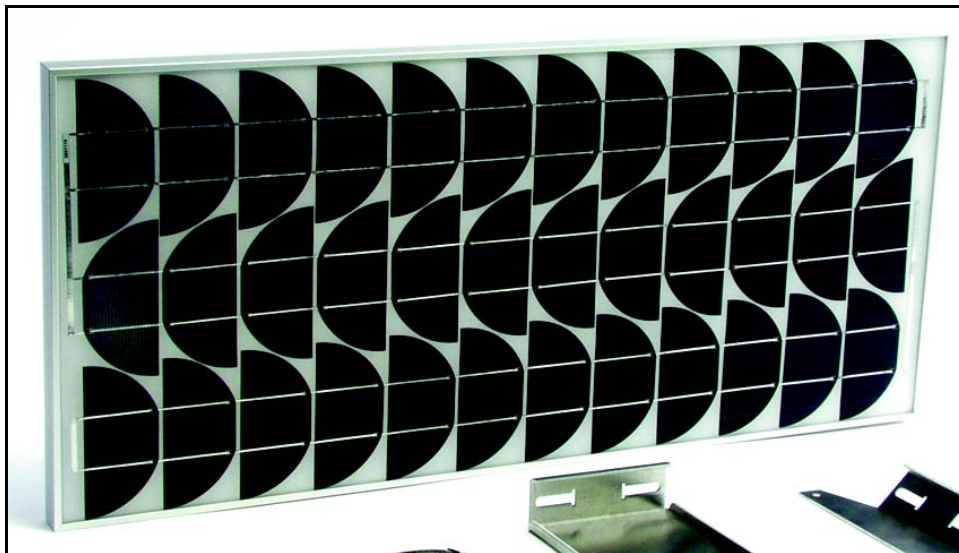


# Isco Solar Panel

## Installation and Operation Guide



Part #60-3003-269  
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Revision M, April 15, 2011



## Foreword

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Teledyne Isco recommends that you read this manual completely before placing the equipment in service.

Although Teledyne Isco designs reliability into all equipment, there is always the possibility of a malfunction. This manual may help in diagnosing and repairing the malfunction.

If the problem persists, call or e-mail the Teledyne Isco Technical Service Department for assistance. Simple difficulties can often be diagnosed over the phone.

If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by the Customer Service Department, including the use of the **Return Authorization Number** specified. **Be sure to include a note describing the malfunction.** This will aid in the prompt repair and return of the equipment.

Teledyne Isco welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

**Teledyne Isco is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.**

## Contact Information

### *Customer Service*

Phone: (800) 228-4373 (USA, Canada, Mexico)  
(402) 464-0231 (Outside North America)  
Fax: (402) 465-3022  
Email: IscoCSR@teledyne.com

### *Technical Support*

Phone: (800) 775-2965 (Analytical)  
(866) 298-6174 (Samplers and Flow Meters)  
Email: IscoService@teledyne.com

Return equipment to: 4700 Superior Street, Lincoln, NE 68504-1398

### *Other Correspondence*

Mail to: P.O. Box 82531, Lincoln, NE 68501-2531  
Email: IscoInfo@teledyne.com  
Web site: www.isco.com



# Isco Solar Panel

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# Isco Solar Panel

## 1.1 Introduction

This manual provides installation and operation instructions for the Isco Solar Panel, including information about battery capacity, maintenance, and replacement parts and accessories.



Figure 1-1 Isco solar panel (40W model shown)

## 1.2 Product Description

The Isco Solar Panel is used to charge an Isco 12-volt lead acid battery or user-supplied deep-cycle lead-acid battery powering an Isco portable sampler or flow meter. The Solar Panel allows the sampler or flow meter to be powered continuously for an extended period of time under normal sunlight conditions.

Table 1-1 lists the technical specifications for the Solar Panel.

Table 1-1 Solar Panel Technical Specifications			
Item	Specification		
Approximate weight, excluding mounting bracket:	10W	6.8 lb	
	40W	12.5 lb	
	110W	30.0 lb	
Approximate dimensions in inches, excluding mounting bracket <sup>1</sup> :		H	W
	10W	18.0	11.5
	40W	38.30	17.16
	110W	56.50	25.50
Operating Temperature Range:	0° to 140° F (-17° to 60° C)		
Storage Temperature Range:	-40° to 140° F (-40° to 60° C)		
Output in full sunlight:	10W	600mA @ 16.7 VDC	
	40W	2.4A @ 16.7 VDC	
	110W	6.43A @ 17.10 VDC	
1. Physical dimensions may vary slightly, depending on the exact power output. Dimensions subject to change without notification.			

