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Proposals of amendments to the ATP: pending proposals
ATP Handbook

Interpretation of external surface area measurement for panel vans

Transmitted by the United Kingdom

I. Introduction

1. The interpretation of external surface area measurement of panel vans was originally raised at the 66th session of WP.11 and lead to some misunderstandings over the issues experienced. The problem leads to some van structures receiving lower K values than they otherwise might be entitled to.

2. The existing text of the ATP is not practical for the measurement of the external surface area of insulated vans for all shapes and sizes of vehicle. The smooth contours of a van body make it difficult to establish the most accurate point from which to take measurements. For example, the width of the floor is often different from the ceiling and the front can be narrower than the rear where a side door is installed.

3. Measurement of the external surfaces of a van cannot account for unfilled voids within the structure. Panel voids might also include steel structures that bridge the external heat to the outer edge of the insulated wall panels. The point is illustrated in the diagram below. The grey shading represents the main insulated panel and the black voids represent varying thicknesses of foam infill.

4. The voting on the revised proposal in 2014 was 5 in favour (France, Italy, Poland, Portugal and United States) and 1 against (Germany). In explanation of its vote, Germany said that elements of the proposal were still missing such as required amendments for the model test report.

5. Further to the above, the test report was discussed at the 2015 meeting of the International Institute of Refrigeration (IIR) sub-commission on refrigerated transport in Portugal. A solution was agreed as to what information is required in the test report to support the proposal at the next WP11 meeting.

II. Proposed amendment

6. The following text should be added to annex 1, appendix 2, paragraph 1.2 as follows:

"For calculating the mean surface area of the body of a panel van, the competent authorities' appointed experts shall select from one or a combination of the following three methods.

Method A. The manufacturer shall provide drawings and calculations of the inside and outside surfaces.

The surface areas S_e and S_i are determined taking into consideration the projected surface areas of specific design features of the irregularities of its surface such as curves, corrugations, wheel boxes, etc.

Method B. The manufacturer shall provide drawings and the competent authority shall use the calculations according to the schemes and formulae in the ATP Handbook (using either figures 1, 2 or 3 along with figures 4 and 5).

$$S_i = (((WI \times LI) + (WI \times LI) + (W_i \times W_i)) \times 2)$$

$$S_e = (((WE \times LE) + (WE \times LE) + (W_e \times W_e)) \times 2)$$

Where:

WI is the Y axis of the internal surface area

LI is the X axis of the internal surface area

W_i is the Z axis of the internal surface area

WE is the Y axis of the external surface area

LE is the X axis of the external surface area

W_e is the Z axis of the external surface area

Using the most appropriate formula for the Y axis of the internal surface area

$$WI = (WIa \times a + WIb \times (b + c/2) + WIc \times c/2) / (a + b + c)$$

$$WI = (WIa \times a/2 + WIb (a/2 + b/2) + WIc (b/2) / (a + b)$$

$$WI = ((WIb \times b)+(WIb \times c) – ((WIb – WIc) \times c) + (2 \times ((WIb – WIa) \times a))) / (a + b + c)$$

Where:

WIa is the internal width at the floor or between the wheel arches

WIb is the internal width at the height of the vertical edge from the floor or above the wheel arches.

WIc is the internal width along the roof

a is the height of the vertical edge from the floor

b is either the height between the bottom of the vertical edge and the roof or between the top of the wheel arch and the top of the vertical edge from the floor.

c is the height between the roof and point b

Along with the two formulae for the X and Z axes of the internal surface:

$$LI = ((LIa \times a) + (LIb + LIc) / 2 \times b + (LIc \times c)) / (a + b + c)$$

Where:

LIa is the internal length along the floor

LIb is the internal length above the wheel arches

LIc is the internal length along the roof

a is the height between LIa and LIb

b is the height between LIb and LIc

c is the height between LIc and the roof

$$Wi = (Wi\ back + Wi\ front) / 2$$

Where:

Wi back is the width at the bulkhead

Wi front is the width at the door end

The external surface area is calculated using the formulae below

$$WE = WI + \text{declared mean thickness}$$

$$LE = LI + \text{declared mean thickness}$$

$$We = Wi + \text{declared mean thickness}$$

Method C. If neither of the above is acceptable to the experts, the internal surface shall be measured according to the figures and formulae in method B.

