

## Safety Standards and Components for flammable refrigerants

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### 1 Purpose

The purpose of this guideline is to provide common interpretation of the demands to and application of components in vapour compression systems which use flammable refrigerants within the frames of the HVACR standards in the EU. As flammable refrigerants play a big role in the phase down of refrigerants related emissions this guideline will facilitate the design of low GWP systems.

### 2 Scope

This guideline is valid for the components comprising a vapour compression system using flammable refrigerants i.e. valves, heat exchangers, compressors and other mechanical, electronic and electro-mechanical controls. This guideline covers only components for systems to operate in non-hazardous areas i.e. non ATEX areas, see figure A1. It should be noticed that vapour compression systems serve in a broad variety of applications which may be designed operated under special conditions. This guideline will only cover the main stationary applications which can be found in the ANNEX 1 – 4.

- Chillers
- Split A/C systems & multi-splits
- Roof top units
- Self-contained Commercial refrigeration appliances and remote commercial refrigeration systems

## 3 Definitions

### **refrigerating system**

#### **heat pump**

combination of interconnected refrigerant-containing parts constituting one closed circuit in which the refrigerant is circulated for the purpose of extracting and delivering heat (i.e. cooling and heating)

#### **sealed system**

refrigerating system in which all refrigerant containing parts are made tight by welding, brazing or a similar permanent connection which may include capped valves and capped service ports that allow proper repair or disposal and which have a tested leakage rate of less than 3 grams per year under a pressure of at least a quarter of the maximum allowable pressure

Note 1 to entry: Joints based on mechanical forces which are prevented from improper use by the need of a special tool (e.g. by glue) are considered as a similar permanent connection.

Note 2 to entry: Hermetically sealed systems in EN ISO 14903 are equivalent to sealed systems in EN 378-2:2016.

### **component**

individual functional item of a refrigerating system

### **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 heat at a higher temperature and a higher pressure usually involving changes of the state of the fluid

### **flammable refrigerant**

refrigerant with a flammability classification of Class 2L, Class 2 or Class 3 in accordance with ISO 817

### **lower flammability limit**

#### **LFL**

minimum concentration of refrigerant that is capable of propagating a flame within a homogeneous mixture of refrigerant and air.

### **operator**

the natural or legal person exercising actual power over the technical functioning of refrigerating systems

## 4 Regulatory frames and standards, introduction

The risk analysis scenario is a central element in all safety standards and directives. Safety standards are a sum of experience and to some extent theoretical risk assessment, even though a specific risk assessment procedure is not a part of those standards. This results in boundaries for operating conditions - including service and design.

### 4.1 EN Standards

Harmonised standards are the preferred way to comply with the EU safety directives, such as the EU Pressure Equipment Directive, the EU Low Voltage Directive, and the Machinery Directive, they are however not the only way, as it is allowed for manufactures to replace parts or all of a standard with a risk assessment. There are a number of system safety standards for stationary refrigerating systems. These can be grouped by how broad a market segment they cover. The horizontal standard (also known as group safety standard) covers a wide range of products while the vertical standard (also known as product safety standard) only covers a specific product type. See table 1.

The international standard ISO 5149 is a horizontal system safety standard very similar to EN 378. During the last years text pieces have migrated from ISO 5149 to EN 378 and vice versa. Similar, the International IEC 60335 series standards are comparable to the EN60355 series standards series

The system safety standards for refrigerating equipment sets a number of requirements for systems using flammable refrigerants.

The requirements can be categorized into requirements for:

- Competences of people working with the system
- Charge size limits to minimize the impact of worst case accidents
- Avoiding hot surfaces, to avoid ignition or decomposition of leaked refrigerant
- Avoiding ignition sources beyond hot surface, to avoid ignition of leaked refrigerant

Table 2: Maximum surface temperatures

Refrigerant	Auto ignition temperature (°C)	Maximum surface temperature in EN standards (°C)
R-32	648	548
R-170	515	415
R-290	470	370
R-600a	460	360
R-1234yf	405	305
R-1234ze(E)	368	268
R-1270	455	355

The requirements on competences of people are generally regulated by the certification required by the EU F-gas regulation. The ATEX "Workplace" Directive also requires a sufficient level of competence when working with flammable substances, so even though the

EU F-gas regulation does not cover all flammable substances (e.g., hydrocarbons), there is a legal requirement for personnel to be competent.

The standard ISO 22712:2023 (to become EN ISO 22712) describes the competences needed for relevant personnel in the different phases of the lifecycle of the refrigerating equipment, from design and commissioning, to operation, to service and decommissioning, including flammable refrigerants. This standard reflects the latest changes in the EU F-gas regulation and will replace the EN 13313:2010.

The requirements on competences do not lead directly to requirements on components.

The system safety standards describe a set of rules for refrigerant charge and are only valid within the charge limits they prescribe. The limited amount varies for instance system architecture, location of the system, who has access to the system and sometimes also the purpose of the system. Table 1 gives an overview of the European system safety standards. The charge limits do not set requirements on components.

Table 1: European and other relevant system safety standards

EN 60335-2-11:2022	Household and similar electrical appliances – Safety – Particular requirements for tumble dryers	Currently defines rules for up to 150 g of flammable refrigerant. Copies IEC 60335-2-11:2019 with minor modifications related to EU legislation. The general policy is to adopt latest IEC version with minor modifications.
EN 60335-2-24:2010	Household and similar electrical appliances – Safety – Particular requirements for refrigerating appliances, ice-cream appliances and ice makers	Currently defines rules for up to 150 g of flammable refrigerant. Copies IEC 60335-2-24:2010 with minor modifications related to EU legislation. The general policy is to adopt latest IEC version with minor modifications. New IEC 60335-2-24:2020 does not change rules for charge.
EN 60335-2-40:2013	Household and similar electrical appliances – Safety – Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers	Charge limits depends on refrigerant type and system architecture. Derived from 2002 version of IEC 60335-2-40 with amendments. Process is ongoing to update the EN standard based on the IEC 2022 and harmonise it.
EN 60335-2-89:2017	Household and similar electrical appliances – Safety – Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant condensing unit or compressor	The harmonised EN standard is based on IEC 60335-2-89:2010 and amendment 1 from 2012 with minor modifications related to EU legislation. Currently defines rules for up to 150 g of flammable refrigerant. New IEC standard edition defining rules up to 13×LFL (494g R290 and 1.2 kg for A2L) has been copied into EN 60335-2-89:2022, and is expected to be harmonised in 2023.