The 10W panel is connected to the battery with a 25 ft. (7.6 m) 18 AWG cable. This cable is fitted with three connectors: a 4-pin plastic connector that mates with the connector mounted on the panel's regulator; a 2-pin M/S (Military Spec) connector that mates with the connector on the battery; a 2-pin M/S connector to connect the sampler or flow meter. The connectors are keyed to prevent mis-mated connections. Figure 1-2 shows the 10W panel and connect cable. A 25 ft. (7.6 m) extension cable is available to extend the distance between the panel and the battery.

NOTE: This cable is for the 10W model solar panel only.

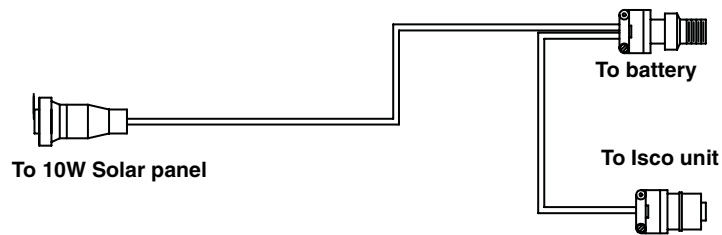


Figure 1-2 10-Watt solar panel battery cable

The 40W and 110W solar panels connect using an 8-foot cable with  $\frac{5}{16}$ " eyelet terminals for direct connection to an external 12VDC lead-acid battery.

**CAUTION**

The Isco Solar Panel is intended for charging lead-acid batteries only. Never attempt to use it with a Ni-Cad battery.

### 1.3 Applications

The Solar Panel is compatible with other equipment configurations used in runoff studies. Isco flow meters, loggers, modules, and liquid level actuators, can be configured together with Isco samplers to provide flow-paced sampling triggered by liquid level.

The Isco Solar Panel, used in conjunction with a lead-acid battery, provides a power system that can be used to power 12VDC equipment located at sites where it is impractical to connect the equipment to 120VAC power. Trips to the site solely for the purpose of changing batteries can be eliminated.

In all applications, the amount of current required varies according to the equipment used and the amount of power provided by a panel varies with the season, climate, and geographical location. In many applications a 10-watt panel will provide sufficient power; other applications may require the output of the 40 or 110-watt panel. Refer to Section 1.6 for a discussion of current requirements.

Sampler sites must be visited regularly to retrieve the samples. The sampler's battery, if discharged, can be replaced with a fully charged battery at the time the samples are collected. However, in cases where the activating events are infrequent, the panel



may have sufficient time to recharge a battery. Refer to Sections 1.7 and 1.8 for a discussion of battery capacity, remaining charge, and recharge periods.

There are many applications for which the Isco Solar Panel is ideally suited, including:

**1.3.1 Deep-Cycle Battery Charging**

The 40- or 110-watt Solar Panel is suitable for continually charging a user-supplied deep-cycle battery (100AH optimal) for sites requiring more power.

**1.3.2 Low-Current Applications**

The 10-watt Solar Panel system can continuously power equipment with relatively low current requirements, such as Isco flow meters. Isco units with options included will have higher current requirements. Contact the factory for more information.

**1.3.3 Standby Power**

The 10-watt Solar Panel can be used to maintain the charge on a battery until an event occurs which activates the associated equipment. For example, runoff or overflow studies require that the equipment be held inactive until rainfall or another event raises the level of the flow stream to a predetermined level. Once the event activates the sampler, the battery provides the power needed to complete the sampling program.

An Isco sampler used with a Liquid Level Actuator, for example, requires little current until the Actuator detects the change in liquid level and activates the sampler. The solar panel can maintain the charge on the sampler's battery until the event occurs, so that the battery will have sufficient capacity to complete the sample program (100AH optimal). Expect to service the battery upon completion of the sample program.

**1.3.4 Remote Power**

The Solar Panel is also suitable for use with Isco equipment that requires remote location of a lead acid battery.

