NEW REFRIGERANTS & REGULATION UPDATES
Ralph Vergara
Regulatory Requirements Driving Change

- CFCs
  - Ozone
  - Global warming
  - Phase-out

- HCFCs
  - Ozone
  - Global warming
  - Phase-out

- HFCs
  - Ozone
  - Global warming

- HFOs
  - Ozone
  - Global warming

Montreal Protocol / Ozone Depletion Concerns
Kyoto Protocol / Global Warming Concerns

Simple Chemistry
Enhanced Chemistry
Advanced Molecules Development
+ Complex Chemistry

R12
R134a
R1234yf
• Final rule for 2015-2019 published October 2014
• Supply/demand gap needs to be filled by reclaim and channel inventory

R-22 allocation rights 57% lower in 2015 than 2014
What is SNAP?

The **Significant New Alternatives Policy (SNAP) Program** is EPA's program to evaluate and regulate substitutes for the ozone-depleting chemicals that are being phased out under the stratospheric ozone protection provisions of the Clean Air Act (CAA).

In **Section 612(c)** of the **Clean Air Act**, the Agency is authorized to identify and publish lists of acceptable and unacceptable substitutes for **class I** or **class II** ozone-depleting substances.

The Administrator has determined a large number of alternatives exist that reduce overall risk to human health and the environment. The purpose of the program is to allow a safe, smooth transition away from ozone-depleting compounds by identifying substitutes that offer lower overall risks to human health and the environment.

The SNAP program has reviewed substitutes for the following **industrial sectors**:

- Refrigeration & Air Conditioning
- Foam Blowing Agents
- Cleaning Solvents
- Fire Suppression and Explosion Protection
- Aerosols
- Sterilants
- Tobacco Expansion
- Adhesives, Coatings & Inks
## Summary of U.S. SNAP Regulation

<table>
<thead>
<tr>
<th>End Use</th>
<th>Delisted Products</th>
<th>Date of Delisting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supermarkets - New</td>
<td>R-404A, R-507 and 8 Other High GWP blends</td>
<td>January 1, 2017</td>
</tr>
<tr>
<td>Supermarkets - Retrofit</td>
<td>R-404A, R-507 and 7 Other High GWP blends</td>
<td>July 20, 2016</td>
</tr>
<tr>
<td>Remote Condensing Units - New</td>
<td>R-404A, R-507 and 8 Other High GWP blends</td>
<td>January 1, 2018</td>
</tr>
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<td>July 20, 2016</td>
</tr>
<tr>
<td>Stand-Alone Medium Temp Units – New - less than 2200 BTU/hour</td>
<td>R-404A, R-507, R-134a, R-410A, and 26 others</td>
<td>January 1, 2019</td>
</tr>
<tr>
<td>Stand-Alone Medium Temp Units – New - more than 2200 BTU/hour</td>
<td>R-404A, R-507, R-134a, R-410A and 26 others</td>
<td>January 1, 2020</td>
</tr>
<tr>
<td>Stand-Alone Low Temp Units – New</td>
<td>R-404A, R-507, R-407 Series, and 18 others</td>
<td>January 1, 2020</td>
</tr>
<tr>
<td>Stand-Alone – Retrofit</td>
<td>R-404a and R-507</td>
<td>July 20, 2016</td>
</tr>
<tr>
<td>Vending Machines - New</td>
<td>R-134a, R-404A, R-507, R-407C, R-410A and 15 more</td>
<td>January 1, 2019</td>
</tr>
<tr>
<td>Vending Machines - Retrofit</td>
<td>R-404A and R-507</td>
<td>July 20, 2016</td>
</tr>
<tr>
<td>Mobile Air Conditioning</td>
<td>R-134a</td>
<td>2021 Model Year</td>
</tr>
</tbody>
</table>

R-404A, R-507 and R-134a are the main targets
EPA list of Potential applications for next SNAP Rule

