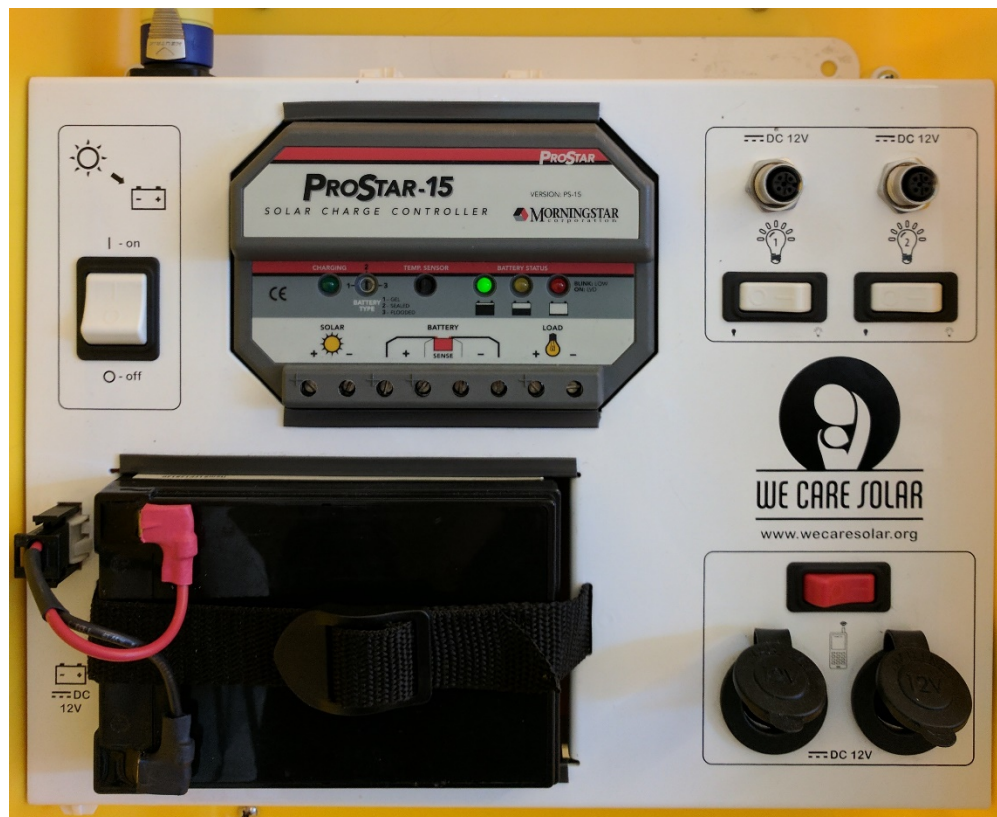




Version 2 We Care Solar Suitcase[®]

Guide for Maintenance Technicians

2021



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Maintenance & Repair Overview



Overview

The Solar Suitcases are built with the highest quality parts. When properly installed, used, and serviced, and with one LFP battery replacement every 5 years, the Solar Suitcases and panels (excluding appliances) can last 10+ years. Maintenance and repair are minimal. However, following up to ensure the system is working properly is the best way to ensure the Solar Suitcase continues to provide lighting and electricity for years to come.

Main Battery Replacement

The main batteries, which are lithium ferrous phosphate (LFP), will need to be replaced after 5 years. We recommend a 12V, 12Ah LFP battery. The Solar Suitcases are also compatible with 12V, 12-14 Ah SLA batteries.

Solar Panels

Panels are built to last for 10+ years and are unlikely to need repair, although they may need to be cleaned periodically.

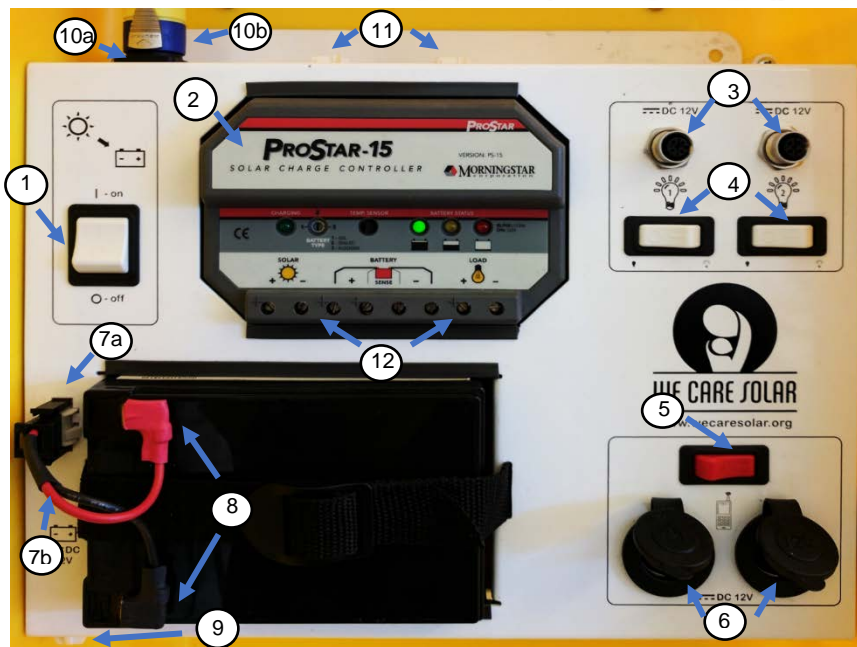
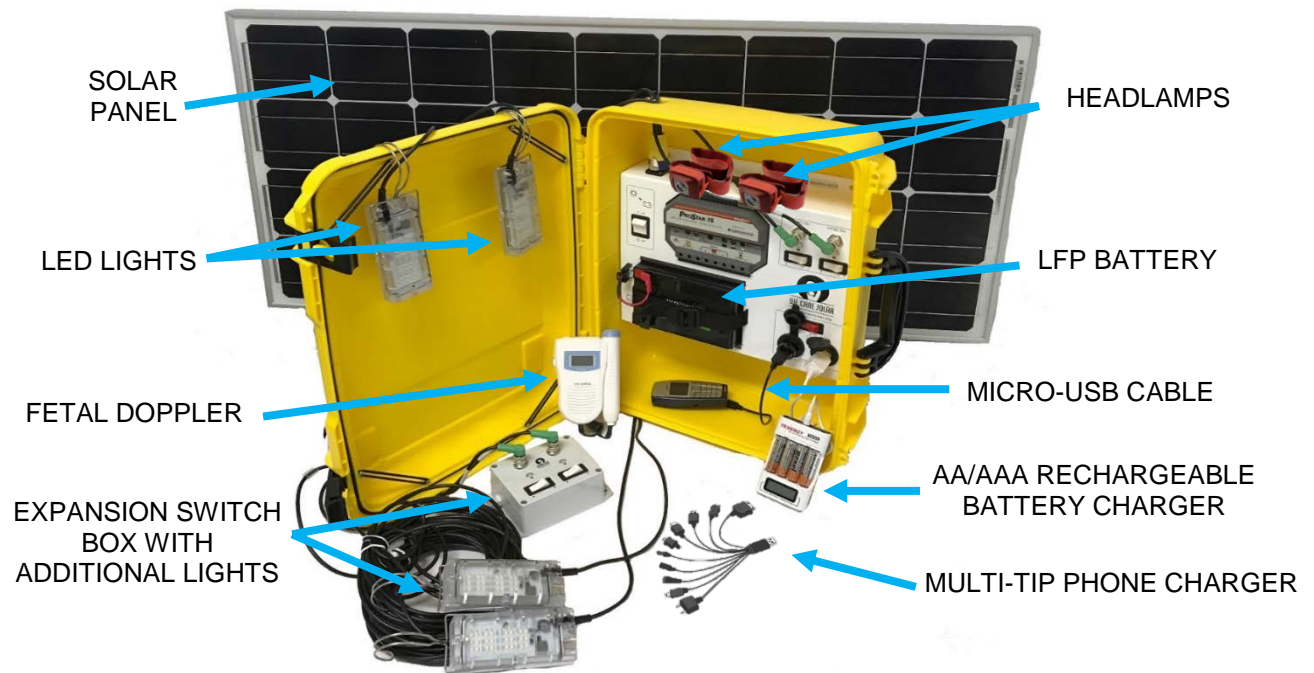
Appliance Anticipated Lifespan

Appliances that come with the Solar Suitcase include: two headlamps, one rechargeable battery charger, one 2-slot USB adaptor, one 10-in-1 USB phone charger, and one fetal Doppler. All of these appliances have a limited life span, and will need to be replaced.