**1.4 Mounting the Solar Panel**

The panel is fitted with an aluminum frame suitable for mounting on a flat surface or a pole. Mounting holes are provided for attaching the panel to a flat surface. Slots provided on the frame can be used to secure the panel to a pole using hose clamps. The pipe's outer diameter is determined by the bracket supplied.

**1.4.1 Mounting Surface Considerations**

The mounting surface should be in an unshaded location within reach of the sampler or flow meter. To take full advantage of the sun, the location must not be shaded between 9:00 a.m. and 3:00 p.m. on the shortest day of the year: December 21 in the Northern Hemisphere and June 21 in the Southern Hemisphere. The panel must be placed so that it faces true south in the Northern Hemisphere and true north in the Southern Hemisphere. (True north and south are not usually identical to magnetic north or south; true north and magnetic north can vary by as much as 22.4 degrees, depending on the site.)

The mounting surface must be solid and able to support the wind load transferred to it by the panel to prevent the panel from being damaged or from shifting out of alignment. Suggested sur-

faces are telephone or power poles, exterior walls, or roofs. When mounting the panel, take care not to bend the panel. The solar module is constructed of thin films of photo voltaic material coating an impact-resistant glass panel. The glass surface is still vulnerable to hard impact, such as rocks or tools. Fractures to the glass panel are not repairable and can disable the unit. Do not concentrate light on the panel to attempt to increase its output.

#### 1.4.2 Correct Angle of Rotation

The angle of the mounted panel is generally fixed at 45 degrees. However, if your setup allows for angle adjustment, the following section may be helpful in obtaining the maximum year-round benefit from the sunlight. Because the amount of sun available to a panel falls to a minimum in midwinter, the panel should be positioned to take full advantage of the minimal sun.

The angle of rotation varies with the latitude. To determine the correct angle of rotation, measured from horizontal, refer to Figures 1-3 and 1-4. The degrees of latitude are marked on the left side of the map; the angle of installation for each marked latitude is noted on the right side. For example, if the panel is to be mounted in latitude of 45°, the panel should be tilted at 55° from horizontal. Users with installations between two marked latitude lines must interpolate to obtain an angle of rotation.

 <b>Note</b>
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Alaskan installations should use an installation angle of 80° from horizontal. Hawaiian installations should use an installation angle of 25°.

If the panels cannot be cleaned regularly, it is recommended that angles of no less than 15° be used in order to maximize cleansing by rainfall. It may be necessary to adjust the panel to a slightly lesser angle in summer and a greater angle in winter.

#### 1.5 Amount of Current Produced

The amount of current produced by a panel varies with the amount of full sun available to the panel. In turn, the amount of full sun varies with the climate and latitude of the installation as well as the time of year. The maps shown in Figures 1-3 and 1-4 show the variations in output and are provided to assist in determining the output of a single panel. The heavy lines in both maps mark a continuous line of sites which will produce the output in milliamps indicated at the end of each heavy line. Users with installations that do not fall on a line of either map must interpolate to determine the mean milliamp-hours for their installation site.

By comparing the maps, you will note that the output lines vary from map to map. Installations can be divided into two categories according to the amount of sun available. Installations used year-round must have enough panels to provide power in midwinter, the period of the year with the least amount of sun available. Installations used only in spring and/or summer will have more sun available and will require fewer panels.

The map in Figure 1-3 should be used in calculations for year-round installations. It illustrates the mean milliamp-hours output, adjusted for latitude and climate, produced along the indicated lines by a single panel in the midwinter period between December 7 and January 4. This period of time yields the least amount of full sun available and represents the seasonal worst-case conditions for year-round installations.

The map in Figure 1-4 should be used in calculations for spring/summer installations - the time period between March 21 and September 21 - which will not need to produce power in the low sun conditions of midwinter. The output lines on this map reflect not only the longer days and higher elevation of the sun in spring and summer, but is adjusted for seasonal climate changes as well.