Change of Status EPA is Considering

- Change of listing status from acceptable to unacceptable
  - EPA thinking potentially later transition dates than in July 20\textsuperscript{th} final rule
  - End-uses based on stakeholder comments and EPA analysis
- Sectors and end-uses where safer alternatives may be available
  - Refrigeration and A/C
    - Chillers: e.g., HFC-134a, R-407C, R-410A
    - Refrigerated food processing and dispensing: e.g., HFC-134a, R-404A, R-507A
    - Household refrigerators and freezers: e.g., HFC-134a
    - Cold storage warehouse: e.g., HFC-134a, R-407C, R-404A, R-507A
    - MVAC: HCFC/HFC blends retrofit Light Duty vehicles
  - Rigid PU spray foam: e.g., HFC-134a, HFC-245fa, HFC-365mfc, HFC-227ea, methylene chloride, formic acid
  - Fire suppression: e.g., PFCs, SF\textsubscript{6}, HFC-23
EC’s Latest Proposal to Regulate HFCs

• Phase Down similar to R-22 (baseline, allowance system and phase-down schedule)

• Product Specific Controls for Centralised Commercial Refrigeration Systems
  – New systems: any HFC with a GWP > 1500, by 1 January 2019; or a blend that contains any HFC where that blend has a GWP > 1500, by 1 January 2019 (Still allowed: Solstice® N40)
  – New systems: any HFC with a GWP > 1000, by 1 January 2024; or a blend that contains any HFC where that blend has a GWP > 1000, by 1 January 2024 (Still allowed: blends in development)
  – Retrofits: the retrofit with: any HFC with a GWP > 2000, by 1 January 2019; or a blend that contains any HFC where that blend has a GWP > 2000, by 1 January 2019 (Still allowed: Solstice N40, Performax® LT)

| Potential Steps for HFC Reduction Schedule |  
|------------------------------------------|---|
| 2018                                     | 90% |
| 2023                                     | 65% |
| 2029                                     | 30% |
| 2035                                     | 15% |

R-404A, R-507, R-407A & others are targeted
Refrigerant Selection Criteria

Key Selection Criteria for New Installations and Retrofits

- **Superheat**: Need to protect compressors and ensure full use of refrigerating capacity.
- **Capacity**: Is there enough capacity to keep the food at required temperatures? Will the system have to run longer and reduce equipment life?
- **Efficiency**: How much does the refrigerant add to the total and peak power consumption of the system? (include all powered systems)
- **Mass Flow**: Higher mass flow means more refrigerant moving through the system. Different mass flow requires changes to TXV valves.
- **Oil Return**: Is refrigerant miscible with oil so that oil returns and protects the compressor?
- **GWP**: Lower is better. (possible future GWP tax)

**BEST REFRIGERANT CHOICE**
Why is Energy Efficiency Important?

- Cost of initial refrigerant charge
- Cost of leak gas over 20 years
- Cost of electricity over 20 years

97.50%

0.50%

2%
Decision-Making Criteria

- Low Global Warming Potential
- Zero Ozone Depletion
- Good Life Cycle Climate Performance in All Climates
- Recycling / Reclamation

- High Energy Efficiency over Operating Range
- Long Term Durability

- In Use, Storage, Transport
- Comprehensive Toxicology Testing
- Acceptable Flammability

- Low Capital Cost
- Low Operating Cost
- Better Cost v’s Alternatives
- Low System Maintenance
LCCP- Life Cycle Climate Performance

LCCP calculations account for global warming impacts due to direct greenhouse gas emissions associated with the energy consumption of the product. In applications such as domestic and commercial refrigeration and stationary and mobile air conditioning equipment with the lowest LCCP rating produces the lowest global warming impact.
The use of R448A (and even R407F) allows considerable reduction of environmental impact when retrofitting existing systems (~50%).

