1. Client Information

Customer Company Name:	Rheem Sales Company, Inc.
Contact Person:	Ralph Hudnall
Position Title:	Engineering Certification Coordinator
Business Address:	2600 Gunter Park Dr. E, Montgomery, Alabama
P.O Box:	N/A
Post Code:	36109
Telephone:	(334) 213-3856
Fax:	(334) 260-1350
Email:	Ralph.Hudnall@rheem.com

2. Test Information

Title of Test:	Performance Test of Electric Storage Water Heaters
Test Procedure:	SASO 2884:2017 in compliance with SASO IEC 60379:2007
Test Performed:	Standing (thermal losses) per 24 h – F.5 Determination of maximum load profile – Annex A and B.2 Calculation of the Energy Efficiency Coefficient – C3.1 Determination of the mixed quantity of water V40 – C.6 and F.6 Heating Energy – F.7
Project Number:	PN6944
Report Number:	PN6944-0355
Test Conducted By:	Hunter Springer
Report Issue Date:	8/30/2018

3. Lab Information

CB Testing Laboratory:	UL Verification Services Inc.
Testing Laboratory Address:	3020 1st Avenue East Newton IA,50208
Contact Person:	Curt Tremel
Telephone:	+1641787 8812

4. Objective

Testing electric storage water heaters to SASO 2884:2017 test procedure.

5. Description of the Product

Brand(s) Name:	Ruud
Manufacturer:	Rheem Sales Company, Inc.
Manufacturer Model Number(s):	PE2-52-2 24 4.5S
Model Year:	2018
Serial Number(s):	Q211829651
Country of Manufacturer / Made In ####	USA/Mexico
Date(s) Manufactured:	22 May 2018
Product Type(s):	Electric Storage Water Heater
Sample Tracking #'s:	ST-2018-0355
Rated Capacity (L) - If any	170
Rated Power (W)	4150 at 230V
Rated Voltage or Voltage Range (V)	220, 230, 240
Rated Current (A)	18
Rated Frequency (Hz)	50/60
Declared Load Profile (*select one and cross out all non-applicable profiles*)	~~3XS, 2XS, XS, S, M,~~ **L,** ~~XL, 2XL, 3XL, 4XL~~
Rated Efficiency (%)	87.3
Rated Annual Energy (kWh)	2973
Rated Mixed Quantity of Water at 40°C – V 40(L)	365
Date(s) Product Received:	6 June 2018
Dimensions of Unit (m × m × m)	0.486 x 0.486 x 1.449
Net Weight of the Unit (kg)	46.323
For Solar Water Heaters Only	
Surface of the collector Asol (m^2)	N/A
Zero loss coefficient (Eo)	N/A
Head loss coefficient $a_1(\frac{W}{m^2.K})$	N/A
Head loss coefficient $a_2(\frac{W}{m^2K^2})$	N/A
Incidence angle of the collector	N/A

