

# BRA Fact finders

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## Pressure Relief Devices: Guidance on selection for the low pressure side of systems

### Review Commentary

The revised BS4434:1995, (in due course to be replaced by European Standard currently prEN378) applies to new designs and existing systems. In the context of this guide, conversion to new refrigerants in existing systems may be particularly relevant.

The 'allowable pressure' for a system relates to the strength to which it must be designed and the safety factors incorporated therein. The above standards state that 'the systems must be protected against excess pressure from, foreseeable causes, including fire'.

It follows therefore that the low and high-pressure sides of a system should be designed accordingly. In many instances, it will be necessary to protect the low-pressure side of the system with a relief device.

The application of safety relief devices to protect pressure vessels fitted to either the high-pressure side or the low-pressure side of a refrigeration system is standard practice. However, protection of the low-pressure side of systems, without a pressure vessel is less obvious.

The selection of pressure relief devices for this purpose is important, and this guide identifies a procedure supported by an example.

### Basic Data

Identify the refrigerant to be used, or in use, in either a new or an existing system.

**For a new system**, determine the minimum pressure at which the high-pressure relief valve, (if fitted) is to operate, using the guidance provided in BS4434:1995.

**For existing systems** subject to an increase in minimum allowable pressure, check the validity of the high-pressure relief valve selection. Also establish that the high-pressure receiver safe operating limits are compliant with any increase in minimum allowable pressure. Similarly ensure that system components and pipework are safe to operate at any revised minimum allowable pressure to which it may be subjected. (See BS4434: 1995 for further guidance)

Based on the high pressure receiver dimensions of length and diameter, and using relief valve selection data as identified in BS4434:1995, (or manufacturers data as typically supplied in Europe) calculate the relief valve capacity in kg air/sec.

Using this value of kg air/sec, select a low-pressure relief device set for, but not above, the allowable pressure for the low-pressure side of the system.

Recommended location for the low-pressure relief valve assembly is adjacent to the compressor(s).

Design Conditions used in the following examples

Refrigerant: - R400A

System: - Designed for use with an air-cooled condenser, against a minimum ambient temperature of 32°C, as specified in table 6 of BS4434:1995.

|   |          |
|---|----------|
| Minimum high-pressure side design temperature | 55°C     |
| Minimum high-pressure side design pressure    | 24.8 bar |
| Minimum low-pressure side design temperature  | 32°C     |
| Minimum low-pressure side design pressure     | 14.0 bar |

### Selection or checking of High Pressure Relief Valve

Based on the high-pressure liquid receiver size

Calculate Capacity C, for high-pressure relief valve from

$$C = f \times D \times L \text{ kg air/ sec}$$

Where:- f = factor for R404A (Table 8 of BS4434:1995)

L = length of vessel in metres;

D = outside diameter of vessel in metres;

Using: f = 0.180; D= 0.5 m; L =3.0 m.

Therefore: C = 0.270 kg air/sec (or 16.20 kg air/min)

A proprietary valve selected from published literature, typically Manufacturer A's valve type xyz (¾"mpt inlet) set at 24.8 bar with a capacity of 19.50 kg/air minute, is an acceptable match

### Selection of Low Pressure Relief Valve

Using the above capacity of C =16.20 kg air/min, select the nearest standard valve to operate at the low-pressure side minimum allowable pressure of 14.0bar. Should a practical selection not be available, use a valve specially adjusted by the manufacturer to meet the required set pressure.

Example: Select Manufacturer A's valve type uvw (1" mpt inlet) set at 14.0bar. This has a capacity of 20.0 kg air/min and, although of larger capacity, it is the nearest standard match. (As an alternative, request from the manufacturer a valve adjusted to match 16.20 kg air/min)

If a bursting disk is not incorporated in the dual relief valve assembly, it may be thought appropriate to install one upstream of this point, if only for environmental protection purposes.

Bursting disks as complementary devices, or as an alternative to relief valves, may also be selected as identified in para 2.7.4.3 of BS4434:1995

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