



**New formulations
- 1st update -**

BAYHYDROL® UH XP 2592
WATERBORNE POLYURETHANE MODIFIED
ALKYD DISPERSION FOR THE FORMULATION
OF TOPCOATS, SINGLE-LAYER COATINGS
AND PRIMERS

POLYISOCYANATES

PREPOLYMERS

DISPERSIONS

UV SYSTEMS



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1. INTRODUCTION



Since the coming into force of the Solvent Emissions Directive (SED) – also known as the VOC Directive in the European Union – the pressure on the coatings industry has mounted further.

The new legislative requirements are forcing the users of coatings to turn increasingly to more environmentally friendly technologies. Water-borne systems are of considerable interest in this respect as their VOC value is considerably lower than 250 g/l. They thus already satisfy requirements that are conceivable in the future.

Bayer was involved in the development of aqueous binders at an early stage and has been instrumental in advances in this technology. In the meantime Bayer MaterialScience has been

able to provide solvent free aqueous dispersions which give the varnish manufacturers a broad range of freedom to formulate their lacquers and help them to surpass demands of current VOC requirements.

With Bayhydrol® UH XP 2592 BayerMaterialScience has an air-drying, polyurethane modified alkyd dispersion in its range for the formulation of high-quality industrial coatings for a broad range of applications methods, e.g. spray or dipping applications. The environmentally friendly delivery form is based on renewable primary products and does not contain any solvent, dryer or anti-skinning agent. This article sets out to look at product-specific aspects, and to give useful information on its application.



2. ADVANTAGES OF BAYHYDROL® UH XP 2592

- Free of organic solvent
- Free of anti-skinning agent
- Free of drier
- Free of emulsifier
- Good viscosity stability of supply form
- No labeling necessary
- Production of co-solvent-free coatings possible
- More flexibility in choice of solvent, drier and anti-skinning agent

3. USES



Bayhydrol® UH XP 2592 is suitable for the formulation of air- and forced-drying topcoats, single-layer coatings and primers. The product can be used in spray application but also in an immersion bath.

Because of its very good anti-corrosion properties and excellent weather stability, this binder is particularly recommended for the

formulation of high-quality one-coat systems. Because Bayhydrol® UH XP 2592 is free of solvents, driers and anti-skinning agents, the user has a maximum formulating freedom as far as the necessary solvents, driers and anti-skinning agents are concerned (see recommended formulations, section 8).

4. CHARACTERISTIC DATA

FATTY ACID MODIFIED PUD	BAYHYDROL® UH XP 2592 CHARACTERISTIC DATA
form supplied	45 % in water approx. 55 % of acid (calculated) groups neutralized with ethyldiisopropylamine
non-volatile content (1 g/1 h/125 °C) DIN EN ISO 3251	approx. 45 %
viscosity at 23 °C, D ca. 40s ⁻¹ DIN EN ISO 3219/A.3	approx. 300 mPas
pH (1:4 in demineralized H ₂ O) DIN 53785	approx. 7.2
GENERAL INFORMATION	
acid value DIN EN ISO 2114	approx. 12 mg KOH/g
mean particle size Laser correlation spectroscopy	approx. 125 nm
OH-content calculated on solid resin	approx. 2.1 %
density at 20 °C DIN EN ISO 2811	1,0 g/ml
additives in form supplied calculated	no





5. PROCESSING

To obtain the coating qualities described in the brochure, the individual steps for producing the surface coating given in the formulations based on the binder should be adhered to.

5.1 GRINDING

Bayhydrol® UH XP 2592 has good shear stability. With extreme shear stress and a simultaneous significant increase in the temperature of the mill base (inadequate cooling), it is nevertheless possible that partial decomposition of the binder can

occur. This is expressed initially in a marked increase in viscosity; later, the coating precipitates. For this reason, the grinding temperature should not exceed 40 °C.

5.2 NEUTRALIZATION

In its supplied form, Bayhydrol® UH XP 2592 is only partly neutralized. To improve pigment wetting, the binder should be 80 to 100 % neutralized in the mill base (see table below), as a function of the pigment used and the pigment concentration.

Suitable amines for air-drying coatings are

triethylamine (TEA) or ethyldiisopropylamine (EDIPA), and for forced-drying coatings, EDIPA, dimethylethanolamine (DMEA) or 2-dimethylamino-2-methyl-1-propanol (DMAMP). Ammonia has a negative effect on the rheology, pigment wetting and stability and is therefore unsuitable as a neutralizing agent.



**% AMINE CALCULATED ON SUPPLIED RESIN FORM
(RECOMMENDATION FOR SUBSEQUENT NEUTRALIZATION IN THE MILL BASE)**

Bayhydrol® UH XP 2592	TEA	EDIPA	DMEA	DMAMP	NH ₃
NG* 80 %	0.54	0.69	0.47	0.79	Not suitable for neutralization
NG* 100 %	0.97	1.16	0.86	1.42	Not suitable for neutralization

* neutralization level

AMP: supply form did not work, but mixture AMP : Water = 1 : 1 is possible and shows good coating stability
→ no thickening

Bayhydrol® UH XP 2592 can be handled easily. The coating components can be dispersed one after the other into the non-pre-diluted supplied resin form in the usual sequence (first the liquid components – solvent, drier, anti-skinning agent –, then the pigments). After this, the formulation can be set to the optimum milling viscosity. If possible, the amine should be thinned with water (to approx. 20% amine content) and added under

agitation. It takes some time before the neutralization equilibrium of the finished coating and thus the final viscosity is established, because this Bayhydrol® type is only additionally neutralized in the mill base and because it is generally the resin supply form with a low pH that is let down. Prior to setting the viscosity in the supply form, the coatings should be allowed to stand for 24 h.

