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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 Clause 3)	Designing	Pre-assembly	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
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

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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	BA	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

**Table A.3 — Piping, joints and valves**

Piping, joints and valves		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>														
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														
Piping	a	FO	FO	FO	WK	WK	WK	WK	WK	WK	FO	WK	BA	FO
Joints	b	FO	FO	FO	WK	WK	WK	WK	WK	WK	FO	WK	FO	FO
Valves	c	FO	FO	FO	FO	WK	WK	WK	WK	WK	FO	WK	FO	FO
Thermal insulation	d	FO	FO	FO	WK	WK	WK	WK	WK	WK	WK	WK		
Pipe supports	e	FO	FO	FO	WK	WK	WK	WK	WK	WK	WK	WK		
Understanding of the legislation and standards applicable in the region of operation	f	FO	BA	BA	BA	BA	BA	BA	BA	BA	WK	BA		

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Table A.4 — Safety equipment

Safety equipment		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>														
The person shall be able to understand the functioning of the safety equipment listed below and, if necessary, demonstrate actions to control, adjust and check the function of the safety equipment														
Pressure relief device	a	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Pressure relief valve	b	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Bursting disc	c	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Fusible plug	d	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Temperature-limiting device	e	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Type-approved temperature limiter	f	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Safety switching device for limiting the pressure	g	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Type-approved pressure limiter	h	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Type-approved pressure cut out	i	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Type-approved safety pressure cut out	j	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Changeover device	k	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Refrigerant detector	l	FO	WK	WK	FO	WK	WK	WK	FO	WK	FO	WK	WK	
Overflow valve	m	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Surge protection device	n	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Liquid level cut out	o	FO	WK	WK	FO	WK	WK	WK	BA	WK	FO	WK	WK	
Self-closing valve	p	FO	WK	WK	FO	WK	WK	WK	WK	WK	FO	WK	WK	
Understanding of the legislation and standards applicable in the region of operation	q	FO	BA	BA	BA	BA	BA	BA	BA	BA	WK	BA	BA	

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Table A.5 — Fluids

Fluids <sup>a</sup>		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>															
The person shall be able to understand the aspects listed below and, if necessary, demonstrate the use and handling of these aspects															
Refrigerant environmental influences such as ODP, GWP and CO <sub>2</sub> equivalent <sup>a</sup>	a	FO	WK	WK	FO	WK	WK	WK	FO	WK	FO	WK	FO	WK	
Safe storage, transport and handling of refrigerant cylinders <sup>b</sup>	b				WK	WK	BA	BA	BA	BA	WK	BA	WK		
Safe handling in case of leakages from the refrigerant circuit, including first aid	c			WK	WK	WK	WK	WK	WK	WK	WK	WK	WK	WK	
Coolant, secondary loop fluid	d	FO		BA	WK	BA	BA	BA	BA	BA	WK	BA	WK		
Oil	e	FO		BA	WK	WK	WK	WK	FO	BA	FO	FO	FO	BA	
Toxicity	f	FO		WK	WK	BA	BA	BA	BA	BA	WK	BA	WK		
Flammability	g	FO		BA	WK	BA	BA	BA	BA	BA	WK	BA	WK		
Fractionation	h	FO		BA	BA	BA	BA	BA	BA	BA	BA	BA	BA		
Quality of refrigerant	i	FO		WK	FO	BA	BA	BA	BA	BA	FO	BA	FO		
Recover	j	FO		BA	BA	BA	BA	BA	BA	BA	FO	BA	FO		
Recycle	k	FO		BA	BA	BA	BA	BA	BA	BA	FO	BA	FO		
Reclaim	l	BA		BA	BA	BA	BA	BA	BA	BA	BA	BA	BA		
Disposal	m	FO		BA	BA	BA	BA	BA	BA	BA	FO	BA	FO		
<sup>a</sup> ODP – Ozone depletion potential; GWP – Global warming potential.															
<sup>b</sup> This includes understanding of the legislation and standards applicable in the region of operation, such as ATEX, <sup>[9]</sup> GHS, <sup>[13]</sup> CLP, <sup>[8]</sup> ADR, <sup>[12]</sup> IATA, <sup>[14]</sup> etc.															

