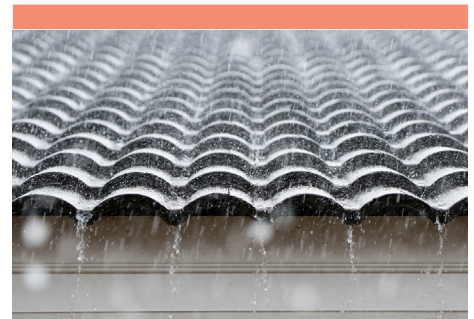


# Oligomers for Weatherability



A key requirement for many UV-curable formulations is that the cured formulation have good weathering properties. Weathering refers to the ability of a material to withstand extended exposure to heat, light, and/or moisture without yellowing, chipping, or losing gloss. One industry that requires a high degree of weatherability is the automotive industry. Exterior automotive parts are exposed to a wide range of weather conditions and must be developed to withstand these conditions for several years. These automotive parts require coatings that are carefully formulated to protect against all kinds of weathering conditions. Several other applications such as inks, roofing, industrial coatings, and packaging applications all require light stability and the ability to withstand exposure to heat, light, and moisture for long periods of time.



# TEST CONDITIONS

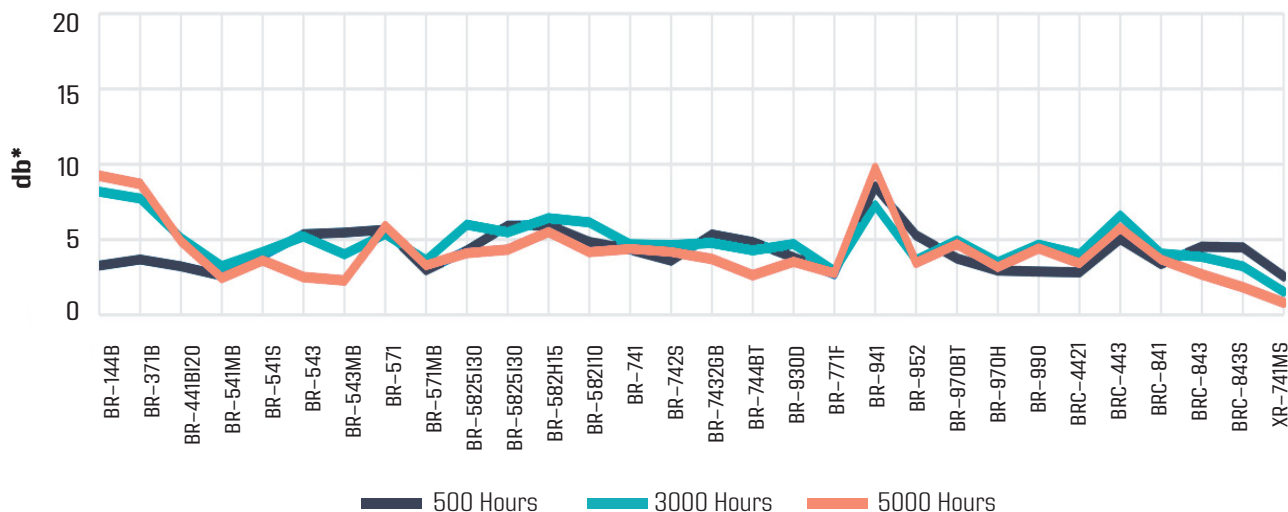
A variety of weathering conditions can be simulated on instruments such as a Q-Sun or QUV, test chambers produced by Q-Lab. The Q-Sun is a xenon arc test instrument that provides various wavelengths of light (UV, visible light, and infrared) encompassing the full-spectrum of potential sunlight exposure. In contrast, the QUV instrument uses only a fluorescent UV light source and can provide more general weathering information in a shorter time frame when compared to the Q-Sun. These instruments simulate outdoor environmental conditions and assist in determining the effect of those conditions on gloss levels, yellowing, cracking, peeling, adhesion, and loss of tensile strength over a defined timeframe of exposure. The results reported in this study were gathered on a Q-Sun as those test conditions more closely simulate true exterior weathering conditions. The test parameters were in accordance with ASTM D6695, Cycle Number 6 for automotive exteriors.

The object of this study was to obtain information on a wide variety of oligomers. This made getting good adhesion to a common substrate extremely difficult while using the same test formulation. Therefore, it was decided to eliminate the substrate by casting 2-mm thick panels and focusing primarily on the difference in yellowing over time rather than adhesion.

## Q-SUN YELLOWING DATA

Data was collected on each sample from the Q-Sun over a total of 5,000 hours. The chart below depicts all materials tested and their output  $\Delta b^*$  (yellowness) value at 500, 3000, and 5000 hours. All materials maintained a yellowness value below  $\Delta b^* = 10.0$  and exceptional oligomers maintained a  $\Delta b^*$  value below 6.0.

Figure 1. Weathering Testing



Samples cast into 2-mm thick panels of 70% Bomar oligomer, 30% IBOA, and 2% Omnirad 184. Cured using EC-2000 for 2 minutes at 50 mW/cm<sup>2</sup>. BR-571 data provided at 4000 hr due to fractures in panel at 5000 hr - unable to read results.

**Table 1.** Bomar Oligomers Ideal for Weathering Applications

Ranking (based on Δb value)	Bomar Oligomer	70% Oligomer, 30% IBOA			Neat Oligomer	
		Tensile, psi [MPa]	Elongation, %	Modulus, ksi [MPa]	Glass Transition Temperature, Tg	Durometer Hardness
<b>Best (&lt;4.0)</b>	BR-571MB	4,500	110	140	50	D74
	BR-970H	4,600	6.5	210	70	D83
	BR-541MB	4,100	85	83	60	D74
	BR-930D	5,000	4.6	215	95	D87
	XR-741MS	8,100	4.5	317	107	D89
<b>Better (4.0 - 5.0)</b>	BR-541S	3,100	120	7.0	44	D62
	BR-741	9,200	10	395	79	D59
	BR-742S	4,500	76	80	66	D80
	BR-744BT	1,000	160	2.4	8	A75
	BR-771F	3,800	10	141	69	D82
	BR-990	2,050	38	9.5	22	D61
	BRC-843	1,400	180	0.8	32	D52
	BRC-843S	2,100	310	0.8	-9	D36
	BRC-4421	3,000	120	89	48	D75
	BRC-841	7,500	4.7	290	96	D86
<b>Good (&gt;5.0)</b>	BR-441BI20	5,800	4.7	240	90	D87
	BR-543	480	85	1.2	-47	A56
	BR-543MB	600	105	1.1	-55	A60
	BR-571	3,400	75	45	63	D64
	BR-582E8	830	90	2.9	29	A86
	BR-582H15	2,800	65	7.0	18	D60
	BR-582H10	3,400	180	1.9	29	D53
	BR-7432GB	1,400	190	3.2	-4	A65
	BRC-443	1,500	220	0.8	34	D58
	BR-5825130	3,300	129	52	46	D65
	BR-952	10,800	5.4	380	153	D89
	BR-970BT	3,200	34	120	59	D75

Helpful Link: QUV & Q-SUN: [A Comparison of Two Effective Approaches to Accelerated Weathering & Light Stability Testing](#)

