Understanding Sizing and Balancing

Objectives

In this course, you will learn about:

- The benefits of proper sizing and balancing of HVAC equipment and ductwork
- The importance of proper placement of equipment
- The importance of proper sizing and installation of refrigerant line sets
- Other factors influencing efficiency of the HVAC system

Importance of Proper Sizing & Balancing

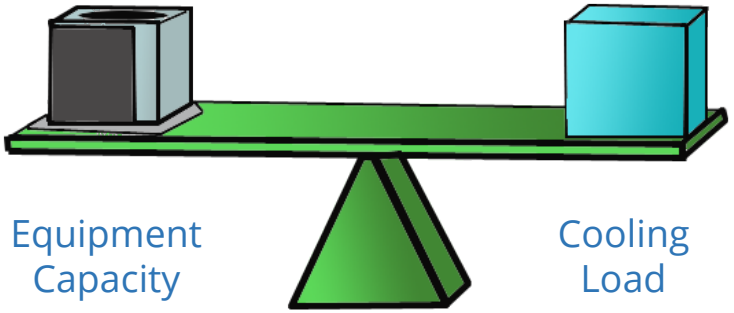
Introduction

- Efficiency of HVAC system depends on:
  - Selection & sizing of equipment
  - Location of equipment
  - Duct system & airflow
  - Refrigerant charge
  - Refrigerant line sizing and installation
  - Thermostat style, location, and adjustment

Sizing HVAC

Size to match cooling load

- For greatest efficiency, equipment must be sized to match cooling load on conditioned space
- *Too often, sizing is done without adequate thought to accuracy*

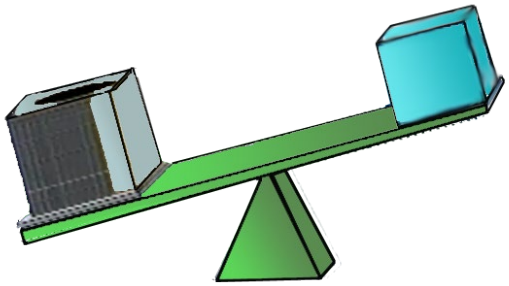


Sizing HVAC

Avoiding errors in sizing

- Avoid rough estimates and "rules of thumb"
- Don't size based on similar jobs
- Don't size using the size of existing equipment
- Don't use elevated design temperatures
- Measure – *Don't guess!*

Typical result: OVERSIZING



Sizing HVAC

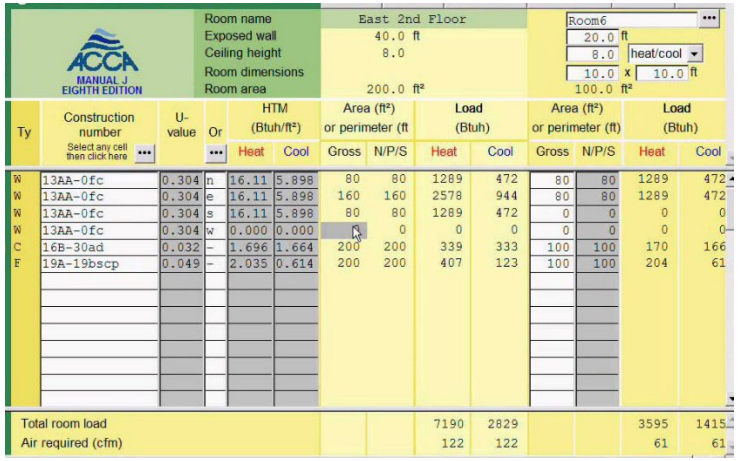
Consequences of oversized equipment

- High equipment costs
- Short cycling
- Ineffective humidity control
- Large swings in temperature
- Uncomfortable customers
- Low efficiency

Sizing HVAC

Benefits of accurate load calculation

- Efficiency increases
- Equipment lasts longer when well maintained
- Comfort is improved
- Utility costs are lowered
- Air balancing of the system is easier for the technician
- Customers are more satisfied



ACCA MANUAL J EIGHTH EDITION

Room name	East 2nd Floor
Exposed wall	40.0 ft
Ceiling height	8.0
Room dimensions	
Room area	200.0 ft²

