APPLIED MATERIALS & ENGINEERING, INC.
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May 5, 2011 *Revised on 12/13/2011 to Include Tensile Strength Tests*

Mr. Stewart Wentworth Project Number 111203C
QUICK MOUNT PV
936 Detroit Avenue, Suite D
Concord, CA 94518-2539

Subject: Low Slope Mount QMLSH-9 Hardware Load Testing

Dear Mr. Wentworth:

As requested, Applied Materials & Engineering, Inc. (AME) has completed load-testing the QMLSH-9 hardware. The purpose of our testing was to evaluate the shear and tensile load capacity of the QMLSH-9 hardware attached to a commercially available 2"x4" Douglas Fir rafter.

SAMPLE DESCRIPTION

Nine (9) mockup samples were delivered to our laboratory on April 20, 2011. Mockup configuration consisted of three 16" long rafters at 7"o.c., screwed to 1/2" Structural 1 plywood. The 9" (finished height) Quick Mount Standoff (QMSO) hardware is attached through the plywood into the rafter with two 5/16"x3" lag bolts torqued to 15ft-lbs. Product hardware details are provided in Appendix B.

TEST PROCEDURES & RESULTS

1. Shear Strength Parallel to Rafter

Three samples were tested for shear strength on May 2, 2011 using a United Universal testing machine. Samples were rigidly attached to the testing machine and a shear load was applied to the 5/16"x1" machine bolt connected to the aluminum standoff. The samples were loaded parallel to rafter at a constant rate of axial deformation of 0.01 in./min. without shock until failure occurred. Based on the above testing, the average ultimate shear load, parallel to rafter, of the QMLSH-9 hardware in Douglas Fir was determined to be 763 lbf.

The specific gravity and moisture content of the rafter was tested in accordance with ASTM D2395, Method A (oven-dry). The average specific gravity and moisture content was determined to be 0.456 and 12.5%, respectively. Detailed results are provided in Table I. Test setup and mode of failure are provided in Appendix A.

2. Shear Strength Perpendicular to Rafter

Three samples were tested for shear strength on May 3, 2011 using a United Universal testing machine. Samples were rigidly attached to the testing machine and a shear load was applied to the 5/16"x1" machine bolt connected to the aluminum standoff. The samples were loaded perpendicular to rafter at a constant rate of axial deformation of 0.01 in./min. without shock until failure occurred. Based on the above testing, the average ultimate shear load, perpendicular to rafter, of the QMLSH-9 hardware in Douglas Fir was determined to be 579 lbf.

The specific gravity and moisture content of the rafter was tested in accordance with ASTM D2395, Method A (oven-dry). The average specific gravity and moisture content was determined to be 0.444 and 12.4%, respectively. Detailed results are provided in Table II. Test setup and mode of failure are provided in Appendix A.

3. Tensile Strength

Three samples were tested for tensile strength on June 29, 2011 using a United Universal testing machine. Samples were rigidly attached to the testing machine and a tensile load was applied to the 5/16"x1" machine bolt connected to the aluminum post. The samples were loaded in tension at a constant rate of axial deformation of 0.05 in./min. without shock until failure occurred. Based on the above testing, the average ultimate tensile load of the QMLSH-9 hardware in Douglas Fir was determined to be 3031 lbf.

The specific gravity and moisture content of the rafter was tested in accordance with ASTM D2395, Method A (oven-dry). The average specific gravity and moisture content was determined to be 0.436 and 20.9%, respectively. Detailed results are provided in Table III. Test setup is shown in Appendix C.

If you have any questions regarding the above, please do not hesitate to call the undersigned.

Respectfully Submitted,

APPLIED MATERIALS & ENGINEERING, INC.

Mohammed Faiyaz
Laboratory Manager

REGISTERED PROFESSIONAL ENGINEER
ARMEN TAJIRIAN
No. 35535
Exp. 9/30/13
CIVIL
STATE OF CALIFORNIA

Reviewed By:

Armen Tajirian, Ph.D., P.E.
Principal

TABLE I

LOW SLOPE MOUNT QMLSH-9
9" FINISHED HEIGHT

SHEAR LOAD PARALLEL TO RAFTER TEST RESULTS

PROJECT NUMBER 111203C

SAMPLE ID	ULTIMATE SHEAR LOAD PARALLEL TO RAFTER (LBF)	RAFTER MOISTURE CONTENT (%)	RAFTER SPECIFIC GRAVITY	FAILURE MODE[1.]
9PARA-1	767	11.4	0.468	AL Base Collar Cracked
9PARA-2	753	13.7	0.403	Lag Bolt Pull-Out
9PARA-3	769	12.6	0.499	Lag Bolt Pull-Out
AVERAGE	**763**	**12.5**	**0.456**	**..**

[1.] Upper bolt.

