

4-9-2014

A Semi-Empirical Prediction Model for the Discharge Line Temperature of Hermetic Compressors

Follow this and additional works at: https://ecommons.udayton.edu/stander_posters

 Part of the [Arts and Humanities Commons](#), [Business Commons](#), [Education Commons](#), [Engineering Commons](#), [Life Sciences Commons](#), [Medicine and Health Sciences Commons](#), [Physical Sciences and Mathematics Commons](#), and the [Social and Behavioral Sciences Commons](#)

Recommended Citation

"A Semi-Empirical Prediction Model for the Discharge Line Temperature of Hermetic Compressors" (2014). *Stander Symposium Posters*. 378.

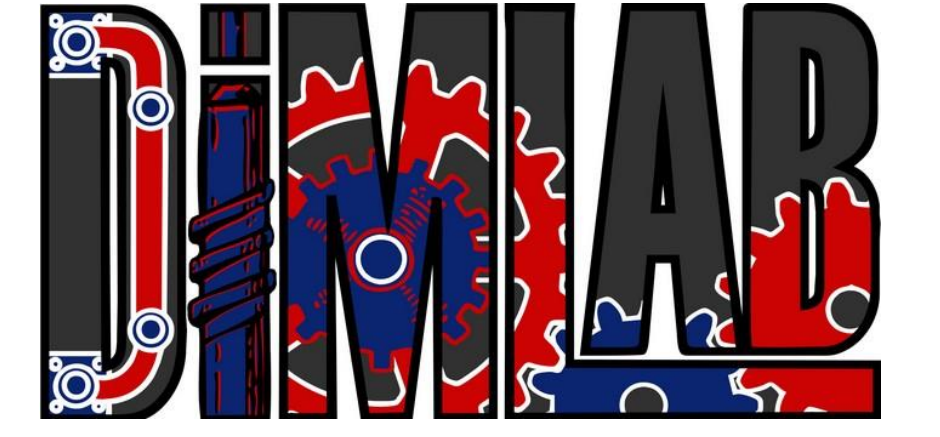
https://ecommons.udayton.edu/stander_posters/378

This Book is brought to you for free and open access by the Stander Symposium at eCommons. It has been accepted for inclusion in Stander Symposium Posters by an authorized administrator of eCommons. For more information, please contact frice1@udayton.edu, mschlangen1@udayton.edu.

A Semi-Empirical Prediction Model for the Discharge Line Temperature of Hermetic Compressors

