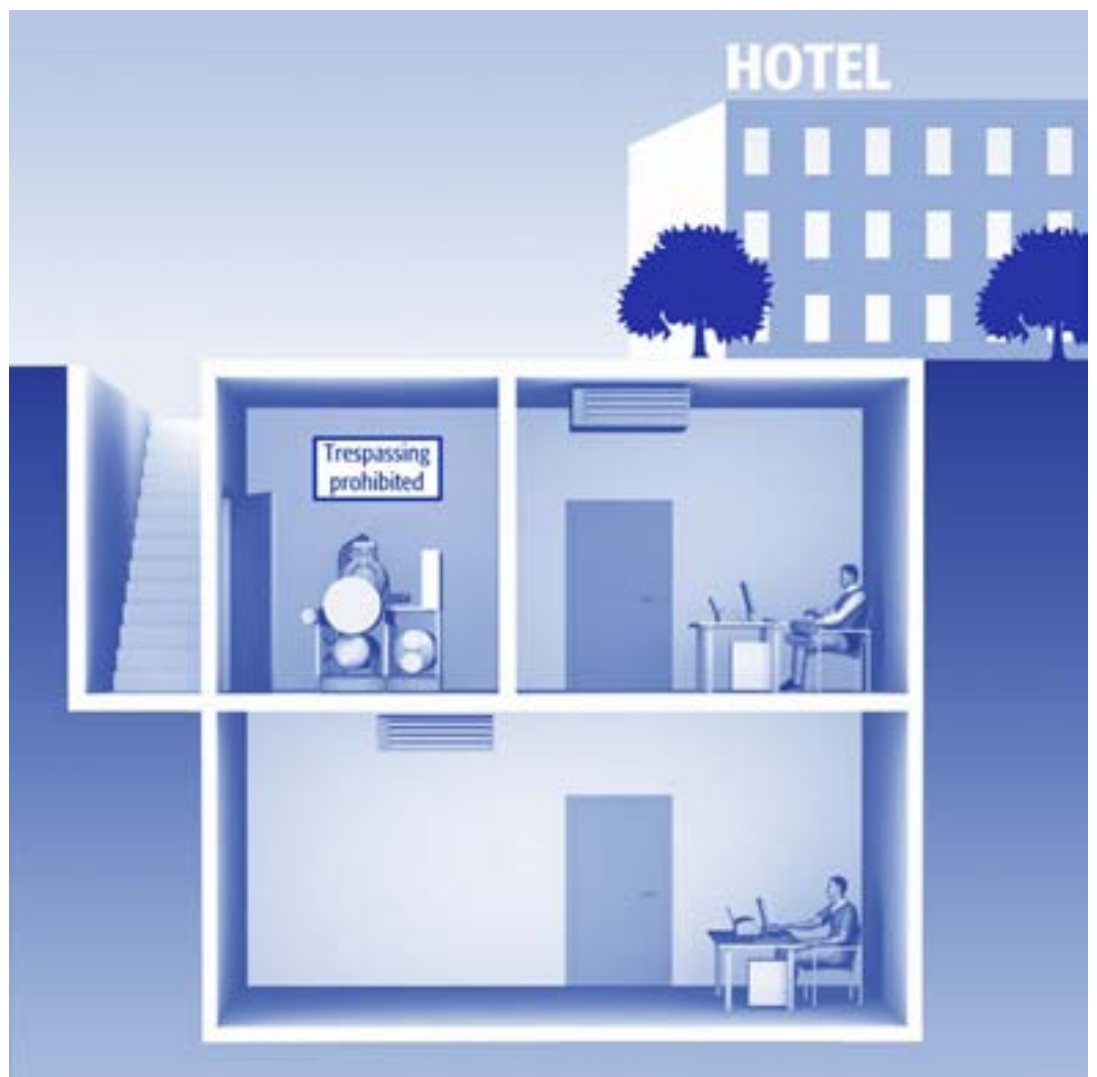


Installation of Liquid Chillers in Member States of the European Union Requirements of EN 378

Application Hints for Planners,
Architects, Plant Manufacturers and Installers



FOREWORD

European directives serve the requirements of machines, systems and services and favour a free turnover of goods and services within the European Union. The Member States of the European Union are obliged to transfer the contents of the directives into national law. So-called Harmonized Norms (EN) are published explaining the requirements of the directives for the purpose of supporting and instigating the directives.

