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RSP 5000-Series OPERATING MANUAL, Doku.-Nr. 390350

Zusammenstellung Produktion

Ordner-Typ : breit, 50mm

Rückenetikette . TECAN RSP 5000 SERIES
Operating Manual

Registerblatt	Dokument	Sub-Dokument	Sub-Sub-Dokument
		390 125 Gebrauchsanweisung 5000-Series	
	390 350 Table of Contents Index of Figures		
Introduction	Chapter 1		
Principles of Operation	Chapter 2		
Installation Procedures	Chapter 3		
Operating Instructions	Chapter 4		
Hazards and Precautions	Chapter 5		
Maintenance	Chapter 6		
Appendices	Appendix 1 Appendix 2(Titelblatt)		
		390 403 Sales & Service Representatives	
	Appendix 3 Appendix 4 Appendix 5 Appendix 6(Titelblatt)		
		390 376 RSP 5000 Command Summary	
	Appendix 7		
bei Bestellung Ordner mitliefern	Falls LiRa Bestellt	**390 368** Linear Rack Drive Operating Manual	**390 522** LiRa Drive Command Set

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TECAN ROBOTIC SAMPLE PROCESSOR 5000-Series

Operating and Service Manual

This manual describes the function, operation and maintenance of the Tecan RSP 5000-Series, Robotic Sample Processor and basic use of RSP Integrator and Immuno-AMI Software.

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PLEASE READ THIS MANUAL BEFORE USING THE TECAN ROBOTIC SAMPLE PROCESSOR

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CHAPTER 1

INTRODUCTION

1.1 TECAN ROBOTIC SAMPLE PROCESSOR

The TECAN Robotic Sample Processor (RSP) is a fully automated sample processor featuring two independently programmed pipetting arms. Each arm is capable of aspirating, dispensing, or diluting operations at any position on the instrument's worktable (see Figures 1-1 and 1-2).

Pipetting positions can be specified with a precision of less than 0.25 mm in X/Y/Z directions. Liquid volumes of 5 ul or greater can be transferred with an accuracy of +/- 1% and with a coefficient of variation of 1% or less.

The dual robotic arms of the RSP can operate in unison to double system throughput, or can be independently programmed for complex, multi-task procedures. The RSP offers a large worktable (740 x 300 mm) which can accomodate virtually any type of rack or tray for reagents and samples.

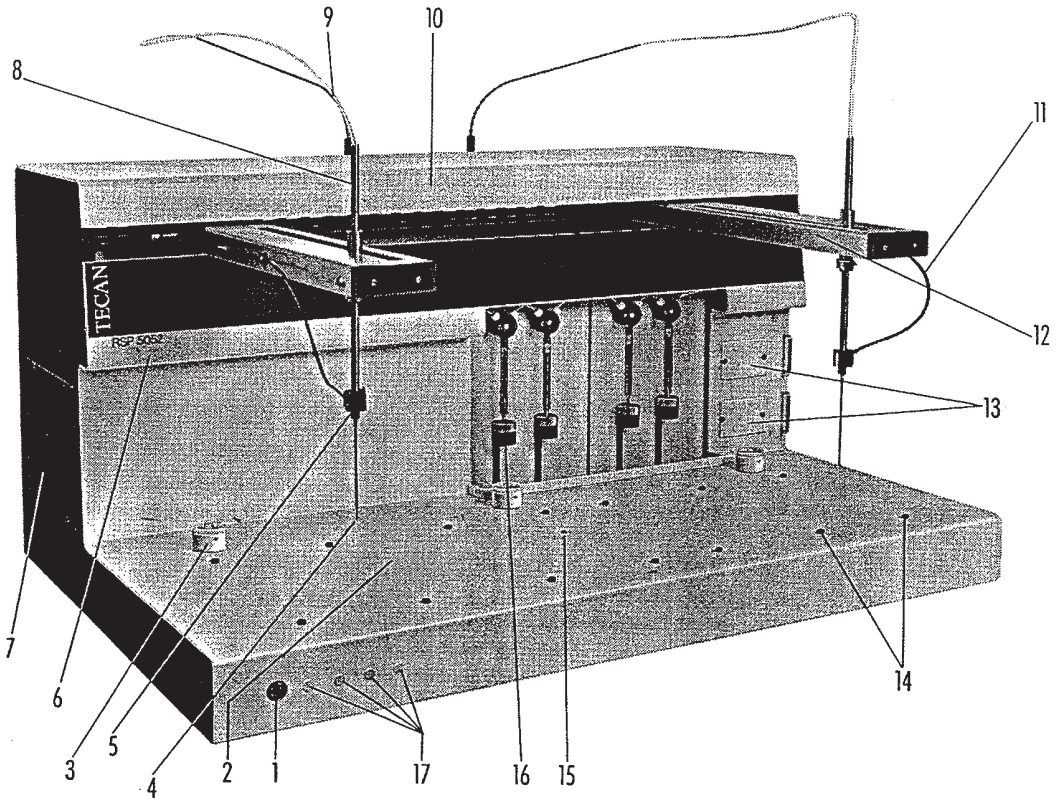
Optional hardware accessories include: multi-channel pipette tips, peristaltic or vacuum pumps, bar code wand, specially designed racks and adaptor plates, magnetic stirrers, and additional external valves.

1.2 SOFTWARE

The RSP comes with the RSP Integrator Software and optional Immuno-AMI Software. The Integrator Software is the master software system for controlling the instrument and operating programs. The RSP can be operated with Integrator Software alone by individuals who have completed a Tecan training course in RSP liquid handling and programming. The optional Immuno-AMI software is customized with menus for creating programs for standard test methodologies

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Figure 1-1 Overview of TECAN RSP (Front, basic configuration)

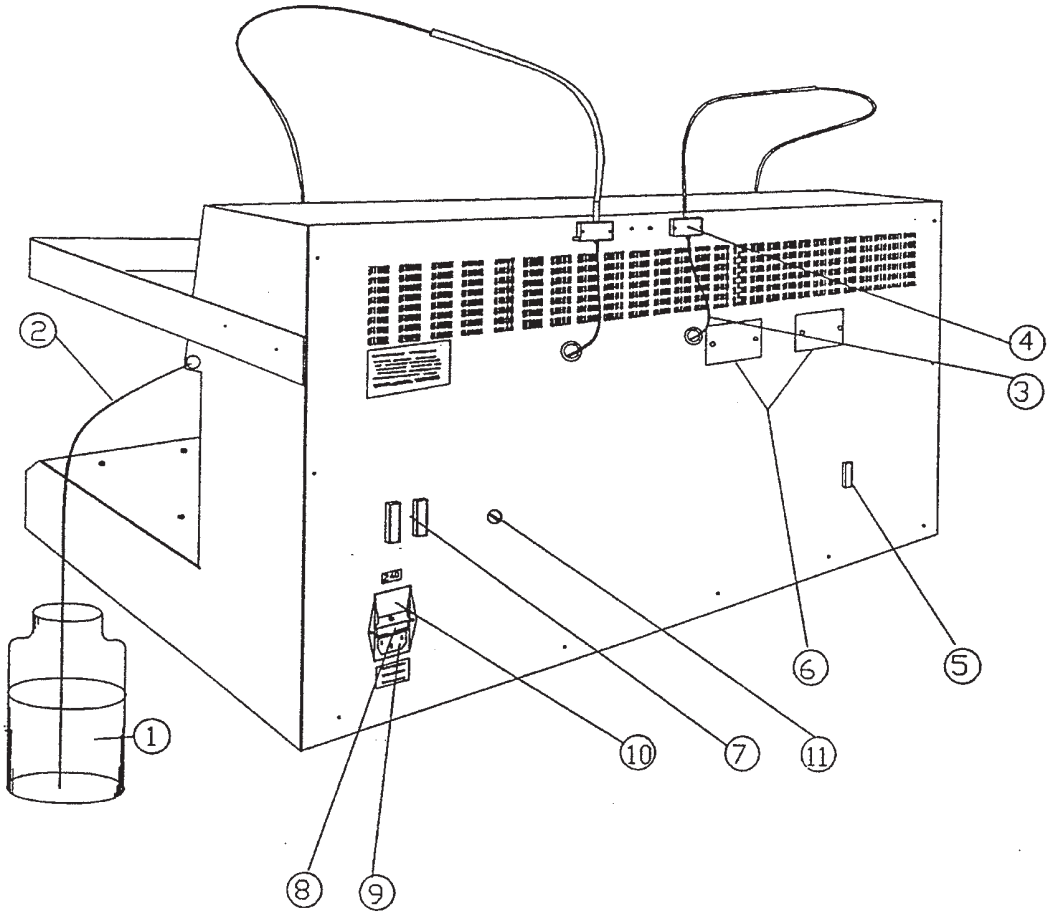


Legend:

1. Green Pilot Lamp
2. Working Table
3. Wash Station
4. Sampling Tip
5. Insulation Block
6. Front Blind
7. Board Cage Access Cover
8. Toothed Rack
9. Pipetting / Support Tubing
10. Case Top
11. Liquid Detector Cable
12. Arm
13. Locations for Additional Valves
14. Rack Locating Pins
15. Reference Point
16. Diluter
17. Speed Controls for Magnetic Stirrers

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Figure 1-2 Rear View of TECAN RSP



Legend:

1. Diluent Reservoir
2. Aspirating Tubing
3. Interconnecting Tubing
4. Liquid Connector Block
5. RS 232 C Interface Connector
6. Locations for Additional Valves
7. Mounting position : Interface connector
8. Mains Fuse Cover
9. Mains Outlet
10. On/Off Switch
11. Transformer Fuse Cover

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1.3 INTENDED USE

The TECAN RSP can be equipped and programmed to automatically perform liquid handling tasks in the laboratory.
The following list is intended to serve as only a limited example of the instrument's capabilities :

Radioimmunoassays (RIA)	- Coated tube assays - Liquid/liquid assays - Coated bead assays
EIA, ELISA, FIA	- Tube/microplate - sampling and dispensing - Timed addition of - reagents - Two-step dilution - assays
Aliquoting, titering	- Plasma, sera or urine in tubes or microplates
Cell Culture	- Hybridoma and Immunology
Washing	- Plates and tubes
Sample Processing	- Gas, liquid, and solid phase chromatography or atomic absorption

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CHAPTER 2

PRINCIPLES OF OPERATION

2.1 INTRODUCTION

The Robotic Sample Processor is a system of microprocessor-controlled liquid handling components controlled by system software which resides on the hard disk of a personal computer (IBM PC model XT, AT or System/2). An operator controls the mechanical components from the computer keyboard. Special software programs, supplied by TECAN or developped locally by the user, are used for each liquid handling application. Programs can be customized for test sample configuration, liquid handling parameters, and data management. Additional programs provided by TECAN permit routine diagnostic tests and assist the operator in troubleshooting component function.

The RSP hardware is based on a modular design concept in which each of the major RSP functions is performed by an independent component of the instrument. The principal liquid handling components of the instrument are: (1) Diluter/Dispenser; (2) X/Y/Z Movement Mechanism (Arm), (3) Liquid Detector; and, (4) Wash Station. See Figure 2-1 for a schematic diagram of the liquid handling system. The modular design of the RSP maximizes the flexibility of the instrument and simplifies maintenance and service procedures.

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2.2 DILUTER/DISPENSER

The diluter/dispenser (also available as a stand-alone unit) is a microprocessor-controlled syringe with a pump and three-way valve that connects to the sampling tip tubing and an external reservoir. All parts that come into contact with liquid are made of inert materials such as glass, Teflon, KEL-F, or FEP. The syringe plunger is driven by a stepper motor with a resolution of 1/3000 of the full syringe volume. Both the valve and the stepper motor are operated by a built-in micro-processor. Two or more diluter/dispensers are incorporated into the RSP to control aspiration and dispensing of programmed volumes of reagents and samples with high accuracy and at variable speeds.

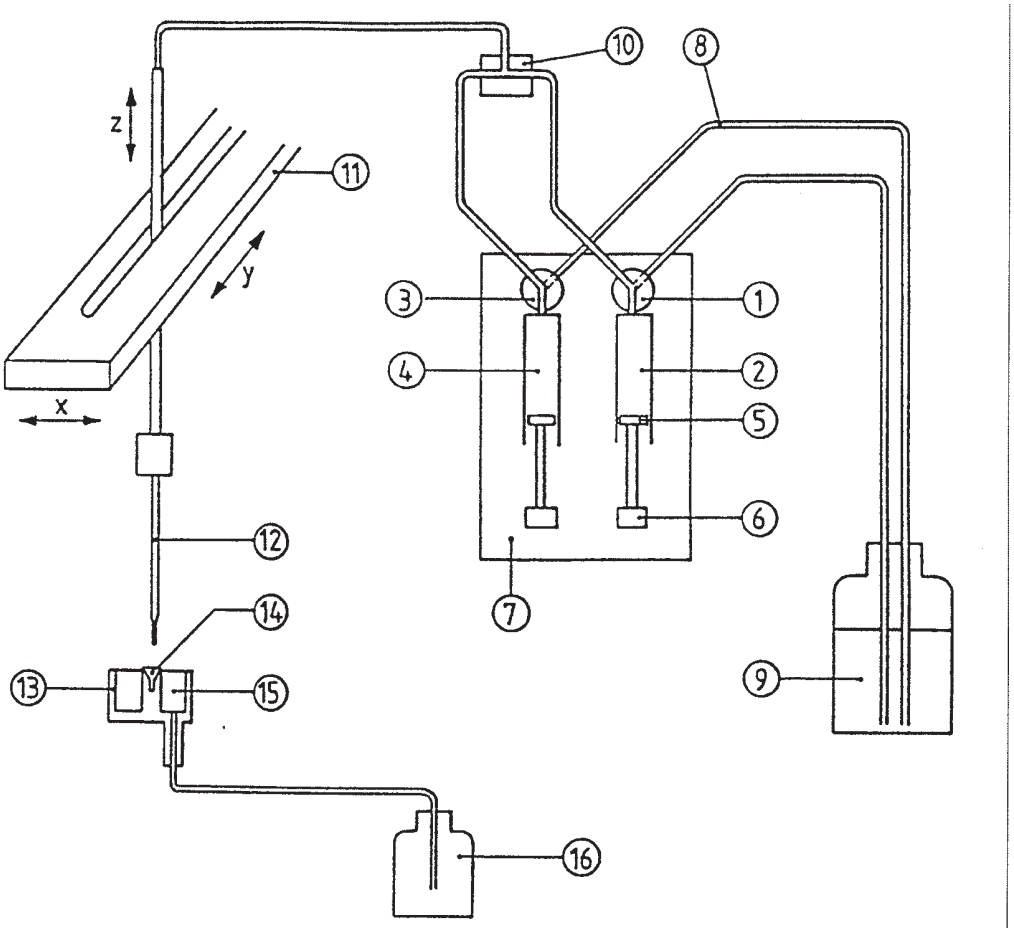
2.3 X/Y/Z MOVEMENT MECHANISM (ARM)

Each RSP sampling tip is mounted on a vertical toothed rack which is raised or lowered (Z-direction) by the Z-stepper motor. The toothed rack is mounted on the Y-slide, which moves front to rear (Y-direction) inside the arm of the RSP, driven by the Y-stepper motor. The arm, in turn, is mounted on the X-slide located inside the instrument casing, and moves left and right (X-direction) driven by the X-stepper motor. The X, Y, and Z stepper motors are powered and controlled by electronics located inside the board cage of the instrument.

The RSP includes two such X,Y,Z movement mechanisms -- one for each arm. Because the two arms share the same X-slide and cannot cross, special safeguards have been built into the RSP software to prevent potential arm collisions. The two arms share a common work surface which covers approximately 85% of the total available work surface.

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Figure 2-1 Liquid System Schematic



1. 3-WAY VALVE
2. SYRINGE
3. 3-WAY VALVE
4. SYRINGE
5. PLUNGER
6. PLUNGER DRIVE
7. DILUTER / DISPENSER
8. FEP TUBING
9. DILUTER / WASHING LIQUID
10. LIQUID CONNECTOR BLOCK
11. X/Y/Z - ARM
12. SAMPLING TIP
13. WASHING STATION
14. CLEAN POSITION
15. WASTE POSITION
16. WASTE

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2.4 LIQUID DETECTOR

Each arm of the RSP is equipped with a liquid sensor located at the pipette tip, which enables it to detect the surface of ionic solutions upon contact. The liquid detectors operate by monitoring the electrical conductivity between the pipette tip and the RSP work table; when the pipette tip touches the liquid surface there is a sudden change in conductivity which generates a detection signal.

The liquid detection feature minimizes tip contamination and the need for washing between samples by permitting the operator to limit the submerge depth of the pipette tip during sampling (usually less than 1 mm).
The liquid detection feature will also alert the operator when there is no liquid, or not enough liquid available for sampling.

2.5 WASH STATION

The sampling tip is rinsed under program control at one of the three wash stations which are located on the left side, center and right side of the work surface . The wash station features a central cavity into which the sampling tip enters for rinsing. Rinsing fluid (usually distilled or deionized water) forced through the sampling tip is turned by the conical shape of the central cavity, and washes up the outside of the tip before spilling into the waste and down the drain. The volume of rinse fluid and the turbulence of the wash are specified in the program by the user. Thus both the inside and the outside of the tip are thoroughly cleaned in one step. Special wash stations are provided for multifold pipette options (4-fold or 2x4-fold).

2.6 SOFTWARE

The RSP Integrator and Immuno-AMI software system reside in a special subdirectory on the computer hard disk. One or more data subdirectories may be created for different users or liquid handling applications, and accessed by changing the working directory path in the Computer Setup menu.

The personal computer software communicates with the RSP via the serial interface (RS-232) to the CPU of arm #1. The CPU of arm #1 communicates also with the CPU of arm #2 (arm #1 CPU is the "master" and arm #2 CPU is the "slave").

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CHAPTER 3

INSTALLATION PROCEDURES

3.1 INSTALLATION REQUIREMENTS

3.1.1 Computer Requirements

Installation and operation of the RSP requires a separate microcomputer having the minimum specifications as listed in Appendix 1 of this manual. The microcomputer is not supplied by Tecan with the RSP.

3.1.2 Site Requirements

The instrument should be placed on a sturdy work table that is large enough to accommodate the RSP, the microcomputer and the printer (optional). The equipment should not be located near a heat source or exposed to direct sunlight. Make sure that a drain or space for placing a waste container is within 1.5 meters (5 feet) of the RSP. Also make sure that the equipment is close to an AC power outlet. The power lines to the equipment should be voltage regulated and surge protected.

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3.2 UNPACKING THE RSP

CAUTION : EVER LIFT THE INSTRUMENT BY THE ARMS!

Use the carrying straps shipped with the unit to carefully lift the instrument out of the shipping box. Unpack all items in the shipping container and check against the packing list. If the items received do not match the packing list, notify the shipper and the nearest TECAN sales office for assistance.

CAUTION : DO NOT INSTALL THE AC POWER CORD!

To avoid potential electrical shock and/or damage to the instrument, do not install the AC Power until instructed to do so in section 3.3.8.3, Installation of the AC Power Cord.

3.2.1 Initial Inspection

All parts of the instrument were thoroughly inspected and tested before the unit was shipped. The instrument should be in good operating order. Carefully inspect the instrument and its accessories for any physical damage sustained in transit. If the instrument is received in damaged condition, please immediately file a claim with the carrier. Save all packing material and notify the nearest TECAN sales office for further assistance.

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3.3 EQUIPMENT INSTALLATION (Standard Equipment)

The following instructions describe the installation procedures applicable to a standard RSP equipped with two single stainless steel pipette tips and no additional optional accessories. Installation procedures for other RSP configurations and optional equipment are described in section 3.6.