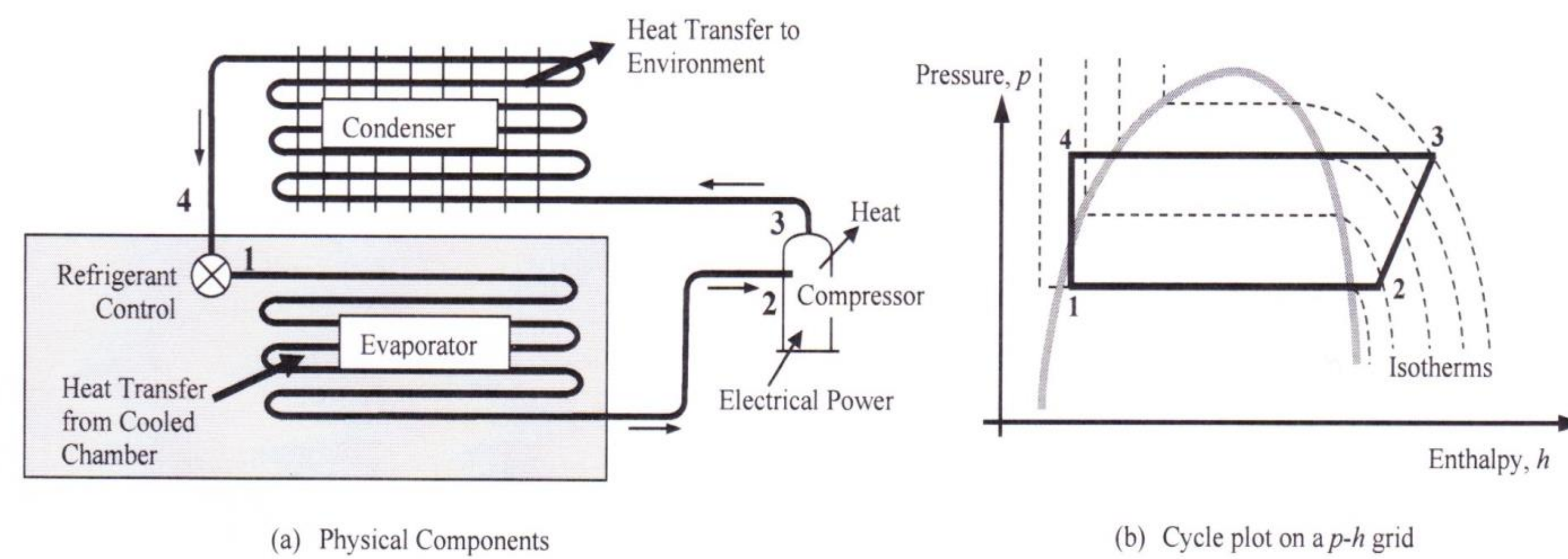
Chen Guan

Advisor: David H. Myszka, Andrew P. Murray



Research Objective: To build a Semi-Empirical prediction model, without using compressor-specific parameters, that produces better correlations with test data by assessing various DLT prediction methods.

Introduction/Motivation



- The compressor draws a mass flow of cool, low pressure refrigerant gas at its inlet (state 2), and discharges hot, high pressure gas (state 3).
- Applying the principle of thermodynamics the state postulate, with given values of T and p at the compressor inlet, the suction density, specific volume, enthalpy and entropy can be determined.
- The compressor performance values are tabulated over a range of evaporator and condenser dew-point temperature. The tabular data is represented by a ten-coefficient, third-order polynomial equation of the form:

$$X = C_1 + C_2 T_e + C_3 T_c + C_4 T_e^2 + C_5 T_e T_c + C_6 T_c^2 + C_7 T_e^3 + C_8 T_e^2 T_c + C_9 T_e T_c^2 + C_{10} T_c^3$$

Methodology

Entropy Approach

Assuming an ideal, adiabatic compression process, the entropy of the exhaust gas will be the same as that of the inlet gas

$$s_2 = s_3$$

An efficiency measure $\alpha = 1.0233$ is identified by test data.

Polytropic Compression Approach

Apply the Polytropic process and follow the relationship:

$$p v^n = C$$

Assuming the exhaust temperature is equal to the DLT.

Energy Balance Approach

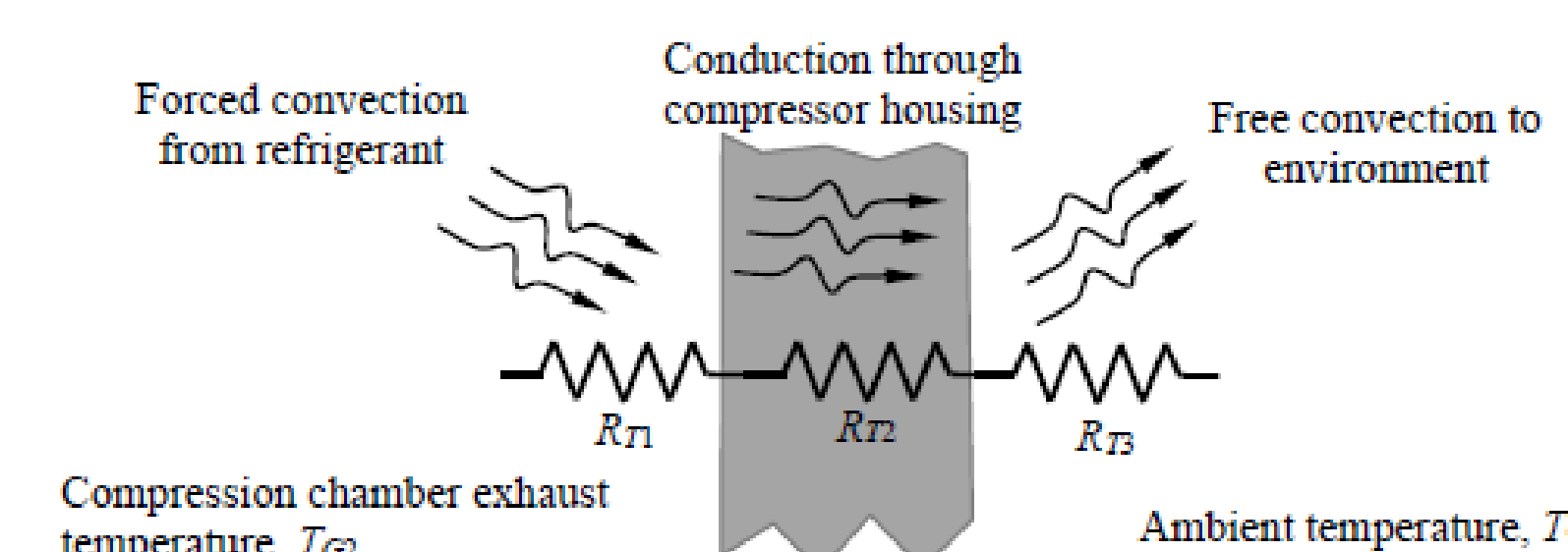
The energy of electrical power W, inlet gas and exhaust gas follow the relationship:

$$m h_3 = (W + m h_2) / \eta$$

Improved Energy Balance Approach

Adding the consideration of the heat Q_{ex} that transfer from the hot, high-pressure side of the compressor to the environment.

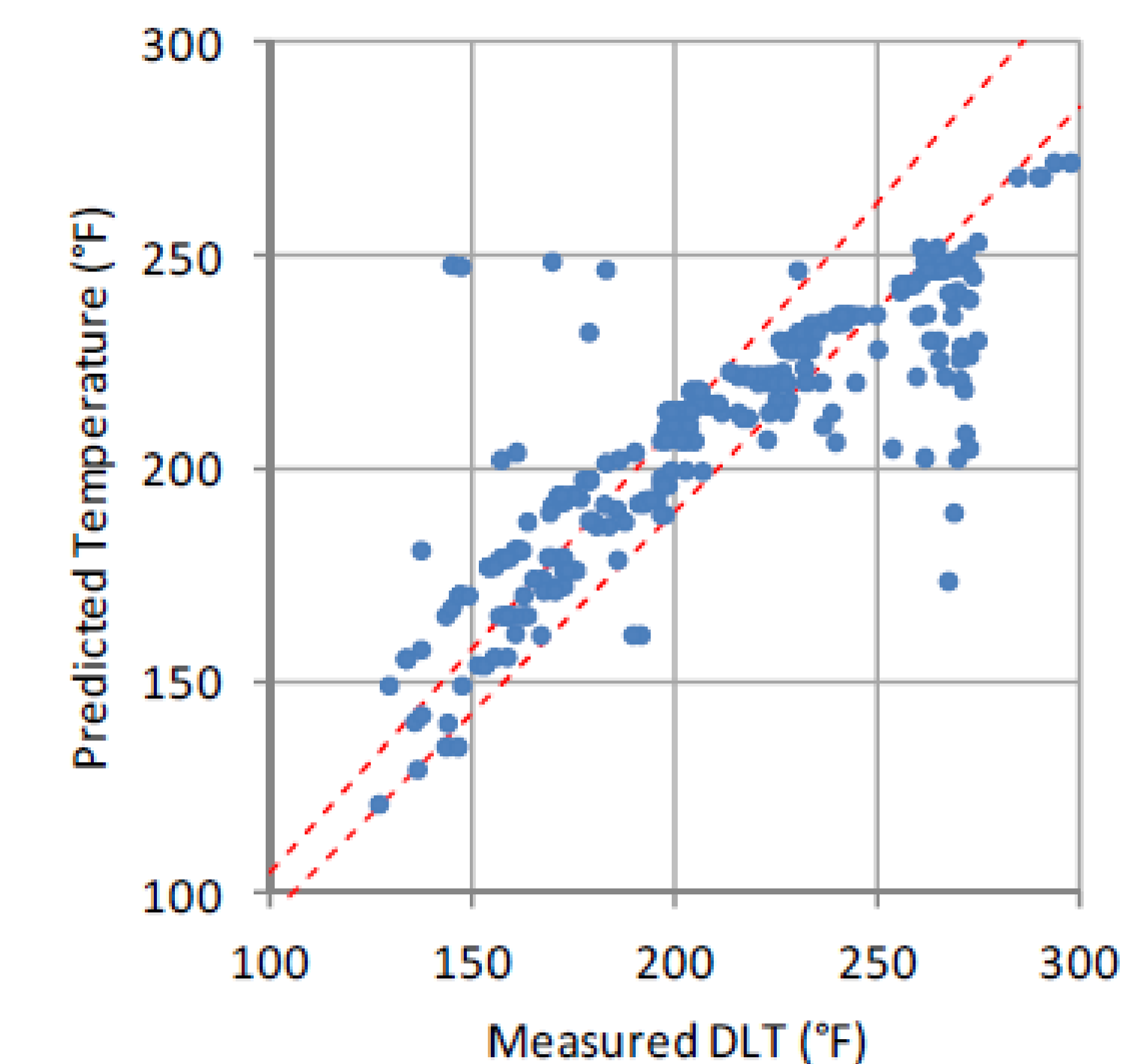
$$m h_3 - Q_{ex} = m h_{DL}$$



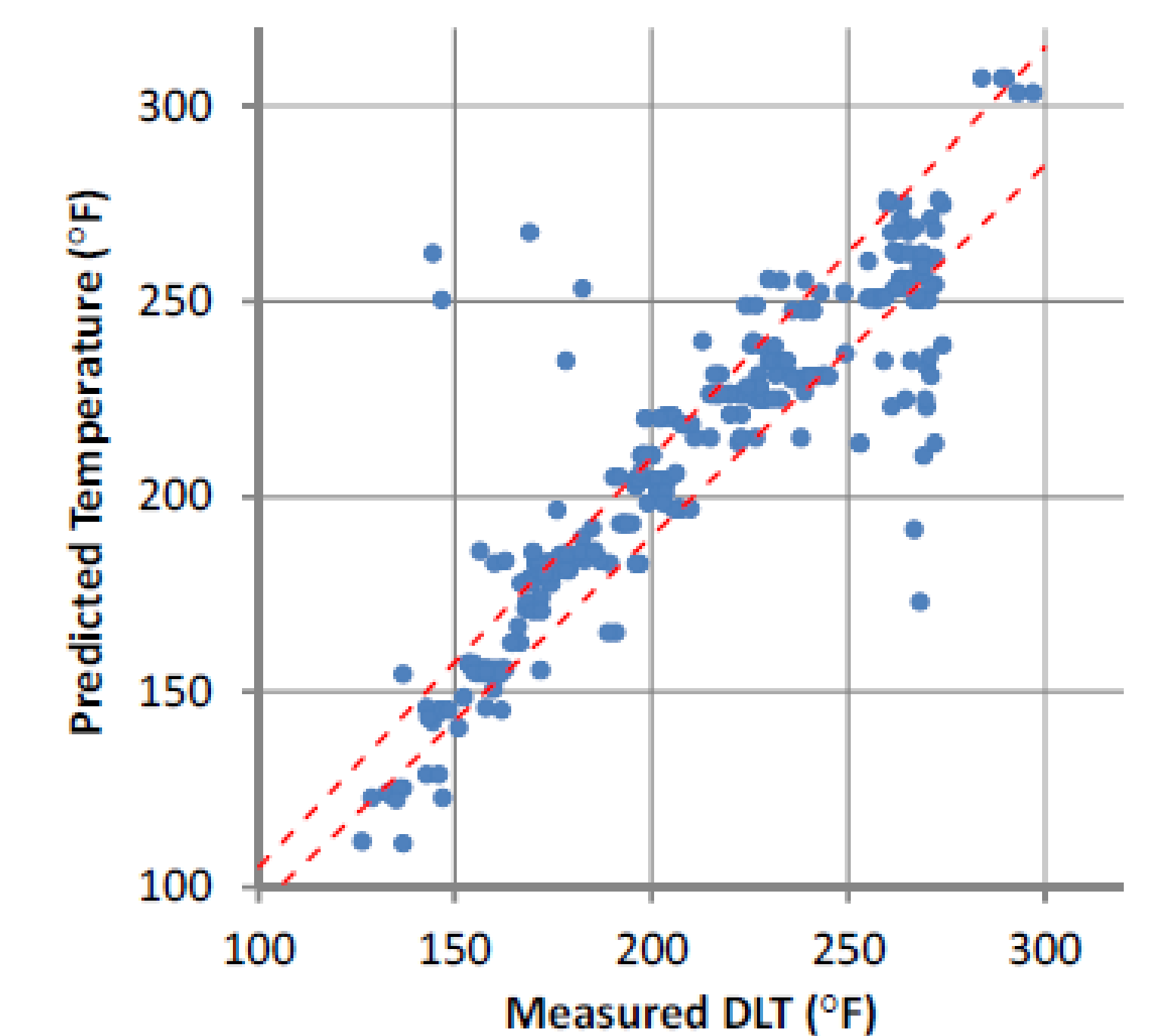
Heat transfer from the refrigerant exiting the compression chamber to environment.