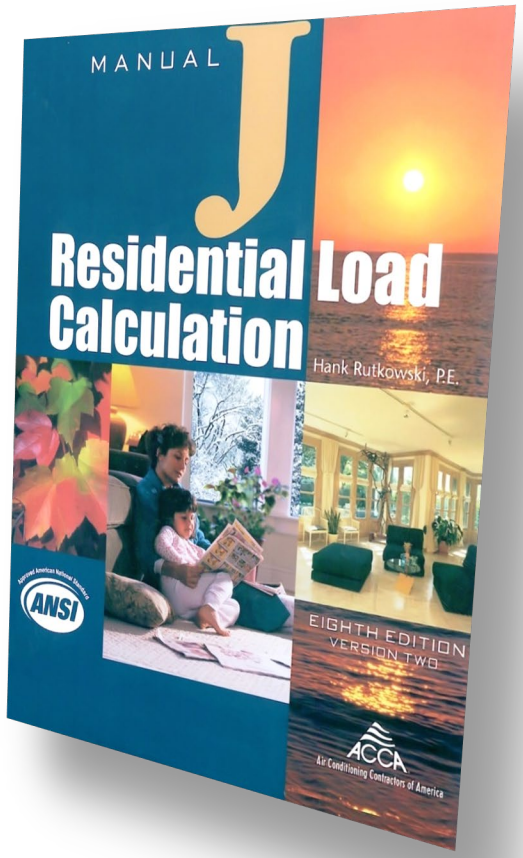
Room6: 20.0 ft; 8.0 heat/cool; 10.0 x 10.0 ft; 100.0 ft²

Ty	Construction number (Select any cell then click here)	U-value	Or	HTM (Btuh/ft²) Heat	HTM (Btuh/ft²) Cool	Area (ft²) or perimeter (ft Gross	Area (ft²) or perimeter (ft N/P/S	Load (Btuh) Heat	Load (Btuh) Cool	Area (ft²) or perimeter (ft) Gross	Area (ft²) or perimeter (ft) N/P/S	Load (Btuh) Heat	Load (Btuh) Cool
W	13AA-0fc	0.304	n	16.11	5.898	80	80	1289	472	80	80	1289	472
W	13AA-0fc	0.304	e	16.11	5.898	160	160	2578	944	80	80	1289	472
W	13AA-0fc	0.304	s	16.11	5.898	80	80	1289	472	0	0	0	0
W	13AA-0fc	0.304	w	0.000	0.000	0	0	0	0	0	0	0	0
C	16B-30ad	0.032	-	1.696	1.664	200	200	339	333	100	100	170	166
F	19A-19bscp	0.049	-	2.035	0.614	200	200	407	123	100	100	204	61
Total room load								7190	2829			3595	1415
Air required (cfm)								122	122			61	61

Sizing HVAC

Manual J

- Tool of choice for most technicians to do a load calculation
- Electronic versions are available



Sizing HVAC

Selecting equipment to match the load

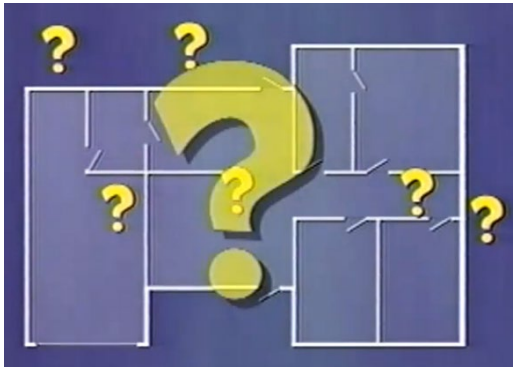
Once load is calculated – both latent and sensible…

- Select equipment matching total sensible with a maximum safety of about 10%
- Do not oversize above the 10% tolerance
- According to EPA, oversizing can lead to efficiency loss of as much as 10%

