



FO-6000

---

*A color balanced tungsten light source for hand-held spectroscopy*

[www.wpiinc.com](http://www.wpiinc.com)

## **INSTRUCTION MANUAL**

Serial No. \_\_\_\_\_

082801

**World Precision Instruments**



## **Contents**

<b>General Warnings and Cautions .....</b>	<b>1</b>
<b>INTRODUCTION .....</b>	<b>2</b>
<b>INSTRUMENT DESCRIPTION .....</b>	<b>3</b>
Front and Side Panel .....	3
Side panel .....	3
Rear Panel .....	4
<b>OPERATING INSTRUCTIONS .....</b>	<b>9</b>
Operating Conditions .....	9
<b>INSTRUMENT MAINTENANCE .....</b>	<b>11</b>
Replacement of the tungsten lamp .....	11
Replacement Parts .....	12
<b>TROUBLESHOOTING .....</b>	<b>13</b>
<b>SPECIFICATIONS .....</b>	<b>14</b>
<b>WARRANTY .....</b>	<b>15</b>

*Copyright © 2001 by World Precision Instruments, Inc. All rights reserved. No part of this publication may be reproduced or translated into any language, in any form, without prior written permission of World Precision Instruments, Inc.*



## **General Warnings and Cautions**

Read this manual before you attempt to use this instrument



**WARNING:** Do not stare directly into the light beam emitted through the SMA connector. The light exiting the FO-6000 is very bright and may damage eyesight.

### **WARNING:**

- All warnings on the unit and in the operating instructions should be adhered to.
- All safety and operating instructions should be read before the unit is operated.
- Before using the instrument for the first time, check for shipping damage.

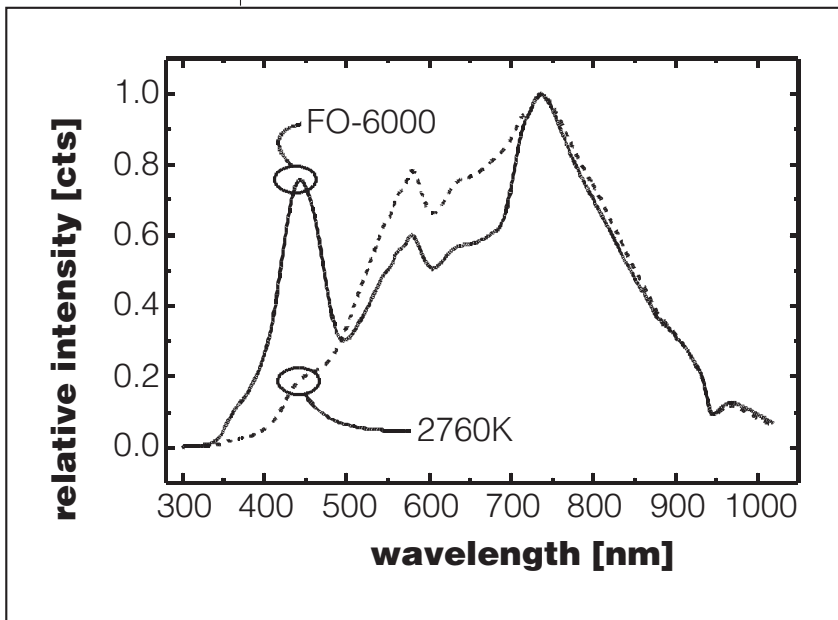
**WARNING:** In case of damage **DO NOT USE THIS INSTRUMENT** — call WPI Technical Support.

## INTRODUCTION

The miniature **FO-6000** tungsten light source has been developed for low-power spectroscopy applications that require precision and portability. The distinguishing features of the FO-6000 include its high light power output, its effective color temperature of 6000 K and its exceptionally low drift below 0.5 mAU/h. The FO-6000 is designed for low noise detectors (*e.g.*, photodiode arrays) and exhibits an exceptionally low signal to noise ratio. To meet portability demands, the instrument was designed for low power consumption, operating on a 12V DC power supply. Thus it is compact and lightweight. The FO-6000 is a complete VIS light source (380 nm – 1700 nm) with a tungsten lamp and a shutter, which can be operated via TTL external triggering. This light source is suitable for a wide range of field applications in environmental and life sciences.

