ESTRON CHEMICAL
THE EDGE OF INNOVATION

EPOMATT® G-151 TECHNICAL BRIEF #1
Powder Coating Gloss Stability

OBJECTIVE:

The primary objective of this project was to investigate the factors affecting the gloss stability of powder coating systems prepared with Epomatt® G-151 and to provide formulating guidelines for maximizing the gloss stability.

PROCEDURE:

Variables which were evaluated include:

- Epomatt® G-151 concentration, 10 and 8 phr
- Two flow agents: L-65F and PL-200
- Five epoxy hardeners: G-91, Estron (Imidazole Epoxy Adduct)
  OTB HT 2844, Ciba (o-tolyl biguanide)
  P-104, Shell (accelerated dicyandiamide)
  Dicyandiamide
  Dicyandiamide with ESCAT 50
- Storage temperature: Room Temperature
  40°C Incubator

After the powder coatings were initially sprayed, each sample was divided in half. One half was stored at room temperature and the other at 40°C (104°F). The gloss was then measured on sprayed panels after 7, 14, and 28 days.

PROCESSING CONDITIONS:

Premix:	Hamilton Beach Food Processor, High Speed for 15 - 20 seconds		
Extruder settings:	Zone 1: 175°F	Zone 2: 185°F	150 rpm
Extruder readings:	Zone 1: 175°F	Zone 2: 200°F	150 rpm
Milling:	Bantam Mill, 010 Herringbone screen; Liquid Nitrogen cooling		
Sieve:	Stainless steel 200 mesh, 75 μm		
Cure:	20 minutes, 180°C		
Substrate:	QD-35, Untreated cold rolled steel panels		

OBSERVATIONS:

409 N. Main St., P.O. Box 127, Calvert City, KY USA 42029
Tel. (270) 395-4195 • Fax (270) 395-5070 • Website www.estron.com

Powder coatings prepared using Epomatt® G-151 as the matting agent have shown varying degrees of increasing gloss values over an extended period of time. And as expected, this phenomenon is accelerated with elevated temperature.

EFFECT OF CURING AGENT:

The type of co-curing agent used with Epomatt® G-151 can have a dramatic effect on the long-term gloss stability. As is shown in Figures 1 and 2, all of the powder coatings prepared with the different co-curing agents except non-accelerated dicyandiamide have reasonable gloss stability at room temperature. However, as shown in Figures 3 and 4, storage of the samples at 40°C dramatically differentiates the gloss stability properties of powder coatings prepared with the different curing agents. The powder coatings prepared with P-104 and OTB have reasonably good gloss stability even at the elevated temperature. Powder coatings prepared with G-91 and the unaccelerated dicyandiamid though, show a significant increase in gloss over a short period of time at this higher temperature.

EFFECT OF FLOW CONTROL AGENT:

The effect on gloss stability of two different flow control agents, one functional and one non-functional, was evaluated with several different curing agents. The gloss stability of powder coatings prepared with Resiflow® PL-200, a non-functional flow control agent and Resiflow® L-65F, an acid-functional flow control agent masterbatched at 10% in epoxy resin, is significantly different. This difference was observed with all the different types of curing agents as is shown in Figures 5 and 6. This improvement of gloss stability is speculated to be due to the acid functionality of L-65F. In addition, L-65F generally provides a lower gloss than the non-functional flow control agent. It has also been observed that during the gel time test, the powder coatings which have L-65F as the flow agent have a "creamier" melt than the powder coatings made with PL-200. While the effect of this "creamier" melt is not always noticeable in the final films, it should produce somewhat smoother coatings.

EFFECT OF G-151 CONCENTRACTION:

Matte finishes (60° gloss # 5) can be achieved by using Epomatt® G-151 at 10 phr in combination with epoxy hardeners G-91, OTB, or P-104. At lower concentrations of G-151, the gloss will be higher. As shown in Figures 7 and 8, the gloss stability is higher for those formulations using the higher level of Epomatt® G-151, i.e. the lower gloss formulae.

