Framingham District Court
Framingham, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

October 12, 2021

Tighe&Bond

100% Recyclable

Section 1
Existing Conditions & Site Observations

Tighe & Bond visited the Framingham District Court on November 17, 2020. While on site we inspected the air handling equipment located in two mechanical rooms and toured the facility to determine if the spaces generally matched usages noted on the architectural plans.

There were no mechanical drawings available for this building, and we found none on site. The lack of plans has resulted in a number of unknown data that is not able to be shown in the following data tables.

Site Visit Attendees:

- *Office of Court Management:*
  - Michael Norman, Manager of Court Facilities
  - Scott Morse, Facilities
  - Patrick Kelly, Courthouse Facilities Staff
- *Tighe & Bond*
  - Todd Holland, PE, Mechanical Engineer

1.1 Existing Ventilation System

The Courthouse was built in 1952 and is approximately 27,600 square feet in size. Ventilation and air conditioning for most of the building is provided by two multizone air handling units (AHUs), AC-1 and AC-2, located in separate mechanical rooms. Each unit has a mixing box with outdoor air (OA) and return air (RA) dampers, filter section, a hot deck with hydronic (hot water) heating coil, and cold deck direct-expansion (DX) cooling coil. The units are constant volume, and the supply and exhaust fans are constant speed. These units have economizer controls for "free" cooling with 100% OA when conditions permit.

AC-1 is a Worthington unit with 10 active zones and one inactive zone. AC-2 is a McQuay unit serving five zones. The individual zone dampers appear to be original equipment, but the actuators were upgraded to electronic (Belimo) in 2008. These units have 2" thick MERV-10 filters in a v-bank arrangement. Cooling for the multizone units is provided by a roof-mounted air-cooled condensing unit, and a Trane 50-ton air-cooled condensing unit, pad-mounted on grade. According to facilities personnel, this condensing unit is oversized and only one of the two refrigeration circuits is used.

A makeup air unit, AHU-1, provides 100% outdoor air to the holding area. This constant-volume unit has an OA damper, filter section, DX cooling coil, supply fan, and an external hydronic heating coil. Cooling is provided by a Trane 4-ton air-cooled condensing unit, located in an air well behind the holding cells. The condensing unit is 25 years old, well past its expected life, and uses R-22 refrigerant which is no longer manufactured.

AHU-2 is a constant-volume unit that serves the accessible vestibule addition and is located above the drop-in ceiling. This unit has a mixing box with OA and RA dampers, filter section, DX cooling coil, supply fan, and hydronic heating coil. This unit has economizer controls. Cooling is provided by a Carrier 7-ton air-cooled condensing unit,

pad-mounted on grade. This condensing unit is 12 years old, approaching its expected life of 12 years, and uses R-22 refrigerant which is no longer manufactured.

There are five unit ventilators, two in the main courtroom, one in Courtroom 4, and two in separate offices. These have only a hot water coil for heating, and an outdoor air damper for ventilation. These appear to be original to the building. Tighe & Bond did not open any for inspection of internal components.

The main courtroom has two mini-spit heat pump systems for auxiliary cooling, these are rated for 3 tons each. They do not provide ventilation air, and it is not known if they are used for heating as well.

The facility is heated by three gas-fired hydronic boilers, installed 2007, in a basement mechanical room. Three sets of pumps serve perimeter radiation, wall-mounted convectors, and heating coils in the AHUs.

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
AC-1	Unknown	Unknown	2" MERV-10	Fair to Poor
AC-2	Unknown	Unknown	2" MERV-10	Fair to Poor
AHU-1	1,400*	1,400	Unknown	Unknown
AHU-2	2,800*	Unknown	Unknown	Good
FCU 1-5	Unknown	Unknown	1" throwaway	Unknown

*Estimated airflow based on cooling capacity

Photo 1 – Representative Air Handler

1.2 Existing Control System

An Alerton BACtalk direct digital control (DDC) building management system (BMS) was installed in 2008. All damper actuators, control valves, and sensors we saw were electronic, we did not note any active pneumatic controls.

Displays from the BMS showed a wide variation in zone supply air temperatures. It is not known if this is due to damper adjustment or temperature sensor calibration.

We observed that the supply air temperatures for zones with the same damper position varied widely. The AC-1 zones calling for full heat, with the cold deck fully closed, varied between 72°F and 101°F. The supply air temperatures for AC-1 zones in full cool, with the cold deck 100% open, ranged from 60°F to 70°F. All zones on AC-2 were calling for full cooling with the cold deck 100% open, and supply air temperatures varying between 72°F and 84°F.

We noted that the OA dampers were fully closed in AC-1 and 15% open in AC-2. These positions were confirmed by visual inspection. The OA damper in AHU-2 was also shown as fully closed, but we were unable to access that unit.

Other issues observed were the filter pressure drop in AC-1 was a negative value, and the supply fan statuses were negative in AC-1 and AHU-2 although the fans were running. Each of the air handlers were showing several active alarms.

