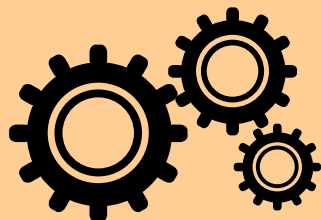


# Formulation SOLUTIONS

A technical bulletin from the Formulation Service Institute,  
BASF's Dispersions & Pigments Division

 **BASF**

We create chemistry



- Industrial Coatings
- Direct to metal gloss topcoat
- Water-based
- Low VOC

## Water-Based Single Component High Gloss Acrylic for DTM and Topcoat Applications

### Features & Benefits

- Low VOC content (100 g/L)
- Outstanding water and humidity resistance
- Excellent direct to metal corrosion resistance
- Excellent UV durability
- Good application characteristics (brush or spray)
- Good hardness and chemical resistance



## Introduction

High performance coatings with low VOC content are needed to meet the market demand and government regulation. BASF has developed a low VOC, high performance, water-based coating system for direct to metal and topcoat applications.

## Starting Point Formulation

Dispersion	lbs.	wt. %	Formulation Attributes	
DIW (demineralized water)	38.08	3.88	% Solids by weight	47.4
<b>Dispex® Ultra FA 4416</b>	0.74	0.08	% Solids by volume	37.0
<b>Dispex CX 4230</b>	3.59	0.37	% PVC	12.4%
<b>Foamstar® ST 2446</b>	1.85	0.19	Viscosity (KU)	75
Ti-Pure® R-900 (DuPont)	153.00	15.57	VOC (calculated)	100 g/L
High Shear Disperser 20 minutes at 2500 rpm			Coverage @ 1.0 mils	593 ft <sup>2</sup> /gal
DIW (demineralized water)	38.08	3.88	Stability (50°C)	>2 weeks
Adjust pH of dispersion with ammonium hydroxide to >9.0				
Add under agitation:				
<b>Joncryl® PRO 1524</b>	705.66	71.83		
Butyl Cellosolve™ solvent (Dow Chemical)	35.05	3.57		
Nalzin® FA-179 (flash rust)	1.00	0.10		
<b>Rheovis® PU 1191</b>	0.42	0.04		
<b>Hydropalat® WE 3322</b>	4.90	0.50		
<b>Total Weight</b>	<b>982.36 lbs.</b>	<b>100%</b>		
<b>Total Volume</b>	<b>100 gal.</b>			
			<b>Dry Times (75°F/50% RH, DFT 2 mils)</b>	
			To touch	15 minutes
			Tack free	20 minutes
			To recoat	4 hours
			To fully cure	30 days

### Application Guidelines

- Conventional and HVLP/LVLP spray
- Reduce up to 5% with DIW
- Fluid tip size: 1.6-2.0 mm
- Tip Pressure: >10 psi for HVLP application
- Atomization Pressure: 60 psi for conventional spray
- Builds to approximately 1.5 mils/dry coat
- Can also be brushed or rolled

## Formulation Guidelines and Tips

### To increase hardness and shorten dry times:

- Incorporate Joncryl 1992

### To increase flexibility:

- Incorporate Joncryl PRO 1522 or Joncryl 1534
- Incorporate Loxanol® CA 5310 coalescent
- Incorporation of slow cosolvents such as Texanol™ will provide flexibility until they eventually leave the film

### Coalescent recommendations:

- Use predominately hydrophilic cosolvents like EB or DB to ensure viscosity stability over time
- Avoid the use of hydrophobic cosolvents to mitigate viscosity increases over time
- Increase open time with slow evaporating hydrophilic cosolvents, such as DB

### Dispersant selection:

- The selection of Dispex CX 4230 and Dispex Ultra FA 4416 resulted from extensive experimentation. This combination affords good gloss development, stability and outstanding corrosion resistance due to the hydrophobic nature of these dispersants

### Pigmentation:

- For high gloss coatings, PVC should be less than 20%
- Titanium dioxide can be easily dispersed, but for organic

pigments the use of a high quality pigment dispersion like Aurasperse® II facilitates formulation

- Anti-corrosive pigments are not necessary to achieve good corrosion resistance properties

### Thickening:

- Urethane-based associative thickeners like Rheovis PU 1191 are very effective at low doses due to the hydrophobic nature of Joncryl PRO 1524. These thickeners do not add water sensitivity or affect gloss

### Defoaming:

- Let down defoamers are not necessary due to the strong defoaming action of Foamstar ST 2246. Additionally, the Hydrolat WE 3322 wetting agent imparts defoaming to the formulation
- If more defoaming is desired, products like: FoamStar ST 2434, FoamStar ST 2436, FoamStar ST 2438, FoamStar SI 2210 NC or FoamStar SI 2280 are recommended for high gloss aqueous applications

### VOC:

- This formulation performs admirably at a VOC of 50 g/L but performance (mainly salt spray) is improved when formulated at 100 g/L