CONCLUSIONS:

409 N. Main St., P.O. Box 127, Calvert City, KY USA 42029
Tel. (270) 395-4195 • Fax (270) 395-5070 • Website www.estron.com

Powder coatings can be formulated using Epomatt® G-151 which have a high level of gloss stability even at 40°C for 28 days of continuous exposure. For an optimum formula (PE-006-6) the 60° gloss only changed from 2.1% to 10.9% after the 28 days at elevated temperature. At room temperature, however, the change was only from 2.1% to 2.9% after 28 days. Other criteria may require different formulations, i.e. cure temperature or gloss level. The use of different curing agents, flow control agents or levels of Epomatt® G-151 can reduce gloss stability during high storage temperatures and/or longer term storage. However, in many cases the reduction in gloss stability is not so severe as to render the product impractical.

FORMULATIONS: NOTEBOOK REFERENCE PE-006

Ingredients	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
GT 7013, Ciba	68.3	62.3	68.8	62.8	68.8	62.8	68.8	62.8	68.5	68.2	69.3	63.3	69.8	63.8	69.8	63.8	69.8	63.8	69.5	69.3
G-151, Estron	6.8	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.8	5.4	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.4
G-91, Estron	3.4	3.4									3.5	3.5								
OTB, Ciba HT 2844			2.7	2.7									2.7	2.7						
P-104, Shell					2.7	2.7									2.7	2.7				
Dicyandiamide							2.7	2.7	2.7	2.7							2.7	2.7	2.7	2.7
ESCAT 50, Estron									0.4	0.8									0.4	0.8
PL-200, Estron	1.0		1.0		1.0		1.0		1.0	1.0	1.0		1.0		1.0		1.0		1.0	1.0
L-65F MBE-1, Estron		6.9		6.9		6.9		6.9				6.9		7.0		7.0		7.0		
TiO_2, DuPont R960	7.8	7.8	7.9	7.9	7.9	7.9	7.9	7.9	7.8	7.8	7.9	7.9	8.0	8.0	8.0	8.0	8.0	8.0	8.0	7.9
$BaSO_4$, Cimbar UF	9.8	9.8	9.8	9.9	9.8	9.9	9.8	9.9	9.8	9.8	9.9	9.9	10.0	10.0	10.0	10.0	10.0	10.0	9.9	9.9
Red Iron Oxide	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0

#9: G-151 was mistakenly omitted from the sample; no valid data available.

60° GLOSS STABILITY DATA: NOTEBOOK REFERENCE PE-006

Room Temp.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Initial	3.6	4.1	5.8	3.0	3.0	2.1	17.3	11.0	—	9.4	7.1	6.1	11.8	4.1	7.5	2.9	37.5	58.6	48.6	28.7
7 Days	3.7	4.6	5.7	3.2	3.0	2.3	15.1	18.7	—	7.9	9.8	7.9	11.8	3.9	7.6	3.4	43.9	56.5	50.8	37.3
14 Days	4.5	5.8	6.2	3.3	3.3	2.7	18.0	22.4	—	10.0	11.6	9.9	12.1	4.1	9.4	5.1	45.6	64.8	48.9	34.1
28 Days	5.6	6.5	6.4	3.4	3.9	2.8	—	16.7	—	9.9	17.1	13.6	13.9	4.4	10.6	5.6	54.9	68.7	46.7	32.0

40°C Incubated	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Initial	3.6	4.1	5.8	3.0	3.0	2.1	17.3	11.0	—	9.4	7.1	6.1	11.8	4.1	7.5	2.9	37.5	58.6	48.6	28.7
7 Days	35.0	25.6	8.9	5.6	8.3	7.1	29.0	53.7	—	38.6	54.9	48.1	20.0	8.0	22.0	14.7	49.5	68.7	69.4	62.7
14 Days	54.4	43.0	13.1	9.6	11.4	8.8	39.6	67.1	—	61.0	73.0	71.0	56.7	24.2	33.5	17.8	64.6	82.3	79.8	74.0
28 Days	59.1	42.0	26.0	19.5	15.3	10.9	40.5	65.7	—	64.0	61.8	68.1	71.7	32.8	44.0	27.2	58.5	82.7	77.2	76.2

409 N. Main St., P.O. Box 127, Calvert City, KY USA 42029
Tel. (270) 395-4195 • Fax (270) 395-5070 • Website www.estron.com

