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Final Report **MP/JOR/99/143**

Provision of Services related to the Training of Good Practices in Refrigeration in Jordan

The above mentioned Training for Trainers was carried out in Amman, Jordan from Sunday 19th November 2000 to Thursday 23rd November 2000 at the T.T.I. Vocational Training Centre.

The main aims and objectives of the Training for Trainers was as follows:-

1. To introduce the Trainers, GCEP personnel and other participants to Recovery, Recycling and Re-use techniques in order to Reduce emissions of ozone depleting substances.
2. To transfer skills and knowledge to the trainers so that they in turn can 'cascade' this skill and knowledge through industry to improve existing practices and to train new entrants to the refrigeration and air conditioning industry.
3. To enable selection of sufficient 'trainers of trainers' to provide the facility to train other trainers and then to carry out training and certification of the technician population in Jordan
4. To ensure that the trainers had the necessary skills and knowledge to proceed with confidence to the next stage.

The programme was carried out as per the proposal and a copy is attached for information. The only variance related to the installation of the training equipment which was carried out, out of the training workshop time, by John Ellis. This was to save time and to ensure maximum participation and opportunity by the delegates. Overall the training programme was successful as can be seen from the enclosed evaluation forms which were issued to the delegates for completion.

Also attached is the list of delegates issued with certificates and a sample of the Post Training Assessment paper.

Observations:

1. Although this was intended to be a training for Trainers programme only about one third of the delegates were employed as Vocational Trainers. The remainder were from industry and GCEP. The participants from industry were from a variety of different companies and contributed in a positive way to the training programme.

2. Some of the trainers had no real experience of the industry in that although they are well qualified they had not had the opportunity to practice their knowledge by application and of course similarly they have not had the opportunity to physically carry out service and maintenance of refrigeration systems. This lack of experience is a problem for the future and will slow down the technician training programme. It is very important that experience practitioners are encouraged to become vocational Trainers in preference to

academics who have only a theoretical knowledge of the practices required to reduce emissions of ozone depleting substances to atmosphere. The vocational Trainers will benefit from the training equipment supplied in this project with the TTI in Amman the focal point for the trainers to practice the use of the recovery/recycling equipment supplied. It is imperative that they gain as much practice as possible to have the confidence to pass on their skills and knowledge to other trainers and then to the technicians in the industry.

3. The staff at the Training and Testing Institute were extremely supportive to all aspects of the Training of Trainers programme and contributed to the smooth running and successful outcomes that transpired.

Conclusion

The aims and objectives of the training programme were successfully carried out. GCEP staff were in attendance throughout the training and this has distinct advantages in that they are fully aware of the standard of vocational trainers available and of course the work covered during the programme. Participants were introduced to simple good practices that enable refrigerant emissions to be reduced.

The overall theme of the workshop can be summarised as follows:

RECOVER
RECYCLE
RE-USE
REDUCE EMISSIONS

The equipment supplied enable the participants to fully utilise the recovery and recycling machine also to practice leak testing, evacuation and dehydration techniques, charging, removing service gauges without loss of refrigerant, recovery, recycling and re-using refrigerant.

Since most refrigerant emissions to atmosphere come about during service and maintenance it is good practice to minimise the number of times that a refrigeration system needs servicing during its lifetime. A recurring problem is the electrical supply, if it fluctuates compressor failure is more frequent, as too the need to open the system with the consequent potential release of refrigerant to atmosphere. Under these circumstances local recovery/recycling networks can make a significant contribution to reducing emissions and local Vocational Training Centres can easily be the hubs of these networks.

Participants were encouraged to give consideration to improvising recovery machines along the lines of the suggestions made in the training programme.

To conclude, the Training of Trainers in Good Refrigeration Practices was a successful programme and enables the rest of the Refrigerant Management Plan to be progressed. There is no reason why the Training of other Trainers cannot now take place with other Vocational Training Centres being equipped in preparation for the national training and certification of technicians to take place.

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The provision of services, supply of demonstration equipment and organisation of a 'Training of Trainers' course at the Vocational Training Centre in Amman, Jordan.

Ellis Training and Consultancy Ltd submit this proposal for consideration in accordance with the published terms of reference. The company has substantial experience in delivering vocational training in the areas of refrigerant recovery and recycling for re use, safe handling of refrigerants and using good refrigeration practice to minimise refrigerant emissions to atmosphere. Training trainers/technicians in these skills leads to substantially improved service and maintenance practices that in turn extend the useful, serviceable life of refrigeration and air conditioning equipment.

Training Trainers is the most cost effective method of enhancing technician training in country, with the trained trainers cascading their skills and knowledge through the work force via the technician training programmes and long term by including recovery and recycling and other modern relevant good refrigeration practices in the training curriculum for new entrants to the industry in the vocational training centres.

The training equipment supplied with this project will enhance and strengthen the delivery of training for trainers and will be available long term to assist the provision of a more comprehensive and up to date refrigeration element in the curricula of the Vocational Training Centre.

Ellis Training & Consultancy Ltd will field John Ellis for this project who is the Managing Director and Principal Consultant. He is extremely experienced in delivering this type of project having been involved in Training of Trainers since 1983. Similar projects have been carried out in Spain, Syria, Turkey, Indonesia and Ghana for private companies and in Barbados, Zambia, Zimbabwe, Egypt and the Philippines for UNIDO.

John Ellis is an experienced and qualified Refrigeration Engineer and Trainer having more than 25 years experience of training refrigeration technicians in vocational skills and knowledge. A Fellow of the Institute of Refrigeration, John Ellis is currently President of the Institute and Chairs its Education and Training Committee. Ellis Training Centre is approved to offer City & Guilds qualifications in Refrigeration and Air Conditioning and trains/assesses in excess of 500 technicians per annum

throughout the United Kingdom. Involved in the development of the National Vocational Qualifications for refrigeration and air conditioning, John Ellis was granted Honorary Membership of the City & Guilds of London for his contribution to Technical and Vocational Education in this field.

The training programme at Annexe 1 meets the requirements of the Terms of Reference and concentrates on the practical aspects of installation, service and maintenance of refrigeration and air conditioning systems, to maintain efficient operation with minimum emissions and to provide the skills and techniques necessary to improve practice and increase energy efficiency

The equipment schedule at Annexe 2 also meets the requirements of the terms of Reference providing a set of equipment suitable to demonstrate and provide suitable practice for trainers on this course and thereafter to train technicians.

This proposal includes the time and necessary costs of procuring the specified equipment and shipping it out to Jordan in good time before the training commences. Delegates will be assessed both before and after training and those delegates who successfully complete the training programme will be awarded certificates confirming their success.

Ellis Training & Consultancy Ltd will prepare pre and post training assessment questionnaires, training manuals for each delegate up to a maximum of twenty and instruction manuals for the recovery and recycling machine supplied.

Confirmations:

Ellis Training & Consultancy Limited confirms the following:

- that sufficient capability exists within the organisation to fully meet the requirements of this project
- that the work can be carried out within the planned time schedule provided adequate co-operation is forthcoming from the host country
- that the organisation can legally enter into a contract with UNIDO, is NOT insolvent, in receivership or bankrupt, and fulfils its tax and social security obligations
- that no Directors or Officers have been convicted or charged with any offences in the last five years

- that the organisation has wide experience of preventing the release to CFCs and other refrigerants to atmosphere and of vocational training in refrigeration and air conditioning
- that the organisation fully understands the work to be carried out and that this work will be carried out by suitably qualified staff within the appropriate time scale

Time Schedule:

The proposed time schedule is as follows:

Procurement of equipment in UK	June/July 2000
Shipping/delivery to Amman	July/August 2000
Delivered to Training Centre	*August/Sept 2000
Preparation for training courses	Sept/Oct 2000
Implementation of Train the Trainers	*Nov/Dec 2000
Reporting	December 2000

*The equipment must be available at the training venue before the training can commence

Annexe 1

Outline Draft Training Programme

Day One

Pre-assessment
Ozone depletion and environmental considerations
Overview of the International CFC phase out programme
Global warming issues
Review of basis principles
Hazards of refrigerants

Day Two

Safe refrigerant handling techniques
Leak detection and prevention
Good refrigeration practice when:-
- Charging
- Evacuating and dehydration systems
- Fault diagnosis and repair

Retrofitting and retrofilling to alternative refrigerants

Day Three

Installing condensing unit, evaporator etc
Pressure and leak testing
Evacuation and Dehydration
Charging and commissioning
Maintenance techniques which minimise the loss of refrigerant to atmosphere

Day Four

Recovery and recycling machines – techniques and principles
Construction of simple recovery machines from recycled components
Practice installation, service and maintenance techniques
Practice recovery and recycling techniques
Practice retrofilling using alternative less harmful refrigerants

Day Five

Plenary session – Training Trainers questions
Hints and tips for Training
Assessment techniques and procedures
Post training assessments

Annex 2

Basic equipment set for the delivery of 'Train the Trainers'

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RMP/ODS Training Equipment Package

1 x Condensing units with service valves
1 x DX evaporators
1 x Thermostatic expansion valves
1 x Combination LP/HP switches
1 x Moisture indicating sight glasses
1 x Liquid line driers
1 x Gauge manifold sets c/w hoses
1 x ¼ drive ratchets
1 x Electronic leak detectors HFC/HCFC/CFC
1 x Empty refrigerant cylinders (10 kg nominal capacity)
1 x 10 m rolls of $^{3/8}$ dia copper tube
1 x 10 m rolls of ¼ dia copper tube
1 x Vacuum pumps
1 x Recycling machine (separation chamber type)

ASSUMPTION MADE:

Available locally in training centre:

Oxyacetylene, nitrogen, refrigerant, normal hand tools for manipulating small tube, flare nuts and flaring tools.

List of Delegates for Training of Trainers 19th to 23rd November 2000

1. Mr Hussein Shahin
2. Mr Ahmed Alkhatib
3. Mr Naim Alsoud
4. Mr Jaber Dradkeh
5. Mr Abdelkarin Shalabi
6. Mr Hamza Sabha
7. Mr Omer Zaidan
8. Mr Nemer Aref
9. Dr Bassam Alzghoul
10. Mr Majed Almsaideen
11. Mr Ali Aljumat
12. Mr Arafat Albustanji
13. Mr Asad Diab Asad
14. Mr Khaled Orabi
15. Mr Abdalsalam Alqaisi
16. Mr Moh'd Khir Baalabki
17. Mr Hassan Alawaisheh
18. Mr Ziad Aljkheim
19. Mr Wasfi Alotoom
20. Mr Murad Kanash
21. Mr Ali AbuHilaleh
22. Mr Eiqd Ahmed Khader
23. Mrs Ibetsam Abdellateef
24. Mr Rafe Moh'd Al-Omari
25. Mr Mahmoud Ubaidat
26. Ms Hanadi Marie

Post-Training Assessment

Circle the correct answer for each of the following questions. Do not guess. Leave blank if the answer is unknown.

1. A halide lamp is used to detect the presence of a leak of R12. If the leak is small the flame colour changes to

   a. blue
   b. green
   c. orange
   d. purple

2. Which one of the following refrigerants is NOT miscible with mineral oil

   a. R12
   b. R22
   c. R502
   d. R134a

3. A cascade system operating within the temperature range of +35°C and -70°C would use the following combination of refrigerants

   a. R11 and R12
   b. R12 and R502
   c. R22 and R13
   d. R717 and R502

4. Which one of the following refrigerants is in common use in large low-temperature cold rooms?

   a. R11
   b. R12
   c. R13
   d. R502

5. Which one of the following properties is particularly related to the viscosity of a refrigeration quality oil?

   a. Thickness
   b. Density
   c. Heat content
   d. Wax content

6. When more than one compressor is used with one or more evaporators in a common circuit it is essential to ensure that

   a. oil returns to the suction line header
   b. compressor oil levels are balanced
   c. oil pressure controls are used
   d. oil pressure controls are fitted

7. When a compressor is installed above the evaporator two small bore tubes may be used as the suction line riser in order to

   a. use smaller, more easily handled tubing sizes
   b. provide an alternative channel if one blocked
   c. assist oil return of the compressor operates partially unloaded
   d. avoid the need to use a suction line strainer

8. To evacuate a system contaminated by moisture it is necessary to

   a. heat the system
   b. pull a vacuum of at least 29 inch Hg gauge
   c. maintain a vacuum for at least 24 hours
   d. have a sufficient vacuum to evaporate moisture at the ambient temperature

9. When fitting a new piston to a reciprocating compressor, the fit should be such that the piston will

   a. slip through a dry bore without pressure
   b. slip through a lubricated core without pressure
   c. go through a lubricated bore with light pressure
   d. go through a lubricated bore with heavy pressure

10. Which one of the following gives a condition under which refrigerant is absorbed into the compressor crankcase oil?

a. during the off cycle period
b. when the compressor is running
c. during a pumpdown cycle
d. when the compressor crankcase oil is 'thin'

11. If the filter of a domestic air-conditioner becomes dirty the effect will be that the

a. evaporator temperature will rise
b. temperature of the air off-coil will rise
c. evaporator will become frosted
d. room will get too cold

12. Into which one of the following refrigerant lines can the charge of refrigerant liquid be safely introduced when the compressor is static

a. discharge line
b. liquid line
c. suction line
d. hot gas line

13. Which one of the following is the voltage between a live and neutral conductor in a 415 volt 50 hertz four wire alternating current supply?

a. 110 volts
b. 120 volts
c. 240 volts
d. 415 volts

14. External pressure equalising devices should be incorporated in thermostatic expansion valves for refrigeration systems which are used

a. at very low temperatures
b. with widely varying refrigeration duties
c. with more than one evaporator and one compressor
d. with a substantial pressure drop through the evaporator

15. A low-pressure float valve opens and closes as a result of changes in

a. condenser pressure
b. evaporator pressure
c. condenser liquid level
d. evaporator liquid level

16. If the voltage of a single phase power supply feeding an electric motor reduces, the current drawn by the motor when fully loaded

a. increases
b. decreases
c. is not changed
d. fluctuates up and down

17. Which one of the following refrigerants has the highest potential to destroy ozone in the stratosphere?

a. R717
b. R502
c. R12
d. R22

18. Which one of the following service valve combinations is correct when fitting gauges or a service manifold?

a. suction service valve front seated, discharge service valve front seated
b. suction service valve front seated, discharge service valve back seated
c. suction service valve back seated, discharge service valve back seated
d. suction service valve back seated, discharge service valve front seated

19. Assuming gauges are fitted directly to the compressor head, which one of the following service valve combinations is correct for testing the suction valve reeds of a reciprocating compressor?

a. suction service valve front seated, discharge service valve front seated
b. suction service valve front seated, discharge service valve back seated
c. suction service valve back seated, discharge service valve back seated
d. suction service valve back seated, discharge service valve front seated

20. In order to pump the refrigerant charge of a system down into the liquid receiver, it is necessary to

a. front seat the discharge service valve
b. front seat the liquid stop valve
c. front seat the suction service valve
d. front seat the crankcase pressure regulating valve

21. Which one of the following gives the most accurate measurement of a deep vacuum?

a. compound gauge
b. pressure gauge
c. torr gauge
d. water gauge

22. Which one of the following methods gives a reasonable approximation of the length of tube remaining on a partly used coil?

a. 3 x coil diameter x length of one coil
b. 3 x coil diameter x number of complete coils
c. 3 x coil circumference x number of complete coils
d. 3 x coil circumference x length of one coil

23. Which one of the following refrigerants has the lowest potential to destroy stratospheric ozone?

a. R717
b. R502
c. R12
d. R22

24. A single phase motor which has a capacitor in series with the highest resistance winding is called

a. a split phase motor
b. a capacitor start motor
c. a capacitor start and run motor
d. a shaded pole motor

25. The function of an evaporator pressure regulating valve is to

a. maintain a constant suction pressure
b. maintain a constant evaporator pressure
c. prevent the evaporator pressure falling below some pre-set minimum
d. prevent the evaporator pressure rising above some pre-set maximum

26. The Montreal Protocol is which of the following

a. a list of do's and don'ts of how to behave in Canada
b. a list of suggestions for working with all refrigerants
c. an internationally controlled organisation regulating the manufacture of ozone depleting products
d. an advisory body promoted by the United Nations for surplus food production

27. Which of the following refrigerants is a CFC?

a. R12
b. R123
c. R22
d. R134a

28. Which of the following refrigerants is an HCFC?

a. R12
b. R502
c. R22
d. R134a

29. Which of the following refrigerants is an HFC?

a. R502
b. R12
c. R134a
d. R123

30. The ozone layer surrounding the earth's atmosphere is being depleted by contact with:

a. fluorine
b. chlorine
c. hydrogen
d. carbon dioxide