# EXPERIENCE CLEAN HEAT

## Residential Heating and Cooling Load Analysis Quality Control Checklist

NEW YORK STATE | NYSERDA

## Use this checklist as a guide to help review residential heating and cooling load calculations for accuracy and reasonableness.

**Disclaimer:** This checklist provides only basic checks for a reviewer of residential heating and cool load calculations and is not to be used as a reference for assumptions made in an ACCA Manual J Standard approved load sizing analysis. This document is also not to be used as a substitute for any ACCA standard protocols or manufacturer training guidance for HVAC equipment sizing and selection.

### Homeowner Information Checks:

☐ Confirm the site is a residential building.

☐ Homeowner name is correct.

☐ Homeowner contact information is correct.

☐ Address information is correct.

### Design Conditions Checks:

☐ Heating design temperature is based on 99% outdoor dry bulb temperature for the region (reference ACCA Manual J Table 1A).

☐ Cooling design temperature is based on 1% outdoor dry bulb temperature for the region (reference ACCA Manual J Table 1A).

☐ Indoor heating design temperature is 70°F.

☐ Indoor cooling design temperature is 75°F and relative humidity is 45, 50 or 55%.

### Building Load Checks:

***Note:** heating load percentages outside these ranges are possible. Heating load percentages depend on the climate and type of construction. If heating load percentages are outside the ranges below, double check inputs are accurate.

☐ The building heating load is greater than the building cooling load. In cold climate regions like New York State, the building cooling load is generally 1/2 to 1/3 of the building heating load.

☐ Windows and glass doors are 15 to 30% of the total heating load.

☐ Above grade walls are 10 to 30% of the total heating load.

☐ Below grade walls are 20 to 40% of the total heating load.

☐ Ceilings are 10 to 30% of the total heating load.

☐ Infiltration is 5 to 30% of the total heating load.

☐ Doors are 0 to 5% of the total heating load.

☐ Ventilation is 5 to 30% of the total heating load.

## Building Layout Checks:

☐ The number of stories is accurate.

☐ Floor by floor loads calculated for a block load sizing analysis.

☐ Room by room loads calculated for a room-by-room analysis.

☐ Room and/or floor names are accurate based on existing conditions.

☐ Confirm the quantity of exterior walls and orientations of walls are accurate. (e.g., There are 3 southeast facing walls and 2 northwest facing walls. Is this accurate?)

> ***Hint:*** *Input the building address into google maps and observe the building in satellite view. Check orientations and number of walls using the satellite view.*
>
> ***Note****: The building's shell may not be the same as the building's thermal envelope is. For example, Cape Cod style homes often have extra unconditioned interstitial spaces on the second floor. Therefore, the thermal envelope may be defined not by the building shell as viewed from outside, but instead by the location of walls as observed from inside.*
>
> ***Note****: Room by room loads should only incorporate the exterior walls in the load calculation. Room by room loads should not include interior walls.*

☐ Confirm the quantity of floor types is accurate.

> ***Hint:*** *Homes with an addition or conditioned bonus room above an attached garage, or an above grade floor overhang will have more than one floor type. There should be a separate floor entry for each distinct type of floor.*

☐ Confirm the quantity of ceiling types is accurate.

> ***Hint:*** *Homes with an addition may have more than one ceiling type. There will often be a separate ceiling type for the addition from the rest of the house.*
>
> ***Hint:*** *Insulated sloped ceilings, such as cathedral or vaulted ceilings, have a larger surface area than the footprint of the room. For best accuracy measure or calculate the square footage of the ceiling.*
>
> ***Hint:*** *Cape Cod style homes often have extra unconditioned interstitial spaces on the second floor. In these instances, there may be two different ceiling types for one room on the first floor. A portion of the first-floor ceiling may be below an unconditioned interstitial space, while another portion may be below a second-floor conditioned bedroom.*
>
> ***Hint****: Cape Cod style homes may have more than one type of insulated ceiling, where part of the insulated ceiling is below vented attic space (top triangle) and part of the insulated ceiling is directly against the roof deck (ceiling of interstitial space).*

## Square Footage and Surface Area Checks:

☐ Conditioned square footage is within +/- 10% of square footage for the home listed on real estate websites (Zillow, Redfin) or government building data websites.

> ***Hint:*** *Square footage may vary substantially from public sources if the building has had a recent addition or if the basement space was recently converted to conditioned space.*

☐ The glass area is 15% or less of the conditioned floor area.

☐ The skylight area does not exceed 5% of the conditioned floor area (if applicable).

☐ Confirm wall surface areas are accurate. Multiply perimeter lengths by ceiling height.

☐ Confirm ceiling heights are reasonable by dividing the total building volume by the square footage. Ceiling heights are typically between 8 to 10 feet on average.

