



Economic and Social Council

Distr.: General
16 February 2022

Original: English

Economic Commission for Europe

Inland Transport Committee

Working Party on the Transport of Perishable Foodstuffs

Seventy-eighth session

Geneva, 3-6 May 2022

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

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 IIR sub-commission on refrigerated transport meeting (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 m² and 87.1 m³ respectively.
4. Initially the capacity required by ATP for frozen carriage was calculated as follows:
$$Q = K \cdot A \cdot \Delta T = 0.4 \times 155.5 \times 50 = 3109 \text{ W}$$
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	$\text{kJ} \cdot \text{kg}^{-1} \cdot \text{K}^{-1}$
ρ	1.290	1.230	$\text{kg} \cdot \text{m}^{-3}$
\dot{v}	0.934	1.322	$\text{m}^3 \cdot \text{s}^{-1}$
\dot{v}	3364	4758	$\text{m}^3 \cdot \text{hr}^{-1}$
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 session in 2020 the following points were raised by Finland, France, Germany and the Netherlands:

(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 $N \geq 40$ 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 BRI

(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 $3300 \text{ m}^3 \cdot \text{hr}^{-1}$. (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 multi-temperature multi-compartment (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.

12. At the WP.11 session in 2021 the following points were raised by Finland:

- (a) It did not completely agree with the statement that 1.75 rule concerning cooling capacity shall be the limiting factor in lorries having internal volume more than 60 m³ and there should be fixed requirement for airflow it should not be required that lorries having internal volume of more than 60 m³ have fixed air flow of 3300 m³/h.

As we have said before at previous sessions only about 22% of systems become limited by airflow before they reach the current ATP requirements on refrigeration capacity, these are mostly small remote evaporators on MTMC systems. There shouldn't be a fixed airflow requirement, it is too restrictive, only a minimum.

- (b) Reminded that FRC and BRC are not comparable frozen classes because in BRC lower limit of the inside temperature is 0 °C. Instead in classes BRI, BRJ, BRK and BRL lower limit is -20 °C as is in FRC.

Agreed

- (c) Did not agree with new air flow requirements of 5500 m³/h instead of 5000 m³/h; if internal volume is more than 100 m³.

Would the Finnish delegation prefer 5000m³ per hour or could they suggest a figure that would be acceptable?

Proposed amendment

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

“The minimum required airflow for equipment where $2 \text{ m}^3 \leq V \leq 100 \text{ m}^3$ is calculated using the following formula¹:

$$\dot{V}_{L\min} = N \cdot V$$

¹ Applies to equipment manufactured after the date of entry into force (DD MM YYYY)

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

With N = 50

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 may be modulated in part load operation to a minimum of N = 40.

For mechanically refrigerated equipment of Class FRC, BRI, BRJ, BRK or BRL the minimum airflow may be reduced to N = 40 and need not be continuous.

Where V exceeds 100 m³ \dot{V}_{Lmin} shall be at least 5000 m³ per hour.”

Annex 1, Appendix 3

14. 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”

15. New footnote added after footnote 10

¹¹ 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.”

16. Original footnotes 11 to 15 to be renumbered 12 to 16.

New text

¹⁰ Where determined in conformity with the provisions of Appendix 2, paragraph 3.2 of this annex.

¹¹ 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.

¹² The effective cooling capacity of each evaporator depends on the number of evaporators fixed at the condensing unit.

¹³ In case of loss, a new Certificate can be provided or, instead of it, a photocopy of the ATP Certificate bearing a special stamp with "CERTIFIED DUPLICATE" (in red ink) and the name of the certifying officer, his signature, and the name of the competent authority or authorized body.

¹⁴ Security stamp (relief, fluorescent, ultraviolet, or other safety mark that certifies the origin of the certificate).

¹⁵ If applicable, mention the way the power for issuing ATP Certificates is delegated.




¹⁶ Write the mark, model, serial number of the manufacturer and month and year of manufacture of the insulated body. All the serial numbers of insulated equipment (containers) having an internal volume of less than 2 m³ shall be listed. It is also acceptable to collectively list these numbers, i.e. from number ... to number ...”

17 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

<i>Type of goods</i>	 <i>Temperature range [°C]</i>	 <i>Sensitivity to humidity</i>	 <i>Recommended airflow rate [times/empty volume of equipment]</i>
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

- 18. 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.
- 19. A defined flowrate for the secondary refrigerant would help ensure all products within the cargo space meet the requirements of Annex 2 and 3.
- 20. However, the airflow result is required in the machine test report and therefore there appears an inconsistency.

