

NALSUN-NG

*Environment-Friendly NALSUN Next Generation Coating
(NALSUN-NG) for Solar Thermal Applications*

Domestic
Hot Water

Industrial
Process Heat

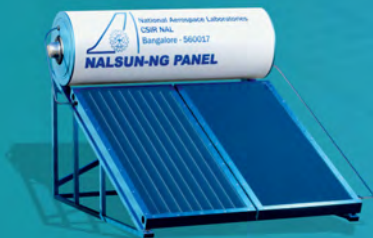
Desalination



CSIR-National Aerospace Laboratories
Bangalore - 560 017

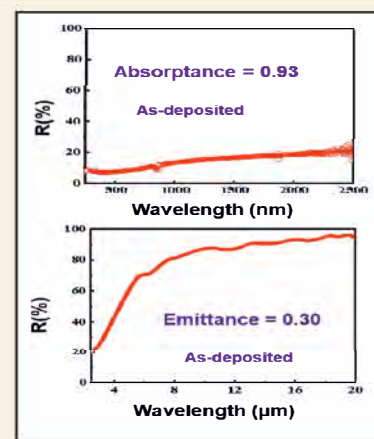
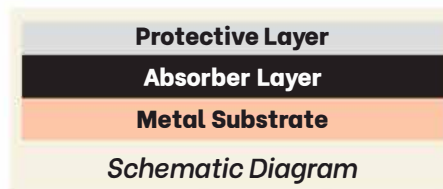


**VOC
FREE**



NALSUN-NG

Preamble: Solar energy is an unlimited source of renewable energy, which can be utilized in energy production to generate both heat and electricity. India is a tropical country, and solar energy is abundant throughout the year. Solar thermal conversion is the simplest and most direct method of harnessing solar energy. In the late 1980s, CSIR-NAL developed NALSUN solar absorber coating technology for domestic water heater applications using the electrodeposition method. However, the coating bath is carcinogenic owing to the presence of hexavalent chromium, and its disposal is a challenge. In addition, there is a need to develop a cost-effective, eco-friendly, and easily scalable coating technology that is not available in the country.



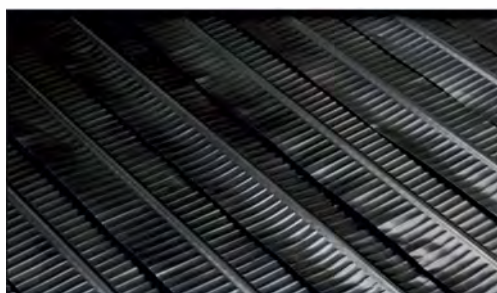
Absorbance and Emittance Measurements

Current Level of Technology: CSIR-NAL has developed an eco-friendly sprayable spectrally selective coating for domestic solar water heater applications. The spectrally selective coating consists of two layers: an absorber layer and an inorganic protective layer. The coating was sprayed manually on 2 m long Al fins, and a solar water heater panel was fabricated. The photothermal conversion efficiency of the NALSUN-NG panel is 70% with heat loss coefficient of 4.36 W/m²C. The coating has qualified all the environmental tests as per the International Energy Standards. Based on the test results, the service life of the coating is expected to be more than 20 years.

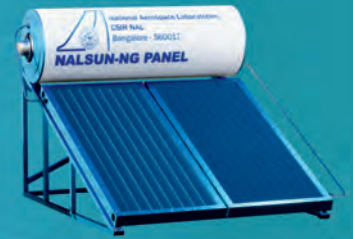
NALSUN-NG coating on aluminum substrates



Coupon Level



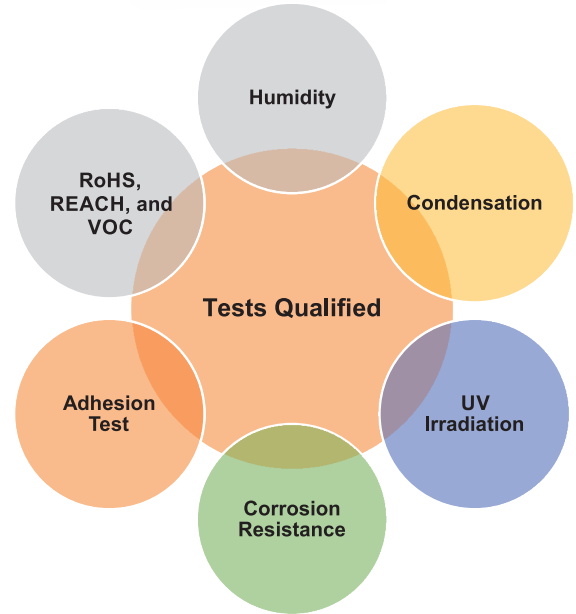
Aluminum Fin (2 m x 0.1 m)



