

TECHNICAL SPECIFICATION



Refrigerant detection systems for flammable refrigerants

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TECHNICAL SPECIFICATION



Refrigerant detection systems for flammable refrigerants

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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FOR FLAMMABLE REFRIGERANTS****FOREWORD**

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IEC TS 63542 has been prepared by subcommittee 61D: Appliances for air-conditioning for household and similar purposes, of IEC technical committee 61: Safety of household and similar electrical appliances. It is a Technical Specification.

This first edition is based on Annex LL of IEC 60335-2-40:2022:

- Clause 4 – based on Clause LL.1, but without the 1st paragraph. An additional last paragraph has been added to link to relevant application standards;
- Clause 5 – based on Clause LL.2. An introductory sentence has been added to link to test conditions in the relevant application standard;
- Clause 6 – based on Clause LL.3;
- Clause 7 – based on Clause LL.4;
- Clause 8 – based on Clause LL.5;
- Clause 9 – based on Clause LL.6;

- Clause 10 – based on Clause LL.7;
- Clause 11 – based on Clause LL.8;
- Clause 12 – based on Clause LL.9;
- Clause 13 – based on Clause LL.10;
- Clause 14 – based on Clause LL.11;
- Clause 15 – based on Clause LL.12;
- Clause 16 – based on Clause LL.13;
- Clause 17 – based on Clause LL.14.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
61D/531/DTS	61D/534/RVDTs

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

NOTE The following print types are used:

- requirements: in roman type;
- *test specifications: in italic type;*
- notes: in small roman type.

Words in **bold** in the text are defined in Clause 3. When a definition concerns an adjective, the adjective and associated noun are also in bold.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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INTRODUCTION

It has been assumed in the drafting of this document that the execution of its provisions is entrusted to appropriately qualified and experienced persons.

A refrigerant detection systems that complies with the text of this document will not necessarily be considered to comply with the safety principles of the document if, when examined and tested, it is found to have other features that impair the level of safety covered by these requirements.

A refrigerant detection systems employing materials or having forms of construction differing from those detailed in the requirements of this document may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be considered to comply with this document.

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REFRIGERANT DETECTION SYSTEMS FOR FLAMMABLE REFRIGERANTS

1 Scope

This document applies to **refrigerant detection systems** for use in appliances complying with a relevant standard of the IEC 60335 series using **flammable refrigerants**.

Relevant standards of the IEC 60335-series include:

- IEC 60335-2-40, Household and similar electrical appliances – Safety – Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers
- IEC 60335-2-89, Household and similar electrical appliances – Safety – Part 2-89: Particular requirements for commercial refrigerating appliances and ice-makers with an incorporated or remote refrigerant unit or motor-compressor
- IEC 60335-2-104, Household and similar electrical appliances – Safety – Part 2-104: Particular requirements for appliances to recover and/or recycle refrigerant from air conditioning and refrigeration equipment
- IEC 60335-2-118, Household and similar electrical appliances – Safety – Part 2-118: Particular requirements for professional ice-cream makers

This document does not take into account refrigerants other than group A2L, A2 and A3 as defined by ISO 817.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60335-2-40:2022, *Household and similar electrical appliances – Safety – Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers*

IEC 60335-2-89, *Household and similar electrical appliances – Safety – Part 2-89: Particular requirements for commercial refrigerating appliances and ice-makers with an incorporated or remote refrigerant unit or motor-compressor*

IEC 60335-2-104, *Household and similar electrical appliances – Safety – Part 2-104: Particular requirements for appliances to recover and/or recycle refrigerant from air conditioning and refrigeration equipment*

IEC 60335-2-118, *Household and similar electrical appliances – Safety – Part 2-118: Particular requirements for professional ice-cream makers*

ISO 817, *Refrigerants – Designation and safety classification*

ISO 7000:2004, *Graphical symbols for use on equipment – Registered symbols*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

flammable refrigerant

refrigerant classified as safety group A2L, A2 or A3 according to ISO 817

3.2

refrigerant detection system

sensing system which gives an output signal in response to a pre-set concentration of refrigerant in the environment

Note 1 to entry: A **refrigerant detection system** can have multiple **refrigerant sensors**.

3.3

lower flammability limit

LFL

minimum concentration of the refrigerant that is capable of propagating a flame through a homogeneous mixture of the refrigerant and air

[SOURCE: ISO 817:2014, 3.1.24, modified – "under the specified test conditions at 23,0 °C and 101,3 kPa" and Notes to entry deleted.]

