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**Refrigerating systems and heat  
pumps — Competence of personnel**

*Systèmes frigorifiques et pompes à chaleur — Compétence du  
personnel*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 1, *Safety and environmental requirements for refrigerating systems*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 182, *Refrigerating systems, safety and environmental requirements*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

Refrigerating systems, if not properly constructed, installed, operated and maintained, can be of danger to the health and safety of persons and the safety of property, can be detrimental to the environment and can increase energy consumption.

It is therefore essential that personnel dealing with such systems have the competence to carry out the activity, or activities, listed in this document. These activities cover the particular sectors in which they can potentially operate, from original design to final dismantling and disposal. As job descriptions can vary from country to country and from company to company, this document specifies the activities which can be carried out. Job descriptions can specify these activities or a selection of these activities.

This document defines the activities related to the refrigerating circuit.

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# Refrigerating systems and heat pumps — Competence of personnel

## 1 Scope

This document defines the activities related to refrigerating systems according to ISO 5149-1, ISO 5149-2, ISO 5149-3 and ISO 5149-4 and other equivalent standards, such as EN 378-1, EN 378-2,<sup>[4]</sup> EN 378-3,<sup>[5]</sup> EN 378-4<sup>[6]</sup> and the associated competence profiles. It also establishes the competence criteria for persons who carry out these activities. Activities concerning electricity are excluded.

NOTE 1 As a refrigerating circuit is considered not to incorporate electrical and electronic systems, activities in this area are not part of this document. National regulations or appropriate International or national standards can be referred to for competence on electrical and electronic systems.

NOTE 2 This document does not apply to persons carrying out work on self-contained refrigerating systems as defined in ISO 5149-1 or EN 378-1, from the initial design of the product to the complete manufacture of the product, provided the process is controlled and the methods used are checked by an organization or individual responsible for the conformance with statutory requirements on health, safety and environment (e.g. energy efficiency).

NOTE 3 This document does not constitute a training programme.

## 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.

EN 378-1, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 1: Basic requirements, definitions, classification and selection criteria*

ISO 5149-1, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 1: Definitions, classification and selection criteria*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5149-1 and EN 378-1 and the following apply.

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

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

### 3.1 assessment

process that evaluates a person's fulfilment of the competence requirements

[SOURCE: ISO/IEC 17024:2012, 3.8, modified — reference to "certification scheme" replaced by "competence requirements".]

### 3.2

#### **competence**

ability to apply knowledge and skills to achieve intended results

[SOURCE: ISO/IEC 17024:2012, 3.6]

### 3.3

#### **qualification**

evidence of a certain level of professional competence

Note 1 to entry: See [4.2](#).

### 3.4

#### **designing**

collecting all data required for making an effective operating refrigerating circuit, or making the conceptual and detailed plan of the refrigerating circuit (e.g. dimensioning, calculation, component selection, refrigerant piping layout and sizing)

### 3.5

#### **pre-assembling**

fabricating parts and sub-assemblies of a refrigerating circuit in a workshop or on site

Note 1 to entry: This excludes charging with refrigerant.

### 3.6

#### **installation**

assembly of components of a refrigerating system and all the apparatus necessary for its operation

### 3.7

#### **putting into operation**

integrity inspection and setting to work of the refrigerating system for the first time or after significant changes

Note 1 to entry: This can potentially include charging with refrigerant.

### 3.8

#### **commissioning**

ensuring that the system is performing according to the predefined conditions after putting the system into operation

Note 1 to entry: "Putting into operation" can potentially include charging with refrigerant.

