

FOREWORD

The information contained in:

- the "Refrigeration Family products": **REFRIBASE**, **REFREPAIR**, **REFRIDIA**, **REFRILEC** and the **MANAGER Software**
- the "**REFRIBASE Manual**"
- the "**REFREPAIR Manual**"
- and this "**User's Manual**"

are liable to be amended without warning.

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In this Manual, **the individual in possession of the password** (the supervisor, trainer etc.) will be referred to as: **THE SUPERVISOR**. Those individuals not in possession of the password (students, trainees, technicians, engineers etc.) will be referred to as: **THE USER**.

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All versions of the software have been registered with the Software Protection Agency since 1990.

The Software will only operate on a multimedia PC using Windows 2000, XP, Vista or Seven. The PC should be configured to a *minimum* of 800 x 600 point mode with 65536 colours in small fonts.

In effect, the Software referred to in this Manual will not function on a PC if the corresponding demonstration version of the Software does not function on that PC.

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Revision March 2010

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USER'S MANUAL FOR REFRIDIA4

REFRIDIAG: DETAILED DESCRIPTION

REFRIDIAG (which follows on from REFREPAIR) is at a "qualified" User level.

REFRIDIAG is a refrigeration fault simulator, which uses as examples several R22 direct expansion A/C systems using air-cooled condensers. It is recommended that the repair techniques of REFREPAIR are fully understood before getting to grips with REFRIDIAG.

REFRIDIAG: USING AND DURATION OF TRAINING

Refrigeration and A/C skills are not easy to acquire. Similarly, the refrigeration aspects of REFRIDIAG may at times appear to be difficult.



This is why, to avoid de-motivating a novice User we would strongly recommend that a high score is first obtained in REFREPAIR before REFRIDIAG is attempted.

Then you should proceed as follows:

1) Make a first attempt on the PC, perhaps with the help of the REFREPAIR Manual (average time required: from 4 to 10 hours to complete all 46 faults in several sessions).

If the score is too low at level 1 and then at level 2, it would perhaps be better not to continue the repairs. It would probably be more beneficial to carefully re-read the REFREPAIR Manual and perhaps repeat the REFREPAIR program.

2) Re-read the REFREPAIR Manual.

3) Second attempt using the PC (average time required: from 2 to 6 hours for all the repairs, in several sessions).

The User could, if he wished, repeat REFRIDIAG as often as necessary until a high enough score is obtained.

Note: These times are, of course, only indications, since they can vary enormously depending on the initial knowledge of the User.



REFRIDIAG has been designed for QUALIFIED technicians. When a User obtains a high score in REFRIDIAG, *having worked through the steps alone*, he should be capable of successfully solving most of the usual refrigeration problems that he might encounter on his own.

REFRIDIAG: THE SEQUENCE OF REPAIRS

Every time REFRIDIAG is run, after a welcome message, the User is automatically taken to the relevant repair where his last score (in points and percentages) is displayed.

REFRIDIAG SAVES THE RESULT OF *EVERY REPAIR CARRIED OUT BY EVERY USER. IT IS THEREFORE ENTIRELY POSSIBLE TO CARRY OUT THE 46 DIFFERENT REPAIRS IN 46 SEPARATE SESSIONS.*

After each diagnosis, REFRIDIAG updates the User's score, archives it on the hard disk and offers the User the choice of continuing or of ending the session.

THE FAULTS ARE ALWAYS PRESENTED IN A RANDOM SEQUENCE.

This random order means that if a User who has completed the 46 repairs wants to re-start REFRIDIAG, then the order in which the faults appear in each level will be different each time.

The 46 faults are split into four levels of increasing difficulty:

Level 1: 5 faults
Level 3: 11 faults

Level 2: 5 faults
Level 4: 25 faults

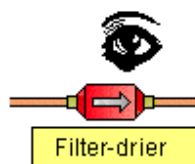


Unless the configuration has been changed, the User must complete all the level 1 faults before he moves on to level 2, and so on.

This allows the User to quickly become accustomed to using REFRIDIAG and to fall in with the aim of the program, that is: *to improve his effectiveness in performing repairs without the risk of any damage being done to equipment!* The User's progress will soon be apparent in the plant room. The success of REFRIDIAG since the appearance of the first version in 1993 is proof of this.

Note: For every repair situation presented, the program will act as if a client has called to say that the ambient temperature is too high, although the system seems to be "running" normally.

At each level, the User arrives at the plant room and has to decide for himself what measurements to make or which inspections he needs to carry out.

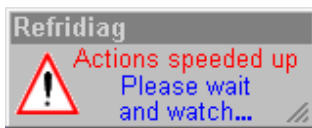
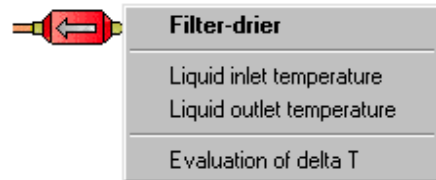


To make a measurement, or to make an inspection, the User should bring the mouse over the relevant equipment. When the cursor changes into an "eye", the name of the equipment will appear.

For example, bringing the mouse cursor onto the filter-drier will cause the image opposite to appear.

The User should then Right-click the mouse to access the available menu (which depends on the level) and then click on the action that he wishes to perform

For example, in the first three levels, the User is presented with the choices shown opposite after clicking the right button of the mouse. All that is then needed is a simple click of the mouse.

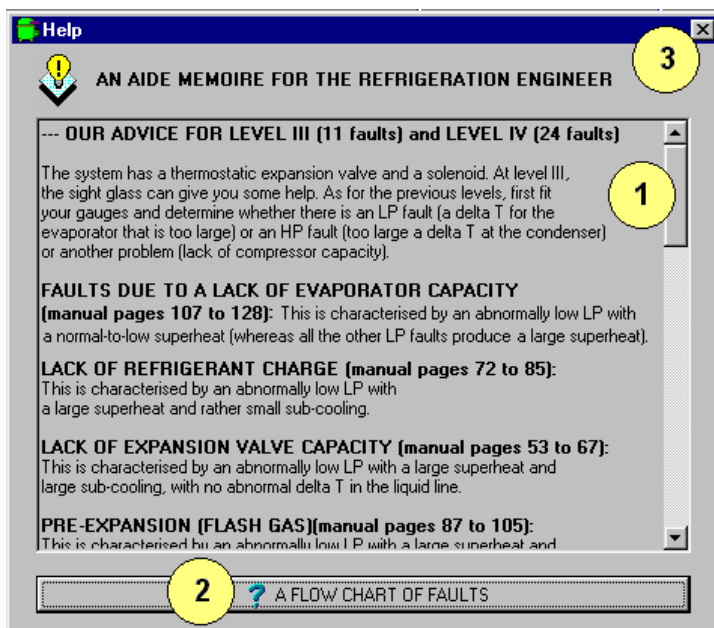
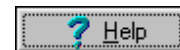


When the box shown opposite is displayed, it indicates that a lengthy procedure is underway (searching for a leak, dismantling of equipment, etc.). These activities are deliberately speeded-up. Be patient and carefully observe what is

happening.

If you are using an early Pentium PC or your PC is short of memory, the time taken for these operations may seem rather long: **If possible, try to use a more powerful PC.**

If the User has problems, he can click on the "Help" button.



A window like that shown opposite will then appear.

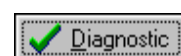
The User may then consult the advice on what action to take. This advice is always appropriate for the level of difficulty involved.

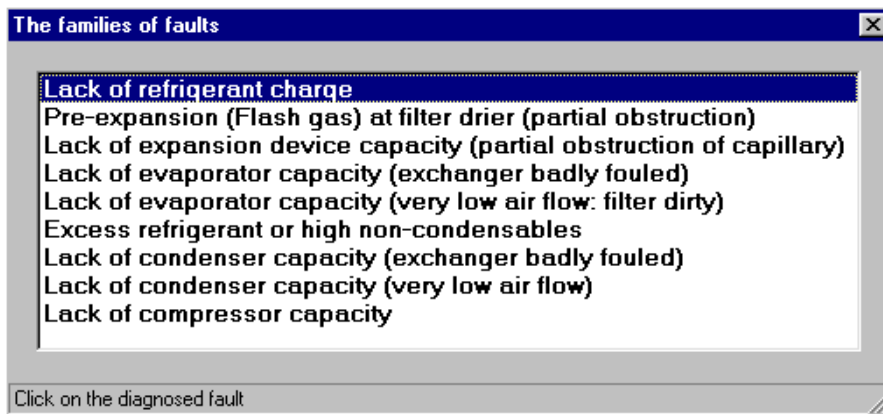
The slide bar can be used (marker 1) to scroll the text.

The User can also click on the bottom bar (marker 2) to display a fault flowchart relevant to the current level of difficulty. This is a helpful at-a-glance reminder.

Remember to always click on (marker 3) to close a window and to return to an earlier screen.

When a User thinks that they have identified the fault as precisely as they can, they should click on the "Diagnosis" button.



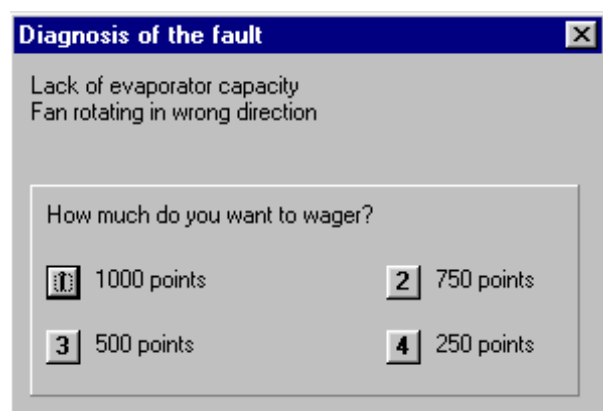


A window then appears with a list of faults appropriate to the current level of difficulty (Opposite is a window from level 1).

The User then clicks on the fault he has diagnosed.

FROM LEVEL II ON, THINGS GET A BIT MORE COMPLICATED: When you click on a family of faults, a second window appears with a choice of sub-families.

For example, at level II, when you click on "Lack of evaporator capacity", another window offers the choice between "Badly fouled exchanger", "Dirty air filter" and "another reason".



If he is not sure, then the User can re-think his diagnosis by closing the window. Otherwise, the User chooses by clicking on the appropriate fault. Now REFRIDIAG asks the User to place a 'bet' on his diagnosis (*the maximum amount he can wager will depend on the level of difficulty and the points he has already gathered*).

Note: Each User that starts REFRIDIAG receives 'capital' of 10,000 points and his percentage score is set at 99.9%.

Once the User has made his wager, REFRIDIAG responds using a personalised message.

- **If his diagnosis is correct**, REFRIDIAG displays a confirmation message and the User wins the points he has wagered.

He can then, if he wishes, continue to make measurements and inspections to explore the effects of the fault he has found on the operating parameters of the system.

- **If his first diagnosis is incorrect**, REFRIDIAG displays an explanation and the User loses the points he has wagered. REFRIDIAG offers the User a second chance to find the fault.

When the first attempt is wrong, the User should start his line of reasoning over again, and should only put forward his second diagnosis when he is absolutely sure.

- ***If the second diagnosis is still incorrect***, REFRIDIAG displays an explanation and the User again loses the points he has wagered.



Just as an unhappy client would look for another engineer, REFRIDIAG does not give the User a third chance to find the fault!



On the other hand, a User who does not want to admit defeat can continue to take measurements and make inspections in an attempt to find the fault. This User, however, can no longer place bets.

In all of these cases, a User's score and percentage success score are updated after every wager.



The User can then click on the [**Continue**] button to move onto the next fault.





He can also click on the [**Quit**] button at any time to end the current session. After confirmation, REFRIDIAG then returns to the User menu. The fault currently displayed is not counted.





If he clicks on the [**Exit**] button, Refridiag also asks for confirmation before it returns to the User Menu. ***This action can be considered equivalent to "leaving the Plant Room".***


REFRIDIAG: REPAIRS at LEVELS I and II

The faults at level I (5 faults) and level II (5 faults) are demonstrated using a small installation equipped with a hermetic compressor and a capillary expansion device. To diagnose these first 10 faults, the User can carry out various inspections by bringing the mouse on to the equipment below and then right-clicking the mouse.

-  **HP-LP Gauges**
 - Fitting the gauges
 - Removing the gauges
-  **Hermetic compressor:**
 - Measuring the suction side temperature
 - Measuring the discharge temperature
 - Touching the top of the compressor
 - Touching the bottom of the compressor

-  **Air-cooled condenser:**
 - Measuring the liquid outlet temperature
 - Measuring the air inlet temperature
 - Measuring the air outlet temperature
 - Examining the condenser

-  **Filter-Drier:**
 - Measuring the liquid inlet temperature
 - Measuring the liquid outlet temperature
 - Measuring delta T


-  **Evaporator:**
 - Measuring the air inlet temperature
 - Measuring the air outlet temperature
 - Examine the evaporator
 - Examine the air filter


REFRIDIAG: REPAIRS AT LEVEL III


The repairs at level three (11 faults) are demonstrated using an installation fitted with a semi-hermetic compressor and a thermostatic expansion valve.


Note: Depending on the fault, the liquid sight-glass "bubbles" just as it would in real life.


At this level, the User can carry out various inspections by bringing the mouse onto the following equipment:


-  **HP-LP Gauges**
 - Fitting the gauges
 - Removing the gauges

-  **Compressor:**
 - Measuring the suction side temperature
 - Measuring the discharge temperature

-  **Air-cooled condenser:**
 - Measuring the liquid outlet temperature
 - Measuring the air inlet temperature
 - Measuring the air outlet temperature
 - Examine the condenser

-  **Filter-Drier:**
 - Measuring the liquid inlet temperature
 - Measuring the liquid outlet temperature
 - Measuring delta T


-  **Solenoid Valve:**
 - Measuring the liquid inlet temperature
 - Measuring the liquid outlet temperature
 - Measuring delta T


-  **Evaporator:**
 - Measuring the air inlet temperature
 - Measuring the air outlet temperature
 - Measuring the expansion valve bulb temperature
 - Examine the evaporator
 - Examine the air filter


You can see a complete list of faults on page 10 onwards.


REFRIDIAG: REPAIRS AT LEVEL IV


The 25 faults at level IV are demonstrated on the same installation as earlier, but the gauges are already fitted and the liquid sight glass has been removed. In addition, the User can perform more inspections on more of the equipment.


-  **Compressor:**
 - Measuring the suction side temperature
 - Measuring the discharge temperature
 - Examining the Identification Plate
 - Examine the motor terminal block
 - Measuring the current passing
 - Perform a mechanical check on the valves
 - Check for leaks


-  **Air cooled-condenser:**
 - Measuring the temperature of the liquid outlet
 - Measuring the air inlet temperature
 - Measuring the air outlet temperature
 - Examining the condenser
 - Measuring the air flow
 - Check for leaks


-  **Condenser fan:**
 - Examining the Identification Plate
 - Examine the motor terminal block
 - Measuring the current passing


-  **Liquid receiver:**
 - Measuring the liquid inlet temperature
 - Measuring the liquid outlet temperature
 - Performing a pump-down test
 - Performing a non-condensable test
 - Check for leaks

-  **Filter-drier:**
 - Measuring the liquid inlet temperature
 - Measuring the liquid outlet temperature
 - Estimating the delta T
 - Check for leaks

-  **Solenoid Valve:**
 - Measuring the liquid inlet temperature
 - Measuring the liquid outlet temperature
 - Estimating the delta T
 - Examining the Identification Plate
 - Measuring the current passing
 - Making a full mechanical inspection
 - Check for leaks

-  **Expansion Valve:**
 - Measuring the bulb temperature
 - Examining the thermostatic line
 - Examining the capacity table
 - Checking the valve adjustment stem
 - Making a full mechanical inspection
 - Check for leaks

-  **Evaporator:**
 - Measuring the air inlet temperature
 - Measuring the air outlet temperature
 - Examining the evaporator
 - Examining the air filter
 - Measuring the air flow
 - Check for leaks

-  **Evaporator fan:**
 - Examining the Identification Plate
 - Examine the motor terminal block
 - Measuring the current passing
 - Making a full mechanical inspection

REFRIDIAG: A LIST OF THE 46 FAULTS

You will find below a listing of the 46 faults that correspond to the numbers displayed during a review of the results.

REFRIDIAG - Faults at Level 1:

1. Lack of refrigerant charge
2. Pre-expansion (Flash-gas) at the filter drier (partial obstruction)
3. Lack of evaporator capacity (air flow too small: dirty filter)
4. Excess refrigerant charge or high non-condensables
5. Lack of condenser capacity (condenser fouled)

REFRIDIAG - Faults at Level 2:

6. Lack of expansion valve capacity (partial obstruction)
7. Lack of evaporator capacity (evaporator fouled)
8. Lack of evaporator capacity (other reason)
9. Lack of condenser capacity - lack of air flow
10. Lack of compressor capacity

REFRIDIAG - Faults at Level 3:

11. Lack of refrigerant charge
12. Pre expansion (flash-gas) in the liquid line - blocked filter-drier
13. Pre-expansion in the liquid line - Liquid outlet valve partially closed
14. Pre-expansion in the liquid line - solenoid not opening fully
15. Lack of evaporator capacity - lack of airflow (dirty filter)
16. Lack of evaporator capacity - lack of airflow (other reason)
17. Lack of evaporator capacity - evaporator fouled
18. Lack of compressor capacity
19. Excess refrigerant charge or high non-condensable
20. Lack of condenser capacity - condenser fouled
21. Lack of condenser capacity - lack of air flow

REFRIDIAG - Faults at Level 4:

22. Lack of refrigerant charge / leak at compressor
23. Lack of refrigerant charge / leak at condenser
24. Lack of refrigerant charge / leak at evaporator
25. Pre-expansion (flash-gas) - obstruction between condenser and liquid receiver
26. Pre-expansion (flash-gas) between filter drier and solenoid valve
27. Pre-expansion - solenoid valve spindle bent
28. Lack of expansion valve capacity / badly adjusted expansion valve, closed too much
29. Lack of expansion valve capacity / valve orifice too small
30. Lack of expansion valve capacity / blocked expansion valve filter

31. Lack of expansion valve capacity / thermostatic line designed for use with R12
32. Lack of expansion valve capacity / MOP point of the thermostatic line too low
33. Lack of evaporator capacity / fan rotating in wrong direction
34. Lack of evaporator capacity / drive belt needs tightening
35. Lack of evaporator capacity / drive belt needs replacing
36. Lack of evaporator capacity / variable pulley of motor open too much
37. Lack of evaporator capacity / 60Hz motor on 50 Hz supply
38. Excess refrigerant or non-condensable / excess refrigerant
39. Excess refrigerant or non-condensable / very high non-condensable
40. Lack of condenser capacity / fan rotating in wrong direction
41. Lack of condenser capacity / motor star connected instead of triangle
42. Lack of condenser capacity / 60Hz motor on 50 Hz supply
43. Lack of compressor capacity / damaged LP valves
44. Lack of compressor capacity / damaged HP valves
45. Lack of compressor capacity / cylinder head gasket leaking between LP and HP
46. Lack of compressor capacity / internal safety valve leaking



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