Measuring HVAC Systems

ACI Track at the National RESNET Conference

San Antonio, Texas

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- Indoor Air Quality Certifications
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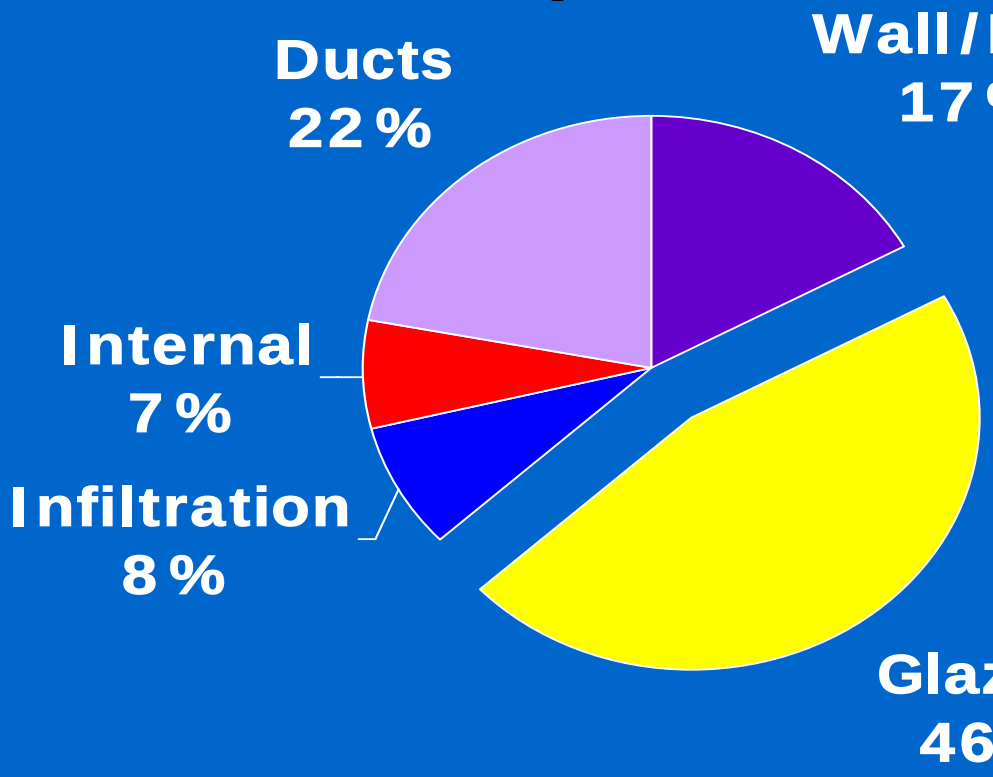
Keys to Successful HVAC Installations

- HVAC Sized Correctly
- Dehumidification
- Properly Sized Ducts
- Air Tight Ducts
- Pressure Balanced Rooms

Biggest Contributors to Cooling Loads

- New home in San Antonio with aluminum windows and dual pane clear glass.

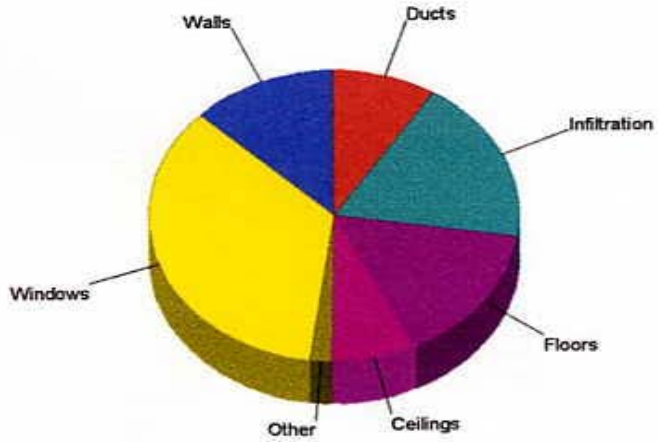


Note: Ducts + Windows = 68% of Total Load!

