

AMICURE[®] IC-321

Curing Agent for Polyisocyanate Resin

DESCRIPTION

Amicure IC-321 is an amine curing agent specifically designed for polyisocyanate resins. Preferred resins of choice are standard and low viscosity HDI trimer isocyanates for a range of industrial applications. Amicure IC-321 curing agent is designed to provide long working pot life and high flexibility. Clear and pigmented topcoats based on Amicure IC-321 curing agent support high aesthetics, UV stability and rapid property development for fast return to service. The product is free of solvents, alkyl phenol derivatives and benzyl alcohol.

Coatings and floorings based on Amicure IC-321 curing agent are recommended to be used in combination with an epoxy primer, especially under damp conditions. Working and drying times are accelerated under high humidity conditions.

TYPICAL PROPERTIES

Property	Value	Unit	Method
Appearance	Light yellow liquid		
Colour	≤215	APHA	ASTM D 1544
Viscosity @ 25°C	100-800	mPa.s	Brookfield RVTD, spindle 4
Water Content	≤0.015	wt %	Karl Fisher Method
Specific Gravity @ 21°C	1.06		
Equivalent	376	Wt{H}	
Recommended Use Level	185	PHR	With HDI Trimer, 21.8 wt% NCO, 2,500 mPa.s at 25°C

ADVANTAGES

- Rapid hardness development with extended working pot life
- Low color and excellent UV durability
- Low mix viscosity
- Low odor

APPLICATIONS

- Topcoats and Sealers

SHELF LIFE

At least 12 months from the date of manufacture in the original sealed container at ambient temperature. Store away from excessive heat and humidity in tightly closed containers.

STORAGE AND HANDLING

Refer to the Safety Data Sheet for Amicure IC-321 amine curing agent.

TYPICAL HANDLING PROPERTIES¹ 25°C, 50% RH

Property	Value	Unit	Method
Mix Viscosity	1,000-1,500	mPa.s	Brookfield RVTD, spindle 4
Working Pot Life	40-50	min	Time to viscosity build of 12 Pa.s at 25°C
Thin Film Set Time	3	h	ASTM D 5895 - BK Drying Recorder, Phase 3
Persoz Hardness after 1 / 7 days	45/210	s	
Shore D Hardness after 1 / 7 days	50/75		
Typical cure schedule	2-7	days	

TYPICAL HANDLING PROPERTIES¹ 5°C, 50% RH*

Property	Value	Unit	Method
Thin Film Set Time	4	h	ASTM D 5895 - BK Drying Recorder, Phase 3
Persoz Hardness after 1 / 7 days	30/205	s	
Shore D Hardness after 1 / 7 days	45/75		

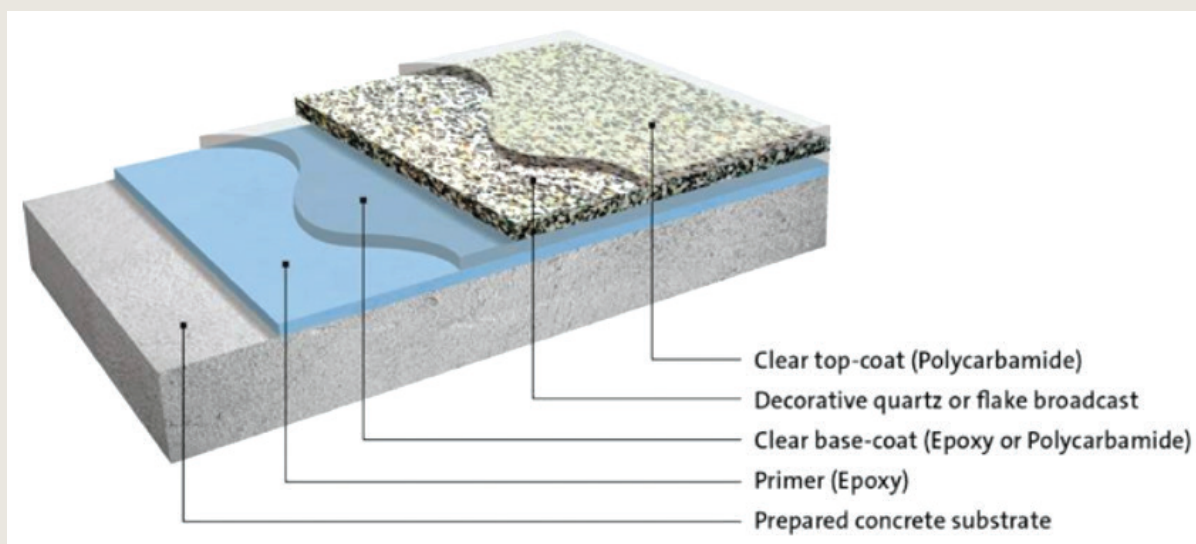
(1) With HDI Trimer, 21.8 wt% NCO, 2,500 mPa.s at 25°C