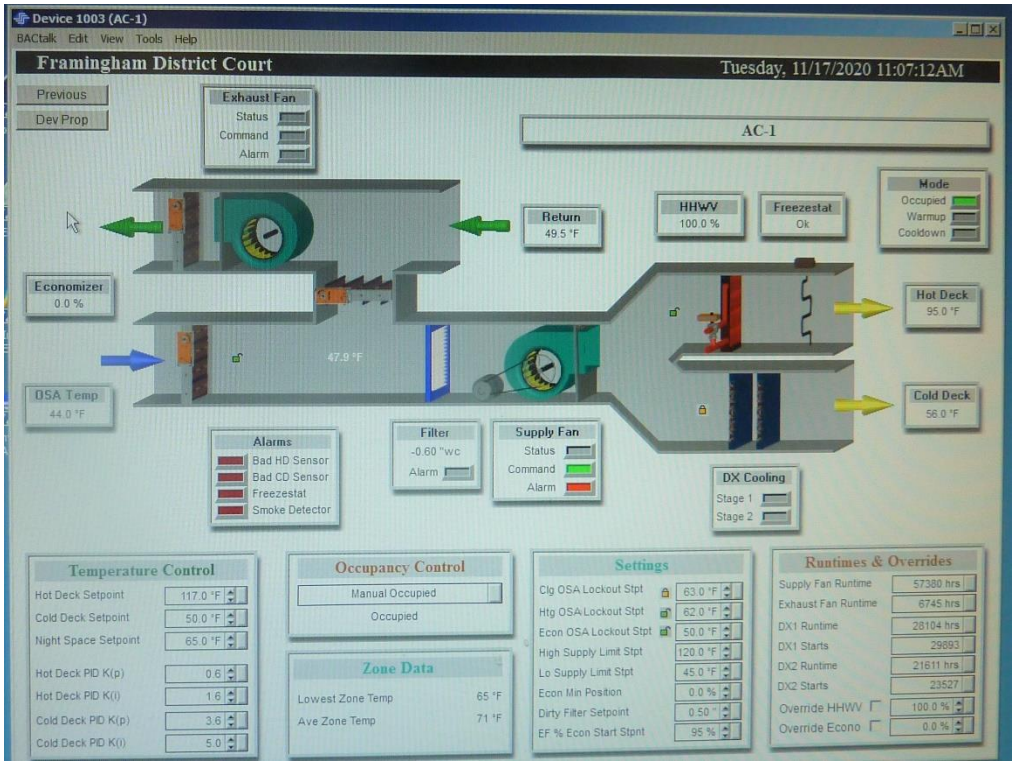

Photo 2 – Representative BMS Screen

Section 2
Recommendations

Below is a list of recommendations that we propose for the Framingham District Court. 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-10 and MERV-8 filters with MERV-13 filters.*

The TAB Contractor and/or Engineer shall verify that all air handlers can accommodate MERV-13 filters.

2.2 Testing & Balancing Recommendations

The air handling units appear to be 40 to 50 years old and it is unknown to Tighe & Bond if they were tested and balanced as part of the 2008 controls upgrade. 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.

Tighe & Bond does not have documentation on the originally designed entering mixed air temperatures for the preheat and DX coils in the AHU. We will need more data to determine if the AHU and zone reheat coils have the capacity to accommodate the 2015 code required ventilation air under peak conditions. Prior to rebalancing efforts, dampers and actuators should be tested to ensure they are operating correctly.

We recommend the following testing and balancing measures be implemented:

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

We recommend rebalancing the air handlers' outside airflow rates to the values shown in Table 2. The cooling and heating coils must be analyzed to determine if they are able to provide proper leaving air conditions under peak outdoor air conditions, assuming the coils are clean, and their performance has not degraded significantly over time.

Tighe & Bond cannot calculate the OA requirements for AC-1 and AC-2 without knowing which zones are served by which units. We can calculate these once we have mechanical drawings that show individual zone airflows, or if that information is provided by the TAB contractor.

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)
AC-1	Unknown	Unknown	TBD	TBD
AC-2	Unknown	Unknown	TBD	TBD
AHU-1	1,200*	1,200	331	TBD
AHU-2	2,800*	Unknown	120	120
FCU 1-5	Unknown	Unknown	TBD	TBD

*Estimated airflow based on cooling capacity

The average airflow rate per person is shown below in Table 3. These values are based on the original design supply airflow rates, which are unknown at this time, and the recommended outdoor air flow rates shown in Table 2 above.

TABLE 3
Average Airflow Rate per Person

	All Spaces	***Courtrooms***	***Non-Courtroom Spaces***
Total Occupancy (People)	371	209	162
Total Supply Air (CFM/Person)	Unknown	Unknown	Unknown
Outdoor Air (CFM/Person)	11	7	16

The airflow rates per person for each Courtroom and the Jury Pool Rooms are shown below in Table 4. These values are based on full occupancy without taking diversity into account, and the recommended outdoor airflow rate. Since Tighe & Bond does not have access to mechanical design drawings or test and balance data, we cannot determine the original design supply airflow rates.

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)***
Jury Pool Room B-1	17	Unknown	Unknown	130	8
Jury Room 203	6	395	66	46	8
Main Court (Rm. 106)	109	Unknown	Unknown	638	6
Court 2 (Rm. 207)	45	650	14	329	7
Court 3 (Rm. 205)	40	317	8	293	7
Traffic Court 4	15	303	20	116	8

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 Rooms, based on a reduced occupancy schedule to be determined by the Office of Court Management, is shown below in Table 4a.

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)***
Jury Pool Room B-1	9	Unknown	Unknown	130	14
Jury Room 203	6	395	66	46	8
Main Court (Rm. 106)	32	Unknown	Unknown	638	20
Court 2 (Rm. 207)	19	650	34	329	17
Court 3 (Rm. 205)	21	317	15	293	14
Traffic Court 4	6	303	51	116	19

RTB-6: *Test and balance all air handler hot water coils.*

Testing and balancing the air handler hot 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*.

