Brockton Superior Court
Brockton, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

November 29, 2021

Tighe&Bond

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Section 1
Existing Conditions & Site Observations

Tighe & Bond visited the Brockton Superior Courthouse on February 12, 2021. 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:

- *Plymouth County:*
  - Al DaViega, Courthouse Facilities Staff
- *Tighe & Bond:*
  - Sean Pringle, PE, Mechanical Engineer
  - Tim Bill, Staff Mechanical Engineer

1.1 Existing Ventilation System

The Brockton Superior Courthouse was constructed in 1891 and the HVAC systems appear to have been upgraded several times over the years. The most recent major HVAC improvements were made in 1971, and the lockup area was renovated in 1989. The building and is approximately 42,000 square feet in size.

Six air conditioning units (AC), three heating and ventilation units (HV), and one unit ventilator (UV) serve the building. All AC and HV units are mounted above drop ceilings in occupied areas. Due to the locations of the units in the ceilings and difficulty of access, not all units were observed in detail. Only AC-4 was observed. The unit is in fair condition and is assumed to represent the condition of the remaining AC and HV units.

Each HV unit contains 2" MERV 8 filters, an outdoor air damper, mixing box, steam heating coil, supply fan, and a recently added duct-mounted ultraviolet germicidal irradiation (UVGI) unit. HV-1 and 2 have an associated return air fan in the ductwork and a relief air damper. HV-3 serves the third session courtroom and was not operational at the time of the visit.

Each AC unit contains 2" MERV 8 filters, an outdoor air damper, mixing box, cooling coil, supply fan, and a duct-mounted UVGI unit. AC-4 has an associated return air fan in the ductwork and a relief air damper. AC-1, AC-4, and AC-5 also have steam heating coils in the units. AC-6 has a steam reheat coil located in the supply ductwork. AC-2 and AC-3 do not have heating coils. AC-6 serves the library and is not designed to provide any outdoor air.

Ventilation air is provided to the lockup area via UV-1. Supply air is provided to the areas outside the cells and to some of the cells and exhausted from the cells. At the time of the visit, there was no supply airflow, and the exhaust airflow was very weak. The exhaust fan may not have been working. Some screened security exhaust grilles had been painted over, blocking much of the grille area. According to staff, UV-1 has not operated for many years. There is also a potential issue with the supply and exhaust air balance. According to the drawings, there is 350 CFM more lockup supply air than exhaust air. Generally, the

lockup area should be neutral or slightly negatively pressurized relative to the exterior and slightly negative relative to the rest of the building.

Based on register airflow in the restrooms, there were several toilet exhaust fans that were not operational at the time of the visit. The exhaust fans are located in difficult to reach locations in the attic and were not directly observed at the time of the visit.

Much of the occupied space in the courthouse has no ventilation. Most unventilated spaces are perimeter rooms with operable windows, but there are also several interior rooms with no ventilation or windows.

During the walkthrough, we noted several areas with visible mold growth on registers, suspended ceilings, and on piping above the drop ceiling. This may be a result of improper pressurization, envelope issues, and the combination of spaces with and without air conditioning. According to staff, the building has had ongoing humidity issues.

A 9.4 million BTU/h hot water boiler plant provides hot water to air handlers and steam radiators. A 35 ton, air cooled chiller located on the roof provides chilled water to all air handlers.

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)	Filters	Condition
AC-1	2,600	1,300	2" MERV 8	Fair
AC-2	1,000	100	2" MERV 8	Fair
AC-3	1,000	100	2" MERV 8	Fair
AC-4	2,000	1,000	2" MERV 8	Fair
AC-5	5,400	2,700	2" MERV 8	Fair
AC-6	1,400	0	2" MERV 8	Fair
HV-1	2,600	1,300	2" MERV 8	Fair
HV-2	3,200	1,600	2" MERV 8	Fair
HV-3	4,600	2,300	2" MERV 8	Fair
UV-1	750	750	Unknown	Fair

Photo 1 – Painted Grille

Photo 2 – Mold on Supply Registers

Photo 3 – Mold on Pipe Insulation

Photo 4 – Unit Ventilator in Lockup Area

1.2 Existing Control System

A pneumatic system controls the existing HVAC air handling equipment. The air handling units operate with time clocks that control each unit. There are individual pneumatic control panels in occupied areas near each AHU. It is an old, obsolete system and is likely from the 1971 work. 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.

Section 2
Recommendations

Below is a list of recommendations for the Brockton Superior Courthouse. Please refer to the "Master Recommendation List" for further explanation and requirements of the stated recommendations.

