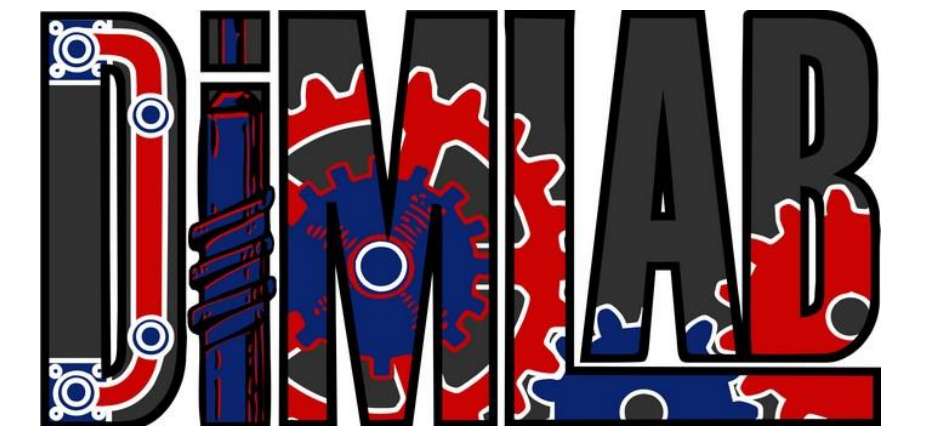


A Semi-Empirical Prediction Model for the Discharge Line Temperature of Hermetic Compressors

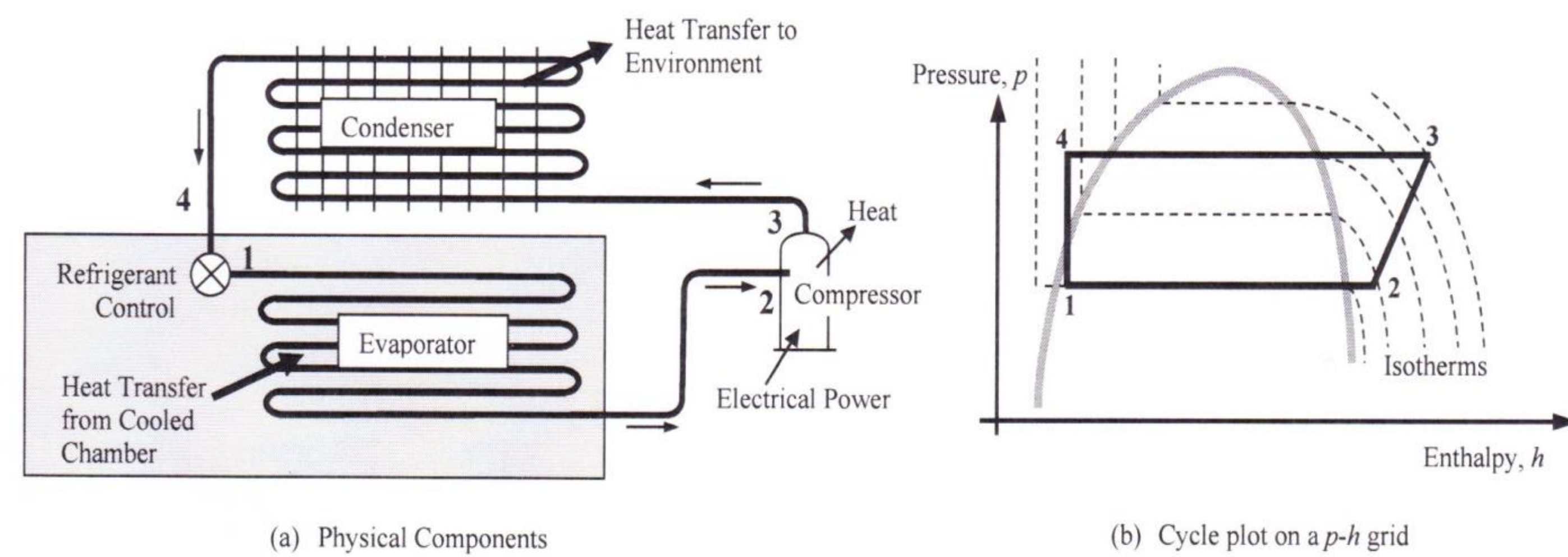
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Research Objective: To build a Semi-Empirical prediction model, without using compressor-specific parameters, that produces better correlations with test data by assessing various DLT prediction methods.

