We will be starting soon!

Thanks for joining us

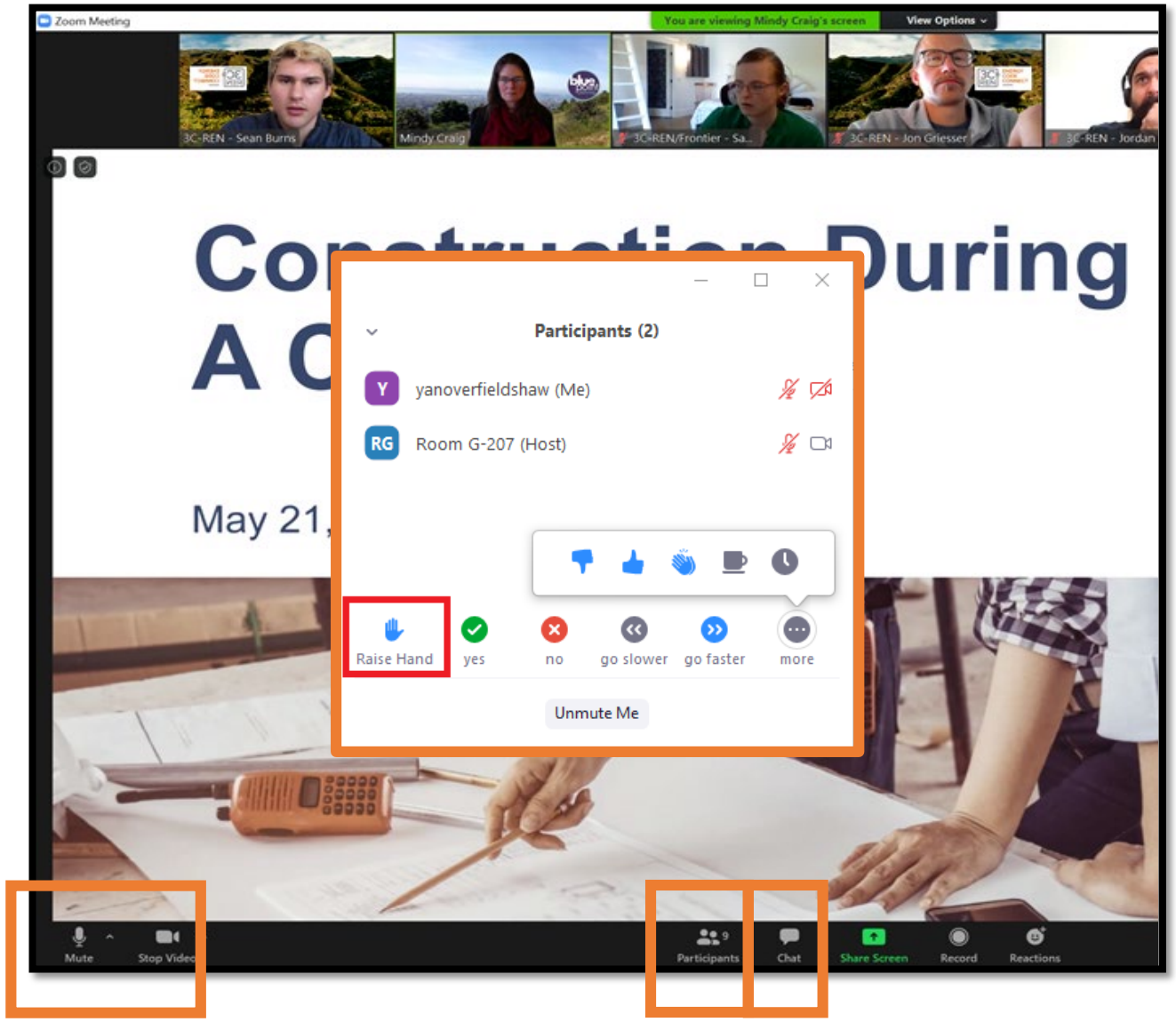
HVAC Design For Code Officials:
Reading and Understanding an ACCA Report - Manuals S, J, and D

Jennifer Rennick – In Balance Green Consulting

March 31st, 2022

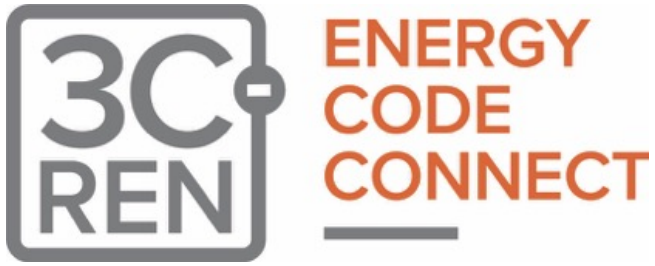
Zoom Orientation

- Please be sure your full name is displayed
- Please **mute** upon joining
- Use "**Chat**“ box to share questions or comments
- Under "**Participant**" select "**Raise Hand**" to share a question or comment verbally
- The session may be **recorded** and posted to 3C-REN's on-demand page. Feel free to ask questions via the chat and keep video off if you want to remain anonymous in the recording.



3C-REN: Tri-County Regional Energy Network

- Three counties working together to improve energy efficiency in the region
- Services for –
  - **Building Professionals:** industry events, training, and energy code compliance support
  - **Households:** free and discounted home upgrades
- Funded by ratepayer dollars that 3C-REN returns to the region


3C
REN
ENERGY
CODE
CONNECT


3C
REN
BUILDING
PERFORMANCE
TRAINING


3C
REN
HOME
ENERGY
SAVINGS

Energy Code Coach Texting Service Now Available!

- **Text the Energy Code Coach Team your questions at (805) 220-9991**

- *The Team will be responding to questions within 2 hours during normal business hours (Monday to Friday from 8 am to 5 pm).*

3C-REN
Staff Online

Need help or have questions about 3C-REN?

Send us a message!

Today's Learning Objectives

- Understand the Code requirements and the goals behind those requirements
- Know the roles and responsibilities of the Energy Consultant, Plans Examiner, HERS rater, and the HVAC Installation Contractor
- Be able to describe the main sections of an ACCA 'Report' including Manuals S, J, D, and other forms you might see
- Recognize key areas that are necessary for proper documentation and what can be done for best practices

Agenda

- Right Sizing Heating, Cooling, and Air Distribution Systems in the California Building Code
- ACCA Calculations in the Code…Roles and Responsibilities
- Key Elements and Forms in ACCA Reports
- Best Practices
- Resources
- Questions

Right Sizing Heating, Cooling and Air Distribution Systems in the California Building Code

Residential Heating, Cooling and Duct Design Impacts:

- Health and Welfare
- Energy Conservation
- Resource Conservation
- Occupant Comfort
- Consumer Protection

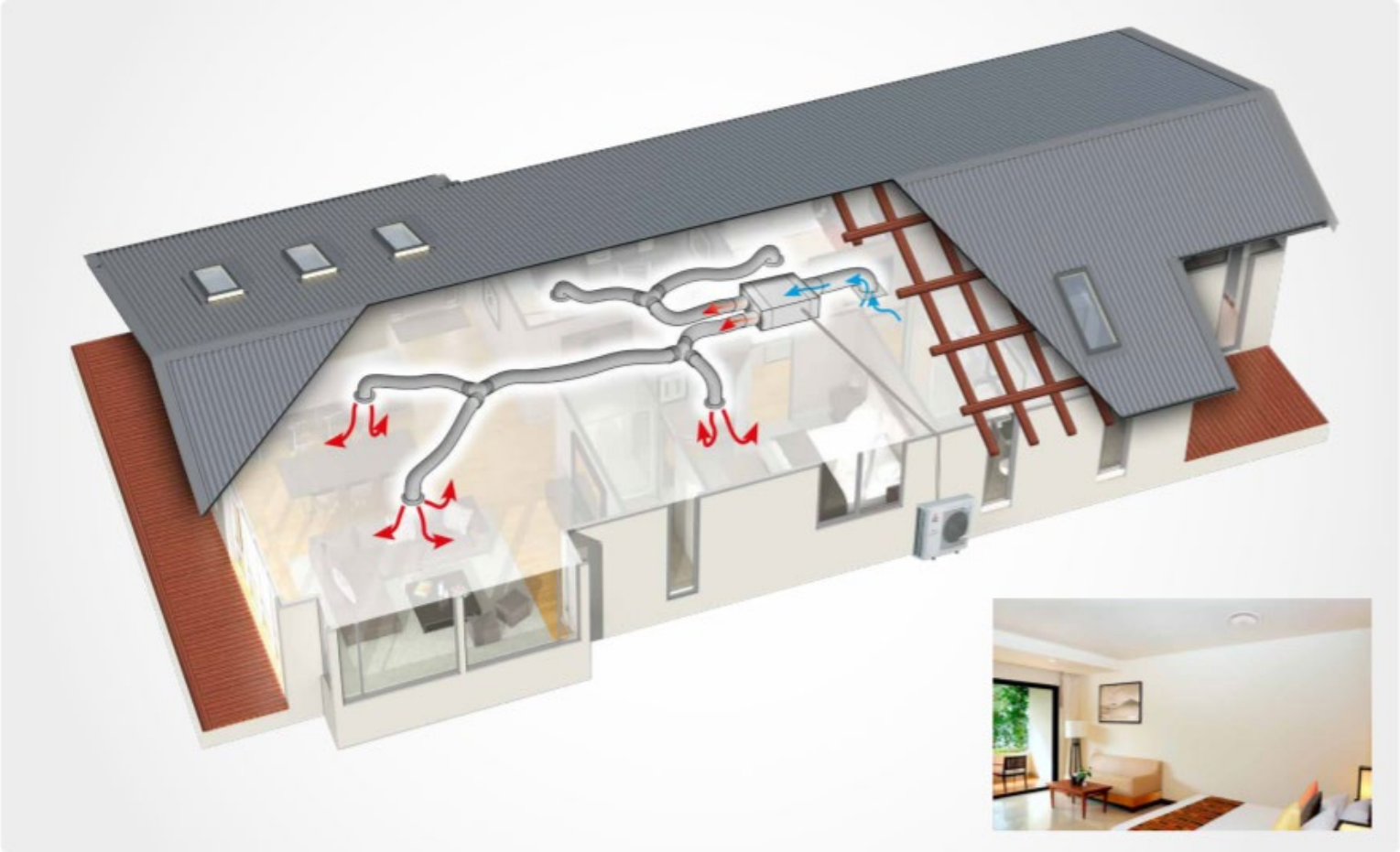


Image Credit: Mitsubishi

Heating, Cooling and Ventilation is part of the California Building Code

- California Mechanical Code Part 4
- California Energy Code Part 6
- CalGreen or California Green Building Standards Code Part 11
- All three reference the proper sizing and design of residential heating and cooling systems
- The Code allows a few methods for showing compliance:
  - ANSI/ACCA
  - ASHRAE
  - Or other approved method

Title 24 Building Standards Code

https://www.dgs.ca.gov/BSC

Part 1 - California Administrative Code
Part 2 - California Building Code
Part 2.5 - California Residential Code
Part 3 - California Electrical Code
Part 4 - California Mechanical Code
Part 5 - California Plumbing Code
Part 6 - California Energy Code
Part 7 - Reserved
Part 8 - California Historical Building Code
Part 9 - California Fire Code
Part 10 - California Existing Building Code
Part 11 - California Green Building Standards Code
Part 12 - California Referenced Standards Code

Part 11 Code Excerpt – Residential Mandatory Measure

Excerpt: Section 4.507 under Chapter 4 of Title 24, Part 11 CalGreen

4.507.2 Heating and air-conditioning system design.

Heating and air-conditioning systems shall be sized, designed and have their equipment selected using the following methods:

1. The heat loss and heat gain is established according to ANSI/ACCA 2 Manual J—2016 (*Residential Load Calculation*), ASHRAE handbooks or other equivalent design software or methods.
2. Duct systems are sized according to ANSI/ACCA 1 Manual D—2016 (*Residential Duct Systems*), ASHRAE handbooks or other equivalent design software or methods.
3. Select heating and cooling equipment according to ANSI/ACCA 3 Manual S—2014 (*Residential Equipment Selection*) or other equivalent design software or methods.

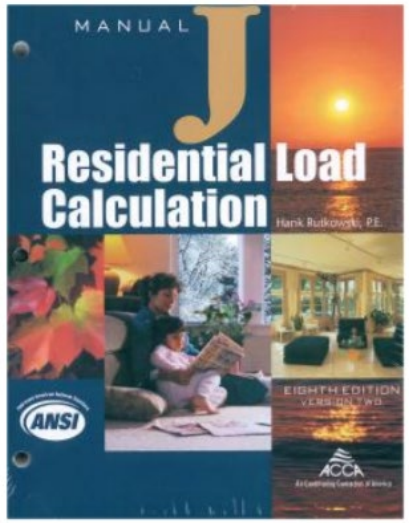
Exception: Use of alternate design temperatures necessary to ensure the systems function are acceptable.

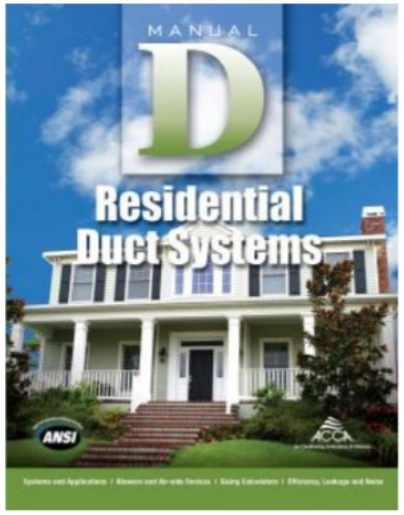
Part 6 Energy Code reinforces the above requirement for residential design, and Part 4 Mechanical Code (314.1(2)) includes Manual B (Balancing) and (601.2) Manual D.

ANSI/ACCA Manual J, D and S

The ACCA Manuals are common method for residential loads, equipment sizing and selection, and duct design.