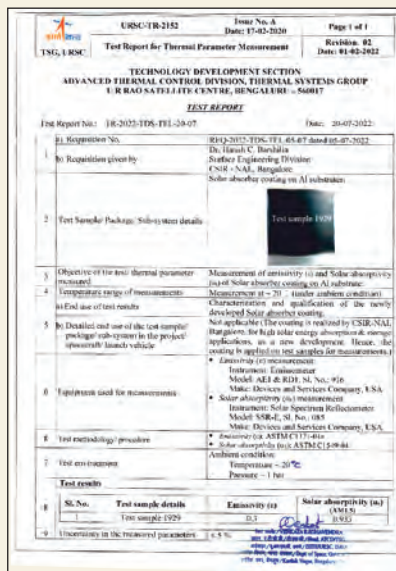
NALSUN-NG

Salient Features of NALSUN-NG Coating

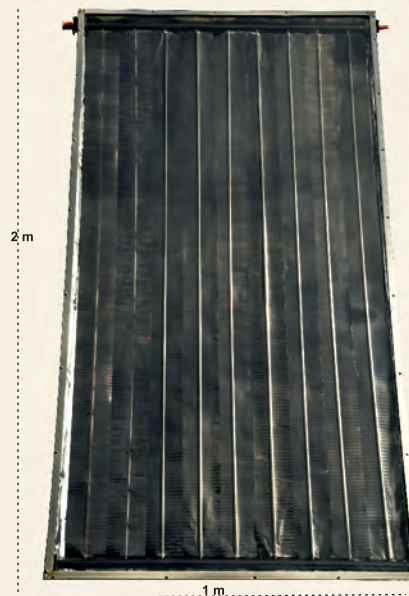
- Non-hazardous raw materials
- New absorber coating formulation
- New inorganic protective layer formulation
- Environment-friendly water borne coating
- High solar absorptance (0.91-0.93)
- Low thermal emittance (0.21-0.30) at 82°C
- Thermally stable in air at 175°C for 600 h
- Developed on metal substrates (Al, GI, etc.)
- No volatile organic compounds
- RoHS and REACH compliant
- Uses very simple effluent treatment process
- Easily scalable and cost-effective spray process



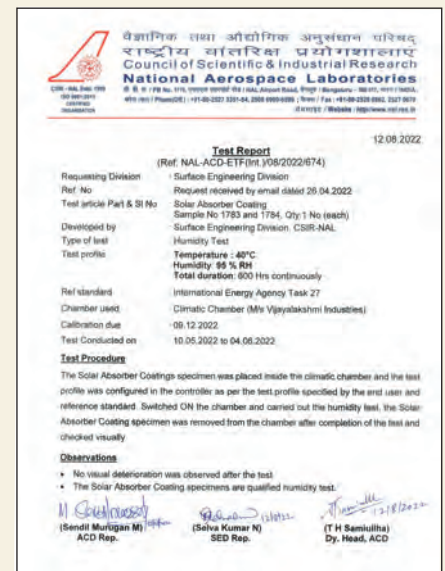
ISRO Report



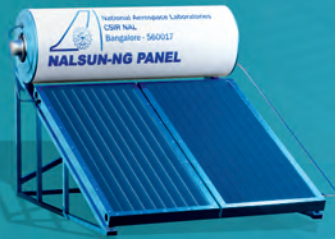
NALSUN-NG Panel



Humidity Report



- Environmental tests were carried out as per International Energy Agency Task 27 standards.
- RoHS, REACH, and VOC tests were carried out at TUV Rheinland, Bangalore.
- Sulphur dioxide-based corrosion test was carried out at TUV Rheinland, Germany.
- Accelerated weathering test was carried out at Ventest Solutions, Bangalore.
- Photothermal conversion efficiency measurement was carried out at Regional Testing Centre, Madurai Kamaraj University, Madurai.



NALSUN-NG

RoHS Certificate



Test Report - Industry Services

Prüfbericht - Nr.: Test Report No.:	IND/BLR/CH/2022/1653	Seite 1 von 4 Page 1 of 4
ULR No.:	TC5688225000001653F	
Auftraggeber: Client:	NATIONAL AEROSPACE LABORATORIES VIMANAPURA POST OFFICE, HAL AIRPORT ROAD, Bangalore 560017.	
Kunden-referenz-Nr.: Client reference no.:	Email Dated: 2022.02.24	Auftrags-Nr.: Order no.: 146655116
Gegenstand der Prüfung: Test item:	GOPF-5	Auftragsdatum: Order date.: 2022.02.24
Bezeichnung Typ-Nr.: Identification / Type No.:	-	Wareneingangsdatum: Date of sample receipt: 2022.03.08
Auftrags-inhalt: Order content:	Chemical Test	Prüfmuster-Nr.: Test sample no.: 1653
Prüfgrundlage: Test specification:	RoHS Directive Compliance : Restriction of the use of Hazardous Substances Directive 2011/65/EU, RoHS2 including Phthalates as per EU/2015/863.	Prüfzeitraum Testing Period: 2022.03.08 to 2022.03.28
Ort der Prüfung: Place of testing:	Plot No. 27B, 2 nd Cross, Electronic City Phase1, Hosur Road, Bangalore - 560 100, Karnataka, India.	
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (India) Private Limited	
Prüfergebnis: Test Result:	PASS	