Among current DX technologies, distributed systems using R448A produce environmental impact similar to more sophisticated technologies (cascade and pumped CO2).
Looking Forward, Reduced/Low GWP Options
# Ultra-Low GWP® Refrigerants

<table>
<thead>
<tr>
<th>Examples of Applications</th>
<th>Current Product</th>
<th>Non-Flammable (ASHRAE A1)</th>
<th>Mildly Flammable (ASHRAE A2L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC, Vending, Refrigerators</td>
<td>HFC-134a GWP-1300</td>
<td></td>
<td>yf GWP&lt;1</td>
</tr>
<tr>
<td>Chillers, CO₂ Cascade Refrigerators</td>
<td>R-123 GWP-79</td>
<td>zd GWP=1</td>
<td>ze GWP&lt;1</td>
</tr>
</tbody>
</table>

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## Lower GWP ® Blends

<table>
<thead>
<tr>
<th>Examples of Applications</th>
<th>Current Products</th>
<th>N Series Reduced GWP Option Non-Flammable (ASHRAE A1)</th>
<th>L Series Lowest GWP Option Mildly Flammable (ASHRAE A2L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chillers, Medium Temp Refrigeration</td>
<td>HFC-134a GWP-1300</td>
<td>N-13 GWP&lt;600 (R-450A)</td>
<td>L-20-GWP&lt;300 (*R-444B)</td>
</tr>
<tr>
<td>Stationary AC, Refrigeration</td>
<td>HCFC-22 GWP-1760</td>
<td>N-20-GWP&lt;1000</td>
<td>L-40-GWP-200-300</td>
</tr>
<tr>
<td>Low-and Med-Temp Refrigeration</td>
<td>R-404A GWP-3943</td>
<td>N-40-GWP&lt;1300 (R-448A)</td>
<td>L-41-GWP&lt;600 (R-447A)</td>
</tr>
<tr>
<td>Stationary AC Applications</td>
<td>R-410A GWP-1924</td>
<td>L-41-GWP&lt;600 (R-447A)</td>
<td></td>
</tr>
</tbody>
</table>
R448A / R450A
® **R448A (R-448A)**

**R448A (R-448A) is the lowest GWP / A1 alternative to R-404A for existing R-404A equipment**

R448A is an *HFO blend* designed to replace R-404A in low and medium temperature refrigeration equipment such as supermarket fridge and freezer cases and transport refrigeration. The performance and properties of R448A have been calculated to closely match that of R-404A and R-22 for both new and retrofit applications.

- **Attributes**
  - Composition - R32 (26%) / R125 (26%) / R134a (21%) / R1234ze (7%) / R1234yf (20%)
  - Approved for Use by Major Compressor Manufacturers (Copeland / Bitzer ...)
  - Simple replacement / retrofit* of R-404A → Minor adjustment to settings
  - Significant Energy Savings over R-404A → Lower total cost of ownership
  - Improved Capacity v R-404A → Longer equipment life
  - Significant reduction in GWP (65%) → Reduced impact on environment
  - Performance proven in Supermarket trials and Laboratory Tests in EU and US

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Emerson – Supermarket Laboratory Results

*Lowest GWP, Best Performing A1 Alternative to R-404A*
**® R448A (R-448A)**

3rd Party Evaluations on Product Performance

Oak Ridge National Laboratory (US)

- Supermarket System Evaluation
  - Reduced compressor power by 3.7%
  - Increased refrigeration capacity by 7.5%
  - Increased system COP by 11.6%

- Condensing Unit Performance trial
  - Ambient tests at 90° & 110° C to JIS 8623 (std)
  - R448A showed 4-16% higher COP and excellent match in capacity

- Full ‘Mock-Up’ Supermarket Lab Trial
  - Tested on both Semi-Hermetic & Scroll
  - ‘R448A provides superior Energy Efficiency to that of R-404A with reduced GWP’

- Successful >16 months trial store comparison
  - Improved capacity and efficiency vs. R404A
  - Simple retro-fit with minimal system adjustment
  - Discharge Temp close to R404A level (no liq injection required on LT)

*R448A is well engineered refrigerant to meet requirement as an alternative to R404A*

