



The **Housing Assistance Council** is a national nonprofit organization that helps build homes and communities across rural America.



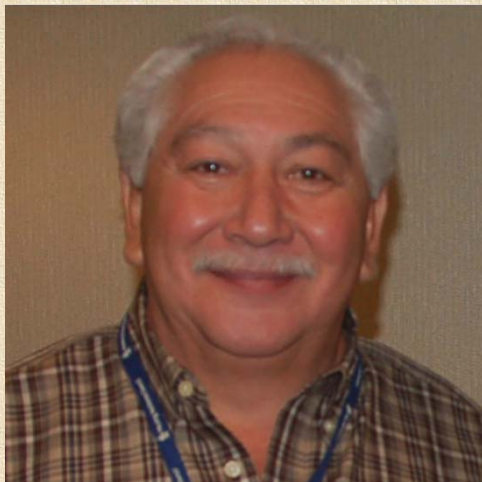
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PRACTITIONERS' GUIDE TO MEETING ENERGY STAR 3.0

Heating, Ventilation and Air Conditioning (HVAC) System Contractors Checklist Part A

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HVAC System Quality Installation



*A Cozy Home Requires A Good
Comfort System. A Good
Comfort System Begins With A
Professional Design.*



Complete HVAC System



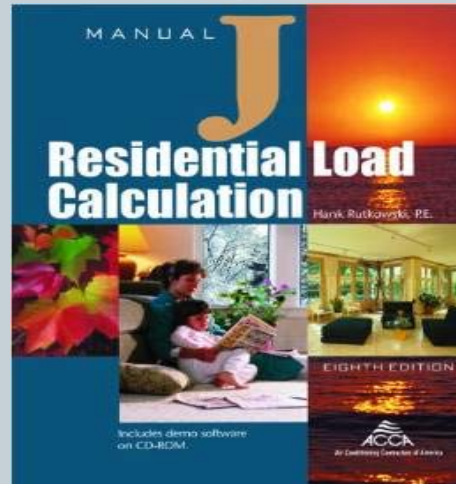
- Three fundamental procedures
 - ACCA Manual J Load Calculation
 - ACCA Manual S Equipment Selection
 - ACCA Manual D Duct Design
- Plumbers and Installers must be Energy Star Certified

*Air. Conditioning Contractors of America (ACCA)



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Manual J Load Calculation



Manual J Load Calculations



- First step in the design process of a new heating and air conditioning system
- HVAC designers are able to:
 - Determine the total amount of heat that is lost through the exterior of a home during cooler months
 - Determine the heat that is gained through the exterior of a home during the warmer months
- Analyze all aspects of the thermal characteristics of every wall, floor, ceiling, door and windows



Manual J Load Calculations (cont.)



- HVAC Load Calculation takes into consideration other factors
 - Home's geographic location
 - Orientation of the sun
 - Envelope tightness
 - Duct leakage
 - Light and appliances
- Calculates the amount of heat and humidity that each occupant of the house will add to the interior of the home

Manual J Load Calculations (cont.)



- Two types of Manual J Load Calculations
 - Whole House (Block) HVAC Load Calculations
 - Room-by-Room Load Calculations



Whole House (Block) HVAC Load Calculations



- Provide the heating and cooling loads for the entire house
- Used when there is no need to design or modify an existing duct system
- Commonly used to determine the correct HVAC equipment size
- Match-up that is require when replacing the HVAC system in an existing home

Room-by-Room Load Calculations

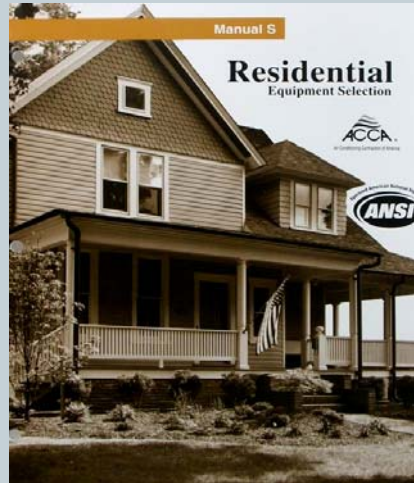


- Provide the heating and cooling loads for each individual room within the home
- Determines the amount of air that is required to heat and cool each individual room
- Critical when determining the individual duct size as well as the size and overall layout of the duct system