In the field of refrigeration technology, the Norm EN 378 is of special relevance. In four parts, the requirements for the safety of persons and property, as well as for local and global environment, are determined relating to stationary and mobile refrigerating systems and heat pumps of any size. [EN 378-1: 1.1]. This leaflet acquaints the reader with the requirements of EN 378 relating to liquid chillers and gives him a general overview of the requirements placed upon both the system installation and refrigerant selection.

In the Member States of the European Union, additional regulations may prevail.

MACHINERY ROOM (ACC. TO EN 378: SPECIAL MACHINERY ROOM)

Room or enclosure specially intended to contain, for reasons connected with safety and environmental protection, components of the refrigerating system not accessible to the public [EN 378-1: 3.2.1].

REFRIGERANT CLASSES

Refrigerants are divided into three classes. The following table lists the classes of refrigerants applied in the field of liquid chillers.

Refrigerant class	Refrigerant
L1	R134a, R404A, R407C, R410A, R507
L2	R717

INSTALLATION AREAS

The installation areas of refrigerating systems are divided into three classes. Corresponding safety requirements are placed upon these installation classes.

Class A

Presence of persons of uncontrolled number (e.g. public buildings, hospitals, dwelling houses, theatres, supermarkets, schools, hotels, etc.)

Class B

Presence of persons of limited number some of them are acquainted with the special conditions (e.g. office- and business buildings, laboratories, rooms for general manufacture and work)

Class C

Rooms and buildings to which only authorized persons are granted access (e.g. production buildings, cold stores, dairies, slaughterhouses, non-public areas of supermarkets) [EN 378-1: 5.3.1]

REFRIGERANT CHARGE DEPENDING ON SYSTEM INSTALLATION SITE

Refrigerant class	Installation area	Installation site	Charge	Source in EN 378-1
L1	Class A	no machinery room	$< PGW \times V$ ¹⁾	C2.1.2.1
		HP side in machinery room or in the open	no restriction	C2.1.2.2b
		all refrigerant-containing parts in machinery room or in the open	no restriction	C2.1.2.3
	Class B	no machinery room	no restriction, provide sufficient number of emergency exits	C2.1.3.1
		HP side in machinery room or in the open	no restriction	C2.1.3.2
		all refrigerant-containing parts in machinery room or in the open	no restriction	C2.1.3.2
	Class C	independent of installation site	no restriction	C2.1.4
L2	Class A	no machinery room	$< PGW \times V$	C2.2.2.1
		HP side in machinery room or in the open	$< PGW \times V$	C2.2.2.1
		all refrigerant-containing parts in machinery room or in the open	no restriction, if no direct connection to class A areas and exit to the open exists	C2.2.2.2
	Class B	no machinery room	$< 10\text{kg}$	C2.2.3.1
		HP side in machinery room or in the open	no restriction	C2.2.3.2
		all refrigerant-containing parts in machinery room or in the open	no restriction, no direct connection to occupied areas	C2.2.3.3
	Class C	no machinery room	$\leq 50\text{ kg}$ with max. 1 person/10 m ² surface, otherwise $\leq 10\text{ kg}$	C2.2.4.1
		HP side in machinery room or in the open	no restriction	C2.2.4.2
		all refrigerant-containing parts in machinery room or in the open	no restriction	C2.2.4.3

¹⁾ PGW: Practical limit (see page 6)

V: Room volume

Note: see Annex C in EN 378-1 for more information, the Annex C in Draft prEN 378-1:2003-11, however, is the norm

EXAMPLES OF MACHINERY ROOM ARRANGEMENTS

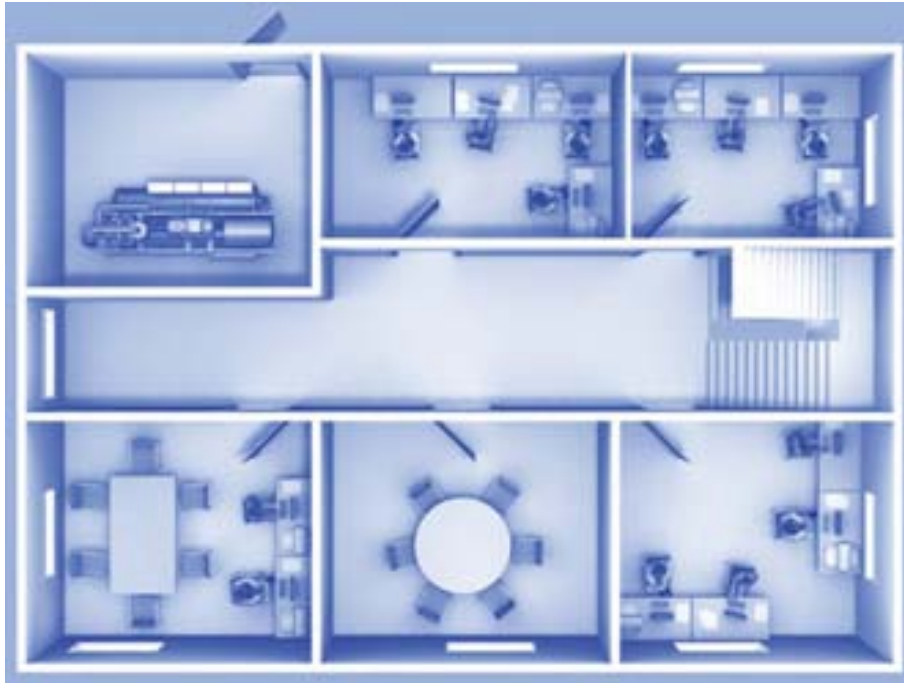


Figure 1

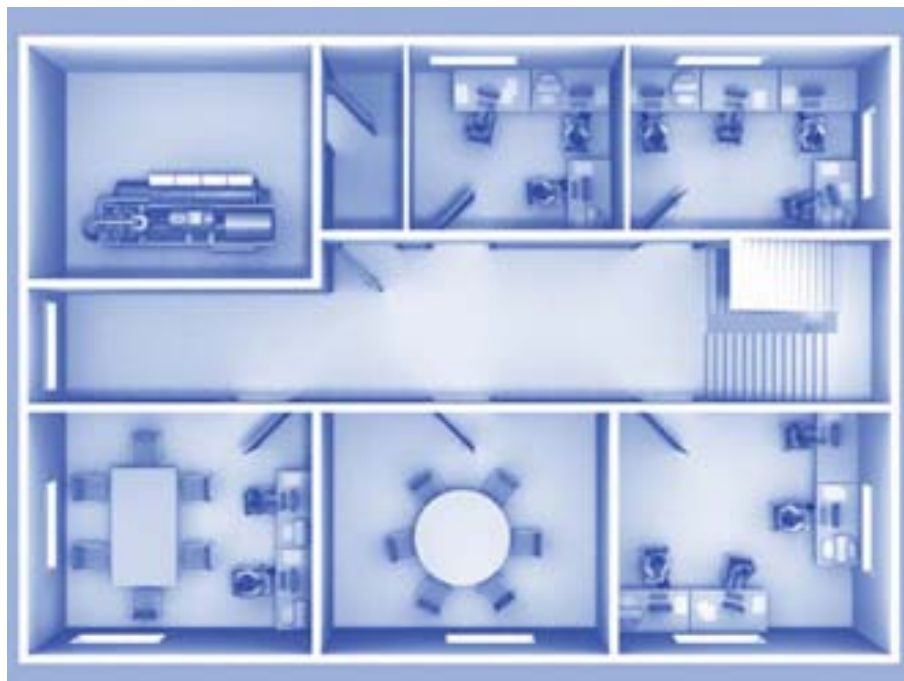


Figure 2

By providing an access to the machinery room exclusively from the outside (figure 1) or a corridor (figure 2), a direct public access to the machinery room is prevented. When selecting one of these arrangements, all remaining sections of the building can be transformed into class C installation areas.

LOCATION ON 1ST BASEMENT FLOOR

By providing a separate access to the machinery room in this hotel, figure 3, an arrangement in a class C area with unrestricted charge is rendered possible. There are also no restrictions for basement floors, if all remaining requirements on machinery rooms are observed.

