METHODOLOGY: DOCUMENTATION

This initial step for the environmental management team not only provides the information needed to proceed, but is also an important team-building exercise. The discovery and sharing of information, commonly used terminology, job responsibilities and background knowledge can create a better working relationship between team members and a strong sense of shared responsibility for long-term collection preservation.

Documentation worksheets are provided in this section and broken into three categories:

- Documentation of the building
- Documentation of mechanical systems
- Documentation of storage and exhibition spaces

The information that is collected for these documents will help paint a picture of the facility and the air handling system and determine the parameters for any testing that will be employed. The collected information will shed light on building occupancy, use, air distribution, what the system can do and what temperature and RH levels the collection can withstand, among other information. The team will use this information to help formulate a plan for what strategies can be employed and how to employ them. The more data that is available the easier the strategies may be to plan.

It is not necessary to have all the information or documentation that is suggested. Some institutions may have little to none of this information, while other institutions will have most of the documentation readily available. Not having all of the recommended documents should not end the project. If the documentation is missing, some of it can be found by asking the right staff members or determined by an examination of the building or system. For example, not knowing the design dew point control of a system can be substituted by installing dataloggers and tracking and evaluating dew point conditions in the system and spaces. If mechanical drawings are missing, cartooning can replace a section diagram, and zone maps can be created by following ductwork and drawing it in on a floor plan of the facility.

Recreating or creating some of this documentation should be an important consideration whether for the project or for institutional knowledge. It is very useful in a facility to know the system operation or what air handling unit serves what area of the building. Learning the facility and its operation will benefit the team as a whole. There is a good chance that some of the documentation may not have ever existed for a facility. In this case the team should build what they can, be aware of what they might be missing, and proceed with data gathering, which may help fill in some of the gaps. Again, not having all of this documentation should not immediately terminate the process.

The worksheets that follow include lists of certain information and documentation that may prove useful in the optimization and sustainable preservation process; however, these are by no means all-inclusive. Institutions may find additional documentation or material beyond these lists that apply to the building, system, or preservation environment – take advantage of whatever information you can find.

Documentation Meetings

Pre-meeting Process

- Each team member gathers all available and relevant documentation from their area of responsibility (see Documentation Worksheets).
- Each team member prepares a short-description of the following, according to their responsibilities and perspectives:
    - Their goals for the project
    - Current advantages (things that are going right)
    - Current shortcomings (things that need improvement)
- Conduct a team walk-through of the collections spaces and mechanical systems to be examined during the process.
- Create a main project collection point, (binder, folder on a shared file server) where all information and files pertaining to the project can be stored and accessible to the team. Note that this resource should consist of copies of the original documentation – all original copies should remain with the office where they originated.

Initial Documentation Meeting Activities:

- Focused group, often 3 to 5 individuals
- Statement of current/primary concerns regarding:
    - Preservation
    - Energy use
    - Mechanical system capabilities
- Establish documentation goals and plans for the use of this information:
    - Identify which spaces hold collection materials for storage, exhibition, etc. (use floor plans to identify each).
    - Identify which mechanical systems serve which collections spaces (use zone maps and mechanical drawings to confirm). Note instances of:
        - One system serving one space
        - Many systems serving one space
        - One system serving many spaces (including spaces that are not collections)
    - Identify non-collections spaces that may also be served by the same air-handling units.
- Identify and review your ability to measure the actual storage climate over time in each area where

significant collections are housed (dataloggers, data analysis software).

- Identify your ability to document and verify mechanical system operation and current environmental data gathering capability of mechanical systems (BMS trending software, data logging).
- Identify the need for any additional documentation from each area:
    - Additional or improved data logging – number of dataloggers needed and locations where the dataloggers will be placed
    - Upgraded data analysis software
    - New or improved trending software
    - Other documents to be located or created

Follow-up Documentation Meeting Activities

- Begin creating zone maps and mechanical cartoons if needed; these can also be worked on and completed during the Data Gathering phase.
- Gather any documentation or information identified as missing during the initial Documentation meeting.
- Continue adding documentation to the team binder/file share, including lists of missing documentation, project and equipment needs, etc.
- Full documentation and review among the team may take 2-3 meetings, depending on the availability and quantity of material.

Collection Space Documentation to Gather:

- Type of collection – information about material types, risks, (including risk assessment if available), existing degradation
- History of concerns (leaks, insects, mold, dust, etc.)
- Housing – storage layout equipment and housing
- Space use information – storage/exhibition, etc., hours of occupancy, lighting (type, quantity, method of control)
- Collected environmental data
    - Number, location, and type of dataloggers in use
    - Date range of available data
    - Temperature, relative humidity, and dew point graphs (digital or analog?)
- Documentation of the mechanical system(s) serving the space

- Locations of supply air diffusers and return air intakes
    - Positive vs. Negative Pressurization – test at doors and windows with a tissue or light piece of paper. If the tissue blows into the room, the room is negative. If it pushes against the door or window, the room is positive.

Collection Space Documentation Worksheet

Building: Floor:

Room Number/Name:

Primary Use: ☐ Storage ☐ Exhibition ☐ Accessioning/ Cataloging

☐ Other

Storage Furniture:

☐ Open shelving ☐ Closed cabinets ☐ Compact shelving

☐ Rolling racks/ Wall mounted racks ☐ Rolled textiles

☐ Other

Are materials stored in boxes and/or covered in some manner?

Environmental Documentation:

☐ Collection risk assessment

☐ Preservation requirements (Optimal conditions)

☐ Previous conditions

Notes:

Dataloggers in the space:

Datalogger Type	Location	Serial #	Comments

Mechanical System Serving the Space:

AHU #(s):

Sketch of space: (Mark locations of thermostats, other sensors, supply and return vents)

Is the space positively or negatively pressurized?

Number and Type of Stand-alone Conditioning Units Used in the Space:

☐ Humidifier ☐ Dehumidifier ☐ Fan

☐ Other:

Lighting:

☐ Type: ☐ Hours of use:

Structural Information:

Number of exterior walls: Insulated? Vapor barrier?

Number of exterior doors: Sealed?

Number of windows: Protection from natural light?

Number of interior doors:

Use of surrounding spaces:

Sources of water (pipes, sinks, nearby bathrooms, utility closets, etc.):

Occupation of Space:

Human occupation - frequency of work or other activities in the area:

Types of ongoing activities:

Hours of occupation:

Office or other equipment use:

Concerns (note, location, date, etc.):

Leaks:

Pest incursions:

Mold:

Dust:

Building Documentation to Gather:

Don't expect to find everything on the list – gather what is available to you.

