

# **Sizing Heating & Cooling Systems**

**Tuesday, Sept. 9, 2008**

**ACI New Jersey Home Performance Conference  
for Whole House Energy Solutions**

**Atlantic City, NJ**

**Joe Kuonen**

**CLEAResult Consulting, Inc.**

# First of all:

- This is NOT an in-depth load calculation training session or software training session. That would require several days
- This is an overview of some of the capabilities and limitations of Manual J8, data input requirements, and a quick sample load on a small, simple home

# Sizing Equipment Properly

## Topics:

- Why bother? Is it worth the trouble?
- Benefits of properly sized vs. oversized/undersized equipment
- Manual J8 applicability: types of structures
- Limitations and guidelines for use of J8 AE (Abridged Edition)
- Input data; survey and inspection items
- Example load using Wrightsoft software tool

# Why bother? Is it worth the trouble?

## Benefits of properly sized vs.

### **OVERSIZED** equipment

- Reduces short-cycling, blasts of **hot** or **cold** air
- Better air mixing; more even temperatures, less stratification
- Allows time for equipment to reach **steady state**, improved “real-time” vs. “rated” efficiency
- Better dehumidification in cooling mode; “Bigger is not Better”

# Why bother? Is it worth the trouble?

## Benefits of properly sized vs. **OVERSIZED** equipment

- Smaller equipment is less expensive to purchase AND to operate
- Less air noise, better filtration
- Requires smaller, less expensive ducts

# Why bother? Is it worth the trouble?

## Benefits of properly sized vs.

### **UNDERSIZED** equipment

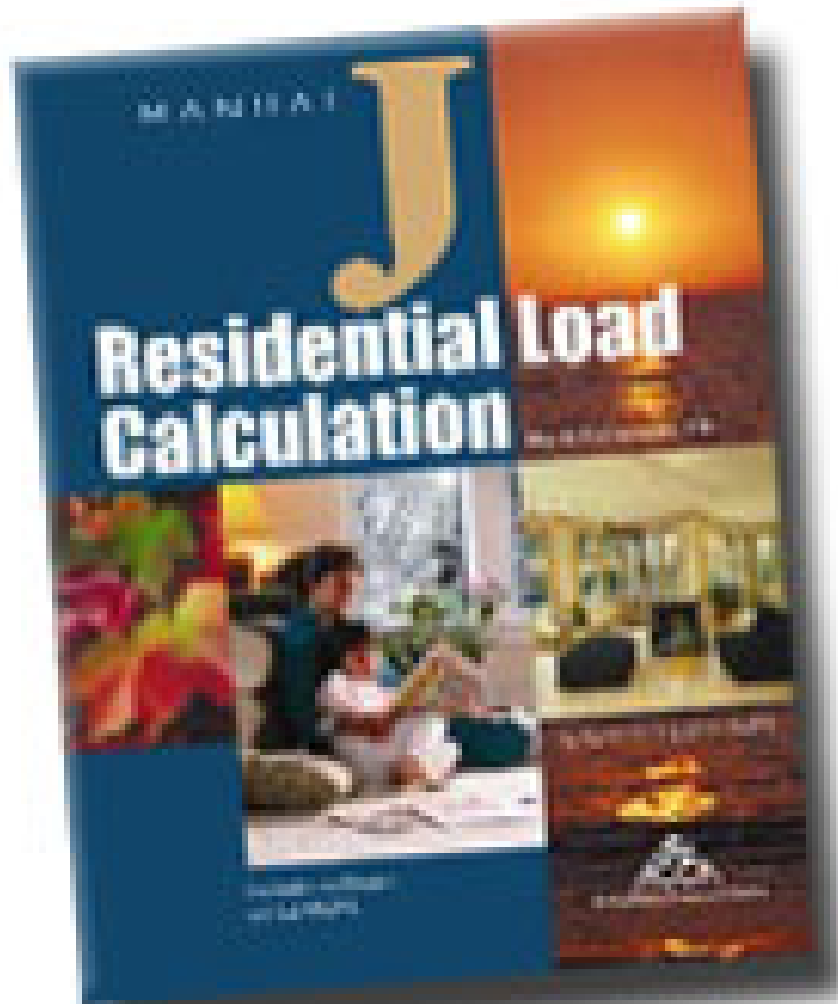
- Undersized equipment cannot meet the load requirements for comfort at peak conditions
- Homeowner responds by closing registers and interior doors, creating additional problems
- Compensation via window units, space heaters in problem areas

# Why bother? Is it worth the trouble?

## Benefits to contractor for properly sizing equipment

- Taking time to calculate and explain shows concern and care for customer
- Professionalism, differentiation
- Fewer callbacks, complaints, better referrals
- Documents building weaknesses, encourages whole-house approach including insulation, air sealing, duct repairs, etc. MORE \$ PER JOB

