GRATING(S) (TURRET)

| SIDE 1 (A) | | SIDE 2 (B) | |
|---|---|---|---|
| GV/MM | 1200 G/mm | GV/MM | 600 G/mm |
| BLAZE | 330 N.M. | BLAZE | 750 N.M. |
| SERIAL # | 99877 | SERIAL # | 99878 |
| GV/MM | | GV/MM | |
| BLAZE | | BLAZE | |
| SERIAL # | | SERIAL # | |
| GV/MM | | GV/MM | |
| BLAZE | | BLAZE | |
| SERIAL # | | SERIAL # | |

**OPTICAL COMPONENTS:**

GRATING(S) SURFACE QUALITY: O.K.

MIRROR(S) SURFACE QUALITY: O.K.

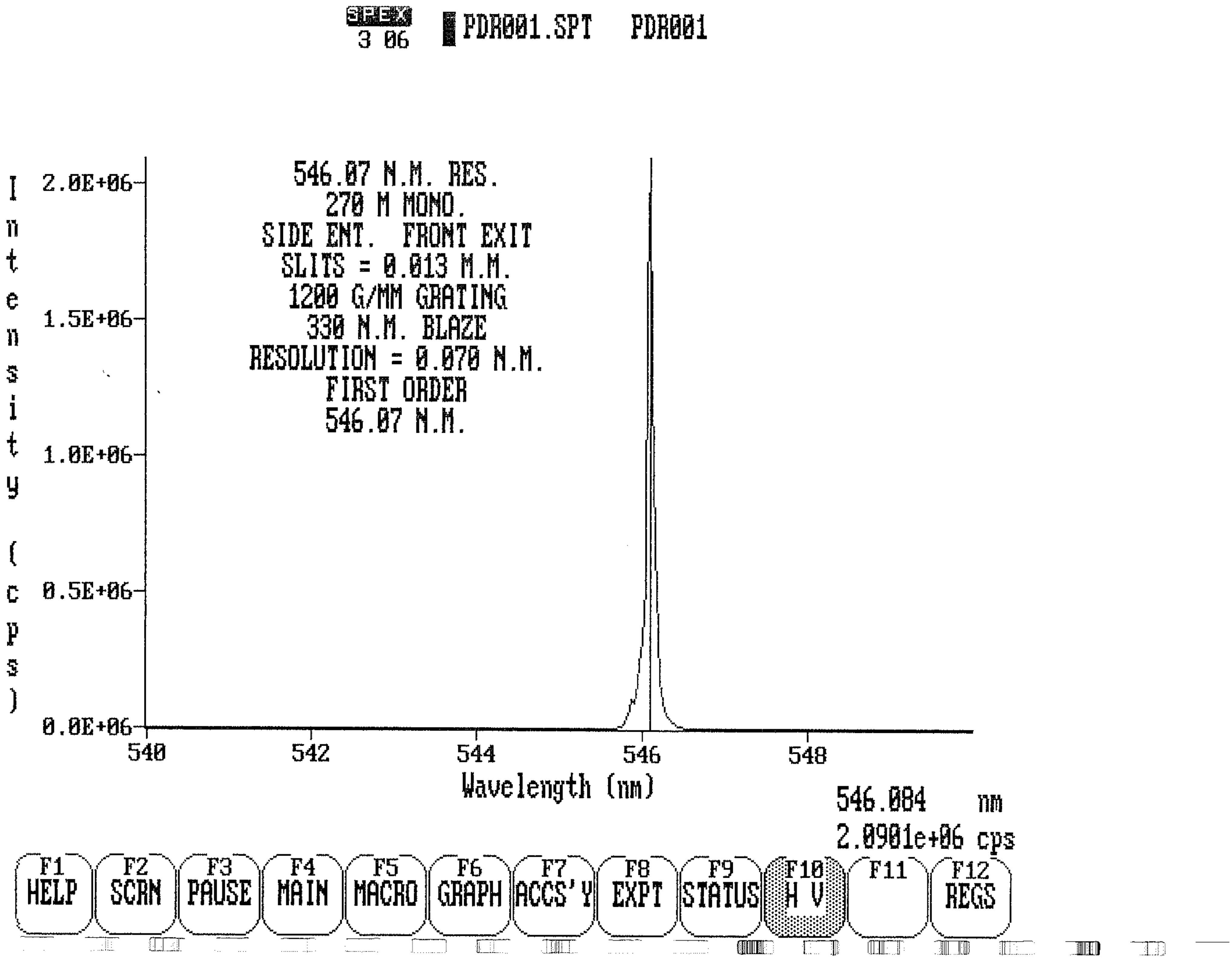
**MECHANICAL OPERATIONS:**

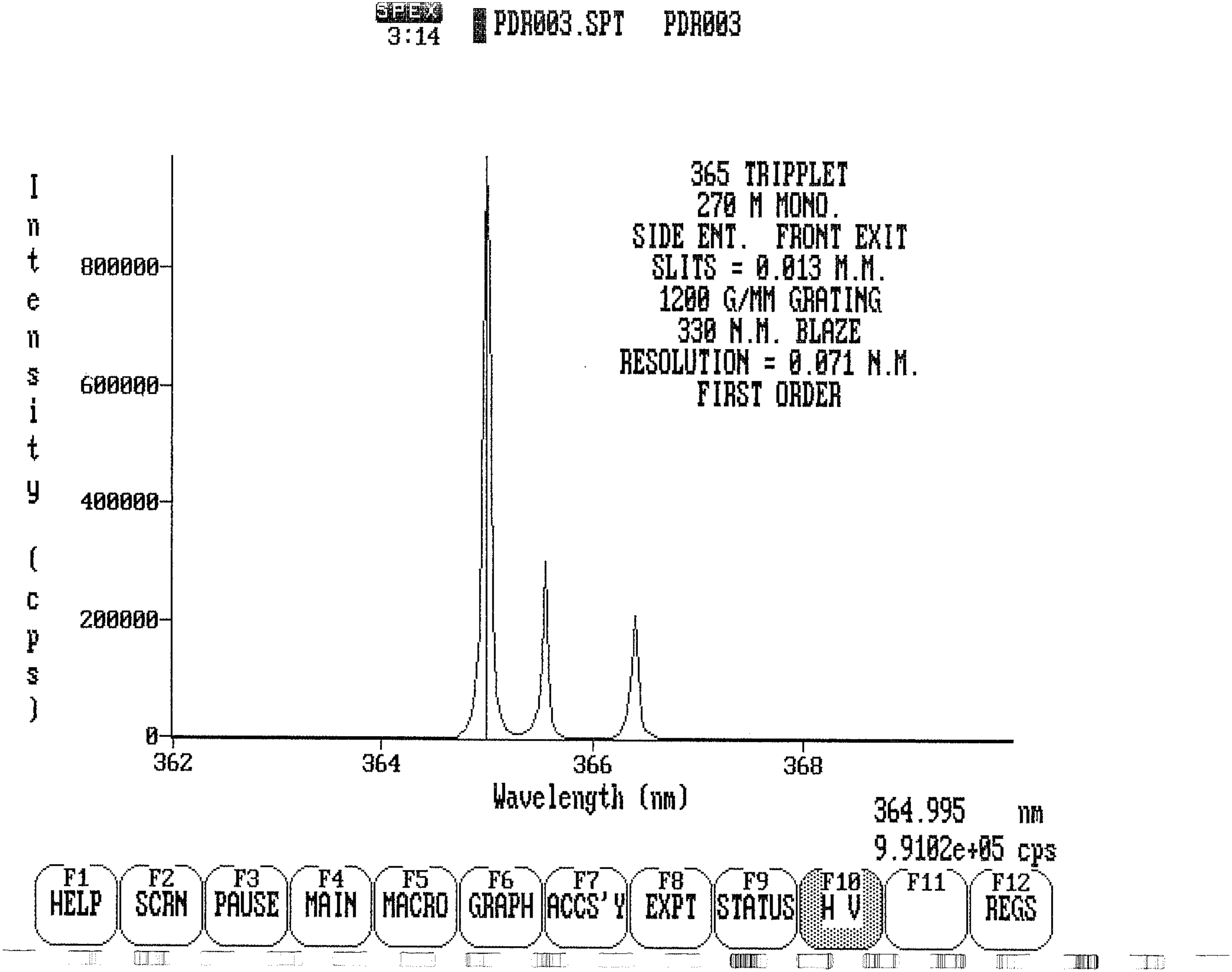
| | |
|---|---|
| SLIT OPERATION | ✓ |
| RESOLUTION | ✓ |
| LINEARITY | ✓ |
| REPEATABILITY | ✓ |
| LIGHT LEAK | ✓ |
| TURRET OPERATION | ✓ |
| GRATING INTERCHANGE | ✓ |

## RESOLUTION

| | |
|---|---|
| GRATING TYPE | 1200 G/mm @ 330 N.M. BLAZE |
| GRATING SERIAL# | 99877 |
| GV/MM | 1200 |
| ENTRANCE SLIT | AXIAL/LATERAL |
| EXIT SLIT | AXIAL/LATERAL |
| SLIT WIDTH | 0.013 M.M. |
| SLIT HEIGHT ENT. | 1.0 M.M |
| SLIT HEIGHT EXIT | 1.0 M.M. |
| WAVELENGTH | 546.07 N.M. |
| ORDER | 1ST ORDER |
| SCAN SPEED (INC) | 0.0312 N.M. |
| CHART SPEED | N/A |
| INT. TIME | 0.050 SEC. |
| DIAMOND MASK | N/A (MASK ON COLL. MIRROR ONLY) |
| RESOLUTION | 0.070 N.M. |