EN 378:2016	Refrigerating systems and heat pumps — Safety and environmental requirements	Charge limits depends on system architecture, location of the system, who has access to the system and the purpose of the system.
EN 50570:2018	Household and similar electrical appliances – Safety – Particular requirements for commercial electric tumble dryers	Currently allows 150 g of flammable refrigerant; A proposal circulated 2021 is to increase the limit to 500g for flammable refrigerant regardless of flammability class.
ISO 20854:2019	Thermal containers – Safety standard for refrigerating systems using flammable refrigerants – Requirements for design and operation	The standard describes how to do risk assessment of refrigerated cargo containers. It does not prescribe specific limits to refrigerant charge amount, and most requirements are related to what needs to be considered in the risk assessment. No EN version is planned.
IEC 60335-2-118:2021	Household and similar electrical appliances – Safety – Particular requirements for professional ice-cream makers	Requirements for professional ice-cream makers with non-flammable refrigerants. No EN version is published. Requirements for flammable refrigerants are expected to be included in next revision based on IEC 60335-2-89.

European system safety standards generally regulate hot surfaces separately from other ignition sources. In the EN standards the requirement is that surfaces in the system which may come into contact with leaked refrigerant has to be 100 K below the auto-ignition temperature of the flammable refrigerant (EN 378-2, EN 60335-2-11, EN 60335-2-24, EN 60335-2-40, EN 60335-2-89). This is tougher than the requirements of ATEX, which would only require surfaces to be below the auto-ignition temperature. The maximum surface temperatures of selected refrigerants are given in table 2. In practice it is very few components which can become hot enough for this requirement to be relevant.

## 4.2 Risk assessment option

In the EU legislative system, product safety is often shown by compliance with harmonized standards. Following a harmonized standard gives the manufacturer a right to presume conformity with the law that the standard is harmonized towards.

Although harmonized EN standards are the preferred way of complying with European safety laws, it is also possible to follow “other specifications than harmonised standards”, see figure 1. This approach is normally called the risk assessment approach.

Doing a risk assessment from scratch infers a risk of overlooking potential risks, and therefore the approach is usually limited to a single aspect of an application. Often the risk assessment is based on complying with a non-harmonized standard, i.e. a risk assessment showing that this non-harmonized standard is appropriate for addressing the risks in the application. An example could be following the latest IEC 60335-2-40, even before it gets adopted in the EU as EN 60335-2-40 and gets harmonised.

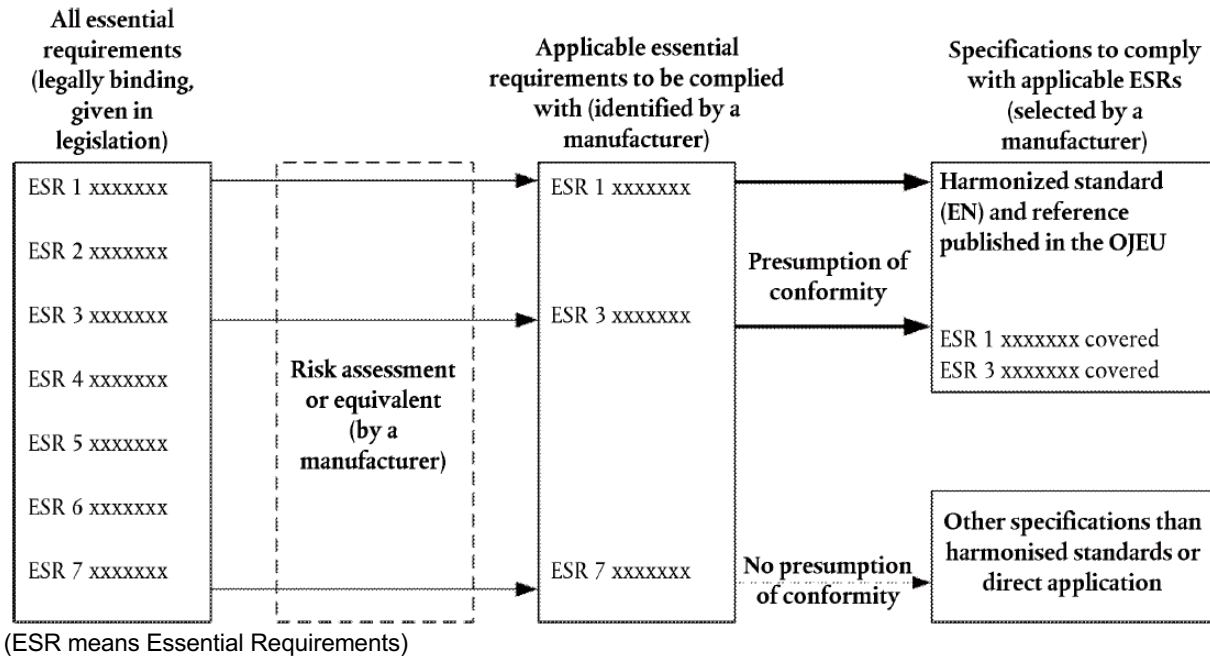


Figure 1: EU legislative system for products according to the EU Blue Guide

## 5 Demands on components

Standards are not by default aligned, harmonised or well written. This can create confusion in the market and the result may be an overreaction to the demands for components. One example could be a system builder who cannot make a clear interpretation of requirements for ignition sources in a standard. He may then require a 'safe' but unnecessary high specification which often is the ATEX certification. This is of course not a viable way to proceed.

