

**US contributions
IEA HP Programme
Annex 33**

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Overview

- US National Team
 - Participation supported by ASHRAE Technical Committees
 - Air-to-refrigerant heat transfer equipment
 - Unitary air conditioners and heat pumps
 - Progress reports provided after each Annex meeting
- Five projects contributed by US
 - 4 sponsored by Air Conditioning & Refrigeration Institute
 - One by US Department of Energy

US project status

- Completed
 - Air-side performance of flat-tube heat exchangers
 - Super- and near-critical heat transfer of R410A in small diameter tubes
- Ongoing
 - Void fraction measurement and modeling for condensing refrigerant flows in small diameter tubes
 - Novel materials for heat exchangers
 - Modeling and analysis of heat exchangers with carbon-fiber structures

Woven Graphite Fiber Heat Exchanger

Ed Vineyard

James Hemrick

Oak Ridge National Lab

Greg Walker

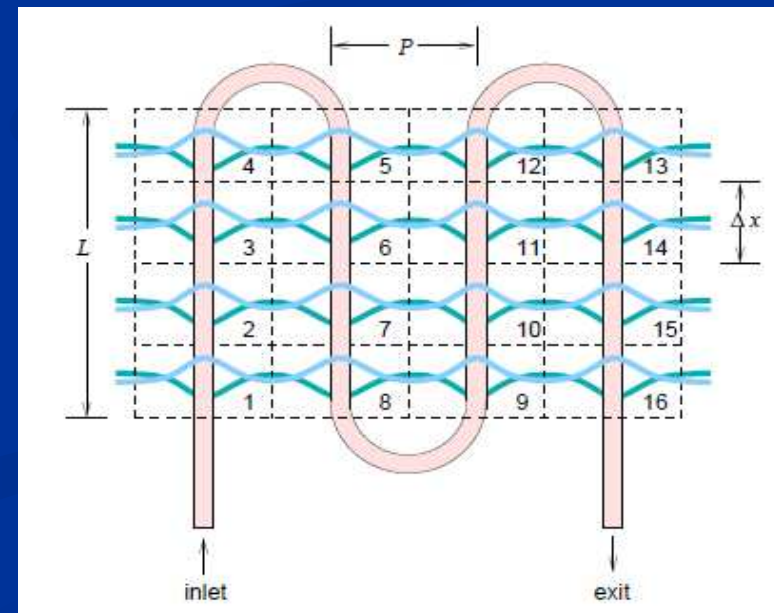
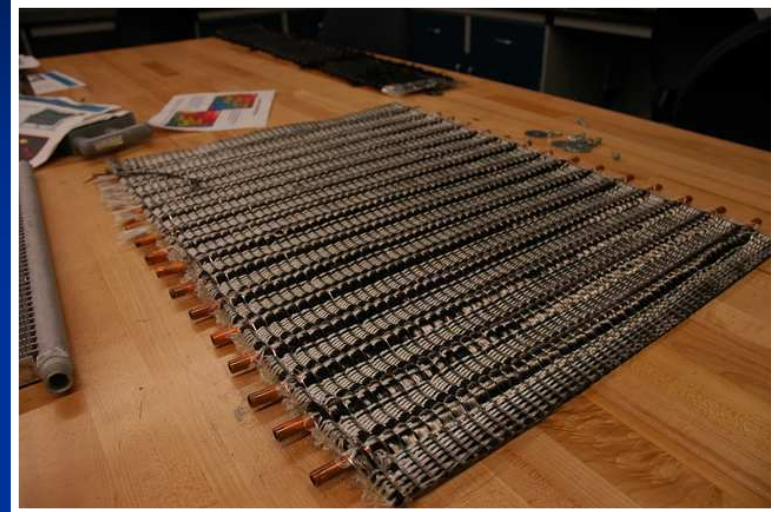
Vanderbilt University

Objectives

- **Woven graphite fibers as a fin material to**
 - Increase fin efficiency
 - Reduce HX size and weight
- **Evaluate prototype performance in a wind tunnel**
- **Identify ways to improve next generation woven graphite fiber HX designs**

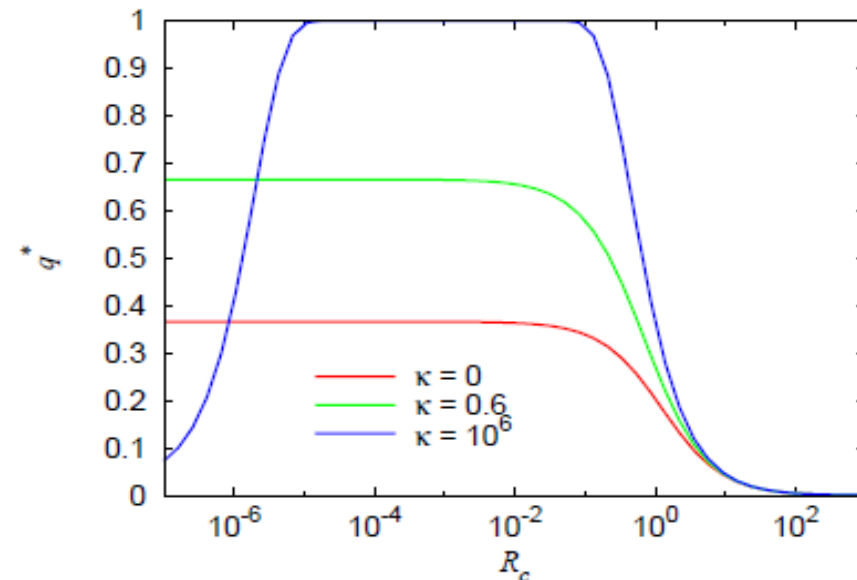
First Generation Prototypes

- Built and installed in frame
- Performance measured at various flow rates and inlet air and water temperatures
- Prototype performance fell short of conventional car radiator of the same size



Results

- NTU model used to reduce experimental data
- Limiting factor is fiber/tube contact resistance
- Thermal epoxy may improve
- Increased fiber conductivity could be counterproductive



- Optimal circuiting depends on tradeoff between fiber conductivity & contact resistance

Future Work

- Investigate contact mechanisms
- Alternative weave configurations to reduce pressure drop
- Build & test second generation woven graphite fiber heat exchanger
- First generation prototype fell short of conventional performance, but technology holds promise