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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

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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).

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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.

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.

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.

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,[4] EN 378-3,[5] EN 378-4[6] 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 breaking into the circuit

3.12
general maintenance
keeping or restoring a refrigerating system to a state from which the desired operation can be provided, without breaking into 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 breaking into 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 guidelinge 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[10] are set out in Annex C. Annex D provides guidance on how to convert the assessment schemes from Annex A to fit into scemes 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.

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 3.21, 3.22, 3.23 and 3.24.

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** 3.8	**Pre-assembling** 3.9	**Installation** 3.10	**Putting into operation** 3.11	**Commissioning** 3.12	**Operating** 3.13	**In-service inspection** 3.14	**Leakage checking** 3.15	**General maintenance** 3.16	**Circuit maintenance** 3.17	**Decommissioning** 3.18	**Removing refrigerant** 3.19	**Dismantling** 3.20
Knowledge and skills to assess														
Know the basic SI units, for example: temperature, pressure, mass, density, energy	a	FO	BA	BA	WK	WK	WK	WK	FO	BA	WK	BA	WK	

Table A.1 *(continued)*

Basic thermodynamics		**Tasks**												
Description of tasks (see Clause 3)		**Designing** 3.8	**Pre-assembling** 3.9	**Installation** 3.10	**Putting into operation** 3.11	**Commissioning** 3.12	**Operating** 3.13	**In-service inspection** 3.14	**Leakage checking** 3.15	**General maintenance** 3.16	**Circuit maintenance** 3.17	**Decommissioning** 3.18	**Removing refrigerant** 3.19	**Dismantling** 3.20
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** 3.8	**Pre-assembling** 3.9	**Installation** 3.10	**Putting into operation** 3.11	**Commissioning** 3.12	**Operating** 3.13	**In-service inspection** 3.14	**Leakage checking** 3.15	**General maintenance** 3.16	**Circuit maintenance** 3.17	**Decommissioning** 3.18	**Removing refrigerant** 3.19	**Dismantling** 3.20
Knowledge and skills to assess														
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														
Compressor (e.g. comparable)	a	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Lubrication system	b	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	BA	BA	BA
Capacity control	c	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	BA	BA	BA
Pressure vessel	d	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Condenser	e	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Gas cooler	f	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Liquid receiver	g	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Liquid separator	h	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Evaporator	i	FO	BA	WK	FO	FO	WK	WK	BA	WK	FO	WK	FO	BA
Defrosting systems on evaporators	j	FO	BA	WK	FO	FO	WK	WK	FO	WK	FO	WK	BA	BA

Table A.2 *(continued)*

Components and tests of refrigeration systems		Tasks												
Description of tasks (see Clause 3)		**Designing** 3.8	**Pre-assembling** 3.9	**Installation** 3.10	**Putting into operation** 3.11	**Commissioning** 3.12	**Operating** 3.13	**In-service inspection** 3.14	**Leakage checking** 3.15	**General maintenance** 3.16	**Circuit maintenance** 3.17	**Decommissioning** 3.18	**Removing refrigerant** 3.19	**Dismantling** 3.20
Expansion devices	k	FO	WK	FO	FO	FO	WK	WK	FO	WK	FO	FO	FO	BA
Preassembled units	l	WK		WK	FO	FO	WK	WK	FO	WK	FO	WK	FO	
Strength pressure test	m	FO	BA	WK	FO	FO		BA	BA	BA	WK	WK	BA	
Tightness pressure test for leak detection	n	FO	BA	WK	FO	FO		BA	BA	BA	FO	WK	BA	
Determination of required refrigerant charge	o	LE		WK	FO	FO	WK	WK	WK	WK	FO	WK	FO	
Check the charge of refrigerant including leakage checking	p	BA			FO	FO	WK	WK	WK	WK	FO	WK	WK	BA
Understanding of the legislation and standards applicable in the region of operation	q	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 Clause 3)		**Designing** 3.8	**Pre-assembling** 3.9	**Installation** 3.10	**Putting into operation** 3.11	**Commissioning** 3.12	**Operating** 3.13	**In-service inspection** 3.14	**Leakage checking** 3.15	**General maintenance** 3.16	**Circuit maintenance** 3.17	**Decommissioning** 3.18	**Removing refrigerant** 3.19	**Dismantling** 3.20
Knowledge and skills to assess														
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		

Table A.4 — Safety equipment

Safety equipment	Tasks												
Description of tasks (see Clause 3)	**Designing** 3.8	**Pre-assembling** 3.9	**Installation** 3.10	**Putting into operation** 3.11	**Commissioning** 3.12	**Operating** 3.13	**In-service inspection** 3.14	**Leakage checking** 3.15	**General maintenance** 3.16	**Circuit maintenance** 3.17	**Decommissioning** 3.18	**Removing refrigerant** 3.19	**Dismantling** 3.20
Knowledge and skills to assess													