



**Institute of Refrigeration**

Kelvin House, 76 Mill Lane Carshalton, Surrey SM5 2JR United Kingdom

Tel: +44 (0)20 8647 7033 Fax: +44 (0)20 8773 0165

Email: [ior@ior.org.uk](mailto:ior@ior.org.uk) Website: [www.ior.org.uk](http://www.ior.org.uk)

## **EN-378:2008 Review of Key Revisions**

The European Standard for the design and construction of refrigeration systems EN378 has been republished following a comprehensive review period. The previous version of the standard, EN378:2000 has been withdrawn and is replaced by EN378:2008. The title of the standard is unchanged:

“Refrigerating systems and heat pumps — Safety and environmental requirements”

It is published in four parts:

Part 1: Basic requirements, definitions, classification and selection criteria

Part 2: Design, construction, testing, marking and documentation

Part 3: Installation site and personal protection

Part 4: Operation, maintenance, repair and recovery

These are generally the same as in the previous version but some content has been moved from one part to another where it is more appropriate.

### **Harmonisation with EC Directives**

The main reason for the update was to harmonise the standard with the European Commission’s Pressure Equipment Directive 97/23/EC, and it was also assessed for conformity with the Machinery Directives 98/37/EC and 2006/42/EC. The conclusion of this exercise was that Part 2, which deals with design, needed to be in conformity with the directives, but the other parts were beyond the directives’ scope, so did not need to be assessed. Details of the correlation between EN378 and the directives are given in Annexes ZA and ZB of part 2. As part 2 has been accepted as a “new approach” standard by the European Commission, compliance with the standard provides a “presumption of conformity” with the associated directives.

As with all standards the text is either “normative” or “informative”. In general normative sections use the word “shall” and informative sections use less definitive terms such as “should” or “may”. By convention any text given in a note to the text is treated as informative, not normative. Annexes to the text may be normative or informative – generally this is stated in the title of the annex. Normative text is mandatory, but informative is only advisory, so that it is possible to be in conformity with the standard even if the text of an informative section has not been implemented.

### **Changes to Part 1: Basic requirements, definitions, classification and selection criteria**

In part 1 a number of new definitions were added, particularly reflecting the introduction of cascade and transcritical carbon dioxide systems. A few definitions were also removed where the text is no longer used in the standard. The classes L1, L2 and L3 adopted in EN378:2000 have been dropped and the safety classes for toxicity, A and B, and the safety classes for flammability, 1, 2 and 3 have been reintroduced. This gives the more familiar designation of refrigerants as A1 (eg R-134a), B2

(eg R-717) and A3 (eg R-290). This is in line with the Institute's safety codes on refrigerants, which are being revised to coincide with the publication of EN378:2007. The table in Annex C (table C1) has been simplified to make it easier to follow, but in general the requirements for system location dependent on occupancy have not changed, however the permitted charge sizes for flammable refrigerants have changed to give a more rational basis for the maximum charge sizes (which can be less than those defined by the Practical Limit and room volume). Annex C (Refrigerant Charge Limitations) is now Normative.

It should be emphasised that each refrigerant listed in Annex E, tables E.1, E.2 and E.3 has a "practical limit", calculated by the method described in Annex F. The practical limit has units of  $\text{kg/m}^3$  and is the maximum charge of a system that can be installed in a certain room volume without additional safety precautions. So for example if the practical limit is  $0.25 \text{ kg/m}^3$  (R-134a) and the room volume is  $24 \text{ m}^3$  then the maximum refrigerant charge allowed without additional safety measures is 6kg. If the system charge exceeds this amount then suitable additional safety measures are required. These might include automatic gas detection in the occupied space linked to evacuation alarms or automatic isolation valves. The type of detection and alarm is specified in part 3.

### **Changes to Part 2: Design, construction, testing, marking and documentation**

Part 2 is the most widely updated section of the standard, and it is now the only one harmonized with the European Directives. A comprehensive table of cross-references has been introduced and the table of specified design temperatures has been extended to cover a wider range of operating conditions (table 2).

New terms have been introduced for pressure testing. These seem strange at first but they highlight an important difference between testing for leaks during installation or after repair and testing for leaks during operation. Two types of pressure test are required by part 2. A "strength test" is required for each component, and for the final assembly of the system. Typically component tests use water as the test medium, but the assembly strength test may use an appropriate gas if water would cause contamination of the assembly. The pressure requirement for strength testing of components has been set at 1.43 Ps, however there are circumstances defined where this extreme pressure may not be required.

A "tightness" test is then required to ensure that the component or assembly is not leaking. It is explicitly stated in part 2 that a tightness test must not be conducted until the system integrity has been proved by a successful strength test, or has been verified by a type test. Where the manufacturer consents, the component tightness tests may be conducted on the assembly. Various types of tightness test are permitted, but they should be equivalent to the sensitivity of applying soapy water to joints while the test piece is pressurised to the allowable pressure of the system. The term "leak test" is no longer used for this type of test – leak testing is a different activity described in part 4.

The requirements for protection against excess pressure have been codified in the form of a 4-part flow diagram. This may look daunting at first, but it has been carefully prepared to make the selection of safety equipment easier to follow, and the intention was that the requirements of the previous standard should not be altered, but should be explained more clearly.

Several paragraphs have been added to address the mechanical hazards of vibration, protection against hot surfaces and protection against moving parts, in order to ensure conformity with the Machinery Directive. Several useful annexes have been added to part 2 providing additional guidance for ammonia systems (Annex A) describing how PED categories can be determined (Annex B), and giving details of acceptable safety device arrangements (Annex G).

### **Changes to Part 3: Installation site and personal protection**

In part 3 the distinction between "machinery rooms" and "special machinery rooms" has been reduced – all rooms containing refrigerating equipment (except rooms containing only evaporators) are classed as machinery rooms, and where a room is designated a "special machinery room" the

difference is that installation of other equipment is not permitted in the room. For ammonia systems the requirement for emergency showers has been specified more precisely, including the specification of flow rate and water temperature. The requirements for gas detection and breathing apparatus have been clarified in Annex A, and it is made clear that this refers to all refrigerants, not just ammonia. Annex A indicates that the level of personal protective equipment provided for emergency use on site should be discussed and agreed with the local emergency responders – in practice this means the local Fire Brigade. Annex A also indicates that canister respirators should be used whenever applying heat (welding or brazing) to fluorocarbon systems to protect against the products of decomposition, but points out that such respirators offer no protection against the effects of large releases of A1 refrigerants (including carbon dioxide as well as fluorocarbons), where the main danger is oxygen deprivation. However, Annex A is informative and therefore does not form part of the mandatory requirements of the standard.

#### **Changes to Part 4: Operation, maintenance, repair and recovery**

Part 4 has not been significantly altered from the previous version. A few additional explanations and interpretations have been provided, including some flow diagrams to explain the relationship between refrigerant recovery, reclaim and recycling. Part 4 also describes the testing of systems in operation for refrigerant, now known as “leak testing”. Leak testing uses a refrigerant detector to sense refrigerant in the atmosphere – this is not an acceptable form of tightness testing, as it would require refrigerant to be charged into the system before the equipment had been proved to be free of leaks. Part 4 of EN378 does not recognise some of the methods suggested by the EU Regulation on Fluorinated Gases proposals as leak test methods – it requires leaks to be “identified”. As this requires pinpointing the source of a leak it is clear that a gas detection unit in the machinery room is not suitable, nor is an indirect method such as software monitoring of receiver levels. In practice the wording of part 4 suggests that inspection after repair work should include strength and tightness testing before refrigerant is charged into the system and leak testing once the system has been charged. This is described in Annex D of part 4, where the term “pressure test for system” is used to describe the strength and tightness tests and “refrigerant leakage detection” is used to describe the leak test.

#### **Input to the revision from the UK**

The United Kingdom’s input to the development of this revised standard was co-ordinated through the British Standards Institute Technical Committee for Refrigeration Safety, RHE/18. The Institute of Refrigeration’s Technical Committee provided some experts to RHE/18, and to the associated CEN committee TC/182. The Institute’s Technical Committee also acted as a peer reviewer for the standard at various stages during its development.

#### **Sources of Further Information**

Copies of EN standards can be purchased from the [BSI Bookshop](http://www.bsi-bookshop.com) on +44 (0)20 8996 7858, or on line at [www.bsi-global.com](http://www.bsi-global.com)

IOR provides Safety Codes which are guides to interpretation of the Standard written for the various groups of refrigerants in use (Group A1 - halocarbon; Group A2 and A3 – flammable; Ammonia; and Carbon Dioxide). These can be purchased at [www.ior.org.uk](http://www.ior.org.uk)