A qualified component for a flammable refrigerant comply to relevant 'non-flammable' requirements and further

- (1) Possible higher PED classification
- (2) Ensured lowest surface temperatures below prescribed ignition temperatures if relevant
- (3) Ensured by design or instalment specification that it is a non-ignition source

Systems with flammable refrigerants can use components qualified for the specific flammable refrigerant. Though, the manufacturer of the system is responsible for designing a safe system, and systems must be designed, installed and serviced according to the demands in the safety standards and the local regulations.

## 5.1 EN Standards

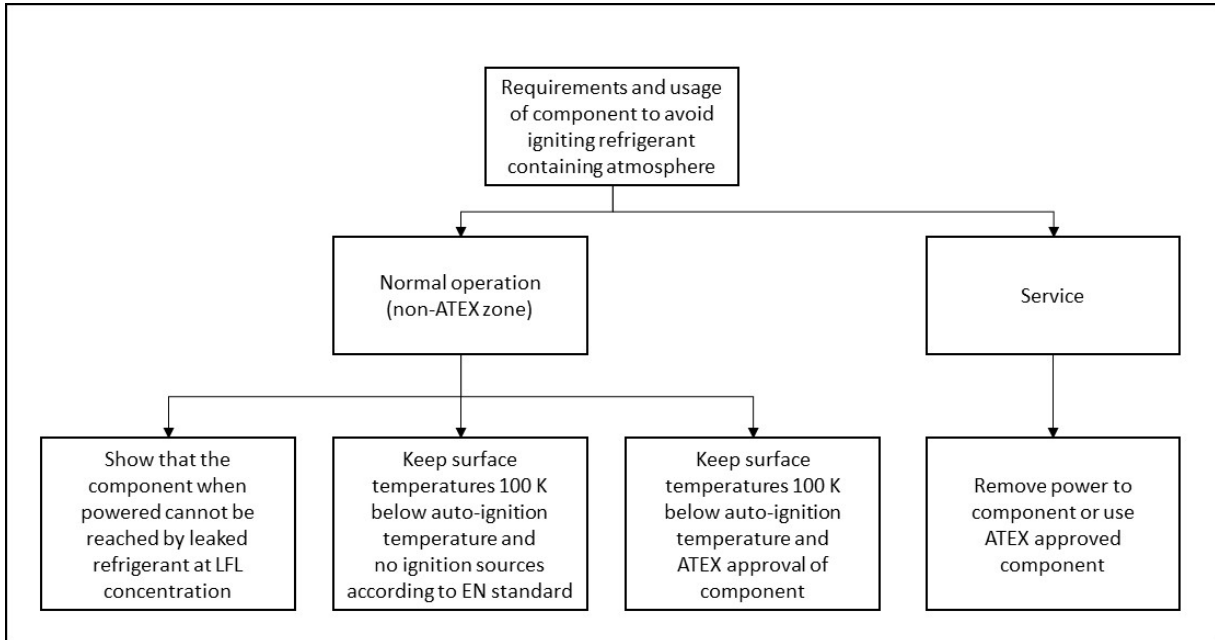


Figure 2: Requirements and usage of components for flammable refrigerants

European system safety standards set requirements on avoiding ignition of leaked refrigerant. The requirements in the system safety standards which are specifically relevant for components for flammable refrigerants, are the requirements on maximum temperatures of hot surfaces and the requirements to avoid ignition sources.

To summarise, there are 3 different approaches in the EN standards to avoid ignition of leaked refrigerant, see figure 2.

European system safety standards set a maximum allowed surface temperature of components when they are used for flammable atmosphere, see table 2 for the specific temperatures. Most components are not able to approach these temperatures, but for electrical heaters special precautions may be needed to limit the maximum temperature or ensure that leaked refrigerant cannot reach the hot surface.

The requirement to avoid other ignition sources than hot surfaces only applies to components which are supposed to create sparks (electronic or electro-mechanical components) and are placed where they can be reached by leaked refrigerant. The standards have specific test procedures to determine where this is.

It is possible to introduce mitigating measures e.g. place electronic controllers in a box or similar, so it cannot be reached by the leaked refrigerant. Again, it is the responsibility of the system manufacturer to ensure that the electronic controller is placed where the component manufacturer specifies.

In case components in a refrigerating system are placed where they can be reached by leaked refrigerant according to the test in the relevant system safety standard, it is required

to prove that the component does not have ignition sources. As mentioned above the system safety standards generally refer to specific selected clauses of EN 60079-15.

*When European system safety standards set requirements to avoid other ignition sources, they are going beyond the requirements of ATEX. System safety standards assume a larger potentially flammable gas cloud than ATEX does and accordingly have strict location and occupancy demands. It means also they have less requirements for proving that a system has no ignition sources (other than hot surfaces). For instance EN 60335-2-89 refers to clauses from EN60079-15, a standard harmonised with ATEX, but EN60335-2-89 excludes clauses 1 through 15. There are three aspects where the system safety standards are more relaxed than ATEX:*

- The disconnection of plugs on components is generally not considered to be normal operation in system safety standards.
- The required resistance to impact is lower than required by ATEX as most components considered to be protected from impacts
- Components generally do not need to be IP54 if they are protected by an enclosure. (For ATEX approval IP54 is one of the mandatory requirements).

## 5.2 Requirements from the ATEX and PED directives

Only equipment and components which need to remain powered during a service situation, i.e. emergency lightning, alarms, gas detectors and the emergency ventilation in machinery rooms, needs to be approved for use in ATEX zone 2. For the ventilation only the components in the leak affected air-stream which need to be approved. See also Annex 1

It is however common practice for component manufactures to use ATEX approval of those components to prove that there are no ignition sources. This approval is going beyond the requirements of the safety standards, but can be a pragmatic solution for some products, for instance pressure and temperature switches.

Under ATEX a rule of thumb is that leaks happening less than ones per year are too infrequent to justify defining an ATEX zone, and when a leak occur the ATEX standard EN 60079-10-1 will usually assume the hole has a size of no more than 0,1 mm<sup>2</sup> (for a DN50 pipe). By contrast the frequency of large leaks in refrigerating systems is much less than once per year, and the system safety standards typically assumes the hole is large enough to leak the whole refrigerant charge in 4 minutes.