COMPARISON OF HARDENERS

L-65F Flow Agent - Room Temperature

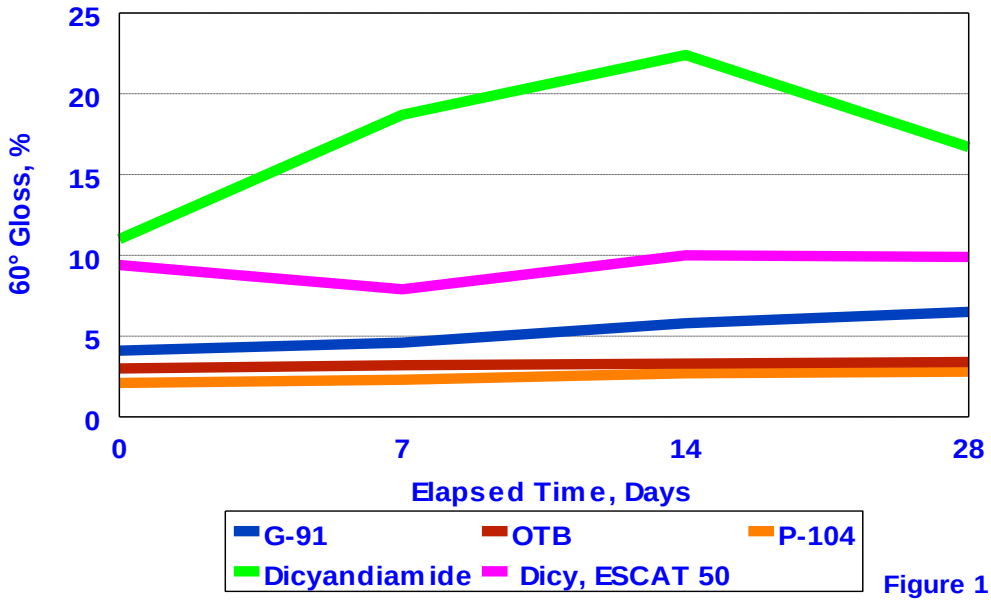

Figure 1

409 N. Main St., P.O. Box 127, Calvert City, KY USA 42029
Tel. (270) 395-4195 • Fax (270) 395-5070 • Website www.estron.com

