

Cardinal LoE-i81 Coating

The Federal Government Stimulus Package for Windows stipulates that the overall window must have a U-Value of 0.30 and a Solar Heat Gain Coefficient of 0.30. If the window has this performance, the homeowner is entitled to a tax credit of 30% of the window cost up to a total of \$1500. To meet the thermal performance as stipulated in the stimulus package, some window manufactures have had to either use a pyrolytic LoE coating on surface #4 of an IG unit or triple glazing. In addition, the EPA (Environmental Protection Agency) new Energy Star program (formerly run by the DOE (Department of Energy), and the International Energy Conservation Code, will most likely continue to increase the energy efficiency requirements of window systems for Residential and Commercial applications, necessitating Window Companies to either re-design their window frame or use triple glazing and/or durable LoE coatings that can be applied to surface #4 of an IG unit or surface #6 of a triple glazed unit.

In the desire to assist our customers with more energy efficient glass products that meet or exceed Federal Government Stimulus Package, DOE Energy Star, and IECC, Cardinal CG company has developed a durable sputtered TCO (Transparent Conductive Oxide) that can be used on the roomside glass surface (surface #4 of an IG unit) or surface #6 of a triple glazed unit. This coating is designated LoE-i81. The results of considerable testing of this new and unique LoE-i81 coating have produced the following attributes:

- In an IG unit with Cardinal's LoE³-366 coating on surface #2 and the LoE-i81 coating on surface #4, the center of glass U-Value with a 90% argon fill is 0.20.
- In an IG unit with Cardinal's LoE³-366 coating on surface #2 and the LoE-i81 coating on surface #4, the center of glass U-Value with air fill is 0.23.
- The coating has an emissivity of 0.149.
- The coating is durable so that it can be used on the roomside glass surface.
- The coating has the same haze as clear glass.
- The coating is not rough like most pyrolytic coatings and is easily cleaned.
- The coating is compatible with most glazing sealants used in the window industry.
- The coating is compatible with Cardinal's Preserve glass protective film.
- The coating is compatible with most glazing tapes used in the window industry.
- Label removal on the LoE-i81 coating will be similar to that of clear glass.

The LoE-i81 coating is an Indium Tin Oxide Coating applied by the sputtering process which Cardinal CG company has applied for Patent Protection. The coating is unique, using state of the art technology for production of this coating. It has applications in windows, storm panels, freezer doors, etc. and can assist in the performance of windows to meet energy codes in high altitude applications where argon filling cannot be done because capillary tubes are used.

Other considerations for the LoE-i81 coating.

- To obtain the grain structure of the coating, the LoE-i81 product must be supplied as a heat treated glass product (Heat Strengthened Glass or Tempered Glass).
- Because the coating on the number 4 glass surface in an IG unit or number 6 glass surface in a triple glazed unit reflects roomside radiation back into the room, the roomside pane of glass will be colder than the same glass construction that does not include the i-81 coating. This will result in a slightly colder roomside pane in winter conditions with the potential of having a higher probability of roomside glass condensation in the winter. Naturally this is very dependent on the outdoor ambient temperature, indoor room temperature, and the % RH in the room.
- When LoE-i81 is used on the roomside pane, at this time there is no way to non-destructively measure argon fill levels using Sparklite Gasglass technology because you cannot spark through a metalized coating.
- The use of a LoE coating as the center lite of a triple pane unit requires Heat Strengthening of the center LoE lite to reduce the risk for thermal stress breakage. One exception is with the triple pane combination of LoE³-366 #2/LoE-179 #4/LoE-i81 #6 where in typical glazing applications all three lites could be annealed due to the solar control properties of the LoE³-366 product. Contact Cardinal's Technical Service department for recommendations on Heat Treating of LoE products in triple pane applications.
- No special cleaning requirements are necessary to clean the LoE-i81 coated glass. Standard cleaning solutions such as a soap solution with clean water or standard window cleaning products can be used.
- As with standard non-coated glass products, razor blades or other sharp instruments should not be used when cleaning the LoE-i81 glass surface. If a squeegee is used to clean the coated glass surface, the squeegee should not have any metal edges exposed as the metal edges could scratch the coating or glass itself.

