Why do people live in Florida?

Florida population 1900 to 2004

Table 1. Florida Population Growth, 1900-2004

Year	Population	Decade Change	Percent Change
1900	528,542	----------	--------
1910	752,619	224,077	42.4
1920	968,470	215,851	28.7
1930	1,468,211	499,741	51.6
1940	1,897,414	429,203	29.2
1950	2,771,305	873,891	46.1
1960	4,951,560	2,180,255	78.7
1970	6,791,418	1,839,858	37.2
1980	9,746,961	2,955,543	43.5
1990	12,937,926	3,190,965	32.7
2000	15,982,378	3,044,307	23.5
2004	17,516,732	1,534,354	9.6

Sources: **1)** U.S. Census Bureau, *1990 Census of Population and Housing*, CPH-2-ll, April 1993. **2)** Bureau of Economic and Business Research, *Florida Population: Census Summary 2000*, May 2001. **3)** Bureau of Economic and Business Research, *Florida Estimates of Population: April 1, 2004*, February 2005.

- What happened in the 1960s that would have spurred all this population growth?

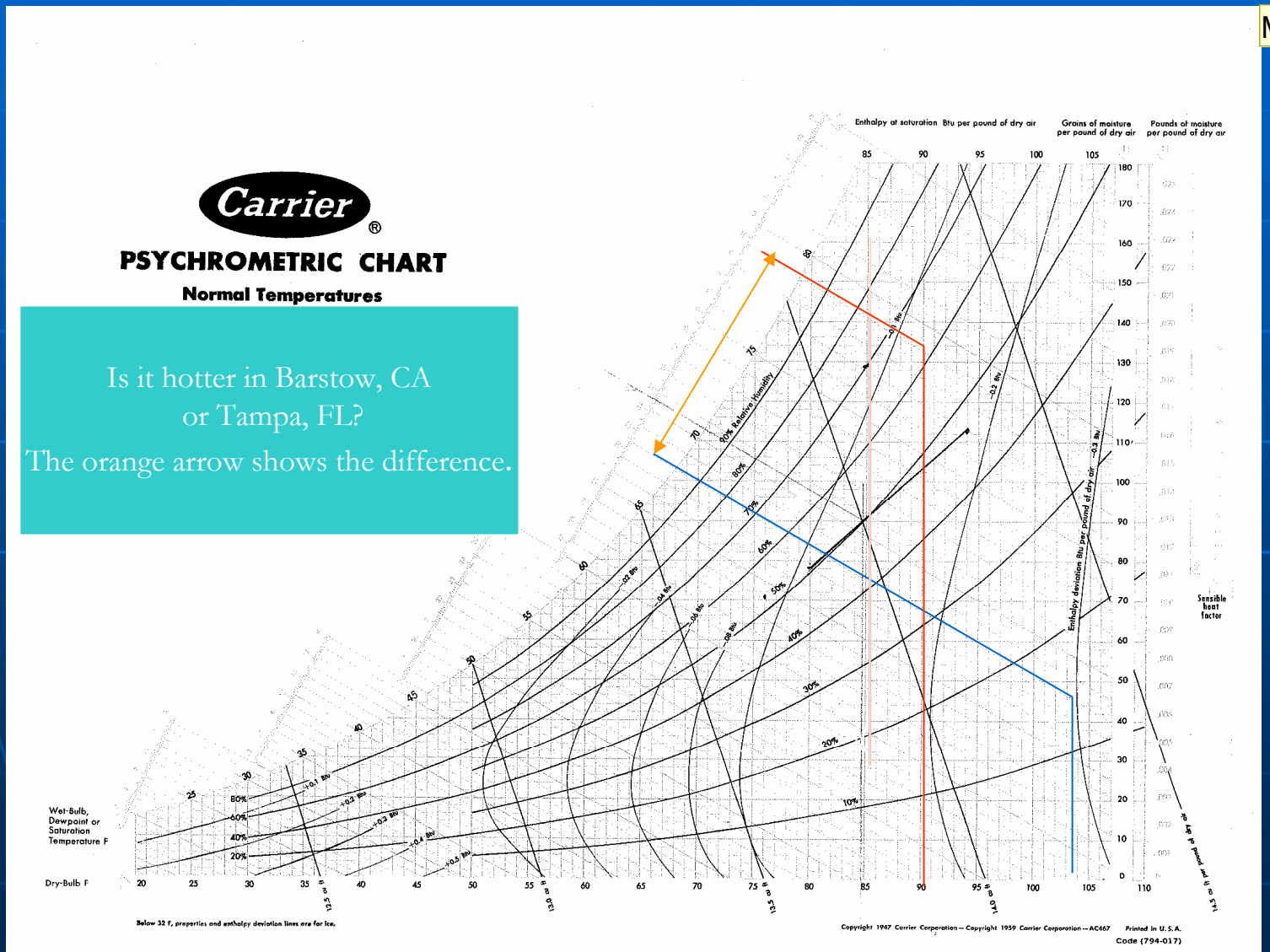
- A/C! (Central Air Conditioning)

