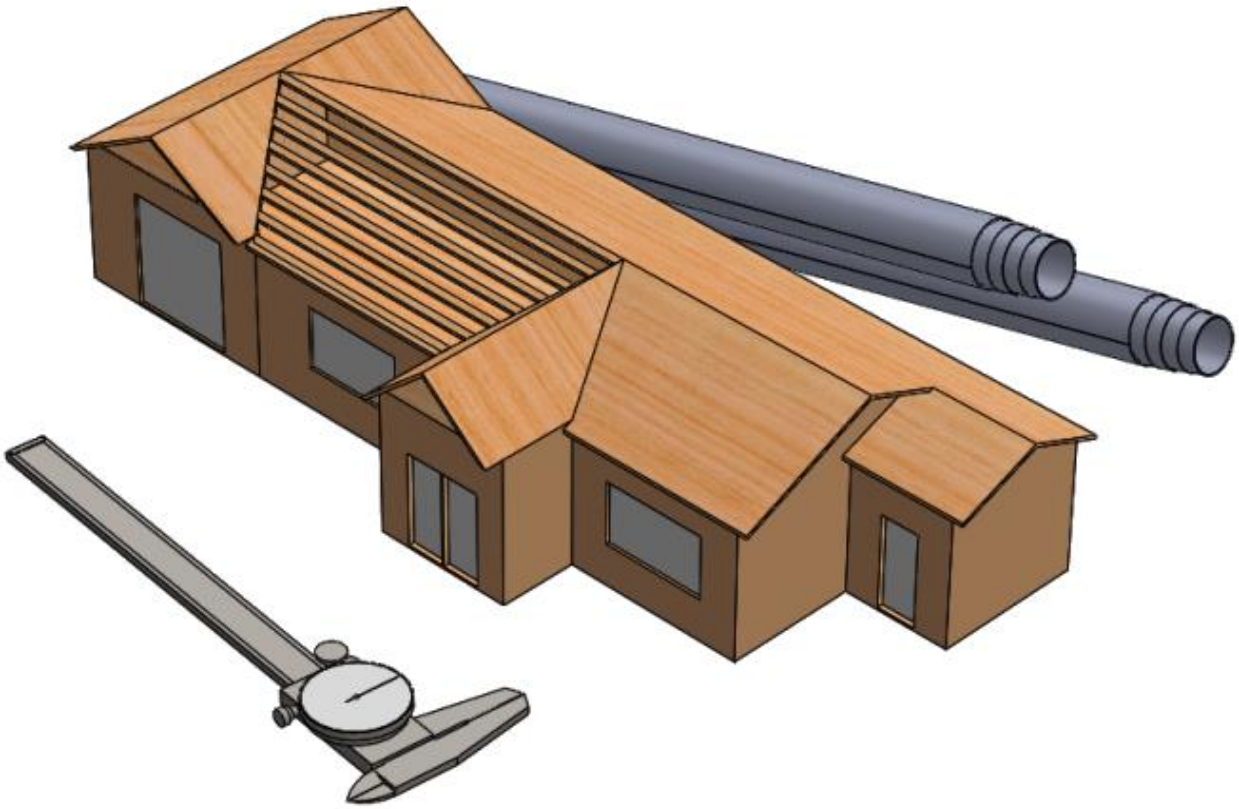
System Sizing & Performance Tables (*SSPT)*

CLASSIC and PRIME series - Heating and Cooling



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ENERGY STAR

Disclaimer

This manual contains system sizing procedures and performance tables for EarthLinked® Heating and Cooling systems which may be combined with field specified, hydronic components, thermostats, water heaters, water storage tanks and associated fittings, controls and piping.

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COMPLIES WITH
IEC 60204-1
IEC 60335-2-40
IEC 61000-3-11

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I. System Sizing Guidelines

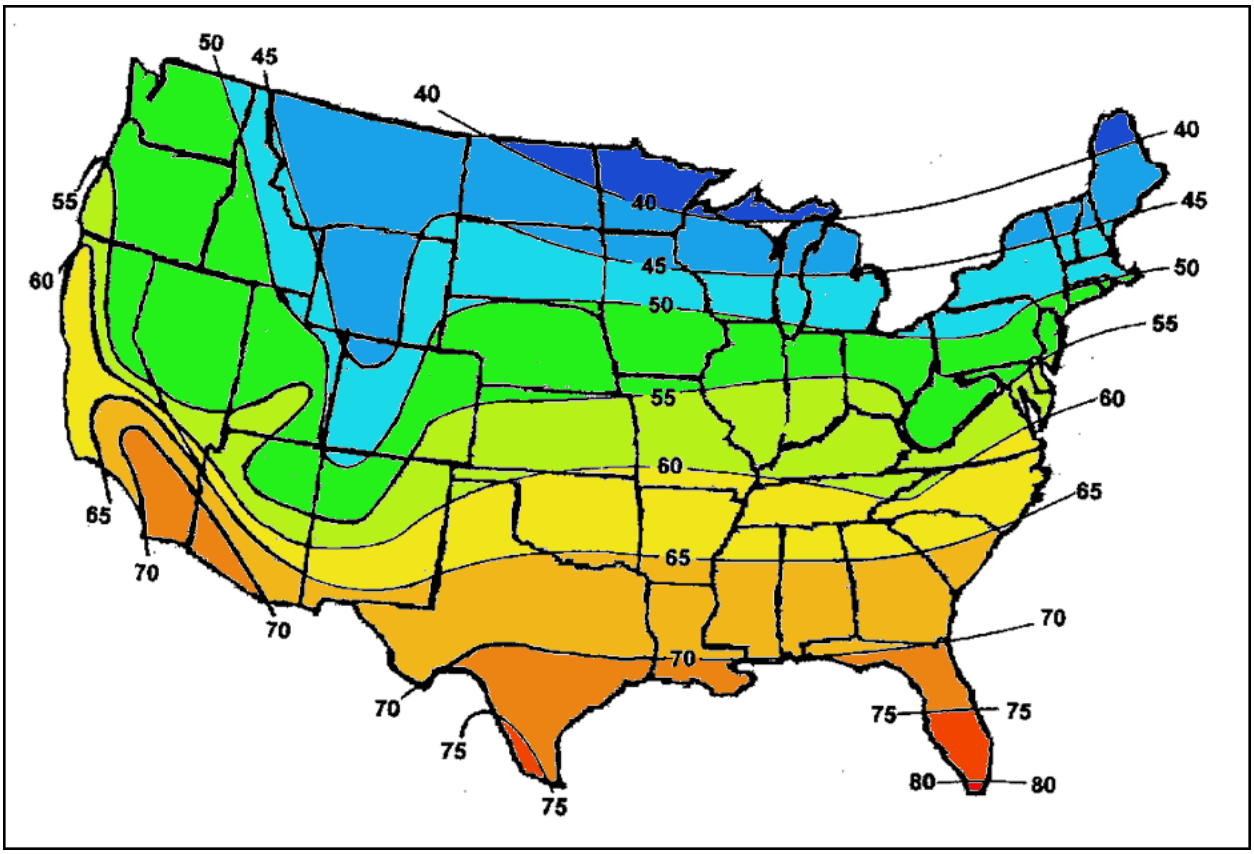
Please note that compressor **nominal capacities** are given in **kBTUH** and not in Tons.

This Manual describes the procedure to size an EarthLinked system. This will ensure that the house heating and cooling needs will be covered by the EarthLinked Geothermal System between the ASHRAE 99.6% heating design temperature and the 0.4% cooling design temperature.

1) Sizing factors

To ensure comfort and maximize economy of operation for the homeowner, EarthLinked® Systems must be sized properly for the application.
System Sizing is a function of the following 3 factors:

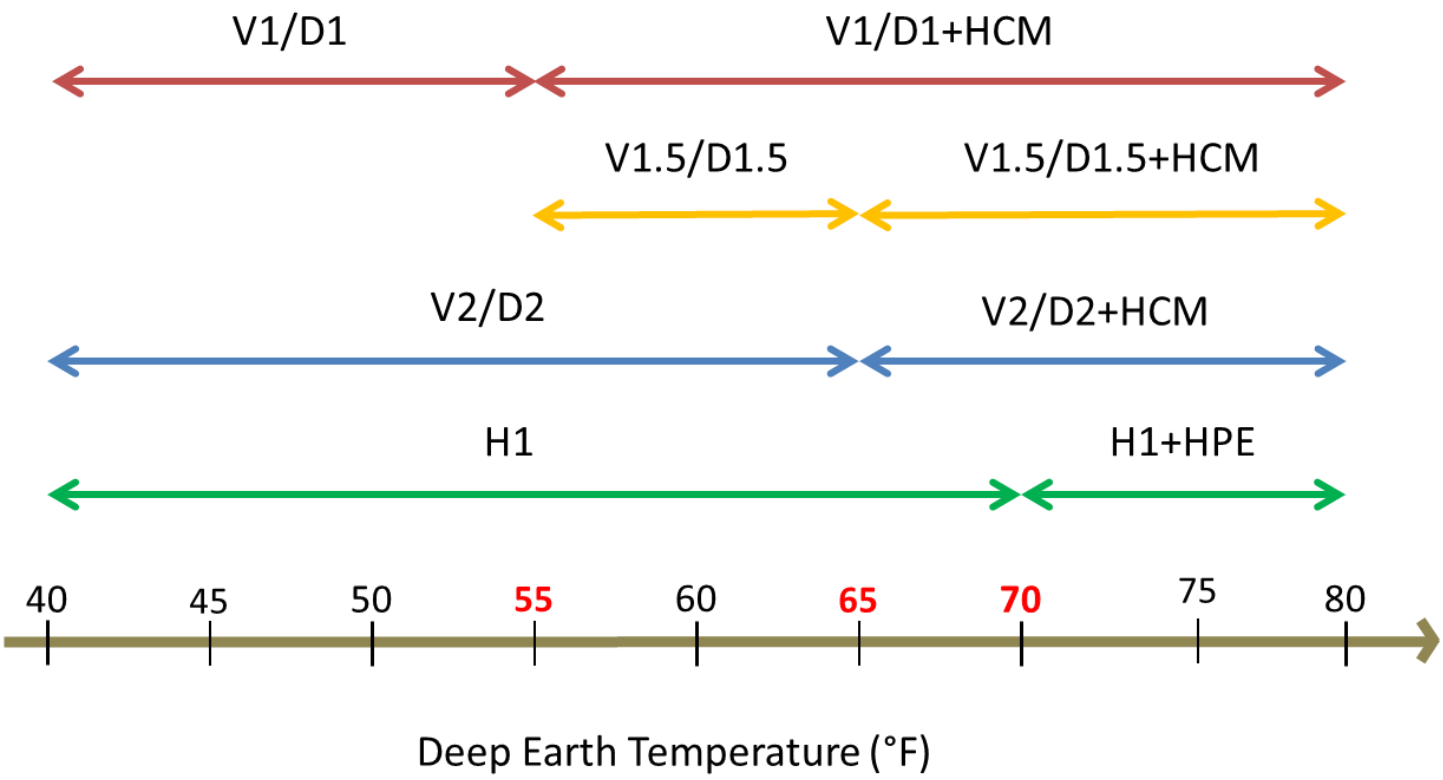
1) Heating and Cooling Loads: The requirement to calculate the heating and cooling loads of the structure in accordance with the **ACCA Manual J** (latest edition) or ASHRAE procedures is absolutely necessary. Use the outdoor design temperatures listed in *Section III*.
2) Mean Ground Temperature: The performance of the EarthLinked® System depends on the deep ground temperatures.
   The deep earth temperatures for the contiguous United States and southern Canada are shown below on the map. For locations between the lines shown below: (1) **ROUND DOWN** to the lower temperature line for heating dominant loads and (2) **ROUND UP** to the higher temperature line for cooling dominant loads.



Earth Temperature in Contiguous United States and Southern Canada

3) Earth Loop Configuration: The most appropriate type of earth loop for the application will be based on the local earth geology and space available for installation of the earth loop system. For specification of the most appropriate earth loop system for the application, refer to the EarthLinked® Earth Loop Manual.

Range of use of loops as a function of deep Earth Temperature



2) Primary requirements

Primary Requirements for Specifying an EarthLinked System

1) All EarthLinked® space heating and cooling systems must be equipped with supplemental heat with a rating of at least **20% of heating load**.
2) EarthLinked® compressor units that provide space cooling shall be equipped with an EarthLinked® Hybrid Cooling Module (**HCM**) when:
   a. Required by the performance tables (see *Section IV*)
   b. or when **BOTH** of the following **circumstances** occur:
      - Ambient outdoor temperatures have exceeded the outdoor summer design temperature conditions (see *Section III*) for at least **7 hours** of continuous system run time
      - In presence of soil with **low thermal conductivity** that do not effectively absorb and dissipate heat. Examples of such soils are light dry soil, dry sand, peat and organic soils, dry clay and hardpan.

No Cooling capacity or efficiency adjustments are necessary for the addition of the Hybrid Cooling Module (HCM) to the system.

3) EarthLinked® compressor units that provide heating and cooling shall be factory-equipped with a Heating Performance Enhancement Kit (**HPE**) when required by the performance tables (see *Section IV*). It is recommended for any applications – especially **commercial** - where automatic change-over or switching between heating and cooling occurs within a 24-hour period.
4) The following restrictions apply to the application of a copper earth loop system as a component of an EarthLinked® Heating and Cooling System:
   a. Do not install an earth loop system in **soils with high concentrations** of acids, chlorides, sulfides, sulfates, carbon, coal, cinders or ammonia; or **organic soils** with anaerobic bacteria, or in **coastal areas** with brackish water marches, salt water intrusions or acidic peat bogs.
   Prior to drilling or excavating for the earth loop system, it is the responsibility of the EarthLinked® system specifier to determine the presence of these noted concentrations by taking soil samples at manifold and other appropriate depths below the ground surface and at appropriate multiple locations within the intended earth loop field. Further, the **soil is to be sampled, analyzed and documented by a licensed soil testing laboratory**.
   b. **DO NOT** install an earth loop system within **½ mile of a salt water sea shore** or any tidal body of water.
5) Do not install components or equipment with an EarthLinked® system that are not safety listed by an industry recognized safety standards agency such as UL or ETL.
6) The use of non-listed or "home-made" earth loops, heat exchangers, air handlers, cased coils, etc. will jeopardize the system safety and performance and will void the warranty.
7) Do not deviate from the **guideline piping configurations** in the appropriate EarthLinked® Quick-Start manual for the system being specified, without **prior written approval** from EarthLinked Technologies, Inc. Technical support at 1-863-701-0096.
8) Specifications for an EarthLinked® system must adhere to the above requirements and other requirements stated in this manual. **Failure to do so** will result in **financial consequences** for the installer and will void the EarthLinked® Heat Pump HVAC Components and DIRECT AXXESS® Earth Loops Limited Warranty.

3) Optimal system sizing and Auxiliary Heat

a. *Optimal system mix*

EarthLinked offers the two options when designing an EarthLinked Geothermal System:

1. Design the system to satisfy 100% of the Design Heating Load with geothermal heating.
2. Design a system that features a mix of geothermal heating and supplemental heat to satisfy the Design Heating Load.

Therefore, when selecting an EarthLinked Geothermal System and sizing it to meet the loads of a house, one must resolve the tension between two opposing economic logic in order to choose the optimal system to install. The first logic wants to minimize the cost of operation of the system and recognizes geothermal as the most efficient solution and the cheapest to operate. The second logic wants to minimize the cost of installation of the system and resorts to auxiliary source of heat to find an optimal system mix. This second logic makes use of the fact that a geothermal system can be supplemented by an auxiliary heat source to meet the heating load. **IN ANY CIRCUMSTANCES, THE SYSTEM SHOULD NEVER BE UNDERSIZED ON THE COOLING SIDE (MEANING: NEVER LESS THAN 105% OF TOTAL AND SENSIBLE COOLING LOADS).**

In both scenarios one must find an economic optimum – which will differ from one project to the next - tailored to the home owner and his expressed needs. To facilitate the calculation of this economic optimum, EarthLinked has partnered with GeoConnections, Inc. to develop a **customized version of LoopLink** (see section I.3) b.)

1) 100% Geothermal System

If cost of installation isn't an issue, EarthLinked Geothermal Heat Pumps remain the most efficient systems and an ideal solution to minimize cost of operations of the system. In this case, Auxiliary Heat will only serve as supplementary heat. Auxiliary Heat is a **required component** of the system.

EarthLinked requires that supplemental heat with a rating of **at least 20% of the heating load**, in BTUH, is installed with the system to anticipate extreme weather conditions when design temperatures may be exceeded. Auxiliary heat can also serve as emergency back-up heat.

