

# Electrical and Mechanical Services Department

## GUIDANCE NOTE ON STANDALONE COMMERCIAL REFRIGERATORS USING FLAMMABLE REFRIGERANT

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## 1. Foreword and Scope

- 1.1 This guidance note covers the safety guidelines related to the standards, storage, transportation, installation, maintenance and disposal of standalone commercial refrigerators using flammable refrigerant.
- 1.2 Liquefied petroleum gas (LPG) which is a common fuel for burning can also be used as refrigerant. An example is the refrigerant R600a (butane) which is a common refrigerant used in household refrigerators. As LPG is one of the gases defined in the Gas Safety Ordinance (Cap. 51), certain provisions in this Ordinance may be applicable in association with the LPG used as refrigerant in the standalone commercial refrigerators. For non-LPG refrigerant classified as dangerous goods, it shall be regulated by FSD under the Dangerous Goods Ordinance (Cap. 295).
- 1.3 This guidance note applies to standalone commercial refrigerators using flammable refrigerant only. It shall be read in conjunction with all relevant statutory provisions under the Laws of the Hong Kong Special Administrative Region, including but not limited to the following:-
- Dangerous Goods Ordinance (Cap. 295);
  - Dangerous Goods (General) Regulations (Cap. 295B);
  - Electricity Ordinance (Cap. 406);
  - Electricity (Wiring) Regulations (Cap. 406E);
  - Fire Services Ordinance (Cap. 95);
  - Factories and Industrial Undertakings Ordinance (Cap. 59);
  - Factories and Industrial Undertakings (Dangerous Substances) Regulations (Cap. 59AB);
  - Factories and Industrial Undertakings (Gas Welding and Flame Cutting) Regulation (Cap. 59AI);
  - Gas Safety Ordinance (Cap. 51);
  - Occupational Safety and Health Ordinance (Cap. 509);
  - Waste Disposal Ordinance (Cap. 354); and
  - Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354C).
- 1.4 This guidance note shall also be read in conjunction with the manufacturer's instructions and shall not supersede such instructions unless the latter conflict with the relevant statutory provisions.

1.5 This document is for guidance only and is not intended to relieve persons from their statutory responsibilities.

## 2. Terms and Abbreviations

### 2.1 Terms

Term	Meaning
Cylinder wagon	A motor vehicle designed and constructed, or adapted, primarily for the conveyance of cylinders on roads.
Flammable refrigerant	It refers to refrigerant with flammability class 2L, 2 or 3 according to the safety classification of refrigerants of the ASHRAE Standard 34 and ISO 817.
Liquefied Petroleum Gas	A gas defined in Cap. 51, which is a mixture of:- (a) hydrocarbons primarily consisting of butanes, butylenes, propane or propylene; or (b) all or any of the hydrocarbons referred to in paragraph (a).
Lower flammability limit	The minimum concentration of the refrigerant that propagates a flame through homogeneous mixture of refrigerant and air.
Maintenance workshop	Premises designated for any activity related to the repair and maintenance of standalone commercial refrigerators using flammable refrigerant.
Refrigerant	Fluid used for heat transfer in a refrigerating system, which absorbs heat at a low temperature and a low pressure of the fluid and rejects it at a higher temperature and a higher pressure of the fluid usually involving changes of the phase of the fluid.
Service personnel	Technician who has completed relevant training, provided by the relevant standalone commercial refrigerator manufacturer or recognized training institute, to the install, repair, maintenance, servicing and disposal procedures on standalone commercial refrigerators using flammable refrigerant.
Standalone commercial refrigerator	Standalone electrically operated commercial refrigerating appliances that have an incorporated compressor.

Term	Meaning
Standard	means (a) the British Standard published by the British Standards Institution; (b) the European Standard published by the European Committee for Electrotechnical Standardization; (c) the International Standard published by the International Electrotechnical Commission or the International Organization for Standardization; or (d) any other relevant standards.
Supplier	means a person who supplies an electrical product.

