

The "Changing State" of Refrigerants

R-404A

R-410A

R-22

Gary Parker – Product Manager





Refrigerant Suite

The RSD Refrigerant Suite is your central clearing house for all refrigerant related information, Literature - Technical Data, Rules, Regulations, Pending Legislations, Technician Certification, Refrigerant Recovery and more. Refrigerants industry is evolving rapidly and the RSD Refrigerants Suite will keep you "In the Know".

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What's New

California roles out proposal to Reduce HFC Emissions



RSD Notes

Utilities

★★★★★ 22345

OPEN

Menu PT Chart - R448A List

150°F	_____
125°F	_____
100°F	temp _____ bubble 241.3 dew 212.3
75°F	_____
50°F	_____
25°F	_____
0°F	_____
-25°F	_____
-50°F	_____

R448A, Blend, HFO

Menu RSD Locations Map

A

- RSD - Anaheim
2890 E. Coronado St
Anaheim, CA 92806
- RSD - Anchorage
520 W. 41st Ave. Unit A
Anchorage, AK 99503
- RSD - Aurora
3220 N Lisbon St. Bldg. D
Aurora, CO 80011

B

- RSD - Bakersfield
621 E. 21st St.
Bakersfield, CA 93305
- RSD - Bellingham
3924 Irongate Rd. Unit A
Bellingham, WA 98226
- RSD - Billings
20 Moore Lane
Billings, MT 59101
- RSD - Boise
423 N. Mitchell St.
Boise, ID 83704
- RSD - Buena Park
6391 Orangethorpe Ave.
Buena Park, CA 90620
- RSD - Burbank

A-Z State Distance

RSD Product Catalog

Menu Products Orders

Search by keywords

Scheduled Courses

The "Changing State" of Refrigerants

With R22 in the rearview mirror, regulations are now focusing on Climate Change. This presentation will address where we are, what new rules are on the horizon, and how these will change our industry forever.

- Air Conditioning / Heating Equipment 666
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❖ What Are A2L's and Why !

- Current Refrigerants all have High Global Warming Potential
- Most of the replacements have Flammability Risk
- ASHRAE Flammability Categories
 - A1 - No Flame Propagation
 - **A2L** - Same as A2 with lower flame velocity (A2-Lite)
 - **A2** - Flame Propagation and low flammability
 - **A3** - High Flammability (Propane - Isobutene)
- Charge Limit for **A2, A2L, A3** Refrigerants are Changing 300 to 500g +
- Goal is to safely implement refrigerants < 700 GWP
- R410A To be banned in New Equipment effective 1-1-2025
- A2L Candidates:
 - R32 - Daikin: Used currently in Europe and Asia (Pure Fluid)
 - R454B - Carrier, Lennox, Rheem/RUUD, Trane(Low Glide)

➤ Significant Regulation Changes

- 2016 Kigali Amendment began International HFC Phasedown*.
 - *2018 US Federal Court suspended our participation*
- 2018 California Cooling Act *Mirrored the Kagali framework*
 - *Oregon HB4024 - Washington HB1112*
- 2020 R22 (HCFC) Production Ban
- **2020 U.S. AIM Act*** Signed into Law (Re-started the HFC Phasedown)
- 2022 “Proposed” EPA Sector Controls
- 2023 New D.O.E. Efficiency Standard for AC and Heat Pumps
- 2023 “Proposed” EPA Emission Reduction & Reclaim Program

○ California Regulation History

- 2012 Refrigerant Management Program - Regulates systems > 50-lbs
- 2016 SB1383 - Adopted SLCP Regulations
- 2018 California Cooling Act - Adopted EPA SNAP Regulations*
- Present - Stationary Refrigeration & AC Regulations
 - 2022 New Refrigeration Systems over 50# must be below 150 GWP
 - ~~2023~~ 2025 New Air Conditioning Equipment must be below ~~750~~ 700 GWP
 - * Effective based on date of manufacture...
 - 2024 New Chiller Systems must be below 700 GWP
 - * Effective based on date of manufacture...
 - 2030 A Blended 1400 GWP Target for Market chains over 25 locations

Changing State of Refrigerants – Digest 2020-12

CARB Approves an HFC Refrigerant Phase out for Refrigeration and AC

Background:

On December 10th, the California Air Resources Board (CARB) voted to approve regulations to phase out the use of HFC refrigerants in Retail Food Facilities (Super Markets) Industrial Refrigeration/Cold Storage and Stationary Air Conditioning.

Retail Food Facilities/Supermarkets:

Effective 1-1-2022: New and Fully Remodeled Facilities with individual system charges of 50lbs or greater must use a refrigerant that is below 150 GWP. This will require the use of Natural refrigerants such as Co2 or Ammonia.

For Existing Facilities, the regulation requires operators reduce their installed refrigerant inventory, to a companywide-weighted average below 1400 GWP by 2030. To accomplish this, they will need to use a combination of low GWP HFO refrigerant retrofits and natural refrigerant remodels.