3.3.1 Installation of the Wash Stations

The standard RSP is equipped with 3 circular wash stations located at the left, middle, and right rear sides of the instrument work table. Install a drain tube in each of the wash stations as follows (see Figure 3-1):

1. Loosen the allen head set screw located on the side of the wash station support and remove the wash station.

2. Connect one end of the flexible drain tubing to the drain outlet on the bottom of the wash station.

3. Feed the other end of the drain tubing down through the wash station support and underneath the base plate of the instrument. Secure the tubing within the retaining clip on the underside of the base plate (it may be necessary to loosen the retaining clip screws). Continue to feed the waste tubing through until the wash station is seated within the support.

4. Tighten the allen head set screw on the side of the wash station support (do not over tighten).

5. Place the end of the drain tubing into a suitable waste container or drain. Check to see that the tubing is sloped sufficiently and is not kinked, and that the end of the tube is always above the liquid level in the waste container.

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3.3.2 Installation of the Toothed Racks

1. Thoroughly clean each toothed rack with acetone or alcohol, using a lint-free tissue. Inspect to make sure that all the rack teeth are free of any oil, dust, or other contaminants.

2 Install a toothed rack into each arm by inserting the rack into the Z-bearing located within the slot of the arm.

NOTE: **The toothed rack for the left arm must be installed with the rack teeth facing to the left, and the rack for the right arm with the rack teeth facing to the right. Also, both racks must be installed so that the small flat area that has been machined into the rack teeth is at the bottom.**

3. Gently position each toothed rack so that it extends out of the Z-bearings by about half Its length.

3.3.3 Installation of the Aspirating Tubing

The aspirating tubing connects the diluter/dispensers with a reservoir of system fluid (usually diluent). The aspirating tubing is identified by a white screw connector at one end of the tubing. The standard RSP comes equipped with two double-syringe diluter/dispensers, thus requiring four aspirating tubes (see Figure 3-2).

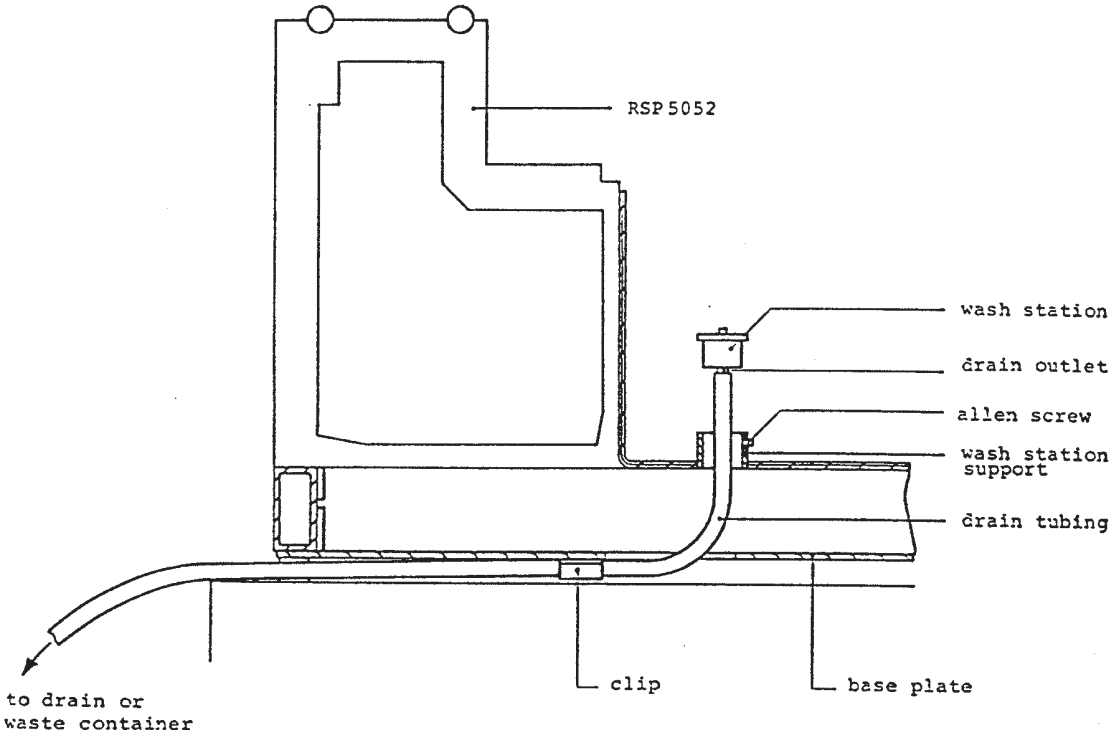
1. Insert the four aspirating tubes (connector end first) into the entry port on the right hand side of the instrument casing and through the tunnel.

2. Connect the four aspirating tubes to the right side of each diluter valve. Make sure that the tubing passes over the valves and is not kinked.

3. Cut the free ends of the tubing so all are the same length. Place the ends of the tubing into the container that provides the washing solution or diluent for the liquid system.

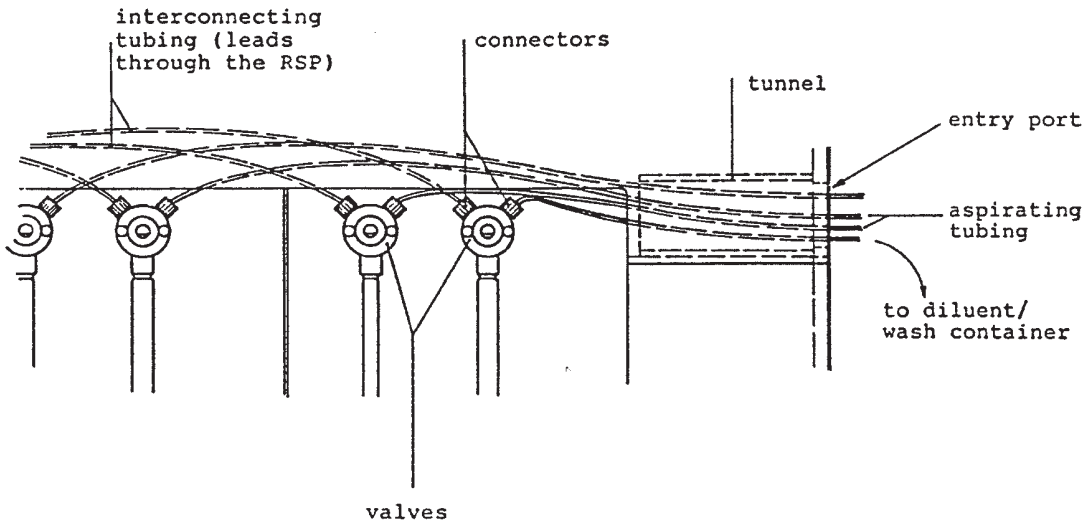
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Figure 3-1 Installation of the Wash Station



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Figure 3-2 Installation of the Aspirating Tubing



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3.3.4 Installation of the Pipetting Tubing (Standard Stainless Steel Pipettes)

In the standard RSP, pipetting tubing connects each pipette tip with a liquid connector block at the rear of the instrument. The standard pipetting tubing consists of FEP tubing (2.5/1.5 x 1200 mm). It is supplied with a threaded black plastic tubing guide at one end (see Figure 3-3).

CAUTION : HANDLE THE LIQUID DETECTOR CABLE WITH CARE DURING INSTALLATION. IF THE CABLE IS DAMAGED, THE LIQUID DETECTOR MAY NOT FUNCTION PROPERLY.

1. Thoroughly clean the inside and outside of the insulation blocks with an alcohol impregnated lint-free tissue to remove residual oil, water and dust.

2. Connect an individual pipetting tubing to each of the two liquid connector blocks located at the top of the rear panel of the instrument. Connect each pipetting tubing by firmly screwing the black plastic tubing guide into the top port of the liquid connector block.

3. Slide a metal tubing support over each pipetting tubing and insert the metal support down into the black plastic tubing guide. The longer end of the metal tubing support should extend toward the free end of the pipette tubing.

4. Slide a piece of support tubing (polyethylene, 4/3 x 900 mm) over the free end of each pipette tubing. The enlarged end of the support tubing should point toward the metal tubing support. Push the enlarged end of the support tubing up over the end of the metal tubing support.

CAUTION : HANDLE THE PIPETTES WITH CARE TO AVOID DAMAGE TO THE GREEN COLORED TEFLON COATING AT THE TIP.

5. Securely connect the free end of each pipetting tubing to a stainless steel pipette tip by sliding the tubing over the larger end of the tip. A small piece of fine sandpaper can be used to help grip the tubing.

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6. Carefully insert the pipetting tips into the top of the toothed rack of each arm. The left arm should receive pipetting tubing from the left liquid connector block; and the right arm should be linked to the right liquid connector block. Push the pipettes and tubing through the toothed racks until the pipettes are completely exposed below the toothed racks.

7. Remove the protective cover from the pipetting tip.

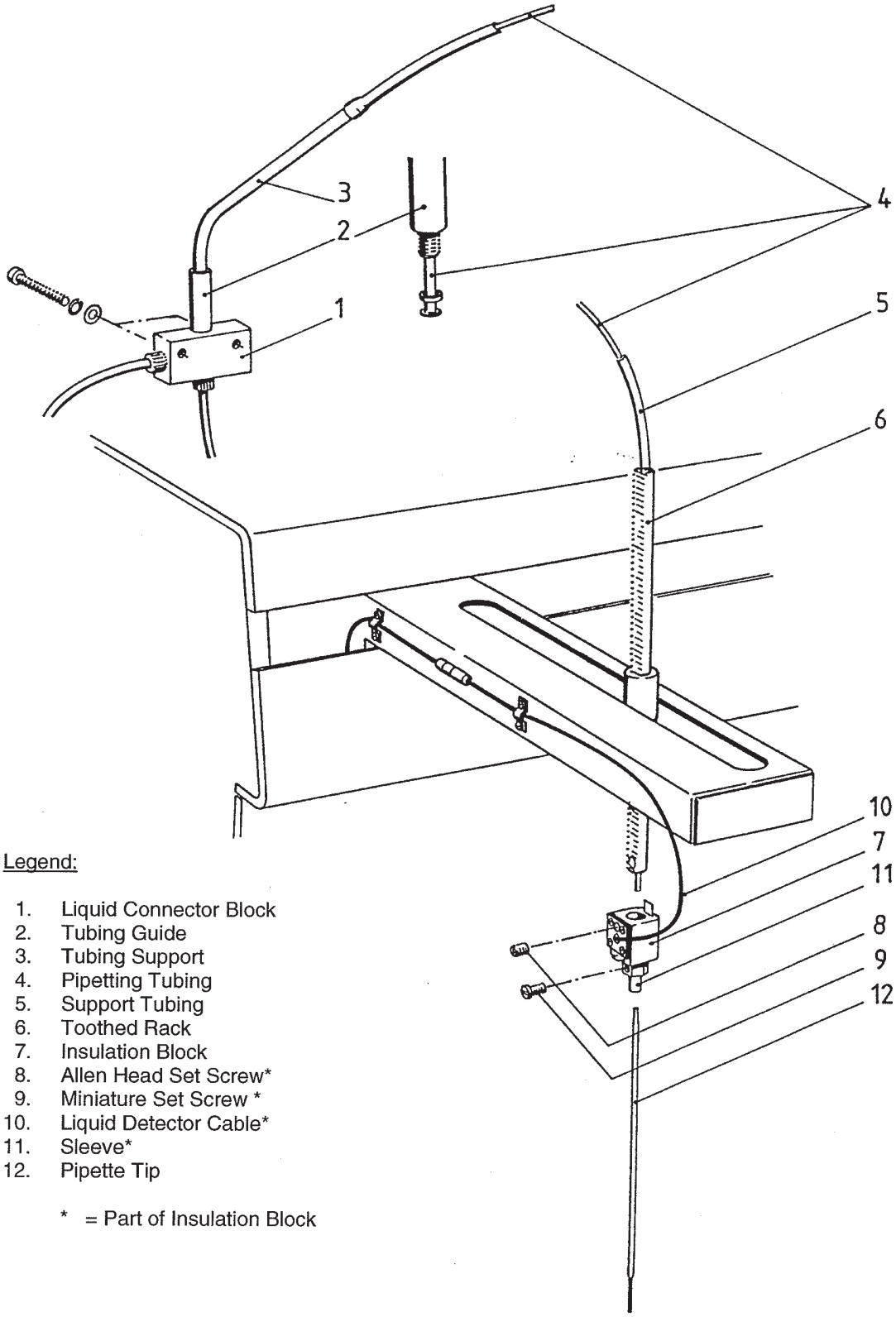
8. Slide the insulation blocks over the pipette tips and onto the toothed racks. Make sure that the liquid detector cable is positioned on the left side of the left arm and on the right side of the right arm.

9. Tighten the allen head set screws located above each liquid level sensor cable to secure the insulation blocks to the toothed racks.

10. Carefully position each pipette to align the top of the ring mark on the pipette with the bottom of the metal sleeve at the lower end of the insulation block. Tighten the miniature set screw in the sleeve of insulation block to hold the pipette in place.

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Figure 3-3 Installation of Pipetting Tubing



Legend:

1. Liquid Connector Block
2. Tubing Guide
3. Tubing Support
4. Pipetting Tubing
5. Support Tubing
6. Toothed Rack
7. Insulation Block
8. Allen Head Set Screw*
9. Miniature Set Screw *
10. Liquid Detector Cable*
11. Sleeve*
12. Pipette Tip

* = Part of Insulation Block

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3.3.5 Installation of the Syringes (See Figure 3-4)

1. Select syringes with the appropriate volume for the intended application. Each diluter/dispenser provided with the standard RSP has a 1 ml syringe on the left and a 2.5 ml syringe on the right.

NOTE: In general, the left syringe of each diluter/ dispenser is utilized for all small volume pipetting (usually using a 500 ul or 1 ml syringe) and the right hand syringe is used for tip washing and diluent addition (usually using a 2.5 or 5 ml syringe). To maximize precision and accuracy during critical pipetting steps, the syringe size should not exceed 100 times the smallest desired sample volume. For example, a 5 ul sample requires a 500 ul syringe or smaller. However, syringes with volumes smaller than 500 ul will bring better results only if smaller pipetting tubing and tips are used. Consult your Tecan representative if volumes smaller than 5 ul need to be pipetted.

2. Loosen the plunger locking ring on the diluter/dispenser and push the ring and the plunger drive slowly down to its bottom position.

3. Insert the syringe Luer-Lock tip into the Luer-Lock hub of the valve and carefully screw the syringe clockwise into the valve. Take care not to cross thread.

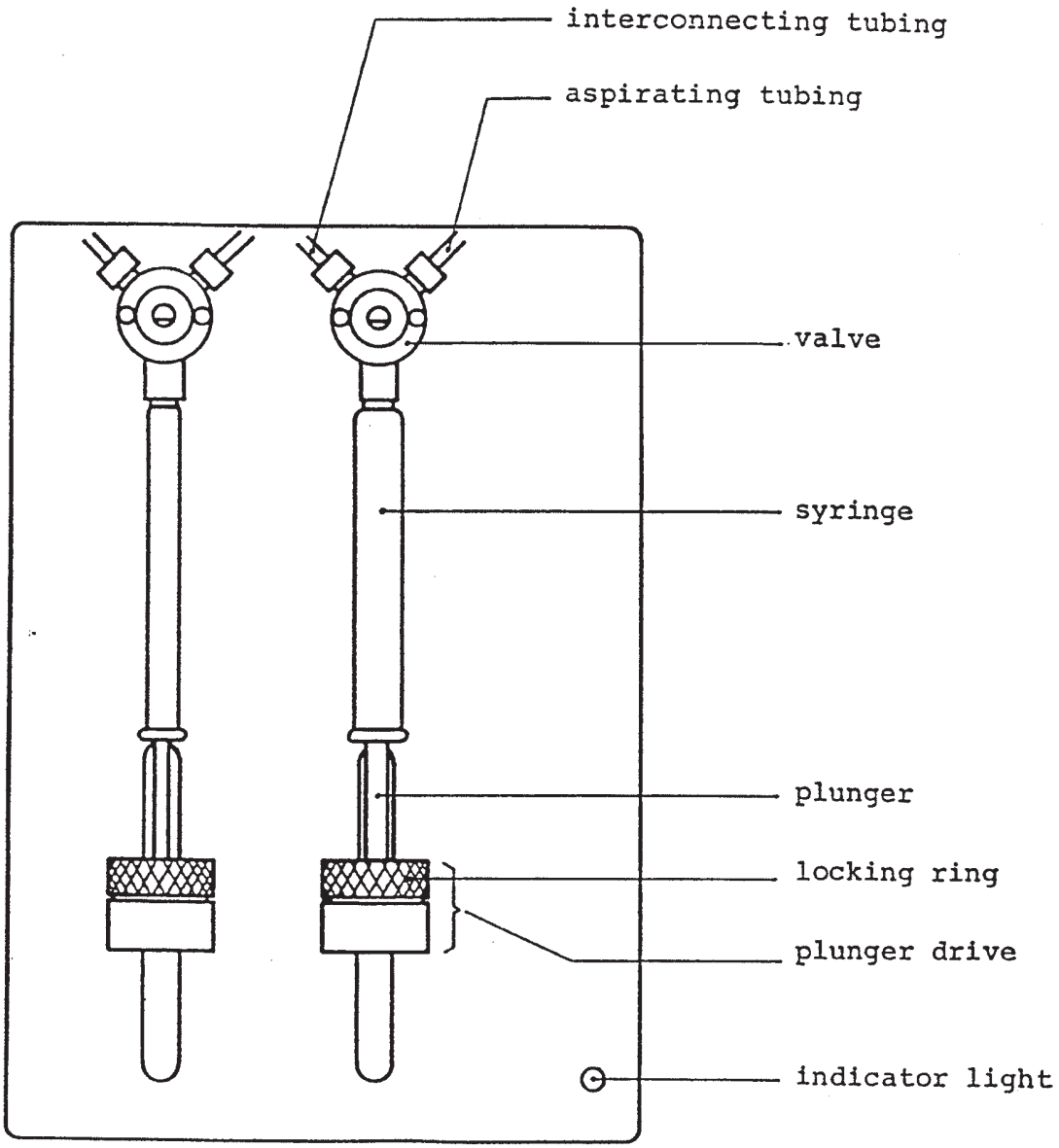
4. Slowly move the plunger drive manually upward until the plunger fits the appropriate recess of the locking ring.

5. Tighten the plunger locking ring to lock the syringe plunger in place.

6. Check to verify that the syringe is mounted securely by manually moving the plunger drive up and down.

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Figure 3-4 Installation of the Syringes



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3.3.6 Installation of the Electronic Circuit Boards

To prevent damage to sensitive electronic components during shipment, some of the electronic circuit boards for the RSP are delivered in separate protective packaging. These circuit boards must be installed into the slotted card cage located within the left side of the instrument case.

CAUTION : MANY OF THE COMPONENTS ARE SENSITIVE TO STATIC ELECTRICITY. TO MINIMIZE THE POSSIBILITY OF DAMAGE FROM HANDLING, PLEASE DISCHARGE ANY STATIC ELECTRICITY TO GROUND BY TOUCHING A SUITABLY EARTHED CONDUCTOR.

1. Remove the circuit board access cover located on the left side of the RSP case by unscrewing the four retainer screws.

2. Remove the POSU-board (power supply electronics) from its protective antistatic bag.

3. Carefully insert the edges of the POSU-board into the first set of guides located toward the back of the instrument (see Figure 3-5). The circuit board must be positioned with its electronic components facing toward the front of the instrument. Slide the circuit board into the guides until it is firmly seated against the stop.

4. Remove the two CPU-boards from their protective antistatic bags.

5. Install the CPU-boards into the second and fourth set of card edge guides (numbering from the rear of the instrument). The electronic components on the circuit boards must face the front of the instrument.