- American National Standards Institute (ANSI) is a non-profit testing and standards organization
- Air Conditioning Contractors of America (ACCA) is a non-profit trade association
- Manual J, S, D, etc. are registered trademarks of ACCA
- ACCA Manual J8 refers to the Eighth Edition of Manual J (MJ8)

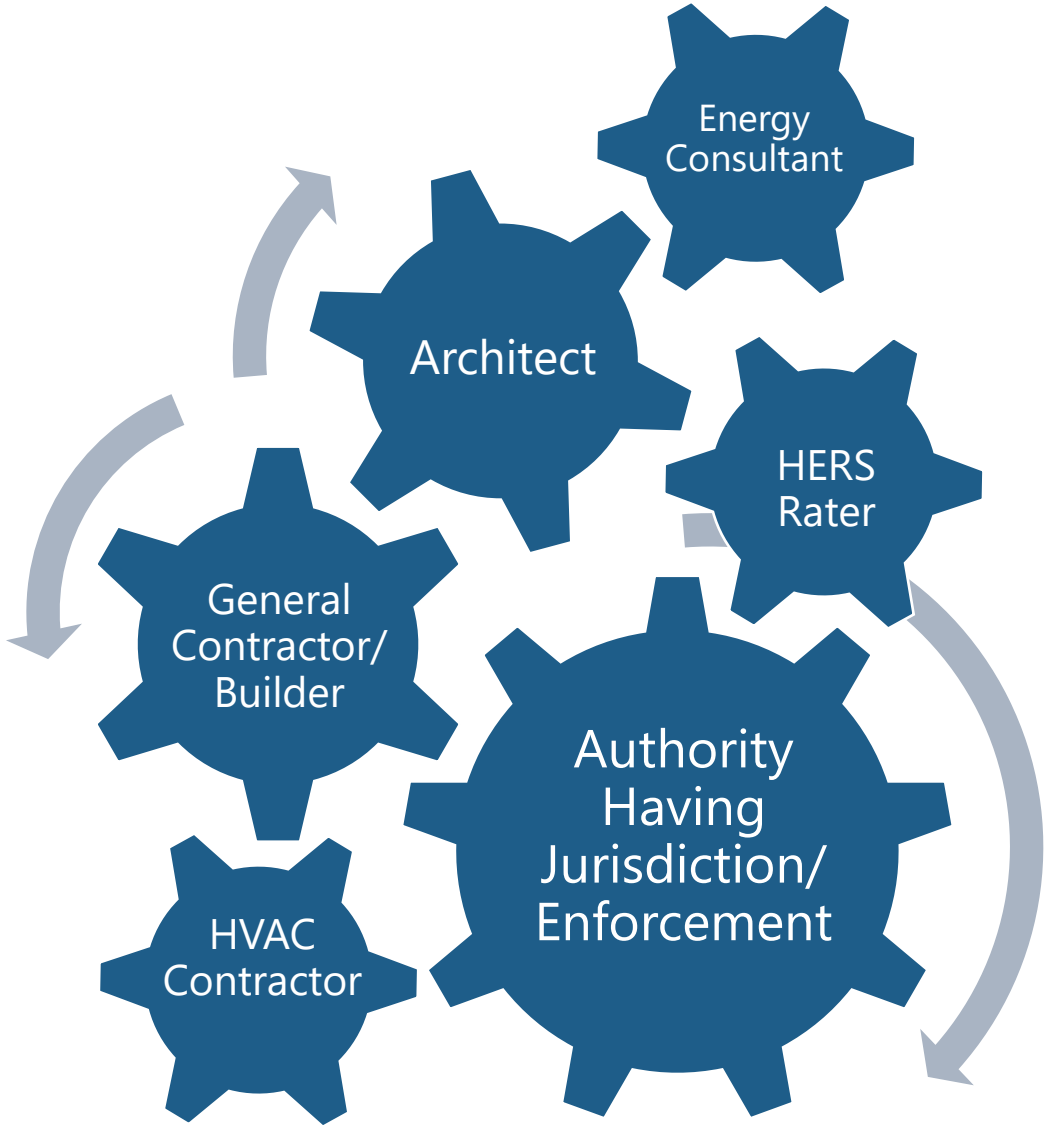




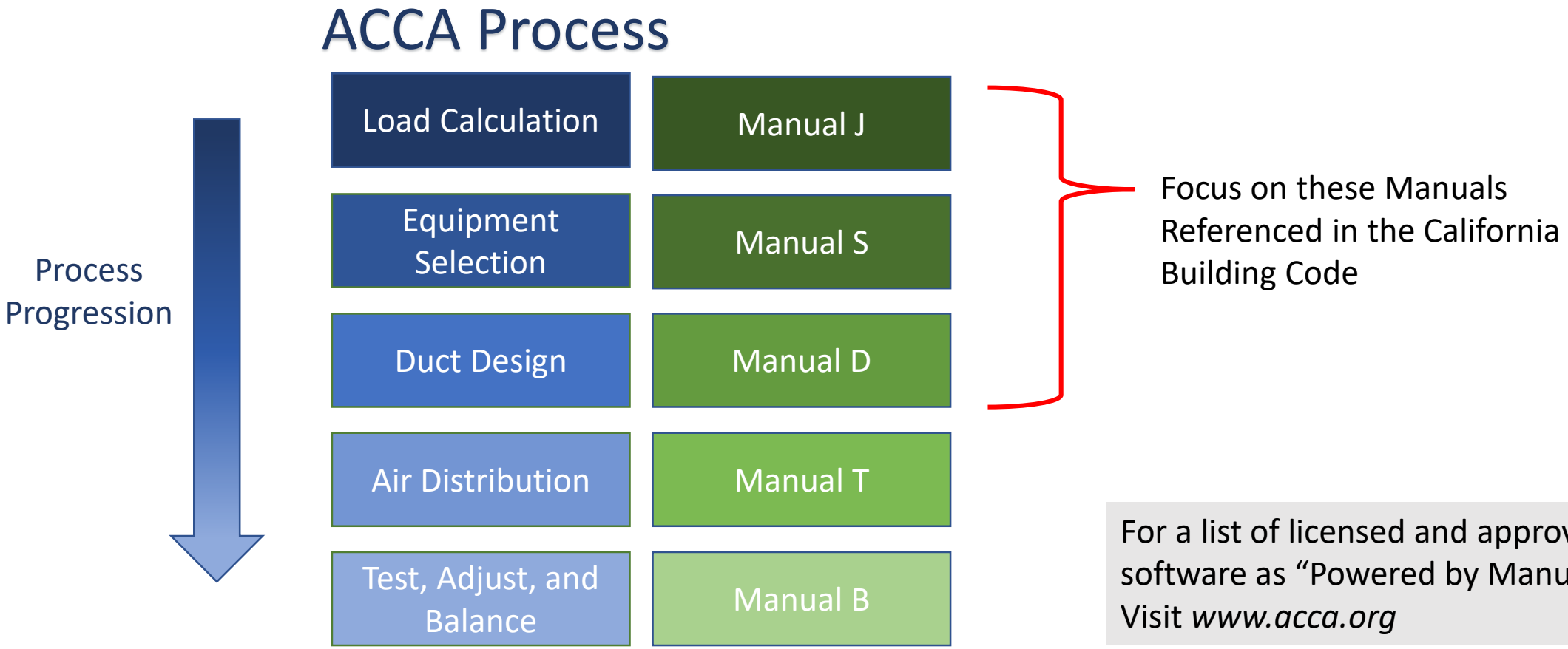
ACCA Calculations in the Building Code... Who does what?

Roles and Responsibilities

- Many players in the process
- Different roles depend on each other; some entities play more than one role
- ACCA Methodology is a **tool set for** the tradesperson - for the HVAC designer/installer
- ACCA (or equal) is required for Residential HVAC Design
- Many Energy Consultants offer:
  - Energy Code Documentation (i.e. Title 24 Energy Reports)
  - HERS Services
  - ACCA Reports



ACCA Residential HVAC Design Process



For a list of licensed and approved software as “Powered by Manual J” Visit *www.acca.org*

Parallel 'Title 24' –Energy Code Documentation

Appendix A Compliance Documents

Page 1

NOTE: For Documents and User Instructions, please visit our website at:
http://energy.ca.gov/title24/2019standards

Doc Type	Doc Category	Category Description	Document Description
CF1R's – Certificate of Compliance			
CF1R-	ADD-01-E	Additions	Prescriptive Additions Less Than 1,000 ft²
CF1R-	ADD-02-E	Additions	Prescriptive Additions – Simple NonHERS (paper version)
CF1R-	ALT-01-E	Alterations	Prescriptive Alterations
CF1R-	ALT-02-E	Alterations	Prescriptive Alterations HVAC
CF1R-	ALT-05-E	Alterations	Prescriptive Alterations – Simple NonHERS (paper version)
CF1R-	ENV-02-E	Envelope	Area Weighted Average Calculation Worksheet
CF1R-	ENV-03-E	Envelope	Solar Heat Gain Coefficient (SHGC) Worksheet
CF1R-	ENV-04-E	Envelope	Solar Reflective Index (SRI) Worksheet
CF1R-	ENV-05-E	Envelope	Alternative Default Fenestration Procedure (NA6) Worksheet
CF1R-	ENV-06-E	Envelope	Interior and Exterior Insulation Layers Worksheet
CF1R-	NCB-01-E	Newly Constructed Buildings	Prescriptive Newly Constructed Buildings and Additions Equal to or Greater Than 1,000 ft²
CF1R-	PLB-01-E	Plumbing (DHW)	Hydronic Heating System Worksheet
CF1R-	PRF-01-E	Performance	Residential Performance Compliance Method
CF1R-	STH-01-E	Solar Thermal	OG 100 Solar Water Heating Worksheet
CF2R's – Certificate of Installation			
CF2R-	ADD-02-E	Additions	Prescriptive Additions – Simple NonHERS (paper version)
CF2R-	ALT-05-E	Alterations	Prescriptive Alterations – Simple NonHERS (paper version)
CF2R-	ENV-01-E	Envelope-NonHERS	Fenestration Installation
CF2R-	ENV-03-E	Envelope-NonHERS	Insulation Installation
CF2R-	ENV-04-E	Envelope-NonHERS	Roofing – Radiant Barrier
CF2R-	ENV-20-H	Envelope-HERS	Building Leakage Diagnostic Test
CF2R-	ENV-21-H	Envelope-HERS	QII - Framing Stage
CF2R-	ENV-22-H	Envelope-HERS	QII – Insulation Installation Stage
CF2R-	LTG-01-E	Lighting-NonHERS	Lighting - Single Family Dwellings

Appendix A Compliance Documents

Page 2

Doc Type	Doc Category	Category Description	Document Description
CF2R-	LTG-02-E	Lighting-NonHERS	Lighting - Multifamily Dwellings
CF2R-	MCH-01-E	Mechanical-NonHERS	Space Conditioning Systems
CF2R-	MCH-02-E	Mechanical-NonHERS	Whole House Fan
CF2R-	MCH-04-E	Mechanical-NonHERS	Evaporative Coolers
CF2R-	MCH-20-H	Mechanical-HERS	Duct Leakage Diagnostic Test
CF2R-	MCH-21-H	Mechanical-HERS	Duct Location Verification
CF2R-	MCH-22-H	Mechanical-HERS	Fan Efficacy
CF2R-	MCH-23-H	Mechanical-HERS	Airflow Rate
CF2R-	MCH-24-H	Envelope-HERS	Building Envelope Air Leakage Worksheet
CF2R-	MCH-25-H	Mechanical-HERS	Refrigerant Charge Verification
CF2R-	MCH-26-H	Mechanical-HERS	Rated Space Conditioning System Equipment Verification
CF2R-	MCH-27-H	Mechanical-HERS	Indoor Air Quality and Mechanical Ventilation
CF2R-	MCH-28-H	Mechanical-HERS	Return Duct Design and Air Filter Grille Device Sizing According to Tables 150.0-B or C
CF2R-	MCH-29-H	Mechanical-HERS	Duct Surface Area Reduction; R-Value; Buried Ducts Compliance Credit
CF2R-	MCH-30-E	Mechanical-HERS	Ventilation cooling compliance credit
CF2R-	MCH-31-H	Mechanical-HERS	HERS Verified Whole House Fan
CF2R	MCH-32-H	Mechanical-HERS	Kitchen Ventilation
CF2R-	PLB-01-E	Plumbing-DHW-NonHERS	Multifamily Central Hot Water System Distribution
CF2R-	PLB-02-E	Plumbing (DHW)-NonHERS	Single Dwelling Unit Hot Water System Distribution
CF2R-	PLB-03-E	Plumbing (DHW)-NonHERS	Pool and Spa Heating Systems
CF2R-	PLB-21-H	Plumbing (DHW)-HERS	HERS Verified Multifamily Central Hot Water System Distribution
CF2R-	PLB-22-H	Plumbing (DHW)-HERS	HERS Verified Single Dwelling Unit Hot Water System Distribution
CF2R-	PVB-01-E	Photovoltaics-NonHERS	Photovoltaic Systems
CF2R-	PVB-02-E	Photovoltaics-NonHERS	Battery Storage Systems
CF2R-	SRA-01-E	Solar Ready	Solar Ready Areas
CF2R-	SRA-02-E	Solar Ready	Minimum Solar Zone Area Worksheet
CF2R-	STH-01-E	Solar Thermal	Solar Water Heating Systems