COMPARISON OF HARDENERS

PL-200 Flow Agent - Room Temperature

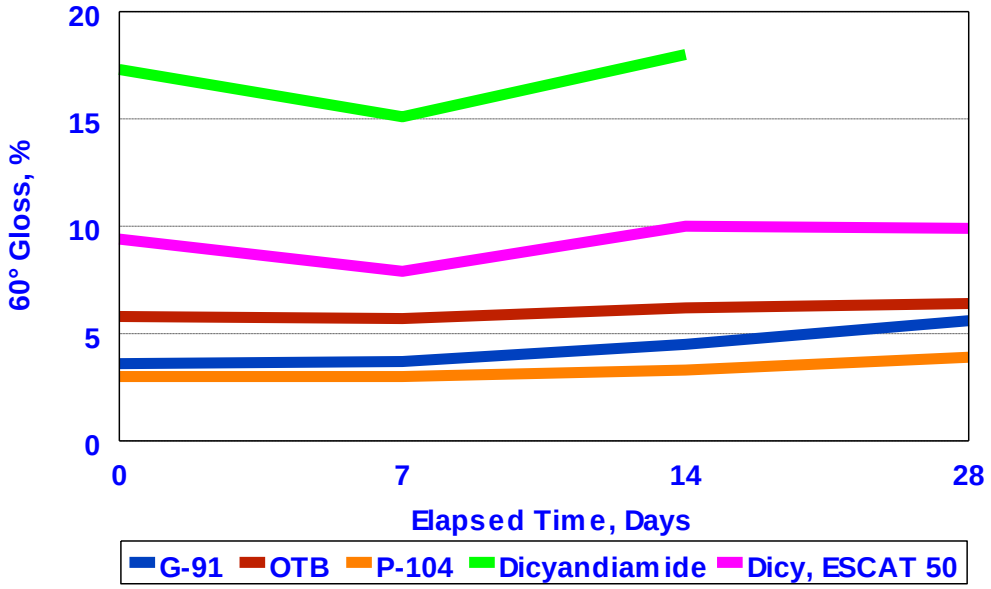

Figure 2

COMPARISON OF HARDENERS

L-65F Flow Agent - 40° C

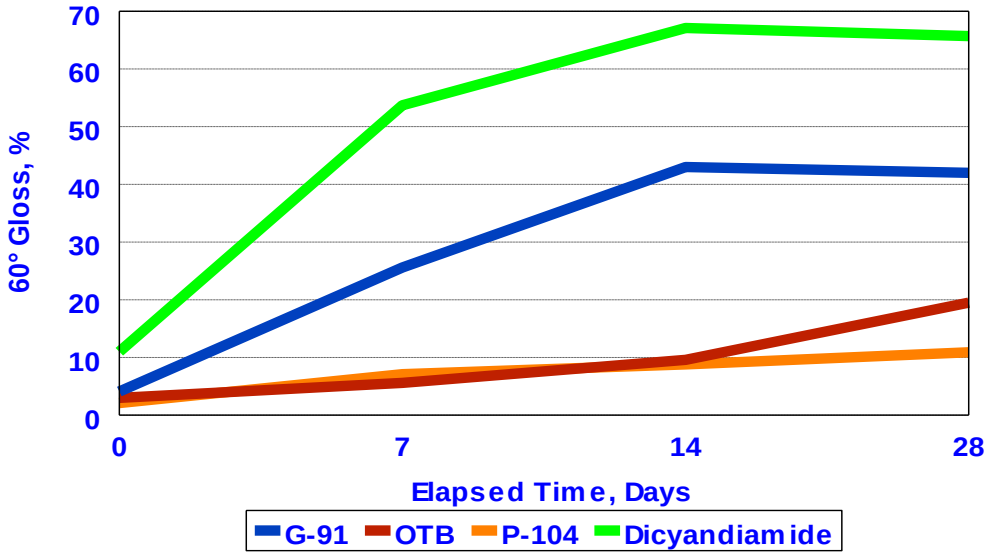

Figure 3

409 N. Main St., P.O. Box 127, Calvert City, KY USA 42029
Tel. (270) 395-4195 • Fax (270) 395-5070 • Website www.estron.com

COMPARISION OF HARDENERS

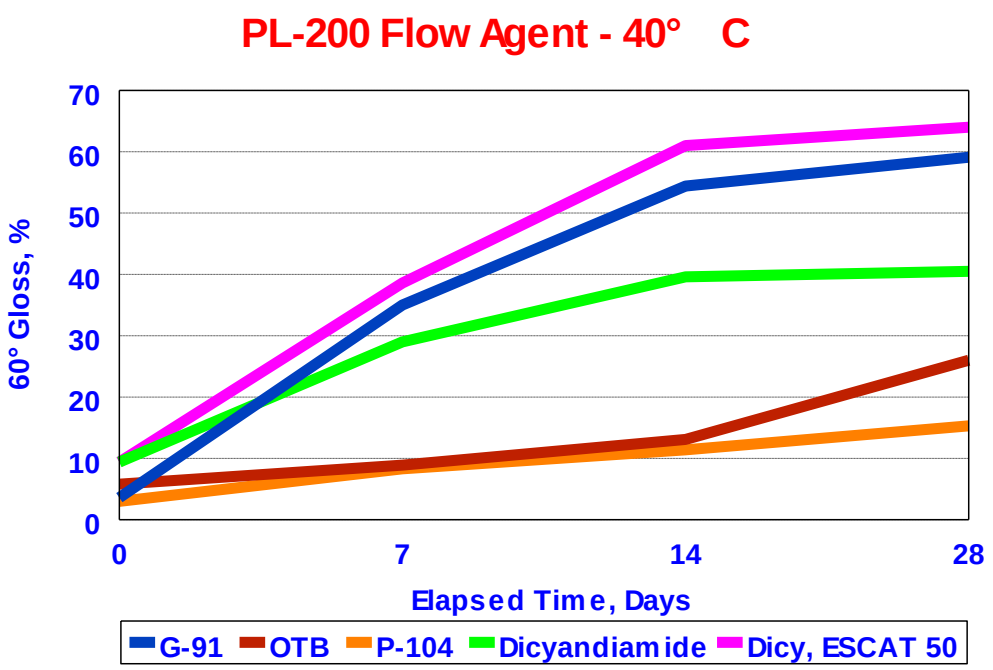

Figure 4

409 N. Main St., P.O. Box 127, Calvert City, KY USA 42029
Tel. (270) 395-4195 • Fax (270) 395-5070 • Website www.estron.com

