



Residential Load Calculation Fundamentals and Insights (Manual J) and Equipment Selection (Manual S)

Presented by
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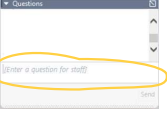
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Webinar Procedures


- All attendees are on mute
- Submit questions in **Questions** tab at any time
- The webinar is being recorded
- Please take the after-class survey!



Click this arrow if you don't see the GoTo toolbar. It might be on your other screen, if you have 2 monitors!



Enter a question for staff



A couple different ways it might look to ask questions

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Upcoming Events

Course	Day	Time
Seattle's Brand-New Building Emissions Performance Standard: What You Need to Know Now	Thu Feb 1	10:00am-11:30am
SEM – Fundamentals of Strategic Energy Management and What It Can Do For You and Your Facility	Tue Feb 13	10:00am-11:30am
Improving Energy Performance and Achieving Decarb Goals With US DOE's 50001 Ready™ and Superior Energy Performance 50001™	Thu Feb 15	10:00am-11:30am
PAE CHPWH Retrofit in Seattle - Details to come	Thu Feb 29	TBD

Let us know what you think of this new programming and tell us what you want us to add at lightingdesignlab@seattle.gov

Stay up-to-date at LightingDesignLab.com and by [subscribing to our newsletter](#).

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Related Rebates and Other Funding

- Heat pump contractor discounts through [participating distributors](#)
 - \$300-\$600 instant discount per home
- City of Seattle [Clean Heat Program](#)
 - \$2000 instant rebate
 - Oil-heated homes moving to electric heat
- [Federal tax credits](#) and upcoming funding
 - 2022: \$300; 2023-2032: 30% of cost (\$2000 cap per year)
 - IRA rebate possibilities from state



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HVAC PRO BLOG conduit tech

The Ultimate Introduction to HVAC Load Calculations

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About our host: Chris Morin

MITSUBISHI ELECTRIC **HVAC PRO BLOG** **MARINES**

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What we'll cover today:

- **A brief overview of load calculations**
- **What today's environment and building codes mean are requiring**
- **Heat loss drivers**, and how to evaluate them
 - Temperature difference
 - Air exchange (infiltration)
- **Key factors impacting cooling gains**, and how to evaluate them
 - Solar heat gain
 - Internal gains and cooling
- **Tech & tools to streamline your process**
- **Q&A**


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Land Navigation



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Load Calculations: The Road Map to your Sales Process & Solution



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Why do load calculations? Manual J load calculations are also required!

M1401.3 Equipment and Appliance Sizing.
"Heating and cooling equipment shall be sized in accordance with ACCA Manual S or other approved methodologies based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies."

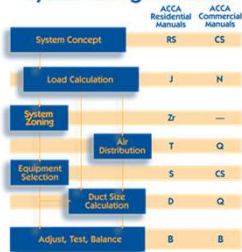
2009, 2012, 2015 International Residential Code



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Why do load calculations? They're an input to critical system design!

System Design Process



Necessary input to System Sizing (Manual S) and evaluating ductwork (Manual D)

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What do we need to understand to conduct a load calculation? 4 key elements:

- Temperature Difference
- Air Exchange
- Solar Heat Gain
- Internal Gains

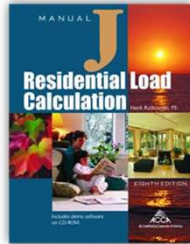


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What do the results of a Manual J load calculation yield?

1. Perform load calculation on whole structure to acquire BTU and CFM amount.
2. Break down room by room BTU and CFM amount.

**Manual J software is recommended, which will auto calculate room BTU's and CFM.*

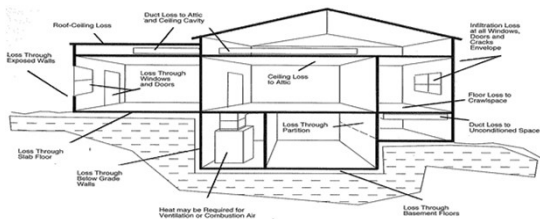


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Conducting a Site Survey to Capture What Matters

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We capture these details through a Manual J Site Survey: Heat Loss



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We capture these details through a Manual J Site Survey: Cooling Gains

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Manual J Site Survey

Load Calculation Survey Sheet

- Location and Outdoor/Indoor Design Conditions
- Determine Framing and Wall Insulation
- Determine Attic and Ceiling Insulation
- Identify Roof Type and Unique Characteristics (Dormers?)
- Determine Floor Condition and Insulation
- Identify Internal Gains (People, Appliances, Plants, etc.)