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

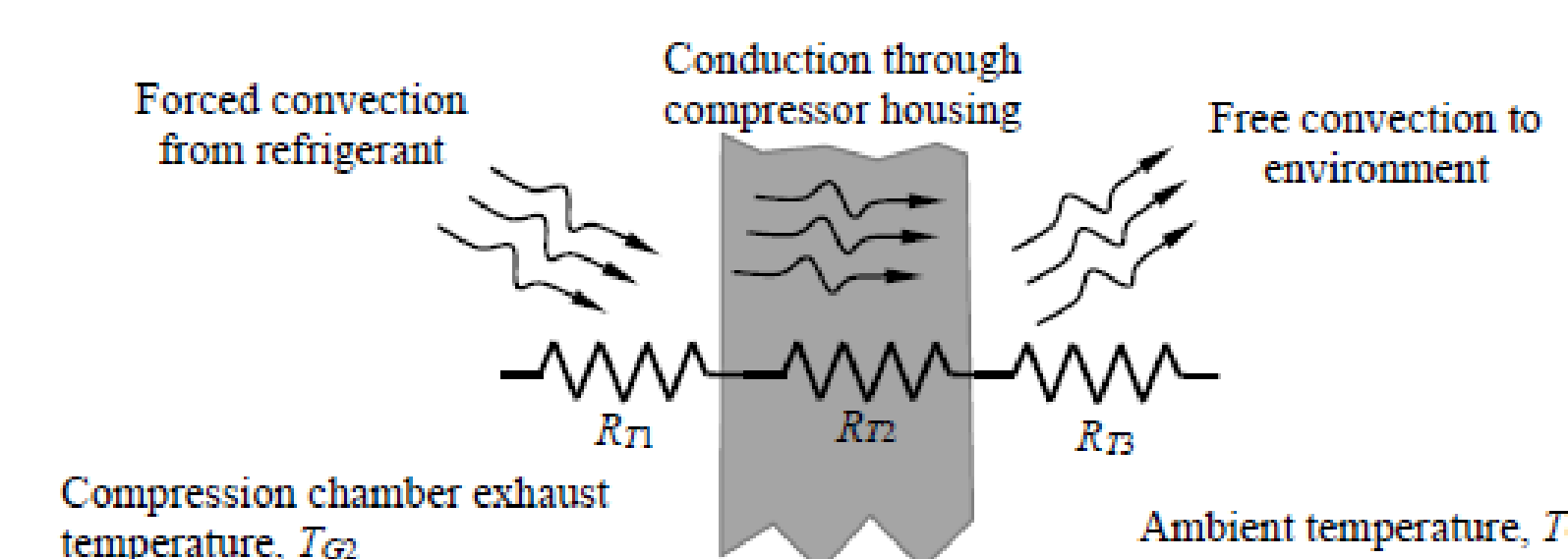
The energy of electrical power W, inlet gas and exhaust gas follow the relationship:

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

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.