Cardinal has submitted to the International Glazing Data Base, the LoE-i81 coating Spectral Data Files and these files were approved for use in the NFRC Certification Program.

Thermal performance of the LoE-i81 coating when it is used in double and triple glazed glass constructions is attached.

INSULATING GLASS PERFORMANCE COMPARISON

| Product | IG Construction | Visible Light | | | Center of Glass | | | Indoor | | Center of Glass | | Indoor | | Krochman Damage (Fx) 300-600nm | UV Trans 300-380 nm | ISO Fading Function 300-700 nm |
|--|---------------------------|---------------|-------------|------|--|---------|-----------|----------------------|----------------------|----------------------|--------|--------|----------------------|--------------------------------|---------------------|--------------------------------|
| | | Trans. % | Reflectance | | Winter U-Value Btu/hr/ft ² /F | Air RHG | Argon 90% | Glass Temperature °F | Glass Temperature °F | Allowable % RH @70°F | Summer | Winter | Glass Temperature °F | | | |
| | | | % Out | % in | | | | | | | | | | | | |
| Two Pane LoE ⁺ -272 | 3.0E4/13.0/3.0 | 72 | 11 | 12 | 0.41 | 0.48 | 98 | 0.30 | 0.25 | 0.20 | 56 | 84 | 61 | 16 | 33 | 55 |
| Two Pane LoE ⁺ -272 w/i81 #4 | 3.0E4/13.0/3.0/81 | 64 | 16 | 20 | 0.38 | 0.44 | 89 | 0.23 | 0.20 | 0.20 | 47 | 93 | 44 | 15 | 30 | 48 |
| Two Pane LoE ⁺ -270 | 3.0E0/13.0/3.0 | 70 | 12 | 13 | 0.37 | 0.42 | 88 | 0.30 | 0.25 | 0.25 | 56 | 83 | 61 | 14 | 31 | 53 |
| Two Pane LoE ⁺ -270 w/i81 #4 | 3.0E0/13.0/3.0/81 | 63 | 17 | 21 | 0.34 | 0.39 | 80 | 0.23 | 0.20 | 0.20 | 47 | 91 | 44 | 14 | 28 | 46 |
| Two Pane LoE ⁺ -366 | 3.0X3/13.0/3.0 | 65 | 11 | 12 | 0.27 | 0.31 | 66 | 0.29 | 0.24 | 0.24 | 56 | 82 | 61 | 5 | 21 | 43 |
| Two Pane LoE ⁺ -366 w/i81 #4 | 3.0X3/13.0/3.0/81 | 58 | 15 | 20 | 0.25 | 0.28 | 59 | 0.23 | 0.20 | 0.20 | 48 | 89 | 45 | 5 | 18 | 37 |
| Two Pane LoE ⁺ -272 | 4.7E4/13.0/4.7 | 71 | 10 | 11 | 0.40 | 0.47 | 96 | 0.30 | 0.25 | 0.25 | 56 | 86 | 61 | 15 | 32 | 53 |
| Two Pane LoE ⁺ -272 w/i81 #4 | 4.7E4/13.0/4.7/81 | 63 | 16 | 20 | 0.37 | 0.43 | 87 | 0.23 | 0.20 | 0.20 | 47 | 96 | 44 | 14 | 29 | 47 |
| Two Pane LoE ⁺ -270 | 4.7E0/13.0/4.7 | 69 | 12 | 12 | 0.36 | 0.41 | 86 | 0.29 | 0.25 | 0.25 | 56 | 85 | 61 | 13 | 40 | 51 |