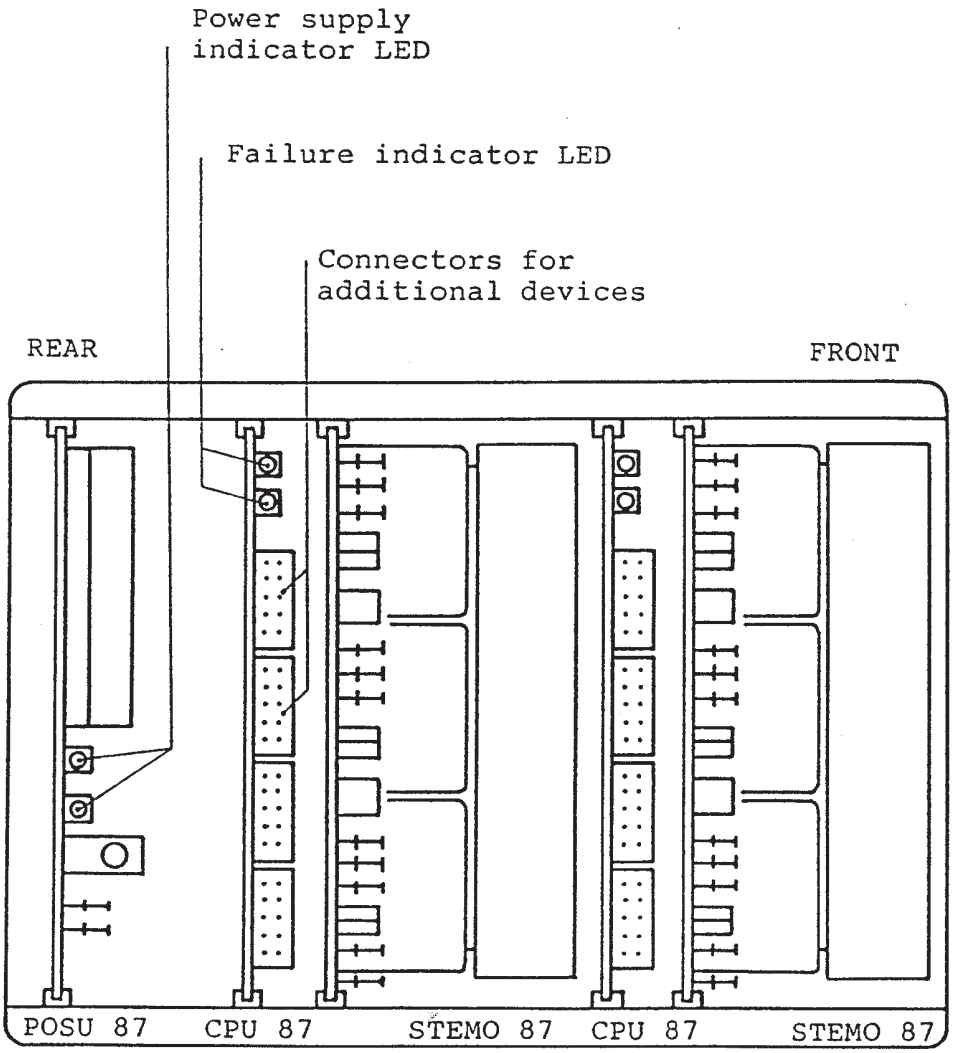
6. Remove the two STEMO-boards (stepper motor electronics) from the antistatic bags and install into the remaining two circuit board slots (third and fifth slots from the rear). Again, the circuit board components must face to the front.

7. Check to ensure all circuit boards are securely seated.

8. Replace the circuit board access cover.

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Figure 3-5 Installation of the Electronic Circuit Boards



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3.3.7 Installation of the Computer and Printer

The RSP operates under the control of a microcomputer which must conform with the minimum system specifications given in Appendix 1 under "Computer Specifications".

1. Place the computer and the printer (optional) on either side of the instrument. Consult the computer and printer operating manuals for proper set up of the computer equipment.

2. Install the RS-232C serial communications cable and cable adaptor (if required) between the computer and the RSP (RS-232C cable and connector adaptors are supplied with the RSP). The RSP serial interface connector is located on the back panel of the instrument.

3.3.8 AC Power Connection

3.3.8.1 Operating Power Requirements

The RSP is set at the factory for operation at either 120 or 240 volts AC, and a line frequency of 50/60 Hertz. The rear panel of each instrument is marked with a label which specifies the required operating voltage for that instrument. Check the voltage rating label to verify that the instrument is compatible with the AC voltage available at the installation site

3.3.8.2 Grounding Requirements

CAUTION: PLEASE READ CAREFULLY!

To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the instrument be properly grounded. The instrument is equipped with a three conductor AC power cord which, when connected to an appropriate AC power outlet, grounds the instrument. To preserve this protection feature, do not operate the instrument from an AC power outlet which has no ground connection.

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3.3.8.3 Installation of the AC Power Cord

Connect the AC power cord to the main power connector located on the rear panel of the instrument.

CAUTION: **IF IT IS NECESSARY TO REPLACE THE AC POWER CORD, THE REPLACEMENT CORD MUST HAVE THE SAME POLARITY AS THE ORIGINAL CORD. INSTALLING A POWER CORD WITH THE INCORRECT POLARITY COULD CREATE AN ELECTRICAL SHOCK HAZARD FOR OPERATING PERSONNEL. IT COULD ALSO POTENTIALLY DAMAGE THE EQUIPMENT**

3.3.8.4 Fuses

CAUTION: **DISCONNECT THE AC POWER CORD BEFORE REMOVING OR INSTALLING A FUSE TO AVOID THE POSSIBILITY OF SERIOUS INJURY.**

There are two AC line fuses (slow blow) which are located above the main power connector on the rear of the instrument. Fuse selection is as follows:

Line Voltage 120 VAC - 2 x 5.0 A slow blow fuse
Line Voltage 240 VAC - 2 x 2.5 A slow blow fuse

One special AC line fuse (slow blow) for the transformer is located apart from the other fuses and covered seperately. Transformer fuse selection:

Line Voltage 120 VAC - 4 A slow blow fuse
Line Voltage 40 VAC - 2 A slow blow fuse

To change a fuse :

a) **main line fuse**: disconnect the AC power cord. Remove the fuse cap with a screwdriver. To re-install, insert the fuse in the holder. Press on the holder until the fuse locks into place.

b) **transformer fuse**: disconnect the AC power cord. Remove the fuse cap by twisting the fuse holder counter-clockwise. To re-install, insert the fuse into the holder. Press on the holder and twist clockwise until the fuse locks in place.

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3.4 LOADING TECAN SOFTWARE ONTO HARD DISK

The Tecan RSP Software is delivered on a series of diskettes. A READ.ME file on disk 1 should be reviewed prior to beginning installation. It can be printed or displayed on the screen to assist the user during installation. In addition, the individual performing installation should complete an information sheet provided by TECAN which shows the name of the subdirectory into which the software is installed, lists the custom program files which have been provided by TECAN, and describes how to access different operating screens.

3.4.1 Installation of the RSP Software

Before starting to install the Integrator Software on hard disk, display or print the file READ.ME located on Disk 1 of the Integrator Series.

1. Turn on the computer and go to the root directory on the C drive. The DOS command for this is CD C:\ <enter> resulting in C:\ appearing on the screen. Check the computer manual for the exact command sequence and proper screen appearance, which may slightly differ, depending on your computer configuration.

2. Insert Disk 1 of the RSP Software into drive A.

3. To print the information, enter TYPE **A:READ.ME > PRN** <enter> . To display information on the screen, enter TYPE **A:READ .ME** <enter>.

After completing the instructions provided in the READ.ME file, the Tecan RSP Software can then be installed on hard disk. To start the installation procedure:

1. Check to see that Disk 1 of the Integrator series is in drive A. Repeat steps 1 and 2 of the previous section if Disk 1 is not in drive A.

2. Enter **A : iNSTALL** <enter>.

An installation program on Disk 1 will guide the installation procedure.

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3.5 DIAGNOSTIC TESTS

Each of the following diagnostic tests should be conducted after completing installation of all hardware and software for the RSP. These tests are to verify proper operation of the RSP and should be performed before placing the instrument into service. The diagnostic tests should also be conducted after transporting the unit to another location; and as an aid for trouble-shooting, or following certain corrective maintenance procedures, as specified in Chapter 6 "Maintenance".

1. Check the Computer Setup according to the instructions specified in section 4.3.1 of this manual.

2. Check the RSP Machine Setup according to the instructions specified in section 4.3.2 of this manual. Verify the X/Y/Z step coordinates for both arms of the reference position and the cleaner and waste positions.

3. Use the Diagnostic/Keyboard Operation feature to verify the proper operation of all installed devices on the RSP. Refer to section 6.3.2 and Appendix 2 of this manual for information on keyboard operation.

4. Fill the system with liquid until all air is removed from the tubing and syringes. If air bubbles persist, check to make sure all liquid system connections are tight. Air bubbles may also indicate that the syringes need cleaning. Refer to section 6.4.3 for instruction on cleaning the syringes.

5. Run the Random XYZ Test as described in section 6.3.3.

6. Run the Liquid Detector Checkout diagnostic test according to the instructions given in section 6.3.4.

Note: This test does not apply to multi-fold pipette tips.

7. Perform the Calibration Test program according to section 6.2 of this manual.

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CHAPTER 4

OPERATING INSTRUCTIONS

4.1 IMPORTANT CONCEPTS

4.1.1 Software Design

The software which controls the RSP consists of either the RSP Integrator or of a combination of RSP Integrator/Immuno-AMI software, depending upon the user's needs:

1. The RSP Integrator contains operating commands for adapting the system to local computer hardware and RSP configuration, the master files for sample racks and layouts, diagnostic checks used in preventive maintenance, and advanced database management and programming utilities. The RSP can be operated with this single software system by individuals who have completed a Tecan training course in RSP liquid handling and programming.

2. The RSP Integrator/Immuno-AMI software contains all of the program features of the RSP Integrator plus customized screens which permit the operator to adapt the RSP to routine methods. There are two user level options for the Immuno-AMI software: 1) a restricted level which is limited to routine methods; and 2) an unrestricted level which also permits the creation of new method programs via easy menu options and change in or deletion of existing methods.

Figure 4-1 shows the relationship of these two software packages when installed according to the directions in chapter 3 of this manual, and a list of Main Menu commands.

During installation, decisions must be made about whether a screen will automatically be loaded when the computer is turned on (Autoexec.bat option) and, if Immuno-AMI is used, which level will be loaded automatically.

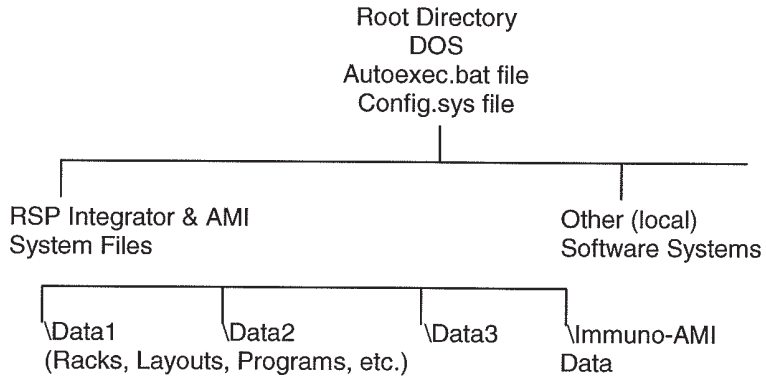
Refer to your Installation Information Record to determine the configuration of your operating system. The user level option can be changed at any time and unrestricted users can move freely among all software options with simple DOS commands.

RSP software commands are of the "pull-down" type with related items grouped by function and displayed together. Figure 4-2 shows a sample screen with overlay windows. Commands may be selected by positioning the highlighter bar over the desired command with the cursor or arrow keys, or by pressing the keyboard key corresponding to the highlighted letter of the command word.

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Figure 4-1

Directory Structure of RSP Integrator and Immuno-AMI Software



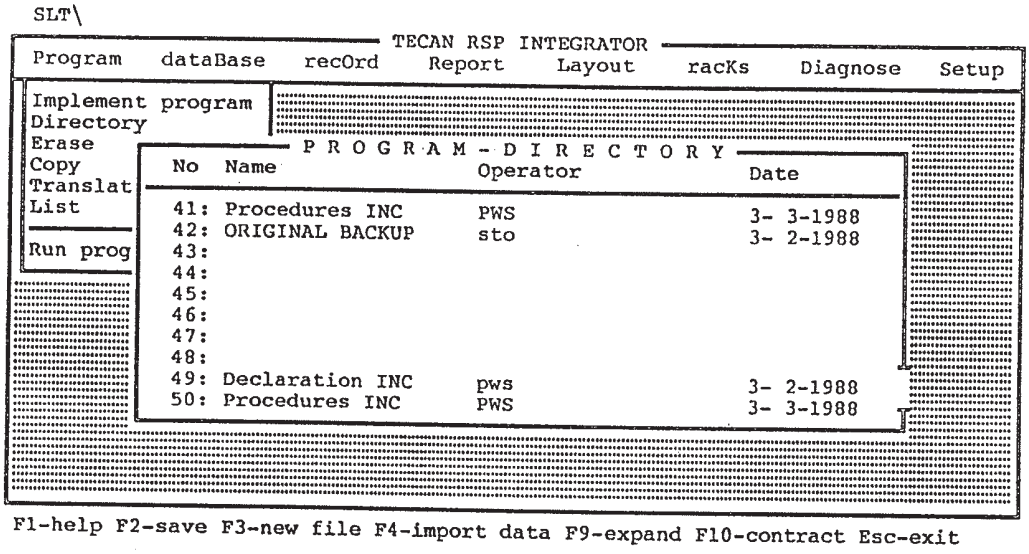
Main Menu Choices

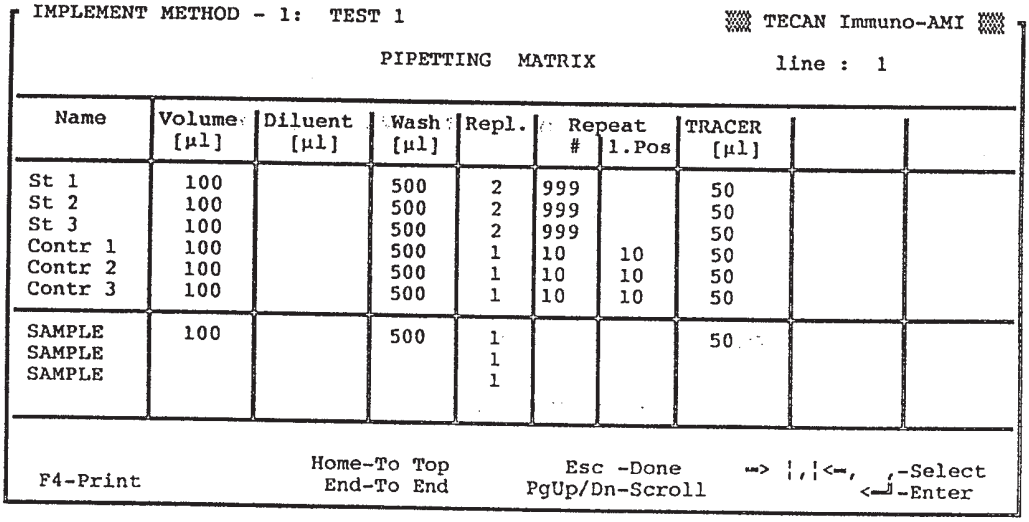
Program	-	Create, or run RSP programs or AMI methods.
Database	-	Enter data, edit the data format, or print reports.
Record	-	Define a database structure (up to 14 fields may be assigned).
Report	-	Design a format for printing information related to the RSP operation.
Layout	-	Establish a layout (racks and liquid handling parameters) for a specific use.
Racks	-	Establish rack (test tube, vial or microplate) configuration.
Diagnose	-	Run special programs supplied by TECAN or created locally.
Setup	-	Check or change factory-set parameters for the computer and the RSP; the subcommand for exiting the system is also located under this heading.

Where appropriate, these main menu choices also include subcommands to permit the copying, erasing, and listing of files in the current directory.

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Figure 4-2 Sample RSP Integrator and Integrator/AMI Program Screens





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4.1.2 Keyboard Use

Below are listed some of the special keys which facilitate the use of the RSP software systems:

Key	Use
Esc	To back up to a previous screen or step; sometimes used to escape from a procedure in progress.
Return or <Enter>	To execute a highlighted command or to enter information from the keyboard into memory.
F2	Poseval or position evaluation; to check arm/tip position in Rack Implement and Machine Setup procedures.
F4	To print information displayed on the screen in Layout, Racks, Diagnose or Setup commands.
F10	To halt or interrupt Diagnostic procedures or operating programs.
Arrows	To move the cursor or highlighter bar left/right across menu options or up/down through screens which are scrolled through a window.
Scroll Lock	To select arm 1 or arm 2 during Poseval (position evaluation).

Additional uses of the keys are displayed on the screen during special computer operations and described in Appendix 2.

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4.1.3 Information Handling by the Tecan Software

Before the Tecan RSP is used in routine sample handling, there are important steps to adapting the software to local equipment and sampling needs.
The steps are described in general below, and are discussed in further detail in section 4.3, System Configuration.The order of the steps is important, because information in one step can affect another.

1. Setup Computer - establishes the characteristics of the local computer, monitor, printer and assigns a subdirectory location for stored data.

2. Setup Machine - verifies the reference position (ref.pos.) and the three wash/cleaner positions of each arm. These positions are expressed as X, Y, and Z coordinates. The reference coordinates for each arm are used to calculate the correct sample positions for the different rack configurations. If the reference position coordinates change (as may occur with tip or arm replacement or adjustment), the rack positions are automatically re-calculated.

3. Racks Implement - creates or verifies the X/Y/Z coordinates of racks used in the laboratory. These coordinates are always relative to the reference position previously established.

4. Layout Implement (2 screens) - creates or verifies the proper layout of racks and liquid handling parameters for their use in programs. Racks cannot be accessed directly by programs; they must first be incorporated into a layout.

It is important to remember to use the above sequence of steps and to update or verify the information in these files after making changes to the system which may alter reference positions, accessories, or computer parameters.

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4.1.4 Standard Commands

There are four commands used under a number of main menu headings which provide basic file management functions :

1. Implement - Allows the operator to create or change information in a file. Up to 50 files may be created in most situations, but this limit applies only to a given working directory.More working directories may be established and accessed via the Setup Computer commands to provide more files if necessary.

2. Directory - Provides current information about file names, the operator who createdthe file, and the date of the latest changes.

3. Erase - Permits the operator to permanently remove an existing file from the working directory.

4. Copy - Permits the operator to copy a file to another directory on the hard disk or to a floppy disk on another drive. This command can be useful in preparing backup copies of important files. When using this command, it is necessary to specify the source location of the file (the default current data directory is displayed) and destination location (file path and/or drive)

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4.1.5 Liquid Handling Concepts

Users of the RSP Integrator Program or Layout Implement commands should be familiar with general rules of liquid handling. These guidelines are incorporated into layout or program files delivered with the Immuno-AMI software.

1. Treat all samples, standards, references, and controls alike.

2. Five submerge steps should be sufficient in most instances. If foaming is common on the liquid surface, increase the number of submerge steps.

3. Slower aspiration speeds (in ul/sec) increase accuracy. Small volumes should be aspirated slowly; volumes smaller than 20ul, very slowly.

4. If more than one liquid is to be aspirated in the same step, aspirate the smallest volume last.

5. If diluent is used in a sampling step, aspirate that first.

6. A wash volume of 5-10 times the sample volume or at least 750ul should be used after each sample to avoid carry-over. A wash step should be omitted only if a large amount of diluent is added.

7. Larger volumes of liquid (>300 ul) require a larger air gap (>20 ul).

8. Higher dispense speeds increase splashing and foaming. Very small volumes (<20 ul) should be dispensed at very high speed. See Figure 4-3 for the relative flow rates of different syringes at different speeds.

For more information on liquid handling, consult theTecan Liquid Handling Manual.

