

Overview of Residential and Light Commercial HVAC Design Standards

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Nevada Legislative Committee on Energy
December 8, 2015

Agenda

- **Relevant Organizations and Standards**
- **“Right Sizing” HVAC**
 - What are Manual J and Manual D?
 - Why are they important?
- **What do the Standards say?**
- **Impact of HVAC oversizing**
- **Recommendations to maximize energy efficiency**
- **Questions?**

Standards Organizations

- **Primary Players:**

- ICC = International Code Council
- ASHRAE = American Society of Heating, Refrigeration, and Air-conditioning Engineers
- ACCA = Air Conditioning Contractors of America
- ANSI = American National Standards Institute
- Energy Star and others



International Code Council (ICC)

- **ICC Publications:**

- International Energy Conservation Code (IECC)
- International Residential Code (IRC)
- Others
- Most local jurisdictions reference ICC publications in building code requirements



IECC Standards

- **2012 IECC- Residential**

- IRC is residential only and includes all building components (structural, plumbing, etc.)
- IRC and IECC are consolidated in 2012 standards
- ACCA Manuals J, S, and D are referenced

- **2012 IECC- Commercial**

- Adopts ASHRAE 90.1 and references ASHRAE 183 for HVAC design
- Includes both “Simple” systems (unitary or packaged with one zone/thermostat and “Complex” systems (all others; zoned and central plant type)



What do the Standards Say?

Residential

- 2012 IRC: Chapter 14- Heating and Cooling Equipment and Appliances
 - Section M1403.3 Sizing- “Heating and cooling equipment and appliances shall be sized in accordance with ACCA Manual S based on building loads calculated with Manual J or other *approved* heating and cooling calculation methodologies.”
- 2012 IRC: Chapter 16- Duct Systems
 - Section M1601.1 Duct Design- “Ducts systems serving heating, cooling, and ventilation equipment shall be installed in accordance with the provisions of this section and ACCA Manual D or other *approved* methods.”

What do the Standards Say?

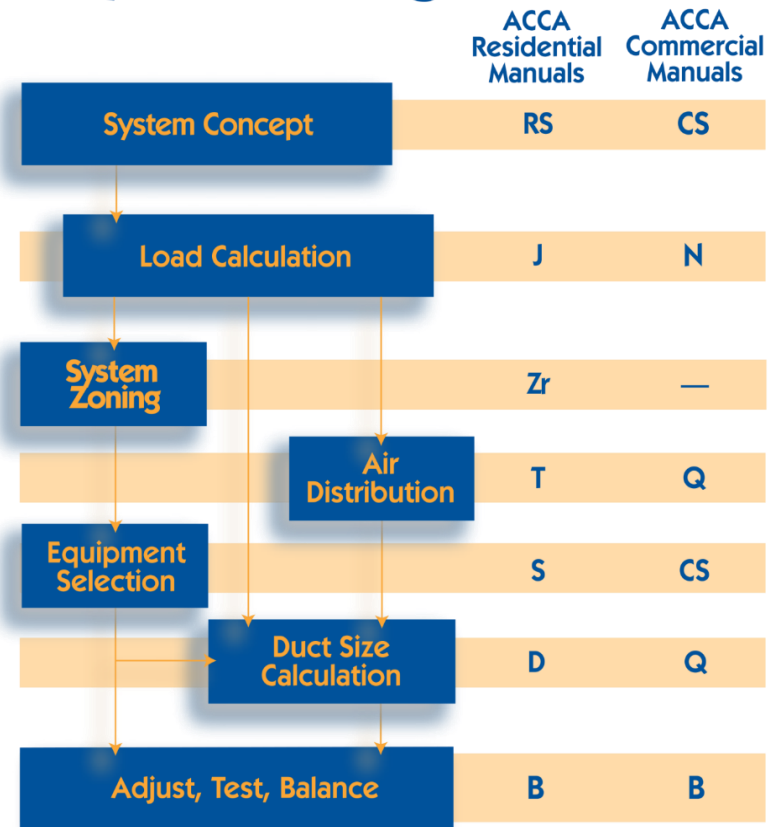
Commercial

- 2012 IECC: Chapter 4 Commercial Energy Efficiency
 - Section C403.2.1 Calculation of heating and cooling loads-
“Design loads shall be determined in accordance with procedures described in ANSI/ASHRAE/ACCA Standard 183... Alternatively, design loads shall be determined by an approved equivalent computational procedure.”
 - Provisions are also included for system sizing, ducts, and other related components/processes
 - Applies to both Simple (C403.3) and Complex (C403.4) HVAC systems

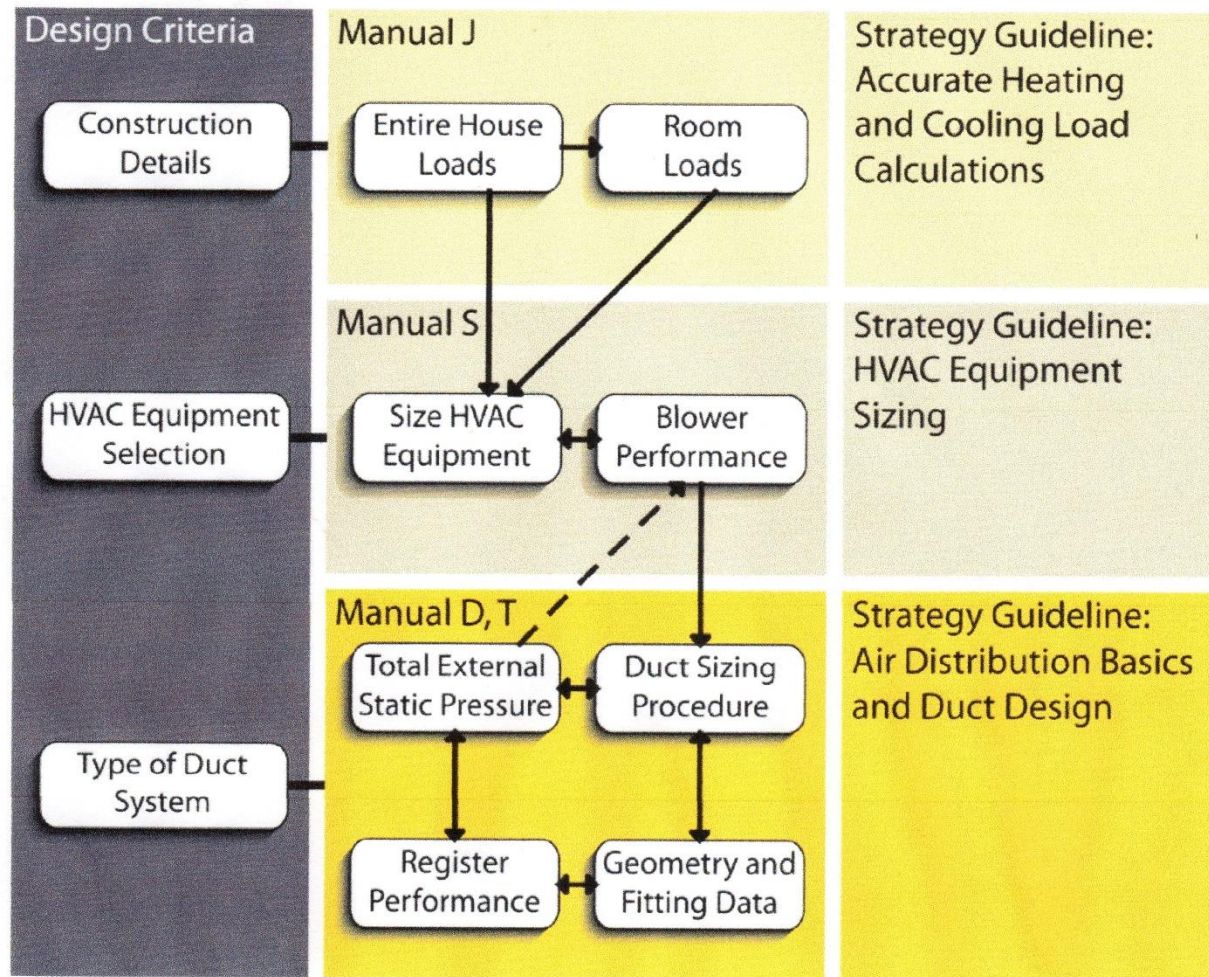
ACCA Manuals

- Addresses both Residential and Light Commercial (Simple) systems
- Standards for HVAC system design, selection, installation, and commissioning/testing

System Design Process

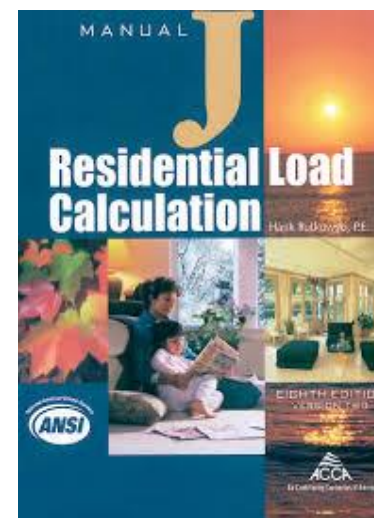


ACCA Residential Design Process



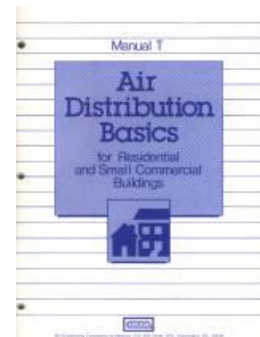
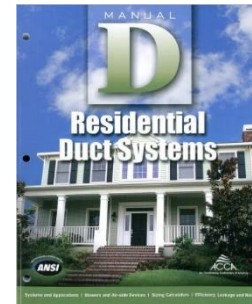
ACCA Manual J

- **Manual J- Heating and Cooling Load**
 - Calculation of how much heat the building loses in winter and gains in summer-determines how much conditioned air needs to be delivered to each room
- **Key Inputs:**
 - Building orientation/climate
 - Square footage and volume by room
 - Wall, ceiling, and subfloor insulation
 - Window and door characteristics
 - Air tightness of the building envelope
 - Internal gains/occupancy



ACCA Manual S, D, and T

- **Manual S- Equipment Selection**
 - Characteristics of the HVAC equipment that will deliver the amount of conditioned air required
- **Manual D- Duct Sizing and Design**
 - Type, size, and location of the air handler and ducts required to deliver the conditioned air to each room
- **Manual T- Air Distribution Basics**
 - Type, size, and location of registers, diffusers, and grilles to be used



Why is this important?

- **All components/systems in a building are interdependent**
 - Structural components
 - Furnace and A/C system
 - Ducts
 - Hot water heater
 - Others
- **ALL must perform to deliver energy efficiency, comfort, indoor air quality, and durability of the building**



Testing & Verification Tools

- **Air Infiltration Testing**
 - A Blower Door Test can be used to calculate the specific air leakage of the building for Manual J input
 - Eliminates subjective estimates, but adds cost
- **Duct Leakage Testing**
 - Required by 2009 & 2012 IECC
- **Flow hood/Air-flow Testing**
 - Used to confirm designed system performance



How Has Oversizing Occurred?

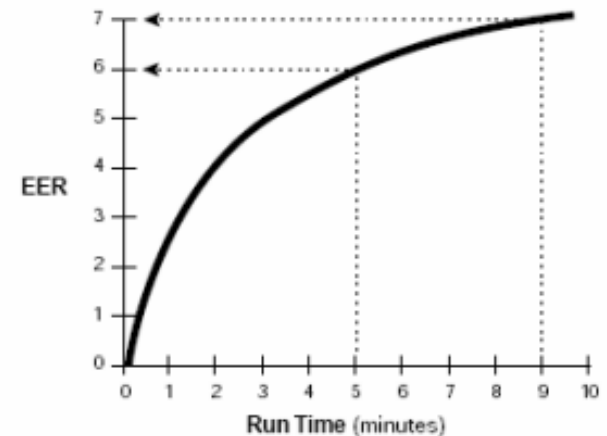
- **“Garbage in, Garbage out”**
 - Improper or inaccurate inputs/calculations
- **Building envelope issues**
 - Load calculation will call for a larger system
 - Even an oversized HVAC system can’t typically overcome deficient insulation or air-sealing
- **“Rule of Thumb” design**
 - Such as “400 sq. ft. per ton” of cooling capacity
 - Building structures have evolved, the “rule of thumb” has not
- **Replacement with “same size” systems**
- **Tendency to oversize to reduce re-calls/complaints**

Impact of Oversizing

- **Higher up-front equipment cost**
- **Loss of efficiency and higher energy cost**
 - From increased “on and off” cycling
- **Increased maintenance and reduced longevity of equipment**
- **Poor humidity control**
 - Short run time; can compromise comfort, air quality, and durability
- **Slightly undersized equipment may provide greater comfort at lower cost**



FIGURE 1: EFFICIENCY VERSUS RUN TIME



Recommendations for EE

- **Always evaluate the building envelope**
 - Insulation, windows/doors, and air-sealing
 - When deficient- improve ***before*** sizing HVAC!
- **Don't overlook the duct system**
 - Confirm proper sizing and design
 - Seal and insulate
- **Test and verify actual performance**
 - Blower Door test for actual air leakage data
 - Duct leakage and flow hood/air flow testing
- **Education**
 - Homeowners, contractors, and building officials



Questions

