NEWBURYPORT DISTRICT COURTHOUSE
HVAC SYSTEM EVALUATION SUMMARY

Visited August 26, 2020. While on site inspected the air handling equipment located in the mechanical rooms and toured the facility to determine if the spaces generally matched usages noted on the architectural plans. The Newburyport District Courthouse was constructed in 1991 and is approximately 57,000 square feet in size.

1.0 Airflow Rate per Person (Reduced Occupancy)

		Total Air		*Outdoor Air*	
Courtroom	*Total People*	*Supply Airflow (CFM)*	*Airflow Rate (CFM/Person)*	*Outside Airflow (CFM)*	*Airflow Rate (CFM/Person)*
Jury Pool Room	16	1,800	113	540	34
Courtroom C 202	17	3,000	176	960	56
Courtroom C 206	23	3,000	130	900	39
Courtroom C 212	16	3,000	188	960	60
Courtroom C 236	18	3,000	167	900	50

2.0 Recommendations

Section	Recommendation/Finding	Action
2.1	**Filtration Efficiency**	
RF-1	Replace filters with MERV 13	In-progress
RF-3	Install a differential pressure sensor across the filter banks	In-progress
RF-3b	Display pressure sensor and connect to BMS	In-progress
2.2	**Testing and Balancing**	
RTB-1	Test and rebalance air handling unit supply air and minimum outside air flow rates	Complete
2.3	**Equipment Maintenance and Upgrades**	
RE-1	Test existing air handling system dampers and actuators for proper operation	Complete
2.4	**Control System**	
RC-1	Implement a pre and post-occupancy flush sequence	Complete
2.5	**Additional Filtration and Air Cleaning**	
RFC-1	Install portable HEPA filters in high traffic areas – *if courthouse is to operate at a high occupancy (i.e. 50-75% or greater), install portable HEPA filters in high traffic areas.*	Complete
2.6	**Humidity Control**	On-going
2.7	**Other Recommendations**	
2.7.1	Study courthouse to determine feasibility of installing mechanical ventilation in all occupied spaces.	Deferred – added to 5-year Capital Plan

2.7.2	Replace Fan coil units	Deferred- added to 5-year Capital Plan
2.7.3	Install a Building Management System	In-progress
2.7.4	Convert chilled and hot water systems to variable flow	Deferred- added to 5-year Capital Plan
2.7.5	Replace pneumatic damper and valve actuators with electronic actuators	Deferred- added to 5-year Capital Plan

Newburyport District Court
Newburyport, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

March 22, 2021

Tighe&Bond

100% Recyclable

Section 1
Existing Conditions & Site Observations

Tighe & Bond visited the Newburyport District Courthouse on August 26, 2020. While on site we inspected the air handling equipment located in the mechanical rooms and toured the facility to determine if the spaces generally matched usages noted on the architectural plans.

Site Visit Attendees:

- *Office of Court Management:*
  - Anthony Imperial, Courthouse Facilities Staff
- *Tighe & Bond*
  - Jason Urso, PE, Mechanical Engineer
  - Tim Bill, Staff Engineer

1.1 Existing Ventilation System

The Newburyport District Courthouse was constructed in 1991 and is approximately 57,000 square feet in size. One York air handling unit provides ventilation air to the basement holding area and associated office and conference rooms. The remainder of the building is served by fan coil units.

The air handling unit (AHU-1) contains a supply fan, hot water heating coil, chilled water cooling, and 2" MERV 8 filters. The air handling unit appears to be original from 1991 is in poor condition. The heating and cooling coils are in poor condition. There are holes in one of the coils. The cooling coil condensate pan is rusted and was flooded at the time of the visit. Since the condensate drain pan isn't draining properly, the condensate trap may be incorrectly sized. The outdoor air damper is rusty, in poor condition, and was closed during our site investigation. The actuator appeared to be newer.

We inspected two of the fan coil units while on site to generally understand the condition of the units. They appear to be in fair (borderline poor) condition and contain a 1" filter. The MERV rating is unknown. We presume all fan coil units are of the same condition and contain the same type of filter.

Two roof mounted exhaust fans serve toilet rooms in the building. The fans are in good condition and appear to be newer.

Table 1 summarizes the air handling units' designed airflow rates, the MERV rating of the installed filters, and the condition.

TABLE 1
Existing Air Handling Units

Unit	Original Design Airflow (CFM)	Original Design Min. O.A. (CFM)	Pre/Final Filters	Condition
AHU-1	4,950	2,500	2" MERV 8	Poor
FC-4	600	180	1" MERV Unknown	Fair
FC-5	800	240	1" MERV Unknown	Fair
FC-6	1,000	300	1" MERV Unknown	Fair
FC-7	1,400	420	1" MERV Unknown	Fair
FC-8	1,500	450	1" MERV Unknown	Fair
FC-9	1,800	540	1" MERV Unknown	Fair
FC-10	2,800	840	1" MERV Unknown	Fair
FC-11	2,800	840	1" MERV Unknown	Fair
FC-12	3,000	900	1" MERV Unknown	Fair
FC-13	3,800	1140	1" MERV Unknown	Fair

Note 1: FC-1,2,3,14, and 15 do not provide outdoor air.

