

The DAIKIN logo is in blue, bold, italicized capital letters. Below the text is a graphic element consisting of a black triangle on the left and a blue triangle on the right, both pointing towards the top right corner.The McQuay International logo features the word "McQuay" in a green, bold, sans-serif font with a registered trademark symbol. Below it, the word "International" is written in a smaller, white, sans-serif font inside a green rectangular box.

# Scroll Chillers – Transition from HCFC-22 to HFCs

An HVAC Manufacturer's Perspective

**Todd Brown**

**McQuay International**

Business Development Manager – Chillers

[todd.brown@mcquay.com](mailto:todd.brown@mcquay.com)

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# Agenda

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- HCFC-22 Alternatives for Scroll Chillers
  - Zeotropes/azeotropes
  - Lubricants
  
- Manufacturing/Production Challenges
  - Making the transition
  - Factors affecting cost

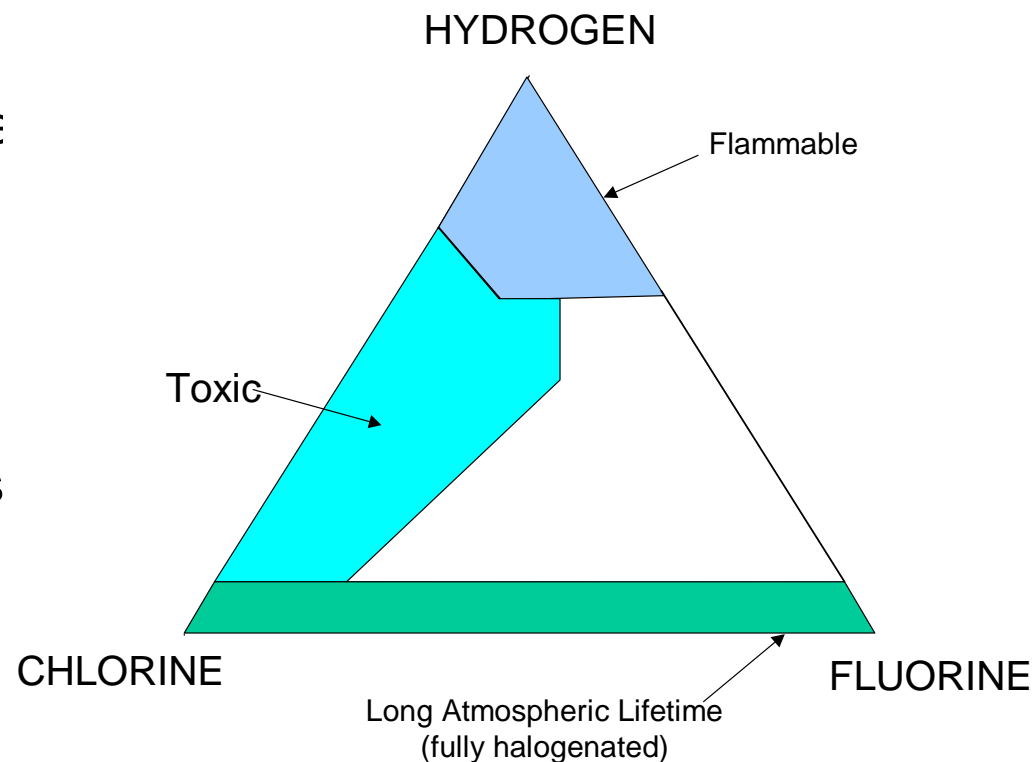
# Refrigerant Chemistry And HCFC-22 Alternatives

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- Only A Small Number Of Chemicals Can Meet Refrigerant Requirements
- Fluorocarbons Are Among The Best
- Many Other Groups Have Been Investigated But They Have Been;
  - Toxic
  - Flammable
  - Poor Performers

# Fluorocarbons

- HCFCs and HFCs
- Limited Combinations
  - Adding Chlorine Or Bromine Increases ODP
  - Adding Fluorine Increases GWP
  - Adding Hydrogen Increases Flammability

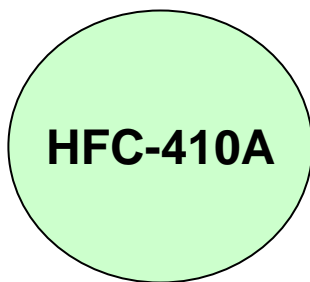


# HCFC-22 Alternatives

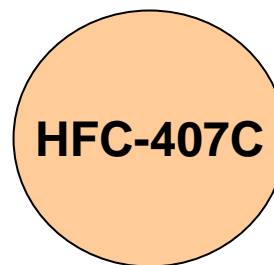
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- Identified by Alternative Refrigerant Evaluation Program (AREP)
  - Industry backed program of major refrigerant suppliers and manufacturers

