SnapNrack
Solar Mounting Solutions

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SnapNrack Series 100 Roof Mount System

COVER LETTER

The loading criteria used in this report is from ASCE 7-10. For codes that reference ASCE 7-05, Appendix A is provided to convert the wind speeds in ASCE 7-05 to the wind speeds used in this report. Instructions for this conversion are provided in Appendix A. This report covers wind speeds (V_{ult}) to 190 MPH, ground snow to 120 PSF, building heights to 60 feet, and tilt angles to 60 degrees.

The following codes are covered in this report:

- IBC 2015
- IBC 2012
- IBC 2009
- IBC 2006

The mounting system structural submittal package shall consist of the following:

- Pages 1-17 of the report (this includes this cover letter).
- Applicable page from the following:
  - C1 – C15 for 0 to 30 ft. Mean Roof Height and 6063 alloy rail
  - C17 – C32 for 31 to 60 ft. Mean Roof Height and 6063 alloy rail
  - C33 – C48 for 0 to 30 ft. Mean Roof Height and 6005 alloy rail
  - C49 – C64 for 31 to 60 ft. Mean Roof Height and 6005 alloy rail
- Appendix A (if applicable).
- The applicable installation details (listed on page 17 of this report).

This report provides structural engineering calculations and installation criteria for the mounting system only. It does not certify the capacity of the supporting members. The capacity of the supporting structure is to be certified by the licensed professional responsible for the building's structural certification.

Please contact SnapNrack at (877) 732-2860, or Contact@snapnrack.com, for questions regarding this report.

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Structural Report and Calculations

Series 100
Roof Mount

For

SnapNrack
775 Fiero Lane, Suite 200
San Luis Obispo, CA 93401

Prepared By

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Building Department Support Calculations

Building Department Support Calculations

Introduction

This report describes, illustrates, and explains the Structural Calculation Packet for SnapNrack's Series 100 Mounting System, dated 7/6/2016. The calculations have been performed in accordance with the codes referenced in the cover letter. The racking system has been designed to withstand code-prescribed forces due to its own weight, the weight of the solar panels, the snow loads, and both the wind and seismic forces.

Rail Spans

This report covers two different material options for the system rails. Although they are both aluminum, one rail option uses a 6063 alloy (25 ksi yield) and the other uses a 6005 alloy (35 ksi yield).

Despite having different yield strengths, both types of rails support the PV panels. As for the rails themselves, they are supported by mounting hardware which attaches them to the roof structure with spans that are expressed in inches. Refer to the tables below for rail spans under varying conditions of rail alloy and roof height. Shaded cells require an edge zone adjustment (see details following charts).

Notes for Tables 1A thru 2H

1. Determine the mean roof height, tilt angle, and rail alloy (if you are unsure, use the 6063 alloy values). For mean roof heights less than 30 feet, use Table 1A/2A for tilt angles less than 19 degrees, Table 1B/2B for tilt angles between 20 and 36 degrees, Table 1C/2C for tilt angles between 37 and 45 degrees, and Table 1D/2D for tilt angles between 46 and 60 degrees. For mean roof heights between 31 and 60 feet use Table 1E/2E for tilt angles less than 19 degrees, Table 1F/2F for tilt angles between 20 and 36 degrees, Table 1G/2G for tilt angles between 37 and 45 degrees, and Table 1H/2H for tilt angles between 46 and 60 degrees.
2. Determine the wind and snow load for the project site from the building department. Make certain to use 2015 IBC wind loads. Locate the wind load in the table across top rows and the snow load down the left columns to find corresponding maximum rail span.
3. For snow loads, column Pg equals the ground snow.
4. Shaded cells require application of an edge zone adjustment (details to follow).

6063 Alloy Rail Tables

0-30 ft. Roof Height

Table 1A: Rail Spans (in) for Roof Slopes and Tilt Angles 0˚ to 19˚ *6063 Alloy*																
Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-10.7	-11.7	-12.7	-13.8	-14.9	-16.1	-17.3	-18.6	-19.9	-21.2	-22.6	-25.5	-28.6	-31.9
	0	0	116	110	104	99	95	91	87	83	80	77	75	70	65	62
	10	8	114	110	104	99	95	91	87	83	80	77	75	70	65	62
	20	15	89	89	89	89	89	89	87	83	80	77	75	70	65	62
	30	23	75	75	75	75	75	75	75	75	75	75	75	70	65	62
	40	31	66	66	66	66	66	66	66	66	66	66	66	66	65	62
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	60
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

0-30 ft. Roof Height

Table 1B: Rail Spans (in) for Roof Slopes and Tilt Angles 20˚ to 36˚ *6063 Alloy*																
Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-7.0	-7.6	-8.3	-9.0	-9.7	-10.5	-11.3	-12.1	-13.0	-13.8	-14.7	-16.6	-18.7	-20.8
	0	0	120	120	120	120	120	118	112	108	103	99	95	89	83	78
	10	8	112	111	110	109	108	107	105	104	103	99	95	89	83	78
	20	15	89	89	89	89	89	89	88	88	87	87	86	85	83	78
	30	23	75	75	75	75	75	75	75	75	75	75	75	75	74	73
	40	31	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	60
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

0-30 ft. Roof Height

Table 1C: Rail Spans (in) for Roof Slopes and Tilt Angles 37˚ to 45˚ *6063 Alloy*																
Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-6.7	-7.3	-7.9	-8.6	-9.3	-10.0	-10.8	-11.6	-12.4	-13.2	-14.1	-15.9	-17.8	-19.9
	0	0	120	120	120	120	120	120	116	111	106	102	98	91	85	80
	10	8	112	111	110	109	108	107	105	104	103	102	98	91	85	80
	20	15	89	89	89	89	89	89	88	88	87	87	86	85	83	80
	30	23	75	75	75	75	75	75	75	75	75	75	75	75	74	73
	40	31	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	60
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

0-30 ft. Roof Height

Table 1D: Rail Spans (in) for Roof Slopes and Tilt Angles 46˚ to 60˚ *6063 Alloy*																
Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-6.3	-6.9	-7.6	-8.2	-8.9	-9.6	-10.3	-11.0	-11.8	-12.6	-13.4	-15.2	-17.0	-18.9
	0	0	120	120	120	120	118	115	113	110	107	105	101	94	88	82
	10	8	106	105	104	102	101	100	98	97	96	94	93	90	88	82
	20	15	89	88	87	87	86	85	84	83	82	82	81	79	77	76
	30	23	75	75	75	75	75	75	75	74	74	73	72	71	70	69
	40	31	66	66	66	66	66	66	66	66	66	66	66	65	64	63
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	59
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

31-60 ft. Roof Height

Table 1E: Rail Spans (in) for Roof Slopes and Tilt Angles 0˚ to 19˚ *6063 Alloy*																
Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-12.3	-13.5	-14.7	-15.9	-17.2	-18.6	-20.0	-21.4	-22.9	-24.5	-26.1	-29.4	-33.0	-36.7
	0	0	106	101	96	91	87	83	80	77	74	71	69	64	61	57
	10	8	106	101	96	91	87	83	80	77	74	71	69	64	61	57
	20	15	89	89	89	89	87	83	80	77	74	71	69	64	61	57
	30	23	75	75	75	75	75	75	75	75	74	71	69	64	61	57
	40	31	66	66	66	66	66	66	66	66	66	66	66	64	61	57
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	57
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

31-60 ft. Roof Height

Table 1F: Rail Spans (in) for Roof Slopes and Tilt Angles 20˚ to 36˚ *6063 Alloy*																
Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-8.0	-8.8	-9.6	-10.4	-11.2	-12.1	-13.0	-14.0	-14.9	-16.0	-17.0	-19.2	-21.5	-24.0
	0	0	120	120	120	119	113	108	103	99	95	91	88	82	77	72
	10	8	110	109	108	107	106	104	103	99	95	91	88	82	77	72
	20	15	89	89	89	89	89	88	87	86	86	85	84	82	77	72
	30	23	75	75	75	75	75	75	75	75	75	75	75	74	73	72
	40	31	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	60
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

31-60 ft. Roof Height

Table 1G: Rail Spans (in) for Roof Slopes and Tilt Angles 37˚ to 45˚ *6063 Alloy*																
Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-7.7	-8.4	-9.1	-9.9	-10.7	-11.6	-12.4	-13.3	-14.3	-15.2	-16.2	-18.3	-20.6	-22.9
	0	0	120	120	120	120	116	111	106	101	97	93	90	84	79	74
	10	8	110	109	108	107	106	104	103	101	97	93	90	84	79	74
	20	15	89	89	89	89	89	88	87	86	86	85	84	83	79	74
	30	23	75	75	75	75	75	75	75	75	75	75	75	74	73	72
	40	31	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	60
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

31-60 ft. Roof Height

Table 1H: Rail Spans (in) for Roof Slopes and Tilt Angles 46˚ to 60˚ *6063 Alloy*																
Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-7.3	-8.0	-8.7	-9.5	-10.2	-11.0	-11.9	-12.7	-13.6	-14.5	-15.5	-17.5	-19.6	-21.8
	0	0	120	120	119	116	113	110	107	104	100	96	93	86	81	76
	10	8	104	103	101	100	98	97	96	94	93	91	90	86	81	76
	20	15	88	87	86	85	84	83	82	81	81	80	79	77	75	73
	30	23	75	75	75	75	75	74	73	73	72	72	71	70	68	67
	40	31	66	66	66	66	66	66	66	66	66	65	65	64	63	62
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	59	58
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	54
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

6005 Alloy Rail Tables

0-30 ft. Roof Height

Table 2A: Rail Spans (in) for Roof Slopes and Tilt Angles 0˚ to 19˚ *6005 Alloy*

Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-10.7	-11.7	-12.7	-13.8	-14.9	-16.1	-17.3	-18.6	-19.9	-21.2	-22.6	-25.5	-28.6	-31.9
	0	0	140	132	125	119	114	109	104	100	96	93	89	84	79	74
	10	8	137	132	125	119	114	109	104	100	96	93	89	84	79	74
	20	15	106	106	106	106	106	106	104	100	96	93	89	84	79	74
	30	23	90	90	90	90	90	90	90	90	90	90	89	84	79	74
	40	31	79	79	79	79	79	79	79	79	79	79	79	79	79	74
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	72
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

0-30 ft. Roof Height

Table 2B: Rail Spans (in) for Roof Slopes and Tilt Angles 20˚ to 36˚ *6005 Alloy*

Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-7.0	-7.6	-8.3	-9.0	-9.7	-10.5	-11.3	-12.1	-13.0	-13.8	-14.7	-16.6	-18.7	-20.8
	0	0	144	144	144	144	144	141	135	129	124	119	114	107	100	94
	10	8	134	133	132	130	129	128	127	125	124	119	114	107	100	94
	20	15	106	106	106	106	106	106	106	105	105	104	103	101	100	94
	30	23	90	90	90	90	90	90	90	90	90	90	90	90	89	88
	40	31	79	79	79	79	79	79	79	79	79	79	79	79	79	79
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	72
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

0-30 ft. Roof Height

Table 2C: Rail Spans (in) for Roof Slopes and Tilt Angles 37˚ to 45˚ *6005 Alloy*

			Wind Load													
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-6.7	-7.3	-7.9	-8.6	-9.3	-10.0	-10.8	-11.6	-12.4	-13.2	-14.1	-15.9	-17.8	-19.9
	0	0	144	144	144	144	144	144	139	133	127	122	118	109	102	96
	10	8	134	133	132	130	129	128	127	125	124	122	118	109	102	96
	20	15	106	106	106	106	106	106	106	105	105	104	103	101	100	96
	30	23	90	90	90	90	90	90	90	90	90	90	90	90	89	88
	40	31	79	79	79	79	79	79	79	79	79	79	79	79	79	79
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	72
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

0-30 ft. Roof Height

Table 2D: Rail Spans (in) for Roof Slopes and Tilt Angles 46˚ to 60˚ *6005 Alloy*

			Wind Load													
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-6.3	-6.9	-7.6	-8.2	-8.9	-9.6	-10.3	-11.0	-11.8	-12.6	-13.4	-15.2	-17.0	-18.9
	0	0	144	144	144	144	142	139	135	132	129	126	121	113	105	99
	10	8	128	126	124	123	121	120	118	116	115	113	112	109	105	99
	20	15	106	106	105	104	103	102	101	100	99	98	97	95	93	91
	30	23	90	90	90	90	90	90	90	89	88	88	87	85	84	82
	40	31	79	79	79	79	79	79	79	79	79	79	79	78	77	76
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	71
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

31-60 ft. Roof Height

Table 2E: Rail Spans (in) for Roof Slopes and Tilt Angles 0˚ to 19˚ *6005 Alloy*																
Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-12.3	-13.5	-14.7	-15.9	-17.2	-18.6	-20.0	-21.4	-22.9	-24.5	-26.1	-29.4	-33.0	-36.7
	0	0	128	121	115	109	105	100	96	92	89	86	83	77	73	69
	10	8	128	121	115	109	105	100	96	92	89	86	83	77	73	69
	20	15	106	106	106	106	105	100	96	92	89	86	83	77	73	69
	30	23	90	90	90	90	90	90	90	90	89	86	83	77	73	69
	40	31	79	79	79	79	79	79	79	79	79	79	79	77	73	69
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	69
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

31-60 ft. Roof Height

Table 2F: Rail Spans (in) for Roof Slopes and Tilt Angles 20˚ to 36˚ *6005 Alloy*																
Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-8.0	-8.8	-9.6	-10.4	-11.2	-12.1	-13.0	-14.0	-14.9	-16.0	-17.0	-19.2	-21.5	-24.0
	0	0	144	144	144	142	135	129	123	118	114	109	105	98	92	87
	10	8	132	131	129	128	127	125	123	118	114	109	105	98	92	87
	20	15	106	106	106	106	106	105	105	104	103	102	101	98	92	87
	30	23	90	90	90	90	90	90	90	90	90	90	90	89	87	86
	40	31	79	79	79	79	79	79	79	79	79	79	79	79	79	79
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	72
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

31-60 ft. Roof Height

Table 2G: Rail Spans (in) for Roof Slopes and Tilt Angles 37˚ to 45˚ *6005 Alloy*																
Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-7.7	-8.4	-9.1	-9.9	-10.7	-11.6	-12.4	-13.3	-14.3	-15.2	-16.2	-18.3	-20.6	-22.9
	0	0	144	144	144	144	139	133	127	122	117	112	108	101	94	89
	10	8	132	131	129	128	127	125	124	122	117	112	108	101	94	89
	20	15	106	106	106	106	106	105	105	104	103	102	101	99	94	89
	30	23	90	90	90	90	90	90	90	90	90	90	90	89	87	86
	40	31	79	79	79	79	79	79	79	79	79	79	79	79	79	79
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	72
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

31-60 ft. Roof Height

Table 2H: Rail Spans (in) for Roof Slopes and Tilt Angles 46˚ to 60˚ *6005 Alloy*																
Wind Load																
Ground Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-7.3	-8.0	-8.7	-9.5	-10.2	-11.0	-11.9	-12.7	-13.6	-14.5	-15.5	-17.5	-19.6	-21.8
	0	0	144	144	143	139	136	132	129	125	120	115	111	104	97	91
	10	8	125	123	122	120	118	116	115	113	111	110	108	104	97	91
	20	15	105	104	103	102	101	100	99	98	97	96	95	92	90	88
	30	23	90	90	90	90	90	89	88	87	87	86	85	83	82	80
	40	31	79	79	79	79	79	79	79	79	79	79	78	77	76	74
	50	39	72	72	72	72	72	72	72	72	72	72	72	71	70	69
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	65
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

Rail Testing

The aluminum rails have been designed in accordance with the 2015 Aluminum Design Manual (ADM) as referenced in the IBC. Testing was conducted per the standards set forth by the IBC Section 1715; Preconstruction Load Test. The results of this testing procedure were used in comparison with the calculated values to establish the maximum uplift load allowed for the rails.

Racking Connections to the Existing Roof

Contained within the calculation packet are calculations for the connection of the rails to the roof framing. Using the sizes provided by SnapNrack, we have calculated the maximum forces that will be resisted based on the withdrawal value of the lag screws, and the strength of the aluminum components which are involved in transferring these forces from the rail to the roof framing. These components consist of the flashed L-foot (SnapNrack Drawing PEN-D01), Standoff (PEN-D02, D03), Seam Clamp (PEN-D04), Corrugated Block (PEN-D05), Metal Roof Base (PEN-D09, D10, D11, D12) and Hanger Bolt (PEN-D06). All (6) options are acceptable under the parameters shown in SnapNrack's plans. The results from our analysis have been integrated into the summary charts.

The connection of the PV racking system to the roof will use a 5/16" diameter Lag Bolt installed with a minimum 2 ½" embedment into the framing member. Bolts shall be installed to a rafter or blocking capable of supporting both wind and seismic loads along with the weight of the PV system.

When PEN-D07 is involved, use minimum quantity 2 ¼-20 lag bolts with minimum 1.25" embedment. In addition, SnapNrack's Tile Roof Hooks (Drawing PEN-D13, D14) are also acceptable attachment components when the following limitations are followed:

1. tile roof hooks have been reviewed up to 120 mph, Design Wind Speed
2. rail span is limited to 6 feet with tile roof hooks

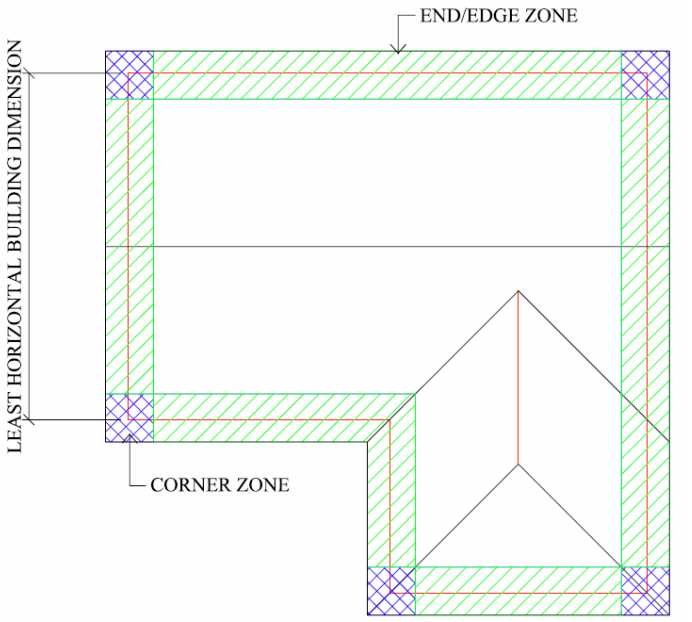
Summary Charts and Topographic Factors

The attached pages of this summary contain some of the most common building configurations with varying wind speeds. These charts serve as quick references for looking up maximum rail spans based on the building and site conditions. However, it must be noted that for any building where a topographic factor is applied (e.g. hills, mesas, seashore), the rail span lengths given might exceed what is allowed for the given site condition. In that case, a registered structural engineer shall evaluate the exact topographic conditions for the specific site.

End Zone and Edge Distances

The edge zones and/or end zones of the roof area shall be determined based on the building's least horizontal dimension (LDH). The edge zone, "a", is equal to 10% of the LDH where a = .1 * LDH. It should be noted that if the solar panels installed cross two different roof sections, the smaller LDH shall be used.

Rail spans in the corner zone shall be a maximum of 24 inches and this restriction will only apply to the rail attachments located in the end and edge zones (does not apply to modulus or rails that overhang into the zone). Furthermore, all edge zones requiring an adjustment (shaded cells in chart) shall be reduced by 24 inches to a minimum of 32 inches.



Detail 1 roof end /edge and corner zones

Site – Specific Analysis

A site-specific analysis is required if the location of the solar panel installation corresponds to any of the following criteria:

- The total pitch of the solar panel (solar panel pitch & roof pitch) is greater than 60 degrees above the horizontal.
- A topographic factor applied to a location. Generally, topographic factors are applied when the structure is on a hill, mesa or bluff, or is adjacent to a large body of water. For complete descriptions of topographic factors, please refer to ASCE 7-10 section 26.8
- The mean roof height of the structure that the solar panels will be installed on is greater than 60 ft. above grade.
- A combination of loads and/or site conditions applied that is not addressed in the attached rail span charts.

If one or more of these factors corresponds to the project location, please contact NSSE, and we will analyze the site conditions and recommend standoff spacing for each specific site.

Existing Building Limitations

This summary letter addresses the structural adequacy of the solar racking system only and does not investigate or validate the adequacy of the structure the racking system is being placed upon. It does not address the ability of the existing roofing or roof framing to support the new loads imposed upon them by the new system, nor does it address the new localized forces between the roofing and the roof framing which might be imposed by the new standoff connections. It also does not address the additional lateral forces imposed upon the building due to the seismic and wind forces that the new system will add to the existing roof. These various building-specific issues need to be evaluated by the appropriate registered professional(s) prior to the addition of the photovoltaic and racking systems. NSSE may be consulted for building-specific structural evaluation. NSSE assumes the systems will be installed to the specifications presented here and the installer will use good structural judgment.

Please note that all sizes, materials specifications, and weights have been provided by SnapNrack. Installation must be in accordance with SnapNrack drawings as noted:

Drawing Title	Revision
S100-D01	F
S100-D02	F
S100-D03	F
S100-D03	F
S100-D04	F
S100-D05	F
S100-D06	F
S100-D07	F
S100-D08	F
S100-D09	F
S100-D10	F
S100-D11	F
PEN-D01	F
PEN-D02	F
PEN-D03	F
PEN-D04	F
PEN-D05	F
PEN-D06	F
PEN-DO7	F
PEN-D08	F
PEN-D09	F
PEN-D10	F
PEN-D11	F
PEN-D12	F
PEN D13	F
PEN D14	F

Please see SnapNrack plans for limits on the bolt parameters. Torque all 5/16" diameter hardware as specified in SnapNrack's plans (10-16 ft-lbs for Silver Stainless Steel and 7-9ft –lbs for black Stainless Steel, unless otherwise noted). All waterproofing, roofing and drainage issues are the responsibility of SnapNrack's customer(s) otherwise known as the contractor(s) or the professional solar installer(s).

Please let us know if you have any questions.

Norman Scheel PE, SE
LEED-AP BD+C, LEED-AP Homes
Fellow SEAOC
Fellow A.S.C.E.

Series 100

Wind Design ASCE 7-10 Main Force Resisting System
6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

Velocity Pressure 28.3.2 ASCE 7-10

$q_z = q_h = 0.00256\ k_z\ k_{zt}\ k_d\ V^2$

Risk Category: II (Table 1.5-2)

Wind Exposure Category C

k_z	=	0.98	Velocity Pressure Exposure Coefficients (Table 26.8-1)
K_{zt}	=	1.00	Topographic Factor (Fig. 26.8-1)
K_d	=	0.85	Wind Directionality Factor (Table 26.6-1)

Velocity Pressures														
Wind Speed	110	115	120	125	130	135	140	145	150	155	160	170	180	190
q_h	25.80	28.20	30.71	33.32	36.04	38.86	41.80	44.84	47.98	51.23	54.59	61.63	69.09	76.98
ASD (0.6W)	15.48	16.92	18.42	19.99	21.62	23.32	25.08	26.90	28.79	30.74	32.75	36.98	41.46	46.19

$P = q_h\ [\ GC_{pf} - GC_{pi}\ ]$

q_h	=	Velocity Pressure (psf)
GC_{pi}	=	+/- Internal Pressure Coefficient
GC_{pf}	=	External Pressure Coefficient

GC_{pf} Roof Zones Fig 28.4-1 ASCE 7-10					
Pitch	Slope	Zone 2	Zone 3	Zone 2E	Zone 3E
0/12	0.0	-0.69	-0.37	-1.07	-0.53
1/12	4.8	-0.69	-0.37	-1.07	-0.53
2/12	9.5	-0.69	-0.40	-1.07	-0.53
3/12	14.0	-0.69	-0.44	-1.07	-0.53
4/12	18.4	-0.69	-0.47	-1.07	-0.54
5/12	22.6	-0.45	-0.35	-0.72	-0.65
6/12	26.6	-0.10	-0.15	-0.19	-0.58
7/12	30.3	0.21	-0.43	0.27	-0.53
8/12	33.7	0.21	-0.43	0.27	-0.53
9/12	36.9	0.21	-0.43	0.27	-0.53
10/12	39.8	0.21	-0.43	0.27	-0.53
11/12	42.5	0.21	-0.43	0.27	-0.53
12/12	45.0	0.21	-0.43	0.27	-0.53
21/12	60.0	0.32	-0.41	0.40	-0.51

Notes

1) *GCpi equal + - 0.10 based on published data from the Solar America Board for Codes and Standards.*

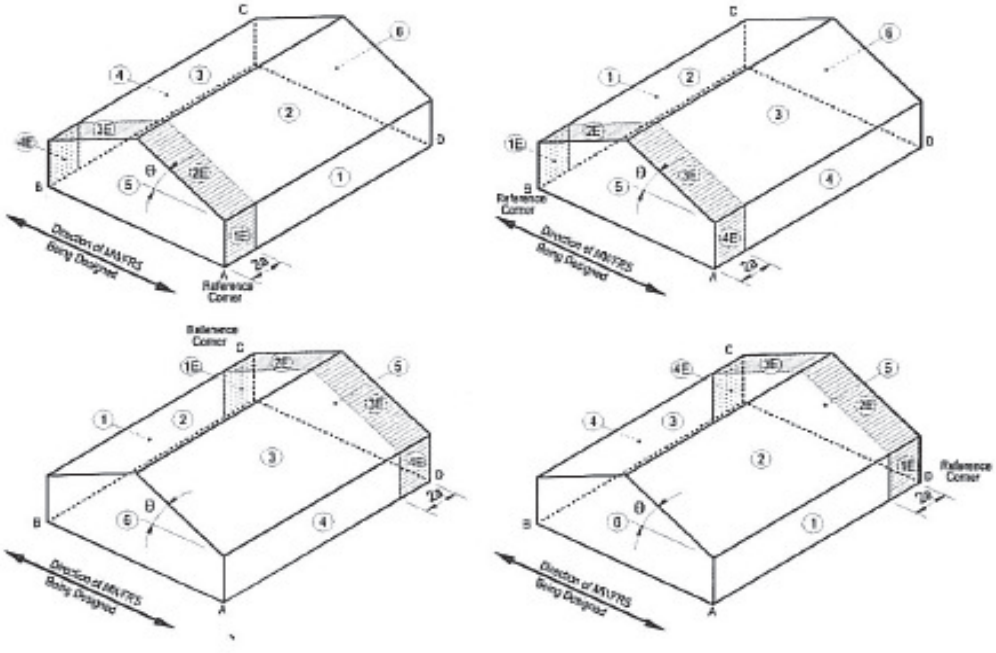
2) Wind Exposure B and C covered in this document.

Series 100

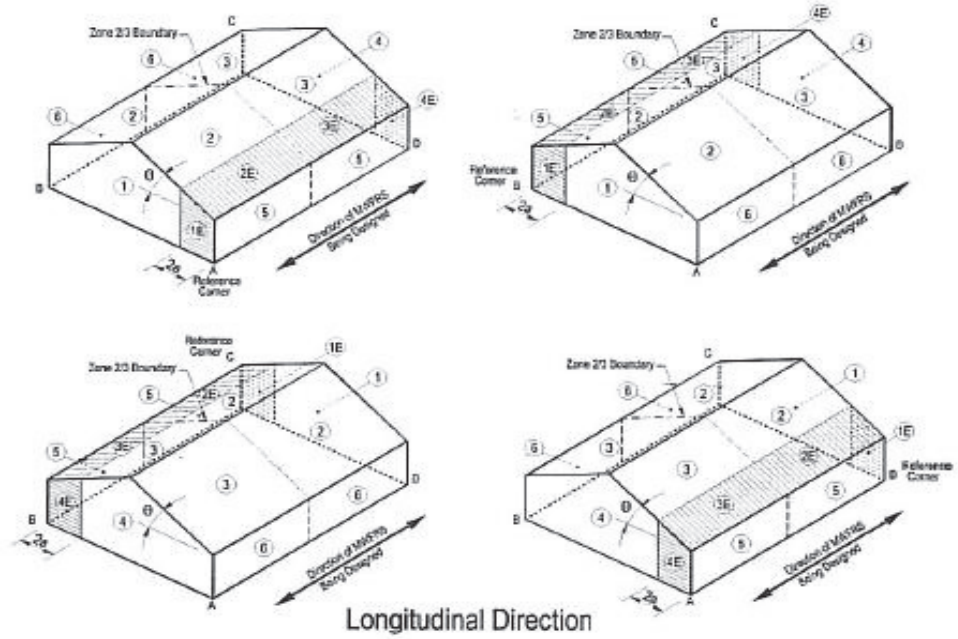
Wind Design ASCE 7-10 Main Force Resisting System
6063 Alloy Rail

SnapNrack™
PV Mounting Systems

Mean Roof Height 0 to 30 ft



Transverse Direction



Longitudinal Direction

Zone Locations Main Force Resisting Systems ASCE 7-10

Series 100

Wind Design ASCE 7-10 Components and Cladding Walls
6063 Alloy Rail

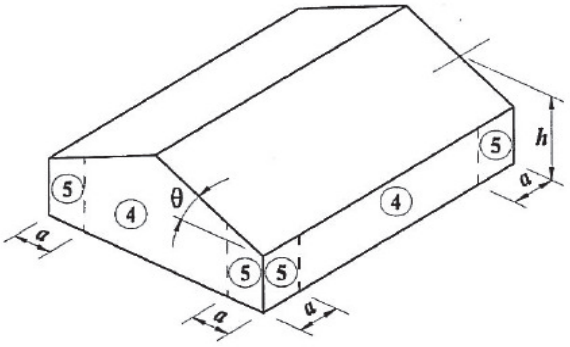
SnapNrack™ PV Mounting Systems

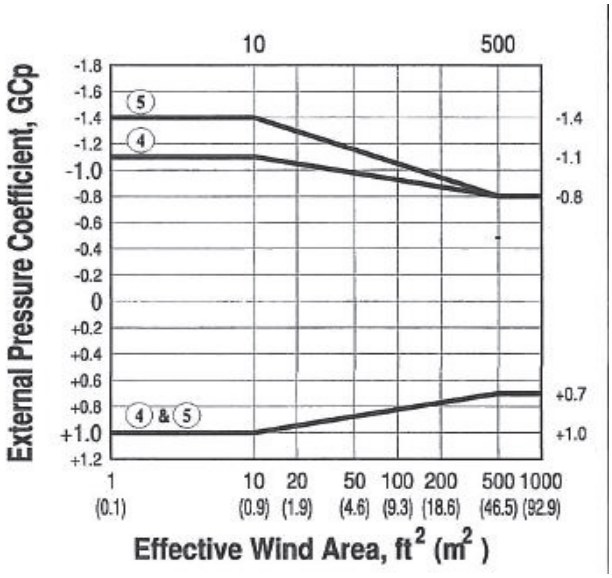
Mean Roof Height 0 to 30 ft

Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_p = External Pressure Coefficient





	GC_p Walls (Fig. 30.4-1)		
Slope in Degrees	Zone 4	Zone 5	Zone 4 & 5
0 to 10	-1.00	-1.27	0.91
10 to 45	-1.10	-1.39	-1.00

Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Wind Design ASCE 7-10 Components and Cladding Roof
0 to 7 degrees for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

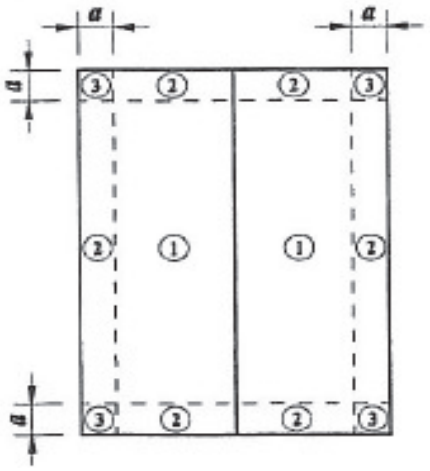
Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

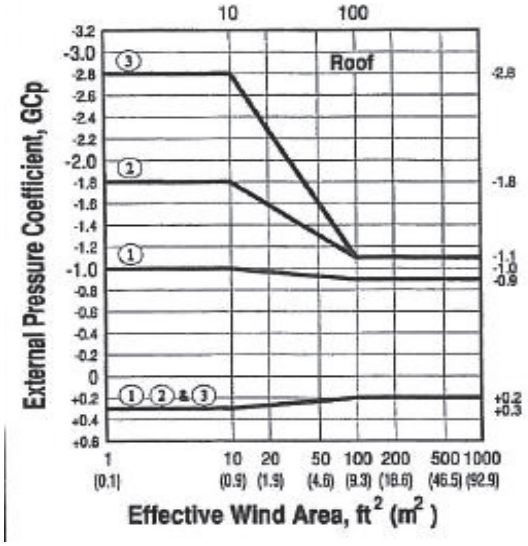
$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)

GC_{pi} = +/- Internal Pressure Coefficient

GC_p = External Pressure Coefficient





GC_p Roofs Fig. 30.4-2A				
Slope in Degrees	Zone 1	Zone 2	Zone 3	Zone 1,2,3
0 to 7	-0.99	-1.71	-2.59	0.29

Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Wind Design ASCE 7-10 Components and Cladding Roof
7 to 27 degrees for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

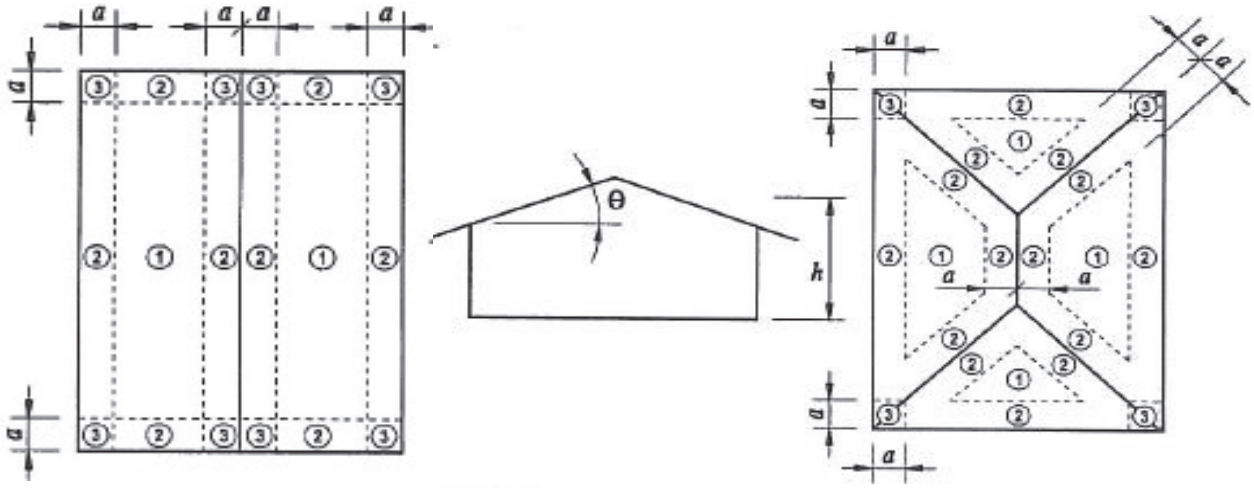
Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

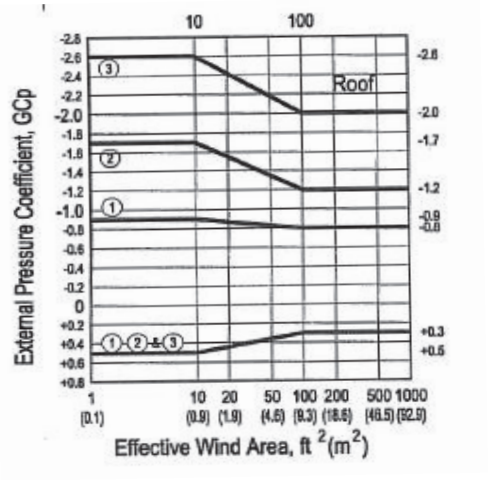
q_h = Velocity Pressure (psf)

GC_{pi} = +/- Internal Pressure Coefficient

GC_p = External Pressure Coefficient



GC_p Roofs Fig. 30.4-2B				
Slope in Degrees	Zone 1	Zone 2	Zone 3	Zone 1,2,3
7 to 27	-0.89	-1.64	-2.53	0.48



Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Wind Design ASCE 7-10 Components and Cladding Roof
27 to 45 degrees for 6063 Alloy Rail

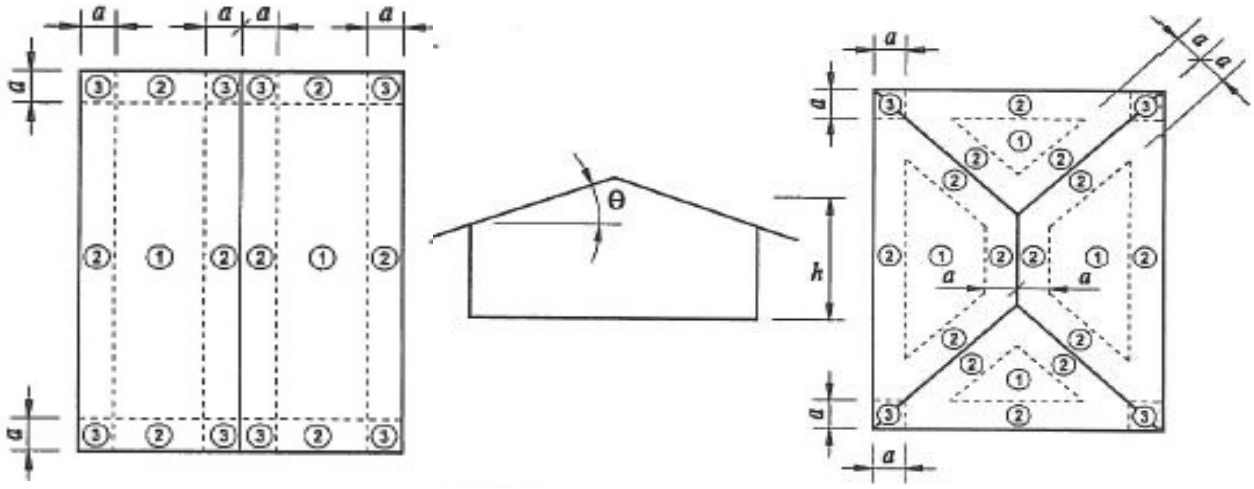
SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

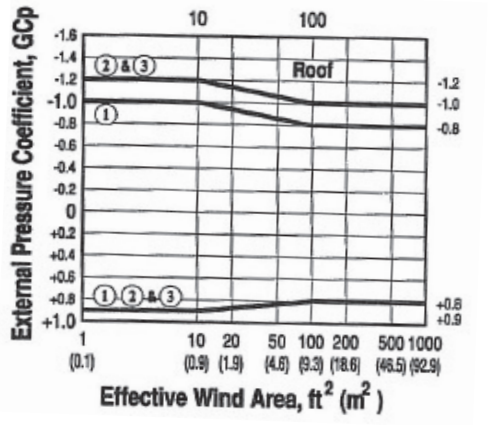
Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_p = External Pressure Coefficient



GC_p Roofs Fig. 30.4-2C				
Slope in Degrees	Zone 1	Zone 2	Zone 3	Zone 1,2,3
27 to 45	-0.98	-1.18	-1.18	0.89



Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Seismic Design ASCE 7-10 Chapter 11 and 13
6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

ASCE 7-10 Seismic Design Section 13.6.9

Site Classification		D	Default "D"
Seismic Use Group		II	Table 11.5-1
R_p	=	2.5	Input from Table 13.6-1 ASCE 7-10
A_p	=	1.0	Input from Table 13.6-1 ASCE 7-10
I_p	=	1.0	Input from Table 11.5-1 ASCE 7-10
S_s	=	3.0	Input from USGS Program
S_1	=	1.5	Input from USGS Program
F_a	=	1.0	Site Coefficient Table 11.4-1
F_v	=	1.5	Site Coefficient Table 11.4-2
S_{ms}	=	3.0	ASCE 7-10 Section 11.4.3
S_{m1}	=	2.3	ASCE 7-10 Section 11.4.3
S_{ds}	=	2.0	ASCE 7-10 Section 11.4.3
S_{d1}	=	1.5	ASCE 7-10 Section 11.4.3
z	=	30.5	Height at point of Attachment (ft.)
h	=	30.0	Average Roof Height of Structure (ft.)