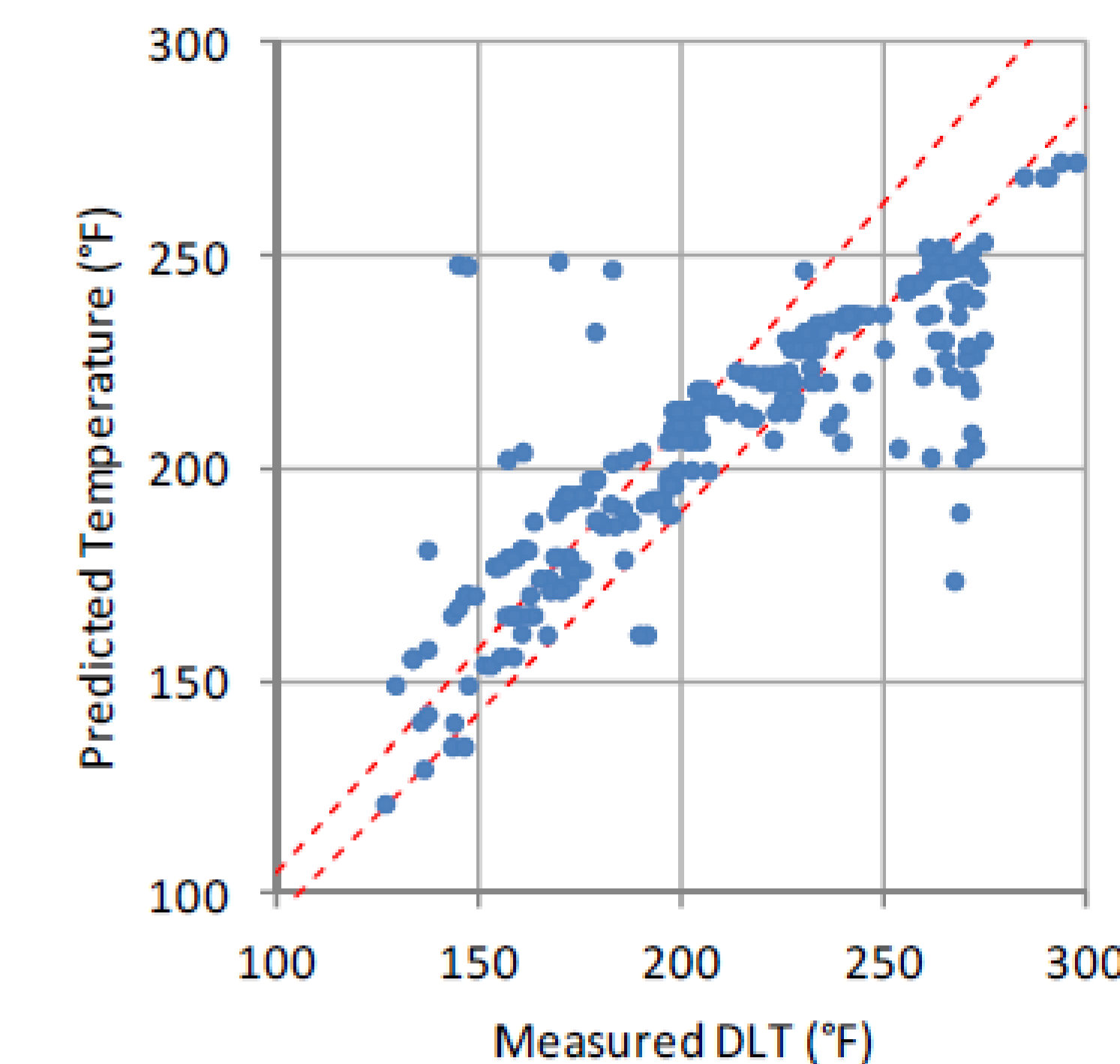
$$m h_3 - Q_{ex} = m h_{DL}$$



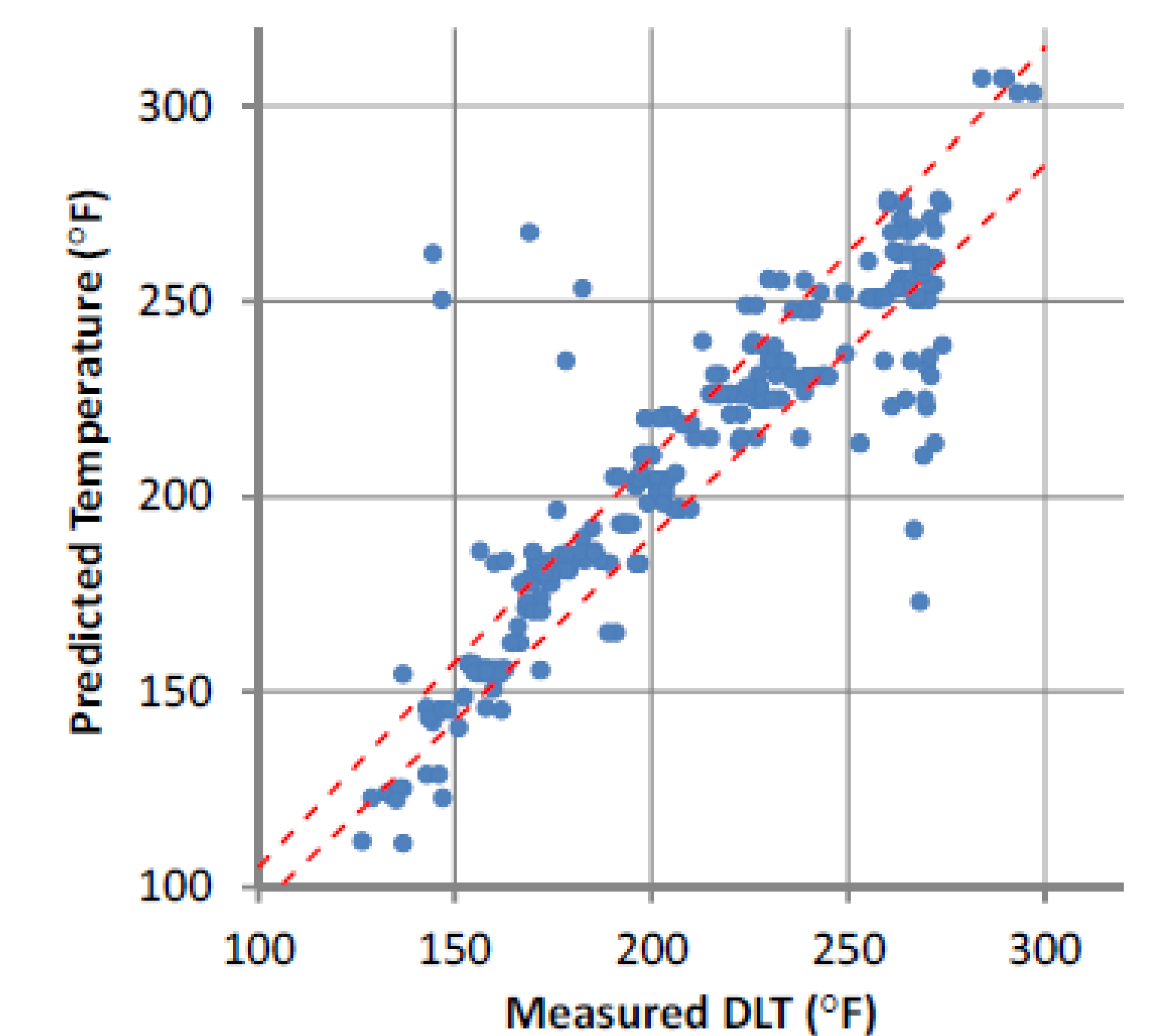
Heat transfer from the refrigerant exiting the compression chamber to environment.