## Major Scroll Chiller Candidates



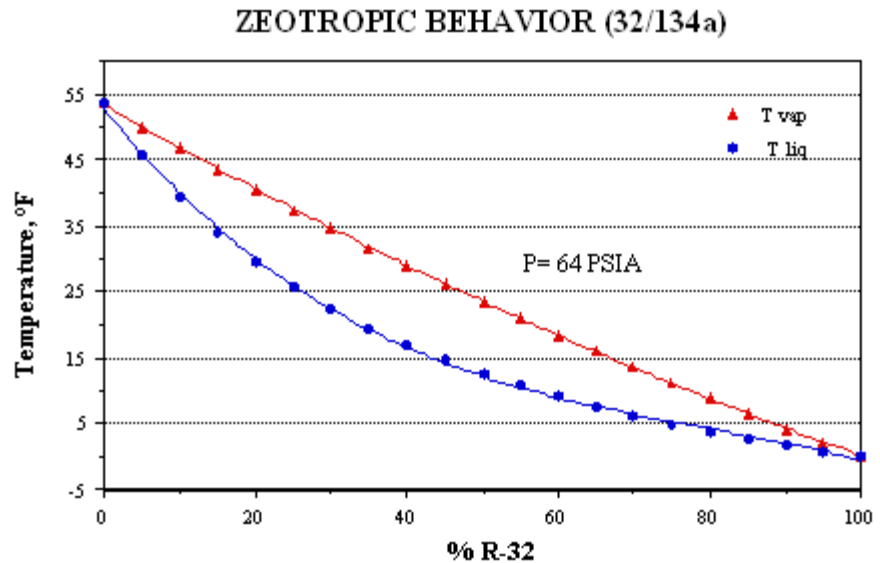
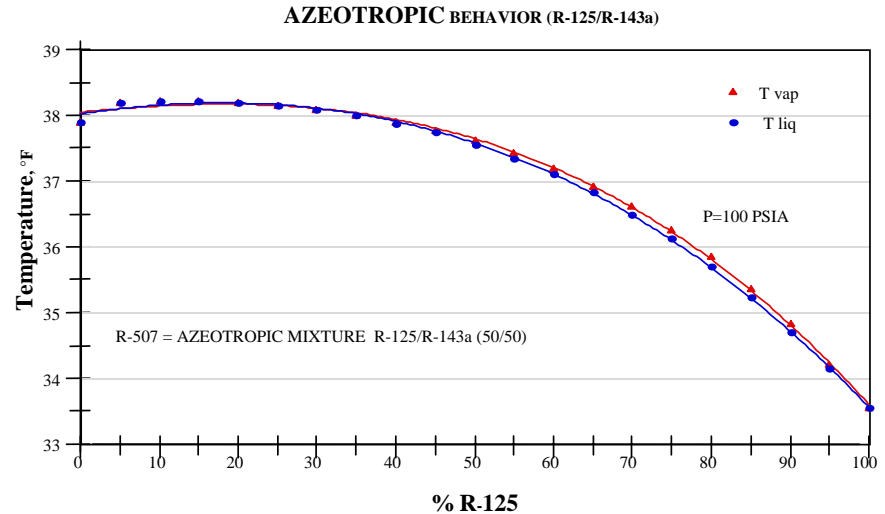
**Zeotropic Blend  
HFCs 32(50%),  
125(50%)**



**Zeotropic Blend  
HFCs 32(23%),  
125(25%), 134a(32%)**

# Blends

- Mixture Of Two Or More Refrigerants
- Near Azeotropic
  - Components Behave As One Refrigerant
  - R-410A
- Zeotropes
  - Changed Saturation Temperature As It Boils (Glide)
  - R-407C



# Major Scroll Chiller HCFC-22 Alternatives

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	<u>Azeotrope</u>		<u>Zeotropic</u>
Refrigerant	134a	407C	410A
Capacity	67%	95%	141%
Efficiency	95-97%	95-101%	102-105%
Suction Press, abs	59%	91%	159%
Cond Press, abs	68%	115%	157%