Corrosion Resistance Test




Test Report - Industry Services

Prüfbericht - Nr.: Test Report No.:	IND/BLR/CH/2022/4515	Seite 1 von 4 Page 1 of 4
Auftraggeber: Client:	NATIONAL AEROSPACE LABORATORIES Vimanapura Post Office, HAL Airport Road, Bangalore-560017, India.	
Kunden-referenz-Nr.: Client reference no.:	Email Dated: 2022.05.26	Auftrags-Nr.: Order no.: 146683861
Gegenstand der Prüfung: Test item:	Coated Panel	Auftragsdatum: Order date.: 2022.07.08
Bezeichnung Typ-Nr.: Identification / Type No.:	-	Wareneingangsdatum: Date of sample receipt: 2022.07.22
Auftrags-inhalt: Order content:	Sulfur Dioxide test	Prüfmuster-Nr.: Test sample no.: 4515
Prüfgrundlage: Test specification:	As per ISO 10062: 2006	Prüfzeitraum Testing Period: 2022.07.08 to 2022.07.22
Ort der Prüfung: Place of testing:	Plot No. 27B, 2 nd Cross, Electronic City Phase1, Hosur Road, Bangalore-560100, Karnataka, India.	
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (India) Private Limited	
Prüfergebnis: Test Result:	PASS, Refer Page No.2 to 4	

REACH Certificate



Test Report - Industry Services

Prüfbericht - Nr.: Test Report No.:	IND/BLR/CH/2022/6751	Seite 23 von 23 Page 23 of 23	
ULR No.:	TC568822500006751P		
Sl.No.	Substance name	CAS No.	Results (%)
222	S-(tricyclo (5.2.1.02.6)deca-3-en-8(or 9)-yl O-(isopropyl or isobutyl or 2-ethylhexyl) O-(isopropyl or isobutyl or 2-ethylhexyl) Phosphorodithioate	255881-94-8	ND
223	Tris (2-methoxyethoxy)vinylsilane	1067-53-4	ND
<p>Note : ND denotes not detected, % denotes percentage 1. The substances are tested in term of its respective elements only (eg.As, Pb, cd). The actual concentration of its compound cannot be confirmed 2.The substances are tested in term of Cr(VI) 3. Single substances with an amount of <0.01% were not considered by the calculation of the sum. 4. In the case of all substances according to table were not detected, the result is stated not detected 5. 5.Detection limit(DL) for the compound serial no. 155,184 is 0.01% and 185 is 0.001% 6. Limit of detection for SVHCs is 0.005% unless otherwise specified ---- End of Part-II Test Report ----</p>			
<p>Remarks: The tested Article complies with the SVHC obligation as per REACH regulation. The concentration of SVHC is well within the limit (0.1% wt/wt).</p>			
<p>Test Item Photograph:</p>  <p>---- End of Test Report ----</p>			

VOC Certificate



Test Report - Industry Services

Prüfbericht - Nr.: Test Report No.:	IND/BLR/CH/2022/7003	Seite 1 von 3 Page 1 of 3
Auftraggeber: Client:	NATIONAL AEROSPACE LABORATORIES Vimanapura Post Office, HAL Airport Road, Bangalore - 560017.	
Kunden-referenz-Nr.: Client reference no.:	E-mail date: 04.08.2022	Auftrags-Nr.: Order no.: 146706097
Gegenstand der Prüfung: Test item:	GOPF-23	Auftragsdatum: Order date.: 2022.08.04
Bezeichnung Typ-Nr.: Identification / Type No.:	Oil Sample	Wareneingangsdatum: Date of sample receipt: 2022.08.04
Auftrags-inhalt: Order content:	Customer requirement : Volatile Organic Compound (VOC) test	Prüfmuster-Nr.: Test sample no.: 7003
Prüfgrundlage: Test specification:	VOC	Prüfzeitraum Testing Period: 2022.08.19 to 2022.08.26
Ort der Prüfung: Place of testing:	Plot No. 27B, 2 nd Cross, Electronic City Phase1, Hosur Road, Bangalore - 560 100, Karnataka, India.	
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (India) Private Limited	
Prüfergebnis: Test Result:	Refer Page No.2 to 3	
Zusammengestellt: compiled by	Anbukumar S	Genehmigt von: Authorized by: Rajesh Jain B
Datum:	2022-08-30	Ausstelldatum: Issue date: 2022-08-30
Stellung / Position:	Manager - Operation, Material Testing Laboratories	Stellung / Position: Asst. General Manager Material Testing Laboratories
Sonstiges/ Other: Nil.		
Zustand des prüfgegenstandes bei Anlieferung: Good. Acceptable for Test Requested. Condition of the test item at the time of delivery:		
<p>Abkürzungen: ok / P = entspricht Prüfgrundlage Abbreviations: ok / P = passed fail / F = entspricht nicht Prüfgrundlage fail / F = failed n.a. / N = nicht anwendbar n.a. / N = not applicable</p>		
<p>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report relates to the a.m test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark. Test item submitted by client. Sampling not done by TÜVRI. Laboratory employs simple acceptance rule in making Pass or Fail decisions on test results with no guard band.</p>		

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 E-mail: director@nal.res.in

