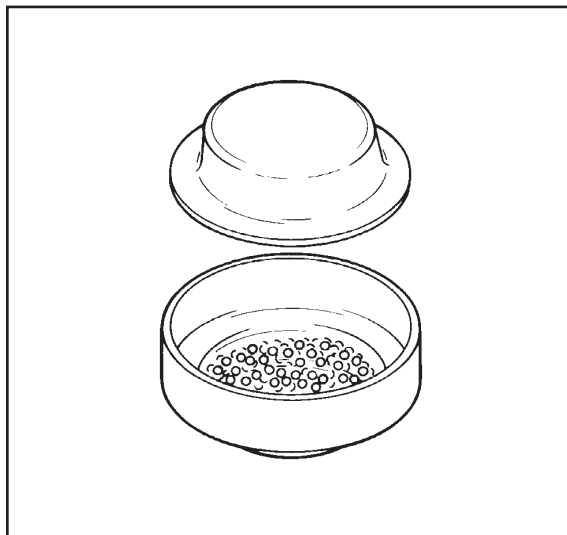


4. Place the pan in the well of the lower die of the sample encapsulating press (see Figure 5.13).



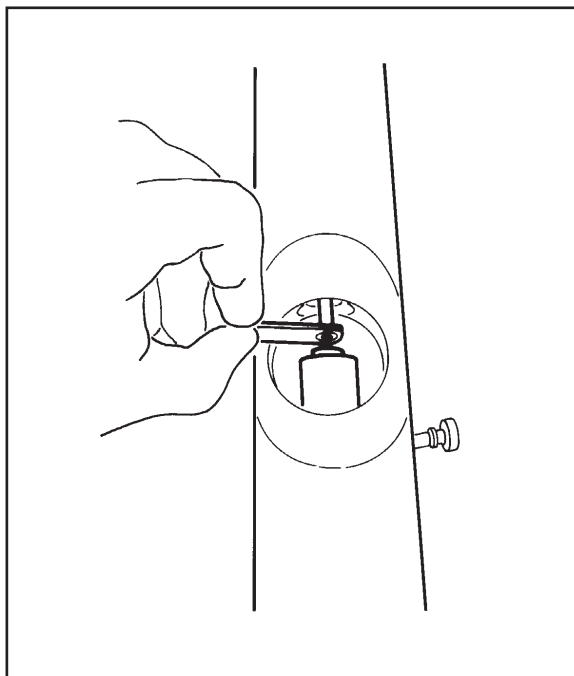
**Figure 5.13**  
**The DSC Sample**  
**Press Set Up**  
**for Hermetic Sealing**

5. Place the cover over the pan as shown in Figure 5.14.



**Figure 5.14**  
**Placing the Cover**  
**over the Hermetic Pan**

6. Place the hermetic preforming tool, grooved side down, around the upper die plunger (see Figure 5.15).

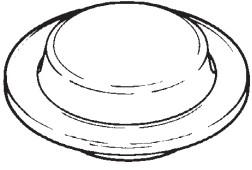
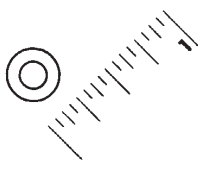


**Figure 5.15**  
**Using the**  
**Preforming Tool**

7. Use your other hand to pull the lever forward. Push down on the lever until it stops moving. You will need to use more force for hermetic sealing than for crimping.
8. Raise the lever. Flip the preforming tool over (grooved side up) and place it around the upper die plunger.
9. Lower the lever again and push down gently until it stops moving.
10. Raise the lever and remove the pan from the well. Check the pan to ensure that it meets the specifications in Table 5.2.

If the pan does not meet the specifications in the table, you may need to adjust the height of the lower die. To adjust the lower die, loosen the lower die thumbscrew (see Figure 5.1) and follow steps 9 through 11 on page 5-8.

**Table 5.2**  
***Specifications for***  
***Properly Sealed***  
***Hermetic Pans***

Description	Illustration
Complete seal around circumference of pan	
Diameter of pan approximately 5/16 inch (0.300 to 0.310 inches)	

11. Place the pan in the Autosampler tray and record the cell position, corresponding reference pan number, and sample name in the Sample Information Chart (see example in Figure 5.11 on page 5-23).