Appendix A Compliance Documents

Page 3

CF3R's – Certificate of Installation			
CF3R-	ENV-20-H	Envelope-HERS	Building Leakage Diagnostic Test
CF3R-	ENV-21-H	Envelope-HERS	QII - Framing Stage
CF3R-	ENV-22-H	Envelope-HERS	QII – Insulation Installation Stage
CF3R-	EXC-20-H	Existing Conditions	HERS Verification of Existing Conditions for Residential Alterations
CF3R-	MCH-20-H	Mechanical-HERS	Duct Leakage Diagnostic Test
CF3R-	MCH-21-H	Mechanical-HERS	Duct Location Verification
CF3R-	MCH-22-H	Mechanical-HERS	Fan Efficacy
CF3R-	MCH-23-H	Mechanical-HERS	Airflow Rate
CF3R-	MCH-24-H	Envelope-HERS	Building Envelope Air Leakage Worksheet
CF3R-	MCH-25-H	Mechanical-HERS	Refrigerant Charge Verification
CF3R-	MCH-26-H	Mechanical-HERS	Rated Space Conditioning System Equipment Verification
CF3R-	MCH-27-H	Mechanical-HERS	Indoor Air Quality and Mechanical Ventilation
CF3R-	MCH-28-H	Mechanical-HERS	Return Duct Design and Air Filter Device Sizing According to Tables 150.0-B or C
CF3R-	MCH-29-H	Mechanical-HERS	Duct Surface Area Reduction; R-value; Buried Ducts Compliance Credit
CF3R-	MCH-31-H	Mechanical-HERS	HERS Verified Whole House Fan
CF3R-	MCH-31-H	Mechanical-HERS	Kitchen Ventilation
CF3R-	PLB-21-H	Plumbing (DHW)-HERS	HERS Verified Multifamily Central Hot Water System Distribution
CF3R-	PLB-22-H	Plumbing (DHW)-HERS	HERS Verified High Rise Residential/Hotel/Motel Single Dwelling Unit Hot Water System Distribution
NRCV-	MCH-04-H	Mechanical-HERS	Duct Leakage Diagnostic Test
NRCV-	MCH-24-H	Mechanical-HERS	Building Envelope Air Leakage Worksheet
NRCV-	MCH-27-H	Mechanical-HERS	Indoor Air Quality and Mechanical Ventilation
NRCV-	PLB-21-H	Plumbing (DHW)-HERS	HERS Verified Multifamily Central Hot Water System Distribution
NRCV-	PLB-22-H	Plumbing (DHW)-HERS	HERS Verified High Rise Residential/Hotel/Motel Single Dwelling Unit Hot Water System Distribution

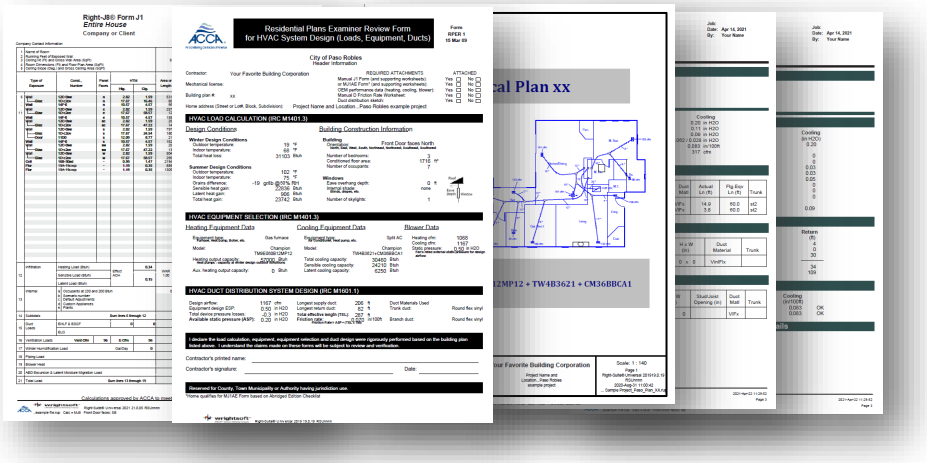
What Key Elements and Forms could be in an ACCA Report?

What can you expect to see in an ACCA Report?

- General Information
  - Plans Examiner Review Form
  - Project Summary Form
- Manual J
  - J1 Forms and worksheets
  - Loads Short Form
  - Building Analysis
- Manual S
  - Manual S Compliance Form
- Manual D
  - Duct Layout / Distribution Sketch
  - Friction Rate Worksheet
  - Duct Design Summary

- Equipment Spec Sheets

  Original Equipment Manufacture (OEM) Performance Data
  - Model /Make
  - Efficiency
  - Capacity (output) –Heating and Cooling
  - External Static Pressure and Fan (CFM) Performance Data –Blower Data

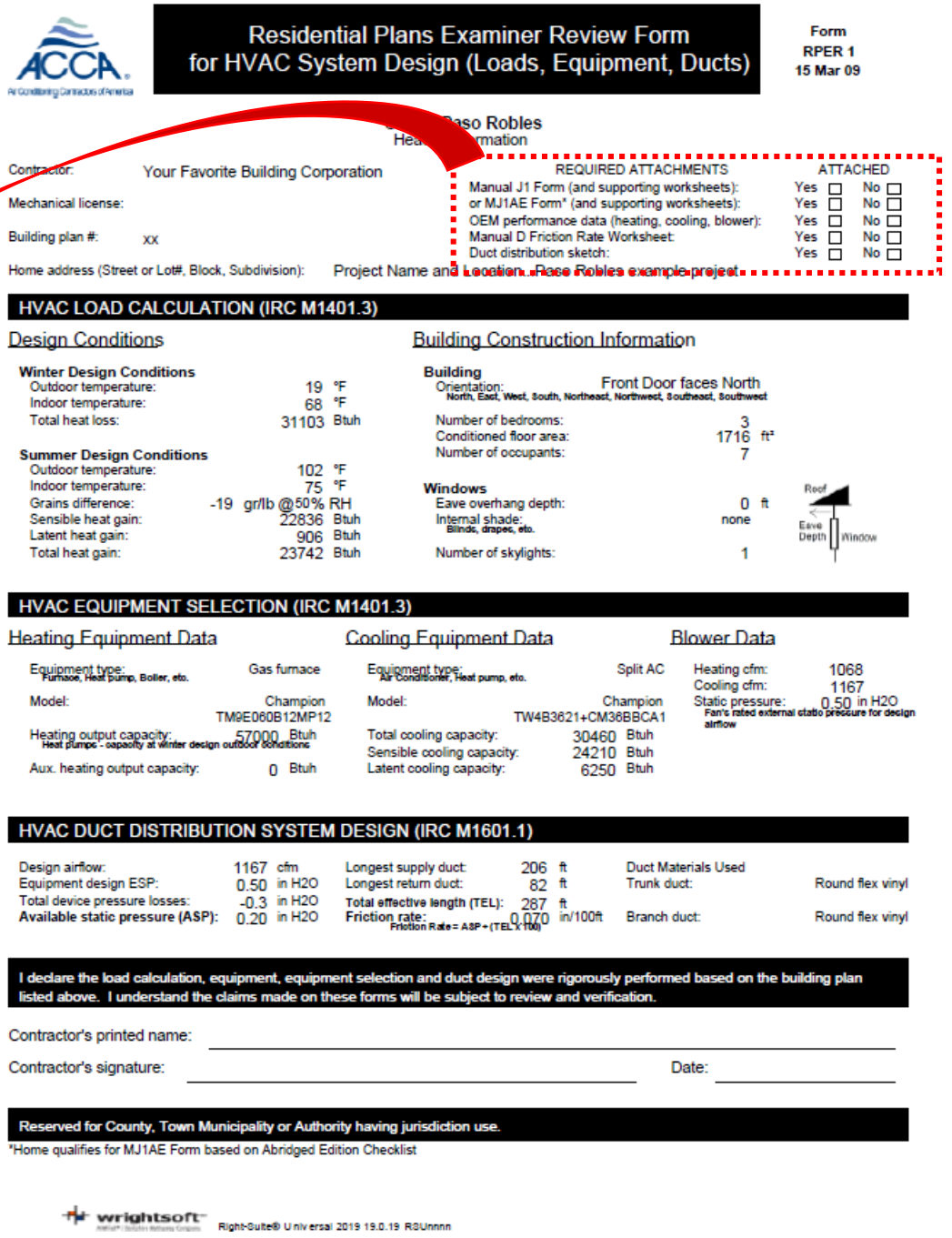


Ask for the ACCA **Residential Plans Examiner Review Form**

REQUIRED ATTACHMENTS	ATTACHED	
Manual J1 Form (and supporting worksheets):	Yes ☐	No ☐
or MJ1AE Form* (and supporting worksheets):	Yes ☐	No ☐
OEM performance data (heating, cooling, blower):	Yes ☐	No ☐
Manual D Friction Rate Worksheet:	Yes ☐	No ☐
Duct distribution sketch:	Yes ☐	No ☐

Needed, but often missing:

- ❑ *OEM – system performance spec sheets or cut sheets*
- ❑ *Friction Rate Worksheet*



Residential Plans Examiner Review Form for HVAC System Design (Loads, Equipment, Ducts)

Form RPER 1 15 Mar 09

Paso Robles
Hea mation

Contractor: Your Favorite Building Corporation
Mechanical license:
Building plan #: xx
Home address (Street or Lot#, Block, Subdivision): Project Name and Location - Paso Robles example project

REQUIRED ATTACHMENTS	ATTACHED	
Manual J1 Form (and supporting worksheets):	Yes ☐	No ☐
or MJ1AE Form* (and supporting worksheets):	Yes ☐	No ☐
OEM performance data (heating, cooling, blower):	Yes ☐	No ☐
Manual D Friction Rate Worksheet:	Yes ☐	No ☐
Duct distribution sketch:	Yes ☐	No ☐

HVAC LOAD CALCULATION (IRC M1401.3)

Design Conditions

Winter Design Conditions
Outdoor temperature: 19 °F
Indoor temperature: 68 °F
Total heat loss: 31103 Btuh

Summer Design Conditions
Outdoor temperature: 102 °F
Indoor temperature: 75 °F
Grains difference: -19 gr/lb @ 50% RH
Sensible heat gain: 22836 Btuh
Latent heat gain: 906 Btuh
Total heat gain: 23742 Btuh

Building Construction Information

Building
Orientation: Front Door faces North (North, East, West, South, Northeast, Northwest, Southeast, Southwest)
Number of bedrooms: 3
Conditioned floor area: 1716 ft²
Number of occupants: 7

Windows
Eave overhang depth: 0 ft
Internal shade: none (Blinds, drapes, etc.)
Number of skylights: 1

HVAC EQUIPMENT SELECTION (IRC M1401.3)

Heating Equipment Data
Equipment type: Gas furnace (Furnace, Heat pump, Boiler, etc.)
Model: Champion TM9E060B12MP12
Heating output capacity: 57000 Btuh (Heat pumps - capacity at winter design outdoor conditions)
Aux. heating output capacity: 0 Btuh

Cooling Equipment Data
Equipment type: Split AC (Air Conditioner, Heat pump, etc.)
Model: Champion TW4B3621+CM36BBCA1
Total cooling capacity: 30460 Btuh
Sensible cooling capacity: 24210 Btuh
Latent cooling capacity: 6250 Btuh

Blower Data
Heating cfm: 1068
Cooling cfm: 1167
Static pressure: 0.50 in H2O (Fan's rated external static pressure for design airflow)

HVAC DUCT DISTRIBUTION SYSTEM DESIGN (IRC M1601.1)

Design airflow: 1167 cfm
Equipment design ESP: 0.50 in H2O
Total device pressure losses: -0.3 in H2O
Available static pressure (ASP): 0.20 in H2O
Longest supply duct: 206 ft
Longest return duct: 82 ft
Total effective length (TEL): 287 ft
Friction rate: 0.070 in/100ft (Friction Rate = ASP ÷ (TEL x 100))

Duct Materials Used
Trunk duct: Round flex vinyl
Branch duct: Round flex vinyl

I declare the load calculation, equipment, equipment selection and duct design were rigorously performed based on the building plan listed above. I understand the claims made on these forms will be subject to review and verification.

Contractor's printed name: _____
Contractor's signature: _____ Date: _____

Reserved for County, Town Municipality or Authority having jurisdiction use.

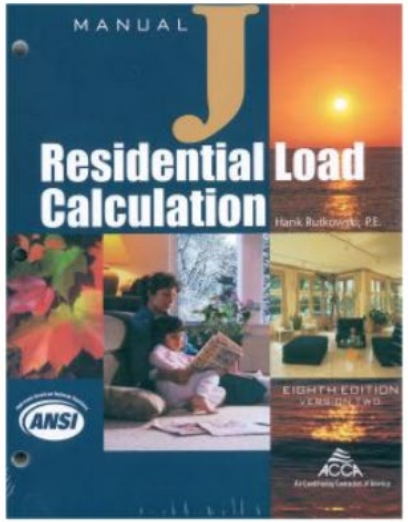
*Home qualifies for MJ1AE Form based on Abridged Edition Checklist

wrightsoft Right-Suite® Universal 2019 19.0.19 RSUnnnn

Manual J Load Calculation

'Load' refers to the heating and cooling capacity the mechanical equipment will need in order to meet occupant comfort. Method used to determine the size of the mechanical equipment.

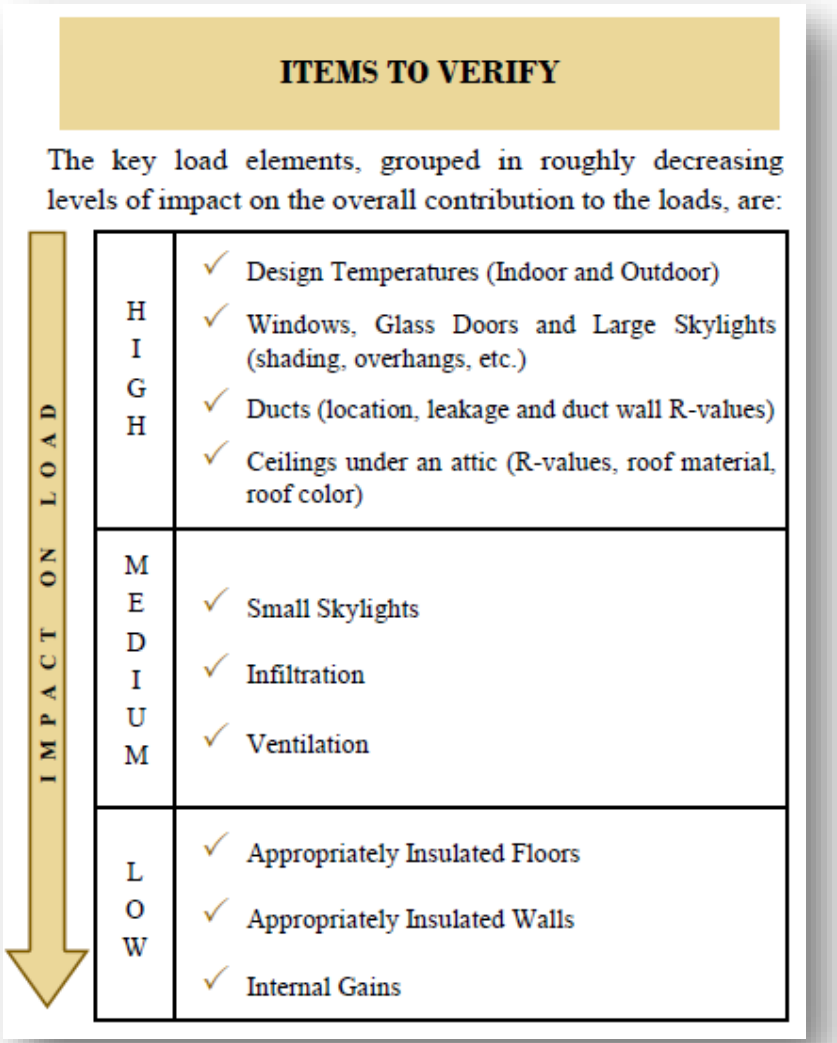
- Approved computer software
- Energy/Computer Model includes:
  - Location / Climate Data
  - Building Orientation
  - Wall Assemblies
  - All windows and Skylights
  - All doors
  - Roof Assembly(s)
  - Floor/Slab Assembly(s)
  - Infiltration
  - Ventilation
  - Occupants



MJ8 and J1 Forms–What to Check?

Impact on Energy

Items to Verify	Useful Info
Climate / Location Data	Reference Joint Appendices JA2
Duct Location	*Entirely in Conditions Space (?)*
Building Component Orientation especially Windows	*South / West -very important East / North -less important*
Windows, Skylights, Glass Doors	Code U-0.30, SHGC-0.23
Wall Assemblies	2x6 R-19 U-o.074
Roof Assembly(s)	R-30 Attic, U-0.031
Floor/Slab Assembly(s)	Floor R-19 U-0.037; Slab F-0.73
Infiltration	Semi-tight (5 ACH50)
Ventilation	Per Title 24 and mech design
Occupants / Internal Gains	Per bedroom count
Solid Doors	Code U-0.20



ITEMS TO VERIFY

The key load elements, grouped in roughly decreasing levels of impact on the overall contribution to the loads, are:

IMPACT ON LOAD

HIGH	✓ Design Temperatures (Indoor and Outdoor) ✓ Windows, Glass Doors and Large Skylights (shading, overhangs, etc.) ✓ Ducts (location, leakage and duct wall R-values) ✓ Ceilings under an attic (R-values, roof material, roof color)
MEDIUM	✓ Small Skylights ✓ Infiltration ✓ Ventilation
LOW	✓ Appropriately Insulated Floors ✓ Appropriately Insulated Walls ✓ Internal Gains

Excerpted from the ACCA Manual J Brochure

Form J1 and Worksheet

Looking for ‘Red Flags’

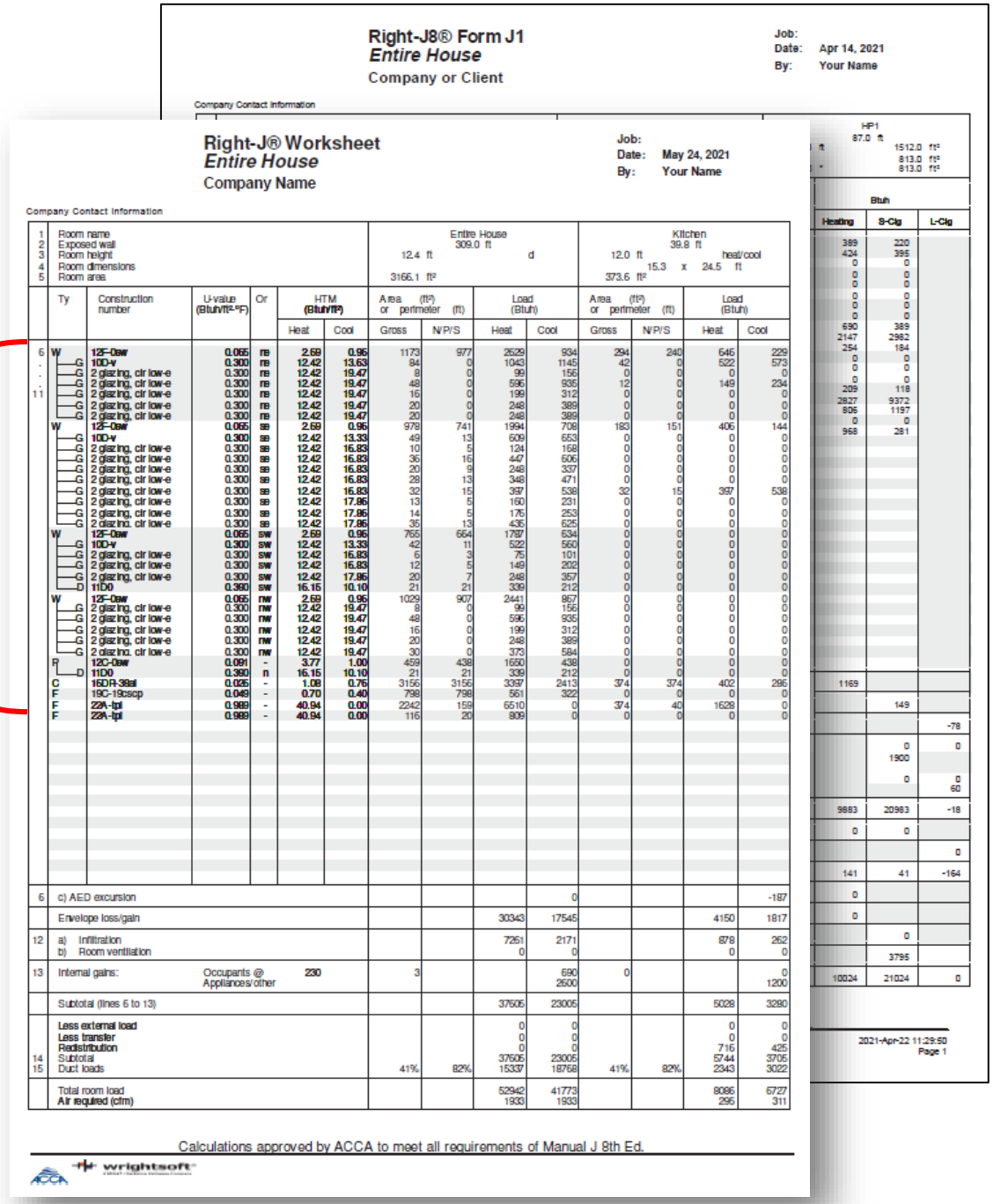
- Notice the general building tree: Wall –Glazing and Orientation
- U-values look valid; match T24?
- Window areas look reasonable?
- Floor and Ceiling areas align?

	Ty	Construction number	U-value (Btuh/ft²·°F)	Or	HTM (Btuh/ft²) Heat	HTM (Btuh/ft²) Cool	Area (ft²) or perimete Gross
6	W	12F-0sw	0.065	ne	2.69	0.96	1173
.	G	10D-v	0.300	ne	12.42	13.63	84
.	G	2 glazing, clr low-e	0.300	ne	12.42	19.47	8
.	G	2 glazing, clr low-e	0.300	ne	12.42	19.47	48
11	G	2 glazing, clr low-e	0.300	ne	12.42	19.47	16
	G	2 glazing, clr low-e	0.300	ne	12.42	19.47	20
	G	2 glazing, clr low-e	0.300	ne	12.42	19.47	20
	W	12F-0sw	0.065	se	2.69	0.96	978
	G	10D-v	0.300	se	12.42	13.33	49
	G	2 glazing, clr low-e	0.300	se	12.42	16.83	10
	G	2 glazing, clr low-e	0.300	se	12.42	16.83	36
	G	2 glazing, clr low-e	0.300	se	12.42	16.83	20
	G	2 glazing, clr low-e	0.300	se	12.42	16.83	28
	G	2 glazing, clr low-e	0.300	se	12.42	16.83	32
	G	2 glazing, clr low-e	0.300	se	12.42	17.86	13
	G	2 glazing, clr low-e	0.300	se	12.42	17.86	14
	G	2 glazing, clr low-e	0.300	se	12.42	17.86	35
	W	12F-0sw	0.065	sw	2.69	0.96	765
	G	10D-v	0.300	sw	12.42	13.33	42
	G	2 glazing, clr low-e	0.300	sw	12.42	16.83	6
	G	2 glazing, clr low-e	0.300	sw	12.42	16.83	12
	G	2 glazing, clr low-e	0.300	sw	12.42	17.86	20
	D	11D0	0.390	sw	16.15	10.10	21
	W	12F-0sw	0.065	nw	2.69	0.96	1029
	G	2 glazing, clr low-e	0.300	nw	12.42	19.47	8
	G	2 glazing, clr low-e	0.300	nw	12.42	19.47	48
	G	2 glazing, clr low-e	0.300	nw	12.42	19.47	16
	G	2 glazing, clr low-e	0.300	nw	12.42	19.47	20
	G	2 glazing, clr low-e	0.300	nw	12.42	19.47	30
	P	12C-0sw	0.091	-	3.77	1.00	459
	D	11D0	0.390	n	16.15	10.10	21
	C	16DR-38al	0.026	-	1.08	0.76	3156
	F	19C-19cscp	0.049	-	0.70	0.40	798
	F	22A-tpl	0.989	-	40.94	0.00	2242
	F	22A-tpl	0.989	-	40.94	0.00	116

‘Useful Info’

- Windows, Skylights, Glass Doors
- Wall Assemblies
- Roof Assembly(s)
- Floor/Slab Assembly(s)

- Code U-0.30, SHGC-0.23
- 2x6 R-19 U-o.074
- R-30 Attic, U-0.031
- Floor R-19 U-0.037; Slab F-0.73



Right-J8® Form J1
Entire House
Company or Client

Job:
Date: Apr 14, 2021
By: Your Name

Company Contact Information

Right-J® Worksheet
Entire House
Company Name

Job:
Date: May 24, 2021
By: Your Name

Company Contact Information

		Entire House	Kitchen
1	Room name		
2	Exposed wall	309.0 ft d	39.8 ft
3	Room height	12.4 ft	12.0 ft heat/cool
4	Room dimensions		15.3 x 24.5 ft
5	Room area	3166.1 ft²	373.6 ft²

	Ty	Construction number	U-value (Btuh/ft²·°F)	Or	HTM (Btuh/ft²) Heat	HTM (Btuh/ft²) Cool	Area (ft²) or perimeter (ft) Gross	N/P/S	Load (Btuh) Heat	Load (Btuh) Cool	Area (ft²) or perimeter (ft) Gross	N/P/S	Load (Btuh) Heat	Load (Btuh) Cool
6	W	12F-0sw	0.065	ne	2.69	0.96	1173	977	2629	934	294	240	646	229
.	G	10D-v	0.300	ne	12.42	13.63	84	0	1043	1145	42	0	522	573
.	G	2 glazing, clr low-e	0.300	ne	12.42	19.47	8	0	99	156	0	0	0	0
.	G	2 glazing, clr low-e	0.300	ne	12.42	19.47	48	0	596	935	12	0	149	234
11	G	2 glazing, clr low-e	0.300	ne	12.42	19.47	16	0	199	312	0	0	0	0
	G	2 glazing, clr low-e	0.300	ne	12.42	19.47	20	0	248	389	0	0	0	0
	G	2 glazing, clr low-e	0.300	ne	12.42	19.47	20	0	248	389	0	0	0	0
	W	12F-0sw	0.065	se	2.69	0.96	978	741	1994	708	183	151	406	144
	G	10D-v	0.300	se	12.42	13.33	49	13	609	653	0	0	0	0
	G	2 glazing, clr low-e	0.300	se	12.42	16.83	10	5	124	168	0	0	0	0
	G	2 glazing, clr low-e	0.300	se	12.42	16.83	36	16	447	606	0	0	0	0
	G	2 glazing, clr low-e	0.300	se	12.42	16.83	20	9	248	337	0	0	0	0
	G	2 glazing, clr low-e	0.300	se	12.42	16.83	28	13	348	471	0	0	0	0
	G	2 glazing, clr low-e	0.300	se	12.42	16.83	32	15	397	538	32	15	397	538
	G	2 glazing, clr low-e	0.300	se	12.42	17.86	13	5	160	231	0	0	0	0
	G	2 glazing, clr low-e	0.300	se	12.42	17.86	14	5	176	253	0	0	0	0
	G	2 glazing, clr low-e	0.300	se	12.42	17.86	35	13	435	625	0	0	0	0
	W	12F-0sw	0.065	sw	2.69	0.96	765	664	1797	634	0	0	0	0
	G	10D-v	0.300	sw	12.42	13.33	42	11	522	560	0	0	0	0
	G	2 glazing, clr low-e	0.300	sw	12.42	16.83	6	3	75	101	0	0	0	0
	G	2 glazing, clr low-e	0.300	sw	12.42	16.83	12	5	149	202	0	0	0	0
	G	2 glazing, clr low-e	0.300	sw	12.42	17.86	20	7	248	357	0	0	0	0
	D	11D0	0.390	sw	16.15	10.10	21	21	339	212	0	0	0	0
	W	12F-0sw	0.065	nw	2.69	0.96	1029	907	2441	867	0	0	0	0
	G	2 glazing, clr low-e	0.300	nw	12.42	19.47	8	0	99	156	0	0	0	0
	G	2 glazing, clr low-e	0.300	nw	12.42	19.47	48	0	596	935	0	0	0	0
	G	2 glazing, clr low-e	0.300	nw	12.42	19.47	16	0	199	312	0	0	0	0
	G	2 glazing, clr low-e	0.300	nw	12.42	19.47	20	0	248	389	0	0	0	0
	G	2 glazing, clr low-e	0.300	nw	12.42	19.47	30	0	373	584	0	0	0	0
R		12C-0sw	0.091	-	3.77	1.00	459	438	1650	438	0	0	0	0
	D	11D0	0.390	n	16.15	10.10	21	21	339	212	0	0	0	0
C		16DR-38al	0.026	-	1.08	0.76	3156	3156	3397	2413	374	374	402	286
F		19C-19cscp	0.049	-	0.70	0.40	798	798	596	322	0	0	0	0
F		22A-tpl	0.989	-	40.94	0.00	2242	159	6510	0	374	40	1628	0
F		22A-tpl	0.989	-	40.94	0.00	116	20	809	0	0	0	0	0
6	c) AED excursion									0				-187
	Envelope loss/gain								30343	17545			4150	1817
12	a) Infiltration b) Room ventilation								7251 0	2171 0			878 0	262 0
13	Internal gains:	Occupants @ Appliances/other	230				3			690 2500	0			0 1200
	Subtotal (lines 6 to 13)								37605	23005			5028	3280
14 15	Less external load Less transfer Redistribution Subtotal Duct loads								0 0 0 37605 15337	0 0 0 23005 18768			0 0 716 5744 2343	0 0 425 3705 3022
								41%				82%		
	Total room load Air required (cfm)								52942 1933	41773 1933			8086 295	6727 311

Calculations approved by ACCA to meet all requirements of Manual J 8th Ed.

wrightsoft

HP1 87.0 ft		
1512.0 ft²		
813.0 ft²		
813.0 ft²		
Btuh		
Heating	S-Clg	L-Clg
389	220	
424	395	
0	0	
0	0	
0	0	
0	0	
0	0	
0	0	
690	389	
2147	2982	
254	184	
0	0	
0	0	
0	0	
209	118	
2827	9372	
806	1197	
0	0	
968	281	
1169		
	149	
		-78
	0	0
	1900	
	0	0
		60
9883	20983	-18
0	0	
		0
141	41	-164
0		
0		
	0	
	3795	
10024	21024	0

2021-Apr-22 11:29:50
Page 1

MJ8 – Form J1

Looking for ‘Red Flags’

Quick check on the Duct Loads… Does this value look reasonable?...lots of zeros … Verify that the ducts are completely within the conditioned space.

12	Infiltration	Heating Load (Btuh)		Effect ACH	0.34	WAR 1.00	3812		
		Sensible Load (Btuh)			0.15			487	
		Latent Load (Btuh)							-254
13	Internal	a	Occupants at 230 and 200 Btuh				0	0	0
		b	Scenario number					1900	
		c	Default Adjustments						
		d	Custom Appliances					0	0
		e	Plants						60
14	Subtotals			Sum lines 6 through 12			27714	42312	-194
15	Duct Loads	EHLF & ESGF		0	0		0	0	
		ELG							0
16	Ventilation Loads	Vent Cfm	96	E Cfm	96		423	123	-494
17	Winter Humidification Load			Gal/Day	0		0		
18	Piping Load						0		
19	Blower Heat							0	
20	AED Excursion & Latent Moisture Migration Load							6786	
21	Total Load			Sum lines 13 through 19			28138	42435	0

Right-J8® Form J1
Entire House
Company or Client

Job:
Date: Apr 14, 2021
By: Your Name

Company Contact Information

		Entire House	HP1
1	Name of Room		
2	Running Feet of Exposed Wall	283.6 ft	87.0 ft
3	Ceiling Ht (Ft) and Gross Wall Area (SqFt)	9.0 ft 5621.3 ft²	9.0 ft 1512.0 ft²
4	Room Dimensions (Ft) and Floor Plan Area (SqFt)	2193.5 ft²	813.0 ft²
5	Ceiling Slope (Deg.) and Gross Ceiling Area (SqFt)	0 ° 2193.5 ft²	0 ° 813.0 ft²

	Type of Exposure	Const., Number	Panel Faces	HTM Htg.	HTM Clg.	Entire House Area or Length	Entire House Btuh Heating	Entire House Btuh S-Clg	Entire House Btuh L-Clg	HP1 Area or Length	HP1 Btuh Heating	HP1 Btuh S-Clg	HP1 Btuh L-Clg
6	Wall	12C-0sw	n	2.82	1.59	531	1328	750		162	389	220	
	Glaz	1D-c2ov	n	17.67	16.46	60	1065	992		24	424	395	
	Wall	14F-0	n	10.57	4.57	95	999	432		0	0	0	
	Wall	12C-0sw	e	2.82	1.59	257	689	389		0	0	0	
11	Glaz	1D-c2ov	e	17.67	58.57	12	216	718		0	0	0	
	Wall	14F-0	e	10.57	4.57	158	1665	720		0	0	0	
	Wall	12C-0sw	se	2.82	1.59	25	34	19		0	0	0	
	Glaz	1D-c2ov	se	17.67	47.22	14	239	637		0	0	0	
	Wall	12C-0sw	s	2.82	1.59	797	1680	949		387	690	389	
	Glaz	1D-c2ov	s	17.67	24.54	180	3178	4414		122	2147	2982	
	Door	11D0	s	12.09	8.77	21	254	184		21	254	184	
	Wall	14F-0	s	10.57	4.57	162	1713	740		0	0	0	
	Wall	12C-0sw	sw	2.82	1.59	25	37	21		0	0	0	
	Glaz	1D-c2ov	sw	17.67	47.22	13	221	590		0	0	0	
	Wall	12C-0sw	w	2.82	1.59	504	590	333		234	209	118	
	Glaz	1D-c2ov	w	17.67	58.57	295	5208	17265		160	2827	9372	
	Ceil	16B-30ad	-	0.99	1.47	2194	2176	3229		813	806	1197	
	Flor	19A-19cvcp	-	1.19	0.35	889	1058	307		0	0	0	
	Flor	19A-19cvcp	-	1.19	0.35	1305	1553	451		813	968	281	

12	Infiltration	Heating Load (Btuh)		Effect ACH	0.34	WAR 1.00	3812			WAR 1.00	1169		
		Sensible Load (Btuh)			0.15			487				149	
		Latent Load (Btuh)							-254				-78
13	Internal	a	Occupants at 230 and 200 Btuh			0		0	0	0		0	0
		b	Scenario number					1900				1900	
		c	Default Adjustments										
		d	Custom Appliances					0	0			0	0
		e	Plants						60				60
14	Subtotals			Sum lines 6 through 12			27714	42312	-194		9883	20983	-18
15	Duct Loads	EHLF & ESGF		0	0		0	0			0	0	
		ELG							0				0
16	Ventilation Loads	Vent Cfm	96	E Cfm	96		423	123	-494		141	41	-164
17	Winter Humidification Load			Gal/Day	0		0				0		
18	Piping Load						0				0		
19	Blower Heat							0				0	
20	AED Excursion & Latent Moisture Migration Load							6786				3795	
21	Total Load			Sum lines 13 through 19			28138	42435	0		10024	21024	0

Calculations approved by ACCA to meet all requirements of Manual J 8th Ed.

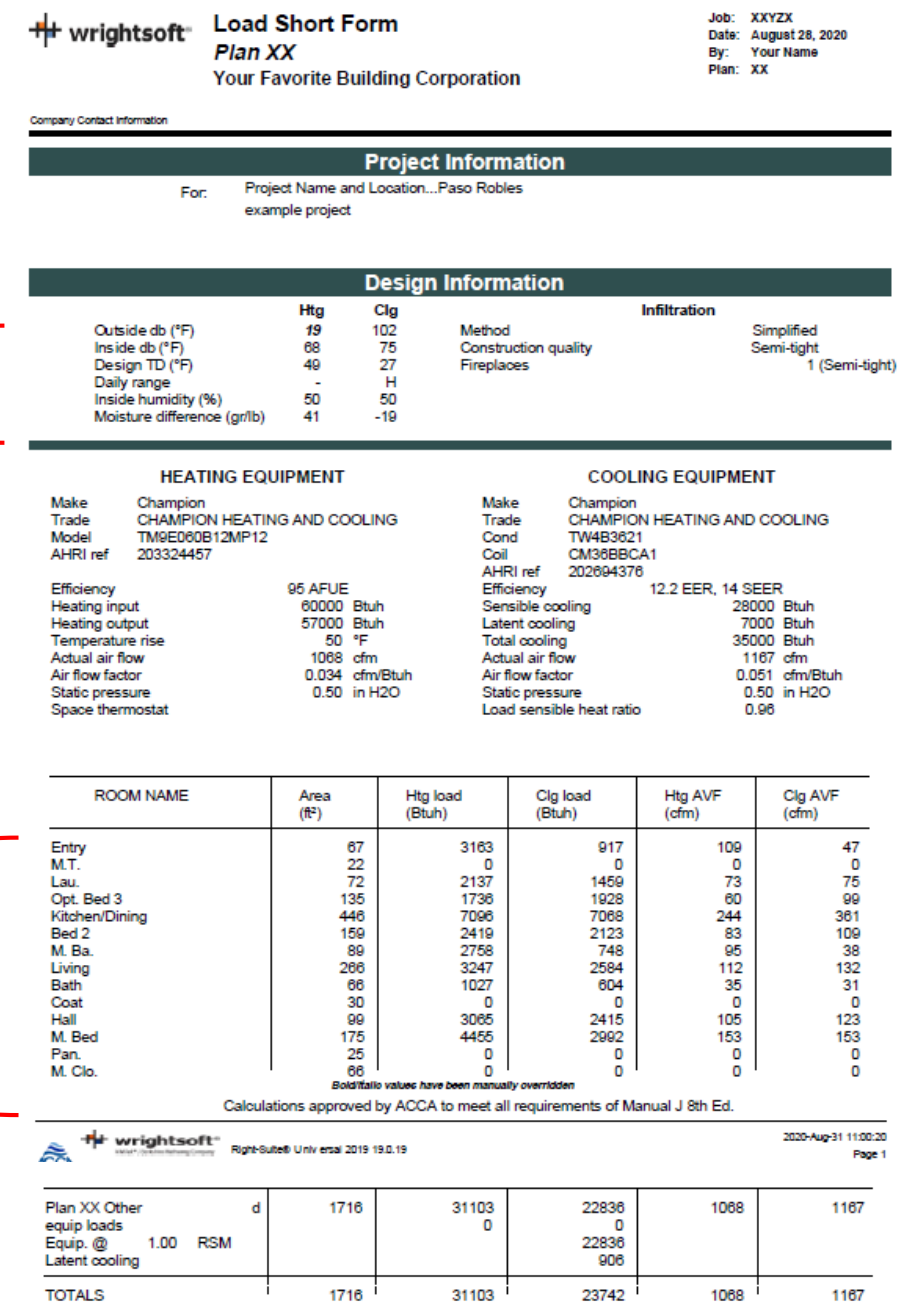
Load Short Form

Helpful Information:

See Climate Design Data at a glance.
Ask, do these Outside dry bulb (db) temperatures match the location?
Are they from the California Joint Appendices JA2?

Note: California uses inside dry bulb (db) temperature of 68 deg F for winter heating (Htg) and 75 deg F for summer cooling (Clg)

See the rooms and floor areas, and their relative load (Btuh) impact at a glance.



wrightsoft

Load Short Form
Plan XX
Your Favorite Building Corporation

Job: XXYZX
Date: August 28, 2020
By: Your Name
Plan: XX

Company Contact Information

Project Information

For: Project Name and Location...Paso Robles
example project

Design Information

	Htg	Clg
Outside db (°F)	19	102
Inside db (°F)	68	75
Design TD (°F)	49	27
Daily range	-	H
Inside humidity (%)	50	50
Moisture difference (gr/lb)	41	-19

Infiltration

Method	Simplified
Construction quality	Semi-tight
Fireplaces	1 (Semi-tight)

HEATING EQUIPMENT

Make	Champion
Trade	CHAMPION HEATING AND COOLING
Model	TM9E060B12MP12
AHRI ref	203324457
Efficiency	95 AFUE
Heating input	60000 Btuh
Heating output	57000 Btuh
Temperature rise	50 °F
Actual air flow	1068 cfm
Air flow factor	0.034 cfm/Btuh
Static pressure	0.50 in H2O
Space thermostat	

COOLING EQUIPMENT

Make	Champion
Trade	CHAMPION HEATING AND COOLING
Cond	TW4B3621
Coil	CM36BBCA1
AHRI ref	202694376
Efficiency	12.2 EER, 14 SEER
Sensible cooling	28000 Btuh
Latent cooling	7000 Btuh
Total cooling	35000 Btuh
Actual air flow	1167 cfm
Air flow factor	0.051 cfm/Btuh
Static pressure	0.50 in H2O
Load sensible heat ratio	0.96

ROOM NAME	Area (ft²)	Htg load (Btuh)	Clg load (Btuh)	Htg AVF (cfm)	Clg AVF (cfm)
Entry	67	3163	917	109	47
M.T.	22	0	0	0	0
Lau.	72	2137	1459	73	75
Opt. Bed 3	135	1736	1928	60	99
Kitchen/Dining	446	7096	7068	244	361
Bed 2	159	2419	2123	83	109
M. Ba.	89	2758	748	95	38
Living	266	3247	2584	112	132
Bath	66	1027	604	35	31
Coat	30	0	0	0	0
Hall	99	3065	2415	105	123
M. Bed	175	4455	2992	153	153
Pan.	25	0	0	0	0
M. Clo.	66	0	0	0	0
Plan XX Other equip loads	d	1716	31103 0	22836 0	1068	1167
Equip. @ 1.00 RSM Latent cooling				22836 906		
TOTALS		1716	31103	23742	1068	1167

Bold/Italic values have been manually overridden

Calculations approved by ACCA to meet all requirements of Manual J 8th Ed.

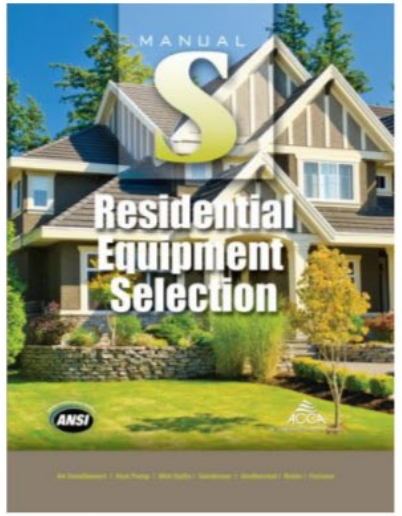
wrightsoft Right-Suite® Universal 2019 19.0.19

2020-Aug-31 11:00:20
Page 1

Manual S Equipment Selection

Based on the Load Calculation from Manual J –may need refinement after the duct design process

- Use Manufacture's Data
- Adjust AHRI standard values for a dry climate; CA Joint Reference Appendices JA2 Climate Data (Title 24 Part 6)
- Heating Capacity (Output)
- Cooling Capacity (Output)
- Blower Performance Data Tables
  - External Static Pressure (ESP)
  - Fan CFM at the rated Capacity



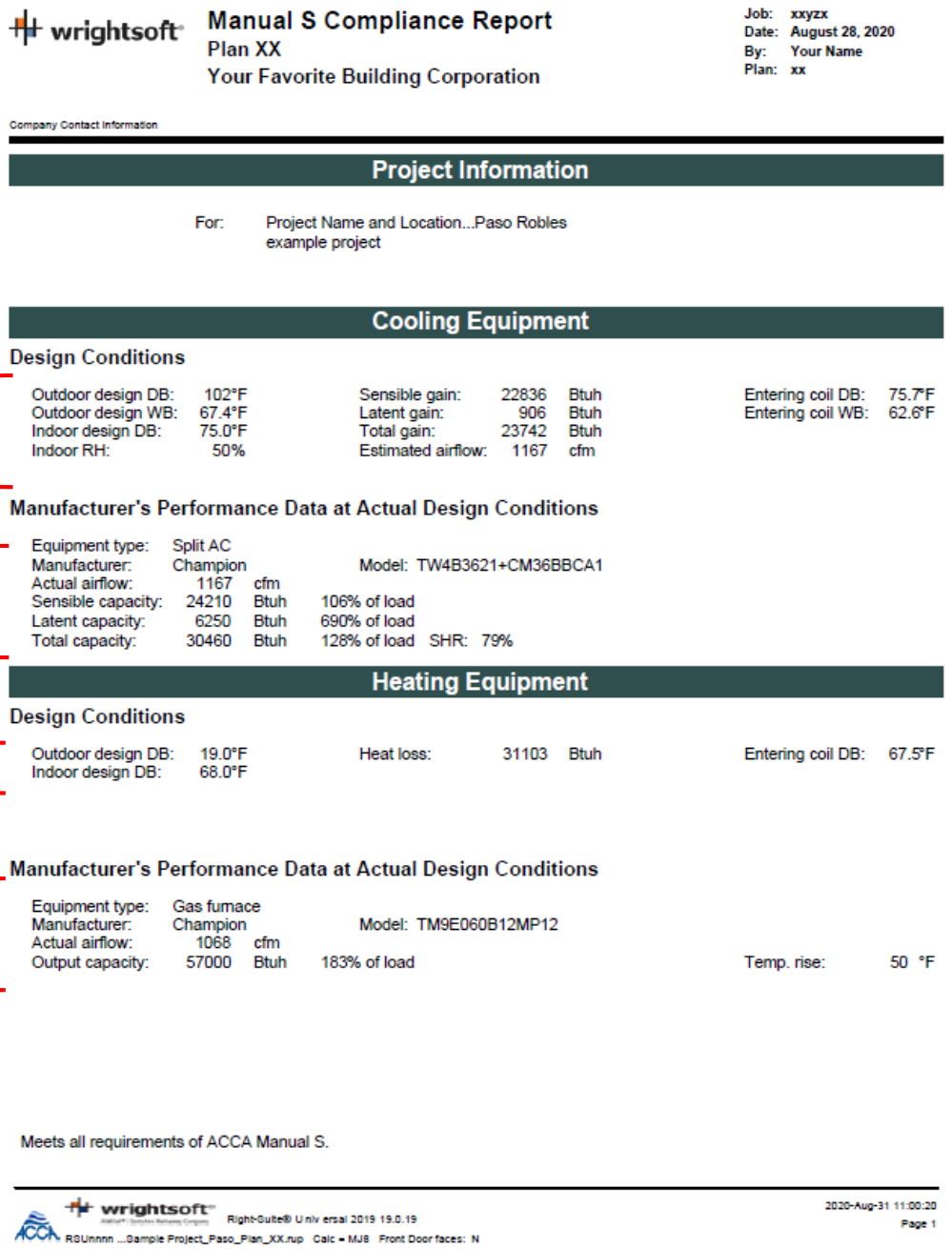
Manual S Compliance Report

Climate Data match the location and JA2?
Indoor Design DB (dry bulb) 75 deg F for summer?

Does Capacity meet the load? Is it within 100 – 115%
If not, is there a smaller unit available

Indoor Design DB (dry bulb) 68 deg F for winter?

Does Capacity meet the load? Is it within 100 – 140%
If not, is there a smaller size available?
Was the equipment sized for the blower /fan ?



wrightsoft

Manual S Compliance Report
Plan XX
Your Favorite Building Corporation

Job: xxyzx
Date: August 28, 2020
By: Your Name
Plan: xx

Company Contact Information

Project Information

For: Project Name and Location...Paso Robles
example project

Cooling Equipment

Design Conditions

Outdoor design DB:	102°F	Sensible gain:	22836 Btuh	Entering coil DB:	75.7°F
Outdoor design WB:	67.4°F	Latent gain:	906 Btuh	Entering coil WB:	62.6°F
Indoor design DB:	75.0°F	Total gain:	23742 Btuh		
Indoor RH:	50%	Estimated airflow:	1167 cfm		

Manufacturer's Performance Data at Actual Design Conditions

Equipment type:	Split AC				
Manufacturer:	Champion			Model:	TW4B3621+CM36BBCA1
Actual airflow:	1167	cfm			
Sensible capacity:	24210	Btuh	106% of load		
Latent capacity:	6250	Btuh	690% of load		
Total capacity:	30460	Btuh	128% of load	SHR:	79%

Heating Equipment

Design Conditions

Outdoor design DB:	19.0°F	Heat loss:	31103 Btuh	Entering coil DB:	67.5°F
Indoor design DB:	68.0°F				

Manufacturer's Performance Data at Actual Design Conditions

Equipment type:	Gas furnace				
Manufacturer:	Champion			Model:	TM9E060B12MP12
Actual airflow:	1068	cfm			
Output capacity:	57000	Btuh	183% of load	Temp. rise:	50 °F

Meets all requirements of ACCA Manual S.

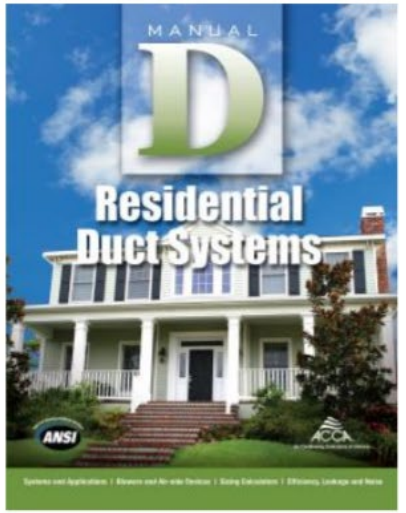
wrightsoft Right-Suite® Universal 2019 19.0.19
RSUnnnn ...Sample Project_Paso_Plan_XX.rup Calc = MJ8 Front Door faces: N

2020-Aug-31 11:00:20
Page 1

Manual D Duct Design

Influences Energy Use and Comfort and Equipment Life

- Duct Layout Sketch
- Specialized Software is useful
- Calculates duct sizes /diameter
- Takes into account:
  - Duct layout
  - Duct material, i.e. sheet metal, flex, other
  - Duct profile / shape
  - Duct lengths
  - Connectors, Reducers, other Fittings
  - Tees and Splitter Wyes
  - Elbows -Radius or square



Duct Layout Sketch

Basic floor plan is drawn to scale

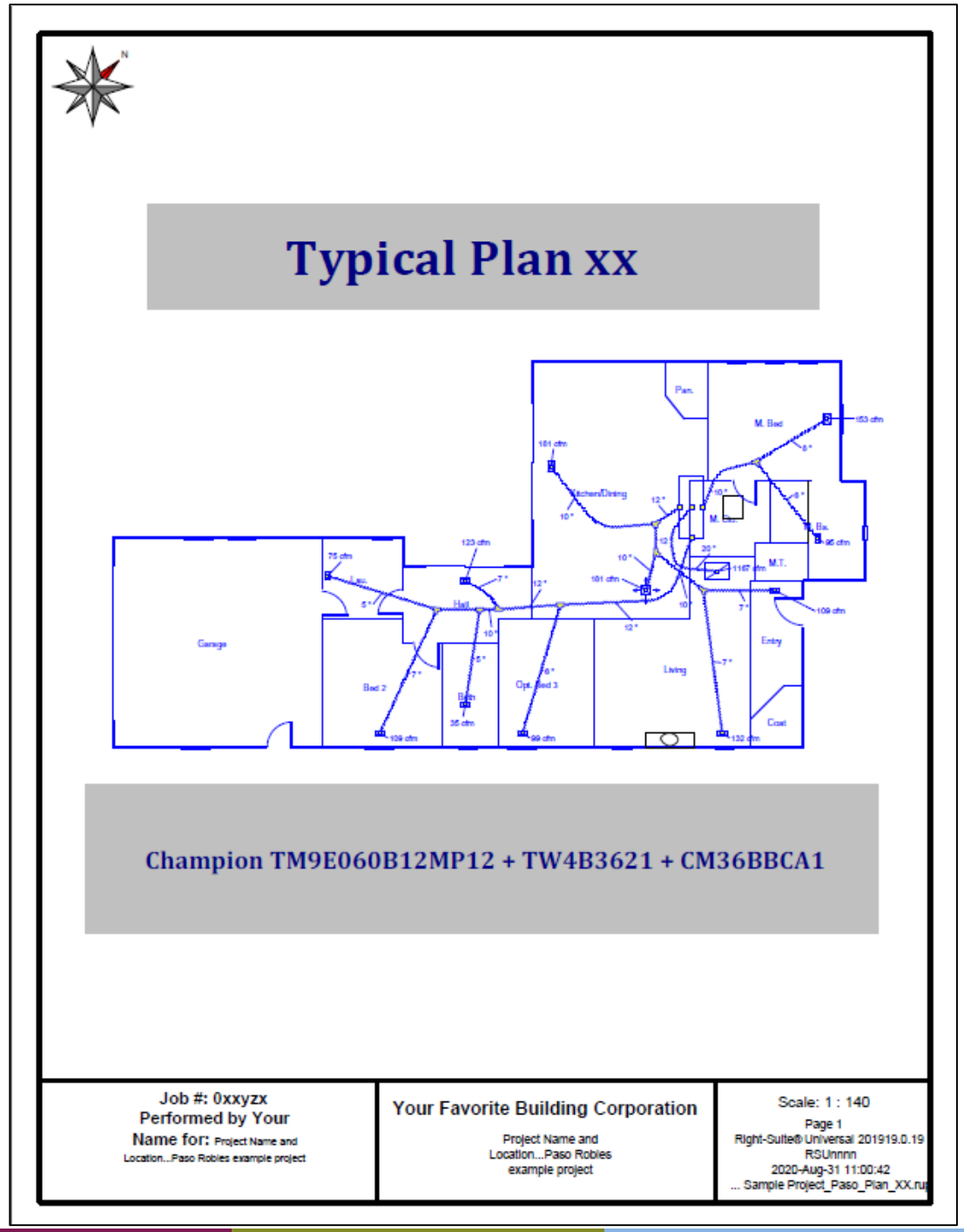
User chooses from a library of preferred duct and connector types for the duct system

The user draws the preferred duct runs (branch and trucks or radial pattern, etc) and register locations

Per length of duct, the size / diameter is calculated and called out on the plan

The supply air volume rate (cfm –cubic feet per minute) is called out at each register

The return air volume and register is labeled on the plan



Duct System Summary

External static pressure (ESP) comes from the Manufacture Blower Performance

Pressure losses are determined from product data

Actual air flow and Total effective length (TEL) are calculated as part of Manual D

Heating Equipment Example

Blower Performance CFM - Any Position (without filter)

Models	Speed	Airflow Data (SCFM)[1,2] Ext. Static Pressure (in. H_2O)							
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
TM9E040A10MP12	High	1172	1147	1116	1083	1035	984	933	870
	Medium High	952	919	896	865	839	809	780	765
	Medium	882	861	824	802	771	746	709	685
	Medium Low	754	716	688	650	610	588	551	523
	Low	688	648	619	584	541	518	481	446
TM9E060A10MP12	High	1239	1209	1175	1143	1124	1095	1066	1019
	Medium High	1142	1102	1080	1050	1019	989	960	924
	Medium	971	935	909	869	839	805	761	731
	Medium Low	915	891	848	818	776	744	708	691
	Low	773	739	687	655	604	572	527	496
TM9E060B12MP12	High	1342	1316	1290	1268	1243	1219	1172	1116
	Medium High	1297	1267	1247	1217	1189	1159	1129	1087
	Medium	1165	1139	1108	1080	1051	[illegible]	983	948
	Medium Low	1027	995	965	936	894	862	825	778
	Low	822	775	740	687	649	605	566	512
	High	1418	1390	1364	1333	1304	1281	1246	1205

wrightsoft **Duct System Summary**
Plan XX
Your Favorite Building Corporation

Job: xxyzx
Date: August 28, 2020
By: Your Name
Plan: xx

Company Contact Information

Project Information

For: Project Name and Location...Paso Robles
example project

	Heating	Cooling
External static pressure	0.50 in H2O	0.50 in H2O
Pressure losses	0.30 in H2O	0.30 in H2O
Available static pressure	0.20 in H2O	0.20 in H2O
Supply / return available pressure	0.143 / 0.057 in H2O	0.143 / 0.057 in H2O
Lowest friction rate	0.070 in/100ft	0.070 in/100ft
Actual air flow	1068 cfm	1167 cfm
Total effective length (TEL)	287 ft	

