

冷凍空調與新興冷媒檢測標準介紹



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大綱

- 家用冷凍冷藏產品標準
- 空調機標準
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節能專案—節能減排。永續發展



Go Green₃

China now largest hvac market

IN ADDITION to being the largest producer of heating, ventilating and air conditioning products in the world, China is now also the largest market for hvac, a new report claims.

The top three Chinese manufacturers, Haier, Midea and Gree, can supply 50% of the world's demand for HVAC products, according to the report by Frost & Sullivan.

Driven by a boom in China's commercial property, high-end real estate and energy saving policies, it is estimated that China's HVAC market was £5bn in 2011, a 20% increase on 2010. With an annual growth rate of 20%, it is predicted that the total market size will reach £11bn in 2015.

Far eastern manufacturers Daikin, Hitachi, Toshiba and Samsung took the largest market share (32%) in 2011. Western companies York, Carrier, Trane, Mcquay and Dunham-Bush had 23% of total market size. Domestic brands Haier, Gree and Midea accounted for 22% of the market.

Chinese government electronics subsidies fuelled a double digit growth in room air conditioners between 2009 and 2011, but with the programme ending this year, exports declining, raw materials increasing and over production, the market is predicted to decline.

China's biggest room AC manufacturers, Midea, Haier and Gree, were trapped by huge inventory backlog in 2011. Latest statistics quoted by Frost & Sullivan show that the inventory backlog was over 20 million units by the end of 2011. As a result, to solve the problem of liquidity, most manufacturers began to lay off staff to save operational cash flow. An extreme example indicates that Midea laid off 50% of its sales staff nationally by the end of 2011.

2010年各國空調機市場

地區	銷量(萬台)
全球	8900
中國	3620
美國	1270
日本	890
歐盟	640

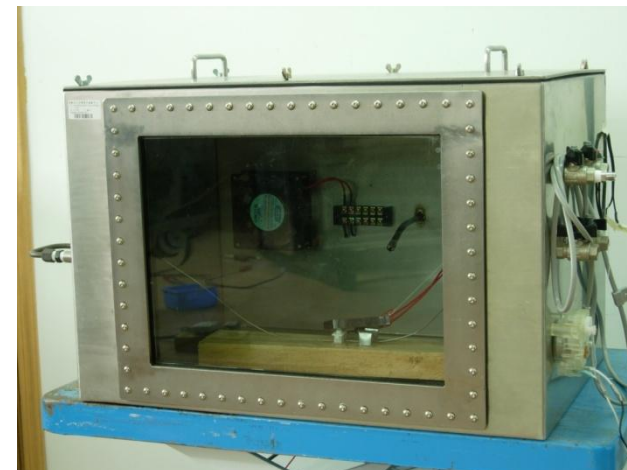


From: JARN



家用冷凍冷藏產品標準

項目	ISO/IEC	美國	歐盟	日本	中國	台灣
性能	IEC62552:2007 (新版本修訂中)	ANSI/AHAM HRF-1:2007	EN ISO 15502:2005 BS EN153:2006	JIS C9801:2006	GB/T8059	CNS2062:2000
安規	IEC60079-15 IEC60335-2-24 ISO5149	ASHRAE 15 ASHRAE 34 UL250	EN378	JIS C9607:2007 JIS C9335-2-24	GB 4706.1 GB 4706.13	CNS3765 CNS3765-24 (IEC60335-2-24)



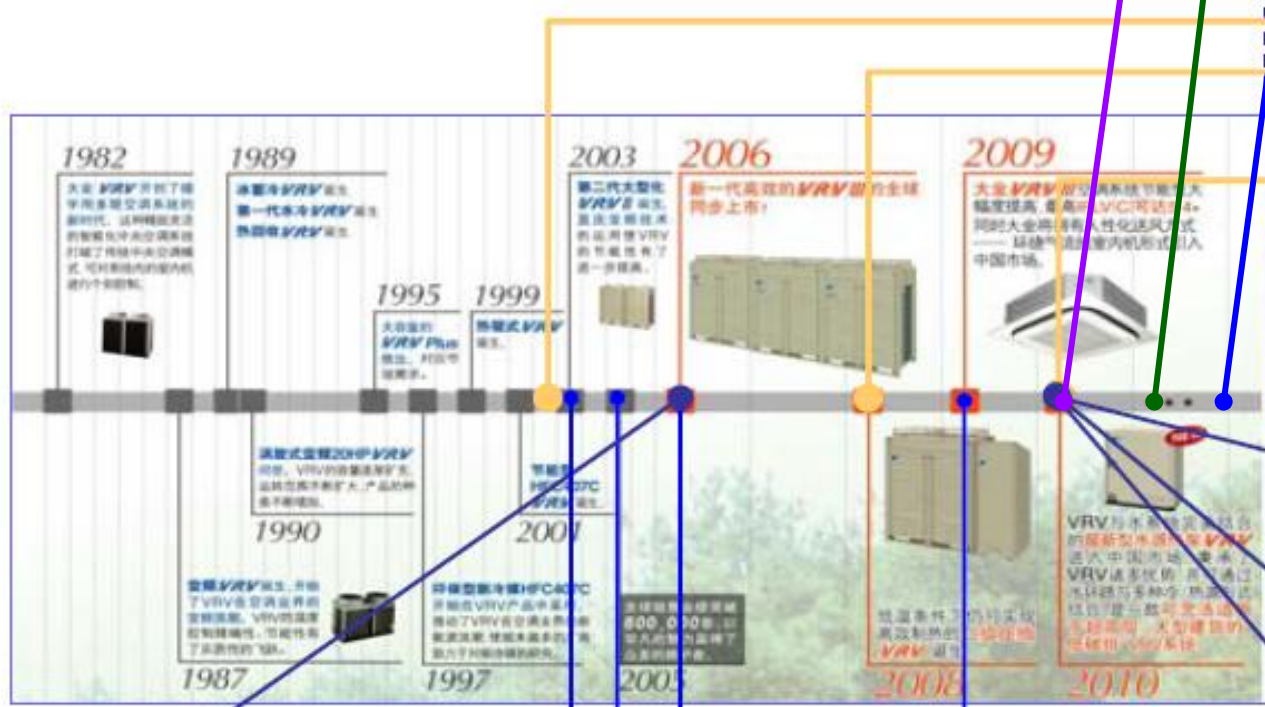


房間空調機標準

項目	ISO/IEC	美國	歐盟	日本	中國	台灣
性能	ISO5151:2010 ISO13253	ARI210/240:2008 ANSI RAC-1:2008 ASHRAE 16	EN14511(方法) EN14825(能效)	JIS C9612 :2005 JIS B8615.1 JIS B8615.2	GB/T7725:200 4	CNS3615 CNS14464:2010 (方法、能效) CNS15173
安規	IEC60335-2-40	UL484	EN60335-2-40	JIS C9335-2-40	GB4706.1 GB4706.32	CNS3765 CNS3765-40



多聯式空調機標準



- 2010: CNS14464 附錄I
- 2011: ISO15042
- 2012 : BS EN14825(4月出版)
- 2002: GB/T 18837-2002
- 2008: GB 21454-2008 (能效标准)
- GB/T 22069-2008 (燃气热泵)
- 2010: GB/T 25857-2010 (低温热泵)
- JGJ 174-2010
- GB/T 多联式空调(热泵)机组
- 应用设计与安装要求(报批稿)

- 2010: AHRI 1230 (<19kW、≥19kW)
- 2010: PrEN 14825 (草案)
- 2010: ISO/CD 16358 (草案)

- 2009: JRA 4049:2009修订
- JRA 4048: 2009修订(<50.4kW)
- 2006: JRA 4048: 2006 (<28kW) 《单元式空调机SEER》
- 2005: JIS C 8616: 2005 (国标 《单元式空调机SEER》)
- JRA 4049:2005 (<10kW) 《一拖多房间空调器SEER》
- 2003: JRA 4055: 2003 《多联机季节季节耗电量计算基准》

2006: KS B ISO 15042 (等同GB/T18837-2002)



季節性能相關標準

- **BS EN 14825** —Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling. Testing and rating at part load conditions and calculation of seasonal performance .(2012年4月出版)
- ISO/CD16358系列標準(制定中)
 - **ISO/CD16358-1** — Air-cooled air conditioners and air-to-air heat pumps. Testing and calculating methods for seasonal performance factors. Part 1. Cooling seasonal performance factor (CSPF)
 - **ISO/CD16358-2** — Air-cooled air conditioners and air-to-air heat pumps. Testing and calculating methods for seasonal performance factors. Part 2. Heating seasonal performance factor (HSPF)
 - **ISO/CD16358-3** — Air-cooled air conditioners and air-to-air heat pumps. Testing and calculating methods for seasonal performance factors. Part 3. Annual performance factor (APF)
- 「空調機**SEER**能源效率基準研究」冷凍空調工程工業同業公會協助制定中



空調機標準參考資料

Selected Codes and Standards Published by Various Societies and Associations

Subject	Title	Publisher	Reference
<i>Air Conditioners</i>	Commercial Application, Systems, and Equipment, 1st ed.	ACCA	ACCA Manual CS
	Residential Equipment Selection, 2nd ed.	ACCA	ANSI/ACCA Manual S
	Methods of Testing for Rating Ducted Air Terminal Units	ASHRAE	ANSI/ASHRAE 130-1996 (RA06)
	<u>Non-Ducted Air Conditioners and Heat Pumps—Testing and Rating for Performance</u>	ISO	<u>ISO 5151:1994</u>
	<u>Ducted Air-Conditioners and Air-to-Air Heat Pumps—Testing and Rating for Performance</u>	ISO	<u>ISO 13253:1995</u>
	Guidelines for Roof Mounted Outdoor Air-Conditioner Installations	SMACNA	SMACNA 1998
Central	Heating and Cooling Equipment (2005)	UL/CSA	ANSI/UL 1995/C22.2 No. 236-05
	Performance Standard for Single Package Central Air-Conditioners and Heat Pumps	CSA	CAN/CSA-C656-05
	Performance Standard for Rating Large and Single Packaged Air Conditioners and Heat Pumps	CSA	CAN/CSA-C746-06
	Performance Standard for Split-System and Single-Package Central Air Conditioners and Heat Pumps	CSA	CAN/CSA-C656-05
Gas-Fired	Heating and Cooling Equipment (2005)	UL/CSA	ANSI/UL 1995/C22.2 No. 236-05
	Gas-Fired, Heat Activated Air Conditioning and Heat Pump Appliances	CSA	ANSI Z21.40.1-1996 (R2002)/CGA 2.91-M96
	Gas-Fired Work Activated Air Conditioning and Heat Pump Appliances (Internal Combustion)	CSA	ANSI Z21.40.2-1996 (R2002)/CGA 2.92-M96
	Performance Testing and Rating of Gas-Fired Air Conditioning and Heat Pump Appliances	CSA	ANSI Z21.40.4-1996 (R2002)/CGA 2.94-M96
Packaged Terminal	Packaged Terminal Air-Conditioners and Heat Pumps	ARI/CSA	ARI 310/380-04/CSA C744-04
Room	<u>Room Air Conditioners</u>	AHAM	<u>ANSI/AHAM RAC-1-2008</u>
	Method of Testing for Rating Room Air Conditioners and Packaged Terminal Air Conditioners	ASHRAE	ANSI/ASHRAE 16-1983 (RA99)
	Method of Testing for Rating Room Air Conditioner and Packaged Terminal Air Conditioner Heating Capacity	ASHRAE	ANSI/ASHRAE 58-1986 (RA99)
	Method of Testing for Rating Fan-Coil Conditioners	ASHRAE	ANSI/ASHRAE 79-2002 (RA06)



空調機標準參考資料

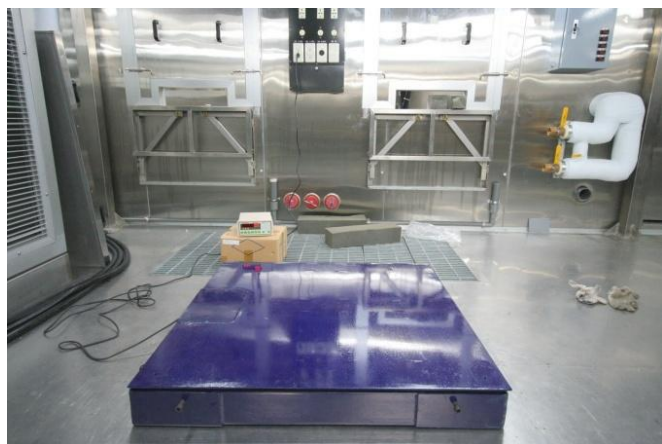
	Performance Standard for Room Air Conditioners	CSA	CAN/CSA-C368.1-M90 (R2007)
	Room Air Conditioners	CSA	C22.2 No. 117-1970 (R2007)
	<u>Room Air Conditioners (2007)</u>	UL	<u>ANSI/UL 484</u>
Unitary	Unitary Air-Conditioning and Air-Source Heat Pump Equipment	ARI	ANSI/ARI 210/240-2006
	Sound Rating of Outdoor Unitary Equipment	ARI	ARI 270-95
	Application of Sound Rating Levels of Outdoor Unitary Equipment	ARI	ARI 275-97
	Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment	ARI	ARI 340/360-2007
	Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment	ASHRAE	ANSI/ASHRAE 37-2005
	Methods of Testing for Rating Heat-Operated Unitary Air-Conditioning and Heat Pump Equipment	ASHRAE	ANSI/ASHRAE 40-2002 (RA06)
	Methods of Testing for Rating Seasonal Efficiency of Unitary Air Conditioners and Heat Pumps	ASHRAE	ANSI/ASHRAE 116-1995 (RA05)
	Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners	ASHRAE	ANSI/ASHRAE 127-2007
	Method of Rating Unitary Spot Air Conditioners	ASHRAE	ANSI/ASHRAE 128-2001
Ships	Specification for Mechanically Refrigerated Shipboard Air Conditioner	ASTM	ASTM F1433-97 (2004)
Accessories	Flashing and Stand Combination for Air Conditioning Units (Unit Curb)	IAPMO	IAPMO PS 120-2004

資料來源：ASHRAE handbook,2008



熱泵熱水器標準

項目	ISO/IEC	美國	歐盟	日本	中國	台灣
性能	ISO13256-2	ASHRAE 118.1 ASHRAE 118.2	EN 16147:2011	JRA 4050	GB/T23137 GB/T21362	CNS15466:2 011
安規	IEC60335-2-40	UL 1995	EN60335-2-40 EN60204-1	JIS C9335-2-40 JIS C9335-2-21	GB4706.11 GB4706.12 GB4706.32	CNS3765-40 CNS3765-21



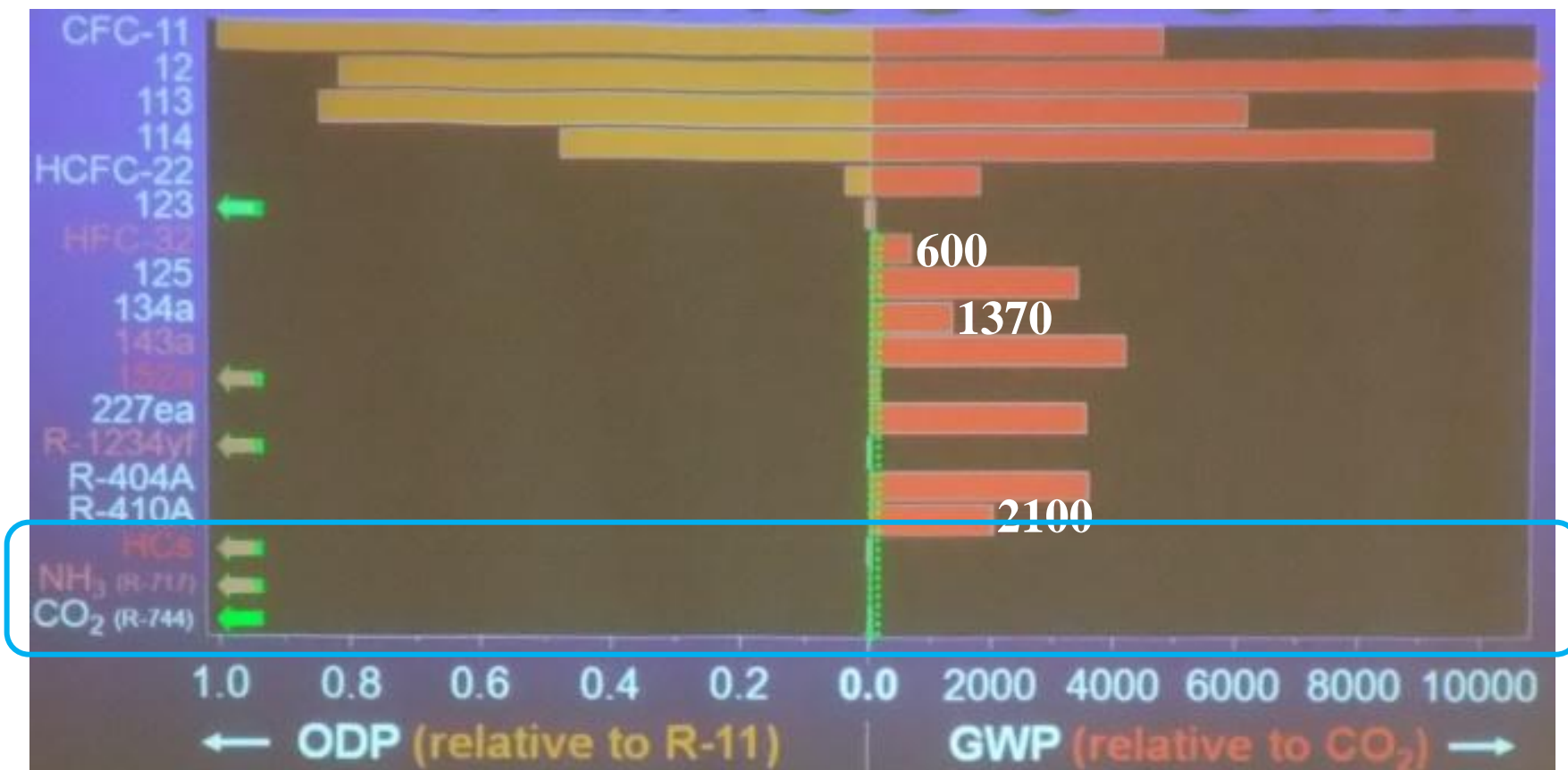


標準編號	制定國家/ 發佈年份	標準名稱	適用範圍
CNS 15466	台灣 2011	空氣源式熱泵熱水器之性能試驗」	1. 型式：商/家用空氣源 2. 耗電量 < 12 kW
EN 16147	歐盟 2011	Heat pumps with electrically driven compressors —— Testing and requirements for marking of domestic hot water units.	1. 型式：家用空氣源或水源
JRA 4050	日本 2007	家庭用ヒートポンプ給湯」	1. 型式：家用空氣源 2. 製熱能力: • CO ₂ 冷媒 < 11.58 kW • HFC冷媒 < 19.3 kW
ASHRAE 118.1	美國 2008	Method of testing for rating commercial gas, electric, and oil service water heating equipment.	1. 型式：商用空氣源 2. 耗電量 > 6 kW
ASHRAE 118.2	美國 2006	Method of testing for rating residential water heaters.	1. 型式：家用空氣源 2. 耗電量 < 6 kW
GB/T 21362	中國 2008	商業或工業用及類似用途的熱泵熱水機	1. 型式：商/工業用空氣源或水源 2. 製熱能力 > 3 kW
GB/T 23137	中國 2008	家用和類似用途熱泵熱水器	1. 型式：家用空氣源或水源



冷媒現況

- CFC與HCFC冷媒 → HFC冷媒 (高GWP → 低GWP)
 → HCs (R600a, R290), CO₂, Ammonia (NH₃)



冷媒特性

ASHRAE 34:2007

Safety Group		
Higher Flammability	A3	B3
Lower Flammability	A2	B2
	A2L ⁺	B2L ⁺
No Flame Propagation	A1	B1
	Lower Toxicity	Higher Toxicity

*A2L and B2L are lower flammability refrigerants with a maximum burning velocity of ≤ 10 cm/s.

Refrigerant	ASHRAE 34		GWP (100-yr)	
	Safety Group	Designation		
Carbon Dioxide	A1	R-744	1	MVAC, self-contained commercial refrigeration, supermarket systems
Ammonia	B2	R-717	0	Industrial refrigeration, supermarket refrigeration, chillers
Hydrocarbons	A3	R-290, R-600, R-600a, etc.	< 5	Self-contained commercial refrigeration, room AC, supermarket refrigeration, chillers
A2L fluids	A2L	R-1234yf	4	MVAC, residential & commercial air conditioning, commercial refrigeration
		R-1234ze	6	
		R-32	675	



各國冷媒應用

- 歐洲
 - 將CO₂冷媒應用到小容量的製冷設備
 - 歐洲已經開放R290冷媒在冰箱、小型空調、汽車空調領域裏的應用。
 - IEC60335-2-40和EN378-1:2008中規定了最大安全充灌量為290克的R290冷媒空調機可使用在10m²且安裝高度在2.2m的房間

$$A_{\min} = (m / (2,5 \times \text{LFL}^{5/4} \times h_0))^2$$

Category	LFL (kg/m ³)	h ₀ (m)	Charge amount (M) in kg						
			Minimum room area (m ²)						
R290	0,038		0,152	0,228	0,304	0,456	0,608	0,76	0,988
		0,6		82	146	328	584	912	1541
		1,0		30	53	118	210	328	555
		1,8		9	16	36	65	101	171
		2,2		6	11	24	43	68	115

From:IEC60335-2-40 & EN378-1



各國冷媒應用

- 中國
 - 開發使用R290冷媒之家用空調機
 - 進行R32冷媒應用於商業用途之安全性評估
- 美國
 - 2011年12月美國環境保護局(Environmental Protection Agency , EPA) 顯著替代方案(Significant New Alternatives Policy (SNAP) program) 接受三種HC冷媒 — 丙烷 (R290)、異丁烷 (R600a)、R441A (碳氫混合物) 成為替代冷媒, 使用到家用電冰箱和小型商用冷凍冷藏櫃。家用空調機因安全顧慮仍不開放使用。



美國AHRI 進行低GWP冷媒研究計畫

- Phase one of the study reviewed regulations and standards in the United States, Europe, and Japan relevant to HVAC&R applications using low-GWP refrigerants.
<http://www.ahrinet.org/technical+results.aspx>
- Phase two, 'Defining the configurations of residential air conditioning and heat pump systems using hydrocarbons (HCs), ammonia (NH₃), carbon dioxide (CO₂), and HFO- 1234yf as refrigerants and meeting previously defined safety requirements. The project is expected to be completed within six months (2012/3).



AHRI 低GWP冷媒第一階段研究報告



ARTI Report No. 09001-01

REVIEW OF REGULATIONS AND STANDARDS FOR THE USE OF REFRIGERANTS
WITH GWP VALUES LESS THAN 20 IN HVAC&R APPLICATIONS

Final Report

Date Published – April 2010 with Errata



AHRI 低GWP冷媒標準調查 — CO2

冷媒	國家	冷凍冷氣藏設備	家用空調
	美國	<ul style="list-style-type: none"> - ASHRAE 15-2007 - ASHRAE 34-2007 - UL 471 (Small Comm. only) - UL 1995 (Supermarket, Walk-In only) - UL 984 	<ul style="list-style-type: none"> - ASHRAE 15-2007 - ASHRAE 34-2007 - UL 984 - UL 1995
CO2 (A1)	歐洲	<ul style="list-style-type: none"> - EN 378:2008 - EN 60079 	<ul style="list-style-type: none"> - EN 378:2008 - IEC 60335-2-40
	日本	<ul style="list-style-type: none"> - ISO 5149 (as referenced in JIS B8612) - JIS B8240 	<ul style="list-style-type: none"> - JIS B8240 - JIS B8616 - JIS B8620

參考資料：Review of regulations and standards for the use of refrigerants with GWP values less than 20 in hvac&r applications.



AHRI 低GWP冷媒標準調查 — Ammonia

冷媒	國家	冷凍冷氣藏設備	家用空調
	美國	<ul style="list-style-type: none"> - ASHRAE 15-2007 - ASHRAE 34-2007 - UL 471 (Small Comm. only) 	<ul style="list-style-type: none"> - ASHRAE 15-2007 - ASHRAE 34-2007
Amm onia (B2L)	歐洲	<ul style="list-style-type: none"> - EN 378:2008 - EN 60079 	<ul style="list-style-type: none"> - EN 378:2008 - IEC 60335-2-40
	日本	<ul style="list-style-type: none"> - ISO 5149 as referenced in JIS B8612 - JIS B8240 	<ul style="list-style-type: none"> - JIS B8240 - JIS B8616 - JIS B8620

參考資料： Review of regulations and standards for the use of refrigerants with GWP values less than 20 in hvac&r applications.



AHRI 低GWP冷媒標準調查 – HCs

冷媒	國家	冷凍冷氣藏設備	家用空調
	美國	<ul style="list-style-type: none"> - ASHRAE 15-2007 - ASHRAE 34-2007 - UL 471 (Small Comm. only), - UL 1995 (Supermarket, Walk-In only) 	<ul style="list-style-type: none"> - ASHRAE 15-2007 - ASHRAE 34-2007 - UL 1995
HCs (A3)	歐洲	<ul style="list-style-type: none"> - EN 378:2008 - EN 60079 - IEC 60335-2-75 - IEC 60335-2-89 	<ul style="list-style-type: none"> - EN 378:2008 - IEC 60335-2-40
	日本	<ul style="list-style-type: none"> - ISO 5149 as referenced in JIS B8612 - JIS B8240 	<ul style="list-style-type: none"> - JIS B8240 - JIS B8616 - JIS B8620

參考資料：Review of regulations and standards for the use of refrigerants with GWP values less than 20 in hvac&r applications.



AHRI 低GWP冷媒標準調查 – A2L Fluids

冷媒	國家	冷凍冷氣藏設備	家用空調
	美國	<ul style="list-style-type: none"> - ASHRAE 15-2007 - ASHRAE 34-2007 - UL 471 (Small Comm. only) - UL 1995 (Supermarket, Walk-In only) 	<ul style="list-style-type: none"> - ASHRAE 15-2007 - ASHRAE 34-2007 - UL 1995
A2L Fluids (A2L)	歐洲	<ul style="list-style-type: none"> - EN 378:2008 - EN 60079 - IEC 60335-2-75 (商用自動販賣機) - IEC 60335-2-89 (商用製冷器具) 	<ul style="list-style-type: none"> - EN 378:2008 - IEC 60335-2-40
	日本	<ul style="list-style-type: none"> - ISO 5149 as referenced in JIS B8612 - JIS B8240 	<ul style="list-style-type: none"> - JIS B8240 - JIS B8616 - JIS B8620

參考資料：Review of regulations and standards for the use of refrigerants with GWP values less than 20 in hvac&r applications.



結論

- **CO₂**：因為所需的更高的工作壓力，CO₂系統可能面臨一定的設計挑戰
- **Ammonia**：氨的毒性構成了重大障礙。主要限於工業應用。
- **HCs**
 - 高可燃性形成應用障礙。現行標準和法規允許僅允許使用少量的碳氫冷媒，這些充填量限制僅僅可適用於家用製冷和小型商業用設備。
 - UL 250 limits the charge to 50 g (1.7 oz) for domestic refrigerators, and UL 471 limits the charge to 150 g (5 oz) for small commercial refrigeration equipment.
 - IEC60335-2-24 限制冷媒充填量小於150g
- **A2L Fluids**
 - 由於其較低的可燃性而逐漸受到青睞(具有專利)。然而，要推動A2L冷媒普及，需修改設備的安全標準和於建築法規納入。
 - A2L冷媒在美國和日本已有不少的進展。歐洲尚未將A2L分類納入到其規定。



感謝聆聽
敬請指教



電風扇使用弱風運轉，可比使用強風省約50%到60%的電費