Changing State of Refrigerants – Digest 2021-10

The AIM Act Final Rule

On December 27th 2020: The American Innovation and Manufacturing (AIM) Act was signed into law. This Act authorizes the EPA to administrate a 15-year phasedown of HFC refrigerants. The goal is to achieve an -85% reduction (based on avg 2011 to 2013 levels) by 2036. **Phasedown Schedule:**

HFC Reduction based on Average 2011-2013 Consumption	Effective Year & Percentage Reduction	Allowance Caps (in MMTEV's)	
		Consumption	Production
Step - 1	2022 - 10%	273 m	344 m
Step - 2	2024 - 40%	182 m	229 m
Step - 3	2029 - 70%	91 m	114 m
Step - 4	2034 - 80%	60 m	76 m
Plateau	2036 - 85%	45 m	57 m

B - EPA HFC SECTOR-SPECIFIC PROHIBITIONS RULE NEW EQUIPMENT ONLY

INDUSTRY SECTOR	GWP LIMIT/RANGE	EXCLUDED PRODUCTS	WHEN	COMPLIANT PRODUCT
Residential & Light Commercial HVAC	700	R-410A	Jan 1, 2025	454B,R32
VRF	700	R-410A	Jan 1, 2026	454B,R32
Chillers (Excluding IPR with exciting fluid below - 50)	700	R-410A, R-134a	<u>2028 (-58F -> -22F)</u> 2026 (>-22F), Comfort Cooling	<u>454B, 454C, L40X</u> 515B, 513A,1234ze, 1233zd, 1234yf, N71
Data centers	700		Jan 1, 2027	515B, 513A, 454B, 1234ze, 1233zd, R471A
Industrial refrigeration (non-chiller)	150-700		2026-2028	515B, 513A,1234ze, 1234yf, 454C, R455A, N71
Retail	150-300	R-448A , R-404A, R-407's, R-410A, R- 507A, HFC-134A and more	2026 – 2028 (supermarket systems 2027)	R455A, 454C, N71, 515B, 1234ze, 1234yf
Ice Machines (Batch type w/ harvest rate <=1000 lb/24 hr ice and continuous type w/ harvest rate <=1000 lb/24 hr)	150	R-404A, R-407's, R-410A, R- 507A, HFC-134A and more	Jan 1, Jan 1, 2026	R455A, 454C, 1234yf
Cold Storage	150 - 300		2026	R455A, 454C, 1234ze, 1234yf

*Honeywell recommended products based on GWP limits and application requirements, list may change

❖ The Latest EPA “SNAP” Rules

Final Rule 25: In April 2023, the EPA approved the following A2L refrigerants {R32, R1234YF, R452B, R454A, R454B, R454C} for use in Residential Humidifiers and Centrifugal or Positive Displacement Chillers for Comfort Cooling and Industrial Process Air Conditioning *In January 2024/25, Chiller Manufactures must also meet the requirements of UL Standard 60335-2-40 3rd edition, pertaining to charge limits and leak detection requirements.

Proposed Rule 26: In May 2023, the EPA proposed the approval of refrigerants {R32, R1234yf, R454A, R455B, R454C, R455A, R457A, R516A} for use in the following applications with specific use conditions. Commercial Ice Machines, Industrial Process Refrigeration, Cold Storage Warehouses, Ice Rinks, Retail Food Processing/Dispensing and Remote Condensing units.

Also, **Proposed Rule 26** will allow for the venting of R290 (Propane), and eliminate the need for recovery, which is currently required by the Clean Air Act Section 608

EPA (Proposed) Emission Reduction and Reclamation Program

On October 6th 2023: the EPA issued a proposal to establish an Emissions Reduction and Reclamation Program. This is the first amendment to AIM Act (see Digest 2021-10) The primary goal is to reduce HFC emissions from HVACR & MAC equipment and maximize the use of reclaimed refrigerant in these applications.

What Are Key Provisions of the Rule?

- New Leak repair requirements for appliances with an HFC charge > 15-lbs, using a refrigerant greater than 53 GWP
- Automatic Leak Detection will be required for systems with a charge >1500-lbs. Effective dates will vary for new and existing systems.
- A Uniform Recovery and Reclamation standard will be adopted including the requirement to evacuate single use refrigerant cylinders before disposal.
- New requirement to use reclaimed HFC's to service select HVACR applications.
- Refrigerant cylinder tracking for HFC's used in service or installation, to include Labeling, Recordkeeping and Reporting.
- The EPA is not proposing rules that would prohibit the use of existing equipment.

Refrigerant	AKA	Manufacture	HFC Fluids					Hydrocarbons			GWP
			R32	R125	R134a	R143a	R227ea	R236fa	R600	R600a	
R-404A	FX70/HP62	Arkema/Dupont		44.0	4.0	52.0					3922
R-407A	KLEA60	Ineos Fluor	20.0	40.0	40.0						1923
R-407C	KLEA 66 SUVA 9000	Ineos Fluor	23.0	25.0	52.0						1677
R-407F	22LT	Honeywell	30.0	30.0	40.0						1674
R-410A	AZ20 SUVA9100	Honeywell	50.0	50.0							2088
R-422D	MO29	Honeywell/Dupont		65.1	31.5				3.4		2473
R-427A	FX100	Arkema	15.0	25.0	50.0	10.0					2024
R-434A	RS-45	Ref. Services Inc		62.3	16.0	18.0			2.8		3246
R-438A	MO99	Chemours	8.5	45.0	44.2			1.7		0.6	2059
R-458A	TDX20	Bluon	20.5	4.0	61.4		13.5	0.6			1564