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Manual S Equipment Selection



Manual S Equipment Selections

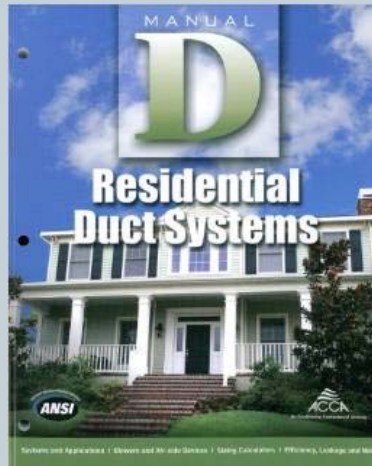


- Once Manual J Load Calculation has been completed
 - HVAC designed will have the information required to accurately select the proper HVAC equipment
 - Equipment selection is based on performance criteria such as:
 - ✖ The equipment's total capacity to remove heat and moisture from air as well as how much total air
 - ✖ At what pressure the system can produce
 - ✖ A 3 ton system that is installed in Maryland performs differently than an identical installed in Houston



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Manual D Duct Designs



Manual D Duct Designs



- Is the ACCA method to determine the overall duct lay-out including the individual duct sizes
 - Must have completed a Room-by-Room Manual J load calculation and Manual S equipment selection
 - Due to the ever growing present of new building materials, advanced insulation systems, and efficient ventilation systems, it's impossible to use rule-of-thumb.
 - ✘ Complains of temperature
 - ✘ Complains of excessive noise



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HVAC System Quality Installation Contractor Checklist



ENERGY STAR Certified Homes, Version 3 (Rev. 07)
HVAC System Quality Installation Contractor Checklist

Home Address: _____ City: _____ State: _____ Zip Code: _____

System Description: _____ Heating system for temporary occupant use? Yes No

System Description	Pass	Fail	NA
1. Whole-Building Mechanical Ventilation Design			
1.1 Ventilation system installed that has been designed to meet ASHRAE 62.2-2010 requirements including, but not limited to, requirements in Items 1.1.1 & 1.1.2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.2 Ventilation system does not utilize an intake duct to the return side of the HVAC control valve for system purge and/or to provide fresh air and is automatically based on a timer and is tested either at 150% or 100% of design total heat loss (see Item 1.1.2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.3 Documentation is attached with ventilation system type, location, design rate, and frequency and duration of each ventilation cycle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.4 If present, continuously operating unit & exhaust fans designed to operate during of-occupancy hours	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.5 If present, continuously operating whole-house ventilation system designed to automatically operate at 100% of design total heat loss (see Item 1.1.2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Heating & Cooling System Design			
2.1 Fuel Source	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.2 Fuel System Method	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.3 Equipment Selection Method	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.4 Outdoor Design Temperature	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.5 Orientation of Heat Loss (e.g., North, South)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.6 Number of Occupants Served by System	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.7 Conditioned Floor Area in Heated Home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.8 Unheated Floor Area in Heated Home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.9 Unheated Floor Area in Heated Home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.10 Infiltration Rate in Heated Home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.11 Mechanical Ventilation Rate in Heated Home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.12 Design Load Heat Gain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.13 Design Total Heat Gain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.14 Design Total Heat Loss	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.15 Design Airflow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.16 Design Total Pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.17 Fuel Load Calculation, Request Attached	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.18 Fuel Load Calculation, Request Attached	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Selected Heating Equipment, if Heating Equipment to be Installed			
3.1 Equipment Manufacturer & Model	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2 Annual Efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.3 AFUE Reference #	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4 Listed Efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.5 Heating Device Type	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.6 Equipment Type	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.7 Fuel Source Type	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.8 Listed Fuel Load Capacity of Design Load	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.9 Listed Fuel Load Capacity of Design Load	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.10 Listed Fuel Load Capacity of Design Load	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.11 Listed Fuel Load Capacity of Design Load	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.12 Listed Fuel Load Capacity of Design Load	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.13 AFUE Efficiency Reference	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.14 AFUE Efficiency Reference	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Selected Heat Pump Equipment, if Heating to be Installed			
4.1 AFUE Efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.2 Performance at 47°F	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.3 Performance at 47°F	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Effective for homes permitted starting 08/01/2012. Revised 08/01/2012. Page 1 of 16

HVAC System Quality Installation Contractor Checklist (cont.)



ENERGY STAR Certified Homes, Version 3 (Rev. 07)
HVAC System Quality Installation Contractor Checklist

Home Address: _____ City: _____ State: _____ Zip Code: _____

System Description: _____ Heating system for temporary occupant use? Yes No

System Description	Pass	Fail	NA
5. Selected Furnace, if Furnace to be Installed			
5.1 Furnace Manufacturer & Model	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.2 Annual Efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.3 Listed Output Heating Capacity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.4 Listed Output Heating Capacity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.5 AFUE Reference #	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.6 Listed Efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.7 Heating Device Type	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.8 Equipment Type	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.9 Fuel Source Type	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.10 Listed Fuel Load Capacity of Design Load	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.11 Listed Fuel Load Capacity of Design Load	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.12 Listed Fuel Load Capacity of Design Load	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.13 AFUE Efficiency Reference	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.14 AFUE Efficiency Reference	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Refrigerant Charge			
6.1 Outdoor ambient temperature at condenser	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.2 Indoor ambient temperature at evaporator	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.3 Liquid line pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.4 Suction line pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.5 Suction line pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.6 Suction line pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Refrigerant Measurements			
7.1 Condenser saturation temperature	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.2 Suction saturation temperature	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.3 ORV subcooling point	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.4 Subcooling saturation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.5 Superheat value	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.6 ORV subcooling point	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.7 Superheat value	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.8 ORV subcooling point	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.9 Superheat value	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.10 An ORV test procedure (e.g., as defined for a ground source heat pump) has been used in place of sub-cooling or super-heat process and documentation has been attached with test procedure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Electrical Measurements - taken at electrical disconnect with component in operation			
8.1 Compressor on time on 15-minute test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.2 Compressor on time on 15-minute test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.3 Compressor on time on 15-minute test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. All-Pipe Tests			
9.1 Test performed to which code?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.2 Test performed to which code?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.3 Supply side static pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.4 Return side static pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.5 Test results are well-documented and accessible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.6 Return side static pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.7 Return side static pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.8 Return side static pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.9 Return side static pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. All-Balance			
10.1 Balancing test performed and allowed indicating the room name and design airflow for each supply and return register in addition, the individual room airflow measured and averaged through one of the following options	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10.2 Balancing test performed using ASHRAE 62.2-2010 protocol, equipped by contractor on the balancing equipment, & verified by contractor to be within the greater of a 20% or 25 CFM of design airflow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10.3 To be measured, documented, and certified by a third party per Item 10.2 of the HVAC System Quality Checklist	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. System Controls			
11.1 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11.2 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11.3 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11.4 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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11.99 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.00 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.01 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.02 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.03 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.04 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.05 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.06 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.07 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.08 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.09 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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12.11 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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12.14 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.15 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.16 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.17 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.18 Thermostat and safety controls meet OEM requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.19 Thermostat and safety controls meet OEM requirements			



Contractor's Checklist



- Whole-Building Mechanical Ventilation Design
- Heating and Cooling System Design
- Selected Cooling Equipment
 - If cooling equipment to be installed
- Selected: Heat Pump
 - If heat pump to be installed
- Selected Furnace
 - If Furnace to be installed

Contractor's Checklist (cont.)



- Refrigerant Tests
 - Run System for 15 minutes before testing
- Refrigerant Calculations
- Electrical Measurements
- Air Flow Test
- Air Balance
- System Controls
- Drain Pan



Whole-Building Mechanical Ventilation Design



- **Ventilation System:**
 - Meet ASHRAE 62.2-2010 requirement
 - Does not utilize an intake duct to return side of the HVAC system
 - ✦ Unless the system is designed to operate intermittently and automatically based on timer and a restrict outdoor air intake when not in use
 - Documentation is attached with ventilation system type, location, design rate
 - Continuously-Operating vent & exhaust
 - Intermittently-operating whole-house ventilation system
 - ✦ Operate at least once per day
 - ✦ Least 10% of every 24 hours

Heating and Cooling System Design



- | | |
|--|--|
| <ul style="list-style-type: none">• Heat Loss/Gain Method• Duct Designed Method• Equipment Selection Method• Outdoor Design Temperatures• Orientation of Rated Home• Number of Occupants Served by they System• Conditioned Floor Area• Window Area | <ul style="list-style-type: none">• Predominant Window SHGC• Infiltration Rate• Design Latent Heat Gain• Design Sensible Heat Gain• Design Total Heat Gain• Design Total Heat Loss• Design Air Flow• Design Duct Static Pressure• Full Load Calculations Report Attached |
|--|--|



Selected Cooling Equipment



- Condenser Manufacture & Model
- Evaporator/Fan Coil Manufacture & Model
- AHRI Reference Number
- Listed Efficiency
- Metering Device Type
- Refrigerant Type
- Fan Speed Type
- Listed System: Sensible Capacity at Design Cond.
- Listed System: Total Capacity at Design Cond.
- Listed System: Latent Capacity
 - (Value 3.8) < Design Latent Heat Gain (Value 2.12)
- Listed System: Total Capacity
 - (Value 3.8) is 95-115% of Design Total Gain (Value 2.14)
- AHRI Certificate Attached

Selected Heat Pump Equipment



- AHRI Listed Efficiency
- Performance at 17°F
- Performance at 47°F



Selected Furnace



- Furnace Manufactures & Model
- Listed Efficiency
- Listed Output Heating Capacity
 - Heating Capacity (Value 5.3)" is 100-140% of Design Total Heat Loss (Value 2.15) or next nominal size

Refrigerant Tests



- Run system for 15 minutes before testing
- Outdoor ambient temperature at condenser
 - Return-side air temperature inside duct near evaporator
 - Liquid line pressure
 - Liquid line temperature
 - Suction line pressure
 - Suction line temperature



Refrigerant Calculations



- **For System with Thermal Expansion Value (TXV):**
 - Condenser saturation temperature
 - Subcooling value
 - OEM subcooling goal
 - Subcooling deviation
- **For System with Fixed Orifice:**
 - Evaporator saturation temperature
 - Superheat value
 - OEM superheat goal
 - Superheat deviation
 - Value 7.4 value $\pm 3^{\circ}\text{F}$ or value 7.8 is $\pm 5^{\circ}\text{F}$

Electrical Measurements



- **Taken at electrical disconnect while component is in operation**
 - Evaporator or furnace air handler fan
 - Condenser unit
 - Electrical measurements within OEM-specified tolerance of nameplate value



Air Flow Tests



- Air volume at evaporator
- Test performed in which mode
 - Heating
 - Cooling
- Return duct static pressure
- Supply duct static pressure
- Test hole location are well-marked and accessible
- Airflow volume at evaporator

Air Balance



- Balancing report prepared and attached indicating the room name and design airflow
- Measured by contractor using ANSI/ACCA
- Measured, document, and. Verified by a Rater per item



The **Housing Assistance Council** is a national nonprofit organization that helps build homes and communities across rural America.

Drain Pan



- Corrosion-resistant drain pan
- Property slope to drainage system
- HVAC component that produces condensate

Housing Assistance Council



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Reference Materials

- www.ruralhome.org
- www.energystar.gov
- www.epa.gov/watersense
- www.usgbc.org
- greenhomeguide.com/program/leed-for-homes
- youtu.be/czlCDoo0Scs



Discussion





The **Housing Assistance Council** is a national nonprofit organization that helps build homes and communities across rural America.



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Thank you for your participation in today's webinar.



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