



# Development of Improved R134a Refrigerant System

Jan Xu  
Jay Amin

Climate Control  
Visteon Corporation

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# Introduction

- **Reduce R134a Direct Emission**

- Reduce R134a leakage
- Reduce Refrigerant Charge

- **Reduce R134a Indirect Emission**

*(indirect emission of carbon dioxide attributed to the power required for running the mobile air conditioning system)*

- Reduce system power consumption/increase system efficiency

# R134a Direct Emission Reduction



- **Reduce R134a Leakage**
  - Low permeation hose reduces R134a permeation by 78%
  - Full flow P-nut fitting reduces R134a leakage by 88% (compare to P-nut fitting)
  
- **Refrigerant Charge Reduction**
  - Reduce charge 18% (28 oz v.s. 34 oz)
  - Due to
    - Integrated R/D Subcool Condenser
    - Extruded tube evaporator
    - TXV

# Power Reduction and COP Increase



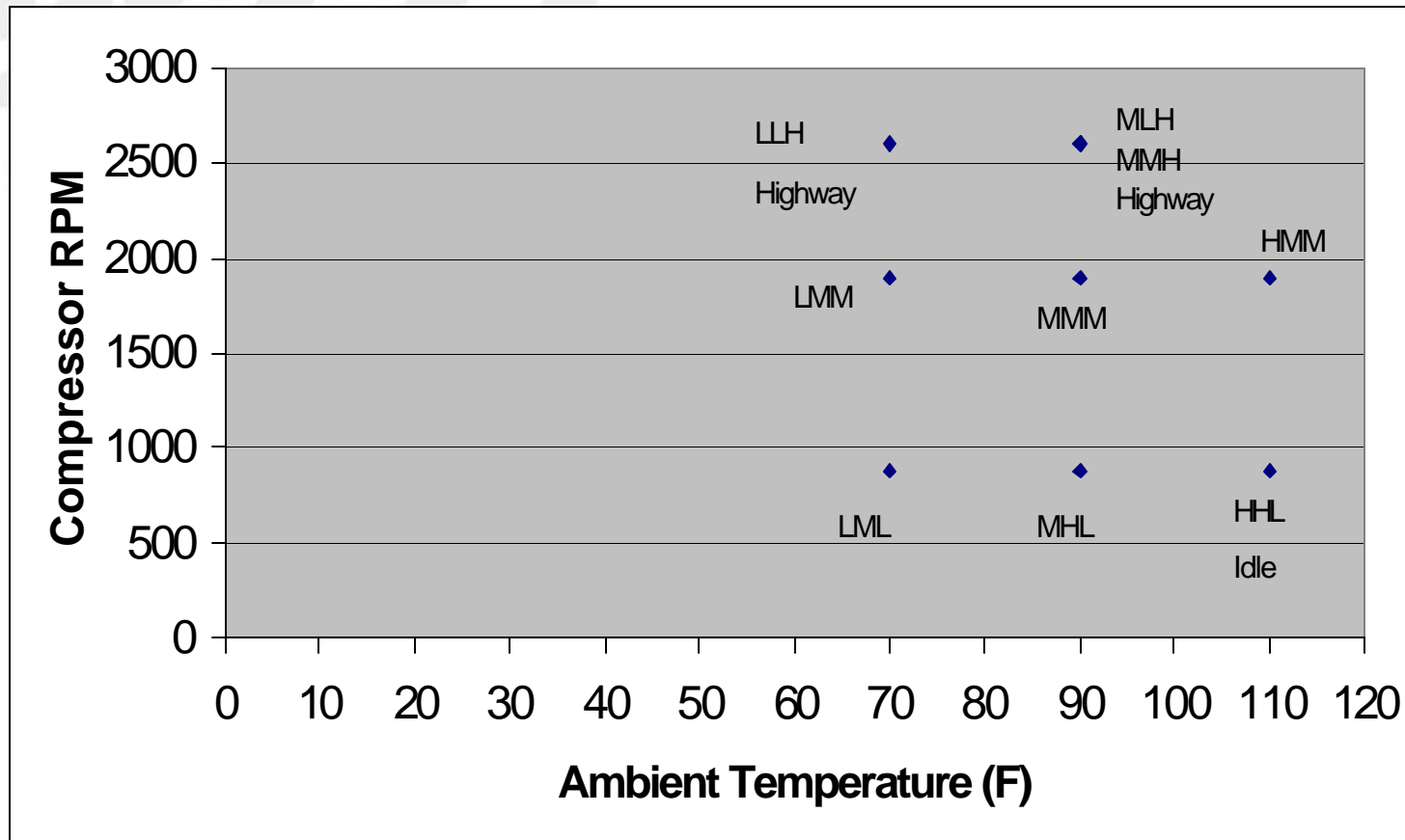
- **System Comparison**

| <b>Components</b> | <b>Baseline System</b> | <b>Improved R134a (iR134a) System</b> | <b>Comments</b>   |
|-------------------|------------------------|---------------------------------------|-------------------|
| Compressor        | 170 cc swash-plate     | Variable displacement                 |                   |
| Condenser         | 6mm plate-fin          | Integrated R/D sub-cool               | Same surface area |
| Evaporator        | 90mm plate-fin         | 50mm extruded tube evaporator         | Same surface area |
| Expansion Device  | Orifice tube           | 1.5 ton cross-charge TXV              |                   |

# Power Reduction and COP Increase



- System Testing Conditions



# Power Reduction and COP Increase



- **System Testing Results**
  - Weighting Factors For Annual AC Usage

| Condition | HHL   | MHL   | LML  | HMM   | MMM   | LMM   | LLH   | MLH   | MMH   |
|-----------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| Factor    | 0.187 | 0.187 | 0.12 | 0.062 | 0.062 | 0.044 | 0.083 | 0.129 | 0.129 |

- Average Power Consumption and COP

| System   | Cooling (Btu/hr) | Cooling % | HP   | HP % | COP  | COP % |
|----------|------------------|-----------|------|------|------|-------|
| Baseline | 12275            | base      | 2.78 | base | 1.73 | base  |
| IR134a   | 11323            | -7.8%     | 1.95 | 30%  | 2.28 | 32%   |

