Salem Probate & Family Court
Salem, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

December 14, 2021

Tighe&Bond

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Section 1
Existing Conditions & Site Observations

Tighe & Bond visited the Salem Probate and Family Courthouse on March 2, 2021. While on site we viewed 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:*
  - Norman Eldredge, Courthouse Facilities Staff
- *Tighe & Bond*
  - Ryan Ablondi, Mechanical Engineer
  - Matt Mancini, Staff Mechanical Engineer

1.1 Existing Ventilation System

The Salem Probate and Family Courthouse was constructed in 1895 and is approximately 77,000 square feet in size. This Courthouse underwent a major renovation in 2014 including the installation of a new mechanical system. Ventilation air is provided by four variable air volume (VAV) air handling units. AHU-1 serves the basement level office space, AHU-2 serves all levels of the North wing of the building including Courtroom 4, AHU-3 serves the second floor including courtrooms 1, 2, and 3 and AHU-4 serves the first floor. Each unit contains a VFD controlled supply and return fan, chilled water cooling coils, hot water heating coils, 2" MERV 13 pre filter, and a 4" MERV 13 final filter. All air handling units were installed during the 2014 renovation and they appear to be in great condition. The dampers and actuators appear to be in very good condition, and the heating and cooling coils are clean. The hot and chilled water control valves and actuators also appear to be in very good condition. Supply air is distributed from each air handler to VAV boxes, which control the airflow to each zone.

According to the drawings provided to Tighe & Bond, there are 13 exhaust fans serving the building. Four fans serve toilet rooms, one fan serves the lockup area and the remaining 8 serve mechanical spaces. At the time of our site visit one exhaust fan (EF-7) serving the public restrooms on the basement level was not running due to reduced occupancy in the Courthouse. The restrooms being served by EF-7 are currently not being used by anyone and that exhaust system has been turned off. All other toilet exhaust fans and lockup exhaust fan were all running at the time of our site visit.

A pair of Fulton gas-fired hydronic boilers, rated at 1.84 million BTU/hr each, provide hot water to the air handlers, VAV reheat coils and perimeter finned tube radiation. A 200 ton, air cooled chiller located on the roof provides chilled water to all air handlers. There is also an air cooled VRF system which serves the electrical rooms and data closets.

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

TABLE 1
Existing Air Handling Units

Unit	Original Design Airflow (CFM)	Original Design Min. O.A. (CFM)	Pre/Final Filters	Condition
AHU-1	7,500	3,000	2" MERV-13, 4" MERV-13	Very Good
AHU-2	10,000	3,600	2" MERV-13, 4" MERV-13	Very Good
AHU-3	17,000	5,400	2" MERV-13, 4" MERV-13	Very Good
AHU-4	12,000	4,200	2" MERV-13, 4" MERV-13	Very Good

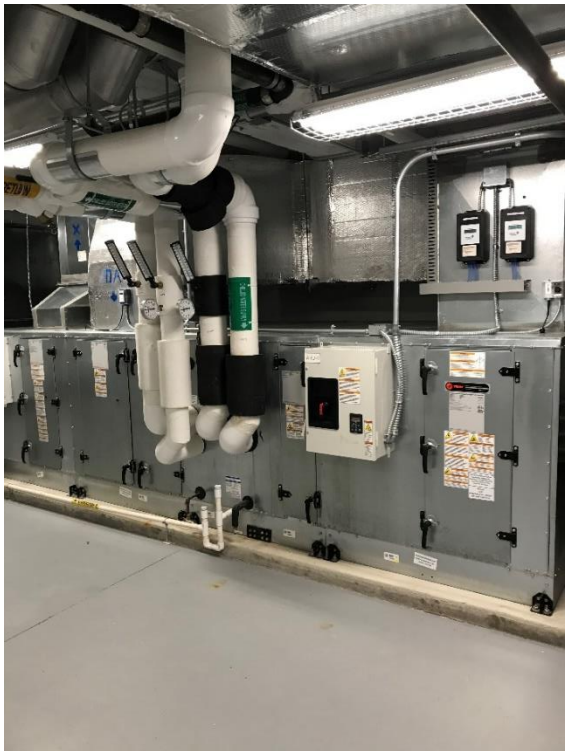

Photo 1 – Representative Air Handler

1.2 Existing Control System

The HVAC equipment is controlled by a Building Management System (BMS). Air handlers, exhaust fans, boilers, chillers, and pumps are all tied into the system. All Air handlers operate under a demand control ventilation (DCV) sequence of operation, where outdoor ventilation air is increased when CO2 levels rise above setpoint based upon CO2 sensors

located within the return air duct and densely occupied zones. Each AHU has also been equipped with a full outside air economizer section.

