IG Performance Data

LoĒ™ coatings provide thermal insulation and regulate the amount of solar energy transmitting through the insulating glass (IG) product.

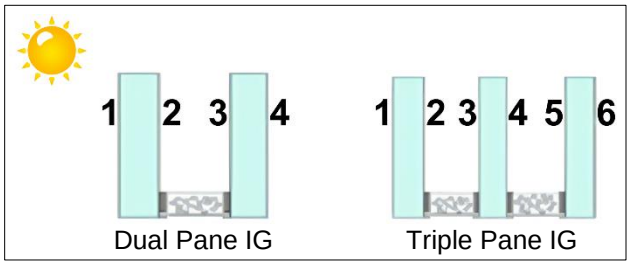
Solar radiation blocking LoĒ coatings include LoĒ²-240®, LoĒ³-366®, LoĒ³-340®, and Quad LoĒ-452+®. Generally used in warm, high solar regions.

Passive, non-blocking solar radiation, LoĒ coatings include LoĒ-180®, LoĒ-180 ESC™, LoĒ-i89®, and LoĒ-Di89®. These coatings are generally used on surface #3 of a dual pane IG unit. This allows for high solar heat gain to occur and is generally used in cold environments.

Balanced solar controlled LoĒ coatings include LoĒ²-272® & LoĒ²-270® coatings. These coatings both allow and block a medium amount of the solar radiation. They are used in areas where a mix of cold and warm season exist.

In addition to LoĒ coatings, tinted glass products are used to provide color, glare reduction, and additional solar control benefits in some IG configurations.

Winter U-factors are not affected when Cardinal's LoĒ coatings are used on the #2 or #3 glass surface in a dual pane IG unit, but the Solar Heat Gain Coefficient (SHGC) will be higher when the coatings are on the #3 glass surface compared to the #2 glass surface.



Cardinal also does not recommend solar control LoE coatings (LoĒ²-240®, LoĒ³-366®, LoĒ³-340®, and Quad LoĒ-452+®) to be used on the #3 glass surface of a dual pane IG unit with a clear outdoor lite. The potential for having inside glass breakage from thermally induced stress is increased. These coatings are designed as #2 glass surface coatings in a dual or triple pane IG unit.

The following pages contain performance values for different IG constructions

Cardinal Double Pane Insulating Glass Performance Data

Glass	Airspace	Glass
3mm	13.0mm	3mm
⅛"	½"	⅛"

Exterior Glass	Interior Glass	Visible Light			SHGC	Center of Glass U-Factor (BTU/hr/ft²/°F)		Center of Glass Indoor Glass Temperature (°F)		UV Trans
		Trans	Reflectance							
			Out	In		Air	Argon	Winter	Summer	
Clear	Clear	82%	15%	15%	0.78	0.48	0.46	45	90	58%
Clear	LoĒ-i89 (3)	80%	15%	14%	0.75	0.33	0.29	54	98	55%
Clear	LoĒ-180 ESC (3)	79%	15%	15%	0.71	0.31	0.27	55	94	25%
Clear	LoĒ-180 (3)	79%	15%	15%	0.69	0.31	0.26	55	94	29%
Clear	LoĒ-Di89 (3 & 4)	79%	14%	14%	0.71	0.26	0.23	44	122	52%
LoĒ-180 ESC (2)	Clear	79%	15%	15%	0.67	0.31	0.27	55	87	25%
LoĒ-180 (2)	Clear	79%	15%	15%	0.64	0.31	0.26	55	87	29%
LoĒ²-272 (2)	Clear	72%	11%	12%	0.41	0.30	0.25	56	84	16%
LoĒ²-270 (2)	Clear	70%	12%	13%	0.37	0.30	0.25	56	83	14%
LoĒ³-366 (2)	Clear	65%	11%	12%	0.27	0.29	0.24	56	82	5%
Quad LoĒ-452+ (2)	Clear	52%	10%	15%	0.22	0.29	0.24	56	83	1%
LoĒ²-240 (2)	Clear	40%	14%	11%	0.25	0.30	0.26	55	86	16%
LoĒ³-340 (2)	Clear	39%	13%	16%	0.18	0.29	0.25	56	83	2%
LoĒ-180 ESC® (2)	LoĒ-i89 (4)	78%	15%	14%	0.64	0.24	0.21	46	107	24%
LoĒ-180 (2)	LoĒ-i89 (4)	77%	15%	14%	0.62	0.24	0.21	46	105	27%
LoĒ²-272 (2)	LoĒ-i89 (4)	70%	11%	11%	0.41	0.23	0.20	47	94	16%
LoĒ²-270 (2)	LoĒ-i89 (4)	68%	12%	13%	0.36	0.23	0.20	47	93	14%
LoĒ³-366 (2)	LoĒ-i89 (4)	63%	11%	12%	0.27	0.23	0.20	48	90	5%
Quad LoĒ-452+ (2)	LoĒ-i89 (4)	51%	10%	14%	0.21	0.23	0.20	48	91	1%
LoĒ²-240 (2)	LoĒ-i89 (4)	39%	14%	10%	0.24	0.24	0.21	47	95	15%
LoĒ³-340 (2)	LoĒ-i89 (4)	38%	13%	15%	0.17	0.23	0.20	47	91	2%

