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SP100 Series

Microprocessor Controlled Syringe Pumps

INSTRUCTION MANUAL

Serial No._____

101812

www.wpiinc.com

World Precision Instruments

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Fig. 1—Two-Syringe Push-Pull Pump SP120p



Fig. 2—Two-Syringe Microdialysis Pump SP101i



Fig. 3—Single-Syringe Infusion Pump SP100i

ABOUT THIS MANUAL

The following symbols are used in this guide:



This symbol indicates a CAUTION. Cautions warn against actions that can cause damage to equipment. Please read these carefully.



This symbol indicates a WARNING. Warnings alert you to actions that can cause personal injury or pose a physical threat. Please read these carefully.

NOTES and TIPS contain helpful information.

INTRODUCTION

Operation of the pump is simplified by using a keypad to select features from a menu displayed on an alphanumeric LCD. All control functions are performed automatically by the pump microcontroller and are based on linear motion of the pusher block associated with the syringe size (diameter) to deliver a known volume. After entering the syringe diameter, either directly or from a table in memory, all calibration and control functions are performed by the pump automatically.

Features

The SP100 series pumps are simple, accurate, cost-effective syringe pumps designed to hold glass or plastic syringes, of any make, from 10µL to 60mL for the **SP100i**, 10µL to 15mL for the **SP120p**, and 10µL to 10mL for the **SP101i**.

The models **SP100i** and **SP101i** are infusion only pumps. The flow rates of the **SP101i** are six times slower than that of the **SP100i** and the units of flow rate are suitably adjusted. The **SP120p** is a push-pull simultaneous infusion/withdrawal pump.

Setup and pump operation for all of the **SP100** series pumps are similar and extremely simple. A menu, displayed on an alphanumeric LCD "prompts" you to make the necessary selections using the keypad for choice of features and numerical entries.

The **internal diameter of the syringe** is used by the control program to calibrate the pump and deliver the volume and flow rate selected. For simplicity, the syringe diameter is also used to set automatically the volume and flow rate units.

The syringe diameter can be **entered directly** or the syringe can be identified from a **table of syringes** held in memory. When the syringe is selected from the table the diameter is entered automatically.

Two dispense modes are available:

- **dispense volume mode** in which the pump keeps track of the volume dispensed and automatically stops the pump when a set target volume is reached.

- **run mode** where the pump runs at the set flow rate until manually stopped.

In the event of a **power interruption** during operation, the pump can be programmed to either resume operation or remain stopped when power is restored.

For convenience, all pump **settings are stored in non-volatile memory** to minimize the number of setting changes required.

Notes and Warnings

Please read the following safety precautions to ensure proper use of your syringe pump. To avoid potential hazards and product damage, use this product only as instructed in this manual. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

To Prevent Hazard or Injury

CAUTION: **Use Proper Power Supply –** The pump is supplied with an approved power supply and line cord. Use only the line cord shipped with the product and make sure line cord is certified for country of use.

CAUTION: **Ground the Product** – This product is grounded through the grounding conductor of the power cord. To avoid electric shock, use only approved line cord with the product and insure it is connected to earth ground.



Protective Ground Terminal

CAUTION: **Make Proper Connections** – Make sure all connections are made properly and securely.

CAUTION: **Orient Equipment Properly** – Do not position the equipment such that it is difficult to reach the disconnecting device.

CAUTION: **Observe all Terminal Ratings** – Review the operating manual to learn the ratings on all connections.

CAUTION: **Avoid Exposed Circuitry** – Do not touch any electronic circuitry inside of the product.

CAUTION: **Do Not Operate with Suspected Failures** – If damage is suspected on or to the product, do not operate the product. Contact qualified service personnel to perform inspection.

CAUTION: **Avoid Pinch Hazard** – A pinch hazard may exist between the Pusher Block and End Blocks. Avoid placing fingers between these points while the pump is running.

CAUTION: **Observe all Warning Labels on Product** – Read all labels on product to ensure proper usage.

NOTE: This pump is not registered with the FDA and is not for clinical use on human or veterinary patients. It is intended for research use only.

Unpacking

Upon receipt of this instrument, make a thorough inspection of the contents and check for possible damage. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed damage should be reported at once to the carrier and an inspection requested. Please read the section entitled "Claims and Returns" on page 15 of this manual. Please contact WPI Customer Service if any parts are missing at 941.371.1003 or customerservice@wpiinc.com.