Manual J Calculation

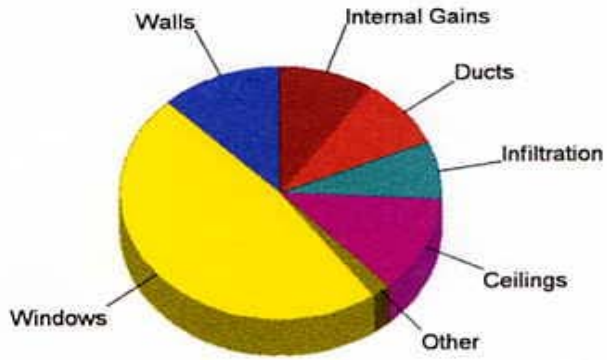
H E A T I N G

Component	Btuh/SqFt	Btuh	% of Btuh
Walls	2.4	5251	12.8
Windows	28.5	14429	35.1
Doors	18.4	773	1.9
Ceilings	1.3	3051	7.4
Floors	10.1	6367	15.5
Infilt.	13.7	7503	18.2
Ducts		3737	9.1



C O O L I N G

Component	Btuh/SqFt	Btuh	% of Btuh
Walls	1.6	3444	12.2
Windows	26.6	13456	47.6
Doors	11.8	495	1.7
Ceilings	1.5	3509	12.4
Floors	0.1	34	0.1
Infilt.	3.8	2063	7.3
Ducts		2570	9.1
Int.Gains		2700	9.6