*Also a good retro-fit option for R22*
R404 Replacement Overview

<table>
<thead>
<tr>
<th>R-404A Replacement (MT/LT supermarket and LT self-contained)</th>
<th>R-404A</th>
<th>R-407A</th>
<th>Performax LT R407F</th>
<th>Solstice N40 R448A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitor(s)</td>
<td>All</td>
<td>All</td>
<td>HON</td>
<td>HON</td>
</tr>
<tr>
<td>Capacity</td>
<td>100%</td>
<td>101%</td>
<td>104%</td>
<td>107%</td>
</tr>
<tr>
<td>Efficiency</td>
<td>100%</td>
<td>108%</td>
<td>113%</td>
<td>114%</td>
</tr>
<tr>
<td>GWP</td>
<td>3943</td>
<td>1923</td>
<td>1674</td>
<td>1273</td>
</tr>
<tr>
<td>Discharge Temperature (LT)</td>
<td>210</td>
<td>265</td>
<td>280</td>
<td>250</td>
</tr>
<tr>
<td>Glide</td>
<td>1.1</td>
<td>8.1</td>
<td>8.0</td>
<td>8.5</td>
</tr>
<tr>
<td>Equipment Modifications</td>
<td>n/a</td>
<td>Adjust valves</td>
<td>Adjust valves</td>
<td>Adjust valves</td>
</tr>
<tr>
<td>Equipment Modifications LT</td>
<td>n/a</td>
<td>add mitigation</td>
<td>add mitigation</td>
<td>add mitigation</td>
</tr>
</tbody>
</table>

- All candidates will require valve adjustments if retrofitting 404
- All replacements may require discharge temp mitigation in low temp applications
- All blends are only suitable for DX applications.
R404A to ® R448A (R448A) Retrofit

- Recover R404A using industry best practices (Green Chill Guidelines)
- Evaluate expansion devices
  - Most TXVs will need adjustment (close)
  - Input R448A curve into electronic TXVs
  - NI type TXVs will require adjustment kits
- Replace filter driers and oil system filters if required
- Evacuate and check for leaks, current leak detection equipment is suitable
- Charge the system with R448A, (+4%)
- Set controller to P-T curve of R448A
  - Set all operating controls/valves

No oil change required – R448A utilizes POE oil
R450A (R-450A)

R450A (R-450A) is the lowest GWP / A1 alternative to R-134a for existing R-134a equipment

R450A is an HFO blend designed to replace R-134a medium temperature refrigeration equipment such as ‘plug-in’ cabinets, supermarket cabinets and vending machines. The performance and properties of R450A have been calculated to closely match that of R-134a for new applications.

• Attributes Composition - R134a (42%) / R1234ze (58%)
  ✓ Approved for Use by Major Compressor Manufacturers (Copeland / Bitzer ...)
  ✓ Similar system operating characteristics as R-134a → easy-to-use /apply
  ✓ Improved COP at higher ambient temperatures → energy savings
  ✓ Maintain A1 category / non-flammable → ease of use
  ✓ Significant reduction in GWP (58%) → Reduced impact on environment
  ✓ Lower discharge temperature than R-134a → Longer equipment life
The target for R450A is both new and retrofit.
- New designs can increase displacement to offset capacity shortfall
- Completed supermarket retrofit of 134a to R450A in a medium temperature DX application shows efficiency increase over 134a.
- Most systems can accommodate capacity ~ 10%, evaluate prior.
- Same lubricant as 134a, minimal to no txv adjustment required.
- XP 10 0°F glide is of no advantage in DX systems.

<table>
<thead>
<tr>
<th>134A Replacement (MT supermarket and MT/LT self-contained)</th>
<th>R-134a</th>
<th>Solstice N13 R450A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitor(s)</td>
<td>All</td>
<td>HON</td>
</tr>
<tr>
<td>Capacity</td>
<td>100%</td>
<td>90%</td>
</tr>
<tr>
<td>Efficiency</td>
<td>100%</td>
<td>101%</td>
</tr>
<tr>
<td>GWP</td>
<td>1300</td>
<td>547</td>
</tr>
<tr>
<td>Discharge Temperature</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Glide</td>
<td>0</td>
<td>0.8</td>
</tr>
<tr>
<td>Equipment Modifications</td>
<td>n/a</td>
<td>Add capacity?</td>
</tr>
</tbody>
</table>
Summary & Conclusions

• HFO’s and HFO blends should be considered as part of the solution to transition away from High GWP refrigerants.