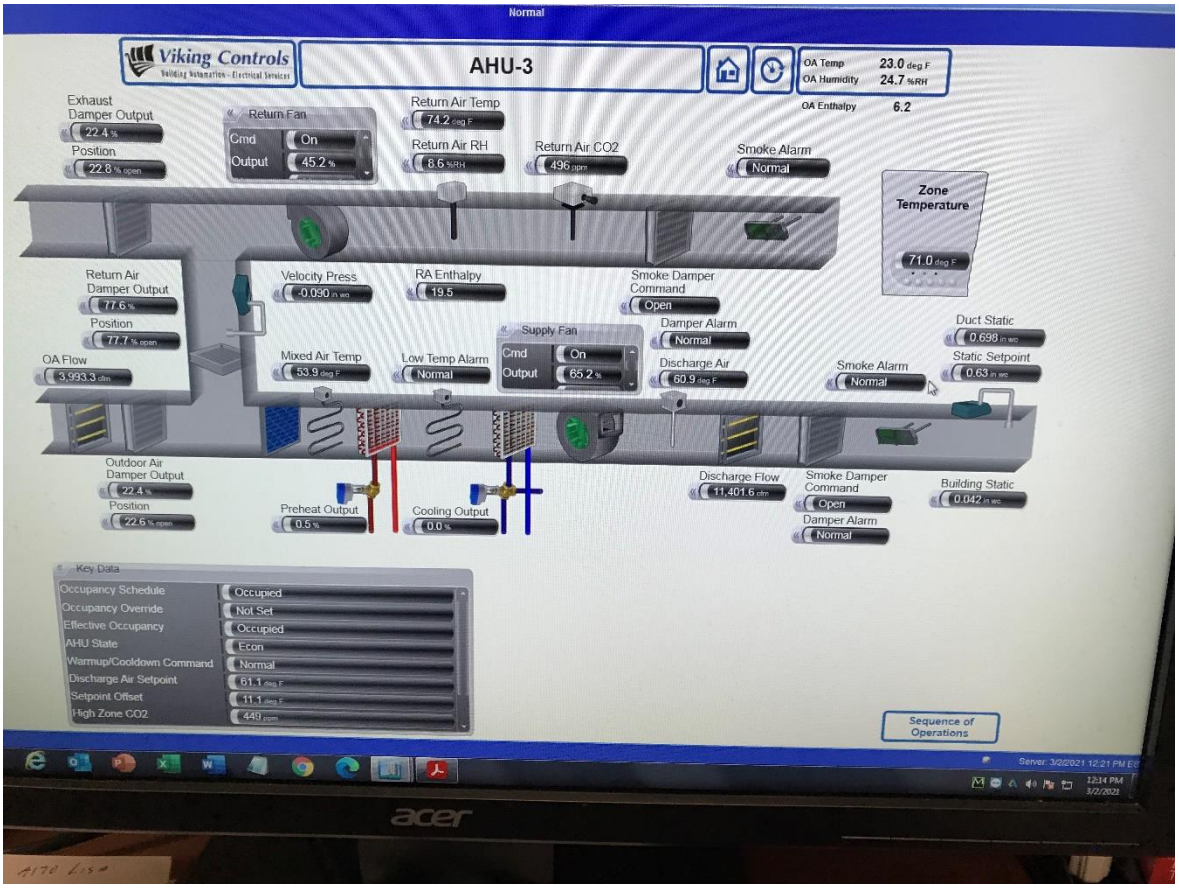

Photo 2 – Representative BMS Screen

Section 2
Recommendations

Below is a list of recommendations for the Salem Probate and Family 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 for the existing air handling units:

RF-1: *MERV-13 Filters.*

We recommend the continued use of MERV-13 pre and final filters as they meet ASHRAE's minimum recommended MERV rating. The existing pre and final filters should be checked to ensure that they are within their recommended service life, and that they have been installed correctly. Filter racks should be inspected and adjusted to ensure that filters fit tightly and that end spacers are in place to minimize filter bypass.

RF-3a: *Check the pressure sensor alarms on the BMS.*

Differential pressure sensors with displays have already been installed within each AHU but they do not have the ability to tie into the BMS. We recommend installing differential pressure switches across each filter bank and providing a dirty filter alarm to the BMS.

2.2 Testing & Balancing Recommendations

The air handling units are approximately 7 years old and have not been tested or balanced since they were installed. Also, the code requirements to determine the outside air flow rates that were used to design the original system may be 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 balance air handling unit supply air and minimum outside air flow rates.*

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

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	7,500	3,000	3,832	**3,900**
AHU-2	10,000	3,600	3,794	**3,800**
AHU-3	17,000	5,400	5,345	**5,400**
AHU-4	12,000	4,200	4,108	**4,200**

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.

Our ventilation air analysis discovered that many spaces 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 some air handlers, increasing the load on the heating and cooling coils. These loads appear to exceed the capacity of the units. We recommend temporarily reducing the occupancy of the spaces that are not receiving the code required ventilation air. Table 3 lists the spaces that would require a reduced occupancy. The recommended outdoor air flow rates listed in Table 2 reflect the outdoor air requirements based on a reduced occupancy shown in Table 3.

TABLE 3
Recommended Occupancy During COVID-19 Pandemic

Room & Associated AHU	*2015 IMC Permitted Occupancy (# of People)*	*Recommended Occupancy (# of People)*
AHU-2		
Kitchenette M104	5	4
Staff Break Room 1030	10	3*
Courtroom 4 2035	152	75
Hearing Room 2037	16	14
Conference Room 2034	8	5
Conference Room 2035	8	4
AHU-3		
Detainee Holding 2016 & 2017	7	5*
Courtroom 1 2013	144	75
Courtroom 2 2026	96	40
Courtroom 3 2028	96	40
Hearing Room 2001	23	17
Conference Room 2023	6	4
Conference Room 2025	10	8
Conference Room 2012	6	4
Conference Room 2031	5	4
Conference Room 2030	5	4

* It is also recommended that the minimum supply airflow rate from the VAV box serving this room be raised to 100 CFM along with the reduced occupancy.

During the pandemic, we recommend maintaining the outdoor airflows at the original designed values where they exceed the code minimums calculated by Tighe & Bond. Supplying more outdoor than required by code will provide better indoor air quality (as with AHU-3 and AHU-4).

Where we recommend increasing the outdoor air beyond the original design (as with AHU-1 and AHU-2) it appears the cooling and heating coils should be able to provide leaving air conditions similar to the original design under peak outdoor air conditions, assuming the coils are clean, and their performance has not degraded significantly over time. Supply air temperatures during the heating and cooling season should be monitored to ensure they are not dropping below design values. If the supply air temperature does drop below design values, the outdoor airflow rate should be reduced, but not below the originally designed outdoor air flow rates.