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Figure 4-3

Approximate Flow Rates of Syringes
for Speed Settings on the RSP
(ul/second)

Previous Speed Settings 500 Series Samplers	Syringe Volume in ml				
	1.0	2.5	5.0	10.0	25.0
(fastest)					
1	833	2083	4166	8333	20833
2	800	2000	4000	8000	20000
3	714	1785	3571	7143	17857
4	625	1562	3125	6250	15625
5	526	1315	2631	5263	13158
6	454	1136	2272	4545	11364
7	384	961	1923	3846	9615
8	345	862	1724	3448	8621
9	303	758	1515	3030	7576
10	270	675	1351	2701	6757
11	233	581	1162	2326	5814
12	200	500	1000	2000	5000
13	167	417	833	1667	4167
14	133	333	667	1333	3333
15	100	250	500	1000	2500
16	67	167	333	667	1667
17	33	83	167	333	833
(slowest)					

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4.2 ENTERING AND EXITING THE SOFTWARE

The methods for entering and exiting your software will be established during installation of your system (see Installation Information provided by your Tecan representative). If an Autoexec.bat option was chosen during installation, simply turn on or re-boot the system by pressing the following keys simultaneously : <ctrl> <alt> <del>.

To exit from either software or move from one to the other, use the "Exit" command. This command is in the main menu command for restricted Immuno-AMI users, and is under the Setup command of other screens. From Immuno-AMI, it may be necessary to exit to the Integrator, and then exit to DOS from the Integrator.

Always exit to DOS (look for C> prompt on the screen) before turning off the computer.

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4.3 SYSTEM CONFIGURATION

4.3.1 Computer Setup

Upon selecting these commands, the factory-set computer characteristics are displayed for review or modification. The preset values are for standard IBM computer, graphics colour monitor and Epson compatible (80 character/line) printer. If your equipment is different, it may be necessary to consult the equipment manuals or your Tecan representative.

Data directory - means the directory path (drive and directory) for most data files and the setup data. It is also called Work directory, for each user will gather his programs and the correlated data in a specific DOS directory. By switching directories it is possible to access many different data sets (50 programs, 50 layouts, 50 racks each), and to keep related data together. The key <F10> will let you select one of the already existing DOS directories.

Network directory- This directory is of importance when using several RSPs in a computer network. Here you will specify the path to the server. All database files are accessed in this directory, e.g. a sample list. For normal use of a single RSP, both data and network directory should be the same. Use <F10> to select.

Swap directory - specifies the location of the swap file if swapping to disk. (The program directory will be used if no swap directory is specified). If sufficient EMS memory is available, the swap file will no be used. To mimimize swap times, it's a good idea to put the swap file on the fastest drive that will hold it (e.g a RAM disk). It is prudent to avoid a floppy drive because the user may change disks while the child process is active. Note that swapping may lead to swap files approaching 600K bytes in size ! (See the NOTE on swapping at the end of paragraph 4.3.1.)

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User Program - Leave this field empty if you want to execute a DOS command after having left the Integrator by Exec DOS. Pressing <F10> enables you to pick any file available on your hard disk. Of course, here it makes sense to specify an executable file only. This program will be run immediately upon leaving the Integrator by Exec DOS. For detailed information please refer to the software manual: Integrator function ExecDos.

User Command -if the chosen program requires any command line parameters, enter them here. More information in the software manual.

Network Node - is relevant only when using several RSPs in a network. Then each work station will have its own node number. It is an identification of the workstation.

Comm Port RSP - assigns a serial port for communication with the RSP.

Swap allowed - allows you to select different ways to execute DOS programs while in the INTEGRATOR:
(See the NOTE on swapping at the end of paragraph 4.3.1.)

1 : No swap : swapping is not allowed - only the remamining memory is available to DOS programs.

2 : EMS / disk : swapping allowed. If enough EMS memory is available it will be used, else the swap file will be used.

3 : Disk only : the swap file will be used. EMS is left untouched in order to allow a child process to use all EMS memory.

EMS (Expanded Memory System) will work much faster but requires fitting computer hardware.

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Communication Protocol - must be set to ENHANCED for EPROM versions 2.0 and higher. This protocol is supported by INTEGRATOR/ AMI versions 7.01 and higher.

Printer setup - specifies page margins and print type. NOTE: If your printer does not support semigraphics, please select here "Semigraphics: NO". Otherwise a listing of an IMMUNO-AMI method might become illegible !

Setup string - allows to send control codes to the printer before printing (enabling the modification of character size, font spacing, etc. as required). Consult your printer manuals for the use of this option.

Screen setup - allows a choice of screen types. Some types of screens require suppression of "snow" during program run.

NOTE: A FEW COMMENTS TO SWAPPING:

As we all know, the 640K of memory available to DOS programs is looking smaller every year. DOS programmers have devised a number of methods - using expanded and extended memory, overlays, and so on - to cram more functions into the same space.
The RSP software allows executing DOS programs - so called child processes - from the menu system or from within an INTEGRATOR application. Because the RSP software uses almost all of available memory, large child processes could not be executed up to now.
Therefore, another method - called swapping - has been implemented. By swapping most of the RSP Software into expanded memory or to disk, a lot more free memory is available to the child process. When the child process ends, the RSP software is swapped back into place and continues normally.

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4.3.2 Machine Setup

Upon selecting these commands, the factory-set physical coordinates for each RSP arm are displayed for review, verification, or modification.

4.3.2.1 **Machine Range** - is set at the factory and should not be modified by the operator without consultation by TECAN representatives. The machine range may vary with different tip accessory options.

4.3.2.2 **Reference Position** - is the X, Y, and Z coordinates of each arm when the pipette tip is positioned over the reference position set screw located in the center of the worktable. In the case of multiple tips on an arm, one of the tips must be designated the reference tip, and always used for reference and rack coordinate checks. The reference coordinates are used by the computer to calculate rack position coordinates for each arm (see Racks Implement in section 4.3.3 of this manual). To verify or change the reference position coordinates:

1. Remove all racks from the worktable. With a small flat-head screw driver, turn the reference position set screw approximately 5 turns counterclockwise until it stops, raising the top above the work table surface.

2. On the computer screen, place the highlighter bar on the "X" field of arm 1 Ref. Pos. then press the <F2> key for Poseval (position evaluation). Arm 1 will move to the X/Y coordinates of the current reference position.

3. If the pipette tip is not aligned correctly with the reference position set screw, it may be guided to the correct position using the cursor keys (see the Poseval section of 4.3.3 - Rack implementation for further description of arm control).

4. When the tip is in proper contact with the set screw (in X, Y, and Z directions), press <enter> and the new coordinates will be entered for that arm.

5. Repeat for arm 2.

6. Return the reference position set screw to its normal position flush with the worktable when finished.

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4.3.2.3 **Clean/Waste** - Clean and Waste positions should also be verified after installation or repair of the clean/waste stations, or if a different station is necessary for alternative tip manifolds. Note that only two clean/ waste positions are accessible by each arm, yet it is possible to address all three in the software. This allows the definition of a third clean/waste position to accommodate different tip configurations or special applications.

4.3.2.4 **Lowest Z-travel**

Lowest Z-travel must be set above highest wash station or any other physical obstacle, if applicable (e.g. Light shield of Linear Rack, if installed).

4.3.3 Communications

This submenu allows to set all communication parameters when using a second instrument beside the RSP (e.g. a photometric reader or a gamma counter):
Communication port and queue sizes, transmission parameters, file transfer protocol. Please refer to the manual of the instrument you want to work with.

4.3.4 Directory

opens a window showing all files in the current directory. <F10> allows to toggle between a normal and a wide display mode. The capital letter on the right side of the display represents the file attribute (e.g. A = Archive etc --> see DOS manual). Selecting ".. <UP-DIR> " or " <SUB-DIR> " allows entering any directory on the hard disk. A file can be marked by pressing <F5> , if you like to copy it to another directory (e.g. setup.dat, which contains all data defined in the menu SETUP). The files may be sorted according to different criteria: Press <F1> to get information about the possibilities.

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4.3.5 Racks Implement

A data diskette delivered with the instrument contains information for standard TECAN racks. These will be found in the rack directory after installation. It is possible to use these without modification; however, rack positions should be verified before using them for the first time, and after replacement or repair of pipette or rack parts and accessories.

1. To create a new rack type or change an existing one, select the Rack Implement command; choose from the directory of existing racks or assign a new file name to the directory. To modify an existing rack, it is wise to copy it first, using the copy command and assign the file a new directory position and name. The old rack can then be deleted if not needed.

2. Select the rack type from the options provided:

Rectangular	Any regularly spaced rack which is rectangular or square and is positioned parallel with the X/Y axis of the instrument. The total number of positions and the X, Y, and Z coordinates of the first and last positions must be defined.
Circular	A regularly spaced circular rack which may contain 1 or 2 concentric rings of positions. The center and radial X/Y/Z coordinates and total number of positions per circle must be defined.
Rotor	A conveyor belt which moves samples through a single or dual sampling position. X/Y/Z coordinates of only the sampling station (one or two positions) must be defined.

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Reagent	An irregularly spaced rack of up to 50 positions. Each position must be individually defined. Only one such rack may be included in a layout or loaded into a program at any time. The last tray "PF" in a layout is reserved for this type of rack.
Discrete Position	An irregularly spaced rack which has the same descriptive parameters as a rectangular rack, but require each position to be defined.

When the type of rack is selected, a table is displayed on the screen which allows entry of rack information and position evaluation (poseval <F2>). Complete the rack table by moving the highlighted cursor to each field and entering the appropriate data. Refer to the status line at the bottom of the screen for information on the type of entry or keystrokes expected.

Positions may be expressed numerically or alphabetically (toggle between the two using arrow keys). Position sequency may be in the X or Y direction, and rows or columns may be displaced in either direction by a constant distance (number of steps); this allows the use of racks with every other row/column offset (honeycomb array).

Enter the coordinates of critical positions into the table or determine the number of steps by using Poseval <F2>:

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Poseval (Position Evaluation - <F2>)

1. Select either arm 1 or arm 2 by pressing <Scroll Lock> and locate the highlighter bar over the position you wish to evaluate. Note: it is not necessary to implement racks with both arms (if the same type of tip is used), because positions are automatically translated for the other arm by the software.

2. Press <F2>; movement of the arm is then controlled by using the cursor keys. As the arm moves, the coordinates are automatically entered into the current field of the rack being implemented. The arm will move initially at a moderate speed, if the cursor key is continually pressed then the arm will continue at a faster speed. <PgUp> and <PgDn> keys control movement in the Z direction. For very small movements (single steps) <Ctrl> should be pressed at the same time as the cursor key. When the correct position is reached, press <Enter> to store the coordinates of the tip in the current field.

3. Evaluate the X (left/right) and Y (front/back) and Z (up/down) position coordinates as indicated on the screen for the particular type of rack.

4. Evaluate the Z (up/down) positions as follows:

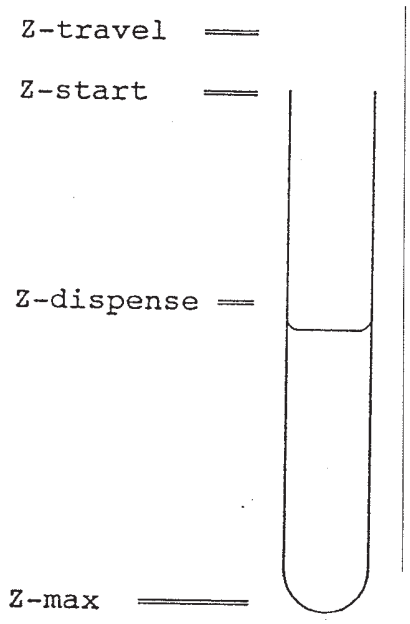
Z-max	The lowest position allowed in the rack; usually 0.5-1.0 mm or 5-10 steps above the bottom of the container.
Z-start	The top of the container; at this setting, the liquid detection feature begins to travel downward in air, "searching" for liquid.
Z-dispense	The height at which the pipette tip dispenses; at least 0.5 cm or 50 steps above the usual sample meniscus.
Z-travel	The safe travelling height of the pipette over the rack; at least 0.5 cm or 50 steps above the rim of the container. For racks of similar heights, use the same Z travel height for all racks, to result in a smoother running of methods .
Z-pos	(Reagent rack only) A position-specific Z-travel setting which is used only when moving between positions within the reagent rack.
Inner Diam	The inner diameter of the tubes in the rack; used to determine the tracking speeds during aspiration and dispensing, and to calculate the remaining volume of sample.

Refer to Figure 4-4 for an illustration of the Z standard positions.

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Figure 4-4

Vertical Z Positioning for the RSP Probe Tip

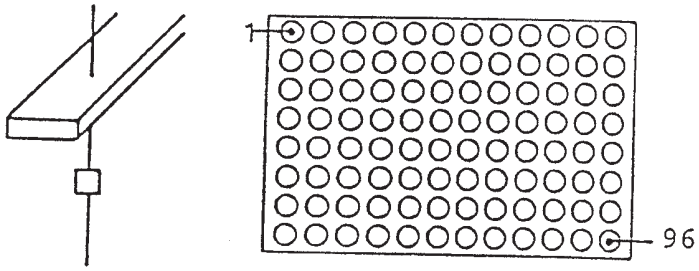


5. To leave Poseval mode without saving X/Y/Z coordinates press <ESC>. No data are saved until the end of the editing session, when the user has an opportunity to discard, print, and/or save any changes.

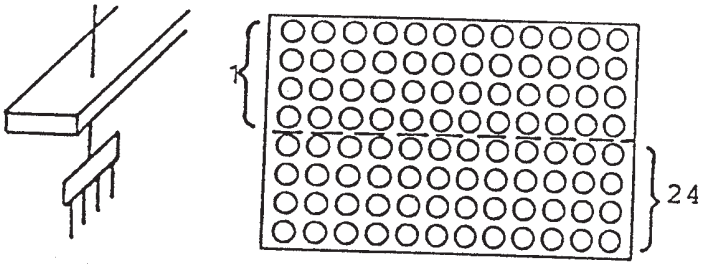
NOTE: **Different racks must be created for use with different sampling tip configurations. This is be-cause the X/Y coordinates of a standard rectangular rack are different when using a single tip pipette than those when using a multiple tip.Figure 4-5 illustrates these differences. Z coor-dinates will be similarly affected by tips of different length.**

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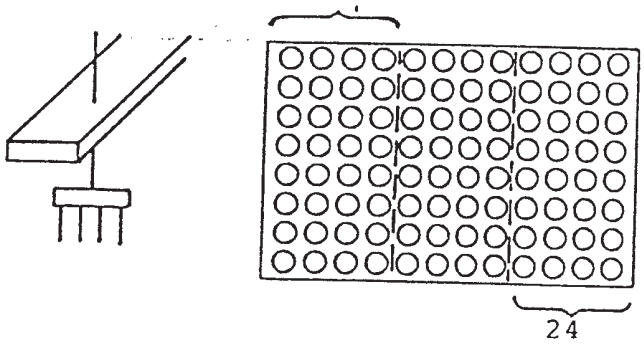
Figure 4-5 One Standard Rack Becomes Three Different Racks with Different Sampling Tip Configurations



I. **A standard, 96-well microplate has 8 rows, 12 columns, and 96 positions with a single tip.**



II. **The same microplate has 2 rows, 12 columns and 24 positions when a 4-fold manifold aligned with the plane of the arm is used.**



III. **The same microplate has 8 rows, 3 columns, and 24 positions when a 4-fold manifold aligned perpendicular to the plane of the arm is used.**

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4.3.6 Layout Implement

The layout is a set of data which may be accessed by any program or method. It provides the computer with essential information about which racks are available and which liquid handling parameters are to be used for each rack.

In order for racks, diluters, or pumps to be used with the RSP, it is first necessary to incorporate them into a layout. A single layout may function in several different methods or programs, but only one layout may be used at a time.

Once a layout is implemented it can be stored in a directory (maximum 50 layouts), copied and edited as required. Layout implementation is divided into two screens or "pages":

1. The first screen or page contains information about the diluters or peristaltic pumps associated with each arm. Each arm may have up to 2 peristaltic pumps or up to 4 diluters (two diluters are standard but an additional two may be mounted externally).

   Type - indicates whether there are diluters or peristaltic pumps (toggle with arrow keys).

   Volume - determines the maximum volume of each syringe or pump in microlitres. If a peristaltic pump is used, set the volume initially at 10,000 ul.

   Cutoff - determines the ramping pattern of the diluter (this is factory set and should not be under changed normal conditions).

   Wash and Flush determine the aspiration and dispensing rates of each diluter when the Wash and Flush commands are executed in the program (speed in microlitres per second at the tip).

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2. The second page of the layout is reached by pressing <F2>. This page containsinformation about the racks being used and the liquid handling parameters to be used with each rack. The combination of rack/liquid handling creates a "tray." The same rack may be used in more than one tray if different liquid handling parameters are necessary. Up to 27 different trays may be included in a layout; the last tray is reserved for a reagent rack, if needed.

   In order to assign a tray to a layout the following information must be specified (refer to section 4.1.5 and Figure 4-4 for information about these values):

   Submerge Steps — The number of Z steps which the tip will move after the detection of liquid.

   Liq Handling — The error handling option when Liquid is not detected: the four choices are:

   - F1 (Normal) - program stops and operator is required to select from a choice of possible actions.
   - F2 Error handled by the program (see programming manual).
   - F3 Provides a second programmed option as in F2.
   - F4 Ignores liquid detection; the tip will always aspirate from the Z-max position.
   - F5 Enable Clot detection (if clot detector is installed)

   Asp Speed — The speed of aspiration in microlitres per second at the tip

   Disp Speed — The speed of dispensing in microlitres per second at the tip. These speeds are maintained even if more than one syringe is being used at a time.

   Asp Delay — The delay in microseconds after aspiration.

   Disp delay — The delay in microseconds after dispensing.

   Rack Number — Select from the rack directory presented on the screen.

   Rack Name — The name corresponding to the rack number is automatically entered.

   Aspiration and Dispensing delays are important to allow the liquid column to equilibrate before removing the tip from the rack position and are particularly important when viscous liquids are being handled.

3. When entries have been made for each required rack (now called a "tray,") the layout may be saved to disk by pressing <ESC> followed by <Y>.

NOTE: **It is important when creating or changing programs to ensure that the correct layout is named in the program and that the correct trays from the active layout are designated in the program. In order to reduce the possibility of mistakes, it is suggested that each program have its own layout (preferably in the corresponding directory position) and that only those racks required for that program are assigned in the layout. If an invalid call for a tray is made by a program, a serious "run- time" error will occur..A serious "run-time" error places the operator into DOS and some data loss may occur. To restart the program from DOS, enter "RSP".**

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4.3.7 Program/Method Implementation or Modification

4.3.7.1 Using RSP Integrator Software

Customized or standard programs may be delivered with the TECAN RSP Integrator software. The names of these programs will appear in the Program Directory, and the corresponding layouts and racks will appear in the appropriate directories.

Only TECAN representatives or individuals who have received advanced training in liquid handling and RSP Integrator programming should attempt to create new programs or alter programs in the RSP Integrator Program directory. Separate Liquid Handling and Programming Manuals are provided to these individuals.

4.3.7.2 Using the Immuno-AMI Software Option

Upon turning on the computer, the Immuno-AMI main menu will appear on the screen. The term "method" is used in place of "program" throughout the Immuno-AMI software to represent a specific adaptation of the technique to which the customized Immuno-AMI program is dedicated. Within a method-specific program, the sampler can be adapted for local use without advanced knowledge of liquid handling and computer programming.

1. Make sure that the Computer/Machine Setup and Racks/Layout Implement protocols have been completed, as described earlier in this section.

2. Select Implement Method to create a local adaptation or change an existing method.

3. Enter the information as indicated on the series of screens which appear. Note the instructions in the help window at the bottom of the screen:

Assay Configuration - Enter name of method and whether it is a single or dual assay. A single assay would have the two arms operating cooperatively on the same assay; a dual assay permits the two arms to function independently of one another and requires a complete implementation protocol for each arm (even if the protocols are identical). Identify the layout and reports to be used, the type of sample tips being used on each arm, washing schedule and tray locations. A second Assay Configuration screen requires assignment of trays from the layout to primary (source) and secondary (delivery) functions.