### 3.9

#### **operating**

running the refrigerating system in a routine manner ensuring that the system works within the conditions required in the user manual

### 3.10

#### **in-service inspection**

all activities needed to check if the refrigerating system conforms to predefined requirements (e.g. functionality, correlation of temperature and pressure, capacity checks, quality checks of joints for existence of corrosion)

### 3.11

#### **leak checking**

identifying if there is a leak of refrigerant from the refrigerating system and if so, identifying the exact location of the leak and reporting the results without opening the refrigerating circuit

### 3.12

#### **general maintenance**

keeping or restoring a refrigerating system to a state from which the desired operation can be provided, without opening the refrigerating circuit



**3.13****circuit maintenance**

keeping or restoring a refrigerating system to a state from which the desired operation can be provided, by opening the refrigerating circuit

**3.14****decommissioning**

ensuring that the refrigerating system is in a safe and environmentally proper condition during the period that it is out of operation

**3.15****removal of refrigerant**

recovering the refrigerant out of a refrigerating circuit

**3.16****dismantling**

breaking the refrigerating circuit down into pieces

Note 1 to entry: This excludes removal of refrigerant.

**3.17****basic appreciation level****BA**

level of expertise required to discuss the main elements of the skill with others

**3.18****working knowledge level****WK**

level of expertise required for direct involvement in decisions and actions

**3.19****fully operational level****FO**

level of expertise required to personally perform the majority of the activities concerned

**3.20****leading edge level****LE**

level of expertise required for significant development of the skill area

**4 Requirements****4.1 General**

Persons shall be deemed to be qualified if it can be demonstrated that they are capable of carrying out the activities listed in this document.

**4.2 Competence levels****4.2.1 General**

Persons shall demonstrate a level of predefined competence as defined in [Annex A](#). A guideline for the application of this document is set out in [Annex B](#). Examples of applying assessment schemes for HFC refrigerants under Regulation (EU) No. 517/2014<sup>[10]</sup> are set out in [Annex C](#). [Annex D](#) provides guidance on how to convert the assessment schemes from [Annex A](#) to fit into schemes for R 717. [Annex E](#) provides guidance on how to convert the assessment schemes from [Annex A](#) to fit into schemes for R 744. An example of personnel with tasks on a refrigerant circuit containing a flammable refrigerant is given in [Annex F](#).

#### 4.2.2 Evaluation procedures

National regulations define the evaluation procedures dealing with the competence of persons related to the refrigerating circuit.

NOTE If no national regulation is available, ISO/IEC 17024 can be used to identify appropriate procedures.

#### 4.2.3 Criteria for the evaluation of competence

If criteria for the evaluation of competence are not defined by national regulations, they shall be used according to [Annex A](#).

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## Annex A (normative)

### Criteria for the evaluation of competence

#### A.1 General

[Annex A](#) provides a general overview of how this document is structured.

This annex consists of six tables, each with an area where knowledge and skills necessary for "the circuit" are shown. These areas are:

- basic thermodynamics;
- components;
- piping, joints and valves;
- safety equipment;
- fluids;
- communication.

#### A.2 Areas of assessment

In [Tables A.1](#) to [A.6](#), the **horizontal headings** provide a description of the various tasks which may be performed on "**the refrigerating system**" during the life cycle of "**the circuit**". The numbers listed refer to the job defined in [Clause 3](#).

The **vertical cells** provide a description of the skills to assess in order to determine whether the person has the competence to perform various tasks well during an assessment.

The cells of each table describe the level of the assessment according to the definitions as given in [3.17](#), [3.18](#), [3.19](#) and [3.20](#).

The assessment can be carried out by theoretical assessment, which is indicated by the unshaded cells, or by a practical assessment, which is indicated by the shaded cells. The black cells mean no assessment is necessary.