If Auxiliary Heat is to be electrical, EarthLinked Air Handlers are shipped with a **minimum Heat Strip of 5kW**, which covers this 20% Auxiliary Heat requirement all the way through 60 kBTUH of nominal capacity.

$$\text{Minimum Auxiliary Heat (kW)} = \frac{\text{Heating load (BTUH)} * 0.2}{3412}$$

2) System Mix

If cost of installation is a problematic issue, one can resort to back-up systems for heating such as supplemental electrical heat or dual fuel. To optimize the system mix and decide what the ideal proportion of back-up heat is and determine an economic balance point, EarthLinked developed the **EarthLinked Geothermal Design Software** with GeoConnections, Inc. (see LoopLink see section I.3) b.). This web tool will allow you to look at the operating profile of your chosen system mix and see the impact on operating costs.

CASE STUDY:

1. Let's create a project on EarthLinked's LoopLink with the following specifications:
    - *Location: Charlotte, NC*
    - *Deep Earth Temperature: 62°C*
    - ASHRAE 99.6% Heating Design Condition: 19 °F
    - ASHRAE 0.4% Cooling Design Condition: 94 °F
    - *Heating Load: 39,050 BTUH*
    - *Cooling Load: 25,500 BTUH*

2. We select the following system for example:
    - *Compressor: PSC-030 (Prime Series, 2.5 ton)*
    - *Loop: H1*
    - *Back-Up System: Supplemental (electric resistance)*
3. LoopLink shows the following system output

Heating Capacity: 29,112 BTUH *Total Cooling Capacity: 38,040 BTUH*

% Sizing (heating load): 75.6 % *Sensible Cooling Capacity: 28,530 BTUH*

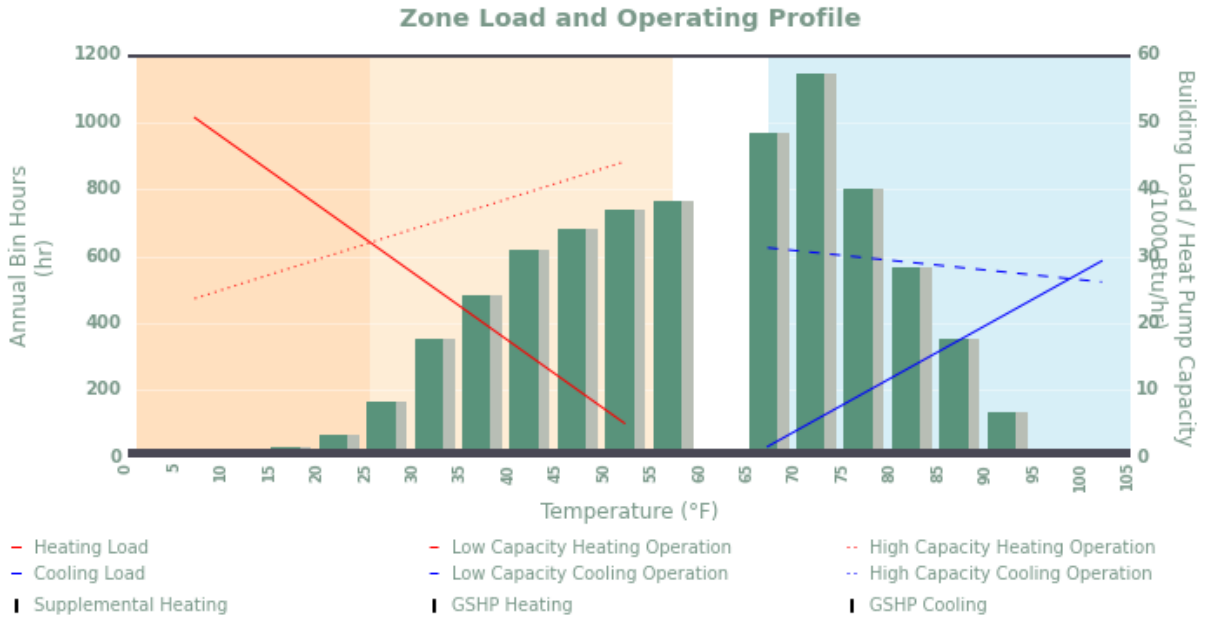
% Energy from Geothermal: 98.1 % *% Oversizing: 24.3 %*

Building Balance Point Temperature: 25.6 °F

GSHP Heating Operating Cost: $329.29 GSHP Cooling Operating Cost: $159.79

Supplemental Cost: $26.46

As can be seen, the cooling load is fully covered (minimum of 5% of oversizing required) but the heating load is only covered by 75.6% by the EarthLinked geothermal system. However the annual energy covered solely by the geothermal system is of 98.1% and supplemental heat only represents an additional $26.46 a year. This can be explained by studying the operating profile below (automatically generated by LoopLink):



In this case, the number of bin hours below Building Balance Point temperature (*the outdoor air temperature at which the heat generated inside the building balances the building's heat losses to maintain a desired indoor temperature*) is of only 38 hours, which explains the low additional cost of operation due to supplemental heat. By using a PSC-030 instead of a PSC-036 we save on installation cost, without compromising the cost of operation of the system. We have therefore **optimized the system mix** and selected an **optimal system balance** between geothermal and supplemental.

If you wish to use the *System Sizing Worksheets* (see section II.) for sizing purposes, you will need to **adapt the sheet instructions** if you are not sizing to 100% of the heating load.

EXAMPLE: *You used the Balance Point Calculator to calculate a target Balance Point Temperature and determined that you only need to size to 84% of the heating load to achieve that*.

You will need to adjust your Heating Load as well as the Heating Output (the "Design capacity" given in the performance tables) to use the worksheets

- Design Heating Load @ 84% (BTUH) = 0.84 * Heating Load (BTUH)
- To calculate the system heating capacity at 84%, you will need to use the performance tables. Once you know the Earth Temperature and the Loop type, read the heating **Maximum Capacity** and the heating **Design Capacity @ 100%**.

Design Capacity @ 84% (BTUH) = 0.84 * **Design Capacity (100%)** (BTUH) + (1 – 0.84) * **Maximum Capacity** (BTUH)

- **Verify that**: Design Capacity @ 84% (BTUH) ≥ Design Heating Load @ 84%
- Calculate the amount of Auxiliary Heat you will be needing:

$$\text{Minimum Auxiliary Heat (kW)} = \frac{\text{Design Heating Load @ 84\% (BTUH)} * 0.2}{3412} + (1 - 0.84) * \frac{[\text{Heating Load (BTUH)} - \textit{Design Capacity} \text{ @ 84\% } (\textit{BTUH})]}{3412}$$

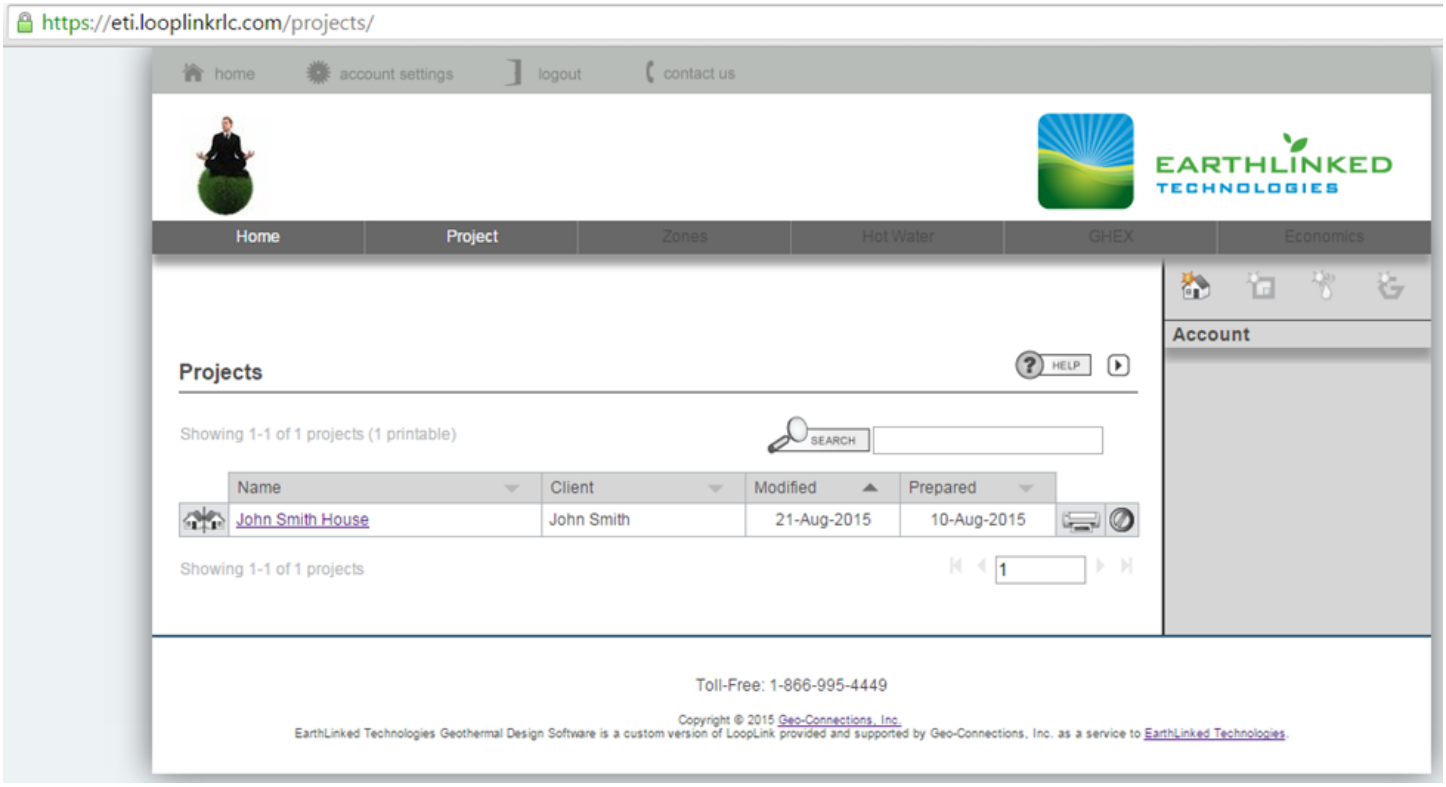
Auxiliary heat to anticipate extreme weather conditions when design temperatures may be exceeded

Supplement heat to meet the rest of the heating load

b. *LoopLink*

In partnership with GeoConnections, Inc., EarthLinked developed the **EarthLinked Geothermal Design Software**, a **customized version of LoopLink**. This powerful web-based ground loop design tool that enables you to design loop fields for multiple zone, multiple heat pump geothermal systems faster and more accurately than ever before.

The tool can be accessed at: https://eti.looplinkrlc.com where you will be able to subscribe to a plan.



Screenshot of the LoopLink interface

4) Thermostat set up

a. *Thermostat control*

Two-stage thermostat heating control: First stage controls the compressor and second stage controls supplemental heat.
(**Note**: EarthLinked two-speed units don't run at low speed in heating mode because there is no advantage to it: the unit would have to run longer at low speed to satisfy the load, increasing runtime without necessarily generating savings. The main advantage of a two-stage unit is for dehumidification purposes in cooling mode)

Two-stage thermostat cooling control: EarthLinked two-speed units come with an automatic 10-minute timer for the low speed in cooling mode, before initiating the high speed when required by the cooling load. Two-stage thermostat control is still an option for cooling: the first stage of the thermostat will simply be overridden by the timer if the compressor exceeds 10 minutes of runtime in first stage.

→ Based on that information, any thermostat you install has the following minimum compatibility requirement: two stages for heating and one stage for cooling.

b. *Auxiliary heat set up*

→ Supplemental heat should **not** be triggered by temperature differential alone.

CASE 1: Auxiliary heat controlled by outdoor sensor/balance point temperature:

→ In this case, you will need to purchase an outdoor thermostat (EarthLinked's Model THOD or equivalent) to initiate supplemental heat. Use the Balance Point Calculator embedded in the System Sizing Worksheets to calculate the balance point temperature and set the outdoor thermostat (set point) to the balance point temperature.

You can access the Balance Point Calculator at earthlinked.com/dealers under the "System Sizing & Performance Tables" header in the "Technical Manuals" section. Download and open the excel file.

CASE 2: Auxiliary heat controlled by time:

→ Read the manufacturer's thermostat manual to correctly adjust the different settings, such as runtimes, temperature differential, set point temperatures, heating/cooling start temperatures etc.

→ Supplemental heat should **not** be triggered by the temperature differential alone, but (also) by time: a maximum unit runtime needs to be set. Exceeding this runtime will turn supplemental heat on. Keep in mind when setting this that you have to compromise between the following factors:

- ***System efficiency*** (geothermal being more efficient, delaying supplemental heat can help keep the cost operation down. However excessively long run times can increase the necessary ground recovery time)
- ***Comfort*** (shorter cycles can help maintaining appropriate comfort levels in the home)
- ***Dehumidification*** (which benefits from longer run times)
- ***Compressor lifespan*** (minimum compressor run time: 10 minutes, minimum compressor off time: 5 minutes)

II. System Sizing Worksheets

- The 4 sizing guides noted below cover **all combinations** for (1) air and hydronic heating and cooling systems, and (2) heating and cooling dominant loads.
- They are **listed below** and provide the procedures for correctly sizing an EarthLinked® system for a specific application.
- Each of the guides **utilize information** from previously and separately calculated **heating and cooling loads** at design temperatures (*Section III*), and selected system performance values (*Section IV*).
- Please note that compressor **nominal capacities** are given in **kBTUH** and not in Tons.

The worksheets are as follows:

EarthLinked®

SYSTEM SIZING GUIDE

AIR HEATING, 100%

EARTHLINKED TECHNOLOGIES

DOMINANT LOAD: **HEATING** SIZING TO: **100% OF HEATING LOAD**

This worksheet applies to systems using a DX air handler or cased coil.

1) Heating and Cooling Loads:

Determine heating and cooling requirements (heat gain and heat loss) of the structure, based on the ACCA Manual J (latest edition) procedure using the **ASHRAE 99.6% heating design temperature** and the **0.4% cooling design temperature** from the *EarthLinked® System Sizing and Performance Tables (SSPT - section III)*. Elite RHVAC or Wrightsoft Right-J software is recommended.

2) Domestic water heating

If domestic water heating by Heat Recovery Module (HRM) is part of the system, **for each occupant add 1,000 BTUH** to the **Heating Load**.

Winter Design Temp: _____ °F

Summer Design Temp: _____ °F

Heating Load: _____ BTUH

Total Cooling Load: _____ BTUH

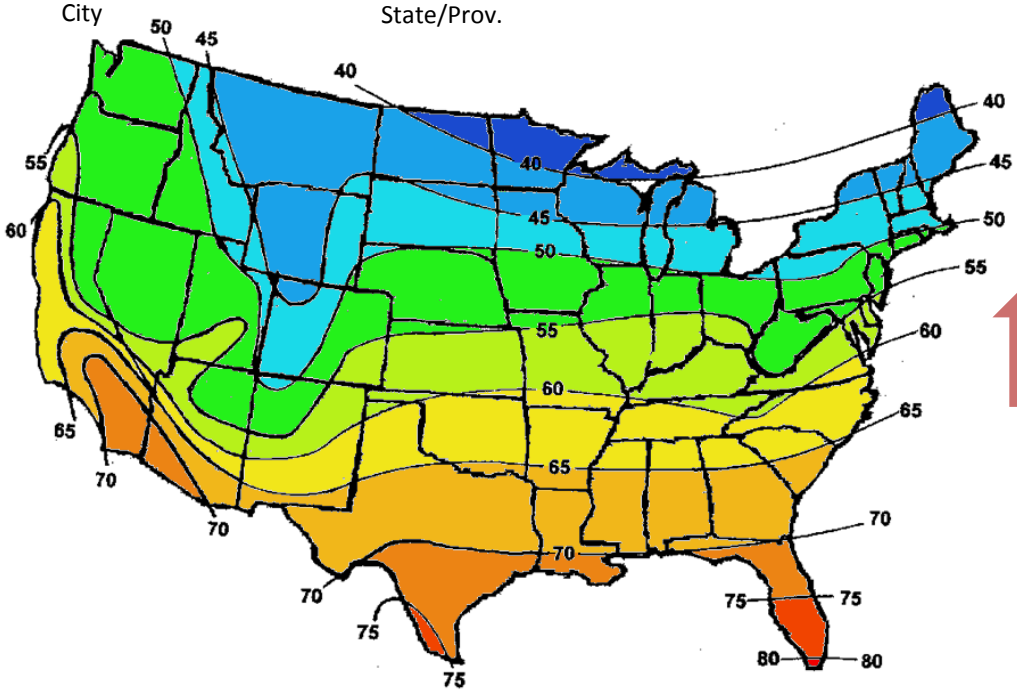
Sensible Cooling Load: _____ BTUH

3) Local Earth Temperature

Determine local earth temperature from Temperature Map.

