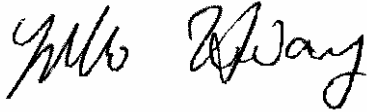


Curriculum Vitae

Yunho Hwang

I have read the following and certify that this curriculum vitae is a current and accurate statement of my professional record.



Signature__

Date_04/01/2004_____

Office: 3163 Martin Hall Bldg., Department of Mechanical Engineering
University of Maryland, College Park, MD 20742
(301) 405-5247 yhhwang@eng.umd.edu
Home: 10257 Tuscany Road, Ellicott City, MD, 21042, U.S.A. (410) 480-5441

PERSONAL INFORMATION:

Department: Mechanical Engineering

Current Rank: Assistant Research Scientist since January 08, 2004

EDUCATIONAL BACKGROUND:

Ph. D. in Mechanical Engineering, University of Maryland, College Park, MD, 1997

Dissertation: Comprehensive Investigation of Carbon Dioxide Refrigeration Cycle

M.S. in Mechanical Engineering, University of Maryland, College Park, MD, 1995

Thesis: Evaluation of R-22 Alternatives for Heat Pumps

B.E. in Mechanical Engineering, Korea University, Seoul, Korea, 1983

EMPLOYMENT BACKGROUND:

Assistant Research Scientist, 1998-current, CEEE, Dept. of Mechanical Eng., Univ. of Maryland, College Park, MD

Faculty Research Assistant, 1996-1997, CEEE, Dept. of Mechanical Eng., Univ. of Maryland, College Park, MD

Graduate Research Assistant, 1993-1996, CEEE, Dept. of Mechanical Eng., Univ. of Maryland, College Park, MD

Senior Researcher, 1983-1993, R&D Center, Samsung Electronics Co., Suwon-city, Korea

PUBLICATIONS:

Book:

Vapor Compression Heat Pumps with Refrigerant Mixtures, Reinhard Radermacher, **Yunho Hwang**, Published, 04/2001.

Technical Heat Transfer, **Yunho Hwang**, Published by Samsung Electronics Co., 09/1988.

Chapter in Book:

Automotive Air-Conditioning, 2nd Edition, Chapter: Alternative Refrigeration Cycle, **Yunho Hwang**, Published by Denso Corp., 2002.

Referred Journal Papers (8):

1. *Comparing R-290 with R22 in Heat Pumps*, **Y. Hwang**, A. Gado and R. Radermacher, ASHRAE Journal, Vol. 45, No. 1, p. 40, 2003.
2. *An Experimental Evaluation of a Residential Sized Evaporatively Cooled Condenser*, **Y. Hwang**, W. Kopko and R. Radermacher, International Journal of Refrigeration, Vol. 24, No. 1, pp. 238-249, 2001.
3. *Evaporatively-Cooled Condenser with Rotating Disks*, **Y. Hwang**, S. I. Haider, B. Markey, W. Kopko and R. Radermacher, Journal of Enhanced Heat Transfer, Vol. 7 No. 4, pp.273-287, 2000.
4. *Experimental Investigation of the Carbon Dioxide Refrigeration Cycle*, **Y. Hwang** and R. Radermacher, ASHRAE Transactions, Vol. 105, Part 1, pp. 1219-1227, CH-99-22-2, 1999.
5. *Theoretical Evaluation of Carbon Dioxide Refrigeration Cycle*, **Y. Hwang** and R. Radermacher, International Journal of HVAC&R Research, Vol. 4, No. 3, pp. 245-263, 1998.
6. *Experience with Refrigerant Mixtures*, **Y. Hwang**, J. Judge, and R. Radermacher, ASHRAE Transactions, Vol. 103, Part 1, pp. 765-776, 1997.
7. *Performance Assessment of Multistage Absorption Cycles*, K. Cheung, **Y. Hwang**, J.F. Judge, A. Singh and R. Radermacher, International Journal of Refrigeration, Vol. 19, No. 7, pp. 473-481, 1996.

<Accepted Paper>

8. *Potential Energy Benefits of Integrated Refrigeration System with Microturbine and Absorption Chiller*, **Y. Hwang**, Accepted for International Journal of Refrigeration, 2004.

