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Is it safe?

Two new refrigeration safety and environmental standards have been adopted and published by Standards Australia. Vince Aherne, M.AIRAH, takes a first look at these new Australian Standards, which have both been adopted from the International Organization for Standardization (ISO).

Standards Australia has just adopted and published two new refrigeration safety and environmental standards. AS/NZS/ISO 817:2016 *Refrigerants – Designation and safety classification* will replace AS/NZS 1677.1:1998. AS/NZS 5149 *Refrigerating systems and heat pumps – Safety and environmental requirements:* Parts 1 to 4 will replace AS/NZS 1677.2:1998.

The ISO in the designator for the 817 Standard indicates that it is identical to the International version. No changes were required for application in Australia or New Zealand. The four standards in the 5149 series have been modified for adoption in Australia and New Zealand, and so do not include ISO in the designator. The specific amendments for each standard are listed in an Appendix ZZ. The main items of change are discussed here.

CHANGES TO REFRIGERANT SAFETY CLASSIFICATIONS

AS/NZS ISO 817 covers the designation and safety classification of refrigerants, and includes classification for 109 refrigerants (AS/NZS 1677.1:1998 previously classified 66 refrigerants). The standard outlines the refrigerant numbering system and designation prefixes, the refrigerant safety classification system and the Refrigerant Concentration Limit (RCL) for each refrigerant. AS/NZS ISO 817:2016 is intended to be used with other standards such as AS/NZS 5149.

The refrigerant classification system continues to align with ANSI/ASHRAE 34 and is broadly similar to that used in AS/NZS 1677.1 1998. The major change from AS/NZS 1677.1 is the introduction of a new 2L "Lower Flammability" classification to the existing system (see Figure 1). The 2L classification recognises that not all flammable refrigerants are the same, and further categorises this group based on heat of combustion and burning velocity to create the new "Lower Flammability" classification.

> "The major change from AS/NZS 1677.1 is the introduction of a new 2L 'Lower Flammability' classification"

	Safety Group	
Higher Flammability	A3	B3
Flammable	A2	B2
Lower Flammability	A2L	B2L
No flame propagation	A1	B1
	Lower Toxicity	Higher Toxicity

Figure 1: Expanded refrigerant classification system.

The need for a more precise flammability index was originally proposed in the ISO 817 revision working group (WG) in 1999. This was introduced to provide a design pathway to allow for the increased use of flammable refrigerants while high-GWP refrigerants are phased down. For most refrigerants, lowering the GWP intrinsically means that the substance is less stable and likely to be more flammable.

The new 2L category was adopted in ASHRAE 34 in 2010 and in ISO 817 in 2014. It is expected that EN 378 will also adopt this category in its next edition scheduled for 2016. 2L refrigerants such as R32 and R717 (Ammonia) are already in use in Australia. Newly developed HFO refrigerants such as R1234yf or R1234ze also all fall under this 2L category.

The terminology of "Practical Limit" (kg/m3) from 1677 has changed to "Refrigerant Concentration Limit" (ppm) in 817, but this is still based on the toxicity, flammability or oxygen deprivation limit for the specific refrigerant type and classification. The lower value is adopted as the RCL, and this feeds into safety design standard AS/NZS 5149.2.

Another change that end-users should be aware of is that Class A3 refrigerants are not required to be odorised under 817. This was a requirement of AS/NZS 1677.1; the change reflects international acceptance that odourisation of flammable working fluids is not an effective risk-management option for refrigeration systems. This is because the system and its components act to remove the odourant additive or reduce its effectiveness.

The AS/NZS ISO 817 standard also specifies the quality of the data sources to be used, as well as the test methods that must be used to determine the fundamental refrigerant properties needed for refrigerant classification. The standard also explains how blends are to be treated in calculations, provides all of the refrigerant data used in its classifications, and outlines the procedure for external parties to propose a new refrigerant be added into the classification table (a system managed by ASHRAE, which holds the ISO secretariat for the standard).