- Current floor plans (simple view – can often use copies that are required for building safety)
- Original floor plans
- As-built original architectural drawings
    - Architectural series
    - Information on wall construction, insulation, and vapor barrier
- Current architectural drawings (any updated drawings of the spaces in question)
- Building envelope studies
- Air-handling zone maps
- Occupancy (public and staff hours)
- Energy usage data (cost/usage compared to goals)
- Current plans for future building updates
- Note and mark all door and window locations on the building map
- Optional:
    - Fire protection drawings and information
    - Plumbing drawings showing location of pressurized water lines and floor drains
- Other (on as needed basis):
    - _____
    - _____
    - _____

Notes: _____

_____

_____

_____

HVAC Documentation to Gather:

Don't expect to find everything on the list – gather what is available to you.

- As-built original mechanical series (should include heating, air conditioning, and ventilation information)
- As-built original electrical series
- Design schedule for the mechanical system
- Current mechanical series (any updated drawings to the systems in question)
- Current electrical series
- Original sequence of operation, including:
    - System set points
    - Operating schedule
- Current sequence of operation
- Air-balancing studies
- Plans for future mechanical updates
- Other (on as needed basis):
    - _____
    - _____
    - _____

Notes: _____

_____

_____

_____

How to Fill Out the HVAC Worksheet

What you will need

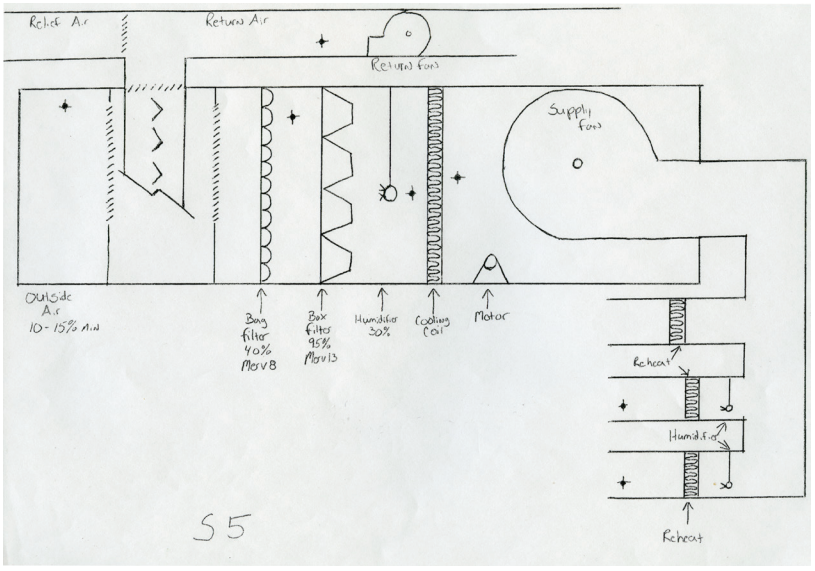
- Access to your mechanical system
- Assistance from your facilities or maintenance staff
- A cartoon sketch of your AHU
- Blueprints
    - Preferably the M series of prints. This is the series of prints that details the HVAC system layout and design. In the M series you will need to locate the schedule for the HVAC system and the prints that indicate the AHU location and duct layout.

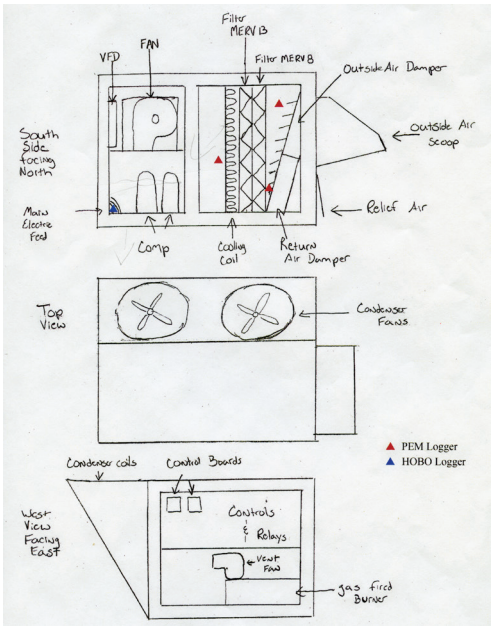
Mechanical System Cartoon

Your cartoon does not have to be perfect. It is a reference, and provides two major advantages:

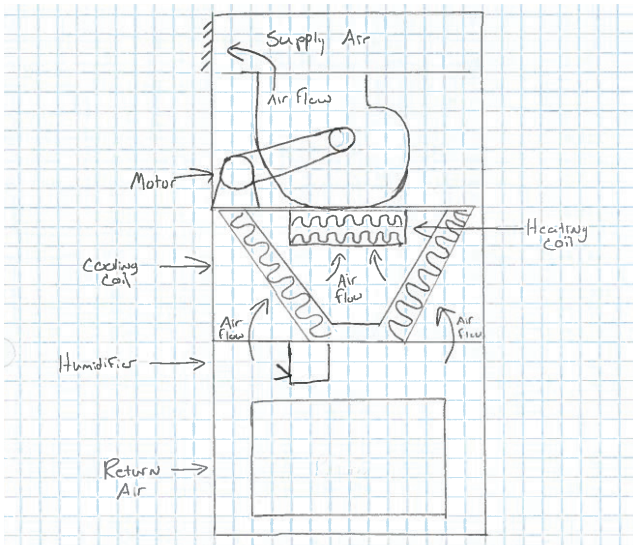
- It helps you understand the layout and air flow inside your unit. This will help you understand what work is done to the air and where.
- It also provides a reference for the unit that you can refer to at any time. If a component were to fail in the unit, the cartoon can help you understand exactly how that will effect your environment.

Below are a few examples of what your cartoon may look like:





Below is a mechanical system (left) and a cartoon for the system (right):



HVAC Worksheet

Begin by filling out the mechanical system notes section of the form.

Location: The room or area of the building that the system is located in.

Type: Is the unit a roof top unit, standalone, dual duct, etc.

Manufacturer: Who built this unit?

Model & Serial number: May be available by locating a name plate on a unit. However, not all units are labeled with a model and serial number.

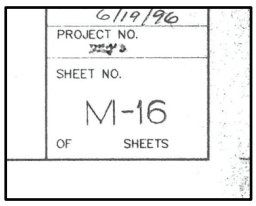
BMS system: Is this unit on a BMS system?