Key Note Papers (3):

1. *Integration of Air-conditioning and Refrigeration with Distributed System*, **Y. Hwang** and R. Radermacher, International Congress of Refrigeration, Washington D.C., 2003.
2. *Alternative Refrigerant Heat Pump and Refrigeration Systems*, R. Radermacher and **Y. Hwang**, Proceedings of the 12th International Heat Transfer Conference, Vol. 1, pp. 395-402, Grenoble, France, 2002.
3. *Emerging Refrigerants*, **Y. Hwang** and R. Radermacher, Proceedings of IIR Conference, "Emerging Trends," pp. 1.1-1.14, New Delhi, India, 1998.

Peer Reviewed Conference Papers (23):

1. *Oil Circulation Behavior in Low Temperature CO₂ Climate Control Systems*, **Y. Hwang**, L. Cremaschi, R. Radermacher, T. Hirata, Y. Ozaki, and T. Hotta, SAE SP-1859, pp. 33-38, 2004.
2. *Performance of Propane in a Unitary Heat Pump*, **Y. Hwang**, A. Gado, and R. Radermacher, Proceedings of the Int. Congress of Refrigeration, Washington D.C., 2003.
3. *Oil Circulation Ratio in CO₂ Climate Control Systems*, **Y. Hwang**, L. Cremaschi, R. Radermacher, T. Hirata, Y. Ozaki, and T. Hotta, SAE World Congress, 03HX-25, 2003.
4. *Performance Comparison of Hydrocarbon R-290 with R-22 in Residential Heat Pump System*, **Y. Hwang**, A. Gado, and R. Radermacher, Proceedings of the 5th IIR-Gustav Lorentzen Conference, pp. 603-610, Guangzhou, China, 2002.
5. *Options for A Two-stage Transcritical Carbon Dioxide Cycle*, H. Huff, **Y. Hwang**, and R. Radermacher, Proceedings of the 5th IIR-Gustav Lorentzen Conference, pp. 143-149, Guangzhou, China, 2002.
6. *Oil Circulation Ratio Measurement in CO₂ Cycle*, **Y. Hwang**, L. Cremaschi, R. Radermacher, T. Hirata, Y. Ozaki, and T. Hotta, Proceedings of the 2002 International Conference "New Technologies in Commercial Refrigeration," pp. 22-28, Urbana-Champaign, IL, 2002.
7. *An Experimental Investigation on Oil Retention Characteristics in CO₂ Air-Conditioning Systems*, J. Lee, **Y. Hwang**, and R. Radermacher, The International Compressor Engineering Conference and Refrigeration and Air Conditioning Conference, Purdue, IN, 2002.
8. *Opportunities with Alternative Refrigerants*, **Y. Hwang** and R. Radermacher, IThERM 2002, San Diego, CA, 2002.
9. *Experimental Investigations on Oil Accumulation Characteristics in a Vertical Suction Line*, J. Lee, **Y. Hwang**, R. Radermacher, and S. Mehendale, ASME International Mechanical Engineering Congress, New York, NY, 2001.
10. *CO₂ Transcritical Cycles for High Temperature Applications*, **Y. Hwang**, H. Huff, M. Preissner, and R. Radermacher, ASME International Mechanical Engineering Congress, New York, NY, 2001.
11. *An Experimental Investigation on Flow Characteristics of Refrigerant/Oil Mixture in Vertical Upward Flow*, **Y. Hwang**, J. Lee, and R. Radermacher, Proceedings of 4th IIR-Gustav Lorentzen Conference, Purdue, IN, 2000.

