

Naps Solar Power Kits installation- and userguide





Cover picture: In the picture you can see an example of complete Naps Solar Power Kit. Content of the accessory kit can vary between different kits.

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NAPS*

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General Information

Read all instructions given here before beginning installation or use. The warranty for the devices is only valid if these instructions have been followed when installing and using the kit. Keep these instructions available! If you feel insecure about the installation or you find yourself troubled while doing so, contact a Naps sales representative. We will be happy to help you.

This Manual and the methods described herein conform to common electrical installation codes and can be undertaken by any person with basic electrical / mechanical skills without the necessity of a certified electrician."

Packaging material (cardboard) can be recycled in drop-off collection points or burned. Once a controller or battery has come to the end of its life span, it should be taken to a drop-off collection point reserved for the purpose. The panel consists of various metals, glass, plastics and semiconductors. It is also recycled through a recycling centre or an equivalent drop-off point.

The Naps Solar Power Kit consists of following main components:

1. Solar panel

Converts sunlight directly into direct current. The current produced by the panel is directly proportional to the intensity of the light.

2. Battery

Stores the electric energy produced by the panel and feeds it to consumption devices.

3. Control unit

Gives the readings for battery and panel status, for example. Lengthens the lifetime of the battery by preventing overload and deep discharge.

Note!

Even though the voltage in the terminals of a single panel is 20 V at the maximum, there may be some sparking when connecting the device. The devices of a solar power kit may not be installed in spaces containing flammable liquids or gases! Tools needed for installation:

screwdriver and side cutters

- knife
- hammer
- battery-driven drilling machine or hand drill
- 16 mm drill bit for wood

Planning Kit Installation

Introduction

First determine the locations for lights, plugs, the battery, control unit and panels. The aim is to keep the distance between the control unit and the battery, panel and consumption devices as short as possible. See cabling example (on page 4, picture 3).

The most important things to note:

- the cable length between the control unit and the panel depends on the power of the panel and the thickness of the cable to be used.
- the maximum cable length between the control unit and the battery is 3 m (or otherwise 2 x 6.0 mm² cable is to be used, in which case the maximum length is 4 m. A battery cable is included in the Naps kit). The maximum cable lengths between the control unit and consumption devices, depending on the total amount of current required by the devices:

Table 1	Load current				
Cable	1A	2A	3A	4A	5A
2 x 2,5mm ²	35m	17m	12m	9m	7m
$2 x 4,0 mm^2$	57m	28m	19m	14m	11m
2 x 6,0mm ²	85m	42m	28m	21m	17m

Example:

a) Determining load current:

consumption device: Portable television, power 60 W, voltage 12 V

load current =
$$\frac{1}{12} = \frac{60}{12} = 5 \text{ A}$$



b) Maximum cable length:

Plan carefully (Table 1) the installation of the battery and load cables. The table will show, for example, that the maximum length of a 2 x 2.5 mm² cable between the control unit and the portable television is 7 m when the load current is 5 A.

Note! The wiring between the television and the control unit should be as short as possible. We recommend $2 \times 4.0 \text{ mm}^2$ cable. For most portable colour televisions, the current consumption is approximately 4 - 8 A. The length of the TV's own cord is included in the total length.

Polarity rule for devices and wires

With all cabling relating to the kit, the rule ensuring correct polarity is to be used.

The wires coming from the panel and battery to the control unit, as well as the wires from the control unit to the plugs, distribution boxes and devices, must be connected so that the plus wire is red and the minus wire is blue.

The poles + and - have been marked into the wall outlet connectors (picture 1).



Connect the plugs and consumption devices so that the plus wire (red) is connected with the plus connector and the minus wire (blue) with the minus connector. Respectively, the contact plugs of the consumption device cords should be connected so that the plus wire is connected to the thicker connecting plug.

Note that the plug casing will only fit in one way: the bigger hole on the plus side.

Connections to control unit

As a general rule, the following order is to be used when connecting cables into the control unit: first connect the battery, then the solar panels, and last the load circuits (picture 2).



When making connections to the NC15/30 control unit, first connect the cable coming from the battery to the middle plus/minus connector of the control unit: plus wire to the plus connector and minus wire to the minus connector. After this, connect the cable of the solar panel to the left inlet.

When using several panels, the panels can be installed into parallel connection in a special panel centre which may also contain overvoltage protection devices and fuses.