Supply Branch Detail Table

Name		Design (Btuh)	Htg (cfm)	Clg (cfm)	Design FR	Diam (in)	H x W (in)	Duct Matl	Actual Ln (ft)	Ftg.Eqv Ln (ft)	Trunk
Bath-A	h	1027	35	31	0.079	5.0	0x 0	VlFx	37.0	145.0	st5
Bed 2	c	2123	83	109	0.070	7.0	0x 0	VlFx	45.7	160.0	st5
Entry-A	h	3163	109	47	0.090	7.0	0x 0	VlFx	20.0	140.0	st7
Hall	c	2415	105	123	0.087	7.0	0x 0	VlFx	29.6	135.0	st4
Kitchen/Dining	c	3534	122	181	0.108	10.0	0x 0	VlFx	17.3	115.0	st3
Kitchen/Dining-A	c	3534	122	181	0.106	10.0	0x 0	VlFx	10.2	125.0	st6
Lau.-A	c	1459	73	75	0.070	5.0	0x 0	VlFx	43.4	160.0	st5
Living	c	2584	112	132	0.085	7.0	0x 0	VlFx	27.6	140.0	st7
M. Ba.-A	h	2758	95	38	0.107	6.0	0x 0	VlFx	18.5	115.0	st1
M. Bed	h	4455	153	153	0.109	8.0	0x 0	VlFx	16.9	115.0	st1
Opt. Bed 3	c	1928	60	99	0.097	6.0	0x 0	VlFx	32.5	115.0	st2

Supply Trunk Detail Table

Name	Trunk Type	Htg (cfm)	Clg (cfm)	Design FR	Veloc (fpm)	Diam (in)	H x W (in)	Duct Material	Trunk
st2	Peak AVF	357	436	0.070	555	*12.0*	*0* x *0*	VinlFlx	
st4	Peak AVF	297	337	0.070	430	12.0	0 x 0	VinlFlx	st2
st5	Peak AVF	192	214	0.070	392	10.0	0 x 0	VinlFlx	st4
st3	Peak AVF	464	540	0.085	688	*12.0*	*0* x *0*	VinlFlx	
st6	Peak AVF	342	359	0.085	458	12.0	0 x 0	VinlFlx	st3
st7	Peak AVF	220	179	0.085	404	10.0	0 x 0	VinlFlx	st6
st1	Peak AVF	248	191	0.107	454	10.0	0 x 0	VinlFlx	

Return Branch Detail Table

Name	Grille Size (in)	Htg (cfm)	Clg (cfm)	TEL (ft)	Design FR	Veloc (fpm)	Diam (in)	H x W (in)	Stud/Joist Opening (in)	Duct Matl	Trunk
rb1	0x 0	1068	1167	81.6	0.070	535	*20.0*	*0x 0*		VlFx	

Static Pressure and Friction Rate

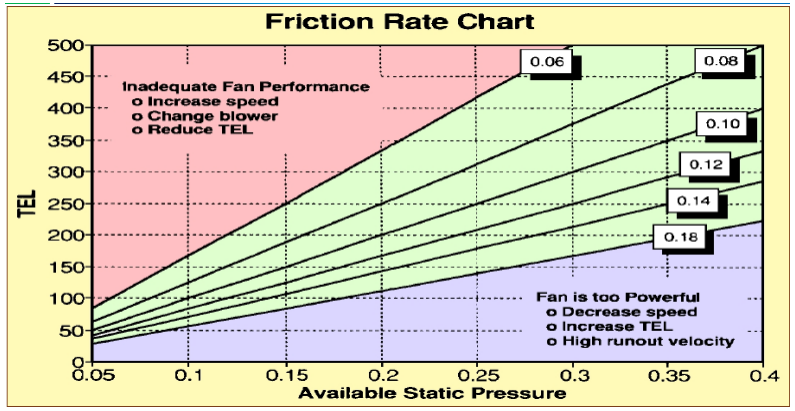
Does the External Static Pressure (ESP) match the manufacture blower performance data? Range upper limit around 1.0 IWC

The equipment external static pressure (ESP) may include the coil pressure loss –read footnotes

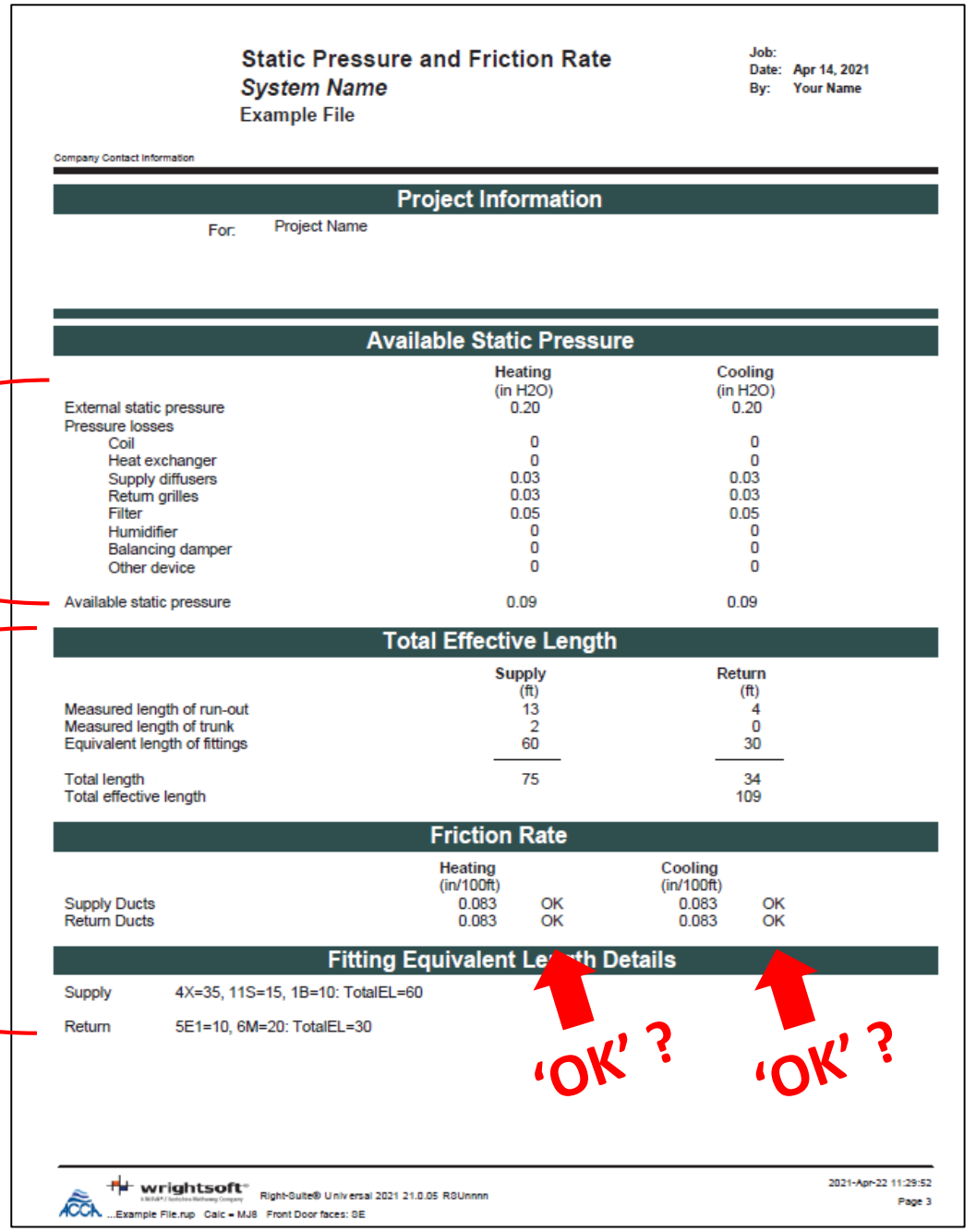
Sometimes the equipment includes an assumed 0.10 pressure drop for air filter –read footnotes

Typical value for diffusers, grilles and balancing dampers pressure loss is 0.03 IWC

Filter loss could vary greatly...



TEL = Total Effective Length



Static Pressure and Friction Rate
System Name
Example File

Job:
Date: Apr 14, 2021
By: Your Name

Company Contact Information

Project Information

For: Project Name

Available Static Pressure

	Heating (in H2O)	Cooling (in H2O)
External static pressure	0.20	0.20
Pressure losses		
Coil	0	0
Heat exchanger	0	0
Supply diffusers	0.03	0.03
Return grilles	0.03	0.03
Filter	0.05	0.05
Humidifier	0	0
Balancing damper	0	0
Other device	0	0
Available static pressure	0.09	0.09

Total Effective Length

	Supply (ft)	Return (ft)
Measured length of run-out	13	4
Measured length of trunk	2	0
Equivalent length of fittings	60	30
Total length	75	34
Total effective length		109

Friction Rate

	Heating (in/100ft)		Cooling (in/100ft)	
Supply Ducts	0.083	OK	0.083	OK
Return Ducts	0.083	OK	0.083	OK

Fitting Equivalent Length Details

Supply 4X=35, 11S=15, 1B=10: TotalEL=60

Return 5E1=10, 6M=20: TotalEL=30

'OK' ?

'OK' ?

wrightsoft Right-Suite® Universal 2021 21.0.05 RSUnnnn
...Example File.rup Calc = MJ8 Front Door faces: SE

2021-Apr-22 11:29:52
Page 3

Best Practices

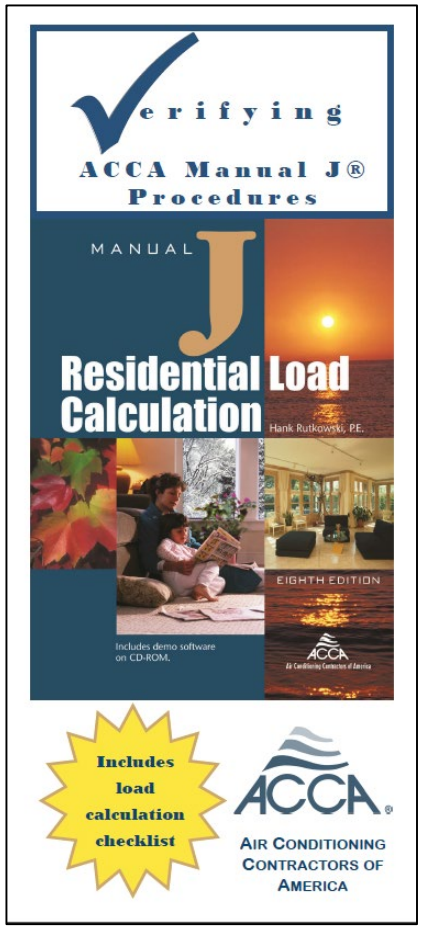
Best Practices

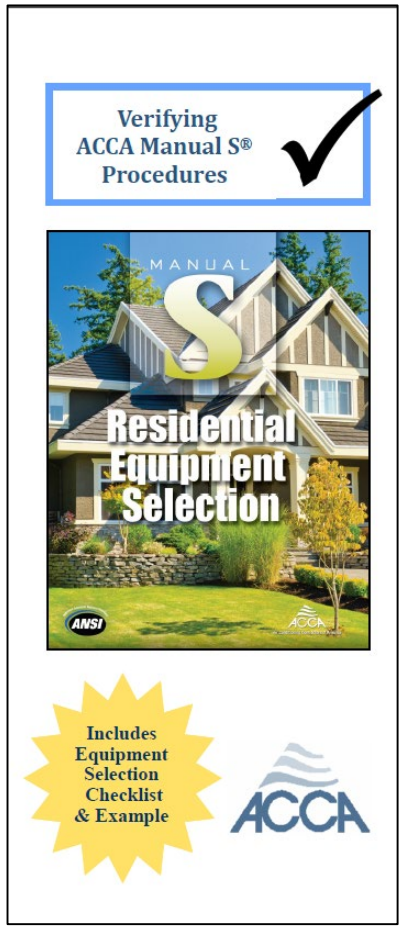
- ✓ Use the Residential Plans Examiner Review Form
- ✓ Compare ACCA Documents to CF1R, CF2R, CF3R's
- ✓ 'Experiment' with software such as Wrightsoft Right-J and Right-D software
- ✓ Create an ACCA Checklist of your desired forms
  - Project Summary
  - J1 Form and J Worksheet
  - Manual S Summary
  - Duct Layout / Distribution
  - Duct Design Summary
  - Static Pressure and Friction Loss Worksheet
  - OEM –Manufactures Performance Data

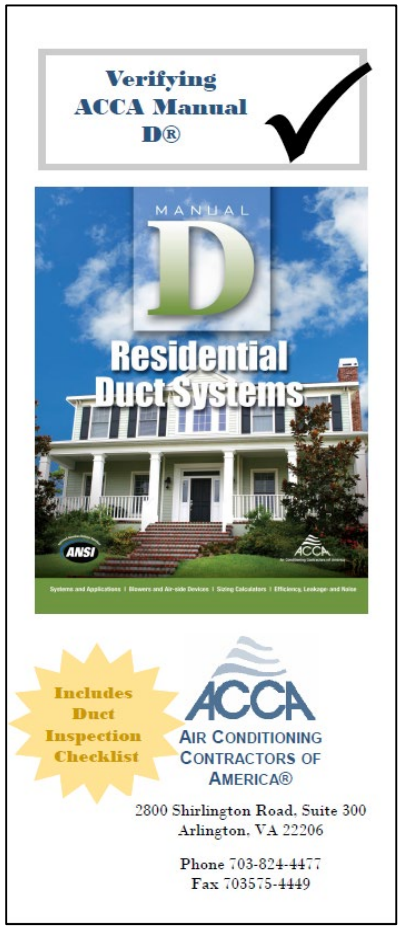
Resources

Resources

ACCA.org –on line store and public resources







https://www.acca.org/viewdocument/hvac-brochures-for-code-officials

https://www.energy.gov/sites/default/files/2013/11/f5/hvac_guide.pdf

ACCA Manual D Brochure, page 2

Friction Rate Worksheet

Step 1) Manufacturer's Blower Data

External Static Pressure (ESP) = 0.70 IWC CFM= 1200 CFM

Step 2) Device Pressure Losses (DPL)

Direct expansion refrigerant coil	0.23 IWC
Electric heat resistance coil	
Hot water coil	
Filter	0.18 IWC
Humidifier	
Supply outlet	0.03 IWC
Return grille	0.03 IWC
Balancing dampers	0.03 IWC
Other device	
Total device losses	0.50 IWC

Step 3) Available Static Pressure (ASP)

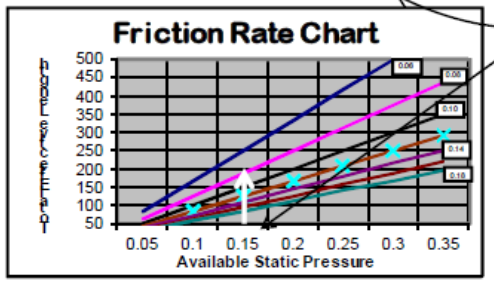
ASP = ESP – DPL (Step 1 – Step 2) 0.20 IWC

Step 4) Total Effective Length (TEL)

Supply side TEL + Return side TEL = 200 ft TEL

Step 5) **Friction Rate** Design Value [FR= (ASPx100)÷TEL] 0.10 IWC from chart below

Friction Rate Chart



A From manufacturer's data—equipment CFM at rated capacity

B From Manufacture's Blower Performance Data corresponding to the CFM (#1)

C From Manufacturer's Performance Data

D **Total Effective Length** ≈ loss from duct lengths, reducers, elbows and other fittings

E **Friction Rate** is found by reading bottom scale to 0.20 and up the side scale to 200 feet the intersecting line is the 0.10. That is the design friction rate. This example, 0.10, is within the acceptable friction rate range.

