EVONIK INDUSTRIES

TEGO Co-Binders – The Perfect Fit for Paints, Coatings and Printing Inks

tego

Evonik. Power to create.

Masthead

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The TEGO range of co-binders includes the TEGO® VariPlus and TEGO® AddBond product groups. Both are based on different technologies which help to deliver tailor-made solutions for diverse problems and fields of application.

TEGO® VariPlus products are based on modified ketone-aldehyde resins which are unsaponifiable, neutral and hard. Their use in coatings and in printing inks results in significantly improved hardness, gloss, blocking resistance and touch-drying time. The low solution viscosities of these resins also enable the solids content to be increased, thus reducing levels of VOC.

With their customized functional groups, TEGO® VariPlus resins are ideal for high color intensity pigment concentrates. Furthermore, adhesion is also improved with selected products in this line, complementing the TEGO® AddBond range in certain applications.

TEGO® AddBond products are customized polyester resins designed for improving adhesion which exhibit excellent compatibility with a multitude of systems. These resins optimize adhesion on a wide range of very different substrates and can be used in solventborne, waterborne or radiation-curing coatings and printing inks.

The outstanding effectiveness of selected TEGO® VariPlus and TEGO® AddBond products in typical formulations is described in the following pages.

This know-how, combined with our expertise in surface chemistry, make Evonik a strong partner in meeting the challenges faced by coatings and printing ink formulators.

TEGO – Adding Advantages.

Printing Inks

TEGO® VariPlus SK vs. maleic resin in a nitrocellulose, blue surface ink on treated PET

Binder
Nitrocellulose

Substrate
Treated polyester foil

Advantages of using **TEGO® VariPlus SK** compared to a maleic resin:

- higher color strength (F = 150 with maleic resin, F = 170 with **TEGO® VariPlus SK**)
- better pigment wetting
- higher transparency
- better compatibility
- better adhesion
- improved water resistance

With maleic resin

With **TEGO® VariPlus SK**

Guiding formulation

Formulation (p. b. wt.)

	Maleic resin	TEGO® VariPlus SK
HAGEDORN colorless Chips AH 27 – 20% ATBC (nitrocellulose as binder, plasticizer)	11.05	11.05
MIFAST DISPERCEL™ blue nitrocellulose 6030/70 (nitrocellulose as binder, plasticizer, blue pigment)	7.35	7.35
ERKAMAR® 3260 (maleic resin, grinding vehicle)	7.70	–
TEGO® VariPlus SK (grinding vehicle)	–	7.70
HEXAMOLL® DINCH® (plasticizer)	3.30	3.30
Methoxy propanol (propylene glycol methyl ether, solvent)	7.20	7.20
Ethanol (dry) (solvent)	50.00	50.00
Ethyl acetate (solvent)	11.30	11.30
Butyl acetate (solvent)	2.10	2.10
Total	100.00	100.00

Product Properties

Solids content:	29.8%
Pigment content:	4.8%
Plasticizer content:	5.7%
Nitrocellulose content:	11.3%

All other ingredients are put in the solvent mixture and dissolved in a dissolver. Viscosity (Zahn cup 4, 23°C): 24 s

Application

37 µm wet application with a coating rod on a treated polyester foil

Properties	Maleic resin	TEGO® VariPlus SK
Gardner color	max. 10	≤ 1
Acid number (mg KOH/g)	180 – 210	< 1

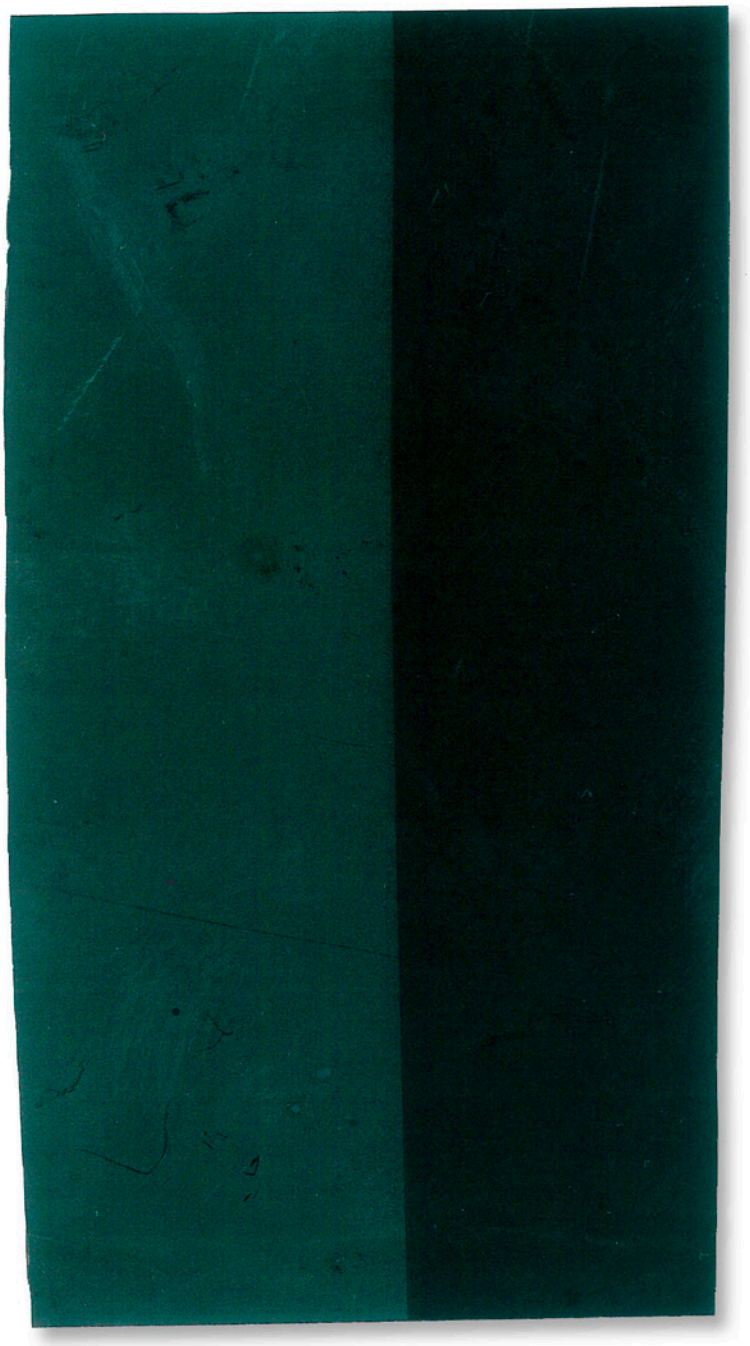
TEGO® VariPlus SK in a nitrocellulose, black surface ink on art paper

Binder
Nitrocellulose

Substrate
Art paper

Advantages of using **TEGO® VariPlus SK:**
- higher jetness
- better pigment wetting
- higher gloss

Control | With **TEGO® VariPlus SK**



Guiding formulation

Formulation (p. b. wt.)

Nitrocellulose SS ¼'' varnish	
Nitrocellulose SS ¼'' (binder)	36.0
Ethanol (solvent)	40.0
n-Propyl acetate (solvent)	20.0
HEXAMOLL® DINCH® (plasticizer)	4.0
Total	100.0

Mill base

Ingredients	Without TEGO® VariPlus SK	With TEGO® VariPlus SK
Nitrocellulose SS ¼'' varnish	25.0	25.0
SPECIAL BLACK® 4 (pigment)	10.0	10.0
HEXAMOLL® DINCH® (plasticizer)	3.0	3.0
TEGO® Dispers 710 (wetting agent)	4.0	4.0
Ethanol (solvent)	5.0	5.0
Ethyl acetate (solvent)	5.0	5.0

Letdown

Nitrocellulose SS ¼'' varnish	12.0	4.0
TEGO® VariPlus SK varnish (50% in EA) (grinding vehicle)	–	10.0
Ethyl acetate (solvent)	8.0	8.0
Ethanol (solvent)	18.0	16.0
Methoxy propanol (solvent)	8.0	8.0
VESTOWAX® H 2050 SF (wax)	2.0	2.0
Total	100.00	100.00
Remarks	2 h paint shaker	2 h paint shaker
Fineness of dispersion	20 µm	20 µm
Viscosity (Zahn cup 4, 23°C)	16 s	13 s

The formulations were diluted with 35% (formulation without TEGO® VariPlus SK) or 30% (formulation with TEGO® VariPlus SK) of ethanol/ethyl acetate (8:2) to get the printing viscosity of 24 s (Zahn cup 2, 23°C).

