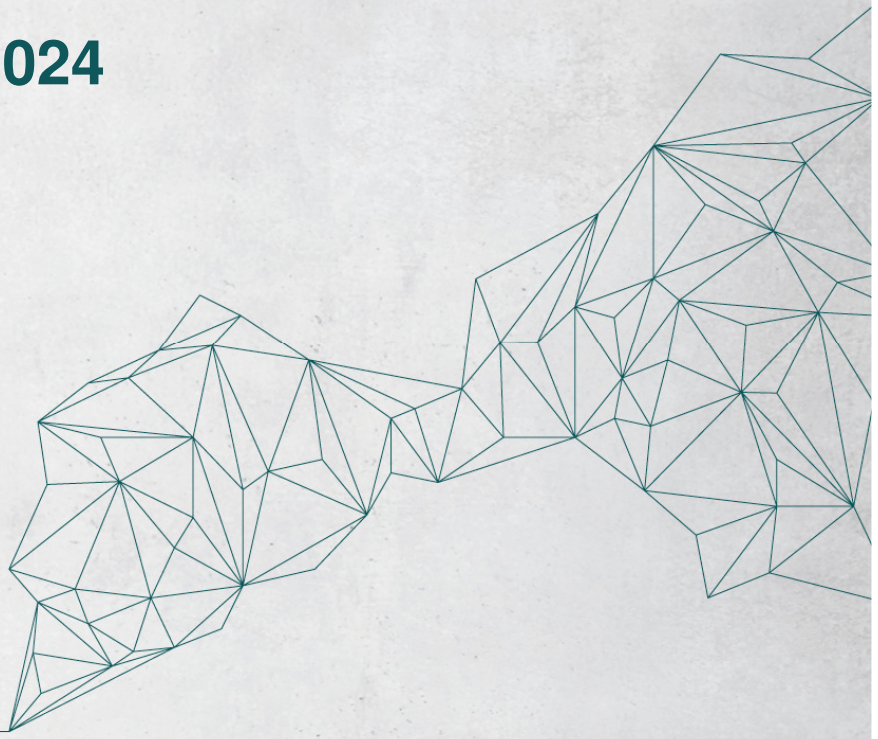
Hall 7A

CHILLVENTA

Chillventa Specialist Forums 2024
Chillventa Fachforen 2024

CONNECTING EXPERTS.



MARSTAIR
REFRIGERATION AND SPECIALIST AIR CONDITIONING

MARSTAIR
Hall 6
Stand 117

A2L SOLUTIONS

Presented By
Chris Chisman BEng, MInstR, Technical Director, TEV / Marstair

DESIGNED AND BUILT IN THE UK

In partnership with
QUARTZ
FAN COILS AND HVAC

WWW.MARSTAIR.COM

A summary of the challenges A2L refrigerants face for split system cold room applications relative to refrigerant charge limits, flammability limits, room sizes and pipe runs.

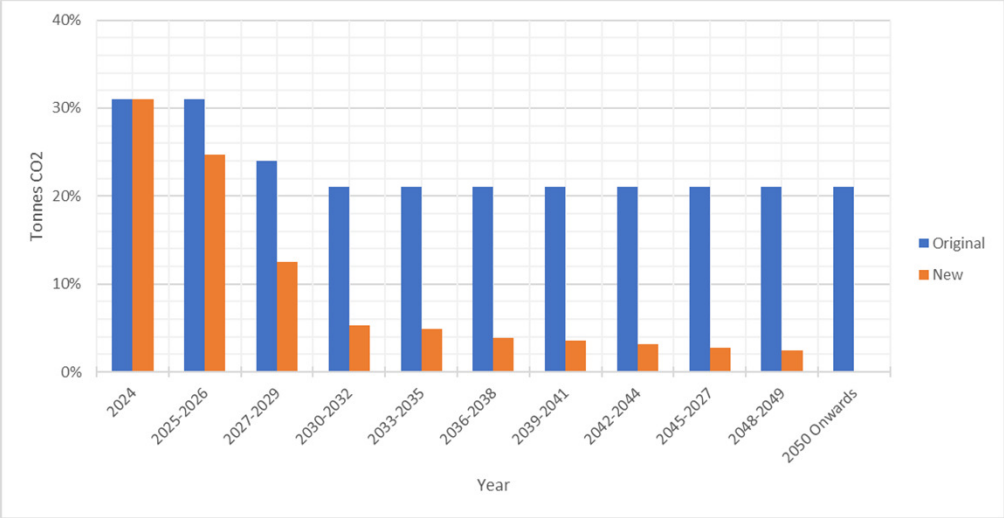
How does the Marstair A2LsysteMatch overcome this with case study examples.