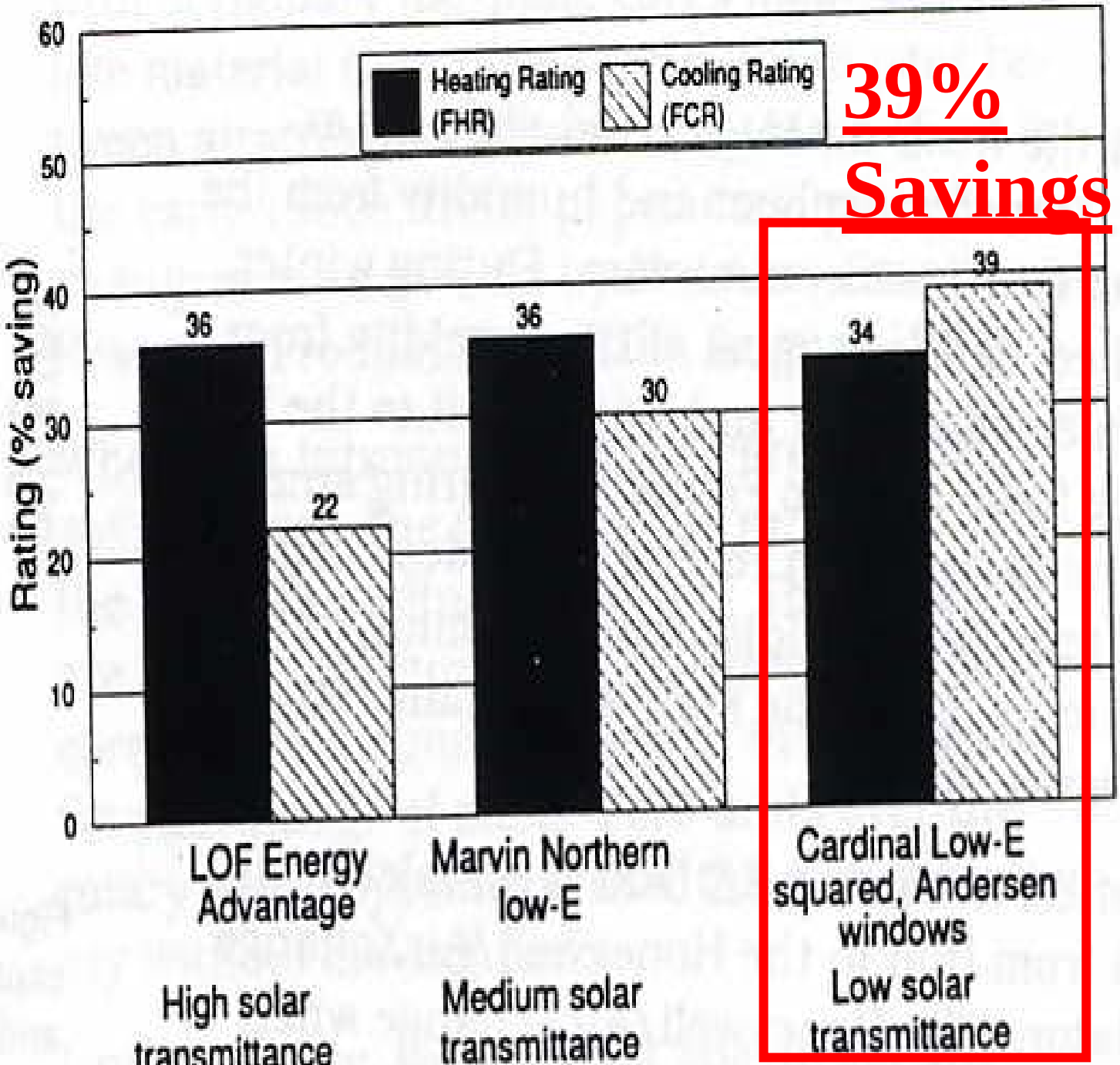


Overall U-Value = 0.136

Impact of Low E Windows on HVAC Cooling Loads

- The U. S. Department of Energy has calculated that installing Low E windows instead of double pane clear windows reduces what was a 5.0 Ton load down to a 3.5 Ton load!
- They will always be there.

Low E Window Energy Savings %



39% Savings

Sizing of Residential Return Air Grilles

11-6 Residential Example

Size a standard residential grille and a residential filter grille to handle 1000 CFM of return air.

Solution - standard grille:

Standard grille gross area = 1000 / 300 = 3.33 Sq.Ft.

Approximate size (30 inches x 16 inches)

Solution - filter grille:

Filter grille gross area = 1000 / 200 = 5.00 Sq.Ft.

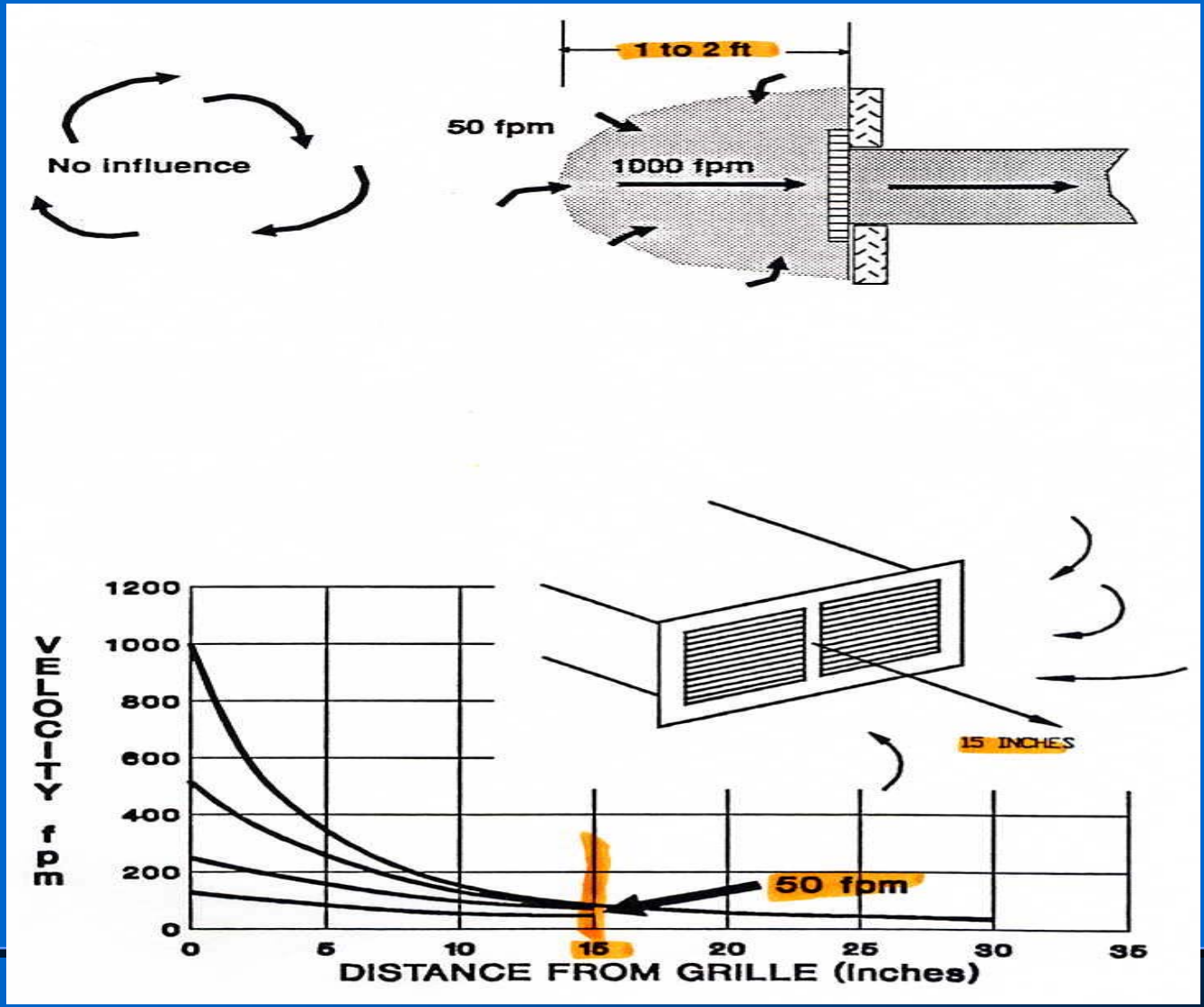
Approximately size (32 inches x 22 inches)