Reagent Configuration - Enter the total number of reagents and the name of each reagent to be used, the location of the reagent in the tray, the arm to be used, when the reagent is to be distributed, and the manner of distribution. Refer to the bottom of the screen for a list of possible choices.

Control/Standard Positions - Name all controls and standards, their source tray and position.

Pipetting Matrix - Indicate the volume for each sample, diluent (system liquid), reagent, and washing between samples. Also indicate whether replicate samples are desired and the frequency at which controls and standards are to be repeated.

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4.4 ROUTINE OPERATION

4.4.1 Preparation

Before running a program or method on the RSP , the following preparation steps should be completed:

1. Empty all waste containers.
2. Check the system fluid reservoirs to ensure an adequate supply of system fluid is available.
3. Verify that the correct size syringes are installed on each diluter (refer to the lay-out to determine the correct syringe sizes).
4. Clean all pipette tips using isopropyl alcohol and a lint-free tissue.
5. Inspect all samples, controls and reagents for particulate matter or material that could clog the pipette tips. Do not attempt to use such samples on the sampler.
6. Load all samples and reagents in correct or-der into the appropriate trays and carefully position each tray at its correct location on the RSP worktable. Do not use tube, microplate or reagent vial adapters unless they have been manufactured to TECAN specifications.

CAUTION: TO PREVENT SAMPLING ACCIDENTS AND/OR ERRONEOUS RESULTS, ALWAYS CAREFULLY CHECK THE ARRANGE-MENT OF THE WORKTABLE AND SEQUENCE OF SAMPLES AND REAGENTS PRIOR TO OPERATION.

7. Turn on the equipment in the following order:
    1. Printer (if applicable)
    2. Computer
    3. External diluter (if applicable)
    4. RSP

The diluter valves should turn to initializeand the green indicator lights on the diluters and RSP should be on.

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4.4.2 Running An RSP Integrator Program

To run a program on the RSP, select the "Program" heading from the RSP Integrator Software main menu, then select "Run Program". A list of available programs will then appear on the computer screen. Up to 50 different programs are available within each directory. Use the Up/Down keys to move the highlighted cursor through in the selection window and the <PgUp> and <PgDn> keys to toggle between different selection windows. Select a program for execution by moving the highlighted cursor to your program selection and then press the <Enter> key, or by pressing the appropriate function key <F1-F10>.

When the selection has been made the program will begin to run immediately.

NOTE : To temporarily halt operation of an RSP program, press the <F10> key. This may be done at any time if there is a need to interrupt program operation. To resume program operation, press the <ESC> key or, to abort the execution, type ABORT <enter>.

Upon completion of a program the Main Menu screen is displayed ready for the next selection.

4.4.3 Running an Immuno-AMI Method

To run an Immuno-AMI method, select Run Method. A directory of up to 50 methods will be displayed in the window. Use the up/down arrow keys and <PgUp> and <PgDn> keys to move through the 50 possible choices; choose the method by <F> keys or move the highlighter to the method and press <enter>. Follow the directions on the screen specific for the method chosen. Press "Y" to start the program and "N" to abort. The "Distribute Reagents Later" command can be used in two-step reagent dispensing protocols established in the method protocol.

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4.5 Special Commands

As described earlier in this section, the Directory, Erase, Copy, and List commands are used to display and manipulate program or method files. The following additional features are described in detail in the TECAN Programming Manual.

4.5.1 Report	-	Permits the operator to design a standard format for printing information related to the RSP operation.
4.5.2 Record	-	Establishes the design of the database (up to 14 fields may be assigned).
4.5.3 Database	-	Permits the entry of the data, editing of the format, and printing of defined reports.
4.5.4 Program Translate	-	transforms programming language into computer language; it is necessary to translate any new programs or modifications or copies of old programs before the computer can interpret them and execute the steps.

In addition to these, there are special commands which provide access to diagnostic checks on the machine. The Diagnose commands are discussed fully in section 6.3 of this manual.

4.6 Shutdown

After completing a working session on the RSP, and before turning the instrument off, follow the daily maintenance procedures outlined in section 6.1.2 of this manual.

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CHAPTER 5

HAZARDS AND PRECAUTIONS

5.1 PRECAUTIONS FOR DIAGNOSTIC APPLICATIONS

For all diagnostic and clinical applications of the Tecan RSP, it is essential that the user strictly follow all instructions supplied by the manufacturer of the diagnostic kits.
The user must ensure that requirements of each diagnostic protocol are carefully observed.
Attention must be given to:

-Sample/reagent volumes and concentrations
-Sequence of liquid handling steps
-Temperature restrictions
-Time limits

Controls, standards, or reference materials recommended by the test kits manufacturer should be processed by the Tecan RSP in the same manner as test samples. Prior to any first time application, test runs should be made with the assay to allow optimization of all liquid handling parameters.

The RSP requires accurate positioning of all reagents, samples, racks, and plates on the instrument's worktable by the operator. The user should verify that all components are correctly positioned on the RSP worktable before executing any program. All racks and trays must be identified to provide a reliable and repeatable means of fixing its position on the worktable. Racks of different designs must not be interchanged within the same application program.

In the event of power outage or otherwise aborted run, all partially processed samples and racks should bediscarded. Do not attempt to re-start an interrupted program unless the screen provides explicit instructions for resuming operation.

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5.2 HAZARDS

5.2.1 Mechanical Hazards

The Tecan RSP is a robotic device which operates under computer control. As with most robotic devices, there is a potential for injury and bodily harm from moving mechanical components whenever the instrument is in operation. The instrument is designed for automatic "hands-off" operation only. Never reach into the instrument workspace when the unit is in an operating mode. A safety guard is provided with the instrument to prevent accidental contact with any moving components. The safety guard should be installed at all times.

If it is necessary to interrupt operation of the instrument, check the screen display for the "User Break" command (usually the <F-10> key on the computer keyboard). To resume program operation, press the <Esc> key. The program should then continue from the point where it was interrupted.

Should either of the robotic arms accidentally impact another object, it is necessary to first reinitializethe arm before resuming program operation. Otherwise, the arm position will be in error, causing the arm to crash after the program is resumed.

5.2.2 Liquid Hazards

Potential hazards may exist to personnel from the liquids being handled by the RSP. Infectious clinical samples, toxic or corrosive chemicals, or radioactive substances may be present. Although the "hands-off" operating features of the RSP minimizes exposure to these agents, the potential for hazardous exposure still exists. Hand, eye, and clothing protection, as well as radioactive monitoring badges should always be worn, where appropriate.

5.2.3 Electrical Hazards

The same precautions considered when using any electrical equipment should be observed with this equipment. Do not touch any switches or outlets with wet hands. Switch the instrument off before disconnecting the AC power cord. Unplug the instrument prior to cleaning up any major liquid spills and prior to servicing any of the electrical or internal components.

Electrical servicing should be performed only by qualified personnel. Replace all access covers before operating the instrument.

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CHAPTER 6

MAINTENANCE

6.1 PREVENTIVE MAINTENANCE

6.1.1 Introduction

The TECAN RSP is designed to require a minimum amount of maintenance from the user. However, to preserve the accuracy and reliability of the instrument, the following preventive maintenance procedures must be performed on a regular basis according to the maintenance schedules given below.

1. **Daily preventive maintenance -** at the end of each day or after every 8 hours of RSP operation.

2. **Weekly preventive maintenance -** at the end of each week or after 40 hours of operation.

3. **Periodic preventive maintenance -** at the end of every 6 months or approximately 400 hours, whichever comes first.

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6.1.2 Daily Preventive Maintenance

1. If the liquid system has been filled with anything other than distilled or deionized water, thoroughly flush the system with distilled or deionized water, using the total volume capacity of each syringe x 10 cycles. If the liquid system uses saline or phosphate solutions, or if the diluter valves appear to be wearing out too soon, the daily cycling may need to be extended for 10-20 minutes.

2. If the instrument is not used for several hours, leave the system filled with the distilled or deionized water; other solutions may form precipitates, which can considerably shorten the life of the tubing, valves and syringes, and effect the precision and accuracy of the instrument.

3. Remove racks from the instrument surface. Carefully clean the work surface using isopropyl alcohol and a soft cloth.

4. Check the level of the system fluid in the diluent container. It is good laboratory practice to replace the system liquid at least once each day.

5. Empty all waste containers.

6. Clean the sampling tip by gently wiping with a lintfree tissue containing isopropyl alcohol.

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6.1.3 Weekly Preventive Maintenance

1. Perform all the required daily maintenance.

2. Check the syringes for leaks (bubbles) or internal contamination (particles, crystals, etc.). If required, clean the syringes as described in section 6.4.3. If the syringes are leaking, replace the caps on the syringe plungers.

3. Check around the valves for signs of moisture (indicating possible leaks). Replace if there is evidence of leaking (see section 6.4.4).

4. Check the green teflon coating of the stainless steel pipette tip. Replace the pipette tip if the teflon coating is damaged (see section 6.4.2.1). Check the tip of the drawn FEP pipette (if applicable) for signs of wear. Replace the FEP pipette if the tip is ragged, bent or otherwise damaged (see 6.4.2.2).

5. Check that there are no air bubbles or contamination in the pipetting tubing. Tighten the tubing connections or replace the tubing as required (see 6.4.2).

6. Check the waste tubing for contamination. Clean it with appropriate detergent or antiseptic solution as required.

7. Clean the toothed rack with a lint-free tissue. Do not use oil or solvents to clean the toothed rack.

8. Run the Random X/Y/Z test and Liquid Detector Checkout according to the instructions given in section 6.3. Perform the Calibration Check according to section 6.2 if pipette tips, tubing, syringes or valves have been repaired or replaced.

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6.1.4 Periodic Maintenance

1. Perform the required daily maintenance.
2. Replace the entire sampling tubing.
3. Replace the syringes (see section 6.4.3).
4. Replace the waste tubing (see section 3.3.1).
5. Replace the pipette tips (see section 6.4.2).
6. Replace the diluter valves (see section 6.4.4).
7. Replace the level detector cable and the insulation block.
8. Fill the system with liquid to check for air bubbles and leaks.
   Make sure all tubing connections are tight.
9. Run the Random X/Y/Z test and Liquid Detector Checkout according to the instructions given in sections 6.3.3 and 6.3.4, respectively.
   Perform the Calibration Check according to section 6.2.

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6.2 CALIBRATION TEST

The Calibration Test is a special program supplied with the Integrator Software which allows the operator to check the accuracy and precision of the RSP. With volumes of 5ul or more and syringe of appropriate volume, the instrument is capable of delivering with an accuracy of +/- 1% and with CV of 1% or better, although some uses of the RSP may allow less stringent standards. The Calibration Test should be performed upon receipt of the instrument, after repair or replacement of any liquid handling component, and whenever routine control, references, or standards indicate drifting or erratic test results. A scale, accurate to 0.1 mg is necessary for the test.

1. Place 10 thoroughly clean sample tubes in the sample rack defined as tray TA in Layout #49.

2. Check to see that RSP and printer are turned on. In the Main Menu of the Integrator, select Racks Implement and verify the data for the sample rack. Then select Layout Implement and make sure the sample rack you intend to use matches that defined as Tray TA in Layout #49.

3. Select Program, then Run Program, then Calibration Test from the directory display. Follow the instructions on the screen carefully. The operator is first directed to weigh the empty tubes and enter the weight, later to choose the RSP arm he wants to run the test with. Then the RSP dispenses a predetermined volume into each tube, after which the operator is again directed to weigh the filled tubes and enter their full weights.

4. A graph and table are automatically generated, showing the individual weights plotted against the expected weights, the mean, range, accuracy, standard deviation, and coefficient of variation for each arm.

5. Review the resulting data from the Calibration Test run.

6. If the Calibration Test results do not meet the requirements of the application, inspect for leaks in the liquid path, and review syringe, tubing and tip requirements. If necessary, replace the liquid path components. Repeat the Calibration Test; if the values are still out of range, contact TECAN.

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6.3 DIAGNOSTIC ROUTINES

6.3.1 Introduction

The diagnostic routines are used in verifying proper operation of the instrument after maintenance and service procedures, and in investigating suspected malfunction of the RSP. The following 4 commands are found under the command "Diagnose" in the RSP main menu:

1. Keyboard Operation - enables the operator to direct the function of a single RSP component from the keyboard by the entry of "string commands." This feature is useful in isolating a component for observation and/or evaluation or in recovering from sampling accidents ("crash"). In the event of a sampling accident, use the <F10> key to access keyboard operation.

2. Random X/Y/Z Test - checks the operation of the arms in left/right, front/back, and up/down positions.

3. Liquid Detector Checkout - tests the liquid detector for each RSP arm.

4. Batch files - permits the user to group together into a file a sequence of frequently-used string commands; the file may then be run any time the operator wishes to repeat the same sequence of commands, without entering the commands via the keyboard. This feature also permits the operator to test more than one component or component function without having to enter separate command strings.

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6.3.2 Keyboard Operation

This command is used to direct the operation of a single RSP component by entering command strings from the computer keyboard. To run this diagnostic routine, choose "Diagnose" from the main program menu,and then select "Keyboard Operation". A special window will then appear on the screen, allowing the entry of string commands from the keyboard. Each string command consists of an arm number (preceded by a # character), device number, command and, where required, operands.

Example:	#1	8	ZX	10,5,1000
	^	^	^	^
	arm number	device number	command	parameters

String commands can be sent to six different devices for each arm on the RSP:

Device #	Device
1	Left Syringe
2	Right Syringe
3	Left External Syringe (optional)
4	Right External Syringe (optional)
6	External Valve/Magnetic Stirrer (optional)
8	X/Y/Z Drive

A Command Summary which lists all of the available string commands and the syntax rules for command string structure is given in Appendix 2. Refer to the appendix for further details concerning command strings.

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6.3.3 Random X/Y/Z Test

The Random X/Y/Z Test automatically drives both RSP arms to random locations within the instrument work table, simultaneously recording information about errors, skipped steps, and the parameters of the current test cycle. To perform the Random X/Y/Z Test:

1. Check the RSP setup (see Chapter 4) to verify that the Z-max value will not result in the needle crashing into the work table.

2. Fill the system with liquid (Fill Liquid System batch file or program file - check your local file directories for the location).

3. Select "Diagnose" from the main menu and then select "Random X/Y/Z Test". The operator will be prompted to enter the number of cycles required and then to remove everything from the RSP work table. In order to avoid a crash with an possibly present (but not connected) Linear Rack Drive, the operator will then be asked whether this device is installed or not. This prompt will appear only if the RSP cannot locate a Linear Rack Drive.

at least 1350

CAUTION: TO PREVENT COLLISIONS, REMOVE EVERYTHING FROM THE WORK TABLE BEFORE STARTING THE RANDOM X/Y/Z TEST.

4. After clearing the work table, enter "Y" to begin the test. The following information will appear on the screen:

# of Init Errors - The number of errors occurring during an initialization cycle. This number must be zero.

Steps Lost After Last Init - The number of steps lost between two initializations. This number must not exceed 3.

Max Error steps - The maximum number of steps lost during the entire test. This number must not exceed 3.

Programmed Ramp, Start, and End Frequencies - Factory-set values.

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 # Moves Done - Shows the total number of moves completed by the arm. At least 1350 moves should be completed in a random test.

 # Inits Done - The total number of initializations the arm has performed. A minimum of 50 initializations is recommended for a meaningful run.

Once begun, the test continues until either function key F10 is pressed to temporarily interrupt the test, or ESC key to end the test. The test results may be printed out by responding to the screen prompt.

5. After running the random test, check for the formation of liquid at the probe tips and on the work table. The presence of drops may indicate a loose connection or air leakage somewhere in the liquid system. Manually tighten all liquid system connections if necessary.

6.3.4 Liquid Detector Checkout

The Liquid Detector Checkout is used to test the function of the liquid detector by repetitive measurements of known quantities of liquid in several sample tubes.

1. To begin the Liquid Detector Checkout select "Diagnose" from the main menu and then select "Liquid Detector Checkout". The following test parameters can then be selected by the user, referring to prompts on the screen:

Layout - select from the current Layout directory (it may be desirable to have a special layout just for the Liquid Detector Checkout).

Speed - tip speed (steps/sec) in the Z direction while searching to detect liquid.

Arm - select arm 1 or arm 2 for each test position.

Tray - select from current tray directory.

Pos - the position of the sample tube(s) within a specified tray.

Liquid - answer (yes/no) whether there is at least 300ul liquid in the container at the designated tube position.

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To Do - how many times to repeat liquid detection checks at a specific tube position. A total of at least 25 is recommended at each position.

Uncert - the statistical uncertainty (%) associated with the number of repetitive trials entered in "to do" (automatically calculated). The operator can alternatively enter from the keyboard the acceptable uncertainty level, and the required "to do" figure will be calculated.

These parameters may be saved for use again later.

2. After completing a test layout, install the selected trays in the correct positions on the work table. Fill tubes with known quantities of liquid: 300 ul of 0.05M sodium chloride is recommended to test the minimum limit of the liquid detector, although tap water may work, depending upon its mineral content. Tube volumes may vary, some tubes may be empty to test if the detector is too sensitive. Use round-bottom tubes with 12mm or 13mm diameter.

3. Place each tube into its designated position in the layout. To begin the test run, press the <HOME> key. During execution of the Liquid Detector Checkout, the following information is displayed on the screen for each position sampled:

Steps Done - how many detections have been completed.

Error - how many detection errors occurred (how many times liquid was not detected in tubes containing at least 300ul liquid and how many times liquid was detected in tubes containing no liquid (according to the "yes/no" information entered in step #1 above). Note: For a successful completion of the test, this number must be zero.

Min. - The minimum height (in steps) of the detected liquid level.

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Max. - The maximum height (in steps) of the detected liquid level. Note: The difference between the min. and max. values must not be more than 10 steps.

Dev. - The standard deviation for the variations in the height of the liquid level detected.

Uncert - The statistical uncertainty (%) of the values obtained from the multiple tests at each position. This value may be ignored unless other values are out of range.

4. Press the ESC key to discontinue a test in progress and END key to leave the Liquid Detector Checkout. Enter <F4> to print the results of the test.

The Liquid Detector Checkout is successfully completed only if the there were no detection errors, the difference between the minimum and maximum values of the detected liquid level for each tube is less than 10 steps, and the standard deviation is less than 2.0.

6.3.5 Batch Files

Batch files are used to send standard sequences of command strings to the RSP. Some batch files (for example, the Fill Liquid System) will be installed with your operating software. For information on command strings, refer to Appendix 2 of this manual.

There are five batch file commands under the "Diagnose" command in the main menu:

Run Batch File - Select and run an existing batch file.

Implement Batch File - Create a new or change an existing batch file. There are subcommands which permit the creation of Do loops and options for suspension of programs to allow user interaction.

Directory - Display a directory of available batch files.

Erase - Delete a batch file from disk.

Copy - Copy a batch file to another disk or anoth subdirectory of the same disk.

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6.4 MINOR CORRECTIVE MAINTENANCE

6.4.1 Introduction

All minor corrective maintenance can be performed by the operator. After completing any maintenance on the RSP, it is important to perform the diagnostic tests specified in maintenance procedures before returning the instrument to operation.

6.4.2 Pipette Tip Replacement

6.4.2.1 Stainless Steel Pipette

1. Empty liquid system and switch the instrument off.

2. Loosen the set screw on the metal sleeve of the insulation block. Slide the pipette and pipette tubing up out of the top of the toothed rack. Remove the insulation block from the toothed rack by loosening the allen screw (refer to Figure 3-3 in this manual).

