INTERNATIONAL STANDARD

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Mechanical refrigerating systems used for cooling and heating — Safety requirements

Systèmes frigorifiques mécaniques utilisés pour le refroidissement et le chauffage — Prescriptions de sécurité

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Annexes

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 5149 was prepared by Technical Committee ISO/TC 86, *Refrigeration*, Sub-Committee SC 1, *Safety*.

This first edition cancels and replaces the first edition ISO/R 1662:1971, which has been technically revised.

Annexes A, B and C of this International Standard are for information only.

Introduction

The International Standard concerning the safety of refrigerating systems takes into account regulations already in force, or existing in draft form, in a number of countries. The provisions represent minimum requirements for the design, construction, installation, and operation of a refrigerating plant. However, in particular cases, more severe requirements may be necessary. Where national regulations are in force, full account should be taken of them.

Reference is made in this International Standard to pressure-vessel codes, electrical codes and the like, and in many countries such codes exist and are mandatory. In the absence of such mandatory rules in any particular country, an acceptable substitute becomes necessary. It is recommended therefore that a relevant document that has received national or international recognition should be used. However, such regulations must be acceptable to and be accepted by all the parties concerned in each transaction.[1)]

This International Standard is intended solely to minimize possible hazards to persons and property from refrigerating systems; it does not constitute a technical design manual. These hazards are associated essentially with the physical and chemical characteristics of refrigerants as well as the pressures and temperatures occurring in refrigeration cycles. Inadequate precautions may result in

— rupture of a part or even an explosion, with risk from flying pieces of metal;

— escape of refrigerant following a fracture or simply due to leakage, or to incorrect operation during running or repair, or during charging;

— burning or explosion of escaping refrigerant, with consequent risk of fire.

Refrigerants, on the one hand, affect a refrigerating system internally according to the nature of the materials used and the pressures and temperatures and, on the other hand, they may have external effects when they are toxic, flammable or explosive, and may present risks to personnel, goods or materials (from burns, poisoning, asphyxiation, deterioration and corrosion).

Dangers due to the states of pressure and temperature in refrigeration cycles are essentially due to the simultaneous presence of the liquid and vapour phases, from which certain consequences follow. Furthermore, the state of the refrigerant and the stresses that it exerts on the various components do not depend solely on the processes and functions inside the plant, but also on external causes.

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1) See chapter 5 of the *Practical Guide to Refrigerating Storage,* International Institute of Refrigeration (IIR), Paris.

The following dangers are worth noting.

a) Danger from the direct effect of temperature:

- brittleness of metals at low temperatures;
- freezing of heat-transferring liquids (for example water, brine) in closed spaces;
- thermal stresses;
- damage to buildings resulting from freezing of the ground beneath them;
- injurious effects to persons caused by low temperatures.

b) Danger from excessive pressure due to:

- increase in the pressure of condensation, caused by inadequate cooling or the partial pressure of non-condensable gases or an accumulation of oil or liquid refrigerant;
- increase in the pressure of saturated vapour due to excessive external heating, for example of a liquid cooler, or when defrosting an air cooler, or high ambient temperature when the plant is at a standstill;
- expansion of liquid refrigerant in a closed space without the presence of vapour, caused by a rise in external temperature;
- fire.

c) Danger from the direct effect of the liquid phase:

- excessive charge or flooding of apparatus;
- presence of liquid in compressors, caused by siphoning, or condensation in the compressor;
- loss of lubrication due to emulsification of oil.

d) Danger from the escape of refrigerants:

- fire;
- explosion;
- toxicity;
- panic;
- asphyxiation.

Attention is drawn to dangers common to all compression systems, such as excessive temperature at discharge, liquid slugging, erroneous operation (for example, discharge valve closed while running), or reduction in mechanical strength caused by corrosion, erosion, thermal stress, liquid hammer, or vibration. Corrosion, however, should have special consideration as conditions peculiar to refrigerating systems arise due to alternate frosting and defrosting or the covering of apparatus by insulation.

The above analysis of the risks applying to refrigerating installations explains the plan on which this International Standard has been based.

After general considerations (Section 1) and a classification of the occupancies, the cooling and heating systems and the refrigerants (Section 2), Section 3 defines the precautions to be considered at the design, construction and assembly stages, in the choice of working and test pressures, in the use of materials and in the disposition of safety devices in the various parts of the installation. Section 4 provides rules for the utilization of refrigerating equipment in the various types of occupancy with limits for refrigerant charge, requirements for machine rooms and also miscellaneous precautions. Finally, Section 5 describes instructions necessary to safeguard personnel, to secure correct operation of the plant and to prevent its deterioration.

Refrigerating systems with a relatively small amount of refrigerant charge, such as household refrigerators, commercial refrigerated cabinets, room air conditioners, heat pump units or small unitary refrigerating and air conditioning equipment, have specific safety aspects and need appropriate requirements. The appropriate safety requirements for these refrigerating systems are included in this International Standard. Additional requirements for the whole appliance may be found in other standards. Such special requirements are found in the references listed in subclause 1.2 and in annex C.

The next revision of this International Standard will incorporate data on ozone-depletion refrigerants.

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Mechanical refrigerating systems used for cooling and heating — Safety requirements

Section 1: General

1.1 Scope

This International Standard specifies the requirements relating to the safety of persons and property for the design, construction, installation and operation of refrigerating systems.

It applies to all types of refrigerating systems in which the refrigerant is evaporated and condensed in a closed circuit, including heat pumps and absorption systems, except for systems using water or air as the refrigerant.[2)]

Individual safety standards for identifiable types of refrigerating systems may deviate from requirements set forth in this International Standard to accommodate particular needs, provided that there is no reduction in the level of safety achieved.

This International Standard is applicable to new refrigerating systems, extensions and modifications of already existing systems, and for used systems on being transferred to and operated on another site. Deviations are permissible only if equivalent protection is ensured.

It also applies in the case of the conversion of a system for another refrigerant, for example R 40 to R 12, or ammonia to R 22.

1.2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 817:—[3)], *Refrigerants — Number designation.*

ISO 4126-1:1991, *Safety valves — Part 1: General requirements.*

IEC 335-2-24:1984, *Safety of household and similar electrical appliances — Part 2, Section 24 — Particular requirements for refrigerators and food freezers.*

IEC 335-2-34:1980, *Safety of household and similar electrical appliances — Part 2, Section 34 — Particular requirements for motor-compressors.*

IEC 335-2-40:1992, *Safety of household and similar electrical appliances — Part 2, Section 40 — Particular requirements for electric heat pumps, air-conditioners and dehumidifiers.*

1.3 Definitions

For the purposes of this International Standard, the following definitions apply.

1.3.1 abnormal fire risk: Fire risk that may arise from conflagration uncontrollable by the normal fire fighting facilities of a municipality.

1.3.2 absorption (or adsorption) refrigerating system: System in which refrigeration is effected by evaporation of a refrigerant, the vapour then being

2) More stringent regulations may exist, for example, for mines or transport (rail or road vehicles, ships and aeroplanes). Where such regulations exist, they take precedence.

3) To be published. (Revision of ISO 817:1974)