



The RAQ, LLC  
2510 S Telegraph Rd. Suite L302  
Bloomfield Hills, MI  
48302

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The RAQ, LLC.  
2510 S. Telegraph Rd., Bloomfield Hills, MI 48302

Please visit our website at [www.solarraq.com](http://www.solarraq.com) for further information or call

313-473-7271

Revised 10/16

This document is Confidential and Proprietary to The RAQ, LLC.

NOTICE OF COMPLETION  
AND  
AUTHORIZATION TO APPLY THE UL MARK



04/28/2014

Sader Power Enterprises Llc  
Mr. Cyril Narishkin  
9930 Chef Menteur Hwy  
New Orleans La 70127, Us

Our Reference: File E353639, Vol. 1 Project Number 4786194016  
Your Reference: TBD  
Project Scope: Phase 2 - Electrical Testing for UL 2703 Listing of RAQ Solar Panel Racking System

Dear Mr. Cyril Narishkin:

Congratulations! UL's investigation of your product(s) has been completed under the above Reference Number and the product was determined to comply with the applicable requirements. This letter temporarily supplements the UL Follow-Up Services Procedure and serves as authorization to apply the UL Mark at authorized factories under UL's Follow-Up Service Program. To provide your manufacturer(s) with the intended authorization to use the UL Mark, you must send a copy of this notice to each manufacturing location currently authorized under File E353639, Vol. 1.

Records in the Follow-Up Services Procedure covering the product are now being prepared and will be sent in the near future. Until then, this letter authorizes application of the UL Mark for 90 days from the date indicated above.

Additional requirements related to your responsibilities as the Applicant can be found in the document "Applicant responsibilities related to Early Authorizations" that can be found at the following web-site:  
<http://www.ul.com/EAResponsibilities>

Any information and documentation provided to you involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL.

We are excited you are now able to apply the UL Mark to your products and appreciate your business. Feel free to contact me or any of our Customer Service representatives if you have any questions.

Very truly yours,

Nathan Wang  
847-664-3951  
Senior Project Engineer  
Nathan.Wang@ul.com

Reviewed by:

William R. Carney  
847/664-1088  
Chief Engineer Director I  
William.R.Carney@ul.com

NBKB7CF-7556F1



NOTICE OF COMPLETION  
AND  
AUTHORIZATION TO APPLY THE UL MARK

04/28/2014

Sader Power Enterprises LLC  
Mr. Cyril Narishkin  
9930 Chef Menteur Hwy  
New Orleans La 70127, Us

Our Reference: File E353639, Vol. 1 Project Number 4786194016  
Your Reference: TBD  
Project Scope: Phase 2 - Investigation for Bonding for RAQ Solar Panel Racking System to UL 2703 and ULC/ORD-C1703, UL/CUL Certification

Dear Mr. Cyril Narishkin:

Congratulations! UL's investigation of your product(s) has been completed under the above Reference Number and the product was determined to comply with the applicable requirements. This letter temporarily supplements the UL Follow-Up Services Procedure and serves as authorization to apply the UL Mark at authorized factories under UL's Follow-Up Service Program. To provide your manufacturer(s) with the intended authorization to use the UL Mark, you must send a copy of this notice to each manufacturing location currently authorized under File E353639, Vol. 1.

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Very truly yours,

Nathan Wang  
847-664-3951  
Senior Project Engineer  
Nathan.Wang@ul.com

Reviewed by:

William R. Carney  
847/664-1088  
Chief Engineer Director I  
William.R.Carney@ul.com

NBKB7CF-7556F1



NOTICE OF COMPLETION  
AND  
AUTHORIZATION TO APPLY THE UL MARK

02/23/2016

Raq L L C  
JON SADER  
2885 Sanford Ave Sw.  
Grandville Mi 49418, Us

Our Reference: File TO BE DETERMINED, Vol. TO BE DETERMINED Project Number 4787321288  
Your Reference: N/A  
Project Scope: E353639 System Fire Classification for use on steep slope roof for Class A with Type 1 and Type 2 modules

Dear JON SADER:

Congratulations! UL's investigation of your product(s) has been completed under the above Reference Number and the product was determined to comply with the applicable requirements. This letter temporarily supplements the UL Follow-Up Services Procedure and serves as authorization to apply the UL Mark at authorized factories under UL's Follow-Up Service Program. To provide your manufacturer(s) with the intended authorization to use the UL Mark, you must send a copy of this notice to each manufacturing location currently authorized under File TO BE DETERMINED, Vol. TO BE DETERMINED.

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Very truly yours,

Nathan Wang  
847-664-3951  
Senior Project Engineer  
Nathan.Wang@ul.com

Reviewed by:

Bruce A. Mahrenholz  
847-664-3009  
CPO Director  
Bruce.A.Mahrenholz@ul.com

NBKA7C8-6D4007



NOTICE OF COMPLETION  
AND  
AUTHORIZATION TO APPLY THE UL MARK

12/17/2013

Sader Power Enterprises Llc  
Mr. Cyril Narishkin  
1539 Jackson Ave Ste 100  
New Orleans La 70130-5861, Us

Our Reference: File TO BE DETERMINED, Vol. TO BE DETERMINED Project Number 4786185525  
Your Reference: C.Narishkin 12/11  
Project Scope: E353639 - Add CUL, mechanical only, for existing racking systems in file

Dear Mr. Cyril Narishkin:

Congratulations! UL's investigation of your product(s) has been completed under the above Reference Number and the product was determined to comply with the applicable requirements. This letter temporarily supplements the UL Follow-Up Services Procedure and serves as authorization to apply the UL Mark at authorized factories under UL's Follow-Up Service Program. To provide your manufacturer(s) with the intended authorization to use the UL Mark, you must send a copy of this notice to each manufacturing location currently authorized under File TO BE DETERMINED, Vol. TO BE DETERMINED.

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Very truly yours,

Nathan Wang  
847-664-3951  
Senior Project Engineer  
Nathan.Wang@ul.com

Reviewed by:

William R. Carney  
847/664-1088  
Chief Engineer Director I  
William.R.Carney@ul.com

NBKE744-47C1E7

## UNDERWRITERS LABORATORIES

### INSPECTION REPORT

E35363911606240633

Date	06/23/2016	File Number	E353639
Responsible Office	Northbrook	Volume	1
Inspection Center	326	CCN	QIMS
Product Type	Rack Mounting Systems for Photovoltaic Modules and Panels	UL Rep Name	Steven Smith
Deliverable Type	Listed	UL Representative ID	06544
Party Site Number	1312973	Subscriber Number	
Manufacturer Name and Address	RAQ L L C 392 S Sanford Pontiac, MI 48342	Factory Representative	Mr. Jon Sader
		Factory Rep Phone	248-229-9644
		Factory Rep Email	jsader@solarraq.com

Nature of Visit	Initial Production Inspection	Sample Status	Samples required but none available
Listing/Classification/Recognized (Unlisted) Component Marks Used Since Last Visit	Yes	Listing/Classification/Recognized (Unlisted) Component Marks Removed	No
Variation Notice Issued	No		

#### PRODUCT DOCUMENTS / PRODUCTION READY VISIT

No Products Examined - Production Ready Visit

Model	Product	Class	Section/ RNN	Multiple Listed
SR-1000 &SR-3000 -Panel	SADER RAQ 3 Solar Panel			No

#### SAMPLE DOCUMENTS

If samples are required to be sent to ULI Laboratory, indicate below. If required samples are not sent, explain in the Comments area.

Type/Style/ Cat/Model	Name	Sample Tag Number	Shipped to Office
No Samples			

Additional Comments:

In addition to the requirements specified in the applicable UL Services agreement and Follow-Up Service Procedure, UL further defines responsibilities, duties and requirements for both manufacturers and UL representatives in the document titled "UL Mark Surveillance Requirements" that can be located at [www.ul.com/fus](http://www.ul.com/fus), and in accordance with the applicable terms and conditions of the document at [www.ul.com/responsibilities](http://www.ul.com/responsibilities). Manufacturers without Internet access may obtain the current versions of these documents from their local UL customer service representative or UL field representative.



VP Engineering  
 SADER POWER ENTERPRISES LLC  
 9930 CHEF MENTEUR HWY  
 New Orleans LA 70127

Date: 2014/04/30  
 Subscriber: 100579269  
 PartySite: 742963  
 File No: E353639  
 Project No: 4786194016  
 PD No: 14M18562  
 Type: R  
 PO Number: TBD

Subject: Procedure And/Or Report Material

The following material resulting from the investigation under the above numbers is enclosed.

Issue

<u>Date</u>	<u>Vol</u>	<u>Sec</u>	<u>Pages</u>	<u>Revised Date</u>
2013/11/22	1	1	Revised Description Page(s) 1,2,3,4,5,6	2014/04/28
2013/11/22	1	1	New Illustration(s) 13	2014/04/28
2013/11/22	1	1	New Test Record 3	2014/04/28

Inspections at your plant will be conducted under the supervision of CHARLES LOVER, AREA MANAGER, UL INSPECTION CENTER MID-SOUTH AREA OFFICE, UL LLC, #266, 123 A HWY 80 E, CLINTON, MS, United States, 39056., PHONE: 601-372-2250, FAX: 347-513-7694, EMAIL: Charles.E.Lover@us.ul.com

Please file revised pages and illustrations in place of material of like identity. New material should be filed in its proper numerical order.

NOTE: Follow-Up Service Procedure revisions DO NOT include Cover Pages, Test Records and Conclusion Pages. Report revisions DO NOT include Authorization Pages, Indices, Section General Pages and Appendixes.

Please review this material and report any inaccuracies to UL's Customer Service Professionals. Contact information for all of UL's global offices can be found at <http://www.ul.com/global/eng/pages/corporate/contactus>.

If you'd like to receive updated materials FASTER, UL offers electronic access and/or delivery of this material. For more details, contact UL's Customer Service Professionals as shown above.

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NBK File

UL INSPECTION CENTER 416

## DESCRIPTION

PRODUCT COVERED: Rack Mounting Systems and Clamping Devices for Flat-Plate Photovoltaic Modules and Panels

Models: SR-1000 Sader RAQ 1-Panel, SR-3000 SADER RAQ 3-Panel

USL - Listed for Outline of Investigation for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for use with Flat-Plate Photovoltaic Modules and Panels, UL2703, Issue 2, dated November 13, 2012.

CNL - Listed to the Standard for Flat-Plate Photovoltaic Modules and Panels, ULC/ORD-C1703, 1<sup>st</sup> Edition, dated October 2001

The rack mounting systems identified above been evaluated for use with Listed PV Modules as noted in the below table:

Model	Investigated for Bonding	Investigated for Mounting	Tested in combination with
SR-1000 Sader RAQ 1-Panel	Y	Y	UL Listed Trina PV Module Models:  TSM-215PA05, TSM-220PA05, TSM-225PA05, TSM-230PA05, TSM-235PA05, TSM-240PA05, TSM-245PA05, TSM-250PA05, TSM-255PA05, TSM-260PA05
SR-3000 SADER RAQ 3-Panel	Y	Y	UL Listed Trina PV Module Models:  TSM-215PA05, TSM-220PA05, TSM-225PA05, TSM-230PA05, TSM-235PA05, TSM-240PA05, TSM-245PA05, TSM-250PA05, TSM-255PA05, TSM-260PA05



## GENERAL:

\*The SR-1000 Sader RAQ 1-Panel and SR-3000 SADER RAQ 3-Panel have been investigated for mounting **and bonding**.

Installation manual can be found as ILL. 12. A French language version shall be provided with products labeled with the CUL Mark.

All **galvanized** components with G90 finish may be additionally powder coated for cosmetic purposes.

## CONSTRUCTION DETAILS:

Markings - Each component shall be shipped with the following markings on shipping carton or individual component. A French language version shall be provided with products labeled with the CUL Mark.

1. Manufacturer's name, trademark, or other descriptive marking
2. Model Number
3. Load rating
4. Date of manufacture, consisting of the following is located as part of the serial number.

YY-DDD

where

YY - year, (20)13, (20)14, (20)15, etc.

DDD - Julian date, i.e. 317=317<sup>th</sup> day of the year.

## SR-1000 Sader RAQ 1-Panel - ILL. 1

General - All dimensions are nominal unless otherwise specified.

1. Panel Rail - 2 provided - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 40.0 x 2.5 x 1.125 inches. Provided with slots and holes as shown in ILL. 3.
2. Rail Spacer Assembly - 2 sets provided - Secured to the Panel Rail with hardware described below in Item 3.
  - a. Rail Spacer - 2 provided per set - 16 gauge steel with minimum G90 finish. Minimum thickness 0.064 inches. Overall dimensions 38.5 x 2.25 x 0.75 inches. See ILL. 4 for additional details.
  - b. Rail Spacer Brace - 2 per set - 16 gauge steel with minimum G90 finish. Minimum thickness 0.064 inches. Overall dimensions 10 x 0.56 inches. See ILL. 5 for additional details. The braces are secured with rivets to allow for securement onto the Panel Rail, Item 1.
3. Hardware assembly to secure Panel Rail to Rail Spacer Assembly - 4 sets provided.
  - a. 1/4-20 x 3" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - b. 1/4-20 Galvanized Steel Nut. Minimum G90 finish.
  - c. 1/4 Galvanized Steel Flat Washer. Minimum G90 finish.
  - d. 1/4 Galvanized Steel Lock Washer. Minimum G90 finish.
  - e. 5/16-18 x 1/2" Galvanized Steel Thread-Cutting Bolt. Minimum G90 finish. (Secures Rail Spacer Brace to Panel Rail)
  - f. **Bonding assembly**
    1. M10 Machine Screw - two provided - 304 Stainless Steel.
    2. Wire - R/C (AVLV2), 12 AWG, 600V, 105C.
    3. Connector - R/C (ZMVV2), various manufacturers, U shaped terminal crimp connector used with appropriate crimp tool.
4. Anchor Base Assembly - 4 sets provided.
  - a. Anchor Base - 6005-T5 Aluminum - "L" shaped. Overall dimensions 6.0 x 4.0 x 2.0 inches. See ILL. 6 for additional details.
  - b. 5/16-18 x 3/4" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. 5/16" Galvanized Steel Flat Washer. Minimum G90 finish.
  - \* e. M10 Internal Star Washer - 2 provided - A2 Stainless Steel (304SS). (Located between Square Nut and Panel Rail.) See ILL. 13 for details.

5. Clamp Assembly - 4 sets provided.
- a. Panel Clamp - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 1.76 x 1.36 x 0.375 inches. See ILL. 7 for additional details.
  - b. 5/16-18 x 3" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. 1/4 Galvanized Steel Flat Washer. Minimum G90 finish.
  - e. Panel Spacer (Optional) - UHMW reprocessed plastic. Overall dimension 1.18 x 1.0 x 0.78 inches. Installation aide - does not contribute to the structural integrity.
  - f. Hose (Optional) - 1/2" x 2-1/4" Automotive hose. Installation aide - does not contribute to the structural integrity.
  - g. M10 Internal Star Washer - 3 provided - A2 Stainless Steel (304SS). (Located between Bolt head and Clamp, Flat Washer and Panel Rail, Square Nut and Panel Rail.) See ILL. 13 for details.
6. Start Bracket Assembly - 2 sets provided. See ILL. 9 for additional information.
- a. Start Bracket - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 4.625 x 2.5 x 1.125 inches. See ILL. 10 for additional details.
  - b. 5/16-18 x 1" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. Start Clamp Adapter A/B/C/D - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. L-shaped. See ILL. 12 for additional details.
  - e. M10 Internal Star Washer - 2 provided - A2 Stainless Steel (304SS). (Located between Start Bracket and Panel Rail.) See ILL. 13 for details.
7. Ground Assembly
- Washer Combination
- a. 5/16" Bolt - 304 Stainless Steel
  - b. Cup Washer - 304 Stainless Steel
  - c. Flat Washer - 304 Stainless Steel
  - d. Star Washer - 304 Stainless Steel
  - e. 5/16" Nut - 304 Stainless Steel

Alternate - Ground Lug - (KDER.E69905) type 2058729, manufactured by Tyco Electronics.

## SR-3000 Sader RAQ 3-Panel - ILL. 2

General - All dimensions are nominal unless otherwise specified.

1. Panel Rail - 2 provided - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 120.0 x 2.5 x 1.125 inches. Provided with slots and holes as shown in ILL. 8.
2. Rail Spacer Assembly - 2 sets provided - Secured to the Panel Rail with hardware described below in Item 3.
  - a. Rail Spacer - 2 provided per set - 16 gauge steel with minimum G90 finish. Minimum thickness 0.064 inches. Overall dimensions 38.5 x 2.25 x 0.75 inches. See ILL. 4 for additional details.
  - b. Rail Spacer Brace - 2 per set - 16 gauge steel with minimum G90 finish. Minimum thickness 0.064 inches. Overall dimensions 10 x 0.56 inches. See ILL. 5 for additional details. The braces are secured with rivets to allow for securement onto the Panel Rail, Item 1.
3. Hardware assembly to secure Panel Rail to Rail Spacer Assembly - 4 sets provided.
  - a. 1/4-20 x 3" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - b. 1/4-20 Galvanized Steel Nut. Minimum G90 finish.
  - c. 1/4 Galvanized Steel Flat Washer. Minimum G90 finish.
  - d. 1/4 Galvanized Steel Lock Washer. Minimum G90 finish.
  - e. 5/16-18 x 1/2" Galvanized Steel Thread-Cutting Bolt. Minimum G90 finish. (Secures Rail Spacer Brace to Panel Rail)
  - f. Bonding assembly
    1. M10 Machine Screw - two provided - 304 Stainless Steel.
    2. Wire - R/C (AVLV2), 12 AWG, 600V, 105C.
    3. Connector - R/C (ZMVB2), various manufacturers, U shaped terminal crimp connector used with appropriate crimp tool.
4. Anchor Base Assembly - 6 sets provided.
  - a. Anchor Base - 6005 Aluminum - "L" shaped. Overall dimensions 6.0 x 4.0 x 2.0 inches. See ILL. 6 for additional details.
  - b. 5/16-18 x 3/4" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. 5/16" Galvanized Steel Flat Washer. Minimum G90 finish.
  - \* e. M10 Internal Star Washer - 2 provided - A2 Stainless Steel (304SS). (Located between Square Nut and Panel Rail.) See ILL. 13 for details.

5. Clamp Assembly - 8 sets provided.
- a. Panel Clamp - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 1.76 x 1.36 x 0.375 inches. See ILL. 7 for additional details.
  - b. 5/16-18 x 3" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. 1/4 Galvanized Steel Flat Washer. Minimum G90 finish.
  - e. Panel Spacer (Optional) - UHMW reprocessed plastic. Overall dimension 1.18 x 1.0 x 0.78 inches. Installation aide - does not contribute to the structural integrity.
  - f. Hose (Optional) - 1/2" x 2-1/4" Automótive hose. Installation aide - does not contribute to the structural integrity.
  - g. M10 Internal Star Washer - 3 provided - A2 Stainless Steel (304SS). (Located between Bolt head and Clamp, Flat Washer and Panel Rail, Square Nut and Panel Rail.) See ILL. 13 for details.
6. Start Bracket Assembly - 2 sets provided. See ILL. 9 for additional information.
- a. Start Bracket - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 4.625 x 2.5 x 1.125 inches. See ILL. 10 for additional details.
  - b. 5/16-18 x 1" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. Start Clamp Adapter A/B/C/D - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. L-shaped. See ILL. 12 for additional details.
  - e. M10 Internal Star Washer - 2 provided - A2 Stainless Steel (304SS). (Located between Start Bracket and Panel Rail.) See ILL. 13 for details.
7. Ground Assembly
- Washer Combination
- a. 5/16" Bolt - 304 Stainless Steel
  - b. Cup Washer - 304 Stainless Steel
  - c. Flat Washer - 304 Stainless Steel
  - d. Star Washer - 304 Stainless Steel
  - e. 5/16" Nut - 304 Stainless Steel

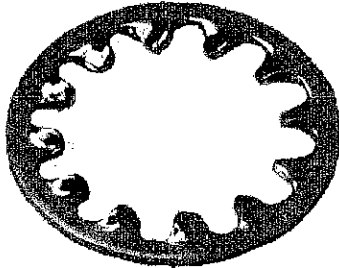
Alternate - Ground Lug - (KDER/7.E69905) type 2058729, manufactured by Tyco Electronics.

1/9/14

M10 A2 Stainless Steel DIN 6797 Internal Star Lock Washer | Fastenal



### M10 A2 Stainless Steel DIN 6797 Internal Star Lock Washer



#### General Information

**Fastenal Part No. (SKU):** 11509480  
**UNSPSC :** 31161801  
**Manufacturer:** Fastenal Approved Vendor  
**Category:** Fasteners > Washers > Lock Washers

**Wholesale:**  
\$0.1199

**Quantity:**  
1  x 1 (EA)

[Add to Cart](#)

**Availability:**  
Web Store: Email  
websales@fastenal.com for  
Availability  
Show Inventory Availability for my  
local Fastenal store

#### Product Details

**Inner Diameter:** 10.50mm  
**Outer Diameter:** 18mm  
**Nominal Size:** M10  
**Material:** Stainless Steel  
**Finish:** Plain  
**Grade:** A2  
**Type:** Lock Washer  
**Specification:** DIN 6797  
**Nominal Thickness:** 0.90mm  
**Style:** Internal Star  
**Product Weight:** 0.002 lbs.

## DESCRIPTION

PRODUCT COVERED: Rack Mounting Systems and Clamping Devices for Flat-Plate Photovoltaic Modules and Panels

Models: SR-1000 Sader RAQ 1-Panel, SR-3000 SADER RAQ 3-Panel

USL - Listed for Outline of Investigation for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for use with Flat-Plate Photovoltaic Modules and Panels, UL2703, Issue 2, dated November 13, 2012.

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SR-3000 SADER RAQ 3-Panel	Y	Y	UL Listed Trina PV Module Models:  TSM-215PA05, TSM-220PA05, TSM-225PA05, TSM-230PA05, TSM-235PA05, TSM-240PA05, TSM-245PA05, TSM-250PA05, TSM-255PA05, TSM-260PA05

## GENERAL:

\*The SR-1000 Sader RAQ 1-Panel and SR-3000 SADER RAQ 3-Panel have been investigated for mounting **and bonding**.

Installation manual can be found as ILL. 12. A French language version shall be provided with products labeled with the CUL Mark.

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## CONSTRUCTION DETAILS:

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2. Model Number
3. Load rating
4. Date of manufacture, consisting of the following is located as part of the serial number.

YY-DDD

where

YY - year, (20)13, (20)14, (20)15, etc.

DDD - Julian date, i.e. 317=317<sup>th</sup> day of the year.



## SR-1000 Sader RAQ 1-Panel - ILL. 1

General - All dimensions are nominal unless otherwise specified.

1. Panel Rail - 2 provided - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 40.0 x 2.5 x 1.125 inches. Provided with slots and holes as shown in ILL. 3.
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  - a. Rail Spacer- 2 provided per set - 16 gauge steel with minimum G90 finish. Minimum thickness 0.064 inches. Overall dimensions 38.5 x 2.25 x 0.75 inches. See ILL. 4 for additional details.
  - b. Rail Spacer Brace - 2 per set - 16 gauge steel with minimum G90 finish. Minimum thickness 0.064 inches. Overall dimensions 10 x 0.56 inches. See ILL. 5 for additional details. The braces are secured with rivets to allow for securement onto the Panel Rail, Item 1.
3. Hardware assembly to secure Panel Rail to Rail Spacer Assembly - 4 sets provided.
  - a. 1/4-20 x 3" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - b. 1/4-20 Galvanized Steel Nut. Minimum G90 finish.
  - c. 1/4 Galvanized Steel Flat Washer. Minimum G90 finish.
  - d. 1/4 Galvanized Steel Lock Washer. Minimum G90 finish.
  - e. 5/16-18 x 1/2" Galvanized Steel Thread-Cutting Bolt. Minimum G90 finish. (Secures Rail Spacer Brace to Panel Rail)
  - f. Bonding assembly
    1. M10 Machine Screw - two provided - 304 Stainless Steel.
    2. Wire - R/C (AVLV2), 12 AWG, 600V, 105C.
    3. Connector - R/C (ZMVV2), various manufacturers, U shaped terminal crimp connector used with appropriate crimp tool.
4. Anchor Base Assembly - 4 sets provided.
  - a. Anchor Base - 6005-T5 Aluminum - "L" shaped. Overall dimensions 6.0 x 4.0 x 2.0 inches. See ILL. 6 for additional details.
  - b. 5/16-18 x 3/4" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. 5/16" Galvanized Steel Flat Washer. Minimum G90 finish.
  - \* e. M10 Internal Star Washer - 2 provided - A2 Stainless Steel (304SS). (Located between Square Nut and Panel Rail.) See ILL. 13 for details.

5. Clamp Assembly - 4 sets provided.
  - a. Panel Clamp - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 1.76 x 1.36 x 0.375 inches. See ILL. 7 for additional details.
  - b. 5/16-18 x 3" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. 1/4 Galvanized Steel Flat Washer. Minimum G90 finish.
  - e. Panel Spacer (Optional) - UHMW reprocessed plastic. Overall dimension 1.18 x 1.0 x 0.78 inches. Installation aide - does not contribute to the structural integrity.
  - f. Hose (Optional) - 1/2" x 2-1/4" Automotive hose. Installation aide - does not contribute to the structural integrity.
  - g. M10 Internal Star Washer - 3 provided - A2 Stainless Steel (304SS). (Located between Bolt head and Clamp, Flat Washer and Panel Rail, Square Nut and Panel Rail.) See ILL. 13 for details.
  
6. Start Bracket Assembly - 2 sets provided. See ILL. 9 for additional information.
  - a. Start Bracket - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 4.625 x 2.5 x 1.125 inches. See ILL. 10 for additional details.
  - b. 5/16-18 x 1" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. Start Clamp Adapter A/B/C/D - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. L-shaped. See ILL. 12 for additional details.
  - e. M10 Internal Star Washer - 2 provided - A2 Stainless Steel (304SS). (Located between Start Bracket and Panel Rail.) See ILL. 13 for details.
  
7. Ground Assembly

**Washer Combination**

- a. 5/16" Bolt - 304 Stainless Steel
- b. Cup Washer - 304 Stainless Steel
- c. Flat Washer - 304 Stainless Steel
- d. Star Washer - 304 Stainless Steel
- e. 5/16" Nut - 304 Stainless Steel

Alternate - Ground Lug - (KDER.E69905) type 2058729, manufactured by Tyco Electronics.

## SR-3000 Sader RAQ 3-Panel - ILL. 2

General - All dimensions are nominal unless otherwise specified.