Re-Training Health Workers and Training New Health Workers

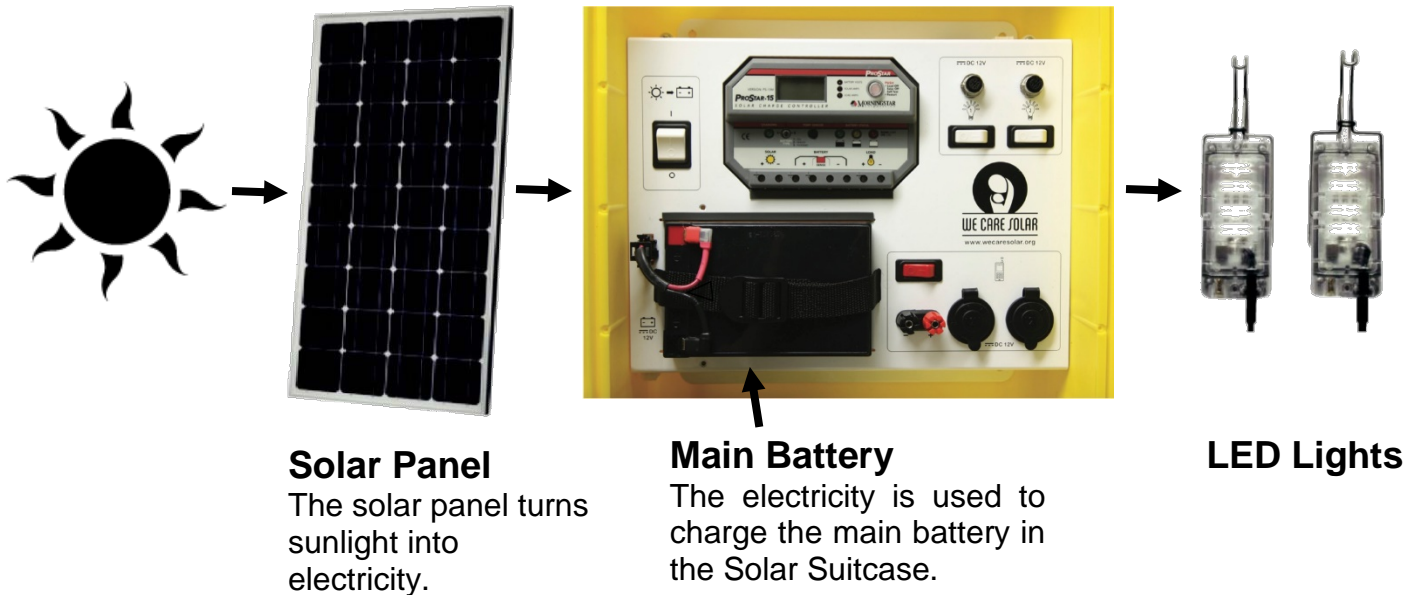
Although health workers will have been trained during installation on how to properly use the Solar Suitcase, some users need refresher training and new health workers may lack information on how to use the Solar Suitcase. Training health workers is an important component of any maintenance visit.

Solar Suitcase System Overview



- | | |
|-------------------------------------|---|
| 1 Main power switch/circuit breaker | 7b Internal battery cable |
| 2 Charge controller | 8 Battery terminals/slip-on connectors |
| 3 Light sockets | 9 External battery socket |
| 4 Light switches/circuit breaker | 10a Solar socket |
| 5 Appliance switch/circuit breaker | 10b Solar plug on homerun cable |
| 6 Appliance sockets (12V DC) | 11 2 expansion sockets |
| 7a Internal battery socket | 12 Terminal screws (on charge controller) |

Batteries, Panels, and Lights



Main Battery

The Solar Suitcase includes a Lithium Ferrous Phosphate battery (LFP; 12 volt, 12 amp-hour) that stores electricity for night time use.

The LFP battery lasts for 5 years, and can be fully charged and discharged hundreds of times before it needs replacement. It can also be stored for months without harm to the battery.

The Solar Suitcase is also compatible with Sealed Lead Acid (SLA) batteries.

Main Battery Replacement

After years of usage, if you notice the battery is full at the beginning of the evening, but runs out of charge quickly (for example, the battery cannot provide enough power for one LED light through the night), it is time to replace the battery.

Refer to p.25 for instructions on how to replace the main battery.



THIS SOLAR SUITCASE IS 12 VOLT DC
The LED lights can only be used with the Solar Suitcase.

Charge Controller

The Solar Suitcase connects solar panels to a charge controller, which optimizes the solar charge into the battery. The charge controller also regulates the use of the energy stored in the battery to power lights and other appliances.



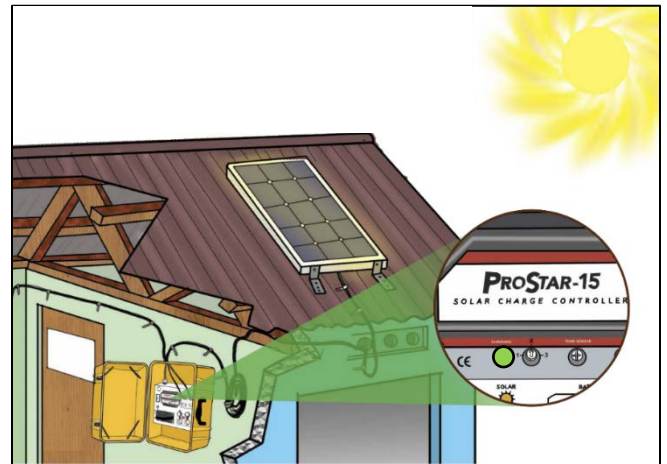
Solar Charging Light

The battery is charged every sunny day. But how do you know your battery is charging?

There is a green light on the charge controller above the sun. This light is called the solar charging light.

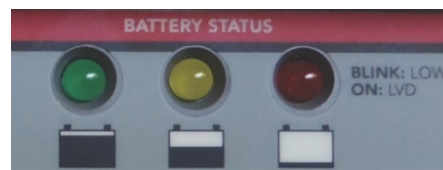
When it is daytime and the homerun cable is properly connected, this light will be green.

If you do not see this light in the daytime, the system is not properly connected.









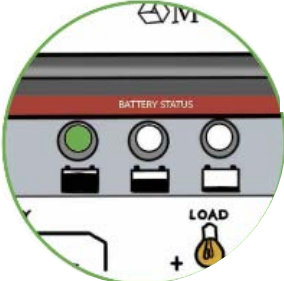




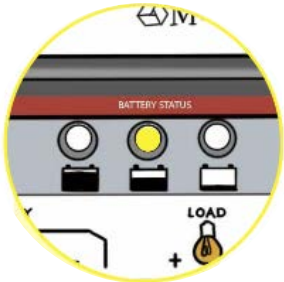





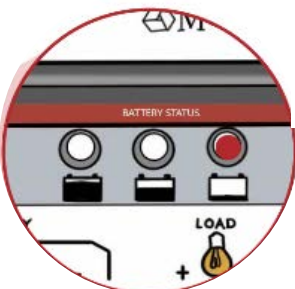




Battery Status Lights

The three colored lights allow the user to assess the level of charge in the battery. The battery status light guides users as to when they can use lights and charge appliances.



Battery Status Light

The battery status light guides users as to when they can use lights and charge appliances. It is important to make sure users understand how to interpret these lights.

			 Lights	 Phone Charging	 Appliance Charging
	BLINKING GREEN 	 100%	✓	✓	✓
	SOLID GREEN 	 10%-90%	✓	✓	✗   <i>or on a sunny day</i>
	YELLOW 	 <10%	✗ 	✗ 	✗ 
	RED OR BLINKING RED 	 0%	✗ 	✗	✗  <i>or only in an emergency</i>

Appliances

The Solar Suitcase comes with the following appliances:



2 headlamps



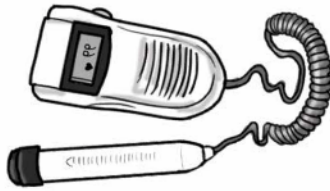
Micro USB cable for headlamp



2-slot USB adaptor



Multi-tip phone charger



fetal Doppler



AA/AAA rechargeable battery charger

Charging Appliances

Appliances should only be **charged during the day** and when the battery status light is **green**. The battery status light on the charge controller will tell you whether or not it is ok to charge appliances.

To charge appliances, BOTH the solar charging light AND the battery status light should be green.

If the battery is:



BLINKING GREEN – Battery is full. This is the best time to charge mobile phones and other appliances.



SOLID GREEN – Battery is between 10% and 90% charged. You may charge appliances on sunny days.

If the yellow or red lights are on, your battery is low. Do not charge any appliances at this time.

