



2004 SAE Alternate Refrigerant Symposium

Welcome To A Few Challenging Days In The Desert

- **Technical Presentations**
- **Vehicle Rides**
- **Technical Workshops**



And For A Start !!



2004 The Mobile A/C Industry

- **Where Has It Been?**
- **Where Is It Going?**

June 29, 2004



First Phoenix Alternate Refrigerant Forum

July 15 - 18, 1998 Scottsdale, Arizona

75 Attendees

29 Companies

Government

University

Industry Association



Since 1999 Hotel Facility Size Has Limited Attendees To 225/230



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The Ride



The Work [CO₂ CHARGERS]



The Fun



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1998 Meeting Issues To Resolve Prior To Mass Production

- **Performance**
 - Ability to Provide Comparable “Comfort”
 - Efficiency - Energy Usage (Climate Dependent)
 - Energy Use Over Full Range of Evaporator Loads
- **Environmental Benefit - TEWI (Now LCCP)**
 - Direct GW Impact (Refrigerant Emissions)
 - Indirect GW Impact (Fuel Emissions)
- **Safety**
- **Reliability**
 - Refrigerant Containment
 - Materials Compatibility
 - Noise & Vibration
- **Costs**
 - Capital (Tooling, etc.)
 - Incremental (Parts Cost)
 - Operational (Customer Costs to Operate)
- **Serviceability**



Cooling Demand

- **Consumer Expects Comfort When Weather Is Hot**
 - **Must Consider Performance and Real Energy Requirements**
 - **Summer Weather Loads - Not Annual Weather Loads**
 - **Summer of 2003 European's Used Their A/C Equipped Vehicles For Sleeping**
- **Consumers Acceptance of New Vehicles**
 - **May 2004 U.S. Gulf States Customers**
 - **Unhappy With Scion XB Cooling**
- **Will Small Vehicles and Hybrids Have Reduced Cooling?**
 - **Like Seen In Prior Phoenix Vehicle Surveys**



“Relative Cooling Value” (no solar load)

- Use of annual average weather conditions do not reflect expected A/C system “Real World” energy requirements [Including Daytime Soak Conditions]
 - Mobile A/C systems must:
 - Provide occupant comfort when cooling demand is required
 - Be energy efficient when high RCV demands are encountered
- Phase I SAE ARCRP 4 test load requirements covered July RCV [no solar requirements] for typical international cities



“Relative Cooling Value” (no solar load)

Relative Cooling Value (RCV)