12. *Development of Carbon Dioxide Environmental Control Unit*, B. Cutler, **Y. Hwang** and R. Radermacher, Proceedings of 4th IIR-Gustav Lorentzen Conference, Purdue, IN, 2000.
13. *Comparison of Automotive Air-Conditioning System with CO₂ and R134a*, M. Preissner, B. Cutler, S. Singanamalla, **Y. Hwang**, and R. Radermacher, Proceedings of 4th IIR-Gustav Lorentzen Conference, Purdue, IN, 2000.
14. *Development of Hermetic Carbon Dioxide Compressor*, **Y. Hwang** and R. Radermacher, Proceedings of the International Refrigeration Conference at Purdue, pp. 171-175, West Lafayette, IN, 1998.
15. *Experimental Evaluation of CO₂ Water Heater*, **Y. Hwang** and R. Radermacher, Proceedings of the IIR-Gustav Lorentzen Conference, pp. 321-328, Oslo, Norway, 1998.
16. *Boiling Heat Transfer Correlation for Carbon Dioxide*, **Y. Hwang**, B. Kim, and R. Radermacher, Proceedings of IIR-Conference, "Heat Transfer Issues in Natural Refrigerants," pp. 81-94, College Park, MD, 1997.
17. *Evaluation of Carbon Dioxide Heat Exchanger*, **Y. Hwang** and R. Radermacher, Proceedings of IIR-Conference, "Heat Transfer Issues in Natural Refrigerants," pp. 105-114, College Park, MD, 1997.
18. *An Experimental Evaluation of Flammable/Non-Flammable High Pressure HFC Replacements for R-22*, M. Pande, **Y. Hwang**, J. Judge, and R. Radermacher, Proceedings of the International Refrigeration Conference at Purdue, pp. 21-27, Purdue, IN, 1996.
19. *Evaluation of R-22 Alternatives for Heat Pumps*, **Y. Hwang**, J. Judge, and R. Radermacher, Proceedings of the ASME International Mechanical Engineering Congress, AES-Vol. 34, pp. 11-17, San Francisco, CA, 1995.
20. *Experimental Results of Two Drop-In Replacement Refrigerants for HCFC-22*, J. Judge, **Y. Hwang**, and R. Radermacher, Proceedings of 19th International Congress of Refrigeration, Vol. IVb, pp. 1168-1175, The Hague, The Netherlands, 1995.
21. *An Experimental Evaluation of Medium and High Pressure HFC Replacements for R-22*, **Y. Hwang**, J. Judge, and R. Radermacher, Proceedings of the International CFC and Halon Alternatives Conference, pp. 41-48, Washington D.C., 1995.

<Accepted Papers>

22. *Interfacial Friction Factor between Gaseous CO₂ and Oil*, **Y. Hwang** and R. Radermacher, Accepted for: 5th International Conference on Multiphase Flow, 2004.
23. *Performance Measurements of A Forced Convection Air-Cooled Rack*, Y. Hwang, R. Radermacher, S. Spinazzola, and Z. Menachery, Accepted for IThERM 2004.
24. *Two-stage Rolling Piston Carbon Dioxide Compressor*, N. Dreiman, R. Bunch, Y. Hwang, and R. Radermacher, Accepted for the International Refrigeration Conference at Purdue, West Lafayette, IN, 2004.
25. Investigation of Oil Retention in Residential Heat Pump, L. Cremaschi, Y. Hwang, R. Radermacher, Accepted for the International Refrigeration Conference at Purdue, West Lafayette, IN, 2004.
26. Measurements of the Dynamic Performance and Behavior of Air-Conditioning Systems Using a Dynamic Test Facility, A. Gado, Y. Hwang, and R. Radermacher, Accepted for the International Refrigeration Conference at Purdue, West Lafayette, IN, 2004.
27. Performance of CO₂ Cycles with a Hermetic, Two-Stage CO₂ Compressor, A. Celik, Y. Hwang, R. Radermacher, Accepted for the International Refrigeration Conference at Purdue, West Lafayette, IN, 2004.