The highest total load current of the panels may not exceed the nominal value of the controller inlet (NC15 = 15 A and NC30 = 30 A): The total current of the consumption devices may not exceed NC15 = 15A and NC30 = 30 A.

The NC15/30 control units have one load circuit (see picture 2). The loads can be connected to the controller through a separate fuse box and/or distribution boxes.

In case several 12 V batteries are used, they must be installed into parallel connection. It is recommendable to use a 15 A fuse on the patch cord if the batteries are not located right next to each other.



To be noted when installing cables:

- As the battery cable, use the cable that comes in the package; the length of the cable is 3-4 m, depending on the kit. Shorten if needed.
- The wire coming from the plus terminal of the battery, approximately 0.5 m from the battery, must have a fuse. A ready-made battery cable with a 20 A or 25 A automatic fuse is delivered together with the Naps kit. This is the main fuse of the kit. Do not use the switch in the fuse to cut off the current when leaving the cottage; this would prevent the battery from recharging. However, the switch should be used during additional installations or maintenance.
- The plus terminal of the battery has been marked with a red terminal cover and a + mark next to the terminal. Similarly, the minus terminal has been marked with a blue terminal cover and a - mark next to the terminal.
- The installation equipment set for the kit contains 2 x 2.5 mm² wire for cabling. Always check in the loading table (on page 2 table 1) that the lengths of the cables to be installed do not exceed the maximum lengths set for the various current readings.

- The loading circuits should be divided into appropriate groups. For example, motor loads (pump, fan, etc.) into one group, and lights and TV into separate groups (cabling example picture 3). In case 230 V consumption devices are used, an inverter must always be connected straight to battery terminals.
- If needed, load circuits and cable extensions must be branched through distribution boxes.
- Especial care must be taken to ensure that the cords of consumption devices containing electronics (TV, radio, fluorescent lamps, radiophones, etc.) have been connected with the correct terminals. Using incorrect terminals may cause the device to break. If the polarity of the cord has not been clearly indicated with the colours red (+) and blue (-) or some other marking, it is best to leave the installation to a professional.
- To lead the cable in, you can drill a 16 mm hole to the wall and install a M16 installation conduit into the lead-in to cover the cable, especially in such moving structures as timber walls. A lead-in made into a woodwork joint in a timber wall requires a conduit in the strength class 4.
- The cables may not be installed inside thermal insulation material (except for lead-ins).



- If a sauna light is installed more than a meter above the floor, special sauna cable must be used for the purpose and the light must be made up of structure marked with T125C.
- The cables should be mounted with appropriate nail fasteners.
- The cable should be covered with suitable moulding in places where it can get damaged.
- Always avoid damaging the cable with nails.
- For underground installations, we recommend using underground cable, for example type MCMK.
- In case other related components or installation materials are acquired to the kit (for example, cables), contact a supplier or a professional in electric engineering to ensure that the electric installation of your kit is safe and functional.

III Panel Location

Handle the panel with care. If the glass is broken, it cannot be fixed. Fasten the panel tight enough to endure wind and snow.

The correct tilt angle

In high latitudes (e.g. $50-60^{\circ}$), the most advantageous tilt angle varies between 30° and 90° according to the season (picture 4). In lower latitudes but outside the tropics the optimum tilt angle is latitude + 15° for all year around loads. For summer loads the the tilt should be latitude - 15° and for all year around load except winter the tilt equals with the latitude.



- Tilt angle = Latitude 15/20° guarantees the best possible electricity production during summer. Tilt angles below 15° should be avoided to prevent dust, dirt and snow from gathering above the panel and from disturbing electricity production.
- 2. Tilt angle = Latitude is the best tilt angle when trying to maximise the annual electricity production with a single panel position.
- 3. Tilt angle = Latitude + 15/20° gives the best electricity production reading during winter season.

The correct direction angle

The direction angle of the panel is not equally critical. In general, the panel should be directed towards south (or north in southern hemisphere). The panel also works in a satisfactory way when the direction is within the sector southeast - south-west (picture 5).



Panel locations

The most important thing is to locate the panel in a place which gets the most sunlight. *The panel or its cells may not be shadowed by any nearby obstacles, such as buildings, eaves, or tree branches.* Shadows heavily decrease the production of the panel (picture 6).

Suitable locations for installation include, among others, roofs, walls and waterfront. If a panel is mounted on a wall, it must be ensured that eaves do not cast a shadow on the panel even when the sun is at its highest in the summer.