1. Panel Rail - 2 provided - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 120.0 x 2.5 x 1.125 inches. Provided with slots and holes as shown in ILL. 8.
2. Rail Spacer Assembly - 2 sets provided - Secured to the Panel Rail with hardware described below in Item 3.
  - a. Rail Spacer - 2 provided per set - 16 gauge steel with minimum G90 finish. Minimum thickness 0.064 inches. Overall dimensions 38.5 x 2.25 x 0.75 inches. See ILL. 4 for additional details.
  - b. Rail Spacer Brace - 2 per set - 16 gauge steel with minimum G90 finish. Minimum thickness 0.064 inches. Overall dimensions 10 x 0.56 inches. See ILL. 5 for additional details. The braces are secured with rivets to allow for securement onto the Panel Rail, Item 1.
3. Hardware assembly to secure Panel Rail to Rail Spacer Assembly - 4 sets provided.
  - a. 1/4-20 x 3" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - b. 1/4-20 Galvanized Steel Nut. Minimum G90 finish.
  - c. 1/4 Galvanized Steel Flat Washer. Minimum G90 finish.
  - d. 1/4 Galvanized Steel Lock Washer. Minimum G90 finish.
  - e. 5/16-18 x 1/2" Galvanized Steel Thread-Cutting Bolt. Minimum G90 finish. (Secures Rail Spacer Brace to Panel Rail)
  - f. Bonding assembly
    1. M10 Machine Screw - two provided - 304 Stainless Steel.
    2. Wire - R/C (AVLV2), 12 AWG, 600V, 105C.
    3. Connector - R/C (ZMVV2), various manufacturers, U shaped terminal crimp connector used with appropriate crimp tool.
4. Anchor Base Assembly - 6 sets provided.
  - a. Anchor Base - 6005 Aluminum - "L" shaped. Overall dimensions 6.0 x 4.0 x 2.0 inches. See ILL. 6 for additional details.
  - b. 5/16-18 x 3/4" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. 5/16" Galvanized Steel Flat Washer. Minimum G90 finish.
  - \* e. M10 Internal Star Washer - 2 provided - A2 Stainless Steel (304SS). (Located between Square Nut and Panel Rail.) See ILL. 13 for details.

5. Clamp Assembly - 8 sets provided.
- a. Panel Clamp - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 1.76 x 1.36 x 0.375 inches. See ILL. 7 for additional details.
  - b. 5/16-18 x 3" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. 1/4 Galvanized Steel Flat Washer. Minimum G90 finish.
  - e. Panel Spacer (Optional) - UHMW reprocessed plastic. Overall dimension 1.18 x 1.0 x 0.78 inches. Installation aide - does not contribute to the structural integrity.
  - f. Hose (Optional) - 1/2" x 2-1/4" Automotive hose. Installation aide - does not contribute to the structural integrity.
  - g. M10 Internal Star Washer - 3 provided - A2 Stainless Steel (304SS). (Located between Bolt head and Clamp, Flat Washer and Panel Rail, Square Nut and Panel Rail.) See ILL. 13 for details.
6. Start Bracket Assembly - 2 sets provided. See ILL. 9 for additional information.
- a. Start Bracket - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 4.625 x 2.5 x 1.125 inches. See ILL. 10 for additional details.
  - b. 5/16-18 x 1" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. Start Clamp Adapter A/B/C/D - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. L-shaped. See ILL. 12 for additional details.
  - e. M10 Internal Star Washer - 2 provided - A2 Stainless Steel (304SS). (Located between Start Bracket and Panel Rail.) See ILL. 13 for details.
7. Ground Assembly
- Washer Combination
- a. 5/16" Bolt - 304 Stainless Steel
  - b. Cup Washer - 304 Stainless Steel
  - c. Flat Washer - 304 Stainless Steel
  - d. Star Washer - 304 Stainless Steel
  - e. 5/16" Nut - 304 Stainless Steel

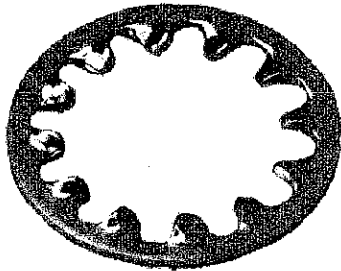
Alternate - Ground Lug - (KDER/7.E69905) type 2058729, manufactured by Tyco Electronics.

1/9/14

M10 A2 Stainless Steel DIN 6797 Internal Star Lock Washer | Fastenal



### M10 A2 Stainless Steel DIN 6797 Internal Star Lock Washer



#### General Information

Fastenal Part No. (SKU): 11509480  
UNSPSC : 31161801  
Manufacturer: Fastenal Approved Vendor  
Category: Fasteners > Washers > Lock Washers

Wholesale:  
\$0.1199

Quantity:  
1 x 1 (EA)

[Add to Cart](#)

Availability:  
Web Store: Email  
wobsales@fastenal.com for  
Availability  
Show Inventory Availability for my  
local Fastenal store

#### Product Details

Inner Diameter: 10.50mm  
Outer Diameter: 18mm  
Nominal Size: M10  
Material: Stainless Steel  
Finish: Plain  
Grade: A2  
Type: Lock Washer  
Specification: DIN 6797  
Nominal Thickness: 0.90mm  
Style: Internal Star  
Product Weight: 0.002 lbs.

TEST RECORD NO. 3

## SAMPLES:

Ssamples of the photovoltaic rack mounting system as indicated below and constructed as described herein, were submitted by the manufacturer for examination and test; to add bonding for both US and Canadian requirements.

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 SR-1000 Sader RAQ 1-Panel
 

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 SR-3000 Sader RAQ 3-Panel
 

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## GENERAL:

Test results relate only to the items tested.

Additional 304 stainless steel star washers have been provided at each joint to cut through the non-conductive powder coat material.

A bonding wire has been added between panel rail and spacer.

Two additional ground components were evaluated for connection of a grounding electrode conductor. A Hardware Washer Combination (Subject 2703 cl. 8.3 & C1703 cl. 4.5.7) and the Tyco 2058729 ground connector.

During tests, a nickel plated cupwasher was used in place of the described 304 stainless steel version. Due to the lower conductivity of nickel, it was considered representative of the stainless steel hardware.

The following tests were conducted.

BONDING PATH RESISTANCE TEST:	Subject 2703 Sec. 13 (C1703 cl. 5.8)
TEMPERATURE CYCLING TEST	Subject 2703 Sec. 17 (C1703 5.17)
BONDING PATH RESISTANCE TEST - Following the TEMPERATURE CYCLING TEST:	Subject 2703 Sec. 13 (C1703 cl. 5.8)
HUMIDITY CYCLING TEST	Subject 2703 Sec. 18 (C1703 5.18)
BONDING PATH RESISTANCE TEST - Following the HUMIDITY TEST:	Subject 2703 Sec. 13 (C1703 cl. 5.8)
BONDING CONDUCTOR TEST (135%, 200% & Limited-Short Circuit) followed by Bonding Path Resistance Test	Subject 2703 Sec. 22 Subject 2703 Sec. 13 (C1703 cl. 5.8)

For the HF10 and TC200 tests, one bonding junction of each representative sample was tested. Since the bonding junctions' constructions are repeatable due to controlled materials, dimensions and appropriate clamp load by the proper torque compared to manufacturing process for a complete PV module, one bonding junction of each is suitable. Additionally, the Bonding conductor test was performed on six samples of each junction involving all components that utilize nonconductive treated surfaces.

The test methods and results of the above tests have been reviewed and found in accordance with the requirements in the Outline of Investigation for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for use with Flat-Plate Photovoltaic Modules and Panels, UL 2703, Issue Number 2, Dated November 13, 2012 and the Standard for Flat-Plate Photovoltaic Modules and Panels, ULC/ORD-C1703, 1<sup>st</sup> Edition, dated October 2001.

Test Record Summary:

The results of this investigation indicate that the products evaluated comply with the applicable requirements and, therefore, such products are judged eligible to bear UL's Mark as described on the Conclusion Page of this Report.

Test Record by:

Nathan Wang  
Senior Project Engineer

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Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL.

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File E353639  
Project 4786114624

Issued: November 22, 2013  
Revised: April 2, 2015

REPORT

on

MOUNTING SYSTEMS, MOUNTING DEVICES, CLAMPING/RETENTION DEVICES, AND GROUND  
LUGS FOR USE WITH FLAT-PLATE PHOTOVOLTAIC MODULES AND PANELS

**RAQ LLC**  
Grandville MI

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File E353639

Vol. 1

Sec. 1

Page 1

Issued: 2013-11-22



DESCRIPTION

PRODUCT COVERED: Rack Mounting Systems and Clamping Devices for Flat-Plate Photovoltaic Modules and Panels

Models: SR-1000 Sader RAQ 1-Panel, SR-3000 SADER RAQ 3-Panel

USL - Listed for Outline of Investigation for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for use with Flat-Plate Photovoltaic Modules and Panels, UL2703, Issue 2, dated November 13, 2012.

CNL - Listed to the Standard for Flat-Plate Photovoltaic Modules and Panels, ULC/ORD-C1703, 1<sup>st</sup> Edition, dated October 2001

The rack mounting systems identified above been evaluated for use with Listed PV Modules as noted in the below table:

Model	Investigated for Bonding	Investigated for Mounting	System Fire Classification (A, B, or C)	Tested in combination with
SR-1000 Sader RAQ 1-Panel	See Below	See Below	A	<b>Listed Fire Performance Type 1 and 2 Modules in Steep Slope</b>
	Y	Y	See Above	UL Listed Trina PV Module Models:  TSM-215PA05, TSM-220PA05, TSM-225PA05, TSM-230PA05, TSM-235PA05, TSM-240PA05, TSM-245PA05, TSM-250PA05, TSM-255PA05, TSM-260PA05
SR-3000 SADER RAQ 3-Panel	See Below	See Below	A	<b>Listed Fire Performance Type 1 and 2 Modules in Steep Slope</b>
	Y	Y	See Above	UL Listed Trina PV Module Models:  TSM-215PA05, TSM-220PA05, TSM-225PA05, TSM-230PA05, TSM-235PA05, TSM-240PA05, TSM-245PA05, TSM-250PA05, TSM-255PA05, TSM-260PA05



## GENERAL:

\*The SR-1000 Sader RAQ 1-Panel and SR-3000 SADER RAQ 3-Panel have been investigated for mounting, bonding, **and system fire classification.**

Installation manual can be found as ILL. 12. A French language version shall be provided with products labeled with the CUL Mark.

All galvanized components with G90 finish may be additionally powder coated for cosmetic purposes.

## CONSTRUCTION DETAILS:

Markings - Each component shall be shipped with the following markings on shipping carton or individual component. A French language version shall be provided with products labeled with the CUL Mark.

1. Manufacturer's name, trademark, or other descriptive marking
2. Model Number
3. Load rating
4. Date of manufacture, consisting of the following is located as part of the serial number.

YY-DDD

where

YY - year, (20)13, (20)14, (20)15, etc.

DDD - Julian date, i.e. 317=317<sup>th</sup> day of the year.

## SR-1000 Sader RAQ 1-Panel - ILL. 1

General - All dimensions are nominal unless otherwise specified.

1. Panel Rail - 2 provided - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 40.0 x 2.5 x 1.125 inches. Provided with slots and holes as shown in ILL. 3.
2. Rail Spacer Assembly - 2 sets provided - Secured to the Panel Rail with hardware described below in Item 3.
  - a. Rail Spacer - 2 provided per set - 16 gauge steel with minimum G90 finish. Minimum thickness 0.064 inches. Overall dimensions 38.5 x 2.25 x 0.75 inches. See ILL. 4 for additional details.
  - b. Rail Spacer Brace - 2 per set - 16 gauge steel with minimum G90 finish. Minimum thickness 0.064 inches. Overall dimensions 10 x 0.56 inches. See ILL. 5 for additional details. The braces are secured with rivets to allow for securement onto the Panel Rail, Item 1.
3. Hardware assembly to secure Panel Rail to Rail Spacer Assembly - 4 sets provided.
  - a. 1/4-20 x 3" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - b. 1/4-20 Galvanized Steel Nut. Minimum G90 finish.
  - c. 1/4 Galvanized Steel Flat Washer. Minimum G90 finish.
  - d. 1/4 Galvanized Steel Lock Washer. Minimum G90 finish.
  - e. 5/16-18 x 1/2" Galvanized Steel Thread-Cutting Bolt. Minimum G90 finish. (Secures Rail Spacer Brace to Panel Rail)
  - f. **Bonding assembly**
    1. **M10 Machine Screw - two provided - 304 Stainless Steel.**
    2. **Wire - R/C (AVLV2), 12 AWG, 600V, 105C.**
    3. **Connector - R/C (ZMVV2), various manufacturers, U shaped terminal crimp connector used with appropriate crimp tool.**
4. Anchor Base Assembly - 4 sets provided.
  - a. Anchor Base - 6005-T5 Aluminum - "L" shaped. Overall dimensions 6.0 x 4.0 x 2.0 inches. See ILL. 6 for additional details.
  - b. 5/16-18 x 3/4" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. 5/16" Galvanized Steel Flat Washer. Minimum G90 finish.
  - \* e. **M10 Internal Star Washer - 2 provided - A2 Stainless Steel (304SS). (Located between Square Nut and Panel Rail.) See ILL. 13 for details.**

5. Clamp Assembly - 4 sets provided.
- a. Panel Clamp - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 1.76 x 1.36 x 0.375 inches. See ILL. 7 for additional details.
  - b. 5/16-18 x 3" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. 1/4 Galvanized Steel Flat Washer. Minimum G90 finish.
  - e. Panel Spacer (Optional) - UHMW reprocessed plastic. Overall dimension 1.18 x 1.0 x 0.78 inches. Installation aide - does not contribute to the structural integrity.
  - f. Hose (Optional) - 1/2" x 2-1/4" Automotive hose. Installation aide - does not contribute to the structural integrity.
  - g. M10 Internal Star Washer - 3 provided - A2 Stainless Steel (304SS). (Located between Bolt head and Clamp, Flat Washer and Panel Rail, Square Nut and Panel Rail.) See ILL. 13 for details.**
6. Start Bracket Assembly - 2 sets provided. See ILL. 9 for additional information.
- a. Start Bracket - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 4.625 x 2.5 x 1.125 inches. See ILL. 10 for additional details.
  - b. 5/16-18 x 1" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. Start Clamp Adapter A/B/C/D - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. L-shaped. See ILL. 12 for additional details.
  - e. M10 Internal Star Washer - 2 provided - A2 Stainless Steel (304SS). (Located between Start Bracket and Panel Rail.) See ILL. 13 for details.**
7. Ground Assembly

**Washer Combination**

- a. 5/16" Bolt - 304 Stainless Steel
- b. Cup Washer - 304 Stainless Steel
- c. Flat Washer - 304 Stainless Steel
- d. Star Washer - 304 Stainless Steel
- e. 5/16" Nut - 304 Stainless Steel

**Alternate - Ground Lug - (KDER.E69905) type 2058729, manufactured by Tyco Electronics.**

## SR-3000 Sader RAQ 3-Panel - ILL. 2

General - All dimensions are nominal unless otherwise specified.

1. Panel Rail - 2 provided - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 120.0 x 2.5 x 1.125 inches. Provided with slots and holes as shown in ILL. 8.
2. Rail Spacer Assembly - 2 sets provided - Secured to the Panel Rail with hardware described below in Item 3.
  - a. Rail Spacer - 2 provided per set - 16 gauge steel with minimum G90 finish. Minimum thickness 0.064 inches. Overall dimensions 38.5 x 2.25 x 0.75 inches. See ILL. 4 for additional details.
  - b. Rail Spacer Brace - 2 per set - 16 gauge steel with minimum G90 finish. Minimum thickness 0.064 inches. Overall dimensions 10 x 0.56 inches. See ILL. 5 for additional details. The braces are secured with rivets to allow for securement onto the Panel Rail, Item 1.
3. Hardware assembly to secure Panel Rail to Rail Spacer Assembly - 4 sets provided.
  - a. 1/4-20 x 3" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - b. 1/4-20 Galvanized Steel Nut. Minimum G90 finish.
  - c. 1/4 Galvanized Steel Flat Washer. Minimum G90 finish.
  - d. 1/4 Galvanized Steel Lock Washer. Minimum G90 finish.
  - e. 5/16-18 x 1/2" Galvanized Steel Thread-Cutting Bolt. Minimum G90 finish. (Secures Rail Spacer Brace to Panel Rail)
  - f. **Bonding assembly**
    1. **M10 Machine Screw - two provided - 304 Stainless Steel.**
    2. **Wire - R/C (AVLV2), 12 AWG, 600V, 105C.**
    3. **Connector - R/C (ZMVV2), various manufacturers, U shaped terminal crimp connector used with appropriate crimp tool.**
4. Anchor Base Assembly - 6 sets provided.
  - a. Anchor Base - 6005 Aluminum - "L" shaped. Overall dimensions 6.0 x 4.0 x 2.0 inches. See ILL. 6 for additional details.
  - b. 5/16-18 x 3/4" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. 5/16" Galvanized Steel Flat Washer. Minimum G90 finish.
  - \* e. **M10 Internal Star Washer - 2 provided - A2 Stainless Steel (304SS). (Located between Square Nut and Panel Rail.) See ILL. 13 for details.**

5. Clamp Assembly - 8 sets provided.
- a. Panel Clamp - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 1.76 x 1.36 x 0.375 inches. See ILL. 7 for additional details.
  - b. 5/16-18 x 3" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. 1/4 Galvanized Steel Flat Washer. Minimum G90 finish.
  - e. Panel Spacer (Optional) - UHMW reprocessed plastic. Overall dimension 1.18 x 1.0 x 0.78 inches. Installation aide - does not contribute to the structural integrity.
  - f. Hose (Optional) - 1/2" x 2-1/4" Automotive hose. Installation aide - does not contribute to the structural integrity.
  - g. **M10 Internal Star Washer - 3 provided - A2 Stainless Steel (304SS). (Located between Bolt head and Clamp, Flat Washer and Panel Rail, Square Nut and Panel Rail.) See ILL. 13 for details.**
6. Start Bracket Assembly - 2 sets provided. See ILL. 9 for additional information.
- a. Start Bracket - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. Overall dimensions 4.625 x 2.5 x 1.125 inches. See ILL. 10 for additional details.
  - b. 5/16-18 x 1" Galvanized Steel Machine Bolt. Minimum G90 finish.
  - c. 5/16-18 Galvanized Steel Square Nut. Minimum G90 finish.
  - d. Start Clamp Adapter A/B/C/D - 12 gauge steel with minimum G90 finish. Minimum thickness 0.108 inches. L-shaped. See ILL. 12 for additional details.
  - e. **M10 Internal Star Washer - 2 provided - A2 Stainless Steel (304SS). (Located between Start Bracket and Panel Rail.) See ILL. 13 for details.**

7. Ground Assembly

Washer Combination

- a. 5/16" Bolt - 304 Stainless Steel
- b. Cup Washer - 304 Stainless Steel
- c. Flat Washer - 304 Stainless Steel
- d. Star Washer - 304 Stainless Steel
- e. 5/16" Nut - 304 Stainless Steel

Alternate - Ground Lug - (KDER/7.E69905) type 2058729, manufactured by Tyco Electronics.

<b>Issued to:</b>	<b>RAQ L L C</b> 2885 Sanford Ave SW. Grandville MI 49418
<b>This is to certify that representative samples of</b>	<b>MOUNTING SYSTEMS, MOUNTING DEVICES, CLAMPING DEVICES AND GROUND LUGS FOR USE WITH PHOTOVOLTAIC MODULES AND PANELS</b> Rack Mounting Systems and Clamping Devices for Flat-Plate Photovoltaic Modules and Panels. Models: SR-1000 Sader RAQ 1-Panel, SR-3000 SADER RAQ 3-Panel
	Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.
<b>Standard(s) for Safety:</b>	UL 2703, Outline of Investigation for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for use with Flat-Plate Photovoltaic Modules and Panels CSA-C22.2 No. 41 Grounding and Bonding Equipment
<b>Additional Information:</b>	See the UL Online Certifications Directory at <a href="http://www.ul.com/database">www.ul.com/database</a> for additional information

Only those products bearing the UL Listing Mark for the US and Canada should be considered as being covered by UL's Listing and Follow-Up Service meeting the appropriate requirements for US and Canada.

The UL Listing Mark for the US and Canada generally includes: the UL in a circle symbol with "C" and "US" identifiers: the word "LISTED"; a control number (may be alphanumeric) assigned by UL; and the product category name (product identifier) as indicated in the appropriate UL Directory.

Look for the UL Listing Mark on the product.



Number of pages in this package \_\_\_\_ [ including additional pages \_\_\_\_ ]  
 (Fill in when using printed copy as record)

--

CLIENT INFORMATION	
Company Name	SADER POWER ENTERPRISES LLC
Address	Suite 100 1539 Jackson Avenue New Orleans, LA 70130 United States

AUDIT INFORMATION:				
<input checked="" type="checkbox"/> Description of Tests	Per Standard No.	UL Subject 2703	Edition	Second: November 13, 2012
<input checked="" type="checkbox"/> Tests Conducted by +	Nathan Wang		Nathan Wang	
	Printed Name		Signature	
<input type="checkbox"/> UL Staff conducting or witnessing testing (WTDP, TMP, WMT only)				
<input type="checkbox"/> UL Staff supervising UL Staff in training				
<input type="checkbox"/> Authorized Signatory (CTDP, TPTDP, TCP, PPP, SMT)	Printed Name		Signature. Include date for CTDP, TPTDP, TCP, PPP, WMT, TMP, SMT	
Reviewed and accepted by qualified Project Handler	Nathan Wang		Nathan Wang	
	Printed Name		Signature	

TESTS TO BE CONDUCTED:			
Test No.	Done+ ++	Test Name	<input checked="" type="checkbox"/> Comments/Parameters <input type="checkbox"/> Tests Conducted by ++
1	X	MECHANICAL LOADING TESTS	Trina Solar

Instructions -

+ - When all tests are conducted by one person, printed name and signature can be inserted here instead of including printed name and signature on each page containing data. Must indicate number of pages in the data package.

++ - When test conducted by more than one person, printed name and signature of person conducting the test can be inserted next to the test name instead of including printed name and signature on each page containing data. Test dates may be recorded here instead of entering test dates on the individual datasheet pages. Must indicate number of pages in the data package.

+++ - Use of this field is optional and may be employed differently. If used to include a date instead of entering the testing date on the individual datasheet pages, the date shall be the date the test was conducted.

Special Instructions -

All weights are weighed on the calibrated scale prior to use. Sand bags used for each module are documented below.

~~[ ] Unless specified otherwise in the individual Methods, the tests shall be conducted under the following ambient conditions. Confirmation of these conditions shall be recorded at the time the test is conducted.~~

<del>Ambient Temperature, °C</del>	<del>N/A</del>	<del>Relative Humidity, %</del>	<del>N/A</del>	<del>Barometric Pressure, mBar</del>	<del>N/A</del>		
------------------------------------	----------------	---------------------------------	----------------	--------------------------------------	----------------	--	--

[x] No general environmental conditions are specified in the Standard(s) or have been identified that could affect the test results or measurements.

RISK ANALYSIS RELATED TO TESTING PERFORMANCE:

The following types of risks have been identified. Take necessary precautions. This list is not all inclusive.

<input type="checkbox"/> Electric shock	<input type="checkbox"/> Radiation		
---	------------------------------------	--	--

<input type="checkbox"/> Energy related hazards	<input type="checkbox"/> Chemical hazards		
---	---	--	--

<input type="checkbox"/> Fire	<input type="checkbox"/> Noise		
-------------------------------	--------------------------------	--	--

<input type="checkbox"/> Heat related hazards	<input type="checkbox"/> Vibration		
---	------------------------------------	--	--

<input checked="" type="checkbox"/> Mechanical	<input type="checkbox"/> Other (Specify) __		
--	---	--	--

--

~~[ ] The CAS Staff or Field Services Member, as indicated below, (a competent L1, L2 or L3 in a similar CCN/Standard for a similar test method) was utilized to conduct the witnessing of tests on behalf of the project handler. (Please complete the table below to document the rationale and approval.)~~

<del>Name of UL Staff conducting WTDP</del>	<del>CCN/Standard to be witnessed</del>	<del>Test(s) to be witnessed</del>	<del>L1, L2 or L3 Competency</del>	<del>Similar CCN/Standard Competency</del>	<del>L3 Reviewer Approval &amp; Date (Similar CCN/Standard)</del>
---	---	------------------------------------	------------------------------------	--	---

TEST LOCATION: (To be completed by Staff Conducting the Testing)						
<input checked="" type="checkbox"/> UL or Affiliate	<input type="checkbox"/> WTDP	<input type="checkbox"/> CTDP	<input type="checkbox"/> TPTDP	<input type="checkbox"/> TCP	<input type="checkbox"/> PPP	
	<input type="checkbox"/> WMT	<input type="checkbox"/> TMP	<input type="checkbox"/> SMT			
Company Name:	UL LLC					
Address:	333 Pfingsten Rd Northbrook, IL 60062					

TEST EQUIPMENT INFORMATION

UL test equipment information is recorded on Meter Use in UL's Laboratory Project Management (LPM) database.

UL test equipment information is recorded on <<insert location and local laboratory equipment system identification.>>

Inst. ID No.	Instrument Type	Test Number +, Test Title or Conditioning	Function/Range	Last Cal. Date	Next Cal. Date
NBK24247	Torque wrench	Mechanical loading	0-150 in-lbs	2013-06-06	2014-06-30
ICO-0433	Tape Measure	Mechanical Loading	0-25ft	2011-09-22	2014-09-30
NBK41710	Scale	Mechanical Loading	0-500lbs	2013-04-26	2014-04
NBK72207	Timer	Mechanical Loading	99H:59M:509S	2013-05-01	2014-05-31
NBK25213	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25216	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25223	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25225	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25229	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25235	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25237	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25240	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25242	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25247	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31

NBK25248	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25249	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25250	Sandbag	Mechanical Loading	20 lbs	2013-06-11	2016-06-30
NBK25253	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25262	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25263	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25267	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25270	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25272	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
Inst. ID No.	Instrument Type	Test Number +, Test Title or Conditioning	Function/Range	Last Cal. Date	Next Cal. Date
NBK25275	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25276	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25278	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25279	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31
NBK25284	Sandbag	Mechanical Loading	20 lbs	2012-01-23	2015-01-31

+ - If Test Number is used, the Test Number must be identified on the data sheet pages or on the Data Sheet Package cover page.

The following additional information is required when using client's or rented equipment, or when a UL ID Number for an instrument number is not used. The Inst. ID No. below corresponds to the Inst. ID No. above.

Inst. ID No.	Make/Model/Serial Number/Asset No.

TEST SAMPLE IDENTIFICATION:

The table below is provided to establish correlation of sample numbers to specific product related information. Refer to this table when a test identifies a test sample by "Sample No." only.

