



INDESTRUCTIBLE PAINT LTD

DOCUMENT TYPE Laboratory Test report	DOCUMENT NUMBER 576-R1-RM001	ISSUE 001
TITLE 576-450-002-R1, formula change validation vs 576-450-002 Rockhard Sealer		
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<p>ABSTRACT/SUMMARY</p> <p>Rockhard Clear Varnish/Sealer has been re-formulated to remove Ethyl Glycol Acetate (EGA) due to H&S and environmental concerns.</p> <p>The resultant coating 576-450-002-R1 is formulated to retain the original Resin/Binder and additives blend. The change present in the revised formulation is limited to the volatile organic components (VOC, solvents) that do not form part of the final cured coating.</p> <p>The 576-450-002-R1 coating has been evaluated against the original formulation to assess all aspects of performance for the product revision. The performance of the volatile components within the coating at point of application is an integral part the substrate wetting and drying properties of the coating. A test programme has been performed to examine these aspects during the preparation of test specimens used to validate the cured coating performance of 576-450-002-R1</p>
<p>ADDITIONAL KEYWORDS – Solvent, Environment</p>

CIRCULATION: open

SUMMARY:

AUTHORS SIGNATURE: *R Banks*

APPROVED BY: R. Banks

CUSTOMER: Unspecified			
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576-450-002-R1 validation vs 576-450-002

The Results for Laboratory based testing of the 576-450-002-R1 formulation change demonstrate that the applied, cured coating does not differ from the original 576-450-002 product. This result is as expected. The resin and additive components of the two coatings are identical.

Evaluation of the coating application properties also demonstrates equivalence for the two formulations. The formulation brief for 576-450-002-R1 required the removal of EGA as a component solvent for the VOC present in the wet product. This criterion was achieved with no detriment to the usability of the coating or the physical properties of the dry/baked coating.

Results

Production Capability:

576-450-002 and 576-450-002-R1 follow the same manufacturing routes through Indestructible Paint production facility. In both cases the base resin components are dispersed into pre-blended solvents using high speed dispersion equipment. Trials run at Laboratory and Small Production Scale demonstrate no requirement for any handling changes due to the formulation evolution.

Stability / Shelf Life Evaluation:

Coating Variant	Test Days	Viscosity ISO4 @ 23°C (sec)	Film Forming Properties	Colour change vs Standard Product
576-450-002	7	44	Standard product QC approved	Standard coating – light Amber
576-450-002-R1	7	41	Comparable to Standard	Equivalent to Standard
576-450-002	14	44	No-Change	No-Change
576-450-002-R1	14	41	No-Change	Equivalent to Standard
576-450-002	28	46	No-Change	Minor darkening
576-450-002-R1	28	42	No-Change	Equivalent to Standard
576-450-002	56	47	No-Change	Minor Darkening
576-450-002-R1	56	45	No-Change	Equivalent to Standard

There is no significant difference between the behaviour of the two formulations. Both wet specimens start as a light Amber colour. Slight colour darkening occurs during the test period. The Viscosity differences between the specimens are not considered significant when uncertainties from the test method are taken into consideration.



Application Properties:

Spray Application: 576-450-002-R1

Substrate – Aluminium and Magnesium

Degreased – 120-220 alumina grit blasted Aluminium

Chromate treated Magnesium

Degreased low alloy Steel

Substrate wetting, Film forming during Air Drying before Baking and Coating Appearance post Baking are all equivalent to the standard 576-450-002 formulation.

Dip Application: 576-450-002-R1

Substrate – Aluminium and Magnesium

Degreased – 120-220 alumina grit blasted Aluminium

Chromate treated Magnesium

Degreased low alloy Steel

Substrate wetting, Film forming during Air Drying before Baking and Coating Appearance post Baking are all equivalent to the standard 576-450-002 formulation. The standard and –R1 formulations both require thinning before dip application to prevent the formation of fat lower edges and unwanted tears of coating forming due to the flow off of the coating. The Standard and –R1 formulations provide equivalent coatings under laboratory conditions.