Content

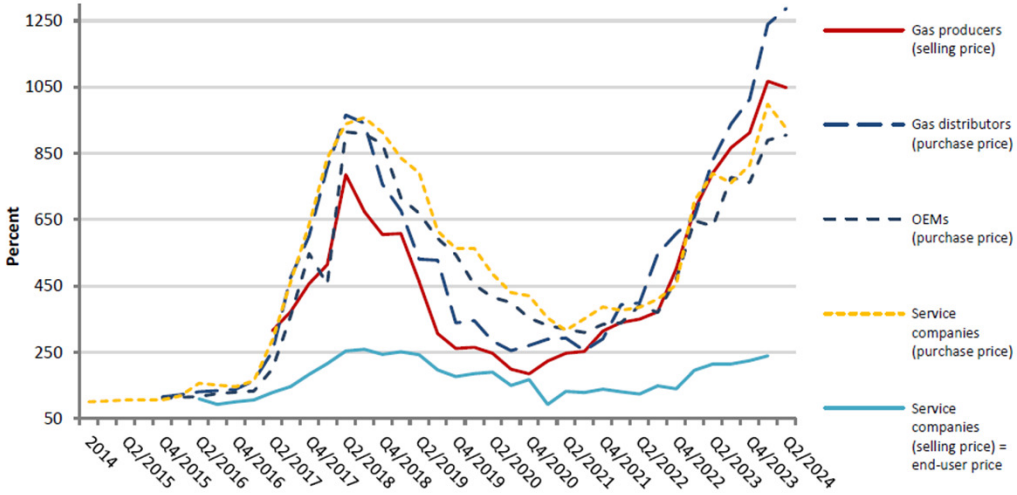
- ✓ F-Gas Regulation and EN 378 Standard
- ✓ A2LsysteMatch Development
- ✓ A2LsysteMatch Case Studies
- ✓ Total Cost of Ownership (TCO) & Environmental Benefits
- ✓ A2L Selection Software

F-Gas Regulation

EU F-Gas Phase Down



Refrigerant Price Trend



F-Gas Regulation

EU F-Gas Phase Down

Year	2015	16-17	18-20	21-23	2024	25-26	27-29	30-32	33-35	36-38	39-41	42-44	45-27	48-49	50
GWP	3922	3647	2471	1765	1216	968	489	206	191	153	139	124	109	95	0
%	100.0%	93.0%	63.0%	45.0%	31.0%	24.7%	12.5%	5.3%	4.9%	3.9%	3.5%	3.2%	2.8%	2.4%	0.0%

Equivalent Refrigerant GWP

Refrigerant	GWP	Flammable	Charge Weight	System GWP	Percentage 2015
R404A	3922	No	1	3922	100%
R449A	1397	No	1	1397	36%
R454C	148	Yes	1	148	4%
R454C	148	Yes	1/3	49	1%

EN 378 Refrigeration Product Safety Standard

e) determine the charge limit for the refrigerating system based on flammability as the greater of:

1) Charge limit from Table C.2;

2) m_1 x 1,5 for sealed refrigerating systems using flammability class 2L;

3) m_1 for sealed refrigerating systems using flammability class 2 or 3;

4) 150 g for sealed refrigerating systems;

The cap factors shown in Table C.2 are:

— $m_1 = 4\ m^3 \times LFL$

— $m_2 = 26\ m^3 \times LFL$

— $m_3 = 130\ m^3 \times LFL$

Maximum allowable R455A before table C2
R455A has a LFL of 0.431kg/m³ * 4m³ * 1.5 = 2.586kg
R454C has a LFL of 0.293kg/m³ * 4m³ * 1.5 = 1.758kg

Tracer gas leak test

3.1.7
sealed system
refrigerating system in which all refrigerant containing parts are made tight by welding, brazing or a similar permanent connection which may include capped valves and capped service ports that allow proper repair or disposal and which have a tested leakage rate of less than 3 grams per year under a pressure of at least a quarter of the maximum allowable pressure

Note 1 to entry: Joints based on mechanical forces which are prevented from improper use by the need of a special tool (e.g. by glue) are considered as a similar permanent connection.

Note 2 to entry: Hermetically sealed systems in EN 16084 are equivalent to sealed systems in EN 378-2.

Thread sealant

EN 378 Refrigeration Product Safety Standard

e) determine the charge limit for the refrigerating system based on flammability as the greater of:

1) Charge limit from Table C.2;

2) m_1 x 1,5 for sealed refrigerating systems using flammability class 2L;

3) m_1 for sealed refrigerating systems using flammability class 2 or 3;

4) 150 g for sealed refrigerating systems;

- Table C2 Standard limits A2L refrigerant charge to 20% X room volume X LFL (Lower Flammability limit)
- R455A has a LFL of 0.431kg/m³
- Example: 30m³ Room allows 20% X 0.431 X 30 = 2.586kg refrigerant.
- Rooms smaller than 30m³ can have 2.586kg of R455A in sealed systems
- Larger rooms can have move using 20% X room volume X LFL equation
- Maximum allowable Table C2 charge for general access rooms R455A = 26m³ X 0.431 X 1.5 = 16.8kg
- Higher charge weights are allowed using alternative C3 method, but is more complicated.

