

The European approach in training refrigeration and air conditioning technicians and experts

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On behalf of



Why is there the need of qualified refrigeration technicians and Master craftsman

- New technologies, complexity and variety of RAC systems need well prepared craftsman
- Development, with well trained experts new technologies can be introduced
- Energy labelling, optimal efficiency of RAC in the field require experts
- Future, census of energy estimates require a consistent installation state of the art
- Laws, change continuously and you need to apply these consistent over the country



EU certified refrigeration technicians upgrade for F-gas

- The EU law 303/2008 following the F-gas which regulates the use of fluorinated substances regulates the certification of technicians.
- There are four categories and scholarship for additional certification of certified technicians.

Cat.	Ref.quantity (kg)	Qualification
I	No limits	May carry out all the activities
II	>3kg	May carry out leakage checking without breaking the circuit!
II	<3kg	May carry out recovery, installation, maintenance and servicing
III	<3kg	May carry out recovery without breaking the circuit!
IV	<3kg	May carry out leakage checking without breaking the circuit!



Support service technicians for seasonal work

- Support service technician are needed but:
 - Their duties are for short periods
 - They perform duties specifically aimed at the product they work on
 - Their training is limited to installation of equipment
- Specific good training for installing equipment is feasible but the expectation that they are able to provide the best advise to customers is not consistent
- Support service technicians OK when commissioning is done by certified refrigeration technician or Master Craftsman



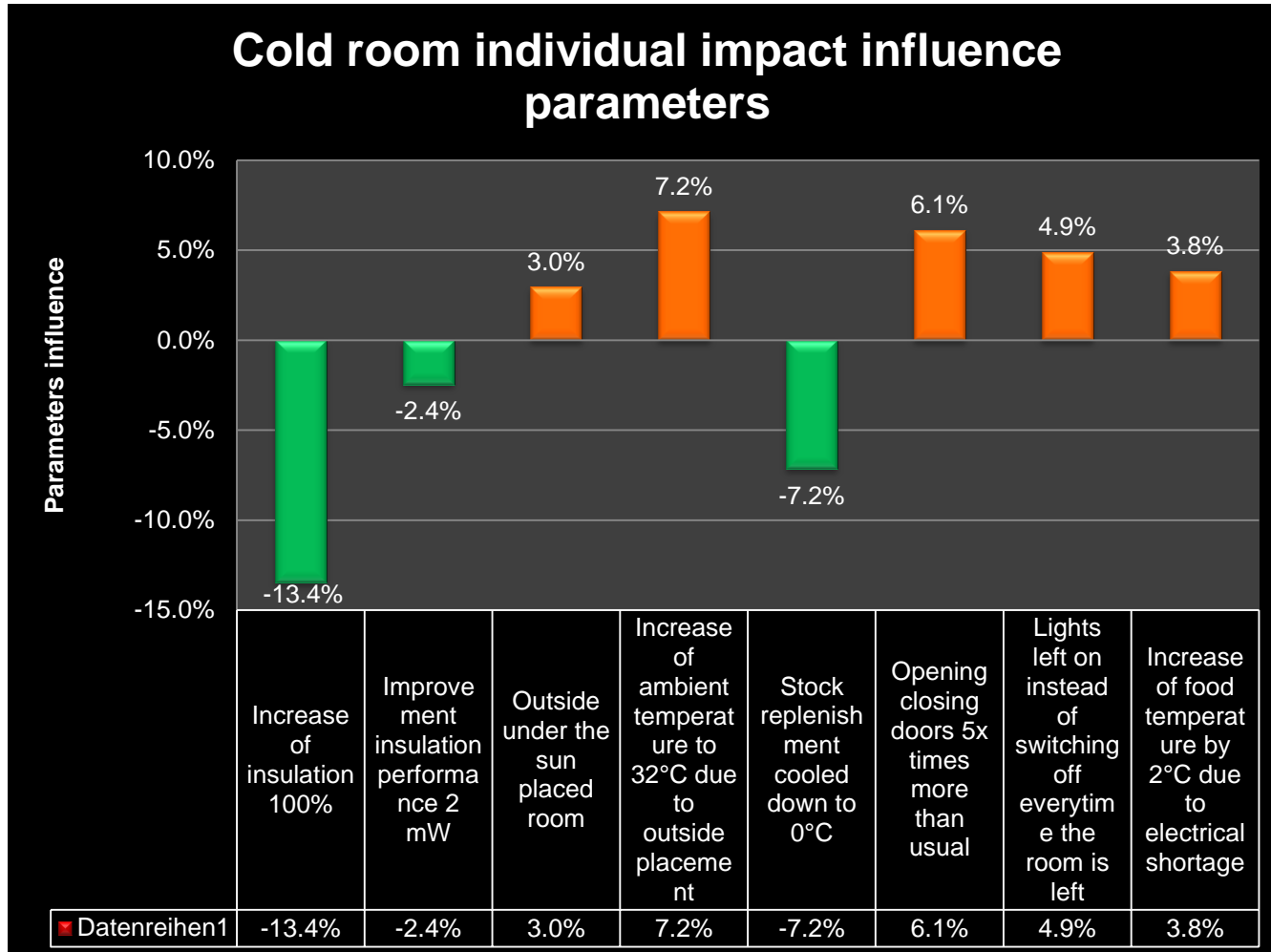
Example of a service technician practical work

- The service technician is visiting the following cold room
- His services go well beyond the traditional repair job, he needs to understand the performance and scope of the cold room
- The customer needs advise to improve the performance, food security and energy saving

Status quo	
Thickness insulation walls (mm)	50
Thickness insulation roof (mm)	75
Insulation material	PU
Thermal conductivity (mW/m.K)	22
Size cold room (LxWxH m)	6x4x2.5
Cold room real temperature °C	-10.00
Stored food A	Fish
Stored food B	Beer
Stored food A required temp. °C	-8
Stored food B required temp. °C	0
Mass of stored food A	4788
Mass of stored food B	470.4
Cold room real temperature °C	-10
Ambient temperature °C	25
Daily stock renewal	10%
New stock temperature °C	10.00



Cold room – Service technician competences





Educational course of studies

- Starting point is pre-high school educational level
- Entrance level examination
- A 3-4 year apprenticeship together with a Master Craftsman combined with weekly education in a vocational or specialised institution
 - Sound practical development of craftsmanship
 - Strong theoretical basis aimed at the application



Fast track

- A 3-4 year apprenticeship of studying and working is fast track
- An apprentice following the study program earns qualifications which are motivating!
- Learns in practice to convert the theory with tutoring of a Master craftsman



A refrigeration technician have a very versatile job and cover knowledge points like:

- Metal working
- Electrical engineering
- Chemistry
- Thermodynamics
- Administration, reporting, documentation
- Environmental
- Laws and regulations
- Health and Safety

This is not frightening and many did it before.



Short description minimum study course elements

Component	Description
Materials and components	Knowing the properties of piping, brazing materials, components function selection and working principle
Oils, refrigerants and chemicals	Knowing the properties, use, risks, environmental impact and performance
Thermodynamics	Understand the refrigeration cycle, superheat, subcooling
Electrical and control systems	Knowing and understanding electrical systems, setting of control systems optimization, energy efficiency
Mechanical workmanship	learning how to install components and piping and all other mechanical workmanships (cutting, drilling etc.)
Installation	Planning of the installation, checking suitability of the area
Servicing and repair	Apply good practices, diagnose of malfunctions

Always Theory and Practical workmanship!



Study course elements

Component	Description
Standards and laws	Knowing and applying all the standards and laws in place and take responsibility
Work and health safety	Being able to provide first aid, inform surrounding area on dangers activities and use of chemicals
Environmental protection	know how and where to dispose of chemicals, inform about environmental damage, recording of data
Documentation	Know how to read, apply and understand user-, service-manuals, electrical diagrams and other information
Communication	Be able to explain clearly the working, environmental, health and safety issues
Reporting	Being able to make drawings of the installation and reporting the work performed
Advise	Provide advise on the use of the equipment, train the user, and advise improvement on energy efficiency use of RAC system

Always Theory and Practical workmanship!



Bridging period

- OEM already train technicians installing the equipment and basics like leakage testing, recycling on their specific equipment
- It is unrealistic that OEM provide a complete educational program for refrigeration technicians or Master Craftsman, it's not their core business or competence
- Introduce installation by OEM technicians and commissioning by Master Craftsman
- Tasks oriented to specific knowledge increases efficiency and customer satisfaction
- Start with a curriculum of refrigeration technician and Master craftsman, the competence is already there only channelling required.

green cooling initiative

For more information, please refer to the webpages of the Green Cooling Initiative and the Cool Training Alumni:

<http://www.green-cooling-initiative.org/>

<https://www.green-cooling-initiative.org/rac-alumni-network/>

On behalf of

BMZ



Federal Ministry
for Economic Cooperation
and Development



GIZ Proklima training Theory + Practical workmanship

Job Competence		Core Activities							The National Authorities to certify Qualification have to make sure that European and National Regulations, Directives and Norms are complied with particular as mentioned below
Description		Pre-assembly	Installation	Technical Reports	Commissioning	Monitoring	Fault Finding	Dismantling	
1.1 Basic Thermodynamics		1	2	3	4	5	6	7	
Description The ARC is capable of giving a theoretical explanation about a basic compression refrigerating system									
Success Criteria									
1.1.1	Know the basic ISO standard units as for temperature, pressure, mass, density, energy			X	X	X	X	X	EN 13313
1.1.2	Calculate the basic refrigeration terms as Superheat, High Side, Heat of Compression, Enthalpy, Refrigeration Effect, Low Side, Sub-cooling, Vapor Quality, Saturated liquid			X	X	X	X	X	EN 13313
1.1.3	Describe the lines of a Log P-H chart of a refrigerant			X	X	X	X	X	EN 13313
1.1.4	Use the saturation tables of a refrigerant			X	X	X	X	X	EN 13313
1.1.5	Draw a scheme of a single compression refrigeration cycle			X	X	X	X	X	EN 13313
1.1.6	Describe the operation and function of the main components used in a refrigeration system as compressor, condenser, expansion valve, evaporator	X	X	X	X	X	X	X	EN 13313
1.1.7	Describe the operation and function of the following components used in a refrigeration system								
1.1.8	- Valves (ball valves, diaphragms, globe valves, relief valves)	X	X	X	X	X	X	X	EN 13313
1.1.9	- Temperature and Pressure Controls	X	X	X	X	X	X	X	EN 13313
1.1.10	- Sight glasses and Moisture Indicators	X	X	X	X	X	X	X	EN 13313
1.1.11	- Defrost Controls	X	X	X	X	X	X	X	EN 13313
1.1.12	- System Protectors	X	X	X	X	X	X	X	EN 13313
1.1.13	- Measuring Devices as manifold thermometer	X	X	X	X	X	X	X	EN 13313
1.1.14	- Oil Control Systems	X	X	X	X	X	X	X	EN 13313
1.1.15	- Receivers	X	X	X					EN 13313
1.1.16	- Liquid and Oil Separators	X	X	X					EN 13313
Results									
The ARC explains "how the refrigeration system works" to a client									
The ARC analyzes the operation of the refrigeration system and writes his conclusions in a report.									

Job Competence		Core Activities							The National Authorities to certify Qualification have to make sure that European and National Regulations, Directives and Norms are complied with particular as mentioned below
Description		Pre-assembly	Installation	Technical Reports	Commissioning	Monitoring	Fault Finding	Dismantling	
2.1 Component: Compressor		1	2	3	4	5	6	7	
Description The ARC is capable of installing, putting into operation and carrying out the maintenance of reprocoting, screw and scroll compressors, single and two stage up to a power supply of 25 Kw.									
Success Criteria									
2.1.1	Explain the function of the compressor in the system	X	X	X	X	X	X	X	EN 13313
2.1.2	Explain the working of the compressor	X	X	X	X	X	X	X	EN 13313
2.1.3	Explain the lubricating system of the compressor		X	X	X	X	X	X	EN 13313
2.1.4	Explain the capacity control of the compressor		X	X	X	X	X	X	EN 13313
2.1.5	Install the above mentioned different kinds of compressors	X	X						prEN 378-2 art. 5.1
2.1.6	Connect the safety and control switches	X	X						prEN 378-2 art. 5.1
2.1.7	Install the suction and discharge valves	X	X				X		prEN 378-2 art. 5.1
2.1.8	Install the oil return system	X	X				X		prEN 378-2 art. 5.1
2.1.9	Start up and shut down these kinds of compressors	X	X	X	X	X	X	X	prEN 378-2 art. 6.3
2.1.10	Do measurements during operation of compressor	X	X	X	X	X	X	X	prEN 378-4 art. 5
2.1.11	Check the good working condition of the compressor	X	X	X	X	X	X	X	prEN 378-4 art. 5
2.1.12	Write a report about the condition of the compressor	X	X	X	X	X	X	X	prEN 378-4 art. 4.3
2.1.13	Take the decision to repair the compressor	X			X	X	X		prEN 378-4 art. 4.3
2.1.14	Take the decision to replace the compressor				X	X	X		prEN 378-4 art. 4.3
Results									
A perfectly working compressor contributes to a low energy consumption and a reliable performance as planned for the client.									

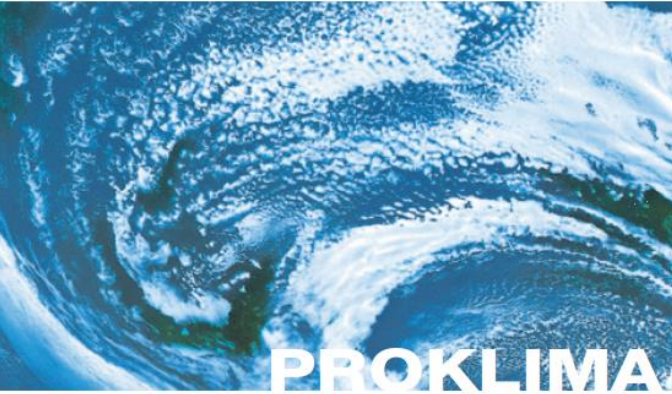
Job Competence		Core Activities							The National Authorities to certify Qualification have to make sure that European and National Regulations, Directives and Norms are complied with particular as mentioned below
Description		Pre-assembly	Installation	Technical Reports	Commissioning	Monitoring	Fault Finding	Dismantling	
2.2 Component: Condenser		1	2	3	4	5	6	7	
Description The ARC is capable of installing, putting into operation and carrying out the maintenance of air cooled and water cooled condensers.									
Success Criteria									
2.2.1	Explain the function of the condenser in the system	X	X	X	X	X	X	X	EN 13313
2.2.2	Explain the working of the condenser	X	X	X	X	X	X	X	EN 13313
2.2.3	Adjust a discharge pressure control of the condenser	X	X	X	X	X	X	X	EN 13313
2.2.4	Install the above mentioned types of condensers	X	X						prEN 378-2 art. 6.1
2.2.5	Connect the safety and control switches	X	X						prEN 378-2 art. 6.1
2.2.6	Install the discharge and liquid lines in the correct position	X	X						prEN 378-2 art. 6.1
2.2.7	Purge non condensable gases out of the condenser	X	X				X		prEN 378-2 art. 6.1
2.2.8	Start up and shut down all types of condensers	X	X	X	X	X	X	X	prEN 378-2 art. 6.3
2.2.9	Do measurements during operation of the refrigeration system	X	X	X	X	X	X	X	prEN 378-4 art. 4
2.2.10	Check the good working condition of the condenser	X	X	X	X	X	X	X	prEN 378-4 art. 4
2.2.11	Check the surface of the condenser	X	X	X	X	X	X	X	prEN 378-4 art. 4
2.2.12	Write a report about the condition of the condenser	X	X	X	X	X	X	X	prEN 378-4 art. 4.3
2.2.13	Take the decision to repair a part of the condenser				X	X	X		prEN 378-4 art. 4.3
2.2.14	Take the decision to replace the condenser				X	X	X		prEN 378-4 art. 4.3
Results									
A perfectly working condenser contributes to a low energy consumption and a minimum of heat load to the environment.									

Job Competence		Core Activities							The National Authorities to certify Qualification have to make sure that European and National Regulations, Directives and Norms are complied with particular as mentioned below
Description		Pre-assembly	Installation	Technical Reports	Commissioning	Monitoring	Fault Finding	Dismantling	
2.3 Component: Evaporator		1	2	3	4	5	6	7	
Description The ARC is capable of installing, putting into operation and carrying out the maintenance of air cooled and liquid cooled evaporators.									
Success Criteria									
2.3.1	Explain the function of the evaporator in the system	X	X	X	X	X	X	X	EN 13313
2.3.2	Explain the working of the evaporator	X	X	X	X	X	X	X	EN 13313
2.3.3	Explain the several ways of defrosting the evaporator		X	X	X	X	X	X	EN 13313
2.3.4	Adjust an evaporating pressure control of the evaporator		X	X	X	X	X	X	prEN 378-2 art. 6.1
2.3.5	Install the above mentioned kinds of evaporators	X	X						prEN 378-2 art. 6.1
2.3.6	Connect the safety and control switches	X	X						prEN 378-2 art. 6.1
2.3.7	Install the liquid and suction pipelines in the correct position	X	X				X		prEN 378-2 art. 6.1
2.3.8	Install the hot gas defrost pipeline in the right position	X	X				X		prEN 378-2 art. 6.1
2.3.9	Install the hot gas pipeline to protect a watercooled evaporator against low evaporation pressure	X	X	X	X	X	X	X	prEN 378-2 art. 6.1
2.3.10	Start up and shut down all kinds of evaporators	X	X	X	X	X	X	X	prEN 378-2 art. 6.3
2.3.11	Do measurements during operation of the refrigeration system	X	X	X	X	X	X	X	prEN 378-4 art. 4
2.3.12	Check the good working condition of the evaporator	X	X	X	X	X	X	X	prEN 378-4 art. 4
2.3.13	Check the surface of the evaporator	X	X	X	X	X	X	X	prEN 378-4 art. 4
2.3.14	Write a report about the condition of the evaporator			X	X	X	X		prEN 378-4 art. 4.3
2.3.15	Take the decision to repair a part of the evaporator				X	X	X		prEN 378-4 art. 4.3
2.3.16	Take the decision to replace the evaporator				X	X	X		prEN 378-4 art. 4.3
Results									
A perfectly working evaporator contributes to a low energy consumption and a reliable performance as planned for the client.									



GIZ series on safe use of natural refrigerants

Proklima International




PROKLIMA

Guidelines for the safe use of flammable refrigerants in the production of room air-conditioners

A handbook for engineers, technicians, trainers and policy-makers – For a climate-friendly cooling

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of



Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

of the Federal Republic of Germany



The collage displays several book covers from the Proklima series, including:

- Operation of split air conditioning systems with hydrocarbon refrigerant**: A companion guide for technicians, trainers and engineers.
- Good Practices in Refrigeration**
- Natural Foam Blowing Agents**: Sustainable, Green- and Climate-Friendly Alternatives to HFCs.
- Production conversion of domestic refrigerators from halogenated to hydrocarbon refrigerants**: A Guidebook.
- Natural Refrigerants**: Sustainable, Green- and Climate-Friendly Alternatives to HFCs.



Thank you for your attention!

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BMZ



On behalf of
Federal Ministry
for Economic Cooperation
and Development





Example of Legal competence:

Registered refrigeration experts regularly get law updates and need to understand and convert these in practice

Which changes are applicable from 1.1.2015 regarding leakage controls in refrigeration systems.

With the application of the (EU Law) 517/2014[#] of 1.1.2015 is the leakage control not anymore according to the quantity but according the corresponding CO₂-equivalent of the system. This means the charged quantity is multiplied by the corresponding GWP value of the refrigerant. The periodic timing of the controls must be newly calculated and adjusted. For support a table is put for use on (www.bfs-kaelte-klima.de/download/merkblaetter/Kaeltemittelgrenzen.pdf)

Leakage controls only by certified technicians. For hermetic closed system leakage controls from 10T upwards.

Charge GWP	Frequency leakage control without leakage control warning system	Frequency with leakage control warning system
a) From 5 to <50 Ton	Every 12 months	Every 24 months
b) From 50 to <500 Ton	Every 6 months	Every 12 months
c) From 500 Ton	Every 3 months	Every 6 months

REGULATION (EU) No 517/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006