Conclusions

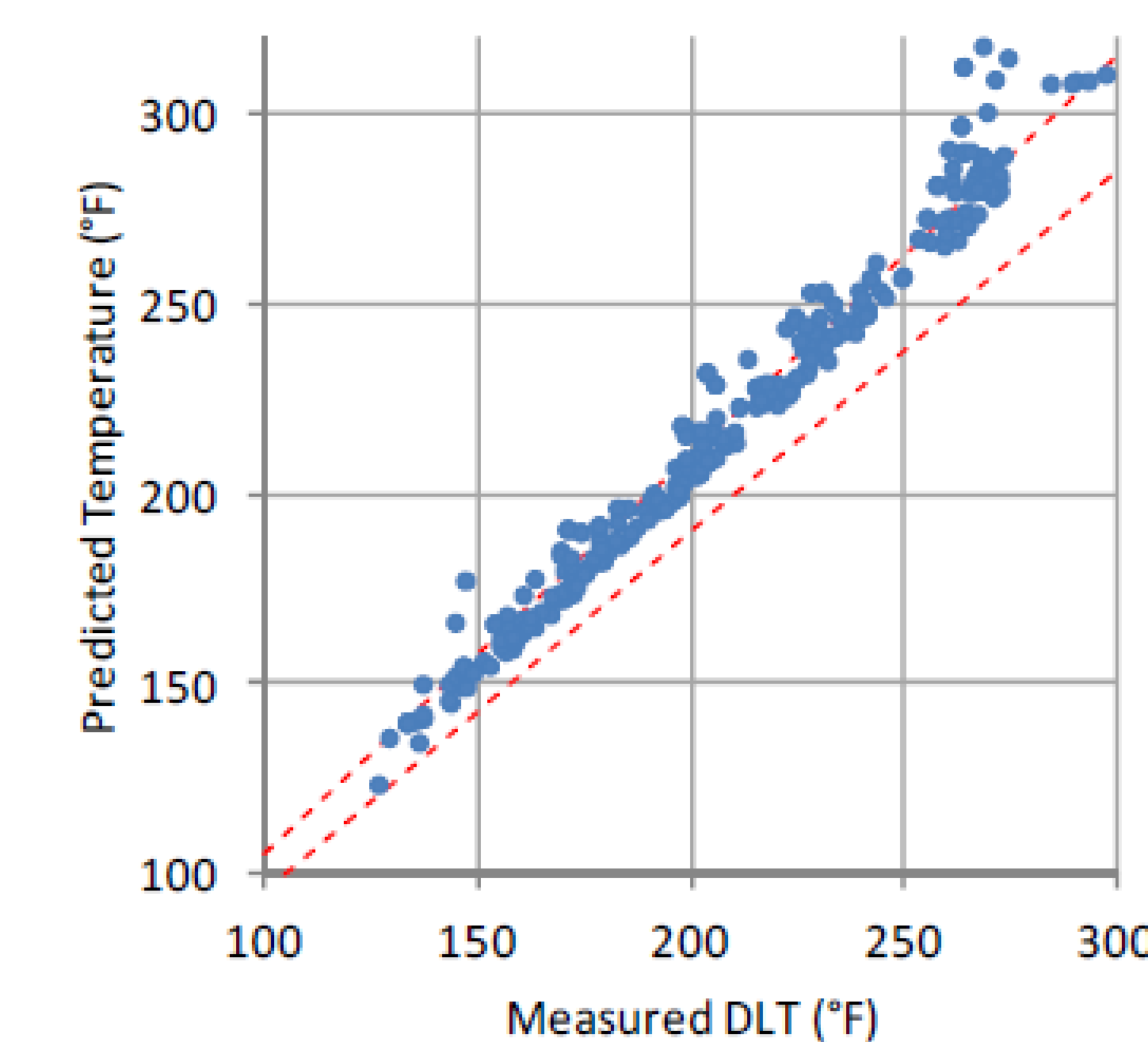
	Calculation Approach			
	Entropy	Polytropic	Energy Balance	Improved Energy Balance
Mean Error	0.00 F°	0.04 F°	11.6 F°	0.00 F°
Std. Dev.	22.47 F°	19.06 F°	8.72 F°	3.30 F°
within ± 5 F°	22.77%	35.31%	19.33%	92.41%
within ± 10 F°	39.60%	61.72%	51.00%	98.35%



