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Qualification and Certification of Refrigeration Technicians

The IIR publishes Informatory Notes designed to meet the needs of decision-makers worldwide, on a regular basis. These notes summarize knowledge in key refrigeration-technology and refrigeration-application domains. Each note puts forward future priority developmental axes and provides IIR recommendations in this context.

Due to ozone layer depletion and global warming concerns, some refrigerants used in refrigerating systems are in the process of being phased out/down, to eventually be replaced by more environmentally-friendly refrigerants. However, some of the latter are toxic, flammable or operate at high pressure. Consequently, a safe handling of refrigerating systems using these alternative refrigerants requires specialized theoretical and practical qualifications. The purpose of this Informatory Note is to summarize global, regional and national standards and regulations relative to the qualification and certification of refrigerating systems personnel. This note describes the international standard ISO 5149, the EU “F-gas” Regulation and the European standard EN 13313. A state-of-the-art of certification schemes in various developed and developing countries is presented. To conclude, the IIR provides several recommendations which can help reduce risks of injury and environmental problems, and increase certification implementation in countries.

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Introduction

Fluorinated gases are used in numerous applications such as Refrigeration, Air Conditioning and Heat Pumps (RACHP), foams, fire protection systems, aerosols, industrial processes etc. However, some of these have been phased out by the Montreal Protocol because of their ozone depletion potential (ODP). An example being chlorofluorocarbons (CFCs) with production ceased in 1996 in developed countries and in 2010 in developing countries. The same is true for hydrochlorofluorocarbons (HCFCs) which will be phased out in developed and developing countries by 2020 and 2030 respectively. As a result CFCs and HCFCs are mostly replaced by non-ozone depleting substances (ODS) such as hydrofluorocarbons (HFCs). In 1992, HFCs were included in the Rio Convention as greenhouse gases (GHG), due to their high global warming potential (GWP). Accordingly, countries have to reduce HFC emissions, and international negotiations are underway to phase down HFCs over the next decades.

The use of low GWP and non ODP refrigerants such as ammonia, hydrocarbons, carbon dioxide, low GWP HFCs, including unsaturated HFCs or Hydrofluoro-olefins (HFOs) and HFO blends address as well as ozone layer depletion and climate change concerns. However, ammonia presents a problem of toxicity, hydrocarbons are very flammable, carbon dioxide operates at high pressures, and low GWP HFCs, including HFOs, are mildly flammable. Consequently, the handling of refrigerating systems requires specialized theoretical and practical training intended to reduce refrigerant leakage, accidents and environmental problems. It is the responsibility of each country to set up appropriate national legal measures to comply with their commitments under the Montreal Protocol to phase out HCFCs and other ozone depleting substances. To assist countries, there are international and regional standards where requirements for training, assessments and certifications of refrigerating systems personnel and companies are defined. These requirements are intended to minimize injury risks to persons and damage to property and the environment resulting from improper handling of the refrigerants or of the refrigerating systems. Nowadays, various agreements, requirements or regulations are in discussion, or in some cases already in application at international, regional and national levels.

This Informatory Note is designed to summarize global, regional and national standards and regulations relative to certifications of the personnel and companies handling refrigerating systems. This note will describe the international standards ISO 5149 on "Refrigerating systems and heat pumps- safety and environmental requirements", and ISO 817 on "Refrigerants- designation and safety classification", the EU "F-gas" Regulation No 517/2014, the European standard EN 13313 on "Refrigerating systems and heat pumps- competence of personnel", and the certification schemes of some countries.

International standards

The International Organization for Standardization (ISO) is a worldwide federation of national standards bodies, formed in 1947 and currently counting 162 countries. International standards are prepared and adopted by ISO technical committees (TC). However, these standards are not mandatory. They are based on a consensual mechanism within a wide network of national members and stakeholders. Yet in practice, many developing countries have limited engagement in the standardization process and consequently cannot review, vote and contribute to the standards and the process of developing these.

ISO 5149 “Refrigerating systems and heat pumps - Safety and environmental requirements” specifies requirements for safety and environmental aspects in relation to operation, maintenance and repair of refrigerating systems and the recovery, reuse and disposal of all refrigerant types, refrigerant oil, heat transfer fluid, refrigerating systems and part thereof.

