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APPLICATION OF A COOL-DOWN TEST FOR INDEPENDENT MECHANICALLY REFRIGERATED EQUIPMENT WITH A VIEW TO RENEWING THE CERTIFICATE OF COMPLIANCE WITH ATP AT 6 AND 9 YEARS

(Procedure)

Note by the secretariat

The secretariat reproduces below a proposal submitted by France.

1. Purpose and scope

This procedure describes the conditions for the preparation and application of a cool-down test for single and multi-temperature and single and multi-evaporator independent mechanically refrigerated equipment.

The relevant registration is intended for the competent authority for the renewal of the certificate of compliance of the vehicle with ATP at six and nine years. This test shall be carried out by an authorized professional selected by the owner of the vehicle(s) or his agent.

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2. Reference

Annex 1 of the amended ATP Agreement.

3. Definitions

cf. Annexes I and II.

4. Principle

The purpose of the test is to obtain a recording of a temperature cool-down representative of the refrigeration performance of the equipment.

5. Conditions required for carrying out the test

5.1 Personnel

The professionals carrying out the cool-down test shall be specialized in on-board refrigeration. The tests shall be carried out under the responsibility of authorized persons who will sign the test report.

The list of authorized professionals is updated every six months and may be consulted on G.I.E. CEMAFROID's web site (www.cemafroid.fr).

5.2 Equipment

5.2.1 Environment

The test shall be carried out as far as possible inside a closed building with adequate ventilation, and in any case under cover and sheltered from wind and sun. The environmental conditions shall ensure some degree of stability in the ambient temperature which must not be less than +15° C.

The outside temperature is the mean of all the instant temperatures. The instant outside temperature is the mean of the temperatures recorded by the outside sensors at any given moment. The difference between the warmest and the coldest instant temperature shall not exceed 5° C.

Exhaust gases must not interfere with the course of the test.

5.2.2 Measuring instruments

The temperature recorder shall be equipped with at least four sensors, disposed as indicated in 6.2.4.

The recordings shall be printed on paper and plotted; they shall include at least the following:

Date of the test;

Identification of the transport equipment tested (identification number of the body and registration number of the vehicle, if appropriate);

Record of the temperatures for each sensor and the position of the sensors; the mean of the air temperatures - at mid-height and in the middle of the sides, and also at the rear of the body;

Name of the person in charge of the test.

The maximum interval between two measurements is 15 minutes.

The equipment shall comply with the standard NF E 18-150 or its CEN equivalent, and shall be calibrated regularly.

5.3 Documents

The presentation and content of the model forms for the declaration and for the test results shall correspond to the models in annex III.

6. Carrying out the test

6.1 Informing the competent authority

The competent authority shall be informed (e.g. by fax or e-mail) of the date, time and place of the tests and the identification of the equipment tested three working days before the start of the tests.

6.2 Preparation of the test

6.2.1 Prior preparation of the equipment

The equipment, which has been repaired and/or has had its refrigeration unit revised, shall be brought to the test location empty of any load. The revision of the refrigeration unit is mandatory if it is more than nine years old.

6.2.2 Balancing the inside and outside temperatures

The body, with the bulkheads removed if necessary, shall be dry and in thermal equilibrium. (For example, the equipment is left for at least three hours with the unit stopped and the doors open.)

6.2.3 Blocking the defrosting cycles

In order to ensure that defrosting will not interfere with the first six hours of the test, one of the following methods may be used:

disconnection of the defrosting programming clock;

or programming of the command system so that the first defrosting will take place after six hours have elapsed;

or disconnection of the sensor fixed to the evaporator which permits defrosting by closing the contact.

6.2.4 Location of the temperature sensors

The temperature sensors shall be disposed as follows:

One sensor on the blower of each evaporator;

One sensor on the return airflow of each evaporator;

One sensor outside the body, at mid-height in the middle of one side;

One sensor outside the body in its rear section.

The external sensors which enable the outside temperature to be confirmed are protected from solar radiation and from any other interfering source of heat.

6.2.5 Connection and activation of the recorder

6.2.6 Closure of the doors

6.3 Multi-temperature vehicles

In the case of multi-temperature vehicles with fixed bulkheads, the test shall be carried out simultaneously in each compartment.