TABLE II

LOW SLOPE MOUNT QMLSH-9
9" FINISHED HEIGHT

SHEAR LOAD PERPENDICULAR TO RAFTER TEST RESULTS

PROJECT NUMBER 111203C

SAMPLE ID	ULTIMATE SHEAR LOAD PERPENDICULAR TO RAFTER (LBF)	RAFTER MOISTURE CONTENT (%)	RAFTER SPECIFIC GRAVITY	FAILURE MODE
9PERP-1	516	12.6	0.396	Plywood Buckled/Bent Machine Bolt
9PERP-2	631	11.9	0.487	Plywood Buckled/Bent Machine Bolt
9PERP-3	589	11.7	0.451	Plywood Buckled/Bent Machine Bolt
AVERAGE	**579**	**12.1**	**0.444**	**..**

TABLE III

LOW SLOPE MOUNT QMLSH-9
9" FINISHED HEIGHT

TENSILE LOAD TEST RESULTS

PROJECT NUMBER 111203C

SAMPLE ID	ULTIMATE TENSILE LOAD (LBF)	RAFTER MOISTURE CONTENT (%)	RAFTER SPECIFIC GRAVITY	FAILURE MODE
7PULL-1	2807	20.7	0.402	Lag bolt pull-out
7PULL -2	3283	22.0	0.476	Lag bolt pull-out
7PULL -3	3003	20.0	0.430	Lag bolt pull-out
AVERAGE	**3031**	**20.9**	**0.436**	**..**