The PED directive (see Annex 2) will categorise the component depending on pressure, size and fluid type. Depending on the category different demands on design and material certification have to apply.

## 5.3 Risk assessment option

The timing of adaption of standards like IEC versus EN standards makes it reasonable to apply the latest and often most progressive standard even the before the standard is harmonised in the EU.



Here it is especially worth mentioning that recent changes to IEC standards for A2L refrigerants and draft EN standards can be applied to components and systems, even though these standards are not yet available as harmonised EN standards. For example as to the point of view of proving that a component cannot ignite A2L refrigerant or allowing higher maximum surface temperatures.

Though, to use these not yet harmonised standards it is necessary to do a risk assessment to show that the requirements adopted are appropriate for the specific component (or application)

## 6 Requirements on components used as mitigation measures

Mitigating components ensure that flammable atmospheres are detected and mitigated before reaching LFL levels in occupied space or machine rooms. By ensuring these mitigation measures flammable atmospheres are prevented. Components that can function as mitigation instruments are typically:

- Shut-off valves referenced from IEC 60335-2-40.
- Gas detectors referenced from IEC 60335-2-40, EN 378, and ISO 5149.
- Ventilation fans and circulation air flow fans.

The specific demands for these components are rarely different to demands other components see again figure 2. However, IEC 60335-2-40 is considering having special seat leakage demands for shut off valves for sectioning or partitioning systems.

## 7 Bibliography

Non-binding guide to good practice for implementing the European Parliament and Council Directive 1999/92/EC on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres, Directorate-General for Employment, Social Affairs and Inclusion (European Commission), 2005, ISBN: 92-894-8721-6.

ATEX “Workplace” directive: Directive 1999/92/EC 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres (15th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)

ATEX “Equipment” directive: Directive 2014/34/EU 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres (recast)

Pressure Equipment Directive, PED 2014/68/EU: Directive 2014/68/EU 15 May 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment

EU F-Gas regulation: Regulation (EU) No 517/2014 Of The European Parliament And Of The Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006

EN 60079-10-1:2015 Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres (IEC 60079-10-1:2015)

EN 1127-1:2019 Explosive atmospheres - Explosion prevention and protection, Basic concepts and methodology

EN 13313:2010 Refrigerating systems and heat pumps. Competence of personnel.

EN 378-1:2016, EN 378-2:2016, EN 378-3:2016, EN 378-4:2016, Refrigeration Systems and Heat Pumps – Safety and Environmental Requirements.

EN 50570:2018, Household and similar electrical appliances – Safety – Particular requirements for commercial electric tumble dryers

EN 60335-2-11:2022, Household and similar electrical appliances – Safety – Part 2-11: Particular requirements for tumble dryers

EN 60335-2-24:2010, Household and similar electrical appliances – Safety – Part 2-24: Particular requirements for refrigerating appliances, ice-cream appliances and ice makers

EN 60335-2-40:2013, Household and similar electrical appliances – Safety – Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers

EN 60335-2-89:2017, Household and similar electrical appliances – Safety – Part 2-89: Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant condensing unit or compressor

EN 60335-2-89:2022, Household and similar electrical appliances – Safety – Part 2-89: Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant condensing unit or compressor

IEC 60335-2-11:2019, Household and similar electrical appliances – Safety – Part 2-11: Particular requirements for tumble dryers

IEC 60335-2-24:2010, Household and similar electrical appliances – Safety – Part 2-24: Particular requirements for refrigerating appliances, ice-cream appliances and ice makers

IEC 60335-2-24:2020, Household and similar electrical appliances – Safety – Part 2-24: Particular requirements for refrigerating appliances, ice-cream appliances and ice makers

IEC 60335-2-89:2010, Household and similar electrical appliances – Safety – Part 2-89: Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant condensing unit or compressor

# GUIDELINE

Last update: April 2023



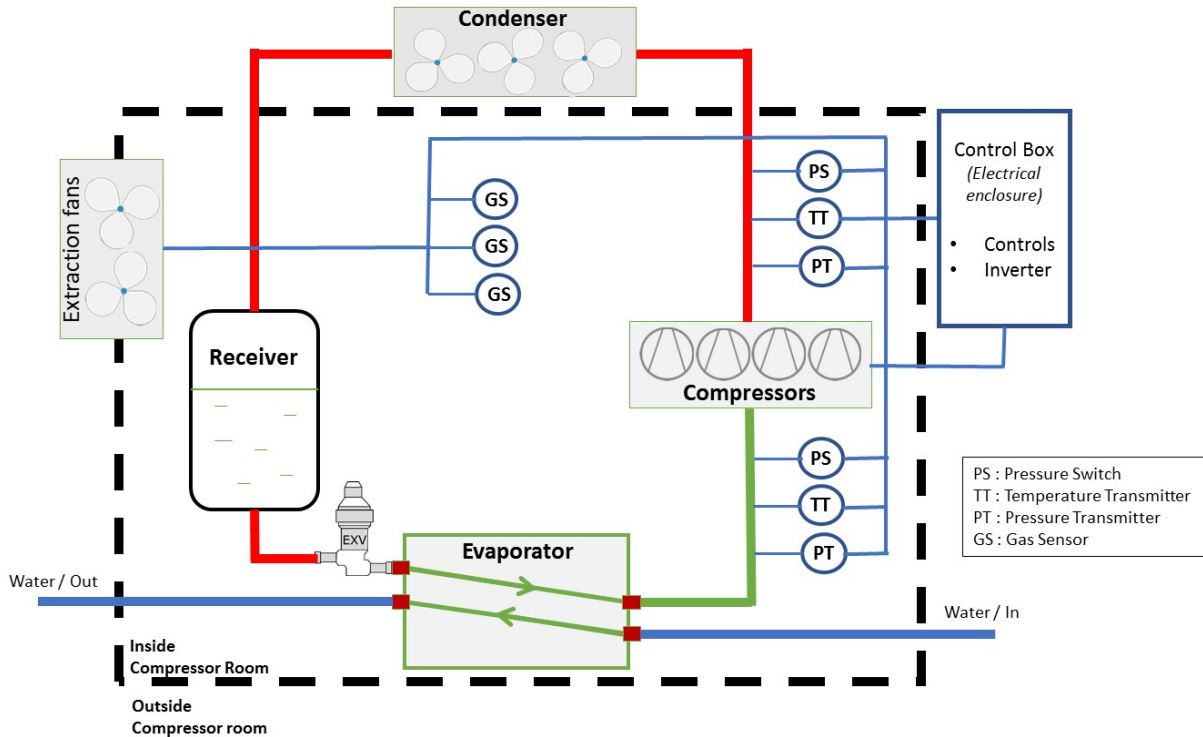
IEC 60335-2-40:2022, Household and similar electrical appliances – Safety – Part 2-40:  
Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers

IEC 60335-2-118:2021, Household and similar electrical appliances – Safety – Part 2-118:  
Particular requirements for professional ice-cream makers

ISO 20854:2019, Thermal containers — Safety standard for refrigerating systems using  
flammable refrigerants — Requirements for design and operation

ISO 22712:2023, Refrigerating systems and heat pumps — Competence of personnel

## ANNEX 1: R290 Chiller example



The above figure shows a typical R290 chiller layout, and this annex briefly explains the design choices of components for a specific chiller regarding avoiding ignition of leaked refrigerant.

The purely mechanical components are not considered to be potential ignition sources, but to be sure they have been checked against the potential ignition sources listed in Annex K of EN 378-2:2016.

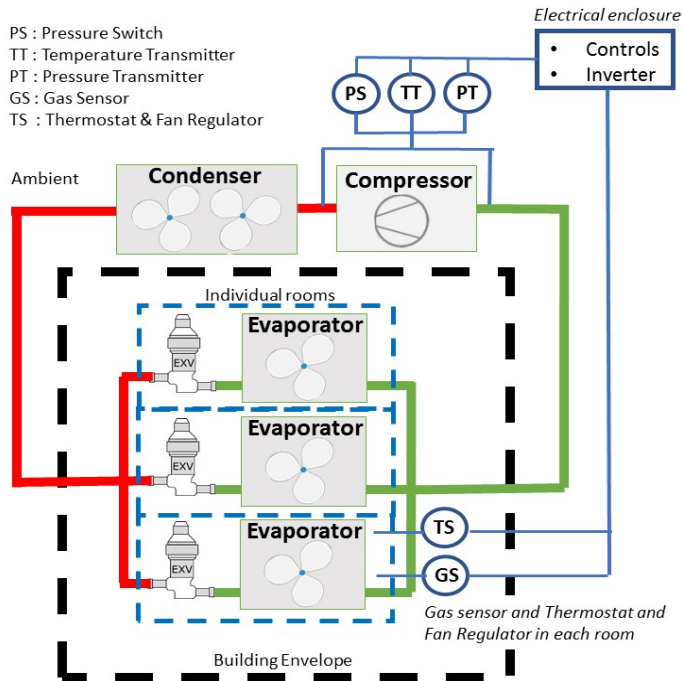
The electrical components can be proved not to be ignition sources in various ways, but in this specific case the choice has been: (see also figure 2)

Show that the component cannot be reached by leaked refrigerant	No ignition sources according to EN standard	ATEX approval of component
Controls	EXV	Pressure switch
Inverters	Temperature transmitter**	Pressure transmitter**
	Compressors	Gas sensor
	Crankcase heater for compressors	

\*\* P and T-transmitters often are selected with ATEX approval as this may be the most favourable commercial decision. In principle transmitters are not recognised as ignition sources.

The choice of placing controls and inverters outside the compressor room was made partly to allow easy access by technicians and partly to avoid the risk of igniting refrigerant. Had the inverter been mounted on the compressor, then the inverter could have been approved by applying a risk assessment e.g. IEC 60335-2-40 or be ATEX approved.

## ANNEX 2: Example on Split and multi split AC incl. reversible systems



The above figure shows a typical multisplit AC layout, and this annex briefly explains the design choices of components for a specific system regarding avoiding ignition of leaked refrigerant. Demands on the system design and the instalment (room size and placing of the evaporator) will ensure that components just follows the diagram in figure 2. The purely mechanical components are not considered to be potential ignition sources, but to be sure they have been checked against the potential ignition sources listed in Annex K of EN 378-2:2016. The electrical components can be proved not to be ignition sources in various ways, but in this specific case the choice has been: (see also figure 2)

Show that the component cannot be reached by leaked refrigerant	No ignition sources according to EN standard	ATEX approval of component
Controls	EXV	Pressure switch
Inverters	Temperature transmitter**	Pressure transmitter**
	Compressors	Gas sensor
	Crankcase heater for compressors	