The average airflow rate per person is shown below in Table 3. These values are based on the original full design supply airflow rate and the recommended outdoor airflow 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 3
Average Airflow Rate per Person

	All spaces	***Courtrooms***	***Non-Courtroom Spaces***
Total Occupancy (People)	670	342	328
Total Supply Air (CFM/Person)	69	28	112
Outdoor Air (CFM/Person)	26	10	43

The airflow rate per person for each Courtroom and Hearing Room is shown below in Table 4. These values are based on full occupancy without taking diversity into account, the original full 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 4
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)***
Courtroom 1 (2013)	144	3,050	21	969	7
Courtroom 2 (2026)	96	1,700	18	680	7
Courtroom 3 (2028)	96	1,700	18	680	7
Courtroom 4 (2035)	152	3,200	21	1,280	8
Hearing Room (2001)	23	660	29	264	11
Hearing Room (2037)	16	550	34	220	14

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 Hearing Room, based on a reduced occupancy schedule determined by the Office of Court Management, is shown below in Table 4a. 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 4a
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)*
Courtroom 1 (2013)	22	3,050	138	969	44
Courtroom 2 (2026)	16	1,700	106	680	43
Courtroom 3 (2028)	18	1,700	94	680	38
Courtroom 4 (2035)	25	3,200	128	1,280	51
Hearing Room (2001)	7	660	94	264	38
Hearing Room (2037)	7	550	78	220	31

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

RTB-2: *Rebalance system return air flow rate.*

We recommend testing and balancing the return fan airflow rate to ensure the correct quantity of return air is being delivered to the air handler.

RTB-6: *Test and balance all 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-5: *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.*

We recommend implementing a sequence that starts all air handlers and exhaust fans each day before the building enters its occupied mode, and allows it to run for a period of time following occupancy. The start and stop times should be early and late enough to allow for a minimum of three complete air changes of ventilation air before and after the building is normally occupied. The systems should also be run in occupied mode while cleaning staff are in the building.

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

The existing BMS appears to be sophisticated enough to implement this type of sequence, however new control sequences must be defined.

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.

RC-4: *Confirm the economizer control sequence is operational.*

RC-5: *Disable demand control ventilation sequences.*

During the COVID-19 pandemic, we recommend disabling any DCV sequences that may reduce the quantity of outdoor ventilation air into occupied spaces.

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 adding active humidification 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.

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.

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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Section 3
Testing & Balancing Results

Milharmer Associates, Inc. visited the Salem Probate and Family Courthouse on October 15, 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 5 and 7. It should be noted that RA flow was measured at the RA fan, upstream of the mixed air damper where the return airflow should be equal to the supply airflow. The return airflow values listed in table 5 were calculated by Tighe & Bond assuming the exhaust airflow rate is equal to the outside air intake airflow rate. The full testing and balancing report is attached. The balancing report also contains the water flow rate testing results of the air handler hot and chilled water coils, a summary of those results can be found in Table 6.

TABLE 5
Air Handler Airflow Testing & Balancing Results

	Design			Actual		
Unit	Total Supply Fan Airflow (CFM)	Recommended Outdoor Airflow (CFM)	Return Airflow (CFM)	Supply Fan Airflow (CFM)	Outdoor Airflow (CFM)	Return Airflow (CFM)
AHU-1	7,500	3,900	3,600	7,617	4,082	3,535
AHU-2	10,000	3,800	6,200	9,851	3,772	6,079
AHU-3	17,000	5,400	11,600	17,025	5,212	11,813
AHU-4	12,000	4,200	7,800	12,885	4,019	8,866

TABLE 6
Air Handler Waterflow Testing & Balancing Results

	Design		Actual	
Unit	Chilled Water Flow Rate (GPM)	Hot Water Flow Rate (GPM)	Chilled Water Flow Rate (GPM)	Hot Water Flow Rate (GPM)
AHU-1	56	20	54	20
AHU-2	67	22	65	23
AHU-3	120	23	114	25
AHU-4	80	25	72	25

TABLE 7
Exhaust Fan Testing & Balancing Results

Unit	Serving	Design Return/Exhaust Airflow (CFM)	Actual Return/Exhaust Airflow (CFM)
REF-1	Addition Toilets East	2,000	1,902
REF-2	Addition Toilets West	1,500	1,409
REF-3	Existing Toilets East	1,650	1,702
REF-4	Holding Cels	200	212
EF-7	Level 00 Toilets South	850	800

The typical balancing tolerance for air systems is ±10% of the design airflow. In VAV systems, airflow issues may reside in downstream VAV boxes resulting in a total supply airflow reading at the air handler less than the designed value. Further investigation is required to determine the cause of a low airflow reading at the air handling unit.

In reviewing the airflow report data, the following should be noted:

1. The TAB report states the return fan airflows are very close to the supply fan airflows. The sequence of operation calls for each AHU to maintain a positive pressure of 0.05 in wc in the "return air discharge plenum" to ensure the building is maintained at a positive pressure of 0.02 in wc. Based on the data in the TAB report, the return airflow is 0-2% less than the supply airflow and it is unclear whether this is enough to maintain a positive pressure in the building. We recommend reviewing the control sequence and any available trend data for associated control points to ensure that the building is maintained at a positive pressure as intended.

2. The airflow testing data for all AHUs shows that airflows are within acceptable range of 10% of design.

3. The waterflow testing data for all AHUs shows that the actual flow rates are within the acceptable range of 10% of design flow.

4. The exhaust fan airflow testing data shows that all EFs are operating with 10% of the design airflow values.

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: **Salem Probate & Family Court PH 4**
36 Federal St., Salem, MA

Project No.: **21-541** **Project Date:** **10/15/2021**

MECHANICAL CONTRACTOR
Tighe & Bond

3384

A N.E.B.B. Certified Company

Project:	Salem Probate & Family Court PH 4		
Address:	36 Federal St., Salem, MA		
Date:	10/15/2021	**Project No.**	21-541

CERTIFICATION

Submitted & Certified by:

Milharmer Associates, Inc.

