Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

ISBN 978-0-626-29419-9

SANS 10147:2014

Edition 5

SOUTH AFRICAN NATIONAL STANDARD

Refrigerating systems, including plants associated with air-conditioning systems

WARNING
This document references other documents normatively.

Published by SABS Standards Division
1 Dr Lategan Road Groenkloof ✉ Private Bag X191 Pretoria 0001
Tel: +27 12 428 7911 Fax: +27 12 344 1568
www.sabs.co.za
© SABS

SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Table of changes

Change No.	Date	Scope

Acknowledgement

The SABS Standards Division wishes to acknowledge the valuable technical input of the Southern African Refrigerated Distribution Association (SARDA), GEA Refrigeration Africa, Anglo American, WSP Industrial, Hatch, Johnson Controls, Ammonia Training Solutions, the South African Refrigeration and Air Conditioning Contractors' Association (SARACCA), MetraClark, Palfridge, and HC Heat-Exchangers in the development of this document.

Foreword

This South African standard was approved by National Committee SABS/TC 086, *Refrigeration and air-conditioning*, in accordance with procedures of the SABS Standards Division, in compliance with annex 3 of the WTO/TBT agreement.

This document was published in October 2014.

This document supersedes SANS 10147:2009 (edition 4.1).

This document is referenced in the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), the South African Qualifications Authority Act, 1995 (Act No. 58 of 1995), the Mine Health and Safety Act, 1996 (Act No. 29 of 1996), and the Skills Development Act, 1998 (Act No. 97 of 1998).

Reference is made in 3.4 to the "relevant national authority". In South Africa, this means the South African National Accreditation System (SANAS).

Reference is made in 3.5 to a "government-endorsed body". In South Africa, this means the South African National Accreditation System (SANAS).

Reference is made in 3.14, 6.1.3, 6.1.4, 6.9.1, 6.11.2.2(c), 7.6, 7.7(c) to the "relevant national legislation". In South Africa, this means the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

Reference is made in 3.57, 5.3.1, 6.12.1.5, 6.13.1, 7.3(b), 8.2.3, 8.2.4, 8.2.5, D.4.3.2(b), D.4.4.2(b), D.4.5.2(b), E.4.4, and table H.1 to the "relevant national legislation". In South Africa, this means the Pressure Equipment Regulations of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

Reference is made in 5.6.1(c) and 5.6.2(c) to the "relevant national legislation". In South Africa, this means the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) and the Mine Health and Safety Act, 1996 (Act No. 29 of 1996).

Reference is made in 6.9.3.2 to the "relevant national legislation". In South Africa, this means the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), the South African Qualifications Authority Act, 1995 (Act No. 58 of 1995), and the Mine Health and Safety Act, 1996 (Act No. 29 of 1996).

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Foreword *(concluded)*

Reference is made in B.5(g) to the "relevant national legislation". In South Africa, this means the Mine Health and Safety Act, 1996 (Act No. 29 of 1996).

Reference is made in D.2 to the "relevant national legislation". In South Africa, this means the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), and in particular, the Driven Machinery Regulations and Pressure Equipment Regulations of said Act.

Reference is made in D.4.3.1 to the "minimum relevant national requirement". In South Africa, this means the South African Qualification and Certification Committee (SAQCC) Gas Refrigeration Category A (operator) or Category A (trainee).

Reference is made in D.4.4.1 to the "minimum relevant national requirement". In South Africa, this means SAQCC Gas Refrigeration Category B subdivided into commercial refrigeration, ammonia refrigeration, automotive air conditioning, transport refrigeration or marine refrigeration.

Reference is made in D.4.5.1 to the "minimum relevant national requirement". In South Africa, this means SAQCC Gas Refrigeration Category C (inspector).

Reference is made in D.5.1 to the "relevant national body". In South Africa, this means SAQCC Gas.

Reference is made in D.5.2 to the "relevant national body". In South Africa, this means SAQCC Gas or SANAS.

Reference is made in E.2 to the "relevant national regulating body". In South Africa, this means the Department of Trade and Industry.

Reference is made in E.2 to the "relevant national approval authority". In South Africa, this means the Department of Environmental Affairs and Tourism.

Reference is made in H.1 to the “requirements specified in the relevant national legislation”. In South Africa, this means the risk-based inspection requirement of the Pressure Equipment Regulations of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

Annexes A, B, D, E, H and I form an integral part of this document. Annexes C, F and G are for information only.

Introduction

This document was revised in order to align it with current practices and to comply with the requirements of the *Montreal Protocol on substances that deplete the ozone layer*.

It is intended to provide an authoritative source of basic safety principles for use by responsible and competent persons or organizations. It is not intended to be regarded as either an instruction manual for untrained persons or a specification for detailed refrigeration plant design. The requirements and the recommendations given in this document are intended to minimize the possible hazards in refrigeration plants and air-conditioning plants.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

This page is intentionally left blank

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Contents

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Contents *(concluded)*

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Refrigerating systems, including plants associated with air-conditioning systems

1 Scope

1.1 This standard describes the general aspects of safety, construction, erection, installation, operation, inspection and testing of refrigeration plants. It covers the measures necessary for the protection of individuals and the prevention of damage to property.

It also includes recovery and refrigerant conversions, as well as modifications and replacement of parts or components if they are not identical in function and capacity.

1.2 This standard specifies fundamental requirements for the general design, construction, installation and operation of most types of refrigeration equipment.

1.3 This standard covers all refrigeration systems with a refrigerant charge that exceeds 150 g.

NOTE Refrigeration systems that use lower refrigerant charges are covered by SANS 60335-2-89 and SANS 60335-2-40. Only those refrigerants in common use are dealt with in this standard. If information about any other type of refrigerant is required, reference should be made to other sources, for example ASHRAE 34.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from the SABS Standards Division.

2.1 Standards

AHRI 700, *Specifications for fluorocarbon refrigerants*.

AS 4041, *Pressure piping*.

ASHRAE 34, *Designation and safety classification of refrigerants*.

ASHRAE 147, *Reducing the release of halogenated refrigerants from refrigerating and air-conditioning equipment and systems.*

ASME B16.5, *Pipe flanges and flanged fittings: NPS ½ through NPS 24 metric/inch standard.*

ASME B16.11, *Forged fittings, socket-welding and threaded.*

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

ASME B31.3, *Process piping*.

ASME B31.5, *Refrigeration piping and heat transfer components.*

ASME B36.10M, *Welded and seamless wrought steel pipe.*

ASTM A105, *Standard specification for carbon steel forgings for piping applications*.

ASTM D93, *Standard test methods for flash point by Pensky-Martens closed cup tester.*

EN 137, *Respiratory protective devices – Self-contained open-circuit compressed air breathing apparatus with full face mask – Requirements, testing, marking.*

EN 378-4:2012, *Refrigerating systems and heat pumps – Safety and environmental requirements – Part 4: Operation, maintenance, repair and recovery.*

EN 1759-1, *Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, class designated – Part 1: Steel flanges, NPS ½ to 24*.

ISO 6708*, Pipework components – Definition and selection of DN (nominal size).*

ISO 11650, *Performance of refrigerant recovery and/or recycling equipment.*

SANS 347:2012, *Categorization and conformity assessment criteria for all pressure equipment*.

SANS 1123, *Pipe flanges*.

SANS 10012, *The use of light metals in hazardous locations at mines.*

SANS 10108, *The classification of hazardous locations and the selection of apparatus for use in such locations.*

SANS 10227, *Criteria for the operation of inspection authorities performing inspection in terms of the Pressure Equipment Regulations.*

SANS 10250, *Fitment and repair centres for automotive air-conditioning systems*.

SANS 10142-1, *The wiring of premises – Part 1: Low-voltage installations.*

SANS 10400-P, *The application of the National Building Regulations – Part P: Drainage.*

2.2 Other publications

The Montreal Protocol on substances that deplete the ozone layer, Department of Environmental Affairs and Tourism. 1999.

3 Definitions

For the purposes of this document, the following definitions apply.

3.1
absorption system
absorption refrigerating system
system in which refrigeration is effected by evaporation of a refrigerant, the vapour is then absorbed (adsorbed) by an absorbent (adsorbent) medium, from which it is subsequently expelled at a higher partial pressure by heating, and liquefied by cooling

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

3.2
acceptable
acceptable to the authority administering this standard, or to the parties concluding the purchase contract, as relevant

3.3
airlock
chamber that is provided with separate entrance and exit doors and that allows passage between two spaces but isolates the spaces from each other

3.4
approved organization
awarding body
organization that is recognized by the relevant national authority (see foreword) to assess competence, to award certificates (a proof of competence), and to register persons that are authorized to work on refrigeration systems and heat pumps

NOTE The said relevant national authority sets the standards for assessment. Examining bodies are qualified by this authority.

3.5
approved testing laboratory
laboratory that is accredited by a government-endorsed body (see foreword) and that

a) is acceptable to the authorities that have jurisdiction,

b) provides uniform testing and examination standards for compliance with the design, manufacturing and factory test requirements of this standard,

c) is properly organized, equipped and qualified for testing, and

d) has a follow-up inspection service of the current production of the listed products

3.6
assessment
<of a person> process by which the evidence of qualifications is judged to determine competence

3.7
brazed joint
gas-tight joint that is formed by joining metal parts by means of non-ferrous filler metal alloys that melt at temperatures lower than the melting point of the joined parts

NOTE 1 Non-ferrous filler metal alloys that are used for brazed joints generally have a melting point higher than 450 °C but lower than the melting point of the joined parts. The parent metal, therefore, does not make the joint by fusion.

NOTE 2 The term “brazing” includes the process otherwise known as "silver soldering".

3.8
brine
solution of a salt in water that is used as a secondary coolant

3.9
bursting disc
rupture member
pressure-relief device that ruptures at a predetermined pressure

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

3.10
certificate
document that is issued under the rules of the assessment system specified in this standard, and that indicates that the named person is competent to deal with the applicable health, safety, environmental protection and energy conservation requirements for refrigerating systems and heat pumps

3.11
certification
procedure that is used to demonstrate the qualifications of personnel at a specified level, and that leads to the issue of a certificate and registration

3.12
change-over device
valve that controls two protection devices in such a manner as to render one of the devices inoperative at any given moment

3.13
competence
ability to perform safely and satisfactorily the activities within an occupation, and to have the knowledge or skill (or both) to perform the task(s) under consideration, so that a level in accordance with this standard is achieved

3.14
competent person
person as defined in the relevant national legislation (see foreword)

3.15
compressor
device that compresses a refrigerant vapour

3.16
compressor unit
compressor with its prime mover and accessories

3.17
condenser
part of a refrigerating system where refrigerant is liquefied by the removal of heat

3.18
condensing unit
combination of one or more power-driven compressors, condensers and liquid receivers (when required)

3.19
container
cylinder that is used for the transportation of refrigerant

NOTE See SANS 10019.

3.20
critical pressure
minimum pressure that is needed to liquefy a gas at its critical temperature

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

3.21
critical temperature
point on the saturation curve where the refrigerant liquid and vapour have identical volume, density and enthalpy, and where there is no latent heat

NOTE The critical pressure and the critical temperature both occur at the same point on the saturation curve.

3.22
department store
supermarket
hypermarket
place where more than 100 persons congregate, other than on a street, to purchase personal merchandise

3.23
design pressure
maximum pressure
pressure that is not exceeded in any part of a refrigeration plant, whether or not the plant is operating

3.24
entrance
opening in the outer wall of the building or machinery space, with or without a door or gate, used to gain access to the building or machinery space

3.25
evaporator
heat exchanger in which liquid refrigerant is vaporized by absorbing heat from the substance to be cooled

3.26
evaporator coil
evaporator of coil form that is constructed from piping or tubing

NOTE The evaporator coil is not enclosed in a pressure vessel.

3.27
exit
opening in the outer wall of the building or machinery space, with or without a door or gate, used to vacate the building or machinery space

3.28
field test
test that is performed in the field (installation site) to check system tightness

3.29
fusible plug
fusible component
safety device that melts at a specified temperature and that allows the relief of pressure

3.30
gauge pressure
difference between the absolute pressure in the system and the atmospheric pressure at the site

3.31
gross internal volume
volume that is calculated from the internal dimensions of a pressure vessel

NOTE No account is taken of the volume of any internal parts.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

3.32
hallway
corridor that is intended for the passage of persons

3.33
header
pipe or tube component of a refrigerating system to which a number of other pipes or tubes are connected

3.34
heat pump
device that transfers heat from a cooler reservoir to a hotter reservoir, expending mechanical energy in the process, especially when the main purpose is to heat the hotter reservoir rather than to refrigerate the cooler one

3.35
high-pressure side
part of a refrigerating system that is subjected to the pressure of condensation

3.36
isolating valve
stop valve
valve that is used to shut off flow completely

NOTE Valves can be arranged to isolate sections for the purpose of assembly or maintenance while other sections remain charged with refrigerant.

3.37
limited-charge system
refrigerating system in which the internal volume and total refrigerant charge are such that with the system idle, the design pressure will not be exceeded if complete evaporation of the refrigerant occurs

3.38
liquid receiver
vessel that is permanently installed in the high-pressure side of a refrigerating system to provide a reserve of liquid refrigerant

3.39
listed product
equipment that has been tested and identified as acceptable by an approved testing laboratory

3.40
lobby
large hallway or waiting room that serves as a hallway

3.41
low-pressure side
part of a refrigerating system that is subjected to the pressure of evaporation

3.42
manufacturer
company or organization that accepts responsibility for refrigeration equipment by affixing its name, trade name or trademark to such equipment

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

3.43
non-positive displacement compressor
compressor in which an increase in vapour pressure is attained without changing the internal volume of the compression chamber

3.44
occupied space
space that is normally frequented or occupied by persons, but that excludes plant rooms and refrigerated spaces

3.45
owner
individual company, holding company or any other organization to which the refrigerant or refrigeration equipment belongs

NOTE This also applies to mines or chain stores that belong to the same group.

3.46
packaged unit
self-contained system
unit system
complete factory-assembled, self-contained refrigerating system or air-conditioning system with a suitable frame or enclosure, and for which no refrigerant-containing parts need to be connected on site

3.47
pipe duct
tube or conduit that is used to encase piping or tubing

3.48
plant room
machinery room
room in which part or all of the main equipment that constitutes a refrigeration plant is installed

3.49
positive displacement compressor
compressor in which an increase in vapour pressure is attained by changing the internal volume of the compression chamber

3.50
ppm
parts per million

NOTE This is a non-preferred SI unit. See volume fraction (3.75).

3.51
premises
tract of land and the buildings thereon

3.52
pressure gauge
device that is used to measure and display the pressure present in a specified part of the refrigerating system

NOTE The device includes instruments that use analogue or digital displays.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

3.53
pressure-imposing device
any device or part of the equipment that is used to increase refrigerant pressure

3.54
pressure-limiting device
high-pressure cut out
pressure-responsive mechanism that is designed to automatically stop the compressor before the design pressure is reached

NOTE The pressure-limiting device may also operate an alarm.

3.55
pressure-relief device
pressure-actuated (not temperature-actuated) valve or bursting disc that is designed to automatically relieve pressure in excess of a predetermined set point

3.56
pressure-relief valve
pressure-actuated valve that is held closed by a spring or other means that is designed to automatically relieve pressure in excess of its setting

3.57
pressure vessel
any refrigerant-containing receptacle in a refrigerating system

NOTE The term "pressure vessel" includes vessels and heat exchangers as defined in the relevant national legislation (see foreword).

3.58
qualification
evidence of a certain level of training, professional knowledge, skill and experience

3.59
reclaim
to reprocess refrigerant by means that can include distillation, so that the refrigerant complies with new product specifications

NOTE The term "reclaim" usually implies the use of processes or procedures available only at a reprocessing or manufacturing facility.

3.60
recovery
removal of refrigerant in any condition from a system and its storage in an external container, without necessarily testing or processing it in any way

3.61
recycle
to clean refrigerant for reuse by means of oil separation and single or multiple passes through devices such as replaceable core filter-driers, which reduce moisture, acidity and particulate matter

NOTE The term "recycle" usually applies to procedures implemented at the field job site or at a local repair service shop.

3.62
refrigerant
fluid that absorbs heat at a low temperature and pressure with a change in phase, and that rejects it at a higher temperature and pressure

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

3.63
refrigerant mixture
blend of two or more refrigerants that, however thoroughly blended, retain their own properties

3.64
refrigerating system
combination of interconnected parts that form a closed circuit in which refrigerant is circulated for the purpose of absorbing heat in one place and rejecting it in another

3.65
refrigeration plant
plant
assembly of components of a refrigerating system and all the apparatus necessary for its use

3.66
saturation pressure
pressure at which vapour and liquid can exist in equilibrium at a given temperature

3.67
sealed absorption system
packaged unit in which all refrigerant-containing parts are made permanently tight by welding or brazing

3.68
secondary coolant
any liquid that is used for the transmission of heat without a change in phase and that has no flash point or that has a flash point above 66 °C when determined in accordance with ASTM D93

3.69
set pressure
pressure at which a pressure-relief device or pressure-control device is set to operate

3.70
soldered joint
gas-tight joint formed by joining metal parts by means of alloys that melt at temperatures in the range 200 °C to 450 °C

NOTE 1 The parent metal does not make the joint by fusion.

NOTE 2 This definition does not apply to fusible plugs or to components used for relief purposes.

3.71
standard atmospheric air
air that has a density of 1,22 kg/m^3 (dry air) or a specific volume of 0,833 m^3/kg (dry air) at 21 °C dry bulb or 16 °C wet bulb, at a sea level barometric pressure of 101,325 kPa

3.72
surge drum
vessel that contains liquid refrigerant at a low temperature and pressure, and that is connected by liquid feed and return pipes to an evaporator

3.73
tenant
person or organization that has the legal right to occupy premises

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

3.74
toxicity level
level above which the concentration of the refrigerant vapour becomes lethal or will cause permanent injury

3.75
volume fraction
volume of a substance divided by the volume of all the substances in the mixture

NOTE 500 × 10^{-6} is the same as 500 ppm (see 3.50).

4 Refrigerating systems

4.1 Refrigerant numbers and classes

4.1.1 Refrigerant numbers

Each refrigerant is assigned a refrigerant number, based on the chemical formula of the refrigerant in accordance with ASHRAE 34.

4.1.2 Refrigerant classes

Each refrigerant is assigned a class (see table 1) in accordance with the dominant characteristics of the refrigerant, as follows:

a) Toxicity

1) Class A: Refrigerants that have a lower degree of toxicity as indicated by a permissible exposure level (PEL) of 400 × 10^{-6} or greater, if assigned; otherwise a recommended occupational exposure level (OEL) of 400 × 10^{-6} or greater.

2) Class B: Refrigerants that have a higher degree of toxicity as indicated by a PEL of 400 × 10^{-6} or less, if assigned; otherwise a recommended OEL of 400 × 10^{-6} or less.

NOTE For the definitions of PEL and OEL, see ASHRAE 34.

b) Flammability

1) Class 1: A refrigerant that does not show flame propagation when tested in air at 60 °C and 101,3 kPa.

2) Class 2: A refrigerant that exhibits flame propagation when tested at 60 °C and 101,3 kPa. It has a lower flammability level greater than 0,10 kg/m^3 and has a heat of combustion less than 19 000 kJ/kg.

3) Class 3: A refrigerant that exhibits flame propagation when tested at 60 °C and 101,3 kPa. It has a lower flammability level less than 0,10 kg/m^3 and has a heat of combustion greater than 19 000 kJ/kg.

4) Additional character L: This modifier denotes refrigerants with a lower flammability than class 2. In this standard, class A2/B2 also includes A2L/B2L, unless otherwise specified.

For all classes, a refrigerant blend test shall be carried out with the worst-case tolerances of the flammable components of the blend.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Table 1 — Safety classes for refrigerants

1	2	3
Flammability classes	**Safety class**	
	Lower toxicity	**Higher toxicity**
Higher flammability	Class A3	Class B3
Lower flammability	Class A2	Class B2
	Class A2L	Class B2L
No flame propagation	Class A1	Class B1
L = lower (i.e. class A2L has a lower flammability than class A2)		
Classes A2L and B2L are lower flammability refrigerants with a maximum burning velocity of $\leq$ 10 cm/s.		

4.2 Types of refrigerating system

4.2.1 General

A refrigerating system is one of the following three basic types of system (see figure 1):

a) direct system;

b) indirect system; or

c) double indirect system,

depending on the method used for extracting or delivering heat in the system. Each refrigerating system that encloses a separate body of evaporative refrigerant is considered to be a separate direct system.

4.2.2 Direct systems

The evaporator or condenser of the system is in direct contact with the substance or space that is being refrigerated or heated.

The following are subtypes of direct systems:

a) Direct open-circuit system: A cryogenic gas is injected into the space to be refrigerated or heated. The gas can be reclaimed but need not be reclaimed.

b) Direct closed system: The evaporator is in direct contact with the substance or space to be refrigerated or heated, or is located in air-conditioning passages that communicate with such substances or spaces.

