

Re: Structural Certification for the IronRidge *FlashVue*

This letter certifies the structural capacity of IronRidge *FlashVue* for use as a roof attachment for flush mounted PV solar systems. The *FlashVue* assembly consists of an aluminum bracket cap (*GripCap* or *GripCap Plus*) and an 8" x 12" aluminum flashing. *FlashVue* is fastened to an underlying roof rafter using a 5/16" x 4.25" lag bolt. The full assembly details are shown in Exhibit EX-0019.

The referenced uplift, and lateral capacities of *FlashVue* are based on mechanical load tests conducted along the three respective load directions shown in Figure 1, using a Universal Instron Test Unit in accordance with ASTM D1761-20 "Standard Test Methods for Mechanical Fasteners in Wood and Wood-Based Materials". For each load test, a *FlashVue* assembly using *GripCap* or *GripCap Plus* was installed on a sample roof deck composed of 15/32" OSB Board over 2x4 rafters. The moisture content and the specific gravity of the rafters were measured per ASTM D2395-17 "Standard Test Methods for Density and Specific Gravity (Relative Gravity) of Wood and Wood-Based Materials". The recorded moisture content of the rafters among all sample roof decks is between 10% and 15%. For each load direction, the tests provided different capacity results for *FlashVue* assemblies using *GripCap* or *GripCap Plus*. The tabulated results reported in this letter are the lesser of the allowable capacities for *GripCap* or *GripCap Plus* and therefore are applicable to *FlashVue* using either bracket cap.

The critical failure mode along the uplift direction was observed on the *FlashVue* using *GripCap Plus* as the pullout of the 5/16" lag bolt from the rafter. The average peak loads recorded at the ultimate failure point is 3483 lbs. on rafters with a measured specific gravity of 0.50. A safety factor of 3 was applied which results in an allowable uplift capacity of 1161 lbs.

Along the lateral direction (parallel to rafter), the controlling failure mode was observed in the tests using *GripCap Plus* as the bending yielding of the 5/16" lag bolt. The average peak load recorded at the ultimate failure point is 1060 lbs. A safety factor of 3 was applied which results in an allowable capacity of 353 lbs. in the lateral direction along the roof slope.

The dominating failure mode observed for the lateral direction (perpendicular to rafter) was observed in the tests for the assembly using *GripCap* as the compressive rupture of the OSB board adjacent to the rafter. The average peak load recorded at the ultimate failure point is 772 lbs. A safety factor of 2.54 was applied according to National Design Specification for Wood Construction (NDS-2018) which results in an allowable capacity along the cross slope lateral direction of 304 lbs.

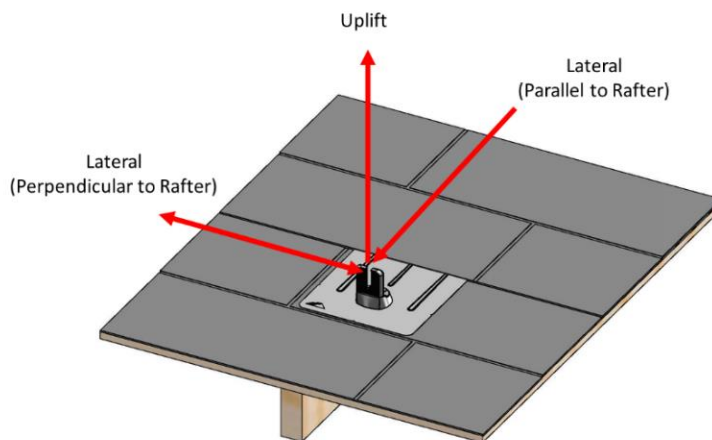


Figure 1: FlashVue Assembly and Applied Loading Directions (using *GripCap* or *GripCap Plus*).

Table 1: IronRidge FlashVue Allowable Capacities ⁽¹⁾⁽²⁾						
Load Direction	Specimen Quantity	Average Peak Load at Failure (lbs)	Deviation of Test Results ⁽³⁾	Critical Failure Mode	Safety Factor ⁽⁴⁾	Allowable Capacity (lbs) ⁽⁵⁾
Uplift Load Perpendicular to Roof Surface	5	3483	6.80%	Lag pull out from rafter	3	1161 ⁽⁶⁾
Lateral Load (Parallel to Rafter)	5	1060	10%	Bending yielding of lag bolt	3	353
Lateral Load (Perpendicular to Rafter)	5	772	5%	Compressive rupture of roof deck adjacent to rafter	2.54	304

Table 1 Notes:

(1) The summarized results are the lesser of the allowable capacities of assemblies using *GripCap* or *GripCap Plus* and shall be applicable to Flashvue using either bracket cap.