Table A.6 — Communication

Communication		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>														
Arrange an appointment with the client	a	LE		BA	WK	FO	FO	BA	FO	BA	FO	WK	WK	BA
Properly inform the client about the method of operation of the refrigeration system	b	LE		BA	WK	FO	FO	BA	BA	BA	FO	WK	WK	BA
Consider the client's wishes	c	LE		BA	FO	FO	BA	BA	BA	BA	WK	WK	WK	BA
Write a report about the condition of one or more components	d	WK		BA	FO	FO	BA	BA	BA	BA	WK	WK	WK	BA
Advise the client about the need to repair one or more components	e	LE	BA	BA	BA	BA	BA	BA	FO	FO	FO	WK	WK	
Advise the client about the need to replace one or more components	f	LE	BA	BA	BA	BA	BA	BA	FO	FO	FO	WK	WK	
Advise the client about maintenance planning	g	LE		BA	BA	BA	WK	WK	WK	WK	FO	WK	WK	
Advise the client on saving energy and efficiency	h	LE		BA	BA	BA	WK	WK	WK	WK	WK	WK	WK	
Make the client aware of environmental issues and the global impacts	i	LE		BA	FO	FO	WK	WK	WK	WK	WK	WK	WK	
Advise the client on safety issues	j	LE		BA	FO	FO	WK	WK	WK	WK	WK	WK	WK	
Process client complaints	k	LE		BA	BA	BA	WK	WK	WK	WK	WK	WK	WK	
Advise the client with regard to shutting down the refrigeration system	l	LE		BA	BA	BA	WK	WK	WK	WK	FO	WK	WK	
Explain to the client the work procedures	m	WK		BA	FO	FO	BA	BA	FO	BA	WK	WK	WK	
Explain to the client the content of a report	n	WK		BA	FO	FO	BA	BA	FO	BA	WK	WK	WK	
Fill in all the legally required documents and certificates	o	BA		BA	FO	FO	FO	FO	FO	FO	FO	FO	FO	FO

## Annex B (informative)

### Guidelines for the application of this document

#### B.1 Objective of the guidelines

These guidelines describe the background of this document and can be used as a tool for authorities responsible for the content of an assessment as described in [Clause 4](#).

#### B.2 Background and explanation

##### B.2.1 Scope

The objective of the document is to describe the necessary skills and assessment methods for persons working on a refrigerant circuit. This relates to the scope of products as described in the ISO 5149 series and European standards, such as the EN 378 series (vapour compression cycle products). These standards describe the activities that are related to the whole lifecycle of a refrigerant circuit from their original design to the final dismantling. The listed tasks are not necessarily carried out by the same person, thus one person can potentially be in charge of one task or a combination of tasks depending on the job description.

This document is not a training or education programme, but an assessment of the tools on which training, qualification or certification programmes can be based, so that trained persons can successfully achieve a qualification or certification assessment based on this document. This document also helps policy makers, training institutes and assessment bodies to compare qualification or certification programmes on an equal basis.

##### B.2.2 Reference to ISO/IEC 17024

ISO/IEC 17024 contains requirements a certification body needs to comply with to demonstrate it is competence to certify persons from a specific scope.

##### B.2.3 Explanation of [Annex A](#)

###### B.2.3.1 [Annex A](#) — [A.1](#) General

[Annex A](#) consists of six tables, where five tables describe technical competence and one table describes the communication competence.

###### B.2.3.2 [Annex A](#) — [A.2](#) Areas of assessment

###### B.2.3.2.1 General

The definitions in [Clause 3](#), specifically mentioned under [3.4](#) to [3.16](#), are concise; the relevant board of experts can provide additional content on the skills to assess depending on the daily practice.

The level of assessment is given in the matrix of cells. It is up to the board of experts to give details depending on the daily practice and the importance of the task in relation to the type of refrigerant.