| Two Pane LoE ⁺ -270 w/i81 #4 | 4.7E0/13.0/4.7/81 | 61 | 17 | 20 | 0.33 | 0.38 | 78 | 0.23 | 0.20 | 0.20 | 47 | 95 | 44 | 12 | 27 | 45 |
| Two Pane LoE ⁺ -366 | 4.7X3/13.0/4.7 | 64 | 11 | 11 | 0.27 | 0.31 | 65 | 0.29 | 0.24 | 0.24 | 56 | 84 | 61 | 5 | 20 | 42 |
| Two Pane LoE ⁺ -366 w/i81 #4 | 4.7X3/13.0/4.7/81 | 56 | 15 | 20 | 0.24 | 0.28 | 59 | 0.23 | 0.20 | 0.20 | 48 | 91 | 45 | 4 | 18 | 36 |
| Two Pane LoE ⁺ -272 | 5.7E4/13.0/5.7 | 70 | 10 | 11 | 0.40 | 0.46 | 95 | 0.30 | 0.25 | 0.25 | 56 | 87 | 61 | 14 | 31 | 53 |
| Two Pane LoE ⁺ -272 w/i81 #4 | 5.7E4/13.0/5.7/81 | 63 | 16 | 20 | 0.36 | 0.42 | 86 | 0.23 | 0.20 | 0.20 | 47 | 96 | 44 | 14 | 29 | 47 |
| Two Pane LoE ⁺ -270 | 5.7E0/13.0/5.7 | 68 | 12 | 12 | 0.36 | 0.41 | 85 | 0.29 | 0.25 | 0.25 | 56 | 86 | 61 | 13 | 30 | 50 |
| Two Pane LoE ⁺ -270 w/i81 #4 | 5.7E4/13.0/5.7/81 | 61 | 17 | 21 | 0.32 | 0.37 | 77 | 0.23 | 0.20 | 0.20 | 47 | 95 | 44 | 12 | 27 | 45 |
| Two Pane LoE ⁺ -366 | 5.7X3/13.0/5.7 | 63 | 11 | 11 | 0.27 | 0.31 | 65 | 0.29 | 0.24 | 0.24 | 56 | 84 | 61 | 4 | 20 | 41 |
| Two Pane LoE ⁺ -366 w/i81 #4 | 5.7X3/13.0/5.7/81 | 56 | 15 | 20 | 0.24 | 0.28 | 59 | 0.23 | 0.20 | 0.20 | 48 | 92 | 45 | 4 | 18 | 36 |
| Triple Pane LoE ⁺ -366/LoE ⁺ -179-#4/81 #6 | 3.0X3/9.8/3.0C7/9.8/81 #6 | 51 | 18 | 0.22 | 0.26 | 53 | 53 | 0.16 | 0.13 | 0.13 | 54 | 91 | 57 | 2 | 14 | 31 |
| Triple Pane LoE ⁺ -272/LoE ⁺ -179-#4/81 #6 | 3.0E4/9.8/3.0C7/9.8/81 #6 | 57 | 19 | 0.34 | 0.39 | 80 | 80 | 0.17 | 0.13 | 0.13 | 54 | 97 | 57 | 6 | 21 | 39 |
| Triple Pane LoE ⁺ -179/LoE ⁺ -179-#4/81 #6 | 3.0C7/9.8/3.0C7/9.8/81 #6 | 62 | 24 | 0.51 | 0.59 | 119 | 119 | 0.17 | 0.14 | 0.14 | 53 | 109 | 55 | 9 | 23 | 42 |

NOTES:

- (1) Data was calculated using Window 5.2 computer program.
- (2) Comfort Indoor Glass Temperatures are for the center portion of the glass. Winter and Summer ASHRAE conditions used for calculations.
- (3) Gas Fill levels are based on a 90% fill level; actual fill levels may vary.
- (4) The triple pane construction of 272/179/81 and 179/179/81 have a higher thermal stress breakage risk than the 366/179/81 construction, and may require Heat Treating the center LoE-179 lite.
- (5) The Center of Glass allowable %RH is based on the indoor glass temperature at 0°F outdoor; 70°F indoor, no solar load, and 15 mph wind. Values shown are the maximum indoor relative humidity before condensation starts to appear.