# R-407C

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- Zeotropic Mixture
  - 23% HFC-32
  - 25% HFC-125
  - 52% HFC-134a
- 8F (4C) Glide
- Drop in replacement for R-22 (change the oil though!)
- Great solution when there's no time to redesign equipment
  - Save money by not redesigning
- A1 Refrigerant (ASHRAE Standard 34)
- Must be liquid charged to ensure proper mixture



# R-410A

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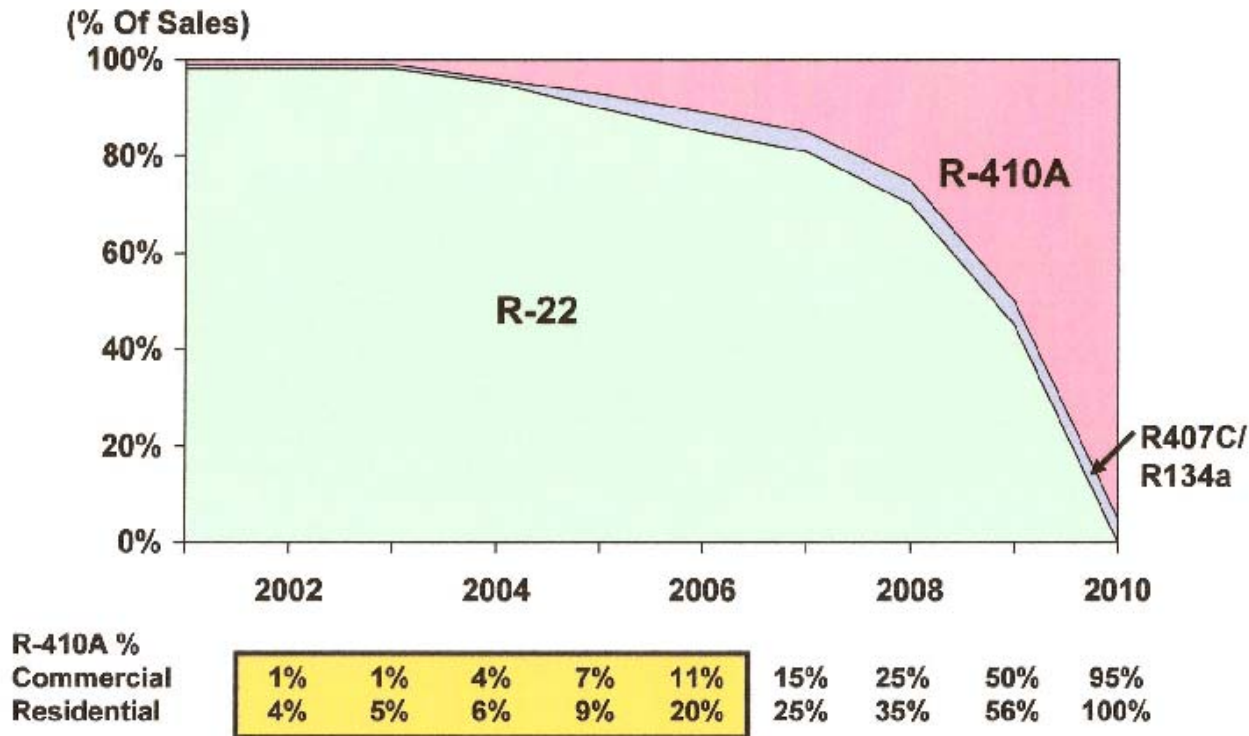
- Zeotropic Mixture
  - 50% HFC-32
  - 50% HFC-125
- 1F (0.5C) Glide
- Higher operating pressure (50% higher than R-22)
  - Requires new system design
  - More robust equipment = less leaks
- A1 refrigerant
- Properties
  - High heat transfer
  - Lower pressure drop
  - Reduced refrigerant charge



Higher Efficiency!

