Minimum Qualification Requirements for Personnel in the European Community Involved in the Containment and Recovery of Fluorinated Greenhouse Gases (F-Gases) and Ozone Depleting Substances (ODS)

—FINAL REPORT—

CONFIDENTIAL REPORT PREPARED FOR THE EUROPEAN COMMISSION

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Contents

Executive Summary

This study establishes minimum qualification requirements and conditions for mutual recognition of these qualifications for personnel dealing with ODS and F-Gases, to ensure that qualified personnel are used to minimise emissions of these gases during the operation and recovery of equipment and products containing such gases. Specifically, the study reviews and recommends minimum qualification requirements for personnel involved with the containment and/or recovery[1] of F-Gases and/or ODS from:

- Stationary refrigeration, air-conditioning, and heat pump equipment (ODS and F-Gases);
- Mobile vehicle air-conditioning (MVAC) equipment (F-Gases);
- Fire protection systems (ODS and F-Gases);
- Solvent-containing equipment/products (ODS and F-Gases); and
- High and medium voltage switchgear (F-Gases).

Based on the review of existing requirements, programmes, and standards in place in the EU-25, Bulgaria, and Romania, recommendations for minimum qualification requirements for personnel were tailored to each sector. In developing the recommendations, the following considerations were borne in mind with regard to the nature of each sector:

- ***Refrigeration/Air Conditioning/Heat Pumps:*** Personnel in this sector work on a wide range of equipment types, from small residential AC units and domestic refrigerators to supermarket refrigeration systems and custom-designed industrial process refrigeration (IPR) systems. Because there are so many of these systems in use throughout the EU, the number of personnel in this sector is significant. Further, because of the diverse settings in which the equipment are used—from households to office buildings, retail stores to industrial warehouses—the sector is not highly structured or specialised, and the work environment not easily controlled. Thus, ensuring adequate minimum personnel qualifications and training presents more of a challenge in this sector than for other sectors. Similarly, there is a need to ensure that that the large number of (typically small) establishments employing technicians in this sector provide their staff with the tools needed to minimise emissions (e.g., refrigerant recovery devices, etc.).

- ***MVACs:*** The population of personnel servicing MVACs is quite substantial, and consists largely of small-scale independent garages. Because of the large, widespread, and diverse labour market, the minimum qualifications for this sector must be flexible and not place an undue burden on smaller operations or their personnel that may receive the majority of their training on-the-job, while at the same time ensure that proper procedures are in place. Additionally, because of the technical differences between MVACs and stationary AC systems, unique minimum qualifications are needed for this sector to ensure that all personnel possess a set of knowledge and skills specifically relevant to this equipment.

- ***Solvents:*** The remaining ODS and existing F-Gas solvent applications in the European Community are highly specialized and quite limited. Therefore, the personnel pool in this sector is small and their job activities may be unique from company to company. The high-tech nature of the industry and the few players involved render it more likely that companies will adhere to good practices and provide its personnel with the necessary tools for minimising emissions on the job.

- ***High and medium voltage switchgear (SF_6):*** All personnel working in this sector must be highly trained and experienced to ensure safety. Employment of untrained personnel may result, not only in F-Gas emissions, but also failure of the insulation system, risk of injury to

[1] Associated activities include installation, servicing and maintenance (including leak inspection), and recovery at equipment disposal/decommissioning.

personnel, and loss of power supply to serviced areas. Because of the highly specialised nature of this sector, rigorous in-house technician training programmes are already provided by companies that install, service, maintain, or decommission high and medium voltage equipment. Further, most companies in this sector adhere to exacting industry standards that help to ensure that best environmental practices are followed.

- ***Fire Protection:*** Because fire protection systems are often custom-designed, they are often installed, serviced/maintained, and decommissioned by the original equipment manufacturer (OEM). In some cases, decommissioning may be conducted by personnel of halon banks. In accordance with EC regulations, systems must also be checked regularly for leakage; this activity, which does not require detailed technical knowledge, is likely to be performed by general building maintenance personnel.

Based on this understanding, the following recommendations are made:

- All personnel in all sectors should possess a basic understanding of the technical, legal, and practical requirements and procedures needed to minimise emissions of ODS and/or F-Gases. To ensure and document this level of understanding, it is recommended that ***technician certification*** be awarded following demonstration of this knowledge, either through formal education channels (e.g., vocational schools) or in-house company training programmes, depending on the sector. The recommended framework for certification schemes and core knowledge areas are tailored to each sector, as described further below. At this time, periodic recertification is not recommended in any sector; however, certification renewal (e.g., every five years) should be considered for the future.

- Further, ***personnel in charge*** of work activities in all sectors—with the exception of the MVAC sector—should possess a tertiary education in a relevant field (i.e., a degree from a vocational school, career college, or university) or five years of relevant experience (which could be obtained through apprenticeship). Such qualifications are commonly required for *all* personnel in these sectors; in the refrigeration/AC/heat pump and fire protection sectors, such requirements are often mandated at the state level, while in the solvents and power distribution sectors, such qualifications are generally the industry status quo (i.e., company personnel in these positions generally have such qualifications). This qualification requirement is not recommended for the MVAC sector, given the less technical/specialised nature of the work.

- While beyond the official scope of the study, ***company licensing/certification*** should be encouraged to ensure that companies provide the necessary tools for their personnel to minimise emission on the job. This may be particularly viable in the refrigeration/AC/heat pump and fire extinguishing sectors, where a number of Member States already require company licensing. At the non-state level, industry certifications are very common in the power distribution sector, which can be considered a proxy for adherence to best environmental practice. For example, most companies in the power distribution sector are ISO 9000/14000 certified and are members of voluntary industry consortia. Such certifications could serve as *de facto* licensing for operation at the state level. In the MVAC sector, company licensing/certification may be onerous to implement, given the large number of small companies in operation.

Minimum Qualification Requirements and Certification for Personnel, By Sector

As mentioned above, the recommended certification schemes and training modules vary by sector; they are summarised in the following section. It is recommended that each Member State should ensure that the certification schemes recognised in their state adequately cover the recommended minimum knowledge areas specified in this section. Member States should also ensure that those

programmes/companies executing training and issuing certificates are entitled to do so and have the proper certifications in place.

Refrigeration/AC/Heat Pumps

A total of three certification types are recommended, each tailored to the types of equipment that will be worked on and the activities to be performed. Table ES-1 presents the framework for the certification scheme recommended for this sector, and the suggested training modules to be covered under each certification type. It is suggested that certification be provided by vocational training programmes and/or by companies (on-the-job), and should include hands-on instruction and/or testing.

Table ES-1: Framework of Recommended Certification Scheme and Required Knowledge Areas in the Refrigeration/AC/Heat Pump Sector (ODS and F-Gases)

Type of Equipment	Knowledge Areas by Certification Type	
	Leak Detection Certification	Universal Certification (All Activities)
Level I: Household and Other Small Appliances	NA	Core Training Modules • Ozone depletion, Montreal Protocol, and relevant EC Regulations • Climate change, Kyoto Protocol, and relevant EC regulations • Refrigeration basics (refrigerant states, pressures, gauges, etc.) • Refrigerant identification and labeling • Recovery, recycling, and reclamation (definitions and overview of techniques) • Leak detection • Safety (as related to refrigerant containment) In-Depth Training Modules • Recovery requirements and techniques • EC waste regulations • Proper handling and destruction of waste refrigerants (including mixed refrigerants)
Level II: Larger Systems (High and Low Pressure Refrigerated Systems)	Core Training Modules • Ozone depletion, Montreal Protocol, and relevant EC Regulations • Climate change, Kyoto Protocol, and relevant EC regulations • Refrigeration basics (refrigerant states, pressures, gauges, etc.) • Refrigerant identification and labeling • Recovery, recycling, and reclamation (definitions and overview of techniques) • Leak detection • Safety (as related to refrigerant containment)	Core Training Modules • Ozone depletion, Montreal Protocol, and relevant EC Regulations • Climate change, Kyoto Protocol, and relevant EC regulations • Refrigeration basics (refrigerant states, pressures, gauges, etc.) • Refrigerant identification and labeling • Recovery, recycling, and reclamation (definitions and overview of techniques) • Leak detection • Safety (as related to refrigerant containment) In-Depth Training Modules • Leak repair for high and low pressure systems • Recovery techniques for high and low pressure systems • Recharging techniques for high and low pressure systems • Pressure-temperature relationships • Components of high and low pressure units • EC waste regulations • Proper handling and destruction of waste refrigerants (including mixed refrigerants)

NA = Not applicable; leak detection is not required for small appliances.

Because ODS and F-Gas systems are very similar, training on both of these controlled substances should be taught under the same modules. For technicians already certified to work on ODS-containing equipment, their expertise should be easily transferred to apply to F-Gas-containing equipment. It is recommended that an "add-on" course be offered to cover F-Gas-specific training.

Such a course would include modules covering climate change, the Kyoto Protocol, relevant EC regulations, and technical aspects specific to F-Gas refrigerants.

MVACs

Certification in the MVAC sector should be provided by vocational training programmes and/or companies on-the-job, and should include hands-on instruction and/or testing. Certification should ensure that all technicians possess a core knowledge of:

- Climate change, Kyoto Protocol, and relevant EC Regulations
- Refrigerant identification and labelling
- Recovery, recycling, refilling, and reclamation (definitions and techniques, including proper use of equipment)
- Leak Repair
- Safety (as related to refrigerant containment)
- Proper handling and destruction of waste refrigerants, including EC waste regulations

Solvents

Companies in the solvent sector should implement mandatory in-house training programmes that result in personnel certification. In-house training programmes should be tailored to the specific tasks of equipment engineers and operators, based on the types of activities they will be performing and the types of equipment with which they will be working, and should cover:

- Ozone depletion, Montreal Protocol, and relevant EC Regulations
- Climate change, Kyoto Protocol, and relevant EC Regulations
- Technical procedures related to proper handling of solvent containing equipment;
- Technical procedures related to recovery of ODS and F-Gas solvents;
- Avoiding and managing spills;
- Maintenance procedures;
- Relevant EC waste legislation; and
- Health and safety concerns (as pertains to containment).

Power Distribution (SF_6)

Technician training and certification should be provided by companies in-house. Specialised training, including tailored examinations, should be based on the types of activities performed in the sector, and should be part of the training available to personnel working with this type of equipment. Further, it is recommended that the approach for training schemes be modular and cumulative, with each additional level of training building on the knowledge set developed from the previous level. Table ES-2 summarises the proposed structure, and presents the general knowledge areas that should be covered in each of the recommended training levels. According to this structure, personnel responsible for gas handling and recovery of SF_6 in service would need to complete Level 1 and 2b trainings; personnel responsible for major refurbishment and end of life would require the successful completion of training Levels 1, 2a, 2b, and 3.

Table ES-2: Recommended Knowledge Areas by Training Level (Power Distribution Sector)

Level 1: Operators of Filled SF_6 Equipment	Level 2a: Operators of New SF_6[a]	Level 2b: Operators of Used SF_6	Level 3: Waste Operators
• SF_6 properties • Environmental awareness, including Kyoto Protocol • Legal obligations pursuant to Regulation (EC) No. 842/2006	• Monitoring of SF_6 gas and appropriate recording of data related to national environmental obligations • Gas handling	• Monitoring of SF_6 gas and appropriate recording of data related to national environmental obligations • Gas handling	• Breakdown properties of SF_6 • Precautions and preparations for the opening of SF_6 filled electrical equipment • Personal protection

Level 1: Operators of Filled SF_6 Equipment	Level 2a: Operators of New SF_6[a]	Level 2b: Operators of Used SF_6	Level 3: Waste Operators
• Handling, control and storage • Safety in terms of release of SF_6 from storage and failed equipment • Communication actions in the event of non-routine occurrences • Transport of clean and recycled SF_6 related to national environmental obligations	operations, including evacuation, filling and "topping up", and leak detection • Measurement techniques (quality, density, moisture, acidity)	operations, including evacuation, filling and "topping up", and leak detection • Measurement techniques (quality, density, moisture, acidity)	equipment • SF_6 recovery • Decontamination • Waste management

[a] This module should cover IEC 60376 (Specification and acceptance of new Sulphur hexafluoride) or IEC 60480 (Guide to the checking and treatment of SF_6 taken from electrical equipment and specification for its re-use).

Fire Protection

Certification in the fire protection sector should be provided by vocational training programmes and/or companies on-the-job, and should include hands-on instruction and/or testing. To earn certification, technicians should possess a core knowledge of:

- Ozone depletion and climate change science (basics), Montreal Protocol, and Kyoto Protocol, and relevant EC Regulations
- Agent identification and labelling
- Recovery, recycling, refilling, and reclamation (definitions and techniques, including proper use of equipment)
- Leak detection and repair
- Safety (as pertains to containment)

Because ODS and F-Gas extinguishing systems are very similar, training on both of these controlled substances should be taught under the same modules. For technicians already certified to work on ODS-containing equipment, their expertise should be easily transferred to apply to F-Gas-containing equipment. It is recommended that an "add-on" course be offered to cover F-Gas-specific training. Such a course would include modules covering climate change, the Kyoto Protocol, relevant EC regulations, and technical aspects specific to F-Gas fire extinguishing agents.

1. Background

Regulation (EC) No 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases (F-Gases)[2] entered into force on 4 July 2006. The Common Position is comprised of two components; the Directive for the phase-out of HFC-134a in motor vehicle air conditioners (MACs), and the Regulation that implements the following:

- Provisions on containment, recovery, and labelling for stationary applications (e.g., refrigeration, air conditioning, fire-fighting, and high-voltage switchgear);
- Requirements for technician training and certification; and
- Use bans and prohibitions.

Under Article 5 of the Regulation, the Commission must establish minimum requirements and mutual recognition for training programmes and certification for the relevant personnel and for the companies and personnel involved in the above activities by the date of entry into force of the regulation. By one year upon entry into force of the regulation, Member States must establish or adapt their training programmes to meet the Commission's minimum requirements.

Additionally, Regulation (EC) No 2037/2000 was adopted by the European Parliament in October 2000 to comply with the Montreal Protocol and reduce emissions of ozone-depleting substances (ODS). The regulation applies to the production, importation, exportation, placing on the market, use, recovery, recycling, reclamation and destruction of ODS, including chlorofluorocarbons (CFCs), halons, carbon tetrachloride, methyl chloroform and hydrochlorofluorocarbon (HCFCs). Article 16(1) of Regulation (EC) No 2037/2000 requires that ODS contained in refrigeration, air-conditioning and heat pump equipment, as well as fire protection systems/fire extinguishers and equipment containing solvents be recovered during equipment servicing and maintenance or prior to disposal. The recovered ODS must either be recycled, reclaimed, or destroyed using technologies approved by the Parties or by any other environmentally acceptable destruction technology.

In addition to specifying the proper handling of ODS in equipment during servicing, maintenance and disposal, Regulation (EC) No 2037/2000 mandates the minimisation of leakage during equipment use. Specifically, Article 17(1) requires that users of ODS take all precautionary measures practicable to prevent and minimise leakage. In particular, stationary equipment with a refrigerating fluid charge size of

Definitions of Recycling, Reclamation, and Destruction

Recycling involves the extraction and cleaning of ODS fluid from an appliance for reuse, without meeting purification requirements for reclamation. In general, recycled ODS is fluid that is cleaned using oil separation, as well as single or multiple passes through filtering devices, such as replaceable core filter-dryers, which reduce moisture, acidity and particulate matter. These procedures are usually implemented at the field job site.

Reclamation involves the purification of ODS fluid to a specified level, requiring the complete removal of particulates, oil, organic and chlorinated acids, moisture (all of which are removed to some degree in recycling operations), as well as removal of non-condensable gases. In general, reclamation involves the use of processes or procedures available only at a reprocessing or manufacturing facility.

Proper *destruction* of ODS is critical to ensure that ODS do not escape to the atmosphere once the ODS-containing equipment reaches the end of its life, or recycled or reclaimed material is deemed to be no longer needed to replenish new or existing systems. ODS destruction technologies approved by the Parties are those described in reports by the United Nations Environment Programme (UNEP) and by the Technology and Economic Assessment Panel (TEAP), as well as the Incineration Directive, Decision XIV/6 on the status of destruction technologies of ozone-depleting substances, and the Report of the Canadian Workshop (from 10 July 2000). Examples of approved ODS destruction technologies include cement kiln incineration, liquid injection incineration, gaseous/fume oxidation, reactor cracking, rotary kiln incineration, municipal solid waste incineration and radio frequency destruction.

[2] OJ l 161 14.6.2006, p 1.

more than 3 kilogrammes (kg) must be checked regularly for leakage.

This provision is an important part of the Regulation with regards to the Regulation on fluorinated greenhouse gases because reducing leak rates can reduce emissions to a significant degree. Under Article 17(1), Member States are required to establish the minimum qualification requirements for the personnel involved and to report to the Commission on the programmes related to the above qualification requirements.

2. Purpose

The purpose of this study is to establish minimum qualification requirements and the conditions for mutual recognition of these qualifications for personnel dealing with ODS and F-Gases, to ensure that qualified personnel are used to minimise emissions of these gases during the operation and recovery of equipment and products containing such gases. In particular, this report reviews and recommends qualifications and programmes for personnel in the EU-25, Bulgaria and Romania, involved with the containment and/or recovery[3] of F-Gases and/or ODS from:

- Stationary refrigeration, air-conditioning, and heat pump equipment (ODS and F-Gases);
- Mobile vehicle air-conditioning (MVAC) equipment (F-Gases);
- Fire protection systems (ODS and F-Gases);
- Solvent-containing equipment/products (ODS and F-Gases); and
- High and medium voltage switchgear (F-Gases).

In addition to recommending minimum qualification requirements and training programmes for personnel, this study also aims to:

- Assess the extent to which other EU environmental legislation and standards impact the training and minimum qualification requirements;
- Assess how existing training programmes have been effective in the reduction of emissions and the recovery of ODS and F-Gases, and what is needed to ensure such effectiveness;
- Describe the deficiencies of existing training programmes; and
- Determine which Member States' provisions currently would comply with the recommended qualification requirements and certification.

[3] Associated activities include installation, servicing and maintenance (including leak inspection), and recovery at equipment disposal/decommissioning.

3. Methodology

ICF International (ICF) was contracted by the European Commission to assist in the evaluation of measures taken by the 25 Member States and two acceding countries regarding the minimum qualifications requirements and programmes for personnel pursuant to articles 16(1), 16(5), and 17(1) of Regulation (EC) No 2037/2000 and article 5 of the Regulation. In preparing this report, ICF reviewed the information contained in available Member State reports, and prepared and disseminated surveys to Member States and association/organizations relating to relevant minimum qualification requirements and programmes in place. All information was collated, summarized, and evaluated, as described in more detail below.

3.1 Data Collection and Summarisation

All Member States were asked to provide the most up-to-date information on the status of minimum qualifications and programmes for ODS and F-Gases in the end uses of interest. To facilitate the survey response process for Member State representatives, ICF first gathered any readily available information related to minimum qualifications and programmes in place in each Member State, and summarized the information in a table for Member State representatives to confirm or update as needed.[4] The summary tables were designed to solicit information on minimum qualifications and programmes arranged into four broad end-use categories, each with several sub-categories, for both ODS and F-Gases, as follows:

Refrigeration, Air Conditioning, and Heat Pump Equipment

- Minimum qualification requirements for personnel or companies involved in installation, maintenance, repair, and/or decommissioning
- Programmes for personnel or companies involved in equipment installation
- Programmes for personnel or companies involved in leak inspection/prevention (equipment maintenance)
- Programmes for personnel or companies involved in equipment servicing (including gas recovery)
- Programmes for personnel or companies involved in equipment decommissioning (including gas recovery) for eventual reclamation or destruction

Motor Vehicle Air Conditioning Containing F-Gases (HFCs)

- Minimum qualification requirements for personnel or companies involved in installation, maintenance, repair, and/or decommissioning
- Programmes for personnel or companies involved in equipment installation
- Programmes for personnel or companies involved in equipment servicing (including gas recovery and leak control, if applicable)
- Programmes for personnel or companies involved in equipment decommissioning (gas recovery) for eventual reclamation or destruction

Solvents

- Minimum qualification requirements for personnel or companies involved in installation, maintenance, repair, and/or decommissioning
- Programmes for personnel or companies involved in equipment installation
- Programmes for personnel or companies involved in equipment servicing (including gas recovery and leak control, if applicable)

[4] Information was taken from original submissions provided by Member State representatives in response to two previous studies recently conducted by the Commission: (1) the review and evaluation of the minimum qualification requirements and programmes for leak reduction, recycling, recovery, reclamation, and destruction of ODS, as required by Articles 16(5) and 17(1) of Regulation (EC) No 2037/2000 in the EU-15 (2005); and (2) the review to establish standard inspection requirements for technicians for preventing and minimising leakages and emissions of fluorinated greenhouse gases from stationary applications in the refrigeration, air conditioning, and fire protection sectors in EU-25, as required under Article 3 of the Common Positions (2006).

- Programmes for personnel or companies involved in equipment decommissioning (gas recovery) for eventual reclamation or destruction

High and Medium Voltage Equipment Containing SF_6

- Minimum qualification requirements for personnel or companies involved in installation, maintenance, repair, and/or decommissioning
- Programmes for personnel or companies involved in installation
- Programmes for personnel or companies involved in equipment servicing (including gas recovery and leak control, if applicable)
- Programmes for personnel or companies involved in equipment decommissioning (gas recovery) for eventual reclamation or destruction

Fire Protection Systems

- Minimum qualification requirements for personnel or companies involved in installation, maintenance, repair, and/or decommissioning
- Programmes for personnel or companies involved in equipment installation
- Programmes for personnel or companies involved in leak inspection/prevention (equipment maintenance)
- Programmes for personnel or companies involved in equipment servicing (including gas recovery)
- Programmes for personnel or companies involved in equipment decommissioning (gas recovery) for eventual reclamation or destruction

These surveys were sent via email to Member State representatives, and all responses received were summarized and assessed according to the methodology described in Section 3.2.

Additionally, questionnaires were sent to industry associations and relevant companies and equipment manufacturers to collect information on any training programmes they offer and obtain input on the key elements needed to ensure the effectiveness of a certification program.

3.2 Assessment of Survey Responses

Seven criteria were developed to assess the qualifications and training programmes in place in each Member State, by sector, as summarized in Table 1. These criteria allowed the minimum qualifications and programmes in place throughout all 27 countries to be succinctly summarized and easily compared.

As shown in Table 1, stars (*) are awarded for various qualification requirements for personnel and/or training programmes in place in each Member State; therefore, the more stars a Member State receives, the more rigorous the minimum qualification requirements/training programmes in place. The following conventions were also used to denote specific meanings in summary assessment tables presented in each chapter (arranged by sector):

- NA = Not applicable; used to denote cases where Member States have entirely phased out of ODS/F-Gases in a particular sector, and qualification requirements for personnel and training programmes are not needed.
- - [Dash] = Member States have no qualifications or programmes in place but use of ODS/F-Gases persists in a particular sector.
- [Blank] = Unclear whether a specific criterion is met by a Member State based on survey response/follow-up communication.

Table 1: Criteria Used to Summarize and Assess Member State Requirements and Programmes in Place in Each Sector

Criteria		Maximum Number of Stars(*)
Minimum Qualification Requirements		
1. Nature of Certification	Certification is required by law (*)	*
2. Who Must be Certified	Company expert/ manager (*); or	**
	All personnel (**)	
3. How to Obtain Certification	Successfully complete an examination (*), and/or	***
	Minimum years of experience (*), and/or	
	Completion of required courses (*)	
4. Certification Renewal?	Needed only for company expert/manager (*), or	**
	Needed for all personnel (**)	
Content/Rigor of Programmes/Training		
5. Nature of Programme	To obtain certification, completion of an examination is required by law (*), and/or	**
	To obtain certification, training programme is required by law (*)	
6. Nature of Education	Training includes both lecture & practical components (*), and/or	***
	Training covers regulatory requirements (*), and/or	
	Programme covers leak detection and prevention (*)	
7. Competency Testing	Written examination that tests theoretical knowledge (*), and/or	***
	Written examination that tests legal knowledge (*), and/or	
	Practical examination (*)	

It should be noted that in evaluating the minimum qualifications and programmes of Member States, any relevant legislation (pertaining to qualifications or programmes) recently approved or *pending* parliamentary approval was considered.

Voluntary certification schemes and training programmes offered in Member States are also discussed in each chapter, based on information provided through surveys responses.

4. Impact of Other Legislation and Standards on Minimum Qualification Requirements

4.1 Legislation

In addition to the Regulation (EC) No 842/2006 and Regulation (EC) No 2037/02000, other EU legislation influences the requirements of personnel handling certain types of ODS and F-Gases—namely *waste* ODS and F-Gases. Indeed, the survey responses received from the competent Member State authorities of Belgium, Finland, Italy, and Lithuania all referred to hazardous waste laws which govern the minimum qualification requirements in place for those personnel involved with the recovery/decommissioning of ODS and/or F-Gases from products and equipment.

In particular, Council Directives 91/689/EEC and 2000/53/EC serve to reinforce the requirements stipulated under Regulation (EC) No 842/2006 and Regulation (EC) No 2037/02000, as they aim to ensure that waste ODS and F-Gases (as well as other hazardous wastes) are properly handled by personnel to minimise emissions. Specifically, Council Directive 91/689/EEC of 12 December 1991 on hazardous waste, pursuant to Directive 75/442/EEC, requires that all hazardous waste, including halogenated organic substances, be identified, labelled, and not mixed with other hazardous waste. This Directive also stipulates that the disposal or recovery of any hazardous waste requires a permit from the competent authority,[5] and that organisations carrying out disposal or recovery of hazardous waste are subject to inspection. Similarly, Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on End-of-Life Vehicles (the "ELV Directive") requires the recovery of all fluids from old cars before scrapping. (EC 2003)

4.2 Industry Standards

In addition to EU waste legislation, a large number of industry standards and codes of practice exist which have often been linked to required minimum qualifications in Member States and/or generally help ensure that personnel dealing with ODS and F-Gases in products and equipment perform their work properly, to minimise emissions and maximise safety on the job.

For example, companies may be registered under the Eco-Management and Audit Scheme (EMAS), the EU voluntary instrument that acknowledges organisations that improve their environmental performance on a continuous basis. Similarly, companies may possess certification from the International Standards Organization (ISO), such as the ISO 9000 series on Quality Management Systems, and/or the ISO 14000 series on Environmental Management Systems (EMS). The ISO 9000 series provides generic details for organisations to develop quality management systems, which are intended to ensure that organisations are meeting all applicable regulations. The ISO 14000 guides organisations in developing EMS, with the overall goal to protect the environment and prevent pollution while maintaining the economic goals of organisations. The series stipulates requirements to guide organisations in the development of management policies, taking legal and other relevant requirement and environmental aspects into account.

Other sector-specific industry standards and/or codes of practice are also often incorporated into minimum qualification requirements. For example, in Sweden, technicians in the refrigeration/AC/heat pump sector must pass a standardized exam which tests their knowledge of the Swedish Refrigeration Code. In Germany, Hungary, and Slovenia, training for personnel in that sector covers standard EN 378, on safety and environmental requirements. Similarly, in Estonia, personnel

[5] The permit must cover the types and quantities of waste, technical requirements, security precautions, a designated disposal site, and the treatment method. The permit can be waived if a Member State adopts general rules listing the type and quantity of waste and legislates specific conditions and other requirements for carrying out different forms of recovery.

performing leak inspections will be required to follow ISO 17020:2004 on "General criteria for the operation of various types of bodies performing inspection."

Likewise, in the fire sector, personnel in Spain generally follow ISO 14520 or the Spanish UNE23570. In the UK, maintenance activities are generally performed by an engineer familiar with the design requirements of BS ISO 14520-1-2000(E), while in Ireland, those recovering halon are recommended to follow I.S. EN 27201-1: 1994 and I.S. EN 27201-2:1994. Austria requires personnel who perform testing and maintenance of fire extinguishers to take the Expert Training for Fire Protection Specialist to earn certification, in compliance with ÖNORM F 1053.