Refrigerant	AKA	Manufacture	HFC Fluids				Co2	HFO Fluids			Safty Class	GWP
			R32	R125	R134a	R227ea	R744	1234yf	1234ze	R1336M		
R-448A	N-40	Honeywell	26.0	26.0	21.0			20.0	7.0		A1	1273
R-449A	XP40	Chemours	24.3	24.7	25.7			25.3			A1	1282
R-450A	N13	Honeywell			42.0				58.0		A1	547
R454A	XL40	Chemours	35.0					65.0			A2L	239
R454B	XL-41	Chemours	68.9					31.1			A2L	466
R-454C	XL-20	Chemours	21.5					78.5			A2L	148
R-455A	L40X	Honeywell	21.5		10.2		3.0	75.5			A2L	148
R-471A	N71	Honeywell				4.3			78.7	17.0	A1	146
R-513A	XP10	Chemours			44.0			56.0			A1	573
R-515A	XP10	Chemours				12.0			88.0		A1	573

R410a - Transition

Production Deadline: Per EPA Rule

Packaged or self-contained equipment: and can be built up to 12-31-24.

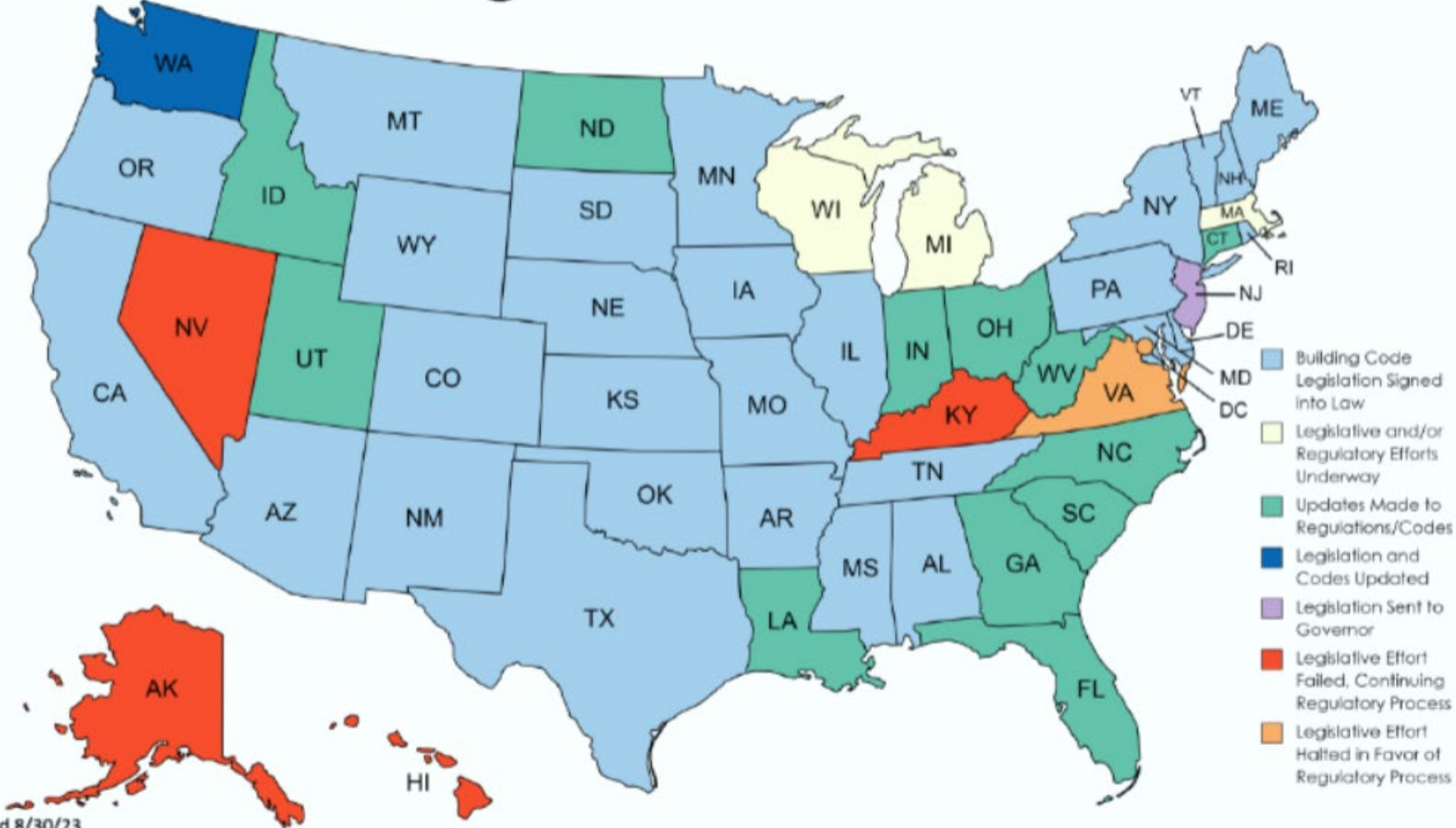
- There will be a 3-yr sell through period for in stock equipment.
- CARB has an unlimited sell through, but EPA rule applies

Split System components: can be built up to 12-31-24.

- There will be a 1-yr sell through/install period for in stock equipment.

Service Components: Production of R410a condensing units are not prohibited.