The above shows the importance of the board of experts in ensuring good artisanship.

### B.2.3.2.2 Guidelines on how to use the standard tasks in assessment practice

A person who performs a refrigeration circuit activity during the life cycle has a task package that is described in a job description. It is generally preferable in a job description to use the same reference numbers or to refer to the definitions of this document, where applicable, for the work on a refrigerant circuit. Choosing this approach facilitates the following:

- a) comparing and evaluating job packages;
- b) training people for assessment so that they are competent for the task;
- c) evaluating for external examiners.

In daily practice, in addition to the tasks they have to carry out on a refrigerant circuit, individuals will also have other tasks, such as the electro-technical control of the refrigeration system, which is not covered by this document.

The different levels of assessment of the specified skills are indicated by task as defined in [3.17](#) to [3.20](#) (BA, WK, FO and LE). The assessment can be completed by theoretical (unshaded cells in the table) and practical (shaded cells) assessment. Black cells mean no assessment is necessary.

In practice, many assessments will be a combination of tasks described in the 6 tables.

### B.2.3.3 Annex A — Table A.1, Basic thermodynamics

An overview of theoretical knowledge is given in the vertical headings.

Some examples for an assessment are given below.

EXAMPLE Under "Knowledge and skills to assess", row "c" can involve the following tasks:

- a) "Designing" level FO: in the assessment the person can be asked to perform a log p/h diagram for a refrigerant of compression refrigeration circuit;
- b) "Commissioning" level WK: in the assessment the person can be asked to describe the decisions and actions based on a figure in a log p/h diagram;
- c) "Leak checking" level BA: in the assessment the person can be asked to identify the main elements of a log p/h diagram by a multiple-choice questionnaire.

### B.2.3.4 Annex A — Table A.2, Components and test of refrigeration system

An overview of the most common components in a refrigeration circuit, including the necessary activities to bring and hold the system in operation, is given in the vertical headings.

Skills to assess: the person is able to understand the functioning of the components listed in [Table A.2](#) and, if necessary, is able to demonstrate the use and handling of these components.

Some examples for an assessment are given below.

EXAMPLE For the component "Compressor" three examples are given below:

- a) "Designing" level FO: in the theoretical assessment the person can for instance perform a decision as to which kind of compressor will be chosen, and provide justification for the choice;
- b) "Installation" level WK: in the theoretical assessment the person can explain which actions are needed to make sure that the compressor is installed vibration-free and what this means for the pipeline;
- c) "Leak checking" level BA: in the practical assessment the person can find a leak on a compressor.

### B.2.3.5 Annex A — Table A.3, Piping, joints and valves

[Table A.3](#) is a brief overview of the most common piping issues of a refrigerant circuit. The overview is so brief, because the materials and joints are already covered in several standards. The materials and compounds used are usually dependent on the type of refrigerant.

Skills to assess: the person is able to demonstrate the execution of a complete piping circuit with components.

It is up to the board of experts to determine which assessment best covers the competence of the person.

Piping systems are composed of multiple segments that are connected to each other by joints, brazing or welding, and/or may be connected to the shut-off valves and other components. It is common for descriptions to be made for the types of connections, with reference standards and test methods. For the designers and installers of the connections, a method description is needed, and the installers shall demonstrate that they are competent to execute the connection method.

In the refrigeration industry, the piping systems have to deal with temperature differences. In order to prevent loss of efficiency, pipes are insulated. Particularly in the case of temperatures lower than ambient temperature, it is specific in the refrigeration industry that the pipe insulation is provided with a vapor barrier which is of great importance for the quality of the insulation and the piping system. For designers, the right choice of material and thickness of insulation is important. Not all installers themselves will insulate pipes, but they are able to evaluate performance quality, especially with regard to the quality of the vapour barrier.

Depending on the length of the pipes, the pipes are supported by and attached with brackets, taking into account thermal differences of pipe sections and vibration caused by compressors and fans.

Some examples for an assessment are given below.