• There is no single refrigerant solution, application and selection criteria/market will determine final application of available solutions.

• Energy efficiency will always be a major factor in determining equipment/refrigerant design choice.

• System and refrigerant comparisons should be done scientifically using proper experimental protocols.

• True environmental performance should be considered when making refrigerant/system choices.
Retrofitting
Notes from the Field
Lubricant Issues when retrofitting

- R-22 is miscible with mineral oil over most of the commercial refrigeration and air-conditioning operating temperature range

- HFCs and HFC/Hydrocarbon blends are **not** miscible with mineral oil

- The addition of hydrocarbons to HFCs can increase solubility and assist the return of lubricant from evaporators. Liquid receivers do not benefit from this addition.
How important is miscibility?

Liquid receiver of a low temperature R22 refrigeration system using mineral oil.

An experiment was run to simulate a liquid flood back event and approximately 1/3 of the compressor lubricant left the crankcase.

Oil can be seen fully entrained in the liquid refrigerant, the lubricant left the receiver with the refrigerant and returned to the compressor.

Above: same liquid receiver using leading HFC/HC blend advertised as a drop in R-22 replacement. The lubricant is mineral oil.

The same experiment was run as for the R22 mineral oil experiment.

Oil can be seen floating on the surface of the liquid HFC. The hydrocarbon in this blend is not capable of duplicating the original HCFC/mineral oil relationship.

Lower than normal oil levels were measured in the compressor sump under these conditions.

Tested “Drop-ins” Using Hydrocarbons Did Not Duplicate R-22 / Mineral Oil Performance
• Seals and gaskets in the “O” Ring configuration must be changed when going from an HCFC to any HFC
  - The exposure of many elastomers to chlorine has created a set which will not be duplicated after converting to an HFC. This is a refrigerant issue, not a lubricant issue.
  - This includes:
    ▪ Schrader valves
    ▪ Receiver level indicators and alarms
    ▪ Heat reclaim and condenser splitting valves
• Fractionization of moderate glide blends in operating systems due to leaks has not materialized.
  - Proper charging of 400 series refrigerants mandates that only liquid be removed from the cylinder.
Fractionation of Blends during Leak Events

- Test System/Operating Leak events were simulated using a 0.1mm ID orifice and two scenarios:
  - System ON: 1) Vapor discharge line, 2) Middle of condenser (liquid-vapor)
  - System OFF: in the middle of the condenser (vapor while system OFF)
- Small refrigerant samples (4g each) were analyzed using Gas Chromatography.
# R448A Leak - Composition and Performance Results (Fractionation)

<table>
<thead>
<tr>
<th>R448A (R448A)</th>
<th>Description</th>
<th>Start</th>
<th>Vapor leak at suction line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (hours)</td>
<td>0</td>
<td>197.0</td>
<td></td>
</tr>
<tr>
<td>Charge (%)</td>
<td>100%</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
<td>-------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R32</td>
<td>26.0%</td>
<td>23.70%</td>
<td></td>
</tr>
<tr>
<td>R125</td>
<td>26.0%</td>
<td>25.57%</td>
<td></td>
</tr>
<tr>
<td>R134a</td>
<td>21.0%</td>
<td>22.90%</td>
<td></td>
</tr>
<tr>
<td>R1234yf</td>
<td>20.0%</td>
<td>20.77%</td>
<td></td>
</tr>
<tr>
<td>R1234ze</td>
<td>7.0%</td>
<td>7.06%</td>
<td></td>
</tr>
<tr>
<td>Performance before top-off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>100%</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>COP</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Performance after top-off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity (%)</td>
<td>N/A</td>
<td>99%</td>
<td></td>
</tr>
<tr>
<td>COP (%)</td>
<td>N/A</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