Return Air Grilles Sizing:

- 2,000 CFM Divided by 200 CFM per gross SF of area = 10 SF of face area!

- 2,000 CFM Divided by 300 CFM per gross SF of area = 6.6 SF of face area!

Return Air Grille Effects:



IAQ – The Building Performance Approach for Texas Homes

- **HVAC Role:**
- **Design to ACCA Manual D**
- **Return Grilles – 200/300 CFM/SF grille area**
  - **Non-Filter Grilles = 3.3 SF/1,000 CFM**
  - **Filter Grilles = 5.0 SF/1,000 CFM**
- **Supply Ducts Equivalent Length = Long-0.06" or less, Med.-0.08", Short-0.10" W.C.**

Air Tight Ducts

- Amount of Duct Leakage
- Impacts of Duct Leakage on EER and Capacity
- Impacts of Duct Leakage on Moisture and IAQ
- Safety Concerns Related to Duct Leakage

How Much Do Ducts Leak?

- Studies by Texas utilities, cities and universities found leakage averaging 30% of rated airflow!
- U.S. Dept. of Energy research found the same leakage across the nation.
- This costs us all a fortune, as in Billions of dollars each year!

What Are the Impacts of Duct Leakage?

- Forces contractor to increase tonnage to compensate for unknown loss of capacity.
- Slashes efficiency of equipment!
- Costs builders, home owners billions.
- Increases peak demand for electricity.
- Worst impacts when conditions are worst!