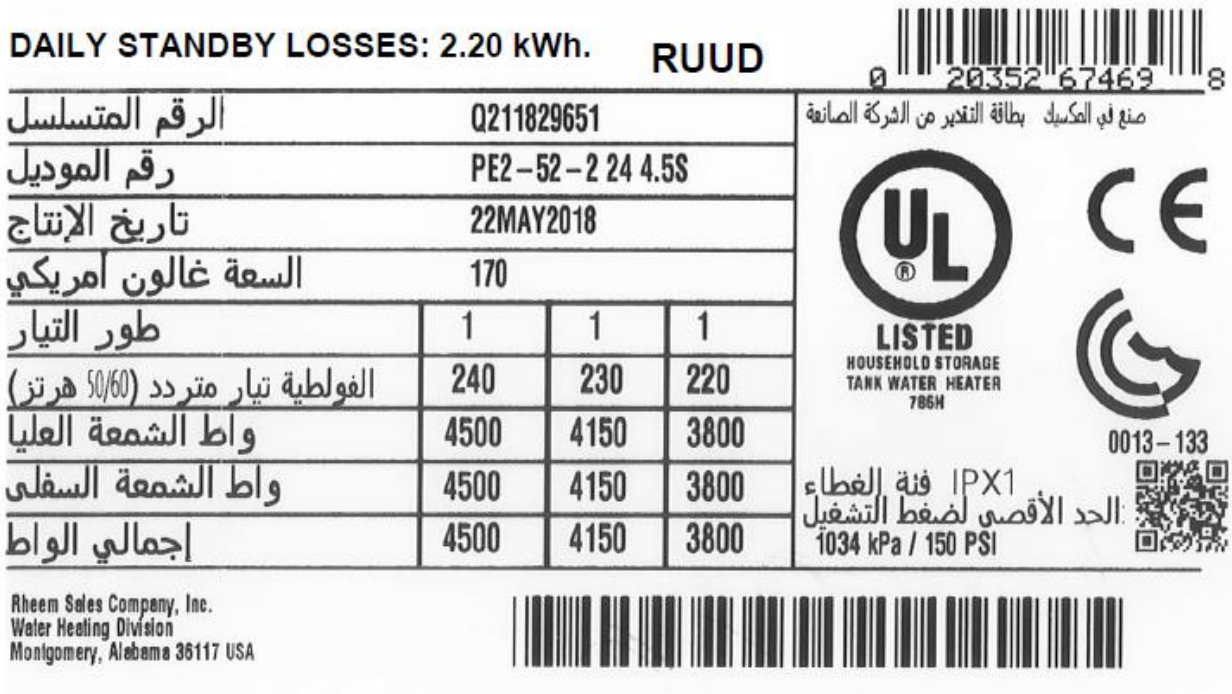
Thermal losses Power $S_2(W)$	N/A
Power of the pump $S_{pmp}(W)$	N/A
Standby power $S_{stby}(W)$	N/A
For Hot Water Storage Only	
Rated Thermal Losses - $Qpr(\frac{kWh}{24h})$	2.20

6. Summary

(a) Tests performed:

- Standing (thermal losses) per 24 h – F.5
- Determination of maximum load profile – Annex A and B.2
- Calculation of the Energy Efficiency Coefficient – C3.1
- Determination of the mixed quantity of water V40 – C.6 and F.6
- Heating Energy – F.7

Marking Plate – Tested Model:



Marking Plate – Derivative Model:

Marking Plate – Derivative Model:

Product Photo – Tested Model:

Product Photo – Derivative Model:

Product Photo – Derivative Model:

Test Verdict:
Product meets requirement ……..……P (Pass or Complete).
Product does not meet requirement ……F (Fail).
Product/Test not checked……..N/C (Not Checked).
Product/Test not applicable……...N/A (Not Applicable).

SASO 2884:2017			
Clause	**Requirement Test**	**Result Remark**	**Verdict**
4	**CRITERIA FOR APPLYING THE MINIMUM ENERGY PERFORMANCE STANDARD (MEPS)**		
4.2	Determining the minimum performance		
4.2.1	Minimum energy performance on the Water Heating Energy Efficiency	See Annex C (add details for Annex C below)	**P**
4.2.2	Declaration of the Load Profile	See Annex A or Storage Water Heater as per Clause E.2 (Add details for Annex A and E.2 below)	**P**
4.2.3	Minimum Energy Efficiency Performance Standard (MEPS) for Water Heaters	Large $> 73\%$	**P**
4.2.4	Minimum Energy performance Standard (MEPS) for Hot Water Storage Tanks Qpr (Note: Applicable for capacities higher than or equal to 25 liters)	$Q_{pr} \leq \frac{504 + 248 \times V_{rated}^{0.4}}{1000}$ Required Qpr ≤ 2.44 kWh Tested Qpr = 2.22	N/A
4.3	Acceptance Criteria for Labelling and Market Surveillance	Rated power = 4150 Watts Tested power = 4144 Watts	-
		Tested Power ≥ 0.90 X rated power	**P**
		Tested Power ≤ 1.05 X rated power	**P**
		Tested thermal losses (Q_{pr}) ≤ 1.05 rated $Q_{pr,rated}$	**P**
		Rated Capacity = 170 Liters Tested Capacity = 171 Liters	-
		Tested Capacity ≥ 0.98 X rated capacity	**P**
		Rated V_{40} = 365 Tested mixed quantity of water V_{40} = 363 Liters	**P**
		Tested mixed quantity of water (V_{40}) ≥ 0.97 X rated V_{40}	**P**
		Tested Energy (any type) ≤ 1.05 X rated energy (any type)	**P**
		Tested Collector Aperture (m^2) ≥ 0.98 X rated value	N/A
		Tested Standby Power $P_{sol;stby}$≤ 1.03 X rated $P_{sol;stby}$	N/A
		Tested Pump Power Consumption $P_{sol;pump}$≤ 1.03 X rated $P_{sol;pump}$	N/A

ANNEX A			
SASO 2884:2017: Annex A – Load Profiles of Water Heaters			
Clause	**Requirement - Test**	**Result**	**Verdict**
	Referenced the load profiles as presented in SASO 2884:2017 - Table A1 through A3	Met declared load profile tested	**P**

ANNEX B			
SASO 2884:2017: Annex B – Test Procedures and measurements			
Clause	**Requirement - Test**	**Result**	**Verdict**
B.1	Measurement done as per standard listed in Clause 2 – SASO IEC 60379	Measurement met the technical parameters and conditions called out in SASO IEC 60379	**P**
B.2	Measurement carried out as per the load profile set out in Annex A	Declared load profile (L) was found to be the maximum load profile	**P**
B.3	Conditions for testing smart water heaters		N/A
B.4	Conditions for testing solar water heaters		N/A
B.5	Conditions for testing heat pump water heaters		N/A
B.6	Technical requirements of water heaters		
(a)	Daily electric consumption (Q_{elec})	12.59 kWh	**P**
(b)	Declared load profile	L	**P**
(c)	Daily fuel consumption (Q_{fuel})	0 kWh	**P**
(d) – (g)	Requirements for smart water heaters		N/A
(h)	Mixed water at 40 °C (V40)	363 Liters	
(i) – (p)	Requirements for solar water heaters		N/A
B.7	Technical parameters of Hot Water Storage Tanks		N/A
B.8	Testing Water Storage Tanks		N/A

ANNEX C			
SASO 2884:2017: Annex C – Calculation of the Energy Efficiency			
Clause	**Requirement - Test**	**Result**	**Verdict**
C.1	Application Methods	Used technical parameters from Annex B	**P**
C.2	Technical Parameters of Water Heaters	Round ηwh to one decimal place	**P**
C.3	Calculation of the Emery Efficiency Coefficient	ηwh = 87.3%	**P**
C.4	Smart Control Factor		N/A
C.5	Determiantion of the Ambient Correction Term	Qcor = -0.2148	**P**
C.6	Determination of the mixed quantity of water V40	V40 =363 Liters	**P**

ANNEX D			
SASO 2884:2017: Annex D – Calculation of the Annual Energy Consumption			
Clause	**Requirement - Test**	**Result**	**Verdict**
All	Autocalculated in the SASO registration process		N/C

ANNEX E			
SASO 2884:2017: Annex E – Simplified Method Applicable to Electric Storage Water Heaters			
Clause	**Requirement - Test**	**Result**	**Verdict**
All	Simplified Method Applicable to Electric Storage Water Heaters		N/C

ANNEX F			
SASO 2884:2017: Annex F – Modification to SASO IEC 60379 and SASO GSO 1858 and 1859			
Clause	**Requirement - Test**	**Result**	**Verdict**
All	Add modifications from Annex F to SASO IEC 60379	Followed instructions and procedures from SASO IEC 60379 with the modifications from Annex F applied	**P**

ANNEX G			
SASO 2884:2017: Annex G – Water Heater registration Application Renewal Form (Informative)			
Clause	**Requirement - Test**	**Result**	**Verdict**
All		Description of product is at the beginning of this report. Test results are in Annexes above and in the results summary below this section.	**P**

7. Test Results

1. Capacity (L) Rated: 170 Tested:171
2. Power (W) Rated: 4150 Tested: 4144
3. Voltage (V) Rated: 230 Tested: 230
4. Current (A) Rated: 18 Tested: 18
5. Mixed quantity of water at 40°C – V_{40} expressed in liters (L) and in percentage of the actual capacity (%) Rated:365 Tested: 363, 212%
6. Thermal Losses, Qpr (kWh) Rated: 2.20 Tested 2.22
7. Determination of maximum load profile – Annex A and B.2: Large
8. Calculation of the Energy Efficiency Coefficient – C3.1: 87.3%
9. Heating Energy – F.7: E,heat,50: 8.59 kWh
   E,heat,30: 5.16 kWh
   Tr,50: 02:04:29
   Tr,30: 01:14:41

8. Test Setup and Procedure

Ambient temperature was maintained at 20 +/- 2°C for all tests

Capacity was determined by placing the empty water heater on a calibrated scale. The scale was then zeroed and the water heater was filled with water at a consistent temperature until full. The weight of the water was multiplied by the density of water at the temperature used to determine the capacity. The water heater was then emptied and the test was repeated to ensure accuracy.

Power, voltage, and current ratings were averages taken from the recorded data from the standing (thermal losses) per 24 h test.

The V40 test was started after the water heater fully recovered. Power was shut off to the unit then 15°C water was supplied to the water heater until the outlet temperature dropped to 40°C. A water meter was used to determine the volume of water. The flow rate used was the maximum flow rate specified from the maximum load profile for this water heater.

Standing (thermal losses) per 24 h was determined by letting the unit sit on standby and recording tank temperature and energy used. The unit was allowed to cycle through six recoveries and then the test period started. The test ran until the first recovery after 48 hours from the start of the test period.

The maximum load profile was determined by running multiple load profiles until the test water heater could not meet the required the Qtap values with the specified temperature and flow requirements. The declared load profile was then determined to be the largest profile that the test water heater could complete.

Data from the maximum load profile test was used to calculate the Energy Efficiency Coefficient according to C3.1

The heating energy test was performed after the V40 test. The water flow was shut off and power to the unit was turned back on. Tank temperature and energy use was recorded until the unit was fully recovered. This recorded data was then used to calculate the required energy and time to heat tank up 30°C and 50°C.

9. Equipment Used

Instrument Type	**Brand**	**Model #**	**Accuracy**	**Date of last calibration** (mm/dd/yyyy)	**Calibration due date** (mm/dd/yyyy)
Data Acquistion 0680	Keysight	34972A	+/- 0.01% + 0.004	09/12/2017	09/12/2018
Power Meter 0666	Yokogawa	WT310	+/- 0.1% + 0.1% range	09/13/2017	09/13/2018
Water Meter 1087	Krohne	Optiflux 1000 with IFC 300	+/- 0.3%	02/28/2018	02/28/2019
4 Wire RTD 0784	Pyromation	R5T185L384-16-12B -45	+/- 0.18F	10/03/2017	10/03/2018
4 Wire RTD 0788	Pyromation	R5T185L384-08-12B -45	+/- 0.18F	10/03/2017	10/03/2018
4 Wire RTD 0793	Pyromation	R5T185L384-08-12B -45	+/- 0.18F	10/03/2017	10/03/2018
4 Wire RTD 5850427	Pyromation	RAF185L484-04-12B-45	+/- 0.18F	06/13/2018	06/13/2019
Scale 0520	Sartorius	CAPP1U-500-HH-LU	+/- 0.1 lbs	07/16/2018	07/16/2019

10. Status

Testing Started:	7/16/2018
Testing Done:	7/23/2018
Report Completed:	8/30/2018

11. Report Revision History:

Revision	Date:	Description
1	9/17/18	Added rated standby and mixed quantity of water information
2	10/10/18	Added rated efficiency and annual energy consumption information

12. Conclusion:

The model tested in this report meets all SASO 2884:2017 requirements
Sample tested is a L load profile and Yellow/D energy class.

13. Authorizing Signatures

Report Prepared By:	Tests Reviewed By:
Hunter Springer	Curt Tremel
Name: Hunter Springer	Name: Curt Tremel
Title: Engineering Associate	Title: Engineering Manager

UL Verification Services Inc.
3020 1st Ave. E.
Newton, IA 50208

14. Intended Use of This Test Report

This report is confidential and is intended for the exclusive use of the client named above.
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**********END OF TEST REPORT**********