United Nations ECE/TRANS/WP.11/2012/1

Economic and Social Council

Distr.: General
13 August 2012
English
Original: French

Economic Commission for Europe

Inland Transport Committee

Working Party on the Transport of Perishable Foodstuffs

Sixty-eighth session
Geneva, 22–25 October 2012
Item 5 (b) of the provisional agenda
Proposals of amendments to the ATP: New proposals

Mandatory procedure for the efficiency testing of independent, multi-temperature, mechanically refrigerated equipment

Transmitted by the Government of France

Principle

1. 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:

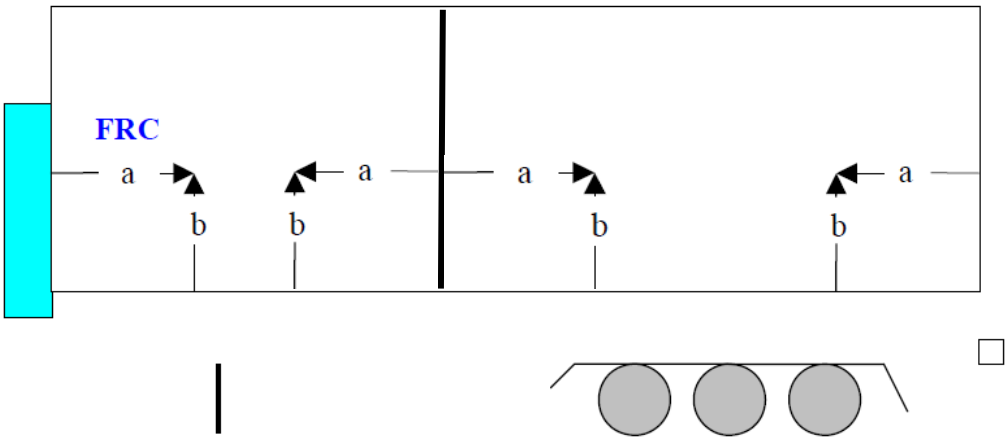
Outside temperature (ºC)	*30*	*29*	*28*	*27*	*26*	*25*	*24*	*23*	*22*	*21*	*20*	*19*	*18*	*17*	*16*	*15*
Class C	360	350	340	330	320	310	300	290	280	270	260	250	240	230	220	210
Class B	270	262	253	245	236	228	219	211	202	194	185	177	168	160	151	143
Class A	180	173	166	159	152	145	138	131	124	117	110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

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

Placing of temperature sensors

3. Temperature measuring sensors that are protected from heat radiation should be placed on the inside and outside of each compartment in the equipment.

4. 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

5. 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

6. 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

7. The following calculations should be made:

- At all times and for each compartment: T_{hold}, the mean holding temperature, which is the mean of the instantaneous temperatures of the inner sensors
- At the start of the recording period: $T_{out\ 0}$, the mean of the instantaneous temperatures of the two outside sensors
- For each compartment, the initial deviation: $\Delta T_0 = T_{hold\ 0} - T_{out\ 0}$

8. The test may begin if for each compartment ΔT_0 is between -3° C and 3° C and if the inside temperature has not varied by more than 3.0° C over a 30-minute period.

Defrosting cycles

9. 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

- 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° C for compartment A and at -20° 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° C
- Starting the unit
  - The internal combustion engine should be set to the speed indicated in the initial test report and on the unit
- 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

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

Cool-down

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

- 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.

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

Compartment 1	*Compartment 2*
-20° C	0° C
0° C	-20° C

Set points with three compartment

Compartment 1	*Compartment 2*	*Compartment 3*
0° C	-20° C	0° C
-20° C	0° C	-20° C

12. 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

13. 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.
- Any additional tests conducted are satisfactory.

14. 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.

Cool-down test report for independent, multi-temperature equipment

15. The model report to be used is shown on the next page.

TEST REPORT FOR CERTIFICATE RENEWAL APPLICATION
TEMPERATURE EFFICIENCY TESTING
Page 1/1

Name:	**Authorization No.:**
File No.:	**Date:**

INDEPENDENT MULTI-TEMPERATURE EQUIPMENT

Recorder No.:

Outside temperatures

Instantaneous T	Minimum	Maximum	Deviation
Mean T	Side wall	Rear of the body	Selected mean T (lowest/coldest)

Time (in minutes) required to reach the temperature of the class in question:

Outside temperature (°C)	**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

Equipment cool-down time: test results

Starting the unit time

Procedure		**Compartment 1**		**Compartment 2**		**Compartment 3**	
		time	duration (in minutes)	time	duration (in minutes)	time	duration (in minutes)
Time at which the temperature measured by the warmest internal sensor is brought to the class limit:	-20.0° C (Class C) -10.0° C (Class B) 0.0° C (Class A)						

Additional tests

In conformity □ **Not in conformity** □

Position of the partition(s)
(Draw a sketch showing the distances)

Test result (delete as appropriate)

Class-compliant	☐
Non-compliant	☐

Signature of testing centre manager

Comments

A copy of this form is to be retained by the testing centre

Mandatory procedure for the testing of the capacity of non-independent, multi-temperature, mechanically refrigerated equipment to maintain equilibrium temperatures