6.4 Progress of the test

Before the unit starts up, it shall be checked that the outside and inside temperatures are identical.

6.4.1 Starting up the unit

The compressor is engaged by the heat engine at the speed indicated in the initial test record.

6.4.2 Regulation of the thermostats

The thermostats shall be so regulated as to bring the lower temperature to the limit for the class in question:

Class C: -20° C;
Class B: -10° C;
Class C: 0° C.

The instruction for regulation must be 5° C less than the class temperature limit for each evaporator.

6.4.3 Cool-down

6.5 End of test

The unit may be stopped once the temperature at the return airflow of the evaporator reaches the class temperature limit. Where there are several evaporators, all the return airflow sensors must have reached the class temperature limit. The sensors may then be disconnected and the defrosting unit restored.

6.6 Printing out the recording

The temperature recordings shall be printed out so that they can be attached to the test report (cf. paragraph 8).

7. Interpretation of the tests

When the equipment has several evaporators, the interpretation of the test shall be according to the least favourable evaporator recording (with the longest time).

8. Writing the test report

The presentation and content of the test report shall correspond to the model in annex III. All the entries shall be correctly completed, particularly those concerning the description of the equipment tested.

The temperature recording(s) and the test report shall be handed over to the author of the request for the test for transmission to the competent authority.

Annex I

Definitions[1]

Definitions	Remarks
Removable: refers to a thermal appliance which can be entirely or partially removed and put back.	For example, this may be a cooling appliance in which the eutectic plates must be placed in a chill room in order to be deep-frozen (small containers used for general distribution). Equipment with ***removable*** or ***non-independent*** appliances shall have an additional letter X in their distinguishing marks (annex 1, appendix 4 of ATP).
Independent: a refrigerating appliance is said to be independent when the energy source is independent from that for moving the vehicle.	Equipment with ***removable*** or non-independent appliances have an additional letter X in their distinguishing marks (annex 1, appendix 4 of ATP).
Movable bulkhead means a rigid or flexible bulkhead which may be connected to the roof or to the side walls of the equipment by fixed rails. Such bulkheads may be moved lengthwise or crosswise for a certain distance, raised to the roof or jointed with the walls.	Flexible bulkheads not connected to the walls can only be used in multi-compartment equipment if they comply strictly with health requirements (body/partition matching, cleanliness).
K coefficient means the overall coefficient of heat transfer which represents the insulating capacity of the equipment.	For a cell with normal insulation (IN): $0.40<K\leq0.70$ W/m^2.K For a cell with heavy insulation (IR): $K\leq0.40$ W/m^2.K
Safety coefficient means the multiplication factor (applied to the heat flow through the walls of the body (Q) for refrigerated appliances), which ensures that the effective refrigerating capacity of the **thermal appliance** is greater than the thermal losses from the body.	ATP has set the minimum limit of the coefficient at 1.75.
Compliance with ATP means that equipment must meet the following conditions in order to comply with ATP: 1. They belong to a series in which a model has undergone a complete test of the equipment (body and unit), or more generally separate tests of the body and the unit. These tests shall be carried out in an ATP-recognized laboratory and certified by the issue of the relevant test report(s). 2. They are certified by the competent authority; in France, they are inspected on the production site and when approvals are issued or renewed.	

Definitions	Remarks
Thermal appliance means an appliance which produces cold (refrigeration unit, cooling appliance) or heat (heating appliance).	
Appliance finished in the workshop means a body produced by a coach-builder and sent to a concessionary for mounting on a chassis with the possible addition of the ***thermal appliance***.	
Model or prototype means equipment which, after testing in a laboratory recognized by ATP and certification by the issue of a test report, will permit the approval of new equipment mass produced according to the model.	In the case of ***multi-compartment*** vehicles, each compartment may or may not be fitted with a thermal appliance. This may concern: units completely separate (refrigeration, cooling or heating); a ***multi-evaporator*** mechanical refrigeration unit.
Kit means a body comprising several elements supplied unassembled and so described in the model certificate.	The assembly is decentralized and must be carried out in accordance with the assembly guide.
Single-temperature means equipment in which all of the insulated body is kept at the same temperature.	The volume thus constituted may or not be divided into compartments by movable or non-movable bulkheads. The cold distribution is ensured by one or more evaporators.
Multi-evaporator means a refrigeration unit with several evaporators constituting a common section under high pressure (drive, compressor, condenser and automaticity appliances) located outside the body and connected to evaporators placed in one or more different compartments. These may either be of the ventilated type or the flooded type in eutectic plates or tubes.	
Multi-temperature means equipment in which the compartments are kept at temperatures which may be different.	
Thin walled means equipment in which the thickness of the side walls of the insulated body is less than 45 mm.	
Delivery is taken of a vehicle when it has undergone a satisfactory inspection of the requirements for compliance with ATP.	

