ACTION AIR CONDITIONING & REFRIGERATION

TECHNICIAN TRAINING BULLETIN · TB-01

THE LOAD IS NOT THE WHOLE JOB

> Why a Manual J number sizes the air conditioner but does not size the moisture strategy — worked through one ordinary Florida house.

If you take one thing from this bulletin, take this: **the air conditioner removes the least moisture at exactly the hours the house makes the most.** Everything else here is the arithmetic that proves it.

START HERE

TWO DIFFERENT JOBS

An air conditioner does two jobs at once. It lowers the temperature, and it removes water. In most of the country those two jobs finish at roughly the same time. In Florida they do not, and everything difficult about our work comes from that one fact.

THE JOB	WHAT IT IS CALLED	HOW YOU FEEL IT
Lowering the temperature	**Sensible**	The thermostat reads it. When this job is done, the thermostat is satisfied and the unit shuts off.
Removing the water	**Latent**	Nothing reads it. The house feels clammy, windows fog, doors stick, and eventually something grows.

THE CATCH

The thermostat only watches the first job. When it is satisfied, the machine stops — whether or not the second job is finished. That is not a fault. It is what a thermostat is. It is also why a Florida house can be cold and damp at the same time, and why the homeowner's instinct — turn it down further — makes it worse.

WHY WATER IS HARDER TO REMOVE THAN HEAT

Removing a pound of water from the air takes roughly **1,060 Btu**. Dropping the temperature of a pound of air by one degree takes about **0.24 Btu**. Water is expensive. That is why moisture removal is the part that gets missed — there is a lot of work hiding in air that does not feel especially wet.

THE NUMBER THAT MAKES FLORIDA DIFFERENT

Design conditions for Clearwater are **93°F outdoors at a 79.4°F dew point**. Miami's design dry bulb is 91.8°F. Denver's is also 91.8°F. Phoenix is sixteen degrees hotter than Miami.

152.6 vs 92.3

Grains of water per pound of outdoor air at design — Clearwater against Denver, at nearly the same temperature.

A grain is a unit of weight — 7,000 grains make a pound. When we say air carries 152.6 grains per pound, we mean that every pound of outdoor air brings that much water with it into the building.

THE EXAMPLE

ONE ORDINARY HOUSE

A 2,500 square foot, four-bedroom Florida house. Block, slab, single storey, ducts in a vented attic. Manual J comes back at **42,000 Btu/h total load**. That is the number the whole industry works from. We are going to take it apart.

STEP 1

Split the load into its two jobs

Manual J does this for you. On a typical Florida residence the split runs about 80% sensible to 20% latent.

```
Total load              42,000 Btu/h
Sensible  (temperature)   33,600 Btu/h
Latent    (water)          8,400 Btu/h
```

Most people stop here. This is where the mistake starts.

STEP 2

Add the ventilation air — the part that gets left out

Code requires fresh air. For this house, ASHRAE 62.2 works out to **113 CFM, running continuously**. That air arrives at 79.4°F dew point and we hold the house at 55°F dew point. The difference is 88.6 grains per pound, and we pay for every one of them.

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Fresh air required   0.03 × 2,500  +  7.5 × 5  =  113 CFM
Latent load         0.68 × 113 × 88.6  =  6,778 Btu/h
```

That is not a rounding error. It is **eighty percent as much latent load again** as everything the house itself produces.

STEP 3

Now look at the real number

