

Grain Raising Calculation

Finish Brand	Grain Raising Ra	Bare Oak Ra			Average Bare Oak Ra	First Coat Ra			Average First Coat Ra
AquaZar Waterbased Polyurethane	4	99	128	73	100	94	116	103	104
Benjamin Moore Stays Clear	2	100	115	82	99	128	82	93	101
Crystalac Premium Gloss	4	87	99	73	86	92	107	71	90
Fuhr 355 Acrylic Varnish	7	70	105	112	96	90	109	108	102
General Finishes High Performance	-2	90	100	108	99	102	102	88	97
Hydrocote Resisthane Plus	9	120	96	124	113	133	98	135	122
JE Moser's Marine Shield	4	88	83	86	86	89	91	88	89
JE Moser's Simple Success	2	113	120	72	102	113	114	84	104
Minwax Polycrylic	15	113	130	104	116	148	129	116	131
ML Campbell Ultrastar	4	87	98	100	95	86	94	117	99
Olympic Waterbased PU	3	99	110	112	107	104	113	114	110
Target Ultima Brushing Varnish	7	85	90	102	92	86	95	117	99
Varathane Diamond Polyurethane	-3	90	98	82	90	80	106	76	87
Minwax Fast Dry Polyurethane	-8	99	104	84	96	52	66	145	88
ML Campbell Magnamax	-7	84	120	116	107	120	83	95	99

The average surface roughness (Ra) of the bare oak portion of the finished panel was determined by measuring three uncoated areas of the panel with a laboratory profilometer and averaging the results. The same procedure was used to determine the average surface roughness of the portion of the panel that was coated with one coat of finish, The bare oak surface roughness was subtracted from the first coat surface roughness to determine the net increase or decrease in surface roughness that could be attributed to the first coat of finish. All measurements are in microinches. For reference the diameter of a typical human hair is approximately 2000 microinches.

Waterborne Finish Test 2006 Color Sample Measurements

Finish	L*	a*	b*	dL*	da*	db*
AquaZar Waterbased Polyurethane	90.69	-0.77	2.87	-2.06	-0.11	2.80
Benjamin Moore Stays Clear	88.51	-2.16	13.20	-4.23	-1.50	13.13
Crystalac Premium Gloss	91.43	-1.04	4.49	-1.31	-0.38	4.41
Fuhr 355 Acrylic Varnish	91.31	-0.76	2.80	-1.43	-0.10	2.73
General Finishes High Performance	90.00	-1.14	7.55	-2.75	-0.48	7.47
Hydrocote Resisthane Plus	92.27	-0.75	1.42	-0.47	-0.09	1.35
JE Moser's Marine Shield	85.14	-0.74	27.42	-7.60	-0.08	27.34
JE Moser's Simple Success	90.24	-1.58	9.40	-2.51	-0.92	9.33
Minwax Polycrylic	90.51	-0.63	3.50	-2.23	-0.03	3.43
ML Campbell Ultrastar	89.27	-1.65	13.61	-3.47	-0.99	13.54
Olympic Waterbased PU	85.14	-0.93	4.77	-7.60	-0.27	4.70
Target Ultima Brushing Varnish	90.67	-1.62	7.90	-2.08	-0.96	7.83
Varathane Diamond Polyurethane	91.74	-0.73	2.55	-1.00	-0.07	2.42
Minwax Fast Dry Polyurethane	90.39	-3.70	25.51	-2.36	-3.04	25.44
ML Campbell Magnamax	88.97	-2.32	14.38	-3.77	-1.66	14.31
White Panel w/ Blank Dish	92.74	-0.66	0.07			

Four milliliters of finish was placed in a clear plastic dish and allowed to dry. A blank dish was placed on a calibrated white panel and the color of the plastic dish on the white panel was measured with a laboratory spectrophotometer to establish the base L*a*b* color. Each individual finish was then measured with the spectrophotometer and the resulting L*a*b* was recorded. The color difference, dL*da*db* was determined mathematically. The db* scale is the "yellowness" index, the larger the number the more yellow.