COMPARISON OF FLOW AGENTS

Room Temperature - G-151, 10 PHR

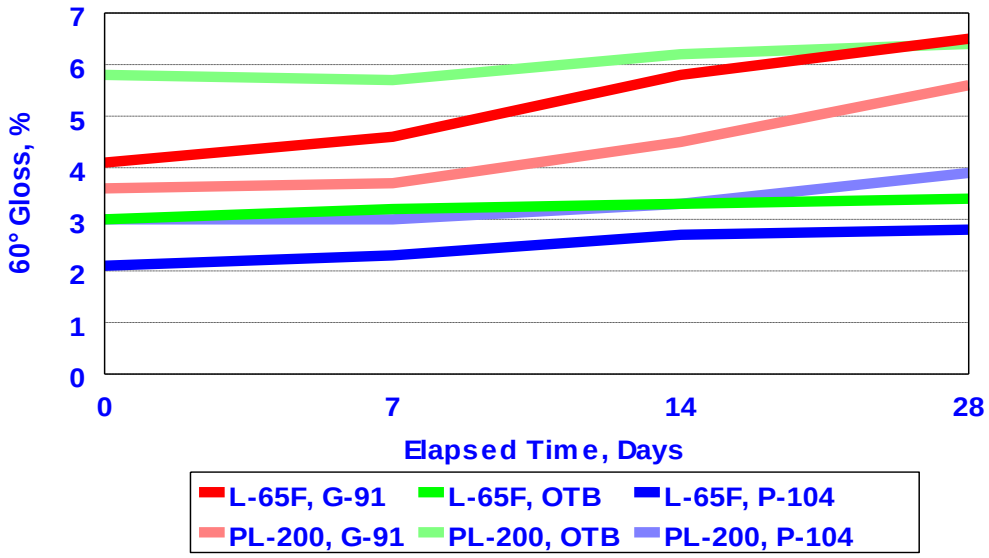

Figure 5

409 N. Main St., P.O. Box 127, Calvert City, KY USA 42029
Tel. (270) 395-4195 • Fax (270) 395-5070 • Website www.estron.com