```
Latent from the house      8,400 Btu/h
Latent from ventilation   6,778 Btu/h
TOTAL LATENT      15,178 Btu/h
```

WHAT JUST HAPPENED TO THE JOB

Counting only the house, the split looked like **80/20** — four parts cooling to one part drying. Counting the fresh air the code requires, it is **69/31**. Nearly a third of the work is water.

If the load calculation does not include the ventilation air, it understates the moisture job by almost half.

THE EXAMPLE · CONTINUED

WHAT THE EQUIPMENT ACTUALLY DOES

A 42,000 Btu/h load selects a 3.5-ton system. Now the question nobody asks: how much water does that machine actually remove, and when?

THE CATALOGUE NUMBER IS NOT THE WORKING NUMBER

Every rating in the catalogue is taken at **80°F and 67°F wet bulb** — about 51% relative humidity. At that condition a typical system puts roughly a quarter of its capacity into moisture removal.

We do not run houses at 80°F and 51%. We run them at **75°F and about 50%**, which is 63°F wet bulb. Drier air entering the coil means less water condenses out of it. In the real operating condition, moisture removal drops to around **15%** of capacity.

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3.5 ton  =  42,000 Btu/h total
Moisture removal while running   42,000 × 15%  =  6,300 Btu/h
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Against a latent load of 15,178 Btu/h. **Even running flat out at the worst hour of the year, the air conditioner covers less than half the moisture job.**

AND IT ONLY REMOVES WATER WHILE IT IS RUNNING

This is the part that matters most, and it is the part that is least obvious. The moisture removal above is a *rate*. It only happens while the compressor is on.

CONDITION	RUNTIME	WATER REMOVED	WHAT IS HAPPENING
Design hour 93°F outside	~100%	6,300 Btu/h	Hottest hour of the year. The machine never stops, and still covers under half the latent load.
August afternoon 84°F, overcast, after rain	~40%	2,520 Btu/h	**Dew point is at its highest here, not at 93°F.** But it is only 84°F out, so the thermostat is nearly satisfied and the unit barely runs.
House empty 80°F setback	~8%	504 Btu/h	Snowbird season. Compressor almost never calls. Moisture removal is effectively zero, and the ventilation air keeps arriving 24 hours a day.

THE WHOLE BULLETIN IN ONE LINE

The wettest hours in Florida are not the hottest hours. Peak moisture arrives at around 84°F — nine degrees below the design temperature. The air conditioner is sized for 93°F, so at 84°F it satisfies the thermostat quickly and shuts down, right when the outdoor air is at its wettest.

The machine works least at the moment the house needs it most.

THE ANSWER

SIZING THE MOISTURE STRATEGY

Now convert Btu/h into something you can picture. Divide by 1,060 to get pounds of water per hour, then work it out per day. A pint weighs roughly a pound.

WATER THIS HOUSE PRODUCES, EVERY DAY

SOURCE	PER DAY	NOTE
Ventilation air	147 pints	Runs 24 hours. Does not stop for weather, occupancy or season.
The household	~82 pints	People, cooking, showers, laundry, mopping. Averaged over a day, not at peak.
Total	**~229 pints**	About 29 gallons of water a day, entering a 2,500 square foot house.

WATER THE AIR CONDITIONER REMOVES

CONDITION	REMOVES	SHORTFALL
Typical August day, ~40% runtime	~55 pints	**~175 pints/day short**
House empty at 80°F setback	~11 pints	**~161 pints/day short**

160 – 175 pints per day

The gap a dedicated dehumidifier has to cover on an ordinary Florida house — after a correctly sized, correctly installed air conditioner has done everything it can.

WHICH CASE DO WE SIZE TO?

The empty house. Not because it is the biggest number — it is not — but because it is the condition where the air conditioner gives us no help at all. Size for the occupied case and the house is unprotected for six months of the year. Size for the empty house and the occupied case takes care of itself.

WHAT THIS CHANGES ON THE JOB

OLD HABIT	WHAT WE DO INSTEAD
Read the Manual J latent number, assume the AC covers it	Add the ventilation air to the latent side first, then work out what the AC actually delivers at part load.
Size equipment on total load and move on	Size the AC on total load, then size the dehumidifier on the leftover moisture at the unoccupied case.
Pick equipment from the catalogue rating	Pull the expanded performance table and read latent capacity at 75°F / 63°F wet bulb — the condition it will actually run in.
Bigger unit for a humidity complaint	Never. A bigger unit runs shorter, removes less water, and makes the complaint worse.
Fan set to ON to "circulate"	Fan on AUTO. A running fan blows the water back off a wet coil and returns it to the house.

Figures. 2,500 ft², 4 bedroom, 42,000 Btu/h Manual J at St Petersburg/Clearwater design conditions (93.2°F dry bulb, 79.4°F dehumidification dew point, 152.6 gr/lb). Load split, runtime fractions and internal moisture diversity are representative values for teaching, not a substitute for a load calculation on an actual house. Full method: *Connected Climate Control* Sections 03, 04C and 04H.