A significant problem with tungsten lamps is their inherent low light output at wavelengths below 430 nm. The FO-6000 was developed to overcome this limitation. The light intensity of a conventional tungsten lamp (2760 K) drops below 10% at a wavelength of 420 nm. The light intensity of the FO-6000 does not drop below 10% until 365 nm. At 365 nm, the intensity of the tungsten lamp is at

approximately 2% relative light output. Typical light power intensities of the FO-6000 light output and a conventional tungsten lamp are shown in Fig. 1.

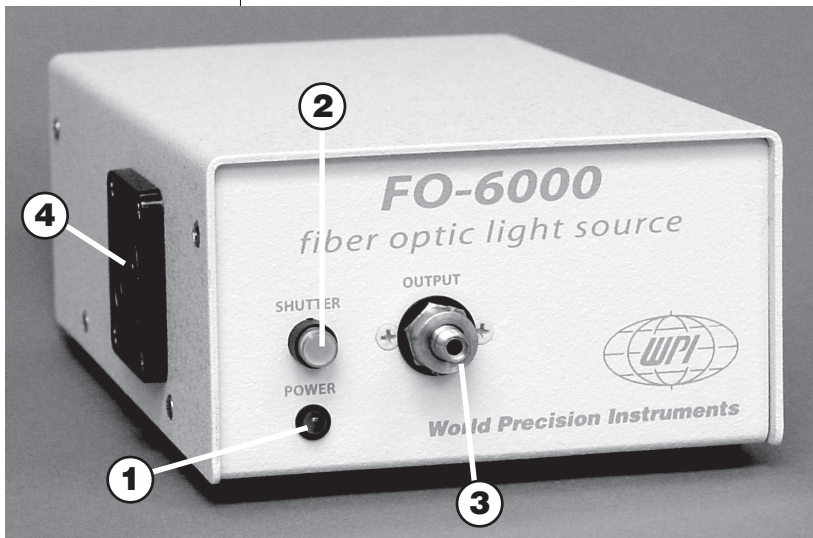


**Fig. 1: Relative intensities of the FO-6000's light output and a 2760 K tungsten lamp measured with a TIDAS II spectrophotometer**



## **INSTRUMENT DESCRIPTION**

### **Front and Side Panel**



**Fig. 2**

① **Power On LED Indicator Light.**

② **Lighted Shutter Push-button.**

Upon pressing the Shutter button, the button illuminates, the shutter opens and light exits the SMA fiber optic connector ③. Pressing the lighted Shutter button closes the shutter and extinguishes the light.

③ **SMA Fiber Optic Connector** (collimator) with adjacent mounting screws.