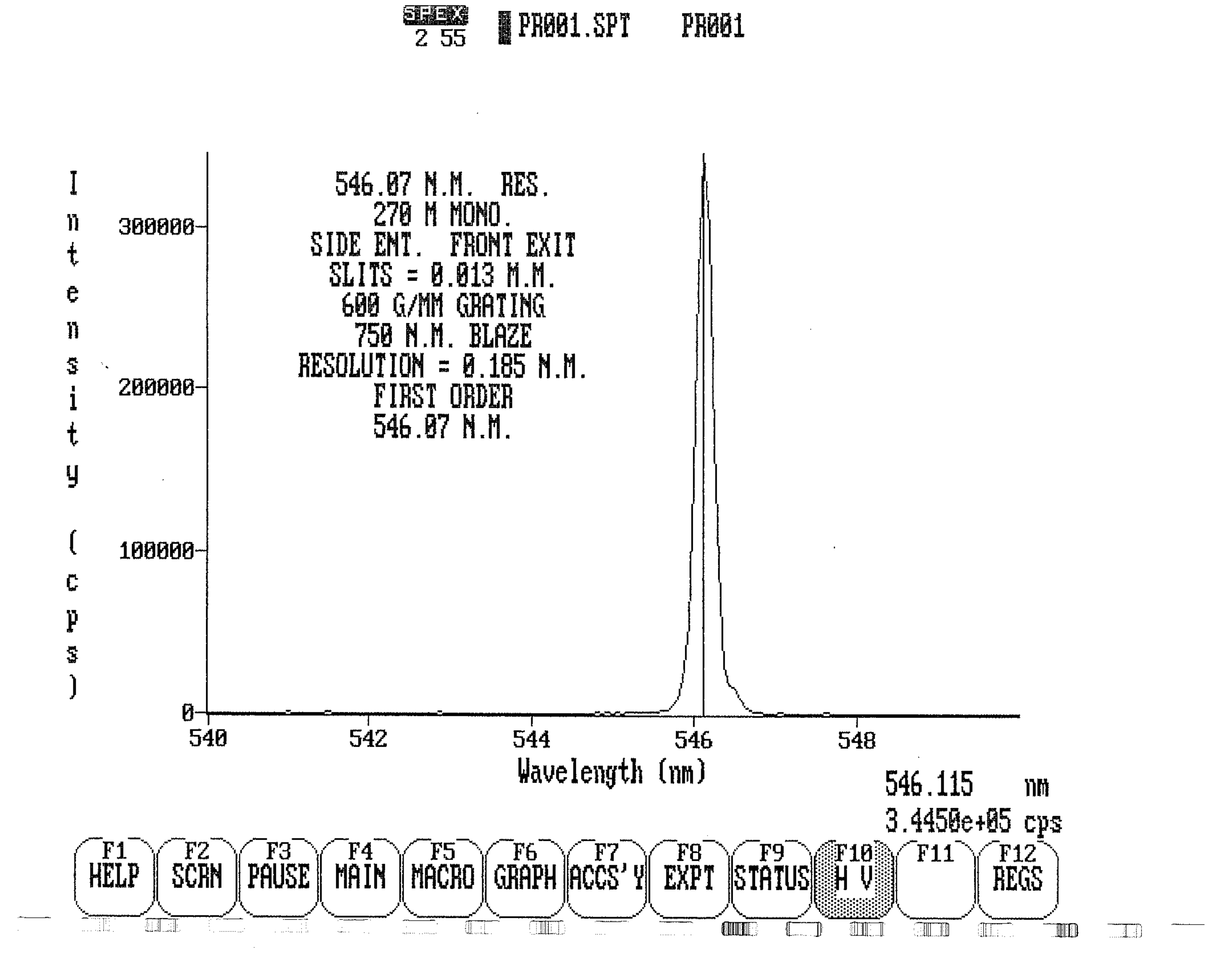
ATTACH TRACE HERE


SPEX
3 06
PDR001.SPT PDR001
546.07 N.M. RES.
270 M MONO.
SIDE ENT. FRONT EXIT
SLITS = 0.013 M.M.
1200 G/MM GRATING
330 N.M. BLAZE
RESOLUTION = 0.070 N.M.
FIRST ORDER
546.07 N.M.
Intensity (cps)
2.0E+06
1.5E+06
1.0E+06
0.5E+06
0.0E+06
540
542
544
546
548
Wavelength (nm)
546.084 nm
2.0901e+06 cps
F1 HELP
F2 SCRN
F3 PAUSE
F4 MAIN
F5 MACRO
F6 GRAPH
F7 ACCS'Y
F8 EXPT
F9 STATUS
F10 H V
F11
F12 REGS


SPEX
3:14
PDR003.SPT PDR003
365 TRIPPLET
270 M MONO.
SIDE ENT. FRONT EXIT
SLITS = 0.013 M.M.
1200 G/MM GRATING
330 N.M. BLAZE
RESOLUTION = 0.071 N.M.
FIRST ORDER
Intensity (cps)
800000
600000
400000
200000
0
362
364
366
368
Wavelength (nm)
364.995 nm
9.9102e+05 cps
F1 HELP
F2 SCRN
F3 PAUSE
F4 MAIN
F5 MACRO
F6 GRAPH
F7 ACCS'Y
F8 EXPT
F9 STATUS
F10 H V
F11
F12 REGS

## RESOLUTION

| | | |
|---|---|---|
| GRATING TYPE | 600 G/mm @750 N.M. BLAZE | |
| GRATING SERIAL# | 99878 | |
| GV/MM | 600 | |
| ENTRANCE SLIT | AXIAL/LATERAL | |
| EXIT SLIT | AXIAL/LATERAL | |
| SLIT WIDTH | 0.013 M.M. | |
| SLIT HEIGHT ENT. | 1.0 M.M. | ATTACH TRACE HERE |
| SLIT HEIGHT EXIT | 1.0 M.M. | |
| WAVELENGTH | 546.07 N.M. | |
| ORDER | 1ST ORDER | |
| SCAN SPEED (INC) | 0.0624 N.M. | |
| CHART SPEED | N/A | |
| INT. TIME | 0.050 Sec. | |
| DIAMOND MASK | N/A (MASK ON COLL. MIRROR ONLY) | |
| RESOLUTION | 0.185 N.M. | |


SPEX
2 55
PR001.SPT PR001
546.07 N.M. RES.
270 M MONO.
SIDE ENT. FRONT EXIT
SLITS = 0.013 M.M.
600 G/MM GRATING
750 N.M. BLAZE
RESOLUTION = 0.185 N.M.
FIRST ORDER
546.07 N.M.
Intensity (cps)
300000
200000
100000
0
540
542
544
546
548
Wavelength (nm)
546.115 nm
3.4450e+05 cps
F1 HELP
F2 SCAN
F3 PAUSE
F4 MAIN
F5 MACRO
F6 GRAPH
F7 ACCS'Y
F8 EXPT
F9 STATUS
F10 H V
F11
F12 REGS

## DRIVE CALIBRATION USING HG. LAMP

| ACTUAL N.M. | OCCURING AT N.M. | ERROR N.M. |
|---|---|---|
| 365.01 | 365.00 | -0.01 N.M. |
| 435.83 | 435.90 | +0.07 N.M. |
| 546.07 | 546.08 | +0.01 N.M. |
| 871.67 | 871.93 | +0.26 N.M. |

## SWITCH POSITION

NM. 1180.625000

STEPS 37780

DELTA STEPS 2580 (HANDSCAN OFFSET)

{32 step/nm
{0.03126 nm/step
(at 1200 g/mm grating)

## UPPER/LOWER LIMIT POSITION

UPPER 1180.625000 N.M.

LOWER 0 N.M.

## CONTROLLER INFORMATION

| | |
|---|---|
| TYPE OF CONTROLLER | RS 232 AND IEEE 488 |
| CONTROLLER SERIAL NUMBER | HANDSCAN S/N 8159 |
| OPERATING LINE VOLTAGE | (110) / 220 |
| SOFTWARE SHIPPED | SPEX 232/488 SUPPORT DISKETTE |
| SOFTWARE VERSION | 1.3 Version |

## CHECK LIST

| | | |
|---|---|---|
| FEET INCLUDED | ✓ | |
| PADS INCLUDED | ✓ | |
| MASK GLUED ON MI | ✓ | |
| ALL MIRRORS TIGHTENED | ✓ | |
| INTERIOR CLEANED | ✓ | |
| EXTERIOR CLEANED | ✓ | |
| ALLEN WRENCHES INCL. | ✓ | |
| SWINGAWAY MIRRORS SECURE | N/A | |
| DRIVE SECURED | ✓ | |
| SERIAL # PROPERLY ATTACHED | ✓ | |
| SWITCH POSITION ATTACHED | ✓ | |
| MIRROR TARGET INCLUDED | N/A | |
| MAGIC WAND INCLUDED | ✓ | |
| CONTROLLER CABLE INCLUDED | ✓ | SERIAL COMM. CABLE P/N 97133<br>HANDSCAN CABLE P/N 36406 |
| LINE CORDS INCLUDED | ✓ | 115 VAC |

Approved P. Ruane

Final test ______________

Comments INSTRUMENT ALIGNED & CALIBRATED O.K.

RUNS O.K. WITH RS 232 VIA P.C. AND HANDSCAN CONTROL.

ALSO RUNS O.K. WITH IEEE 488 VIA P.C. AND SUPPORT DISC

Customer BROOKHAVEN NAT'L. LAB Tested By PAUL RUANE

Sales Order 01059743

```
<- Arrow -> to Tweek Mono:    200.000       6400    0
F1   - Set
F2   - Start Position        :   100.000
F3   - End Position          :   200.000
F4   - Scan Speed            :     3.125        100
F5   - Calibrate
F6   - Shutter               :  CLOSED
 T     - Turret              :   0
 E     - Entrance Mirror     :   0
 X     - Exit Mirror         :   0
F7 - Scan                    :  STOPPED
F8 - HALT
F9 - Tweek Speed             :  Slow Increment
F10 - EXIT

Marker A :    100.000
Marker B :    110.000
Marker C :    170.000

            Command: F8
```

Motor DRVR BRK TYPE OPT 2

V2.01RS-232 HW CONFIGURATION PROGRAM Verify: ON

| MONO SYSTEM | 1 | 2 | MONO SYSTEM | 1 | 2 | MONO SYSTEM | 1 | 2 |
|---|---|---|---|---|---|---|---|---|
| Mono Drive. . . . | Y | N | Front Entr Shut. . | N | N | Filter Wheel. . . | N | N |
| Front Entr Slit. . | N | N | Side Entr Shut. . | N | N | Accessory 1 . . . | N | N |
| Side Entr Slit. . | Y | N | Swing Entr Mirror. | N | N | Accessory 2 . . . | N | N |
| Front Exit Slit. . | Y | N | Swing Exit Mirror. | N | N | Accessory 3 . . . | N | N |
| Side Exit Slit. . | N | N | Turret . . . . . . . | Y | N | Accessory 4 . . . | N | N |

| MONO SYSTEM | 1 | 2 | MONO SYSTEM | 1 | 2 |
|---|---|---|---|---|---|
| Mono Type . . . . . | 13 | 0 | Front Entr Slit Type. | 0 | 0 |
| Actual Grating 1 . . | 1200 | 0 | Side Entr Slit Type. | 2 | 0 |
| Actual Grating 2 . . | 600 | 0 | Front Exit Slit Type. | 2 | 0 |
| Auto Calibr Offset . | 2580 | 0 | Side Exit Slit Type. | 0 | 0 |

SYSTEM WIDE PARAMETERS

| | | | | | |
|---|---|---|---|---|---|
| High Voltage 1. . . . | N | Accessory 1 . . . . . . | N | H V 1 Limit . . | 0 |
| High Voltage 2. . . . | N | Accessory 2 . . . . . . | N | H V 2 Limit . . | 0 |
| Data Acq Module . . . | N | Accessory 3 . . . . . . | N | 488 Addrress. . | 1 |

| F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 |
|---|---|---|---|---|---|---|---|---|---|
| HELP | READ HARDWAR | WRITE HARDWAR | VERIFY MODE | | | | PRINT OPTIONS | COMM PARAMTR | QUIT |

Copyright Park Scientific, Inc. 1991 COM2: 19200 Baud

Limit Type None

Self Cal Yes

Slits 7mm → Type 2

Func Menu
Dev LST

Mono Drive
Installed

FR EN SLIT
NOT INST

SD EN SLIT
INSTALLED

FR EX SLIT
INSTALLED

SD EX SLIT
NOT INST

FR EN SHTR
NOT INST

SD EN SHTR
INSTALLED

ENT MIRROR
INSTALLED ?