Equipment Location

Impact of equipment placement

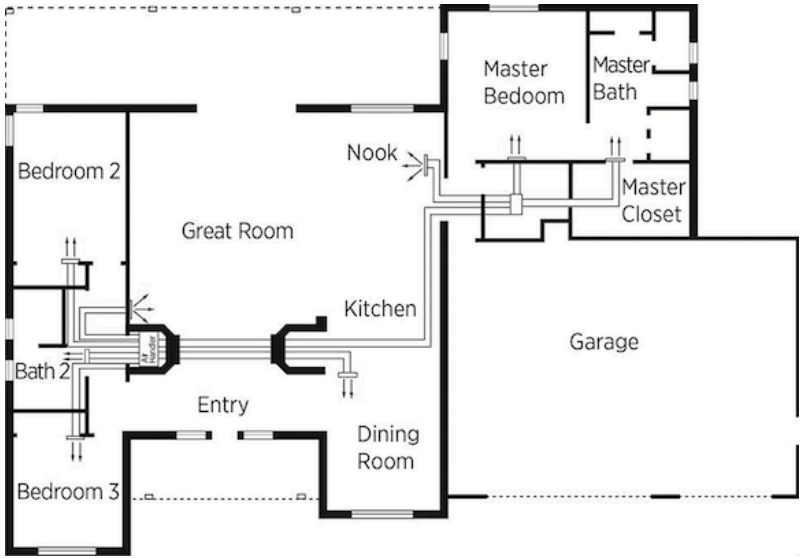
- When technician has some input into the location of equipment, use that say wisely
- Location of indoor and outdoor equipment can have a major effect on efficiency of the system



Equipment Location

Indoor equipment

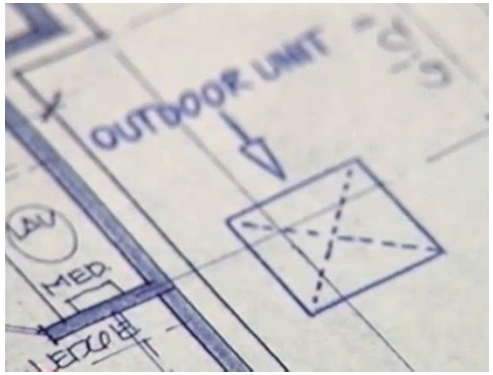
- Keep duct runs short
- Plan efficient and quiet airflow
- Allow easy service access

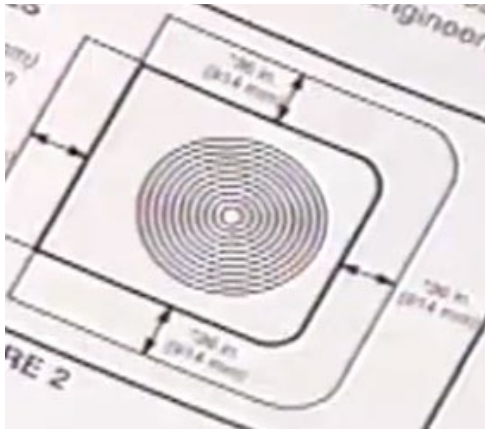


Equipment Location

Outdoor equipment

- When possible, locate the outdoor unit on the north or east side
- Meet minimum clearances specified by manufacturer
- Follow-up with customer to make them aware that shrubs and bushes must be maintained with minimum clearance to the condensing unit





Duct System & Airflow

Good airflow & equipment location

- Good airflow foundation begins with location of equipment
- Well-designed duct system depends partly on placement of indoor unit
- Outside – clear air stream through the condenser is a must for efficient heat transfer

Duct System & Airflow

What's the problem?

- Equipment appears to be sized correctly to match the load
- All components appear to be operating
- The charge appears to be ok
- BUT – customer complains:
  - Poor temperature control
  - Poor humidity control
  - High utility bills

A few quick checks lead to a major problem:

Airflow is too low!

Duct System & Airflow

What's the problem? – cont.

- Evaporator is receiving too much refrigerant for the airflow
- Liquid might be flooding back
- Coil is cold – but not enough air is delivered

In this installation, the ducts are too small for the equipment capacity.