Repair or replace the dampers and actuators that are not opening and closing fully, or not going to the position commanded by the controls.

RE-2: *Clean air handler coils.*

The coils in air handlers appear to be original, and Tighe & Bond does not know how regularly they have been cleaned. There was a visible accumulation of dust and debris on the coils in AC-1 and AC-2.

2.4 Control System Recommendations

We recommend the following for the control system:

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

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

The existing BMS appears sophisticated enough to implement this type of sequence.

Currently, an economizer sequence is used to provide 100% OA when conditions permit. When the OA damper is 100% open on AC-1 or AC-2, the exhaust fan runs so that the building is not over-pressurized. This sequence should be reviewed, with the exhaust fan either activated at less than 100% open, or with VFDs installed on the exhaust fans, controlled to maintain proper building pressurization.

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

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. It is unlikely that this building was constructed to handle a humidification system.

Duct mounted humidifiers must be engineered, integrated into the building control system, tested, and commissioned. All of the available configurations require substantial maintenance and additional controls. If not properly maintained, they 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 deploy, 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, potentially adverse effects to the building envelope and IAQ, it may be warranted as a temporary solution in some areas.

2.7 Other Recommendations

2.7.1 Test Existing Zone Dampers and Actuators for Proper Operation

Wide variations in discharge air temperature for zones in AC-1 and AC-2 with the same displayed damper position demonstrate that dampers are not at the position indicated on the BMS. Repair or replace the dampers and actuators that are not opening and closing fully, or not going to the position commanded by the controls.

2.7.2 Replace Air Handling Units

Replacing the air handlers should be considered within 3-5 years. Indoor central station air handling units have a life expectancy of 35-40 years. The multizone units appear to be much older than that, and they have components that are in poor condition and subject to imminent failure, which will result in an immediate and extended interruption to Courthouse activities. The small size of the mechanical rooms, particularly for AC-2, will present a challenge. Original exhaust fans and unit ventilators should be replaced as well.

2.7.3 Repair and Calibrate Filter Differential Pressure Sensor

The filter pressure drop displayed for AC-1 was -0.60" w.g., which is actually a pressure rise. It is possible that the taps for the upstream and downstream pressures are reversed. We recommend testing and calibrating this sensor so that it can accurately flag when filters should be replaced.

2.7.4 Install Automatic Controls for Exhaust Fans in Holding Area

The exhaust fans that serve the holding area are currently controlled by manual switches. These were not running at the time of the site visit, although one of the cells was occupied. AHU-1 is controlled by the BMS, and we recommend adding control points for the fans so that all three units run whenever the area is occupied.

2.7.5 Provide Exhaust Ventilation for Holding Cell B33

A recent renovation added a combination toilet and lavatory fixture to one of the small holding cells, but no ventilation was added. Code requires an exhaust airflow rate of 1.0 cfm per square foot of floor area.

Section 3
Testing & Balancing Results

Wing's Testing and Balancing visited the Framingham District Court on April 1, 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 6. Wings returned on September 9 to test airflows to individual diffusers in selected rooms. Results were used to revise Tables 4 and 4a in Section 2, and notes 7-10 below, The full testing and balancing (TAB) report is attached.

TABLE 5
Air Handler Testing & Balancing Results

	Design			Actual		
Unit	**Total Supply Airflow (CFM)**	**Recommended Outdoor Airflow (CFM)**	**Return Airflow (CFM)**	**Supply Airflow (CFM)**	**Outdoor Airflow (CFM)**	**Return Airflow (CFM)**
AC-1	Unknown	2,700	Unknown	10,787	2,585	8,202
AC-2	Unknown	3,100	Unknown	12,292	2,941	9,351
AHU-1	1,200*	1,200	-	500	500	-
AHU-2	2,800*	120	2,680	2,851	127	2,724

*Estimated supply airflow based on cooling capacity

TABLE 6
Exhaust Fan Testing & Balancing Results

Unit	**Serving**	**Design Return/Exhaust Airflow (CFM)**	**Actual Return/Exhaust Airflow (CFM)**
EF	Women's Holding	Unknown	1,075
EF	Men's Holding	Unknown	3,256
EF	Jury Pool B-1	Unknown	729
F-9	N. Toilet Rooms	250**	57
F-10	Toilet Rooms	Unknown	219

**Estimated exhaust airflow based on number of flush fixtures

The typical balancing tolerance for air systems is ±10% of the design airflow.

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

1. The air filters in the unit ventilators, FCU 1-5 (UV 1-5 in the TAB report), are not MERV rated. The supply fans in these units do not run, and the outdoor air louvers have been closed off and packed with insulation.

2. The exhaust airflow for F-9 that serves the north toilet rooms is very low, it is the TAB contractor's opinion that it should be replaced.
3. Further investigation is required to determine the cause of the low airflow reading at AHU-1, the makeup air unit that serves the holding area. The hot water flow to this unit was not tested because there is no circuit setter, and the pipe insulation may contain asbestos.
4. The fan on AC-1 was originally rotating backward, and this condition was fixed.
5. The sequence for AC-1 does not have the return fan operating under normal conditions.
6. The recommended outdoor airflows in Table 5 are based on the assumption that the areas served by AC-1 and AC-2 are split fairly evenly, resulting in a required outdoor air volume of 25% for both systems. The tested outdoor airflows are just shy of this, but within the accepted tolerance.