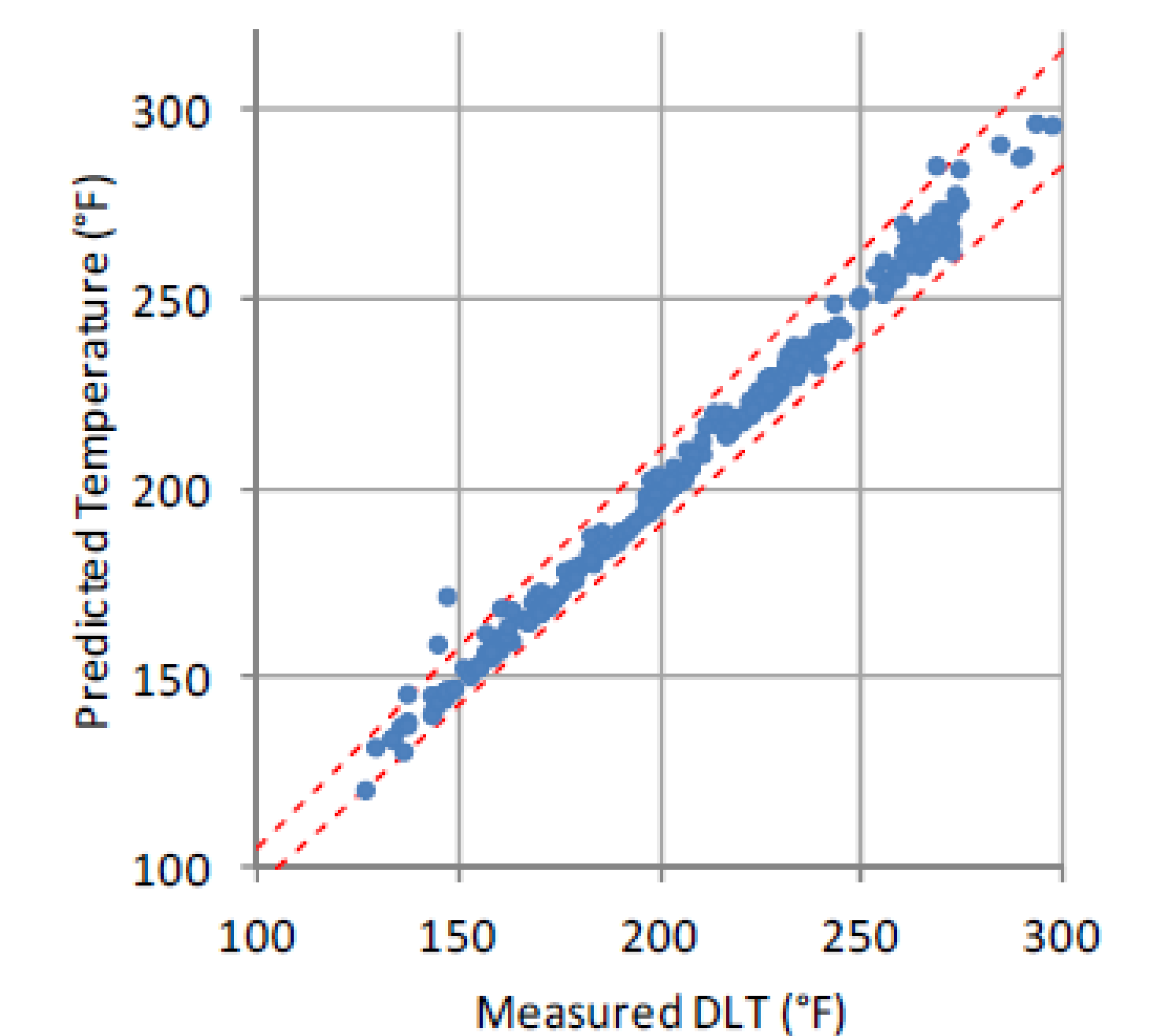
(a) Entropy approach



(b) Polytropic approach



(c) Energy approach



(d) Improved energy approach