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Manual J Site Survey

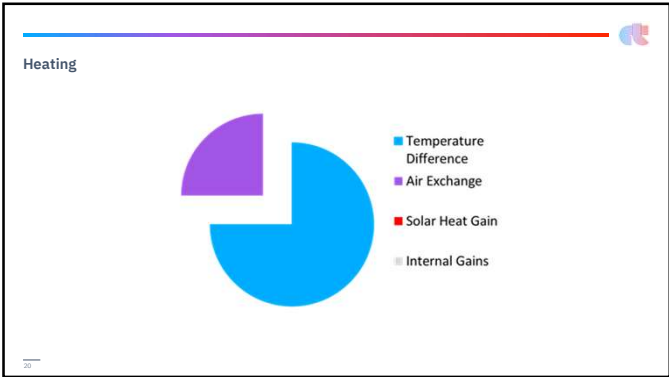
Load Calculation Survey Sheet

- Make rough drawing of floor plan – measure
- Evaluate Ductwork

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How to Evaluate the factors that drive Heating

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Temperature Difference:

Do NOT design for record breaking weather conditions
Do NOT add a "safety factor" to table 1A / 1b
Do NOT design for abnormally low or high indoor temperature or humidity conditions

365 Days x 1% = 3.65 Days

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Air Exchange

We want to evaluate how “leaky” the home is

- 1) A blower door, is best practice to tell you this
- 2) Alternatively, visual cues to evaluate infiltration:
 - a) Is there lots of dust accumulating?
 - b) Does the homeowner mention draftiness?
 - c) What was the year built / or year of major remodel?



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Air Leakage: Infiltration Rates & Construction Quality

Home Infiltration Rates are determined by ACH (Tightness) and Floor Area (sq. ft.)

Construction	Default Air Change Values for Single Story Construction					Infiltration ¹ CFM for One Fireplace
	Air Changes per Hour — Heating					
	Floor Area of Heated Space (SqFt)					
	900 Or Less	901 to 1500	1501 to 2000	2001 to 3000	3001 or More	
Tight	0.21	0.16	0.14	0.11	0.10	0
Semi-Tight	0.41	0.31	0.26	0.22	0.19	13
Average	0.61	0.45	0.38	0.32	0.28	20
Semi-Loose	0.95	0.70	0.59	0.49	0.43	27
Loose	1.29	0.94	0.80	0.66	0.58	33

1) For one additional fireplace, add 7 CFM to the above fireplace values. For two or more additional fireplaces, add 10 CFM (total) to the above.

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Air Leakage: Infiltration Rates & Construction Quality

Assumptions almost always necessary based on age of home, unless a weatherization (air sealing/insulation) retrofit.

- Assume “Tight” for a Net Zero, Passive home, Spray Foam
- Assume “Semi-tight” for home Energy Star Home
- Assume “Average” for home built 1995+
- Assume “Semi-Loose” for home 1950 – 1994*
- Assume “Loose” for home older than 1950*

*Assumptions based on average leakage rates provided by Lawrence Berkeley Laboratory within study “Air-Tightness of U.S. Dwellings”, 1994 and Energy Star recommendations.

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Air Exchange - Ceilings

Attic and Ceiling Insulation Key

Questions:

- Is it under a Vented Attic?
- Unvented Attic?
- Roof/Ceiling Combination?
- Ceiling Insulation
- R-7, R-11, R-19, R-30?



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Air exchange: Evaluating the Insulation

What you see:	What it probably is	Depth (inches)	Total R-value
Loose fibers	light-weight yellow, pink, or white	_____	=2.5×depth
	dense gray or near-white, may have black specks	_____	=2.8×depth
	small gray flat pieces or fibers (from newsprint)	_____	=3.7×depth
Granules	light-weight	_____	=2.7×depth
Batts	light-weight yellow, pink, or white	_____	=3.2×depth
		fiberglass	_____



Closed Cell Spray Foam = 6.5 x depth

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Air Leakage - Ductwork


Ductwork may or may not be sealed, and it may not be tight. Evaluating the condition, location, materials and insulation of ductwork will impact your loads.



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Air Exchange: Fresh Air

Evaluate both what local code requires, and what actually serves the home today.

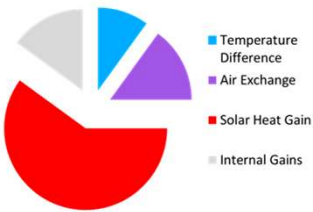


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How to Evaluate the factors that drive Cooling

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Cooling



- Temperature Difference
- Air Exchange
- Solar Heat Gain
- Internal Gains

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Solar Heat Gain: Windows & Skylights


Frame?
Metal / Wood / Vinyl / Insulated Fiberglass

Glass Type?
Clear, Heat Absorbing, Low-E, etc.

