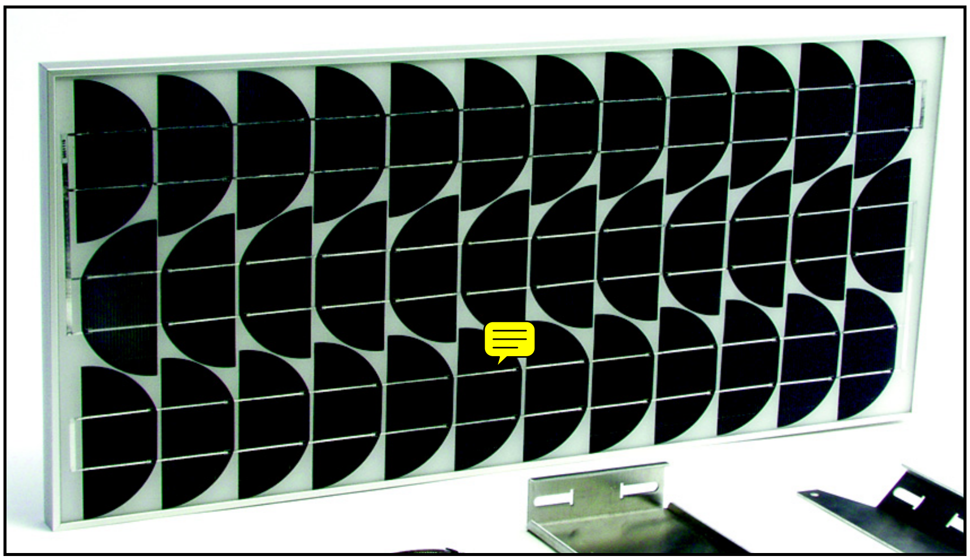
Isco Solar Panel

Installation and Operation Guide



TELEDYNE ISCO
A Teledyne Technologies Company

Part #60-3003-269

Revision J, March 6, 2006

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 Service

Phone: (800) 775-2965 (Analytical)

(800) 228-4373 (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

Revised September 15, 2005

Isco Solar Panel

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Isco Solar Panel

1.1 Introduction

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

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. Use of 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:	5W 40W 90W	3 lb 12.5 lb 23.0 lb	
Approximate dimensions in inches, excluding mounting bracket[1]:	 5W 40W 90W	H 11.85 38.30 56.93	W 9.88 17.16 22.80
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:	5W 40W 90W	310mA @ 16.4 VDC 2.4A @ 16.7 VDC 5.17A @ 17.4 VDC	

1. Physical dimensions may vary slightly, depending on the exact power output. Dimensions subject to change without notification.

Figure 1-1 Isco Solar Panel

The 5-watt 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 panel and connect cable. A 25 ft. (7.6 m) extension cable is available to extend the distance between the panel and the battery.

