## WINDOW RATIO CALCULATION §143(b)

### A. TOTAL LINEAR DISPLAY
- PERIMETER

\[ \text{FT} \times 6 \text{ FT} = \text{ft}^2 \text{ DISPLAY AREA} \]

### B. TOTAL GROSS EXTERIOR WALL AREA

\[ \text{ft}^2 \times 0.40 = \text{ft}^2 \text{ 40% of GROSS EXTERIOR WALL AREA} \]

### C. ENTER LARGER OF (A or B)

\[ \text{ft}^2 \text{ MAXIMUM STANDARD AREA} \]

### D. ENTER PROPOSED WINDOW AREA

\[ \text{ft}^2 \text{ PROPOSED AREA} \]

If the Proposed Window Area is greater than the Maximum Standard Area, then go to Window Adjustment step below.

### E. WINDOW WALL RATIO

\[ \frac{\text{Row D}}{\text{Row B}} = \text{ Must meet RSHG in Table 143-A, 143-B, or 143-C} \]

### WEST WINDOW RATIO CALCULATION

### F. WEST LINEAR DISPLAY
- PERIMETER

\[ \text{FT} \times 6 \text{ FT} = \text{ft}^2 \text{ WEST DISPLAY AREA} \]

### G. WEST EXTERIOR WALL AREA

\[ \text{ft}^2 \times 0.40 = \text{ft}^2 \text{ 40% of WEST EXTERIOR WALL AREA} \]

### H. ENTER LARGER OF (F or G)

\[ \text{ft}^2 \text{ MAXIMUMSTANDARD WEST AREA} \]

### I. ENTER PROPOSED WEST WINDOW AREA

\[ \text{ft}^2 \text{ PROPOSED WEST WINDOW AREA} \]

If the Proposed West Window Area is greater than the Maximum Standard West Area, then Go to Window Adjustment step below.

### J. WINDOW WALL RATIO

\[ \frac{\text{Row I}}{\text{Row G}} = \text{ Must meet RSHG in Table 143-A, 143-B, or 143-C} \]

### Combined Area for North, East and South Walls

### K. N/E/S DISPLAY PERIMETER
- (A Minus F)

\[ \text{FT} \times 6 \text{ FT} = \text{ft}^2 \text{ N/E/S of WEST EXTERIOR WALL AREA} \]

### L. N/E/S EXTERIOR WALL AREA
- (B Minus G)

\[ \text{ft}^2 \times 0.40 = \text{ft}^2 \text{ 40% N/E/S AREA} \]

### M. ENTER LARGER OF K or L

\[ \text{ft}^2 \text{ MAXIMUM STANDARD N/E/S AREA} \]

### N. PROPOSED N/E/S WINDOW AREA
- (D Minus I)

\[ \text{ft}^2 \text{ PROPOSED N/E/S AREA} \]

### Window Adjustment

O. IF D>C and/or if I>H, Proceed to the calculation Step 1 for all walls or Step 2 for West wall. If not, go to the Skylight Area Test on ENV-3C Page 6, CALCULATE ADJUSTED AREAS.

1. **IF D>C:** Use the calculated Window Adjustment Factor (WAF) for all walls.

\[ \text{MAX. STANDARD AREA (from C) ÷ PROPOSED WINDOW AREA (from D) = WINDOW ADJUSTMENT FACTOR} \]

2. **IF I>H:** Calculate one Window Adjustment Factor (WAF) for the West wall.

\[ \text{MAX. STANDARD ÷ PROPOSED WEST AREA (from I) = WEST WINDOW ADJUSTMENT FACTOR} \]
### SKYLIGHT RATIO CALCULATION §143(b)

<table>
<thead>
<tr>
<th>ACTUAL GROSS ROOF AREA</th>
<th>MAXIMUM ALLOWED STANDARD SKYLIGHT AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. IF Atrium/Skylight Height is ( \leq 55 ) ft; or</td>
<td>( \text{ft}^2 \times 0.05 = \text{ft}^2 )</td>
</tr>
<tr>
<td>B. IF Atrium/Skylight Height is &gt; 55 ft</td>
<td>( \text{ft}^2 \times 0.10 = \text{ft}^2 )</td>
</tr>
<tr>
<td>C. Proposed Skylight Area</td>
<td>( \text{ft}^2 )</td>
</tr>
</tbody>
</table>

D. Skylight Ratio = Proposed Skylight Area (Row C) Divided by Actual Gross Roof Area = % SRR\textsubscript{Prop}

E. Maximum Allowed Skylight Roof Ratio = Maximum Allowed Standard Skylight Area (Row A or B) Divided by Total Gross Exterior Roof Area = % SRR\textsubscript{STD}

*IF THE PROPOSED SKYLIGHT AREA IS GREATER THAN THE STANDARD SKYLIGHT AREA PROCEED TO THE NEXT CALCULATION FOR THE SKYLIGHT AREA ADJUSTMENT. IF NOT GO TO PAGE 3 OF 6.*

### SKYLIGHT AREA ADJUSTMENT

IF F>D, Proceed To Calculation Step 1

Step 1. Calculated the Skylight Adjustment Factor (SAF).