EXAMPLE Under "Knowledge and skills to assess" by the rows "a", "b" and "c", the person is able to demonstrate actions with a piping circuit with components. The kind of assessment depends on the task.

- a) "Designing" level FO: in the theoretical assessment the person can, for instance, perform a decision as to which kind of piping will be chosen, and provide justification for the choice;
- b) "Installation" level FO: in the practical assessment the person can, for instance, perform by the right method description the connection by welding or brazing of a pipeline section, and select the recommended standard for different diameters of pipelines. For example, to carry out the assessment of a shut-off valve in combination with the strength and tightness test (see [Table A.2](#), rows "n" "o").
- c) "General maintenance" level WK: in the theoretical assessment the person can be assessed on the basis of a site plan where the weak spots are for insulation.

### B.2.3.6 Annex A — Table A.4, Safety equipment

The components listed in [Table A.4](#) are defined in the EN 378 series and the ISO 5149 series. The designer's task is to determine the safety components, depending on the laws and regulations. The other tasks include the proper use, setting and assessing function of the safety components.

It is recommended that the board of experts decide that at least 50 % of the safety accessories are covered in the entire personal assessment because they are in the interest of the environment and health and safety aspects.

Some examples for an assessment are given below.

EXAMPLE 1 Under "Knowledge and skills to assess" by the row "j", the person is able to demonstrate actions with a safety pressure cut out. The kind of assessment depends on the task.

- a) "Designing" level FO: in the theoretical assessment the person can, for instance, perform the decision as to which which kind of safety equipment will be chosen, and provide justification for the choice;

- b) “Putting into operation”: level FO, in the practical assessment the person can, for instance, perform the right adjustment of the safety pressure switch.

EXAMPLE 2 Under “Knowledge and skills to assess” by the row “1”, the person is able to demonstrate actions with a refrigerant leak detector. The kind of assessment depends on the task.

- a) “Operating” level WK: in the theoretical assessment the person can be assessed to check control of data in a logbook for all the kinds of installations and the different refrigerants.

### B.2.3.7 Annex A — Table A.5, Fluids

[Table A.5](#) gives a summary of the properties of the fluids with which the circuits are filled. More details of the fluid properties are defined in ISO 817.

NOTE Additional properties are also covered in ASHRAE 34.<sup>[7]</sup>

The fluid of a circuit determines the proper operation of the system and the power consumption. The emission of the refrigerant amount (leakage) affects health and safety and the environment. At the end of the life cycle, the refrigerant has to be reclaimed.

Skills to assess: the person is able to understand the aspects mentioned in [Table A.5](#) and, if necessary, demonstrate the use and handling of these aspects.

Some examples for an assessment are given below.

EXAMPLE 1 Under “Knowledge and skills to assess” by the row “a”, the person is able to explain the meaning of the terms in this row. The kind of assessment depends on the task.

- a) “Designing” level FO: in the theoretical assessment the person can, for instance, decide which refrigerant is most suitable for use in the refrigerant circuit with due regard to health and safety and environmental aspects and provide justification for the choice.

EXAMPLE 2 Under “Knowledge and skills to assess” by the row “e”, the person is able to demonstrate the behaviour of oil by using different kind of refrigerants. The kind of assessment depends on the task.

- b) “Removing refrigerants” level FO: in the practical assessment means the person is able to recover the refrigerant from the circuit and separate the oil with a recycling machine.

### B.2.3.8 Annex A — Table A.6, Communication

[Table A.6](#) contains an overview of the communication skills defined to be important for good artisanship. All assessments are made by a practical assessment. Most communicative assessment can be taken in combination with the assessments of the preceding tables.

EXAMPLE In case of “Leak checking”, a person is assessed on the practical aspect of leak checking, which can be combined with writing a report and giving a recommendation to the customer.

## Annex C (informative)

### Example of applying assessment schemes for HFC refrigerants under Regulation (EU) No 517/2014<sup>[10]</sup>

#### C.1 General

This annex provides guidance on how to convert the assessment schemes in relation to the F-Gas Regulation 517/2014<sup>[10]</sup> and 2015/2067<sup>[11]</sup> for HFC refrigerants.

