



CODE OF PRACTICE

FOR

REFRIGERANT LEAK TIGHTNESS

IN COMPLIANCE WITH THE

F-GAS REGULATION

VERSION 1
DECEMBER 2007

SUPPORTED BY



DISCLAIMER

While BRA/FETA have made every effort to prepare this guide in compliance with the requirements of current regulations and industry practice, BRA/FETA can accept no responsibility for the consequences of individual or corporate actions as a result of following the code.

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Section 1 Introduction

This Code of Practice sets out the recommendations of the British Refrigeration Association (BRA) for good practice in carrying out tightness testing for leakage in Fluorocarbon refrigeration systems in commercial and light industrial applications.

Whilst it is felt the Code of Practice cannot be exhaustive, it is nevertheless thought to reflect the industry's technical capabilities and technological understanding, together with legislation and standards at the time of publication.

The Code of Practice should form the basis for users of refrigeration equipment to provide the installing/servicing contractor/designer with requirements for tightness testing for leakage in order that emissions of refrigerant are minimised.

The Code of Practice also identifies the competence requirements for individuals performing leakage detection tasks in accordance with best practice and legal requirements.

The Code of Practice emphasises the need for those designing, installing, commissioning, servicing and maintaining refrigeration systems to take all reasonable steps to minimise leakage potential.

Section 2 Regulations, Standards and Directives

2.1 Introduction

There are Regulations, Standards and Directives that stipulate requirements for tightness testing for leakage of refrigeration systems.

2.2 Environmental Protection Act 1990

Under the Environmental Protection Act the deliberate venting of refrigerant is an offence.

Specific to the activities undertaken during the service and maintenance of refrigeration systems the following actions could be construed as deliberate venting.

- 1 The venting of “surplus” refrigerant from a system to atmosphere, if it is considered that the system may be overcharged.
- 2 The venting of the refrigerant charge to atmosphere instead of recovery when decommissioning a refrigeration system.
- 3 The use of refrigerant as a tracer for leak detection.
- 4 The process of “breaking a vacuum” with refrigerant during the process of multiple evacuation of a refrigeration system.
- 5 The use of a refrigeration system or refrigerant container as a source of pressurised gas for cleaning purposes.
- 6 The addition of refrigerant to a system thought or known to be leaking before locating and rectifying the leaks.

The following actions could be construed as inadvertent loss:

- 1 Loss of refrigerant from leaking joints, seals, gaskets and cracked pipes etc, before the leak has been detected and eliminated.
- 2 Loss of refrigerant from safety relief devices during operation to prevent danger.
- 3 Loss of residual refrigerant dissolved in oil etc, after normal processes of refrigerant recovery have been undertaken.
- 4 Loss of small quantities of refrigerant from “charging lines” such as occurs during the normal service process of connecting and disconnection to the system.
- 5 Loss of small quantities of refrigerant from sections of system pipework or components, after having taken all practicable steps to recover refrigerant.
- 6 Loss of small quantities of refrigerant along with non-condensable gas only when the system is purged through a properly refrigerated non-condensable gas purging device.

Under the duty of care refrigerant being recovered would be classified as “Controlled waste”. It would not be classified as “waste” if the recovered refrigerant is recycled and returned to the original owner.
Also refer to Hazardous Waste Regulation requirements for handling and movement of recovered refrigerant.

Section 33 of the Environmental Protection Act, states that it is illegal to “treat, keep or dispose of a controlled waste in a manner likely to cause pollution to the environment, or harm to human health”. Therefore care should be taken to avoid accidental discharge of such controlled wastes and ensure all who handle them are aware of Regulations.

Section 34 of the Act (Duty of Care) places a specific responsibility on personnel who have control over any refrigeration system to ensure that anyone undertaking tasks on their behalf does not allow these substances to escape. If all of the elements of “actual power over the technical functioning” as defined by the EU Commission, are devolved by the operator to a third party through contractual arrangements, the authority of operator and the responsibilities attached to it under the Regulation should be deemed transferred to that third party.

2.3 F-Gas Regulation (EC) 846/2006

The F-Gas Regulation places duties on operators and personnel involved in the manufacture, installation service and maintenance of applications containing fluorinated greenhouse gases covered by the Kyoto Protocol.

Article 3 – Containment

Operators of stationary refrigeration, air conditioning and heat pump equipment, shall:

- 1 prevent leakage of these gases, and
- 2 as soon as possible repair any detected leak.

Operators of these applications shall ensure they are checked for leakage by certified personnel according to the following schedule:

- 1 applications containing $\geq 3\text{kG}$ shall be checked at least once every 12 months. This would not apply to hermetically sealed systems containing $< 6\text{kG}$.
- 2 applications containing $\geq 30\text{kG}$ shall be checked at least once every 6 months.
- 3 applications containing $\geq 300\text{kG}$ shall be checked at least once every 3 months.

The applications shall be checked for leakage within one month after a leak has been repaired, to ensure the repair has been effective. The British Refrigeration Association recommendation is that this shall be carried out on a subsequent visit.

Operators of applications containing $\geq 300\text{kG}$ shall install leakage detection systems. These systems shall be checked at least once every 12 months to ensure proper functioning.

Where a proper functioning leakage detection system is in place, the frequency of the leakage inspections shall be halved.

Operators of applications $\geq 3\text{kG}$ shall maintain records on the quantity and type of gas installed, and any quantities added and the quantity recovered during servicing, maintenance and final disposal. They shall also maintain records identifying the company or technician who performed maintenance, as well as the dates and results of the leakage inspections. These records shall be made available on request to the competent authority and to the Commission.

Article 4 – Recovery

Operators of stationary refrigeration cooling circuits, air conditioning and heat pump equipment shall be responsible for ensuring proper recovery by certified personnel to ensure their recycling, reclamation or destruction.

Article 5 – Training and certification

At present, in the UK the minimum requirement for personnel handling F-Gas refrigerants is either:

- 1 City & Guilds 2078 certificate in handling refrigerants.
- 2 CITB Safe handling of refrigerant certificate.

Consultations are continuing across the EU Commission Member states and the above may be subject to change in 2008.

Ozone Depleting Substances Regulation (EC) 2037/2000

Under the Ozone Depleting Substances Regulation it is mandatory that Chlorofluorocarbon (CFC) and Hydrochlorofluorocarbon (HCFC) refrigerants are recovered, recycled or destroyed. The Regulation also states that it is the user's responsibility to ensure that applications containing $\geq 3\text{kG}$ are checked for leakage annually and that appropriate steps are taken to detect and remedy refrigerant leaks.

2.5 BS EN378/2000 and EN378/2007 (Final draft) Refrigeration systems and heat pumps – safety and environmental requirements.

This standard is intended to minimise possible hazards to persons, property and the environment from refrigeration systems and refrigerants.

In doing so, it identifies the required design pressures for the system based upon the type and design of the system, and the refrigerant utilised. It further identifies the relationship between the design pressure and the pressures for limiting devices, relief valve setting, rating for pressure relief discharge, leakage test pressure and strength test pressure.

The minimum value of allowable design pressure shall be determined by the minimum specified temperature given in the table below to determine the saturated refrigerant pressure.

Ambient condition	≤32°C	≤38°C	≤43°C	≤55°C
High pressure side with air-cooled condenser	55°C	59°C	63°C	67°C
High pressure side with water cooled condenser or water pump	Maximum leaving water temperature +8K			
High pressure side with evaporative condenser	43°C	43°C	43°C	55°C
Low pressure side with heat exchanger exposed to outdoor ambient temperature	32°C	38°C	43°C	55°C
Low pressure side with heat exchanger exposed to the indoor ambient temperature	27°C	33°C	38°C	38°C

When evaporators can be subject to high side pressure e.g. during gas defrosting or reverse cycle operation, the high pressure side specified temperature shall be used.

The pressure relationships to which the system and components shall be designed to meet relative to the maximum allowable pressure (p_s), are given in the below.

Design pressure	$\geq 1.0 \times p_s$
System strength test pressure	1.1 to 1.3 $\times p_s$
Tightness test pressure for assemblies	$\geq 1.0 \times p_s$
Safety switch device for limiting the pressure for systems with relief device, setting	$\geq 0.9 \times p_s$
Safety switch device for limiting the pressure for systems without relief device, setting	$\geq 1.0 \times p_s$
Pressure relief device, setting	$\geq 1.0 \times p_s$
Pressure relief valve achieves the required flow at 1.1 p_s	$\geq 1.1 \times p_s$

Section 3 Direct refrigerant detection methods

3.1 Introduction

Notwithstanding the legal requirements to identify and remedy refrigerant leaks, there are other good reasons for this to be carried out:

- 1 Environmental impact – many refrigerants damage the ozone layer and most also contribute to global warming.
- 2 Higher running costs – running costs will escalate as the leakage of refrigerant reduces efficiency. This has a double impact on the environment in that the lost refrigerant has an impact, but the additional energy consumption of the system leads to greater carbon dioxide emissions from power stations.
- 3 Increased servicing costs – these may include call out charges, finding and remedying the leak, replacement refrigerant, possibly even the replacement of a burnt-out compressor and consequent system cleaning.
- 4 Health and safety hazards – dependant upon the refrigerant and the location of the leakage, if it were into a confined space exposure levels could potentially be exceeded leading to suffocation if sufficient loss and displacement of air occurs.

3.2 Fixed refrigerant detection systems

There are a number of systems commercially available on the market. These fixed multi point type systems monitor refrigeration installations for refrigerant leakage continuously, recording the levels of refrigerant detected. These devices can be configured to activate different alarms dependant upon the level of refrigerant detected.

The F-Gas Regulation identifies a legislative requirement for a fixed leakage detection system to be installed on all refrigeration systems containing $\geq 300\text{kg}$ of fluorinated greenhouse gases.

As with portable refrigerant detectors, different refrigerant detection technologies exist, and suitability of the application and refrigerant should be verified with the system manufacturer.

System design:

The following points should be considered at the design stage:

- Areas to be covered for refrigerant detection – sample points should be in locations of historical leakage and susceptible areas e.g. compressor housings, plant rooms, packs/plant, condenser

headers, receiver assemblies, suction/liquid filter drier assemblies, valve stations, evaporator coils, bases of pipe work risers etc.

- Number of sample points allocated per detector channel – a system with a greater number of sampling points will generally provide greater coverage increasing potential to detect refrigerant.
- If there is more than one refrigerant utilised in the installation.
- If confined spaces exist that require monitoring for safety reasons, covering these areas ensures compliance with BS EN378:2000 (BS EN378:2007).
- How alarms are to be enunciated – consider alerting employees at risk from asphyxiation from localised leakage in confined areas. This can be by a warning beacon/sounder or a relay connection to a building management system (BMS).
- What should be done with the data generated by the system – an IP addressable system enables remote monitoring to continually retrieve alarms events and fault data and automatically initiate an alarm via e-mail, SMS or fax. Response times and reports can be generated to provide an overview of performance.

System installation:

The monitor should be located to be easily accessible for manual interrogation and maintenance.

Systems that utilise sample tubing should ensure that the pipework is not:

- Installed such that kinking or flattening can occur
- Run from a very warm to very cold space
- Installed with a corner radius less than 150mm
- Sample points should be installed facing down
- “split” sample pipes should be of equal length from the junction to sample point
- All pipework to be securely clipped to cable tray and not restrict access to other equipment

Commissioning:

Commissioning should be carried out by the manufacturer/supplier of the system to ensure:

- The system is set up and configured to factory specification and tolerances
- Each channel is configured to correct requirements for the area under cover i.e. refrigerant, concentration level for alarm
- All connections to remote alarms and/or BMS system are tested
- IP address for the unit if connected to Local or Wide Area Network is configured
- Appropriate training and instruction is provided to appropriate personnel, both maintainers and operators of the system.

3.3 Portable electronic refrigerant detectors

There are ranges of portable electronic refrigerant detectors that are sensitive to leakage rates as small as 3 g/yr. The selection of these devices must be made to ensure that their suitability for the refrigerant within the system.

Caution should be taken to use suitable electronic refrigerant detection devices with Hydrocarbon (HC) refrigerants due to their flammability.

For the most part, there are four types of electronic refrigerant detection devices:

- Corona discharge
- Heated diode
- Infrared
- Ultrasonic

In all cases individual manufacturer's data should be consulted to verify suitability.

Whilst carrying out refrigerant detection inspections in plant areas it may be necessary to temporarily isolate ventilation systems and compressor cooling fans.

3.4 Ultraviolet (UV) indication fluids

Refrigerant detection systems have been developed using a fluorescent or coloured dye which is added into the system and is distributed throughout the system with the lubricant, it indicates leaks by its emission with the leaking refrigerant. The refrigerant evaporates and the additive remains at the site of the leak. This becomes visible under an ultraviolet lamp. Care must be taken with this method to ensure compatibility with system components, and the compressor manufacture should be consulted to authorise its' use. The client or operator of the system should also be consulted for consent to the fluid being utilised. There is no reaction with the refrigerant therefore the use of this method is not limited to fluorocarbon refrigerants.

It should be noted that the effectiveness of this method of leakage detection will be significantly reduced in systems with efficient oil separation devices.

In order for this method to be most effective it is important that any emitted fluid is thoroughly cleaned from the components once the area of leakage has been identified and the leak remedied.

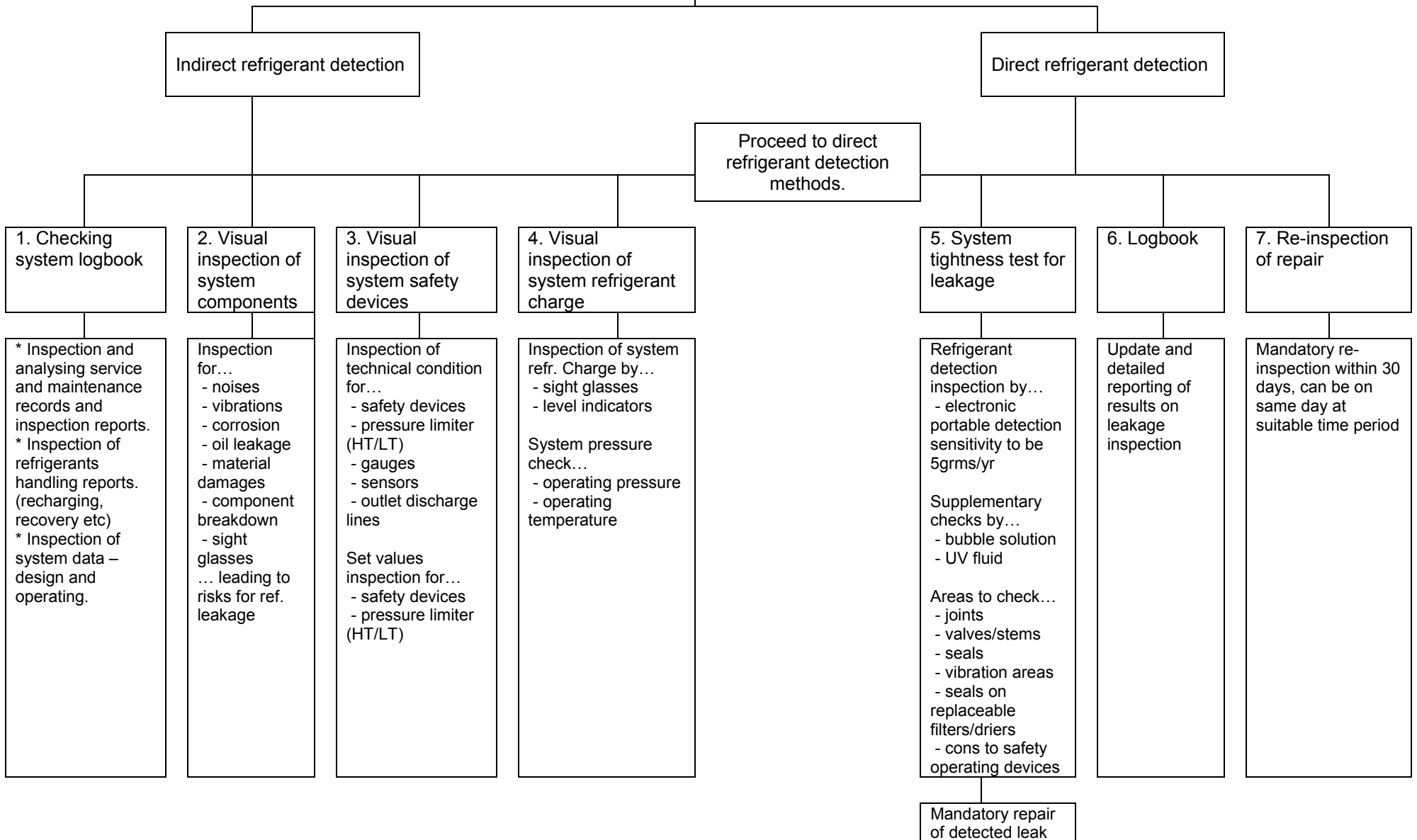
3.5 Proprietary bubble solutions

Possibly the simplest and the most sensitive of methods of tightness testing for leakage is a “weak soap” solution applied to the area being tested. Commercially available purpose made liquids are recommended for this procedure, as these make this task easier and cleaner.

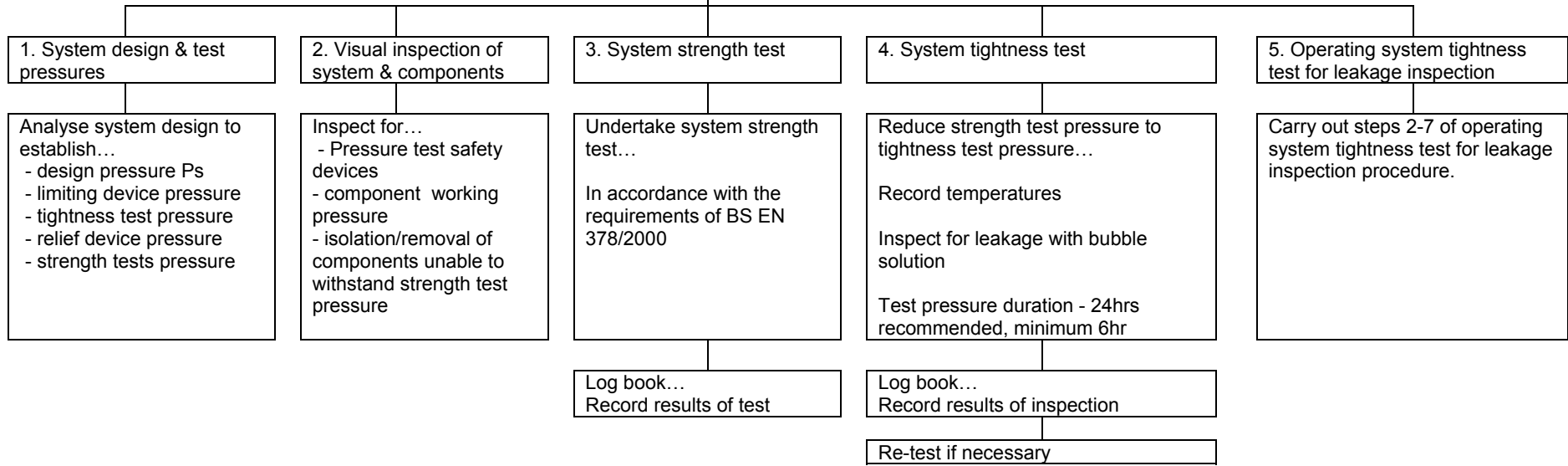
This method would be unsuitable if the system or section being tested is operating in a vacuum.

The use of this method should be considered in conjunction with the use of portable electronic refrigerant detection devices.

REFRIGERANT TIGHTNESS TESTING FOR LEAKAGE INSPECTION PROCEDURES - OPERATIONAL SYSTEM -



**REFRIGERANT TIGHTNESS TEST FOR LEAKAGE INSPECTION PROCEDURE
- NEW SYSTEM PRESSURE TEST -**



Section 4 Indirect refrigerant detection methods

4.1 Introduction

In addition to direct refrigerant detection methods, good practice during the service and maintenance procedures by employing indirect refrigerant detection techniques may identify a requirement for further direct refrigerant detection procedures to be implemented.

Manual checks – Refrigerant loss may be identified by carrying out manual checks of the system and its operating conditions against the design operating conditions, by analysis of one or more of the following parameters;

- Pressure
- Temperature
- Compressor current
- Liquid level
- Recharge volume

Refrigerant loss indication – Any presumption of refrigerant loss shall be followed up by an examination of tightness testing for leakage using a direct method as described for an operational system.

Refrigerant loss presumption – One or more of the following conditions being experience would constitute the presumption of refrigerant loss;

- A fixed refrigerant detection system indicates refrigerant detection
- The system produces abnormal noises, vibrations, ice formation or insufficient cooling capacity
- Indications of corrosion, oil leaks, component or material damage at possible leakage points
- Indication of refrigerant loss from sight glasses or level indicators or other visual aids
- Indications of damage in safety switches, pressure switches, gauges and sensor connections
- Deviations from normal operation conditions indicated by the parameters analysed, including readings from real time electronic systems
- Other signs indicating refrigerant charge loss.

Section 5 Refrigerant detection system certification

5.1 Introduction

There are no Regulations, Standards or Directives at the time of publication that stipulate the minimum requirement for the level of sensitivity for static or portable electronic refrigerant detection devices, or the requirement and frequency for calibration of these devices. In the absence of this detail and to ensure sufficient provision exists to achieve adequate levels of refrigerant detection, the following levels of sensitivity and frequency of calibration are recommended.

5.2 Sensitivity – the recommended sensitivity level in the absence of legislative requirement for fixed and portable electronic leakage detection devices is 5 g/yr.

5.3 Calibration – to ensure reliable operation of fixed refrigerant detection devices is maintained, and in the absence of a legislative requirement, it is recommended for these devices to be calibrated every 12 months.

Fixed refrigerant detection devices should be serviced and calibrated by the manufacturer or an approved agent. A certificate of service and calibration should be issued to the operator of the fixed refrigerant detection system.

For portable electronic refrigerant detection devices the recommended frequency for calibration by the British Refrigeration Association is every 3 months. Calibration can be self-certified by the user employing a measured calibration leakage device available from the manufacturer of the refrigerant detection device. A record of the calibration must be maintained by the operator of these devices and be made available for inspection upon request by the operator of the refrigeration system, with whom the responsibility for maintaining records for F-Gas Regulation compliance lies.

Section 6 Individual competence and training

6.1 Introduction

In order that the task of refrigerant loss detection and system pressure testing is carried out safely and effectively, it is necessary that minimum levels of individual competence and training is identified and accreditation acquired by the individual or company.

6.2 Refrigerant handling

The F-Gas Regulation at the time of publication has identified the minimum level of training requirement for personnel handling F-Gas refrigerants to be either:

- City & Guilds 2078 certificates in Handling Refrigerants
- CITB Safe Handling of Refrigerants certificate

Consultations are continuing across the EU Commission Member states and the above may be subject to change in 2008.

6.3 Brazing

Installers of new and those altering existing systems under the Pressure Equipment Directive are required to be certified to the appropriate level dependant upon the level or category of joint being made under the Directive.

For most commercial applications an “industry recognised” qualification level suitable for Sound Engineering Practice (SEP) and category 1 as defined by the Pressure Equipment Directive can be brazed by personnel qualified as a minimum to:

- The British Refrigeration Association’s Specification for Brazing and Brazer Assessment.

Category 2, 3 and 4 joints can only be made by personnel certified by a third party assessor, this invariably being a Pressure Equipment Directive Notified Body.

6.4 Leakage detection inspection

Personnel undertaking refrigerant loss detection and inspection activities shall;

- Be qualified for refrigerant handling as 6.2.
- Have awareness and understanding of the system design, operation and performance criteria.
- Understand the operating pressures within the system and have the ability to interpret against system design.
- Have sufficient knowledge of areas of the system susceptible to refrigerant loss.
- Inspect the log book to identify areas having had refrigerant loss and carry out close examination.
- Thoroughly and systematically inspect all parts of the system that are regularly accessed and maintained.
- Have available calibrated equipment designed for the task in hand.
- Be approved by their employer to competence levels commensurate with the specific task being undertaken.
- Have the brazing competence levels needed to satisfy the requirements of the Pressure Equipment Directive when carrying out remedial works.
- Inspect and identify any potential areas where future refrigerant loss may occur.

Section 7 Removing refrigerant from the system

7.1 Introduction

Once a system has been identified as having a leak, in order to effect a repair it is necessary to remove refrigerant from the section concerned, and it will be necessary to isolate the leaking component or section of the system. Pumping the system down in order to achieve this is unlikely to be sufficient, recovery of the refrigerant will be necessary.

Removal of refrigerant is also necessary when the system is decommissioned at the end of its useful life.

7.2 Refrigerant recovery

Removal of refrigerant from a system can be achieved in numerous ways of varying degrees. For example, liquid refrigerant can sometimes be transferred into recovery cylinders by using the system's own pressure, but this will not remove all the system charge, and it will be necessary to utilise a recovery machine to recover the vapour left in the system. Alternatively recovery machines are available that can recover liquid refrigerant and the residual vapour.

Recovered refrigerant must only be stored in special purpose recovery cylinders – cylinders for new refrigerants must not be used.

Whilst recovering refrigerants it is essential that the cylinder is not overfilled. Whenever refrigerant is being transferred into a cylinder it must be continuously and accurately weighed. The maximum permissible contents of a cylinder are printed on its data plate. The figure is a variable depending on the density of the refrigerant. A general guide of 80% of the cylinder volume is usually used.

Some "high" pressure refrigerants e.g. R410A may require specific recovery cylinders.

There is no practical way of separating and reprocessing refrigerant mixtures, therefore, care is required to avoid mixing of refrigerants. Mixed refrigerants have to be destroyed – a process which should be avoided as it is costly in financial and energy terms and the refrigerant is lost for future use.

There are three categories that are used when defining the recovery and reuse of refrigerants:

Recovery – To remove refrigerant from a system and transfer it to an external cylinder. Depending upon the equipment used, the refrigerant may or may not be treated in some way or have its condition tested.

Recycling – To treat used refrigerant to remove contaminants such as oil, moisture, acid and particulate matter. This is typically achieved by passing the refrigerant one or more times through an oil separator and filter drier cores.

Reclamation – To reprocess the recovered refrigerant to virgin standard quality and specification.

7.3 Options for the reuse of refrigerants

When repairing, maintaining or decommissioning a system, there are various options that can be employed:

- Recover and reuse refrigerant in the original system
- Recover, recycle and reuse by original owner
- Recover, reclaim and reuse by original owner
- Recover, reclaim and make available for reuse by others
- Recover and destroy

Refrigerant that has been simply recovered should only be used in the system from which it was taken.

Recycled refrigerant should only be reused in systems belonging to the same owner.

Only refrigerant reclaimed to virgin quality and original specification should be sold or used in equipment of different ownership.

Grossly contaminated and mixed refrigerants have to be destroyed as they are unsuitable and cannot be reclaimed.

7.4 Recovery for reclamation or destruction

When refrigerant is transferred from a system as a liquid, the cylinder shall display a warning that the refrigerant may contain contaminants. Having recovered the refrigerant the system will retain any contaminants (oil, water, acids and particulate matter) Disposal of this oil must be in accordance with the requirements of the Hazardous Waste Regulation.

Recovered refrigerants should be returned to the original supplier or to a similar organisation for reprocessing or destruction. Transport and movement of the refrigerant must also be in accordance with the requirements of the Hazardous Waste Regulation.

Section 8 System charging

8.1 Introduction

In order for the refrigeration system to operate efficiently it must contain the correct quantity of refrigerant. On a new system this will have been calculated and form part of the commissioning documentation.

There are two methods of adding refrigerant into the refrigeration system by gas or liquid. When the refrigerant is a Zeotropic blend it must be removed from the cylinder as a liquid, as if it is not, the composition will change and the system performance may be affected. Charging points should be incorporated into both high and low pressure sides of the system to allow refrigerant to be charged in the appropriate form. The hoses and manifold used to charge refrigerant must not contain air or another refrigerant, to remove this either evacuate them or purge. When purging use refrigerant in vapour form and at the lowest possible pressure.

Refrigerant can be added to a system in two possible ways:

- As liquid into the receiver or liquid line. This is usually done after the system has been evacuated prior to initial start up.
- As a gas into the suction line, this is usually done when the system is running and is being topped up. Never add liquid into the suction line.

NOTE

If charging a Zeotropic blend into the suction line, it is necessary to evaporate (flash off) the liquid by throttling the low side valve of the charging manifold, proprietary devices for use in conjunction with a charging manifold are available for this purpose.

New refrigerants should not contain any contamination, but, to be safe it is recommended to incorporate a filter drier in the charging line.

Reclaimed refrigerants should only be used from a recognised source to ensure it is of a proven purity of acceptable standard.

Recovered refrigerant should only be reused in the system from which it was recovered from, to avoid any potential for cross contamination.

The weight of refrigerant must be recorded and entered onto the record log as required under the F-Gas Regulation.

8.2 Adding refrigerant to a system that has lost a small but unknown quantity of refrigerant.

On small or critically charged systems, the residual charge should be recovered and re-charged weighing in refrigerant to the same weight as originally charged into the system at commissioning.

On larger commercial type systems, where the remaining quantity of refrigerant cannot be identified, the addition of refrigerant can be in two possible ways:

- As liquid into the receiver or liquid line. This is usually done after the system has been evacuated prior to initial start up.
- As a gas into the suction line, this is usually done when the system is running and is being topped up. Never add liquid into the suction line.

For Zeotropic refrigerant additions refer to the charging procedure previously described.

Refrigerant should be charged into the system until there are no bubbles observed in the sight glass when the system is operating at design conditions. The sight glass should not be solely relied upon, system operating pressures and temperatures, compressor current and temperatures should be as recorded in the commissioning log. Recorded operating levels should also be considered.

The weight of refrigerant must be recorded and entered onto the record log as required under the F-Gas Regulation.

8.3 Adding refrigerant to a system that has lost a large proportion of the refrigerant charge.

In the event of a large refrigerant loss from a system containing a Zeotropic refrigerant, and where the loss has occurred from the vapour side of the system where the potential for fractionation exists, the remaining refrigerant should be recovered from the system and the system recharged with new refrigerant.

Section 9 Record Logs

9.1 Introduction.

In order that a detailed history of the work undertaken on the refrigeration system is available to service personnel and the operator a suitable record of such should be maintained and be available at site level to operative undertaking any works on the system.

9.2 Refrigerant usage.

The F-Gas Regulation states that operators of stationary refrigeration, air conditioning and heat pump applications containing 3kg or more of fluorinated greenhouse gases, shall maintain records of the quantity and type of refrigerant installed, any quantities added and the quantity recovered during servicing maintenance and final disposal. They shall also maintain records of other relevant information including the identification of the company or technician who performed the servicing or maintenance as well as the dates and results of leakage checks carried out. These records shall be made available upon request to the competent authority and to the Commission.

An example record log is provided on the DEFRA web site, see Appendix I.

9.2.1 BS EN378:2000 (BS EN378:2007 Final draft) identifies a requirement for an updated log-book to be maintained for refrigeration systems.

The following information shall be recorded in the log-book:

- Details of all maintenance work and repairs
- Quantities, kind of (new, re-used or recycled) refrigerant charged on each occasion, and quantities transferred from the system on each occasion
- If there is an analysis of re-used refrigerant, the results shall be kept in the log-book
- Source of re-used refrigerant
- Changes and replacements of components of the system
- Results of periodic routine tests
- Significant periods of non-use.

Section 10 Appendices

10.1 Appendices

Appendix I DEFRA Record log sample

10.2 Reference

Regulation (EC) No 842/2006 - F-Gas Regulation.

Regulation (EC) 2037/2000 - Ozone Depleting Substances

Environmental Protection Act 1990

Pressure Equipment Directive 1999

Hazardous Waste Regulations 2005

10.3 Bibliography

DETR Good Practice Guide 178

CITB Safe Handling of Refrigerants

BS EN 378:2000 Refrigeration systems and heat pumps – safety and environmental requirements.

(BS EN 378:2007 Final draft) Refrigeration systems and heat pumps – safety and environmental requirements.

10.4 Other guidance

British Refrigeration Association Guide to Good Commercial Refrigeration Practice

Institute of Refrigeration Code of practice for the minimisation of refrigerant emissions from refrigeration systems

Institute of Refrigeration safety code for refrigerating systems utilising group A1 and A2 refrigerants

Annex 1

Sample Log Sheet for Record Keeping Obligation

The table below shows an example record sheet for compliance with the F gas Regulation. Records of this type must be kept for **each** refrigerant plant that contains more than 3 kg of HFC refrigerant.

General Information			
Plant Name		Reference No.	
Location of plant			
Plant Operator ⁷			
Operator Contact ⁸			
Cooling loads served			
Refrigerant Type		Refrigerant Quantity installed (kg)	
Plant manufacturer		Year of installation	
Refrigerant Additions			
Date	Engineer ⁹	Amount Added, kg	Reason for addition
Refrigerant Removals			
Date	Engineer	Amount Removed, kg	Reason for removal. What was done with recovered refrigerant
Leak Tests			
Date	Engineer	Test Result	Follow up actions required
Follow-up Actions			
Date	Engineer	Related to test on	Actions Taken
Testing of Automatic Leak Detection System (if fitted)			
Date	Engineer	Test Result	Comments

⁷ Name and address of company operating the plant

⁸ Contact details for Operator's nominated person responsible for F-Gas compliance

⁹ Identify both the Company and the actual Technician carrying out the work, with contact details – to provide evidence of competence.

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