## CHAPTER 6: Diagnostics

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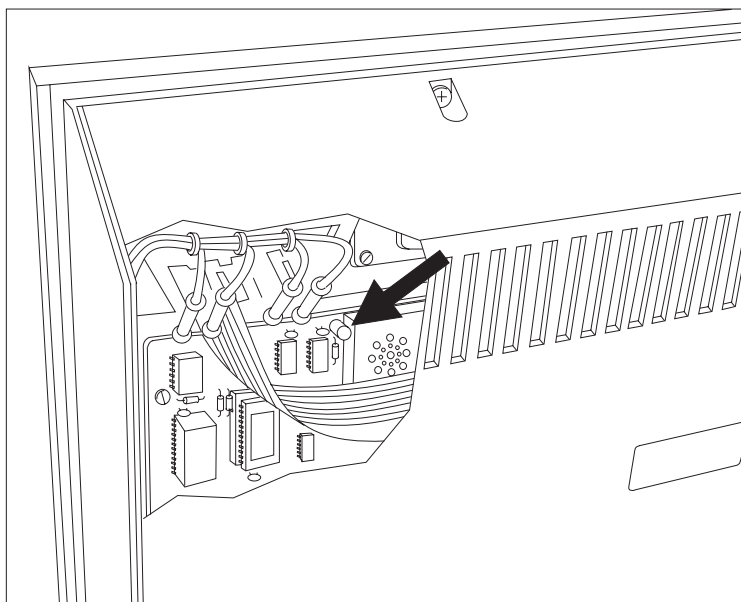
Using the Confidence Test Ready Light .....	6-3
Testing Autosampler Functions .....	6-6
The Cycle Lids Test .....	6-7
The Cycle Pans Test .....	6-8
The Sensors Test .....	6-9
The Rear Switches Test .....	6-15
The Keyboard Test .....	6-16
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The Display Test .....	6-18
The Motion Test .....	6-19
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Error Messages .....	6-22
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Messages on the Autosampler Display .....	6-23
Fatal Error Messages .....	6-23
Nonfatal Error Messages .....	6-27
Error Messages on the Controller Screen .....	6-46

## Diagnostics

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## Using the Confidence Test Ready Light

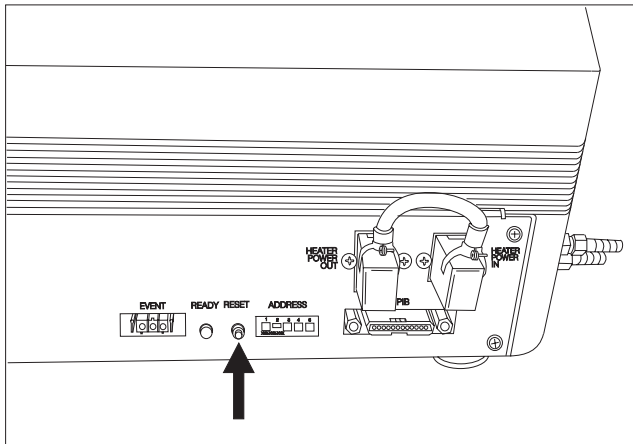
If the Autosampler screen fails the confidence test at start-up, you can use the red “ready” light on the unit’s back panel (see Figure 6.1) to determine whether the other confidence tests detect any errors.



**Figure 6.1**  
***The Autosampler Confidence Test Ready Light***

Follow the guidelines beginning on the next page to diagnose problems with the confidence test ready light.

- If the Autosampler is already on, press the reset switch on its back panel to restart the confidence tests (see Figure 6.2).



**Figure 6.2**  
**Reset Switch**

- Watch the ready light carefully. As each system is tested, the light emits either a short (1/4 second) or a long (3/4 second) flash to indicate whether the system has passed or failed. A short flash means that the system being tested has passed; a long flash means that it has failed.

Table 6.1 on the next page lists the confidence tests in the order in which they occur. If you see a long flash, use the table to determine which system failed the test, then call an authorized service representative. For example, if the fifth test yields a long flash, the keyboard has failed the confidence test.



**Table 6.1**  
**Order of the Confidence Tests**

Flash Number	Test
1	EPROM checksum
2	Variable RAM
3	Liquid crystal display
4	8155
5	Keyboard
6	Location RAM
7	GPIB
8	RS-232-C
9	Timer interrupt
10	Watchdog timer
11	Up/down (z-axis) motor and sensor
12	In/out (r-axis) motor and sensor
13	Rotation ( $\theta$ -axis) motor and sensors

## Testing Autosampler Functions

The Autosampler TEST key, a manual mode key, calls up a menu of tests that check the Autosampler's:

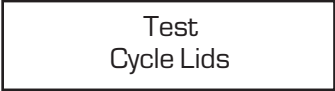
- Calibration
  - Cycle Lids test
  - Cycle Pans test
- Sensors
- Configuration jumpers
- Keyboard operation
- GPIB configuration
- Display screen
- Motors
  - Motion test
  - Cycle A-B test.

The following pages describe how to use each of the tests available through the TEST key.

## *The Cycle Lids Test*

The Cycle Lids test loads and unloads the cell lids continuously to test the calibration of the Autosampler's lid storage and cell positions.

1. Press the TEST key once. The Autosampler screen displays:



Test  
Cycle Lids

2. Press ENTER to select the test displayed on the screen. The Autosampler begins moving the cell lids from their storage positions to the cell. When the cell is covered, the Autosampler returns the lids to their storage positions. This procedure continuously cycles until you stop the test (step 3).
3. Press ESCAPE/CLEAR when you are ready exit the Cycle Lids test. If any of the lids are left on the cell when you interrupt the test, the Autosampler will not remove them; it will remove them the next time a pan needs to be placed in the cell.

## *The Cycle Pans Test*

The Cycle Pans test loads and unloads pans from the tray to the DSC cell to test the calibration of the Autosampler's tray and cell pan positions.

1. Press the TEST key two times. The Autosampler screen displays:

Test  
Cycle Pans

2. Press ENTER to select the test displayed on the screen. The Autosampler begins loading the pan in tray position #1 into the cell reference position, as indicated on the screen:

Cycle Pans 0001  
Loading Ref.