Certification No.: ***3384*** Certification Expiration Date: **3-31-23**

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

SCOTT F. MILLER

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

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

CP-23541

NEBB Certification Number

March 31, 2023

Expiration Date

NEBB President

NEBB President-Elect

Firm Certification

MILHARMER ASSOCIATES, INC.

HAS MET ALL REQUIREMENTS FOR NEBB CERTIFIED STATUS IN THE FOLLOWING DISCIPLINE

Testing, Adjusting and Balancing of Environmental Systems

3384

NEBB Certification Number

March 31, 2023

Expiration Date

NEBB President

NEBB President-Elect

Project:	Salem Probate & Family Court PH 4		
Address:	36 Federal St., Salem, MA		
Date:	10/15/2021	**Project No.**	21-541

TABLE OF CONTENTS

Project:	Salem Probate & Family Court PH 4		
Address:	36 Federal St., Salem, MA		
Date:	10/15/2021	**Project No.**	21-541

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	8-20-21	8-20-22
2	Shortridge Flow Hood	8-20-21	8-20-22
3	Ampmeter	8-20-21	8-20-22
4	Tachometer	8-20-21	8-20-22
5	Airflow Anemometer	8-20-21	8-20-22
6	Digital Thermometers	8-20-21	8-20-22
7	Shortridge Water Meter	8-20-21	8-20-22
8	Sound Meter	8-20-21	8-20-22
9	Vibration Meter	8-20-21	8-20-22

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

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:	Salem Probate & Family Court PH 4		
Address:	36 Federal St., Salem, MA		
Date:	10/15/2021	**Project No.**	21-541

REPORT SUMMARY

The following is the report for the Salem Probate Court with the following comments:

AHU-2 OUTSIDE AIR		
MAX: 3,767 CFM	DAMPER: 35% OPEN	SP: -0.042
MIN: 3,811 CFM	DAMPER: 55% OPEN	SP: -0.044
AHU-3 OUTSIDE AIR		
MAX: 5,686	DAMPER: 25% OPEN	SP: -0.12
MIN: 5,688	DAMPER: 65% OPEN	SP: -0.122
AHU-4 OUTSIDE AIR		
MAX: 4,240 CFM	DAMPER: 30% OPEN	SP: -0.042
MIN: 4,386 CFM	DAMPER: 65% OPEN	SP: -0.168

Project:	Salem Probate & Family Court PH 4		
Address:	36 Federal St., Salem, MA		
Date:	10/15/2021	**Project No.**	21-541

REPORT SUMMARY

AIR HANDLING UNITS

UNIT	SUPPLY	RETURN	OUTSIDE AIR
AHU-1	7,617 CFM	7,568 CFM	4,082 CFM
AHU-2	9,851 CFM	9,671 CFM	3,772 CFM
AHU-3	17,025 CFM	5,212 CFM	17,021 CFM
AHU-4	12,885 CFM	12,722 CFM	4,019 CFM

FANS

UNIT	EXHAUST
REF-1	1,902 CFM
REF-2	1,409 CFM
REF-3	1,702 CFM
REF-4	212 CFM
EF-7	800 CFM

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

FAN DATA SHEET

	FAN NO. AHU-1		FAN NO. Return	
Serves / Location:	Court	Mech. 0012	Court	Mech. 0012
Manufacturer:	Trane		Trane	
Model Number:	CSAA017UAL00		CSAA017UAL00	
Size:	NL		NL	
Serial Number:	K15D35524		K15D35524	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	Baldor	NL	Baldor
Frame Number:	NL	215T	NL	184T
Horsepower:	10	10	7.5	7.5
Brake Horsepower:	NL	5.19	NL	3
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	481/483/483	460/3	481/481/482
Motor Amperage:	12.5	6.5/6.6/6.3	8.6	3.7/3.4/3.6
Motor RPM:	1750	1712	1750	1412
Speeds:	VFD	59 Hz	VFD	49 Hz.
Heater Size:	NL	VFD Protected	NL	VFD Protected
Heater Amps.:	NL	VFD Protected	NL	VFD Protected
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:	7500	7617		
Return Air CFM:			7500	7568
Exhaust Air CFM:				
Outside Air CFM:	3900	4082		
Suction Pressure:		-1.1		-0.4
Discharge Pressure:		1.49		1.12
Fan Static Pressure:		2.59		1.52
External Pressure:	2	1.3		0.88
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	Direct Drive	NL	Direct Drive
Motor Drive:	NL	Direct Drive	NL	Direct Drive
Motor Size/Bore:	NL	Direct Drive	NL	Direct Drive
Fan Drive:	NL	Direct Drive	NL	Direct Drive
Fan Size/Bore:	NL	Direct Drive	NL	Direct Drive
Belt Size / Number:	NL	Direct Drive	NL	Direct Drive
Shafts C-C:	NL	Direct Drive	NL	Direct Drive
Turns Open:	NL	Direct Drive	NL	Direct Drive

Comments:

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech. Room

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	44	" WIDTH x	18	" DEPTH	Sq Ft = 5.50

AIR DENSITY DATA

STATIC PRESS @ CL:	0.71	InWg.	DESIGN CFM =	7500
DUCT AIR TEMP :	55	Deg F	ACTUAL CFM =	7384
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**7617**

AIR DENSITY RATIO CORRECTION = 1.03
SCFM CORRECTION FACTOR 1.03
ACTUAL DENSITY 0.077

TEST HOLE	1	2	3	4	5	6	7
A	966	1051	1132	1445	1387	1343	
B	946	1006	1476	1462	1510	1605	
C	1146	1319	1380	1455	1527	1319	
D	1207	1207	1557	1625	1736	1414	
E							
F							
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 1343

J							
K							
L							
M							
N							
O							
P							
Q							
R							

Damper 45% open

TECHNICIAN: Joe Lennon

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T1
Outside Air Max Condition TRAVERSE LOCATION: Mech. Room