Low GWP Building Code Status



Updated 8/30/23

R410A vs R32 or R454B

Fluid	Evap T	SH	Cond T	SC	Mass Flow		Capacity		Power		Discharge		GWP (AR4)
	(°F)	(°F)	(°F)	(°F)	(lb/s)	Ratio	(Btu/h)	Ratio	(kW)	Ratio	(psia)	Ratio	
R410A	45	10.08	105	10.08	0.038		10,301		0.626		356.1		1924
R32	45	10.08	105	10.08	0.028	72.21%	11,115	107.90%	0.666	106.39%	364.3	102.30%	677
R454B	45	10.08	105	10.08	0.030	78.97%	9,902	96.12%	0.592	94.57%	332.3	93.32%	466

R-32 and R-454B are A2L Refrigerants for new Equipment ONLY - **ARE NOT RETROFIT OPTIONS**

❖ R32 and R454B

❖ To the Fire Authority "it is either flammable, or it's not.."

DANGER
H221 Flammable gas.
H280 Contains gas under pressure; may explode if heated.

ATTENTION!
Asphyxiant in high concentrations.
Contact with evaporating liquid may cause frostbite or freezing skin.
Do not remove this label.

R32
UN 3252
GWP 675

Difluoromethane R32
CAS 75-10-5
CH₂F₂



ADR 2.1

P210 Keep away from heat, hot surfaces, sparks, open flames and other ignition sources.

DANGER
H221 Flammable gas.
H280 Contains gas under pressure; may explode if heated.

ATTENTION!
Asphyxiant in high concentrations.
Contact with evaporating liquid may cause frostbite or freezing skin.
Do not remove this label.

R454B
UN 3161
GWP 466

Liquefied gas, flammable, N.O.S.

R32 • CAS 75-10-5 • 68,9 %
Difluoromethane
CH₂F₂
R1234yf • CAS 754-12-1 • 31,1 %
2,3,3,3-Tetrafluoropropene
C₃H₂F₄



ADR 2.1

NET 10 kg
4,7 t CO₂-eq

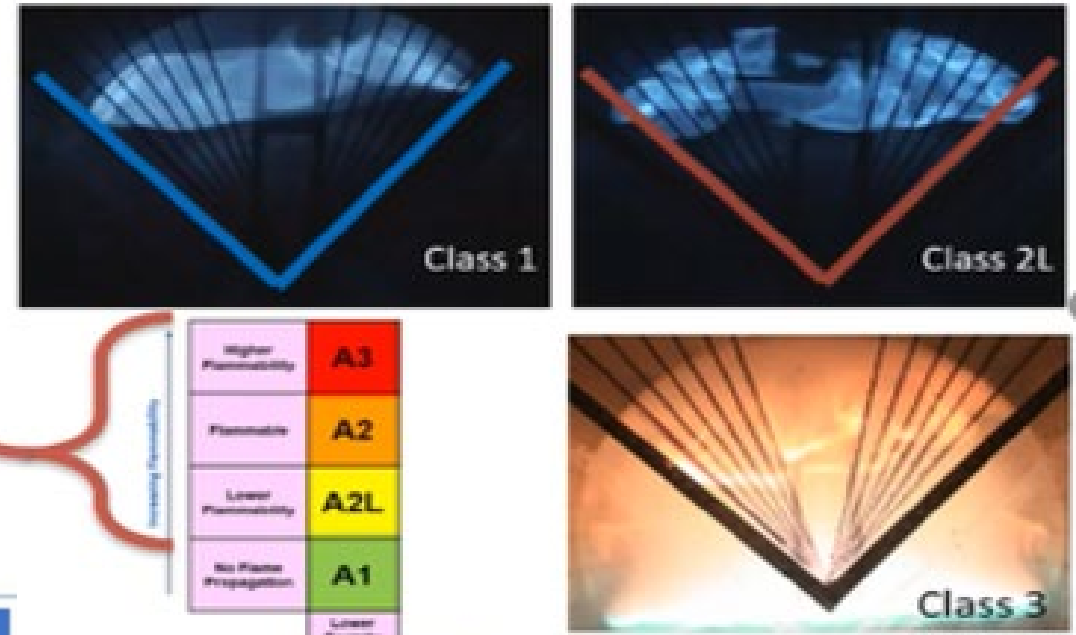
P210 Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P377 Leaking gas fire. Do not extinguish, unless leak can be stopped safely.
P381 Eliminate all ignition sources if safe to do so.
P403 Store in a well ventilated place.

Lower Flammability Limit (LFL)

- The lower flammability limit (LFL) is the minimum concentration of a flammable substance, in this case a refrigerant, that is capable of ignition when there is a sufficient mixture of air and the substance.
- The LFL is expressed as refrigerant percentage by volume.
- Refrigerant flammability is determined by the ASHRAE-modified ASTM E-681 Flammability test.

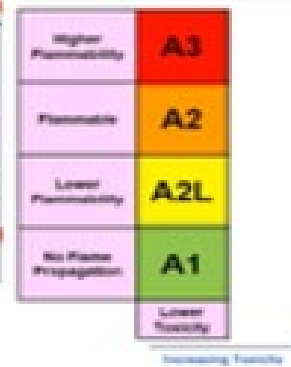
ASTM E681 Test Examples

- Flame spread $> 90^\circ$ indicates “flammability”
- There are three flammable classes:
 - 3 – higher flammability
 - 2 – flammable
 - 2L – lower flammability



Comparison of Flammability Parameters

Refrigerant ASHRAE Designation	Opteon™ XL41 (R-454B)	Propane (R-290)
ASHRAE Safety Group	A2L	A3
Lower Flammability Limit (LFL) (g/m³)	297	38
Minimum Ignition Energy (MIE) (mJ)	100 - 300	0.25