3.4

refrigerant sensor

assembly in which the sensing element is housed and that may also contain associated circuit components

[SOURCE: IEC 60079-29-1:2016, 3.3.2, modified – "sensor" replaced by "refrigerant sensor"]

3.5

limited life refrigerant sensor

refrigerant sensor which is expected to fail within the life of the appliance

4 General requirement

Refrigerant detection systems shall give an output signal at a predetermined alarm set point in response to leaked refrigerant.

Refrigerant detection systems may respond directly to the refrigerant concentration or may respond to gases being displaced by the refrigerant.

In this document, where **LFL** is referenced and for refrigerant used for all tests, the composition shall be the nominal composition as specified in the relevant appliance standard.

The **refrigerant detection systems** shall be capable of detecting refrigerant concentration above the alarm set point, for the refrigerant marked on the appliance, over the full range of operating temperature and humidity as specified by the appliance manufacturer. Worst case combined effects of declared manufacturing tolerances and drift shall be considered.

The tests of Clause 8, Clause 9, Clause 10, and Clause 14 are carried out on 3 separate samples for each clause; these samples shall not be used for other tests. All samples shall pass the tests.

The tests in other clauses of this document shall be done with 3 samples and the tests are carried out in the following order: Clause 7, Clause 11, Clause 12, Clause 13, Clause 6. All samples shall pass the tests.

Where this document requires a notification to the user that replacement of the **refrigerant sensor** is required, this may be implemented as a signal to the appliance, which the appliance relays to the user.

NOTE IEC 60335-2-40 is an example of how an application standard sets requirements to forward such a signal.

5 Test gases and default test conditions

Where test conditions are not defined in this document, the test conditions of the relevant application standard applies.

For the test in Clause 6, the test gas shall be 24 % to 25 % of *LFL*.

For the test in Clause 7, the low ratio test gas shall be $(3 \pm 0,3)$ % of *LFL* below the alarm set point declared by the manufacturer, but no lower than $(1,1 \pm 0,1)$ % of *LFL*.

For the test in Clause 7, the high ratio test gas shall be $(3 \pm 0,3)$ % of *LFL* above the alarm set point declared by the manufacturer, but no higher than $(24,7 \pm 0,3)$ % of *LFL*.

For the tests in 8.9, Clause 9, Clause 10, Clause 11, Clause 12, and Clause 13, the low ratio test gas shall be $(6 \pm 0,6)$ % of *LFL* below the alarm set point declared by the manufacturer, but no lower than $(1,1 \pm 0,1)$ % of *LFL*.

For the tests in 8.9, Clause 9, Clause 10, Clause 11, Clause 12, and Clause 13, the high ratio test gas shall be $(6 \pm 0,6)$ % of *LFL* above the alarm set point declared by the manufacturer, but no higher than $(24,7 \pm 0,3)$ % of *LFL*.

Table 1 illustrates the relationship between alarm set point, tolerances, and test gas concentrations.

For the test in Clause 14, the test gas shall be $(110 \pm 0,5)$ % of the stoichiometric concentration.

The test shall be made in a test gas chamber whose construction shall be such as to ensure that the apparatus is exposed to a specific volume ratio of test gas in a reproducible manner.

Unless otherwise specified, the following conditions shall be maintained within the test gas chamber:

- *at constant temperature ± 2 °C within the range 15 °C to 25 °C throughout the duration of each test;*
- *at constant relative humidity ± 10 % RH within the range 30 % RH to 70 % RH throughout the duration of each test;*
- *at constant pressure ± 1 kPa within the range of 86 kPa to 108 kPa throughout the duration of the test.*

Table 1 – Relationship among alarm set point, tolerance and test gas (informative)