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	39	" WIDTH x	38	" DEPTH	Sq Ft =	10.29

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.05	InWg.	DESIGN CFM =	3900
DUCT AIR TEMP :	75	Deg F	ACTUAL CFM =	4119
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4082**

AIR DENSITY RATIO CORRECTION = 0.99
SCFM CORRECTION FACTOR 0.99
ACTUAL DENSITY 0.074

TEST HOLE	1	2	3	4	5	6	7
A	284	309	333	425	408	395	
B	394	296	434	430	444	472	
C	337	388	406	428	449	388	
D	355	355	458	478	496	416	
E	346	399	525	465	428	427	
F	263	477	429	440	314	316	
G							
H							
I							

NO. OF READINGS = 36 AVERAGE FPM = 400

J							
K							
L							
M							
N							
O							
P							
Q							
R							

Damper 45% open

TECHNICIAN: Joe Lennon

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Mech. Room

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	60	" WIDTH x	16 " DEPTH	Sq Ft =	6.67

AIR DENSITY DATA

STATIC PRESS @ CL:	0.71	InWg.	DESIGN CFM =	7500
DUCT AIR TEMP :	55	Deg F	ACTUAL CFM =	7337
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**7568**

AIR DENSITY RATIO CORRECTION = 1.03
SCFM CORRECTION FACTOR 1.03
ACTUAL DENSITY 0.077

TEST HOLE	1	2	3	4	5	6	7
A	966	951	932	1145	1187	1134	
B	946	906	1176	1162	1110	1405	
C	947	1019	1080	1255	1127	1119	
D	907	1007	1157	1325	1337	1114	
E							
F							
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 1101

J							
K							
L							
M							
N							
O							
P							
Q							
R							

Damper 45% open

TECHNICIAN: Joe Lennon

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

FAN DATA SHEET

	FAN NO. AHU-2		FAN NO. Return	
Serves / Location:	Court	Mech. 0202	Court	Mech. 0202
Manufacturer:	Trane		Trane	
Model Number:	CSAA025UAL00		CSAA025UAL00	
Size:	NL		NL	
Serial Number:	K15D35535		K15D35535	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	Baldor	NL	Baldor
Frame Number:	NL	213T	NL	183T
Horsepower:	2 @ 7.5	7.5	2 @ 5	5
Brake Horsepower:	NL	5.31	NL	3.51
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	481/483/483	460/3	481/481/482
Motor Amperage:	18.8	13.2	13.2	5.2/5.4/5.2
Motor RPM:	1750	2140	1750	1558
Speeds:	VFD	73 Hz	VFD	54
Heater Size:	NL	VFD Protected	NL	VFD Protected
Heater Amps.:	NL	VFD Protected	NL	VFD Protected
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:	10000	9851		
Return Air CFM:			10000	9671
Exhaust Air CFM:				
Outside Air CFM:	3800	3772		
Suction Pressure:		-1.41		-1.02
Discharge Pressure:		2.69		0.8
Fan Static Pressure:		4.1		1.82
External Pressure:	2.3	2.01	1	0.8
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	Direct Drive	NL	Direct Drive
Motor Drive:	NL	Direct Drive	NL	Direct Drive
Motor Size/Bore:	NL	Direct Drive	NL	Direct Drive
Fan Drive:	NL	Direct Drive	NL	Direct Drive
Fan Size/Bore:	NL	Direct Drive	NL	Direct Drive
Belt Size / Number:	NL	Direct Drive	NL	Direct Drive
Shafts C-C:	NL	Direct Drive	NL	Direct Drive
Turns Open:	NL	Direct Drive	NL	Direct Drive

Comments:

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T-1
Supply Main TRAVERSE LOCATION: 2nd Fl. Mech. Rm.

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	56	" WIDTH x	18	" DEPTH Sq Ft =	7.00

AIR DENSITY DATA

STATIC PRESS @ CL:	0.69	InWg.	DESIGN CFM =	10000
DUCT AIR TEMP :	55	Deg F	ACTUAL CFM =	9550
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**9851**

AIR DENSITY RATIO CORRECTION = 1.03
SCFM CORRECTION FACTOR 1.03
ACTUAL DENSITY 0.077

TEST HOLE	1	2	3	4	5	6	7
A	1213	1430	1299	1365	1303	1377	1300
B	1353	1317	1357	1405	1455	1383	1345
C	1549	1487	1322	1494	1477	1371	1305
D	1441	1496	1499	1430	1420	1423	1247
E							
F							
G							
H							
I							

NO. OF READINGS = 36 AVERAGE FPM = 1364

J	1391	1336					
K	1273	1330					
L	1333	1167					
M	1259	1164					
N							
O							
P							
Q							
R							

TECHNICIAN: Joe Lennon

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T-2
Outside Air Min TRAVERSE LOCATION: Mech. Room

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	39	" WIDTH x	38	" DEPTH	Sq Ft =	10.29

AIR DENSITY DATA

STATIC PRESS @ CL:	0.06	InWg.	DESIGN CFM =	3900
DUCT AIR TEMP :	75	Deg F	ACTUAL CFM =	3805
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**3772**

AIR DENSITY RATIO CORRECTION = 0.99 VFD @ 63Hz
SCFM CORRECTION FACTOR 0.99
ACTUAL DENSITY 0.074

TEST HOLE	1	2	3	4	5	6	7
A	302	313	377	354	402	462	
B	292	332	350	384	482	392	
C	284	333	338	332	490	477	
D	328	362	342	328	465	460	
E	343	392	324	312	456	424	
F	331	323	352	369	308	396	
G							
H							
I							

NO. OF READINGS = 36 AVERAGE FPM = 370

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Joe Lennon

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T-3
Return TRAVERSE LOCATION: 2nd Fl. Mech. Rm.