[1] Words in ***bold italics*** are given definitions.

Annex II

Abbreviations and units

Abbreviation	Meaning	Unit

Refrigerated equipment and units

IN	normally insulated	/
IR	heavily insulated	/
K	overall coefficient of heat transfer	$W/(m^2 * K)$ (watts per square metre and per Kelvin)
P	effective refrigerating capacity indicated by the constructor of the refrigerating appliance	W (watt)

Multi-evaporator refrigeration units

P_{total}	total nominal capacity of the high pressure unit	W
P_{comp}	effective capacity of the evaporator of the unit in the compartment in question (given in the table of effective values in the test report)	W
S_m	mean surface area of the body $Sm = \sqrt{Si.Se}$	m^2 (square metre)
S_i	inside surface area of the body	m^2
S_e	outside surface area of the body	m^2

Multi-compartment equipment

S_{mtotal}	mean surface area of the whole body	m^2
S_{mcomp}	mean surface area of the compartment in question in its largest dimensions	m^2
$\Delta\theta$	temperature difference between the outside temperature of 30° C and the inside temperature (0° C, -10° C or -20° C depending on the class in question)	K (Kelvin)
$\varphi = K*S_m*\Delta\theta$	heat flow through the walls of the body	W
$U = K*S_m$	coefficient used to compare the respective heat results of a cooling appliance (to be approved) and the cooling appliance tested in the tunnel	$m^2.K$

Annex III

Declaration
of a cool-down test for independent mechanically refrigerated equipment
(*the document shall be sent to the competent authority three working days before the start of the test)*

Company authorized to carry out the test:

Name:

Address:

Company reference:

Date of start of test:

Owner of equipment tested:

Body	*Unit*
Name: Address:	Name: Address:

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Results
of the cool-down test of mechanically refrigerated equipment
(*delivered to the author of the request for the test,*
for transmission to the competent authority)

Equipment subjected to testing:

Registration number	Type:	Make:
Body: Make: Type No. of report of reference test Serial number: Date of manufacture:	Date of initial issue of the certificate of compliance Original K coefficient	Unit: Make: Model: No. of test report: Serial number: Refrigerant: Date of manufacture: Number of hours of operation

Special features of the equipment:

		Number	Location
Bulkhead(s) (specify fixed or removable)			
Evaporator	No. 1 No. 2 No. 3	Type	

Test data: **Recorder reference:**

Number of recording graphs attached:
Mean temperatures recorded during the test:

Mid-height side	Rear of body	Difference between the two means	Mean outside temperature retained[1]

(Reverse side)

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

Outside Temp-erature (° C)	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15
Class C	360	348	336	324	312	300	288	276	264	252	240	228	216	204	192	180
Class B	270	260	250	240	230	220	210	200	190	180	170	160	150	140	130	120
Class A	180	172	164	156	148	140	132	124	116	108	100	92	84	76	68	60

Time of starting up the unit:		Evaporator 1	Evaporator 2	Evaporator 3
Time at which the temperature at the return airflow of the evaporator is:	-20° C (Class C)			
	-10° C (Class B)			
	0° C (Class A)			
Time (in minutes) required to achieve the temperature of the class in question:				

Result of the cool-down test: In conformity[3] Not in conformity[3]

Signature:

Name and position of signatory:

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[1] If the difference between the two means is greater than 2° C, the lower mean should be retained; if the difference is less than 2° C, the mean between the two outer temperatures should be retained.

[3] Delete as appropriate.