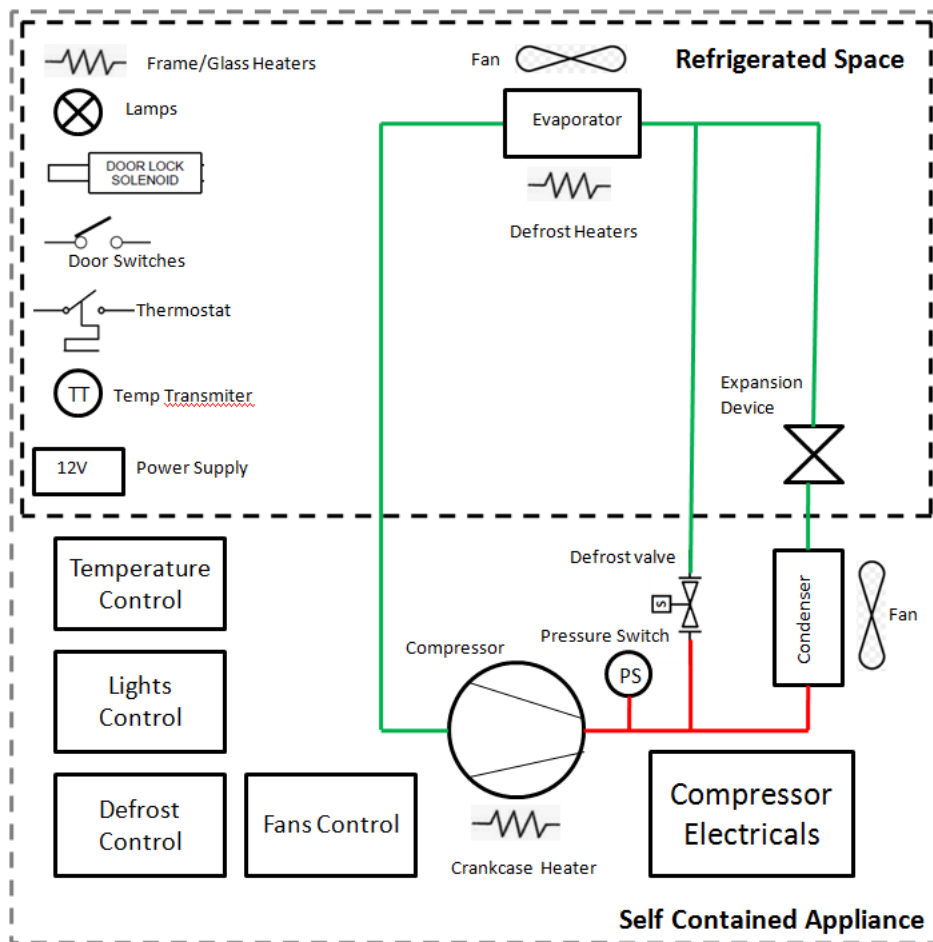
\*\* P and T-transmitters often are selected with ATEX approval as this may be the most favourable commercial decision. In principle transmitters are not recognised as ignition sources.

The choice of placing controls and inverters outside building envelope was made partly to allow easy access by technicians and partly to avoid the risk of igniting refrigerant. Had the inverter been mounted on the compressor and the refrigerant been an A2L refrigerant, then the inverter would probably have been approved by applying a risk assessment and e.g. IEC 60335-2-40.

## **ANNEX 3: Example with reference to operating with flammable refrigerants: Self-contained Commercial refrigeration appliances and remote commercial refrigeration systems**

### **Description of typical self-contained commercial refrigeration appliances**

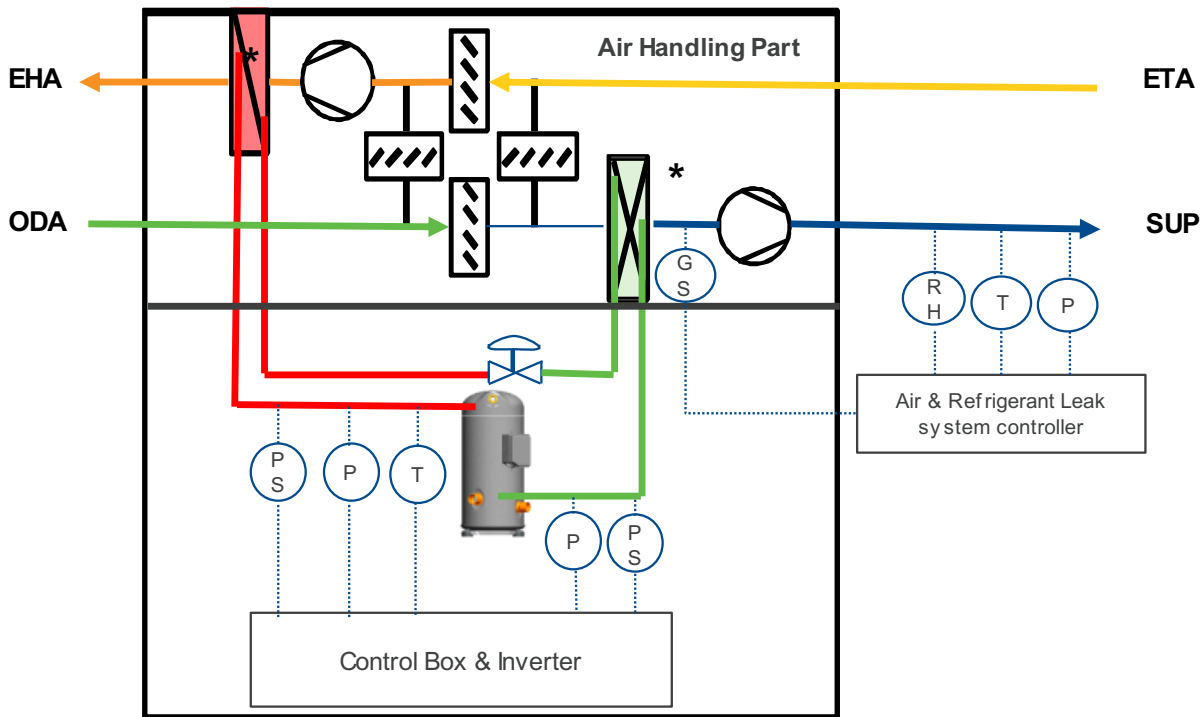
A self-contained appliance is designed to work alone and so should be equipped with all the control and security system needed. In such appliances, distinct types of evaporation systems can be used. One defined as a protected system, with an indirect exchange. And the one studied in this document with a direct exchange, which can be judged as the most critical.



The self-contained appliances, both, household or commercial, are covered by relevant product safety standard as mentioned before in this document. Three main ones are: EN 60335-2-24 covering household appliances, EN60335-2-89 that covers commercial applications (including those with remote condensing unit), and IEC 60335-2-118 that covers professional ice-cream makers. Other similar standards like EN60335-2-11 and EN60335-2-75 (using-24) are adopting the same concepts and same charge. See Table 1 for charge limits.