Application

With a coating rod RDS Rod 5 on an art paper

Conclusion

TEGO® VariPlus SK has the following advantages:

	Without TEGO® VariPlus SK	With TEGO® VariPlus SK
Jetness	3	0
Gloss	1	0

5 poor ⟶ 0 excellent

TEGO® VariPlus SK in a nitrocellulose/polyurethane, red surface ink on treated OPP

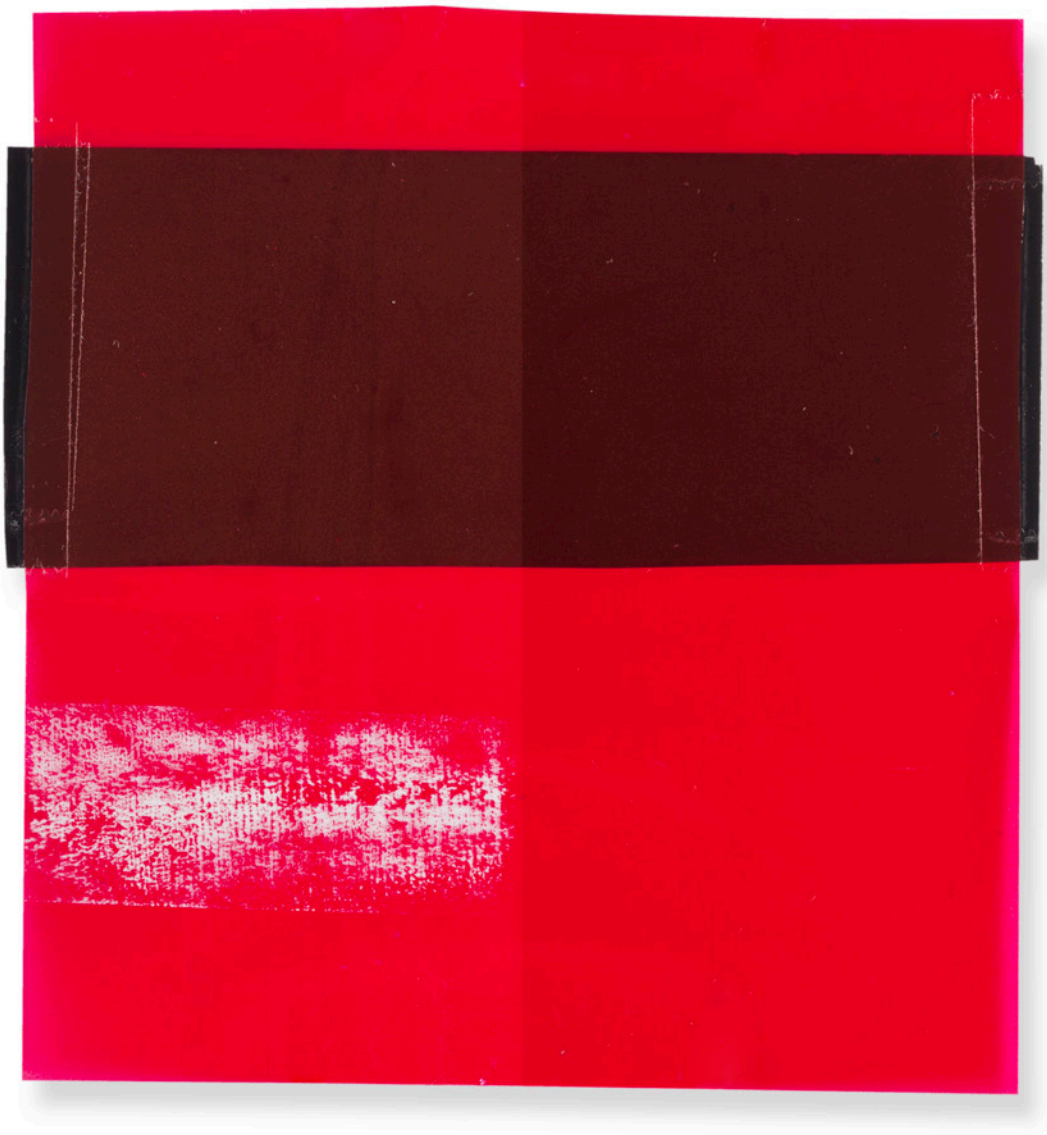
Binder
Nitrocellulose/polyurethane

Substrate
Treated, oriented polypropylene

Advantages of using **TEGO® VariPlus SK:**
- higher color strength
- better color shade (more bluish)
- higher transparency
- no bronzing effect
  (pigment is perfectly surrounded by TEGO® VariPlus SK; if there isn't a perfect wetting, the dry pigment particles which are pushed up through the surface cause a diffused reflection called bronzing)
- better adhesion

Control

With **TEGO® VariPlus SK**



Guiding formulation

Formulation (p. b. wt.)

Nitrocellulose SS ¼'' varnish		Nitrocellulose base	
Nitrocellulose SS ¼'' (binder)	36.0	Nitrocellulose SS ¼'' varnish	28.0
Ethanol (solvent)	40.0	HEXAMOLL® DINCH® (plasticizer)	4.0
n-Propyl acetate (solvent)	24.0	Ethanol (solvent)	20.0
Total	100.0	Ethyl acetate (solvent)	5.0
		IRGALITE® Rubine D 4242 (red pigment)	20.0
		Ethanol (solvent)	23.0
		Total	100.0
		Remarks	2 h paint shaker
		Fineness of dispersion	20 µm
		Viscosity (Zahn cup 4, 23°C)	18 s

Ingredients	PE wax compound	Nitrocellulose/polyurethane varnish
Nitrocellulose SS ¼'' varnish	30.0	32.0
VESTOWAX® H 2050 SF (wax)	30.0	–
HEXAMOLL® DINCH® (plasticizer)	–	3.7
NEOREZ® U-335 (polyurethane binder)	–	21.0
Ethyl acetate (solvent)	–	19.6
Methoxy propanol (solvent)	–	3.0
Ethanol (solvent)	40.0	20.7
Total	100.0	100.0
Remarks	Dissolver for 5 min at 3000 rpm	Lab stirrer
Fineness of dispersion	20 µm	20 µm
Viscosity (Zahn cup 4, 23°C)	14 s	14 s

Ingredients	Nitrocellulose/polyurethane	Nitrocellulose/polyurethane with 5% TEGO® VariPlus SK (solid)
Nitrocellulose base (first part)	50.0	50.0
PE wax compound	5.0	5.0
Nitrocellulose/polyurethane varnish	43.0	33.0
VERTEC™ PI 2 (adhesion promoter)	2.0	2.0
TEGO® VariPlus SK varnish (50% in EA)	–	10.0
Total	100.0	100.0
Remarks	5 min lab stirrer	5 min lab stirrer
Viscosity (Zahn cup 4, 23°C)	24 s	21 s

Guiding formulation

Application
With coating bar RDS Rod 6 on a treated, oriented polypropylene foil

Conclusion
Such a printing ink is used for packaging on plastic foils.

Polyurethane resin in letdown improves adhesion and resistance towards chemicals and heat. However, the color development (gloss) drops due to poor wetting properties. **TEGO® VariPlus SK** helps to overcome this drawback (better wetting → higher gloss, higher color strength).

This Nitrocellulose/polyurethane printing ink formulation can also be used for reverse printing.

TEGO® VariPlus SK in a nitrocellulose/polyurethane, white surface ink on treated OPP

Binder
Nitrocellulose/polyurethane

Substrate
Treated, oriented polypropylene

Advantages of using **TEGO® VariPlus SK:**
- better color development (more brilliant color)
- higher gloss
- better adhesion
- better scratch resistance

Control | With VERTEC™ PI 2 | With **TEGO® VariPlus SK**

Guiding formulation

Formulation (p. b. wt.)

Nitrocellulose A 400 varnish		Nitrocellulose base*	
Nitrocellulose A 400 (binder)	36.0	Nitrocellulose A 400 varnish	28.0
Ethanol (solvent)	40.0	HEXAMOLL® DINCH® (plasticizer)	2.0
Ethyl acetate (solvent)	24.0	Ethanol (solvent)	23.0
Total	100.0	Ethyl acetate (solvent)	7.0
		KRONOS® 2310 (pigment)	40.0
		Total	100.0

* 30 min DISPERMAT®, 3000 rpm, 23°C, 2 mm glass beads, inks/beads 1:1 (by volume)

Ingredients	PE wax compound	Nitrocellulose/polyurethane varnish
Nitrocellulose A 400 varnish	30.0	32.0
VESTOWAX® H 2050 SF (wax)	30.0	–
HEXAMOLL® DINCH® (plasticizer)	–	3.7
NEOREZ® U-335 (polyurethane binder)	–	21.0
Ethyl acetate (solvent)	–	19.6
Methoxy propanol (solvent)	–	3.0
Ethanol (solvent)	40.0	20.7
Total	100.0	100.0
Remarks	Dissolver for 5 min at 3000 rpm	Lab stirrer
Ethanol (viscosity adjustment)	64.5	10.0
Viscosity (Zahn cup 4, 23°C)	15 s	15 s

Ingredients	Nitrocellulose/polyurethane	Nitrocellulose/polyurethane with 2% VERTEC™ PI 2	Nitrocellulose/polyurethane with 5% TEGO® VariPlus SK (solid)
Nitrocellulose base (first part)	50.0	50.0	50.0
PE wax compound	5.0	5.0	5.0
Nitrocellulose/polyurethane varnish	43.0	43.0	33.0
VERTEC™ PI 2 (adhesion promoter)	–	2.0	–
TEGO® VariPlus SK varnish (50% in EA)	–	–	10.0
Total	98.0	100.0	98.0
Remarks	Lab stirrer	Lab stirrer	Lab stirrer

Application
A coating rod RDS Rod 6 on a treated, oriented poly propylene foil

TEGO® VariPlus SK in a nitrocellulose, red surface ink on treated LDPE

Binder
Nitrocellulose

Substrate
Treated low density polyethylene (LDPE)

Test
Flexibility after treatment of the ink in cooking oil

Advantages of using **TEGO® VariPlus SK:**
- improvement of oil resistance
- better adhesion

Control

With **TEGO® VariPlus SK**

Guiding formulation

Formulation (p. b. wt.)