TYPICAL PERFORMANCE¹

Property	Value	Unit	Method
UV-A Resistance after 500 h	<5	ΔE	
Impact Resistance Direct/Reverse	>200/>200	kg.cm	
Abrasion Resistance, CS17, 1000 cycli	40	mg loss	
Compressive Strength	32	MPa	
Tensile Strength	21	MPa	
Tensile Elongation at Break	25	%	
Glass Transition Temperature	40	°C	Differential Scanning Calorimetry (DSC)
Carbamation Resistance	5	Scale 1-5, 5=best	ISO 2812 (wet patch method)

SUPPLEMENTARY DATA

POLYCARBAMIDE RESIN TECHNOLOGY - MODIFIED AMINE CURING AGENTS FOR POLYISOCYANATES: The new polycarbamide resin technology offers the complete package for top coat application with Amicure IC-221 and Amicure IC-321 curing agents. Amicure curative based clear- and pigmented coatings exhibit rapid property development, high UV stability and high aesthetics. Both products are specifically designed to deliver clear and pigmented coatings that can be applied up to 500 μm in a single pass, when cured with standard HDI trimer isocyanates. An epoxy primer is recommended for best performance and longevity of the flooring system.



(1) With HDI Trimer, 21.8 wt% NCO, 2,500 mPa.s at 25°C

TABLE 5: AMICURE IC-321 CURING AGENT

Performance	Comparable Technology	Polycarbamide Property Characteristics
UV and light stability	2K Polyurethane	$\Delta E < 5$ after 500 h QUV-A
Abrasion and impact resistances	2K Polyurethane	40 mg loss (CS17, 1kg, 1000 cycles), >200 kg.cm Impact resistances
Fast cure speed	Methacrylate (MMA)	<24 h walk-on at 0 °C 6 h walk-on at ambient

FAST RETURN TO SERVICE

Coatings based on Amicure IC-221 curing agent offer fast property development. At 25 and 5 °C cure conditions, the return to service is demonstrated through the ability of the system to build hardness development. Figures 1 and 2 show the rapid early hardness build of Amicure IC-221 curing agent based systems, even at the low temperature condition. The fast return to service combined with the high performance attributes provide competitive advantages to formulator's product line.

FIGURE 1: SHORE D HARDNESS (3 MM CLEAR CASTING)

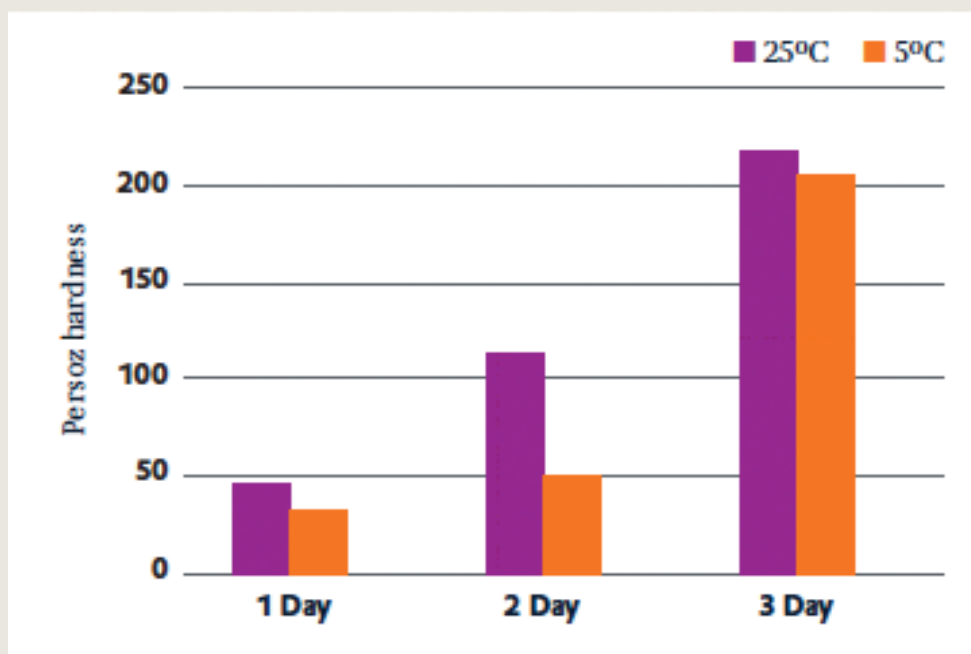
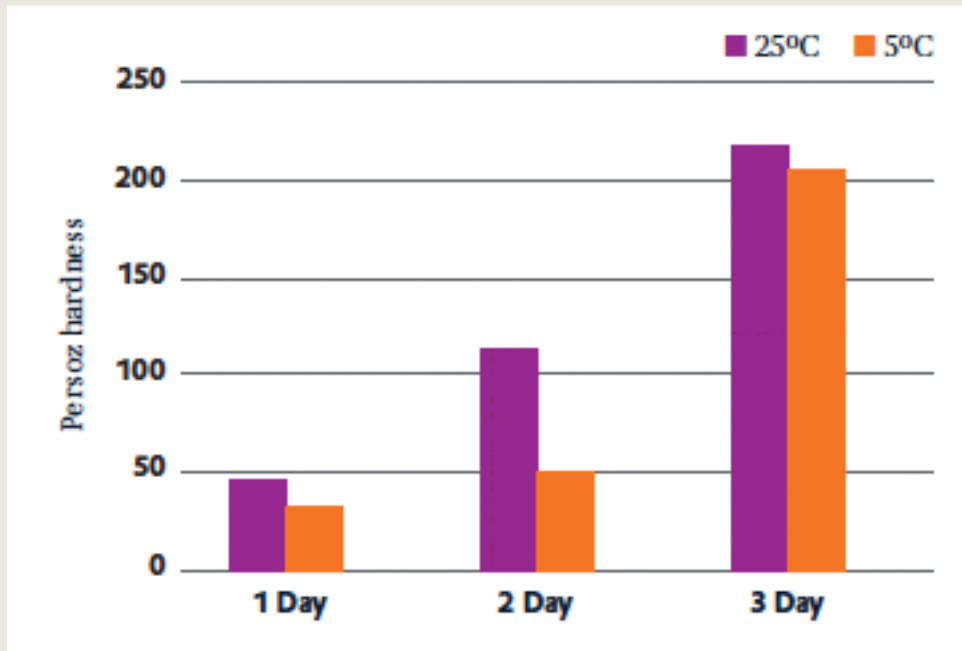


FIGURE 2: PERSOZ HARDNESS (150 µm COATING)



BALANCE OF WORKING POT-LIFE AND CURE SPEED: Amicure IC-321 curing agent can be used to extend potlife and open time of coatings based on Amicure IC-221 curing agent. Open time (or ‘wet edge’) is defined as the time duration after mixing components that the applied coating exhibits good flow and leveling without leaving visible application marks after cure. Amicure IC-321 curing agent based coatings demonstrate long working pot-life and an open time of ca. 18-20 minutes. Figure 3 and 4 show the impact of coating formulations with Amicure IC-221.

The walk on time is determined by the dry to handle time (ASTM D 1640). Amicure IC-321 curing agent based coatings offer fast cure speed and a walk on time of ca. 6 h. Blends with Amicure IC-221 curative results in a further acceleration of walk on time as shown in figure 5.

FIGURE 3: VISCOSITY TIME PROFILE OF AMICURE IC-221 AND IC-321 CURING AGENT

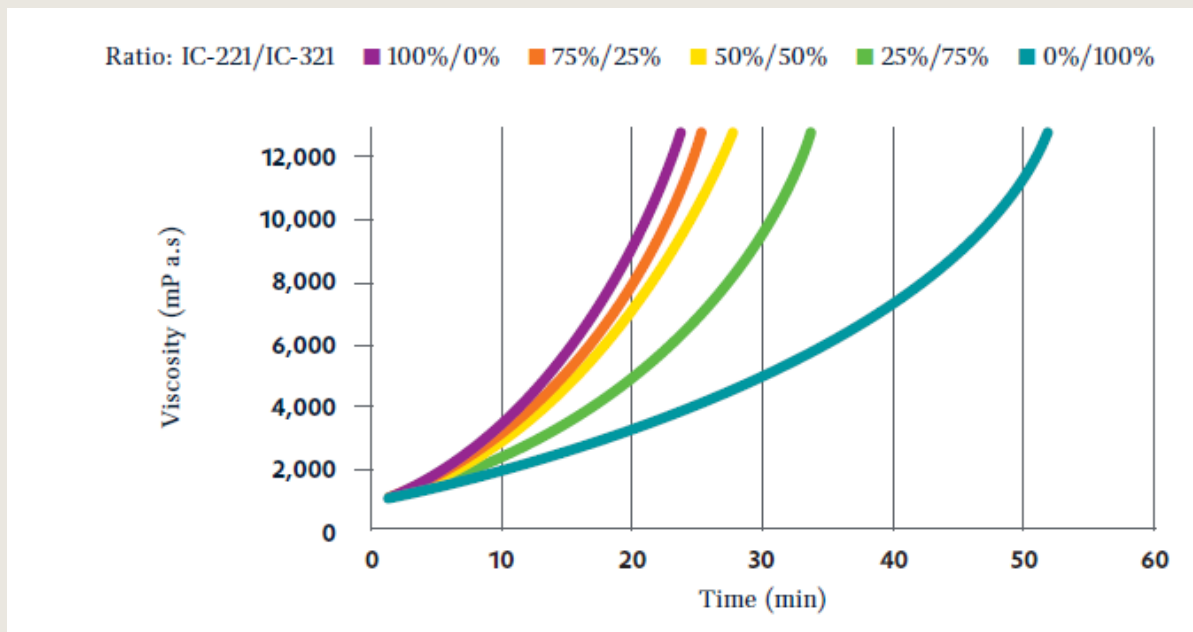


FIGURE 4: OPEN TIME OF AMICURE IC-221 AND IC-321 CURING AGENT

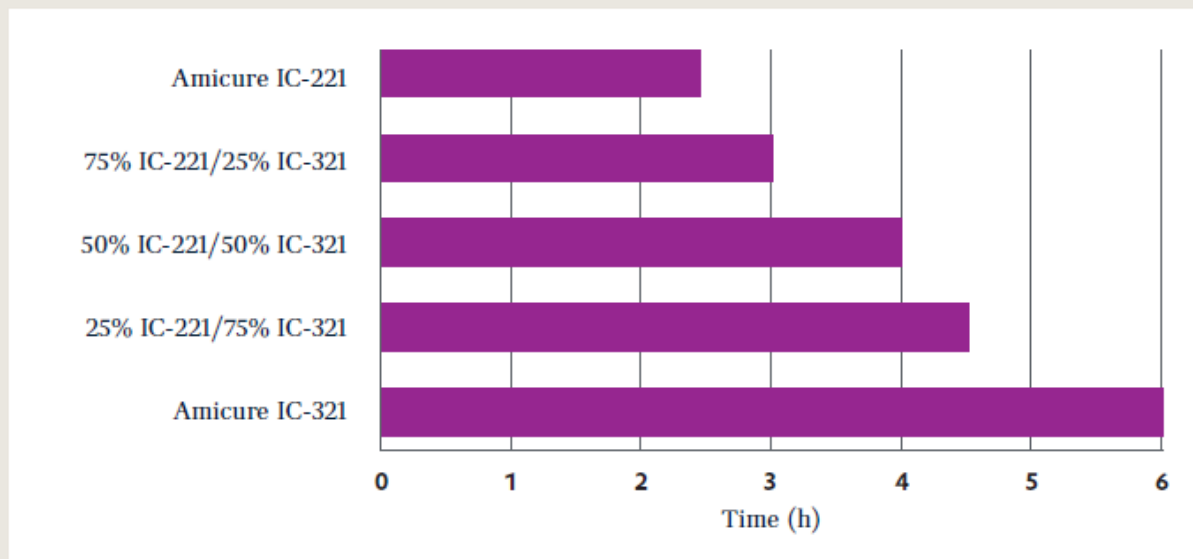
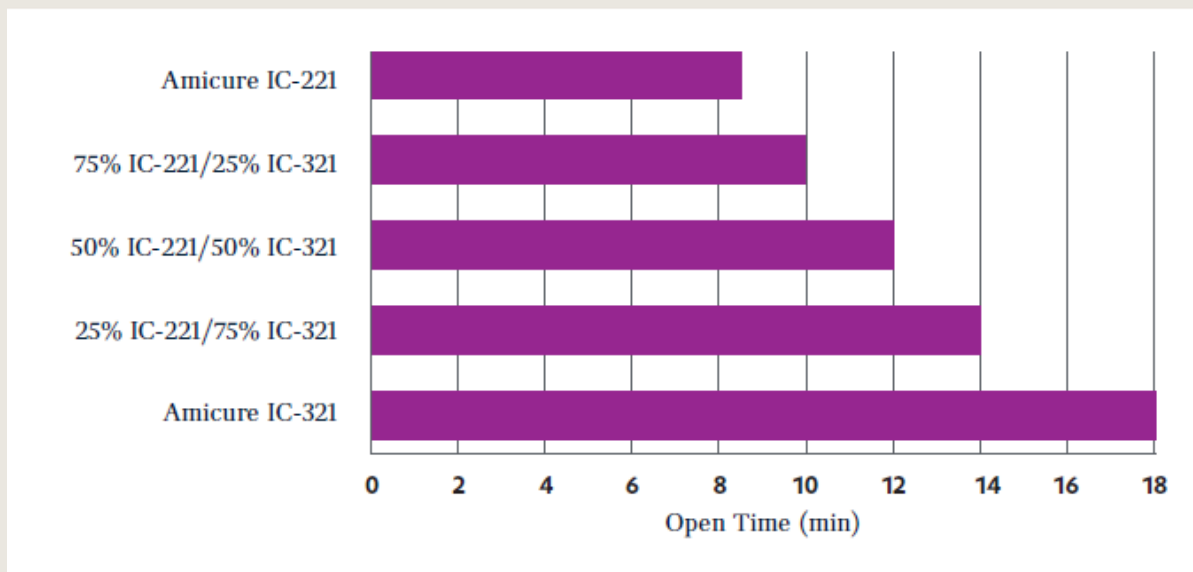


FIGURE 5: WALK ON TIME OF AMICURE IC-221 AND IC-321 CURING AGENT



CHEMICAL AND SOLVENT RESISTANCE: Amicure IC-321 was evaluated for chemical resistance using spot test method (ASTM D 1308). The test consisted of soaking a white felt paper and placing it directly on the panel and covering with a watch glass. Following 24 hours and 7 days exposure, reagents are removed and the surface area dried with a cloth. Clear coatings of 10 mils dry film thickness were applied on standardized steel panel or cementitious fiberboard and cured for 7 days at 23°C and 50% Relative Humidity. Coating were evaluated on alterations in the surface, such as discoloration, change in gloss, blistering or loss of adhesion. The results are shows in tables 6 and 7.

Amicure IC-321 curing agent based coatings offer good resistance to a wide range of household chemicals such as coffee, cola, ammonia and bleach solution. Coatings also demonstrated good resistance to water and organic acids, such as sulfuric and hydrochloric acid. Amicure IC-321 curing agent based coatings offer limited resistance to xylene and methyl ethyl ketone and are not recommended for areas with prolonged exposure to these solvents.

TABLE 6: RESULTS HOUSEHOLD CHEMICALS (ASTM D 1308, SPOT TEST METHOD)

CHEMICAL	24 Hours	7 Days
Coffee	No Change	No Change
Cola	No Change	No Change
Grape Juice	No Change	No Change
Ketchup	No Change	No Change
Mustard	Transient Yellowing	Transient Yellowing
Citrus Cleaning Solvent	No Change	Slight Blisters
Bleach Solution (5-10%)	No Change	No Change
Ammonia (28%)	No Change	No Change
Motor Oil	No Change	No Change
Unleaded Regular Gasoline	No Change	No Change
Brake Fluid	No Change	Slight Blisters

TABLE 7: RESULTS INDUSTRIAL CHEMICALS AND SOLVENTS (ASTM D 1308, SPOT TEST METHOD)

CHEMICAL	24 Hours	7 Days
Tap Water	No Change	No Change
10% Acetic Acid Solution	No Change	Blisters
85% Lactic Acid Solution	No Change	Down Gloss
100% Ethanol	No Change	No Change
50% Sulfuric Acid Solution	No Change	No Change
38% Hydrochloric Acid Solution	No Change	No Change
50% Sodium Hydroxide Solution	Transient Yellowing	Transient Yellowing
Methyl Ethyl Ketone (MEK)	Delamination	Delamination
Xylene	Delamination	Delamination
Mineral Spirits	No Change	No Change
Skydrol® PE-5	No Change	No Change
ChangeSodium Chloride Solution (10%)	No Change	No Change

FORMULATION GUIDELINES: The following recommendations are offered to streamline further technical work with polycarbamide resin technology. Note that working and drying times of coatings and floorings based on Amicure IC-321 are accelerated under conditions of high humidity.

TABLE 8: FORMULATION GUIDELINES AND TROUBLE SHOOTING

STOICHIOMETRY	
Ensure the appropriate stoichiometry of Tolonate polyisocyanate is used with Amicure IC curing agents.	
Recommended is to start with a stoichiometry of 1.05:1 (isocyanate to amine) and adjust based on application trials.	
$EWNCO = 4200/(\%NCO)$	
$SEW = (pbwA+pbwB)/(pbwA.EWA+pbwB.EWB)$	
Parts Amine (per 100 NCO) = $(100/1.05)*(EWAmine/EWNCO)$	
Parts by weight (pbw); % isocyanate (NCOi); equivalent weight per active hydrogen (EW/{H}) or per isocyanate (EWNCO)	
COATING HAZINESS RELATED BINDER COMPONENTS	
Use the recommended standard HDI trimer polyisocyanate resin (eg Vestanat HT 2500/100)	
Alternatively, lower viscosity HDI trimers may be used (eg Vestanat HT2500 LV) as well as solvent-based HDI trimers (eg Vestanat HT2500E)	
Addition of other components such as polyols, diluents, modifiers and/or other amines could cause incompatibility or effect working timeTHE	
THE FOLLOWING ADDITIVES FOR WETTING, LEVELING AND DEFOAMING ARE COMPATIBLE	
Tego® Airex 931 and 940 (Evonik Industries)	Disperbyk® 2155 (Byk Chemie)
Tego® Wet 250 and 260 (Evonik Industries)	Sylosiv® A4 (Grace Davison)
USE OF SOLVENTS	
Solvent are optional and can be added to Amicure IC-221 curing agent based formulations to reduce viscosity and increase pot-life. Recommended solvents include hydrocarbon and ester-based materials such as: t-butyl acetate; para-chlorobenzotrifluoride; dimethyl carbonate; hydrocarbon solvent (Aromatic 100); or xylene.	
When using solvent(s), care should be taken to review solvent entrapment during cure. Minimize solvent entrainment by applying thin film coating (<250 μm)	

TRADEMARK REFERENCE

Evonik Industries GmbH	Amicure® Curing Agent Vestanat®; Tego®
E. I. du Pont de Nemours	Ti-pure®



TECHNICAL DATA (CLEAR TOPCOAT)

Mixed Viscosity	1,000 – 1,500 mPa.s
Walk On Time	6-8 h
Working Time	20-40 min
Gloss (20°)	80-85 GU

STARTING POINT FORMULATIONS:

CLEAR TOPCOAT FOR INDUSTRIAL FLOORING STARTING POINT

PART A	Parts by Weight
(1) HDI Trimer Isocyanate (22 wt% NCO)	100
PART B	
(2) Amicure IC-321 curing agent	187
(3) Borch Gol 0011 air release agent *	2
TOTAL PARTS	289

*The use of an air release agent should be tested for recoatability and film clarity especially in thicker films

MANUFACTURING PROCEDURE PART B

Charge components 2 and 3 and stir homogeneous at low shear.

APPLICATION INSTRUCTIONS

Mix Part A and B under slow speed for 2-3 minutes taking care not to introduce excessive air and moisture. Once thoroughly mixed, pour onto substrate and spread by squeegee or trowel and back roll for proper leveling as required, taking care not to excessively roll.

WHITE PIGMENTED COATING FOR INDUSTRIAL FLOORING — STARTING POINT FORMULATION

PART A	Parts by Weight
(1) HDI Trimer Isocyanate (22 wt% NCO)	100
PART B	
(2) Amicure IC-221 curing agent	185
(3) Tego Airex 940 air release agent	4.3
(4) TiPure R960 (titanium dioxide pigment)	92
(5) Barium Sulfate, $d_{50} = 3 \mu\text{m}$	46
TOTAL PARTS	427.3

MANUFACTURING PROCEDURE PART B

Charge components 2-3 and stir homogeneous at low shear. Slowly add components 4-5 while increasing the speed to 10-20 m/s. Grind with high speed for 15 minutes.

APPLICATION INSTRUCTIONS

Mix Part A and B under slow speed for 2-3 minutes taking care not to introduce excessive air and moisture. Once thoroughly mixed, pour onto substrate and spread by squeegee or trowel and back roll for proper leveling as required, taking care not to excessively roll.

TECHNICAL DATA

Mixed Viscosity	1500 – 2000 mPa.s
Walk On Time	6-8 h
Working Time	20-40 min
Gloss (20°)	80-85 GU

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