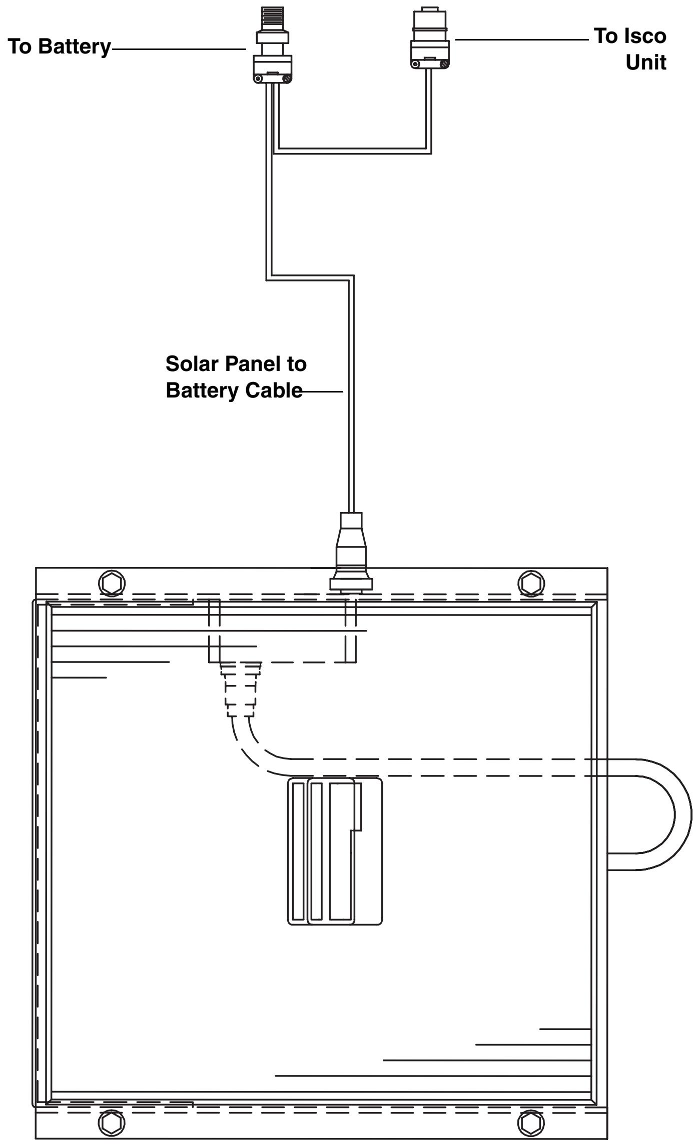


Figure 1-2 Solar Panel and Solar Panel to Battery Cable

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

There are many applications for which the Isco Solar Panel is ideally suited.

1. The 5-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.

2. The 40 or 90-watt Solar Panel is suitable for continually charging a user-supplied deep-cycle battery (100AH optimal) for sites requiring more power.
3. The 5-watt Solar Panel system 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.
   The Solar Panel is compatible with other equipment configurations used in runoff studies. Isco flow meters, loggers, and liquid level actuators, can be configured together with Isco samplers to provide flow-paced sampling triggered by liquid level.
   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. Users may refer to Sections 1.7 and 1.8 for a discussion of battery capacity, remaining charge, and recharge periods.
4. The Solar Panel is also suitable for use with Isco equipment that requires remote location of a lead acid battery. Figure 1-3 illustrates how to connect the Solar Panel to such devices.

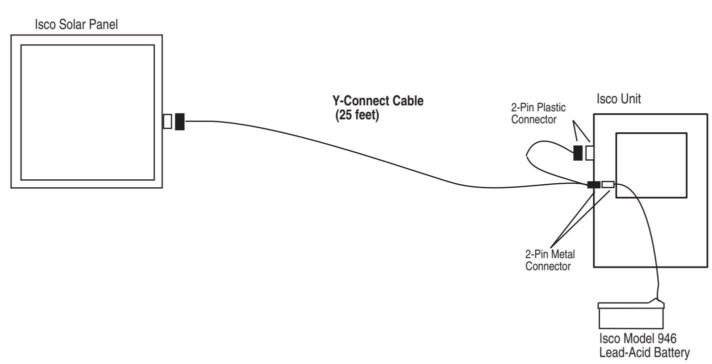


Figure 1-3 Connecting the Solar Panel to Equipment Requiring Remote Lead-Acid Battery Location

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 5-watt panel will provide sufficient power; other applications may require the output of the 40 or 90-watt panel. Refer to Section 1.6 for a discussion of current requirements.

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 suppied.

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 surfaces 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 Figure 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. Note:

Alaskan installations would use an installation angle of 80° from horizontal. Installations in Hawaii should use an installation angle of 25°.

If the panels cannot be cleaned regularly, it is recommended that angles of no less that 15° be used so that the user can take advantage of the cleansing effect of rainfall. Users may find it necessary to adjust the angle slightly to a lesser angle in summer and a greater angle in winter.