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	52	" WIDTH x	20	" DEPTH Sq Ft =	7.22

AIR DENSITY DATA

STATIC PRESS @ CL:	-1	InWg.	DESIGN CFM =	10000
DUCT AIR TEMP :	72	Deg F	ACTUAL CFM =	9726
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**9671**

AIR DENSITY RATIO CORRECTION = 0.99
SCFM CORRECTION FACTOR 0.99
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	1129	1365	1391	1336	1300	1377	1303
B	1147	1405	1273	1330	1345	1383	1455
C	1268	1494	1333	1167	1305	1371	1477
D	1299	1430	1259	1164	1247	1423	1420
E							
F							
G							
H							
I							

NO. OF READINGS = 36 AVERAGE FPM = 1347

J	1213	1430					
K	1353	1317					
L	1549	1487					
M	1441	1496					
N							
O							
P							
Q							
R							

TECHNICIAN: Joe Lennon

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

FAN DATA SHEET

	FAN NO. AHU-3		FAN NO. Return	
Serves / Location:	Court	Attic	Court	Attic
Manufacturer:	Trane		Trane	
Model Number:	CSAA040UAL00		CSAA040UAL00	
Size:	NL		NL	
Serial Number:	K15E38655		K15E38655	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	Baldor	NL	Baldor
Frame Number:	NL	213T	NL	183T
Horsepower:	2 @ 10	10	2 @ 5	5
Brake Horsepower:	NL	5.31	NL	3.51
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	481/483/483	460/3	481/481/482
Motor Amperage:	12.5	13.2	7.4	5.2/5.4/5.2
Motor RPM:	1750	1751	1750	1765
Speeds:	VFD	60 Hz	VFD	60
Heater Size:	NL	VFD Protected	NL	VFD Protected
Heater Amps.:	NL	VFD Protected	NL	VFD Protected
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:	17000	17025		
Return Air CFM:			17000	17021
Exhaust Air CFM:				
Outside Air CFM:	5400	5212		
Suction Pressure:		-3.12		-1.21
Discharge Pressure:		1.12		0.1
Fan Static Pressure:		4.24		1.31
External Pressure:	2	1.68	1.2	0.78
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	Direct Drive	NL	Direct Drive
Motor Drive:	NL	Direct Drive	NL	Direct Drive
Motor Size/Bore:	NL	Direct Drive	NL	Direct Drive
Fan Drive:	NL	Direct Drive	NL	Direct Drive
Fan Size/Bore:	NL	Direct Drive	NL	Direct Drive
Belt Size / Number:	NL	Direct Drive	NL	Direct Drive
Shafts C-C:	NL	Direct Drive	NL	Direct Drive
Turns Open:	NL	Direct Drive	NL	Direct Drive

Comments:

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

TRAVERSE DATA

SYSTEM: AHU-3 TRAVERSE NUMBER : T-1
Supply Main TRAVERSE LOCATION: Attic Mech. Rm.

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 60 " WIDTH x 30 " DEPTH Sq Ft = 12.50

AIR DENSITY DATA

STATIC PRESS @ CL:	0.95	InWg.	DESIGN CFM =	17000
DUCT AIR TEMP :	55	Deg F	ACTUAL CFM =	16495
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**17025**

AIR DENSITY RATIO CORRECTION = 1.03
SCFM CORRECTION FACTOR 1.03
ACTUAL DENSITY 0.077

TEST HOLE	1	2	3	4	5	6	7
A	1705	1551	1415	1511	1393	1455	1663
B	1284	1263	1171	1234	1279	1317	1375
C	1293	1281	1261	1131	948	1034	1339
D	1368	1293	1072	1058	1045	1201	1433
E	1660	1413	1238	1323	1190	1167	1249
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1320

J	1560	1445	1449				
K	1272	1191	1405				
L	1280	1166	1243				
M	1344	1400	1465				
N	1358	1408	1381				
O							
P							
Q							
R							

TECHNICIAN: Joe Lennon

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

TRAVERSE DATA

SYSTEM: AHU-3 TRAVERSE NUMBER : T-2
Return TRAVERSE LOCATION: Attic Mech. Rm.

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	60	" WIDTH x	30 " DEPTH	Sq Ft =	12.50

AIR DENSITY DATA

STATIC PRESS @ CL:	-1.23	InWg.	DESIGN CFM =	17000
DUCT AIR TEMP :	55	Deg F	ACTUAL CFM =	16580
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**17021**

AIR DENSITY RATIO CORRECTION = 1.03
SCFM CORRECTION FACTOR 1.03
ACTUAL DENSITY 0.077

TEST HOLE	1	2	3	4	5	6	7
A	1507	1448	1321	1501	1329	1382	1390
B	1358	1427	1270	1327	1370	1488	1288
C	1229	1345	1281	1310	1220	1392	1270
D	1286	1496	1202	1292	1227	1282	1168
E	1366	1201	1296	1262	1190	1228	1292
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1326

J	1377	1423	1427				
K	1222	1410	1526				
L	1329	1329	1355				
M	1292	1277	1426				
N	1177	1155	1355				
O							
P							
Q							
R							