4.2.3 Indirect systems

The evaporator and an associated heat exchanger cool a secondary fluid or coolant (for example brine or water) that is then circulated to the substance or space to be refrigerated or heated.

The following are subtypes of indirect systems:

a) Indirect open-spray system: The secondary coolant is in direct contact with the substance or space to be refrigerated or heated.

b) Indirect vented open-spray system: A system similar to the indirect open-spray system except that the evaporator or condenser is placed in an open or appropriately vented tank.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

c) Indirect closed system: The secondary coolant is circulated through a heat exchanger located within the substance or space to be refrigerated or heated.

d) Indirect vented closed system: A system similar to the indirect closed system except that the evaporator or condenser is placed in an open or appropriately vented tank.

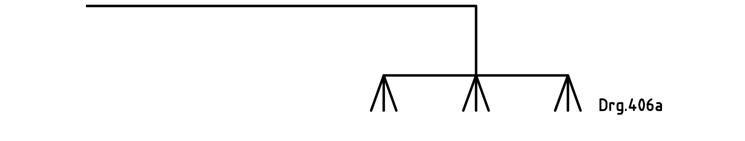
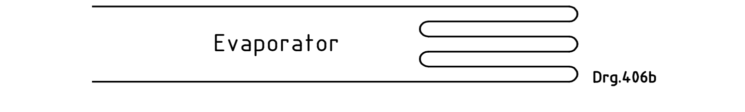
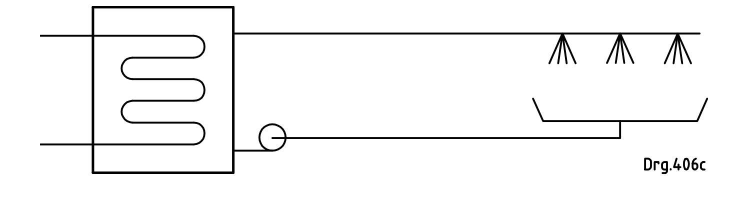
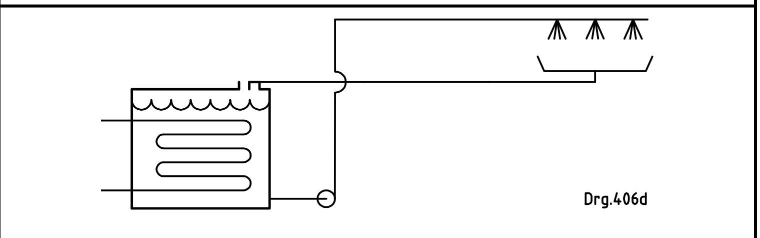
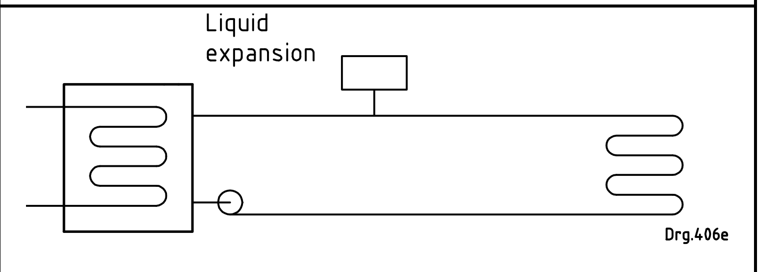
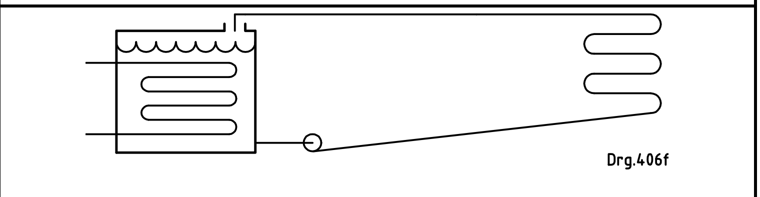
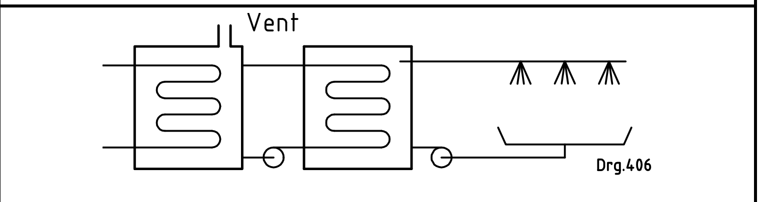
Direct open-circuit system	
Direct closed system	
Indirect open-spray system	
Indirect vented open-spray system	
Indirect closed system	
Indirect vented closed system	
Double indirect vented open-spray system	

Figure 1 — Types of refrigerating system

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

4.2.4 Double indirect systems

An indirect system passes the secondary fluid or coolant to a second heat exchanger, from which a separate tertiary coolant is passed to the substance or space to be refrigerated or heated.

The following are subtypes of double indirect systems:

a) double indirect open-spray systems,

b) double indirect closed systems,

c) double indirect vented closed systems, and

d) double indirect vented open-spray systems (see figure 1).

4.3 Occupancy classification of locations (areas)

4.3.1 General

Refrigerating systems are classified in accordance with the occupancy classes of areas in which they are situated (see table 2). The permitted combinations of refrigerant class, refrigerating system type, and occupancy classes are given in table 3, and the maximum allowable concentrations of refrigerant shall be in accordance with ASHRAE 34.

4.3.2 Mixed occupancy

Where locations of two or more different occupancy classes occur on the same premises and the areas are not separated by doors that are normally kept closed, the more stringent occupancy class requirement shall apply to both areas.

4.3.3 Locations adjacent to premises

Equipment (other than pipes) located within 6 m of any opening of a building shall be governed by the occupancy classification of such building.

Table 2 — Occupancy classes

1	2	3
Occupancy class	**General characteristics**	**Examples**
A: Institutional	Persons are restricted in their movement	Hospitals, courthouses, prison cells, underground mining areas
B: Public assembly	Persons can assemble freely	Theatres, dance studios, department stores, railway stations, schools, churches, lecture halls, restaurants
C: Residential	Sleeping accommodation is provided	Homes, hostels, residential apartments, clubs, colleges
D: Commercial	Any number of persons can be assembled, some of whom are necessarily acquainted with the general safety precautions of the establishment	Business or professional offices, small shops and restaurants, laboratories, places for general manufacturing and the performance of work, markets with unrestricted entry
E: Industrial	Only authorized persons have access to the plant and to the areas where manufacturing, processing or storage of materials or products takes place	Plants that manufacture chemicals, food, beverages, ice cream and ice, refineries, cold stores, dairies, abattoirs, surface mining areas

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Table 3 — Selection of refrigerant class and refrigerating system type in relation to occupancy class

1	2	3	4	5	6	7
Refrigerant class	**Refrigerating system type**	**Subclause containing restrictions on use**				
		Occupancy class[a]				
		A	**B**	**C**	**D**	**E**
A1/B1	Direct open Direct closed Indirect open-spray	6.2.1[b]				No restriction
	Indirect vented open Indirect closed Indirect vented closed Double indirect	6.2.2				
A2/B2	Direct closed Indirect open-spray Indirect vented open-spray Indirect closed	6.3.1[c] 6.3.1[cd] 6.3.1[c] 6.3.1[cd]				
	Indirect vented closed Double indirect	6.3.2[c]				
A3/B3	All refrigerant system types	Not to be used			6.4[c]	6.4[c]
For mining applications, the employer shall carry out a risk assessment to ensure that all systems pose an acceptable risk. Any system that poses an unacceptable risk should be modified so that it poses an acceptable risk.						

[a] See table 2 for definitions of occupancy classes.
[b] If open flames are present, the cooling system shall not be used without hooding and venting.
[c] Where the concentration of refrigerant, in the event of a leak, can exceed the levels given in 6.7.2, the temperature of any hot surfaces or flames shall be at least 100 °C less than the minimum ignition.
[d] Can be classified as an indirect vented closed system, provided that a refrigerant detector is fitted in the secondary refrigerant circuit (see 6.5).

5 Construction

5.1 Materials

All the materials used in the construction and installation of refrigerating systems shall be suitable for conveying the refrigerant used (see annex A). Some refrigerants are corrosive to certain materials in the presence of moisture or air (or both). Material that will deteriorate in the presence of moisture or air because of the refrigerant or the oil (or their combination) shall not be used. The material shall also be resistant to possible impurities and contaminants and to any heat-transferring liquids that could be present. All materials used shall comply with a national or an international standard.

5.2 Components

All components or fittings shall comply with an acceptable standard. The suitability of any component or fitting not dealt with by such a standard shall be determined either by a strength calculation in accordance with normal pressure-vessel procedures, or by the ability of the component or fitting to withstand, without bursting, a hydrostatic pressure of not less than three times the design pressure applicable to the component or fitting, when applied for at least 1 min.

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

5.3 Refrigerant containers (pressure vessels)

5.3.1 Refrigerant containers shall be designed in accordance with the relevant national legislation (see foreword). The user or employer or, where relevant, the design engineer or the installing contractor (where responsible for design), shall be responsible for advising the container manufacturer of the combination of the most severe pressure and most severe temperature conditions that can be experienced in normal service. The developed pressures of refrigerants at various temperatures are given in table 4.

5.3.2 To compensate for possible corrosion on pressure vessels exposed directly to the environment (installed outside) or subject to condensation or ice formation, a minimum corrosion allowance of 1,5 mm shall be added to the shell and ends. This does not apply to the frames of plate and frame type heat exchangers. Surface mining refrigeration systems that use ammonia as the refrigerant shall be in accordance with annex B.

5.3.3 All carbon steel pressure vessels that contain ammonia, with the exception of oil separators, oil coolers and oil filter housings, shall be subject to PWHT (post weld heat treatment). (See annex B for surface mining refrigeration systems that use ammonia as the refrigerant.)

5.3.4 To reduce the risk of stress corrosion cracking in carbon steel ammonia vessels, only hot formed or normalized carbon manganese steel plate/pipe/forgings with a maximum specified yield strength of 300 MPa shall be used. In addition, the use of high strength welds and welding electrodes that contain nickel shall be avoided.

5.3.5 Pipe threads shall be capable of operating at a pressure of up to 3 MPa.

5.3.6 Test pressures shall be applied as determined by the code of manufacture.

5.3.7 Permanently mounted pressure gauges shall be provided for the operational control of the system.

5.3.8 Pressure-relief devices shall be provided where required in this standard.

5.3.9 Ammonia refrigeration vessels (see annex B), such as liquid receivers, accumulators, surge drums, intercoolers and economizers, shall be subjected to at least 10 % spot radiography.

5.3.10 If the pressure vessel is to be insulated, provision shall be made for the manufacturer's data plate to be visible after it has been insulated, i.e. by means of an extended bracket.

5.4 Design pressure

5.4.1 The design pressure(s) shall be not less than the pressures that could arise under all operating, shipping and stand-by conditions, and shall be such as to ensure that there will be no permanent deformation as a result of the application of the test pressures in accordance with 5.6.

When the minimum design pressure is being selected, suitable allowance shall be provided for setting pressure-limiting devices and pressure-relief devices to avoid shutdowns and loss of refrigerant under maximum operating conditions. The minimum design pressure(s) shall be not less than the saturation gauge pressure (absolute pressure (see table 4) minus atmospheric pressure), appropriate to the following temperatures:

a) low-pressure sides of all systems: 35 °C;

b) high-pressure sides of all water-cooled or evaporation-cooled systems: 40 °C; and

c) high-pressure sides of air-cooled systems: 50 °C.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

For cascade and transcritical systems that use R 744 (carbon dioxide), the system designer shall choose suitable pressures dependent on the operating and standstill pressures and shall include provisions to ensure that these pressures cannot be exceeded in practice.

Table 4 — Developed pressures of refrigerants

1	2	3	4	5
Refrigerant number	**Absolute pressure** kPa			**Critical temperature**
	Saturated temperature °C			
	35	**40**	**50**	°C
R 22	1 355	1 534	1 943	96
R 23	Pressures above the critical point			26
R 123	131	155	213	184
R 134a	887	1 017	1 319	101
R 170	Pressures above the critical point			32
R 290	1 218	1 369	1 713	97
R 404A	1 620	1 830	2 316	73
R 407C	1 545	1 749	2 216	87
R 410A	2 145	2 426	3 071	72
R 422D	1 460	1 651	2 089	80
R 507A	1 655	1 868	2 361	71
R 600a	465	531	684	135
R 717	1 350	1 554	2 032	133
R 744	Pressures above the critical point			31
R 1234yf	895	1 018	1 301	95
R 1270	1 472	1 652	2 058	92

5.4.2 The design pressure selected shall exceed, by a suitable margin, the maximum pressure attained under any anticipated normal operating condition (including conditions created by reasonable fouling of heat exchange surfaces). This margin shall be agreed upon between the purchaser and the designer (or manufacturer) in order to allow for probable surges of pressure during operation and to prevent the unnecessary operation of pressure-relief devices. Higher design pressures for both the high-pressure side and the low-pressure side shall be used for packaged units delivered in the ready-charged condition.

5.4.3 Stand-by conditions are intended to include all the normal conditions that can occur in the system when it is not operating. In the selection of the design pressure for components for the low-pressure side, consideration shall also be given to the pressure developed as a result of equalization, or as a result of heating owing to changes in ambient temperature after the system has stopped.

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

5.4.4 In the selection of the design pressure for components (for both the low-pressure side and the high-pressure side) that are to be shipped as part of a gas-charged or a refrigerant-charged system, consideration shall be given to internal pressures that arise from exposure to maximum temperatures anticipated during the course of shipment.

5.4.5 The design pressure selected for either the high-pressure side or the low-pressure side need not exceed the critical pressure of the refrigerant, unless such pressures are anticipated during operating, shipping or stand-by conditions.

5.4.6 When part of a limited-charge system is protected by a pressure-relief device, the design pressure of such part need not exceed the setting of the pressure-relief device.

5.4.7 Where a compressor is used to obtain a low pressure and the compressor discharges into the suction line of another system, the booster compressor is considered part of the low-pressure side. The values listed (see table 4) for the low-pressure side and a design gauge pressure that corresponds to a saturation temperature of 35 °C shall be used for both the high-pressure side and the low-pressure side of the booster compressor.

5.4.8 Any component that is connected to pressure vessels and is subject to the same pressure as the pressure vessel shall have a design pressure at least equal to that of the pressure vessel.

5.5 Maximum working pressure

The design pressure can be different for the high-pressure side, for the low-pressure side, and for the inter-stages of a refrigeration plant.

The maximum value at a particular point in a refrigeration plant depends on the highest temperature that can occur at that point during operation or when on stand-by. The design pressure on the low-pressure side is affected mainly by the maximum temperature of that part of the system (this can be influenced by, for example, the ambient temperature or the defrosting system). The determining factor on the high-pressure side is normally the temperature of condensation when this occurs under the least favourable conditions.

5.6 Test pressures

5.6.1 Factory tests

The following test pressures shall be used for factory tests:

a) castings: at least 1,5 times the design pressure;

b) fabricated construction (other than pressure vessels) and rolled or drawn materials: at least 1,3 times the design pressure;

c) pressure vessels: the test pressure prescribed in the relevant national legislation (see foreword) and SANS 347; and

d) other components: the test pressure arrived at by calculation, or a pressure of at least three times the design pressure applicable to the component.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

5.6.2 Field tests (see also 6.12)

The following test pressures shall be used for field tests:

a) castings: at least 1,1 times the design pressure;

b) fabricated construction (other than pressure vessels) and rolled or drawn materials: at least 1,1 times the design pressure;

c) pressure vessels: the test pressure prescribed in the relevant national legislation (see foreword); and

d) other components: the test pressure arrived at by calculation, or a pressure of at least 1,1 times the design pressure applicable to the component.

5.7 Limiting pressure in the system

5.7.1 Pressure relief

5.7.1.1 Each refrigerating system that contains a class A1/B1 refrigerant and that has a prime mover of a rating that exceeds 10 kW, and each system that contains a class A2/B2 or a class A3/B3 refrigerant, shall be protected by pressure-relief devices.

At least one pressure-relief device shall be fitted so as to protect the high-pressure side of a system. The pressure-relief device(s) may discharge into the atmosphere (see 5.7.1.6), but may also discharge into the low-pressure side of the system, where the low-pressure side is fitted with a pressure-relief valve or a bursting disc that is of adequate capacity and that discharges into the atmosphere.

Pressure-relief valves shall be

a) all set to relieve the same pressure on the low side of the system,

b) all set to relieve the same pressure on the high side of the system, and

c) selected to protect the pressure vessel with the lowest design pressure rating of that part of the system, i.e. high or low pressure sides.

5.7.1.2 A system that contains a class A1/B1 refrigerant and that has a prime mover of a rating less than 10 kW may be protected either by pressure-relief devices or by an acceptable pressure-limiting device, except that where such a system contains any pressure vessels as defined, a pressure-relief device shall be fitted.

5.7.1.3 A pressure-relief device to relieve hydrostatic pressure to another part of the system shall be used on the portion of the liquid-containing parts of the system that can be isolated from the system during operation or service and that could be subjected to over-pressure from hydrostatic expansion, owing to temperature rise of the contained liquid.

5.7.1.4 When a pressure-relief device discharges into the low-pressure side of the system, the effect of back-pressure shall be taken into account when the valve is being selected.

5.7.1.5 Fusible plugs can only be used with systems that contain less than 2,5 kg of a class A1 refrigerant.

5.7.1.6 Systems with any ozone-depleting substances or systems with a charge that exceeds 10 kg of a refrigerant with a global warming potential (GWP) that is greater than 1 500 shall discharge into the low-pressure side of the system.

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

5.7.2 Protection of components

5.7.2.1 Positive displacement compressor protection

5.7.2.1.1 A positive displacement compressor with a displacement that exceeds 0,024 m^3/s shall be fitted with a pressure-relief valve or a bursting disc (fitted between the compressor and the discharge isolating valve, when such a valve is used) that is capable of preventing a rise in pressure that could endanger the system.

5.7.2.1.2 The discharge from the pressure-relief valve shall be vented into the low-pressure side of the refrigerating system, in which case the valve shall be of a type not affected by back-pressure (for example bellows type), and shall be sized in accordance with the following equations:

$$W_a = W_r \times r_w \qquad (1)$$

$$W_r = Q \times \eta_v / v_g \qquad (2)$$

$$r_w = \frac{C_a}{C_r} \times \sqrt{\frac{T_r}{T_a}} \times \sqrt{\frac{M_a}{M_r}} \qquad (3)$$

where

W_a is the mass flow of standard atmospheric air, in kilograms per second;

W_r is the mass flow of refrigerant, in kilograms per second;

r_w is a calculated value from table 5;

Q is the swept volume of the compressor, in cubic metres per second;

η_v is the volumetric efficiency of the compressor, assumed to be 0,9 unless the actual volumetric efficiency at the relieving pressure is known;

v_g is the specific volume of saturated refrigerant vapour, in cubic metres per kilogram, and is as follows:

a) for high-stage or single-stage compressors, it shall be based on 10 °C saturated suction temperature at the compressor suction;

b) for low-stage or booster compressors that can only run when discharging to the suction of a high-stage compressor, it shall be based on the saturated suction temperature equal to the design operating intermediate temperature;

C_a is the constant for air (197,31);

$$C_r = 288{,}15\sqrt{k\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}} \qquad (4)$$

where

C_r is the refrigerant constant;

k is the specific heat ratio C_p:C_v;

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

where

C_p is the specific heat of refrigerant at constant pressure, in joules per kilogram kelvin;

C_v is the specific heat of refrigerant at constant volume, in joules per kilogram kelvin;

T_r is the absolute temperature of the refrigerant (283,15 K);

T_a is the absolute temperature of standard atmospheric air (288,15 K);

M_a is the molecular mass of air (28,97 kg/mol);

M_r is the molecular mass of the refrigerant, in kilograms per mol.

5.7.2.1.3 In addition, the compressor shall be protected by means of a pressure-limiting device, the set pressure of which shall not exceed 90 % of the relief-valve pressure.

5.7.2.1.4 If a pressure-relief valve that vents to the low-pressure side of the system is fitted to protect the compressor, this valve shall be of a type not appreciably affected by back-pressure, for example the balanced-bellows type.

Table 5 — Calculated values for C_r and r_w for high-stage or single-stage compressors

1	2	3	4	5
Refrigerant number	**Specific heat ratio C_p:C_v** K	**Molecular mass** kg/mol	**Refrigerant constant C_r** J/kg·K	**Calculated value r_w**
R 134a	1,196	102,00	186,7	0,56
R 22	1,319	86,49	193,3	0,59
R 404A	1,279	97,60	191,2	0,56
R 407C	1,270	86,20	190,7	0,59
R 410A	1,434	72,58	198,9	0,62
R 507A	1,284	98,86	191,4	0,55
R 717	1,422	17,03	198,4	1,28
R 744	2,690	44,01	242,2	0,65

5.7.2.2 Non-positive displacement compressor protection

Provided that it is not possible for the pressure in a non-positive displacement compressor to exceed the design pressure, such a compressor need not have a pressure-relief device.