Cured Coating Examination –

Bake/Cure Confirmation: 5 minutes rubbing with Acetone applied to a cotton cloth over a 25 x 25mm square area of coating. Substrate – Aluminium

576-450-002 and 576-450-002-R1 coatings both exhibit full resistance to this test. Neither coating shows evidence of the test either during the process or after the test when all solvents have evaporated from the coating surface.

Adhesion:

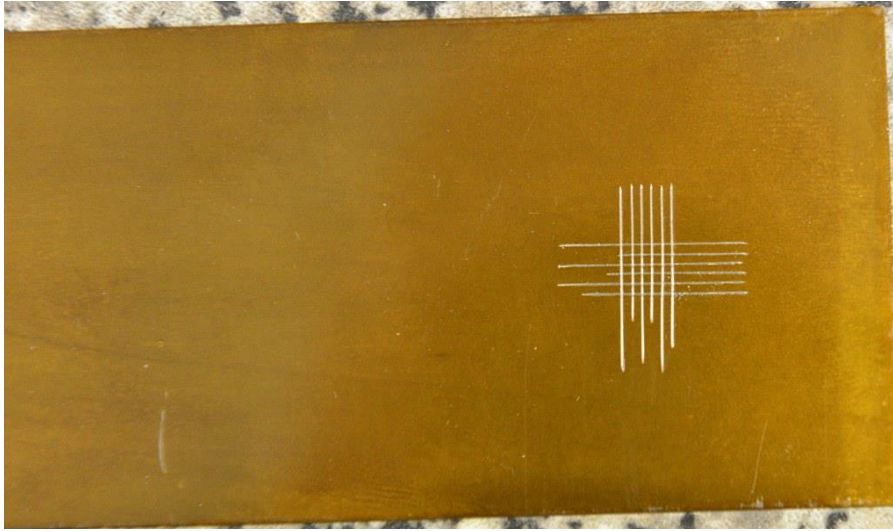
Cross Cut Adhesion – BS EN ISO 2409 - 1mm lattice

Substrate - Magnesium

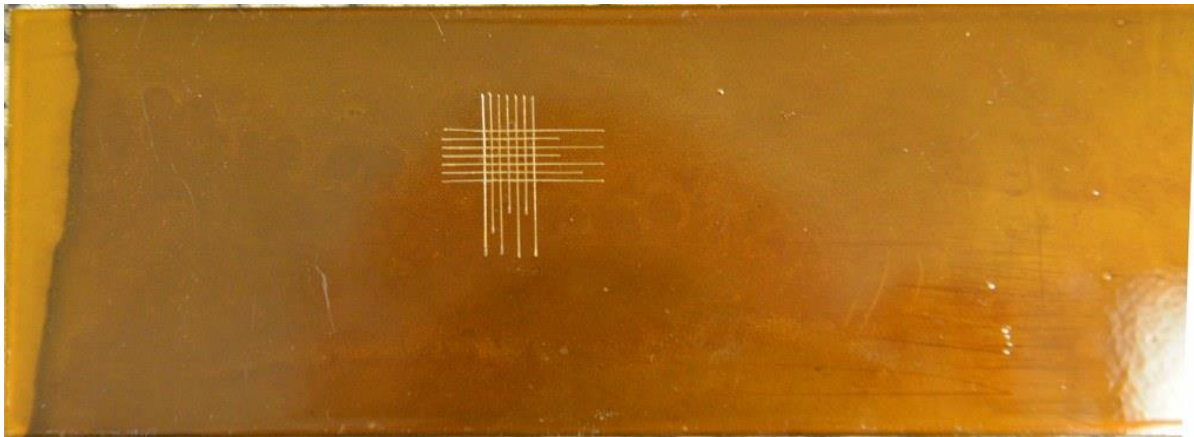
The 576-450-002 and 576-450-002-R1 results are equivalent.

The two coatings achieve Pass – grade 0.