over

Func Menu
Config Dev OPT 2

ACT Grat 1
1200

ACT Grat 2
600

Mono Type
13

STEP offst
2580

FR EN SLIT
0

SD EN SLIT
2

FR EX SLIT
2

SD EX SLIT
0

FILT TYPE
0

MOTOR DRVR
BRK TYPE OPT2

LIMIT TYPE
None

Self Cal
Yes

EX MIRROR
NOT INST

TURRET
INSTALLED

FILTER WHL
NOT INST

MONO DRIVE
INSTALLED

V2.01IEEE-488 HW CONFIGURATION PROGRAM Verify: OFF

| MONO SYSTEM | 1 | 2 | MONO SYSTEM | 1 | 2 | MONO SYSTEM | 1 | 2 |
|---|---|---|---|---|---|---|---|---|
| Mono Drive. . . . | Y | N | Front Entr Shut. . | N | N | Filter Wheel. . . | N | N |
| Front Entr Slit. . | N | N | Side Entr Shut. . | N | N | Accessory 1 . . . | N | N |
| Side Entr Slit. . | Y | N | Swing Entr Mirror. | N | N | Accessory 2 . . . | N | N |
| Front Exit Slit. . | Y | N | Swing Exit Mirror. | N | N | Accessory 3 . . . | N | N |
| Side Exit Slit. . | N | N | Turret . . . . . . . | Y | N | Accessory 4 . . . | N | N |

| MONO SYSTEM | 1 | 2 | MONO SYSTEM | 1 | 2 |
|---|---|---|---|---|---|
| Mono Type . . . . . | 13 | 0 | Front Entr Slit Type. | 0 | 0 |
| Actual Grating 1 . . | 1200 | 0 | Side Entr Slit Type. | 2 | 0 |
| Actual Grating 2 . . | 600 | 0 | Front Exit Slit Type. | 2 | 0 |
| Auto Calibr Offset . | 2580 | 0 | Side Exit Slit Type. | 0 | 0 |

SYSTEM WIDE PARAMETERS

| | | | | | |
|---|---|---|---|---|---|
| High Voltage 1. . . . | N | Accessory 1 . . . . . . | N | H V 1 Limit . . | 0 |
| High Voltage 2. . . . | N | Accessory 2 . . . . . . | N | H V 2 Limit . . | 0 |
| Data Acq Module . . . | N | Accessory 3 . . . . . . | N | 488 Addrress. . | 1 |

| F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 |
|---|---|---|---|---|---|---|---|---|---|
| HELP | READ HARDWAR | WRITE HARDWAR | VERIFY MODE | | | | PRINT OPTIONS | 488 ADDRESS | QUIT |

 488 Address: 1

July 27, 1992

Dear Spex Customer,

In order to provide you with the most up-to-date and useful documentation available for the Spex product(s) that you have purchased, this manual has been sent to you in a preliminary form.

The documentation is as correct and complete as possible as of the date of shipment. However, we expect to make further revisions and additions in the near future.

We at Spex are concerned that you, the user, receive correct and complete documentation in a form that is easy to access and understand,.

Toward that end, we would appreciate your assistance in improving the quality of the documentation by feeding back your comments, suggestions and unanswered questions.

We will do our utmost to provide the information that you need.

Sincerely,

Spex Industries, Inc.

For this manual, the contact person at Spex is Jim Dermody.
He can be reached by FAX at 908-549-5125, or by telephone at 908-549-7144, ext 133. Voice mail is available.

# 270M Rapid Scanning Imaging Spectrograph/Monochromator

# User Manual

## Including:

## Graphical Monochromator Interface Software

## and

## SPEX.SYS Device Driver

SPEX

## About the Manuals...

You may have more than one manual, depending on your system configuration. To find the manual that has the information you need, these guidelines may help.

- Each manual generally covers a product and the features and accessories peculiar to and/ or contained within that product.
- Accessories that can be applied to other products are normally covered by separate documentation.
- Software that is exclusively used with one instrument or system is covered in the manual for that product.
- Software that can be used with a number of other products is covered in its own manual.
- If you are reading about a product that interacts with other products, you will be referred to other documentation as necessary.

## Table of contents:

# 1 Overview of the 270M:

The 270M is a new generation spectrometer. It includes several new innovations, along with the best of proven technology and features.

## 1.1 Total Automation:

All moving parts of the 270M are automated. The slits, scanning drive, and optional turret, shutters, and side port selection mirrors are controlled remotely by any of several computer/ software options or the HandScan via the optional SPEX232. You can alter system performance and function as necessary without direct access to the instrument. With computer program control, it is possible to automatically adjust bandpass, change gratings, switch detectors or inputs without operator intervention.

## 1.2 Rapid Scanning Wavelength Drive:

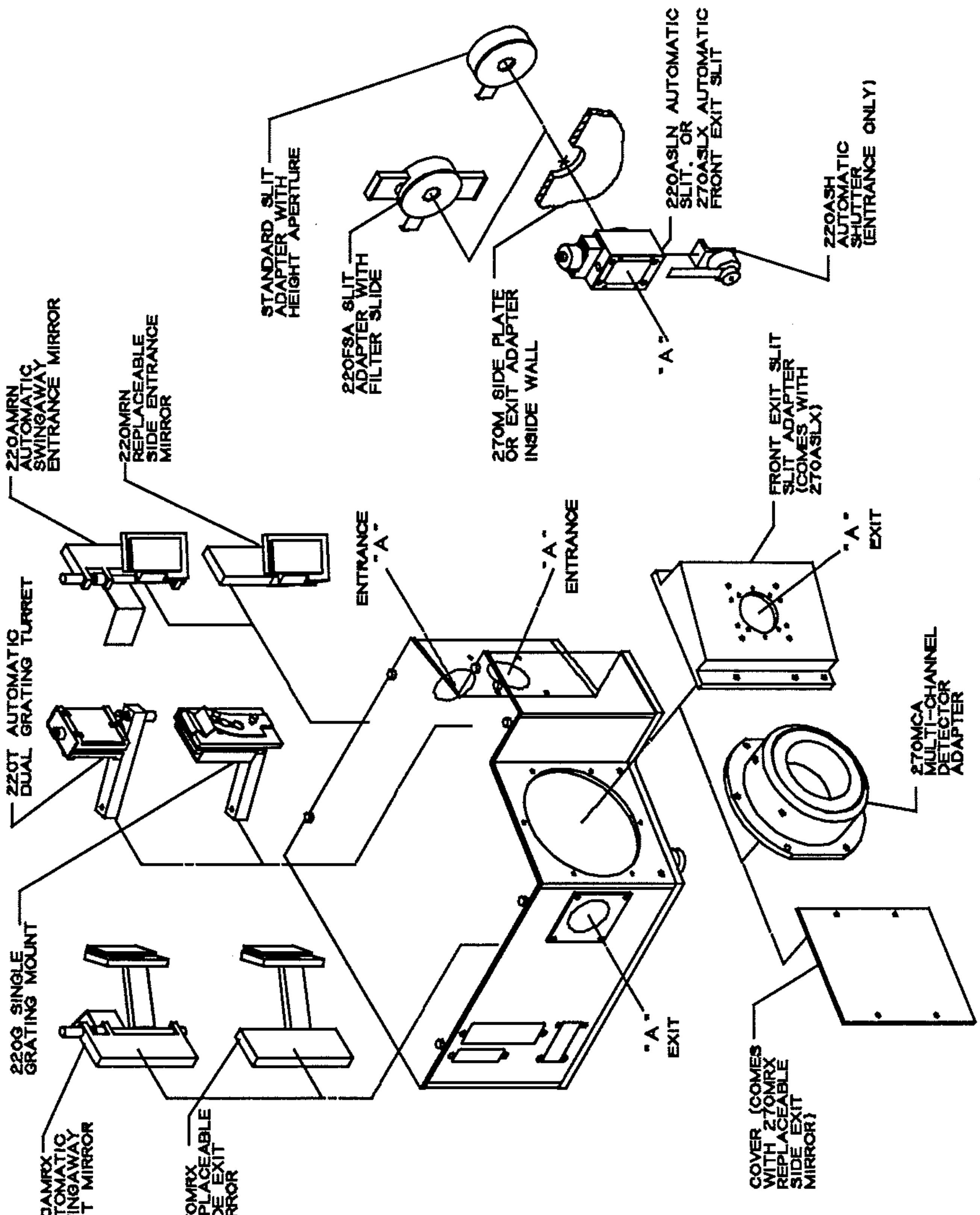
A unique high speed sine drive moves the 270M's grating in steps that correspond to linear increments of wavelength change at the exit slit, or the center pixel of an array detector. The constant step size simplifies control, and eliminates the possibility of disparities in scanned data that could arise from using a direct worm drive that may have significant unevenness of wavelength movements. For 1200 g/mm gratings a step equates to 0.03125 nm. Step sizes for all other grating groove densities can be calculated by applying an inversely proportional scale factor. For example: a 300 g/mm grating would move 0.125 nm per step. This conversion is done automatically by Spex controllers and software.

## 1.3 Optical Design Optimized for Imaging:

Optical performance is radically improved over earlier designs by a unique Czerny-Turner configuration utilizing a proprietary aspheric optical correction. The optical correction provides for exceptional imaging capabilities. Astigmatism, inherent in classical Czerny-Turner systems, is negligible. The fast (f/4) system delivers near perfect spectral imaging over an area 25 mm wide by 12 mm high in the spectrograph image plane. The computer aided geometric design prevents rediffracted light from reaching the detector. With other designs this rediffracted light can be detected as a spurious signal.

## 1.4 Dual Axis Grating Turret:

Instruments equipped with an optional 220T grating turret pay no penalty in optical performance for the convenience of automated grating interchange. To maintain image






**270M Options**

quality, throughput, and flatness of field it is essential that the grating is scanned by rotating on the correct axis. That axis is vertical, at the center of the face of the grating. This turret indexes the selected grating using a turret pivoting axis that is separate from the scanning axis. Either selected grating is positioned so that the center of its face is exactly on the scanning axis. By scanning the grating on this axis, throughput and image quality are preserved to the maximum extent possible throughout the scanning range. Because the turret is interchangeable, there is no limitation on the number of different gratings that can be mounted in a system.

## 2 Unpacking:

Your 270M was shipped in packing designed to protect it from harm under normal shipping conditions.

If shipping damage is noticed upon delivery, the carrier should note such damage on the receipt, and sign all copies. This will facilitate processing a damage claim with the carrier.

Open the top of the shipping carton and remove packing material until the instrument is exposed.

**CAUTION:** Do not use slit housings or other protrusions for lifting. Reach down around the edges of the instrument, grasp the bottom, and carefully lift it out of the remaining packing. Place it on a sturdy table. Check through the packing and gather the small parts, cables, and documents that were shipped with it.

### 2.1 Inspection for Damage:

Inspect the instrument for visible evidence of any damage. Check that all readily visible mechanical and electrical components are in their proper places and intact. **If damage is evident, do not operate the instrument. Notify SPEX Industries Customer Service Department and the carrier at once.**

Many public carriers do not recognize claims for concealed damage reported later than 15 days after delivery. For a shipping damage claim, inspection by the carrier agent is normally required. For this reason, the original packing should be retained as evidence. While SPEX Industries, Inc. is not liable for damage in transit, the company will extend every effort to aid and advise.

### 2.2 Initial Setup:

Install the three leveling legs by screwing them into the threaded holes provided in the bottom of the instrument, two near the front corners, and one at the rear in the center. Place the pads provided under the legs and level the instrument.

Remove the top cover and familiarize yourself with the various components in your spectrometer. Refer to the **270M Options** figure for component names and locations.

**2.2.1** Removal of Shipping Restraints:

CAUTION: Take care not to touch any of the optical surfaces in the instrument. Damage can easily occur and degrade performance. Such damage is not covered by the warranty. Fingerprints on a grating surface cause permanent damage. Once a fingerprint is on a grating, it is probably best to leave it alone. (See Cleaning Optics under **Installation and Care of Optics**.) Attempts to remove a fingerprint usually do not significantly restore any lost grating performance. There is a high risk of making it worse.

If your 270M has motorized swing-away side entrance or exit mirrors (220AMRN or 270AMRX), the restraints must be removed. Taking care to avoid touching the any mirror surfaces, using wire cutters, cut the nylon straps that hold the mirrors against the side walls.