5.3 CROSSLINKING

With this binder, crosslinking is carried out via oxygen absorption and should be accelerated by the addition of suitable driers (see recommended additives).

Because of the OH groups present in the binders, crosslinking with IPDI based polyisocyanate Bayhydur® 401-70 is also possible. Hardness and resistance properties can be slightly improved as a result, especially after drying over night. Nevertheless, the pot life of the coating is significantly reduced as a result.

Where higher drying temperatures, ≥ 120 °C, are available, the binder can also be crosslinked with melamine resins. In this way, harder and more resistant coatings are obtained. Under baking conditions, there is a tendency to yellowing, which means that the described combination should only be used for darker shades. With baking formulations, EDIPA or DMEA should be used as the neutralizing amine.



6. INFLUENCE OF VARIOUS COATING COMPONENTS ON THE PROPERTIES OF BAYHYDROL® UH XP 2592 BASED TOPCOATS

Bayhydrol® UH XP 2592 gives the coatings formulator great scope for variation with regard to the choice of solvents, driers and anti-skinning agents. The influence of the respective components on the coating properties of a white Bayhydrol® UH XP 2592 topcoat is shown in the following summaries.

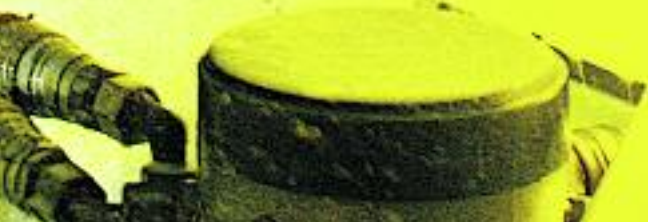
6.1 VARYING THE NEUTRALIZING AGENT

For the subsequent neutralization of Bayhydrol® UH XP 2592 the following amines are recommended (see Section 5.2).

AMINES*) IN FORMULATION FBG 6604 (WHITE TOPCOAT)	ETHYLDIISO- PROPYLAMINE	TRIETHYL- AMINE	DIMETHYL- ETHANOLAMINE	WITHOUT AMINE
amount of amine calc. on lacquer	0.13 %	0.10 %	0.09 %	–
CHARACTERISTIC DATA OF THE LACQUER (60 S DIN CUP 4 MM)				
solid content	49.5 %	49.0 %	49.0 %	53.7 %
organic co-solvent	3.7 %	3.6 %	3.6 %	3.9 %
pH (1 : 4 in demin. water)	7.3	7.2	7.2	7.2
COATING PROPERTIES (RT)				
drying time (T ₁ /T ₃)	1 h/5 h	1 h/5 h	1 h/5 h	1 h 5 h
gloss 20° angle (1 d / 7 d)	75/69	69/63	73/61	13/9
pendulum hardness (1 d / 7 d / 14 d)	27 s/73 s/87 s	27 s/73 s/87 s	26 s/65 s/80 s	25 s/35 s/35 s
water resistance (16 h)	>3 d	2 d	2 d	6 d
xylene test (2 d 1 min / 7 d 5 min)*	4/2	4/2	4/2	4/2

*) Addition of amine to neutralize the resin in the mill base up to approx. 80 %.

* **SCORING** : 0 = no findings | 1 = test side visible, film remains hard | 2 = test side visible, film slightly softened | 3 = slight change in film (blistering, wrinkling) | 4 = pronounced change in film (blistering, wrinkling) | 5 = film destroyed



6.2 VARYING THE CO-SOLVENTS

When using Bayhydrol® UH XP 2592, it is also possible to formulate coatings free of co-solvents or, alternatively, to influence the appearance and drying properties through the specific selection of

the organic solvents (see Table below). Through the addition of organic solvents, the viscosity of Bayhydrol® UH XP 2592 increases considerably.

ORGANIC CO-SOLVENTS IN FORMULATION FBG 6604 (WHITE TOPCOAT)	BUTOXYETHANOL/ DOWANOL® DPnB 1 : 1	BUTOXYETHANOL/ DOWANOL® DPnB 1 : 1	BUTOXYETHANOL/ DOWANOL® DPnB 2 : 1	FREE OF CO-SOLVENTS
CHARACTERISTIC DATA OF THE LACQUER (60 S DIN CUP 4 MM)				
solid content	51.3 %	52.9 %	53.2 %	54.0 %
organic co-solvent	4 %	3 %	3 %	0
pH (1 : 4 in demin. water)	7.3	7.3	7.3	7.3
COATING PROPERTIES (RT)				
drying time (T1/T3)	1 h/5 h	1 h/5 h	1 h/4 h	1 h/3 h
gloss 20° angle (1 d / 7 d)	78/71	74/67	73/67	12/10
pendulum hardness (1 d / 7 d / 14 d)	27 s/68 s/82 s	28 s/61 s/76 s	30 s/61 s/76 s	31 s/65 s/76 s
water resistance (16 h)	2 d	2 d	2 d	2 d
water resistance (7 d RT)	8 h	1 d	1 d	8 h
COATING PROPERTIES (30 MIN 80° C + 1h RT)				
gloss 20° angle	82	78	78	41
pendulum hardness	42 s	44 s	42 s	47 s
water resistance	3 d	3 d	3 d	3 d
xylene test (5 min)*	4-5	4-5	4-5	4-5

For example, the following solvents can also be used: Butoxyethanol, Dowanol™ PM, alone or in combination with higher-boiling co-solvents e.g. Dowanol™ DPM or N-methyl pyrrolidone.



6.3 VARYING THE DRIER

In addition to the standard driers, cobalt-free driers can also be used in Bayhydrol® UH XP 2592 formulations.

