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# THE COOPER GROUP
# COMPUTER SIMULATION REPORT

**SCOPE OF WORK**
LIBERTY RESTORATION DOUBLE HUNG - NFRC 100/200/500

**REPORT NUMBER**
P0851.02-116-45 R0

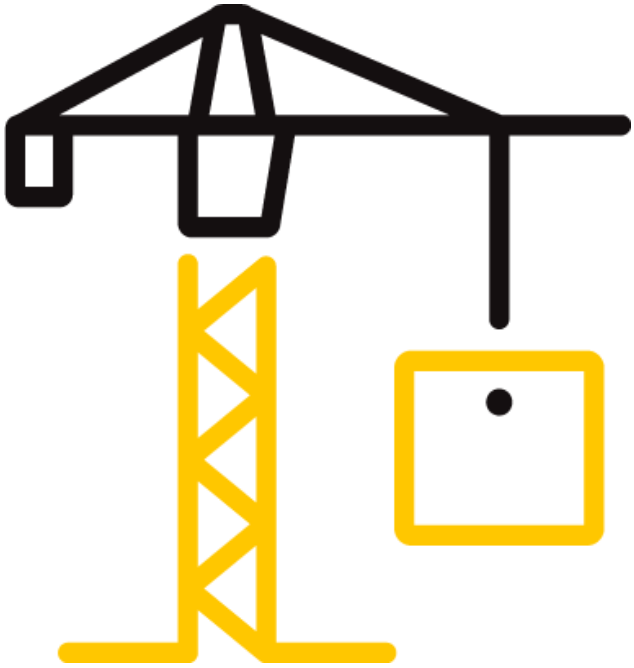
**TEST DATE**
01/11/23

**ISSUE DATE**
01/11/23

**REVISION DATE**
06/07/23

**PAGES**
12

**DOCUMENT CONTROL NUMBER**
RT-R-AMER-Test-4044 (04/11/22)

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**TEST REPORT FOR THE COOPER GROUP**
Report No: P0851.02-116-45 R0
Date: 06/07/23

## REPORT ISSUED TO

**THE COOPER GROUP**
25 White Rock Bridge Road
Pawcatuck, Connecticut 06379

## SECTION 1

**SUMMARY**

**SERIES/MODEL: Liberty Restoration Double Hung**

Architectural Testing, Inc. (an Intertek company) dba Intertek Building & Construction (B&C) was contracted to perform U-Factor, Solar Heat Gain Coefficient, Visible Transmittance and Condensation Resistance simulations in accordance with the National Fenestration Rating Council (NFRC).

This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. Intertek B&C will service this report for the entire test record retention period. The test record retention period ends five years after the test date. Test records, such as detailed drawings, datasheets, representative samples of test specimens, or other pertinent project documentation, will be retained for the entire test record retention period.

FOR INTERTEK B&C:

| | | | |
|---|---|---|---|
| **COMPLETED BY:** | Jacob Points | **REVIEWED BY:** | Eric S. Leitner |
| **TITLE:** | Simulation Technician | **TITLE:** | Manager - Simulations and Thermal Testing, SIRC |
| **SIGNATURE:** | Digitally Signed by: Jacob Points | **SIGNATURE:** | Digitally Signed by: Eric S. Leitner |
| **DATE:** | 06/07/23 | **DATE:** | 06/07/23 |

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## SECTION 2
## TEST METHODS

The products were evaluated in accordance with the following:

***ANSI/NFRC 100-2020,*** *Procedure for Determining Fenestration Product U-Factors*

***ANSI/NFRC 200-2020,*** *Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence*

***NFRC 500-2017,*** *Procedure for Determining Fenestration Product Condensation Resistance Values*

**Condensation Resistance results obtained from this procedure are for controlled laboratory conditions and do not include the effects of air movement through the specimen, solar radiation, and the thermal bridging that may occur due to the specific design and construction of the fenestration system opening.*

Ratings values included in this report are for submittals to an NFRC-licensed IA and are not meant to be used directly for labeling purposes. Only those values identified on a valid Certificate of Authorization (CA) by an NFRC accredited Inspection Agency (IA) are to be used for labeling purposes. The ratings values were rounded in accordance with NFRC 601, NFRC Unit and Measurement Policy.