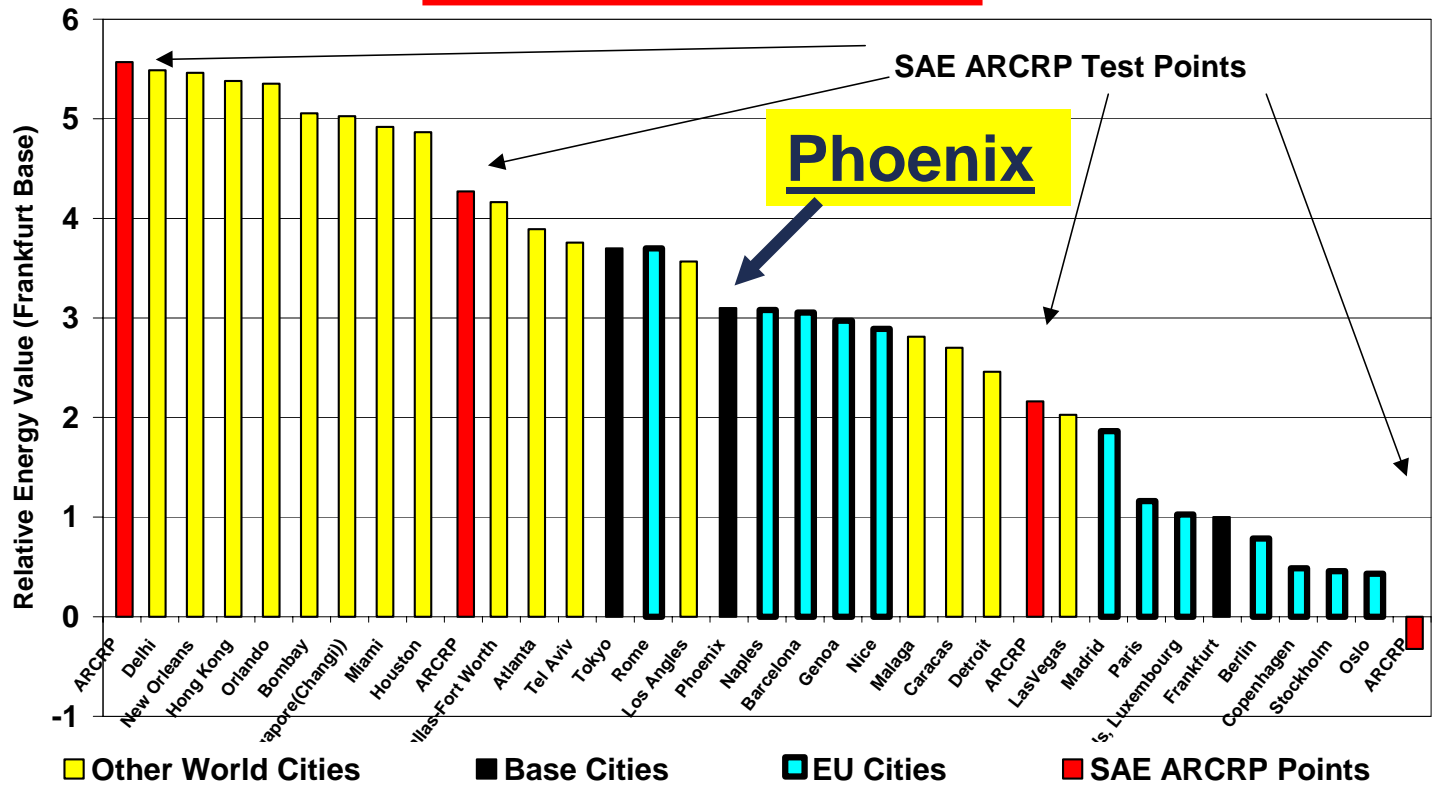
System Cooling Requirements To Provide Occupant Comfort

- Enthalpy of the initial heat load [Air] of a soaked vehicle or operation of the system on outside air
- Cooling capacity to achieve in vehicle air Enthalpy at 22 C x 40% A/C for comfort



Cooling Demand

**World Cities July Cooling Requirements
Not Including Solar Heating**



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6 Years Later!

1998 Commercialization Issues Still Unresolved

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Unresolved in Yellow



Replacement Refrigerant Issues

- **Safety For**
 - **Vehicle Occupants**
 - **Manufacturing Personnel**
 - **Service Personnel**
- **System Lifetime Compared to HFC-134a**
 - **Refrigerant Containment**
 - **Cost For Additional Recharges**
 - **System Refrigerant Charge Sensitivity**
 - **City traffic - Idle and Acceleration Requirements**
 - **Component Durability**



Replacement Refrigerant Issues

- **Compared To HFC-134a Systems**
 - System Costs
 - System Total Weight
 - Complexity Of Refrigerant Control System
 - Energy Requirement
 - When Consumer Expects Cooling In Hot Weather
- **Manufacturing Complications [Vehicles For Different Markets]**
 - Meeting EC Requirements
 - Exporting To Other Countries [Infrastructure costs]
- **Providing Dealers And Service Industry**
 - Required Service Equipment
 - Technician Training
 - Availability of Replacement Parts



The Challenge

- **Can A Replacement Refrigerant Be Commercialized In Time To Meet The European Time Table?**