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

5.7.2.3 Pumps

Each refrigerant pump in a refrigerating system shall be protected by a pressure-relief valve that is fitted on the discharge side between the pump non-return valve (if fitted) and the shut-off valve. The discharge from the device shall be vented into the low-pressure side of the refrigerating system.

5.7.2.4 Evaporators

A pressure-relief valve shall be fitted to evaporators that are located either downstream or upstream of the heating coil, but that are within 460 mm of a heating coil.

Such a pressure-relief valve shall not be required on packaged units if the volume of the low-pressure side of the system, which can be shut off by valves, exceeds the specific volume of the refrigerant at critical conditions of temperature and pressure, V_{gc}, as determined by using the following equation:

$$V_{gc} \geq \frac{V_1}{\left[W_1 - \frac{(V_2 - V_1)}{V_{gt}} \right]} \qquad (5)$$

where

V_{gc} is the specific volume at critical temperature and pressure, in cubic metres per kilogram;

V_1 is the low-pressure side volume, in cubic metres;

V_2 is the total volume of the system, in cubic metres;

W_1 is the total mass of the refrigerant in the system, in kilograms;

V_{gt} is the specific volume of the refrigerant vapour at 43,5 °C, in cubic metres per kilogram.

5.7.2.5 Refrigerant vessels

5.7.2.5.1 Each refrigerant vessel that can be shut off from the other parts of the system shall be protected by a pressure-relief device (i.e. a pressure-relief valve, a bursting valve, a bursting disc, or a fusible plug). The minimum required discharge capacity, $C_{min.}$, of the pressure-relief device for each pressure vessel shall be determined by using the following equation:

$$C_{min.} = fDL \qquad (6)$$

where

$C_{min.}$ is the minimum required discharge capacity of the pressure-relief device, in kilograms of standard atmospheric air per second;

f is the discharge capacity factor, as given in table 6;

D is the outside diameter of the vessel, in metres;

L is the length of the vessel, in metres.

When combustible materials such as vessel thermal insulation or stored lubricants are used within 6 m of a pressure vessel the values of *f* shall be multiplied by 2,5.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

5.7.2.5.2 The rated discharge capacity, *C,* of a bursting disc or fusible plug that discharges into the atmosphere under critical flow conditions shall be determined by using the following equation:

$$C = 1{,}36 \times 10^{-6} \times P_1 \times d^2 \qquad (7)$$

where

C is the rated discharge capacity, in kilograms of standard atmospheric air per second;

P_1 is one of the following:

a) for bursting discs: 1,1 times the rated gauge pressure plus 101,33 kPa, in kilopascals;

b) for fusible plugs: absolute saturation pressure that corresponds to the smaller of the stamped temperature melting point of the fusible plug or the critical pressure of the refrigerant used, in kilopascals;

d is the smallest of the internal diameters of the inlet pipe, retaining flanges, fusible plug and bursting disc, in millimetres, for example

$$d = 857{,}5\sqrt{\frac{C}{P_1}} \qquad (8)$$

5.7.2.5.3 Where two or more pressure-relief devices are used in parallel to obtain the required capacity, the two devices shall be considered a unit and, therefore, as one pressure-relief device. When one pressure-relief device or fusible plug is used to protect more than one pressure vessel, the minimum required discharge capacity of the pressure-relief device or fusible plug shall be the sum of the capacities required for each pressure vessel.

5.7.2.6 Liquid refrigerant in pipes and fittings

Consideration shall be given to the possible dangers that could arise as a result of liquid refrigerant being locked up in pipes or fittings between shut-off devices. Depending on circumstances, such as the size of pipe, type of refrigerant, surroundings and occupancy class, a hydrostatic valve set to discharge at the hydrostatic test pressure of the component can be used (see 6.8).

5.7.2.7 Liquid refrigerant storage vessels

Liquid refrigerant storage vessels of which the gross internal volume exceeds 0,285 m^3 shall be protected by two pressure-relief valves or two bursting discs controlled by a change-over device.

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Table 6 — Discharge capacity factors of refrigerants

1	2	3
Applications	**Refrigerant**	**Discharge capacity factor** ***f***
When used on a low-pressure side of a limited-charge system	R 23, R 170, R 744, R 1150, R 508A, R 508B	0,082
	R 13, R 13B1, R 503	0,163
	R 14	0,203
Other applications	R 718	0,016
	R 717	0,041
	R 32, R 113, R 123, R 142b, R 152a, R 290, R 600, R 600a, R 764	0,082
	R 22, R 114, R 124, R 134a, R 401A, R 401B, R 401C, R 405A, R 406A	0,131
	R 407C, R 407E, R 409A, R 409B, R 411A, R 411B, R 411C, R 412A	0,131
	R 414A, R 414B, R 1270	0,131
	R 143a, R 402B, R 403B, R 407A, R 408A, R 413A	0,163
	R 115, R 402A, R 403B, R 404A, R 407B, R 410A, R 410B, R 507A, R 509A	0,203

5.7.3 Specific requirements for pressure-relief devices

5.7.3.1 General

All pressure-relief devices shall be actuated by direct pressure. The seats and discs of pressure-relief devices shall be constructed of a suitable material to resist corrosion or other chemical action caused by the refrigerant. Seats or discs of cast iron shall not be used. Any distortion of seats or discs (or both) shall not cause a set pressure change that exceeds 5 % in five years.

For R 744 (carbon dioxide), precautions shall be taken in the design of pressure-relief valve systems so that when venting to the atmosphere, these cannot become blocked with solid carbon dioxide.

5.7.3.2 Pressure-relief valves

The pressure required to open a pressure-relief valve fully shall not exceed 1,1 times the gauge pressure at which the valve begins to open, unless the applicable health and safety standard listed in annex A of SANS 347:2012 specifies a lower factor.

5.7.3.3 Bursting discs and holders

Each bursting disc shall have a certified bursting pressure at a specific temperature, and this pressure and temperature, and the manufacturer's name, trade name or trademark shall be shown on the disc in such a manner that the operation of the disc is not affected; when this is not practicable, these markings shall appear on the container in which the discs are packed by the manufacturer. The disc shall be so located in the holder that the free aperture area is maintained throughout the body of the holder.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

5.7.4 Location of protective devices

5.7.4.1 General

All protective devices shall be mounted on, or near, the parts of the refrigerating system that they protect. The devices shall be easily accessible and shall be mounted above the level of the liquid refrigerant. No isolating valve shall be inserted between the pressure-relief device and the apparatus intended to be protected. Where more than one pressure-relief device is fitted, a change-over device may be used in order to facilitate testing and repairs.

5.7.4.2 Pressure-relief devices

A pressure-relief device may discharge into the low-pressure side of a system, provided that it is of a type not appreciably affected by back-pressure and provided also that the low-pressure side of the system is equipped with protective devices of such capacity (calculated in accordance with 5.7.2.5) as to protect all connected vessels that are subjected simultaneously to excess pressure. Such pressure-relief devices on the low-pressure side of the system shall be vented to the outside of the building.

5.7.4.3 Pressure-limiting devices (high-pressure safety switches or transducers)

Pressure-limiting devices shall be provided on all systems that operate above atmospheric pressure, except that a pressure-limiting device may be omitted on any packaged unit that contains less than 10 kg of a class A1 refrigerant. Pressure-limiting devices shall be connected between the pressure-imposing element and any isolating valve on the discharge side.

5.7.5 Settings of pressure-relief devices and pressure-limiting devices

5.7.5.1 Each pressure-relief device shall start to function at a pressure that does not exceed the design pressure of the part(s) of the system that is(are) protected.

5.7.5.2 The maximum pressure to which a pressure-limiting device can be readily set (by using the adjusting means provided) shall not exceed

a) the pressure of the high-pressure side of a system that is not protected by a pressure-relief device, and

b) 90 % of the setting of the pressure-relief device in a system that has a pressure-relief device installed on the high-pressure side of the system (except for systems that use non-positive displacement compressors). In every case, the setting of the pressure-limiting device shall be lower than the setting of any overflow safety valves as specified in 5.7.2.1.

The pressure-limiting device shall stop the action of the pressure-imposing device at a pressure no higher than the maximum setting.

5.7.6 Discharge of pressure-relief devices

5.7.6.1 Safety of occupants

The discharge of a pressure-relief device shall take place in such a manner that no person is endangered by the escaping refrigerant. The refrigerant may be diffused into the air by acceptable means or discharged into a suitable absorbing liquid. Ozone-depleting refrigerants shall not be deliberately discharged into the atmosphere. They shall be discharged into suitable containers or to the low-pressure side of the system.

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

5.7.6.2 Pressure discharge into the atmosphere

The discharge of refrigerants with an ozone depletion potential that is greater than zero or with a global warming potential that exceeds 1 500 into the atmosphere shall be allowed only on the low-pressure side of the circuit in accordance with 5.7.1.6.

In all systems, pressure-relief devices that are used on a system that contains

a) more than 50 kg of a class A1 refrigerant, or

b) more than 3 kg of a class B1 or class A2 or class B2 refrigerant, or

c) a class A3 or class B3 refrigerant,

shall discharge into the atmosphere at a location at least 4,5 m above the adjoining ground level and at least 6,0 m from any window, ventilation opening, or exit in any building. The discharge shall be so terminated as to prevent direct spray of discharged refrigerant onto personnel in the vicinity and to prevent foreign material or debris from entering the discharge pipes. Discharge pipes connected to the discharge side of a fusible plug or bursting disc shall have a means of preventing the pipes from being plugged in the event of the fusible plug or bursting disc functioning.

5.7.6.3 Discharge of ammonia

5.7.6.3.1 Where ammonia is used as the refrigerant, the preferred discharge is into the atmosphere, but ammonia may be discharged into a tank of water, provided that the water is used for ammonia absorption only. At least 1 m^3 of water shall be provided for every 100 kg of ammonia in the system. Means other than salt or chemicals shall be used to prevent the water from freezing.

The tank shall be constructed of iron or steel of thickness at least 3,0 mm. The width of the tank shall not exceed one-half of the depth. The tank shall have a hinged cover or, if of the enclosed type, shall have a vent hole at the top. Pipe connections shall only be through the top of the tank. Discharge pipes from pressure-relief valves shall discharge the ammonia into the centre of the tank, near the bottom.

5.7.6.3.2 An indirect ammonia-water absorption packaged unit installed outdoors adjacent to a single family residence need not comply with 5.7.6.3.1, provided that the discharge is shielded and dispersed.

5.7.6.4 Size and length of discharge pipe

5.7.6.4.1 The design back-pressure due to flow in the discharge piping at the outlet of pressure-relief devices and fusible plugs discharging into the atmosphere, shall be limited by the allowable equivalent length of piping determined by using the following equation:

$$L = \frac{7{,}4381 \times 10^{-15} \times d^5 \left(P_0{}^2 - P_2{}^2\right)}{f C_r^2} - \frac{d \times \ln\left(\frac{P_0}{P_2}\right)}{500\, f} \qquad (9)$$

where

L is the equivalent length of discharge piping, in metres;

d is the inside diameter of the pipe or tube, in millimetres;

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

P_0 is the allowed back pressure (absolute), in kilopascals, at the outlet of pressure specified by the manufacturer, or, when the allowed back pressure is not specified, is one of the following values, where P is the set pressure:

a) for conventional relief valves, 15 % of set pressure: 0,15P + atmospheric pressure,

b) for balanced relief valves, 25 % of set pressure: 0,25P + atmospheric pressure,

c) for rupture members, fusible plugs, and pilot-operated relief valves, 50 % of set pressure: 0,50P + atmospheric pressure;

NOTE For fusible plugs, P is the saturated absolute pressure, in kilopascals, for the stamped temperature melting point of the fusible plug or the critical pressure of the refrigerant used, whichever is smaller, and atmospheric pressure is at the elevation of the installation above sea level. A default value is the atmospheric pressure at sea level (101,325 KPa).

P_2 is the absolute pressure at the outlet of the discharge piping, in kilopascals;

ln is the natural logarithm;

f is the Moody friction factor in fully turbulent flow (see typical values in tables 7 and 8);

Cr is the rated capacity as stamped on the relief device, in kilograms per second, or as adjusted for reduced capacity due to piping as specified by the manufacturer of the device, or as adjusted for reduced capacity due to piping as estimated by an acceptable method.

5.7.6.4.2 Where pressure-relief devices of different set points are connected to a common pipe, the size and length of the common pipe shall be determined by the sum of the rated discharge capacities of all the relevant pressure-relief devices at the lowest set point of any of the devices, but the area of the header calculated in this way shall be not less than the sum of the areas of the pipes connected to it.

Table 7 —Typical Moody friction factors (*f*) for fully turbulent flow in copper tubing

1	2	3	4
Tubing outside diameter OD in.[a]	**Nominal outside diameter DN** mm	**Inside diameter ID** mm	**Moody friction factor** f
3/8	9,5	8	0,0136
1/2	12	10,9	0,0128
5/8	16	13,8	0,0122
3/4	19	16,9	0,0117
7/8	22	19,9	0,0114
1 1/8	28	26	0,0108
1 3/8	35	32,1	0,0104
1 5/8	42	38,2	0,0101
[a] These copper pipe sizes are still referred to in inches.			

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Table 8 — Typical Moody friction factors *(f)* for fully turbulent flow in steel pipe

1	2	3
Nominal outside diameter DN mm	**Inside diameter ID** mm	**Moody friction factor** f
15	15,8	0,0259
20	20,9	0,0240
25	26,6	0,0225
32	32,2	0,0209
40	40,9	0,0202
50	52,5	0,0190
65	62,7	0,0182
80	73,6	0,0173
100	102,3	0,0163
125	128,2	0,0155
150	154	0,0149

5.8 Reserve pressure-relief devices

In cases where additional pressure-relief devices have to be provided for servicing convenience, the valve system used to isolate any such device shall be so designed that it is impossible to operate the system with a lower discharge capacity than that required in 5.7.2.5.2.

5.9 Refrigerant substitution

Should the originally supplied refrigerant be changed in terms of a manufacturer's accepted procedure, the new refrigerant shall be compatible in every way with the complete system, inclusive of seals, gaskets and lubricants. Care shall be taken to ensure that the pressure/temperature correlation of the new refrigerant is similar to that being replaced and that pressure vessels are still operated within the originally specified design working pressure.

5.10 Marking

5.10.1 Systems

Each pre-assembled package and each separate condensing unit, compressor or compressor unit sold for field assembly in a refrigerating system shall carry a name plate marked with the following:

a) the manufacturer's name, trade name or trademark;

b) the identification number of the part;

c) the design pressure(s); and

d) the refrigerant that is currently in use.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

5.10.2 Refrigerant substitution

Where a different refrigerant has been substituted for the refrigerant provided by the manufacturer, all name plates, drawings and operating manuals shall be amended to show the new refrigerant name.

5.10.3 Pressure-relief devices

All pressure-relief devices for refrigerant-containing components shall be set and sealed by the manufacturer or the assembler, and shall be marked by the manufacturer or the assembler with the pressure setting and capacity. Where the refrigerant type is changed, it shall be marked accordingly.

5.10.4 Recertification of pressure-relief devices and replacement of bursting discs

All pressure relief valves shall be checked and recalibrated by the manufacturer or an acceptable service representative and recertified every three years. Bursting discs shall be replaced every three years.

NOTE Mine refrigeration installations have different inspection frequencies (see annex B).

5.11 Refrigerant pressure gauges or indicators

5.11.1 General

Pressure indicators for refrigerants shall be marked to indicate the pressure, in kilopascals or bars. In the case of gauges, the corresponding temperature of the saturated vapour, in degrees Celsius, shall be indicated. The design pressure shall be indicated by a red mark. If a pressure gauge is permanently installed on the high-pressure side of a refrigerating system, its dial shall be graduated to at least 1,2 times the design pressure of the system.

Alternatively, where the plant is controlled or monitored by a programmable logic controller-based (PLC-based) system, the pressure, in kilopascals, can be read from a display screen.

5.11.2 Essential pressure gauges

5.11.2.1 Compressors

A compressor shall be fitted with at least one discharge pressure indicator if the compressor functions in a system in which the refrigerant charge exceeds one of the following:

a) 50 kg, in the case of a class A1 refrigerant (other than carbon dioxide); or

b) 25 kg, in the case of a class B1 or class A2 or class B2 refrigerant.

In other systems where a class A1 or class B1, or class A2 or class B2 refrigerant is used, a compressor shall have pressure gauge connections but the fitting of permanent pressure gauges is optional. In the case of class 3 refrigerants and carbon dioxide, pressure gauges shall be fitted.

5.11.2.2 Positive displacement liquid refrigerant pumps

A pressure gauge shall be fitted on the discharge side of each positive displacement liquid refrigerant pump, and a suitable self-closing device shall be incorporated to prevent leakage of fluid.

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

5.11.2.3 Pressure vessels

Each pressure vessel shall be fitted with a pressure gauge that is separate and remote from the test pressure connection.

A mechanical-type gauge is required on pressure vessels.

5.12 Liquid level indicators

The glass of a liquid level indicator shall comply with the relevant requirements for refrigeration systems. Each liquid level indicator shall be capable of withstanding the test pressure applied in the part of the installation to which it is fitted. Inlet and outlet connections of liquid level indicators shall be fitted with automatic shut-off devices. The glass used in liquid level indicators of the bull's-eye type or reflex type shall be such as to comply with the required design application. Glass-tube type level indicators shall not be used.

5.13 Refrigerant piping, valves, fittings and related parts

5.13.1 Design

Refrigeration piping, valves, fittings and related parts shall comply with ASME B31.5, where applicable.

System components designed in accordance with an approved testing laboratory or design code shall also be acceptable.

All refrigerant-containing parts and joints of refrigeration systems located in an air duct of an air-conditioning system shall be constructed to withstand, without leakage, a temperature of 375 °C.

Welded or brazed or soldered joints shall be used extensively so as to minimize escape of refrigerant. Flanged or screwed connections shall only be used to facilitate removal of equipment.

When using R 744 (carbon dioxide) and copper tubing, it is important to note that normally available copper tubing generally has insufficient strength to hold the high pressures developed with this refrigerant (even in subcritical systems).

The minimum wall thickness, T (in millimetres), can be calculated using the following equation:

$$T = \frac{P \times D \times 0{,}01}{20F + (P \times 0{,}01)} \qquad (10)$$

where

P is the design pressure, in kilopascals;

D is the outside diameter of the tube, in millimetres;

F is the design stress of 40 N/mm^2, in newtons per square millimetre.

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

5.13.2 Shut-off valves

5.13.2.1 A shut-off valve shall be a valve that is recognized for use in refrigeration applications.

5.13.2.2 It shall be possible to tighten or change the gland seal(s) while the valve is exposed to system pressure.

5.13.2.3 Capped valves shall be fitted with a vented cap to release any pressure under the cap as soon as pressure removal is started. The vent can be in the form of either a drilled hole through the side of the cap or a broached slot down the length of the thread.

5.13.3 Brazed joints

When copper tubing is used in refrigerating systems that contain class A2/B2 or class A3/B3 refrigerants, brazed joints shall be made by means of alloys that have a melting point of at least 450 °C.

5.13.4 Threaded joints

Threaded joints shall not be used in refrigerating systems that contain class A3/B3 refrigerants, unless the joints are sealed by welding or brazing. Joints shall be taper-to-taper where sealing is on the thread. Threaded pipes of nominal size that exceeds 25 mm shall not be used with organic or class A3/B3 refrigerants.

5.13.5 Flanged joints

Steel flanges shall comply with ASME B16.5, EN 1759-1 and SANS 1123.

Proprietary flanges may be used, provided that their construction is such that the gasket or joint is trapped and the material is suitable for the required pressure/temperature rating. Where the accepted normal operating pressures exceed 2,1 MPa, metallic or compound metallic gaskets shall be used on flat-face flanges or raised-face flanges. Compressed non-metallic gaskets may be used in recessed joints.

In the case of class 2 and class 3 refrigerants, flanges for liquid refrigerant shall be of the weld-neck design. Vapour line flanges may be of the slip-on type. All flanges for class A2/B2 and class A3/B3 refrigerants shall be of the raised-face or tongue-and-groove type.

5.13.6 Compression joints

Joints between copper tube and brass or steel compression-type fittings may be used for refrigerating systems that are not subjected to vibration. Compression joints shall comply with AS 4041.

5.13.7 Flared compression fittings

Flared compression fittings shall be used for tubing of diameter that does not exceed 19 mm.

Flared connections shall be tightened by means of a torque wrench to the following values:

a) 6,35 mm: 14 Nm to 18 Nm;

b) 9,52 mm: 33 Nm to 42 Nm;

c) 12,7 mm: 50 Nm to 62 Nm;

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

d) 15,88 mm: 63 Nm to 77 Nm;

e) 19,05 mm: 90 Nm to 110 Nm.

