Marco Buoni

Ing. Marco Buoni, a European expert in refrigeration and air conditioning, has been the Vice President of AREA (Air conditioning and Refrigeration European Association) since 2010. AREA voices the interests of 20 national associations from 17 European countries, representing more than 13,000 companies, which employ some 110,000 people. Buoni is also an expert in capacity building in refrigeration and air conditioning, leading the training activities related to certification and best practices. He is highly active as the Technical Director of Centro Studi Galileo in the organisation of training and conferences in refrigeration technologies worldwide. Every year he leads over 300 training courses for up to 3000 participants.
Training and provision of equipment: keys for the refrigeration servicing sector in Africa

UNIDO, Vienna Talks 15 June 2017

Marco Buoni
VicePresident, AREA
Air Conditioning & Refrigeration European contractors’ Association (www.area-eur.be)
Secretary General Italian Association of Refrigeration Technician, ATF (www.associazioneATF.org)
Director Centro Studi Galileo (www.centrogalileo.it)
CENTRO STUDI GALILEO
Associazione dei Tecnici italiani del Freddo

• For 40 years has been organizing training courses, seminars and conferences in the field of refrigeration, air conditioning, 3000 technicians, 300 training sessions a year

• publishes the International Special Issue (ISI) of Industria & Formazione in 2006, 2008, 2010, 2012, 2014, 2016. The magazine is published with UNEP and IIR, with an introduction from the UN Under-Secretary General, Achim Steiner, and the Italian Minister of the Environment. Distributed at the climate change summits in Bangkok, New Delhi, Cancun and Doha, the summits of the Montreal protocol in Durban, Copenhagen and Geneva.

• Monthly publishes newsletters, emails and magazines

• international presence in Europe (particular in UK) and it is working with UNEP, UNIDO, UNDP in Rwanda, Benin, Gambia, Tunisia, Arabic Countries, Eritrea, Sri Lanka, Thailand etc….

• 10 training centres in Italy – 3 in UK

• 1000 technians trained in alternative refrigerants (HCs, CO2, NH3)
Last conference was under the Patronage of

THE LATEST TECHNOLOGY
IN AIR CONDITIONING AND REFRIGERATION INDUSTRY
NEW REFRIGERANTS, COMPONENTS AND EQUIPMENT
COLD STORAGE AND FOOD CONSERVATION

With the participation of
United Nations Industrial Development Organisation (UNIDO),
United Nations Environment Programme (UNEP),
Food and Agriculture Organisation of United Nation (FAO),
International Institute of Refrigeration (IIR), AFF, AREA, AHRI, ASHRAE, EPEE……
Main points of discussion
Importance of Training and Certification

• New emerging technologies and alternatives
• Motivation for RAC technicians to join the training. Regulatory and institutional framework; linkages with certification system
• Roles of Agencies involved: NOU/Industries/Association/Vocational Training
• Approaches for regional cooperation to achieve effective training
Strengthening national RAC associations

- Connecting contractors
- Training, Seminars and Conferences
- Information – magazine - newsletter
- Connecting with the industry
- Speak with One voice to the National, International Institutions and Governments
- (important driver at the moment) fast moving sector in technology and in legislation: F-gas regulations, RES directive, Refrigerants future
- Organizing training and certifications sessions

Keep the association LIVE!
Services and Budget requirements for RAC associations

Services and Revenues:

• Members fee (in Europe starting from 63 Euro…)
• Events: trainings, conferences, summits
• Certification of persons and of companies
• Magazines
• Websites
• Sponsors (without mining Association indipendence)
International Observers
New AREA membership category

What are your benefits?

**Recognition:** you become part of a globally recognised association of professional technicians and you can use AREA’s logo to demonstrate this.

**Shaping the industry:** early developments of AREA guidelines, good practice guides and training & certification documents.

**Intelligence:** regular informative briefs, quarterly newsletter.

**Visibility:** listing on AREA website and Annual Report.

**Network:** you meet your peers and share best practices during the spring and autumn general assembly meetings, you connect with European RACHP contractors associations.

AREA ([www.area-eur.be](http://www.area-eur.be)) is the European organisation of air-conditioning, refrigeration and heat pump contractors.

Established in 1988, AREA voices the interests of 23 national members from 20 European countries, representing more than 13,000 companies (mainly small to medium sized enterprises), employing some 110,000 people and with an annual turnover approaching € 20 billion.
Contractors’ training with low GWP refrigerants: mind the gap!

Kigali Amendment includes measures in favour of a decreased use of HFCs in RACHP equipment. Such measures would, in turn, result in an increased use of alternatives, namely low GWP (global warming potential) refrigerants, and in particular the so-called “natural refrigerants” (CO2, hydrocarbons and ammonia). Mindful of the key role played by contractors in the safe, efficient and reliable functioning of equipment working with natural refrigerants, AREA sought an overview of the availability and level of training in the EU.

<table>
<thead>
<tr>
<th>Table 2: Analysis of training in climate-friendly alternative refrigerants to fluorinated greenhouse gases</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>Training available in country (% of Member States)</td>
</tr>
<tr>
<td>Proportion of certified fluorinated gas personnel trained in alternative refrigerants</td>
</tr>
</tbody>
</table>

In EU:
Report of EU commission presented at Consultation Forum 1st December

Solution could be starting from the F-Gas certification of personnel adding modules for natural refrigerants
Certification is an important tool for the industry of RAC sector

Or legislatively imposed:
- Reducing Refrigerant Emissions, GHG, ODS
- Increasing energy efficiency (reducing CO2)

Or Industry-driven:
- More aggressive competition requires proof of higher quality and certification

Or Customer-driven:
- Wholesalers, distributors, big customers … require environmentally friendly and energy efficient products
- Protects the interests of customer through providing services according to applicable standards

→ Certification of the personnel and of the companies who handle air conditioning, refrigeration and heat pumps equipment
Recommendations of AREA: Minimum Requirements for alternative refrigerants HC – NH₃ – CO₂ – HFO

<table>
<thead>
<tr>
<th>COMPETENCE OF SERVICE TECHNICIANS</th>
<th>Assessment: P Practical T Thoretical</th>
<th>HC</th>
<th>NH₃</th>
<th>CO₂</th>
<th>HFO A2L</th>
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<tbody>
<tr>
<td>BASIC THERMODYNAMICS AND PHYSICS</td>
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<tr>
<td>• Properties: temperature, pressure, density, thermal capacity.</td>
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<tr>
<td>• Differences between Low GWP refrigerants and HFCs</td>
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<td>• ......</td>
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<tr>
<td>GOOD PRACTICE</td>
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<tr>
<td>• Identify typical application</td>
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<tr>
<td>• State and identify the commonly used refrigerants designation</td>
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<td>• ......</td>
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<tr>
<td>HEALTH AND SAFETY REQUIREMENTS</td>
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<tr>
<td>• Safe system shutdown and isolation</td>
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<tr>
<td>• Extinguish a fire, First aid care treatment</td>
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<tr>
<td>• ......</td>
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<tr>
<td>REGULATIONS AND STANDARDS</td>
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<tr>
<td>• Knowledge of International and National Regulations standards</td>
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<tr>
<td>• Storage of the refrigerant</td>
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<tr>
<td>• ......</td>
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</tbody>
</table>

Details in AREA Guidance: www.area-eur.be
**Example: training for Hydrocarbons**

**Course details**
- Thermodynamic characteristic of Hydrocarbons as refrigerant - p/h diagram
- Specific components for Hydrocarbons
- Electronic components suitable for flammable refrigerants
- Refrigeration and Air conditioning applications with HC
- Recovery or Venting Hydrocarbons
- Vacuum-Charging procedures
- Leak testing
- Mechanical/compression joint connections – avoid brazing
- Flammability and safety issues, first aid
- Conversion HCFC – HFC systems into HC
- National and European regulations and standards
- Transport and storage requirements
- Logbook

**Necessary equipment and components (minimum)**
- Test Rig equipped with Pressure Gauges, sight glasses in key points, service valves for connections, temperature well - thermowell (Domestic/Commercial refrigerator or small packaged portable air conditioning unit)
- Mechanical/compression joint tool and connectors
- Nitrogen Regulator - Cylinder of High Purity Nitrogen
- Electronic Weighing Platform
- Hydrocarbon Cylinder
- Electronic or analogue Vacuum gauge
- Manifold set - Hoses with ball valves
- Vacuum Pumps and Hose
- Electronic Leak Detector (suit HC)
- Proprietary Leak Spray
- Temperature meter
- Ammeter
- Tools, Pipe Cutters, Pipe Deburring Tool, Pipework Expanders, Hacksaws, Brazing Rods
- Flaring Tool
- Personal protective equipment
AREA guidelines

• Equipment for handling refrigerants with lower (A2L) and higher (A3) flammability

Example of Figure from the guideline:
Possible sources for leakage and safety equipment used when filling flammable refrigerant

Translated already in 8 languages, including arabic!
# Example: R32 Service tools

<table>
<thead>
<tr>
<th>Tool</th>
<th>R32</th>
<th>R410A</th>
<th>R22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge manifold</td>
<td>Slightly different scale for HFC32 and R410A so check with tool supplier if manifold is shareable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charge hose</td>
<td>Common</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scale</td>
<td>Common</td>
<td></td>
<td></td>
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<tr>
<td>Pipe bender</td>
<td>Common</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe cutter</td>
<td>Common</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flaring tool</td>
<td>Common</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torque wrench</td>
<td>Common</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder thread adaptor</td>
<td>Depends on the cylinder – some have different thread for flammable gases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vacuum pump</td>
<td>Common</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery pump</td>
<td>Check with tool supplier if shareable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electr. Leak detector</td>
<td>Check with tool supplier if shareable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refrigerant recovery cylinder</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Equipment and tools

<table>
<thead>
<tr>
<th>Equipment and tools of the certified personnel to be supplied by his employer</th>
<th>RC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manifold</td>
<td>x</td>
</tr>
<tr>
<td>Vacuum Gauge or Vacuum Meter</td>
<td>x</td>
</tr>
<tr>
<td>Temperature meter</td>
<td>x</td>
</tr>
<tr>
<td>Portable leak detector</td>
<td>x</td>
</tr>
<tr>
<td>Refrigerant weight Scale</td>
<td>x</td>
</tr>
<tr>
<td>Vacuum pump</td>
<td>x</td>
</tr>
<tr>
<td>Recovery set</td>
<td>x</td>
</tr>
<tr>
<td>Nitrogen pressure regulator</td>
<td>x</td>
</tr>
<tr>
<td>Recycling cylinder</td>
<td>x</td>
</tr>
</tbody>
</table>

- **Figure 4** Recovery cylinder, how to label it
- **Figure 5** Vacuum pump
- **Figure 6** Refrigerant recovery machine
- **Figure 7** Leak detector
- **Figure 8** Scale
- **Figure 9** Vacuum Gauge
- **Figure 10** Pressure Manifold
- **Figure 11** Temperature Meter
Assessment: practical organization issues

- Maximum 20-25 candidates per class dependent on number of assessors
- Assessor/s should be independent and not involved in the training of the candidates
- Multiple answers tests, between 30 and 45 questions for 60-90 minutes duration (Sample questions in annex V)
- The same test among candidates with variation of questions to prevent predictability among candidates
- Closed books, only specific technical tools such as calculator and pressure-temperature comparator allowed
- NO! mobile phones or cameras NO! copying or communication between candidates
- YES! speaking to the assessor to ask explanation of the modalities and of the questions if not understood; many candidates use different words and vocabulary to identify the same concept (eg. Valves)
- Theoretical assessment: Pass mark above 60% correct answers
- Laboratory should be properly equipped for performing the practical test (see Annex IV of Certification Booklet)
- Practical assessment: Pass if candidate proves competence in performing main RAC service technicians activities without or with only small hesitations (remember candidates could be knowledgeable but be nervous!):
  - Thermodynamic parameters reading through gauges and devices, temperature, pressure, subcooling, superheating
  - Parameters interpretation, troubleshooting
  - Perform a leak test
  - Vacuum, charge, recovery with minimum emissions
  - System Logbook reading, understanding and competition
  - Brazing leak tight joints
Assessor Qualification and competence

- Assessors and Trainers should hold a certificate
- Assessors should have multiple years of experience in the field
- Assessors should be comfortable in trainees' evaluation
- Please see International Standards as ISO 17024 for more details

N.B in order to confirm the value and guarantee the sustainability of the certification, standards must be kept high and therefore not everyone will pass the exam!

Certification is both a theoretical and a practical assessment

A certificate is not:
A training course where a Participation Certificate is issued at the end without a written, oral or practical assessment which proves the ability of the service technician or the quality of the company
1. The hazards of R32 include:
   High flammability
   Mild flammability
   High toxicity
   Mild toxicity

2. What is the maximum charge of R290 that can be used on a supermarket shop floor (occupancy category A)?
   It cannot be used in this application
   150 g
   1.5 kg
   There is no limit

3. What is the pressure of R744 in a system which is at standstill in an ambient temperature of 20°C?
   4.9 bar g
   7.4 bar g
   55 bar g
   72.8 bar g

4. What is the approximate displacement required for a compressor operating on R600a compared to one operating on R134a to give the same cooling capacity?
   The same
   Two times
   Seven times
   Half

5. According to the latest European F Gas regulation (EU517/2014) how frequently must an R1234ze system with a charge of 300kg and a fixed leak detection system.
   It does not need to be leak tested
   Once per year
   Twice per year
   Four times per year

6. Which refrigerant can be detected by the use of litmus paper?
   R32
   R744
   R290
   R717

7. When working with R1270 what is the recommended radius around the work area that should be free from sources of ignition?
   0.3 m
   1 m
   3 m
   10 m

8. What is the usual method for removing R744 from a system?
   It is vented
   It is recovered using a high pressure recovery machine
   It is pumped into high pressure cylinders
   The system is pumped down
Technology and knowledge Training, Assessment (1)

In the past 3 years several projects has been started on transfer of Technology and knowledge, training and certification

- Rwanda (African Anglophone Countries) around 15 technicians certified
- Benin (African Francophone and Lusophone Countries) around 20 technicians has been certified
- Eritrea around 20 technicians
- Tunisia
- Saudi Arabia 2 sessions
- Montenegro (Around 10 technicians certified)
- Ukraine, Belarus, Tajikistan, Uzbekistan
- Others .............
Training and certification for Ghana on natural refrigerants: Hydrocarbons HC

A delegation of technicians from Ghana received theoretical and practical training on the safe handling and design of equipment with hydrocarbon refrigerants at the headquarters of the Centro Studi Galileo, Casale Monferrato, Italy. The training is in line with the country’s efforts to phase out HCFCs and establish a safe hydrocarbon and natural refrigerant use culture.
Certification of technicians in servicing sector how it runs

Brazing

Temperature, Pressure, Subcooling, Superheating

Vacuum, Charge, Recovery
Online Register with the name of all the service technicians and companies which are certified.

Anybody can see if someone is or is not certified.
Technology and knowledge Training, Assessment

The Gambia (LVC)

Outcome: Technical and financial support on replacement refrigerants, and reducing greenhouse gas emissions and operational costs, is ensured.

Aim: To pilot a technology transfer mechanism through the establishment and operation of the technical support mechanism, while introducing innovative technologies to this sector.

The technology focus will be on energy efficiency improvements; reduction of ODS leaks and reduction of contaminated refrigerants; and introduction of two types of demonstration systems – one using hydrocarbon refrigerant for retrofits and a second full-scale CO$_2$ industrial or commercial unit with cascade – to be piloted in a training environment.

→ Similar project in Tunisia
With UNIDO Training and Equipment in Gambia

- CO2 Equipment
- HC Equipment
- Training in Alternative refrigerants and managing training and certification sessions
With UNIDO Training and Equipment in Tunisia

• Training
• Certification Session
• Delivery of equipment
• Base Certification on traditional refrigerant mandatory + voluntary certification on alternative refrigerants
With UNIDO Training in Saudi Arabia

- Certification Session

For the success of projects, provide demonstrative equipment with and for Alternative Refrigerants + certification of personnel.

Prove of their capacity to use the equipment correctly.
Training and certification worldwide

• Together with the UN implementing agencies UNEP, UNIDO, UNDP over the past few years AREA has been deeply involved in helping developing countries through training RSS technicians to install, repair, maintain and design RAC systems and numerous Certification Sessions in Africa and Asia.

• Pics from top: Rwanda, Former Soviet Union Rep, Benin, Gambia, and also Ghana, Tunisia, Eritrea, Montenegro, Saudi Arabia, Turkey… etc…).
Certification is the best practical method to verify the competence of personnel handling refrigerants and to ensure the correct installation, maintenance, repair and dismantling of a refrigeration, airconditioning and heat pump systems.
"REAL Alternatives for LIFE" is a new and extended project to update existing content, develop new materials on applying safety standards and introduce a range of practical exercises and assessments. It will also include train the trainer events and study days held across Europe.

Will Reach 220,000 technicians

in thirteen working languages and include fifteen partner organisations based in UK, France, Germany, Italy, Belgium, Poland, Czech Republic, Slovakia, Spain, Romania, Denmark, Portugal, and Turkey.
REAL Alternatives blended learning resources:

- flexible learning programmes for use by individuals, companies or training providers.
- multi-lingual website
- interactive e-learning in five languages (*more countries interested to translate it*)
- searchable e-library with over free 100 downloads you can add to
- tracking spreadsheets, report formats and other tools
- standard on-line tests and controlled assessment papers with optional certification
- opportunities for stakeholders to contribute and update the materials and resources
- downloadable guides and training booklets

*Free – E-learning usable from Smartphone, Tablet, Desktop etc…*
Conclusions

- In Kigali–Rwanda has been decided the future of a HFCs phase down worldwide under the Protocol of Montreal

- You need a Package for demonstration of feasibility in Training Schools or in Factories, Manufacturing, Industry
  Training for designing, installing and repairing new Equipment
  Training for handle new tools suitable for alternative refrigerants
  Certification of Personnel
  + HC, CO2, NH3 Equipment

Will Make it self sustainable and economically feasible

- Could be a solution to succeed in the new goals of shifting to alternative refrigerants worldwide

- To preserve our water, our climate and our environment we should move to new refrigerants but we should do it with competence.

- Strengthening the association
- Providing the training equipment
- Providing the training session
- Delivering Certification
- Writing and Implementing a Certification Scheme in your country
THANK YOU!

Email: buoni@centrogalileo.it

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Air Conditioning & Refrigeration European contractors’ Association
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Secretary General Italian Association of Refrigeration Technician, ATF
(www.associazioneATF.org)