## Test Results using Starting Point Formulation

**Substrate:** unpolished CRS

**Preparation:** naphtha degreasing

**Application:** two continuous coats

Test	Result
60° Gloss	>80
Adhesion (CRS) 7day RT age (ASTM D3359, method B)	5
Wet Adhesion (immerse after 4 hr dry @ room temperature for 24 hrs)	5
1/8" Conical Mandrel bend (7 day RT age)	0
500 hr. Salt Spray (ASTM B-117)	No face blistering
14 day Water immersion	No blistering, no adhesion loss
100°F/100% humidity chamber 14 days (ASTM D2247)	No blistering
Pencil Hardness – 24 hrs (gouge)	2B
– 7 days (gouge)	B
– 14 days (gouge)	HB
Chemical spot testing: Gas (0 = best, 4 = complete destruction)	2
Chemical spot testing: 10% NaOH	2
Chemical spot testing: Formula 409®	1
Chemical spot testing: Clorox® Bleach	0
Chemical spot testing: 50% Ethanol	1
Chemical spot testing: Windex®	1
QUV A 340, ASTM 4587 8/4 Cycle	>80% gloss retention at >500 hrs
Stability @ 50°C (2 weeks)	No change in viscosity

## List of Formulation Ingredients

**Joncryl® PRO 1524** is an acrylic dispersion for high gloss corrosion-resistant coatings. It has excellent corrosion resistance without the use of anti-corrosive pigments as determined by Standard Practice for operating Salt Spray (Fog) Apparatus (ASTM B 117). Furthermore, this emulsion offers good chemical resistance, excellent wet and dry adhesion and can be formulated at VOC levels of less than 100 g/L VOC. Joncryl PRO 1524 is designed for industrial direct-to-metal applications that require a high gloss (> 80 at 60°) and exhibits an excellent balance of performance properties.

**Joncryl PRO 1525** is an emulsion for direct to metal applications. It has good corrosion resistance without the use of anti-corrosive pigments as determined by Salt Spray Resistance ASTM B 117. This emulsion is harder than Joncryl PRO 1522 and shows improved block performance.

**Joncryl PRO 1522** is an emulsion for direct to metal applications. It has excellent corrosion resistance without the use of anti-corrosive pigments as determined by Salt Spray Resistance ASTM B 117. This emulsion offers exterior durability, is compatible with anti-corrosive pigments, and can be formulated between 100 – 250 g/L VOC.

**Joncryl 1992** is a waterborne thermoplastic acrylic emulsion that can be used in either ambient or force-dry systems. It offers good chemical resistance and clarity in a good hard film.

**Joncryl 1534** is an acrylic emulsion for maintenance and industrial coating applications. It offers excellent adhesion to a variety of substrates, humidity resistance and corrosion resistance.

**Foamstar® ST 2446** is based on a patented hyper-branched star polymer compounded with high-end organo-silicone polymers. It is one of our best defoamers for zero to 50 g/l VOC, medium to low PVC premium paints. FoamStar ST 2446 is a product of choice when other defoamers do not work. It allows for very good film appearance properties despite its very high efficiency.

**Dispex® CX 4230** is a low VOC, low odor, hydrophobic dispersant for use with titanium dioxide and extender pigments that can be used in both interior and exterior coatings. Recommended usage levels range from 1.0 – 3.0% based on pigment solids.

**Dispex Ultra FA 4416** is a wetting and dispersing agent for aqueous coatings which require high gloss, good color strength and excellent rub-out properties. It is designed for use in aqueous topcoats based on various binder types, including polyester solutions, polyacrylics and PUR-emulsions.

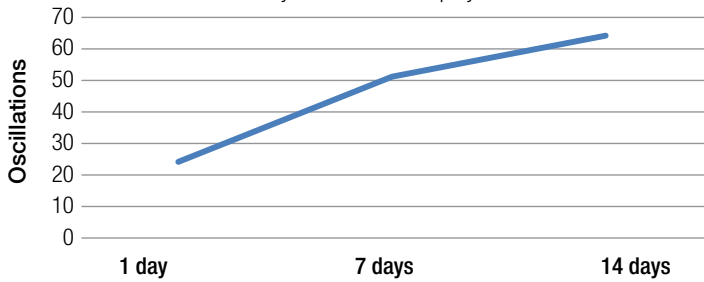
**Rheovis® PU 1191** is a heavy metal-, solvent- and VOC free solution of a polyurethane in water/diluent. It is a highly efficient, environmentally friendly associative polyurethane thickener designed to achieve a highly pseudoplastic viscosity compared to other PUR thickeners. It offers superior sag resistance, low viscosity drop on tinting and excellent chemical and UV stability.

**Hydropalat® WE 3322** is a non-ionic, 100% active wetting agent effective in water-borne coatings intended for metal, wood and plastic substrates. This wetting agent is effective in coatings and inks based on a wide variety of emulsions including PUDs, acrylics, and styrenated acrylics. Hydropalat WE 3322 does not stabilize foam and can act as a defoamer in formulations, in addition to imparting outstanding wetting properties. When used at the recommended level, Hydropalat WE 3322 should not diminish the corrosion resistance or change the recoat characteristics of the coating. The product is free of silicones, alkyl phenol ethoxylates (APEs) and solvent.