Duct System & Airflow

Problems from poor airflow and duct design

- Efficiency loss
- Total CFM is too low
  - Installed cooling capacity drops
  - Latent cooling control is lost
  - Uncomfortable humidity levels
  - Compressor is less reliable

Duct System & Airflow

Problems from poor airflow and duct design

- Total CFM is too high
  - Less dehumidification
  - Uncomfortable humidity levels
  - Air leakage and capacity loss
  - Lower blower efficiency
  - Higher operating costs

Duct System & Airflow

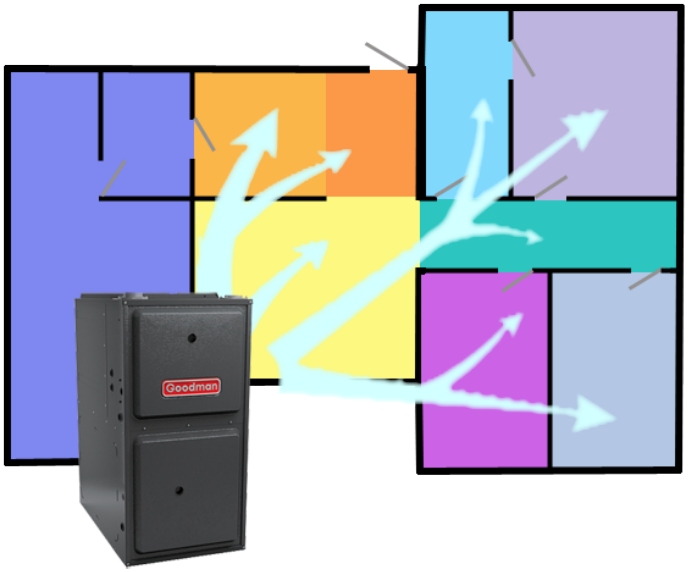
Keys to proper airflow design

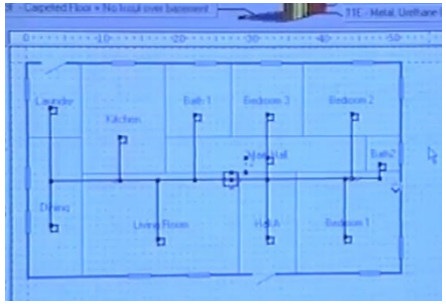
- Duct sizing
- Connection, sealing, & insulation
- Duct balancing

Duct System & Airflow

Duct sizing

- Manual J tells you the total CFM required to match the total sensible load
- Typically, total CFM is between 350 and 450 per ton of cooling
- Total CFM is divided in proportion to cooling load of each room
- Precise calculations = supply blower and duct design that operate with optimum efficiency
- Each duct run laid out to deliver required CFM at proper velocity with minimum thermal losses and leakage