If the panel is mounted on a roof, it must be mounted near the ridge. It must not be mounted on an eave, because it would create a barrier for snow. The panel may also be erected, for example on robust 2" steel pipe mounted on a pediment. The same pipe can be used as a mast for a TV antenna. (Ground the pipe and the panel).



If you cannot find a place on the roof of your cottage which receives direct sunlight for 6 hours during the day, it is even better to install the panel to waterfront 50 meters away from waterline than on the shadowy roof. It is recommendable to use, for example, a 3-metre long steel pipe in waterfront installation.

IV Naps Solar Power Battery

The purpose of the battery is to store electricity for the dark and rainy season. Naps batteries have been developed from starter batteries and they are low-antimony special batteries suitable for solar power use. Their casings are shockproof plastic and they have durable carry handles.

In case several batteries are connected to the kit to increase capacity, they must be installed into parallel connection (picture 7): the plus terminals to each other and the minus terminals to each other.



Connect the plus wire of the connection cable to the plus terminal on one battery, and the minus wire to the minus terminal of a second or third battery. It is also useful to protect each battery with a separate fuse unless they have been located right next to each other.

Battery location

The battery should be installed to a well ventilated space. If this is not possible, it is imperative to draw the gas outlet hose out through the wall or to use the tank that is delivered as accessory. The hose must be cut to a suitable length so that no loops or curves remain. However, the amount of gas from the battery in normal use is very low. It is useful to keep an acid-proof drainage basin below the battery or to place it in a protective casing.

The battery must be located in a place which is sheltered from rain and humidity, and the temperature may not rise above + 35°C. If the kit is also used during winter, decrease of charge level below 75% should be avoided (see battery maintenance instructions).

The cable is connected to the battery with insulated quick couplings. The red connector is connected with the plus wire and the blue connector with the minus wire. The battery contains terminal covers that correspond to the colours of the connectors. If batteries have screw terminals then suitable terminal shoes are used.

Battery maintenance

- Check the liquid level of the battery at least twice a year (at the beginning and end of use).
- Fill the battery up to the plastic mark inside the battery (the plates of the cells must be covered with liquid at all times). When filling, use only refined battery water. Do not add water during frost season.
- Make sure that the gas outlet hose is not clogged.
- Always keep the battery clean and dry to prevent surface leaks.
- Check the cleanliness of the contact surfaces of battery terminals and quick couplings once a year.



- It is forbidden to continuously overload or deep discharge the battery, or to keep it undercharged. You can notice an overcharge through increased water consumption and moisture on the battery surface. The control unit of the Naps kit ensures that your battery is not overloaded or deep discharged. It also makes sure that the battery receives full charge when loading is cut off and sunlight is available.

Battery storage and winter use

If you need to store your Naps battery detached from the controller (detach also the cables from the controller), check the density of the acid once a month and conduct an after charge once the density has dropped below 1.22 g/cm³. The easiest way to determine the charge status of the battery is to measure the density of sulphuric acid. Since temperature affects acid density, see below (table 2) for density readings in various temperatures, corresponding to the battery charge statuses.

Table 2

		Battery state of charge (SOC)			
Temperature	25%	50%	75%	100%	
C ˆ					
+20	1,13	1,18	1,23	1,28	
+10	1,14	1,19	1,24	1,29	
0	1,15	1,20	1,25	1,30	
-10	1,16	1,21	1,26	1,31	

Take into account that if left outside during frost season, a battery in less than full charge may freeze and get damaged. During winter season, make sure to charge the battery after use. In November-February, the panel is able to maintain the existing charge. Depending on the charge status, the electrolyte liquid in the battery will freeze as follows:

- 25% charge, freezing point -10°C
- 50% charge, freezing point -20°C
- 75% charge, freezing point -40°C
- 100% charge, freezing point -60°C

Installation of gas outlet hose to the battery

Plastic hose, with inner diameter 5 mm, is coupled to either connection at the end of the battery and led through the floor or wall, or to the tank that is delivered as accessory.

Instructions for the installation and use of acidometer

Installation

- Remove the covering foam plastic or other cover from the dipstick (float) in the glass tube
- Place the dipstick into the glass tube in the position shown in picture 8.
- Push the suction pipe tightly inside the glass tube.

Instructions for use



- Open the battery cover and put the suction pipe into the battery. Suck battery fluid into the glass tube by pressing the air pump. Suck fluid only enough to make the dipstick float freely in the fluid (not to lie at the bottom or hit the walls).
- The charge status is measured from the intersection of the fluid surface and the dipstick.
- Take the measure for all six cells.
- Note that the reading is only suggestive; the measuring result is taken from the top of the cells.