Locating the Prints

Drawing Number System

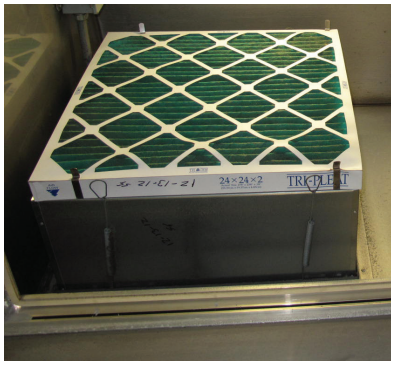
- There is a specific number system designed for organizing blueprints
- This number can be found in the title block of the print
- This will help you locate a print for a specific area faster
- A cover page for the blueprints will sometimes break down what drawings are included and how many pages there should be for each

A = Architectural
C = Civil
E = Electrical
F = Fire Protection
I = Interior Furnishings
L = Landscape
M = Mechanical
P = Plumbing
Q = Equipment
S = Structural
T = Telecommunications

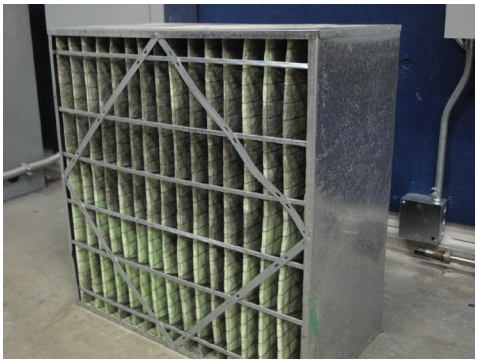


Filter Capacity

The filter capability section is best filled out by visiting the unit and seeing first hand what filters are being used. Below are sample images of some filters you may find in a unit. Most units will likely have only one or two of these filters.



Pleated or Pre-filters



Box Filters

Charcoal Filters

Gas Phase

Bag Filters

The MERV rating can be found on the side or label of most filters

Standard Air Filters

PRE Filter (G Class)	< 65%	MERV 1	G1	Am < 65%	Particle bigger than 10.0 μm • Pollen • Spanish moss • Dust mites • Sanding dust • Spray paint dust	• Minimal filtration • Residential • Window A/C units
	65-70%	MERV 2	G2	65% ≤ Am < 80%		
	70-75%	MERV 3				
	75-80%	MERV 4				
	80-85%	MERV 5	G3	80% ≤ Am < 90%	Particle size within 3.0 μm-10.0 μm • Mold • Spores • Hair spray • Cement dust • Snuff • Powdered milk	• Commercial buildings • Better residential • Industrial workplace • Paint booth inlet
	85-90%	MERV 6				
	25-30%	MERV 7	G4	90% ≤ Am		
	30-35%	MERV 8				

Am: Average arrestance efficiency for coarse filters Em: Average efficiency for fine filters

High Efficiency Air Filters

HEPA Filter (H Class)	≥ 95% at 0.3 μm	n/a	H10	≥ 85% at MPPS	Particle bigger than 0.3 μm • Virus (unattached) • Carbon dust • Sea salt • All combustion smoke • Radon progeny	All types of cleanrooms
	≥ 98% at 0.3 μm		H11	≥ 95% at MPPS		
	≥ 99.97% at 0.3 μm	TYPE A				
	≥ 99.99% at 0.3 μm	TYPE C	H12	≥ 99.5% at MPPS		
	≥ 99.995% at 0.3 μm		H13	≥ 99.95% at MPPS		
	≥ 99.999% at 0.3 μm	TYPE D	H14	≥ 99.995% at MPPS		
ULPA Filter (U Class)	≥ 99.9995% at 0.12 μm	TYPE F	U15	≥ 99.9995% at MPPS	Particle size bigger than 0.12 μm	Super cleanroom
	≥ 99.99995% at 0.12 μm		U16	≥ 99.99995% at MPPS		
	≥ 99.999995% at 0.12 μm		U17	≥ 99.999995% at MPPS		

MPPS: Most penetrating particle size

Blueprints

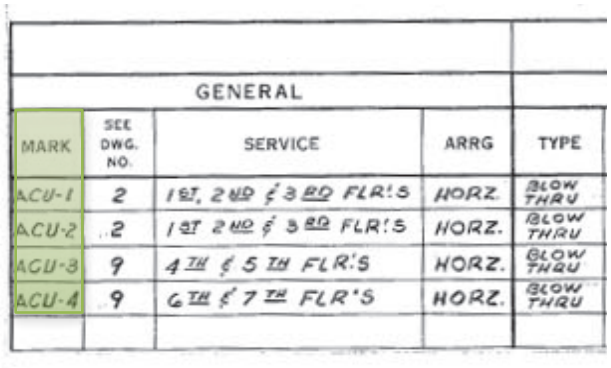
- Be sure to verify with your facilities or maintenance department the accuracy of your prints.
- Older prints may have out-of-date information as components are repaired, replaced or upgraded over time.
- "As-built" prints are the better prints to have. Any final changes to design or layout during construction should be included in the as-built prints.

No Prints

- If no prints are available for the equipment, specifications for the equipment may be found by searching online using the manufacturer and model number as the query.
- For some smaller equipment a user or installation manual is available that can provide the necessary information. If these are not available to you on-site, many can also be found online once you know the correct model and serial number.

Reading the AHU Schedule

- Not all schedules will look the same
- Not all prints will have all of the necessary information on them
    - Some prints will not have the exiting wet and dry bulb conditions
    - Some schedules may not have fan speeds
- Using the prints you have, try to get as much information as possible to complete the HVAC forms.

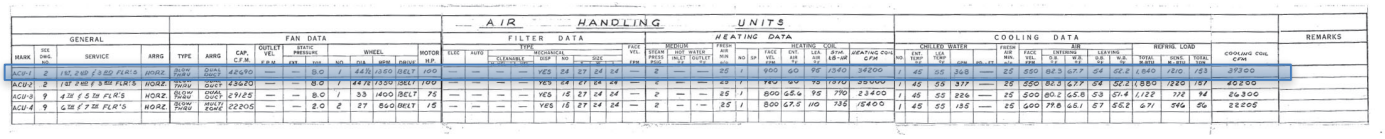


GENERAL				
MARK	SEE DWG. NO.	SERVICE	ARRG	TYPE
ACU-1	2	1ST, 2ND & 3RD FLR'S	HORZ.	BLOW THRU
ACU-2	2	1ST 2ND & 3RD FLR'S	HORZ.	BLOW THRU
ACU-3	9	4TH & 5TH FLR'S	HORZ.	BLOW THRU
ACU-4	9	6TH & 7TH FLR'S	HORZ.	BLOW THRU

The highlighted section of the schedule contains the unit name or number.

