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## Economic Commission for Europe

### Inland Transport Committee

#### Working Party on the Transport of Perishable Foodstuffs

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Item 5 (a) of the provisional agenda

##### Proposals of amendments to the ATP

##### Pending proposals

### **Procedure for the efficiency testing of in-service independent, multi-temperature equipment**

**Transmitted by the Government of France**

#### **Background**

1. The ATP<sup>1</sup> was amended in 2013 to cover multi-compartment, multi-temperature equipment.
2. The Agreement explains the test and dimensioning procedures for multi-temperature equipment. It also provides a model for test reports and ATP certificates for such equipment, but not for renewal of certificates or the relevant tests for equipment in service, although that information is given for mono-temperature equipment.
3. A test method is required for equipment in service at 6 and 9 years for each type.
4. Most multi-temperature equipment in use is independent mechanically refrigerated equipment. The test method for multi-temperature independent mechanically refrigerated equipment should be developed first. It should be in line with the other test methods for equipment in service given in ATP, and specifically the method for mono-temperature independent mechanically refrigerated equipment. Another proposal relates to dependent multi-temperature equipment.
5. In 2012, France presented the test method that had been developed for such equipment and used since 2002 for over 2,000 units each year.

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<sup>1</sup> Agreement on the International Carriage of Perishable Foodstuffs and on the Special Equipment to be Used for such Carriage.

6. The present document proposes a formal amendment to include this modification in ATP.

**Proposal**

7. The proposed procedure is given below.

**Principle**

8. The purpose of the test is to obtain a recording of a temperature cool-down that is representative of the equipment’s refrigeration performance. It will thus verify that, when the outside temperature is not lower than +15.0° C, and the deviation between the highest and lowest instantaneous outside temperatures during the duration of the temperature-holding period does not exceed 5.0° C, the inside temperature of each compartment in the empty equipment can be brought to the relevant class temperature within a maximum period of (... minutes), as prescribed in the table below:

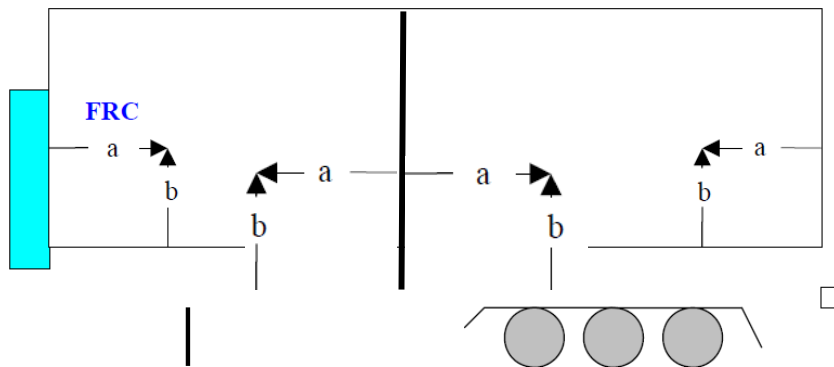
| <i>Outside temperature (°C)</i> | 30  | 29  | 28  | 27  | 26  | 25  | 24  | 23  | 22  | 21  | 20  | 19  | 18  | 17  | 16  | 15  |
|---------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Class C                         | 360 | 350 | 340 | 330 | 320 | 310 | 300 | 290 | 280 | 270 | 260 | 250 | 240 | 230 | 220 | 210 |
| Class B                         | 270 | 262 | 253 | 245 | 236 | 228 | 219 | 211 | 202 | 194 | 185 | 177 | 168 | 160 | 151 | 143 |
| Class A                         | 180 | 173 | 166 | 159 | 152 | 145 | 138 | 131 | 124 | 117 | 110 | 103 | 96  | 89  | 82  | 75  |

9. The inside temperature of each compartment in the empty equipment must previously be brought to the outside temperature.

**Placing of temperature sensors**

10. Temperature measuring sensors that are protected from heat radiation should be placed on the inside and outside of each compartment in the equipment, as for mono-temperature equipment.

11. In order to measure the temperature inside each compartment in the equipment, at least two temperature measuring points should be selected inside each compartment at a maximum distance of 50 cm from the front wall and 50 cm from the rear door or wall and at a height of between 15 cm and 20 cm above the floor, as shown in the diagram below:



a = maximum 50 cm from the front wall and the rear door  
 b = minimum 15 cm and maximum 20 cm above the floor

12. In order to measure the temperature outside the body, two temperature measuring sensors should be placed at a distance of at least 10 cm from an outer wall of the body, along the vertical centreline and as high as possible. The first sensor should be placed close to a side wall of the tank, while the second should be placed at the rear of the equipment. The external sensors, which verify the outside temperature, should be protected from sunlight and any extraneous heat sources, while allowing the ambient air to circulate around them.

### **Equalizing the inside and outside temperatures**

13. The inside temperature of each compartment in the empty equipment must previously be brought to the outside temperature. The purpose of achieving this equilibrium is to ensure that the amount of thermal energy stored in the walls is minimal.

The body should be dry and at the outside ambient temperature

The sensors should be installed inside each compartment of the tank as shown above

The equipment doors should be closed

The temperature sensors should be connected to the temperature recorder, which should be switched on

Temperatures should be recorded at least every 5 minutes

14. The following calculations should be made:

At all times and for each compartment:  $T_{\text{hold}}$ , the mean holding temperature, which is the mean of the instantaneous temperatures of the inner sensors

At the start of the recording period:  $T_{\text{out } 0}$ , the mean of the instantaneous temperatures of the two outside sensors

For each compartment, the initial deviation:  $\Delta T_0 = T_{\text{hold } 0} - T_{\text{out } 0}$

15. The test may begin if for each compartment  $\Delta T_0$  is between  $-3^\circ\text{C}$  and  $3^\circ\text{C}$  and if the inside temperature has not varied by more than  $3.0^\circ\text{C}$  over a 30-minute period.

