# Window U-values

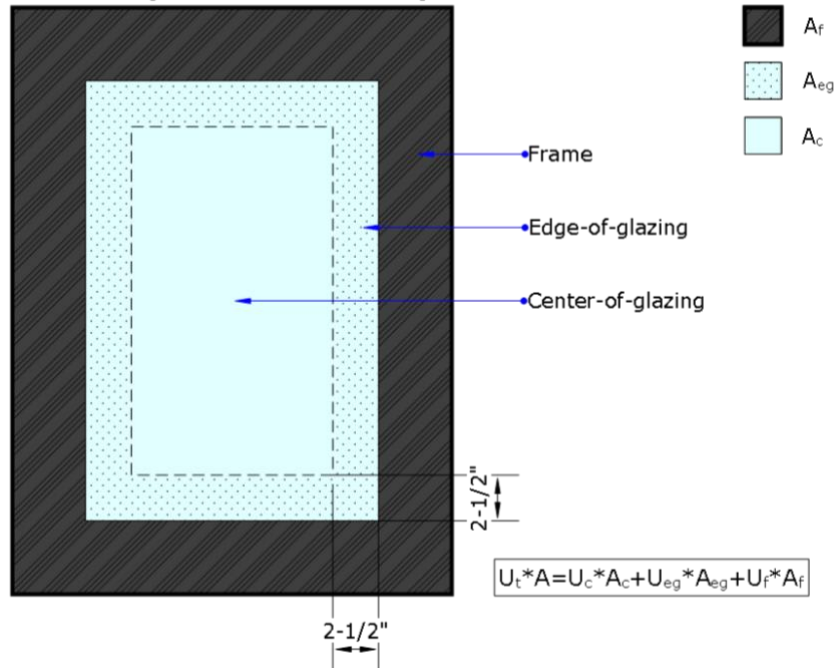## What to put into TRNSYS and why

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There are two main standards for finding window U-values (thermal transmittance): NFRC, from the U.S., and DIN, from Germany. TRNSYS uses the NFRC standard, with some modification. The key difference between these two standards is how they handle thermal transfer from spacers between the panes of glass in a window.
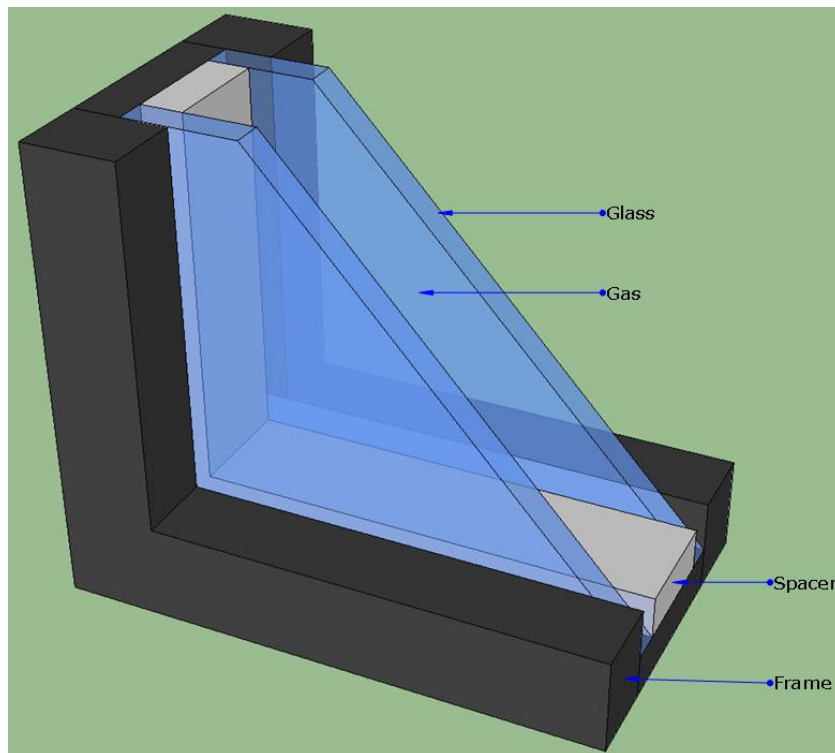
NFRC

NFRC accounts for the spacer by forming a 2.5-inch (63.5 mm) buffer inside the glass. This buffer is called the "edge-of-glazing," while the remaining glass is called the "center-of-glazing." The edge-of-glazing and center-of-glazing each have their own areas and U-values: A_{eg} and U_{eg} for the edge-of-glazing, and A_c and U_c for the center-of-glazing. All areas are measured in m^2 and all U-values are measured in $W/(m^2 \cdot K)$. The frame area (A_f) is the projected area of the frame and sash in the plane(s) parallel to the glazing surface. The total fenestration product area (A) is the sum of A_c, A_{eg}, and A_f. Since the NFRC standard is American, most U-values listed by American manufacturers are calculated using this standard.