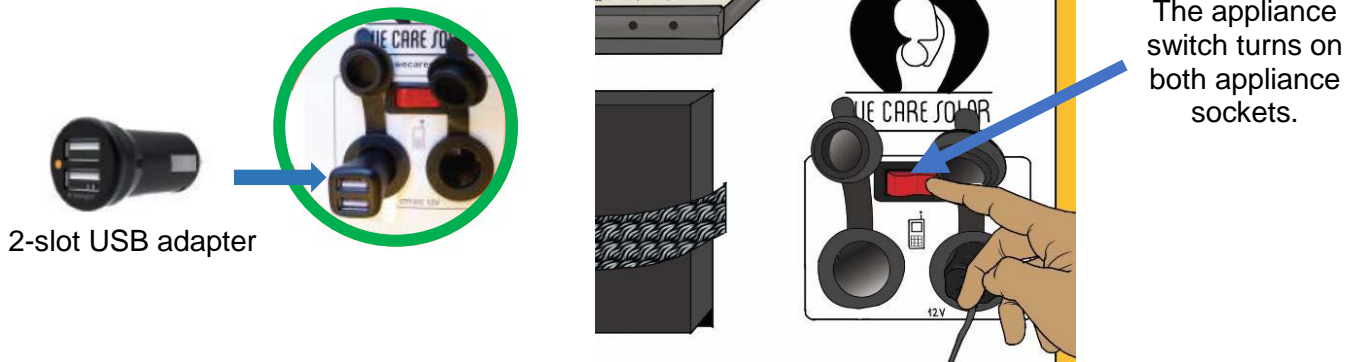


Phone Charger

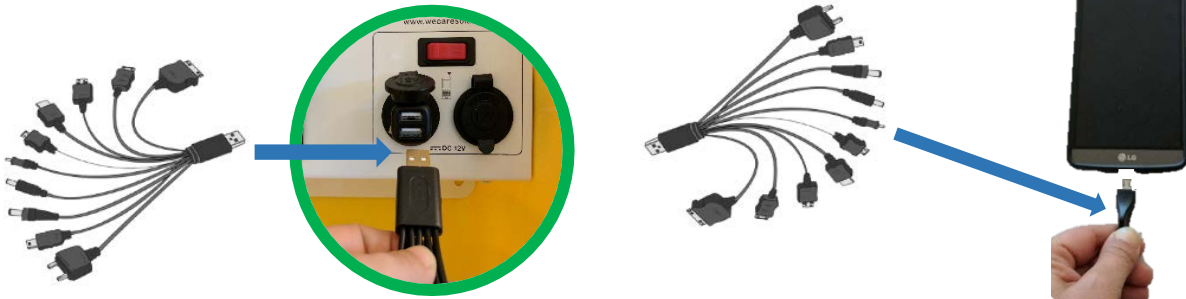
The Solar Suitcase comes with a multi-tip phone charger that is able to charge most types of cell phones.

Using the phone charger:

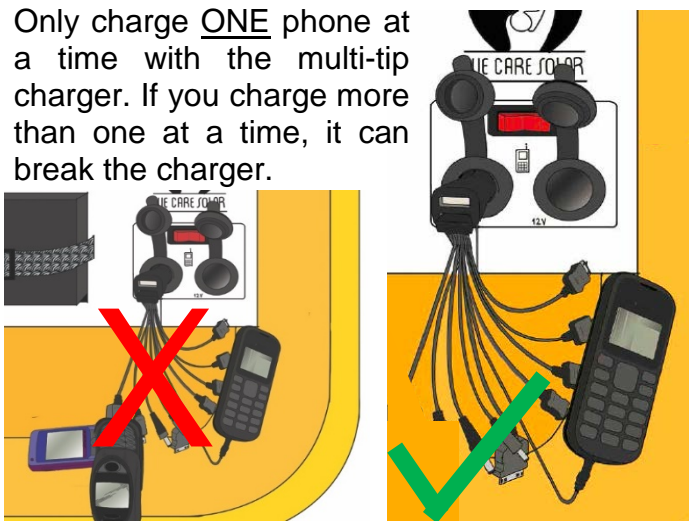
- 1) Plug the 2-slot USB adaptor into one of the appliance sockets and flip the appliance (red) switch to turn the appliance charger on.



- 2) Plug the multi-tip phone charger into the 2-slot USB adaptor and the appropriate plug on the other end of the multi-tip phone charger into the cell phone.



Only charge ONE phone at a time with the multi-tip charger. If you charge more than one at a time, it can break the charger.

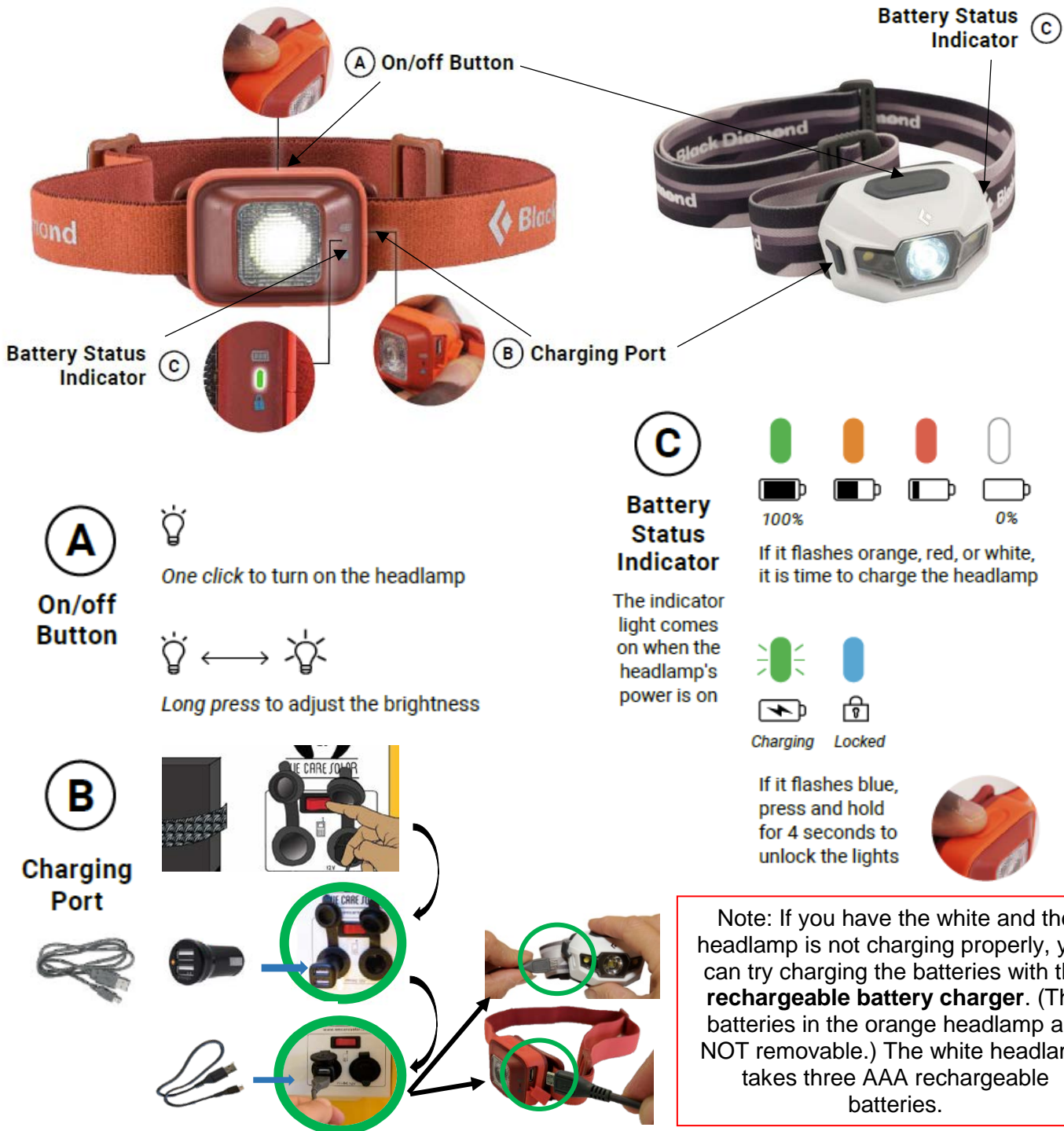


You can also use your own cell phone charger with the Solar Suitcase, either by using the 2-slot USB adaptor or by plugging a car charger directly into the appliance socket.