Conclusions

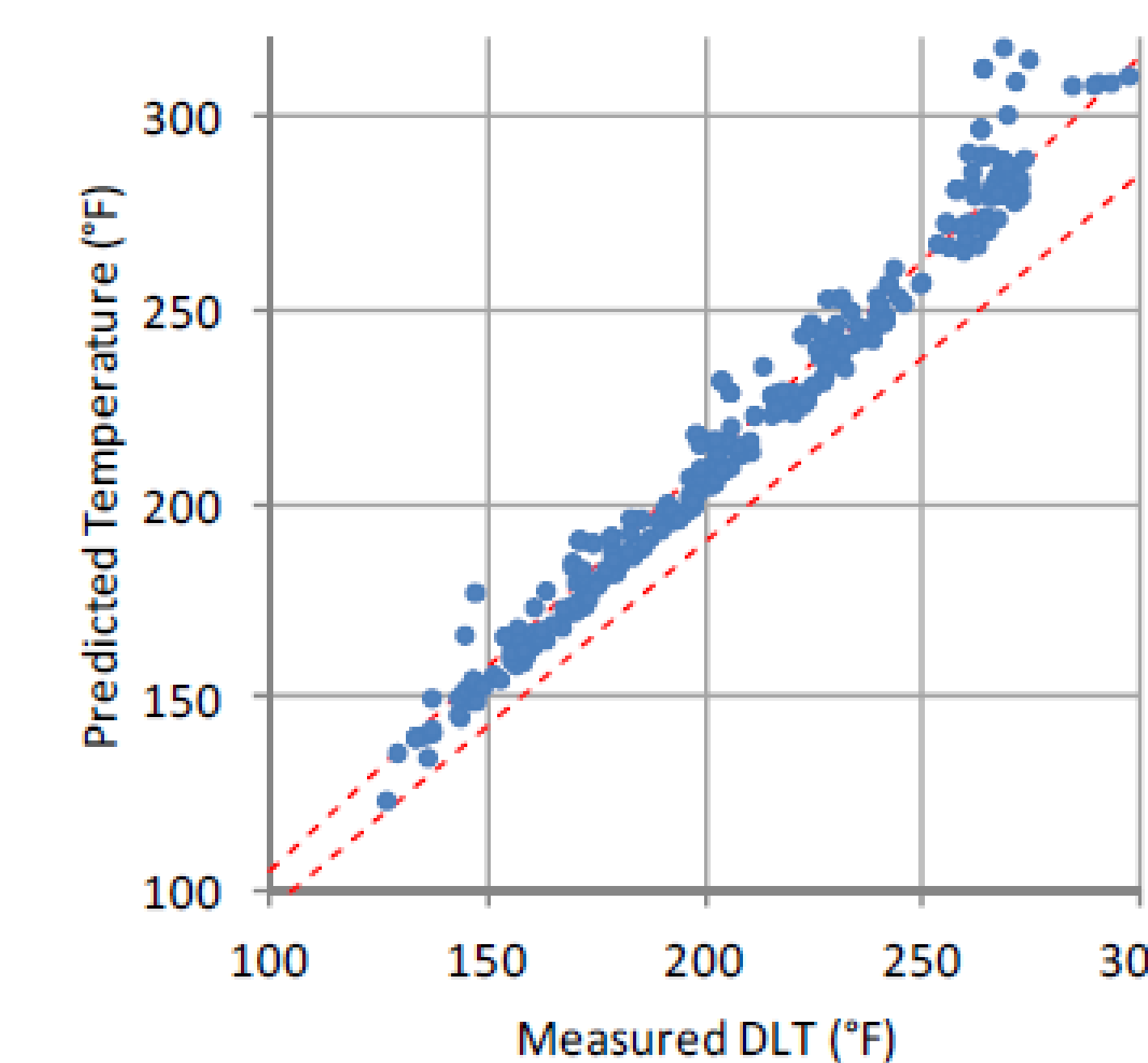
	Calculation Approach			
	Entropy	Polytropic	Energy Balance	Improved Energy Balance
Mean Error	0.00 F°	0.04 F°	11.6 F°	0.00 F°
Std. Dev.	22.47 F°	19.06 F°	8.72 F°	3.30 F°
within ± 5 F°	22.77%	35.31%	19.33%	92.41%
within ± 10 F°	39.60%	61.72%	51.00%	98.35%