Site Location: _____ _____ Earth Temp: _____ °F

City State/Prov.



EARTH TEMPERATURES IN CONTIGUOUS UNITED STATES AND SOUTHERN CANADA

4) System parameters:

Locate the System Performance Data in the *Air Heating Performance Table (SSPT-section IV)* based on:

a) Compressor type: _____ (Classic Series or Prime Series)

b) Earth Temperature _____ (see step **3**)

c) Earth Loop Configuration _____ (H1, V1, D1, V1.5, D1.5, V2 or D2 based upon available land area and geology of the earth at the site)

5) System Size and Heating Output:

- Size of the system determined by: **Heating Output (Design Capacity) of the system**.

Use the appropriate *Air Heating Performance Table (SSPT-section IV)* selected based on step **4** above.

- The initial selection of a system size (nominal capacity) should have a **Heating Output of at least 100% of the Heating Load** in step **2**.

Supplemental heat with a rating of at least 20% of the heating load, in BTUH, is a required component of the system.

System Size (nominal capacity)	Heating Output (Design Capacity @ 100% Load)	Heating Load (see Step **2**)
_____ kBTUH	_____ BTUH	_____ BTUH

Is Heating Output at least 100% of the heating load? ☐ YES ☐ NO

Does the performance table require that the unit be equipped with an **HPE**? ☐ YES ☐ NO

*(**HPE**: Heating Performance Enhancement Kit is a required component to enhance heating performance for Horizontal loops where ground temperature is 70°F or higher. It is **recommended for any applications where automatic change-over or switching between heating and cooling occurs within a 24-hour period**)*

6) Cooling Outputs:

From the appropriate *Air Cooling Performance Table (SSPT-section IV)* determine the Total and Sensible Cooling Outputs using:

- System parameters (see Step **4**)
- System size (see Step **5**)

Re-Enter the system size (see Step **5**) and the Total Cooling Load and Sensible Cooling Load values (see Step **2**) below:

System Size (nominal capacity)	Cooling Output (Design Capacities)	Cooling Loads (see Step **2**)
_____ kBTUH	TOTAL: _____ BTUH	TOTAL: _____ BTUH
	SENSIBLE: _____ BTUH	SENSIBLE: _____ BTUH

Is Total Cooling Output 5% greater than Total Cooling Load? ☐ YES ☐ NO

Is Sensible Cooling Output 5% greater than Sensible Cooling Load? ☐ YES ☐ NO

Does the performance table require that the unit be equipped with an **HCM**? ☐ YES ☐ NO

*(**HCM**: Hybrid Cooling Module is a required component to enhance cooling mode system efficiency and performance when required by the performance tables or for applications having **low thermal conductivity soils** or **sustained high summer temperatures** above cooling design temperature)*

7) Selected system:

System Size: _____ kBTUH Compressor Unit Model: _____

Air Handler/Cased Coil Model: _____

Supplemental Electric Heat Kit: ☐ 5kW ☐ 10kW ☐ 15kW ☐ 20kW (must be ≥ 20% heat load)

Earth Loop Model: _____

Domestic Water Heating: _____ (Heat Recovery Module Model)

Heating Performance Enhancement Kit (HPE): _____

Hybrid Cooling Module (HCM): _____

8) Balance Point:

The balance point temperature for a heating system must be determined if an **outdoor thermostat is installed to initiate supplemental heat**. The outdoor thermostat **set point** is adjusted to the **balance point temperature**.

For EarthLinked® R-410A systems two **heating outputs** must be known to determine balance point temperature:

- **Design capacity @ 100% Load** (see Step 5).
- **Maximum capacity** (the MAXIMUM **heating** capacity taken from the *Air Heating Performance Table (SSPT-section IV)* for the specific system selected. Row right above the "Design capacity @ 100% Load")

To access the Balance Point Calculator: go to www.earthlinked.com/dealers. Sign in under the "**EXISTING USERS LOG IN**" section. The Calculator can be found under the "**System Sizing & Performance Tables**" header in the "Technical Manuals" section. Download and open the excel file.

BALANCE POINT CALCULATOR

(Applies only to Heating—do not use for Cooling)

INPUT

U.S. Units of Measure

ENTER DATA

BUILDING HEATING LOAD @DT =	37,500	BTUH	RESET
OUTDOOR WINTER DESIGN TEMP = (ASHRAE 99.6% DB)	3.5	°F	
EQUIPMENT MAXIMUM CAPACITY =	60,400	BTUH	
EQUIPMENT DESIGN CAPACITY =	38,400	BTUH	

See step 1 and Manual J

See step 8 above

See step 5

OUTPUT

RESULTS

BALANCE POINT CAPACITY =	38,067.2	BTUH
BALANCE POINT TEMPERATURE =	2.5	°F

70°F INDOOR DESIGN (fixed)

Balance Point Capacity = _____ BTUH

Balance Point Temperature = _____ °F

B. Air Cooling, 105% load

EarthLinked®

SYSTEM SIZING GUIDE

AIR COOLING, 105%

EARTHLINKED TECHNOLOGIES

DOMINANT LOAD: **COOLING** SIZING TO: **105% OF COOLING LOADS**

This worksheet applies to systems using a DX air handler or cased coil.

1) Heating and Cooling Loads:

Determine heating and cooling requirements (heat gain and heat loss) of the structure, based on the ACCA Manual J (latest edition) procedure using the **ASHRAE 99.6% heating design temperature** and the **0.4% cooling design temperature** from the *EarthLinked® System Sizing and Performance Tables (SSPT - section III)*. Elite RHVAC or Wrightsoft Right-J software is recommended.

2) Domestic water heating

If domestic water heating by Heat Recovery Module (HRM) is part of the system, **for each occupant add 1,000 BTUH** to the **Heating Load**.

Summer Design Temp: _____ °F

Total Cooling Load: _____ BTUH

Sensible Cooling Load: _____ BTUH

Winter Design Temp: _____ °F

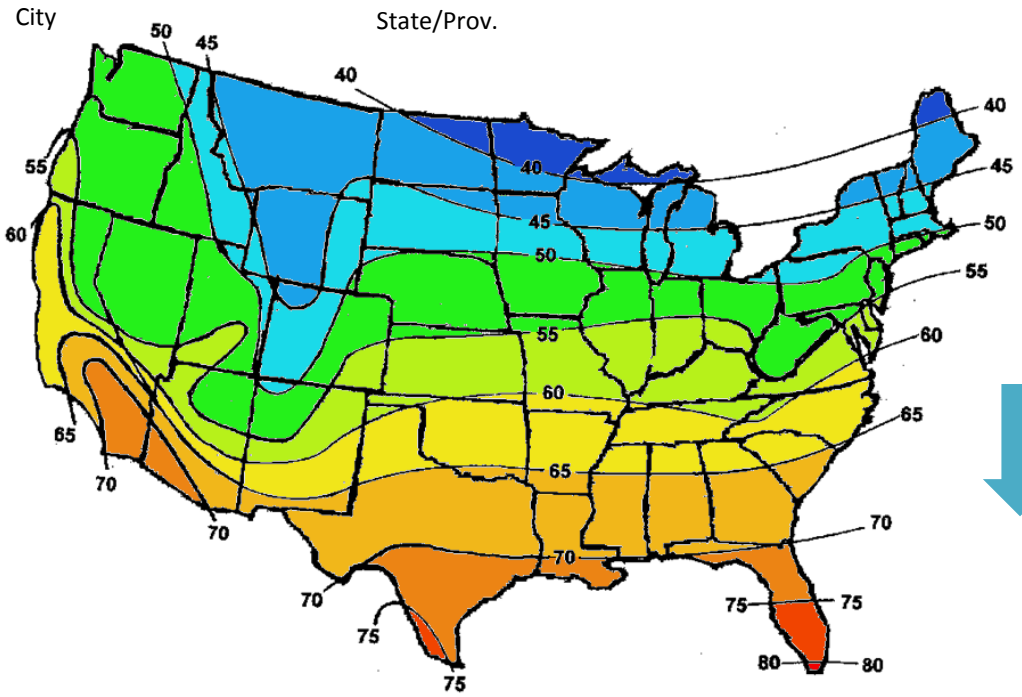
Heating Load: _____ BTUH

3) Local Earth Temperature

Determine local earth temperature from Temperature Map.

Site Location: _____ _____ Earth Temp: _____ °F

City State/Prov.



ROUND UP in cooling

EARTH TEMPERATURES IN CONTIGUOUS UNITED STATES AND SOUTHERN CANADA

4) System parameters:

Locate the System Performance Data in the *Air Cooling Performance Table (SSPT-section IV)* based on:

a) Compressor type: _____ (Classic Series or Prime Series)

b) Earth Temperature _____ (see step **3**)

c) Earth Loop Configuration _____ (H1, V1, D1, V1.5, D1.5, V2 or D2 based upon available land area and geology of the earth at the site)

5) System Size and Cooling Output:

- Size of the system determined by: **Total Cooling Output** and **Sensible Cooling Output**

Use the appropriate *Air Cooling Performance Table (SSPT-section IV)* selected based on step **4** above.

- The initial selection of a system size (nominal capacity) should have a **Total and Sensible Cooling outputs of at least 105% of the Total and Sensible Cooling Loads respectively**.

System Size (nominal capacity)	Cooling Output (Design Capacities)	Cooling Loads (see Step **2**)
_____ kBTUH	TOTAL: _____ BTUH	TOTAL: _____ BTUH
	SENSIBLE: _____ BTUH	SENSIBLE: _____ BTUH

Is Total Cooling Output 5% greater than Total Cooling Load? ☐ YES ☐ NO

Is Sensible Cooling Output 5% greater than Sensible Cooling Load? ☐ YES ☐ NO

Does the performance table require that the unit be equipped with an **HCM**? ☐ YES ☐ NO

*(**HCM**: Hybrid Cooling Module is a required component to enhance cooling mode system efficiency and performance when required by the performance tables or for applications having **low thermal conductivity soils** or **sustained high summer temperatures** above cooling design temperature)*

6) Heating Output:

From the appropriate *Air Heating Performance Table (SSPT-section IV)* determine the Heating Output using:

- System parameters (see Step **4**)
- System size (see Step **5**)

Supplemental heat with a rating of at least 20% of the heating load, in BTUH, is a required component of the system.

Re-Enter the system size (see Step **5**) and the Heating Load value (see Step **2**) below:

System Size (nominal capacity)	Heating Output (Design Capacity @ 100% Load)	Heating Load (see Step **2**)
_____ kBTUH	_____ BTUH	_____ BTUH

Is Heating Output at least 100% of the heating load? ☐ YES ☐ NO

Does the performance table require that the unit be equipped with an **HPE**? ☐ YES ☐ NO

*(**HPE**: Heating Performance Enhancement Kit is a required component to enhance heating performance for Horizontal loops where ground temperature is 70°F or higher. It is **recommended for any applications where automatic change-over or switching between heating and cooling occurs within a 24-hour period**)*

7) Selected system:

System Size: _____ kBTUH Compressor Unit Model: _____

Air Handler/Cased Coil Model: _____

Supplemental Electric Heat Kit: ☐ 5kW ☐ 10kW ☐ 15kW ☐ 20kW (must be ≥ 20% heat load)

Earth Loop Model: _____

Domestic Water Heating: _____ (Heat Recovery Module Model)

Heating Performance Enhancement Kit (HPE): _____

Hybrid Cooling Module (HCM): _____

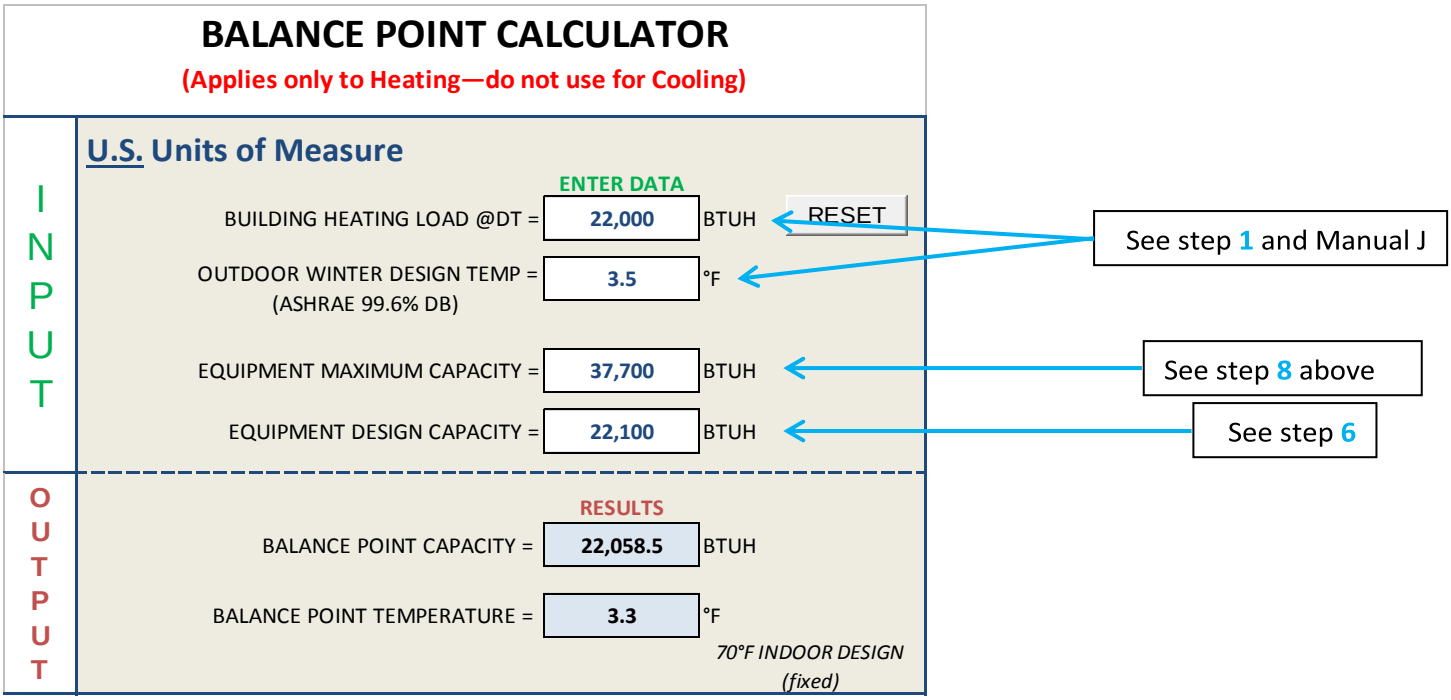
8) Balance Point:

The balance point temperature for a heating system must be determined if an **outdoor thermostat is installed to initiate supplemental heat**. The outdoor thermostat **set point** is adjusted to the **balance point temperature**.

For EarthLinked® R-410A systems two **heating outputs** must be known to determine balance point temperature:

- **Design capacity @ 100% Load** (see Step 6).
- **Maximum capacity** (the MAXIMUM **heating** capacity taken from the *Air Heating Performance Table (SSPT-section IV)* for the specific system selected. Row right above the "Design capacity @ 100% Load")

To access the Balance Point Calculator: go to www.earthlinked.com/dealers. Sign in under the "**EXISTING USERS LOG IN**" section. The Calculator can be found under the "**System Sizing & Performance Tables**" header in the "Technical Manuals" section. Download and open the excel file.



Balance Point Capacity = _____ BTUH

Balance Point Temperature = _____ °F

EarthLinked®

SYSTEM SIZING GUIDE

HYDRONIC HEATING, 100%

DOMINANT LOAD: **HEATING** SIZING TO: **100% OF HEATING LOAD**

This worksheet applies to radiant panel hydronic systems using a hydronic water module (HWM) or a compressor equipped with an internal refrigerant to water heat exchanger.

1) Heating and Cooling Loads:

Determine heating and cooling requirements (heat gain and heat loss) of the structure, based on the ACCA Manual J (latest edition) procedure using the **ASHRAE 99.6% heating design temperature** and the **0.4% cooling design temperature** from the *EarthLinked® System Sizing and Performance Tables (SSPT-section III)*. Elite RHVAC or Wrightsoft Right-J software is recommended.

2) Domestic water heating

If domestic water heating by Heat Recovery Module (HRM) is part of the system, **add 1,000 BTUH** for each adult and teenager to the **Heating Load**.

