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A Structured Software for Presentation of Compressor Information

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ABSTRACT

Since the personal computer was introduced in late seventies, The PC has become a powerful tool for engineers, designers, and analysts. The software for use in the HVAC industry is becoming increasingly popular. After the releasing of ARI 540 Standard, Residential and commercial system designers are able to use the unified performance coefficients in the PC based simulation program to optimize the system design. The compressor specification and performance tables have been used more than ever. A concise, structured, and easily maintained program has been developed for presenting the compressor information.

NOMENCLATURE

$C_1 \sim C_{10}$	Equation coefficients
Cm,Cn	Constants
P_c	Absolute Condensing Pressure
P_e	Absolute Evaporating Pressure
T_c	Saturated Condensing Temperature
T_e	Saturated Evaporating Temperature
T_{sh}	Superheat Temperature
T_{sc}	Subcooling Temperature

INTRODUCTION

After the releasing of ARI 540 Standard, Residential and commercial system designers are able to use the unified performance coefficients in the PC based simulation program to optimize the system design. The compressor specification and performance tables have been used more than ever. A concise, structured, and easily maintained program has been developed for presenting the compressor information.

BACKGROUND

Before the release of the ARI 540 Standard, refrigeration compressor manufacturers usually used the polynomial equations, as functions of saturated temperatures or absolute pressures from the condensing and evaporating conditions, to generate the compressor performance data, as shown in following (1) and (2) below:

(1) $$Y = C_1+C_2T_c+C_3T_c^2+C_4T_e+C_5T_cT_e+C_6T_c^2T_e+C_7T_e^2+C_8T_cT_e^2+C_9T_c^2T_e^2$$

(2) $$Y = C_1+C_2P_c+C_3P_e+C_4P_c^{Cm}+C_5P_e^{Cn}+C_6P_cP_e$$

where: Y = Capacity (Btu/Hr)
Power (watts)
Current (amps)
Mass Flow (lb/hr)

In ARI 540, the unified polynomial equation is a third degree equation with ten coefficients in the form of:

(3) $$Y = C_1+C_2T_e+C_3T_c+C_4T_e^2+C_5T_cT_e+C_6T_c^2+C_7T_e^3+C_8T_cT_e^2+C_9T_c^2T_e+C_{10}T_c^3$$

Also, the standard recommends that the method of least squares be used to establish the coefficients of an equation.

PROGRAM DESCRIPTION

This program was developed to let the customer conveniently obtain the compressor information, which includes product line summary, individual compressor performance table/polynomial coefficients, specification. The executable files in the program were compiled using the easily maintained and low cost compiler, Microsoft™ Quick Basic, version 4.5. This allows execution on any IBM or IBM compatible computer with a DOS™ operating system. The printer routine supports major line and laser printers.

FILE ORGANIZATION

Executable Files

Both the main program and printer routine are executable files that have been compiled independently and that interact together by the "CHAIN" command. The debug code allows the user to push the control/break keys which stops the program during execution. Both files share the BRUN45.EXE path file in order to reduce their size.