The following should be noted from the follow-up TAB report:

7. Jury Pool Room B-1 uses a portable AC unit, and no mechanical supply air ventilation. There is 729 cfm of exhaust.
8. Jury Room 203 has no return air because a damper is closed.
9. Airflow readings cannot be taken in the Main Courtroom 106 because of the high ceiling, a lift would be required. The duct layout in the mechanical room prevents measurements from being taken at the unit.
10. Loose insulation material was found inside the diffuser serving Traffic Court 4, and was removed to improve airflow.

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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WING'S TESTING & BALANCING CO., INC.

Framingham District Court
Airflow Testing

* * * *

Tighe & Bond
Attn: Jason Urso
53 Southampton Road
Westfield, MA 01085

September 9, 2021

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WING'S TESTING & BALANCING CO., INC.

Tighe & Bond
Attn: Jason Urso
53 Southampton Road
Westfield, MA 01085

September 9, 2021

Re: Framingham District Court – Airflow Testing

Dear Jason,

The air flow testing of the above referenced location has been completed and noted on our attached data sheets. The following are our results:

- We measured air flow rates in all diffusers in the Jury Pool Room B-1, Jury Room 203, Court-2 (Room 207), Court-3 (Room 205), and Traffic Court, except for the Main Court Room. The Main Court Room has high ceilings and traverse pitot tube readings cannot be taken due to sheetrock ceiling. Only exposed ductwork exists in the Mechanical Room, but due to ductwork layout measurements cannot be taken. To measure distribution in the room, a lift is needed and coordination with Court authorities about time to perform work.
- There is no chilled water serving AC's and AHU's refrigerant only.

The following pages are your record of current operating conditions. If you have any questions, or if we can be of further service, please do not hesitate to call.

Very truly yours,

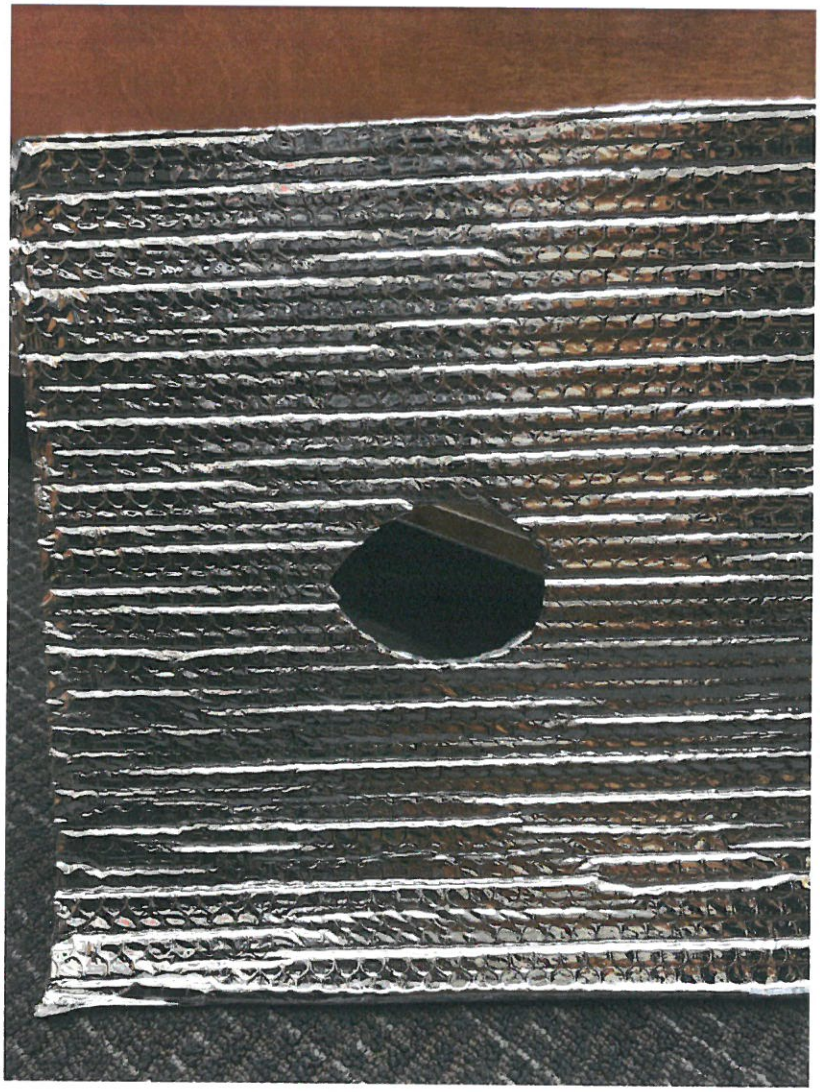
Wing's Testing & Balancing Co., Inc.
ICB Certified Contractor for:
TABB—Commissioning—Fire/Life Safety L1&L2—Sound & Vibration

Marek Sadowski
Certified TABB Technician #BB1083468T
CT SM-2 License #7078
MA SM-2 4508
HVAC Fire Life Safety Level 1 Tech FLS11083468T
EPA Universal Technician AA2804U0003

WING'S TESTING & BALANCING CO., INC.