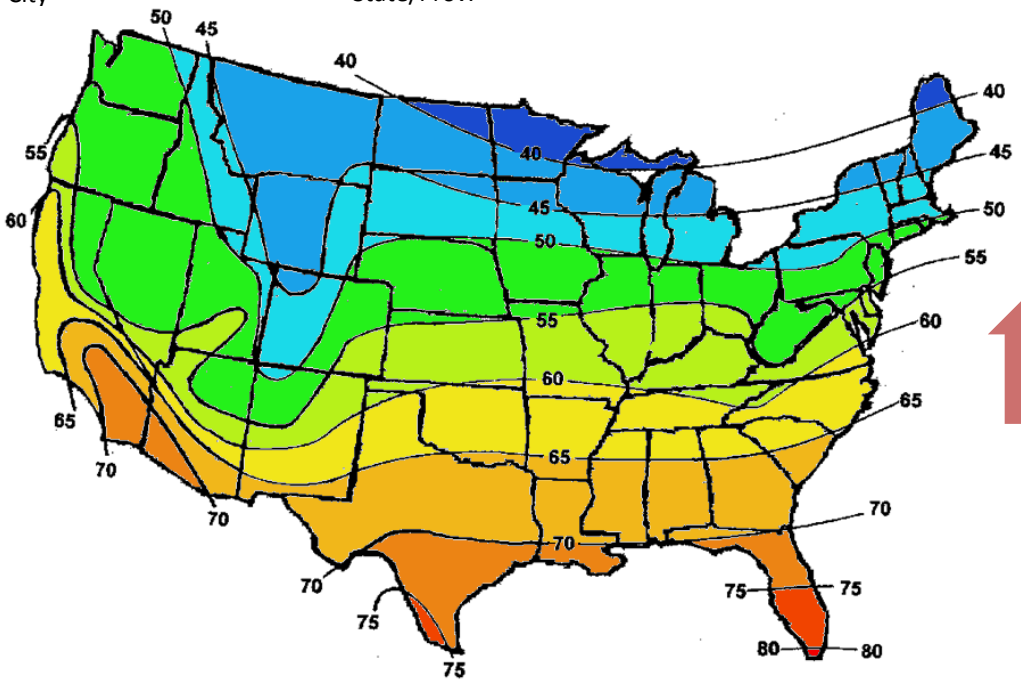
Winter Design Temp: _____ °F Heating Load: _____ BTUH

Summer Design Temp: _____ °F Total Cooling Load: _____ BTUH

3) Local Earth Temperature: determine local earth temperature from Temperature Map.

Site Location: _____ _____ Earth Temp: _____ °F

City State/Prov.



EARTH TEMPERATURES IN CONTIGUOUS UNITED STATES AND SOUTHERN CANADA

4) System parameters:

Locate the System Performance in the *Hydronic Heating Performance Table* *(SSPT-section IV)* based on:

a) Compressor type: _____ (Classic Series or Prime Series)

b) Earth Temperature _____ (see step **3**)

c) Earth Loop Configuration _____ (H1, V1, D1, V1.5, D1.5, V2 or D2 based upon available land area and geology of the earth at the site)

5) System Size and **Adjusted** Heating Output:

- Size of the system determined by: **Adjusted Heating Output of the system**.

Use the appropriate *Hydronic Heating Performance Table* *(SSPT-section IV)* selected based on step **4** above.

- The initial selection of a system size (nominal capacity) should have an **Adjusted Heating Output of at least 100% of the Heating Load** in step **2**.

Supplemental heat with a rating of at least 20% of the heating load, in BTUH, is a required component of the storage water heater.

Start by **adjusting the Heating Output** (Design Capacity @ 100% Load) by multiplying it by the appropriate correction factor below. The correction factor is based on the desired **Leaving Water Temperature** (as measured at the outlet of the heat exchanger).

CORRECTION FACTORS
HYDRONIC HEATING ONLY

Leaving Water Temperatures (°F)	CORRECTION FACTORS (Capacity & COP)
80	1.17
90	1.09
100	1.00
110	0.90

Adjusted Heating Output = Heating Output (Design Capacity @ 100% load) **X** Correction factor

= _____ BTUH **X** _____

= _____ BTUH

System Size (nominal capacity)	Adjusted Heating Output (see above)	Heating Load (see Step **2**)
_____ kBTUH	_____ BTUH	_____ BTUH

Is Adjusted Heating Output at least 100% of the heating load? ☐ YES ☐ NO

Does the performance table require that the unit be equipped with an **HPE**? ☐ YES ☐ NO

*(**HPE**: Heating Performance Enhancement Kit is a required component to enhance heating performance for Horizontal loops where ground temperature is 70°F or higher. It is **recommended for any applications where automatic change-over or switching between heating and cooling occurs within a 24-hour period**)*

6) Cooling Output:

For a chilled water air handler: from the appropriate *Hydronic Cooling Performance Table (SSPT-section IV)* determine the Total Cooling Output using:

- System parameters (see Step 4)
- System size (see Step 5)

You should **adjust the Total Cooling Output** (Design Total Capacity) by multiplying it by the appropriate correction factor below. The correction factor is based on the desired **Leaving Water Temperature** (as measured at the outlet of the heat exchanger).

CORRECTION FACTORS HYDRONIC COOLING ONLY	
Leaving Water Temperatures (°F)	**CORRECTION FACTORS (Capacity & EER)**
42	0.94
45	1.00
48	1.06
52	1.15
56	1.24
60	1.33

Adjusted Cooling Output

= Cooling Output (Design Total Capacity) **X** Correction factor

= _____ BTUH **X** _____

= _____ BTUH

Re-Enter the system size (see Step 5) and the Total Cooling Load value (see Step 2) below:

System Size (nominal capacity)	Adjusted Cooling Output (see above)	Cooling Load (see Step 2)
_____ kBTUH	TOTAL: _____ BTUH	TOTAL: _____ BTUH

Is Adjusted Total Cooling Output 5% greater than Total Cooling Load? ☐ YES ☐ NO

Does the performance table require that the unit be equipped with an **HCM**? ☐ YES ☐ NO

*(**HCM**: Hybrid Cooling Module is a required component to enhance cooling mode system efficiency and performance when required by the performance tables or for applications having **low thermal conductivity soils** or **sustained high summer temperatures** above cooling design temperature)*

7) Selected system:

System Size: _____ kBTUH Compressor Unit Model: _____

Hydronic Water Module Model: _____

Supplemental Electric Heat Kit: ☐ 5kW ☐10kW ☐15kW ☐20kW (must be ≥ 20% heat load)

Earth Loop Model: _____

Domestic Water Heating: _____ (Heat Recovery Module Model)

Heating Performance Enhancement Kit (HPE): _____

Hybrid Cooling Module (HCM): _____

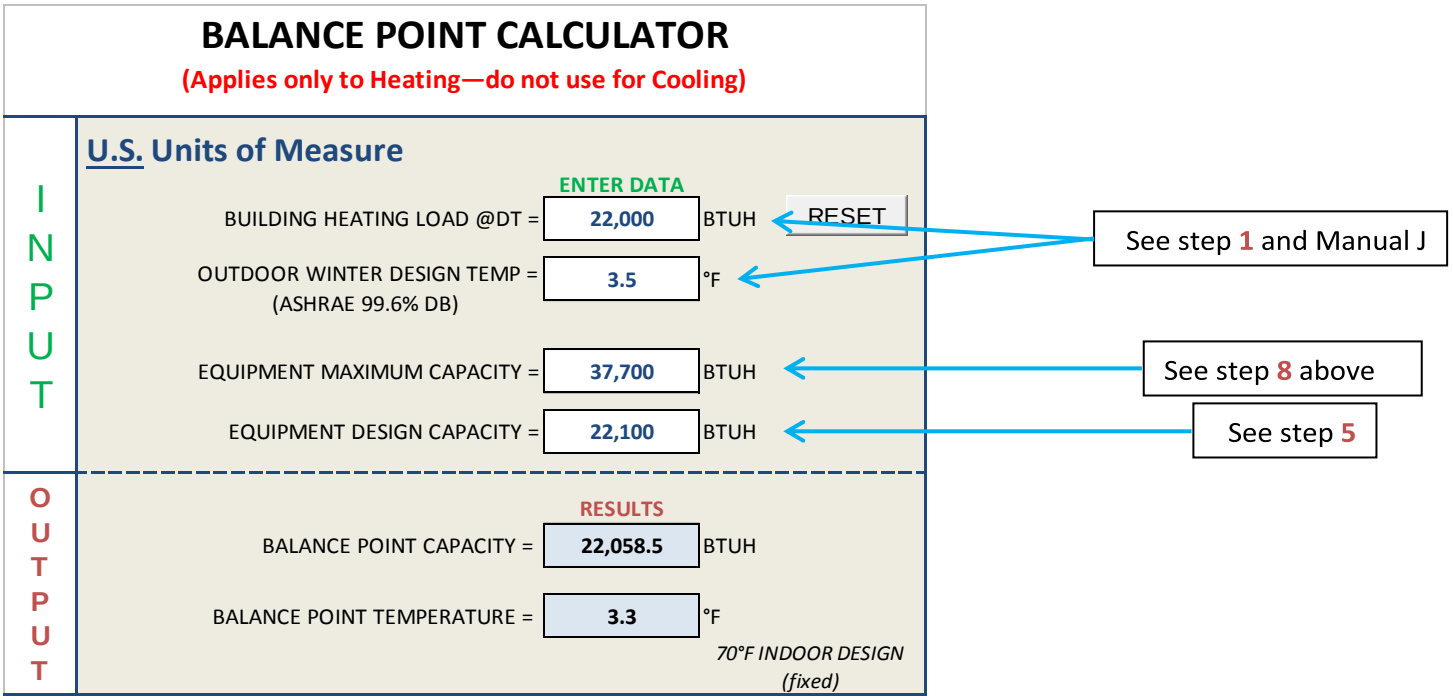
8) Balance Point:

The balance point temperature for a heating system must be determined if an **outdoor thermostat is installed to initiate supplemental heat**. The outdoor thermostat **set point** is adjusted to the **balance point temperature**.

For EarthLinked® R-410A systems two **heating outputs** must be known to determine balance point temperature:

- **Adjusted Heating Output** (see Step 5).
- **Maximum capacity** (the MAXIMUM **heating** capacity taken from the *Hydronic Heating Performance Table (SSPT-section IV)* for the specific system selected. Row right above the "Design capacity @ 100% Load")

To access the Balance Point Calculator: go to www.earthlinked.com/dealers. Sign in under the "**EXISTING USERS LOG IN**" section. The Calculator can be found under the "**System Sizing & Performance Tables**" header in the "Technical Manuals" section. Download and open the excel file.



Balance Point Capacity = _____ BTUH

Balance Point Temperature = _____ °F

D. Hydronic Cooling, 105% load

EarthLinked®

SYSTEM SIZING GUIDE

HYDRONIC COOLING, 105%

EARTHLINKED TECHNOLOGIES

DOMINANT LOAD: **COOLING** SIZING TO: **105% OF COOLING LOAD**

This worksheet applies to radiant panel hydronic systems using a hydronic water module (HWM) or a compressor equipped with an internal refrigerant to water heat exchanger.

1) Heating and Cooling Loads:

Determine heating and cooling requirements (heat gain and heat loss) of the structure, based on the ACCA Manual J (latest edition) procedure using the **ASHRAE 99.6% heating design temperature** and the **0.4% cooling design temperature** from the *EarthLinked® System Sizing and Performance Tables (SSPT-section III)*. Elite RHVAC or Wrightsoft Right-J software is recommended.

2) Domestic water heating

If domestic water heating by Heat Recovery Module (HRM) is part of the system, **add 1,000 BTUH** for each adult and teenager to the **Heating Load**.

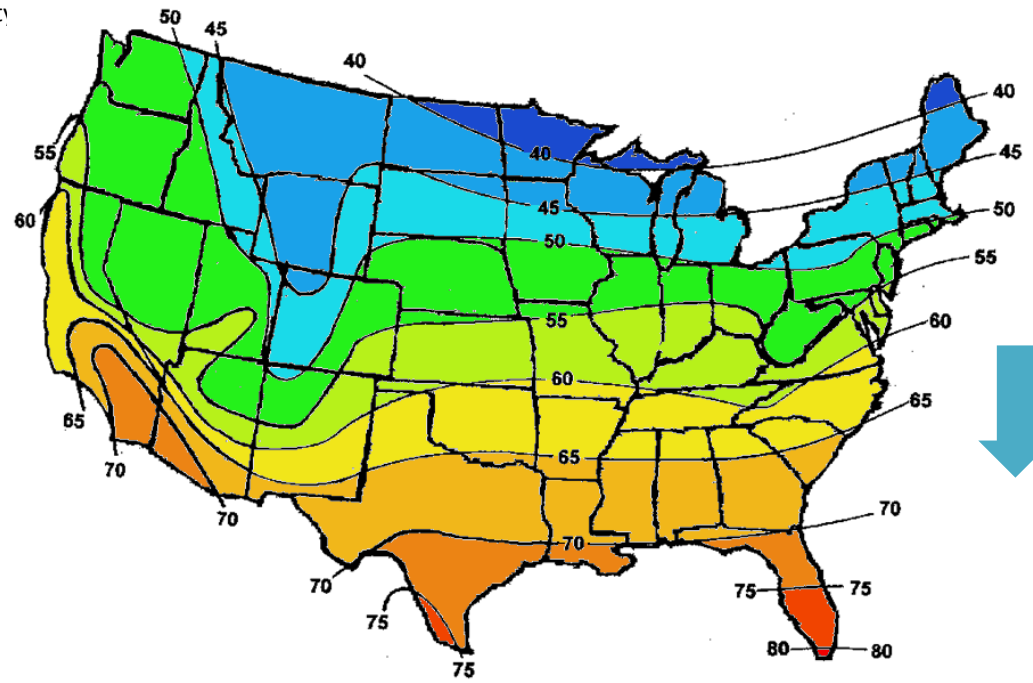
Summer Design Temp: _____ °F Total Cooling Load: _____ BTUH

Winter Design Temp: _____ °F Heating Load: _____ BTUH

3) Local Earth Temperature: determine local earth temperature from Temperature Map.

Site Location: _____ _____ Earth Temp: _____ °F

City



EARTH TEMPERATURES IN CONTIGUOUS UNITED STATES AND SOUTHERN CANADA

4) System parameters:

Locate the System Performance in the *Hydronic Cooling Performance Table (SSPT-section IV)* based on:

a) Compressor type: _____ (Classic Series or Prime Series)

b) Earth Temperature _____ (see step **3**)

c) Earth Loop Configuration _____ (H1, V1, D1, V1.5, D1.5, V2 or D2 based upon available land area and geology of the earth at the site)

5) System Size and **adjusted** Cooling Output:

- Size of the system determined by: **Adjusted Cooling Output of the system**.

Use the appropriate *Hydronic Cooling Performance Table (SSPT-section IV)* selected based on step **4** above.

- The initial selection of a system size (nominal capacity) should have an **Adjusted Cooling Output of at least 105% of the Cooling Load** in step **2**.

Start by **adjusting the Cooling Output** (Design Total Capacity) by multiplying it by the appropriate correction factor below. The correction factor is based on the desired **Leaving Water Temperature** (as measured at the outlet of the heat exchanger).

CORRECTION FACTORS
HYDRONIC COOLING ONLY

Leaving Water Temperatures (°F)	CORRECTION FACTORS (Capacity & EER)
42	0.94
45	1.00
48	1.06
52	1.15
56	1.24
60	1.33

Adjusted Cooling Output
= Cooling Output (Design Total Capacity) **X** Correction factor
= _____ BTUH **X** _____
= _____ BTUH

System Size (nominal capacity) _____ kBTUH

Adjusted Cooling Output (see above) TOTAL: _____ BTUH

Cooling Load (see Step **2**) TOTAL: _____ BTUH

Is Adjusted Total Cooling Output 5% greater than Total Cooling Load? ☐ YES ☐ NO

Does the performance table require that the unit be equipped with an **HCM**? ☐ YES ☐ NO
*(**HCM**: Hybrid Cooling Module is a required component to enhance cooling mode system efficiency and performance when required by the performance tables or for applications having **low thermal conductivity soils** or **sustained high summer temperatures** above cooling design temperature)*

6) Heating Output:

If Hydronic Heating is also required, from the appropriate *Hydronic Heating Performance Table (SSPT-section IV)* determine the Heating Output using:

- System parameters (see Step 4)
- System size (see Step 5)

Supplemental heat with a rating of at least 20% of the heating load, in BTUH, is a required component of the storage water heater.

You should **adjust the Heating Output** (Design Capacity @ 100% Load) by multiplying it by the appropriate correction factor below. The correction factor is based on the desired **Leaving Water Temperature** (as measured at the outlet of the heat exchanger).