As noted above, much of the building is unventilated. Building areas without adequate ventilation and filtration significantly increase the risk of spreading viruses like COVID-19, especially areas with high occupant density and where people occupy the same space for relatively long periods of time. Consider significantly reducing occupancy or relocating occupants to other areas with adequate ventilation.

2.1 Filtration Efficiency Recommendations

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

RF-1: *Replace filters with MERV-13 filters.*

The TAB Contractor and/or Engineer shall verify that the air handlers can accommodate a MERV-13 filter per Appendix A in the overview of recommendations report. Filter racks should be inspected and adjusted to ensure that filters fit tightly and that end spacers are in place to minimize filter bypass. This applies to the AC and HV air handling units only.

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

This applies to the AC and HV air handling units only.

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

Maximum differential pressure should be set per manufacturer's recommendation based on air velocity to ensure filters are within their service lives. Typically, this is not more than 1.0" w.g.

Alarm setpoints for each bank of filters should be reviewed, to ensure they are consistent with the filter manufacturer's recommendation.

The alarm could be added to the control panel near each AHU.

2.2 Testing & Balancing Recommendations

The air handling units are approximately 50 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 outdoor 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 outdoor 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)
AC-1	2,600	1,300	120	1,300
AC-2	1,000	100	150	150
AC-3	1,000	100	70	100
AC-4	2,000	1,000	540	1,000
AC-5	5,400	2,700	950	2,700
AC-6*	1,400	0	440	0
HV-1	2,600	1,300	960	1,300
HV-2	3,200	1,600	1,100	1,600
HV-3	4,600	2,300	740	2,300
UV-1	750	750	130	750

*AHU has no outdoor air ductwork.

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.

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.

For AC-2, where we recommend increasing the outdoor air beyond the original design, it appears the cooling coil 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 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. Note that this unit does not provide any heating. The increased outdoor airflow will reduce the supply temperature and may reduce comfort during the winter months.

Note that AC-1 serves an office area, but the unit was originally designed as a courtroom space. Post-Covid, the outdoor airflow to this space should be reduced to more closely reflect the current use.

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. Note that areas without ventilation are not included in the averages below.

TABLE 3
Average Airflow Rate per Person

	All spaces	***Courtrooms***	***Non-Courtroom Spaces***
Total Occupancy (People)	460	395	65
Total Supply Air (CFM/Person)	54	44	112
Outdoor Air (CFM/Person)	22	24	29

The airflow rate per person for each Courtroom and the Jury Pool 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.

TABLE 4
Airflow Rate per Person (Full Occupancy)

		Total Air		***Outdoor Air***	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outdoor Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Jury Pool Room	36	Unventilated	0	Unventilated	0
First Session	147	3,200	22	1,600	11
Second Session	130	5,400	42	2,700	21
Third Session	101	4,600	46	2,300	23
Fourth Session	109	1,965	18	983	9
Fifth Session	74	2,000	27	1,000	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 the Jury Pool 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.

TABLE 4a
Airflow Rate per Person (Reduced Occupancy)

		Total Air		Outdoor Air	
Courtroom	*Total People*	*Supply Airflow (CFM)*	*Airflow Rate (CFM/Person)*	*Outdoor Airflow (CFM)*	*Airflow Rate (CFM/Person)*
Jury Pool Room	8	Unventilated	0	Unventilated	0
First Session	14	3,200	229	1,600	114
Second Session	13	5,400	415	2,700	208
Third Session	16	4,600	288	2,300	144
Fourth Session	17	1,965	116	983	58
Fifth Session	9	2,000	222	1,000	111

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

RTB-5: *Test and balance all air inlets and outlets.*

If the airflow to each space has not been recently tested, we recommend testing the airflow rates in the holding cells, control room, Courtrooms, Jury Pool room, and other densely occupied areas as a minimum. These systems are very old, and the airflow rate delivered to and returned from these spaces may not match the original design intent.

If specific areas within the Courthouse experience regular cooling and heating comfort complaints this may be an indication of a lack of airflow to the space. We recommend testing and balancing the air inlets and outlets serving those spaces to the designed values. Prior to rebalancing the building, we recommend verifying the chilled water plants are maintaining the correct supply water temperature. Incorrect supply water temperature may be contributing to the temperature control complaints instead of a lack of airflow.