576-450-002



576-450-002-R1



HATE Pull Off Adhesion – PosiTest – Pull-Off Adhesion Tester, 20mm dolly diameter.
Substrate - Aluminium

576-450-002

1. Coating cured @ 190°C for 1 hour – average 360 psi, adhesion failure to substrate
2. After Hot Oil testing @ 150°C for 200 hours - average 348 psi, adhesion failure to substrate

576-450-002-R1

1. Coating cured @ 190°C for 1 hour – average 383 psi, adhesion failure to substrate
2. After Hot Oil testing @ 150°C for 200 hours - average 388 psi, adhesion failure to substrate

All results are the average from 6 dolly pulls. The coatings are considered to be equivalent within the accuracy limits for this procedure.



Scratch Resistance: ISO 1518, Scratch Stylus A, hemispherical hard-metal stylus with 0.5mm diameter.

Substrate - Aluminium

576-450-002 – Pass, load 20N. No coating removal or break through. Fine indent trace present after test.

576-450-002-R1 – Pass, load 20N. No coating removal or break through. Fine indent trace present after test.

Hot Oil Resistance: Immersion at 150°C, 200 hours.

Substrate - Aluminium

576-450-002 – Pass, load 20N. No coating removal or break through. Fine indent trace present after test. Coating darkens from Amber to Mid Brown.

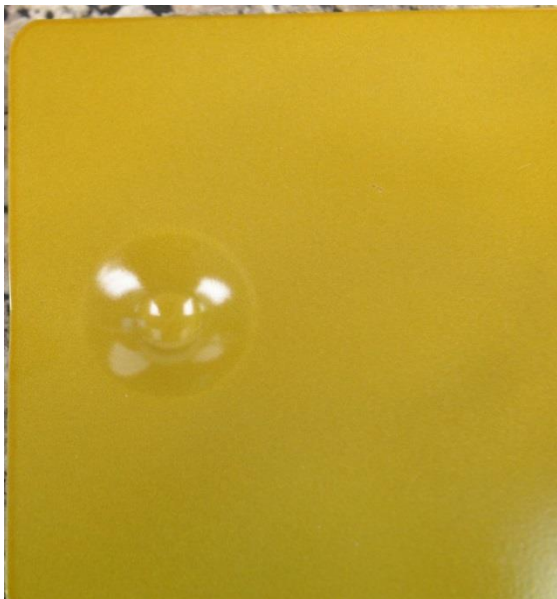
576-450-002-R1 – Pass, load 20N. No coating removal or break through. Fine indent trace present after test. Coating darkens from Amber to Mid Brown.

Impact Resistance: ISO 6272-1 - falling weight method - large diameter (20mm) impactor.

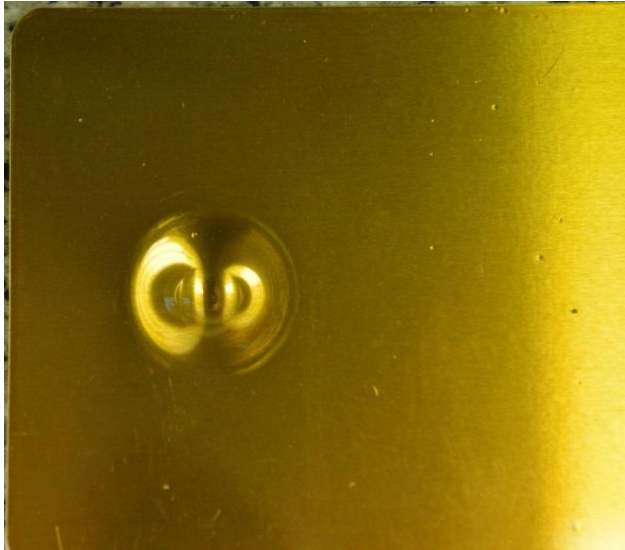
Substrate - Aluminium

The 576-450-002 and 576-450-002-R1 coatings are equivalent using a 5mm direct impact indent. There is no adhesion failure within the indent and no cracking or adhesion loss around the indent circumference.