Wherever possible, the use of flare fittings should be avoided.

5.14 Components other than pressure vessels and piping

Liquid refrigerant receivers or those parts of a system that are designed to receive the refrigerant charge during pump-down shall be of such capacity as to receive the pump-down charge without the liquid refrigerant occupying more than 80 % of the volume when the temperature of the refrigerant is 35 °C. Where no shut-off valve is provided between the condenser outlet and the receiver inlet, the receiver capacity shall be such as to receive the pump-down charge without the liquid refrigerant occupying more than 100 % of the receiver volume plus 30 % of the condenser volume.

5.15 Requirements for servicing

5.15.1 General

5.15.1.1 All the components of refrigerating systems that require servicing shall be easily and safely accessible.

5.15.1.2 All systems shall have provisions for handling the refrigerant charge safely for servicing purposes. Properly located isolating valves, liquid-transferring valves, refrigerant storage tanks and necessary venting for safe disposal may be used.

5.15.2 Isolating valves

5.15.2.1 Systems that contain more than 3 kg of a class A2/B2 or class A3/B3 refrigerant (other than systems that use non-positive displacement compressors) shall have isolating valves installed at the following locations:

a) the suction inlet of each compressor, compressor unit or condensing unit;

b) the discharge of each compressor, compressor unit or condensing unit; and

c) the outlet of each liquid refrigerant receiver.

5.15.2.2 Systems that contain more than 50 kg of refrigerant (other than systems that use non-positive displacement compressors, or systems that have a pump-out receiver for the storage of the refrigerant charge, or packaged units) shall have isolating valves installed at the following locations:

a) the suction inlet of each compressor, compressor unit or condensing unit;

b) the discharge of each compressor, compressor unit or condensing unit;

c) the inlet of each liquid refrigerant receiver, except in the case of packaged units or where the receiver is an integral part of the condenser or receiving unit;

d) the outlet of each liquid refrigerant receiver; and

e) the inlet and outlet of each compressor, receiver, condenser and evaporator when more than one compressor, receiver, condenser or evaporator is used in parallel in the system.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

5.15.2.3 Isolating valves used with annealed copper tubing of outside diameter 22 mm or smaller shall be securely mounted, independent of any tubing fastenings or any supports.

5.15.2.4 Isolating valves shall be suitably labelled in cases where the components to and from which the valve regulates the flow are not in view at the valve location. Numbers may be used to label the valves, provided that a key to the numbers is located within sight of the valves and has letters of height at least 12,7 mm.

5.15.2.5 Multi-stage and other complicated systems shall have a piping diagram permanently fixed within a frame and permanently secured to a wall or partition near the compressor. An independent light source shall be provided.

5.16 Factory tests

Before delivery, subject all the relevant components of a system, at the manufacturer's works, to a strength test followed by a leakage test. In both tests, apply the test pressures gradually and carefully and, except when items such as pressure gauges and control devices cannot withstand the test pressures without permanent distortion, ensure that the test pressures are as given in 5.6. Carry out the leakage test with a gas that is safe to work with (for example an inert gas or dry nitrogen) at a pressure of 1,1 times the design pressure of the component under test.

6 Siting and installation

6.1 General

6.1.1 Regulations

A refrigerating system shall be so installed at a location that all building, electricity, gas or other regulations are complied with.

6.1.2 Foundations and supports

Foundations and supports for refrigeration equipment shall be designed by a competent person.

When a pressure vessel is installed horizontally, only one end shall be fixed permanently. The other end shall be free or floating, to allow for expansion and contraction.

6.1.3 Moving machinery

Fans and moving machinery shall be guarded in accordance with the relevant national legislation (see foreword).

6.1.4 Reasonable access

Reasonable access, including ladders, platforms and clear space adequate for inspection and servicing of condensing units, compressors, condensers and other machinery shall be provided in accordance with the relevant national legislation (see foreword).

6.1.5 Condensing units or compressor units with enclosures

Condensing units or compressor units with enclosures shall be readily accessible for inspection and servicing.

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

6.1.6 Water supply connections and discharge connections

6.1.6.1 Water supply connections and discharge connections shall comply with all the applicable health and safety standards listed in annex A of SANS 347:2012. In the case of water-cooled systems, the water shall be tested at least once a year for legionnaire's disease and dated clearance certificates shall be issued.

6.1.6.2 In refrigeration plants where ammonia is used, a safety eye-wash facility and a safety shower facility shall be available on the outside of the plant, but close to the engine room and to other convenient points adjacent to intended service points in passages.

NOTE Potable water is essential for washing eyes affected by ammonia and for washing down floors, since it readily absorbs ammonia.

6.1.6.3 Discharge water lines shall not be connected to the waste system or sewer system direct. The waste from water lines shall pass through an air gap and trap in accordance with SANS 10400-P.

6.1.7 Air ducts

6.1.7.1 Air duct systems of air-conditioning systems that use mechanical refrigeration shall be designed and installed in accordance with recognized standards.

6.1.7.2 Air ducts that pass through a plant room shall be of tight construction and shall not permit the ingress of refrigerant vapours into the air stream.

6.1.8 Joints

When the joints and all refrigerant-containing parts of a refrigerating system are located in an air duct through which conditioned air is transported to and from an occupied space, the joints and parts shall be so constructed as to withstand a temperature of 375 °C without causing leakage into the air stream. Joints on refrigerant-containing copper tubes that are made by the addition of filler metal shall be brazed.

6.2 System types that contain class A1/B1 refrigerants

6.2.1 Direct and indirect open cooling systems

In the case of systems designed to be used in occupancy classes A, B, C and D, the charge of refrigerant M_R, in kilograms, shall not exceed the mass given by the following equation:

$$M_R = 0{,}001\ cV \qquad (11)$$

where

c is the maximum allowable concentration of the refrigerant, in grams per cubic metre (see table C.2 or ASHRAE 34) in the occupied spaces;

V is either

a) the volume, in cubic metres, of the smallest occupied space into which the whole of the refrigerant charge could leak; or

b) the total volume, in cubic metres, of all occupied spaces cooled by one air-circulation system, provided that the duct work serving those spaces cannot be shut off other than in an emergency.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

It is not necessary to relate the maximum refrigerant charge to the volume of the rooms crossed by the piping if the pipelines are carried through rigid, tightly sealed, continuous, fire-resistant channels or ducts that vent to the atmosphere or to a plant room associated with the system or to a space containing other parts of the system (see 6.6).

In the case of refrigeration applications, the employer shall carry out a risk assessment to ensure that all systems pose an acceptable risk. Any system that poses an unacceptable risk shall be modified so that it poses an acceptable risk.

6.2.2 Indirect vented open, indirect closed, indirect vented closed and double indirect refrigerating systems

The maximum charge of refrigerant shall be restricted in accordance with 6.2.1, unless the refrigerating system (other than components outside the building and piping (see 6.6)) is to be installed in a plant room, in which case there are no restrictions on the charge.

6.3 System types that contain class A2/B2 refrigerants

6.3.1 Direct closed, indirect open, indirect vented open and indirect closed refrigerating systems

The restrictions that apply to the use of class A2/B2 refrigerants are given in table 9.

Table 9 — Restrictions that apply to class 2 refrigerants

1	2	3
Occupancy	**Restrictions for class A2/B2 refrigerants**	
	Maximum charge (mass) kg	**Use**
Class A	2,5	Restricted to hermetically sealed absorption systems installed or designed to be used only in kitchens, mortuaries and laboratories
Class B	2,5	Restricted to hermetically sealed absorption systems or to packaged units installed or designed to be used only in kitchens, mortuaries and laboratories
Class C	2,5	Restricted to hermetically sealed absorption systems and to packaged units
Class D	10	Restricted to hermetically sealed absorption systems and to packaged units
Class E	No restrictions[a]	All compressors and high-pressure side machinery shall be installed in a plant room with special requirements (see 6.11.3)

[a] Direct systems shall not be allowed for refrigeration areas with a personnel density greater than one person per 10 m^2, i.e. deboning rooms and sorting halls.

6.3.2 Indirect vented closed and double indirect refrigerating systems

6.3.2.1 The maximum charge of class A2/B2 refrigerants shall be as follows:

a) for class A occupancies: 250 kg;

b) for class B occupancies: 500 kg; and

c) for class C, D and E occupancies: no restrictions.

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

6.3.2.2 Machinery shall be installed in a plant room that complies with the requirements given in 6.11.3, or in the open air as follows:

a) for class A and B occupancies: all machinery; and

b) for class C, D and E occupancies where the refrigerant charge exceeds 500 kg: all compressors and high-pressure side machinery.

6.4 System types that contain class A3/B3 refrigerants

All systems that contain a refrigerant charge greater than 150 g shall have electrical equipment for hazardous areas that comply with SANS 10108.

All systems irrespective of the size of the charge of class A3/B3 refrigerants shall only be worked upon by technicians that have received specific training on such refrigerants.

6.5 Secondary refrigerants (heat-transferring substances)

Secondary refrigerants used in any indirect system in any occupancy class shall have either

a) no flashpoint, or

b) a flashpoint higher than 66 °C.

Systems that use secondary refrigerants with a capacity of over 500 kW shall be fitted with refrigerant detectors in the secondary circuit.

6.6 Location of refrigerant piping

6.6.1 Piping

Refrigerant-carrying piping shall comply with the requirements of this standard for the particular installation as detailed in ASME B31.5.

6.6.2 Passages

Refrigerant-carrying piping shall not obstruct free movement in any passage in a building.

Refrigerant-carrying piping shall not be located in any lift shaft, dumb waiter, shaft that contains a moving object, or in any shaft that opens into living quarters or main exits.

6.6.3 Refrigerant piping for class A1/B1 refrigerants

Refrigerant piping for class A1/B1 refrigerants shall not be located in any exit, lobby or stairway. However, non-ferrous tubing of an outside diameter that does not exceed 28,6 mm may pass across an exit if the tubing is contained in a rigid metal pipe.

6.6.4 Refrigerant piping for class A2/B2 and class A3/B3 refrigerants

Refrigerant piping for class A2/B2 refrigerants shall not be located in any exit, lobby or stairway, nor shall it be laid in rooms of occupancy class A, B or C. In the case of occupancy class D, piping that crosses rooms that do not contain other refrigeration machinery shall be carried through rigid, tightly sealed continuous, fire-resistant channels or ducts that vent to the atmosphere or to the plant room. In the case of class A3/B3 refrigerants, piping shall be restricted to rooms that contain the other refrigeration machinery concerned.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

6.6.5 Installation of piping

6.6.5.1 Location of piping

Refrigerant-carrying piping shall be so located that it will not be liable to accidental damage by moving vehicles. Split systems shall be installed in ducts that have a negative grading away from the shaft.

6.6.5.2 Visual inspection and testing

Refrigerant-carrying piping erected on refrigeration plant premises shall be visually inspected and pressure tested before being covered or enclosed.

6.6.5.3 Piping clearance

Refrigerant-carrying piping that is installed in an open space that affords passageway into any building shall be located against the ceiling or not less than 2,2 m above floor level.

6.6.5.4 Recommended spacing for supports for piping

6.6.5.4.1 The recommended maximum spacing for supports for copper pipe is given in table 10.

Table 10 — Recommended maximum spacing for supports for copper pipe

1	2
Outside diameter mm	**Spacing** m
15 to 22 soft[a]	2
22 to < 54 half hard[a]	3
54 to 67 half hard[a]	4
[a] The terms "soft" and "half hard" are defined in EN 12735-1 and EN 12735-2.	

6.6.5.4.2 The recommended maximum spacing for supports for steel pipe is given in table 11.

Table 11 — Recommended maximum spacing for supports for steel pipe

1	2
Nominal diameter (DN) of nominal bore (in accordance with ISO 6708) mm	**Spacing** m
15 to 25	2
32 to 50	3
65 to 80	4,5
100 to 150	5
200 to 350	6
400 to 450	7

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

6.6.5.5 Vertical piping

Vertical refrigerant-carrying piping shall only be installed as follows:

a) from the basement(s) to the ground floor, or from the top floor to a refrigeration plant penthouse or to the roof, or between adjacent floors served by the refrigerating system; and

b) for the purpose of interconnecting separate pieces of equipment not located as described in (a),

   1) the piping may be carried in a rigid, tightly sealed, continuous, fire-resistant pipe duct or shaft that has no openings into floors not served by the refrigerating system, or

   2) it may be carried on the outer wall of the building, provided that it is not located in a ventilation shaft or in a closed court or in similar spaces enclosed within the outer walls of the building. The pipe duct or shaft shall vent to the outside of the building.

6.6.5.6 Horizontal piping

Refrigerant-carrying piping shall be installed horizontally in closed floors or in open spaces. Piping installed in concrete floors shall be encased in pipe ducts.

6.7 Refrigerant detectors

6.7.1 General

Refrigerant detectors shall be fitted into plant rooms for refrigerants with an ozone depletion potential greater than zero and a global warming potential greater than zero, as well as in plant rooms that have toxic refrigerants or asphyxiation characteristics (or both).

6.7.2 Detector sensitivity

A refrigerant vapour detector shall function at a concentration that does not exceed

a) 25 % of the lower flammability limit (LFL) or 50 % of the acute toxicity exposure level (ATEL) or oxygen depletion level (ODL). Note that for refrigerants with a characteristic odour below the ATEL or ODL, for example ammonia (R 717), detectors are not required for toxicity but to limit the possibility of an explosion;

b) for ammonia (R 717/NH_3) systems with more than 50 kg that present an explosion or fire hazard: 350 mg/m^3 (500 × 10^{-6} (volume fraction)) for an alarm and when the emergency ventilation system should be started, and up to a maximum of 7 070 mg/m^3 (10 000 × 10^{-6} (volume fraction)) whereupon the plant power supply shall be switched off thereby disabling the plant, and

c) 25 % of the lower explosive limit of the refrigerant vapour in the case of class A2/A3 refrigerants.

NOTE Detection of lower concentrations is preferred. For instance, in unoccupied ammonia plant rooms the limit should be 500 × 10^{-6} for alarm and 1 000 × 10^{-6} for trip conditions, and for occupied spaces the limit should be 50 × 10^{-6}. See also annex B for alarm and trip points for mine installations.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

6.7.3 Detector location

To ensure that all the refrigerant-containing equipment is properly monitored, the refrigeration concentration in each room shall be monitored in accordance with the detector manufacturer's recommendations concerning the area per unit. The location of detectors shall be chosen in relation to the refrigerant, and these shall be located where the refrigerant from a leak will collect. Areas around ammonia pumps and compressors that could suffer from shaft seal leaks shall be given priority.

6.7.4 Warning

A detector shall, when activated by a refrigerant concentration that exceeds the pre-set limit, in addition to its other functions, initiate an alarm that shall remain on until reset manually.

The power supply to the detection system shall be from an independent source.

When the refrigerant detection system is to remain operational beyond the pre-set limit, it shall comply with the instrumentation class suitable for use in hazardous areas as defined in SANS 10108.

6.8 Isolating devices

6.8.1 General

Valves and stopcocks shall be of such a type that it is possible to tighten or to change the gland packing while the refrigerating system is under pressure.

6.8.2 Isolating devices for operation at any time

All refrigeration systems shall have sufficient critical isolating valves to restrict refrigerant release during repairs or other incidents. Isolating devices for essential operation at any time or during an emergency shutdown shall have either a hand-wheel or a rigidly mounted manually operated element.

6.8.3 Isolating devices that are not used during the operation of the refrigeration plant

Isolating devices that are not used during the operation of the plant (i.e. devices for facilitating repair and maintenance) need not be fitted with a hand-wheel or with a rigidly mounted manually operated element. They may be fitted with screwed sealing caps, to prevent their being operated by unauthorized persons.

If gland leakage has taken place, danger could arise when sealing caps are removed from valves used for ammonia and other class A2/B2 or B3 refrigerants.

6.8.4 Arrangement of isolating devices

To minimize danger and to prevent loss of refrigerant, machines and apparatus shall be equipped, individually or in groups, with isolating devices.

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Any piping, machinery or apparatus that is isolated with devices fitted with hand-wheels and that can be subjected to hydraulic lock (i.e. containing liquid that might, due to an increase in temperature, cause extreme pressures) shall be fitted with a suitable pressure-relief device vented to a safe area or back into another part of the refrigeration system in a safe manner. In the latter case, the pressure-relief device shall be of a type not affected by back-pressure. Items that can be isolated with devices fitted with sealing caps shall only be isolated by level B and C competent persons (see annex D).

NOTE Because of the danger of brittle fracture at low temperatures, any apparatus that has to be removed periodically for maintenance should be so installed between isolating devices that it can be removed without the pipes having to be sprung.

6.9 Electrical equipment

6.9.1 General

Electrical equipment and installations shall comply with the relevant national legislation (see foreword). In locations where condensation can occur, the equipment shall be of a type suitable for these conditions.

The wiring of premises (including air-conditioning) shall be in accordance with SANS 10142-1 in terms of the said relevant national legislation.

6.9.2 General arrangements

The electricity supply to a refrigeration plant shall be so arranged that it can be switched on or off independently of the electricity supply to other items of plant and equipment, in general, and to any lighting system, warning system and mechanical ventilation unit, in particular.

6.9.3 Auxiliary electricity supply

6.9.3.1 Mechanical ventilation

The switching arrangements for fans for the mechanical ventilation of spaces of a refrigeration plant that uses a class A1/B1 refrigerant may be located inside the spaces. In the case of class A2/B2 or class A3/B3 refrigerants, the fans shall be controlled by switches located outside the spaces with an independent power supply.

6.9.3.2 Lighting

Lighting appliances inside and outside of a refrigeration plant shall facilitate the free movement of personnel, operation and maintenance in complete safety. An acceptable emergency lighting system that complies with the relevant national legislation (see foreword) shall also be provided to ensure that, in the event of failure of the normal lighting system, the operation of all controls and the evacuation of personnel can be speedily effected.

6.9.4 Special arrangements

6.9.4.1 Class A2/B2 and class A3/B3 refrigerants (excluding ammonia)

The electrical equipment of a refrigerating system that contains a flammable class A2/B2 refrigerant or a class A3/B3 refrigerant shall be suitable for use with an acceptable explosion protection technology for the classification of the area as defined in SANS 10108.

NOTE SANS 10108 classifies hazardous locations and specifies the types of electrical equipment to be used in those areas.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

6.9.4.2 Emergency push-stop buttons

Emergency push-stop buttons shall be installed in positions remote from the plant room and from enclosed spaces in all refrigerating systems. In the case of a system that contains a class A2/B2 or a class A3/B3 refrigerant, at least one emergency push-stop button shall be installed in a clearly defined location remote from the relevant space.

The purpose of the push-stop button is to stop the power to the refrigeration plant (but not to the lighting or ventilation systems, which shall be in accordance with SANS 10108) in the case of an emergency such as a refrigerant leakage or major mechanical failure. If the refrigeration motor control panel is installed in the same room as the refrigeration machinery, the emergency push-stop button shall disconnect the power supply from a remote position. The remote position shall be at the main distribution board and not at the refrigeration motor control panel, where the opening of a circuit-breaker could cause a spark.

6.9.4.3 Ammonia-and-air mixtures

Ammonia-and-air mixtures can be explosive, but only in the unusually high concentration range of 15 % to 27 % (mg/m^3) of ammonia and if ignited by a high-temperature source. Ammonia at a concentration of 0,0025 % (mg/m^3) or less is readily detected by smell, and detectors can detect it at a concentration of 0,05 % (mg/m^3) or less. In areas or enclosed spaces that house compressors and other non-static parts of refrigerating systems that contain ammonia, isolation of electrical circuits shall be affected by circuit-breaker(s) installed in a safe place.

The circuit-breaker(s) shall be controlled by the following:

a) at least one refrigerant detector (see 6.7) that

   1) operates at a level of concentration that does not exceed 500 × 10^{-6} (volume fraction) of ammonia;

   2) is fixed over non-static items of equipment from which leakage can occur;

   3) is so arranged as to give visible and audible alarms; and

   4) switches on equipment for increased ventilation (if installed); or

   5) switches off the refrigeration plant electricity supply if concentrations exceed the maximum permissible high level concentration limit for the plant maximum limit of 10 000 × 10^{-6} (volume fraction) (see the note to 6.7.2); and

b) push-stop buttons, if the area or enclosed space is always manned and occupied. The push-stop buttons shall be of the break-glass type, and shall be located outside exit doors.

NOTE 1 % (volume fraction) is equal to 1 000 000 × 10^{-6} (volume fraction).

6.10 Lightning protection

A refrigeration installation shall be protected from the harmful effects of lightning when the installation is in an area that is exposed to lightning strikes (for example roof mounted) or subjected to medium to high lightning occurrence, i.e. more than six strikes a year. Flexible joints and anti-vibration pads shall have earth continuity conductors bonded across them to pass harmful electric currents or to prevent the build-up of high voltages.