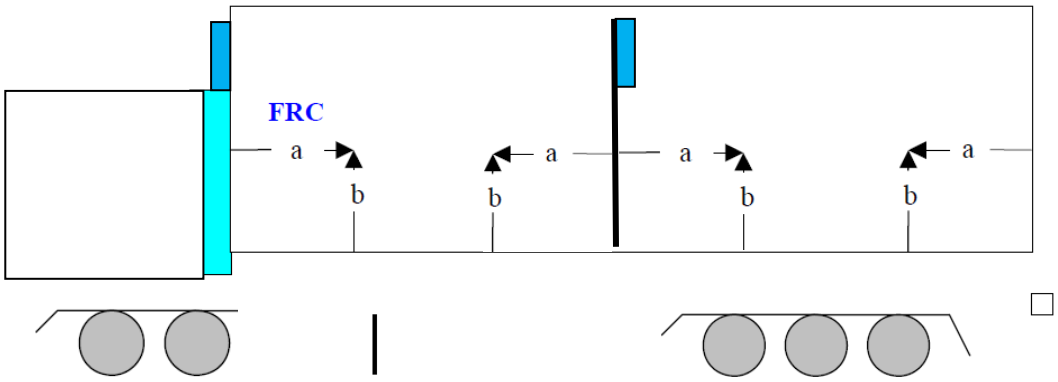
Principle

16. The purpose of the test is to obtain a recording of temperature maintenance 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 reached during the duration of the temperature-holding period does not exceed 5.0° C, the inside temperature of the equipment when free of all cargo can be maintained at the class temperature for at least **1 hour and 30 minutes** when the vehicle engine speed is maintained at the idle speed defined by the manufacturer (where applicable), with a tolerance of plus or minus 100 revolutions per minute.

Placing of temperature sensors

17. Temperature measuring sensors that are protected from heat radiation should be placed on the inside and outside of each compartment in the equipment.

18. 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:



19. 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.

Positioning of the movable partitions

20. 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° C for compartment A and at -20° C for compartment C.

21. For reversible equipment, the partitions should be positioned so that the compartment surfaces are proportional to the individual capacities of the evaporators at 0° C.

Closing the doors and cooling down the equipment

22. The doors of the equipment should be closed and the unit's set points should be selected so that the compartment temperatures reach the target class temperatures (e.g., when using electrical power or while on the road):

- For Class C: -20.0° C to -22.0° C
- For Class B: -10.0° C to -12.0° C
- For Class A: 0.0° C to -2.0° C

Defrosting cycles

23. It must be ensured that defrosting does not interfere during the testing period.

Running the test

24. The temperature-holding test is run simultaneously in each compartment.

25. The vehicle should maintain the target class temperature while the engine is idling for at least 1 hour and 30 minutes. During this period, the set point may not be changed. During the compressor driving phase, the engine and compressor rotation speeds should be measured. The engine idle speed should be within 100 revolutions per minute above or below the idle speed specified by the vehicle manufacturer. Idle speed is measured using a tachometer. When measurements cannot be taken due to the design of the vehicle, this value should be read from the vehicle's rpm gauge.

Additional operating test

26. There is no additional test for dual-temperature equipment. For multi-temperature reversible equipment, after the temperature-holding test has been performed, the set points should subsequently be modified according to the table below and a proper regulation of the temperatures of the compartments set to 0.0° C must 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 be raised with the doors closed, using the unit.

Set points with two compartments

Compartment 1	*Compartment 2*
-20° C	0° C
0° C	-20° C

Set points with three compartments

Compartment 1	*Compartment 2*	*Compartment 3*
0° C	-20° C	0° C
-20° C	0° C	-20° C

27. The temperatures should be recorded; there is no maximum time limit for this test.

Conclusion of the test

28. The interior temperature used should be the mean of the temperatures measured at any given time by the two sensors throughout the testing period. The equipment should be considered compliant if it meets the following requirements:

- The mean interior temperature falls within the ranges defined above
- The amplitude of temperature variations above or below the calculated mean temperature is ± 3° C
- The additional tests performed are satisfactory (for multi-temperature equipment only)

Temperature-holding test report for non-independent, multi-temperature equipment

29. The model report to be used is shown on the next page.

TEST REPORT FOR CERTIFICATE RENEWAL APPLICATION TEMPERATURE MAINTENANCE TESTING Page 1/1			
Name:		**Authorization No.:**	
File No.:		**Date:**	
INDEPENDENT MULTI-TEMPERATURE EQUIPMENT Recorder No.: Rpm gauge No.:			
Temperatures			
	Minimum	Maximum	Deviation
T external			
Engine speeds			
	engine		road compressor
Speeds			

Target class temperature maintenance:

Time temperature maintained by the unit: test results						
Operation						
Maintenance	**Evaporator 1**		**Evaporator 2**		**Evaporator 3**	
	Temperature (°C)	Duration	Temperature (°C)	Duration	Temperature (°C)	Duration
Internal temperature						
Maximum deviation (absolute value) from the calculated mean						

Position of the partition(s)
(Draw a sketch showing the distances)

Additional tests

In conformity □ **Not in conformity** □

Test result (delete as appropriate)

Class-compliant	☐
Non-compliant	☐

	Signature of testing centre manager

Comments

A copy of this form is to be retained by the testing centre