All standards (EN 60335-2-11, -2-24, -2-75, and -2-89) require the appliance to be designed to avoid any fire or explosion hazard in event of the refrigerant leakage from the cooling system. Components has to be placed where they cannot be reached by leaked refrigerant or be without ignition sources.

## ANNEX 4: Rooftop Ducted Equipment



The above figure shows a typical Rooftop heat pump & rooftop air conditioner with 2/3/4 damper;

In case of using A2L refrigerants, the unit falls under the ducted system and it is covered by IEC60335-2-40:2022. The requirement for the charge limits, room size, leak detector and fan operations modes are covered by the standard. The harmonised standard EN60335-2-40 is under revision for alignment with IEC60335-2-40. See the section 5.4 for the risk assessment. In case of using A3 refrigerants, the rooftop unit although installed outdoor is classified as indoor. This is because in case of evaporators leaks, the refrigerant flows into the occupied space. The charge of the propane per refrigerating circuit is limited to 988 g for equipment falling under the scope of IEC60335-2-40:2022.

## ANNEX 5: Clarification on ATEX Directives

There are two EU ATEX directives:

- ATEX “Workplace” Directive 1999/92/EC covers worker safety when working where there is a risk of an explosive atmosphere.
- ATEX “Equipment” Directive 2014/34/EU covers equipment for use in flammable atmospheres

The ATEX “Workplace” Directive is implemented through national legislation and in general close to the “Non-binding guide to good practice for implementing Directive 1999/92/EC “ATEX” (explosive atmospheres)”. This national legislation is relevant when servicing systems with a flammable refrigerant, as mistakes in the procedures can lead to a flammable atmosphere. Note that ATEX considers all flammable refrigerants as explosive i.e. no difference between A2L and A3 refrigerants.

The “Equipment” Directive is a more traditional product safety directive, which sets minimum requirements for equipment which is to be used in an ATEX zone. ATEX consider three zones for gasses (0, 1, 2):

- Zone 0 is a place in which an explosive atmosphere is present continuously or for long periods or frequently;
- Zone 1 is a place in which an explosive atmosphere is likely to occur in normal operation occasionally;
- Zone 2 is a place in which an explosive atmosphere is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

It is obvious that most refrigerating systems are not installed in an ATEX zone. In case a system with components in the scope of this guideline is installed in an ATEX zone e.g. a petro-chemical plant, then the system builder has to ensure an ATEX approval of the system. Such system can also contain several non-ATEX approved components while other ‘critical’ components may then be required certified, see Figure A1.

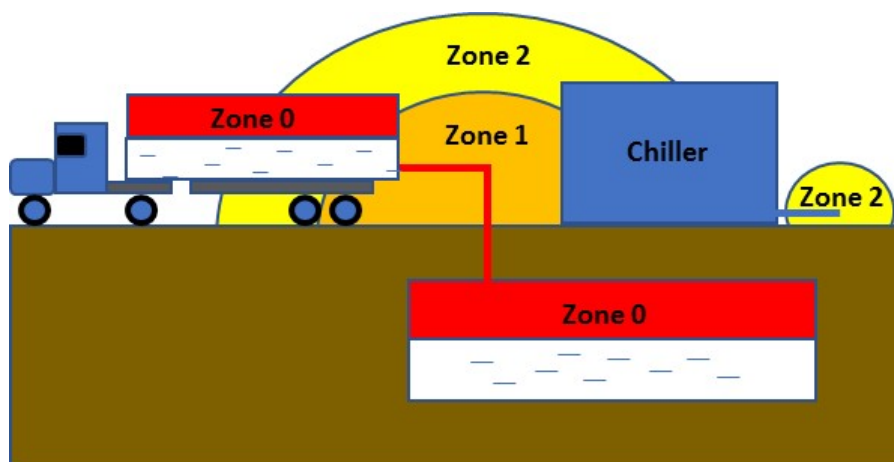


Figure A1: Zone classification according to ATEX.



In general refrigerating systems are tight, and the joints used between refrigerant containing parts are "enhanced tightness" as defined in EN 1127-1:2019. ***This means that joints and components are not considered to give rise to a flammable atmosphere, and therefore not give rise to an ATEX zone, and therefore refrigerating systems do not lead to ATEX zones.***

In machinery rooms the use of gas detectors enforces the concept of "enhanced tightness" as it monitors the joints for tightness. If a leak is detected, it is detected at a level of no more than 25% LFL, where all components with ignition sources are shut down according to the safety standards.

There are two notable exceptions where an ATEX zone is defined:

1. *When a system manufacturer defines a part of the installation as an ATEX zone due to requirement from the installation site.* The system manufacturer and the installer are required to ensure that all components in this zone have the appropriate approval. Safety standards mandates that the discharge pipe of safety valves of refrigerating systems, is lead to a safe place. Some system manufacturers chose to define this safe place as an ATEX zone 2. However, it is not a normal procedure to place any components in this area.
2. *When servicing the system there is a risk of a flammable atmosphere, and this situation normally leads the service personnel to define an ATEX zone 2.* When this is done, service equipment and other systems that are to remain powered need to be approved for ATEX zone 2. The prime examples are emergency lightning, alarms, gas sensors and emergency ventilation in machinery rooms. Sound praxis for all service situation is that service personnel should also use portable gas sensors, and these need to be approved for ATEX zone 2.

In other cases, the system safety standards use concepts very close to that of ATEX, and even sometimes refers to clauses in standards which are harmonised with ATEX.

For instance the safety standards require that all components which remain powered in a machinery room after a leak is detected to be without ignition sources. One way of ensuring this is to have them approved for ATEX zone 2, but another option is to comply with specific clauses of EN 60079-15 which is harmonised with the ATEX equipment standard. In practice these components are the emergency lightning, alarms, gas detectors and normally the emergency ventilation, because they need to remain powered for safety reasons. Incidentally these are the same components which need to remain powered during a service situation and include the components that enforce the durably technically tight concept.