Sample Card No.	Date Received	<input checked="" type="checkbox"/> Test No.+	Sample No.	Manufacturer, Product Identification and Ratings
1759541	2013-11-14	1-3	1	Rack Mounting System: SADER POWER ENTERPRISES LLC, SR-3000. Cap screws torqued to 11ft-lbs.
1759541	2013-11-14	1	2-4	UL Listed PV Module: Trina Solar, TSM-240PA05

+ - If Test Number is used, the Test Number or Numbers the sample was used in must be identified on the data sheet pages or on the Data Sheet Package cover page.

Sampling Procedure -

This document contains data using color and if printed, should be printed in color to retain legibility and the information represented by the color.

## METHOD A

## Positive Load Test -

A sample of Model SR-3000 Sader RAQ 3-Panel mounting system was assembled per the mfr's installation instructions.

The following additional hardware (such as PV modules and assorted parts which are not supplied as part of the mounting system) was also used.

Sample No.	Additional parts or hardware used.
2	PV Module Trina Solar, model TSM-240PA05
--	2x4 wooden beams to represent roof joist structure for negative load

Mounting method: Blue boxes show the 2x4 wooden beam setup for the negative load.

NW 2013-11-14: In the actual test setup we did not need the horizontal braces to stabilize the test setup.

~~[ ] Hydrostatic pressure method - A plywood box was constructed around the assembly. A sheet of polyethylene plastic was laid over the front of the modules or panels and raised to form the walls of the trough.~~

~~The calculated hydrostatic pressure was applied to the front (superstrate) of the module. The sample was maintained under this pressure for a period of 30 minutes. The hydrostatic pressure was removed and the sample inspected for any signs of structural or mechanical damage.~~

[x] Sandbag method - Sandbags equal to the calculated test load were applied evenly to the top (superstrate) of the assembly. The sample was maintained under this load for a period of 30 minutes. The static load was removed and the sample inspected for any signs of structural or mechanical damage.

~~[ ] Building integrated products - The distance of the laminate surface above the ground ( $X_1$ ) was measured with the product un-loaded, and again with the full load applied ( $X_2$ ). The deflection was calculated as the difference between the two measurements.~~

~~The weight is to be applied in a manner so as to not to impose shocks, uneven or additional forces on the module. The weight is to be applied in a manner to concentrate the force on the laminate and to minimize the force applied directly to the mounting frame.~~

	<del>Length (L)</del>	<del>L/240</del>
<del>Test value</del>	<del>N/A</del>	<del>N/A</del>

Load direction	Design Load (lbs/ft <sup>2</sup> )	Test Load (1.5 x design load in lbs/ft <sup>2</sup> )	Total Weight in lbs. (Test Load x Area in ft <sup>2</sup> )	Hydrostatic test load - inches of water (Test load x 0.1916667 in./[lbs/ft <sup>2</sup> ].)
Positive	30	45	2376.6	N/A
Negative	30	45	2376.6	N/A

Positive Loading: Anchor base are placed on the floor. Sandbags/Shotbags are placed directly on the superstrate of the module.

Negative Loading: Anchor base are secured to the 2x4 wooden beams. Loose sand is placed on the substrate of the module, until the sand is level to the frame structure. Then sandbags/shotbags are placed on the modules.

Each module is 39"x65"

Area of 3 modules is 52.8125 ft<sup>2</sup>

MECHANICAL LOADING TESTS (CONT'D):	Subject 2703 Sec. 21
------------------------------------	----------------------

Sample No.	1-4	
Test Start Date:Time	2013/11/14 9:45AM	
Test Completion Date:Time	2013/11/14 10:15AM	
Models:	SR-3000 Sader RAQ 3-Panel with Trina Modules identified in the table above.	
Tested By:	Nathan Wang	

RESULTS A

The sample [withstood] ~~[did not withstand]~~ 1-1/2 times the design positive load ~~[with]~~ [with no] visible signs of structural or mechanical failure to the sample.

~~Complete the following for BIPV products:~~

	$L/240$	$x_1$	$x_2$	$x_1 - x_2$
Value:	N/A	N/A	N/A	N/A

~~[ ] For building integrated products the maximum deflection of the module ( $x_1 - x_2$ ) [was] [was not] less than  $L/240$ , where L equals the clear span length of the module in feet.~~

NW 2013-11-14: The total weight was evenly distributed between all three modules.



MECHANICAL LOADING TESTS (CONT'D) :	Subject 2703 Sec. 21
-------------------------------------	----------------------

Sample No.	1-4	
Test Start Date:Time	2013/11/14 11:30AM	
Test Completion Date:Time	2013/11/14 12:00PM	
Models:	SR-3000 Sader RAQ 3-Panel with Trina Modules identified in the table above.	
Tested By:	Nathan Wang	

METHOD B

Negative Load Test - The same loading mechanism used in Method A was applied to the back (substrate) of the module and was maintained for a period of 30 min.

RESULTS B

The sample [withstood] ~~[did not withstand]~~ 1-1/2 times the design negative load ~~[with]~~ [with no] visible signs of structural or mechanical damage.

~~CAS to select the following:~~

~~[ ] For building integrated products the maximum deflection of the module [was] [was not] less than L/240, where L equals the clear span length of the module in feet.~~

Positive	Total Weight	2376.6		Negative	Total Weight	2376.6	
	Panel 1	Panel 2	Panel 3		Panel 1	Panel 2	Panel 3
<b>TOTAL:</b>	<b>796.1</b>	<b>792.8</b>	<b>792.2</b>	<b>TOTAL:</b>	<b>796.1</b>	<b>792.8</b>	<b>792.2</b>
	50.3	49.9	51.5		50.3	49.9	51.5
	50.1	45.4	50.9		50.1	45.4	50.9
	51.7	51.3	46.3		51.7	51.3	46.3
	51.9	49.4	49.6		51.9	49.4	49.6
	27.4	27.8	27.8		27.4	27.8	27.8
	27.3	27.2	28.1		27.3	27.2	28.1
	27.9	28.3	27.2		27.9	28.3	27.2
	27.7	28.1	28.3		27.7	28.1	28.3
	27.6	28.1	27.9		27.6	28.1	27.9
	27.7	27.6	27.7		27.7	27.6	27.7
	28	28	27.7		28	28	27.7
	27.7	27.8	27.2		27.7	27.8	27.2
	27.8	27.9	28		27.8	27.9	28
	27.2	27.4	27.2		27.2	27.4	27.2
	27.9	28	28.1		27.9	28	28.1
	27.9	27.8	28.5		27.9	27.8	28.5
	20	27.6	27.9		20	27.6	27.9
	20	27.2	21.4		20	27.2	21.4
	20	28	27.8		20	28	27.8
	20	20	28		20	20	28
	20	20	27.9		20	20	27.9
	20	20	27.4		20	20	27.4
	20	20	27.8		20	20	27.8
	20	20	27.5		20	20	27.5
	20	20	20		20	20	20
	20	20	20		20	20	20
	20	20	4.5		20	20	4.5
	20	20			20	20	
	20				20		

END OF DATASHEET PACKAGE. THIS PAGE INTENTIONALLY LEFT BLANK

Number of pages in this package  8  [ including additional pages      ]  
 (Fill in when using printed copy as record)

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CLIENT INFORMATION	
Company Name	SADER POWER ENTERPRISES LLC
Address	Suite 100 1539 Jackson Avenue New Orleans, LA 70130 United States

AUDIT INFORMATION:				
<input checked="" type="checkbox"/> Description of Tests	Per Standard No.	UL Subject 2703	Edition	Second: November 13, 2012
<input checked="" type="checkbox"/> Tests Conducted by +			Stephen Bartelt	
	Printed Name		Signature	
<input type="checkbox"/> UL Staff conducting or witnessing testing (WTDP, TMP, WMT only)				
<input type="checkbox"/> UL Staff supervising UL Staff in training				
<input type="checkbox"/> Authorized Signatory (CTDP, TPTDP, TCP, PPP, SMT)	Printed Name		Signature. Include date for CTDP, TPTDP, TCP, PPP, WMT, TMP, SMT	
Reviewed and accepted by qualified Project Handler	Nathan Wang		Nathan Wang	
	Printed Name		Signature	

TESTS TO BE CONDUCTED:			
Test No.	Done+ ++	Test Name	<input type="checkbox"/> Comments/Parameters <input type="checkbox"/> Tests Conducted by ++
1	2013/11/20	TEST METHOD FOR WEIGHT [MASS] OF COATING	

Instructions -

- + - When all tests are conducted by one person, printed name and signature can be inserted here instead of including printed name and signature on each page containing data. Must indicate number of pages in the data package.
- ++ - When test conducted by more than one person, printed name and signature of person conducting the test can be inserted next to the test name instead of including printed name and signature on each page containing data. Test dates may be recorded here instead of entering test dates on the individual datasheet pages. Must indicate number of pages in the data package.
- +++ - Use of this field is optional and may be employed differently. If used to include a date instead of entering the testing date on the individual datasheet pages, the date shall be the date the test was conducted.

Special Instructions -

Unless specified otherwise in the individual Methods, the tests shall be conducted under the following ambient conditions. Confirmation of these conditions shall be recorded at the time the test is conducted.

Ambient Temperature, C	N/A	Relative Humidity, %	N/A	Barometric Pressure, mBar	N/A		
------------------------	-----	----------------------	-----	---------------------------	-----	--	--

No general environmental conditions are specified in the Standard(s) or have been identified that could affect the test results or measurements.

RISK ANALYSIS RELATED TO TESTING PERFORMANCE:

The following types of risks have been identified. Take necessary precautions. This list is not all inclusive.

<input type="checkbox"/> Electric shock	<input type="checkbox"/> Radiation		
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<input type="checkbox"/> Energy related hazards	<input type="checkbox"/> Chemical hazards		
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<input type="checkbox"/> Fire	<input type="checkbox"/> Noise		
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<input type="checkbox"/> Heat related hazards	<input type="checkbox"/> Vibration		
---	------------------------------------	--	--

<input type="checkbox"/> Mechanical	<input type="checkbox"/> Other (Specify)___		
-------------------------------------	---	--	--

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The CAS Staff or Field Services Member, as indicated below, (a competent L1, L2 or L3 in a similar CCN/Standard for a similar test method) was utilized to conduct the witnessing of tests on behalf of the project handler. (Please complete the table below to document the rationale and approval.)

Name of UL Staff conducting WTDP	CCN/Standard to be witnessed	Test(s) to be witnessed	L1, L2 or L3 Competency	Similar CCN/Standard Competency	L3 Reviewer Approval & Date (Similar CCN/Standard)

TEST LOCATION: (To be completed by Staff Conducting the Testing)						
<input type="checkbox"/> UL or Affiliate	<input type="checkbox"/> WTDP	<input type="checkbox"/> CTDP	<input type="checkbox"/> TPTDP	<input type="checkbox"/> TCP	<input type="checkbox"/> PPP	
	<input type="checkbox"/> WMT	<input type="checkbox"/> TMP	<input type="checkbox"/> SMT			
Company Name:	UL LLC					
Address:	NBK					

TEST EQUIPMENT INFORMATION

UL test equipment information is recorded on Meter Use in UL's Laboratory Project Management (LPM) database.

UL test equipment information is recorded on <<insert location and local laboratory equipment system identification.>>

Inst. ID No.	Instrument Type	Test Number +, Test Title or Conditioning	Function /Range	Last Cal. Date	Next Cal. Date

+ - If Test Number is used, the Test Number must be identified on the data sheet pages or on the Data Sheet Package cover page.

The following additional information is required when using client's or rented equipment, or when a UL ID Number for an instrument number is not used. The Inst. ID No. below corresponds to the Inst. ID No. above.

Inst. ID No.	Make/Model/Serial Number/Asset No.

TEST SAMPLE IDENTIFICATION:

The table below is provided to establish correlation of sample numbers to specific product related information. Refer to this table when a test identifies a test sample by "Sample No." only.

Sample Card No.	Date Received	<input checked="" type="checkbox"/> Test No.+	Sample No.	Manufacturer, Product Identification and Ratings
1761042	2013-11-15	1	1	G90 sample from sader

+ - If Test Number is used, the Test Number or Numbers the sample was used in must be identified on the data sheet pages or on the Data Sheet Package cover page.

Sampling Procedure -

This document contains data using color and if printed, should be printed in color to retain legibility and the information represented by the color.

## METHOD

As described in ASTM A 90/A 90M - 09 Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings. Stripping of zinc alloy coatings containing less than 90 % zinc shall be done using the dilute hydrochloric acid method. Strip the zinc coating from the specimens by using one of the following methods: hydrochloric acid (1 + 1), hydrochloric acid-antimony trichloride solution, or sulfuric acid (25 + 75). For zinc alloy coatings containing less than 90 % zinc, the stripping shall be done using hydrochloric acid (1 + 1) or sulfuric acid (25 + 75).

Calculate the weight [mass] of zinc coating in Inch-Pound Units as follows:

$$C = [(W_1 - W_2)/A] \times K$$

C = weight [mass] of coating, oz/ft<sup>2</sup> of sheet,

W<sub>1</sub> = original weight [mass] of specimen, g,

W<sub>2</sub> = weight [mass] of stripped specimen, g,

A = area of sheet, in.<sup>2</sup> or mm<sup>2</sup>, and,

K = a constant = 5.08 when A is in in.<sup>2</sup> = 3.28 X 10<sup>3</sup> when A is in mm<sup>2</sup>.

NOTE - If the specimen was prepared with an area of 5.02 - 5.11 in.<sup>2</sup> (3237 - 3295 mm<sup>2</sup>), the loss of weight [mass] in grams is numerically equal to the weight [mass] of coating in ounces per square foot of sheet.

TEST METHOD FOR WEIGHT [MASS] OF COATING (CONT'D):	
--	--

Sample No.	1	
Test Start Date:Time	2013/11/20 - 12:24 pm	
Test Completion Date:Time	2013/11/20 - 12:55 pm	
Models:	G90 sample	
Tested By:	Stephen Bartelt	

RESULTS

Ambient Temperature, C	23.4	Relative Humidity, %	24	Barometric Pressure, mBar	N/A
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Substrate	Steel	Form	Rail	Thickness (mm)	1.452
Start Date:	2013/11/20	End Date:	2013/11/20		

Indicate stripping solution:	<input type="checkbox"/> hydrochloric acid - antimony trichloride
	<input checked="" type="checkbox"/> dilute hydrochloric acid (1+1)
	<input type="checkbox"/> sulfuric acid (25 + 75)

Results inserted from Validated Spreadsheet	Spreadsheet No:
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RESULTS

Validated Spreadsheet NBK63147

The Samples [comply] [~~do not comply~~] with minimum G90 weight of coating requirement.



END OF DATASHEET PACKAGE. THIS PAGE INTENTIONALLY LEFT BLANK

When a measurement is needed to determine compliance with a clause the actual measured value must be recorded in the space provided. A simple 'Yes' / 'No' response is not sufficient. (See 'UL Certification Program - Work Instructions for Completion of Construction Review Datasheets (CRD) For C-UL Mark' (00-OP-W0038) for details).

CONSTRUCTION COMPLIANCE REVIEW RECORD

Completed Construction Compliance Review was Reviewed and accepted by:	Nathan Wang	Nathan Wang
	(Qualified Reviewer) Printed Name	Signature

Sample Identification -

Sample Card No.	Date Received	Sample No.	Manufacturer, Product Identification and Ratings
N/A	N/A	N/A	Sader Power Enterprises LLC, SR-1000 Sader RAQ 1-Panel, SR-3000 SADER RAQ 3-Panel

[X] - No samples received or examined. Drawings or other information was provided to support the addition of a new model that is similar to a currently certified product.

Measurement Instrument Information -

Inst. ID No.	Instrument Type	Function/Range	Last Cal. Date	Next Cal. Date
N/A	N/A	N/A	N/A	N/A

The following additional information is required when using client's or rented equipment, or when a UL ID Number for an instrument number is not used. The Inst. ID No. below corresponds to the Inst. ID No. above.

Inst. ID No.	Make/Model/Serial Number/Asset No.
N/A	N/A

CONSTRUCTION COMPLIANCE REVIEW:					
The sample was reviewed for compliance with the construction requirements in the following Standard and compliance with applicable construction requirements is noted below.					
Standard	ULC/ORD C1703, Flat-Plate Photovoltaic Modules and Panels			Edition	01
Clause/Par. Reference and Construction Requirement	Comply			Comments/Measurements	Inst. ID No.
	Yes	No	N/A		
4. Construction					
4.1 General					
4.1.1 Module is Completely Assembled when Shipped from the Factory, Panel May be Completely Assembled or Provided in Subassemblies			X		
4.1.2 Module or Panel Assembly Bolt, Screw, or Other Part is Not Intended for Securing the Complete Device to its Support	x			rACKING SYSTEM UTILIZES TOP DOWN CLAMPS TO SECURE MODULES IN PLACE	
4.1.3 Incorporation of a Module or Panel into the Final Assembly Does Not Require Any Alteration to the Module or Panel	x				
4.1.4 Altering or Removal of Any Cover, Baffle, Insulation, or Shield is Not Required During Installation	X				
4.1.5 Parts are Prevented from Loosening or Turning	X				
4.1.6 Friction is Not the Sole Means of Preventing Loosening or Turning	X			TORQUE VALUE (11.8 FT-LBS) SPECIFIED FOR PROPER CLAMP LOAD.	
4.1.7 Adjustable or Movable Structural Part is Provided with a Locking Device			X		
4.1.8 Metals Used in Locations that May be Wet or Moist	X				
4.1.9 Edges, Projections, and Corners of Photovoltaic Modules and Panels	X				

4.1.10 Measurements for Determining Compliance with Clause 4.1.9			X		
4.2 Polymeric Materials					
4.2.1 Polymeric Material System Serving as the Enclosure of a Part Involving a Risk of Fire or Electric Shock			X		
4.2.2 Polymeric Material System Serving as the Support or Insulation of a Part Involving a Risk of Fire or Electric Shock			X		
4.2.3 Thermal Index of a Polymeric Substrate or Superstrate			X		
4.2.4 Polymeric Material that Serves as the Outer Enclosure			X		
4.2.5 Barrier or Liner of Polymeric Insulating Material			X		
4.3 Current-Carrying Parts and Internal Wiring					
4.3.1 Mechanical Strength and Ampacity			X		
4.3.2 Material for Current-Carrying Parts			X		
4.3.3 Wiring Used in a Module or Panel			X		
4.3.4 Insulation of a Splice			X		
4.3.5 Joint or Connection is Mechanically Secure and Provide Electrical Contact			X		
4.3.6 Securing an Uninsulated Live Part to its Supporting Surface			X		
4.3.7 Strain Relief Provided			X		
4.3.8 Location of the Wiring of a Module or Panel			X		
4.4 Wireways					
4.4.1 Enclosure for Wire is Smooth and Free from Sharp Edges, Burrs, Etc			X		
4.5 Connection Means					

4.5.1 Connection Means Considered to be Those to which Field-Installed Wiring is Connected when the Product is Installed			X		
4.5.2 Module or Panel is Capable of Accommodating at Least One of the Acceptable Wiring Systems			X		
4.5.3 Module or Panel is Provided with Wiring Terminals, Connectors, or Leads to Accommodate Current-Carrying Conductors of the Load Circuit			X		
4.5.4 Location of the Connection Means for a Module or Panel			X		
4.5.5 Size and Insulation of a Lead Intended to be Spliced in the Field to a Circuit Conductor			X		
4.5.6 Free Length of a Lead for Field Connection			X		
4.5.7 Wire-Binding Screw or Stud- and Nut-Type Terminal Used to Terminate Conductors Not Larger than 5.3 mm <sup>2</sup>			X		
4.5.8 Wire Connector Intended to Accommodate Conductors			X		
4.5.9 Separable Multipole Connectors are Polarized			X		
4.5.10 Grounding Member is First to Make and Last to Break Contact with the Mating Connector			X		
4.6 Bonding and Grounding					
4.6.1 Module or Panel Has a Means for Grounding All Accessible Conductive Parts			X	RACKING SYSTEMS HAVE NOT BEEN EVALUATED FOR BONDING	
4.6.2 Routine Maintenance Does Not Involve Breaking or Disturbing the Bonding Path			X		
4.6.3 Bonding is by a Positive Means			X		

4.6.4 Acceptability of a Bolted or Screwed Connection that Incorporates a Star Washer Under the Screwhead or a Serrated Screwhead			X		
4.6.5 All Joints in the Bonding Path are Mechanically Secure			X		
4.6.6 Separate Bonding Conductor or Strap			X		
4.6.7 Corrosion Protection for a Ferrous Metal Part in the Grounding Path			X	ALL STEEL COMPONENTS ARE HOT DIPPED WITH A MINIMUM G90 ZINC COATING	
4.6.8 Metal-to-Metal Multiple-Bearing Pin-Type Hinge is an Acceptable Bonding Means			X		
4.6.9 Identification of a Terminal of a Module or Panel Intended to Accommodate an Equipment Bonding Conductor			X		
4.6.10 Location of Marking Used to Identify an Equipment-Bonding Terminal			X		
4.6.11 Visibility of a Green-Coloured Part Used to Identify the Equipment-Bonding Terminal			X		
4.6.12 Green Insulation on the Surface of a Lead of a Module or Panel Intended for the Connection of an Equipment-Bonding Conductor			X		
4.7 Spacings					
4.7.1 Spacings Between Uninsulated Live Parts Not of the Same Potential and Between a Live Part and an Accessible Metal Part			X		
4.7.2 Measurement of Spacings at a Field-Wiring Terminal			X		
4.7.3 Surfaces Separated by 0.33 mm or Less are Considered in Contact			X		

4.7.4 Potential Involved is the Maximum Voltage for Tables 2 and 3			X		
4.7.5 Barrier or Liner of Electrical Grade Fibre Provided the Sole Insulation Between Parts			X		
4.8 Wiring Components					
4.8.1 General					
4.8.1.1 Relevant Clauses			X		
4.8.1.2 Internal Volume			X		
4.8.1.3 Provision for Accommodating a Wiring System Employing a Raceway or Cable			X		
4.8.1.4 No More than One Openings when the Module or Panel is Shipped from the Factory			X		
4.8.1.5 Use of Gaskets and Seals			X		
4.8.1.6 Wiring Compartment that is Secured to a Substrate by Means of an Adhesive			X		
4.8.2 Metallic Wiring Compartments					
4.8.2.1 Sheet Steel Wall Thickness			X		
4.8.2.2 Sheet Aluminum Wall Thickness			X		
4.8.2.3 Cast Iron, Aluminum, Brass, or Bronze Wall Thickness			X		
4.8.2.4 Threaded Hole in a Metal Wiring Compartment for the Connection of Rigid Metal Conduit			X		
4.8.2.5 Threads in the Metal and Bushing if Threads for Conduct Connection are Tapped all the Way Through			X		
4.8.2.6 Threads in the Metal and Inlet Hole if Threads are Not Tapped all the Way Through			X		
4.8.2.7 Flat Surface of Sufficient Area Around the Opening to Accept the Bearing Surfaces of the Bushing and Lock Washer			X		

4.8.3 Non-Metallic Wiring Compartments					
4.8.3.1 Considerations of 4.2.1 Also Apply			X		
4.8.3.2 Non-Metallic Wiring Compartment Intended to Accommodate Non-Metallic Conduit			X		
4.8.3.3 Marking of a Module or Panel Provided with a Non-Metallic Wiring Compartment Having a Threaded Opening			X		
4.8.3.4 Socket for the Connection of Non-Metallic Conduit in a Non-Metallic Compartment			X		
4.8.3.5 Knockout or Opening in a Non-Metallic Wiring Compartment Intended to Accommodate Rigid Non-Metallic Conduit			X		
4.9 Corrosion Resistance					
4.9.1 Coatings for Sheet Steel Having Thickness of 3.05 mm or More that May be Exposed to the Weather			X		
4.9.2 Coatings for Sheet Steel Having Thickness of Less than 3.05 mm that May be Exposed to the Weather			X		
4.9.3 Evaluation of the Coating System	X			WEIGHT OF COATING USED TO DETERMINE EQUIVALENCE TO MINIMUM g90	
4.9.4 Acceptability of Other Finishes			X		
4.9.5 Annealed Coating on Sheet Steel is Additionally Painted in the Bent or Formed Areas			X		
4.9.6 Simple Sheared or Cut Edges and Punched Holes Do Not Require to be Additionally Protected	X				
4.9.7 Corrosion Protection of Iron or Steel Serving as a Necessary Part But Not Exposed to the Weather			X		



4.9.8 Use of Aluminum, Stainless Steel, and Polymeric Materials without Corrosion Protection			X		
4.9.9 Evaluation of Materials Not Specifically Mentioning in this Section			X		
4.9.10 Acceptability of Evidence of Compliance			X		
4.10 Accessibility of Uninsulated Live Parts					
4.10.1 Accessible Parts Do Not Involve a Risk of Electric Shock			X		
4.10.2 Evaluation of the Module or Panel			X		
4.10.3 Determining of Voltages Between Parts of the Individual Unconnected Product			X		
4.10.4 Determining if a Part is Accessible			X		
4.10.5 Application of the Probe			X		
4.11 Fire Resistance					
4.11.1 Module or Panel Intended for Stand-Off, Rack, or Direct Mounting in Combination with a Specified Roof or Intended for Integral Mounting			X		
4.12 Superstrate					
4.12.1 Compliance of a Module or Panel Superstrate			X		

Number of pages in this package \_\_\_\_ [ including additional pages \_\_\_\_ ]  
 (Fill in when using printed copy as record)

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CLIENT INFORMATION	
Company Name	SADER POWER ENTERPRISES LLC
Address	Suite 100 1539 Jackson Avenue New Orleans, LA 70130 United States

AUDIT INFORMATION:				
<input checked="" type="checkbox"/> Description of Tests	Per Standard No.	UL Subject 2703	Edition	Second: November 13, 2012
<input checked="" type="checkbox"/> Tests Conducted by +	Dale Petersen		Dale Petersen	
	Printed Name		Signature	
<input type="checkbox"/> UL Staff conducting or witnessing testing (WTDP, TMP, WMT only)				
<input type="checkbox"/> UL Staff supervising UL Staff in training				
<input type="checkbox"/> Authorized Signatory (CTDP, TPTDP, TCP, PPP, SMT)	Printed Name		Signature. Include date for CTDP, TPTDP, TCP, PPP, WMT, TMP, SMT	
Reviewed and accepted by qualified Project Handler	Nathan Wang		Nathan Wang	
	Printed Name		Signature	

TESTS TO BE CONDUCTED:			
Test No.	Done+ ++	Test Name	<input type="checkbox"/> Comments/Parameters <input type="checkbox"/> Tests Conducted by ++
1	X	BONDING PATH RESISTANCE TEST:	Done, 2014-03-11, Dale Petersen
2	X	TEMPERATURE CYCLING TEST	Done, 2014-04-23, Dale Petersen
3	X	BONDING PATH RESISTANCE TEST - Following the TEMPERATURE CYCLING TEST:	Done, 2014-04-23, Dale Petersen
4	X	HUMIDITY CYCLING TEST	Done, 2014-04-03, Dale Petersen
5	X	BONDING PATH RESISTANCE TEST - Following the HUMIDITY TEST:	Done, 2014-04-03, Dale Petersen

Instructions -

+ - When all tests are conducted by one person, printed name and signature can be inserted here instead of including printed name and signature on each page containing data. Must indicate number of pages in the data package.