Intertek B&C is an NFRC accredited simulation laboratory and all simulations were conducted in full compliance with NFRC approved procedures and specifications. The values included in this report are not considered in compliance with ANSI/NFRC 100, ANSI/NFRC 200, and/or NFRC 500 unless the associated validation test requirements have been satisfied, as applicable.

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## SECTION 3
## TEST PROCEDURE

The total product, including specific frame, spacer, and glass details, was modeled using NFRC approved software.

| | |
|---|---|
| **FRAME AND EDGE MODELING** | THERM 7.4.4 |
| **CENTER-OF-GLASS MODELING** | WINDOW 7.4.14 |
| **TOTAL PRODUCT CALCULATIONS** | WINDOW 7.4.14 |
| **SPECTRAL DATA LIBRARY** | IGDB 91.0 |

### Modeling Assumptions / Technical Interpretations

Any modeling assumptions and technical interpretations required to model this product are listed below.

1) To prevent air infiltration, tape was applied to all interior sash crack locations.
2) Generic Softwood material was used for this simulation.

## SECTION 4
## SIMULATION SPECIMEN DESCRIPTION

| | |
|---|---|
| **SERIES/MODEL** | Liberty Restoration Double Hung |
| **PRODUCT TYPE** | Double Hung |
| **FRAME MATERIAL** | WD - Wood |
| **SASH MATERIAL** | WD - Wood |
| **STANDARD SIZE** | 1200mm x 1500mm |

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## SECTION 4 (Continued)
## SIMULATION SPECIMEN DESCRIPTION

| SPACER OPTIONS | | | |
|---|---|---|---|
| ***TYPE*** | ***PRIMARY SEAL*** | ***SECONDARY SEAL*** | ***CODE*** |
| TGI Spacer | PIB | Silicone | TS-D |

| GRID OPTIONS | | |
|---|---|---|
| ***GRID SIZE*** | ***GRID TYPE*** | ***GRID PATTERN*** |
| None | - | - |

| REINFORCEMENT OPTIONS | |
|---|---|
| ***LOCATION*** | ***MATERIAL*** |
| None | - |

| GAS FILLING TECHNIQUE | |
|---|---|
| ***FILL TYPE*** | ***METHOD*** |
| 90% Argon | Single probe |
| 90% Krypton | Two-probe with concentration sensor |

| EDGE-OF-GLASS CONSTRUCTION | |
|---|---|
| ***INTERIOR CONDITION*** | Silicone between glazing bead and glass |
| ***EXTERIOR CONDITION*** | Silicone between sash leg and glass |

| WEATHERSTRIPPING | | |
|---|---|---|
| ***TYPE*** | ***QUANTITY*** | ***LOCATION*** |
| Vinyl bulb gasket | 2 rows | Bottom rail |
| Vinyl bulb gasket | 1 row | Stiles, head |
| Mohair | 2 rows | Head, jamb |
| Mohair | 1 row | Sill |

| FRAME/SASH MATERIALS FINISH | |
|---|---|
| ***INTERIOR*** | Wood |
| ***EXTERIOR*** | Wood |

| VALIDATION MATRIX* | |
|---|---|
| ***PRODUCT LINE*** | ***REPORT NUMBER*** |
| None | - |

**These products are part of a validation matrix. Only one is required for validation testing.*

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## SECTION 5
## SPECIALTY PRODUCTS TABLE

The specialty products method allows the manufacturer to determine the overall product SHGC and VT for any glazing option. The center of glass SHGC and/or VT must be determined using WINDOW 7.4.14. The method calculates overall product SHGC and VT indexed on center of glass properties. All values used in the calculations are truncated to six decimal place precision.

| | No Dividers | Dividers < 1 | Dividers > 1 |
|---|---|---|---|
| **SHGC0** | 0.003253 | 0.005847 | 0.008283 |
| **SHGC1** | 0.692856 | 0.616011 | 0.543846 |
| **VT0** | 0.000000 | 0.000000 | 0.000000 |
| **VT1** | 0.689603 | 0.610164 | 0.535563 |

$$SHGC = SHGC0 + SHGCc\ (SHGC1 - SHGC0)$$

$$VT = VT0 + VTc\ (VT1 - VT0)$$

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## SECTION 6
## SIMULATION RESULTS