#### C.2 Example for the conversion of this document in relation with Regulation (EU) No 517/2014

[Table C.1](#) gives an informative example of the conversion of this document in relation to Regulation No 517/2014.

Regulation (EU) No 517/2014 is mandatory in the European Union and the associated Commission Regulation (EU) No 2015/2067 provides minimum competence requirements for specific categories of personnel.

**Table C.1 — Conversion Table of this document and F-Gas regulation**

F-Gas Regulation 2015/2067 <sup>[11]</sup>	This document												
F-Gases category	Designing	Pre-assembly	Installation	Putting into operation	Commissioning	Operating	In-service inspection	Leakage checking	General maintenance	Circuit maintenance	Decommissioning	Removing refrigerant	Dismantling
I		X	X	X	X		X	X		X	X	X	
II		X	X	X	X		X	X		X	X	X	
III												X	
IV						X		X					

**Category I** certificate holders may carry out the following activities: leak checking, recovery, installation, repair, maintenance or servicing, and decommissioning.

**Category II** certificate holders may carry out leak checking provided that it does not entail opening the refrigeration circuit containing fluorinated greenhouse gases. Category II certificate holders may carry out the following activities: recovery, installation, repair, maintenance and servicing and decommissioning in relation to equipment referred to refrigeration circuits containing less than 3 kg of fluorinated greenhouse gases, or, if hermetically-sealed systems which are labelled as such are concerned, containing less than 6 kg of fluorinated greenhouse gases.

**Category III** certificate holders may carry out activity recovery in relation to equipment referred to refrigeration circuits containing less than 3 kg of fluorinated greenhouse gases, or, if hermetically-sealed systems which are labelled as such are concerned, containing less than 6 kg of fluorinated greenhouse gases.

**Category IV** certificate holders may carry out the activity leak checking provided that it does not entail opening the refrigeration circuit containing fluorinated greenhouse gases.

**NOTE** The F-Gas certification includes some additional requirements not covered by this document, such as information on relevant technologies to replace or to reduce the use of fluorinated greenhouse gases and their safe handling.

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## Annex D (informative)

### R 717 (NH<sub>3</sub>)

#### D.1 General

In this annex an example is given for personnel with tasks on a circuit filled with R 717 (ammonia) as refrigerant.

This annex provides guidance on how to convert the assessment schemes from [Annex A](#) to fit into schemes for R 717.

[Tables D.1](#) to [D.6](#) provide examples of personnel operating refrigeration circuits containing R 717.

Personnel qualified for operating refrigeration circuits containing R 717 have to be assessed for operating, in-service inspection and leak checking tasks.

**Table D.1 — R 717 — Basic thermodynamics**

Basic thermodynamics		Tasks												
Description of tasks (see <a href="#">Clause 3</a> )		Designing	Pre-assembling	Installation	Putting into operation	Commissioning	Operating	In-service inspection	Leakage 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 units, for example: temperature, pressure, mass, density, energy	a						WK	WK	FO					
Understand basic refrigeration terms, for example: enthalpy and entropy, pressure, temperature, refrigerating capacity, power consumption, energy reduction, superheat, sub-cooling, liquid and vapour properties	b						WK	WK	WK					
Know the layout as well as use of the log p/h diagrams of refrigerants and transcritical area	c						WK	WK	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						WK	WK	BA					
Draw a scheme of a compression refrigeration circuit	e						WK	WK	BA					
Understand the meaning of different kind of pressure (e.g. design pressure, absolute and gauge pressure, strength test pressure, test pressure for leak detection)	f						WK	WK	FO					