++ - When test conducted by more than one person, printed name and signature of person conducting the test can be inserted next to the test name instead of including printed name and signature on each page containing data. Test dates may be recorded here instead of entering test dates on the individual datasheet pages. Must indicate number of pages in the data package.

+++ - Use of this field is optional and may be employed differently. If used to include a date instead of entering the testing date on the individual datasheet pages, the date shall be the date the test was conducted.

TEST LOCATION: (To be completed by Staff Conducting the Testing)						
<input checked="" type="checkbox"/> UL or Affiliate	<input type="checkbox"/> WTDP	<input type="checkbox"/> CTDP	<input type="checkbox"/> TPTDP	<input type="checkbox"/> TCP	<input type="checkbox"/> PPP	
	<input type="checkbox"/> WMT	<input type="checkbox"/> TMP	<input type="checkbox"/> SMT			
Company Name:	UL, LLC					
Address:	2191 Zanker Road, San Jose, CA 95131					

TEST EQUIPMENT INFORMATION

UL test equipment information is recorded on Meter Use in UL's Laboratory Project Management (LPM) database.

UL test equipment information is recorded on <<insert location and local laboratory equipment system identification.>>

Inst. ID No.	Instrument Type	Test Number +, Test Title or Conditioning	Function /Range	Last Cal. Date	Next Cal. Date

+ - If Test Number is used, the Test Number must be identified on the data sheet pages or on the Data Sheet Package cover page.

The following additional information is required when using client's or rented equipment, or when a UL ID Number for an instrument number is not used. The Inst. ID No. below corresponds to the Inst. ID No. above.

Inst. ID No.	Make/Model/Serial Number/Asset No.

TEST SAMPLE IDENTIFICATION:

The table below is provided to establish correlation of sample numbers to specific product related information. Refer to this table when a test identifies a test sample by "Sample No." only.

Sample Card No.	Date Received	[x] Test No.+	Sample No.	Manufacturer, Product Identification and Ratings
1797352	2014-01-15	1,2,3	1,3,5,7,9	Sader Power Enterprises LLC, SR-3000 Sader RAQ 3-Panel  Assorted bonded connection interfaces shown below.
1797352	2014-01-15	1,4,5	2,4,6,8,10	Sader Power Enterprises LLC, SR-3000 Sader RAQ 3-Panel  Assorted bonded connection interfaces shown below.
1797352	2014-01-15	1-5	1,2	Frame segment from UL Listed Trina Solar PV modules TSM-XXXPA05
1813918	2014-02-12	1-5	11	SS Washer Hardware
1823387	2014-02-26	1-5	12	Tyco, SolarLok hardware
1823388	2014-02-26	1-5	13	East Coast Lightning Equipment, BF15T

+ - If Test Number is used, the Test Number or Numbers the sample was used in must be identified on the data sheet pages or on the Data Sheet Package cover page.

[ ] Sampling Procedure -

[x] This document contains data using color and if printed, should be printed in color to retain legibility and the information represented by the color.

Assembly No.	Photo with termination
Assembly #1: Rail, Clamp, PV Module Frame  Sample 1 & 2	
Assembly #2: Starter Bracket (A) to Rail to BF15T lug (I)  Sample 3 & 4  Ground electrode conductor clamped into blue dot of (I)	

Assembly No.	Photo with termination
Assembly #3: Rail to Brace  Sample 5 & 6	

Assembly #4: Roof Anchor (feet) I to Rail to SolarLok ground (H)	
Sample 7 & 8	
Assembly #5: Ground Lug (F) to Rail to Washer Ground (G)	
Sample 9 & 10	
Washer Ground (G) will need to be separately added to assembly.	

NW 2014-04-24: Connection Point F & I will not be used for certification at this time.

BONDING PATH RESISTANCE TEST:	Subject 2703 Sec. 13
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Sample No.	1-10	
Test Start Date:Time	2014-03-11, 13:00	
Test Completion Date:Time	2014-03-11, 14:00	
Models:	SR-3000 Sader RAQ 3-Panel Bonding connection interfaces	
Tested By:	Dale Petersen	

#### METHOD

The impedance of the bonding-for-grounding connection of various points indicated below was measured. Using a ~~[60 Hz]~~ ~~[50 Hz]~~ [DC] source of supply, a current of TWICE the maximum Overcurrent Protection rating specified for the product was passed between the equipment grounding means and the parts indicated below. The impedance was then calculated.

Description of bonding termination points:					
Termination	Location	Mounting Hole Diameter	Lug, bolt or other	Conductor size, or metal on metal	Torque, or factory set
A	Starter Bracket			AWG 10 Solid	11.8 ft-lbs
B	PV Module Frame			AWG 10 Solid	11.8 ft-lbs
C	Rail			AWG 10 Solid	11.8 ft-lbs
D	Brace			AWG 10 Solid	11.8 ft-lbs
E	Roof Anchor			AWG 10 Solid	11.8 ft-lbs
F	Ground Lug			AWG 10 Solid	Factory Set
G	Washer Ground			AWG 10 Solid	11.8 ft-lbs
H	SolarLok			AWG 10 Solid	<del>11.8 ft-lbs</del> 45 in-lbs / 25 in-lbs
I	BF15T Lug			AWG 10 Solid	<del>11.8 ft-lbs</del> 75 in-lbs

Circuit path being tested:
----------------------------

First Termination (A,B,C...)	Second Termination (A,B,C...)	Overcurrent Protection rating	Test Current (A)
A	I	15	30
B	C	15	30
C	D	15	30
E	H	15	30
F	G	15	30

Special instructions:	See photos above.
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NW 2014-04-24: Connection Point F & I will not be used for certification at this time.

### RESULTS

Sample	Part tested	Measured Voltage Drop, (V)	Measured Current (A)	Calculated Impedance, ohms (V/A)
1	Assembly 1	0.242	30.0	0.0081
2	Assembly 1	0.165	30.0	0.0055
3	Assembly 2	0.076	30.0	0.0025
4	Assembly 2	0.103	30.0	0.0034
5	Assembly 3	0.178	30.0	0.0059
6	Assembly 3	0.153	30.0	0.0051
7	Assembly 4	0.112	30.0	0.0037
8	Assembly 4	0.123	30.0	0.0041
9	Assembly 5	0.090	30.0	0.0030
10	Assembly 5	0.077	30.0	0.0026

[ ] Test equipment was used which automatically measured the impedance of the sample so the voltage and current values were not recorded.

The grounding impedance [did not exceed] ~~[exceeded]~~ 0.1 ohms.

Formulas used;

Shunt resistance = ~~===~~ .001 Ω.

Applied Amperage = = = = = 30 Amps

Resistance = = = = 0.0081 Ohms

NW 2014-04-24: Connection Point F & I will not be used for certification at this time.

TEMPERATURE CYCLING TEST	Subject 2703 Sec. 17
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### METHOD

One representative sample of the ~~[complete product]~~ [each critical construction item] was placed in a chamber. Leads were connected to terminals and mounting surfaces of each sample to allow for continuous

individual detection of circuit continuity:

Samples tested are described as follows:

Sample No.	
1	Assembly 1
3	Assembly 2
5	Assembly 3
7	Assembly 4
9	Assembly 5

Description of bonding termination points:						
Sample No.	Termination point	Location on product	Mounting Hole Diameter	Lug, bolt or other	Conductor size, or metal on metal	Torque, or factory set
3	A	Starter Bracket			AWG 10 Solid	11.8 ft-lbs
1	B	PV Module Frame			AWG 10 Solid	11.8 ft-lbs
1,3,5,7,9	C	Rail			AWG 10 Solid	11.8 ft-lbs
5	D	Brace			AWG 10 Solid	11.8 ft-lbs
7	E	Roof Anchor			AWG 10 Solid	11.8 ft-lbs
9	F	Ground Lug			AWG 10 Solid	Factory Set
9	G	Washer Ground			AWG 10 Solid	11.8 ft-lbs
7	H	SolarLok			AWG 10 Solid	<del>11.8 ft-lbs</del> 45 in-lb 45 in-lb
3	I	BF15T Lug			AWG 10 Solid	<del>11.8 ft-lbs</del> 75 in-lb

**[x]** Circuit continuity through the grounding path was monitored between the same points used for the grounding continuity test.

First Termination (A,B,C...)	Second Termination (A,B,C...)
A	I
B	C
C	D
E	H
F	G

TEMPERATURE CYCLING TEST (cont'D)	Subject 2703 Sec. 17
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The temperature of the chamber as a function of time was varied as shown in Fig. 17.1 of UL Subject 2703. The temperature of the samples under test, were measured using thermocouples placed near the center of the sample.

Each cycle consisted of a chamber temperature transition from 25°C to -40°C, dwell at -40°C (+/- 2°C), transition from -40°C to 90°C, dwell at 90°C (+/- 2°C), and a transition to 25°C.

All temperature transitions were at maximum of 120°C/h. All chamber temperature dwell times were for a minimum of 30 minutes, and until the module temperature was within 2C of the chamber temperature, to a maximum of 1 hr 45 min. Total exposure was 200 such cycles.

Following the last excursion to 90°C, the sample was subjected to the Bonding Path Resistance Test.



TEMPERATURE CYCLING TEST (cont'D)		Subject 2703 Sec. 17
Sample No.	1,3,5,7,9	
Test Start Date:Time	2014-03-19, 12:03	
Test Completion Date:Time	2014-04-23, 14:00	
Models:	SR-3000 Sader RAQ 3-Panel Bonding connection interfaces	
Tested By:	Dale Petersen	
RESULTS		

There ~~was~~ [was no] loss of circuit continuity.

There ~~was~~ [was no] corrosion of metal parts

**[x]** Immediately following the removal of the sample from the test chamber, the BONDING PATH RESISTANCE TEST was conducted

NW 2014-04-24: Connection Point F & I will not be used for certification at this time.

BONDING PATH RESISTANCE TEST - FOLLOWING THE TEMPERATURE CYCLING TEST:		Subject 2703 Sec. 13
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Sample No.	1,3,5,7,9	
Test Start Date:Time	2014-04-23, 14:15	
Test Completion Date:Time	2014-04-23, 15:15	
Models:	SR-3000 Sader RAQ 3-Panel Bonding connection interfaces	
Tested By:	Dale Petersen	

#### METHOD

The impedance of the bonding-for-grounding connection of various points indicated below was measured. Using a ~~[60 Hz]~~ ~~[50 Hz]~~ [DC] source of supply, a current of TWICE the maximum Overcurrent Protection rating specified for the product was passed between the equipment grounding means and the parts indicated below. The impedance was then calculated.

Description of bonding termination points:					
Termination	Location	Mounting Hole Diameter	Lug, bolt or other	Conductor size, or metal on metal	Torque, or factory set
A	Starter Bracket			AWG 10 Solid	11.8 ft-lbs
B	PV Module Frame			AWG 10 Solid	11.8 ft-lbs

C	Rail			AWG 10 Solid	11.8 ft-lbs
D	Brace			AWG 10 Solid	11.8 ft-lbs
E	Roof Anchor			AWG 10 Solid	11.8 ft-lbs
F	Ground Lug			AWG 10 Solid	Factory Set
G	Washer Ground			AWG 10 Solid	11.8 ft-lbs
H	SolarLok			AWG 10 Solid	<del>11.8 ft-lbs</del> 45 in-lb 45 in-lb
I	BF15T Lug			AWG 10 Solid	<del>11.8 ft-lbs</del> 75 in-lb

Circuit path being tested:			
First Termination (A,B,C...)	Second Termination (A,B,C...)	Overcurrent Protection rating	Test Current (A)
A	I	15	30
B	C	15	30
C	D	15	30
E	H	15	30
F	G	15	30

Special instructions:	See photos above.
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RESULTS

Sample	Part tested	Measured Voltage Drop, (V)	Measured Current (A)	Calculated Impedance, ohms (V/A)
1	Assembly 1	0.305	30.0	0.01017
3	Assembly 2	0.142	30.0	0.00473
5	Assembly 3	0.296	30.0	0.00987
7	Assembly 4	0.152	30.0	0.00507
9	Assembly 5	0.127	30.0	0.00423

[ ] Test equipment was used which automatically measured the impedance of the sample so the voltage and current values were not recorded.

The grounding impedance [did not exceed] [~~exceeded~~] 0.1 ohms.

Formulas used;

Shunt resistance =  $0.001 \Omega$ .

Applied Amperage = = = = = 30 Amps

Resistance = = = = 0.01017 Ohms

NW 2014-04-24: Connection Point F & I will not be used for certification at this time.

HUMIDITY CYCLING TEST	Subject 2703 Sec. 18
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METHOD

One representative sample of the ~~[complete product]~~ [each critical construction item] was placed in a chamber. Leads were connected to terminals and mounting surfaces of each sample to allow for continuous individual detection of circuit continuity:

Samples tested are described as follows:

Sample No.	
2	Assembly 1
4	Assembly 2
6	Assembly 3
8	Assembly 4
10	Assembly 5

Description of bonding termination points:						
Sample No.	Termination point	Location on product	Mounting Hole Diameter	Lug, bolt or other	Conductor size, or metal on metal	Torque, or factory set
4	A	Starter Bracket			AWG 10 Solid	11.8 ft-lbs
2	B	PV Module Frame			AWG 10 Solid	11.8 ft-lbs
2, 4, 6, 8, 10	C	Rail			AWG 10 Solid	11.8 ft-lbs
6	D	Brace			AWG 10 Solid	11.8 ft-lbs
8	E	Roof Anchor			AWG 10 Solid	11.8 ft-lbs
10	F	Ground Lug			AWG 10 Solid	Factory Set
10	G	Washer Ground			AWG 10 Solid	11.8 ft-lbs
8	H	SolarLok			AWG 10 Solid	<del>11.8 ft-lbs</del> 45 in-lb 25 in-lb
4	I	BF15T Lug			AWG 10 Solid	<del>11.8 ft-lbs</del> 75 in-lb

**[x]** Circuit continuity through the grounding path was monitored between the same points used for the grounding continuity test.

First Termination (A, B, C...)	Second Termination (A, B, C...)
A	C
B	C
C	D
E	H
F	G



The temperature and humidity of the chamber as a function of time were varied and controlled as shown in Fig. 18.1 of UL Subject 2703.

Each cycle consisted of a transition in the chamber temperature from 25°C to 85°C, dwell at 85°C and 85 percent relative humidity, transition from 85°C to -40°C, dwell at -40°C, and transition from -40°C to 25°C.

Chamber temperature transitions were at a maximum of 120 or 200°C/h, as shown.

Total exposure was ten such cycles.

Following the Humidity Cycling Test, the modules were subjected to the BONDING PATH RESISTANCE TEST.

HUMIDITY CYCLING TEST (cont'D):		Subject 2703 Sec. 18
Sample No.	2,4,6,8,10	
Test Start Date:Time	2014-03-24, 15:14	
Test Completion Date:Time	2014-04-03, 07:30	
Models:	SR-3000 Sader RAQ 3-Panel Bonding connection interfaces	
Tested By:	Dale Petersen	
RESULTS		

There ~~was~~ [was no] loss of circuit continuity.

There ~~was~~ [was no] corrosion of metal parts.

Immediately following the removal of the sample from the test chamber, the BONDING PATH RESISTANCE TEST was conducted.

NW 2014-04-24: Connection Point F & I will not be used for certification at this time.

BONDING PATH RESISTANCE TEST - FOLLOWING THE HUMIDITY TEST:		Subject 2703 Sec. 13
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Sample No.	2,4,6,8,10	
Test Start Date:Time	2014-04-03, 08:00	
Test Completion Date:Time	2014-04-03, 09:00	
Models:	SR-3000 Sader RAQ 3-Panel Bonding connection interfaces	
Tested By:	Dale Petersen	

#### METHOD

The impedance of the bonding-for-grounding connection of various points indicated below was measured. Using a ~~[60 Hz]~~ ~~[50 Hz]~~ [DC] source of supply, a current of TWICE the maximum Overcurrent Protection rating specified for the product was passed between the equipment grounding means and the parts indicated below. The impedance was then calculated.

Description of bonding termination points:					
Termination	Location	Mounting Hole Diameter	Lug, bolt or other	Conductor size, or metal on metal	Torque, or factory set
A	Starter Bracket			AWG 10 Solid	11.8 ft-lbs

B	PV Module Frame			AWG 10 Solid	11.8 ft-lbs
C	Rail			AWG 10 Solid	11.8 ft-lbs
D	Brace			AWG 10 Solid	11.8 ft-lbs
E	Roof Anchor			AWG 10 Solid	11.8 ft-lbs
F	Ground Lug			AWG 10 Solid	Factory Set
G	Washer Ground			AWG 10 Solid	11.8 ft-lbs
H	SolarLok			AWG 10 Solid	<del>11.8 ft-lbs</del> 45 in-lb 25 in-lb
I	BF15T Lug			AWG 10 Solid	<del>11.8 ft-lbs</del> 75 in-lb

Circuit path being tested:			
First Termination (A,B,C...)	Second Termination (A,B,C...)	Overcurrent Protection rating	Test Current (A)
A	I	15	30
B	C	15	30
C	D	15	30
E	H	15	30
F	G	15	30

Special instructions:	See photos above.
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RESULTS

Sample	Part tested	Measured Voltage Drop, (V)	Measured Current (A)	Calculated Impedance, ohms (V/A)
2	Assembly 1	0.198	30.0	0.0066
4	Assembly 2	0.157	30.0	0.0052
6	Assembly 3	0.192	30.0	0.0064
8	Assembly 4	0.219	30.0	0.0073
10	Assembly 5	0.159	30.0	0.0053

[ ] Test equipment was used which automatically measured the impedance of the sample so the voltage and current values were not recorded.

The grounding impedance [did not exceed] [~~exceeded~~] 0.1 ohms.

Formulas used;

Shunt resistance = === .001 Ω.

Applied Amperage = = = = = 30 Amps

Resistance = = = = 0.0066 Ohms

NW 2014-04-24: Connection Point F & I will not be used for certification at this time.

END OF DATASHEET PACKAGE. THIS PAGE INTENTIONALLY LEFT BLANK



Number of pages in this package 14 [ including additional pages      ]

(Fill in when using printed copy as record)

CLIENT INFORMATION	
Company Name	SADER POWER ENTERPRISES LLC
Address	Suite 100 1539 Jackson Avenue New Orleans, LA 70130 United States

AUDIT INFORMATION:				
<input checked="" type="checkbox"/> Description of Tests	Per Standard No.	UL Subject 2703	Edition	Second: November 13, 2012
<input checked="" type="checkbox"/> Tests Conducted by +	Alberto Tapia		Alberto Tapia	
	Printed Name		Signature	
<input type="checkbox"/> UL Staff conducting or witnessing testing (WTDP, TMP, WMT only)				
<input type="checkbox"/> UL Staff supervising UL Staff in training				
<input type="checkbox"/> Authorized Signatory (CTDP, TPTDP, TCP, PPP, SMT)	Printed Name		Signature. Include date for CTDP, TPTDP, TCP, PPP, WMT, TMP, SMT	
Reviewed and accepted by qualified Project Handler	Nathan Wang		Nathan Wang	
	Printed Name		Signature	

TESTS TO BE CONDUCTED:			
Test No.	Done+++	Test Name	<input type="checkbox"/> Comments/ Parameters <input type="checkbox"/> Tests Conducted by ++
1	2014-04-01	BONDING CONDUCTOR TEST (Limited-Short Circuit) [followed by Bonding Path Resistance Test] (Method B):	

Instructions -

+ - When all tests are conducted by one person, printed name and signature can be inserted here instead of including printed name and signature on each page containing data. Must indicate number of pages in the data package.

++ - When test conducted by more than one person, printed name and signature of person conducting the test can be inserted next to the test name instead of including printed name and signature on each page containing data. Test dates may be recorded here instead of entering test dates on the individual datasheet pages. Must indicate number of pages in the data package.

+++ - Use of this field is optional and may be employed differently. If used to include a date instead of entering the testing date on the individual datasheet pages, the date shall be the date the test was conducted.

Special Instructions -

Unless specified otherwise in the individual Methods, the tests shall be conducted under the following ambient conditions. Confirmation of these conditions shall be recorded at the time the test is conducted.

Ambient Temperature, C	N/A	Relative Humidity, %	N/A	Barometric Pressure, mBar	N/A
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No general environmental conditions are specified in the Standard(s) or have been identified that could affect the test results or measurements.

RISK ANALYSIS RELATED TO TESTING PERFORMANCE:

The following types of risks have been identified. Take necessary precautions. This list is not all inclusive.

<input checked="" type="checkbox"/> Electric shock	<input type="checkbox"/> Radiation
--	------------------------------------

<input type="checkbox"/> Energy related hazards	<input type="checkbox"/> Chemical hazards
---	---

<input type="checkbox"/> Fire	<input type="checkbox"/> Noise
-------------------------------	--------------------------------

<input checked="" type="checkbox"/> Heat related hazards	<input type="checkbox"/> Vibration
--	------------------------------------

<input type="checkbox"/> Mechanical	<input type="checkbox"/> Other (Specify)___
-------------------------------------	---

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The CAS Staff or Field Services Member, as indicated below, (a competent L1, L2 or L3 in a similar CCN/Standard for a similar test method) was utilized to conduct the witnessing of tests on behalf of the project handler. (Please complete the table below to document the rationale and approval.)

Name of UL Staff conducting WTDP	CCN/Standard to be witnessed	Test(s) to be witnessed	L1, L2 or L3 Competency	Similar CCN/Standard Competency	L3 Reviewer Approval & Date (Similar CCN/Standard)


TEST LOCATION: (To be completed by Staff Conducting the Testing)						
<input checked="" type="checkbox"/> UL or Affiliate	<input type="checkbox"/> WTDP	<input type="checkbox"/> CTDP	<input type="checkbox"/> TPTDP	<input type="checkbox"/> TCP	<input type="checkbox"/> PPP	
	<input type="checkbox"/> WMT	<input type="checkbox"/> TMP	<input type="checkbox"/> SMT			
Company Name:	UL LLC					
Address:	333 Pfingsten Rd, Northbrook, IL 60062					

TEST EQUIPMENT INFORMATION

UL test equipment information is recorded on Meter Use in UL's Laboratory Project Management (LPM) database.

UL test equipment information is recorded on <<insert location and local laboratory equipment system identification.>>

Inst. ID No.	Instrument Type	Test Number +, Test Title or Conditioning	Function /Range	Last Cal. Date	Next Cal. Date

+ - If Test Number is used, the Test Number must be identified on the data sheet pages or on the Data Sheet Package cover page.

The following additional information is required when using client's or rented equipment, or when a UL ID Number for an instrument number is not used. The Inst. ID No. below corresponds to the Inst. ID No. above.

Inst. ID No.	Make/Model/Serial Number/Asset No.

TEST SAMPLE IDENTIFICATION:

The table below is provided to establish correlation of sample numbers to specific product related information. Refer to this table when a test identifies a test sample by "Sample No." only.

Sample Card No.	Date Received	[*] Test No.+	Sample No.	Manufacturer, Product Identification and Ratings
1797176	2014-01-15	1-2	1A-5F	Sader Power Enterprises LLC, SR-3000 Sader RAQ 3-Panel  Assorted bonded connection interfaces shown below.
1797176	2014-01-15	1-2	1A-5F	Frame segment from UL Listed Trina Solar PV modules TSM-XXXPA05
1811620	2014-02-07	1-2	5A-5F	Washer Grounding Assembly
1821130	2014-02-24	1-2	5A-5F	Tyco, SolarLok
1821131	2014-02-24	1-2	2A-2F	East Coast Lightning Equipment, BF15T

+ - If Test Number is used, the Test Number or Numbers the sample was used in must be identified on the data sheet pages or on the Data Sheet Package cover page.

[ ] Sampling Procedure -

[ ] This document contains data using color and if printed, should be printed in color to retain legibility and the information represented by the color.

Assembly No.	Photo with termination
Assembly #1: Rail, Clamp, PV Module Frame  Sample 1A,1B,1C,1D,1E,1F	
Assembly #2: Starter Bracket (A) to Rail to BF15T Lug (I)  Sample 2A,2B,2C,2D,2E,2F  Ground electrode conductor clamped into blue dot of (I)	

NW 2014-04-24: Connection Point I will not be used for certification at this time.

Assembly No.	Photo with termination
Assembly #3: Rail to Brace  Sample 3A,3B,3C,3D,3E,3F  11.8ft-lb torque spec from Rail to Brace.	

<p>Assembly #4: Roof Anchor (feet) (E) to Rail to SolarLok ground (H)</p> <p>Sample 4A,4B,4C,4D,4E,4F</p> <p>SolarLok (H) will need to be separately added to assembly.</p>	
<p>Assembly #5: Ground Lug (F) to Rail to Washer Ground (G)</p> <p>Sample 5A,5B,5C,5D,5E,5F</p> <p>Washer Ground (G) will need to be separately added to assembly. Torqued to 11.85 ft-lb.</p>	

NW 2014-04-24: Connection Point F will not be used for certification at this time.

BONDING CONDUCTOR TEST (LIMITED-SHORT CIRCUIT) [FOLLOWED BY BONDING PATH RESISTANCE TEST] (METHOD B):		UL2703 cl. 22
Sample No.	1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, 5A, 5B.	
Test Start Date: Time	2014-04-01:8:00AM	
Test Completion Date: Time	2014-04-01:10:00AM	
Model:	See Sample Description	

METHOD

This test was conducted across the bonding junction.

The test circuit was capable of delivering 5000 Amps at 240 Volts AC and having a power factor of 90-100 percent through shorted bus bars, with a Listed branch-circuit 15 Amp fuse placed in series with the sample under test. The test sample circuit was connected to the bus bar by 1.22 m (4 ft.) of No. 12 AWG wire. The test was conducted until ultimate conditions occurred, i.e. fuse opened or bonding path failed.

The Bonding Path Resistance Test was conducted after the Bonding Conductor test.

The above test parameters [were] [~~were not~~] applied.

The fuse [did] [~~did not~~] open.

2014-04-01

METHOD

While in an ambient temperature of 25 +/- 3°C, a direct current supplied by an external source, was caused to flow through the bonding junction. The current was increased from zero to the value specified below (twice the series fuse rating for the module/module-component under test, or 25-Amps, whichever is less) uniformly in approximately 5 s, and was maintained at the level for 2 minutes at which time the measurement was taken.

After allowing a cooling time of at least 15 minutes, the bonding resistance is also measured from the Mounting/Bonding clamp to furthest point on the vertical rack fixture.