NOTE SANS 10313 covers the protection of structures against lightning.

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

6.11 Machinery areas and plant rooms

6.11.1 General

6.11.1.1 Refrigeration machinery or equipment shall be so located as to be protected against tampering, physical damage or exposure to excessive heat. Access may be restricted as follows:

a) in the case of machinery or equipment that is kept outdoors: by means of a shelter, shed, security fence, crash barriers, or other suitable form of protection or enclosure; and

b) in the case of machinery or equipment that is kept indoors: by installing the equipment either in a special plant room or in a general plant room that has restricted access.

6.11.1.2 A plant room shall be easily accessible for proper servicing, maintenance and operation. There shall be a clear head room of at least 2,2 m below equipment situated over passageways (see 6.6.5.3). Access to the plant room shall be restricted to authorized personnel.

6.11.1.3 Access to and from plant rooms shall be in accordance with particular site risk assessments.

6.11.1.4 Plant rooms shall be equipped with refrigerant vapour detectors with alarms.

6.11.1.5 No open-flame device or apparatus that can produce an open flame shall be used in a plant room where a class A2/B2 or a class A3/B3 refrigerant is used without adherence to particular site safety rules.

6.11.1.6 Plant rooms used as workshops etc. shall be considered occupied spaces under occupancy class E, but machine rooms for refrigerant plants that use class A2/B2 and A3/B3 refrigerants shall not be used for any other purpose.

6.11.2 Ventilation

6.11.2.1 Risk assessment

The employer shall carry out a risk assessment to ensure that all systems pose a manageable risk.

6.11.2.2 General (excluding underground mining operations)

An area that contains refrigeration equipment shall be ventilated in accordance with the following requirements:

a) Plant rooms shall vent to the outdoors. Natural ventilation, such as obtained through permanent openings or grilles, may be used unless mechanical ventilation is required because of practical considerations. The flow area for natural ventilation shall not be obstructed by shaft walls or surrounding buildings.

b) Natural ventilation shall not be used when the refrigerant vapour cannot be properly dispersed through the available openings. The total area of the unobstructed cross-sectional areas for such ventilation shall be related to the mass of refrigerant in the largest refrigerating system, any part of which is located in the plant room, and in accordance with the equation given in 6.11.2.3.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

c) Mechanical ventilation shall be by means of one or more power-driven fans that provide an exhaust of air from the plant room in accordance with 6.11.2.4. Multi-speed fans may be used to obtain a reduced airflow for normal ventilation. The air inlets shall be close to the refrigeration plant and shall be in line with the requirements of the relevant national legislation (see foreword). Discharge of the air shall be outdoors in such a manner as not to cause inconvenience or danger. Openings that allow the inlet of air to the plant room shall be so positioned as to avoid the intake of discharged air.

6.11.2.3 Natural ventilation

The unobstructed cross-sectional area for the natural ventilation of a plant room, *F*, shall be at least that calculated in accordance with the following equation:

$$F = 0{,}14 \times G^{0{,}5} \qquad (12)$$

where

F is the unobstructed cross-sectional area, in square metres;

G is the mass of refrigerant, in kilograms, in the largest part of the refrigerating system, any part of which is located in the plant room.

The openings shall be located with due regard to the density of the refrigerant in relation to the density of air.

6.11.2.4 Mechanical ventilation

Where natural ventilation is not provided, the exhaust airflow provided by mechanical ventilation shall be the volume required to maintain a maximum temperature of 8 K above ambient temperature, and the calculations shall be based on the heat generated by all the machinery in the room.

6.11.2.5 Emergency ventilation

For emergency ventilation, the air quantity shall be calculated in accordance with the following equation:

$$Q = 0{,}07 \times G^{0{,}5} \qquad (13)$$

where

Q is the airflow, in cubic metres per second;

G is the mass of refrigerant, in kilograms, in the largest part of the refrigerating system, any part of which is located in the plant room.

6.11.3 Special requirements for plant rooms (excluding underground mining operations)

The plant room shall comply with the following special requirements (in addition to the requirements given in 6.11.1) to isolate the refrigeration equipment from the occupied space, where necessary:

a) There shall be no flame-producing device or hot surface of temperature that exceeds 300 °C permanently installed in the room (see also footnote c to table 3).

b) Doors communicating to the building shall be acceptable, self-closing, tight-fitting doors.

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

c) Any wall, floor or ceiling shall be airtight and of not less than 1 h fire-resistant construction.

d) The plant room shall have an exit door that opens direct to the outside or through a vestibule-type exit equipped with self-closing, tight-fitting doors.

e) Any exterior opening shall not be situated under any fire escape or open stairway.

f) All pipes that pierce the interior walls, ceiling or floor shall be tightly sealed to the walls, ceiling or floor through which they pass.

g) Emergency remote controls to stop the action of the refrigerant compressor shall be provided and located outside the plant room.

h) An independent mechanical ventilating system that does not pressurize the exhaust duct and operates continuously shall be provided in basements. In all other locations, the machinery shall have continuous ventilation that does not pressurize the exhaust duct or shall be equipped with a refrigerant vapour detector that will automatically start the ventilating system and actuate an alarm at the lowest practical detection levels (maximum of 500×10^{-6} for class A2/B2 and A3/B3 refrigerants). The refrigerant vapour detector shall also initiate a supervised alarm in order that corrective action can be initiated. Regular testing of the detector(s), alarm(s) and mechanical ventilating system shall be performed.

i) Emergency remote controls for mechanical ventilating systems shall be located outside the plant room.

j) When class A2/B2 or class A3/B3 refrigerants, excluding ammonia (see 6.9.4.3) are used, the plant room shall comply with the requirements of SANS 10108.

k) When class A2/B2 and A3/B3 refrigerants, including ammonia, are used, the emergency ventilation fans and emergency lighting shall comply with the requirements of SANS 10108.

l) In plant rooms for class A2/A3 refrigerants (except ammonia) where the risk of explosion might occur should the concentration of refrigeration reach the lower flammability limit, some explosion relief (for example a frangible wall or roof) shall be provided.

NOTE It is strongly recommended that fire sprinkler systems not be installed in a plant room where ammonia is the refrigerant. Adding water to a pool of liquid ammonia can cause a sharp increase in the concentrations in the area with the possibility of elevating the concentration to the ignition level. In addition, this could create an ammonia/water vapour cloud that would elevate the dangers in the room by reducing visibility.

6.12 Field tests

NOTE See also 5.6.2.

6.12.1 General

6.12.1.1 After complete installation and before operation, test and prove gas-tight every refrigerant-containing part of every refrigerating system that is erected on site, except compressors, condensers, evaporators, safety devices, pressure gauges, control mechanisms and systems that are factory-tested.

6.12.1.2 Test the high-pressure side and the low-pressure side of each system and prove them gas-tight at the pressures given in 5.6.2.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

6.12.1.3 Systems that use a class A1/B1 refrigerant and copper tubing of outside diameter that does not exceed 16 mm, may be tested by means of the refrigerant charged into the system at the minimum design pressure of the refrigerant at 20 °C.

6.12.1.4 Ensure that the means used to build up the test pressure (see 5.6) either has a pressure-limiting device or a pressure-reducing device with a pressure-relief device and a gauge on the outlet side. Set the pressure-relief device at a pressure above the test pressure (see 5.6) but low enough to prevent permanent deformation of any system components.

6.12.1.5 Provide a declaration of the test (and the date thereof) for all refrigerating systems in accordance with the relevant national legislation (see foreword) Ensure that the declaration provides the name of the refrigerant and the field test pressures applied to both the high-pressure side and the low-pressure side of the system. Ensure that the declaration is signed by the installer or tester and the approved inspection authority (AIA) (in accordance with SANS 10227), as applicable.

6.12.2 Test medium

6.12.2.1 Use an inert gas for testing the system.

6.12.2.2 Do not, under any circumstances, use oxygen or a combustible gas or a mixture of combustible gases for testing within the system.

6.12.2.3 Do not use carbon dioxide in the testing of ammonia systems.

6.13 Marking

6.13.1 Pressure vessels and pressurized refrigerant vessels

Each pressure vessel and pressurized refrigerant vessel shall be fitted with a manufacturer's data plate that shall be securely attached to the outer shell in a conspicuous position. The manufacturer’s data plate shall bear at least the following information, and any other information that may be required in terms of the relevant national legislation (see foreword) and SANS 347, in legible and permanent marking:

a) the manufacturer's name;

b) the country of origin;

c) the manufacturer's serial number;

d) the year of construction;

e) the design pressure, in kilopascals;

f) the capacity, in cubic metres;

g) the reference number, date and edition of the health and safety standard (listed in annex A of SANS 347:2012);

h) the maximum and minimum design temperature, in degrees Celsius;

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

i) the unique mark of an approved inspection authority (AIA) (in accordance with SANS 10227) as applicable; and

j) the hazard category in accordance with the requirements of SANS 347.

If the pressure vessel is to be insulated, provision shall be made for the manufacturer's data plate to be visible after the vessel has been insulated, for example by an extended bracket.

6.13.2 Compressor units

Each compressor unit shall be fitted with a manufacturer's identification plate that is securely attached to the outer shell in a conspicuous position and that bears the following information in legible and permanent marking:

a) the manufacturer's name;

b) the model number;

c) the serial number;

d) the prime mover power, in kilowatts; and

e) the refrigerant type.

6.13.3 Metal signs

Refrigerating systems that contain more than 500 kg of refrigerant shall have metal signs, which have letters of height at least 20 mm, to designate the isolating shut-off valves to each vessel, the main stream control or the electrical control, the remote control switches, and the pressure-limiting devices installed outside the refrigeration plant room.

A schematic drawing of the plant shall be mounted outside the plant room clearly identifying all of the numbered critical isolation valves in the system. All exposed high-pressure and low-pressure piping shall bear signs with the name of the refrigerant, the medium in the pipes, its direction of flow, and the letters "HP" or "LP".

All mandatory safety, first-aid and emergency procedures, and plant signs shall be mounted on metal plates in a clearly visible position outside the plant room.

6.14 Personnel inside cold rooms

Any refrigerated chamber (and associated airlocks), the dimensions of which are sufficient to permit entrance to a person, shall be so constructed as to incorporate the following safety provisions:

a) an escape door that can readily be opened outwards from the inside when every outside-operated lock or catch is fastened;

b) in the case of any door that opens pneumatically, a means for opening the door by hand, and a means to prevent a closing door from causing injury;

c) an alarm, operated by means of illuminated buttons or by chains hanging near the door, and incorporating a fixed or flashing signal or a buzzer or bell that is visible or audible in a constantly manned place;

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

d) where artificial lighting is provided within the chamber, a light switch inside the chamber, and an outside indicator lamp, arranged to show whether the chamber lighting is on;

e) a means to ensure that the way towards emergency exits and the way towards signage remains visible in the event of failure of the lighting system; and

f) in the case of a class A2/B2 or a class A3/B3 refrigerant there shall be, for each refrigerant pipeline that enters the cold room, an individual isolating valve that is situated outside the cold room. One or more of the following provisions shall also be available:

   1) emergency tools, for example an axe or spanner, inside each chamber near the door;

   2) a verbal communication device in every chamber; and

   3) an unlocked safety exit that can be opened from the inside only, or a panel in the door of the chamber that is of a size large enough to permit a man to pass through, and that can be readily removed from inside the chamber.

6.15 Plant and equipment in the open air

Refrigeration plant and equipment installed outdoors shall be weatherproof. Both the plant and the equipment shall be inaccessible to unauthorized persons. When the plant is installed on a roof, care shall be taken to ensure that no refrigerant can enter the building below.

A plant installed in the open shall have a risk assessment performed to determine its effect on the immediate environment.

7 Staff competence, operation and maintenance

7.1 General

The levels of competence shall be as given in annex D.

All personnel involved in the operation and maintenance of refrigeration installations shall have been trained on the functioning of the installation to ensure that they are fully conversant with the equipment concerned.

In the case of a refrigeration plant erected on site, the personnel that are to be involved in the operation and maintenance shall be present during the erection, testing, charging of refrigerant, and adjustment of the plant. Personnel who, in the course of their duties, have to enter refrigerated spaces, shall be trained in the use of all safety devices, procedures and health hazards and shall be qualified at the appropriate level of competency.

Control and safety devices that shall not be operated by unauthorized persons, shall be safeguarded against deliberate or accidental actuation.

The operation and maintenance of existing refrigeration plants shall comply with the requirements given in clause 7, and any conversions or modifications to such plants, shall be carried out by a level B or C competent person.

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

7.2 Duties of the responsible person

It shall be the duty of the user or employer of the premises on which a refrigerating system that contains more than 25 kg of refrigerant is installed, to place instructions (conspicuously and as near as is practicable to the refrigerant compressor) for the operation of the system, and the precautions to be observed in the case of a breakdown or leak, as follows:

a) essential instructions for operation of the system;

b) instructions for shutting down the system in the event of an emergency;

c) the name, address and day and night telephone numbers of the installer;

d) the name, address and telephone number of the relevant emergency service that has jurisdiction;

e) instructions to notify the relevant emergency service immediately;

f) information on the system refrigerant type and charge, operating pressures, relief valve settings and compressor oil;

g) first-aid instructions; and

h) a suitable diagram of the piping layout of the refrigerating system that indicates the critical shut-down valves for an emergency.

7.3 Instruction manual

The manufacturer or installer shall supply, with the refrigeration plant, at least one copy of an instruction manual that contains at least the following information:

a) a description of the plant and equipment (accompanied by a refrigerant circuit diagram and an electrical circuit diagram);

b) technical data sheets on construction in accordance with the relevant national legislation (see foreword) and SANS 347, including but not limited to

   1) pressure vessel certification,

   2) pressure certification for compressors and heat exchangers (such as evaporators and condensers),

   3) certificates of compliance for all valves and controls,

   4) material certificates for all pipework and fittings used,

   5) piping stress calculations (signed off by a professional engineer),

   6) pressure-relief valve sizing calculations,

   7) welding procedures, and

   8) welder's qualifications;

c) certification by a level C competent person (see annex D) that the plant complies with this standard;

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

d) detailed information for starting up and shutting down the plant, and emergency procedures;

e) notes on possible failures, their causes, and methods of repair;

f) maintenance instructions (preferably accompanied by a schedule);

g) detailed information on first-aid procedures in the event of injury;

h) the designation of the refrigerant and the charge in kilograms required for normal operation;

i) a warning against erroneously charging with the wrong refrigerant;

j) a material safety data sheet for the refrigerant in the system;

k) a warning against the freezing of water in condensers, coolers, etc.; and

l) a detailed warning that substitution of a refrigerant shall not be made without the approval of a level C competent person.

7.4 Schedule of operation

The operation of a refrigeration plant shall be carried out by level A qualified competent personnel. In cases where the input power to the compressor(s) exceeds 20 kW or in cases where the installation is used in conjunction with a refrigerated chamber, the following shall be required:

a) the user or employer shall appoint, in writing, at least one level B competent person to examine and operationally test the entire system, excluding pressure-relief devices, at least once every three months;

b) the user or employer shall provide a logbook in which the following shall be entered:

   1) the name and level of competency of the competent person(s), or the name of his employer, responsible for the maintenance of the plant;

   2) the name and address of the manufacturer or, when relevant, of the supplier of the system;

   3) the maximum rated refrigerating capacity stated by the manufacturer, in kilowatts, and the temperatures, in degrees Celsius, at which the capacity is calculated;

   4) the refrigerant used and its charge in kilograms;

   5) the design pressure, in kilopascals;

   6) pressure vessel test certificates/data sheets; and

   7) all information and tests in accordance with statutory requirements;

c) in the case of a system that uses a class A2/B2 or a class A3/B3 refrigerant

   1) the user or employer shall provide, at the entrance to every plant room (or at a readily accessible place nearby), an acceptable length of 25 mm hose that is permanently connected to a water supply with a minimum pressure of 400 kPa complete with a diffusion nozzle, two suitable gas masks and two sets of air-breathing apparatus (see 7.8) that shall be examined at least once every three months by a competent person (see (e)), and

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

2) the user or employer shall, in a safe area close to the entrance to every plant room that contains equipment charged with refrigerant, or stored refrigerant, post instructions in the first-aid treatment of persons suffering from gassing effects and ensure that a water supply is available;

d) before commissioning or re-commissioning the refrigeration plant, the user or employer shall confirm that a level B qualified competent person has ensured that all safety devices are in proper working order and has satisfied the employer, in writing, that the entire plant is in safe running order. The said competent person shall also pay particular attention to the high-pressure side of the system and its operating conditions;

e) the user or employer shall ensure that the competent person who carries out the examinations required in terms of (c)(1), duly records, signs and dates the result of each examination in the logbook; and

f) the user or employer shall take precautions to ensure that no system (or part thereof) that contains or can generate dangerous, toxic, asphyxiating, explosive or flammable liquids, gases, fumes or vapour will be opened until the section being repaired is fully vented of all dangerous fumes and fluids, all other personnel in the danger zone are evacuated, and that level B qualified competent repair personnel are protected with properly maintained breathing apparatus and resuscitation apparatus (that can be easily and readily used) and lifelines are readily available (see 7.8).

CAUTION To prevent mixing of unsuitable substances (that could cause an explosion or other accident) when charging or transferring refrigerant, the correct gas cylinders for the system shall be used. Refrigerant cylinders shall be disconnected from the system immediately after completion of a transfer of the refrigerant and the charging valve shall be properly blanked off.

When transferring refrigerant out of the system into cylinders, proper procedures shall be employed to make sure that the receiving cylinders are never overfilled. Frequent determination of the mass of refrigerant in the transfer cylinder shall be made using a scale, so as not to exceed the permissible mass stamped on the cylinder.

7.5 Maintenance

To avoid danger to persons and damage to equipment, refrigeration plants shall be carefully maintained by level B qualified personnel to whom this duty is assigned. As a minimum, checks shall include a visual examination of the plant for leakage and damage, to ensure that the function of the automatic protective devices and controls are in good order, and that instrument readings etc. are within the design conditions.

No works or repairs shall be carried out before a hazard analysis and a risk assessment for the works have been done and approved by the resident engineer. If there is no resident engineer, a competent level B person shall draw up the report and submit it to the user or owner.

The user or owner of the refrigerating plant shall ensure that the system is inspected regularly, supervised, and that all safety equipment is maintained in an acceptable manner. The results of these works and any remedial works shall be recorded in the logbook.

When a dangerous leakage of refrigerant has occurred (see annexes E and F), non-qualified personnel shall be evacuated and shall not be permitted to re-enter the enclosed space until it has been cleared by purging or ventilating. Only appropriately qualified and appropriately clothed level B personnel shall enter the enclosed space wearing a lifeline gas mask or breathing apparatus. In all cases, at least one level B competent person, similarly clothed, shall remain in attendance outside, and next to, the entrance of the enclosed space ready and able to assist, if necessary.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

7.6 Use of arc-producing and flame-producing apparatus

If any work, repairs or modification requires the use of arc-producing and flame-producing apparatus (such as welding and brazing equipment), the work shall not be started until a full risk assessment of the works has been approved by the responsible person and that part of the plant, including the surrounding area, has been thoroughly ventilated. While the work is being carried out, the mechanical ventilation, if any, shall be kept in constant operation and all windows and doors shall be kept open. In the case of repairs to parts of the refrigerant circuit, the workman shall always have a second person with a fire extinguisher in attendance. No unqualified site personnel shall be present.

The necessary protective equipment, as deemed by the risk assessment, shall be available and fire-extinguishing apparatus shall be readily accessible.

Special attention shall be applied when the refrigerant is class A2L, A2 or A3, i.e. flammable. Only personnel correctly trained in the use of these refrigerants shall be allowed to open equipment housings and break into the refrigerant circuit. The leak detection equipment used shall be non-sparking, sealed or intrinsically safe and shall comply with annex E of EN 378-4:2012.

Welding and brazing shall comply with the requirements of the relevant national legislation (see foreword) and shall be carried out by suitably qualified welders in accordance with procedures as laid out in the applicable health and safety standards listed in annex A of SANS 347:2012. When apparatus and piping are being connected by welding or brazing, care shall be taken to ensure that the apparatus and piping are completely free from explosive gas mixtures and oil.

7.7 Standard operating procedures for refrigerated chambers

The following administrative arrangements and standard operating procedures shall be arranged and enforced:

a) the mechanisms of all emergency exit doors shall be kept in good working order and shall be periodically tested;

b) all emergency exit doors shall be kept easily accessible and unlocked when personnel are working in the enclosure;

c) personnel should not work alone in a refrigerated chamber. If working alone is unavoidable, a safety check shall be made at least hourly, and at more frequent intervals where installations operate at below zero temperatures or where, for other reasons, more care is necessary. Due regard shall be taken of the relevant national legislation (see foreword);

d) after work has ceased, a responsible person (see 7.2 and D.3.2.1) shall inspect each refrigerated chamber to ensure that it is clear of personnel and then lock it; and

e) an audible alarm button shall be located inside the cold room in an easily accessible place for emergency purposes should cold room personnel be locked inside the room accidentally.