The K value shall then be calculated based on the internal surface area, taking the insulation thickness as nil. From this K value, the average insulation thickness is calculated from the assumption that λ for the insulation has a value of 0.025 W/m·K.

$$d = S_i \times \Delta T \times \lambda / W$$

Once the thickness of the insulation has been estimated, the external surface area is calculated and the mean surface area is determined. The final K value is derived from successive iteration."

III. Test report

7. To reflect the panel van dimensions in the test report, the maximum internal length and height, top and bottom width, the method and figures have to be included in Model Test Report No 1 A in annex 1, appendix 1.

IV. Proposed amendment

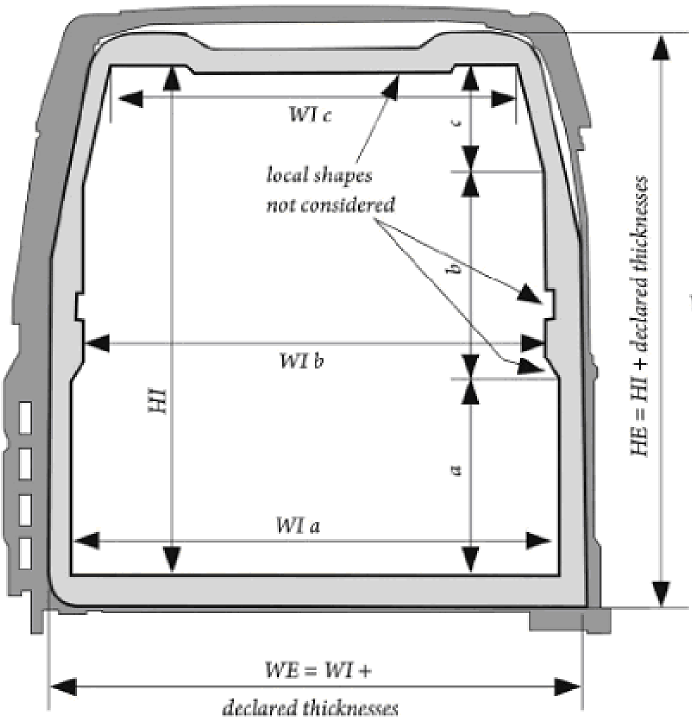
8. Insert the following text in annex 1, appendix 1, model test report No. 1A after "Usable internal volume of body":

"Method used [1,3] .... Figures used [1, 3]………..…………….".

V. ATP Handbook

9. It is proposed to include the following drawings in the ATP Handbook with examples.

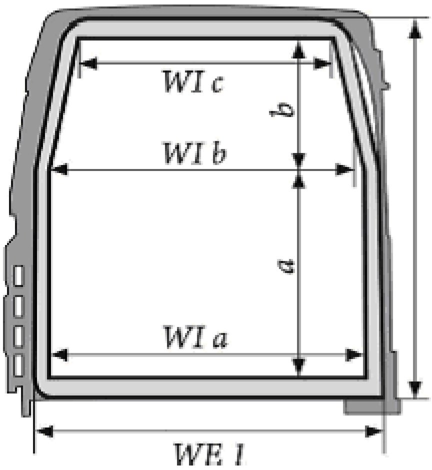
Figure 1



$$WI = \frac{WIa \times a + WIb \times \left(b + \frac{c}{2}\right) + WIc \times \frac{c}{2}}{a + b + c}$$

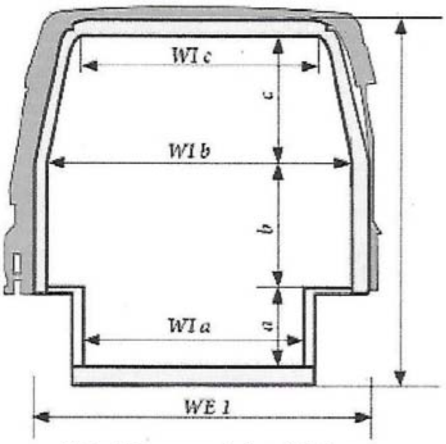
$$\text{Mean declared thicknesses (mm)} < \frac{25}{K}$$

Figure 2



$$WI = \frac{WIa \times \frac{a}{2} + WIb\left(\frac{a}{2} + \frac{b}{2}\right) + WIc\left(\frac{b}{2}\right)}{a + b}$$