V Kit Installation

Location

- Select a shadowless location (throughout the day) for the solar panel. Remember that the sufficiency of the cross-sectional area of the cable must be checked in relation to cable length.
- 2. A central location must be selected for the control unit. Try to keep the cables as short as possible to minimize voltage loss (picture 12).



Picture 11

3. The battery should be placed as close to the control unit as possible (as short a cable as possible, max length 4 m). Check the ventilation and make sure that the battery is located in a dry place. It is recommendable to use the gas outlet hose which comes with the battery (pictures 13 and 14). When using a separate protective casing, check carefully that the gas exhaust system has been tightly installed (see also paragraph battery on page 17).



Wiring







4. A 3 - 4 m long battery cable, which is delivered in the installation package, is connected between the control unit and the battery. Set the automatic fuse in the cable into OFF position until you have finished all wirings also those leading to the consumption devices (picture 15).



5. To begin wiring from the panels, begin by fastening the panel to a mounting bracket in a shadowless place. The panel is wired according to the diagrams below. Note that different panels have varying connecting boxes behind the panel. Bring the cable to the control unit, but do not connect the cable to the unit yet.

Examples of various connecting boxes in panels:

Some panels have plus and minus connector casings at different ends behind the panel (picture 16). However, plus and minus connectors are usually in the same casing. You only need to peel the cable enough to make the wires reach their corresponding connectors in the casing. After leading the wires through bushings, remove 10 mm of insulation material at the ends of the wires.



Compress a suitable connector (blue or yellow) with pliers from the plier/connector set to the end of the wires and screw them beneath the washer; the red cable to the plus connector and the blue cable to the minus connector (picture 17).



Some panels contain special connecting boxes in which wires are led beneath spring-loaded connectors (picture 18). In this case, both plus and minus wires must be peeled for about 17-19 mm. As the wire is led beneath the connector, the spring is released by pressing a finger on the connector in question (picture 19). Remember to ensure the tightness of the connection by tightening the bushings.



6. Fastening a cable coming from the panel: Connect the panel to the panel point in the control unit; plus wire to the point marked with a plus and minus wire to the point marked with a minus. In case of several panels, they can be installed into parallel connection in the panel centre (picture 20). The panel centre should be placed close to the panels. Note that there maybe a need for cable with larger cross-sectional area between the panel centre and the controller.



 Wiring to consumption devices: Connect the load circuits into the control unit straight through the distribution boxes or via the load fuse box (picture 21). The load fuse box is mainly used with the NC30 controller. See also the wiring for a distribution box (picture 22).





 Connect the battery fuse into ON position and check the battery voltage from the controller display. Check if the consumption devices, such as lamps, function normally. Check also from the controller display that the panel charges the battery during sunny periods.

The cabling is now completed. Unless you have charged the battery at home right before installation, let the battery charge for two sunny days before taking the kit into use.





Mounting a battery fuse box

- Twist the bottom off the box with a screwdriver (grey box) or from above the box (white box) (item 1, picture 23).
- Remove the automatic fuse from the bottom of the box. When you turn the metal or plastic loop in the automatic fuse in the direction of the arrow with a screwdriver, the locking will be released and the automatic fuse can be removed (item 2, picture 23).
- Fasten the bottom to the wall (item 3, picture 23).
- Press and fasten the automatic fuse back to the bottom, replace the cover and make sure that the wires do not get squeezed (item 4, picture 23).

Installation of load switch

- Lever the handle straight upwards and remove the cover plate (box) by opening the side bolts with a screwdriver (picture 24).
- Remove 8 mm of wire insulation (marked at the back of the base). The cover plate (box) is replaced by slightly pressing the stop spring with a screwdriver.
- The arrows on the switch lever and base indicate the correct direction of installation (picture 24). The handle can now be replaced. See pictures 25, 26 and 27.









VI Control Unit Functions

Control unit switches and display

The Naps NC15 and NC30 controllers are smart controllers based on a micro processor and equipped with a display. On the display of the charge controller, you can get information on system functions in symbols and numbers. All settings and the display can be controlled with two operating switches. The settings will remain in the controller even after current cut-off.



The controller operates in a state that is based either on the battery State-Of-Charge (SOC) or voltage. See the controller user instructions for further information on choosing the operation mode. Note that it may take a while before the battery SOC indicated by the controller settles to the actual level after start-up. The amount of time needed depends on the battery usage and requires several battery cycles.