Several registers in the holding cells have been painted over and appear to have restricted airflow. Once the unit ventilator and exhaust fans have been repaired or replaced, we recommend rebalancing these registers, and cleaning or replacing them if needed to attain the proper airflow.

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 pneumatic actuators that are not functioning properly.

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

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.*

This can likely be implemented by adjusting the existing AHU timers.

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.

As much of the courthouse is unventilated, we recommend the use of portable HEPA filters in these areas if they will be occupied.

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.

2.7 Other Recommendations

2.7.1 Repair Handling Unit HV-3

This unit was not operational at the time of the site visit. According to staff, repairs were planned.

2.7.2 Repair or Replace Holding Cell and Toilet Exhaust Fans

We recommend repairing or replacing the holding cell and toilet exhaust fans that are not working or are not exhausting the proper airflow rate.

2.7.3 Repair or Replace Lockup Unit Ventilator.

We recommend repairing or replacing the Unit Ventilator serving the holding cell area to provide proper ventilation to the space and makeup air for the exhaust fan.

2.7.4 Mold Study and Remediation

In several occupied areas, mold was visible on registers and on suspended ceiling tiles. The presence of mold is a significant health concern that negatively impacts IAQ and can increase susceptibility to infection from viruses like COVID-19. We recommend engaging a reputable mold testing company to test various surfaces and wall cavities for the presence of mold and types of mold present. Any contaminated materials should be properly cleaned or discarded based on the findings of the mold testing.

2.7.5 Mechanical Ventilation and Feasibility Study

Much of the Courthouse is not mechanically ventilated. Operable windows do exist in some areas, and natural ventilation is acceptable per code. However, windows are typically not opened during cold or hot outdoor air temperatures. Additionally, several interior office spaces do not have operable windows also do not have any mechanical ventilation. Note that although the library is served by AC-6, this unit does not provide any outdoor air. Consider adding a ventilation system to serve these areas.

We recommend a study of the Courthouse to determine how feasible it is to install mechanical ventilation in all occupied spaces.

2.7.6 Upgrade Air Handling Units, Return Fans, and Cooling System

Indoor air handling units have a life expectancy of 25-35 years. The air handlers are approximately 50 years old and are in fair condition. Consider replacing these units as soon as possible. Replacing the return fans should also occur in conjunction with the replacement of the air handling units and should be sized correctly to provide an overall positive building pressure to reduce infiltration.

Currently, only some AHU's provide cooling. The HV units do not provide any cooling. Having a mix of conditioned and unconditioned spaces in the courthouse, compounded with varying pressurization in different areas is likely contributing to the mold and humidity issues in the building. If possible, all air handling equipment serving occupied areas should provide cooling to the spaces served, and pressurization should be managed to ensure that unconditioned air is never drawn into spaces from the exterior or adjacent unconditioned spaces. This will require additional chilled water distribution and likely a larger chiller.

2.7.7 Install a Building Management System

We recommend replacing the pneumatic control system and actuators with a Building Management System and electronic sensors and actuators to control and monitor HVAC equipment. Pneumatic air systems are antiquated and do not offer the same benefits as a BMS. A BMS can monitor the position of electronic valves, trend valve position data, and report alarms.

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.

This recommendation is primarily an energy saving and maintenance measure and does not affect the indoor air quality of the building, although it would make some of the recommended measures easier to implement.

If possible, installing a BMS should be implemented at the same time as measure 2.7.3, 2.7.5 and 2.7.6 as a single HVAC improvement project.

Section 3
Testing & Balancing Results

Wing's Testing and Balancing visited the Brockton Superior Courthouse on September 7, 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. The full testing and balancing report is attached. No water flow testing was conducted as there were no circuit setters present on the coils, and the existing piping insulation was suspected to be ACM and could not be removed to install an ultrasonic meter.

TABLE 5
Air Handler 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)
AC-1	2,600	1,300	1,300	416	127	289
AC-2	1,000	150	850	999	110	889
AC-3	1,000	100	900	906	397	509
AC-4	2,000	1,000	1,000	1,270	470	800
AC-5	5,400	2700	2,700	3,438	580	2,858
AC-6	1,600	0	1,600	1,111	0	1,111
HV-1	2,600	1,300	1,300	2,659	0	2,659
HV-2	3,000	1,600	1,400	2,899	0	2,899
HV-3	4,600	2,300	2,300	2,334	108	2,226