## 2.2 Abbreviations

Abbreviation	Meaning
ASHRAE	The American Society of Heating, Refrigerating and Air-Conditioning Engineers
Cap.	Chapter
°C	degree Celsius
EMSD	Electrical and Mechanical Services Department
EPD	Environmental Protection Department
FSD	Fire Services Department
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
g	gram
K	kelvin (unit of temperature in the International System of Units)
kg	kilogram
kW	kilowatt
LD	Labour Department
LFL	Lower flammability limit
LPG	Liquefied petroleum gas
m <sup>2</sup>	square metre
m <sup>3</sup>	cubic metre
mm	millimetre
MPa	megapascal
MSDS	Material safety data sheet
NGI	Notifiable gas installation
REC	Registered electrical contractor
REW	Registered electrical worker

### 3. Product Safety, Marking and Safety Instructions

#### 3.1 Electrical product safety

Standalone commercial refrigerators shall comply with the applicable safety requirements stipulated in IEC 60335-2-89 in conjunction with IEC 60335-1. Should standalone commercial refrigerators be conforming to other safety standards, such standards should be proved to be equivalent to IEC 60335-2-89.

#### 3.2 Refrigerant safety

3.2.1 The refrigerant safety requirements are made by reference to ISO 817, ASHRAE Standard 34 and IEC 60335-2-89 in conjunction with IEC 60335-1.

3.2.2 Any party who stores, conveys or uses flammable refrigerant shall comply with all relevant regulatory requirements. LPG whether or not used as refrigerant in standalone commercial refrigerators shall comply with the applicable requirements of the Gas Safety Ordinance (Cap. 51). For non-LPG refrigerant classified as Category 2 dangerous goods under the Dangerous Goods Ordinance (Cap. 295), it shall be regulated by FSD.

3.2.3 The safety classification shall consist of two alphanumeric characters with a third character L designating low burning velocity. The capital letter indicates the toxicity; the Arabic numeral denotes the flammability.

3.2.4 For toxicity classification, refrigerants shall be assigned to one of two classes:-

- Class A (lower chronic toxicity);
- Class B (higher chronic toxicity).

3.2.5 For flammability classification, refrigerants shall be assigned to one of four classes below based on lower flammability limit testing:-

- Class 1 (no flame propagation);
- Class 2L (lower flammability);
- Class 2 (flammable);
- Class 3 (higher flammability).

3.2.6 The toxicity and flammability classifications described in Clauses 3.2.4 and 3.2.5 yield eight separate safety classifications for refrigerants. These classifications

are represented by the matrix below:-

	Safety Group	
Higher Flammability	A3	B3
Flammable	A2	B2
Lower flammability	A2L	B2L
No flame Propagation	A1	B1
	Lower Toxicity	Higher Toxicity

3.2.7 In accordance with IEC 60335-2-89, the mass of refrigerant in standalone commercial refrigerators which use flammable refrigerant in their cooling system shall not exceed the following refrigerant charge in each separate refrigerant circuit.

Standard Edition	Maximum refrigerant charge in each separate refrigerant circuit
IEC60335-2-89:2010+AMD1:2012+AMD2:2015	150 g
IEC 60335-2- 89:2019	Shall not exceed 13 x LFL or 1.2 kg in any refrigerating circuit, whichever is smaller

3.2.8 The required minimum room floor area, A, to install a commercial refrigerator with refrigerant charge, M, shall be determined as follows:-

$$A = M / (2.2 \times 0.25 \times \text{LFL})$$

- where
- A is the required minimum room floor area, in m<sup>2</sup>
  - M is the refrigerant charge, in kg
  - LFL is the lower flammability limit, in kg/m<sup>3</sup>
  - 2.2 is the assumed minimum room height, in m
  - 0.25 is the coefficient that gives 25% of LFL

3.2.9 For appliances complying with IEC 60335-2-89:2019 and having a refrigerant charge within any refrigerating circuit exceeding 150 g of flammable refrigerant, the following shall be complied with:-

- (a) The refrigerant-containing parts shall be protected and shall not be an accessible part.
- (b) Any external surface that is adjacent or in contact with parts containing

refrigerant shall have adequate mechanical impact withstand strength.