3. Pull the pipette from the end of the pipette tubing.

4. To replace the pipette tubing, remove the plastic support tubing and metal tubing support from the pipette tubing. Disconnect the pipette tubing from the liquid connector block at the rear of the instrument by unscrewing the black tubing guide. Install the new pipette tubing and replace the plastic support tubing and metal tubing support.

5. Securely connect the pipette tubing to a new pipette tip.

6. Carefully insert the pipette tip and tubing into the top of the toothed rack and push the tubing through until the pipette is completely exposed below the toothed rack.

7. Slide the insulation block over the tip and onto the toothed rack. The liquid detector cable should be positioned on the left side of the left arm, and on the right side of the right arm.

8. Tighten the allen set screw to secure the insulation block to the toothed rack.

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9. Carefully position the pipette tip to align the groove on the upper end of the tip with the bottom of the metal sleeve on the insulation block. Secure the tip by tightening the set screw on the metal sleeve.

10. Adjust the plastic support tubing so that it is pushed firmly into the top of the toothed rack.

11. Fill the liquid system, and run the Calibration Check, the Liquid Detector Test and the Random X/Y/Z Test (see sections 6.2 and 6.3).

6.4.2.2 Drawn FEP Pipette

1. Empty liquid system and switch the instrument off.

2. Loosen the set screw on the metal sleeve of the insulation block. Slide the pipette and tubing up out of the top of the toothed rack (refer to Figure 3-14 of this manual).

3. Remove the insulation block from the toothed rack by loosening the allen screw.

4. Remove the plastic support tubing and metal tubing support from the pipette tubing.

5. Disconnect the pipette tubing from the liquid connector block at the rear of the instrument by unscrewing the black tubing guide. Install the new pipette tubing and replace the plastic support tubing and metal tubing support.

6. Carefully insert the sampling tip into the toothed rack and push the pipetting tubing with the tip through until the sampling tip is exposed below the toothed rack.

7. Slide the insulation block and sleeve over the tip and onto the toothed rack. The liquid detector cable should be positioned on the left side of the left arm, and on the right side of the right arm.

8. Tighten the allen screw to secure the insulation block to the toothed rack.

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9. Continue to push the pipetting tubing down from the top of the toothed rack until the pipetting tubing is approximately 0.5mm below the bottom of the liquid detector wire.

10. Secure the tip by tightening the tip set screw on the metal sleeve of the insulation block.

11. Adjust the plastic support tubing so that it is pushed firmly into the top of the toothed rack.

12. Fill the liquid system, and run the Calibration Check, the Liquid Detector Test and the Random X/Y/Z Test (see sections 6.2 and 6.3).

6.4.2.3 Double Tip

1. Empty liquid system and switch the instrument off.

2. Loosen the set screw on the metal sleeve of the insulation block. Slide the top of the vertical pipette off of the tubing and disconnect the branched pipette tip from its tubing. If the vertical pipette tubing is also to be replaced, slide it up out of the top of the toothed rack. Remove the insulation block from the toothed rack by loosening the allen screw (refer to Figure 3-13 in this manual).

3. To replace the vertical pipette tubing, remove the clasps attaching the branched pipette tubing, then remove the plastic support tubing and metal tubing support. Disconnect the pipette tubing from the liquid connector block at the rear of the instrument by unscrewing the black tubing guide. Install the new pipette tubing and replace the plastic support tubing and metal tubing support.

4. To replace the branched pipette tubing, remove the clasps attaching it to the vertical tip tubing, then disconnect it from the liquid connector block at the rear of the instrument by unscrewing the black tubing guide. Install the new pipette tubing and replace the clasps to the vertical tip tubing.

5. Refer to section 3.6.5.2 of this manual for replacing the double tip onto the tubing.

6. Fill the liquid system, and run the Calibration Check, the Liquid Detector Test and the Random X/Y/Z Test (see sections 6.2 and 6.3).

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6.4.2.4 Multi-Fold Pipetting or Washing Tips/Tubing

1. Empty liquid system and switch the instrument off.

2. Remove the two short screws on the side of the tubing/tip assembly (see Figure 3-9 of this manual). Remove the assembly casing.

3. On the bottom of the assembly, remove the two screws and detach the tip housing block.

4. Disconnect the tubing from the pipette tips.

5. If tubing is to be replaced, unscrew from the liquid connector block ports and pull through. If replacing Washing Assembly tubing, note the label of the tubing from each port, so that new tubing may be appropriately labeled.

6. Attach new tubing beginning at the liquid connector block and thread through the metal tube guides. Attach to the tips, then replace the assembly casing.

7. Fill the liquid system, and run the Calibration Check, the Liquid Detector Test and the Random X/Y/Z Test (see sections 6.2 and 6.3).

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6.4.3 Syringe Cleaning or Replacement

1. Empty liquid system and switch the instrument off.

2. Loosen the plunger locking ring which holds the syringe plunger and slowly move the plunger drive down to the lowest position.

3. Carefully unscrew and remove the syringe from the diluter valve (refer to Figure 3-4).

4. Remove the syringe plunger and thoroughly inspect the Teflon plunger cap for signs of wear or damage. Replace the plunger if necessary.

5. Thoroughly degrease the inside surfaces of the glass syringe barrel with acetone and rinse with distilled water.

6. Reinstall the syringe onto the Luer Lock hub of the diluter valve.

7. Slowly move the diluter plunger drive manually upward until the syringe plunger fits the appropriate recess of the locking rings. Tighten the locking ring securely.

NOTE: **If syringes are exchanged frequently, the locking ring should be removed and the threads of the plunger holder cleaned with alcohol. Lubricate the ring with silicon oil.**

8. Check if the syringes are mounted securely by manually moving the plunger drive up and down.

9. Fill the system with liquid and check for air bubbles in the syringe barrel. Perform the Calibration Check according to section 6.2.

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6.4.4 Diluter Valve Replacement

1. Empty the liquid system. The valve drive should be set in the "I" (input) position. To ensure this, switch the instrument off, then on again.

2. Switch the instrument off.

3. Loosen the locking ring holding the syringe plunger and move plunger drive to its bottom position (see Figure 6-1).

4. Carefully unscrew the syringe from the valve and remove it.

5. Unscrew the tubing connectors from the valve.

6. Remove the two screws holding the valve and carefully pull the valve from the diluter housing.

7. Before installing the new valve make sure that the notch in the valve stem is positioned properly in the "I" (input) position (see Figure 6-1). If it is not, adjust the valve stem with a pair of flat nose pliers or a screwdriver.

8. Hold the new valve with the Luer Lock hub pointing downward and press it lightly against the male coupling of the diluter. Do not force the valve into position. Switch the instrument on. The valve drive will initialize and turn the valve stem which should allow the valve to seat into the correct position. If this is not the case, switch the instrument off and return to point 7.

9. Switch the instrument off and tighten the screws that hold the valve.

10. Connect the aspirating tubing to the right valve port and the interconnecting tubing to the left valve port.

11. Install the syringe into the diluter plungerdrive. Insert the syringe Luer Lock tip into the Luer Lock hub of the valve and carefully screw the syringe onto the valve.

12. Slowly move the plunger drive manually upward until the plunger bottom fits the appropriate recess of the plunger locking ring. Fasten the plunger locking ring.

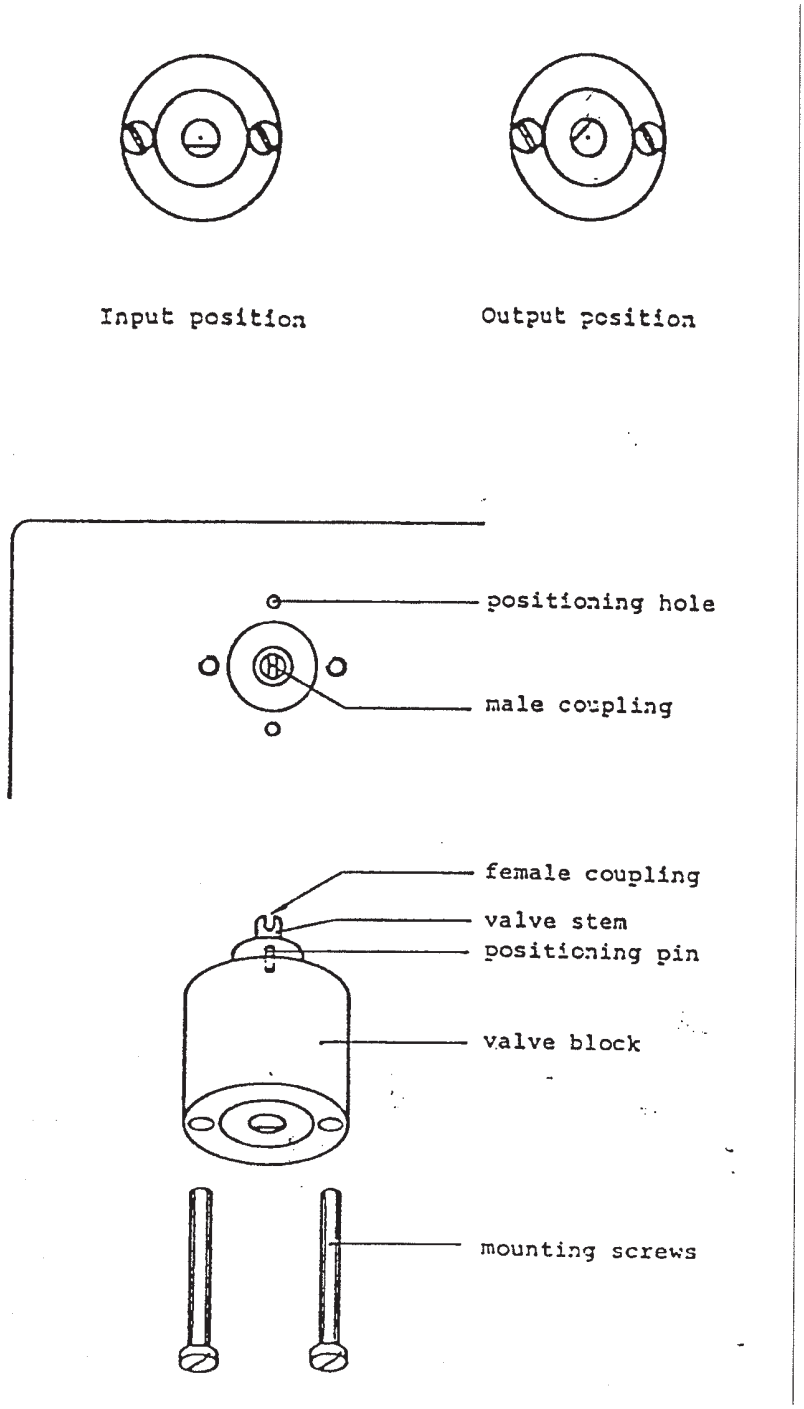
13. Make sure the syringe is mounted securely by manually moving the plunger drive up and down slowly.

14. Switch the instrument on.

15. Fill the system with liquid and run the Random X/Y/Z and the Calibrations Check.

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Figure 6-1Diluter Valve Replacement



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6.5 TROUBLE-SHOOTING

6.5.1 Error Codes and Messages

Many RSP operating problems can be corrected by the user, based upon the error codes and messages appearing on the computer screen, and the information contained in this chapter. When it is necessary to call TECAN for assistance, a precise description of the problem should be available, including any error code information and attempted corrective action.

Error codes are displayed along with a brief message and numbers identifying the device involved. The error codes and corresponding messages are as follows:

Code #	Message
1	Initialization Error
2	Invalid Command
3	Invalid Operand
4	Invalid Command Sequence
5	Device Not Implemented
6	Timeout Error
7	Device Not Initialized
8	Command Overflow
9	Plunger Overload/No Liquid Detected
10	Valve Blocked/Z-position overrun
11	Not Enough Liquid for Sampling
12	No Liquid Detected
13	Not Enough Liquid Detected
16	Stemo Temp Fail
17	Arm Collision Avoided

Figures 6-2 through 6-4 provide possible causes and corrective actions for these errors.

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Figure 6-2

Error Key for Diluters/Pumps (Device #1-4)

Error Code	Possible Causes	Corrective Action
1	Defective diluter valve	Replace diluter valve
	Defective syringe	Replace syringe
	Valve drive faulty	Contact TECAN
	Plunger faulty	Contact TECAN
2	Software problem	Refer to Software Manual
	Wrong string command	Refer to Appendix 2
3	Program problem	Refer to Software Manual
	Wrong set up	Check machine set up
	Wrong operand in string command	Refer to Appendix 2
4	Software problem	Refer to Software Manual
5	External diluter turned on after RSP	Turn on external diluter before RSP
	Use of a non-implemented device	Refer to Software Manual
	Diluter faulty	Contact TECAN
	CPU87 faulty	Contact TECAN
6	Valve worn out	Replace valve
	Diluter faulty	Contact TECAN
7	Device not initialized	Initialize the device via the keyboard (refer to section 6.3.2 and Appendix 2)
	Diluter faulty	
8	Use of too many commands on one line	Refer to Software Manual
9	Syringe too tight	Replace syringe
	Probe clogged	Replace probe
	Valve blocked	Replace valve
	Diluter speed too fast	Refer to Liquid Handling Manual
	Diluter faulty	Contact TECAN
10	Valve worn out	Replace valve
	Diluter faulty	Contact TECAN

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Figure 6-3

Error Key for External Valve/Relay (Device #6)

Error Code	PossibleCauses	Corrective Action
1	Valve blocked Valve drive faulty	Replace valve ontact TECAN
2	Software problem Wrong string command	Refer to Software Manual Refer to Appendix 2
3	Software problem Wrong set-up Wrong operand in string command	Refer to Software Manual Check Machine Set-up Check Appendix 2
4	Software problem	Refer to Software Manual
5	Use of a non-implemented device CPU87 faulty	Correct program Contact TECAN
6	Valve worn out Valve drive faulty	Replace valve Contact Tecan
7	Device not initialized	Initialize the device via the keyboard (refer to section 6.3.2 and Appendix 2)
8	Use of too many commands in one line	Refer to Software Manual

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Figure 6-4

Error Key for Positioning (Arm - Device #8)

Error Code	Possible Causes	Corrective Action
1	Set-up not correct Arm blocked Poni PCB faulty	Check machine set-up Check free movement of arm Contact TECAN
2	Software problem Wrong string command	Refer to Software Manual Refer to Appendix 2
3	Software problem Wrong setup Wrong operand in string	Refer to Software Manual Check Machine Setup Check Appendix 2
4	Software problem	Refer to Software Manual
5	Non-implemented device CPU87 faulty	Correct program Contact TECAN
7	Device not initialized	Initialize the device via the keyboard (section 6.3.2)
8	Use of too many commands in one line	Refer to Software Manual
9	No liquid in the container or insufficient liquid Poni board faulty	Check container/add liquid Contact TECAN
10	Software problem	Refer to Software Manual
11	Not enough liquid in container to aspirate	Check liquid handling options in Layout
12	No liquid in the container or insufficient liquid Poni board faulty	Check container Contact TECAN
13	Same as #11 above	
16	Stemo board too hot Stemo board or CPU87 or Mother board fault	Check ambient temperature Contact TECAN Contact TECAN
17	One arm is not initialized One arm is in the other arm's range	Initialize both arms Move the arm out of the way by string commands

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6.5.2 Observed Errors and Corrective Actions

6.5.2.1 Probe tip misses target (tube, well, bottle, etc.) -

1. Check rack position on the work table and rack configuration.
2. Run X/Y/Z random test to see if the drive is losing steps.

6.5.2.2 Drops form on the end of the sampling tip -

1. Tighten the liquid system connections.

6.5.2.3 Tip does not detect liquid -

1. Check to see that an ionized liquid is handled.
2. Check to see that there is no gap between the bottom of the sample container and the surface of the work table or a suitable metal plate in contact with the work table.
3. Increase the liquid volume above 300ul (minimum for liquid detection).
4. If the problem persists, contact TECAN (possible Poni board fault).

6.5.2.4 Tip detects "air" as if it were liquid -

1. Poni board is too sensitive; contact TECAN.

6.5.2.5 Volume of dispensed liquid varies -

1. If foaming is observed in the dispensed liquid, increase the number of submerge steps in the Layout.
2. If air is observed in the liquid system, tighten the system connections.
3. If problem persists, contact TECAN (possible diluter fault or Poni board too sensitive, causing the tip to detect air)

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6.5.2.6 Poor test results

6.5.2.6.1 Large CV (coefficient of variation) -

1. Check for probe damage or bubbles (air) in the liquid system.

2. Verify that the liquid volumes used are not too small for the syringe size (refer to the TECAN Liquid Handling Manual).

3. Verify the acceptable performance of equipment other than the RSP (for example, a particle counter or photometer) and reagent involved in the test.

4. If the problem persists after making corrections as indicated in 1-3 above call TECAN.

6.5.2.6.2 Carryover of samples or reagents -

1. Check for probe damage or insufficient washing between liquids; if appropriate, replace needle and increase diluter volume in Layout.

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6.6 MAJOR CORRECTIVE MAINTENANCE

6.6.1 Introduction

The RSP is designed in a modular concept to permit skilled engineers or local TECAN representatives to remove individual modules for factory service by TECAN.
Major corrective maintenance should not be attempted by unauthorized personnel if the instrument is under warranty or if a maintenance agreement is in effect.

The following table lists the serviceable modules and the instrument panels which must be removed to gain access:

Module	Instrument Panels To Remove :
Liquid Connector Block	None
Insulation Block	None
CPU87, Stemo, Mother or Posu Boards	Board Access Cover
Arm	Top Cover and Front Panels
Poni/Alid Board	Top Cover and Front Panel
Diluter	Work Table and Front Panel
Valve Drive	Work Table and Front Panel
Board Cage	Top Cover, Work Table, and Front Panel
Transformer	Top Cover, Work Table, and Front Panel

CAUTION: ALWAYS DISCONNECT THE MAIN POWER SUPPLY CORD AND THE COMMUNICATIONS CABLE WHEN PREPARING TO REMOVE AND REPLACE INSTRUMENT PANELS AND MODULES.

Note: Do not remove either side panel from the instrument; contact TECAN if this becomes necessary.

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6.6.2 Removal/Replacement of Instrument Panels

6.6.2.1 Preliminary Steps

1. Assemble the following tools which are required to remove and replace RSP panels:

   1 knife or flat-blade instrument
   1 metric screwdriver no. 5
   1 metric screwdriver no. 0 (supplied by TECAN)
   1 metric set of allen screwdrivers (supplied by TECAN)

2. Disconnect the AC power cord and the communications cable. Proceed with steps 3-9, depending upon the area of the machine to which access is needed. Consult Figures 1-1 and 1-2 of the manual and the table in this section if in doubt:

3. Remove the probe tip to prevent damage during maintenance.

4. Remove all racks from the instrument work table.

5. Remove aspirating and/or pipetting tubing and tubing guide.

6. Remove insulation block.

7. Remove toothed rack.

8. Remove third valve (if installed on the front of the instrument).

9. Remove the three wash stations.

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6.6.2.2 Work table

1. Slowly move the two arms to the middle of the instrument (fast movement by hand can damage the Stemo Board).

2. Remove the five plastic caps and five screws which hold the work table in place.

3. Pull the work table 10cm toward the front.

4. Remove the washing stations by loosening the hexagonal screw in front of the washing station. Lift the washing station and remove the waste tubing by pushing it downward.

5. Lift the work table from the instrument.

6. When ready to replace the work table, make sure that the two arms are centered.

7. Place the work table on the instrument and mount the washing stations.

8. Push the work table to the back of the instrument and replace the five screws. Do not tighten until all five screws have been replaced.

9. Replace the plastic caps.

10. Re-check the reference positions for both arms (Racks, Implement, and Poseval commands, section 4) and run the Liquid Detector Checkout before returning the instrument to operation.

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6.6.2.3 Front Panel

1. Remove the hexagonal screw located on the right side while holding the panel stationary with the left hand.

2. Switch hands holding the panel and remove the left hexagonal screw.

3. Remove the front panel by pulling toward the front of the instrument.

4. When ready to replace, seat the panel in the proper position, hold stationary with the left hand and mount the hexagonal screw on the right side.