**TOTAL PRODUCT CALCULATIONS (Liberty Restoration Double Hung)**

| Option Number | Pane Thickness 1 (in) | Gap Width 1 (in) | Pane Thickness 2 (in) | Gap Width 2 (in) | Pane Thickness 3 (in) | Gap Width 3 (in) | Pane Thickness 4 (in) | Gap Fill | Low-e (Surface #) | Tint | Spacer | Grid Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | U-Factor (Btu/Hr-Ft2-F) | | | Solar Heat Gain Coefficient (SHGC) Grids (None / <1 / >=1) | | | | | Visible Transmittance (VT) Grids (None / <1 / >=1) | | Condensation Resistance (CR) | |
| 1 | clr / arg / TC-88 / arg / 70/36 (#5) (DS/HM/DS) - 0.833" OD | | | | | | | | | | | |
| | 0.117 | 0.298 | 0.003 | 0.298 | 0.117 | | | ARG90 | 0.11(#3) / 0.105(#4) / 0.036(#5) | CL | TS-D | N |
| | **U-Factor** | | **0.24** | **SHGC(N)** | | | **0.30** | | **VT(N)** | **0.39** | **CR** | **63** |
| 2 | clr / kry / TC-88 / kry / 70/36 (#5) (DS/HM/DS) - 0.833" OD | | | | | | | | | | | |
| | 0.117 | 0.298 | 0.003 | 0.298 | 0.117 | | | KRY90 | 0.11(#3) / 0.105(#4) / 0.036(#5) | CL | TS-D | N |
| | **U-Factor** | | **0.21** | **SHGC(N)** | | | **0.30** | | **VT(N)** | **0.39** | **CR** | **66** |
| 3 | clr / arg / TC-88 / arg / TC-88 / arg / 70/36 (#7) (DS/HM/HM/DS) - 1.119" OD | | | | | | | | | | | |
| | 0.117 | 0.298 | 0.003 | 0.298 | 0.003 | 0.298 | 0.117 | ARG90 | 0.11(#3) / 0.105(#4) / 0.11(#5) / 0.105(#6) / 0.036(#7) | CL | TS-D | N |
| | **U-Factor** | | **0.20** | **SHGC(N)** | | | **0.27** | | **VT(N)** | **0.31** | **CR** | **69** |
| 4 | clr / kry / TC-88 / kry / TC-88 / kry / 70/36 (#7) (DS/HM/HM/DS) - 1.119" OD | | | | | | | | | | | |
| | 0.117 | 0.298 | 0.003 | 0.298 | 0.003 | 0.298 | 0.117 | KRY90 | 0.11(#3) / 0.105(#4) / 0.11(#5) / 0.105(#6) / 0.036(#7) | CL | TS-D | N |
| | **U-Factor** | | **0.17** | **SHGC(N)** | | | **0.26** | | **VT(N)** | **0.31** | **CR** | **71** |
| 5 | clr / arg / SC-75 / arg / 70/36 (#5) (DS/HM/DS) - 0.833" OD | | | | | | | | | | | |