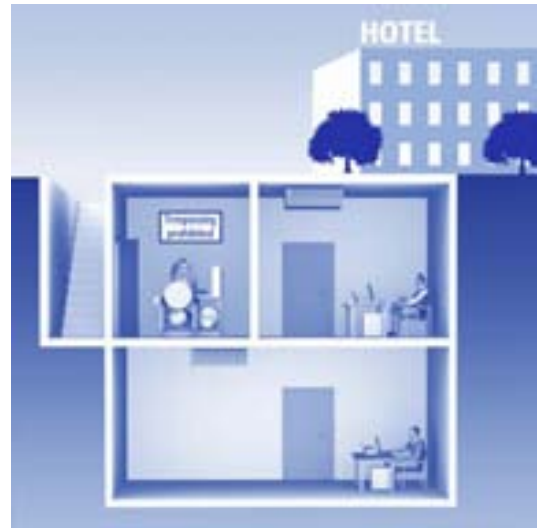


Figure 3

LOCATION ON 2ND BASEMENT FLOOR

The machinery room in figure 4 has no separate access. Hence, the room with access to the machinery room may be occupied solely by authorized instructed personnel in accordance with installation area class C EN 378.

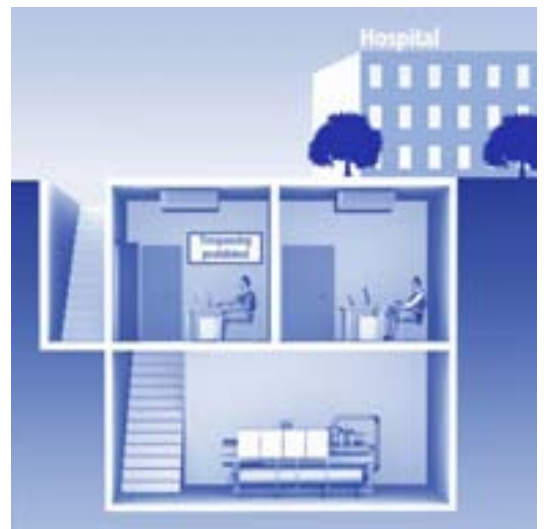


Figure 4

LOCATION ON UPPER FLOOR

The machinery room has a separate access via the staircase and solely authorized personnel are granted access. Hence, the location in figure 5 again complies with class C EN 378 without restrictions concerning the charge.



Figure 5

PRACTICAL LIMITS FOR DIFFERENT REFRIGERANTS

	Refrigerant class	Practical limit according to EN 378-1; table E.1
R134a	L1	0,25 kg/m ³
R404A	L1	0,48 kg/m ³
R407C	L1	0,31 kg/m ³
R410A	L1	0,44 kg/m ³
R507	L1	0,49 kg/m ³
R717	L2	0,00035 kg/m ³

COMPARISON BETWEEN AMMONIA SYSTEMS AND REFRIGERATING SYSTEMS WITH L1-REFRIGERANT CHARGES

	L1	NH ₃
General requirements		
Indicating apparatus when using blow-off devices [EN 378-2: 7.3.2.1.2]	o	o
Pressure relief device on each pressure vessel [EN 378-2: 7.4.3.4]	o	o
Pressure relief device in refrigerating system [EN 378 2: 7.4.2.1]	o	o
Use of a type approved pressure cut-out and a second parallel electrically series-connected type approved safety pressure cut-out with pressure relief device for the compressor starting from 100 kg refrigerant [EN 378-2: 7.4.2.2 b)]	o	o
Requirements when locating the refrigerating system in a machinery room		
Ventilation of machinery room [EN 378-3: 5.5.1]	o	o ¹⁾
Monitoring the refrigerant concentration by detectors [EN 378-3: 7.1, 7.4.1] and actuating an alarm when the practical limit is exceeded (see table above) [EN 378-3: 7.7]	o	o ²⁾
Device for remote shutdown of system outside the machinery room (emergency shutdown), in case the practical limit is exceeded [EN 378-3: 5.1f)]	o	o ³⁾
Provision of personal protective equipment [EN 378-3: 9.1]	o	o
Provision of respiratory protective devices with filter (full face mask) or self-contained breathing apparatus [EN 378-3: 9.2 & 9.3.2]	x	o
Installation of an emergency body shower and an eye shower [EN 378-3: 9.3.1]	o ⁴⁾	o ⁵⁾