7.8 Personal protective equipment

7.8.1 Respiratory protection

7.8.1.1 Respirators and self-contained breathing apparatus shall be provided as follows:

a) if the amount of a class A2/B2 refrigerant used in a system exceeds 50 kg, at least two respirators (masks or hoods) with rubber gloves shall be provided at a location conveniently close to the plant room;

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

b) in cases where the amount of any refrigerant exceeds 500 kg in a confined space with class A1/B1, class A2/B2 and class A3/B3 refrigerants or for controlled atmospheric cold rooms, two self-contained breathing apparatus that have an effective life of at least 25 min shall be provided in addition to the respirators; and

c) at least one additional air cylinder per self-contained breathing apparatus shall be kept to extend the response time available.

7.8.1.2 Respirators and breathing apparatus shall be selected, used, inspected and maintained in accordance with EN 137, and, in particular,

a) a logbook of inspections and any renewals or replacements shall be kept;

b) inspection intervals shall not exceed three months;

c) canisters and cartridges shall be renewed immediately

   1) after use,

   2) when the seal has been broken for any reason, and

   3) on the marked expiry date; and

d) cylinders of compressed air shall be renewed or refilled immediately after use.

All personnel who might have to use these respirators shall be given practical training in the fitting and use of respirators.

Canister respirators are not suitable for high concentrations of gases or for use for prolonged periods.

7.8.2 Protective clothing

Where more than 500 kg of ammonia is used as the refrigerant, one set of acceptable protective clothing shall be provided for each set of self-contained breathing apparatus. This shall include the following:

a) a level B chemical suit;

   NOTE Levels of protection of chemical suits are defined in NFPA 1991.

b) one pair of steel cap rubber boots;

c) one pair of suitable rubber cold-resistant gloves;

d) one lifeline; and

e) one roll of tape to seal gloves and boots to the chemical suit.

7.8.3 Location and storage of protective equipment

Personal protective equipment shall be kept in a suitable, easily accessible, locked cabinet immediately outside the refrigeration plant room. The cabinet shall be reserved exclusively for such equipment and shall be clearly and suitably marked. In a release or emergency situation at the plant, it shall be possible to access the protection equipment. This could require that a set of equipment be kept remote from the plant room.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

8 Inspection and testing of refrigeration plants

8.1 General

All refrigeration plants with a prime mover of over 10 kW shall be subjected to a written scheme of examination, comprising the following:

a) identification of all the pressure components within the refrigeration system;

b) those items that require periodic inspection;

c) the type of inspection that is required;

d) the maximum period between inspections;

e) the name of the authorized person certifying the written scheme of inspection; and

f) the date of certification.

A suggested layout of the written scheme of examination is shown in annex G.

8.2 Inspection and testing

8.2.1 During the operational life of the refrigeration system, carry out inspection and testing in accordance with the applicable health and safety standards listed in annex A of SANS 347:2012 or, alternatively, in accordance with annex H.

Table 12 shows the actions to be carried out for various inspection and test procedures.

Table 12 — Refrigeration system inspection and testing guide

1	2	3	4	5
External visual inspection (in accordance with annex H)	**Test**			**Subclause**
	Pressure test system	**Refrigerant leak detection**	**Safety device check**	
X				8.2.2
X		X		8.2.3
X	X	X		8.2.4
X	X	X		8.2.5
		X		8.3
			X	8.4

8.2.2 Carry out in-service inspection in accordance with annex H.

8.2.3 Carry out inspections in accordance with the relevant national legislation (see foreword), in the following cases:

a) after work that is liable to affect strength, or when a change of use, has occurred,

b) when changing to another refrigerant,

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

c) operation at a higher pressure, or

d) after a standstill for a period longer than two years.

8.2.4 Carry out inspections after repair, significant alterations or extensions to the system. Ensure that testing is restricted to the parts affected. Where repairs have been made to vessels or piping, ensure that the requirements of the relevant national legislation (see foreword) and SANS 347 have been complied with.

8.2.5 Carry out inspections after a system is reinstalled on another site. Should the reinstallation comprise the disassembly of the pressure envelope, also apply a pressure test.

Ensure that the requirements of the relevant national legislation (see foreword) with regard to inspection for reinstallation, are complied with.

8.3 Refrigerant leakage

8.3.1 If a serious refrigerant leak is suspected, inspect the system by using direct or indirect methods to focus on the parts of the system that are most likely to leak.

8.3.2 For self-contained and small systems with a refrigerant charge below 3 kg, carry out in-service inspection after repairs have been made. If a refrigerant leak occurs on such systems, leak test the whole system.

8.3.3 On ammonia systems, investigate leaks before repairs are carried out owing to the fact that pinhole leaks might be the result of stress corrosion cracking, and repair welding might cause further cracking.

8.3.4 The mandatory inspection periods for leak testing refrigeration systems are given in table 13.

Table 13 — Frequency of inspection for leakage

1	2
Refrigerant charge and system type	**Frequency of leak detection** months
Charge over 3 kg, except for hermetic systems that contain less than 6 kg	12
Applications that contain more than 30 kg	6
Applications that contain more than 300 kg	3

8.4 Safety devices

Check safety devices other than relief devices on site every three months. This includes safety switches, emergency signals, alarm systems and refrigerant detectors.

8.5 Pressure-relief devices

Every six months, visually inspect pressure-relief devices externally for corrosion, accumulation of scale, and for leaks. Connect an access pipe section to the outlet of each relief valve to permit individual checking for leaks along with a device to indicate if a relief valve has vented. Inspect vent lines to ensure that they discharge to a safe place and are protected against the ingress of moisture.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

At intervals that do not exceed three years, remove pressure-relief valves (or cartridges) and replace these with new or overhauled and recalibrated valves (or cartridges) with suitably marked seals, and issue new certificates indicating the valve details and repair date.

Correctly select replacement pressure-relief devices both for set pressure or operating pressure and for capacity or throughput. Ensure that common vent lines that interconnect a series of relief valves are suitably sized.

Ensure that pressure relief valves never directly vent liquid refrigerant to the atmosphere. Ensure that all relief connections from a liquid source freely vent into a system pressure vessel that has relief valve protection from the vessel gas space.

9 Charging, discharging or substitution of refrigerants

NOTE See annex E for the provisions that relate to ozone-depleting substances.

9.1 Charging and discharging of refrigerants

9.1.1 When a refrigerant is added to a system, except to a packaged unit that requires less than 3 kg of refrigerant, the refrigerant shall be charged into the low-pressure side of the system. Any point on the downstream side of the main liquid-line isolating valve shall be considered part of the low-pressure side when the system is operating with the isolating valve in the closed position. No service container shall be left connected to a system except when the refrigerant is being charged or discharged.

NOTE All zeotropic refrigerants (for example 400 series) should be charged in liquid form. Refer to the manufacturer's instructions for details.

9.1.2 Refrigerants discharged from refrigerating systems shall be transferred to acceptable containers only. As any refrigerant-contaminated water is classed as hazardous waste, no refrigerant shall be discharged into a sewer, river, stream or lake.

Ammonia may be discharged into the open atmosphere with due regard to safety, but preferably it should be discharged into water.

9.1.3 Containers used for capturing refrigerants that have been discharged from refrigerating systems shall be carefully weighed each time they are used for this purpose, and the containers shall not be filled in excess of the permissible filling mass for such containers and such refrigerants.

9.1.4 The amount of refrigerant stored in plant rooms (over and above the normal charge) shall not exceed the greater of 20 % of the normal refrigerant charge and 100 kg of the refrigerant. The refrigerant in the system shall be stored in a permanently attached receiver or in standard storage containers.

9.1.5 In the case of refrigerating systems that use refrigerants designated as controlled substances under the *Montreal Protocol on substances that deplete the ozone layer*, precautions shall be taken to avoid the emission of such refrigerants into the atmosphere during operation and maintenance (see annex E). Unless impractical, such precautions shall involve practices and devices recommended in national or international standards on the conservation and reclamation of such refrigerants.

9.1.6 Discharge of refrigerants into the atmosphere shall be minimized. Unavoidable discharge of refrigerants shall take place in such a way that persons are not endangered or in a way that impacts on the environment. The requirements given in D.3 shall apply for the treatment of all refrigerants.

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

9.2 Substitution of refrigerants

9.2.1 Substitution of a refrigerant shall not be made without the permission of the AIA and the tenant or the owner, as applicable, the manufacturers of the original equipment, and without due observance of the relevant safety requirements. The following considerations shall also be taken into account:

a) the effect of the substitute refrigerant on the lubricant and components in the system;

b) the possibility of overloading the liquid receiver on pump-down, which should contain not more than 80 % of the liquid;

c) the possibility of exceeding the rated motor power, design pressure or any other element that would violate any requirement of this standard;

d) the suitability of the existing refrigerant controls for maintaining the functioning of the substitute refrigerant in the system;

e) the possible hazards created by the mixture of the original and the substitute refrigerant; and

f) the effect of the classification of the refrigerant as provided in this or in any other relevant standard.

9.2.2 When the refrigerant is substituted in accordance with 9.2.1, the existing metal sign shall be replaced with a new metal sign (of the same type as specified in 6.13.3) that clearly indicates that a substitution has been made, and that gives the same information for the substitute refrigerant as was given for the original refrigerant.

9.3 Manual emergency discharge of refrigerant

The manual discharge of refrigerant is not recommended. However, should the manual discharge of refrigerant be absolutely necessary during an emergency, it shall be carried out in accordance with annex I.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Annex A
(normative)

Selection of materials

A.1 General

A.1.1 The materials to be used for the construction of, or for welding and brazing on, refrigeration plants shall be chosen with consideration for the chemical, mechanical and thermal stresses to which they will be subjected. The materials shall be resistant to the refrigerants to be used, to mixtures of refrigerant and oil, to possible impurities and contaminants, and to any heat-transferring liquids that might be present.

A.1.2 Pressure vessels, tanks, piping and fittings shall be manufactured from materials that comply with the appropriate health and safety standards listed in annex A of SANS 347:2012.

A.2 Ferrous metals

A.2.1 Cast iron and malleable iron

Cast iron and malleable iron pipes and fittings shall not be used in the refrigerant circuit, but may be used in heat-transferring liquid circuits.

A.2.2 Unalloyed and low-alloyed steel and cast steel

Steel and cast steel (unalloyed and low-alloyed of acceptable quality) may be used for all parts that carry refrigerant and also for heat-transferring liquid circuits. In low-temperature installations, the impact strength shall be acceptable for the design conditions.

NOTE A pipeline that carries a mixture of oil and refrigerant should be regarded as a refrigerant-carrying pipeline.

A.2.3 High-alloy steel

High-alloy steel, which is a special material, could be required for use at low temperatures, at higher pressures, and where corrosion risks are present.

A.3 Non-ferrous metals and their alloys

A.3.1 Copper and copper alloys

Copper in contact with refrigerants shall be oxygen-free or deoxidized.

Copper or copper alloys that have a high percentage of copper shall not be used in contact with ammonia or methyl formate. Copper alloys, such as brass and bronze, may be used after careful testing of their compatibility with the materials that they will come into contact with, for example, as a component of brass and bronze alloys for bearings or other non-refrigerant-containing uses.

A.3.2 Light metals

Light metals (for example aluminium and its alloys) shall not be used in contact with methyl chloride (chloromethane). Light metals are, however, suitable for use in ammonia systems. If used as a material for gaskets for use with refrigerants, light metals shall be of suitable purity as given in SANS 10012.

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

A.3.3 Zinc

Zinc and its alloys shall not be used in contact with methyl chloride, ammonia or fluorinated refrigerants.

A.3.4 Magnesium

Magnesium and its alloys shall not be used in contact with methyl chloride (chloromethane) or with any halogenated refrigerants. Alloys that have a low percentage of magnesium may be used, provided that their ability to resist the materials that they come into contact with has been carefully tested.

A.3.5 Lead

Except for packing purposes, lead shall not be used in contact with fluorinated refrigerants.

A.3.6 Tin and lead or tin alloys

Tin and lead or tin alloys are corroded by fluorinated hydrocarbons and their use at operating temperatures below −10 °C is not recommended.

A.3.7 Soldering and brazing alloys

A.3.7.1 Soft soldering alloys

Tin-based solders may be used where mechanical stresses are low, but are not recommended for operating temperatures below −10 °C.

A.3.7.2 Brazing alloys

Before use, brazing alloy components shall be tested for their compatibility with refrigerants.

NOTE Owing to the development of new soldering materials and methods, in particular for joining aluminium parts, recommendations on the use of soldering materials and methods are not given. Soldering materials that contain zinc or other metals that are normally not compatible with certain refrigerants should, however, only be used after the manufacturer of the refrigeration equipment has proved conclusively that such soldering materials can be safely used.

A.4 Non-metallic materials

A.4.1 Gaskets and packing materials

Packing materials for sealing joints and for sealing stuffing-boxes on fittings etc. shall be resistant to the refrigerants and the refrigerating machine oils used, and shall also be suitable for the pressures and temperatures concerned. Care shall be taken to prevent erosion that could cause leakage and risks.

A.4.2 Glass

Glass may be used anywhere in the system, particularly for fluid gauges and for observation ports, provided that it is of a quality resistant to the pressures, temperatures and chemical actions that could occur.

A.4.3 Plastics materials

Plastics materials may be used, provided that they are adequate for the mechanical, thermal, chemical and long-term creep stresses that occur, and provided that they do not increase fire risks.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Annex B
(normative)

Ammonia refrigeration safety for mining applications

B.1 General

Underground mining areas are classified in accordance with table 2 as class A occupancies. Ammonia refrigeration machines installed on mines typically have large cooling capacities and, consequently, special care shall be exercised when dealing with ammonia safety on mines. The requirements given in this annex are additional to the requirements of this standard.

B.2 Location of plants

B.2.1 Ammonia refrigeration plants shall be located not less than 200 m downwind from the closest air intake to the underground workings.

B.2.2 Ammonia plants shall be located taking cognizance of the prevailing wind direction in order to reduce the risk of ammonia reaching the mine shaft(s).

B.2.3 More than one escape route shall be installed in the plant rooms. Each exit shall have safety showers and eyewash facilities.

B.3 Ventilation and lighting

B.3.1 The exhaust airflow used for ventilation in plant rooms that house ammonia refrigeration plants shall be the greater of the value calculated in accordance with 6.11.2.4 and the value needed to change the air in the plant room 10 times every hour. Additional emergency ventilation (in the case of leaks) shall also be readily available to increase the normal ventilating airflow by 33 %.

NOTE If physical security is the only issue in an area, then the options vary from an inherently safe open location to a lock-up plant room. If circumstances necessitate a lock-up plant room, the security of the room will only require normal construction and normal ventilation.

B.3.2 Emergency lighting and exhaust ventilation fans installed in plant rooms that house ammonia refrigeration machines shall be of explosion-proof technology in accordance with SANS 10108.

B.4 Ammonia detection

B.4.1 Each ammonia refrigeration machine shall have at least two ammonia detectors installed within its boundary. These ammonia sensors shall set off the alarm at a value not higher than 50×10^{-6} (volume fraction) and trip the complete installation at a value not higher than 200×10^{-6} (volume fraction).

B.4.2 It is mandatory to install ammonia sensors at the air outlet of surface bulk air coolers that cool mine air as a minimum requirement, which shall set off the alarm at a value not higher than 25×10^{-6} (volume fraction) and trip the complete installation at a value not higher than 50×10^{-6} (volume fraction). These settings also apply to any compressed air intake that could be in the path of a potential ammonia leak.

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

It is recommended that

a) the location and number of ammonia sensors be displayed, and

b) the concentration levels of the alarm and trip settings for surface bulk air coolers be determined following a risk-based assessment of conditions of the site, activities around the bulk air cooler, the amount of mixing between the cold air leaving the bulk air cooler and the air flowing down the shaft as well as the configuration of the ventilation network downstream.

B.4.3 Differential pH monitors shall be installed across the evaporators to monitor ammonia leaks into the chilled water. These shall set off the alarm at a differential value of one and trip the complete installation at a differential value of two. The monitors shall be set to read an absolute differential value such that when backwash is taking place (i.e. plate heat exchangers) they are also able to detect leaks when the water flow is reversed.

B.5 Pressure vessels

Pressure vessels that contain ammonia, including oil separators and oil filter vessels, shall comply with the following:

a) The minimum corrosion allowance shall be 2 mm.

b) The high-pressure side of an ammonia refrigeration installation shall be designed with a minimum pressure rating of 1 825 kPa absolute.

c) Unless unavoidable, no screwed connections should be used. This will greatly increase safety and reduce the risk of leaks.

d) The minimum size of connections (stubs) shall be DN 40.

e) Where possible, the pressure vessels shall be subjected to 100 % radiography.

f) Carbon steel pressure vessels shall be subjected to post weld heat treatment (PWHT). This shall be supervised by an AIA. Magnetic particle inspection (MPI) shall be carried out before and after the PWHT takes place in order to make sure that no cracks develop during the heat treatment.

g) The relevant national legislation (see foreword) requires that pressure vessels be inspected on a yearly basis and pressure tested every two years. This is deemed impractical and costly for ammonia refrigeration machines of the type and size installed on mines. It is customary for mines to apply for an exemption from the relevant government inspectorate, in order to have two-yearly thickness testing of the vessels and four-yearly complete shutdowns to inspect (externally and internally, where possible) and pressure test the ammonia pressure vessels to look for stress corrosion cracking and other latent defects. These tests shall be supervised by the AIA.

h) Pressure-relief valves on ammonia pressure vessels shall be of the dual type, installed with a three-way valve to make sure that one valve is always open. These pressure relief valves shall be recalibrated within a period that does not exceed two years.

B.6 Electrical switchgear

B.6.1 The electrical switchgear and control equipment shall be housed in a separate motor control centre (MCC) and sealed from the plant room to avoid ingress of ammonia in the case of a leak.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

B.6.2 The electrical substations shall be installed as far away and upwind from ammonia refrigeration plants as possible.

B.6.3 Safety circuits are required for the tripping of the machines. These shall be designed by competent persons.

B.6.4 Most of the ammonia process-related trips shall be installed as both hardwired and PLC trips. Any time delays required by the hardwired trips shall be incorporated as part of the safety circuit.

B.6.5 In the event of a serious ammonia leak into the air (i.e. greater than 200×10^{-6} (volume fraction)), all power supply to the plant room shall be isolated, with the exception of the emergency lighting, ammonia sensors and ventilation fans.

B.7 Refrigeration pipework

B.7.1 Welded ammonia piping shall be subjected to 100 % radiography.

B.7.2 Flanged liquid ammonia lines shall use weld-neck flanges, also subjected to 100 % radiography.

B.7.3 Valves, flanges and fittings shall be rated for use at 2 500 kPa as a minimum requirement.

B.7.4 Screwed pipe connections shall be avoided. This will greatly increase safety and reduce the risk of leaks.

B.7.5 All ammonia piping shall be seamless, provided that

a) the wall thickness for pipe sizes DN 40 and smaller shall not be less than schedule 80 (in accordance with ASME B36.10M);

b) the wall thickness for pipe sizes DN 50 to DN 250 shall not be less than schedule 40 (in accordance with ASME B36.10M);

c) the wall thickness for pipe sizes DN 300 to DN 500 shall not be less than schedule 30 (in accordance with ASME B36.10M);

d) where threaded piping cannot be avoided, such piping shall not be greater than DN 40 and the wall thickness shall not be less than schedule 80 (in accordance with ASME B36.10M);

e) any sockets, couplings, plugs or connections shall be of heavy duty non-galvanized carbon steel in accordance with ASME B16.11 (rated 3 000 lb) and ASTM A105;

f) the acceptance criteria for welds and any non-destructive testing shall be in accordance with ASME B31.3; and

g) the minimum size of pipe connections shall be DN 25.

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Annex C
(informative)

Properties of refrigerants

C.1 Toxicity of refrigerants

The toxicity of refrigerants, the safety of installations, and research with regard to contamination prevention shall be taken into consideration in the application of direct refrigerating systems for the cooling of occupied space.

Table C.1 gives the physical properties of refrigerants and table C.2 gives the comparative results of laboratory tests for various periods of exposure at various levels of concentration of refrigerant in air. The basic premise is that no significant change in concentration can occur in normal refrigeration plant operation, and that only an abnormal occurrence can cause an escape.

The toxicity data for class B2/B2L/B3 refrigerants explain the restriction on their application.

Some gases have no lasting, harmful effect at a concentration of $0,25 \times 10^{-6}$ (volume fraction), but the problem of toxic decomposition products that result from refrigerants in contact with flames or hot surfaces under certain conditions, still exists. Hydrochloric acid, chlorine and phosgene are toxic, but their exceedingly irritating smell provides an automatic and definite warning, even at concentrations too low to produce harmful effects.

