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Working Party on the Transport of Perishable Foodstuffs

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Item 6 (a) of the provisional agenda
Proposals of amendments to ATP:
pending proposals

Amendment to Annex 1, Appendix 2 paragraph 3.2.6 and the ATP Handbook

Transmitted by the Government of the United Kingdom

Revision

Introduction

1. Cambridge Refrigeration Technology (CRT) was asked to provide justification for the proposed airflow requirement figures given in the working document ECE/TRANS/WP.11/2019/17. When discussed during the 2020 CERTE meeting it was also requested that the proposal was simplified.

2. Air change requirements of 40 – 60 and 50 – 90 were proposed for frozen and chilled/heating operation respectively. Whilst the members of WP.11 broadly agreed that sufficient airflow is required for cooling there was less agreement on how much airflow was needed for this.

3. Common dimensions were used for trailer surface area and volume yielding 155.445 m^2 and 87.1 m^3 respectively.

4. Initially the capacity required by ATP for frozen carriage was calculated as follows:

$$Q = K \cdot A \cdot \Delta T = 0.4\ x\ 155.5\ x\ 50 = 3109\ W$$

5. This increases to 5441 W with the safety factor of 1.75 given in the text of the agreement. For chilled operation the equivalent capacity is 3265 W.

6. CRT looked at data from trailer refrigeration systems operating on thermostatic control. Typically, at frozen temperatures road transport systems operate in “stop-start” mode whilst at chilled they operate continuously. Frozen cargo is less temperature sensitive than chilled cargo. Chilled products must be kept both cold enough to ensure quality and food safety but also warm enough to prevent partial freezing therefore tight temperature control is needed, hence continuous operation.

7. Without a narrow band of temperature control, it is possible to freeze cargo near the supply air whilst simultaneously allowing cargo at the lower door end to heat up enough to allow spoilage. When cargo is loaded at the correct temperature it will remain at a temperature between supply and return air whilst the refrigeration system is running.

8. From the data it was apparent that during frozen operation the difference in supply and return air temperatures is between 4 and 5 K. At chilled setpoints running continuously it is close to 2 K. Using these figures in conjunction with the capacity required by ATP the airflow required was calculated using the following equation:

$$\dot{v} = \frac{Q}{c_p \cdot \rho \cdot \Delta T}$$

9. With $\dot{v}$ being airflow, c_p specific heat and ρ density. The table below shows the values used and results of the calculation.

Return air	-20	0	°C
Average ΔT	4.5	2.0	K
Q_{req}	5441	3265	W
c_p	1.003	1.004	$kJ \cdot kg^{-1} \cdot K^{-1}$
ρ	1.290	1.230	$kg \cdot m^{-3}$
$\dot{v}$	0.934	1.322	$m^3 \cdot s^{-1}$
$\dot{v}$	3364	4758	$m^3 \cdot hr^{-1}$
Air changes	39	55	-

10. Although the capacity required is less at chilled setpoints the operation of refrigeration systems, mandated by the nature of the cargo, requires higher airflow due to the limited temperature differential across an evaporator coil.

Proposed amendment

11. We propose to amend the text as follows with a new paragraph which is added to 3.2.6:

"The required airflow for equipment where 2 $m^3 \leq V \leq 100$ m^3 is calculated using the following formula:

$\dot{V}_L = N \cdot V$

Where airflow rate $\dot{V}_L$ is air changes per hour, N, multiplied by the empty volume, V."

Option 1a

"With:

$40 \leq N \leq 65$ for frozen mode" or "$50 \leq N \leq 90$ for chilled/heating mode".

Option 2a

"With:

$N \geq 55$"

12. The air delivery system shall be compensated for any loss of airflow due to internal equipment such as air ducts and the frosting of the evaporator(s) and need not be continuous.

Option 1b

"If the internal volume V is less than 2 m^3 or greater than 100 m^3, the competent authority where the equipment is registered or recorded shall determine adequate airflow based on the overall heat transfer."

Option 2b

"If the equipment internal volume V is less than 2 m^3 or greater than 100 m^3, the competent authority can issue a certificate of compliance without meeting the airflow requirement."

Annex 1, Appendix 3

13. The ATP certificate will need to be amended with a new section below in Annex 1, Appendix 3.

"7.2.6 XX air changes/hour"

Where XX is the number of air changes per hour calculated by dividing the total airflow of the evaporator fans by the total internal volume of the equipment as a whole.

The following could be added to the ATP handbook for additional explanation:

"Airflow is an essential parameter within temperature-controlled transport. For frozen cargoes, airflow should be low to avoid desiccation but sufficient to remove heat entering through the insulated walls, supply air can deviate below the set temperature to remove heat without damaging the product. Chilled cargoes require higher airflow for good temperature distribution and also because the supply air temperature cannot be allowed to deviate significantly below the set temperature due to freezing or chilling damage. Some chilled cargoes are metabolically active and therefore require higher airflow to remove that heat.

Intermittent fan operation should not be used for sensitive cargo where close temperature distribution is required. Generally, start/stop operation of the unit when the evaporator fans/unit are allowed to cycle should be used only for frozen goods transportation.

Table 1
Examples of air flow requirements for temperature sensitive goods

Type of goods	*Temperature range [°C]*	*Sensitivity to humidity*	*Recommended airflow rate [times/empty volume of equipment]*
Hanging meat	-1/+1°C	Yes	50 –90
Chilled products	-1/+6°C	Yes	50 – 90
Frozen foods	< -18°C	No	40 – 60
Ice cream	< -20 °C	low	40 – 60

"

Impact

14. This change would modernise ATP and a positive impact would be that food safety and quality would improve. The financial impact to industry is that there would be an additional cost for an airflow test in cases where it is not carried out already.

15. A defined flowrate for the secondary refrigerant would help ensure all products within the cargo space meet the requirements of Annex 2 and 3.

16. However, the airflow result are required in the machine test report and therefore there appears an inconsistency.