Table D.2 — R 717 — Components and tests of refrigeration systems

Components and tests of refrigeration systems		Tasks											
Description of tasks (see <a href="#">Clause 3</a> )	Designing	Pre-assembly	Installation	Putting into operation	Commissioning	Operating	In-service inspection	Leakage 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>													
The person shall be able to carry out an assessment to demonstrate actions to the circuit or components or activities as mentioned below.													
The refrigerating circuit [Refrigeration and air conditioning (RAC) and heat pump installation]	a					WK	WK	BA					
Compressor (e.g. comparable)	b					WK	WK	BA					
Lubrication system	c					WK	WK	BA					
Capacity control	d					WK	WK	BA					
Pressure vessel	e					WK	WK	BA					
Condenser	f					WK	WK	BA					
Gas cooler	g					WK	WK	BA					
Liquid receiver	h					WK	WK	BA					
Liquid separator	i					WK	WK	BA					
Evaporator	j					WK	WK	BA					
Defrosting systems on evaporators	k					WK	WK	FO					
Expansion devices	l					WK	WK	FO					
Preassembled units	m					WK	WK	FO					
Strength pressure test	n					BA	BA	BA					
Tightness pressure test for leak detection	o					BA	BA	BA					
Removing moisture and non-condensable gases from the refrigerating circuit by evacuation with vacuum pumps	p					BA	BA	BA					
Vacuum test	q					BA	BA	BA					
Determination of required refrigerant charge	r					WK	WK	WK					
Fill the circuit with refrigerant	s					BA	BA	BA					
Check the charge of refrigerant including leak checking	t					WK	WK	WK					
Understanding of the legislation and standards applicable in the region of operation	u					BA	BA	BA					

Table D.3 — R 717 — Piping, joints and valves

Piping, joints and valves		Task												
Description of tasks (see Clause 3)		Designing	Pre-assembly	Installation	Putting into operation	Commissioning	Operating	In-service inspection	Leakage 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 carry out an assessment to demonstrate execution of a complete piping circuit with components.														
Piping	a						WK	WK	WK					
Joints	b						WK	WK	WK					
Valves	c						WK	WK	WK					
Thermal insulation	d						WK	WK	WK					
Pipe supports	e						WK	WK	WK					
Understanding of the legislation and standards applicable in the region of operation	f						BA	BA	BA					

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Table D.4 — R 717 — Safety equipment

Safety equipment		Tasks											
Description of tasks (see <a href="#">Clause 3</a> )	Designing	Pre-assembly	Installation	Putting into operation	Commissioning	Operating	In-service inspection	Leakage 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>													
The person shall be able to carry out an assessment to demonstrate actions to control, adjust and check the function of the safety equipment													
Pressure relief device	a					WK	WK	WK					
Pressure relief valve	b					WK	WK	WK					
Bursting disc	c					WK	WK	WK					
Fusible plug	d					WK	WK	WK					
Temperature-limiting device	e					WK	WK	WK					
Type-approved temperature limiter	f					WK	WK	WK					
Safety switching device for limiting the pressure	g					WK	WK	WK					
Type-approved pressure limiter	h					WK	WK	WK					
Type-approved pressure cut out	i					WK	WK	WK					
Type-approved safety pressure cut out	j					WK	WK	WK					
Changeover device	k					WK	WK	WK					
Refrigerant detector	l					WK	WK	FO					
Overflow valve	m					WK	WK	WK					
Surge protection device	n					WK	WK	WK					
Liquid level cut out	o					WK	WK	BA					
Self-closing valve	p					WK	WK	WK					
Understanding of the legislation and standards applicable in the region of operation	q					BA	BA	BA					