In the case of any refrigerating system,

a) the equipment shall be safe from interference or damage and enough ventilation shall be provided for normal needs, and

b) the machinery shall be isolated from the atmosphere, in order to achieve a low-hazard rating.

NOTE Tables C.1 and C.2 do not contain an exhaustive list of all the possible refrigerants, but give a selection of those most likely to be encountered. Complete listings can be found in ISO 817 and ASHRAE 34.

C.2 Flammable refrigerants

Class A2/A2L/A3 refrigerants are all flammable, but are not toxic. Precautions shall be taken for the storage and handling of flammable gas.

At intervals that do not exceed two years, pressure-relief valves (or cartridges) shall be removed and replaced with new or overhauled and recalibrated valves (or cartridges) and new certificates shall be issued.

All replacement pressure-relief devices shall be correctly selected both for set pressure or operating pressure and for capacity or throughput.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Table C.1 — Refrigerants and their physical properties

1	2	3	4	5	6	7	8	9	10	11	12
								Combustibility			
Refrigerant number	**Refrigerant class**	**Chemical name or composition**	**Chemical formula**	**Boiling point at 101,3 kPa bubble/dew**	**Molecular mass**	**Critical pressure**	**Critical temperature**	**Ignition temperature**	**Explosive range in air** % (volume fraction)		**GWP (100 year)**
		%		°C	g/mol	kPa	°C	°C	**Lower**	**Upper**	
R 22	A1	Chlorodifluoromethane	$CHClF_2$	−40,8	86,5	4 989	96,13	–	–	–	1 700
R 23	A1	Trifluoromethane	CHF_3	−82,1	70,0	4 827	26,13	–	–	–	11 700
R 123	B1	2,2-dichloro-1,1,1-trifluoroethane	$CHCl_2CF_2$	27,0	123,0	3 668	183,7	–	–	–	120
R 134a	A1	1,1,1,2, Tetrafluoroethane	CH_2FCF_3	−26,2	102,0	4 059	101	–	–	–	1 300
R 170	A3	Ethane	CH_3CH_3	−88,8	30,0	4 872	32,17	580	3,2	12,5	3
R 290	A3	Propane	$CH_2CH_3CH_2$	−42,1	44,1	4 247	96,68	525	2,4	9,5	< 4
R 404A	A1	R 125/R 143a/R 134a (44/52/4)	–	−46,6/−45,8	97,6	3 735	72,15	–	–	–	3 260
R 407C	A1	R 32/R 125/R 134a (23/25/52)	–	−43,8/−36,7	86,2	4 597	86,79	–	–	–	1 525
R 410A	A1	R 32/R 125 (50/50)	–	−51,6/−51,4	72,6	4 925	72,13	–	–	–	1 725
R 422D	A1	R 125/R 134a/R 600a (65.1/31.5/3.4)	–	−43,2/−38,4	109,9	3 903	79,55	–	–	–	2 230
R 507A	A1	R 125/R 143a (50/50)	–	−47,1	98,0	3 714	70,74	–	–	–	3 850
R 600a	A3	Isobutane	$CH(CH_3)_2CH_3$	−11,7	58,1	3 640	134,7	530	1,8	8,0	3
R 717	B2L	Ammonia	NH_3	−33,3	17,0	11 333	132,3	651	16,0	28,0	0
R 744	A1	Carbon dioxide	CO_2	−78,4	44,0	7 377	30,98	–	–	–	1
R 1234yf	A2L	2,3,3,3,-tetrafluoro-1-propene	$CF_3CF=CH_2$	−29,4	114,0	3 382	94,55	405	6,2	12,3	4
R 1270	A3	Propylene (propene)	$CH_3CH=CH_2$	−48,0	42,1	4 665	92,42	497	2,0	11,1	< 4

GWP = global warming potential

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Table C.2 — Refrigerants and their physiological effects

1 **Refrigerant number**	2 **Refrigerant class**	3 **Chemical name or composition** %	4 **Chemical formula**	5 **OEL**[a] % (volume fraction)	6 **RCL**[b] % (volume fraction)	7 **RCL**[b] g/m^3	8 **High toxicity or toxic under code classification**[c]
R 22	A1	Chlorodifluoromethane	$CHClF_2$	1 000	59 000	210	Neither
R 23	A1	Trifluoromethane	CHF_3	1 000	41 000	120	Neither
R 123	B1	2,2-dichloro-1,1,1-trifluoroethane	$CHCl_2CF_2$	50	9 100	57	Neither
R 134a	A1	1,1,1,2,-Tetrafluoroethane	CH_2FCF_3	1 000	50 000	210	Neither
R 170	A3	Ethane	CH_3CH_3	1 000	8 500	16	Neither
R 290	A3	Propane	$CH_2CH_3CH_2$	1 000	5 300	9,5	Neither
R 404A	A1	R 125/R 143a/R 134a (44/52/4)	–	1 000	130 000	500	Neither
R 407C	A1	R 32/R 125/R 134a (23/25/52)	–	1 000	76 000	270	Neither
R 410A	A1	R 32/R 125 (50/50)	–	1 000	130 000	390	Neither
R 422D	A1	R 125/R 134a/R 600a (65.1/31.5/3.4)	–	1 000	58 000	260	Unclassified[d]
R 507A	A1	R 125/R 143a (50/50)	–	1 000	130 000	520	Neither
R 600a	A3	Isobutane	$CH(CH_3)_2CH_3$	1 000	4 000	9,6	Neither
R 717	B2L	Ammonia	NH_3	25	320	0,22	Neither
R 744	A1	Carbon dioxide	CO_2	5 000	40 000	72	Neither
R 1234yf	A2L	2,3,3,3,-tetrafluoro-1-propene	$CF_3CF=CH_2$	400	16 000	75	Neither
R 1270	A3	Propylene (propene)	$CH_3CH=CH_2$	500	1 000	1,7	Neither

[a] OEL (Occupational Exposure Limit) is the time weighted average (TWA) concentration for a normal 8 h workday and a 40 h workweek to which nearly all workers can be repeatedly exposed without adverse effect.

[b] Refrigeration concentration limit (RCL) is the refrigerant concentration limit in air, determined in accordance with ASHRAE 34 and intended to reduce the effects of acute toxicity, asphyxiation and flammability hazards in normal occupied enclosed spaces.

[c] "Highly toxic", "toxic" or "neither", where the former two are defined in the *2012 International Fire Code* (see bibliography). The category "neither" has lesser toxicity than highly toxic or toxic.

[d] Although presently unclassified, R 422D, due to its constituents, is non-toxic.

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Annex D
(normative)

Levels of competence for personnel involved with refrigeration and air-conditioning systems

D.1 General

D.1.1 This annex describes procedures for achieving and assessing the competence of persons who design, construct, install, inspect, test and commission, maintain, repair, decommission and dispose of refrigerating systems and heat pumps with respect to health, safety, environmental protection and energy conservation requirements.

D.1.2 These procedures do not apply to those persons who

a) carry out work on the basis of instructions, if they are supervised by a competent person, or

b) operate the system according to the operation manuals, or

c) carry out work that does not affect the refrigerant circuit, or

d) carry out work in a manufacturing process (from the initial design of the product to the complete manufacture of the product), provided the process is controlled and the methods used are checked by a competent person.

D.2 Compliance with legislation

Personnel who work with refrigeration and air-conditioning systems shall comply with the relevant national legislation (see foreword) for the safe operation of refrigeration and air-conditioning systems.

D.3 Requirements

D.3.1 General

A company that works in any field of refrigeration shall have registered competent personnel.

NOTE Such company should have adequate equipment to enable the competent person to do the work.

D.3.2 Personnel

D.3.2.1 Responsible persons

Persons who are responsible for the design, construction, installation, inspection, testing and commissioning, maintenance, repair, decommissioning, and disposal of refrigerating systems and their parts shall be competent to perform their tasks with respect to health, safety, environmental protection and energy conservation purposes. Their competence shall be proved in accordance with D.3.2.2.

D.3.2.2 Competence

The competence of persons who work on refrigerating systems shall be assessed, in accordance with D.4.2, based on their ability to demonstrate the following:

a) good practice when undertaking refrigeration tasks covered in this standard and compliance with the health, safety, environmental and energy conservation requirements;

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

b) sufficient relevant knowledge of health, safety and environmental legislation to carry out the tasks within their responsibility;

c) sufficient knowledge of basic refrigeration theory and practice to carry out the tasks within their responsibility.

Competence can also be restricted to one or more of the applications indicated in D.3.2.1. This restriction should be noted on any certificate and registration issued.

The design and development activities shall be assigned to registered qualified personnel equipped with the necessary resources.

Personnel that perform specific assigned tasks shall be qualified on the basis of appropriate training or experience (or both), as required. Appropriate records of training shall be maintained. This standard provides the option of including specific requirements for competence in the quality system to demonstrate compliance with this standard. Proof of continuing education/training is required.

D.4 Competence training

D.4.1 General

Training of persons to achieve competence in safety aspects of refrigerating systems and components, environmental and energy conservation requirements shall be governed by national schemes.

Where required by legislation or because industry considers it desirable, a certification scheme shall be implemented. This clause suggests methods by which a certification scheme will be achieved. These will be used if there are no other legislation or industry requirements.

D.4.2 Categories of competent persons

There are three categories of competence levels, depending on the duties to be performed:

a) level A: operation personnel;

b) level B: installation personnel and repair personnel;

c) level C: designers, commissioning personnel and inspectors.

The required skills and training for each competence level are described in D.4.3 to D.4.5.

D.4.3 Level A

D.4.3.1 General

A person with competence in level A (that complies with the minimum relevant national requirement (see foreword)) shall be able to operate a refrigerating system safely with due regard to environmental requirements and energy efficiency without breaking into the refrigerant circuit.

D.4.3.2 Training programme for level A

The minimum requirements for theoretical knowledge and practical experience for level A shall be as follows:

a) Knowledge of basic health and safety requirements.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

b) Legislation: Basic knowledge of the relevant national legislation (see foreword), and the *Montreal Protocol on substances that deplete the ozone layer.*

c) National standards. Basic knowledge of this standard (in particular clauses 1, 2 and 3, 4.1, 5.4, 5.5, 5.7.2.6, 5.10.1, 5.11, 5.12, 6.1.6, 6.9.3, 6.13, 6.14, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.5, 9.1 and annex F).

d) Basic knowledge and skills concerning:

1) the handling of refrigerants (knowledge only),

2) personal protective equipment (how to use it),

3) leakage prevention of refrigerants (measures to prevent leakage),

4) the refrigerating process,

5) refrigerants,

6) refrigeration components and equipment,

7) electrical and control functions,

8) maintenance,

9) piping and instrumentation diagrams (P and ID),

10) refrigerating systems, and

11) energy conservation (measures applied for energy efficiency).

e) Practical experience, for example in plant installation, operation and maintenance.

D.4.4 Level B

D.4.4.1 General

A person with competence in level B (that complies with the minimum relevant national requirement (see foreword)) shall

a) understand and be able to apply given specifications and piping and instrumentation diagrams;

b) understand and be able to apply requirements in this standard that concern health, safety, environmental protection and energy efficiency; and

c) understand and be able to apply, in a practical manner, safety measures for different refrigerants.

D.4.4.2 Training programme for level B

The minimum requirements for theoretical knowledge and practical experience for level B shall be as follows:

a) Knowledge of health and safety requirements.

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

b) Legislation: Detailed knowledge of the relevant national legislation (see foreword), and the *Montreal Protocol on substances that deplete the ozone layer.*

c) National standards. Detailed knowledge of this standard (in particular clauses 1, 2, 3 and 4, 5.1, 5.2, 5.4, 5.5, 5.6, 5.7.1, 5.7.2.1*, 5.7.2.2, 5.7.2.3, 5.7.2.4*, 5.7.2.6, 5.7.2.5*, 5.7.2.7, 5.7.3, 5.7.4, 5.7.5, 5.7.6.1, 5.7.6.2, 5.7.6.3, 5.8, 5.10.1, 5.11, 5.12, 5.13, 5.14, 5.15, 6.1.3, 6.1.4, 6.1.5, 6.1.6, 6.1.7, 6.1.8, 6.6, 6.7, 6.8, 6.9, 6.11.1, 6.11.2, 6.12, 6.13, 6.14, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.5, clause 9, annex A, annex I, annex F, annex C).
   * Knowledge required of the text but no requirement for carrying out calculations.

d) Detailed knowledge and skills concerning:

   1) the handling of refrigerants,

   2) personal protective equipment (how to use it),

   3) leakage prevention of refrigerants (measures to prevent leakage),

   4) the refrigerating process,

   5) refrigerants,

   6) refrigeration components and equipment,

   7) electrical and control functions,

   8) maintenance,

   9) piping and instrumentation diagrams,

   10) refrigerating systems,

   11) energy conservation (measures to take for energy efficiency).

e) Practical experience, for example in plant installation, operation, maintenance and repair for a period of at least three years.

D.4.5 Level C

D.4.5.1 General

A person with competence in level C (that complies with the minimum relevant national requirement (see foreword)) shall

a) be competent to ensure that a refrigerating system complies with the requirements of this standard that concern health, safety, environmental protection and energy efficiency;

b) have specialized and in-depth knowledge of legislation and regulations relating to refrigerating systems and heat pumps;

c) be able to design systems, develop and check piping and instrumentation diagrams, instructions, manuals, etc.; and

d) be able to give instructions concerning safety measures and procedures for the used refrigerants, etc.

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

D.4.5.2 Training programme for level C

The minimum requirements for theoretical knowledge and practical experience for level C shall be as follows:

a) Knowledge of health and safety requirements.

b) Legislation: Specialized and in-depth knowledge of the relevant national legislation (see foreword), and the *Montreal Protocol on substances that deplete the ozone layer.*

c) National standards. Specialized and in-depth knowledge of this standard.

d) Specialized and in-depth knowledge and skills concerning:

   1) the handling of refrigerants,

   2) personal protective equipment (how to use it),

   3) leakage prevention of refrigerants (measures to prevent leakage),

   4) the refrigerating process,

   5) refrigerants,

   6) refrigeration components and equipment,

   7) electrical and control functions,

   8) maintenance,

   9) piping and instrumentation diagrams,

   10) refrigerating systems, and

   11) energy conservation (measures to take for energy efficiency).

e) Technical experience, for example in design, construction, installation, operation, maintenance and repair.

D.5 Assessment of competence

D.5.1 General

All persons who demonstrate their practical and theoretical competence by being successfully assessed by an approved organization shall receive a certificate of competence and be registered with the relevant national body (see foreword).

D.5.2 Assessment

The certification of competence shall be as required by the relevant national body (see foreword). The theoretical and practical assessment shall cover all the parts of the respective training programme as set out in D.4.3.2, D.4.4.2 and D.4.5.2.

NOTE Some aspects of a person's competence will need to be reassessed on a regular basis.

D.6 Maintenance of competence

Persons shall maintain their competence, as appropriate, for example by the study of relevant literature, and doing practical work.

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Annex E
(normative)

Ozone-depleting substances

E.1 General

Ozone-depleting substances shall comply with the requirements of AHRI 700, ASHRAE 147 and *The Montreal Protocol on substances that deplete the ozone layer*.

Substances identified as ozone-depleting substances by the said *Montreal Protocol* are given in table E.1.

NOTE The substances given in table E.1 are grouped according to type and not according to their dominant characteristics.

E.2 Importation and exportation of CFC refrigerants and equipment that contains these substances

Since 31 December 1993, CFC refrigerants (or any appliance or plant that contains these substances) have been prohibited from being imported from any country that is not a signatory to the said *Montreal Protocol*.

Since 1 January 1996, no fully halogenated CFCs, or any appliance that contains these refrigerants, shall be

a) imported from any country,

b) locally produced, or

c) exported to any country,

except as authorized in accordance with permits issued by the relevant national regulating body (see foreword), after consultation with, and with the approval of, the relevant national approval authority (see foreword).

E.3 Prohibition on venting of refrigerants

Ozone-depleting substances used as refrigerants shall not be deliberately vented to the atmosphere by any person who manufactures, maintains, services, repairs or disposes of air-conditioning or refrigeration equipment. Only the following three types of release are permitted:

a) the absolute minimum quantities of refrigerant released in the course of making attempts in good faith to recover, recycle or reclaim refrigerant;

b) refrigerants emitted in the course of normal operation of air-conditioning and refrigeration equipment, such as from leaks, equipment failure and mechanical purging (as opposed to refrigerants emitted during the installation, maintenance, servicing, repair or disposal of this equipment); and

c) releases caused by the actuation of pressure-relief safety devices.

All necessary precautions shall be taken to prevent discharge of refrigerants into the atmosphere.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Table E.1 — Ozone-depleting substances

1	2	3
Group	**Substance**	**Date by which it was phased out**
I	CFC-11 CFC-12 CFC-113 CFC-114 CFC-115	1 January 1996
II	CFC-13 CFC-111 CFC-112 CFC-211 CFC-212 CFC-213 CFC-214 CFC-215 CFC-216 CFC-217	1 January 1996
III	Halon-1211 Halon-1301 Halon-2402	1 January 1994
IV	Carbon tetrachloride	1 January 1996
V	1,1,1-trichloroethane	1 January 1996
VI	HCFC-21 HCFC-22 HCFC-31 HCFC-121 HCFC-122 HCFC-123 HCFC-124 HCFC-131 HCFC-132 HCFC-133 HCFC-141 HCFC-142 HCFC-151 HCFC-221 HCFC-222 HCFC-223 HCFC-224 HCFC-225 HCFC-226 HCFC-231 HCFC-232 HCFC-233 HCFC-234 HCFC-235 HCFC-241 HCFC-242 HCFC-243 HCFC-244 HCFC-251 HCFC-252 HCFC-253 HCFC-261 HCFC-262 HCFC-271	Subject to phase out schedule of Montreal protocol for article 5 countries commencing on 1 January 2013
CFC = Chlorofluorocarbon HCFC = Hydrochlorofluorocarbon		

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

E.4 Requirements

E.4.1 Servicing

No worker shall service refrigeration or air-conditioning equipment or a machine that uses CFC and HCFC refrigerant, or that uses mixtures that contain CFCs and HCFCs, if such a worker does not make use of recovery equipment for the recovery of the refrigerant for recycling or reclamation purposes. All such workers shall, at least, have received appropriate training in

a) dangers to the environment as a result of leakage of CFCs and HCFCs to the atmosphere,

b) servicing refrigeration and air-conditioning equipment, and

c) operation of the recovery equipment.

Refrigerant recovery and recycling equipment shall comply with the requirements of ISO 11650 or SANS 10250.

E.4.2 Leak detection

Refrigeration or air-conditioning equipment or plants that use CFC and HCFC refrigerant or that use refrigerant mixtures that contain CFCs and HCFCs, which have to be repaired or serviced, shall first be checked for refrigerant leaks and shall not be charged with new or recycled refrigerant that contains CFCs and HCFCs, until all leaks have been repaired. Upon completion of the repairs or service, that part of the cooling system that has been repaired or serviced shall be rechecked for refrigerant leaks, and should any be found, the procedure shall be repeated until no leaks can be detected (subject to the requirements of E.5).

E.4.3 Evacuation of equipment and recovery of refrigerant

E.4.3.1 Evacuation of air-conditioning and refrigeration equipment

Equipment used to evacuate air-conditioning and refrigeration equipment shall be capable of evacuating the equipment to the levels given in table E.2.

Table E.2 — Evacuation levels for recovery and recycling equipment

1	2	3
Type of air-conditioning or refrigeration equipment with which recycling or recovery equipment is to be used[a]	**Type of refrigerant**	**Absolute pressures**[b] **that shall be achieved by recovery or recycling equipment** kPa
High-pressure equipment with a charge of less than 25 kg	R 12, R 502, etc.	67
High-pressure equipment with a charge that exceeds 25 kg		34
Very-high-pressure equipment (over 2 500 kPa)	R 13, R 503, etc.	Atmospheric
Intermediate-pressure equipment	R 114 etc.	17
Low-pressure equipment	R 11	3

[a] Excluding small appliances.
[b] Absolute pressures are given to accommodate any altitude.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

E.4.3.2 Recovery and recycling of refrigerant

Recovered or recycled refrigerant may be returned to the same system or to other systems owned by the same person, without restriction. When the refrigerant changes ownership, however, that refrigerant should, where possible, be reclaimed, i.e. all impurities shall be removed and the refrigerant shall be chemically analysed to verify that it has been purified in accordance with the requirements of AHRI 700.

E.4.4 Regulations

Refrigerants shall be stored, handled, controlled and used in accordance with the relevant national legislation (see foreword).

E.5 Refrigerant leaks and purging

Losses through leaks and purging shall be prevented.

E.6 Disposal of equipment that contains refrigerant

Where feasible, the refrigerant shall be removed and recovered from equipment that is typically dismantled on site before disposal (for example retail food refrigeration, cold-storage warehouse refrigeration, chillers and industrial process refrigeration), in accordance with the requirements for servicing (see 5.15 and E.4.1).