| | 0.117 | 0.298 | 0.003 | 0.298 | 0.117 | | | ARG90 | 0.76(#3) / 0.045(#4) / 0.036(#5) | CL | TS-D | N |
| | **U-Factor** | | **0.27** | **SHGC(N)** | | | **0.24** | | **VT(N)** | **0.37** | **CR** | **60** |
| 6 | clr / kry / SC-75 / kry / 70/36 (#5) (DS/HM/DS) - 0.833" OD | | | | | | | | | | | |
| | 0.117 | 0.298 | 0.003 | 0.298 | 0.117 | | | KRY90 | 0.76(#3) / 0.045(#4) / 0.036(#5) | CL | TS-D | N |
| | **U-Factor** | | **0.23** | **SHGC(N)** | | | **0.24** | | **VT(N)** | **0.37** | **CR** | **63** |
| 7 | clr / arg / SC-75 / arg / SC-75 / arg / 70/36 (#7) (DS/HM/HM/DS) - 1.119" OD | | | | | | | | | | | |
| | 0.117 | 0.298 | 0.003 | 0.298 | 0.003 | 0.298 | 0.117 | ARG90 | 0.76(#3) / 0.045(#4) / 0.76(#5) / 0.045(#6) / 0.036(#7) | CL | TS-D | N |
| | **U-Factor** | | **0.21** | **SHGC(N)** | | | **0.19** | | **VT(N)** | **0.29** | **CR** | **68** |
| 8 | clr / kry / SC-75 / kry / SC-75 / kry / 70/36 (#7) (DS/HM/HM/DS) - 1.119" OD | | | | | | | | | | | |
| | 0.117 | 0.298 | 0.003 | 0.298 | 0.003 | 0.298 | 0.117 | KRY90 | 0.76(#3) / 0.045(#4) / 0.76(#5) / 0.045(#6) / 0.036(#7) | CL | TS-D | N |
| | **U-Factor** | | **0.18** | **SHGC(N)** | | | **0.19** | | **VT(N)** | **0.29** | **CR** | **70** |
| 9 | lami 060PVB / arg / TC-88 / arg / 70/36 (#5) (LAMI/HM/DS) - 1.014" OD | | | | | | | | | | | |
| | 0.294 | 0.298 | 0.003 | 0.298 | 0.117 | | | ARG90 | 0.11(#3) / 0.105(#4) / 0.036(#5) | CL | TS-D | N |
| | **U-Factor** | | **0.24** | **SHGC(N)** | | | **0.29** | | **VT(N)** | **0.38** | **CR** | **63** |
| 10 | lami 060PVB / kry / TC-88 / kry / 70/36 (#5) (LAMI/HM/DS) - 1.014" OD | | | | | | | | | | | |
| | 0.294 | 0.298 | 0.003 | 0.298 | 0.117 | | | KRY90 | 0.11(#3) / 0.105(#4) / 0.036(#5) | CL | TS-D | N |
| | **U-Factor** | | **0.20** | **SHGC(N)** | | | **0.28** | | **VT(N)** | **0.38** | **CR** | **66** |