# What is ACCA Manual J?



# What is ACCA Manual J?

- A methodology and process for modeling the heat-loss and heat-gain characteristics of residential structures at “peak-load” conditions (1% design)
- A pre-requisite for proper equipment selection and distribution system design and construction

# Manual J8

**Produces equipment sizing loads for:**

- single-family-detached homes
- small multi-unit structures
- condominiums, town houses
- manufactured homes

# Manual J8

## **New version of MJ8:**

- “More user-friendly format”
- Incorporates tables, graphs, appendices for quick reference
- Incorporates recent developments and understandings in building science and modern construction techniques, window types, etc.

# Manual J8

**Unabridged MJ8 also accommodates exceptional architectural features and life style accessories such as:**

- Dwellings that have limited exposure or no exposure diversity
- Homes with large south-facing glass area or rooms with unusually large glass area
- A thermally isolated solarium
- “Sealed attics” and “sealed crawlspaces”
- Customized internal load estimates

# **MJ8: sensitive to a variety of construction materials and methods**

## **Including:**

- Fenestration loads for glass rated by the National Fenestration Rating Council (NFRC)
- Improved duct load models (leakage, insulation, & location impacts)
- Improved methods for estimating effects of internal and external shading devices
- Infiltration can be estimated based on blower door test

# MJ8:

- Sensitivity to latitude and altitude
- Sensitivity to skylight glazing material, curb construction and light shaft construction
- Heat gain sensitivity to roofing material, roof color and use of radiant barriers

## MJ8:

- Heat loss and gain for log walls, structural foam panels, aerated autoclaved concrete block, insulated form concrete panels, brick walls, concrete walls, wood foundation walls, other types of walls and insulation options

**Input data**

**Survey and inspection items**

# Location & outdoor design conditions

- Weather location: State & city
- Latitude & elevation
- Winter design temperature
- Summer design temperature
- Grains difference values: 45, 50, & 55% humidity
- Daily range

# Zoning requirements

- MJ8 AE does not apply to zoned systems
- Use unabridged edition of MJ8 for zoned systems

# Indoor design conditions

- Indoor dry bulb temperature, heating = 70 F
- Indoor dry bulb temperature, cooling = 75 F
- Indoor RH for a dry-coil climate = 45%
- Preferred indoor RH for wet-coil climate = 50%
- Acceptable indoor RH for a large latent load application = 55%

# Measure & identify construction components

- Compass orientation
- All surfaces that separate conditioned from unconditioned space
- Cavity insulation, sheathing, int/ext. bd. Insul.
- Window and door sizes
- Window glazing and frame type, storms, tinting, shading, screens, blinds, o'hangs, etc.
- Door type, storms present, etc.

# Measure & identify construction components

- Roof type & color
- Slab floor, crawl, basement, below-grade and above-grade walls, insulation type and amount
- Air leakage of structure (estimate or blower door)
- Duct leakage (measure or estimate degree of sealing)
- Supply & return duct type, location, layout (radial, perimeter, trunk & branch, etc.)

# **Measure & identify construction components**

- Attached buffer zones, garages, etc.
- Internal load survey (appliances, people, etc.)
- Retrofit possibilities and opportunities