The followings are emphasized ¹:

Operation instructions

Personnel in charge of operation, supervision, maintenance of refrigerating systems shall be adequately instructed and competent with respect to their tasks. They shall know in service inspection requirements (Annex D ISO 5149-4), have knowledge and experience of the mode of functioning, operation and day-by-day monitoring of the systems and shall know the change of refrigerant type process (ISO 5149-4 5.4), the properties and handling of the refrigerant used, the safety measures to be observed.

Each refrigerating system shall have an updated logbook (ISO 5149-4 4.3) to record: details of all maintenance and repair work, quantities, sources and kind (new, reused or recycled) of refrigerants charged in or transferred from the system on each occasion, changes and replacements of components of the system, etc.

Maintenance and repair

Each refrigerating system shall be subjected to preventive maintenance in accordance with the instruction manual (ISO 5149-2). The person responsible for the refrigeration system shall ensure that the system is inspected, regularly supervised and maintained. Also, they shall demonstrate proficiency of draining procedure (ISO 5149-4:2014 Annex A) and shall know the different circumstances which require regular leak tests, inspections and checking of the safety equipment (ISO 5149-4:2014 Annex D).

It is required that the refrigeration responsible for system repairs knows: the process of refrigerant containing components repairs (ISO 5149-4:2014 5.3.1), the required tasks after each periodic maintenance or each repair (ISO 5149-4:2014 5.3.3).

Requirements for recovery, reuse and disposal

All parts of refrigerating systems e.g. refrigerant, oil, heat-transfer medium, filter, drier, insulation material, shall be recovered, reused and/or disposed properly in accordance with national regulations (ISO 5149-4:2014 6.5). To reduce refrigerant losses, the specialist shall follow the required process for handling and storage of refrigerants (ISO 5149-4:2014 Annex C) and shall ensure that recovered refrigerants follow required paths (acid test and moisture test) before their reuse.

Another international standard, **ISO 817 “Refrigerants - Designation and safety classification”** is also very important in this context. This standard specifies the different classes of refrigerants according to their flammability and toxicity and is prepared by the same TC than ISO 5149, TC 86 “Refrigeration and air-conditioning”. ISO 817:2014 categorizes 8 safety groups of refrigerants: A1 (no flammability, lower toxicity), A2L (lower flammability with low flame speed, lower toxicity), A2 (lower flammability, lower toxicity), A3 (higher flammability, lower toxicity), B1 (no flammability, higher toxicity), B2L (lower flammability with low flame speed, higher toxicity), B2 (lower flammability, higher toxicity) and B3 (higher flammability, higher toxicity).

These international standards are not mandatory, but can be used as a reference for regional standards or regulations establishment e.g. European norms.

European standards and Regulations

EU "F-Gas" Regulation No 517/2014

"F-gas" Regulation on certain fluorinated GHG aim to reduce the emission of HFCs, PFCs and SF₆, which contribute to climate change if emitted to the atmosphere. The regulation concerns all 28 EU member states. The first edition 842/2006 established on 17 May 2006 is replaced by the actual 517/2014 which came into effect on 1 January 2015. This regulation applies to persons carrying out the following tasks: recovery of fluorinated GHGs, installation, servicing, maintenance, repair, decommissioning or leak check of stationary refrigeration equipment, of stationary air-conditioning equipment, of stationary heat pumps, of stationary fire protection equipment, of refrigeration units in refrigerated trucks and trailers and of electrical switchgear. The "F-gas" Regulation requires all personnel and companies to have a certification proving their ability to manipulate systems using "F-gases". The personnel certification is obtained after a theoretical and practical assessment (EC No 303 & 304/2008 for examination requirements). For Refrigeration and Air Conditioning (RAC) personnel, the European Commission Regulation 303/2008 refers to 4 different levels of certification. These are: categories I, II, III and IV (refer to table below).

Table: Different "F-gas" certification levels

Category	Holders may carry out	Type of RAC systems
I	All refrigerant handling activities	Any size of RAC system containing HFC
II	Refrigerant recovery, installation, maintenance and servicing	<ul style="list-style-type: none"> ▶ Containing less than 3 kg of "F-gases" ▶ Less than 6 kg for hermetically sealed systems
III	Refrigerant recovery	<ul style="list-style-type: none"> ▶ Containing less than 3 kg of "F-gases" ▶ Less than 6 kg for hermetically sealed systems
IV	Leak checks	Any plant without breaking into "F-gas" circuit

To obtain a company certification, regulations (EC) No 303 & 304/2008 require that companies employ certified personnel for the relevant activities in a sufficient number to cover the expected volume of activities and prove that the necessary tools and procedures have been made available to the personnel engaged in those activities.