U-Value? NFRC Sticker...

Exterior Bug Screen?

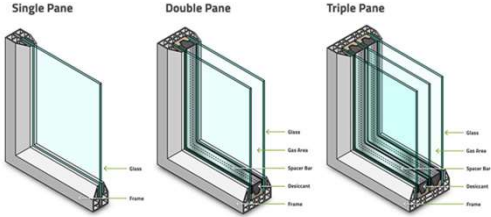
Internal Shading?
Assume Blinds at 45 degrees, unless otherwise noted.



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Solar Heat Gain: Windows & Skylights

Single Pane **Double Pane** **Triple Pane**




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Solar Heat Gain: Windows & Skylights

Overhang: Can reduce SHGC

Foreground:
Grass
Asphalt
Concrete New/Old
Crushed Rock



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Solar Heat gain: Home Orientation

Take into account what windows / walls face North, east, South, West - they'll differentially impact the load



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Internal Loads

People = Number of Bedrooms + 1
(Master Bedroom has 2)

Full-time Guests = Elderly Family, etc.

Appliances = Block load Amounts
1,200 Btu/hr - Kitchen
2,400 Btu/hr - Refrigerator

Other Major Appliances: Range with Vented Hood,
Dishwasher, Washer/Vented Dryer, Electronic
Equipment & Lighting



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Remember!

- No Manipulating Outdoor Design Temp (i.e. Max 14°F CLTD)
- Take full credit for efficient construction features!
- Research studies indicate that Manual J V8 procedure provides an adequate safety factor - don't add on!



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Using a load calculation to build value on site

Evaluate efficiency gains

Comfort improvements

Cost efficacy & right-sizing

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What Does This Mean For Me?

Properly Sized vs. Oversized Equipment

- Equipment Costs less
- Uses smaller ductwork
- More Comfortable
- Less operating costs
- Reduce chance of cracked heat exchanger
- Reduces load on grid

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Manual S & Heat Pump Selection

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Manual S - Heat Pumps

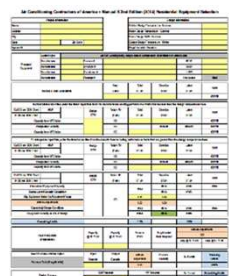
ACCA Manual S Equipment Selection (2nd Ed): Air-Air Heat Pumps

Equipment Type	Climate	Capacity	Single-Speed		Multi-Stage		Variable Speed	
			Min. 90%	Max. 115%	Min. 90%	Max. 120%	Min. 90%	Max. 130%
Air-Air Cooling Only & Heat Pump	*Mild Winter or has Latent Cooling Load	Total	Min. 90%	Max. 115%	Min. 90%	Max. 120%	Min. 90%	Max. 130%
		Latent			Min. 100%	Inf. Max. 150%		
Air-Air Cooling Only & Heat Pump	**Cold Winter and No Latent Cooling Load	Sensible			Minimum 90%			
		Total			Minimum 90%			
			Max. Manual J Total Cooling Load = 15,000 Btu/hr					

*Mild Winter: (Heating Degree Days Base 65°F) / (Cooling Degree Days Base 50°F) < 2.0
 ** Cold Winter: (Heating Degree Days Base 65°F) / (Cooling Degree Days Base 50°F) > 2.0

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Manual S - ACCA Speedsheet



ACCA Manual S Speedsheet/Report

- Easily Interpolate (4 Different Tabs)
- Provides Report
- Complete Yellow Cells
- Still need Expanded Cooling Data
- Min/Max Check Built-in

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Manual S - Heat Pumps

- Heat Pumps are sized for **COOLING!**
- Balance Point Diagram needed for sizing supplemental


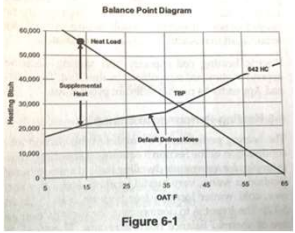



Figure 6-1

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Manual S – Heat Pumps

When to switch over?
 Comfort: Balance Point Diagram
 Cost: Break-Even COP

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An example - the Diamond System Builder

Diamond System Builder

- Calculates Zones Capacities
- Built in Compatibility, Line Lengths
- Calculates Additional Ref. Charge
- Lists Available Accessories

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The Role of Technology

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Technology & Tools can dramatically change the speed of this process

Pen & Paper
(example of streamlined site survey)

Complex building modeling software




Automated 3D modeling, 2D floorplans & 15 minute load calculations



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Conduit creates accurate load calcs, 2D floorplans and 3D models in 15 minutes or less - all integrated into clear sales materials and documentation for the install team



DESIGN

▼

SALES

▼

INSTALLATION

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