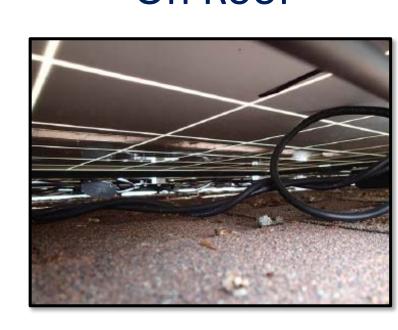
Common Wire Management Issues

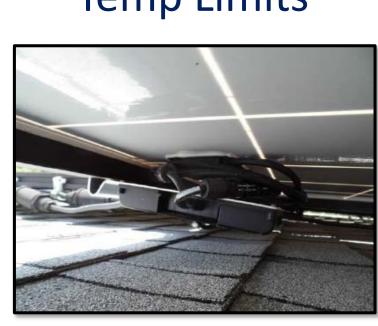
Dirt Inside Connectors



Wires Rubbing On Roof



Exceeding Temp Limits

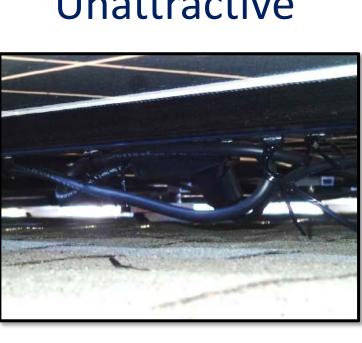


Solar Ties

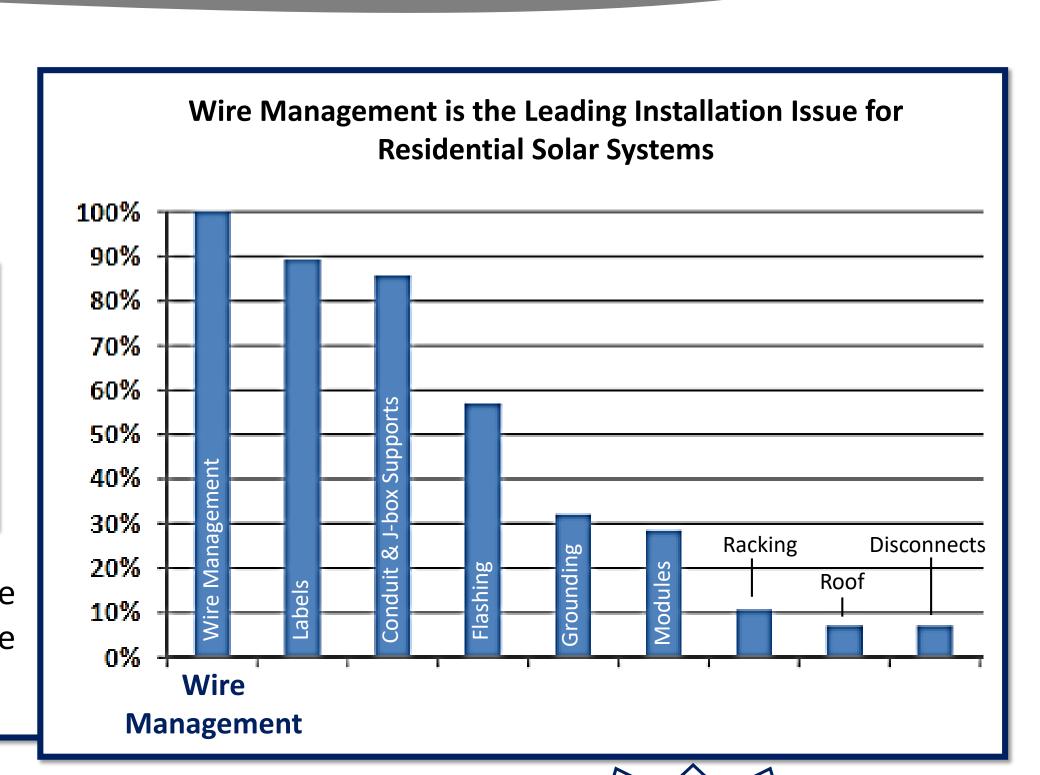
Pinched/Cut Wires



Messy & Unattractive



A study of residential solar systems showed that 100% of the systems audited had wire management issues. Conventional wire management devices were deployed on all systems. However, improper, delayed, and insufficient usage led to poor installation quality. Integrated wire management solutions have the opportunity to drastically reduce installation issues and eliminate electrical failures that could lead to shock hazards or system ground faults.



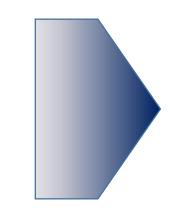
Wire Management **Evolution**

Fully integrated wire management (FIWM) products have the potential to simplify the supply chain, reduce installation time and increase AHJ approvals. Installers find that clip and tie costs are larger than anticipated for any given job. There are