- (c) Appliances shall be constructed so that their operation does not cause excessive vibration or resonance points in the piping connected to the motor-compressor.
- (d) Appliances shall be constructed so that a leak of refrigerant shall not result in a flammable refrigerant concentration surrounding the appliance. In the event of a leak from the appliance while energized, if airflow is required to meet these requirements, the airflow shall be guaranteed. If airflow is not maintained at a level sufficient to comply with the requirements, the motor-compressors and heating elements shall be switched off within 5 minutes and an alarm shall be given. The motor-compressor and heating elements shall only be capable of restarting after the required airflow level has been reinstated.
- (e) The refrigerant tubing shall be protected from potential damage during normal use relocation, repositioning and user maintenance.
- (f) Low-temperature solder alloys having melting point of less than 450 °C shall not be used for pipe connections in a refrigerating circuit.

3.2.10 Appliances with a protected cooling system and which use flammable refrigerants shall be so constructed as to avoid any fire or explosion hazard in the event of leakage of the refrigerant from the cooling system. Also the appliances, including protective enclosures of a protected cooling system, shall withstand:-

- (a) A pressure of 3.5 times the saturated vapour pressure of the refrigerant at 70 °C, or equal to 3.5 times the pressure at the critical temperature if this is lower than 70 °C, the test pressure being rounded up to the next 0.5 MPa (5 bar), for parts exposed to the high side pressure during normal use.
- (b) A pressure of 5 times the saturated vapour pressure of the refrigerant at 20 °C, or equal to 2.5 MPa (25 bar), whichever is the greater, the test pressure being rounded up to the next 0.2 MPa (2 bar) for parts exposed only to low side pressure during normal use.

3.2.11 For compression-type appliances with unprotected cooling systems and which use flammable refrigerants, any electrical component, other than luminaires, located inside the food storage compartment, that during normal operation or



abnormal operation produces arcs or sparks, shall be tested.

3.2.12 Compression-type appliances which use flammable refrigerants shall be constructed so that leaked refrigerant will not stagnate and thus cause a fire or explosion hazard in areas outside the food storage compartments where components producing arcs or sparks or luminaires are mounted.

3.2.13 Temperatures on surfaces that may be exposed to leakage of flammable refrigerants shall not exceed the auto-ignition temperature of the refrigerant reduced by 100 K.

3.2.14 For appliances complying with IEC 60335-2-89:2019, only hermetically sealed systems shall be used in appliances with flammable refrigerant.


### 3.3 Marking

3.3.1 The markings and labeling on standalone commercial refrigerators provide information for safe use and safe installation of the appliances. They shall be in compliance with Clause 7: Marking and instructions of IEC 60335-2-89 in conjunction with IEC 60335-1.

3.3.2 Standalone commercial refrigerators using flammable refrigerant shall be marked with flame symbol ISO 7010-W021, and its meaning "warning: Risk of fire/flammable materials" shall be explained. The perpendicular height of the triangle for the symbol shall be at least 15 mm.

3.3.3 The flame symbol shall be placed on the nameplate of the unit near the declaration of the refrigerant type and charge information. It shall be visible after installation of the appliance.

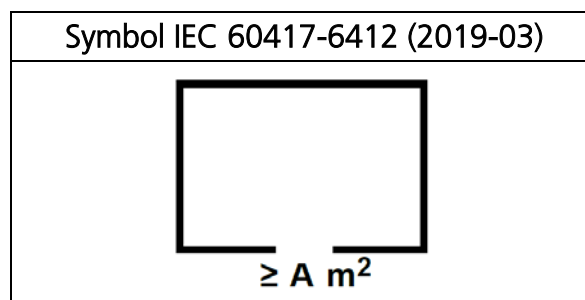
3.3.4 A sample of the flame symbol is shown below:-

Symbol ISO 7010 W021	Meaning
	WARNING; Risk of fire/flammable materials

3.3.5 The marking of the type of flammable refrigerant and of the flammable

insulation blowing gas, shall be visible when gaining access to the motor-compressors.

- 3.3.6 For appliances complying with IEC 60335-2-89:2019 and having a refrigerant charge within any refrigerating circuit exceeding 4 times the LFL for refrigerants having a flammability classification of Class A2 or Class A3 and exceeding 6 times the LFL for refrigerants having a flammability classification of Class A2L, the appliances shall be marked with symbol IEC 60417-6412 (2019-03) and its meaning "minimum room floor area" shall be explained. The perpendicular height of the rectangle for the symbol shall be at least 40 mm. It shall be visible after installation of the appliance. The value of A in the symbol below shall be determined as per Clause 3.2.8. Also, appliances having a refrigerant charge exceeding 150 g of flammable refrigerants within any refrigerating circuit shall be marked with the maximum allowable pressure for which the system is designed to withstand.



