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EUROPEAN F-GAS TRAINING AND ASSESSMENT: QUALIFICATIONS FOR TECHNOLOGIES THAT REPLACE HFC'S

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EUROPEAN F-GAS TRAINING AND ASSESSMENT - ADDITION OF QUALIFICATIONS FOR TECHNOLOGIES THAT REPLACE HFC'S

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Abstract

The Training and Assessment programme to allow natural persons to comply with the F Gas Regulations, has been available within the EU for the approximately 10 years. We are also seeing similar assessment schemes being adopted worldwide. EU 2015/2067 requires candidates to be assessed on their theoretical understanding of low GWP refrigerants and their relevant technical and safety characteristics..

Whilst this is important, practical competency should also be assessed, for this reason many training providers have adapted the practical assessments to include “hands on” training on Air Conditioning systems running on R32 and Refrigeration systems that utilise R600a, R290 and R1234ze, thereby allowing candidates to be assessed on the safe handling of A2L and A3 refrigerants.

Introduction

With the updated F-Gas Regulations (EC 517), and the quite rapid phase down of Hydrofluorocarbon (HFC) Refrigerants, there has been an increase in the use of low GWP Refrigerants. Alongside the revised F-Gas Regulations was the adoption of EC Regulation 2015/2067. This repeals regulation 303/2008. The new regulation establishes the minimum requirement for the certification of natural persons carrying out leakage checking, recovery, installation, repair, maintenance, servicing and decommissioning of refrigerating systems.

Along with some minor changes with regard to theoretical testing, the main additions are again theoretical but with regard to technologies that replace fluorinated greenhouse gases.

A range of competencies needs to be theoretically assessed over all categories of F-Gas certification. The subject areas are:

- Know the relevant alternative technologies to replace or reduce the use of fluorinated greenhouse gases and about refrigerant safe handling (Categories 1-4).
- Know the relevant system designs to reduce the charges size of fluorinated greenhouse gases and to increase energy efficiency (Categories 1 and 2).
- Know the relevant safety regulations and standards for the use, storage and transportation of flammable or toxic refrigerants or refrigerants requiring higher operating pressure (Categories 1 and 2).
- Understand the respective advantages and disadvantages, notably in relation to energy efficiency, of alternative refrigerants according to the intended application and to the climate conditions of the different regions (Categories 1 and 2).

What is not clear from the amended regulation is how much detail is required and how are all the knowledge-based competencies are to be assessed.

When we look at the second subject listed above, this could involve a lot of theoretical training just to illustrate the challenges of selecting the correct alternative refrigerant for the application. Following is an example of the complex work that is required to select the optimum alternative refrigerant for a particular refrigerating compressor:

Oil-Free Centrifugal Vapour Compressor Design (CVC)

The CVC compressor developed by Venus Systems Ltd in conjunction with Business Edge Ltd requires several specific characteristics in respect of the refrigerant to function correctly and efficiently.

Business Edge Ltd has therefore conducted an evaluation of these characteristics for several refrigerants to establish the best for CVC oil-free compressor applications.

As can be seen from the table below, there are a number of important factors and parameters to consider when selecting the appropriate refrigerant(s) for a specific application and compressor type. From this group of refrigerants, it was not possible to select a single refrigerant that is capable of providing perfect parameters in every case. Consequently, the selection has to be made on the basis of a well-considered compromise, focusing on the most important parameters as having the highest priority.

There is also the need to look forward to the future to ensure that those parameters most important in the market place are also considered, either as they currently stand or in what way they may be affected in the future, GWP being a good example of a parameter that is likely to drive market decisions in terms of what refrigerants are or are not acceptable.

Refrigerant Comparison & Evaluation

The following table sets out some of the parameters under consideration:

Property	Reference	R134a	R1233zd(E)	R1234ze(E)	R1234yf	R513A	R32	R600a	R245fa	R407G	Property
Price / kg (£)	[1]	£ 16.98	£ 26.70	£ 84.60	£ 115.48	£ 81.68	£ 18.54	£ 16.84	-	-	Price / kg (£)
Safety Class	[2]	A1	A1	A2L	A2L	A1	A2L	A3	B1	N/C	Safety Class
PED Fluid Group	[2]	2	2	2	1	2	1	1	2	N/C	Fluid Group
GWP	[2]	1430	4.5	0.6	4	631	677	3	1030	1460	GWP
Saturation Pressure @ 5°C (bar)	[3]	3.5	0.6	2.6	3.7	3.9	9.5	1.9	0.7	1.6	Saturation Pressure @ 5°C (bar)
Saturation Pressure @ 23°C (bar)	[3]	6.3	1.2	4.7	6.4	6.8	16.0	3.3	1.4	1.6	Saturation Pressure @ 23°C (bar)
Saturation Pressure @ 42.5°C (bar)	[3]	10.9	3.3	8.2	10.9	11.5	26.4	5.7	2.7	11.2	Saturation Pressure @ 42.5°C (bar)
Saturation Pressure @ 60°C (bar)	[3]	16.7	3.9	12.8	16.4	17.5	39.3	8.8	4.6	17.6	Saturation Pressure @ 60°C (bar)
Saturation Pressure @ 75°C (bar)	[3]	23.6	5.8	18.0	22.7	24.1	53.5	12.2	7.0	25.3	Saturation Pressure @ 75°C (bar)
Pressure Safety Design Value = 100°C (bar)	[3]	39.7	10.4	30.3	CRITICAL	CRITICAL	CRITICAL	19.8	12.7	Value = 100°C (bar)	
GLIDE (°K)		No	No	No	No	No	No	No	No	1.6	GLIDE (°K)
Sat Temp at Atmos Pressure (°C)	[3]	-26.1	18.3	-19.0	-24.9	-29.6	-52.6	-12.4	15.1	Atmos Pressure (°C)	
Comp Ratio-Stage 1		1.8	2.0	1.8	1.7	1.7	1.7	1.8	2.0	#DIV/0!	Comp Ratio-Stage 1
Comp Ratio-Stage 2		1.7	1.9	1.8	1.7	1.7	1.6	1.7	2.0	#DIV/0!	Comp Ratio-Stage 2
Comp Ratio-Total 5/42,5		3.1	3.9	3.2	2.9	3.0	2.8	3.0	4.0	#DIV/0!	Comp Ratio-Total 5/42,5
Comp Ratio-Total 5/60		4.8	6.6	4.9	4.4	4.5	4.1	4.6	6.8	#DIV/0!	Comp Ratio-Total 5/60
Comp Ratio-Total 5/75		6.7	9.8	7.0	6.1	6.2	5.6	6.4	10.3	#DIV/0!	Comp Ratio-Total 5/75
NETT REFRIGERANT EFFECT											NETT REFRIGERANT EFFECT
Sub-Cooled Liquid Temp (°C)		22	22	22	22	22	22	22	22	22	Sub-Cooled Liquid Temp (°C)
Sub-Cooled Liquid Enthalpy (kJ/kg)		230.6	227.5	230.0	229.7		239.9	251.7	219.3	230.5	Sub-Cooled Liquid Enthalpy (kJ/kg)
Super-Heated Vapour Temp (°C)		15	15	15	15	15	15	15	15	15	Super-Heated Vapour Temp (°C)
Super-Heated Vapour Enthalpy (kJ/kg)		410.6	416.4	396.6	376.0		516.9	574.5	415.5	412.0	Super-Heated Vapour Enthalpy (kJ/kg)
Nett Refrigerating Effect kJ/kg		179.9	189.0	166.6	146.4	0.0	277.0	322.8	196.1	181.5	Nett Refrigerating Effect kJ/kg
Liquid Viscosity @ 22.226°C											Liquid Viscosity @ 22.226°C
Vapour Density @ 47.5°C/11 bar) kg/m3		51.81	12.3	42.27	59.69					62.765	Vapour Density @ 47.5°C/11 bar) kg/m3
Heat of Compression kJ/kg 5°C/42.5°C											Heat of Compression kJ/kg 5°C/42.5°C
Heat of Compression kJ/kg 5°C/60°C											Heat of Compression kJ/kg 5°C/60°C
Heat of Compression kJ/kg 5°C/75°C											Heat of Compression kJ/kg 5°C/75°C

Certificating Bodies

In the UK there are currently three certificating bodies for individuals wishing to gain F-Gas qualifications. At the time of writing only one of those are offering a qualification that assesses knowledge competencies in line with the regulation. The other two are yet to amend the assessment criteria.

The Department of the Environment (UK Authorised Persons) have stated that the amended regulations must be included within the training/assessment syllabus as of the beginning of July 2017. One option for Training Providers to ensure that they allow the attendees to meet the revised competencies is to sign students up to the Real Alternatives E-Learning portal.

International E- Learning on Alternative Refrigerants

There are eight modules:

1. Introduction to alternative refrigerants.
2. Systems design using alternative refrigerants.
3. Containment and leak detection.
4. Maintenance and repair.
5. Retrofitting existing systems.
6. Checklist of legal obligations when working with alternative refrigerants.
7. Measuring the financial and environmental impact of leakage.
8. Tools and guidance for conducting site surveys.

Candidates are required to complete module one before the other modules become available. Upon successful completion, the candidate will receive a CPD certificate. The fact that this is done away from the assessment centre means that there is no proof that it was completed by the attendees. It is therefore unclear if it could be permitted as evidence of accredited prior learning.

Training in Low GWP Refrigerants

The only disappointment to come out of the revised F-Gas Regulations was that the certification requirements on alternative refrigerants was limited to theoretical assessments and not practical. With the growing use of low GWP Refrigerants, one of the main concerns is the increased risk with these predominantly flammable refrigerants and the lack of training and awareness within the industry. One of the F-Gas Certification Bodies, City & Guilds launched additional Training and Assessment Modules in the UK aimed at personnel that Install and Maintain Refrigeration, Air Conditioning and Heat Pump Systems with particular emphasis on Low GWP Refrigerants.

These were, overall, very good; unfortunately, the take up within the industry has been limited to say the least. This has resulted in the awarding body deciding to stop offering these modules, as they are not cost effective to support. This will obviously cause us further difficulties when trying to ensure that the industry has a well-trained competent workforce.

More and more organisations/manufacturers are utilising either A2L or A3 Refrigerants. With greater use of these substances comes an increased risk of an incident occurring in the workplace, which could result in personal injury or financial loss.

Service Equipment

At the time of writing, we have seen the launch of recovery units for the safe handling of A2L Refrigerants along with vacuum pumps, gauges and manifolds etc. Some manufacturers of recovery equipment are stating that their existing product range is suitable for use with A2L refrigerants as long as they are used in conjunction with adequate forced ventilation and a flammable gas leak detector positioned at a low level. Recovery units for the safe handling of A3 Refrigerants have been available for some time.

No matter how many, and how good they are, the weakest link in the process may be the technician. If they have inadequate or no training in the specific risks involved in handling flammable refrigerants, the potential for an incident to occur would be increased.

We feel that certain manufacturers are not helping the situation as they are deliberately “playing down” the risk of A2L “mildly flammable” Refrigerants. It is true that these Refrigerants are less hazardous than A3 but it is still very possible for an incident to arise.