Nitrocellulose SS ¼'' varnish		Nitrocellulose base	
Nitrocellulose SS ¼'' (binder)	36.0	Nitrocellulose SS ¼'' varnish	28.0
Ethanol (solvent)	40.0	HEXAMOLL® DINCH® (plasticizer)	2.0
n-Propyl acetate (solvent)	24.0	Ethanol (solvent)	20.0
Total	100.0	Ethyl acetate (solvent)	7.0
		IRGALITE® Rubine D 4242 (red pigment)	20.0
		Ethanol (solvent)	23.0
		Total	100.0
		Remarks	2 h paint shaker
		Fineness of dispersion	20 µm
		Viscosity (Zahn cup 4, 23°C)	18 s

Ingredients	PE wax compound	Mixed nitrocellulose varnish
Nitrocellulose SS ¼'' varnish	30.0	39.0
VESTOWAX® H 2050 SF (wax)	30.0	–
HEXAMOLL® DINCH® (plasticizer)	–	2.5
Ethyl acetate (solvent)	–	16.0
Methoxy propanol (solvent)	–	2.5
Ethanol (solvent)	40.0	40.0
Total	100.0	100.0
Remarks	Dissolver for 5 min at 3000 rpm	Lab stirrer
Fineness of dispersion	20 µm	20 µm
Viscosity (Zahn cup 4, 23°C)	14 s	10 s

Ingredients	Nitrocellulose	Nitrocellulose with 5% TEGO® VariPlus SK (solid)
Nitrocellulose base (first part)	50.0	50.0
Mixed nitrocellulose varnish	43.0	33.0
PE wax compound	5.0	5.0
VERTEC™ PI 2 (adhesion promoter)	2.0	2.0
TEGO® VariPlus SK varnish (50% in EA)	–	10.0
Total	100.0	100.0
Remarks	5 min lab stirrer	5 min lab stirrer
Viscosity (Zahn cup 4, 23°C)	25 s	21 s

Guiding formulation

Application
With a coating rod RDS Rod 5 on a treated low density polyethylene foil

Conclusion
The same result is achieved by using **TEGO® VariPlus SK** in nitrocellulose/polyamide printing inks on plastic foils used for rice, chicken or meat packaging.

TEGO® VariPlus CA and TEGO® VariPlus SK in a nitrocellulose/ polyurethane, red surface ink on treated OPP

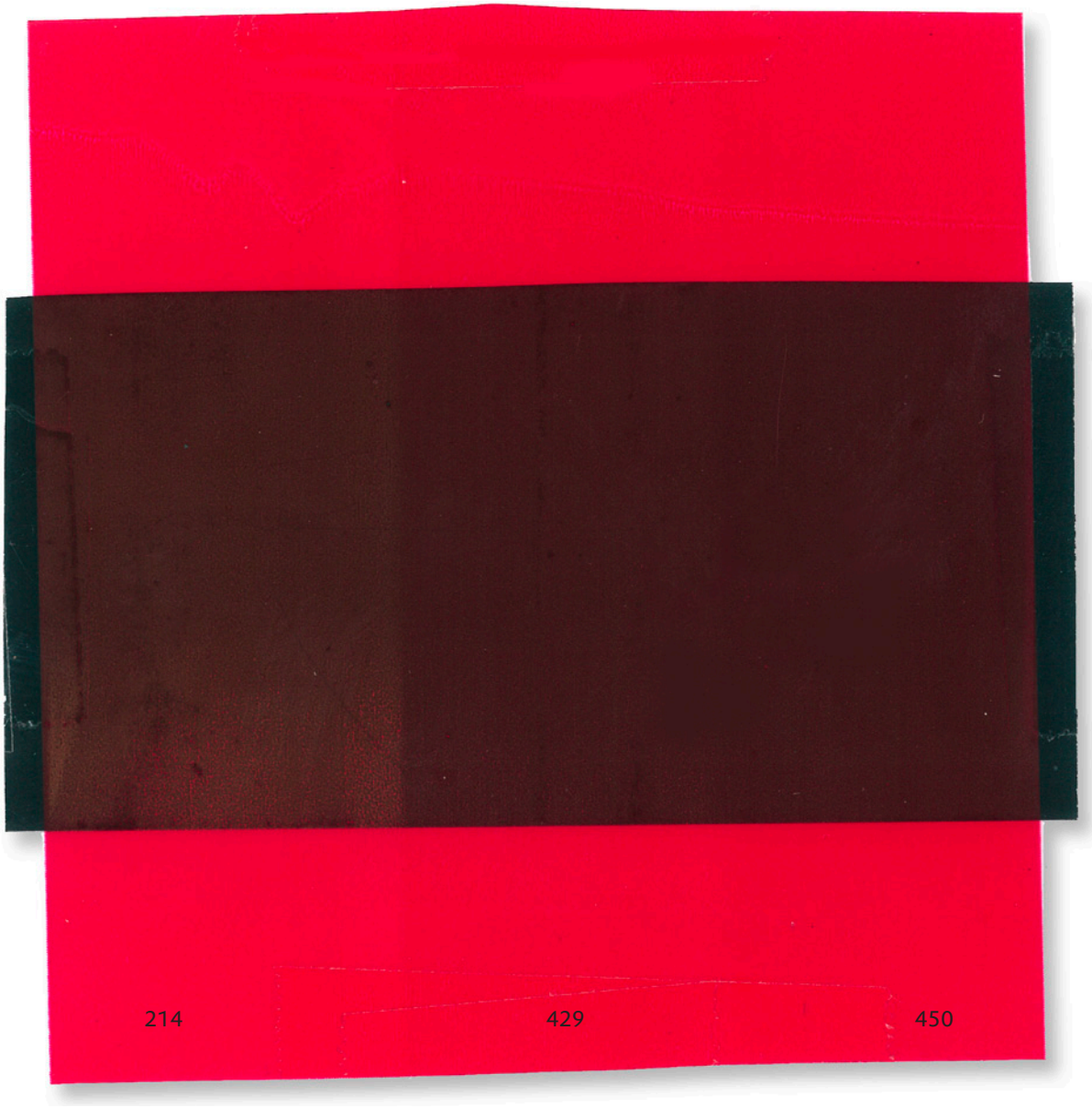
Binder
Nitrocellulose/polyurethane

Substrate
Treated, oriented polypropylene

Advantages of using
TEGO® VariPlus CA and **TEGO® VariPlus SK:**
- better color development (strength and shade)
- higher gloss
- better adhesion
- better scratch resistance

Performance order
TEGO® VariPlus SK > **TEGO® VariPlus CA**

Control | With **TEGO® VariPlus CA** | With **TEGO® VariPlus SK**



214 | 429 | 450 Color strength [F]

Guiding formulation

Formulation (p. b. wt.)

Nitrocellulose SS ¼'' varnish		Nitrocellulose base	
Nitrocellulose SS ¼'' (binder)	36.0	Nitrocellulose SS ¼'' varnish	28.0
Ethanol (solvent)	40.0	HEXAMOLL® DINCH® (plasticizer)	2.0
n-Propyl acetate (solvent)	24.0	Ethanol (solvent)	20.0
Total	100.0	Ethyl acetate (solvent)	7.0
		IRGALITE® Rubine D 4242 (red pigment)	20.0
		Ethanol (solvent)	23.0
		Total	100.0
		Remarks	2 h paint shaker
		Fineness of dispersion	20 µm
		Viscosity (Zahn cup 4, 23°C)	18 s

Ingredients	PE wax compound	Nitrocellulose/polyurethane varnish
Nitrocellulose SS ¼'' varnish	30.0	32.0
VESTOWAX® H 2050 SF (wax)	30.0	–
HEXAMOLL® DINCH® (plasticizer)	–	3.7
NEOREZ® U-335 (polyurethane binder)	–	21.0
Ethyl acetate (solvent)	–	19.6
Methoxy propanol (solvent)	–	3.0
Ethanol (solvent)	40.0	20.7
Total	100.0	100.0
Remarks	Dissolver for 5 min at 3000 rpm	Lab stirrer
Fineness of dispersion	20 µm	20 µm
Viscosity (Zahn cup 4, 23°C)	14 s	14 s

Ingredients	Nitrocellulose/polyurethane	Nitrocellulose/polyurethane + 5% TEGO® VariPlus CA (solid)	Nitrocellulose/polyurethane + 5% TEGO® VariPlus SK (solid)
Nitrocellulose base (first part)	50.0	50.0	50.0
PE wax compound	5.0	5.0	5.0
Nitrocellulose/polyurethane varnish	43.0	33.0	33.0
VERTEC™ PI 2 (adhesion promoter)	2.0	2.0	2.0
TEGO® VariPlus CA varnish (50% in EA)	–	10.0	–
TEGO® VariPlus SK varnish (50% in EA)	–	–	10.0
Total	100.0	100.0	100.0
Remarks	5 min lab stirrer	5 min lab stirrer	5 min lab stirrer
Viscosity (Zahn cup 4, 23°C)	24 s	21 s	21 s

TEGO® VariPlus 3350 UV in an epoxy resin based UV-OPV on a red, nitrocellulose/ polyurethane ink