In addition to these training and certification obligations, the "F-gas" Regulation set up legislative texts on prevention of fluorinated GHG emissions, leak checks, leakage detection systems, record keeping, recovery, labeling of systems, reduction of HFC placed on the market, collection of emission data, etc. "F-gas" is mandatory unlike EN 13313 & 378.

European standard EN 13313:2010 "Refrigerating systems and heat pumps - Competence of personnel"

The main European standard relating to refrigerating plant systems is standard EN 378, "Refrigerating systems and heat pumps- safety and environmental requirements" which is currently under revision. Although it was established before ISO 5149, it is less advanced. Its requirements are similar to those of ISO 5149 described previously.

This section will focus mainly on EN 13313, "Refrigerating systems and heat pumps- competence of personnel". This standard defines the activities related to refrigerating circuits and the associated competence profiles and establishes procedures for assessing the competence of persons who carry out these activities. According to the standard, persons responsible for design, construction, installation, inspection, testing,

commissioning, maintenance, repair, decommissioning, and disposal of refrigerating systems and their parts, must have the following competencies to be certified by an approved national organization:

- Good practice of the health, safety, environmental and energy conservation of every refrigeration task undertaken that is covered by EN 378-1², EN 378-2³, EN 378-3⁴ and EN 378-4⁵;
- Sufficient knowledge relevant to health, safety, environmental legislation;
- Sufficient knowledge of basic refrigeration theory;
- The design and development activities shall be assigned to qualified personnel equipped with adequate resources;
- Personnel performing specific assigned tasks shall be qualified on the basis of appropriate training and/or experience, as required.

This standard doesn't apply to those persons who are supervised by competent persons during tasks, who carry out work that does not affect refrigerant circuit or who operate according to the operation manuals.

Also, companies working in any refrigeration field shall be certified by a recognized national organization. To be certified, companies shall have trained personnel (with refrigeration certification), and adequate equipment to enable the competent persons to carry out the work.

On a national level, these requirements are often adapted or adopted by national standardization or regulation bodies to comply with local agreements.

Case studies

Situation in some European countries

France: EU "F-gas" Regulation No 842/2006 was implemented in France by Decree 2007-737 on 7 May 2007. National standards and regulations are similar to European⁶ ones with certain complementary measures specific to France⁷. As in "F-gas" regulations, in France personnel certificate is valid for life and company certificate is to renew every 5 years. All French companies are required to report the quantity of "F-gases" acquired, charged, recovered, reused and disposed at the end of each year. These directives enable the control of the amount of "F-gas" used⁸. In 2015, 30,000 companies and 75,000 persons (including automotive air-conditioning sector) were certified under "F-gas" Regulation⁹.

Germany: Standards are governed by German Institute for Standardization, DIN (Deutsches Institut für Normung). Betriebs-sicherheitsverordnung regulation covers requirements for the safe handle of carbon dioxide refrigeration plant. Betreiben von Kälteanlagen, Wärmepumpen und Kühleinrichtungen (BGR500Kap.2.35) "Operation of refrigerating systems, heat pumps and cooling appliances" rule includes requirements for the regular training of workers, provision of adequate personal protective equipment both regarding refrigerant hazards as well as low temperature impacts, the storage of refrigerants and some special inspection obligation. In 2014, 25,000 persons and 1,800 companies were certified under "F-gas" Regulation¹⁰.

Italy: "F-gas" Regulation covered by presidential decree 43/2012 entered in force on 5 May 2012. This law requires technicians (and companies) carrying out refrigeration tasks¹¹, after being registered in the national "F-gas" register, to obtain a certificate issued by an accredited certification body after a theoretical and practical examination on knowledge and skills for a safe refrigeration system handling. Since 2013, each year by 31 May, all "F-gas" operators must submit a declaration containing information on the amount of "F-gas" emitted into the atmosphere in the previous year. In Italy, there are now around 43,000 persons and 12,000 companies certified¹².