CORRECTION FACTORS HYDRONIC HEATING ONLY	
Leaving Water Temperatures (°F)	**CORRECTION FACTORS (Capacity & COP)**
80	1.17
90	1.09
100	1.00
110	0.90

Adjusted Heating Output

= Heating Output (Design Capacity) **X** Correction factor

= _____ BTUH **X** _____

= _____ BTUH

Re-Enter the system size (see Step 5) and the Heating Load (see Step 2) below:

System Size (nominal capacity)	Adjusted Heating Output (see above)	Heating Load (see Step 2)
_____ kBTUH	_____ BTUH	_____ BTUH

Is Adjusted Heating Output at least 100% of the heating load? ☐ YES ☐ NO

Does the performance table require that the unit be equipped with an **HPE**? ☐ YES ☐ NO

*(**HPE**: Heating Performance Enhancement Kit is a required component to enhance heating performance for Horizontal loops where ground temperature is 70°F or higher. It is **recommended for any applications where automatic change-over or switching between heating and cooling occurs within a 24-hour period**)*

7) Selected system:

System Size: _____ kBTUH Compressor Unit Model: _____

Hydronic Water Module Model: _____

Supplemental Electric Heat Kit: ☐ 5kW ☐ 10kW ☐ 15kW ☐ 20kW (must be ≥ 20% heat load)

Earth Loop Model: _____

Domestic Water Heating: _____ (Heat Recovery Module Model)

Heating Performance Enhancement Kit (HPE): _____

Hybrid Cooling Module (HCM): _____

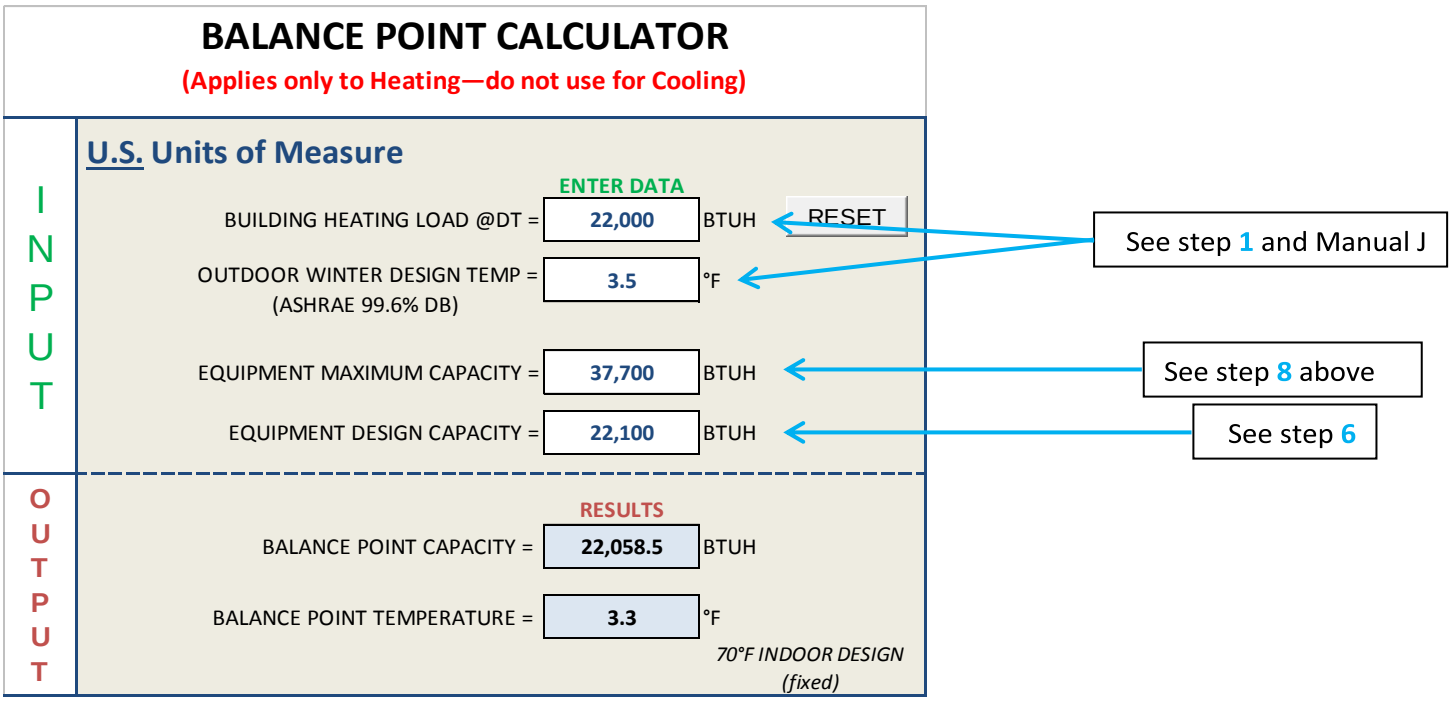
8) Balance Point:

The balance point temperature for a heating system must be determined if an **outdoor thermostat is installed to initiate supplemental heat**. The outdoor thermostat **set point** is adjusted to the **balance point temperature**.

For EarthLinked® R-410A systems two **heating outputs** must be known to determine balance point temperature:

- **Adjusted Heating Output** (see Step 6).
- **Maximum capacity** (the MAXIMUM **heating** capacity taken from the *Hydronic Heating Performance Table (SSPT-section IV)* for the specific system selected. Row right above the "Design capacity @ 100% Load")

To access the Balance Point Calculator: go to www.earthlinked.com/dealers. Sign in under the "**EXISTING USERS LOG IN**" section. The Calculator can be found under the "**System Sizing & Performance Tables**" header in the "Technical Manuals" section. Download and open the excel file.



Balance Point Capacity = _____ BTUH

Balance Point Temperature = _____ °F

III. Design Temperatures

ASHRAE Outdoor Design Condition

Heating and cooling design temperatures for selected locations in the U.S.A. and Canada are listed on the following pages. This table is from the 2009 ASHRAE Handbook of Fundamentals, Chapter 14, Climatic Design Information – Appendix, with permission from ASHRAE.

The values for heating design temperatures represent 99.6% of the recorded temperatures during the heating season for the selected location. The values for cooling design temperatures represent all but 0.4% of the recorded temperatures during the cooling season for the selected location.

LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°	LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°
Alabama			***California – con't***		
AUBURN-OPELIKA APT	23.7	93.0	BURBANK-GLENDALE-PASSADENA AI	39.0	98.3
BIRMINGHAM MUNICIPAL AP	19.6	95.0	CAMARILLO (AWOS)	37.3	84.6
CAIRNS AAF/OZARK	26.9	95.4	CAMP PENDLETON MCAS	32.8	92.0
DOTHAN MUNICIPAL	27.3	95.3	CARLSBAD/PALOMAR	43.0	81.7
GADSEN MUNI (AWOS)	18.6	93.4	CASTLE AFB/MERCED	30.6	99.5
HUNTSVILLE INTL/JONES FIELD	17.0	94.6	EL TORO MCAS	40.3	92.1
MAXWELL AFB/MONTGOM	27.9	97.2	FRESNO YOSEMITE INTL AP	31.5	103.6
MOBILE REGIONAL AP	26.9	93.5	FULLERTON MUNICIPAL	39.2	92.7
MONTGOMERY DANNELLY FIELD	23.7	96.2	GEORGE AFB	27.6	100.7
MUSCLE SHOALS REGIONAL AP	17.8	95.5	HAYWARD AIR TERM	37.1	87.6
TUSCALOOSA MUNICIPAL AP	20.6	95.7	IMPERIAL	35.6	111.1
Alaska			JACK NORTHROP FLD H	44.7	85.9
FAIRBANKS INTL ARPT	-43.3	81.2	LANCASTER GEN WM FOX FIELD	21.5	102.3
FT. RICHARDSON/BRYA	-18.6	73.9	LEMOORE REEVES NAS	29.7	103.0
ANCHORAGE/ELMENDORF	-26.0	73.7	LIVERMORE MUNICIPAL	30.3	98.8
LAKE HOOD SEAPLANE	-22.6	74.5	LOMPOC (AWOS)	32.4	81.4
ANCHORAGE INTL AP	-22.7	71.4	LONG BEACH DAUGHERTY FLD	41.2	91.2
ANCHORAGE MERRILL FIELD	-23.9	72.9	LOS ANGELES INTL ARPT	44.4	83.7
JUNEAU INT'L ARPT	3.8	73.5	MARCH AFB/RIVERSIDE	34.2	100.6
Arizona			MCCLELLAN AFB	31.7	101.9
CASA GRANDA (AWOS)	32.0	108.5	MODESTO CITY-COUNTY AP	31.0	101.1
DAVIS-MONTHAN AFB	32.9	105.4	MONTEREY PENINSULA	36.7	77.3
FLAGSTAFF AIRPORT	3.9	85.5	MOUNTAIN VIEW MOFFETT FLD NAS	36.4	88.2
LUKE AFB/PHOENIX	35.3	110.8	NAPA CO. AIRPORT	30.0	91.2
PHOENIX SKY HARBOR INTL AP	38.6	110.2	NORTON AFB/SAN BERN	33.9	102.9
PRESCOTT LOVE FIELD	17.5	94.3	OAKLAND METROPOLITAN ARPT	37.2	81.8
TUCSON INTERNATIONAL AP	31.7	105.9	ONTARIO	36.0	100.6
YUMA INTL AIRPORT	41.8	110.8	PALM SPRINGS INTL	42.7	111.2
YUMA MCAS	41.7	110.9	PALM SPRINGS THERMAL AP	31.0	111.3
Arkansas			POINT ARGUELLO	45.6	71.2
BENTONVILLE (AWOS)	10.1	93.5	POINT MUGU NF	38.9	82.0
FAYETTEVILLE DRAKE FIELE	8.0	95.2	PORTERVILLE (AWOS)	30.4	100.4
FORT SMITH REGIONAL AP	14.7	99.1	REDDING MUNICIPAL ARPT	28.4	105.9
JONESBORO MUNI	12.4	96.4	RIVERSIDE MUNI	36.0	99.8
LITTLE ROCK ADAMS FIELD	17.2	98.0	SACRAMENTO EXECUTIVE ARPT	31.4	100.1
LITTLE ROCK AFB	15.3	99.3	SACRAMENTO MATHER AIRPORT	29.8	101.3
LITTLE ROCK/ADAMS F	16.4	95.2	SACRAMENTO METROPOLITAN AP	31.5	100.4
PINE BLUFF FAA AP	21.1	97.1	SALINAS MUNICIPAL AP	33.8	82.9
ROGERS (AWOS)	10.0	93.4	SAN DIEGO LINDBERGH FIELD	44.8	84.1
SILOAM SPRING(AWOS)	10.3	95.5	SAN DIEGO MIRAMAR NAS	38.9	90.3
TEXARKANA WEBB FIELD	21.6	98.5	SAN DIEGO NORTH ISLAND NAS	44.6	82.3
California			SAN DIEGO/BROWN FLD	38.9	88.3
ALAMEDA NAS	40.3	83.4	SAN DIEGO/MONTGOMER	40.9	88.3
BAKERSFIELD MEADOWS FIELD	32.2	103.1	SAN FRANCISCO INTL AP	38.8	83.0
BEALE AFB/MARYSVILE	32.1	100.7	SAN JOSE INTL AP	35.7	92.3

ASHRAE Design Temperatures for Selected Locations 1/8

LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°	LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°
California – con't			***Florida – con't***		
SAN LUIS CO RGNL	34.0	88.3	OCALA MUNI (AWOS)	29.7	93.2
SANTA BARBARA MUNICIPAL AP	34.7	82.9	ORLANDO EXECUTIVE AP	40.0	93.6
SANTA MARIA PUBLIC ARPT	32.2	84.2	ORLANDO INTL ARPT	37.7	93.7
SANTA ROSA (AWOS)	29.7	95.3	ORLANDO SANFORD AIRPORT	38.6	94.9
STOCKTON METROPOLITAN ARPT	30.5	100.8	PANAMA CITY BAY CO	32.1	92.7
TRAVIS AFB/FAIRFLE	31.8	98.8	PENSACOLA FOREST SHERMAN NAS	28.3	93.2
TUSTIN MCAF	38.9	93.5	PENSACOLA REGIONAL AP	29.5	93.7
VISALIA MUNI (AWOS)	29.9	99.8	SARASOTA BRADENTON	39.3	92.2
Colorado			SOUTHWEST FLORIDA I	41.2	93.8
BUCKLEY ANGB/DENVER	-0.2	93.0	ST PETERSBURG CLEAR	42.6	93.2
COLORADO SPRINGS MUNI AP	-0.7	90.3	TALLAHASSEE REGIONAL AF	25.4	95.5
DENVER INTL AP	0.7	94.3	TAMPA INTERNATIONAL AP	38.4	92.4
DENVER STAPLETON INT'L ARPT	-4.0	93.5	TYNDALL AFB	31.9	91.2
DENVER/CENTENNIAL	-1.8	91.4	VENICE PIER	42.3	87.6
FORT COLLINS (AWOS)	0.1	93.5	VERO BEACH MUNICIPAL ARPT	38.9	91.7
FORT COLLINS(SAWRS)	-4.8	89.8	WEST PALM BEACH INTL ARPT	44.2	91.4
GRAND JUNCTION WALKER FIELD	6.0	97.4	***Georgia***		
GREELEY/WELD (AWOS)	-5.5	95.4	ALBANY DOUGHERTY COUNTY AP	26.4	96.7
PUEBLO MEMORIAL AP	-2.0	98.4	ATHENS BEN EPPS AP	21.8	95.2
Connecticut			ATLANTA (NEXRAD)	19.1	92.8
BRIDGEPORT SIKORSKY MEMORIAL	10.7	87.4	ATLANTA HARTSFIELD INTL AI	20.7	93.8
HARTFORD BRADLEY INTL AP	3.1	91.5	AUGUSTA BUSH FIELD	22.2	97.1
HARTFORD BRAINARD FD	6.4	90.5	AUGUSTA\DANIEL FLD	27.5	96.8
OXFORD (AWOS)	3.1	87.7	COLUMBUS METROPOLITAN ARPT	25.1	96.3
WILLIMANTIC (ASOS)	3.1	89.9	DEKALB PEACHTREE	22.6	93.3
Delaware			DOBBINS AFB/MARIETT	19.5	93.5
DOVER AFB	13.9	92.1	FORT BENNING	23.0	96.7
WILMINGTON NEW CASTLE CNTY AP	11.7	91.9	FULTON CO ARPT BROW	19.8	93.6
Florida			GAINESVILLE\LEE GIL	23.0	91.3
CECIL FIELD	29.8	96.3	HUNTER AAF	28.0	95.4
DAYTONA BEACH INTL AP	34.7	92.7	MACON MIDDLE GA REGIONAL AP	23.5	96.7
FORT LAUDERDALE HOLLYWOOD INT	46.7	91.8	MOODY AFB/VALDOSTA	29.9	95.7
FORT MYERS PAGE FIELD	42.4	93.7	ROME RB RUSSELL AP	17.2	96.4
GAINESVILLE REGIONAL AF	29.7	93.5	SAVANNAH INTL AP	27.1	95.5
HOMESTEAD AFB	46.4	91.2	VALDOSTA WB AIRPORT	27.5	95.4
JACKSONVILLE INTL ARPT	29.2	94.5	WARNER ROBINS AFB	25.0	97.3
JACKSONVILLE NAS	32.2	95.5	***Hawaii***		
JACKSONVILLE/CRAIG	31.6	93.4	BARBERS POINT NAS	59.4	90.9
MACDILL AFB/TAMPA	40.3	93.1	HILO INTERNATIONAL AP	61.5	85.6
MAYPORT NS	34.4	94.5	HONOLULU INTL ARPT	61.2	89.9
MELBOURNE REGIONAL AP	39.0	92.6	KANEOHE BAY MCAS	64.3	85.3
MIAMI INTL AP	47.7	91.8	***Idaho***		
MIAMI/KENPALL-TAMPA	45.4	92.4	BOISE AIR TERMINAL	2.7	98. 1
NAPLES MUNICIPAL	43.8	90.9	CALDWELL (AWOS)	11.6	97.0
NASA SHUTTLE FCLTY	38.4	91.9	COEUR D1 ALENE(AWOS)	6.7	91.4

