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Proposals of amendments to ATP: pending proposals

Requirements for the consideration of a change of refrigerant (to an alternative benign retrofit refrigerant) for an approved, vapour-compression refrigeration unit

Transmitted by Transfrigoroute International (TI)

Summary

Action to be taken: Amend annex 1, appendices 2 section 4.

Related documents: ECE/TRANS/WP.11/2016/18

Introduction

1. In accordance with the Kyoto Protocol, Regulation (EU) No. 517/2014 of the European Parliament and of the Council on fluorinated greenhouse gases, known as F-Gases, came into effect on 1 January 2015. It aims to reduce emissions of greenhouse gases through a series of measures that includes implementing a schedule for reducing the placing on the market of HFC refrigerants and limiting the global warming potential (GWP) of refrigerants that can be used, to a certain threshold, determined according to a schedule, the purpose of the refrigerant and the work carried out.

2. This regulation will have a global impact on the availability of R404A and other common refrigerants in the transport refrigeration branch as for example R404A, R410A or

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R134a, which will be replaced by new refrigerants with a lower GWP step by step. Nevertheless in some markets those refrigerants will be in operation for a certain transition period for availability reasons and therefore have to be considered as well.

3. Currently, refrigeration units for trucks and trailers based on mechanical vapour compression circuits mainly use R404A as a refrigerant (it comprises 95 % of the total amount of fluids banked in this type of equipment). In accordance with the F-Gas Regulation, R404A will be covered by the quota reduction schedule. As the allocated quotas decrease, the quantities of refrigerants produced will also decrease. A huge reduction in the allocated quotas is scheduled to take place in 2018, but the price for R404A already started to increase drastically and has doubled within the last 6 months. The availability of R404A has been announced by some major manufacturers to become drastically restricted starting in 2018 already. The availability is predicted to become worse at the next step of phase down in the European F gas regulation which is scheduled for 2021.

4. Manufacturers are adopting different strategies, which range from using natural refrigerants, anticipating the appearance of refrigerants with low GWP values, and anticipating or implementing interim solutions which involve using refrigerants that respect the GWP limits established for the start of 2020. For manufacturers, interim solutions based on using blends of HFOs as refrigerants seem to be a good short-term alternative for the next few years.

5. Bearing in mind that the thermodynamic properties of replacement refrigerants are usually close to those to be replaced (for example R404A), and other relevant boundary conditions are well defined as described in this proposal below, a procedure is proposed for assessing the impact of the change of refrigerant on the characteristics of new and in service types of identical refrigeration units that have already been tested or will be tested in accordance with ATP and will be operated with several replacement refrigerants.

I. Proposal

6. The present proposal introduces a method for reducing the number of tests carried out on vapour-compression refrigeration units when the refrigerant used in the units is replaced by other refrigerants with similar properties (so-called retrofit refrigerants).

7. Checks are carried out on these units in order to determine the impact on the refrigerating capacity due to the change of refrigerant.

Both cases will be covered by this proposal:

a) Refrigeration units which have already been tested (in most cases with R404A as a refrigerant) and might have been in service;

b) Refrigeration units which have not been tested at all (new units without existing ATP test report).

II. Principle of the test

8. The test methodology is based on the tests described in ATP, annex 1, appendix 2, section 4, entitled “PROCEDURE FOR MEASURING THE EFFECTIVE REFRIGERATING CAPACITY W0 OF A UNIT WHEN THE EVAPORATOR IS FREE FROM FROST”, in the version approved on 19 December 2016.

9. The type test and the resulting test reports are based on the following criteria:

9.a) Properties of reference and retrofit refrigerants and the influence to the refrigeration circuit

The following considerations have to be made when a replacement of one refrigerant by another is carried out by the manufacturer.

The thermophysical and chemical properties of the retrofit refrigerant must be similar to those of the approved reference refrigerant.

In addition to that the replacement by a retrofit refrigerant shall result in a similar behaviour in the refrigeration circuit especially in terms of refrigerating capacities.

9.b) Permitted modifications of the refrigeration units and their components

The basic setup of the refrigeration circuit shall not be different using different refrigerants.

Modifications are allowed for the expansion device (type, setting), the lubricant and the gaskets.