DRIERS IN FORMULATION FBG 6604 (WHITE TOPCOAT)	OCTA-SOLIGEN® CO 7 AQUA	AQUACAT®	BORCHERS® DRY 0347 AQUA
	Cobalt	Cobalt	Cobalt-free
DRIER CALCULATED ON SOLID RESIN	0.08 %	0.08 %	3 %
CHARACTERISTIC DATA OF LACQUER (60 s DIN CUP 4 MM)			
solid content	49.0 %	49.0 %	49.0 %
organic co-solvent	3.7 %	3.7 %	3.7 %
pH (1 : 4 in demin. water)	7.3	7.3	7.3
COATING PROPERTIES (RT)			
drying time (T1/T3)	1 h/5 h	1 h/5 h	1 h/5 h
gloss 20° angle (1 d / 7 d)	67/64	57/52	75/69
pendulum hardness (1 d / 7 d / 14 d)	30 s/40 s/96 s	30 s/41 s/97 s	30 s/73 s/87 s
water resistance (16 h)	no blistering after 3 d exposure		
xylene test (2 d 1 min/7 d 5 min)*	4/2	4/2	4/2

* **SCORING** : 0 = no findings | 1 = test side visible, film remains hard | 2 = test side visible, film slightly softened | 3 = slight change in film (blistering, wrinkling) | 4 = pronounced change in film (blistering, wrinkling) | 5 = film destroyed



6.4 VARYING THE ANTI-SKINNING AGENT

As the following results show, Borchino[®] Nox M2 can be replaced by the butanone oxime-free anti-skinning agent, Ascini[®] Anti Skin 0445, without negatively influencing the hardness or skinning.

ANTI-SKINNING AGENTS IN FORMULATION FBG 6604 (WHITE TOPCOAT)	BORCHINO [®] NOX M2	BORCHINO [®] NOX M2	ASCINI [®] ANTI SKIN	ASCINI [®] ANTI SKIN
	butanone oxime		free of butanone oxime	
AMOUNT CALCULATED ON SOLID RESIN	0.3 %	0.6 %	0.25 %	0.35 %
CHARACTERISTIC DATA OF LACQUER (60 S DIN CUP 4 MM)				
solid content	49.0 %	49.5 %	49.0 %	49.5 %
organic co-solvent	3.7 %	3.7 %	3.7 %	3.7 %
pH (1 : 4 in demin. water)	7.3	7.3	7.3	7.3
skinning (0 = good, 5 = bad)	1	1-2	1-2	1-2
COATING PROPERTIES (RT)				
drying time (T1/T3)	1 h/5 h	1 h/5 h	1 h/5 h	1 h/5 h
gloss 20° angle (1 d / 7 d)	70/63	70/63	75/69	66/59
pendulum hardness (1 d / 7 d / 14 d)	27 s/76 s/87 s	27 s/79 s/80 s	27 s/73 s/87 s	27 s/77 s/94 s
water resistance (16 h)	no blistering after 3 d exposure			
xylene test (2 d 1 min/7 d 5 min)*	2-3/2	2-3/2	4/2	4/2



7. SUITABLE PIGMENTS, ADDITIVES AND RESINS FOR COMBINATION



DRYING :

Bayhydrol® UH XP 2592 does not contain any driers in its supplied form, which means they have to be added to the formulation. Apart from cobalt-based driers, cobalt-free driers can also be used without any negative influence on the final properties. The following addition is recommended:

Cobalt-free drier: 3 % Borchers® Dry 0347 aqua¹⁾, form supplied on solid resin or standard drier with cobalt: e.g. Octa-Soligen® Co 7 Aqua¹⁾, 0.08 % cobalt metal on solid resin or Aquacat²⁾, also 0.08 % cobalt metal on solid resin.

In our experience, additional drying has no substantial advantages.

The use of pigments with a large surface area or free acid groups (e.g. amorphous silicic acid, carbon blacks) or also hydrolysis can result in a slight decrease in the effectiveness of the drier over time and thus in longer curing times when using binders or coatings which have been in storage. In this case, we recommend drying the coating with an additional 0.04 % cobalt metal calculated on solid resin. Octa-Soligen® Cobalt 7 Aqua¹⁾ and Aquacat²⁾ are suitable drying agents.

ANTI - SKINNING :

With Bayhydrol® UH XP 2592, the following additives prevent skinning (in each case, form supplied calculated on solid resin): 0.25 % Ascinin®

Anti Skin 0445¹⁾ (butanone oxime-free!)
0.3–0.6 % Borchl® Nox M2¹⁾ (based on butanone oxime)

ACCELERATION :

Mixtures with acrylic resins are often tried out to accelerate drying, but this may adversely affect the anti-corrosion properties. Binder compatibility should be carefully tested on a case-by-case basis. Because drying with Bayhydrol® UH XP 2592 can be controlled via the type and quantity of organic solvents used in the formulation, combination with fast drying acrylic resins is not absolutely necessary.

FLEXIBILIZATION :

Combination with Bayhydrol® UH 240 (up to 10% calculated on solid resin) significantly improves flexibility. In addition, flexibilization has a positive effect on the adhesion properties and corrosion protection. Except for a slight reduction in hardness and slightly diminished gloss, all other coating properties are not adversely affected.

PIGMENTS/EXTENDERS :

Positive experiences have been reported with common inert and alkali pigments. If acidic pigments (e.g. some types of carbon black) are used, viscosity decreases and neutralization with triethylamine and/or dimethylethanolamine



becomes essential.

The extender named in the starting formulations below, Microdol® Super³⁾, is not available on the U.S. market. Dolocron® 3215⁴⁾ is recommended as an equivalent substitute. The same applies to Micro Talc AT extra³⁾, which can be replaced with Arctic Mist³⁾ with no adverse effect on coating properties. A number of other extenders have proven to be unsuitable; please contact us for detailed information.