5. Switch hands holding the panel and mount the left hexagonal screw.

6.6.2.4 Top Cover

1. Remove the two allen screws on the left and right sides of the side panels.

2. Remove the allen screw on the back plate.

3. Remove the instrument top cover by lifting it away from the instrument.

4. When ready to replace the top cover, place it into position and mount the allen screw on the back plate. Do not tighten until all screws are in place.

5. Replace the two allen screws on the side panels and tighten all three screws.

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6.6.3 Removal/Replacement of Modules

6.6.3.1 Liquid Connector Block

1. Empty the liquid system.

2. Turn the instrument off, and disconnect the AC power cord and the communications cable.

3. Remove the pipetting tubing and unscrew the interconnecting tubing (refer to Figure 6-5).

4. Remove the screws holding the liquid connector block and pull the block free of its mounting.

5. To replace, seat the liquid connector block in place and mount and tighten the screws.

6. Reposition the interconnecting tubing and tighten the connections.

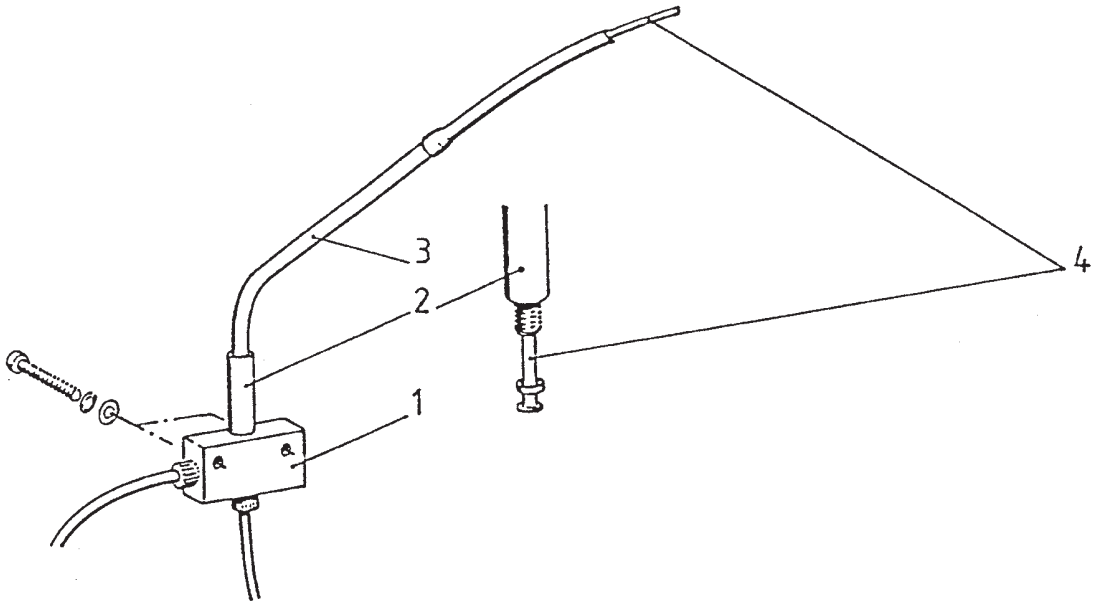
7. Install the pipetting tubing according to section 3.3.4 of this manual.

8. Reconnect the AC power cord, the communications cable, and turn on the sampler.

9. Fill the system with liquid and run the Random X/Y/Z test and Calibration Check before returning the instrument to operation.

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Figure 6-5 Removal/Replacement of the Liquid Connector Block



Legend:

1. Liquid Connector Block
2. Tubing Guide
3. Tubing Support
4. Pipetting Tubing

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6.6.3.2 Insulation Block

1. Remove the pipetting tubing (refer to section 3.3.4 of this manual).

2. Loosen the holder that attaches the liquid detector cable to the arm (refer to Figure 6-6). Disconnect the liquid detector cable at the metal connection on the arm.

3. Loosen (but do not remove) the allen screw that holds the insulation block onto the toothed rack.

4. Remove the insulation block.

5. To replace the insulation block, place it on the bottom of the toothed rack and tighten the allen screw.

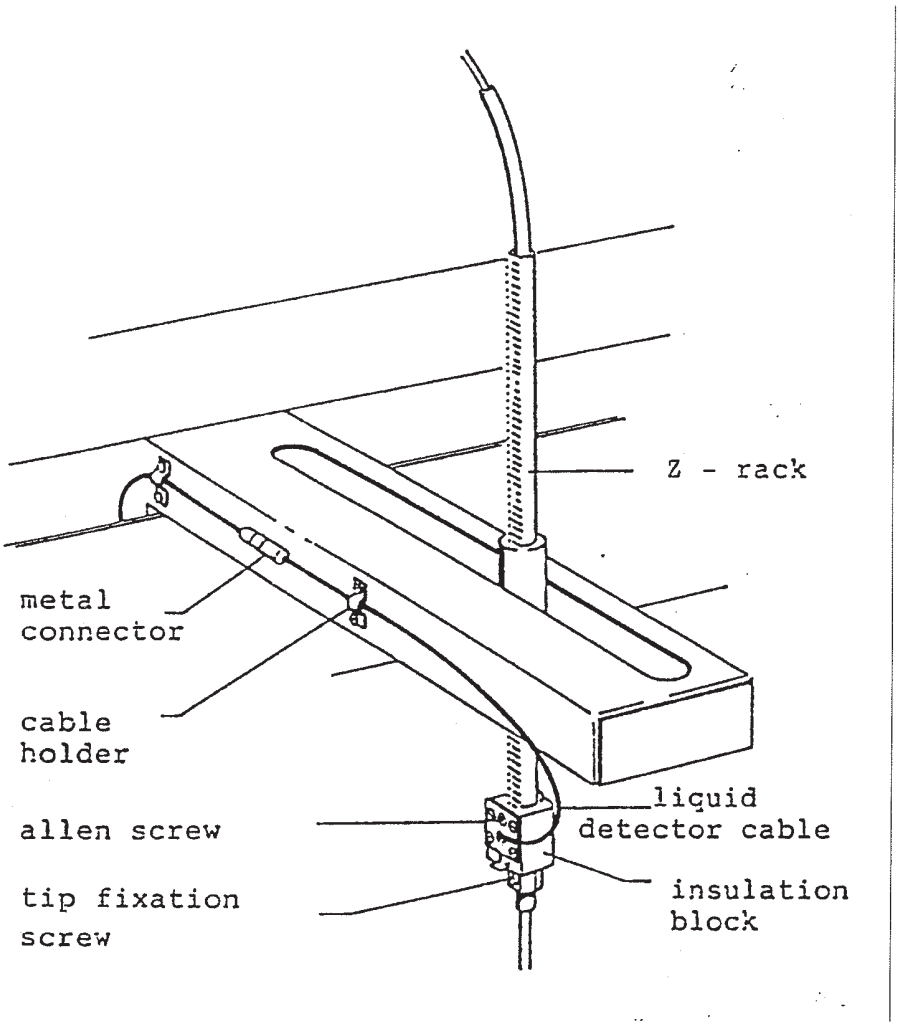
6. Connect the liquid detector cable and mount in the holder on the arm.

7. Replace the pipetting tubing according to section 3.3.4 of this manual.

8. Fill the system with liquid and run the Liquid Detector Checkout according to section 6.3.4 of this manual.

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Figure 6-6 Removal/Replacement of the Insulation Block



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6.6.3.3 CPU, Stemo, Mother, or Posu Boards

NOTE: Many RSP components are sensitive to static electricity. To minimize the possibility of damage during handling, always discharge any static electricity by touching a suitably grounded conductor.

1. Disconnect the AC cord and turn off the instrument.

2. Remove the board cage access cover on the left side of the instrument (refer to Figure 1-1 of this manual).

3. Carefully remove the defective board (refer to Figure 3-5 of this manual). If a CPU87 board must be replaced, first disconnect any flat cables.

4. Install the new board, making certain that the components face forward; reconnect the flat cables if a CPU87 board is being replaced. Push in firmly and check for proper seating.

5. Replace the board access cover and screws.

6. Reconnect the power supply and turn the instrument on. Initialize all devices from the keyboard. Fill the system with liquid and run the Liquid Detector Checkout and the Random X/Y/Z test. Operate all optional devices from the keyboard.

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6.6.3.4 Arm

NOTE: When replacing the arm, the arm must be moved manually. Move the arm gently to avoid damaging the Stemo board.

1. Remove the top cover and front panel. Slowly move the arm to be removed to the center of the sampler.
2. Disconnect the flat cable from the mother board.
3. Remove the front allen screws located on top of the arm and the two allen screws between the two bars of the X-slide (refer to Figure 6-7a).
4. Loosen but do not remove the single allen screw on the top of the arm near the back panel.
5. Slowly move the arm on the X-slide to the left just above the right hand side of the board cage.

NOTE: Do not push the arm to the left as this may damage the photosensor when removing the arm.

6. Remove the two allen screws that hold the flat cable holding bar (Figure 6-7b).
7. While holding the arm, remove the rear allen screw and lift off the arm.

NOTE: When removing an arm for repair by TECAN, be sure to return with it the associated Poni board and the flat cable.

8. To replace the arm, position the arm support on the left side just to the right hand side of the board cage.
9. Place the arm on the arm support and place the rear allen screw into position. Tighten.
10. Move the arm slowly to the center of the sampler.
11. Connect the flat cable to the mother board. Mount the flat cable holder bar.
12. Install the four remaining allen screws and tighten them. Do not over-tighten.

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13. Slowly slide the arm all the way to the left and make sure that the zero position flag for the X-movement fits into the slot of the photoelectric eye on the arm. If not, gently bend the flag into position.

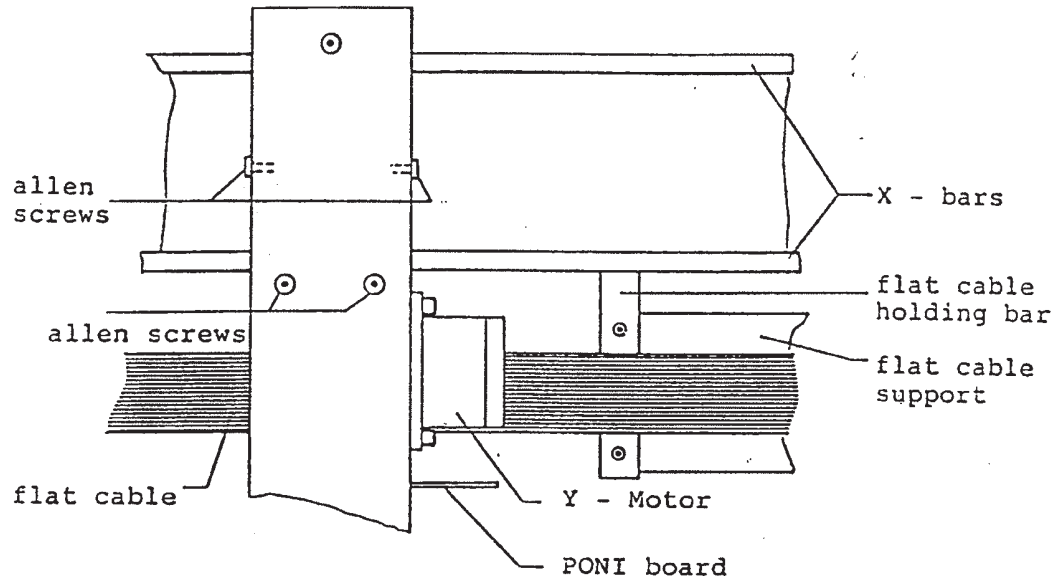
14. Slowly slide the arm all the way to the right and check that the flat cable does not become trapped.

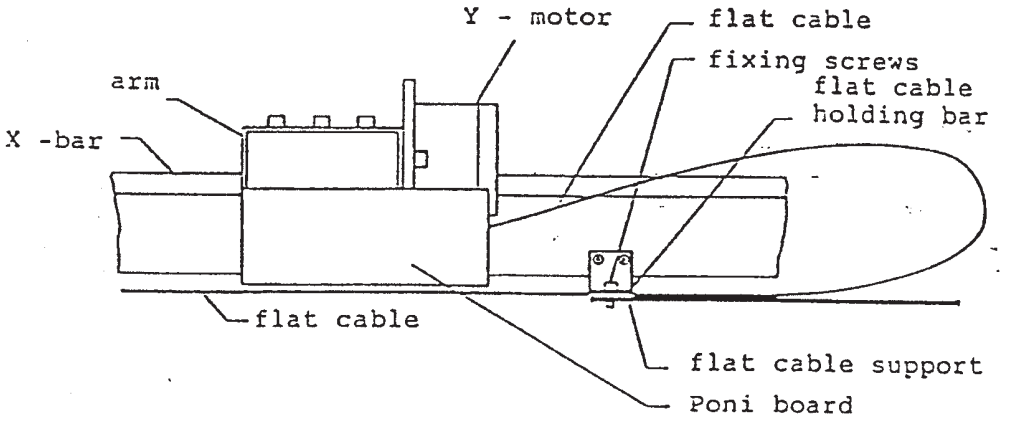
15. Replace the instrument panels; recheck the reference position and rack positions (which may slightly change), in that order. Refer to Racks, Implement and Poseval commands, section 4 of this manual.

16. Fill the system with liquid and run the Random X/Y/Z test and the Liquid Detector Checkout.

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Figure 6-7a & b Removal/Replacement of the Arm





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6.6.3.5 Poni/Alid Board

1. Remove the arm according to the previous section.

2. Disconnect the level detector cable from the side of the arm (refer to Figure 6-6).

3. Disconnect the flat cable and the two black motor plugs on the Poni board (refer to Figure 6-8).

4. Slide the Y-slide to the front position on the arm. Remove the two screws holding the Poni-Alid board.

5. Remove the board with the liquid sensor cable.

6. Replace the Poni/Alid board, connect the flat cable connector and black motor plugs on the Poni board.

7. Install the Poni/Alid board with the two screws. Carefully tighten.

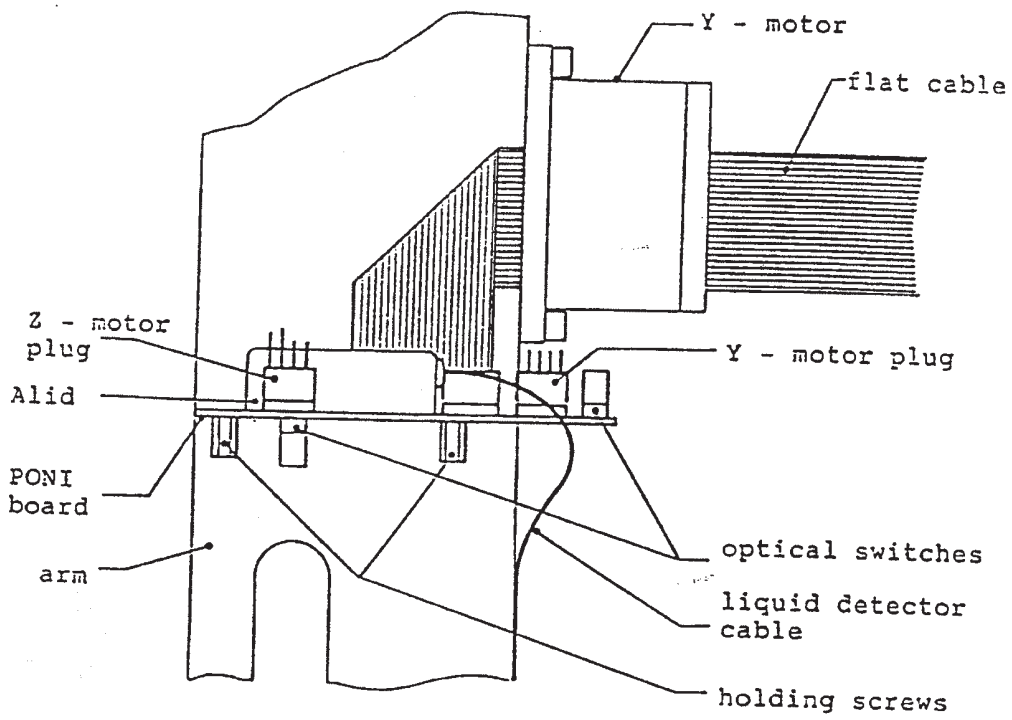
8. Carefully push the Y-slide toward the back of the arm and check to see if the zero position flag for the Y-movement fits into the slot of the optical switch on the Poni-Alid board. It the flag does not fit, bend it into position.

9. Attach the Alid cable to the arm with the cable holders.

10. Reattach the arm according to the instructions in the previous section, steps 8-16.

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Figure 6-8 Removal/Replacement of the Poni/Alid Board



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6.6.3.6 Diluters

1. Remove the work table and front panel according to section 6.6.2.

2. Remove the two screws holding the diluter mounting plate (refer to Figure 6-9a).

3. Holding the diluter with both hands, lift up and pull it out of the instrument. Place it on the instrument working area.

4. Disconnect the serial interface and the main power cable.

5. Turn the diluter upside down and loosen the four hexagonal screws that hold the diluter on the mounting plate (Figure 6-9b). Be careful not to damage the spacers on the hexagonal screws.

6. To replace a diluter, turn it upside down and place the mounting plate and four hexagonal screws and spacers into position. Take care not to damage the spacers.

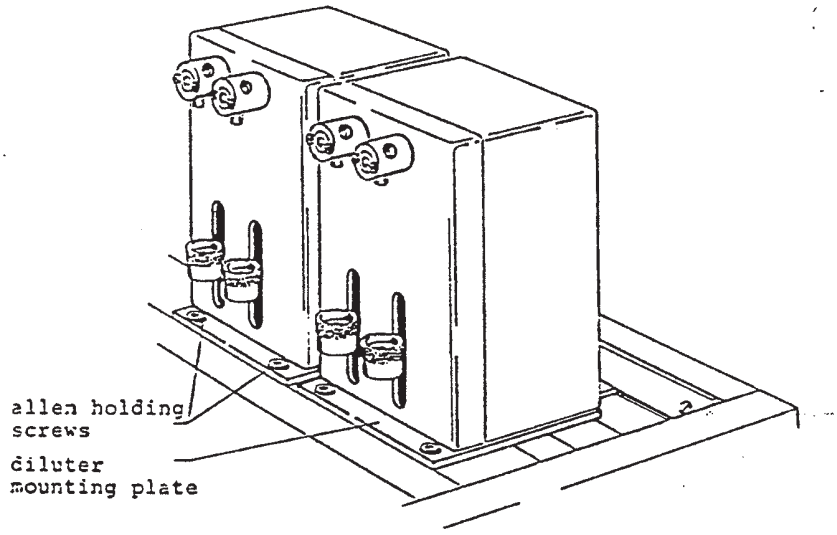
7. Place the diluter upright on the instrument working area and connect the serial interface and the main power cable. Make sure the switch on the diluter is in the "on" position.

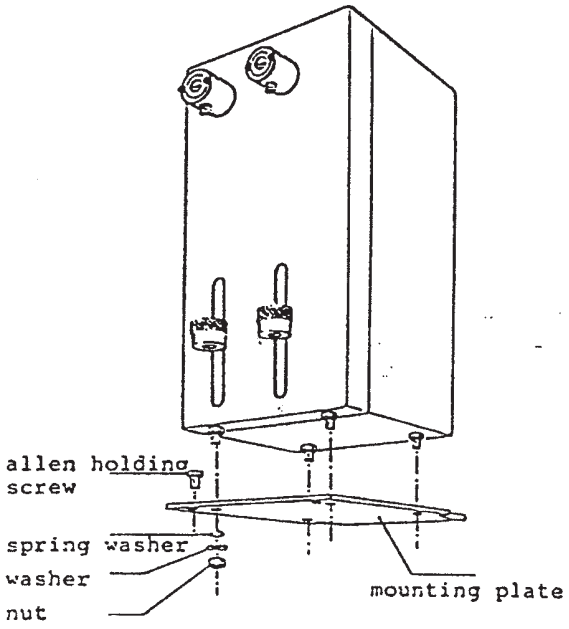
8. Replace the work table and front panel.