Some of the relevant industry standards and codes of practices that are or may be incorporated into minimum qualification requirements or taught in voluntary programmes in the EU are listed below, by sector:[6]

Refrigeration/AC/Heat Pump

- European Standard EN 378:2000, Refrigeration systems and heat pumps—safety and environmental requirements
- European Standard EN 13313:2001, Refrigeration systems and heat pumps—competence of personnel
- ISO 15161 - Guidelines for the Application of ISO 9001:2000 for the Food and Drink Industry
- ISO 17020:2004 on "General criteria for the operation of various types of bodies performing inspection."
- Code of Good Practice for the Reduction of Emissions of CFCs R-11 and R-12 in Refrigeration and Air Conditioning Appliances (Commission of the European Communities, DG Environment)
- Guidelines for Recovery & Recycling Systems – Refrigeration Sector (UNEP 1999)
- Swedish Refrigeration Code. Coordination Foundation of the Refrigeration Industry (1988)
- Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems (Environment Canada)
- Good Practice in Refrigeration and Air Conditioning (Environment Canada)
- Guidebook for Implementation of Codes of Good Practice - Refrigeration Sector (UNEP DTIE 1998)
- Training Manual on Good Practices in Refrigeration (UNEP 1994)
- Training Manual on Chillers and Refrigerant Management. UNEP. 1994.

MVACs:

- ISO/TS 16949 Quality systems - Automotive suppliers
- J1628 rev: Technician Procedure for Using electronic refrigerant leak detectors for service of mobile ac systems [draft]
- J2211 rev: recommended service procedure for the containment of HFC-134a [draft]
- J2727 rev: R-134a mobile ac system leakage chart [draft]

SF_6

- IEC 61634: High-voltage switchgear and control gear – use and handling of SF_6 in high-voltage switchgear and control gear
- IEC 61276-200: A.C. metal-enclosed switchgear and control gear for rated voltages above 1kV and up to and including 52kV
- IEC 60376: Specification and acceptance of new Sulphur hexafluoride
- IEC 60480: Guide to the checking and treatment of SF_6 taken from electrical equipment and specification for its re-use
- IEC 61276-203: Gas-insulated metal-enclosed switchgear for rated voltages above 52kV
- IEC 14040: Environmental management – life cycle assessment – principles and framework

[6] See chapters 5 through 9 for details on which industry standards are incorporated into specific national requirements/training programmes. No applicable industry standards in the solvents sector were noted in survey responses.

- CIGRE 276: Guide for the Preparation of Customised "Practical SF_6 Handling Instructions." Task Force B3.02.01 (2005).
- CIGRE 234: SF_6 Recycling Guide. Task Force B3.02.01 (2003).

Fire Extinguishing
- ISO 14520: Gaseous fire-extinguishing systems -- Physical properties and system design.
- ÖNORM F 1053 (Austria): examination, maintenance and marking of portable fire extinguishers as well as examination plaque.
- BS EN 27201-1:1994: Fire protection. Fire extinguishing media. Halogenated hydrocarbons. Specifications for halon 1211 and halon 1301
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5. Refrigeration, Air Conditioning, and Heat Pumps

5.1 Background

The refrigeration, air-conditioning (AC), and heat pump sector includes a wide range of equipment types that have historically used ozone-depleting substances (ODS), namely chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs). As the ODS phase out has taken effect, equipment has been retrofitted or replaced with non-ODS alternatives, including F-Gases (e.g., R-134a, R-404A, R-407C, R-410A). ODS and F-Gases are emitted to the atmosphere during equipment installation, operation, repair and decommissioning/disposal. To minimise emissions from this sector, personnel working on ODS or F-Gas-containing equipment must be trained in the proper procedures for installing, servicing, maintaining, and decommissioning such equipment.

5.2 Survey Response

Survey responses were received from 24 Member States and Bulgaria,[7] as well as 18 industry associations, manufacturers, and other independent organizations including the following:

- Air Conditioning and Refrigeration Industry Board (ACRIB) – United Kingdom
- Air Conditioning and Refrigeration European Association (AREA) - EU
- Daikin Europe NV (Including Daikin Belgium, France, Germany, Italy, Slovakia)
- European Cold Storage and Logistics Association (ECSLA)
- Confederation of the Food and Drink Industries of the EU (CIAA) – EU
- Test und Weiterbildungszentrum Wärmepumpen und Kältetechnik gGmbH (TWK) – Germany
- Association Matal Formation – France
- *Verband Deutscher Kälte-Klima-Fachbetriebe* e.V. (VDKF) – Germany
- Centro Studi Galileo – Italy
- Refrigeration Research and Development Center (COCH) – Poland
- Carcow University of Technology – Poland
- PROZON Foundation/National Refrigeration Forum (*Krajowe Forum Chlodnictwa*) – Poland
- Slovak Association for Cooling and Air Conditioning Technology, Rovinka (SZ CHKT) – Slovakia
- BOC Refrigerants – United Kingdom
- Hungarian Standards Institution Secretariat for Certification (MSZT) – Hungary
- South West Trains – United Kingdom
- Sea Containers Railway Services (SCRS) – United Kingdom
- Domestic Appliance Service Association (DASA) – United Kingdom

Information provided through these surveys on the minimum qualification requirements in place, as well as any voluntary or required training programmes offered, is presented in this chapter. In addition, the effectiveness of programmes currently in place is discussed, and industry recommendations on essential programme components needed to ensure training effectiveness and personnel skills/knowledge are summarised. Finally, recommendations for minimum qualifications for personnel dealing with refrigeration, AC, and heat pump equipment are presented at the end of the chapter.

[7] Responses were not received from Latvia and Romania.

5.3 Member State Minimum Qualification Requirements and Training Programmes: ODS

All 24 respondent Member States have minimum qualification currently in place or soon to be implemented for personnel working with ODS in refrigeration, AC, and heat pump equipment.

5.3.1 Member States with minimum qualification requirements for personnel (ODS)

All Member States, with the exception of Denmark and Sweden, require (or will soon require) *all* personnel working with ODS-containing equipment in this sector to be certified. In Denmark and Sweden, personnel may forego certification if they work under the supervision of a person who is certified or for an accredited company (with a certified work manager), respectively. In addition, certification renewal is required in Belgium, Czech Republic, Greece, Hungary, Lithuania, Malta, Poland, Portugal, Slovakia, Sweden and the United Kingdom.

The requirements for obtaining certification are most rigorous (at least on paper) in Bulgaria, Cyprus, Czech Republic, Estonia, Finland, Germany, Greece, Hungary, Italy, Lithuania, Malta, Portugal, Slovakia, Slovenia, and Spain—where personnel must (1) complete a training course or required level of education; (2) pass an exam; and (3) posses a minimum level of experience.[8] Legislation to regulate such requirements is not yet final in Cyprus, Italy, Lithuania, Malta, and the United Kingdom. The bullets below describe the programmes in place or pending in each of these Member States and Bulgaria:

- The **Bulgarian** Decree No. 254/1999, as amended by Decree No. 224/2002, requires that all personnel working with ODS in refrigeration, AC, or heat pump equipment must have at least three years of experience, have technical higher education, and take a required training course to be certified. The Institute of Refrigeration and Air-Conditioning is licensed by the Ministry of Education and Science to organize the required training, but no specific information on the course was available.

  An additional amendment, which will enter into force on 1 January 2007, will specify how often certification must be renewed. This amendment will also specify separate certifications for personnel performing recovery activities and personnel performing leak inspections. Specific information regarding these certifications was not available. (Bulgaria 2006)

- **Cyprus** expects to have legislation defining requirements for personnel working on stationary refrigeration and AC equipment in place by the end of October 2006. These requirements will be the same as those in place for personnel working with MVACs and shall include the completion of a required training programme and a standardized test. Personnel will have to meet minimum years of experience depending on their level of education.[9] (Cyprus 2006)

[8] The survey responses provided by Bulgaria and Finland did not explicitly indicate that an exam is required, but it is assumed that this included in the specific training courses and/or degrees required by these Member States.
[9] Specific information on the years of experience needed was not provided.

- In the **Czech Republic**, Government Order 117 establishes requirements for personnel that handle controlled refrigerants and perform leak inspections. Personnel that handle controlled refrigerants must obtain certification by completing a certain level of education (e.g., secondary vocational education, university education, adult education) and having at least two years of professional experience. Personnel that inspect equipment must obtain a different certification by completing a certain level of education and a specific training course (which culminates in a final exam), and must have at least four years of professional experience. The training course required for personnel performing leak inspections includes nine modules that include both lecture and practical components and cover the relevant legislation and leak detection (see text box). Depending on their previous education, personnel are not required to take all modules; the only required module is the final leak inspection training module, which includes a written theoretical, practical, and oral exam. The certification for personnel performing leak inspections must be renewed every three years. (Czech Republic 2006)

Leak Inspection Modules in the Czech Republic

Nine modules are included in the training programme for personnel performing leak inspections in the Czech Republic:

1. Refrigeration and AC I: basic principles, applications, terminology, physics of refrigeration and AC
2. Refrigeration and AC II: diagrams, circuits, heat exchange, calculations
3. Manipulation with Refrigerants and Oils: refrigerants, relations to the environment, TEWI, ODP, recovery, material safety data sheets
4. Basics of Electrotechnics and Electronics: basic principles, measurements, connection schemes, malfunctions, IT, data archives, usage of PC
5. Construction and Installation of Pipe Systems: pipe installation, soldering, vibration, evacuation, leakage, leakage detection, condensers
6. Service and Maintenance Procedures: detecting malfunctions, circuit opening, compressor installation/exchange, evacuation, leakage detection in complex equipment
7. AC: basic principles, AC systems, installation, pipe insulation, AC in buildings
8. The Green Card Certificate: environmental legislation, recovery without leakage, energetic efficiency
9. Leakage Inspection Training: detection methods, leakage areas, calculations, keeping records, reporting requirements

- In **Estonia**, the Ministerial Regulation No. 16 of the Minister of the Environment establishes two levels of certification for personnel working with refrigeration/AC equipment: mechanic and technicians, with technicians being qualified to perform leak detection. All personnel are required to have various amounts of experience,[10] basic education, and professional training that culminates in an exam. The training courses for mechanics and technicians—which are provided by a private company (OU Opimaja/Training House) that operates under a license from the Ministry of Education and Science—include three weeks of theoretical class work covering the relevant legislation and health and safety, and three months of practical experience. The practical part of the course for technicians includes leak detection and repair. Information on the exam administered at the end of the course was not available.

- In **Finland**, similar but differing minimum qualification requirements for personnel working with refrigeration and AC equipment with charges less than three kilogrammes and those working with equipment with charges greater than three kilogrammes are designated by Government Decree No. 1187/2001, as amended by No. 1239/2003. Requirements also differ for personnel in charge versus those performing the work, and for personnel installing and servicing equipment versus those decommissioning equipment. All personnel must have some previous years of experience, various degrees or other education qualifications, and complete a training course related to hazardous wastes, as ODS and HFCs are considered hazardous waste in Finland. Personnel in charge of any activity must have two years of experience; personnel who install and/or service

[10] Mechanics must have at least one year of practical work experience with ODS or F-Gas-containing equipment and with equipment used for electrical installation, metalworking, and plumbing. Technicians must have at least three years of experience.

equipment must only have one year of experience; and personnel who decommission equipment must have two years of experience.[11]

In addition, personnel in charge must either have a technician degree or a specialist vocational qualification in the refrigeration field. Personnel who install and service equipment must have a basic degree relevant to occupational safety, handling of refrigerants, refrigeration technology, and energy efficiency and one year of work experience, or a basic degree or specialists vocational qualification in the refrigeration field. Personnel that decommission equipment must have basic training as a waste reception centre superior and/or technical training. All personnel are required to have knowledge of the relevant regulations. (Finland 2006)

- Minimum qualifications for personnel working with refrigeration, AC, and heat pump equipment in **Germany** are defined in the *ChemOzonSchichtV* regulation. Personnel are required to have completed technical training and passed an exam as either a refrigeration engineer/tradesman or a licensed technician in the field of refrigeration technology.[12] Personnel that perform leak detection are also required to have at least five years of experience in the planning, construction, and maintenance of refrigeration equipment.

  The training to become a refrigeration tradesman takes 3.5 years and includes a series of practical and lecture courses that cover the following:
  - basics of refrigeration and AC equipment including installation, maintenance, and servicing;
  - relevant regulations;
  - refrigerants, replacement refrigerants, and retrofitting;
  - recovery, evacuation, recycling, and disposal;
  - safety; and
  - leak detection.

  Personnel performing leak detection must take a one-day course on leak proof construction and a two-day course on leak detection and impermeability, which includes hands-on practice. (Germany 2006, VDKF 2006)

- In **Greece**, Presidential Decree No. 87 requires that personnel involved in the installation, maintenance, and servicing of refrigeration and AC equipment must have a Refrigeration Fitter License. In order to obtain this license, a technician must have (1) several levels of degrees/diplomas in refrigeration installations (or the equivalent); and (2) at least 250 days experience working on refrigeration installations. At the time of the publication of the Presidential Decree, licenses were also granted to those technicians with at least three years of experience in the refrigeration field who passed an examination. Technical leaders of technician work crews must have additional qualifications, including several levels of degrees/diplomas, the successful completion of the necessary exams, and at least 10 years of experience working with refrigeration/AC installations. All licenses are reviewed every five years.

  All required examinations mentioned above include both an oral and written section. Although the specific topics are determined by the examination committee, the exams always cover the basic concepts of refrigeration, refrigeration and AC equipment, the rules of installation (including filling), refrigerants, refrigerant recovery, leak detection and repair, and environmental and safety issues.

- **Hungary** has had regulations in place since 1993 (Order 22/1993, VII. 20, KTM) requiring personnel handling refrigerants or performing any activity that could lead to refrigerant emissions

[11] Experience must be in the installation/maintenance or waste management field.
[12] Personnel with similar competencies from other Member States can also meet the requirements.

to be certified through the Hungarian Refrigeration and Air Conditioning Association (HRACA). Technician certification is given in the following four levels:

- Class A – Home Appliance Service Craftsman: can service plug-in/capillary appliances;
- Class B – Industrial and Commercial Refrigeration Craftsman/Installer: can service all refrigeration and AC equipment;
- Class C – Ventilation and AC Installers: can service comfort ACs and chillers up to 5 kg charge; and
- Class D – Small Capacity AC Unit Installers: can service split system equipment.

In order for technicians to become certified in one of these classes, they must receive a green card from HRACA by completing vocational education and postgraduate training and by passing an exam. The vocation education is an eight-year programme consisting of 40% theoretical and 60% practical training. The postgraduate training covers new technological developments, products, and refrigerants (including F-Gases) and an environmental protection course, "Refrigerant Safe Handling and Certification." This course covers the environmental impact of refrigerants; environmental protection during installation, repair, and maintenance; repair and maintenance of refrigeration and AC applications; ODS-substitute refrigerants; health and safety; and refrigerant recovery.

The need for previous experience is assessed on a case-by-case basis by the Competence Committee of HRACA for those technicians with Class B certification. Previous experience is not needed for the other certification classes. The green card must be renewed every five years.

For personnel performing leak inspections, minimum qualification requirements are established by Governmental Decree 94/2003. Technicians wishing to be certified to perform leak inspections must posses a valid Class B green card, have three years of working experience, and then obtain an orange card from HRACA by taking a two-day training course on leak detection. In addition, candidates must successfully complete an exam, which includes an oral component covering theoretical and legal knowledge as well as a practical component. The orange card must be renewed every five years by taking a course. (Hungary 2006)

Required Training Course Offered in Italy

The Italian training course will cover the following topics:

Section I – Legislation
- Environmental problems associated with ODS;
- Legislative framework for refrigeration/AC installations and equipment;
- Prevention and controls to reduce leakage of ODS;
- Roles, responsibilities, and obligations of qualified refrigeration technicians in controlling and reducing atmospheric emissions of ODS; and
- Proper maintenance and leak checks, recovery, and disposal of ODS refrigerants.

Section II – Technical Part
- Knowledge of ODS refrigerants controlled by EC Regulation No 2037/2000;
- Knowledge of replacement refrigerants;
- Awareness of the technical and environmental implications of the use and replacement of ODS refrigerants; and
- Examination of the problems relating to the sealed installation of refrigeration circuits.

Section III – Practical Tests
- Operations to recover refrigerant and related packaging;
- Assessment of critical loss points in refrigeration circuits; and
- Leak detection using portable surveying equipment.

- In **Italy**, a regulation on minimum qualification requirements and training for personnel involved in recycling, recovery, reclamation, and destruction of ODS was drafted in 2001, but is still pending approval by the Italian Parliament.[13] Once finalised, this regulation will require technicians performing leak inspections and ODS recovery, recycling, reclamations, and/or destruction to (1) have one year of experience and have completed upper secondary education *or* have at least three years of experience (without

[13] Currently, the Italian Waste Legislative Decree No. 22 of 5 February 1997 requires companies working with refrigeration, AC, and heat pump equipment containing ODS to obtain a permit from their respective Region. These companies must ensure that their technicians have completed the required training course, which covers the same topics as the training course to be offered under the new legislation, and culminates in a final exam.

necessarily having completed upper secondary education), (2) have completed a standardized training course, and (3) have passed an exam

The required training course will consist of three parts, including legislation (4 hours), technical aspects (15 hours) and practical tests (15 hours) (see text box). Technicians can also obtain additional training from vocation schools or industry associations, such as Centro Studi Galileo (Euro Heating & Cooling), Assofreddo (National Association for Refrigerator Engineer), and Confartigianato. (Italy 2006)

- In **Lithuania**, general minimum qualification requirements for personnel servicing, maintaining, and dismantling refrigeration and AC equipment using ODS are approved by Ministerial Order No D1-206 and include experience with and knowledge of equipment, environmentally safe handling of ODS, and emission prevention. Because these requirements do not include a specific certification, the Ministry of Environment drafted a Governmental Resolution requiring vocational training, which is expected to be implemented in 2006.[14] The details of this training are currently being prepared and are to be implemented on 1 January 2008. In addition to the national programme, some independent companies, such as JSC "Folinas" voluntarily certify their technicians, and some vocational schools, such as Kaunas Builder Training Centre, have included ODS-related topics in their training programmes.

  In addition to the general minimum qualification requirements that are currently in preparation, specific certification requirements for personnel handling hazardous waste, including ODS recovery, recycling, reclamation, and destruction, are defined in the Order of the Minister of Environment No 684. This order requires all companies handling hazardous waste to obtain a license by ensuring that their personnel possess the appropriate qualification certificates, among other requirements. In order to obtain a qualification certificate, personnel must have (1) completed secondary school, (2) completed an approved training programme, (3) have previous work experience (will be required only for managers as of 1 January 2007), (4) possess specific knowledge and skills relating to the handling of hazardous wastes, and (5) pass an exam at the Certification Centre of Building Products. The exams and training programmes, which are currently offered by the Centre for Environmental Policy and the Environmental Management and Audit Institute, are specific to the waste flow to be handled (i.e., ODS). The hazardous waste certificate must be renewed every five years. (Lithuania 2006a)

- In **Malta**, a technician certification programme is in place that is currently voluntary, but will be required by future legislation. To earn certification, technicians must have a minimum of three years of work experience in the refrigeration, AC, and heat pump sector, and must successfully complete a two-day theoretical and practical training course on the safe handling of ODS (and F-Gases). This course, offered at the University of Malta, includes a dedicated module on leak inspection and reduction and concludes in a written exam. Once the legislation has passed, certification will have to be renewed, although the frequency has not yet been established. (Malta 2006)

- In **Portugal**, personnel involved in leak detection and repair of equipment containing ODS and in the recovery, recycling, reclamation, and destruction of ODS must be certified in one of two schemes, according to Decree-Law 152/2005. To earn one type of certification, personnel must have an engineering degree with specific training in the refrigeration/AC field or a general engineering degree with at least five years of experience in the field. To earn the second type of certification, personnel must take at least one of the offered training courses, pass a standardized exam, and have at least five years of experience. Both certifications must be renewed after five years. The training courses are offered by industry associations and training organizations and

[14] Currently in Lithuania, the Construction law and secondary legislation (namely STR 1.01.06:2002) requires that personnel in charge of the installation of refrigeration system must be certified and have completed training. No details on this training were provided.

last anywhere from 35 hours to six months. The courses include lecture and practical elements that cover regulatory requirements but not necessarily leak detection. (Portugal 2006)

- In **Slovakia**, the Slovak Association of Refrigeration and Air Conditioning Engineers (SZ CHKT) is licensed by the Ministry to certify personnel working with refrigeration and AC equipment, as required by Law No. 76/1998 Col. and Ministerial Order No. 283/1998 Col. Two categories of certification are given for refrigerant handling and leak inspection: Competency for Handling Refrigerants and Competent Specialist on Checking Pressure Vessels. Both certifications are obtained by (1) completing a required four- to five-day training course that includes both theoretical and practical components and covers the legislation/regulations and leak reduction/inspection; and (2) passing a standardized written and practical exam. Refrigerant handling technicians must also have previous experience, with three years being required for personnel performing equipment maintenance and six years being required for personnel performing equipment installation and repair. Certifications must be renewed every five years. (Slovakia 2006, SZ CHKT 2006)

- In **Slovenia,** according to regulation OJ RS No 42/03, personnel that install, maintain, service, and decommission equipment must successfully complete the training course, "Correct Handling of Substances in Different Equipment," offered by the Center za poslovno usposabljanje (CPU). In order to be qualified to take the course and receive the certification, personnel must either: (1) complete vocational training of level IV in electrical or mechanical engineering and have three years of experience assembling, servicing, and maintaining refrigeration, AC, and heat pump equipment; or (2) complete vocational training of level V in electrical or mechanical engineering. The 40-hour training programme includes 26 hours of theoretical training and 14 hours of practical exercises and covers the environmental protection legislation; refrigerants; refrigeration, AC and heat pump techniques; recovery, recycling, reclamation and destruction of ODS; and practical exercises (including determination of defects and repair, working with up to date servicing equipment, and recovery and system refilling). The course culminates in a written and practical exam. In addition, physical or legal entities that perform maintenance activities on ODS equipment must be registered, and to do, they must fulfil a variety of technical conditions. As part of these conditions, they must have equipment for recovery, storage, recycling, and instruments for measuring equipment leakage, and they must have at least one qualified equipment servicer on staff. Companies must renew their registration every four years. (Slovenia 2006)

- In **Spain,** regulation requires personnel that install, maintain, and/or perform leak inspections on refrigeration/AC equipment to be licensed. Currently, the RSF regulation requires personnel to have some years of experience, hold a degree for industrial vocational studies specialising in refrigeration installation, maintenance, and/or repair and pass a standardized exam. As the RSF is in the process of being revised, the new regulation will also require all personnel to take a training course called the "First Degree of Professional Scholar Training," to obtain a license. This course will cover leakage prevention, refrigerant recovery and management, environmental protection, ODS handling, waste management, and energy efficiency. It is divided into two segments, the first of which requires three to five years to complete (covering 2,000 hours of course work) and culminates in a final exam. The second level of the course includes an additional 2,000 hours covering the installation and maintenance of refrigeration, AC, and heat pump equipment. (Spain 2006)

France requires either the completion of a training course or minimum years of experience and, for personnel performing recovery/reclamation or leak prevention, a diploma/certificate, which is assumed to culminate in a final exam. Specifically:

- The French Decree No 92-1271, as amended by Decree No. 98-560 (and currently being revised) establishes minimum qualifications for companies and individuals working with refrigeration, AC, and heat pump equipment containing more than two kilogrammes of CFCs, HCFCs, or HFCs. Companies are required to register with the prefecture and provide proof that their

personnel have either (1) a diploma/certification from a training centre approved by the Industry Ministry, the Agricultural Ministry, or the Association for Adult Vocation Training; (2) an equivalent certification from another Member State; *or* (3) proof of six years of experience. Personnel performing recovery/reclamation on household cooling equipment must have a Level IV diploma/certificate, and those performing leakage prevention must obtain a Level IV or Level V certification, depending upon the type of equipment being serviced.[15] Numerous education programmes offer Level IV and V certification including National Education Diplomas, the Association for Adult Vocational Training, The Paris Chamber of Commerce and Industry, and the Ground Army. The national education programmes last two years, and the level V programme requires 30 hours of on-site education as an apprentice. Company registration must be renewed every five years, but personnel are not required to renew their qualifications. (France 2006)

Two Member States—Luxembourg and Poland—require the successful completion of a training course and a standardized exam, with no minimum years of practical experience, as described below:

- In **Luxembourg**, the Règlement grand-ducal of 2004 requires all personnel that work with refrigeration and AC equipment to have either (1) a master craftsman's license as a refrigeration engineer or (2) a certificate issued by the Chamber of Trades. To receive the certificate, personnel must take a training course—which consists of four two-hour classes and two four-hour classes that cover the legislation, refrigerant recovery, leak reduction, and waste management—and pass an exam at the end of the course. (Luxembourg 2006)

- In **Poland**, minimum qualification requirements are defined in the ODS Act of 20 April 2005. Certification programmes exist for personnel performing activities in the following three categories related to refrigeration and AC equipment:

    1. Handling of any controlled substance;
    2. Repair, maintenance, or servicing of cooling equipment or systems containing any controlled substance or the handling of such substances; and
    3. Disassembly of systems or equipment or recovery, recycling, reclamation, and destruction or handling of any controlled substance.

    In order to obtain certification, personnel must (1) complete basic vocational or secondary education; (2) have taken a specific lecture-based and hands-on training course on controlled substances that covers legislation, the environmental impacts of controlled substances, refrigerant recovery, the handling of refrigerant waste, replacement refrigerants, and the installation, maintenance, repair, and inspection of refrigeration and AC equipment (including leak detection);[16] and (3) have passed a standardized theoretical and practical exam that covers the topics taught in the training course. Certification must be renewed every five years by taking a follow-up course and passing an exam. (Poland 2006)

Austria requires the completing of a training course for all personnel, as described below.

- In **Austria**, the Order on Refrigerating Equipment requires that personnel performing inspections on and maintaining, servicing, repairing, and recharging refrigeration and AC equipment take a training course covering the environmental hazards of refrigerants and accident prevention. The following three courses are offered to train personnel:

    1. Order on Training as a Refrigeration Machinery Mechanic;
    2. Order on Training as a Refrigeration Equipment Engineer; and
    3. Order on Training for the Trade of Heating, Refrigeration, Noise and Fire Insulation.

[15] Specific information on the types of equipment and the related required level of education was not provided.
[16] Personnel that have completed secondary *technical* education do not have to take this training course.

Belgium, UK, Ireland, and the Netherlands only require the successful completion of an exam:

- In **Belgium**, the Royal Decree of 21 December 1974 stipulates the qualification requirements for refrigeration technicians working in small- and medium-sized enterprises (SMEs). Technicians must be certified by (1) taking a course in secondary school or, if the technicians already has sufficient experience, a specific course in recycling and (2) passing an exam. However, because this regulation does not guarantee the compliance required under the EC regulation, additional regulations in the Flanders, Brussels, and Walloon regions are being prepared, as described below.

  In both the Flemish and Brussels regions, a proposal requiring certification for refrigeration companies is currently being prepared. In order for a company to be certified, all personnel working there must pass a standardized exam offered by accredited examination centres. In the Walloon region, companies must be certified and personnel must have a certificate of environmental competence to perform installation, maintenance, and servicing on refrigeration and AC equipment containing more than three kilogrammes of fluorinated refrigerants. Personnel obtain certification by passing an exam recognized by the DGRNE (General Administration of Natural Resources and Environment). All required exams will have theoretical, regulatory, and practical components.

  Renewal is required in all regions. In both the Flemish and Brussels regions, the proposed regulation will require personnel to take a short, theoretical renewal exam every five years. In the Walloon region, technicians must attend an eight-hour training course covering the current techniques and legislation every five years.

  While no specific courses are required in order to qualify for the certification, several organizations—including secondary schools, universities, adult education programmes, and private institutions—offer courses to train refrigeration and AC technicians as required under the Royal Decree of 21 December 1974. Many of these courses include both lecture and practical aspects, and in the Walloon region, curriculum must cover the impact of different refrigerants on the environment, the regulations governing the application of refrigerants, and the code of good practice, among other topics. Different courses are offered in each region, but in general, refrigeration classes are taught at technical secondary schools; cooling installation courses are offered in vocational secondary schools; and AC is taught as part of higher education in electrical engineering classes. Adult education classes on the topic of refrigerants are also offered for those already working in the sector, including self-employed individuals, and those seeking employment. In the Flemish region, one private organization offers a programme of courses, including a two-day course on CFC handling, to prepare technicians for the CFC vocational qualification diploma for qualification as refrigeration engineer in the Netherlands (STEK). Programme lengths vary greatly, with a higher degree in electrical engineering including AC in the Flemish region lasting three years, and other courses offered by private institutions lasting only one to two days. (Belgium 2006)

- In the **UK**, regulations are expected to enter into force in the summer of 2006 that will require all personnel handling ODS to complete either (1) the City and Guilds Vocational Award Scheme No. 2078 on Handling Refrigerants, or (2) the Construction Industry Training Board (CITB) Construction Skills Building Engineering Services (BES) Scheme on the Safe Handling of Refrigerants. While the successful completion of an exam is the only required aspect to obtain these certification schemes, nearly all entrants take some training to ensure they have the necessary knowledge on the current legislation, standards, and industry best practices. Applicants for the City and Guilds Scheme are not required to have minimum years of experience, but some experience is generally desirable; applicants for the CITB Scheme must have some experience with the recovery and charging of refrigerants.