F_p	=	0.97	Wp
$F_{p\ max}$	=	3.20	Wp
$F_{p\ min}$	=	0.60	Wp
Use F_p	=	**0.97**	**Wp**

(Eq. 13.3.1)

$$F_p = \frac{0.4\ a_p\ S_{DS}\ W_p}{\left(\frac{R_p}{I_p}\right)}\left(1+2\frac{z}{h}\right)$$

(Eq. 13.3.2) $F_p = 1.6\ S_{DS}\ I_p\ W_p$ **Max**

(Eq. 13.3.3) $F_p = 0.3\ S_{DS}\ I_p\ W_p$ **Min**

Vertical Accelerations

$0.20\ (S_{ds})\ W_p$

Notes

1) *Based on an average deal load of 4 psf the anticipated maximum seismic load is approximately 4 psf with a vertical accelerations of 1.6 psf wind loads govern the design of the PV system.*

Series 100

Snow Loads ASCE 7-10 Chapter 7
6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

ASCE 7-10 Snow Loads Chapter 7

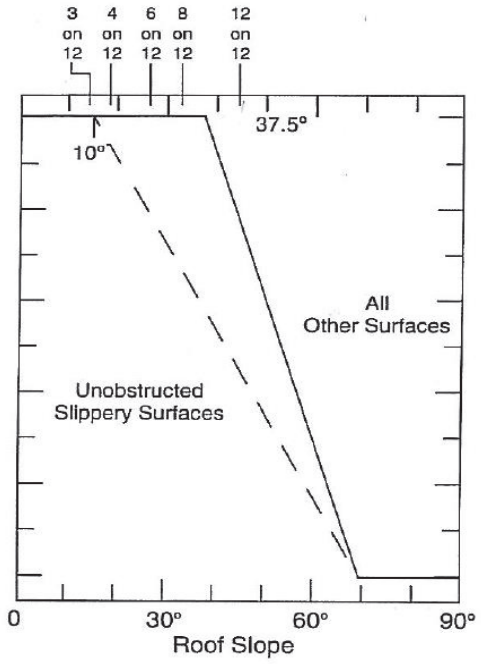
$P_f = 0.7\ C_e\ C_t\ I\ P_g$

$P_s = C_s\ P_f$

Snow Load Chart			
Ground Snow P_g	Flat Roof P_f	Sloped Roof P_s Slope < 9/12	Sloped Roof P_s Slope 9/12 to 12/12
10 psf	8	8	8
20 psf	15	15	15
30 psf	23	23	23
40 psf	31	31	31
50 psf	39	39	39
60 psf	46	46	46
70 psf	54	54	54
80 psf	62	62	62
100 psf	77	77	77
120 psf	92	92	92

Calculations for Snow Loads Chapter 7

C_e	=	1.00	Exposure Factor (Section 7.3.1)
C_t	=	1.10	Thermal Factor (Section 7.3.2)
I	=	1.00	Importance Factor (Section 7.3.3)



7-2b: Cold roofs with C_t=1.1

Series 100

Rail Properties for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

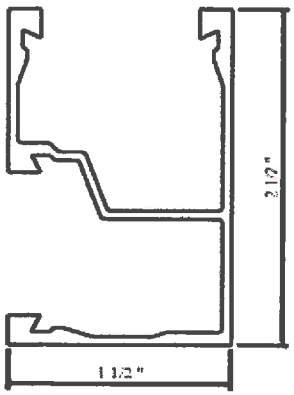
Rail Properties for Downward Loads

Section Properties

A	=	0.63	in^2
S	=	0.34	in^3
I	=	0.46	in^4

Stresses

F_b	=	15.2	ksi
F_v	=	15.2	ksi
E	=	10000	ksi
M_{allow}	=	5.17	k-in
V_{allow}	=	6.38	k



Rail Section

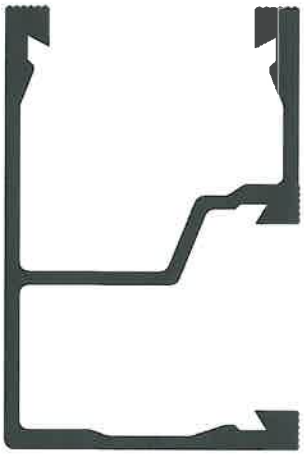
Rail Properties for Upward Loads

Section Properties

A	=	0.41	in^2
S	=	0.25	in^3
I	=	0.11	in^4

Stresses

F_b	=	15.2	ksi
F_v	=	15.2	ksi
E	=	10000	ksi
M_{allow}	=	3.84	k-in
V_{allow}	=	4.16	k



SnapNrack Standard Rail
6063 Alloy

Notes

1) *Rail section properties determined from test data.*
2) *Rail test date performed per guidelines of chapter 17 of the 2015 IBC.*
3) *This report is using 6063 Alloy Rail*

Series 100

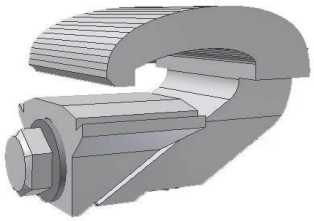
PV panel Calculations & Component and Cladding Forces
6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

PV Panel Calculations for 39" x 65" Panel Connections

Panel Dimensions			
65" Long Panels			
Panel Width	=	39.0	in
Panel Length	=	65.0	in
Panel Weight	=	70.4	#
Panel Area	=	17.6	ft^2



Universal End Clamp

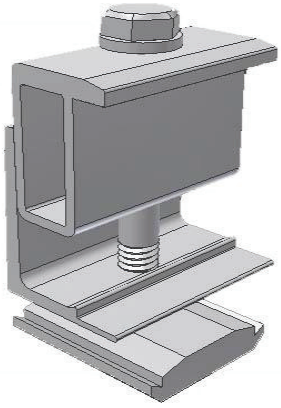
Wind Loading

ASCE 7-10 Component and Cladding

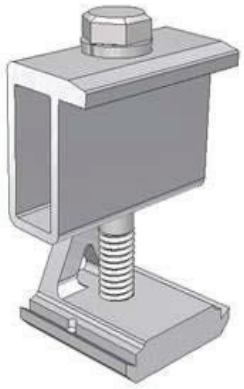
Wind Speed	110 to 190 mph
Exposure Cat.	C
Edge Distance (a)	4 Ft

Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
Max	-22.96	-30.71	-30.71	68.51
Min	-76.21	-128.56	-197.85	12.64

1) *Roof slopes from 0^o to 45^o*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*



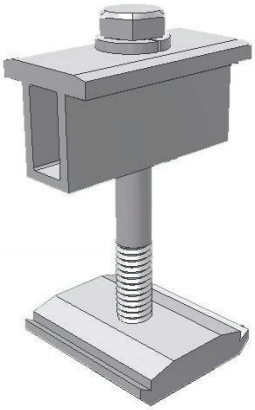
Adjustable End Clamp



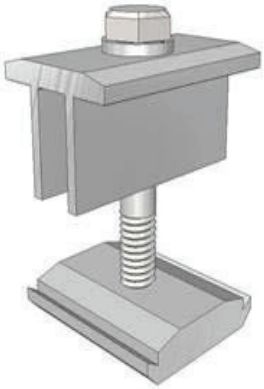
X-Clamp

Maximum Force at Mounting Bracket				
Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
End Clamp	-335	-566	-871	302
Int. Clamp	-671	-1132	N/A	603

1) *4 brackets minimum per PV panel to rail connection*
2) *Only one corner of one PV panel may be located in zone 3*
3) *Zone 2 may have multiple panels located in this zone*



Mid Clamp 1



Mid Clamp 2

Series 100

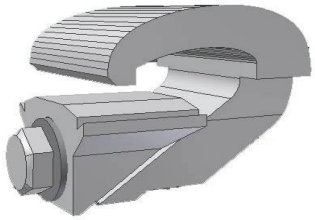
PV panel Calculations & Component and Cladding Forces
6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

PV Panel Calculations for 39" x 78" Panel Connections

Panel Dimensions			
78" Long Panels			
Panel Width	=	39.0	in
Panel Length	=	78.0	in
Panel Weight	=	84.5	#
Panel Area	=	21.1	ft^2



Universal End Clamp

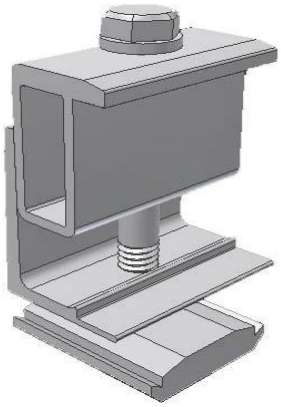
Wind Loading

ASCE 7-10 Component and Cladding

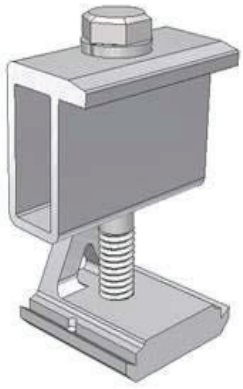
Wind Speed	110 to 190 mph
Exposure Cat.	C
Edge Distance (a)	4 Ft

Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
Max	-22.96	-30.71	-30.71	68.51
Min	-76.21	-128.56	-197.85	12.64

1) *Roof slopes from 0^o to 45^o*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*



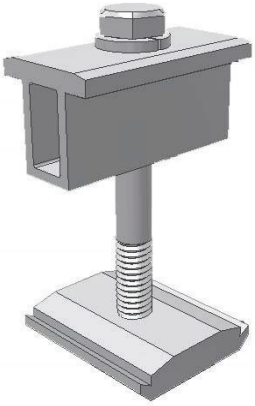
Adjustable End Clamp



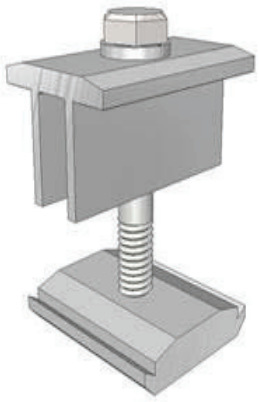
X-Clamp

Maximum Force at Mounting Bracket				
Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
End Clamps	-402	-679	-1045	362
Int. Clamp	-805	-1358	N/A	724

1) *4 brackets minimum per PV panel to rail connection*
2) *Only one corner of one PV panel may be located in zone 3*
3) *Zone 2 may have multiple panels located in this zone*



Mid Clamp 1



Mid Clamp 2

Series 100

Lag Bolt Design 2012 NDS for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

Lag Bolt Calculations for Roof Connection 65" long Panel

Bolt Connection to Roof Structure

2012 National Design Specifications
5/16" Diameter Lag Bolt 2 1/2" min. embedment into framing member

Allowable Tension	=	258 #/in
Embedment length	=	1.81 in
Duration of Load	=	1.6 wind
Allowable Tension	=	747.2 #
Allowable Uplift	=	339.6 #

65" Long Panels				
Maximum Wind Uplift (psf) per Span Based On Lag Bolt				
Span	Zone 2	Zone 3	Zone 2E	Zone 3E
2 ft	62.7	62.7	62.7	125.4
4 ft	31.3	31.3	31.3	62.7
6 ft	20.9	20.9	20.9	41.8
8 ft	15.7	15.7	15.7	31.3

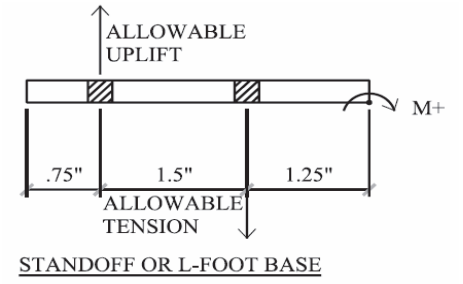
Lag Bolt Calculations for Roof Connection 78" long Panel

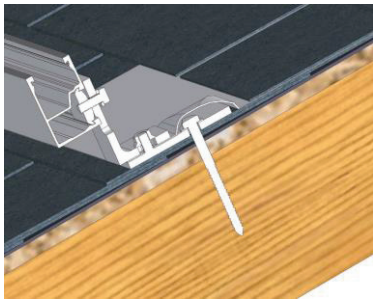
Bolt Connection to Roof Structure

2012 National Design Specifications
5/16" Diameter Lag Bolt 2 1/2" min. embedment into framing member

Allowable Tension	=	258 #/in
Embedment length	=	1.81 in
Duration of Load	=	1.6 wind
Allowable Tension	=	747.2 #
Allowable Uplift	=	339.6 #

78" Long Panels				
Maximum Wind Uplift (psf) per Span Based On Lag Bolt				
Span	Zone 2	Zone 3	Zone 2E	Zone 3E
2 ft	52.2	52.2	52.2	104.5
4 ft	26.1	26.1	26.1	52.2
6 ft	17.4	17.4	17.4	34.8
8 ft	13.1	13.1	13.1	26.1





Notes

1) *Only one corner of one PV panel may be located in zone 3E*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 0 to 19 degrees for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angle 0 to 19 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-10.7	-11.7	-12.7	-13.8	-14.9	-16.1	-17.3	-18.6	-19.9	-21.2	-22.6	-25.5	-28.6	-31.9
	0	0	116	110	104	99	95	91	87	83	80	77	75	70	65	62
	10	8	114	110	104	99	95	91	87	83	80	77	75	70	65	62
	20	15	89	89	89	89	89	89	87	83	80	77	75	70	65	62
	30	23	75	75	75	75	75	75	75	75	75	75	75	70	65	62
	40	31	66	66	66	66	66	66	66	66	66	66	66	66	65	62
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	60
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 19 to 37 degrees for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angle 20 to 36 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-7.0	-7.6	-8.3	-9.0	-9.7	-10.5	-11.3	-12.1	-13.0	-13.8	-14.7	-16.6	-18.7	-20.8
	0	0	120	120	120	120	120	118	112	108	103	99	95	89	83	78
	10	8	112	111	110	109	108	107	105	104	103	99	95	89	83	78
	20	15	89	89	89	89	89	89	88	88	87	87	86	85	83	78
	30	23	75	75	75	75	75	75	75	75	75	75	75	75	74	73
	40	31	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	60
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 37 to 45 degrees for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angle 37 to 45 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-6.7	-7.3	-7.9	-8.6	-9.3	-10.0	-10.8	-11.6	-12.4	-13.2	-14.1	-15.9	-17.8	-19.9
	0	0	120	120	120	120	120	120	116	111	106	102	98	91	85	80
	10	8	112	111	110	109	108	107	105	104	103	102	98	91	85	80
	20	15	89	89	89	89	89	89	88	88	87	87	86	85	83	80
	30	23	75	75	75	75	75	75	75	75	75	75	75	75	74	73
	40	31	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	60
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 45 to 60 degrees for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angles 46 to 60 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-6.3	-6.9	-7.6	-8.2	-8.9	-9.6	-10.3	-11.0	-11.8	-12.6	-13.4	-15.2	-17.0	-18.9
	0	0	120	120	120	120	118	115	113	110	107	105	101	94	88	82
	10	8	106	105	104	102	101	100	98	97	96	94	93	90	88	82
	20	15	89	88	87	87	86	85	84	83	82	82	81	79	77	76
	30	23	75	75	75	75	75	75	75	74	74	73	72	71	70	69
	40	31	66	66	66	66	66	66	66	66	66	66	66	65	64	63
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	59
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Wind Design ASCE 7-10 Main Force Resisting System
6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

Velocity Pressure 28.3.2 ASCE 7-10

$q_z = q_h = 0.00256\ k_z\ k_{zt}\ k_d\ V^2$

Risk Category: II (Table 1.5-2)

Wind Exposure Category C

k_z = 1.13 Velocity Pressure Exposure Coefficients (Table 26.8-1)
K_{zt} = 1.00 Topographic Factor (Fig. 26.8-1)
K_d = 0.85 Wind Directionality Factor (Table 26.6-1)

Velocity Pressures														
Wind Speed	110	115	120	125	130	135	140	145	150	155	160	170	180	190
q_h	29.75	32.52	35.41	38.42	41.56	44.81	48.19	51.70	55.32	59.07	62.95	71.06	79.67	88.77
ASD (0.6W)	17.85	19.51	21.24	23.05	24.93	26.89	28.92	31.02	33.19	35.44	37.77	42.64	47.80	53.26

$P = q_h\ [\ GC_{pf} - GC_{pi}\ ]$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_{pf} = External Pressure Coefficient

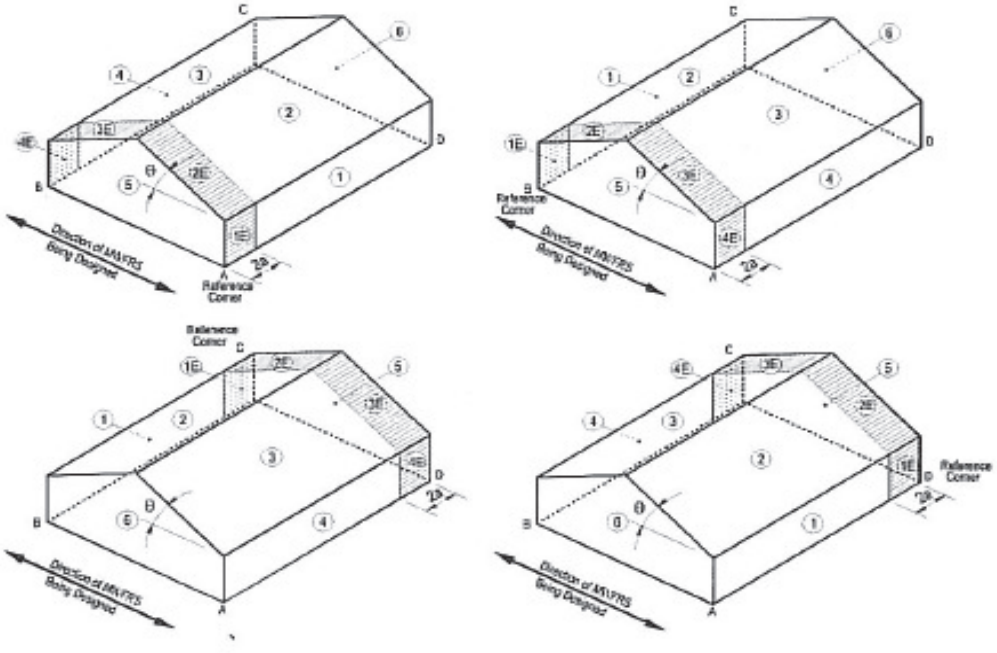
GC_{pf} Roof Zones Fig 28.4-1 ASCE 7-10					
Pitch	Slope	Zone 2	Zone 3	Zone 2E	Zone 3E
0/12	0.0	-0.69	-0.37	-1.07	-0.53
1/12	4.8	-0.69	-0.37	-1.07	-0.53
2/12	9.5	-0.69	-0.40	-1.07	-0.53
3/12	14.0	-0.69	-0.44	-1.07	-0.53
4/12	18.4	-0.69	-0.47	-1.07	-0.54
5/12	22.6	-0.45	-0.35	-0.72	-0.65
6/12	26.6	-0.10	-0.15	-0.19	-0.58
7/12	30.3	0.21	-0.43	0.27	-0.53
8/12	33.7	0.21	-0.43	0.27	-0.53
9/12	36.9	0.21	-0.43	0.27	-0.53
10/12	39.8	0.21	-0.43	0.27	-0.53
11/12	42.5	0.21	-0.43	0.27	-0.53
12/12	45.0	0.21	-0.43	0.27	-0.53
21/12	60.0	0.32	-0.41	0.40	-0.51

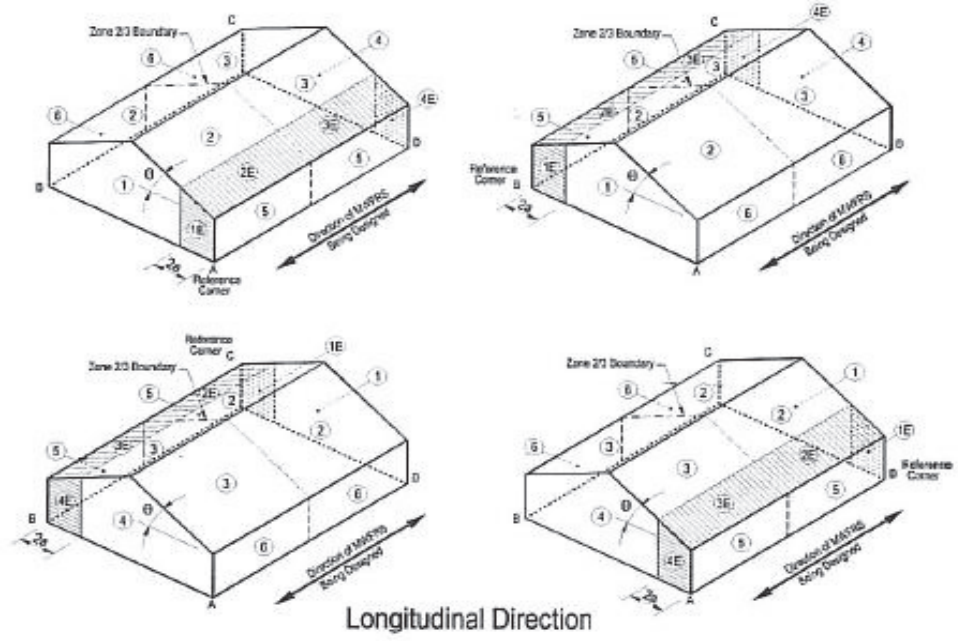
Notes

1) *GCpi equal + - 0.10 based on published data from the Solar America Board for Codes and Standards.*

2) Wind Exposure B and C covered in this document.

Mean Roof Height 30 to 60 ft





Zone Locations Main Force Resisting Systems ASCE 7-10

Series 100

Wind Design ASCE 7-10 Components and Cladding Walls
6063 Alloy Rail

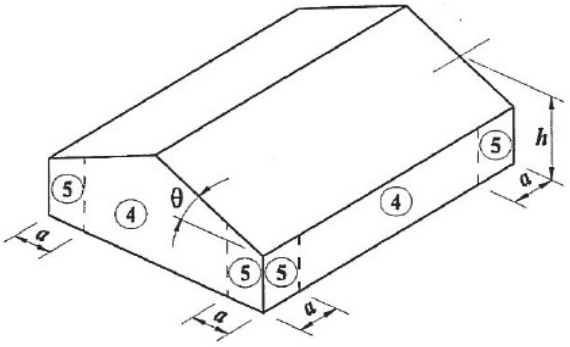
SnapNrack™ PV Mounting Systems

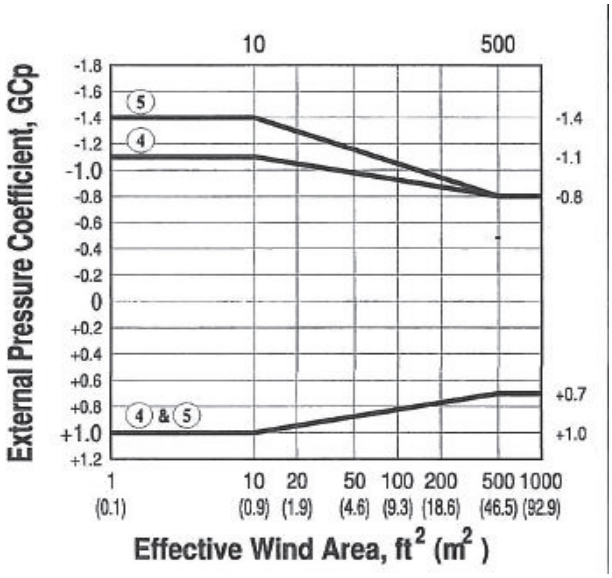
Mean Roof Height 30 to 60 ft

Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_p = External Pressure Coefficient





	GC_p Walls (Fig. 30.4-1)		
Slope in Degrees	Zone 4	Zone 5	Zone 4 & 5
0 to 10	-1.00	-1.27	0.91
10 to 45	-1.10	-1.39	-1.00

Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Wind Design ASCE 7-10 Components and Cladding Roof
0 to 7 degrees for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

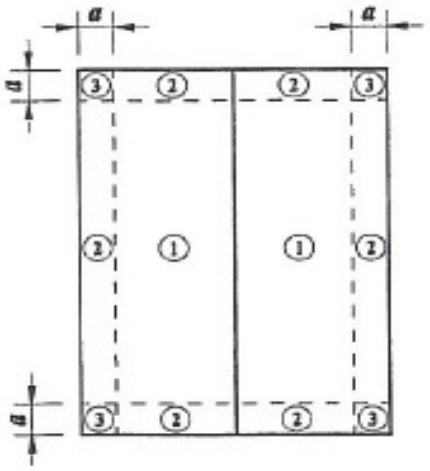
Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

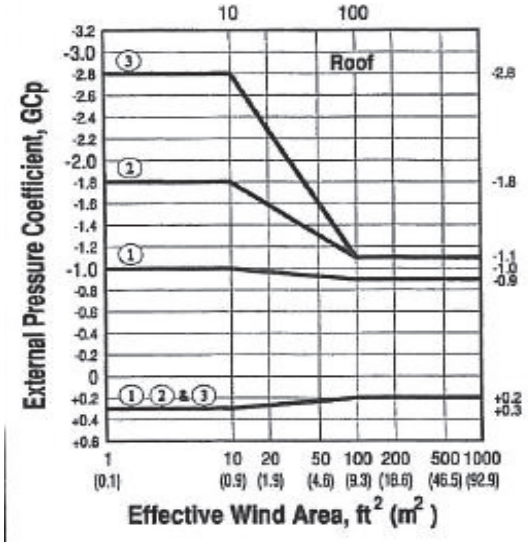
$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)

GC_{pi} = +/- Internal Pressure Coefficient

GC_p = External Pressure Coefficient





GC_p Roofs Fig. 30.4-2A				
Slope in Degrees	Zone 1	Zone 2	Zone 3	Zone 1,2,3
0 to 7	-0.99	-1.71	-2.59	0.29

Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Wind Design ASCE 7-10 Components and Cladding Roof
7 to 27 degrees for 6063 Alloy Rail

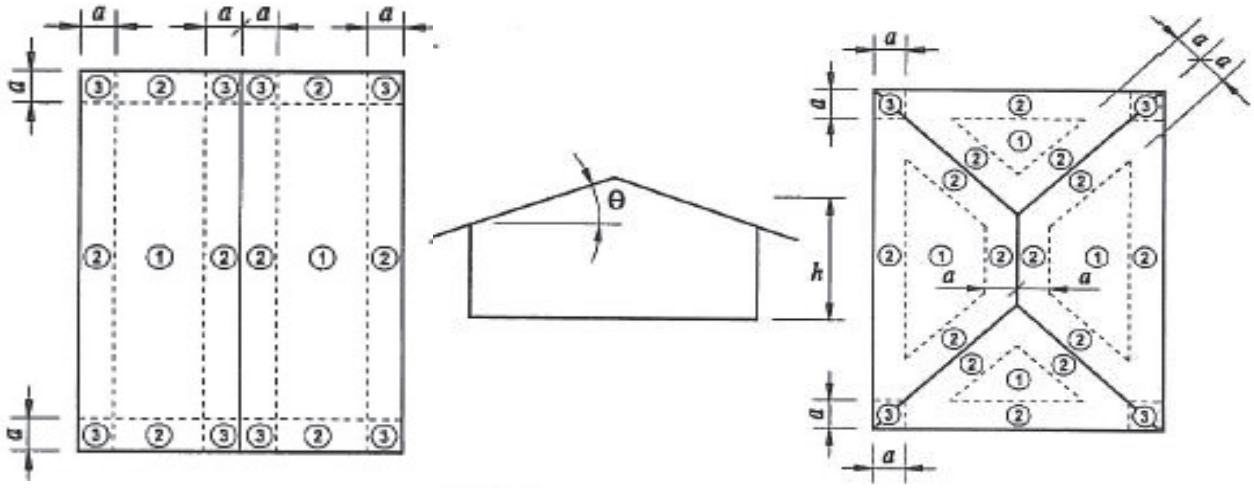
SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

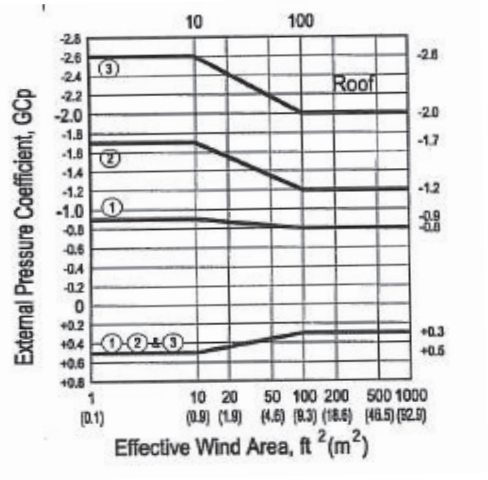
Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_p = External Pressure Coefficient



GC_p Roofs Fig. 30.4-2B				
Slope in Degrees	Zone 1	Zone 2	Zone 3	Zone 1,2,3
7 to 27	-0.89	-1.64	-2.53	0.48



Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Wind Design ASCE 7-10 Components and Cladding Roof
27 to 45 degrees for 6063 Alloy Rail

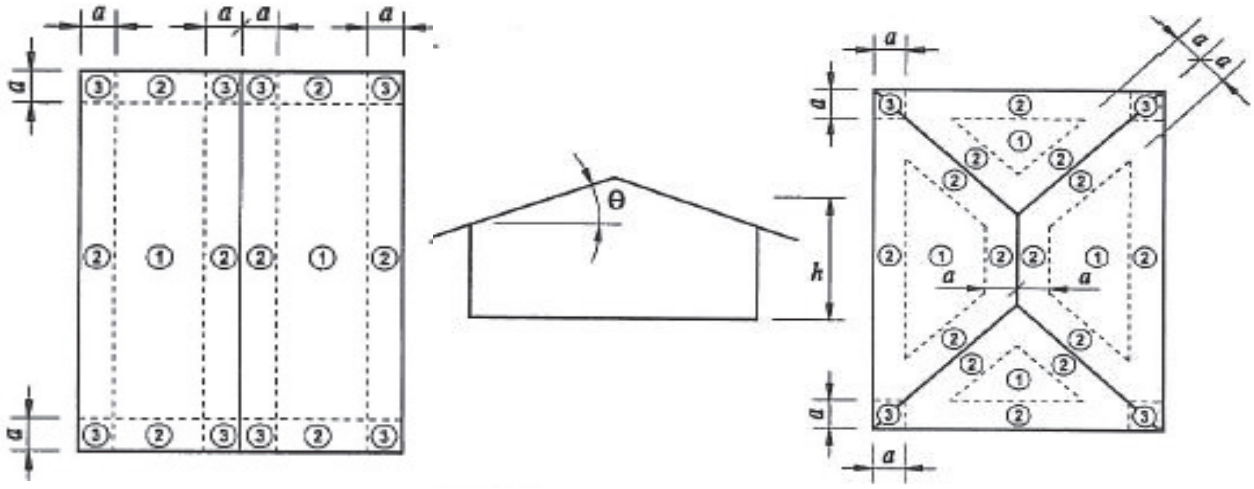
SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

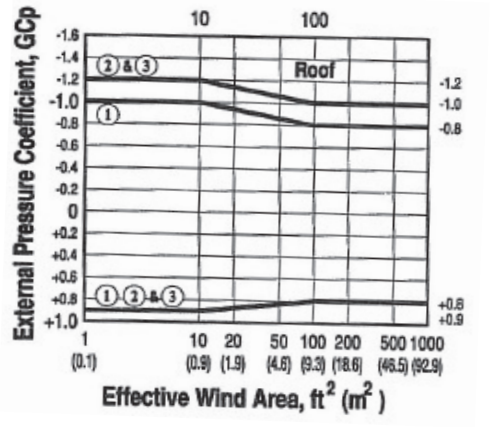
Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_p = External Pressure Coefficient



GC_p Roofs Fig. 30.4-2C				
Slope in Degrees	Zone 1	Zone 2	Zone 3	Zone 1,2,3
27 to 45	-0.98	-1.18	-1.18	0.89



Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Seismic Design ASCE 7-10 Chapter 11 and 13
Alloy Rail

6063

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

ASCE 7-10 Seismic Design Section 13.6.9

Site Classification		D	Default "D"
Seismic Use Group		II	Table 11.5-1
R_p	=	2.5	Input from Table 13.6-1 ASCE 7-10
A_p	=	1.0	Input from Table 13.6-1 ASCE 7-10
I_p	=	1.0	Input from Table 11.5-1 ASCE 7-10
S_s	=	3.0	Input from USGS Program
S_1	=	1.5	Input from USGS Program
F_a	=	1.0	Site Coefficient Table 11.4-1
F_v	=	1.5	Site Coefficient Table 11.4-2
S_{ms}	=	3.0	ASCE 7-10 Section 11.4.3
S_{m1}	=	2.3	ASCE 7-10 Section 11.4.3
S_{ds}	=	2.0	ASCE 7-10 Section 11.4.3
S_{d1}	=	1.5	ASCE 7-10 Section 11.4.3
z	=	60.5	Height at point of Attachment (ft.)
h	=	60.0	Average Roof Height of Structure (ft.)

F_p	=	0.97 Wp
$F_{p\ max}$	=	3.20 Wp
$F_{p\ min}$	=	0.60 Wp
Use F_p	=	**0.97 Wp**

(Eq. 13.3.1)

$$F_p = \frac{0.4\ a_p\ S_{DS}\ W_p}{\left(\frac{R_p}{I_p}\right)} \left(1+2\ \frac{z}{h}\right)$$

(Eq. 13.3.2) $F_p = 1.6\ S_{DS}\ I_p\ W_p$ **Max**

(Eq. 13.3.3) $F_p = 0.3\ S_{DS}\ I_p\ W_p$ **Min**

Vertical Accelerations

0.20 (S_{ds}) W_p

Notes

1) *Based on an average deal load of 4 psf the anticipated maximum seismic load is approximately 4 psf with a vertical accelerations of 1.6 psf wind loads govern the design of the PV system.*

Series 100

Snow Loads ASCE 7-10 Chapter 7
6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

ASCE 7-10 Snow Loads Chapter 7

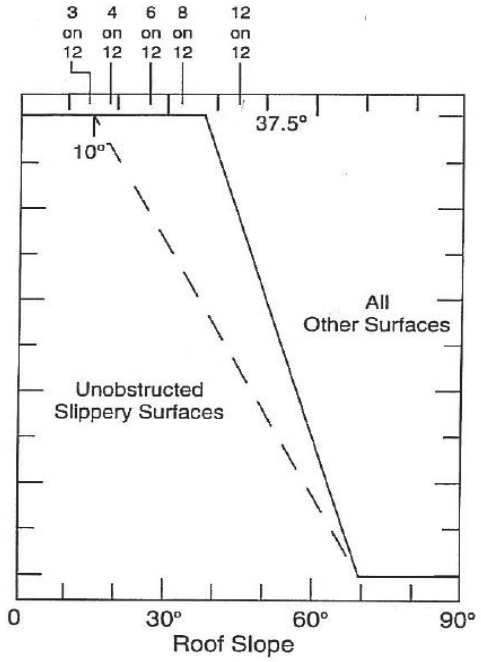
$P_f = 0.7\ C_e\ C_t\ I\ P_g$

$P_s = C_s\ P_f$

Snow Load Chart			
Ground Snow P_g	Flat Roof P_f	Sloped Roof P_s Slope < 9/12	Sloped Roof P_s Slope 9/12 to 12/12
10 psf	8	8	8
20 psf	15	15	15
30 psf	23	23	23
40 psf	31	31	31
50 psf	39	39	39
60 psf	46	46	46
70 psf	54	54	54
80 psf	62	62	62
100 psf	77	77	77
120 psf	92	92	92

Calculations for Snow Loads Chapter 7

C_e	=	1.00	Exposure Factor (Section 7.3.1)
C_t	=	1.10	Thermal Factor (Section 7.3.2)
I	=	1.00	Importance Factor (Section 7.3.3)



7-2b: Cold roofs with C_t=1.1

Series 100

Rail Properties for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

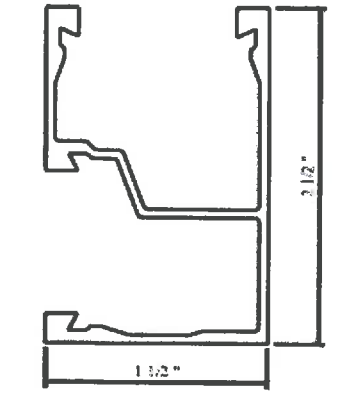
Rail Properties for Downward Loads

Section Properties

A	=	0.63	in^2
S	=	0.34	in^3
I	=	0.46	in^4

Stresses

F_b	=	15.2	ksi
F_v	=	15.2	ksi
E	=	10000	ksi
M_{allow}	=	5.17	k-in
V_{allow}	=	6.38	k



Rail Section

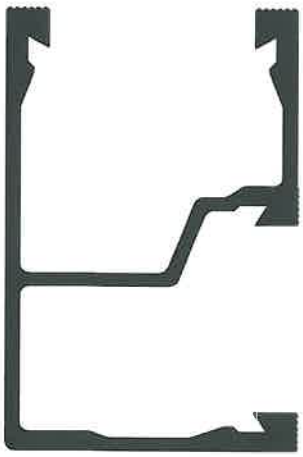
Rail Properties for Upward Loads

Section Properties

A	=	0.41	in^2
S	=	0.25	in^3
I	=	0.11	in^4

Stresses

F_b	=	15.2	ksi
F_v	=	15.2	ksi
E	=	10000	ksi
M_{allow}	=	3.84	k-in
V_{allow}	=	4.16	k



SnapNrack Standard Rail
6063 Alloy

Notes

1) *Rail section properties determined from test data.*
2) *Rail test date performed per guidelines of chapter 17 of the 2015 IBC.*
3) *This report is using 6063 Alloy Rail*

Series 100

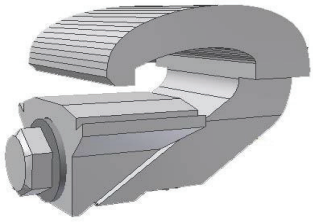
PV panel Calculations & Component and Cladding Forces for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

PV Panel Calculations for 39" x 65" Panel Connections

Panel Dimensions 65" Long Panels		
Panel Width	=	39.0 in
Panel Length	=	65.0 in
Panel Weight	=	70.4 #
Panel Area	=	17.6 ft^2



Universal End Clamp

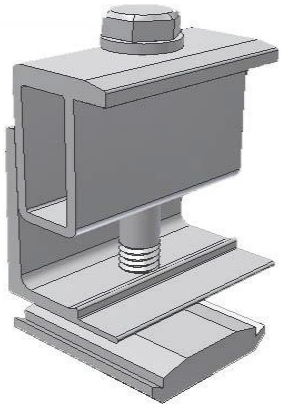
Wind Loading

ASCE 7-10 Component and Cladding

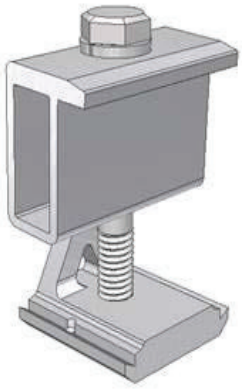
Wind Speed	110 to 190 mph
Exposure Cat.	C
Edge Distance (a)	4 Ft

Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
Max	-26.48	-35.41	-35.41	79.00
Min	-87.88	-148.24	-228.13	14.58

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*



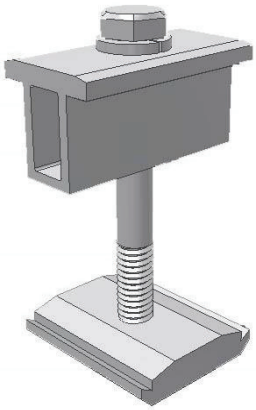
Adjustable End Clamp



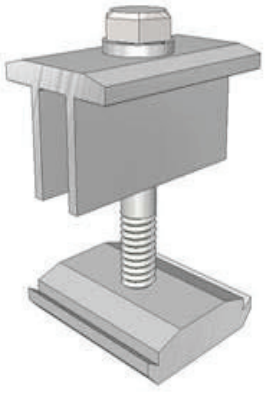
X-Clamp

Maximum Force at Mounting Bracket				
Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
End Clamp	-387	-652	-1004	348
Int. Clamp	-774	-1305	N/A	695

1) *4 brackets minimum per PV panel to rail connection*
2) *Only one corner of one PV panel may be located in zone 3*
3) *Zone 2 may have multiple panels located in this zone*



Mid Clamp 1



Mid Clamp 2

Series 100

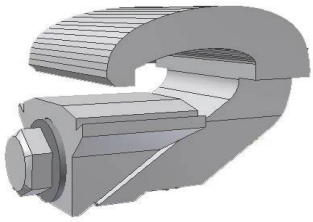
PV panel Calculations & Component and Cladding Forces for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

PV Panel Calculations for 39" x 78" Panel Connections

Panel Dimensions 78" Long Panels		
Panel Width	=	39.0 in
Panel Length	=	78.0 in
Panel Weight	=	84.5 #
Panel Area	=	21.1 ft^2



Universal End Clamp

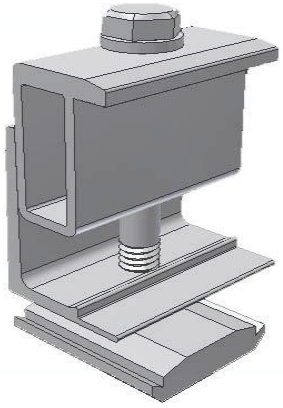
Wind Loading

ASCE 7-10 Component and Cladding

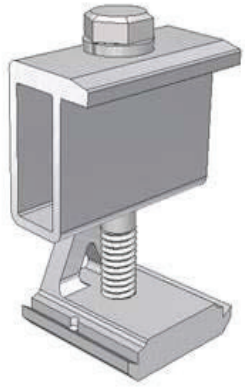
Wind Speed	110 to 190 mph
Exposure Cat.	C
Edge Distance (a)	4 Ft

Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
Max	-26.48	-35.41	-35.41	79.00
Min	-87.88	-148.24	-228.13	14.58

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*



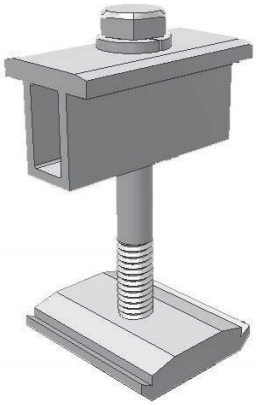
Adjustable End Clamp



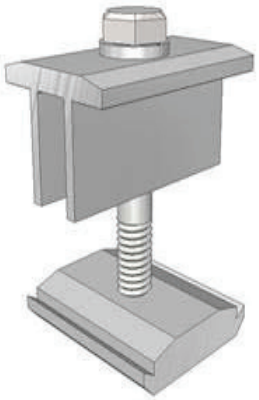
X-Clamp

Maximum Force at Mounting Bracket				
Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
End Clamps	-464	-783	-1205	417
Int. Clamp	-928	-1566	N/A	834

1) *4 brackets minimum per PV panel to rail connection*
2) *Only one corner of one PV panel may be located in zone 3*
3) *Zone 2 may have multiple panels located in this zone*



Mid Clamp 1



Mid Clamp 2

Series 100

Lag Bolt Design 2012 NDS for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

Lag Bolt Calculations for Roof Connection 65" long Panel

Bolt Connection to Roof Structure

2012 National Design Specifications
5/16" Diameter Lag Bolt 2 1/2" min. embedment into framing member

Allowable Tension	=	258 #/in
Embedment length	=	1.81 in
Duration of Load	=	1.6 wind
Allowable Tension	=	747.2 #
Allowable Uplift	=	339.6 #

65" Long Panels				
Maximum Wind Uplift (psf) per Span Based On Lag Bolt				
Span	Zone 2	Zone 3	Zone 2E	Zone 3E
2 ft	62.7	62.7	62.7	125.4
4 ft	31.3	31.3	31.3	62.7
6 ft	20.9	20.9	20.9	41.8
8 ft	15.7	15.7	15.7	31.3

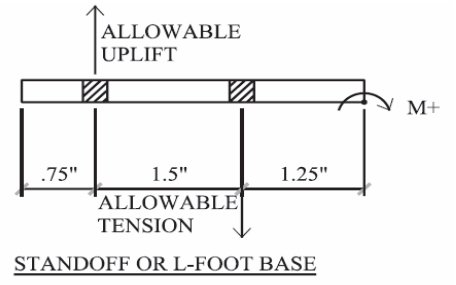
Lag Bolt Calculations for Roof Connection 78" long Panel

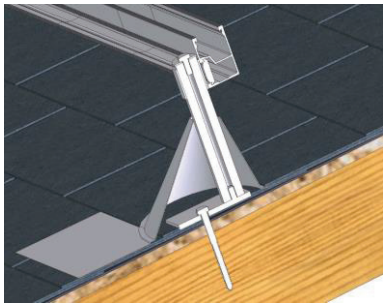
Bolt Connection to Roof Structure

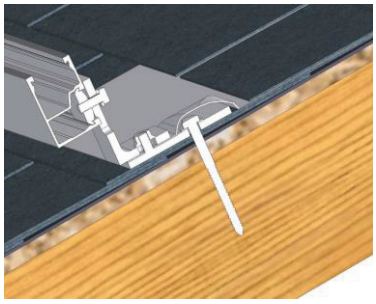
2012 National Design Specifications
5/16" Diameter Lag Bolt 2 1/2" min. embedment into framing member

Allowable Tension	=	258 #/in
Embedment length	=	1.81 in
Duration of Load	=	1.6 wind
Allowable Tension	=	747.2 #
Allowable Uplift	=	339.6 #

78" Long Panels				
Maximum Wind Uplift (psf) per Span Based On Lag Bolt				
Span	Zone 2	Zone 3	Zone 2E	Zone 3E
2 ft	52.2	52.2	52.2	104.5
4 ft	26.1	26.1	26.1	52.2
6 ft	17.4	17.4	17.4	34.8
8 ft	13.1	13.1	13.1	26.1