Framingham District Court
September 9, 2021

Court-3 (Room 205)
Found inside Supply Diffuser



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AIR DEVICE REPORT

PROJECT: Framingham District Court | **DATE:** 9/9/21

SYSTEM / AREA: VER 1 | **TECH:** MS

LOCATION	NO.	SIZE	A K	DESIGN FPM	DESIGN CFM	TEST FPM	TEST CFM	FINAL FPM	FINAL CFM	NOTES
Jury Pool Room B-1										
Exhaust	E1	24" x 24"	FH	---	ND	---	729			(1)
Jury Room 203										
Supply	S1	10" x 10"	FH	---	ND	---	395			
Return	R1	10" x 10"	FH	---	ND	---	0			(2)
Main Court Room 106										
Supply	S1		FH	---	ND	---				
Supply	S2		FH	---	ND	---				
Supply	S3		FH	---	ND	---				
Supply	S4		FH	---	ND	---				
Supply	S5		FH	---	ND	---				
Supply	S6		FH	---	ND	---				
					ND					(3)
Court-2 Room 207										
Supply	S1	22" x 22"	FH	---	ND	---	650			
Return Lower	R1	26" x 24"	FH	---	ND	---	266			
Return Upper	R2	30" x 16"	FH	---	ND	---	306			
					ND		672			
Court-3 Room 205										
Supply	S1	15" x 15"	FH	---	ND	---	81/317			(4)
Return	R1	24" x 12"	FH	---	ND	---	197			
Traffic Court-4										
Supply	S1	16" x 12"	FH	---	ND	---	303			
Return	R1	16" x 12"	FH	---	ND	---	247			
					ND		550			
Return	R1	24" x 24"	FH	---	ND	---	0			
Return	R2	30" x 16"	FH	---	ND	---	115			
Return	R3	16" x 12"	FH	---	ND	---	89			
					ND		204			

REMARKS

(1) For cooling used portable AC. Cabinet unit heating/cooling disconnected.
(2) OBD closed
(3) Can not take readings due to high ceiling. Lift needed. Can not take traverse reading in duct serving room due to layout.
(4) We found aluminium foam on the collar, as shown in picture, second reading when piece was removed.

WING'S TESTING & BALANCING CO., INC.

Framingham District Court
HVAC/Ventilation Survey
REVISED

* * * *

Tighe & Bond
Attn: Jason Urso
53 Southampton Road
Westfield, MA 01085

April 5, 2021

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WING'S TESTING & BALANCING CO., INC.

Tighe & Bond
Attn: Jason Urso
53 Southampton Road
Westfield, MA 01085

April 5, 2021

Re: Framingham/HVAC Ventilation Survey

Dear Jason,

REVISED 5/26/21: Since our last visit the controls contractor fixed and/or replaced the non-modulating outside air damper on AHU-2. Upon our return we re-tested this unit and its outside air. This was reset to the numbers on our previous report. This unit is achieving design CFM and the outside air damper is set appropriately.

We have completed our HVAC/Fresh-Air survey for the above-mentioned project. Through our testing we found:

- North Restroom Exhaust Fan is very low on air and needs replacing. The fan is dying out as this letter is written and is only exhausting a total of 57 CFM combined out of three restrooms.
- AHU-1 was the only unit below design; however, the hot water to this unit could not be tested due to no circuit setter being installed and apparent asbestos on the pipes above ceiling.
- AC-1 was found to be rotating backwards and since has been fixed. Also the sequence of operations has the AC-1 RF not operating under normal conditions.
- The filters in the UV's/FCU's are not MERV rated and the outside air louvers for these units have been packed with insulation.

This report includes Brake Horsepower (BHP) calculations. When a motor has a VFD, we take the amperage measurements from there. When we calculate from volts and amps, it means there has to be a nameplate on the motor. Many times, these are missing or illegible. If BHP is not listed for an individual motor, this is because we do not have enough information to calculate it. It should be noted that that the older a motor is, the less likely it is to follow the affinity laws for BHP- since the efficiency degrades over time. We have used accepted constants for efficiency and the power factor, which should result in fairly close calculations, but are not as accurate for older motors.

Framingham District Court
April 5, 2021

The following pages are your record of current operating conditions. If you have any questions, or if we can be of further service, please do not hesitate to call.

Very truly yours,
Wing's Testing & Balancing Co., Inc.
ICB Certified Contractor for:
TABB—Commissioning—Fire/Life Safety L1&L2—Sound & Vibration

Barry Stratos
Certified TABB Technician BB996928T

SUPPLY FAN REPORT

PROJECT: Framingham District Court	**DATE:** 4/1/21
AREA SERVED: Various	**TECH:** BS

FAN DATA						
FAN NUMBER	AC-1		AC-1 RF		AC-2	
LOCATION	Basement		Basement		Basement	
AREA SERVED	1st Floor		1st Floor		2nd Floor	
MANUFACTURER	McQuay		Woods Air Movement		McQuay	
MODEL OR SIZE	NA		30J 15PA		NA	
	DESIGN	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**
TOTAL CFM	ND	10,787 (1)	ND	9949	ND	12,292
RETURN AIR	ND	8202 (1)	ND	---	ND	9351
OUTSIDE AIR	ND	2585 (1)	ND	---	ND	2941
DISCH. STATIC	---	---	---	+0.46"	---	+0.42"
SUCTION STATIC	---	---	---	-2.01"	---	-1.64"
TOTAL STATIC	---	---	---	2.47	---	2.02
FAN RPM	---	882	DD	DD	---	685
PULLEY O.D.	12 1/2" x 1 3/16"		DD		16" x 2 5/16"	
ESP	---		---		1.59	
VFD SPEED	No VFD		No VFD		No VFD	
O.A.D. MIN POS	25%		NA		15%	