Color change

Finish Brand	Color Change Cherry		Color Change Red Oak	
	Incandescent Light	Fluorescent Light	Incandescent Light	Fluorescent Light
AquaZar Waterbased Polyurethane	8	5	6	6
Benjamin Moore Stays Clear	6	3	3	3
Crystalac Premium Gloss	3	6	1	1
Fuhr 355 Acrylic Varnish	2	1	8	8
General Finishes High Performance	1	2	2	2
Hydrocote Resisthane Plus	14	14	13	13
JE Moser's Marine Shield	13	13	14	14
JE Moser's Simple Success	11	11	11	11
Minwax Polycrylic	9	9	12	12
ML Campbell Ultrastar	10	10	4	4
Olympic Water Based Polyurethane	7	4	9	9
Target Ultima Brushing Varnish	5	8	7	7
Varathane Diamond Polyurethane	4	7	5	5
Minwax Fast Dry Polyurethane	NA	NA	NA	NA
ML Campbell Magmax	NA	NA	NA	NA

Color Change of Various Wood Species			
Wood Species	Hydrocote Resisthane Plus	General Finishes High Performance	Shellac
Paduak	Deep Red	Orange Red	Deep Red
Purpleheart	Gray / Black	Dark Purple	Bright Purple
Butternut	Slight Gray/Brown	Natural Nutmeg Brown	Natural Nutmeg Brown
Mahogany	Medium Brown (mottled appearance)	Natural Mahogany Color	Golden Yellow Mahogany Color
Australian Lace Wood	Slight Graying	Whitish Overtones (looks Frosted)	Golden Yellow

One inch square pieces of cherry and red oak end grain were prepared for this test. 1/2 of each square was sealed with a commercially available 2# cut de-waxed shellac sealer and dried overnight. Two coats of finish (two hours dry between coats) were then applied to the individual cherry and oak squares and allowed to dry overnight. Each square was inspected to determine the visual color difference between the shellac sealed side and the unsealed side.

To my eye, all the waterborne finishes tend to "gray" the wood to some extent. I visually lined up the finished samples and arranged them in increasing order of "grayness". 1 = least gray, 14 = most gray

Spray notes

Finish Brand	Viscosity	Vertical Sag	Notes	Sprayability
AquaZar Waterbased Polyureth	40	4	Can states "do not thin", excessive bubbles, some orange peel	Poor
Benjamin Moore Stays Clear	160	11	Thinned ~15%, sprays surprisingly well even with high viscosity, very few bubbles (wet), orange peel when wet, dried flat.	Excellent **
Crystalac Premium Gloss	134	9	thinned ~15%, sprays well, hangs well even thinned, dries flat, some bubbles	Good **
Fuhr 355 Acrylic Varnish	16	10	Sprayed very nice, hangs well, dries flat, low atomization pressure	Excellent
General Finishes High Performa	98	8	Sputtered without thinning, Thinned ~10%, sprayed very nice, no vertical slump even thinned, no visible bubbles (wet)	Excellent **
Hydrocote Resisthane Plus	25	10	no thinning. Sprayed nicely, some small bubbles but not objectionable, good vertical hang	Excellent
JE Moser's Marine Shield	15	7	Sprayed very well, very low atomization pressure needed, some bubbles but acceptable	Excellent
JE Moser's Simple Success	9	< 2	Sprayed very well, very low atomization pressure needed, very poor vertical hang, some bubbles	Fair
Minwax Polycrylic	24	4	Can States "thinning not recommended", excessive bubbles/pinholes	Good
ML Campbell Ultrastar	12	4	Sprayed very nicely, dried flat, no bubbles, some small fisheyes probably from chart not finish, good vertical hang	Excellent
Olympic Waterbased PU	25	6	Thinned ~10%, sprays great, few bubbles (wet),	Excellent **
Target Ultima Brushing Varnish	15	9	Sprays clear like solvent finish, good hang, v few bubbles (wet)	Excellent
Varathane Diamond Polyuretha	31	5	No thinning, sprayed very nice, good vertical sag resistance, no visible bubbles (wet)	Good

Wagner Spray Tech HVLP conversion spray gun, #3 nozzle & needle, pattern adjusted to ~8" for each finish, Input air pressure 25psi, output air adjusted for individual finish to achieve best atomization.