1.5 Amount of Current Produced

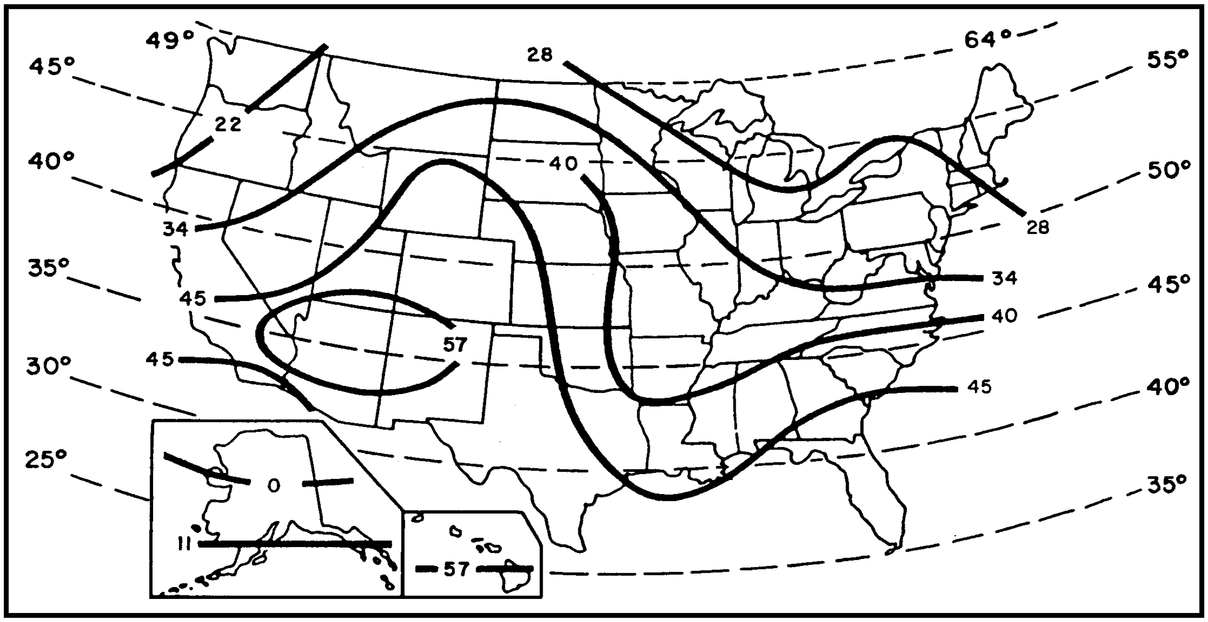
The amount of current produced by a panel varies with the amount of full sun available to the panel. In turn, the amount of full sun varies with the climate and latitude of the installation as well as the time of year. The two maps shown in Figure 1-4 show the variations in output and are provided to assist the user 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. A panel positioned at the correct angle of rotation and located on or near 40 mA output line would produce a mean output of 40 mA. 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 first map 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. By referring to this map, the user can see that a solar panel located in Lincoln, Nebraska would produce a mean output of 40 mA-hr in that time period.