Important! The charge controller is equipped with several functions which allow it to protect itself, the batteries and the consumption devices. Regardless of these functions, the controller may get damaged if the allowed reference values are exceeded. See the controller user instructions for further information on the operation of the controller.

Main switch

The controller has no actual main switch. However, the switch of the automatic fuse on the system battery wire can be used as a main switch. **Note!** When the switch is in open position, the panel will not recharge the battery. This switch should only be used during maintenance.



Charging adjustment

Depending on the status of the battery, the controller automatically selects the optimal charging method. These include continuous charging, quick charging and equalisation charging. For each charging method, different voltage and SOC limits apply. In addition, the controller accommodates the ambient temperature in final readings. The need for equalisation charging is checked every 30 days. Open and closed batteries have separate limits.

Note that you must observe the liquid levels in the batteries during charging, because water consumption and the formation of explosion gas will be somewhat increased. The control unit looks after battery charging and will cut off the charging current once the battery is full.

Important! When the panel charges the battery, its terminal voltage increases to the maximum towards the end of the charging: 13.9 V in continuous charging and 14.4 V in quick charging (open battery). If you use consumption devices during the day when the charging voltage is high, it may be useful to check the durability of the device for overvoltage.

Deep discharge protection

The control unit prevents deep discharge of the battery by cutting off the current supply to the load circuits when the voltage drops below approx. 11.1 V (voltage control) or below 30% of the SOC (SOC control). The controller gives an alarm for disconnecting consumption devices in slightly higher voltage or SOC levels, depending on the control mode.

The loads are re-connected once the battery voltage or SOC has increased a bit over the higher limit values.

VII Maintenance Instructions

To get the full advantage out of your kit also later on, we recommend that you carry out the following scheduled system maintenance tasks. Suitable times for maintenance are in the spring at the beginning of the using period and in the autumn after the using period has ended.

1. Solar panels

Check the fastening to the bracket and clean up

the surface of the panel. Make sure that vegetation does not cast shadows on the panel. Check electric connections (every two years).

2. Battery

Check acid density (charge status) with an acidometer. Clean the terminals and the battery cover. Check the liquid level. Make sure that the battery has a sufficient charge level over the winter, either by charging with the panel or by using an aggregate to charge it.

3. Control unit

Never take the battery fuse out of use. This prevents the battery from getting charged through the panel. Check regularly the electric connections to the controller.

4. Water pump

The water system must be protected from freezing by emptying the whole system from water. Do as follows:

- cut off the current to the pump.
- open the water taps to release the pressure.
- remove the casing of the micro filter and leave the filter cartridge in its place to dry up without the casing.
- empty the pressure pipe by detaching it from the pump, and let the pipework and pressure accumulator empty from water.
- remove the suction pipe from the pump, and the base valve from the pipe, and let the suction pipe empty.
- turn the pump on for a while to let it empty from the remaining water. If possible, take the pump to your home for winter storing. A condition for the warranty of the pump is that it is emptied from water when temperature drops to 0°C or below.

5. Refrigerator

Empty and dry the refrigerator after use, and leave the door ajar.

VIII Troubleshooting

Symptom: The battery has emptied, the control unit cuts the current off from the load circuits.

To check:

- Measure the charge status of the battery in all the cells with an acidometer. The reading should be almost identical in all the cells. If the charge level of a cell is significantly lower than in the other cells, the battery is defective.
- If the previous measuring gave good readings for all the cells, check the connections between the battery and the control unit, and measure if the voltage in the connectors going to the battery of the control unit is the same as in the battery terminals when loaded (lights and TV). If the voltage is higher than 11.5 V in the control unit end and it still cuts off the current, the defect is in the control unit.
- If the charge status reading was low, check the charging end and the recent amount of consumption. Check panel connections, shading, and the correct direction and tilt angles.

Symptom: The control unit does not show the charge level when the sun is shining to the panel and the charge level does not rise. (Note! The rise of the battery charge level may be slow. It is affected by the weather, loading and charging power of the panel).

To check:

- Check panel connections and cabling.
- Estimate your recent amount of consumption and take into account the output of the solar panel with regard to the season; in the winter season (November-January) the panel can only maintain the existing charge level (in higher latitudes), there is not enough power for consuming. If the control unit does not show the charging status, the defect is in the control unit.

Symptom: The battery does not take charging in.

To check:

- If the battery does not take charging in, it is indicated by increased terminal voltage in the battery while the charge status still remains low.

This happens if the battery has been in a low SOC level for a long time. In this case, let the battery recover from it: charge the battery with an external charger and let it get fully charged in the system (this may take several sunny days, depending on how many panels the system contains). If you detect this defect late in the autumn or early in the winter, the battery must be charged with an external battery.

Symptom: A part of the devices do not work.

Cause: A fuse has blown in the load connecting box; a connection has become loose in the load circuit or the device is defective. If your device is defective, contact the place of purchase.

Symptom: The pump will not start

To check:

- the tightness of the wire connections in the electric circuit
- the switch of the electric circuit is in the "on" position
- the fuse in the electric circuit is intact
- the battery is charged
- the battery terminals have not become oxidized

Check *also* if the engine of the pump receives current by connecting a voltmeter or a 12 V lamp to the terminals of the device connector. If the pump receives current (the lamp is on, the voltmeter reading is 12 V or more) and the pump will not start, the pump is defective.

If the pump terminals do not get current, it is likely that the switch is defective. **Note:** If the pump will not start as pressure decreases in the pipework, or if the pump runs continuously when the taps are closed, the pressure switch of the pump is defective.

Symptom: The pump runs but there is little or no water

To check:

- the suction pipe connections do no leak
- the suction pipe is not folded or clogged
- there is no clogging in the suction filter
- the regulator on "top" of the pump can be used to increase pressure.

Detach the pipe on the pressure side from the pump. If water comes in from the nozzle of the pump, the suction pipework is intact and the defect can be found further ahead in the pressure pipework.



IX Safety Instructions

Protecting the kit from lightning strikes

The solar power system is not prone to lightning strikes when the electric network is small and limited and when it encompasses only one building. If the solar panel has to be installed in a mast above the roof to avoid shadows, it has to be grounded. However, thunder may cause overvoltages to the system through, for example, the telephone network.

Grounding the solar panel

The frame of the solar panel has a hole for grounding. Connect uninsulated cross-section 16 mm² copper wire to it. The connection is made using a tin-coated cable clip.

Bring the cable to the ground along the building wall and dig it about 0.7 m deep in the length of 15 m. Attach the wire to the wall with fasteners and place a protective cover on it 1.5 m above the ground and 0.2 m below the ground.

Choose a moist place for the cable trench to achieve the best possible grounding resistance. The grounding can also be conducted with a so called earth spike, in which case there is not need to dig a trench. Choose a moist place for the rod and stick it to the ground 1.5 deep and connect the wire to the rod.

Grounding equipment is available in electric supplies shops.

Battery

The electrolyte in lead-acid batteries is sulphuric acid, which is highly corrosive. Any sulphuric acid that has got into contact with skin, eyes or clothes must be rinsed immediately with plenty of water. It is wise to use goggles when handling the battery and sulphuric acid.

The battery may cause danger to your health or property if incorrectly handled.

Make sure that the placement of the battery is ventilated and use the gas outlet hose that comes with the delivery. If the battery has been located in an interior space, use an acid-proof sink beneath the battery or a separate battery casing.

Keep the battery clean.

Warning: Never connect the battery terminals with each other! Do not handle fire or liquid petroleum gas (LPG) in the same space with the battery!

Remember that the gas mixture which develops in the battery is explosive. When charging the battery, among other things hydrogen gas develops and may cause an explosive concentration even outside the battery. In the gas outlet hole, this may be the case for several days.

Do not bring any glowing or sparkling items near the battery and/or gas outlet hole; even the discharge of static electricity from clothing may cause an explosion. The danger of explosion can be minimised by using the gas outlet hose that comes with the battery.

The gases streaming from the gas outlet hose must be directed to a well ventilated space, preferably outdoors. When using a separate protective casing for the battery, the installation of the gas exhaust system needs to be checked carefully; even a small leak causes water to gather in the casing, and if the cover of the casing forms a leak-proof space to its upper part, hydrogen will not escape since it is lighter than water.

Always disconnect the battery connector when making connections. Disconnect also the plus wire of the panel. Use battery connectors that come with the kit. When using a protective casing, open carefully the cover of the casing and let the casing empty of any gases for a couple of minutes before disconnecting any connectors. You can accelerate the dilution of gases by cleaning the surroundings of the connectors by blowing. This has to be done every time the battery is charged with a charger or when the battery is moved from one place to another before and after moving it.





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