Alarm set point	Clause 7						Subclause 8.9, Clause 9, Clause 10, Clause 11, Clause 12, and Clause 13					
	Tolerance of refrigerant detection system: $\pm 2,5$ % of <i>LFL</i>		Low ratio test gas: $(3 \pm 0,3)$ % of <i>LFL</i> below the alarm set point, but no lower than $(1,1 \pm 0,1)$ % of <i>LFL</i>		High ratio test gas: $(3 \pm 0,3)$ % of <i>LFL</i> above the alarm set point, but no higher than $(24,7 \pm 0,3)$ % of <i>LFL</i>		Tolerance of refrigerant detection system: $\pm 5,0$ % of <i>LFL</i>		Low ratio test gas: $(6 \pm 0,3)$ % of <i>LFL</i> below the alarm set point, but no lower than $(1,1 \pm 0,1)$ % of <i>LFL</i>		High ratio test gas: $(6 \pm 0,3)$ % of <i>LFL</i> above the alarm set point, but no higher than $(24,7 \pm 0,3)$ % of <i>LFL</i>	
	Lower limit	Upper limit	Low ratio test gas, min.	Low ratio test gas, max.	High ratio test gas, min.	High ratio test gas, max.	Lower limit	Upper limit	Low ratio test gas, min.	Low ratio test gas, max.	High ratio test gas, min.	High ratio test gas, max.
% <i>LFL</i>	% <i>LFL</i>	% <i>LFL</i>	% <i>LFL</i>	% <i>LFL</i>	% <i>LFL</i>	% <i>LFL</i>	% <i>LFL</i>	% <i>LFL</i>	% <i>LFL</i>	% <i>LFL</i>	% <i>LFL</i>	% <i>LFL</i>
1,0	1,0	3,5	1,0	1,2	3,7	4,3	1,0	6,0	1,0	1,2	6,7	7,3
2,0	1,0	4,5	1,0	1,2	4,7	5,3	1,0	7,0	1,0	1,2	7,7	8,3
3,0	1,0	5,5	1,0	1,2	5,7	6,3	1,0	8,0	1,0	1,2	8,7	9,3
4,0	1,5	6,5	1,0	1,3	6,7	7,3	1,0	9,0	1,0	1,2	9,7	10,3
5,0	2,5	7,5	1,7	2,3	7,7	8,3	1,0	10,0	1,0	1,2	10,7	11,3
6,0	3,5	8,5	2,7	3,3	8,7	9,3	1,0	11,0	1,0	1,2	11,7	12,3
7,0	4,5	9,5	3,7	4,3	9,7	10,3	2,0	12,0	1,0	1,3	12,7	13,3
8,0	5,5	10,5	4,7	5,3	10,7	11,3	3,0	13,0	1,7	2,3	13,7	14,3
9,0	6,5	11,5	5,7	6,3	11,7	12,3	4,0	14,0	2,7	3,3	14,7	15,3
10,0	7,5	12,5	6,7	7,3	12,7	13,3	5,0	15,0	3,7	4,3	15,7	16,3
11,0	8,5	13,5	7,7	8,3	13,7	14,3	6,0	16,0	4,7	5,3	16,7	17,3
12,0	9,5	14,5	8,7	9,3	14,7	15,3	7,0	17,0	5,7	6,3	17,7	18,3
13,0	10,5	15,5	9,7	10,3	15,7	16,3	8,0	18,0	6,7	7,3	18,7	19,3
14,0	11,5	16,5	10,7	11,3	16,7	17,3	9,0	19,0	7,7	8,3	19,7	20,3
15,0	12,5	17,5	11,7	12,3	17,7	18,3	10,0	20,0	8,7	9,3	20,7	21,3
16,0	13,5	18,5	12,7	13,3	18,7	19,3	11,0	21,0	9,7	10,3	21,7	22,3
17,0	14,5	19,5	13,7	14,3	19,7	20,3	12,0	22,0	10,7	11,3	22,7	23,3
18,0	15,5	20,5	14,7	15,3	20,7	21,3	13,0	23,0	11,7	12,3	23,7	24,3
19,0	16,5	21,5	15,7	16,3	21,7	22,3	14,0	24,0	12,7	13,3	24,4	25,0
20,0	17,5	22,5	16,7	17,3	22,7	23,3	15,0	25,0	13,7	14,3	24,4	25,0
21,0	18,5	23,5	17,7	18,3	23,7	24,3	16,0	25,0	14,7	15,3	24,4	25,0
22,0	19,5	24,5	18,7	19,3	24,4	25,0	17,0	25,0	15,7	16,3	24,4	25,0
23,0	20,5	25,0	19,7	20,3	24,4	25,0	18,0	25,0	16,7	17,3	24,4	25,0
24,0	21,5	25,0	20,7	21,3	24,4	25,0	19,0	25,0	17,7	18,3	24,4	25,0
25,0	22,5	25,0	21,7	22,3	24,4	25,0	20,0	25,0	18,7	19,3	24,4	25,0

6 Response time of the refrigerant detection system

The refrigerant detection system shall give an output signal within 30 s when the refrigerant sensor is put into refrigerant concentration of 25 % of *LFL*.

Compliance is checked by test.

