

Review of Standard AS 1731:2003 and
Amendments
Indicating Issues and their suggested solutions

Technical Discussion Paper

Prepared by Tony Fairclough of Thermatek Consultancy (Australia)
and Rod King Design Services (New Zealand)

June 2008

Contents

| | |
|---|-----|
| GLOSSARY | 3 |
| 1. INTRODUCTION | 4. |
| 2. OVERVIEW OF CURRENT AUSTRALIAN STANDARD AS 1731:2003 | 4. |
| 3. SUMMARY OF REFRIGERATED DISPLAY CABINET ISSUES | 9. |
| 4. ISSUES TO BE CONSIDERED | 11. |
| 4.1 RDCS AND COMMERCIAL REFRIGERATORS AS TYPES | 11. |
| 4.2 CATEGORY FOR CATERING AND PROCESS REFRIGERATORS | 12. |
| 4.3 RDCS AND MIXTURE OF DOOR STYLES | 12. |
| 4.4 PROPOSED ADDITIONAL MEPS LEVELS | 13. |
| 4.5 MEPS BASED ON REFRIGERATED STORAGE VOLUME | 15. |
| 4.6 REFRIGERATORS FOR PHARMACEUTICALS OR DRUGS | 16. |
| 4.7 REFRIGERATING MEDIUM USED AND METHOD OF APPLICATION | 16. |
| 4.8 REGISTRATION AS DEEMED TO COMPLY | 17. |
| 4.9 TDA AND VPA USE IN STANDARD | 17. |
| 4.10 REGISTRATION OF RE-MANUFACTURED RDCS | 17. |
| 4.11 REVIEW OF HIGH EFFICIENCY MEPS LEVELS | 17. |
| 5. RECOMMENDATIONS | 18. |
| 6. REFERENCES | 19. |
| APPENDIX A. SUMMARY OF AUSTRALIAN TABLES | 20. |
| APPENDIX B. SUMMARY OF OVERSEAS VERSIONS | 22. |

GLOSSARY

For convenience and clarity the following short descriptive terms are used. For precise definitions please refer to the literature.

Climate Class – Classification of the test room climate according to the dry bulb temperature and relative humidity.

Gross refrigerated volume – Volume within the walls of the cabinet or of a compartment without internal fittings, doors or lids if any being closed, the load limit being taken into account if the cabinet has no door or lid.

Island refrigerated display cabinet – A refrigerated display cabinet to be placed inside the sales area so that the consumer has access to all sides.

Load Limit – For each part of the cabinet boundary surface consisting of a plane or several planes within which all test packages can be maintained within the limits for the M-package temperature class.

M Package – A test package fitted with a temperature measuring device.

Net volume – Volume available for the storage of product within the load limit.

Non-retail application – Refrigerated display cabinet used for holding foodstuffs which require some preparation or processing before sale to the end customer.

Pulldown – Reduction of the temperature of product from ambient temperature or higher to a chilled or frozen condition.

Refrigerated Display Cabinet (RDC) – A cabinet cooled by a refrigerating system which enables chilled and frozen foodstuffs placed therein for display to be maintained within the prescribed temperature limits.

Remote Cabinet - A refrigerated display cabinet that has a remote condensing unit.

Retail Cabinet - A cabinet that holds product on display for sale directly to customers.

Self-contained cabinet – A refrigerated display cabinet that has the condenser unit built into the cabinet.

Total Display Area (TDA) – Total visible product storage area, including visible area through the glazing, defined by the sum of the horizontal and vertical projected surfaces of the net volume.

Type/s – A classification of the refrigerated display cabinet families.

Visibility of products by arc method (VPA) – Total visible foodstuff area, including visible area through glazing, defined by the arc method.

1. Introduction

The purpose of this Technical Discussion Paper is to review issues presented by stakeholders and to offer recommendations in the form of further amendments to Australian Standard AS 1731:2003.

The issues referred to are those which have been raised with the Regulatory Contacts in Australia and New Zealand, and also those which have emerged in the Registration Process of Refrigeration Display Cabinets (RDC).

Further to this, to enable the scope of the standard to be broadened to include product not currently covered, additional efficiency levels will need to be determined and type definitions widened. Alternate methods of calculating the efficiency of products not fitting the current definitions may also need to be adopted.

The original version of the AS 1731 standard was based on the European EN 441 series of publications. These have now been revised and consolidated into a two part ISO standard, ISO 23953. While the content has remained basically the same the layout is considerably simplified. Further developments are taking place this year which should see the ISO standard more closely aligned with Australian and New Zealand requirements.

In principal a revised standard will, in keeping with the basis of other efficiency standards, comprise a Part 1 which specifies the test requirements and Part 2s which specify the product classifications and MEPS levels.

The report will be distributed to industry for discussion with the feedback being collated and presented with recommendations to amend AS 1731:2003 if required to the ME – 008 Australian Standards Committee for AS 1731:2003.

2. Overview of current Australian Standard AS 1731: 2003

The Standard is formed in fourteen (14) parts, and it is intended to impact on the Commercial Refrigeration Markets of Australia and New Zealand by the requirement to meet Minimum Energy Performance Standards (MEPS) levels for product types, and in its forward development, the introduction of High Efficiency levels for MEPS.

The Standard encompasses a descriptive requirement in the manufacture of RDCs, also in testing procedure and performance maintenance.

Parts 1 to 13 cover the test specifications of 'Refrigerated Display Cabinets' while Part 14 defines the product types and specifies the minimum efficiency and high efficiency levels for these types.

Compliance with the standard requires maintenance of temperature conditions which reflect the registered operation of the RDC, and by nomination of the M-package temperature as shown in the following Table 1 reproduced from AS 1731.6:2003.

Table 1: M-package temperature classes (AS 1731.6 Table 1)

| Class | The highest temperature θ_{ah} of the warmest M-package equal to or lower than °C | The lowest temperature θ_b of the coldest M-package equal to or higher than °C | The lowest temperature θ_{al} of the warmest M-package equal to or lower than °C |
|--------------|--|---|---|
| L1 | -15 | NA | -18 |
| L2 | -12 | NA | -18 |
| L3 | -12 | NA | -15 |
| M1 | + 5 | -1 | NA |
| M2 | + 7 | -1 | NA |
| H1 | + 5 | + 1 | NA |
| H2 | + 10 | -1 | NA |
| S | Special classification | | |

'Cold Chain' conditions as required by the 'Food Safety' guidelines (ANZFA 2001), are covered by the nomination of the registered Temperature Class, and denote the intended temperature range of the product.

The MEPS levels as shown in Table 2 and Table 3 below, as reproduced from AS 1731.14:2003, represent the minimum efficiency levels currently applicable to Remote Cabinets and Self-contained Cabinets respectively when tested in Climate Class 3 conditions and with the M-package having the lowest temperature range in which the cabinet is intended to operate in. Where 'no value' has been inserted in the table a MEPS level has not been determined for these 'Types' of product.

Table 2: Maximum energy consumption - remote cabinets (AS 1731.14 Table 2.1)

| Type | Maximum energy consumption TEC/TDA (kWh/day/m ²) |
|-------------------|--|
| RS1 Unlit shelves | 12.55 |
| RS1 Lit shelves | 17.76 |
| RS2 Unlit shelves | 12.73 |
| RS2 Lit shelves | 16.98 |
| RS3 Unlit shelves | 14.84 |
| RS3 Lit shelves | 18.39 |
| RS4 Solid door | no value |
| RS4 Glass door | 9.73 |
| RS5 Solid door | no value |
| RS5 Glass door | no value |
| RS6 Gravity coil | 14.21 |
| RS6 Fan Coil | 14.16 |
| RS7 Gravity coil | no value |
| RS7 Fan Coil | 14.79 |
| RS8 Gravity coil | 12.25 |
| RS8 Fan Coil | 13.19 |
| RS9 Gravity coil | no value |
| RS9 Fan Coil | 12.09 |
| RS10 High | no value |
| RS10 Medium | no value |
| RS10 Low | 18.67 |
| RS11 | 38.13 |
| RS12 | 66.33 |
| RS13 Solid sided | 19.48 |
| RS13 Glass sided | 19.58 |
| RS14 Solid sided | 15.49 |
| RS14 Glass sided | 37.08 |
| RS15 Solid door | no value |
| RS15 Glass door | 37.08 |
| RS16 Solid door | no value |
| RS16 Glass door | 40.56 |
| RS17 Solid door | no value |
| RS17 Glass door | no value |
| RS18 | 48.58 |
| RS19 | 36.15 |
| RS20 | no value |

**Table 3: Maximum energy consumption self-contained cabinets in kWh/day/m²
(AS 1731.14 Table 2.2)**

| Type | | M-package temperature classes (See AS 1731.6 Cl 5) | | Type | | M-package temperature classes (See AS 1731.6 Cl 5) | |
|------|------------|---|----------|------|------------|---|----------|
| | | M1 | M2 | | | L1 | L2 |
| HC1 | | 11.50 | 11.50 | HF1 | | no value | no value |
| HC2 | | no value | no value | HF2 | | no value | no value |
| HC3 | | no value | no value | HF3 | | no value | no value |
| HC4 | | 15.50 | 15.50 | HF4 | | 26.50 | 26.50 |
| HC5 | | no value | no value | HF5 | | no value | no value |
| HC6 | | no value | no value | HF6 | | 8.00 | 8.00 |
| VC1 | | 37.50 | 28.00 | VF1 | | no value | no value |
| VC2 | | 27.00 | 25.50 | VF2 | | no value | no value |
| VC3 | | no value | no value | VF3 | | no value | no value |
| VC4 | Solid Door | 17.00 | 17.50 | VF4 | Solid Door | 44.00 | 39.00 |
| VC4 | Glass Door | 17.00 | 17.50 | VF4 | Glass Door | 44.00 | 39.00 |
| YC1 | | no value | no value | YF1 | | no value | no value |
| YC2 | | no value | no value | YF2 | | no value | no value |
| YC3 | | no value | no value | YF3 | | no value | no value |
| YC4 | | no value | no value | YF4 | | no value | no value |

Note: Where a cabinet is designed to operate at more than one M package temperature the cabinet shall be tested to the lowest M package temperature range.

The MEPS levels as shown in Tables 4 and 5 below as reproduced from AS 1731.14::2003 and represent the High Efficiency levels as currently applicable to Remote Cabinets and Self-contained Cabinets respectively when tested in Climate Class 3 conditions and with the M-package having the lowest temperature range in which the cabinet was intended to operated in. Where 'no value' has been inserted in the table a MEPS level has not been determined for these Types of product.

**Table 4: Maximum energy consumption for 'High Efficiency' remote display cabinets
(AS 1731.14 Table 3.1)**

| Type | Maximum energy consumption TEC/TDA (kWh/day/m ²) |
|-------------------|---|
| RS1 Unlit shelves | 8.37 |
| RS1 Lit shelves | 10.66 |
| RS2 Unlit shelves | 8.49 |
| RS2 Lit shelves | 11.32 |
| RS3 Unlit shelves | 10.32 |
| RS3 Lit shelves | 12.26 |
| RS4 Solid door | no value |
| RS4 Glass door | 6.77 |
| RS5 Solid door | no value |
| RS5 Glass door | no value |
| RS6 Gravity coil | 9.88 |
| RS6 Fan Coil | 9.85 |
| RS7 Gravity coil | no value |
| RS7 Fan Coil | 9.86 |
| RS8 Gravity coil | 8.52 |
| RS8 Fan Coil | 9.17 |
| RS9 Gravity coil | no value |
| RS9 Fan Coil | 8.06 |
| RS10 High | no value |
| RS10 Medium | no value |
| RS10 Low | 12.99 |
| RS11 | 26.52 |
| RS12 | 46.14 |
| RS13 Solid sided | 12.99 |
| RS13 Glass sided | 13.62 |
| RS14 Solid sided | 11.45 |
| RS14 Glass sided | 12.86 |
| RS15 Solid door | no value |
| RS15 Glass door | 27.41 |
| RS16 Solid door | no value |
| RS16 Glass door | 29.98 |
| RS17 Solid door | no value |
| RS17 Glass door | no value |
| RS18 | 39.75 |
| RS19 | 29.57 |
| RS20 | no value |

Table 5: Maximum energy consumption 'High Efficiency' self-contained cabinets in kWh/day/m² (AS 1731.14 Table 3.2)

| Type | | M-package temperature classes (See AS 1731.6 Cl 5) | | Type | | M-package temperature classes (See AS 1731.6 Cl 5) | |
|------|------------|---|----------|------|------------|---|----------|
| | | M1 | M2 | | | L1 | L2 |
| HC1 | | 8.50 | 8.50 | HF1 | | no value | no value |
| HC2 | | no value | no value | HF2 | | no value | no value |
| HC3 | | no value | no value | HF3 | | no value | no value |
| HC4 | | 11.40 | 11.40 | HF4 | | 19.50 | 19.50 |
| HC5 | | no value | no value | HF5 | | no value | no value |
| HC6 | | no value | no value | HF6 | | 5.90 | 5.90 |
| VC1 | | 27.60 | 20.60 | VF1 | | no value | no value |
| VC2 | | 19.90 | 18.80 | VF2 | | no value | no value |
| VC3 | | no value | no value | VF3 | | no value | no value |
| VC4 | Solid Door | 7.30 | 7.30 | VF4 | Solid Door | 32.40 | 28.70 |
| VC4 | Glass Door | 10.70 | 10.70 | VF4 | Glass Door | 32.40 | 28.70 |
| YC1 | | no value | no value | YF1 | | no value | no value |
| YC2 | | no value | no value | YF2 | | no value | no value |
| YC3 | | no value | no value | YF3 | | no value | no value |
| YC4 | | no value | no value | YF4 | | no value | no value |

Note: Where a cabinet is designed to operate at more than one M package temperature the cabinet shall be tested to the lowest M package temperature range.

3. Summary of Issues

Refrigerated Display Cabinets and Energy Efficiency Standards

The Australian Standard AS 1731:2003 categorises refrigerated display cabinets into a large number of 'Types' by physical description and in some cases dimensional ranges.

Remote refrigerated cabinets are broken into thirty six (36) of the 'Type' classifications however currently twelve (12) of these do not have performance levels prescribed.

Self-contained refrigerated cabinets are split into thirty (30) 'Type' classifications with twenty (20) of these not having levels prescribed.

Many of the perceived issues are as a result of uncertainty as to what 'Type' class refrigerated equipment should be categorised into.

As well the differences between products intended for the sale and display of food products and product that is intended for use in catering and similar non-retail applications can be difficult to interpret.

A number of types are seen to have extremely low numbers of registrations (CRIPL 2008) while other types such as vertical glass door display cabinets have large numbers of registrations. To some extent this typifies the market size, in Australia and especially New Zealand, with a large variety of product types both imported and locally manufactured but with relatively low numbers of each type distributed into the market place. The following figures show the numbers of registrations for each Type broken down into the minimum efficiency and high efficiency levels (See Appendix A, Table 9 and Table 10).

Figure 1: Registrations for minimum and high efficiency remote display cabinets

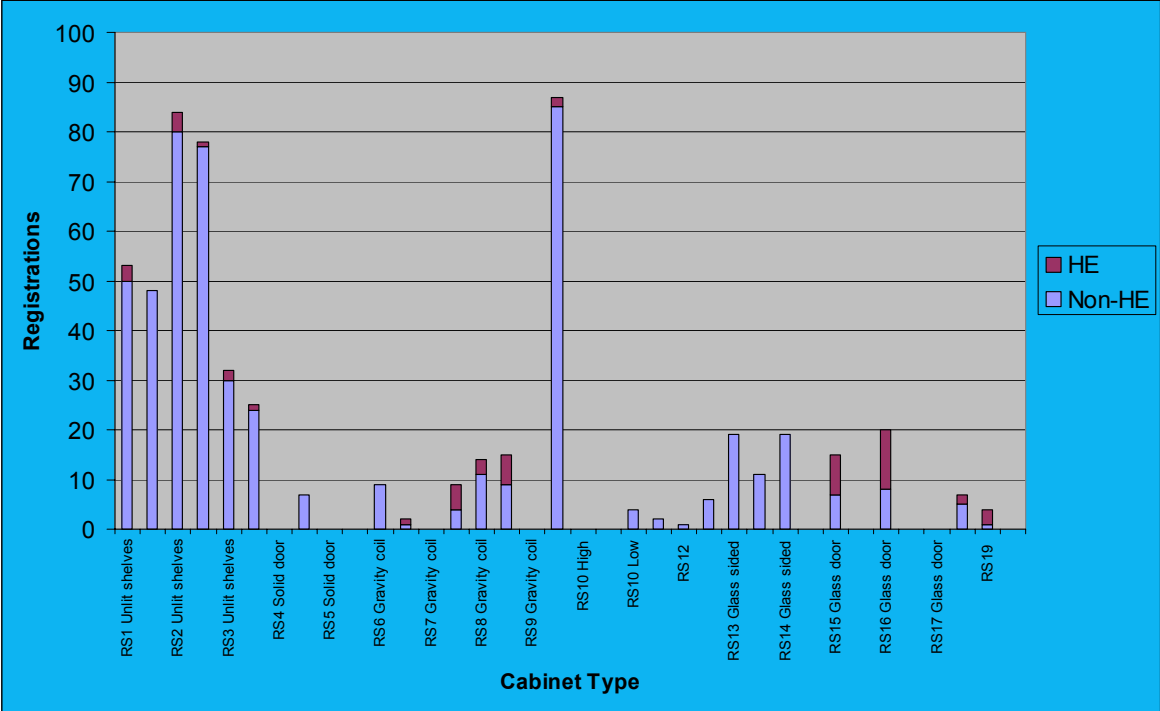
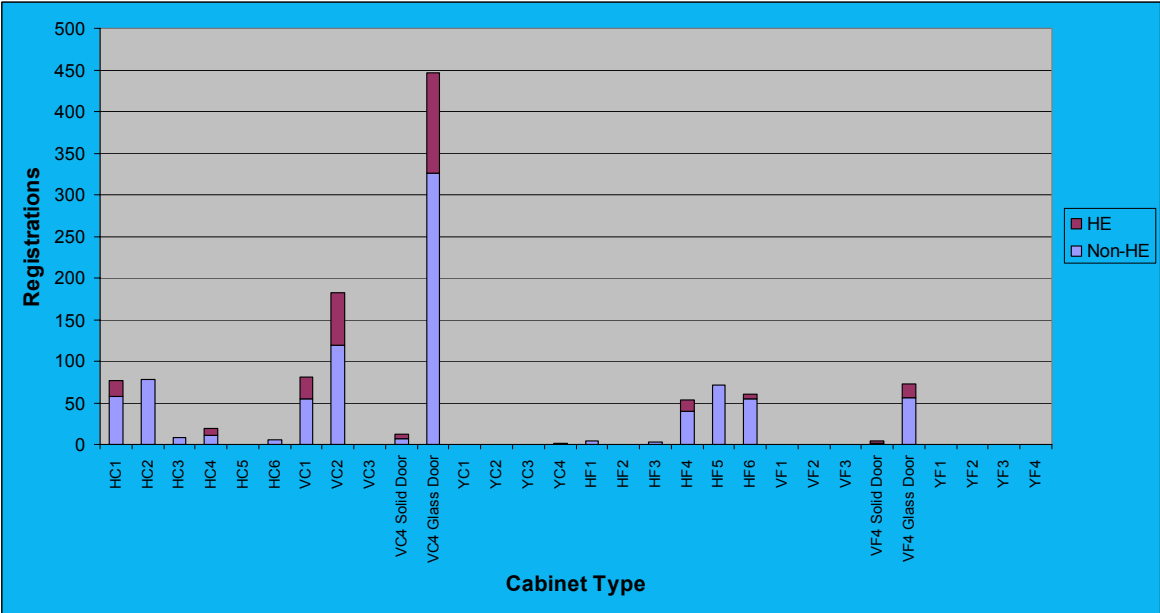


Figure 2: Registrations for minimum and high efficiency self-contained cabinets



Any solution to these issues will be complex and the need to increase the energy efficiency on a continuing basis will mean that reliable data as well as coverage of wider field of equipment is going to be essential.

In the short term compiling data and prescribing efficiency levels where these are not currently set will provide some benefits in terms of covering more product, however in the medium term a less complicated system of classification may be required.

In this respect the Canadian and United States have adopted methods based on simply defined categories with energy efficiency relating to product storage volume and linear length rather than total display area.

This enables a very much wider coverage of the market ensuring all refrigerated equipment can be regulated without the inherent interpretation issues of using the European based standard.

It appears at present that the EN 441 series, now ISO 23953 Parts 1 and 2 is not used as the basis of any MEPS based regulatory scheme outside of Australia and New Zealand.

While any change of the current basis for determining the energy efficiency would involve complications a gradual process could be implemented.

Additional information such as storage volume, and daily energy consumption could be added to that which must be reported currently and mandated with a planned timeframe for existing registrations to meet.

This additional published data would assist those choosing new product and also build up the data base to enable better decisions to be made in the future.

This would then enable a continual programme of removing a certain percentage of product from the market to be easily implemented. The data would be transparent and easily understood.

It is possible to readily determine the daily energy consumption on the current published data but most purchases are based on storage volume for self-contained product and linear length for supermarket equipment. Total display area presents a confused picture to those buying product.

A suggested long term goal may be to move away from the current standard and transition into adopting the North American standards. This approach is been taking with other commercial refrigeration products like Ice Makers and Ice Storage Bins and Refrigerated Beverage Vending Machines.

4. Issues to be Considered

4.1 RDCs and Commercial Refrigerators as Types

A clear and definitive statement in AS 1731 is that the scope in the standard applies to either Remote or Self Contained design, but does not include products for Catering or Non Retail applications. The classification of 'Types' defines the foregoing category as listed in the respective tables in Part 14 of the standard. The current classification table is not, and was not intended to be, exhaustive of all possible configurations, but it was at the time of inclusion, representative of the market place volume supply by a range of suppliers.

The market place was surveyed and invited to submit a spreadsheet of data on their products that matched particular limiting guidelines. These guidelines included physical dimensions, refrigerated display envelopes, and most particularly, fitted into the standard temperature ranges required by the Food Safety Authorities for Retail Food Display and Sale.

The latter requirement also assumes a further important component, and that is that the Refrigerated Merchandise performance is based on the stock of food product being pre-cooled to the required standard before being placed in the RDC.

A summary explanation of this latter important fact is that the available 'pulldown' refrigeration load is limited to after defrost recovery, stocking of the RDC, and maintenance of storage conditions being the prime contributor to the total refrigerating effect.

Recommendation is that the descriptive input to the table of 'Types' be considered for simplification especially where the MEPS levels are very similar. ie 'Unlit Shelf' versions of RS1 and RS 2 could be combined as could 'Lit Shelf' versions of these Types.

4.2 Category for Catering or Process Refrigerators (Non Retail)

A category for Types of 'Refrigerating Storage Cases', as opposed to 'Refrigerating Display Case', would include Catering, Process and Preparation style of refrigerators, which whilst having very similar appearances to other RDCs, would have different capabilities in total refrigeration capacity requirements.

The possibility of assigning a MEPS level which satisfies all requirements for this style of case is impossible, as the level of testing parameters cannot determine a 'one fits all' condition.

A suggestion would be the assignment of a MEPS level which was based on a 'Gross Refrigerated Volume' calculation, the difference being to that of the 'Retail' style of case would be a contribution to a heavier pulldown component. This component would be the difference made between 'Gross' and 'Net' volume in calculation of its MEPS assignment.

Using the Gross Volume figure, when determining the area to which the MEPS level is applied, would realise a greater value to that which can be computed from the area as bounded by the product load lines.

4.3 RDCs and mixtures of door styles

Issues have arisen in queries to Regulators where a RDC or Refrigerated Storage Case, has Solid or Glass Doors at the rear as well as the front of the case, and there could be two (2) interpretations of the intended use.

If the case is not intended to be an Island configuration, i.e. the contents are not accessible for selection by customers as a Retail choice, then the door deemed as the 'rear' door, provides a convenient restocking access for staff. It also, in the foregoing description, may well be from another refrigerated environment, and be beneficial to the load imposed on the case.

If the case was of an Island configuration, and customer access was from both sides, then it could be expected that the Gross Refrigerated Volume of the case was greater than a case as described in the former.

A summary interpretation would be that the MEPS for the former would be based on a single entry door, and a Glass door rating if Glass was on any of the sides, otherwise Solid, if only these doors were fitted.

For the latter of the two (2) descriptions, MEPS for both doors would be included as the Total Display Area (TDA) would be greater per unit length over a greater volume.

4.4 Proposed additional MEPS levels

The MEPS tables for Remote and Self Contained Cabinets have a considerable number of 'No Value' entries, and whilst all their descriptive types exist, they escape the registration process.

A suggestion to resolve this issue, for a restricted time, is to consider levels based on a calculation of MEPS in lieu of a submitted test report with registration.

Commercial RDCs having an entry as 'No Value' could use the Specific Daily Energy Consumption (SDEC) levels recommendations for Remote Cabinets, and Self Contained Cabinets use values based on Refrigerated Volume.

Cross checks with those published in other overseas like markets, suggests a close accord with the levels assigned to the types where AS1731 has an indicated figure.

Canadian Standard C 657-04 is suggested as the source standard for Remotes, but the Canadian levels for Self Contained are based as denoted by adopting the Californian levels; see Energy Efficiency Regulations (NRCAN 2006 and ASHRAE 72:1998 in conjunction with ASHRAE 117:1992, Appendix B: Canada B1, Ontario B2).

The following tables contain proposed new minimum efficiency levels (shaded cells) to replace the 'No Value' entries. Table 6 covers Remote Cabinets and Table 7 Self-contained Cabinets.

Table 6: Proposed new minimum efficiency values for Remote cabinets

| Type | Maximum energy consumption TEC/TDA (kWh/day/m ²) |
|-------------------|---|
| RS1 Unlit shelves | 12.55 |
| RS1 Lit shelves | 17.76 |
| RS2 Unlit shelves | 12.73 |
| RS2 Lit shelves | 16.98 |
| RS3 Unlit shelves | 14.84 |
| RS3 Lit shelves | 18.39 |
| RS4 Solid door | 11.45 (a) |
| RS4 Glass door | 11.45 (a) |
| RS5 Solid door | 11.45 (a) |
| RS5 Glass door | 11.45 (a) |
| RS6 Gravity coil | 14.21 |
| RS6 Fan Coil | 14.16 |
| RS7 Gravity coil | 11.45 (b) |
| RS7 Fan Coil | 14.79 |
| RS8 Gravity coil | 12.25 |
| RS8 Fan Coil | 13.19 |
| RS9 Gravity coil | 11.45 (b) |
| RS9 Fan Coil | 12.09 |
| RS10 High | Under review |
| RS10 Medium | Under review |
| RS10 Low | 18.67 |
| RS11 | 38.13 |
| RS12 | 66.33 |
| RS13 Solid sided | 19.48 |
| RS13 Glass sided | 19.58 |
| RS14 Solid sided | 15.49 |
| RS14 Glass sided | 37.08 |
| RS15 Solid door | 23.05 (a) |
| RS15 Glass door | 23.05 (a) |
| RS16 Solid door | 23.05 (a) |
| RS16 Glass door | 40.56 |
| RS17 Solid door | 23.05 (a) |
| RS17 Glass door | 23.05 (a) |
| RS18 | 48.58 |
| RS19 | 36.15 |
| RS20 | 36.15 (c) |

Note: (a) These values are in accord with the UK Energy Technology Criteria List of July 2007, and are the Energy Efficiency Index (EEI) levels for relevant temperature class and type of cabinet.

(b) This value has been indicated as in Note (a), but it is expected that a Gravity Coil application would be reflecting a lower level of TDA/TEC.

(c) This value equates to RS19.

Table 7: Proposed new minimum efficiency levels for self-contained cabinets in kWh/day/m²

| Type | | M-package temperature classes | | Type | | M-package temperature classes | |
|------|------------|-------------------------------|----------|------|------------|-------------------------------|----------|
| | | M1 | M2 | | | L1 | L2 |
| HC1 | | 11.50 | 11.50 | HF1 | | 26.50 | 26.50 |
| HC2 | | 11.50 | 11.50 | HF2 | | Note (d) | Note (d) |
| HC3 | | 15.50 | 15.50 | HF3 | | 26.50 | 26.50 |
| HC4 | | 15.50 | 15.50 | HF4 | | 26.50 | 26.50 |
| HC5 | | 15.50 | 15.50 | HF5 | | 26.50 | 26.50 |
| HC6 | | 15.50 | 15.50 | HF6 | | 8.00 | 8.00 |
| VC1 | | 37.50 | 28.00 | VF1 | | Note (e) | Note (e) |
| VC2 | | 27.00 | 25.50 | VF2 | | Note (e) | Note (e) |
| VC3 | | 17.50 | 17.00 | VF3 | | Note (e) | Note (e) |
| VC4 | Solid Door | 17.00 | 17.50 | VF4 | Solid Door | 44.00 | 39.00 |
| VC4 | Glass Door | 17.00 | 17.50 | VF4 | Glass Door | 44.00 | 39.00 |
| YC1 | | 18.9 (f) | 18.9 (f) | YF1 | | 32.3 (g) | 32.3 (g) |
| YC2 | | 18.9 (f) | 18.9 (f) | YF2 | | 32.3 (g) | 32.3 (g) |
| YC3 | | 18.9 (f) | 18.9 (f) | YF3 | | 32.3 (g) | 32.3 (g) |
| YC4 | | 18.9 (f) | 18.9 (f) | YF4 | | 32.3 (g) | 32.3 (g) |

Note: (d) No current description of this type

(e) More descriptive information to be assigned

(f) Levels indicated at a similar ratio to HC4:HF4.

(g) Values as indicated in Eurovent Certification Program Table for LT Combo type cabinet

4.5 MEPS based on refrigerated storage volume.

The refrigerated internal volume of a refrigerator is the whole of that space which must accommodate the stored stock, the furniture to support, it and where necessary the cooling apparatus (evaporator). This internal volume is the Gross Volume.

The internal volume which is bounded by the product load lines and markings, and leaves adequate space for air circulation, stock removal, and clearance for the removal or maintenance of items such as lighting etc, is the controlled space. This internal volume is the Net Volume.

The Air Curtain may be so arranged that it has a top discharge point above the uppermost load limit line, and therefore above the horizontal limit of the TDA.

It is recommended that Table 8, Page 16, AS 1731-14 extract below) should be amended in the Description column, by reference to the upper limit of the 'product load line', or the 'length of air curtain', when determining its 'Type'.

Table 8: Examples of types of remote refrigerated cabinets – medium temperature (AS 1731.14 Table A1)

| Name | Type | Description | Subclass | |
|-----------------------|------|--|-------------|---------------|
| | | | Lit Shelves | Unlit shelves |
| High open multideck | RS 1 | Medium temperature multideck, length of air curtain 1.5 - 1.9 m. Cabinet height of 2.2 - 2.5 m and depth of 0.6 - 1.2 m | Lit Shelves | Unlit shelves |
| Medium open multideck | RS 2 | Medium temperature multideck, length of air curtain 1.0 - 1.5 m. Cabinet height of 1.8 - 2.19 m and depth of 0.6 - 1.2 m | Lit Shelves | Unlit shelves |
| Low open multideck | RS 3 | Medium temperature multideck, length of air curtain 0.8 - 1.2 m. Cabinet height of 0 - 1.79 m and depth of 0.6 - 1.2 m | Lit Shelves | Unlit shelves |
| | | | | |

4.6 Refrigerators for Pharmaceutical or Drugs

The Quality Care Pharmacy Program (QCPP) administered by The Pharmacy Guild of Australia in respect of requirements for Refrigerators for the storage of Drugs refers to temperature maintenance in the 2°C to 8°C (QCCP 2004) range, and the Cold Chain Testing Protocol as described on the QCPP site, deem these products to be a special category.

Therefore a recommendation is that a Special Type/Category be allocated to this product with the appropriate research on applicable MEPS levels.

4.7 Refrigerating medium used and method of application

Indications are that a significant lift in the efficiency of RDCs, particularly those in the 'Remote' category is to be realized, as more installations are completed using other than traditional Commercial Refrigerants, particularly in the High Pressure range of products.

The use of CO₂ in supermarket installations suggests power consumption savings, which require to be documented in laboratory testing on single product evaluation, but most commercial facilities are not capable of collecting this data readily.

Plans are underway to validate results recorded in field use, but this is some way off being available as a 'best practice' figure.

Liquid Recirculation of a Refrigerant medium, that can and will, have some gas component in its flow, does not transmit accurate mass flow rates via conventional flow metering.

A suggestion is that RDCs operated on other than Direct Expansion Refrigerant or Secondary Coolants are registered as 'Special' with a forecasted MEPS level.

Major end users of RDCs are now announcing in public documentation their move to Eco friendly systems that have considerable power saving results, and therefore these applications must be recognized in the compliance with standards.

4.8 Registration as 'deemed to comply'.

Many refrigerated cabinets are so customized that they cannot match exactly to a 'Type', or their use is such that they are designed as 'fit for purpose'.

Their 'Type' is more accurately defined as 'Special', and introduction of a Category which records as 'deemed to comply', provides input to a Data Base as to the size of this market segment, and its impact on Energy Consumption.

Registration in this Category would require Test Data to be submitted.

4.9 Total Display Area (TDA) and Visibility of Products by Arc method (VPA) in standard

The use of TDA in the presentation of the MEPS value for a particular 'Type' of RDC is mandatory, and as such, the VPA as described in AS 1731:14 Appendix E whilst described as 'informative' has no requirement to be presented in the Registration process.

A suggestion is that the detail in respect of VPA be removed.

4.10 Registration of Re-manufactured RDCs

Original RDCs, whether Remote or Self Contained style, have an indefinite validation whilst remaining in an 'as originally supplied' configuration. Should the product receive modification which alters the original specification parameters, then re-registration should be part of the legal requirement that validates 'Second Hand' sales.

Whilst no proposal is suggested in making a separate category for such an event as in the foregoing, a reference note in the body of AS 1731, positioned under the description of Scope, could be considered as follows: *This Standard specifies terminology, general mechanical and physical requirements, test conditions as well as installation and maintenance including a user's guide, for refrigerated display cabinets for the sale or display, or both, of food products (as detailed in the opening section of each part of the standard).* This scope applies to original, and any subsequent supply of cabinets, whether 'on sold' from original owner, or being the result of any modifications.

4.11 Review of High Efficiency MEPS levels

The tables in Appendix A (Table 9 and Table 10) detail a comparison of the MEPS level at Standard Efficiency compared with those as indicated for High Efficiency levels, which suggests improvement values in the order of 25% to exceeding 30%.

The low levels of registrations claiming High Efficiency to AS 1731 (see Figures 1 and 2), would conclude that in some cases these levels are too hard to attain. As the aim of MEPS is to remove the least efficient RDC products from sale, this aim would receive contributory positive impact if purchasers had a greater selection of competing products claiming High Efficiency.

A comprehensive review by European Bio Intelligence Service [LOT12 2007] of third country identified legislation of MEPS, shows that comparisons between current (end 2007) and those to be introduced (start 2008), suggests improvements would be in the order of 10% and 15%.

A suggestion is that the High Efficiency levels be lowered to levels of around this order.

5. RECOMMENDATIONS

It is recommended that:

1. Amendments to ISO 23953 be taken into account before any amendments are made to AS 1731:2003
2. Where possible the number of 'Types' should be consolidated and simplified.
3. Non-Retail refrigerated equipment should be included possibly covered by using efficiency levels based on a energy consumption versus product storage volume basis.
4. The Total Display Area definition be reviewed to ensure known interpretation difficulties are overcome.
5. Additional MEPS levels be introduced to cover those 'Types' that currently have 'No-value' MEPS levels.
6. MEPS levels to cover Pharmaceutical and Drugs refrigerators be introduced.
7. The use of alternative refrigerants in remote display cabinets will need to be taken into account in the future in regards to measuring refrigerant flow.
8. The reference to VPA - Visibility of Products by Arc method should be removed from the standard.
9. Re-manufactured RDCs may need to be covered by regulation to ensure that there is a timely uptake on energy efficient models.
10. High Efficiency levels should be re-examined to ensure that realistic efficiency level targets are set.

Comments on this document should be sent to:

Dermot Fitzpatrick
Equipment Energy Efficiency Team
Dept of the Environment, Water, Heritage and the Arts.
Email dermot.fitzpatrick@environment.gov.au

Comments should be received prior to 31 September 2008 to enable the relevant Australia New Zealand Standards Committee to consider changes to the standard.



Please consider the environment before printing this e-mail.

6. REFERENCES

- ANZFA 2001 *Standard 3.2.2 - Food Safety Practices and General Requirements 2001 - Australia and New Zealand Food Authority.*
- CRIPL 2008 Commercial Refrigeration – Inactive Product List Registrations as at April 2008 – www.energyrating.com.au
Dept of the Environment, Water, Heritage and the Arts.
- Lot 12 2007 *Commercial refrigerators and freezers – Lot 12*
Preparatory Studies for Eco-design Requirements of EuPs
Bio intelligence Service S A S – 2007
- QCCP 2004 *COL-2 Storing Temperature Sensitive Products*
Quality Care Pharmacy Program. The Pharmacy Guild of
Australia.
- NRCAN 2006 *Energy Efficiency Regulations – Canadian Gazette Part II*
November 2006.

APPENDIX A

Australian Tables.

Table 9: Comparison of registrations and MEPS levels of minimum and high efficiency remote display cabinets (Consolidation of Table 2.1 and Table 3.1 of AS 1731.14).

| Type | | Energy Consumption | | Levels | Registrations | | Levels |
|------|---------------|--------------------|----------|---------------|---------------|-----------|-------------|
| | | Maximum | HE | % diff | Total | HE | HE % |
| RS1 | Unlit shelves | 12.55 | 8.37 | 66.7% | 53 | 3 | 5.7% |
| RS1 | Lit shelves | 17.76 | 10.66 | 60.0% | 48 | 0 | 0.0% |
| RS2 | Unlit shelves | 12.73 | 8.49 | 66.7% | 84 | 4 | 4.8% |
| RS2 | Lit shelves | 16.98 | 11.32 | 66.7% | 78 | 1 | 1.3% |
| RS3 | Unlit shelves | 14.84 | 10.32 | 69.5% | 32 | 2 | 6.3% |
| RS3 | Lit shelves | 18.39 | 12.26 | 66.7% | 25 | 1 | 4.0% |
| RS4 | Solid door | no value | no value | | | | |
| RS4 | Glass door | 9.73 | 6.77 | 69.6% | 7 | 0 | 0.0% |
| RS5 | Solid door | no value | no value | | | | |
| RS6 | Fan Coil | 14.16 | 9.85 | 69.6% | 2 | 1 | 50.0% |
| RS7 | Gravity coil | no value | no value | | | | |
| RS7 | Fan Coil | 14.79 | 9.86 | 66.7% | 9 | 5 | 55.6% |
| RS8 | Gravity coil | 12.25 | 8.52 | 69.6% | 14 | 3 | 21.4% |
| RS8 | Fan Coil | 13.19 | 9.17 | 69.5% | 15 | 6 | 40.0% |
| RS9 | Gravity coil | no value | no value | | | | |
| RS9 | Fan Coil | 12.09 | 8.06 | 66.7% | 87 | 2 | 2.3% |
| RS10 | High | no value | no value | | | | |
| RS10 | Medium | no value | no value | | | | |
| RS10 | Low | 18.67 | 12.99 | 69.6% | 4 | 0 | 0.0% |
| RS11 | | 38.13 | 26.52 | 69.6% | 2 | 0 | 0.0% |
| RS12 | | 66.33 | 46.14 | 69.6% | 1 | 0 | 0.0% |
| RS13 | Solid sided | 19.48 | 12.99 | 66.7% | 6 | 0 | 0.0% |
| RS13 | Glass sided | 19.58 | 13.62 | 69.6% | 19 | 0 | 0.0% |
| RS14 | Solid sided | 15.49 | 11.45 | 73.9% | 11 | 0 | 0.0% |
| RS14 | Glass sided | 37.08 | 12.86 | 34.7% | 19 | 0 | 0.0% |
| RS15 | Solid door | no value | no value | | | | |
| RS15 | Glass door | 37.08 | 27.41 | 73.9% | 15 | 8 | 53.3% |
| RS16 | Solid door | no value | no value | | | | |
| RS16 | Glass door | 40.56 | 29.98 | 73.9% | 20 | 12 | 60.0% |
| RS17 | Solid door | no value | no value | | | | |
| RS17 | Glass door | no value | no value | | | | |
| RS18 | | 48.58 | 39.75 | 81.8% | 7 | 2 | 28.6% |
| RS19 | | 36.15 | 29.57 | 81.8% | 4 | 3 | 75.0% |
| RS20 | | no value | no value | | | | |
| | | | | Totals | 571 | 53 | 9.3% |

Table 10: Comparison of registrations and MEPS levels of minimum and high efficiency self-contained display cabinets (Consolidation of Table 2.2 and Table 3.2 of AS 1731.14).

| Medium Temp Types | | | | | | | | | | | |
|------------------------------|------------|---------------------------|-----------|--------------------|---------------------------|-----------|--------------------|----------------------|------------|------------|--------------|
| | | Energy Consumption | | MEPS Levels | Energy Consumption | | MEPS Levels | Registrations | | | |
| | | Max | HE | % diff | Max | HE | % diff | Total | HE | HE% | |
| Type | | M1 | M1 | | M2 | M2 | | | | | |
| HC1 | | 11.50 | 8.50 | 73.9% | 11.50 | 8.50 | 73.9% | 77 | 19 | 24.7% | |
| HC2 | | no value | no value | | no value | no value | | 78 | 0 | 0.0% | |
| HC3 | | no value | no value | | no value | no value | | 8 | 0 | 0.0% | |
| HC4 | | 15.50 | 11.40 | 73.5% | 15.50 | 11.40 | 73.5% | 19 | 8 | 42.1% | |
| HC5 | | no value | no value | | no value | no value | | | | | |
| HC6 | | no value | no value | | no value | no value | | 5 | 0 | 0.0% | |
| VC1 | | 37.50 | 27.60 | 73.6% | 28.00 | 20.60 | 73.6% | 81 | 26 | 32.1% | |
| VC2 | | 27.00 | 19.90 | 73.7% | 25.50 | 18.80 | 73.7% | 182 | 63 | 34.6% | |
| VC3 | | no value | no value | | no value | no value | | | | | |
| VC4 | Solid Door | 17.00 | 7.30 | 42.9% | 17.50 | 7.30 | 41.7% | 13 | 6 | 46.2% | |
| VC4 | Glass Door | 17.00 | 10.70 | 62.9% | 17.50 | 10.70 | 61.1% | 446 | 120 | 26.9% | |
| YC1 | | no value | no value | | no value | no value | | | | | |
| YC2 | | no value | no value | | no value | no value | | | | | |
| YC3 | | no value | no value | | no value | no value | | | | | |
| YC4 | | no value | no value | | no value | no value | | 1 | 0 | 0.0% | |
| | | | | | | | | Totals | 910 | 242 | 26.6% |
| Low Temperature Types | | | | | | | | | | | |
| | | Energy Consumption | | MEPS Levels | MEPS Levels | | MEPS Levels | Registrations | | | |
| | | Max | HE | % diff | Max | HE | % diff | Total | HE | HE% | |
| Type | | L1 | L1 | | L2 | L2 | | | | | |
| HF1 | | no value | no value | | no value | no value | | 4 | 0 | 0.0% | |
| HF2 | | no value | no value | | no value | no value | | | | | |
| HF3 | | no value | no value | | no value | no value | | 3 | 0 | 0.0% | |
| HF4 | | 26.50 | 19.50 | 73.6% | 26.50 | 19.50 | 73.6% | 54 | 14 | 25.9% | |
| HF5 | | no value | no value | | no value | no value | | 71 | 0 | 0.0% | |
| HF6 | | 8.00 | 5.90 | 73.8% | 8.00 | 5.90 | 73.8% | 60 | 5 | 8.3% | |
| VF1 | | no value | no value | | no value | no value | | | | | |
| VF2 | | no value | no value | | no value | no value | | | | | |
| VF3 | | no value | no value | | no value | no value | | | | | |
| VF4 | Solid Door | 44.00 | 32.40 | 73.6% | 39.00 | 32.40 | 83.1% | 4 | 3 | 75.0% | |
| VF4 | Glass Door | 44.00 | 32.40 | 73.6% | 39.00 | 32.40 | 83.1% | 73 | 17 | 23.3% | |
| YF1 | | no value | no value | | no value | no value | | | | | |
| YF2 | | no value | no value | | no value | no value | | | | | |
| YF3 | | no value | no value | | no value | no value | | | | | |
| YF4 | | no value | no value | | no value | no value | | | | | |
| | | | | | | | | Totals | 269 | 39 | 14.5% |

Appendix B

Summary of Overseas Versions for MEPS determinations in Refrigerated Cabinets

Overseas Trends

The following is a summary of the current situation with energy efficiency standards and regulation relating to commercial refrigeration equipment as they apply in certain overseas markets.

Vending Machines and Ice Makers have been excluded although in most cases they are also subject to standards and regulation in the markets surveyed.

Canada

National Resources Canada have implemented energy efficiency levels for 'Self-contained commercial Refrigerators', 'Self-contained commercial freezers' and 'self-contained commercial refrigerator freezers'.

Models with solid/opaque doors are subject to the US ENERGY STAR[®] performance levels.

Efficiency is based on maximum daily energy consumption in relation to internal volume.

Ontario

Ontario Ministry of Energy introduced, in April 2003, minimum energy efficiency levels for 'Commercial Refrigerators/Freezers' which are manufactured for sale in Ontario or imported into Ontario.

Efficiency is based on maximum annual energy consumption in relation to internal volume.

In June 2006 'Refrigerated Display Cabinets' were added. In this case the efficiency is based on the maximum specific daily energy consumption in relation to unit length.

California

The California Energy Commission introduced State Standards in 2003 for Energy Efficiency for a number of refrigerated appliances. These include 'Walk-in Refrigerators and Walk-in Freezers with Transparent Reach-in Doors', 'Reach-in cabinets, Pass-Through cabinets, Reach-in or Roll-Through Cabinets, and Wine Chillers that are not Consumer Products'

Efficiency is based on maximum permitted daily energy consumption in relation to internal volume. The levels having been adjusted downwards several times since their inception.

US DOE

The United States Department of Energy under its EPACK 2005 programme has adopted Standards for the test procedures and measurement of energy consumption of "Commercial refrigerators, freezers and refrigerator freezers".

Efficiency is based on daily energy consumption in relation to internal volume and/or TDA.

US EPA

The United States Environmental Protection Agency and the United States Department of Energy jointly administer the ENERGY STAR[®] voluntary programme.

Since September 2001 Commercial Solid Door Refrigerators and Freezers that meet with the requirements and comply with the minimum performance levels are able to be accepted and listed on a website.

Efficiency is based on daily energy consumption in relation to internal volume.

North American CEE

The US/Canadian Consortium for Energy Efficiency administers a voluntary scheme run among members and based on ENERGY STAR specifications.

Efficiency is based on daily energy consumption in relation to internal volume.

European Union

The European Commission have been investigating worldwide trends on product standards and determining the most suitable method of resolving overall impact of commercial refrigeration on the environment. A comprehensive report prepared by the Bio Intelligence Service covers all aspects of energy efficiency including the overall effect on costs and on the environment of product design changes and refrigerants.

United Kingdom

The United Kingdom operates an Enhanced Capital Allowance scheme which aims to encourage the purchase of energy efficient products.

Included in this are Refrigerated Display Cabinets and Commercial Service Cabinets.

The product criteria is based on modified requirements to EN441 and ISO 23953 using internal volume for Service Cabinets and Total Display Area for Display Cabinets.

Overseas Programme Details

B.1. CANADA (Federal)

Scope

The technical requirements cover Self-Contained Commercial Refrigerators and Freezers and apply to:

Self-contained commercial refrigerator

- i. has at least one compartment for the storage of food and beverages at temperatures above 0°C;
- ii. has no more than one compartment for the freezing and storage of food and beverages at temperatures between 0°C and -13.3°C; and
- iii. has a self-contained refrigeration system that requires energy input;

but does not include

- a refrigerated buffet table, a commercial refrigerator that is designed to function as a table or counter for receiving and refrigerating food and from which persons can serve themselves, and that uses a mechanical refrigeration system;
- a refrigerated preparation table, a commercial refrigerator the top of which is a work surface on which food can be prepared, displayed and kept refrigerated at temperatures between 1°C and 5°C; or
- a walk-in commercial refrigerator.

Self-contained commercial freezer

- i. all the compartments are designed for the freezing and storage of food, beverages or ice; and
- ii. has a self-contained refrigeration system that requires energy input; but does not include
 - a walk-in commercial freezer.

Self-contained commercial refrigerator-freezer

- i. has two or more compartments, at least one of which is for the storage of food and beverages at temperatures above 0°C and at least one other which is for the freezing and storage of food and beverages at temperatures below -13.3°C; and
- ii. has a self-contained refrigeration system that requires energy input;

but does not include

- a walk-in commercial freezer.

Applicable Standards and Test Methods

The Canadian Test Method currently uses the following publications:

ASHRAE standard 117-1992, *Method of Testing Closed Refrigerators*

ASHRAE standard 72-1998, *Method of Testing Open Refrigerators*

ANSI/AHAM HRF-1-2004, *Household Refrigerators/Household Freezers*

is used to determine the **V**olume of the refrigerated compartment.

Note: Variations in the test method and the standards are specified.

Efficiency Levels

Maximum Daily Energy Consumption for Self-contained Commercial Refrigerators and Freezers

| Product | | Maximum E daily (kWh/day) | | |
|---|-------------------------|--------------------------------------|--------------------------------|-------------------|
| Door or drawer type | | April 1, 2007 - December 31, 2007 | on or after January 1, 2008 | |
| Self-contained commercial refrigerators | opaque doors or drawers | $0.00441 V + 4.22$ | $0.00441 V + 2.76$ | |
| | transparent doors | $0.00607 V + 5.78$ | $0.00607 V + 4.77$ | |
| | other* | N/A | N/A | |
| Self-contained commercial freezers | opaque doors | $V < 340$ | 7.62 | 7.07 |
| | | $V \geq 340$ | $0.0141 V + 2.83$ | $0.0141 V + 2.28$ |
| | transparent doors | $0.0332 V + 5.10$ | $0.0332 V + 5.10$ | |
| | other* | N/A | N/A | |
| Self-contained commercial refrigerator-freezers | opaque doors | $0.00964 AV + 2.63$ | $0.00964 AV + 1.65$ | |
| | other* | N/A | N/A | |
| * Product has no energy efficiency performance requirements but must meet all other regulatory requirements | | | | |

B.2. ONTARIO, Canada (Provincial)

Scope

Covered are '**Commercial refrigerators, freezers and refrigerator freezers**' of the following types:

- reach-in cabinet
- reach-in wine cooler
- ice cream cabinet
- milk or beverage cabinet
- milk or beverage and ice cream cabinet
- worktop table
- undercounter cabinet

with sub-classification being determined by type of door – transparent or solid.

The maximum annual energy consumption is specified and calculated using a volume basis.

Applicable Standards and Test Methods

CAN/CSA C827-98, *Energy Performance Standard for Food Service Refrigerators and Freezers*

ASHRAE standard 117-1992, *Method of Testing Closed Refrigerators*

ANSI/AHAM HRF-1-1992, *Household Refrigerators/Household Freezers*

is used to determine the **Volume** of the refrigerated compartment.

Note: Variations in the test method and the standards are specified.

Efficiency Levels

Maximum Annual Energy Consumption – Commercial Refrigerators Solid and Glass Doors

| Type | Doors | Standard Efficiency | High Efficiency |
|---|-------|---------------------|-----------------|
| Reach-in | Solid | 59V + 1010 | 54V + 470 |
| | Glass | 118V + 2020 | 108V + 940 |
| Reach-in Wine Cooler | Solid | 51V + 300 | 47V + 10 |
| | Glass | 102V + 600 | 94V + 20 |
| Roll-in or Roll-Through | Solid | * | * |
| | Glass | * | * |
| Pass-Through | Solid | * | * |
| | Glass | * | * |
| Milk or Beverage type | Solid | 31V + 450 | 28V + 260 |
| | Glass | 62V + 900 | 56V + 520 |
| Preparation Table | Solid | * | * |
| | Glass | * | * |
| Worktop table/undercounter | Solid | 87V + 780 | 79V + 210 |
| | Glass | 174V + 1560 | 158V + 420 |
| V is the refrigerator volume in ft ³ | | | |
| * insufficient product data available | | | |

Maximum Annual Energy Consumption – Commercial Freezers Solid and Glass Doors

| | | | |
|---|-------|---------------------|-----------------|
| Reach-in | Solid | 172V + 930 | 156V + 1270 |
| | Glass | 334V + 1860 | 312V + 2540 |
| Roll-in or Roll-Through | Solid | 51V + 300 | 47V + 10 |
| | Glass | 102V + 600 | 94V + 20 |
| Pass-Through | Solid | * | * |
| | Glass | * | * |
| Ice cream cabinet | Solid | 86V + 1270 | 78V + 755 |
| | Glass | 172V + 2540 | 156V + 1510 |
| Preparation Table | Solid | * | * |
| | Glass | * | * |
| Type | Doors | Standard Efficiency | High Efficiency |
| Worktop table/undercounter | Solid | 367V + 2200 | 334V - 400 |
| | Glass | 734V + 4400 | 668V - 800 |
| V is the refrigerator volume in ft ³ | | | |
| * insufficient product data available | | | |

Maximum Annual Energy Consumption – Commercial Refrigerator-Freezers Solid Door

| Type | Standard Efficiency | High Efficiency |
|---------------------------------------|---------------------|-----------------|
| Reach-in vertical split | 92V + 1900 | 84V + 1160 |
| Milk or beverage and ice cream | * | * |
| Preparation Table | * | * |
| Worktop table/undercounter | * | * |
| * insufficient product data available | | |

Additional Product Regulated

In addition **Refrigerated Display Cabinets** of the following types were covered from June 2006 based on:

- refrigerated display cabinets that are intended for displaying and merchandising food products, including canned and bottled beverages, ice intended for human consumption and other perishable merchandise

Applicable Standards and Test Methods

CAN/CSA C657-04 *Energy Performance Standard for commercial refrigerated display cabinets and merchandisers.*

Specific Daily Energy consumption associated with a unit of length and expressed in kWhrs/unit length/day is used with Maximum SDEC ratings being specified.

Note: Variations in the test method and the standards are specified

Efficiency Levels

Maximum Ratings for Refrigerated Display Cabinets as specified by CAN/CSA –C657-04

| Class | Integrated Average Temperature (IAT) | | Specific Daily Energy Consumption (SDEC) | |
|--------------|--------------------------------------|--------|--|------------|
| | °C | °F | kWh/m/day | kWh/ft/day |
| 1 | 5.0 | (41.0) | 13.1 | (4.0) |
| 2 | 5.0 | (41.0) | 9.5 | (2.9) |
| 3 | 5.0 | (41.0) | 5.4 | (1.6) |
| 4 | -17.8 | (0.0) | 30.8 | (9.4) |
| 5 | -17.8 | (0.0) | 15.1 | (4.6) |
| 6a | 5.0 | (41.0) | 7.5 | (2.3) |
| 6b | -17.8 | (0.0) | 20.0 | (6.1) |
| 7a (fan) | 5.0 | (41.0) | 8.7 | (2.6) |
| 7b (gravity) | 5.0 | (41.0) | 3.3 | (1.0) |

B.3. CALIFORNIA (State)

Scope

Levels based on California Tier 1 and upgraded to Tier 2 in Jan 2008.

The technical requirements cover energy efficiency standards for:

Commercial Refrigerator, Refrigerator-Freezer and Freezers of the following types

- Refrigerated Buffet and preparation tables.
- Self-Contained Commercial Refrigerators, refrigerator-freezers and Freezers with doors; and
- Self-contained commercial refrigerators, refrigerator-freezers and freezers without doors

In addition Energy Design Standards are specified for the following components;

Lighting of Cabinets and Wine Chillers covering types of lighting that can be used in certain cabinets.

Walk-in Refrigerators and Walk-in Freezers that cover Door Closers, Envelope Insulation values and Evaporator and Condenser Fan motor selection.

Walk-in Refrigerators and Walk-in Freezers with Transparent Reach-in Doors that cover the type of door and selection of anti-sweat wires.

Applicable Standards and Test Methods

The standards specify the following test methods:

ANSI/ASTM F2143-04, *Standard Test Method for performance of Refrigerated Buffet and Preparation Tables*

ASHRAE standard 117-1992, *Method of Testing Closed Refrigerators*

ASHRAE standard 72-1998, *Method of Testing Open Refrigerators*

ANSI/AHAM HRF-1-2004, *Household Refrigerators/Household Freezers*

is used to determine the **Volume** of the refrigerated compartment.

Note: Variations in the test method and the standards are specified

Efficiency Levels

Maximum Daily Energy consumption is specified as follows:

Standards for Reach-in cabinets, Pass-Through Cabinets, Roll-in or Roll-Through and Wine Chillers that are Not Consumer Products

| Appliance | Doors | Max Daily Energy Consumption (kWh) |
|---|----------------------|------------------------------------|
| Reach-in cabinets, pass-through cabinets, and roll-in and roll-through cabinets that are refrigerators; and wine cabinets that are not consumer products. | Solid | $0.10V + 2.04$ |
| | Transparent | $0.12V + 3.34$ |
| Reach-in cabinets, pass-through cabinets, and roll-in and roll-through cabinets that are Freezers (except ice cream freezers). | Solid | $0.40V + 1.38$ |
| | Transparent | $0.75V + 4.10$ |
| Reach-in cabinets, pass-through cabinets, and roll-in and roll-through cabinets that are Freezers that are ice cream freezers. | Solid | $0.39V + 0.82$ |
| | Transparent | $0.88V + 0.33$ |
| Reach-in cabinets that are refrigerator-freezers and have adjusted volumes (AV) of 5.19 ft^3 or greater. | Solid | $0.27V - 0.71$ |
| Reach-in cabinets that are refrigerator-freezers and that have an adjusted volume (AV) of less than 5.19 ft^3 . | Solid or Transparent | 0.70 |
| <p>$V = \text{total volume (ft}^3\text{)}$</p> <p>$\text{AV} = \text{Adjusted Volume} = [1.63 \times \text{freezer volume (ft}^3\text{)}] + \text{refrigerator volume (ft}^3\text{)}$</p> | | |

B.4. US DOE (Federal)

Scope

The technical requirements cover energy efficiency standards for:

- Commercial Refrigerators,
- Freezers,
- Refrigerator-Freezers
- Ice-Cream Freezers

Reporting of both TDA and Refrigerated Volume

Applicable Standards and Test Methods

The following Test Standards are called up:

ANSI/ARI 1200-2006 *Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets*

However the above standard calls up the test method of **ASHRAE standard 72.**

ANSI/AHAM HRF-1-2004, *Household Refrigerators/Household Freezers*

is used to determine the Volume of the refrigerated compartment.

Efficiency Levels

Performance levels are not specified

B.5. US EPA ENERGY STAR

Scope

Qualifying Product

- Reach-in Cabinets – Solid Doors
- Undercounter Cabinet –Solid Doors
but excluding Preparation Tables
- Roll-in or Roll-through Cabinet – Solid Doors
- Pass-through Cabinet – Solid Doors

Applicable Standards and Test Methods

The standards specify the test method:

ASHRAE standard 117-1992, *Method of Testing Closed Refrigerators*

Note: Variations to the test method and standard are specified.

Efficiency Levels

Specification for ENERGY STAR Qualified Commercial Solid Door Refrigerators and Freezers

| Product Type | Energy Consumption (kWh/day) |
|---|------------------------------|
| Refrigerators | $\leq 0.10V + 2.04$ |
| Freezers | $\leq 0.40V + 1.38$ |
| Refrigerator-Freezers | $\leq 0.27AV - 0.71$ |
| Ice Cream Freezers | $\leq 0.39V + 0.82$ |
| V = total volume (ft ³) AV = Adjusted Volume = [1.63 x freezer volume (ft ³)] + refrigerator volume (ft ³) | |

B.6. US/CANADIAN CONSORTIUM FOR ENERGY EFFICIENCY (CEE)

Product voluntarily regulated among participants

The initiative for commercial reach-in, solid door refrigerators and freezers was launched in December 2002 and one year later glass door reach-in refrigerators being added in December 2003.

The specifications are in-line with ENERGY STAR specifications as well as California Energy Commission standards

The current High Efficiency specifications became effective Jan 1 2006, and the Higher Efficiency levels became effective January 1 2007.

Applicable Standards and Test Methods

Test Method specified is

ASHRAE standard 117-2002, *Method of Testing Closed Refrigerators*

at 38°F +/-2°

ANSI/AHAM HRF-1-1979, *Household Refrigerators/Household Freezers*

is used to determine the **Volume** of the refrigerated compartment

Efficiency Levels

Solid Door, reach-in refrigerators and freezers

| Solid Door Equipment | Specification | Corresponding Base Specification | Maximum Daily Energy Use (kWh/day) |
|----------------------|---------------|----------------------------------|------------------------------------|
| Refrigerator | CEE Tier 1 | ENERGY STAR | $0.10V + 2.04$ |
| | CEE Tier 2 | ENERGY STAR + 40% | $0.06V + 1.22$ |
| Freezer | CEE Tier 1 | ENERGY STAR | $0.40V + 1.38$ |
| | CEE Tier 2 | ENERGY STAR + 30% | $0.28V + 0.97$ |

Glass Door, reach-in refrigerators

| Glass Door Equipment | Specification | Corresponding Base Specification | Maximum Daily Energy Use (kWh/day) |
|----------------------|---------------|----------------------------------|------------------------------------|
| Refrigerator | CEE Tier 1 | 25% of top performing products | $0.12V + 3.34$ |
| | CEE Tier 2 | 28% more efficient than Tier 1 | $0.086V + 2.39$ |

V = interior volume in cubic feet as determined in ANSI/AHAM HRF-1

B.6. UNITED KINGDOM ENHANCED CAPITAL ALLOWANCE SCHEME

Scope

The scheme added Commercial Service Cabinets to the Energy Technology List in August 2004 with revisions in 2004 and 2007. Refrigerated Display Cabinets were added in August 2004.

Commercial Service Cabinets are defined as products designed to store, but not to display chilled and frozen foodstuffs and must be integral cabinets with solid doors drawers or lids. Tested as M1 or L1 at Climate Class 3 of EN 441:1995 for a test period of 48 hours.

Refrigerated Display Cabinets are defined as products that are specifically designed to store and display chilled and/or frozen foodstuffs. Tested as Class L1, L3, M0, M1, M2, H1 and H2 at Climate Class 4 of EN 23953.2.

Applicable Standards and Test Methods

Test Method specified for Commercial Service Cabinets is:

EN 441: 1995/1996 *Refrigerated Display Cabinets*

Test Method specified for Refrigerated Display Cabinets is

BS EN ISO 23953-2:2005 *Refrigerated Display Cabinets*

Performance thresholds

Commercial Service Cabinets

| Type | Gross internal volume (litres) | Chilled (M1) | Energy efficiency index performance threshold (kWh/48hrs/m ³) |
|--|--------------------------------|--------------|---|
| | | | Frozen (L1) |
| Single Door | 400 and 600 (+/-15%) | EEI <=16.0 | EEI <=38.0 |
| Double Door | 1,300 (+/- 15%) | EEI <=12.0 | EEI <=34.0 |
| Under counter and counter cabinets with solid doors or drawers | 150 and 180 (+/-15%) | EEI <=21.6 | EEI <=40.0 |

Refrigerated Display Cabinets

| Temperature Classification | | | | EEI Performance threshold (kWh/day/m ²) | |
|----------------------------|----------------------------|---------------------------|---------------------------|---|---------|
| | Highest of the coldest etc | Lowest of the coldest etc | Lowest of the warmest etc | Integral | Remote |
| M0 | + 4 °C | - 1 °C | - | <=12.50 | <=11.75 |
| M1 | + 5 °C | - 1 °C | - | <=11.95 | <=11.45 |
| M2 | + 7 °C | - 1 °C | - | <=10.55 | <=10.85 |
| H1 | + 10°C | + 1 °C | - | n/a | <=8.0 |

| | | | | | |
|-----------|----------------|---------------|----------------|-------------------|-------------------|
| H2 | + 10 °C | - 1 °C | - | <=9.20 | <=9.20 |
| L1 | - 15 °C | - | - 18 °C | <=19.10 | <=23.50 |
| L3 | - 12 °C | - | - 15 °C | n/a | <=21.0 |

TEMPERATURE REQUIREMENTS

Amongst all the various North American programs the test temperatures are generally consistent:

Test Room conditions:

| | |
|----------|---------------|
| Dry Bulb | 24.0 °C ± 1.0 |
| Wet Bulb | 18.0 °C ± 1.0 |
| Airflow | 0.25 m/s |
| Lighting | > 800 lux |

Product Average Temperatures

| | |
|--------------|-----------------|
| Refrigerator | 3.3 °C ± 1.1 |
| Wine | 7.2 °C ± 1.1 |
| Freezer | -17.8 °C ± 1.1 |
| Ice Cream | - 20.6 °C ± 1.1 |

With the exception of C657-95 that specifies:

Test Room conditions:

| | |
|----------|---------------|
| Dry Bulb | 23.9 °C ± 1.0 |
| Wet Bulb | 17.8 °C ± 1.0 |

Nominal Product Temperatures

Medium Temperature Applications such as meat, deli, dairy, produce and bakery products:

2 °C

Low Temperature Applications such as frozen food, ice and ice cream:

- 20 °C

However a curve is generated and performance values read from diagram at the specified temperature levels.

Other Temperatures

With the UK ECA Scheme being based on EN 441/ISO 23953 the temperatures vary from the above:

Refrigerated Display Cabinets being tested at 25 °C and,

Commercial Service Cabinets at 30 °C

Note. The latest version of ASHRAE standard 72 –the 2005 edition, supersedes both ASHRAE 72-1998 and ASHRAE 117-2002 as it combines both open and closed refrigerator test methods.