Notes:

(1) Data was calculated using LBNL Window computer program with winter & summer NFRC environmental conditions.
(2) Calculations based on 90% Argon gas fill level.
(3) Shading Coefficient (SC) can be calculated by dividing SHGC by 0.87.
(4) The UV Transmittance is determined as an average for wavelengths 310-380 nm.

Cardinal Double Pane Insulating Tinted Glass Performance Data

Glass	Airspace	Glass
3mm	13.0mm	3mm
⅛"	½"	⅛"

Exterior Glass	Interior Glass	Visible Light			SHGC	Center of Glass U-Factor (BTU/hr/ft²/°F)		Center of Glass Indoor Glass Temperature (°F)		UV Trans
		Trans	Reflectance							
			Out	In		Air	Argon	Winter	Summer	
Green	Clear	75%	14%	15%	0.60	0.48	0.46	45	94	36%
Green	LoĒ-i89 (3)	74%	13%	14%	0.56	0.33	0.29	54	95	35%
Green	LoĒ-180 ESC (3)	73%	14%	15%	0.53	0.31	0.27	55	92	16%
Green	LoĒ-180 (3)	73%	13%	15%	0.52	0.31	0.26	55	92	19%
Green	LoĒ-Di89 (3 & 4)	72%	13%	13%	0.53	0.26	0.23	44	115	34%
Green	LoĒ²-272 (3)	66%	11%	11%	0.42	0.30	0.25	56	97	11%
Green	LoĒ²-270 (3)	64%	12%	12%	0.39	0.30	0.25	56	97	10%
Green	LoĒ³-366 (3)	59%	11%	11%	0.35	0.29	0.24	56	100	3%
Green	Quad LoĒ-452+ (3)	48%	14%	10%	0.36	0.29	0.24	56	108	1%
Green	LoĒ²-240 (3)	37%	10%	14%	0.42	0.30	0.26	55	117	11%
Green	LoĒ³-340 (3)	36%	14%	13%	0.36	0.29	0.25	56	114	1%
Gray	Clear	55%	9%	14%	0.58	0.48	0.46	45	95	32%
Gray	LoĒ-i89 (3)	54%	9%	13%	0.53	0.33	0.29	54	97	30%
Gray	LoĒ-180 ESC (3)	53%	9%	14%	0.50	0.31	0.27	55	93	14%
Gray	LoĒ-180 (3)	53%	9%	14%	0.49	0.31	0.26	55	93	17%
Gray	LoĒ-Di89 (3 & 4)	52%	9%	12%	0.50	0.26	0.23	44	117	29%
Gray	LoĒ²-272 (3)	48%	8%	10%	0.37	0.30	0.25	56	96	10%
Gray	LoĒ²-270 (3)	47%	9%	11%	0.34	0.30	0.25	56	97	9%
Gray	LoĒ³-366 (3)	43%	8%	10%	0.29	0.29	0.24	56	98	3%
Gray	Quad LoĒ-452+ (3)	35%	10%	9%	0.30	0.29	0.24	56	106	<1%
Gray	LoĒ²-240 (3)	27%	7%	14%	0.37	0.30	0.26	55	115	9%
Gray	LoĒ³-340 (3)	26%	10%	13%	0.31	0.29	0.25	56	111	1%
Bronze	Clear	61%	10%	14%	0.63	0.48	0.46	45	94	33%
Bronze	LoĒ-i89 (3)	59%	10%	13%	0.58	0.33	0.29	54	97	32%
Bronze	LoĒ-180 ESC (3)	59%	10%	14%	0.55	0.31	0.27	55	93	15%
Bronze	LoĒ-180 (3)	59%	10%	14%	0.53	0.31	0.26	55	93	17%
Bronze	LoĒ-Di89 (3 & 4)	58%	10%	13%	0.55	0.26	0.23	44	119	30%
Bronze	LoĒ²-272 (3)	53%	9%	10%	0.39	0.30	0.25	56	96	10%
Bronze	LoĒ²-270 (3)	52%	10%	12%	0.36	0.30	0.25	56	97	9%
Bronze	LoĒ³-366 (3)	48%	9%	11%	0.31	0.29	0.24	56	99	3%
Bronze	Quad LoĒ-452+ (3)	39%	11%	9%	0.32	0.29	0.24	56	107	<1%