- Leak in the suction line with system OFF caused minor changes in composition, within 2%
- Capacity decreased less than 2% while COP was maintained during leakage
- Top-off with nominal R448A recovers composition and performance to the original values

If the charge is topped-off, composition and performance return original values
Setting TD controls for blends with glide

<table>
<thead>
<tr>
<th>Temp. (°F)</th>
<th>R22 Pressure</th>
<th>AZ-20 (410A) Bubble Pressure</th>
<th>AZ-20 (410A) Dew Pressure</th>
<th>404A Bubble Pressure</th>
<th>404A Dew Pressure</th>
<th>Performax LT (407F) Bubble Pressure</th>
<th>Performax LT (407F) Dew Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>106</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>114</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Do not forget to update the P-T curve on your controller

Average pressure = (287+257)/2 = 272 psig

Always use the average when setting up EPR’s and Fan Controls
Condenser Sizing

- Condenser sizing is typically carried out using TD based on dew point temperature.
- For a blend with glide, however, design TD should be based on the average coil temperature. (bubble and dew points)

While sizing a condenser for a blend, design TD should be based on the average coil temperature (average of bubble and dew points) and not solely on dew point.
### Fractionation of Blends during Leak Events

<table>
<thead>
<tr>
<th>Description</th>
<th>Time (hours)</th>
<th>Start</th>
<th>Vapor leak at discharge line</th>
<th>Two-phase leak in the middle of the condenser</th>
<th>Slow Vapor leak in the middle of the condenser</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (hours)</td>
<td>0</td>
<td>26.7</td>
<td>22.1</td>
<td>20.3</td>
<td></td>
</tr>
<tr>
<td>Charge (%)</td>
<td>100%</td>
<td>82%</td>
<td>78%</td>
<td>79%</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R32</td>
<td>30%</td>
<td>31.8%</td>
<td>28.3%</td>
<td>29.2%</td>
<td></td>
</tr>
<tr>
<td>R125</td>
<td>30%</td>
<td>30.0%</td>
<td>28.0%</td>
<td>29.8%</td>
<td></td>
</tr>
<tr>
<td>R134a</td>
<td>40%</td>
<td>38.2%</td>
<td>43.7%</td>
<td>41.1%</td>
<td></td>
</tr>
<tr>
<td><strong>Performance before top-off</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>100%</td>
<td>102%</td>
<td>96%</td>
<td>99%</td>
<td></td>
</tr>
<tr>
<td>COP</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td><strong>Performance after top-off</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity (%)</td>
<td>N/A</td>
<td>101%</td>
<td>97%</td>
<td>99%</td>
<td></td>
</tr>
<tr>
<td>COP (%)</td>
<td>N/A</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

If the charge is topped-off, composition and performance return original values.
Resources
Genetron Properties Software

Input Cycle

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Option</th>
<th>Unit</th>
<th>Value</th>
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<tbody>
<tr>
<td>Refrigerant</td>
<td>R404A</td>
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<tr>
<td>Project Description</td>
<td>Low Temperature Refrigerant</td>
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<td>Compressor</td>
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<td>Volumetric Efficiency</td>
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<tr>
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<tr>
<td>Pressure Change</td>
<td>Drop Of Saturation</td>
<td>°F</td>
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<td>Condenser</td>
<td>Condensing Temp</td>
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<tr>
<td>Temperature Setting</td>
<td>Outlet Subcooling</td>
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<tr>
<td>Pressure Setting</td>
<td>Pressure Drop</td>
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<tr>
<td>Liquid Line</td>
<td>Temperature Change</td>
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<tr>
<td>Pressure Change</td>
<td>Drop Of Saturation</td>
<td>°F</td>
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<tr>
<td>Evaporator</td>
<td>Evaporating Temp</td>
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<tr>
<td>Temperature Setting</td>
<td>Outlet Superheat</td>
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<td>10.08</td>
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<td>Pressure Setting</td>
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<td>Suction Line</td>
<td>Temperature Rise</td>
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<tr>
<td>Pressure Change</td>
<td>Drop Of Saturation</td>
<td>°F</td>
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</tr>
</tbody>
</table>
There’s an App for that!