9.c) Test program

A refrigeration unit to be operated, approved and certified for different refrigerants always needs to be tested and approved in accordance with ATP, annex 1, appendix 2, section 4, with one refrigerant, the approved reference refrigerant, specified by the manufacturer, considering all speeds, modes of drive and temperatures levels with the reference refrigerant.

The evaluation of the test results is based on the differences between refrigerating capacities of the approved reference refrigerant and the retrofit refrigerant. A criterion for equivalence is defined which allows an at max. 10 % lower refrigerating capacity for the retrofit refrigerant when compared with the approved reference refrigerant, taking into account the measurement uncertainties required in the ATP agreement.

The minimum requirement for the type test approval of a retrofit refrigerant is at least a test at the lowest and at the highest temperature of the tested temperature class in the mode of drive with the highest refrigerating capacities. In the case of a range of refrigeration units, the test program may be reduced according to section 9.d).

Dependent on the results of these tests further measurements may be necessary. Distinctions are made for the following two cases:

- Strict equivalence: is the case when the difference between the refrigerating capacities of the retrofit refrigerant is lower than or equal to 10 % less at all tested temperatures of the respective temperature class when compared to the reference refrigerant.
  In the case of higher or up to 5 % lower refrigerating capacities, the refrigerating capacities of the reference refrigerant can be kept in the test report of the retrofit refrigerant. In the case of more than 5 % lower refrigerating capacities, the refrigerating capacities of the retrofit refrigerant may be calculated based on the test results.

- Restricted equivalence: is the case when at least at one tested temperature of the respective temperature class the difference between the refrigerating capacities of the retrofit refrigerant is less than or equal to 10 % lower when compared to the reference refrigerant. In this case a further measurement at an intermediate temperature as specified by the manufacturer is necessary in order

to confirm the tendency of the deviation and to calculate the refrigerating capacities of the retrofit refrigerant based on the test results.

If the power consumption tested with the retrofit refrigerant deviates from the results obtained with the approved reference refrigerant, the data of power consumption shall be adjusted according to the measured values by means of calculation, as well in case of strict as in case of restricted equivalence

9.d) Range of refrigeration units

In case of a range of refrigeration units which describes a model range of a specific type of refrigeration units of different sizes and different refrigerating capacities but same setup of refrigeration circuit (e.g. for example 1- or 2-stage, with or without economizer) with similar components of following characteristics, which are:

- same compressor type or construction (e.g. piston, screw type) and same design of compressors (e.g. scroll with or without vapour injection),
- same number and type of heat exchangers (e.g. evaporators, condensers, sub-coolers) and their fans, same type of expansion valves

a further reduction of tests is possible. A unit shall not be regarded as being part of the above named range of units unless it satisfies the above named minimum criteria. The testing stations shall take measures to verify that each regarded unit is in conformity to the range of refrigeration units.

If at least two refrigeration units of the range including the units with the smallest and the highest refrigerating capacities tested with the retrofit refrigerant have been proven to be equivalent to the results of the approved reference refrigerant, type approval certificates for all other units of this range of refrigeration units may be carried out by calculation based on this limited number of tests.

9.e) Test reports

An addendum for the refrigeration unit containing the test results of both, the retrofit refrigerant and the approved reference refrigerant, shall be added to the test report of the retrofit refrigerant. All actual modifications according to 9.b) have to be given in this addendum. If the refrigerating capacities and may be also the power consumption of the retrofit refrigerant are established by calculation, the procedure of calculation has to be described in this addendum too.

III. Environmental impact

10. This proposal would make it possible to considerably reduce the number of tests and thus their environmental impact. It would also avoid penalizing the use of mechanical vapour-compression units that use new refrigerants, which are mentioned in international protocols aimed at limiting the greenhouse gas effect.

IV. Economic impact

11. The cost of testing these materials will fall significantly once they are scheduled to be introduced into a broad range of refrigeration units. The cost for manufacturers and, in turn, their customers will be drastically reduced.

V. Proposed amendment to ATP

12. It is proposed that a new paragraph should be added to the ATP Agreement, annex 1, appendix 2, section 4.

"4.5 Procedure for testing mechanically refrigeration units that can be operated with different refrigerants

4.5.1 General principles

The test is in line with the procedure described in section 4., paragraphs 4.1. to 4.4. and based on a complete test of the refrigeration unit with one refrigerant, the reference refrigerant.