**WARNING:** Never move the swingaway mirrors by hand. The miniature gearhead motors are delicate and expensive. Forcing them manually may result in time consuming, costly repair.

If you have a grating turret, remove the foam block that is packed above it, along with the tape that secures the block. Save the block , for if you ever need to ship your 270M for any reason. the block is needed to repack the instrument.

Last, while holding the grating cover in place, **CAREFULLY** remove the tape that holds the cover on the grating (if you have a turret, only the grating facing the interior of the 270M is covered, be careful to avoid touching the surface of the other grating). When the tape is removed, hold the bottom edge of the cover in place, and tilt the top edge of the cover away from the grating, then move the cover down and away from the grating. This technique minimizes the risk of grating damage. Anything, including dust, smoke, or organic vapors, that comes in contact with the surface of the grating is likely to cause damage or loss of reflectivity.

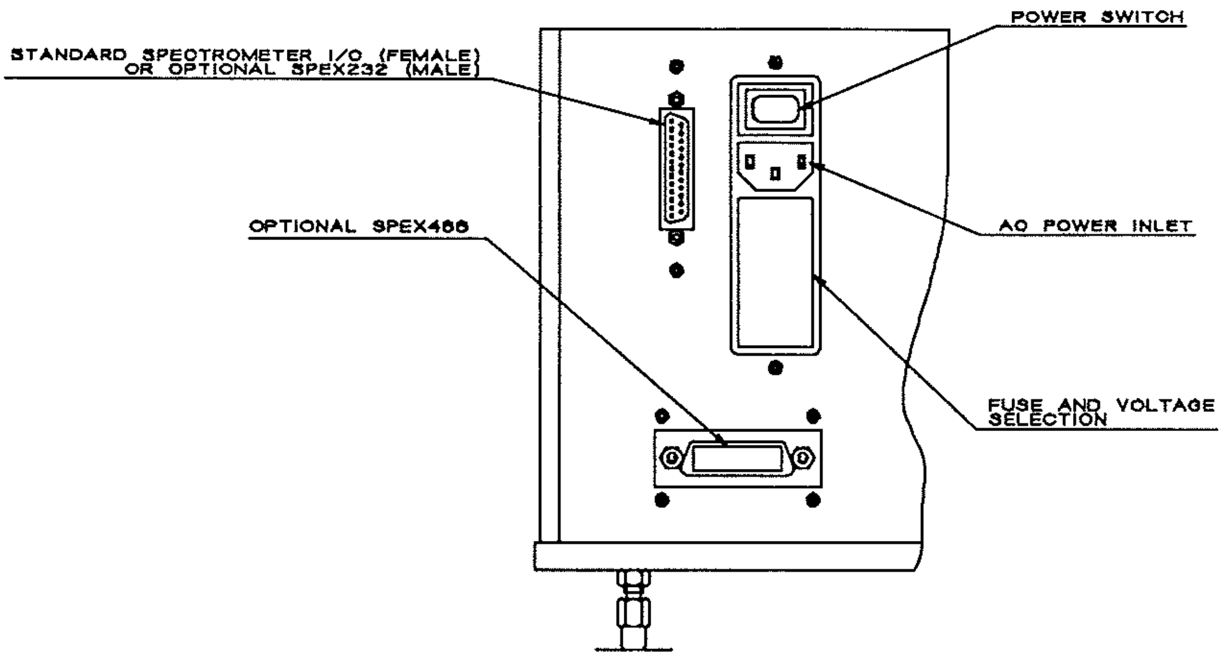
**2.2.2** Locating Your Instrument:

Your spectrometer should be kept in an atmosphere free of dust, corrosives and smoke. For specified performance, the 270M should be operated in a room where temperature control is maintained within ±2° C.

## 3 Electrical Connections:

The 270M requires connection to an AC power source. The connector for the line cord, the power switch, fuse and 220/110 volt selection are provided in an integrated power module.

Connections for controllers or computers vary depending on the options present. The locations of the connectors are shown in the diagram.




**270M Electrical Connections**

### 3.1 Control Cable Connections:

The cable connections for the 270M vary, depending on the interface used and the controlling device or computer attached. The following table lists the cable connections to the 270M that are required for the various configurations. Some configurations involving a controller and a computer will require other cabling between the controller and the computer. Refer to the manual for your controller for further information.

**270M Control Interface Cabling**

| Interface type: | 270M connector: | Cable number: | Connects to: | Software/ Controller Options: |
|---|---|---|---|---|
| Standard Spectrometer I/O (TTL) | 25 pin "D" female | 35816 | PC parallel (LPT) port | Graphical Monochromator Interface (GMI), or User program via SPEX.SYS driver |
| Standard Spectrometer I/O (TTL) | 25 pin "D" female | 33990 | DataScan Mono Drive 1 or 2 connector | AutoScan, or user program via DataScan Programmer's Instruction Set |
| Standard Spectrometer I/O (TTL) | 25 pin "D" female | 33990 | DM3000 Mono1,2,3,or 4 connector on CTI board | DM3000 software for Research Spectroscopy |
| Standard Spectrometer I/O (TTL) | 25 pin "D" female | 33990 | QuikScan Motor Drive connector on Digital card | QuikView, or AutoScan (if special ordered for motor control via QuikScan digital board), or user program via PDALOAD.EXE driver |
| Optional SPEX232 | 25 pin "D" male | 36406 | HandScan connector | HandScan controller |
| Optional SPEX232 | 25 pin "D" male | 97133 | PC COM port, High memory accessible | QuikView if special ordered for use with SPEX232-270M |
| Optional SPEX232 | 25 pin "D" male | 97133 | PC COM port | User program via 270M Programmer's Instruction Set |
| Optional SPEX488 | 24 contact "D" female | user provided cable | IEEE-488 GPIB | User program via 270M Programmer's Instruction Set |

Connector pin assignments are listed in Appendix A.

If you have a 225MCD or 226MCD shutter, connect the shutter cable #xxx to the BNC connector and refer to your detector system manual to determine proper connection to the detector control electronics.

## 4 Software Installation and Control Interfacing:

The 270M must be controlled by an external controller or computer. The full automation of all moving parts of the spectrometer makes it unnecessary to have direct physical access to the instrument.

If your 270M does not contain the optional SPEX232 or SPEX488 interface, the Graphical Monochromator Interface (GMI) software is provided.

Spex also offers several software options to control your 270M, such as AutoScan for use via a DataScan controller, QuikView for use in conjunction with a QuikScan Photodiode Array, and the DM3000 Spectroscopy Computer. Each of these are configured at the factory for your system and you need not be concerned with protocols or handshaking.

A Programmer's Instruction set is also provided with systems that include the optional DataScan controller, or the SPEX232 or SPEX488 interfaces.

Each group of controlling options is outlined in this section, along with direction to further documentation, if necessary.

Refer to the **Electrical Connections** section for appropriate cable connections.

At this point, the installation procedure branches. Please find the subsection pertaining to the software/ controller you will be using.

### 4.1 Standard Graphical Monochromator Interface (GMI):

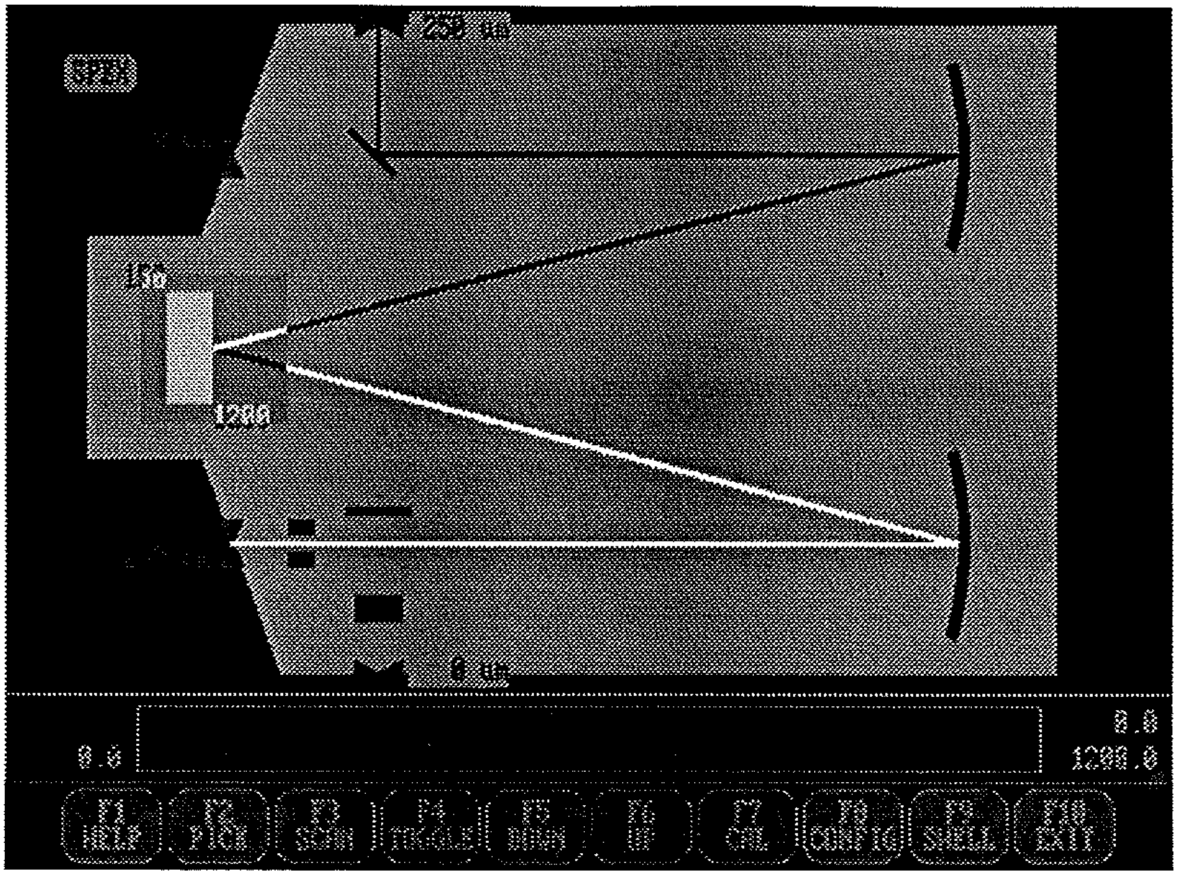
If your 270M does not contain the optional SPEX232 or SPEX488 interface, the GMI software is provided on a diskette for installation on a PC running MS DOS 3.3 or 5.0. You will need to know the number of an available parallel port (LPT1,2,3,or 4). Connect the 35816 cable to that port, and to the 270M standard spectrometer I/O connector.

To Install the GMI software on your PC:

- Boot your PC
- Insert the diskette into the floppy drive and from the DOS prompt, type"A: [Enter]"
- at the A:\> prompt, type "install [Enter]"
- Follow the instructions on the monitor screen to install the GMI software on your computer.
- To run the GMI software after installation, at the DOS c:\ prompt: type "CD\GMI [Enter]" (to go to the directory where GMI is installed) and then type "GMI [Enter]" to execute the program.

If communications with the 270M fails, the GMI will prompt to offer running in demo mode. To correct this, check that the 35816 cable is properly connected to the 270M standard spectrometer I/O connector and the parallel port on your PC that you specified when installing the GMI.

The GMI screen displays a graphical representation of the 270M. The screen shows the available devices in the spectrometer that can be controlled. Present slit widths, wavelength, turret and side mirror positions are displayed. The screen also has brief prompts to assist you, and the [F1] key calls detailed context-sensitive Help messages to further explain the various functions called.




