American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

ASHRAE WORK STATEMENT
FROM
TECHNICAL COMMITTEE 8.5, LIQUID-TO-REFRIGERANT HEAT EXCHANGERS

TITLE

Experimental Determination of Heat Transfer in Water Cooled Condensers and Direct Expansion Water Coolers Using Brazed Plate Heat Exchangers

BACKGROUND

Brazed plate heat exchangers use copper brazed joints instead of elastomer gaskets to seal between plates. This makes them suitable for use with halocarbon refrigerants. The plate geometry allows for large amount of wetted surface in a small volume, and makes the devices of commercial interest where size is important.

Because of their descendance from fluid to fluid process heat exchangers, early brazed plate heat exchangers were not optimized for condensing or evaporating duty with halocarbon refrigerants. Current designs are better suited for this duty.

Published studies are rare and of limited usefulness to a practicing engineer. Manufacturer's data is frequently no better.

Correlations and operative information from this study will appear in the condensing and evaporating chapters of the ASHRAE Handbook for which TC 8.5 is responsible.

JUSTIFICATION OF NEED

Brazed plate heat exchangers have recently become a popular choice for liquid to refrigerant heat exchangers in the HVAC industry. ASHRAE literature contains no basic information to permit potential users to evaluate plate heat exchangers as refrigerant evaporators and condensers.

OBJECTIVE

The objective of this research is to obtain average refrigerant and water heat transfer coefficients for R-22 and R134a evaporating and condensing on one side of a plate heat exchanger with water flowing counterflow in the other side. The effects of exit superheating (evaporating mode) and exit subcooling (condensing mode) shall be investigated.

SCOPE

This project is intended to study the performance of a minimum of two commercially available plate heat exchangers from different manufacturers. Each shall be tested in the condensing and evaporating modes. Obtain average heat transfer coefficients for: a) refrigerant coefficients during condensing, b) water side coefficients under condensing conditions, c) refrigerant coefficients during evaporating and d) water side coefficients under evaporating conditions. Pressure drop on both water and refrigerant side shall be measured. Condensing tests shall be done at 105°F effective saturation pressure. Evaporating shall be at 35°F effective saturation pressure. Mass flows shall be varied over the full range of commercial application.

The results of (a) through (d) shall be presented as functions of their respective mass flows.

The effect of exit superheat (evaporating mode) and exit subcooling (condensing mode) shall be investigated while holding the refrigeration saturation pressure, inlet water temperature, and water flowrate constant. All testing shall be done in accordance with ASHRAE Stds 22 and 24. Circulating oil levels shall be measured per ASHRAE 41.4.

The plate heat exchangers chosen for this study shall be rated at least 36,000 BTU/hr at the ARI nominal rating point. They shall be commercially available and shall be suitable for both condensing and evaporating duty. Installation and orientation shall be per manufacturer's specifications.

For analysis purposes, the heat transfer area shall be stated in terms of projected plan area (length x width) of the plate rather than extended surface area as may be specified by the manufacturer. Flow areas between passages should likewise be specified as a nominal area.

After testing is complete, data analyzed and correlated and approved by the cognizant TC 8.5 Project Monitoring Subcommittee, the heat exchangers shall be disassembled and the geometry of the plates (enhancement geometry, height, angle, frequency, etc.) shall be included in the research report.

DELIVERABLES

a. Progress and Financial Reports in quadruplicate shall be made to the Society through its Manager of Research at quarterly intervals.

b. The Principal Investigator shall report in person to the TC at the annual and winter meetings, and answer such questions regarding the research as may arise.

c. A Final Report shall be prepared and submitted to the Society by the end of the contract period covering complete details of all research carried out on the project.

Unless otherwise specified, the final report shall be furnished in the following manner:

- Six bound copies.
- One unbound copy, printed on one side only, suitable for reproduction.
- Two copies on 5 1/4" diskette(s); one in ASCII format and one in the word processing format used to produce the report.

d. One or more Technical Paper(s) shall be prepared in a form suitable for presentation at a Society meeting. The Paper(s) shall conform to Section 5 of the Society's "Authors' Manual for Technical and Symposium Papers."

e. A Technical Article suitable for publication in the *ASHRAE JOURNAL*, may be requested by the Society.

f. A summary which delineates suggested changes to the *ASHRAE Handbook* that were suggested by this research.

All documents shall be prepared using dual units; e.g., rational inch-pound with equivalent SI units shown parenthetically. SI usage shall be in accordance with ASTM Standard E 380-79.

LEVEL OF EFFORT

Total completion time for this project is specified as two years elapsed time. The level of effort is expected to be 24 man months for a research assistant and 8 man months for the Principal Investigator.

ADDITIONAL INFORMATION FOR BIDDERS

It is expected that those bidding this research project will have an existing facility capable of testing the specified size of heat exchangers at the specified conditions. No funds are included in this project to design and build such a facility.

PROPOSALS

Proposals submitted to ASHRAE for this project should include the following minimum information:

1. Statements describing test facilities, equipment, capabilities, procedures, etc., to be used.

2. Statements indicating experience in conducting research associated with performing heat transfer measurements under conditions of condensation and evaporation.

3. Resume of the Principal Investigator and others involved in the study.

4. Planned schedule and length of time for the project to be completed.

5. Budget information.

REFERENCES

Baskin, E., "Applicability of Plate Heat Exchangers in Heat Pumps." ASHRAE paper 3522.