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Table D.5 — R 717 — Fluids

Fluids <sup>a</sup>		Tasks												
Description of tasks (see <a href="#">Clause 3</a> )	Designing	Pre-assembly	Installation	Putting into operation	Commissioning	Operating	In-service inspection	Leakage 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>														
The person shall be able to carry out an assessment to demonstrate use and handling, taking into account the characteristics of each subject as mentioned below.														
Refrigerant environmental influences such as ODP, GWP and CO <sub>2</sub> equivalent <sup>a</sup>	a						WK	WK	FO					
Safe storage, transport and handling of refrigerant cylinders <sup>b</sup>	b						BA	BA	BA					
Safe handling in case of leakages from the refrigerant circuit, including first aid	c						WK	WK	WK					
Coolant, secondary loop fluid	d						BA	BA	BA					
Oil	e						WK	WK	FO					
Toxicity	f						BA	BA	BA					
Flammability	g						BA	BA	BA					
Fractionation	h						BA	BA	BA					
Quality of refrigerant	i						BA	BA	BA					
Recover	j						BA	BA	BA					
Recycle	k						BA	BA	BA					
Reclaim	l						BA	BA	BA					
Disposal	m						BA	BA	BA					
<sup>a</sup> ODP – Ozone depletion potential; GWP – Global warming potential.														
<sup>b</sup> This includes understanding of the legislation and standards applicable in the region of operation, such as ATEX, <sup>[9]</sup> GHS, <sup>[13]</sup> CLP, <sup>[8]</sup> ADR, <sup>[12]</sup> IATA, <sup>[14]</sup> etc.														

Table D.6 — R 717 — Communication

Communication	Task												
	Designing 3.4	Pre-assembly 3.5	Installation 3.6	Putting into operation 3.7	Commissioning 3.8	Operating 3.9	In-service inspection 3.10	Leakage checking 3.11	General maintenance 3.12	Circuit maintenance 3.13	Decommissioning 3.14	Removing refrigerant 3.15	Dismantling 3.16
<b>Knowledge and skills to assess</b>													
Arrange an appointment with the client	a					FO	BA	FO					
Properly inform the client about the method of operation of the refrigeration system	b					FO	BA	BA					
Consider the client's wishes	c					BA	BA	BA					
Write a report about the condition of one or more components	d					BA	BA	BA					
Advise the client about the need to repair one or more components	e					BA	BA	FO					
Advise the client about the need to replace one or more components	f					BA	BA	FO					
Advise the client about maintenance planning	g					WK	WK	WK					
Advise the client on saving energy and efficiency	h					WK	WK	WK					
Make the client aware of environmental issues and the global impacts	i					WK	WK	WK					
Advise the client on safety issues	j					WK	WK	WK					
Process client complaints	k					WK	WK	WK					
Advise the client with regard to shutting down the refrigeration system	l					WK	WK	WK					
Explain to the client the work procedures	m					BA	BA	FO					
Explain to the client the content of a report	n					BA	BA	FO					
Fill in all the legally required documents and certificates	o					FO	FO	FO					

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## Annex E (informative)

### R 744 (CO<sub>2</sub>)

#### E.1 General

In this annex an example is given for personnel with tasks on a circuit filled with R 744 (carbon dioxide) as refrigerant.

This annex provides guidance on how to convert the assessment schemes from [Annex A](#) to fit into schemes for R 744.

[Tables E.1](#) to [E.6](#) provide examples of personnel installing refrigeration circuits containing R 744 by making an assembly on site (e.g. supermarket systems).

Personnel qualified for installing refrigeration circuits containing R 744 by making an assembly on site have to be assessed for installation, putting into operation and commissioning tasks.

**Table E.1 — R 744 — Basic thermodynamics**

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

Table E.2 — R 744 — Components and tests of refrigerating systems

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

Table E.3 — R 744 — Piping, joints and valves

Piping, joints and valves		Tasks											
Description of tasks (see Clause 3)	Designing	Pre-assembly	Installation	Putting into operation	Commissioning	Operating	In-service inspection	Leakage 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 carry out an assessment to demonstrate execution of a complete piping circuit with components													
Piping	a		FO	WK	WK								
Joints	b		FO	WK	WK								
Valves	c		FO	FO	WK								
Thermal insulation	d		FO	WK	WK								
Pipe supports	e		FO	WK	WK								
Understanding of the legislation and standards applicable in the region of operation	f		BA	BA	BA								

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Table E.4 — R 744 — Safety equipment

