EIGA Environmental Newsletter

Prepared by WG Environment ENL N° 18/08

Fluorinated-GAS MONITORING AND LEAKAGE DETECTION

1- Summary

EIGA Working Group 5 – Environment has compiled this environmental newsletter to give information to EIGA members, specifically to directors, technical managers, company environmental specialists and National trade associations on meeting the monitoring and leak detection requirements of Regulation (EC) No 842/2006 on certain fluorinated greehouse gases (17 May 2006). This is a Regulation not a Directive so the requirements are directly applicable to Member States. The aim of the regualtion is to contain, prevent and thereby reduce emissions of fluorinated greenhouse gases covered by the Kyoto protocol

With regard to the monitoring and leak detection system requirements of the regulations, EIGA members are users of these gases in equipment and so must be aware of the
need for monitoring of refrigeration units containing F-gases
reporting of information on F-gases to regulators
need to prevent leakage of these gases and repair any leakage from equipment as soon as possible, using all measures that are technically feasible that do not entail disproportionate cost

2- Introduction

The Regulation on F-gases applies to fluorinated green house gases such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6) as listed in Annex I of the Regualtion (Appendix 1) of the regulations and preparations containing these substances. The scope of the Regualtion covers F-gas in stationary applications such as refrigeration equipment, air conditioning and heat pump equipment, including their circuits, as well as fire protection equipment.

Operators of equipment containing F-gas are required to check equipment for leakage of gas according to a a set schedule using certified personnel. Within the context of the Regulation “checked for leakage” means that equipment or systems are examined for leakage using direct or indirect measuring methods, focusing on those parts of the equipment or system most likely to leak. The requirement for checking for leakage by indirect and direct measuring methods was proposed to be established by the commission by the 4th July 2007 for each category of equipment application. As this advice has not yet been published by the Commission this newsletter has been written to provide some advice on the available methods for direct and indirect measurement of F-gas from equipment. The Regulation also requires that applications containing more than 300 kg of F-gas also require a leakage detection system. Within the context of the Regulation a “leakage detection system” means a calibrated mechanical, electrical or electronic device for detecting leakage of fluorinated greenhouse gases which, on detection alerts the operators.

Appendix 2 includes some information on leak detection systems. It should be noted that some regulatory authorities across Europe have published further guidance on “leakage detection sytems” that proposes that the definition could include systems designed to detect refrigerant (e.g. sniffer device) and also devices such as those which detect a drop in pressure from the system. These systems are also covered in this newsletter.

EUROPEAN INDUSTRIAL GASES ASSOCIATION AISBL
AVENUE DES ARTS 3 – 5 ♦ B-1210 BRUSSELS
PHONE +32 2 217 70 98 - FAX + 32 2 219 85 14 - E-mail : info@eiga.eu - www.eiga.eu

The table below summaries the leak checking requirements of the regulation for different sizes of F-gas charge in applications and the method of leak checking.

F-gas charge in application/equipment	Schedule for checks of leakage by certified personnel	Method for leak checking
< 3 kg *	12 months	Direct/Indirect
< 30 Kg	6 months	Direct/Indirect
< 300 Kg	3 months	Direct/Indirect + leak detection system

* Equipment that is hermetically sealed and labelled as such and contains less than 6 Kg of F-gas does not require leakage checks.

Where a properly functioning appropriate leakage detection system is in place for equipment containing an F-gas charge of < 30 Kg and <300 Kg, the frequency of checks can be halved. Where any equipment has been repaired as a result of a leak it must be checked for leakage within one month of the leak.

In addition to the above requirements, operators of equipment containing 3 kg or more of F-gas are required to:

- maintain records on the quantity and type of fluorinated greenhouse gases instaled, any quantities added and the quantity recovered during servicing, maitenance and fianl disposal
- maintain records of other relevant information such as the name of the company or technician who performaed the servicing or maintenance job as well as the dates when the equipment was checked and repaired
- make records available to the regulatory authority

3-IMPACT ON EIGA MEMBERS

EIGA members are users of these gases so must be aware in particular of the need for Monitoring and keeping good and accurate records that can be made available for authorities.

4-REFERENCES

EN. 2005. “EN 378-4 Refrigerating Systems and head pumps – Safety and environmental requirements – Part 4: Operation, maintenance, repair and recovery.” European Committee for standardisation, Brussels, Belgium.

ICF International. May 2006. The establishment of technical leak checking requirements for refrigeration, air conditioning, heat pump equipment and fire protection systems which contain fluorinated greenhouse gases controlled by the Kyoto Protocol.

Feedback

EIGA WG5 members welcome feedback on this and other publications.
If you need any more information or would like to make any comments please contact your WG5 representative, the WG5 Chairman or the EIGA office Stephen Bradley, Air Products PLC Chairman WG5; Telephone +44 1932 24 9992; Fax+ 44 1932 24 9271; e-mail: bradlesc@airproducts.com

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Appendix 1

Fluorinated Greenhouse Gases referred to Annex 1 of the Regulation (EC) No 842/2006

Fluorinated Greenhouse Gas	**Chemical Formula**	**Global Warming Potential (GWP)**
Sulphur hexafluoride	SF_6	22 200
Hydrofluorocarbons (HFCs):		
HFC-23	CHF_3	12 000
HFC-32	CH_2F_2	550
HFC-41	CH_3F	97
HFC-043-10mee	$C_5H_2F_{10}$	1 500
HFC-125	C_2HF_5	3 400
HFC-134	$C_2H_2F_4$	1 100
HFC-134a	CH_2FCF_3	1 300
HFC-152a	$C_2H_4F_2$	120
HFC-143	$C_2H_3F_3$	330
HFC-143a	C_3HF_7	4 300
HFC-227ea	$CH_2FCF_2CF_3$	3 500
HFC-236cb	$CH_2FCF_2CF_3$	1 300
HFC-236ea	CHF_2CHFCF_3	1 200
HFC-236fa	$C_3H_2F_6$	9 400
HFC-245ca	$C_3H_3F_6$	640
HFC-245fa	$CHF_2CH_2CF_3$	950
HFC-365mfc	$CF_3CH_2CF_2CH_3$	890
Perfluorocarbons (PFCs):		
Perfluoromethane	CF_4	5 700
Perfluoroethane	C_2F_6	11 900
Perfluoropropane	C_3F_8	8 600
Perfluorobutane	C_4F_{10}	8 600
Perfluoropentane	C_5F_{12}	8 900
Perfluorohexane	C_6F_{14}	9 000
Perfluorocyclobutane	$c\text{-}C_4F_8$	10 000

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Appendix 2 Leak detection methods

For large systems, fixed detection systems are considered best practice and should be in place to continuously monitor the presence of leaks. Indeed, Standard EN 378-4 and Swedish Association of Refrigeration Contractors (KYL 2005) require that systems containing over 300kg of refrigerant charge have fixed detection systems. Fixed detection systems operate using one of the following sensors:
Infrared
Electrochemical, or
Ceramic metal oxide/solid state

There are a number of suppliers on the market that provide fixed detection systems that can provide an alarm alert to an operator and have the ability to detect the most common refrigerants at multiple points on a system.

In cases where leaks are found, further checking using a manual detector will be needed to pinpoint the location of the leak, so that remedial action can be taken There are a number of well known methods for detecting leaks used. These are described below.

***Soapsuds**:* The system is pressurised with nitrogen and soapsuds are spread onto the system to determine if there are leaks. This method can be as accurate as 10 to 30 g/year, and is particularly useful for the verification of braking leak tightness before refrigerant charge.

***Electronic and ultrasonic testers**:* Effective for locating the general area of small leaks. Many electronic leak detectors sniff or take small air samples around equipment to detect leaks. Ultrasonic leak detectors listen for leaking gas. This method requires some advance knowledge of the location of the leak and a fairly low background noise level. It is used with a nitrogen test gas and may also be used with a noise source of a specific frequency placed inside the equipment and the detector tuned to the frequency.

***Bright (red or blue) oil*-soluble dyes**: Bright red or blue dyes are added to the system to mix with the oil residue. The dye will then appear on the external surface of the system at the source of small leaks.

***Fluorescent leak detection**:* A small quantity of a fluorescent dye is added into the oil/refrigerant charge of an operating system. The additive will show as bright yellow-green or blue glow under an ultraviolet (UV) lamp at the source of the leak. This method can detect leaks as low as 7 g/year.

Areas associated with leaks which should be checked as part of sytematic checks would include: joints, valves, seals, parts of the system subject to vibration, replacement driers and filters, connections to pressure switches and pressure gauges, areas around oil leaks and accessible pipe work and condenser/evaporator coils.

In addition to the use of fixed detection systems, several steps should be followed to establish whether a system is experiencing significant leakage over a period of time:
Logbook check
Visual check
Manual check
Pressure check.

Records and Log Books

For each refrigeration, air conditioning or heat pump unit, a logbook should be kept tracking refrigerant handling (refrigerant filling and recovery and losses), types of pre-maintenance checks, and service/repair history with respect to refrigerant safety. System refrigerant levels should also be recorded in the log book. Such records can help operators gather information over a period of time to spot the most leak-prone components which will allow them to improve the system. After completing leak checks (and any repair, if needed), all activities should be recorded in the logbook.

Visual Checks
Visual checks aim to locate signs of leakage. Initially, the refrigerant system may be checked visually using various types of equipment, including sight glasses, which give an indication for losses of the refrigerant charge of the system.

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In addition, visual checks should aim to locate:
The presence of corrosion on equipment where corrosion damage may result in refrigeration leakages
The presence of oil traces that may indicate the leakage of refrigerant

Manual Checks
In addition to visual checks, other signs of leakage may be identified by listening for abnormal noises and/or checking certain equipment components as follows:
Starting at the compressor head, following system through to return to the compression suction. Checking and making note of any possible leakage, small pipes “singing” and potential metal fatigue points. Manually checking the existing pressure safety devices and ensuring that the set points of equipment are appropriate for the operating pressure of the system
Checking for abnormal vibrations by touch and feel

Pressure Checks
There are three types of pressure tests that can be used to determine if a leak is present:

High Pressure Side – this type of pressure check is performed as an intial check, while the compressor is running (preferably at full load) and the head pressure is at normal maximum. Following system from the compressor head along to the thermal expansion valves (TEV). Note the runing discharge pressure. If a problem is apparent, additional leak testing should be conducted to locate (and repair) the leak.
Standing Pressure Testing – using this test, technicians test system pressure while the compressor is stopped; any chilled water or condensed pumps must also be stopped, to leave standing pressure as high as feasible. Pressurised nitrogen is added as a test gas via service connections from the low and high pressure sides. Technicians must ensure that all of the shut-off valves and solenoid valves are open. After pressurising the system, technicians must note the pressure at the head gauge and the suction gauge. If the pressure falls over a 24-hour period while the ambient temperature remains constant, this indicates that there is a leak, and additional leak testing should be conducted.
Vent Time – This check can be performed is a system has components that operate at pressures below atmospheric pressure. Using this test, technicians check and record the vent time of the system; if the vent time is increased relative to the normal vent time, one or more leaks are present

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