

FACTS

Cooperative Research Program

Project Summary Alternative Refrigerants

Purpose

With the emergence of new and uncertain worldwide environmental regulations governing the use of HFC 134a in vehicle air conditioning (A/C) systems, as used throughout the global automotive industry, the supply chain was faced an extraordinary challenge. As changing regulations would likely cause new designs and systems to be adopted, this was to impact significantly the investment in research, design, development, and testing of new systems.

The issue was one faced by many organizations making it a candidate for a joint venture research projects where two or more organizations pool their resources to study a pre-competitive technical area and share in the results. SAE was looked to for its Cooperative Research Program capabilities and for its leadership role in mobile A/C standards.

Project Scope

The full effort consisted of three research projects (I-MAC, CRP150, and CRP1234yf), as described below, to optimize current HFC 134a based systems and to test and evaluate new alternative refrigerant systems.

I-MAC

The I-MAC (Improved Mobile Air Conditioning) project was divided into three undertakings, each to conduct studies and testing to develop and prove out design concepts that would:

- Cut emissions of HFC134a in mobile A/C systems by 50%
- Improve efficiency of HFC134a systems by 30%
- Reduce vehicle heat loads by 30%

CRP150

The CRP 150 project investigated four viable alternative refrigerants to HFC134a with a Global

Warming Potential of less than 150 to provide test results that would aid participants in future design and business decisions. The research and testing was carried out in three phases:

- Toxicology and risk assessments
- Chemical and material compatibility
- System efficiency issues

CRP1234yf

As a result of the CRP150 project findings, a new candidate refrigerant HFO1234yf was developed and presented an alternative. This new refrigerant received the same toxicology and risk, chemical and material compatibility, and system efficiency testing protocols developed in the CRP150 project. A work-in-progress, testing of HFO1234yf continues through the fourth quarter of 2008.

Participants

Invited for participation were OEMs from the USA, Europe, Japan, Korea and India, air conditioning component suppliers, chemical manufacturers who supply refrigerant products and environmental government agencies such as the US EPA. On the following page is a list of participants for each project, I-MAC, CRP150, and CRP1234yf.

Role of SAE

Project management

- Provide a legal framework for industry discussion, meeting space and meeting facilitation
- Establish project milestones and schedules
- Provide oversight to ensure confidentiality of proprietary information
- Develop, execute and monitor strict non-disclosure agreements and procedures; code test results and components

Continued

Alternative Refrigerants (cont'd.)

Project Participants

Company/ Organization	I-MAC	CRP150	CRP1234yf
Air International Thermal	-	●	-
Arkema	●	-	-
Audi	●	●	-
Behr	●	-	-
Bergstrom	-	●	-
BMW	●	●	-
Chrysler LLC	-	●	-
Daimler	-	●	-
DaimlerChrysler	●	-	-
Dayco	-	●	●
Delphi	●	-	●
Denso	●	●	●
Dow	-	●	●
DuPont	●	●	●
Eaton	-	●	-
FIAT Group	-	●	●
Ford	●	●	●
Freudenberg	-	●	●
Fujikoki America	●	●	-
General Motors	●	●	●
Goodyear	●	●	●
Honeywell	-	●	●
Hutchinson	-	●	●
Ineos Fluor America	●	●	-
Japan Fluor Mfg.	●	-	-
Maflow S.p.A.	-	●	-
Manuli	●	-	-
Modine	●	-	-
Nissan	●	-	-
Opel	-	●	-
Parker Hannifin Corp.	●	●	●
Porsche	-	●	-
PSA Peugeot Citroen	-	●	●
Renault	-	●	-
Sanden	●	●	-
Sanyo	-	●	-
Solvay	-	●	-
Toyota	●	-	-
Trelleborg Sealing Solutions	●	●	●
U.S. EPA	●	-	-
Valeo	-	●	●
Viking Plastics	●	-	-
Visteon	●	●	●
Volkswagen	●	●	-
Volvo	-	●	-

Subcontract administration

- Identify key testing organizations
- Acquire proposals and bids from subcontractors
- Develop and administer contracts with all testing subcontractors; monitor deliverables and schedules

Organization of funding and fiscal management

- Budget development
- Prepare required agreements to obtain funding
- Solicit funding among prospective participants
- Develop proposals for and acquire government funding
- Establish escrow accounts, account for all funding, and disburse project funds as required

Subcontractor/Partner/Affiliate Organizations

Testing and lab facilities

- Creative Thermal Solutions
- Delphi
- GM
- NREL (National Renewable Energy Labs Participants)
- University of Illinois

Toxicology and risk assessments

- Gradient Corporation
- US Army

Chemical and materials compatibility

- ILK-Dresden
- Spauschus Associates

Final Deliverables

Project results were delivered to participants on CD-ROM and through private and secure website postings. More than 662 reports were prepared for both for common use and proprietary to individual companies including over 480 data reports, photos, and videos. Presentations were delivered to a broader industry audience via conferences and other venues including the 2007 and 2008 SAE Alternative Refrigerant Symposium.

Budget

- I-MAC: \$1.76 million
- CRP150: \$1.6 million
- CRP1234yf : \$880,000

Project Timelines

- I-MAC: September 2004 through August 2007
- CRP150: September 2006 through March 2008
- CRP1234yf: October 2007 through fourth quarter, 2008