- 3.4 Safety instructions to be shown in the user manual
- 3.4.1 Safety instructions shall be in compliance with Clause 7: Marking and instructions of IEC 60335-2-89 in conjunction with IEC 60335-1.
- 3.4.2 The user manual shall include the following basic safety requirements:-
- (a) The flame symbol in Clause 3.3.4 to alert users and service personnel that the commercial refrigerator is using flammable refrigerant.
  - (b) Minimum installation room area.
  - (c) The instructions shall include information pertaining to the handling, installation, cleaning, servicing and disposal of refrigerant and the standalone commercial refrigerator.
  - (d) The following warning labels shall be provided:-

- (i) WARNING: Keep clear of obstruction all ventilation openings in the appliance enclosure or in the structure for building-in.
  - (ii) WARNING: Do not use mechanical devices or other means to accelerate the defrosting process, other than those recommended by the manufacturer.
  - (iii) WARNING: Do not damage the refrigerant circuit.
  - (iv) WARNING: Do not use electrical appliances inside the food storage compartments of the appliance, unless they are of the type recommended by the manufacturer.
- (e) The standalone commercial refrigerator shall not be installed near ignition sources or open flames.
  - (f) Servicing shall be performed only as recommended by the manufacturer.
  - (g) In case the refrigerant circuit is damaged, do not use any electric or gas appliances, ensure no source of ignition (e.g. lighter, matches) nearby, and open all windows to provide good ventilation, and should contact supplier/supplier's agent/maintenance agent to follow up. In case of emergency, call 999 immediately.
  - (h) The markings mentioned in Clause 3.3 shall be kept throughout the life cycle of the standalone commercial refrigerator. The user manual should be handed over to any person who would use or handle the commercial refrigerator whenever the commercial refrigerator would be transferred to another location and delivered to a recycling plant.

3.4.3 Manufacturers of the standalone commercial refrigerators may include other safety requirements.

## **4. Sales**

### **4.1 Safety messages to be shown in the sales documents**

4.1.1 The sales documents shall include the following safety messages:-

- (a) The flame symbol in Clause 3.3.4 to alert consumers that the commercial refrigerator is using flammable refrigerant.
- (b) The standalone commercial refrigerator shall be installed in accordance

with manufacturer's recommended minimum room floor area.

(c) The installation, repair and maintenance works shall be performed by trained service personnel.

4.1.2 Supplier/supplier's agent shall ensure that sales personnel, either employed by him or his authorized distributors and dealers, are trained to be familiar with safety messages in Clause 4.1.1 and he/she should be able to deliver these messages to consumers.

## **5. Storage and Transportation**

### **5.1 General**

5.1.1 Any party who stores, conveys or uses flammable refrigerant shall comply with all relevant regulatory requirements.

### **5.2 Storage**

5.2.1 Storage of commercial refrigerators using LPG as refrigerant shall comply with the Gas Safety Ordinance (Cap. 51). The aggregate water capacity of LPG from all refrigerators shall not be over 130 litres inside the storage room. Otherwise, prior approval must be sought from the Gas Authority for construction and use of an NGL. (The permitted number of stored LPG refrigerators may vary according to the water capacity of LPG contained in each refrigerator.)

5.2.2 If the composition of a refrigerant falls within the definition of LPG under the Gas Safety Ordinance (Cap. 51), the storage of such refrigerant may be regulated by this Ordinance.

5.2.3 For refrigerants classified as dangerous goods (other than LPG), FSD can invoke the Dangerous Goods Ordinance (Cap. 295) and regulate their manufacture, storage, transport and general use but not their import or supply, nor their use in commercial refrigerators. The cylinders containing non-LPG dangerous goods shall be marked or labelled in accordance with the Dangerous Goods (General) Regulations (Cap. 295B).

5.2.4 The standalone commercial refrigerators using flammable refrigerant shall be

stored in a room without continuously operating ignition sources. Storage package protection should be constructed in such a way that mechanical damage to the standalone commercial refrigerators inside the package will not cause a leak of the refrigerant charge.