RESULTS

Bonding Junction Tested	Sample Assm. No.	Measured Voltage Drop Vdc	Test Current A, dc	Maximum Resistance, Milliohms
Assembly #1: Rail, Clamp, PV Module Frame	1A, 1B	1A:0.0581 1B:0.628	25	1A:0.0023 1B:0.0251
Assembly #2: Starter Bracket (A) to Rail to BF15T Lug (I)	2A, 2B	2A:0.0357 2B:0.0281	25	2A:0.0014 2B:0.0011
Assembly #3: Rail to Brace	3A, 3B	3A:0.115 3B:0.118	25	3A:0.0046 3B:0.0047
Assembly #4: Roof Anchor (feet) (E) to Rail to SolarLok ground (H)	4A, 4B	4A:0.1223 4B:0.0742	25	4A:0.0049 4B:0.0030
Assembly #5: Ground Lug (F) to Rail to Washer Ground (G)	5A, 5B	5A:0.0206 5B:0.0152	25	5A:0.0008 5B:0.0006

The current path [~~remained~~] [~~did not remain~~] intact. The calculated resistances between the points of current application on the stated bonding junction [~~exceeded~~] [~~did not exceed~~] 0.1 ohm.

NW 2014-04-24: Connection Point F & I will not be used for certification at this time.

BONDING CONDUCTOR TEST @135% of Rated Current [followed by Bonding Path Resistance Test] (Method B):	UL2703 cl. 22
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2014-03-18

METHOD

Using a second set of samples; the Bonding Conductor Test @135% of rated current was conducted. The test was conducted between through the bonding junction on the 2 samples with the current and time noted in the below table. After the sample is allowed to cool for 15-minutes, it is subjected to the BONDING PATH RESISTANCE TEST [AFTER BONDING CONDUCTOR TEST @ 135% of Rated Current].

Bonding Junction Tested	Sample Assm. No.	Test Current (A)	Test Duration (min)
Assembly #1: Rail, Clamp, PV Module Frame	1A, 1B	20.25	60
Assembly #2: Starter Bracket (A) to Rail to BF15T Lug (I)	2A, 2B	20.25	60
Assembly #3: Rail to Brace	3A, 3B	20.25	60
Assembly #4: Roof Anchor (feet) (E) to Rail to SolarLok ground (H)	4A, 4B	20.25	60
Assembly #5: Ground Lug (F) to Rail to Washer Ground (G)	5A, 5B	20.25	60

The above test parameters [were] [~~were not~~] applied.

NW 2014-04-24: Connection Point F & I will not be used for certification at this time.



BONDING PATH RESISTANCE TEST - [AFTER BONDING CONDUCTOR TEST @ 135% of Rated Current] (Method B)	UL2703 Sec. 13
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2014-03-18

METHOD

Using the same samples subject to the Bonding Conductor Test @ 135% of current; this test was conducted in an ambient of 25 +/- 3°C. A direct current supplied by an external source, was caused to flow through the bonding junction. The current was increased from zero to the value specified below (twice the series fuse rating for the module/module-component under test, or 25-Amps, whichever is less) uniformly in approximately 5 s, and was maintained at the level for 2 minutes at which time the measurement was taken.

RESULTS

Bonding Junction Tested	Sample Assm. No.	Measured Voltage Drop Vdc	Test Current A, dc	Maximum Resistance, Milliohms
Assembly #1: Rail, Clamp, PV Module Frame	1A, 1B	1A:0.743 1B:0.0575	25	1A:0.0297 1B:0.0023
Assembly #2: Starter Bracket (A) to Rail to BF15T Lug (I)	2A, 2B	2A:0.338 2B:0.441	25	2A:0.0135 2B:0.0176
Assembly #3: Rail to Brace	3A, 3B	3A:0.104 3B:0.133	25	3A:0.0042 3B:0.0053
Assembly #4: Roof Anchor (feet) (E) to Rail to SolarLok ground (H)	4A, 4B	4A:0.1937 4B:0.0679	25	4A:0.0077 4B:0.0027
Assembly #5: Ground Lug (F) to Rail to Washer Ground (G)	5A, 5B	5A:0.0142 5B:0.0198	25	5A:0.0006 5B:0.0008

The current path [remained] [~~did not remain~~] intact. The calculated resistances between the points of current application on the stated bonding junction [~~exceeded~~] [did not exceed] 0.1 ohm.

NW 2014-04-24: Connection Point F & I will not be used for certification at this time.

BONDING CONDUCTOR TEST @200% of Rated Current [followed by Bonding Path Resistance Test] (Method B):	UL2703 cl. 22
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2014-03-18

METHOD

Using a third set of samples; the Bonding Conductor Test @200% of rated current was conducted. The test was conducted between through the bonding junction on the 2 samples with the current and time noted in the below table. After the sample is allowed to cool for 15-minutes, it is subjected to the BONDING PATH RESISTANCE TEST [AFTER BONDING CONDUCTOR TEST @ 200% of Rated Current].

Bonding Junction Tested	Sample Assm. No.	Test Current (A)	Test Duration (min)
Assembly #1: Rail, Clamp, PV Module Frame	1A, 1B	30	2
Assembly #2: Starter Bracket (A) to Rail to BF15T Lug (I)	2A, 2B	30	2
Assembly #3: Rail to Brace	3A, 3B	30	2
Assembly #4: Roof Anchor (feet) (E) to Rail to SolarLok ground (H)	4A, 4B	30	2
Assembly #5: Ground Lug (F) to Rail to Washer Ground (G)	5A, 5B	30	2

The above test parameters [were] ~~[were not]~~ applied.

NW 2014-04-24: Connection Point F & I will not be used for certification at this time.

BONDING PATH RESISTANCE TEST - [AFTER BONDING  
 CONDUCTOR TEST @ 200% of Rated Current] (Method B)  
 2014-03-18

UL2703 Sec. 13

METHOD

Using the same samples subject to the Bonding Conductor Test @ 200% of current; this test was conducted in an ambient of 25 +/- 3°C. A direct current supplied by an external source, was caused to flow through the bonding junction. The current was increased from zero to the value specified below (twice the series fuse rating for the module/module-component under test, or 25-Amps, whichever is less) uniformly in approximately 5 s, and was maintained at the level for 2 minutes at which time the measurement was taken.

RESULTS

Bonding Junction Tested	Sample Assm. No.	Measured Voltage Drop Vdc	Test Current A, dc	Maximum Resistance, Milliohms
Assembly #1: Rail, Clamp, PV Module Frame	1A, 1B	1A:0.377 1B:0.0577	25	1A:0.0161 1B:0.0023
Assembly #2: Starter Bracket (A) to Rail to BF15T Lug (I)	2A, 2B	2A:0.315 2B:0.449	25	2A:0.0126 2B:0.0180
Assembly #3: Rail to Brace	3A, 3B	3A:0.104 3B:0.134	25	3A:0.0042 3B:0.0054
Assembly #4: Roof Anchor (feet) (E) to Rail to SolarLok ground (H)	4A, 4B	4A:0.1822 4B:0.0675	25	4A:0.0073 4B:0.0027
Assembly #5: Ground Lug (F) to Rail to Washer Ground (G)	5A, 5B	5A:0.0145 5B:0.0191	25	5A:0.0006 5B:0.0008

The current path [remained] [~~did not remain~~] intact. The calculated resistances between the points of current application on the stated bonding junction [~~exceeded~~] [did not exceed] 0.1 ohm.

NW 2014-04-24: Connection Point F & I will not be used for certification at this time.

END OF DATASHEET PACKAGE. THIS PAGE INTENTIONALLY LEFT BLANK

When a measurement is needed to determine compliance with a clause the actual measured value must be recorded in the space provided. A simple 'Yes' / 'No' response is not sufficient. (See 'UL Certification Program - Work Instructions for Completion of Construction Review Datasheets (CRD) For C-UL Mark' (00-OP-W0038) for details).

CONSTRUCTION COMPLIANCE REVIEW RECORD

Sample Identification -

Currently certified product used for comparison (include Report references if not in the same report):	Sader Power Enterprises LLC, SR-3000 Sader RAQ 3-Panel and SR-1000 Sader RAQ 1-Panel
Alternate construction details:	Addition of stainless steel, grade A2 (304SS), star washers to bond rail joints together. Addition of bonding wire between panel rail and spacer brace. Addition of Tyco Solar Lock ground lug. Addition of 304SS grounding hardware

No samples received or examined. Drawings or other information was provided to support the  alternate construction.  revised construction.  addition of a new model that is similar to a currently certified product. ]

See the following table.

Sample Card No.	Date Received	Sample No.	Manufacturer, Product Identification and Ratings
1797176	2014-01-15	1-6	Sader Power Enterprises LLC, SR-3000 Sader RAQ 3-Panel  Ground hardware and (KDER.E69905), Tyco model 2058729 shown below

Measurement Instrument Information -

Inst. ID No.	Instrument Type	Function/Range	Last Cal. Date	Next Cal. Date
N/A				

The following additional information is required when using client's or rented equipment, or when a UL ID Number for an instrument number is not used. The Inst. ID No. below corresponds to the Inst. ID No. above.

Inst. ID No.	Make/Model/Serial Number/Asset No.
N/A	

Measurement instrument information is recorded on UL's Laboratory Project Management (LPM) database. (This statement may be selected only if CRDs are completed at a UL facility)

CONSTRUCTION COMPLIANCE REVIEW:					
Due to similarity to the existing construction described under "Sample Identification", a limited review for compliance with the construction requirements in the following Standard was conducted. The construction requirements applicable to the [ <del>alternate</del> ][ revised ] construction and compliance with those requirements are noted below.					
Standard	ULC/ORD C1703, Flat-Plate Photovoltaic Modules and Panels		Edition/Revision Date	01	
Clause/Par. Reference and Construction Requirement	Comply		Comments/Measurements	Inst. ID No.	
	Yes	No			
4. Construction					
4.1 General					
4.1.6 Friction is Not the Sole Means of Preventing Loosening or Turning	X			TORQUE VALUE (11.8 FT-LBS) SPECIFIED FOR PROPER CLAMP LOAD remains the same.	
4.6 Bonding and Grounding					
4.6.1 Module or Panel Has a Means for Grounding All Accessible Conductive Parts	X				
4.6.2 Routine Maintenance Does Not Involve Breaking or Disturbing the Bonding Path	X				
4.6.3 Bonding is by a Positive Means	X				
4.6.4 Acceptability of a Bolted or Screwed Connection that Incorporates a Star Washer Under the Screwhead or a Serrated Screwhead	X				
4.6.5 All Joints in the Bonding Path are Mechanically Secure	X				
4.6.6 Separate Bonding Conductor or Strap			X		
4.6.7 Corrosion Protection for a Ferrous Metal Part in the Grounding Path			X	ALL STEEL COMPONENTS ARE HOT DIPPED WITH A MINIMUM G90 ZINC COATING	
4.6.8 Metal-to-Metal Multiple-Bearing Pin-Type Hinge is an Acceptable Bonding Means			X		

4.6.9 Identification of a Terminal of a Module or Panel Intended to Accommodate an Equipment Bonding Conductor	X				
4.6.10 Location of Marking Used to Identify an Equipment-Bonding Terminal			X		
4.6.11 Visibility of a Green-Coloured Part Used to Identify the Equipment-Bonding Terminal			X		
4.6.12 Green Insulation on the Surface of a Lead of a Module or Panel Intended for the Connection of an Equipment-Bonding Conductor			X		

CLIENT INFORMATION	
Company Name	The RAQ
Address	2885 Sanford Ave SW Grandville, MI 49418

AUDIT INFORMATION:			
<input checked="" type="checkbox"/> Description of Tests "Tests for Fire Resistance of Roof Covering Materials"	Per Standard No. ANSI/UL 790  ANSI/UL 2703	Edition (Revised Date)	8th. Edition (July 29, 2014)  1 <sup>st</sup> Edition (January 28, 2015)
<input checked="" type="checkbox"/> Tests Conducted by+	See Data Sheets		
	Printed name		Signature
<input type="checkbox"/> UL Staff witnessing testing (WTDP only)			
	Printed name		Signature
Reviewed and accepted by qualified Project Handler	NATHAN WANG		
	Printed Name		Signature

TESTS TO BE CONDUCTED:			
Test No.	Done	Test Name	<input type="checkbox"/> Comments/Parameters <input type="checkbox"/> Tests Conducted by ++
	8	Roofing Spread Of Flame Test	
	8	Roofing Burning Brand Test	

Instructions -

+ - When all tests are conducted by one person, printed name and signature can be inserted here instead of including printed name and signature on each page containing data. Must indicate number of pages in the data package.

++ - When test conducted by more than one person, printed name and signature of person conducting the test can be inserted next to the test name instead of including printed name and signature on each page containing data. Must indicate number of pages in the data package.

[X]Unless specified otherwise in the individual Methods, the tests shall be conducted under the following ambient conditions. Confirmation of these conditions shall be recorded at the time the test is conducted.					
Ambient Temperature, °F	70 ± 20	Relative Humidity, %	N/A	Barometric Pressure, mBar	N/A

--

No general environmental conditions are specified in the Standard(s) or have been identified that could affect the test results or measurements.

RISK ANALYSIS RELATED TO TESTING PERFORMANCE:



The following types of risks have been identified. Take necessary precautions. This list is not all inclusive.

<input type="checkbox"/> Electric shock	<input type="checkbox"/> Radiation
<input type="checkbox"/> Energy related hazards	<input type="checkbox"/> Chemical hazards
<input type="checkbox"/> Fire	<input type="checkbox"/> Noise
<input type="checkbox"/> Heat related hazards	<input type="checkbox"/> Vibration
<input type="checkbox"/> Mechanical	<input type="checkbox"/> Other (Specify) __

TEST LOCATION: (To be completed by Staff Conducting the Testing)						
<input checked="" type="checkbox"/> UL or Affiliate	<input type="checkbox"/> WTDP	<input type="checkbox"/> CTDTP	<input type="checkbox"/> TPTDP	<input type="checkbox"/> TCP	<input type="checkbox"/> PPP	
	<input type="checkbox"/> WMT	<input type="checkbox"/> TMP	<input type="checkbox"/> SMT			
Company Name:	UL LLC					
Address:	333 Pfingsten Road, Northbrook, Illinois, 60062					

TEST EQUIPMENT INFORMATION

UL test equipment information is recorded on Meter Use in UL's Laboratory Project Management (LPM) database.

UL test equipment information is recorded on Dept. 3019's electronic equipment database tracking system (ShrCal) - See the attached sheet(s) "Department 3019FPD Instrument Calibration Tracking".

Department 3019FPD Instrument Calibration Tracking			
Procedure: UL790 ROOFING TOWER			
Test Dates: 2016-01-29 to 2016-01-28			
File Number:	E353639	Assignment Number:	4787321288
Customer:	The RAQ		

Software:			
FPD ID / LEM ID	Description	Version	Version Date
1F05TCP/34693	software/Roofing fire test apparatus control program	2011-12-20	1.0.12e

Instruments				
FPD ID / LEM ID	Description	Range	Last Cal	Next Cal
152F12DAS/75469	instrument	Roofing fire test control	2015-12-18	2016-12-31
153F12DAS/79593	instrument	Roofing cal cart DAS control room test time clock	2015-12-18	2016-12-31
83F01CLK/20562	instrument	Roofing	2015-12-18	2016-12-31
295F15MD/89279	instrument	24" bubble level	2015-12-18	2016-12-31
187F07MD/45792	instrument	Roofing cal cart DAS input card	2015-12-18	2016-12-31
79F03IC/20665	instrument	Roofing cal cart velocity pressure trans	2015-12-18	2016-12-31
16FA5EPT/21312	instrument	Roofing cal cart velocity pressure trans	2015-12-18	2016-12-31
160F99EPT/21311	instrument	Roofing cal cart velocity pressure trans	2015-12-18	2016-12-31
149F65EPT/21333	instrument	Roofing cal cart velocity pressure trans	2015-12-18	2016-12-31
115F11MT/70474	instrument	Roofing Tower datalogger input card (tc compensation)	2015-12-18	2016-12-31
16F01IC/21096	instrument	Roofing fire test control	2015-12-18	2016-12-31
119F12CLK/75468	instrument	Roofing	2015-12-18	2016-12-31
295F15MD/89279	instrument	24" bubble level	2015-12-18	2016-12-31
187F07MD/45792	instrument	Roofing Tower	2015-12-18	2016-12-31
115F11MT/70474	instrument	Roofing fire test control	2015-12-18	2016-12-31
152F12DAS/75469	instrument	control room test time clock	2015-12-18	2016-12-31
83F01CLK/20562	instrument	Roofing fire test control	2015-12-18	2016-12-31
119F12CLK/75468	instrument	Roofing	2015-12-18	2016-12-31
295F15MD/89279	instrument	24" bubble level	2015-12-18	2016-12-31
187F07MD/45792	instrument	Roofing Tower	2015-12-18	2016-12-31
115F11MT/70474	instrument	Roofing Tower	2015-12-18	2016-12-31
80F12SCL/75841	instrument		2015-12-18	2016-12-31

THERMOCOUPLES				
FPD ID / LEM ID	Description	Type	Last Cal	Next Cal
0925140003/86461	instrument	Type Roofing Fire	2015-12-18	2016-12-31

**Daily Apparatus Calibration:**

01281601.cal

ULVersion=1

Company=ULI

File=UL790

ProjectNumber=Calibration

Sample=Thermocouple

TestLocation=RoofingFire

Technician=07036 Albert J. Hislop

testdate=01-28-2016

AverageVel=1046.333  
VelReading1=1108  
VelReading2=1007  
VelReading3=1024  
VelometerCorrection(applied)= 0  
AverageTemp=1363.3  
GasUsage=NA  
PreGasReading=NA  
PostGasReading=NA  
GasFlowrate=15.6  
GasValveSetting=52.8  
VelocityUnits=Feet per Minute  
GasUnits=Cubic Feet  
TemperatureUnits=Degrees F

01291601.cal  
ULVersion=1  
Company=ULI  
File=UL790  
ProjectNumber=Calibration  
Sample=Thermocouple  
TestLocation=RoofingFire  
Technician=07036 Albert J. Hislop  
testdate=01-29-2016  
AverageVel=1046.667  
VelReading1=1101  
VelReading2=1010  
VelReading3=1029  
VelometerCorrection(applied)= 0  
AverageTemp=1374.7  
GasUsage=NA  
PreGasReading=NA  
PostGasReading=NA  
GasFlowrate=15.9  
GasValveSetting=52.0  
VelocityUnits=Feet per Minute  
GasUnits=Cubic Feet  
TemperatureUnits=Degrees F

TEST EQUIPMENT INFORMATION

Inst. ID No.	Instrument Type	Test Number +, Test Title or Conditioning	Function /Range	Last Cal. Date	Next Cal. Date

+ - If Test Number is used, the Test Number must be identified on the data sheet pages or on the Data Sheet Package cover page.

The following additional information is required when using client's or rented equipment, or when a UL ID Number for an instrument number is not used. The Inst. ID No. below corresponds to the Inst. ID No. above.

Inst. ID No.	Make/Model/Serial Number/Asset No.

TEST SAMPLE IDENTIFICATION:

The table below is provided to provide correlation of sample numbers to specific product related information. Refer to this table when a test identifies a test sample by "Sample No." only.

Sample Card No.	Date Received	<input type="checkbox"/> Test No.	Sample No.	Manufacturer, Product Identification and Ratings

+ - If Test Number is used, the Test Number or Numbers the sample was used in must be identified on the data sheet pages or on the Data Sheet Package cover page.

Sampling Procedure -

This document contains data using color and if printed, should be printed in color to retain legibility and the information represented by the color.

Fire Test Sample Summary

Test code	Test Type	Class	Slope (in/ft)	Pass/Fail	Sample Description
01281605	SF	A	5	P	System 1 - Baseline (not used)
01281606	SF	A	5	P	System 1- Baseline
01281607	SF	A	5	P	System 1- Baseline
01281608	SF	A	5	P	System 1- Baseline
01281609	SF	A	5	P	System 2 - Type 1
01281610	SF	A	5	P	System 2- Type 1
01281611	SF	A	5	P	System 3- Type 2
01281612	SF	A	5	P	System 3- Type 2
01281601	BB	A	5	P	System 4- Type 1

01281602	BB	A	5	P	System 4- Type 1
01281603	BB	B	5	P	System 6- Type 1
01281604	BB	B	5	P	System 6- Type 1
01291604	BB	A	5	P	System 5- Type 2
01291606	BB	A	5	P	System 5- Type 2
01291607	BB	B	5	P	System 7- Type 2
01291608	BB	B	5	P	System 7- Type 2

<b>Project:</b>	4787321288	<b>File:</b>	E353639	<b>TestCode:</b>	01281605
<b>Tested by:</b>	NICOLE HICKMAN	<b>Engineer:</b>	NATHAN WANG	<b>Date:</b>	2016-01-28

**SPREAD OF FLAME TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.3  
The roof covering material was applied in accordance with paragraph 4.4  
The test sample was conditioned in accordance with paragraph 4.5

<b>Client Name:</b>	The RAQ			
<b>System No.:</b>	1	<b>Test No.:</b>	5	
<b>Class:</b>	A	<b>Slope (in/ft):</b>	5	<b>Ambient Temp (°F):</b> 71

**System Description:**

Underlayment: 1 Layer GAF Shingle Mate  
Roofing Material: 3 Tab Shingles  
Baseline - No PV Modules

**Flame Spread Data**

<b>Distance (Feet)</b>	<b>Time (Min:Sec)</b>	<b>Distance (Feet)</b>	<b>Time (Min:Sec)</b>
Ignition	04:05	2.5	07:05
1	04:05	3	07:37
1.5	05:09	3.5	08:22
2	06:25		

Notes:  
SOF - 46 inches

**Summary of Results:**

<b>Maximum spread of flame (feet):</b>	3.5	<b>Test Duration (minutes):</b>	10
--	-----	---------------------------------	----

There was no significant lateral spread of flame from the path directly exposed to the test flame.  
No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.  
The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.  
No portions of the roof deck fell away in the form of glowing particles.

**Pass/Failed: Pass**

Only those products bearing the UL Mark should be considered as being covered by UL.

Not used, see tests 01281606-01 281608 for baseline testing. Project:	4787321288	<b>File:</b>	E353639	<b>TestCode:</b>	01281606
<b>Tested by:</b>	NICOLE HICKMAN	<b>Engineer:</b>	NATHAN WANG	<b>Date:</b>	2016-01-28

**SPREAD OF FLAME TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.3  
The roof covering material was applied in accordance with paragraph 4.4  
The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ				
System No.	1	Test No.:	6		
Class:	A	Slope (in/ft):	5	Ambient Temp (°F):	71

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate  
Roofing Material: 3 Tab Shingles  
Baseline - No PV Modules

**Flame Spread Data**

Distance (Feet)	Time (Min:Sec)	Distance (Feet)	Time (Min:Sec)
Ignition	02:54	3	05:48
1	02:54	3.5	06:24
1.5	03:35	4	07:48
2	04:19	4.5	08:47
2.5	04:46		

Notes:  
SOF - 54 inches

**Summary of Results:**

Maximum spread of flame (feet):	4.5	Test Duration (minutes):	10
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There was no significant lateral spread of flame from the path directly exposed to the test flame.  
No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.  
The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.  
No portions of the roof deck fell away in the form of glowing particles.

**Pass/Failed: Pass**

Only those products bearing the UL Mark should be considered as being covered by UL.

Project:	4787321288	File:	E353639	TestCode:	01281607
Tested by:	NICOLE HICKMAN	Engineer:	NATHAN WANG	Date:	2016-01-28

**SPREAD OF FLAME TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.3  
The roof covering material was applied in accordance with paragraph 4.4  
The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ				
System No.	1	Test No.:	7		
Class:	A	Slope (in/ft):	5	Ambient Temp (°F):	71

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate  
Roofing Material: 3 Tab Shingles  
Baseline - No PV Modules

**Flame Spread Data**

Distance (Feet)	Time (Min:Sec)	Distance (Feet)	Time (Min:Sec)
Ignition	02:30	3.5	05:08
1	02:30	4.5	07:56
2	03:41	4	07:59
2.5	04:03	4.5	09:32
3	04:20		

Notes:  
SOF - 52 inches

**Summary of Results:**

Maximum spread of flame (feet):	4.5	Test Duration (minutes):	10
There was no significant lateral spread of flame from the path directly exposed to the test flame.			
No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.			
The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.			
No portions of the roof deck fell away in the form of glowing particles.			
<b>Pass/Failed: Pass</b>			
Only those products bearing the UL Mark should be considered as being covered by UL.			

Project:	4787321288	File:	E353639	TestCode:	01281608
Tested by:	NICOLE HICKMAN	Engineer:	NATHAN WANG	Date:	2016-01-28

**SPREAD OF FLAME TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.3  
The roof covering material was applied in accordance with paragraph 4.4  
The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ				
System No.	1	Test No.:	8		
Class:	A	Slope (in/ft):	5	Ambient Temp (°F):	71

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate  
Roofing Material: 3 Tab Shingles  
Baseline - No PV Modules

**Flame Spread Data**

Distance (Feet)	Time (Min:Sec)	Distance (Feet)	Time (Min:Sec)
Ignition	03:14	3	06:31
1	03:14	3.5	06:44
2	04:47	4	07:24
2.5	05:40		

Notes:  
SOF - 50 inches

**Summary of Results:**

Maximum spread of flame (feet):	4	Test Duration (minutes):	10
There was no significant lateral spread of flame from the path directly exposed to the test flame.			
No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.			
The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.			
No portions of the roof deck fell away in the form of glowing particles.			
<b>Pass/Failed: Pass</b>			
Only those products bearing the UL Mark should be considered as being covered by UL.			

Project:	4787321288	File:	E353639	TestCode:	01281609
Tested by:	NICOLE HICKMAN	Engineer:	NATHAN WANG	Date:	2016-01-28

**SPREAD OF FLAME TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.3  
The roof covering material was applied in accordance with paragraph 4.4  
The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ				
System No.	2	Test No.:	9		
Class:	A	Slope (in/ft):	5	Ambient Temp (°F):	71

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate  
 Roofing Material: 3 Tab Shingles  
 Type 1 PV Module & Racking System mounted Portrait  
 Panel is at 40" (Baseline - 12") from front of deck  
 Module Manufacturer: SolarWorld  
 Module Model Number: SunModule Plus SW 260Mono  
 Serial Numbers: 161502161780

**Flame Spread Data**

Distance (Feet)	Time (Min:Sec)	Distance (Feet)	Time (Min:Sec)
Ignition	02:57	2.5	04:59
1	02:57	3	05:42
1.5	03:52	3.5	06:48
2	04:25	4	08:03

**Summary of Results:**

Maximum spread of flame (feet):	4	Test Duration (minutes):	10
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There was no significant lateral spread of flame from the path directly exposed to the test flame.  
 No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.  
 The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.  
 No portions of the roof deck fell away in the form of glowing particles.

**Pass/Failed: Pass**

Only those products bearing the UL Mark should be considered as being covered by UL.