Binder
Epoxy resin

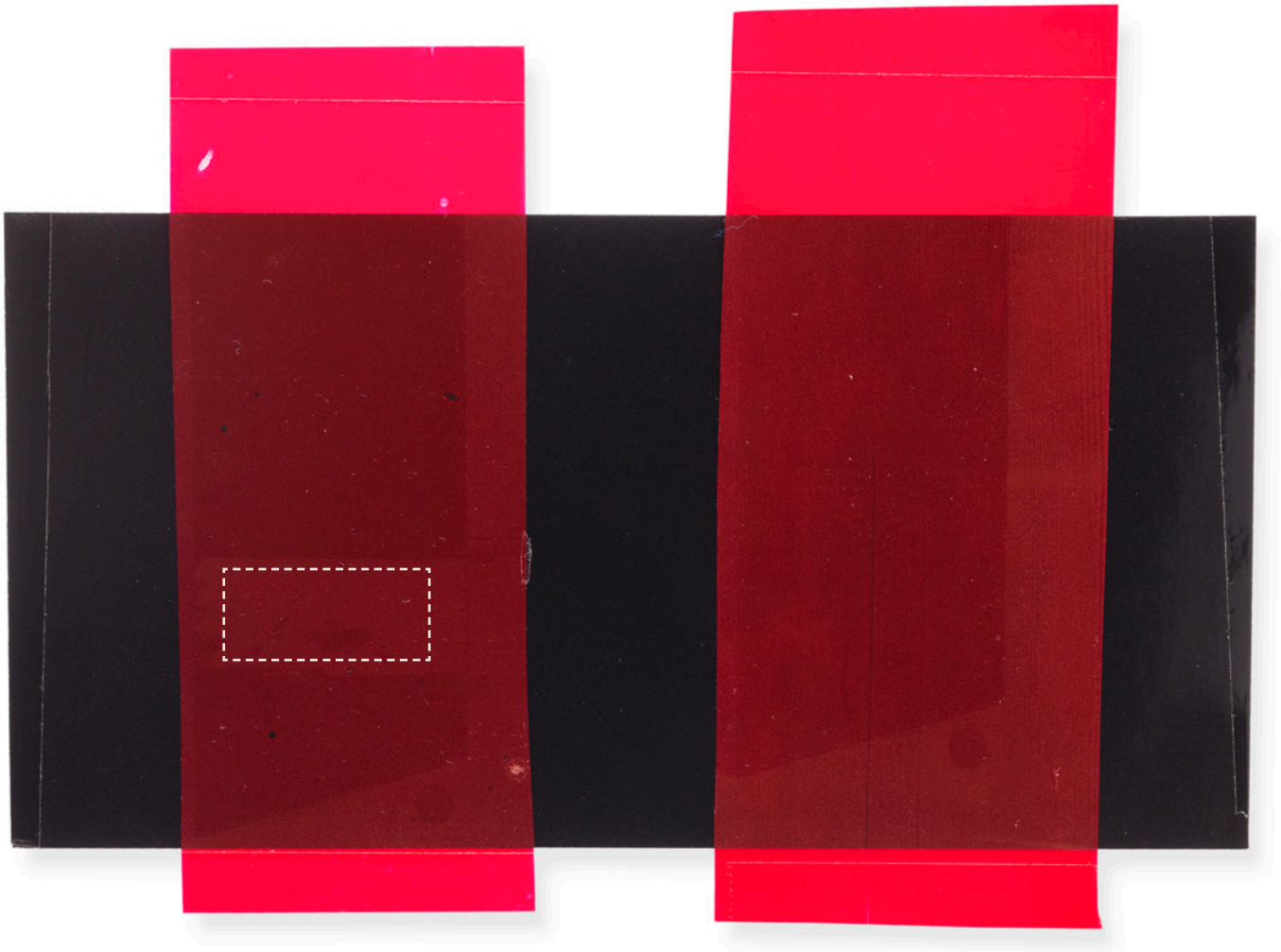
Substrate
Red nitrocellulose/polyurethane printing ink applied on treated polyester

Test
Tape peel adhesion

Advantages of using **TEGO® VariPlus 3350 UV:**
- improvement of adhesion
- acceleration of cure speed

Control

With **TEGO® VariPlus 3350 UV**



Guiding formulation

Formulation (p. b. wt.)

Ingredients	Epoxy	Epoxy + TEGO® VariPlus 3350 UV
EBECRYL® 605 (binder)	38.0	26.5
TEGO® VariPlus 3350 UV (50% in TPGDA) (co-binder)	–	17.2
OTA 480 (reactive diluent)	27.0	27.0
TPGDA (reactive diluent)	20.5	14.8
TEGO® Rad 2300 (surface control agent)	0.5	0.5
Benzophenone (40% in TPGDA) (photoinitiator)	10.0	10.0
EBECRYL® P115 (co-initiator)	4.0	4.0
Total	100.0	100.0
Viscosity (mPa s, cone/plate) at 20°C	190	315

Application
With proof press (Flexiproof 100 UV, 10 m/min.) on a red nitrocellulose/polyurethane printing ink applied on a treated polyester foil (see formulation page 8).

Pigment Concentrates

TEGO® VariPlus TC vs. acrylic resin in a solventborne, black pigment concentrate

Substrate
Non-treated polyester foil

Advantages of using **TEGO® VariPlus TC:**
- better pigment wetting
- higher jetness and gloss
- lower viscosity
- less solvent
- higher concentrate stability

NEOCRYL® B-725

TEGO® VariPlus TC

Guiding formulation

Formulation (p. b. wt., optimized on pigment loading capacity)

	NEOCRYL® B-725	TEGO® VariPlus TC
NEOCRYL® B-725 (thermoplastic acrylic resin, grinding vehicle)	15.8	–
TEGO® VariPlus TC (wetting/dispersing agent, grinding vehicle)	–	26.0
Methoxypropyl acetate (solvent)	39.5	27.3
Butyl acetate (solvent)	7.9	–
Xylene (solvent)	15.8	–
DISPERBYK®-116 (98%) (wetting and dispersing additive)	6.0	–
TEGO® Dispers 672 (40%) (wetting and dispersing additive)	–	18.7
SPECIAL BLACK® 4 (black pigment)	15.0	28.0
Total	100.0	100.0
Viscosity (23°C, 200 s^{-1})	n.m.[1)]	330

[1)] viscosity wasn't measurable because the concentrate was too thixotropic

Dispersing conditions
All ingredients are put into a DISPERMAT®
60 – 70 minutes
3000 – 4000 rpm
Temperature: 40°C
1 mm glass beads

Application
100 µm wet with a coating rod on a non-treated polyester foil

TEGO® VariPlus TC vs. acrylic resin in a black/white pigment concentrate

Black/white pigment mixture 1 : 10

Substrate
Non-treated polyester foil

Advantages of using **TEGO® VariPlus TC:**
- higher tinting strength
- more bluish black

NEOCRYL® B-725 **TEGO® VariPlus TC**

Guiding formulation

Black/white pigment mixture 1 : 10

Formulation (p. b. wt.)

	Black concentrate 1	White concentrate 1	Black concentrate 2	White concentrate 2
NEOCRYL® B-725 (thermoplastic acrylic resin, grinding vehicle)	15.8	10.8	–	–
TEGO® VariPlus TC (wetting/dispersing agent, grinding vehicle)	–	–	26.0	14.3
Methoxypropyl acetate (solvent)	39.5	22.6	27.3	17.7
Butyl acetate (solvent)	7.9	5.4	–	–
Xylene (solvent)	15.8	10.7	–	–
DISPERBYK®-116 (98%) (wetting and dispersing additive)	6.0	1.5	–	–
TEGO® Dispers 672 (40%) (wetting and dispersing additive)	–	–	18.7	3.0
SPECIAL BLACK® 4 (gas black pigment)	15.0	–	28.0	–
SACHTLEBEN® R-KB-2 (white pigment)	–	49.0	–	65.0
Total	100.0	100.0	100.0	100.0

Dispersing conditions
All ingredients of a formulation are put into a DISPERMAT®

Black concentrate
DISPERMAT®
60 – 70 minutes
3000 – 4000 rpm
Temperature 40°C
1 mm glass beads

White concentrate
DISPERMAT®
20 minutes
2000 – 3000 rpm
Temperature 40°C
2 mm glass beads

Mixture
Mixing the black and the white concentrate (1 with 1 or 2 with 2, pigment ratio black : white = 1 : 10) with a stirrer