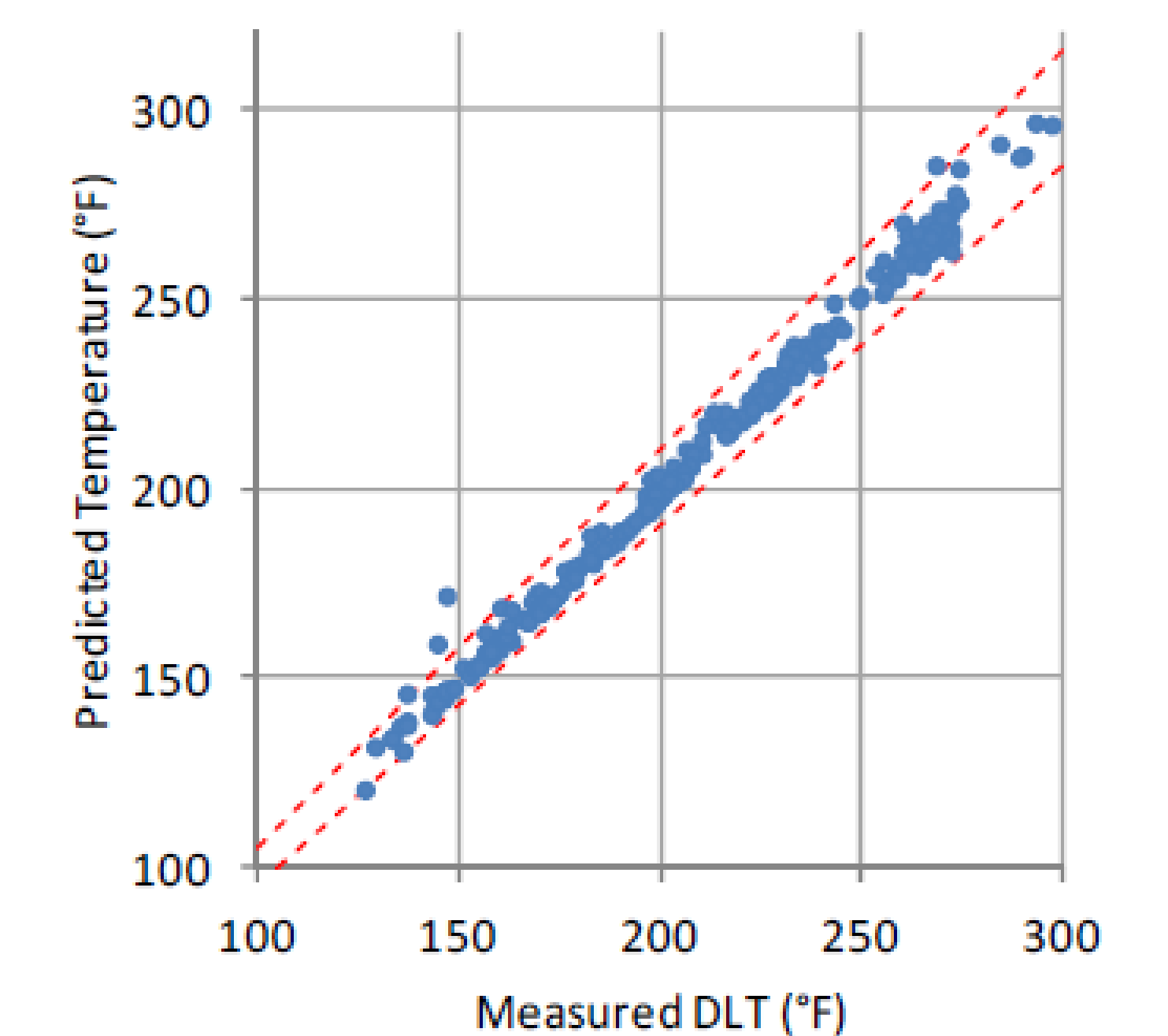
(a) Entropy approach



(b) Polytropic approach



(c) Energy approach



(d) Improved energy approach