APPENDIX A

LOW SLOPE MOUNT QMLSH-9
9" FINISHED HEIGHT

SHEAR TEST SETUP

PROJECT NUMBER 111203C

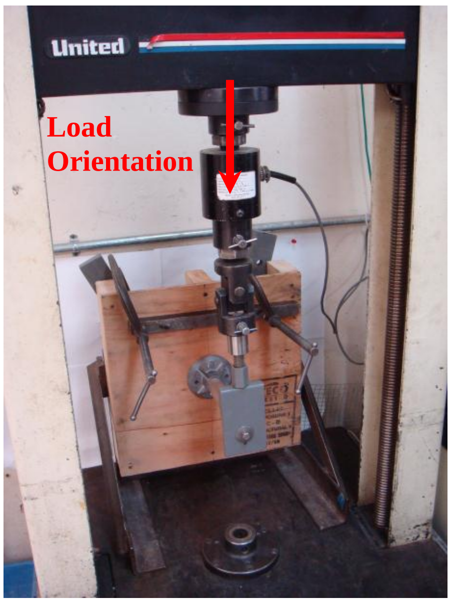


Figure 1a. Shear Parallel to Rafter

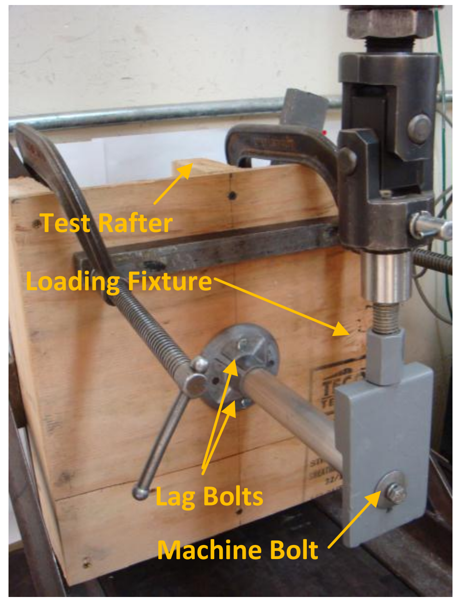


Figure 1b. Shear Test Close-up

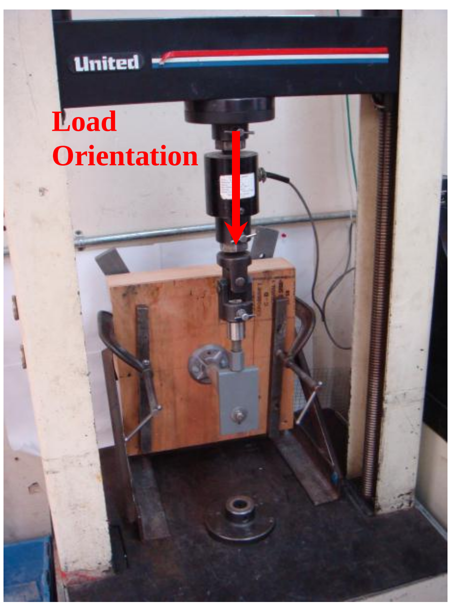


Figure 2a. Shear Perpendicular to Rafter

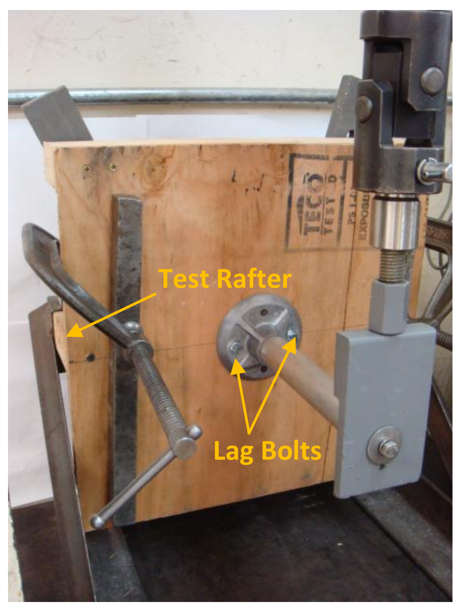


Figure 2b. Shear Test Close-up

LOW SLOPE MOUNT QMLSH-9
9" FINISHED HEIGHT

FAILURE MODES

PROJECT NUMBER 111203C

Figure 3. Cracked Aluminum Base Collar
Shear Parallel to Rafter

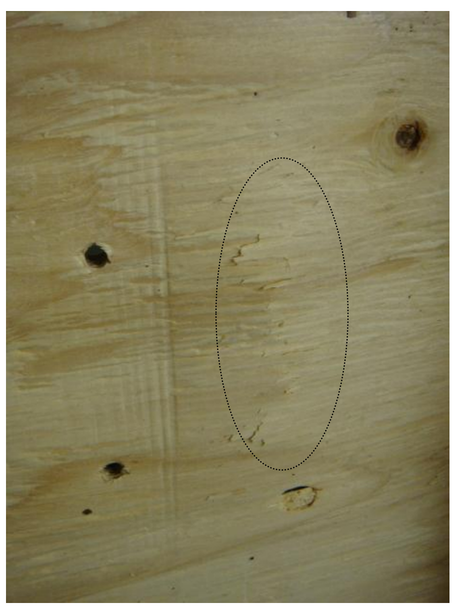


Figure 4. Buckled Plywood
Shear Perpendicular to Rafter

APPENDIX B

LOW SLOPE MOUNT QMLSH-9
9" FINISHED HEIGHT

HARWARE SPECIFICATION

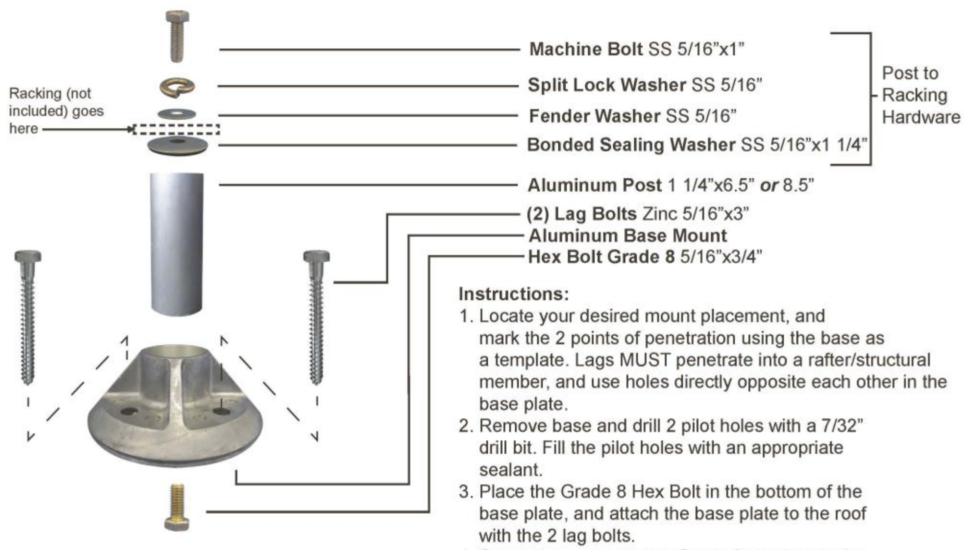
PROJECT NUMBER 111203C

Quick Mount PV®

Your *Solution* in Mounting Products

Solar • H_2O • Conduit • HVAC • Custom

Low Slope Mount Specifications



Instructions:

1. Locate your desired mount placement, and mark the 2 points of penetration using the base as a template. Lags MUST penetrate into a rafter/structural member, and use holes directly opposite each other in the base plate.
2. Remove base and drill 2 pilot holes with a 7/32" drill bit. Fill the pilot holes with an appropriate sealant.
3. Place the Grade 8 Hex Bolt in the bottom of the base plate, and attach the base plate to the roof with the 2 lag bolts.
4. Screw the post onto the Grade 8 Hex bolt in the base plate. attach the post-to-racking hardware to the top of the post for ease of location.
5. You are now ready to flash the mounts and attach racking to them.

IMPORTANT-PLEASE READ:
This product DOES NOT include flashing, and therefore is not waterproof by itself. As the installer, it is your responsibility to make sure all roof penetrations are flashed properly!

Lag pull-out (withdrawal) capacities (lbs) in typical lumber:

Lag Bolt Specifications

	Specific Gravity	2/ea 5/16" shaft per 2.5" thread depth	5/16" shaft per 1" thread depth
Douglas Fir, Larch	.50	1330	266
Douglas Fir, South	.46	1175	235
Engelmann Spruce, Lodgepole Pine (MSR 1650 f & higher)	.46	1175	235
Hem, Fir	.43	1060	212
Hem, Fir. (North)	.46	1175	235
Southern Pine	.55	1535	307
Spruce, Pine, Fir	.42	1025	205
Spruce, Pine, Fir (E of 2 million psi and higher grades of MSR and MEL)	..50	1330	266

Sources: Uniform Building Code; American Wood Council
Notes: 1) Thread must be embedded in a rafter or other structural roof member.
2) Pull-out values incorporate a 1.6 safety factor recommended by the American Wood Council.
3) See IBC for required edge distances.

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APPENDIX C

LOW SLOPE MOUNT QMLSH-9
9" FINISHED HEIGHT

LOAD TEST SETUP

PROJECT NUMBER 111203C

Tensile Test

Report Revision History

12/13/2011

Page 1:	Editorial revision
Page 2:	Tensile strengths tests added
Page 5:	Table III added
Page 11:	Appendix C added

Quick Mount PV®
RESPECT THE ROOF

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November 20, 2013
Engineering Letter

Stamped Engineering Test Reports Do Not Expire

To whom it may concern,

Quick Mount PV offers extensive testing for all our products conducted by a third-party licensed professional engineer. All our third-party engineering reports are stamped by a licensed professional engineer at the time the reports were prepared and **do not expire**. Our engineering reports continue to be valid as long as the professional engineer's license (date within the stamp) was valid when the reports were prepared (the report date). Even if the license has expired between the time the engineering reports were prepared and the time when a local agency reviews them, the reports do NOT need to be re-stamped with a current stamp.

This information is written into California State law under the Professional Engineers Act within the Business and Professions Code (B&P Code §§ 6700-6799). The California Board for Professional Engineers and Land Surveyors (BPELS) provides further clarification of the code in their Guide to Engineering & Land Surveying for City and County Officials, page 12 section 27, which is cited below.

> **27. If the license has expired between the time the engineering documents were prepared and the time when the local agency's review is performed, do the documents need to be re-sealed by a licensee with a current license? (B&P Code §§ 6733, 6735, 6735.3, 6735.4)**
> As long as the license was current at the time the engineering documents were prepared, the documents do not need to be re-sealed prior to review by the local agency. However, any changes (updates or modifications) to the documents that are made following the review by the local agency would have to be prepared by a licensed engineer with a current license and those changes would have to be signed and sealed.

It should also be noted that as of January 1, 2010 professional engineers are not required to include their license expiration date when they sign and stamp engineering documents only the date that they signed the document (B&P Code §§ 6735, 6735.3, 6735.4, 6764, 8750, 8761 & 8764.5). Links to all of the codes and guides referenced in this letter may be found online at quickmountpv.com under FAQ. Please submit any further questions to tech@quickmountpv.com.

Sincerely,

Jennifer D. Alfsen

Jennifer D. Alfsen, BSME
R&D Mechanical Engineer
Quick Mount PV