What is the object of A/C?

1. Comfort!
2. Comfort!
3. Comfort!

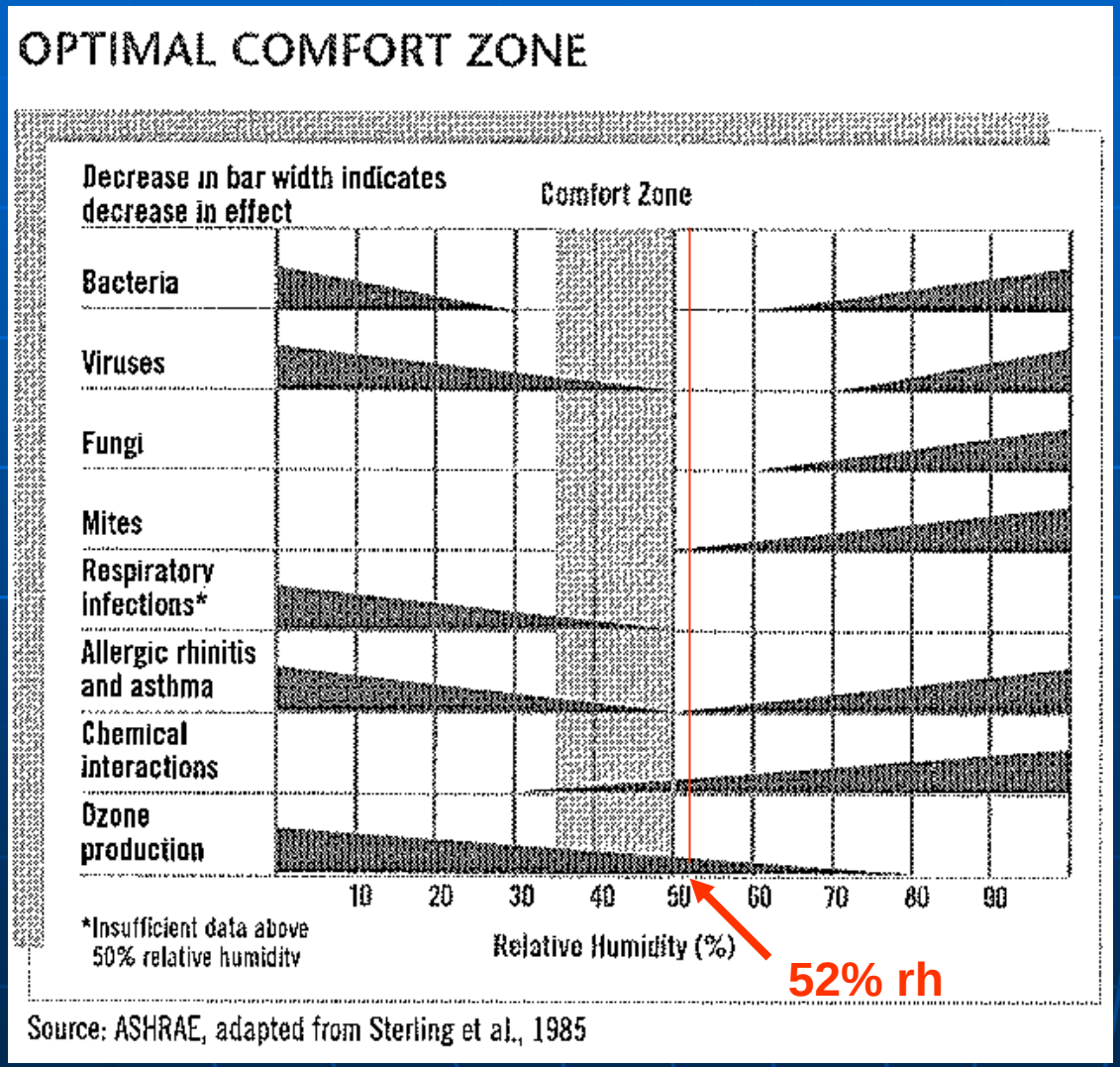
Properties of Air – Psych Chart

MSOffic



MSOffice3 Is it hotter in Barstow, CA in the desert than in Tampa, FL - summer design? The orange arrow is the absolute heat difference (enthalpy) and yes, Tampa's air has significantly greater heat.
, 2/9/2007

What is the optimum humidity?



The reality in Florida is: humidity levels less than 55% are good, less than 52% great.

A driver on humidity with modern tight construction is how the occupants live.

Do they use bath exhaust fans, kitchen hood exhaust when cooking steam producing foods, etc?

Why Florida specific codes?

- Most other "*Energy Codes*" give passing comments with regard to humidity control, dehumidification (Excerpt IECC below)

402.5 Moisture control. (Mandatory). The building design shall not create conditions of accelerated deterioration from moisture condensation Above-grade frame walls, floors and ceilings not ventilated to allow moisture to escape shall be provided with an approved vapor retarder The vapor retarder shall be installed on the warm-in-winter side of the thermal insulation.

“Better?”

- You drive a car that you selected on several parameters?
  1. Size
  2. MPG
  3. 4-wheel drive?
  4. Towing?
  5. Number of seats?

A/C is similar

- Parameters:
- What size and type system is optimal for my house?

1. People load
2. Temperature requirements
3. Fenestration
4. Efficiency, SEER (mpg)
5. Ability to remove humidity