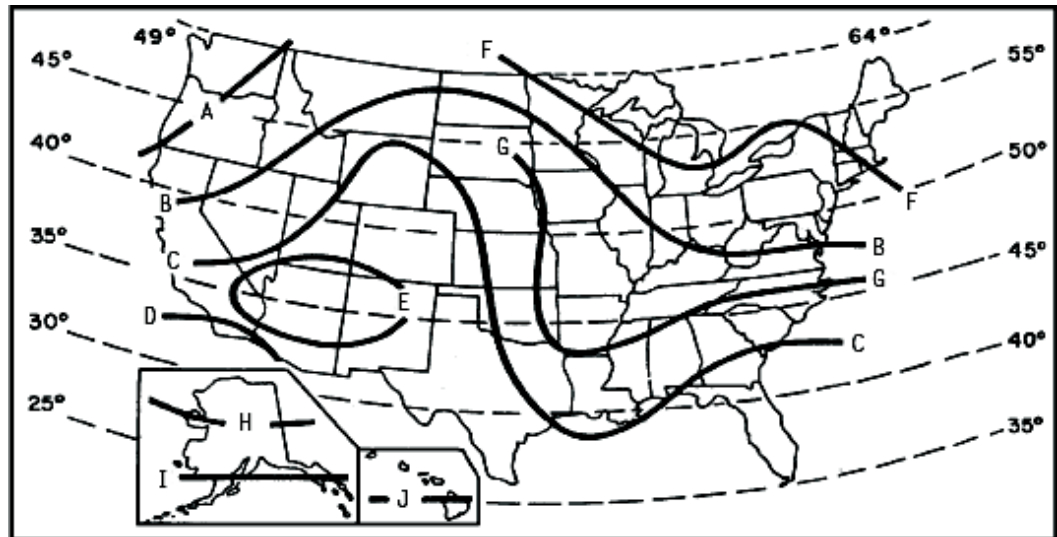


Figure 1-3 Angle of rotation according to latitude: Midwinter

<b>Table 1-2 Output in Milliamps for Year-Round Installations</b>			
<b>mA for:</b>	<b>10W</b>	<b>40W</b>	<b>110W</b>
A	44	176	484
B	68	272	748
C	90	360	990
D	90	360	990
E	114	456	1254
F	56	224	616
G	80	160	880
H	0	0	0
I	22	44	242
J	114	456	1254

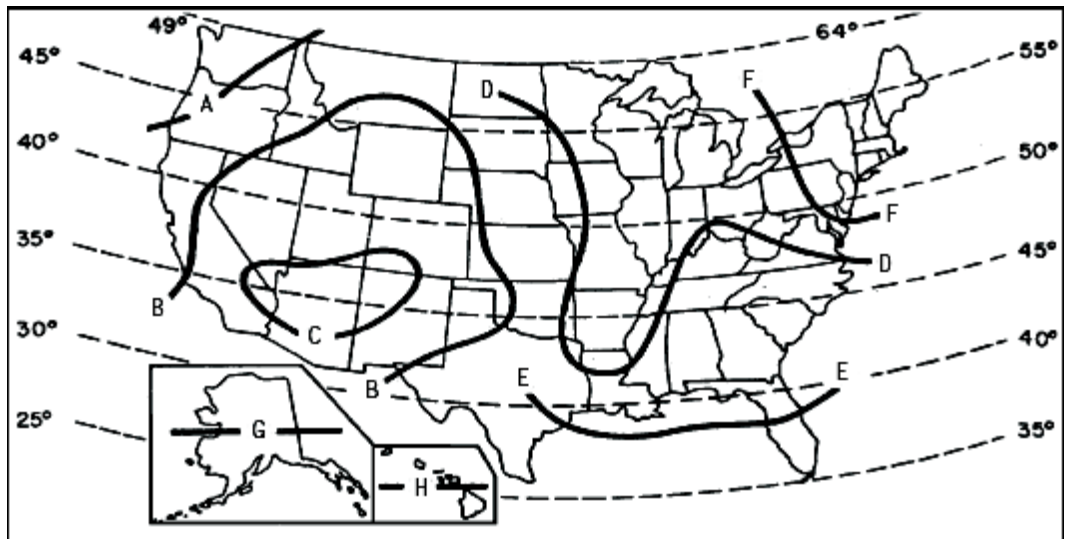


Figure 1-4 Angle of rotation according to latitude: Spring/Summer

<b>Table 1-3 Output in Milliamps for Spring/Summer Installations</b>			
<b>mA for:</b>	<b>10W</b>	<b>40W</b>	<b>110W</b>
A	90	360	990
B	114	456	1254
C	136	544	1496
D	102	408	1122
E	106	424	1166
F	90	360	990
G	68	272	748
H	114	456	1254

### 1.6 Current Requirements

The current requirements for a number of Isco flow meters and samplers can be determined by referring to Table 1-4. For example, a 4210/4220 Flow Meter with the plotter running at 1" per hour is 16 mA. For solar panel installations with Isco equipment not listed here, contact Isco Customer Service.