576-450-002



576-450-002-R1

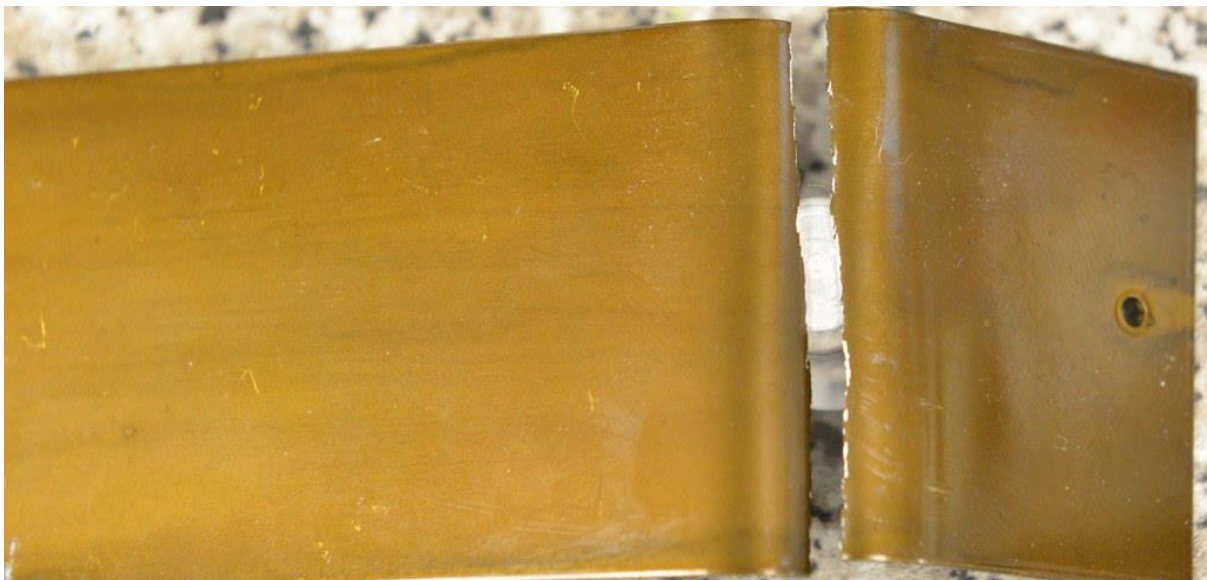


Bend Adhesion:

Substrate – Magnesium

The 576-450-002 and 576-450-002-R1 results are equivalent. Panels for each were repeatedly flexed and then bent through to substrate failure. Using a chromate treated AZ31 magnesium alloy panel there is no cracking or delamination of the coating at the bend or along the broken panel edge.

576-450-002



576-450-002-R1



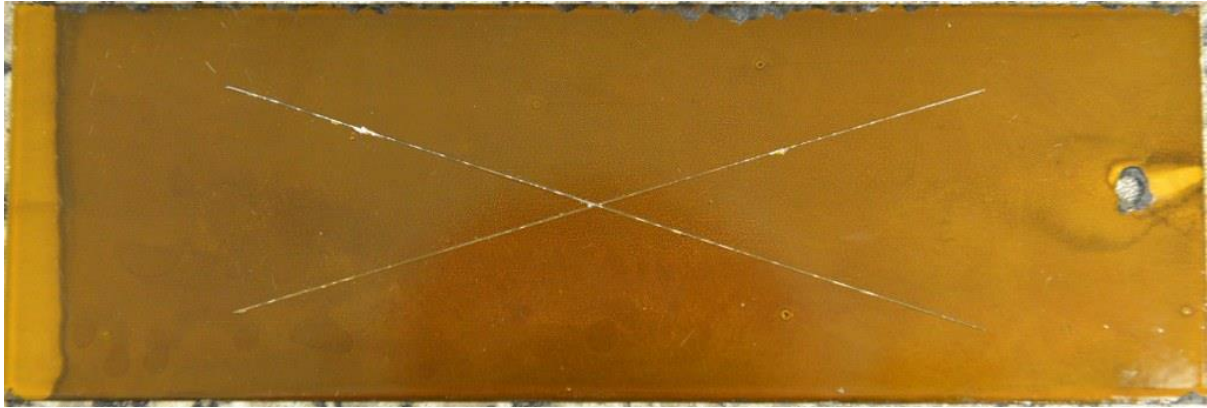
Salt Spray: ASTM B117 – neutral hot salt spray. 200 hours unbroken exposure.
Substrate – Magnesium

The 576-450-002 and 576-450-002-R1 results are equivalent. The test coatings exhibit minor areas of white corrosion product within the cross cut. The two coatings present no undermining, blistering, crazing or cracking of the coating.