Notes

1) *Only one corner of one PV panel may be located in zone 3E*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 0 to 19 degrees for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angle 0 to 19 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-12.3	-13.5	-14.7	-15.9	-17.2	-18.6	-20.0	-21.4	-22.9	-24.5	-26.1	-29.4	-33.0	-36.7
	0	0	106	101	96	91	87	83	80	77	74	71	69	64	61	57
	10	8	106	101	96	91	87	83	80	77	74	71	69	64	61	57
	20	15	89	89	89	89	87	83	80	77	74	71	69	64	61	57
	30	23	75	75	75	75	75	75	75	75	74	71	69	64	61	57
	40	31	66	66	66	66	66	66	66	66	66	66	66	64	61	57
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	57
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 19 to 37 degrees for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angle 20 to 36 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-8.0	-8.8	-9.6	-10.4	-11.2	-12.1	-13.0	-14.0	-14.9	-16.0	-17.0	-19.2	-21.5	-24.0
	0	0	120	120	120	119	113	108	103	99	95	91	88	82	77	72
	10	8	110	109	108	107	106	104	103	99	95	91	88	82	77	72
	20	15	89	89	89	89	89	88	87	86	86	85	84	82	77	72
	30	23	75	75	75	75	75	75	75	75	75	75	75	74	73	72
	40	31	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	60
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 37 to 45 degrees for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angle 37 to 45 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-7.7	-8.4	-9.1	-9.9	-10.7	-11.6	-12.4	-13.3	-14.3	-15.2	-16.2	-18.3	-20.6	-22.9
	0	0	120	120	120	120	116	111	106	101	97	93	90	84	79	74
	10	8	110	109	108	107	106	104	103	101	97	93	90	84	79	74
	20	15	89	89	89	89	89	88	87	86	86	85	84	83	79	74
	30	23	75	75	75	75	75	75	75	75	75	75	75	74	73	72
	40	31	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	60	60
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 45 to 60 degrees for 6063 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angles 46 to 60 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-7.3	-8.0	-8.7	-9.5	-10.2	-11.0	-11.9	-12.7	-13.6	-14.5	-15.5	-17.5	-19.6	-21.8
	0	0	120	120	119	116	113	110	107	104	100	96	93	86	81	76
	10	8	104	103	101	100	98	97	96	94	93	91	90	86	81	76
	20	15	88	87	86	85	84	83	82	81	81	80	79	77	75	73
	30	23	75	75	75	75	75	74	73	73	72	72	71	70	68	67
	40	31	66	66	66	66	66	66	66	66	66	65	65	64	63	62
	50	39	60	60	60	60	60	60	60	60	60	60	60	60	59	58
	60	46	55	55	55	55	55	55	55	55	55	55	55	55	55	54
	70	54	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	80	62	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	100	77	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	120	92	40	40	40	40	40	40	40	40	40	40	40	40	40	40

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Wind Design ASCE 7-10 Main Force Resisting System
6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

Velocity Pressure 28.3.2 ASCE 7-10

$q_z = q_h = 0.00256\ k_z\ k_{zt}\ k_d\ V^2$

Risk Category: II (Table 1.5-2)

Wind Exposure Category C

k_z	=	0.98	Velocity Pressure Exposure Coefficients (Table 26.8-1)
K_{zt}	=	1.00	Topographic Factor (Fig. 26.8-1)
K_d	=	0.85	Wind Directionality Factor (Table 26.6-1)

Velocity Pressures														
Wind Speed	110	115	120	125	130	135	140	145	150	155	160	170	180	190
q_h	25.80	28.20	30.71	33.32	36.04	38.86	41.80	44.84	47.98	51.23	54.59	61.63	69.09	76.98
ASD (0.6W)	15.48	16.92	18.42	19.99	21.62	23.32	25.08	26.90	28.79	30.74	32.75	36.98	41.46	46.19

$P = q_h\ [\ GC_{pf} - GC_{pi}\ ]$

q_h	=	Velocity Pressure (psf)
GC_{pi}	=	+/- Internal Pressure Coefficient
GC_{pf}	=	External Pressure Coefficient

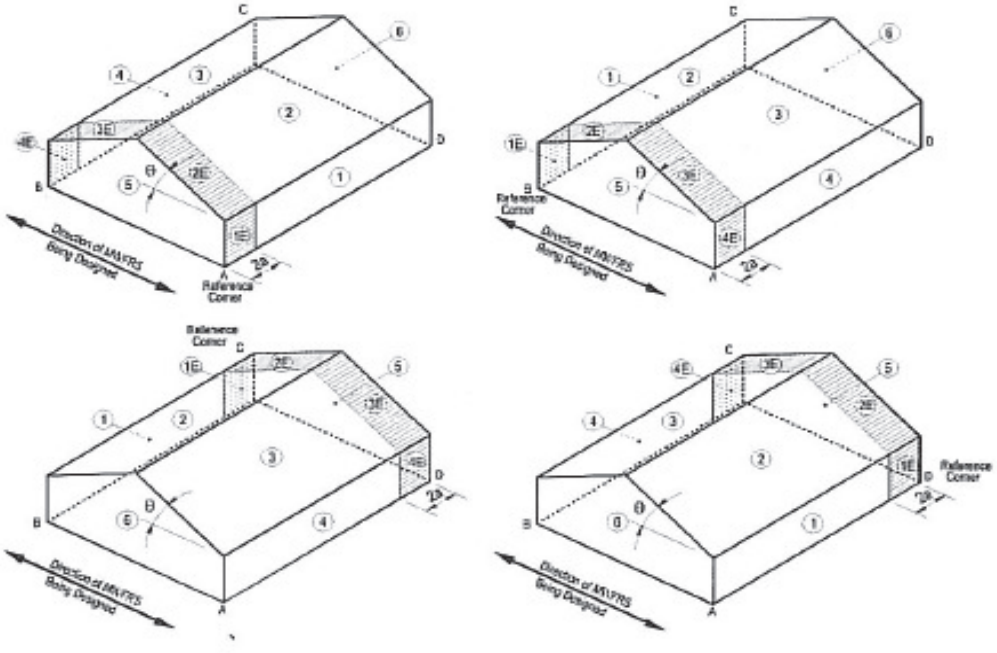
	GC_{pf} Roof Zones Fig 28.4-1 ASCE 7-10				
Pitch	Slope	Zone 2	Zone 3	Zone 2E	Zone 3E
0/12	0.0	-0.69	-0.37	-1.07	-0.53
1/12	4.8	-0.69	-0.37	-1.07	-0.53
2/12	9.5	-0.69	-0.40	-1.07	-0.53
3/12	14.0	-0.69	-0.44	-1.07	-0.53
4/12	18.4	-0.69	-0.47	-1.07	-0.54
5/12	22.6	-0.45	-0.35	-0.72	-0.65
6/12	26.6	-0.10	-0.15	-0.19	-0.58
7/12	30.3	0.21	-0.43	0.27	-0.53
8/12	33.7	0.21	-0.43	0.27	-0.53
9/12	36.9	0.21	-0.43	0.27	-0.53
10/12	39.8	0.21	-0.43	0.27	-0.53
11/12	42.5	0.21	-0.43	0.27	-0.53
12/12	45.0	0.21	-0.43	0.27	-0.53
21/12	60.0	0.32	-0.41	0.40	-0.51

Notes

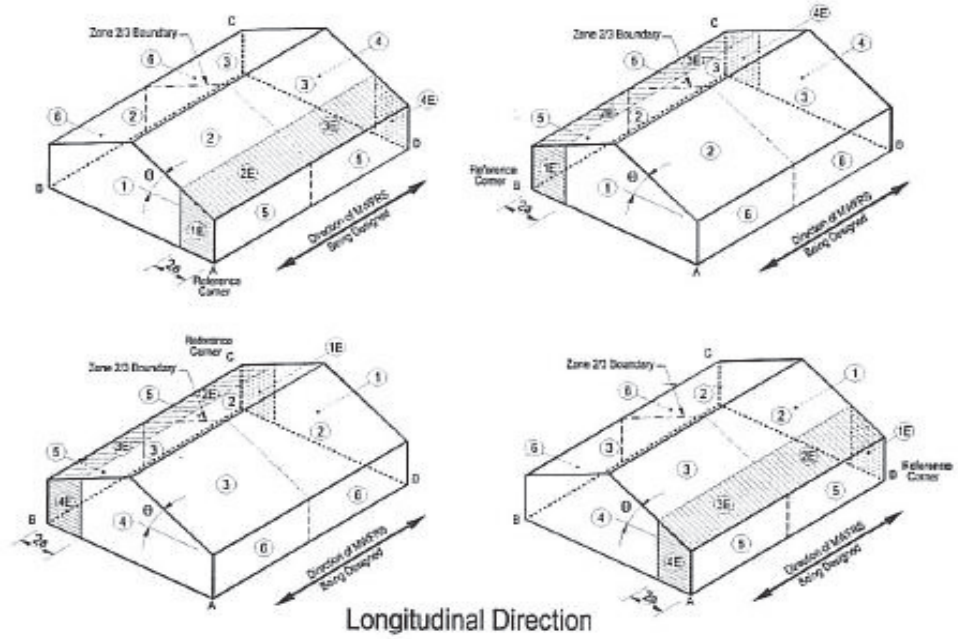
1) *GCpi equal + - 0.10 based on published data from the Solar America Board for Codes and Standards.*

2) Wind Exposure B and C covered in this document.

Mean Roof Height 0 to 30 ft



Transverse Direction



Longitudinal Direction

Zone Locations Main Force Resisting Systems ASCE 7-10

Series 100

Wind Design ASCE 7-10 Components and Cladding Walls
6005 Alloy Rail

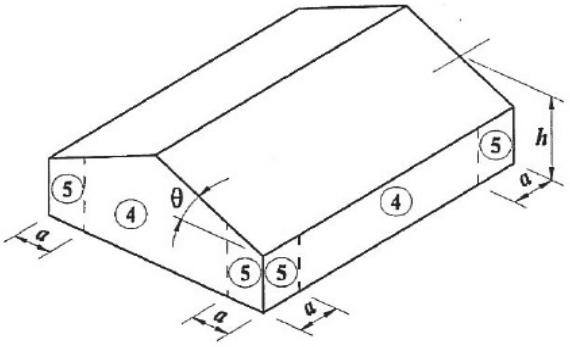
SnapNrack™ PV Mounting Systems

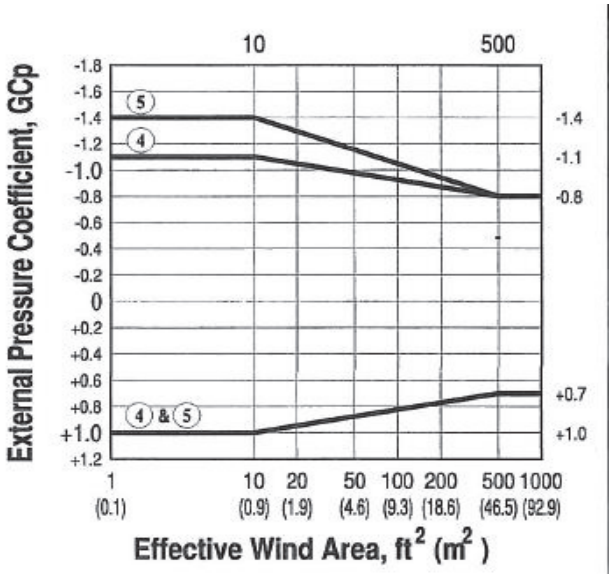
Mean Roof Height 0 to 30 ft

Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_p = External Pressure Coefficient





GC_p Walls (Fig. 30.4-1)			
Slope in Degrees	Zone 4	Zone 5	Zone 4 & 5
0 to 10	-1.00	-1.27	0.91
10 to 45	-1.10	-1.39	-1.00

Notes

1) *Roof slopes from 0^o to 45^o*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Wind Design ASCE 7-10 Components and Cladding Roof
0 to 7 degrees for 6005 Alloy Rail

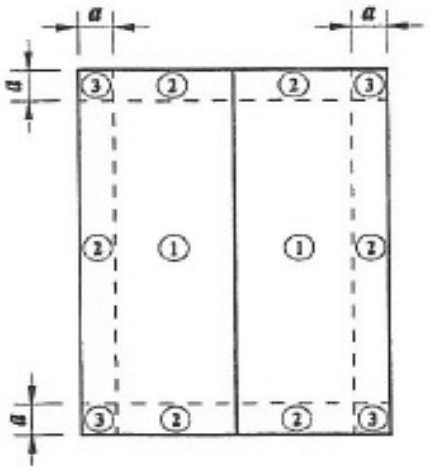
SnapNrack™ PV Mounting Systems

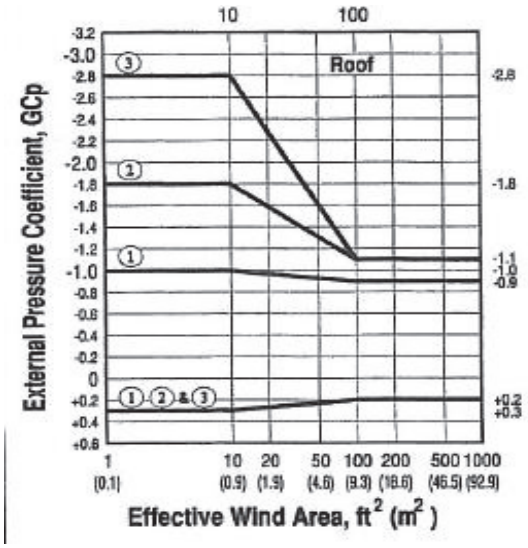
Mean Roof Height 0 to 30 ft

Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_p = External Pressure Coefficient





GC_p Roofs Fig. 30.4-2A				
Slope in Degrees	Zone 1	Zone 2	Zone 3	Zone 1,2,3
0 to 7	-0.99	-1.71	-2.59	0.29

Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Wind Design ASCE 7-10 Components and Cladding Roof
7 to 27 degrees for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

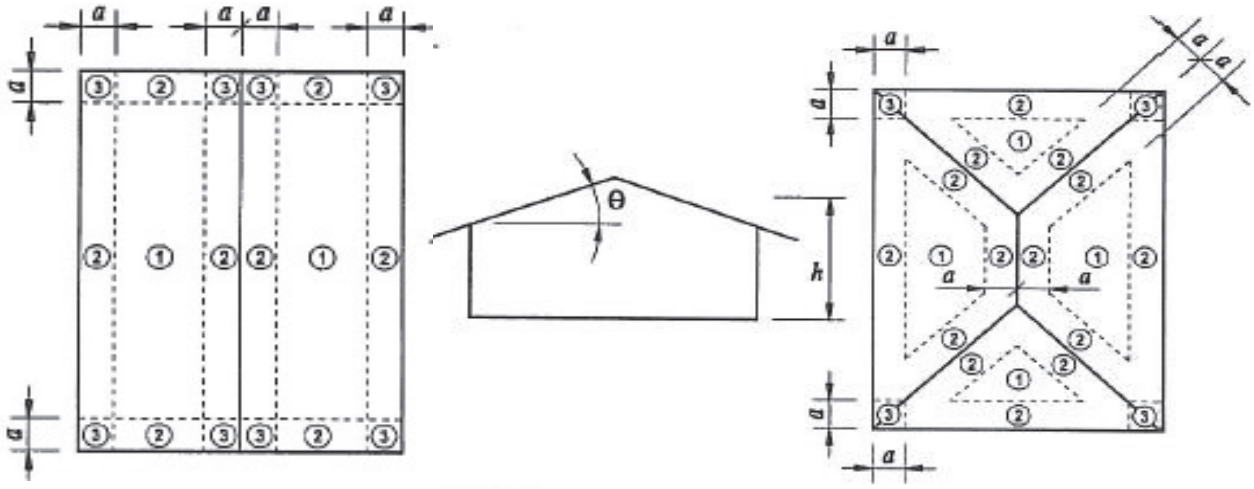
Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

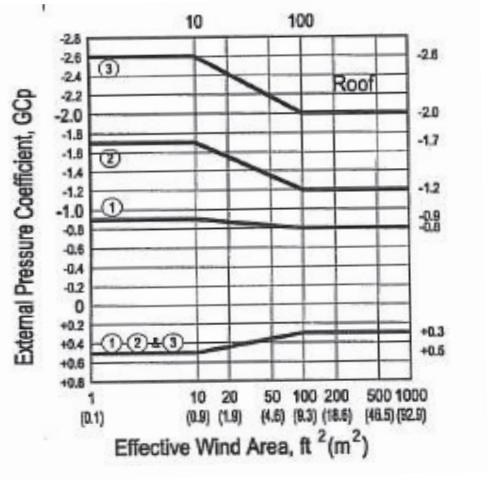
q_h = Velocity Pressure (psf)

GC_{pi} = +/- Internal Pressure Coefficient

GC_p = External Pressure Coefficient



GC_p Roofs Fig. 30.4-2B				
Slope in Degrees	Zone 1	Zone 2	Zone 3	Zone 1,2,3
7 to 27	-0.89	-1.64	-2.53	0.48



Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Wind Design ASCE 7-10 Components and Cladding Roof
27 to 45 degrees for 6005 Alloy Rail

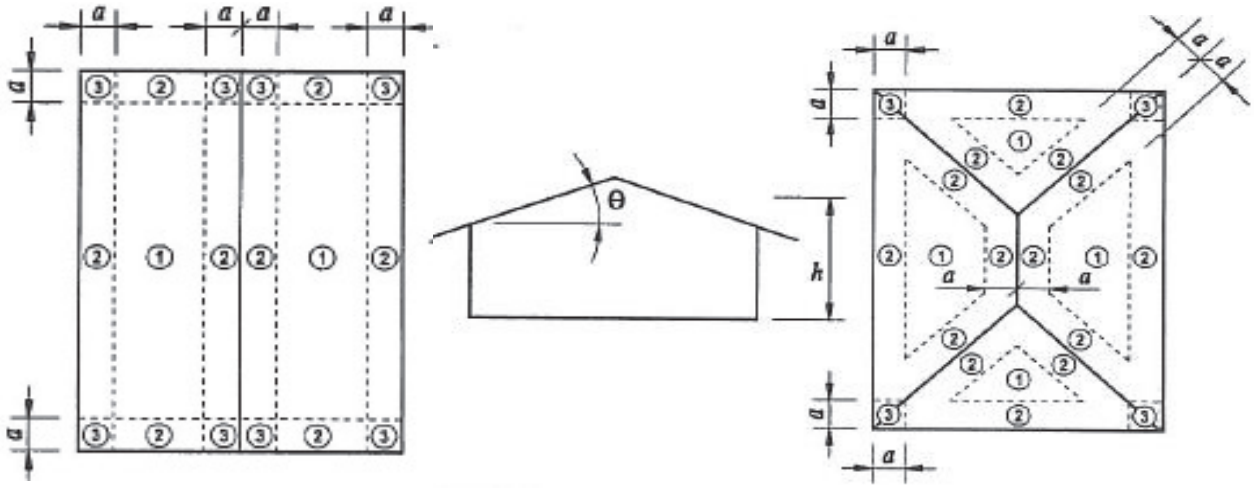
SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

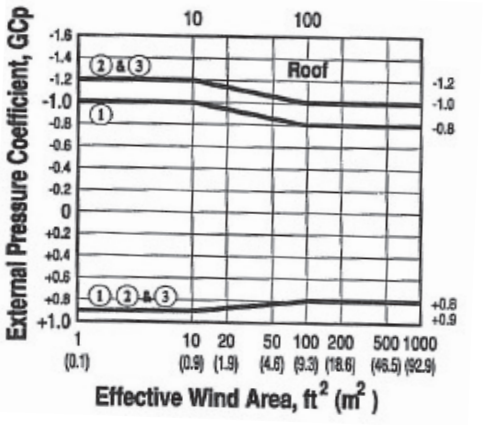
Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_p = External Pressure Coefficient



GC_p Roofs Fig. 30.4-2C				
Slope in Degrees	Zone 1	Zone 2	Zone 3	Zone 1,2,3
27 to 45	-0.98	-1.18	-1.18	0.89



Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Seismic Design ASCE 7-10 Chapter 11 and 13
6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

ASCE 7-10 Seismic Design Section 13.6.9

Site Classification		D	Default "D"
Seismic Use Group		II	Table 11.5-1
R_p	=	2.5	Input from Table 13.6-1 ASCE 7-10
A_p	=	1.0	Input from Table 13.6-1 ASCE 7-10
I_p	=	1.0	Input from Table 11.5-1 ASCE 7-10
S_s	=	3.0	Input from USGS Program
S_1	=	1.5	Input from USGS Program
F_a	=	1.0	Site Coefficient Table 11.4-1
F_v	=	1.5	Site Coefficient Table 11.4-2
S_{ms}	=	3.0	ASCE 7-10 Section 11.4.3
S_{m1}	=	2.3	ASCE 7-10 Section 11.4.3
S_{ds}	=	2.0	ASCE 7-10 Section 11.4.3
S_{d1}	=	1.5	ASCE 7-10 Section 11.4.3
z	=	30.5	Height at point of Attachment (ft.)
h	=	30.0	Average Roof Height of Structure (ft.)

F_p	=	0.97 Wp
$F_{p\ max}$	=	3.20 Wp
$F_{p\ min}$	=	0.60 Wp
Use F_p	=	**0.97 Wp**

(Eq. 13.3.1)

$$F_p = \frac{0.4\ a_p\ S_{DS}\ W_p}{\left(\frac{R_p}{I_p}\right)} \left(1+2\ \frac{z}{h}\right)$$

(Eq. 13.3.2) $F_p = 1.6\ S_{DS}\ I_p\ W_p$ **Max**

(Eq. 13.3.3) $F_p = 0.3\ S_{DS}\ I_p\ W_p$ **Min**

Vertical Accelerations

$0.20\ (S_{ds})\ W_p$

Notes

1) *Based on an average deal load of 4 psf the anticipated maximum seismic load is approximately 4 psf with a vertical accelerations of 1.6 psf wind loads govern the design of the PV system.*

Series 100

Snow Loads ASCE 7-10 Chapter 7
6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

ASCE 7-10 Snow Loads Chapter 7

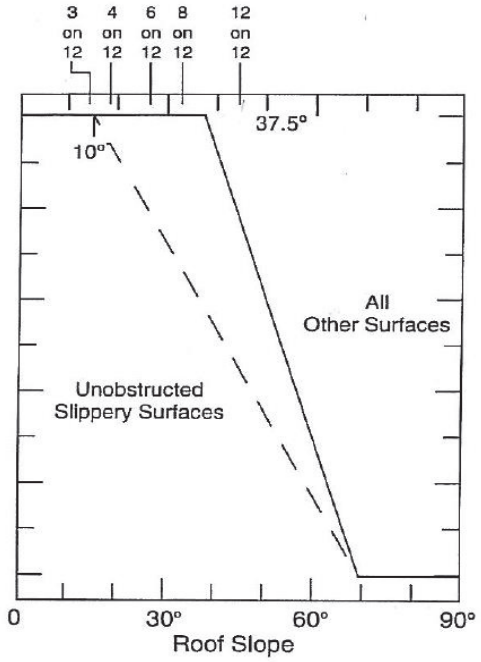
$P_f = 0.7\ C_e\ C_t\ I\ P_g$

$P_s = C_s\ P_f$

Snow Load Chart			
Ground Snow P_g	Flat Roof P_f	Sloped Roof P_s Slope < 9/12	Sloped Roof P_s Slope 9/12 to 12/12
10 psf	8	8	8
20 psf	15	15	15
30 psf	23	23	23
40 psf	31	31	31
50 psf	39	39	39
60 psf	46	46	46
70 psf	54	54	54
80 psf	62	62	62
100 psf	77	77	77
120 psf	92	92	92

Calculations for Snow Loads Chapter 7

C_e	=	1.00	Exposure Factor (Section 7.3.1)
C_t	=	1.10	Thermal Factor (Section 7.3.2)
I	=	1.00	Importance Factor (Section 7.3.3)



7-2b: Cold roofs with C_t=1.1

Series 100

Rail Properties for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

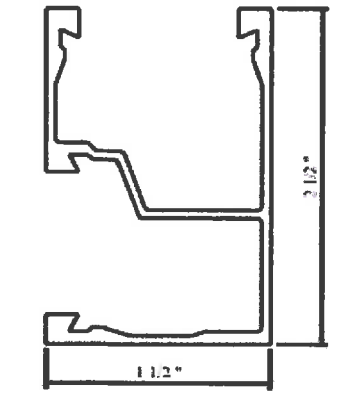
Rail Properties for Downward Loads

Section Properties

A	=	0.63	in^2
S	=	0.34	in^3
I	=	0.46	in^4

Stresses

F_b	=	21.9	ksi
F_v	=	21.9	ksi
E	=	10000	ksi
M_{allow}	=	7.45	k-in
V_{allow}	=	6.38	k



Rail Section

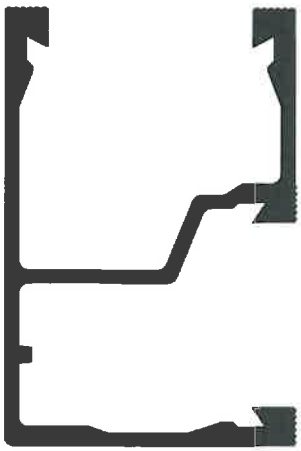
Rail Properties for Upward Loads

Section Properties

A	=	0.41	in^2
S	=	0.25	in^3
I	=	0.11	in^4

Stresses

F_b	=	21.9	ksi
F_v	=	21.9	ksi
E	=	10000	ksi
M_{allow}	=	5.53	k-in
V_{allow}	=	4.16	k



SnapNrack Standard Rail
Keyed 6005 Alloy

Notes

1) *Rail section properties determined from test data.*
2) *Rail test date performed per guidelines of chapter 17 of the 2015 IBC.*
3) *This report is using 6005 alloy rails*

Series 100

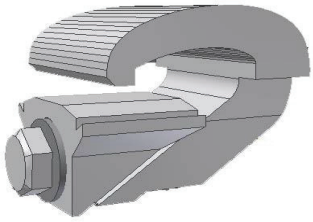
PV panel Calculations & Component and Cladding Forces for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

PV Panel Calculations for 39" x 65" Panel Connections

Panel Dimensions 65" Long Panels		
Panel Width	=	39.0 in
Panel Length	=	65.0 in
Panel Weight	=	70.4 #
Panel Area	=	17.6 ft^2



Universal End Clamp

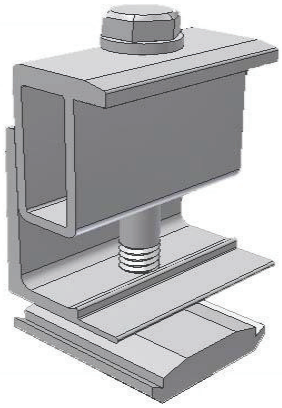
Wind Loading

ASCE 7-10 Component and Cladding

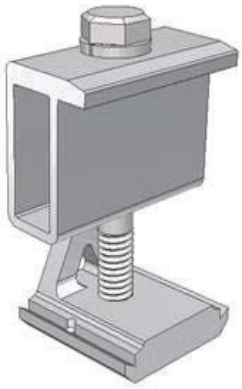
Wind Speed	110 to 190 mph
Exposure Cat.	C
Edge Distance (a)	4 Ft

Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
Max	-22.96	-30.71	-30.71	68.51
Min	-76.21	-128.56	-197.85	12.64

1) *Roof slopes from 0^o to 45^o*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*



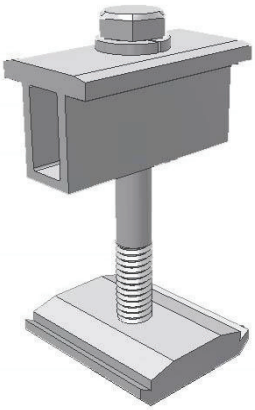
Adjustable End Clamp



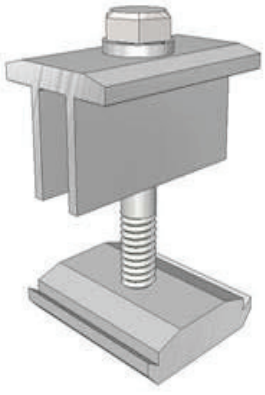
X-Clamp

Maximum Force at Mounting Bracket				
Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
End Clamp	-335	-566	-871	302
Int. Clamp	-671	-1132	N/A	603

1) *4 brackets minimum per PV panel to rail connection*
2) *Only one corner of one PV panel may be located in zone 3*
3) *Zone 2 may have multiple panels located in this zone*



Mid Clamp 1



Mid Clamp 2

6005 Alloy Rail

Series 100

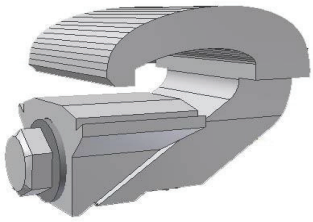
PV panel Calculations & Component and Cladding Forces for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

PV Panel Calculations for 39" x 78" Panel Connections

Panel Dimensions 78" Long Panels		
Panel Width	=	39.0 in
Panel Length	=	78.0 in
Panel Weight	=	84.5 #
Panel Area	=	21.1 ft^2



Universal End Clamp

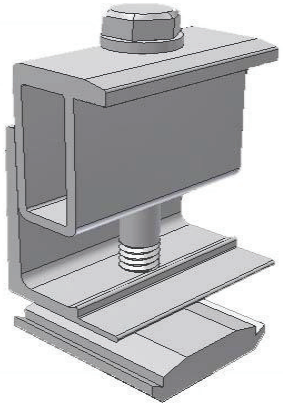
Wind Loading

ASCE 7-10 Component and Cladding

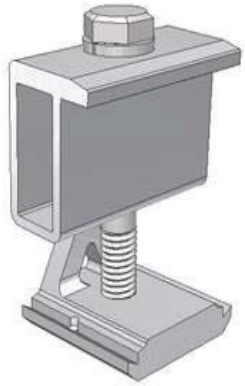
Wind Speed	110 to 190 mph
Exposure Cat.	C
Edge Distance (a)	4 Ft

Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
Max	-22.96	-30.71	-30.71	68.51
Min	-76.21	-128.56	-197.85	12.64

1) *Roof slopes from 0^o to 45^o*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*



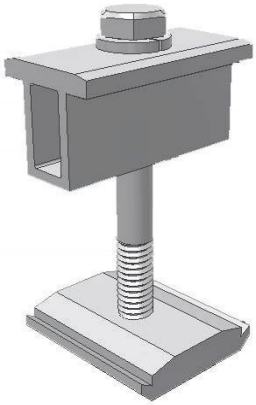
Adjustable End Clamp



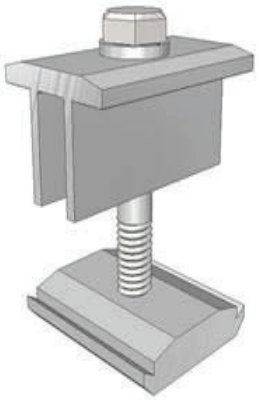
X-Clamp

Maximum Force at Mounting Bracket				
Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
End Clamps	-402	-679	-1045	362
Int. Clamp	-805	-1358	N/A	724

1) *4 brackets minimum per PV panel to rail connection*
2) *Only one corner of one PV panel may be located in zone 3*
3) *Zone 2 may have multiple panels located in this zone*



Mid Clamp 1



Mid Clamp 2

6005 Alloy Rail

Series 100

Lag Bolt Design 2012 NDS for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

Lag Bolt Calculations for Roof Connection 65" long Panel

Bolt Connection to Roof Structure

2012 National Design Specifications
5/16" Diameter Lag Bolt 2 1/2" min. embedment into framing member

Allowable Tension	=	258 #/in
Embedment length	=	1.81 in
Duration of Load	=	1.6 wind
Allowable Tension	=	747.2 #
Allowable Uplift	=	339.6 #

65" Long Panels				
Maximum Wind Uplift (psf) per Span Based On Lag Bolt				
Span	Zone 2	Zone 3	Zone 2E	Zone 3E
2 ft	62.7	62.7	62.7	125.4
4 ft	31.3	31.3	31.3	62.7
6 ft	20.9	20.9	20.9	41.8
8 ft	15.7	15.7	15.7	31.3

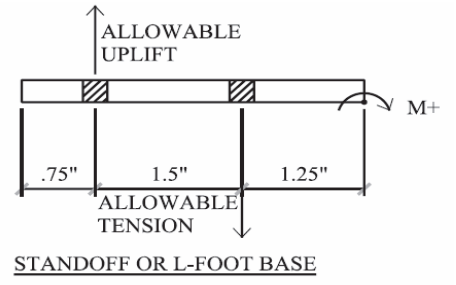
Lag Bolt Calculations for Roof Connection 78" long Panel

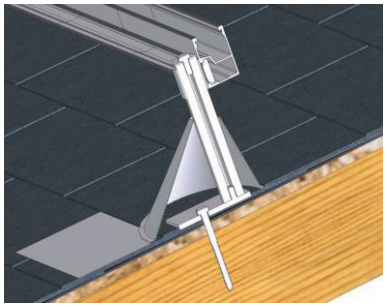
Bolt Connection to Roof Structure

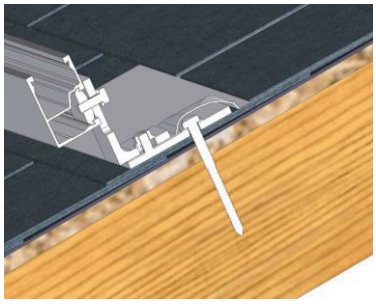
2012 National Design Specifications
5/16" Diameter Lag Bolt 2 1/2" min. embedment into framing member

Allowable Tension	=	258 #/in
Embedment length	=	1.81 in
Duration of Load	=	1.6 wind
Allowable Tension	=	747.2 #
Allowable Uplift	=	339.6 #

78" Long Panels				
Maximum Wind Uplift (psf) per Span Based On Lag Bolt				
Span	Zone 2	Zone 3	Zone 2E	Zone 3E
2 ft	52.2	52.2	52.2	104.5
4 ft	26.1	26.1	26.1	52.2
6 ft	17.4	17.4	17.4	34.8
8 ft	13.1	13.1	13.1	26.1







Notes

1) *Only one corner of one PV panel may be located in zone 3E*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 0 to 19 degrees for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angle 0 to 19 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-10.7	-11.7	-12.7	-13.8	-14.9	-16.1	-17.3	-18.6	-19.9	-21.2	-22.6	-25.5	-28.6	-31.9
	0	0	140	132	125	119	114	109	104	100	96	93	89	84	79	74
	10	8	137	132	125	119	114	109	104	100	96	93	89	84	79	74
	20	15	106	106	106	106	106	106	104	100	96	93	89	84	79	74
	30	23	90	90	90	90	90	90	90	90	90	90	89	84	79	74
	40	31	79	79	79	79	79	79	79	79	79	79	79	79	79	74
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	72
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 19 to 37 degrees for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angle 20 to 36 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-7.0	-7.6	-8.3	-9.0	-9.7	-10.5	-11.3	-12.1	-13.0	-13.8	-14.7	-16.6	-18.7	-20.8
	0	0	144	144	144	144	144	141	135	129	124	119	114	107	100	94
	10	8	134	133	132	130	129	128	127	125	124	119	114	107	100	94
	20	15	106	106	106	106	106	106	106	105	105	104	103	101	100	94
	30	23	90	90	90	90	90	90	90	90	90	90	90	90	89	88
	40	31	79	79	79	79	79	79	79	79	79	79	79	79	79	79
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	72
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 37 to 45 degrees for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angle 37 to 45 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-6.7	-7.3	-7.9	-8.6	-9.3	-10.0	-10.8	-11.6	-12.4	-13.2	-14.1	-15.9	-17.8	-19.9
	0	0	144	144	144	144	144	144	139	133	127	122	118	109	102	96
	10	8	134	133	132	130	129	128	127	125	124	122	118	109	102	96
	20	15	106	106	106	106	106	106	106	105	105	104	103	101	100	96
	30	23	90	90	90	90	90	90	90	90	90	90	90	90	89	88
	40	31	79	79	79	79	79	79	79	79	79	79	79	79	79	79
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	72
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 45 to 60 degrees for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 0 to 30 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angles 46 to 60 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		15.5	16.9	18.4	20.0	21.6	23.3	25.1	26.9	28.8	30.7	32.8	37.0	41.5	46.2
	P_g	P_s	-6.3	-6.9	-7.6	-8.2	-8.9	-9.6	-10.3	-11.0	-11.8	-12.6	-13.4	-15.2	-17.0	-18.9
	0	0	144	144	144	144	142	139	135	132	129	126	121	113	105	99
	10	8	128	126	124	123	121	120	118	116	115	113	112	109	105	99
	20	15	106	106	105	104	103	102	101	100	99	98	97	95	93	91
	30	23	90	90	90	90	90	90	90	89	88	88	87	85	84	82
	40	31	79	79	79	79	79	79	79	79	79	79	79	78	77	76
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	71
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Wind Design ASCE 7-10 Main Force Resisting System
6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

Velocity Pressure 28.3.2 ASCE 7-10

$q_z = q_h = 0.00256\ k_z\ k_{zt}\ k_d\ V^2$

Risk Category: II (Table 1.5-2)

Wind Exposure Category C

k_z = 1.13 Velocity Pressure Exposure Coefficients (Table 26.8-1)
K_{zt} = 1.00 Topographic Factor (Fig. 26.8-1)
K_d = 0.85 Wind Directionality Factor (Table 26.6-1)

Velocity Pressures														
Wind Speed	110	115	120	125	130	135	140	145	150	155	160	170	180	190
q_h	29.75	32.52	35.41	38.42	41.56	44.81	48.19	51.70	55.32	59.07	62.95	71.06	79.67	88.77
ASD (0.6W)	17.85	19.51	21.24	23.05	24.93	26.89	28.92	31.02	33.19	35.44	37.77	42.64	47.80	53.26

$P = q_h\ [\ GC_{pf} - GC_{pi}\ ]$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_{pf} = External Pressure Coefficient

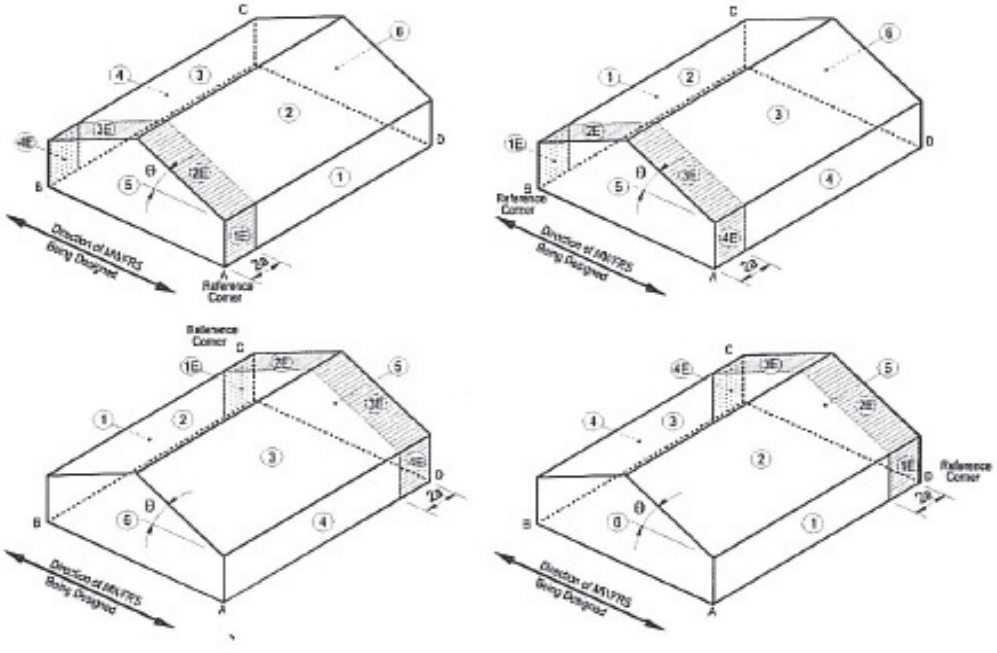
GC_{pf} Roof Zones Fig 28.4-1 ASCE 7-10					
Pitch	Slope	Zone 2	Zone 3	Zone 2E	Zone 3E
0/12	0.0	-0.69	-0.37	-1.07	-0.53
1/12	4.8	-0.69	-0.37	-1.07	-0.53
2/12	9.5	-0.69	-0.40	-1.07	-0.53
3/12	14.0	-0.69	-0.44	-1.07	-0.53
4/12	18.4	-0.69	-0.47	-1.07	-0.54
5/12	22.6	-0.45	-0.35	-0.72	-0.65
6/12	26.6	-0.10	-0.15	-0.19	-0.58
7/12	30.3	0.21	-0.43	0.27	-0.53
8/12	33.7	0.21	-0.43	0.27	-0.53
9/12	36.9	0.21	-0.43	0.27	-0.53
10/12	39.8	0.21	-0.43	0.27	-0.53
11/12	42.5	0.21	-0.43	0.27	-0.53
12/12	45.0	0.21	-0.43	0.27	-0.53
21/12	60.0	0.32	-0.41	0.40	-0.51

Notes

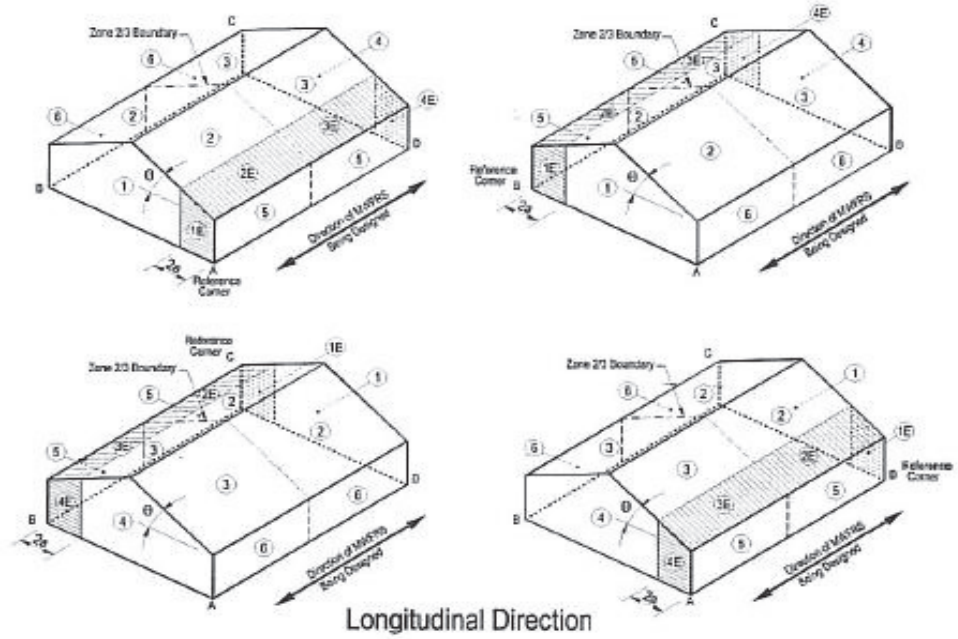
1) *GCpi equal + - 0.10 based on published data from the Solar America Board for Codes and Standards.*

2) Wind Exposure B and C covered in this document.

Mean Roof Height 30 to 60 ft



Transverse Direction



Longitudinal Direction

Zone Locations Main Force Resisting Systems ASCE 7-10

Series 100

Wind Design ASCE 7-10 Components and Cladding Walls
6005 Alloy Rail

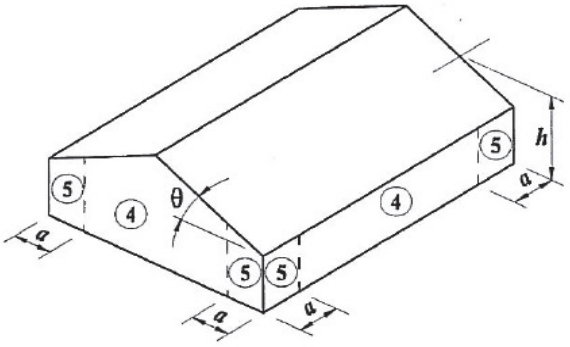
SnapNrack™ PV Mounting Systems

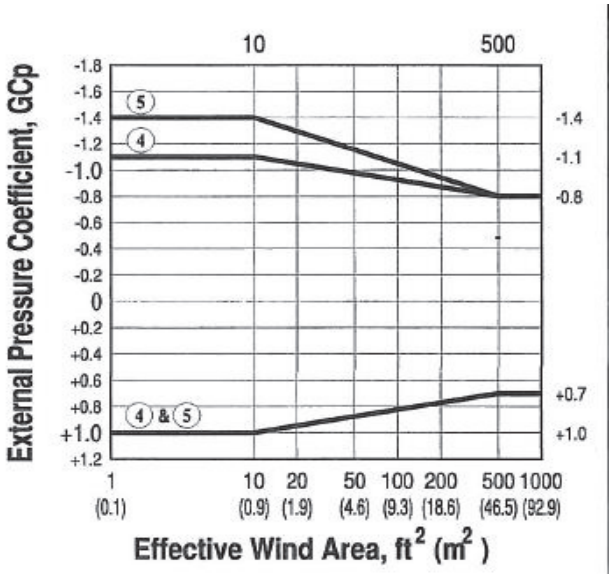
Mean Roof Height 30 to 60 ft

Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_p = External Pressure Coefficient





GC_p Walls (Fig. 30.4-1)			
Slope in Degrees	Zone 4	Zone 5	Zone 4 & 5
0 to 10	-1.00	-1.27	0.91
10 to 45	-1.10	-1.39	-1.00

Notes

1) *Roof slopes from 0^o to 45^o*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Wind Design ASCE 7-10 Components and Cladding Roof
0 to 7 degrees for 6005 Alloy Rail

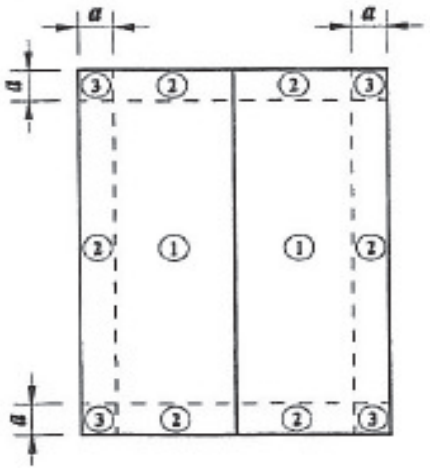
SnapNrack™ PV Mounting Systems

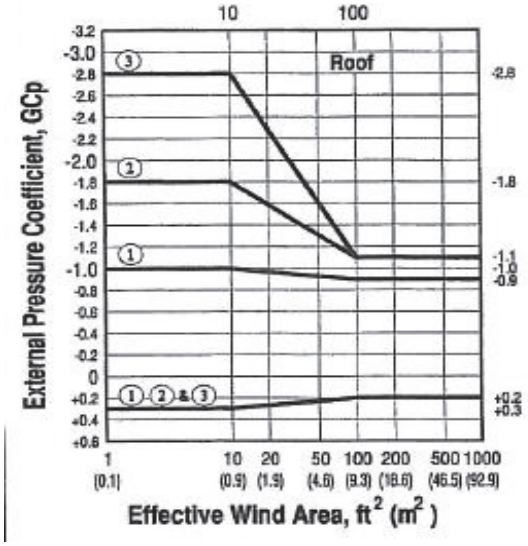
Mean Roof Height 30 to 60 ft

Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_p = External Pressure Coefficient





GC_p Roofs Fig. 30.4-2A				
Slope in Degrees	Zone 1	Zone 2	Zone 3	Zone 1,2,3
0 to 7	-0.99	-1.71	-2.59	0.29

Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Wind Design ASCE 7-10 Components and Cladding Roof
7 to 27 degrees for 6005 Alloy Rail

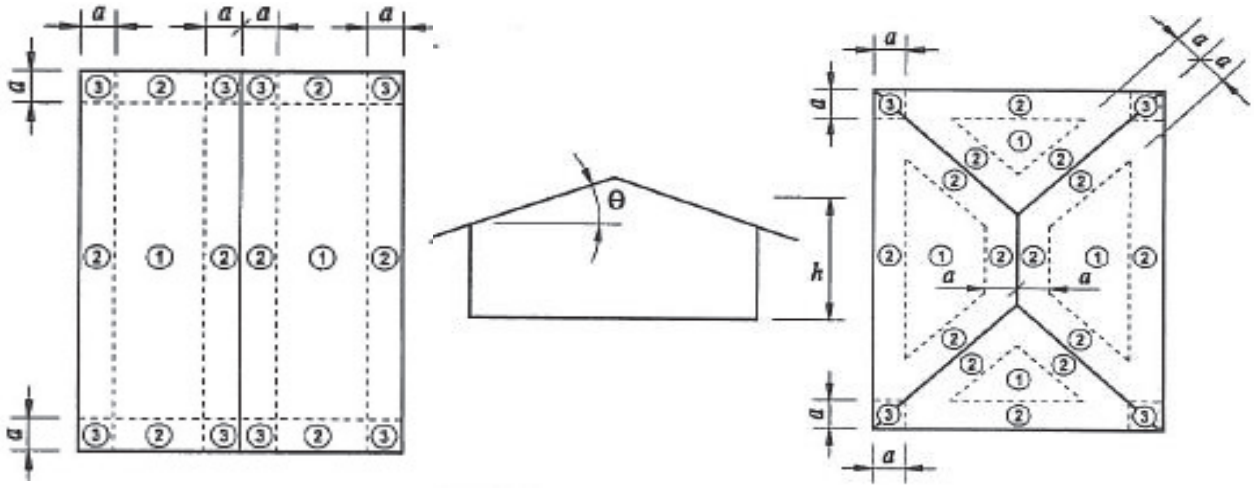
SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

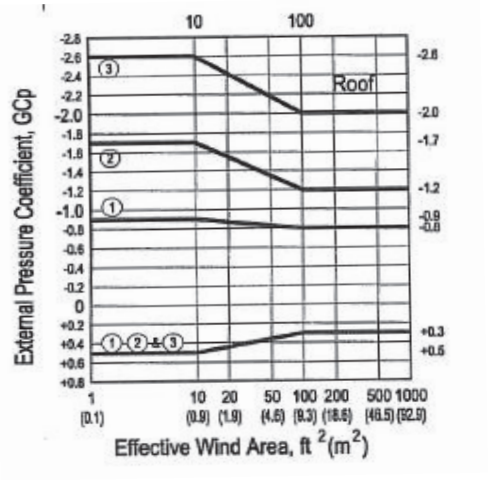
Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_p = External Pressure Coefficient



GC_p Roofs Fig. 30.4-2B				
Slope in Degrees	Zone 1	Zone 2	Zone 3	Zone 1,2,3
7 to 27	-0.89	-1.64	-2.53	0.48



Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Wind Design ASCE 7-10 Components and Cladding Roof
27 to 45 degrees for 6005 Alloy Rail

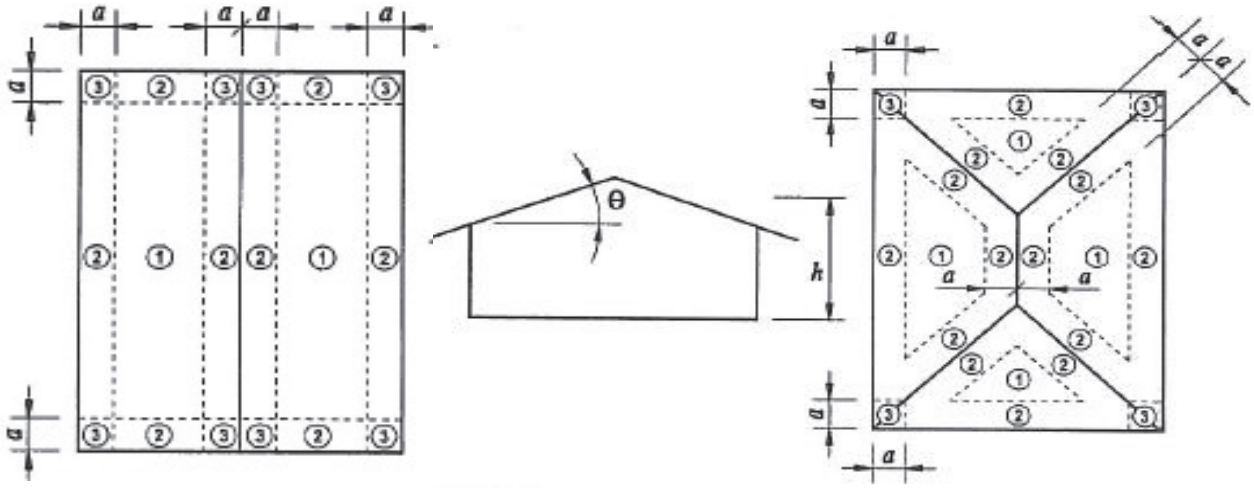
SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

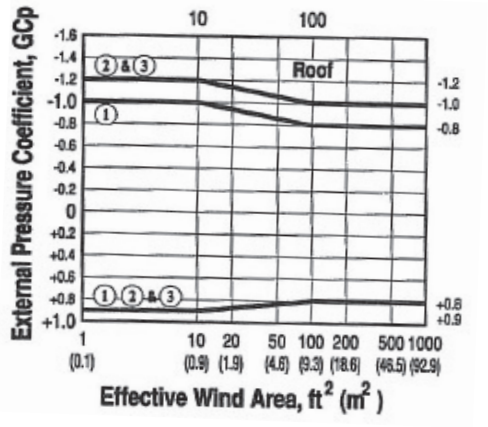
Components and Cladding Low-Rise Buildings ASCE 7-10 30.4-1

$$P = q_h [GC_p - GC_{pi}]$$

q_h = Velocity Pressure (psf)
GC_{pi} = +/- Internal Pressure Coefficient
GC_p = External Pressure Coefficient



GC_p Roofs Fig. 30.4-2C				
Slope in Degrees	Zone 1	Zone 2	Zone 3	Zone 1,2,3
27 to 45	-0.98	-1.18	-1.18	0.89



Notes

1) *Roof slopes from 0° to 45°*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 0.1 * LDH (Least Horizontal Dimension)*
4) *Based on an area equal to the maximum area of one 39" x 78" PV panel*

Series 100

Seismic Design ASCE 7-10 Chapter 11 and 13
6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

ASCE 7-10 Seismic Design Section 13.6.9

Site Classification		D	Default "D"
Seismic Use Group		II	Table 11.5-1
R_p	=	2.5	Input from Table 13.6-1 ASCE 7-10
A_p	=	1.0	Input from Table 13.6-1 ASCE 7-10
I_p	=	1.0	Input from Table 11.5-1 ASCE 7-10
S_s	=	3.0	Input from USGS Program
S_1	=	1.5	Input from USGS Program
F_a	=	1.0	Site Coefficient Table 11.4-1
F_v	=	1.5	Site Coefficient Table 11.4-2
S_{ms}	=	3.0	ASCE 7-10 Section 11.4.3
S_{m1}	=	2.3	ASCE 7-10 Section 11.4.3
S_{ds}	=	2.0	ASCE 7-10 Section 11.4.3
S_{d1}	=	1.5	ASCE 7-10 Section 11.4.3
z	=	60.5	Height at point of Attachment (ft.)
h	=	60.0	Average Roof Height of Structure (ft.)

F_p	=	0.97 Wp
$F_{p\ max}$	=	3.20 Wp
$F_{p\ min}$	=	0.60 Wp
Use F_p	=	**0.97 Wp**

(Eq. 13.3.1)

$$F_p = \frac{0.4\ a_p\ S_{DS}\ W_p}{\left(\frac{R_p}{I_p}\right)} \left(1+2\ \frac{z}{h}\right)$$

(Eq. 13.3.2) $F_p = 1.6\ S_{DS}\ I_p\ W_p$ **Max**

(Eq. 13.3.3) $F_p = 0.3\ S_{DS}\ I_p\ W_p$ **Min**

Vertical Accelerations

$0.20\ (S_{ds})\ W_p$

Notes

1) *Based on an average deal load of 4 psf the anticipated maximum seismic load is approximately 4 psf with a vertical accelerations of 1.6 psf wind loads govern the design of the PV system.*

Series 100

Snow Loads ASCE 7-10 Chapter 7
6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

ASCE 7-10 Snow Loads Chapter 7

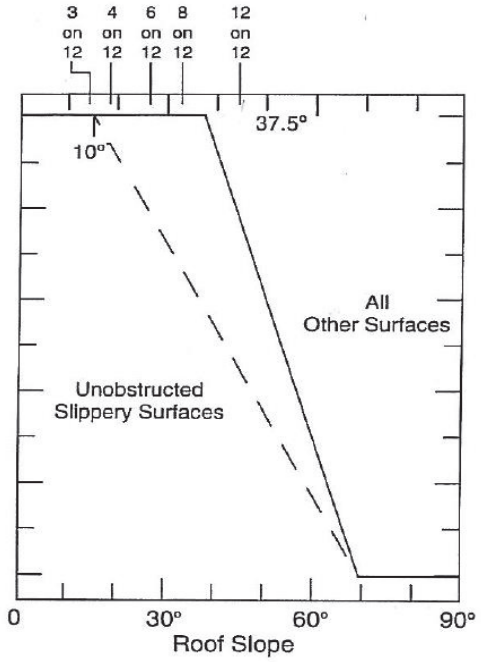
$P_f = 0.7\ C_e\ C_t\ I\ P_g$

$P_s = C_s\ P_f$

Snow Load Chart			
Ground Snow P_g	Flat Roof P_f	Sloped Roof P_s Slope < 9/12	Sloped Roof P_s Slope 9/12 to 12/12
10 psf	8	8	8
20 psf	15	15	15
30 psf	23	23	23
40 psf	31	31	31
50 psf	39	39	39
60 psf	46	46	46
70 psf	54	54	54
80 psf	62	62	62
100 psf	77	77	77
120 psf	92	92	92

Calculations for Snow Loads Chapter 7

C_e	=	1.00	Exposure Factor (Section 7.3.1)
C_t	=	1.10	Thermal Factor (Section 7.3.2)
I	=	1.00	Importance Factor (Section 7.3.3)



7-2b: Cold roofs with C_t=1.1

Series 100

Rail Properties for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

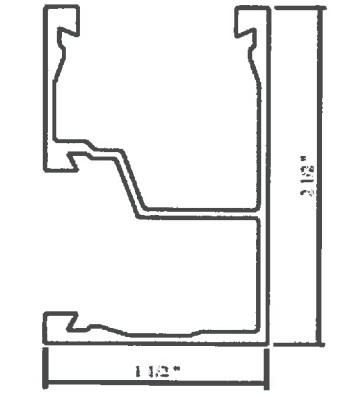
Rail Properties for Downward Loads

Section Properties

A	=	0.63	in^2
S	=	0.34	in^3
I	=	0.46	in^4

Stresses

F_b	=	21.9	ksi
F_v	=	21.9	ksi
E	=	10000	ksi
M_{allow}	=	7.45	k-in
V_{allow}	=	6.38	k



Rail Section

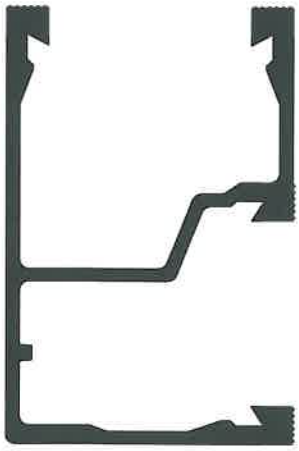
Rail Properties for Upward Loads

Section Properties

A	=	0.41	in^2
S	=	0.25	in^3
I	=	0.11	in^4

Stresses

F_b	=	21.9	ksi
F_v	=	21.9	ksi
E	=	10000	ksi
M_{allow}	=	5.53	k-in
V_{allow}	=	4.16	k



SnapNrack Standard Rail
Keyed 6005 Alloy

Notes

1) *Rail section properties determined from test data.*
2) *Rail test date performed per guidelines of chapter 17 of the 2015 IBC.*
3) *This report is using 6005 alloy rails*

Series 100

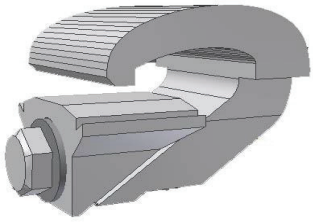
PV panel Calculations & Component and Cladding Forces for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

PV Panel Calculations for 39" x 65" Panel Connections

Panel Dimensions 65" Long Panels		
Panel Width	=	39.0 in
Panel Length	=	65.0 in
Panel Weight	=	70.4 #
Panel Area	=	17.6 ft^2



Universal End Clamp

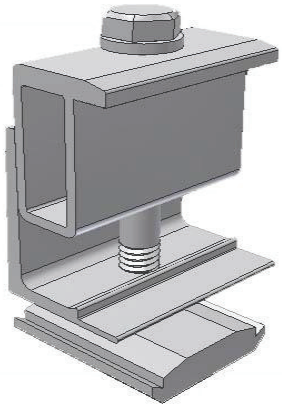
Wind Loading

ASCE 7-10 Component and Cladding

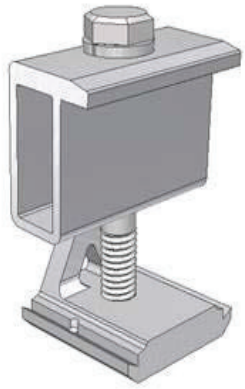
Wind Speed	110 to 190 mph
Exposure Cat.	C
Edge Distance (a)	4 Ft

Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
Max	-26.48	-35.41	-35.41	79.00
Min	-87.88	-148.24	-228.13	14.58

1) *Roof slopes from 0^o to 45^o*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 4 ft based on a 40 ft least width or depth and a mean roof height less than 60 ft.*



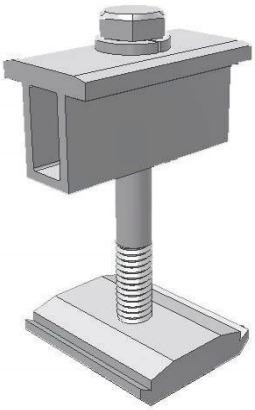
Adjustable End Clamp



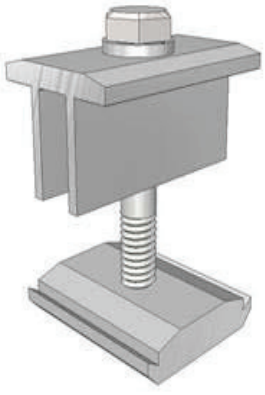
X-Clamp

Maximum Force at Mounting Bracket				
Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
End Clamp	-387	-652	-1004	348
Int. Clamp	-774	-1305	N/A	695

1) *4 brackets minimum per PV panel to rail connection*
2) *Only one corner of one PV panel may be located in zone 3*
3) *Zone 2 may have multiple panels located in this zone*



Mid Clamp 1



Mid Clamp 2

6005 Alloy Rail

Series 100

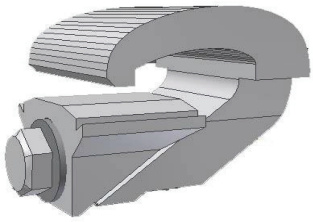
PV panel Calculations & Component and Cladding Forces for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

PV Panel Calculations for 39" x 78" Panel Connections

Panel Dimensions 78" Long Panels		
Panel Width	=	39.0 in
Panel Length	=	78.0 in
Panel Weight	=	84.5 #
Panel Area	=	21.1 ft^2



Universal End Clamp

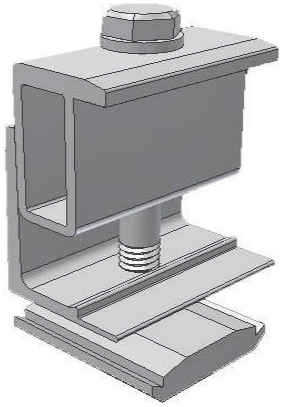
Wind Loading

ASCE 7-10 Component and Cladding

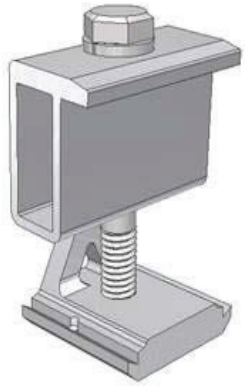
Wind Speed	110 to 190 mph
Exposure Cat.	C
Edge Distance (a)	4 Ft

Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
Max	-26.48	-35.41	-35.41	79.00
Min	-87.88	-148.24	-228.13	14.58

1) *Roof slopes from 0^o to 45^o*
2) *Wind loading from 110 mph to 190 mph 3-s Gust.*
3) *Edge distance a = 4 ft based on a 40 ft least width or depth and a mean roof height less than 60 ft.*



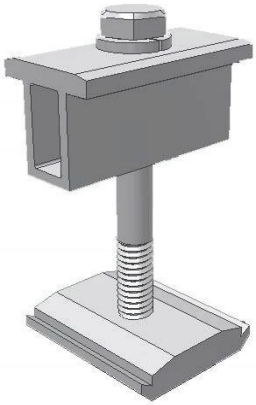
Adjustable End Clamp



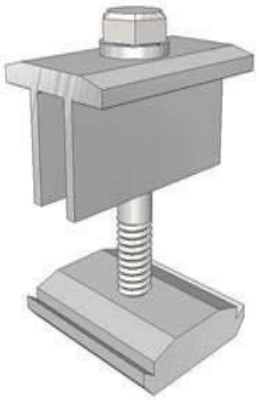
X-Clamp

Maximum Force at Mounting Bracket				
Component and Cladding				
Loading	Zone 1	Zone 2	Zone 3	Zones 1, 2, & 3
End Clamps	-464	-783	-1205	417
Int. Clamp	-928	-1566	N/A	834

1) *4 brackets minimum per PV panel to rail connection*
2) *Only one corner of one PV panel may be located in zone 3*
3) *Zone 2 may have multiple panels located in this zone*



Mid Clamp 1



Mid Clamp 2

6005 Alloy Rail

Series 100

Lag Bolt Design 2012 NDS for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

Lag Bolt Calculations for Roof Connection 65" long Panel

Bolt Connection to Roof Structure

2012 National Design Specifications
5/16" Diameter Lag Bolt 2 1/2" min. embedment into framing member

Allowable Tension	=	258 #/in
Embedment length	=	1.81 in
Duration of Load	=	1.6 wind
Allowable Tension	=	747.2 #
Allowable Uplift	=	339.6 #

65" Long Panels				
Maximum Wind Uplift (psf) per Span Based On Lag Bolt				
Span	Zone 2	Zone 3	Zone 2E	Zone 3E
2 ft	62.7	62.7	62.7	125.4
4 ft	31.3	31.3	31.3	62.7
6 ft	20.9	20.9	20.9	41.8
8 ft	15.7	15.7	15.7	31.3

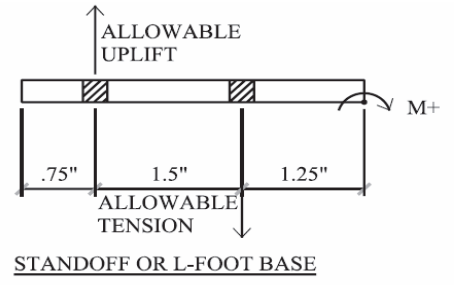
Lag Bolt Calculations for Roof Connection 78" long Panel

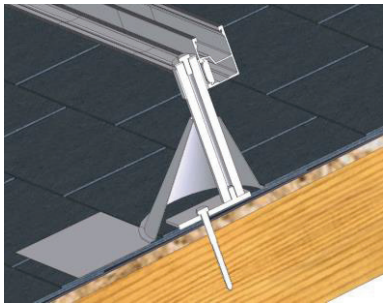
Bolt Connection to Roof Structure

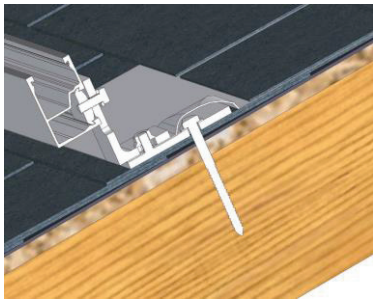
2012 National Design Specifications
5/16" Diameter Lag Bolt 2 1/2" min. embedment into framing member

Allowable Tension	=	258 #/in
Embedment length	=	1.81 in
Duration of Load	=	1.6 wind
Allowable Tension	=	747.2 #
Allowable Uplift	=	339.6 #

78" Long Panels				
Maximum Wind Uplift (psf) per Span Based On Lag Bolt				
Span	Zone 2	Zone 3	Zone 2E	Zone 3E
2 ft	52.2	52.2	52.2	104.5
4 ft	26.1	26.1	26.1	52.2
6 ft	17.4	17.4	17.4	34.8
8 ft	13.1	13.1	13.1	26.1







Notes

1) *Only one corner of one PV panel may be located in zone 3E*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 0 to 19 degrees for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angle 0 to 19 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-12.3	-13.5	-14.7	-15.9	-17.2	-18.6	-20.0	-21.4	-22.9	-24.5	-26.1	-29.4	-33.0	-36.7
	0	0	128	121	115	109	105	100	96	92	89	86	83	77	73	69
	10	8	128	121	115	109	105	100	96	92	89	86	83	77	73	69
	20	15	106	106	106	106	105	100	96	92	89	86	83	77	73	69
	30	23	90	90	90	90	90	90	90	90	89	86	83	77	73	69
	40	31	79	79	79	79	79	79	79	79	79	79	79	77	73	69
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	69
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 19 to 37 degrees for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angle 20 to 36 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-8.0	-8.8	-9.6	-10.4	-11.2	-12.1	-13.0	-14.0	-14.9	-16.0	-17.0	-19.2	-21.5	-24.0
	0	0	144	144	144	142	135	129	123	118	114	109	105	98	92	87
	10	8	132	131	129	128	127	125	123	118	114	109	105	98	92	87
	20	15	106	106	106	106	106	105	105	104	103	102	101	98	92	87
	30	23	90	90	90	90	90	90	90	90	90	90	90	89	87	86
	40	31	79	79	79	79	79	79	79	79	79	79	79	79	79	79
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	72
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 37 to 45 degrees for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angle 37 to 45 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-7.7	-8.4	-9.1	-9.9	-10.7	-11.6	-12.4	-13.3	-14.3	-15.2	-16.2	-18.3	-20.6	-22.9
	0	0	144	144	144	144	139	133	127	122	117	112	108	101	94	89
	10	8	132	131	129	128	127	125	124	122	117	112	108	101	94	89
	20	15	106	106	106	106	106	105	105	104	103	102	101	99	94	89
	30	23	90	90	90	90	90	90	90	90	90	90	90	89	87	86
	40	31	79	79	79	79	79	79	79	79	79	79	79	79	79	79
	50	39	72	72	72	72	72	72	72	72	72	72	72	72	72	72
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	66
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Series 100

Rail Spans per ASCE 7-10 Loads
Tilt Angle 45 to 60 degrees for 6005 Alloy Rail

SnapNrack™ PV Mounting Systems

Mean Roof Height 30 to 60 ft

Rail Spans (in) Based on Load Combinations for ASCE 7-10 Chapter 2

Load Combinations 3, 5, 6, 7 and Lag Bolt Tension Values Tilt Angles 46 to 60 Degrees																
Wind Load																
Snow Load (psf)	Vult		110	115	120	125	130	135	140	145	150	155	160	170	180	190
	q_h		17.9	19.5	21.2	23.1	24.9	26.9	28.9	31.0	33.2	35.4	37.8	42.6	47.8	53.3
	P_g	P_s	-7.3	-8.0	-8.7	-9.5	-10.2	-11.0	-11.9	-12.7	-13.6	-14.5	-15.5	-17.5	-19.6	-21.8
	0	0	144	144	143	139	136	132	129	125	120	115	111	104	97	91
	10	8	125	123	122	120	118	116	115	113	111	110	108	104	97	91
	20	15	105	104	103	102	101	100	99	98	97	96	95	92	90	88
	30	23	90	90	90	90	90	89	88	87	87	86	85	83	82	80
	40	31	79	79	79	79	79	79	79	79	79	79	78	77	76	74
	50	39	72	72	72	72	72	72	72	72	72	72	72	71	70	69
	60	46	66	66	66	66	66	66	66	66	66	66	66	66	66	65
	70	54	62	62	62	62	62	62	62	62	62	62	62	62	62	62
	80	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
	100	77	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	120	92	48	48	48	48	48	48	48	48	48	48	48	48	48	48

Notes

1) *Tables are based on critical rail span for load combinations as specified in chapter 2 of the ASCE 7-10 and lag bolt withdraw values per the 2012 NDS.*

2) *Basic Load Combinations from ASCE 7-10 Section 2.4 Allowable Stress Design.*
   1. *D*
   2. *D + L*
   3. *D + (Lr or S or R)*
   4. *D + 0.75L + 0.75(Lr or S or R)*
   5. *D + (0.6W or 0.75L)*
   6a. *D + 0.75L+ 0.75(0.6W) + 0.75(Lr or S or R)*
   6b. *D + 0.75L + 0.75(0.7E) + 0.75S*
   7. *0.6D + 0.6W*
   8. *0.6D + 0.7E*

3) *Edge zone reductions are only required at shaded spans where reduction is 24 inches to a minimum of 32 inches.*

Appendix A: ASCE-2010 to 2005 conversion sheet

The 100 Series report's results have been calculated according to the ASCE-2010 guidelines. If the results would rather be examined in terms of the ASCE-2005 codes, the following conversions must be applied for the two codes' results to be of equivalence.

This appendix also applies for converting to different years for IBC codes. For 2006 and 2009 IBC, use the ASCE-2005 codes, and for the 2012 and 2015 IBC, use the ASCE-2010 codes.

Factors specific to this report

1) The roof-mounted solar panels are in terms of Risk Category II
2) The importance factor for the ASCE-2005 code is I = 1.0
3) The ASCE-2010 code has no importance factor for the wind loads
4) The snow load's importance factor remains the same for both the 2005 and 2010 codes
5) Thus, calculations that utilize wind loads are the ONLY ones that need conversions

Velocity Equivalence (mph)

$V_{3\text{-sec}}$ (ASCE7-05)	$V_{ult.}$ (ASCE7-10)
85	100
90	116
100	129
110	142
120	155
130	168
140	181
150	194

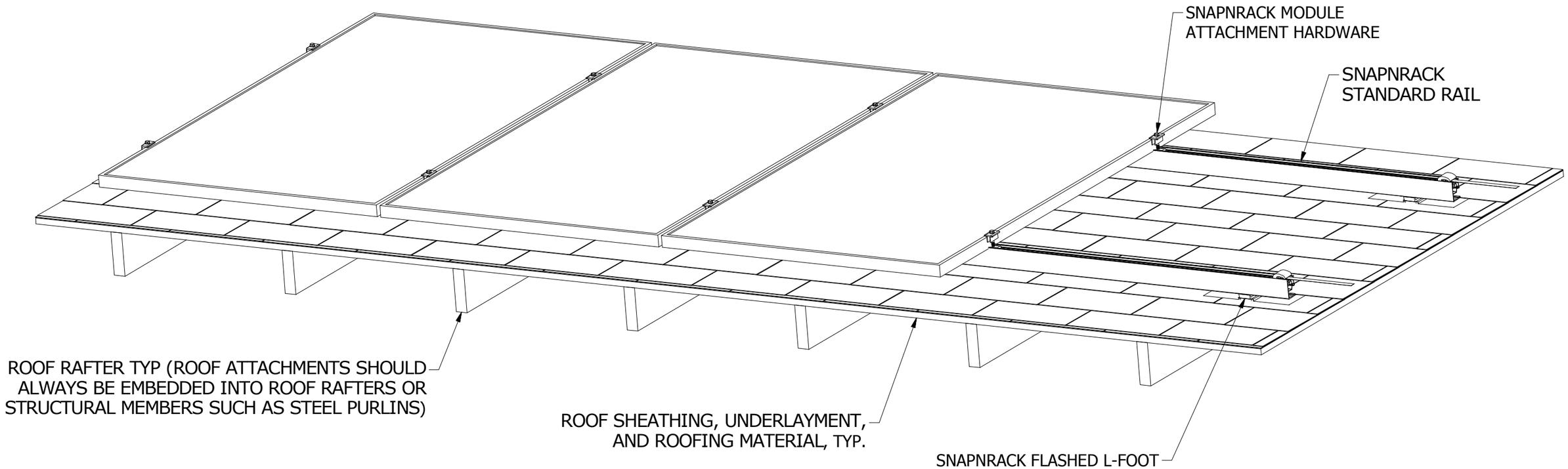
The following velocities listed in the graph refer to some V_{2005} being equal to some V_{2010}. In other words, use the following velocities in accordance with either ASCE-2005 or ASCE-2010.

SNAPNRACK SERIES 100 ON FLASHED L-FEET

FLASHED L-FEET ARE OPTIMIZED FOR QUICK AND ROBUST INSTALLATION ON STANDARD COMPOSITION SHINGLE ROOF SURFACES

FOR OTHER ROOF TYPES STANDOFFS ARE RECOMMENDED

REVISION:

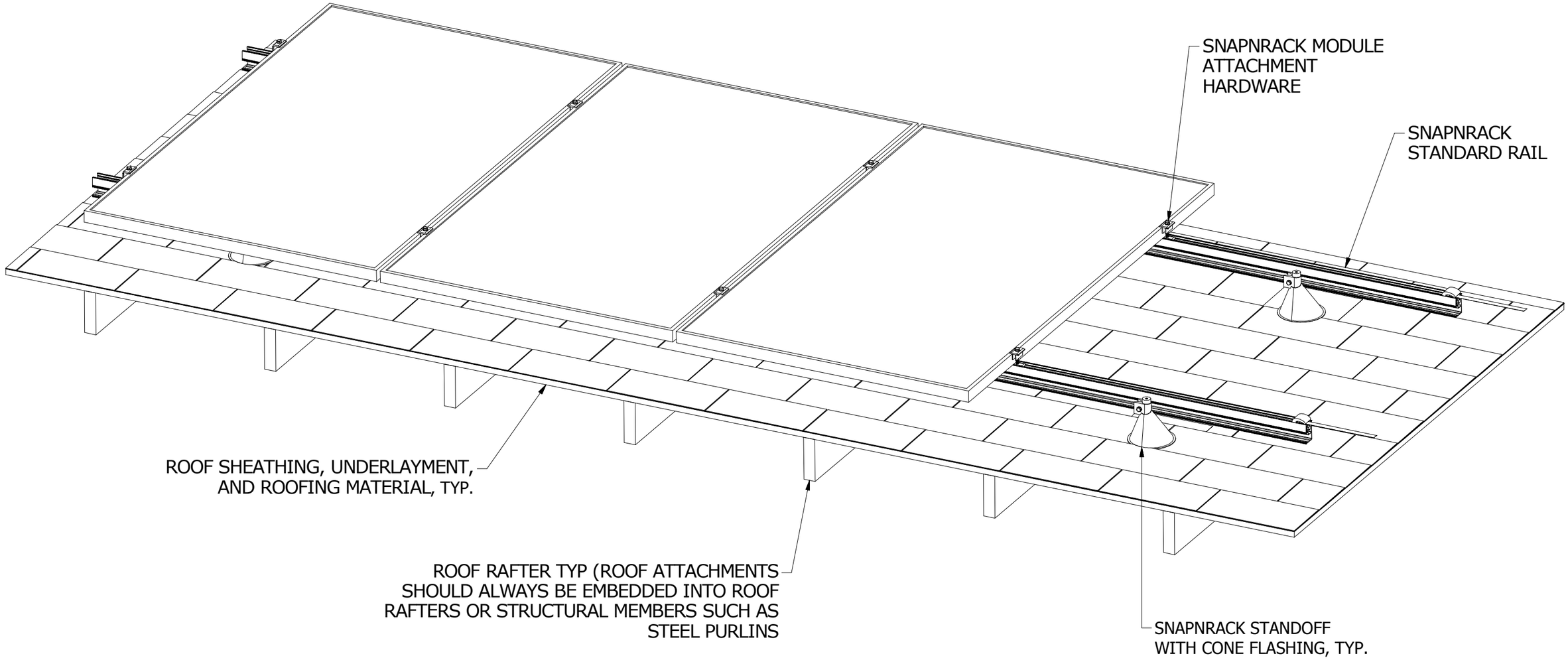


SnapNrack™ PV Mounting Systems

MAINSTREAM ENERGY CORP.
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER:	SCALE:	PART NUMBER:	DESCRIPTION:	REV
G McPheeters	DNS	S100 D01	SERIES 100 OVERVIEW, ON FLASHED L-FEET	F
DRAFTER: D Ryan	DATE: 120113			
APPROVED BY:				

REVISION:



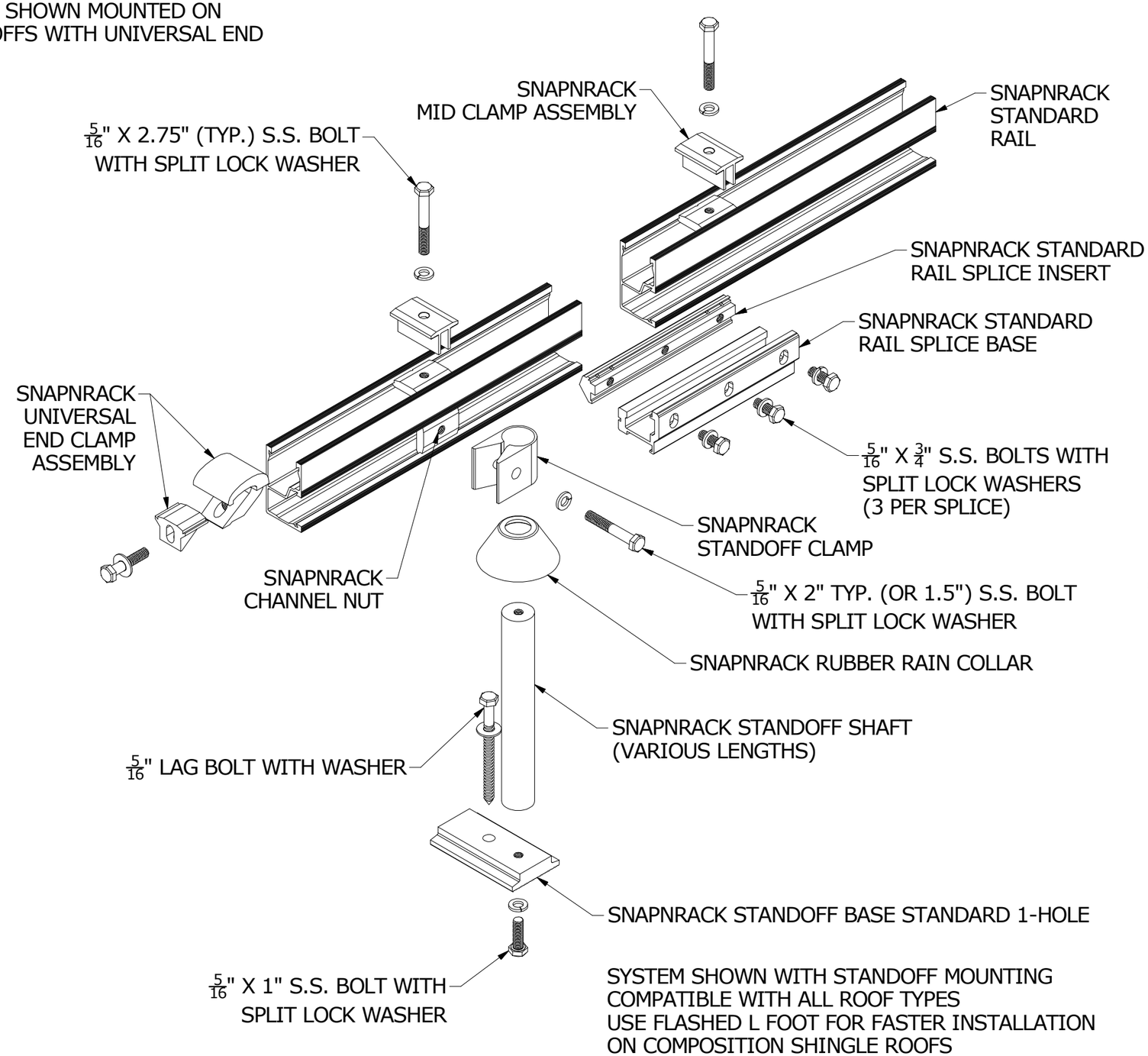
SnapNrack™ PV Mounting Systems

MAINSTREAM ENERGY CORP.
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER: G McPheeters DRAFTER: D Ryan APPROVED BY:	SCALE: DNS DATE: 120113	PART NUMBER: S100 D02	DESCRIPTION: SERIES 100 OVERVIEW, ON STANDOFFS	REV F

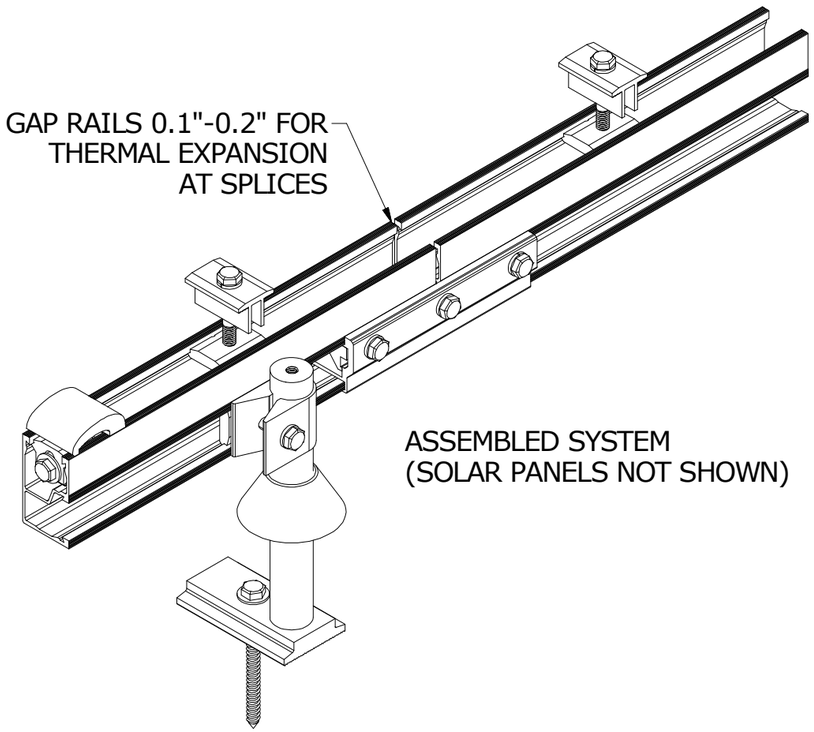
SNAPNRACK SERIES 100 RACKING SYSTEM SHOWN MOUNTED ON STANDOFFS WITH UNIVERSAL END CLAMPS

REVISION:



SYSTEM SHOWN WITH STANDOFF MOUNTING COMPATIBLE WITH ALL ROOF TYPES
USE FLASHED L FOOT FOR FASTER INSTALLATION ON COMPOSITION SHINGLE ROOFS

NOTES:
- STANDARD LAG BOLT SPEC ASSUMES 5/16" LAG BOLTS WITH 2.5" EMBEDMENT IN ROOF STRUCTURAL MEMBERS/RAFTERS
- TORQUE ALL 5/16" HARDWARE TO THE FOLLOWING:
  - SILVER S.S. 10-16 FT-LBS
  - BLACK S.S. 7-9 FT-LBS
RAIL CAN MOUNT TO EITHER SIDE OF POST (UPSLOPE vs. DOWNSLOPE)
- FOR UNEVEN ROOF SURFACES, USE UP TO TWO LEVELING SPACERS PER L FOOT OR STANDOFF. SEE DRAWING "STANDARD RAIL LEVELING" FOR DETAILS AND LIMITATIONS



ASSEMBLED SYSTEM (SOLAR PANELS NOT SHOWN)

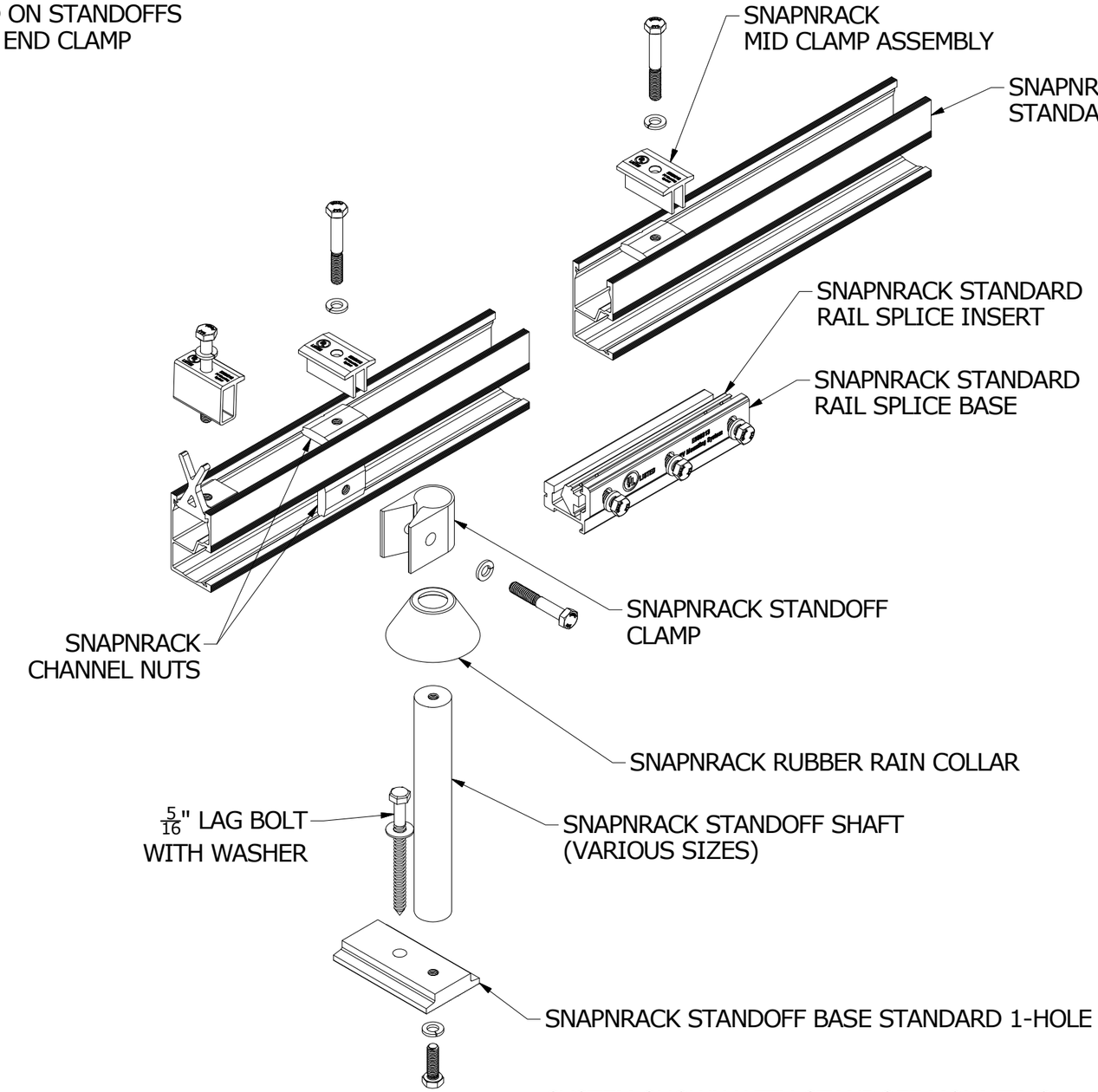
SnapNrack™ PV Mounting Systems

MAINSTREAM ENERGY CORP.
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER:	SCALE:	PART NUMBER:	DESCRIPTION:	REV
G McPheeters	DNS	S100 D03	SERIES 100 ASSEMBLY DETAILS UEC	F
DRAFTER: D Ryan	DATE: 120113			
APPROVED BY:				

SNAPNRACK SERIES 100 RACKING SYSTEM
SHOWN MOUNTED ON STANDOFFS
WITH TOP MOUNT END CLAMP

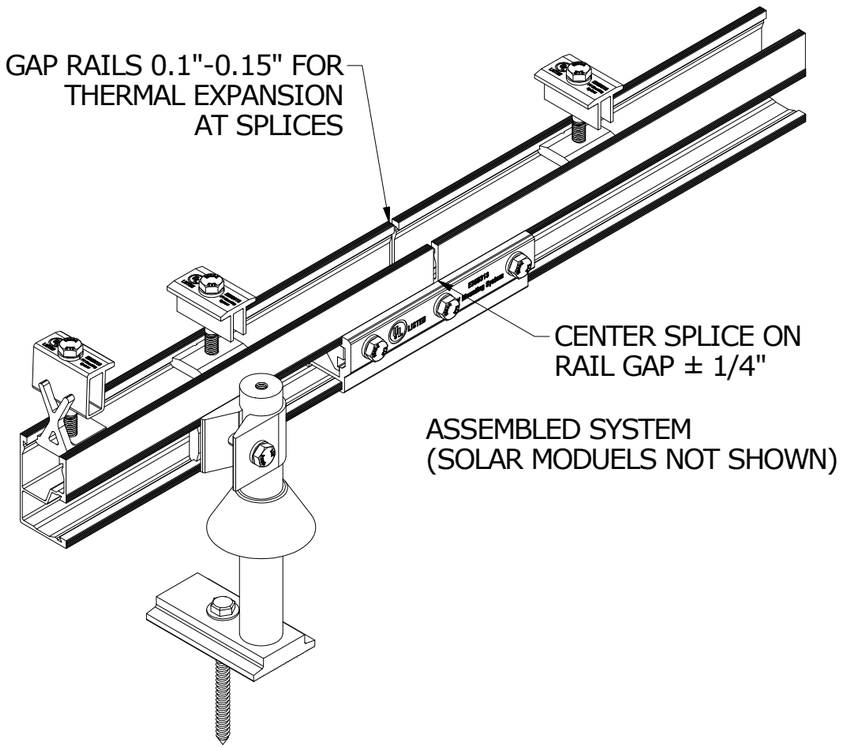
REVISION:
F 12/02/15



SYSTEM SHOWN WITH STANDOFF MOUNTING
COMPATIBLE WITH ALL ROOF TYPES
USE FLASHED L FOOT FOR FASTER INSTALLATION
ON COMPOSITION SHINGLE ROOFS

NOTES:
- STANDARD LAG BOLT SPEC ASSUMES 5/16" LAG BOLTS WITH 2.5" EMBEDMENT IN ROOF STRUCTURAL MEMBERS/RAFTERS
- TORQUE ALL $\frac{5}{16}$" HARDWARE TO THE FOLLOWING:
  - SILVER S.S. 10-16 FT-LBS
  - BLACK S.S. 7-9 FT-LBS

RAIL CAN MOUNT TO EITHER SIDE OF POST (UPSLOPE vs. DOWNSLOPE)
- FOR UNEVEN ROOF SURFACES, USE UP TO TWO LEVELING SPACERS PER L FOOT OR STANDOFF. SEE DRAWING "STANDARD RAIL LEVELING" FOR DETAILS AND LIMITATIONS



ASSEMBLED SYSTEM
(SOLAR MODUELS NOT SHOWN)

SnapNrack™
PV Mounting Systems

MAINSTREAM ENERGY CORP.
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

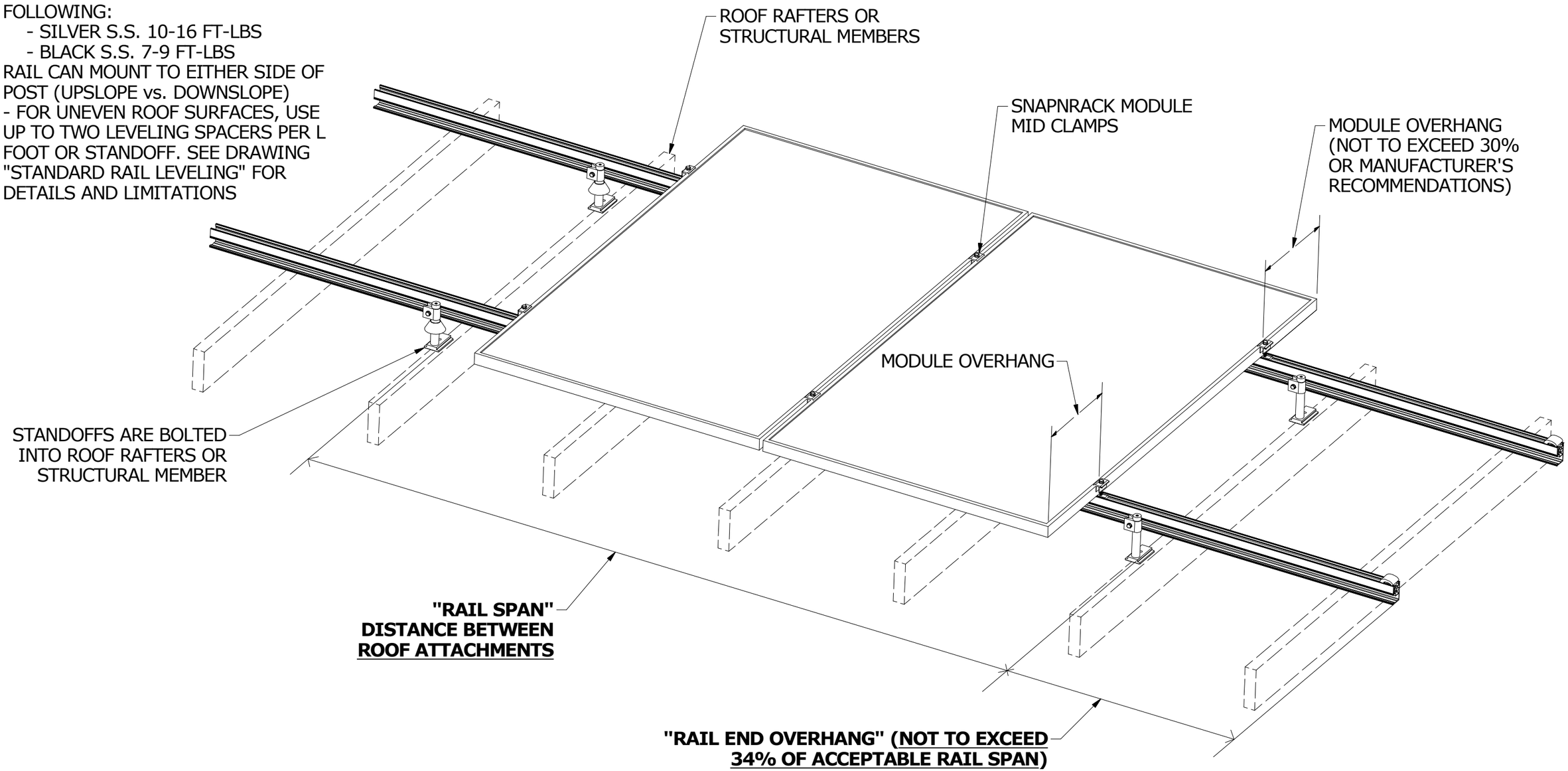
DESIGNER:	SCALE:	PART NUMBER:	DESCRIPTION:	REV
G.McPheeters	DNS	S100 D04	SERIES 100 TILT KITS 0-15 DEG	F
DRAFTER: D.Ryan				
APPROVED BY: G.McPheeters	DATE: 12/02/15			

SNAPNRACK SERIES 100 RACKING SYSTEM TYPICAL ROOF LAYOUT

REVISION:

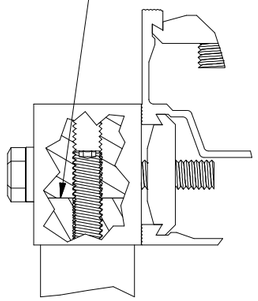
NOTES:
- STANDARD LAG BOLT SPEC ASSUMES 5/16" LAG BOLTS WITH 2.5" EMBEDMENT IN ROOF STRUCTURAL MEMBERS/RAFTERS
- TORQUE ALL $\frac{5}{16}$" HARDWARE TO THE FOLLOWING:
  - SILVER S.S. 10-16 FT-LBS
  - BLACK S.S. 7-9 FT-LBS

RAIL CAN MOUNT TO EITHER SIDE OF POST (UPSLOPE vs. DOWNSLOPE)
- FOR UNEVEN ROOF SURFACES, USE UP TO TWO LEVELING SPACERS PER L FOOT OR STANDOFF. SEE DRAWING "STANDARD RAIL LEVELING" FOR DETAILS AND LIMITATIONS



SnapNrack™ PV Mounting Systems	MAINSTREAM ENERGY CORP. 775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA PHONE (805) 528-9705 • FAX (805) 528-9701 THE INFORMATION IN THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY. ANY REPRODUCTION, DISCLOSURE, OR USE THEREOF IS PROHIBITED WITHOUT THE WRITTEN CONSENT OF MAINSTREAM ENERGY CORPORATION.	DESIGNER: G McPheeters DRAFTER: D Ryan APPROVED BY:	SCALE: DNS DATE: 120113	PART NUMBER: S100 D05	DESCRIPTION: SERIES 100 TYPICAL LAYOUT	REV F

USE CARE DURING INSTALLATION TO ENSURE THAT THE SET SCREW IS ROUGHLY CENTERED BETWEEN THE TWO PIECES BEING JOINED

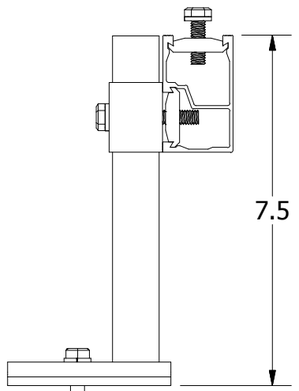


DETAIL A
SCALE 5:8

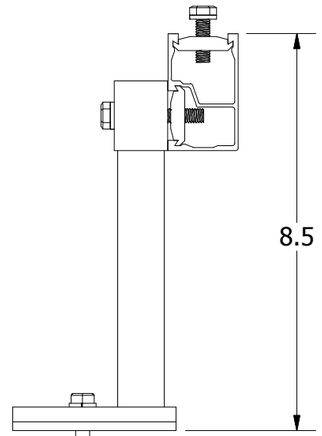
- 1X SNAPNRACK LEVELING SPACER
- 1X $\frac{5}{16}$"-18 X 1" LONG SET SCREW

- 2X SNAPNRACK LEVELING SPACER
- 2X $\frac{5}{16}$"-18 X 1" LONG SET SCREW

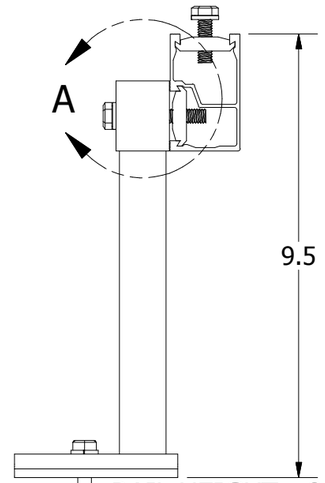
REVISION:



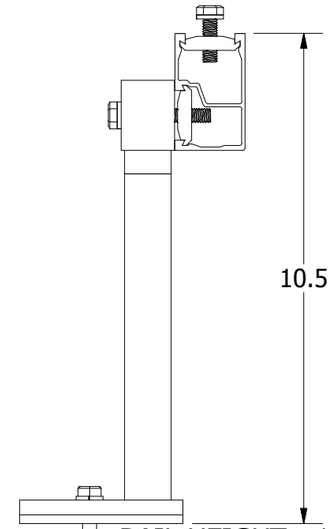
RAIL HEIGHT =7.5"
ABOVE ROOF SURFACE
7" STANDOFF



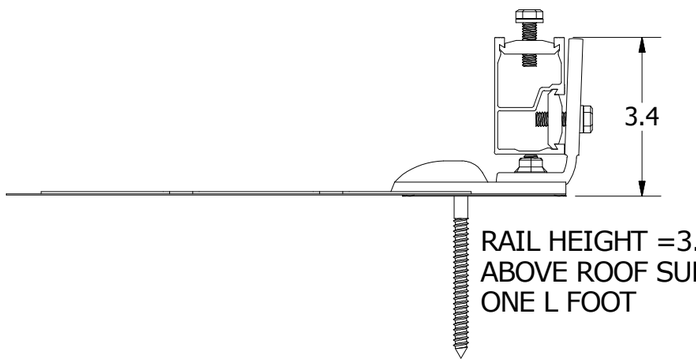
RAIL HEIGHT =8.5"
ABOVE ROOF SURFACE
7" STANDOFF



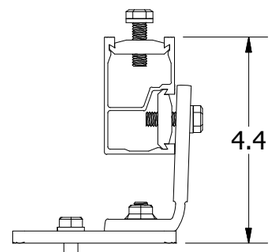
RAIL HEIGHT =9.5"
ABOVE ROOF SURFACE
7" STANDOFF
PLUS ONE SPACER
ON TOP OF STANDOFF



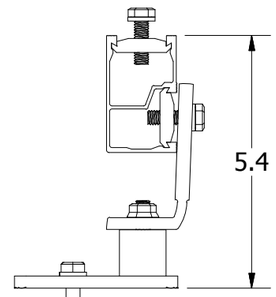
RAIL HEIGHT =10.5"
ABOVE ROOF SURFACE
7" STANDOFF
PLUS TWO SPACERS
ON TOP OF STANDOFF



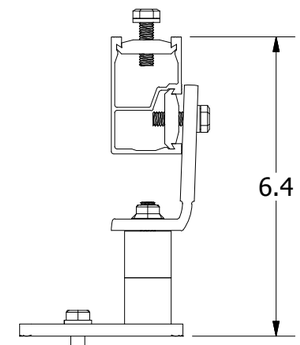
RAIL HEIGHT =3.4"
ABOVE ROOF SURFACE
ONE L FOOT



RAIL HEIGHT =4.4"
ABOVE ROOF SURFACE
ONE L FOOT



RAIL HEIGHT =5.4"
ABOVE ROOF SURFACE
ONE L FOOT
PLUS ONE SPACER
UNDER L FOOT



RAIL HEIGHT =6.4"
ABOVE ROOF SURFACE
ONE L FOOT
PLUS TWO SPACERS
UNDER L FOOT

STANDARD SERIES 100 ATTACHMENTS FEATURE 3" OF VERTICAL ADJUSTABILITY ON ALL MOUNTING POINTS WITH THE USE OF 1" LEVELING SPACERS

THE FIRST INCH OF ADJUSTABILITY IS ACCOMPLISHED WITH SLIDING FEATURES BUILT INTO BOTH L FOOT AND STANDOFF CLAMP COMPONENTS

FOR AN ADDITIONAL INCH OF HEIGHT ADJUSTMENT, ADD ONE LEVELING SPACER. USE OF SINGLE LEVELING SPACER NOT TO EXCEED 30% OF ATTACHMENT POINTS ON L-FEET OR 10" STANDOFFS.

FOR A SECOND ADDITIONAL INCH OF HEIGHT ADJUSTMENT, ADD ANOTHER LEVELING SPACER. USE OF TWO LEVELING SPACERS NOT TO EXCEED 10% OF ATTACHMENT POINTS ON L-FEET OR 10" STANDOFFS.

SnapNrack™
PV Mounting Systems

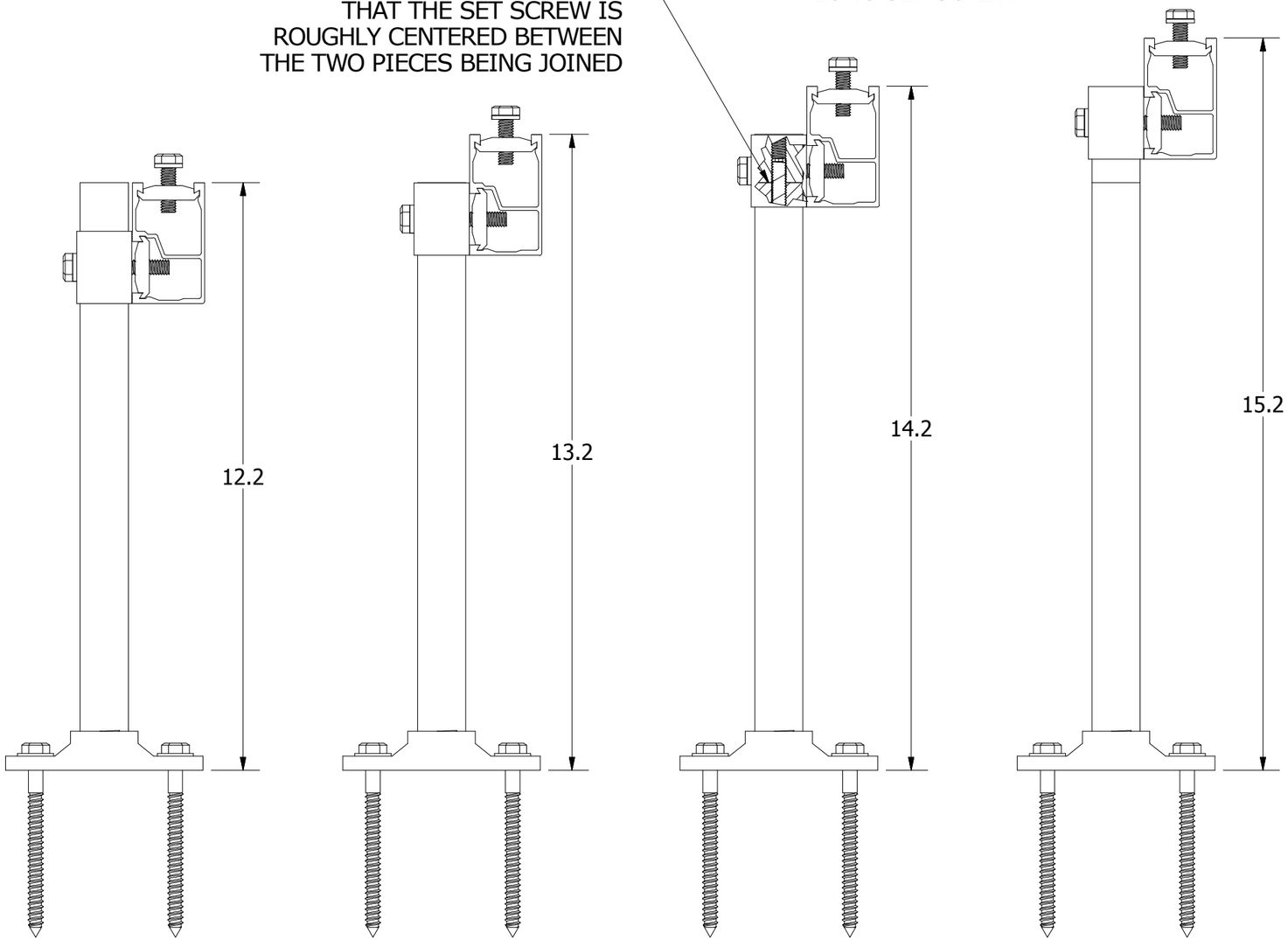
MAINSTREAM ENERGY CORP.
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER: G McPheeters DRAFTER: D Ryan APPROVED BY:	SCALE: DNS DATE: 120113	PART NUMBER: S100 D06	DESCRIPTION: SERIES 100 RAIL LEVELING	REV F

REVISION:

- 1X SNAPNRACK LEVELING SPACER
- 1X $\frac{5}{16}$"-18 X 1" LONG SET SCREW
- 2X SNAPNRACK LEVELING SPACER
- 2X $\frac{5}{16}$"-18 X 1" LONG SET SCREW

USE CARE DURING INSTALLATION TO ENSURE THAT THE SET SCREW IS ROUGHLY CENTERED BETWEEN THE TWO PIECES BEING JOINED



RAIL HEIGHT =12.2"
ABOVE ROOF SURFACE
12" HD STANDOFF

RAIL HEIGHT =13.2"
ABOVE ROOF SURFACE
12" HD STANDOFF

RAIL HEIGHT =14.2"
ABOVE ROOF SURFACE
12" HD STANDOFF
PLUS ONE SPACER ON
TOP OF STANDOFF

RAIL HEIGHT =15.2"
ABOVE ROOF SURFACE
12" HD STANDOFF
PLUS TWO SPACERS
ON TOP OF STANDOFF

STANDARD SERIES 100 ATTACHMENTS FEATURE 3" OF VERTICAL ADJUSTABILITY ON ALL MOUNTING POINTS WITH THE USE OF 1" LEVELING SPACERS

THE FIRST INCH OF ADJUSTABILITY IS ACCOMPLISHED WITH SLIDING FEATURES BUILT INTO BOTH L FOOT AND STANDOFF CLAMP COMPONENTS

FOR AN ADDITIONAL INCH OF HEIGHT ADJUSTMENT, ADD ONE LEVELING SPACER. USE OF SINGLE LEVELING SPACER NOT TO EXCEED 30% OF ATTACHMENT POINTS.

FOR A SECOND ADDITIONAL INCH OF HEIGHT ADJUSTMENT, ADD ANOTHER LEVELING SPACER. USE OF TWO LEVELING SPACERS NOT TO EXCEED 10% OF ATTACHMENT POINTS.

THE LIMITS ABOVE APPLY WHEN YOU ARE AT THE MAXIMUM STANDOFF HEIGHT DEPENDING ON THE STANDOFF BASE BEING USED. FOR HD STANDOFFS ON HD STANDOFF BASES, THE MAXIMUM STANDOFF HEIGHT (BEFORE APPLYING THE LIMITATIONS ABOVE) IS 12".

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PV Mounting Systems

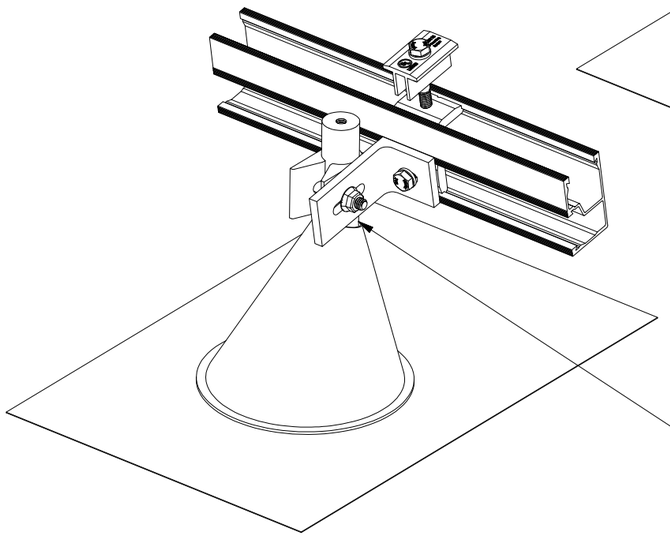
MAINSTREAM ENERGY CORP.
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER: G McPheeters DRAFTER: D Ryan APPROVED BY:	SCALE: DNS DATE: 120113	PART NUMBER: S100 D07	DESCRIPTION: SERIES 100 RAIL LEVELING HD STANDOFF	REV F

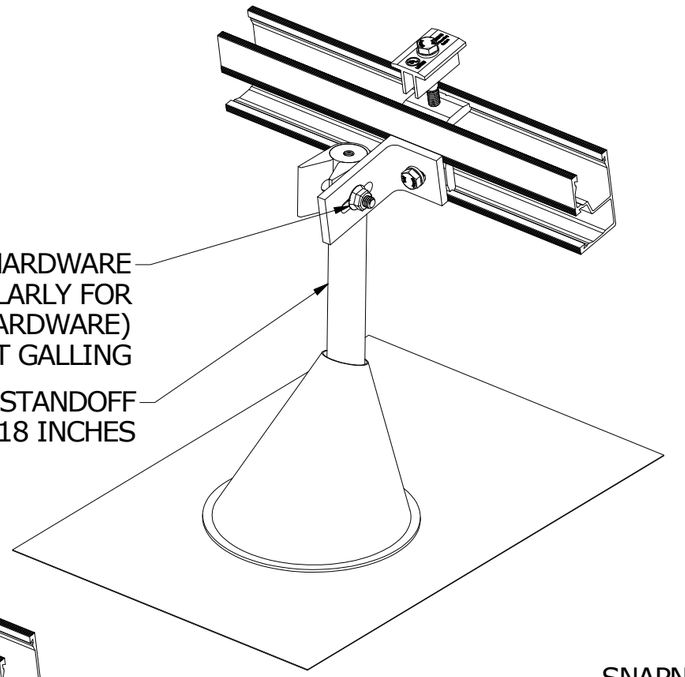
USE TILT KIT OPTION FOR INSTALLATIONS THAT REQUIRE MODULES TO BE TILTED ABOVE THE EXISTING ROOF SLOPE

LOW TILT SYSTEM SHOWN IS DESIGNED FOR TILT ANGLES FROM 0 TO 15 DEGREES ABOVE ROOF SURFACE

REVISION:		
F	12/02/15	

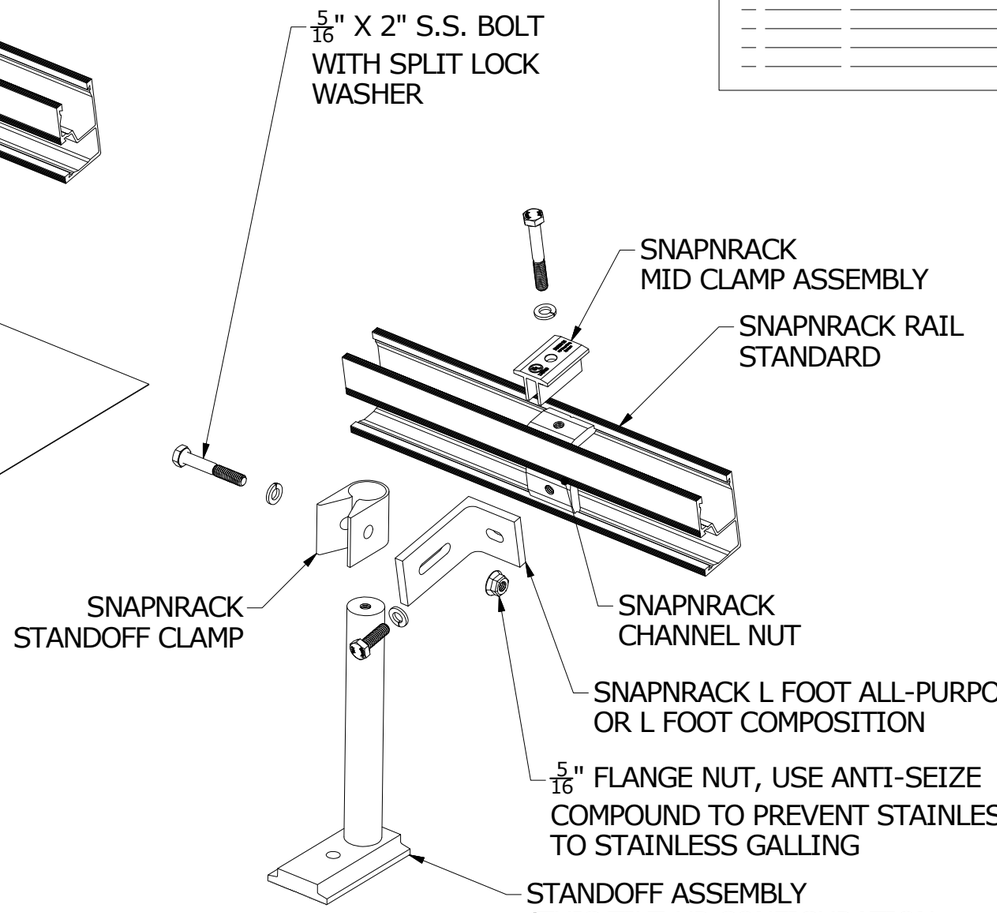


USE SHORTEST POSSIBLE FRONT STANDOFF TO MEET FLASHING REQUIREMENTS



USE OF ANTI-SEIZE ON TILT HARDWARE IS RECOMMENDED (PARTICULARLY FOR STAINLESS TO STAINLESS HARDWARE) TO PREVENT GALLING

MAX. REAR STANDOFF HEIGHT: 18 INCHES



$\frac{5}{16}$" X 2" S.S. BOLT WITH SPLIT LOCK WASHER

SNAPNRACK MID CLAMP ASSEMBLY

SNAPNRACK RAIL STANDARD

SNAPNRACK STANDOFF CLAMP

SNAPNRACK CHANNEL NUT

SNAPNRACK L FOOT ALL-PURPOSE OR L FOOT COMPOSITION

$\frac{5}{16}$" FLANGE NUT, USE ANTI-SEIZE COMPOUND TO PREVENT STAINLESS TO STAINLESS GALLING

STANDOFF ASSEMBLY (THIS TILT-UP CONFIGURATION IS ALSO COMPATIBLE WITH THE FLASHED L FOOT MOUNTING OPTION)

NOTES:

- TORQUE $\frac{5}{16}$" HARDWARE TO THE FOLLOWING UNLESS OTHERWISE NOTED:
  - SILVER S.S. 10-16 FT-LBS
  - BLACK S.S. 7-9 FT-LBS
- REFER TO ENGINEERING CHARTS FOR RAIL SPAN BASED ON MODULE TILT ANGLE, WIND SPEED, AND SNOW LOAD
- FOR HIGHER TILT APPLICATIONS SEE "SERIES 100 TILT KIT 10-45 DEG"

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MAINSTREAM ENERGY CORP.
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER:	G McPheeters	SCALE:	DNS	PART NUMBER:	DESCRIPTION:	REV
DRAFTER:	D Ryan	DATE:	12/02/15	S100 D08	SERIES 100 TILT KITS 0-15 DEG	F
APPROVED BY:	G McPheeters					

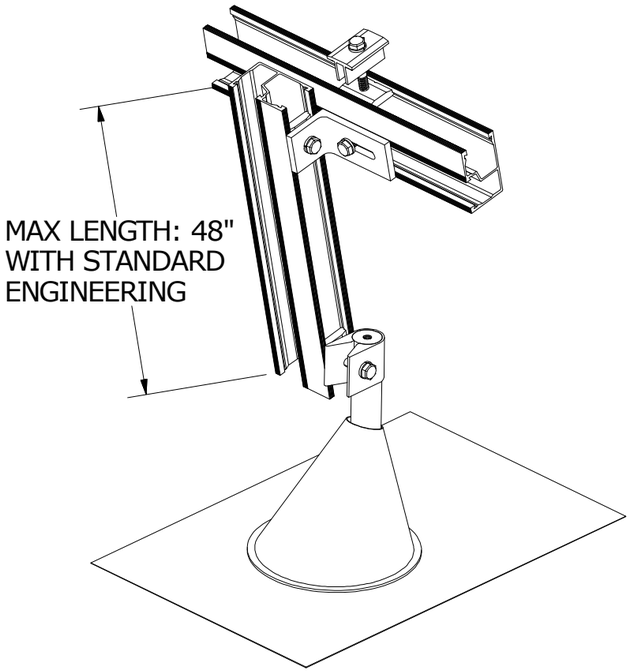
USE TILT KIT OPTION FOR INSTALLATIONS THAT REQUIRE MODULES TO BE TILTED ABOVE THE EXISTING ROOF SLOPE

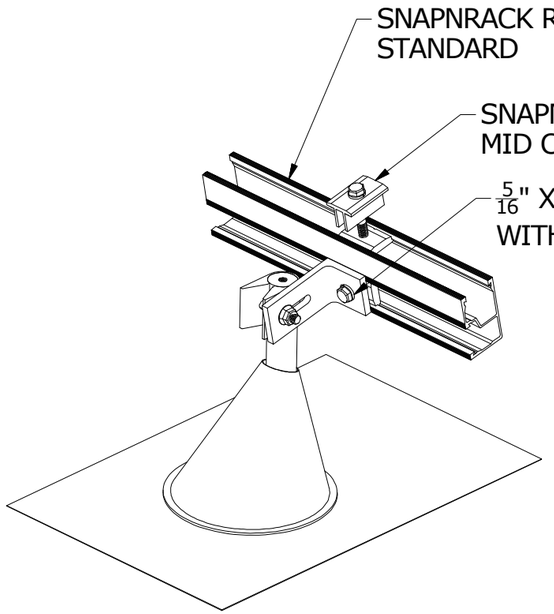
SYSTEM SHOWN IS DESIGNED FOR TILT ANGLES FROM 10 TO 45 DEGREES ABOVE ROOF SURFACE

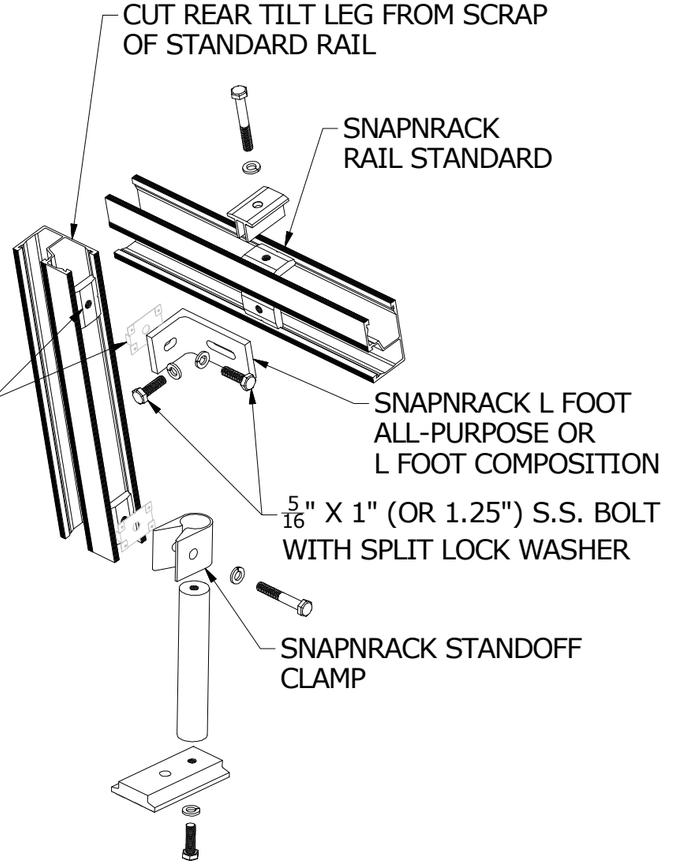
USE OF ANTI-SEIZE ON TILT HARDWARE IS RECOMMENDED (PARTICULARLY FOR STAINLESS TO STAINLESS HARDWARE)

REFER TO S100 TKT SERIES 170 TILT KIT TOOL FOR A SIMPLE TOOL THAT DRAMATICALLY SIMPLIFIES TILT KIT INSTALLATION BY SUPPORTING THE UPPER RAIL AHEAD OF MODULE INSTALLATION

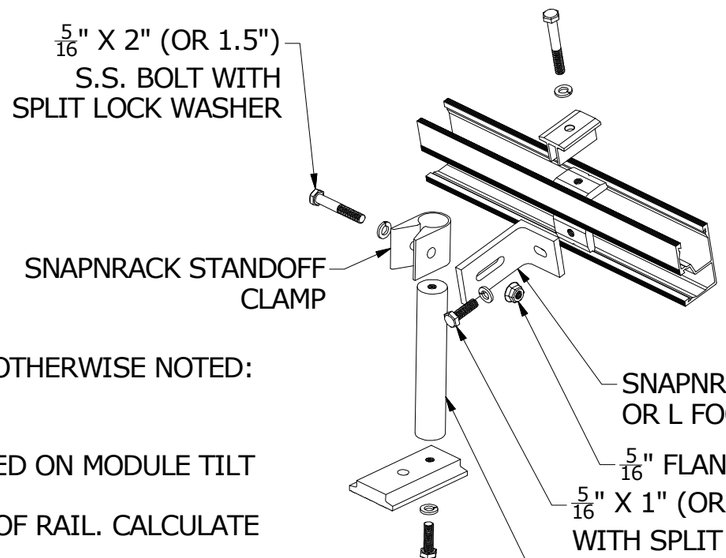
REVISION:







SNAPNRACK CHANNEL NUTS, TORQUE TO 10-16 FT-LBS WHEN USING WEEBS. WHEN USING SNAPNRACK BONDING CHANNEL NUTS, TORQUE TO 14-16 FT-LBS. WEEBS ARE NOT REQUIRED WITH BONDING CHANNEL NUTS.



NOTES:

- TORQUE 5/16" HARDWARE TO THE FOLLOWING UNLESS OTHERWISE NOTED:
  - SILVER S.S. 10-16 FT-LBS
  - BLACK S.S. 7-9 FT-LBS
- REFER TO ENGINEERING CHARTS FOR RAIL SPAN BASED ON MODULE TILT ANGLE, WIND SPEED, AND NOW LOAD
- BACK SUPPORT "LEG" IS FABRICATED FROM A SCRAP OF RAIL. CALCULATE REQUIRED TILT LEG LENGTH AND CUT RAIL TO LENGTH
- FOR LOWER TILT APPLICATIONS SEE "SERIES 100 TILT KIT 0-15 DEG"
- SNAPNRACK RAIL COVER CAN BE USED TO COVER CHANNEL IN REAR TILT LEG

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MAINSTREAM ENERGY CORP.
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER: G McPheeters	SCALE: DNS	PART NUMBER: S100 D09	DESCRIPTION: SERIES 100 TILT KITS 10-45 DEG	REV F
DRAFTER: D Ryan				
APPROVED BY:	DATE: 120113			

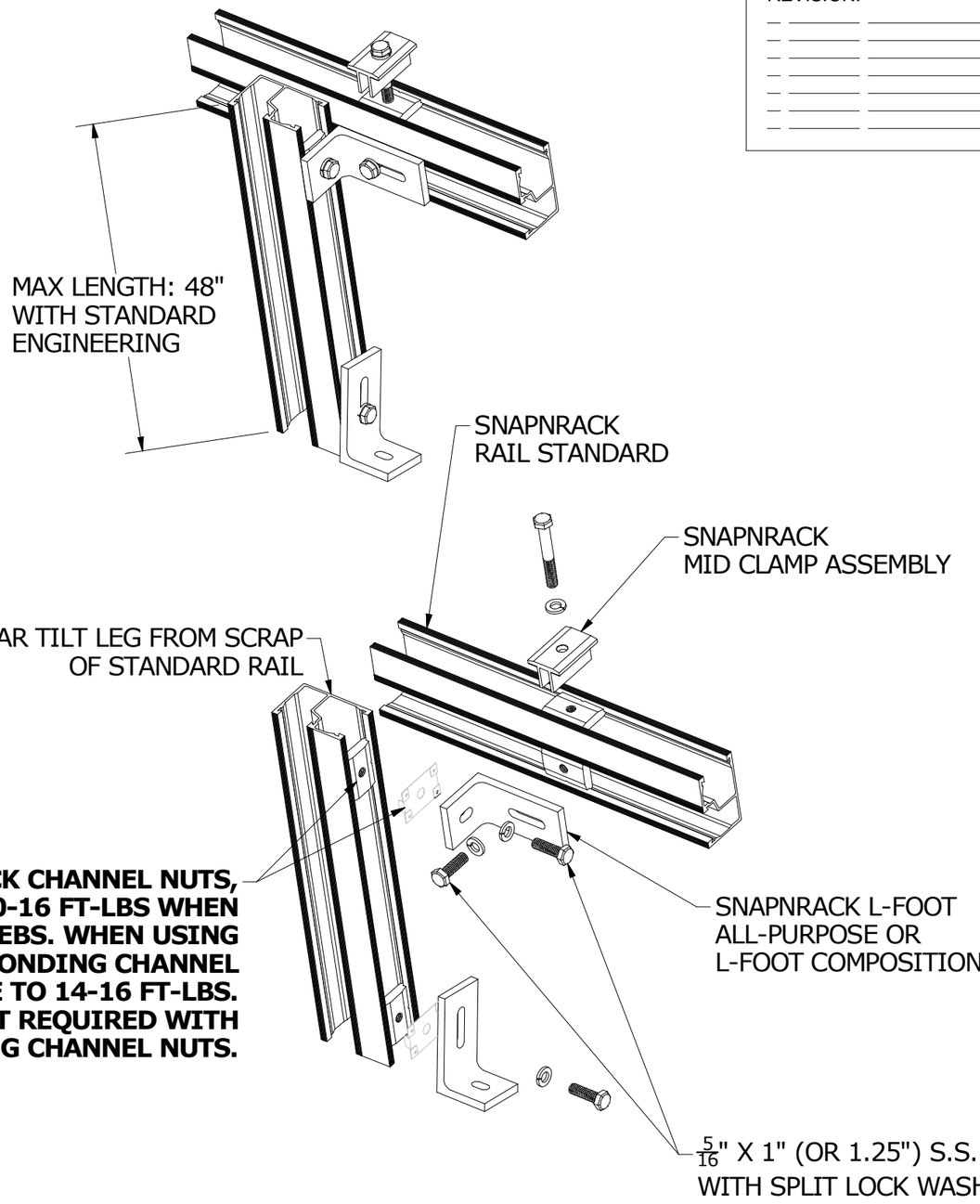
USE TILT KIT OPTION FOR INSTALLATIONS THAT REQUIRE MODULES TO BE TILTED ABOVE THE EXISTING ROOF SLOPE

SYSTEM SHOWN IS DESIGNED FOR TILT ANGLES FROM 10 TO 45 DEGREES ABOVE ROOF SURFACE

USE OF ANTI-SEIZE ON TILT HARDWARE IS RECOMMENDED (PARTICULARLY FOR STAINLESS TO STAINLESS HARDWARE)

REFER TO S100 TKT SERIES 170 TILT KIT TOOL FOR A SIMPLE TOOL THAT DRAMATICALLY SIMPLIFIES TILT KIT INSTALLATION BY SUPPORTING THE UPPER RAIL AHEAD OF MODULE INSTALLATION

REVISION:



NOTES:

- TORQUE $\frac{5}{16}$" HARDWARE TO THE FOLLOWING UNLESS OTHERWISE NOTED:
  - SILVER S.S. 10-16 FT-LBS
  - BLACK S.S. 7-9 FT-LBS
- REFER TO ENGINEERING CHARTS FOR RAIL SPAN BASED ON MODULE TILT ANGLE, WIND SPEED, AND SNOW LOAD
- BACK SUPPORT "LEG" IS FABRICATED FROM A SCRAP OF RAIL. CALCULATE REQUIRED TILT LEG LENGTH. USE WEEB GROUNDING WASHERS AT JOINTS BETWEEN L-FEET AND SNAPNRACK STANDARD RAIL SCRAP PIECE
- FOR LOWER TILT APPLICATIONS SEE "SERIES 100 TILT KIT 0-15 DEG"
- SNAPNRACK RAIL COVER CAN BE USED TO COVER CHANNEL IN REAR TILT LEG

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PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER:	SCALE:	PART NUMBER:	DESCRIPTION:	REV
G McPheeters	DNS	S100 D10	SERIES 100 TILT KITS 10-45 DEG WITH L FOOT MOUNT	F
DRAFTER: D Ryan				
APPROVED BY:	DATE: 120113			

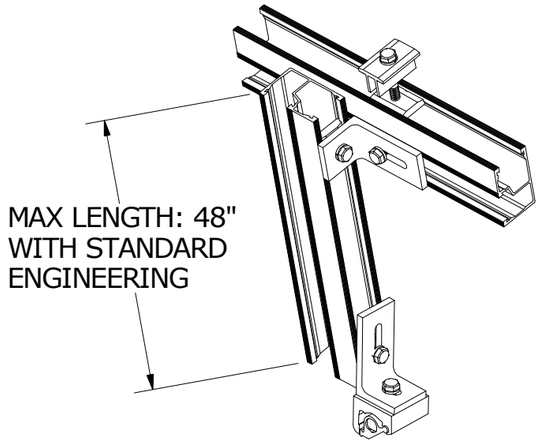
USE TILT KIT OPTION FOR INSTALLATIONS THAT REQUIRE MODULES TO BE TILTED ABOVE THE EXISTING ROOF SLOPE

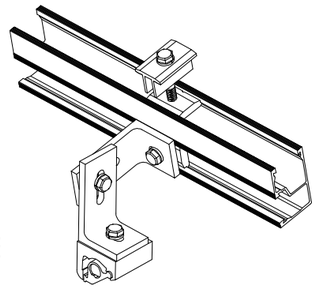
SYSTEM SHOWN IS DESIGNED FOR TILT ANGLES FROM 10 TO 45 DEGREES ABOVE ROOF SURFACE ON STANDING SEAM METAL ROOFS

USE OF ANTI-SEIZE ON TILT HARDWARE IS RECOMMENDED (PARTICULARLY FOR STAINLESS TO STAINLESS HARDWARE)

REFER TO S100 TKT SERIES 170 TILT KIT TOOL FOR A SIMPLE TOOL THAT DRAMATICALLY SIMPLIFIES TILT KIT INSTALLATION BY SUPPORTING THE UPPER RAIL AHEAD OF MODULE INSTALLATION

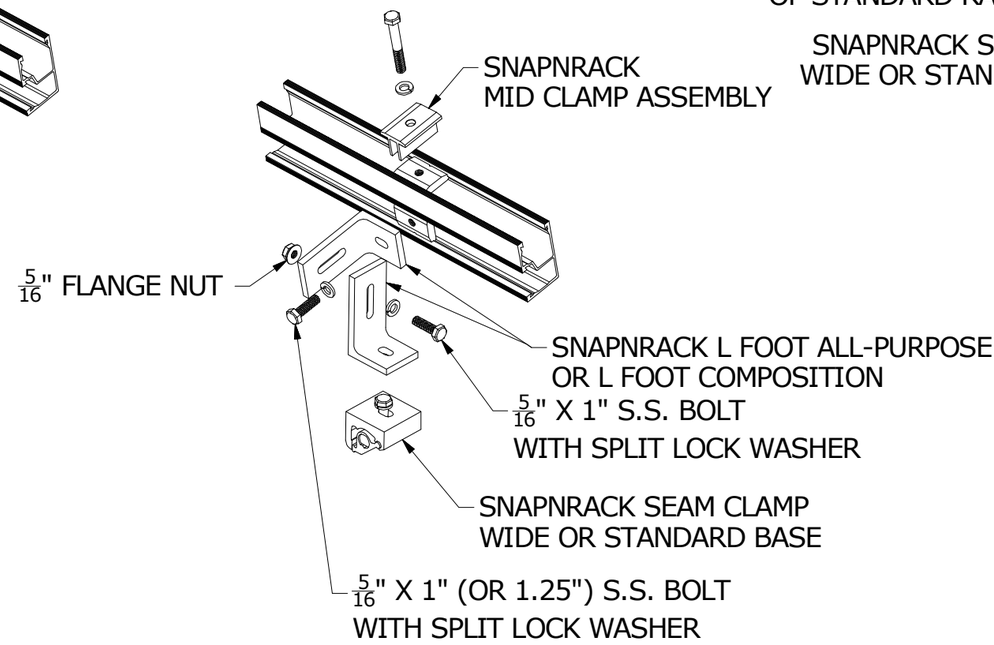
REVISION:





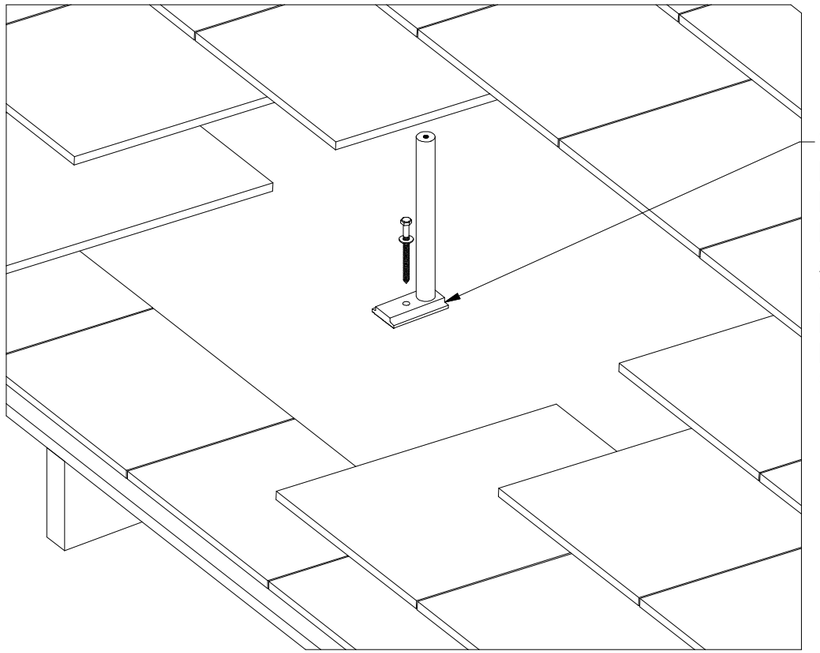
NOTES:

- TORQUE $\frac{5}{16}$" HARDWARE TO THE FOLLOWING UNLESS OTHERWISE NOTED:
  - SILVER S.S. 10-16 FT-LBS
  - BLACK S.S. 7-9 FT-LBS
- REFER TO ENGINEERING CHARTS FOR RAIL SPAN BASED ON MODULE TILT ANGLE, WIND SPEED, AND SNOW LOAD
- BACK SUPPORT "LEG" IS FABRICATED FROM A SCRAP OF RAIL. CALCULATE REQUIRED TILT LEG LENGTH AND CUT RAIL TO LENGTH
- FOR LOWER TILT APPLICATIONS SEE "SERIES 100 TILT KIT 0-15 DEG"
- SNAPNRACK RAIL COVER CAN BE USED TO COVER CHANNEL IN REAR TILT LEG



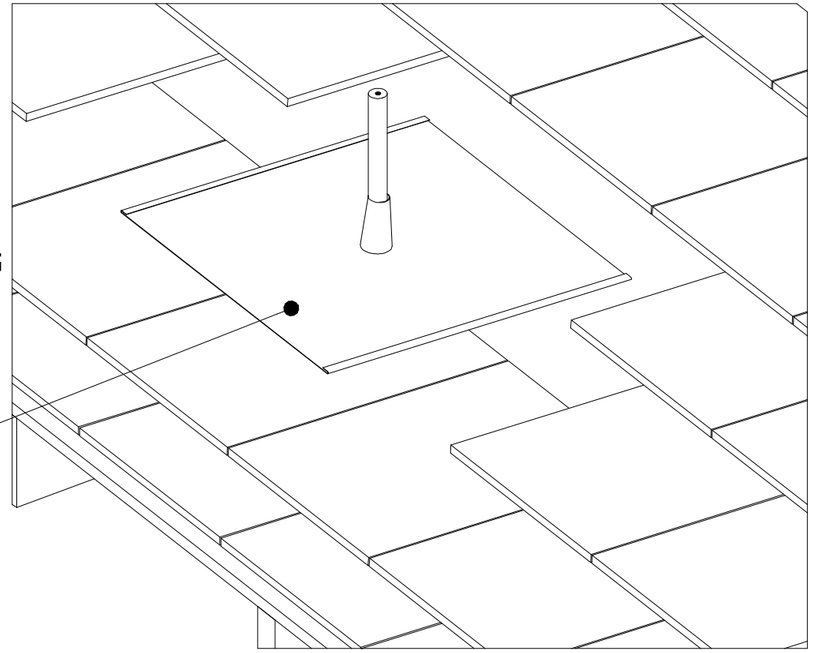
SnapNrack™ PV Mounting Systems	MAINSTREAM ENERGY CORP. 775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA PHONE (805) 528-9705 • FAX (805) 528-9701 THE INFORMATION IN THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY. ANY REPRODUCTION, DISCLOSURE, OR USE THEREOF IS PROHIBITED WITHOUT THE WRITTEN CONSENT OF MAINSTREAM ENERGY CORPORATION.	DESIGNER: G McPheeters DRAFTER: D Ryan APPROVED BY:	SCALE: DNS DATE: 042514	PART NUMBER: S100 D11	DESCRIPTION: SERIES 100 TILT KITS 10-45 DEG SEAM CLAMP MOUNT	REV F

REVISION:

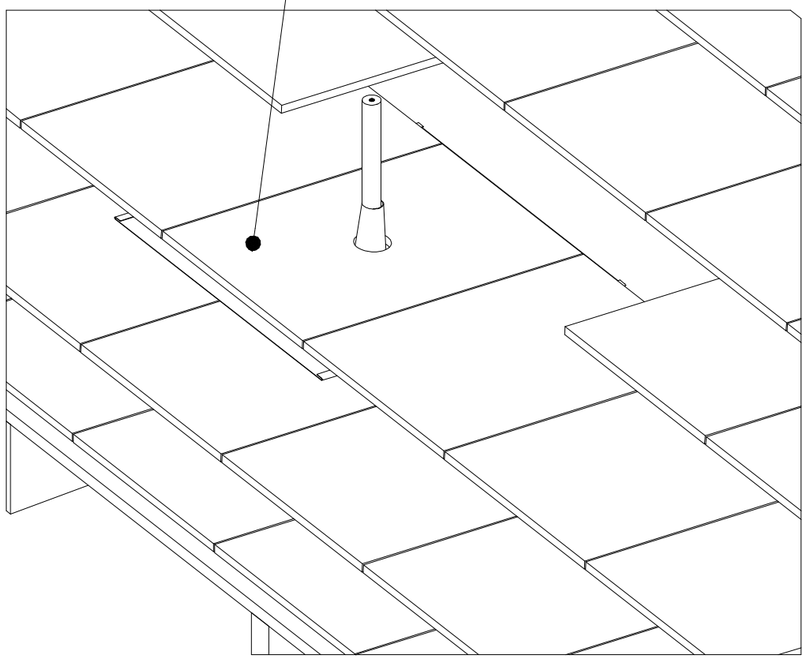


STEP 1:
REMOVE TILE AND IDENTIFY RAFTER LOCATION WITH A PILOT DRILL. MOUNT STANDOFF ASSEMBLY TO ROOF SHEATHING WITH A 5/16IN LAG BOLT MINIMUM 2.5" EMBEDMENT TYP. BE SURE LAG BOLT IS FULLY SEATED

STEP 2:
SLIDE FLASHING OVER POST, UNDER UPPER LAYER OF TILE

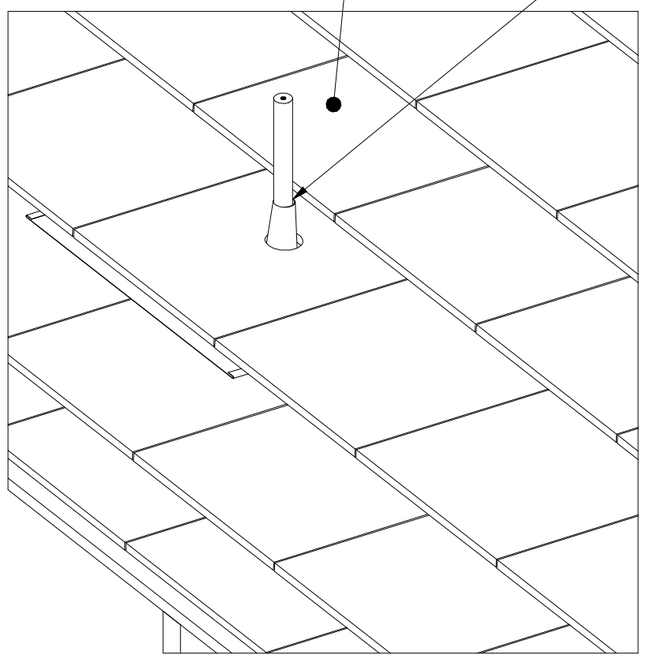


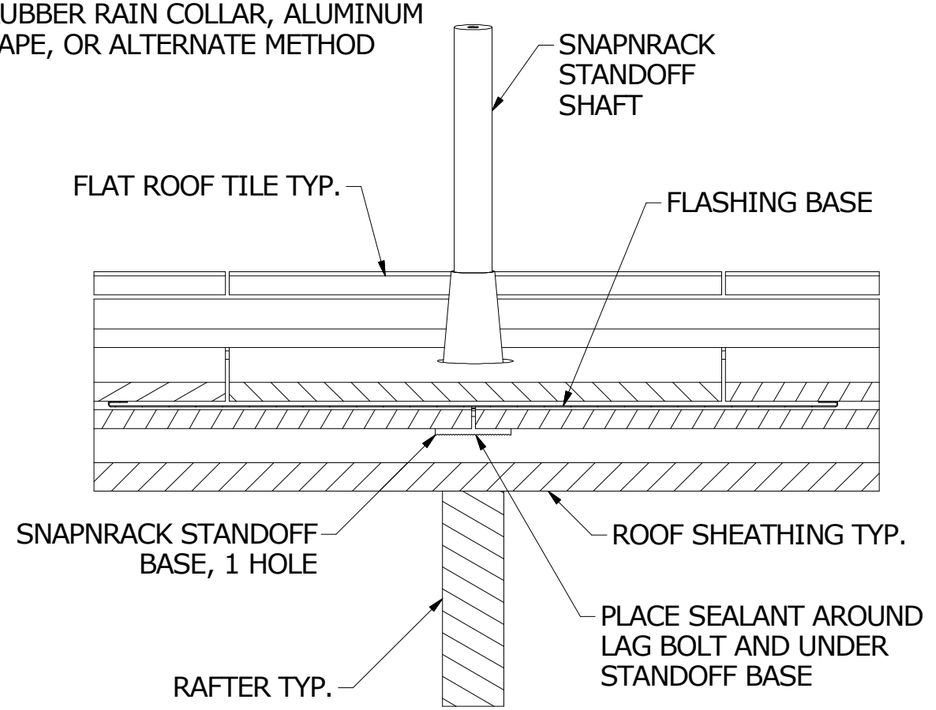
STEP 3:
USE CORING BIT OR OTHER METHOD TO DRILL CLEARANCE HOLE IN TILE TO ALLOW IT TO BE REPLACED IN ORIGINAL LOCATION



STEP 4:
REPLACE TILES

SEAL TOP OF CONE FLASHING WITH RUBBER RAIN COLLAR, ALUMINUM TAPE, OR ALTERNATE METHOD





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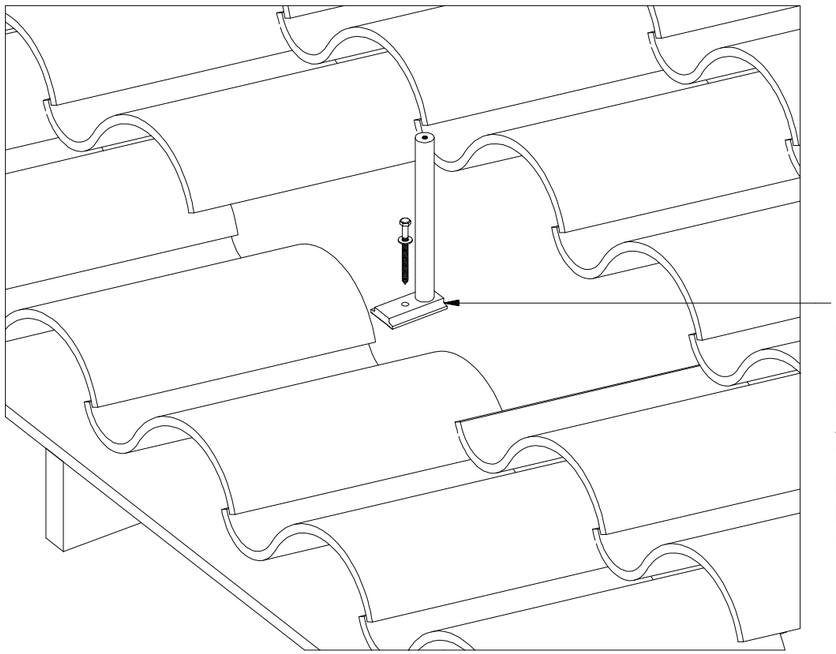
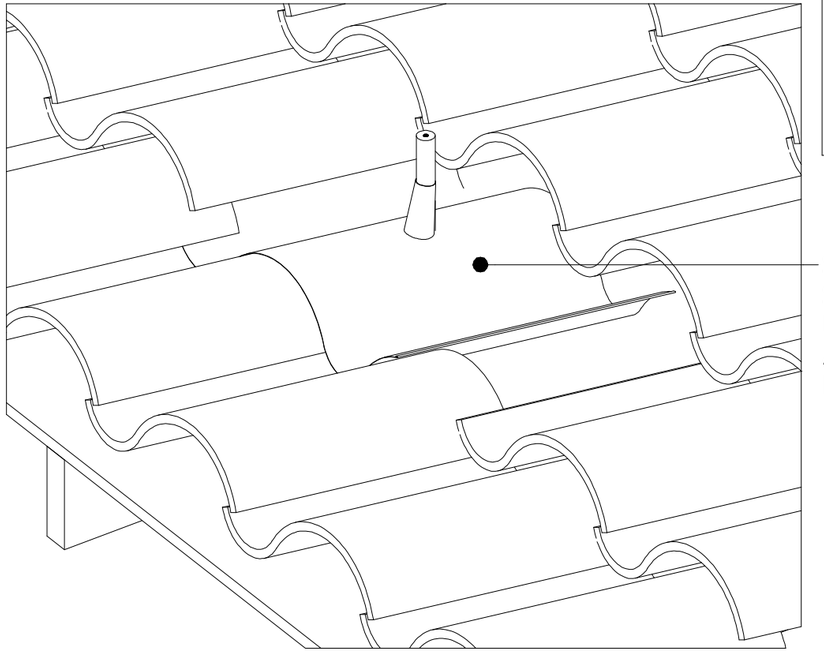
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER: G McPheeters DRAFTER: D Ryan APPROVED BY:	SCALE: DNS DATE: 120113	PART NUMBER: S100 D12	DESCRIPTION: SERIES 100 FLASHING DETAIL, STANDOFF WITH FLAT TILE	REV F

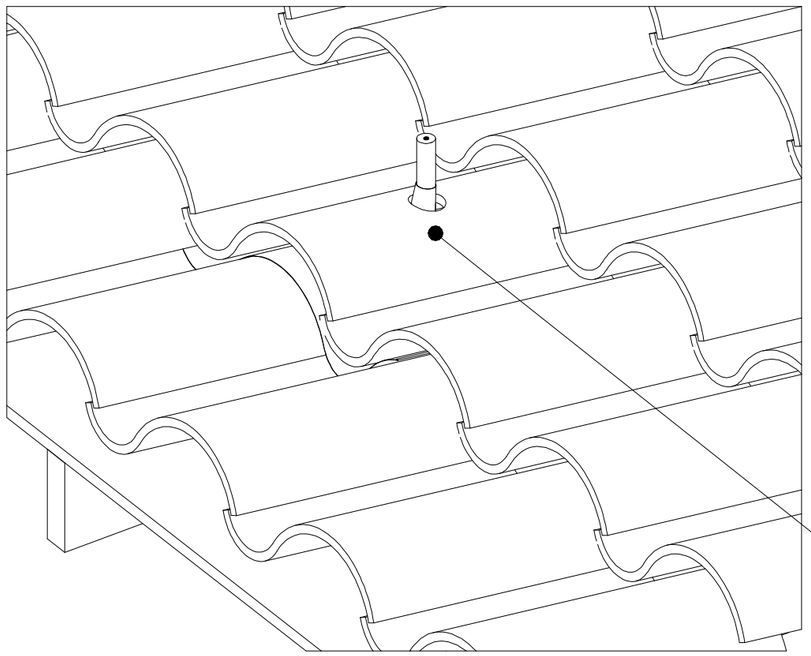
REVISION:



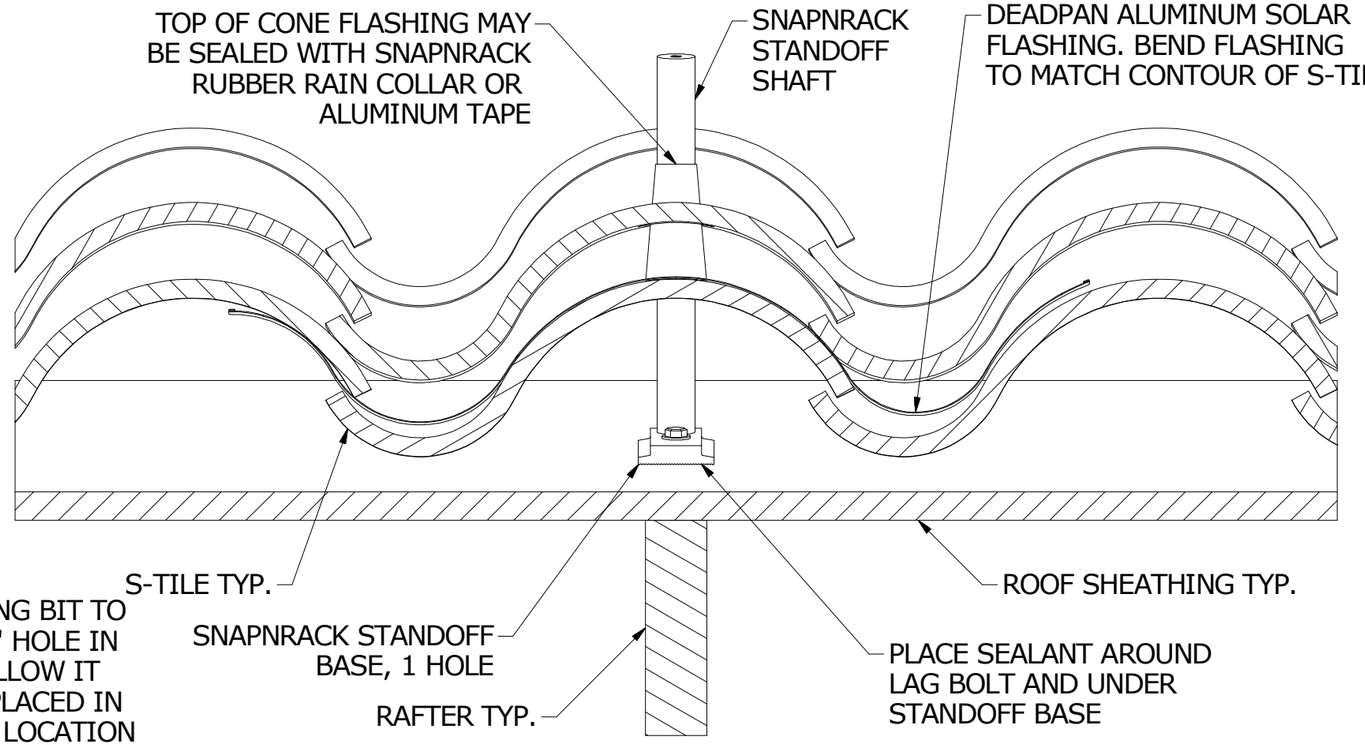
STEP 1:
REMOVE TILE AND IDENTIFY RAFTER LOCATION WITH A PILOT DRILL. MOUNT STANDOFF ASSEMBLY TO ROOF SHEATHING WITH A 5/16IN LAG BOLT MINIMUM 2IN EMBEDMENT TYP. BE SURE LAG BOLT IS FULLY SEATED



STEP 2:
SLIDE FLASHING OVER POST, UNDER UPPER LAYER OF TILE, AND FORM FLASHING TO MATCH CONTOUR OF TILES



STEP 3:
USE CORING BIT TO DRILL 2.5" HOLE IN TILE TO ALLOW IT TO BE REPLACED IN ORIGINAL LOCATION



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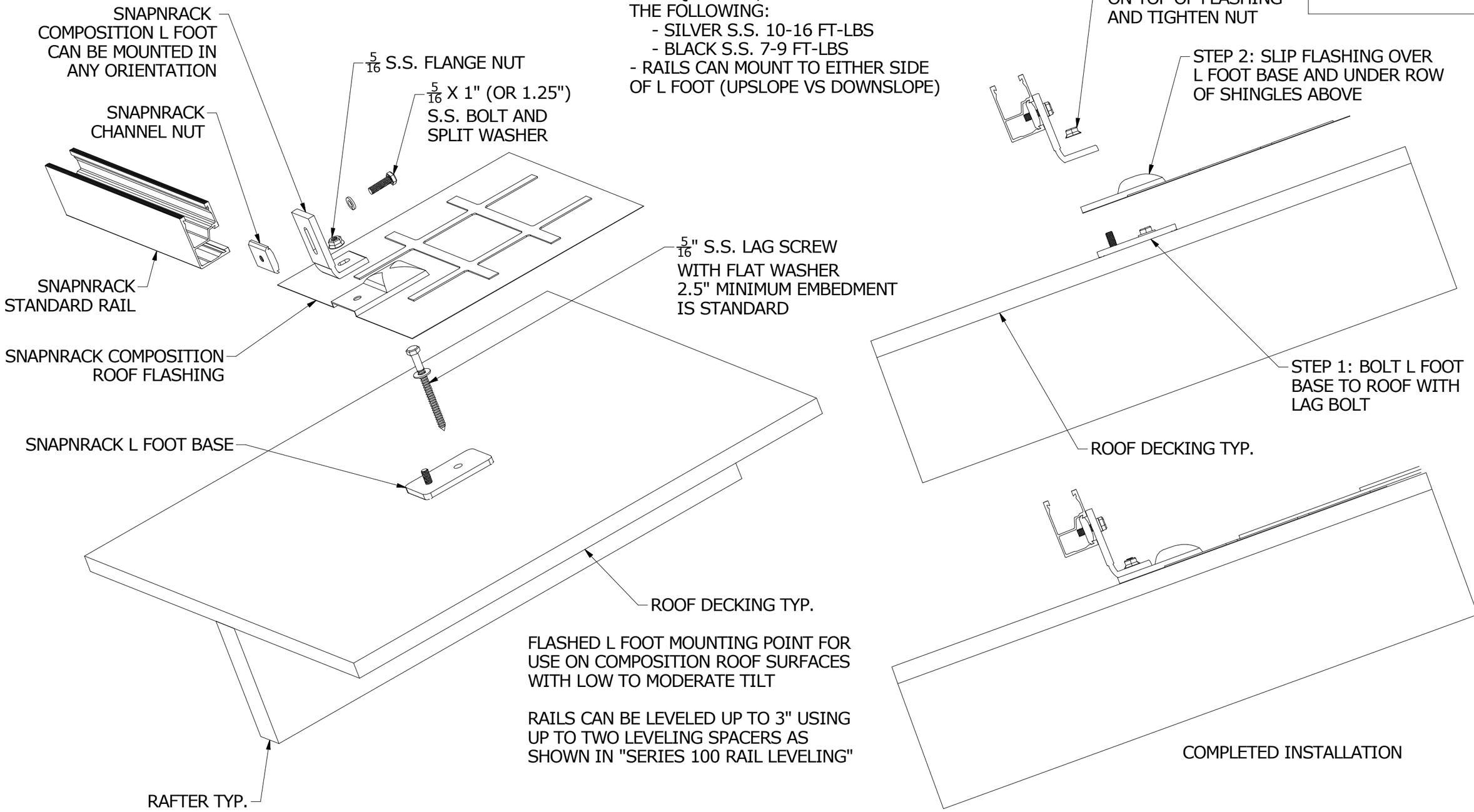
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER:	SCALE:	PART NUMBER:	DESCRIPTION:	REV
G McPheeters	DNS	S100 D13	SERIES 100 FLASHING DETAIL, STANDOFF ON S-TILE ROOF	F
DRAFTER: D Ryan	DATE: 120113			
APPROVED BY:				

NOTES:

- 5/16" LAG BOLTS MUST EMBED 2.5" INTO ROOF STRUCTURAL MEMBERS/RAFTERS
- TORQUE ALL 5/16" HARDWARE TO THE FOLLOWING:
  - SILVER S.S. 10-16 FT-LBS
  - BLACK S.S. 7-9 FT-LBS
- RAILS CAN MOUNT TO EITHER SIDE OF L FOOT (UPSLOPE VS DOWNSLOPE)

REVISION:



FLASHED L FOOT MOUNTING POINT FOR USE ON COMPOSITION ROOF SURFACES WITH LOW TO MODERATE TILT

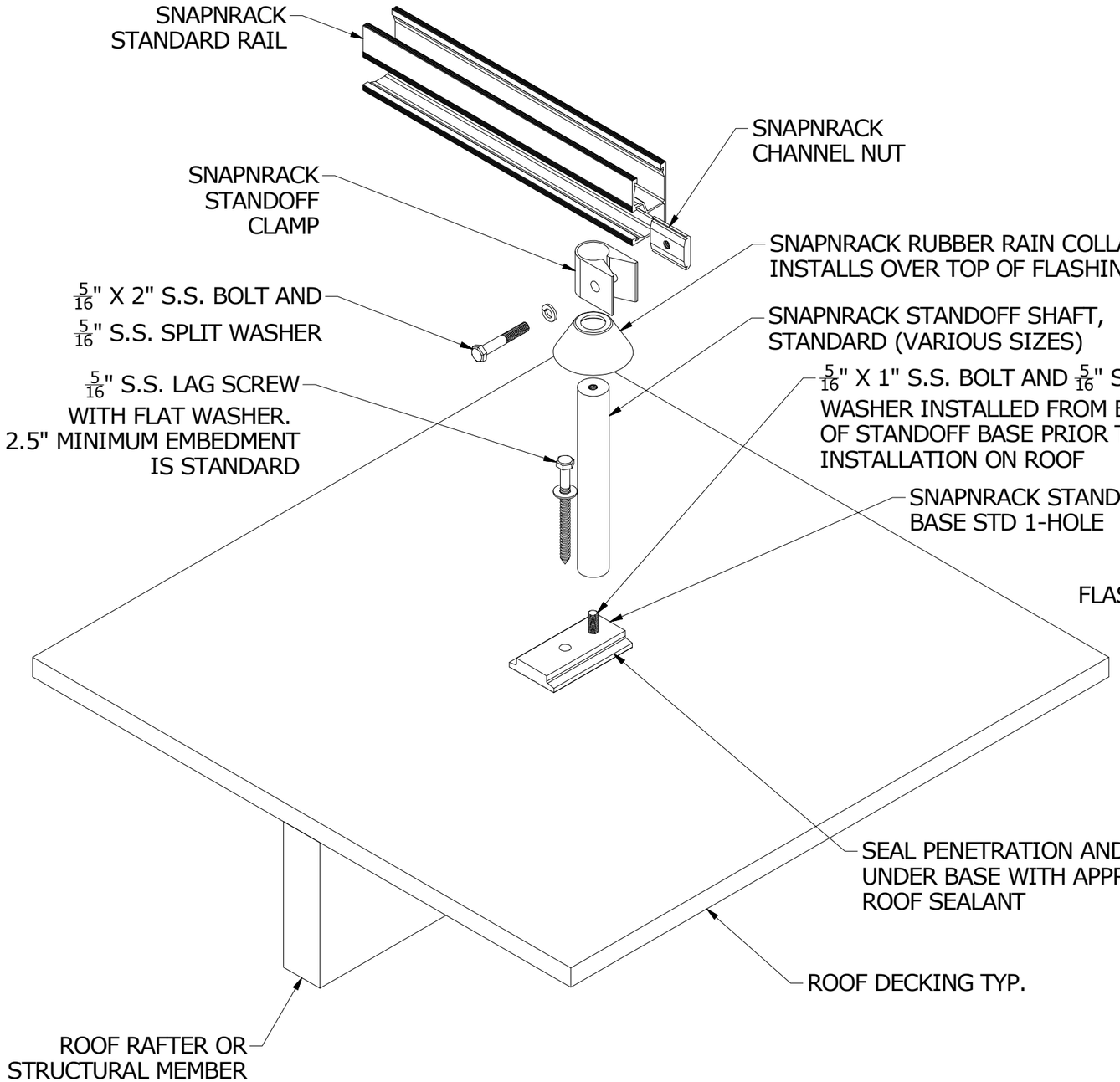
RAILS CAN BE LEVELED UP TO 3" USING UP TO TWO LEVELING SPACERS AS SHOWN IN "SERIES 100 RAIL LEVELING"

COMPLETED INSTALLATION

SnapNrack™ PV Mounting Systems

MAINSTREAM ENERGY CORP.
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER: G McPheeters	SCALE: DNS	PART NUMBER: S100 PEN D01	DESCRIPTION: PEN DETAIL 01, FLASHED L FOOT TO RAFTER	REV F
DRAFTER: D Ryan	DATE: 120113			
APPROVED BY:				



NOTES:

- 5/16" LAG BOLTS MUST EMBED 2.5" INTO ROOF STRUCTURAL MEMBERS/RAFTERS

- TORQUE ALL 5/16" HARDWARE TO THE FOLLOWING:
  - SILVER S.S. 10-16 FT-LBS
  - BLACK S.S. 7-9 FT-LBS

- RAILS CAN MOUNT TO EITHER SIDE OF POST (UPSLOPE VS. DOWNSLOPE)

- RAILS CAN BE LEVELED UP TO 3" USING UP TO TWO LEVELING SPACERS AS SHOWN IN "SERIES 100 RAIL LEVELING"

* A POURED SEALANT-STYLE FLASHING MAY BE USED WITH SNAPNRACK STANDOFFS AS AN ALTERNATIVE TO A TYPICAL CONE FLASHING WHEN INSTALLED PER MANUFACTURER'S INSTRUCTIONS ON LOW-SLOPE ROOF SURFACES

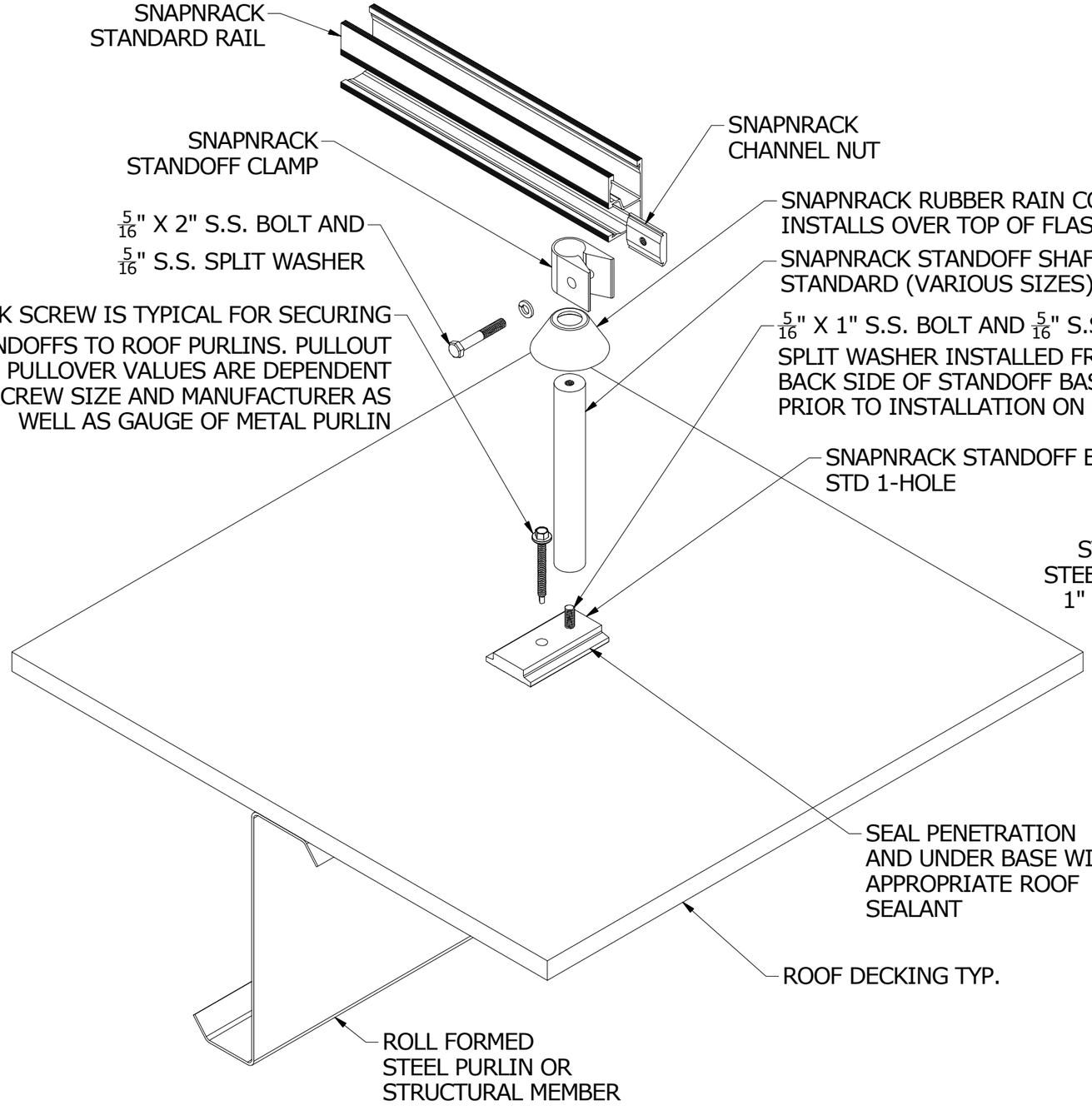
REVISION:

COMPLETE INSTALLATION
(SHOWN WITH FLASHING IN PLACE)

SnapNrack™ PV Mounting Systems

MAINSTREAM ENERGY CORP.
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER: G McPheeters DRAFTER: D Ryan APPROVED BY:	SCALE: DNS DATE: 120113	PART NUMBER: S100 PEN D02	DESCRIPTION: PEN DETAIL 02, STANDOFF TO RAFTER	REV F



NOTES:

- TEK SCREWS MUST EMBED IN ROOF STRUCTURAL MEMBERS/PURLINS

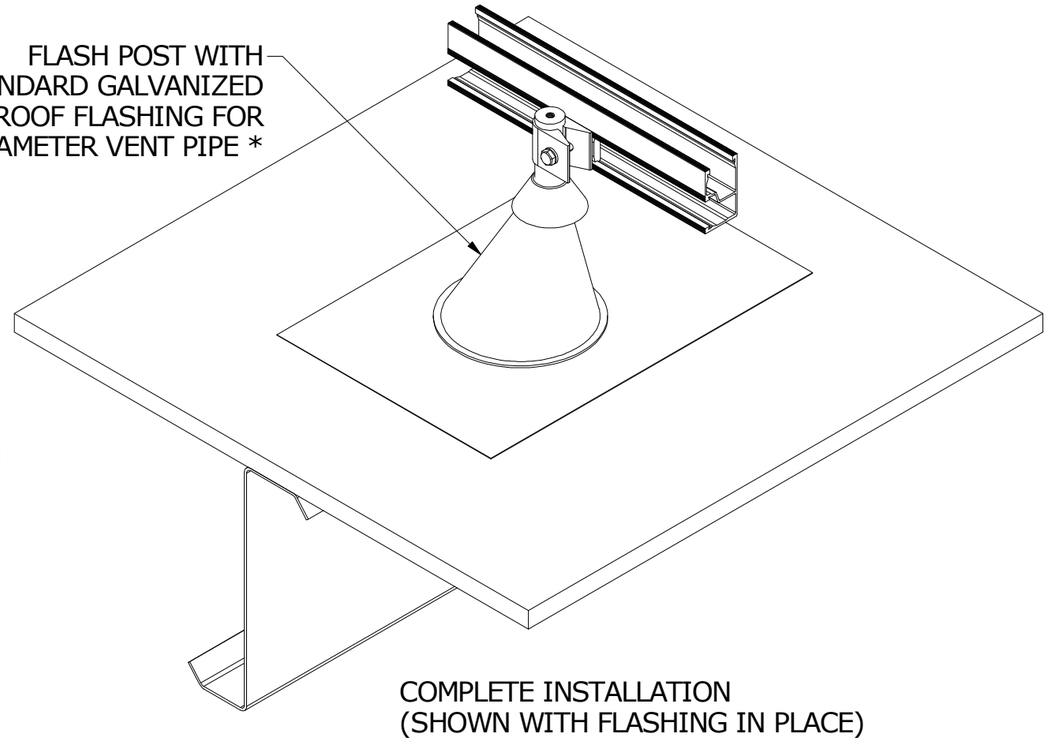
- TORQUE ALL 5/16" HARDWARE TO THE FOLLOWING:
  - SILVER S.S. 10-16 FT-LBS
  - BLACK S.S. 7-9 FT-LBS

- RAILS CAN MOUNT TO EITHER SIDE OF POST (UPSLOPE VS. DOWNSLOPE)

- RAILS CAN BE LEVELED UP TO 3" USING UP TO TWO LEVELING SPACERS AS SHOWN IN "SERIES 100 RAIL LEVELING"

* A POURED SEALANT-STYLE FLASHING MAY BE USED WITH SNAPNRACK STANDOFFS AS AN ALTERNATIVE TO A TYPICAL CONE FLASHING WHEN INSTALLED PER MANUFACTURER'S INSTRUCTIONS ON LOW-SLOPE ROOF SURFACES

REVISION:



COMPLETE INSTALLATION
(SHOWN WITH FLASHING IN PLACE)

SnapNrack™ PV Mounting Systems

MAINSTREAM ENERGY CORP.
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER:	SCALE:	PART NUMBER:	DESCRIPTION:	REV
G McPheeters	DNS	S100 PEN D03	PEN DETAIL 03, STANDOFF TO PURLIN	F
DRAFTER: D Ryan				
APPROVED BY:	DATE: 120113			

CAMMING SEAM CLAMPS ARE SPECIFIED WITH A BLACK OXIDE STAINLESS STEEL BOLT. IT IS IMPORTANT TO USE THE PROVIDED BOLT AND TO TIGHTEN TO 16 FT-LBS FOR FULL LOAD CAPABILITY

REVISION:

CLAMP CAN BE USED TO SECURE RAILS OR DIRECTLY SUPPORT SOLAR MODULES WITH MODULE CLAMPS

L FOOT OR SIMILAR TILT BRACKETS CAN BE ATTACHED TO THE TOP OF THE CLAMP AND PROVIDE A MOUNTING POINT FOR RAILS OR OTHER STRUCTURAL MEMBERS

SEAM CLAMP BASE (STD BASE SHOWN BUT INSTALLATION OF WIDE BASE IS IDENTICAL)

SEAM CLAMP CAM

1: INSTALLATION STARTS WITH CLAMP IN OPEN POSITION WITH BOLT LOOSE

SEAM CLAMP THREAD INSERT

2: OPEN CLAMP GETS LOWERED ONTO SEAM

3: BOLT IS TIGHTENED, SECURING CLAMP AND L FOOT AT THE SAME TIME

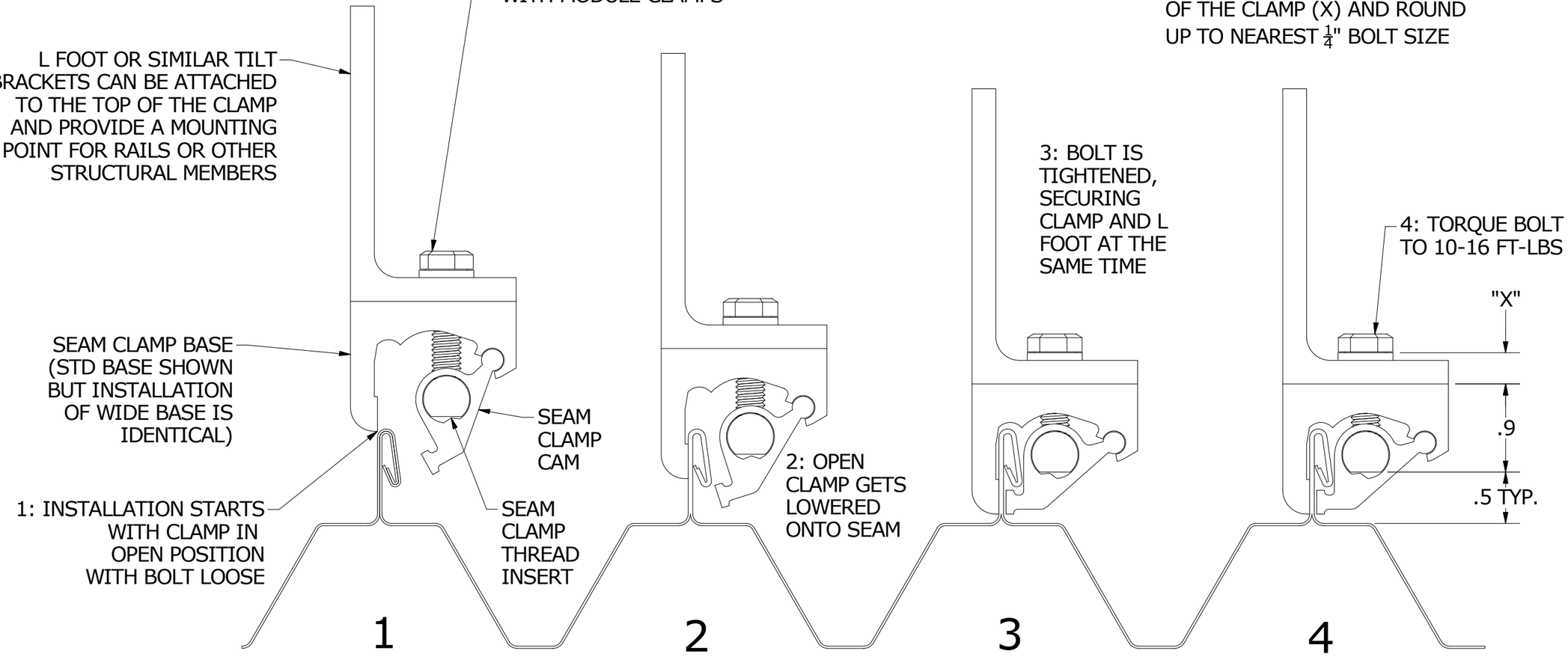
TO DETERMINE BOLT SIZE ADD 1.17" TO THE "STACK" ON TOP OF THE CLAMP (X) AND ROUND UP TO NEAREST $\frac{1}{4}$" BOLT SIZE

4: TORQUE BOLT TO 10-16 FT-LBS

"X"

.9

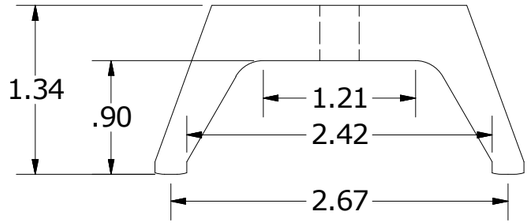
.5 TYP.



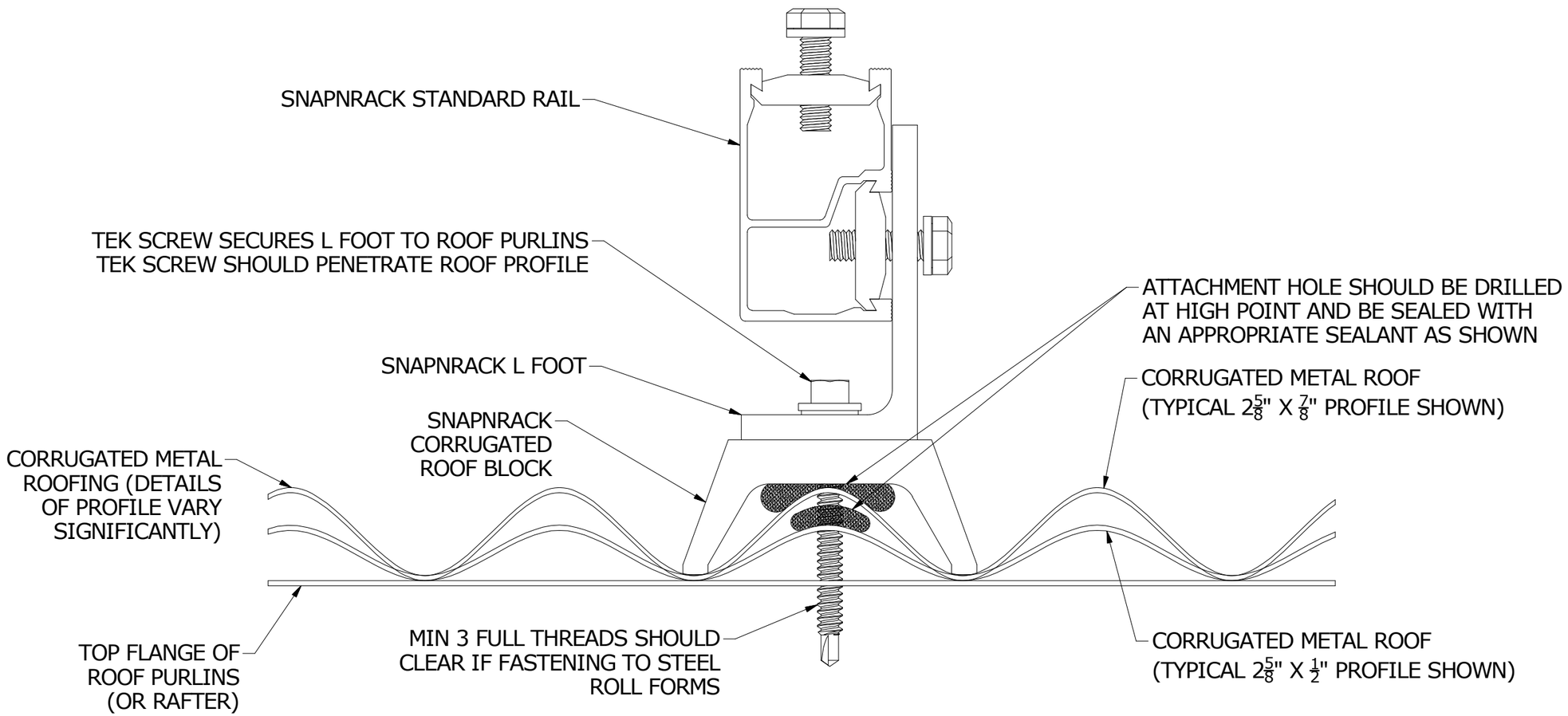
SnapNrack™ PV Mounting Systems	MAINSTREAM ENERGY CORP. 775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA PHONE (805) 528-9705 • FAX (805) 528-9701 THE INFORMATION IN THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY. ANY REPRODUCTION, DISCLOSURE, OR USE THEREOF IS PROHIBITED WITHOUT THE WRITTEN CONSENT OF MAINSTREAM ENERGY CORPORATION.	DESIGNER: G McPheeters DRAFTER: D Ryan APPROVED BY:	SCALE: DNS DATE: 120113	PART NUMBER: S100 PEN D04	DESCRIPTION: PEN DETAIL 04, SEAM CLAMP	REV F

REVISION:

USE THE SNAPNRACK CORRUGATED ROOF BLOCK TO STRADDLE THE RAISED PORTIONS OF CORRUGATED METAL ROOFING MATERIALS. THIS ALLOWS AN L FOOT TO BE MOUNTED WITH THE PENETRATION AT THE HIGH POINT OF THE ROOFING MATERIAL WITHOUT CRUSHING THE ROOF PROFILE. SHOWN WITH A TEK SCREW ATTACHMENT TYPICAL OF A METAL PURLIN STRUCTURE, BUT THE SYSTEM WORKS WELL WITH A LAG BOLT INTO A WOOD RAFTER AS WELL. BE SURE TO USE PROPER SEALANT TO SEAL UP THE HOLE IN THE METAL ROOFING MATERIAL



PART DIMENSIONS



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PHONE (805) 528-9705 • FAX (805) 528-9701

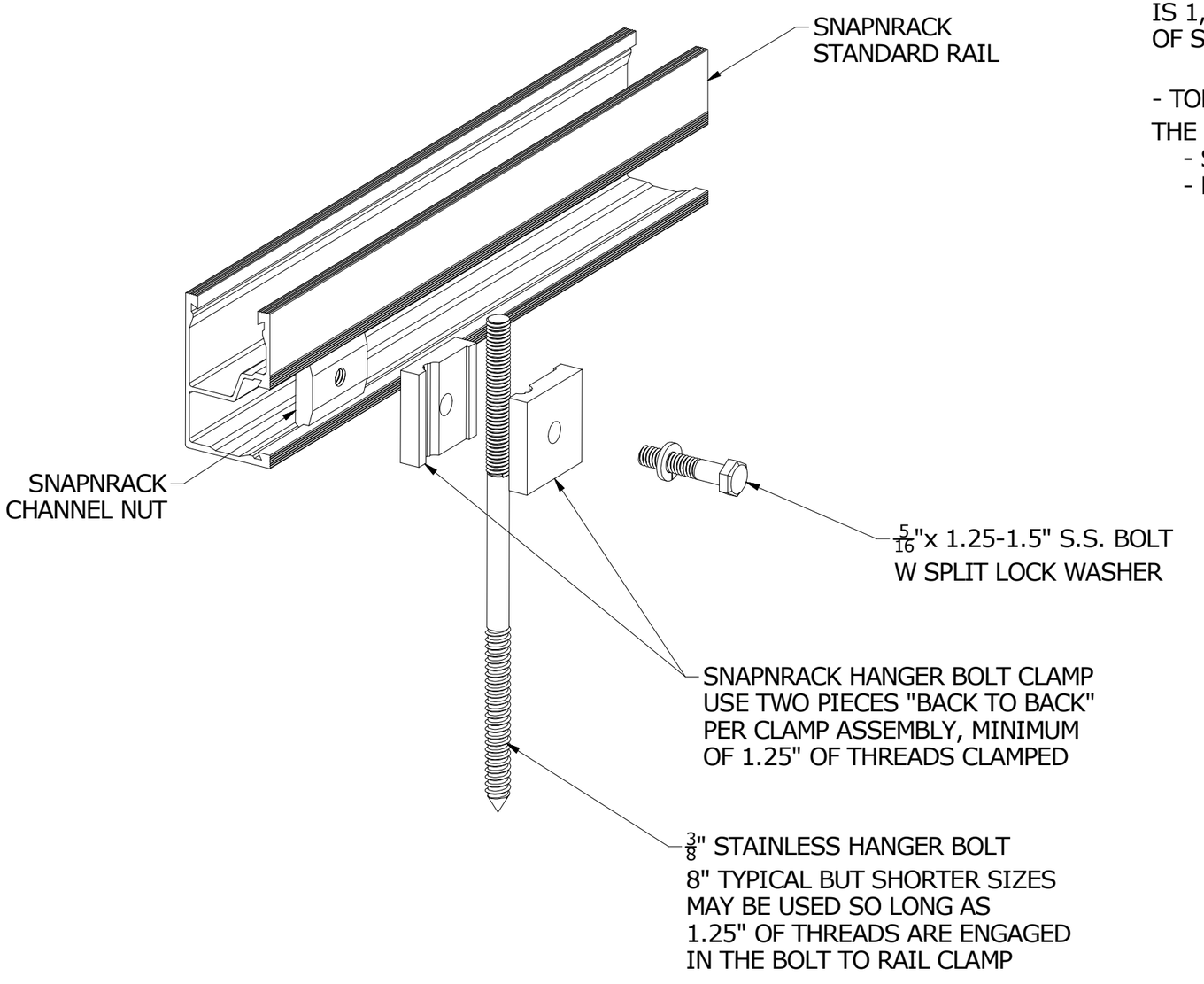
DESIGNER:	SCALE:	PART NUMBER:	DESCRIPTION:	REV
G McPheeters	DNS	S100 PEN D05	PEN DETAIL 05, CORRUGATED ROOF BLOCK	F
DRAFTER: D Ryan	DATE: 120113			
APPROVED BY:				

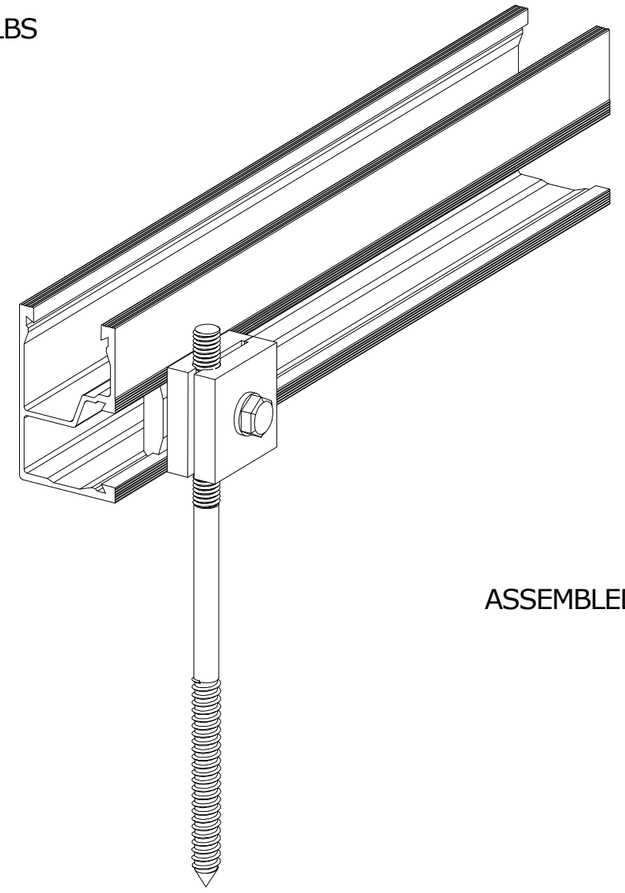
HANGER BOLT CLAMPS HAVE BEEN DESIGNED FOR USE WITH STANDARD $\frac{3}{8}$" STAINLESS HANGER BOLTS. THEY ARE COMPATIBLE WITH ANY $\frac{3}{8}$" STAINLESS BOLT OR THREADED ROD.

THE CLAMPS ARE 1.5" TALL AND ENGINEERED TO HAVE A MINIMUM OF 1.25" OF THREAD IN THE CLAMP AT ALL TIMES. MAXIMUM DESIGN LOAD IS 1,000 LBS (AXIAL) OR 250 LBS IF A FACTOR OF SAFETY OF 4 IS APPLIED.

- TORQUE ALL $\frac{5}{16}$" HARDWARE TO THE FOLLOWING:
  - SILVER S.S. 10-16 FT-LBS
  - BLACK S.S. 7-9 FT-LBS

REVISION:





ASSEMBLED UNIT

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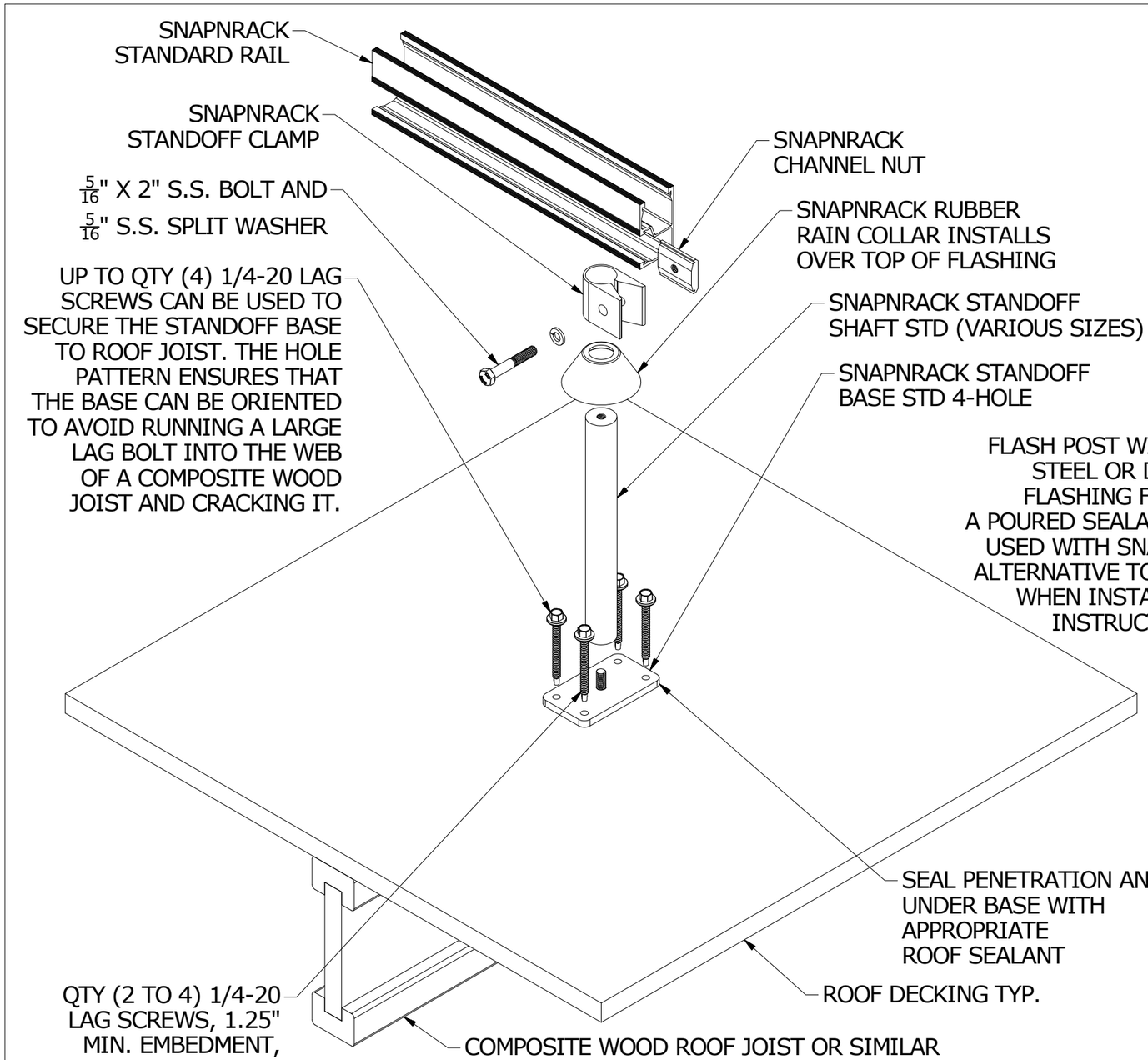
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER:	SCALE:	PART NUMBER:	DESCRIPTION:	REV
G McPheeters	DNS	S100 PEN D06	PEN DETAIL 06 L HANGER BOLT	F
DRAFTER: D Ryan	DATE: 120113			
APPROVED BY:				



NOTE: THE 4 HOLE HAS BEEN DESIGNED TO ALLOW THE INSTALLER TO AVOID SPLITTING THE WEB OF THE JOIST WITH A SINGLE LARGE LAG BOLT.

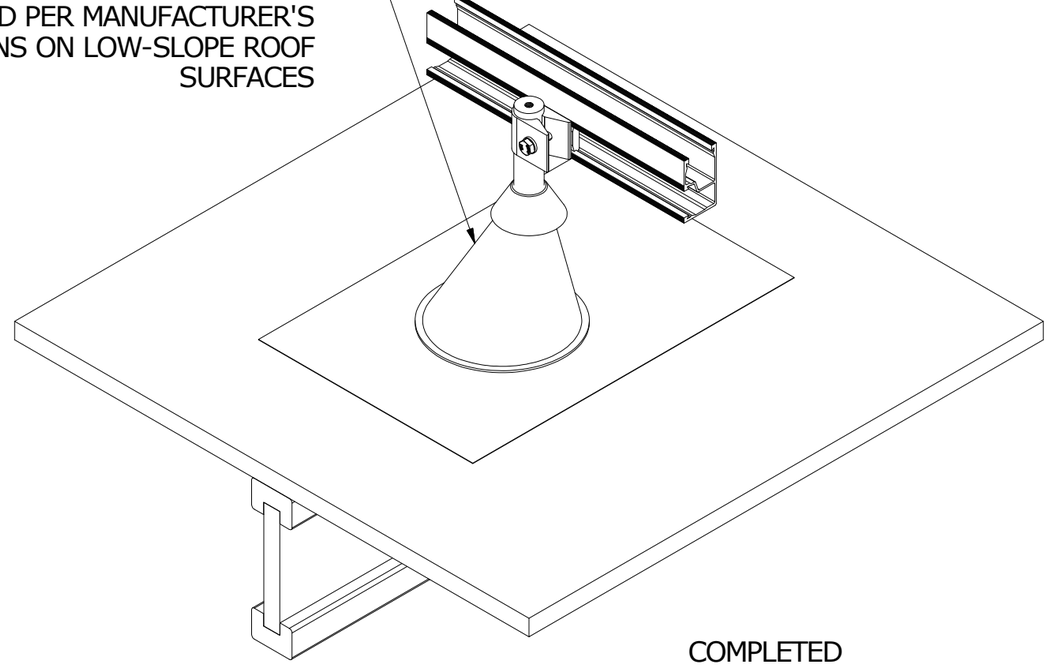
NOTES:

- WOOD SCREWS MUST EMBED IN ROOF STRUCTURAL MEMBERS/JOISTS. TYPICAL DESIGN UPLIFT LOAD REQUIREMENT IS 340 LBS PER ATTACHMENT
- TORQUE ALL 5/16" HARDWARE TO THE FOLLOWING:
  - SILVER S.S. 10-16 FT-LBS
  - BLACK S.S. 7-9 FT-LBS
- RAILS CAN MOUNT TO EITHER SIDE OF POST (UPSLOPE VS. DOWNSLOPE)
- RAILS CAN BE LEVELED UP TO 3" USING UP TO TWO LEVELING SPACERS AS SHOWN IN "SERIES 100 RAIL LEVELING"

REVISION:

F	12/02/15	

FLASH POST WITH STANDARD GALVANIZED STEEL OR DEAD SOFT ALUMINUM ROOF FLASHING FOR 1" DIAMETER VENT PIPE. A POURED SEALANT-STYLE FLASHING MAY BE USED WITH SNAPNRACK STANDOFFS AS AN ALTERNATIVE TO A TYPICAL CONE FLASHING WHEN INSTALLED PER MANUFACTURER'S INSTRUCTIONS ON LOW-SLOPE ROOF SURFACES



COMPLETED INSTALLATION (SHOWN WITH FLASHING IN PLACE)

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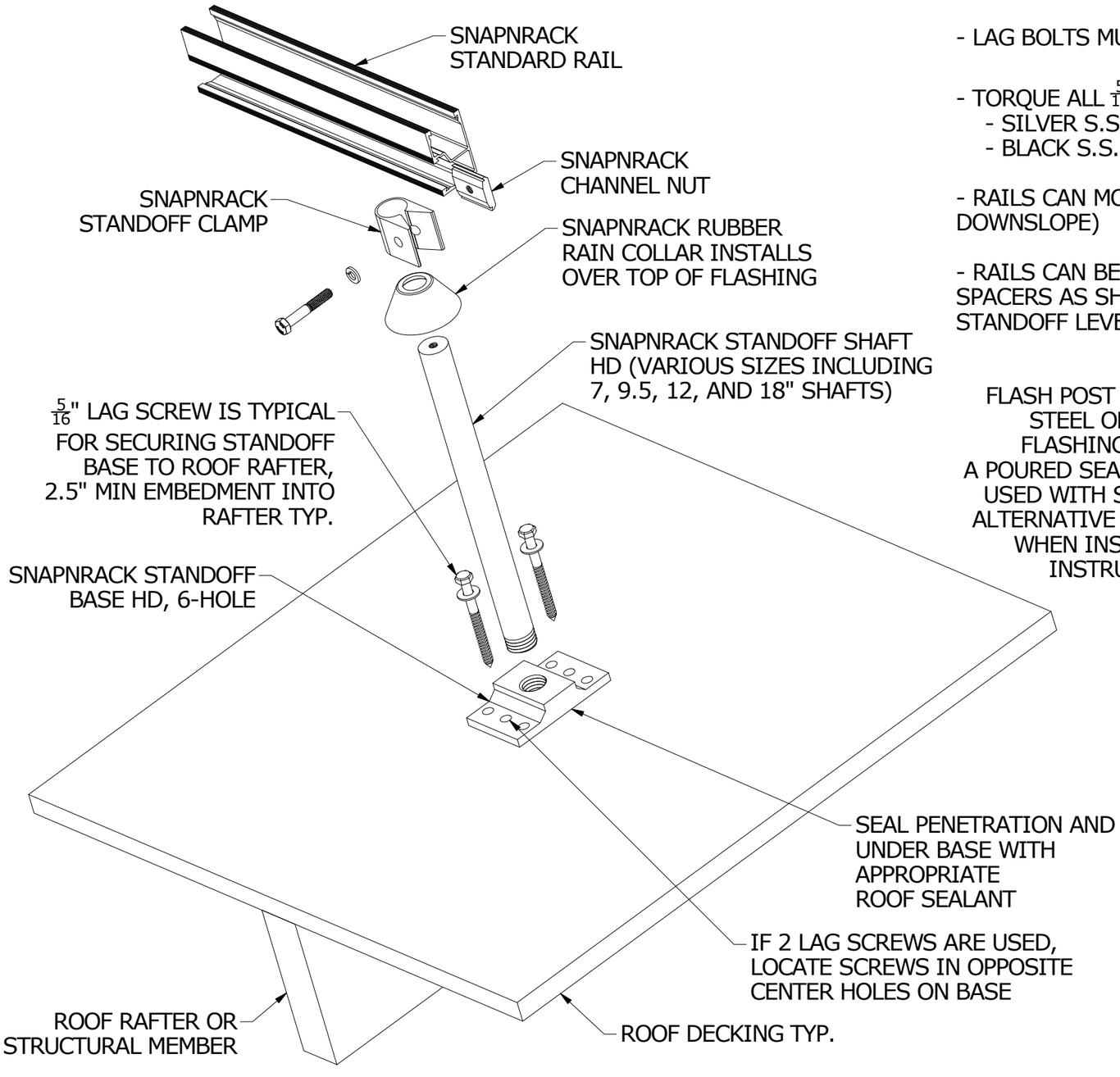
MAINSTREAM ENERGY CORP.
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER: G McPheeters DRAFTER: D Ryan APPROVED BY: G McPheeters	SCALE: DNS DATE: 12/02/15	PART NUMBER: S100 PEN D07	DESCRIPTION: PEN DETAIL 07, STANDOFF TO JOIST	REV F



SNAPNRACK STANDOFF MOUNTING POINT
FOR USE ON ALL ROOF SURFACES

NOTES:

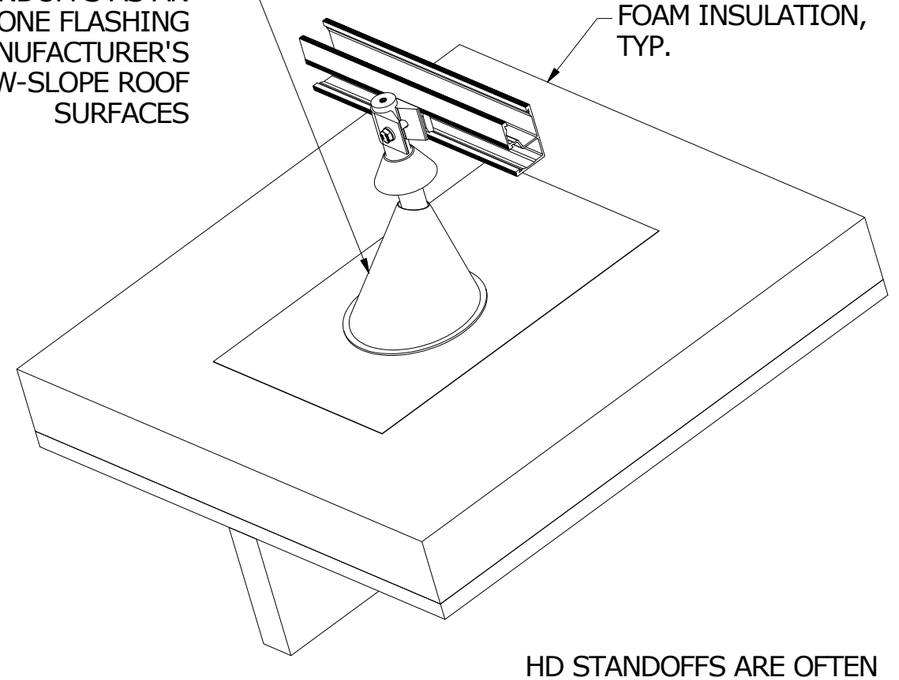
- LAG BOLTS MUST EMBED IN ROOF STRUCTURAL MEMBERS/RAFTERS

- TORQUE ALL $\frac{5}{16}$" HARDWARE TO THE FOLLOWING:
  - SILVER S.S. 10-16 FT-LBS
  - BLACK S.S. 7-9 FT-LBS

- RAILS CAN MOUNT TO EITHER SIDE OF POST (UPSLOPE VS. DOWNSLOPE)

- RAILS CAN BE LEVELED UP TO 3" USING UP TO TWO LEVELING SPACERS AS SHOWN IN DRAWING S100 D07 "SERIES 100 HD STANDOFF LEVELING"

FLASH POST WITH STANDARD GALVANIZED STEEL OR DEAD SOFT ALUMINUM ROOF FLASHING FOR 1" DIAMETER VENT PIPE. A POURED SEALANT-STYLE FLASHING MAY BE USED WITH SNAPNRACK STANDOFFS AS AN ALTERNATIVE TO A TYPICAL CONE FLASHING WHEN INSTALLED PER MANUFACTURER'S INSTRUCTIONS ON LOW-SLOPE ROOF SURFACES



HD STANDOFFS ARE OFTEN USED WITH FOAM ROOF INSULATION

REVISION:

F	12/02/15	

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DESIGNER: G McPheeters	SCALE: DNS	PART NUMBER:	DESCRIPTION:	REV
DRAFTER: D Ryan		S100 PEN D08	PEN DETAIL 08, HD STANDOFF	F
APPROVED BY: G McPheeters	DATE: 12/02/15			

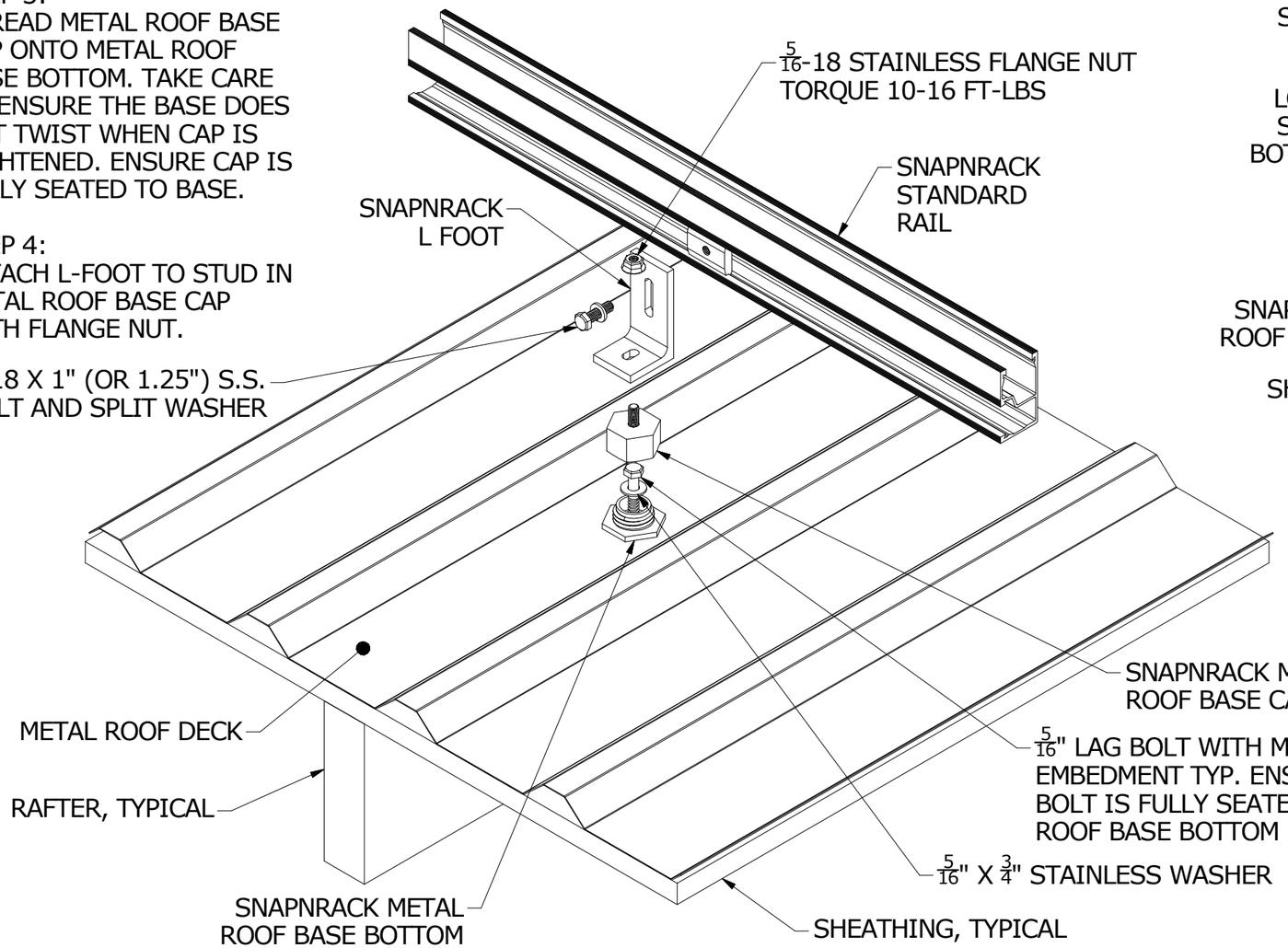
REVISION:

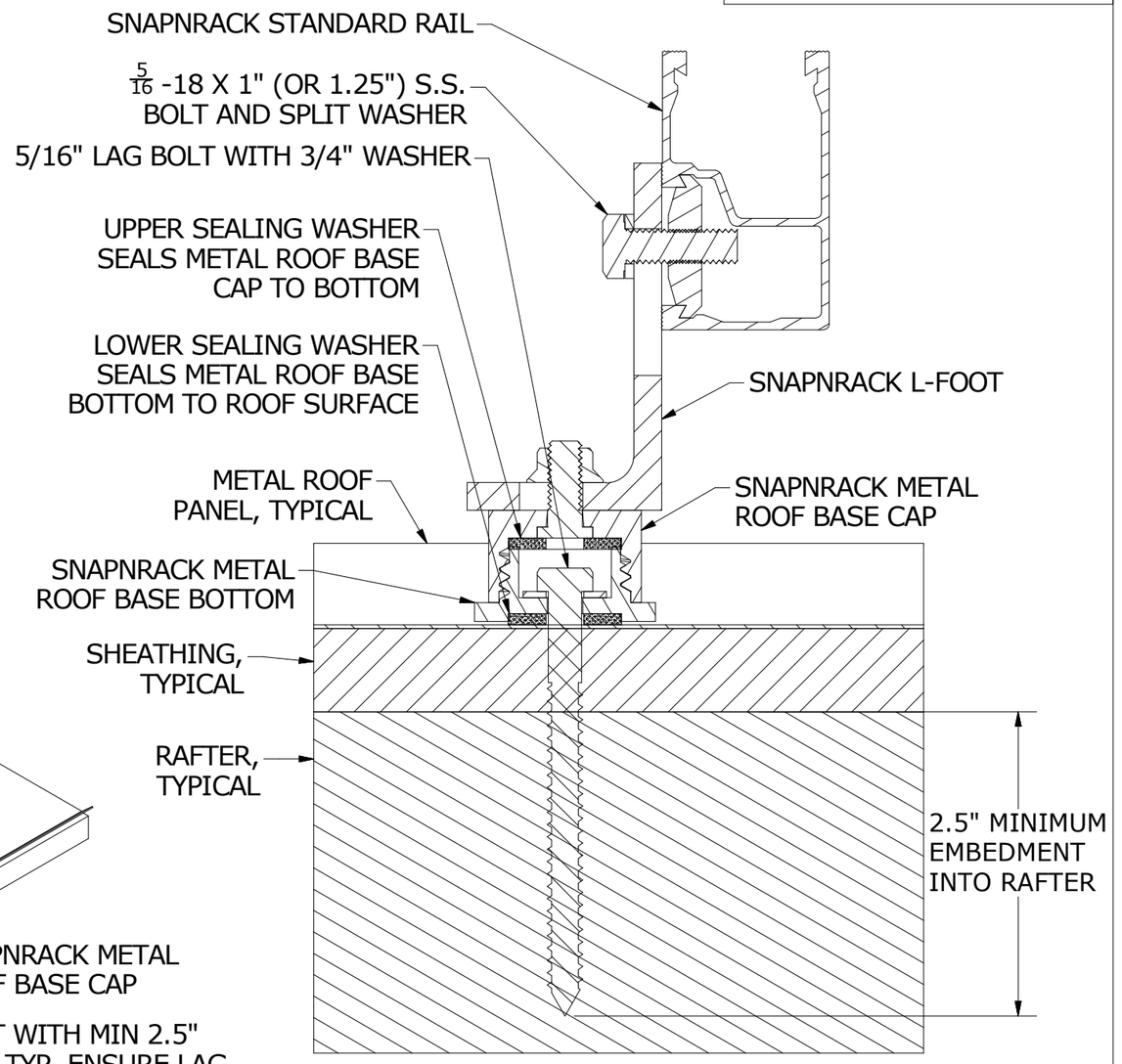
STEP 1:
DRILL 3/16" PILOT HOLE IN RAFTER. ENSURE AREA SURROUNDING HOLE IS FREE FROM METAL SHAVINGS AND DEBRIS.

STEP 2:
ATTACH METAL ROOF BASE TO RAFTER WITH 5/16IN LAG BOLT. TORQUE TO 10-16 FT LBS.

STEP 3:
THREAD METAL ROOF BASE CAP ONTO METAL ROOF BASE BOTTOM. TAKE CARE TO ENSURE THE BASE DOES NOT TWIST WHEN CAP IS TIGHTENED. ENSURE CAP IS FULLY SEATED TO BASE.

STEP 4:
ATTACH L-FOOT TO STUD IN METAL ROOF BASE CAP WITH FLANGE NUT.





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PHONE (805) 528-9705 • FAX (805) 528-9701

DESIGNER:	SCALE:	PART NUMBER:	DESCRIPTION:	REV
GMcPHEETERS	DNS	S100 PEN D09	PEN DETAIL 09, METAL ROOF BASE TO RAFTER	F
DRAFTER: DRyan	DATE: 120113			
APPROVED BY:				

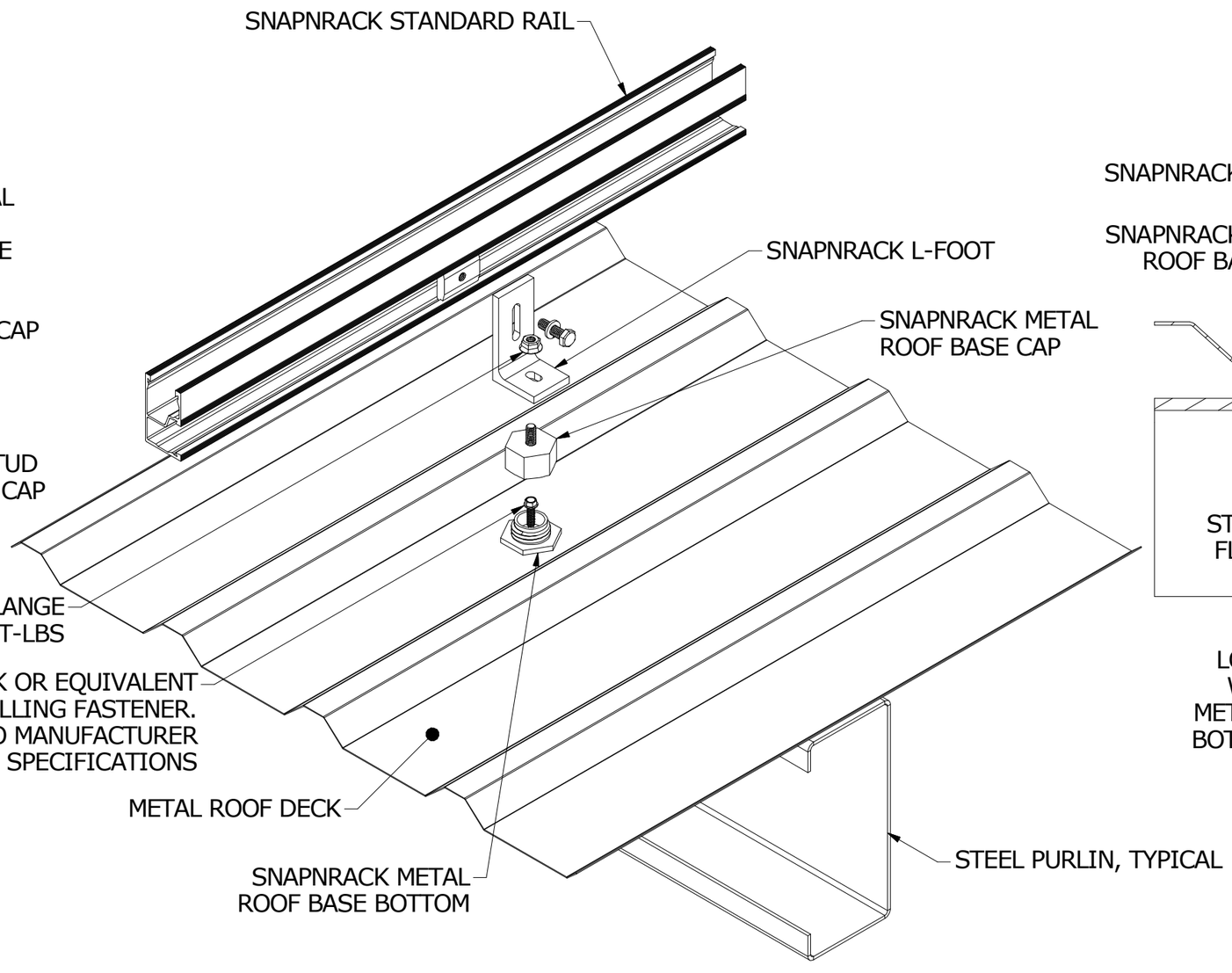
REVISION:

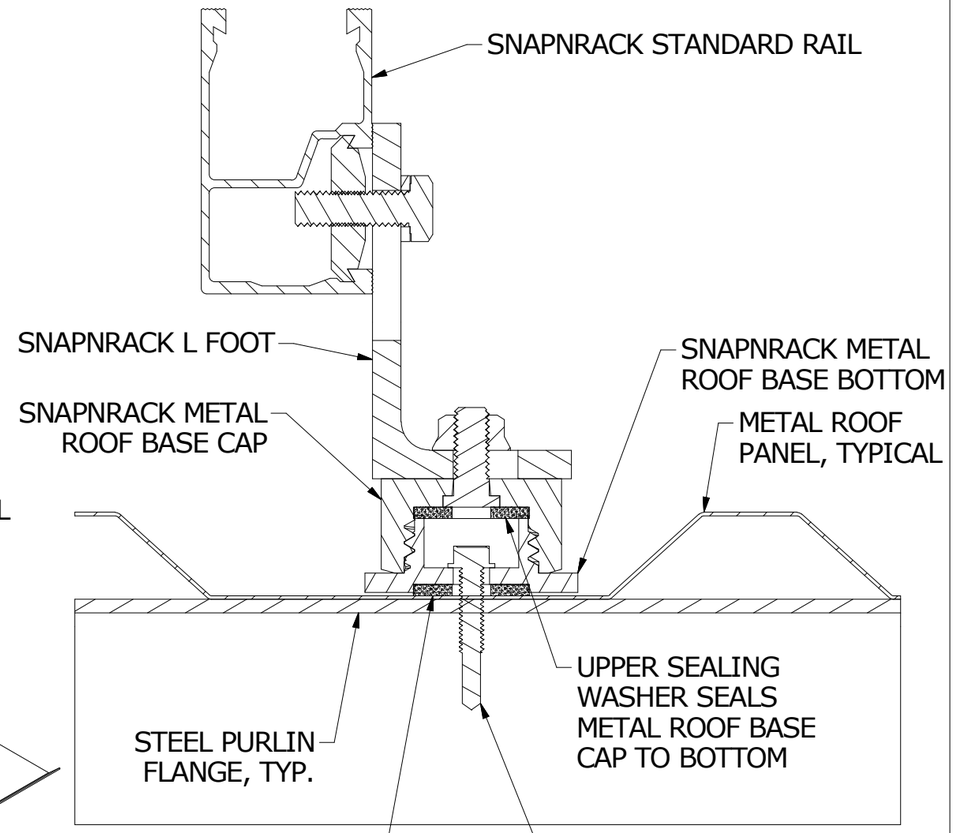
STEP 1:
DRILL 3/16" PILOT HOLE IN PURLIN. ENSURE AREA SURROUNDING HOLE IS FREE FROM METAL SHAVINGS AND DEBRIS.

STEP 2:
ATTACH METAL ROOF BASE TO PURLIN WITH $\frac{1}{4}$" TEK OR EQUIVALENT SELF DRILLING FASTENER. TORQUE TO MANUFACTURER SPECIFICATIONS.

STEP 3:
THREAD METAL ROOF BASE CAP ONTO METAL ROOF BASE BOTTOM. TAKE CARE TO ENSURE THE BASE DOES NOT TWIST WHEN CAP IS TIGHTENED. ENSURE CAP IS FULLY SEATED TO BASE.

STEP 4:
ATTACH L-FOOT TO STUD IN METAL ROOF BASE CAP WITH FLANGE NUT.





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DESIGNER:	SCALE:	PART NUMBER:	DESCRIPTION:	REV
GMcPHEETERS	DNS	S100 PEN D10	PEN DETAIL 10, METAL ROOF BASE TO PURLIN	F
DRAFTER: DRyan	DATE: 120113			
APPROVED BY:				

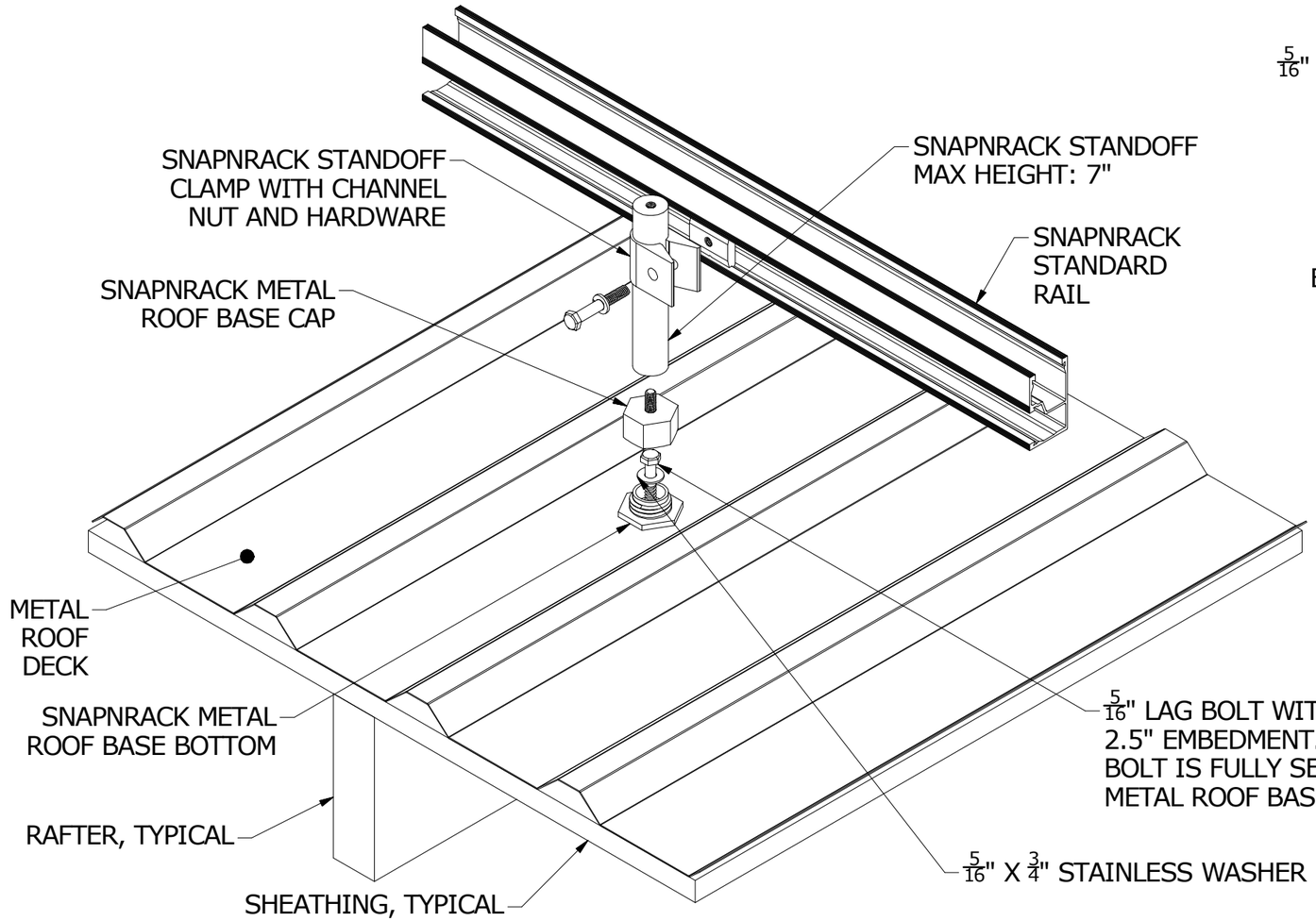
STEP 1:
DRILL 3/16" PILOT HOLE IN RAFTER. ENSURE AREA SURROUNDING HOLE IS FREE FROM METAL SHAVINGS AND DEBRIS.

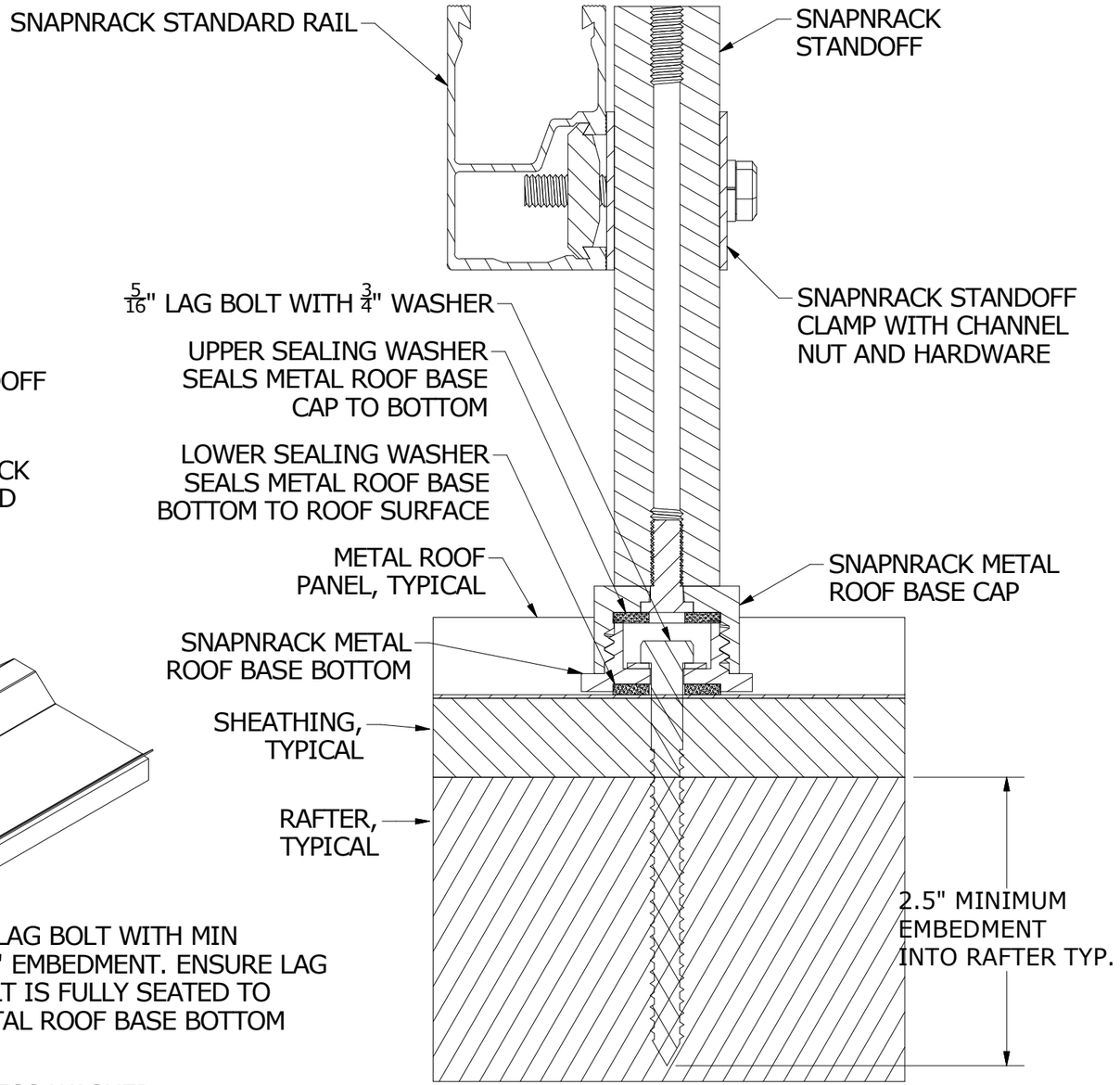
STEP 2:
ATTACH METAL ROOF BASE TO RAFTER WITH 5/16IN LAG BOLT. TORQUE TO 10-16 FT LBS.

STEP 3:
THREAD METAL ROOF BASE CAP ONTO METAL ROOF BASE BOTTOM. TAKE CARE TO ENSURE THE BASE DOES NOT TWIST WHEN CAP IS TIGHTENED. ENSURE CAP IS FULLY SEATED TO BASE.

STEP 4:
ATTACH STANDOFF TO METAL ROOF BASE CAP. STANDOFFS UP TO 7" IN LENGTH MAY BE USED.

REVISION:





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DESIGNER: GMcPHEETERS	SCALE: DNS	PART NUMBER: S100 PEN D11	DESCRIPTION: PEN DETAIL 11, METAL ROOF BASE WITH STANDOFF TO RAFTER	REV F
DRAFTER: DRyan	DATE: 120113			
APPROVED BY:				

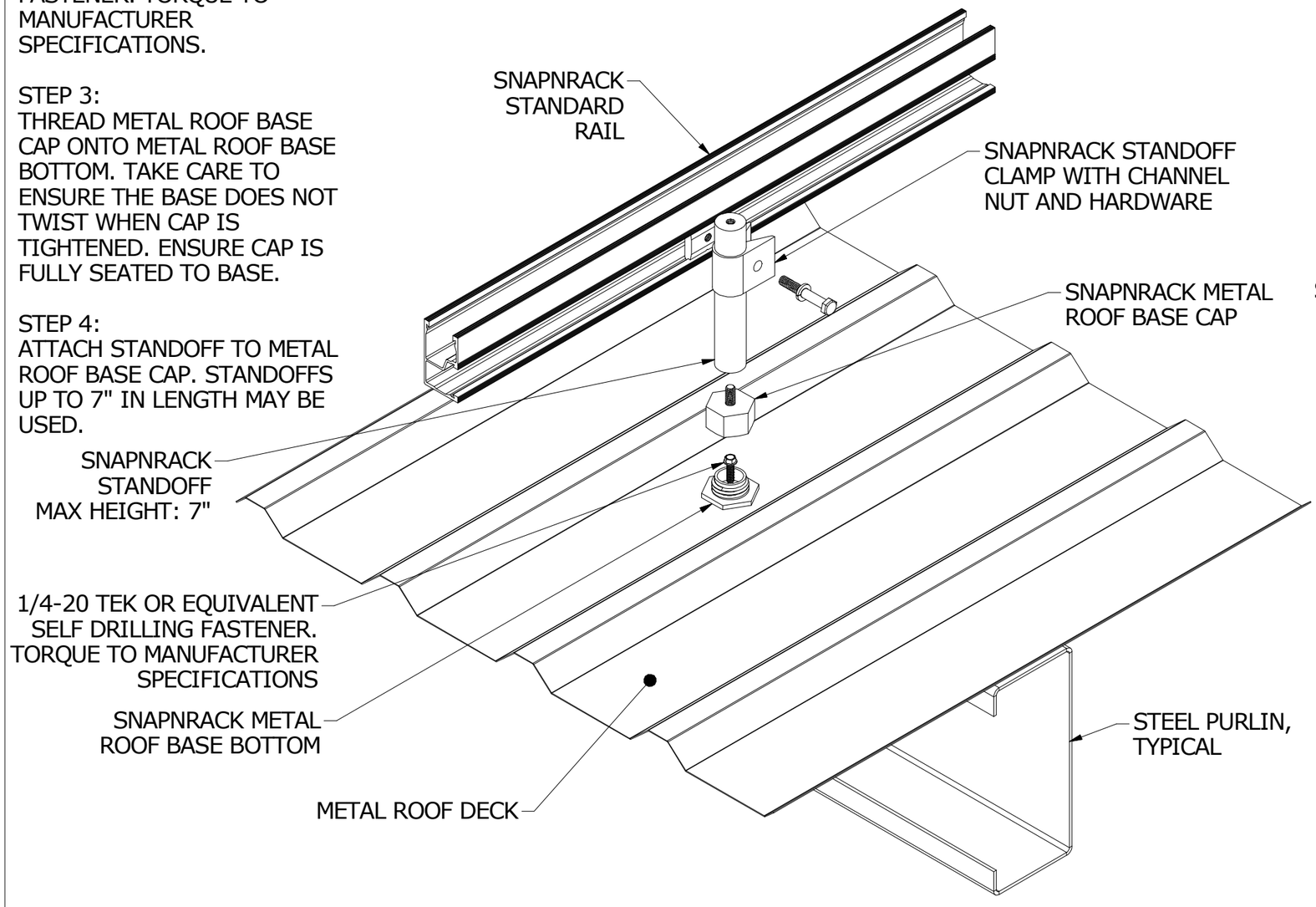
STEP 1:
DRILL 3/16" PILOT HOLE IN PURLIN. ENSURE AREA SURROUNDING HOLE IS FREE FROM METAL SHAVINGS AND DEBRIS.

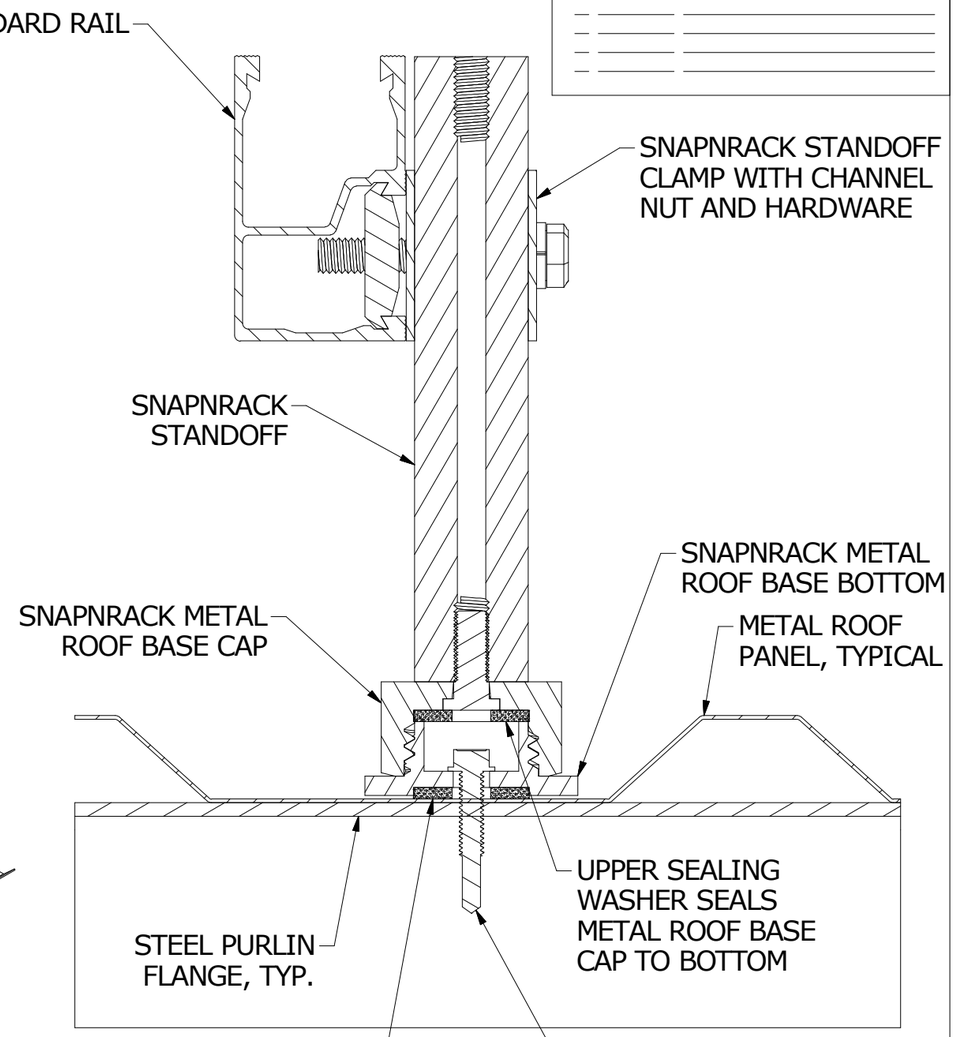
STEP 2:
ATTACH METAL ROOF BASE TO PURLIN WITH 1/4" TEK OR EQUIVALENT SELF DRILLING FASTENER. TORQUE TO MANUFACTURER SPECIFICATIONS.

STEP 3:
THREAD METAL ROOF BASE CAP ONTO METAL ROOF BASE BOTTOM. TAKE CARE TO ENSURE THE BASE DOES NOT TWIST WHEN CAP IS TIGHTENED. ENSURE CAP IS FULLY SEATED TO BASE.

STEP 4:
ATTACH STANDOFF TO METAL ROOF BASE CAP. STANDOFFS UP TO 7" IN LENGTH MAY BE USED.

REVISION:





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MAINSTREAM ENERGY CORP.
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PHONE (805) 528-9705 • FAX (805) 528-9701

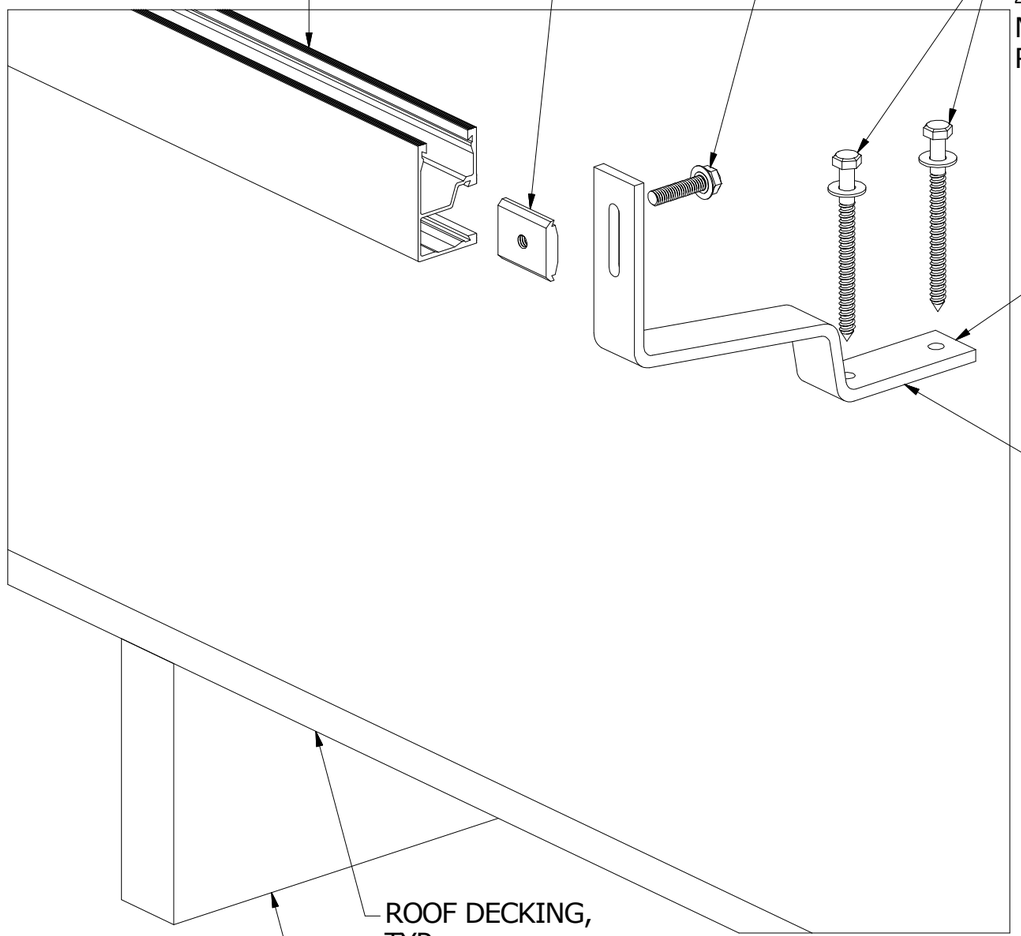
DESIGNER: GMcPHEETERS DRAFTER: DRyan APPROVED BY:	SCALE: DNS DATE: 120113	PART NUMBER: S100 PEN D12	DESCRIPTION: PEN DETAIL 12, METAL ROOF BASE WITH STANDOFF TO PURLIN	REV F

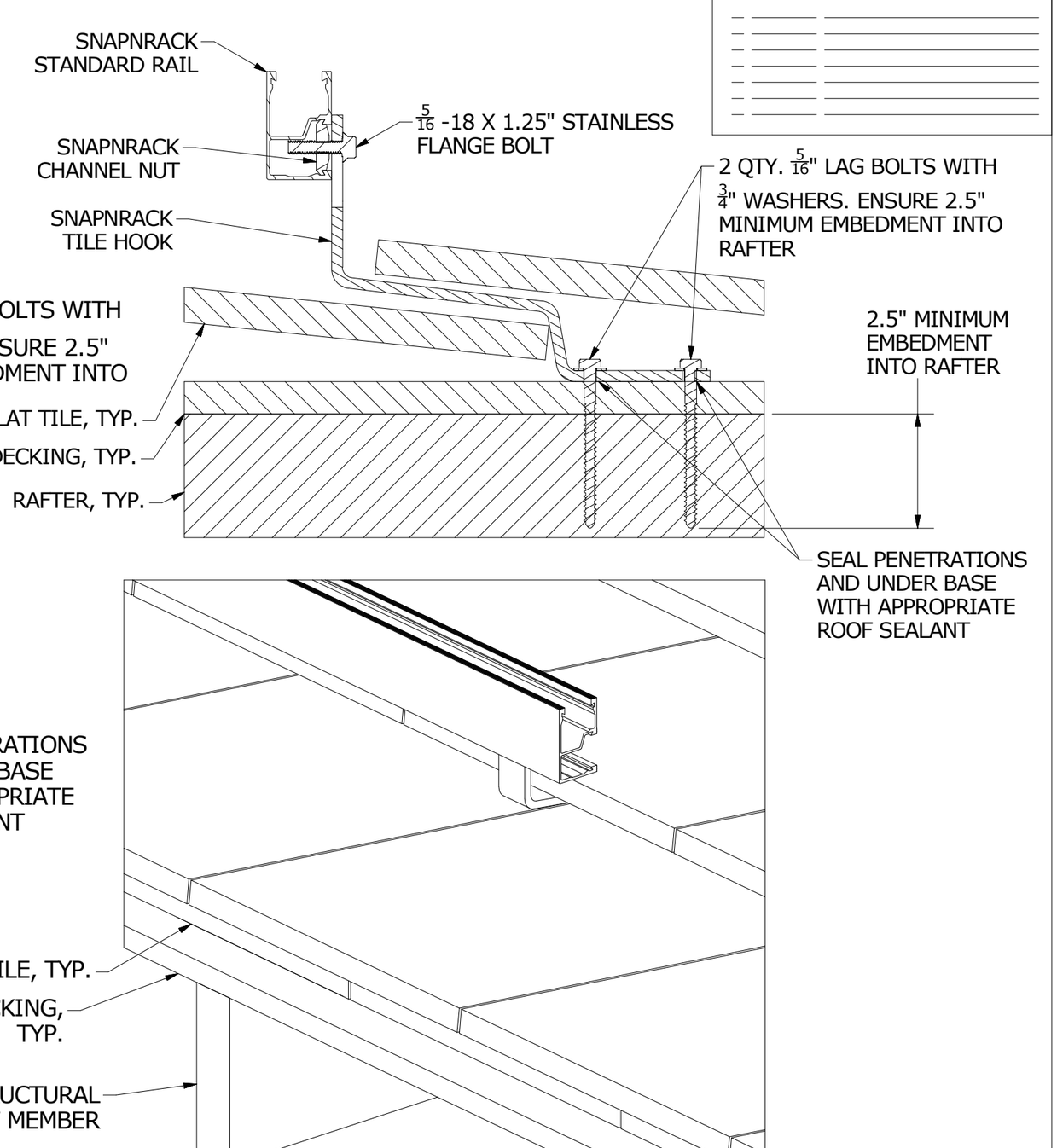
NOTES:

- INSTALLATIONS OF SNAPNRACK TILE HOOKS ARE LIMMITED TO A MAXIMUM WIND SPEED OF 120MPH (IBC2012) AND MAXIMUM ATTACHMENT SPAN OF 6FT.

- 5/16" LAG BOLTS MUST EMBED 2.5" INTO ROOF STRUCTURAL MEMBERS / RAFTERS
- TORQUE ALL $\frac{5}{16}$" HARDWARE TO 10-16 FT-LBS
- RAILS CAN MOUNT TO EITHER SIDE OF TILE HOOK (UPSLOPE VS. DOWNSLOPE)
- RAILS CAN BE LEVELED UP TO 1.25" USING THE SLOT IN THE TILE HOOK

REVISION:





COMPLETED INSTALLATION

SnapNrack™ PV Mounting Systems

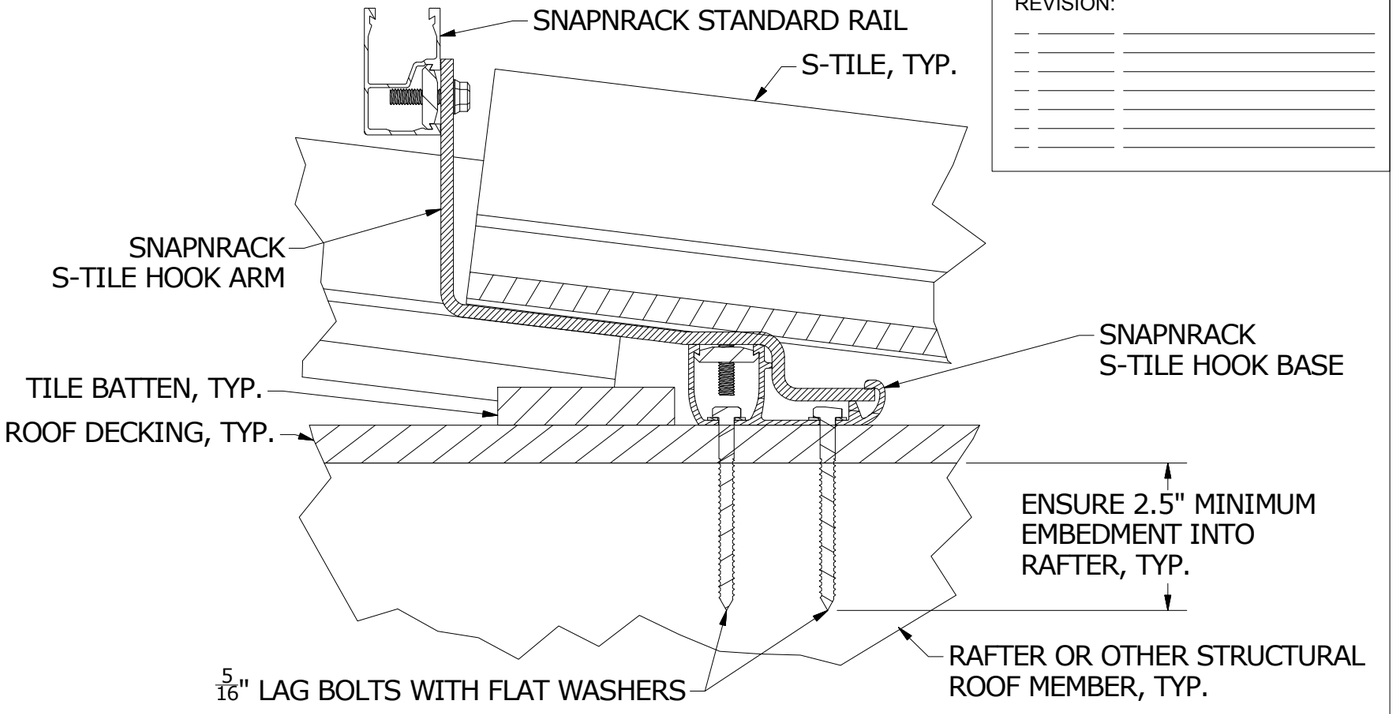
MAINSTREAM ENERGY CORP.
775 FIERO LANE, SUITE 200 • SAN LUIS OBISPO, CA 93401 USA
PHONE (805) 528-9705 • FAX (805) 528-9701

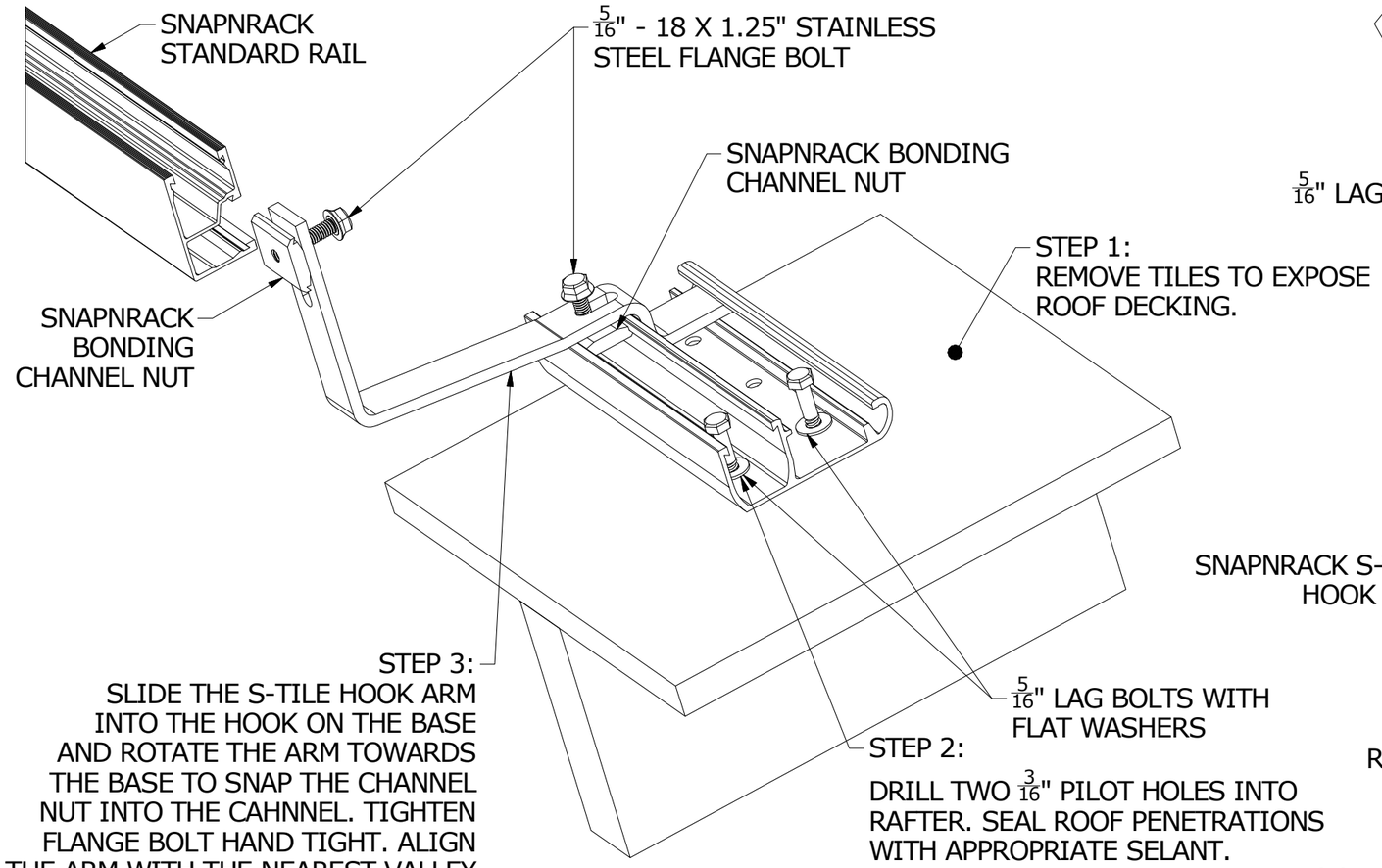
DESIGNER: G McPheeters	SCALE: DNS	PART NUMBER: S100 PEN D13	DESCRIPTION: SERIES 100 PEN DETAIL 13, TILE HOOK WITH FLAT TILE	REV F
DRAFTER: D Ryan	DATE: 031615			
APPROVED BY:				

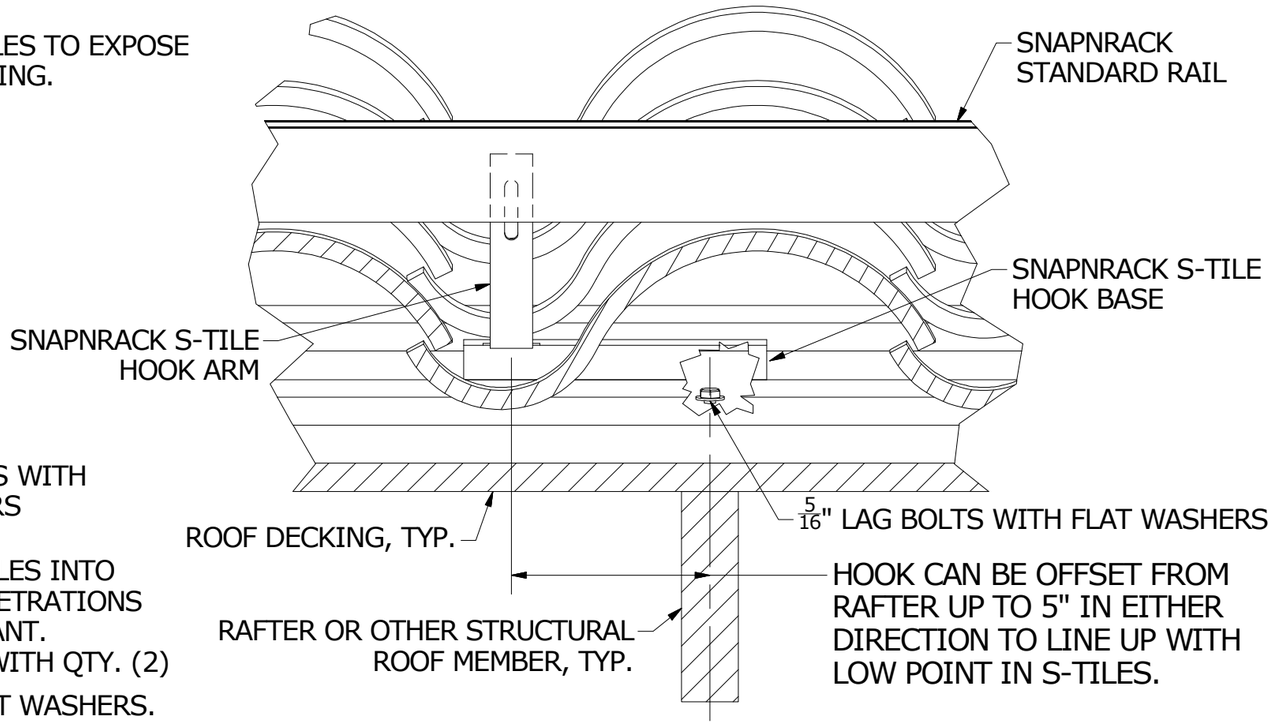
THE SNAPNRACK S TILE ROOF HOOK OFFERS A QUICK, COST EFFECTIVE SOLUTION FOR MOUNTING ON S-TILE ROOFTOPS. THE SIMPLE DESIGN HAS BEEN OPTIMIZED FOR SNAPNRACK AND THE HOOKS ARE BUILT INTO OUR SYSTEM ENGINEERING AND UL LISTING. ONCE A TILE HAS BEEN REMOVED, THE BASE PIECE IS BOLTED DOWN TO A RAFTER. ONCE THE BASE IS IN PLACE, THE TILE HOOK ARM IS INSERTED INTO THE HOOK FEATURE IN THE BASE AND ROTATED DOWN TOWARDS THE TRACK SO THAT THE BONDING CHANNEL NUT SNAPS INTO THE CHANNEL. ONCE THE ARM IS ATTACHED TO THE BASE, SLIDE IT ON THE BASE SO THAT IT ALIGNS WITH A LOW POINT IN THE S-TILES, SIMPLY TIGHTEN IT IN PLACE AND REPLACE THE TILE THAT WAS REMOVED. WITH SOME TYPES OF TILE YOU MAY WANT TO DO A LITTLE GRINDING TO HELP EVERYTHING FIT BACK TOGETHER SMOOTHLY, BUT IN MANY CASES NO GRINDING IS REQUIRED.

INSTALLATIONS OF SNAPNRACK S TILE ROOF HOOKS ARE LIMITTED TO A MAXIMUM WIND SPEED OF 120MPH (IBC 2012) AND A MAXIMUM ATTACHMENT SPAN OF 6FT.

REVISION:







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