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## SECTION 6 (Continued)
## SIMULATION RESULTS

**TOTAL PRODUCT CALCULATIONS (Liberty Restoration Double Hung)**

| Option Number | Pane Thickness 1 (in) | Gap Width 1 (in) | Pane Thickness 2 (in) | Gap Width 2 (in) | Pane Thickness 3 (in) | Gap Width 3 (in) | Pane Thickness 4 (in) | Gap Fill | Low-e (Surface #) | Tint | Spacer | Grid Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | U-Factor (Btu/Hr-Ft2-F) | | | Solar Heat Gain Coefficient (SHGC) Grids (None / <1 / >=1) | | | | | Visible Transmittance (VT) Grids (None / <1 / >=1) | | Condensation Resistance (CR) | |
| 11 | lami 060PVB / arg / TC-88 / arg / TC-88 / arg / 70/36 (#7) (LAMI/HM/HM/DS) - 1.267" OD | | | | | | | | | | | |
| | 0.294 | 0.298 | 0.003 | 0.298 | 0.003 | 0.298 | 0.117 | ARG90 | 0.11(#3) / 0.105(#4) / 0.11(#5) / 0.105(#6) / 0.036(#7) | CL | TS-D | N |
| | **U-Factor** | | **0.20** | **SHGC(N)** | | | **0.25** | | **VT(N)** | **0.31** | **CR** | **70** |
| 12 | lami 060PVB / kry / TC-88 / kry / TC-88 / kry / 70/36 (#7) (LAMI/HM/HM/DS) - 1.267" OD | | | | | | | | | | | |
| | 0.294 | 0.298 | 0.003 | 0.298 | 0.003 | 0.298 | 0.117 | KRY90 | 0.11(#3) / 0.105(#4) / 0.11(#5) / 0.105(#6) / 0.036(#7) | CL | TS-D | N |
| | **U-Factor** | | **0.17** | **SHGC(N)** | | | **0.25** | | **VT(N)** | **0.31** | **CR** | **70** |
| 13 | lami 090SGP / arg / TC-88 / arg / 70/36 (#5) (LAMI/HM/DS) - 1.052" OD | | | | | | | | | | | |
| | 0.324 | 0.298 | 0.003 | 0.298 | 0.117 | | | ARG90 | 0.11(#3) / 0.105(#4) / 0.036(#5) | CL | TS-D | N |
| | **U-Factor** | | **0.24** | **SHGC(N)** | | | **0.28** | | **VT(N)** | **0.37** | **CR** | **63** |
| 14 | lami 090SGP / kry / TC-88 / kry / 70/36 (#5) (LAMI/HM/DS) - 1.052" OD | | | | | | | | | | | |
| | 0.324 | 0.298 | 0.003 | 0.298 | 0.117 | | | KRY90 | 0.11(#3) / 0.105(#4) / 0.036(#5) | CL | TS-D | N |
| | **U-Factor** | | **0.20** | **SHGC(N)** | | | **0.27** | | **VT(N)** | **0.37** | **CR** | **67** |
| 15 | lami 090SGP / arg / TC-88 / arg / TC-88 / arg / 70/36 (#7) (LAMI/HM/HM/DS) - 1.349" OD | | | | | | | | | | | |
| | 0.324 | 0.298 | 0.003 | 0.298 | 0.003 | 0.298 | 0.117 | ARG90 | 0.11(#3) / 0.105(#4) / 0.11(#5) / 0.105(#6) / 0.036(#7) | CL | TS-D | N |
| | **U-Factor** | | **0.20** | **SHGC(N)** | | | **0.24** | | **VT(N)** | **0.30** | **CR** | **70** |
| 16 | lami 090SGP / kry / TC-88 / kry / TC-88 / kry / 70/36 (#7) (LAMI/HM/HM/DS) - 1.349" OD | | | | | | | | | | | |
| | 0.324 | 0.298 | 0.003 | 0.298 | 0.003 | 0.298 | 0.117 | KRY90 | 0.11(#3) / 0.105(#4) / 0.11(#5) / 0.105(#6) / 0.036(#7) | CL | TS-D | N |
| | **U-Factor** | | **0.17** | **SHGC(N)** | | | **0.24** | | **VT(N)** | **0.30** | **CR** | **70** |
| 17 | clr / arg / 70/36 (#3) (DS/DS) - 0.534" OD | | | | | | | | | | | |
| | 0.117 | 0.298 | 0.117 | | | | | ARG90 | | CL | TS-D | N |
| | **U-Factor** | | **0.33** | **SHGC(N)** | | | **0.33** | | **VT(N)** | **0.48** | **CR** | **52** |
| 18 | clr / kry / 70/36 (#3) (DS/DS) - 0.534" OD | | | | | | | | | | | |
| | 0.117 | 0.300 | 0.117 | | | | | KRY90 | 0.036(#3) | CL | TS-D | N |
| | **U-Factor** | | **0.28** | **SHGC(N)** | | | **0.34** | | **VT(N)** | **0.48** | **CR** | **56** |
| 19 | clr / air / 70/36 (#3) (DS/DS) - 0.534" OD | | | | | | | | | | | |
| | 0.117 | 0.300 | 0.117 | | | | | AIR | 0.036(#3) | CL | TS-D | N |
| | **U-Factor** | | **0.37** | **SHGC(N)** | | | **0.33** | | **VT(N)** | **0.48** | **CR** | **48** |
| 20 | clr / arg / 80/71 (#3) (DS/DS) - 0.534" OD | | | | | | | | | | | |
| | 0.117 | 0.300 | 0.117 | | | | | ARG90 | 0.082(#4) | CL | TS-D | N |
| | **U-Factor** | | **0.36** | **SHGC(N)** | | | **0.47** | | **VT(N)** | **0.55** | **CR** | **29** |

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## SECTION 6 (Continued)
## SIMULATION RESULTS