MOTOR DATA						
MANUFACTURER	Baldor		NA		Baldor	
MODEL OR FR.	213 T		213 TZ		215 T	
HORSEPOWER	7.5	7.5	7.5	7.5	10	10
MOTOR RPM	1770	1770	1750	1750	1770	1770
VOLTAGE / PH.	230/3	230/3	280/3	280/3	230/3	230/3
AMPS LEG 1	19.4	20.1	18.6	17.0	24.0	23.8
AMPS LEG 2	---	19.6	---	16.8	---	23.6
AMPS LEG 3	---	20.8	---	17.2	---	22.9
SHEAVE O.D.	6 1/2" x 1 3/8"		DD		6" x 1 3/8"	
BELTS - QTY / SIZE	2/B93		DD		2/B112	
SHEAVE POSITION	Fixed		DD		Fixed	
BHP	7.5		6.8		9.5	

REMARKS

(1) The building and AHU normally run without the Return Fan operating.

NA-Not Available
ND-No Design DD-Direct Drive

SUPPLY FAN REPORT

PROJECT: Framingham District Court	**DATE:** 4/1/21
AREA SERVED: Various	**TECH:** BS

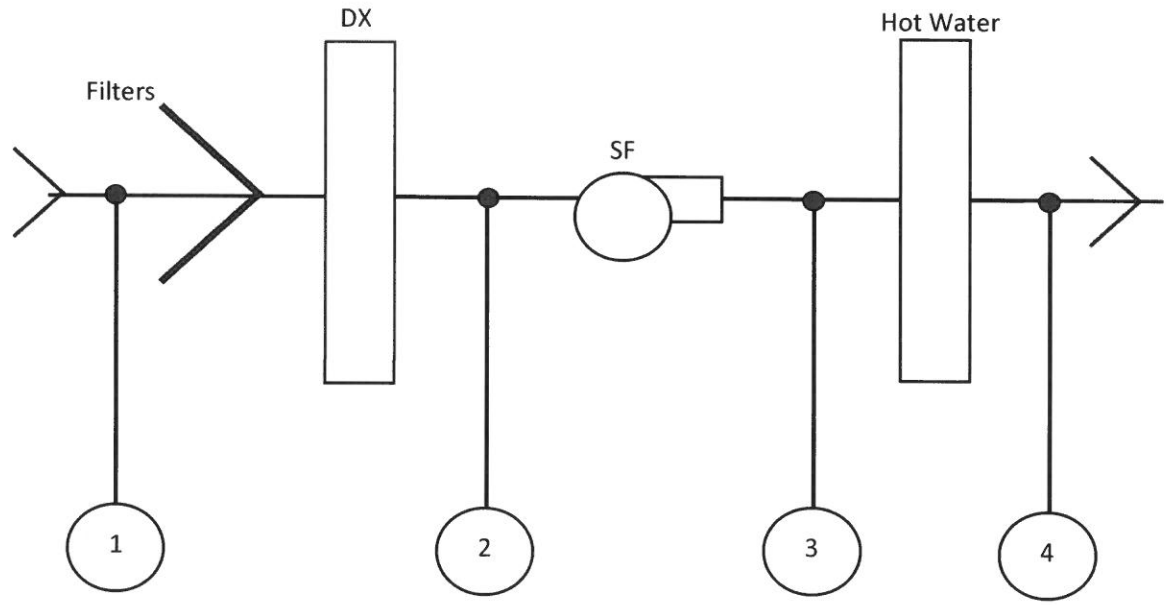
FAN DATA						
FAN NUMBER	AC-2 RF		AHU-1		AHU-2	
LOCATION	Basement		Lock Up		Entry	
AREA SERVED	2nd Floor		Lock Up		Entry	
MANUFACTURER	Woods Air Movement		Trane		Carrier	
MODEL OR SIZE	30J 15 PA		TWE 060 A3		40 RM-007-B611HC	
	DESIGN	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**
TOTAL CFM	ND	10,354	1200	500	2800	2851
RETURN AIR	---	---	0	0	2680	2724
OUTSIDE AIR	---	---	1200	500	120	127
DISCH. STATIC	---	+1.06"	---	---	---	+0.40"
SUCTION STATIC	---	-1.84"	---	---	---	-0.51"
TOTAL STATIC	DD	2.90	---	---	---	0.91
FAN RPM	DD		---	1004	---	NA
PULLEY O.D.	---		6" x 5/8"		NA	
ESP	---		---		0.34	
VFD SPEED	No VFD		No VFD		No VFD	
O.A.D. MIN POS	NA		100%		15%	
MOTOR DATA						
MANUFACTURER	NA		Marathon		GE	
MODEL OR FR.	NA		FR 56		56 Y	
HORSEPOWER	---	NA	3/4	3/4	2.4	2.4
MOTOR RPM	---	NA	1725	1725	1725	1725
VOLTAGE / PH.	208/3	208/3	230/3	230/3	230/3	230/3
AMPS LEG 1	18.6	13.4	3.1	2.0	5.8	5.6
AMPS LEG 2	---	16.2	---	2.0	---	5.6
AMPS LEG 3	---	17.3	---	2.0	---	5.6
SHEAVE O.D.	DD		4" x 5/8"		NA	
BELTS - QTY / SIZE	DD		1/Ax43		NA	
SHEAVE POSITION	DD		100% Closed		NA	
BHP	NA		0.5		2.3	

