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Status and implementation of the Agreement on the International Carriage of Perishable Foodstuffs and on the Special Equipment to be Used for such Carriage (ATP): interpretation of ATP

Discussion document on K Value

Submitted by the Government of the United Kingdom

Introduction

1.   According to Annex 1, Appendix 2:

"*If the refrigerating appliance with all its accessories has undergone separately, to the satisfaction of the competent authority, a test to determine its effective refrigerating capacity at the prescribed reference temperatures, the transport equipment may be accepted as mechanically refrigerated equipment without undergoing an efficiency test if the effective refrigerating capacity of the appliance in continuous operation exceeds the heat loss through the walls for the class under consideration, multiplied by the factor 1.75.*"

2.   "…heat loss through the walls" refers to the heat transfer across the walls of the equipment. This is calculated using a rearrangement of the equation for overall heat transfer coefficient, K, given in paragraph 1.1 of the same appendix.

$$K = \frac{W}{S \cdot \Delta T} \qquad \text{Equ.1}$$

3.   With power input W, mean surface area S and temperature difference ΔT. This can be rearranged for heat loss through the walls as follows:

$$W = K \cdot S \cdot \Delta T \qquad \text{Equ.2}$$

4.   Here, both S and K are specific to the considered equipment as these are both measured and calculated respectively to ensure compliance. ΔT is the difference between 30 °C and the class temperature. For class C this is 50 K and for class A, 30 K.

"*The nominal refrigerating capacity of the multi-temperature refrigeration unit shall be at least equal to the heat loss through the outer body walls of the equipment as a whole multiplied by the factor 1.75 as specified in paragraph 3.2.6 of this appendix.*"

Annex 1, Appendix 2, paragraph 7.3.1

5. The differing wording, i.e. "*heat loss through outer body walls*" versus "*heat loss through the walls for the class under consideration*" arises not because of a different calculation method, but rather the requirement of multi-temperature multi-compartment (MTMC) equipment having an outer body $K \leq 0.40$ W m^{-2} K^{-1}. According to Annex 1, paragraph 2, temperature classes B and C, -10 and -20 °C respectively, require $K \leq 0.40$ W m^{-2} K^{-1}.

6. Further, the methodologies of Annex 1, Appendix 2, paragraphs 7.2.2 – 7.2.4 require operation at -20 °C from each evaporator of an MTMC system, therefore all MTMC refrigeration systems are class C according to Annex 1, paragraph 3. The words "*class under consideration*" are superfluous as a refrigeration system of any other class cannot complete the testing requirements for MTMC.

7. This means that the ΔT in equation 2, for an MTMC system, is always 50 K. The K and S values are then dependent upon the nature of the equipment used. If this were not the case the minimum required refrigerating capacity would simply be equal to the mean surface area of the body multiplied by 35.

8. The veracity of the above interpretation is further proven by the inequality of Annex 1, Appendix 2, part 7.3.2:

$$P_{nominal} > 1.75 \cdot K_{body} \cdot S_{body} \cdot \Delta T \qquad \text{Equ.3}$$

9. Where K and has the body subscript and is defined as "*the K value of the outer body*". $P_{nominal}$ is the "*nominal refrigerating capacity*" referred to in Annex 1, Appendix 2, paragraph 7.3.1.

10. When chamber testing is conducted for the purpose of checking the insulating capacity of equipment in service which verifies that the K value is less than or equal to the class limit, rather than determination of the K value, the measured value should also be used. In this special case the measured value may be equal to the class value however the value obtained from testing should be used. Whilst the K value of the originally tested prototype may be less than the class limit, the verification test only shows that the K value meets the class limit and provides no evidence that it is any lower.

11. During inspections of in-service equipment the current condition of the equipment is being considered, not the condition the equipment was in when it was new. The presently measured K-value should, therefore, be used.

Conclusion

12. There has been confusion as whether to use the measured value or the class value in dimensioning calculations. From the above the measured K value of the body should always be used.