

Achieving ENERGY EFFICIENCY with Standard Air-Conditioning Units



Mike West, PhD, PE
 Advantek Consulting, Inc
AdvanTek

Standard Air Conditioning Unit

Packaged Unit
 Split System
 DX (not chilled water)
 Air-cooled



ENERGY EFFICIENCY

- ◆ **EER**
 - single point *Energy Efficiency Ratio*
 - MBH per kW
- ◆ **SEER** (5 tons and less)
 - *Seasonal Energy Efficiency Ratio*
 - kBtu per kWh
- ◆ **IPLV** (10 tons and up)
 - Seasonal *Integrated Part-Load Value*
 - MBH per kW

FEMP Recommendation*

Efficiency Recommendation		
Product Type ^a and Size	Recommended	Best Available
< 65 MBtu/h (3 phase)	12.0 SEER or more ^b	14.5 SEER
65 – 135 MBtu/h	11.0 EER or more 11.4 IPLV or more	11.8 EER 13.0 IPLV
> 135 – 240 MBtu/h	10.8 EER or more 11.2 IPLV or more	11.5 EER 13.3 IPLV

*How to Buy an Energy-Efficient Commercial Unitary Air Conditioner
 NOVEMBER 2001

CEE Recommendation

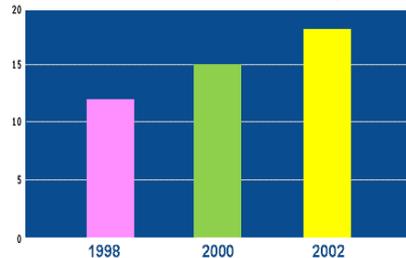
CEE's Tier I level is minimum industry standard. CEE's Tier II is the new "high efficiency" requirement, promoted by ENERGY STAR[®] and FEMP.

Minimum Allowable EER Ratings MBH per kW

	MBH 65-135	135-240
ASHRAE 90.1-1999 (Effective 10/29/2001)	10.3	9.7
CEE - Tier I	10.3	9.7
CEE - Tier II and EPA Energy Star	11.0	10.8
FEMP (as of 1/1/2002)	11.0	10.8
FEMP (after 1/3/2006)	12.0	12.0

MBH = kBtu/hr (1 ton = 12 MBH)
 (65 = 5.4 tons, 135 = 11.3 tons, 240 = 20 tons)
 CEE - Consortium for Energy Efficiency
 EER - Energy Efficiency Rating
 FEMP - Federal Energy Management Program

Percent Meeting CEE Tier II*



*<http://www.cee1.org/resrc/updates/02-08hecac/02-08hecac.html>

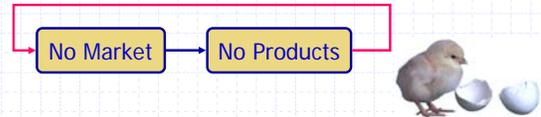
What is available *today*?

- ◆ “Standard Efficiency” IPLV **8.5 to 10.0**
- ◆ “High Efficiency” IPLV **9.5 to 14.0**
 - So-called “High Efficiency” unitary products are 10% to 40% more energy efficient than “Standard Efficiency.”

Systems 5-tons and smaller are as high as SEER 18
Water cooled-chiller systems are as high as IPLV 20

“High Efficiency ... ”

- ... is really not very high
... is 20% to 60% **LESS efficient** than the best
- ◆ small split systems
 - ◆ water cooled chiller systems
 - ◆ they could be made (*given a market*)



Achieving ENERGY EFFICIENCY

- ◆ CAPACITY / SIZE
- ◆ SYSTEM DESIGN
- ◆ MODEL SELECTION
- ◆ INSTALLATION
- ◆ DUCTS
- ◆ OPERATION
- ◆ MAINTENANCE

CAPACITY / SIZE

Avoid Over-sizing

- Frequent cycling shortens component life
- Efficiency ratings are at steady-state
- Costs more & uses more power

Example: compare power draws of 2 units

15 ton: 15.7 kW

17½ ton: 18.9 kW

Added electric demand of 3.2 kW – \$300 per year

Insist that documented sizing calculations be performed using accepted ACCA or ASHRAE procedures. ACCA methods have sufficient built-in safety factors. Use ASHRAE design conditions.

SYSTEM DESIGN

- ◆ Use manufacturer's performance tables to determine real unit capacity (not nominal rating)
 - ◆ Select the model closest in capacity to the load
- ◆ Specify that TAB shall include supply air CFM, fan RPM, External SP, and EAT-LAT
- ◆ OA CFM must meet ASHRAE 62, provide exhaust makeup, *and* pressurize the building 0.02 to 0.04 in.wg [5 to 10 Pa]
- ◆ Consider price to avoid value-*un* engineering

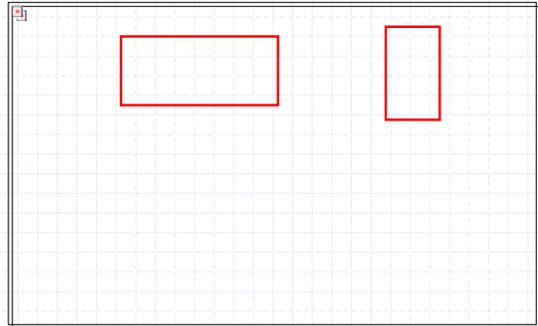
SYSTEM DESIGN

- ◆ Factory Equipment Options
 - Filter pressure drop sensor
 - Motorized fresh-air damper with Economizer
 - Communications interface
 - ~~High-Static Drive~~ – Use *static regain* duct design
- ◆ After-market Add-ons
 - **LPA** liquid pressure amplification
 - **EER-Plus** desuperheater / subcooler