What is New with R454B



Leak Detector



Scroll and Rotary Compressors



TXV / EEV



System Installation

- The maximum charge size for the A2L equipment being installed will be limited by the cubic feet of airspace served by the equipment.
- The space must be large enough, and have enough air, to keep the refrigerant at or below a percentage of the lower flammability limit (LFL) should the entire charge leak into the space (referred to as dispersal volume)



Transportation

- In most circumstances, 2Ls can typically be transported from a storage area to the jobsite in the same manner as other flammable gases such as oxygen and acetylene in a service vehicle.
- Refrigerant cylinders should be transported in the upright position so that the pressure relief valve is in contact with the vapor space of the cylinder.
- Depending on state or local codes, placards and ventilation may be required on the service vehicle. These requirements vary depending on the volume of gas being transported.
- DOT regulations require refrigerant cylinders containing over 2.2 lbs. of a 2L refrigerant to be equipped with a pressure relief valve instead of a rupture disc.



HONEYWELL SUSTAINABLE REFRIGERANTS

Honeywell



Retrofit: < 1500 GWP

- **Solstice N40 (R-448A) A1:** Retrofit optimized for R-22, R-404A, R-507, and R-407 replacement in existing equipment

System Type	Regulation (Proposed by EPA)	When? (Estimated Effective Date)
New Equipment (Commercial Refrigeration)	Ban on refrigerants >150 GWP, >300GWP	JAN 1, 2025

New Equipment: < 150 GWP

- **Solstice N71 (R-471A) A1:** All medium temperature applications –optimized for supermarkets
- **Solstice L40X (R-455A) A2L:** Low + Medium temperature applications – optimized for low temp in supermarkets & low + medium temp in convenience / drug stores, self-contained equipment.

System Type	Medium Temperature	Low Temperature
Supermarkets (New Equipment)	N71 (R-471A) Yf, Ze	L40X (R-455A)
Convenience Stores (New Equipment)	L40X (R-455A) Yf, Ze	L40X (R-455A)
Self-contained Equipment (New Equipment)	L40X (R-455A) Yf, Ze	L40X (R-455A)
Retrofit (R-22, R-404A, R-507)	N40 (R-448A)	N40 (R-448A)

Refrigeration Medium / Low Temp

Product Name	ASHRAE #	Incumbent Refrigerant	ASHRAE CLASS	GWP / AR4 (AR5)	Normal Boiling Point °F
Opteon™ XP10	R-513A	R-134a	A1	631 (573)	-21
Opteon™ XP40	R-449A	R-404A	A1	1397 (1282)	-51
Opteon™ XP44	R-452A	R-404A	A1	2140 (1945)	-53
Opteon™ XL10	R-1234yf	R-134a	A2L	4 (1)	-21
Opteon™ XL20	R-454C	R-407A	A2L	148 (146)	-50
Opteon™ XL40	R-454A	R-404A	A2L	239 (238)	-54
Freon™ 404A	R-404A	N/A	A1	3922 (3943)	-51
Freon™ 134a	R-134a	N/A	A1	1430 (1300)	-15

A/C and Heat Pumps

Product Name	ASHRAE #	Incumbent Refrigerant	ASHRAE CLASS	GWP / AR4 (AR5)	Normal Boiling Point °F
Opteon™ XL10	R-1234yf	R-134a	A2L	4 (1)	-21
Opteon™ XP30	R-514A	R-123	B1	7 (2)	84
Opteon™ XL20	R-454C	R-407C	A2L	148 (146)	-50
Opteon™ XL41	R-454B	R-410A	A2L	466 (467)	-51
Freon™ 410A	R-410A	N/A	A1	2088 (1924)	-61
Freon™ 134a	R-134a	N/A	A1	1430 (1300)	-15
Freon™ 123	R-123	N/A	A1	77 (79)	82

Low & Med Temp Transition

Fluid	Evap T	SH	Cond T	SC	Cooling Capacity		Mass Flow		Power		GWP		ASHRAE
	(°F)	(°F)	(°F)		(Btu/h)	Ratio	(lb/s)	Ratio	(kW)	Ratio		Reduction	Safety Class
R404A	0	9	100	9	2980.6		0.0170		0.376		3943		A1
R448A	0	9	100	9	3067.0	102.90%	0.0130	76.62%	0.367	97.61%	1273	-67.71%	A1
R454C	0	9	100	9	2707.4	90.83%	0.0124	72.56%	0.325	86.44%	146	-96.30%	A2L
R455A	0	9	100	9	2985.4	100.16%	0.0131	76.79%	0.361	96.01%	146	-96.30%	A2L

* All Values Based on 1-cu/ft compressor displacement

Fluid	Evap T	SH	Cond T	SC	Cooling Capacity		Mass Flow		Power		GWP		ASHRAE
	(°F)	(°F)	(°F)		(Btu/h)	Ratio	(lb/s)	Ratio	(kW)	Ratio		Reduction	Safety Class
R404a	25	9	100	9	5105.0		0.0273		0.423		3943		A1
R134a	25	9	100	9	3061.5	59.97%	0.0128	46.77%	0.235	55.56%	1300	-67.03%	A1
R471A	25	9	100	9	1993.5	39.05%	0.0094	34.49%	0.153	36.17%	148	-96.25%	A1

* All Values Based on 1-cu/ft compressor displacement

R471A	25	9	100	9	4983.8	97.62%	0.0235	34.49%	0.3825	90.43%	148	-96.25%	A1
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* All Values Based on 2.5-cu/ft compressor displacement

A2L Refrigerant Recovery

Current Regulations will require unique cylinders for A2L recovery.