ASHRAE Design Temperatures for Selected Locations 2/8

LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°	LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°
Idaho – con't			***Kansas – con't***		
IDAHO FALLS FANNING FIELC	-8.7	91.7	TOPEKA FORBES FIELD	1.0	96.7
JOSLIN FLD MAGIC VA	9.4	94.5	TOPEKA MUNICIPAL AP	0.6	97.1
LEW1STON NEZ PERCE CNTY AP	10.2	97.8	WICHITA MID-CONTINENT AP	4.0	100.4
POCATELLO REGIONAL AP	-4.9	94.4	WICHITA/COL JABARA	6.9	99.7
Illinois			***Kentucky***		
AURORA MUNICIPAL	-2.0	90.8	BOWLING GREEN WARREN CO AP	8.5	93.2
CAHOKIA/ST. LOUIS	9.5	93.5	CINCINNATI NORTHERN KY AP	3.1	91.4
CHICAGO MIDWAY AP	-1.6	92.1	FORT CAMPBELL (AAF)	9.9	94.4
CHICAGO OHARE INTL AP	-4.0	91.9	HENDERSON CITY	7.3	92.9
DECATUR	-0.4	93.0	LEXINGTON BLUEGRASS AP	6.0	91.7
GLENVIEW NAS	-4.6	93.2	LOUISVILLE BOWMAN FIELD	7.1	93.3
MOLINE QUAD CITY INTL AP	-6.2	93.5	LOUISVILLE STANDIFORD FIELD	8.0	93.4
PEORIA GREATER PEORIA AP	-3.6	92.7	SOMERSET (AWOS)	13.6	94.7
QU1NCY MUNI BALDWIN FLD	-2.0	93.3	***Louisiana***		
ROCKFORD GREATER ROCKFORD AP	-8.4	91.5	ALEXANDRIA ESLER REGIONAL AP	26.5	97.3
SCOTT AFB/BELLEVILL	4.5	95.1	ALEXANDRIA INTERNATIONAL	26.7	96.6
SPRINGFIELD CAPITAL AP	-2. 1	92.9	BARKSDALE AFB	22.5	97.3
UNIV OF ILLINOIS WI	-1.0	92.5	BATON ROUGE RYAN ARPT	27.6	94.2
W. CHICAGO/DU PAGE	-5.4	90.5	LAFAYETTE REGIONAL AF	28.6	94.2
Indiana			LAKE CHARLES REGIONAL ARPT	29.6	94.1
EVANSVILLE REGIONAL AF	5.6	93.9	MONROE REGIONAL AP	23.6	96.9
FORT WAYNE INTL AP	-2.6	91.1	NEW ORLEANS ALVIN CALLENDER F	30.1	92.5
GRISSOM ARB	-3.9	92.4	NEW ORLEANS INTL ARPT	31.5	93.6
INDIANAPOLIS INTL AP	-0.5	91.1	NEW ORLEANS LAKEFRONT AP	35.6	93.4
LAFAYETTE PURDUE UNIV AP	-2.3	92.4	SHREVEPORT DOWNTOWN	27.0	99.3
MONROE CO	4.8	90.6	SHREVEPORT REGIONAL ARPT	23.8	97.8
SOUTH BEND MICHIANA RGNL AP	-1.5	90.9	***Maine***		
TERRE HAUTE/HULMAN	-0.3	92.1	AUBURN-LEWISTON	-6.8	87.9
Iowa			BANGOR INTERNATIONAL AP	-7.4	87.8
AMES MUNI ARPT	-5.8	90.5	BRUNSWICK NAS	-2.5	86.4
ANKENY REGIONAL ARP	-5.4	94.9	PORTLAND INTL JETPORT	-0.3	86.8
BOONE MUNI	-5.8	91.3	SANFORD MUNI (AWOS)	-6.8	88.4
CEDAR RAPIDS MUNICIPAL AP	-9.6	91.6	***Maryland***		
DAVENPORT NEXRAD	-3.4	90.3	ANDREWS AFB	13.9	94.0
DBS MOINES INTL AP	-6.9	93.4	BALTIMORE BLT-WASHNGTN INTL	12.9	93.9
DUBUQUE REGIONAL AP	-8.2	89.3	THOMAS POINT	17.3	86.7
SIOUX CITY SIOUX GATEWAY AP	-8.8	93.4	***Massachusetts***		
WATERLOO MUNICIPAL AP	-12.7	91.8	BARNSTABLE MUNI BOA	9.6	84.0
Kansas			BOSTON LOGAN INTL ARPT	7.4	90.8
FT RILEY/MARSHALL A	-1.4	99.6	BUZZARDS BAY	11.9	75.6
LAWRENCE MUNI ARPT	5.1	99.1	CHATHAM MUNI ARPT	10.4	81.8
MANHATTAN RGNL	2.5	99.9	LAWRENCE MUNI	2.8	90.2
MCCONNELL AFB	5.2	99.9	MARTHAS VINEYARD	8.9	82.4
OLATHE/JOHNSON CO.	5.2	96.7	NEW BEDFORD RGNL	7.4	88.1
SALINA MUNICIPAL AP	0.9	101.3	NORWOOD MEMORIAL	2.6	90.4

ASHRAE Design Temperatures for Selected Locations 3/8

LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°	LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°
Massachusetts - con't			***Missouri – con't***		
OTIS ANGB	8.3	84.6	SPRINGFIELD REGIONAL ARPT	4.3	95.0
PLYMOUTH MUNICIPAL	4.6	88.4	ST LOUIS LAMBERT INTL ARPT	4.1	95.6
SOUTH WEYMOUTH NAS	5.9	91.2	ST LOUIS SPIRIT OF ST LOUIS A	5.1	95.2
WORCESTER REGIONAL ARPT	1.6	85.7	***Montana***		
Michigan			BILLINGS LOGAN INTL ARPT	-11.6	94.9
DETROIT CITY AIRPORT	4.1	90.8	BOZEMAN GALLATIN FIELE	-18.1	91.3
DETROIT METROPOLITAN ARPT	1.4	90.3	BUTTE BERT MOONEY ARPT	-20.4	87.8
DETROIT WILLOW RUN AP	0.8	90.4	GREAT FALLS	-12.5	90.5
FLINT BISHOP INTL ARPT	-1.0	89.4	GREAT FALLS INTL ARPT	-17.7	92.1
GRAND RAPIDS KENT COUNTY INT	1.4	89.3	MALMSTROM AFB	-16.9	92.9
GROSSE ISLE ARPT	7.3	89.8	MISSOULA INTERNATIONAL AP	-6.0	92.5
HOLLAND/TULIP CITY	7.4	88.3	***Nebraska***		
JACKSON REYNOLDS FIELD	-1.0	88.5	GRAND ISLAND CENTRAL NE RECTO	-6.1	96.2
KALAMAZOO BATTLE CR	3.0	90.1	LINCOLN MUNICIPAL ARPT	-5.4	97.2
LANSING CAPITAL CITY ARPT	-2.5	89.4	OFFUTT AFB/BELLEVUE	-3.2	95.0
MUSKEGON COUNTY ARPT	4.0	86.2	OMAHA EPPLEY AIRFIELD	-6.3	95.0
OAKLAND CO INTL	1.1	89.6	OMAHA WSFO	-7.8	93.4
SAGINAW TRI CITY INTL AP	0.0	89.9	***Nevada***		
SELFRIDGE ANGB	2.7	90.3	LAS VEGAS MCCARRAN INTL AP	30.5	108.3
ST CLAIR COUNTY INT	0.6	90.3	NELLIS AFB	28.2	109.2
Minnesota			RENO TAHOE INTERNATIONAL AP	11.9	95.7
DULUTH HARBOR (COS)	-12.1	86.1	***New Hampshire***		
DULUTH INTERNATIONAL ARPT	-19.5	84.5	CONCORD MUNICIPAL ARPT	-4.8	89.8
FLYING CLOUD	-8.6	90.8	JAFFREY MUNICIPAL	-3.8	86.4
MANKATO(AWOS)	-13.2	89.8	MANCHESTER AIRPORT	1.0	91.2
MINNEAPOLIS/ELAINE	-8.7	90.3	PEASE INTL TRADEPOR	2.6	89.3
MINNEAPOLIS/CRYSTAL	-8.6	90.6	***New Jersey***		
MINNEAPOLIS-ST PAUL INTL ARP	-13.4	91.0	ATLANTIC CITY INTL AP	9.9	92.3
ROCHESTER INTERNATIONAL ARPT	-15.2	88.2	BELMAR-FARMINGDALE	10.7	90.7
SOUTH ST PAUL MUNI	-9.3	90.7	MCGUIRE AFB	10.3	92.9
ST CLOUD REGIONAL ARPT	-19.3	90.0	MILLVILLE MUNICIPAL AP	10.3	91.9
ST PAUL DOWNTOWN AP	-12.0	90.4	NEWARK INTERNATIONAL ARPT	11.0	94.0
Mississippi			TETERBORO AIRPORT	9.9	92.4
HATTIESBURG LAUREL	25.3	95.8	TRENTON MERCER COUNTY AP	9.8	92.6
JACKSON INTERNATIONAL AP	22.0	95.6	***New Mexico***		
KEESLER AFB/BILOX1	30.3	93.5	ALAMOGORDO WHITE SA	21.1	100.0
MERIDIAN KEY FIELD	21.9	95.7	ALBUQUERQUE INTL ARPT	17.7	95.2
MERIDIAN NAAS	20.8	97.2	CANNON AFB/CLOVIS	11.8	97.4
TUPELO C D LEMONS ARPT	18.3	95.9	CLOVIS MUNI (AWOS)	13.8	97.1
Missouri			FARMINGTON FOUR CORNERS REGL	7.5	94.9
CAPE GIRARDEAU MUNICIPAL AP	7.4	94.8	HOLLOMAN AFB	19.0	99.1
COLUMBIA REGIONAL AIRPORT	1.3	94.7	ROSWELL INDUSTRIAL AIR PARK	16.3	99.8
JEFFERSON CITY MEM	7.4	95.2	WHITE SANDS	18.4	99.0
JOPLINMUNICIPALAP	5.8	96.6	***New York***		
KANSAS CITY DOWNTOWN AP	2.6	97.2	ALBANY COUNTY AP	-1.9	89.0
KANSAS CITY INTL ARPT	-0.1	96.2	AMBROSE LIGHT	13.6	83.8

ASHRAE Design Temperatures for Selected Locations 4/8

LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°
New York – con't		
BINGHAMTON EDWIN A LINK FIELD	-1.0	85.5
BUFFALO NIAGARA INTL AF	2.7	86.5
ELMIRA CORNING REGIONAL AP	-1.8	89.9
GRIFFISS AFB	-6.0	88.7
ISLIP LONG ISL MACARTHUR AP	10.6	88.4
JAMESTOWN (AWOS)	1.0	82.4
NEW YORK J F KENNEDY INTL AR	12.8	89.7
NEW YORK LAGUARDIA ARPT	12.6	92.2
NEWBURGH/STEWART	3.5	89.8
NIAGARA FALLS AF	2.5	87.9
PLATTSBURGH AFB	-9.6	86.5
POUGHKEEPSIE DUTCHESS CO AP	0.5	91.4
REPUBLIC	11.9	90.2
ROCHESTER GREATER ROCHESTER I	2.1	88.4
SYRACUSE HANCOCK INTL ARPT	-2.7	88.9
UTICA ONEIDA COUNTY AP	-5.0	87.5
WHITE PLAINS WESTCHESTER CO	7.7	90.0
North Carolina		
ASHEVTLLE REGIONAL ARPT	13.6	88.1
CHARLOTTE DOUGLAS INTLARPT	20.5	94. 1
FAYETTEVILLE RGNL G	21.4	95.5
FORT BRAGG/SIMMONS	21.7	96.6
GREENSBORO PIEDMONT TRIAD INT	17.1	92.2
HICKORY REGIONAL AP	18.9	92.5
JACKSONVILLE (AWOS)	20.0	93.5
NEW RIVER MCAF	22.9	93.2
PITT GREENVILLE ARP	20.9	95.2
POPE AFB	21.2	97.0
RALEIGH DURHAM INTERNATIONAL	18.8	94.1
RICHMOND INTERNATIONAL AP	16.8	94.8
SEYMOUR-JOHNSON AFB	21.7	96.5
WILMINGTON INTERNATIONAL ARPT	24.0	93.3
WINSTON-SALEM REYNOLDS AP	18.2	92.4
North Dakota		
BISMARCK MUNICIPAL ARPT	-20.0	93.9
FARGO HECTOR INTERNATIONAL AP	-20.4	91.0
GRAND FORKS AFB	-20.4	90.8
GRAND FORKS INTERNATIONAL AP	-22.2	90.04
MINOT AFB	-22.2	93.2
MINOT FAA AP	-19.9	91.4
0hio		
AKRON AKRON-CANTON REG AP	1.8	88.7
CINCINNATI MUNICIPAL AP LUNKI	6.3	92.8
CLEVELAND HOPKINS INTL AP	2.5	89.4
COLUMBUS PORT COLUMBUS	3.2	91.1
DAYTON INTERNATIONAL AIRPORT	0.6	90.3

LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°
0hio – con't		
FINDLAY AIRPORT	-0.4	90.4
LANCASTER\FAIRFIEL	3.1	90.5
MANSFIELD LAHM MUNICIPAL ARPT	0.I	88.0
OHIO STATE UNIVERSI	6.9	90.4
RICKENBACKER ANGB	4.3	92.5
TOLEDO EXPRESS AIRPORT	-0.3	91.2
WR1GHT-PATERSON AFB	1.4	91.3
YOUNGSTOWN REGIONAL AIRPORT	1.8	88.5
Oklahoma		
FORT SILL	12.6	100.5
LAWTON MUNICIPAL	17.9	102.4
OKLAHOMA CITY WILL ROGERS WOR	11.4	99.5
OKLAHOMA CITY /WILEY	12.1	99.5
STILLWATER RGNL	13.6	101.8
TINKER AFB	12.1	99.3
TULSA INTERNATIONAL AIRPORT	10.9	99.4
TULSA/LLOYD JONES	15.8	100.1
VANCE AFB	6.5	100.6
Oregon		
AURORA STATE	27.5	91.2
CORVALLIS MUNI	25.0	92.9
EUGENE MAHLON SWEET ARPT	22.4	91.4
MC MINNV1LLE MUNI	27.6	91.4
MEDFORD ROGUE VALLEY INTL AP	22.9	98.9
PORTLAND INTERNATIONAL AP	23.9	91.2
PORTLAND/HILLSBORO	21.8	91.8
REDMOND ROBERTS FIELD	5.4	92.8
SALEM MCNARY FIELD	21.9	92.0
Pennsylvania		
ALLENTOWN LEHIGH VALLEY INT1	7.0	91.0
ALTOONA BLAIR CO ARPT	4.7	88.5
BUTLER CO. (AWOS)	3.1	88.0
ERIE INTERNATIONAL AP	5.2	86.4
HARRISBURG CAPITAL CITY ARPT	8.7	92.4
MIDDLETOWN HARRISBURG INTLAP	10.7	92.6
PHILADELPHIA INTERNATIONAL AI	12.6	93.2
PHILADELPHIA NE PHILADELPHIA	11.0	93.1
PITTSBURGH ALLEGHENY CO AF	4.3	89.9
PITTSBURGH INTERNATIONAL AP	3.7	89.5
READING SPAATZ FIELD	9.4	92.4
WASHINGTON (AWOS)	2.7	88.4
WILKES-BARRE SCRANTON INTL AP	3.5	88.9
WILLOW GROVE NAS	10.2	92.7
Rhode Island		
PAWTUCKET (AWOS)	3.1	88.1
PROVIDENCE T F OREEN STATE AR	7.2	90.1