NFRC (U.S. Standard)

Legend:
- A_f
- A_{eg}
- A_c

- Frame
- Edge-of-glazing
- Center-of-glazing

2-1/2"

2-1/2"

$$U_t * A = U_c * A_c + U_{eg} * A_{eg} + U_f * A_f$$

DIN

There is no equivalent to "edge-of-glazing" in the DIN standard. Instead of forming a buffer, the DIN standard uses the total perimeter of the glazing (l_g), measured in m, and linear thermal transmittance (Ψ_f), measured in W/(m·K). The total perimeter of the glazing is the sum of the visible perimeter of the glass panes in the window. The DIN standard combines edge-of-glazing and center-of-glazing into one value, glazed area (A_g), which is the smaller of the visible areas seen from both sides. This is one of the main reasons why European manufacturers will report U-values that are lower than similar products from American manufacturers. The frame area (A_f) is comparable between the two standards, representing the larger of the internal and external projected frame areas. The area of the window (A_w) is the sum of A_g and A_f. Since the DIN standard is German, most U-values listed by European manufacturers are calculated using this standard.

DIN (European Standard)

Legend:
- A_f
- l_f
- A_g

- Frame
- Glazed area

$$U_w * A_w = U_g * A_g + \Psi_g * l_g + U_f * A_f$$
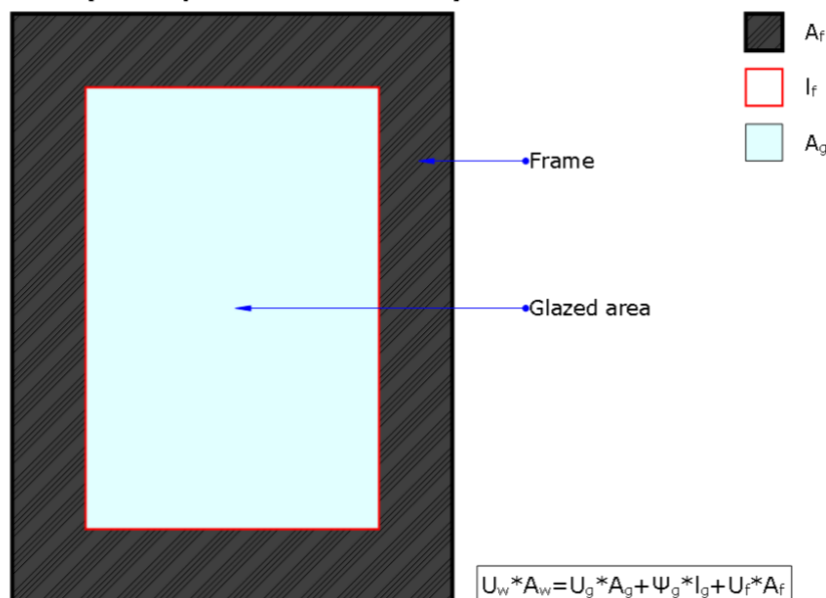
Finding Area

When finding the area of the glass, either A_c for NFRC or A_g for DIN, only the part of the pane facing the outside is included. For standard, flat windows, this is straightforward to find. However, this can be more difficult to find for more complex glass curtain walls, which may be curved or sloped.
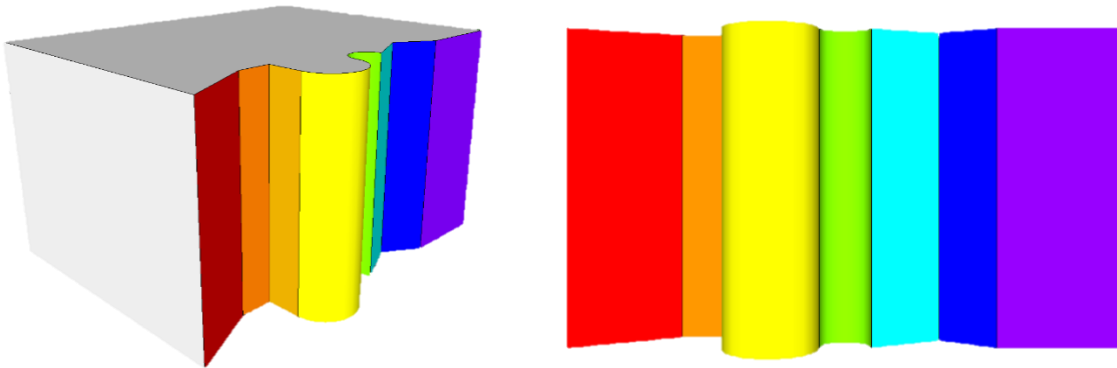
Glass with an irregular form is shown in color on the left. Only the components facing out, shown on the right, are included in the area of glass for the U-value calculation. Note how the light orange component of the pane (third from left) is not included in the area at all since it is perpendicular to the front plane.

TRNSYS Inputs

When using TRNSYS, you should use the NFRC standard instead of DIN. Pay extra attention to numbers received from European manufacturers as these are often found using the DIN standard. In addition, you must make sure that film coefficients are excluded from U_f (really you are inputting the frame's conductance instead of its thermal transmittance). Normal NFRC U-values usually include film coefficients.

While the normal NFRC calculation is interested in the frame area, A_f, TRNSYS is interested in the frame fraction. The frame fraction can be found by taking the ratio of A_f to A.

References

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