## 4.2 SPEX.SYS Driver:

The SPEX..SYS driver is included with the GMI software. Please complete the GMI installation and perform the **Initial Checks** of your 270M with the GMI before proceeding to programming with SPEX.SYS. To avoid confusion, it is best to be sure that the interface and 270M are functioning properly first, then proceed to writing, testing and debugging your program. Writing programs utilizing device drivers such as

SPEX.SYS requires considerable programming skill, and is therefore not recommended for the occasional or novice programmer. Documentation for SPEX.SYS is in appendix B. This documentation is normally sufficient to get an experienced programmer started writing controlling routines for the 270M.

### 4.3 Optional HandScan:

If your 270M will be controlled by a HandScan, please refer to the HandScan section of the DataScan / HandScan / SPEX232 / SPEX488 manual.

Note: Your optional SPEX 232 interface that connects to the HandScan can also be used to control your 270M from a computer. If you would like to use the SPEX 232 connected directly to your computer, please perform the initial checks using the HandScan, then refer to the Programmer's Instruction Set section of the DataScan / SPEX232 / SPEX488 manual. The support diskette provided contains files to get a programmer started writing routines for a DOS PC.

### 4.4 Optional SPEX232 and SPEX488 interfaces, and DataScan Controller:

A Programmer's Instruction Set is provided on a diskette for use with on a PC running MS DOS 3.3 or 5.0. Please refer to the Programmer's Instruction Set section of the DataScan / HandScan / SPEX232 / SPEX488 manual for setup procedures and information about writing your own programs with the Instruction Set.
The DataScan and the SPEX 232 interface also connect to the HandScan. If you have a HandScan, please perform the **Initial Checks** with the HandScan, then refer to the Programmer's Instruction Set section of the DataScan / HandScan / SPEX232 / SPEX488 manual.

### 4.5 Optional DM3000 Spectroscopy Computer:

The DM3000 software controls the 270M via the Standard Spectrometer I/O connector. Please refer to the DM3000 manual to set up the software and familiarize yourself with it. Then return to the 270M manual **Initial Checks** section.

### 4.6 Optional AutoScan Software:

The AutoScan Software controls the 270M via the DataScan, or via the QuikScan digital board in systems special ordered in that configuration. Please refer to the AutoScan manual to set up the software and familiarize yourself with it. Then return to the 270M manual **Initial Checks** section.

### 4.7 Optional QuikScan PDA system:

If your 270M is to be controlled by your PC along with your QuikScan diode array system, please refer to the QuikScan PDA manual to install the controller boards and the QuikView Software manual to familiarize yourself with the software. Then return to the 270M manual **Initial Checks** section.

### 4.8 PDALOAD.EXE Driver:

The PDALOAD.EXE driver is installed with the QuikView software. Please complete the QuikScan installation and check out your 270M with QuikView before proceeding to programming with PDALOAD.EXE. To avoid confusion, it is best to be sure that the interface and 270M are functioning properly first, then proceed to test and debug your program. This method of programming requires considerable programming skill, and is therefore not recommended for the novice or occasional programmer. The documentation provided in the PDALOAD.EXE section is sufficient to get an experienced programmer started writing controlling routines for the 270M.

### 4.9 Controlling the 270M with the Standard Spectrometer Interface:

This subsection details the functionality of the standard Spectrometer I/O, for those who wish to interface directly to the hardware using TTL logic. This discussion does not apply to systems with optional 232 or 488 interfaces, or the DataScan controller.

The easiest way to confirm proper operation of this interface is to install the Graphical Monochromator Interface (GMI) software and SPEX.SYS driver on a DOS PC. Refer to the GMI instructions earlier in this section for further information.

Appendix A includes a pin function table for the Standard Spectrometer I/O (TTL) connector.
zzz need to describe and list the select clock options, and the use of index and sense lines, as well as how to move a mirror, shutter, turret.

## 5 Accessory Installation:

A full line of accessories are available for the 270M from light sources, optical fibers and interfaces to detectors and sample compartments. Most of these are shipped with separate documentation. The accessories described here are only those which are user installable and, in effect, become part of the 270M.

## 5.1 270MCA Spectrograph Exit Port Installation:

If your 270M has a spectrograph exit port for an array detector, remove all of the tape and the cover plate from the adapter flange and find the two 10-32 oval point retaining screws that will hold the detector mounting cup inside the adapter flange. If your 270M was shipped together with an array detector purchased from Spex on the same order, the detector mounting cup may be mounted to your detector. Otherwise, mount the cup to your detector with the three 8-32 flat head screws, washers, and nuts provided.

If you have a 226MCD shutter that was not factory installed, install it on the front surface of the detector mounting cup. See the Accessories section for instructions.

Insert the detector mounting cup, with the detector attached, into the adapter flange. If your array detector was shipped from Spex with the mounting cup attached, there may be pencil marks at the top of the cup and the adapter flange to provide a reference location for detector alignment. Snug the two 10-32 retaining screws to hold the detector. See the alignment section for final adjustment.

## 5.2 225MCD Shutter:

This external mount shutter replaces the spacer/ height limiter at the entrance slit. It is intended for exposure control on a Spectrum One CCD and QuikScan PDA detector systems. To install it, remove the four 6-32 socket head capscrews along with the spacer and remove the two 10-32 setscrews to the right of the slit. Then open the cover and attach the 225MCD in its place with the two 6-32 and two 10-32 screws provided with the shutter. replace the cover to the shutter.

The BNC connector on the right side of the shutter housing connects to the shutter cable of a Spectrum One or QuikView detection system.

## 5.3 226MCD Shutter:

This is an internal mount shutter that is intended for exposure control on Spectrum One CCD and QuikScan PDA detector systems. It attaches to the detector mounting cup of the 270MCA multichannel array adapter, fitting into the spectrograph exit port of the 270M. To Install it, see figure xxx. There are four holes in the cup. Use only three of these holes, leaving the top hole unused. Insert 3 of the 2-56 screws provided, screwing on the three 0.5 inch spacers, followed by three set screws. Place the shutter on the set screws and fasten it in place using the three 0.375 inch spacers. Fasten the baffle plate over the shutter with three phillips head 2-56 screws. Remove the plug from the purge port on the back of the 270M, and replace it with the BNC connector provided. the wiring on the BNC connector should pass through the purge port and under the circuit board(s) inside and should be routed neatly with the existing wiring towards the spectrograph exit. When the detector/ cup/ shutter assembly is inserted into the multichannel adapter flange, connect the shutter wiring to the BNC and neatly secure any slack wiring with the existing wire retainers.

The BNC connector on the back of the 270M connects to the shutter cable of a Spectrum One or QuikScan detection system.

# 6 Installation and Care of Optical Components:

The mirrors and gratings in your spectrometer require no routine maintenance. Still, care should be exercised to prevent damage to their surfaces which will degrade throughput. Your spectrometer should be kept in an atmosphere free of dust, corrosives and smoke.

WARNING: Never turn the swingaway mirrors by hand. The gearhead motors are delicate. Forcing them manually may result in time consuming, costly repair.

## 6.1 Interchanging Gratings on Turrets:

If your 270 M has a turret option, you may select either grating on the turret automatically, using the controller or software that is connected to your system. Refer to the instructions that pertain to your system's controller or software. The gratings are mounted and aligned on the turret assembly. They are prealigned in their interchangeable two grating mount, so it is best not to remove them from the mounts or disturb their adjustments.

xxx interchangeable turret removal/replacement procedure and figure. part #?

If your 270M has the standard single grating mount, one grating is mounted in the instrument for shipment, and additional gratings are packed separately. Be careful to avoid touching a grating surface.

Normally, any grating that has been aligned in the instrument need not be realigned each time it is installed. In the alignment section of this manual, there is a procedure to follow, should it become necessary. The standard single grating mount is shown in Figure xxx2B. To remove the grating from the instrument, hold the grating mount by the edges, being careful not to touch the grating surface. The slotted leaf spring at the rear of the mounting bracket is pulled up to disengage the stud on the back of the grating mount.

## 6.2 Installing a Single Grating:

Place the mounted grating face-up on an uncluttered clean surface. Carefully peel tape off one side of the grating and, using the tape on the other side as a hinge, swing the cover up and away from the grating. Separate the cover from the grating. Grasp the grating mount and place it in the instrument so that the stud passes through the keyhole slot in the retainer spring, and the three contact points engage properly. The top point is rounded and fits into a cup in the instrument. At the bottom of the grating mount there is another rounded contact point that indexes in a grooved insert in the instrument. The third point, also at the bottom, is a slightly convex surface on the grating capsule that rests against a flat surface in the mounting bracket in the instrument. With all three points in proper positions, push the retaining leaf spring back and down to hold the grating in place, ready for use.

Place the 270M top cover back on the instrument to keep dust out while continuing unpacking and setup.

## 6.3 Cleaning Optics:

Dust or other solid debris should be blown off with dry dusting gas or nitrogen. If particles cannot be dislodged, consider leaving well enough alone, rather than risking surface damage. A fingerprint on a mirror or grating surface should be flushed off as soon as practical by squirting the surface of the mirror with research-grade methanol from a clean squeeze bottle. If the flow from the wash bottle does not remove the fingerprint, call Spex Customer Service for further advice.

## 6.4 Entrance and Exit Slits:

Your spectrometer has motorized adjustable slits located at the entrance and exit ports. The 220ASLN and 270ASLX slits are controlled remotely by the HandScan or your Computer. The slit width can be varied in steps of 12.5 µm. Since the dispersion of the 270M with 1200 g/mm gratings is 3.7 nm/mm, opening the slits by 0.1 mm allows an additional 0.37 nm of spectral bandwidth to pass through the instrument. In this case, a slit setting of 0.5 mm equates to a 1.85 nm bandpass. Assuming broadband light entering the spectrometer, the bandpass at the exit for moderate to narrow slit widths will approximate a Gaussian distribution. The nominal bandpass is measured at half of the peak intensity.

See Pg 17. exit slit consideration

## 6.5 Spectrograph Exit Port:

The 270MCA is an adapter to mount and support most multichannel array detectors that conform to the industry standard three bolt circular pattern and focal plane position. The Spex QuikScan and Spectrum One detectors fit, of course, as do most other manufacturer's spectroscopic array detectors. If your detector is not from Spex, please refer to the spectrograph port interface drawing in the **Mechanical Interfacing** section and compare dimensions with the detector or documentation you have with your array system. The spectrograph port provides for translation in and out to locate the array in the focal plane, and rotation to align the array pixels with the vertical slit image.

# 7 Initial Checks:

## 7.1 Equipment Required:

- HandScan or IBM PC/AT compatible computer
- If using a computer, you will also need the GMI diskette for parallel interface control, or the Datascan/ SPEX232/ Spex488 support diskette for serial or GPIB interface control.
- Mercury lamp, or fluorescent room light.
- Photodetector and detection electronics.

## 7.2 Checkout:

For HandScan, AutoScan, and QuikScan controlled systems, the wavelength, slit, turret, mirror, and 220ASH shutter drives will run through a self-test and self-calibration when the controlling program or device runs a hardware initialization routine. For a fully loaded system, this may require a few minutes, as each automated device is initialized in sequence. With the top cover removed, you can verify the movement of the various drives. Do not interfere with or force any of the devices to move, as this may result in damage to your 270M. With the slit blocking/ height limiting slides open, you may observe and verify each of the slits opening and closing, in turn, during initialization. At the end of the initialization, the slits will be "closed" to a nominal width of 10 microns. Following initialization, depending on the controller you use, the wavelength drive will be positioned at the calibration switch at the high end of its travel, or it will be set to the nominal center of its range. Some software options will then reset the various drives to their last-used positions.