Safety accessories		Tasks											
Description of tasks (see <a href="#">Clause 3</a> )	Designing	Pre-assembly	Installation	Putting into operation	Commissioning	Operating	In-service inspection	Leakage 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>													
The person shall be able to carry out an assessment to demonstrate actions to control, adjust and check the function of the safety equipment.													
Pressure relief device	a		WK	FO	WK								
Pressure relief valve	b		WK	FO	WK								
Bursting disc	c		WK	FO	WK								
Fusible plug	d		WK	FO	WK								
Temperature-limiting device	e		WK	FO	WK								
Type-approved temperature limiter	f		WK	FO	WK								
Safety switching device for limiting the pressure	g		WK	FO	WK								
Type-approved pressure limiter	h		WK	FO	WK								
Type-approved pressure cut out	i		WK	FO	WK								
Type-approved safety pressure cut out	j		WK	FO	WK								
Changeover device	k		WK	FO	WK								
Refrigerant detector	l		WK	FO	WK								
Overflow valve	m		WK	FO	WK								
Surge protection device	n		WK	FO	WK								
Liquid level cut out	o		WK	FO	WK								
Self-closing valve	p		WK	FO	WK								
Understanding of the legislation and standards applicable in the region of operation	q		BA	BA	BA								

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Table E.5 — R 744 — Fluids

Fluids <sup>a</sup>		Tasks												
Description of tasks (see <a href="#">Clause 3</a> )	Designing	Pre-assembly	Installation	Putting into operation	Commissioning	Operating	In-service inspection	Leakage 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>														
The person shall be able to carry out an assessment to demonstrate use and handling, taking into account the characteristics of each subject as mentioned below.														
Refrigerant environmental influences such as ODP, GWP and CO <sub>2</sub> equivalent <sup>a</sup>	a		WK	FO	WK									
Safe storage, transport and handling of refrigerant cylinders <sup>b</sup>	b			WK	WK									
Safe handling in case of leakages from the refrigerant circuit, including first aid	c		WK	WK	WK									
Coolant, secondary loop fluid	c		BA	WK	BA									
Oil	d		BA	WK	WK									
Toxicity	e		WK	WK	BA									
Flammability	f		BA	WK	BA									
Fractionation	g		BA	BA	BA									
Quality of refrigerant	h		WK	FO	BA									
Recover	i		BA	BA	BA									
Recycle	j		BA	BA	BA									
Reclaim	k		BA	BA	BA									
Disposal	l		BA	BA	BA									
<sup>a</sup> ODP – Ozone depletion potential; GWP – Global warming potential.														
<sup>b</sup> This includes understanding of the legislation and standards applicable in the region of operation, such as ATEX, <sup>[9]</sup> GHS, <sup>[13]</sup> CLP, <sup>[9]</sup> ADR, <sup>[12]</sup> IATA, <sup>[14]</sup> etc.														

Table E.6 — R 744 — Communication

Communication		Tasks												
Description of tasks (see <a href="#">Clause 3</a> )		Designing	Pre-assembly	Installation	Putting into operation	Commissioning	Operating	In-service inspection	Leakage 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>														
Arrange an appointment with the client	a			BA	WK	FO								
Properly inform the client about the method of operation of the refrigeration system	b			BA	WK	FO								
Consider the client's wishes	c			BA	FO	FO								
Write a report about the condition of one or more components	d			BA	FO	FO								
Advise the client about the need to repair one or more components	e			BA	BA	BA								
Advise the client about the need to replace one or more components	f			BA	BA	BA								
Advise the client about maintenance planning	g			BA	BA	BA								
Advise the client on saving energy and efficiency	h			BA	BA	BA								
Make the client aware of environmental issues and the global impacts	i			BA	FO	FO								
Advise the client on safety issues	j			BA	FO	FO								
Process client complaints	k			BA	BA	BA								
Advise the client with regard to shutting down the refrigeration system	l			BA	BA	BA								
Explain to the client the work procedures	m			BA	FO	FO								
Explain to the client the content of a report	n			BA	FO	FO								
Fill in all the legally required documents and certificates	o			BA	FO	FO								

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