Application
100 µm wet with a coating rod on a non-treated polyester foil

TEGO® VariPlus DS 50 in a waterborne, green pigment concentrate

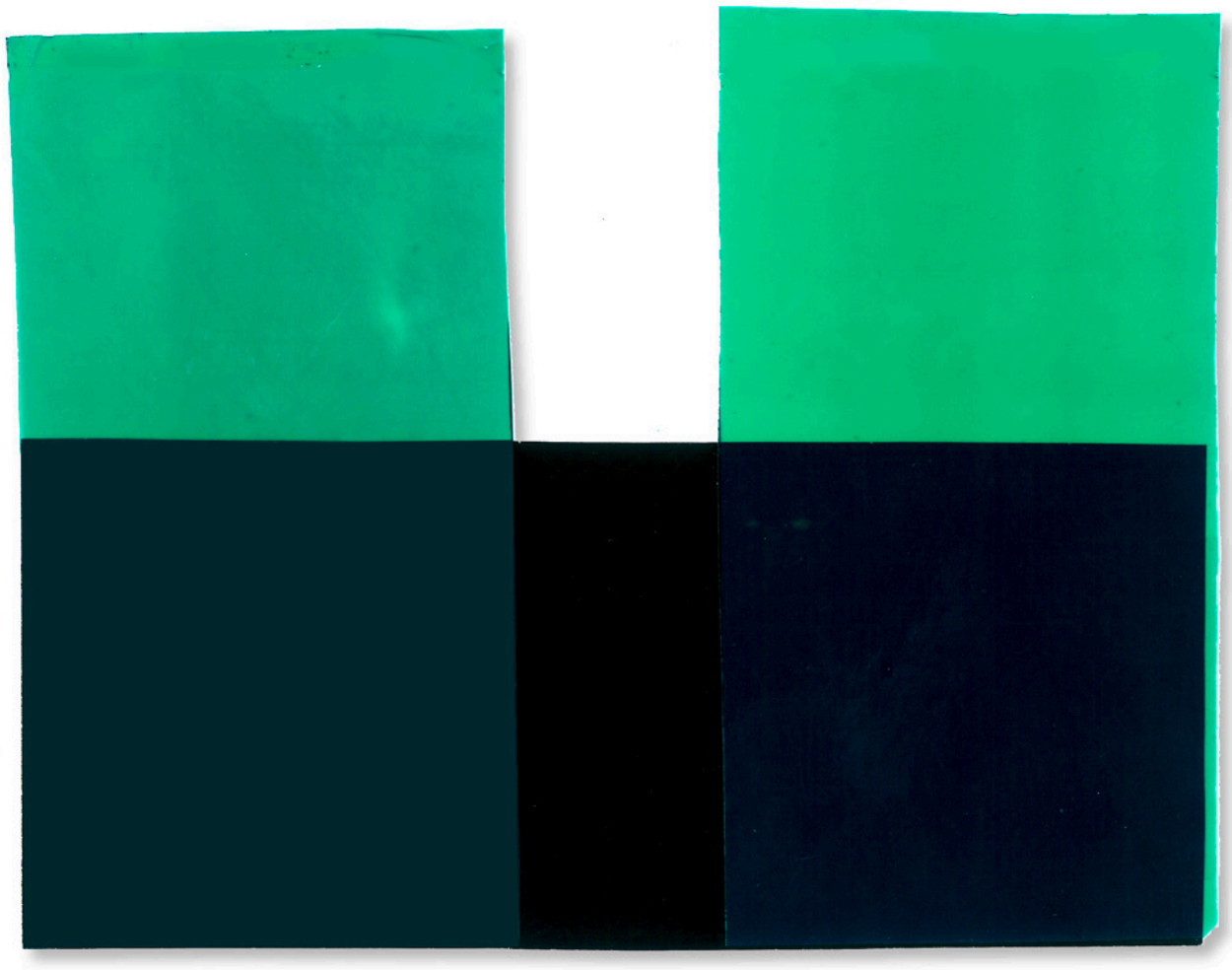
Binder
Polyurethane dispersion

Substrate
Non-pretreated polyester foil

Advantages of using **TEGO® VariPlus DS 50:**
- reduction of higher molecular wetting agents of at least 50%
- higher transparency

Control

With **TEGO® VariPlus DS 50**



Guiding formulation

Partial exchange of TEGO® Dispers 750 W against TEGO® VariPlus DS 50

Formulation (p. b. wt.)

	1	2
TEGO® VariPlus DS 50 (33%) (wetting and dispersing co-binder)	–	10.9
Demineralized water	25.0	25.0
TEGO® Dispers 760 W (35%) (wetting and dispersing additive)	3.6 (10% on pigment)	3.6
TEGO® Dispers 750 W (40%) (wetting and dispersing additive)	18.0 (50% on pigment)	9.0
HELIOGEN® Green L 8730 (phthalocyanine green pigment)	35.0	35.0
AEROSIL® 200 (hydrohilic fumed silica, rheology control and anti-settling agent)	1.0	1.0
Demineralized water	17.4	15.5
Total	100.0	100.0
Remarks	–	Half of TEGO® Dispers 750 W exchanged with TEGO® VariPlus DS

Letdown
ALBERDINGK® U 8001 (polyurethane dispersion) was added while mixing with a magnetic stirrer.

Pigment volume concentration (PVC)
8

Filtration
5 µm textile filter

Application
50 µm wet with a coating rod on a non-pretreated polyester foil

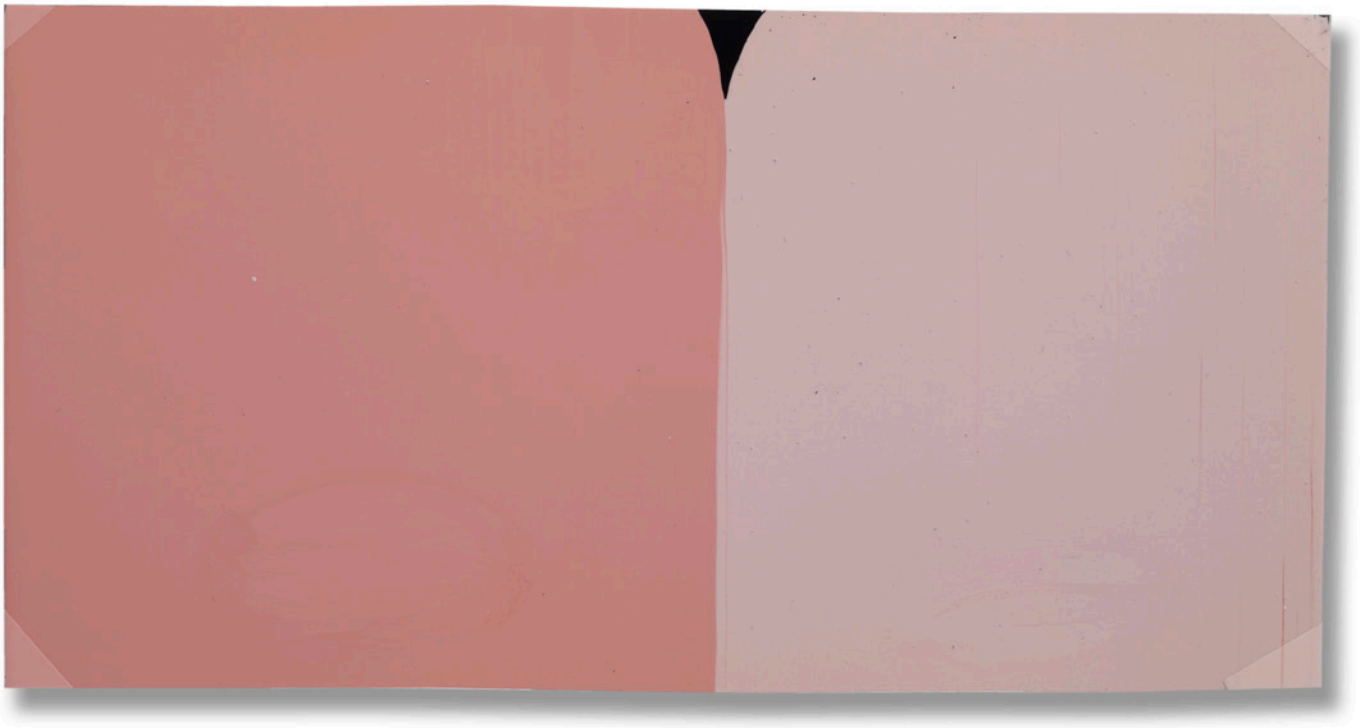
TEGO® VariPlus TC in a solvent-borne, red pigment concentrate to tint aromatic free, white alkyd paints

Substrate
Checked black/white cardboard

Advantages of using **TEGO® VariPlus TC:**
- soluble in aliphatic hydrocarbons
- excellent pigment wetting
- excellent compatibility (low ΔE rub-out)
- high jetness and gloss
- low concentrate viscosity

TEGO® VariPlus TC/
TEGO® Dispers 655

LAROPAL® A 81/
DISPERBYK®-163



Compared to LAROPAL® A 81, TEGO® VariPlus TC shows better compatibility in alkyd systems free of aromatic hydrocarbons. As LAROPAL® A 81 is not soluble in those, the white base paint lies above the red pigment concentrate.

Guiding formulation

Formulation (p. b. wt.)

	TEGO® VariPlus TC	LAROPAL® A 81
TEGO® VariPlus TC (60% in MPA) (grinding resin)	17.0	–
LAROPAL® A 81 (60% in MPA) (grinding resin)	–	17.0
Methoxy propyl acetate (MPA, solvent)	12.3	5.9
TEGO® Dispers 655 (100%) (wetting and dispersing agent)	5.2	–
DISPERBYK®-163 (45%) (wetting and dispersing agent)	–	11.6
BAYFERROX® 130 M (inorganic red pigment)	65.0	65.0
AEROSIL® 200 (anti-settling agent)	0.5	0.5
Total	100.0	100.0
Viscosity (23°C, 200 s^{-1})	124	566

Dispersing conditions
Pigment and AEROSIL® placed in a mixture of resin, solvent and additive while stirring with a dissolver, then predispersed for 15 min.
Added 2 mm glass beads placed the mixture into a Lau disperser for 1 h.

Tinting
2.5 g pigment concentrate on 100 g of white alkyd resin (free of aromatics, e.g., Impredur 840), shaking for 9 min in Lau disperser.