Assuming that there was no damage discovered during unpacking and installation, the optics in the 270M should require no further attention. Actually, they are best left undisturbed.

As an initial check to determine that the calibration and alignment are not grossly out of place, you may verify that the visible mercury lines are passed through the exit. To check this, illuminate the entrance slit with the mercury lamp, and with your controller, tune the wavelength drive to 546 nm. Note that the correct steps/nm factor must be used when configuring your controller. A 1200 g/mm grating in a 270M requires 32 steps/nm factor. Other grating groove densities require proportionally more or less steps/nm. With the slits opened to 250 micron, the green line should be visible through the exit slit. If your system has no exit slit, hold a piece of ground glass as a focus screen in the center of the spectrograph focal plane to find the green image of the entrance slit (frosted tape on a microscope slide makes a good substitute, or use tracing paper). Extra lamp intensity, or a darkened room may help you see it. The same test can be repeated at the 577 and 579 nm orange doublet lines.

If you wish to accurately check calibration, mount a photodetector at the exit, and close the slits to 13 microns and set the height limiter to 1 mm. when you scan past the spectral lines that your detector responds to, they should peak within +/- 0.1 nm of their indicated wavelengths, if you are using a 1200 g/mm grating. For other gratings, the tolerance scales inversely to g/mm. Note that all calibration scans should be made in the direction of increasing wavelength. When moving to shorter wavelengths, overshoot by at least 10 nm with a 1200 g/mm grating, (or 320 steps in any case) to allow for backlash correction. Backlash correction is automatic with DM3000 and AutoScan software. Refer to the calibration data shipped with the instrument for the calibration plots that were run on your spectrometer prior to shipment from the factory.

## 8 Optical Interfacing Considerations:

### 8.1 Grating Selection:

Once the spectrometer itself is chosen, a key variable in determining the working specifications of the system is the grating.

Groove density affects resolution or bandpass or coverage on an array detector. The grating can often be chosen to enhance sensitivity over a range of wavelengths of interest. There are gratings available to allow the 270M to be used from 185 nm to 50 µm and beyond. In many cases resolution or throughput can be enhanced by choosing a higher groove density, Or change the spectral coverage on your array by selecting a different groove density than you are now using.

The blaze wavelength of a Ruled grating is its wavelength of peak efficiency. generally the efficiency will stay stronger farther toward longer wavelengths than shorter. Although Ruled gratings can be highly efficient, beware of the inevitable grating ghosts that can reduce signal to noise ratios. This is not apparent from efficiency data. The effect can be quite distracting when using a single grating system in conjunction with a laser. Even worse, if the signal of interest is weak compared to the laser, as in Raman spectroscopy, for example. The ghosts are caused by minute mechanically induced errors in groove spacing. Even using state-of-the-art dual interferometer controlled ruling engines cannot eliminate this problem entirely. Generally, the ghosts are most severe in high groove density gratings, Ghost intensity increases as the square of groove density.

Most systems using Low density gratings for broad coverage on an array, or blazed for the Infrared do not suffer significantly from ghosts. Ruled gratings remain the best choice for these cases.

Standard Holographic gratings are created by optical holographic techniques, and as a result, have no spacing error, hence no ghosts. They generally exhibit broader response, at the expense of high peak efficiency. There are Holographic gratings optimized for wavelengths from the UV to the near IR.

The newer Blazed Holographic gratings provide the high efficiency comparable to that of a ruled grating without the ghosts. For many cases in the UV and Visible, these are now the best gratings available.

The growing list of available gratings is too extensive to describe adequately in this manual. The gratings are also too important to system performance to make quick, uninformed selections.

Contact your Spex sales representative for detailed information and advice in selecting gratings for your specific applications. In order to assure you of optimal selections for your applications, we need to know:

- The total range of wavelengths you wish to work over
- The resolution / bandpass you need
- The type of source you are using
- The spectroscopic phenomenon you will observe, i.e., emission, absorption, transmission, fluorescence, Raman, etc.
- The type and spectral response of your detector
- If an array detector is used, the size if the pixels and the array size
- For arrays also, the coverage required in a single readout.

### 8.2 Optical Coupling at the Entrance Slits:

To allow the 270M to provide its maximum throughput, one of the most important considerations is the proper coupling of light into the entrance slit. The Ideal is to maximize the signal of interest, while minimizing noise. To accomplish this, some understanding of the optical requirements is helpful.

The 270M, like most spectrometers, is an imaging system. An image at the entrance slit will be dispersed into its various wavelengths, and for each wavelength present in the signal, an image of the entrance image (as masked by the entrance slit) will be formed at the exit.

The best results are obtained when your signal is imaged on the entrance slit, on the optical axis that is defined by the center of the slit and the center of the collimating mirror. If the signal is visible light , a quick check can be made by placing a white card in front of the collimating mirror. You should see homogeneous illumination across the entire active surface. If some image or structure is observed in the card, the image is probably not well focused at the entrance.

To optimize the signal to noise ratio, it is important that the collimating mirror is filled, but not overfilled by the signal beam. Underfilling usually implies that more signal can be obtained, by using faster collection optics. Overfilling the spectrometer optics can only increase the possibility of stray light reaching the detector. Limit the aperture of the beam so that the collimating mirror is just filled.

### 8.3 Exit Slit Considerations:

Bandpass in optical spectrometers is determined by multiplying the dispersion by the exit slit width, or the width of the image of the entrance slit that is formed at the exit, whichever is the greater of the two widths. The difference is significant in instruments such as the 270M which have a magnification factor due to the exit arm focal length being greater than the entrance arm focal length. The 270M has a nominal 220 mm entrance arm, and 270 mm exit arm. The magnification factor is the ratio of the entrance arm to the exit arm lengths, or 1.23. Hence, the image of the entrance slit at the exit is 23% larger than the entrance slit width.

If you set the entrance and exit slits to the same width, the resolution will be consistent with the entrance slit width, but throughput will be limited by the exit slit width. With the 270m, setting the exit up to 23% wider than the entrance will give more throughput without sacrificing resolution. Beyond that, the resolution degrades, as the increase in exit slit width will allow a larger bandpass to exit.

### 8.4 Spectrograph Port Focusing:

Please refer to the instructions provided with your array detector, and set it up in a realtime display mode for final adjustment. If reatime display is not available, the alignment will take longer, as you must view the change in detected signal after each trial adjustment.

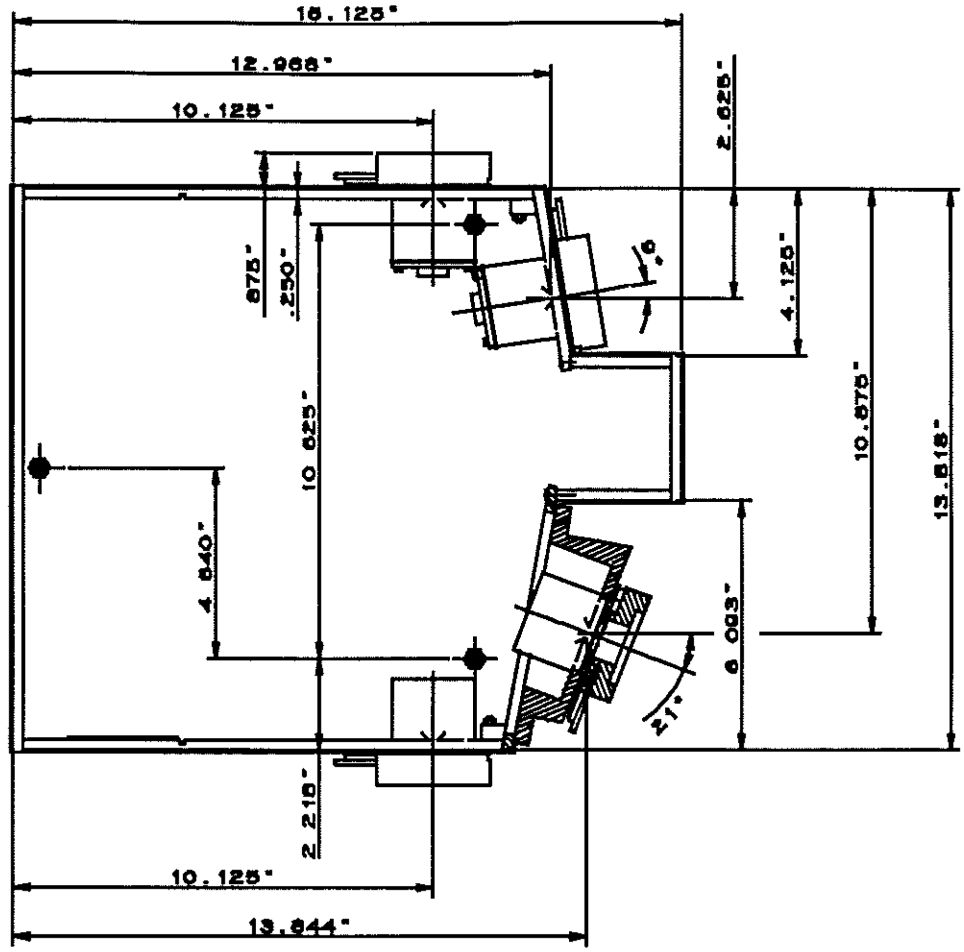
The 270 M spectrograph port provides for translation in and out to locate the array in the focal plane, and rotation to align the array pixels with the vertical slit image. The goal is to get the best focus and vertical alignment. to start, set up a spectral lamp at the entrance (e.g. Mercury, neon, or fluorescent desk lamp). Acceptable results can often be attained without coupling optics, provided that the source or reflected beam is directly on the optical axis entering the slit. (For best results, the lamp should be properly coupled to the entrance slit. See the Optical Interfacing section for further information.)

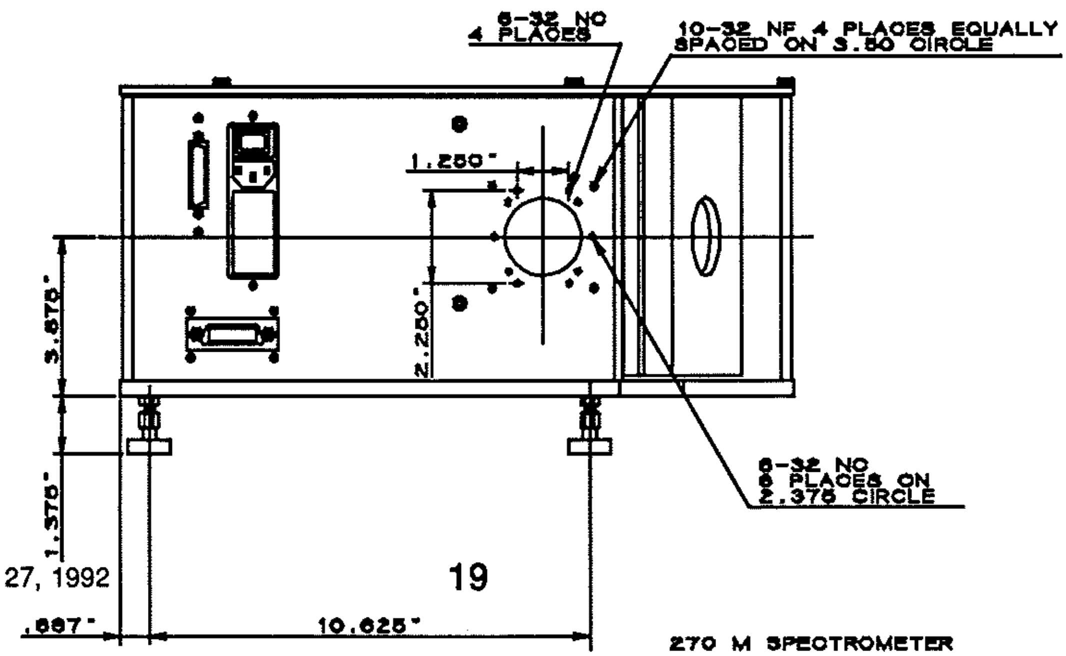
Set the spectrometer drive to the wavelength of a known spectral line, such as the mercury 546.1 nm emission line. Set the entrance slit to 80% of the width of a pixel on your array, or slightly smaller (this takes into account the magnification factor of the 270M). Adjust the light intensity until you have a low to mid scale signal on the display. Ideally, set the 270M to a wavelength region where several lines are imaged on various parts of the array simultaneously. With multiple lines, you can optimize focus over the entire array. If this is not possible, then move the spectrometer drive to position spectral lines alternately at the center and ends of the array. While observing the realtime display, rotate the detector to minimize the width of the image on the array. Then translate the detector in and out to find the best focus. Be careful not to be fooled by apparent intensity fluctuations that may occur as a function of small movements of a narrow image being shared between adjacent pixels. Through your careful attention during alignment, you can be assured that you will realize the exceptional performance capability that was designed and built into your 270M by Spex. Optimization of the focus adjustment is an iterative process. Repeat the rotation and translation with successively smaller movements until no further improvement is observed.