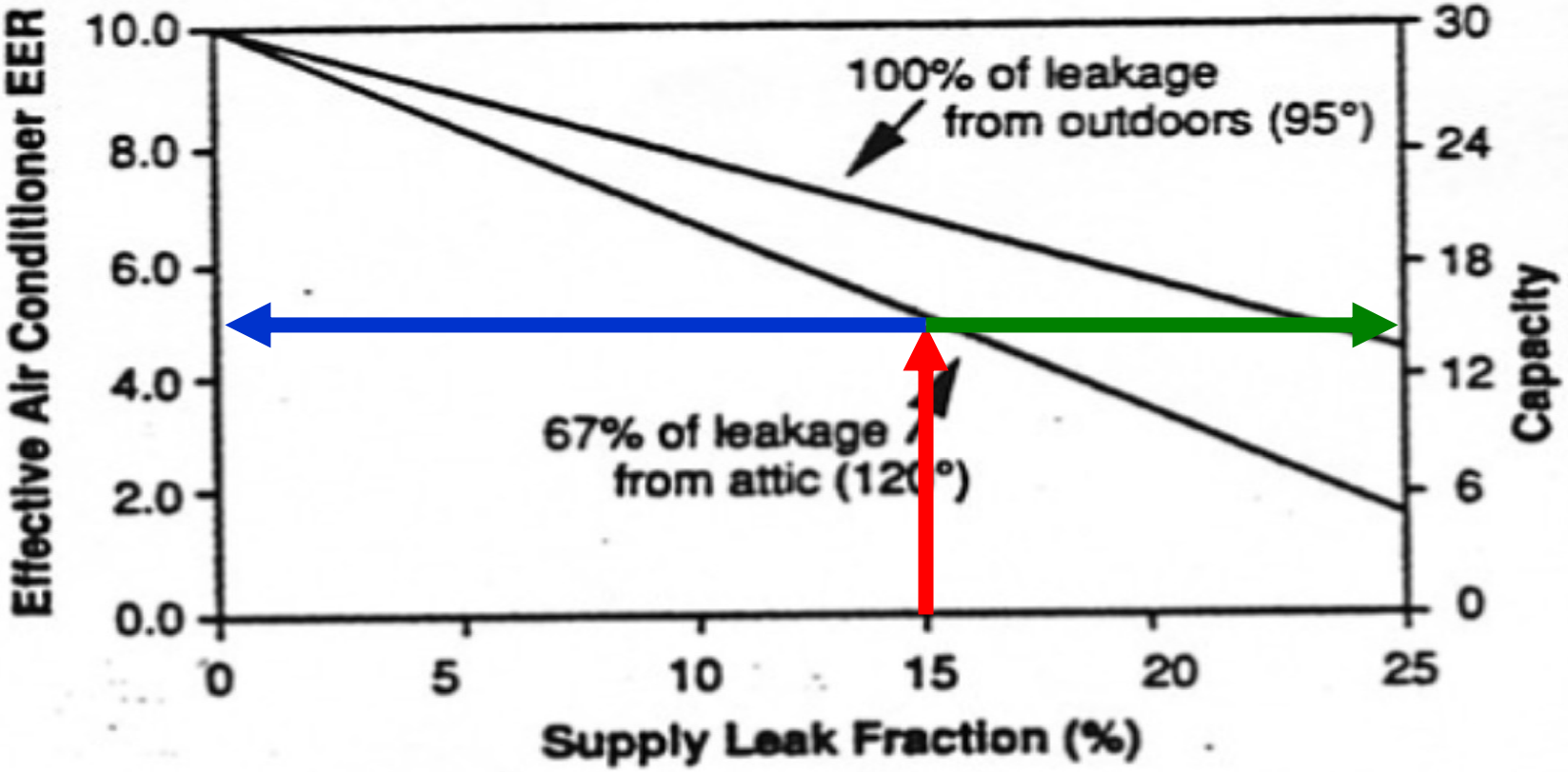


Figure 2. Air-conditioner efficiency and capacity diminish rapidly with an increasing proportion of supply leaks. This graph assumes a 2.5-ton air conditioner with 10 EER. As more of the duct leakage is drawn from the attic, the slope gets steeper. It is even possible for an air conditioner to *heat* a house, if attic air overloads capacity so much that the air conditioner can't cool the distribution air lower than the house air. FSEC

Performance degradation of air conditioner when attic air is drawn into air handler, assuming room is 78° and attic air is 120° F