TABLE 6
Exhaust Fan Testing & Balancing Results

Unit	Serving	Design Return/Exhaust Airflow (CFM)	Actual Return/Exhaust Airflow (CFM)
EF-8	Toilet	600	1,018
EF-10	Toilet	600	646
EF-11	Toilet	600	Inoperable
EF-12	Toilet	200	Doesn't Exist
EF-16	Toilet	600	650

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 filters for all AC and HV units at the time of testing were 2" MERV 10.
2. AC-2, AC-3, HV-1, and HV-2 are performing within the acceptable airflow range. It appears the filters in these units can be upgraded to MERV-13.
3. AC-1 is performing at only 16% of the design supply airflow and 16% of the design outdoor airflow. This may be intentional to account for the current use of this space (office) vs the original design intent (courtroom). While less than design, the outdoor airflow for this space meets the calculated requirement for the current use.
    a. We recommend investigating with facility staff / engineering to determine if this airflow was reduced intentionally, or if there is an issue with the unit. If the reason for the current flow cannot be established, we recommend that an engineer review the current equipment, ductwork, and space use, and establish proper operating conditions for this unit. Consider replacing this unit in the near term with one more appropriately sized for the current the use.
4. AC-4, AC-5, and HV-3 are well below (50%-70% of) the design airflow. It does not appear that a sheave adjustment alone would be adequate to meet the design airflow. We recommend investigating the cause of the low airflow.
5. AC-6 is operating at 70% of the design airflow, but it appears that there is adequate motor capacity to meet the design airflow with a sheave adjustment.
6. According to the balancer, there is no way to balance the return and outdoor air, and the outdoor air dampers for these units are a two-position type. The outdoor air dampers for all the HV units did not operate with the unit.
    a. We recommend configuring the outdoor air dampers for all units to open during occupied periods, unless these have been disabled to address the ongoing mold issues in the building.
        i. If the outdoor air dampers have been disabled due to mold issues, we recommend enabling them for the heating season, and disabling them for the cooling season.
    b. We recommend adding balancing dampers to the return and outdoor air ducts to allow balancing of the outdoor airflow and repairing any inoperable outdoor air dampers/actuators. Note that due to the small outdoor air ductwork and openings, it may not be possible to balance the system to meet both the outdoor and supply airflow simultaneously. If this occurs, the outdoor airflow should maximized, while maintaining 85-90% of supply airflow.
7. EF-8 is operating well above the design airflow.
    a. The fan speed should be reduced by adjusting the sheaves to match the design airflow.
8. EF-10 and EF-16 are operating within the acceptable airflow range.
9. EF-11 was inoperable at the time of the test. This fan should be repaired.
10. According to the balancer, EF-12 does not exist. On the plans, this fan appears to serve only a single restroom in room 1-10 (Judge's Office).

   a. If there is still a restroom present in this location, we recommend adding a fan, ductwork, and louver in a suitable exhaust location to serve this restroom.
11. There are additional exhaust fans (EF-3 and EF-5) that appear to serve toilet rooms that were not tested during the balancer's visit. We recommend testing these as part of any future balancing work.
12. The supply and exhaust systems serving the lockup area (UV-1 and EF-1) are inoperable. These should be repaired or replaced.
13. The 208V electrical plug for AC-3 is corroded from condensation dripping on it. The failed/missing insulation should be repaired, and the damaged electrical components replaced.

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.

Brockton Superior Court
Brockton, MA

* * * *

Tighe & Bond
Attn: Jason Urso
1 University Ave #100
Westwood, MA 02090

September 14th, 2021

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WING'S TESTING & BALANCING CO., INC.

September 14th, 2021

Tighe & Bond
Attn: Jason Urso
1 University Ave #100
Westwood, MA 02090

Re: Brockton Superior Court

Dear Jason,

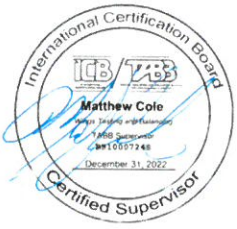
We have completed our HVAC/fresh air survey for the above mentioned site. The results are as follows:

- The 208 volts plug for AC-3 has condensate leaking on it and is rusted out.
- There is no way to set the outside airs for AC-1 through AC-6. The dampers open when these units are running and close when they are off.
- The outside air dampers for HV-1 through HV-3 never open when the units are on. This needs to be addressed.
- The motor tag for the AC-4 only lists voltage. This fan was not sped up as we do not know what the full-load-amperage is.
- EF-12 does not exist in the space. It is only present on the prints.
- EF-11 does not run and is currently being looked at for repairs.
- There is no way to test the water here. There are no circuit setters, and the piping insulation is suspected to be ACM.