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Annex F
(informative)

Dangers inherent in refrigerating systems

F.1 General dangers

F.1.1 The hazards that occur in refrigeration plants and air-conditioning plants are associated essentially with the physical and chemical characteristics of refrigerants and the pressures and temperatures that occur in refrigerant cycles. Inadequate precautions could result in

a) either rupture of a part, or an explosion, coupled (in both cases) with the risk of flying pieces of metal,

b) escape of refrigerant caused by a fracture, leakage or incorrect operation during operation, repair or charging, and

c) burning or explosion of escaping refrigerant, with the consequent risk of fire.

F.1.2 When a refrigerating system is being selected, consideration shall be given to minimizing personal hazard to occupants of the building, should the refrigerant escape. The factors that shall be considered are as follows:

a) the degree of toxicity (toxicity level), flammability, or other risk characteristics of the particular refrigerant;

b) the quantity of refrigerant that can conceivably escape in the event of an accident;

c) features of the refrigerant plant (direct, indirect, etc.) or features of the installation (isolated plant rooms etc.), which could have a bearing on the degree of probability that a refrigerant, should an escape occur, will penetrate a populated area; and

d) the differing degrees to which the populations of different types of building could be vulnerable to, or unable to escape from, the consequences of a leaking refrigerant.

To deal with these variables, a classification system for refrigerants and for building usage, a type system for the refrigeration plant, the nature of the plant's location and the permissible levels of atmospheric contamination have been included in tables 1 and 2 and figure 1.

F.2 Specific dangers

F.2.1 Low temperatures

Low temperatures can result in injuries to persons. Low temperatures also cause

a) brittleness of metals,

b) freezing of heat-transferring liquids (for example water and brine) in closed spaces,

c) thermal stresses, and

d) damage to buildings (as a result of the ground freezing beneath them).

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

F.2.2 Excessive pressure

Excessive pressure can occur because of

a) an increase in the pressure of condensation (caused by inadequate cooling, or the partial pressure of non-condensable gases, or an accumulation of oil or liquid refrigerant), or

b) an increase in the pressure of saturated vapour (caused by excessive external heating, for example of a liquid cooler, or the defrosting of an air cooler, or a high ambient temperature when the refrigeration plant is at a standstill), or

c) the expansion of a liquid refrigerant (in a closed space that contains no vapour) that is caused by a rise in external temperature, or

d) the replacement of an existing refrigerant with an alternative refrigerant with higher operating pressures which can exceed the pressure limitations of the existing system (typically replacing refrigerant R 22 with refrigerant R 410A).

F.2.3 Escape of refrigerants

The escape of refrigerants can cause the following:

a) fires;

b) explosions;

c) the release of toxic gases;

d) asphyxiation;

e) chemical burns;

f) panic; and

g) damage to, and loss of, perishable goods in cold rooms.

F.2.4 Breakdowns and unsatisfactory operation

Breakdowns and the unsatisfactory operation of the refrigeration plant could be as a result of the following:

a) excessive charging or flooding of apparatus;

b) the presence of liquid in compressors (caused by liquid carry-over or condensation in the compressor, or faulty piping layout);

c) loss of lubrication or emulsification of oil; or

d) corrosion.

This standard does not cover the dangers common to all compression plants, such as excessive temperature at discharge, the possibility of erroneous operation (for example a discharge valve being left closed while the plant is operating), and reduction in mechanical strength caused by corrosion or vibration. Special attention should, however, be given to the prevention of corrosion, since corrosive conditions peculiar to refrigeration plants arise because of alternative frosting and defrosting, and to the covering of apparatus by insulation.

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Annex G
(informative)

Suggested format for the written scheme of inspection

The following is a suggested format for the written scheme of inspection, and it also shows the format for the inspection and maintenance schedule.

Refrigeration system users should draw up a scheme appropriate to the range of equipment installed and identify the relevant qualifications for the staff within or external to their organization to carry out the tasks. All items should be recorded in the system logbook. Items marked with an asterisk (*) are typical of those where a specific logbook entry is required. The register shall be updated when any major items of equipment are repaired or replaced.

Client: …………………………………………………..
Site: ……………………………………………………..
Equipment:

Piping and instrument diagram drawing number: …………………………………..
Refrigerant: ……………………………… Low-side pressure in kPa
Approximate charge: …………………… High-side pressure in kPa

Identification	**Item description**	**Serial/tag number**	**Type of inspection/ maintenance**	**Carried out by**	**Frequency (minimum)**	**Extent of inspection**	**Specific items***

* A specific logbook entry is required for the items listed in this column.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Annex H
(normative)

In-service inspection of pressure equipment in refrigeration service

H.1 This in-service inspection shall be applied together with the requirements for manufacture and operation given in this standard and may be used as an alternative to the requirements specified in the relevant national legislation (see foreword).

H.2 For category 1 equipment (see SANS 347): all the inspections allocated to the approved inspection authority for in-service inspections (AIA-IS) shall be undertaken by the user.

H.3 For category 2 and higher equipment (see SANS 347): the inspections shall be undertaken by an AIA-IS.

H.4 The checklist for the in-service inspection is given in table H.1. The in-service pressure test is not required if the inspection procedure in this checklist is complied with.

Table H.1 — Checklist for in-service inspection of pressure equipment in refrigeration service

1	2	3
Item or procedure to be inspected	**Inspection undertaken by**	**Frequency of inspection**
1 Check visually for mechanical damage to the installation.	User	Monthly
	AIA-IS	Every 36 months
2 Check that the installation has not been modified since the last inspection.[a]	User	Monthly
	AIA-IS	Every 36 months
3 Check that all the applicable pressure equipment records, certification, and the manufacturer's data plates comply with the relevant national legislation (see foreword).	AIA-IS	Every 36 months
4 Check the external condition of pressure vessels/piping as follows:		
a) Un-insulated vessels/piping Ensure that un-insulated pressure vessels/piping are given a thorough external visual examination and wall thickness survey.	User AIA-IS	Monthly Every 36 months
Where there is surface corrosion that does not materially affect the wall thickness of the pressure-containing parts, treat the corrosion to prevent recurrence.[b]	User AIA-IS	Monthly Every 36 months
b) Insulated vessels/piping Check for signs (visual inspection) of insulation damage, such as ice formation, condensation, external deterioration, discoloration, mechanical damage, collapsed insulation, loss of vapour barrier, or any other degradation. Pay particular attention to any points where frosted pipework protrudes from the insulation as this can be a point of deterioration. If there is damage to the insulation or vapour barrier, then remove sections of the insulation in order to visually inspect the underlying surface. If corrosion is detected, proceed as in (a) above.[c]	User AIA-IS	Monthly Every 36 months

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Table H.1 *(concluded)*

1	2	3
Item or procedure to be inspected	**Inspection undertaken by**	**Frequency of inspection**
5 If an ammonia vessel in service is found not to have been subjected to heat treatment or the heat treatment status cannot be confirmed, then carry out special examinations at the specified intervals.[d] Where stress corrosion cracking is evident, replace the vessel.	AIA-IS	Every 36 months
6 Inspect pressure relief devices for external corrosion and leakage and for compliance with 5.10.3.	User	Monthly
7 Check that pressure relief devices are recertified/replaced in accordance with 5.10.4.	User	Every 36 months
	AIA-IS	Every 36 months
8 Check vibrations and movement caused by pressure and temperature changes.	User	Monthly
9 Check operation of isolating valves – free operation.	User	Monthly
10 Visually inspect vessel, pipe and machinery supports.	User	Monthly
11 Visually inspect equipment for mechanical damage.	User	Monthly
12 Visually inspect equipment for overheating.	User	Monthly
13 Check protection of moving parts.	User	Monthly
14 Check existence and functionality of refrigerant leak detectors.	User	Monthly

[a] Should modification have taken place, the AIA-IS shall check that all the changes have been carried out and documented in accordance with the requirements of the relevant national legislation (see foreword).

[b] Where the corrosion has caused a reduction of the wall thickness of the pressure-containing parts (as determined by an appropriate non-destructive testing (NDT) method), the user shall recalculate the wall thickness of the vessel/piping to determine whether the remaining thickness is sufficient in accordance with the code of manufacture as listed in annex A of SANS 347:2012 or other appropriate guidance for assessing corrosion, and shall determine whether the vessel/piping is fit for further service, requires reduced inspection intervals, shall be de-rated or withdrawn from service. The results of calculations and NDT reports shall be added to the vessel's inspection records and verified by an approved inspection authority for manufacturing (AIA-M), where necessary.

[c] All repairs to the insulation and vapour barrier shall be carried out with the vessels/piping at ambient temperature. Surfaces shall be appropriately treated with a rust preventive coating before re-insulation.

[d] Special examinations shall, as a minimum, include the following:

a) visual internal inspection or remote inspection, where possible;

b) fluorescent magnetic particle examination of all internal weld areas and areas of high stress, where accessible, or alternatively, ultrasonic examination of non-accessible areas;

c) radiography of the main seam welds if internal magnetic particle or ultrasonic testing is not possible;

d) external visual inspection of all surfaces;

e) wall thickness measurements.

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Annex I
(normative)

Emergency discharge of refrigerants

I.1 Introduction

No refrigerants shall be discharged into a sewer, river, stream, lake or the atmosphere.

Ammonia may be discharged into the open atmosphere with due regard to safety, but the preferred method is to discharge ammonia into water. The ammonia water shall be treated as hazardous and disposed of by a waste disposal specialist.

I.2 Emergency discharge pipes

An emergency discharge pipe shall be independent of any other pipes and shall be connected above the liquid refrigerant level on the high-pressure side and, where specified by the engineer, on the low-pressure side of the system. The emergency discharge pipe shall be so pitched as to drain into the system and shall extend into an emergency refrigerant control box, which shall be kept locked and identified with a permanent label that bears the words "Emergency refrigerant control box" and the name of the refrigerant in the system.

I.3 Isolating valves

A readily accessible isolating valve and a suitable pressure gauge shall be installed on the emergency discharge pipe within the emergency refrigerant control box. The gauge shall be located ahead of the isolating valve, and the valve shall have the same capacity as the discharge pipe it serves. A permanent label shall be attached to the valve and shall bear the words "High-pressure refrigerant discharge valve" or "Low-pressure refrigerant discharge valve", as relevant.

I.4 Sizing valves and pipes

The size of the discharge pipe and the size of the isolating valve shall be determined by the required discharge capacity (see 5.7.2.1, 5.7.2.4, 5.7.2.5.1 and 5.7.2.5.2) and the length of the discharge header (see 5.7.6.4).

I.5 High-pressure to low-pressure control valve

When both the high-pressure side and the low-pressure side emergency discharge valves are located in a common box, an isolating valve that connects them on the system side of the emergency discharge isolating valves shall be provided in the box. The isolating valve and connecting pipe shall be the same size as the higher pressure line. The isolating valve and connecting pipe shall be labelled "High-pressure to low-pressure control valve".

I.6 Diffuser

When an emergency discharge pipe is not connected to a common header or to a vent riser, it shall be provided with a diffuser at its upper extremity. The diffuser shall provide for mixing refrigerant with air, and shall have a rain cap or other means to prevent water from entering the vent pipe.

 © SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

I.7 Sizing headers and diffusers

When more than one pressure-relief valve or emergency discharge pipe is connected to a common header or common riser for discharge into the atmosphere, a diffuser shall be installed on the common riser. The area of the header or riser and the diffuser inlet shall, at least, be equal to the sum of the areas of all of the pressure-relief valve vent pipes and emergency discharge pipes that feed the header, or riser and diffuser inlet.

I.8 Location of the diffuser

The diffuser shall be so located that it can discharge into the atmosphere.

I.9 Drip legs (pockets)

Drip legs (pockets) that are adequately sized for collecting moisture shall be installed on every emergency discharge pipe beyond the emergency valve and shall be exposed to the atmosphere.

I.10 Ammonia diffusion systems (see 5.7.6.3)

I.10.1 Diffusion

In locations where the diffusion of ammonia into the atmosphere can be hazardous because of the proximity of persons or other premises, the diffuser shall be equipped with a flame device for reducing the charge to nitrogen and water, or the emergency systems shall discharge into a storage tank (see 5.7.6.3.1), water retention basin (see I.10.5) or water mixer (see I.10.6).

I.10.2 Ammonia discharge pipes

In the case of emergency discharge connections to the system, the isolating valves and control box shall be as described in this annex.

I.10.3 Ammonia flares

Systems for reducing the ammonia to nitrogen and water shall be approved by the jurisdictional authority.

I.10.4 Water tanks

Water tanks shall be constructed in accordance with 5.7.6.3.1.

I.10.5 Water retention basins

Water retention basins shall comply with the requirements specified by the local fire chief.

I.10.6 Ammonia/water mixers

Ammonia/water mixers shall consist of the following:

a) a connection to a permanent water supply that is able to deliver 17 L/s of water per 1 kg/s of ammonia. The ammonia flow can be estimated at 77 % of the equivalent standard airflow calculated for the discharge line (see 5.7.2.1, 5.7.2.5.1 and 5.7.2.5.2);

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

b) a fire department inlet hose connection to the diffuser that is adjacent to the emergency refrigerant control box (see H.2);

c) an engineered ammonia/water mixing chamber, of a size to cater for (a);

d) a connection to an acceptable storage tank, basin, or drainage system by means of welded or flanged pipes; and

e) the necessary control valves, check valves and fittings.

I.11 Design responsibility

The engineer is responsible for the design of tanks and retention basins and the design of any manual emergency discharge system and its components, such as the diffusers for mixing refrigerants with air or water.

I.12 Stress corrosion cracking

Consideration should be given to the possibility of stress corrosion cracking in vessels and pipework exposed to ammonia. Stress relieving of vessels after manufacture by an appropriate heat treatment shall be applied to ammonia vessels (see 5.3.3).

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

Bibliography

Standards

AS 1210, *Pressure vessels.*

AS 1271, *Safety valves, other valves, liquid level gauges, and other fittings for boilers and unfired pressure vessels*.

AS 1349, *Bourdon tube pressure and vacuum gauges*.

AS 1358, *Bursting discs and bursting disc devices – Application, selection and installation*.

AS 2106.0, *Methods for the determination of the flash point of flammable liquids (closed cup) – Part 0: General*.

AS 2106.2, *Methods for the determination of the flash point of flammable liquids (closed cup) – Part 2: Determination of flash point – Pensky-Martens closed cup method*.

AS 2106.3, *Methods for the determination of the flash point of flammable liquids (closed cup) – Part 3: Determination of flash/no flash – Rapid equilibrium closed cup method*.

AS 2106.5, *Methods for the determination of the flash point of flammable liquids (closed cup) – Part 5: Determination of flash/no flash – Closed cup equilibrium method*.

AS D26, *Tube fittings with Dryseal American standard taper pipe and unified threads for automotive and industrial use.*

ASHRAE 15, *Safety standard for refrigeration systems*.

ASHRAE 16, *Method of testing for rating room air conditioners and packaged terminal air conditioners*.

ASHRAE 26, *Mechanical refrigeration and air-conditioning installations aboard ship*.

ASME BPVC Section VIII, Division 1, *Rules for construction of pressure vessels.*

AS/NZS 1677.1, *Refrigerating systems – Part 1: Refrigerant classification*.

AS/NZS 1677.2, *Refrigerating systems – Part 2: Safety requirements for fixed applications*.

AS/NZS 1715, *Selection, use and maintenance of respiratory protective equipment*.

AS/NZS 2106.1, *Methods for the determination of the flash point of flammable liquids (closed cup) – Part 1: Abel closed cup method*.

ASTM B42, *Standard specification for seamless copper pipe – Standard sizes*.

ASTM B43, *Standard specification for seamless red brass pipe – Standard sizes*.

ASTM B88, *Standard specification for seamless copper water tube*.

ASTM B280, *Standard specification for seamless copper tube for air conditioning and refrigeration field service*.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

EN 378-1, *Refrigerating systems and heat pumps – Safety and environmental requirements – Part 1: Basic requirements, definitions, classification and selection criteria.*

EN 378-2, *Refrigerating systems and heat pumps – Safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation.*

EN 378-3, *Refrigerating systems and heat pumps – Safety and environmental requirements – Part 3: Installation site and personal protection.*

EN 10216-1, *Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties.*

EN 10216-2, *Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties.*

EN 10216-4, *Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 4: Non-alloy and alloy steel tubes with specified low temperature properties*.

EN 10217-1, *Welded steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties.*

EN 10217-3, *Welded steel tubes for pressure purposes – Technical delivery conditions – Part 3: Alloy fine grain steel tubes.*

EN 12284, *Refrigerating systems and heat pumps – Valves – Requirements, testing and marking*.

EN 12735-1, *Copper and copper alloys – Seamless, round copper tubes for air conditioning and refrigeration – Part 1: Tubes for piping systems.*

EN 12735-2, *Copper and copper alloys – Seamless, round copper tubes for air conditioning and refrigeration – Part 2: Tubes for equipment.*

ISO 817, *Refrigerants – Designation system.*

NFPA 1991, *Vapor-protective ensembles for hazardous materials emergencies.*

PD 5500, *Specification for unfired fusion welded pressure vessels*.

SANS 275/EN 12083, *Respiratory protective devices – Filters with breathing hoses, (Non-mask mounted filters) – Particle filters, gas filters, and combined filters – Requirements, testing, marking*.

SANS 10019, *Transportable pressure receptacles for compressed, dissolved and liquefied gases – Basic design, manufacture, use and maintenance.*

SANS 10220, *The selection, use and maintenance of respiratory protective equipment*.

SANS 10313, *Protection against lightning – Physical damage to structures and life hazard.*

SANS 50136/EN 136, *Respiratory protective devices – Full face masks – Requirements, testing, marking.*

SANS 50140/EN 140, *Respiratory protective devices – Half masks and quarter masks – Requirements, testing, marking.*

© SABS

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

SANS 50143/EN 143, *Respiratory protective devices – Particle filters – Requirements, testing, marking*.

SANS 50149/EN 149, *Respiratory protective devices – Filtering half masks to protect against particles – Requirements, testing, marking*.

SANS 54511-1/EN 14511-1, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Part 1: Terms and definitions*.

SANS 54511-2/EN 14511-2, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Part 2: Test conditions*.

SANS 60335-2-40/IEC 60335-2-40, *Household and similar electrical appliances – Safety – Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers*.

SANS 60335-2-89/IEC 60335-2-89, *Household and similar electrical appliances – Safety – Part 2-89: Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant unit or compressor*.

Other publications

2012 International Fire Code. International Code Council. 2011.

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

This page has been left blank intentionally

Licensed exclusively to Wesley Gabriels
License ID : 9BPD-NEX2-34XN
Copying and network storage prohibited.

SABS – Standards Division

The objective of the SABS Standards Division is to develop, promote and maintain South African National Standards. This objective is incorporated in the Standards Act, 2008 (Act No. 8 of 2008).

Amendments and Revisions

South African National Standards are updated by amendment or revision. Users of South African National Standards should ensure that they possess the latest amendments or editions.

The SABS continuously strives to improve the quality of its products and services and would therefore be grateful if anyone finding an inaccuracy or ambiguity while using this standard would inform the secretary of the technical committee responsible, the identity of which can be found in the foreword.

The SABS offers an individual notification service, which ensures that subscribers automatically receive notification regarding amendments and revisions to South African National Standards.
Tel: +27 (0) 12 428 6883 Fax: +27 (0) 12 428 6928 E-mail: sales@sabs.co.za

Buying Standards

Contact the Sales Office for South African and international standards, which are available in both electronic and hard copy format.
Tel: +27 (0) 12 428 6883 Fax: +27 (0) 12 428 6928 E-mail: sales@sabs.co.za
South African National Standards are also available online from the SABS website http://www.sabs.co.za

Information on Standards

The Standards Information Centre provides a wide range of standards-related information on both national and international standards. The Centre also offers an individual updating service called INFOPLUS, which ensures that subscribers automatically receive notification regarding amendments to, and revisions of, international standards.
Tel: +27 (0) 12 428 7911 / 0861 27 7227 Fax: +27 (0) 12 428 6928 E-mail: info@sabs.co.za

Copyright

The copyright in a South African National Standard or any other publication published by the SABS Standards Division vests in the SABS or, in the case of a South African National Standard based on an international standard, in the organization from which the SABS adopted the standard under licence or membership agreement. In the latter case, the SABS has the obligation to protect such copyright. Unless exemption has been granted, no extract may be reproduced, stored in a retrieval system or transmitted in any form or by any means without prior written permission from the SABS Standards Division. This does not preclude the free use, in the course of implementing the standard, of necessary details such as symbols, and size, type or grade designations. If these details are to be used for any purpose other than implementation, prior written permission must be obtained.

Details and advice can be obtained from the Manager – Standards Sales and Information Services.
Tel: +27 (0) 12 428 6883 Fax: +27 (0) 12 428 6928 E-mail: sales@sabs.co.za