Photo 1 – Air Handler AHU-1

1.2 Existing Control System

A pneumatic system controls the existing HVAC air handling equipment. It is an old, obsolete system; however, some components do appear to be newer. We did not see any evidence or components of a Building Management System (BMS) during our site visit. We are not aware of any demand control ventilation sequences in use at this courthouse.

AHU-1 dampers and coils are controlled with pneumatic actuators and appear to be in good condition. According to staff, the actuators have been replaced in the last 10 years.

Section 2
Recommendations

Below is a list of recommendations that we propose for the Newburyport District Courthouse. Please refer to the "Master Recommendation List" for further explanation and requirements of the stated recommendations.

2.1 Filtration Efficiency Recommendations

We recommend the following measures be implemented the existing air handling units:

RF-1: *Replace 2" MERV-8 filters with MERV-13 filters in AHU-1.*

The TAB Contractor and/or Engineer shall verify that the air handler can accommodate a MERV-13 filter per Appendix A in the overview of recommendations report.

The fan coil units contain a 1" filter and based on the two fan coil units we observed, it may be difficult to add a 2" filter. The units may also not have adequate fan power to overcome the additional pressure drop of a MERV 13 filter.

RF-3: *Install a differential pressure sensor with a display across the filter bank.*

RF-3a: *Connect the pressure sensor to a local alarm.*

2.2 Testing & Balancing Recommendations

The air handling unit and fan coil units are approximately 30 years old and it is unknown to Tighe & Bond when the last time the units were tested and balanced. Also, the code requirements to determine the outside air flow rates that were used to design the original system were different than the 2015 International Mechanical Code (IMC) and current ASHRAE Standard 62.1 requirements.

We recommend the following testing and balancing measures be implemented:

RTB-1: *Test and rebalance air handling unit supply air and minimum outside air flow rates.*

We recommend testing and balancing the outdoor air flow rates for air handling unit AHU-1 and all fan coil units to the recommended minimum O.A. rates listed in Table 2.

Our ventilation air analysis discovered that the two Jury Conference rooms were not receiving the correct quantity of outdoor air based on today's code requirements at full occupancy. Our calculations showed that the quantity of outdoor air required per code would result in a significant increase in outdoor air for the fan coil unit serving these spaces. The additional outdoor air appears to exceed the capacity of the existing coils in the fan coil unit. We recommend to temporarily limit the occupancy of these spaces. Table 3 lists the recommended reduced occupancy that can accommodate the original outdoor airflow specified.

TABLE 2
Recommended Air Handler O.A. Flow Rates

Unit	Original Supply Airflow (CFM)	Original Design Min. O.A. (CFM)	Current Code Min. O.A. Requirements (CFM)	Recommended Minimum O.A. (CFM)
AHU-1	4,950	2,500	1,225	2,500
FC-4	600	180	611	180
FC-5	800	240	40	240
FC-6	1,000	300	110	300
FC-7	1,400	420	190	420
FC-8	1,500	450	330	450
FC-9	1,800	540	425	540
FC-10	2,800	840	150	840
FC-11	2,800	840	350	840
FC-12A (Courtroom C202)	3,000	900	960	960
FC-12B (Courtroom C212)	3,000	900	600	900
FC-12C (Courtroom C206)	3,000	900	960	960
FC-12D (Courtroom C236)	3,000	900	690	900
FC-13	3,800	1,140	315	1140

Note: Although the ASHRAE Position Document on Infectious Aerosols recommends using the latest published standards and codes as a baseline for minimum ventilation, the mechanical code in effect at the time the HVAC systems were designed and constructed is what governs the required outdoor air flowrate for the HVAC equipment, if there have been no additions, renovations, alterations or changes in occupancy to the building. The 2015 International Mechanical Code does not prevent the continued use of existing systems.

TABLE 3
Recommended Occupancy During COVID-19 Pandemic

Room & Associated AHU/FCU	***2015 IMC Permitted Occupancy (# of People)***	***Recommended Occupancy (# of People)***
FCU-4 Jury Conference Room C244	15	6

Jury Conference Room C235	14	6

The average airflow rate per person is shown below in Table 4 These values are based on the original design supply airflow rate and the recommended outdoor air flow rates shown in Table 2. The airflow rate per person assumes a diversity factor of 70%, meaning the maximum number of occupants assumed to be in all zones at all times equates to 70% of the code required occupancy.

TABLE 4
Average Airflow Rate per Person

	All spaces	***Courtrooms***	***Non-Courtroom Spaces***
Total Occupancy (People)	527	307	221
Total Supply Air (CFM/Person)	98	39	180
Outdoor Air (CFM/Person)	32	12	59

The airflow rate per person for each Courtroom and the Jury Pool Room is shown below in Table 5. These values are based on full occupancy without taking diversity into account, the original design supply airflow rate, and the recommended outdoor airflow rate. The airflow rate per person assumes the full supply airflow is being delivered to the room. At times when the supply airflow is reduced due to the space temperature being satisfied, the airflow rate per person will also be reduced.