Application
125 µm wet with a coating rod on a black/white cardboard (checked)

Color properties of the tinted white, aromatic free alkyd paints

Color properties	TEGO® VariPlus TC	LAROPAL® A 81
a*	21.10	11.18
ΔE rub out	0.28	2.25

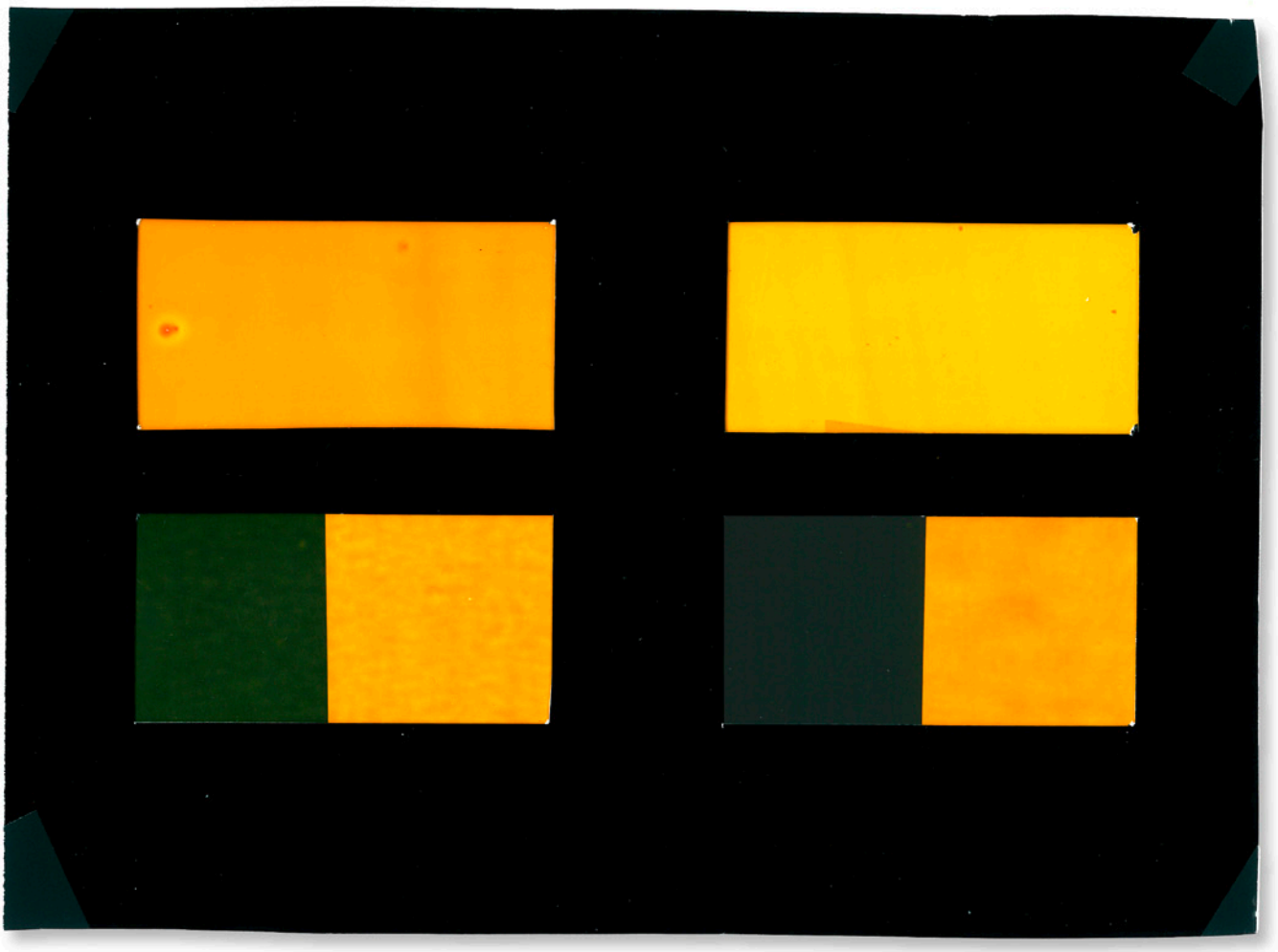
TEGO® VariPlus DS 50 in a waterborne, yellow, transparent pigment concentrate

Substrate
Pretreated polyester foil

Advantages of using **TEGO® VariPlus DS 50:**
- high transparency
- faster drying

DISPERBYK®-102/
DISPERBYK®-2095/
DISPERBYK®-2091

TEGO® VariPlus DS 50/
TEGO® Dispers 752 W



Guiding formulation

Formulation (p. b. wt.)

	BYK additives	TEGO® VariPlus DS 50
TEGO® VariPlus DS 50 (33%) (grinding resin)	–	52.5
TEGO® Dispers 752 W (50%) (grinding resin)	–	9.7
DISPERBYK®-102 (90%) (wetting and dispersing agent)	6.0	–
DISPERBYK®-2095 (98%) (wetting and dispersing agent)	8.2	–
DISPERBYK®-2091 (55%) (wetting and dispersing agent)	9.7	–
Demineralized water (solvent)	46.1	12.9
SICOTRANS® Yellow L 1916 (iron oxide pigment)	30.0	24.9
Total	100.0	100.0
Viscosity (mPa s, 25°C, 200 s^{-1})	62	55
% grinding resin on pigment	–	70
% dispersing agent (100%) on pigment	63	20

Dispersing conditions
Pigment was added portion by portion to grinding resin and dispersing additives while stirring slowly with a dissolver. To 100 g of concentrate 130 g of 2 mm glass beads were added. The mixture was dispersed in a DISPERMAT® at 3000 rpm and 40°C for 90 min. After approximately 20 min, 6.5 g of water was added. After the complete dispersion process the residual amount of water was added.

Letdown
ALBERDINGK® U 8001 (PUR dispersion) was added while mixing with a magnetic stirrer.

Application
40 µm wet with a coating rod on a pretreated polyester foil. The transparency was measured via the optical density over the white back side of a black/white cardboard with a SPECTROEYE® (spectrophotometer).

Transparent yellow coating	Optical density
DISPERBYK® additives	1.76
TEGO® VariPlus DS 50/TEGO® Dispers 752 W	2.37

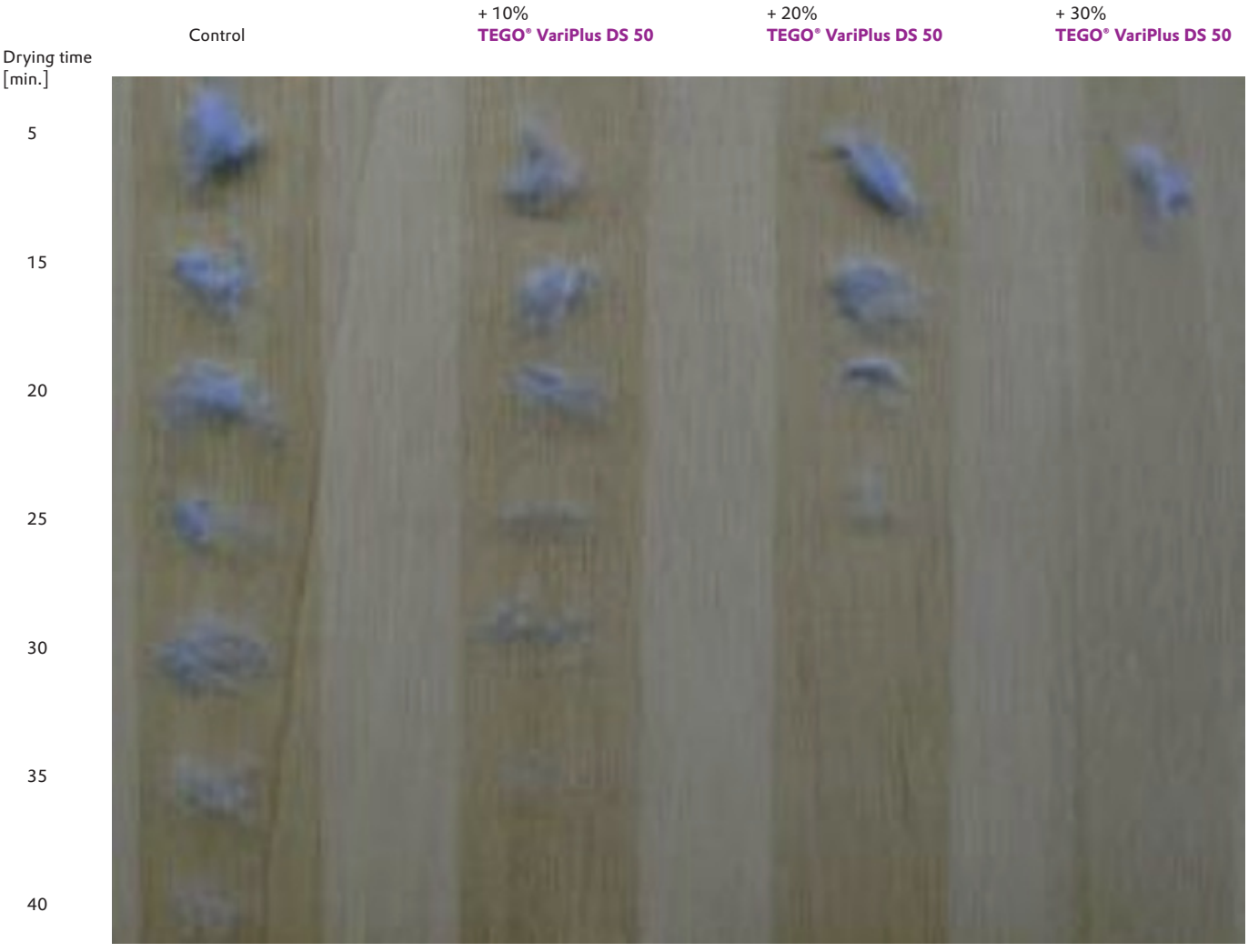
Coatings

TEGO® VariPlus DS 50 in a waterborne wood coating

Binder
Polyurethane dispersion

Substrate
Blockboard

Advantages of using **TEGO® VariPlus DS 50:**
- faster drying
- faster through-cure
- higher hardness
- higher gloss



Guiding formulation

Base formulation (p. b. wt.)