A/C is different than a car

- If you don't like the car… trade it in!
- You are "*stuck*" with the A/C for 10+ years, so getting things correct the first time (and every time) is key.

What is the A/C “load”?

- Not to make you an engineer, but this is of paramount importance to what is trying to be accomplished

1. Heat total = Heat Sensible + Heat Latent
2. Heat Sensible – what you measure with a dry bulb thermometer, what you *sense*
3. Heat Latent – moisture, humidity

Latent Heat

Latent heat is actually MORE important than sensible heat to achieve our goal – **comfort**

If the temperature is 90 and the rh is 15% people say they are comfortable

If the temperature is 72 and the rh is 80% people are uncomfortable

The “problem” with Latent Heat

- Latent heat is more difficult to remove than sensible heat
- With a non-variable speed AHU it takes some 5-minutes of run-time to reach dewpoint (removing moisture)
- Until the “*heat of the afternoon*” A/C typical thermostats operate on a 6-minute cycle.

Oversizing, common?

- **UF & Florida Solar Energy Center** researched some 1600 homes, throughout Florida, what percentage of these homes did they determine to be oversized at least ½ ton?
  _____%

Oversizing - What happens?

1. Equipment is larger, more 1st cost
2. Ductwork needs to be larger
3. More refrigerant in system
4. Less run time, cycles in afternoon
5. *Think, late afternoon rain, moderate temperature (76 F), ULTRA high humidity (99%), NO RUN TIME, no dehumidification*