Notes:

(1) Data was calculated using LBNL Window computer program with winter & summer NFRC environmental conditions.
(2) Calculations based on 90% Argon gas fill level.
(3) Shading Coefficient (SC) can be calculated by dividing SHGC by 0.87.
(4) The UV Transmittance is determined as an average for wavelengths 310-380 nm.

Cardinal Double Pane Insulating Glass Performance Data

Glass	Airspace	Glass
6mm	13.0mm	6mm
¼"	½"	¼"

Exterior Glass	Interior Glass	Visible Light			SHGC	Center of Glass U-Factor (BTU/hr/ft²/°F)		Center of Glass Indoor Glass Temperature (°F)		UV Trans
		Trans	Reflectance							
			Out	In		Air	Argon	Winter	Summer	
Clear	Clear	80%	15%	15%	0.72	0.47	0.45	45	96	48%
Clear	LoĒ-i89 (3)	78%	14%	14%	0.69	0.33	0.29	54	102	46%
Clear	LoĒ-180 ESC (3)	77%	14%	15%	0.66	0.31	0.26	55	98	21%
Clear	LoĒ-180 (3)	77%	14%	15%	0.64	0.30	0.26	55	98	24%
Clear	LoĒ-Di89 (3 & 4)	76%	14%	13%	0.66	0.26	0.23	45	127	44%
LoĒ-180 ESC (2)	Clear	77%	15%	14%	0.62	0.31	0.26	55	93	21%
LoĒ-180 (2)	Clear	77%	15%	14%	0.60	0.30	0.26	55	92	24%
LoĒ²-272 (2)	Clear	70%	11%	11%	0.40	0.29	0.25	56	87	14%
LoĒ²-270 (2)	Clear	68%	12%	13%	0.36	0.29	0.25	56	86	12%
LoĒ³-366 (2)	Clear	63%	11%	12%	0.27	0.29	0.24	56	84	4%
Quad LoĒ-452+ (2)	Clear	51%	9%	15%	0.22	0.29	0.24	56	85	1%
LoĒ²-240 (2)	Clear	37%	13%	10%	0.24	0.30	0.25	56	88	13%
LoĒ³-340 (2)	Clear	38%	13%	15%	0.18	0.29	0.24	56	85	2%
LoĒ-180 ESC (2)	LoĒ-i89 (4)	75%	15%	14%	0.60	0.24	0.21	46	114	20%
LoĒ-180 (2)	LoĒ-i89 (4)	75%	15%	13%	0.58	0.24	0.21	47	112	23%
LoĒ²-272 (2)	LoĒ-i89 (4)	68%	10%	11%	0.39	0.23	0.20	47	99	14%
LoĒ²-270 (2)	LoĒ-i89 (4)	66%	12%	12%	0.35	0.23	0.20	47	97	12%
LoĒ³-366 (2)	LoĒ-i89 (4)	61%	11%	11%	0.26	0.23	0.19	48	93	4%
Quad LoĒ-452+ (2)	LoĒ-i89 (4)	50%	9%	14%	0.21	0.23	0.19	48	93	1%
LoĒ²-240 (2)	LoĒ-i89 (4)	37%	13%	9%	0.23	0.24	0.21	47	98	13%
LoĒ³-340 (2)	LoĒ-i89 (4)	37%	13%	14%	0.17	0.23	0.20	48	93	2%