Project:	4787321288	File:	E353639	TestCode:	01281610
Tested by:	NICOLE HICKMAN	Engineer:	NATHAN WANG	Date:	2016-01-28

**SPREAD OF FLAME TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.3  
 The roof covering material was applied in accordance with paragraph 4.4  
 The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ				
System No.	2	Test No.:	10		
Class:	A	Slope (in/ft):	5	Ambient Temp (°F):	71

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate  
 Roofing Material: 3 Tab Shingles  
 Type 1 PV Module & Racking System mounted Portrait  
 Panel is at 40" (Baseline - 12") from front of deck  
 Module Manufacturer: SolarWorld  
 Module Model Number: SunModule Plus SW 260Mono  
 Serial Numbers: 16150178552

**Flame Spread Data**

Distance (Feet)	Time (Min:Sec)	Distance (Feet)	Time (Min:Sec)
Ignition	02:52	2.5	05:19
1	02:52	3.5	06:35
1.5	03:50	4	08:37



2		04:33			
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**Summary of Results:**

Maximum spread of flame (feet):	4	Test Duration (minutes):	10
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There was no significant lateral spread of flame from the path directly exposed to the test flame.  
 No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.  
 The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.  
 No portions of the roof deck fell away in the form of glowing particles.

**Pass/Failed: Pass**

Only those products bearing the UL Mark should be considered as being covered by UL.

Project:	4787321288	File:	E353639	TestCode:	01281611
Tested by:	NICOLE HICKMAN	Engineer:	NATHAN WANG	Date:	2016-01-28

**SPREAD OF FLAME TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.3  
 The roof covering material was applied in accordance with paragraph 4.4  
 The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ				
System No.	3	Test No.:	11		
Class:	A	Slope (in/ft):	5	Ambient Temp (°F):	71

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate  
 Roofing Material: 3 Tab Shingles  
 Type 2 PV Module & Racking System mounted Portrait  
 Panel is at 40" (Baseline - 12") from front of deck  
 Module Manufacturer: LG  
 Module Model Number: LG315N1C-G4  
 Serial Numbers: 506K3HX1W065

**Flame Spread Data**

Distance (Feet)	Time (Min:Sec)	Distance (Feet)	Time (Min:Sec)
Ignition	03:13	3	05:36
1	03:13	3.5	06:44
1.5	03:42	4	07:28
2	04:27	4.5	09:41
2.5	05:29		

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**Summary of Results:**

Maximum spread of flame (feet):	4.5	Test Duration (minutes):	10
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There was no significant lateral spread of flame from the path directly exposed to the test flame.  
 No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.  
 The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.  
 No portions of the roof deck fell away in the form of glowing particles.

**Pass/Failed: Pass**

Only those products bearing the UL Mark should be considered as being covered by UL.

Project:	4787321288	File:	E353639	TestCode:	01281612
Tested by:	NICOLE HICKMAN	Engineer:	NATHAN WANG	Date:	2016-01-28

**SPREAD OF FLAME TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

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The test deck was constructed in accordance with paragraph 4.3
The roof covering material was applied in accordance with paragraph 4.4
The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ				
System No.	3	Test No.:	12		
Class:	A	Slope (in/ft):	5	Ambient Temp (°F):	71

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate
Roofing Material: 3 Tab Shingles
Type 2 PV Module & Racking System mounted Portrait
Panel is at 40" (Baseline - 12") from front of deck
Module Manufacturer: LG
Module Model Number: LG315N1C-G4
Serial Numbers: 506K3FN1W0CH

**Flame Spread Data**

Distance (Feet)	Time (Min:Sec)	Distance (Feet)	Time (Min:Sec)
Ignition	02:57	2	04:21
1	02:57	3	06:03
1.5	03:23	3.5	07:42

**Summary of Results:**

Maximum spread of flame (feet):	3.5	Test Duration (minutes):	10
There was no significant lateral spread of flame from the path directly exposed to the test flame.			
No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.			
The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.			
No portions of the roof deck fell away in the form of glowing particles.			
<b>Pass/Failed: Pass</b>			
Only those products bearing the UL Mark should be considered as being covered by UL.			

Project:	4787321288	File:	E353639	TestCode:	01281601
Tested by:	MARK PASTOR	Engineer:	NATHAN WANG	Date:	2016-01-28

**BURNING BRAND TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.2
The roof covering material was applied in accordance with paragraph 4.4
The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ			Brand Weight (g):	2009
System No.	4	Test No.:	1	Deck Thickness (in):	3/8
Class:	A	Slope (in/ft):	5	Ambient Temp (°F):	68

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate
Roofing Material: 3 Tab Shingles
Type 1 PV Module & Racking System mounted Portrait
Class A brand placed on top of module
Module Manufacturer: SolarWorld
Module Model Number: SunModule Plus SW 260Mono
Serial Numbers: 161501768090

**Underside Activity**

First Smoke (Hr:Min:Sec)	First Asphalt Drip (Hr:Min:Sec)	First Glow (Hr:Min:Sec)	Flames On Underside (Hr:Min:Sec)
NA	NA	NA	None

**Test Observations:**

00:02:35 Ignition of solar panel backsheet	00:09:31 Brand 50% consumed
00:05:05 Surface flames 1 foot above top of brand	00:16:10 Brand 75% consumed
00:05:07 Brand 25% consumed	00:20:26 Surface flames 1/2 foot above top of brand
00:05:31 Surface flames 2-1/2 feet above top of brand	00:26:29 Discoloration of plywood on underside
00:06:48 Solar panel glass cracked/shattered	00:31:50 Brand 100% consumed
00:09:28 Surface flames 1/2 foot above top of brand	00:32:00 All action ceased, test terminated.

**Summary of Results:**

Char Depth (inches):	1/8	Test Duration (minutes):	32.0
No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.			
The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.			
No portions of the roof deck fell away in the form of glowing particles.			
There was no sustained flaming of the underside of the deck.			
<b>Pass/Failed: Pass</b>			
Only those products bearing the UL Mark should be considered as being covered by UL.			

Project:	4787321288	File:	E353639	TestCode:	01281602
Tested by:	MARK PASTOR	Engineer:	NATHAN WANG	Date:	2016-01-28

**BURNING BRAND TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.2
The roof covering material was applied in accordance with paragraph 4.4
The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ	Brand Weight (g):	1987
System No.	4	Test No.:	2
Class:	A	Slope (in/ft):	5
		Deck Thickness (in):	3/8
		Ambient Temp (°F):	69

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate
Roofing Material: 3 Tab Shingles
Type 1 PV Module & Racking System mounted Portrait
Class A brand placed on top of module
Module Manufacturer: SolarWorld
Module Model Number: SunModule Plus SW 260Mono
Serial Numbers: 161501797728

**Underside Activity**

First Smoke (Hr:Min:Sec)	First Asphalt Drip (Hr:Min:Sec)	First Glow (Hr:Min:Sec)	Flames On Underside (Hr:Min:Sec)
00:22:34	NA	NA	None

**Test Observations:**

00:02:25 Surface flames 1/2 foot above top of brand	00:09:45 Surface flames 1/2 foot above top of brand
00:02:33 Ignition of solar panel backsheet	00:09:46 Brand 75% consumed
00:02:43 Dripping of backsheet onto deck surface	00:21:40 Surface flames 1/2 foot above top of brand
00:02:57 Surface flames 1-1/2 feet above top of brand	00:22:34 Smoke on underside at Horizontal Joint
00:03:32 Surface flames 2 feet above top of brand	00:22:37 Discoloration of plywood on underside
00:03:58 Surface flames 2-1/2 feet above top of brand	00:25:40 Brand 100% consumed
00:05:11 Brand 25% consumed	00:35:50 All action ceased, test terminated.
00:06:28 Solar panel glass cracked/shattered	

**Summary of Results:**

Char Depth (inches):	1/4	Test Duration (minutes):	35.8
No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.			
The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.			
No portions of the roof deck fell away in the form of glowing particles.			

There was no sustained flaming of the underside of the deck.

**Pass/Failed: Pass**

Only those products bearing the UL Mark should be considered as being covered by UL.

Project:	4787321288	File:	E353639	TestCode:	01281603
Tested by:	MARK PASTOR	Engineer:	NATHAN WANG	Date:	2016-01-28

**BURNING BRAND TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.2  
The roof covering material was applied in accordance with paragraph 4.4  
The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ	Brand Weight (g):	518
System No.	6	Test No.:	3
Class:	B	Slope (in/ft):	5
		Deck Thickness (in):	3/8
		Ambient Temp (°F):	70

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate  
Roofing Material: 3 Tab Shingles  
Type 1 PV Module & Racking System mounted Portrait  
Class B brand placed between module and roof  
Module Manufacturer:SolarWorld  
Module Model Number:SunModule Plus SW260Mono  
Serial Numbers:161501797807

**Underside Activity**

First Smoke (Hr:Min:Sec)	First Asphalt Drip (Hr:Min:Sec)	First Glow (Hr:Min:Sec)	Flames On Underside (Hr:Min:Sec)
00:04:00	NA	NA	None

**Test Observations:**

00:00:22 Surface flames 1 foot above top of brand	00:10:28 Surface flames 1/2 foot above top of brand
00:03:13 Brand 25% consumed	00:10:31 Brand 75% consumed
00:04:00 Smoke on underside at Horizontal Joint	00:19:16 Brand 100% consumed
00:07:20 Brand 50% consumed	00:19:21 Smoke continues on underside
00:07:25 Surface flames 1/2 foot above top of brand	00:25:03 All action ceased, test terminated.
00:07:29 Discoloration on underside at plywood joint	

**Summary of Results:**

Char Depth (inches):	1/4	Test Duration (minutes):	25.1
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No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.  
The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.  
No portions of the roof deck fell away in the form of glowing particles.  
There was no sustained flaming of the underside of the deck.

**Pass/Failed: Pass**

Only those products bearing the UL Mark should be considered as being covered by UL.

Project:	4787321288	File:	E353639	TestCode:	01281604
Tested by:	MARK PASTOR	Engineer:	NATHAN WANG	Date:	2016-01-28

**BURNING BRAND TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.2  
The roof covering material was applied in accordance with paragraph 4.4  
The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ	Brand Weight (g):	518
System No.	6	Test No.:	4
		Deck Thickness (in):	3/8

Class:	B	Slope (in/ft):	5	Ambient Temp (°F):	73
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**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate  
 Roofing Material: 3 Tab Shingles  
 Type 1 PV Module & Racking System mounted Portrait  
 Class B brand placed between module and roof  
 Module Manufacturer: SolarWorld  
 Module Model Number: SunModule Plus SW260Mono  
 Serial Numbers: 161501797807 \ Same Module Flip

**Underside Activity**

First Smoke (Hr:Min:Sec)	First Asphalt Drip (Hr:Min:Sec)	First Glow (Hr:Min:Sec)	Flames On Underside (Hr:Min:Sec)
00:07:33	NA	NA	None

**Test Observations:**

00:02:08 Surface flames 1 foot above top of brand	00:10:43 Brand 75% consumed
00:04:48 Brand 25% consumed	00:13:52 Discoloration of plywood on underside
00:07:18 Surface flames 1/2 foot above top of brand	00:21:24 Surface flames 1/2 foot above top of brand
00:07:19 Brand 50% consumed	00:22:05 Brand 100% consumed
00:07:33 Smoke on underside at Horizontal Joint	00:25:39 All action ceased, test terminated.
00:07:51 Discoloration on underside at plywood joint	

**Summary of Results:**

Char Depth (inches):	1/8	Test Duration (minutes):	25.7
No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.			
The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.			
No portions of the roof deck fell away in the form of glowing particles.			
There was no sustained flaming of the underside of the deck.			
<b>Pass/Failed: Pass</b>			
Only those products bearing the UL Mark should be considered as being covered by UL.			

Project:	4787321288	File:	E353639	TestCode:	01291604
Tested by:	MARK PASTOR	Engineer:	NATHAN WANG	Date:	2016-01-29

**BURNING BRAND TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.2  
 The roof covering material was applied in accordance with paragraph 4.4  
 The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ	Brand Weight (g):	2008
System No.	5	Test No.:	9
Class:	A	Slope (in/ft):	5
		Deck Thickness (in):	3/8
		Ambient Temp (°F):	69

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate  
 Roofing Material: 3 Tab Shingles  
 Type 2 PV Module & Racking System mounted Portrait  
 Class A brand placed on top of module  
 Module Manufacturer: LG  
 Module Model Number: LG315N1C-G4  
 Serial Numbers: 506K3ZH1WOK3

**Underside Activity**

First Smoke (Hr:Min:Sec)	First Asphalt Drip (Hr:Min:Sec)	First Glow (Hr:Min:Sec)	Flames On Underside (Hr:Min:Sec)
NA	NA	NA	None

**Test Observations:**

00:02:01 Surface flames 1 foot above top of brand	00:07:31 Brand 50% consumed
00:02:49 Ignition of solar panel backsheet	00:10:33 Brand 75% consumed
00:02:57 Dripping of backsheet onto deck surface	00:12:00 Surface flames 1 foot above top of brand
00:03:53 Surface flames 2-1/2 feet above top of brand	00:15:55 Surface flames 1/2 foot above top of brand
00:04:55 Brand 25% consumed	00:20:24 Surface flames 1/2 foot above top of brand
00:06:14 Solar panel glass cracked/shattered	00:27:00 All action ceased, test terminated.
00:06:19 Brand falls through solar panel	

**Summary of Results:**

Char Depth (inches):	1/8	Test Duration (minutes):	27.0
No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.			
The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.			
No portions of the roof deck fell away in the form of glowing particles.			
There was no sustained flaming of the underside of the deck.			
<b>Pass/Failed: Pass</b>			
Only those products bearing the UL Mark should be considered as being covered by UL.			

Project:	4787321288	File:	E353639	TestCode:	01291606
Tested by:	MARK PASTOR	Engineer:	NATHAN WANG	Date:	2016-01-29

**BURNING BRAND TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.2
The roof covering material was applied in accordance with paragraph 4.4
The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ	Brand Weight (g):	1997
System No.	5	Test No.:	10
Class:	A	Slope (in/ft):	5
		Deck Thickness (in):	3/8
		Ambient Temp (°F):	69

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate
Roofing Material: 3 Tab Shingles
Type 2 PV Module & Racking System mounted Portrait
Class A brand placed on top of module
Module Manufacturer: LG
Module Model Number: LG315N1C-G4
Serial Numbers:506K3FN1WO5H

**Underside Activity**

First Smoke (Hr:Min:Sec)	First Asphalt Drip (Hr:Min:Sec)	First Glow (Hr:Min:Sec)	Flames On Underside (Hr:Min:Sec)
NA	NA	NA	None

**Test Observations:**

00:02:27 Surface flames 1 foot above top of brand	00:06:13 Solar panel glass cracked/shattered
00:02:28 Ignition of solar panel backsheet	00:06:24 Brand falls through solar panel
00:02:39 Dripping of backsheet onto deck surface	00:07:24 Brand 50% consumed
00:03:19 Surface flames 2 feet above top of brand	00:13:39 Brand 75% consumed
00:03:23 Surface flames 2-1/2 feet above top of brand	00:18:11 Surface flames 1 foot above top of brand
00:04:20 Brand 25% consumed	00:24:52 All action ceased, test terminated.
00:05:30 Surface flames 1 foot above top of brand	

**Summary of Results:**

Char Depth (inches):	1/8	Test Duration (minutes):	24.9
No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.			
The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.			
No portions of the roof deck fell away in the form of glowing particles.			
There was no sustained flaming of the underside of the deck.			

**Pass/Failed: Pass**

Only those products bearing the UL Mark should be considered as being covered by UL.

Project:	4787321288	File:	E353639	TestCode:	01291607
Tested by:	MARK PASTOR	Engineer:	NATHAN WANG	Date:	2016-01-29

**BURNING BRAND TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.2
The roof covering material was applied in accordance with paragraph 4.4
The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ	Brand Weight (g):	516
System No.	7	Test No.:	11
Class:	B	Slope (in/ft):	5
		Deck Thickness (in):	3/8
		Ambient Temp (°F):	70

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate
Roofing Material: 3 Tab Shingles
Type 2 PV Module & Racking System mounted Portrait
Class B brand placed between module and roof
Module Manufacturer: LG
Module Model Number: LG315N1C-G4
Serial Numbers:506K3ZH1SOOS

**Underside Activity**

First Smoke (Hr:Min:Sec)	First Asphalt Drip (Hr:Min:Sec)	First Glow (Hr:Min:Sec)	Flames On Underside (Hr:Min:Sec)
00:09:23	NA	NA	None

**Test Observations:**

00:01:16 Surface flames 1/2 foot above top of brand	00:14:06 Surface flames 1/2 foot above top of brand
00:06:07 Brand 25% consumed	00:18:12 Discoloration of plywood on underside
00:09:23 Smoke on underside at Horizontal Joint	00:20:33 Brand 100% consumed
00:09:27 Discoloration on underside at plywood joint	00:23:37 Smoke continues on underside
00:09:33 Brand 50% consumed	00:28:17 All action ceased, test terminated.
00:14:02 Brand 75% consumed	

**Summary of Results:**

Char Depth (inches):	1/8	Test Duration (minutes):	28.3
No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.			
The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.			
No portions of the roof deck fell away in the form of glowing particles.			
There was no sustained flaming of the underside of the deck.			

**Pass/Failed: Pass**

Only those products bearing the UL Mark should be considered as being covered by UL.

Project:	4787321288	File:	E353639	TestCode:	01291608
Tested by:	MARK PASTOR	Engineer:	NATHAN WANG	Date:	2016-01-29

**BURNING BRAND TEST - ANSI/UL790 (Eighth Edition -2014/07/29)**

The test deck was constructed in accordance with paragraph 4.2
The roof covering material was applied in accordance with paragraph 4.4
The test sample was conditioned in accordance with paragraph 4.5

Client Name:	The RAQ	Brand Weight (g):	519
System No.	7	Test No.:	12
Class:	B	Slope (in/ft):	5
		Deck Thickness (in):	3/8
		Ambient Temp (°F):	69

**System Description:**

Underlayment: 1 Layer GAF Shingle-Mate Roofing Material: 3 Tab Shingles Type 2 PV Module & Racking System mounted Portrait Class B brand placed between module and roof Module Manufacturer: LG Module Model Number: LG315N1C-G4 Serial Numbers:506K3CF1SOQW
--

**Underside Activity**

<b>First Smoke (Hr:Min:Sec)</b>	<b>First Asphalt Drip (Hr:Min:Sec)</b>	<b>First Glow (Hr:Min:Sec)</b>	<b>Flames On Underside (Hr:Min:Sec)</b>
00:07:02	NA	NA	None

**Test Observations:**

00:03:16 Surface flames 1/2 foot above top of brand 00:05:24 Brand 25% consumed 00:07:02 Smoke on underside at Horizontal Joint 00:07:27 Discoloration on underside at plywood joint 00:09:01 Brand 50% consumed	00:12:32 Brand 75% consumed 00:12:39 Surface flames 1/2 foot above top of brand 00:13:51 Discoloration of plywood on underside 00:19:49 Brand 100% consumed 00:24:00 All action ceased, test terminated.
--	--

**Summary of Results:**

Char Depth (inches):	1/8	Test Duration (minutes):	24.0
No portion of the roof covering material was blown or fell off the test deck in the form of flaming/glowing brands.			
The roof deck was not exposed by breaking, sliding, cracking, or warping of the roof covering.			
No portions of the roof deck fell away in the form of glowing particles.			
There was no sustained flaming of the underside of the deck.			
<b>Pass/Failed: Pass</b>			
Only those products bearing the UL Mark should be considered as being covered by UL.			

END OF DATASHEET PACKAGE. THIS PAGE INTENTIONALLY LEFT BLANK.



When a measurement is needed to determine compliance with a clause the actual measured value must be recorded in the space provided. A simple 'Yes' / 'No' response is not sufficient. (See 'UL Certification Program - Work Instructions for Completion of Construction Review Datasheets (CRD) For C-UL Mark' (00-OP-W0038) for details).

CONSTRUCTION COMPLIANCE REVIEW RECORD

Sample Identification -

Currently certified product used for comparison (include Report references if not in the same report):	Sader Power Enterprises LLC, SR-3000 Sader RAQ 3-Panel and SR-1000 Sader RAQ 1-Panel
Alternate construction details:	Addition of system fire rating Class A for use with UL1703 Listed PV modules with a fire classification rating of Type 1 and 2.

No samples received or examined. Drawings or other information was provided to support the [ ~~alternate construction.~~ ][ ~~revised construction.~~ ]  
 [ addition of a new model that is similar to a currently certified product. ]

See the following table.

Sample Card No.	Date Received	Sample No.	Manufacturer, Product Identification and Ratings

Measurement Instrument Information -

Inst. ID No.	Instrument Type	Function/Range	Last Cal. Date	Next Cal. Date
N/A				

The following additional information is required when using client's or rented equipment, or when a UL ID Number for an instrument number is not used. The Inst. ID No. below corresponds to the Inst. ID No. above.

Inst. ID No.	Make/Model/Serial Number/Asset No.
N/A	

Measurement instrument information is recorded on UL's Laboratory Project Management (LPM) database. (This statement may be selected only if CRDs are completed at a UL facility)

CONSTRUCTION COMPLIANCE REVIEW:	
---------------------------------	--

Due to similarity to the existing construction described under "Sample Identification", a limited review for compliance with the construction requirements in the following Standard was conducted. The construction requirements applicable to the [~~alternate~~][ revised ] construction and compliance with those requirements are noted below.

Standard	ULC/ORD C1703, Flat-Plate Photovoltaic Modules and Panels	Edition/Revision Date	01
----------	---	-----------------------	----

Clause/Par. Reference and Construction Requirement	Comply			Comments/Measurements	Inst. ID No.
	Yes	No	N/A		
4.11 Fire Resistance					
4.11.1 Module or Panel Intended for Stand-Off, Rack, or Direct Mounting in Combination with a Specified Roof or Intended for Integral Mounting	X			Complied with UL1703 3 <sup>rd</sup> edition, Section 31.2	

TEST RECORD NO. 1

SAMPLES:

A sample of the photovoltaic rack mounting system as indicated below and constructed as described herein, was submitted by the manufacturer for examination and test.

SR-1000 Sader RAQ 1-Panel
SR-3000 Sader RAQ 3-Panel

The Model SR- 3000 Sader RAQ 3-Panel was used for test purposes and considered representative of the entire series.

GENERAL:

Test results relate only to the items tested.

This evaluation is to evaluate only the mechanical loading utilizing Trina TSM-XXXPA05 series modules.

Testing was conducted on the PV module model, TSM-240PA05, and considered representative of the other models in the series due to the similarity in frame type, size and overall construction.

The SR-3000 is similar in construction to the SR-1000 version. Both versions utilize rails, anchor bases, rail spacers, rail spacer braces, and panel clamps. The quantity of each component are different since the SR-3000 version is intended to mount 3 modules on each rack where the SR-1000 mounts 1 module.

Testing of the SR-3000 was considered representative of the SR-1000 since the 3 module versions utilizes the same structural joints but would be subjected to a larger mechanical test load.

The following tests were conducted.

Weight of Coating	Subject 2703 Sec. 20
Mechanical Loading Tests	Subject 2703 Sec. 21

Applying clause 6.5; we have an 8.53:1 safety factor for the top down clamp cap screws. Applying clause 6.6; we have a 3.15:1 safety factor for bracket to rack cap screws utilized in shear.

The test methods and results of the above tests have been reviewed and found in accordance with the requirements in the Outline of Investigation for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for use with Flat-Plate Photovoltaic Modules and Panels, UL 2703, Issue Number 2, Dated November 13, 2012.

Test Record Summary:

The results of this investigation indicate that the products evaluated comply with the applicable requirements and, therefore, such products are judged eligible to bear UL's Mark as described on the Conclusion Page of this Report.

TEST RECORD NO. 2

SAMPLES:

A sample of the photovoltaic rack mounting system as indicated below and constructed as described herein, was submitted by the manufacturer for examination and test to add Canadian Certification for mechanical load only.

SR-1000 Sader RAQ 1-Panel
SR-3000 Sader RAQ 3-Panel

GENERAL:

Test results relate only to the items tested.

In regards to mechanical loading, the construction requirements for ULC/ORD-C1703 and UL 2703 are similar and no changes were made to the construction. Therefore, no tests were considered necessary.

Tests were considered covered as follows:

Test	File Reference	Report Date	Test Record No.
Weight of Coating	E353639	2013-11-22	1
Mechanical Loading Tests	E353639	2013-11-22	1

The test methods and results of the above tests have been reviewed and found in accordance with the requirements in the Standard for Flat-Plate Photovoltaic Modules and Panels, ULC/ORD-C1703, 1<sup>st</sup> Edition, dated October 2001.

Test Record Summary:

The results of this investigation indicate that the products evaluated comply with the applicable requirements and, therefore, such products are judged eligible to bear UL's Mark as described on the Conclusion Page of this Report.

Test Record by:
Nathan Wang
Senior Project Engineer

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL.

TEST RECORD NO. 3

## SAMPLES:

Ssamples of the photovoltaic rack mounting system as indicated below and constructed as described herein, were submitted by the manufacturer for examination and test; to add bonding for both US and Canadian requirements.

SR-1000 Sader RAQ 1-Panel
SR-3000 Sader RAQ 3-Panel

## GENERAL:

Test results relate only to the items tested.

Additional 304 stainless steel star washers have been provided at each joint to cut through the non-conductive powder coat material.

A bonding wire has been added between panel rail and spacer.

Two additional ground components were evaluated for connection of a grounding electrode conductor. A Hardware Washer Combination (Subject 2703 cl. 8.3 & C1703 cl. 4.5.7) and the Tyco 2058729 ground connector.

During tests, a nickel plated cupwasher was used in place of the described 304 stainless steel version. Due to the lower conductivity of nickel, it was considered representative of the stainless steel hardware.

The following tests were conducted.

BONDING PATH RESISTANCE TEST:	Subject 2703 Sec. 13 (C1703 cl. 5.8)
TEMPERATURE CYCLING TEST	Subject 2703 Sec. 17 (C1703 5.17)
BONDING PATH RESISTANCE TEST - Following the TEMPERATURE CYCLING TEST:	Subject 2703 Sec. 13 (C1703 cl. 5.8)
HUMIDITY CYCLING TEST	Subject 2703 Sec. 18 (C1703 5.18)
BONDING PATH RESISTANCE TEST - Following the HUMIDITY TEST:	Subject 2703 Sec. 13 (C1703 cl. 5.8)
BONDING CONDUCTOR TEST (135%, 200% & Limited-Short Circuit) followed by Bonding Path Resistance Test	Subject 2703 Sec. 22 Subject 2703 Sec. 13 (C1703 cl. 5.8)

For the HF10 and TC200 tests, one bonding junction of each representative sample was tested. Since the bonding junctions' constructions are repeatable due to controlled materials, dimensions and appropriate clamp load by the proper torque compared to manufacturing process for a complete PV module, one bonding junction of each is suitable. Additionally, the Bonding conductor test was performed on six samples of each junction involving all components that utilize nonconductive treated surfaces.