- o required
x not required

- 1) The machinery room shall be fitted with a mechanical ventilation system which can be started and stopped from outside the machinery room [EN 378-3: 5.1g)]
- 2) The mechanical ventilation system shall be actuated by refrigerant detectors. Should the ventilation system fail, an alarm must be actuated. [EN 378-3: 6.2.5.3]
- 3) Remote shutdown shall be actuated by refrigerant detectors. All electric circuits leading into the machinery room shall be interrupted except the low-voltage alarm circuits. [EN 378-3: 6.2.5.2]
- 4) required for refrigerant charges greater than 200 kg refrigerant
- 5) acc. to EN 378-3: 9.3.4. for charges greater than 50 kg ammonia

REQUIREMENTS ON LOCATION OF LIQUID CHILLERS IN MACHINERY ROOMS

Example

For a 200 kW-chiller (L x W x H: approx. 3m x 1m x 2m) a charge of 15 kg NH₃ or approx. 60 kg R134a is required.

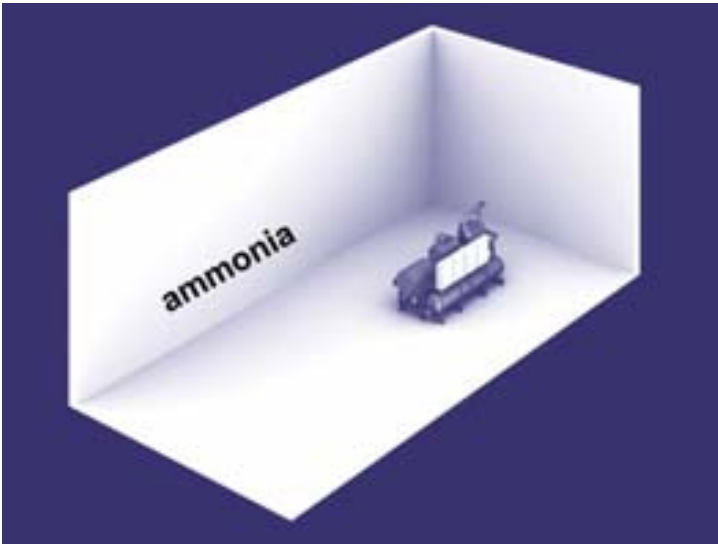


Figure 6

Machinery room with:

- ventilation
- refrigerant detectors
- emergency shutdown (remote shutdown)
- personal protective equipment
- respiratory protective device

5m x 10m x 3,50 m
floor space **50m²**

Q_o = 200 kW, 15 kg NH₃

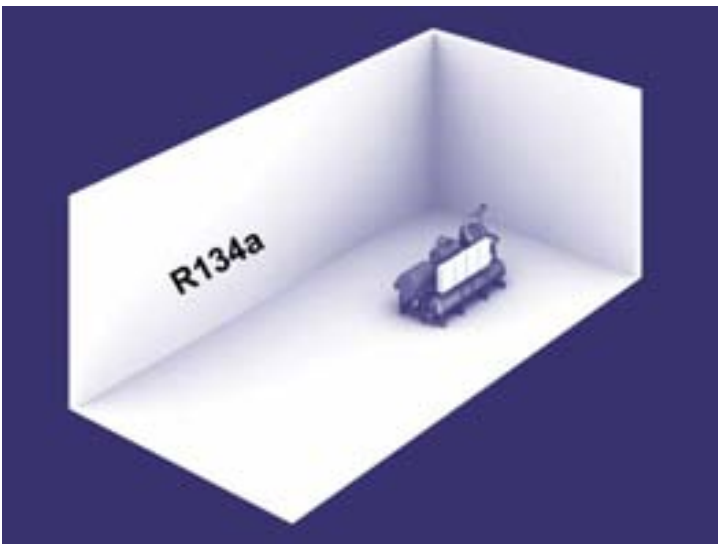


Figure 7

Machinery room with:

- ventilation
- refrigerant detectors
- emergency shutdown (remote shutdown)
- personal protective device

5m x 10m x 3,50 m
floor space **50m²**

Q_o = 200 kW, 60 kg R134a

For refrigerant detectors not to be required for the R134a-chiller, the installation room should have a volume of not less than 240 m³ (thus, the practical limit will not be reached). At a room height of 3,50 m, this would mean a floor space of not less than **70 m²**!

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