<table>
<thead>
<tr>
<th>STANDARD SKYLIGHT AREA</th>
<th>PROPOSED SKYLIGHT AREA (IF E = 0 ENTER 1)</th>
<th>SKYLIGHT ADJUSTMENT FACTOR (SAF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{\text{standard area}}{\text{proposed area}} )</td>
<td>( \frac{\text{standard area}}{\text{proposed area}} )</td>
<td>( \frac{\text{standard area}}{\text{proposed area}} )</td>
</tr>
</tbody>
</table>

CARRY THE WINDOW ADJUSTMENT FACTOR (SAF) TO PAGE 6 OF 6 TO CALCULATE THE ADJUSTED AREA.
TDV for the Standard Design Building, See Reference Nonresidential Appendix NA5.2

<table>
<thead>
<tr>
<th>Assembly Type¹</th>
<th>Orientation</th>
<th>Number Of Like Assembly Type⁴</th>
<th>Roofs or Floor Mass Type²</th>
<th>Exterior Surface Area</th>
<th>Fenestration Type</th>
<th>Criteria</th>
<th>Coefficients for⁹</th>
<th>Standard TDV Energy¹⁰</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>U-factor</td>
<td>SHGC ⁷</td>
<td>VT</td>
</tr>
</tbody>
</table>

1. Indicate type of assembly for the Envelope (e.g. Wall, Floor, Roof, Window, Skylight & Door). One assembly type for each row.
2. Enter the area of each different assembly.
3. Enter the type of fenestration; M=Manufactured, SB=Site-built, SK=Skylight and F=Fabricated.
4. Grouping of like assemblies in the same orientation is allowed. Indicate the number in column E.
5. Enter Roofs, Floors, Walls, and for Mass Walls the categories are light mass (HC<7), medium mass (7<=HC,15), and heavy mass (HC>=15).
6. Standard Design U-factor are from Table 143-A, B or C.
7. Standard Design SHGC are from Table 143-A, B or C. Enter "0" if not applicable for each skylight. Note: Not all vertical windows have an overhang then assume SHGC as value entered.
8. To calculate the fenestration standard design VT in Column I. Multiply Column H by 1.2.
9. Coefficients for; U-factor (Csu,i), SHGC (Css,i), and VT(Cst,i) can be found in Table NA5.2, through Table NA5.5 of the Reference Nonresidential Appendices NA5. The Coefficient for SHGC and VT are only enter for the fenestration products. Enter “0” when not applicable.
### TDV for the Proposed Design Building, See Reference Nonresidential Appendix NA5.3

**Occupy Type and Coefficients Tables**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assembly Type</td>
<td>Orientation</td>
<td>Number Of Like Assembly Type</td>
<td>Total Exterior Surface Area</td>
<td>Fenestration Type</td>
<td>U-factor</td>
<td>SHGC</td>
<td>VT</td>
<td>Coefficients for Proposed TDV Energy</td>
<td></td>
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</tbody>
</table>

1. Indicate type of assembly for the Envelope (e.g. Wall, Floor, Roof, Window, Skylight & Door). One assembly type for each row.
2. Indicate the orientation for walls, doors & windows. 2A. Note: Grouping of like assemblies in the same orientation is allowed. Enter the number in column C.
3. Indicate the Exterior Surface Area of the Assembly for that one assembly or if like assemblies then the total surface area of all assemblies in the same orientation.
4. Enter the type of fenestration; M=Manufactured, SB=Site-built, SK=Skylight and F=Fabricated.
5. Proposed Design U-factor are from Table 143-A, B or C for the appropriate assembly type.
6. Proposed Design SHGC are from Table 143-A, B or C. Enter “0” if not applicable. Note: Not all vertical windows have an overhang then assume SHGC as value entered.
7. To calculate the fenestration proposed design VT in Column H. Multiply Column G by 1.2.
8. Coefficients for U-factor \( C_{u,i} \), SHGC \( C_{s,i} \), and VT \( C_{s,i} \) can be found in Table N45.2, through Table N4.5 of the Reference Nonresidential Appendices NA5. The Coefficient for SHGC and VT are only entered for the fenestration products. Enter “0” when not applicable.

---

**Table 4.3: Total Proposed Design**

| Assembly Type | Orientation | Number Of Like Assembly Type | Total Exterior Surface Area | Fenestration Type | U-factor | SHGC | VT | Coefficients for Proposed TDV Energy | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

<table>
<thead>
<tr>
<th>Total Proposed Design</th>
<th>Proposed ≤ Standard</th>
</tr>
</thead>
</table>

---

**10. Calculate the TDV Standard Design for each Envelope Assembly Type:**

\[
TDV_{std} = \text{Column C x Column E x ((U-factor}_{S,i} x C_{s,i}) + (SHGC}_{S,i} x C_{s,i}) + (VT}_{S,i} x C_{s,i})\]

See Nonresidential Manual Examples in Section 3.7.1 for details.
9. Calculate the Cool Roof, McR, first by using the next page (Page 5 of 6). Enter the value in the Proposed Column L.