The test methods and results of the above tests have been reviewed and found in accordance with the requirements in the Outline of Investigation for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for use with Flat-Plate Photovoltaic Modules and Panels, UL 2703, Issue Number 2, Dated November 13, 2012 and the Standard for Flat-Plate

Photovoltaic Modules and Panels, ULC/ORD-C1703, 1<sup>st</sup> Edition, dated October 2001.

Test Record Summary:

The results of this investigation indicate that the products evaluated comply with the applicable requirements and, therefore, such products are judged eligible to bear UL's Mark as described on the Conclusion Page of this Report.

Test Record by:
Nathan Wang
Senior Project Engineer

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL.

TEST RECORD NO. 4

## SAMPLES:

Samples of the photovoltaic rack mounting system as indicated below and constructed as described herein, were submitted by the manufacturer for examination and test; to add system fire classification.

SR-1000 Sader RAQ 1-Panel, SR-3000 Sader RAQ 3-Panel
--

The SR-1000 was considered representative of the SR-3000.

## GENERAL:

Test results relate only to the items tested.

This evaluation only covers the fire testing. Bonding and mechanical evaluation conducted in previous test records. The system was evaluated for Steep Slope roof systems with a 5 inch gap.

Testing was conducted using the following modules:

Manufacturer	Model	Series Represented	Type Rating
SolarWorld	SunModule Plus SW 260Mono	SunModule Plus SW ###Mono, where ### is replaced by three digits	1
LG	LG315N1C-G4	LG###N1C-G4, where ### is replaced by three digits	2

The following tests were conducted.

FIRE PERFORMANCE - SPREAD OF FLAME:	ANSI/UL 2703 Sec. 15
FIRE PERFORMANCE - BURNING BRAND:	ANSI/UL 2703 Sec. 15

The test methods and results of the above tests have been reviewed and found in accordance with the requirements in the Standard For Safety For Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for use with Flat-Plate Photovoltaic Modules and Panels, UL 2703, 1<sup>st</sup> Edition, Dated January 28, 2015 and the Standard for Flat-Plate Photovoltaic Modules and Panels, ULC/ORD-C1703, 1<sup>st</sup> Edition, dated October 2001.

## Test Record Summary:

The results of this investigation indicate that the products evaluated comply with the applicable requirements and, therefore, such products are judged eligible to bear UL's Mark as described on the Conclusion Page of this Report.

Test Record by:	Reviewed by:
Nathan Wang	Jim Abplanalp
Senior Project Engineer	Staff Engineer

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL.



## CONCLUSION

A sample of the product covered by this Report has been found to comply with the requirements covering the category and the product is found to comply with UL's applicable requirements. The description and test result in this Report are only applicable to the sample(s) investigated by UL and does not signify UL certification or that the product(s) described are covered under UL's Follow-Up Service Program. When covered under UL's Follow-Up Service Program, the manufacturer is authorized to use the UL Listing Mark on such products which comply with UL's Follow-Up Service Procedure and any other applicable requirements of UL LLC. The Listing Mark of UL LLC on the product, or the UL symbol on the product and the Listing Mark on the smallest unit container in which the product is packaged, is the only method to identify products investigated by UL to published requirements and manufactured under UL's Listing and Follow-Up Service.

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Report by:
Nathan Wang
Senior Project Engineer

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LOUISVILLE, KY 40219

Order	Rls	Frnt	Customer P.O.	Gauge	Tolerance	Quality
413212036	2	DEL	0025517	.09900	+.00600	HDCOHS

Date	Time	Customer Part#	Width	Tolerance	Length	#Lifts
12/05/13	19:41:18	M-2374	4.3590	+/- .0050		6

Coated Weight: G-120

**Engineering Material Specification:**

Type: ASTM Desc: A653 SS 50 CLASS 1 G120 CO

Chemical Analysis (Wt %)

713263057-2 Lift: 339101 Net: 3,400 lbs Tare: 25 lbs Gross: 3,425 lbs

C: .210 Mn: .684 P: .011 S: .008 Si: .007 Al: .053 Cr: .049  
Ni: .019 Cu: .028 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .006

Tensile: 82.0 ksi Yield: 56.0 ksi Elong: 23.3 % NValue: .119 Rockwell(B) 84  
RValue: .6378 Footage  
Heat: 0133660

713263057-3 Lift: 339101 Net: 3,400 lbs Tare: 25 lbs Gross: 3,425 lbs

C: .210 Mn: .684 P: .011 S: .008 Si: .007 Al: .053 Cr: .049  
Ni: .019 Cu: .028 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .006

Tensile: 82.0 ksi Yield: 56.0 ksi Elong: 23.3 % NValue: .119 Rockwell(B) 84  
RValue: .6378 Footage  
Heat: 0133660

713263057-4 Lift: 339102 Net: 3,400 lbs Tare: 25 lbs Gross: 3,425 lbs

C: .210 Mn: .684 P: .011 S: .008 Si: .007 Al: .053 Cr: .049  
Ni: .019 Cu: .028 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .006

Tensile: 82.0 ksi Yield: 56.0 ksi Elong: 23.3 % NValue: .119 Rockwell(B) 84  
RValue: .6378 Footage  
Heat: 0133660

713263057-5 Lift: 339102 Net: 3,400 lbs Tare: 25 lbs Gross: 3,425 lbs

C: .210 Mn: .684 P: .011 S: .008 Si: .007 Al: .053 Cr: .049  
Ni: .019 Cu: .028 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .006

Tensile: 82.0 ksi Yield: 56.0 ksi Elong: 23.3 % NValue: .119 Rockwell(B) 84  
RValue: .6378 Footage  
Heat: 0133660

**MILL STEEL COMPANY**  
**CERTIFICATION**

1005

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<u>Order</u>	<u>Rls</u>	<u>Frnt</u>	<u>Customer P.O.</u>	<u>Gauge</u>	<u>Tolerance</u>	<u>Quality</u>
413212036	2	DEL	0025517	.09900	+ .00600	HDCOHS

<u>Date</u>	<u>Time</u>	<u>Customer Part#</u>	<u>Width</u>	<u>Tolerance</u>	<u>Length</u>	<u>#Lifts</u>
12/05/13	19:41:18	M-2374	4.3590	+/- .0050		6

Coated Weight: G-120

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**713263057-6**    **Lift:** 339103    **Net:** 3,400 lbs    **Tare:** 25 lbs    **Gross:** 3,425 lbs

**C:** .210    **Mn:** .684    **P:** .011    **S:** .008    **Si:** .007    **Al:** .053    **Cr:** .049  
**Ni:** .019    **Cu:** .028    **Ti:** .001    **V:** .002    **Nb:** .004    **B:** .000    **Mo:** .006

**Tensile:** 82.0 ksi    **Yield:** 56.0 ksi    **Elong:** 23.3 %    **NValue:** .119    **Rockwell(B)** 84  
**RValue:** .6378    **Footage**

**Heat:** 0133660

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**713263057-7**    **Lift:** 339103    **Net:** 3,400 lbs    **Tare:** 25 lbs    **Gross:** 3,425 lbs

**C:** .210    **Mn:** .684    **P:** .011    **S:** .008    **Si:** .007    **Al:** .053    **Cr:** .049  
**Ni:** .019    **Cu:** .028    **Ti:** .001    **V:** .002    **Nb:** .004    **B:** .000    **Mo:** .006

**Tensile:** 82.0 ksi    **Yield:** 56.0 ksi    **Elong:** 23.3 %    **NValue:** .119    **Rockwell(B)** 84  
**RValue:** .6378    **Footage**

**Heat:** 0133660

-----

**713263057-8**    **Lift:** 339104    **Net:** 3,400 lbs    **Tare:** 25 lbs    **Gross:** 3,425 lbs

**C:** .210    **Mn:** .684    **P:** .011    **S:** .008    **Si:** .007    **Al:** .053    **Cr:** .049  
**Ni:** .019    **Cu:** .028    **Ti:** .001    **V:** .002    **Nb:** .004    **B:** .000    **Mo:** .006

**Tensile:** 82.0 ksi    **Yield:** 56.0 ksi    **Elong:** 23.3 %    **NValue:** .119    **Rockwell(B)** 84  
**RValue:** .6378    **Footage**

**Heat:** 0133660

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**713263057-9**    **Lift:** 339104    **Net:** 3,400 lbs    **Tare:** 25 lbs    **Gross:** 3,425 lbs

**C:** .210    **Mn:** .684    **P:** .011    **S:** .008    **Si:** .007    **Al:** .053    **Cr:** .049  
**Ni:** .019    **Cu:** .028    **Ti:** .001    **V:** .002    **Nb:** .004    **B:** .000    **Mo:** .006

**Tensile:** 82.0 ksi    **Yield:** 56.0 ksi    **Elong:** 23.3 %    **NValue:** .119    **Rockwell(B)** 84  
**RValue:** .6378    **Footage**

**Heat:** 0133660

**MILL STEEL COMPANY**  
**CERTIFICATION**

1005

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1172 INDUSTRIAL BLVD  
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1172 INDUSTRIAL BLVD  
LOUISVILLE, KY 40219

<u>Order</u>	<u>Rls</u>	<u>Frnt</u>	<u>Customer P.O.</u>	<u>Gauge</u>	<u>Tolerance</u>	<u>Quality</u>
413212036	2	DEL	0025517	.09900	+.00600	HDCOHS

<u>Date</u>	<u>Time</u>	<u>Customer Part#</u>	<u>Width</u>	<u>Tolerance</u>	<u>Length</u>	<u>#Lifts</u>
12/05/13	19:41:18	M-2374	4.3590	+/- .0050		6

Coated Weight: G-120

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<b>713263057-10</b>	<b>Lift:</b>	<b>339105</b>	<b>Net:</b>	<b>3,400</b>	<b>lbs</b>	<b>Tare:</b>	<b>25</b>	<b>lbs</b>	<b>Gross:</b>	<b>3,425</b>	<b>lbs</b>		
<b>C:</b>	.210	<b>Mn:</b>	.684	<b>P:</b>	.011	<b>S:</b>	.008	<b>Si:</b>	.007	<b>Al:</b>	.053	<b>Cr:</b>	.049
<b>Ni:</b>	.019	<b>Cu:</b>	.028	<b>Ti:</b>	.001	<b>V:</b>	.002	<b>Nb:</b>	.004	<b>B:</b>	.000	<b>Mo:</b>	.006
<b>Tensile:</b>	82.0	ksi	<b>Yield:</b>	56.0	ksi	<b>Elong:</b>	23.3	%	<b>NValue:</b>	.119	<b>Rockwell(B)</b>	84	
									<b>RValue:</b>	.6378	<b>Footage</b>		
						<b>Heat:</b>	0133660						

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<b>713263057-11</b>	<b>Lift:</b>	<b>339105</b>	<b>Net:</b>	<b>3,400</b>	<b>lbs</b>	<b>Tare:</b>	<b>25</b>	<b>lbs</b>	<b>Gross:</b>	<b>3,425</b>	<b>lbs</b>		
<b>C:</b>	.210	<b>Mn:</b>	.684	<b>P:</b>	.011	<b>S:</b>	.008	<b>Si:</b>	.007	<b>Al:</b>	.053	<b>Cr:</b>	.049
<b>Ni:</b>	.019	<b>Cu:</b>	.028	<b>Ti:</b>	.001	<b>V:</b>	.002	<b>Nb:</b>	.004	<b>B:</b>	.000	<b>Mo:</b>	.006
<b>Tensile:</b>	82.0	ksi	<b>Yield:</b>	56.0	ksi	<b>Elong:</b>	23.3	%	<b>NValue:</b>	.119	<b>Rockwell(B)</b>	84	
									<b>RValue:</b>	.6378	<b>Footage</b>		
						<b>Heat:</b>	0133660						

---

<b>713263057-12</b>	<b>Lift:</b>	<b>339106</b>	<b>Net:</b>	<b>3,400</b>	<b>lbs</b>	<b>Tare:</b>	<b>25</b>	<b>lbs</b>	<b>Gross:</b>	<b>3,425</b>	<b>lbs</b>		
<b>C:</b>	.210	<b>Mn:</b>	.684	<b>P:</b>	.011	<b>S:</b>	.008	<b>Si:</b>	.007	<b>Al:</b>	.053	<b>Cr:</b>	.049
<b>Ni:</b>	.019	<b>Cu:</b>	.028	<b>Ti:</b>	.001	<b>V:</b>	.002	<b>Nb:</b>	.004	<b>B:</b>	.000	<b>Mo:</b>	.006
<b>Tensile:</b>	82.0	ksi	<b>Yield:</b>	56.0	ksi	<b>Elong:</b>	23.3	%	<b>NValue:</b>	.119	<b>Rockwell(B)</b>	84	
									<b>RValue:</b>	.6378	<b>Footage</b>		
						<b>Heat:</b>	0133660						

---

<b>713263057-13</b>	<b>Lift:</b>	<b>339106</b>	<b>Net:</b>	<b>3,400</b>	<b>lbs</b>	<b>Tare:</b>	<b>25</b>	<b>lbs</b>	<b>Gross:</b>	<b>3,425</b>	<b>lbs</b>		
<b>C:</b>	.210	<b>Mn:</b>	.684	<b>P:</b>	.011	<b>S:</b>	.008	<b>Si:</b>	.007	<b>Al:</b>	.053	<b>Cr:</b>	.049
<b>Ni:</b>	.019	<b>Cu:</b>	.028	<b>Ti:</b>	.001	<b>V:</b>	.002	<b>Nb:</b>	.004	<b>B:</b>	.000	<b>Mo:</b>	.006
<b>Tensile:</b>	82.0	ksi	<b>Yield:</b>	56.0	ksi	<b>Elong:</b>	23.3	%	<b>NValue:</b>	.119	<b>Rockwell(B)</b>	84	
									<b>RValue:</b>	.6378	<b>Footage</b>		
						<b>Heat:</b>	0133660						



**MILL STEEL COMPANY  
CERTIFICATION**

1005

**Shipper: 814017244**  
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**SCAC: TRCK**  
**Move: 314016414-2**

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 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Ordered By: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Bill-To: (3321)**  
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 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

Order	Rls	Frnt	Customer P.O.	Gauge	Tolerance	Quality		
413212036	5	DEL	0025517	.09900	+.00600	HDCOHS		
Date	Time	Customer Part#	Width	Tolerance	Length	#Lifts		
1/17/14	14:27:16	M-2374	4.3590	+/- .0050		3		

Coated Weight: G-120

**Engineering Material Specification:**

**Type: ASTM Desc: A653 SS 50 CLASS 1 G120 CO**

Chemical Analysis (Wt %)

**713288042-2 Lift: 14105 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs**

**C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032**  
**Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002**

**Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83**  
**RValue: Footage**  
**Heat: 0134305**

**713288042-3 Lift: 14105 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs**

**C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032**  
**Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002**

**Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83**  
**RValue: Footage**  
**Heat: 0134305**

**713288042-4 Lift: 14104 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs**

**C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032**  
**Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002**

**Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83**  
**RValue: Footage**  
**Heat: 0134305**

**713288042-5 Lift: 14104 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs**

**C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032**  
**Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002**

**Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83**  
**RValue: Footage**  
**Heat: 0134305**

**MILL STEEL COMPANY  
CERTIFICATION**

1005

**Shipper: 814017244**  
**Truck: FOUR STAR TRANSPORTATION**  
**SCAC: TRCK**  
**Move: 314016414-2**

**Ship-To: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Ordered By: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Bill-To: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

Order	Rls	Frnt	Customer P.O.	Gauge	Tolerance	Quality
413212036	5	DEL	0025517	.09900	+.00600	HDCOHS

Date	Time	Customer Part#	Width	Tolerance	Length	#Lifts
1/17/14	14:27:16	M-2374	4.3590	+/- .0050		3

Coated Weight: G-120

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<b>713288042-10</b>	<b>Lift:</b>	14101	<b>Net:</b>	4,037 lbs	<b>Tare:</b>	25 lbs	<b>Gross:</b>	4,062 lbs					
<b>C:</b>	.220	<b>Mn:</b>	.760	<b>P:</b>	.013	<b>S:</b>	.007	<b>Si:</b>	.013	<b>Al:</b>	.057	<b>Cr:</b>	.032
<b>Ni:</b>	.014	<b>Cu:</b>	.023	<b>Ti:</b>	.001	<b>V:</b>	.002	<b>Nb:</b>	.004	<b>B:</b>	.000	<b>Mo:</b>	.002
<b>Tensile:</b>	84.3	ksi	<b>Yield:</b>	58.5	ksi	<b>Elong:</b>	28.4 %	<b>NValue:</b>	.164	<b>Rockwell(B)</b>	83		
								<b>RValue:</b>		<b>Footage</b>			
						<b>Heat:</b>	0134305						

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<b>713288042-11</b>	<b>Lift:</b>	14101	<b>Net:</b>	4,037 lbs	<b>Tare:</b>	25 lbs	<b>Gross:</b>	4,062 lbs					
<b>C:</b>	.220	<b>Mn:</b>	.760	<b>P:</b>	.013	<b>S:</b>	.007	<b>Si:</b>	.013	<b>Al:</b>	.057	<b>Cr:</b>	.032
<b>Ni:</b>	.014	<b>Cu:</b>	.023	<b>Ti:</b>	.001	<b>V:</b>	.002	<b>Nb:</b>	.004	<b>B:</b>	.000	<b>Mo:</b>	.002
<b>Tensile:</b>	84.3	ksi	<b>Yield:</b>	58.5	ksi	<b>Elong:</b>	28.4 %	<b>NValue:</b>	.164	<b>Rockwell(B)</b>	83		
								<b>RValue:</b>		<b>Footage</b>			
						<b>Heat:</b>	0134305						

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<b>*** TOTAL ***</b>	<b>Net:</b>	<b>24,222</b> lbs	<b>Tare</b>	<b>150</b> lbs	<b>Gross:</b>	<b>24,372</b> lbs
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**Lift Summary**

Lift	Cnt	Net	Tare	Gross
014105	2	8,074 lbs	50 lbs	8,124 lbs
014104	2	8,074 lbs	50 lbs	8,124 lbs
014101	2	8,074 lbs	50 lbs	8,124 lbs

**MILL STEEL COMPANY  
CERTIFICATION**

1005

**Shipper: 814020207**  
**Truck: HADDAD INTERNATIONAL**  
**SCAC: HITI**  
**Move: 314016019-1**

**Ship-To: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Ordered By: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Bill-To: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

Order	Rls	Frnt	Customer P.O.	Gauge	Tolerance	Quality		
413212036	5	DEL	0025517	.09900	+.00600	HDCOHS		
Date	Time	Customer Part#	Width	Tolerance	Length	#Lifts		
1/20/14	12:50:45	M-2374	4.3590	+/- .0050		3		

Coated Weight: G-120

**Engineering Material Specification:**

**Type: ASTM Desc: A653 SS 50 CLASS 1 G120 CO**

Chemical Analysis (Wt %)

**713288042-6** Lift: 14103 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs

C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032  
 Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002

Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83  
 RValue: Footage  
 Heat: 0134305

**713288042-7** Lift: 14103 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs

C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032  
 Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002

Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83  
 RValue: Footage  
 Heat: 0134305

**713288042-8** Lift: 14102 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs

C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032  
 Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002

Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83  
 RValue: Footage  
 Heat: 0134305

**713288042-9** Lift: 14102 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs

C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032  
 Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002

Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83  
 RValue: Footage  
 Heat: 0134305





**MILL STEEL COMPANY  
CERTIFICATION**

1005

**Shipper: 814017244**  
**Truck: FOUR STAR TRANSPORTATION**  
**SCAC: TRCK**  
**Move: 314016414-2**

**Ship-To: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Ordered By: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Bill-To: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

Order	Rls	Frnt	Customer P.O.	Gauge	Tolerance	Quality
413212036	5	DEL	0025517	.09900	+.00600	HDCOHS

Date	Time	Customer Part#	Width	Tolerance	Length	#Lifts
1/17/14	14:27:16	M-2374	4.3590	+/- .0050		3

Coated Weight: G-120

**Engineering Material Specification:**

**Type: ASTM Desc: A653 SS 50 CLASS 1 G120 CO**

Chemical Analysis (Wt %)

**713288042-2** Lift: 14105 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs

C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032  
 Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002

Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83  
 RValue: Footage  
 Heat: 0134305

**713288042-3** Lift: 14105 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs

C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032  
 Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002

Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83  
 RValue: Footage  
 Heat: 0134305

**713288042-4** Lift: 14104 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs

C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032  
 Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002

Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83  
 RValue: Footage  
 Heat: 0134305

**713288042-5** Lift: 14104 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs

C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032  
 Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002

Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83  
 RValue: Footage  
 Heat: 0134305

**MILL STEEL COMPANY  
CERTIFICATION**

1005

**Shipper: 814017244**  
**Truck: FOUR STAR TRANSPORTATION**  
**SCAC: TRCK**  
**Move: 314016414-2**

**Ship-To: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Ordered By: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Bill-To: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

Order	Rls	Frnt	Customer P.O.	Gauge	Tolerance	Quality
413212036	5	DEL	0025517	.09900	+.00600	HDCOHS

Date	Time	Customer Part#	Width	Tolerance	Length	#Lifts
1/17/14	14:27:16	M-2374	4.3590	+/- .0050		3

Coated Weight: G-120

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<b>713288042-10</b>	<b>Lift:</b>	14101	<b>Net:</b>	4,037 lbs	<b>Tare:</b>	25 lbs	<b>Gross:</b>	4,062 lbs					
<b>C:</b>	.220	<b>Mn:</b>	.760	<b>P:</b>	.013	<b>S:</b>	.007	<b>Si:</b>	.013	<b>Al:</b>	.057	<b>Cr:</b>	.032
<b>Ni:</b>	.014	<b>Cu:</b>	.023	<b>Ti:</b>	.001	<b>V:</b>	.002	<b>Nb:</b>	.004	<b>B:</b>	.000	<b>Mo:</b>	.002
<b>Tensile:</b>	84.3	ksi	<b>Yield:</b>	58.5	ksi	<b>Elong:</b>	28.4 %	<b>NValue:</b>	.164	<b>Rockwell(B)</b>	83		
								<b>RValue:</b>		<b>Footage</b>			
						<b>Heat:</b>	0134305						

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<b>713288042-11</b>	<b>Lift:</b>	14101	<b>Net:</b>	4,037 lbs	<b>Tare:</b>	25 lbs	<b>Gross:</b>	4,062 lbs					
<b>C:</b>	.220	<b>Mn:</b>	.760	<b>P:</b>	.013	<b>S:</b>	.007	<b>Si:</b>	.013	<b>Al:</b>	.057	<b>Cr:</b>	.032
<b>Ni:</b>	.014	<b>Cu:</b>	.023	<b>Ti:</b>	.001	<b>V:</b>	.002	<b>Nb:</b>	.004	<b>B:</b>	.000	<b>Mo:</b>	.002
<b>Tensile:</b>	84.3	ksi	<b>Yield:</b>	58.5	ksi	<b>Elong:</b>	28.4 %	<b>NValue:</b>	.164	<b>Rockwell(B)</b>	83		
								<b>RValue:</b>		<b>Footage</b>			
						<b>Heat:</b>	0134305						

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<b>*** TOTAL ***</b>	<b>Net:</b>	<b>24,222</b> lbs	<b>Tare</b>	<b>150</b> lbs	<b>Gross:</b>	<b>24,372</b> lbs
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**Lift Summary**

Lift	Cnt	Net	Tare	Gross
014105	2	8,074 lbs	50 lbs	8,124 lbs
014104	2	8,074 lbs	50 lbs	8,124 lbs
014101	2	8,074 lbs	50 lbs	8,124 lbs

**MILL STEEL COMPANY  
CERTIFICATION**

1005

**Shipper: 814020207**  
**Truck: HADDAD INTERNATIONAL**  
**SCAC: HITI**  
**Move: 314016019-1**

**Ship-To: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Ordered By: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Bill-To: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

Order	Rls	Frnt	Customer P.O.	Gauge	Tolerance	Quality		
413212036	5	DEL	0025517	.09900	+.00600	HDCOHS		
Date	Time	Customer Part#	Width	Tolerance	Length	#Lifts		
1/20/14	12:50:45	M-2374	4.3590	+/- .0050		3		

Coated Weight: G-120

**Engineering Material Specification:**  
**Type: ASTM Desc: A653 SS 50 CLASS 1 G120 CO**

Chemical Analysis (Wt %)

**713288042-6** Lift: 14103 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs

C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032  
 Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002

Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83  
 RValue: Footage  
 Heat: 0134305

**713288042-7** Lift: 14103 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs

C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032  
 Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002

Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83  
 RValue: Footage  
 Heat: 0134305

**713288042-8** Lift: 14102 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs

C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032  
 Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002

Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83  
 RValue: Footage  
 Heat: 0134305

**713288042-9** Lift: 14102 Net: 4,037 lbs Tare: 25 lbs Gross: 4,062 lbs

C: .220 Mn: .760 P: .013 S: .007 Si: .013 Al: .057 Cr: .032  
 Ni: .014 Cu: .023 Ti: .001 V: .002 Nb: .004 B: .000 Mo: .002

Tensile: 84.3 ksi Yield: 58.5 ksi Elong: 28.4 % NValue: .164 Rockwell(B) 83  
 RValue: Footage  
 Heat: 0134305

**MILL STEEL COMPANY  
CERTIFICATION**

1005

**Shipper: 814020207**  
**Truck: HADDAD INTERNATIONAL**  
**SCAC: HITI**  
**Move: 314016019-1**

**Ship-To: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Ordered By: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

**Bill-To: (3321)**  
 ROLLER DIE & FORMING  
 1172 INDUSTRIAL BLVD  
 LOUISVILLE, KY 40219

<u>Order</u>	<u>Rls</u>	<u>Frnt</u>	<u>Customer P.O.</u>	<u>Gauge</u>	<u>Tolerance</u>	<u>Quality</u>
413212036	5	DEL	0025517	.09900	+.00600	HDCOHS

<u>Date</u>	<u>Time</u>	<u>Customer Part#</u>	<u>Width</u>	<u>Tolerance</u>	<u>Length</u>	<u>#Lifts</u>
1/20/14	12:50:45	M-2374	4.3590	+/- .0050		3

Coated Weight: G-120

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<b>713288042-12</b>	<b>Lift:</b>	<b>Net:</b>	<b>4,037</b>	<b>lbs</b>	<b>Tare:</b>	<b>50</b>	<b>lbs</b>	<b>Gross:</b>	<b>4,087</b>	<b>lbs</b>			
<b>C:</b>	.220	<b>Mn:</b>	.760	<b>P:</b>	.013	<b>S:</b>	.007	<b>Si:</b>	.013	<b>Al:</b>	.057	<b>Cr:</b>	.032
<b>Ni:</b>	.014	<b>Cu:</b>	.023	<b>Ti:</b>	.001	<b>V:</b>	.002	<b>Nb:</b>	.004	<b>B:</b>	.000	<b>Mo:</b>	.002
<b>Tensile:</b>	84.3	ksi	<b>Yield:</b>	58.5	ksi	<b>Elong:</b>	28.4	%	<b>NValue:</b>	.164	<b>Rockwell(B)</b>	83	
						<b>Heat:</b>	0134305		<b>RValue:</b>		<b>Footage</b>		