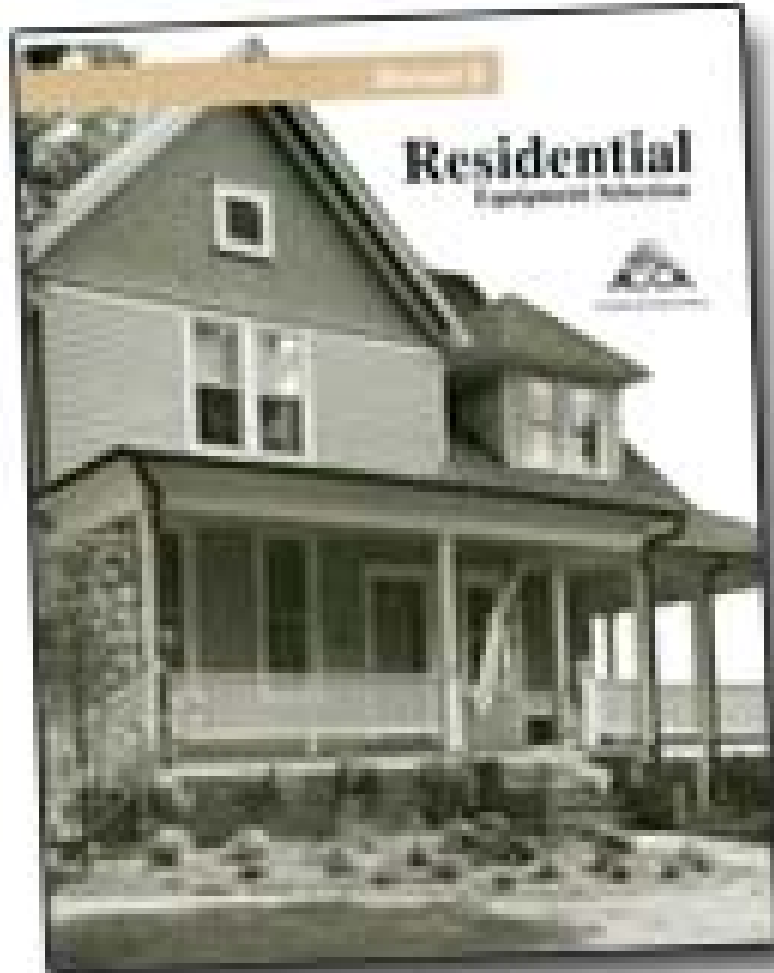
# Owner Interview

- Needs, expectations
- Design issues, indoor air quality, health concerns
- Combustion air and safety issues
- Allowable swings in temperature and humidity, zoning issues
- Appliances, internal & external shading
- Guests and entertaining loads

**Now, let's do one!**

# **Other valuable resources for your library**

# Manual S



# Manual S

- The essential companion to Manual J!
- How to select and size heating and cooling equipment to meet Manual J loads
- Sizing strategies for all types of cooling and heating equipment
- How to use comprehensive manufacturer's performance data on sensible, latent, or heating capacity for various operating conditions.

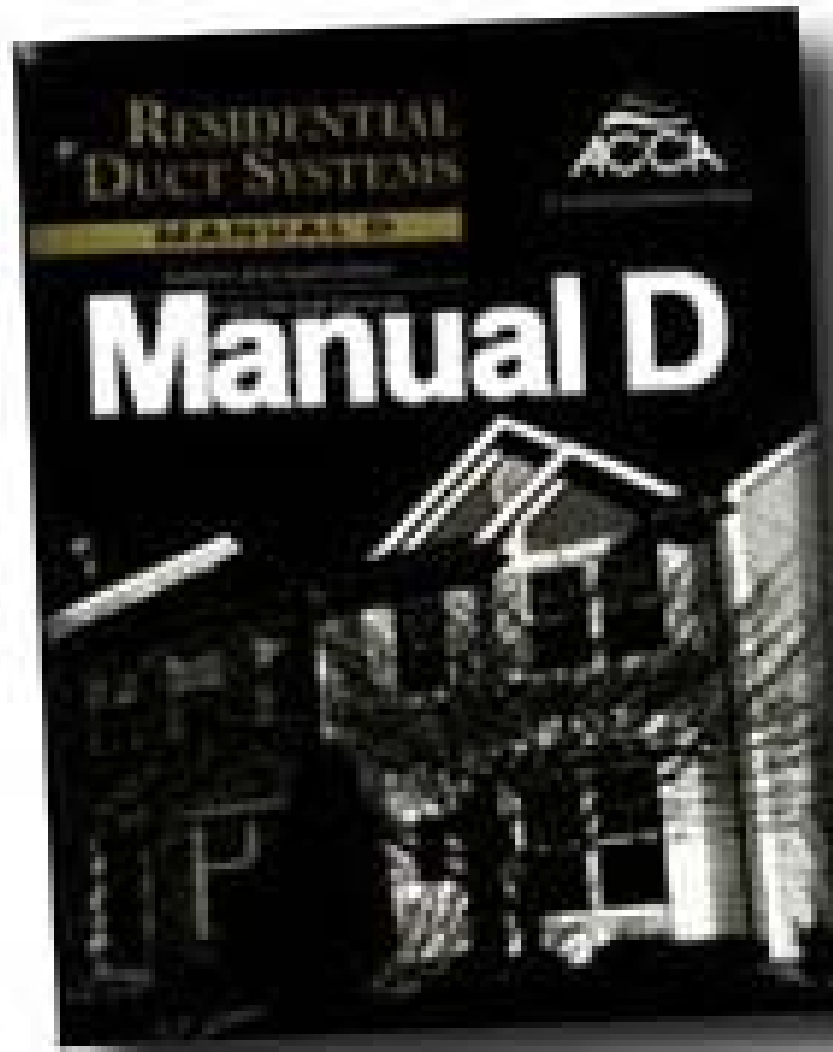
# Topics include:

- Comprehensive performance data compared with ARI directory data for air conditioners and heat pumps, and the presentation formats used by different manufacturers.
- How ventilation loads and air distribution system loads affect equipment size and performance.
- How to determine the condition of the air approaching the cooling coil when outdoor air is introduced into the return side of the duct system, including specific tables and charts.

