



## ANTI-CORROSION UV CURABLE COATINGS

Formulating a UV curable anti corrosion coating is a very important challenge for the future. For this reason, a preliminary general screening on acrylate monomers and oligomers was performed in order to select the best products likely to give good adhesion onto metal. Adhesion is a prerequisite property to achieve good salt spray test results.

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### Selected Oligomers

Three oligomers gave very good results in terms of adhesion to steel, galvanised steel, phosphated steel and aluminum. **CN704** is a highly flexible polyester-based acrylate which is already well known for its very good adhesion to metal and plastic (polyolefines) substrates.

**CN131B** and **CN152** are two monofunctional epoxy acrylates, aromatic and aliphatic respectively, which provide very good adhesion to metal and which also have a very low viscosity.

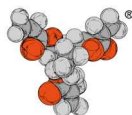
Product	Description	Viscosity
<b>CN704</b>	Polyester based acrylate	7 Pa.s @ 70°C
<b>CN131B</b>	Monofunctional aromatic epoxy acrylate	120 mPa.s @ 25°C
<b>CN152</b>	Monofunctional aliphatic epoxy acrylate	120 mPa.s @ 25°C

### Selected Monomers

Isobornyl acrylate is definitely the best monomer for adhesion to metal. Its very low shrinkage and high T<sub>g</sub> have proven to be two fundamental properties for this study. **SR285** (THFA), another monofunctional and **SR833S** (TCDDMDA), difunctional, could also be used to a certain extent, but exhibited lower performances compared to **SR506D**. However, they could be added to adjust the properties.

Product	Description
<b>SR506D</b>	Isobornyl acrylate (IBOA)
<b>SR285</b>	Tetrahydrofurfuryl acrylate (THFA)
<b>SR833S</b>	Tricyclodecane dimethanoldiacrylate

By using these oligomers and monomers, it is possible to prepare UV curable coatings for metal, with or without any acidic adhesion promoters, which have very good adhesion to various metal substrates. The table below gives some ideas of typical formulations for different metal substrates based on these products.



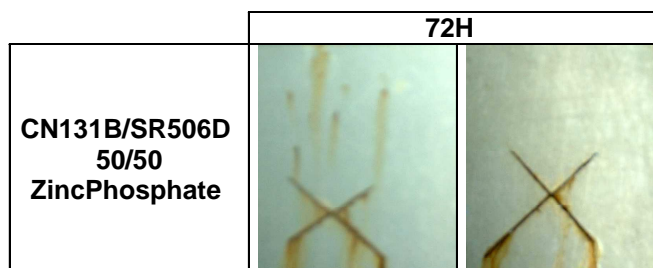
Formulations	1	2	3	4	5	6
	Withadhesionpromoter			Noadhesionpromoter		
<b>CN131B</b>	25.0	12.5	37.5	25.5	12.8	38.3
<b>CN704</b>	25.0	37.5	12.5	25.5	38.3	12.8
<b>SR506D</b>	30.0	30.0	30.0	30.6	30.6	30.6
<b>SR833S</b>	14.6	14.6	14.6	14.9	14.9	14.9
<b>SR9051</b>	2.0	2.0	2.0	0.0	0.0	0.0
<b>Irgacure819</b>	0.4	0.4	0.4	0.4	0.4	0.4
<b>Darocur1173</b>	3.0	3.0	3.0	3.0	3.0	3.0
<b>Adhesion</b>						
Steel	0	0	0	0	0	0
Galvanisedsteel	0	0	0	0/1	0/1	1
phosphatedsteel	0	0	0	0	0	0
aluminium	0	0	0	0	0	0
tinplate	1	0/1	5	5	1	5
<b>Reactivity (m/mn/L)</b>	≅5	≅5			≅5	
<b>Acetoneswab (s)</b>	0	0			0	
<b>HardnessPersoz (s)</b>	175±1	177±5		173±3		
<b>Flexibilitymandrin (mm)</b>	3	3			3	
<b>Erichsen(mm)</b>	8	8			6	

Once the adhesion problems were resolved, a screening of the same products was performed to measure anti-corrosion performance.

Three oligomers were selected: **CN131B**, **CN152** and **CN704**.

The oligomers were tested with and without anti-corrosion pigments, coated directly on phosphated steel, at 6µm with no protective topcoat.

The results were very good for **CN131B** and **CN152** using Zinc phosphate as an anti-corrosion pigment.





	72H	
<b>CN152/SR506D 50/50 Zincphosphate</b>		

In order to further improve the general performance of these two oligomers, an optimisation of the formulation was performed, using the different monomers selected in the first part of the study. The formulation which gave the best properties in terms of corrosion resistance and reactivity is given in the table below:

Name	FOR3113	%Wt
<b>CN131B</b>	Monfonctionalepoxyacrylatearomatic	59.6
<b>SR506D</b>	Isobornylacrylate	25.0
<b>SR9051</b>	Acidicadhesionpromoter	2.0
<b>Irgacure819</b>	Photoinitiator(Ciba)	0.4
<b>Darocur1173</b>	Photoinitiator(Ciba)	3.0
<b>ZincPhosphate</b>	AnticorrosionPigment	10.0
		100.0

No propagation along the cross was observed after 48 hours in the salt spray test.

	µm	At24h	At48h	Propagation (mm)
<b>FOR3113 Ref</b>	9			0