10. Calculate the Overhang M_OH on the next page (Page 5 of 6). Enter the value in the Proposed Column M.

11. The Proposed TDV energy use for all assemblies other than roofs must be equal to or less than Standard TDV in Page 3 of 6. Therefore; TDV<sub>P</sub> = Column D x [(U factor x CSu) + (CRui x URi x MCRi) + (SHGCP x CSsi x MOH) + (VTP x CSt)] Enter the calculated value in Column N.

12. Sum up all the Proposed TDV Energy in Column N and enter value in the cell. Similarly enter the sum of all Standard TDV Energy and compare. Proposed must be ≤ to the Standard.
### Overview of Tables and Coefficients

#### Occupancy Type and Coefficients Tables
- **Nonresidential**: See Table NA5-3
- **24-Hour Use**: See Table NA5-4
- **Retail**: See Table NA5-5

#### Overhang Multiplier (MOH)

#### Coefficients of Calculation

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>C&lt;sub&gt;Ref&lt;/sub&gt;</td>
<td>C&lt;sub&gt;Emit&lt;/sub&gt;</td>
<td>ρ&lt;sub&gt;aged prop&lt;/sub&gt;</td>
<td>ρ&lt;sub&gt;aged std&lt;/sub&gt;</td>
<td>ε&lt;sub&gt;prop&lt;/sub&gt;</td>
<td>ε&lt;sub&gt;std&lt;/sub&gt;</td>
<td>M&lt;sub&gt;CR,i&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

#### Excerpt from Table NA5-2

**Where:**
- Standard design values for Solar Reflectance and Thermal Emittance.

**Standard Aged Solar Reflectance** (Column D)

**Standard Thermal Emittance** (Column F)

#### Overhang Multiplier Eq.

**Cool Roof Multiplier**

\[
M_{CR,i} = 1 + C_{Ref} \times (\rho_{aged \ prop} - \rho_{aged \ std}) + C_{Emit} \times (\varepsilon_{prop} - \varepsilon_{std}) \text{ or } 1 + Col A \times (Col C - Col D) + Col B \times (Col E - Col F)
\]

**Overhang Multiplier (MOH)**

**Occupancy Type and Coefficients Tables**
- **Nonresidential**: See Table NA5-3
- **24-Hour Use**: See Table NA5-4
- **Retail**: See Table NA5-5

#### Overhang Orientation

<table>
<thead>
<tr>
<th>Coefficients of</th>
<th>Fenestration Overhang</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Overhang</td>
<td>1st Projection Factor&lt;sup&gt;1&lt;/sup&gt;</td>
<td>2nd Projection Factor&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Orientation</td>
<td>a&lt;sub&gt;i&lt;/sub&gt;</td>
<td>b&lt;sub&gt;i&lt;/sub&gt;</td>
</tr>
</tbody>
</table>
1. Where: \(a_i\) and \(b_i\) are the coefficients for the overhang projection factor (see tables) and is climate zone dependent.

2. \(PF = \frac{H}{V}\) (Horizontal (H) projection of the overhang from the surface of the window in feet, but no greater than \(V\) and the Vertical (V) distance from the window sill to the bottom of the overhang, in feet.) Enter results in Column F.

3. \(M_{\text{ØH}}} = 1 + (a_i \times PF_i) + b_i \times PF_i^2\). Enter results in Column G.

### WINDOW AREA ADJUSTMENT CALCULATIONS

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>WALL NAME (e.g. Wall-1, Wall-2)</td>
<td>ORIENTATION</td>
<td>GROSS AREA</td>
<td>DOOR AREA</td>
<td>WINDOW AREA</td>
<td>FACTOR (From Page 1of 6)</td>
<td>AREA (D(\times)E)</td>
</tr>
<tr>
<td>N</td>
<td>E</td>
<td>S</td>
<td>W</td>
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### SKYLIGHT AREA ADJUSTMENT CALCULATIONS

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
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</thead>
<tbody>
<tr>
<td>ROOF NAME</td>
<td>GROSS</td>
<td>SKYLIGHT</td>
<td>SKYLIGHT ADJUSTMENT</td>
<td>ADJUSTED SKYLIGHT</td>
<td>ADJUSTED ROOF AREA</td>
</tr>
<tr>
<td>(e.g. Roof-1, Roof-2)</td>
<td>AREA</td>
<td>AREA</td>
<td>T FACTOR (From Page 2 of 6)</td>
<td>AREA (C×D)</td>
<td>(B - E)</td>
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**TOTALS:**