Table A.1 — Basic thermodynamics

Basic thermodynamics		Tasks												
Description of tasks (see <a href="#">Clause 3</a> )	Designing	Pre-assembly	Installation	Putting into operation	Commissioning	Operating	In-service inspection	Leak checking	General maintenance	Circuit maintenance	Decommissioning	Removing refrigerant	Dismantling	
	<a href="#">3.4</a>	<a href="#">3.5</a>	<a href="#">3.6</a>	<a href="#">3.7</a>	<a href="#">3.8</a>	<a href="#">3.9</a>	<a href="#">3.10</a>	<a href="#">3.11</a>	<a href="#">3.12</a>	<a href="#">3.13</a>	<a href="#">3.14</a>	<a href="#">3.15</a>	<a href="#">3.16</a>	
<b>Knowledge and skills to assess</b>														
Know the basic SI or metric units, for example: temperature, pressure, mass, density, energy	a	FO	BA	BA	WK	WK	WK	WK	FO	BA	WK	BA	WK	
Understand basic refrigeration terms, for example: enthalpy and entropy, pressure, temperature, refrigerating capacity, power consumption, energy reduction, superheating, sub-cooling, liquid and vapour properties	b	FO		BA	FO	FO	WK	WK	WK	BA	FO	BA	WK	
Know the layout as well as use of the log p/h diagrams of refrigerants and understand triple and critical points and supercritical area	c	FO		BA	WK	WK	WK	WK	BA	BA	WK	BA	BA	
Know and be able to use the saturated and superheated vapour tables of all refrigerants in correlation with the log p/h diagrams	d	FO		BA	WK	WK	WK	WK	BA	BA	BA	BA	BA	
Draw a scheme of a compression refrigeration circuit	e	FO		BA	WK	WK	WK	WK	BA	BA	BA	BA	BA	
Understand the meaning of different kinds of pressures (e.g. design pressure, absolute and gauge pressure, strength test pressure, test pressure for leak detection)	f	FO	BA	BA	WK	WK	WK	WK	FO	BA	FO	BA	BA	

Table A.2 — Components and tests of refrigerating systems

Components and tests of refrigeration systems		Tasks												
Description of tasks (see Clause 3)		Designing	Pre-assembling	Installation	Putting into operation	Commissioning	Operating	In-service inspection	Leak checking	General maintenance	Circuit maintenance	Decommissioning	Removing refrigerant	Dismantling
		3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	3.13	3.14	3.15	3.16
<b>Knowledge and skills to assess</b>														
The person shall be able to understand the functioning of the components listed below and, if necessary, be able to demonstrate the use and handling of these components														
The refrigerating circuit (RAC and Heat pump installation)	a	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Compressor (e.g. comparable)	b	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Lubrication system	c	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	BA	BA	BA
Capacity control	d	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	BA	BA	BA
Pressure vessel	e	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Condenser	f	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Gas cooler	g	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Liquid receiver	h	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Liquid separator	i	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Evaporator	j	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Defrosting systems on evaporators	k	FO	BA	WK	FO	FO	WK	WK	FO	WK	FO	WK	BA	BA
Expansion devices	l	FO	WK	FO	FO	FO	WK	WK	FO	WK	FO	FO	FO	BA
Preassembled units	m	WK		WK	FO	FO	WK	WK	FO	WK	FO	WK	FO	
Strength pressure test	n	FO	BA	WK	FO	FO		BA	BA	BA	WK	WK	BA	
Tightness pressure test for leak detection	o	FO	BA	WK	FO	FO		BA	BA	BA	FO	WK	BA	
Removing moisture and non-condensable gases from the refrigerating circuit by evacuation with vacuum pumps	p	FO		WK	FO	FO	FO	WK	WK	WK	FO	WK	FO	
Vacuum test	q	FO		WK	FO	FO	WK	WK	WK	WK	FO	WK	WK	
Determination of required refrigerant charge	r	LE		WK	FO	FO	WK	WK	WK	WK	FO	WK	FO	
Fill the circuit with refrigerant	s	FO			FO	FO	WK	WK	WK	WK	FO	WK	WK	BA
Check the charge of refrigerant including leak checking	t	BA			FO	FO	WK	WK	WK	WK	FO	WK	WK	BA
Understanding of the legislation and standards applicable in the region of operation	u	FO			BA	BA	BA	BA	BA	BA	WK	BA	BA	BA