> ***Hint:*** *Check for a change in ceiling height in the load calculations for living rooms with vaulted high ceilings.*

☐ Total floor area is within +/-5% of the total ceiling area. Floor areas and ceiling areas are typically the same for flat ceilings. Insulated sloped ceilings will have greater area than the floor area.

☐ No adiabatic surfaces modeled with heating or cooling loads (e.g., floors, ceilings, or walls, between two conditioned spaces).

> ***Hint:*** *When a middle floor apartment has conditioned spaces above and below, the floor and ceiling of the apartment modeling are considered adiabatic/interior surfaces. Only the apartment walls that are directly exposed to unconditioned space should be modeled to contribute to the heating and cooling loads.*

☐ Confirm below grade walls are modeled as below grade and not above grade. Confirm accuracy of below grade depth input.

> ***Hint:*** *The depth of the below grade walls of a raised ranch is often minimal (typically only 2 feet) compared to a standard ranch. A standard ranch typically has a full basement below grade with 6-foot ceilings or higher. Double check the home is a raised ranch or a standard ranch and check the below grade wall depth is accurate.*
>
> ***Hint****: Double check the below grade floor for this area is the same depth as the below grade wall.*

## Ductless System Checks:

☐ No duct losses modeled for a proposed ductless air source heat pump system.

## Ducted System Checks:

☐ Duct sealing selected is reasonable and aligns with the following criteria.

> ***Unsealed*** *– no observable effort to seal the system*
>
> ***Partially Sealed*** *– reasonable effort has been made to seal the duct runs and the air handler*
>
> ***Average/Default Sealed*** *– all seams, joints, boots, grill flanges, and air handler panels sealed*
>
> ***Notably or Extremely Sealed*** *– verified by a duct leakage test*

☐ If new ductwork will be installed, confirm Manual J inputs match the work-scope specified duct insulation R-value.

## Mechanical Ventilation System Checks:

☐ Confirm modeled ventilation rates match the installed equipment's average continuous CFM.

☐ If modeling a Heat Recovery Ventilator (HRV) or Energy Recovery Ventilator (ERV), confirm the system's recovery efficiency.

☐ For airtight high performance/passive house/or energy efficient rated homes, check for heat recovery or energy recovery unit inputs. Double check inputs are correct if these units are not present in the load calculation.

## Infiltration Checks:

☐ Confirm the quantity of fireplaces is accurate.

☐ Confirm completion of blower door testing and equivalent leakage area is input correctly.

☐ If blower door testing is not viable, then confirm the reasonableness of the air-tightness level by comparing the building to the following air tightness characteristics.

***Tight*** *– Passive house or new construction/recently renovated or retrofitted.*

- *All cracks, joints and penetrations are sealed using a combination of an air barrier, taping, packing and caulking.*
- *Bath exhaust fans, kitchen exhaust fans, and dryer vents are equipped with back draft dampers.*
- *No recessed light fixtures or if recessed light fixtures exist, then they are completely sealed.*
- *No combustion equipment (furnaces, water heaters, dryers, etc.) contained within the conditioned space.*
- *Windows and doors are high performance and low leakage rated.*
- *No fireplaces or if there are then fireplaces receive combustion air from outdoors and glass doors are tight.*

***Semi-tight*** *– Envelope conditions between tight and average. Energy efficient building likely built in the last 10 years or a building that had several envelope upgrades done in the last 20 years.*

***Average*** *–The building was built in the last 25 to 30 years with no renovation or retrofit to the building envelope.*

- *Cracks, joints and penetrations are reasonably sealed using the combination of an air barrier, taping, packing and caulking.*
- *Bath exhaust fans, kitchen exhaust fans, and dryer vents are equipped with back draft dampers.*
- *Some leakage around windows and doors.*
- *No recessed light fixtures or if there are then there is some minor leakage around the fixtures.*
- *Combustion equipment (furnaces, water heaters, dryers, etc.) is contained within the conditioned space and equipment receives combustion air from the indoors.*
- *No fireplaces or if there are then fireplaces receive combustion air from the indoors but have tight glass doors and a chimney damper.*

***Semi-loose*** *– Envelope conditions are between average and loose. Buildings likely built between 1950 and 1995 with no renovation/retrofit done in the last 15 years.*

***Loose*** *– The building was likely built before 1950 and has had no minor renovation/retrofit.*

- *No effort or inadequate effort has been made to seal cracks, joints and penetrations.*
- *Window and doors are not rated and there is substantial leakage around them.*
- *Substantial recessed light fixture leakage.*
- *Natural draft combustion equipment is installed.*
- *Minimal insulation levels during physical check of attic and basement.*
- *One or more conventional fireplaces are present.*

## Building Assembly U-Factor and R-Value Checks:

☐ Confirm above grade wall assembly description and insulation R-values are accurate.