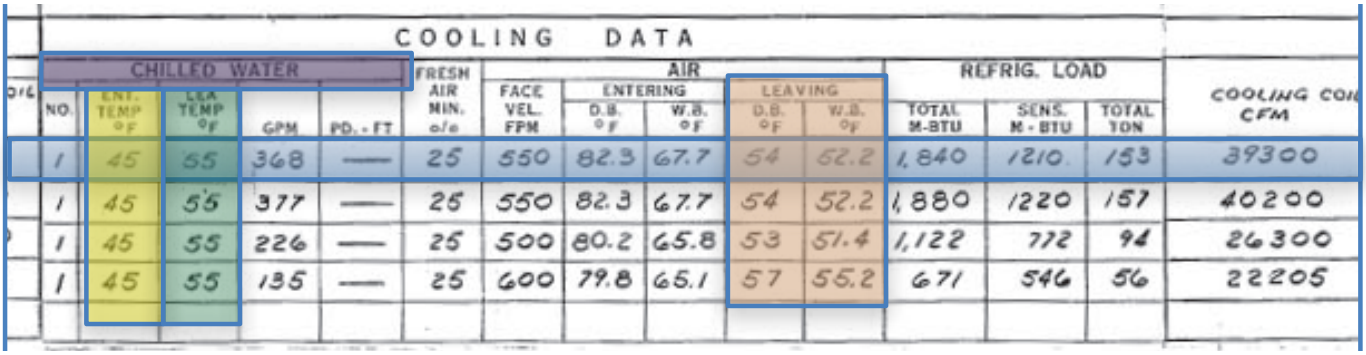
Locate the AHU that will be used for the study.

Throughout the remainder of these instructions we will use ACU -1.



Cooling Capacity

- Type of cooling: For this system chilled water is used. See
- Entering water temp: Will be 45°. See
- Leaving water temp: Will be 55°. See
- Designs:
    - Leaving WB: Will be 52.2°. See
    - Leaving DB: Will be 54°. See
    - To determine the DP a psychrometric chart or online psychrometric calculator can be used. The following website is one example: http://www.csgnetwork.com/dewptrelhumcalc.html
- Face and Bypass: This may be determined by examining the unit. While inspecting the unit is there an alternative path for the air to pass around the cooling coil?

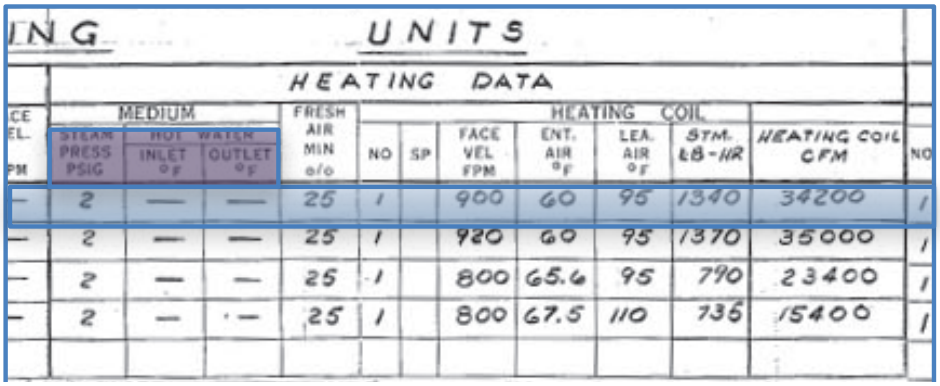


COOLING DATA

	CHILLED WATER				FRESH AIR MIN.	AIR FACE VEL. FPM	AIR ENTERING D.B. °F	AIR ENTERING W.B. °F	AIR LEAVING D.B. °F	AIR LEAVING W.B. °F	REFRIG. LOAD TOTAL M-BTU	REFRIG. LOAD SENS. M-BTU	REFRIG. LOAD TOTAL TON	COOLING COIL CFM
NO.	ENT. TEMP °F	LEA. TEMP °F	GPM	PD. - FT	o/o									
1	45	55	368	—	25	550	82.3	67.7	54	52.2	1,840	1210	153	39300
1	45	55	377	—	25	550	82.3	67.7	54	52.2	1,880	1220	157	40200
1	45	55	226	—	25	500	80.2	65.8	53	51.4	1,122	772	94	26300
1	45	55	135	—	25	600	79.8	65.1	57	55.2	671	546	56	22205

Heating Capacity

- Type of heating: For this system steam heat is used. See
- Heater location: This may be determined by examining the unit. Note where the heating coil is located in the unit.
- Reheats: Note if there are reheats located downstream in the ductwork. These may also be indicated elsewhere in the mechanical schedule.
- Mixing boxes: Note if there are mixing boxes downstream in the ductwork.
- Terminal VAV reheat: Note if there are VAV reheats downstream in the ductwork.



ING UNITS

HEATING DATA

MEDIUM			FRESH AIR MIN	HEATING COIL							
STEAM PRESS PSIG	HOT WATER INLET °F	HOT WATER OUTLET °F	o/o	NO	SP	FACE VEL FPM	ENT. AIR °F	LEA. AIR °F	STM. LB-HR	HEATING COIL CFM	NO
2	—	—	25	1		900	60	95	1340	34200	1
2	—	—	25	1		920	60	95	1370	35000	1
2	—	—	25	1		800	65.6	95	790	23400	1
2	—	—	25	1		800	67.5	110	735	15400	1

Humidifier Capacity

This information may be found on the schedule or may be found by examining the unit.

- Type of humidifier: This is the type of humidification used by the system.
- Humidifier location: Note where the humidifier is located in the system.

Desiccant Type

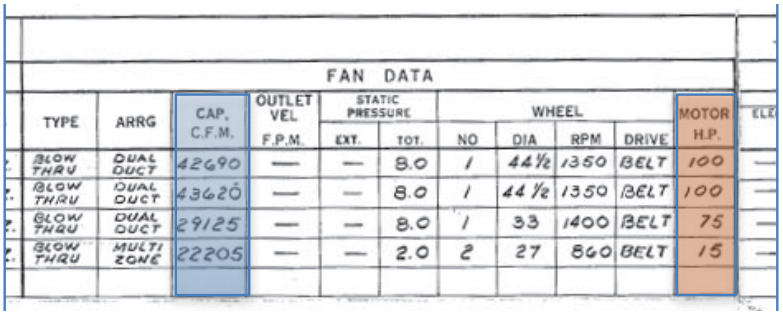
The desiccant would be an additional form of dehumidification that the system utilizes. This feature does not exist on all air handling systems. This information may be found on the schedule or may be found by examining the unit.