Papers Presented at Other Magazine, Conferences and Workshops (10):

1. *Comparison of Hydrocarbon R-290 and Two HFC Blends R-404A and R-410A for Medium Temperature Refrigeration Applications*, Y. Hwang, D. Jin, and R. Radermacher, 15th Annual Earth Technologies Forum, Washington D.C., 2004.
2. *Thoughts on CO₂ Compressor Testing and Rating*, Y. Hwang and R. Radermacher, Seminar 24, ASHRAE Winter Meeting, 2004.
3. *Investigation of Oil Distribution in CO₂ Transcritical Cycle*, **Y. Hwang**, J. Lee, R. Radermacher, VDA Alternate Refrigerant Winter Meeting, Austria, 2003.
4. *CO₂ Transcritical Cycle Research at CEEE*, **Y. Hwang**, and R. Radermacher, The Magazine of the SAREK, Vol. 31, No. 7, pp. 45-52, ISBN No. 1229-6430, 2002.
5. *Refrigeration Cycle Using CO₂ as its Refrigerant*, **Y. Hwang**, The Magazine of the SAREK, Vol. 31, No. 1, pp. 34-44, ISBN No. 1229-6430, 2002.
6. *High-Side Pressure Optimization in Transcritical CO₂ Cycles with Work-Extracting Expansion Devices*, H. Huff, **Y. Hwang**, and R. Radermacher, Proceedings of the 2002 Alternate Refrigerant Systems Symposium, SAE, Phoenix, AZ, 2002.

7. *Alternative Refrigerants for Refrigeration Systems and Options for Performance Improvement*, **Y. Hwang** and R. Radermacher, IMAPS Advanced Technology Workshop on Thermal Management, Palo Alto, CA, 2002.
8. *Comparison of Refrigerants Comparison*, **Y. Hwang** and R. Radermacher, Workshop: Vapor Compression with the Critical Point in Mind, University of Maryland, 2000.
9. *Safety Consideration*, **Y. Hwang** and R. Radermacher, Workshop: Vapor Compression with the Critical Point in Mind, University of Maryland, 2000.
10. *Natural Refrigerants*, **Y. Hwang**, M. Ohadi and R. Radermacher, Mechanical Engineering, Vol. 120, No. 10, pp. 96 - 99, 1998.
11. *Carbon Dioxide Heat Pump System*, **Y. Hwang** and R. Radermacher, Proceedings of IIR Workshop on CO₂ Technology in Refrigeration, Heat Pump & Air-Conditioning Systems, pp. 71-78, Trondheim, Norway, 1997.
12. *The Noise Effects of the Cross Flow Fan and Duct System for the Forced Convection of the Space Heater*, **Y. Hwang**, The Second Proceedings of the Industrial Graduate School Theses, Samsung Electronics, pp. 3-40, 1990.

Invited Seminars:

- Title: CO₂ Transcritical Cycle
Invitation: Advanced Heat Transfer, January, 2004
- Title: Advances in Thermoelectronics and Refrigeration Cycle
Invitation: Denso, LG Electronics, Samsung Electronics, June, 2003
- Title: Natural Refrigerants
Invitation: Korea Specialty Chemical Industry Association, Nov., 2001
- Title: CO₂ Transcritical Cycle
Invitation: Yonsei University, Denso, LG Electronics, Mando, Matsushita, Mitsubishi, Sanyo, Toshiba, Samsung Electronics, Nov., 2001
Invitation: Tecumseh Products (Nov. 2000), Embraco (Nov. 2000), Thermoking (Mar., 2001)
- Title: R-22 Alternatives for Heat Pumps
Invitation: Korea University, Samsung Electronics Co., August, 1995

CONTRACTS AND GRANTS:

(Granting Effort, Budget, Year: \$ 0.6 M since 2001):

- **ARI:** Green Project (50%, \$125K, 2003)
- **ASHRAE:** Refrigerant Distribution in Evaporator Manifolds (90%, \$120K, 2003)
- **Advanced Heat Transfer:** Refrigerant Alternatives Consortium Membership (90%, \$25K, 2003)
Design and Evaluation of CO₂ Heat Exchanger (100%, \$25K, 2003)
- **Copeland:** Evaluation of Oil Return Behavior (50%, \$45K, 2002)
- **Denso:** OCR Measurement (100%, \$29K, 2002; 100%, \$30K, 2003)
RAC Membership (50%, \$15K/yr, 2001, 2002, 2003)
- **Embraco:** Development of Carbon Dioxide Vending Machine (50%, \$53K, 2001)
- **LG Electronics:** Feasibility Study on Advanced Cycles (100%, \$45K, under process)
RAC Membership (100%, \$15K/yr, 2001, 2002, 2003)
- **Samsung Electronics:** Evaluation of Tropical Compressor Performance (100%, \$34K, 2002)
Reliability Analysis of Rotary Compressor (100%, \$39K, 2001)
Modeling of Hermetic Compressor (100%, \$30K, under process)
Transient Modeling of Refrigerator (100%, \$62K, 2003)
RAC Membership (100%, \$15K/yr, 2001, 2002, 2003)
- **Sanyo:** Optimization of Split Two-stage Cycle (90%, \$30K, 2003)
RAC Membership (50%, \$15K/yr, 2001, 2002, 2003)
- **Tecumseh Products:** RAC Membership (50%, \$15K/yr, 2002, 2003)