Notes:

(1) Data was calculated using LBNL Window computer program with winter & summer NFRC environmental conditions.
(2) Calculations based on 90% Argon gas fill level.
(3) Shading Coefficient (SC) can be calculated by dividing SHGC by 0.87.
(4) The UV Transmittance is determined as an average for wavelengths 310-380 nm.

Cardinal Double Pane Insulating Tinted Glass Performance Data

Glass	Airspace	Glass
6mm	13.0mm	6mm
¼"	½"	¼"

Exterior Glass	Interior Glass	Visible Light			SHGC	Center of Glass U-Factor (BTU/hr/ft²/°F)		Center of Glass Indoor Glass Temperature (°F)		UV Trans
		Trans	Reflectance							
			Out	In		Air	Argon	Winter	Summer	
Green	Clear	69%	12%	14%	0.50	0.47	0.45	45	98	25%
Green	LoĒ-i89 (3)	68%	12%	14%	0.45	0.33	0.29	54	96	24%
Green	LoĒ-180 ESC (3)	67%	12%	15%	0.43	0.31	0.26	55	94	11%
Green	LoĒ-180 (3)	67%	12%	15%	0.42	0.30	0.26	55	94	13%
Green	LoĒ-Di89 (3 & 4)	66%	12%	13%	0.43	0.26	0.23	45	114	23%
Green	LoĒ²-272 (3)	61%	10%	10%	0.37	0.29	0.25	56	97	8%
Green	LoĒ²-270 (3)	59%	11%	12%	0.35	0.29	0.25	56	97	7%
Green	LoĒ³-36® (3)	55%	10%	11%	0.32	0.29	0.24	56	99	2%
Green	Quad LoĒ-452+ (3)	44%	13%	9%	0.32	0.29	0.24	56	106	<1%
Green	LoĒ²-240 (3)	33%	9%	13%	0.36	0.30	0.25	56	114	7%
Green	LoĒ³-340 (3)	33%	13%	13%	0.32	0.29	0.24	56	111	1%
Gray	Clear	40%	7%	13%	0.46	0.47	0.45	45	101	20%
Gray	LoĒ-i89 (3)	39%	7%	12%	0.41	0.33	0.29	54	99	19%
Gray	LoĒ-180 ESC (3)	38%	7%	13%	0.38	0.31	0.26	55	95	9%
Gray	LoĒ-180 (3)	38%	7%	13%	0.37	0.30	0.26	55	95	10%
Gray	LoĒ-Di89 (3 & 4)	38%	7%	12%	0.38	0.26	0.23	45	118	18%
Gray	LoĒ²-272 (3)	35%	6%	9%	0.29	0.29	0.25	56	96	7%
Gray	LoĒ²-270 (3)	34%	7%	11%	0.27	0.29	0.25	56	96	6%
Gray	LoĒ³-366 (3)	31%	7%	10%	0.23	0.29	0.24	56	97	2%
Gray	Quad LoĒ-452+ (3)	25%	7%	9%	0.24	0.29	0.24	56	102	<1%
Gray	LoĒ²-240 (3)	19%	6%	13%	0.29	0.30	0.25	56	109	6%
Gray	LoĒ³-340 (3)	19%	7%	13%	0.24	0.29	0.24	56	106	<1%
Bronze	Clear	48%	8%	13%	0.51	0.47	0.45	45	100	21%
Bronze	LoĒ-i89 (3)	47%	8%	13%	0.47	0.33	0.29	54	100	20%
Bronze	LoĒ-180 ESC (3)	46%	8%	14%	0.44	0.31	0.26	55	96	9%
Bronze	LoĒ-180 (3)	46%	8%	14%	0.43	0.30	0.26	55	96	11%
Bronze	LoĒ-Di89 (3 & 4)	45%	8%	12%	0.44	0.26	0.23	45	120	19%
Bronze	LoĒ²-272 (3)	42%	7%	9%	0.32	0.29	0.25	56	97	7%
Bronze	LoĒ²-270 (3)	40%	8%	11%	0.30	0.29	0.25	56	97	6%
Bronze	LoĒ³-366 (3)	37%	7%	10%	0.26	0.29	0.24	56	98	2%
Bronze	Quad LoĒ-452+ (3)	30%	8%	9%	0.27	0.29	0.24	56	104	<1%
Bronze	LoĒ²-240 (3)	22%	7%	13%	0.33	0.30	0.25	56	112	6%
Bronze	LoĒ³-340 (3)	22%	9%	13%	0.27	0.29	0.24	56	109	<1%

