

Powder coating resin PC-17-7N

Based on Eastman NPG™ glycol and EMS Chemie
AG Primid™ XL552 formulation

Features

- Excellent weathering resistance
- High impact resistance
- Good flexibility

Table 1 Synthesis of resin PC-17-7N^a

Reactants	Equivalents	Moles	Grams
1st Stage			
Eastman NPG™ glycol	11.663	5.832	607.42
Trimethylolpropane (TMP)	0.357	0.119	15.97
Terephthalic acid	10.522	5.261	874.09
Adipic acid	0.325	0.163	23.78
Triphenyl phosphite	—	—	0.75
Fascat™ 4100 (butylstannoic acid)	—	—	1.5
2nd Stage			
Eastman™ purified isophthalic acid (PIA)	2.107	1.053	175
Total reactant charge			1,698.5
Water loss			–198.5
Resin yield			1,500

^aExcess glycol of 1%–2% is recommended in addition to the charges indicated.

Procedure

1. Setup: A 3-liter reactor equipped with mechanical stirrer, heated packed column, distillation condenser, thermocouples, nitrogen stream, and accessories needed for computer-controlled reactor.
2. Charge the first stage glycols and melting at 140°C. While stirring, gradually charge the first stage acids, stabilizer, and catalyst. Maintain a nitrogen stream and stirrer speed @ 300 rpm.
3. Set heat control as follows:

25°–180°C	over	1.3 hours
180°–235°C	over	6 hours
235°C hold	for	7 hours

Remove water from the reaction through heated column and distillation condenser.
4. Process to acid number of 5–10 (mg KOH/g resin) and cone and plate melt viscosity @ 200°C of 8–12 poise (0.8–1.2 Pa-s).
5. Cool to 180°C and add the second stage Eastman™ purified isophthalic acid.
Up heat and hold at 235°C for 2 hours followed by 2 hours of mild vacuum.

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Table 2 Properties of resin PC-17-7N

Hydroxyl number, mg KOH/g resin	5–10
Acid number, mg KOH/g resin	32–38
Gel permeation chromatography	
Weight-average molecular weight, \bar{M}_w	8,300–8,700
Number-average molecular weight, \bar{M}_n	2,600–2,800
T_g , glass transition temperature (DSC, 2nd cycle, midpoint)	62°–65°C
Melt viscosity, cone and plate, @ 200°C, poise (Pa·s)	30–40 (3.0–4.0)

Raw material suppliers

Adipic acid	DuPont
Benzoin	Estron
Fascat™ 4100	Arkema
Eastman™ purified isophthalic acid	Eastman
Modaflow™ powder 2000	Cytec
Eastman NPG™ glycol	Eastman
Primid™ XL552	EMS Chemie AG
Terephthalic acid	Amoco
TiO ₂ , Ti-Pure™ R-960	DuPont
Trimethylolpropane	Celanese, Perstorp

Table 3 Formulation and physical properties of polyester/Primid™ XL552 powder coating based on resin PC-17-7N

Ingredients	Grams
Polyester resin PC-17-7N	1,140
Primid™ XL552	60
Benzoin	6
Flow control agent (Modaflow™ 2000)	21
TiO ₂ , Ti-Pure™ R-960	600
Total weight	1,827

- A 30-mm twin-screw extruder is used with Zone 1 and Zone 2 set @ 100°C and 110°C respectively with screw speed of 300 rpm.
- Powder particle size average is 25 microns; maximum is 74 microns.
- Powder caking stability test @ 40°C for 3 days is acceptable.

Table 4 Physical properties of coating enamel^a

Cure temperature/time, °C/min (°F/min)	163–176/20 (325–350/20)
Thickness, microns (mils)	46–58 (1.8–2.3)
Gloss, Gardner™ 20°/60°	80/90
Impact resistance, front/reverse, N·m (in.-lb)	18.1/18.1 (160/160)
Pencil hardness	H–2H
Solvent resistance, MEK double rubs	200+
Conical mandrel flexibility, 3 mm (1/8 in.), % pass	100

^aUnprimed, zinc-phosphated cold-rolled steel panels were used.



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