

Guide
To
**SEMI FLEXIBLE
SOLAR PANELS**

**HOW TO MAKE
SMALL RVs**

COMFORTABLE

**BY INSTALLING
INCONSPICUOUS & LOW-PROFILE
SOLAR PANELS**

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Table Of Contents

| | |
|-----------------------------------|----|
| Introduction | 4 |
| Semi Flexible Panels | 5 |
| Class B or Cargo Van Conversions | 6 |
| Solar Requirements | 6 |
| PHOTOVOLTAIC FACTS | 7 |
| Weight | 8 |
| Drawbacks | 8 |
| Specifications | 9 |
| Conclusion | 10 |
| System calculation for small RV's | 11 |

GUIDE TO SEMI FLEXIBLE SOLAR PANELS

New approaches for small RV's.

INTRODUCTION

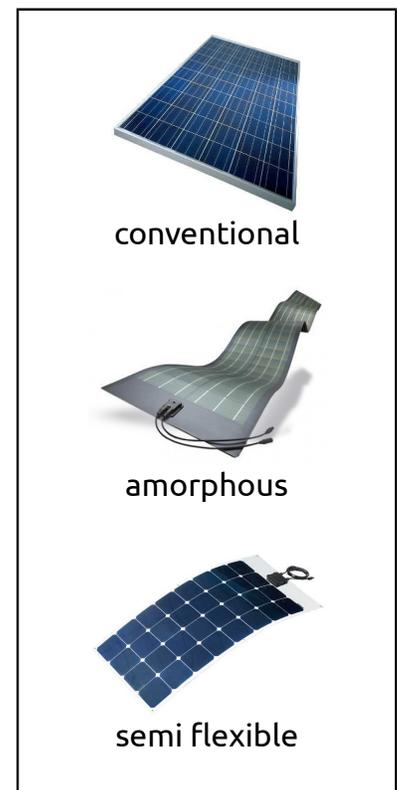
This decade has seen many advances in solar panel research, with the development of a wide array of new materials, which is changing rv life.

Let's explain. Three types of solar panels are widely available to the general public:

- Conventional rigid modules in a metal framework with a glass pane.
- So-called amorphous thin film – Flexible peel & stick.
- The new Semi Flexible panels.

The rigid panels have been around longest and are well tested for RV use. They often come in large sizes and can supply large amounts of electricity. Its solar cells are protected with a glass pane.

A decade ago Unisolar came with amorphous thin film solar that was fairly light, easy to apply and had great low-light properties. Efficiency was low and



consequently needed much roof space.

Quite recently the Semi Flexible panels came to market, with the efficiency of the rigid modules and some of the flexibility of the amorphous panels.

The rigid panels are still the staple of many RV's, the amorphous are limited by their efficiency and limited because Unisolar, the company that made them, is in bankruptcy. The new guy in town, semi flexible, has some intriguing properties.

Semi Flexible Panels

- High Efficiency
- Expensive (2x)
- Thin ($\frac{3}{32}$ - $\frac{3}{16}$ in)
- Flexible (up to 30°)
- Light weight
- No roof penetration

With this type of module, the solar cells are placed on a stiff backing and covered with a polymer.

Their higher efficiency means a smaller footprint. And although they are more expensive, they are still affordable.

As they can be glued to the roof, it means no additional holes in the roof, with less chance of water penetration.

Because of their flexibility these panels can follow the curve of many car roofs, while their minimal thickness hides them from the public eye.

Class B or Cargo Van Conversions

Less important to the big rigs, that have large, flat roofs to support a large numbers of panels, the smaller Class B RV's and Cargo Van Conversions tend to have precious little room for sufficient solar power generating equipment. And those with curved roofs (for example converted vans or Airstreams) are even less fortunate. Another concern for smaller vehicles is overall weight, as their restricted payloads limit installation of an extensive photovoltaic system.

Most often the rigid residential solar modules are used by RV's, but flexible panels started to make inroads a few years ago. These low-efficiency panels offered no solution for the Class B traveler, as they came in clumsy sizes and needed more roof space, that was lacking already.

Solar Requirements

Lately, a new generation of semi flexible panels has entered the market, with fairly high efficiency, a good performance in indirect light & high heat and less prone to wind damage. In most cases they have a relatively higher cost, while their longevity is still in question as this is a new technology that hasn't been well tested.

More importantly for the RV enthusiast, being off-grid in a Recreational Vehicle, little research of what actually works under real life circumstances has been performed, leaving early adapters in limbo. Efforts are made by individual members the RV community to change that. One example is the [Comparative Analysis for Flexible Solar Panels](#) by the Technomadia team (2014-2015).

SEMI FLEXIBLE SOLAR PANELS by Van Williams

These new semi flexible panels can be installed directly on the roof without the need for any brackets or mounting devices which allows them to blend in more and make them more aesthetically pleasing.