Notes:

(1) Data was calculated using LBNL Window computer program with winter & summer NFRC environmental conditions.
(2) Calculations based on 90% Argon gas fill level.
(3) Shading Coefficient (SC) can be calculated by dividing SHGC by 0.87.
(4) The UV Transmittance is determined as an average for wavelengths 310-380 nm.

Cardinal Triple Pane Insulating Glass Performance Data

Glass	Airspace	Glass	Airspace	Glass
3mm	9.8mm	3mm	9.8mm	3mm
⅛"	⅜"	⅛"	⅜"	⅛"

Exterior Glass	Center Glass	Interior Glass	Visible Light			SHGC	Center of Glass U-Factor (BTU/hr/ft²/°F)		Center of Glass Indoor Glass Temperature (°F)		UV Trans
			Trans	Reflectance							
				Out	In		Air	Argon	Winter	Summer	
LoĒ-180 ESC (2)	Clear	LoĒ-180 ESC (5)	70%	21%	21%	0.58	0.19	0.15	61	94	10%
LoĒ-180 (2)	Clear	LoĒ-180 (5)	70%	20%	20%	0.56	0.19	0.15	61	94	13%
LoĒ-180 ESC (2)	Clear	LoĒ-Di89 (3 & 4)	69%	20%	19%	0.58	0.17	0.14	53	119	19%
LoĒ²-272 (2)	Clear	LoĒ-180 (5)	63%	15%	18%	0.37	0.19	0.15	61	87	8%
LoĒ²-270 (2)	Clear	LoĒ-180 (5)	62%	16%	19%	0.33	0.19	0.15	61	86	7%
LoĒ³-366 (2)	Clear	LoĒ-180 (5)	57%	15%	18%	0.25	0.19	0.14	62	83	2%
Quad LoĒ-452+ (2)	Clear	LoĒ-180 (5)	46%	12%	21%	0.20	0.18	0.14	62	83	<1%
LoĒ²-240 (2)	Clear	LoĒ-180 (5)	35%	16%	17%	0.22	0.19	0.15	61	86	7%
LoĒ³-340 (2)	Clear	LoĒ-180 (5)	34%	15%	21%	0.16	0.19	0.14	61	83	1%
LoĒ-180 ESC (2)	LoĒ-180 ESC (4)	LoĒ-i89 (6)	68%	21%	19%	0.54	0.16	0.13	54	112	11%
LoĒ-180 (2)	LoĒ-180 (4)	LoĒ-i89 (6)	68%	21%	19%	0.53	0.16	0.13	54	111	13%
LoĒ²-272 (2)	LoĒ-180 (4)	LoĒ-i89 (6)	62%	15%	16%	0.36	0.16	0.13	54	97	8%
LoĒ²-270 (2)	LoĒ-180 (4)	LoĒ-i89 (6)	60%	16%	18%	0.32	0.16	0.13	54	95	6%
LoĒ³-366 (2)	LoĒ-180 (4)	LoĒ-i89 (6)	56%	15%	17%	0.24	0.16	0.13	55	90	2%
Quad LoĒ-452+ (2)	LoĒ-180 (4)	LoĒ-i89 (6)	45%	12%	19%	0.19	0.16	0.13	55	90	<1%
LoĒ²-240 (2)	LoĒ-180 (4)	LoĒ-i89 (6)	34%	16%	15%	0.21	0.16	0.13	54	95	7%
LoĒ³-340 (2)	LoĒ-180 (4)	LoĒ-i89 (6)	33%	15%	19%	0.15	0.16	0.13	55	89	1%