Current requirements for systems, for example flow meter/sampler systems, can be calculated by totaling the current requirements of each piece of equipment.

**Note**

The current requirements given in Table 1-4 are only basic currents for single units. Any options, such as a 4-20 milliamp output, will require additional current.

**Table 1-4 Isco Devices and Current Requirements**

Device	Current Requirements
1640 Liquid Level Actuator	5 mA standby, 70 mA when actuated (in addition to current requirement of connected equipment)
3700/3710 Portable Sequential/Composite Sampler	10 mA standby, 2.5 - 3 Amps pumping
4 - 20 mA Sampler Input Interface	2.5 mA average (in addition to sampler current requirements)
6712 Portable Sampler	11 mA standby, 30 mA average running a standard sampling program (200 ml sample every hour, 10 ft suction line and 5 ft head). Add 240 mA when backlight is on.
6712 Sampler (in standby) with a 701 pH /Temperature Module installed, readings every 10 minutes	26 mA average
6712 Sampler (in standby) with a 710 Ultrasonic Module installed, readings every 10 minutes	35 mA average
6712 Sampler (in standby) with a 720 Submerged Probe Module installed, readings every 10 minutes	27 mA average
6712 Sampler (in standby) with a 730 Bubbler Module installed, readings every 10 minutes	49 mA average
6712 Sampler (in standby) with a 750 Area Velocity Module installed, readings every 10 minutes	171 mA average
6712 Sampler (in standby) with a 780 4-20 mA Module installed, readings every 10 minutes	17 mA average
4110/4150 Flow Meter	10 mA average
4120 Flow Meter	5 mA average
4210/4220 Flow Meter, chart speed at 1" per hour	16 mA average *
4230 Flow Meter, chart speed at 1" per hour, at 1.5 bubbles per sec.	16 mA average *
4250 Flow Meter, chart speed at 1" per hour	14 mA average *
Internal Modem for Isco Flow Meters and Flow Loggers	0.1 mA standby, 60 mA during operation (in addition to current requirement of host flow meter/logger)
Liquid Crystal Display (LCD) backlighting for Isco Flow Meters	250 mA when ON (in addition to flow meter requirements)
2150 Flow Module	100mA typical
High-Low Alarm Relay Box for Isco Flow Meters	190 mA with both alarm relays actuated, 10 mA continuous (in addition to current requirements of connected flow meter)
<p><i>*4200 Series Flow Meters: Higher consumption is required to run the plotter at greater speeds. The consumption is directly proportional to chart speed at a rate of 15 mA per 1" per hour. Thus, a chart speed of 2" per hour would require 15 mA in addition to that listed above. A chart speed of 4" per hour would require 45 mA in addition to that listed above.</i></p>	

### 1.6.1 Variable Current Load

The current requirement for flow meters is constant. When calculating the current requirements for a sampler, however, keep in mind that the current requirements are variable: current requirements vary with the duty cycle of the pump. Determine the *average* current requirement of the sampler over a 24 hour

period to determine the power required to maintain full battery charge. An example of the calculations necessary to determine the average current requirements is placed below. The current requirements for the sampler are taken from Table 1-4.

1. For a sampler collecting 24 samples per day, where the pump runs for approximately 2 minutes or .033 hours at 3 Amps (3000 mA), the load for the event is 2376 mA - hours.

$$24 \text{ samples} \times 0.033 \text{ hours} \times 3000 \text{ mA} = 2376 \text{ mA-hours}$$

2. This consumption should be added to the total amount of current required to maintain the unit: 240 mA. The sampler requires 10 mA per hour to maintain the unit in addition to the current required by the pump.

$$24 \text{ hours} \times 10 \text{ mA} = 240 \text{ mA}$$

3. Combining the two loads yields 2616 mA-hours.

$$2376 \text{ mA-hours} + 240 \text{ mA-hours} = 2616 \text{ mA-hours}$$

4. To include system losses and a safety factor, increase the total load requirements by 20 percent.

$$2616 \text{ mA-hours} \times 1.20 = 3139 \text{ mA-hours}$$

5. The average load (3139 mA-hours ÷ 24 hrs) is 131 mA.

## 1.7 Battery Capacity

The length of time the battery will be able to power the flow meter or sampler in cloudy weather varies with the average load current requirements of the units powered by the battery. A 4210/4220 Flow Meter with the chart speed at 1" per hour consumes 16 mA continuously. The battery capacity, where Isco's 6.5A lead acid battery is being used, for this unit would be 17 days; in other words, the battery would power the flow meter for 17 days without input from the solar panel.