*The test shall be conducted after the warm-up time for the **refrigerant sensor** has elapsed.*

*Expose the **refrigerant sensor** to a step change in the gas volume ratio from clean air to the test gas specified in Clause 5 within 5 s.*

*The **refrigerant detection system** shall give an output signal within 30 s after the step change is completed.*

*Expose the **refrigerant sensor** to clean air. If the **refrigerant detection system** gives an output signal indicating a leak after 5 h of exposure to clean air, then the **refrigerant detection system** or the appliance shall provide notification to the user that replacement of the **refrigerant sensor** is required.*

The samples shall not be used for subsequent tests.

7 Refrigerant detection system calibration and short-term stability

The **refrigerant detection systems** shall have an alarm set point and be calibrated from the factory for the refrigerant marked on the appliance.

The **refrigerant detection system** shall consistently give an output signal at the alarm set point with a tolerance of $\pm 2,5$ % of *LFL*, but not lower than 1 % of *LFL*.

The alarm set point shall not be adjustable. Recalibration other than self-recalibration shall not be allowed.

Compliance is checked by inspection and test.

*To confirm the pre-set alarm set point, the **refrigerant detection system** shall respond as intended when tested as follows:*

- *The **refrigerant sensor** shall be exposed to the low ratio test gas specified in Clause 5 for 5 min and the **refrigerant detection system** shall not give an output signal within this time.*
- *The **refrigerant sensor** shall be exposed to the high ratio test gas specified in Clause 5 for 5 min and the **refrigerant detection system** shall give an output signal within this time.*

Repeat twice after the initial test with a 5 min interval between tests.

8 Selectivity test and poisoning test

8.1 Refrigerant detection system including **refrigerant sensors** shall not have false or nuisance trips, and not be subject to poisoning.

After being exposed to the gases in Table 2, the **refrigerant detection system** shall consistently give an output signal at the alarm set point with a tolerance of ± 5 % of *LFL*, but not lower than 1 % of *LFL*.

Compliance is checked by the following test.

8.2 *The **refrigerant sensor** shall be exposed sequentially, as described in 8.4 to 8.8, to the concentrations of gases and vapours shown in Table 2.*

Table 2 – Gas and vapour concentrations

Substance	Concentration, ppm
Methane	500
n-Butane	300
n-Heptane	500
Ethyl acetate	200
Isopropyl alcohol	200
Carbon dioxide	5 000
Ammonia	100
Ethanol	200
Toluene	200
Acetone	200
Hexamethyldisiloxane	110
ppm: parts per million.	

8.3 Based on the interior volume of the test chamber, calculate the amount of each test substance necessary to supply the concentrations given in Table 2.

8.4 Ensure that the chamber has been well ventilated with fresh air. Place the **refrigerant sensor** in operation inside the chamber and allow it to run for 15 min ± 5 min. Close and seal the chamber to prevent air infiltration.

8.5 Using a syringe or equivalent device, add the calculated amount of the first substance into the chamber at a rate and in a location such that it is well mixed with the air and does not cause localized high concentrations.

8.6 Allow the **refrigerant sensor** to remain in the chamber for 2 h. During this time, the output signal shall not indicate the presence of refrigerant concentration above the alarm set point.

8.7 Purge the chamber with clean air to remove all of the test atmosphere. Maintain clean air in the chamber for a recovery time of 16 h or as specified by the manufacturer. In no case shall recovery time exceed 16 h.

8.8 Reseal the chamber and repeat the test using another substance from Table 2 until the **refrigerant sensor** has been exposed to all substances. It is not required that exposure to the substances be in any particular order.

8.9 At the end of the test:

- the **refrigerant sensor** shall be exposed to the low ratio test gas specified in Clause 5 for 5 min and the **refrigerant detection system** shall not give an output signal within this time;
- the **refrigerant sensor** shall be exposed to the high ratio test gas specified in Clause 5 for 5 min and the **refrigerant detection system** shall give an output signal within this time.

9 Refrigerant poisoning and oil spray test

9.1 General

The **refrigerant detection system** shall not be subject to poisoning or damage by the refrigerant(s) marked on the appliance mixed with oil.

After being exposed to the refrigerant(s) marked on the appliance mixed with oil, the **refrigerant detection system** shall

- consistently give an output signal at the alarm set point with a tolerance of $\pm 5\%$ of *LFL*, but not lower than 1% of *LFL*, and shall give an output signal within 60 s when the **refrigerant sensor** is put into refrigerant concentration of 25% of *LFL*, or
- give an output signal indicating a refrigerant leak and notify the user that the **refrigerant sensor** has to be replaced. The output signal shall continue until the **refrigerant sensor** has been replaced.