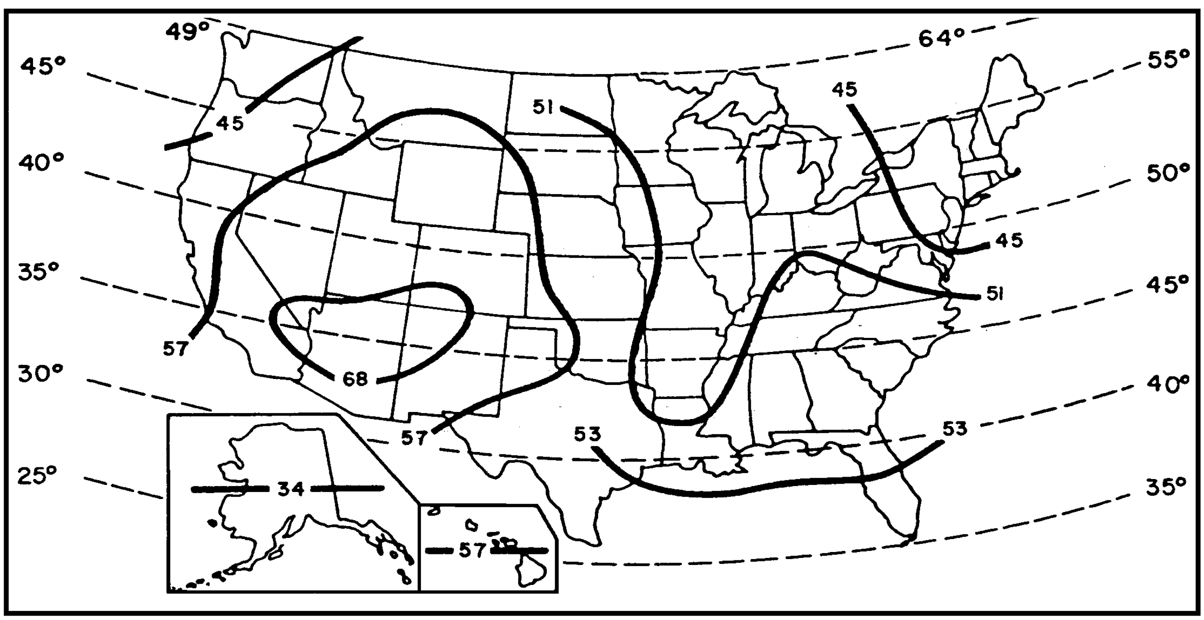
The second map should be used in calculations for spring/summer installations - the time period between March 21 and September 21 – which will not need to produce power in the low sun conditions of midwinter. The output lines on this map reflect not only the longer days and higher elevation of the sun in spring and summer, but is adjusted for seasonal climate changes as well. A panel located in Lincoln, Nebraska is located between the 51 mA and 57 mA output lines; by interpolating, the user could expect the panel to produce approximately 53 mA.

Latitude **Angle of Rotation**



Year-round installations: Output in milliamps of a 5-watt solar panel in Midwinter
(December 7 to January 4)

Latitude **Angle of Rotation**



Spring/Summer installations: Output in milliamps of a 5-watt solar panel.

Figure 1-4 Angle of Rotation According to Latitude

1.6 Current Requirements

Users can determine the current requirements for a number of Isco flow meters and samplers by referring to Table 1-2. For example, a 4210/4220 Flow Meter with the plotter running at 1" per hour is 16 mA. Users who wish to install the solar panel with Isco equipment not listed here may obtain assistance from 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 1-2 are only basic currents for single units. Any options, such as a 4-20 milliamp output, will require additional current.

Table 1-2 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)

Table 1-2 Isco Devices and Current Requirements (Continued)	
Device	**Current Requirements**
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)
**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.*	

1.6.1 Variable Current Load

The current requirement for flow meters is constant so the user will not need to consider variable current requirements. When calculating the current requirements for a sampler, however, the user must keep in mind that the current requirements are variable: current requirements vary with the duty cycle of the pump. The user must 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 1-2.

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 samples × 0.033 hours × 3000 mA = 2376 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 hours × 10 mA = 240 mA

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

   2376 mA-hours + 240 mA-hours = 2616 mA-hours

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

   2616 mA-hours × 1.20 = 3139 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 mA-hr ÷ 16 mA = 406 hr
406 hr ÷ 24 hr/day = 17 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. The user can provide an additional safety margin by checking on the installation before the battery is estimated to be completely discharged.

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. By using worst case calculations, the user is able to identify a time period in which the battery can be considered 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. Users can approximate the amount of charge remaining 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 1-8, requires 2376 mA-hours per day. Assuming the sampling program is completed in one day, the user can subtract this amount from the capacity of the battery to determine the remaining capacity.

6500 mA-hr - 2376 mA-hr = 4124 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, the user must use the following formula.