TABLE 5
Airflow Rate per Person (Full Occupancy)

		Total Air		***Outdoor Air***	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outside Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Jury Pool Room	55	1,800	33	540	10
Courtroom C 202	131	3,000	23	960	7
Courtroom C 206	131	3,000	23	900	7
Courtroom C 212	82	3,000	37	960	12
Courtroom C 236	94	3,000	32	900	10

Note: Courtroom occupant density is based on 70 people/1,000 square feet, per the 2015 International Mechanical Code

The airflow rate per person for each Courtroom and the Jury Pool Room, based on a reduced occupancy schedule determined by the Office of Court Management, is shown below in Table 5a. The airflow rate per person assumes the full supply airflow is being delivered to the room. At times when the supply airflow is reduced due to the space temperature being satisfied, the airflow rate per person will also be reduced.

TABLE 5a
Airflow Rate per Person (Reduced Occupancy)

		Total Air		Outdoor Air	
Courtroom	Total People	Supply Airflow (CFM)	Airflow Rate (CFM/Person)	Outside Airflow (CFM)	Airflow Rate (CFM/Person)
Jury Pool Room	16	1,800	113	540	34
Courtroom C 202	17	3,000	176	960	56
Courtroom C 206	23	3,000	130	900	39
Courtroom C 212	16	3,000	188	960	60
Courtroom C 236	18	3,000	167	900	50

Note: If occupancy is further reduced, the airflow rate per person will increase, assuming full airflow is being delivered to the space.

RTB-3: *Increase outside air flow rate beyond minimum under non-peak conditions.*

Due to the age of the units, the ability for the coils to maintain the supply air temperature is uncertain. We recommend increasing the outdoor air flow rate by only 10% beyond the recommended outdoor air flow rates. We do not believe this would cause a threat of a potential coil to freeze given the amount of outside air as a percentage of total supply air, however cold spots on the coil may develop due to poor mixing. This may cause nuisance freeze stat trips via the existing freeze stat.

RTB-4: *Test and balance air handler chilled and hot water coils.*

Testing and balancing the air handler hot and chilled water coils will help ensure the coils are receiving the proper water flow rates. Due to the age of the coils, the coils may not perform as required to properly temper the supply air. Coils become fouled over time, which degrades the performance.

2.3 Equipment Maintenance & Upgrades

We recommend the following equipment maintenance and upgrades:

RE-1: *Test existing air handling system dampers and actuators for proper operation*.

Replace dampers and actuators that are not functioning properly.

RE-2: *Clean air handler coils and drain pans.*

RE-5: *Install freeze stat or confirm the existing freeze stat is working correctly on each air handling unit.*

RE-7: Test the existing air handler control valves and actuators for proper operation.

2.4 Control System Recommendations

We recommend the following for the control system:

RC-1: *Implement a pre and post-occupancy flush sequence.*

RC-2: *Install controls required to introduce outside air beyond the minimum requirements.*

Prior to implementing this control strategy, the TAB Contractor should verify the quantity of outside air the outdoor air louvers can accommodate without exceeding an intake air velocity of 450 feet/minute (FPM). Exceeding this air velocity through an intake air louver may result in rain or snow entering the louver.

2.5 Additional Filtration and Air Cleaning

We recommend the installation of the following air cleaning devices:

RFC-1: *Install portable HEPA filters.*

If the Courthouse is to operate at a high capacity (i.e. 50% occupancy or greater), we recommend installing portable HEPA filters in high traffic areas, such as entrance lobbies. They should also be considered for Courtrooms, depending on the occupancy of the room and how much noise is generated from the filters. The noise levels will vary depending on the manufacturer.

2.6 Humidity Control

Installing duct mounted or portable humidifiers can help maintain the relative humidity levels recommended by ASHRAE. The feasibility of using duct mounted humidification or portable humidifiers is determined by the building envelope. Buildings that were not designed to operate with active humidification can potentially be damaged due to a lack of a vapor barrier, adequate insulation, and air tightness. We are not aware if this building was constructed to accommodate a humidification system.

Duct mounted humidifiers must be engineered, integrated into the building control system, tested, and commissioned. They are available in many configurations, but require substantial maintenance and additional controls. They also run the risk of adversely affecting IAQ from growing microorganisms, or leaking water through poorly sealed ductwork damaging insulation and ceilings. Portable humidifiers are easier to install and require less maintenance, but still have the potential to damage the building envelope.

While active humidification is not recommended as a whole building solution due to high installation costs, operational costs, potential to damage the building envelope and adversely affect poor IAQ, it may be warranted as a temporary solution in some areas.