**Loxanol® CA 5310** was developed for coatings formulations with less than 50g/L VOC. It is produced from renewable raw materials and can replace traditional VOC contributing coalescents. Traditional coalescents vaporize in the air during the drying process and contribute towards VOC. However, Loxanol CA 5310 remains in the paint film to provide a long lasting coalescing effect, and at the same time increasing the total solids content of the system. Loxanol CA 5310 is supplied as a 100% active pale yellow liquid. Loxanol CA 5310 not only reduces the VOCs of the paint, but also improves key performance properties.

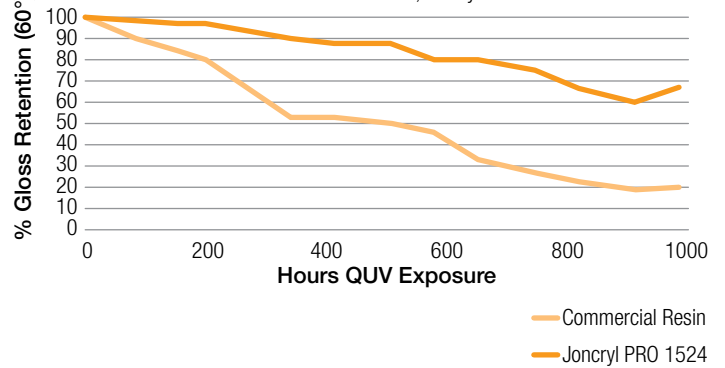
## König Pendulum Hardness

1.8 - 2.2 dry mils White DTM sprayed on CRS



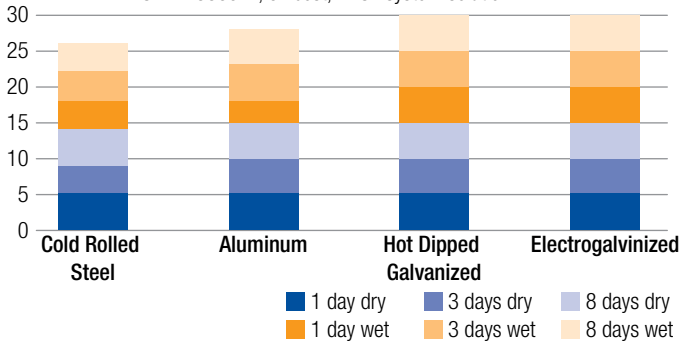
## QUV Exposure

ASTM D4587 UVA 340, 8/4 cycle



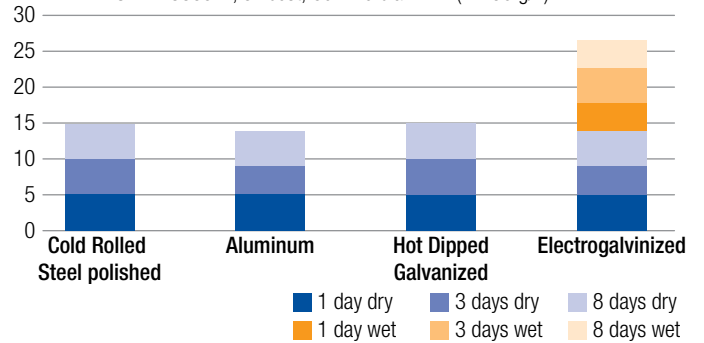
## Wet and Dry Adhesion

ASTM D3359-B, 5=best, BASF system solution



## Wet and Dry Adhesion

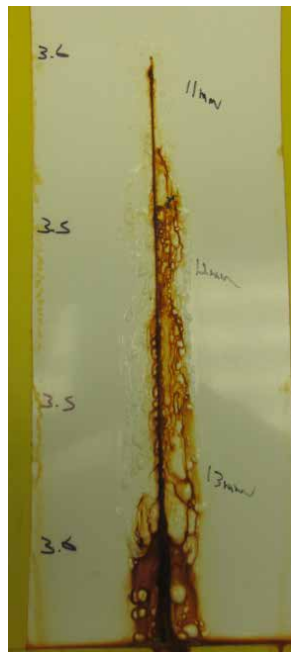
ASTM D3359-B, 5=best, Commercial DTM (~ 150 g/L)



## 495 hours of Salt Spray (ASTM B-117)



Two coats (DFT = 2.2 mils)



Three coats (DFT = 3.6 mils)

## Safety

The usual safety precautions when handling chemicals must be observed. These include the measures described in Federal, State, and Local health and safety regulations, thorough ventilation of the workplace, good skin care, and wearing of personal protective equipment.

## Safety Data Sheets

All safety information is provided in the Material Safety Data Sheets.

## About the Formulation Service Institute

The North American Formulation Services Institute exists to assist customers in selection of materials for coatings and development of advanced formulations that address specific application challenges in the coatings, printing and packaging industries. Our FSI team has over 100 years of experience formulating solutions using a broad portfolio of resins, cross linkers, pigments, performance and formulation additives.

FSI's Formulation Solutions was designed to provide formulation knowledge and guidelines to quickly resolve formulation problems and help customers reduce time to market.

We look forward to helping you optimize your formulation and remain committed to our mission of: Advancing our customers' formulations with our passion for chemistry.

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