The number in the upper right of the screen is a counter that indicates how many pans have been cycled. Each time a new pan is loaded from the tray, the counter increments by one.

The Autosampler continues loading and unloading pans, going through all positions in the tray, until you stop the test (step 3). Each time it fills the cell, it places the lids on the cell. It then removes the lids, removes the pans, and begins another cycle.

**NOTE:**

|| If you want the Cycle Pans test to continue indefinitely, you must fill the entire sample tray with pans.

3. Press ESCAPE/CLEAR when you are ready to exit the Cycle Pans test.

## The Sensors Test

The Sensors test displays a series of digits that indicate whether or not the Autosampler sensors are detecting an object.

1. Press the TEST key three times. The Autosampler screen displays:



Test  
Sensors

2. Press ENTER to select the test displayed on the screen. The Autosampler screen displays a series of 0s and 1s. For example:



Sensors  
1100 1110 000

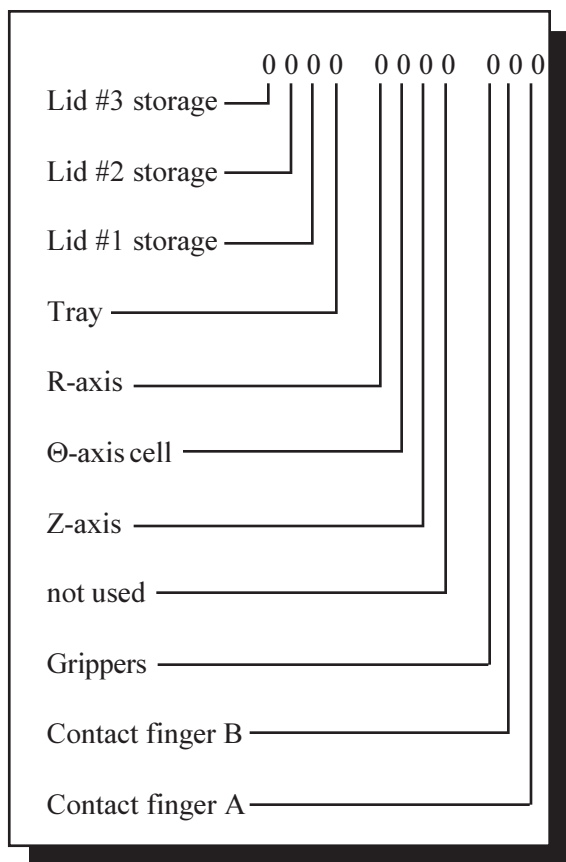
Each digit in the above screen corresponds to a separate sensor on the Autosampler.

3. Use Table 6.2 (on the next page) to determine which digit corresponds to the sensor you want to test. Then move the object being detected by the sensor (*e.g.*, remove the silver lid from its storage position) and watch the screen. If the digit changes (from 0 to 1 or from 1 to 0) as you move the object, the sensor is working correctly.

Table 6.3 (pages 6-11 to 6-12) explains what each sensor indicates when a 0 (zero) or 1 is displayed.

4. Press ESCAPE/CLEAR to exit the Sensors test.

**Table 6.2**  
***The Sensor Test Digits***



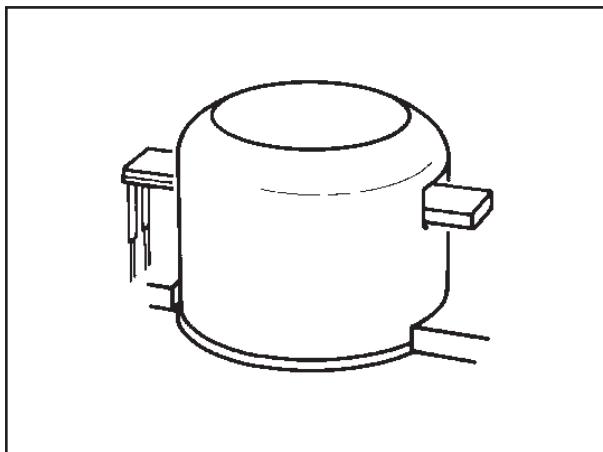
**Table 6.3**  
**Explanation of Sensors**

Sensor	Indication
Lid #3 storage	1 = Lid #3 (the large lid) is in its storage position. 0 = Lid #3 is not in its storage position.
Lid #2 storage	1 = Lid #2 (the medium-sized lid) is in its storage position. 0 = Lid #2 is not in its storage position.
Lid #1 storage	1 = Lid #1 (the small lid) is in its storage position. 0 = Lid #1 is not in its storage position.
Tray	1 = The sample tray is fully inserted. 0 = The tray is not fully inserted.
R-axis	1 = The turret arm is centered over the turret assembly (halfway between the innermost and outermost limits; see Figure 6.3). 0 = The arm is not centered over the turret assembly. <i>(table continued)</i>