Figure 3



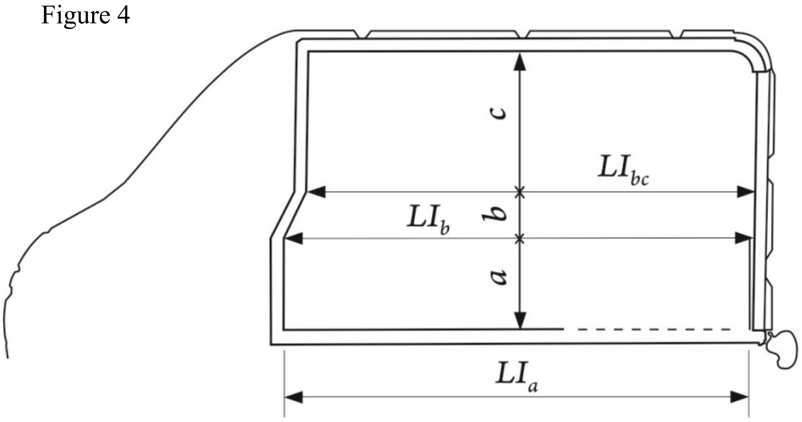
WE = WI + mean declared thicknesses

$$WI = \frac{((WIb \times b)+(WIb \times c)-((WIb-WIc) \times c)+(WIb \times a)+(2 \times ((WIb-WIa) \times a)))}{(a+b+c)}$$

key

W_{ia}	internal width between the wheel arches
W_{ib}	internal width above the wheel arches
W_{ic}	internal width of the roof
a	internal height of the wheel arches
b	internal height above the wheel arches
c	internal height above the wheel arches where the side wall width ends

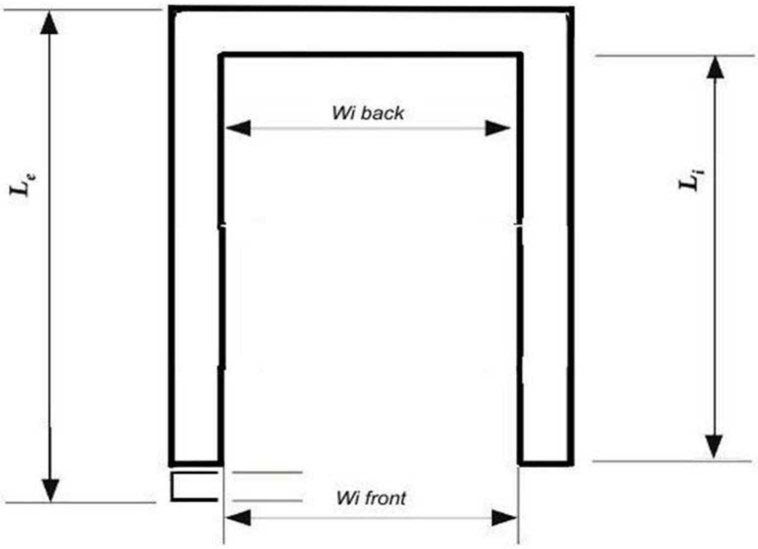
Figure 4



$$LI = \frac{(LI_a \, x \, a) + \left(LI_b + LI_c\right)/2 \, x \, b + (LI_c \, x \, c)}{a + b + c}$$