CHANGES TO SAFETY AND ENVIRONMENTAL STANDARDS

The AS/NZS 5149 standard will be published in four parts, comprising more than 160 pages of technical safety and environmental requirements under the general title, Refrigerating systems and heat pumps –Safety and environmental requirements:

Part 1: Definitions, classification and selection criteria (ISO 5149-1:2014, modified)

Part 2: Design, construction, testing, marking and documentation (ISO 5149-2:2014, modified)

Part 3: Installation site (ISO 5149-3:2014, modified)

Part 4: Operation, maintenance, repair and recovery (ISO 5149-4:2014, modified)

The standard format and layout of ISO 5149 has been based on EN 378:2008, also currently under revision. The scope has been expanded from the 2005 edition to include guidance on protection of the environment and procedures for the recovery and reuse of refrigerants. Previous editions covered safety aspects only.

The 5149 standard does not apply where products or appliances are covered by product-specific ISO or IEC standards that detail refrigerant charge limits, e.g. the IEC 60335 series of standards.

AS/NZS 5149 recognises – in all parts – alternative performance-based approaches, which are allowed as long as a technical assessment by a competent person demonstrates that the system is no less safe than if the system had been designed to comply with the prescriptive requirements of the standard. The performance clause cannot be applied to appliances covered under product-specific standards. The standard also references the AS/NZS 60079 for hazardous atmosphere assessments.

PART 1

AS/NZS 5149.1:2016 Part 1 *Definitions, classification and selection criteria* maintains the same "Occupancy Categories" of AS/NZS 1677.2. However, the terminology has changed from Category "I, II and III" to Category "a, b and c" in 5149. The system classifications of AS/NZS 1677.2 have been expanded to include for more variations in design, and a new system "Location Classification" has been introduced as Class I, II, III and IV. The system charge limits are calculated based on the classification of occupancy, the system type, the system location, and the Refrigerant Concentration Limit as specified in 817.

The variations made to ISO 5149.1:2014 that make it suitable for use in Australia and New Zealand are:

- Machinery rooms are considered as an "Authorised occupancy c" in accordance with Table 1;
- Allowable charge limits for multi-split and VRF air conditioners using A2L refrigerant are defined in AS/NZS 60335.2.40, so Annex A and Clause A.5 is not applicable to those system types;
- Appendix ZA has been added to provide worked examples of refrigerant charge determination for several different refrigerant scenarios, calculation of charge limits can be complex given the many variables involved and a range of examples have been provided to assist users of the standard;
- Appendix ZB outlines the relationship between the AS/NZS ISO 817 refrigerant safety classification system, as used in AS/NZS 5149, to the Australian Dangerous Goods (ADG)

code and GHS classification. These systems use different flammability classifications and the appendix has been provided to clarify any potential confusion and misapplication.

CLASSIFICATION CONFUSION

ADG = Australian Dangerous Goods code,

GHS = Globally Harmonised System

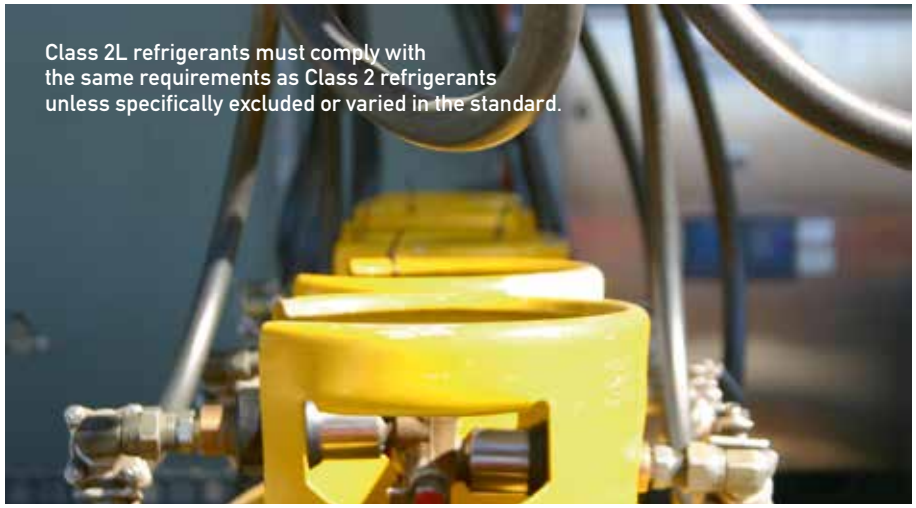
Appendix ZB clarifies that the refrigerant R1234ze is classified as Lower Flammability A2L by ISO 817 but it is classed as non-flammable, non-toxic under the ADG and GHS systems; "Division 2.2" under ADG, and as "Gas Under Pressure H280" under GHS. Most other A2, A2L and A3 refrigerants are classed as "Division 2.1 Flammable gases" under ADG, and as "Flammable Gases Category 1 H220" under GHS.