ASHRAE Design Temperatures for Selected Locations 5/8

LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°	LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°
South Carolina			***Texas – con't***		
CHARLESTON INTL ARPT	26.9	94.3	HOUSTON/ELLINGTON	32.0	96.1
COLUMBIA METRO ARPT	22.0	97.0	KELLY AFB	28.4	100.2
FLORENCE REGIONAL AP	23.4	95.9	KILLEEN MUNI (AWOS)	25.9	99.5
FOLLY ISLAND	31.6	87.6	LAREDO INTL AIRPORT	33.9	102.5
GREEK GREENVL-SPARTANBRG AP	20.5	94.0	LAUGHLIN AFB	29.4	104.2
SHAW AFB/SUMTER	24.2	95.4	LONGVIEW GREGG COUNTY AP	21.6	99.1
South Dakota			LUBBOCK INTERNATIONAL AF	13.3	98.8
ELLSWORTH AFB	-9.2	96.5	LUFKIN ANGELINA CO	25.4	97.5
RAPID CITY REGIONAL ARPT	-10.5	96.9	MC GREGOR (AWOS)	25.2	99.9
SIOUX FALLS FOSS FIELD	-13.7	92.8	MCALLEN MILLER INTL AP	36.58	100.1
Tennessee			MCK1NNEY MUNI ARPT	21.4	100.3
BRISTOL TRI CITY AIRPORT	11.4	89.8	MIDLAND INTERNATIONAL AP	18.3	100.3
CHATTANOOGA LOVELL FIELD AF	17.7	94.5	NACOGDOCHES (AWOS)	25.3	97.4
JACKSON MCKELLAR-SIPES REG A	13.5	94.7	PORT ARANSAS	36.6	85.9
KNOXVILLE MCGHEE TYSON AP	15.0	92.6	PORT ARTHUR JEFFERSON COUNTY	30.5	94.2
MEMPHIS INTERNATIONAL AP	17.0	96.0	RANDOLPH AFB	27.5	99.4
MILLINGTON MUNI ARP	14.0	97.3	REESE AFB	12.1	100.0
NASHVILLE INTERNATIONAL AF	12.9	94.4	SABINE	32.2	88.4
Texas			SAN ANGELO MATHIS FIELD	20.1	100.2
ABILENE DYESS AFB	16.2	101.4	SAN ANTONIO INTL AP	27.4	98.5
ABILENE REGIONAL AP	17.9	99.3	SAN ANTONIO/STINSON	30.5	100.0
AMARILLO INTERNATIONAL AP	7.2	97.3	SAN MARCOS MUNI	27.9	99.1
AUSTIN/BERGSTROM	25.2	99.7	VICTORIA REGIONAL AP	29.8	96.6
BROWNSVILLE S PADRE ISL INTL	36.4	95.5	WACO REGIONAL AP	22.9	100.8
CAMPMABRY	26.7	99.4	WICHITA FALLS MUNICIPAL ARPT	15.3	102.5
COLLEGE STATION EASTERWOOD FL	26.0	99.2	***Utah***		
CORPUS CHRISTI INTL ARPT	32.6	95.8	HILL AFB/OGDEN	8.6	93.3
CORPUS CHRISTI NAS	35.6	93.2	LOGAN-CACHE AIRPORT	-6.3	95.0
DALLAS HENSLEY FIELD NAS	18.5	99.7	PROVO MUNI (AWOS)	9.0	94.6
DALLAS LOVE FIELD	21.6	100.3	SAINT GEORGE (AWOS)	26.8	106.2
DALLAS/REDBIRD ARPT	26.5	100.2	SALT LAKE CITY INTL ARPT	9.3	97.4
DALLAS-FORT WORTH INTL AP	20.3	100.4	***Vermont***		
DEL RIO INTERNATIONAL AP	30.7	101.5	BURLINGTON INTERNATIONAL AP	-8.3	88.3
DRAUGHON MILLER CEN	24.9	99.5	***Virginia***		
EL PASO INTERNATIONAL AP	22.6	100.6	DANVILLE FAA AP	18.4	93.2
FORT HOOD/GRAY AAF	23.7	99.9	DINWIDDIE CO	15.9	97.4
FORT WORTH ALLIANCE	21.5	101.6	FORT BELVOIR/DAVISO	12.6	96.2
FORT WORTH MEACHAM	19.9	100.9	LANGLEY AFB/HAMPTOK	20.6	92.9
FORT WORTH NAS	18.8	100.2	LEESBURG/GODFREY	14.2	94.8
GALVESTON/SCHOLES	33.0	91.4	LYNCHBURG REGIONAL ARPT	14.4	92.1
GEORGETOWN (AWOS)	26.5	99.1	MANASSAS MUNI(AWOS)	11.9	92.8
HARLINGEN RIO GRANDE VALLEY 1	36.6	98.8	NEWPORT NEWS	18.7	94.5
HOUSTON BUSH INTERCONTINENTAL	29.1	96.8	NORFOLK INTERNATIONAL AP	21.7	93.7
HOUSTON WILLIAM P HOBBY AP	31.3	95.1	NORFOLK NAS	22.7	93.8
HOUSTON/D.W. HOOKS	30.2	98.7	OCEANA NAS	21.1	92.9

ASHRAE Design Temperatures for Selected Locations 6/8

LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°
Virginia – Con't		
QUANTICO MCAS	16.2	92.6
ROANOKE REGIONAL AP	14.2	92.1
STAUNTON/SHENANDOAH	12.1	93.3
VIRGINIA TECH ARPT	10.3	88.4
WASHINGTON DC DULLES INTL AR	10.7	93.5
WASHINGTON DC REAGAN AP	16.3	94.3
Washington		
ARLINGTON MUNI	20.8	82.1
BELLINGHAM INTL AP	18.0	79.4
BREMERTON NATIONAL	23.7	85.6
FAIRCHILD AFB	4.6	91.4
FELTS FLD	6.9	94.7
GRAY AAF	19.3	86.4
KELSO WB AP	21.6	88.0
MC CHORD AFB/TACOMA	20.6	86.2
OLYMPIA AIRPORT	20.1	87.3
PASCO	6.8	99.5
PEARSON FLD	25.3	90.7
SEATTLE BOEING FIELD	24.0	86.1
SEATTLE SEATTLE-TACOMA INTL A	24.5	84.9
SHELTON/S ANDERSON	24.7	87.6
SNOHOMISH CO	27.7	79.4
SPOKANE INTERNATIONAL AP	2.9	92.8
TACOMA NARROWS	29.5	83.7
WALLA WALLA CITY COUNTY AP	8.1	98.9
WEST POINT (LS)	29.0	70.6
YAKIMA AIR TERMINAL	6.3	95.7
West Virginia		
CHARLESTON YEAOER ARPT	8.5	91.3
HUNTINGTON TRI-STATE ARPT	8.4	91.9
PARKERSBURG WOOD COUNTY AP	5.4	90.8
Wisconsin		
APPLETON/OUTAGAMIE	-5.8	88.5
EAU CLAIRE COUNTY AP	-15.6	90.8
FOND DU LAC CO.	-3.9	88.5
GREEN BAY AUSTIN STRAUBEL INT	-9.9	88.4
KENOSHA RGNL	0.5	90.3
LA CROSSE MUNICIPAL ARPT	-12.3	92.1
MADISON DANE CO REGIONAL ARPT	-9.1	89.8
MANITOWAC MUNI AWOS	-4.2	84.5
MILWAUKEE MITCHELL INTL AF	-4.0	90.3
MOSINEE/CENTRAL WI	-10.7	87.6
SHEBOYGAN	-1.9	88.2
SHEBOYGAN	-2.2	83.2
WAUSAU MUNICIPAL ARPT	-13.6	88.1
WITTMAN RGNL	-5.6	88.4
Wyoming		
CASPER NATRONA CO INTL AP	-10.3	93.8
CHEYENNE MUNICIPAL ARPT	-6.4	89.2
Canada		
Alberta		
CALGARY INTL A	-20.4	83.5
COP UPPER	-18.3	82.7
EDMONTON CITY CENTRE A	-21.5	82.5
EDMONTON INT'L A	-26.5	81.5
EDMONTON NAMAO A	-23.1	80.9
FORT MCMURRAY A	-34.2	84.1
GRANDE PRAIRIE A	-33.5	81.4
LACOMBE CDA 2	-27.2	82.9
LETHBRIDGE A	-21.6	88.5
LETHBRIDGE CDA	-19.0	89.5
MEDICINE HAT A	-24.1	90.4
RED DEER A	-26.8	82.3
SPRINGBANK A	-25.0	80.3
British Columbia		
ABBOTSFORD A	16.5	85.4
AGASSIZ CS	18.6	86.2
BALLENAS ISLAND	30.7	75.1
COMOXA	22.4	80.1
DISCOVERY ISLAND	31.8	73.7
ENTRANCE ISLAND CS	29.1	75.1
ESQUIMALT HARBOUR	28.2	72.6
HOWE SOUND - PAM ROCKS	27.2	77.2
KAMLOOPS A	-5.5	92.7
KELOWNAA	-1.0	90.9
MALAHAT	21.9	81.7
PENTICTON A	6.4	90.6
PITT MEADOWS CS	18.9	87.0
POINT ATKINSON	31.2	77.0
PRINCE GEORGE A	-23.9	81.8
SANDHEADS CS	25.4	72.1
SUMMERLAND CS	5.9	91.3
VANCOUVER HARBOUR CS	26.8	78.3
VANCOUVER INT'L A	19.4	77.0
VERNONCS	5.4	91.6
VICTORIA GONZALES CS	27.5	76.4
VICTORIA HARTLAND CS	27.0	83.4
VICTORIA INT'L A	23.6	79.9
VICTORIA MARINE	22.0	69.9
VICTORIA UNIVERSITY CS	28.2	80.5
WEST VANCOUVER AUT	21.6	80.6
WHITE ROCK CAMPBELL SCIENTIFI	22.4	76.7

ASHRAE Design Temperatures for Selected Locations 7/8

LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°	LOCATION	99.6% HEATING DESIGN TEMP, F°	0.4% COOLING DESIGN TEMP, F°
Canada – con't			***Prince Edward Island***		
Manitoba			CHARLOTTETOWN A	-4.9	80.1
WINNIPEG RICHARDSON INTL A	-25.9	87.4	***Quebec***		
New Brunswick			BAGOTVILLE A	-22.2	84.6
FREDERICTON A	-10.5	85.5	JONQUIERE	-20.6	84.2
MONCTON A	-8.7	83.2	LA BAIE	-22.8	84.4
SAINT JOHN A	-8.3	78.9	LAC SAINT-PIERRE	-13.9	81.7
Newfoundland and Labrador			L'ACADIE	-11.3	86,2
ST JOHN'S A	3.7	76.3	L'ASSOMPTION	-14.7	86.7
Northwest Territories			LENNOXVILLE	-14.8	85.0
YELLOWKN1FEA	-41.7	77.4	MCTAVISH	-8.2	86.3
Nova Scotia			MONT-JOLI A	-11.0	80.1
HALIFAX STANFIELD INT'L A	-1.4	81.7	MONT-ORFORD	-19.2	77.2
SHEARWATER A	1.4	78.7	MONTREAL/MIRABEL INTL A	-15.6	85.0
SHEARWATER JETTY	7.0	78.5	MONTREAL/PIERRE ELLIOTT TRUDE	-10.6	86.0
SYDNEY A	-0.4	81.1	MONTREAL/ST-HUBERT A	-11.7	86.2
Nunavut			MONTREAL-EST	-10.0	86.9
IQALUIT A	-40.2	61.7	NICOLET6W	-14.1	83.8
Ontario			POINTE-AU-PERE (INRS)	-7.8	73.6
BEAUSOLEIL	-11.0	85.9	QUEBEC/JEAN LESAOE INTL A	-15.2	84.0
BELLE RIVER	5.7	88.9	SHERBROOKEA	-19,0	83.5
BURLINGTON PIERS (AUT)	4.5	86.5	ST-ANICET1	-12.7	86.2
ERIEAU (AUT)	5.7	80.4	STE-ANNE-DE-BELLEVUE 1	-11.5	86.1
LAGOON CITY	-11.1	81.6	STE-FOY (U. LAVAL)	-12.9	84.5
LONDON INTL AIRPORT	-0.9	86.2	TROIS-RIVIERES	-11.4	81.4
NORTH BAY A	-18.1	82.0	VARENNES	-10.9	86.6
OTTAWA MACDONALD-CARRIER INT	-12.0	87.1	***Saskatchewan***		
PETERBOROUGH A	-11.0	85.2	MOOSE JAW A	-27.9	90.3
PORT WELLER (AUT)	7.7	84.7	MOOSE JAW CS	-21.5	90.0
SAULT STE MARIE A	-13.2	83.1	PRINCE ALBERT A	-33.8	84.7
SUDBURY A	-18.7	84.5	REOINAA	-29.2	88.5
THUNDER BAY A	-21.9	84.3	SASKATOON DIEFENBAKER INTL A	-31.0	87.5
TIMMINS VICTOR POWER A	-28.6	84.9	SASKATOON KERNEN FARM	-28.3	87.2
TORONTO BUTTONVILLE A	-4.2	89,1	***Yukon Territory***		
TORONTO ISLAND A	3.0	83.3	WHITEHORSEA	-40.0	78.1
TORONTO LESTER B.PEARSON INT	-1.8	88.1			
TRENTON A	-7.3	84.5			
WELCOME ISLAND (AUT)	-14.8	76.2			
WINDSOR A	2.4	89.4			

ASHRAE Design Temperatures for Selected Locations 8/8

IV. Performance Tables

1) Introduction

PUTTING PERFORMANCE TABLES IN THEIR PROPER PERSPECTIVE

Compressor unit and air handler system performance tables are based upon data from the performance of ETI-specified compressor units and air handlers that are components of systems that are properly sized and installed, and have earth loops located in soil that has average thermal conductivity for their region. The tables describe only the performance of ETI-specified compressor units and air handlers within the range of normal operating conditions.

The performance, comfort and economy afforded by an EarthLinked® System is dependent upon the proper sizing and selection, installation and maintenance of the entire system for the specific application and location. The complete system may include the compressor unit, earth loops, air handler and ducting (or refrigerant-to-water heat exchanger, water tank, pumps and water piping., for a hydronic system) and thermostat.

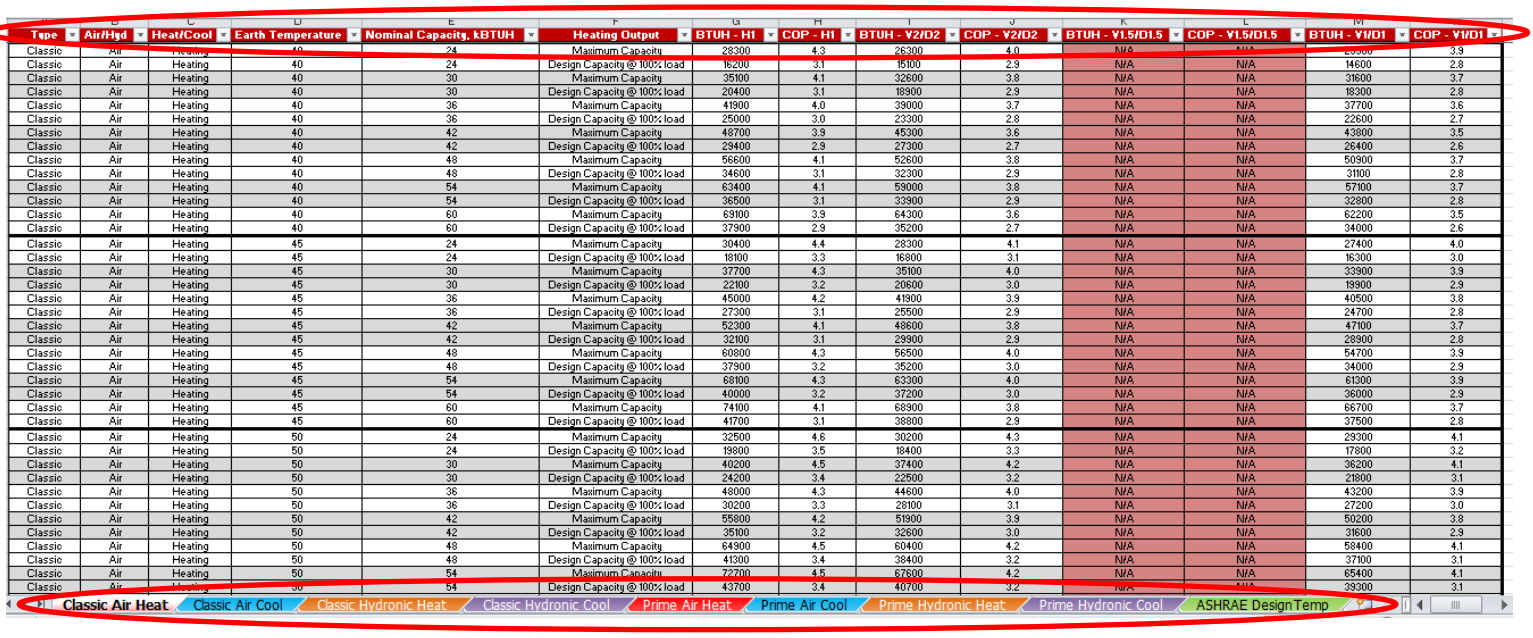
A detailed, documented heating and cooling load calculation must be accurately completed in accordance with the ACCA Manual J (latest edition), and utilized with the appropriate ASHRAE design temperatures listed in this manual for the location of the installation. It is imperative that the equipment is sized in accordance with the procedures in this manual.

Failure to perform correct heating and cooling load calculations or to properly select and install the appropriate system size and other components for the project will affect system performance and will void the application of the warranty. The heating and cooling system operation habits of the building occupants (such as adjusting the thermostat beyond the temperature range for which the specific installation was designed, etc.) may also negatively affect system performance.