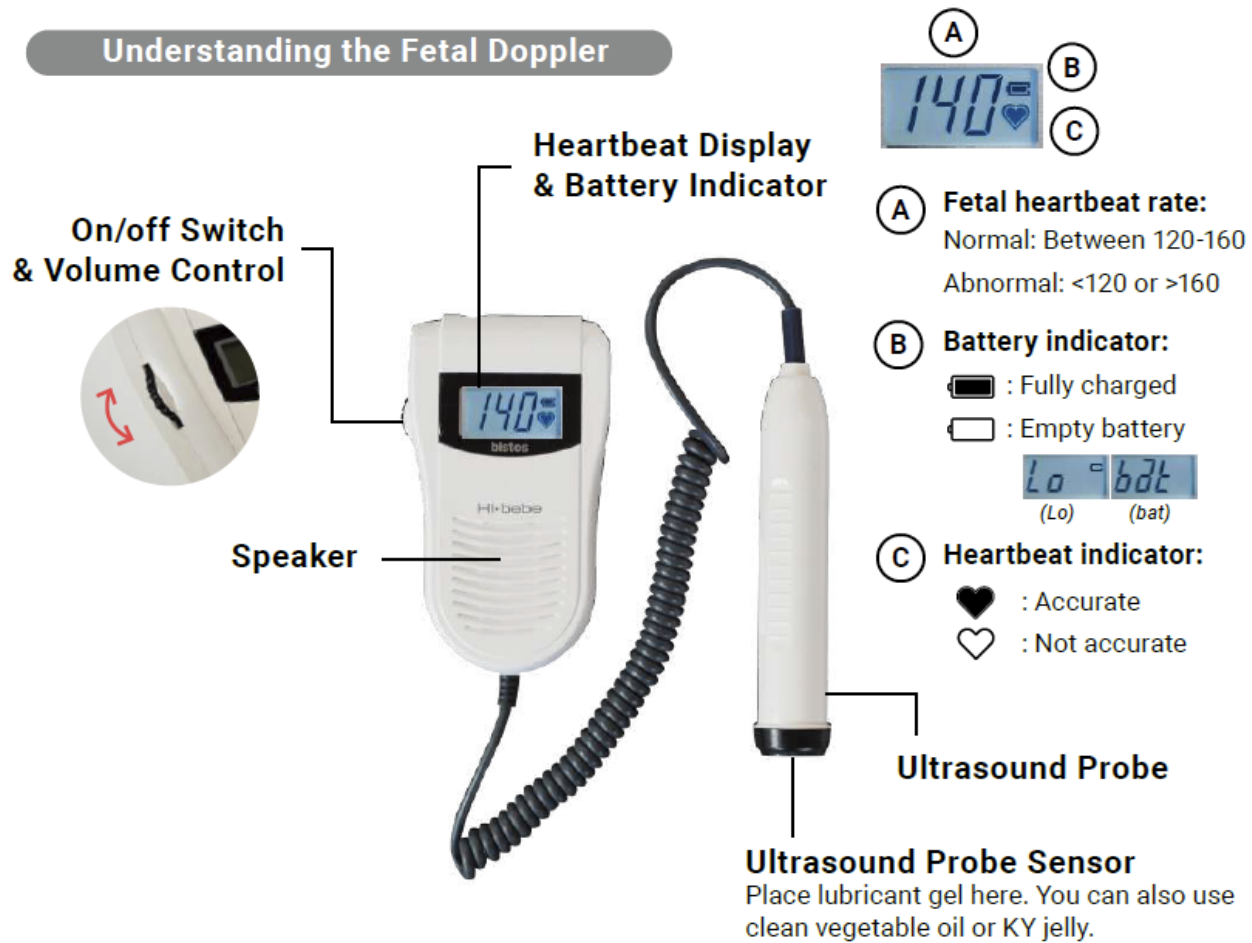
Headlamps

The Solar Suitcase comes with two headlamps. Depending on when this Solar Suitcase was received, there could be different models of headlamps. The most likely models are pictured below



Fetal Doppler

Understanding the Fetal Doppler



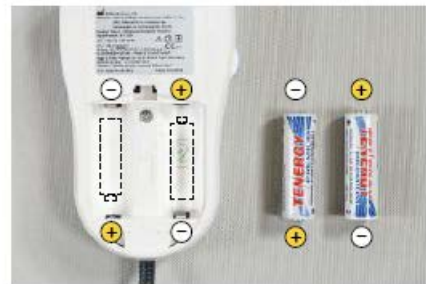
Loading AA Rechargeable Batteries into the Fetal Doppler

Step 1



Open the back cover
Press down and pull backward to open

Step 2



Place batteries
Make sure to match up the + & - symbols

Using the Fetal Doppler

- 1 Find the position of the baby and locate fetal chest



- 2 Place gel, clean vegetable oil, or KY jelly where you will best hear the heartbeat



- 3 Turn on the fetal Doppler



- 4 Hold the probe for 5 seconds and adjust the volume up if needed



- 5 If you don't hear the heartbeat, shift the angle of the probe and wait for 5 seconds



- 6 If you still don't hear the heartbeat, move the probe slightly to find the heartbeat and wait for 5 seconds



- ! Turn off the fetal Doppler when done

Rechargeable Battery Charger

The rechargeable battery charger charges AA and AAA rechargeable batteries, like those found in the fetal Doppler or some models of headlamps.

- 1) Open the back of the fetal Doppler or headlamp. Remove the batteries for charging.



- 2) To charge, place the positive side of the batteries in the positive side of the charger. To charge AA rechargeable batteries, the small white tab on the battery charger needs to be in the upright position. To charge AAA batteries, the small white tab needs to be moved downwards. Make sure you match up the + and – signs.

Charging AA batteries



Charging AAA batteries



White tabs



*Note:
The positive tips
of the batteries
face in the same
direction when
they are placed in
the charger.*

- 3) Plug the rechargeable battery charger into the 12v socket. Read the rechargeable battery indicator. If the LCD screen is not lit, check that the charger is properly inserted into the appliance socket.



Charging



Fully charged



This battery shows the word "rechargeable" and can be used repeatedly



This battery is not rechargeable. It should be discarded when it is no longer working.

! Warning: Rechargeable Batteries vs Single-Use

- Only use rechargeable batteries with the TENERGY battery charger
- You should not throw away rechargeable batteries. They can be used over and over.

Maintenance Visits

Planning & Preparation

Planning – Before the Day of your Visit

1. Identify maintenance team. Most teams will include one driver and 2-3 technicians.
2. Inform the local government technicians of your visit. If possible, they should accompany you to the facility for knowledge transfer and information sharing.
3. Location planning – Call the clinic at least one day in advance.
 - a. **Ensure the person in charge of the clinic will be present**, as well as most of the midwives so that they can be trained on Solar Suitcase use and maintenance.

On the Day of your Maintenance Visit

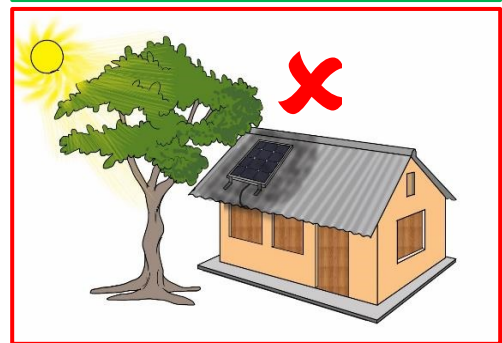
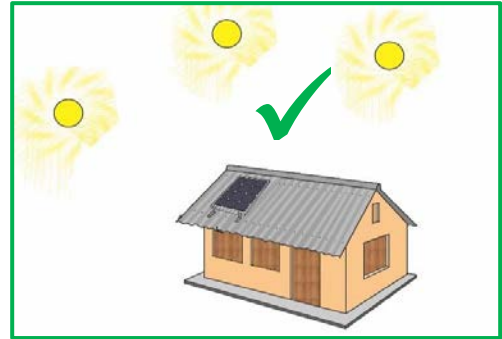
1. Prepare and load tools and spare parts in vehicle. Ensure you have the following items:
 - a. Tools and drills
 - b. Spare parts
 - c. Ladder for getting onto the roof
 - d. Forms/paperwork
 - e. Water and snacks
2. Arrive and introduce yourselves to the person in charge of the clinic. Take a tour of the clinic with the medical team.
3. Ask the health workers about the Solar Suitcase. Some questions to ask include:
 - a. Are you using the Solar Suitcase? Is it working?
 - b. Are the lights staying on all night when you need them?
 - c. Are you having any trouble charging or using the appliances?
 - d. Does the main battery get fully discharged quicker than it used to?
4. Perform basic maintenance such as cleaning the case and solar panel (see section on Basic Maintenance).
5. Inspect the Solar Suitcase and ensure everything is functioning, including the main battery, lights, and appliances (see section on Solar Suitcase Inspection).
6. Troubleshoot and perform repairs if needed (see section on Troubleshooting).
7. Train the healthcare workers how to use and maintain the Solar Suitcase (see section on Teaching the Healthcare Worker).
8. Complete paperwork*.
9. Clean up the site – take away debris and re-organize any furniture moved.