System Controls

- System Controls: Which method of control is used by the HVAC system.
- Brand: Which brand of control system is used.
- Interface: What type of interface is used between the system and brand.

Fans

- Most systems do not utilize all three types of fans. Many only use one or two fans.
- The information should be found in the schedule or on the prints. However, some information may require examining the unit.
- CFM: 42690 CFM. See
- Motor HP: 100. Can be found in schedule See or on the nameplate of the motor.
- Motor in airstream: Is the motor on the system located inside the unit or outside the unit? A motor located within the air stream can potentially add heat to the air.
- Hand Amp reading: Can be obtained by measuring one leg of power going into the VFD. **(NOTE: this should be performed by an experienced individual)**
- VFD: Is there a Variable Frequency Drive on the fan.



FAN DATA

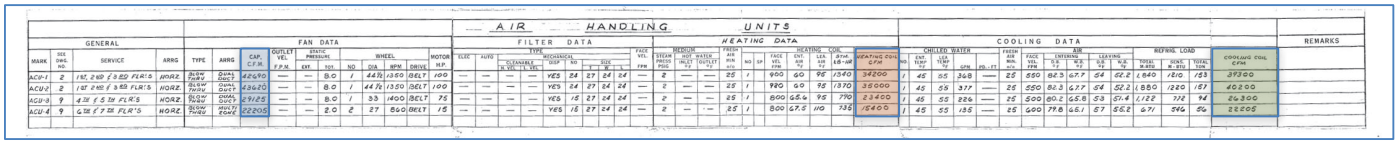
TYPE	ARRG	CAP. C.F.M.	OUTLET VEL F.P.M.	STATIC PRESSURE EXT.	STATIC PRESSURE TOT.	WHEEL NO	WHEEL DIA	WHEEL RPM	WHEEL DRIVE	MOTOR H.P.
BLOW THRU	DUAL DUCT	42690	—	—	8.0	1	44½	1350	BELT	100
BLOW THRU	DUAL DUCT	43620	—	—	8.0	1	44½	1350	BELT	100
BLOW THRU	DUAL DUCT	29125	—	—	8.0	1	33	1400	BELT	75
BLOW THRU	MULTI ZONE	22205	—	—	2.0	2	27	860	BELT	15

Condensing Unit and Settings

- Condensing Unit: What type of condensing unit is used for the system?
- Operational Settings: What are the daily temperature and humidity operational settings for the system? Are there any nightly setbacks used?
- Set points: Are seasonal set points used for winter and summer?
- Damper Type: This information may require examining the unit. Are the dampers for the system motorized or fixed? What is the position of the dampers when inspected?

Air Flow

- Total airflow: Total airflow for this system is 42690 CFM. See
- Airflow over coils
    - Heating Coil: 34200 CFM. See
    - Cooling Coil: 39300 CFM. See
- Outside Air: This would be the amount of air the system brings in from outside the building. This is not listed on this graphic.
- % Bypass: This would be the maximum amount of air that can bypass one of the coils. No bypass is available on this system.
- Economizer: This would be the amount of air the system was designed to use in economizer mode. No economizer mode is available on this system.



AIR HANDLING UNITS

MARK	SERVICE	ARRG	TYPE	ARRG	CAP. CFM	FAN DATA: OUTLET VEL F.P.M.	STATIC PRESSURE EXT.	WHEEL DIA	NO	DIA	RPM	DRIVE	MOTOR H.P.	FILTER DATA: ELEC	AUTO	TYPE	CLEANABLE NO. SIZE	MECHANICAL NO. SIZE	FACE VEL. FPM	HEATING DATA: MEDIUM	STEAM PRESS PSIG	WATER IN °F	WATER OUTLET °F	FACE VEL FPM	NO	W	FACE VEL FPM	ENT. AIR °F	LEAV. AIR °F	HEATING COIL CFM
ACU-1	1ST, 2ND & 3RD FLR'S	HORIZ.	BLOW THRU	DUAL DUCT	42690	—	—	80	1	44 7/8	1350	BELT	100	—	—	—	—	YES	24	27	24	—	—	—	—	25	1	900	60	98	34200
ACU-2	1ST, 2ND & 3RD FLR'S	HORIZ.	BLOW THRU	DUAL DUCT	42620	—	—	80	1	44 7/8	1350	BELT	100	—	—	—	—	YES	24	27	24	—	—	—	—	25	1	920	60	98	35000
ACU-3	4TH & 5TH FLR'S	HORIZ.	BLOW THRU	DUAL DUCT	29125	—	—	80	1	33	1400	BELT	75	—	—	—	—	YES	18	27	24	—	—	—	—	25	1	800	65.4	95	23400
ACU-4	GTH & 7TH FLR'S	HORIZ.	BLOW THRU	MULTI ZONE	22205	—	—	200	2	27	860	BELT	15	—	—	—	—	YES	18	27	24	—	—	—	—	25	1	800	67.5	110	735	15400