Enter the Energy Code

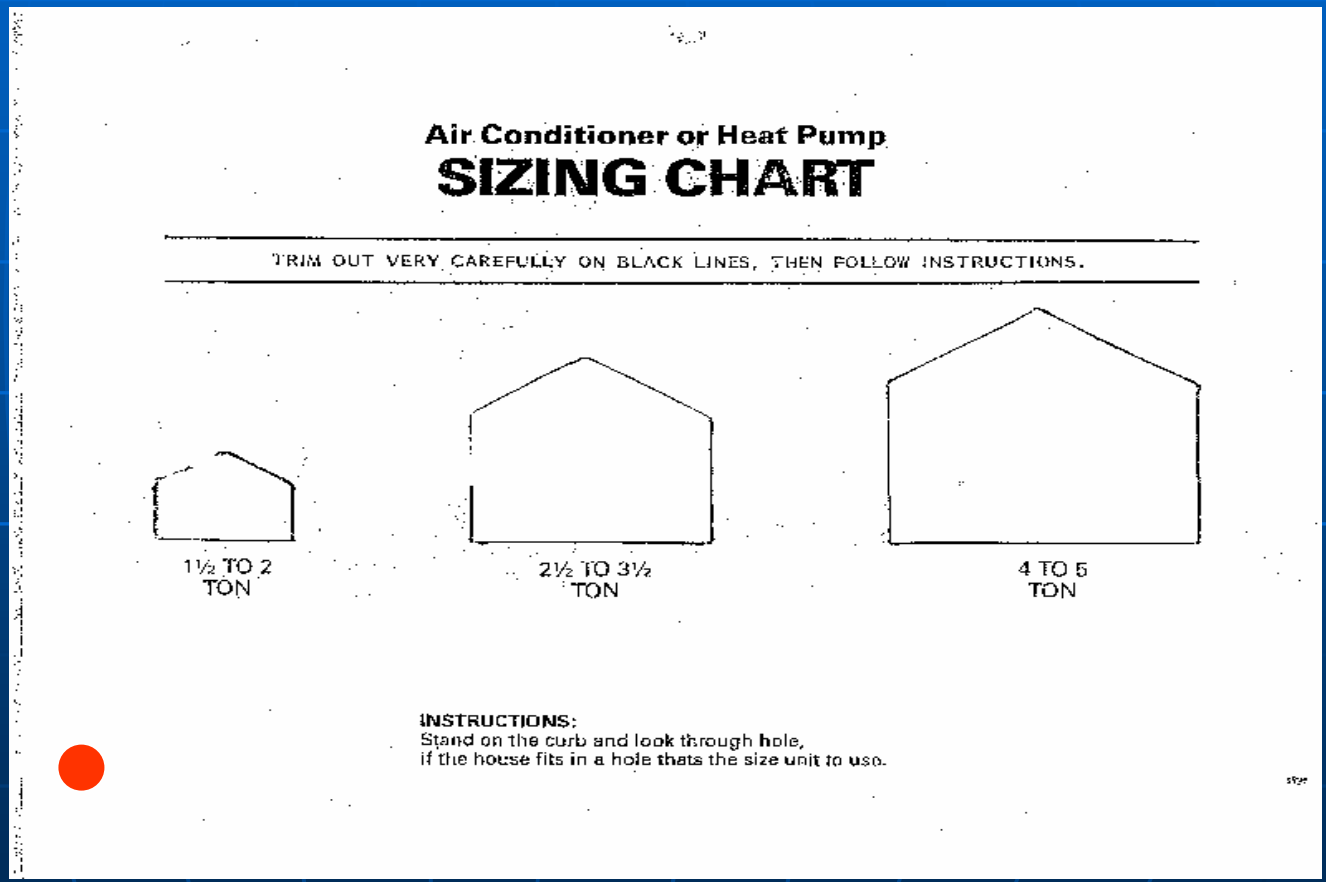
- Since the A/C industry appears to be unable or unwilling to “do the right thing” government constraints are instituted
  - Mandatory load definition (Manual J)
  - Mandatory equipment sizing parameters
  - Regulation on lighting, water heating, outdoor use, etc.

What is Energy Code's purpose?

- The object to is achieve uniform, reasonable methods of providing the desired comfort at the lowest energy use with the ability to duplicate that desired goal statewide

Early Methods of Sizing, some still employ this method due to simplicity of use

Look through hole to determine exact size



Air Conditioner or Heat Pump

SIZING CHART

TRIM OUT VERY CAREFULLY ON BLACK LINES, THEN FOLLOW INSTRUCTIONS.

1½ TO 2 TON

2½ TO 3½ TON

4 TO 5 TON

INSTRUCTIONS:
Stand on the curb and look through hole,
if the house fits in a hole thats the size unit to use.

What is Manual J

- An engineering method for non-engineers to arrive at consistently accurate heat gain and heat loss calculations.
- Manual J is a "best estimate" of the true heat transfer characteristics of a house
- From these calculations the correct, best fit, cooling and heating systems may be selected

Why do contractors oversize?