576-450-002



576-450-002-R1



Substrate Type and Preparation

Aluminium – Alloy 5005 – H24, 150 x 100 x 1mm

All specimens - Degreased and grit blasted using 120-220 mesh brown alumina – no chromate pre-treatment.

Magnesium - Alloy AZ 31 sheet, 150 x 50 x 0.9mm

All specimens - Chrome treated to DTD 911C

Test Procedure / Method

Production Capability:

Process flow analysis for the production of 576-450-002-R1 vs 576-450-002

Evaluation will report if any alterations to process times and/or procedures are required to manufacture the revised coating.

Stability / Shelf Life Evaluation:

Minimum 250ml volumes of 576-450-002 and 576-450-002-R1 are to be subjected to continuous 40°C dry heat. Following exposure periods of 7, 14, 28, 56 days the specimens will be examined to assess viscosity, colour, and film forming properties. Result will be reported as a comparison with the current 576-450-002 formulation.

Application Properties: all assessment to be performed in direct comparison to 576-450-002 taken from regular production. Coatings to be examined for film forming properties, edge coverage, resistance to solvent boil during flash off and baking operations and general appearance after baking.



Spray Application: 576-450-002-R1 will be spray applied using Devilbiss Trans Tech air atomising spray guns fitted with 1.6mm fluid nozzles (Indestructible Paint QC lab standard).

Dip Application: 576-450-002-R1 thinned 10% by volume with 665-550-025 Thinner to be used for the dip coating of 100 x 150 x 1mm aluminium panels. Testing performed under laboratory conditions of 18-21°C, 30-60% RH.

Cured Coating Examination –

Bake/Cure Confirmation: 5 minutes rubbing with Acetone applied to a cotton cloth over a 25 x 25mm square area of coating.

Adhesion:

Cross Cut Adhesion – Specimens evaluated to BS EN ISO 2409 using 1mm lattice produced using a metal cutting guide and Stanley snap off blade knife, part No: 2-10-150. (ASTM D3359 and ISO 2409 require a lattice cut of squares into the coating. The assessment is ASTM D3359 Pass-5B, Fail-0B, ISO 2409 Pass-0, Fail-5)

HATE Pull Off Adhesion – PosiTest – Pull-Off Adhesion Tester, 20mm dolly diameter, DeFelsko. BS EN ISO 4624

Scratch Resistance: ISO 1518, Scratch Stylus A, hemispherical hard-metal stylus with 0.5mm diameter.

Hot Oil Resistance: Immersion testing at 150°C for 200 hours using Oil to: DOD-L-85734, Def Stan 91-100, DERD 2497, 160°C. Specimen plates to be examined for retention of scratch resistance, ISO 1518 cleaning by gentle wiping with white spirit soaked cotton cloth.

Impact Resistance: ISO 6272-1 - falling weight method using large diameter (20mm) impactor. The test is performed as a direct impact onto the coating to provide an indent of 5mm. Reporting details adhesion properties of the coating at the point of impact and the condition of the deformed coating around the circumference of the indent.

Bend Adhesion: Coatings applied to chromate treated AZ31 Magnesium Alloy panels to be repeatedly bent until failure of the coating or the panel occurs. Test to be performed at room temperature using a suitable clamp mechanism to hold one end of the specimen plate. Panel to be bent 45° above and below a horizontal plane up to failure or a minimum of 50 up and down deflections.

Salt Spray: ASTM B117 – neutral hot salt spray. Test specimens cut through to substrate using a steel blade to provide an open scribe that exposes bare metal to the test environment. A visual examination with an x10 magnifier is performed along the scribe to ensure that a line of unbroken bare metal is exposed.