Base	
Halwedrol OX TN 7735/40 W (binder)	27.0
TEGO® Foamex 810 (defoamer)	0.8
TEGO® Wet 270 (substrate wetting and leveling agent)	0.35
ACEMATT® OK 520 (matting agent)	2.00
LANCO™ PP 1362 D (wax)	0.50
Mixture 1	2.00

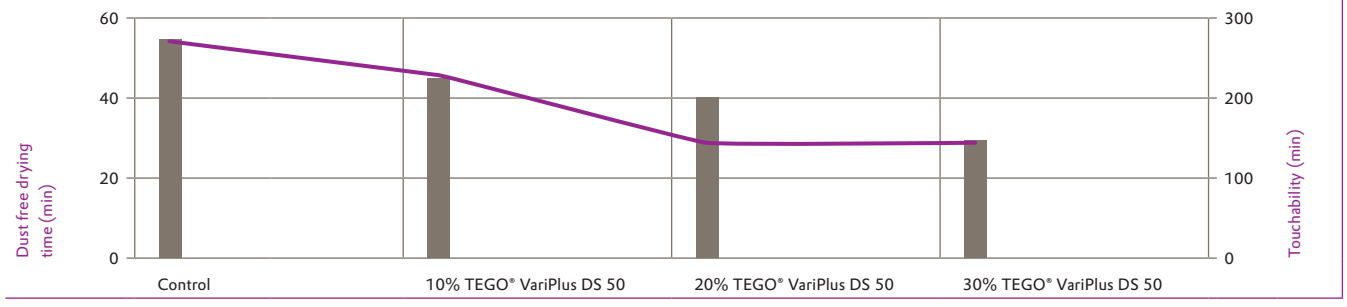
Mixture 1	
AQUACAT™ (Co drier)	0.50
Zircat (Zn drier)	0.50
Demineralized water	1.00

Formulation (p. b. wt.)

	Control	10% TEGO® VariPlus DS 50	20% TEGO® VariPlus DS 50	30% TEGO® VariPlus DS 50
Base	32.65	32.65	32.65	32.65
Halwedrol OX TN 7735/40W	27.50	22.05	16.06	11.14
DOWANOL™ DPnB	1.00	1.00	1.00	1.00
Demineralized water	19.70	19.70	19.70	19.70
COLLACRAL® PU 75 (1:1 with demineralized water)	1.40	1.40	1.40	1.40
RHEOLATE® 350 D	1.25	1.25	1.25	1.25
TEGO® VariPlus DS 50	–	6.60	13.20	19.80

Dispersing conditions:
130 g lacquer, 160 g glass beads Ø 2mm, 20 min DISPERMAT®,
35°C temperature, keep lacquer over night.

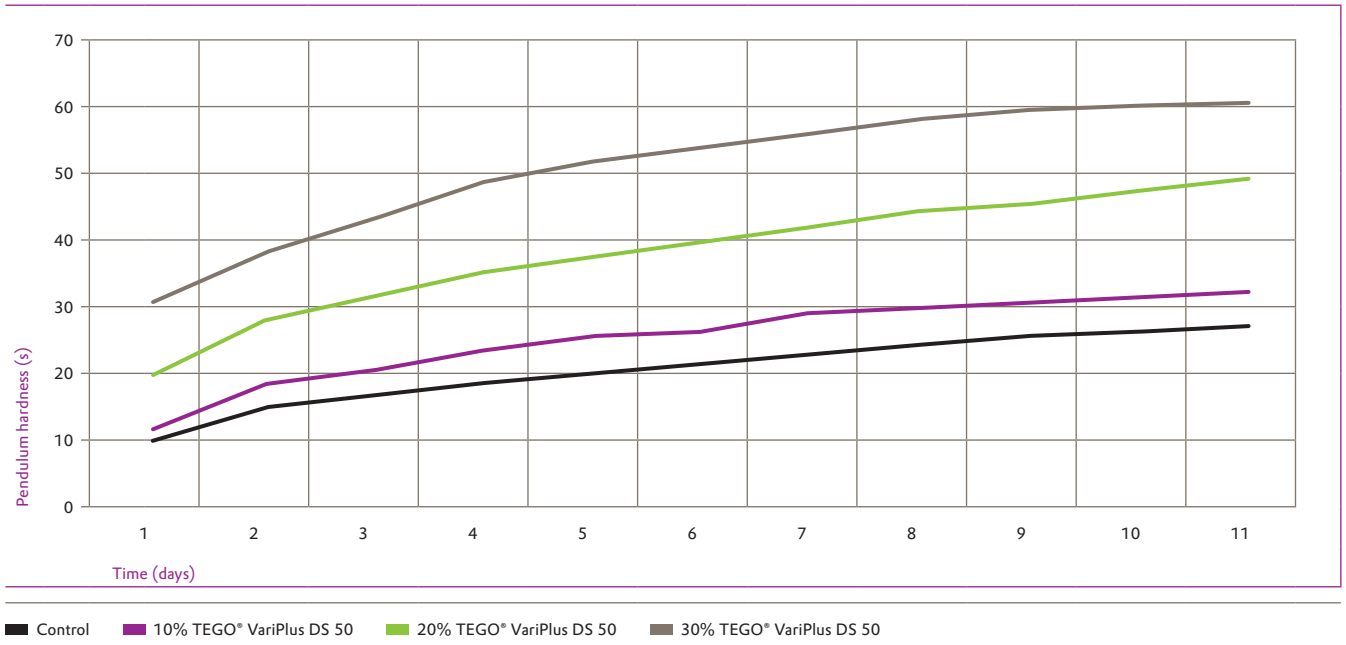
Drying properites



Dust free drying time Touchability

Guiding formulation

Pendulum hardness as a function of time



Wet film thickness 200 µm on a blockboard

TEGO® VariPlus DS 50 in a waterborne primer coating

Waterborne filler for CED

Binder
Saturated polyester/melamine resin

Substrate
Cathodic electrodeposition (CED) on cold rolled steel

Advantages of using **TEGO® VariPlus DS 50:**
- improved intercoat adhesion between primer and CED
- better stone chip resistance

Control

With **TEGO® VariPlus DS 50**

Guiding formulation

Formulation (p. b. wt.)

	Control	TEGO® VariPlus DS 50
Plusaqua V 389 (polyester binder)	25.3	22.8
Dimethylethanolamine (DMEA)/demineralized water (1/1)	3.2	3.2
Demineralized water	19.7	19.7
MAPRENAL® MF 900w/95 (melamine hardener)	4.6	4.6
Butyldiglycol (solvent)	2.5	2.5
Demineralized water	14.9	12.0
TEGO® VariPlus DS 50 (adhesion promoter)	–	5.4
Total	70.2	70.2
10 min Dissolver (pH approx. 8.5)		
TEGO® Wet 270 (wetting and leveling agent)	0.2	0.2
TEGO® Airex 902 W (defoamer and leveling agent)	0.5	0.5
AEROSIL® 200 (rheology control agent)	0.7	0.7
Blanc fixe micro (filler)	5.4	5.4
KRONOS® 2059 (white pigment)	23.0	23.0
Total	100.0	100.0

Working conditions

Dilution: demineralized water
Spray viscosity: 40 – 45 s (Ford 4 cup, 23°C)
pH-value: 8.2 – 8.8
(adjust with DMEA/dem. water = 1/1)
Stoving conditions: flash off approx. 10 min, then curing
for 20 min at 160°C

Technical properties
Substrate: CED on cold rolled steel
Film thickness: 25 – 35 microns

	Control	With TEGO® VariPlus DS 50
Pendulum hardness (König)	150 s	178 s
Cross hedge (intercoat adhesion)	0	0
Gloss (20°/60° angle)	53-54/85	80-82/97
Haze-Gloss	272 – 291	168 – 189
Stonechip resistance*	3	2

*(VW specification: 2 x 500 g/2 bar)

TEGO® AddBond LTH in a primer coating

Binder
Chlorinated rubber

Substrate
Cold rolled steel

Advantage of using **TEGO® AddBond LTH:**
- improvement of adhesion

Control

With **TEGO® AddBond LTH**

Guiding formulation

Formulation (p. b. wt.)

	1	2
PERGUT® S10 (chlorinated rubber)	23.6	21.1
Xylene (solvent)	23.6	23.6
TEGO® AddBond LTH (polyester resin, adhesion promoter)	–	2.5
Stirring		
Xylene (solvent)	20.2	20.2
EDENOL® D 81 (epoxidized soy bean oil, plasticizer)	9.0	9.0
KRONOS® 2059 (white pigment)	23.6	23.6
Total	100.0	100.0

Substrate: cold rolled steel, non-pretreated
Thinner: xylene/butyl acetate = 1/1
Spray viscosity: 21 s (DIN 4 mm cup, 23°C)
Coating thickness: 80 µm wet with a coating rod
Drying conditions: 15 min room temp + 2h 60°C

	Without TEGO® AddBond LTH (formulation 1)	With TEGO® AddBond LTH (formulation 2)
Cross hatch test (taped)	5	0

