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MANUAL J8 INPUTS FOR SINGLE FAMILY RESIDENTS WITH ADEQUATE DIVERSITY EXPOSURE

INTRODUCTION

Deriving a comprehensive set of inputs for a wide variety of construction designs and conditions for dwellings that have adequate diversity exposure (ADE) creates a formidable challenge. **GWSSI** has calculated results of different inputs from Manual J8 on actual design plans and compared the results with previous MJ7 inputs on the same house designs. Based on our studies, Manual J Eighth Edition directives, and **GWSSI** empirical data, the following tables of inputs were developed. The following excerpts are from ACCA MJ8, authored by Hank Rutowski, which forms the framework for our parameter selections.

> Heating and cooling load estimates are part of a design procedure that moves from system selection to heat loss and gain calculations, to equipment selection procedures, to placement and selection of air distribution hardware, to duct routing and airway sizing or pipe layout and pipe sizing. Since the load calculations affect every aspect of the system design procedure, it must be as accurate as possible.
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> - Equipment capacity that matches the size of the applied heating and cooling loads will deliver comfort, efficiency and reliability over the entire range of operating conditions.
> - Heating and cooling loads determine the total air delivery requirement (blower CFM) and the airflow requirement for each room (room CFM). This airflow information is then used to select supply air outlets and to size the duct runs.
> - For dwellings with ADE (as far as fenestration is concerned), the average load procedure simulates conditions that will be encountered late in the afternoon during mid-summer.
> - For new construction or when working from plans, take full credit for all external overhangs.
> - For new construction or when working from plans, assume that all glass doors and conventional windows will be equipped with an internal shading device that is compatible with the type of room.
> - For new construction or when working from plans, assume that a window will not have internal shading if it is specifically used for day lighting and has no effect on privacy.
> - The total capacity (sensible plus latent) of the cooling equipment should not exceed the total load (sensible plus latent) by more than 15% for the cooling-only applications and warm-climate heat pump applications; or by more than 25% for cold-climate applications. This rule applies to air and water source equipment.
> - Use comprehensive performance data to select equipment that is compatible with the indoor design conditions, the outdoor design conditions and the estimated cooling loads. See Manual S for more information on manufacturer's performance data, equipment sizing limits and equipment selection procedures.
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> **Under Sizing Heating and Cooling Equipment**
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> The obvious problem with significantly undersized equipment is that it will not maintain the desired setpoint temperature when a passing weather system imposes a design load on the heating and cooling equipment. However, slightly undersized cooling equipment – by a margin of 10% or less – may actually provide more comfort at a lower cost.

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Over Sizing Heating and Cooling Equipment

Excessively oversized equipment causes short-cycles, marginalizes part-load temperature control, creates pockets of stagnant air (unless the blower operates continuously), degrades humidity control during the cooling season, requires larger duct runs, increases the installed cost, increases the operating cost, increases the installed load on the utility system and causes unnecessary stress on the machinery.

Humidity Control During the Cooling Season

Sensible and latent cooling loads are imposed on a dwelling located in climates that have a substantial amount of moisture in the air during the cooling season. When the summer design condition occurs, properly sized equipment will operate continuously or almost continuously, both loads will be completely neutralized, and the occupants will be comfortable. But the design condition only occurs for a few dozen hours per season. This means the equipment will cycle for 1,000's of hours per season. This is the real test of the equipment's ability to control humidity. Oversized equipment will fail to control humidity at part load. Properly sized equipment will provide adequate humidity control at part-load conditions.

Safety Factors

Manual J calculations should be aggressive, which means the designer should take full advantage of legitimate opportunities to minimize the size of the estimated loads. In this regard, the practice of manipulating the outdoor design temperature, not taking full credit for the efficient construction features, ignoring internal and external window shading devices and then applying an arbitrary "safety factor" is indefensible.

Research studies and the experience of knowledgeable system designers indicate that aggressive use of Manual J procedures provides an adequate factor of safety. No additional safety factors are required when load estimates are based on accurate information pertaining to envelope construction and duct system efficiency.

Large errors are possible if there is uncertainty about insulation levels, fenestration performance, envelope tightness or the efficiency of duct runs installed in an unconditioned space. If there is uncertainty pertaining to any aspect of the construction, the designer either has to conduct tests that provide the required data or make conservative assumptions about the performance of the items or systems under consideration. In this regard, leakage tests are recommended for existing dwellings, especially when the ducts are routed through unconditioned spaces. When working from drawings for new construction, consider the track record of the builder and the HVAC contractor when making assumptions about performance. Document all assumptions and make sure that all the stakeholders understand and agree with these assumptions before proceeding with the design.

GWSSI MJ8 INPUT TABLES 9/25/03

The following tables will give variable inputs used by GWSSI.

Calculation Method in Data System

Variable	Rationale
Average Load Procedure	Turn OFF the Peak Load calculations. Average load procedure simulates conditions that will be encountered late in the afternoon (worst case conditions) during mid-summer.