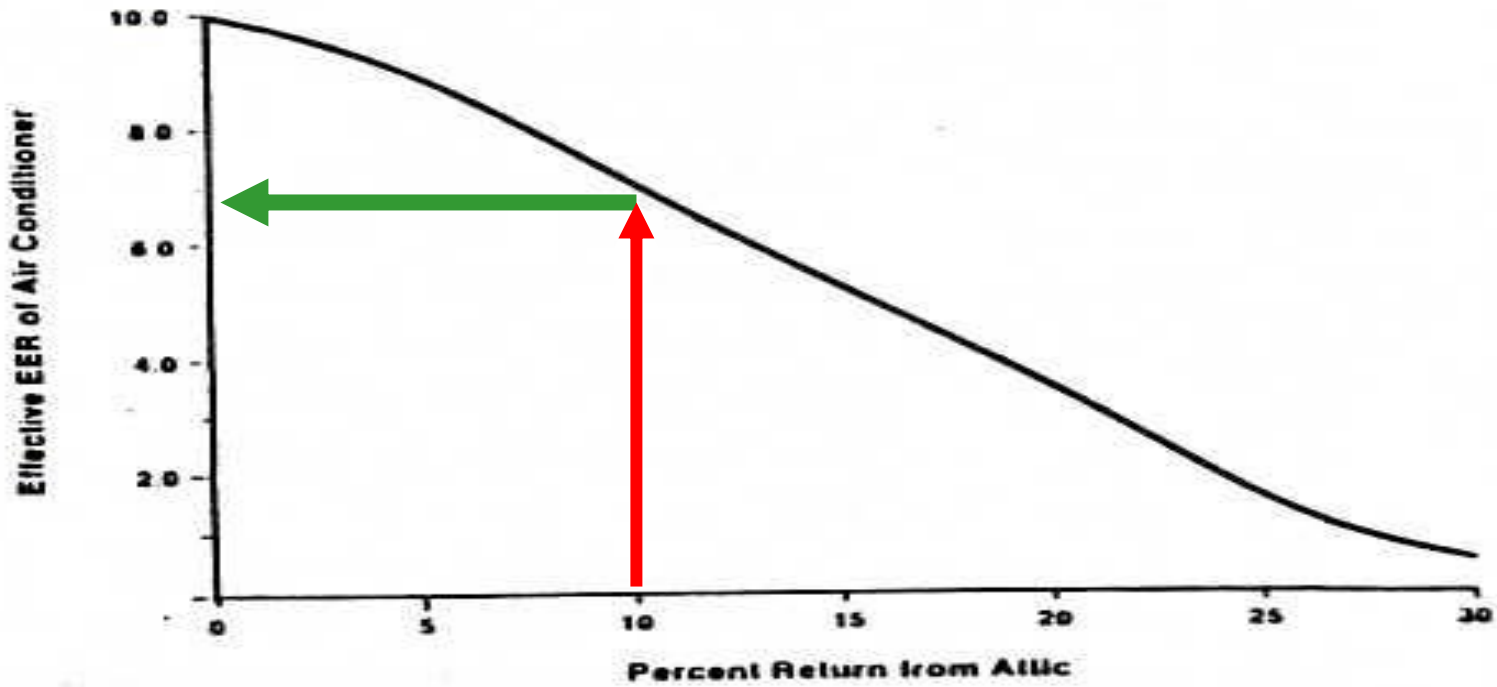


Figure 5-9
Air Conditioner Performance and Return Leakage

Latent And Sensible Loads for Hot Ventilation Air

- Outside= 95 @ 45%R.H.(76WB/70dp) 110 grains per Cubic Foot.
- Inside=75 @ 50%RH (63WB/54dp)64grs.
- Qs=1.1 x TD x 50 CFM
- Ql=0.68 x Grs. D x 50 CFM
- Qs= 935 BTU's Sensible Load
- Ql= 1,564 BTU's Latent Load!
- 60%Latent / 40%Sensible