PHOTOVOLTAIC FACTS

| SOLAR PANEL TYPES | | | |
|---|-------------------|---------------------|---------------------|
| | Rigid Residential | Flexible | |
| | | Amorphous Thin Film | Semi Flexible |
| average cost per watt ¹ | \$ 0.80-2.00 | \$ 1.50 | \$ 2.00-7.00 |
| low light performance | average | good | good ² |
| high heat performance | average | good | good ² |
| efficiency | 15 watt/sf | 5.5 watt/sf | 15 watt/sf |
| weight | 40 oz/sf | 11 oz/sf | 7.5 oz/sf |
| roof penetration | yes | no | no |
| warranty | 20-25 yrs | 20 yrs | 10 yrs ³ |
| ¹ 2014 ² Several unconfirmed user tests indicate low light and high heat performance are less than rigid panels. ³ Misuse of the limited flexibility is often given as a reason for the shorter warranty period. Product life maybe similar to rigid panels. | | | |

Weight

In particular, when you do your own cargo van conversion. Weight is often a hidden issue. Only a little payload capacity is left for construction and interior decorating, including appliances. After that and deduction of the driver and passengers, little is left for solar equipment.



*Where the conventional panels often weigh 5 times more than the new semi flexibles, this **critical weight difference** opens up the opportunity to install more solar panels.*

Drawbacks

As a general indication, prices for these panels are double that of regular rigid modules. For that, you'll get a substantial weight reduction and a more aesthetically pleasing finish and maybe even some improved fuel mileage.

Lack luster high heat performance is probably the biggest drawback, where some users indicate a considerable performance drop during the hottest part of the day. Under low light circumstances, they seem to under perform too, however no significant amount of energy is produced those times of the day anyway.

A simple solution for these problems is to oversize your system by adding an extra panel, if needed. Test your basic system after installation and, if necessary, add a panel that you can hang on the side of your van or other location, when you are parked in the shade. Store it under your mattress while driving.

Specifications

Aside from all these practical considerations, the technical data should be checked out first when designing a system. These semi flexible panels can often be simply incorporated in existing systems, as they have no special requirements.

| EXAMPLE PANEL COMPARISONS | | | |
|------------------------------------|-------------------|---------------------|---------------|
| | Rigid Residential | Flexible | |
| | | Amorphous Thin Film | Semi Flexible |
| | Kyocera | Unisolar | AMSolar |
| maximum Power (P_{max}) | 245W | 128W | 100W |
| voltage at P_{max} (V_{mp}) | 29.8V | 33V | 18V |
| current at P_{max} (I_{mp}) | 8.23A | 3.88A | 5.56A |
| short-circuit Current (I_{sc}) | 8.91A | 4.8A | 6A |
| open-circuit Voltage (V_{oc}) | 36.9V | 47.6V | 21.3V |
| size | 65.5"x39" | 216"x15.5" | 41.2"x21.2" |
| weight | 44lbs | 17lbs | 5.5lbs |

CONCLUSION

How much of a premium you are willing to pay for semi flexible panels may depend on the type of your RV that you have. When I focus on a converted cargo van or small Class B, the advantages of these new high efficiency panels probably outweigh the extra investment.

Comfortable boondocking or stealth living may finally be achievable with few restrictions. The newer European styled cargo vans like the Ford Transit, Ram Promaster and the MB Sprinter have larger and flatter roof systems that can accommodate at least 4 of these panels, giving the owners a theoretical 400 watts or 24 Ah to work with. At 5 hours of maximal sun exposure, one can produce well over 100 Ah a day, more than sufficient for a small 12V fridge, a induction cooktop, a heating source and a variety of electronic gadgetry. Enough to spend extended periods on the road without the need of a campground.

One major uncertainty remains as little is known about the long term performance of these modules. Including other issues, such as scratch resistance and production quality.

That will not stop you, if you want to push the boundaries and be among the first with this new technology.

ADDENDUM

| SYSTEM CALCULATION FOR SMALL RVs | | | |
|----------------------------------|-------------------------|--|--|
| | conventional | alternative | |
| Step 1 | Calculate usage needs | 2 x 6V or 1 x 12V battery system ¹ | 4 x 6V or 2 x 12V battery system ¹ |
| Step 2 | Calculate panel wattage | Calculate maximum number of panels and adjust for available space. ²³ | |
| Step 3 | Calculate batteries | Adjust your usage | |

¹ A small RV or converted van can only reasonably store 2 or 4 - 6V batteries.
² Provide enough wattage to adequately recharge your batteries.
³ Flexible lightweight panels allow you to use them as portable additions to fixed panels and store them under your bed.

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ONLINE PROJECTS

For all online projects, go to:

► cargovanconversion.com/woodworking

Follow the progress of a hands-on cargo van conversion project online at:

► cargovanconversion.com

Thank You For Your Attention!

I thank you for reading this guide from start to finish.

Thanks again, and I'll see you online...

Van Williams

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P.S.

I'd appreciate it if you shared this guide with anyone you think could benefit from it. You can send them to cargovanconversion.com

Or just forward this PDF directly through to them via email. Thanks again!

Disclaimer (And Reality Check!)

The above information is for entertainment purposes only. I'm not an expert in any of these subjects, so please, verify any installations with the appropriate specialists.

I have 30 years of experience in the outdoors and a wealth of practical knowledge about campers and RV's, but every situation is different and in need of its own solution.

I hope the included information will help you get started, because there is no gain without trying.

*Set a realistic goal and **Go!***