The refrigeration unit, its refrigeration circuit and the components of the refrigeration circuit shall not be different when using replacement refrigerants. Only very limited modifications are permitted that are

- Modification and change of expansion device (type, setting);
- Exchange of the lubricant;
- Exchange of gaskets.

Making it a retrofit refrigerant, a replacement refrigerant must have thermo-physical and chemical properties similar to the reference refrigerant and shall result in a similar behaviour in the refrigeration circuit especially in terms of refrigerating capacities.

4.5.2 Test procedure

Due to the similar behaviour of the retrofit and the reference refrigerants the number of tests necessary for a type approval can be reduced. In terms of refrigerating capacity the retrofit refrigerants must comply with a criterion of equivalence which allows an at maximum 10 % lower refrigerating capacity for the retrofit refrigerant when compared with the approved reference refrigerant.

The criterion of equivalence is defined by the formula

$$\frac{Q_{retrof}-Q_{ref}}{Q_{ref}} \geq -0{,}10 \quad (1)$$

where:

Q_{ref} is the refrigerating capacity of the unit tested with the reference refrigerant,

Q_{retrof} is the refrigerating capacity of the unit tested with the retrofit refrigerant,

The number of tests and the evaluation of the retrofit refrigerants is based on the differences in test results when compared with the reference refrigerant. At least a test at the lowest and at the highest temperature of the respective temperature class in the mode of drive with the highest refrigerating capacities has to be carried out.

In the case of a range of refrigeration units the test program may be further reduced according to paragraph 4.5.3.

Dependent on the results of these tests further measurements may be necessary. Distinctions are made for the following cases:

- Strict equivalence: is the case when the difference between the refrigerating capacities of the retrofit refrigerant is lower than or equal to 10 % less at all tested temperatures of the respective temperature class when compared to the reference refrigerant. In the case of higher or up to 5 % lower refrigerating capacities, the refrigerating capacities of the reference refrigerant can be kept in the test report of the retrofit refrigerant. In the case of more than 5 % lower refrigerating capacities, the refrigerating capacities of the retrofit refrigerant may be calculated based on the test results.
- Restricted equivalence: is the case when at least at one tested temperature of the respective temperature class the difference between the refrigerating capacities of the retrofit refrigerant is less than or equal to 10 % lower when compared to the reference refrigerant. In this case a further measurement at an intermediate temperature as specified by the manufacturer is necessary in order to confirm the tendency of the deviation and to calculate the refrigerating capacities of the retrofit refrigerant based on the test results.

If the power consumption tested with the retrofit refrigerant deviates from the results obtained with the reference refrigerant, the data of power consumption shall be adjusted according to the measured values by means of calculation, as well in case of strict as in case of restricted equivalence.

4.5.3 Test procedure for a range of refrigeration units

A range of refrigeration units describes a model range of a specific type of refrigeration units of different sizes and different refrigerating capacities but with the same setup of refrigeration circuit and same type of components of the refrigeration circuit.

In case of a range of refrigeration units a further reduction of tests is possible.

If at least two refrigeration units of the range including the units with the smallest and the highest refrigerating capacities tested with the retrofit refrigerant have been proven by the test procedure described in 4.5.2 to be equivalent to the results of the approved reference refrigerant, test reports for all other units of this range of refrigeration units may be established by calculating the refrigerating capacities based on the test reports of the refrigerating units operating with the reference refrigerant and based on this limited number of tests with the retrofit refrigerant.

The conformity of the tested refrigeration units and each other regarded refrigeration unit with the range of refrigeration units has to be confirmed by the manufacturer. In addition, the competent authority shall take adequate measures to verify that each regarded unit is in conformity to this range of refrigeration units.

4.5.4 Test report

An addendum containing both, the test results of the retrofit refrigerant and the approved reference refrigerant, shall be added to the test report of the refrigeration unit operated by a retrofit refrigerant. All modifications of the refrigerating unit according to 4.5.1 have to be documented in this addendum.

In case the refrigerating capacities and maybe also the power consumption of the refrigeration unit containing the retrofit refrigerant have been established by calculation, the procedure of calculation has to be described in this addendum too.”.