Excellent = sprays like solvent lacquer, Good = sprayed very well but some bubbles, Fair = excessive microbubbles in the dried finish cause haze , Poor = visible orange peal or excessive bubbles or pinholes.

** thinning of no more than 15% needed to spray acceptably

Heat Resistance

Finish Brand	Visual appearance after 30 Minute	Visual appearance after 24 hours and after buffing	Heat Resistance
AquaZar Waterbased Polyurethane	Slight ring mark, some whitening	mark buffed out	Good
Benjamin Moore Stays Clear	slight ring mark, very slight whitening	mark buffed out and whitening disappeared	Good
Crystalac Premium Gloss	very slight mark, no whitening	mark buffed out	Good
Fuhr 355 Acrylic Varnish	No damage	No damage	Excellent
General Finishes High Performance	Slight ring mark, some whitening	ring mark buffed out but the oak has a black stain under the finish. Indicates porous finish	Poor
Hydrocote Resisthane Plus	Slight ring mark, no whitening	mark buffed out	Good
JE Moser's Marine Shield	No damage	No damage	Excellent
JE Moser's Simple Success	Major whitening of the finish, nut stuck to the finish.	No change after buffing, still major whitening	Poor
Minwax Polycrylic	major whitening of the finish	no change	Poor
ML Campbell Ultrastar	No damage	No damage	Excellent
Olympic Water Based Polyurethane	very slight mark, no whitening	mark buffed out	Good
Target Ultima Brushing Varnish	very slight mark, no whitening	mark buffed out	Good
Varathane Diamond Polyurethane	very slight mark, no whitening	mark buffed out	Good
Minwax Fast Dry Polyurethane	No damage	No damage	Excellent
ML Campbell Magmax	No damage	No damage	Excellent

Heat resistance test -- 3/4" galvanized steel nuts were heated in boiling water for 10 minutes. The hot wet nut was placed on the finished (three coats) surface of each panel and allowed to cool to room temperature. After 30 minutes the nut was removed from the test panel and any remaining water was wiped off with a paper towel. The surface was inspected for damage. After 24 hours the panels were inspected again and the damaged area (if any) was buffed with a soft dry cloth to try to remove the damage.

Rating scale -- Excellent = no damage at the 30 minute inspection, Good = slight damage at the 30 minute inspection but was buffed out at 24 hour inspection
 Poor = damage that could not be buffed out at 24 hour inspection.

