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## Economic Commission for Europe

Inland Transport Committee

### Working Party on the Transport of Perishable Foodstuffs

**Seventy-seventh session**
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Item 5 (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 2**

## Introduction

1. Cambridge Refrigeration Technology (CRT) were 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 WP11 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 v̇ being airflow, cp 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.

11. At the WP.11 meeting in 2020 the following points were raised by Finland Netherlands Germany and France:

(a) It should be clear in the proposal that the amendment would apply only to equipment manufactured after the entry into the force of the amendment. (Finland)

*Footnote added*

(b) Sentence "For mechanically refrigerated equipment of Class F the airflow may be reduced with N ≥ 40 and where V exceeds 100 $m^3$ VL may be limited to 5500 $m^3$ per hour." should cover also Class C. (Finland)

*Agreed FRC and BRC*

(c) Air flow capacity of ventilators without cooling or heating should be taken into account when calculating the available airflow capacity. (Finland)

*Any fans can be accounted for evaporator fans and replaced with circulation fans*

(d) Lorries having internal volume more than 60 $m^3$, should have fixed requirement of 3300 $m^3 \cdot hr^{-1}$. (Finland)

*This should not be required as the 1.75 rule will be breached before the airflow requirement*

(e) How air flow requirements in each compartment in MTMC equipment were dealt with? (Finland)

*Dealt with in Annex 1 appendix 3*

(f) Justification for limiting the air flow above a capacity of 100 $m^3$: Thermal units shall be able to circulate air in a sufficient amount to maintain temperature. As in practical use this will also depend on the volume of foodstuffs in the equipment and the way these are placed inside the equipment empty volume is chosen as a general rule for a minimum requirement. Earlier attempts to include air flow requirements failed based on larger equipment used in particular countries that allow greater heights of road vehicles. As thermal units are not lay-out for this a deviation may be taken above 100 $m^3$. This may be justified by accepting that in practice equipment is not used empty and the volume of the foodstuffs load will increase air flow. (Netherlands)

*Agreed*

(g) We would support you with the option 2a and circulation rate of 50. (Germany)

*Agreed*

(h) The proposal says this would improve food safety and quality but how do we measure/evaluate this? *(France)*

*Air circulation has been determined to be important during pharmaceutical storage trials*

Also, financial impact is not only airflow test, it might lead to bigger evaporator and a related impact for transporter (cost, size ...). Regardless of capacity, more airflow could mean bigger fan so bigger evaporator. *(France)*

*In most cases properly designed units already have the correctly sized fans.*

(i) Start stop is used for insensitive chilled produce such as dairy and saves energy restricting its use and limiting the minimum airflow to 40 stops it use (France)

*Agreed, the wording is now modified to allow this and to mirror the draft CEN Standard. ATP is principally for food safety and cannot use the words sensitive or insensitive cargo and this left for CEN standards.*

(j) However, if we assume that the trailer is loaded and that there is counterpressure from the load or air chute systems, some refrigeration units might have problems with the minimum flow rate, because their fans can only provide sufficient air performance without counterpressure. (Germany)

*Partially agreed, the static pressure of a duct or chute would be easily measured but degree of frosting more subjective, therefore word frosting removed.*

## Proposed amendment

12. 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: [1]

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

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

Where $N \geq 50$

The air delivery system shall be compensated for any loss of airflow due to internal equipment such as air ducts and in part load need not be continuous and or may be modulated.

For mechanically refrigerated equipment of Class FRC or BRC the airflow may be reduced to $N \geq 40$ and need not be continuous.

Where V exceeds 100 $m^3$ $V_L$ may be limited to at least 5500 $m^3$ per hour. "

## Annex 1, Appendix 3

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

[1] Applies to equipment manufactured after the date of entry in to force (DD MM YEAR)

"7.2.6 XX air changes/hour"

Option 1

Where XX is the number of air changes per hour calculated by dividing the total airflow of the circulation fans by the total internal volume of the equipment. In the case of multi-compartment equipment with movable bulkheads, for each compartment the total airflow of the circulation fans is divided by the maximum internal volume of the compartment.

Option 2

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

Nb CERTE D2 group prefers option 1 at their meeting 28th April 2021

**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 is required in the machine test report and therefore there appears an inconsistency.