Select Current Genetron Refrigerant

HFO-1234yf  R-23  R-134a  R-245fa

Simply scroll to the Genetron refrigerant you’re using, tap on it, and you’ll get all the information you need about that refrigerant.
QR info for App
Supermarket Calculator

Use this calculator to compare the difference in energy consumption, annual energy savings, and payback time between Honeywell Genetron Performax LT and R-407A. You can also schedule a detailed analysis with a Honeywell representative.

Results
Estimated Annual Genetron Performax LT Energy Savings: $3,970
Estimated Payback: Genetron Performax LT vs. R-407A: 0.8 Years
One-Stop Resource Shop

Resources

Home > Resources

Browse & Download
- All Retrofit Resources
- All Software and Apps
- All Technical Brochures
- All Solstice™ Resources
- All Case Studies
- All Videos and Webinars
- Pressure Temperature Charts

What's New in the Refrigerants Resource Center
- Refrigerant modeling software
- Genetron 407C One-Page information Sheet
- Mise a niveau Systemes de refrigeration et climatisation au R-22
- Guide to retrofitting A/C systems from R-22 to R-422D or R-407C

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Retrofit Guidelines

Honeywell Genetron® Refrigerants

HCFC Air Conditioning Retrofit Guidelines

HCFC-22 to: Genetron 407C
Genetron 422D

Honeywell Genetron® Refrigerants

HFC Retrofit Guidelines

HFC-404A & HFC-507 to: HFC-407F
Genetron® Performax™ LT
Questions?

Genetron Refrigerants Technical Service
1-800-631-8138

www.honeywell-refrigerants.com

Ralph.vergara@honeywell.com

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Thank you!
BACK UP
Commercial Refrigeration
## Centralized DX System

![Diagram of Centralized DX System]

### Features
- Compressor rack in machine room far from cases
- Long connecting lines

### Pros
- Convenient installation in most buildings – in common practice
- Very familiar to store owners and contractors

### Cons
- Larger refrigerant charge
- Higher leak rates

### Current
- R22
- R404A
- R407A
- R407F

### Future
- R448A
Distributed DX System

**Features**

- Condenser in rooftop and compressor at store level closer to cases
- Short connecting lines

**Pros**

- Lower refrigerant charge (about 1/2 of centralized systems)
- Lower leak rates since condensing units are factory assembled
- Potentially more efficient than centralized – better match of suction groups, shorter lines

**Cons**

- Not always feasible in some buildings

**Current**

R404A
R407F
R407A

**Future**

R448A
# Secondary Loop System

**Features**
- Secondary fluid (CO2 or glycol) distributed to the cases
- Short connecting lines on the refrigerant side

**Pros**
- Lower refrigerant charge (about 1/4 of centralized systems)
- Very low leak rates
- Refrigerant confined in machine room may allow mildly flammable options with very low GWP

**Cons**
- Compressor can operate at lower pressures leading to higher energy consumption, also adds pumping power

<table>
<thead>
<tr>
<th>Current</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>R404A R407F 134a</td>
<td>R448A L40 R450A</td>
</tr>
</tbody>
</table>

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## CO2 Cascade Systems with Secondary Loop

**Features**
- Secondary fluid (glycol) for medium temp cases
- DX CO2 for the low temp cases
- Short connecting lines on the refrigerant side

**Pros**
- Very low refrigerant charge
- Very low leak rates
- Refrigerant confined in machine room may allow mildly flammable options with very low GWP
- Higher efficiency

**Cons**
- Higher initial cost

**Current**
- R404A
- R407F
- R134a

**Future**
- R448A
- L40
- R450A
- R1234ze