PARKER
COLORADO

Revised 2016

RESIDENTIAL HVAC DESIGN & TESTING REQUIREMENTS

1. Manual J, S and D calculations are required for each model.
2. All models must have a mechanical plan showing furnace size and location along with duct size and location. This includes types of fittings used. Include any options that modify the mechanical layout.
3. All models must provide testing to verify that the systems work as designed. Once a model has passed it can be built without further testing if there are no changes or modifications.
   Example: Model XYZ has passed required testing. Model XYZ has mechanical plans showing furnace size and location along with duct size and location. Model XYZ can now be built over and over without further testing as long as the installation does not vary from the approved mechanical plan.

I have attached a sample commissioning form. The minimum required testing will be:

At rough prior to installation of gypsum board

- Duct leakage at rough -*Max. 4CFM per 100 square feet of conditioned area when tested at a pressure differential of 0.1inches w.g. (25Pa) across the system, including the manufacturer's air handler enclosure. All registers shall be taped or otherwise sealed during testing. If air handler is not installed at the time of test, total leakage shall be less than or equal to 3CFM per 100 square feet of conditioned floor area- section R403.3.4 2015IECC*

- Total External Static pressures (supply and return) should not be more than the manual D design.

- Total system flow including room to room flows with the blower set at the highest design speed

At final prior to Certificate of Occupancy

- Duct leakage at final -*only* required if the duct work is damaged *(Max. 4CFM per 100 square feet of conditioned area when tested at a pressure differential of 0.1 inches w.g. (25Pa) across the system, including the manufacturer's air handler enclosure.)*

- Total External Static pressures (supply and return) at final

- Total flow and room to room flows with blower set at the highest design speed

- Room to room pressure should not be more than ± 3 Pascal's.

- Weather permitting: Heat exchanger temperature rise, superheat or sub cooling for the Air Conditioner

4. Heat for building during construction:

Best case scenario: Do not use permanent heating equipment for temporary heat during Construction

If: The permanently installed furnace is used to provide heat during construction

Then: Adequate precautions shall be implemented to insure that construction debri does not enter the HVAC system.

Example of 'Adequate Precautions':

All permanent return air outlets are completely sealed
All permanent supply air outlets are covered with screens
Cut a hole in the return air drop at the furnace and cover with several filters

Please Note: Field inspectors will verify the HVAC protection during rough inspections. If at drywall nail inspection any of the HVAC protection has been removed the job site superintendent will be notified. At final inspection a certificate from the HVAC trade contractor will be required, stating that the HVAC system (equipment and ductwork) has been cleaned and is in proper working order.

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MANUAL J LOAD CALCULATION
KEY ELEMENTS

Design Temperatures	Outdoor	Heating	-3° F
		Cooling	90° F
	Indoor	Heating	70°F @ 30% RH
		Cooling	75°F @ 50% RH The design grains will be about -30 to -39 depending on the weather data the software uses
Windows, Skylights and Doors that are > 50% Glass	U-Values & SHGC	Values shall match the construction plans	
	Shading values	Default for blinds shall be: 50% blinds at 45° medium color Screens shall be as designed	
	Overhangs	Shall be reasonably close too: as designed and shown on construction plans	
	Total area	Shall be reasonably close too: As designed and shown on construction plans	
	Exposure Direction	One time builds shall be oriented as planned Production homes shall be oriented for the worst case air conditioning load	
	Adequate Exposure Diversity	If the excursion adjustment exceeds 1000 Btuh in any one room, a separate zone should be considered. Refer to Manual J 8th edition section A3-3 for a more detailed analysis.	
Opaque Doors	Total Area and Location	Shall be reasonably close too: As designed and shown on construction plans	
	U- Value	Values shall match the construction plans	
Above Grade Walls Below Grade Walls Partition Walls	Construction Type	Shall match construction plans	
	Insulation	R-Values shall match construction plans	
	Total Area	Shall be reasonably close too: As designed and shown on construction plans	
Ceilings	Construction Type	Shall match construction plans	
	Insulation	R-Values shall match construction plans	
	Radiant Barrier	Shall match construction plans	
	Roof color and material type	Shall match construction plans	
	Total Area	Shall be reasonably close too: As designed and shown on construction plans	
Floors over unconditioned spaces and outside air	Construction Type	Shall match construction plans	
	Insulation	R-Values shall match construction plans	
	Total Area	Shall be reasonably close too: As designed and shown on construction plans	

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MANUAL J LOAD CALCULATION
KEY ELEMENTS

Infiltration	Building Envelope Tightness	Most will use the 'Average Construction' setting. Builders with a history of blower door test results will use 'Semi Tight' or 'Tight'. Refer to Manual J 8th edition table 5A for a more detailed analysis.
	Above Grade Volume	Shall be reasonably close too: As designed and shown on construction plans
Internal Gains	Appliances	1200 Btuh is the default in most software programs and works for dishwashers and refrigerators. Table 6B in Manual J 8th edition, provides loads for many different types of appliances. The builder can and should design for the anticipated appliance load. This would include any humidifiers.
	Occupants	Number of occupants = Number of bedrooms +1 Occupants can be placed in any room(s) for the calculation as long as the total does not exceed the above formula.
Ducts	Duct location	Ducts must be correctly located either inside or outside the buildings thermal envelope. Ductwork in vented attics can add significant heating and cooling loads. Ducts located outside the buildings thermal envelope shall have an R-8 insulation
	Duct tightness	Most software programs default to 'Average Sealed'. With the testing that is required in Parker, builders could use a higher tightness category. Refer to manual J 8th edition section 3-12 for a more detailed analysis.
Ventilation	Intermittent or spot ventilation exhaust fans	Do not include in calculation
	Ventilation Strategy	Parker requires some type of ventilation strategy. Exhaust only, supply only or a balanced system are all acceptable methods. Minimum cfm formula: (Number of bedrooms +1 x 7.5) + (conditioned floor area x .01) Many Manual J software programs default to 20 cfm of outside air per person. This is typically very close to the required ventilation.