2) Tutorial

The complete performance tables can be found in IV.3) in the form of an Excel file. Simply double-click on the file icon and the Microsoft Excel file will open. Here are a few tips to easily use the file:

- **View**: once opened, you will see the following:

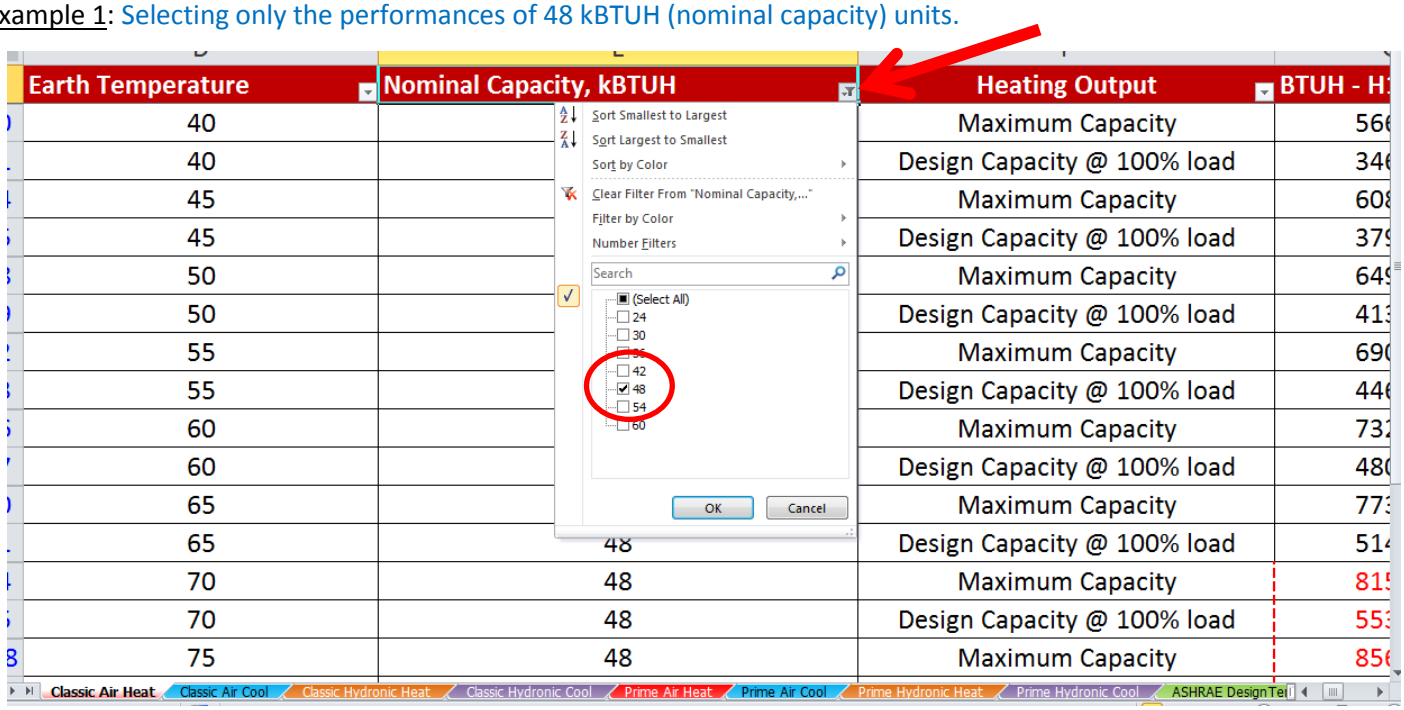


Type	Air/Hyd	Heat/Cool	Earth Temperature	Nominal Capacity, kBTUH	Heating Output	BTUH - H1	COP - H1	BTUH - V2/D2	COP - V2/D2	BTUH - V1.5/D1.5	COP - V1.5/D1.5	BTUH - V1/D1	COP - V1/D1
Classic	Air	Heating	40	24	Maximum Capacity	28300	4.3	26300	4.0	N/A	N/A	25500	3.9
Classic	Air	Heating	40	24	Design Capacity @ 100% load	16200	3.1	15100	2.9	N/A	N/A	14600	2.8
Classic	Air	Heating	40	30	Maximum Capacity	35100	4.1	32600	3.8	N/A	N/A	31600	3.7
Classic	Air	Heating	40	30	Design Capacity @ 100% load	20400	3.1	18900	2.9	N/A	N/A	18300	2.8
Classic	Air	Heating	40	36	Maximum Capacity	41900	4.0	39000	3.7	N/A	N/A	37700	3.6
Classic	Air	Heating	40	36	Design Capacity @ 100% load	25000	3.0	23300	2.8	N/A	N/A	22600	2.7
Classic	Air	Heating	40	42	Maximum Capacity	48700	3.9	45300	3.6	N/A	N/A	43800	3.5
Classic	Air	Heating	40	42	Design Capacity @ 100% load	29400	2.9	27300	2.7	N/A	N/A	26400	2.6
Classic	Air	Heating	40	48	Maximum Capacity	56600	4.1	52600	3.8	N/A	N/A	50900	3.7
Classic	Air	Heating	40	48	Design Capacity @ 100% load	34600	3.1	32300	2.9	N/A	N/A	31100	2.8
Classic	Air	Heating	40	54	Maximum Capacity	63400	4.1	59000	3.8	N/A	N/A	57100	3.7
Classic	Air	Heating	40	54	Design Capacity @ 100% load	36500	3.1	33900	2.9	N/A	N/A	32800	2.8
Classic	Air	Heating	40	60	Maximum Capacity	69100	3.9	64300	3.6	N/A	N/A	62200	3.5
Classic	Air	Heating	40	60	Design Capacity @ 100% load	37900	2.9	35200	2.7	N/A	N/A	34000	2.6
Classic	Air	Heating	45	24	Maximum Capacity	30400	4.4	28300	4.1	N/A	N/A	27400	4.0
Classic	Air	Heating	45	24	Design Capacity @ 100% load	18100	3.3	16800	3.1	N/A	N/A	16300	3.0
Classic	Air	Heating	45	30	Maximum Capacity	37700	4.3	35100	4.0	N/A	N/A	33900	3.9
Classic	Air	Heating	45	30	Design Capacity @ 100% load	22100	3.2	20600	3.0	N/A	N/A	19900	2.9
Classic	Air	Heating	45	36	Maximum Capacity	45000	4.2	41900	3.9	N/A	N/A	40500	3.8
Classic	Air	Heating	45	36	Design Capacity @ 100% load	27300	3.1	25500	2.9	N/A	N/A	24700	2.8
Classic	Air	Heating	45	42	Maximum Capacity	52300	4.1	48600	3.8	N/A	N/A	47100	3.7
Classic	Air	Heating	45	42	Design Capacity @ 100% load	32100	3.1	29900	2.9	N/A	N/A	28900	2.8
Classic	Air	Heating	45	48	Maximum Capacity	60800	4.3	56500	4.0	N/A	N/A	54700	3.9
Classic	Air	Heating	45	48	Design Capacity @ 100% load	37900	3.2	35200	3.0	N/A	N/A	34000	2.9
Classic	Air	Heating	45	54	Maximum Capacity	68100	4.3	63300	4.0	N/A	N/A	61300	3.9
Classic	Air	Heating	45	54	Design Capacity @ 100% load	40000	3.2	37200	3.0	N/A	N/A	36000	2.9
Classic	Air	Heating	45	60	Maximum Capacity	74100	4.1	68900	3.8	N/A	N/A	66700	3.7
Classic	Air	Heating	45	60	Design Capacity @ 100% load	41700	3.1	38800	2.9	N/A	N/A	37500	2.8
Classic	Air	Heating	50	24	Maximum Capacity	32500	4.6	30200	4.3	N/A	N/A	29300	4.1
Classic	Air	Heating	50	24	Design Capacity @ 100% load	19800	3.5	18400	3.3	N/A	N/A	17800	3.2
Classic	Air	Heating	50	30	Maximum Capacity	40200	4.5	37400	4.2	N/A	N/A	36200	4.1
Classic	Air	Heating	50	30	Design Capacity @ 100% load	24200	3.4	22500	3.2	N/A	N/A	21800	3.1
Classic	Air	Heating	50	36	Maximum Capacity	48000	4.3	44600	4.0	N/A	N/A	43200	3.9
Classic	Air	Heating	50	36	Design Capacity @ 100% load	30200	3.3	28100	3.1	N/A	N/A	27200	3.0
Classic	Air	Heating	50	42	Maximum Capacity	55800	4.2	51900	3.9	N/A	N/A	50200	3.8
Classic	Air	Heating	50	42	Design Capacity @ 100% load	35100	3.2	32600	3.0	N/A	N/A	31600	2.9
Classic	Air	Heating	50	48	Maximum Capacity	64900	4.5	60400	4.2	N/A	N/A	58400	4.1
Classic	Air	Heating	50	48	Design Capacity @ 100% load	41300	3.4	38400	3.2	N/A	N/A	37100	3.1
Classic	Air	Heating	50	54	Maximum Capacity	72700	4.5	67600	4.2	N/A	N/A	65400	4.1
Classic	Air	Heating	50	54	Design Capacity @ 100% load	43700	3.4	40700	3.2	N/A	N/A	39300	3.1

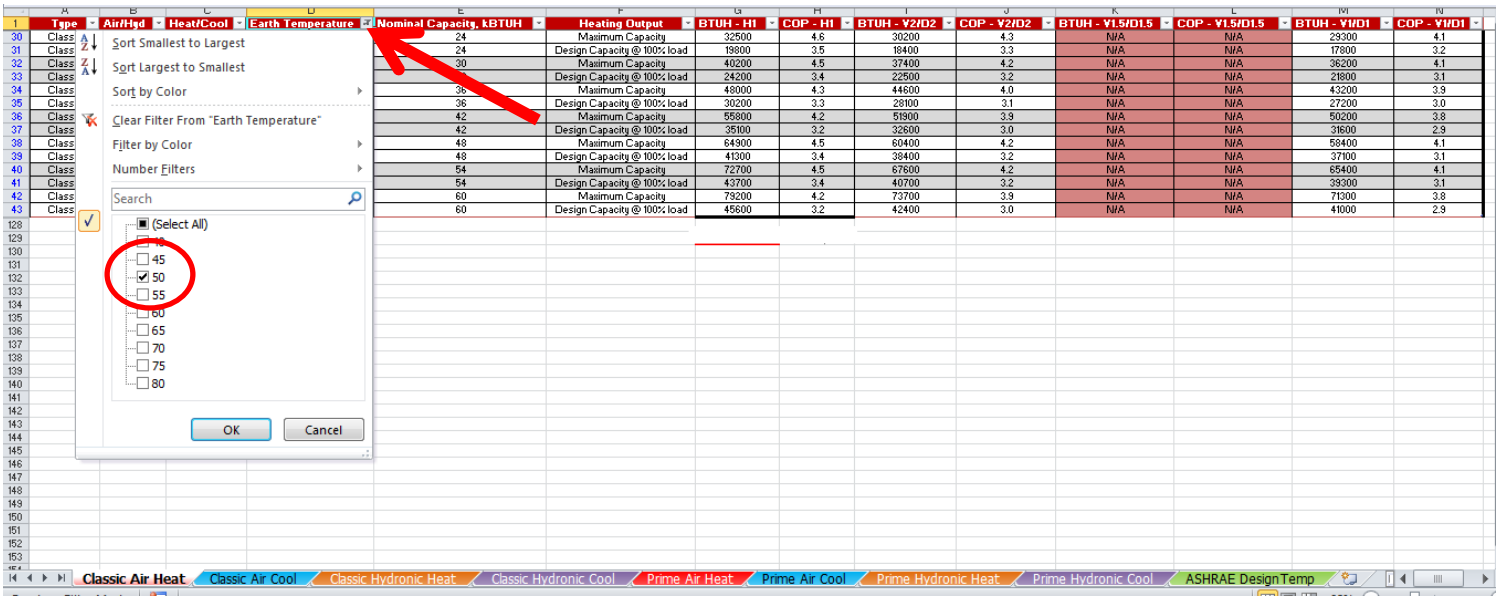
Classic Air Heat | Classic Air Cool | Classic Hydronic Heat | Classic Hydronic Cool | Prime Air Heat | Prime Air Cool | Prime Hydronic Heat | Prime Hydronic Cool | ASHRAE DesignTemp

  - **Bottom tabs**: At the bottom you will see 9 tabs: 8 correspond to the different performance tables (with all combinations of (1) Air and Hydronic, (2) Heating and Cooling and (3) Classic and Prime Series). The last one "ASHRAE Design Temp" lists the *ASHRAE Outdoor Design Condition* that you can also find in section III (enabling you to search the page to quickly find a specific location).
  - **Column Headers**: There are 14 Column Headers. The 6 first specify the type of system (Product Series, Application, Mode, nominal capacity) and the condition (Earth Temperature, Output type). The remaining 8 columns list the performance – Capacities (BTUH) and Efficiencies (COP and EER) – for each loop type. You can click on the arrow at the bottom left of the header to filter the data shown:

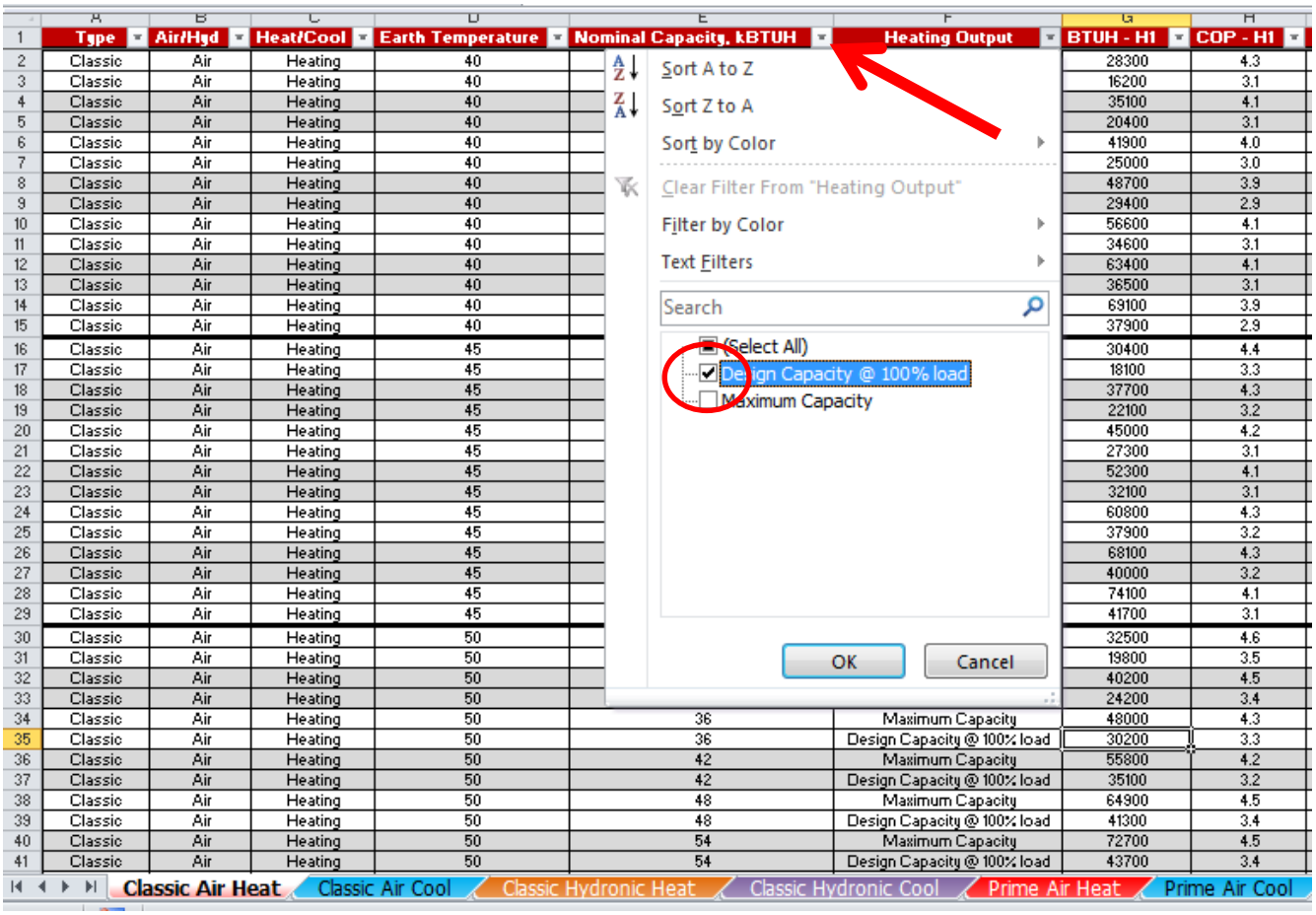
Example 1: Selecting only the performances of 48 kBTUH (nominal capacity) units.



Example 2: Selecting only the performances in 50°F degree Earth.



Example 3: Selecting only the Design capacities when sizing a unit.



3) Complete Performance Tables

Download the Excel file “ETI Performance Tables – 10.22.15. xls” at http://earthlinked.com/dealers/technical-manuals/

Go to www.earthlinked.com/dealers. Sign in under the “**EXISTING USERS LOG IN**” section. The file can be found under the “**System Sizing & Performance Tables**” header in the “Technical Manuals” section. Download and open the excel file.

Please note that compressor **nominal capacities** are given in **kBTUH** and not in Tons.