### **Defrosting cycles**

16. It must be ensured that defrosting does not interfere during the testing period. If defrosting does occur during testing, however, and the total time (cool-down + defrosting) is less than the times given in the chart contained in the model report, the equipment should be considered compliant.

### **Running the test**

17. Positioning of movable partitions

For dual-temperature equipment, the partitions should be positioned so that the compartment surfaces are proportional to the individual capacities of the evaporators at  $0^\circ\text{C}$  for compartment A and at  $-20^\circ\text{C}$  for compartment C.

For reversible equipment, the partitions should be positioned so that the compartment surfaces are proportional to the individual capacities of the evaporators at  $0^\circ\text{C}$ .

18. Starting the unit

The internal combustion engine should be set to the speed indicated in the initial test report and on the unit.

19. The thermostats should be adjusted to bring the inside temperature to the class temperature limit for each compartment:

Class C: -20.0° C

Class B: -10.0° C

Class A: 0.0° C

For dual-temperature equipment the class A compartment should be adjusted from 0.0° C to -2.0° C.

**Cool-down**

20. The unit should cool the different compartments simultaneously. The Class A compartment of a dual-temperature unit will typically maintain a temperature of 0° while the cooling process continues for the compartment(s) of the lowest temperature class(es).

21. Measurements should be taken until the warmest temperature measured by one of the two sensors located inside each compartment of the lowest temperature class reaches the temperature limit for that class.

22. For dual-temperature equipment, the unit may be stopped once the previous measurements have been taken, and the cool-down times for each compartment should be compared to the times listed in the table in the model report.

23. For multi-temperature reversible equipment, once the previous measurements have been taken, the following additional operating tests should be conducted:

24. The set points should subsequently be modified according to the table below, and a proper maintenance of the temperatures of the compartments set to 0.0° C should be observed for at least 10 minutes (from when the first sensor reaches the set point temperature). The set point temperature is ± 3° C. The temperature should rise with the doors closed, with the unit in use.

**Set points with two compartments**

| <i>Compartment 1</i> | <i>Compartment 2</i> |
|----------------------|----------------------|
| -20° C               | 0° C                 |
| 0° C                 | -20° C               |

**Set points with three compartments**

| <i>Compartment 1</i> | <i>Compartment 2</i> | <i>Compartment 3</i> |
|----------------------|----------------------|----------------------|
| 0° C                 | -20° C               | 0° C                 |
| -20° C               | 0° C                 | -20° C               |

25. The temperatures should be recorded; there is no maximum time limit for this test. The unit may be stopped as soon as the additional tests have been completed. The sensors can then be disconnected and the defrosting system restored.

## Conclusion

26. The equipment is considered compliant if:
  - For each compartment, the class temperature has been reached within the time limit shown in the table in the model test report. To define this time limit, select the lowest (coldest) mean outside temperature from the two sets of measurements taken with the two outside sensors.
27. Any additional tests conducted are satisfactory.
  - If one of the compartments fails to reach the class temperature within the set limits, a multi-temperature unit may be considered to qualify as a dual-temperature, non-reversible unit. The initial position of the movable partitions should remain the same if one of the compartments is downgraded.

## Impact

28. This proposal is based on the test method for mono-temperature independent equipment. It adds only one test for the reversibility of compartments that will make it possible to limit the length of the test while retaining all its relevance.
29. The cost of this test is very similar to that of the test for mono-temperature equipment, although slightly higher as it requires more sensors and a longer time for instrumentation and analysis.
30. The environmental impact is significant, as servicing can be made compulsory, leading to better machine performance.

## Proposed amendment to ATP

31. It is proposed to add to ATP a paragraph 6.6, as follows:

### **“6.6 Multi-compartment, multi-temperature equipment**

**For multi-temperature equipment, if the partitions are movable, they should be positioned so that the compartment surfaces are proportional to the individual capacities of the evaporators at 0° C.**

**The test prescribed in paragraph 6.2 is conducted simultaneously for all the compartments.**

**Measurements should be taken until the warmest temperature measured by one of the two sensors located inside each compartment reaches the temperature limit for that class:**

- **Once the previous measurements have been taken, the following additional operating tests should be conducted: the set points should be modified in turn according to the table below, and a proper maintenance of the temperatures of the compartments set to 0.0° C should be observed for at least 10 minutes (from when the first sensor reaches the set point temperature). The set point temperature is  $\pm 3^\circ$  C. The temperature should rise with the doors closed, with the unit in use.**

**Set points with two compartments**

| <i>Compartment 1</i> | <i>Compartment 2</i> |
|----------------------|----------------------|
| -20° C               | 0° C                 |
| 0° C                 | -20° C               |

**Set points with three compartments**

| <i>Compartment 1</i> | <i>Compartment 2</i> | <i>Compartment 3</i> |
|----------------------|----------------------|----------------------|
| 0° C                 | -20° C               | 0° C                 |
| -20° C               | 0° C                 | -20° C               |

The temperatures should be recorded; there is no maximum time limit for this test. The unit may be stopped as soon as the additional tests have been completed. The sensors can then be disconnected and the defrosting system restored.

The equipment is considered compliant if:

- For each compartment, the class temperature has been reached within the time limit shown in the table in 6.2. To define this time limit, select the lowest (coldest) mean outside temperature from the two sets of measurements taken with the two outside sensors.
- Any additional tests conducted are satisfactory.”

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