MODEL SELECTION

- ◆ Efficiency Rating (IPLV, SEER, or EER)
- ◆ Fan motor efficiency rating
 - ◆ Fan is 10 to 20% of unit power draw [kW]
 - ◆ Fan is 20% to 50% of unit energy usage [kWh]
- ◆ Number of Stages
- ◆ Ease of Maintenance
- ◆ Price

MODEL SELECTION

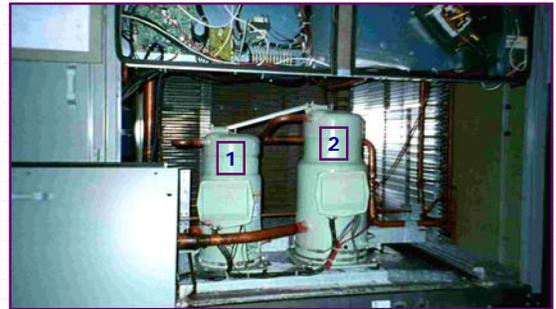


MODEL SELECTION



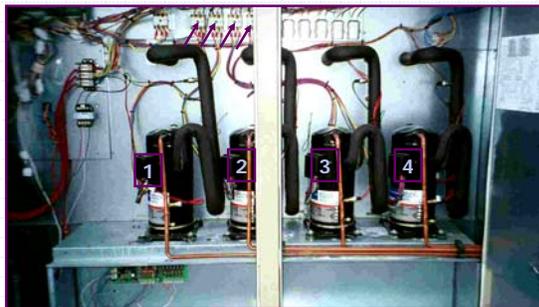
MODEL SELECTION

This unit has 2-compressors, but only 1 refrigerant circuit



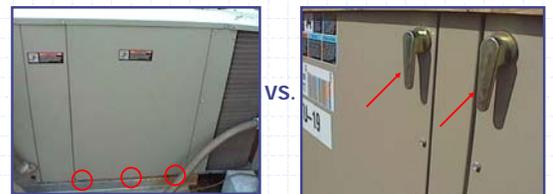
MODEL SELECTION

This unit has 4 compressors, but only 2 control stages



MODEL SELECTION

Ease of Maintenance



MODEL SELECTION

Dual Source - the energy efficiency of ground-source with the low first cost of air-source

- ✦ Uses ground-coupling to extend the delta-T available from ambient air

Application Example: MS Naval Training Classroom Building

24,730 square feet

Two 35-ton Roof Top Package Units

Electric Cost: STANDARD AC: \$17,600

DUAL-SOURCE: \$12,400 (30%)

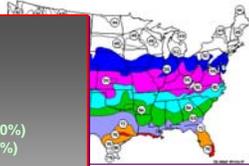
GEOTHERMAL: \$8,000 (55%)

Installed Cost / Payback

STANDARD AC: \$30,000

DUAL-SOURCE: \$49,000 / 3.6 years

GEOTHERMAL: \$125,000 / 9.9 years



INSTALLATION

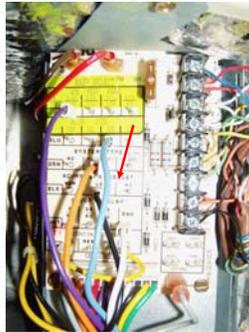
Motorized Fresh-air damper with Economizer



INSTALLATION

Operating EER can vary up or down by one point with the fan speed setting and proper matching of indoor and outdoor unit sections.

Check these details to ensure the rated EER is realized.



DUCTS

Air leakage and heat gain rob air-conditioning system efficiency.

- ✦ **The insulation level of traditional ducting is typically only R-4 to R-6 (1.5 to 2.2 inches).**
 - Specify R-8 (3-inches)
- ✦ **Leakage rates are typically 10% to 15% of total system airflow, sometimes higher.**
 - Specify ASHRAE Leakage Class-3
- ✦ **Test and Balance the Duct System**

OPERATION

- Select a thermostat that will retain settings through a power outage, and that has a lockout or adjustment limits
- Program temperatures and occupied / unoccupied periods



MAINTENANCE

... critical to realizing rated EER for the life of the unit



MAINTENANCE

- Numerous energy surveys clearly show that *lack of preventative maintenance is by far the major cause of air conditioning energy waste in FEDERAL buildings.*
- Common and costly problems include:
 - clogged, corroded cooling and condenser coils
 - sizeable duct leaks and cabinet air leaks
 - low refrigerant, *even in brand-new units*
 - maladjusted air dampers
 - un-calibrated or nonfunctioning thermostats

RECOMMENDED ACTION PLAN

1. **Determine** the **actual operating efficiency** of installed equipment. Compare with the best new equipment.
2. Identify units that are **candidates for replacement**
 - if existing EER is 4 or more points less than the best new units.
3. Identify units that are **candidates for upgrades**
 - existing EER is 2 to 4 points less than the best new units.
4. Identify units for a **thorough** preventative maintenance **check and tune-up** when the existing EER is within 2 points of the best available units.

**Achieving ENERGY EFFICIENCY
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Thank you!



Michael West, Ph.D., P.E.
Building Systems Scientist
Advantek Consulting, Inc.
mwest@advantekinc.com

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