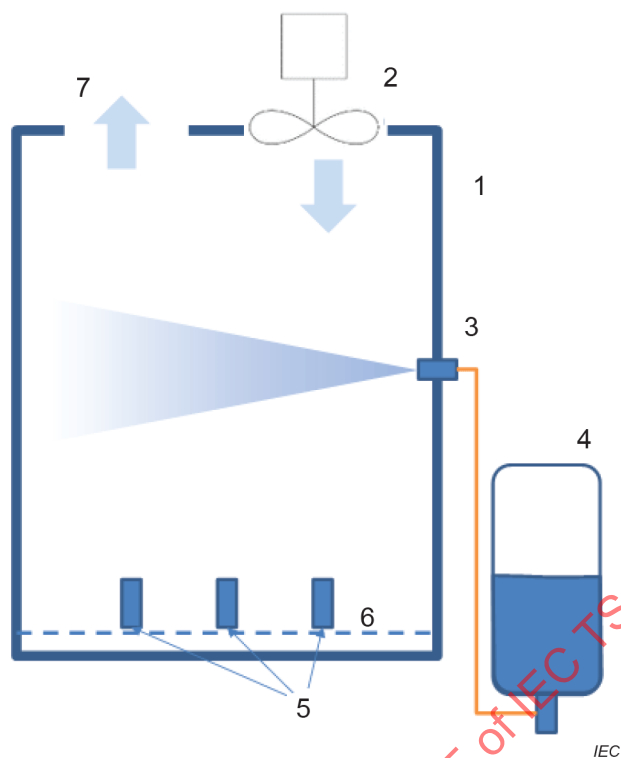
9.2 Test set-up

- a) The test vessel shall be a cylindrical shape and have enough bottom area to accommodate 3 sample **refrigerant sensors** to be placed without contact at bottom level.
- b) The **refrigerant sensors** shall be placed in the vessel on a grid that is $2\text{ cm} \pm 0,5\text{ cm}$ above the bottom of the vessel with orientation in accordance with the manufacturer's instructions.
- c) The height of the vessel shall be greater than the diameter of the vessel, but less than 2 times the diameter.
- d) An orifice size shall be chosen to release refrigerant at a rate of $200\% \pm 20\%$ of the vessel volume per minute, based on $0,022\text{ 4 m}^3/\text{mol}$.
- e) The orifice shall be located at the middle of the vessel height and directed to make a horizontal release of refrigerant.
- f) The liquid refrigerant shall contain $2\% \pm 0,2\%$ of oil to be used in the appliance or other miscible oil with the refrigerant between $15\text{ }^\circ\text{C}$ and $30\text{ }^\circ\text{C}$.
- g) The refrigerant and oil mixture shall be taken from the liquid phase.

NOTE 1 This can be accomplished by using a refrigerant cylinder with a dip tube or the refrigerant cylinder can be placed upside down to ensure the release is taken from the liquid phase.

- h) The total amount of refrigerant per release with lubricant shall be $800\% \pm 80\%$ of the vessel volume, based on $0,022\text{ 4 m}^3/\text{mol}$.
- i) A ventilation fan with nominal flow rate to dilute the released refrigerant to $50\% \pm 10\%$ of *LFL* shall be provided at the top plate of the vessel to introduce fresh air to the vessel.
- j) The output signal of one **refrigerant detection system** shall be wired to make the ventilation fan operate 15 s after the **refrigerant detection system** gives an output.
- k) An exhaust opening shall be provided, also at the top plate of the vessel, to have velocity less than 1 m/s based on the nominal airflow rate of the fan. The exhaust opening shall have a minimum area of 100 cm^2 .

NOTE 2 An example of a test set-up design is given in Figure 1 and Table 3.