**TOTAL PRODUCT CALCULATIONS (Liberty Restoration Double Hung)**

| Option Number | Pane Thickness 1 (in) | Gap Width 1 (in) | Pane Thickness 2 (in) | Gap Width 2 (in) | Pane Thickness 3 (in) | Gap Width 3 (in) | Pane Thickness 4 (in) | Gap Fill | Low-e (Surface #) | Tint | Spacer | Grid Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | U-Factor (Btu/Hr-Ft2-F) | | | Solar Heat Gain Coefficient (SHGC) Grids (None / <1 / >=1) | | | | | Visible Transmittance (VT) Grids (None / <1 / >=1) | | Condensation Resistance (CR) | |
| 21 | clr / kry / 80/71 (#3) (DS/DS) - 0.534" OD | | | | | | | | | | | |
| | 0.117 | 0.300 | 0.117 | | | | | KRY90 | 0.082(#4) | CL | TS-D | N |
| | **U-Factor** | | **0.34** | **SHGC(N)** | | | **0.47** | | **VT(N)** | **0.55** | **CR** | **32** |
| 22 | clr / air / 80/71 (#3) (DS/DS) - 0.534" OD | | | | | | | | | | | |
| | 0.117 | 0.300 | 0.117 | | | | | AIR | 0.082(#4) | CL | TS-D | N |
| | **U-Factor** | | **0.37** | **SHGC(N)** | | | **0.47** | | **VT(N)** | **0.55** | **CR** | **27** |
| 23 | lami 060PVB / arg / 70/36 (#3) (LAMI/DS) - 0.714" OD | | | | | | | | | | | |
| | 0.294 | 0.300 | 0.117 | | | | | ARG90 | 0.036(#3) | CL | TS-D | N |
| | **U-Factor** | | **0.32** | **SHGC(N)** | | | **0.32** | | **VT(N)** | **0.47** | **CR** | **53** |
| 24 | lami 060PVB / kry / 70/36 (#3) (LAMI/DS) - 0.714" OD | | | | | | | | | | | |
| | 0.294 | 0.300 | 0.117 | | | | | KRY90 | 0.036(#3) | CL | TS-D | N |
| | **U-Factor** | | **0.27** | **SHGC(N)** | | | **0.32** | | **VT(N)** | **0.47** | **CR** | **56** |
| 25 | lami 060PVB / air / 70/36 (#3) (LAMI/DS) - 0.714" OD | | | | | | | | | | | |
| | 0.294 | 0.300 | 0.117 | | | | | AIR | 0.036(#3) | CL | TS-D | N |
| | **U-Factor** | | **0.37** | **SHGC(N)** | | | **0.32** | | **VT(N)** | **0.47** | **CR** | **49** |
| 26 | lami 090SGP / arg / 70/36 (#3) (LAMI/DS) - 0.714" OD | | | | | | | | | | | |
| | 0.324 | 0.300 | 0.117 | | | | | ARG90 | 0.036(#3) | CL | TS-D | N |
| | **U-Factor** | | **0.32** | **SHGC(N)** | | | **0.31** | | **VT(N)** | **0.46** | **CR** | **53** |
| 27 | lami 090SGP / kry / 70/36 (#3) (LAMI/DS) - 0.714" OD | | | | | | | | | | | |
| | 0.324 | 0.300 | 0.117 | | | | | KRY90 | 0.036(#3) | CL | TS-D | N |
| | **U-Factor** | | **0.27** | **SHGC(N)** | | | **0.31** | | **VT(N)** | **0.46** | **CR** | **57** |
| 28 | lami 090SGP / air / 70/36 (#3) (LAMI/DS) - 0.714" OD | | | | | | | | | | | |
| | 0.324 | 0.300 | 0.117 | | | | | AIR | 0.036(#3) | CL | TS-D | N |
| | **U-Factor** | | **0.36** | **SHGC(N)** | | | **0.31** | | **VT(N)** | **0.46** | **CR** | **49** |
| 29 | lami 060PVB / arg / lami 060PVB (#3) (LAMI/LAMI) - 0.895" OD | | | | | | | | | | | |
| | 0.294 | 0.300 | 0.294 | | | | | ARG90 | | CL | TS-D | N |
| | **U-Factor** | | **0.43** | **SHGC(N)** | | | **0.47** | | **VT(N)** | **0.55** | **CR** | **44** |
| 30 | lami 090SGP / arg / lami 090SGP (#3) (LAMI/LAMI) - 0.948" OD | | | | | | | | | | | |
| | 0.324 | 0.300 | 0.324 | | | | | ARG90 | | CL | TS-D | N |
| | **U-Factor** | | **0.43** | **SHGC(N)** | | | **0.44** | | **VT(N)** | **0.51** | **CR** | **44** |