COMPARISON OF FLOW AGENTS

40° C - G-151, 10 PHR

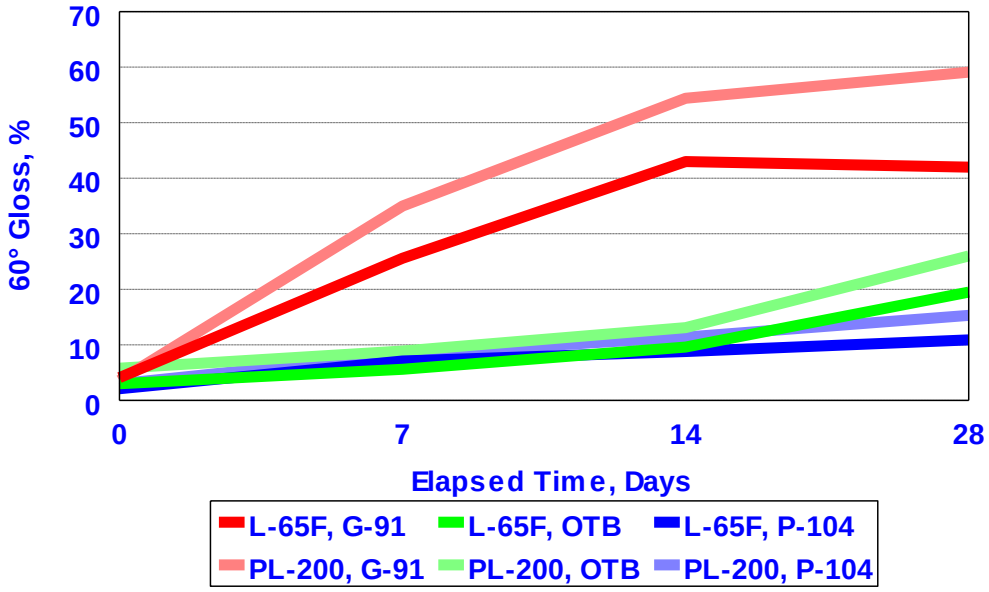

Figure 6

COMPARISON OF G-151 LEVEL

ROOM TEMPERATURE - RESIFLOW L65-F

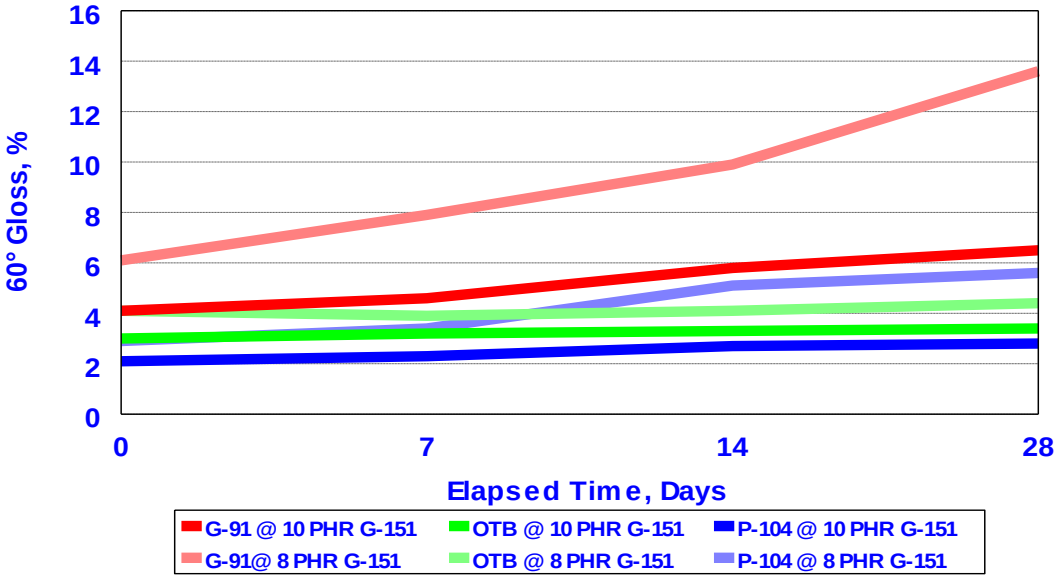

Figure 7

409 N. Main St., P.O. Box 127, Calvert City, KY USA 42029
Tel. (270) 395-4195 • Fax (270) 395-5070 • Website www.estron.com

COMPARISON OF G-151 LEVEL

40° C - RESIFLOW L65-F

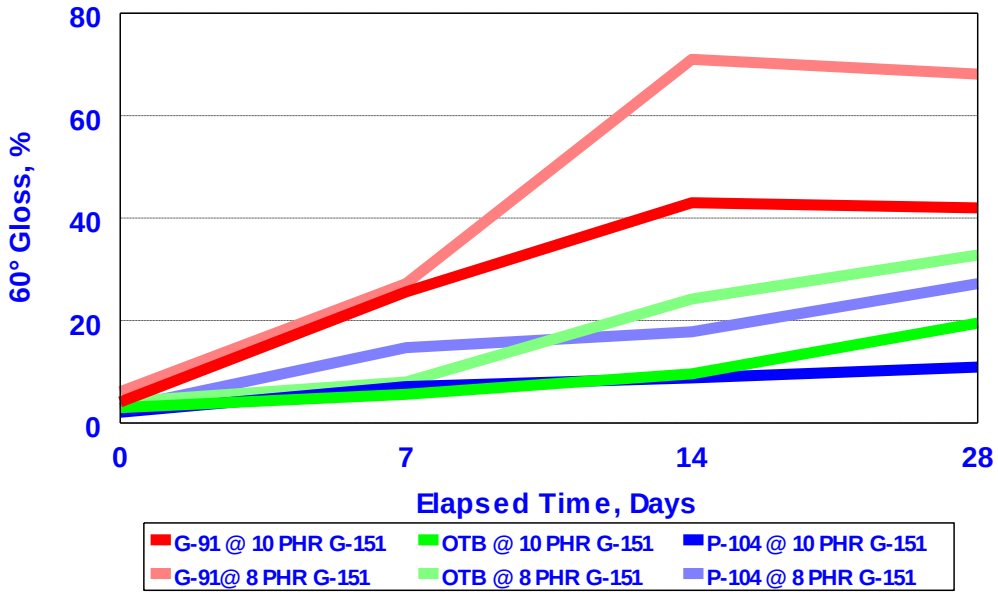

Figure 8

409 N. Main St., P.O. Box 127, Calvert City, KY USA 42029
Tel. (270) 395-4195 • Fax (270) 395-5070 • Website www.estron.com