**Key**

- 1 test vessel
- 2 fan
- 3 spray orifice
- 4 cylinder for refrigerant-oil mix
- 5 test samples
- 6 floor grid (raised from floor)
- 7 exhaust opening

Figure 1 – Example of test chamber design

Table 3 – Example of the test chamber design

Vessel volume	20 L (5 gal) pail
Refrigerant	R-32 (molar mass 52 kg/kmol; <i>LFL</i> 0,306 kg/m ³)
Release rate	1,5 g/s Verification: 1,5 g/s is $1,5 \times 60 = 90$ g/min, this is $90/52 = 1,73$ mol/min, or $1,73 \times 0,022\ 4 = 0,038\ 8$ m³/min. - In % of vessel volume 1,5 g/s is $0,038\ 8 / 0,02 \times 100 = 194$ % of vessel volume per minute. - This is within the accepted tolerance range.
Release amount	360 g including (7,2 ± 0,72) g of lubricant Released in approximately 4 min (total amount has priority than the release duration)
Ventilation rate	0,6 m ³ /min Verification: - The required ventilation is $1,5\ \text{g/s} \times 0,001\ \text{kg/g} \times 60\ \text{s/min} / (0,50 \times 0,306\ \text{kg/m}^3) = 0,588\ \text{m}^3/\text{min}$. - The ventilation rate is within the accepted tolerance range.
Opening area for exhaust	Square opening 100 mm × 100 mm, or round opening with 112 mm diameter.
Orifice size	Diameter 0,8 mm to 1,0 mm

9.3 Test procedure

A set-up in accordance with 9.2 shall be provided.

- Start the release of refrigerant with oil at the specified rate.
- The ventilation fan shall be activated 15 s after the **refrigerant detection system** gives an output signal.
- Maintain the release of refrigerant with oil until the specified amount is released. This will take approximately 4 min from the start of the release.
- Maintain the ventilation fan operation at least 5 min after the reset of the **refrigerant detection system**.
- If the **refrigerant detection system** or the appliance provides notification to the user that replacement of the **refrigerant sensor** is required, then the **refrigerant detection system** shall give an output signal indicating a leak until the **refrigerant sensor** has been replaced and the test shall be terminated.
- Stop ventilation fan.
- Test in accordance with 9.4.
- Repeat steps of a) to g) for a total of 5 times.

9.4 Check of alarm set point and response time

The **refrigerant detection system** shall respond as intended when tested as follows:

- The **refrigerant sensor** shall be exposed to the low ratio test gas specified in Clause 5 for 5 min and the **refrigerant detection system** shall not give an output signal.
- The **refrigerant sensor** shall be exposed to the high ratio test gas specified in Clause 5 for 5 min and the **refrigerant detection system** shall give an output signal.
- Expose the **refrigerant sensor** to clean air for (15 ± 5) min.
- Expose the **refrigerant sensor** to a step change in the gas volume ratio from clean air to 24 % to 25 % of *LFL* within 5 s.

- e) The **refrigerant detection system** shall give an output signal within 60 s after the step change is completed.

10 Long term stability

Over a period of 90 days, the **refrigerant detection system** shall consistently give an output signal at the alarm set point with a tolerance of ± 5 % of *LFL*, but not lower than 1 % of *LFL*.

Compliance is checked by the following test:

The **refrigerant sensor** shall be exposed to clean air and energized continuously for a period of 90 days. The constant pressure requirement of Clause 5 shall not apply to this test. Every 15 days:

- the **refrigerant sensor** shall be exposed to the low ratio test gas specified in Clause 5 for 5 min and the **refrigerant detection system** shall not give an output signal within this time;
- the **refrigerant sensor** shall be exposed to the high ratio test gas specified in Clause 5 for 5 min and the **refrigerant detection system** shall give an output signal within this time.

11 Humidity test

Over the humidity range of the appliance, the **refrigerant detection system** shall consistently give an output signal at the alarm set point with a tolerance of ± 5 % of *LFL*, but not lower than 1 % of *LFL*.

NOTE Condensation on refrigerant sensors is not considered by this document.

Compliance is checked by the following test:

The **refrigerant sensor** shall be exposed for 60 min to clean air humidified to (30 ± 5) % RH at (15 ± 2) °C.

To confirm the pre-set alarm set point, the **refrigerant detection system** shall respond as intended when tested as follows:

- the **refrigerant sensor** shall be exposed to the low ratio test gas specified in Clause 5 for 5 min and the **refrigerant detection system** shall not give an output signal within this time;
- the **refrigerant sensor** shall be exposed to the high ratio test gas specified in Clause 5 for 5 min and the **refrigerant detection system** shall give an output signal within this time.

The test gases of Clause 5 shall also be humidified.

The procedure shall be repeated with (90 ± 5) % RH at (40 ± 2) °C.

12 Temperature test

Over the temperature range of the appliance, the **refrigerant detection system** shall consistently give an output signal at the alarm set point with a tolerance of ± 5 % of *LFL*, but not lower than 1 % of *LFL*.