2.7 Other Recommendations

2.7.1 Repair AHU-1Replace AHU-1 Coil and Outdoor Air Damper or Consider Replacing AHU-1

There are several issues with AHU-1. One of the coils contains a hole, which affects the performance of the coil. The outdoor air damper is rusted and may need replacement and a properly sized condensate trap should be installed to allow the unit to drain properly. As an alternative, replacing the entire air handler should be considered. The unit is 30 years old and is in fair to poor condition and nearing the end of its useful life.

2.7.2 Replace Fan Coil Units

The average life expectancy of fan coil units is approximately 35 years old. Assuming all fan coil units are original, they are 30 years old and should be considered for replacement within 5 years.

To reduce the maintenance costs associated with multiple fan coil units, a central air handling system may be able to be installed to replace the fan coil units. A further evaluation is required to determine the feasibility of this suggestion.

2.7.3 Install a Building Management System

We recommend replacing the pneumatic control system with a Building Management System to control and monitor HVAC equipment. Pneumatic air systems are antiquated and do not offer the same benefits as a BMS. This recommendation is an energy saving and maintenance measure and does not affect the indoor air quality of the building.

2.7.4 Convert Chilled and Hot Water Systems to Variable Flow

According to the 1989 design drawings, the hot and chilled water hydronic systems are constant flow. Constant flow pumps circulate the same volume of water to the air handling unit and fan coil units regardless of whether the water is required or not. If units do not require this water, the three-way valves serving the air handler and fan coil unit coils bypass the water around the coils and is pumped back to the chiller or boiler plant. We recommend investigating the possibility of converting these systems to variable flow. The three-way valves serving the air handler and fan coil units would have to be replaced with two-way valves, as well as any other three-way valves that are in the system. Variable frequency drives (VFD) may be able to be connected to the existing hot and chilled water pumps, allowing the pumps to vary the flow rate to match the demand. This recommendation is an energy saving measure and does not affect the indoor air quality of the building.

2.7.5 Replace Pneumatic Damper and Valve Actuators with Electronic Actuators

If the existing pneumatic system can cycle damper and valve actuators and position the valves and dampers in their correct position repeatedly, then immediate replacement is not necessary. If the system cannot cycle the actuators to correct damper or valve positions, this may cause too little or too much outdoor air flow and water flow through the units, affecting the quantity of ventilation air and heating and cooling capacity of the coils.

Section 3
Testing & Balancing Results

Milharmer Associates, Inc. visited the Newburyport District Courthouse on January 6, 2021 to test the airflow rates of the air handling units and the exhaust fans. A summary of the tested airflow rates versus the design airflow rates are shown below in Tables 6 and 7. The full testing and balancing report is attached

TABLE 6
Air Handler Testing & Balancing Results

	Design			Actual		
Unit	**Total Supply Fan Airflow (CFM)**	**Recommended Outdoor Airflow (CFM)**	**Return Fan Airflow (CFM)**	**Supply Fan Airflow (CFM)**	**Outdoor Airflow (CFM)**	**Return Fan Airflow (CFM)**
AHU-1	4,950	2,500	2,450	3,387	1,564	1,823
FCU-4 (2nd fl. offices)	600	180	420	569	166	403
FCU-4 (2nd fl. offices)	600	180	420	531	188	343
FCU-5 (Rm 207)	800	240	560	689	67	622
FCU-6A (Rm 110)	1,000	300	700	200	159	41
FCU-6B (Rm 101)	1,000	300	700	Unit is not operating		
FCU-7 (Clerks)	1,400	420	980	1,199	189	1,010
FCU-8 (Lobby)	1,500	450	1,050	1,369	409	960
FCU-8 (Lobby)	1,500	450	1,050	1,221	416	805
FCU-8 (Lobby)	1,500	450	1,050	1,400	433	967
FCU-8 (Lobby)	1,500	450	1,050	1,322	420	902
FCU-9A (Rm 109)	1,800	540	1,260	1,694	362	1,332
FCU-9B (Rm 118)	1,800	540	1,260	1,645	349	1,296
FCU-10 (Rm 122)	2,800	840	1,960	2,040	557	1,483
FCU-11A (Corridor)	2,800	840	1,960	Unit is not operating		

FCU-11B	2,800	840	1,960	384	0	384
FCU-12 (Court. C202)	3,000	900	2,100	1,995	0	1,995
FCU-12 (Court. 206)	3,000	900	2,100	2,212	0	2,212
FCU-12 (Court. 212)	3,000	900	2,100	2,245	0	2,245
FCU-12 (Court. C236)	3,000	900	2,100	2,166	0	2,166

TABLE 7
Exhaust Fan Testing & Balancing Results

Unit	Serving	Design Return/Exhaust Airflow (CFM)	Actual Return/Exhaust Airflow (CFM)
EF-1	Toilet RM	1,100	1,133
EF-2	Toilet RM	2,265	Not Running

Typical balancing tolerances for air systems is ±10% of the design airflow. In reviewing the airflow report data, the following should be noted:

1. AHU-1 is providing total supply and outdoor air significant less than design. The TAB Contractor concluded a sheave change is required to increase airflow.
2. Several fan coil units were supplying total and outside air below design, and some were not functional. We recommend all fan coil units be serviced to correct possible motor issues or replace fan belts. Some fan coil units appear to need full replacement. We recommend additional air and water balancing once the issues have been corrected.
3. It was noted that some fan coil unit outdoor air dampers were found to be fully closed. Courthouse staff mentioned to the TAB Contractor that these dampers were fully closed due to coil freezes, therefore the dampers were not adjusted. We recommend further investigation to determine if glycol can be added to the hot water system to prevent coil freezes.
4. Toilet exhaust fan EF-2 is not running.