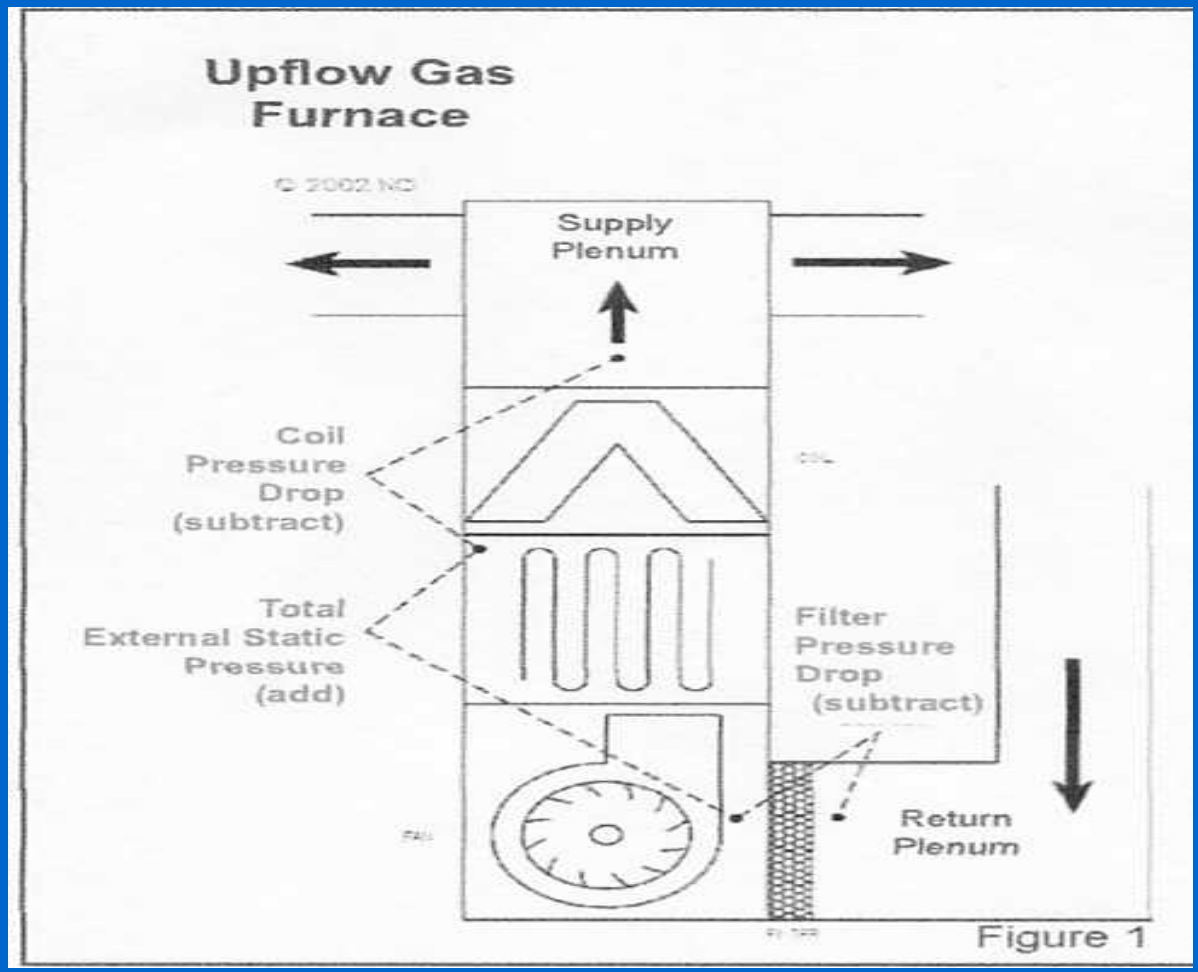
Latent And Sensible Loads for Night/Morning Ventilation Air

- Outside = 85 @ 60%RH (74WB/70dp) 110Gr.
- Inside =75 @ 50%RH (63WB/54dp) 64g
- 50 CFM
- Qs= 550 BTU's Sensible Load
- Ql= 1,564 BTU's Latent Load!
- 75%Latent / 25%Sensible!!

HVAC Performance

- **Measuring Static Pressure:**
  - HVAC Equipment is designed for a maximum of 0.50” static pressure.
  - Most HVAC systems work against 0.80” of static pressure.
  - Why? The Return and Supply ducts and plenums are too small and starve the system on one end and give it asthma at the other!

Measuring Static Pressure



HVAC Performance

- High static pressure can tell you that the coil is dirty.
- It can tell you that the ducts (Return or Supply) are undersized.
- It can explain why there is poor comfort due to insufficient airflow.

HVAC Performance

- **Things to Measure:**
  - Airflow at all supply and return grilles =/-10% ACCA Manual J
  - Static Pressure should be less than 0.50”.
  - Temperature Drop across the coil should be between 17 and 20 degrees. (if you can measure RH too and calc capacity, great)

HVAC Performance

- **Things to Measure:**
  - **Pressure in closed rooms with A/C on should be less than 3 Pascals.**
  - **Return grille sizing should meet ACCA guidelines.**
  - **Duct Leakage should be less than 10% and tighter is better!**

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