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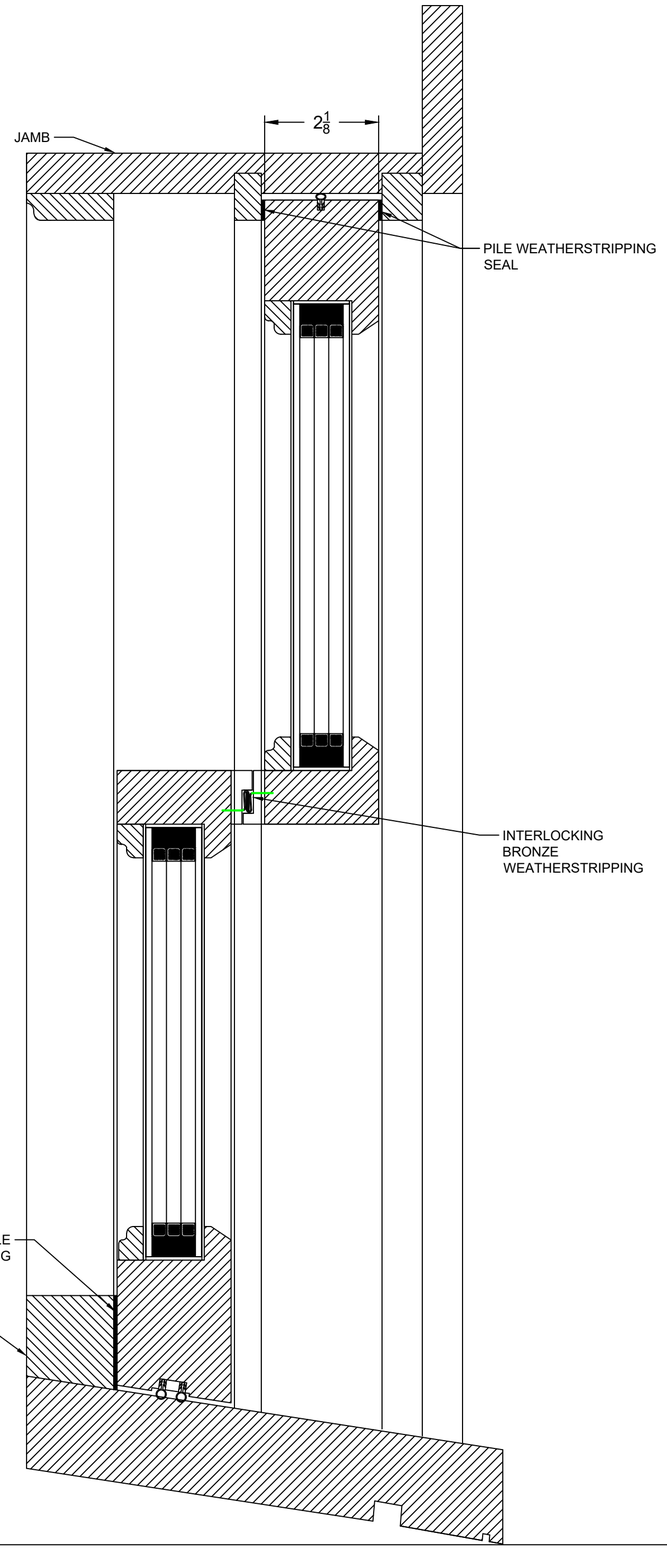
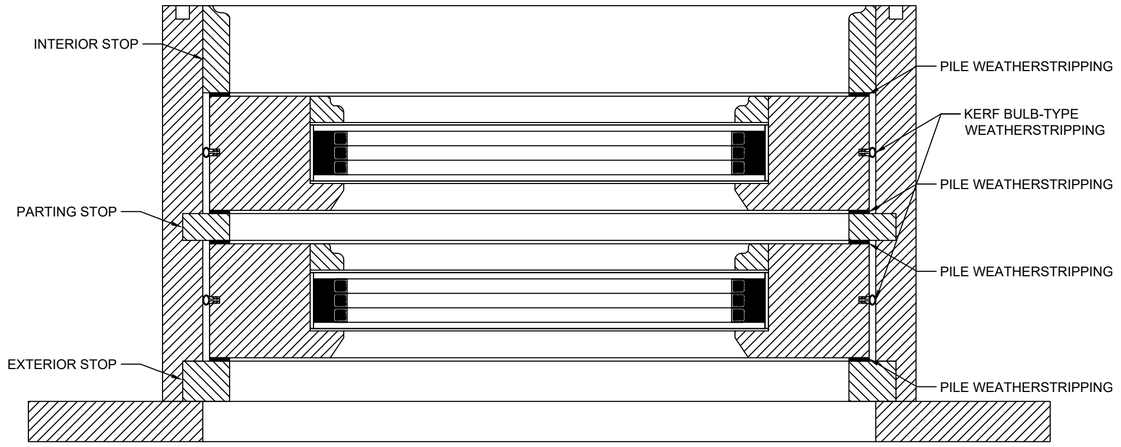
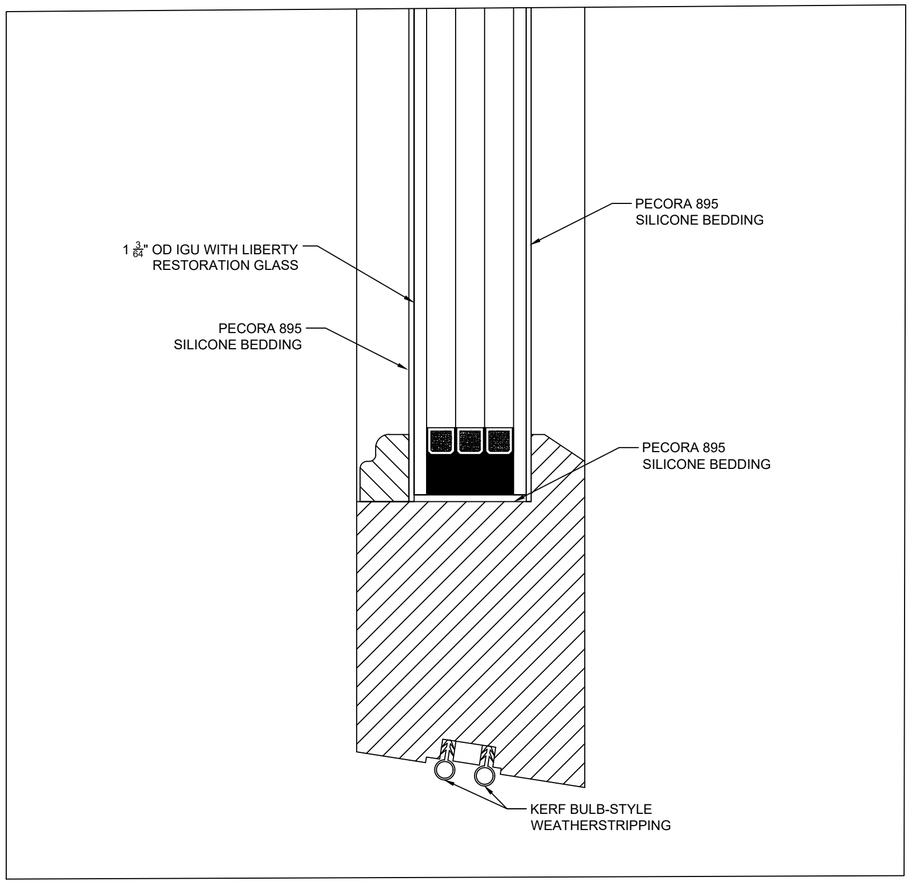
## SECTION 7
## DRAWINGS / BILL OF MATERIALS

The drawings which follow have been reviewed by Intertek B&C and are representative of the simulation results reported herein. Any deviations are documented herein or on the drawings.




intertek Report #: P0851-116-45 Date: 1/11/2023 Verified by:

APPROVED BY:

SIGNATURE DATE

THE COOPER GROUP LLC

DRAWINGS PROVIDED BY:

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| PROJECT NUMBER: | NFRC TESTING |
| DRAWN BY: | JRG --/-- |
| CHECKED BY: | |
| DATE: | 8/2/22 |
| SCALE: | NONE AS NOTED |
| | GATEWAY WINDOW DRAWINGS FOR AAMA |

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## SECTION 8
## REVISION LOG

| REVISION # | DATE | PAGES | REVISION |
|---|---|---|---|
| .01 R0 | 01/11/23 | N/A | Original report issue. |
| .02 R0 | 06/07/23 | All | Added options #17-30 |