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



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SUPPLY FAN REPORT

PROJECT: Brockton Superior Court	**DATE:** 9/7/2021
AREA SERVED:	**TECH:** BS

FAN DATA

	AC-1		AC-2		AC-3 (1)	
FAN NUMBER						
LOCATION	Probate #1		Office		Office	
AREA SERVED	Probate #1		Office		Office	
MANUFACTURER	McQuay		McQuay		McQuay	
MODEL OR SIZE	LS-106H1		LS-104H		LS-104H	
	DESIGN	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**
TOTAL CFM	2600	416	1000	999	1000	906
RETURN AIR	1300	289	900	889	900	509
OUTSIDE AIR	1300	127	100	110	100	397
DISCH. STATIC	---	+0.001"	---	+0.16"	---	+0.13"
SUCTION STATIC	---	-0.07"	---	-0.50"	---	-0.48"
TOTAL STATIC		0.07"		0.66"		0.61"
FAN RPM	NA	943	NA	1355		632
PULLEY O.D.	6.5" x 1 3/8		8.0" x 7/8		6.0" x 7/8	
ESP	0.03		0.3		0.29	
VFD SPEED	No VFD		No VFD		No VFD	
O.A.D.MIN POS	Open		Open		Open	

MOTOR DATA

MANUFACTURER	Marathon		Daylon		Wagner	
MODEL OR FR.	56		56C		G56	
HORSEPOWER	314	314	1/2	1/2	1/2	1/2
MOTOR RPM	1725	1725	1725	1725	1725	1725
VOLTAGE / PH.	208/3	208/3	208/3	208/3	208/3	208/3
AMPS LEG 1	3.3	1.8	2.0	0.8	2.2	1.3
AMPS LEG 2	---	1.8	---	0.8	---	1.3
AMPS LEG 3	---	1.8	---	0.8	---	1.3
SHEAVE O.D.	4.0" x 5/8		3.25" x 5/8		2.75" x 5/8	
BELTS - QTY / SIZE	1/A48		1/A49		1/A46	
SHEAVE POSITION	3/4 Open		Fully closed		Fully closed	

REMARKS

(1) The 208 volt plug for this unit is locked above the ceiling directly under a chilled water line that is condensating all over the plug. The entire plug and jack are completely rusty.

NA-Not Available

ND-No Design DD-Direct Drive

SUPPLY FAN REPORT

PROJECT: Brockton Superior Court	**DATE:** 9/7/2021
AREA SERVED:	**TECH:** BS

FAN DATA						
FAN NUMBER	AC-4		AC-5		AC-6	
LOCATION	Probate #2		1st Session		Library	
AREA SERVED	Probate #2		1st Session		Library	
MANUFACTURER	McQuay		McQuay		McQuay	
MODEL OR SIZE	LS-106H		LS-111H		LS-106H	
	DESIGN	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**
TOTAL CFM	2000	1270	5400	3438	1600	1111
RETURN AIR	1000	800	2700	3358	1600	1111
OUTSIDE AIR	1000	470	2700	580	0	0
DISCH. STATIC	---	+0.09"	---	+0.10"	---	+0.16"
SUCTION STATIC	---	-0.55"	---	-0.61"	---	-0.36"
TOTAL STATIC	---	0.64"	---	0.71"	---	0.52"
FAN RPM	NA	725	NA	657	NA	1148
PULLEY O.D.	6.5 x 1 7/16		11.0 x 1 11/16		6.25 x 1 1/8	
ESP	0.32		0.48		0.22	
VFD SPEED	No VFP		No VFP		No VFP	
O.A.D.MIN POS	Open		Open		Open	
MOTOR DATA						
MANUFACTURER	New Nema		Marathon		AO Smith	
MODEL OR FR.	NA		182T		NA	
HORSEPOWER	NA	NA	3	3	NA	NA
MOTOR RPM	NA	NA	1735	1735	1725	1725
VOLTAGE / PH.	208/3	208/3	208/3	208/3	208/3	208/3
AMPS LEG 1	NA	2.8	9.7	7.0	3.6	1.2
AMPS LEG 2	---	2.8	---	7.0	---	1.3
AMPS LEG 3	---	2.8	---	7.0	---	1.3
SHEAVE O.D.	3.0 x 5/8		5.0 x 1 1/8		4.25 x 5/8	
BELTS - QTY / SIZE	1/A48		1/B67		1/A46	
SHEAVE POSITION	Fixed		3/4 closed		Fully closed	