PART 2

AS/NZS 5149.2:2016 Part 2: *Design, construction, testing, marking and documentation* applies to all stationary or mobile systems, excluding vehicle air conditioning. It applies to new systems, to modifications of existing systems, including the conversion of a system to another refrigerant. Products that comply with the IEC product-specific standards are "deemed" (presumed) to comply with the 5149.2 standard.

Part 2 contains all the detail in relation to design requirements for pipes, piping components and fittings, testing requirements, marking and documentation requirements, as well as requirements for assemblies of components. More stringent requirements apply as the toxicity or flammability classification of the refrigerant increases, with A1 attracting the least stringent requirements and B3 the most stringent. Class 2L refrigerants must comply with the same requirements as Class 2 refrigerants unless specifically excluded or varied in the standard.

Installation is covered in detail, including location, protection, access, safe pressure limiting arrangements, protection devices, testing, marking, and documentation such as instructions, drawings and a refrigerant log book for systems with a refrigerant charge over 3kg. Additional requirements for large volume R717 ammonia-based systems are also included.


Class 2L refrigerants must comply with the same requirements as Class 2 refrigerants unless specifically excluded or varied in the standard.

A significant change from AS/NZS 1677.2 is the minimum system design temperatures that must be used for determining the maximum allowable pressure (PS). This has been raised from 59°C to 63°C for air-cooled condensers. PS is used to determine the various testing pressures – a higher temperature means a higher pressure, so this change will have to be managed by the equipment supply chain.

The variations made to ISO 5149.2:2014 for Australian and New Zealand use include:

- Existing systems can be modified or extended to comply with the standard as long as they are not relocated;
- Reference is made to AS 1170.4/NZS 4219 for information on seismic loading;
- For 2L refrigerants pipework must be protected to prevent damage, joints in occupied spaces must be permanent, and system components must be shipped without refrigerant charge;
- Systems using A2L refrigerants cannot use fusible plugs;
- The hot surface temperature (HST) requirements have been made more stringent for all refrigerants;
- The Protection Against Explosion requirements have been extended to include A2L and B2L refrigerants;
- The assessment of flammable refrigerants and associated ignition sources must be in accordance with AS/NZS 60079.10.1, including electrical compliance with AS/NZS 60079.14 where applicable;
- Protection by ventilation provisions must meet the requirements of the AS/NZS 60079 series.

PART 3

AS/NZS 5149.3:2016 Part 3 *Installation site* outlines the safety requirements applicable to a site and includes the following for applications: new systems, modifications, extensions, relocations and conversions. This standard covers the location of the refrigeration system, the general requirements for machinery rooms, and also the specific additional requirements for plant rooms with flammable refrigerants and ammonia-based systems. The standard also includes alternative site-specific provisions, which can be used for compliance where the allowable charge limits of AS/NZS 5149 Part 1 are exceeded. Requirements for safety alarms, refrigerant detectors, instruction manuals, inspection and maintenance protocols, and local heat sources are also included.

The variations made to ISO 5149.3:2014 for use in Australia and New Zealand include:

- Any equipment in the open air (location Classifications II and III) containing more than two cubic metres of flammable refrigerant (any class) must be secured within a fenced enclosure or barrier;

- Machinery rooms are classified as an "Authorized occupancy c" (Table 1 in AS/NZS 5149.1);
- Negative pressures developed by emergency ventilation systems must not exceed 50Pa;
- Machinery rooms with flammable refrigerants must be assessed for hazardous areas in accordance with AS/NZS 60079.10.1. Electrical installations and other control measures must comply with the relevant parts of the AS/NZS 60079 series;
- Changes to the provisions for emergency exhaust ventilation ductwork, the use of fire suppression systems with R-717, and ignition sources where flammable refrigerants are used;
- Hazardous area exclusions for A2L refrigerants have been removed;
- Gas sensors and controls for flammable refrigerants must comply with the requirements of the AS/NZS 60079.29 series.

PART 4

AS/NZS 5149.4:2016 Part 4 *Operation, maintenance, repair and recovery* covers the ongoing management of a refrigeration and air conditioning system. The standard requires that operating personnel are competent and instructed in the correct operation of a system. Each system must have an operating logbook and be the subject of preventative maintenance procedures specified in the system operating instructions. The standard also includes requirements for maintenance and repair procedures, procedures for changing the refrigerant type in existing systems, as well as requirements for refrigerant transfer, transport and storage, and the recovery, reuse and disposal of refrigerants.

The variations made to ISO 5149.4:2014 for Australian and New Zealand use are as follows:

- The restriction on using disposable containers for refrigerant transfer does not apply in New Zealand;
- Refrigerants recovered expressly for disposal may be mixed in the approved reclaim cylinders used in the "product stewardship scheme";
- Refrigerants of different flammability and/or toxicity classifications must not be mixed in reclaim cylinders.

SO, WHO CARES AND WHO NEEDS TO KNOW?

All stakeholders that have an interest in refrigeration and air conditioning should have an interest in the new refrigeration safety and environmental standards. Compliance with these standards can help all participants in the refrigeration and air conditioning supply chain demonstrate due duty of care.

Nobody wants refrigeration and air conditioning to hurt people or damage the environment. AS/NZS 1677.2 is currently an industry minimum-practice safety standard that provides a compliance and duty-of-care pathway for a range of industry participants. It is also referenced extensively in environmental regulations. The new AS/NZS 5149 will likely continue to provide evidence of safety in design and environmentally responsible installation and operational practices.

This standard will only become more important to industry as we transition to the increased use of flammable refrigerants. The corresponding increased diligence and improved compliance required to meet WHS safety standards and environmental protection standards is vital. The industry is still within a major technical transition, and so are the standards which have also been criticised for being too conservative in regards to the stringency levels for flammable refrigerants.

There is an unprecedented amount of research and development going on in the refrigeration, air conditioning and heat pump fields worldwide, producing new technologies (magnetic, chemical and electro-chemical refrigeration), new methodologies (solar cooling, PV-assisted air conditioning), new risks, and new opportunities at a tremendous rate of change. Over 80 different refrigerants are in play or under development in 2016, and there are many alternatives to refrigerant-based systems hoping to increase their market share.

The AS/NZS 1677:1998 standard was based (in part) on ISO 5149:1994, so the changes involved in moving to the new standards are not severe.

ISO 5149 was revised in 2009 and 2014, and it is likely that a future revision project will commence once the next changes to EN 378 and ASHRAE 34 are finalised. Refrigerant-based industries have been in transition globally since the 1990s, and the current move towards low-GWP solutions is keeping the industry in a flux of change. As a result, the safety and environmental standards are themselves being constantly revised to account for new technologies and new approaches as well as the changing regulatory landscape for refrigerants worldwide.

This is one of the challenges for technical service providers working in the refrigeration and air conditioning sectors. How to get up to speed and stay up to date on the safety and environmental standards in the industry. AIRAH can help and will be partnering with Standards Australia to deliver a series of industry seminars introducing the new standards, outlining the technical requirements and their implications for the industry.

AS/NZS ISO 817 and AS/NZS 5149 parts 1 to 4 are available from SAI Global. All stakeholders in refrigeration and air conditioning design, installation, operation and maintenance are encouraged to familiarise themselves with these important new international minimum safety and environmental benchmarks. ▮

Would you like to know more?

In early 2017 AIRAH will be conducting a nationwide series of seminars on the new standards.

The seminars will be held in Brisbane on February 14, Canberra on February 15, Sydney on February 16, Hobart on February 21, Melbourne on February 22, Perth on March 1 and Adelaide on March 2.

Go to www.airah.org.au/seminars closer to the events.