



## ECA OVERVIEW

The Elite Software Earth Coupled Analysis (ECA) Program quickly calculates the required pipe loop length necessary for heating and cooling a building with a given heat pump, soil, pipe material, loop arrangement, and weather conditions. ECA can analyze vertical bore hole, horizontal trench, and slinky systems. In addition to computing pipe lengths, ECA can also generate a complete bill of materials with a cost estimate of the required labor and materials. Pressure losses through the heat pump, header pipe, and the earth coil are computed along with the purge pressure and flow requirements. Heating and cooling runtime fractions are computed on a temperature bin basis. ECA is supplied with built-in data on many pipe types including polyethylene, polybutylene, copper, iron, and others. However, data on all pipe types can be revised and additional pipe types can be defined as well. Equivalent length data for fittings on all pipe types is also included. ECA comes with a heat pump data file containing performance data on models from numerous manufacturers including Florida Heat Pump, Water Furnace, Climate Master, and Trane. There is also provision for the user to add heat pump data from any other manufacturer. For many of these heat pump models, ECA is able to automatically adjust the heat pump capacity and COP values based on changes in entering water temperatures, gpm flow rate, and air flow rates. Heat pump performance is a major factor on the required loop length. Data on all soil types listed in the ASHRAE manual are built-in to ECA, and the user can add more. Weather data for over 250 cities in the USA and Canada are built-in, and the weather data can be revised or added to as much as desired.

## DEMONSTRATION VERSION

If you would like to evaluate the ECA software in further detail, you can **download free of charge** a functional demo of ECA from Elite's web site, [www.elitesoft.com](http://www.elitesoft.com). Alternately, a CDROM can be ordered directly from Elite Software. This evaluation version is a full version of the program but with limitations on the size of the projects allowed. Demonstration versions can be "unlocked" into full versions by typing in a password you'll receive upon purchase.

## ECA FEATURES

- *Calculates Pipe Loop Lengths and Pressure Drops*
- Handles Horizontal, Vertical, and Slinky Systems
- *Includes Automatic Loop Input Data Builder*
- Prints Bill of Materials with Material and Labor Costs
- Computes Minimum Purge GPM and Pressure
- *References Built-in Heat Pump Data*
- Automatically Adjusts Heat Pump Performance Data
- References Built-in Weather Data on 200 Cities
- Supplied with Data on All Common Soil Types
- References Built-in Pipe and Fitting Data
- Links with Elite's RHVAC Load Calculation Program
- Follows OSU and ASHRAE Calculation Procedures
- Instantaneous Input Error Checking
- *Easy-to-edit Databases for Heat Pumps, Weather Data, Pipe Materials, Fittings and Soil*

## CALCULATION METHOD

The ECA Program follows the methodology described in the Design/Data Manual for Closed-Loop Ground-Coupled Heat Pump Systems published by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE). These procedures as published by ASHRAE were developed at the Oklahoma State University. All results computed by the program can be easily verified by hand to be in accordance with ASHRAE.

## PROGRAM INPUT

The ECA program uses standard Windows data entry techniques that provide a full screen, simple "fill in the blank" input procedure. All input data is checked at the time of entry so that no improper data can be entered. If you have a question about what the program is requesting, you can press the F1 key for context sensitive help. Additionally, there is a Hypertext feature that links all help information together. Two major types of data are requested: general project data and specific system data. The general project data includes the project name and location, client and designer names, project location, the building peak heating and cooling loads, the summer and winter design conditions, and the soil thermal properties. The system data includes the system type (vertical, horizontal, or slinky), pipe material, pipe sizes, fitting data, antifreeze type and percentage, minimum and maximum entering water temperatures, series or parallel flow, heat pump capacity, COP and EER values. An automatic loop builder "wizard" is also provided for the fast creation of all types of horizontal and vertical loop configurations. Much of the input data for the heat pump, soil and weather conditions, and pipe materials can be automatically looked up by ECA. There is also provision for extended heat pump performance data that varies the capacity and efficiency of each heat pump model based on changes in water and air flow rates and temperatures, and dry and wet bulb air temperatures.

## SYSTEM REQUIREMENTS

ECA is a Windows program and will run on any computer with Windows 2000 or higher, including Windows 7.

## PROGRAM OUTPUT

The ECA Program provides the following four basic output reports: general project data, pipe length calculations, bill of materials, and pressure drop calculations. In addition to these reports the built-in pipe data, fitting data, and soil data can be printed. The user can specify exactly what reports are to be printed, the left hand margin, and starting page number.

### Elite Software Development Heating and Air Conditioning Company

(409) 846-2340  
(409) 236-1210

#### Project Summary

Client:	Mr. Client	Company:	Hoist, Inc.
Address:	1234 Main Street	Representative:	John Jones
City:	Anytown, TX 77000	Address:	9876 Vine St.
Phone:	(713) 555-5555	City:	Middletown, NY 02000
Fax:	(713) 555-5556	Phone:	(201) 555-5557
		Fax:	(201) 555-5558

#### Summary Report

COOLING		HEATING	
Heat Pump Manufacturer:		CLIMATE MASTER	
Unit Model Number:		CLIMATE MASTER	
		019	
Capacity:	24600 Btuh		23600 Btuh
Unit Efficiency:	11.09		3.60
Building Loads:	14300 Btuh		17000 Btuh
Location:		Houston, Texas	
Soil Type:		Average Rock	
Loop Layout:		Horizontal	
Total System Pressure Drop:		30.25 Ft of Head	
Total Trench Length:		1221.76 Ft	
Total Pipe Length:		2443.53 Ft	
Total Cost of System:		\$4,175.06	