LE = LI + mean declared thicknesses

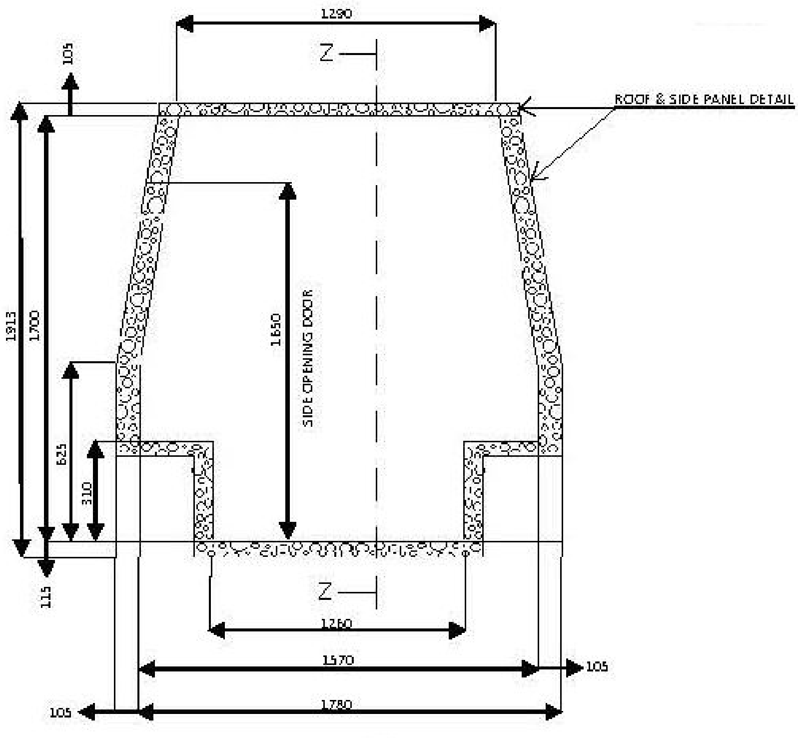
Figure 5

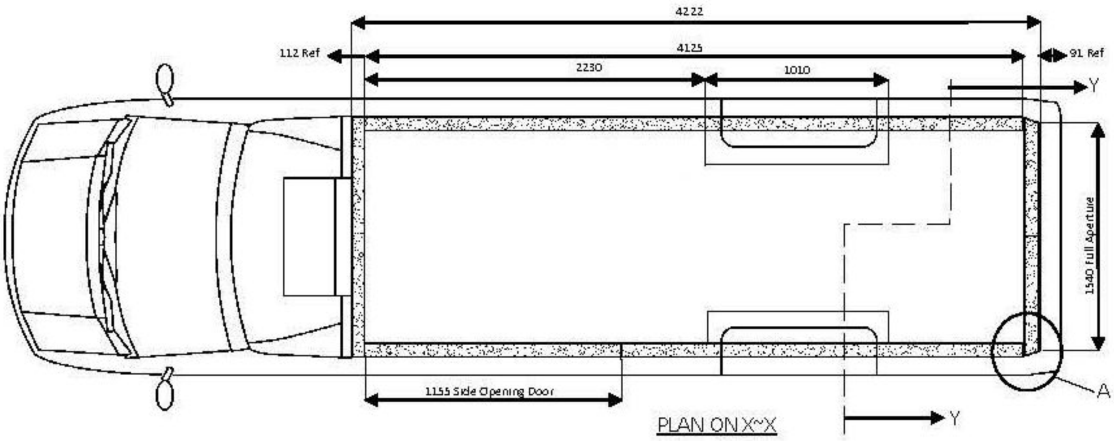


$$Wi = \frac{(Wi\ back + Wi\ front)}{2}$$

We = Wi + mean declared thickness

VI. Examples

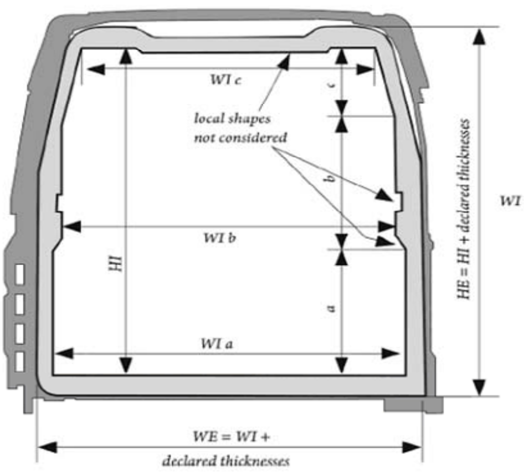




Method A

				Internal					External
Roof	4.125				Roof	4.222			
			1.29	5.32125				1.5	6.333
Floor	4.125				Floor	4.222			
			1.57	6.48				1.78	7.52
Sides	4.125				Sides	4.222			
			1.7	14.025				1.913	16.15337
Bulkhead					Bulkhead				
	1.29					1.5			
		1.70		1.72			1.91		2.55
	1.57					1.78			
Door					Door				
	1.29					1.5			
		1.7		1.72			1.913		2.55
	1.57					1.78			
			Si	29.27				Se	35.11
with wheel arches	0.1922		Si	29.46				Se	35.30

Method B (excluding wheel arches)