5 = total loss 0 = excellent adhesion

TEGO® AddBond LTW in a can coating

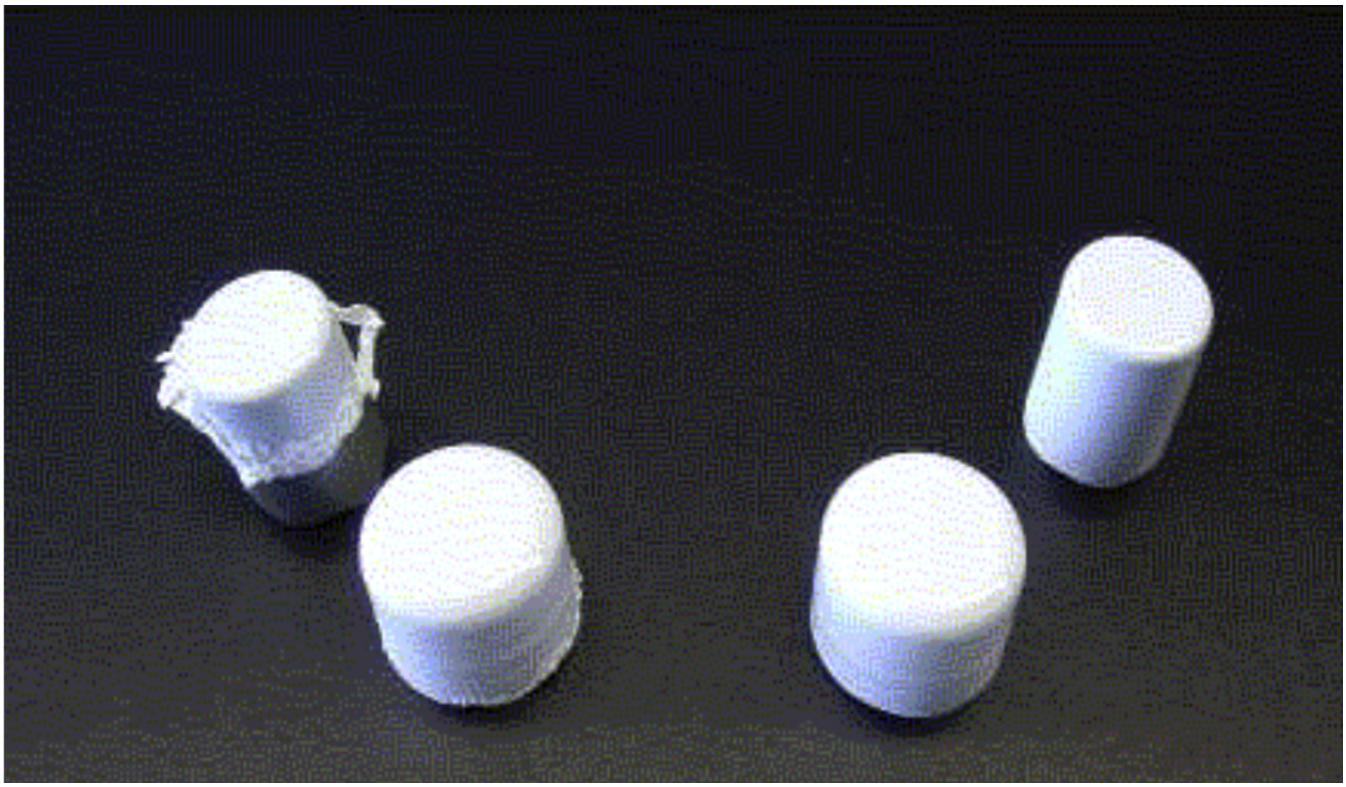
Binder
Saturated polyester

Substrate
Tin plates

Advantages of using **TEGO® AddBond LTW:**
- improvement of sterilization resistance
- higher flexibility
- increase of adhesion

Control

With **TEGO® AddBond LTW**



Stamping enamel for can coating

Guiding formulation

Stamping enamel, white, based on DYNAPOL® LH 818 – 05 – Polyurethane

Formulation (p. b. wt.)

	1	2
DYNAPOL® LH 818 – 05 (polyester resin, binder)	30.9	30.4
TI-PURE® R-902+ (white pigment)	37.9	37.3
Butyl diglycol (solvent)	4.1	4.0
Perlmill < 10 µm		
DYNAPOL® LH 818 – 05 (polyester resin, binder)	12.4	12.2
VESTANAT® B 1358/100 (blocked isocyanate, hardener)	6.1	6.0
TEGO® AddBond LTW (polyester resin, adhesion promoter)	–	1.6
DABCO® T12-CL	0.1	0.1
EASTMAN™ (CAB 551-0.2)/20% in butyl diglycol acetate (cellulose acetate butyrate, leveling agent)	1.5	1.5
Butyl diglycol (solvent)	7.0	6.9
Total	100.0	100.0

Resin/crosslinker: OH/NCO = 1:1

Working conditions
Solid content (0.5 h/160°C): 59%
Viscosity (DIN 4 cup, 20°C): 140 ± 10 s
Substrate: electrolytic tinplate (ETP 2.8/2.8 T 52 0.20)

Curing conditions stamping enamel
10 min. 185°C peak metal temperature (PMT)

Sterilization conditions
30 min 129°C

Application
Roller coating, dry coating thickness 7 – 10 µm

TEGO® AddBond DS 1300 in a white plastic coating

Application
Plastic coatings

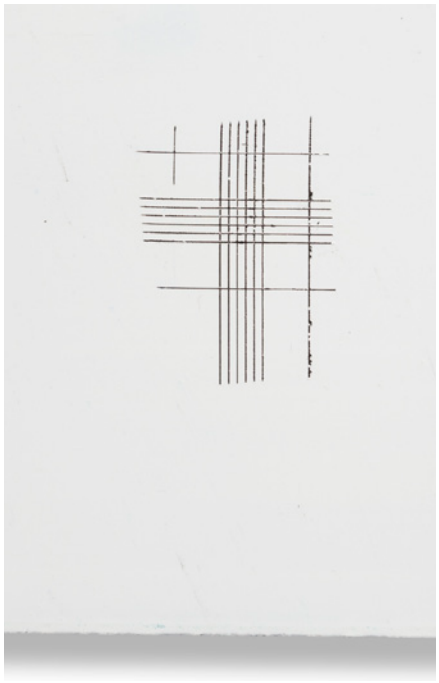
Binder
Styrene-acrylic copolymer

Substrate
ABS

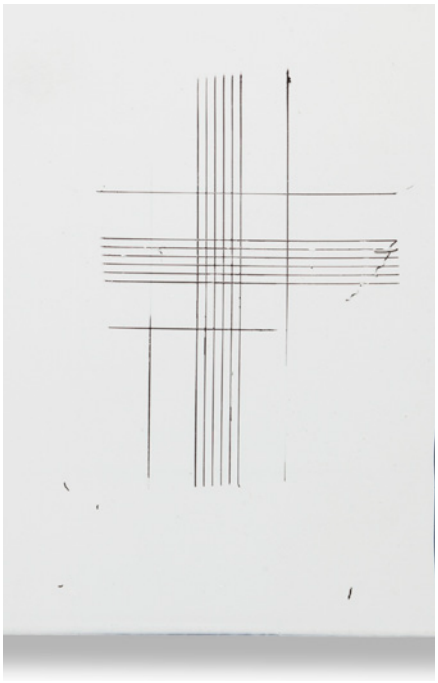
Advantage of using **TEGO® AddBond DS 1300:**
- improvement of adhesion

Control

With 5%
TEGO® AddBond DS 1300



With 10%
TEGO® AddBond DS 1300



Guiding formulation

Formulation (p. b. wt.)

	Control	+ 5% TEGO® AddBond DS 1300	+ 10% TEGO® AddBond DS 1300
REVACRYL® AE 6030 [1] (styrene-acrylic copolymer)	50.6	50.6	50.6
TEGO® Foamex 825 (defoamer)	0.5	0.5	0.5
Butyl glycol (solvent)	4.0	4.0	4.0
HYDROPALAT® 535 N (thixotropic additive)	0.3	0.3	0.3
SACHTLEBEN® R-KB-3 (white pigment)	36.5	36.5	36.5
NUVIS® FX 1010-10% (associative thickener)	1.0	1.0	1.0
CHE®-COAT-CI LAF1 (corrosion inhibitor)	0.5	0.5	0.5
White spirit (solvent)	1.0	1.0	1.0
REVACRYL® AE 6030 (styrene-acrylic copolymer)	5.6	2.8	–
TEGO® AddBond DS 1300 (polyester dispersion, adhesion resin)	–	3.2	6.5
Total	100.0	100.4	100.9

[1] Adjust the pH value to 8.5 by adding a 1:1 mixture of dimethylamino ethanol and demineralized water

Cross hatch test

Substrate: ABS

Application: 150 µm wet with a quadruple film applicator

Drying conditions	Control	5% TEGO® AddBond DS 1300	10% TEGO® AddBond DS 1300
16 h, 23°C + 2 h 60°C	3	1	0

5 = total loss 0 = excellent adhesion

TEGO® AddBond DS 1300 in a waterborne filler

Application
Corrosion protection

Binder
Styrene-acrylic copolymer

Substrate
Galvanized steel

Advantages of using **TEGO® AddBond DS 1300**:
- improvement of adhesion
- corrosion protection

Control

With **TEGO® AddBond DS 1300**

Guiding formulation

Formulation (p. b. wt.)

	Control	With TEGO® AddBond DS 1300
REVACRYL® AE 6030 [1] (styrene-acrylic copolymer)	56.0	53.2
TEGO® Foamex 825 (defoamer)	0.3	0.3
Butyl glycol (solvent)	4.0	3.8
HYDROPALAT® 535 N (thixotropic additive)	0.3	0.3
HEUCOPHOS® ZPZ 09 (basic zinc phosphate hydrate, corrosion protection)	8.0	7.6
MILLICARB® OG (calcit, filler)	8.0	7.6
MISTRON® 754 (filler)	5.5	5.2
BAYFERROX® 130 M (iron oxide red pigment)	15.0	14.1
NUVIS® FX 1010-10% (associative thickener)	1.0	1.0
TEGO® Foamex 825 (defoamer)	0.4	0.4
CHE®-COAT-CI LAF1 (corrosion inhibitor)	0.5	0.5
White spirit (solvent)	1.0	1.0
TEGO® AddBond DS 1300 (polyester dispersion, adhesion resin)	–	5.0
Total	100.0	100.0

[1] Adjust the pH value to 8.5 by adding a 1:1 mixture of dimethylamino ethanol and demineralized water

Cross hatch test

Substrate: galvanized steel

Application: 150 µm wet with a quadruple film applicator

Drying conditions	Control	5% TEGO® AddBond DS 1300
16 h, 23°C + 2 h 60°C	4	0

5 = total loss 0 = excellent adhesion

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