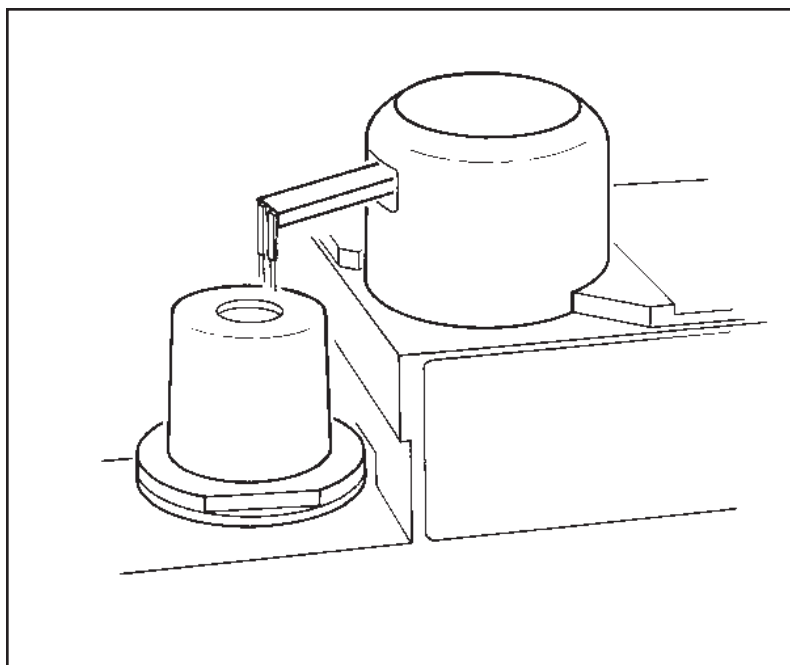
**Table 6.3**  
(continued)

Sensor	Indication
$\Theta$ -axis cell	1 = The turret arm is over the DSC cell (see Figure 6.4). 0 = The turret arm is not over the DSC cell.
Z-axis	1 = The turret is in the full-up position (see Figure 6.5). 0 = The turret is not in the full-up position.
Grippers	1 = The grippers are holding an object or the fingers are touching each other. 0 = The grippers are open.
Contact finger B*	1 = A finger (one side of the grippers) is contacting the cell. 0 = No contact.
Contact finger A*	1 = A finger (one side of the grippers) is contacting the cell. 0 = No contact.
<p>* The sides of the grippers to which “finger A” and “finger B” correspond vary for each Autosampler. You can easily determine this by touching one of the fingers with a short piece of wire, touching the other end of the wire to the cell, and watching to see which sensor changes to “1.”</p>	

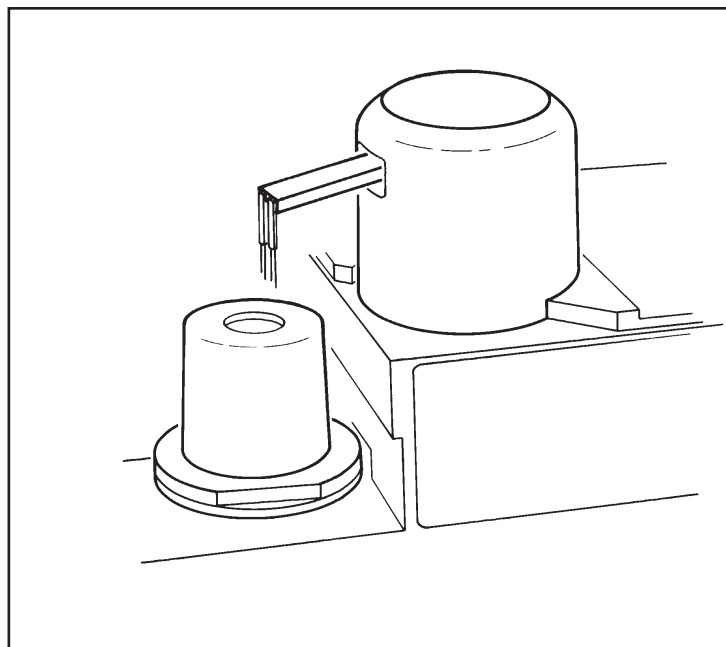




**Figure 6.3**  
**Arm Centered Over**  
**Turret Assembly**



**Figure 6.4**  
**Turret Over Cell**



***Figure 6.5***  
***Turret in Full-Up***  
***Position***

## *The Rear Switches Test*

The Rear Switches Test indicates the current settings of the system configuration jumpers inside the Autosampler.

1. Press the TEST key four times. The Autosampler screen displays:

Test  
Rear Switches

2. Press ENTER to select the test displayed on the screen. The Autosampler displays a series of 0s and 1s. For example:

Rear Switches  
10000 01100

A zero (0) digit means that the jumper is off; one (1) indicates that the jumper is on.

## *The Keyboard Test*

The Keyboard test checks that all Autosampler keys are working properly.

1. Press the TEST key five times. The Autosampler screen displays:

Test  
Keyboard

2. Press ENTER to select the test displayed on the screen.
3. Press each key on the Autosampler keyboard (except the ESCAPE/CLEAR key), and watch the screen to ensure that the key displayed on the screen matches the one you are pressing. For example, if you press the MANUAL/AUTOMATIC key, the Autosampler screen should display:

Manual  
Automatic

4. Press ESCAPE/CLEAR when you are ready to exit the Keyboard test.

## The GPIB Test

The GPIB test enables you to verify the GPIB address setting for the Autosampler (for further information, see Chapter 2).