Power needed to recharge battery ÷ (current provided by panel – avg load current) = hours to recharge battery

or

6.5 Amp-hr ÷ (current provided by panel - avg load current) = hours to recharge battery.

A 5-watt solar panel maintaining a year-round installation located in Lincoln, Nebraska provides a mean output of 40 mA in midwinter. A 4210 Flow Meter requires 16 mA; 24 mA is left to recharge the battery. The battery would be recharged in approximately 271 hrs or 11 days.

6500 mA-hr ÷ (40 mA - 16 mA) = 271 hr,
271 hr ÷ 24 hr/day = 11.3 days

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

1.8.1 Recharge Period for Partially Discharged Battery

To calculate the amount of time needed to recharge a partially discharged battery, the user must 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.

For the example in Section 1.7.1 *Calculating the Remaining Charge*, a 5-watt solar panel would need to provide 2376 mA-hr in excess of the current needed to maintain the sampler. A 5-watt solar panel maintaining a year-round installation in Lincoln, Nebraska provides a mean output of 40 mA in midwinter. The sampler requires 10 mA in maintenance current, leaving 30 mA excess power which will be used to recharge the battery. Using the formula in Section 1.8 *Recharge Period*, the user can determine the recharge period.

Power needed to recharge battery ÷ (current provided by panel – avg load current) = hours to recharge battery.

2376 mA-hr ÷ 30 mA = 79 hrs
79 hrs ÷ 24 hrs/day = 3.3 days

A 5-watt solar panel would thus be able to recharge the battery in 3.3 days.

1.9 Cleaning and Maintenance

The panel should be inspected regularly to make sure all connections remain tight 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.

⚠ CAUTION

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.

Table 1-3 Solar Panel Replacement Parts List

Item No.	Complete Assembly	Description
1	60-5314-478	5W 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.
2	60-5314-347	40W panel with mounting brackets and 10-ft connect cable for deep-cycle lead-acid battery (user-supplied, 100AH optimal). Requires terminal cable 60-1394-023.
3	60-5314-399	90W panel with mounting brackets and 10-ft connect cable for deep-cycle lead-acid battery (user-supplied, 100AH optimal). Requires terminal cable 60-1394-023.
4	60-3114-010	Connect cable for 4100 Series flow logger
5	60-3003-269	Solar Panel instruction manual
6	60-3004-097	Solar Panel to Isco battery cable - 25'
8	60-1394-023	5/16" connect cable with large alligator clips
9	69-2004-451	Power adaptor cable for 2100 Series modules.

Teledyne Isco One Year Limited Factory Service Warranty *

Teledyne Isco warrants covered products against failure due to faulty parts or workmanship for a period of one year (365 days) from their shipping date, or from the date of installation by an authorized Teledyne Isco Service Engineer, as may be appropriate.

During the warranty period, repairs, replacements, and labor shall be provided at no charge. Teledyne Isco's liability is strictly limited to repair and/or replacement, at Teledyne Isco's sole discretion.

Failure of expendable items (e.g., charts, ribbon, tubing, lamps, glassware, seals, filters, fittings, and wetted parts of valves), or from normal wear, accident, misuse, corrosion, or lack of proper maintenance, is not covered. Teledyne Isco assumes no liability for any consequential damages.

This warranty does not cover loss, damage, or defects resulting from transportation between the customer's facility and the repair facility.

Teledyne Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose.

This warranty applies only to products sold under the Teledyne Isco trademark and is made in lieu of any other warranty, written or expressed.

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

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.**

In the event of instrument problems, always contact the Teledyne Isco Service Department, as problems can often be diagnosed and corrected without requiring an on-site visit. In the U.S.A., contact Teledyne Isco Service at the numbers listed below. International customers should contact their local Teledyne Isco agent or Teledyne Isco International Customer Service.

Return Authorization

A return authorization number must be issued prior to shipping. Following authorization, Teledyne Isco will pay for surface transportation (excluding packing/crating) both ways for 30 days from the beginning of the warranty period. After 30 days, expense for warranty shipments will be the responsibility of the customer.

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)
(800)228-4373 (samplers & flow meters)
Sales & General Information (800)228-4373 (USA & Canada)

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TELEDYNE ISCO
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