## 9 Mechanical Interfacing:

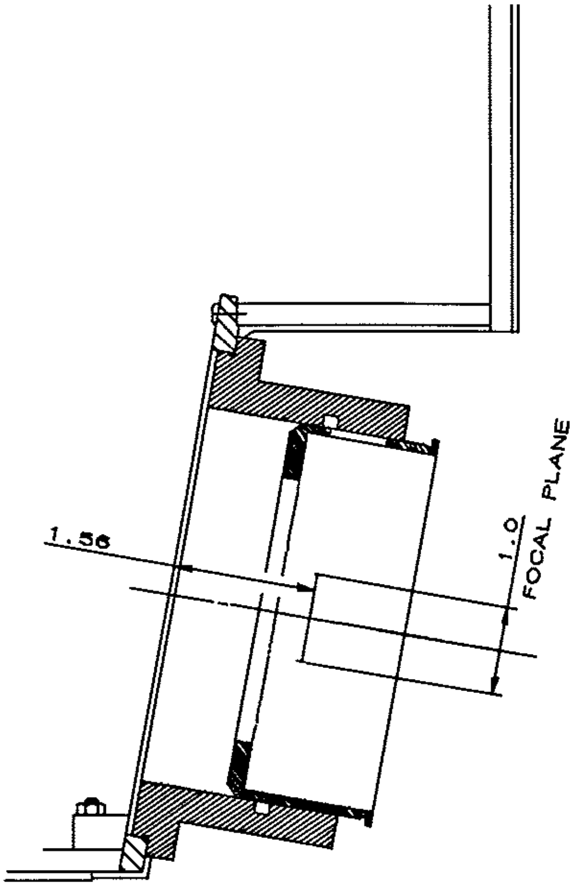
Your Spex 270M is designed to facilitate mounting of accessories and other devices at the entrance and exit ports. The leveling feet may be removed from the bottom to provide threaded mounting holes to attach the 270M to a larger system or baseplate. It is best to avoid straining or torquing the spectrometer bottom, as this may affect alignment of the optics.

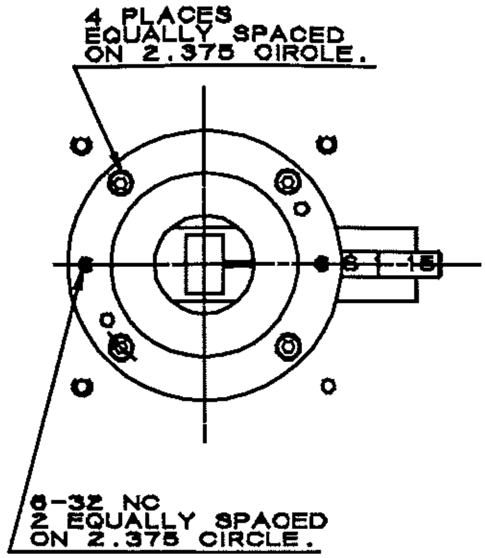
Before finalizing any mechanical fixturing, it is best to review the **Optimizing Optical Performance** section, so that all components can be mounted in optimal locations.



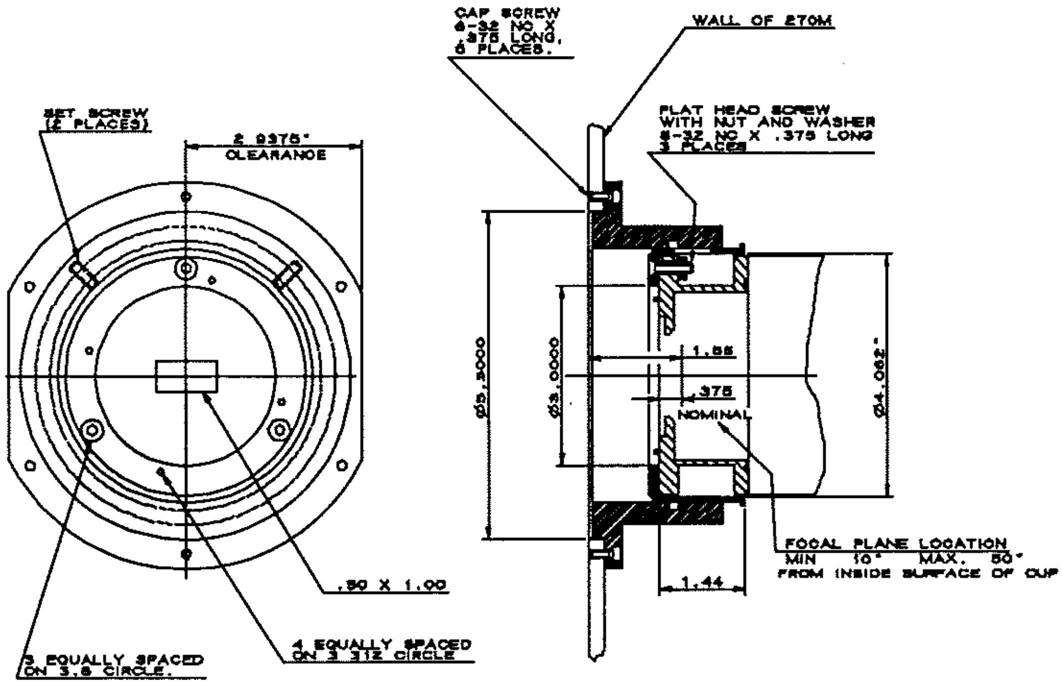

270 M SPECTROMETER




STANDARD SLIT ADAPTER
WITH HEIGHT APERTURE.

270MCA POSITION




270MCA MULTI-CHANNEL DETECTOR ADAPTER.

## 10 Application Examples:

The 270M is quite versatile, and may be operated in various ways, depending on the measurement and the requirements of associated equipment such as detectors. Following are a few representative operating examples for typical uses.

### 10.1 As a Monochromatic Illuminator:

With a broadband light source directly coupled to an entrance slit, the 270M can provide a specific bandpass at the exit. The spectral bandpass can be varied by changing the slit widths. The scan drive facilitates tuning or selecting the central wavelength of the exiting beam.

One might wish to alternately illuminate samples with two wavelengths of light to perform two measurements, let's say transmission at 580 nm, and fluorescence excited by 400 nm light.

The 270M's imaging optics maintain a small illumination spot size at the exit. (Traditional designs spread the spot, reducing its intensity. This is due to aberrations that are eliminated by the 270M design.) For the two measurements the bandpasses can be optimized independently. Under computer control the motorized slits change as programmed. The high speed drive minimizes slewing time.

### 10.2 As a Scanning Monochromator:

Another typical application of the 270M is the measurement of the spectral output of something emits light. This could be a lamp, or the sun, or a laser diode, a glow discharge,....or whatever. If the source is stable over the range of seconds to minutes, or can be pulsed reproducibly, the 270M can be scanned to sequentially present the wavelengths to the detector for measurement.

In this case, using a controller or computer, the start and end wavelengths, as well as the scan speed and wavelength increment between datapoints are programmed.

### 10.3 As a Simple Spectrograph:

Some measurements must be made practically instantaneously, such as logging or monitoring changes in a spectrum from a process. This requires the simultaneous detection of signals over a range of wavelengths. A linear detector such as a PDA positioned in the focal plane of the 270M can capture transient spectral distributions with a time resolution that depends only on the readout or gating time of the detection system.

To set up for this scenario, the light from the process is coupled via an optical fiber to the entrance slit. to minimize coupling loss, an optional fiber optic interface is used to aperture match the fiber to the spectrometer. The QuikScan PDA detector is mounted at the focal plane in the exit of the 270M.

If acquisition of wavelengths beyond the width of the array are required, a tradeoff may be made by using a lower groove density grating that will not disperse the wavelengths so widely. Of course, with closer spacing, resolution would be lower. An alternative, if experimental conditions permit, would be to keep the higher resolution grating, but acquire more than one region, using the rapid slewing capability of the 270M to quickly reposition the grating. Depending on the software you are using, overlapping regions may be "glued" to form continuous spectra.

### 10.4 As an Imaging Spectrograph:

Multiple spectra from light imaged at various heights in the entrance slit can be simultaneously detected with a two dimensional array such as a CCD. The capabilities of a simple spectrograph are multiplied. This is made possible by the imaging optics, which permit close vertical spacing of signals without crosstalk, unlike conventional designs.

A stack of optical fibers imaged on the entrance slit can each carry separate spectral signals from various locations. All of the signals will be captured by the detector during the same exposure time.

Alternatively, a "slice" of a sample or reaction can be imaged directly into the entrance slit. The 270M provides the two-dimensional image quality required to study the spatial/spectral profile of a flame, or other source that exhibits a varied distribution of spectral signals.

## 11 Specifications:

| | |
|---|---|
| Focal Length: | 0.27 meter |
| Entrance Aperture Ratio: | f/4 |
| Image Magnification at the Exit: | 1.23 |
| Scanning range with 1200 g/mm grating: | 0-1100 nm |
| Multichannel coverage with 1200 g/mm grating: | 77 nm over 25 mm array width |
| Flat Field Area in Focal Plane: | 25mm wide X 12 mm high |
| Spectral Dispersion with 1200 g/mm grating: | 3.1 nm/mm |
| Spectral Resolution as a scanning monochromator with 1200 g/mm grating: | 0.1 nm at 546 nm |
| Vertical Resolution: | Resolve 25 fibers, 200 µm each, in 0.5" |
| Wavelength Positioning Accuracy: | +/- 0.1 nm |
| Wavelength Repeatability: | +/- 0.05 nm |
| Maximum Scan / Slew Rate: | 70 nm/second |
| Wavelength Drive Step Size for 1200 g/mm grating: | 0.03125 nm/step |
| Slit Width Drive Step Size: (7mm) | 6.25 µm/step |
| Overall Length: | 16.25 inches (41.3 cm) |
| Overall Width: | 15.5 inches (39.4 cm) |
| Overall Height: | 7.5 inches (19.0 cm) |
| Weight: | 34 Pounds (15.5 kg) |

exit slit = 1.23 x ent. slit

(1300nm → 41,600 steps)

70 nm/s. 0.03125 nm/step = 2240 step/s mono

(use even # steps)

backlash slits (8 step)

backlash mon 3.1 nm/mm

slits closed 0 step
wide open 1100 step
0 - 7mm

6.25×10⁻³ mm/step

3.1 × 6.25×10⁻³ nm/mm · mm/step = 1.9375×10⁻² nm/step

51.61 step/nm at exit

at entr. 41.96 step/nm

51.61 step/nm

# 12 Alignment:

The 270M and its associated grating(s) are aligned together at the factory. Performance data in the form of calibration reports and plots are shipped with the instrument. Normally you need not make any adjustments the instrument to obtain specified performance. If you suspect the instrument has become misaligned, review the Optical Components Installation section first, before proceeding to Alignment. A prerequisite to these procedures is that the instrument must be completely and properly installed.