# What Others Are Saying?

## A/C Refrigerant Trends – North America Systems To 100 Tons

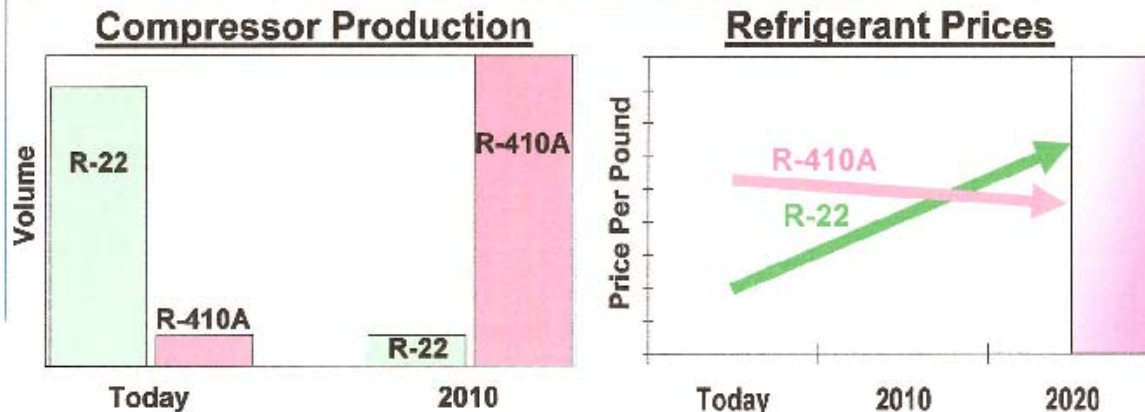


Karl Zellmer  
 Vice President of Sales  
 Emerson Climate Technologies  
 September 26, 2007

# What Are Others Saying?

## *End-Users Predominantly Buying R-22*

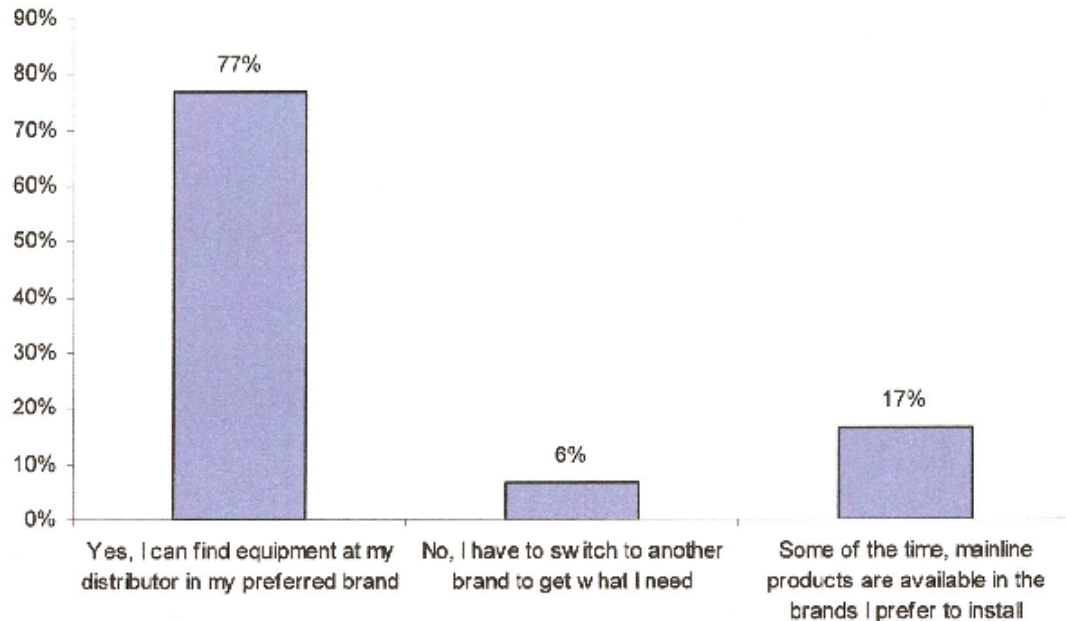
- Majority Of End-Users Are Still Buying R-22 Systems
- These Systems Will Be Phased-Out In 2 Years!
- R-22 Service And Maintenance Costs Will Only Increase
  - Expect Service Refrigerant **Availability** And **Cost** Issues
  - Expect Service Compressor **Costs** To Climb



Karl Zellmer  
Vice President of Sales  
Emerson Climate Technologies  
September 26, 2007

# What Are Others Saying?

*Is it easy to find systems with R-410A that meet your needs?*



**Contractors Not Having Trouble Finding R-410A Systems**

**Karl Zellmer**  
**Vice President of Sales**  
**Emerson Climate Technologies**  
**September 26, 2007**

# For Scroll Chillers R-410A Is U.S. Industry Choice

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- Best Long-Term Solution
  - Best Proven Performance & Reliability (11 Years)
  - No Ozone Depletion
  - 2-5% Higher EER
  - No Fractionation / Glide (Service)
  - Cost Optimization (Less Copper / Less Charge)
  - Systems Available
  - Enhanced Reliability
  - Future Compressor Enhancements