1. Press the TEST key six times. The Autosampler screen displays:

Test  
GPIB

2. Press ENTER to select the test displayed on the screen. The screen should display ten higher than the address you set when you configured your DSC:

GPIB  
Address = xx

*e.g.:* DSC 2910 address = 1  
Autosampler address = 11

3. Press ESCAPE/CLEAR to exit the GPIB test.

## *The Display Test*

The Display test checks the Autosampler screen.

1. Press the TEST key seven times. The Autosampler screen displays:

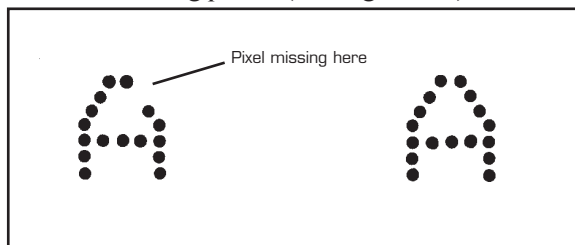
Test  
Display

2. Press ENTER to select the test displayed on the screen. Strings of characters continuously move across the screen:

DEFGHIJKLMNOPQRS  
TUVWXYZ[¥]^\_`abc

3. Watch the display carefully to check for:

- Missing rows
- Missing columns
- Missing pixels (see Figure 6.6).



**Figure 6.6**  
**Checking for**  
**Missing Pixels**

4. Press ESCAPE/CLEAR to exit the Display test.

## The Motion Test

The motion test overrides the software limits on Autosampler motor movement so that service personnel can perform motor diagnostics tests. The software limits protect the hardware from damage and prevent the motors from being overdriven.

◆ **CAUTION:**

The following test is provided primarily for TA Instruments service use. Improper use of this test can cause damage to the turret mechanism. Please contact an authorized service representative for further information.

1. Press the TEST key eight times. The Autosampler screen displays:

Test  
Motion

2. Press ENTER to select the test displayed on the screen. The screen displays:

Motion  
Test

3. Press any of the motion keys. The motor continues to run even when the turret assembly reaches an obstacle. Note that the GRIP and RELEASE keys move the fingers incrementally instead of fully opening and closing them in single keystrokes.

◆ **CAUTION:**

Once the turret stops moving, release the motion key. Do not attempt to continue motion once the motor stalls against an internal mechanical stop.

4. Press ESCAPE/CLEAR to exit the Motion test.

## *The Cycle A–B Test*

The Cycle A–B test cycles the Autosampler between two positions of your choice to check the Autosampler's motor operation.

◆ **CAUTION:**

The following test is provided primarily for TA Instruments service use. Improper use of this test can cause damage to the turret mechanism. This test overrides the Autosampler's anticollision programming; collisions of the turret arm with the enclosure, cell, or sample tray are possible. **NEVER** leave this test operating unattended. Please contact an authorized service representative for further information.

1. Press the TEST key nine times. The Autosampler screen displays:

Test  
Cycle A–B

2. Press ENTER to select the test displayed on the screen. The screen displays:

Cycle A–B  
Enter Point "A"

3. Use the motion keys to put the Autosampler in the first position you wish to cycle between, then press ENTER. The screen displays:

Cycle A–B  
Enter Point "B"



4. Use the motion keys to put the Autosampler in the second position you wish to cycle, then press ENTER. The screen displays:

Cycle A-B  
Enter to Start

5. Press ENTER. The Autosampler continuously cycles between points A and B.

◆ **CAUTION:**

Be ready to press the HALT key to prevent possible collisions of the turret arm with the enclosure, tray, or cell.

Once you are sure the path the Autosampler takes between points A and B will not result in a collision, you can cycle this test indefinitely.

6. Press ESCAPE/CLEAR to exit the Cycle A-B test.

## Error Messages

This section defines and offers a solution for three types of Autosampler error messages:

- (1) Error messages displayed on the Autosampler screen. These messages are explained in alphabetical order starting on page 6-23.
- (2) Error messages generated by the Autosampler and shown on the controller screen.
- (3) Autosampler-related error messages generated by the controller.

### *Other Error Messages*

If you receive any general controller or instrument error messages, please access the online help provided with the *Thermal Solutions/ Advantage* for detailed instructions and read the guidelines below.

**NOTE:**

You can access online help by opening the Error Log in Instrument Control and double-clicking on the error listed.

When an instrument error occurs, the AS run sequence halts and waits for you to correct the error. Once you have corrected the error, select **Control/Resume Motion** from the Autosampler menu to resume the AS run sequence. If you cannot correct the error, select **Control/Reset** or **Control/Stop** from the Autosampler menu to stop the current run. Then select **Control/Start at** and select the next run in the run sequence to continue.

## *Messages on the Autosampler Display*

The Autosampler display messages are divided into two lists: fatal errors and nonfatal errors. Some of the nonfatal errors are ignored, allowing operation to continue, and some cause the Autosampler to halt and wait for operator intervention.

### Fatal Error Messages

Fatal error messages indicate a condition that must be corrected for operation to continue. The Autosampler always stops operating when a fatal error occurs.

Fatal Error 8155 U12
-------------------------

**Problem:** The confidence test has detected that the Autosampler's scratch-pad RAM or I/O (input/output) is not properly storing what is written to it.