- **Fear**, lack of confidence in ability to accurately determine load (Manual J)
- **Expectation of customer**, “I had a 4-ton in my 1800 sq. ft. house, this is 2400, I need 6-tons!”
- **Low temperature requests** from GC or homeowner, “I like it 65 degrees!”
- That unit ran all afternoon, my electric bill will be astronomical...not necessarily

Relative Humidity is the DRIVER!

- Rh is the key to most of the comfort issues with A/C!
- Rh above 60% is considered high, below 48% is low, 50-54% is “just right”

- Think ***“Goldie Locks”*** *rule,* Rh not too high, not too low… <u>just right</u>!

Result

- The percentage of cooling that is temperature reduction increases and the moisture removal is reduced, as a percentage of the total (change of the Sensible Heat Ratio – SHR)

- This is great...if you live in Arizona...if you live in Florida...terrible!

Cardinal Glass Industries Houston Demo Houses

3 Identical Homes With Different Windows

- SHGC = 0.62 (single pane)
- SHGC = 0.52 (double pane)
- SHGC = 0.34 (low solar gain low-E)

courtesy of the Cardinal Glass Industries

Air Conditioner Sized with Windows

Single Pane

- 4 ton

Double Pane

- 3.5 ton

Low Solar Gain Low-E

- 2.5 ton

courtesy of the Cardinal Glass Industries

Windows are the key!

- The fenestrations (windows) are the largest component in the A/C load. Having solar as well as a transmission heat gain component
- Since this component is subject to multiplication later in the Manual J program any error will be multiplied as well
- If the window data is correct in size, quantity and heat gain data input, and orientation, the output data has greater credibility

Why is correct sizing essential?

- You entertain the distinct possibility to **MOLD** a structure if the A/C is improperly sized.

- Too small isn't the problem! You may not be able to keep the house 75 degrees at the rare 97 degree outdoor…

- Too large is! Shorter than standard run time equals higher relative humidity (rh)

The mind of the Home Buyer

- You cheated me! The house next door has a 4-ton unit and I have a 2 ½, you better increase it to 5-tons or I'm going to sue!
- But Mr. Homeowner you have:

1. Different exposure
2. Low e-glass
3. Better insulation
4. Less A/C load, your Manual J states this house needs 2 ½ -tons

Mold is Gold?

- Seminar held in Tampa

- Tobacco – tapped out
- Asbestos – tapped out
- Food
- Obesity
- **Mold**
  - **What does it mean to be *naked*?**

What about "*ultra-high*" SEER

- What we have been looking at thus far is standard systems, not variable speed components

- To achieve very high SEER above 15, typically electronically commutated motors are employed, variable speed technology, they save energy and have speed control (rpm)

Variable Speed Indoor Fans

- This "*new*" technology has been around for quite some time, the first units from the late 1980's
- By preventing air movement simultaneously with compressor start, delaying the ID fan, system dew point may be achieved in under 60-seconds vs. 5+ minutes, then "ramping up" airflow allows coil temps significantly lower than std. A/C
- The 6-minute cycle…when operating other than the long afternoon cycle, this technology gives 5-minutes dehumidification from every cycle vs. 1-minute.

Where are we headed?

- Some form of variable speed technology will filter down even into “builder” type units
- To comply with increasing stringent energy codes the SEER will rise
- To keep from “MOLDing” a building, smart A/C contractors will:

1. Run exact room by room loads
2. Be careful when sizing duct, (bigger is better)
3. Will size equipment on the small side
4. Select equipment for latent heat removal

Remember, what happens if the A/C is oversized?

1. Components are more expensive, larger
2. Ductwork is larger, more airflow, more noise
3. Increase number of starts and stops
4. Increased electric consumption
5. Shorter run time each cycle, higher rh
6. Cycling during afternoon, higher rh
7. Very short cycles in mild weather (under 85 outdoor), may be shorter than 6-minutes, never reaches dew point, higher rh
8. **Nothing good!**

Final Considerations

- Correct sizing is a MUST!
- Old square foot/ton numbers won't work, anyone that says, *"500 sq. ft. per ton"* should be **SHOT!!!**
- Contractors must consider the latent heat consequences when selecting equipment
- Windows are **"the key"** to sizing

Why did people move to Florida?

- **Comfort**
- Central A/C allowed them to be comfortable in a subtropical climate
- High efficiency makes that comfort affordable…**unless**
- We create **MOLD** with improper system selection, so we need to do the job right!

Questions?