**** Paperwork is extremely important. Please take the time to complete the necessary documentation.***

Basic Maintenance

Inspect and clean the Solar Panel

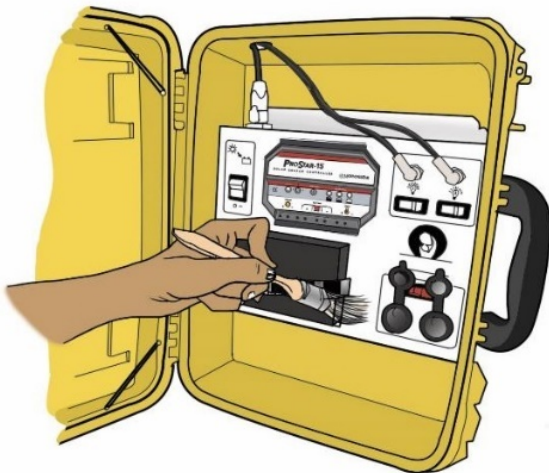
1. Using the ladder, safely climb up onto the roof.
2. Using water and soft cloth, clean any dirt or debris off of the solar panel.
3. Check that there is nothing shading the solar panel at any time of the day. If there is, trim the branches that are shading it if possible.



For more information on cleaning the solar panel, watch our *Video #15: Cleaning the Solar Panel* at www.wecaresolar.org/solar-suitcase/instructional-videos/, or by clicking [here](#).

Clean the Solar Suitcase and Lights


1. Using a soft brush, clean away any dirt that has accumulated on the Solar Suitcase
2. Inspect the back of the LED lights if possible. With a soft damp cloth, clean away and bugs or dirt.




Solar Suitcase Inspection

When you are conducting a maintenance visit, you should inspect and test every component of the Solar Suitcase. While it is important to ask the health workers how it is working, do not rely solely on their response. Visually inspect everything for yourself.

Charge Controller


	YES	NO	Relevant Troubleshooting Section:
Are there lights on the charge controller?	✓	✗	System is not functioning
If it is daytime, is the solar charging light green?	✓	✗	System is not functioning
Are there any signs the wires or parts of the charge controller have gotten hot (melted plastic, etc.)?	✗	✓	N/A – Replacement part needed

Main Battery

	YES	NO	Relevant Troubleshooting Section:
Look back at the charge controller. Is one of the the battery status lights on?	✓	✗	System is not functioning
Is the battery cable missing or broken?	✗	✓	N/A – Replacement part needed
Ask the health worker: Are the lights staying on all night when you need them?	✓	✗	System performance is poor
Ask the health worker: Do the lights stay on as long as they did when you first got the Solar Suitcase?	✓	✗	System performance is poor
Look at the battery replacement date on the battery sticker. Is it close to or past that date?	✗	✓	Replacing the main battery

LED Lights

Turn on each LED light to answer the following questions:

	YES	NO	Relevant Troubleshooting Section:
Do all of the lights turn on?	✓	✗	Light is not functioning
Are any of the lights dimmer/weaker than the others?	✗	✓	Light is not functioning
Do any of the lights flicker	✗	✓	Light is not functioning
Inspect the light cords. Are there any tears/breaks in the cords?	✗	✓	Light is not functioning
Are any of the individual LEDs off inside of the light?	✗	✓	Light is not functioning

Appliances

The health facility should have the following appliances:



2 headlamps



Micro USB cable for headlamp



2-slot USB adaptor



Multi-tip phone charger



Fetal Doppler



Rechargeable battery charger

	YES	NO	Relevant Troubleshooting Section:
Are all of the appliances still present at the health facility?	✓	✗	N/A – Replacement part needed
Are all of the appliances working when you try to use them?	✓	✗	Appliance is not functioning
Does the headlamp and battery charger charge when connected to the Solar Suitcase?	✓	✗	Appliance is not functioning

If any of your responses lead to ✗, then it is likely that the Solar Suitcase or a component is in need of repair or replacement parts. The next section on Troubleshooting is intended to guide you through troubleshooting and repairs.

Troubleshooting



P.19 Appliance is Not Functioning

- One appliance socket is not working
- One specific appliance is not working

P.22 System Performance is Poor

- Lights turn off in the middle of the night
- Lights turn off earlier than they used to

P.24 Light is Not Functioning

- One or more lights do not work
- One or more lights are dimmer than the others
- One or more lights are flickering

P.25 System is Not Functioning

- No appliances or lights work
- No lights on the charge controller display
- It is daytime and the solar charging light is not lit
- Solar Suitcase is not operational

P.26 Replacing the Main Battery

P.27 Spare Parts

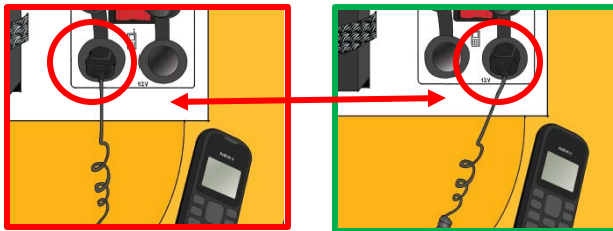
For an overview of troubleshooting common issues, please watch our video on Maintenance & Repair at www.wecaresolar.org/solar-suitcase/version-2/ (Video 5) or by clicking [here](#).

Appliance is Not Functioning

- One appliance socket is not working
- One specific appliance is not working

Make Sure Both Appliance Sockets Are Functioning

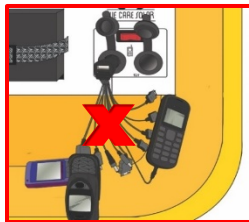
- 1) Make sure the red appliance switch is in the ON position
- 2) Make sure the USB adapter is fully inserted into the socket
- 3) Make sure both sockets are functioning properly



If the appliance still isn't working, follow the instructions below for that appliance.

Phone is Not Charging

- 1) Make sure you are not mis-using the multi-tip phone charger. Charge ONE phone at a time.



- 2) Change to another charger or purchase a new charger.



- 3) If that doesn't work, it could also be that the battery in the phone doesn't work and you need to replace it.



Rechargeable Headlamp is Not Working

1) Check if the rechargeable headlamp is charging properly.

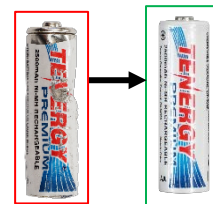


When charging properly, the charging light should be flashing green. If the light is any other color than green, it is not charging.

- a) If the headlamp has REMOVABLE BATTERIES and it is not charging, try removing the batteries and charging them using the AA/AAA battery charger.



- b) If removing the batteries to charge them doesn't work, try replacing the batteries.



2) Check that the headlamp is being used correctly.

Review instructions on how to use the headlamp. A few reminders:



Make sure the headlamp is switched on properly. Switch off headlamp after use.

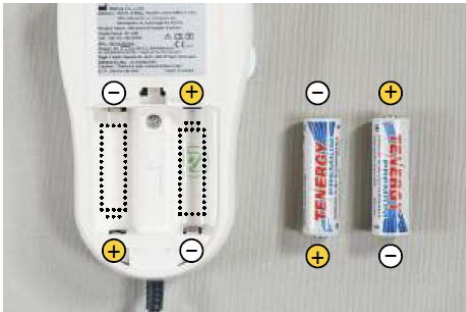


If the charging light is blinking blue when you try to turn it on, it means the headlamp is locked. To unlock it, hold down the main (top) button until the blue light turns off and main light turns on (about 4 seconds).

If it still doesn't work, it may need to be replaced.

Fetal Doppler is Not Working

1) Check the AA rechargeable batteries.



Make sure the batteries are inserted correctly (+ to + and – to –)



Make sure the batteries are fully charged



Replace the AA rechargeable batteries if they are old or damaged

2) Check that the fetal Doppler is being used correctly.

Review instructions on how to use the fetal Doppler.



Be sure the on/off switch is turned on to use and turned off when done



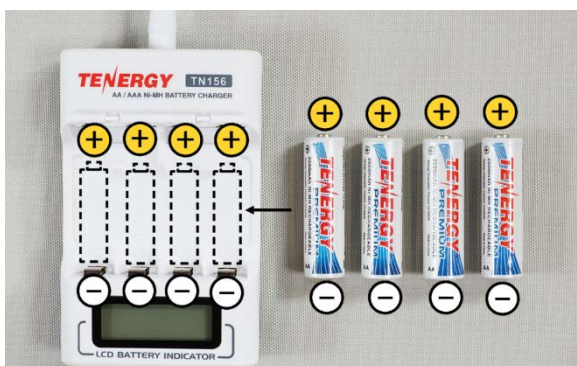
Make sure it is being used correctly



Make sure you use lubricant gel, clean vegetable oil, or KY jelly

Rechargeable Battery Charger is Not Working

1) Check the rechargeable batteries.