$$6500 \text{ mA-hr} \div 16 \text{ mA} = 406 \text{ hr}$$

$$406 \text{ hr} \div 24 \text{ hr/day} = 17 \text{ days}$$

However, the lead-acid battery should be replaced with a fully charged battery **before** the end of the 17 days. At the end of this period of time, the battery would be completely discharged. **Do not run an instrument to complete discharge of the battery.** Total discharge of gelled-electrolyte batteries can cause cell reversal, and this can ruin the battery. One manufacturer recommends **10.5 VDC, loaded at 400 mA**, as complete discharge of a 12-volt battery. Checking on the installation before the battery is estimated to be completely discharged is recommended.

The calculations above assume that the panel will provide no power in cloudy weather. In reality, the panel will be able to produce a reduced amount of current. Use worst case calculations to identify a time period in which the battery can be con-

sidered reliable. One additional consideration: the calculations above assume the battery is fully charged at the beginning of the period.

#### **Note**

If the battery becomes discharged due to poor weather conditions or heavy load demands of a sampler, it is recommended that the discharged battery be replaced with a fully charged battery.

### 1.7.1 Calculating the Remaining Charge

In some cases, the battery may be required to provide a large amount of power for a limited period of time. At the end of this period, the battery is significantly, but not completely discharged. For example, a sampler in a runoff routine may require a large amount of power from the battery for the duration of the sampling program. At the end of the sampling program, the sampler will require less power, but the battery will be somewhat discharged. The amount of charge remaining can be approximated by subtracting the calculated amount of power used from the total capacity of the battery. This method assumes that the battery is fully charged at the beginning of the discharge period.

For example, the sampler in the calculation in *Current Requirements* on page 1-6, requires 2376 mA-hours per day. Assuming the sampling program is completed in one day, subtract this amount from the capacity of the battery to determine the remaining capacity.

$$6500 \text{ mA-hr} - 2376 \text{ mA-hr} = 4124 \text{ mA-hr remaining}$$

This calculation shows that the battery is not completely discharged, and in fact, would be able to provide sufficient power to complete two sampling programs. If the events that activate the sampler are infrequent, the panel or panels may have time to recharge the battery and the battery would not have to be replaced.

## 1.8 Recharge Period

To calculate the number of days required to recharge a completely discharged Isco 6.5 Amp-hour battery, use the following formula.

$$\text{Power needed to recharge battery} \div (\text{current provided by panel} - \text{avg load current}) = \text{hours to recharge battery}$$

or

$$6.5 \text{ Amp-hr} \div (\text{current provided by panel} - \text{avg load current}) = \text{hours to recharge battery.}$$

If this length of time is unacceptable, a higher-powered panel may be required to shorten the recharge time.

To calculate the amount of time needed to recharge a partially discharged battery, first determine the amount of power needed to recharge the battery. The amount of power needed to recharge the battery is essentially the amount of power expended by the battery.

## **1.9 Cleaning and Maintenance**

The panel should be inspected regularly to make sure all connections remain secure and free from corrosion and debris. The panel's effectiveness is reduced by the accumulation of dirt and dust on the surface of the panel. It may be cleaned with a detergent and a soft cloth or sponge. Abrasive cleansers and brushes may damage the panel's surface and should not be used.

 <b>CAUTION</b>
--

**The panel will produce current in any light source. In some conditions there may be sufficient voltage to cause electric shock.**



## 1.10 Replacement Parts and Accessories

A list of common replacement parts for use with the Solar Panel can be found in the following table. When ordering a replacement part or accessory, include the Isco assembly or part number, a complete description, and the serial number of the panel on which the part is going to be used.