Disclaimer

Tighe and Bond cannot in anyway guarantee the effectiveness of the proposed recommendations to reduce the presence or transmission of viral infection. Our scope of work is intended to inform the Office of Court Management on recommendations for best practices based on the guidelines published by ASHRAE and the CDC. Please note that these recommendations are measures that may help reduce the risk of airborne exposure to COVID-19 but cannot eliminate the exposure or the threat of the virus. Implementing the proposed recommendations will not guarantee the safety of building occupants. Tighe & Bond will not be held responsible should building occupants contract the virus. The Office of Court Management should refer to other guidelines, published by the CDC and other governing entities, such as social distancing, wearing face masks, cleaning and disinfecting surfaces, etc. to help reduce the risk of exposure of COVID-19 to building occupants.

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MILHARMER ASSOCIATES, INC.
534 New State Highway, Route 44, Suite 3
Raynham, MA 02767
Tel.: 508-823-8500; Facsimile: 508-823-8600

TEST AND BALANCE REPORT

Project: **Newburyport District Court**
188 State St., Newburyport, MA

Project No.: **21-014** **Project Date:** **3/4/2021**

MECHANICAL CONTRACTOR
Tighe & Bond

3384

A N.E.B.B. Certified Company

Project:	Newburyport District Court		
Address:	188 State St., Newburyport, MA		
Date:	3/4/2021	**Project No.**	21-014

CERTIFICATION

Submitted & Certified by:

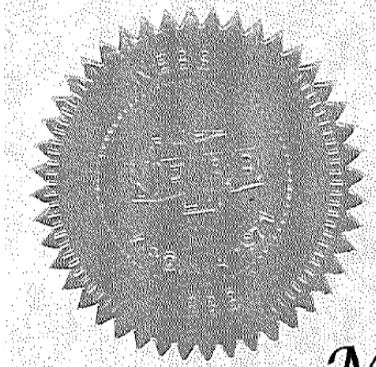
Milharmer Associates, Inc.

Certification No.: ***3384*** Certification Expiration Date: **3-31-21**

The data presented in this Report is a record of system measurements and final adjustments that have been obtained in accordance with the current edition of the ***N.E.B.B. Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems***. Any variances from design quantities which exceed N.E.B.B. tolerances, are noted in the Test-Adjust-Balance Report Project Summary.

N.E.B.B. Qualified TAB Supervisor Name: **Scott F. Miller**

N.E.B.B. Qualified TAB Supervisor Signature:_____



Certification

THIS IS TO CERTIFY THAT

Milharmer Associates, Inc.

HAS MET ALL REQUIREMENTS FOR NEBB CERTIFICATION IN THE FOLLOWING DISCIPLINE

Testing, Adjusting and Balancing of Environmental Systems

FOR THE NEBB BOARD OF DIRECTORS

March 31, 2021

Expiration Date

NEBB President

3384

NEBB Certification Number

NEBB President-Elect

NEBB Certification Board

NEBB Certified Professional

Scott F. Miller

HAS MET ALL THE NEBB REQUIREMENTS FOR NEBB CERTIFIED PROFESSIONAL STATUS IN

Testing, Adjusting and Balancing of Environmental Systems

This Certificate, as well as individual affiliation with a NEBB Certified Firm and associated NEBB Certification Stamp are REQUIRED to provide a NEBB Certified Report. Participation in the NEBB Quality Assurance Program requires the Certificant be affiliated with a NEBB Certified Firm.

March 31, 2021

Expiration Date

23541

NEBB Certificant Number

Richard Farrell

NEBB Certification Board Chairman

Cynthia Heath

NEBB Certification Director

The NEBB Certification Board retains sole ownership of all certificates. The NEBB Certification Board Policy Manual governs use of this certificate.

Project:	Newburyport District Court		
Address:	188 State St., Newburyport, MA		
Date:	3/4/2021	**Project No.**	21-014

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B. N.E.B.B. Company Certificate
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D. Instrument Sheet
E. Symbol Sheet

SECTION 2 **TAB Building Systems**

Project:	Newburyport District Court		
Address:	188 State St., Newburyport, MA		
Date:	3/4/2021	**Project No.**	21-014

INSTRUMENT SHEET

The following is a list of Instruments owned and operated by Milharmer Associates, Inc. and used on this project.