REMARKS

NA-Not Available
ND-No Design DD-Direct Drive

SYSTEM STATIC PRESSURE PROFILE

PROJECT: Framingham District Court	**DATE:** 4/1/21
SYSTEM/AREA SERV: AHU's	**TECH:** BS



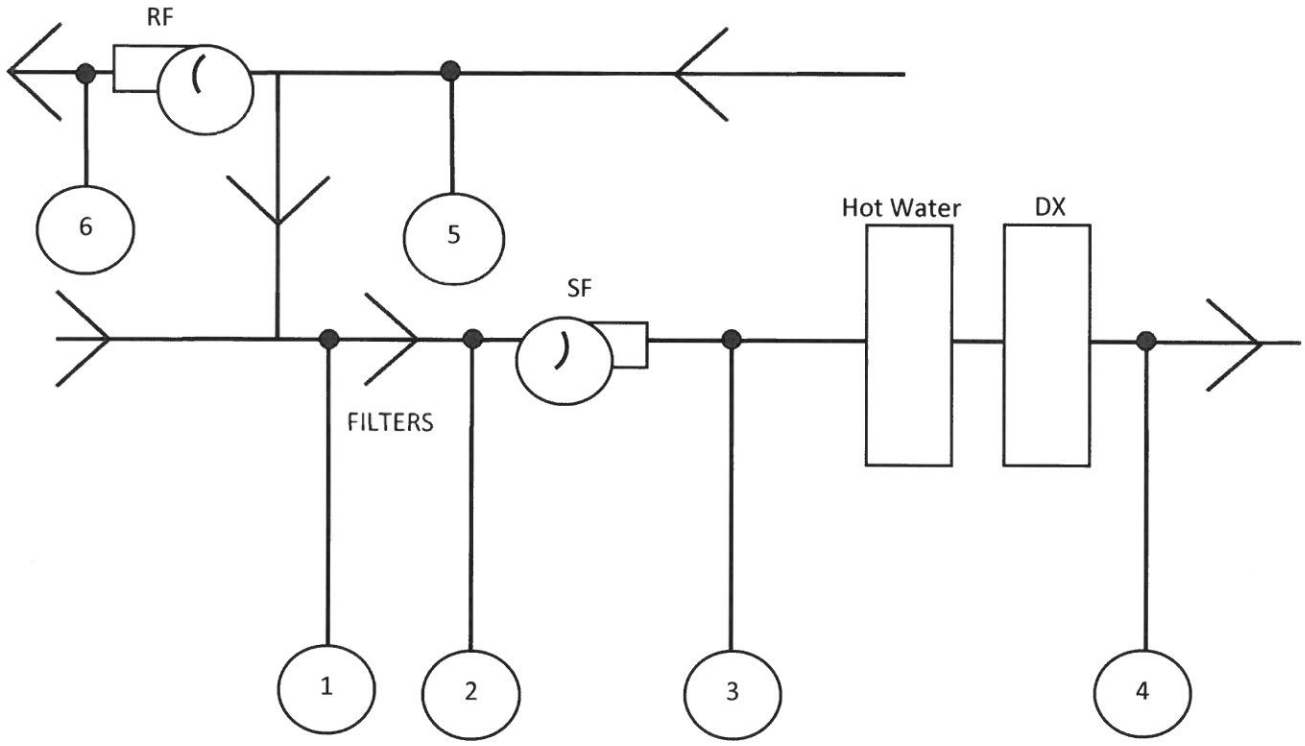
STATIC PRESSURE READINGS "wc

POS. (+) / NEG.(-)	1	2	3	4	5	6	7	NOTES
AHU-1	-0.13"	-0.24"	+0.33"	+0.21"				
AHU-2	-0.20"	-0.51"	+0.40"	+0.28"				

REMARKS

SYSTEM STATIC PRESSURE PROFILE

PROJECT: Framingham District Court	**DATE:** 4/2/21
SYSTEM/AREA SERV: AC's	**TECH:** BS



STATIC PRESSURE READINGS "wc

POS. (+) / NEG.(-)	1	2	3	4	5	6		
AC-1	-0.83"	-0.99"	+0.68"	+0.46"				
AC-2	-1.31"	-1.64"	+0.42"	+0.28"				
AC-1 RF					-2.01"	+0.46"		
AC-2 RF					-1.64"	+0.42"		

REMARKS

VELOCITY PRESSURE READINGS

PROJECT: Framingham District Court | **DATE:** 4/1/21

AREA SERVED: Various | **TECH:** BS

TRAVERSE LOCATIONS	DUCT SIZE "	AREA SQ.FT.	DESIGN		CENTERLINE STATIC PRES."	TEST		NOTES
			FPM	CFM		FPM	CFM	
AC-1 Total	47" x 36"	11.75	---	ND	-0.78"	918	10,787	
AC-1 OA	47" x 36"	11.75	---	ND	-0.04"	220	2585	
AC-1 Return			---	ND	Calc		8202	
AC-1 RF Total	46" x 34"	10.86	---	ND	+0.17"	916	9949	
AC-2 Total	48" x 28"	9.33	---	ND	-1.32"	1317	12,292	
AC-2 Return	44" x 28"	8.56	---	ND	-0.50"	1093	9351	
AC-2 OA			---	ND	Calc		2941	
AC-2 RF Total	44" x 28"	8.56	---	ND	-0.61"	1211	10,354	
AHU-1 Total	16" x 8"	0.89	---	ND	-0.08"	563	500	
AHU-2 Total	24" x 14"	2.33	---	ND	+0.28"	1222	2851	
AHU-2 OA	12"Ø	0.79	---	ND	-0.11"	161	127	
AHU-2 Return			---	ND	Calc		2724	