PAPER REVIEWS:

- ASME: IMECE (2004, 2003, 2000), 5th ASME/JSME Thermal Engineering Joint Conference
- ASHRAE Transactions: 2002, 2001, 2000, 1999, 1998, 1997

- International Institute of Refrigeration: International Congress of Refrigeration (2003), 5th IIR Gustav Lorentzen Conference on Natural Working Fluids (2002)
- International Journal of Refrigeration (1999)
- International Journal of HVAC&R (2000, 1999)
- International Journal of Energy (2001, 2000)
- SAE: SAE Transactions (2002, 2001)
- 5th World Conference on Experimental Heat Transfer, Fluid Mechanics and Thermodynamics

RESEARCH ADVISING:

Undergraduate:

- Mark Treadwell, 02/2003-01/2004, Compressor laboratory, Designed a test facility for the refrigerant mal-distribution in microchannel evaporator (ASHRAE project).
- James Kalinger, 06/2003-12/2003, Heat pump laboratory, Designed a wind tunnel and sized an orifice (Green project)
- Cian Kelly, 06/2001-06/2003, Heat pump laboratory, Constructed oil retention test facility (RAC consortium project)
- Stefanie Robinson, 01/2003-06/2003, Refrigeration Laboratory, Constructed a test set-up for CO2 two-stage cycle (RAC consortium project)
- Corey Merdler, 12/2003-current, Heat pump laboratory, Designed CO2/Oil gas cooling hat transfer measurement facility (RAC consortium project)

Master:

- Aydin Celik, 08/2002-current, Refrigeration Laboratory, Experimental study on CO2 two-stage cycle (RAC consortium project)
- John Linde, 05/2003-current,, Compressor laboratory, Construction of a test facility for the refrigerant mal-distribution in microchannel evaporator (ASHRAE project).
- Layla Monajemi, 08/2002-current, , Compressor laboratory, Constructed compressor test set-up ad evaluation of rotary compressor performance (Samsung project)

Doctoral:

- Amr Gado, 08/2001-current, Heat pump laboratory, Constructed dynamic test facility
- Lorenzo Cremaschi, 06/2001-current, Heat pump laboratory, Developed oil circulation sensor and experimentation of oil retention

German Exchange Student:

- Jan Muehlbauer, 09/2003-02/2004, Compressor laboratory, Constructed CO2 compressor test set-up and measured the performance
- Renate Mueller, 11/2003-02/2004, Heat pump laboratory, Constructed CO2 heat exchanger test facility

Research Faculty:

- Dae-Hyun Jin, 09/2003-12/2003, Heat pump laboratory, Constructed a wind tunnel and propane system test set-up, and ran experiment (Green project)

PROFESSIONAL MEMBERSHIPS:

1999 to present	Member	ASME Membership
1999 to present	Member	SAE Membership
1990 to present	Member	ASHRAE Membership
1983 to present	Member	SAREK Lifetime Membership, Korea
1991 to present	Associate Member	IIR Membership
1998 to present	EPA Chief Examiner (Proctor number: 213-39-8566-1199)	

PROFESSIONAL SERVICE:

1999 to present	Secretary	IIR, Commission B2
2002 to present	Corresponding Member	ASHRAE, TC 7.6

CERTIFICATION:

EPA Certified Universal Technician per Section 608 of Clean Air Act