- 5.2.5 Every container holding flammable refrigerant shall be labelled in accordance with the Factories and Industrial Undertakings (Dangerous Substances) Regulations (Cap. 59AB).

### 5.3 Transportation

- 5.3.1 Transportation of commercial refrigerators using LPG as refrigerant shall comply with the Gas Safety Ordinance (Cap. 51). No person shall use a motor vehicle to carry on a road (a) any cylinder which has a water capacity of not less than 130 litres; or (b) any combination of cylinders which have a combined water capacity of not less than 130 litres, unless (i) the vehicle is a cylinder wagon; and (ii) there is a valid permit issued in respect of the wagon. Therefore, it is required to transport commercial refrigerators using LPG as refrigerant in bulk with a total aggregated water capacity of more than 130 litres by a valid motor vehicle and to comply with all relevant gas safety regulations. (The permitted number of transported refrigerators may vary according to the water capacity of LPG contained in each refrigerator.)

- 5.3.2 For conveyance of refrigerant which is a non-LPG dangerous goods, a licence issued by the Director of Fire Services is required for any vehicle used for the conveyance of Category 2 dangerous goods exceeding its exempt quantity.

- 5.3.3 Standalone commercial refrigerators using flammable refrigerant shall withstand the effects of vibration during transport.

## 6. Installation

### 6.1 Competency of service personnel

- 6.1.1 Employer of service personnel shall comply with the relevant requirements under the Factories and Industrial Undertakings Ordinance (Cap. 59) and the Occupational Safety and Health Ordinance (Cap. 509) and their subsidiary regulations to provide adequate and sufficient training to service personnel and ensure that they are equipped with all the relevant technical knowledge and

skills on working safely with flammable refrigerant.

- 6.1.2 Service personnel shall complete special training on working with flammable refrigerants, provided by relevant supplier/supplier's agent or recognized training institute, to the repair, maintenance, servicing and disposal procedures on commercial refrigerators using flammable refrigerant.
- 6.1.3 The electrical installation works shall be conducted by a registered electrical contractor (REC) and the service personnel engaged in such electrical work on fixed electrical installations must be a registered electrical worker (REW).

## 6.2 Safe work practices

- 6.2.1 A task-specific risk assessment should be carried out by a competent person before the commencement of work with reference made to the relevant MSDS of the refrigerant to be used so as to devise a work method that is safe and without risk to health.
- 6.2.2 Service personnel shall ensure no potential sources of ignition in the vicinity of the standalone commercial refrigerator using flammable refrigerant that could ignite any refrigerant leaks from the commercial refrigerator.
- 6.2.3 Service personnel shall assess the room floor area for the standalone commercial refrigerator using flammable refrigerant to ensure compliance with Clause 3.2.8 or the manufacturer's requirement, whichever the higher.

## 7. Maintenance and Repair

### 7.1 Occupational safety and health

- 7.1.1 In accordance with the Factories and Industrial Undertakings Ordinance (Cap. 59) and the Occupational Safety and Health Ordinance (Cap. 509), proprietors/employers shall ensure, so far as is reasonably practicable, the safety and health at work of all persons employed in their workplaces by:-
  - (a) providing and maintaining plant and systems of work that are safe and without risks to health;
  - (b) making arrangement for ensuring safety and health in connection with the use, handling, storage or transport of plant, articles or substances;

- (c) providing all necessary information, instruction, training, and supervision for ensuring safety and health;
- (d) maintaining the workplace in a condition that is safe and without risks to health, and providing and maintaining safe means of access to and egress from the workplaces; and
- (e) providing and maintaining a safe and healthy work environment.

7.1.2 Every person employed at work shall comply with the general duties of person employed as stipulated under the Ordinances stated in Clause 7.1.1, which include taking reasonable care for the health and safety of himself and of other persons who may be affected by his acts or omissions at work; and as regards any duty or requirement imposed on proprietors/employers for securing the health and safety of person employed in the workplaces, co-operating with him so far as is necessary to enable that duty or requirement to be performed or complied with.