**Solution:** Turn off the Autosampler and power up again. If you still receive this message, call a qualified service representative.

Fatal Error  
Display

**Problem:** The confidence test has detected that the Autosampler screen is not properly displaying what is written to it.

**Solution:** Turn off the Autosampler and power up again. If you still receive this message, call a qualified service representative.

Fatal Error  
EPROM Checksum

**Problem:** The confidence test has detected that the EPROM (erasable program-mable read-only memory) containing the Autosampler programming has been partially erased or altered.

**Solution:** Turn off the Autosampler and power up again. If you still receive this message, call a qualified service representative.

Fatal Error  
Power Failure

**Problem:** The power supply has given a power-fail signal indicating that it cannot deliver the voltages necessary to operate the Autosampler.

**Solution:** Turn off the Autosampler and power up again. If you still receive this message, call a qualified service representative.

Fatal Error  
RAM U5

**Problem:** The confidence test has detected that the RAM storing data for the Autosampler is not operating correctly.

**Solution:** Turn off the Autosampler and power up again. If you still receive this message, call a qualified service representative.

Fatal Error  
Timer Interrupt

**Problem:** The confidence test has detected that the master clock signal that times all Autosampler functions is not operating correctly.

**Solution:** Turn off the Autosampler and power up again. If you still receive this message, call a qualified service representative.

Fatal Error  
Unknown Interr.

(Unknown Interrupt)

**Problem:** The processor has been interrupted from normal operation for an unknown reason.

**Solution:** Turn off the Autosampler and power up again. If you still receive this message, call a qualified service representative.

Fatal Error  
Watchdog Timeout

**Problem:** The Autosampler has detected an internal electronics or software malfunction.

**Solution:** Turn off the Autosampler and power up again. If you still receive this message, call a qualified service representative.

## Nonfatal Error Messages

Nonfatal error messages indicate a condition that may require operator intervention to correct the problem and allow the Autosampler to continue.

Cal. Mem. Error  
<position>

(calibration memory error)

**Problem:** The value for the indicated calibration position has been erased.

**Solution:** Recalibrate the position displayed on the screen (see Chapter 4).

Contact Error  
Finger "X"

(X = A or B)

**Problem:** One of the gripper fingers has touched the DSC cell. Motion is stopped when this occurs to prevent damage to the cell or gripper fingers. All motion keys except the RAISE key become inoperable.

**Solution:** Press the RAISE key to clear the gripper fingers from the cell. Then use the other motion keys to reposition the grippers before you retry the interrupted task.

- OR -

Press RESET SAMPLER and press ENTER to return the Autosampler to the home position, then retry the interrupted task.

**NOTE:**

The "ContactError" messages are only functional when the AutoDSC is connected to the GPIB and is plugged into an outlet to provide a ground.

Contact Error  
Both Fingers

**Problem:** Both of the gripper fingers have touched the DSC cell. Motion is stopped when this occurs to prevent damage to the cell or gripper fingers. All motion keys except the RAISE key become inoperable.

**Solution:** Press the RAISE key to clear the gripper fingers from the cell. Then use the other motion keys to reposition the grippers before you retry the interrupted task.

- OR -

Press RESET SAMPLER and press ENTER to return the Autosampler to home position, then retry the interrupted task.

Error  
GPIB IC U13

**Problem:** The confidence test has detected that the TMS9914 chip cannot generate proper commands; this indicates a faulty part.



**Solution:** Turn off the Autosampler and power up again. If you still receive this message, call a qualified service representative.

Error  
Holding unk. obj

(Holding unknown object)

**Problem:** (1) The Autosampler was switched to automatic mode while it was holding an object or was halted (with the Halt Motion key) while the grippers were closing on an object.

- OR -

(2) You manually gripped an object with the motion keys then attempted to use the LOAD or LIDS key.

**Solution:** (1) Switch to manual mode (see Chapter 3) and release the object with the RELEASE key. Then return to automatic mode.

- OR -

(2) Release the object with the RELEASE key, then retry your command.

Error  
Keyboard shorted

**Problem:** One or more of the Autosampler keys is shorted or was pressed during the confidence test.

**Solution:** Turn off the Autosampler and power up again. If you still receive this message, call a qualified service representative.

Error  
Lid #x dropped

**Problem:** The Autosampler has dropped a lid (lid #1, #2, or #3) or had trouble picking it up. This can be caused by (1) incorrect calibration, (2) bent or damaged gripper fingers, or (3) a faulty Autosampler gripper mechanism.

**Solution:** Try recalibrating the related position(s), then repeat the task. If the error occurs again, call a qualified service representative.

Error  
Lid #x missing

**Problem:** The Autosampler cannot find a lid (lid #1, #2, or #3) either in its storage position or on the DSC cell.

**Solution:** Return the lid to its storage position. When the Autosampler senses the lid, it should return to normal operation. If this does not work, test the lid storage sensor with the TEST key (see page 6-9).

If this error message appears when the Autosampler is gripping a lid, the gripper sensor may be malfunctioning; test the gripper sensor with the TEST key.

Error  
Lid #x not strd.

(Lid #x not stored)

**Problem:** The Autosampler has been reset with one of the Reset Sampler keys, and one of the lids (lid #1, #2, or #3) has not been returned to its storage position.