<b>Table 1-5 Solar Panel Replacement Parts List</b>	
<b>Complete Assembly</b>	<b>Description</b>
60-5314-478	10W panel with pole mount bracket and 25-ft connect cable. Use with Isco 946, 947, or 948 lead-acid batteries.  For non-Isco 12VDC lead-acid batteries, terminal cable 60-1394-023 is required.
60-5314-347	40W panel with mounting brackets and 8-ft connect cable for deep-cycle lead-acid battery (user-supplied, 100AH optimal). Requires terminal cable 60-1394-023 or 60-5304-921 (see below).
60-5314-629	110W panel with mounting brackets and 8-ft connect cable for deep-cycle lead-acid battery (user-supplied, 100AH optimal). Requires terminal cable 60-1394-023 or 60-5304-921 (see below).
60-3114-010	Connect cable for 4100 Series flow logger
60-3004-097	Solar Panel to Isco battery cable - 25' (For 10-Watt solar panel only)
60-3003-098	Cable for connecting 10-Watt solar panels in parallel
60-1394-023	External 12VDC connect cable with large alligator clips. Appropriate for 40W and 110W solar panels.
60-5304-921	Cut-to-length external 12VDC cable with $\frac{5}{16}$ " eyelet terminals. For connection between deep-cycle marine battery and many Isco instruments. Appropriate for 40W and 110W solar panels.
60-5314-189	Cut-to-length external 12VDC cable with large alligator clips (Maximum length 50ft). For connection between deep-cycle marine battery and many Isco instruments. Appropriate for 40W and 110W solar panels.
69-2004-451	Power adaptor cable for 2100 Series modules.
60-3003-269	Solar Panel instruction manual



# Teledyne Isco One Year Limited Warranty\*

## Factory Service for Teledyne Isco Flow Meters, Waste Water Samplers, and Syringe Pumps

This warranty exclusively covers Teledyne Isco instruments, providing a one-year limited warranty covering parts and labor.

Any instrument that fails during the warranty period due to faulty parts or workmanship will be repaired at the factory at no charge to the customer. Teledyne Isco's exclusive liability is limited to repair or replacement of defective instruments. Teledyne Isco is not liable for consequential damages.

Teledyne Isco will pay surface transportation charges both ways within the 48 contiguous United States if the instrument proves to be defective within 30 days of shipment. Throughout the remainder of the warranty period, the customer will pay to return the instrument to Teledyne Isco, and Teledyne Isco will pay surface transportation to return the repaired instrument to the customer. Teledyne Isco will not pay air freight or customer's packing and crating charges. This warranty does not cover loss, damage, or defects resulting from transportation between the customer's facility and the repair facility.

The warranty for any instrument is the one in effect on date of shipment. The warranty period begins on the shipping date, unless Teledyne Isco agrees in writing to a different date.

Excluded from this warranty are normal wear; expendable items such as charts, ribbon, lamps, tubing, and glassware; fittings and wetted parts of valves; and damage due to corrosion, misuse, accident, or lack of proper maintenance. This warranty does not cover products not sold under the Teledyne Isco trademark or for which any other warranty is specifically stated.

No item may be returned for warranty service without a return authorization number issued by Teledyne Isco.

**This warranty is expressly in lieu of all other warranties and obligations and Teledyne Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose.**

The warrantor is Teledyne Isco, Inc. 4700 Superior, Lincoln, NE 68504, U.S.A.

**\* This warranty applies to the USA and countries where Teledyne Isco Inc. does not have an authorized dealer. Customers in countries outside the USA, where Teledyne Isco has an authorized dealer, should contact their Teledyne Isco dealer for warranty service.**

Before returning any instrument for repair, please call, fax, or e-mail the Teledyne Isco Service Department for instructions. Many problems can often be diagnosed and corrected over the phone, or by e-mail, without returning the instrument to the factory.

Instruments needing factory repair should be packed carefully, and shipped to the attention of the service department. Small, non-fragile items can be sent by insured parcel post. **PLEASE BE SURE TO ENCLOSE A NOTE EXPLAINING THE PROBLEM.**

**Shipping Address:** Teledyne Isco, Inc. - Attention Repair Service  
4700 Superior Street  
Lincoln, NE 68504 USA

**Mailing Address:** Teledyne Isco, Inc.  
PO Box 82531  
Lincoln, NE 68501 USA

**Phone:** Repair service: (800) 775-2965 (lab instruments)  
(866) 298-6174 (samplers & flow meters)  
Sales & General Information: (800) 228-4373 (USA & Canada)

**Fax:** (402) 465-3001

**Email:** IscoService@teledyne.com



March 8, 2011 P/N 60-1002-040 Rev E