A1 Recovery Cylinder



A2L Recovery Cylinder

Since all the R400's series A2L blends are under patent, we are working to determine whether they can be recycled and or repackage them.

More info to follow

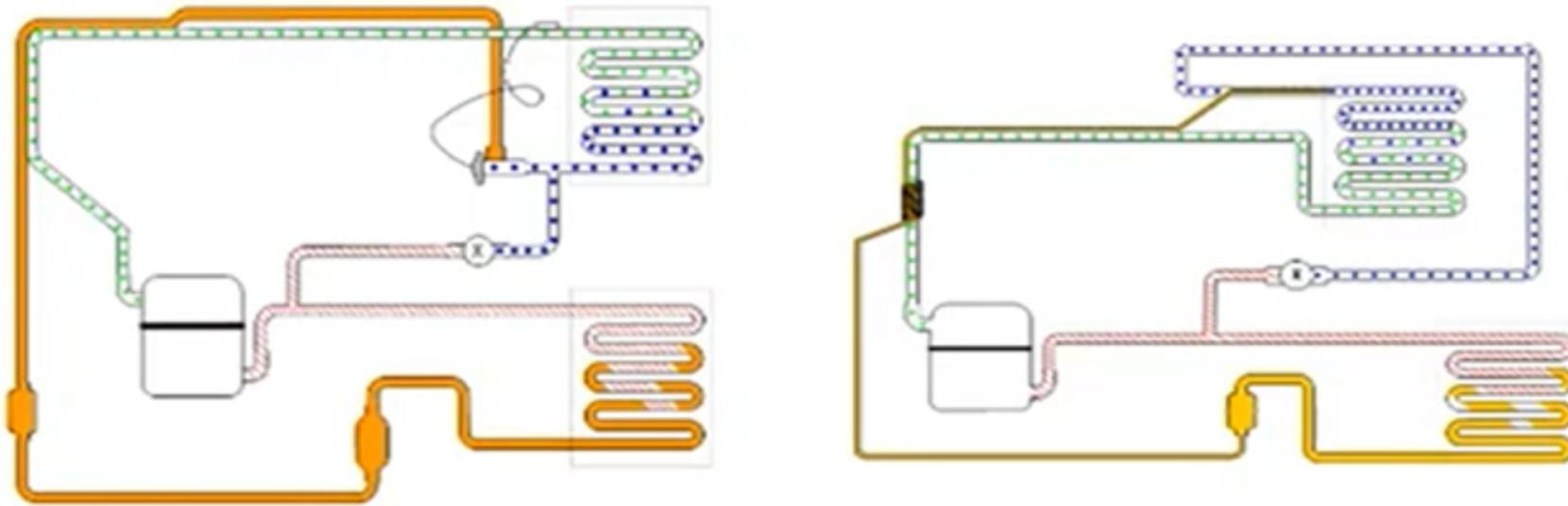
❖ Hydrocarbon Refrigerants R290 – R600



- OEM Training Required by Most Manufactures
- Odorless - High Purity Product
- Current Charge Limits
 - 300 g (10.7 oz) in Closed Cases.
 - 500 g (17.9 oz) in Open Applications - No Doors
- Requires Unique Tools
 - Leak Detector
 - Vacuum Pump
- Sealed Contact Components
 - Motors
 - Overloads
 - Relays
 - Thermostats
 -

❖ Hydrocarbon Refrigerants R290 – R600

- System configuration



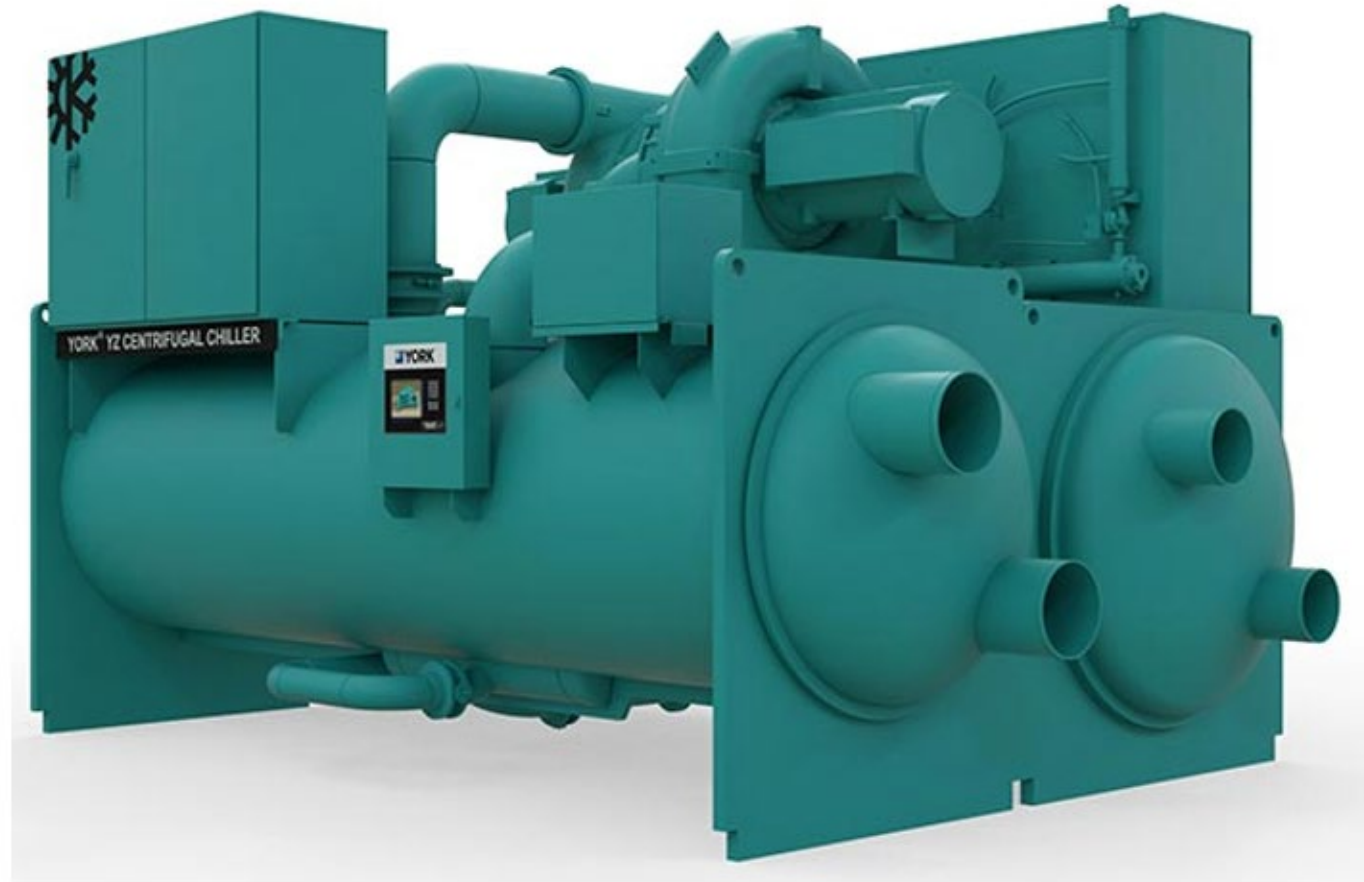
Components and piping arrangement is essentially equal to traditional HCFC/HFC systems

❖ Hydrocarbon Refrigerant Properties

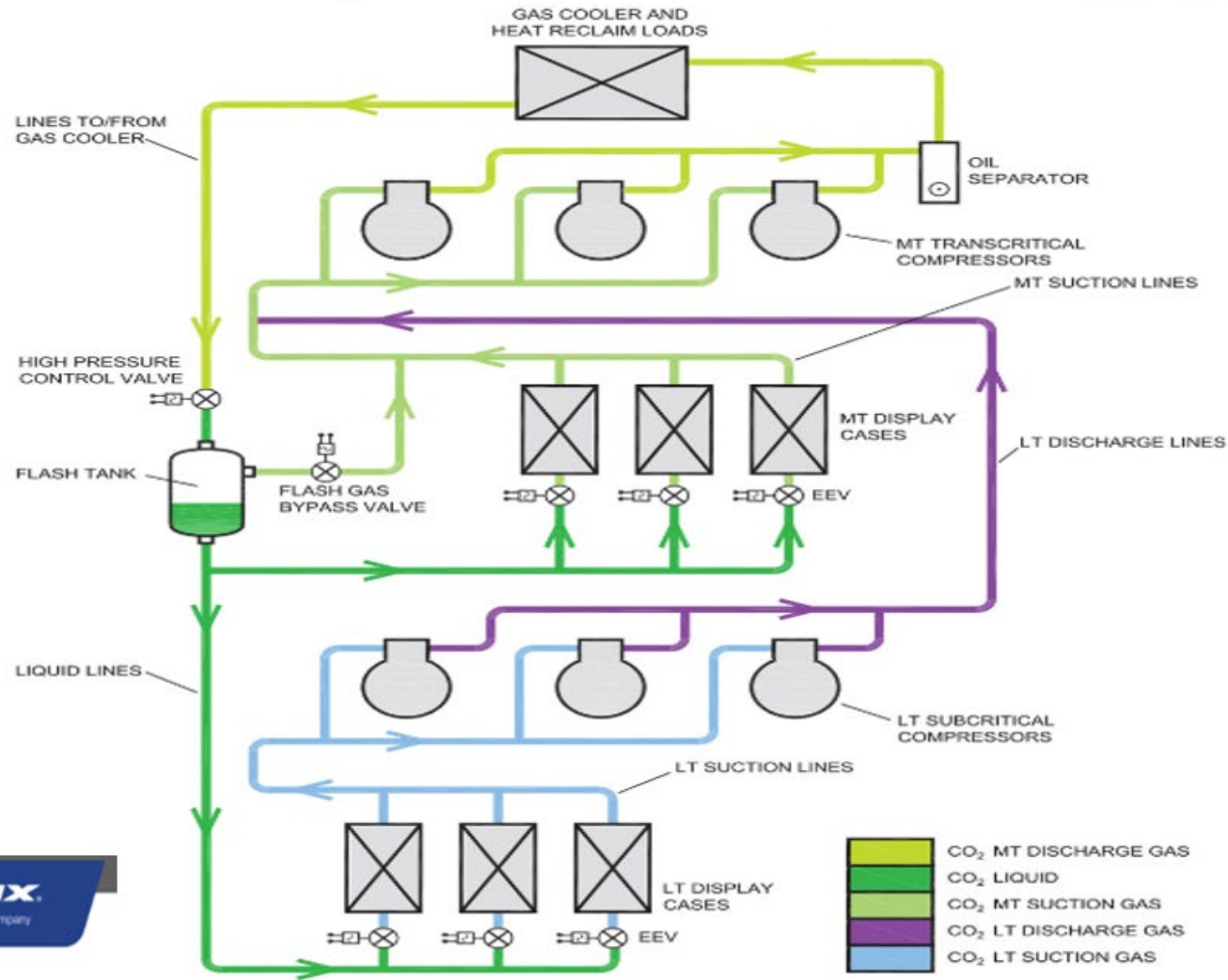
Refrigerant	R-290	R-134A	R-404A	R-22
Name	Propane	Tetrafluoroeth	Mixture R-125, R-134A, R-143	Isobutene
Boiling Point	-43.78	-15.7	-50.44	-41.44
Liquid Density	1.23 lbs.	3.02 lbs.	2.72 lbs.	3.0 lbs.