TECHNICIAN: Joe Lennon

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

FAN DATA SHEET

	FAN NO. AHU-4		FAN NO. Return	
Serves / Location:	Court	Attic	Court	Attic
Manufacturer:	Trane		Trane	
Model Number:	CSAA03038644		CSAA040UAL00	
Size:	NL		NL	
Serial Number:	K15E222C/A		K15E38655	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	Baldor	NL	Baldor
Frame Number:	NL	213T	NL	183T
Horsepower:	2 @ 7.5	7.5	2 @ 5	5
Brake Horsepower:	NL	5.31	NL	3.51
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	481/483/483	460/3	481/481/482
Motor Amperage:	12.5	8.2	7.4	5.2/5.4/5.2
Motor RPM:	1750	1591	1750	1520
Speeds:	VFD	55 Hz	VFD	51 Hz
Heater Size:	NL	VFD Protected	NL	VFD Protected
Heater Amps.:	NL	VFD Protected	NL	VFD Protected
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:	12000	12885		
Return Air CFM:			12000	12722
Exhaust Air CFM:				
Outside Air CFM:	4200	4019		
Suction Pressure:		-1.23		-0.9
Discharge Pressure:		1.62		0.22
Fan Static Pressure:		2.85		1.12
External Pressure:	2.3	1.6	1.2	0.69
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	Direct Drive	NL	Direct Drive
Motor Drive:	NL	Direct Drive	NL	Direct Drive
Motor Size/Bore:	NL	Direct Drive	NL	Direct Drive
Fan Drive:	NL	Direct Drive	NL	Direct Drive
Fan Size/Bore:	NL	Direct Drive	NL	Direct Drive
Belt Size / Number:	NL	Direct Drive	NL	Direct Drive
Shafts C-C:	NL	Direct Drive	NL	Direct Drive
Turns Open:	NL	Direct Drive	NL	Direct Drive

Comments:

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

TRAVERSE DATA

SYSTEM: AHU-4 TRAVERSE NUMBER : T-1
Supply Main High Branch TRAVERSE LOCATION: Attic

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	52	" WIDTH x	24	" DEPTH	Sq Ft =	8.67

AIR DENSITY DATA

STATIC PRESS @ CL:	0.72	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	55	Deg F	ACTUAL CFM =	5873
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**6058**

AIR DENSITY RATIO CORRECTION = 1.03
SCFM CORRECTION FACTOR 1.03
ACTUAL DENSITY 0.077

TEST HOLE	1	2	3	4	5	6	7
A	0	0	600	682	1123	1199	1170
B	0	0	133	684	1090	1157	1283
C	35	0	403	1019	1169	1189	1259
D	220	326	819	1205	934	1194	1098
E							
F							
G							
H							
I							

NO. OF READINGS = 36 AVERAGE FPM = 678

J	789	0					
K	1081	464					
L	878	503					
M	688	0					
N							
O							
P							
Q							
R							

TECHNICIAN: Joe Lennon

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

TRAVERSE DATA

SYSTEM: AHU-4 TRAVERSE NUMBER : T-2
Supply Main Low Branch TRAVERSE LOCATION: Attic Mech Rm.

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	24	" WIDTH x	40	" DEPTH	Sq Ft =	6.67

AIR DENSITY DATA

STATIC PRESS @ CL:	0.57	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	55	Deg F	ACTUAL CFM =	6621
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**6827**

AIR DENSITY RATIO CORRECTION = 1.03
SCFM CORRECTION FACTOR 1.03
ACTUAL DENSITY 0.077

TEST HOLE	1	2	3	4	5	6	7
A	1613	1495	1263	1044	1069	889	
B	1437	1426	1109	756	710	845	
C	1426	1414	815	574	447	659	
D	1521	1501	911	624	538	416	
E	1457	1543	987	392	416	600	
F	1273	1391	1020	882	888	476	
G	1261	1109	1064	1022	1013	416	
H							
I							

NO. OF READINGS = 42 AVERAGE FPM = 993

J							
K							
L							
M							
N							
O							
P							
Q							
R							

T-5: 5873 + T-6: 6923 Unit Total: 12796

TECHNICIAN: Joe Lennon

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

TRAVERSE DATA

SYSTEM: AHU-4 TRAVERSE NUMBER : T-3
Return TRAVERSE LOCATION: Attic Mech Rm.

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	54	" WIDTH x	23	" DEPTH Sq Ft =	8.63

AIR DENSITY DATA

STATIC PRESS @ CL:	0.57	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	55	Deg F	ACTUAL CFM =	12338
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**12722**

AIR DENSITY RATIO CORRECTION = 1.03
SCFM CORRECTION FACTOR 1.03
ACTUAL DENSITY 0.077

TEST HOLE	1	2	3	4	5	6	7
A	1808	1733	1750	1567	1366	1332	1155
B	1783	1728	1687	1691	1477	1407	1254
C	1780	1785	1703	1643	1474	1469	1312
D	1806	1701	1533	1524	1444	1423	1368
E	1543	1634	1641	1309	1342	1400	1250
F							
G							
H							
I							

NO. OF READINGS = 45 AVERAGE FPM = 1430

J	1266	1009					
K	1226	1173					
L	1012	1002					
M	1121	916					
N	900	923					
O							
P							
Q							
R							

T-5: 5873 + T-6: 6923 Unit Total: 12796

TECHNICIAN: Joe Lennon

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

FAN DATA SHEET

	FAN NO. REF-1		FAN NO. REF-2	
Serves / Location:	Elevator	Roof	Toilets	Roof
Manufacturer:	Cook		Cook	
Model Number:	150 ACE		135 ACE	
Size:	NL		NL	
Serial Number:	010SF89201-00/0011201		'010SF89201-00/0012301	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	US Motor	NL	US Motor
Frame Number:	NL	48Y	NL	48Y
Horsepower:	1	1	0.75	0.75
Brake Horsepower:	NL	NA	NL	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	1.7	1.4	1.4	1.1
Motor RPM:	1750	1757	1750	1753
Speeds:	1	1	1	1
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	1902	1500	1409
Outside Air CFM:				
Suction Pressure:		-1.62		-0.82
Discharge Pressure:		0.09		0.06
Fan Static Pressure:		NA		NA
External Pressure:	2.3	1.71	1.2	0.88
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	Direct Drive	NL	Direct Drive
Motor Drive:	NL	Direct Drive	NL	Direct Drive
Motor Size/Bore:	NL	Direct Drive	NL	Direct Drive
Fan Drive:	NL	Direct Drive	NL	Direct Drive
Fan Size/Bore:	NL	Direct Drive	NL	Direct Drive
Belt Size / Number:	NL	Direct Drive	NL	Direct Drive
Shafts C-C:	NL	Direct Drive	NL	Direct Drive
Turns Open:	NL	Direct Drive	NL	Direct Drive