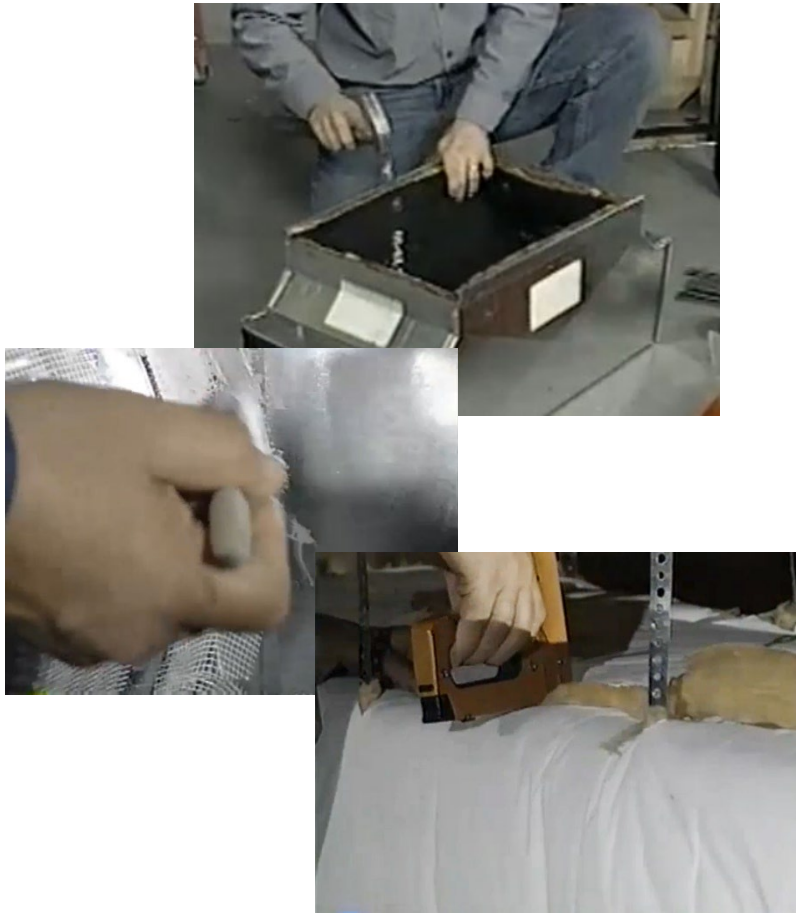




Duct System & Airflow

Connection, sealing, & insulation

- Construct ducts to minimize thermal loss and leakage
- Follow manufacturer recommendations and Manual D for guidelines on installation
- Connect and seal ductwork
- Insulate wherever possible
- If ductwork must be run outside the structure, make sure it's insulated & weatherproofed



Duct System & Airflow

Duct balancing

- Adjust and balance for the CFM required in all spaces that must be cooled
- If possible, include balancing dampers

Refrigerant Charge

Charge affects efficiency

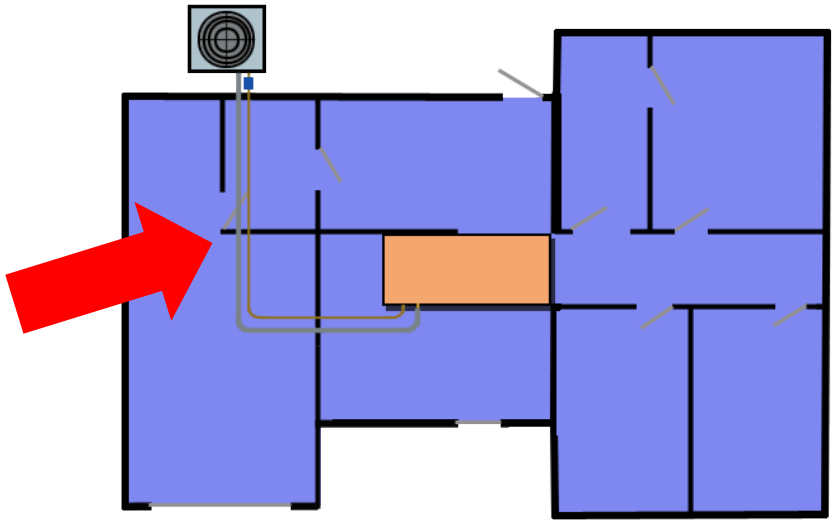
- Check refrigerant charge using correct method
  - Superheat method for cap tube systems
  - Sub-cooling method for TXV systems
- System with low charge:
  - Loses capacity & efficiency
  - Suction gas flow drops
- System overcharged:
  - Loses capacity & efficiency
  - Possibility of evaporator flooding increases
  - Liquid flood-back more likely

Refrigerant Line Sizing & Installation

Sizing guidelines

- Typically most manufacturers design equipment for max line length of 50 ft
- Suction line – sized to keep pressure drop low but efficiency up
- Liquid line – undersized line causes possible liquid flashing with loss of capacity and efficiency

Don't exceed manufacturer's max line length

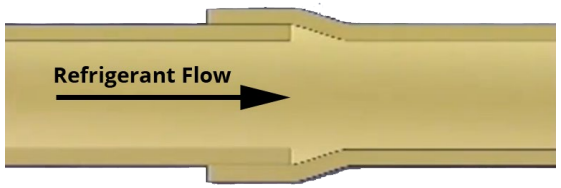


Refrigerant Line Sizing & Installation

Installation guidelines

- Use long radius elbows
- When using swaged fittings, try to put swaged fitting or tube downstream
- Insulate suction line with at least 3/8th inch insulation (1/2 inch preferred)
- Don't insulate liquid line unless routed through unconditioned space
- Make sure the system has been properly evacuated

Long radius elbow fitting



Swaged fitting

Thermostat Location

Proper placement

- Mount close to a return
- Keep it away from a supply diffuser
- Use an interior wall
- Avoid close proximity to windows or exterior doors