REMARKS

AIR DEVICE REPORT

PROJECT: Framingham District Court | **DATE:** 4/5/21

SYSTEM / AREA: Various | **TECH:** BS

LOCATION	NO.	SIZE	A K	DESIGN		TEST		FINAL		NOTES
				FPM	CFM	FPM	CFM	FPM	CFM	
Womens Lock Up	EF-1	15" x 15"	1.56	---	ND	688	1075			
Mens Lock Up	EF-1	20" x 20"	2.78	---	ND	1172	3256			
North Restroom										
2nd Fl Mens	EF-1	8" x 8"	0.32	---	ND	61	20			
2nd Fl Womens	EF-2	8" x 8"	0.32	---	ND	52	17			
1st Fl Judge	EF-3	8" x 8"	0.32	---	ND	60	20			
							57			

REMARKS

EXHAUST FAN REPORT

PROJECT: Framingham District Court					**DATE:** 4/1/21	
AREA SERVED: Various					**TECH:** BS	
FAN DATA						
FAN NUMBER		NA	NA	F-10	F-9	
LOCATION		Pit Outside	Pit Outside	Roof	Roof	
AREA SERVED		Womens Lock Up	Mens Lock Up	Restrooms	Restrooms	
MANUFACTURER		NA	NA	Cook	Cook	
MODEL OR SIZE		NA	NA	120HLCB	120HLCB	
TOTAL	DESIGN	ND	ND	ND	ND	
CFM	ACTUAL	1075	3256	219	57	
FAN	DESIGN	DD	DD	NA	NA	
RPM	ACTUAL	DD	DD	1564	1391	
PULLEY	O.D.	DD	DD	3 1/2" x 3/4"	3 1/2" x 3/4"	
SERVICE		1.00	---	1.35	1.35	
MOTOR DATA						
MANUFACTURER		Magnetek	GE	Dayton	Marathon	
MODEL NUMBER		48	56 Z	48 Y	48 YZ	
MOTOR	DESIGN	1/6	1/3	1/4	1/4	
HP	ACTUAL	1/6	1/3	1/4	1/4	
MOTOR RPM		1150	1075	1725	1725	
VOLTAGE/PHASE		115/1	115/1	115/1	115/1	
MOTOR AMPS	DESIGN	2.8	5.6	4.8	5.0	
	ACT. LEG 1	---	---	---	---	
	ACT. LEG 2	2.5	5.4	4.5	6.0	
	ACT. LEG 3	---	---	---	---	
SHEAVE		DD	DD	3 1/4" x 5/8"	3 1/4" x 5/8	
BELTS-QTY/SIZE		DD	DD	1/4L390	1/4L390	
SHEAVE POSITION		DD	DD	Closed	Closed	
BHP		0.1	0.3	0.2	0.3	
REMARKS						

EXHAUST FAN REPORT

PROJECT: Framingham District Court | **DATE:** 4/1/21

AREA SERVED: Various | **TECH:** BS

FAN DATA						
FAN NUMBER		UV-1	UV-2	UV-3	UV-4	
LOCATION		Courtroom 1	Courtroom 1	Jury Pool	Security	
AREA SERVED		Courtroom 1	Courtroom 1	Jury Pool	Security	
MANUFACTURER		Rittling	Rittling	Rittling	Rittling	
MODEL OR SIZE		RF-200	RF-200	---	---	
TOTAL CFM	DESIGN	(1)	(1)	(2)	(2)	
	ACTUAL	1075	3256	219	57	
FAN RPM	DESIGN	---	---	---	---	
	ACTUAL	---	---	---	---	
PULLEY	O.D.	DD	DD	DD	DD	
SERVICE		---	---	---	---	
MOTOR DATA						
MANUFACTURER		Changzhou	Changzhou	Changzhou	Changzhou	
MODEL NUMBER		NA	NA	NA	NA	
MOTOR HP	DESIGN	25 Watt	25 Watt	25 Watt	25 Watt	
	ACTUAL	25 Watt	25 Watt	25 Watt	25 Watt	
MOTOR RPM		---	---	---	---	
VOLTAGE/PHASE		115/1	115/1	115/1	115/1	
MOTOR AMPS	DESIGN	0.70	0.70	0.70	0.70	
	ACT. LEG 1	---	---	---	---	
	ACT. LEG 2	---	---	---	---	
	ACT. LEG 3	---	---	---	---	
SHEAVE		DD	DD	DD	DD	
BELTS-QTY/SIZE		DD	DD	DD	DD	
SHEAVE POSITION		DD	DD	DD	DD	
BHP						

REMARKS

(1) Motor blowers do not run on UV's. OA louvers are staffed with insulation

(2) Unit completely disconnected from power and controls