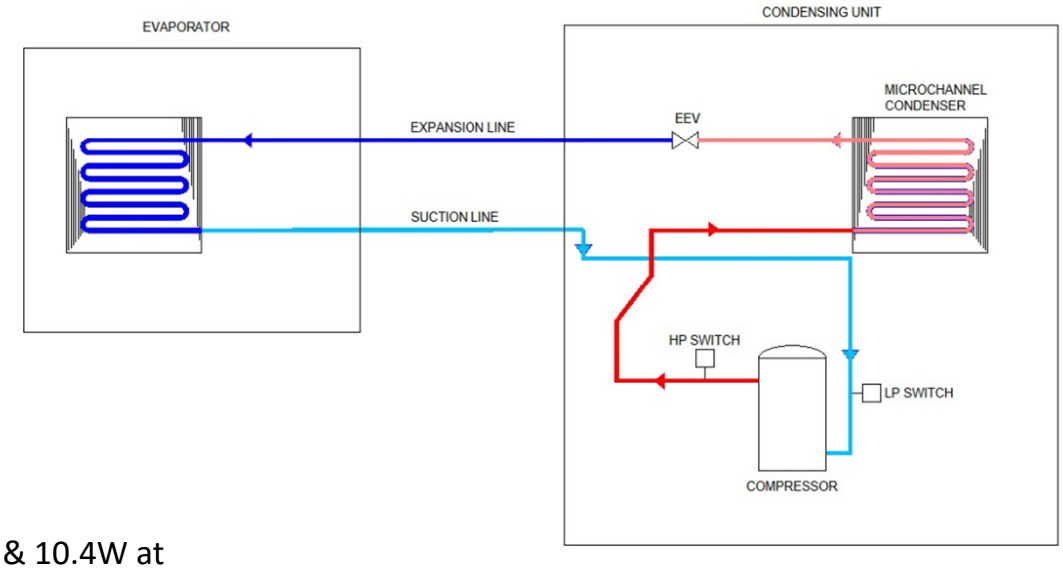
Flammability Class	Access Category		Location Classification			
			1- Occupied Space	2. Compressor in open air or machinery Room	3. All components in Machinery room or open air	4. Ventilated Enclosure
2L	A General Access	Human Comfort	According to C2 and not more than M2a x 1.5 or According to C3 and not more than M3b x 1.5		No Charge Restrictions	Refrigerant Charge not more tthan M3b x 1.5
		Other Applications	20% x LFL x Room volume and not more than M2a x 1.5 or According to C3 and not more than M3b x 1.5			
	B Supervised Access	Human Comfort	According to C.2 and not more than M2a x 1.5 or According to C3 and not more than M3b x 1.5			
		Other Applications	20% x LFL x Room volume and not more than M2a x 1.5 or According to C3 and not more than M3b x 1.5	20% x LFL x Room volume and not more than 25kg or According to C3 and not more than M3b x 1.5		
	C Authorised Access	Human Comfort	According to C.2 and not more than M2a x 1.5 or According to C3 and not more than M3b x 1.5			
		Other Applications	20% x LFL x Room volume and not more than M2a x 1.5 or According to C3 and not more than M3b x 1.5	20% x LFL x Room volume and not more than 25kg or According to C3 and not more than M3b x 1.5		

Product Development – A2L

Project Details:

- F-gas regulations require the use of lower GWP refrigerants
- A2L systems offer 98% GWP reduction
- A2L refrigerants are flammable resulting in new development challenges
- SysteMatch is an Award winning approach
- Improved Energy efficiency over R448A and CO2 systems
- Total Cost of Ownership 25% less than CO2
- Simple skill uplift compared to CO2
- Suitable for 4 A2L refrigerants, R455A, R454A, R454C & R1234YF

Critically charged system schematic with expansion lines



Product Performance:

- Chilled Cold room and cabinet systems available between 1.0 & 10.4W at 0°C room, -10°C evaporating and 32°C external ambient.
- Freezer Cold room and cabinet systems available between 1.0 & 5.6kW at
- -23°C room, -30°C evaporating and 32°C external ambient.