Internal Gains for Houses with Less Than 4000 Sq Ft.

ROOM	Quantity (Sensible Btuh)	Rationale
Utility, Kitchen, Room with Computer, Media Room with TV and Stereo.	4500 SG	MJ8
This table only applies if such rooms exist and are so equipped. Otherwise, adjust values accordingly.		

Internal Gains for Houses with More Than 4000 Sq Ft.

ROOM	Quantity (Sensible Btuh)	Rationale
Utility, Kitchen, Room with Computer, Media Room with TV and Stereo.	5900 SG	MJ8
This table only applies if such rooms exist and are so equipped. Otherwise, adjust values accordingly.		

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WINDOWS

Glass Inputs for rooms with conventional windows (bedroom, kitchen, utility, bathroom).

Variable	**Value**	**Rationale**
Ground Reflection	0.23	MJ8 3E-3 value for grass – most common under windows.
WINTER Internal Shading & SUMMER Internal Shading Amount Drawn	75%	Rooms with conventional windows have more internal shade. **GWSSI** consensus is 75% drawn.
WINTER Internal Shading & SUMMER Internal Shading Type	None	Glass purpose-built as day light windows and skylights.
Insect Screen Type Coverage	 Outside 50%	Empirical data show most windows in these rooms are single hung with ½ screen.
External Shade Screen Coefficient Coverage	 1.0 100%	1=No screen. Empirical data show most windows have no external shade screen.

Glass Inputs for Rooms (Living, Den, Great Room and Foyer) with conventional windows and glass typically not covered such as transom, half rounds, and sidelights.

Variable	**Value**	**Rationale**
Ground Reflection	0.23 grass	MJ8 3E-3 value for grass – most common under windows. (Pg 3E-2)
WINTER Internal Shading & SUMMER Internal Shading Amount Drawn	25%	Rooms with windows used for day lighting have less internal shade. **GWSSI** consensus is 25% drawn.
WINTER Internal Shading & SUMMER Internal Shading Type	None	Glass purpose-built as day light windows and skylights.
Insect Screen Type Coverage	 Outside 50%	Empirical data show most windows in these rooms are single hung with ½ screen.
External Shade Screen Coefficient Coverage	 1.0 100%	1=No screen. Empirical data show most windows have no external shade screen.

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DUCT LOAD FACTORS

Variable	Value	Rationale
DUCT PROPERTIES		
Man J Duct Table	7B-RS	Summary of Default Load Factor Tables, pg 10-37 – radial sealed ductwork most common - 150 Deg attic temperature is common for Southern U.S.
Heating Discharge Temperature	100	MJ8 Section 10-4, Paragraph 1

Comparison Study

GWSSI performed a comparison study of the Btuh loads calculated with MJ7 and the MJ8 inputs outlined above. The study included six actual house plans ranging in size from 1,460 SF to 4,270 SF. The table below is a summary of the findings.

MJ7 versus MJ8

	MJ7		MJ8	
1,460 SqFt House	Sensible Gain	21463	Sensible Gain	19404
Glass/Floor =12%	Latent Gain	3471	Latent Gain	2633
One Story	Cooling Btu/h	24934	Cooling Btu/h	22037
Oklahoma	Heating Btu/h	28563	Heating Btu/h	27491
2,466 SqFt House	Sensible Gain	33174	Sensible Gain	32615
Glass/Floor =12%	Latent Gain	3619	Latent Gain	3594
One Story	Cooling Btu/h	36793	Cooling Btu/h	36209
San Antonio	Heating Btu/h	36780	Heating Btu/h	37096
2,905 SqFt House	Sensible Gain	42360	Sensible Gain	43179
Glass/Floor =15%	Latent Gain	7351	Latent Gain	7748
One Story	Cooling Btu/h	49711	Cooling Btu/h	50927
Houston	Heating Btu/h	52582	Heating Btu/h	64020
2,941 SqFt House	Sensible Gain	53303	Sensible Gain	53863
Glass/Floor =19%	Latent Gain	7813	Latent Gain	8105
Two Story	Cooling Btu/h	61116	Cooling Btu/h	61968
Houston	Heating Btu/h	46846	Heating Btu/h	46529
3,300 SqFt House	Sensible Gain	51603	Sensible Gain	49898
Glass/Floor =15%	Latent Gain	6210	Latent Gain	6304
Two Story	Cooling Btu/h	57813	Cooling Btu/h	56202
Dallas	Heating Btu/h	56510	Heating Btu/h	58484
4,270 SqFt House	Sensible Gain	68384	Sensible Gain	68473
Glass/Floor =14%	Latent Gain	8497	Latent Gain	8229
Two Story	Cooling Btu/h	76881	Cooling Btu/h	76702
Dallas	Heating Btu/h	79734	Heating Btu/h	84146