ANTI-CORROSION PIGMENTS:

The best corrosion protection is achieved with a combination of pigments containing approx. 10% zinc oxide:

K-White 105⁶⁾ (zinc-aluminum triphosphate)/ Bayoxide® Z aktiv³⁾ (zinc oxide) 8% : 0.8% calculated on the coating

– **very good corrosion protection**

Heucophos® ZPA⁷⁾ (zinc-phosphate)/Bayoxide® Z aktiv³⁾ (zinc oxide) 9% : 0.9% calculated on the coating

– **good corrosion protection**

– **slight fading in condensation test**

Predispersion (dissolver prior to neutralization) of the anti-corrosion pigments is not absolutely necessary.

FLUSH RUST:

NALZIN® FA 179⁸⁾ or 379⁸⁾ have proven to be

roughly equally effective additives against flush rust. The recommended addition to the mill base is 0.15 to 0.2%. The corrosion inhibitor L1⁹⁾ can also be used effectively. However, it is a strong alkali and increases the viscosity of coatings based on Bayhydrol® UH XP 2592, thus affecting the amount of water added in the last step.

THICKENER:

Borchi® Gel PW 25³⁾ and Rheolate® 255⁸⁾ provide good thickening with no adverse effects on other coating properties.

The thickener should generally be added in diluted form, e.g. as a 10% aqueous solution. This simplifies metering and ensures better dispersion.

ANTI-FOAM:

FoamStar® MF 330¹⁰⁾, Byk®-024¹¹⁾ and Tego® Foamex 815¹⁴⁾ are effective antifoams. Refer to the manufacturer's instructions for quantities to be added. The antifoams can be added either to the mill base or to the coating itself. Cratering may occur if Tego® Foamex 815¹⁴⁾ is used in coatings with a low pigment content.

SUBSTRATE WETTING:

Byk®-346¹¹⁾ is an outstanding additive for enhancing substrate wetting. Refer to the manufacturer's instructions for quantities to be added.



8. RECOMMENDED FORMULATIONS

8.1 AIR-DRYING ONE COMPONENT TOPCOATS HIGH GLOSS WHITE

8.1.1 BAYHYDROL® UH XP 2592, FORMULATION RR 6160

FORMULATION INSTRUCTIONS			
STEP	INSTRUCTIONS	COMPONENTS	% BY WT.
1	Place in a vessel.	Bayhydrol® UH XP 2592, supply form	22.17
		water	1.0
2	Add water, organic solvents and anti-skinning agent under agitation.	Butoxyethanol/Dowanol™ DPnb ¹⁶⁾ 1 : 1	4.02
		Ascinin® Anti Skin 0445 ¹⁾	0.07
3	Slowly drip in thinned EDIPA while agitating. This quantity of amine neutralizes UH XP 2592 to approx. 80 % in the mill base (improved pigment wetting).	N-ethyl-diisopropyl-amine (EDIPA), 50 % in ethanole	0.31
4		water	approx. 1.60
5	Incorporate the pigment using a dissolver.	Tronox® R-KB-6 ¹³⁾	23.95
6	If necessary, add additional water to establish optimal grinding viscosity.	water	approx. 0.88
7	Grind in a bead mill, degree of grinding < 10 µm.		
8	Let down the mill base with Bayhydrol® UH XP 2592 in supply form.	Bayhydrol® UH XP 2592, supply form	44.41
9		Borchers® Dry 0347 aqua ¹⁾	0.91
10		Borchi Gel® PW 25 (form supplied 1 : 9 in water)	approx. 0.50
11	Let the coating stand for approx. 48 hours. During this period, the neutralization equilibrium is established and the coating defoams. Both of these processes result in a decrease of viscosity.		
12	Use thickener to establish the supply viscosity of approx. 80–90 s, DIN cup 4 mm, 23 °C	Borchi Gel® PW 25 (form supplied 1 : 9 in water)	approx. 0.25

CHARACTERISTIC DATA	
recommended spray viscosity	25–30 s flow time, DIN 4 cup
solid content at spray viscosity	approx. 51 %
organic solvents at spray viscosity	approx. 3.8 %
VOC content at spray viscosity	approx. 130 g/l
pH (1:4 in demin. water)	approx. 7.3
binder/pigment ratio	1/0.8
stability of coating (initial flow time 60 s DIN 4 cup)	After storage for six month at room temperature viscosity decreases to approx. 35 s.

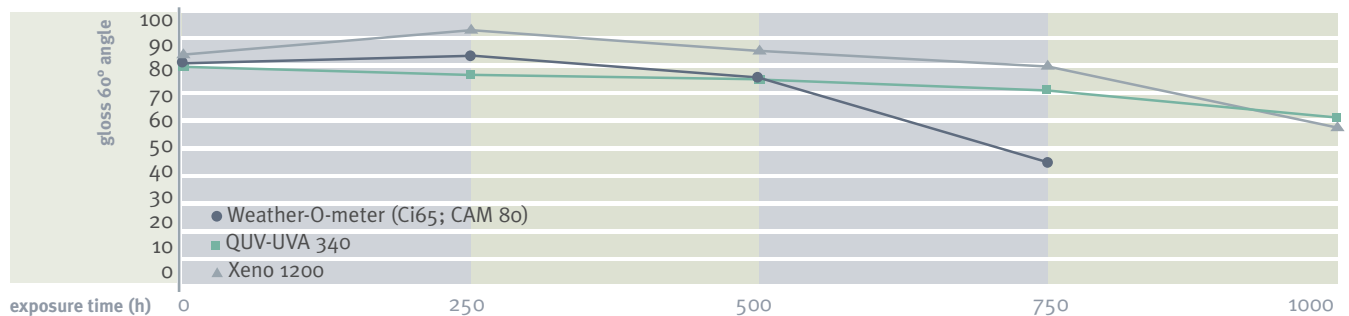
8.1.2 FILM PROPERTIES OF WHITE TOPCOATS FORMULATION RR6160 (BAYHYDROL® UH XP 2592)

Dry film thickness: approx. 50 µm. Substrate: glass. Steel: cold rolled steel sheet, DC 04B.

drying	at 23 °C/50 % rel. humidity T1 approx. 1 h; T3 approx. 5 h			
start of testing	after drying for 1 day at RT	after drying for 7 days at RT	1 h after drying for 30 min at 80 °C	
gloss 20°/60° on glass	78/90	75/90	80/90	
pendulum hardness on glass	approx. 35 s	approx. 70 s	approx. 35 s	
water resistance on glass:				
after 1 d exposure	slight gloss reduction	very slight gloss reduction	no findings	
after 7 d exposure	blisters m2/g2 significant gloss reduction	significant gloss reduction	gloss reduction	
chemical resistance*: (on steel panel)				
xylene	5 min at RT	4-5	2	4
transmission oil	5 min at RT	0	0	0
motor oil	5 min at RT	0	0	0
diesel fuel	5 min at RT	0	0	2
super unleaded gasoline	5 min at RT	5	3	4
sulfuric acid, 2 %	1 h at RT	0	0	0
sodium hydroxide solution, 2 %	1 h at RT	3-4	4	3

* **SCORING** : 0 = no findings | 1 = test side visible, film remains hard | 2 = test side visible, film slightly softened | 3 = slight change in film (blistering, wrinkling) | 4 = pronounced change in film (blistering, wrinkling) | 5 = film destroyed

8.1.3. WEATHERING PROPERTIES OF WHITE TOPCOATS (80% TRONOX R-KB-6), FBG 6604 (BAYHYDROL® UH XP 2592)



results after	blistering/water spots/chalking/cracking/yellowing (Δ E)		
	500 h	750 h	1000 h
Weather-O-meter (Ci65; CAM 180)	0/0 // 0/0/0/0.3	0/0 // 0/0/0/0.3	–
QUV-UVA 340	0/0 // 0/0/0/0.4	0/0 // 0/0/0/0.7	0/0 // 1/0/0/0.7
Xeno 1200	0/0 // 0/0/0/0.6	0/0 // 0/0/0/0.6	0/0 // 1/0/0/0.7

8.2 AIR-DRYING ONE COMPONENT SINGLE-LAYER COATING MATT BLACK

8.2.1 BAYHYDROL® UH XP 2592, FORMULATION RR 6155

FORMULATION INSTRUCTIONS			
STEP	INSTRUCTIONS	COMPONENTS	% BY WT.
1	Place in a vessel.	Bayhydrol® UH XP 2592, supply form	31.95
2	Add organic solvents, anti-skinning agent, drier and liquid additives under agitation.	Butoxyethanol Dowanol® DPnb ¹⁶⁾ Ascinin® Anti Skin 0445 ¹⁾ Borchers® Dry 0347 aqua ³⁾ , 1:1 in water NALZIN® FA 179 ⁸⁾ FoamStar® MF 330 ¹⁰⁾ water	1.92 1.92 0.08 2.88 0.17 0.19 3.82
3	Aerosil, active anti-corrosion pigments and zinc oxide, should be dispersed with the additives into the Bayhydrol® UH XP 2592 for approx. 5 min in a dissolver.	Aerosil® 300 ¹⁴⁾ K-White 105 ⁶⁾ Bayoxide® Z aktiv ³⁾	0.28 8.58 0.85
4	Slowly drip in thinned EDIPA while agitating. This quantity of amine neutralizes the Bayhydrol® UH XP 2592 by approx. 90 % in the mill base (improved pigment wetting). Viscosity will increase significantly!	N-Ethyldiisopropylamine, 50 % in ethanol	0.52
5	Incorporate the remaining pigments and extenders using a dissolver.	Printex® 55 ¹⁴⁾ Microdol® Super ³⁾ Micro Talc AT extra ³⁾	1.36 6.11 3.67
6	If necessary, add additional water to get optimal grinding viscosity.	water	approx. 2.59
7	Grind in a bead mill.		
8	Let down the mill base with the Bayhydrol® UH XP 2592 supply form. If necessary, use some thickener to initially set supply viscosity.	Bayhydrol® UH XP 2592, supply form Borchi® Gel PW25 ¹⁾ , 1 : 9 in water	31.96 approx. 0.70
9	Let the coating stand for approx. 16 hours (over night). During this period, the neutralization equilibrium is established and the coating defoams. Both of these processes result in a decrease of viscosity.		
10	Add Byk®-346 and use thickener to set an initial flow time of 60–100 s in DIN 4 cup.	Byk®-346 ¹¹⁾ Borchi® Gel PW 25 ¹⁾ , 1 : 9 in water	0.10 approx. 0.35

CHARACTERISTIC DATA	
recommended spray viscosity	25–30 s flow time, DIN 4 cup
solid content at spray viscosity	approx. 50 % flow time, DIN 4 cup
organic solvents at spray viscosity	approx. 4 %
VOC content at spray viscosity	approx. 135 g/l
pH (10 % in demin. Water)	approx. 8.0
binder/pigment ratio	1 : 0.7
stability of coating (initial flow time 60 s in DIN 4 cup)	After storage for six months at room temperature, viscosity increases slightly; can be diluted with 1–2 % water to initial value, slight sedimentation, can be reincorporated by agitation.

8.2.2 FILM PROPERTIES OF SINGLE-LAYER COATINGS, FORMULATION RR 6155 (BAYHYDROL® UH XP 2592)

Dry film thickness: approx. 35 µm. Substrate: glass. Zinc: Gardobond® OE, HDG hot-dip galvanized steel. Aluminum: Aluminum Al 99.5 hh. Steel: cold rolled steel sheet, DCo4/B.

drying		at 23°C/50 % rel. humidity, T1 approx 20 min, T3 approx. 60 min		
start of testing		after drying for 1 day at RT	after drying for 7 days at RT	1 h after drying for 30 min at 80 °C
gloss > 60° on glass		19	16	16
pendulum hardness on glass		30	70	40
adhesion (cross hatch)	Steel	Gt 1	Gt 0	Gt 1
	Aluminum	Gt 2-3	Gt 1-2	Gt 0-1
	Zinc	Gt 1	Gt 0-1	Gt 1
chemical resistance*: on steel panel				
xylene	5 min at RT	5	2	5
brake fluid	1 h at RT	5	3	5
hydraulic oil	7 d at RT	1	1	1
	1 d at 120°C	3-4	1	1
motor oil	7 d at RT	1	0	1
	1 d at 120°C	3-4	1	1
diesel fuel	1 d at RT	4	1	3
super unleaded gasoline	5 min at RT	5	1-2	5
2 % sulfuric acid	1 h at RT	2	1	2
	1 d at RT	5	4	4
sodium hydroxide solution, 2 %	1 h at RT	3-4	4	4
water resistance on steel panel	240 h	faded, no blistering	slightly faded	slightly faded, no blistering
salt spray test on steel panel	240 h	(not tested)	surface blisters m1/g1 max. 3 mm lost of adhesion at cut, no rust creep	surface blisters m1/g1, max.3 mm lost of adhesion at cut, no rust creep
humidity test on steel panel	240 h	(not tested)	faded, surface blisters m3/g1	slightly faded, surface blisters m2/g1

* **SCORING** : 0 = no findings | 1 = test side visible, film remains hard | 2 = test side visible, film slightly softened | 3 = slight change in film (blistering, wrinkling) | 4 = pronounced change in film (blistering, wrinkling) | 5 = film destroyed
(The figures given in the table are averages)

8.3 AIR-DRYING ONE COMPONENT ANTI-CORROSION PRIMER, GREY

8.3.1 BAYHYDROL® UH XP 2592, FORMULATION RR 6156

FORMULATION INSTRUCTIONS			
STEP	INSTRUCTIONS	COMPONENTS	% BY WT.
1	Place in a vessel.	Bayhydrol® UH XP 2592, supply form	30.84
2	Add organic solvents, anti-skinning agent, drier and fluid additives under agitation.	Butoxyethanol Dowanol® DPnb ⁶⁾ Ascinin® Anti Skin 0445 ¹⁾ Borchers® Dry 0347 aqua ¹⁾ , 1 : 1 in water NALZIN® FA 179 ⁹⁾ FoamStar® MF 330 ¹⁰⁾	1.85 1.85 0.07 2.78 0.17 0.18
3	Aerosil, active anti-corrosion pigments and zinc oxide, should be dispersed with the additives into the Bayhydrol® UH XP 2592 for approx. 5 min in a dissolver.	Aerosil® 300 ¹⁴⁾ K-White 105 ⁵⁾ Bayoxide® Z aktiv ¹⁾	0.27 8.28 0.82
4	In order to react to the viscosity increase upon solvent addition and neutralization, the Bayhydrol® UH XP 2592 has to be reduced with water before neutralization.	water	approx 1.30
5	Slowly drip in thinned EDIPA while agitating. This quantity of amine neutralizes the Bayhydrol® UH XP 2592 by approx. 80 % in the mill base (improved pigment wetting).	N-ethyl-diisopropylamine, 50 % in ethanol	0.50
6	Incorporate the remaining pigments and extenders using a dissolver.	Tronox® R-KB-2 ¹³⁾ Printex® 55 ¹⁴⁾ Microdol® Super ³⁾ Micro Talc AT extra ³⁾	9.26 0.10 5.89 3.54
7	If necessary , add additional water to get optimal grinding viscosity.	water	1.00
8	Grind in a bead mill.		
9	Let down the mill base with the Bayhydrol® UH XP 2592 supply form and amino resin. If necessary, use some thickener to initially set supply viscosity.	Bayhydrol® UH XP 2592, supply form Borchi® Gel PW 25 ³⁾ , 1 : 9 in water	30.84 approx. 0.20
10	Let the coating stand for approx. 16 hours (over night). During this period, the neutralization equilibrium is established and the coating defoams. Both of these processes result in a decrease in viscosity.		
11	Add Byk®-346 and use thickener to set an initial flow time of 60 – 100 s in DIN 4 cup.	Byk®-346 ¹¹⁾ Borchi® Gel PW 25 ³⁾ , 1 : 9 in water	0.10 approx. 0.16

CHARACTERISTIC DATA	
recommended spray viscosity	25–30 s flow time, DIN 4 cup
solid content at spray viscosity	approx. 55 %
organic solvents at spray viscosity	approx. 3.5 %
VOC content at spray viscosity	approx. 116 g/l
pH (10 % in demin. water)	approx. 8.1
binder/pigment ratio	1 : 1
stability of coating (initial flow time 60 s in DIN 4 cup)	After storage for six months at room temperature, viscosity decreases by approx. 10 %, slight sedimentation, can be reincorporated by agitation.

8.3.2 FILM PROPERTIES OF PRIMERS, FORMULATION RR 6156 (BAYHYDROL® UH XP 2592)

Dry film thickness: approx. 40 µm. Substrate: glass. Zinc: Gardobond® OE, HDG hot-dip galvanized steel. Aluminum: Aluminum Al 99.5 hh. Steel: cold rolled steel sheet, DCo4/B.

drying		at 23 °C/50 % rel. humidity, T1 approx. 0.5 h, T3 approx. 2 (1) h		
start of testing		after drying for 1 day at RT	after drying for 7 days at RT	1 h after drying for 30 min at 80 °C
gloss 85° > on glass		78	78	75
pendulum hardness on glass		30 s	80 s	40 s
adhesion on	Steel	Gt 1	Gt 0-1	Gt 1
(cross hatch)	Aluminum	Gt 2	Gt 3	Gt 2
	Zinc	Gt 1	Gt 1-2	Gt 0-1
chemical resistance*: on steel panel				
xylene	5 min at RT	5	2	5
brake fluid	1 h at RT	5	3	5
hydraulic oil	7 d at RT 1 d at 120°C	1 1	0 1	1 1
motor oil	7 d at RT 1 d at 120°C	1 1	1 1	1 1
diesel fuel	1 d at RT	3	1	1-2
super unleaded gasoline	5 min at RT	5	1-2	4
2 % sulfuric acid	1 h at RT	4	4	3-4
sodium hydroxide solution, 2 %	1 h at RT	4	4	3-4
water resistance on steel panel	240 h	no blistering faded 3	m3/g2 faded 2-3	no blistering faded 2
salt spray test on steel panel	240 h	(not tested)	surface free of findings, max. 3 mm lost adhesion at cut, no rust creep	max. 3 mm lost adhesion at cut, little rust creep
humidity test on steel panel	240 h	(not tested)	faded no blistering	faded no blistering

* **SCORING** : 0 = no findings | 1 = test side visible, film remains hard | 2 = test side visible, film slightly softened | 3 = slight change in film (blistering, wrinkling) | 4 = pronounced change in film (blistering, wrinkling) | 5 = film destroyed (The figures given in the table are averages.)

OVERCOATABILITY:

Once dry, the primer can be overcoated at any time with all conventional solvent- and water-borne 1K or 2K topcoats. If the topcoat is applied shortly (< 4 days) after the primer has

dried, it may take approx. 14 days until perfect topcoat adhesion is achieved. Overcoatability should be carefully tested on a case-by-case basis.

8.4 AIR-DRYING ONE COMPONENT HAMMER METAL FINISH, SILVER

8.4.1 BAYHYDROL® UH XP 2592, FORMULATION RR 6157

FORMULATION INSTRUCTIONS			FBG 6962-7
STEP	INSTRUCTIONS	COMPONENTS	% BY WT.
1	Place resin in a vessel.	Bayhydrol® UH XP 2592 supply form	72.94
		2-Butoxyethanol/ Dowanol® DPnb ¹⁶⁾ (1 : 1)	4.42
		Ascinin® Anti Skin 0445 ¹⁾ / Borchers® Dry 0347 aqua ¹⁾ 1 : 1 in water	0.10 1.97
		water	3.84
	Add thickener to increase viscosity.	Borchi® Gel PW 25, ¹⁾ supply form 2 : 8 in water	1.54
	Add leveling agent, stir complete mixture for 10 min at 1000 rpm.	Baysilone®-Paint Additive MA ¹⁾ 100 %	0.10
	Aluminum paste		
2		water	3.84
		2-Butoxyethanol	3.84
	Add aluminum paste and stir mixture 10 min at < 1000 rpm.	Stapa Hydrolac® W 60 n.l. ¹⁵⁾	2.78
3	Mix components from Step 1 und 2.		
4	Add effect-additive, stir complete mixture again for 10 min at 1000 rpm. The effect of the hammer metal finish can be controlled by the added quantity.	Baysilone®-Paint Additive 3451 ¹⁾	0.25
5		water	4.38

The coating formulated in this way can be set to the desired shade with pigment pastes. The compatibility and storage stability of these formulations should be tested separately. * Developed by OMG Borchers GmbH

Application: In order to achieve this special hammer metal finish effect, you should apply the coating with a spray gun (pressure approx. 2 bar) in two steps. At first spray only a very thin layer to achieve just a dusting on the metal, then allow drying for 1–2 minutes. Finally apply the coating with the desired film thickness. Optimal cleaning and removal of grease is very important for this application.

CHARACTERISTIC DATA	
supply viscosity equal to recommended spray viscosity, DIN 4 mm cup	approx. 95 s flow time, DIN 4 cup
solid content at spray viscosity	approx. 38.1. %
organic solvents at spray viscosity	approx. 10 %
VOC-content at spray viscosity (10 % in demin. water)	approx. 220 g/l approx. 7.3
stability at of coating	No changes after 3 months, slight sedimentation, can be reincorporated by agitation.

8.4.2. FILM PROPERTIES OF HAMMER METAL FINISHES, FORMULATION RR 6157 (BAYHYDROL® UH XP 2592)

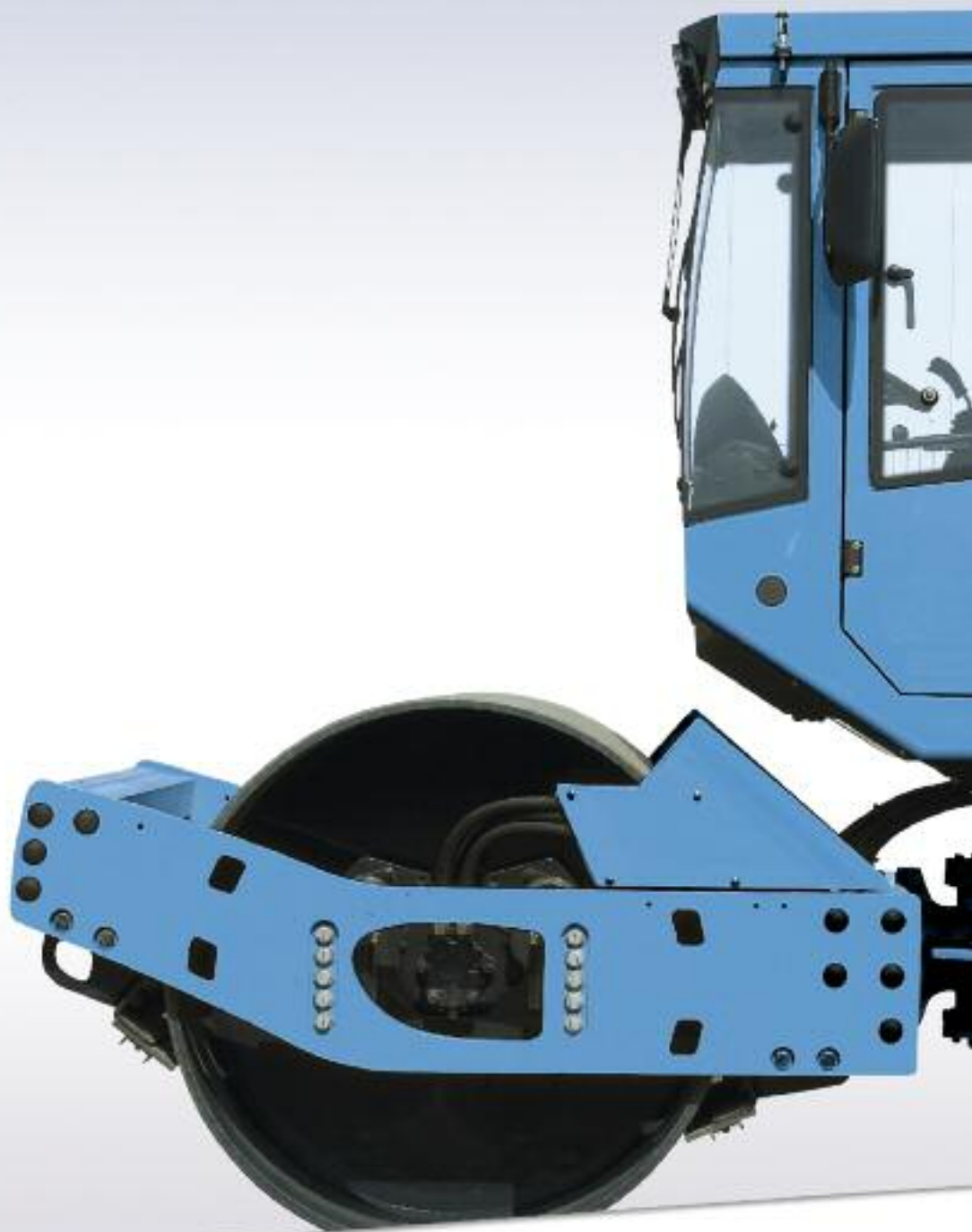
Dry film thickness: approx. 50 µm. Substrate: glass. Steel: cold rolled steel sheet DC 04 B.

drying	at 23 °C/60 % rel. humidity, T1 approx. 2 h, T3 approx. 7 h	
pendulum hardness on glass	1d/7d/14 d	20 s/48 s/56 s
water resistance after 1 d drying at RT on steel panel	24 h exposure	no findings
chemical resistance* scoring after 7 d drying at RT: on steel panel		
xylene	5 min at RT	2
transmission oil	96 h at RT	0
motor oil	96 h at RT	0
diesel fuel	1 h at RT	1
super unleaded gasoline	5 min at RT	2-3
2 % sulfuric acid	96 h at RT	1-2
sodium hydroxide solution, 2 %	1 h at RT	4

* **SCORING** : 0 = no findings | 1 = test side visible, film remains hard | 2 = test side visible, film slightly softened | 3 = slight change in film (blistering, wrinkling) | 4 = pronounced change in film (blistering, wrinkling) | 5 = film destroyed (The figures given in the table are averages.)

9. SUPPLIERS OF RAW MATERIALS

1) OMG Borchers GmbH, Langenfeld, Germany	www.borchers.de
2) Münzing Chemie GmbH, Heilbronn, Germany	www.munzing.com
3) Omya GmbH, Cologne, Germany	www.omya.de
4) Specialty Minerals Inc., Bethlehem, PA, USA	www.specialtyminerals.com
5) Luzenac America Inc., Engelwood, CO, USA	www.luzenac.com
6) Tyca (Japan), represented by Lehmann & Voss, Hamburg, Germany	www.lehvoss.de
7) Heubach GmbH, Langelsheim, Germany	www.heubachinternational.com
8) Elementis Specialties, Diegem, Belgium	www.elementis-specialties.com
9) C. H. Erbslöh, Krefeld, Germany	www.cherbsloeh.de
10) Cognis GmbH, Düsseldorf, Germany	www.cognis.com
11) Byk-Chemie GmbH, Wesel, Germany	www.byk.com
12) Evonik Tego Chemie GmbH, Essen, Germany	www.tego.de
13) Tronox Pigments GmbH, Krefeld, Germany	www.tronox.com
14) Evonik Industries AG, Essen, Germany	www.degussa.de
15) ECKART GmbH & Co KG, Fürth/Bayern, Germany	www.eckart.net
16) Dow Benelux N.V., Rotterdam, The Netherlands	www.dow.com



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