## 7.2 Maintenance and repair work

- 7.2.1 The employer and service personnel shall observe the occupational safety and health requirements stipulated in the relevant LD's publications. Among others, the employer should appoint a competent person to conduct task-specific risk assessments to identify all potential hazards associated with the maintenance and repair work.
- 7.2.2 Prior to starting the maintenance and repair work on standalone commercial refrigerators using flammable refrigerant, safety checks are necessary to ensure that the risk of ignition is minimized. The workplace shall be checked with an appropriate refrigerant detector prior to and during work, to ensure that the service personnel is aware of potentially flammable atmospheres. The leak detection equipment being used is suitable for use with the applicable refrigerants.
- 7.2.3 Maintenance and repair work in connection with flammable refrigerants should be carried out in a well-ventilated place to avoid suffocation, poisoning or accumulation of flammable gases. Appropriate air monitoring equipment, such as portable gas detectors, should also be provided and used.
- 7.2.4 Work related to the handling and replacement of refrigerants must be carried

out by workers with relevant training and experience.

- 7.2.5 If welding work has to be carried out to the refrigerant circuit of commercial refrigerator, the refrigerant must first be completely removed, followed by inert gas purging of the tubing of the refrigerant circuit before welding. Gas welding and flame cutting work must be performed by workers holding a valid certificate pursuant to the Factories and Industrial Undertakings (Gas Welding and Flame Cutting) Regulation (Cap. 59A1). In addition, requirements stipulated in the Code of Practice: Safety and Health at Work for Gas Welding and Flame Cutting should be observed.
- 7.2.6 Refrigerant cylinders should be kept away from any source of ignition or corrosive substances. Service personnel shall be cautious of the fire and explosion hazards when handling flammable refrigerants.
- 7.2.7 Sufficient and suitable fire extinguishers should be provided in the workplace.
- 7.2.8 The maintenance workshop shall not be built below ground level. If a gully or drain in the workshop floor area is unavoidable, the opening/drain shall either be securely covered or suitably sealed.

## **8. Dismantling and Disposal**

- 8.1 When a standalone commercial refrigerator using flammable refrigerant is to be scrapped, all refrigerant shall be removed before disposal of the standalone commercial refrigerator.
- 8.2 The machine used for refrigerant recovery must be suitable for flammable refrigerants and should not have any potential sources of ignition.
- 8.3 The recovery cylinder must be suitable for the refrigerant used. Refrigerants of different safety group classifications must not be mixed in recovery cylinders. The recovered refrigerants should be reused as far as practicable.
- 8.4 Prior to disposal of the standalone commercial refrigerator, the refrigerant content inside the refrigerant circuit of the standalone commercial refrigerator shall be removed to ensure safety. No work involving naked flame or high temperature shall be carried out during the process.



- 8.5 As unwanted refrigerants are classifiable as chemical waste under Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354C), their handling and disposal are subject to control under the Waste Disposal Ordinance (Cap. 354) and its subsidiary Regulations.
- 8.6 Any person or company who produces unwanted refrigerants should first register with EPD as a chemical waste producer. The waste producer is required to properly package, label and store chemical waste, and engage licensed chemical waste collectors to collect and deliver the waste to licensed waste disposal facilities. If there is no proper disposal facility available for the refrigerant in Hong Kong, the waste producer will need to make other disposal arrangements, subject to EPD's approval.

## **9. Reference**

- 9.1 ASHRAE Standard 15-2019 Safety Standard for Refrigeration Systems
- 9.2 ASHRAE Standard 34-2019 Designation and Classification of Refrigerants
- 9.3 Code of Practice: Safety and Health at Work for Gas Welding and Flame Cutting published by the Labour Department, Hong Kong
- 9.4 Fire Protection Notice No. 4 – Dangerous Goods, published by the Fire Services Department, Hong Kong
- 9.5 IEC 60335-1:2010+AMD1:2013+AMD2:2016 Household and similar electrical appliances – Safety – Part 1: General requirements
- 9.6 IEC 60335-2-89:2019 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
- 9.7 ISO 817:2014+AMD1:2017 Refrigerants – Designation and safety classification
- 9.8 ISO 5149-1:2014 to ISO 5149-4:2014 Refrigerating systems and heat pumps – Safety and environmental requirements – Part 1 to Part 4