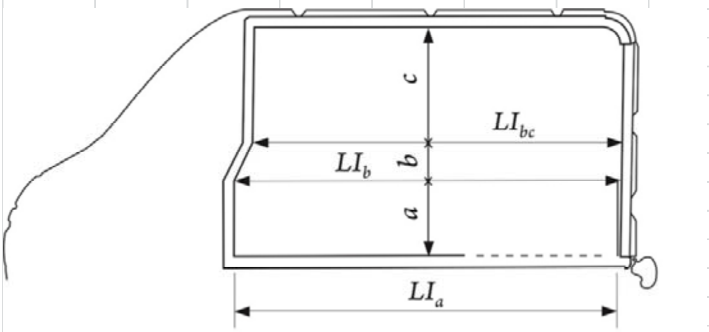


$$WI = \frac{WIa \times a + WIb \times \left(b + \frac{c}{2}\right) + WIc \times \frac{c}{2}}{a + b + c}$$

$$\text{Mean declared thicknesses (mm)} < \frac{25}{K}$$

Wia	1.57
Wib	1.57
Wic	1.29
a	0.31
b	0.315
c	1.075

WI	**1.481471**
Declared Thickness	0.22
WE	**1.701471**

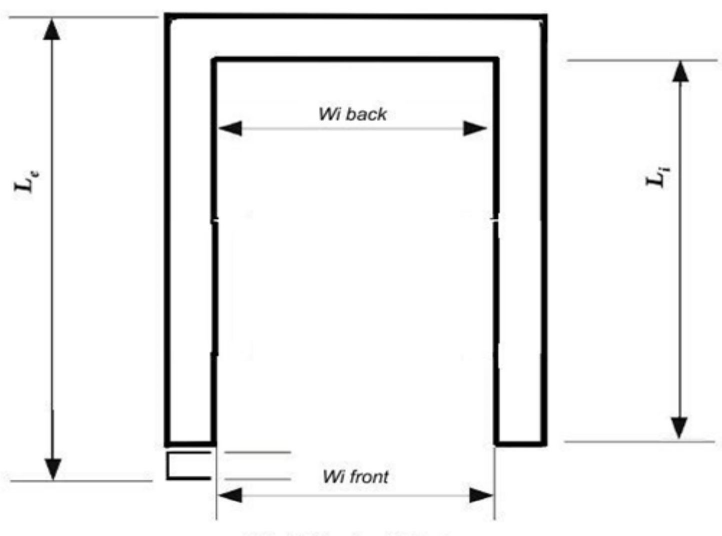


$$LI = \frac{(LI_a \; x \; a) + \left(LI_b + LI_c\right)/2 \; x \; b + (LI_c \; x \; c)}{a + b + c}$$

$$LE = LI + \text{mean declared thicknesses}$$

Lia	4.125
Lib	4.125
Lic	4.125
a	0.31
b	0.315
c	1.075

LI	**4.125**
Declared Thickness	0.203
LE	**4.328**



Wi = Wi back + Wi front

Wiback	1.57
Wifront	1.57

Wi	**1.57**
Declared Thickness	0.21
We	**1.78**

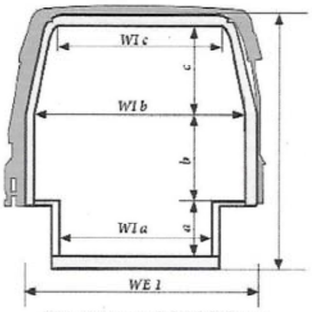
Method C (excluding wheel arches)

Wia	1.57	Lia	4.125	Wib	1.57								
Wib	1.57	Lib	4.125	Wif	1.57								
Wic	1.29	Lic	4.125										
a	0.31	a	0.31										
b	0.315	b	0.315										
c	1.075	c	1.075										
						Si	Se	S	W	Delta T	k	Lambda	d
WI	1.481471	LI	4.125	Wi	1.57	29.37			300	25	0.409	0.025	0.0612
WE	1.6039	LE	4.2474	We	1.6924	29.37	33.43	31.34	300	25	0.383	0.025	0.0653
WE	1.6120	LE	4.2556	We	1.7006	29.37	33.68	31.45	300	25	0.382	0.025	0.0655
WE	1.6125	LE	4.2560	We	1.7010	29.37	33.69	31.46	300	25	**0.381**	0.025	0.0655

Results from all three methods (excluding wheel arches)

	Si	Se	S	W	Delta T	k
Method A	29.27	35.11	32.05	300	25.00	**0.374**
Method B	29.37	35.79	32.42	300	25.00	**0.370**
Method C	29.37	33.69	31.46	300	25.00	**0.381**

Method B (including wheel arches)