**Solution:** Use tweezers to return the lid to its storage position. If the Autosampler is in manual mode, press ESCAPE/CLEAR to clear the error message from the screen.

Error  
Pan #xx dropped

**Problem:** The Autosampler has dropped a pan or cannot pick it up (xx indicates the sample tray number). This can be caused by (1) incorrect calibration, (2) bent or damaged gripper fingers, or (3) a faulty Autosampler gripper mechanism.

**Solution:** Try recalibrating the related position(s), then repeat the task. If the error occurs again, call a qualified service representative.

Error  
Pan #xx missing

**Problem:** A pan that the Autosampler is attempting to load or unload is missing from the DSC cell or the tray.

**Solution:** Whether the pan is missing from the cell or the tray, return it to its proper sample tray position and return all other pans in the cell to their proper tray positions. Press **Reset**, then select **Start AS-Run**. Enter the run number of the failed run to retry the task.

Error  
Position Empty

**Problem:** The Autosampler has been commanded to unload a pan from an empty cell position, or you used tray position zero (0) to unload a pan after pressing one of the Reset Sampler keys.

**Solution:** Enter a sample pan number (other than zero) when using the LOAD key to unload a pan after the Autosampler has been reset.

Error r-axis  
motor or sensor

**Problem:** The confidence test has detected that the r-axis (in/out) motor is not running properly or that motion of the turret arm is not being sensed by the r-axis sensor.

**Solution:** When the confidence tests finish, try moving the r-axis motor by pressing the EXTEND and RETRACT keys. If the turret assembly does not move, the motor needs to be serviced. If the turret moves, test the r-axis sensor with the TEST key (see page 6-9). If the sensor is malfunctioning, have the sensor serviced.

Error theta-axis  
motor or sensor

**Problem:** The confidence test has detected that the  $\theta$ -axis (rotation) motor is not running properly or that rotation of the turret is not being sensed by one of the  $\theta$ -axis sensors.

**Solution:** When the confidence tests finish, try moving the  $\theta$ -axis motor by pressing the ROTATE CW and ROTATE CCW keys. If the turret assembly does not move, the motor needs to be serviced. If the turret moves, test the  $\theta$ -axis sensor with the TEST key (see page 6-9). If the sensor is malfunctioning, have the sensor serviced.

Error  
Watchdog Timer

**Problem:** The watchdog timer is taking too long to time out during the confidence tests.

**Solution:** Turn off the Autosampler and power up again. If you still receive this message, call a qualified service representative.

Error z-axis  
motor or sensor

**Problem:** The confidence test has detected that the z-axis (up/down) motor is not running properly or that the motion of the turret arm is not being sensed by the z-axis sensor.

**Solution:** When the confidence tests finish, try moving the z-axis motor by pressing the RAISE and LOWER keys. If the turret assembly does not move, the motor needs to be serviced. If the turret moves, test the z-axis sensor with the TEST key (see page 6-9). If the sensor is malfunctioning, have the sensor serviced.

GPIB Error 50  
no command found

**Problem:** A null GPIB command was sent from the controller to the Autosampler.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

GPIB Error 51  
unknown command

**Problem:** An undefined GPIB command was sent from the controller to the Autosampler.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation..

<p>GPIB Error 52 missing AC type</p>
--

**Problem:** An undefined GPIB command was sent from the controller to the Autosampler.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

<p>GPIB Error 53 extra characters</p>
---

**Problem:** A GPIB command containing extra characters was sent from the controller to the Autosampler.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

<p>GPIB Error 54 non-num. AC type</p>
---

(non-numeric AC type)



**Problem:** An undefined GPIB command was sent from the controller to the Autosampler.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

GPIB Error 55  
unknown AC type

**Problem:** An undefined GPIB command was sent from the controller to the Autosampler.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

GPIB Error 56  
bad sequence num

(bad sequence number)

**Problem:** The sequence number of a GPIB command sent to the Autosampler contains a non-numeric character.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

GPIB Error 57  
no sequence num.

(no sequence number)

**Problem:** A GPIB command sent to the Autosampler does not contain a sequence number.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

GPIB Error 58  
large sequen num

(large sequence number)

**Problem:** The sequence number of a GPIB command sent to the Autosampler is too large.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

GPIB Error 59  
non-num pan num.

(non-numeric pan number)

**Problem:** The sample pan number in a GPIB command contains a non-numeric character.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

GPIB Error 60  
bad pan number

**Problem:** The sample pan number in a GPIB command does not exist.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

GPIB Error 62  
no pan number

**Problem:** A GPIB command sent to the Autosampler does not contain a pan number.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

GPIB Error 63  
no "B" position

**Problem:** A GPIB command was sent to the Autosampler to load or unload sample B from a DSC cell.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

GPIB Error 64  
no pan in ref

(no pan in reference position)

**Problem:** The Autosampler has been commanded to unload a pan from an empty cell reference position. Remember that the Autosampler always assumes that the DSC cell is empty whenever you press one of the Reset Sampler keys.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation. If there is a pan in the reference position, remove it manually with tweezers.