Returns: Do not return any goods to WPI without obtaining prior approval (RMA # required) and instructions from WPI's Returns Department. Goods returned (unauthorized) by collect freight may be refused. If a return shipment is necessary, use the original container, if possible. If the original container is not available, use a suitable substitute that is rigid and of adequate size. Wrap the instrument in paper or plastic surrounded with at least 100mm (four inches) of shock absorbing material. For further details, please read the section entitled "Claims and Returns" on page 15 of this manual.

INSTRUMENT DESCRIPTION

Keypad Functions

↙ This key has two functions:

- Moves the display to the left.
- Causes the numerical entry to **decrease**. To change the displayed number by a single unit press and release the key quickly. If the key is pressed longer, the number changes with increasing speed.

↗ This key has two functions.

- Moves the display to the right.
- Causes the numerical entry to **increase**. To change the displayed number by a single unit press and release the key quickly. If the key is pressed longer, the number changes with increasing speed.

select This key has three functions:

- Return to main menu when pressed repeatedly.
- Selects the pulsing or "highlighted" feature of the main menu display.
- Enter numerical values.

run/stop This key has two functions:

- Turns the motor on and off.
- Acts as a "pause" during a dispense.

Display

After the pump is programmed, an **arrow** on the right side of the display indicates the **direction of operation**. This arrow pulses when the pump is running.

OPERATING INSTRUCTIONS

Power Switch

The power switch is located at the right, rear corner of the pump. When the power is turned on the LCD will display the Volume or Rate setting. Press the **select** key to return to the main menu.

Main Menu

Pressing **select** repeatedly will always return the display to the main menu. The main menu consists of five variables, three of which are displayed at all times. The center variable pulses to indicate that this option can be reviewed or changed. The menu acts as a continuous loop and the arrow keys ↙ ↗ are used to move around the loop. The variable to be changed can be selected with the **select** key.

←	→ **dia** ←	→ **table** ←	→ **rate** ←	→ **vol** ←	→ **pwr up** ←	→
	direct entry syr dia (mm)	syr dia. mfr, size	flow rate µL or mL/h	dispense vol µL or mL	run/stop	

Syringe Diameter Entry

For automatic internal calibration, the syringe diameter must be entered. Once entered the diameter is retained in .non-volatile memory and need not be entered again unless the syringe used is changed. When a syringe diameter is changed, the Volume and Rate settings are set to zero.

There are two methods of diameter entry.

- **Internal library –** Select **TABLE** from the main line menu. The table of syringes is organized by manufacturer, then by glass or plastic, and then by size. Use the arrow keys to scroll through the table and the select key to enter the correct setting. First, scroll through the manufacturers and select the manufacturer of the syringe used. The menu will next display either syringe type or syringe size. Again, use the arrow keys to move through the table until the correct size is displayed. Press the **select** key when the correct syringe size is displayed. This automatically enters the internal syringe diameter.

  See Table 1 on page 10 for the syringe library.

- **Direct entry –** From the main menu select **DIA.** The display will read "**xx.xx mm**". Use the **arrow** keys to display the measured internal diameter of the syringe in millimeters and enter with the **select** key.

  Changing the diameter clears the Volume and Rate settings, and the display will now prompt for the new Volume setting.

Volume Entry

The Volume setting mode is selected from the main menu or is displayed automatically after changing the diameter.

Display reads: **xx.xx µL** (Units µL or mL depend on syringe diameter entered.)

1. Use the **arrow** keys to enter the dispense volume required.
2. When the correct dispense volume is displayed, enter this number with the **select** key.

   NOTE: If no target dispense volume is required, enter volume = 0.0. The pump will run at the set flow rate until stopped manually or a stall occurs.
3. After setting a Volume the menu prompts for the flow rate setting.

   When the pump runs the actual dispensed volume will be displayed and will increment until the set volume is reached, at which time the pump will stop automatically.

Flow Rate Entry

RATE can be selected from the main menu or will be displayed automatically after the Volume setting.

The display reads: **Rate: X.X µL/h or X.X mL/h**

Rate units are µL/h or mL/h, microliter or milliliter/hour and are selected automatically from the syringe diameter.

1. Use the **arrow** keys to display the flow rate required.
2. Enter the rate with the **select** key.
3. If the rate entered is out of range, a message is displayed "Max Rate XX mL/h" To continue enter a lower rate or select a larger syringe.

   If a dispense volume was set, then the display will now change to "Volume : 0.0" (automatic dispense mode).

   When the pump runs, the actual dispensed volume is displayed and will increment until the set volume is reached, at which time the pump will stop automatically.

   If no dispense volume is set the LCD displays the set flow rate, and, when running, the directional indicator arrow pulses.

Starting the Pump

1. Press the **run/stop** key to start the pump. Press it again to stop the pump.
2. If the pump is stopped during a dispense, the volume accumulator is not cleared and the dispense is *paused*. Restarting the pump with a second press of the **run/stop** key continues the dispense to the target volume.

Power Failure Mode

If there is a temporary power interruption, when no dispense volume is selected, the **Power Up run/stop** option allows the pump to either resume the dispense when the power returns or remain stopped but display a message warning of the power failure.

1. Move the main menu to the right and select **PWR UP**.
2. The display reads **Power Up Run** (or **STOP**). Use the arrow keys to change display and select the required option.

   Run–After power is returned, the pump resumes normal operation. The display flashes **Power Failed** to acknowledge a power interruption. Press **Select** to display the Rate.

   STOP–Pump does not run when power returns. The LCD displays the rate setting.

If a dispense volume is entered, the power interruption stops the pump, clears the volume accumulator and returns the volume to the setpoint. The power failure warning is only displayed when the power failure setting is **Run**.

Change or Review Volume Setting While Running

While the pump is running it is possible to look at the volume and flow rate settings without interrupting the operation of the pump. If required, the volume and flow rate settings can be changed while the pump continues to run. When the changes are entered, the pump immediately changes to the new settings.

1. While operating, press **select** to return to the main menu.
2. Select **Volume** to display the set dispense volume. If no change is required press **select**.
3. For a volume change use the **arrow** keys and press the **select** key to enter the setting.
4. The display moves to **RATE**, permitting a change, if required. Press **select** if no change is required, or use the **arrow** keys to change the setting. The **select** key immediately changes to the new flow rate, and the volume display continues to increment, uninterrupted to the new dispense setting.

   NOTE: If the VOLUME is changed to a setting **smaller** than the volume already dispensed, then the pump stops when the new, smaller dispense volume is selected.

Change or Review Rate Setting While Running

1. Press **select** to change the volume accumulator display to the main menu.
2. Select **RATE**.

3. Make the rate changes (if required) and press **select**.

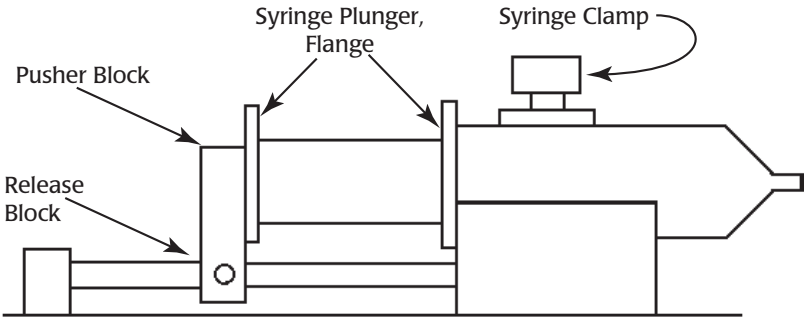
   The pump immediately changes to the new flow rate and the display shows the volume accumulation continuing, uninterrupted at the new rate.

Fast Forward

Press the **run** and the ↗ keys simultaneously to actuate the fast forward mode. The pump travels at its maximum rate while both keys are pressed. If one key is de-actuated the pump will stop and must be restarted with the **run** key.

Loading the Syringe

SP100i and SP101i Infusion Pumps

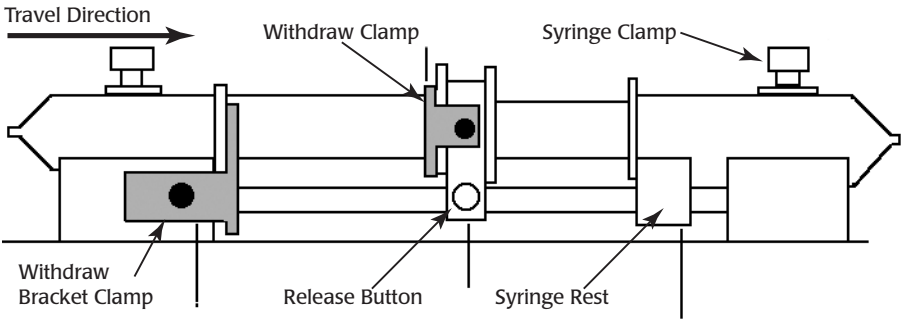


To facilitate loading, the pusher block can be released from the lead screw.

1. Press the bronze button and manually move the pusher block along the guide rods to accommodate the syringe.
2. Raise the spring-loaded retaining clamp and rotate it away from the syringe barrel.
3. Place the syringe barrel in the V of the syringe holder, making sure that the flange of the syringe barrel is pressed against the side of the syringe holder.
4. Rotate and release the syringe clamp to hold the syringe in place.
5. Depress the button and move the pusher block back along the guide rods to make contact with the syringe plunger.

Glass Syringes – With some glass syringes the corners of the flange of the syringe barrel are rounded and can cause a tendency for the syringe barrel to ride up out of the syringe holder. To give a more secure, flatter surface to clamp against, an O-ring or metal collar can be placed over the barrel and pressed against the flange.

SP120p Push-Pull Pump



To facilitate loading , the pusher block can be released from the leadscrew.

1. Press the bronze release button and manually move the pusher block along the guide rods to accommodate the syringes.
2. First place the withdraw syringe in the withdraw syringe holder, using the spring loaded retaining clamp to retain the syringe barrel in the V of the syringe holder.
3. Make sure the barrel flange is held firmly by the withdraw clamp and that the adjusting screws on the withdraw clamp are firmly tightened.
4. While keeping the button firmly depressed, slide the block along the guide rods so that the syringe plunger flange can be retained by the clamp on the pusher block. Tighten the locking screws on the adjusted syringe clamp.
5. Loosen the locking screw on the Adjustable syringe rest and position the rest so that the plunger of the loaded syringe is pressed firmly against the pusher block and the syringe barrel flange is pressed up to the syringe rest.
6. The barrel of the loaded, infusion syringe should be clamped in the V of the syringe holder with the spring loaded clamp.
7. Tighten the screw on the syringe rest to lock the rest in place on the guide rod.

Manual Stall Setting and Microliter Syringes

A movable collar located on the rear guide rod can be set to restrict travel of the pusher block. The block moves until stalling against the collar. Stalling does no permanent damage, but may result in increased wear on the drive mechanism and should not be used routinely. It is only a "fail-safe" action.

Microliter syringes with fine wire plungers can be damaged if the plunger is forced into the end of the syringe barrel. The collar can be adjusted to prevent this occurrence.

NV RAM Failure

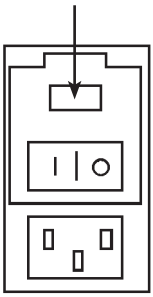
If the settings in the non-volatile memory become corrupted, the display will read "NV RAM Failure," and the pump will not operate.

To recover from this condition, the pump must be powered down and then turned on again. This re-initializes the pump to its default settings. After re-initialization, the pump can be programmed normally.

A second method of clearing the "NV Ram Failure" is to press **select** and then enter a new rate setting.

Fuses

The fuses are located in the power entry module on the rear panel. The line cord **must** be removed to gain access to the fuse holder.



Fuses 5x20mm, 250V~ slow blow, 0.1A

Voltage Selector (CE version only)

If it is necessary to change the input voltage selection:

1. Disconnect the line cord from the entry module on the rear panel.
2. Use a flat bladed screwdriver to open the Fuse Holder access door.
3. Remove the Fuse Holder, flip it over, and reinstall it.
4. Close the access door. The new input voltage selection should be visible through the door window.
5. Install a proper line cord certified for the country of use.

MAINTENANCE

Maintenance is required only for the moving mechanical parts which should be kept clean and lubricated. Occasionally, a little light machine oil should be applied to the guide rods and a little grease or oil to the lead screw.

Solvents of any type should never be used to clean the pump. A mild detergent solution may be used to clean the keypad.

Disposal

Do not dispose of this device with municipal waste — special collection/disposal is required. The instrument may be returned to WPI for proper recycling and disposal.



APPENDIX A: REFERENCE TABLES

Table 1: Syringe Diameters

Air-Tite "All Plastic"

1cc	4.70 mm
2.5	9.70
5.0	12.48
10	15.89
20	20.00
30	22.50
50	28.90

Becton Dickinson

Interim, WW design, Plastipak

1 cc	4.70 mm
3	8.59
5	11.99
10	14.48
20	19.05
30	21.59
60	26.60

Becton Dickson

Glass — all types

0.5 cc	4.64 mm
1	4.64
2.5	8.66
5	11.86
10	14.34
20	19.13
30	22.70
60	28.60

Hamilton

1000-Series Gastight

10 µL	0.46 mm
25	0.78
50	1.03
100	1.46
250	2.30
500	3.26
1 mL	4.61 mm
2.5	7.28
5	10.30
10	14.57
25	23.03
50	32.57

Ranfac

2 cc	9.12 mm
5	12.34
10	14.55
20	19.86
30	23.20
50	27.60

Scientific Glass Engineering SGE

25 µL	0.73 mm
50	1.03
100	1.46
250	2.30
500	3.26
1 mL	4.61mm
2.5	7.28
5	10.30
10	14.57

Sherwood - Monojet Plastic

1 cc	4.65 mm
3	0.94
6	12.70
12	15.90
20	20.40
35	23.80
50	26.60

Terumo

1 cc	4.73mm
3	9.00
5	13.04
10	15.79
20	20.18
30	23.36
60	29.45

Popper & Sons, Inc.	
Perfektum glass	
0.25	3.45 mm
0.5	3.45
1	4.50
2	8.92
3	8.99
5	11.70
10	14.70
20	19.58
30	22.70
50	29.00

Unimetrics	
Series 9000	
10 µL	0.46 mm
25	0.73
50	1.03
100	1.46
250	2.30
500	3.26
1000	4.61

Table 2: Standard Minimum & Maximum Flow Rates

SP100i and SP120p

Syringe size	Minimum	Maximum
10 µL	0.1 µL/h	126 µL/h
25 µL	0.1 µL/h	318 µL/h
50 µL	0.2 µL/h	625 µL/h
100 µL	1.0 µL/h	1274 µL/h
250 µL	2.0 µL/h	3164 µL/h
500 µL	3.0 µL/h	6359 µL/h
1 mL	0.01 mL/h	13.2 mL/h
2.5 mL	0.02 mL/h	31.7 mL/h
3 mL	0.02 mL/h	44.9 mL/h
5 mL	0.03 mL/h	87.0 mL/h
10 mL	0.1 mL/h	125 mL/h
20 mL	0.1 mL/h	219 mL/h
30 mL	0.1 mL/h	282 mL/h
60 mL	0.2 mL/h	426 mL/h

SP101i

Syringe size	Minimum	Maximum
10 µL	0.001 µL/m	0.382 µL/m
25 µL	0.001 µL/m	1.010 µL/m
50 µL	0.001 µL/m	1.762 µL/m
100 µL	0.001 µL/m	3.542 µL/m
250 µL	0.01 µL/m	8.78 µL/m
500 µL	0.01 µL/m	17.65 µL/m
1 mL	0.1 µL/m	35.2 µL/m
2.5 mL	0.1 µL/m	88.0 µL/m
3 mL	0.1 µL/m	122.5 µL/m
5 mL	0.1 µL/m	176.2 µL/m
10 mL	0.001 mL/m	0.351 mL/m
20 mL	0.001 mL/m	0.602 mL/m
30 mL	0.001 mL/m	0.773 mL/m
60 mL	0.001 mL/m	1.175 mL/m

NOTE: Syringes from different manufacturers can have slightly different limits.

SPECIFICATIONS

The 100 series pumps (including the **SP100i**, **SP101i** and **SP120p**) conform to the following specifications:

Syringe Size	10 µL to 60 mL
Electrical Rating	US model 115V~, 0.1A CE model 230V~, 0.06A
Fuse	5x20 mm, 250V~ slow blow, 0.1A
Voltage Operating Range	US model 100-120V~, 50/60Hz CE model 200-240V~,50/60Hz
Drive Mechanism	microprocessor-controlled stepper motor (½ microstepping), driving a leadscrew through a belt and pulley drive mechanism
Pusher Advance per Half Step	~0.529 micron or 2.083x10-5 inch (SP100i) ~0.088 micron (SP101i)
Linear Travel SP100i, SP120p SP101i	 min. 0.00635 cm/hr; max. 76.18 cm/hr min. 0.00106 cm/hr; max. 12.2 cm/hr
Minimum Stepping Rate	one half-step in 30 seconds – may vary depending on syringe size
Maximum Stepping Rate	400 half-steps/sec
Speed Range	12,000:1
Flow Rate Range	0.1 µL/hr (10 µL syringe) to 506 mL/hr (60 mL syringe)
Linear Force	20 lb min. (9 kg)
Dimensions	9 x 6 x 5 in. (23 x 15.25 x 13 cm)
Weight	4.5 lb (2 kg)
Atmospheric Specifications Temperature Humidity	 4°C to 40°C (40°F to 104°F) 20% to 80% RH, non-condensing
Mode of Operation	Continuous
Classification	Class I
Pollution Degree	2
Installation Category	II
Output	N/A
Physiological Effects	N/A
Cooling Conditions	No special considerations
Mechanical Stability	No special considerations
Protective Packaging	No special considerations
Earth Terminals	No External connections required
Removable Protective Means	N/A

DECLARATION OF CONFORMITY

WORLD PRECISION INSTRUMENTS, INC.
175 Sarasota Center Boulevard
Sarasota, FL 34240-9258 USA
Telephone: (941) 371-1003 Fax: (941) 377-5428
e-mail wpi@wpiinc.com

DECLARATION OF CONFORMITY

We: World Precision Instruments, Inc.
175 Sarasota Center Boulevard
Sarasota FL 34240-9258
USA

as the distributor of the apparatus listed, declare under sole responsibility that the product(s):

Title: SP100i Infusion Pump, SP101i Microdialysis Pump, SP120p Push-Pull Pump

to which this declaration relates is/are in conformity with the following standards or other normative documents:

Emissions/Immunity: EN 61326:1997 w/A1:1998 and A2:2001
EN 61000-4-2:1995
EN 61000-4-3:1995
EN 61000-4-4:1995
EN 61000-4-5:1995
EN 61000-4-6:1996
EN 61000-4-11:1994
EN 61000-3-2:2001 w/A.14
EN 61000-3-3:1995

Safety: EN61010-1, 2nd Edition (2001)

and therefore conform(s) with the protection requirements of Council Directives 89/336/EEC relating to electromagnetic compatibility and 73/23/EEC relating to safety.

Issued on: April 3, 2006

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WARRANTY

WPI (World Precision Instruments, Inc.) warrants to the original purchaser that this equipment, including its components and parts, shall be free from defects in material and workmanship for a period of 30 days* from the date of receipt. WPI's obligation under this warranty shall be limited to repair or replacement, at WPI's option, of the equipment or defective components or parts upon receipt thereof f.o.b. WPI, Sarasota, Florida U.S.A. Return of a repaired instrument shall be f.o.b. Sarasota.

The above warranty is contingent upon normal usage and does not cover products which have been modified without WPI's approval or which have been subjected to unusual physical or electrical stress or on which the original identification marks have been removed or altered. The above warranty will not apply if adjustment, repair or parts replacement is required because of accident, neglect, misuse, failure of electric power, air conditioning, humidity control, or causes other than normal and ordinary usage.

To the extent that any of its equipment is furnished by a manufacturer other than WPI, the foregoing warranty shall be applicable only to the extent of the warranty furnished by such other manufacturer. This warranty will not apply to appearance terms, such as knobs, handles, dials or the like.

WPI makes no warranty of any kind, express or implied or statutory, including without limitation any warranties of merchantability and/or fitness for a particular purpose. WPI shall not be liable for any damages, whether direct, indirect, special or consequential arising from a failure of this product to operate in the manner desired by the user. WPI shall not be liable for any damage to data or property that may be caused directly or indirectly by use of this product.

Claims and Returns

Inspect all shipments upon receipt. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed loss or damage should be reported at once to the carrier and an inspection requested. All claims for shortage or damage must be made within ten (10) days after receipt of shipment. Claims for lost shipments must be made within thirty (30) days of receipt of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim is settled. In some instances, photographic documentation may be required. Some items are time-sensitive; WPI assumes no extended warranty or any liability for use beyond the date specified on the container

Do not return any goods to us without obtaining prior approval and instructions from our Returns Department. Goods returned (unauthorized) by collect freight may be refused. Goods accepted for restocking will be exchanged or credited to your WPI account. Goods returned which were ordered by customers in error are subject to a 25% restocking charge. Equipment which was built as a special order cannot be returned.

Repairs

Contact our Customer Service Department for assistance in the repair of apparatus. Do not return goods until instructions have been received. Returned items must be securely packed to prevent further damage in transit. The Customer is responsible for paying shipping expenses, including adequate insurance on all items returned for repairs. Identification of the item(s) by model number, name, as well as complete description of the difficulties experienced should be written on the repair purchase order and on a tag attached to the item.

** Electrodes, batteries and other consumable parts are warranted for 30 days only from the date on which the customer receives these items.*

World Precision Instruments, Inc.

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