## ANNEX 6: The EU Pressure Equipment Directive (PED)

The EU Pressure Equipment Directive (PED) sets requirements for the verification of the pressure strength of components depending on the PED category, which is a function of the size, the maximum allowable pressure of the component, and the PED fluid group of the refrigerant. The higher the PED category, the higher the expected risk, and the higher the requirements for verification of design and production of components. The directive has 5 categories: sound engineering, I, II, III and IV. Sound engineering covers a level below category I, and is also known as “a4p3” or article 4 paragraph 3.

The requirements for verification of the pressure strength depends directly on the PED category. Figure A2 shows how the PED category is assigned for PED fluid group 1 and 2 for components which are more like piping than like vessels.

In general, it is advantageous to use a4p3 (article 4 paragraph 3) “sound engineering practices” for ensuring component pressure strength as an alternative to the more rigorous requirements of PED category I, II, III, and IV.

Traditional HFC refrigerants are gases in PED fluid group 2, non-hazardous substances, and most flammable refrigerants are gases in PED fluid group 1, hazardous substances. There is however an exception, R-1234ze(E) is in PED fluid group 2 despite the safety classification A2L. The reason for this exception is that the flammability test behind the PED fluid group classification is done at 20 °C, while the flammability test behind the A2L safety classification is done at 60 °C. R1234ze(E) is not flammable at 20 °C, but it is flammable at 60 °C.

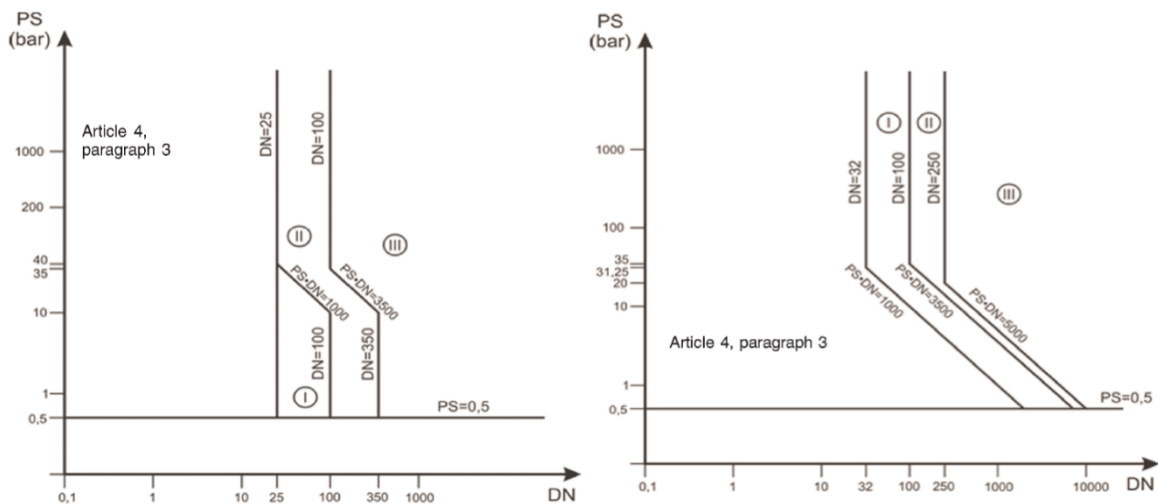


Figure A2: PED Categories for pipe-like components for fluid group 1 i.e. most flammable refrigerants (left) and fluid group 2 i.e. traditional HFC refrigerants and CO<sub>2</sub> (right)

# GUIDELINE

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There are three rules of thumb which are useful for a quick estimate of the impact of switching from non-flammable to flammable refrigerant:

- For flammable refrigerants and pipe-like components the use of a4p3 is only allowed up to DN25, while for non-flammable refrigerants a4p3 can be used up to DN32, and sometimes higher.
- For flammable refrigerants and vessel-like components (incl. hermetic compressors) the use of a4p3 is only allowed up to volume (litres) times pressure (bar) equal to 25, while for non-flammable refrigerants the limit is 50.
- For vessels the PED category is generally increased by 1,

Safety valves are always PED category IV, regardless of the size of the component, and the pressure and flammability of the refrigerant.

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## Revision Index

Revision	Change	Date
A	Initial issue	
B	Final approval	
C	1. Review	December 2019
D	2. Review	April 2023

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These recommendations are addressed to professionals, industrial, commercial and domestic refrigeration system manufacturers / installers. They have been drafted on the basis of what *ASERCOM* believes to be the state of scientific and technical knowledge at the time of drafting, however, *ASERCOM* and its member companies cannot accept any responsibility for and, in particular, cannot assume any liability with respect to any measures - acts or omissions - taken on the basis of these recommendations

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## Further *ASERCOM* Statements and Guidelines:

- Hydrocarbon Refrigerants in Refrigerating Systems
- Carbon Dioxide (CO<sub>2</sub>) in Refrigeration and Air-Conditioning Systems (RAC)
- Containment of Refrigerant Compressors
- Electromagnetic Compatibility Directive 2014/30/EC
- Energy Efficiency Rating
- Recommended liquid line filter dryers and moisture indicators for refrigeration and air conditioning systems with HFCs refrigerants and POE lubricants
- Machinery Directive 2006/42/EC
- Pressure Equipment Directive 2014/68/EU
- Capacity Rating of Thermostatic Expansion Valves
- R22 Phase-Out
- Recommendations for using frequency Inverters with positive displacement Refrigerant Compressors
- *ASERCOM* guidelines for the design of multiple compressor racks using frequency inverters
- Refrigerant Glide and Effect on Performances Declaration
- *ASERCOM* cyber-security guideline for connected HVAC/R equipment



For more information, please refer to *ASERCOM*'s website [www.asercom.org](http://www.asercom.org)

### **About *ASERCOM***

*ASERCOM*, the Association of European Refrigeration Component Manufacturers, is the platform for addressing scientific and technical challenges, promoting standards for performance and safety, encouraging better environmental protection, and supporting the refrigeration and air conditioning industry and its customers.

Further information is available at: [www.asercom.org](http://www.asercom.org)