A2L Refrigerant Options

Refrigeration

- Marstair A2L condensing units are suitable for use with any of the 4 refrigerants shown.
- The compressors have been approved for use with each of the refrigerants.
- The units are also supplied with an electronic expansion valve which can be easily be set up to suit.
- This flexibility allows an end user to have the same refrigerant as other equipment which may have already been specified on site

Refrigerant	GWP	LFL kg/m³	Capacity
R454A	239	0.278	Highest
R455A	148	0.431	
R454C	148	0.293	
R1234yf	4	0.289	Lowest

Product Development – A2LsysteMatch

Example Cold Medium Temp Room Matches:

Max allowable R455A before EN 378 table C2 Calculation =2.586kg

SysteMatch -Medium Temperature - R455A (-8°C Evaporating temperature / 0°C return Air / 32°C External)											
Cooling kW	Condensing unit	Box Evaporator	System charge 0m	10m Pipe Run		20m Pipe Run		30m Pipe Run		40m Pipe Run	
				System charge	BS EN 378 Min Room Size m³	System charge	BS EN 378 Min Room Size m³	System charge	BS EN 378 Min Room Size m³	System charge	BS EN 378 Min Room Size m³
1.4	SMC+15	MBMTE125A	0.28	0.440	7.5	0.60	10.2	0.76	13.0	0.92	15.7
1.9	SMC+20	MBTME125B	0.295	0.455	7.8	0.62	10.5	0.78	13.2	0.94	16.0
2.1	SMC+30	MBMTE130B	0.350	0.510	8.7	0.67	11.4	0.83	14.2	0.99	16.9
2.6	SMC+40	MBMT130E	0.460	0.620	10.6	1.06	18.1	1.36	23.2	1.66	28.3
3.3	SMC+45	MBMT230B	0.654	0.814	13.9	1.25	21.4	1.55	26.5	1.85	31.6
4.6	SMC+50	MBMT230C	0.738	1.038	17.7	1.34	22.8	1.64	28.0	1.94	33.1
5.8	SMC+80	MBMT230E	0.955	1.255	21.4	1.56	26.5	1.86	31.7	2.16	36.8
6.5	SMC+90	MBMT230BE	1.280	1.580	27.0	1.88	32.1	2.72	46.4	3.20	54.6
8.2	SMC+100	MBMT430E	1.220	1.520	25.9	1.90	32.4	2.66	45.4	3.14	53.6
9.8	SMC+150	MBMT430E	1.220	1.700	29.0	2.18	37.2	2.66	45.4	3.14	53.6

Traditional Pumpdown = Medium Temperature - R455A (-8°C Evaporating temperature / 0°C return Air / 32°C External)											
Cooling kW	Condensing unit	Box Evaporator	System charge 0m	10m Pipe Run		20m Pipe Run		30m Pipe Run		40m Pipe Run	
				System charge	BS EN 378 Min Room Size m³	System charge	BS EN 378 Min Room Size m³	System charge	BS EN 378 Min Room Size m³	System charge	BS EN 378 Min Room Size m³
1.4	SMC+15	MBMTE125A	0.56	1.160	19.8	1.76	30.0	N/A	N/A	N/A	N/A
1.9	SMC+20	MBTME125B	0.575	1.175	20.1	1.78	30.3	N/A	N/A	N/A	N/A
2.1	SMC+30	MBMTE130B	0.630	1.230	21.0	1.83	31.2	2.43	41.5	3.03	51.7
2.6	SMC+40	MBMT130E	0.740	1.840	31.4	2.94	50.2	4.04	68.9	5.14	87.7
3.3	SMC+45	MBMT230B	0.934	2.034	34.7	3.13	53.5	4.23	72.3	5.33	91.0
4.6	SMC+50	MBMT230C	1.018	2.118	36.2	3.22	54.9	4.32	73.7	5.42	92.5
5.8	SMC+80	MBMT230E	1.235	2.335	39.9	3.44	58.6	4.54	77.4	5.64	96.2
6.5	SMC+90	MBMT230BE	1.560	2.660	45.4	3.76	64.2	6.72	114.7	8.44	144.0
8.2	SMC+100	MBMT430E	1.500	2.600	44.4	4.94	84.3	6.66	113.7	8.38	143.0
9.8	SMC+150	MBMT430E	1.500	3.220	54.9	4.94	84.3	6.66	113.7	8.38	143.0

Product Development – A2LsysteMatch

Example Cold Low Temp Room Matches:

Max allowable R455A before EN 378 table C2 Calculation =2.586kg

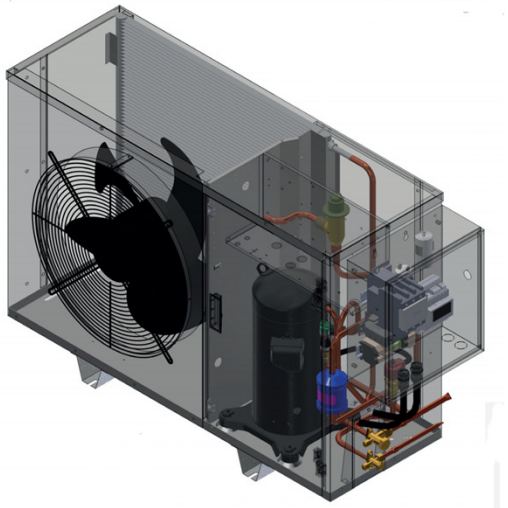
SysteMatch - Low Temperature - R455A (-30°C Evaporating temperature/ -23°C return Air / 32°C External)											
Cooling kW	Condensing unit	Box Evaporator	System charge 0m	5m Pipe Run		10m Pipe Run		15m Pipe Run		20m Pipe Run	
				System charge	BS EN 378 Min Room Size m³	System charge	BS EN 378 Min Room Size m³	System charge	BS EN 378 Min Room Size m³	System charge	BS EN 378 Min Room Size m³
1.4	SMC+LT45	MBLT130C	0.72	0.87	10.1	1.02	11.9	1.17	13.6	1.32	15.4
1.7	SMC+LT50	MTLT130E	0.82	0.97	11.3	1.12	13.0	1.27	14.7	1.42	16.5
1.9	SMC+LT55	MBLT130BE	0.86	1.01	11.8	1.16	13.5	1.31	15.2	1.46	17.0
2.3	SMC+LT60	MBLT130BE	0.86	1.01	11.8	1.16	13.5	1.31	15.2	1.46	17.0
2.7	SMC+LT70	MBLT230C	0.91	1.06	12.2	1.21	14.0	1.36	15.7	1.51	17.5
3.3	SMC+LT80	MBLT230C	1.07	1.22	14.1	1.37	15.9	1.52	17.6	1.67	19.3
4.0	SMC+LT90	MBLT230E	1.29	1.44	16.7	1.59	18.4	1.74	20.1	1.89	21.9
5.0	SMC+LT100	MBLT330C	1.30	1.45	16.8	1.60	18.6	1.75	20.3	2.26	26.2

Traditional Pumpdown - Low Temperature - R455A (-30°C Evaporating temperature/ -23°C return Air / 32°C External)											
Cooling kW	Condensing unit	Box Evaporator	System charge 0m	5m Pipe Run		10m Pipe Run		15m Pipe Run		20m Pipe Run	
				System charge	BS EN 378 Min Room Size m³	System charge	BS EN 378 Min Room Size m³	System charge	BS EN 378 Min Room Size m³	System charge	BS EN 378 Min Room Size m³
1.4	SMC+LT45	MBLT130C	1.00	1.30	15.1	2.10	24.4	2.65	30.8	3.20	37.2
1.7	SMC+LT50	MTLT130E	1.10	1.40	16.3	2.20	25.5	2.75	31.9	3.30	38.3
1.9	SMC+LT55	MBLT130BE	1.14	1.69	19.6	2.24	26.0	2.79	32.4	3.34	38.8
2.3	SMC+LT60	MBLT130BE	1.14	1.69	19.6	2.24	26.0	2.79	32.4	3.34	38.8
2.7	SMC+LT70	MBLT230C	1.19	1.74	20.1	2.29	26.5	2.84	32.9	4.62	53.6
3.3	SMC+LT80	MBLT230C	1.35	1.90	22.0	2.45	28.4	3.00	34.8	4.78	55.5
4.0	SMC+LT90	MBLT230E	1.57	2.12	24.5	3.28	38.1	4.14	48.1	5.00	58.0
5.0	SMC+LT100	MBLT330C	1.58	2.13	24.7	3.30	38.3	4.16	48.2	5.02	58.2

Product Development – A2LcabinetMatch

Project Details:

- Current SMC units can be matched with cabinets
- Requires A2L compliant cabinets
- Cabinet Coils details are required to calculate refrigerant charge sizes
- SMCD Units with Copeland Digital compressors now available for multiple cabinet systems.
- Multi-compressor unit options



Example Cabinet Matches:

Medium Temperature - R454C (-8°C Evaporating temperature / 32°C External)																				
CU Cooling kW	Condensing unit	Required Cabinet Cooing	Cabinet Size	Doors	System charge 0m	5m Pipe Run				10m Pipe Run				15m Pipe Run				20m Pipe Run			
						System charge	BS EN 378 Minimum Room Size m³	Expansion line size	Suction line size	System charge	BS EN 378 Minimum Room Size m³	Expansion line size	Suction line size	System charge	BS EN 378 Minimum Room Size m³	Expansion line size	Suction line size	System charge	BS EN 378 Minimum Room Size m³	Expansion line size	Suction line size
1.6	SMC+20	1.6	1.25	No	0.499	0.579	9.9	3/8"	3/8"	0.659	11.3	3/8"	1/2"	0.739	12.6	3/8"	1/2"	0.819	14.0	3/8"	1/2"
2.4	SMC+40	2.4	1.875	No	0.660	0.740	12.6	3/8"	1/2"	0.820	14.0	1/2"	1/2"	0.900	15.4	1/2"	5/8"	1.260	21.5	1/2"	5/8"
3.2	SMC+45	3.2	2.5	No	1.032	1.112	19.0	3/8"	1/2"	1.192	20.3	1/2"	1/2"	1.482	25.3	1/2"	5/8"	1.632	27.9	1/2"	5/8"
5.7	SMC+80	4.8	3.75	No	1.424	1.504	25.7	1/2"	5/8"	1.724	29.4	1/2"	5/8"	1.874	32.0	1/2"	3/4"	2.024	34.5	1/2"	3/4"
1.3	SMC+15	0.88	1.25	Yes	0.512	0.592	10.1	3/8"	3/8"	0.672	11.5	3/8"	1/2"	0.752	12.8	3/8"	1/2"	0.832	14.2	3/8"	1/2"
1.6	SMC+20	1.32	1.875	Yes	0.677	0.757	12.9	3/8"	3/8"	0.837	14.3	3/8"	1/2"	0.917	15.7	3/8"	1/2"	0.997	17.0	3/8"	1/2"
1.9	SMC+30	1.76	2.5	Yes	0.882	0.962	16.4	3/8"	1/2"	1.042	17.8	3/8"	1/2"	1.122	19.1	3/8"	1/2"	1.202	20.5	3/8"	5/8"
3.2	SMC+45	2.64	3.75	Yes	1.389	1.469	25.1	3/8"	1/2"	1.549	26.4	1/2"	1/2"	1.839	31.4	1/2"	5/8"	1.989	33.9	1/2"	5/8"

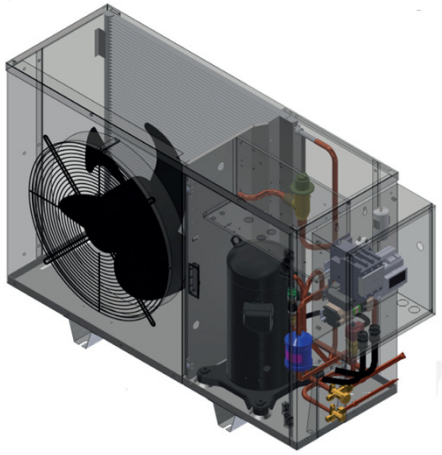
TEV Ltd

Product Development – A2LcellarMatch

MARSTAIR
REFRIGERATION AND SPECIALIST AIR CONDITIONING

Product Details:

- Updated A2L compliant evaporators
- All the advantages of Marstair CXE systems, except A2L
- Lightweight
- Dual purpose Ceiling and wall mounting brackets included
- Anti-bacterial chassis
- Electrics box with door



Example Cellar Cooler Matches:

R454C (12.7°C return Air / 32°C External)											
Cooling kW	Condensing unit	CXE A2L	System charge 0m	5m Pipe Run		10m Pipe Run		15m Pipe Run		20m Pipe Run	
				System charge	BS EN 378 Minimum Room Size m³	System charge	BS EN 378 Minimum Room Size m³	System charge	BS EN 378 Minimum Room Size m³	System charge	BS EN 378 Minimum Room Size m³
2.4	SMC+20	30	0.295	0.375	6.4	0.455	7.8	0.535	9.1	0.615	10.5
2.7	SMC+30	30	0.320	0.400	6.8	0.480	8.2	0.560	9.6	0.640	10.9
4.4	SMC+45	50	0.655	0.735	12.5	0.815	13.9	1.105	18.9	1.255	21.4
6.2	SMC+50	70	0.760	0.840	14.3	1.060	18.1	1.210	20.7	1.360	23.2
7.4	SMC+80	70	0.970	1.050	17.9	1.270	21.7	1.420	24.2	1.570	26.8

Co-op Kibworth – Convenient Savings

4 Cold Room Systems

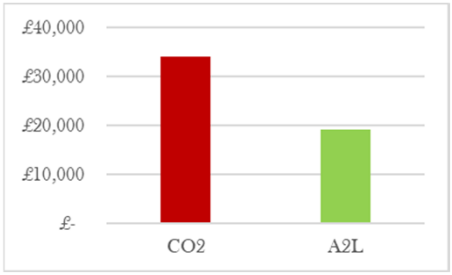
- Main Chill
- Main Frozen
- ISB Bakery Chiller
- Produce Chiller

Total Refrigerant
4 systems
= 3.2kg

The co-operative
Central England Co-operative

Capital Cost Comparison

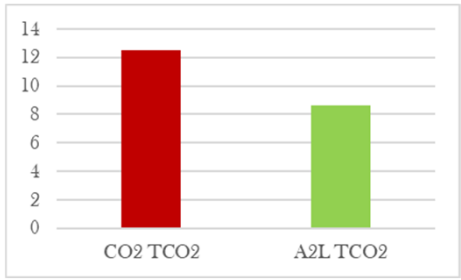
- CO2 total cost - £34,000
- A2L total cost - £19,158