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Manual S
Key Elements

Design Conditions	Was the calculated heating loss and gain transferred from the Manual J correctly?	There is no need for any additional 'safety factors'. A correctly completed Manual J provides accurate heat loss and gains.
Manufacturers Performance Data	Heating: Forced Air Furnace	Output capacity can be up to 140% of the calculated heat loss. Capacity, efficiency and altitude deration are from the performance data. Example of Output capacity: 80% 50,000 Btuh @ 5000' Above sea level .8 x 50,000 = 40,000 Btuh De-rate 2% for each 1000' (from Manufacturers data) above sea level, an additional 10% deration for altitude .9 x 40,000 = 36,000 Btuh
	Air Conditioning: Split system	Total output capacity can be up to 115% of the calculated heat gain. Capacity, efficiency and altitude deration are from the performance data. Capacity will be based on performance at; Outdoor dry bulb 90° F (use 95° F column) Indoor dry bulb 75° F Indoor wet bulb 63° F Be certain to include any adjustments in the performance data table footnotes.
Equipment Performance	Heating: Forced Air Furnace	Temperature rise must be within manufactures limits. Btuh/cfm/(1.1xACF) = Temperature Rise Btuh= Heating Output Cfm = Air flow in cubic feet per minute 1.1 = Formula constant at sea level ACF= Altitude correction factor from Manual J table 10A
	Air Conditioning: Split system	When output capacity is determined it will be at a defined cfm. If manufactures do not provide altitude deration information, appendix 6 Manual S does have two methods, both are acceptable. 1. Adjust air flow; since air at altitude is less dense, you need to move more air for the same performance at sea level. CFM at altitude= Sea level flow rate/Density ratio Density ratio for 5000' = .832 800/0.832 = 962 cfm 2. No air flow adjustment: you can de-rate the entire package. Adjustment for 5000'= Total cooling output capacity x .96

Manual D
Key Elements

Manufactures Data	Blower performance at a range of external static pressures	The blower selected must provide the needed cfm at the design static pressure. At this point the designer has a good idea of what the heat and cooling cfm need to be from the equipment selection process.
Friction Rate	Available Static Pressure (ASP)	The design static pressure less all pressure drops results in the Available Static Pressure for the ductwork. Pressure drops for all devises must be listed. AC Coils, filters, supply and return outlets, balancing dampers, humidifiers, air cleaners, etc. A pressure drop of 0.03 can be used for balancing dampers, supply and return grilles, all other devices must have manufactures data specifying the pressure drop.
	Total Effective Length (TEL)	This is the longest supply plus the longest return path. This includes all fittings, reducers, etc.
	Design Friction Rate	Friction rate formula: ASP x 100/ TEL The design friction rate must be between 0.06 & 0.18, friction rates above or below effect blower performance.
Air Distribution System Design	Air velocity for supply and return ductwork	Objectionable noise can be the result if system velocity is ignored. Refer to Manual D section 1-12 and table A1-1 for a more detailed analysis.
	All ductwork designed based on required cfm and friction rate	Plans must indicate all duct locations, sizes, trunk reductions, material and fitting types. Pictures of the actual fittings are required. A designer may use turning vanes in the design, but the installer (or building inspector) did not know that a 5K fitting has turning vanes.
	Return air path	A ducted return is not required for each room, but a return air path is required. Transfer grilles or jumper ducts work, undercutting of doors will not be allowed.

Manual D
Key Elements

Duct tightness and system testing	At rough prior to installation of gypsum board	Duct leakage at rough -*Max. 4CFM per 100 square feet of conditioned area when tested at a pressure differential of 0.1inches w.g. (25Pa) across the system, including the manufacturer's air handler enclosure. All registers shall be taped or otherwise sealed during testing. If air handler is not installed at the time of test, total leakage shall be less than or equal to 3CFM per 100 square feet of conditioned floor area- section R403.3.4 2015IECC* Static pressures should not be more than the Manual D design Total system flow including room to room flows with the blower set at the highest design speed
	At final prior to Certificate of Occupancy	Static pressure at final Total flow and room to room flows with blower set at the highest design speed Room to room pressure should not be more than ± 3 pascals Weather permitting: Heat exchanger temperature rise, superheat or subcooling for the Air Conditioner

Commissioning Form
Use One Form for each System

HVAC Contractor		Home Builder		Date
Model		System 1 Conditioned Floor Area		
Address		System 2 Conditioned Floor Area		

Rough Testing

Measured Duct Leakage			
Leakage Maximum			**Pass**

Static Pressure	yes	no	
Coil Present			
Filter Removed			
Test at Highest Design Speed			

Return Pressure		
Supply Pressure		
Total Static Pressure	0	
Design Static Pressure		**Fail**

Highest Design Air Flow		
Total Supply Measured Air Flow		**Fail**

Final Commissioning

Air Flow

All Rooms +-15% of Design		
All Rooms within + or - 3 Pa.		

Heating

Return Air Temp		
Supply Air Temp		
Furnace Heatrise		
Furnace Heatrise Range		

Air Conditioning

Condenser Air Entering Temp			
Target Subcooling from Mfg.			
Liquid Line Temp			
High Side Temp (from gauge chart)			
Actual Subcooling		3 degrees from target?	

Ventilation Strategy Exhaust Supply Balanced

Measured Flow		
Design Air Flow		