9. Perform the Calibration Check according to section 6.2.

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Figures 6-9a & b Replacement of the Diluters





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6.6.3.7 Valve drive

1. Remove the diluter according to the instructions in the previous section.

2. Place the diluter front side down and remove the 4 corner allen screws on the back panel of the instrument.

3. Lift the brown casing and disconnect the yellow-green grounding cable and the orange power plug (holds blue and brown wires). Remove the brown casing.

4. Disconnect the flat cable plug of the defective valve drive from the diluter mother board; the connections are marked with colored dots.

5. Loosen the two diagonally positioned allen screws which hold the valve drive. Carefully pull out the valve drive.

6. To replace, insure that the male/female connections of the valve drive are in the vertical position and are compatible.

7. Insert the new valve drive, making sure that it is oriented properly.

8. Tighten the two diagonal allen screws and connect the flat cable to the appropriate socket.

9. Place the brown casing over the four bars and connect the main power supply and grounding. Close the cover and return the four allen screws to the corners.

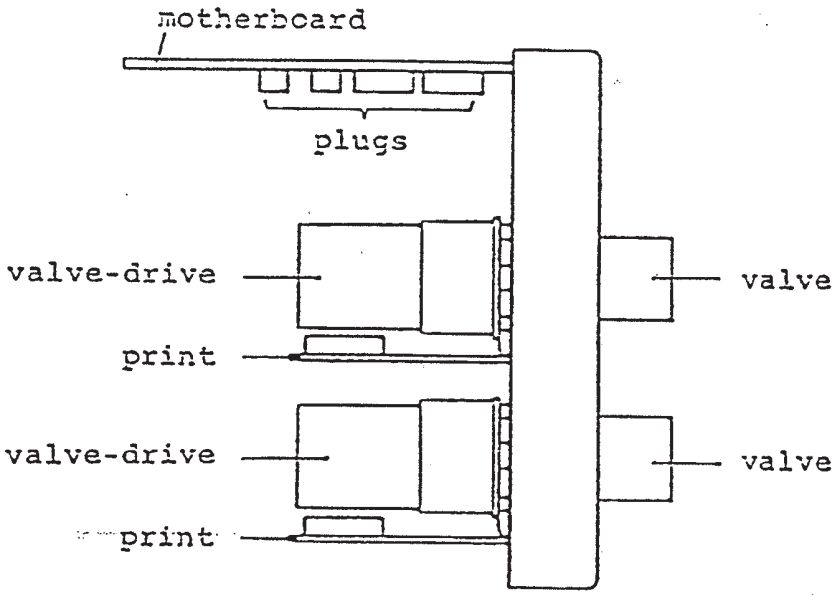
10. Mount the diluter mounting plate and complete the re-installation according to instructions in the previous section. Make sure the switch on the diluter is in the "on" position.

11. Connect the AC cord and turn on the instrument. Observe the valve drive for proper movement.

12. Initialize the valve drive by keyboard commands, then fill the liquid system and run the Random X/Y/Z test.

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Figure 6-10 Removal/Replacement of the Diluter Valve Drive



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6.6.3.8 Board Cage

1. Remove the top cover, the front panel, and the work table according the instructions in section 6.6.2.

2. Slowly slide both arms all the way to the right.

3. Remove all five boards from the board cage according to section 6.6.3.3 of this manual and disconnect the orange transformer plug from the inside of the mother board.

4. Disconnect the flat cables and the black X-motor plugs from the top of the mother board (refer to Figure 6-11).

5. Disconnect the ground cable from the frame by loosening the allen screw and pulling the cable.

6. Remove the two cables for the green pilot lamp from the cable holders.

7. Disconnect the two plugs of the diluter interconnecting cables at the bottom of the mother board (refer to Figure 6-11).

8. From the back of the instrument, and while holding the board cage, remove the four screws holding the board cage (Figure 6-5). The board cage can then be moved away from the instrument.

9. While holding the board cage in place, mount the four screws from the back of the instrument and tighten them.

10. Connect the flat cable, the black X-motor plugs and replace the cables for the green indicator lamp to the mother board.

11. Connect the ground cable to the frame by tightening the allen screw.

12. Connect the plugs of the diluter interconnecting cables at the bottom of the mother board.

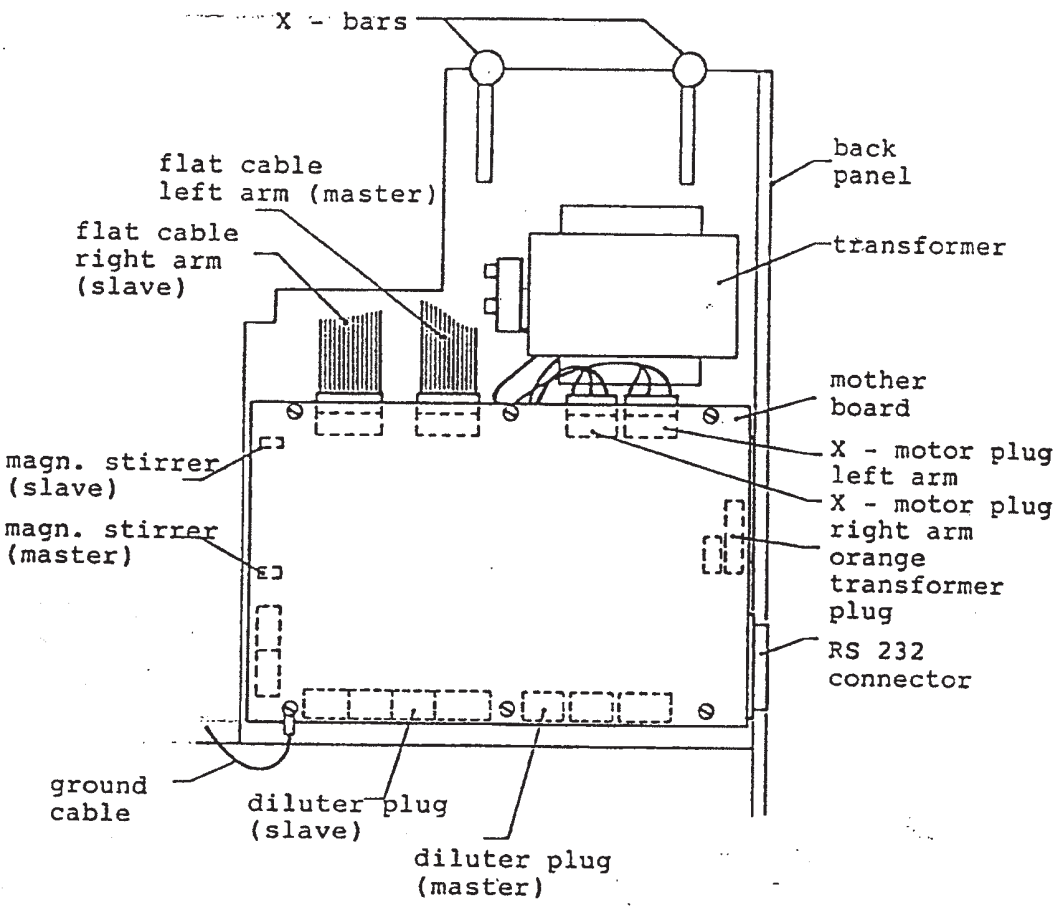
13. Connect the orange transformer plug at the inside of the mother board and insert all five boards into the board cage.

14. Replace the top cover, front panel and work table according the the instructions in section 6.6.2.

15. Connect the AC power supply and turn on the instrument. Fill the system with liquid and run the Random X/Y/Z test.

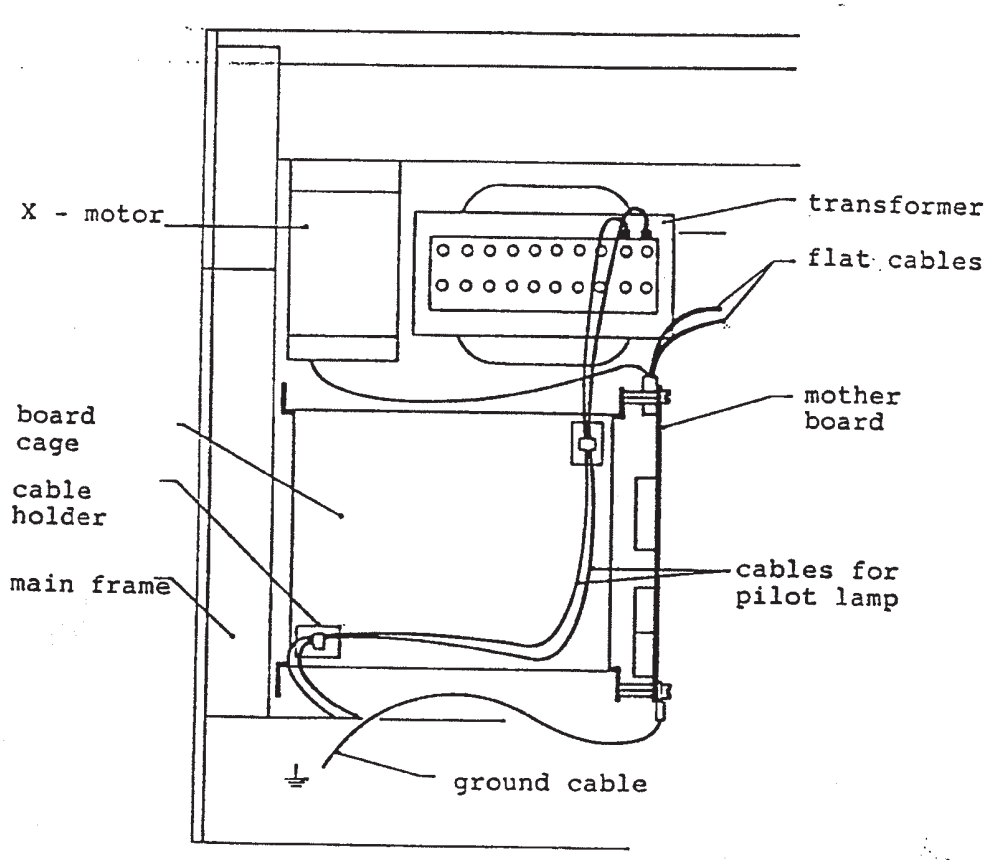
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Figure 6-11a Removal/Replacement of the Board Cage



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Figure 6-11b Removal/Replacement of the Board Cage



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6.6.3.9 Transformer

1. Remove the front panel, work table, and top cover according to section 6.6.2 of this manual.

2. Slowly slide the arms all the way to the right.

3. Remove the blue and brown cables from the transformer.

4. While holding the transformer, remove the four allen screws holding the transformer to the rear panel.

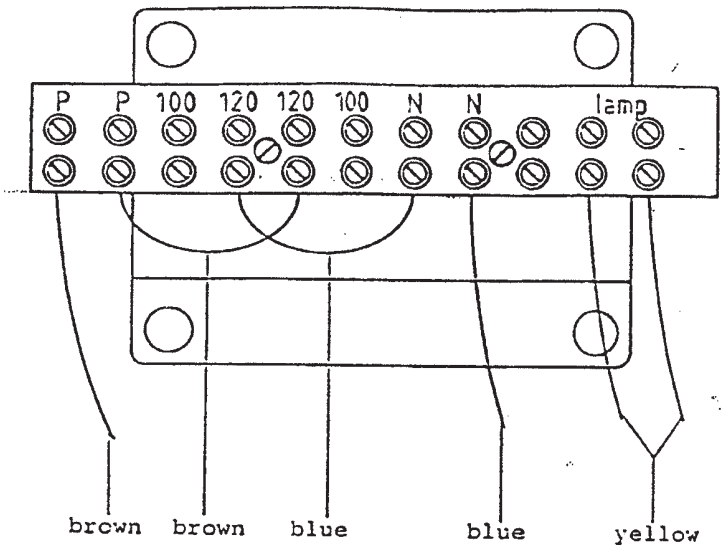
5. To replace, mount the transformer and the four allen screws.

6. Connect the blue and brown cables as shown in Figure 6-12.

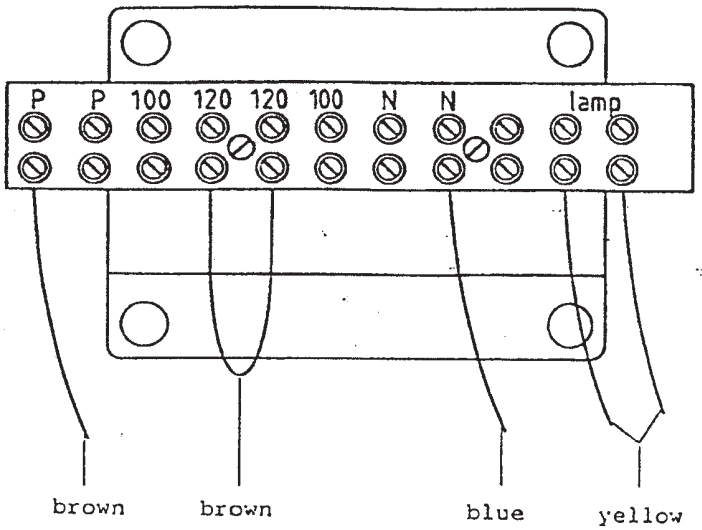
7. Replace the instrument covers; fill the system with liquid and run the Random X/Y/Z test and the Level Detector Checkout before returning the instrument to operation.

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Figure 6-12 Removal/Replacement of the Transformer



120 V



240 V

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6.6.3.10 Noise Filter and Main Power Connector

Removal:

1. Switch instrument off and disconnect power cord.

2. Remove the two Allen screws of the mainpower connector at the rear of the instrument.

3. Pull main power connector carefully out of instrument and disconnect the three cables from the its rear.

Mounting:

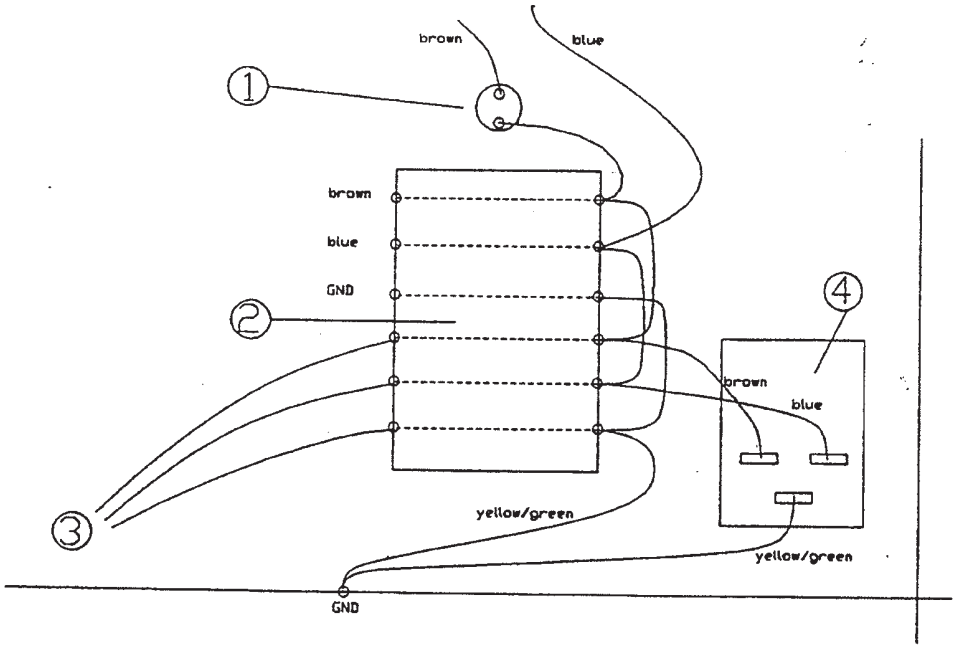
4. Connect the three cables to the noise filter in the proper sequence:

   - the green/yellow striped cable at lower pin;
   - the brown cable to the top left pin;
   - the blue cable to the top right pin.

5. Replace the main power connector; fill the system with liquid and run the Random X/Y/Z test before returning the instrument to operation.

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Figure 6-13 Removal/Replacement of the Noise Filter and Main Power Connector



Legend:

1. Transformer fuse
2. Line distributor
3. To Diluter
4. Main power connector with noise filter

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6.6.3.11 The Board Cage Fan

Note: This work should only be performed by qualified service personnel.

CAUTION: ALWAYS DISCONNECT THE MAIN POWER SUPPLY CORD AND THE COMMUNICATIONS CABLE WHEN PREPARING TO AND REPLACE INSTRUMENT PANELS ANDMODULES.

1. Remove the board cage, see RSP 5000 Manual chapter 6.

2. Remove the fan from the board cage.

To mount a new Cooling Fan:

3. Bolt fan onto distance studs using Allen screws M4 x 10 and spring washers.

Note: Airflow which is indicated on fan casing should be directed into board cage. Electrical connections of the fan should be on that side which is in front when the board cage is installed.

4. Connect the two cables for the fan to the terminals which are labeled LAMP on the transformer terminal strip, see attached sketch. These terminals have a voltage of 220 VAC independent of the line voltage.

Note: The same terminals contain the leads from the transformer. You must be positive that all four cables are securely tightened in the terminals to make sure they do not come loose and touch the board cage. When connecting the cables of the fan disregard polarity.

5. Re-install the board cage, make sure you connect all previously removed cables including optional equipment, if applicable. Hold the wiring for the fan in place using the supplied self adhesive cable binders. Reconnect the ground cable to the frame.

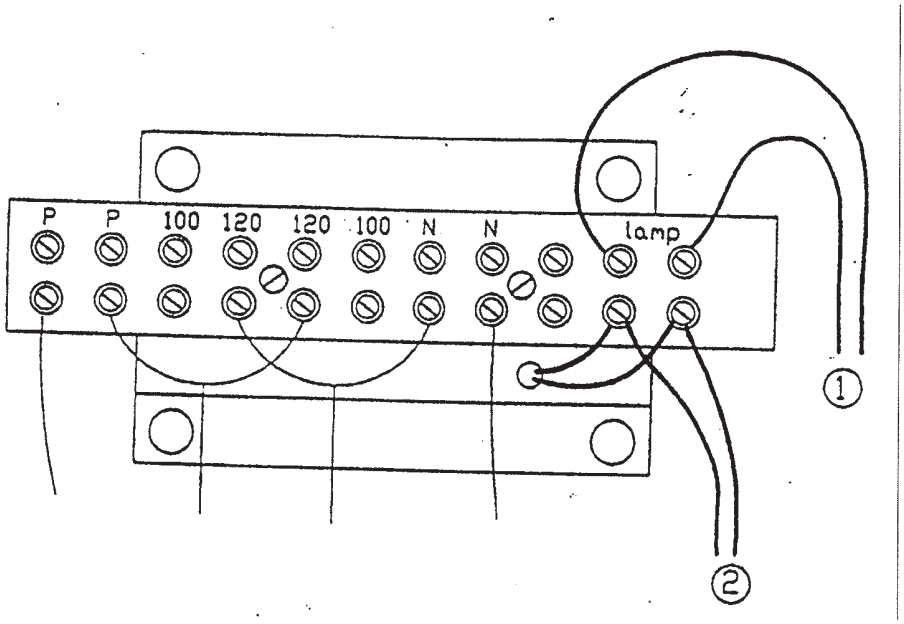
6. Install work table and front blind, switch on the RSP and check for the fan running.

7. Install boards in Board Cage (See Manual Chpt. 6.6.3.3)

8. Run the Random X/Y/Z-test

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Figure 6-14 Wiring for Cooling Fan



Legend:

1. Wires to Control Lamp
2. Wires to Cooling Fan

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