Comments:

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

FAN DATA SHEET

	FAN NO. REF-3		FAN NO. EF-7	
Serves / Location:	Elevator	Roof	Toilets	Roof
Manufacturer:	Cook		Cook	
Model Number:	135C17		80 DB	
Size:	NL		NL	
Serial Number:	010SF8901-00/0012501		010SF89201-00/0006802	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	US Motor	NL	Marathon
Frame Number:	NL	48Y	NL	56
Horsepower:	0.75	0.75	1/3	1/3
Brake Horsepower:	NL	NA	NL	NA
Safety Factor:	NL	1.15	NL	1.35
Volts/Phase:	460/3	460/3	115/1	115/1
Motor Amperage:	1.4	1.1	1.5	1
Motor RPM:	1750	1757	1725	1727
Speeds:	1	1	1	1
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:	1750	1702	985	800
Outside Air CFM:				
Suction Pressure:		-0.62		-0.42
Discharge Pressure:		0.09		0.22
Fan Static Pressure:		NA		NA
External Pressure:	2.3	0.71	1.2	0.64
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	Direct Drive	NL	966
Motor Drive:	NL	Direct Drive	NL	1VL34
Motor Size/Bore:	NL	Direct Drive	NL	5/8"
Fan Drive:	NL	Direct Drive	NL	AL54
Fan Size/Bore:	NL	Direct Drive	NL	3/4"
Belt Size / Number:	NL	Direct Drive	NL	A32
Shafts C-C:	NL	Direct Drive	NL	9 1/2
Turns Open:	NL	Direct Drive	NL	2

Comments:

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

TRAVERSE DATA

SYSTEM: EF-7 TRAVERSE NUMBER : T-1
TRAVERSE LOCATION: Exhaust

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	17	" WIDTH x	12 " DEPTH	Sq Ft =	1.42

AIR DENSITY DATA

STATIC PRESS @ CL:	0.4	InWg.	DESIGN CFM =	985
DUCT AIR TEMP :	55	Deg F	ACTUAL CFM =	776
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**800**

AIR DENSITY RATIO CORRECTION = 1.03
SCFM CORRECTION FACTOR 1.03
ACTUAL DENSITY 0.077

TEST HOLE	1	2	3	4	5	6	7
A	609	588	551	522	488		
B	622	609	503	560	503		
C	570	563	519	499	514		
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 15 AVERAGE FPM = 548

J							
K							
L							
M							
N							
O							
P							
Q							
R							

T-5: 5873 + T-6: 6923 Unit Total: 12796

TECHNICIAN: Joe Lennon

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

FAN DATA SHEET

	FAN NO. REF-4		FAN NO.	
Serves / Location:	Cells	Roof		
Manufacturer:	Cook			
Model Number:	90CV17DHEC			
Size:	NL			
Serial Number:	010SF89201-00/0014501			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	Cook		
Frame Number:	NL	NL		
Horsepower:	1/4	1/4		
Brake Horsepower:	NL	NA		
Safety Factor:	NL	1.35		
Volts/Phase:	120/1	120		
Motor Amperage:	3.4	2.3		
Motor RPM:	300-1750	Direct Drive		
Speeds:	1	Variable		
Heater Size:	NL	NA		
Heater Amps.:	NL	NA		
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	200	212		
Outside Air CFM:				
Suction Pressure:		-0.19		
Discharge Pressure:		0.09		
Fan Static Pressure:		NA		
External Pressure:	0.25	0.28		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	Direct Drive		
Motor Drive:	NL	Direct Drive		
Motor Size/Bore:	NL	Direct Drive		
Fan Drive:	NL	Direct Drive		
Fan Size/Bore:	NL	Direct Drive		
Belt Size / Number:	NL	Direct Drive		
Shafts C-C:	NL	Direct Drive		
Turns Open:	NL	Direct Drive		

Comments:

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** 21-541

AIR DISTRIBUTION

SYSTEM: REF-4

SUPPLY [ ] RETURN [ ] EXHAUST [X]

ROOM OR LOCATION	UNIT NUMBER	UNIT SIZE	AREAxK FACTOR	DESIGN FT/MIN	TEST FT/MIN	DESIGN CFM	TESTED CFM
2017	1	14x4	F.H.	NA	NA	100	105
2016	2	14x4	F.H.	NA	NA	100	107
Comments:					TOTALS:	200	212

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** **21-541**

FLOW METERING DATA

SYSTEM: Chilled Water

ROOM OR LOCATION	UNIT NUMBER	UNIT SIZE	GAUGE Pd	SET Pd	DESIGN GPM	SET GPM	BALANCING VLV SET @
AHU-1	1	3	7.9	7.9	56	54	5.5
AHU-2	2	3	40.3	40.3	67	65	2.5
AHU-3	3	3	28.1	28.1	120	114	5.0
AHU-4	4	3	10.2	10.2	80	72	5.0

Comments:

Project: Salem Probate & Family Court PH 4
Address: 36 Federal St., Salem, MA
Date: 10/15/2021 **Project No.** **21-541**

FLOW METERING DATA

SYSTEM: Chilled Water

ROOM OR LOCATION	UNIT NUMBER	UNIT SIZE	GAUGE Pd	SET Pd	DESIGN GPM	SET GPM	BALANCING VLV SET @
AHU-1	1	6B	13.6	13.6	20	20	55
AHU-2	2	6B	14	14	22	23	75
AHU-3	3	6B	19	19	23	25	10
AHU-4	4	6B	24.2	24.2	25	25	95

Comments: