Adapting to the A2L Refrigerant Transition

Impact, Mitigation Strategies, and Best Practices

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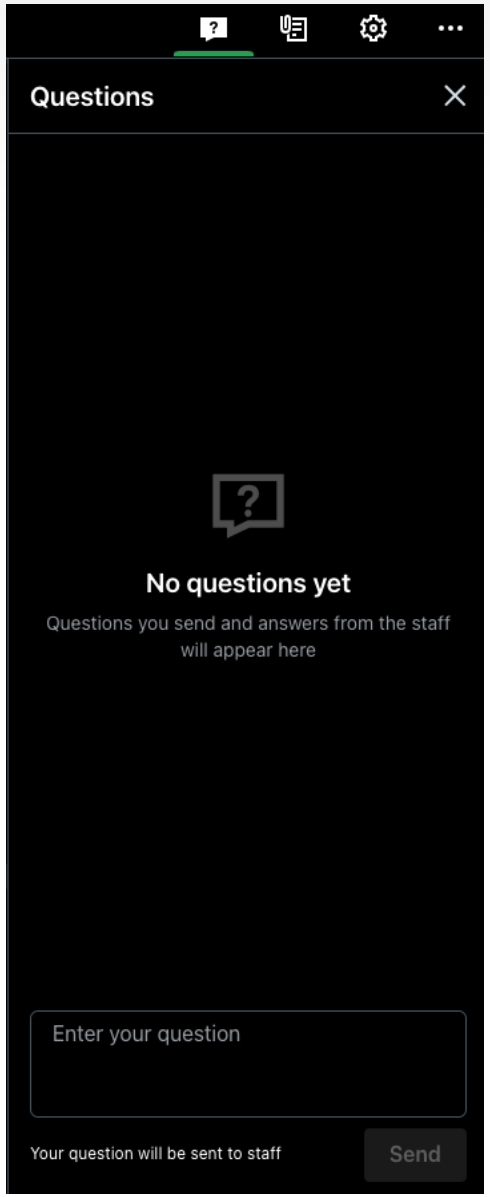

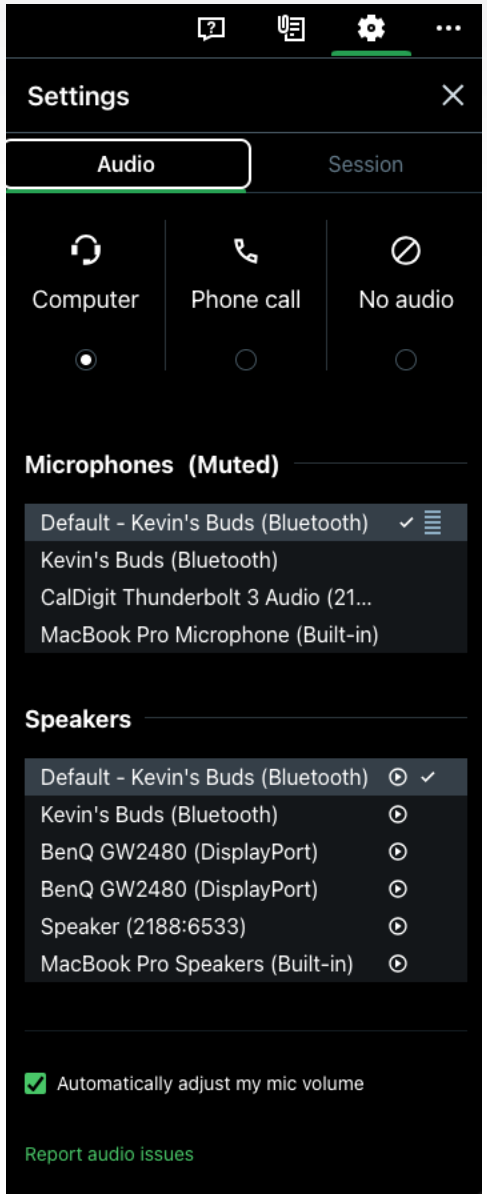

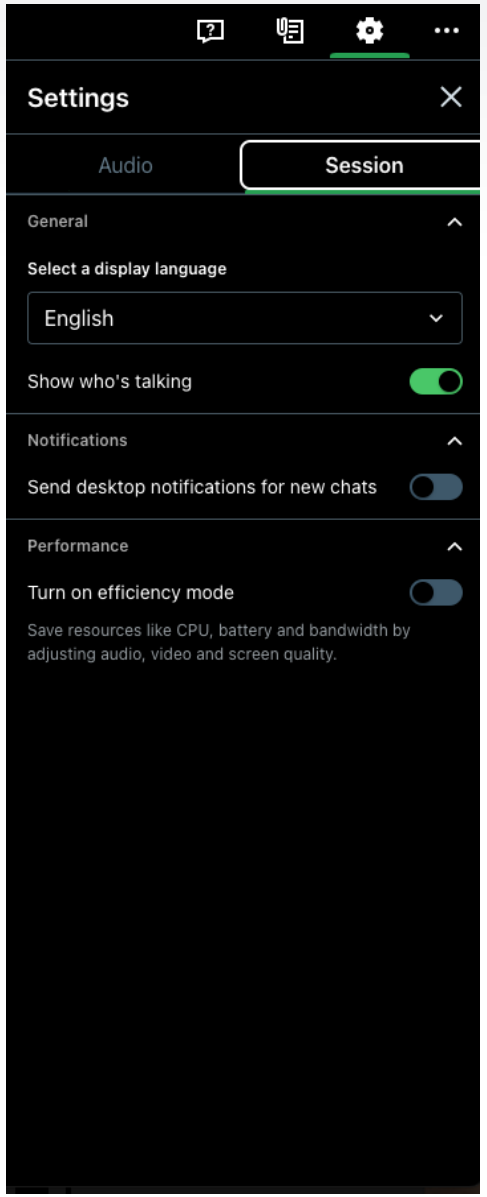

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Meet the Team

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A2L Transition

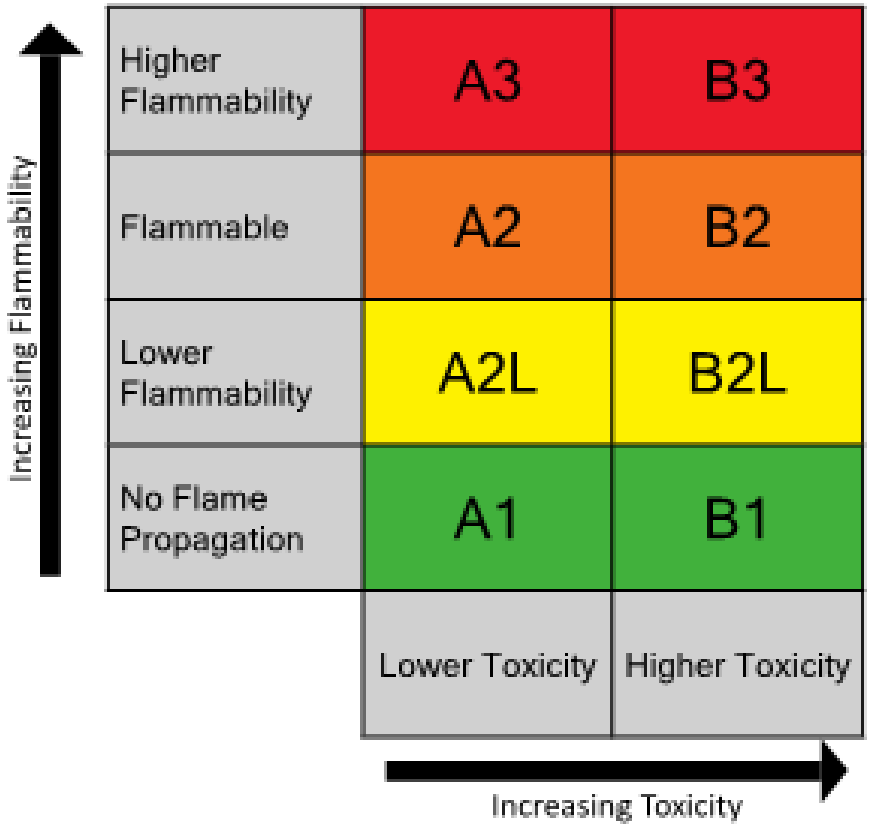
How did we get here?

Timeline

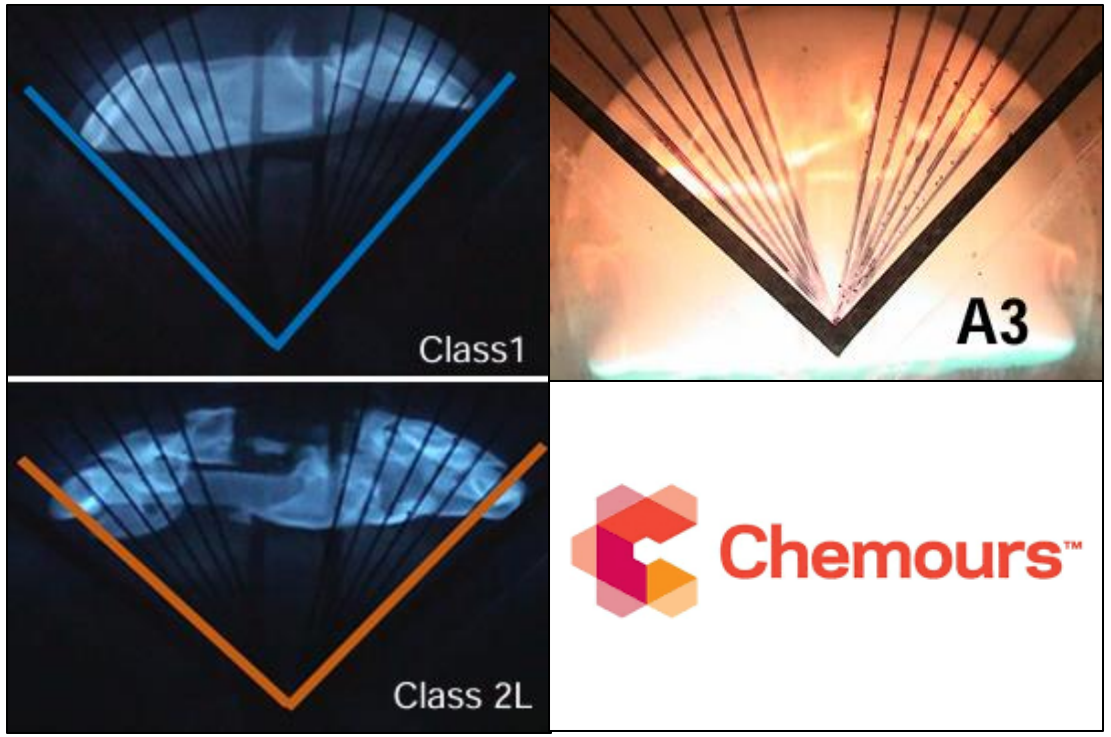
- Dec. 2020 - American Innovation and Manufacturing Act is introduced
- AIM Act gave EPA the authorization to address Hydrofluorocarbons (HFC's), resulting in their phasedown and change to low GWP refrigerants
- Refrigerants out in the field must now be lower than 700 GWP

Refrigerant	GWP Level
R-410A	2,088
R-454B	466
R-32	675
R-22	1,810
R-290	3.3

Refrigerant Classification



Flame Propagation



R-454B Overview and RDS Solution

R-454B Overview

- Enertech has chosen R-454B as our replacement refrigerant for R-410
- R-454B is not a drop-in replacement for R-410A, but its characteristics are similar

Refrigerant Properties Comparison

Refrigerant	R-410A	R-454B	R-32
Safety class	A1	A2L	A2L
Temp. Glide	~0.5	~2	0
Molecular Weight	72.6	62.6	52
Boiling Point	-60.6	-58.9	-61
Oil	POE 32	POE 32	POE 46
Suction Pressure (psig)	130	120	133
Discharge Pressure (psig)	341	318	350
Discharge Temp. (°F)	167	177	195
GWP	2088	466	675

How Does this Impact Our Equipment?

- **Much stays the same**
- **New R-454B compatible equipment in our units**
  - Compressor
  - TXV/EXV
  - Some Heat Exchangers
- **Refrigerant Charge levels**
- **Introduction of Leak/Refrigerant Detection System (LDS/RDS) for units above M1 Charge level (62.6 oz of refrigerant)**

Below M1 Limit	Above M1 Limit
YT 024-048	YT 060-072
WS 036-060	BS/BT & EAD
VS & VT	WS 072-084
ZS & ZT	WT 036-060
WV	

What is an RDS/LDS?

- **Refrigerant Detection Systems, also known as Leak Detection Systems, are sensors within units to identify when a leak has occurred**

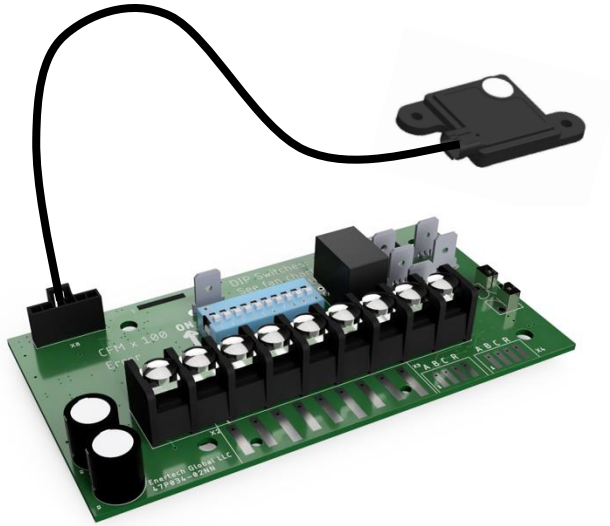
- **These systems, when activated, will shut-off the unit's compressor & electric heat and engage in mitigation mode**
  - Packaged system - Compressor & electric heat will reengage once sufficiently mitigated.
  - Split systems – Electric heat in the air handler can still activate in the case of a leak in the compressor section.

- **Mitigation works to disperse the leaked refrigerant to ensure that the Lower Flammability Level (LFL) of the refrigerant is not met**
  - LFL is the minimum concentration of a flammable gas that can combust

Enertech’s RDS Solution

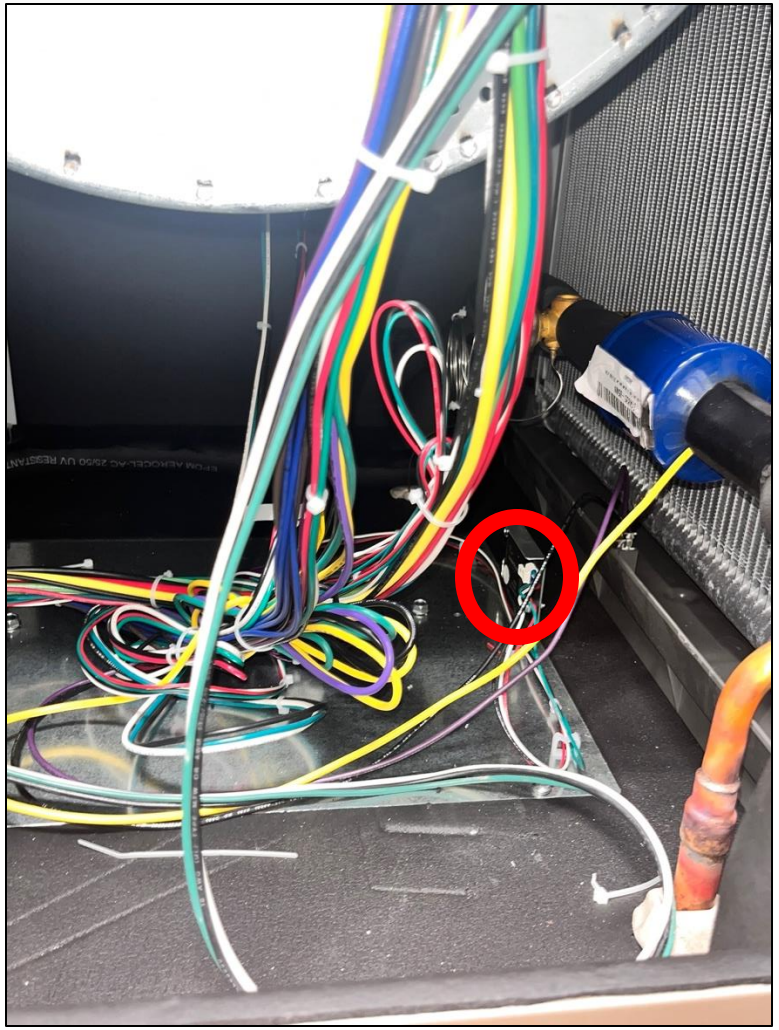
- Sensor(s) is installed within units above the M1 charge level.
- Upon sensing a leak reaching a DTLV (detection threshold limit value) of 10%, mitigation protocol is engaged.
- Sensor is connected to our ECM (fan controller) board.
- Mitigation protocol is activated in the event a sensor is disconnected or stops communicating

Refrigerant Detection System



RDS Sensor in YT Compressor Section

RDS Sensor in YT Blower Section



Mitigation in Packaged Systems and Air Handlers

YT 060-072, EAD

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Mitigation – Packaged & Air Handlers

- Units over M1 charge limit will contain a factory installed leak detection system

- In the event of a leak, RDS will shut down the compressor, disengage electric heat, and turn on the blower to dilute leaked refrigerant throughout conditioned space.

Mitigation – Packaged & Air Handlers Cont.

- Unit cannot be installed in a residence that does not have sufficient conditioned space
- Conditioned spaces are spaces with return and supply ducts.
- Bathrooms, closets, etc. should be excluded from the calculation.
- If the space the unit is installed in contains a return and supply duct, then it should be considered as part of the total conditioned space.

YT minimum space Requirements:

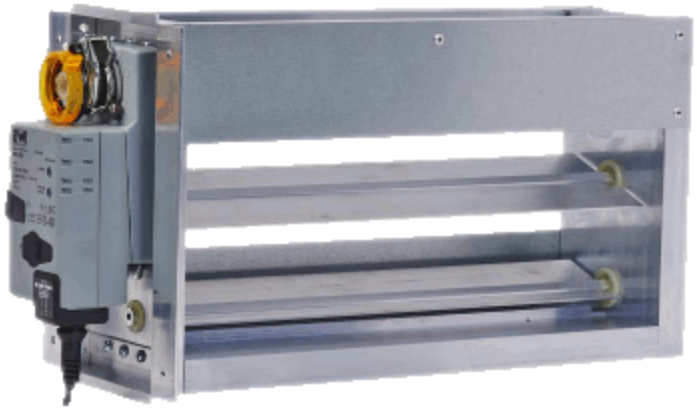
Unit	Total Charge (oz./ kg)	Room Height(s)			
		7.2ft/ 2.2m	8.0ft/ 2.4m	10.0ft/ 3.0m	12.0ft/ 3.7m
		Minimum Total Conditioned Space (ft^2/ m^2)			
YT024	52/ 1.5	N/A- Mitigation Not Required			
YT036	60/ 1.7				
YT048	60/ 1.7				
YT060	80/ 2.3	75.2/ 7.0	67.6/ 6.3	54.1/ 5.0	45.1/ 4.2
YT072	79/ 2.2	74.2/ 6.9	66.8/ 6.2	53.4/ 5.0	44.5/ 4.1

EAD minimum space Requirements:

Total Charge (oz./ kg)	Room Height(s)			
	7.2ft/ 2.2m	8.0ft/ 2.4m	10.0ft/ 3.0m	12.0ft/ 3.7m
	Minimum Total Conditioned Space (ft^2/ m^2)			
62 / 1.77 or less	N/A- Mitigation Not Required			
64/ 1.81	60.1/ 5.6	54.1/ 5.0	43.3/ 4.0	36.1/ 3.4
72/ 2.04	67.6/ 6.3	60.9/ 5.7	48.7/ 4.5	40.6/ 3.8
80/ 2.27	75.2/ 7.0	67.6/ 6.3	54.1/ 5.0	45.1/ 4.2
88/ 2.49	82.7/ 7.7	74.4/ 6.9	59.5/ 5.5	49.6/ 4.6
96/ 2.72	90.2/ 8.4	81.2/ 7.5	64.9/ 6.0	54.1/ 5.0
104/ 2.95	97.7/ 9.1	87.9/ 8.2	70.4/ 6.5	58.6/ 5.4
112/ 3.18	105.2/ 9.8	94.7/ 8.8	75.8/ 7.0	63.1/ 5.9
120/ 3.40	112.7/ 10.5	101.5/ 9.4	81.2/ 7.5	67.6/ 6.3
more than 120/ 3.40	Not Allowed- Max Charge is 120 oz./ 3.40 kg			

Zoning

- **When the unit enters mitigation mode:**
  - Blower section will be running
  - All thermostat terminals including R will be de-energized
  - Red LED on the ECM board flashing 1 time per second.



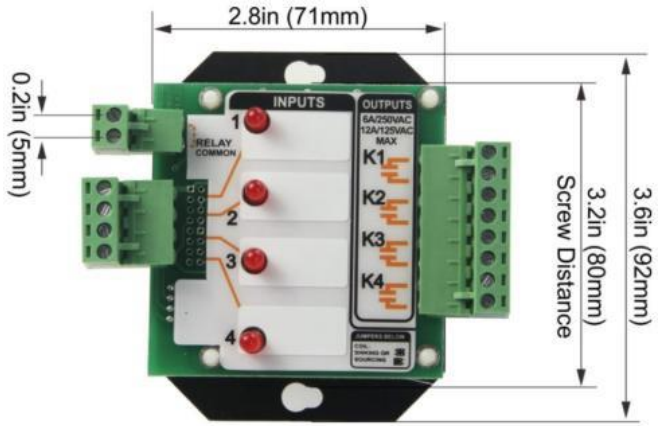
Zoning Scenarios

- **Spring Open Dampers:**
  - Zone controller can be powered from the transformer internal to our product, utilizing 24v supplied at field wiring connections.
  - During mitigation the zone controller will lose power, and all the dampers will spring open.
- **Input to Open All Dampers:**
  - NC (normally closed) relay should be energized by R from our product and used as a dry contact for the signal.
  - Zone controller MUST be powered by an external transformer, so it continues to have power when our product de-energizes R during mitigation.

Zoning Scenarios Cont.

- **No Input to Open All Dampers:**
  - Recommended relay board can be used to open all dampers by providing G calls to each zone individually.

MRB-4 Dimenson:



Electrostatic Air Filters

- **If installing a 24V electronic air cleaner supplied by Enertech:**
  - Air cleaner must get 24V supply from R and C on the geothermal unit's thermostat terminal strip.
  - If there is a leak or airflow falls too low:
    - R & C will be de-energized.
  - If the air cleaner uses 120V, a relay must be used to ensure that it is de-energized when R is de-energized.

Mitigation in Water-to-Water and Compressor Sections

WS 072-084, WT 036-060, BS/BT.

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Mitigation – W2W & Compressor Sections

- Units will contain a factory installed leak detection system/ mitigation kit.
- If the room area that the appliance is installed in is less than Amin, the mitigation kit must be ducted to the outside or to a space that meets the minimum room area requirements.
- If the room area is more than Amin, then it can be ducted into the space.

Mitigation – W2W & Compressor Sections Cont.

- The room area is defined as the area enclosed by the projection to the floor of the walls, partitions and doors of the space in which the appliance is installed.
- Spaces connected by drop ceilings, duct work or similar connection should not be considered a single space.
- Rooms on the same floor and connected by an open passageway can be considered a single room when determining the room area, if the passageway is a permanent opening, extends to the floor, and is intended for people to walk through.

Mitigation – W2W & Compressor Sections Cont.

- Unit installation height is a factor, as it affects the min. room area.
- Installed height is the distance from the floor to the bottom of the cabinet/appliance.
- leak detection system/mitigation kit will be supplied with a ventilation fan to exhaust any leaked refrigerant either outdoors or to another area that does meet the requirements for the minimum room area.
- If the exhaust is vented to another area, the exhaust duct height will determine the minimum room area of that space.

Unit	Total Charge (oz./ kg)	Installed Height			
		0.0ft/ 0.0m	3.0ft/ 0.9m	6.0ft/ 1.8m	9.0ft/ 2.7m
		Minimum Room Area (ft^2/ m^2)			
WT036	64/ 1.81	329.9/ 30.6	144.3/ 13.4	72.2/ 6.7	48.1/ 4.5
WT048	98/ 2.77	773.5/ 71.9	333.5/ 31.0	110.5/ 10.3	73.7/ 6.8
WT060	100/ 2.84	805.4/ 74.8	347.3/ 32.3	112.7/ 10.5	75.2/ 7.0

Altitude Adjustment Factor

- Altitude of the residence is a factor.
- Adjustment factors for units installed at an elevation over 600 meters (1969 ft).
- Minimum room area shall be corrected by multiplying by the altitude adjustment factor

Altitude Adjustment		
Altitude (H_{alt})		Adjustment Factor (AF)
m	ft	
0	0	1.00
200	656	1.00
400	1312	1.00
600	1969	1.00
800	2625	1.02
1000	3281	1.05
1200	3937	1.07
1400	4593	1.10
1600	5250	1.12
1800	5906	1.15
2000	6562	1.18
2200	7218	1.21
2400	7874	1.25
2600	8531	1.28
2800	9187	1.32
3000	9843	1.36
3200	10499	1.40

Mitigation Kit Installed on a BT Indoor Split

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Google Play Store

Apple Store

Installation Example(s)

- Water to Air Package Unit
  - YT060
    - Greenville, IL (540ft Elevation MSL)
    - 10ft ceilings
    - 2000 SqFt Conditioned Space

Apple Store

Google Play Store

Installation Example(s)

- Water to Air Package Unit
  - YT060
    - Greenville, IL (540ft Elevation MSL)
    - 10ft ceilings
    - 2000 SqFt Conditioned Space
  - Required Conditioned Space: 54.12 sq ft
    - Installation Authorized
    - No Additional Mitigation Required

Installation Example(s)

- Water to Water Package Unit
  - WT048
    - Wichita KS (1350 Ft Elevation)
    - 0 ft Installation Height
    - Installed in 800 SqFt basement

Apple Store

Google Play Store

Installation Example(s)

- Water to Water Package Unit
  - WT048
    - Wichita KS (1350 Ft Elevation)
    - 0 ft Installation Height
    - Installed in 800 SqFt basement
  - Required Installation Room Area: 773.47 sq ft
    - Installation Authorized without additional mitigation.

Installation Example(s)

- Split System
  - BT060
    - 98 oz 454B
    - Denver CO (5280 ft elevation MSL)
    - 4ft Installation Height
    - Installed in 200 SqFt Mechanical Room

Apple Store

Google Play Store

Installation Example(s)

- Split System
  - BT060
    - 98 oz 454B
    - Denver CO (5280 ft elevation MSL)
    - 4ft Installation Height
    - Installed in 200 SqFt Mechanical Room
  - Required Installation Room Area: 210 sq ft
    - Installation Requires Additional Mitigation

Best Servicing and Installation Practices

Best Servicing and Installation Practices

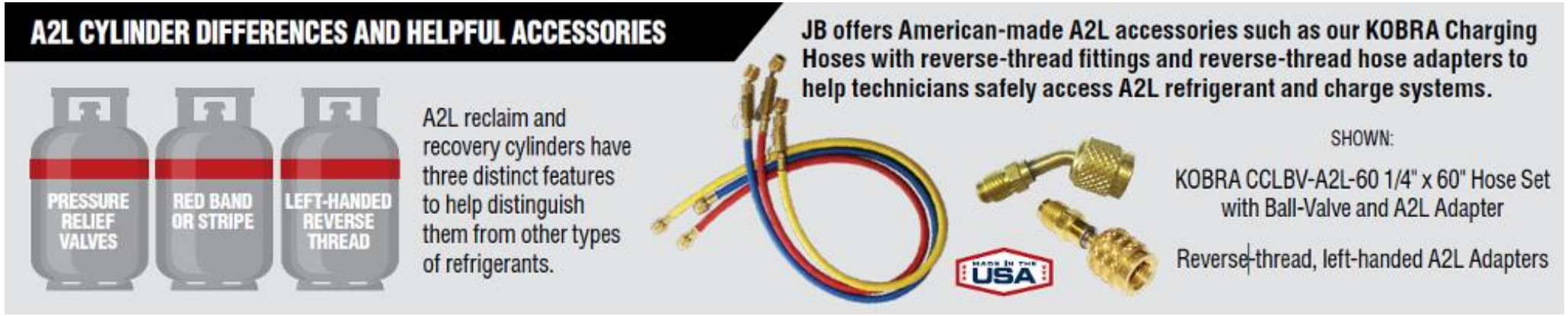
- Servicing the refrigeration system
  - A2L Sensors are quite sensitive to leaked refrigerant, it only takes a small amount for the RDS to activate.
  - If the RDS activates, the fan will turn on to exhaust the refrigerant. After the air is cleared, it will take 5 additional minutes for the unit to recover normal operation.
  - Once repairs or diagnostics have been completed, Remove gauges. If there is lingering refrigerant the RDS will turn on to exhaust the refrigerant.
  - Low Loss fittings for refrigerant gauges are recommended to limit the release of refrigerant while servicing.

Tools

- Most tools off the shelf are already up to A2L standards.
- Check with Manufacture model numbers and specification to confirm.
- Other tools that don’t touch refrigerant circuit such as non-electric hand tools, access valves, and core removal tools can be used for both A1 and A2L systems.
- Tools and equipment that must meet A2L standards
  - Manifold Gauges
  - Vacuum Pumps
  - Recovery Machines
  - Leak Detectors

A2L Cylinder Differences

- A2L reclaim and recovery tanks have 3 main distinct features to help distinguish them from other types of refrigerant.
  - Pressure relief Valves
  - Red Band or Stripe on the tank
  - Left-Handed Reverse Thread
- Enertech equipment has standard thread ¼" pressure taps.



FAQ

- **Is R-454B a drop-in replacement for R-410A?**
  - No. There is no drop-in replacement for R-410A
- **Can R-410A products still be installed after Jan. 1st, 2025?**
  - Yes, R-410Apackaged units have a 3-year sell through period. R-410A splits must be installed by Jan 1st, 2026.
- **How do I know when RDS is required?**
  - Unit charge amount, installation space, **check with local code officials**.
- **Will R-410A replacement components be available?**
  - Yes, there is no restriction on the sale or manufacturing of replacement components currently.

Q&A