Annual Emissions

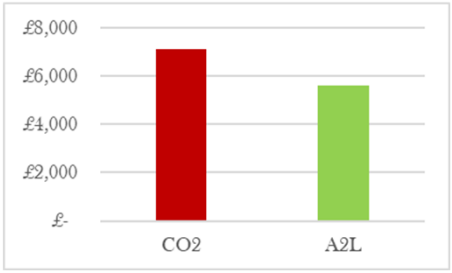
- CO2 cold rooms – 12.54 TCO2
- A2L cold rooms – 8.60 TCO2

*Based on a 3% leak rate and an emissions factor of 0.21233 kgCO2eq/kWh



Annual Energy Consumption

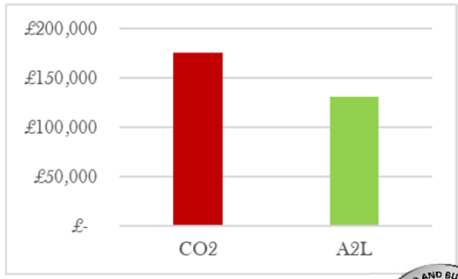
- CO2 cold room consumption cost £7,096
- A2L cold room consumption cost £5,602



Total Cost of Ownership

- CO2 - £175,920
- A2L - £131,198

*Based on 20-year energy performance + CAPEX



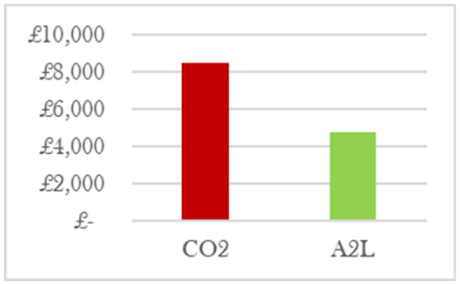
Hay Deli Hereford – Small End User Savings

1 Cold Room System

Total Refrigerant = 0.38kg!!!

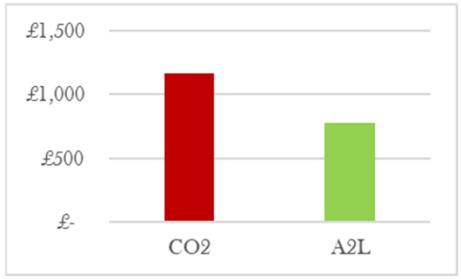
Capital Cost Comparison

- CO2 cost - £8,500
- A2L cost - £4,789



Annual Energy Consumption

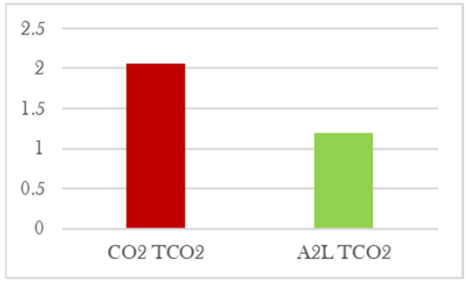
- CO2 coldroom consumption cost £1,166
- A2L coldroom consumption cost £780



Annual Emissions

- CO2 coldrooms – 2.06 TCO2
- A2L coldrooms – 1.2 TCO2

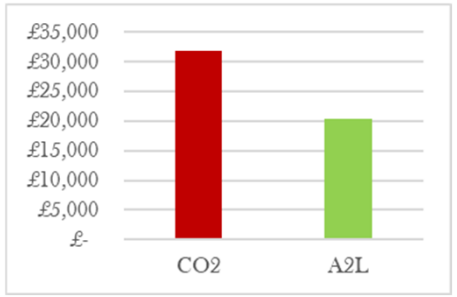
*Based on a 3% leak rate and an emissions factor of 0.21233 kgCO2eq/kWh



Total Cost of Ownership

- CO2 - £31,820
- A2L - £20,389

*Based on 20-year energy performance + CAPEX



What customers said

As we began our low carbon refrigeration journey, we realised that an important piece of the jigsaw was missing. Marstair stepped up to the challenge and in 2021 provided nine individual SysteMatch A2L systems that operate all of the cold rooms at our flagship store in Bootle. These systems meet the key requirements of our refrigeration strategy whilst providing great value for money when compared to other low carbon refrigeration options.
– Brian Churchyard – Asda

ASDA

The Co-op are delighted that their store at Kibworth has been future-proofed with low-GWP refrigeration systems that save energy, capital cost whilst also reducing system emissions. When compared to CO2, the four A2LsysteMatch systems will save an incredible >25% across a 20-year Total Cost of Ownership!
– Central England Co-op