F The **Design CFM** for each room is based on the larger of the Cooling or Heating CFM. Those heat and cool CFM come from the allocation of the system's capacity based on each room's heating and cooling needs.

G The **Friction Rate** is used to determine the duct size.

H The **return duct size** is based on the friction rate and then may be adjusted to a larger size to meet recommended velocity.

I **Grille and register sizes** should be selected to ensure the velocities are acceptable.

Recommended Velocity (FPM) (Manual D, Table 3-1)

	Supply				Return			
	Recommended		Maximum		Recommended		Maximum	
	Rigid	Flex	Rigid	Flex	Rigid	Flex	Rigid	Flex
Trunk Ducts	700	600	900	700	600	600	700	700
Branch Ducts	600	600	900	700	400	400	700	700
Supply Outlet Face Velocity	Size for Throw		700					
Return Grille Face Velocity							500	
Filter Grille Face Velocity							300	

Table of Useful Air Distribution System Design Information

Zone:	One	Design Friction Rate	0.10	Type of System:	Trunk and Branch
Construction Material	Supply Air Trunk	Metal		Supply Air Branch	Flex
Construction Material	Return Air Trunk	Duct board		Return Air Branch	Flex
R-Value of Insulation	Supply	R6		Return	R6

Room	Design CFM	Supply Duct Size(s)	Supply Grille(s) Size, and Velocity	Return Duct Size(s)	Return Grille Size and Velocity
Bedroom 1	150	1 – 8"	1 - 14x6, 600fpm	(9")- 12"	14x14, 300fpm
Walk-in-Closet	15	1 – 4"	1 - 8x4, 450fpm		
Bedroom 2	100	2 – 6"	2 - 10x4, 600fpm	(7") - 8"	14x8, 275fpm
Bedroom 3	100	1 – 7"	1 - 12x4, 600fpm	(7") -8"	14x8, 275fpm
Living Room	275	2 – 8"	2 - 14x6, 575fpm	(16")- 18"	24x24, 350fpm
Den	125	1 – 8"	1 - 14x6, 600fpm		
Dining	125	2 – 6"	2 - 10x4, 600fpm		
Foyer	80	1 – 6"	1 - 10x4, 600fpm		
			2 - 10x4, 625fpm		
Bath 1	65	1 – 6"	1 - 10x4, 600fpm		
Bath 2	40	1 – 5"	1 - 8x4, 500fpm		
Bath 3					
TOTALS	1200				

ACCA does not recommend installing return ducts in kitchens, baths, laundry, or utility rooms

Notes:

Types of Supply System: Trunk and Branch, Perimeter Loop, Radial

Construction Materials: Sheet metal, Fiberglass Ductboard, Rigid Round Fiberglass, Flexible Vinyl Duct, Fiberglass Duct Liner w/ Facing, Flexible Metal Duct

ACCA Manual S Brochure, page 2

Equipment Selection Checklist			
#	Key Item	Verify	Verification Questions
1	Design Conditions	The design conditions fall within specifications.	Do the design conditions fall within the minimum standards for this region as found in Manual J8 Table 1A or 1B? (A)
		The information from the Manual J load calculation was transferred accurately.	Was the Total Heat Gain / Loss information used to evaluate equipment candidates? (B)
2	OEM's Performance Data	The equipment manufacturer's performance parameters match the design parameters used to calculate the heat load.	Does the manufacturer's performance parameters match the design parameters used to calculate the home's heat load (i.e., outdoor dry-bulb, indoor dry-bulb, and indoor wet-bulb)?
			If the performance data parameters are more than 5% greater or less than the design parameters then did the contractor interpolate the equipment manufacturer's performance parameters to match the design parameters used to calculate the heat load?
3	Equipment Performance	Estimated Cooling – CFM based on Temperature Difference	Was the Sensible Heat Ratio calculated? (Sensible Load / Total Load)? (C)
			Was the SHR used to find the proper air flow? (D)
		Equipment selected satisfies Total Btus (for cooling the Sensible and **Latent** load)	Is the total heating capacity of the selected equipment ≤140% of the designed total heating load? (If not reduce equipment size) (E)
			Is the total cooling capacity of the selected equipment ≤115% of the designed total cooling load ? (If not reduce equipment size) (F)
			Does the "Sensible" and/or "Latent" capacities of the selected equipment meet the load's requirements? (G)
			If a heat pump in a very cold climate (heating is primary concern) does the total cooling capacity of the selected equipment exceed 125% of the designed total cooling load?
4	Auxiliary Heat	Heat Pump Balance Point	Does the electric auxiliary heat provide the necessary BTUs to makeup difference in capacity from the heat pump's balance point to the design load conditions? (H)

Equipment Selection using an ExampleChecklist

Design

Winter Design Conditions

Outdoor °F:	27°F (A)	From Manual J8 Table 1A or 1B
Indoor °F:	70°F	Manual J8 §3-6 defaults to 70°F
Total Calculated Heat Loss	50,981Btu/h (B)	Determined by Manual J8 load calculation

Summer Design Conditions

Outdoor°F:	85°F (A)	From Manual J8 Table 1A or 1B
Indoor °F:	75°F	Manual J8 §3-6 defaults to 75°F
Entering Wet Bulb (EWB):	63°F	Manual J8 §3-6 defaults to 63°F EWB (≈ 75°F / 50% RH)
Total Heat Gain	27,543Btu/h (B)	Determined by Manual J8 load calculation
Sensible Heat Gain	23,321Btu/h (G)	
Latent Heat Gain	4,222Btu/h (G)	
Sensible Heat Ratio (SHR)	85% (C)	See formula below
Design Air Flow	1,116 CFM (D)	The "*TARGET*" airflow, we look for equipment that operates in this range (+/- 10%), on **medium** fan speed

(C) SHR = Sensible Heat / Total Heat Gain = 23,321Btu/h / 27,543Btu/h = 85

(D) 85% ≈ 19° Design Temp

Sensible Heat Ratio versus Temperature Design Value	
SHR	Recommended Temp. Design
Below 0.80	21°F
0.80 – 0.85	19°F
Above 0.85	17°F

CFM = Sensible Heat Gain / Design Temp x 1.1

1,116 CFM = 23,321 Btu/h / 19 x 1.1

Application Data: Equipment Capacity

A furnace was selected for comparing "heating only" design and performance. Other types of equipment may be used.

Furnace Model Number:	FU600300	Fictitious furnace
Output BTUH:	52,000Btu/h (E)	Furnace Btu/h Output: (≤ 140% of calculated loss)

A heat pump was selected for comparing cooling and heating design and performance. Other types of equipment may be used.

Outdoor Unit Model Number:	HP-030	Fictitious heat pump
Total Cooling Capacity (≤ 115%)	28,400Btu/h (F)	These capacities are from manufacturer's performance data at the **DESIGN CONDITIONS:** 85°F ODT, 1,000CFM, and 63°F EWB
Sensible Cooling Capacity (≈ Sensible Gain)	21,600Btu/h (G)	
Latent Cooling Capacity (≈ Latent Gain)	6,800Btu/h (G)	
Indoor Unit Model Number:	AH-030	Fictitious air handler
Indoor Blower CFM (CFM in manufacturer's performance data at rated capacity-medium fan speed):	1,000 (D)	The actual equipment rated airflow, (medium fan speed optimal) should fall within target CFM,(+/- 15%)
Btuh Difference between Heat Pump Balance Point and Total Heat Loss	30,281 Btu/h (H)	This heat pump can only produce 20,700Btu/h at design conditions. More capacity is required. (Air Conditioners do not have a balance point.)
Auxiliary Heat (Circle): ~~Electric~~ Gas Oil	10 KW (H)	In this example the auxiliary heat is electric, the formula for electric heat is KW= Btu/h ÷ 3.413

From Manual J8 Tables | From Manual J8 Load Calculation | From Equip. Performance Data

ACCA Manual J Brochure, page 2

The order of this checklist follows Form J1 of ACCA Manual J8®.

#	Key Item	Check	Questions to Ask	Circle Answer*		
1	Design Temperatures	✓ Indoor Design Temperatures	Is the indoor design temperature for *Heating*: per Local Code OR 70°F (21°C) at 30% RH?	YES	NO	-----
			Is the indoor design temperature for *Cooling*: per Local Code OR 75°F (24°C) at 50% RH? [or 55% for humid climate, 45% for dry climate?]	YES	NO	-----
		✓ Outdoor Design Temperatures	Is the outdoor design temperature per Table 1 of MJ8 or Local Code?	YES	NO	-----
2	Windows & Glass Doors	✓ U-values and SHGC values	Are the SHGC and U-values reasonable for the window types and frame constructions? (see Table 2 of MJ8)	YES	NO	-----
		✓ Shading Adjustments	Have window shading (curtains, drapes, insect screens, tinting, etc.) adjustments been made?	YES	NO	-----
		✓ Overhang Adjustments	Have roof overhang adjustments been made?	YES	NO	-----
		✓ Total Area	Is the total area for the windows & glass doors roughly equal to the area shown on the drawing plans?	YES	NO	-----
		✓ Exposure Directions	Do the exposure directions [North (N), North-East (NE), etc.] appear correct?	YES	NO	-----
3	Skylights	✓ U-values and SHGC values	Are the SHGC and U-values appropriate for the skylight types and frame constructions? (see Table 2 of MJ8)	YES	NO	N/A
		✓ Shading Adjustments	Have adjustments been made for drapes, tinting and reflective coatings?	YES	NO	N/A
		✓ Total Area	Is the total area for the skylights roughly equal to the area shown on the drawing plans?	YES	NO	N/A
		✓ Exposure Directions	Do the exposure directions [North (N), North-East (NE), etc.] appear correct?	YES	NO	N/A
4	Doors | Wood, Metal	✓ *None*	----------	-----	-----	-----
5	Walls | Above Grade, Below Grade	✓ Insulation	Are correct wall insulation R-values taken into account when the wall loads are calculated?	YES	NO	-----
		✓ Total Area	Is the total area for the walls equal to the area shown on the drawing plans?	YES	NO	-----
6	Ceilings	✓ Insulation	Is correct ceiling insulation R-value taken into account when the ceiling load is calculated?	YES	NO	N/A
		✓ Radiant Barrier	If applicable, does the load calculation take credit for a radiant barrier?	YES	NO	N/A
		✓ Roof color and material	Is correct roof color and material taken into account when the ceiling load is calculated?	YES	NO	-----
		✓ Total Area	Is the total area for the ceilings equal to the area shown on the drawing plans?	YES	NO	-----
7	Floors	✓ Insulation	Is the floor insulation and type of construction representative of what is built/planned?	YES	NO	-----
8	Infiltration	✓ Envelope Tightness	Is the listed envelope tightness (tight, semi-tight, average, semi-loose, loose) appropriate?	YES	NO	-----
		✓ Above grade volume	Is the total above grade volume equal to what is shown on the drawing plans?	YES	NO	-----
9	Internal Gains	✓ Appliances	Are the appliance gains 1200 Btuh, 2400 Btuh or a value recommended by MJ8?	YES	NO	-----
		✓ Occupants	*Is Maximum Number of Occupants = Number of Bedrooms + 1?*	YES	NO	-----
			- Is Btuh (sensible) = 230 x Number of Occupants? - Is Btuh (latent) = 200 x Number of Occupants?	YES	NO	-----
10	Ducts	✓ Duct Location	If located in an unconditioned space, are the ducts insulated (appropriate R-value)?	YES	NO	N/A
		✓ Duct Tightness	Is the duct tightness category 'average sealed' or higher (i.e. notably sealed, extremely sealed)?	YES	NO	-----
11	Ventilation	✓ Intermittent Fans	Are intermittent bathroom and kitchen fans excluded from the infiltration calculations?	YES	NO	N/A
		✓ Continuous Exhaust Fans	Are dedicated exhaust fans (continuous) included in the calculations?	YES	NO	N/A
		✓ Heat Recovery Equipment	Are the heat recovery equipment and/or a ventilating dehumidifier included in the calculations (if applicable)?	YES	NO	N/A

*Questions should be answered 'YES' (where applicable) to achieve representative load calculations.

Upcoming Courses
Questions

More Information

- **1.5 AIA LU's Available**
- **1.5 ICC LU's Available**
  - Contact spburns@countyofsb.org for any questions regarding LUs
- **Coming to Your Inbox Soon!**
  - Slides, Recording, & Survey – Please Take It and Help Us Out!
- **Upcoming Courses**
  - 4/5 - The Value of Becoming a Certified Energy Analyst
  - 4/21 - All About ADU's for Households
  - 5/10 - All Electric Construction Part 1: Heat Pumps For Heating and Cooling

Thank you!

For more info:
3c-ren.org

For questions:
info@3c-ren.org

3C REN

TRI-COUNTY REGIONAL ENERGY NETWORK

SAN LUIS OBISPO • SANTA BARBARA • VENTURA