# Topics include:

- Cooling-only equipment, air-to-air heat pumps, water-to-air heat pumps, dual fuel heat pumps, multispeed and variable speed equipment.
- Why the “400 CFM per ton rule” is a myth, why the blower CFM is exclusively defined by the sensible heat equation, why lower DX coil air flow rates are compatible with humid climates, and why water source refrigeration cycle equipment should not be sized to satisfy the design heating load.
- Thermal balance point diagrams for heat pumps.
- Economic balance points for dual fuel applications.

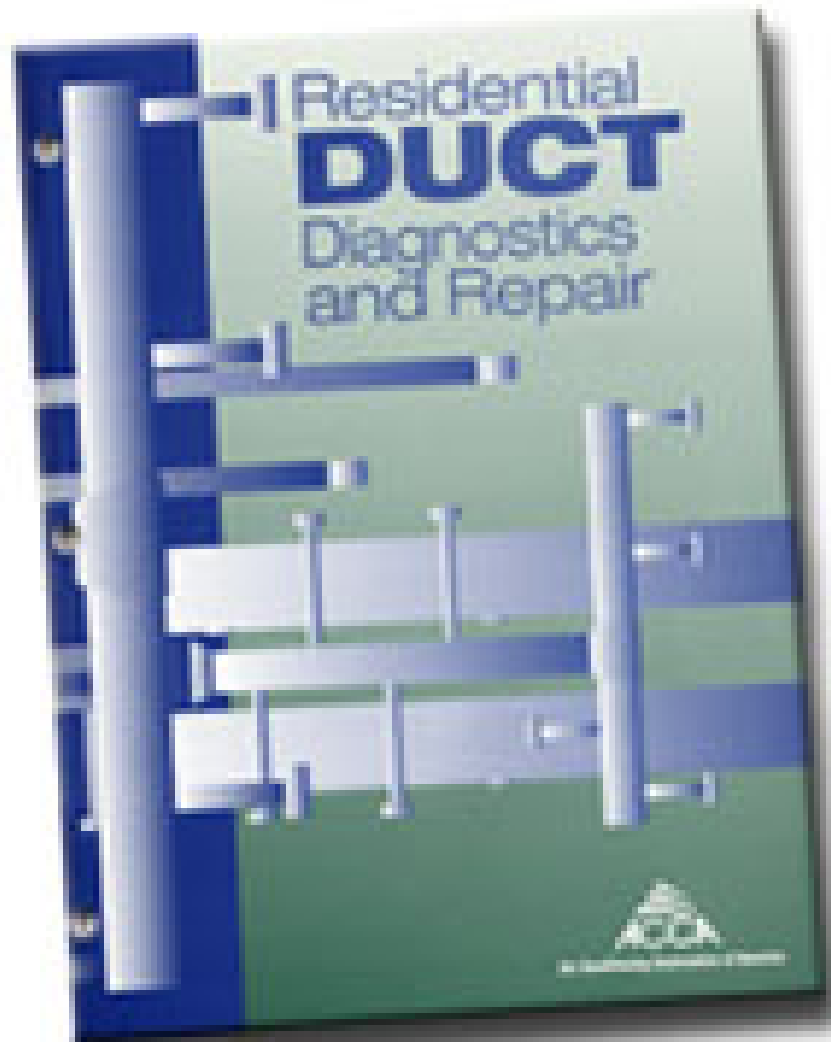
# Manual D



# Manual D Topics include:

- Residential duct system types, applications, and selection
- Residential air-side equipment
- Basic principles of multi-speed and variable speed blowers, pressure loss, operating point, and duct sizing calculations
- Examples of duct sizing calculations—constant volume systems, flexible duct, junction box systems, multiple-zone VAV systems, two-story VAV systems, and system retrofits with VAV dampers
- Duct losses—conductive losses and leakage losses and how duct leakage affects indoor air quality and the combined performance of the envelope equipment system
- Noise control

# Residential Duct Diagnostics & Repair



# Residential Duct Diagnostics & Repair

- Major issues concerning efficiency, comfort, health, and safety
- practical tips on installation and repair
- testing and diagnosing duct systems
- Intended for use by contractors, systems designers, advanced technicians, and other HVAC professionals.
- Focuses on how to:
  - Save money
  - Improve comfort
  - Protect health and safety
  - Improve envelope durability

**THANK  
YOU!**

# **Sizing Heating & Cooling Systems**

**Tuesday, Sept. 9, 2008**

**ACI New Jersey Home Performance Conference  
for Whole House Energy Solutions**

**Atlantic City, NJ**

**Joe Kuonen**

**CLEAResult Consulting, Inc.**