Instrument ID Number	Instrument	Calibration Date	Calibration Due Date
1	ADM-870 Digital Multimeter	8-20-20	8-20-21
2	Shortridge Flow Hood	8-20-20	8-20-21
3	Ampmeter	8-20-20	8-20-21
4	Tachometer	8-20-20	8-20-21
5	Airflow Anemometer	8-20-20	8-20-21
6	Digital Thermometers	8-20-20	8-20-21
7	Shortridge Water Meter	8-20-20	8-20-21
8	Sound Meter	8-20-20	8-20-21
9	Vibration Meter	8-20-20	8-20-21

Please Note: Instruments are tested annually at the M.A.I. Lab. and sent back to the factory if deviation exceeds manufacturing tolerance.

Technician:

SYMBOL SHEET

AHU	Air Handling Unit
AC or ACU	Air Conditioner Unit
ACCU	Air Cooled Condensing Unit
ADJ P.D.	Adjusted Pitch Diameter
AMP	Amperage
AVG	Average
A.D.	Air Density
B.H.P.	Brake Horsepower
CFM	Cubic Feet Per Minute
CH	Chiller
CHWR	Chilled Water Return
CHW or CHWS	Chilled Water Supply
CT	Cooling Tower
CWR	Condenser Water Return
CW or CWS	Condenser Water Supply
DB	Dry Bulb
D.D.	Direct Drive
DIA	Diameter
EAT	Entering Air Temperature
EDC	Electric Duct Coil
EDH	Electric Duct Heater
EF	Exhaust Fan
EMS	Energy Mgt System
EWT	Entering Water Temperature
FCU	Fan Coil Unit
FH	Fume Hood
F.L.A.	Full Load Amperage
FPB	Fan Powered Box
FPM	Feet Per Minute
FT. HD.	Feet of Head
GPM	Gallons Per Minute
HEATER O.L.	Thermal Overload Protection For Motors Located at Starter Motor
HEPA	High Efficiency Particulate Arrestance
HOA	Hand/Off/Auto Switch
H.P.	Horsepower
HPS	High Pressure Steam
HRC	Heat (Recovery or Recliam) Coil
HVAC	Heating, Ventilation and Air Conditioning
HWR	Hot Water Return or Heating Water Return
HWS	Hot Water Supply or Heating Water Supply
HX	Heat Exchanger
I.D.	Inside Diameter
LAT	Leaving Air Temperature
L.D.	Linear Supply Diffuser
LPS	Low Pressure Steam
L.T.	Light Troffer
LWT	Leaving Water Temperature
MAU/MUA	Make Up Air Unit
MBH	1,000 BTU's per Hour
N.A.	Not Accessible
N/A	Not Applicable
N.I.	Not Installed
N.L.	Not Listed

SYMBOL SHEET CONTINUED

O.D.	Outside Diameter	TAB	Testing, Adjusting, and Balancing
OA Min	Outside Air Minimum	TSP	Total Static Pressure
OAT	Outside Air Total	TP	Thermally Protected
PF	Power Factor	UH	Unit Heater
PHC	Preheat Coil		
PH	Phase(s)	V	Volts
PSI	Pounds Per Square Inch	VAV	Variable Air Volume
P.T.	Pitot Traverse	VD	Volume Damper
		VFD	Variable Frequency Drive
RA	Return Air	VP	Velocity Pressure
RF	Return Air Fan		
R.G.	Return Grille	W	Watts
RHC	Reheat Coil	WB	Wet Bulb
RPM	Revolutions per Minute	W.D.	Water Density
		W.G.	Water Guage
SA	Supply Air		
SAT	Supply Air Temperature	F	Degrees Fahrenheit
S.D.	Supply Diffuser		
SEF	Smoke Exhaust Fan	ΔP	Differential (Delta) Pressure or Pressure Drop
SF (AIR)	Supply Fan		
S.F.(Elect)	Service Factors		
SHC	Steam Heating Coil	ΔT	Differential (Delta) Temperature, Net Temperature Decrease or Increase
S.P. "W.C."	Static Pressure Measured in Inches of Water Column	#	PSI or Pounds Per Square Inch Decrease or Increase

Project:	Newburyport District Court		
Address:	188 State St., Newburyport, MA		
Date:	3/4/2021	**Project No.**	21-014

REPORT SUMMARY

The following is the report for the Newburyport District Court. A survey was performed on AHU-1 and the fan coil serving the floors units with the following comments:

1. AHU-1 was tested at 3,387 CFM and is designed for 4,950 CFM. A fan sheave change would be required in order to increase the airflow to design. The new motor sheave would need to be a 1VP71 x 1 1/8" with an BX78 Belt.

2. The Fan Coil Units on the 1st and 2nd Floors were tested and several units would not run and have been noted. The units have fresh air being fed through ductwork connected to outside air louvres. The ductwork has a manual volume damper installed and they were set to various positions with some even fully closed. We were informed by the court that they were closed due to coils freezing and we subsequently decided not to adjust any of the dampers at this time. The units are in need of service or even replacement in some cases and would require a complete air and water rebalance once put back in service.