(2) Capacities apply to rafter size of 2x4 or greater, a deck thickness 15/32" or greater, and lag bolts secured within the center 1/3 of rafter width with a minimum 2.5" end distance. Rafters should be in sound structural condition with no sign of rot or decay.

(3) Deviation reflects the variance of the highest or the lowest test value from the group mean for the respective load direction.

(4) Safety Factor is associated with the respective failure mode recorded and determined by the specific code as shown on Page 1.

(5) Allowable capacity is equal to Average Peak Load at Failure divided by its associated Safety Factor.

(6) The uplift allowable capacity in Table 1 applies to rafters with a specific gravity (SG) of 0.5 or higher. For a wood species with specific gravity lower than 0.50 the allowable uplift capacity shall be adjusted by a factor of $\left(\frac{G}{0.50}\right)^{\frac{3}{2}}$ per National Design Specification (NDS-2018) Eq. (12.2-1). Results of common wood species are adjusted and provided in Table 2 below.

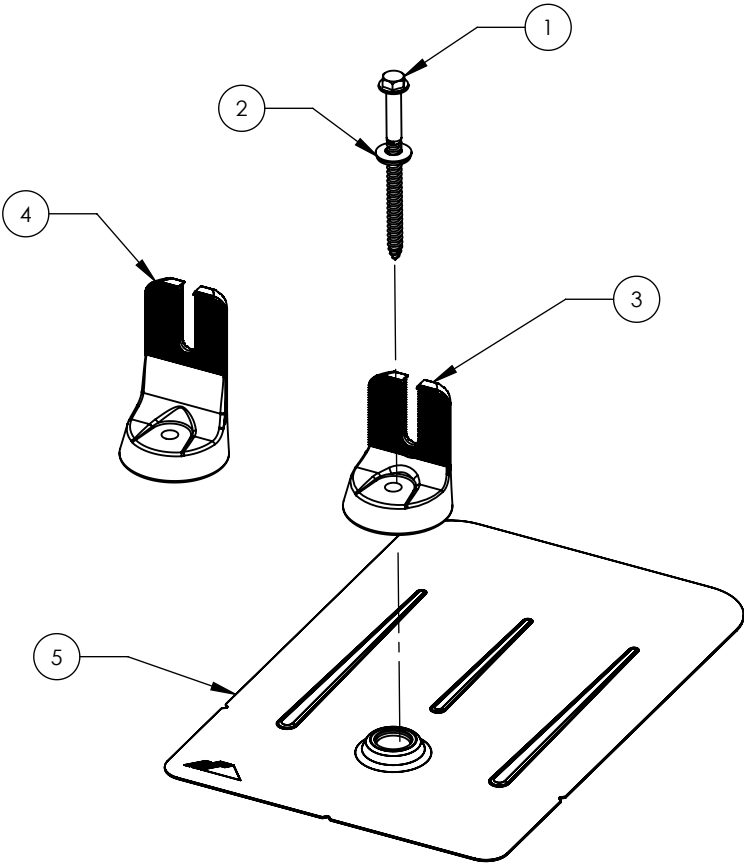
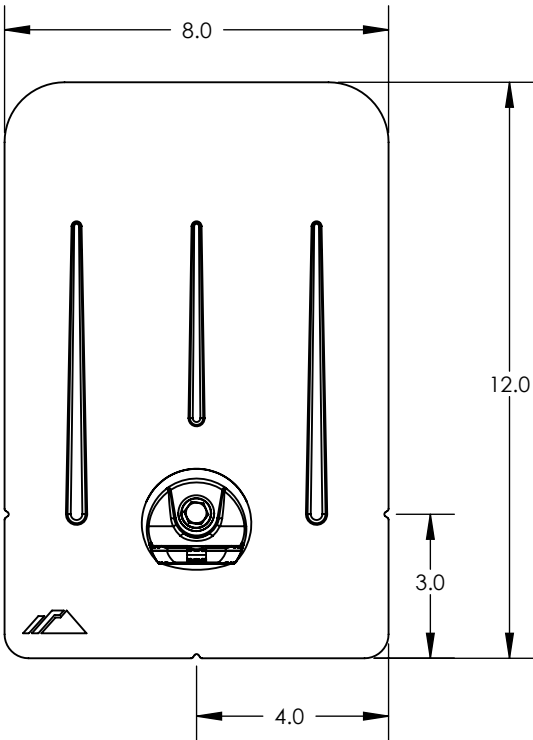
Table 2: IronRidge FlashVue Allowable Uplift Capacities for Rafter with SG Less Than 0.50		
Wood Species	Specific Gravity	Allowable Uplift Capacity (lbs)
Douglas Fir, South	0.46	1025
Hem, Fir (North)	0.46	1025
Hem, Fir	0.43	926
Spruce, Pine, Fir	0.42	894

Sincerely,

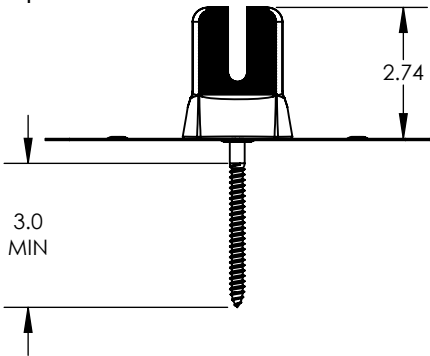


Gang Xuan, SE
Senior Structural Engineer

EXHIBIT: EX-0019

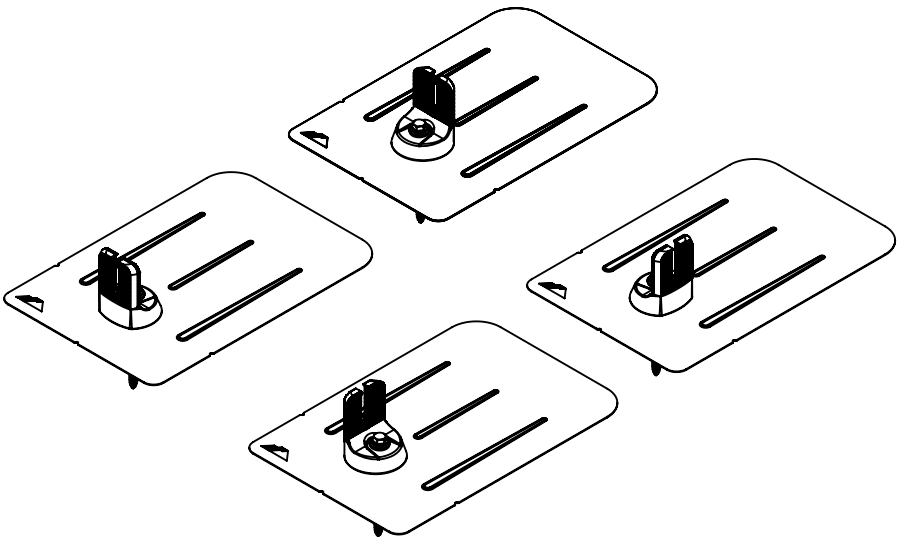
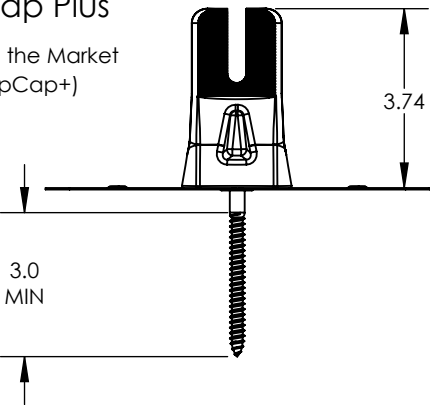


GripCap



GripCap Plus

(Known in the Market as GripCap+)



FLASHVUE GRIPCAP AND GRIPCAP PLUS
CAN BE INSTALLED IN ANY ORIENTATION
AS SHOWN ABOVE

ITEM NO	DESCRIPTION
1	BOLT, LAG 5/16 X 4.0" MINIMUM
2	WASHER, EPDM BACKED
3	GRIPCAP, MILL OR BLACK
4	GRIPCAP PLUS, BLACK
5	FM FLASHING, MILL OR BLACK

**IRONRIDGE**

ASSY, FLASHVUE

DWG. NO. EX-0019