- P/T data; similar to R-22. Will perform well in all temperature ranges
- Refrigerant Charges are critical - **Never Over Charge**
- Equipment must be installed per ASHRAE 15 Safety Standards.
 - ❑ Never install in corridors or hallways

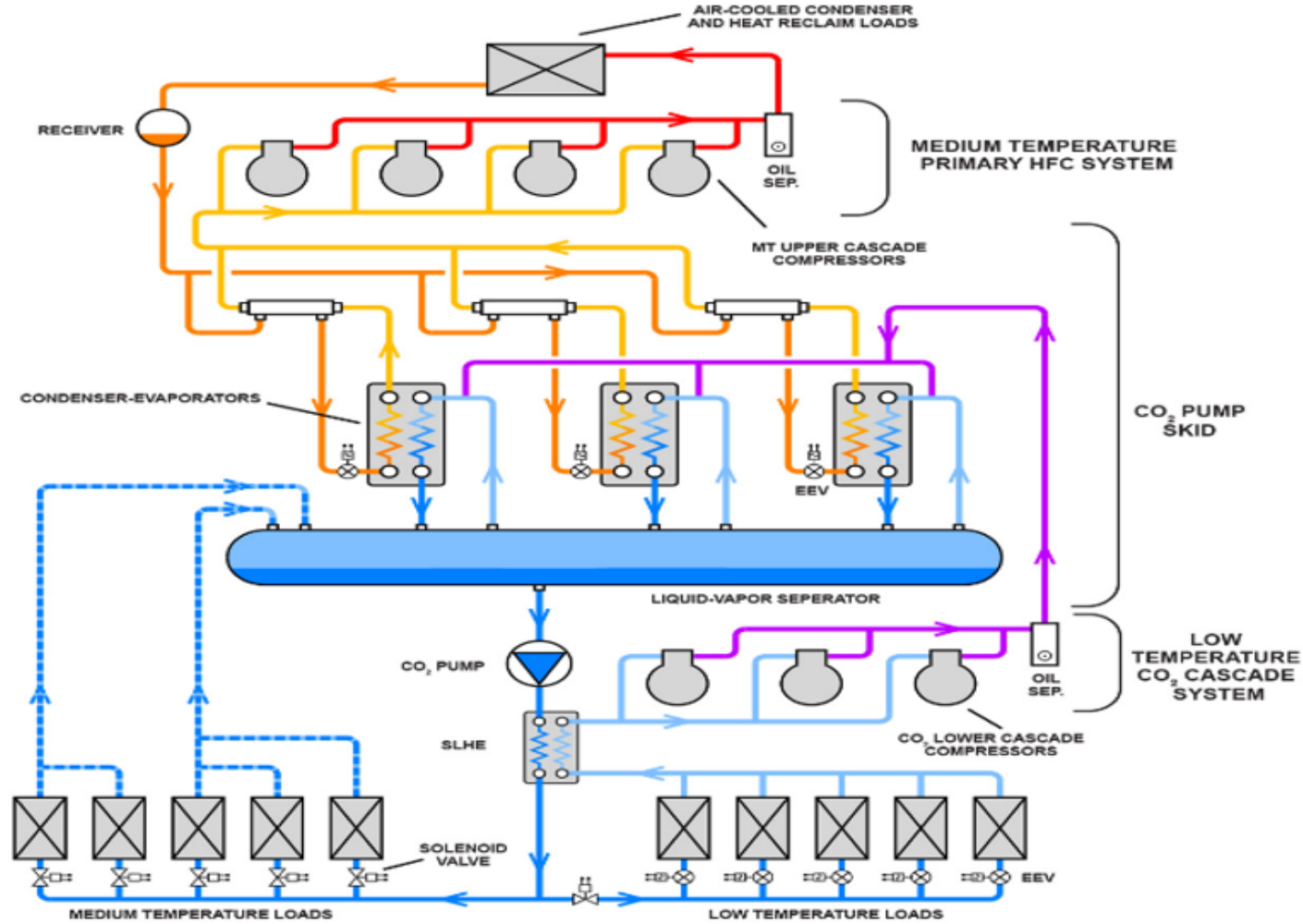
R1233ZD Chiller up to 1200 tons



➤ Low & Med Temperature Trans critical R744 Co2



➤ Low/Med Temperature R744 w/Secondary HFO



Thank you !

For More information go to:

[www.RSD.net/Refrigerant Suite](http://www.RSD.net/Refrigerant%20Suite)

1-800-245-8007 ex 00405