WE = WI + mean declared thicknesses

$$WI = \frac{((WIbxb)+(WIbxc)-((WIb-WIc)xc)+(WIbxa)+(2x((WIb-WIa)xa)))}{(a+b+c)}$$

key

W_{ia} internal width between the wheel arches

W_{ib} internal width above the wheel arches

W_{ic} internal width of the roof

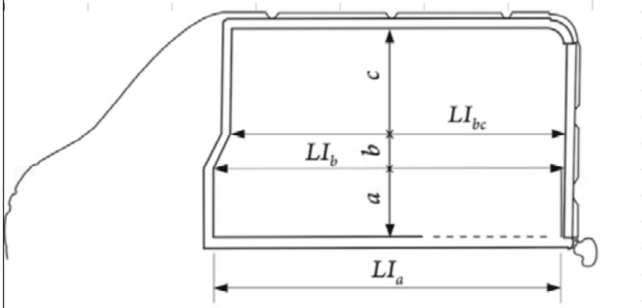
a internal height of the wheel arches

b internal height above the wheel arches

c internal height above the wheel arches where the side wall width ends

Wia	1.26
Wib	1.57
Wic	1.29
a	0.31
b	0.315
c	1.075

WI	**1.506**
Declared Thickness	0.22
WE	**1.726**

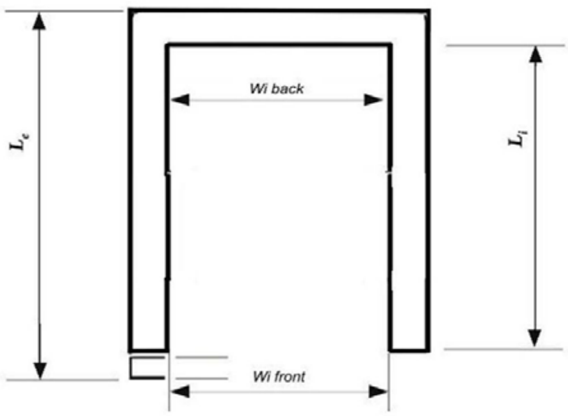


$$LI = \frac{(LI_a \, x \, a) + (LI_b + LI_c)/2 \, x \, b + (LI_c \, x \, c)}{a + b + c}$$

$$LE = LI + mean\ declared\ thicknesses$$

	3.115
Lia	4.125
Lib	4.125
Lic	4.125
a	0.31
b	0.315
c	1.075

LI	**4.125**
Declared Thickness	0.203
LE	**4.328**



$$Wi = \frac{(Wi\ back + Wi\ front)}{2}$$

We = Wi + mean declared thickness

Wiback	1.57
Wifront	1.57

Wi	**1.57**
Declared Thickness	0.21
We	**1.78**

Method C (including wheel arches)

Wia	1.26
Wib	1.57
Wic	1.29
a	0.31
b	0.315
c	1.075
WI	1.506
WE	1.6301
WE	1.6381
WE	1.6386

Lia	4.125
Lib	4.125
Lic	4.125
a	0.31
b	0.315
c	1.075
LI	4.125
LE	4.2491
LE	4.2571
LE	4.2576

Wib	1.57								
Wif	1.57								
		Si	Se	S	W	Delta T	k	Lambda	d
Wi	1.57	29.78			300	25	0.403	0.025	0.0620
We	1.6941	29.78	33.77	31.71	300	25	0.378	0.025	0.0661
We	1.7021	29.78	34.02	31.83	300	25	0.377	0.025	0.0663
We	1.7026	29.78	34.03	31.83	300	25	**0.377**	0.025	0.0663

Results from all three methods (including wheel arches)

	Si	Se	S	W	Delta T	k
Method A	29.46	35.30	32.25	300	25.00	**0.372**
Method B	29.78	36.22	32.84	300	25.00	**0.365**
Method C	29.78	34.03	31.83	300	25.00	**0.377**

VII. Impact

9. There may be a financial impact for industry, in that vans overall become slightly more expensive as the less expensive inferior versions are eliminated. As can be seen the iteration method is slightly harsher on the manufacturer than when the precise drawings are available.

10. Improved K values generally reduce carbon emissions. However, in some instances the higher measured K value might result in the necessity for a larger cooling unit, which would increase carbon emissions.

11. The proposal would ensure that measurements made on panel vans are consistent between different experts and testing stations, avoiding unrealistic test results. This would benefit manufacturers / body assemblers who would be reassured that the precise K value is not dependent on which test station or which expert conducts the test.