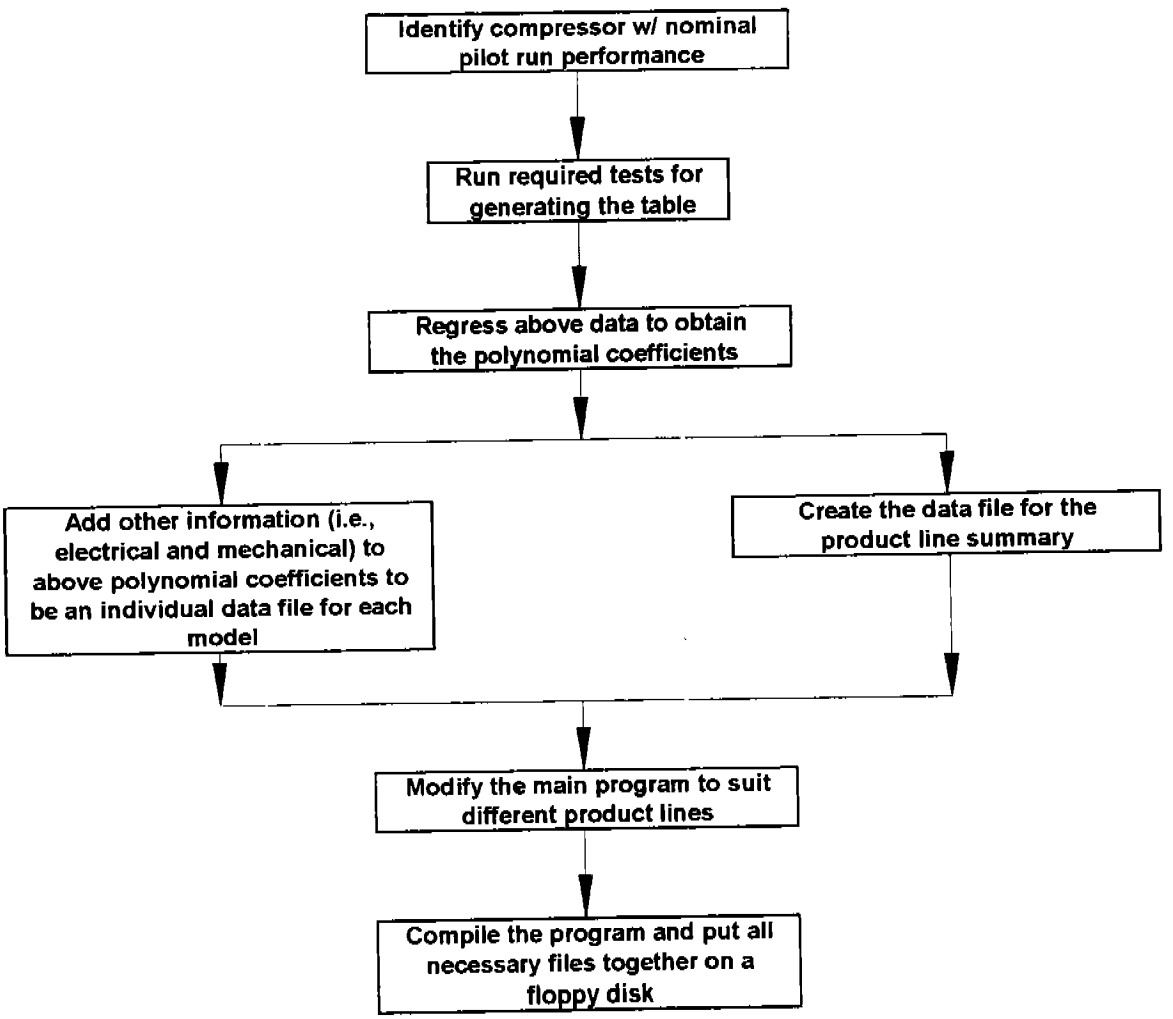
Data Files

The product line summary files are created with control constants at the beginning of the data, which creates a universal format for different product families. In most cases, some combination of four files (i.e. English, Metric, 50Hz, and 60Hz) is needed. The variables or strings, that all four of these files have in common, are stored in one or two data files.

The individual data files for each model combined with the polynomial coefficients, contain all the information needed for the compressor specification. Files that contain different product families, different frequency applications, etc., have different file extensions. This will help reducing any confusion during editing.

PROCEDURE

After finishing the compressors pilot run tests, identify a compressor with nominal performance. Use this compressor to run the required tests at the proper conditions. Obtain the polynomial coefficients by inputting the data first. Regress the input data by using SURFACE in ARI 540 or any regress program with least square method. Create an individual data file for each model, which contains added mechanical and electrical information with the polynomial coefficients. Create separate data file for the product line summary. Modify the main program to suit the different product lines. Compile the main program to create executable files, and put all necessary files together on one floppy.

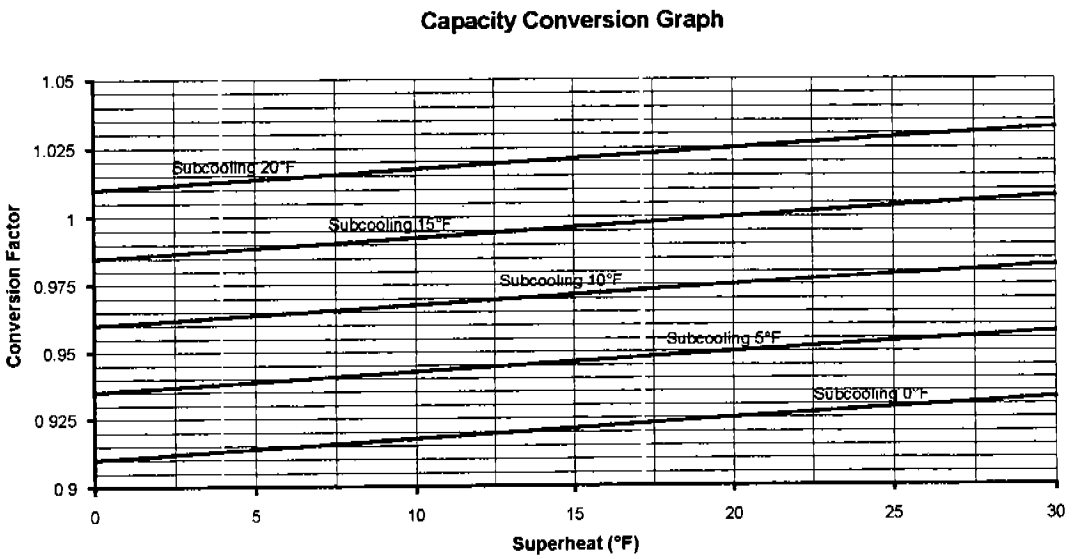


SUPERHEAT AND SUBCOOLING

The effect of superheat and subcooling temperatures on compressor performance needs to be mentioned. The compressor is usually tested at various conditions with constant superheat and subcooling temperatures. Several different correction methods are recommended, which are based on the refrigerant's theoretical enthalpy and density, re-expansion in the compressor, and assumed internal heat transfer. In an actual running compressor, the change due to the superheat and subcooling temperatures can be tested to determine the relative ratio. In most reciprocating compressors, the input power can be assumed dependent only on the pressure difference and the capacity ratio, and could be treated as the function of superheat and subcooling temperatures.

(4) Capacity Ratio = $F(T_{sh}, T_{sc})$

The following graph shows the relationship between capacity conversion factors and different superheat/subcooling temperatures.



CONCLUSION

In order to reduce the expensive cost of hard copies and shipping, the compressor information is being computerized. With data compression technology, all compressor information, for any company product, can be stored in one 1.44 MB floppy disk. The compressor performance table, which should be in polynomial equation form, and the coefficients, need to be easily stored as a data file. This data file should have the ability to be transformed to whatever form is needed, such as a text, ASCII, data base, or spread sheet file. This will provide better service for the system/unit designers in their simulation analysis.

REFERENCES

1. Microsoft Quick Basic - 1988 Microsoft Corporation
2. LaserJet III Printer User's Manual - 1990 Hewlett-Packard Company
3. ARI Standard 540 " Method for Presentation of Compressor Data"
4. DP 9309 - Refrigerant Compressor - Presentation of Performance Data
5. DP 917 - Testing of Refrigerant Compressors