## 12.1 Equipment Required:

- HandScan or IBM PC/AT compatible computer
- If using a computer, AutoScan or DM3000, or the GMI software can be used to control the 270M, or the DataScan/ SPEX232/ Spex488 support diskette program "232_SCAN.BAS or 488_SCAN.BAS. Refer to the **Control Interfacing** section for further information on connections and usage.
- Mercury lamp, or fluorescent room light.
- Coupling optics to image the source on the entrance slit, in a stable fashion.
- Photodetector such as a silicon cell or photomultiplier and housing adapted to the exit slit, and detection electronics such as DataScan or DM3000.

## 12.2 Grating Adjustment:

Caution: Never touch the diffracting surface of a grating. The surface is easily marred and cannot be cleaned as a mirror can. The following three adjustments should be made on a grating the first time it is installed in the instrument. This is done at the factory when the grating is ordered with the instrument and normally will not require further attention. Whenever a grating is reinstalled, the adjustments should be checked but generally none will be required.

The wavelength calibration and vertical adjustment can be done in either order, but the rocking should be done last. For all these procedures the cover of the monochromator must be removed, and a mercury lamp installed at the entrance slit.

### **12.2.1** Grating Wavelength Calibration:

Set both slits to 0.25 nm and set the monochromator to 546.1 nm. Unless the wavelength is grossly out of calibration, a green line will be seen through the exit slit. If not, adjust he wavelength until the line is centered; if it does so with 0.1 nm of 546.1, no calibration is required. Otherwise, set the monochromator to 546.1 nm and (referring to Figure 2xxx), adjust screw S1 on the mount of the grating to bring the line through the instrument. If more than 1/8 turn is required, also adjust S2 in the opposite

direction to balance the total adjustment between them. Further accuracy may be had by viewing the image through the slit and adjusting for maximum intensity.
Replace the monochromator's cover. If photoelectric detection is available, scan slowly from 540 to 548 nm to ascertain that the peak is detected within 0.1 nm of 546.1.

**12.2.2** Grating Vertical Adjustment:

Set the monochromator to 546.1 nm. Observe the image at the exit slit. If it is not vertically centered, center it by adjusting screw S3 (Figure 2) on the grating capsule.

**12.2.3** Rocking the Grating:

If the grating grooves are not parallel to the slits, the diffraction plane will be tilted, and lines imaged at the exit will appear at different heights as a function of wavelength. To correct this, the vertical adjustment must have been already done. Set the monochromator to 0.0 and check whether the exit slit image is vertically centered. If it is not, the grating must be rocked. While sitting at 0 nm, repeat the vertical adjustment as above, then return to 546.1 nm. Adjust screw S4 (figure 2) to re-center the image. If more than 1/8 turn is required, adjust S5 in the opposite direction to balance the adjustment between them. Set the monochromator to 0 nm and check the centering; If it is off, repeat the vertical adjustment. When the grating is properly aligned, the image will be vertically centered at both 0 and 546.1 nm.

## 13 In Case of Difficulty...

Your 270M is designed to provide years of reliable service. If you are experiencing a problem, reviewing this section before contacting us will save time and help you eliminate some simple errors that can be easily corrected.

### 13.1 Troubleshooting:

Some of the more common difficulties that may be encountered are listed below. With each, some suggestions are given that will help correct the problem for most cases.

Spectrometer not responding to any commands:
- Check external cable connections. See the **Electrical Connections** section for proper external cable connections.
- Check internal ribbon cable connections, and jumpers on circuit boards.See the circuit board layout drawings in this section.
- Review the section under **Control Interfacing** that pertains to your controller or computer interface software.
- Check system software or firmware configuration to see that it matches the actual hardware. See **Software Installation** for more information.

Spectrometer responds to some commands, but not all.

- Check to be sure that the failing command is valid, that parameters are within limits for that drive or function
- If you purchased software from us with your system, using the documentation provided with your software, check to see that it matches the actual hardware. In particular, check that the device you wish to control is configured properly.
- If you are running your own software, stop your program and load the software diskette provided with the system to see if the device in question can be controlled. See the subsection that applies to your system under **Software Installation** for more information.

Side port mirror does not move:

- If the mirror is at the side wall, GENTLY nudge it by hand, just enough to get it "unstuck." The miniature gearhead motors are delicate and expensive. Forcing them by applying too much pressure, or moving them too far may result in time consuming, costly repair.
- 

Slit and wavelength drives and accessories do not move:

- Check power switch, connections and fuse.
- Check control cable connections. See **Electrical Connections** section.
- Review the section under **Control Interfacing** that pertains to your controller or computer interface software.
- If you are using your own program, as opposed to software purchased with the system, pay particular attention to interfacing setup connections and parameters.

Background signal too high, background level reduced when room lights are turned off:

- Be sure all covers are in place
- Make sure that the area between the source or sample an d the entrance slit is enclosed, and light tight. Block the entrance slit as a test.
- Check detector mounting and/ or housing for light leaks.
- Starting from the detector, close exit and entrance slits and shutters in turn to determine where stray light may be entering the system. Note that to prevent damage to the knife edges, the slits do not close completely, and will therefore not block all of the light, however, with the signal blocked, reducing the slit width will reduce any stray light that is passing through it.
- Be sure all openings and screw holes are plugged.
- Check to cover, side, baseplate screws, the plates should fit tightly, light seals should be partly compressed, not flattened.
- If leaks persist, use a small flashlight in a dark room to isolate where the leaks are by shining at any suspicious part or joint in the system. and observing detected signal levels.
- For quick fixes, black vinyl electrical tape and black silicone rubber sealant are

normally acceptable. Avoid damage to optical components, moving parts,and do not disturb adjustments.

Signal too noisy:

- Try to increase signal strength at the detector. See **Optical Interfacing Considerations** for suggestions.
- Check for light leaks as suggested under "Background signal too high" in this section.
- If noise is reduced by turning off the spectrometer, rearrange power connections to be sure the spectrometer, source, and detector are tied to the same ground and, if possible, the same power circuit.
- Adding redundant grounds to various points in the total system often helps. Please understand that ground loops and electromagnetic interference can sometimes be challenging problems. In extreme cases, the best approach is to patiently experiment by trying various combinations of grounding connections. As a general rule, try to keep ground wires short, make tight connections, avoid painted, coated, and anodized surfaces when possible. Consider a "star ground" of wires radiating from a single, central location, preferably connected to a grounded metal table surface under the system.
- In extreme cases, such as working with or around high powered pulsed lasers or other high energy apparatus, it may be helpful to construct RFI / EMI shields or cages to contain the noise at its source, or to isolate the detection system from the noise. In these cases, colleagues who are working with similar apparatuses may be your best resource for noise control suggestions.

## 14 Service Policy:

If you need assistance in resolving a problem with your Spex instrument, contact us directly, or through our representative or affiliate in your area, if outside the United States.

Often it is possible to correct, reduce, or localize the problem to a replaceable component through discussion with our Customer Service Engineers.

All Spex Instruments are covered by a warranty. The warranty statement is printed on the inside cover of this manual. Service for out-of-warranty instruments is also available, for a fee. Contact us for details and cost estimates.

If an instrument or component must be returned, The method described in this section should be followed to expedite servicing and reduce your down-time.

If your problem relates to software, please verify your computer's operation by running any diagnostic routines that were provided with it. Be ready to provide version numbers for the DOS that you are using, as well as the software version and firmware version of any controller or interface options in your system. Also knowing the memory type and allocation, and other computer hardware configuration data from the PC's CMOS Setup utility may be useful.

### 14.1 Return Authorization:

All Instruments and Components returned to the factory must be accompanied by a Return Authorization Number issued by our Customer Service Department. If in the United States, you may contact the Customer.Service department directly at (908)549-7144. The fax number for Service is (908)549-2571. Or you may write to SPEX Industries, Spectrometer Customer Service, 3880 Park Avenue, Edison, N.J. 08820. From other locations worldwide, contact the representative or affiliate for your area.

To issue a Return Authorization number, we require:

- The model and serial number of the instrument
- A list of items and/or components to be returned
- A description of the problem, including operating settings
- The instrument user's name, mailing address, telephone, and telefax numbers
- The shipping address for shipment of the instrument to you after service
- Your Purchase Order number and billing information for non-warranty services
- The Original Spex Sales Order number is helpful to know
- Your Customer Account Number, if known, is also helpful
- Any special instructions

### 14.2 Removing returnable components from your instrument:

Turn off the power switch and disconnect the power cord and other cables from the instrument.

**14.2.1** Removing a Grating:

Refer to the **Optical Components: Changing Gratings** section and follow the instructions until the point where the grating or turret is removed. Then cover the grating using only the grating cover that was shipped with the instrument. To prepare a cover, apply a strip of vinyl electrical tape along each side, leaving a 1/2" (1 cm) flap extending beyond each side. Exercise extreme caution to avoid contacting the grating surface. Tilt the cover so that the bottom edge slips under the grating first, then gently rotate the top of the cover until the grating is fully covered. While holding it in place, secure it by sticking the tape flaps to the sides of the grating mount. Do the same for each grating to be returned.

**14.2.2** Removing a Circuit Board:

To remove a Circuit board form the 270M, open the top cover and open the wire harness retainers to provide slack in the wiring. Disconnect the wiring from the boards, noting the connector numbers for future reference. Push the wiring aside as you lift out the baffle from between the circuit boards and the mirror mounts. From the outside of the rear wall remove the screws holding the board spacers and lift the board(s) out of the instrument, disconnecting and noting connector locations for the cables as you go. Pack the board(s) in an antistatic bag for return to the factory.

**14.3 Packing the 270M:**

To prepare your 270M for shipment, it is important to restrain the side entrance and exit mirrors, if your instrument is so equipped.

If the side mirrors are not rotated to the side walls, turn on the power, and they should automatically retract to the walls. With care to avoid contacting the mirror surface,

secure the mirror assemblies to the side walls with nylon cable ties or an equivalent. There are attachments provided on the walls for this purpose.

To protect the grating, use only the cover that was shipped with the instrument. To prepare the cover, apply a strip of vinyl electrical tape along each side, leaving a 1/2" (1 cm) portion extending beyond each side. Exercise extreme caution to avoid contacting the grating surface. Tilt the cover so that the bottom edge slips under the grating first, then gently move the top of the cover to slip over the top of the grating. While holding it in place, secure it by sticking the tape to the sides of the grating mount. If your instrument is equipped with a grating turret, cover only the grating that faces the interior of the 270M. Replace the wrapped foam packing block that was removed on initial unpacking. It fits snugly above the turret. Tape it in place. Make a thorough inspection of the interior and remove or secure any loose objects. Finally, replace the cover and screws.