Make sure the batteries are inserted correctly (+ to + and – to –)



Check the LCD BATTERY INDICATOR. If you see an ERROR message or one specific battery are not lighting up, that battery may need to be replaced.

System Performance is Poor




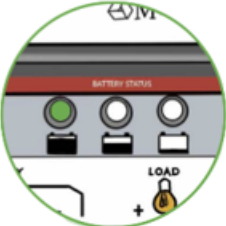










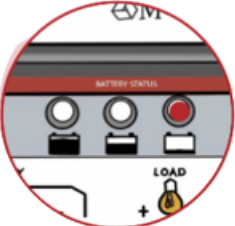




- Lights turn off in the middle of the night
- Lights turn off earlier than they used to

1) Check how old the battery is.

Installation date: 19/06/2017
 Contact name: Joseph Kru
 Contact number: 088 769 473
 Expected replacement date: 19/6/2022

LFP batteries last about 5 years and SLA batteries last about 2 years. There is a sticker on the Solar Suitcase that tells you when the battery will likely need to be replaced. If it is close to or past that date, the Solar Suitcase may need a new battery. See section on Replacing the Main Battery.

2) Make sure the system is not being overused during the day.

			Lights	Phone Charging	Appliance Charging
	BLINKING GREEN 	 100%	✓	✓	✓
	SOLID GREEN 	 10%-90%	✓	✓	✗ 
					 or on a sunny day
	YELLOW 	 <10%	✗ 	✗ 	✗ 
	RED OR BLINKING RED 	 0%	✗ 	✗	✗
					 or only in an emergency

3) Now check what is causing the lack of energy.



If there is bad weather....



Use the lights only when needed and don't charge appliances



If there is shade...



Trim the tree or move the solar panel to an area of the roof that is not shaded



If solar panel is dirty...

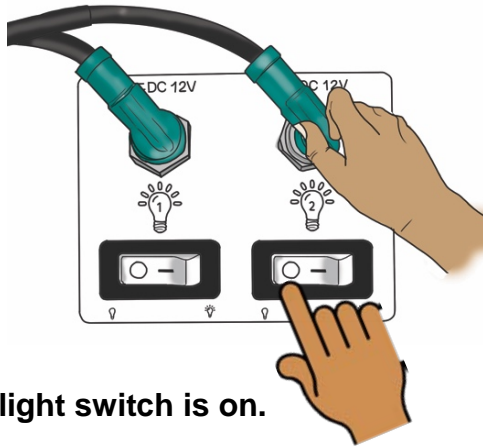


Wash panel with water and a soft cloth

Light is Not Functioning

- One or more lights do not work
- One or more lights are dimmer than the others
- One or more lights are flickering

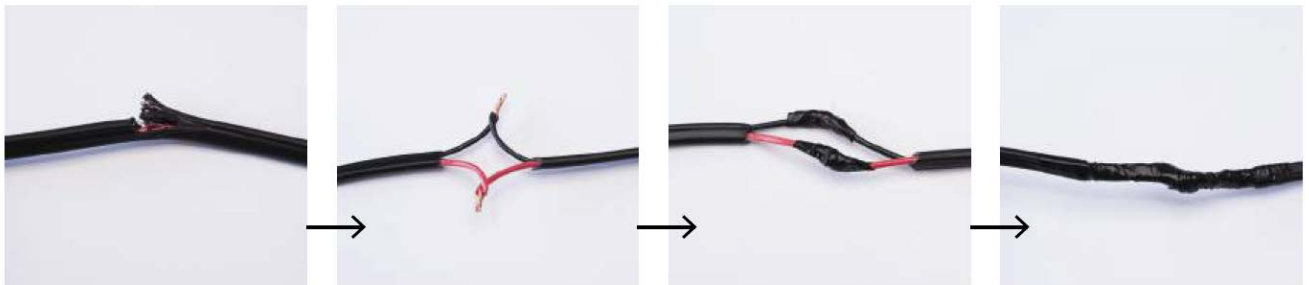
- 1) **Check that the light connectors are inserted correctly and the locking nut is firmly tightened.**



- 2) **Check that the light switch is on.**

- 3) **Check the light cable for damage.**

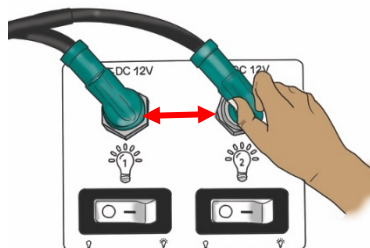
If the wire inside is severely damaged or you can see the metal wire in the cable, wrap electrical tape around each separate negative and positive wire within the larger wire, then wrap tape around the whole bundle.



For more information on repairing a cable, watch our *Video #16: Repairing a Cable* at www.wecaresolar.org/solar-suitcase/instructional-videos/ or click [here](#).

- 4) **Try swapping light connections to see if it is the light or the socket is faulty.**

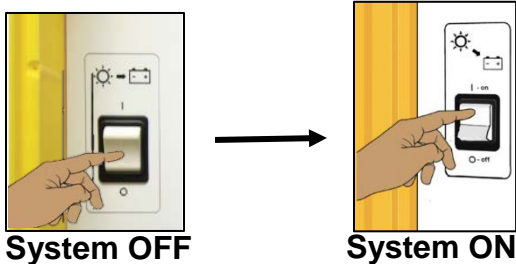
If the light is faulty, the light will need to be replaced.



System is Not Functioning

- No appliances or lights work
- No lights on the charge controller display
- It is daytime and the solar charging light is not lit
- Solar Suitcase is not operational

1) Press the main power switch to OFF. Wait 10 seconds. Press main power switch to ON.



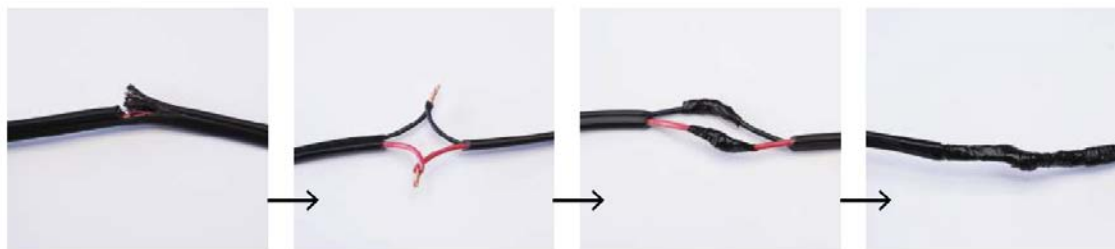
2) Check if the homerun cable and battery cables are firmly connected.



The homerun cable is properly connected when the silver tab clicks into place

3) Check the homerun cable for cuts.

If the wire inside is severely damaged or you can see the metal wire in the cable, wrap electrical tape around each separate negative and positive wire within the larger wire, then wrap tape around the whole bundle.



Note: If the wire is only damaged on the black casing, wrap with electrical tape to prevent further damage.



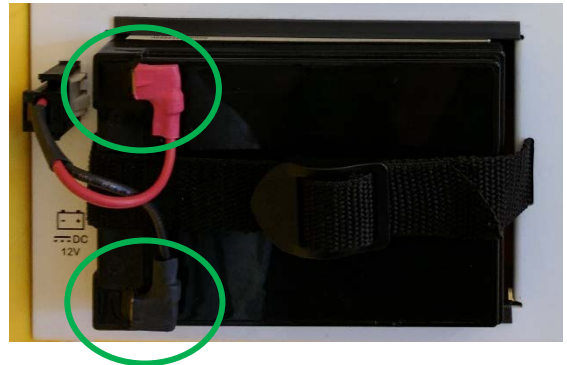
For more information on repairing a cable, watch our *Video #16: Repairing a Cable* at www.wecaresolar.org/solar-suitcase/instructional-videos/ or click [here](#).

Replacing the Main Battery

- 1) Turn the Solar Suitcase main power switch OFF. The lights on the charge controller should go off.



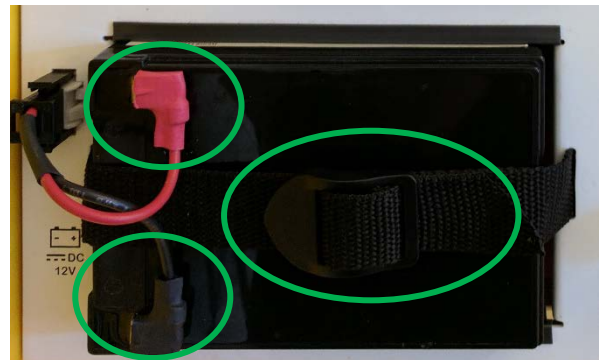
- 2) Remove the black and red wires from the battery.



- 3) Undo the strap that is holding the battery and remove the battery.



- 4) Insert the new battery and secure it to the Solar Suitcase with the strap. Insert the red and black wires back into the battery.



! Ensure the wires are firmly attached to the battery. If the connections are loose, remove the connectors, squeeze the connectors slightly with pliers, and re-insert.

- 5) Turn the Solar Suitcase main power switch back ON. The lights should come on on the charge controller, indicating the battery is properly connected.



Spare Parts

The following is a list of spare parts for the Solar Suitcase. Which items you have available to you may vary by program:

Headlamps with USB charging cord



LED lights



Internal battery cables



USB adapters



Expansion box with 2 LED lights



Maternal health (fetal Doppler) kits



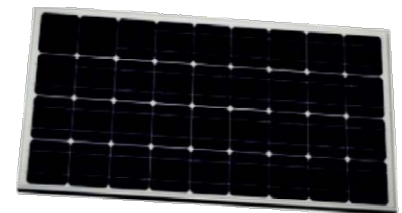
Multi-tip phone chargers



Rechargeable battery chargers



Solar panels



AA & AAA rechargeable batteries



Hardware mounting kits



Homerun cables



14Ah LFP batteries



Teaching Healthcare Workers How to Use the Solar Suitcase

Check for Health Worker Knowledge

If the health workers were ALL present at the training on installation day, you can test their knowledge by asking the following questions:

Ask key users the following questions to demonstrate their knowledge of how to use the Solar Suitcase. Make sure ALL health workers can answer these questions:

1. Where is the main switch? When do you turn it off?
2. What do the different lights mean on the charge controller? (Make sure they know the difference between the solar charging light and the battery status light, as well as what to do when the battery status light is blinking green, green, yellow, and red.)
3. Where are the light switches? When should you use the lights?
4. Where is the appliance switch? When should you charge appliances?
5. Show me how to use the battery charger. What kinds of batteries can you charge in the battery charger? What does it mean to charge the batteries in “families”?
6. When can you charge your phone? How many phones can you charge at one time with the multi-tip phone charger?
7. Show me how to use the fetal Doppler. Should you turn it off when it is not in use? What kinds of lubricants can you use with the fetal Doppler?
8. Show me how to use the headlamp. How do you charge the headlamp?
9. Who do you contact if you have a problem with the Solar Suitcase? Who do you contact when the main battery needs to be replaced?

If healthcare workers can't answer these questions correctly or there are some new health workers there, you should conduct a full refresher training. Refer to the section called Teaching Script for what topics to cover.



We Care Solar Suitcase Teaching Script

This script is an example of how to present all the information about the Solar Suitcase to the healthcare worker. It is meant to act as a guide. As you become familiar with the Solar Suitcase, you do not need to follow the script, but make sure that you have covered all the relevant topics described below.

1. INTRODUCTION: [Say who you are, why you are here, and your role in providing solar suitcase systems to health centers.] For example, “My name is _____, I work [name of in-country organization], I help install Solar Suitcase systems and teach health center staff in the use of the Solar Suitcase.”

2. OVERVIEW: Explain briefly how the Solar Suitcase works using Solar Suitcase and poster.

The Solar Suitcase is a complete solar electric system:

The Solar Panel captures sunlight and changes it into electricity.

The Battery stores electricity: like a bucket storing water.

The Home Run Cable brings electricity from solar panel to battery.

The Charge Controller regulates the electricity going into and out of the battery.

The Charge Controller is like our “eyes” into the battery. It tells us when the battery is full.

The Solar Suitcase comes with Lights, Headlamps, a Cell phone charger, and a Fetal Doppler. [Hold up each appliance.]

The Main Switch turns the whole system on: **Must be on for Solar Suitcase to receive charge from the sun.** Also must be on in order to be able to use lights and charge appliances like the headlamps, cell phones, fetal Doppler.

- Allows electricity to flow from Solar Panel to Solar Suitcase, and from Battery to loads.
- **This Main Switch should always remain on**, except when you want to change the main battery, or if you are transporting the Solar Suitcase. [Invite someone to turn the main power switch from the off position to the on position.]

When **Main Switch** is turned on, the **Charge Controller** lights will turn ON. Now the solar suitcase is ready to be used.

REVIEW OVERVIEW: [Ask questions to ensure people have understood.]

1. What does the battery do?
2. What does the solar panel do? Does it make electricity at night?
3. What does the charge controller do?
4. When should you turn off the **Main Switch**? → Answer: Only to change the main battery

3. READING THE CHARGE CONTROLLER

- **Solar Charging Light:** Above the sun icon: green
 - When the solar panel is under the sun, this light will be lit green. [Show the green light over the sun icon.]
- **Battery Status Lights:** Above battery icon: blinking green, green, yellow, blinking red, red

- These lights tell us when the battery is full, has energy, is nearly empty, or is empty.
- It is important to know how full your battery is to help you know when to charge your appliances and when to save energy.

BLINKING GREEN battery status light – This means there is more power coming from the solar panel than the main battery can utilize. So.... There is EXTRA electricity available.

- ✓ It is a good time to charge your cell phone, your headlamps, or the AA batteries included in your Solar Suitcase for the fetal Doppler.

GREEN battery status light – the battery between 10% and 90% full.

- ✓ Only use lights at night.
- ✓ Only charge necessary appliances during the day.

YELLOW battery status light – the battery is almost empty.

- ✓ It is time to save energy. DO NOT charge up new appliances. Turn off your lights if they are not needed, OR only use one light, and wait for the sun to recharge your battery.
- ✓ If you have a medical procedure and need to use a light, we recommend you use ONE light rather than BOTH of the lights.
- ✓ Get your headlamps ready.
- ✓ Turn off all your other appliances.

RED battery status light – the battery is empty.

- ✓ The battery is depleted and the system will automatically shut off until the battery can recharge from the solar panels.
- ✓ When this occurs, turn off the appliance and light switches so that the battery can fully recharge the next day (when there is sunlight). **Keep the Main Switch ON.**
- ✓ Wait for the battery to recharge. The battery will recharge the next day using sunlight.
- ✓ When the battery status light is green you can use the Solar Suitcase again.

REVIEW CHARGE CONTROLLER [Ask questions to ensure people have understood.]

1. What do the different color lights indicate? → Answer: Blinking green – there is extra power; Green – battery is 10-90% full; Yellow – battery is getting close to empty; Red – battery is empty.
2. How do you know when it is ok to charge appliances? → Answer: When it is sunny and the battery light is blinking green or green.
3. How can you tell that the solar panel is properly connected? → Answer: When the green charging light on the charge controller is lit.

4. USING THE SYSTEM

a. USING THE SYSTEM during the NIGHT:

- The main function of Solar Suitcase is to provide lighting for medical procedures at night.
- **The Main Battery has a LIMITED amount of energy**, and is the only source of energy at night. A fully charged battery will keep the lights on all night.

- **Night is the time to use medical lights.**
 - Use the lights when you need them.
 - Each light has its own switch.
 - Only use one light per room when you are not treating patients.
 - Turn both lights off when they are not needed.
- *DO NOT* charge your cell phone or rechargeable batteries at night, unless there is an emergency. *[Refer to poster. Show that section. Have the entire group read this out loud.]*
- You may *use* appliances at night, however the batteries should be *charged* during the day.

b. USING THE SYTEM during the DAY:

- When it is **daytime**, make sure to TURN OFF your lights, unless needed for medical procedures.
- When the green battery status light is flashing you can use the Solar Suitcase to charge cell phones, the headlamps and rechargeable batteries. When the light is flashing green: There is extra energy, and on a sunny day, the Solar Suitcase can charge several phones and appliances.

REVIEW USING THE SYSTEM: *[Ask questions to ensure people have understood.]*

1. Should you charge cell phone at night? → Answer: No, unless needed for emergency.
2. Should I leave lights on all the time if battery is full? → Answer: No, use the lights when needed. Turn off when not needed.

4. APPLIANCES

a. Appliances- CHARGING CELL PHONES

- *[Show how to connect cell phone to suitcase with USB adapter.]*
- Charge only ONE cell phone at a time on the multi-tip phone charger.
- Make sure USB adapter is pushed all the way into the socket.
- *[Ask for volunteers to charge their phone.]*
- The **Red Appliance Switch** turns on both power sockets on bottom of the Solar Suitcase.
- If you cannot find the right attachment for your particular cell phone, or if the cell phone adaptor breaks, you can use any cell phone charger that comes with a car charger plug. These can be purchased locally.
- Turn OFF the Red Switch when you don't need to charge any device or batteries.

b. Appliances- USING THE HEADLAMPS

- There are two orange headlamps.
- These are special headlamps because they can be charged just like a cell phone.
- First, make sure to place the USB adapter into the appliance socket and turn on the Red Appliance switch.

- To charge the headlamp, insert the micro-USB plug into the hole under rubber stopper on the headlamp and the USB plug into the USB adapter in the appliance socket.
- When the headlamp is charging, the headlamp LED will be blinking green. When the headlamp is fully charged, the LED light on the headlamp will be solid green.
- To turn on headlamp: push the button on top. *[Show how to turn on the headlamps.]*
- Adjust the beam of the light like this. *[Show how to adjust where the light beam directs by swiveling the headlamps. Also, show the different light settings and how to hold down the button and dim the lights to conserve energy and make the batteries last longer]*
- *[Have students practice]*

c. Appliances - USING THE AA/AAA BATTERY CHARGER.

- AA/AAA battery charger will charge RECHARGABLE AA and AAA batteries.
 - RECHARGABLE AA batteries are included in the Solar Suitcase for the fetal Doppler.
 - The charger CANNOT be used with single-use batteries. If you place single-use batteries into the battery charger, the charger will break.
 - Only use the rechargeable batteries provided with the Solar Suitcase in your AA/AAA battery charger, or other batteries that are rechargeable.
 - Charge the batteries in “families”, meaning they get charged and discharged together.
 - These batteries will power your fetal Doppler and other small devices.
- How to charge: place the positive side of the batteries in the positive side of the charger.
- Mark the positive side of the charger with a + sign.
- We included AA rechargeable batteries. The small white tab on the battery charger needs to be in the upright position to accommodate the AA batteries.
- *[Have volunteers demonstrate how to put in batteries in front of whole class.]*
- During the daytime, you CAN charge a phone and the rechargeable battery at the same time.
- If you run out of rechargeable batteries, the fetal Doppler can use single-use batteries. However, you cannot re-charge the single-use batteries in the Battery Charger. **DON'T PUT SINGLE-USE BATTERIES IN BATTERY CHARGER.**
- **ONLY RECHARGE BATTERIES ON SUNNY DAYS WHEN THE MAIN SOLAR SUITCASE BATTERY IS FULL!!!!!!**

d. Appliances- USING THE FETAL DOPPLER

- You can listen to a fetal heart beat by placing the fetal Doppler probe on the mother's abdomen where you think the baby's heart is.
 - Note: It is best to palpate the uterus FIRST and identify where the fetal ribcage should be, before trying to find the heart beat. Once you think you have identified the fetal back, **hold the fetal Doppler still in a single position to allow it to detect the heart beat.** If you need to adjust the position, do this slowly and allow

time for the machine to detect the heart beat in the next position. The sound waves from the fetal Doppler bounce off the heart beat and this takes time.

- If your Solar Suitcase includes a fetal Doppler, it will use Rechargeable AA batteries included with the Solar Suitcase.
 - The batteries go in the back of the fetal Doppler.
 - Make sure they are placed correctly: positive to positive, negative to negative
 - The batteries that come with the Solar Suitcase are RECHARGEABLE.
- Once the fetal Doppler has fully charged batteries, turn it on with the switch on the side. *[Demonstrate turning on the fetal Doppler.]*
 - The switch on the side controls the volume.
 - When you are finished using the fetal Doppler, turn it off – listen for a *click.
- The fetal Doppler **only works with a lubricant on the mother's skin.**
 - You can use the gel in the case.
 - **If you run out of gel you can use any vegetable oil. Water does not conduct the sound well, and should not be used.**
- Ask the midwife to palpate the mother.
 - Identify the position of the fetus, and estimate the position of the fetal thorax.
 - Place gel or oil on the mother's skin close to where you think the fetal heart is.
 - Turn on the fetal Doppler, and hold the probe against the mother's skin, in the direction of the fetal heart.
 - Hold the machine still until you hear a sound. If you can't hear the heart beat, gently adjust the angle of the probe in another direction and wait again. Don't slide the probe around.
- Understanding the fetal Doppler display:
 - The fetal Doppler has a digital display that will show you the heart beat. You must see a solid black heart in the display to be receiving an accurate heart rate reading.
 - The fetal heart rate is normally between 120 and 160 beats per minute. IF the heart beat is less than 120 or more than 160, the baby may be in danger.
 - If the heart beat is less than 100, it may be the mother's heart beat. To confirm whether you are hearing the mother, check her wrist pulse with your hand while listening to the fetal heart rate.

REVIEW APPLIANCES [Ask questions to ensure people have understood.]

1. When can you charge your phone? → Answer: When the battery is full.
2. How do you know if battery is full? → Answer: Look for blinking green light on Charge Controller.
3. Should you charge rechargeable batteries at night? → Answer: No. (Why not?)
4. What should you do if you run out of gel that comes with Solar Suitcase? → Answer: You can use vegetable oil. (Can you use water? → Answer: No).
5. Can you recharge single-use batteries in the battery charger? → Answer: No.
6. When is the best time to charge cell phones? → Answer: During the day.
7. Should the lights stay on all the time? → Answer: No.

OVERALL REVIEW

ONE - Make sure that the solar panels have unshaded sunlight for at least five hours a day. You can leave the solar panels out in the rain and leave it out on cloudy days. Make sure your

panels are clean – rinse them with water when they get dirty (but only if it is safe to do so). Do not climb on roof unless you are trained to do so.

TWO – Make sure that you ALWAYS LEAVE THE **MAIN POWER SWITCH ON**. This switch will turn on your solar panels and battery. If it is off, you cannot use the Solar Suitcase and the battery cannot charge from the sun.

THREE – At night time, only use the Solar Suitcase for lighting and do NOT charge other appliances. (If there is an emergency and you need to call for help, you can charge your cell phone anytime you need). In the day time, turn OFF the lights.

FOUR – During the day, you can charge your cell phones, headlamps, and AA batteries for the Doppler, when your battery is full. Your battery is full when the battery status light is blinking green.

FIVE – If you have questions, refer to the manual and poster that is included with the Solar Suitcase or call your local technician that installed the Solar Suitcase.

5. GROUP PRACTICE FIXING COMMON PROBLEMS

1. First: Start with the main power switch on and both lights on.
2. Second: Everyone cover your eyes until I say "open."
3. Third: Change something on the Solar Suitcase so it does not work (see options below).
4. Fourth: Invite people to open their eyes and choose a volunteer to come up and "solve" the problem with everyone watching.

Options for changing something on the Solar Suitcase so it does not work:

- Turn off the light switch ~ Have them figure out that they just need to turn switch on again.
- Turn off Main Switch ~ Have them figure out that the Main Switch needs to be turned ON to make lights work.
- Unplug the Battery Plug ~ Have them figure out that they need to plug in Battery Plug for system to work.
- Remove the red slip-on battery connector from the positive terminal of the Battery ~ They will need to slip it back on for the system to work.
- Partially unscrew and partially unplug one of the Light Connectors ~ They will need to plug it back in and screw it tight again.
- Partially disconnect the Home Run Cable Plug (blue and yellow end) from top of Main Control Board and see if they notice that no solar amps are coming in and that the charging light is OFF ~ They will need to turn it so it will click back into place.
- Partially plug in the plug in the battery charger, but not enough that it makes the electrical connection ~ They will need to plug it in all the way.
- Turn OFF the appliance switch (red) ~ They will need to turn it on for the battery charger to function.

Teaching Tips

Teaching Tips

- Use the Solar Suitcase User Manual (if available) as a teaching tool when teaching the healthcare workers
- Speak slowly and clearly
- All healthcare workers should know how to interact with the Solar Suitcases and appliances. Don't do it for them! Make sure they get to practice using the Solar Suitcase and appliances.
- Repeat key messages.
- Check healthcare workers understand by asking them to show you or explain what you just taught before moving on to the next topic.
- Reinforce reasons for training – proper usage will ensure midwives have light when they most need it.



User Manual



Solar Suitcase Maintenance Visit Checklist

Use the checklist below to ensure you don't forget anything on the day of your visit to the health facilities:

1. Introduce yourself to the person in charge of the clinic. Take a tour of the clinic with the medical team.
2. Ask health workers about how they are using the Solar Suitcase and whether it is working for them.
3. Perform basic maintenance, such as cleaning the case and solar panel (see section on Basic Maintenance).
4. Inspect the Solar Suitcase and ensure everything is functioning, including the main battery, lights, and appliances (see section on Solar Suitcase Inspection).
5. Troubleshoot and perform repairs if needed (see section on Troubleshooting). Fill out an [Incident Report](#) for technical support if you are unable to resolve the issue.
6. Train the healthcare workers how to use and maintain the Solar Suitcase (see section on Teaching the Healthcare Worker).
7. Complete paperwork. Paperwork to be completed will vary by country and program.
8. Clean up the site – take away debris and re-organize any furniture moved.

Please visit <https://wecaresolar.org/solar-suitcase/version-2/> for more information on the Version 2 Solar Suitcase.

Artwork in this manual courtesy of:

