



The diagram illustrates various HVAC components and processes. It includes a duct section, a psychrometric chart with axes for Enthalpy-H, Humidity-W, and Dry Bulb Temperature, a fan, a pipe with a 2-inch diameter, a coil with AWG 12 wire, and a wall cross-section. A list of 13 HVAC tasks is provided in the center.

### HVAC TOOLS

1. DUCT SIZING
2. WIRE SIZING
3. COIL INTERPOLATION
4. STATE POINT PSYCHROMETRICS
5. MIXED AIR PSYCHROMETRICS
6. FAN CURVE ANALYSIS
7. FAN COST ANALYSIS
8. U-FACTOR
9. REFRIGERATION LINE SIZING
10. GENERAL PIPE SIZING
11. NATURAL GAS PIPE SIZING
12. HOT/CHILLED WATER ANALYSIS
13. HVAC FORMULAS

$$CFM = \frac{LOAD}{1.1 \cdot \Delta T}$$

$$Q = U \cdot A \cdot \Delta T$$

## HVAC TOOLS OVERVIEW

The Elite Software HVAC Tools program allows the quick calculation of 13 common HVAC design tasks. These tasks include duct sizing, wire sizing, three way interpolation of coil and other performance data, mixed air and state point psychrometrics, fan curve and fan operating cost analysis, U-Factor calculations, natural gas (both high and low pressure) pipe sizing, refrigerant line sizing using ASHRAE tables for all the most popular refrigerants, general pipe sizing, hot/chilled water pipe analysis and the quick look-up of common HVAC formulas and conversion factors. HVAC Tools is designed to be used as a quick utility for calculating all of these common tasks. Minimal input is required for each function, and results are instantly displayed on the same screen as the input data. Some of the functions in HVAC Tools are also covered by other Elite programs. For example, duct sizing is done on a system wide basis for multiple duct sections at a time in Elite's ASHRAE Ductsize program and in Elite's ACCA Manual D Ductsize program. The HVAC Tools program just sizes one duct at a time in order to minimize the data entry required. The same situation exists with psychrometrics, pipe sizing, and wire sizing. Elite has numerous programs you may want to consider that address these applications on a complete system basis. For example, Elite Software's H-Sym program does a complete hot and chilled water pipe network analysis. Other piping system programs from Elite Software include Fire for hydraulic sprinkler system analysis, S-Pipe for hot and cold water domestic service supply piping, and D-Pipe for drainage waste pipe, stack, and vent sizing. The PsyChart program does a complete graphic psychrometric analysis. HVAC Tools is a simple and easy to use Windows program that is designed for both engineers and contractors.

## DEMONSTRATION VERSION

If you would like to evaluate HVAC Tools in further detail, you can **download free of charge** a functional demo of HVAC Tools from Elite Software's web site, [www.elitesoft.com](http://www.elitesoft.com) This evaluation version is a full version of the program, but with limitations on the size of the projects allowed.

## HVAC TOOLS FEATURES

- Automates 13 Common HVAC Design Tasks
- Follows ASHRAE and NEC Procedures
- Works in both English (IP) and Metric Units (SI)
- Sizes Round and Rectangular Duct Sections
- Sizes Wire Based on Ampacity and % Voltage Drop
- **Sizes Pipes and Refrigerant Lines**
- Performs Fan Curve and Cost Analysis
- Performs Mixed Air and State Point Psychrometrics
- Performs Three Way Interpolation of HVAC Units
- Automatic U-Factor Calculations for Roofs, Walls, etc.
- Hot and Chilled Water Pipe Sizing and Analysis
- **High and Low Pressure Natural Gas Pipe Sizing**
- Quick Look-Up of Common HVAC Formulas
- Every Tool Uses Simple One Screen Data Input
- Provides Comprehensive and Concise Reports

## CALCULATION METHOD

All HVAC related items in the HVAC Tools program follow the methodology described in the ASHRAE Handbook of Fundamentals. The wire sizing procedures are based on the National Electric Code. For more electrical calculations see also Elite's Electrical Tools program. All results computed by the HVAC Tools program can be easily verified by hand.

## PROGRAM INPUT

The HVAC Tools program is a Windows program, and operates in standard Windows fashion, complete with toolbars and hyper-linked help. All input data is checked at the time of entry so that no improper data can be entered. Most functions of HVAC Tools requires only one screen of input data, and many require only a few items of input data. Others, like the HVAC Formula look-up, require almost no input data. The Duct Size function, for example, requires the length of the duct, the cfm of air carried by the duct, the desired pressure loss per 100 feet of duct, and the material of the duct. There is also provision for entering height and width constraints along with minimum and maximum velocity constraints. Both round and rectangular sizes can be calculated. The Refrigerant Line Sizing function requires refrigerant type, tonnage, temperatures, pipe lengths and type. Most common refrigerant types are built into the software including **R22, R-410a, R-134a, R-404a, R-407c, R-502, R-507, and Ammonia**. The Psychrometric function requires only two conditions to determine all other properties of air for a given state. The Fan Curve Analysis function only requires any two of the following inputs: fan rpm, cfm, static pressure, or brake horsepower. The Wire Sizing function requires the load in either amps, horsepower, or kVA. Given the voltage, wire length, material (aluminum or copper) and conduit type, HVAC Tools calculates for the smallest wire that does not exceed NEC ampacity ratings or the user specified allowable percentage voltage drop.

## SYSTEM REQUIREMENTS

HVAC Tools will run on any computer with Windows 2000 or higher, including Windows 7 and 8.

## PROGRAM OUTPUT

The HVAC Tools program provides presentation quality reports for all 13 functions, including a title page. Shown below are just some of the many screens that can be previewed or printed.

**Refrigerant Line Sizing - Case 1 of 1**

Case No.: 1 Units: Default  
Name: Refrigerant Line Sizing - Sample Project

**At System Capacity**

System Capacity (Tons): 5  
Saturated Suction Temp (Range: -40 to 40): 40 °F  
Condensing Temp (Range: 80 to 140): 140 °F

**At Minimum Capacity**

Minimum Capacity (Tons): 2  
Saturated Suction Temp: 20 °F  
Suction Superheat: 10 °F  
Saturated Condensing Temp: 90 °F  
Discharge Gas Temp: 120 °F  
Liquid Temp: 90 °F

**General**

Refrigerant Type: R-22  
Pipe Material: Copper  
Temperature: °F / °C  
Pressure: psi / Pa  
Length: ft / m  
Line Size: in / cm

**Input Data**

	Suction	Discharge	Liquid
Total Line Length (ft)	26	32	12
Design Pressure Drop (°F)	2	2	2
Additional Loss (psi)	0	0	0
Additional Feet of Loss (ft)	0	0	0
Riser Length (ft)	3	13	N/A
Double Riser	No	No	N/A

**Fittings**

	Suction	Discharge	Liquid
90° Long Radius Elbows	6	5	2
90° Standard Elbows	0	N/A	0
90° Street Elbows	0	N/A	N/A
Branch Tees	0	0	0
Through Tees, No Reduction	0	N/A	0
Through Tees, 1/4 Reduction	0	N/A	0
Through Tees, 1/2 Reduction	0	N/A	0
Globe Valves	0	0	0
Swing Check Valves	0	0	0

**Sizing Results**

	Suction	Discharge	Liquid
Horizontal Line (in)	1.125	0	0
Vertical Riser A (in)	0	0	N/A
Vertical Riser B (in)	0	0	N/A
Actual Horizontal Drop (°F)	0.67	0	0
Actual Vertical Drop (°F)	0	0	N/A
Total Temperature Drop (°F)	0.67	0	0
Total Pressure Drop (psi)	0.97486	0	0

Errors: No errors were found.

**Psychrometrics - Mixed Air - Case 1 of 1**

Case No.: 1 Units: Default  
Name: Psychrometrics - Mixed Air Sample

**Psychrometric Properties**

	Source 1	Source 2	Mixed Air
Air Flow Rate (CFM)	5000	15000	20000
Dry Bulb Temperature (°F)	40	75	66.371
Wet Bulb Temperature (°F)	35	0	55.194
Relative Humidity (%)	0	50	57.07911
Vapor Pressure (psia)	0	0	0.10506
Dew Point Temperature (°F)	0	0	50.738
Moisture Content (Grains/lb)	0	0	99.37768
Specific Volume (ft³/lb)	0	0	24.03474
Enthalpy (Btu/lb)	0	0	31.41017

**General**

Elevation: 15000 ft  
Barometric Pressure: 16.88568 inHg

**Units Options**

Flow: CFM / L/sec  
Temperature: °F / °C  
Pressure: psia / Pa  
Moisture Content: Grains/lb / Grains/kg  
Specific Volume: ft³/lb / cm³/g  
Barometric Pressure: atm / mmHg

No errors were found.

**General Pipe Sizing - Case 1 of 1**

Case No.: 1 Units: Default  
Name: Pipe Sizing Sample Project

**Inputs**

Pipe Type: Schedule 40 Steel Galv  
Roughness Factor (ft): 0.0005  
Fluid Type: Water  
Fluid Density (lb/ft³): 62.34  
Fluid Viscosity (lb/ft-hr): 2.753  
Design Flow Rate (gpm): 2  
Design Head Loss (ft/100ft): 1

**Calculated Results**

Head Loss (ft/100ft): 1  
Fluid Velocity (ft/s): 1.13377  
Inside Diameter (in): 0.84888

**Actual Results**

Head Loss (ft/100ft): 0.36606  
Fluid Velocity (ft/s): 0.74245  
Inside Diameter (in): 1.049  
Nominal Diameter (in): 1

**Units**

Roughness: ft / m  
Density: lb/ft³ / kg/m³  
Viscosity: lb/ft-hr / mN-s/m²  
Flow Rate: gpm / L/min  
Diameter: in / mm

**Constraints**

Diameter (in): Min 1, Max 3  
Velocity (ft/s): Min 0, Max 0

Errors: No errors were found.

# Sample Screens

**Fan Curve - Case 1 of 1**

Case No.: 1 Units: Default  
Name: Fan Curve Sample Project

**Performance Variables**

	Rated	Specified	Unit
Fan Speed	1025	900	RPM
Volume Flow Rate	1000	0	CFM
Static Pressure	0.6	0	inHg
Brake Horsepower	0.32	0	hp

**Results**

Fan Speed: 900 RPM  
Volume Flow Rate: 878.049 CFM  
Static Pressure: 0.463 inHg  
Brake Horsepower: 0.217 hp

Errors: No errors were found.

**Unit Options**

Flow: English: CFM, Metric: L/sec  
Pressure: English: inHg, Metric: bar

**Fan Cost - Case 1 of 1**

Case No.: 1 Units: Default  
Name: Fan Cost Sample Project

**Fan Properties**

Fan Type: Forward Curved  
Fan Brake Horsepower (hp): 0.32  
Design Fan Air Flow (CFM): 0  
Motor Efficiency (%): 90  
Fan Efficiency (%): 60  
Power Cost (\$/kWh): 0.07  
Total Static Pressure (inHg): 0

**General**

English Flow: CFM  
Metric Flow: m³/hr  
English Pressure: inHg  
Metric Pressure: bar

Calculate Brake Horsepower:

**Part Load Performance Data**

	10	20	30	40	50	60	70	80	90	100
Percent Design Fan Air Flow	60	200	600	900	1200	1500	1500	1400	900	500
Operating Hours	0.26	0.32	0.39	0.46	0.54	0.62	0.71	0.8	0.9	1
Part Load Performance	0.083	0.102	0.125	0.147	0.173	0.198	0.227	0.256	0.288	0.32
Fan Brake Horsepower (hp)	0.069	0.085	0.103	0.122	0.143	0.164	0.188	0.212	0.239	0.265
Power Input (kW)	4.138	16.976	62.067	109.811	171.878	246.677	282.485	297.074	214.948	132.622

**Results**

Total Operating Hours: 8760  
Total Fan kWh: 1538.577  
Total Cost: \$ 107.70