Indoor/Outdoor Zip Ties



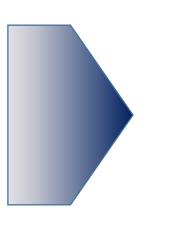
Non Conductive





• Up to 25 Years

Non Conductive





• Up to 25 Years

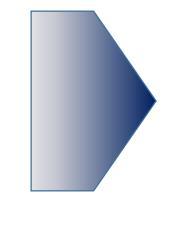
No Tools Required

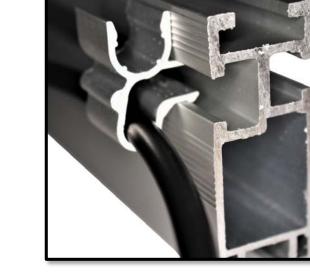
Gloves Required

No Mounting Hole Required

Metal Clips







Racking with Features

to Accept Clips



- No Tools Required
- No Mounting Hole Required
- Homerun Cables Only
- Conductive & Sharp Edges

several reasons for these losses, including the products being: (1) lost or stolen, (2) dropped during installation, (3) damaged, or (4) overused. Because FIWMs are integral to the module or racking, they can't be lost, stolen, misplaced or overused. In addition, since they come with the products, you never need to worry about having enough or having the right wire management devices for the job. FIWM products are there where and when you need them. They allow product installation & wire management to happen at the same time. By immediately securing wires out of the way, they reduce onsite accidents & damage, and increase general site safety. Finally, FIWM has significant benefits for installations in developing countries where wire management devices can be difficult and costly to come by. By building the wire management into the product, everyone everywhere has what they need to install a safe and reliable product.

 Tool Required Mounting Hole required

• 5 year life

Cons:

Multiple Parts Needed

Tool Required Mounting Hole required Multiple Parts Needed

Conductive & Sharp Edges Multiple Parts Needed

Multiple Parts Needed

Testing and Validation

How reliable is your wire management device? Testing any wire management design is critical and the tests that should be performed depend upon the wire management technology one is evaluating. For instance, polymeric wire management devices don't need to be tested by salt spray and metal devices don't need to be UV tested. Testing should evaluate a device's integrity as well as its long term impacts on the wire's insulation. This is accomplished by applying the load to the wire during testing. The pigtail of a standard 72 cell PV module weighs between 3.5-4 oz. So, testing should incorporate a minimum 2x safety factor, or 8 oz load. Following are some of the tests recommended for evaluating wire management devices.

UL 2703 HF10 – Humidity Freeze

Module Integrated Wire Management

vs Wire Clips (Installation Study)

FIWM Cost Savings

■ Installation Cost Savings ■ Soft Costs Savings

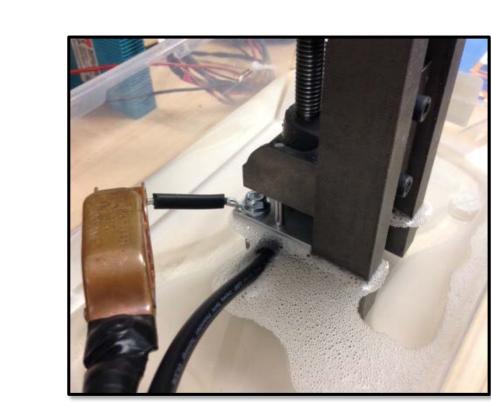
Fully Integrated

Wire Management Cost Reductions

Reduced

Wire Management

Wire Management



Realize the Promise of Fully Integrated Wire Mgt.

sq 20

Benchmark

Wire Clips

UL 1703

Wet Insulation Resistance

ASSTM B117



Ensure your product is the

Cross Functional

Installation Studies

Testing Comparisons

Cost Analysis

best through:

Wire Pull Test

Clip #4

Direct Pull Direct Pull Direct Pull Direct Pull Direct Pull 45 deg

Salt Spray

UL 1703 Leakage Current & Dielectric Voltage-Withstand



- Temperature cycling
- 2X system voltage + 1000V
- 50μA is max allowable leakage current. This product resulted in only 0.5μA

Time (Hours)

Test both AC and DC current 100 lb Day 14 40 20 Time (Hours)

UL 2703

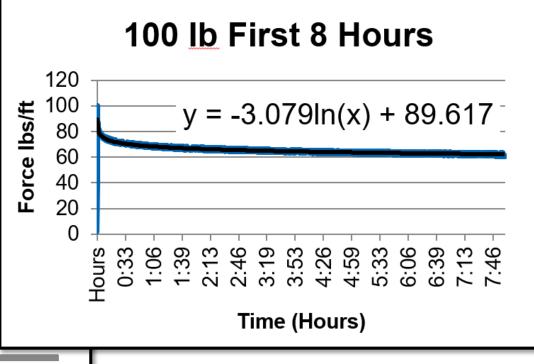
TC200 – Temperature Cycling -40° C to $+90^{\circ}$ C

> High Temp 125°C for 72 hours



- 8 oz one each side of the cable, 16 oz total
- 4x safety factor
- Worst case orientation

Wire Deformation & **Elasticity Testing** ~55% loss in clamping load



Fully Integrated

Wire Management

- Lasts the Life of the System
- No Tools Required
- No Mounting Hole Required
- Non Conductive
- No Sharp Edges
- No Additional Parts or SKUs
- What you need where you need it
- Reduced Install Costs

Racking Integrated



Homerun Cables

Ground Mount Integrated



Homerun Cables

J-box Integrated



- Securement for Shipping and Module Installation
- No Waste, No Tape.

Module Integrated



- Securement for Shipping and Module Installation
- No Waste, No Tape
- Homerun Cables
- Module Cables



TECSI Solar Inc. is an engineering services company for solar product manufacturers. Visit us at www.TECSIsolar.com to learn more.

Module Integrated Wire Mgt