Percent Solids

Finish Brand	% Weight Solids	Sample A			Sample B			Sample A		Sample B	
		Tare	Gross	Net Wet Grams	Tare	Gross	Net Wet Grams	Gross	Net Dry Grams	Gross	Net Dry Grams
AquaZar Waterbased Polyurethane	35%	1.2668	1.8226	0.5558	1.2549	1.7662	0.5113	1.4608	0.194	1.4324	0.1775
Benjamin Moore Stays Clear	32%	1.2503	1.9495	0.6992	1.2611	1.8093	0.5482	1.4723	0.222	1.4344	0.1733
Crystalac Premium Gloss	23%	1.2616	1.868	0.6064	1.2658	1.7621	0.4963	1.4031	0.1415	1.3811	0.1153
Fuhr 355 Acrylic Varnish	38%	1.2568	1.7474	0.4906	1.2708	1.7733	0.5025	1.4428	0.186	1.4623	0.1915
General Finishes High Performance	23%	1.248	1.8012	0.5532	1.2628	1.7939	0.5311	1.373	0.125	1.3827	0.1199
Hydrocote Resisthane Plus	31%	1.2633	1.7952	0.5319	1.2587	1.7643	0.5056	1.4293	0.166	1.4181	0.1594
JE Moser's Marine Shield	33%	1.2497	1.7594	0.5097	1.2653	1.7682	0.5029	1.4187	0.169	1.433	0.1677
JE Moser's Simple Success	31%	1.2489	1.7475	0.4986	1.2607	1.734	0.4733	1.4024	0.1535	1.4046	0.1439
Minwax Polycrylic	31%	1.264	1.8178	0.5538	1.2659	1.7652	0.4993	1.437	0.173	1.4223	0.1564
ML Campbell Ultrastar	30%	1.2671	1.7569	0.4898	1.2644	1.7383	0.4739	1.4146	0.1475	1.4065	0.1421
Olympic Waterbased PU	27%	1.2663	1.7591	0.4928	1.2612	1.7424	0.4812	1.4003	0.134	1.3927	0.1315
Target Ultima Brushing Varnish	33%	1.2623	1.7381	0.4758	1.2549	1.8274	0.5725	1.4201	0.1578	1.4458	0.1909
Varathane Diamond Polyurethane	30%	1.2597	1.7314	0.4717	1.2647	1.7806	0.5159	1.402	0.1423	1.4198	0.1551
Minwax Fast Dry Polyurethane	44%	1.268	1.7551	0.4871	1.2652	1.7815	0.5163	1.4823	0.2143	1.4939	0.2287
ML Campbell Magnamax	29%	1.2568	1.7682	0.5114	1.2646	1.7629	0.4983	1.4055	0.1487	1.4093	0.1447

ASTM Standard D-2369 was followed to determine percent solids by weight for each finish.

Food stain test

Finish Brand	Vinegar	Lemon Juice	Orange Juice	Grape Juice	Tomato Catsup	Hot Coffee	Olive Oil	100-Proof Alcohol	Mustard	Dish Sponge	Food Stain Resistance
AquaZar Waterbased Polyurethane	2	2	2	2	2	2	2	2	0	2	18
Benjamin Moore Stays Clear	2	2	2	2	2	2	2	2	0	2	18
Crystalac Premium Gloss	2	2	2	2	2	2	2	2	0	2	18
Fuhr 355 Acrylic Varnish	2	2	2	2	2	2	2	2	2	2	20
General Finishes High Performance	2	2	2	2	2	2	2	2	0	2	18
Hydrocote Resisthane Plus	1	1	2	2	2	2	2	2	1	2	17
JE Moser's Marine Shield	2	2	2	2	2	2	2	2	0	2	18
JE Moser's Simple Success	2	2	2	2	2	2	2	1	0	2	17
Minwax Polycrylic	1	2	2	2	2	2	2	1	0	2	16
ML Campbell Ultrastar	2	2	2	2	2	2	2	2	2	2	20
Olympic Water Based Polyurethane	2	2	2	2	2	2	2	1	2	2	19
Target Ultima Brushing Varnish	2	2	2	2	2	2	2	2	0	2	18
Varathane Diamond Polyurethane	2	2	2	2	2	2	2	2	1	2	19
Minwax Fast Dry Polyurethane	2	2	2	2	2	2	2	2	2	2	20
ML Campbell Magmax	2	2	2	2	2	2	2	2	2	2	20

The food stain resistance evaluation was conducted in accordance with KCMA testing standards except: the finishes were tested in horizontal position (instead of vertical) to simulate a dining table and all test foods were allowed to stand on the surface for 24 hours (instead of only one hour for mustard).

Scoring: 2 points = no visible damage, 1 point = damage to finish but it could be removed by buffing or washing, 0 points = permanent damage
The food stain resistance score is the sum of the individual scores.