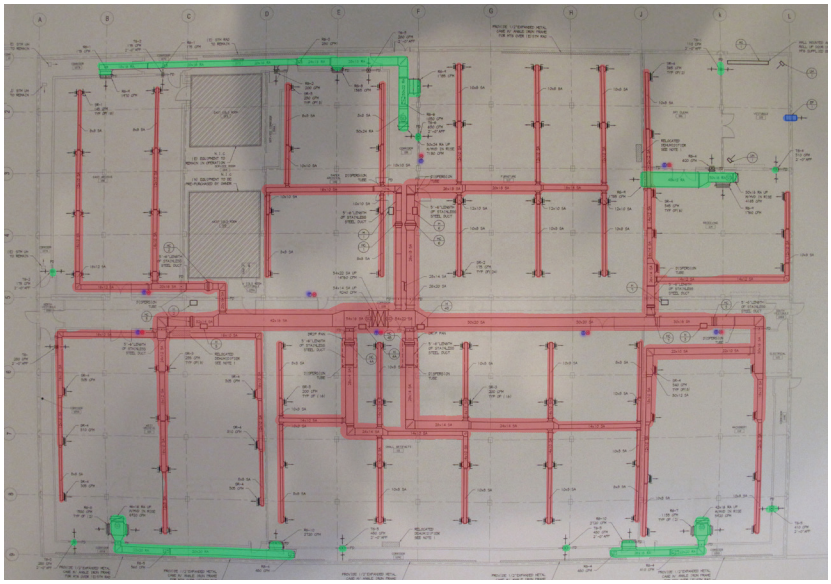
MARK	COOLING DATA: CHILLED WATER ENT. TEMP °F	LEAV. TEMP °F	GPM	PD - FT	AIR FRESH AIR CFM	FACE VEL FPM	ENTER D.B. °F	ENTER W.B. °F	LEAVING D.B. °F	LEAVING W.B. °F	REFRIG. LOAD TOTAL M.BTU	SENS. M.BTU	TONAGE	COOLING COIL CFM	REMARKS
ACU-1	45	55	368	—	25	550	82.3	67.7	54	52.2	1840	1810	153	39300	
ACU-2	45	55	377	—	25	550	82.3	67.7	54	52.2	1880	1220	157	40200	
ACU-3	45	55	226	—	25	500	80.2	65.8	53	51.4	1128	778	94	24300	
ACU-4	45	55	135	—	25	600	79.8	66.1	57	56.2	671	546	56	22205	

Sensor Placement

- Space temp sensor location: Note the location of any thermostats used by this unit.
- Space RH sensor location: Note the location of humidistats used by this unit if any.
- Where supply air enters space: Note where the supply air is exhausted into the space.
- Where return air leaves the space: Note where the return air is pulled from the space.
- Powered exhausts: Note if there are any powered exhausts in the space (normally connected to bathrooms or kitchens).

It may be beneficial to create a detailed map using specific colors to highlight:

- Return Ducts
- Supply Ducts
- Exhaust Ducts
- Thermostats
- Humidistats



Extra Heat Sources

- Extra heat/moisture sources: list any additional heat or moisture sources that may be found in the space.
- Perimeter radiation: can be found by walking the interior perimeter of the facility. List any sources of perimeter heat.
- Portable heaters: are there any portable heaters that are used in the space?
- Occupancy: The rough count of people that occupy this space and how often.

Lighting

- Knowing the lighting in your space will help provide insight into additional energy load and heat load that is in you space.
- This may require you to walk though the space and count fixtures. Check the number of lamps or bulbs per fixture.
- Most lamps or bulbs have their wattage marked on them. You can find the watts for each bulb by reading the end of a bulb.

- To calculate the watts per fixture multiply the watts per lamp or bulb by the number of lamps or bulbs per fixture.
- To find the watts sub-total multiply the number of watts per fixture by the number of fixtures (count).

Architecture

- Select any of the elements that pertain to the space.
- Be sure to add any notes regarding the features as well. It is important to note signs of deterioration like efflorescence, cracked windows, leaking roofs, etc.

Dataloggers in Unit

- Be sure to record the datalogger number used with the correct section of the unit it is covering.
- Always watch the placement of the dataloggers to ensure they are providing the most accurate reading possible.

HVAC System Documentation Worksheet

Building:

Completed By: Date Completed:

Mechanical System Notes

Location: Type: Manufacturer: Model:

Serial Number: BMS system:

Filter Capability

Type of filter: ☐ None ☐ Pre-filters ☐ Bag ☐ Box ☐ HEPA ☐ Charcoal ☐ Gas-phase

MERV Rating:

Cooling/Dehumidifying Capacity

Type of cooling: ☐ None ☐ DX ☐ Chilled Water ☐ Desiccant ☐ Other

Entering water temp:

Leaving water temp:

☐ Designs: Leaving WB: Leaving DB: DP:

☐ Face and Bypass:

Heating Capacity

Type of heating: ☐ None ☐ Gas ☐ Electric ☐ Steam/ Hot Water

Heater location: ☐ Preheat ☐ Before cooling coil ☐ After cooling coil

☐ Reheats

☐ Mixing boxes

☐ Terminal VAV reheat

Humidifier Capacity

Type of humidifier: ☐ None ☐ Steam (Boiler) ☐ Steam (generator) ☐ Ultrasonic

Humidifier location: ☐ Preheat ☐ Before cooling coil ☐ After cooing coil

Desiccant Type

☐ Desiccant wheel ☐ DX ☐ Liquid desiccant ☐ Air dryer ☐ Portable commercial
☐ Portable residential

System Controls

☐ Pneumatic ☐ Digital controls ☐ Combination ☐ Other: _____

Fans

Return fan:
CFM: Motor HP: Motor in Airstream: Hand AMP reading: VFD:

Supply fan:
CFM: Motor HP: Motor in Airstream: Hand AMP reading: VFD:

Relief fan:
CFM: Motor HP: Motor in Airstream: Hand AMP reading: VFD:

Condensing Unit

☐ Air cooled ☐ Evaporative ☐ Water-cooled

Operational Settings

Daily settings: Setbacks:

Set Points

Summer settings: Winter settings:

Damper Type

☐ Fixed ☐ Motorized Position ☐ Relief air

Air Flow

☐ Total airflow: Airflow over coils:

☐ Heating coil:

☐ Cooling coil:

☐ Outside air (design):

☐ % Bypass:

☐ Economizer:

Sensors

Space temp sensor location:

Space RH sensor location:

Zones/Area Served

Note where supply air enters the space:

Note where return air exits the space:

Are there powered exhausts from space?

Extra heat/ moisture sources:

Perimeter radiation:

Portable heaters:

Other equipment: (computers, humidifiers, grills, etc.)