# Lubricants

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- Lubricants are picked for their miscibility with a refrigerant
- Mineral Oil
  - used with R-22
- Polyolester (POE)
  - Used with R-410A and R-407C
  - Good thermal stability
  - Good lubricity
  - Compatible with material
  - Excellent solvent
  - Will absorb moisture

# Polyolester Maintenance Notes:

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- Since POE will absorb moisture from the air
  - Keep POE containers sealed at all times
  - Do not leave compressors or systems open to the air for over 15 minutes
  - System must be vacuumed to at least 500 microns
  - Some moisture may be removed using filter dryers
- Make sure technicians are trained for the new refrigerant and the new lubricant



# Transitioning to HFC's

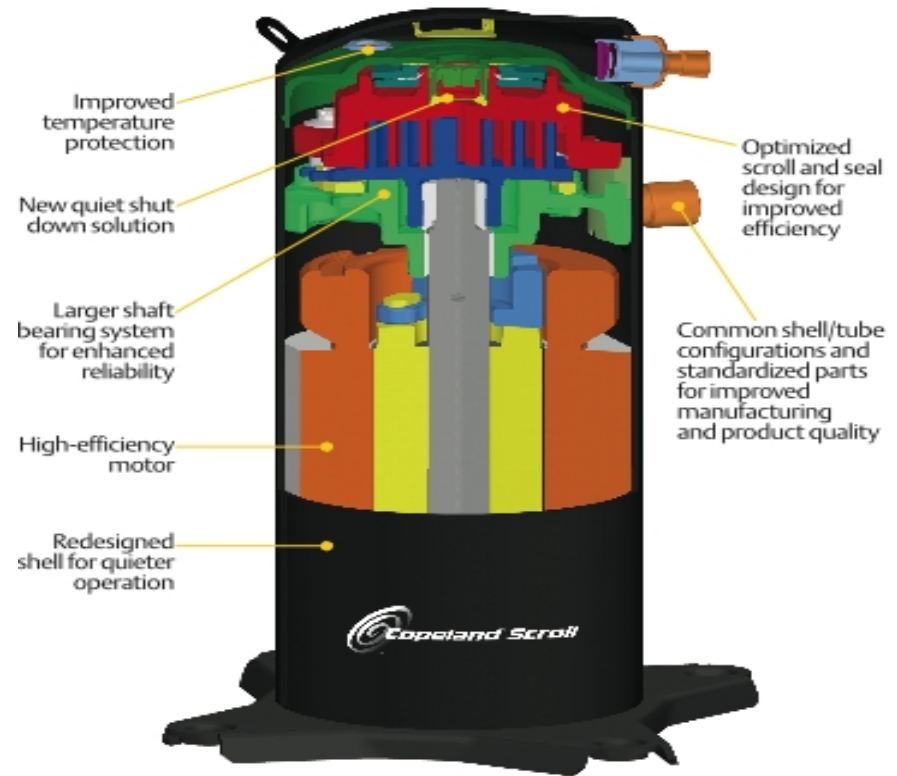
- Most companies are still transferring technology to HFC's
- Transferring is occurring through
  - Introducing R-410A on small scale or pilot production
  - Gradually reduce R-22 and increase R-410A production
  - Use R-407C for immediate change over
- Training is required throughout the process





# Factors affecting cost in moving to HFC's

- R-410A: 10 to 15% more costly
  - Higher operating pressure, thus equipment needs a redesign
  - Thicker compressor shell, heavier wall tubing, superior control and protection
  - Better welds required
  - Better efficiency of refrigerant does allow less copper to be used in heat exchanger
  - 25-30% reduction in refrigerant charge
- R-407C drop in for R-22
  - No need to redesign



# Summary

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- R-410A has some advantages over R-407C
  - Though R-407C does not require a redesign of equipment
  - Need to get the oil out
- Most manufacturers (US) are almost totally transitioned from HCFC refrigerants to HFC refrigerants.
- All manufacturers are considering new technology to achieve global climate objectives.

# Is there a permanent solution?

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- Quick answer
  - Not yet
  - Everyone wants a different answer
- The good news?
  - We are learning about problems at a much quicker rate and making changes faster
- Innovations
  - On a component basis
  - On a refrigerant level
  - On a systems level

# Questions or Comments?

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