Notes:

(1) Data was calculated using LBNL Window computer program with winter & summer NFRC environmental conditions.
(2) Calculations based on 90% Argon gas fill level.
(3) Shading Coefficient (SC) can be calculated by dividing SHGC by 0.87.
(4) The UV Transmittance is determined as an average for wavelengths 310-380 nm.

Performance Comparison of Coating Glass Products
Double Pane Insulating

Glass	Airspace	Glass
3mm	13.0mm	3mm
⅛”	½”	⅛”

Exterior Glass	Interior Glass	Visible Light			SHGC	Center of Glass U-Factor (BTU/hr/ft²/°F)		Center of Glass Indoor Glass Temperature (°F)		UV Trans
		Trans	Reflectance							
			Out	In		Air	Argon	Winter	Summer	
Solar Radiation Blocking Glass Coatings (Low SHGC)										
Cardinal LoÉ³-366 (2)	Clear	65%	11%	12%	0.27	0.29	0.24	56	82	5%
Cardinal Quad LoÉ-452+ (2)	Clear	52%	10%	15%	0.22	0.29	0.24	56	83	1%
Cardinal LoÉ²-240 (2)	Clear	40%	14%	11%	0.25	0.30	0.26	55	86	16%
Cardinal LoÉ³-340 (2)	Clear	39%	13%	16%	0.18	0.29	0.25	56	83	2%
Vitro SolarBan® 70 (2)	Clear	63%	12%	14%	0.26	0.29	0.24	56	83	4%
Guardian ClimaGuard® 62/27 (2)	Clear	62%	11%	12%	0.28	0.29	0.25	56	83	8%
Guardian. ClimaGuard® 55/27 (2)	Clear	56%	17%	19%	0.28	0.29	0.25	56	83	20%
Guardian ClimaGuard® 53/23 (2)	Clear	53%	13%	12%	0.23	0.29	0.24	56	83	10%
Low-E Glass Coatings (Midrange SHGC)										
Cardinal LoÉ²-272 (2)	Clear	72%	11%	12%	0.41	0.30	0.25	56	84	16%
Cardinal LoÉ²-270 (2)	Clear	70%	12%	13%	0.37	0.30	0.25	56	83	14%
Vitro SolarBan® 60 (2)	Clear	73%	11%	12%	0.40	0.30	0.25	56	84	20%
Guardian ClimaGuard® 72/57 (2)	Clear	71%	14%	13%	0.47	0.30	0.25	56	85	26%
Guardian ClimaGuard® 70/36 (2)	Clear	70%	11%	12%	0.38	0.30	0.25	56	83	24%
Passive Design Low-E Glass Coatings (High SHGC)										
Clear	LoÉ-i89 (3)	80%	15%	14%	0.75	0.33	0.29	54	98	55%
Clear	LoÉ-180 ESC® (3)	79%	15%	15%	0.71	0.31	0.27	55	94	25%
Clear	LoÉ-180 (3)	79%	15%	15%	0.69	0.31	0.26	55	94	29%
Clear	LoÉ-Di89 (3 & 4)	79%	14%	14%	0.71	0.26	0.23	44	122	52%
Clear	Guardian ClimaGuard® 80/71 (3)	80%	14%	14%	0.70	0.31	0.27	55	94	44%
Clear	Vitro Sungate® 400 (3)	79%	14%	14%	0.69	0.32	0.28	54	97	32%
Clear	Pilkngton Energy Adv.™ (3)	77%	17%	17%	0.74	0.34	0.30	53	96	51%

Notes:

(1) Data was calculated using LBNL Window computer program with winter & summer NFRC environmental conditions.
(2) Calculations based on 90% Argon gas fill level.
(3) Shading Coefficient (SC) can be calculated by dividing SHGC by 0.87.
(4) The UV Transmittance is determined as an average for wavelengths 310-380 nm.

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