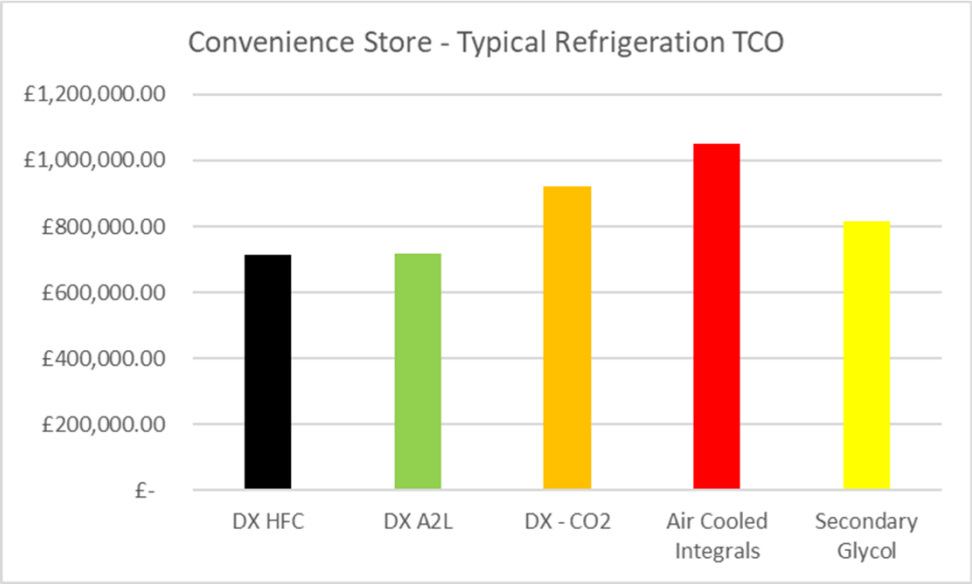
The co-operative
Central England Co-operative

The uplift in cost for this state-of-the-art unit was minimal and one we were very happy to pay given the environmental benefit and to future proof our business. Since it's installation Core Refrigeration have been to site to make sure it's running well and check things over and have always been happy.
– Hay Deli

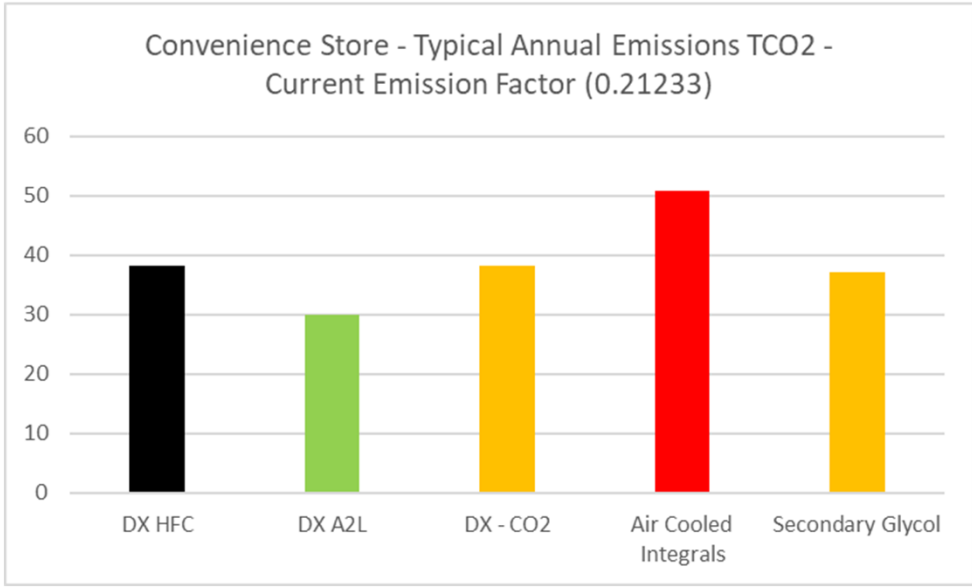
HAY DELI

Omega - ACS Cold Room Technology Comparison

TOTAL COST OF OWNERSHIP (CURRENT ENERGY RATE)



ANNUAL EMISSIONS (CURRENT EMISSIONS FACTOR – 0.21233)



Emissions factor based on 0.21233 kgCO2eq/kWh

The selection tool is FREE to use and can be accessed at **https://a2l.marstair.com/**

Example of an A2LsysteMatch at installation ASDA

A2L Awards

rac COOLING INDUSTRY AWARDS 2020
WINNER

rac COOLING INDUSTRY AWARDS 2022
WINNER

2021 ACR NEWS AWARDS

2022 ACR NEWS AWARDS

Thank You | Q&A:

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