For the City and Guilds Scheme, candidates are individually assessed on theoretical knowledge (through oral questions) and practical activities in two units—Charging Refrigerant and Recovering Refrigerant. During these assessments, candidates must perform charging, recovery, leak testing, and repair activities and answer questions regarding the relevant regulations, industry standards, and leak testing and repair.

For the CITB scheme, candidates are assessed on health and safety, leak testing, recovery, charging, evacuation, environmental impacts, and legislation and regulations through written and practical tests (which last 2.5 hours and 1.5 hours respectively). The typically training taken before the assessment, although dependent on the previous knowledge and experience of the applicant, lasts approximately 10 hours. The CITB certification must be renewed every three years. (UK 2006, ACRIB 2006)

- In **Ireland**, the Department of Environment, Heritage, and Local Government (DEHLG) is currently drafting legislation to establish minimum qualifications that is expected to be enacted by December 2006. The minimum qualifications will require all personnel that perform leakage control, recovery, recycling, reclamation, or destruction of controlled substances to be certified or supervised by a certified person. Personnel that install, service, maintain, dismantle, or dispose of refrigeration, AC, and heat pump equipment using controlled substances must be certified. The completion of the City and Guilds Scheme No. 2078 on Handling Refrigerants, as described above for the United Kingdom, or an equivalent certification scheme will qualify personnel for certification. This scheme offers training but only requires the successful completion of an exam.

- In **the Netherlands**, the Association for the Accreditation of the Refrigeration Installation Industry (STEK, *Sichting Erkenningsverlening voor het Koeltechnisch installatiebedrijf*) is responsible for implementing and maintaining a certification programme for companies that work with equipment containing CFCs, HCFCs, and HFCs. Only companies certified by STEK can work on ODS- or F-Gas-containing refrigeration equipment, and all mechanics that work with CFCs, HCFCs, and HFCs must be certified STEK engineers. In order to become a STEK-certified engineer, personnel must pass a standardized exam that is offered at seven exam centres throughout the country. The exam includes both a theoretical section that covers the regulations and technical aspects of minimising leakages while working with refrigeration equipment, and a practical section that covers refrigerant charging, evacuation, recovery, installation, and pipe soldering. STEK also offers a non-mandatory training programme that includes courses, practical training, self study, and internal company trainings. Once achieved, STEK certification does not need to be renewed. (ICF 2005)

Denmark and Sweden have strong minimum qualifications in place for work managers and/or companies, but not for all personnel, as described below:

- In **Denmark**, Order 2002/243 requires that personnel who perform servicing, maintenance, and dismantling of refrigeration and AC equipment must either (1) be certified refrigeration engineers; (2) have taken a course offered through the adult vocational training system (or similar course); or (3) work under the supervision of such a person. In order to become a certified refrigeration engineer, personnel must have education as a skilled metal worker, 1.5 years of work experience, and complete a four-year course of education.[17] The education consists of 35 weeks of student-selected courses (including courses such English, German, and math) and 20 weeks of courses focused on refrigeration and AC. The adult vocational course most relevant to ODS handling is called "New Refrigerants – CFC/R-134a" and consists of twenty-four 45-minute classes that cover legal requirements (20%), safety and environment (18%), refrigeration substances (14%), lubricants (8%), changing parts (12%), imperviousness testing (8%), operation of equipment

[17] Exceptions to the education requirement can be made for apprentices over 25 years of age with relevant work experience.

(12%), and evaluation (8%). In order to pass, the course must be completed to the teacher's satisfaction. (Denmark 2006)

- In **Sweden**, Refrigerants Order (SNFS 1992:16) requires any enterprise that works with refrigerant circuits or devices that affect their functioning in stationary and mobile refrigeration, AC, and heap pump equipment containing CFCs, HCFCs, and HFCs to be accredited by the Board for Accreditation and Conformity Assessment (SWEDAC). In order for a company to obtain accreditation, its work manager must obtain the relevant certification depending on the class of work they are performing (see text box) by proving their knowledge of the Swedish Refrigeration Code—a standard developed by the Swedish Refrigeration Foundation and the Swedish Environmental Protection Agency that describes installation, servicing, maintenance, recovery, and recycling—through a theoretical and practical exam. Managers must also have previous years of experience, although information on the number of years required was not provided. However, if they possess three years of technical secondary school or college training, they are only required to have one year of work experience. Certification must be renewed every five years by retaking the standardized exam. (Sweden 2006)

Swedish Work Manager Classes

- Class 1: Operation and maintenance of stationary equipment with a charge of more than 200 kg (installed systems) or 300 kg (self-contained, hermetically sealed systems).
- Class 2.1: Draining of systems containing no more than 3 kg of refrigerant.
- Class 2.2: Installation, servicing, and attending to the system requirements of stationary self-contained systems containing no more than 3 kg of refrigerant.
- Class 2.3: Installation, servicing, and attending to the system requirements and inspection of mobile systems containing more than 3 kg of refrigerant.
- Class 3.1: Installation, servicing, and attending to system requirements and inspection of stationary and mobile systems containing no more than 50 kg of refrigerant.
- Class 3.2: Installation, servicing, and attending to the system requirements and inspection of stationary and mobile systems containing more than 50 kg of refrigerant.

5.3.2 Summary of Member State minimum qualifications and programmes: ODS

Table 2 below summarizes and compares the minimum qualifications in place (or pending) in each Member State, per the assessment criteria identified in Section 3.2. No information is available for Latvia and Romania, as no survey responses were provided; therefore, these Member States are not included in the table below.

Table 2: Summary of Minimum Qualification Requirements and Programmes for Refrigeration, AC, and Heat Pump Equipment (ODS)

Member State	Criteria for Minimum Qualification Requirements				Criteria for Programmes		
	Nature of Certification	Who Must be Certified	How to Obtain Certification	Certification Renewal?	Requirement by Law	Nature of Education	Competency Testing
Austria	*	**	*	-	*		-
Belgium	*	**	*	**	*	***	***
Cyprus	*	**	***	-	**		
Czech Republic	*	**	***	**	**	***	**
Denmark	*	**	**	-	*	**	-
Estonia	*	**	***	-	**	***	
Finland[a]	*	**	***	-	**		
France[a]	*	**	**	-	**		
Germany	*	**	***	-	*	***	-
Greece	*	**	***	**	**		*
Hungary	*	**	***	**	**	***	***

Member State	Criteria for Minimum Qualification Requirements				Criteria for Programmes		
	Nature of Certification	Who Must be Certified	How to Obtain Certification	Certification Renewal?	Requirement by Law	Nature of Education	Competency Testing
Ireland	*	**	**	-	**	**	
Italy	*	**	***	-	**	***	
Lithuania	*	**	***	**	**		
Luxembourg	*	**	**	-	**	**	
Malta	*	**	***	**	**	**	*
Netherlands	*	**	*	-	*	*	***
Poland	*	**	**	**	**	***	***
Portugal	*	**	***	**	**	**	
Slovakia	*	**	**	**	**	***	**
Slovenia	*	**	***	**	**	***	***
Spain	*	**	***	-	**	*	
Sweden	*	*	**	*	*		**
UK	*	**	*	**	*	***	**
Acceding Country							
Bulgaria[a]	*	**	***	**	**		

Notes: Dashes (-) indicate that minimum qualification or programme criterion is not in place. Blanks indicate uncertainty regarding whether the criterion is in place, as no information was provided through survey responses.

[a] Although not specifically indicated in the survey response provided, it is assumed that required training course/programme culminates in a final exam.

5.4 Member State Minimum Qualification Requirements and Training Programmes: F-Gases

In 13 of the 23 Member States that responded to the survey, the same minimum qualifications in place for personnel working with ODS in this sector also apply to those working with F-Gases in this sector. In all other Member States, no specific minimum qualifications are in place for personnel working with F-Gases; however, voluntary programmes are offered by industry associations or other training providers in four Member States. The following sections describe existing minimum qualifications and training programmes in more detail.

5.4.1 Member States with minimum qualification requirements for personnel (F-Gases)

Thirteen member states—Austria, Belgium, Cyprus, Denmark, Estonia, Finland, France, Greece, Luxembourg, Malta, the Netherlands,[18] Spain, and Sweden—utilize the same minimum qualification requirements for ODS and F-Gases, as described in Section 5.3.

All of these Member States except Denmark and Sweden currently or will require *all* personnel working with f-containing equipment in this sector to be certified, with Denmark and Sweden requiring only the work manager to possess certification. In Cyprus, Estonia, Greece, Malta, and Spain, personnel must (1) complete a training course or required level of education; (2) pass a standardized exam; and (3) posses a minimum level of experience to obtain certification (although legislation is not yet final in Cyprus or Malta). In Denmark and Finland, personnel must complete a training course *and* have minimum years of experience, whereas in France they must complete either

[18] The Netherlands submitted a new regulation regarding the minimum training requirements to the EC on 6 June that will set new standards for personnel working with F-Gases in this sector, although no specific information on this regulation was provided. (Netherlands 2006).

a training course *or* have minimum years of experience. Luxembourg requires the successful completion of a training course and a standardized exam, with no minimum years of practical experience, while Sweden requires minimum years of experience combined with the completion of a standardized exam, but no required courses/programmes. Austria only requires the completing of a training course and Belgium and the Netherlands only require the successful completion of an exam. Additionally, Belgium, Greece, and Sweden require recertification every five years.

5.4.2 Member States with no minimum qualification requirements for personnel (F-Gases)

The following Member States—the Czech Republic, Germany Hungary, Italy, Lithuania, the Netherlands, Poland, Slovakia, Slovenia, and the United Kingdom—as well as Bulgaria indicated that no specific legislative requirements are currently in place for personnel working with refrigerated stationary equipment using F-Gases. However, several of these Member States, including the Czech Republic, Germany, Hungary, Lithuania, Poland, Slovakia, and Slovenia, indicated plans to draft F-Gas regulations once the EU F-Gas regulation is in place (Czech Republic 2006, Germany 2006, Hungary 2006, Lithuania 2006, Poland 2006, Slovakia 2006, and Slovenia 2006). Indeed, the minimum qualifications programme in **Hungary** was developed to be applicable to both ODS and F-Gases, and the required training course already covers F-Gases (Hungary 2006). **Poland**'s programme that is already in place for ODS can be applied to F-Gases with some modification (Poland 2006).

Although minimum qualifications requirements are also not in place in Bulgaria, Italy, Lithuania, and the United Kingdom, information was provided on voluntary programmes offered in these countries, as described in Section 5.5.

5.4.3 Summary of Member State minimum qualification requirements and programmes: F-Gases

Based on available information provided in survey responses, Table 3 below summarizes and compares the minimum qualifications in place (or pending) in each Member State, per the assessment criteria identified in Section 3.2. Because responses were not received from Latvia and Romania, they are not included in the table. Table 4 lists those Member States without requirements and those that did not respond.

Table 3: Summary of Member State Minimum Qualification Requirements and Programmes for Refrigeration, AC, and Heat Pump Equipment (F-Gases)

Member State	Criteria for Minimum Qualification Requirements				Criteria for Programmes		
	Nature of Certification	Who Must be Certified	How to Obtain Certification	Certification Renewal?	Requirement by Law	Nature of Education	Competency Testing
Austria	*	**	*	-	*		-
Belgium	*	**	*	**	*	***	***
Cyprus	*	**	***	-	**		
Denmark	*	**	**	-	*	**	-
Estonia	*	**	***	-	**	***	
Finland[a]	*	**	***	-	**		
France[a]	*	**	**	-	**		
Greece	*	**	***	**	**		*
Luxembourg	*	**	**	-	**	**	
Malta	*	**	***	**	**	**	*
Netherlands	*	**	*	-	*	*	***
Spain	*	**	***	-	**	*	
Sweden	*	*	**	*	*		**

Notes: Dashes (-) indicate that minimum qualification or programme criterion is not in place. Blanks indicate uncertainty regarding whether the criterion is in place, as no information was provided through survey responses.

[a] Although not specifically indicated in the survey response provided, it is assumed that required training course/programme culminates in a final exam.

Table 4: Member States without Requirements for Personnel in the Refrigeration/AC/Heat Pump Sector (F-Gases) and Member States for which No Information is Available

No Requirements in Place	No Information Available (No Survey Response Provided)
• Bulgaria[a] • Germany • Czech Republic • Hungary • Ireland • Italy • Lithuania • Poland • Portugal • Slovakia • Slovenia • United Kingdom	• Latvia • Romania[a]

[a] Accession countries.

5.5 Voluntary Programmes: ODS and/or F-Gas

Through survey responses received, information was provided on voluntary training programmes offered by industry associations or other training providers in Bulgaria, France, Germany, Italy, Lithuania, Poland, Slovakia, and the United Kingdom. These programmes are summarized below.

Europe (various countries)

- While **Daikin Europe** does not offer any certification of licensing programmes, they and their national sales companies (including Diakin Belgium, France, and Slovakia) do organize product training courses that cover the installation and servicing of particular Daikin products. A basic knowledge of refrigeration and AC techniques is required for these course, which include lectures and practical exercises that last from between one and three days, and conclude in written and practical tests. (Daikin 2006)

Bulgaria

- In Bulgaria**,** the training programme offered by the **Institute of Refrigeration & Air-Conditioning J.S.C** (as described in Section 5.3.1) covers F-Gases as substitutes for ODS refrigerants (Bulgaria 2006).

France

- The **Association Matal Formation** offers a certification programme for halogenated refrigerant recovery for electromechanical personnel in charge of industrial refrigeration equipment. The three-day course contains a lecture and practical component; covers the physical basis of the systems, vacuums, gauges, leaks, and refrigerant recovery; and concludes in an oral, written, and practical exam. (Association Matal Formation 2006)

Germany

- In Germany, **TWK** offers a qualification programme for the installation of refrigeration, AC, and heat pump equipment containing more than 2.5 kg of F-Gas. The programme consists of two five-day courses that cover the functioning of refrigeration plants and the proper handling of refrigerants and a three-day construction/installation course. A practical test is given that covers leak detection using spray and an electronic device, refrigerant recovery, component replacement, density testing, evacuation, filling, functioning testing, troubleshooting, and more.

A theoretical test is also given, but no information was available on the topics covered by this exam. They are also planning to offer a special course on density testing in 2007. (TWK 2006)

Italy

- **Centro Studi Galileo**, which trains about 1,500 technicians every year, offers several courses on ODS and F-Gas recovery and recycling, including the following:
  - Basic course for refrigeration repairers and fitters;
  - Advanced course for refrigeration repairers and fitters;
  - Specialist refrigeration systems;
  - Course for maintenance staff working on refrigerated transport vehicles;
  - Course on commercial and domestic refrigerator repairs;
  - Advanced course on refrigeration systems;
  - Advance course for refrigeration technicians;
  - Course on refrigerating HFC, HCFC, and NH_3 industrial stations and plants;
  - Course on chiller maintenance and repair.

  These courses each last from 16 to 40 hours, cover practical training on vacuum charging, and conclude in a written test. (Centro Studi Galileo 2006b)

- The **Associazione Italiana Condizionamento dell'Aria, Riscaldamento e Refrigerazione (AICARR)** offers theoretical training for engineers and designers of refrigeration and AC systems (Centro Studi Galileo 2006b). No further information on these trainings was available.

- **Daikin Italy** offers a brazing license, which is obtained by completing a one-day training course and passing a final exam created by TUV Certification Body. They are also working with Liguria Regional Agency for Energy (ANE) to create a certification scheme for heat-pump installers. (Daikin 2006) No further information on this proposed certification scheme was available.

Poland

- The **Refrigeration Research and Development Center (COCH)** offers the three qualification certificates described in Section 5.3.1. Candidates for these certificates must have completed basic vocational or secondary education, have no criminal record for offences against the environment, and have completed a preliminary course on ODS. The preliminary two-day course contains lectures that cover the basics of ODS and their substitutes and their effects on the environment; the relevant regulations; the obligations of entities using ODS; the requirements of assembly, servicing, maintenance, repair, and installation; the methods, systems, and devices used to charge, recover, recycle and reclaim ODS; and the structure and construction of AC and refrigeration equipment containing ODS. Practical training that covers recovery, leak testing, maintenance, installation, and the use of personal safety equipment is also given. The course concludes in a written exam with both legal and theoretical components and a practical exam. (COCH 2006)

- **Cracow University of Technology** in Krakow, Poland, also administers the required Polish certifications for refrigeration and AC personnel described in Section 5.3.1. The course offered is similar to the course offered by COCH. (Cracow University of Technology 2006)

Slovakia

- The Slovak Association of Refrigeration and Air Conditioning Engineers (SZ CHKT) is licensed by the Ministry to certify personnel working with refrigeration and AC equipment, as described above in Section 5.3.1. (SZ CHKT 2006)

United Kingdom

- In the UK, **ACRIB** has a certification scheme that covers ODS and HFC refrigerants (United Kingdom 2006). Additional information on this scheme was not provided. Both the **City and**

Guilds and **CITB Construction Skills** qualification programmes cover all refrigerants (see Section 5.3.1 for more information on these qualification programmes) (ACRIB 2006).

- A confidential response from a refrigerant distributor indicated that while they do not offer any licenses themselves, they do offer the City and Guilds 2078 training in conjunction with another training provider. Additionally, all service personnel performing on-site recovery for this company possess the City and Guilds certification and the Chemical Industry Passport qualification. (Anonymous 2006)

- All maintenance engineers that maintain the AC equipment on trains owned by **South West Trains** hold the City and Guilds 2078 refrigerant handling certificate, which they obtain by taking a training course offered by **Cool Concerns, Ltd**. This theoretical and practical course, entitled "AC Service and Maintenance," requires an engineering maintenance background and covers the principles of AC systems and the basic components; refrigerants and associated environmental issues; typical AC system operating conditions; refrigerant handling; charging, and recovery; control settings; and maintenance. At the end of the course, the City and Guilds assessment is given, which includes both practical and oral components that cover legal and theoretical aspects pertaining to CFC, HCFC, HFC, and HC refrigerants.

- **Sea Containers Railway Services**, a maintenance provider for train AC systems, employs only technicians trained and assessed to the latest CITB standards. (Sea Containers Railway Services 2006)

- **Expert Appliance Care**, a member of the **Domestic Appliance Service Association (DASA)**, offers training for engineers that covers refrigerant handling. The training programme is modular and is tailored to the needs of each individual engineer, but all courses cover the safe use and handling of refrigerants, refrigerant recovery and charging, refrigerant identification, leak detection and repair, and pipe joining. The courses consists of lectures and practical exercise, the length can range from 1 month to 9 months or more (covering additional job aspects such as electrical handling and customer care). The trainees are assessed individually through classroom testing and through live, supervised service calls. (DASA 2006)

5.5.1 Summary of voluntary programmes (ODS and F-Gases)

In general, industry associations offer either specific training programmes that do not result in a certification/license or certification programmes that meet the Member State certification requirements.

Table 5: Summary of Voluntary Certification Schemes/Training Programmes for Personnel Working with Refrigeration, AC, and Heat Pump Equipment (ODS and/or F-Gas)

Organization	Member State	Course/ Programme	Education Covers:			Competency Testing Includes:		
			Lecture and Practical Components	Regulatory Requirements	Leak Detection/ Prevention	Written Component		Practical Component
						Legislation	Techniques	
Daikin Europe	N.A.	Product Training Courses	✓	-			✓	✓
Institute of Refrigeration & Air-Conditioning J.S.C	Bulgaria[a]	Certifying Training Programme						
Association Matal Formation	France	Halogenated Refrigerant Recovery Certification Programme for Industrial Refrigeration Engineers	✓		✓		✓	✓
TWK	Germany	Qualification Programme	✓				✓	✓
Centro Studi Galileo	Italy	Recovery and Recycling Training Programme	✓				✓	

Organization	Member State	Course/ Programme	Education Covers:			Competency Testing Includes:		
			Lecture and Practical Components	Regulatory Requirements	Leak Detection/ Prevention	Written Component		Practical Component
						Legislation	Techniques	
AICARR	Italy	Training						
Daikin Italy	Italy	Brazing License						
COCH	Poland	Required Certification	✓	✓	✓	✓	✓	✓
Cracow University of Technology	Poland	Required Certification	✓	✓	✓	✓	✓	✓
SZ CHKT	Poland	Required Certification	✓	✓	✓	✓	✓	✓
ACRIB	UK	Certification Scheme						
City & Guilds	UK	2078				✓	✓	✓
CITB	UK	Construction Skills				✓	✓	✓
Expert Appliance Care	UK	Engineer Training	✓		✓		✓	✓

Notes: Dashes (-) indicate that the programme element is not offered. Blanks indicate uncertainty regarding whether the programme element is offered, as no information was provided through survey responses.
[a] Accession country.

5.6 Industry Recommendations for Ensuring Programme Effectiveness

Several industry associations provided their recommendations on the necessary aspects of a minimum qualifications scheme to ensure programme effectiveness, including:

- Association of National Refrigeration and Air Conditioning Contractor Associations (AREA)
- Daikin Europe
- European Cold Storage and Logistics Association (ECSLA) and the Confederation of the Food and Drink Industries of the EU (CIAA)
- TWK
- Centro Studi Galileo
- Cracow University of Technology
- Anonymous
- South West Trains
- Association Matal Formation

The European Association of National Refrigeration and Air Conditioning Contractor Associations (**AREA**), which represents 21 national associations in Europe, just completed a three year "Leonardo da Vinci" project that aimed to establish a standard list of activities that the a basic refrigeration craftsman should be capable of performing. Through a survey, the project developed a recommended portfolio of the activities/subject matters with which a refrigeration "craftsman" should be knowledgeable. These activities are broken down into the following seven categories: (AREA 2006b)

1. Basic thermodynamics;
2. System components (compressor, condenser, evaporator, expansion valves, other components);
3. Piping;
4. Electrical;
5. Analysis/measurements;
6. Communication (e.g., with the client); and
7. Environmental and safety regulations.

Daikin Europe indicated that the key elements of a training programme included basic theoretical training, practical exercises, an up-to-date overview of the regulations, and specialized product training. **Daikin Italy** indicated that experience working with different types of installations and updates about new products were important elements of a minimum qualifications programme.

Daikin Belgium recommended basic theoretical training about refrigeration, heat pumps and refrigerants, the rules of good practice, and the regulations; practical exercises; specialized training for certain equipment types, such as chillers; and product training. They noted that because the regulations are changing often, this aspect of the training should be conducted on a regular basis. **Daikin France** indicated that training should cover the F-Gas recovery regulation, the performance of leak testing after all interventions with the refrigerant circuits, and the use of the proper equipment to recover F-Gases. (Daikin 2006)

The European Cold Storage and Logistics Association (**ECSLA**) and the Confederation of the Food and Drink Industries of the EU (**CIAA**) indicated that the minimum qualifications criteria should be split into two certification types in order to ease the cost burden on small and medium-sized enterprises (SMEs) and ensure that the full scope of qualifications is met. Type A certification would cover personnel performing leak inspections without performing any necessary repair and, therefore, not interacting directly with the refrigerant. The following qualifications would be required for Type A certification:

- Basic knowledge of the components used in a refrigeration plant;
- Understanding of the use of F-Gases;
- Ability to identify the parts most likely to leak;
- Ability to use a portable leak detector, to check its proper functioning, and to detect and locate a leak;
- Understanding of the principal functioning of a fixed leak detection system (if any) and the ability to use it;
- Ability to do a basic report on the location of a leak and initiate immediate action to stop and repair the leak as soon as possible;
- Understanding of the safety aspects of F- gas use, including the use of protection equipment; and
- Ability to read and interpret indirect measuring parameters, such as pressures, temperatures, and liquid levels, in order to detect signs of a presumption of a leak.

Type B certification would cover craftsmen performing installation, maintenance, servicing, recovery, and/or repair, and would require more comprehensive qualifications. Recommendations for these qualifications were not specified. (ECSLA/CIAA 2006)

TWK, a German company that offers training courses for refrigeration technicians, suggested that a certification programme would cover the following topics with theoretical and practical components:

- Function of the refrigerant equipment;
- Safely working with refrigerants;
- Density testing;
- Connecting technology;
- Relevant standards and directives;
- Correct work with technical tools; and
- Trouble shooting (including leak inspection and repair).

Centro Studi Galileo, an independent training provider in Italy, recommended a five-day basic training course covering refrigeration and AC equipment, ODS and substitute refrigerants, and recovery, vacuuming, and charging activities (including a practical component). They also noted that years of experience are not necessarily an indication of a qualified technician, because technicians may not have been trained properly from the start. (Centro Studi Galileo 2006b)

Conversely, the Refrigeration Research and Development Center (**COCH**) in Poland recommended that technicians have at least two years of experience in the field before being allowed to apply for certification, and that training required for certification should cover at least one day of practical activities. (COCH 2006)

Cracow University of Technology in Krakow, Poland stated that effective training must include both theoretical and practical elements along with a practical examination (Cracow University of Technology 2006).

A confidential response from a refrigerant distributor recommended that training cover the refrigeration cycle, properties and hazards of refrigerants, safety, and best practices. They also suggested that a refresher course could be useful to keep technicians up-to-date on current industry issues. (Anonymous 2006)

South West Trains, a passenger train operator in the UK, stated that the key elements to ensure effectiveness would be the UK City & Guilds 2078 refrigerant handling qualification, as well as specific training for the equipment that the technician would be working with. The City & Guilds refrigerant handling qualification aims to ensure that candidates handle refrigerants safely and minimise refrigerant emissions and contamination. The assessment—which covers CFCs, HCFCs, HFCs, HCs, and blend refrigerants—includes an oral section during which technicians answer questions about safety, environmental issues, legislation, leakage reduction, installation, and system operation. It also includes a practical section during which they must recover and charge refrigerant. (South West Trains 2006)

The **Association Matal Formation**, a French industry association focusing on industrial process refrigeration, indicated that a certification programme should include training on the basics of refrigerant plants and a requirement for several months of experience in the field (Association Matal Formation 2006).

5.7 Effectiveness of Programmes to Date

Unlike personnel in the solvents or SF_6 sectors, personnel handling controlled substances in the refrigeration/AC/heat pump sector do not perform activities in a fixed environment where emissions can be easily monitored. As such, it is not possible to directly quantify the emission impacts associated with personnel training programmes in this sector.

Intuitively, it can be surmised that rigorous training programmes equip technicians with the know-how to minimise emissions during all activities performed on equipment-containing ODS and F-Gases; therefore, to the extent that training is provided and skills are tested prior to allowing technicians to practice in the field, the training programmes in place are indeed effective at reducing emissions of ODS and F-Gases. In terms of the actual quality of training provided across the EU to date, Section 5.8.1 notes those programmes in place that are believed to meet or exceed the requirements recommended in this review. In addition, based on the number of technicians certified throughout the EU in this sector, it can be surmised that the training has resulted in reduced emissions. For example, one Italian training centre alone (Centro Studi Galileo) has trained more than 1,000 technicians through the theoretical and practical education on refrigerant recovery and recycling offered through over 90 courses every year (Italy 2006). As of 2001, the STEK programme in the Netherlands had certified almost 8,000 engineers and recognized almost 2,500 companies (Netherlands 2006).

However, the emission impacts of technician training programmes will depend on more than just a proper education. In particular, technicians must act responsibly (i.e., in compliance with national and EU laws) and practice in the field what they learned in the classroom. For example, knowing how to properly recover refrigerant from a household refrigerator does not guarantee that a technician will actually recover the refrigerant at the time of appliance disposal in place of venting the remaining charge. In such cases, a strong understanding of the legal and environmental impacts associated with venting refrigerant may compel technicians to act accordingly, but financial disincentives could sway technicians in the other direction.

Moreover, to practice in the field what is learned in the classroom, technicians must have access to proper tools on the job, such as refrigerant recovery equipment and leak detectors. In some countries, certification programmes incorporate a company accreditation component to ensure that such tools are provided. For example, in Slovenia, entities that install, service, maintain, or decommission ODS-containing equipment must register with the Ministry, possess equipment for recovery, storage, recycling, and leak detection, and have at least one trained technician that has successfully completed the necessary training (Slovenia 2006). Similarly, in Sweden, enterprises performing installation, service, maintenance, and decommissions must be accredited by having a certified work manager, possessing the necessary equipment to minimise emissions, including recovery machines and leak detectors, and following the proper recordkeeping and reporting routines (Sweden 2006).

In short, the effectiveness of reducing ODS/F-Gas emissions through personnel training in this sector depends on a variety of factors. While no data are available to quantitatively indicate the emission benefits associated with current training programmes in place, the next section presents recommendations on the minimum qualification and training programmes that should be implemented to ensure that technicians receive a sufficiently rigorous training that will adequately equip and compel them to minimise emissions on the job.

5.8 Conclusions and Recommendations

5.8.1 Recommended minimum qualification requirements and programmes in the refrigeration, AC and heat pump sector

Personnel in the refrigeration, AC, and heat pump sector work on a wide range of equipment types, from small residential AC units and domestic refrigerators to supermarket refrigeration systems and custom-designed industrial process refrigeration (IPR) systems. Because there are so many of these systems in use throughout the EU, the number of personnel in this sector is significant. Further, because of the diverse settings in which the equipment is used—from households to office buildings, retail stores to industrial warehouses—the sector is not highly structured, and the work environment not easily controlled. Thus, ensuring adequate minimum personnel qualifications and training presents more of a challenge in this sector than some others, such as the power distribution and solvent sectors.

Based on the review of minimum qualifications for personnel and available training programmes in place, as well as industry recommendations for effectively training personnel, and existing industry standards (e.g., EN 13313:2001), the following minimum qualifications are recommended for adoption at the EU level:[19]

Technician ***certification*** should be required by law for all personnel working with refrigeration, AC, and heat pump equipment containing ODS and F-Gases,[20] regardless of number of years of experience in the field. Certification should guarantee that technicians possess an adequate understanding of the technical, legal, and practical requirements and procedures needed to minimise emissions of ODS and F-Gases. More specifically, certification programmes must ensure that all technicians possess a basic knowledge of ozone depletion and climate change science, as well as a thorough grasp of the associated international protocols and EC regulations that govern the use and disposal of refrigerants and the servicing of refrigerant-containing equipment.

[19] The recommendations presented here could be applied to personnel who deal with mobile refrigeration equipment as well, should the EC regulatory text be amended to include this end use.

[20] Personnel working in facilities that manufacture packaged systems with automatic or semi-automatic equipment may not have to meet minimum qualifications depending on the particular aspects of the end use (e.g., assembly line production of systems with small charges or other similar routine operations should not require certification).

Beyond this core level of understanding, some technicians will require a broader and more in-depth knowledge of certain subject matter, depending on the type of equipment that they work with, and the types of activities they perform. For example, it is envisioned that personnel conducting only leak inspections not be required to demonstrate competence in as many subject areas as those conducting leak repair, installation, and/or decommissioning. Likewise, technicians dealing with large, complex systems will require a more extensive knowledge compared to those dealing with small, factory-assembled appliances. Accordingly, a total of three certification types are recommended, each tailored to the types of equipment that will be worked on and the activities to be performed:

- **Level I Universal**: for technicians wishing to work on household and other small appliances. This certification would cover all types of activities involving small appliances (e.g., servicing, decommissioning, etc.).
- **Level II Leak Detection**: for technicians wishing to perform only leak detection on larger systems containing both high and low pressure refrigerants.
- **Level II Universal**: for technicians wishing to perform any activity on larger systems containing both high and low pressure refrigerants (e.g., installation, maintenance, servicing, decommissioning, etc.).

Under the proposed certification scheme, if a technician wished to be certified to handle all types of refrigerated equipment and perform any type of activity, he/she would be required to obtain the Level I and Level II Universal Certifications. Table 6 presents the framework for the certification scheme recommended for this sector, and the suggested training modules to be covered under each certification type.

Because ODS and F-Gas systems are very similar, training for handling both of these groups of controlled substances should be taught under the same modules. For technicians already certified to work on ODS-containing equipment, their expertise should be easily transferred to apply to F-Gas-containing equipment. It is recommended that an "add-on" course be offered to cover F-Gas-specific training. Such a course would include modules covering climate change, the Kyoto Protocol, relevant EC regulations, the legal and technical procedures for recovering and reusing F-Gas refrigerants, the uses of different lubricants, and the like.

Certification should be provided by vocational training programmes and/or by companies (on-the-job), and should include hands-on instruction and/or testing. Each Member State should ensure that the certification schemes recognised in their state adequately cover the minimum training modules specified in Table 6. Member States should also ensure that those companies and programmes executing training and issuing certificates are entitled to do so and have the proper certifications in place.

The European Commission, in collaboration with industry associations/experts, can help facilitate this process through a variety of measures, including:

- The development of course syllabi for each certification level;
- The development of course curricula for each certification level; and/or
- The development of a standardised exam for each certification level, to ensure that all candidate technicians can demonstrate minimum competence in the required knowledge areas.

The above options should be considered in light of their feasibility, based on available resources and infrastructure.

Table 6. Framework of Recommended Certification Scheme and Required Knowledge Areas in the Refrigeration/AC/Heat Pump Sector (ODS and F-Gases)

Type of Equipment	Knowledge Areas by Certification Type	
	Leak Detection Certification	Universal Certification (All Activities)
Level I: Household and Other Small Appliances	NA	Core Training Modules • Ozone depletion, Montreal Protocol, and relevant EC Regulations • Climate change, Kyoto Protocol, and relevant EC regulations • Refrigeration basics (refrigerant states, pressures, gauges, etc.) • Refrigerant identification and labeling • Recovery, recycling, and reclamation (definitions and overview of techniques) • Leak detection • Safety (as related to refrigerant containment) In-Depth Training Modules • Recovery requirements and techniques • EC waste regulations • Proper handling and destruction of waste refrigerants (including mixed refrigerants)
Level II: Larger Systems (High and Low Pressure Refrigerated Systems)	Core Training Modules • Ozone depletion, Montreal Protocol, and relevant EC Regulations • Climate change, Kyoto Protocol, and relevant EC regulations • Refrigeration basics (refrigerant states, pressures, gauges, etc.) • Refrigerant identification and labeling • Recovery, recycling, and reclamation (definitions and overview of techniques) • Leak detection • Safety (as related to refrigerant containment)	Core Training Modules • Ozone depletion, Montreal Protocol, and relevant EC Regulations • Climate change, Kyoto Protocol, and relevant EC regulations • Refrigeration basics (refrigerant states, pressures, gauges, etc.) • Refrigerant identification and labeling • Recovery, recycling, and reclamation (definitions and overview of techniques) • Leak detection • Safety (as related to refrigerant containment) In-Depth Training Modules • Leak repair for high and low pressure systems • Recovery techniques for high and low pressure systems • Recharging techniques for high and low pressure systems • Pressure-temperature relationships • Components of high and low pressure units • EC waste regulations • Proper handling and destruction of waste refrigerants (including mixed refrigerants)

NA = Not applicable; leak detection is not required for small appliances.

In addition, it is recommended that ***personnel in charge*** of activities also have a tertiary education in a relevant field (i.e., a degree from a vocational school, career college, or university) or at least *five years* of relevant experience. Relevant experience may include that obtained by working as an apprentice to a certified technician. Currently, most Member States have similar requirements for *all* personnel, not just those in charge.

At this time, periodic recertification is not recommended; however, certification renewal (e.g., every five years) should be considered for the future, as it represents an important opportunity for

technicians to "brush-up" on their knowledge and skills and learn about new industry standards, current practices, new technologies, etc.

In addition, while beyond the scope of this evaluation, ***company licensing/certification*** should also be highlighted as an effective means of ensuring compliance with Regulation (EC) No 2037/2000 and Regulation (EC) No 842/2006. In particular, if all companies were to own proper licensed refrigerant recovery equipment and refrigerant identifiers, and ensure best work place practices, this would facilitate the effective recovery of ODS and F-Gases.

5.8.2 Compliance with recommended minimum qualification requirements and programmes in the refrigeration, AC, and heat pump sector

Based on the survey responses provided, Table 7 compares current or pending Member State minimum qualification requirements to those recommended in this assessment. As specific guidance is developed by Member States regarding the actual certification components that will be deemed adequate for accreditation, the applicability of these existing programmes can be determined. A comparison of current (or pending) Member State minimum qualification requirements to those recommended in this assessment is provided in Table 7.

Table 7. Comparison of Recommendations to Minimum Qualifications in Place or Pending (National Requirements)

Member State	Certification Required for All Personnel		Tertiary Degree OR Minimum Years of Experience Required for Personnel In Charge		Company Licensing/ Certification Required	
	ODS	F-Gas	ODS	F-Gas	ODS	F-Gas
Austria	✓	✓				
Belgium	✓	✓			✓	✓
Cyprus	✓	✓	✓	✓		
Czech Republic	✓		✓			
Denmark			✓	✓	✓	✓
Estonia	✓	✓	✓	✓		
Finland	✓	✓	✓	✓		
France	✓	✓	✓	✓	✓	✓
Germany	✓		✓			
Greece	✓	✓	✓	✓		
Hungary	✓		✓			
Ireland	✓					
Italy	✓		✓			
Lithuania	✓		✓			
Luxembourg	✓	✓	✓	✓		
Malta	✓	✓	✓	✓		
Netherlands	✓	✓				
Poland	✓					
Portugal	✓		✓			
Slovakia	✓		✓			
Slovenia	✓		✓		✓	
Spain	✓	✓	✓	✓		
Sweden			✓	✓	✓	✓
UK	✓					
Accession Country						
Bulgaria	✓		✓			

Note: blank spaces indicate that no known requirements are in place.

Because of the varying level of detail in which survey responses were provided, it is difficult to discern whether/which training programmes offered across the Member States (either by government bodies or independent organisations) offer the type and content of programmes recommended in this analysis. Based on the information provided, Table 8 compares the format and content of voluntary

and required training programmes in place across the Member States to those recommended in this analysis.

Table 8. Comparison of Recommendations to (Required and Voluntary) Training Programmes in Place or Pending

Company/ Association	Training Programme			Subjects Taught					
	Specific to Various Activities/ Equipment Types	Lecture Components	Practical Components	Montreal Protocol, Kyoto Protocol and EC Regulations	Refrigerants and Environmental Impact	Leak Inspection and Repair	Refrigerant Recovery, Recycling, and Recharging	Handling of Waste Refrigerants	Safety (as related to refrigerant containment)
Daikin Europe	✓	✓	✓						
Austria (required programme)					✓				
Bulgaria: Institute of Refrigeration & Air-Conditioning J.S.C									
Czech Republic	✓	✓	✓	✓	✓	✓			
Denmark: New Refrigerants				✓	✓	✓			✓
Estonia: OU Opimaja/Training House		✓	✓	✓		✓			✓
France: Association Matal Formation		✓	✓			✓	✓		
Germany: TWK		✓	✓						
Germany (required programme)		✓	✓	✓		✓	✓		✓
Hungary: Refrigerant Safe Handling and Certification					✓		✓		✓
Italy (required programme)		✓	✓	✓	✓	✓	✓	✓	
Italy: Centro Studi Galileo		✓	✓						
Italy: AICARR									
Italy: Daikin									
Lithuania: Centre for Environmental Policy and the Environmental Management and Audit Institute								✓	
Luxembourg: Chamber of Trades Certificate				✓		✓	✓	✓	
Malta (required programme)		✓	✓			✓			
Poland: COCH		✓	✓	✓	✓	✓	✓		✓
Poland: Cracow University of Technology		✓	✓	✓	✓	✓	✓		✓
Portugal (required programme)		✓	✓	✓					
Slovakia: SZ CHKT		✓	✓	✓		✓			
Slovenia: CPU		✓	✓	✓		✓	✓	✓	
Spain: First Degree of Professional Scholar Training					✓	✓	✓	✓	
UK: ACRIB									
UK: Expert Appliance Care		✓	✓			✓	✓		
UK: Cool Concerns		✓	✓		✓		✓		

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6. MVACs

6.1 Background

The motor vehicle air conditioning (MVAC) end use includes air-conditioning systems installed in passenger cars, trucks, and buses. These systems historically used ozone-depleting CFC-12 refrigerant, but HFC-134a has been used in new MVACs in developed countries since 1994 (IPCC 2005). HFC-134a can also be used to retrofit any existing CFC-12 systems still in operation. While HFC-134a has no ODP, it is a potent greenhouse gas with a global warming potential (GWP) of 1,300 (IPCC 2001). According to Directive 2006/40/EC of the new European Parliament and of the Council of 17 May 2006,[21] the use of F-Gases with a GWP higher than 150—including HFC-134a—are banned in new vehicle models in 2011, and in all vehicles in 2017.

HFC-134a MVACs used in passenger vehicles have an average lifetime of nine to 12 years, and an average charge size ranging from 500 to 900 grams (IPCC 2005). Given the large and growing number of MVACs,[22] potential emissions from this equipment is substantial.

ODS/F-Gas emissions from MVACs occur at numerous points: during equipment manufacture, during regular use (gradual or steady loss), from sporadic loss due to system failure, during service, and at the end-of-life (EC 2003). Proper refrigerant handling and recovery, as well as servicing/maintenance activities are required by personnel who deal with MVACs in order to reduce emissions throughout this entire process. In particular personnel must be trained to minimise emissions at: (MCACC 2002)

- *Manufacture*, when employees must fill the systems (typically an automated process) and, occasionally, must empty and refill the system after the initial filling, in order to access other parts of the vehicle;
- *Service*, when technicians may empty the system, perform leak tests and repairs, and refill the system; and
- *End of life*, when motor vehicle dismantlers are responsible for removing the refrigerant from the system.

6.2 Survey Response

Survey responses were received from 24 Member States[23] and five industry associations and manufacturers, including:

- Cyprus Vehicle Airconditioning & Refrigeration Technicians Association (CY VARTA) - Cyprus
- Verband der Automobilindustrie e.V. (VDA) - Germany
- Delphi – United Kingdom
- Motor Cabin Air Conditioning Committee (MCACC)/ The Society of Motor Manufacturers & Traders Ltd (SMMT) – United Kingdom

Information provided through these surveys on the minimum qualification requirements in place, as well as any voluntary or required training programmes offered, is presented in this chapter. In addition, industry recommendations on essential programme components needed to ensure training

[21] OJ L 161,14.6.2006, p. 12.
[22] Globally, there were more than 720 million registered motor vehicles in 2000, and almost half of these vehicles were equipped with AC systems (IPCC 2005). It has been estimated that by 2006 or 2007, approximately 90% of all newly manufactured vehicles will be equipped with AC systems in Western Europe (IPCC 2005).
[23] Survey responses were not provided by Latvia, Portugal, and Romania.

effectiveness and personnel skills/knowledge are also summarized. Finally, recommendations for minimum qualifications for personnel dealing with MVACs are presented at the end of the chapter.

6.3 Member State Minimum Qualification Requirements and Programmes: F-Gases

In twelve Member States, the same minimum qualifications in place for personnel working with stationary AC equipment also apply to those working with MVACs. In all other Member States, no minimum qualifications are in place for personnel working with MVACs; however, voluntary programmes are offered by industry associations or other training providers in five Member States, as described in Section 6.4.

6.3.1 Member States with minimum qualification requirements for personnel (F-Gases)

The minimum qualifications in place for personnel working with MVACs in Bulgaria, Cyprus, Estonia, Finland, France, Greece, Hungary, Malta, the Netherlands, Portugal, Slovenia, and Sweden are the same as those required for personnel working with stationary AC/refrigeration equipment.[24] Specifically, Cyprus, Greece, Hungary, Malta, Portugal, and Slovenia require the completion of (1) training or certain education, (2) a standardized exam, and (3) minimum years of experience for personnel to obtain certification. Bulgaria, Estonia, and Finland require the completion of (1) a training programme or certain education (assumed to include a final exam) and (2) minimum years of experience. Sweden requires the successful completion of (1) a standardized exam and (2) minimum years of experience. France requires either minimum years of experience or the completion of training or certain education. The Netherlands only requires the successful completion of a standardized test. See Section 5.4.1 for more details.

While the minimum *qualification* requirements are the same for personnel dealing with MVACs as those dealing with stationary refrigeration/AC equipment in Cyprus, France, Hungary, and the Netherlands, these four Member States have specific *training programmes* for personnel working with MVACs that differ from those offered to personnel in the stationary sector. The MVAC specific training prorgams offered in these Member States are described below.

- In **Cyprus**, a law was passed in March 2006 specifying that technicians who perform work on vehicles must be certified.[25] Certification is obtained by completing a required training programme and passing a standardized test. Personnel must also meet minimum years of experience depending on their level of education.[26] Through cooperation with the government, the Cyprus Vehicle Air Conditioning and Refrigeration Technicians Association (CY VARTA) organized a 30-hour seminar on the servicing of MVACs and the proper handling of refrigerants. The seminar covers both theory and practice, including the use of recovery/recycling machines, and concludes with an examination. (CY VARTA 2006, Cyprus 2006)

- In **France**, MVAC technicians must either have (1) a diploma or certificate from a training centre approved by the Industry Ministry, the Agricultural Ministry, the Association for Adult Vocation Training, or an equivalent certificate from another Member State, or (2) six years of experience working with MVACs. While no specific education courses are required for all personnel

[24] In Cyprus, minimum qualifications are not yet in place for personnel working with stationary refrigeration/AC equipment, but they are pending and will be the same as those for personnel working with MVACs (Cyprus 2006). In Malta, minimum qualifications are currently voluntary but will be made mandatory through future legislation (Malta 2006). In Slovenia, legislation establishing minimum qualifications for personnel working with MVACs is expected to be prepared by the end of 2006, and will establish the same minimum qualifications as those for personnel working with stationary equipment (Slovenia 2006).
[25] Information was not provided indicating which types of vehicles are covered by this regulation.
[26] Specific information on the years of experience needed was not provided.

working with MVACs, individuals performing reclamation/recovery for certain vehicle AC systems[27] must obtain a Level IV diploma/certificate. Some of the relevant degree programmes offering Level IV diplomas/certificates with specializations in MVACs are: (France 2006)

- National Education Diplomas
  - BAC Professional: Automobile Maintenance (Option A: Specific Vehicles or Option B: Industrial Vehicles)
- Association for Adult Vocational Training
  - TRVI: Industrial Vehicle Repair Technician
  - TDRA: Automobile Diagnosis and Repair Technician
- Certificate of Professional Qualifications
  - Electrician/Mechanic (collective agreement of the branch of automobile services)
  - Automobile Maintenance and Diagnosis Technician

- In **Hungary**, although minimum qualifications are not in place for technicians performing work on stationary equipment using F-Gases, all technicians installing or performing work on MVAC systems are required to have a green card, as described in Section 5.3.1. A green card is obtained by completing vocational and postgraduate training and by passing an exam. (Hungary 2006)

- The **Netherlands** has prepared a new regulation establishing specific minimum qualifications for personnel working with F-Gases, which is not yet finalized (Netherlands 2006). Information was not provided on the detailed requirements of this regulation. Currently, all MVAC technicians are required to possess STEK certification, as described in Section 5.3.1. The STEK examination for MVAC technicians is a modified version of the ODS examination and contains a more comprehensive theoretical part, including a failure analysis component. (ICF 2005)

For more information on the detailed requirements in Bulgaria, Estonia, Finland, Greece, Malta, Portugal, and Sweden, please see Section 5.3.1.

6.3.2 Member States with no minimum qualification requirements for personnel (F-Gases)

No specific requirements for personnel working with MVACs are in place in Austria, Belgium, Czech Republic, Ireland, Italy, Luxembourg, Poland, and Slovakia.[28] Denmark, Poland, and Slovakia provided specific information on other requirements or plans to develop legislation.

- In **Denmark**, while there are no mandatory minimum qualifications for personnel dealing with refrigeration or AC systems with charge sizes below 2.5 kg (which includes MVACs), individual companies are responsible for ensuring that personnel handle refrigerant safely (Denmark 2006a). Voluntary programmes also exist, as described in Section 6.4.

- In **Poland**, certification schemes for personnel handling ODS are easily adaptable to those handling F-Gases and, once the EU F-Gas regulation is implemented, the necessary modifications are to be made (Poland 2006).

- In **Slovakia**, legislation outlining the minimum qualifications for personnel or companies dealing with F-Gases are currently being prepared (Slovakia 2006).

Minimum qualifications requirements are also not in place in Germany, Lithuania, Spain, and the United Kingdom, but voluntary programmes are offered in these Member States, as described in Section 6.4.

[27] Information was not provided on which types of vehicle AC systems are covered by this requirement.
[28] For Austria, Belgium, and Italy, if no information was provided in survey responses regarding specific MVAC minimum qualifications, it was assumed that no qualification requirements are in place. Attempts were made to confirm the lack of qualification requirements, but no responses were received.

6.3.3 Summary of Member State minimum qualification requirements and programmes in the MVAC sector (F-Gases)

Table 9 below summarizes and compares the minimum qualifications in place or pending in Member States, per the assessment criteria identified in Section 3.2. Table 10 lists those Member States without requirements and those that did not respond.

Table 9: Summary of Minimum Qualification Requirements and Programmes for MVACs (F-Gases)

Member State	Criteria for Minimum Qualification Requirements				Criteria for Programmes		
	Nature of Certification	Who Must Be Certified	How to Obtain Certification	Certification Renewal?	Requirement by Law	Nature of Education	Competency Testing
Cyprus	*	**	***	-	**	*	*
Estonia	*	**	***	-	**	***	
Finland[a]	*	**	***	-	*		
France[a]	*	**	*	-	*		
Greece	*	**	***	**	**		*
Hungary	*	**	**	**	**	***	
Malta	*	**	***	**	**	**	*
Netherlands	*	**	*	-	*	*	***
Portugal	*	**	***	**	**	**	
Slovenia	*	**	***	**	**	***	***
Sweden	*	*	**	*	*		**
Accession Country							
Bulgaria[a]	*	**	***	**	*		-

Notes: Dashes (-) indicate that minimum qualification or programme criterion is not in place. Blanks indicate uncertainty regarding whether the criterion is in place, as no information was provided through survey responses.

[a] Although not specifically indicated in the survey response provided, it is assumed that required training course/programme culminates in a final exam.

Table 10: Member States without Requirements for Personnel in the MVAC Sector (F-Gases) and Member States for which No Information is Available

No Requirements in Place	No Information Available (No Survey Response Provided)
• Austria • Belgium • Czech Republic • Denmark • Germany • Ireland • Italy • Lithuania • Luxembourg • Poland • Slovakia • Spain • United Kingdom	• Latvia • Romania[a]

[a] Accession country.

6.4 Voluntary Programmes: F-Gases

In Denmark, Germany, Lithuania, Spain, and the United Kingdom, industry associations, manufacturers, and other organizations offer voluntary certification schemes or training programmes, as described below.

Denmark

- The majority of MVAC technicians in Denmark are members of the **Kølebranchens Miljø Ordning** (KMO organization), which offers education and training for MVAC technicians (Denmark 2006a). A specific adult vocation course is offered in Demark, which consists of 37 classes, each 45 minutes in duration, on MVAC assembly, operation of equipment, maintenance, and health and safety standards, which must be completed to the teacher's satisfaction (Denmark 2006b). The relevant laws and regulations are not covered in this course.

Germany

- Members of the German organization **Verband der Automobilindustrie e.V.** (VDA) have developed workshops for automotive mechanics that are typically two to five days long and conclude with a final examination. The content of these workshops is based on the *Sachkundenachweis*,[29] the German knowledge standard for MVAC technicians, and covers the basics of refrigeration and vehicle AC, HFC refrigerants, environmental effects, and the relevant laws and regulations. (VDA 2006)

Spain

- In Spain, voluntary courses are offered by technical associations and companies that sell recovery and recycling equipment (Spain 2006). No specific information on these training courses was provided.

UK

- **City & Guilds**, the leading vocation awarding body in the UK, partners with colleges, companies, and other training providers to administer vocational certificates in various industry sectors. While City & Guilds does not offer trainings or assessments directly, they develop the qualifications that candidates must meet to achieve certifications and recommended courses of instruction to enable candidates to meet the qualifications.

  The City & Guilds Unit 4101, "Certificate in Automotive Maintenance & Repair, Body & Paint, Vehicle Fitting and Roadside Assistance," includes numerous units that can be combined in different ways to achieve various certification levels. The V78 unit entitled "Air Conditioning and Climate Control Systems" requires the completion of a computer-based multiple choice test and a practical test during which candidates must service and evacuate an AC system, rectify system faults, and repair system leaks. Successful candidates must have a thorough knowledge of the environmental issues, relevant legislation and regulation, and leak detection. (City & Guilds 2006a)

  The City & Guilds Unit 5101, "Certificate in Refrigerant Handling for Mobile Air Conditioning Systems," requires the completion of knowledge and practical tests. Successful candidates must have knowledge of the environmental issues, relevant legislation and regulation, and leak detection. (City & Guilds 2006b)

- The UK **Institute of the Motor Industry** (IMI) governs a voluntary assessment programme called the Automotive Technician Accreditation (ATA). This programme is based on National Occupational Standards and is backed by vehicle manufacturers, independent service and repair organisations, and the Sector Skills Council for the retail motor industry. Technicians can be ATA accredited at three different competency levels (Service Maintenance Technician, Diagnostic Technician, or Master Technician) by passing a series of tests that cover practical skills and knowledge. In order to become a diagnostic technicians, one must take several required tests and several other tests, one of which covers AC. Technicians must pass a re-assessment every five years to maintain their accreditation. (ATA 2006, IMI 2006a)

[29] The *Sachkundenachweis* was developed and published by VDA, in cooperation with the German Federation for Motor, Trades and Repairs (ZDK).

IMI also offers a training programme (Unit 610) for vehicle AC technicians that consists of the following four modules:

- A/C 1: Air Conditioning Fundamentals, Component Operation, and System Diagnosis;
- A/C 2: Refrigerant Handling;
- A/C 3: Fundamental Auto Electrics; and
- A/C 4: Ensuring the Health and Safety of Employees and Protecting the Environment when Dealing with Refrigerants.

These courses cover leak detection and the relevant regulations and environmental issues and conclude in written and/or practical exams. (IMI 2006b)

- **Delphi**, a UK-based manufacturer of MVAC systems, not only serves as an approved ATA assessment centre, but also provides specific training programmes to its customers (which include garages). The AC programme offered consists of the following three modules:
  - AC001 – Introduction to Air Conditioning;
  - AC002 – AC Servicing & Fault Diagnosis; and
  - AC003 – Advanced AC Servicing & Repair.

  Each course is one day in duration, and both AC001 and AC002 cover the safe handling of refrigerants, refrigerant recovery and recycling, leak detection methods. AC003 builds on the material taught in the other courses and also covers fault diagnosis. (Delphi 2006a, b)

6.4.1 Summary of voluntary programmes in the MVAC Sector (F-Gases)

In general, some voluntary programmes include training while others consist only of a certification exam. Often times, these programmes are offered by motor vehicle industry associations of which technicians are members. The training courses and certification exams typically cover the basics of MVACs, refrigerants, maintenance and repair, relevant regulations and laws, and leak detection.

Table 11: Summary of Voluntary Certification Schemes/Training Programmes for Personnel Working with MVACs

Organization	Member State	Course/ Programme	Education Covers:			Competency Testing Includes:		
			Lecture and Practical Components	Regulatory Requirements	Leak Detection/ Prevention	Written Component		Practical Component
						Legislation	Techniques	
KMO	Denmark	Adult Vocation Course						
VDA	Germany	Various Workshops		✓				
City & Guilds	UK	Unit 4101	NA	NA	NA	✓	✓	✓
City & Guilds	UK	Unit 5101	NA	NA	NA	✓	✓	✓
IMI	UK	ATA					✓	✓
IMI	UK	Unit 610		✓	✓	✓	✓	✓
Delphi	UK	AC Training Programme			✓			

Notes:
NA= Not applicable (organisation offers testing only).
Blanks indicate uncertainty regarding whether the programme element is offered, as no information was provided through survey responses.

6.5 Industry Recommendations for Ensuring Programme Effectiveness

Several industry associations provided their recommendations on the necessary aspects of a minimum qualifications scheme to ensure programme effectiveness, including:

- Motor Cabin Air Conditioning Committee (MCACC)
- Society of Motor Manufacturers & Traders Ltd (SMMT)
- Delphi
- Verband der Automobilindustrie e.V. (VDA)

In 2002, the **Motor Cabin Air Conditioning Committee** (MCACC), a consortium of several interested industry associations in the United Kingdom, drafted a comprehensive qualifications programme for F-Gas handlers.[30] Their recommendations included the registration of companies and the certification of refrigerant handlers. Refrigerant handlers would become certified by being trained and/or tested. Key knowledge requirements from the training programme were extracted from the more comprehensive City & Guilds 4100 Progression Award in Automotive Vehicle Servicing and Repair Level 3, Unit 7,[31] and are presented below:

1. An understanding of why certain refrigerants damage the ozone layer and are being withdrawn from use;
2. An understanding of the causes and implications of global warming and why emissions of certain refrigerants are to be minimised;
3. An understanding of the health and safety risks associated with the handling, storage, transportation, and use of refrigerant gases appropriate to the MVAC sector and the precautions to be taken;
4. Demonstration of the correct procedures for identifying different refrigerants and contaminants and labelling refrigerant cylinders and systems accordingly;
5. Demonstration of the correct use of AC and refrigeration servicing equipment to recover and recharge systems;
6. Demonstration of the correct procedures for leak detection and repair; and
7. An understanding of waste legislation and documentation relating to refrigerants.

According to MCACC, all refrigerant handlers should be assessed for their knowledge on the above subjects though both a practical and written assessment. Because experienced technicians may already possess the required knowledge, they would not necessarily be required to be trained prior to taking the exam. A short training course or training packet should be offered for those needing additional information prior to taking the exam. Additionally, technicians already possessing a comprehensive certification in the motor trade industry, such as the National Qualification Framework (NQF), should not be required to be recertified under this programme. In order to meet the recommended training and examination components, MCACC proposes the City & Guilds 5101 Part 1 (Certificate in refrigerant handling for MVAC systems) for the minimum requirements in the UK. MCACC also contends that requiring recertification would be unnecessarily burdensome on small- and medium-sized enterprises (SMEs), which are prominent in the MVAC sector, and therefore, should not be required (MCACC 2002).

The **Society of Motor Manufacturers & Traders Ltd** (SMMT), a member of MCACC, agrees with MCACC's position and proposed minimum qualifications. They also contend that recertification should not be required to cover next generation refrigerants (i.e., R-134a replacements) because such refrigerants are likely to possess similar properties and be used in similar systems as R-134a. Additionally, if the minimum qualification requirements do not enter into force until 2008, and then R-134a is phased out several years later, technicians would have to be recertified after only 4 or 5 years. (SMMT 2006)

Delphi recommended that a training programme should at a minimum be 50 percent practical activities to ensure that technicians obtain a good understanding of and ability to apply the theoretical teachings, particularly related to refrigerant handling and the connection to service ports, as these activities are those that cause the majority of leaks/emissions during servicing. Additionally, because most personnel have little or no experience working with MVACs prior to beginning a course of

[30] MCACC was established as a sub-committee of ACRIB to provide the UK government with input on a proposed mandatory registration scheme for F-Gas refrigerant handlers. Eventually, because of the differences in the stationary refrigeration/AC and MVAC sectors, MCACC separated from ACRIB and today acts independently. It is not clear if/when the MCACC recommendations will be implemented in the UK.

[31] The City & Guilds 4100 Award has since been replaced by 4101, Certificate in Automotive Maintenance & Repair, Body & Paint, Vehicle Fitting and Roadside Assistance.

training, requiring minimum experience to begin training is not logical. But, because other technicians will have prior experience, it is important to identify the base level of knowledge and skills of all entrants into the programme to ensure that technicians enter a course of training at the correct level for their previous experience and are not required to start with technicians with no experience. (Delphi 2006)

The **VDA** in Germany indicated that the appropriate minimum qualifications would be the possession of the general education for car mechanics including knowledge of all information in the *Sachkundenachweis* standard, as previously described (VDA 2006).

6.6 Effectiveness of Programmes to Date

Compared with the overall emissions that occur during the lifetime of an MVAC system, emissions occurring during servicing can be large if the service technicians do not follow proper procedures and do not use the appropriate recycling and recovery equipment of the refrigerant (EC 2003). However, because there is no way of monitoring F-Gases emitted as a result of personnel handling of MVACs, it is not possible to directly quantify the emission impacts associated with personnel training programmes in this sector.

Intuitively, it can be surmised that rigorous training programmes equip technicians with the know-how to minimise emissions during all activities performed on MVACS; therefore, to the extent that training is provided and skills are tested prior to allowing technicians to practice in the field, the training programmes in place are indeed effective at reducing emissions of F-Gases. Only about half of all Member States have required minimum qualifications or voluntary training/certification programmes in place, and in terms of the actual quality of training provided by these programmes to-date, Section 6.7.1 notes those programmes in place that are believed to meet or exceed the requirements recommended in this review.

However, the emission impacts of technician training programmes will depend on more than just technician training. In particular, technicians must act responsibly, in compliance with national and EU laws. For example, knowing how to properly recover refrigerant from an MVAC does not guarantee that a technician will actually recover the refrigerant at the time of disposal in place of venting the remaining charge. In such cases, a strong understanding of the legal and environmental impacts associated with venting refrigerant may compel technicians to act accordingly, but financial disincentives could sway technicians in the other direction.

Moreover, to practice in the field what is learned in the classroom, technicians must have access to proper tools on the job, such as refrigerant recovery equipment and leak detectors. Certification programmes that incorporate a company accreditation component help ensure that such tools are provided.

The next section presents recommendations on the minimum qualification and training programmes that should be implemented to ensure that technicians receive a sufficiently rigorous training that will adequately equip and compel them to minimise emissions on the job.

6.7 Conclusions and Recommendations

6.7.1 Recommended minimum qualifications and programmes in the MVAC sector (F-Gases)

The population of personnel servicing MVACs is quite substantial, and consists largely of small-scale independent garages. Because of the large, widespread, and diverse labour market, the minimum qualifications for this sector must be flexible and not place an undue burden on smaller operations or their personnel that may receive the majority of their training on-the-job, while at the same time

ensure that proper procedures are in place. Additionally, because of the technical differences between MVACs and stationary AC systems, unique minimum qualifications are needed for this sector to ensure that all personnel possess a set of knowledge and skills specifically relevant to this equipment.

Based on the review of minimum qualifications for personnel and available training programmes in place, as well as industry recommendations for effectively training personnel, the following minimum qualifications are recommended for adoption at the EU level:

Technician ***certification*** should be required by law for all personnel servicing MVACs, regardless of the number of years of experience in the field. To earn certification, technicians should possess an adequate understanding of the technical, legal, and practical requirements and procedures needed to minimise emissions of F-Gases when dealing with MVACs. More specifically, certification programmes must ensure that all technicians possess a ***core knowledge*** of:

- Climate change, Kyoto Protocol, and relevant EC Regulations
- Refrigerant identification and labelling
- Recovery, recycling, refilling, and reclamation (definitions and techniques, including proper use of equipment)
- Leak Repair
- Safety (as related to refrigerant containment)
- Proper handling and destruction of waste refrigerants, including EC waste regulations

Certification should be provided by vocational training programmes and/or companies on-the-job, and should include hands-on instruction and/or testing. Each Member State should ensure that the certification schemes recognised in their state adequately cover the recommended minimum knowledge areas specified above. Member States should also ensure that those programmes/companies executing training and issuing certificates are entitled to do so and have the proper certifications in place.

The European Commission, in collaboration with industry associations/experts, can help facilitate this process through a variety of measures, including:

- Developing a course syllabus for core MVAC training programmes;
- Developing a course curriculum for core MVAC training programmes; and/or
- Developing a standardised exam for MVAC certification, to ensure that all candidate technicians can demonstrate minimum competence in the required knowledge areas.

The above options should be considered in light of their feasibility, based on available resources and infrastructure.

At this time, periodic recertification is not recommended; however, certification renewal (e.g., every five years) should be considered for the future, as it represents an important opportunity for technicians to refresh their knowledge and skills and learn about new industry standards, current practices, etc. While beyond the scope of this report, any requirement for recertification in the MVAC sector should consider the inclusion of additional training in preparation for the transition away from R-134a, since the safety and handling requirements of next generation MVACs (i.e., those using F-Gas alternatives, such as CO_2) are likely to be different from those in use today.

In addition, while beyond the scope of this evaluation, ***company licensing/certification*** should also be highlighted as an effective means of ensuring compliance with Regulation (EC) No 842/2006. In particular, if all companies were to own proper refrigerant recovery equipment and refrigerant identifiers, and ensure best work place practices, this would facilitate the effective recovery of F-Gases. However, given the large number of small servicing garages throughout the EU, this may not be practical to require.

6.7.2 Compliance with recommended minimum qualification requirements and programmes in the MVAC sector

Based on survey responses provided, required certification schemes for all personnel are in place or pending in Bulgaria, Cyprus, Estonia, Finland, France, Greece, Hungary, Malta, the Netherlands, Portugal, and Slovenia—which, therefore, meet the requirements suggested in this analysis. Because the programme in Sweden does not require all personnel to be certified, it does not meet the minimum requirements. As specific guidance is developed regarding the actual certification components that will be deemed adequate for accreditation, the applicability of these existing programmes can be determined. A comparison of current (or pending) Member State minimum qualification requirements to those recommended in this assessment is provided in Table 12.

Table 12: Comparison of Recommendations to Minimum Qualification Requirements in Place or Pending (National Requirements)

Member State	Certification required for all personnel
Austria	
Belgium	
Cyprus	✓
Czech Republic	
Denmark	
Estonia	✓
Finland	✓
France	✓
Germany	
Greece	✓
Hungary	✓
Ireland	
Italy	
Lithuania	
Luxembourg	
Malta	✓
Netherlands	✓
Poland	
Portugal	✓
Slovakia	
Slovenia	✓
Spain	
Sweden	
UK	
Accession Country	
Bulgaria	✓

Note: blank cells indicate that no requirements are in place.

Because of the varying level of detail in which survey responses were provided, it is difficult to discern whether/which training programmes offered across the Member States (either by government bodies or independent organisations) offer the type and content of programmes recommended in this report. Based on the information provided, Table 13 compares the format and content of voluntary and required training programmes in place across the Member States to those recommended in this analysis.

Table 13: Comparison of Recommendations to Training Programmes in Place (Required and Voluntary Programmes)

Company/ Association	Training Programme		Subjects Taught					
	Lecture Components	Practical Components	Kyoto Protocol and EC Regulations	Refrigerants and Environmental Impact	Leak Repair	Refrigerant Recovery, Recycling, and Recharging	Handling of waste Refrigerants	Safety (related to containment)

Company/ Association	Training Programme		Subjects Taught					
	Lecture Components	Practical Components	Kyoto Protocol and EC Regulations	Refrigerants and Environmental Impact	Leak Repair	Refrigerant Recovery, Recycling, and Recharging	Handling of waste Refrigerants	Safety (related to containment)
CY VARTA	✓	✓				✓		
KMO								
VDA			✓					
City & Guilds Unit 4101								
City & Guilds Unit 5101								
IMI ATA								
IMI Unit 610			✓		✓			
Delphi					✓			

Notes: Dashes (-) indicate that the programme element is not offered. Blanks indicate uncertainty regarding whether the programme element is offered, as no information was provided through survey responses.

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7. Solvents

7.1 Background

Historically, ODS solvents including CFC-113, methyl chloroform, carbon tetrachloride, and HCFC-141b have been employed in the solvents sector for the cleaning of surfaces, particularly in the electronic industry, electro-technical industry, optical industry, and precision tool production. Under the Montreal Protocol, these ODS have been replaced with non-ODS, fluorinated solvent alternatives, including HFC43-10mee, hydrofluoroether, HFC-365mfc, and HFC-245fa. Non-GWP alternatives such as HFEs, halogen-free organic solvents, and water-based solvents are also in use.

Solvent emissions of ODS and F-Gases may occur during solvent use, disposal, recovery and recycling. Emissions from the solvent sector can be reduced in various ways, such as retrofitting equipment with emission control features or treating waste solvents by vapour recovery or mechanical separation. In addition, emissions from the solvent sector can be reduced by the use of proper handling procedures during solvent recovery, recycling, reclamation and destruction, which require a thorough understanding of the processes and operations by personnel.

As of January 1, 2002, the only remaining legal uses of ODS solvents are hydrochlorofluorocarbons (HCFCs) in precision cleaning of electrical and other components in aerospace and aeronautics applications, as mandated by Article 5 of EC Regulation (EC) 2037/2000. Beginning 31 December 2008, the use of HCFCs in all solvent applications will be prohibited. Thus, throughout the EU-25, very little use of ODS solvents remains, and its use is limited to very specialised applications only. Moreover, some Member States have undertaken phase out efforts that are more aggressive than those stipulated in Regulation (EC) 2037/2000, and may have already phased out of ODS solvents entirely.

Likewise, the use of F-Gas solvents is believed to be very limited in the EU. Some Member States have implemented non-GWP alternatives and do not anticipate future use of F-Gas solvents in most applications (Germany, 2006). As of 2000, the use of F-Gas solvents in the EU was virtually non-existent; however, their use is expected to increase to 6,000 to 7,000 tons by 2010 and 2020 (Harnisch, 2004).

7.2 Survey Response

Survey responses regarding minimum qualification requirements or training programmes for personnel working with *ODS* solvents were received from 24 Member States.[32] Information regarding minimum qualification requirements or training programmes for personnel working with *F-Gas* solvents were received from 19 Member States.[33] Additional survey responses were received from the following industry associations or manufacturers: (1) The European Chemical Industry Council (CEFIC) Petrochemical Programme; and (2) the European Chlorinated Solvents Association.

Information provided through these surveys on the minimum qualification requirements in place, as well as any voluntary or required training programmes offered, is presented in this chapter—first for ODS, then for F-Gases. In addition, industry recommendations on essential programme components needed to ensure training effectiveness and personnel skills/knowledge are also summarized. Finally, recommendations for minimum qualifications for personnel dealing with ODS/F-Gas solvents are provided at the end of the chapter.

[32] Responses were received from all Member States surveyed except Latvia and Romania. Surveys received from Cyprus did not include any information related to ODS solvents.

[33] Responses were received from all Member States surveyed except Latvia and Romania. Surveys received from Belgium, Cyprus, France, Greece, Hungary, Portugal, and the UK did not include any information related to F-Gas solvents.

7.3 Member State Minimum Qualification Requirements and Training Programmes: ODS

Of the 24 Member States that responded to the survey, 15 have entirely phased-out ODS from the solvent sector and, therefore, have no need for minimum qualification requirements or training programmes in this sector. Three Member States provided information on specific minimum qualifications and/or training programmes in place for personnel working with the remaining controlled uses of ODS solvents, as described further in this chapter. Finally, six Member States have no minimum qualifications currently in place for personnel working with the remaining exempted uses of ODS solvents.

7.3.1 Member States with minimum qualification requirements for personnel (ODS)

Denmark, Italy, and Poland have minimum qualification and/or programme requirements in place for personnel dealing with ODS solvents.

- In **Denmark,** workers are required to "be familiar" with Order 2002/243 on ODS, and knowledgeable about techniques/practices to reduce emissions. However, there is no examination or certification required to demonstrate this knowledge. Similarly, because ODS are generally not used in equipment containing solvents, no special training programmes are required. (Denmark, 2006)

- **Italy** requires technicians and companies working with ODS solvents to have regional authorisation, obtained through a 34-hour training programme, similar to that required in other ODS sectors. The required training is aimed at technicians who operate equipment containing ODS used as solvents in systems for confined applications, normally equipped with devices that suck in or capture the solvents and recover them by means of cooling and condensation. The training covers the following topics: (Italy, 2006)
  - Introduction to the environmental issues associated with ODS use;
  - Legislative framework;
  - Leak prevention and control of ODS;
  - Types of ODS used as solvents and their substitutes;
  - ODS solvent recovery operations;
  - Assessment of critical loss points;
  - Technical and environmental implications of ODS solvent use and replacement;
  - Use and maintenance of the equipment employed in operations to recover/recycle ODS solvents; and
  - Disposal of solvents.

- **Poland** requires personnel to take a general training course and examination on the handling of ODS (Poland, 2006). The course is five hours in duration and includes the following topics (among others): (Poland Journal of Laws No. 202, Item 2071)
  - Environmental impact, legislation and standards, and methods of handling controlled substance waste, products, equipment or systems containing such substances;
  - Types and properties of controlled substances and their replacements; and
  - Hands-on practice in recovering controlled substances, testing integrity, servicing equipment and systems, and using personal safety equipment including leak detection.

The examination consists of a theoretical component and a practical component covering (among others): (Poland Journal of Laws No. 202, Item 2071)
- Leak prevention;
- Controlled substances and their replacements;

- Environmental impact, legislation governing controlled substances, and handling of controlled substance waste or products, equipment, or systems containing such substances; and
- Practical skills in the handling of controlled substances, including leak detection.

7.3.2 Member States with no minimum qualification requirements for personnel (ODS)

Fourteen Member States—Austria, Czech Republic, Estonia, Finland, Germany, Greece, Hungary, Lithuania, Luxembourg, Malta, Slovakia, Slovenia, Sweden, and the United Kingdom[34]—as well as Bulgaria have reportedly phased-out ODS from the solvent sector entirely and, therefore, have no need for minimum qualification requirements or training programmes.

Six countries—Belgium, France, Ireland, the Netherlands, Portugal, and Spain—have very little or no ODS solvent use, and no qualification requirements exist for the few remaining uses.

- In the Walloon region of **Belgium**, the use of CFC and HCFC solvents is banned entirely, while in both the Flemish and Brussels regions, only standard requirements exist for personnel dealing with ODS waste in all areas of application. Similarly, in the **Netherlands**, personnel involved in this sector are required to follow the general requirements of the Working Conditions Act. In **Spain**, there are no specific qualification requirements though there are rules of general management and health and safety (Spain, 2006b).

- **France** and **Ireland** have developed guidelines/information sheets for the few remaining applications of ODS solvents. In France, general prescriptions for the use of dangerous solvents are outlined on a "Practical Safety Sheet," which addresses technical performance, including use on electrical material and recycling and health risks and prevention measures. Solvent users in Ireland are referred to an information sheet regarding the "Safe Use of Solvent Degreasing Plant" published by the UK Health and Safety Executive, and the Best Practice Guide on "Good Housekeeping Measures for Solvents."

- **Portuguese** Decree-Law 152/2005 of 31 August 2005, which concerns the minimum qualification requirements for personnel working with ODS, only covers the decommissioning operations of ODS solvents. The requirements for personnel in this sector are not clear, though they may be the same as those for personnel in other sectors, which include certification that must be renewed every five years.

Because no information on minimum qualification requirements for personnel dealing with ODS solvents was included in the survey responses provided by the competent Member State authorities of **Cyprus** it is assumed that no personnel requirements are in place.

7.3.3 Summary of Member State minimum qualification requirements and programmes: ODS Solvents

Survey responses indicate that there are very few remaining uses of ODS solvents. Some countries still have some specialised applications while others have phased-out ODS from the solvent sector entirely. Table 14 below summarizes and compares the minimum qualifications and training programmes in place in each Member State, per the assessment criteria identified in Section 3.2. In cases where Member States have reported zero remaining ODS solvent use in their survey responses, "NA" (for "not applicable") is indicated to denote the fact that there is no need for minimum qualifications or programmes for personnel in this sector. In all other cases, it was assumed that some ODS solvent use remains, and so the minimum qualifications and programmes in those Member

[34] While the competent authority indicated that "there is no longer any known solvent use in the UK," as of 2003, three UK companies reported continued use of HCFC-141b for precision cleaning of electronics and microelectronics, two of which anticipated continued use of this solvent through 2008 (ICF, 2004).

States were assessed against the standard criteria. It should be noted, however, that surveys were not designed to identify the quantity of substances used in each sector and, therefore, Member State representatives may or may not have provided consistent information regarding the status of the ODS phaseout from the solvent sector. In other words, it is possible that additional Member States have already phased-out ODS solvents beyond those identified here, or that some exempted ODS solvent uses exist in those Member States that reported complete phaseout. Table 15 lists those Member States without requirements and those that did not provide a survey response.

Table 14: Summary of Minimum Qualification Requirements and Programmes for ODS Solvents

Member State	Criteria for Minimum Qualification Requirements				Criteria for Programmes		
	Nature of Certification	Who Must be Certified	How to Obtain Certification	Certification Renewal?	Requirement by Law	Nature of Education	Competency Testing
Austria	NA	NA	NA	NA	NA	NA	NA
Belgium (Walloon)	NA	NA	NA	NA	NA	NA	NA
Czech Republic	NA	NA	NA	NA	NA	NA	NA
Denmark	*	**	-	-	-	-	-
Estonia	NA	NA	NA	NA	NA	NA	NA
Finland	NA	NA	NA	NA	NA	NA	NA
Germany	NA	NA	NA	NA	NA	NA	NA
Greece	NA	NA	NA	NA	NA	NA	NA
Hungary	NA	NA	NA	NA	NA	NA	NA
Italy	*	**	**	-	**	***	**
Lithuania	NA	NA	NA	NA	NA	NA	NA
Luxembourg	NA	NA	NA	NA	NA	NA	NA
Malta	NA	NA	NA	NA	NA	NA	NA
Poland	*	**	**	**	**	***	***
Slovakia	NA	NA	NA	NA	NA	NA	NA
Slovenia	NA	NA	NA	NA	NA	NA	NA
Sweden	NA	NA	NA	NA	NA	NA	NA
UK	NA	NA	NA	NA	NA	NA	NA
Accession Country							
Bulgaria	NA	NA	NA	NA	NA	NA	NA

Notes: Dashes (-) indicate that programme criterion is not in place. Blanks indicate uncertainty regarding whether the criterion is in place, as no information was provided through survey responses. Not applicable (NA) indicates ODS solvent use has reportedly been phased out entirely.

Table 15: Member States in which No Minimum Qualification Requirements are in Place or for which No Information was Provided for ODS Solvents

No Minimum Qualification Requirements in Place		No Information Provided	
▪ Belgium (Flanders and Brussels regions)	▪ Netherlands	▪ Cyprus	▪ Romania[a]
▪ France	▪ Portugal	▪ Latvia	
▪ Ireland	▪ Spain		

[a] Accession country.

7.4 Member State Minimum Qualification Requirements and Programmes: F-Gases

Of the 19 Member States that responded to the survey, three States reported zero use of F-Gases in the solvent sector and, therefore, have no need for minimum qualification requirements or training programmes. Similarly, three other Member States indicated only very limited use of F-Gas solvents, which they contended negated the need for minimum qualifications or programmes.

Only one country indicated that they currently have minimum requirements in place for personnel handling F-Gases in the solvents sector. All other Member States reported no minimum qualification requirements for personnel working with F-Gas solvents, although six Member States are in the process of developing such qualifications and/or are prepared to adopt legislation as appropriate.

7.4.1 Member States with minimum qualification requirements for personnel (F-Gases)

Estonia has established qualification requirements for technicians handling fluorinated greenhouse gases in all areas of application. In short, personnel must have a basic level of education with professional training that covers relevant environmental legislation, occupational safety, and environmental hazards. However, there are currently no national training programmes in Estonia. (Estonia, 2006)

7.4.2 Member States with no minimum qualification requirements for personnel (F-Gases)

No minimum qualification requirements exist in **Austria, Finland,** and **Sweden** because there is zero use of fluorinated greenhouse gases in the solvents sector in these countries (Austria, 2006; Finland, 2006; Sweden, 2006). Similarly, **Denmark** has banned PFCs and SF_6 from solvent applications with only a few exemptions given; and **Germany** only permits the use of HFCs in exceptional cases under the amended 2nd Statutory Ordinance pursuant to the German Emission Control Act from 2001. The response provided by **Malta** contended that minimum qualification requirements in this sector are not applicable, presumably because no F-Gases solvents are in use. Therefore, there are no required qualifications or programmes in place in these countries (Denmark, 2006; Germany, 2006; Malta, 2006).

Twelve Member States—Czech Republic, Ireland, Italy, Lithuania, Luxembourg, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, and the United Kingdom—as well as Bulgaria reported no specific requirements or programmes in place for personnel dealing with F-Gas solvents in their countries.[35] However, the **Netherlands** and **Slovenia** are currently in the process of developing legislation regarding such qualifications (Netherlands, 2006; Slovenia, 2006). In addition, **Italy, Poland**, the **Czech Republic,** and **Lithuania** reported that F-Gas legislation can easily be modified from existing ODS legislation for this sector, which could be implemented once the EU F-Gas regulation is finalised. (Italy, 2006; Poland 2006; Czech Republic, 2006; Lithuania, 2006).

[35] For Belgium, Cyprus, France, Greece, Hungary, Portugal and the UK, it is assumed that no minimum requirements are in place, given that no information on the solvents sector was provided in Member State survey responses.

7.4.3 Summary of Member State minimum qualification requirements and programmes for personnel: F-Gas Solvents

Table 16 below summarizes and compares the minimum qualifications and training programmes in place in each Member State, per the assessment criteria identified in Section 3.2. Table 17 lists those Member States without requirements and those that did not provide a response.

Table 16 Summary of Member State Minimum Qualification Requirements and Programmes for F-Gas Solvents

Member State	Criteria for Minimum Qualification Requirements				Criteria for Programmes		
	Nature of Certification	Who Must be Certified	How to Obtain Certification	Certification Renewal?	Requirement by Law	Nature of Education	Competency Testing
Austria	NA	NA	NA	NA	NA	NA	NA
Estonia	*	**	**	-	-	-	-
Finland	NA	NA	NA	NA	NA	NA	NA
Malta	NA	NA	NA	NA	NA	NA	NA
Sweden	NA	NA	NA	NA	NA	NA	NA

Notes: Dashes (-) indicate that programme criterion is not in place. Blanks indicate uncertainty regarding whether the criterion is in place, as no information was provided through survey responses. Not applicable (NA) indicates use of F-Gas solvents is reportedly phased out entirely.

Table 17: Member States in which No Minimum Qualification Requirements are in Place or for which No Information was Provided for F-Gas Solvents

No Minimum Qualification Requirements in Place		No Information Provided	
▪ Bulgaria[a]	▪ Luxembourg	▪ Belgium	▪ Latvia
▪ Czech Republic	▪ Netherlands	▪ Cyprus	▪ Portugal
▪ Denmark	▪ Poland	▪ France	▪ Romania[a]
▪ Germany	▪ Slovakia	▪ Greece	▪ United Kingdom
▪ Ireland	▪ Slovenia	▪ Hungary	
▪ Italy	▪ Spain		
▪ Lithuania			

[a] Accession countries.

7.5 Voluntary Programmes: ODS and F-Gases

No information regarding voluntary programmes for personnel working with ODS or F-Gas solvents was provided.

7.6 Industry Recommendations for Ensuring Programme Effectiveness

Survey responses were received from two of the industry associations contacted: (1) the European Chemical Industry Council (CEFIC) Petrochemical Programme, and (2) the European Chlorinated Solvents Association. The representative of CEFIC was not aware of any uses of ODS or F-Gases in the solvents sector (De Kettenis, 2006). Similarly, the representative of the European Chlorinated Solvents Association stated that the few remaining uses of carbon tetrachloride are as process agents in a small number of chemical operations, and that methyl chloroform is used exclusively as a feedstock (Orban, 2006). Given the limited uses of ODS and F-Gas solvents across the EU, no specific recommendations regarding minimum qualification requirements or training programmes were provided by industry.

7.7 Effectiveness of Programmes to Date

Procedures such as the filling of solvent cleaning baths or tanks or for cold cleaning or vapour degreasing equipment, and maintenance of such equipment can result in substantial emissions if not undertaken by qualified, trained personnel. And, intuitively, any technician training programmes in place will help reduce emissions. However, unlike other sectors, such as refrigeration/AC, personnel have less direct interaction with controlled substances, and therefore, less opportunity to emit them through improper practices/techniques (in fact, it is through good equipment design/modification that emissions can most effectively be reduced). For example, installation of condensing coils, automated covers, and other engineering controls are standard practice for metal and electronic cleaning operations in the solvent sector.

However, because of the limited survey response received from industry in this sector (which is in large part due to the limited use of ODS and F-Gases in this sector), it is not clear whether companies are currently providing training, and if so, whether the training provided is effective. No information is available regarding programme effectiveness in this sector. It is likely however that many operations in this sector are practising Good Manufacturing Practices – limiting solvent emissions and recovering used solvent to meet workplace guidelines, especially because the ODS and F-Gas solvents used in these types of operations are expensive, and the applications generally sophisticated. There may be certain emissive applications in this sector that should be addressed further in terms of ensuring proper procedures are in place.

7.8 Conclusions and Recommendations

7.8.1 Recommended minimum qualification requirements and programmes in the solvent sector (ODS and F-Gases)

Because of the highly specialized nature of the remaining ODS solvent applications in the European Community (e.g., in aeronautical and aerospatial applications), and the fact that ODS will be phased-out from the solvents sector by the end of 2008, a blanket set of personnel qualifications are not practical or appropriate for this sector. Similarly, standard certification schemes would not be appropriate for personnel working with F-Gas solvents, because such applications are also highly specialised and somewhat limited.

Rather, to ensure that personnel in this sector are properly trained, it is recommended that companies implement mandatory ***in-house training programmes*** that are tailored to the specific tasks of equipment engineers and operators, based on the types of activities they will be performing and the types of equipment with which they will be working. In-house training should cover theoretical and practical components related to ODS/F-Gas containment and enable any weaknesses to be identified and strengthened prior to personnel performance of activities. Specifically, the following training modules should be taught to all personnel working with solvent applications that may involve handling of ODS/F-Gases:

- Ozone depletion, Montreal Protocol, and relevant EC Regulations
- Climate change, Kyoto Protocol, and relevant EC Regulations
- Technical procedures related to proper handling of solvent containing equipment;
- Technical procedures related to recovery of ODS and F-Gas solvents;
- Avoiding and managing spills;
- Maintenance procedures;
- Relevant EC waste legislation; and
- Health and safety concerns (as pertains to containment).

Company ***certification*** should be issued to all personnel who successfully complete the required training as documentation and proof that they are adequately trained to handle ODS/F-Gases and minimise emissions during all activities. In addition, each Member State should ensure that company

training programmes/certification schemes recognised in their state adequately cover the recommended minimum knowledge areas specified above. Member States should also ensure that those programmes/companies executing training and issuing certificates are entitled to do so and have the proper certifications in place.

The European Commission, in collaboration with industry associations/experts, can help facilitate this process by developing a ***guidance document*** for use in company training programmes. Such a guidance document could be posted on the EC Communication & Information Resource Centre Administrator (CIRCA) Website.

For personnel in charge of work activities, a ***tertiary education*** in a relevant field (i.e., a degree from a vocational school, career college, or university) or five years of prior field ***experience*** should be required. Such a requirement is likely the industry status quo, but is highlighted in this report to underscore the need for well-qualified individuals to assume responsibility for work activities involving the recovery of controlled substances and the minimisation of their emissions.

In addition, ***company licensing/certification*** should also be highlighted as an effective means of ensuring compliance with Regulation (EC) No 2037/2000 and Regulation (EC) No 842/2006. In particular, if companies own proper vapour recovery or collection equipment, and ensure acceptable engineering controls and work place practices, this would facilitate the effective containment of ODS and F-Gas solvents. As discussed in Section 4.2, to the extent that companies are certified under the ISO 9000 and/or ISO 14000 series (or similar industry standards), compliance with these regulations may be better ensured. Such certifications could serve as *de facto* licensing at the state level, to ensure that best environmental practices are being followed.

7.8.2 Compliance with recommended minimum qualification requirements and programmes in the solvent sector

The limited use of ODS and F-Gas solvents and minimal amount of information received through survey responses renders it difficult to discern whether Member States are in compliance with the recommended minimum qualification requirements and training programmes presented in this report. Based on the available information provided through survey responses, Table 18 compares Member State minimum qualification requirements in place to those recommended here, while Table 19 compares actual and recommended training programmes (mandatory or voluntary).

Table 18: Comparison of Recommendations to Minimum Qualifications in Place (National Requirements)

Member State	Mandatory (In-House) Training/ Certification		Tertiary Degree and Prior Experience Required for Personnel In Charge		Company Licensing/ Certification Required	
	ODS	F-Gases	ODS	F-Gases	ODS	F-Gases
Austria	NA	NA	NA	NA	NA	NA
Belgium (Flanders and Brussels)	-	-	-	-	-	-
Belgium (Walloon)	NA	-	NA	-	NA	-
Cyprus	-	-	-	-	-	-
Czech Republic	NA	-	NA	-	NA	-
Denmark	-	-	-	-	-	-
Estonia	NA	✓	NA	-	NA	-
Finland	NA	NA	NA	NA	NA	NA
France	-	-	-	-	-	-
Germany	NA	-	NA	-	NA	-
Greece	NA	-	NA	-	NA	-
Hungary	NA	-	NA	-	NA	-
Ireland	-	-	-	-	-	-
Italy	✓	-		-	✓	-

Lithuania	NA	-	NA	-	NA	-
Luxembourg	NA	-	NA	-	NA	-
Netherlands	-	-	-	-	-	-
Poland	✓	-	-	-	-	-
Portugal		-		-		-
Slovakia	NA	-	NA	-	NA	-
Slovenia	NA	-	NA	-	NA	-
Sweden	NA	NA	NA	NA	NA	NA
Spain	-	-	-	-	-	-
UK	NA	-	NA	-	NA	-
Accession Country						
Bulgaria	NA	-	NA	-	NA	-

Notes: Check marks (✓) indicate requirements that are in place. Dashes (-) indicate requirements that are not in place. Blanks indicate uncertainty regarding whether the requirement is in place, as not enough information was provided through survey responses. Member States for which no information was provided have been excluded from the table.

Table 19: Comparison of Recommendations to Training Programmes in Place (Required and Voluntary Programmes)

Company/ Association	In-House Training Programme		Subjects Taught					
	Lecture Component	Practical Component	Montreal Protocol, Kyoto Protocol and EC Regulations	Solvents and Environmental Impact	Handling of Solvent Containing Equipment	ODS/ F-Gas Recovery and Reuse or Disposal	Maintenance Procedures/ Managing Spills	Safety (related to containment)
Programmes Specific to ODS Solvents								
Italy (legislated programme content)	✓	✓	✓	✓	✓	✓	✓	
Poland (legislated programme content)	✓	✓	✓	✓	✓	✓	✓	✓

Notes: Check marks (✓) indicate requirements that are in place. Dashes (-) indicate that programme criterion is not in place. Blanks indicate uncertainty regarding whether the criterion is in place, as no information was provided through survey responses.

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8. High and Medium Voltage Equipment Containing SF_6

8.1 Background

Sulphur hexafluoride (SF_6) is a synthesized gas that became commercially available in 1947. It is a colourless, odourless, non-flammable, and chemically-stable gas with strong electronegative properties. It has been identified as the best interrupting and insulating gas for use in electric power systems, and is currently used at gas-insulated substations as an insulating medium, as well as in transformers for cooling purposes (EIA, 1999). In switchgear for high and medium applications, SF_6 provides insulating and arc-quenching benefits.

High and medium voltage equipment containing SF_6 can broadly be categorized into two categories: (1) sealed pressure systems and (2) non-sealed pressure systems, which include closed pressure systems, gas insulated transformers (GIT), and transmission and distribution (T&D) component manufacturing for applications greater than 1 kV. (ECOFYS, 2005)

Sealed pressure systems, typically used in new gas insulated medium voltage switchgear, are designed not to be opened for the equipment lifetime, which is typically 40 years or more. Emissions during gas handling are minimized as gas handling only occurs during manufacture and decommissioning. Combined with emissions due to leakage rates and equipment faults and failure, newer sealed pressure systems have an average emission rate of 0.14%. This type of equipment accounted for 14% to the total SF_6 emissions from electrical equipment in the EU-25+3 in 2003. (ECOFYS, 2005)

Closed pressure systems, characteristic of high and extra-high voltage equipment, are replenished only periodically by connection to an external source of gas. Equipment designed since the mid-1990s requires maintenance involving gas handling typically every 20-25 years. Topping up of SF_6 may be necessary several times during the equipment's lifetime. Average emission rates including design-related leakage rates, equipment faults and failures, and handling losses in the EU-25+3 in 2003 were 1.8%, accounting for 73% of SF_6 emissions from electrical equipment. (ECOFYS, 2005)

GIT applications and T&D component manufacturing contribute less to SF_6 emissions, together accounting for approximately 8.2% of SF6 emissions from electrical equipment in the EU25+3 in 2003. Emissions from both are expected to decline by 2010. (ECOFYS, 2005)

Regional differences in equipment manufacturing and infrastructure are responsible for substantially different emissions characteristics throughout the EU. The EU-10 are smaller contributors to SF_6 emissions on a per-capita basis for two reasons: (1) SF_6 manufacturing does not take place in the EU-10; and (2) the EU-10 have implemented exclusively state-of-the-art technology from suppliers in Western Europe, which has minimal maintenance requirements and exceptional leak tightness. (Siemens, 2006)

8.2 Survey Responses

Survey responses regarding minimum qualification requirements and/or training programmes were received from 22 Member States, although 12 of these responses did not include information related to personnel working with high and medium voltage equipment containing SF_6.[36] Additional survey responses were received from the following industry associations or manufacturers:

- CAPIEL HV and EURELECTRIC – EU
- Siemens AG – Germany

[36] Surveys received from Austria, Belgium, Cyprus, Denmark, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Sweden did not include any information related to high and medium voltage equipment containing SF_6. No survey responses were received from Latvia and Romania.

- Solvay Fluor GmbH – Germany
- Association of German Network Operators (VDN) – Germany
- German Electrical and Electronic Manufactures' Association (ZVEI) – Germany
- AREVA Sachsenwerk GmbH – Germany
- BOC Refrigerants – UK
- National Grid – UK
- Energy Networks Association – UK
- BEMA Power Ltd. – UK
- UNESA (two member companies) – Spain
- National Association of Manufacturers of Capital Goods (Sercobe) – Spain

Information provided through these surveys on the minimum qualification requirements in place, as well as any voluntary or required training programmes offered, is presented in this chapter. In addition, the effectiveness of programmes currently in place is discussed, and industry recommendations on essential programme components needed to ensure training effectiveness and personnel skills/knowledge are also summarized. Finally, recommendations for minimum qualifications for personnel dealing with high and medium voltage equipment containing SF_6 are presented at the end of the chapter.

8.3 Member State Minimum Qualification Requirements and Programmes

The highly skilled and potentially dangerous nature of work related to high and medium voltage equipment demands all personnel be highly experienced and educated to work on this equipment. Because the inherent need for training to some degree precludes the need for standardized qualification requirements, most Member States did not provide a response regarding minimum qualification requirements for personnel working with high and medium voltage equipment containing SF_6. It is assumed that minimum qualification requirements in these Member States have not been put in place yet. Ten Member States provided information on specific minimum qualifications and/or training programmes in place for personnel working with high and medium voltage equipment containing SF_6, although six of these responses included information on industry-run programmes or qualification requirements, which are described in Section 8.4.

8.3.1 Member States with minimum qualification requirements for personnel (SF_6)

Estonia, Finland, Germany, Poland, and Slovenia have legislated minimum qualification requirements that apply to personnel working with high and medium voltage equipment (which may or may not be specific to SF_6). These requirements and/or programmes are summarized below:

- In **Estonia**, minimum qualification requirements for all ODS and F-Gases are in place requiring at least a basic level of education and professional training. However, there are no national programmes for personnel working with high and medium voltage equipment containing SF_6 to meet the qualifications. (Estonia, 2006)

- **Finland** has legislated qualification requirements for personnel handling electrical equipment that is not specific to SF_6 gas insulated equipment. The regulations include company authorisation requirements, qualification requirements for the person in charge, inspections, rules for safe working, and technical installation rules. The certification body, Henkilo-ja yritsarviointi SETI Oy, issues certification to personnel who have sufficient education in the electrical field, sufficient electrical working experience, and pass the exam on safety matters (Finland, 2006).

- In **Malta**, personnel are required to be qualified as an engineer or under the supervision of engineer (HTD) grade technicians. Engineers receive training through the switchgear manufacturer or suppliers for the installation and decommissioning of equipment. ABB, Ltd.

(Sweden) provides trained personnel for the installation and decommissioning of hospital installations. A procedure for handling SF_6, based on recommendations given in standard IEC 61634,[37] is used for training safety personnel in power generation plants. (Malta, 2006)

- In **Poland**, only standard requirements for personnel dealing with high and medium voltage equipment are in place, for which no additional information was provided. (Poland, 2006).

- In **Germany**, there are several standards and regulations that lay out the qualification requirements of personnel working on medium and high voltage switchgear. Companies that provide training must develop and make available an operating directive describing the risks involved with handling SF_6 or decomposition products for persons and the environment, the required protective measures, rules of conduct, behaviour in case of danger, and correct disposal. Employees working on SF_6 gas compartments must be trained prior to beginning work and yearly thereafter on the operating directive. A video on "SF_6 switchgear," issued by the Employers' Liability Insurance Association of Precisions Mechanics and Electrical Engineering, may be used for training. The statutory German regulation on vocational training in the industrial vocations in the field of electrical engineering establishes the required course contents, duration, and examinations for vocations in the field of electrical engineering, which covers "environmental protection." Finally, personnel working on high voltage switchgear must furnish proof of training and qualification as a "specialist electrician," consistent with European standard EN 50110-1:2004-11 *Operation of Electrical Installations*[38] and the harmonised German standard DIN EN 50110-1:2005-06 and national supplement DIN VDE 0105-100:2005-06. The standard sets the minimum requirements and defines general principles of safe operation, staff, organisation, communication, tools, and equipment. (VDN, 2006)

- **Slovenia** requires that all personnel be trained by manufacturers (e.g., Siemens), and be guided by International Electrotechnical Commission (IEC) standards: 60376 Ed. 2.0 b:2005[39] and 60480 Ed. 2.0b:2004.[40] There is no specific legislation on F-Gases in Slovenia; however, legislation will be upgraded to include F-Gases, likely by the end of 2006. (Slovenia, 2006)

8.3.2 Member States with no minimum qualification requirements for personnel (SF_6)

Minimum qualifications requirements are not in place in Bulgaria, France, Spain and the United Kingdom, but information was provided on voluntary programmes or industry standards, which is provided in Section 8.4. Three Member States—Czech Republic, Lithuania, and Slovakia—have no minimum qualification requirements in place or known voluntary programmes/industry standards. In addition, for the 12 Member States that responded to the survey but did not provide information regarding minimum qualification requirements for personnel working with high and medium voltage equipment containing SF_6, it is assumed that no minimum qualifications or programmes for personnel are in place.

8.3.3 Summary of Member State minimum qualification requirements and programmes (SF_6)

Table 20 below summarizes and compares the minimum qualifications and training programmes in place in each Member State, per the assessment criteria identified in Section 3.2. Table 21 lists those Member States without requirements and those that did not provide a response.

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[37] IEC. 61634. "High-voltage switchgear and control gear – use and handling of SF_6 in high-voltage switchgear and control gear."
[38] Prepared by *Comité européen de normalisation électrotechnique* (CENELEC) Task Force 63-3 (1994).
[39] IEC. 60376. "Specification of technical grade sulphur hexafluoride (SF_6) for use in electrical equipment."
[40] IEC. 60480. "Guidelines for the checking and treatment of sulphur hexafluoride (SF_6) taken from electrical equipment and specification of its re-use."

Table 20: Summary of Member State Minimum Qualification Requirements and Programmes for High and Medium Voltage Equipment Containing SF_6

Member State	Criteria for Minimum Qualification Requirements				Criteria for Programmes		
	Nature of Certification	Who Must be Certified	How to Obtain Certification	Certification Renewal?	Requirement by Law	Nature of Education	Competency Testing
Estonia	*	**	**				
Finland	*	*	***	-	**		*
Germany	*	**	**	**	**	***	***
Malta	*	*		-			
Slovenia	*	**	*	-	-	-	-

Notes: Blanks indicate criteria for which no information was provided through survey responses. Dashes (-) indicate that programme criteria are not in place.

Table 21: Member States in which No Minimum Qualification Requirements are in Place or for which No Information was Provided for High and Medium Voltage Equipment Containing SF6

No Minimum Qualification Requirements in Place		No Information Provided	
▪ Bulgaria[a]	▪ Poland	▪ Austria	▪ Italy
▪ Czech Republic	▪ Slovakia	▪ Belgium	▪ Latvia
▪ France	▪ Spain	▪ Cyprus	▪ Luxembourg
▪ Lithuania	▪ United Kingdom	▪ Denmark	▪ Netherlands
		▪ Greece	▪ Portugal
		▪ Hungary	▪ Romania[a]
		▪ Ireland	▪ Sweden

[a] Accession countries.

8.4 Voluntary Programmes: SF_6

Information regarding training programmes and voluntary actions for personnel working with high and medium voltage equipment containing SF_6 was provided by 14 industry associations or companies:

1. CAPIEL HV and EURELECTRIC – EU
2. Siemens AG – Germany
3. Solvay Fluor GmbH – Germany
4. Association of German Network Operators (VDN) – Germany
5. German Electrical and Electronic Manufactures' Association (ZVEI) – Germany
6. AREVA Sachsenwerk GmbH – Germany
7. BOC Refrigerants – UK
8. National Grid – UK
9. Energy Networks Association – UK
10. BEMA Power Ltd. – UK
11. UNESA (two member companies) – Spain
12. National Association of Manufacturers of Capital Goods (Sercobe) – Spain

CAPIEL HV (Coordinating Committee of the National Associations of Manufacturers of Electrical Switchgear in the European Union) and **EURELECTRIC** (Union of Electricity Industry) provided a joint response for themselves and their member companies throughout the EU. In general, organisations follow a modular structure for their training that is specific to the task performed, covering all activities and implications in development, manufacturing, testing, installation, operation, maintenance, inspection, and decommissioning of high and medium voltage switchgear. (CAPIEL, 2006)

Training is provided by SF_6 producers/suppliers, gas handling OEMs and suppliers, switchgear manufacturers, electricity network utilities, and industrial network owners. The high level of speciality related to equipment type and operational procedures demands specific training for the appropriate conduct of tasks related to SF_6 switchgear. SF_6 providers and suppliers of gas recovery equipment provide training specific to their products. Because of the highly specialised gas recovery equipment and switchgear product variety, the training process is largely in-house in the following areas: (CAPIEL, 2006)

a) *Gas Providers*: provide general training related to gas properties, performance criteria, and gas management.
b) *Gas Recovery Equipment Manufacturers*: provide training specific to the equipment (i.e., operational, performance, maintenance, and application), which may be designed to meet the user's specifications.
c) *Switchgear Manufacturers*: receive training in (a) and (b). The training provided in (b) is integrated through in-house training and other procedures. Additional requirements apply to personnel filling and recovering gas from switchgear equipment related to product characteristics and gas condition when gas is recovered from equipment that has been in service. The switchgear manufacturer's in-house training may also be provided to personnel from network utilities when appropriate (i.e., personnel having responsibility for gas handling related to switchgear products in service).
d) *Network Operators*: personnel with gas recovery responsibility receive training and information in the subject areas listed above, as appropriate to the specific products and needs. Equipment that is sealed for life requires handling only at decommissioning, and equipment that is not sealed for life requires gas handling/recovery during installation, in-service maintenance, and at decommissioning.[41] Because of the potential consequences of gas loss, failure of the insulation system, risk of injury to network operator's personnel, and the resultant loss of power supply to areas, gas handling procedures and training is integrated with operational safety procedures.

Personnel conducting gas recovery activities within switchgear manufacturing and service organisations are controlled through in-house procedures and training encompassed by an externally certified ISO 9001:2000 system (or similar). Personnel within network operators are controlled through rigorous safety procedures relevant to the specific network and plant; gas recovery services are limited to those holding appropriate certification to ISO 9001:2000 (or similar). (CAPIEL, 2006)

The major producers, manufacturers, and users of electrical equipment in Germany have agreed to a **Voluntary Commitment** for minimising SF_6 emissions during production, commissioning, and operation of electrical equipment, as well as during recovery, recycling, and disposal of SF_6. Parties to the Voluntary Commitment account for approximately 98% of SF_6 technology manufacturers, 90% of the users in the medium voltage sector, and 100% of the users in the high voltage sector. Specifically, the following associations and their member companies are Parties to the Voluntary Commitment: (AREVA, 2006)

Operators of power transmission and distribution networks

- The Association of German Network Operators (VDN)
- The Industrial Users' Association

Manufacturers of electrical equipment with SF_6 for electrical power transmission and distribution greater than 1 kV

- The German Electrical and Electronic Manufacturers' Association (ZVEI)

[41] This may be subcontracted to specialist service providers, such as the original providers of the switchgear product or specialist third parties. In-house procurement procedures ensure that only appropriate organisations are used for such specialist activities.

Suppliers of SF_6

- Solvay

The Voluntary Commitment requires that companies observe the comprehensive provisions and recommendations of IEC, VDE, CIGRE, and existing legal requirements for liability insurance to ensure personnel handling SF_6 be adequately qualified. All personnel must be regularly instructed and trained, and maintenance only conducted by qualified personnel.

Siemens AG, a member company of CAPIEL and the biggest buyer of banked SF_6 in Germany, provides a regular training for internal and external personnel working with SF_6. The training includes practical and theoretical components resulting in a two year certification, which includes the following relevant topics (among other required topics): (Siemens, 2006)

- Environmental aspects of SF_6;
- Content of voluntary agreement;
- Responsibilities and tasks associated with handling SF_6; and
- Training on detection of SF_6 leakages.

The International Council on Large Electric Systems (CIGRE) "Practical SF_6 Handling Instructions" include minimum qualification requirements for personnel handling SF_6. Specifically, training must be based on the operating instruction manual from the OEM and datasheets, consisting of both theoretical and practical sessions and covering the environmental characteristics and impact of SF_6 and relevant standards, in addition to other technical topics specific to the type of task to be undertaken by the technician.

Siemens also provided a brochure (currently under revision) of their central training centre that provides SF_6-competence short training and SF_6-competence advanced training. Personnel who operate and support GIS or SF_6-insulated switching devices are required to complete the one-day short training, which includes the following relevant topics: (Siemens, 2006)

- Fundamentals, characteristics, hazard potentials, and handling of SF_6;
- Work, health, and environmental protection rules and regulations;
- Operation and fault detection; and
- Hazards and handling of SF_6 decomposition products.

Maintenance personnel must complete the short training in addition to the one-day advanced training, which includes the following relevant topics: (Siemens, 2006)

- Environmental regulations, requirements, and legislation;
- Principles for responsible handling of SF_6;
- Leakages: causation, locating, and elimination; and
- SF_6-detecting devices and their handling.

Solvay Fluor GmbH, in Germany is a producer of SF_6. At Solvay, training sessions on subjects related to regulatory and plant-specific requirements are carried out six times per year, and all staff are required to attend. Topics include emission-free sampling, quality and safety related operation of the production plant, description of machinery function, preparation of containers prior to filling and after filling them (including leak testing), and specific properties of substances covered under the German regulation on dangerous substances. The instruction programme is regularly audited in accordance with their internal and external quality and environmental certifications. (Solvay, 2006)

The Solvay ReUse Concept provides personnel in the SF_6 production and recovery plant with information on:

- The use of SF_6;
- Procedures under various circumstances;
- Product specifications;
- Descriptions and illustrations of equipment types employed for each activity (e.g., leak detection, servicing, transport, etc.)
- Easy-to-follow diagrams;
- Measures to be taken in case of accident or emergency including health and safety; and
- Regulatory and environmental information.

The **Association of German Network Operators** (VDN), a member of EURELECTRIC, adheres to the Voluntary Commitment and internationally recognised CIGRE guidelines, which include minimum qualification requirements for personnel handling SF_6. Specifically, training must be based on the operating instruction manual from the OEM and datasheets, consisting of both theoretical and

practical sessions and covering the environmental characteristics and impact of SF_6 and relevant standards, in addition to other technical topics specific to the type of task undertaken. In addition, VDN has a sectoral certification programme, "Technical Safety Management," which ensures compliance with technical, organisational, and environmental regulations; however, they do not administer training courses. Training is provided by the operators or manufacturers of HV or MV switchgear. (VDN, 2006)

BOC Refrigerants is a supplier of SF_6 who also conducts recovery services to customers in the UK. BOC provides their own personnel for recovery jobs, who are engineering or science educated and have completed City & Guilds 2078 that involves the recovery of fluorocarbon refrigerants. Personnel undergo instruction and are observed and assessed by operations management prior to starting SF_6 recovery. Personnel also follow internal work instructions for recovery work carried out at their waste licensed facilities, where there are also Waste Management Industry Training and Advisory Board (WAMITAB) qualified staff. (BOC, 2006)

National Grid, one of the worlds largest utilities that owns and operates electricity transmission networks in the UK, requires all staff involved in the maintenance of SF_6 equipment or handling SF_6 to pass the *Practical Handling of SF_6 Gas Programme*, developed in partnership with VA Tech Reyrolle (now owned by Siemens). The two-day course covers lecture and practical components, including regulatory requirements, the safety/practical elements of working with SF_6, and a dedicated session on leakage reduction/inspection, which is supplemented by National Grid's Policy on the containment of SF_6. A written examination must be completed successfully. Staff are trained via their in-house accredited Eakring Training Centre, which is responsible for National Grid's apprenticeship and engineering training schemes on SF_6. National Grid reviews staff competencies on a three year basis and, if appropriate, a refresher course is provided. (National Grid, 2006)

The **Energy Networks Association** represents the electricity transmission and distribution companies in the UK. Training for personnel who handle SF_6 is conducted in-house within electricity companies, and encompasses electrical safety and environmental considerations. The level of training is matched to the particular function of the personnel involved. General training is provided for all staff operating equipment containing SF_6, and specialist training is provided for teams required to handle the gas. (Energy Networks Association, 2006)

BEMA Power, Ltd. is a trade association representing switchgear manufacturers based in the UK, including Areva and Siemens. According to BEMA, switchgear manufacturers select personnel according to their skills, capabilities, and responsibilities, and provide in-house training that encompasses safety and environmental considerations, referenced against external standards, where appropriate. The training is applicable to manufacturing based operations and site related activities, specific to the type of switchgear supplied. (BEMA, 2006)

Personnel in **Bulgaria** must meet the requirements established by the National Electric Company (NEC) for the installation, maintenance, repair, and decommissioning of medium and high voltage equipment containing SF_6. In addition, Bulgaria anticipates legislating the requirements for such personnel in 2007, in accordance with the new EC Regulation on certain fluorinated gases.

In **France,** personnel with the appropriate skills, capabilities, and responsibilities are provided with in-house training that is referenced against IEC standards 61634 and 60480 and the CIGRE Practical SF_6 Handling Instructions.

Two unidentified electric companies belonging to the **Spanish Asociacion Espanola de La Industria Electrica (UNESA)**, which represents electric companies using medium and high voltage equipment, provided relevant survey information. The first UNESA member company requires that its field workers be specialised in the maintenance of the high voltage switchgear. In addition, this company trains workers according to the specific tasks they will be conducting (i.e., installation, servicing, decommissioning). The second UNESA member company educates all personnel qualified to work

with electrical risk and substation maintenance on SF_6. Specifically, installers are shown a slide show, which provides a general overview of the safety aspects in case of abnormal release due to internal fault. Personnel involved in equipment servicing including gas recovery and leak control are trained on procedures for SF_6 handling tasks. The code is revised regularly and contains several topics of SF_6 equipment training, including safety, general properties, kinds of impurities and effects, leak detection, use of SF_6 equipment, evaluation of accidental releases of SF_6 to the atmosphere, and cleaning and neutralisation of decomposition products. Personnel involved in equipment decommissioning are trained on gas quality verification for the classification and treatment of used SF_6 and its related equipment. The tests indicate purity, moisture, and acidity of SF_6. (Spain, 2006)

Sercobe, the National Association of Manufacturers of Capital Goods in Spain, requires that personnel be qualified to work with high and medium voltage installations and equipment. All personnel have to be specifically trained on the environmental and safety implications of the use of SF_6 in high and medium voltage switchgear. CAPIEL and EURELECTRIC are developing the following programmes for the following activities: (Spain, 2006)

- *Installers (not involved with gas handling) must complete:*
  - Module A. Awareness
  - Module B. SF_6 Filled Electrical Equipment Operational
- *Servicing providers (involved with gas handling) must complete:*
  - Modules A and B, described above.
  - Module C1. Gas Handling Competence with SF_6 that has not been Subjected to Arcing
  - Module C2. Gas handling Competence (SF_6 in service)
- *Major maintenance operations providers (requiring entrance into SF_6 compartments)*
  - Modules A, B, C1, C2, as described above.
  - Module D. Major Refurbishment/End of Life Competence
- *Equipment decommissioning providers for eventual reclamation or destruction*
  - Modules A, B, C1, C2, and D.

8.4.1 Summary of voluntary programmes (SF_6)

A summary of the voluntary programmes in the SF_6 sector, based on information provided by companies and industry associations, is provided in Table 22.

Table 22: Summary of Voluntary Certification Schemes/Training Programmes for Personnel in the SF_6 Sector

Organization	Country	Course/ Programme	Training Covers:			Competency Testing Includes:		
			Lecture and Practical Components	Regulatory Requirements	Leak Detection/ Prevention	Written Component		Practical Component
						Legislation	Techniques	
BOC Refrigerants	UK, Ireland	In-house training and required qualifications	✓	✓	✓	✓	✓	✓
Siemens AG	Germany	Regular training and instruction	✓	✓	✓	✓	✓	✓
Solvay Fluor GmbH	Germany	In-house training	✓	✓	✓			
National Grid	UK	Practical Handling of SF_6	✓	✓	✓	✓	✓	
UNESA member company 1	Spain	In-house training						
UNESA member company 2	Spain	In-house training			✓			

Notes: Blanks indicate uncertainty regarding whether the programme element is offered, as no information was provided through survey responses.

8.5 Industry Recommendations for Ensuring Programme Effectiveness

According to the response provided by **CAPIEL** and **EURELECTRIC,** and supported by their member organisations, gas handling procedures and training must be integrated with operational safety procedures at the company level. Because of the potential consequences of gas loss, failure of the insulation system, risk of injury to network operator's personnel, and the resulting loss of power supply to areas, training and operational procedures in the electricity supply industry are paramount for safety and operational reasons.

Currently, training is provided to those involved in all aspects of production and use of high voltage switchgear. This training includes specific training at an appropriate level for personnel involved with the recovery of SF_6 from high and medium-voltage equipment.

Furthermore, **CAPIEL** emphasised the need to ensure and document a high level of training on environmental aspects of proper SF_6 handling in the EU with legally required mutual recognition between Member States. CAPIEL maintains that the most promising approach would be to include a legal reference to an industry standard that covers environmental issues and other key training to minimise emissions, in addition to the training on safety precautions that is already the industry norm. In particular, CAPIEL suggested that IEC Standard 62271-303, which is currently under preparation and being adapted from CIGRE 276 (2005), is appropriate for this purpose. Given that IEC Standard 62271-303 will not be finalised before 2008, CAPIEL suggests the intermediate use of the *Publicly Available Specification (PAS)*, which is an accelerated IEC option that provides for a binding framework for a standard with keywords (in lieu of a final, comprehensive standard with global approval procedures). Establishing and adopting the PAS takes just one year. The form of certificate for in house training (including the content of the training), as well as the legal requirements (including the entitlement of companies to execute training and issue certification) would have to be agreed upon and included in the standard. In reference to the latter issue, CAPIEL recommends that companies entitled to execute training and issue certificates be those that have quality and environmental management systems in place with well documented rules and ISO certification or the like.

According to **VDN**, it is essential that programmes train personnel according to the specific activities they will be performing. In particular, VDN notes that the following distinctions should be made among programmes/personnel specialisation in this sector: (VDN, 2006)

1) *SF_6 filled equipment operators*: personnel who operate or undertake the routine operation of SF_6 filled electrical equipment in service but not the 'handling' of gas, inclusive of personnel who have some involvement with SF_6 filled equipment, or operate in areas in the presence of SF_6 in containers or SF_6 filled equipment.
2) *New or technical grade SF_6 operators*: those undertaking gas handling operations including filling, evacuation, and 'topping up' with new equipment using new SF_6 to IEC 60376 or SF_6 to IEC 60480 before equipment is placed in service or tested.
3) *Used SF_6 operators*: personnel undertaking gas handling operations including filling, evacuation, and 'topping up' with equipment which has been placed in service or tested.
4) *Waste operators*: personnel who undertake major maintenance involving access to SF_6 filled enclosures, replacement of components in these enclosures, or activities relating to the end of life of the equipment.

The distinction between SF_6-insulated switchgear for medium voltage and high voltage switchgear is important; currently, medium-voltage switchgear units up to 52 kV are designed primarily as sealed pressure systems, and no re-filling or handling is required (during normal operation) for the duration of the switchgear's service life. (VDN, 2006)

According to **National Grid** of the UK, a key programme element is training in practical handling, which is provided as part of the VA Tech Reyrolle course. Like the VA Tech Reyrolle course,

trainees should receive a broad-based training, with tutor-led presentations and opportunities to ask questions. In addition, training assessments should enable the identification of any areas where an attendee might need further clarification. In order to operate a safe and reliable high voltage electricity system and establish the highest standards of environmental protection, training for the handling of SF_6 filled equipment needs to be integrated into a programme of technical, safety, and professional training and supplemented by clear company policies stressing the safety and environmental importance of SF_6 gas containment and the safe handling and maintenance of SF_6 filled equipment. (National Grid, 2006)

UNESA Member Company 1 believes that training in the servicing and decommissioning of high voltage switchgear should include specific instructions on the handling of SF_6 and the treatment of its decomposition products. In addition, personnel performing equipment decommissioning should be trained in the management of recovered SF_6. (Spain, 2006)

According to **Sercobe**, because this sector is highly specialised, the most suitable (efficient and cost effective) procedure to implement the training programme would be self-certification by the relevant industry. (Spain, 2006)

8.6 Effectiveness of Programmes to Date

According to a 2005 study commissioned by CAPIEL, voluntary actions taken by the European electricity industry have resulted in the reduction of SF_6 emissions by 40% since 1995. Voluntary measures have included training of personnel handling SF_6, as well as improved design for leak tightness, and gas recovery/re-use. According to the study, most of the potential for emission reductions has already been realized, but additional opportunity for emission reduction lies in improving decommissioning infrastructure. (ECOFYS, 2005)

The industry responses that touched on programme effectiveness include those from VDN, CAPIEL, and Solvay:

- **VDN** attributes a 55% reduction in SF_6 emissions between 1995 and 2003 to the voluntary training initiatives taken by companies who operate or manufacture SF_6-insulated switchgear. These companies have extensive experience with the handling procedures, which is based on standards and rules for each task category. (VDN, 2005)

- **CAPIEL** also credits the emission reductions realised since 1995 to the improved training of personnel. According to them, the modular structure of training provided by manufacturers and network operators, where the training is appropriate to the task to be performed, has proven to be highly effective. (CAPIEL, 2006)

- **Solvay** believes that the basic topics included in their training programmes have been highly effective. These topics include emission-free sampling, quality and safety related operation of the production plant, description of machinery function, preparation of containers prior to filling and after filling them (including leak testing), and specific properties of substances covered under the German regulation on dangerous substances. (Solvay, 2006)

It is clear that voluntary agreements and industry provided training programmes throughout the EU have contributed to significant emissions reductions over the last 10 years. Efforts to minimize SF_6 emissions have increased among utilities and equipment manufacturers; however, some of these efforts may not be implemented by smaller manufacturers and users of the equipment (ECOFYS, 2005). There is a continued need for basic efforts to be achieved throughout the electricity industry.

Additionally, without a decommissioning infrastructure that provides easy and cost-effective decommissioning results in some inadvertent venting of SF_6 at equipment end of life. There is a need

to develop a responsibility for decommissioning, an enforcement structure, and the availability of qualified personnel to ensure proper recovery and containment of used SF_6 throughout the EU. (ECOFYS, 2005)

In short, the rigorous training provided by equipment manufacturers and network operators has proven to be highly effective in reducing emissions of SF_6, but further emission reductions can be achieved through additional training of personnel performing decommissioning. Building on these considerations, the next section presents recommendations on minimum qualifications and training programmes for personnel.

8.7 Conclusions and Recommendations

8.7.1 Recommended Minimum Qualifications and Training Programmes in the High and Medium Voltage Equipment Containing SF_6

All personnel working with high and medium voltage equipment containing SF_6 must be highly trained and experienced to ensure safety. Employment of untrained personnel may result, not only in F-Gas emissions, but also failure of the insulation system, risk of injury to personnel, and loss of power supply to serviced areas. Because of the highly specialised nature of this sector, rigorous in-house technician training programmes are already provided by companies that install, service, maintain, or decommission high and medium voltage equipment.

Based on the review of minimum qualifications for personnel and available training programmes in place, as well as industry recommendations for effectively training personnel, the following minimum qualifications are recommended for adoption at the EU level:

In-house technician training should be required by law for all personnel working with, or in proximity to, high and medium voltage equipment containing SF_6. In-house training should cover theoretical and practical components that enable weaknesses to be identified and strengthened prior to personnel performance of activities. Specialised training, including tailored examinations, should be based on the types of activities performed in the sector, and should be part of the training available to personnel working with this type of equipment. The suggested "areas of specialisation," upon which training should be based, and the required training for each area that builds on knowledge tested in the previous level, are presented in Table 23.

Table 23: Areas of Specialisation and Required Training

Specific Areas of specialisation	Level of Training			
	Level 1	Level 2a	Level 2b	Level 3
Personnel Function	Operators of SF_6 filled equipment	Operators of new SF_6 (equipment that has not been subject to arcing)	Operators of used SF_6	Major refurbishment/ end of life activities
Description of Tasks	Operate or work in proximity of SF_6 filled equipment including gas recovery	Handle new SF_6 gas in new equipment before it has been placed in service or tested, including filling, evacuation, and topping up	Handle SF_6 gas in equipment that has been placed in service or tested, including filling, evacuation, and topping up	Decommission SF_6 filled equipment or undertake major maintenance operations (involving access to SF_6 filled enclosures)

It is recommended that the approach for training schemes be modular and cumulative; each additional level of training will build on the knowledge set developed from the previous level. Thus, for example, personnel responsible for gas handling and recovery of SF_6 in service would need to complete Level 1 and 2b trainings; personnel responsible for major refurbishment and end of life

would require the successful completion of training Levels 1, 2a, 2b, and 3. Table 24 summarises the general knowledge areas that should be covered in each of the recommended training levels:

Table 24. Recommended Knowledge Areas by Training Level

Level 1: Operators of Filled SF_6 Equipment	Level 2a: Operators of New SF_6[a]	Level 2b: Operators of Used SF_6	Level 3: Waste Operators
• SF_6 properties • Environmental awareness, including Kyoto Protocol • Legal obligations pursuant to Regulation (EC) No. 842/2006 • Handling, control and storage • Safety in terms of release of SF_6 from storage and failed equipment • Communication actions in the event of non-routine occurrences • Transport of clean and recycled SF_6 related to national environmental obligations	• Monitoring of SF_6 gas and appropriate recording of data related to national environmental obligations • Gas handling operations, including evacuation, filling and "topping up", and leak detection • Measurement techniques (quality, density, moisture, acidity)	• Monitoring of SF_6 gas and appropriate recording of data related to national environmental obligations • Gas handling operations, including evacuation, filling and "topping up", and leak detection • Measurement techniques (quality, density, moisture, acidity)	• Breakdown properties of SF_6 • Precautions and preparations for the opening of SF_6 filled electrical equipment • Personal protection equipment • SF_6 recovery • Decontamination • Waste management

[a] This module should cover IEC 60376 (Specification and acceptance of new Sulphur hexafluoride) or IEC 60480 (Guide to the checking and treatment of SF_6 taken from electrical equipment and specification for its re-use).

Certification should be issued by companies to all personnel who successfully complete the required in-house training as documentation and proof that they are adequately trained to handle SF_6 and minimise emissions during all activities.

In addition to certification, ***personnel in charge*** of work activities should also possess a tertiary education degree in a relevant field (i.e., a degree from a vocational school, career college, or university) or at least five years of ***experience*** in the relevant field. Relevant experience may include that obtained by working as an apprentice to a certified technician. Such a requirement is likely the industry status quo, but is highlighted in this report to underscore the need for well-qualified individuals to assume responsibility for work activities involving controlled substances.

In addition, ***company licensing/certification*** should also be highlighted as an effective means of ensuring compliance with Regulation (EC) No 2037/2000 and Regulation (EC) No 842/2006. Such certification could also ensure the companies providing training and issuing certification to personnel are qualified to do so, and that adequate equipment is provided to minimise emissions on the job. Already, many companies in this sector are ISO 14000 certified, and/or part of voluntary industry consortiums which require adherence to high industry standards (e.g., IEC 61634 on the use and handling of SF_6 in high-voltage switchgear and control gear). Such certifications could serve as de facto licensing at the state level, to ensure that best environmental practices are being followed.

Finally, in recognition of commendable industry efforts to address the EC mandate, it is recommended that a legal reference to the new International Electrotechnical Commission (IEC) standard under preparation—IEC Standard 62271-303, which will cover all training modules listed in

Table 24—be considered for adoption at the EU level. As IEC 62271-303 will not be finalised before 2008, the Publicly Available Specification (PAS) should be considered for adoption in the interim.[42]

To help ensure that in-house training adequately covers environmental issues and regulations, it is recommended that the European Commission, in collaboration with industry experts/associations, prepare a ***guidance fact sheet*** that addresses climate change science, the Kyoto Protocol, and relevant EC regulations. The guidance fact sheet should be incorporated into each company's in-house training programme.

In addition, companies should be encouraged to require refresher courses, to provide personnel with an opportunity to learn about the latest industry standards, practices, and updates, as relevant. For example, periodic courses could be offered equipment operation, leak testing, substances subject to national or EU legislation, or other topics specific to a site or plant. Other issues, such as safety and operation issues, may also be included, although they are not mandated by the Regulation.

8.7.2 Compliance with recommended minimum qualification requirements and Programmes in the high and medium voltage equipment containing SF_6

Based on available information collected through survey responses, Table 25 presents how Member State compliance compares to the recommended minimum qualification requirements suggested in this report. Table 26 compares the mandatory and voluntary training programmes in place to those recommended here.

Table 25: Comparison of Recommendations to Minimum Qualifications in Place (National Requirements)

Member State	Mandatory In-House Training/Certification for All Personnel	Tertiary Degree or Minimum Years of Experience Required for Personnel in Charge	Company Licensing/ Certification Required
Austria	-	-	-
Belgium	-	-	-
Cyprus	-	-	-
Czech Republic	-	-	-
Denmark	-	-	-
Estonia	✓	✓	-
Finland	-[b]	✓	✓
France[a]	✓		
Germany	✓	✓	-
Greece	-	-	-
Hungary	-	-	-
Ireland	-	-	-
Italy	-	-	-
Lithuania	-	-	-
Luxembourg	-	-	-
Malta	✓	✓	-
Netherlands	-	-	-
Poland	-		-
Portugal	-	-	-
Slovakia	-	-	-
Slovenia	✓		
Spain[a]	✓		
Sweden	-	-	-
UK[a]	✓	-	-
Accession Country			

[42] The PAS is an accelerated IEC option that provides for a binding framework for a standard with keywords (in lieu of a final, comprehensive standard with global approval procedures).

Member State	Mandatory In-House Training/Certification for All Personnel	Tertiary Degree or Minimum Years of Experience Required for Personnel in Charge	Company Licensing/ Certification Required
Bulgaria[a]	✓		

Notes: Check marks (✓) indicate requirements that are in place. Dashes (-) indicate requirements that are not in place. Blanks indicate uncertainty regarding whether the requirement is in place, as not enough information was provided through survey responses. Member States for which no information was provided have been excluded from the table.

[a] In-house training may not be legislated but is standard industry practice.

[b] The requirements only exist for the person in charge.

Table 26: Comparison of Recommendations to Training Programmes in Place (Required and Voluntary Programmes)

Company/ Association	In-House Training Programme			Subjects Taught					
	Specific to Various Activities/ Equipment Types	Lecture Component	Practical Component	Kyoto Protocol and Relevant EC Regulations	Equipment Operation and Fault Detection	Gas Handling for SF6 that has not been Subject to Arcing[a]	Gas Handling for SF6 that has been Subject to Arcing	Major Refurbishment/ Decommissioning	Safety (related to containment)
Association of German Network Operators (VDN) Technical Safety Management				✓					✓
BOC Refrigerants[b]	✓	✓	✓	✓			✓	✓	✓
National Electric Company (Bulgaria)	✓								
Sercobe				✓					✓
Siemens	✓	✓	✓	✓	✓	✓	✓		✓
Solvay Fluor GmbH	✓			✓	✓	✓	✓	✓	✓
UNESA Company 1	✓				✓	✓	✓	✓	
UNESA Company 2	✓	✓	✓		✓	✓	✓	✓	✓
VA Tech Reyrolle Practical Handling of SF_6 Gas		✓	✓	✓	✓				✓

Notes: Check marks (✓) indicate requirements that are in place. Dashes (-) indicate that programme criterion is not in place. Blanks indicate uncertainty regarding whether the criterion is in place, as no information was provided through survey responses.

[a] Including operation of leak detection equipment, gas carts, filling devices, etc.

[b] An advanced degree is required.

8.8 References

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9. Fire Extinguishing

9.1 Background

The fire protection sector has historically relied on halon because it is a clean agent—meaning that it does not leave residue on equipment or in the protection enclosure after discharge—works well over a broad temperature range, and has relatively simple design and installation. Halons have high ozone depletion potentials (ODPs), ranging from 3.0 to 10.0. Regulation (EC) No 2037/2000 mandated the decommissioning of all halon systems and extinguishers in the EU by the end of 2003, with the exception of those applications that are defined as critical uses. However, in addition to critical uses, other continued uses of halon are believed to exist in violation of the Regulation.

To replace the use of halons and HCFCs in new and existing applications, various clean agents are available, including HFCs (e.g., HFC-23, HFC-125, HFC-227ea, and HFC-236fa). HFCs have high global warming potentials (GWPs) in the range of 2,800 to 11,700. Non-GWP substitutes are also available, including N_2, argon, and CO_2,

To prevent the inadvertent discharge of fire extinguishing agents to the atmosphere (as well as injury) during recovery, recycling, reclamation, and decommissioning, such activities should only be performed by qualified, well-trained personnel.

9.2 Survey Responses

Survey responses regarding minimum qualification requirements and/or training programmes for personnel working with *ODS* in fire protection equipment were received from 25 Member States.[43] Information regarding minimum qualification requirements or training programmes for personnel working with *F-Gases* in fire protection equipment were received from 23 Member States.[44] Additional survey responses were received from the following industry associations or manufacturers: (1) British Fire Protection Systems Association (BFPSA); (2) British Approval for Fire Equipment (BAFE); (3) Fire Industry Confederation (FIC); (4) LyonTech Engineering, Ltd.; (5) BOC Refrigerants; and (6) ESTO Cheb Ltd.

Information provided through these surveys on the minimum qualification requirements in place, as well as any voluntary or required training programmes offered, is presented in this chapter—first for ODS, then for F-Gases. In addition, the effectiveness of programmes currently in place is discussed, and industry recommendations on essential programme components needed to ensure training effectiveness and personnel skills/knowledge are also summarized. Finally, recommendations for minimum qualifications for personnel dealing with ODS and F-Gas solvents are provided at the end of the chapter.

9.3 Member State Minimum Qualification Requirements and Programmes: ODS

Of the 25 Member States that responded, 20 of these Member States have specific minimum qualifications and/or training programmes in place or awaiting legislation for personnel working with ODS fire protection equipment. The remaining five Member States either do not have minimum qualifications or training programmes in place at the national level. In some cases, this is because no remaining ODS uses are reported in this sector. In other cases, minimum qualifications may be in

[43] Responses were received from all Member States surveyed except Latvia and Romania.
[44] Responses were received from all Member States surveyed except Latvia and Romania. No information for this sector was provided by Hungary or Portugal.

place at a company or military level (for the remaining critical uses), but no information on such qualifications or programmes is available, if applicable.

9.3.1 Member States with minimum qualification requirements for personnel (ODS)

Ten Member States have or in the process of legislating minimum qualification requirements that apply to *all personnel* working with ODS. Specifically, Austria, Hungary, Ireland, Italy, Lithuania, the Netherlands, Poland, Portugal, Slovakia, and the United Kingdom require personnel certification, which must be earned by successfully completing a training course/programme *and* examination. Six of these Member States require certification renewal—Austria, Lithuania, the Netherlands, Poland, Portugal, and Slovakia. The requirements for personnel are not yet legislated in Ireland or the United Kingdom.

- The **Austrian** 2000 Halon-Bank Regulation §2(3) and §3(1) bans halons with the exception of "critical purposes." Under the Trading Regulations Order personnel maintaining and dismantling fire extinguishers and systems must be trained and authorised.[45] Personnel earn certification from the Certification Body of the Fire Protection Association (Brandschutzverband), entitled Expert Training for Fire Protection Specialist (to comply with ONORM F 1053). Certification is issued upon successful completion of 32 units of instruction (45 minutes each), a written assessment of 100 multiple choice questions, and a practical exam. Topics covered in the training include laws and regulations (including the requirements of EC Regulation 2037/2000 and Halon Management System); procedures for testing, filling, and acquiring spare parts; correct and incorrect use of fire extinguishers; hands-on practice; and other required topics. Certification must be renewed every three years. (Austria, 2006)

- In **Hungary**, personnel performing repairs and maintenance of fire extinguishing equipment must take a course and pass an oral examination on environmental protection and halon handling. Technicians are taught how to handle halon in an environmentally sound manner, including laws and regulations, halon standards, filling, halon treatment, halon bank, and alternatives. (Hungary, 2006)

- In **Italy**, all technicians must follow the general training provided by fire-fighting companies to perform activities involving ODS. The training includes: (1) international and national laws on substances used and emissions testing (4 hours); (2) technical training and examination (15 hours); and (3) practical tests including leak detection (15 hours). Training for staff at halon collection centres is organised by the managers of the collection centres and includes current legislation and responsibilities, proper operation and handling of equipment, and other required topics, totalling 35-40 hours. (Italy, 2006)

- **Lithuania** has passed legislation (Order No. 684) establishing qualification requirements for waste treatment personnel, which apply to all personnel conducting ODS recovery, recycling, reclamation, or destruction from fire protection equipment. Technicians must attend a special training course based on the programme approved by the Ministry of Environment, possess knowledge about regulations and the adverse effect of ODS on the environment, and pass an exam. Renewal is required every five years. In addition, technicians installing, servicing, or maintaining fire protection equipment containing ODS must be trained in compliance with LAND 50-2004. (Lithuania, 2006)

- In the **Netherlands**, all personnel that recover ODS from total flooding systems must obtain a certificate from the National Centre for Prevention (NCP), the Dutch foundation for safety and

[45] It is assumed that these qualifications pertain to personnel dealing with critical use applications of halon and halon bank personnel, although this is ambiguous based on the information provided by the competent authorities.

security, which provides a halon training course/seminar on the dismantling, decoupling, and preparation for transport of halon-based extinguishing systems. To earn a certificate, requirements set forth by the NCP must be met (such requirements were not specified). In addition, the Dutch programme for the collection and treatment of CFCs and halons requires halon training for service companies working under the Dutch program's collection scheme. NCP-certified service personnel must obtain the REOB-identity card, which requires a six-day training course and concludes with a theoretical and practical examination. Personnel must renew their certification every five years. Topics specific to ODS and the dismantling and reclaiming of halon from large, fixed equipment are presented in an additional one day training course. (Netherlands, 2006)

- **Polish** regulations require that personnel working with fire protection systems or the substances contained in such systems hold a qualification certificate earned through a required course and exam. The required eight-hour course covers the following relevant topics (among others): (Poland Journal of Laws No. 202, Item 2071)
  - Environmental impact, legislation and standards, and methods of handling controlled substance waste, products, equipment or systems containing such substances;
  - Requirements for installation, support, maintenance, repair and inspection of equipment and systems, with a focus on safety, emission detection and prevention, and integrity control; and
  - Hands-on practice in salvaging controlled substances, testing integrity, servicing equipment and systems, and using personal safety equipment including leak detection.

  The examination is theoretical and practical and covers (among others):
  - Leak prevention;
  - Controlled substances and their replacements;
  - Environmental impact, legislation governing controlled substances, and handling of controlled substance waste or products, equipment, or systems containing such substances; and
  - Practical skills in the handling of controlled substances, including leak detection

  Renewal of the qualification certificate requires the completion of a follow-up course and passing of the examination every five years. (Poland, 2006)

- In **Portugal**, the Institute for the Environment of the Ministry of the Environment provides certification in compliance with Decree-Law 152/2005 of 31 August 2005. All personnel must: (1) have an engineering degree with either specific training in the appropriate field or five years experience; (2) take a professional course; and (3) have five years experience and successfully complete an examination carried out by a designated Committee. Renewal is required every five years. (Portugal, 2006)

- In **Slovakia,** all personnel who handle ODS must have the "Certificate of expert qualification for handling ozone depleting substances," obtained after the completion of a three to four day training course that includes theoretical and practical education, regulations, and leakage reduction/inspection. The training concludes with a theoretical and practical examination. (Slovakia, 2006)

- **Ireland** and the **United Kingdom** anticipate introducing minimum qualification requirements for personnel decommissioning halon-containing equipment, that will require all technicians to be certified by December, 2006. The proposed requirement for equipment decommissioning is the one-day British Fire Protection Systems Association (BFPSA) Competence Certification Course Class I. Under the proposal, two years of practical experience is required and topics covered include (among others): typical applications for gaseous fire suppression systems, the Montreal Protocol, the legislative background behind decommissioning, safe working practices, and handling. Participants must achieve a 75% pass-mark to earn certification. (Ireland, 2006; UK, 2006)

Six Member States have minimum qualification requirements that apply to *all personnel* working with ODS and consist of a training course *or* examination—Belgium, Czech Republic, Estonia, Germany, Luxembourg, and Malta. The requirements for personnel are not yet legislated in Belgium. Details of these requirements are provided below.

- **Belgium** is in the process of developing a certification scheme for maintenance technicians working with installations containing ODS or F-Gases that will apply to all three regions. To receive a certificate, each person will have to pass a theoretical examination on regulatory and technical requirements. While certification is not yet mandatory, most (if not all) companies that install and maintain fire extinguishing systems are certified. This is because insurance companies in all regions enforce a general certification process that includes qualification requirements for the technical expert (among other company requirements). The individual designated as technically responsible with decision competence must have three years experience and prove his competence by passing an examination. The examination topics include: installation rules of fire protection systems (detection, control systems, etc.) and relevant legislation on fire protection. Certification must be renewed every three years. (Belgium, 2006)

- Personnel in the **Czech Republic** must: (1) complete a training course run by the producer of the fire protection equipment or the equipment being used for recovery, recycling, or destruction; (2) obtain a certification of professional authorisation issued by the relevant organisation of the state expert supervision; or (3) have a university education acquired through the accredited study program, Fire Protection and Industrial Safety. (Czech Republic, 2006)

- **Estonia** has established qualification requirements for technicians handling ODS and fluorinated greenhouse gases in all sectors. However, given the status of the halon phaseout, there may be no need for programmes to fulfil the training requirements. All decommissioning work is done by the staff of the National Ozone Office, which was trained via the UNDP project "Baltic Regional Halon Bank." (Estonia, 2006)

- In **Germany,** halons have been banned with the exception of critical uses. The 1993 Implementation Guidelines for §8 of the 1991 CFC/Halon Prohibition Ordinance specify the required qualifications for workers who maintain and decommission fire extinguishing systems. In short, they must be trained and possess expert knowledge and technical skills, as defined in several regulatory documents. The Federal Technical School (Bundesfachschule) follows these guidelines and must adhere to European Norm DIN EN 378, which addresses measures to protect the environment. (Germany, 2006)

- In **Luxembourg**, only one company is authorised to recover halons. All technicians involved in the dismantling of installations and recovery of halons receive specialised training from the fire protection equipment manufacturer. (Luxembourg, 2006)

- In **Malta**, aircraft engineers are responsible for the handling and servicing of equipment containing halons on aircraft. All such engineers are briefed by the Malta Environment and Planning Authority (MEPA) regarding the obligations they must follow. No specific information regarding the content of the briefing was provided. (Malta, 2006)

Three Member States—Finland, France, and Greece—have minimum qualification requirements for *the person in charge* or specified technician that include the completion of a training course *and* an examination. Finland and France require that the certification be renewed after a period of time.

- In **Finland**, the qualifications laid out in Act 562/1999 of Government Decree No. 1187/2001 must be met by the person designated in charge of operations involving the installation and servicing of fire extinguishing equipment. Qualified persons must receive the proper training, work experience, and pass an oral examination to obtain certification. Additional knowledge and

skills are required for the decommissioning of ODS and F-Gases as they are considered hazardous waste. A person is deemed responsible if they have technical training or basic training as a waste reception centre superior; and at least two years' work experience in the installation and maintenance of technical equipment or waste management. Required competence includes: (1) knowledge of the type of equipment handled; (2) knowledge of the equipment needed in the work and correct working practices; and (3) knowledge of the health, safety, and environmental protection regulations. (Finland, 2006)

- In **France**, a company must prove it employs two competent technicians (in addition to other requirements) in order to be certified to recover halon. The person in charge must be educated in the field of safety; the conception, implementation, verification, and maintenance of automatic extinguisher (EAG) installations; and on the extinguishing agents for which the company is requesting certification. This technician must have a diploma in this field or at least three years professional experience in the field of EAG installations. In conjunction with a second technician, both technicians must pass a knowledge based test, or the two technicians can be separately responsible for portions of the test. After two years the certification can be revoked or extended, and must then be reviewed every three years thereafter. (France, 2006)

- In **Greece**, companies involved in the maintenance, inspection, and refilling of fire fighting equipment must meet certain requirements; and the person in charge of the company must hold a University or Technical College degree, be a graduate of a Technical Institute on the relevant area, or possess three years of certified work experience. Certification to persons in charge is granted upon successful completion of a 24-hour training programme and examinations. (Greece, 2006)

In **Spain**, only Fire Protection Authorised *companies* may install, maintain, or repair fire systems. A responsible technician in charge of the company must be identified and the regulation includes stipulations for the type of agents to work with (ODS and HFCs), the proper personnel for the business, proper machines and tools, insurance, and 3 years authorisation that can be renewed. There is no required programme, but authorisation can be obtained by taking a class in the second level of the First Degree of Professional Scholar Training, titled "Installation of building and industrial fire protection systems," which is 2,000 hours in length. For conducting leak checks, individuals can obtain authorisation if they can certify that they have adequate technical and human resources to maintain their systems. (Spain, 2006)

9.3.2 Member States with no minimum qualification requirements for personnel (ODS)

Five Member States do not have minimum qualifications or training programmes in place at the national level.

In **Slovenia,** there are no ODS used in fire protection equipment and minimum qualification requirements have not been put in place. (Slovenia, 2006)

Bulgaria and Cyprus indicated that no specific requirements are currently in place for personnel working with fire protection equipment (Cyprus, 2006). In **Bulgaria**, the producers and merchants of fire protection systems and extinguishers have the obligation to maintain, repair, and/or decommission the fire protection installations with ODS; and train the personnel involved with the repairing or disassembling of fire protection systems and extinguishers (Bulgaria, 2006).

Because a survey response was provided by **Denmark** and **Sweden** but no information on minimum qualification requirements for personnel working with ODS fire fighting equipment was available or included in the response, it is assumed that these Member States do not have requirements for personnel in place. (Denmark, 2006; Sweden, 2006)

9.3.3 Summary of Member State minimum qualification requirements and programmes (ODS)

Table 27 below summarizes and compares the minimum qualifications and training programmes in place in each Member State, per the assessment criteria identified in Section 3.2. In cases where Member States have reported zero remaining halon use in their survey responses, "NA" (for "not applicable") is indicated to denote the fact that there is no need for minimum qualifications or programmes for personnel in this sector. In all other cases, it was assumed that at least some remaining halon use exists, and so the minimum qualifications and programmes in those Member States were assessed against the standard criteria identified in Section 3.2. Table 27 lists those Member States without requirements and those that did not respond.

Table 27: Summary of Minimum Qualification Requirements and Programmes for Fire Protection Equipment Using ODS

Member State	Criteria for Minimum Qualification Requirements				Criteria for Programmes		
	Nature of Certification	Who Must be Certified	How to Obtain Certification	Certification Renewal?	Requirement by Law	Nature of Education	Competency Testing
Austria	*	**	**	*	**	***	**
Belgium	*	**	*	-	*	*	**
Czech Republic	*	**	**	-	*	***	*
Estonia	*	**	**	-	-	-	-
Finland	*	*	***	*	**	*	**
France	*	*	***	*	*	**	***
Germany	NA	NA	NA	NA	NA	NA	NA
Greece	*	*	***	-	**		**
Hungary	*	**	**	-	**	**	**
Ireland	*	**	***	-	**	**	*
Italy	*	**	**	-	**	**	**
Lithuania	*	**	**	**	**	**	**
Luxembourg	*	**	*	-	*		
Malta	*	**	*				
Netherlands	*	**	**	**	**	*	**
Poland	*	**	**	**	**	***	***
Portugal	*	**	***	**	**	**	*
Slovakia	*	**	**	**	**	***	**
Slovenia	NA	NA	NA	NA	NA	NA	NA
Spain	*	*		*			
UK	*	**	***	-	**	**	*

Notes: Dashes (-) indicate that programme criterion is not in place. Blanks indicate uncertainty regarding whether the criterion is offered, as no information was provided through survey responses. Not applicable (NA) indicates ODS solvent use has reportedly been phased out entirely.

Table 28: Member States in which No Minimum Qualification Requirements are in Place or for which No Information was Provided for fire extinguishing equipment containing ODS

No Minimum Qualification Requirements in Place		No Information Provided	
▪ Bulgaria[a]	▪ Denmark	▪ Latvia	▪ Sweden
▪ Cyprus		▪ Romania[a]	

[a] Accession countries.

9.4 Member State Minimum Qualification Requirements and Programmes: F-Gases

Of the 23 Member States that provided a response, six of these Member States have the same minimum qualifications in place for fire protection equipment containing F-Gases as for fire protection equipment containing ODS. F-Gases have been phased out from fire protection equipment completely in two Member States, and the remaining Member States that provided a response indicated that no specific requirements are currently in place for personnel working with F-Gas containing fire protection equipment.

9.4.1 Member States with Minimum Qualification Requirements for personnel in the fire prevention sector: F-Gas

No Member States indicated they had developed specific minimum qualification requirements for personnel working with F-Gases in fire protection systems.

Six Member States—Austria, Belgium, Estonia, Finland, Greece, and Spain—have the same requirements in place for personnel working with F-Gases in the fire protection sector as for personnel working with ODS in the fire protection sector. The legal requirements are not yet legally finalised in Belgium. No national programmes are available in Estonia. (Austria, 2006; Belgium, 2006; Estonia, 2006; Finland, 2006; Greece, 2006; Spain, 2006)

9.4.2 Member States with no minimum qualification requirements for personnel (F-Gases)

Denmark and **Luxembourg** have no fluorinated greenhouse gases used in fire protection equipment and, therefore, no minimum qualification requirements exist in this sector. (Denmark, 2006; Luxembourg, 2006).

Twelve Member States—Cyprus, Czech Republic, France, Germany, Ireland, Italy, Lithuania, Malta, the Netherlands, Poland, Slovakia, Slovenia, and the United Kingdom—and Bulgaria indicated that no specific requirements are currently in place for personnel working with F-Gas containing fire protection equipment.

- In **Bulgaria, Ireland,** and the **UK,** the producers and merchants of fire protection systems and extinguishers have the obligation to train personnel involved with the repairing or disassembling of fire protection systems and extinguishers. (Bulgaria, 2006; Ireland, 2006; UK, 2006)

- The **Czech Republic** will implement the new F-Gas legislation once the EU regulations are finalised. (Czech Republic, 2006)

- In **France**, a company can be certified as described under Section 9.3; however, the certification is not required for companies or personnel working with F-Gases. (France, 2006)

- In **Italy, Lithuania**, and **Poland,** certification schemes for personnel handling ODS are easily adaptable to those handling F-Gases; once the EU F-Gas regulation is implemented, the necessary modifications will be made (Italy, 2006; Lithuania, 2006; Poland 2006).

- The response provided by **Malta** contended that minimum qualification requirements are not applicable, for which no explanation was provided. (Malta, 2006)

- In the **Netherlands, Slovakia**, and **Slovenia,** legislation regarding minimum qualification requirements is under development. (Netherlands, 2006; Slovakia, 2006; Slovenia, 2006)

Because a response was provided by **Hungary, Portugal,** and **Sweden** but no information on minimum qualification requirements for personnel working with F-Gas solvents was available or included in the response, it is assumed that these Member States do not have requirements for personnel in place in this sector. (Hungary, 2006; Portugal, 2006; Sweden, 2006)

9.4.3 Summary of Member State minimum qualification requirements and programmes (F-Gases)

Table 29 below summarizes and compares the minimum qualifications and training programmes in place or pending in each Member State, per the assessment criteria identified in Section 3.2. In cases where Member States have reported zero F-Gas use in their survey responses, "NA" (for "not applicable") is indicated to denote the fact that there is no need for minimum qualifications or programmes for personnel in this sector. In all other cases, it was assumed that at least some remaining F-Gas use exists, and so the minimum qualifications and programmes in those Member States were assessed against the standard criteria identified in Section 3.2. Table 30 lists those Member States without requirements and those that did not provide a response.

Table 29: Summary of Minimum Qualification Requirements and Programmes for Fire Protection Equipment Using F-Gases

Member State	Criteria for Minimum Qualification Requirements				Criteria for Programmes		
	Nature of Certification	Who Must be Certified	How to Obtain Certification	Certification Renewal?	Requirement by Law	Nature of Education	Competency Testing
Austria	*	**	**	**	**	**	***
Belgium	*	**	*	-	*	*	**
Denmark	NA	NA	NA	NA	NA	NA	NA
Estonia	*	**	**	-	-	-	-
Finland	*	*	***	*	**	*	**
Greece	*	*	***	-	**		**
Luxembourg	NA	NA	NA	NA	NA	NA	NA
Malta	NA	NA	NA	NA	NA	NA	NA
Spain	*	*		*			

Notes: Dashes (-) indicate that programme criterion is not in place. Blanks indicate uncertainty regarding whether the criteria is in place, as no information was provided through survey responses. Not applicable (NA) indicates there is no use of F-Gases in fire protection equipment.

Table 30: Member States in which No Minimum Qualification Requirements are in Place or for which No Information was Provided for fire extinguishing equipment containing F-Gases

No Minimum Qualification Requirements in Place		No Information Provided	
▪ Bulgaria[a]	▪ Lithuania	▪ Hungary	▪ Romania[a]
▪ Cyprus	▪ Netherlands	▪ Latvia	
▪ Czech Republic	▪ Poland		
▪ France	▪ Slovakia		
▪ Germany	▪ Slovenia		
▪ Ireland	▪ Sweden		
▪ Italy	▪ UK		

[a] Accession country.

9.5 Voluntary Programmes (ODS and/or F-Gases)

This section describes specific information on voluntary training programmes in place in the UK, Spain, France, Bulgaria, and Czech Republic, as provided by the British Fire Protection Systems Associations (BFPSA), British Association of Fire (BAFE), the Fire Industry Confederation (FIC), LyonTech, BOC Refrigerants, and Esto Cheb Ltd.

According to the joint response provided by the **BFPSA, BAFE,** and **FIC** in the UK, original equipment manufacturers (OEMs) and servicing companies dealing with fire extinguishing system in the UK have their own minimum qualification requirements and training programmes. Specifically, OEMs require that personnel conducting equipment installation: (BFPSA, 2006)

- Be qualified to at least City & Guilds or equivalent in an associated mechanical engineering (site based) discipline; and
- Have documented proof of training by at least one manufacturer of gaseous fire-extinguishing systems in the correct method for installing and commissioning their products.

OR

- Be supervised by a person who has worked in the industry for a minimum of 2 years for a period not shorter than 6 months;
- Be employed by a company with either SP203 mechanical Installation accreditation, LPS1204 or an equivalent 3rd party certification;
- Receive regular Health and Safety training and receive updates on new legislation;
- Be subject to a random inspection at least twice a year by a person of at least installation supervisor level and hold written reports of the outcome; and
- Hold a CSCS card or equivalent.

Personnel conducting equipment maintenance including leak inspection and gas recovery must:

- Have documented proof of training by at least one manufacturer of gaseous fire-extinguishing systems in the correct method for servicing their products;
- If undertaking the room integrity test, must have documented proof of training by the original equipment manufacturer or a certificated agent or training organisation;
- Have at least 12 months experience in gaseous fire-extinguishing system servicing or have been working with an experienced service engineer for at least 6 months;
- Be employed by a third party certificated company to SP203 (mechanical modules), LPS1204 or equivalent; and
- Demonstrate the ability to complete logbooks and other documentation and to communicate with the client regarding relevant issues.

  During the performance of maintenance activities, there may be a requirement for remedial works to be done, which entail installation and/or commissioning. Such remedial works are only permitted provided that the relevant competency measures relating to those activities, as detailed above, apply.

Personnel decommissioning equipment containing ODS can take the BFPSA Competence Certificate Course. There is no industry based scheme for the decommissioning of F-Gas systems, but OEMs provide training for their particular systems. (BFPSA, 2006)

In terms of training, servicing companies and OEMs provide training on installation, maintenance, and decommissioning specific to their particular systems, which includes practical and theoretical aspects taught in the classroom and on the job. Through this training, personnel are taught how to make out the connections, fit valves, assemble the cylinders in the racks, manifolds and hoses, etc. (BFPSA, 2006)

LyonTech Enginnering Ltd., is a UK reclaimer of halons and F-Gases (i.e., HFC-227ea) from fire protection equipment, providing decommissioning and repair/maintenance services. All technicians receive both theoretical and practical training (with hands-on experience gained in the workshop and

on client premises). The training does not provide certification/licensing for technicians.[46] (LyonTech, 2006)

For LyonTech personnel, previous experience is not a necessary requirement, as full training is given to the capable candidates. During the selection process, the candidate undergoes a detailed investigation in to their background experience and their reaction to certain situations is tested. If selected, candidates undergo an initial 6-month trial period, where they begin their training. If they successfully complete the initial training by passing a test, then they undergo a further 6 months of more detailed training focusing on the reclamation process and relevant environmental legislation. (LyonTech, 2006)

BOC Refrigerants manages the ODS bank for critical users and holds a waste management license to handle halons. BOC does not license personnel to handle ODS on their behalf; however, personnel conducting recovery services have City & Guilds 2078, qualifications as well as Chemical Industry Passport qualifications. Halon recovery carries high risks due to the nature of the deluge valve and the absence of national standards for cylinders and valves; however, the industry has an accepted standard for operating that is accepted by the Halon Users National Consortium (HUNC) and DEFRA. All recovery work is managed by internal work instructions consistent with best practices within the chemical industry and all personnel undergo induction training and observed assessment prior to working in this area. (BOC, 2006)

Beginning in June 2006 BOC will start providing training to City & Guilds 2078. The one-day training (for engineers who have existing industry experience) will cover safety issues, environmental issues, before charging a system, charging a system, discharging a system (recovery), and system operation. The course will be theoretical and practical, and include practical assessment and tests as required under the City & Guilds process. (BOC, 2006)

In **Spain**, voluntary courses are offered by technical associations and companies that sell recovery and recycling machines. The First Degree of Professional Scholar Training, which provides a basic knowledge of ODS recovery, recycling, reclamation and destruction processes, is one example. This professional degree has various levels, the second of which includes a class on "Installation of building and industrial fire protection systems" which is 2,000 hours in length. Additionally, companies also typically provide special training courses for their employees related to ISO 9000 and ISO 14001 standards. (Spain 2006)

Similarly, in **France**, companies working with fire protection equipment that does not contain ODS can be certified by the Plenary assembly of the Insurance companies Damage (APSAD), as is required for companies working with systems containing ODS. Specific requirements for personnel are provided in Section 9.3.1. (France, 2006)

The producers and merchants of fire protection systems and extinguishers in **Bulgaria** provide relevant training for their equipment. No specific information on this training was available. (Bulgaria, 2006)

ESTO Cheb Ltd., which operates a Halon bank in the Czech Republic, is coordinating with the Czech ministry to prepare a training centre that will provide training for personnel that maintain equipment and/or handle ODS or F-Gases in the fire protection sector. The training will be 10 programme units covering both theoretical issues (including the general principles of law) and practical issues, and will result in certification. It is expected that the programme will start in May 2007. (ESTO Cheb, 2006)

[46] In the UK, BAFE provides a course and examination that results in certification for technicians to ensure safe decommissioning.

9.5.1 Summary of voluntary programmes (ODS and F-Gases)

Fire protection equipment manufacturers, service companies, and halon bank operators require personnel to be qualified. In addition to prior education requirements, these companies typically provide training on technical and regulatory issues, which may or may not result in certification. The length of training ranges from one day to several months. Generally, programmes cover recovery and decommissioning only.

Table 31: Summary of Voluntary Certification Schemes/Training Programmes for Personnel in the Fire Protection Sector (ODS and F-Gases)

Organization	Member State	Course/ Programme	Education Covers:			Competency Testing Covers:		
			Lecture and Practical Components	Regulatory Requirements	Leak Detection/ Prevention	Written		Practical
						Legislation	Techniques	
ESTO Cheb Ltd. (Halon Bank)	Czech Republic	Training for personnel in the fire protection field	✓✓	✓✓				
APSAD	France	APSAD Certification						✓
Technical associations and companies that sell recovery and recycling equipment	Spain	First Degree of Professional Scholar Training	✓	✓				
BFPSA	UK	Class I Certification	✓	✓	-	✓	✓	
BOC Refrigerants	UK, Ireland	In-house training and required qualifications	✓✓	✓✓	-	✓✓	✓✓	✓✓
LyonTech Engineering Ltd.	UK	In-house training	✓✓	✓✓			✓✓	✓✓

Notes: Dashes (-) indicate that the programme element is not offered. Blanks indicate uncertainty regarding whether the programme element is offered, as no information was provided through survey responses.
✓= Training applies to ODS fire extinguishing agents only.
✓✓ = Training applies to both ODS and F-Gas fire extinguishing agents.

9.6 Industry Recommendations for Ensuring Programme Effectiveness

According to **BOC Refrigerants,** BFPSA Class III and IV further qualifications are not necessary for chemical operators, although more stringent requirements are needed for the waste management license and IPPC licences (such as Waste Management Industry Training and Advisory Board (WAMITAB) training and controlled procedures). BOC supports practical assessment and refresher courses to ensure personnel are up-to-date with developments and changes in gases and procedures and engineering issues within the industry. (BOC, 2006)

ESTO Cheb Ltd. supports task-specific training, such that the level of training required for personnel varies based on the activity performed. They maintain that personnel involved with the maintenance of fire systems should be highly trained, while "customers" that own fire systems and perform routine leak inspection only need very basic programme units. Minimum years experience is not a necessary requirement. A certification programme should involve these minimum programme units: (ESTO Cheb, 2006)

- Theoretical training in the field of organic chemistry;
- Halogenated fluorocarbon agents used in the field of fire protection;
- Environmental impacts of halogenated agents;

- Workplace safety during the maintenance of halogenated systems;
- Practical training for the maintenance of ODS and F-Gas systems; and
- Practical training on hydrostatic bottle tests.

In addition, the competent authority in **Lithuania** supports the development of a guidance document common to all Member States that includes relevant standards and best available technologies. Subsequently, the existing requirements in this sector could be complimented with concrete and technical requirements.

9.7 Effectiveness of Programmes to Date

Unlike personnel in the solvents or SF_6 sectors, personnel handling controlled substances in the fire extinguishing sector do not perform activities in a fixed environment where emissions can be easily monitored. As such, it is not possible to directly quantify the emission impacts associated with personnel training programmes in this sector.

Intuitively, it can be surmised that rigorous training programmes equip technicians with the know-how to minimise emissions during all activities performed on equipment-containing ODS and F-Gases; therefore, to the extent that training is provided and skills are tested prior to allowing technicians to practice in the field, the training programmes in place are indeed effective at reducing emissions of ODS and F-Gases. In terms of the actual quality of training provided across the EU to date, section 9.8.1 notes those programmes in place that are believed to meet or exceed the requirements recommended in this review.

Moreover, to practice in the field what is learned in the classroom, technicians must have access to proper tools on the job, such as gas recovery equipment and leak detectors. In some countries, certification programmes incorporate a company accreditation component to ensure that such tools are provided. For example, in France, entities that recover halon must be certified by the Assembly of Civil Liability Insurance Companies (APSAD). The company certification requirements include having a qualified technician and possessing the necessary equipment to study, implement, verify, and maintain automatic extinguisher (EAG) installations (France, 2006). Similarly, in Greece, enterprises performing maintenance, inspection, and re-filling of fire fighting equipment must possess an operation licence granted by the Prefectoral Government, own specialised equipment, and follow an approved code of rules and procedures in order to be certified. (Greece, 2006)

Overall, required and voluntary programmes/certification schemes are focused on decommissioning, with little if any attention given to leak detection and prevention. This area may represent an important opportunity for further reducing ODS and F-Gas emissions in this sector.

9.8 Conclusions and Recommendations

9.8.1 Recommended minimum qualifications and programmes in the fire protection sector

Because fire protection systems are often custom-designed, they are often installed, serviced/maintained, and decommissioned by the original equipment manufacturer (OEM). In some cases, decommissioning may be conducted by personnel of halon banks. In accordance with EC regulations, systems must also be checked regularly for leakage, which is likely to be performed by on-site maintenance personnel. Minimum qualification requirements and training programmes must account for the level of skill and knowledge needed by these various groups of personnel. Based on this consideration, the review of minimum qualifications for personnel and available training programmes in place, as well as industry recommendations for effectively training personnel, the following minimum qualifications are recommended for adoption at the EU level:

Technician ***certification*** should be required by law for all personnel working with fire extinguishing equipment containing ODS or F-Gases, regardless of number of years of experience in the field—with the exception of those that conduct only leak checking activities.[47] This is inline with current practice, as nearly all Member States require some type of personnel certification, at least for those personnel that deal with ODS.

To earn certification, technicians should be required to possess an adequate understanding of the technical, legal, and practical requirements and procedures needed to minimise emissions of ODS and F-Gases. More specifically, certification programmes must ensure that all technicians possess a ***core knowledge*** of:

- Ozone depletion and climate change science (basics), Montreal Protocol, and Kyoto Protocol, and relevant EC Regulations
- Agent identification and labelling
- Recovery, recycling, refilling, and reclamation (definitions and techniques, including proper use of equipment)
- Leak detection and repair
- Safety (as pertains to containment)
- Proper handling and destruction of waste extinguishing agents

Because ODS and F-Gas extinguishing systems are very similar, training on both of these controlled substances should be taught under the same modules. For technicians already certified to work on ODS-containing equipment, their expertise should be easily transferred to apply to F-Gas-containing equipment. It is recommended that an "add-on" course be offered to cover F-Gas-specific training. Such a course would include modules covering climate change, the Kyoto Protocol, relevant EC regulations, and technical aspects specific to F-Gas fire extinguishing agents.

Certification should be provided by vocational training programmes and/or companies on-the-job, and should include hands-on instruction and/or testing. Each Member State should ensure that the certification schemes recognised in their state adequately cover the minimum knowledge areas specified above. Member States should also ensure that those companies and programmes executing training and issuing certificates are entitled to do so and have the proper certifications in place.

The European Commission, in collaboration with industry associations/experts, can help facilitate this process through a variety of measures, including:

- The development of a course syllabus;
- The development of a course curriculum for; and/or
- The development of a standardised exam, to ensure that all candidate technicians can demonstrate minimum competence in the required knowledge areas.

The options above should be considered in light of their feasibility, based on available resources and infrastructure.

In addition to certification, ***personnel in charge*** should also possess a tertiary education degree (i.e., a degree from a vocational school, career college, or university) and at least *five* years of experience in the relevant field. Relevant experience may include that obtained by working as an apprentice to a certified technician.

At this time, periodic recertification is not recommended; however, certification renewal (e.g., every five years) should be considered in the future, as it represents an important opportunity for technicians

[47] Personnel performing regular leak inspections may not need to meet the minimum qualifications because of the routine and simplistic nature of the operation.

to refresh their knowledge and skills and learn about new industry standards, practices, equipment, etc.

For ***general maintenance personnel*** that are required to conduct regular leak checks on systems with more than 3 kg of agent, it is not recommended that they obtain specialised certification. However, such personnel should be knowledgeable about the proper procedures for conducting leak checks on the equipment they oversee. Such information is generally provided by manufacturers in equipment manuals.

In addition, ***company licensing/certification*** should also be highlighted as an effective means of ensuring compliance with Regulation (EC) No 2037/2000 and Regulation (EC) No 842/2006. In particular, if all companies were to own proper recovery equipment and ensure best work place practices, this would facilitate the effective recovery of F-Gases. The company authorisation programmes in Belgium, France, Greece, Luxembourg, and Spain are designed to ensure this. Similarly, to the extent that companies are ISO 9000 or 14000 certified, this may also be ensured.

9.8.2 Compliance with recommended minimum qualification requirements and programmes in the fire protection sector

Most Member States have established certification programmes that include required training and examination for personnel working with fire extinguishing equipment containing ODS. While the programmes are less often required for personnel working with equipment containing F-Gases, Member State responses indicate programme flexibility such that the inclusion of F-Gases in existing programmes may be an easy transition. Therefore, the recommended examination required for personnel working with equipment containing ODS or F-Gases is largely consistent with existing requirements. In addition, while most Member States did not specify that an advanced degree is required, it is likely that most companies require this of personnel working with total flooding systems. Table 32 compares Member State minimum qualification requirements with those recommended in this report. Table 33 compares in place training programmes (mandatory and voluntary) to those recommended in this report.

Table 32: Comparison of Recommendations to Minimum Qualifications in Place or Pending (National Requirements)

Member State	Certification Required for All Personnel		Tertiary Degree or Minimum Years of Experience Required for Person In Charge		Company Licensing/ Certification Required	
	ODS	F-Gas	ODS	F-Gas	ODS	F-Gas
Austria	✓	✓			-	-
Belgium	✓	✓	✓	✓	✓	✓
Cyprus	-	-	-	-	-	-
Czech Republic	✓	-	✓	-	-	-
Denmark	-	NA	-	NA	-	NA
Estonia	NA	✓			-	-
Finland	✓	✓	✓	✓	-	-
France	✓	-	✓	-	✓	-
Germany	✓	-		-	-	-
Greece	✓	✓	✓	✓	✓	✓
Hungary	✓	-		-	-	-
Ireland	✓	✓	✓	-	-	-
Italy	✓	-		-	-	-
Lithuania	✓	-		-	-	-
Luxembourg	✓	NA		NA	✓	NA
Malta	✓	NA		NA	-	NA
Netherlands	✓	-		-	-	-
Poland	✓	-		-	-	-
Portugal	✓	-	✓	-	-	-

Slovakia	✓	-		-	-	-
Slovenia	NA	-	NA	-	NA	
Spain	✓	✓			✓	-
Sweden	-	-	-	-	-	-
UK	✓	✓	✓	-	-	-
Accession Country						
Bulgaria	✓	✓	-	-	-	-

Notes: Check marks (✓) indicate requirements that are in place. Dashes (-) indicate requirements that are not in place. Blanks indicate uncertainty regarding whether the requirement is in place, as not enough information was provided through survey responses. Member States for which no information was provided have been excluded from the table.

Table 33: Comparison of Recommendations to Training Programmes in Place (Required and Voluntary Programmes)

Company/ Association	Training Programme		Subjects Taught						
	Lecture Component	Practical Component	Montreal Protocol, Kyoto Protocol and EC Regulations	Extinguishing Agents and Environmental Impact	Leak Detection and Repair	Agent Recovery, Recycling, and Refilling	Installation and Decommiss-ioning	Handling of ODS and F-Gas Waste	Safety (related to containment)
Programmes Relevant to Fire Extinguishing Equipment Containing ODS and F-Gases									
Certification Body of the Fire Protection Association (Austria)	✓	✓	✓		✓	✓	✓	✓	
BFPSA Competence Certification Course Class I (Ireland and UK)	✓	✓	✓	✓	-	✓	✓	✓	✓
BOC Refrigerants (in-house training and City & Guilds 2078)	✓	✓		✓		✓	✓	✓	✓
LyonTech Engineering Ltd.	✓	✓	✓	✓		✓	✓	✓	
Programmes Specific to Fire Extinguishing Equipment Containing ODS Only									
ESTO Cheb Ltd. (Czech Republic)	✓	✓	✓						
Hungary (Required Programme)	✓	✓	✓	✓	✓	✓		✓	
Italy (Required Programme)	✓	✓	✓		✓	✓		✓	
Lithuania (Required Programme)			✓	✓	✓	✓	✓		
National Centre for Prevention (Netherlands)	✓	✓				✓	✓		
Poland (national programme)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Slovakia (National Programme)	✓	✓	✓		✓				
First Degree of Professional Scholar Training (Spain)	✓	✓	✓				✓		

Notes: Check marks (✓) indicate requirements that are in place. Dashes (-) indicate that programme criterion is not in place. Blanks indicate uncertainty regarding whether the criterion is in place, as no information was provided through survey responses.

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