GPIB Error 65  
no pan in sample

**Problem:** The Autosampler has been commanded to unload a pan from an empty cell sample position. Remember that the Autosampler always assumes that the DSC cell is empty whenever you press one of the Reset Sampler keys.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation. If there is a pan the sample position, remove it manually with tweezers.

GPIB Error 68  
rec buf overflow

(receive buffer overflow)

**Problem:** The Autosampler GPIB command-receiving buffer has overflowed.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

GPIB Error 69  
xmit buf overflow

(transmit buffer overflow)

**Problem:** The Autosampler GPIB command-transmitting buffer has overflowed.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

GPIB Error 70  
interface error

**Problem:** A GPIB interface error has occurred.

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

GPIB Error 71  
command too long

**Problem:** A GPIB command sent to the Autosampler is too long (longer than 32 characters).

**Solution:** Close the DSC Instrument Control window and turn off the Autosampler. Then restart the Autosampler and reopen DSC Instrument Control and retry your operation.

Parameter Error  
Zero-Power RAM

**Problem:** The confidence test has detected that one or more of the calibration values has been altered.

**Solution:** When the confidence tests finish, test all of the Autosampler's calibration positions (see "Checking Your Calibration" in Chapter 4) and recalibrate the position(s) that have been erased.

R step error  
+xxxxx steps

(or “-xxxxx steps”)

**Problem:** The r-axis motor executed the wrong number of steps to complete a movement. The number is positive when the motor is retracting and negative when the motor is extending. Small numbers of lost steps (<25) indicate a loose or worn gear, while frequent errors involving larger numbers indicate that the motor is binding.

**Solution:** The Autosampler immediately corrects for motor step errors, so this error condition usually does not require any operator action. If your Autosampler starts showing step errors with increasing frequency, however, you should have the unit serviced.

If you are calibrating the Autosampler, press the RESET SAMPLER key and recalibrate the current position whenever you receive a motor step error.

Theta step error  
+xxxxx steps

(or “-xxxxx steps”)

**Problem:** The  $\theta$ -axis motor had to execute the wrong number of steps to complete a movement. The number is positive when the movement is in the counterclockwise direction and negative for the clockwise direction. Small numbers of lost steps (<25) indicate a loose or worn gear, while frequent errors involving larger numbers indicate that the motor is binding.

**Solution:** The Autosampler immediately corrects for motor step errors, so this error condition usually does not require any operator action. If your Autosampler starts showing step errors with increasing frequency, however, you should have the unit serviced.

If you are calibrating the Autosampler, press the RESET SAMPLER key and recalibrate the current position whenever you receive a motor step error.

Waiting for tray

**Problem:** The Autosampler is attempting to remove a pan from the tray or return a pan to the tray, but the tray is missing or is not fully inserted.



**Solution:** Reinsert the tray, making sure you push it all the way back. If this does not correct the problem, you should test the tray sensor with the TEST key (see page 6-9).

Z step error  
+xxxxx steps

(or “-xxxxx steps”)

**Problem:** The z-axis motor had to execute the wrong number of steps to complete a movement. The number is positive when the turret assembly is moving down and negative when it is moving up. Small numbers of lost steps (<25) indicate a loose or worn gear, while frequent errors involving larger numbers indicate that the motor is binding.

**Solution:** The Autosampler immediately corrects for motor step errors, so this error condition usually does not require any operator action. If your Autosampler starts showing step errors with increasing frequency, however, you should have the unit serviced.

If you are calibrating the Autosampler, press the RESET SAMPLER key and recalibrate the current position whenever you receive a motor step error.

## *Error Messages on the Controller Screen*

All Autosampler-generated error messages that appear on the controller screen include the prefix “Err Axx:” (xx = the message number). Further information on these A# messages can be found when you access the online help provided with *Thermal Solutions/Advantage*.

**NOTE:**

You can access online help by opening the Error Log in Instrument Control and double-clicking on the error listed.

Error messages that appear in the form of message boxes are generally system-generated errors. For assistance in solving these problems, press the F1 key to access the online help (or select the **Help** button) for information directly related to the message displayed.

## Appendix A: Parts Lists & Ordering Information

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### Autosampler Parts Lists

*Table A.1*  
*Printed Circuit Boards*

Part Number	Description
911110.901	Motor Drive
911120.901	Communications Board

*Table A.2*  
*Motors and Sensors*

Part Number	Description
990720.901	Gripper Motor Assembly
990737.901	R-Axis (extend/retract) Motor Assembly
990737.902	Θ-Axis (rotation) Motor Assembly
990739.901	Z-Axis (up/down) Motor Assembly

**Table A.3**  
**Supplies**

Part Number	Description
900786.902	Crimped Sample Pan Bottom (200 aluminum)
900779.901	Crimped Sample Pan Cover (200 aluminum)

**Table A.4**  
**Miscellaneous Parts**

Part Number	Description
990732.901	Autosampler Sample Tray (62 position)
990685.001	Die Punch for Crimped Sample Pan
90717.901	Gripper Finger Assembly
990687.001	Lid #1 Ambient (silver, with hole)
990686.002	Lid #2 (stainless steel)
990686.001	Lid #3 (aluminum)
990688.901	Sample Tray Lid
990689.001	Sample Tray Overlay

## Ordering Information

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## Appendix A

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