3. EF-1 and 2 serve the toilets and EF-1 was tested and is low on airflow and EF-2 was not running and needs to be re-wired.

Project:	Newburyport District Court		
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REPORT SUMMARY

AIR HANDLING UNITS

UNIT	SUPPLY	RETURN	OUTSIDE AIR
AHU-1	3,387 CFM	1,823 CFM	1,564 CFM

FAN COIL UNITS

UNIT	TOTAL	OUTSIDE AIR	ROOM
FCU-10	2040	557	122
FCU-6B	*		101
FCU-6A	159	200	110
FCU-11A	*	587	Hallway
FCU-11B	384		
FCU-7	1199	189	Clerks
FCU-9A	1694	362	109
FCU-9B	1645	349	118
2nd FLOOR			
FCU-5	689	67	207
FCU-12	1995	**	202
FCU-12	2212	**	206
FCU-12	2166	**	C236
FCU-12	2245	**	C212
FCU-4	569	166	Offices
FCU-4	531	188	Offices
FCU-8	1369	409	Lobby
FCU-8	1221	416	Lobby
FCU-8	1400	433	Lobby
FCU-8	1322	420	Lobby

* Units not running.

** Outside air damper closed

Project: Newburyport District Court
Address: 188 State St., Newburyport, MA
Date: 3/4/2021 **Project No.** 21-014

FAN DATA SHEET

	FAN NO.	AHU-1	FAN NO.	
Serves / Location:		Basement		
Manufacturer:	YORK			
Model Number:	C5113SBYP			
Size:	NL			
Serial Number:	89-809229A			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	US		
Frame Number:	NL	184T		
Horsepower:	5	5		
Brake Horsepower:	NL	2.9		
Safety Factor:	NL	1.25		
Volts/Phase:	208/230-460	460		
Motor Amperage:	15-13.6/6.8	3.4/3.5/4.0		
Motor RPM:	1740	1740		
Speeds:	NL	1		
Heater Size:	NL	NA		
Heater Amps.:	NL	NA		
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:	4950	3387		
Return Air CFM:	NL	1823		
Exhaust Air CFM:				
Outside Air CFM:	2500	1564		
Suction Pressure:	NL	0.43		
Discharge Pressure:	NL	1.46		
Fan Static Pressure:	NL	1.89		
External Pressure:	NL	NA		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	NA		
Motor Drive:	NL	1VP52		
Motor Size/Bore:	NL	1 1/8"		
Fan Drive:	NL	AK77		
Fan Size/Bore:	NL	1 1/16		
Belt Size / Number:	NL	1/B75		
Shafts C-C:	NL	31 1/2		
Turns Open:	NL	4		

Comments:

Project:	Newburyport District Court		
Address:	188 State St., Newburyport, MA		
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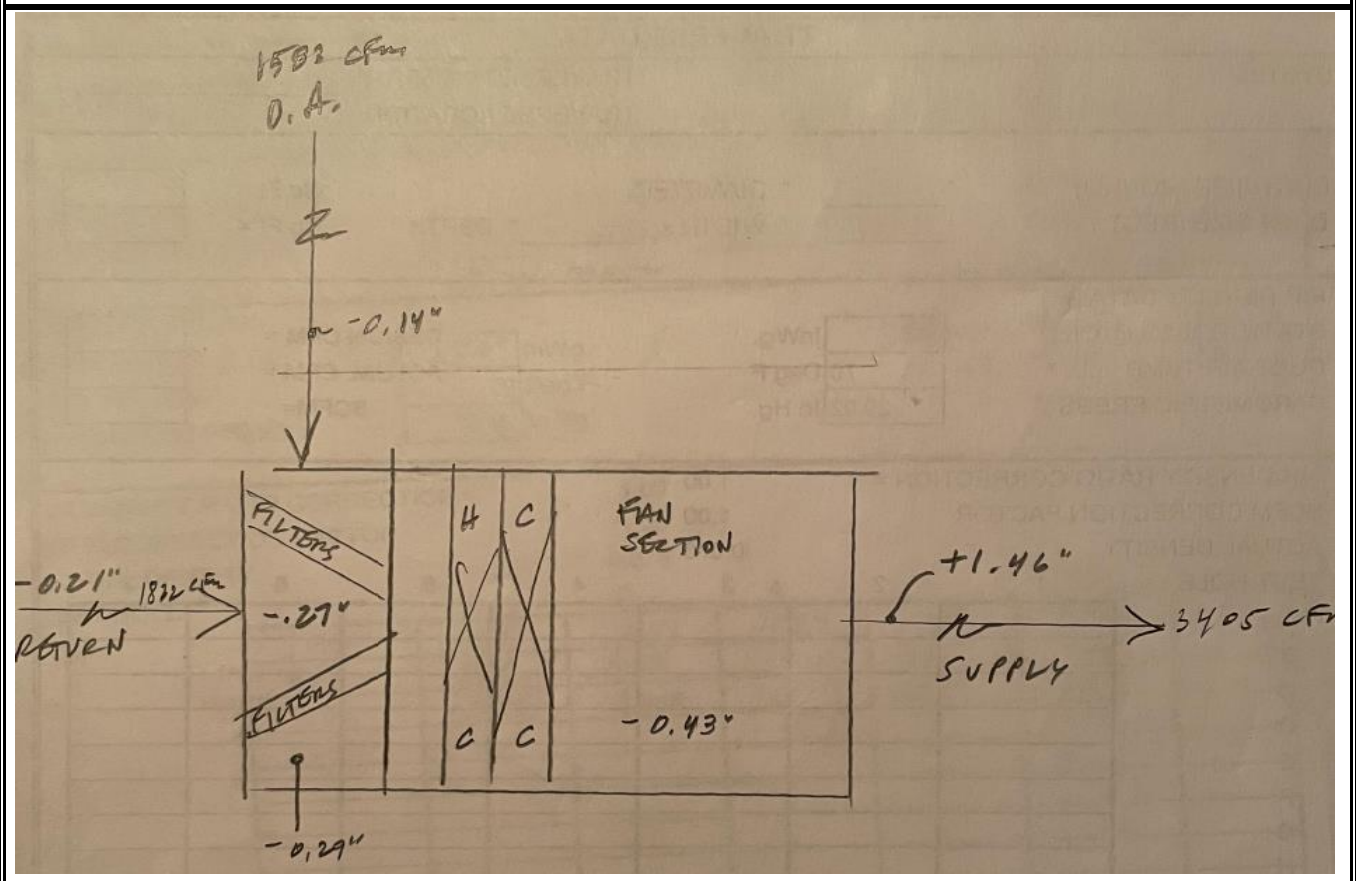
STATIC PRESSURE PROFILE
AHU-1