# Sample Reports

#### Pipe and Trench Length Calculation Report

Customer: Mr. Client      Phone: (713) 555-5556  
 Date: September 03, 1999      Address: 1234 Main Street  
 Job Name: Final Results      City, State: Anytown, TX 77000  
 Comment: Test run

#### Pipe Data and Calculations

Loop Layout:	Horizontal
Pipe Description:	SDR 11 IPS
Pipe Thermal Conductivity:	0.226 Btuh/Ft °F
Nominal Pipe Diameter:	0.75 in
Pipe Inside Diameter:	0.68 in
Pipe Outside Diameter:	1.05 in
Pipe Resistance:	0.1406 Ft-Hr*°F/Btu
Reynolds Number (at 2.5 GPM and 1.38 FPS):	8168.799

#### Soil Information

Soil Description:	Average Rock
Soil Thermal Conductivity:	1.4 Btuh/Ft °F
Soil Thermal Diffusivity:	0.04 F <sup>2</sup> /Hr
Soil Resistance:	0.6966 Ft-Hr*°F/Btu

#### Location Information and Calculations

Reference City:	Houston, Texas
Mean Earth Temperature:	70.6 °F
Annual Temperature Swing:	15.7 °F
Lowest Earth Temperature at 6 feet:	61.70 °F
Highest Earth Temperature at 6 feet:	79.80 °F

#### Heat Pump Information and Calculations

Heat Pump Description:	CLIMATE MASTER
	019
Hours of Continuous Heat Pump Operation:	1500 Hrs/Year
Heating Coefficient of Performance:	3.80
Cooling Coefficient of Performance:	11.09
Minimum Entering Water Temperature:	60 °F
Maximum Entering Water Temperature:	86 °F
Cooling Run Time Fraction:	0.2798
Heating Run Time Fraction:	0.1615
Strip Heating Required:	0.0000 kW/H
Strip Heat Energy Required:	0.0000 kW/H

#### General Project Information

Customer: Mr. Client      Phone: (713) 555-5556  
 Date: September 03, 1999      Address: 1234 Main Street  
 Job Name: Final Results      City, State: Anytown, TX 77000  
 Comment: Test run

#### Project Location Information

Project Location: Houston, Texas  
 General Comment: Test run

#### General Costs

Drilling Cost Per Foot:	\$2.50
Trenching Cost Per Foot:	\$1.50
Circulating Pump Cost:	\$300.00
Antifreeze Cost Per Gallon:	\$4.00
Miscellaneous Material Costs:	\$500.00
Miscellaneous Labor Costs:	\$400.00

#### Heating Loads

Building Heating Load:	17000 Btuh
Winter Balance Temperature:	60 °F
Outdoor Design Temperature:	15 °F
Indoor Design Temperature:	70 °F

#### Cooling Loads

Building Cooling Load:	14300 Btuh
Summer Balance Temperature:	70 °F
Outdoor Design Temperature:	100 °F
Indoor Design Temperature:	75 °F

#### Miscellaneous Properties

Soil Description:	Average Rock
Heat Pump Operating Time:	1500 Hrs/Year
Circulating Fluid Density:	62.37 Lb/FP
Circulating Fluid Viscosity:	2.72 Lb/Hr-Ft
Minimum Purge Velocity:	2 F/Sec

#### Pressure Drop Calculation Report

Customer: Mr. Client      Phone: (713) 555-5556  
 Date: September 03, 1999      Address: 1234 Main Street  
 Job Name: Final Results      City, State: Anytown, TX 77000  
 Comment: Test run

#### Equipment Room Pipe and Fitting Data

Pipe Data	Number of Fittings	Fitting Type
Pipe Type: SCH 40 IPS	4	Regular 90° Elbow
Pipe Length: 120 ft		
Pipe Diameter: 1 in		

#### Header Pipe and Fitting Data

Pipe Data	Number of Fittings	Fitting Type
Pipe Type: SCH 40 IPS	2	Reducer
Pipe Length: 40 ft		
Pipe Diameter: 1.5 in		

#### Earth Loop Pipe and Fitting Data

Pipe Data	Number of Fittings	Fitting Type
Pipe Type: SDR 11 IPS		
Pipe Length: 2443.528 ft		
Pipe Diameter: 0.75 in		

#### Pressure Drop Data

Equipment Room Drop:	0.54	Feet of Head
Heat Pump Drop:	2.34	Feet of Head
Header Pipe Drop:	0.07	Feet of Head
Loop System Drop:	27.29	Feet of Head
Total System Drop:	30.25	Feet of Head
System Purge Flow:	12.69	Gal Per Min
System Purge Pressure:	562.71	Feet of Head
Gallons of Fluid in System:	83.35	Gallons
Minimum Purge Velocity:	2.00	Feet Per Sec

#### Pipe Length and Trench Calculations

Number of Pipes:	2
Average Pipe Depth:	6 Ft
Required Earth Coil Length Per Ton of Heating:	1253.493 Ft/Ton
Actual Earth Coil Length Per Ton of Heating:	1253.493 Ft/Ton
Required Trench Length for Heating:	1221.764 Ft
Required Pipe Length for Heating:	2443.528 Ft
Required Earth Coil Length Per Ton of Cooling:	929.485 Ft/Ton
Actual Earth Coil Length Per Ton of Cooling:	811.4391 Ft/Ton
Required Trench Length for Cooling:	840.5196 Ft
Required Pipe Length for Cooling:	1681.039 Ft
Total Actual Trench Length:	1221.764 Ft
Total Actual Pipe Length:	2443.528 Ft