Occupancy:

Actual:

Design:

Lighting:

Lamps Per Fixture	Watts Per Lamp	Watts Per Fixture	Count	Watts Sub-total

Total: _____

Architecture

☐ Exterior walls ☐ Windows to exterior ☐ Doors to exterior

☐ Doors to interior spaces ☐ Ceiling/Roof exposed to weather ☐ Floor exposed to weather

Loggers in Unit

☐ Outdoor air

☐ Mixed air

☐ Cooling coil

☐ Heating coil

☐ Supply air

☐ Return air

☐ Humidifier

☐ Space/Room

☐ VFD

Problems or Issues Noted:

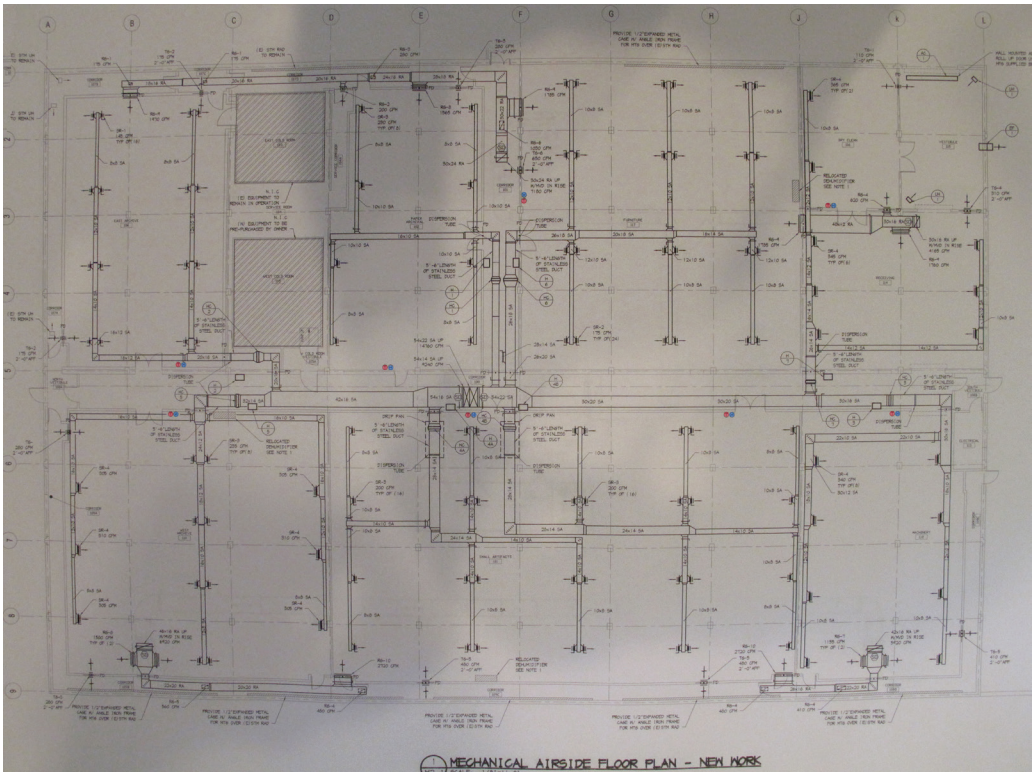
Creating Zone Maps

Zone maps can:

- Be useful in locating what air handler serves what section(s) of the building
- Point out where supply air from different air handlers serves the same area
- Show spaces served by the same air handler that may require conflicting conditions

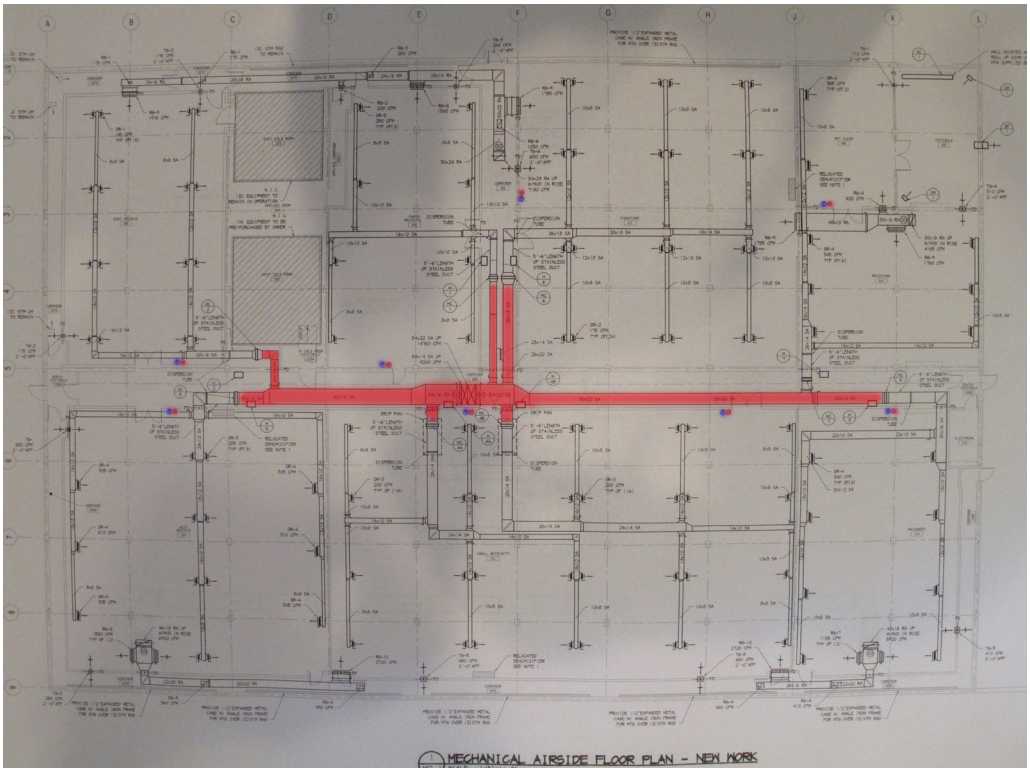
With Prints

If you have a set of blueprints that are considered reliable, making a zone map is a straightforward process. Look through your facility's M series of blueprints and identify the prints showing the location of mechanical systems and the ductwork layout. These will look similar to the image below. Make photocopies of these prints to make notations on, to avoid marking the originals.