Netherlands: STEK (Stichting Emissie preventie Koudetechniek: Foundation for the Prevention of Emissions in Refrigeration) is a Dutch program of certification of companies and persons introduced in 1992. This program aimed to reduce emission of CFC and HCFC refrigerants through containment and regular maintenance. In the Netherlands, certification has been granted since 1993 to companies and persons working in the field of CFCs, HCFCs and HFCs in refrigerating installations. The "F-gas" Regulation has been implemented in the Netherlands on January 1st 2010. In 2011, 98.7% of personnel and 100% of companies were certified according to the "F-gas" Regulation¹³. Since the introduction of certification of companies and personnel, emissions have been reduced from 20% to 3.5% on average in 18 years. The quality of equipment has been improved by manufacturers and due to the training and certification of personnel the quality of installations has been significantly improved¹⁴.

United Kingdom: The norms are established by British Standards Institution (BSI). Requirements of British standards BS EN 13313 are similar to those of EN 13313. The recognized qualifications for those who wish to work as refrigeration, air conditioning and heat pump professionals are based on national occupational standards. It distinguishes different kind of qualifications certified by awarding bodies such as City and Guilds. In refrigeration, air conditioning and heat pumps, there are National Vocational Qualifications (NVQ 6187, 7189, 6127, 6087) and in heating and ventilation there are four NVQs (NVQ 7188, 6188, 6088 and 6128)¹⁵. A separate certification under "F-gas" regulations exists as a mandatory qualification (City & Guilds 2079 or CITB J11-14 and units of the some of the above named qualifications are also recognized). In March 2015, there were 36,000 individuals who hold category 1 certificate, and 6,200 companies were certified under the "F-gas" Regulation¹⁶.

Situation in some developed countries outside Europe

Australia: The Australian Refrigeration Council Ltd (ARC) administers refrigerant handling licenses (RHL) and refrigerant trading authorizations (RTA) on behalf of the Australian government, to professionals in the RAC and auto industry. According to Australian regulations (Ozone Protection and Synthetic Greenhouse Gas Management regulations 1995/ Act 1989), any person who carries out work in relation to RAC equipment must hold a RHL, and any individual or business acquiring, possessing or disposing of fluorocarbon refrigerant must hold a RTA¹⁷. The regulation applies only to GHG and ODS handlers, there is no required certification for new refrigerant handling.

Japan: Refrigeration equipment are regulated by the "High Pressure Gas Safety Act" and the "Refrigeration Safety Regulations". These regulations require refrigeration equipment technicians to hold a "refrigeration safety manager certificate". There are three certificate categories and each class set down the type of refrigeration equipment that the certificate holder can handle according to the refrigerating capacity. There are also private certificates such as the "certificate for the refrigerant handling engineer" provided by the new Act related to the restraint for refrigerant leakage and "the certificate for Refrigeration and Air-conditioning Technologist" provided by Japan Society of RAC Engineers (JSRAE)¹⁸.

New Zealand: The Tamahere Cool Store Disaster in 2008 was a further impetus to the industry to seek a stronger regulatory framework. HVAC&R industry bodies established Refrigeration License New Zealand (RLNZ) in 2012, with a view to provide high quality training for people handling refrigerants under the Environmental Protection Agency (EPA) approved filler and handler requirements. The major refrigerant suppliers in New Zealand have agreed that from 1 January 2015, refrigerants will only be sold to trained, license-holding engineers. The agreement requires purchasers to hold an approved filler or handler

certificate or a refrigerant license and applies to all refrigerants. A voluntary arrangement has been in place since 2011¹⁹. Only persons holding national RAC certification (level 4, NZQA 130) are authorized to install, maintain, service, and commission refrigeration and air conditioning plants and equipment²⁰.

United States of America: According to the EPA's refrigerant recycling rules (Section 608 of the Clean Air Act 1990), all refrigeration technicians who are not closely and continually supervised by a certified technician are required to pass an EPA-approved test given by an EPA-approved certifying organization to become certified under the mandatory program established by the EPA. This regulation applies to CFCs and HCFCs handlers and the EPA is looking to extend it to HFCs. The EPA is also taking others measures, like the Significant New Alternatives Policy (SNAP) program. The purpose of this program is to allow a safe, smooth transition away from ozone depleting compounds by identifying substitutes that offer lower overall risks to human health and the environment. A list of SNAP rules is available²¹. There are voluntary credentials such as North American Technician Excellence (NATE) certification program²² which establishes an individual's basic knowledge of HVAC systems and technologies and the Refrigeration Engineers and Technicians Association (RETA) which offers two certification levels: CARO (Certified Assistant Refrigeration Operator) and CIRO (Certified Industrial Refrigeration Operator)²³. Some states and local jurisdictions have specific licensing and certification requirements for technicians but they are not applicable nationally.

Situation in some emerging and developing countries

In many developing and emerging countries, the certification of refrigeration technicians is not mandatory. However in some countries, some initiatives are already or being taken to establish a certification system.

Argentina: Technicians are trained in middle school and do not need a certification to work in the refrigeration field. But there are some companies as there of AAF ("Asociación Argentina del Frio") whose interested technicians past an examination similar to the ASHRAE certification.

China: Hefei General Machinery Research Institute is responsible for certification. National Standards Committee of RAC equipment SAC/TC238 is the technical standardization body approved by Standardization Administration of China (SAC). Requirements for certification of refrigeration technicians are defined in national standard GB 9237 "Mechanical refrigerating systems used for cooling and heating-Safety requirements" and are similar to requirements of ISO 5149.

Colombia: There is not a mandatory qualification or certification of refrigeration engineers but technicians have certification requirements. According to the National Training Service of Colombia, SENA which defines training and assessment methodology, there are 11,707 certifications granted in the sector of RAC systems.

South Africa: The design and operation of RAC systems have to comply with national standard SANS 10147 which in many respects is similar to EN378. SANS 10147 is a part of Occupational Health & Safety Act (OSH) that all machinery and plants have to comply to. SANS 10147 requires that all service technicians and these handling refrigerants have to be registered as being competent in their specific fields in RAC and such registration is delivered by SAQCC (South African Qualification & Certification Committee).

Tunisia: There is a collaborative project between the Technical Center for Mechanical and Electrical Industries (CETIME) and the French center of expertise in refrigeration, Cemafruid for the establishment of certification system.

Conclusion

The replacement of CFCs, HCFCs and HFCs by more environmentally-friendly alternative refrigerants could have a significant impact on the reduction of the ozone layer depletion and global warming. However, the diversity, the complexity of use, and the flammable and toxic properties of some refrigerants make them dangerous and potentially difficult to handle. Considering this, training of refrigeration personnel and mandatory certification for all refrigerating system handlers are vital. This is the only way to transfer knowledge and new skills for a safer handling. International and regional organizations played a very important role in the development of training and certification schemes by contributing to the development and implementation of international and regional standards, and regulations such as ISO 5149 & 817, EN 378 & 13313, the EU "F-gas" Regulation.

These documents served as references for South Africa, China and EU countries for the establishment of their regulations, legislative texts, and training and certification schemes relative to refrigerating systems. The implementation of a certification system and policy measures relative to the use of refrigerants enhanced important progress in environmental protection, leakage detection and safe use of new refrigerants. For example, with the Dutch STEK program, emissions have been reduced from 20% to 3.5% on average in 18 years in Netherlands. Since entry into force of the "F-gas" Regulation, the frequency of leak checks has increased and refrigeration companies and technicians are more in compliance with the requirements.

However, despite the usefulness of certification, and the necessity to reduce ODS and GHG emissions, many developing countries still do not require certification for refrigeration personnel and have limited engagement in the development of standards, regulations or legislative texts, and in reaching the objectives of the Montreal Protocol and the Rio Convention together. Therefore, to achieve the worldwide objectives of reducing global warming and emission of ODS, of minimizing risks of injury from improper handling of refrigerants or of refrigerating systems, stronger measures should be taken to involve every country in the transition.

References

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Recommendations

To reduce risks of injury and environmental problems resulting from improper handling of refrigerant and the refrigerating systems, the IIR emphasizes the need to:

- Increase interactions with developing countries in international standards development in order to coordinate and synchronize implementation of training and certification schemes for contractors thus avoiding conflicting requirements,
 - Invest and promote research on alternative refrigerants and refrigerating systems equipment to reduce hazards associated with flammability and toxicity,
 - Encourage countries to set up mandatory regulations relative to refrigeration personnel and company certification, to refrigeration systems operation, maintenance and repair,
 - Assist governments in developing countries in setting up certification schemes through cooperation agreement with training organizations in expert countries,
 - Require refrigeration schools to implement certification in training programs.
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