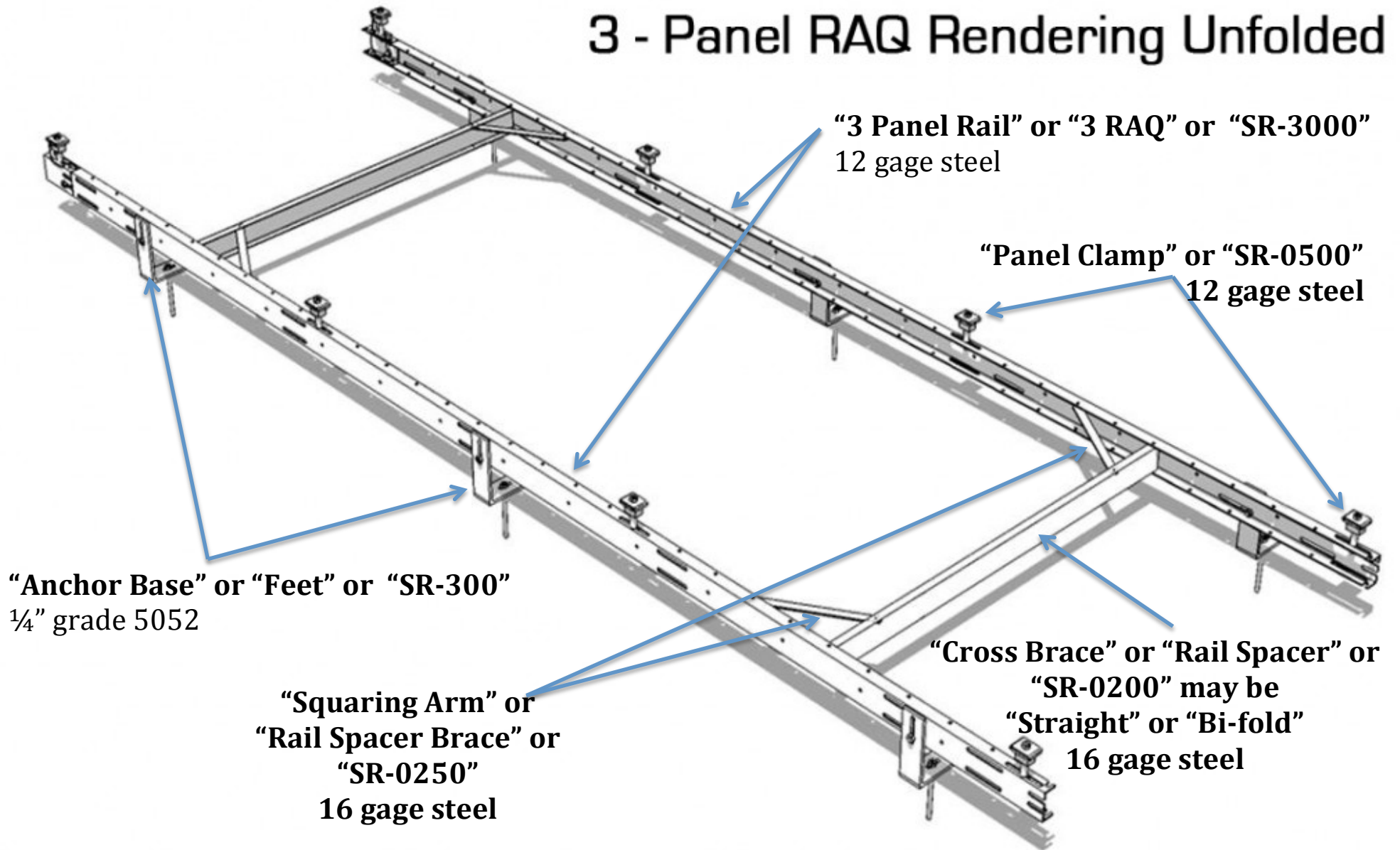
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<b>*** TOTAL ***</b>	<b>Net:</b>	<b>20,185</b>	<b>lbs</b>	<b>Tare</b>	<b>150</b>	<b>lbs</b>	<b>Gross:</b>	<b>20,335</b>	<b>lbs</b>
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**Lift Summary**

<u>Lift:</u>	<u>Cnt:</u>	<u>Net:</u>	<u>Tare:</u>	<u>Gross:</u>
014103	2	8,074 lbs	50 lbs	8,124 lbs
014102	2	8,074 lbs	50 lbs	8,124 lbs
Tag#: 713288042-12	1	4,037 lbs	50 lbs	4,087 lbs

# 3 - Panel RAQ Rendering Unfolded



# 1 Panel Kit unfolded

**"1 Panel Rail" or "1 RAQ" or "SR-1100"**

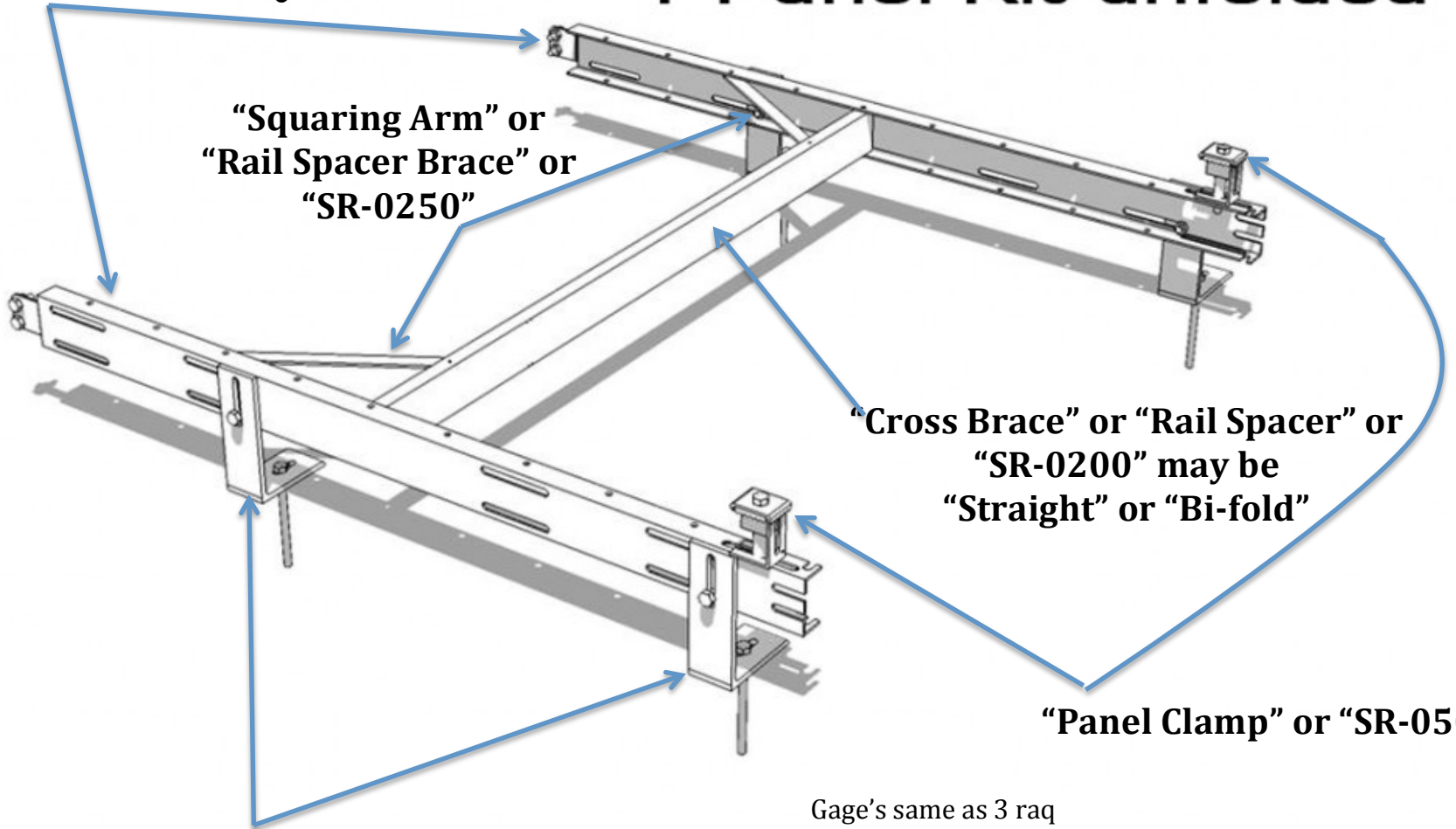
**"Squaring Arm" or  
"Rail Spacer Brace" or  
"SR-0250"**

**"Cross Brace" or "Rail Spacer" or  
"SR-0200" may be  
"Straight" or "Bi-fold"**

**"Panel Clamp" or "SR-0500"**

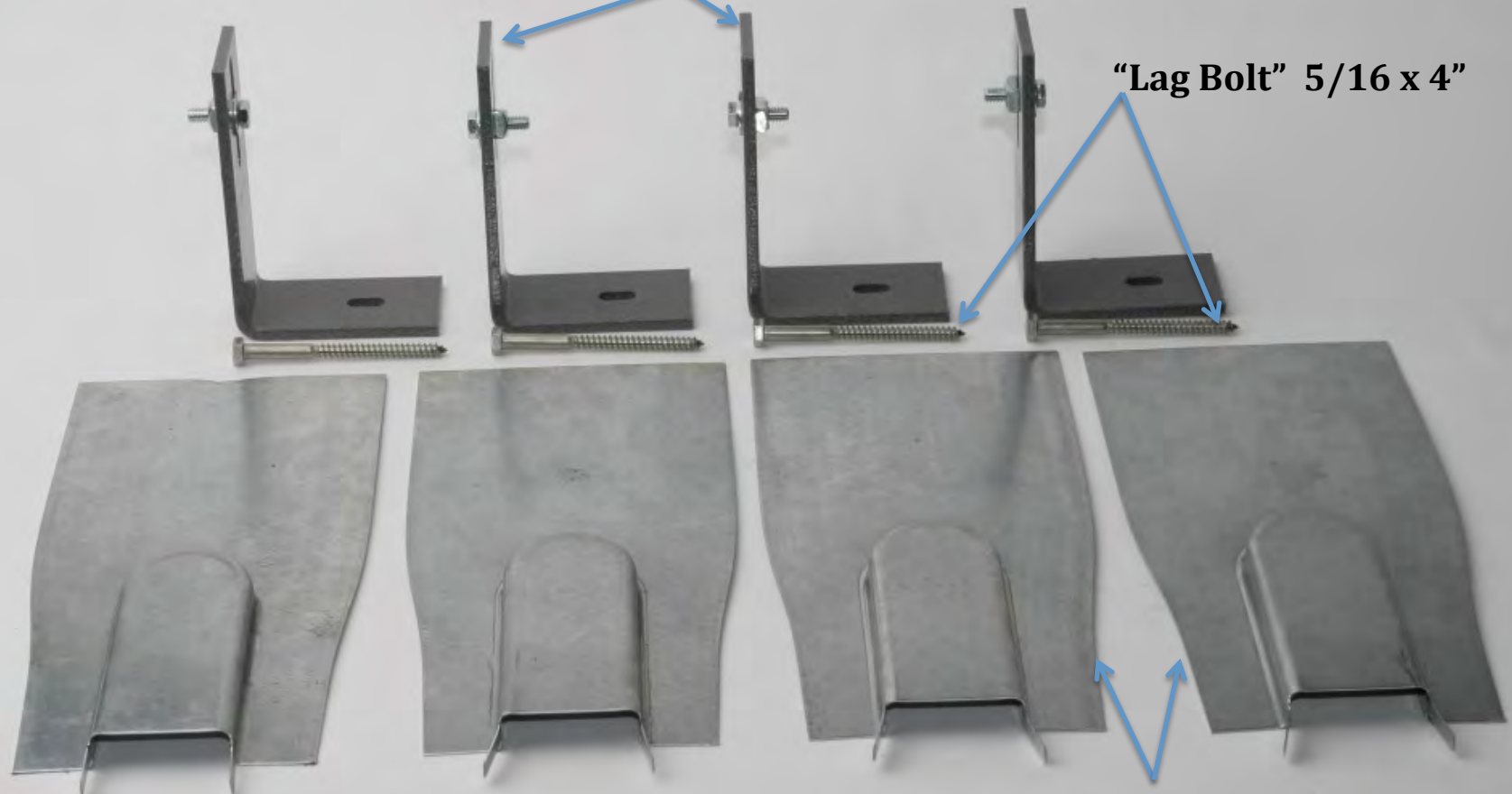
**"Anchor Base" or "Feet" or "SR-300"**

Gage's same as 3 raq



**Supplemental Anchor Base Kit showing all hardware and components**

**“Anchor Base” or “Feet” or “SR-300”**



**“Lag Bolt” 5/16 x 4”**

**“Anchor Base Flashing” or “Feet Flashing” or “Flashing” or “SR-0400” gage 16**





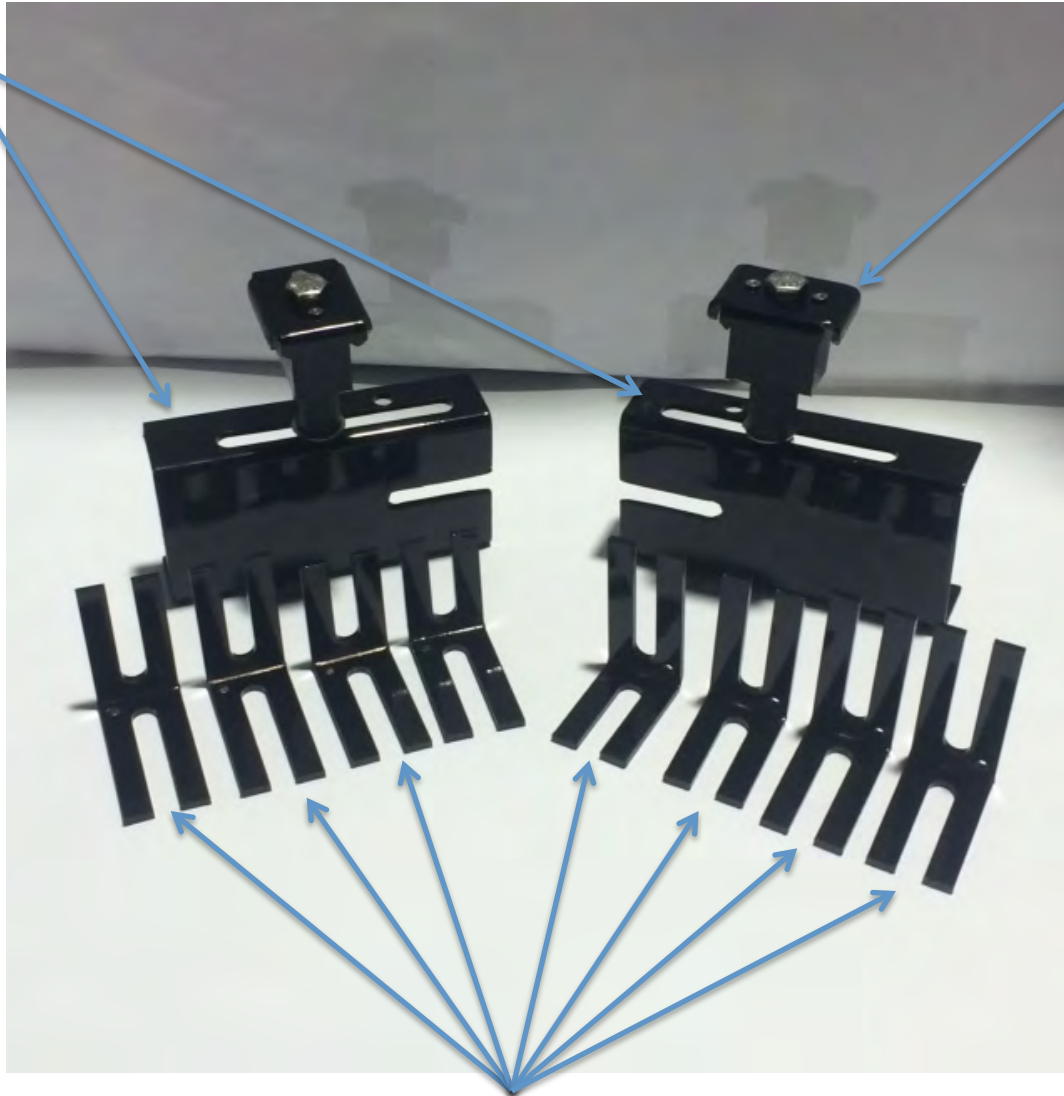
**“Anchor Base Flashing” or  
“Feet Flashing”  
or “Flashing” or  
“SR-0400”**

**“Panel Clamp” or “SR-0500”**

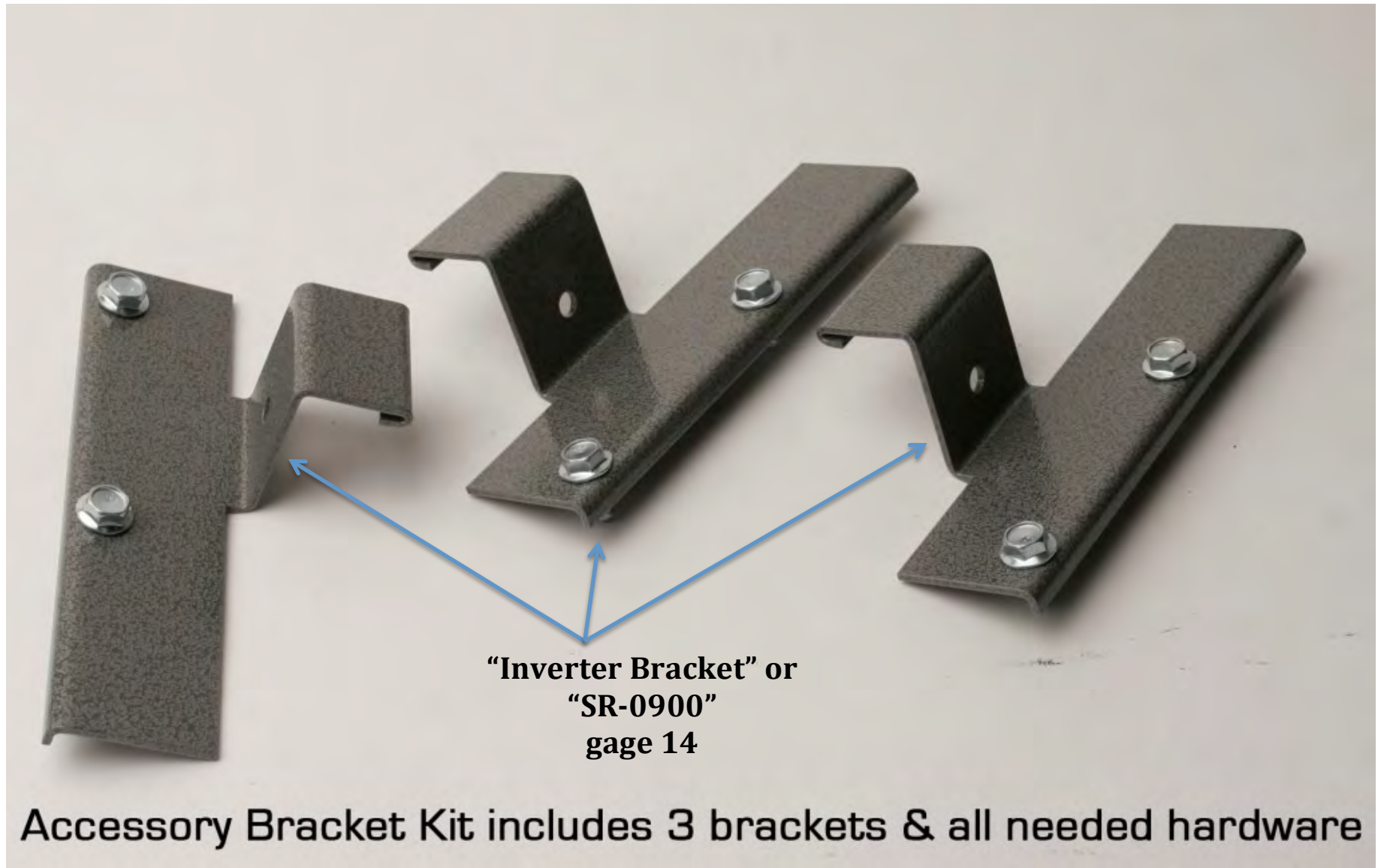
**“Grounding LUG” or “BF15B”**

**“Start Bracket” or  
“SR-0700”  
gage 12**

**“Panel Clamp” or  
“SR-0500”  
gage 12**



**“Panel Clamp End Clip” or  
“End Clip” or  
“SR-0800” gage 15**



**"Inverter Bracket" or  
"SR-0900"  
gage 14**

**Accessory Bracket Kit includes 3 brackets & all needed hardware**



## Highlights

PPG's Envirocyl® and Envirocron® powder coatings are aesthetically pleasing, produce a durable uniform finish and can be custom formulated with finishes from high gloss to low gloss, and in a variety of textures.

PPG's "World Class" Polyester Powder Coatings provide a combination of good physical and chemical resistance properties. This extensive line of Polyester Powders is manufactured to meet the increasing requirement demands of the appliance and industrial markets. These sophisticated Polyesters are the solution to your smoothness, low-bake, durability and physical property requirements. An unsurpassed application development program enables consistently friendly use on a variety of substrates.

## Product Features

Available in a wide range of colors and glosses

Low cure capabilities

Exterior durability

Good chemical resistance

VOCs are essentially zero

UL Approved

## Technical Properties

Property	Test Method	Value
Color		Black Texture
Gloss	ASTM D-523	0.0 - 5.0 @ 60°
Adhesion	ASTM D-3359	100% (5B Pass)
Hardness	ASTM D-3363	H - 2H Pencil (Eagle)
Impact Resistance	ASTM D-2794	80 In.-lbs. Direct 80 In.-lbs. Reverse
Conical Mandrel	ASTM D-522	1/8" Mandrel - No Cracking
Salt Spray	ASTM B-117	1000 Hrs. Pass <1/8" Scribe Creep - No Blisters
Humidity	ASTM D-1735	1000 Hrs. Pass <1/16" Scribe Creep - No Blisters

*Film Properties were determined using 1.5 - 2.5 mils powder film over iron phosphated, chrome rinse pretreated, 22 gauge, unpolished cold rolled steel test panels.*

## Application Data

Application Type:	Electrostatic Spray
Recommended Bake:	12 Minutes at 300 °F Metal Temperature See Cure Curve PCT-045
VOC:	Essentially Zero
Specific Gravity:	1.38 ± .05
Theoretical Coverage:	139 Sq. Ft. per pound at 1.0 mil
Shelf Life from Date of Manufacture:	80 °F Maximum - 6 Months

*PPG recommends that all material be used in FIFO order (first in - first out).  
Materials that exceed the recommended shelf life should be tested prior to use.*



\* Statements and methods described herein are based upon the best information and practices known to PPG Industries, Inc. ("PPG"). Any statements or methods mentioned herein are general suggestions only and are not to be construed as representations or warranties as to safety, performance, or results. Since the suitability and performance of the product is highly dependent on the product user's processes, operations, and numerous other user-determined conditions, the user is solely responsible for, and assumes all responsibility, risk and liability arising from, the determination of whether the product is suitable for the user's purposes, including without limitation substrate, application process, pasteurization and/or processing, and end use. No testing, suggestions or data offered by PPG to the user shall relieve the user of this responsibility. PPG does not warrant freedom from patent infringement in the use of any formula or process set forth herein. Continuous improvements in coatings technology may cause future technical data to vary from what is in this bulletin. Contact your PPG representative for the most up to date information.

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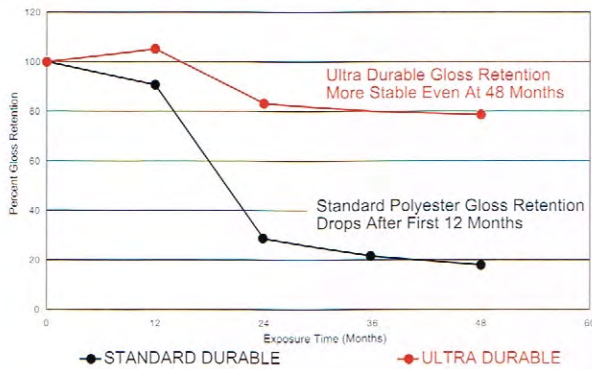
# ENVIROCRON<sup>®</sup> Ultra Durable POWDER COATINGS



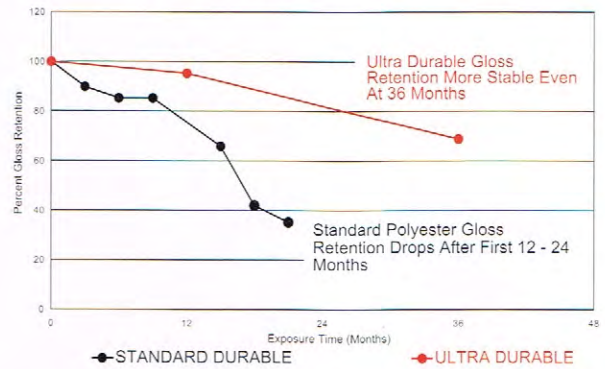
## Florida Exposure - 45° South Weathering *Standard vs. Ultra Durable*

### Gloss Retention vs. Time

BROWN SATIN POLYESTER

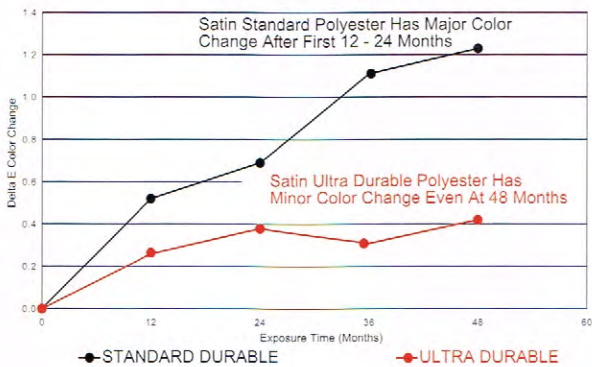


HIGH GLOSS (85+) WHITE URETHANE



### Color Retention vs. Time

BROWN SATIN POLYESTER



HIGH (85+) GLOSS WHITE URETHANE