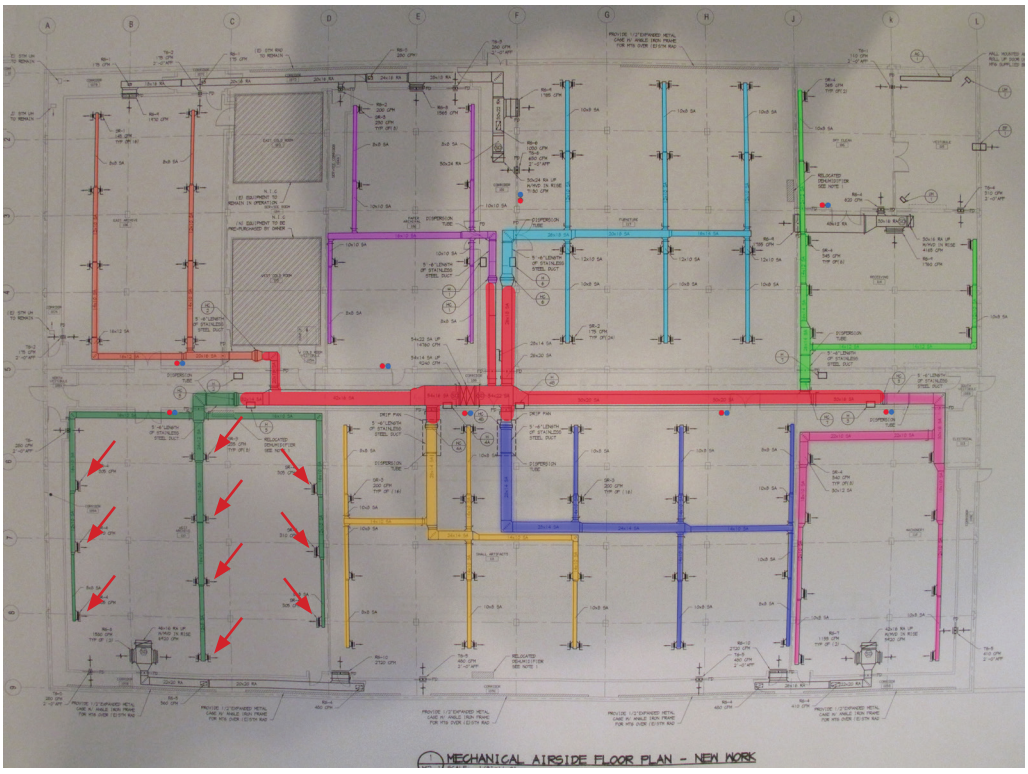
Begin by finding the location of your mechanical systems. If you know where they are located in the building, you can use the floor labels to help find the appropriate print; for example, many air handlers are located in the basement, so the plan labeled "basement" would depict the mechanical system.

Start with a single air handler. By looking at the system in person, you can determine where the return air enters the unit and where the supply air leaves the unit. On the print, follow the supply air, marking it with a highlighter or colored pencil, until something interrupts the line. In the following example, the main duct is marked in red until it reaches VAV boxes; this red area represents the ductwork carrying air at the same conditions, created by the main unit. Each VAV box can create different conditions downstream, so each branch after a VAV indicates a separate zone.

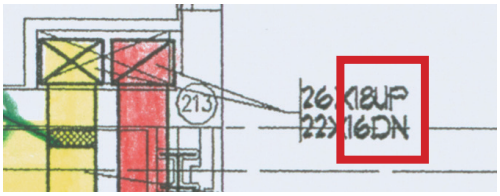


You may not have downstream equipment; in that case, all spaces receive the same conditions from the main unit, and the main supply line would continue directly into the spaces it serves.

Mark all branches off the main line using different colors until each one terminates. When you see a rectangle on the line (labeled below with red arrows), this is the location of a diffuser supplying air into the space.

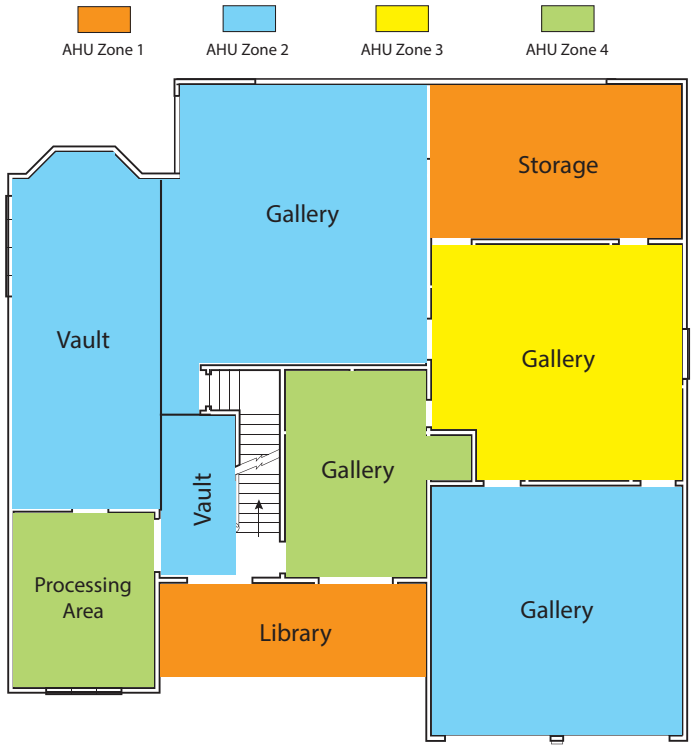


When the line extends to another floor, this is often indicated on the print with text (outlined in the red box below); locate the print for the adjoining floor and continue following the line.



This process can be repeated for any or all air handlers. Be sure to use different colors and keep track of what each color indicates. When you have finished tracing the ductwork, you can add in details, such as the thermostat and/or humidistat location in each space (usually indicated on prints with a "T" or "H" inside a circle, refer to the print legend for the correct symbol), and where return grilles and ductwork are located. These can be helpful details during data analysis, as they may provide clues as to why a sensor in a space is reading differently than others and causing the air handling unit to try to create different conditions. Knowing where the return grilles are in relation to the supply vents will help you evaluate airflow in the space.

You may find when you are done that it is easier for you to understand what is going on by transferring this information to a copy of the floor plan. While looking at the ductwork you traced, you can color code to indicate the branch or air handler serving each space. The example below shows how a supply line from a single AHU branches into four zones to serve nine different spaces.



Keep in mind that the air from any diffuser will extend to the walls of the room. Therefore, if branches from different air handlers serve a single space, the air will be a combination of the conditions of the multiple units and you will need to indicate this (ex. use both colors or only color in sections of the room in each color). Additionally, it may be of benefit to note on the zone map where air could pass between spaces, such as doorways between rooms.

Without Prints

Creating zone maps without prints can be done but requires a bit more time and legwork. You will need:

- Access to the HVAC system
- A ladder
- A flashlight
- A blank floor layout. This does not need to be a blueprint, and could be something as simple as a photocopy of the fire exit map.
- Different color pencils or highlighters

Begin by marking the main unit's location on you map. Follow the supply ductwork out of the unit visually while in the space, and draw it onto your floor plan. Continue to follow the ductwork until it gets to the diffusers in the spaces. It may be necessary to move ceiling tiles to follow the ductwork as you go.

Below is an example of a zone map that was created without using blueprints. The large pink square represents the air handling unit, the green lines represent the supply duct lines, and the pink lines represent the return duct lines. The boxes represent diffusers, where the air is discharged from (green boxes connected to a green supply line) or pulled into (pink boxes connected to pink return lines) the unit.