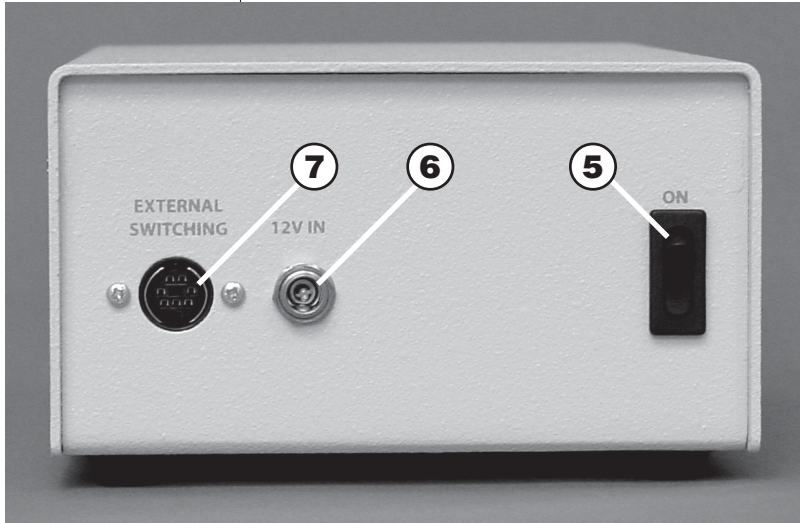
### **Side panel**

④ **Cooling Fan.**

The fan dissipates the heat generated by the tungsten lamp, thereby cooling it. To ensure proper ventilation, the unit should be situated away from walls or panels. Do not obstruct cooling fan openings.



## Rear Panel



### ⑤ Power Switch ON/OFF

When the power switch is turned ON, power is supplied to the unit. The tungsten lamp is switched on and starts to warm up. The Power ON LED indicator ① is lighted at this time.

### ⑥ Input terminal for 12V DC power.

The supply voltage for the FO-6000 is 12 V DC at 800 mA. The inner pin of the connector is +12 V DC, the outer ring is the ground (GND).

### ⑦ TTL Connection (7-pin sub-miniature DIN connector)

The TTL cable connection permits external control of the lamp shutter (HIGH = OPEN, LOW = CLOSE) and the light bulb (HIGH = ON, LOW = OFF, Default: ON).

## Set-up

### Parts List:

- FO-6000 light source
- 12 V DC power supply
- Allen wrench (for adjustment of SMA output and Color Balancing Filter)
- Allen wrench (for changing the lamp)
- This Instruction Manual

### Required but not provided:

- Medium-sized Philips head screwdriver to remove outer instrument housing during maintenance activities.



## **Unpacking**

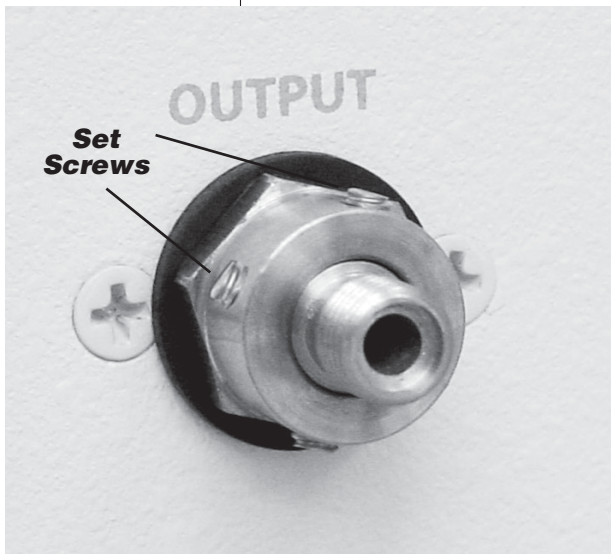
### **WARNING: In case of damage, DO NOT USE THE INSTRUMENT**

Unpack the power supply and light source carefully. Although the tungsten bulb is securely mounted, dropping this instrument can cause permanent damage.

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 loss or damage should be reported at once to the carrier and an inspection requested. Please read the section entitled "Claims and Returns" on the Warranty page of this manual. Please call WPI Customer Service if any parts are missing.

Returns: Do not return any goods to WPI without obtaining prior approval (RMA # required) and instructions from our Returns Department. Goods returned (unauthorized) by collect freight may be refused. If a return shipment is necessary, use the original container. 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 10 cm (4 inches) of shock absorbing material. Please read the section entitled "Claims and Returns" on the Warranty page of this manual.

**Fig. 4**

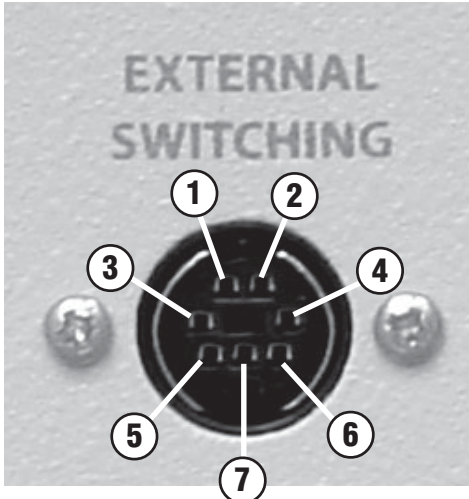


**CAUTION:** Avoid obstructing the airflow into and out of the unit. Leave a minimum of 2-3" (5-7 cm) space at each side of the light source.

**SMA Output:** Optimizing light throughput for different fiber core diameters.

The coupling efficiency of the FO-6000's fiber optic output (collimator) is dependent on the core diameter of the optical fiber used to deliver light to the sample cell. The FO-6000 is delivered pre-calibrated for a 400  $\mu\text{m}$  core diameter fiber. It is usually not necessary to adjust the light collimator. However, to obtain optimum results, the light output into the fiber can be further realigned.

Connect the appropriate optical fiber to the SMA output (collimator) of the FO-6000 and to the



**Fig. 5 — 7-pin sub-miniature DIN connector**

detection system (e.g., spectrometer) for your data analysis. Loosen the set screws (Fig. 4) on to the SMA output connector and slide the SMA connector in and out until maximum intensity is achieved. Be sure to tighten the set screws securely.

### **External Triggering**

The tungsten light bulb and the shutter can be controlled by a 5 V TTL signal at the 7-pin sub-miniature DIN connector located at the rear of the instrument (see Fig. 5). Either the internal or an external 5 V signal can be used.

PIN	1	2	3	4	5	6	7
Function	Shutter	Lamp	GND Signal	GND Power	12V DC	5V DC	5V DC





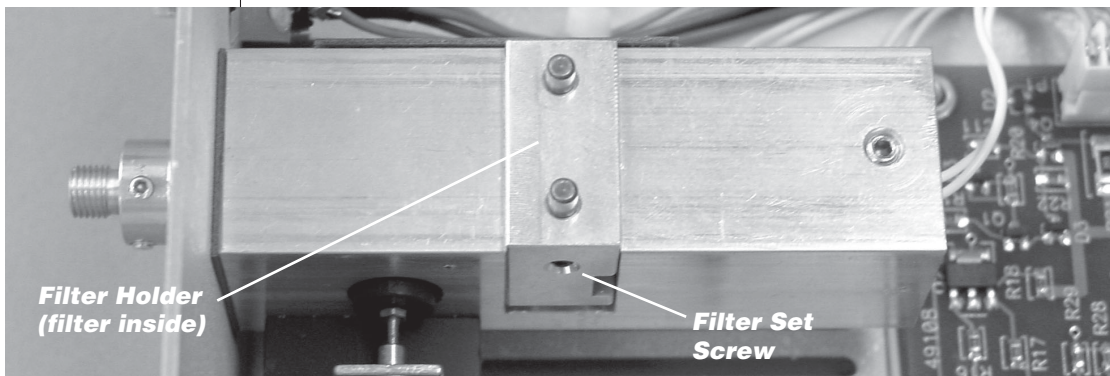
### **Adjustment of the Color Balancing Filter**

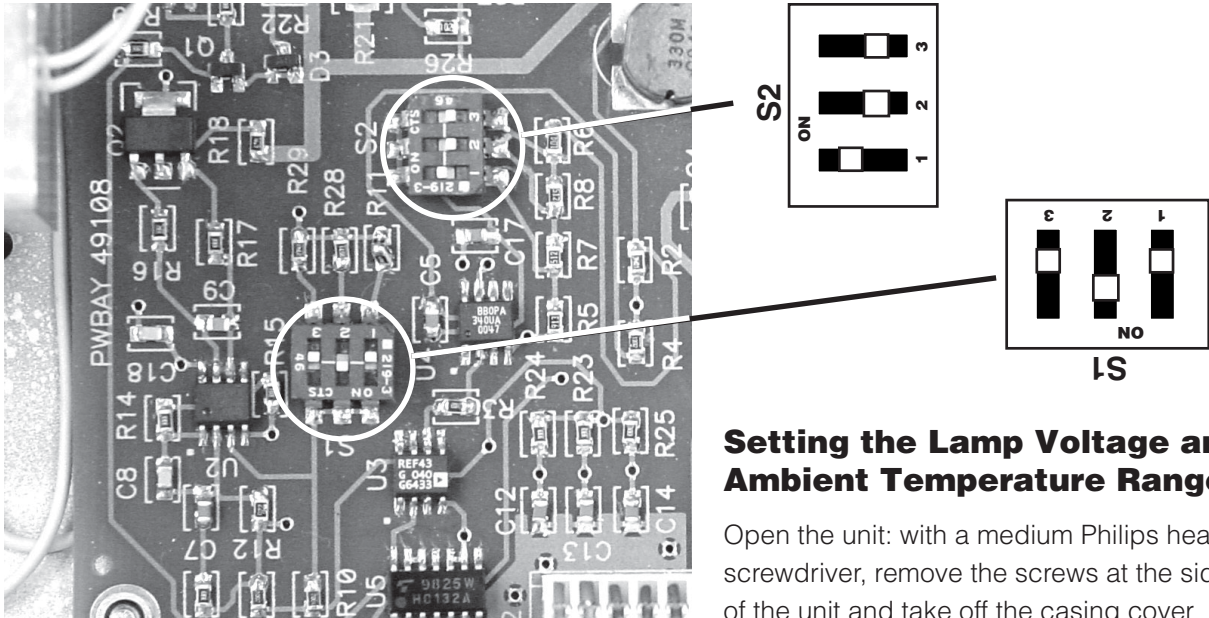
**Note:** The alignment of the filter is critical and the factory settings should only be modified if experimental conditions make it necessary.

The color temperature is pre-set at the factory to optimize light intensity levels in the 360 nm to 1000 nm range for a photodiode array spectrometer module. These settings can be modified. The effective color temperature of the FO-6000's light output is adjusted by sliding the filter holder in and out of the light path.

- 1.** Open the unit: with a medium Philips head screwdriver, remove the screws at the sides of the unit and take off the casing cover.
- 2.** Connect the appropriate optical fiber to the SMA output (collimator) of the FO-6000 and to the detector system (*e.g.*, spectrometer) for data analysis.
- 3.** Loosen the filter setscrews on both sides of the lamp block with the Allen wrench provided. See Fig. 6.
- 4.** Adjust the color balance by sliding the filter holder up and down until the output of the detector (spectrometer) shows optimum results (aligned).
- 5.** Tighten the setscrews to hold the filter in the desired position.

**Fig. 6**




**Fig. 7**

### Setting the Lamp Voltage and Ambient Temperature Range

Open the unit: with a medium Philips head screwdriver, remove the screws at the sides of the unit and take off the casing cover

#### Lamp Voltage

Light output power can be set internally to any one of three different light output power levels using the S2 switch.

Switch position (S2)	Light power [%]	Lifetime [h]
<b>1</b> (default)	100	3000
<b>2</b>	80	5000
<b>3</b>	60	10000

#### Ambient Temperature Range

The FO-6000 can be used in the temperature range of 15 °C to 35 °C. For special applications, this range can be adjusted by changing the settings of the S1 switch.

Switch position (S1)	Temp. Range [°C]
<b>1</b>	8 - 28
<b>2</b> (default)	15 - 35
<b>3</b>	22 - 42



## **OPERATING INSTRUCTIONS**



**WARNING:**

This lamp produces a collimated beam of visible light, which can be harmful to your eyes. Do not look into the light beam. This can cause permanent eye damage

**CAUTION:** This unit must be operated while in a horizontal position.

### **Operating Conditions**

- Use the unit in a clean laboratory environment.
- Moisture: The unit is designed for operation only in rooms with average or below average humidity.
- Ventilation: The unit should be situated so that its location or position does not interfere with its proper ventilation. Do not obstruct cooling fan openings.
- Heat: The unit should be situated away from radiators, ovens or other heat sources
- Power sources: The unit should be connected to a power supply only of the type described in the operating instructions or as marked on the unit.
- Object and liquid entry: Care should be taken that objects do not fall, or liquids spill, into the instrument through any of its openings

#### **1. Power on**

After connecting the FO-6000 to the power supply and the power supply to line voltage, turn on the power switch (5) at the back of the instrument. The lighted LED (1) indicates power on status.

**2. Connect a fiber optic cable** to the FO-6000 light output (3), Fig. 2.

#### **3. Tungsten lamp warm-up**



**WARNING: Do not look into the fiber optic connector.** This lamp produces a power visible light beam, which can be harmful to your eyes. Connect your fiber-optic cable before starting the light source.



The FO-6000 needs 20 to 30 minutes of warm-up time to reach a thermal equilibrium. During this time the intensity of the light output varies slightly. If applications require extreme intensity stability, the lamp should be warmed-up for an additional 15 minutes (a total of 45 minutes). After this time, the lamp will reach the specified drift values.

## INSTRUMENT MAINTENANCE

### Replacement of the tungsten lamp

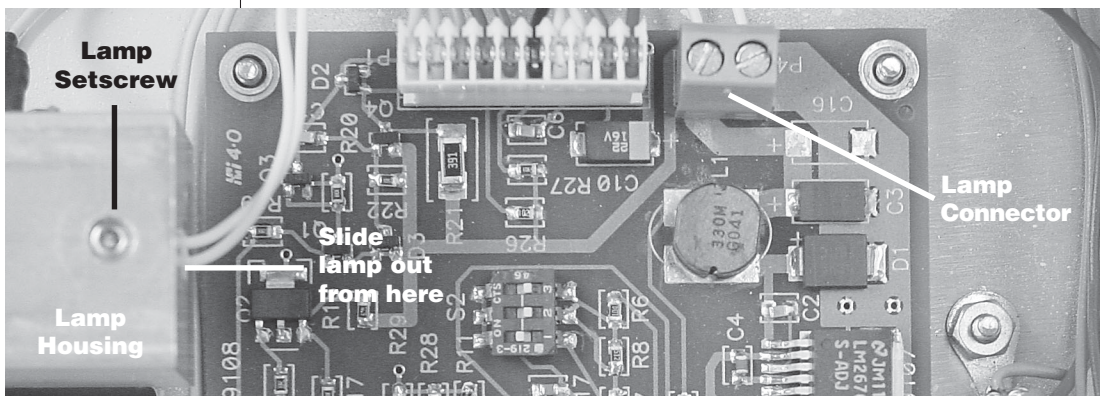
**WARNING:** disconnect the unit from the power supply before attempting to change the lamp.

**WARNING:** During operation the lamp and the lamp block reach very high temperatures. When you change the lamp after it has been in operation, wait at least 20 minutes for the lamp to cool before touching it. The lamp envelope (quartz glass) should not be touched with bare fingers, as this may decrease its lifetime.

**WARNING:** Use only the originally supplied tungsten lamp or its replacement. Use of other lamps may invalidate the warranty of the instrument.

1. Open the unit: with a medium Philips head screwdriver, remove the screws at the sides of the unit and take off the casing cover.
2. Remove the lamp setscrew using the Allen wrench provided (see Fig. 8).
3. Disconnect the lamp from the circuit board by loosening the clamping screws on the lamp connector (see Fig. 8). **Important:** Rotate the clamping screws counter-clockwise until a stop is reached or a clicking noise is heard. Remove the lamp wires from the connector and slide the defective tungsten lamp out of its housing.
4. Place the new tungsten lamp into the lamp housing. Gently tighten the lamp setscrew. Do not overtighten.
5. Insert the new lamp wires in the lamp connector. Tighten the clamping screws securely.

**Fig. 8**





### **Replacement Parts**

<b>WPI Part #</b>	<b>Description</b>
<b>800120</b>	Tungsten Lamp for FO-6000



## **TROUBLESHOOTING**

<b>Fault</b>	<b>Possible Cause</b>	<b>Remedy</b>
LED ① lights up but tungsten light does not work	Defective lamp	Replace tungsten lamp
	Shutter is closed	Open shutter by pressing ②
LED ① does not light up after the light source is switched on	External power supply defective.	Disconnect the unit from the power supply and contact Technical Support at WPI



## **SPECIFICATIONS**

Spectral Range .....	380 – 1100 nm
Equivalent Color Temperature .....	6000 K
Drift .....	<0.5 mAU/h (380 nm to 800 nm)
Input Requirements .....	12VDC regulated/ 1000 mA
Shutter .....	for Zero-adjustments
Functions .....	Lamp and shutter can be operated separately by a TTL signal
Fibers .....	up to 600 $\mu$ m core diameter
Power Consumption .....	approx. 6 Watts
Lifetime .....	3000– 10000 hours, dependent on internal power settings
Ambient Temperature Range .....	8°C to 28°C
(selectable)	15°C to 35°C
	22°C to 42°C
Dimensions .....	170 x 72 x 65 mm
Weight .....	400 g

### **Versions**

The FO-6000 is delivered with a 12 VDC power supply. Specify country/plug when ordering the instrument.

<b>WPI Part #</b>	<b>Description</b>
<b>FO-6000-Y</b>	Tungsten Light Source (120V, US plug)
<b>FO-6000-Z</b>	Tungsten Light Source (240V, Euro plug)
<b>FO-6000-B</b>	Tungsten Light Source (240V, UK plug)





www.wpiinc.com

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

## 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 one year\* 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 10 days after receipt of shipment. Claims for lost shipments must be made within 30 days of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim settles. 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.
- WPI cannot be held responsible for items damaged in shipment en route to us. Please enclose merchandise in its original shipping container to avoid damage from handling. We recommend that you insure merchandise when shipping. The customer is responsible for paying shipping expenses including adequate insurance on all items returned.
- Do not return any goods to WPI without obtaining prior approval and instructions (RMA#) from our returns department. Goods returned unauthorized or by collect freight may be refused. The RMA# must be clearly displayed on the outside of the box, or the package will not be accepted. Please contact the RMA department for a request form.
- Goods returned for repair must be reasonably clean and free of hazardous materials.
- A handling fee is charged for goods returned for exchange or credit. This fee may add up to 25% of the sale price depending on the condition of the item. Goods ordered in error are also subject to the handling fee.
- Equipment which was built as a special order cannot be returned.
- Always refer to the RMA# when contacting WPI to obtain a status of your returned item.
- For any other issues regarding a claim or return, please contact the RMA department

**Warning: This equipment is not designed or intended for use on humans.**

## World Precision Instruments, Inc.

International Trade Center, 175 Sarasota Center Blvd., Sarasota FL 34240-9258

Tel: 941-371-1003 • Fax: 941-377-5428 • E-mail: sales@wpiinc.com

**UK:** Astonbury Farm Business Centre • Aston, Stevenage, Hertfordshire SG2 7EG • Tel: 01438-880025 • Fax: 01438-880026 • E-mail: wpiuk@wpi-europe.com  
**Germany:** Liegnitzer Str. 15, D-10999 Berlin • Tel: 030-6188845 • Fax: 030-6188670 • E-mail: wpide@wpi-europe.com