***Hint:*** *Check any photos taken from the site visit to observe insulation type or printed R-values on insulation face.*

***Hint:*** *R-value of cavity insulation for walls should be at least R-11 for 2"x4" stud framing and at least R-17 for 2"x6" stud framing where insulation exists.*

***Hint:*** *Homes built to code in 2010 or later for climate zone 5/6 or built in 2015 or later for climate zone 4, likely have exterior board insulation if the home has 2"x4" wood framing with fiberglass batt, stone wool batt, or high-density cellulose cavity insulation. If the home was built 2010 or later and no exterior board insulation is input, double check inputs are accurate.*

***Hint:*** *Cross check R-values used in the load calculations using the following table for guidance.*

| Insulation Type | Average R-value/Inch | Common Thickness | | | Typical Applications |
|---|---|---|---|---|---|
| | | 2x4 Wall Cavity | 2x6 Wall Cavity | 1" to 2" Continuous | |
| Cellulose, loose fill | 3.7 | | | | Attic floor |
| Cellulose, high density | 3.2 | R-11 to R-13 | R-17 to R-19 | | Walls, Enclosed Cavities, Framing Transitions |
| Fiberglass, batts | 3.3 | R-11 to R-15 | R-17 to R-23 | | Basement Ceiling, Open Stud Walls, Attic Floor |
| Fiberglass, loose fill | 2.8 | | | | Attic Floor, Walls (existing) |
| Stone/mineral wool | 4.0 | R-13 to R-15 | R-21 to R-23 | | Attic floor, Walls, Basement Ceiling |
| Vermiculite | 2.7 | | | | Attic Floor |
| Spray polyurethane foam (SPF), closed cell | 6.0 | R-21 | R-33 | R-6 to R-12 | Attics, Walls (new construction); Sill Plate, Rim Joist, Framing Transitions |
| Spray polyurethane foam (SPF), open cell | 3.7 | R-13 | R-21 | R-3.7 to R-7.4 | Attics, Walls (new construction); Sill Plate, Rim Joist, Framing Transitions |
| Polyisocyanurate, rigid board | 7.0 | | | R-7 to R-14 | Foundation Walls, Attic Access Doors |
| Expanded polystyrene (EPS), rigid board | 4.0 | | | R-4 to R-8 | Foundation Walls, Sill Plate |
| Extruded polystyrene (XPS), rigid board | 5.0 | | | R-5 to R-10 | Foundation Walls, Sub-Slab, Sill Plate |

☐ Confirm foundation wall assembly description and insulation R-values are accurate.

***Hint:*** *Check any photos taken from the site visit to observe insulation type or printed R-values on insulation face.*

☐ Confirm ceiling assembly description and insulation R-values are accurate.

***Hint:*** *Check any photos taken from the site visit to observe insulation type or printed R-values on insulation face.*

***Hint:*** *Measure the average insulation thickness and refer to insulation type/R-value per inch chart for overall R-value of the assembly.*

☐ Confirm floor assembly description and insulation R-values are accurate.

***Hint:*** *Check any photos taken from the site visit to observe insulation type or printed R-values on insulation face.*

☐ Confirm window inputs (glass type, frame type, number of panes, u-factor, and solar heat gain coefficient) are accurate.

***Hint:*** *Check any photos taken from the site visit of NFRC labels if available.*

***Hint:*** *Some windows print or etch NFRC thermal property ratings or model numbers from which you can look up the ratings on the glass panes or along the pane breaker.*

***Hint:*** *The lower the u-factor the higher performing the windows. If u-factor is equal to or greater than 1.0, double check window inputs are accurate. Windows with factors greater than 1.0 are single pane and very poor performing windows.*

***Hint:*** *Cross check U-factors used in the load calculations using the following default table for guidance. Window U-factor is based on multiple inputs. Modern double pane windows typically have U-factors of 0.32 or lower. These defaults can be understood as worst-case values. Always use NFRC ratings if available.*

| Default Window U-Values | | | |
|---|---|---|---|
| **Frame Type** | **Glazing Type** | **U-Value** | **U-Value w/Low e** |
| Wood | Single | 0.9 | |
| | Single w/Storm | 0.49 | |
| | Double | 0.49 | 0.39 |
| | Triple | 0.39 | 0.3 |
| Vinyl | Double | 0.46 | 0.36 |
| | Triple | 0.36 | 0.36 |
| Metal | Single | 1.31 | |
| | Double | 0.87 | |
| Metal w/Thermal Break | Double | 0.65 | 0.53 |
| | Triple | 0.53 | 0.43 |

## Internal Gains Checks:

☐ Confirm the number of occupants is the number of bedrooms + 1.

☐ Confirm internal load assumptions are reasonable (typically 1,200 to 3,400 Btu/hr).