Project: Newburyport District Court
Address: 188 State St., Newburyport, MA
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TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Basement

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	34	" WIDTH x	16	" DEPTH	Sq Ft =	3.78

AIR DENSITY DATA

STATIC PRESS @ CL:	1.4	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	3387
BAROMETRIC PRESS:	29.92	In Hg.	SCFM=	**3400**

AIR DENSITY RATIO CORRECTION = 1.00
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	754	1019	1051	1087	1076	1123	
B	831	929	915	815	905	1055	
C	803	867	820	540	658	888	
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 18 AVERAGE FPM = 896

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Brian Murphy

Project: Newburyport District Court
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TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Basement

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	36	" WIDTH x	18	" DEPTH	Sq Ft =	4.50

AIR DENSITY DATA

STATIC PRESS @ CL:	0.22	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	1823
BAROMETRIC PRESS:	29.92	In Hg.	SCFM=	**1825**

AIR DENSITY RATIO CORRECTION = 1.00
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	341	375	372	343	338	354	
B	398	435	430	370	458	444	
C	435	433	436	483	423	424	
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 18 AVERAGE FPM = 405

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Brian Murphy

Project: Newburyport District Court
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FAN DATA SHEET

	FAN NO. EF-1		FAN NO. EF-2	
Serves / Location:				
Manufacturer:	PENN BARRY		PENN BARRY	
Model Number:	DX11B		DX12B	
Size:	NL		NL	
Serial Number:	L18AN68035		L18AN68036	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	USMOTORS	NL	USMOTORS
Frame Number:	NL	56H	NL	56H
Horsepower:	NL	3/4	NL	1/2
Brake Horsepower:	NL	NA	NL	NA
Safety Factor:	NL	NA	NL	1.25
Volts/Phase:	208/3	208	208/3	
Motor Amperage:	1.9	NA	1.9	
Motor RPM:	1775	1775	1775	
Speeds:	NL	1	NL	
Heater Size:	NL	NA	NL	NA
Heater Amps.:	NL	NA	NL	NA
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	2000	1133	2000	*1
Outside Air CFM:				
Suction Pressure:				
Discharge Pressure:				
Fan Static Pressure:	0.25		0.25	
External Pressure:				
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	1586	NL	
Motor Drive:	NL	1VP42	NL	MVL34
Motor Size/Bore:	NL	1/2	NL	5/8
Fan Drive:	NL	AK49	NL	Ak44
Fan Size/Bore:	NL	3/4	NL	3/4
Belt Size / Number:	NL	4L240/1	NL	4l220
Shafts C-C:	NL	6"	NL	6"
Turns Open:	NL	2	NL	2

Comments: ***1 Fan is not running.**

Project: Newburyport District Court
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TRAVERSE DATA

SYSTEM: EF-1 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: 2nd Fl Bathroom

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	20	" WIDTH x	10	" DEPTH	Sq Ft =	1.39

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.618	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	1133
BAROMETRIC PRESS:	29.92	In Hg.	SCFM=	**1131**

AIR DENSITY RATIO CORRECTION = 1.00
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	621	802	782				
B	853	913	745				
C	884	963	776				
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 9 AVERAGE FPM = 815

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Brian Murphy