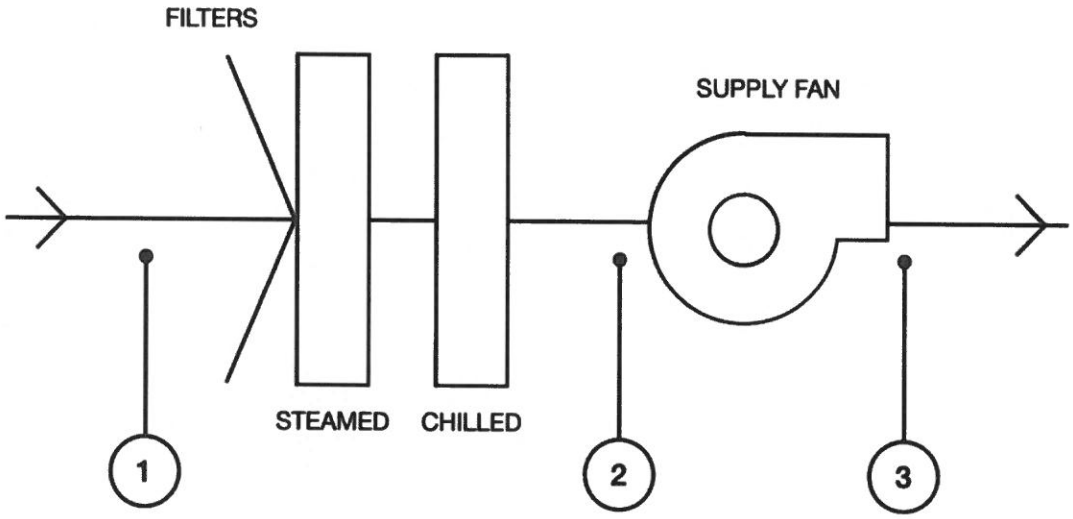
REMARKS

(1) Motor tag only lists voltage, nothing else.

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

SYSTEM STATIC PRESSURE PROFILE

PROJECT: Brockton Superior Court	**DATE:** 9/9/2021
SYSTEM/AREA SERV:	**TECH:** BS



STATIC PRESSURE READINGS "wc

POS. (+) / NEG.(-)	1	2	3	4	5	6	7	NOTES	
AC-1	-0.03"	-0.07"	+0.001"						
AC-2	-0.14"	-0.50"	+0.16"						
AC-3	-0.16"	-0.48"	+0.13"						
AC-4	-0.23"	-0.55"	0.09"						
AC-5	-0.38"	-0.61"	+0.1"						
AC-6	-0.06"	-0.36"	+0.16"						

REMARKS

VELOCITY PRESSURE READINGS

PROJECT: Brockton Superior Court | **DATE:** 9/14/2021

AREA SERVED: | **TECH:** BS

TRAVERSE LOCATIONS	DUCT SIZE "	AREA SQ.FT.	DESIGN		CENTERLINE STATIC PRES."	TEST		NOTES
			FPM	CFM		FPM	CFM	
AC-1 Total	17x17	2.01		2600	+0.001"	207	416	
AC-1 OA	38x16	4.22		1300	-0.001"	30	127	
AC-1 Return				1300	Calculated		289	
AC-2 Total	20x8	1.11		1000	+0.16"	899	999	
AC-2 OA	8x8	0.49		100	-0.01"	251	110	
AC-2 Return				900	Calculated		889	
AC-3 Total	13x13	1.17		1000	+0.13"	774	906	
AC-3 OA	14x6	0.58		100	-0.015"	397	230	
AC-3 Return				900	Calculated		676	
AC-4 Total	24x10ID	1.66		2000	+0.09"	765	1270	
AC-4 OA	24x12	2.0		1000	-0.31"	271	470	
AC-4 Return				1000	Calculated		800	
AC-5 Total	36x22	5.5		5400	+0.10"	716	3938	
AC-5 OA	22x14	2.14		2700	-0.38"	271	580	
AC-5 Return				2700	Calculated		3358	
AC-6 Total	20x12	1.67		1600	+0.04"	665	1111	
HV-1 Total	32x12	2.66		2600	+0.12"	997	2659	
HV-2 Total	34x16ID	3.77		3200	+0.08"	769	2899	
HV-3 Total	53x12	4.42		4600	+0.08"	528	2334	

REMARKS

SUPPLY FAN REPORT

PROJECT: Brockton Superior Court	**DATE:** 9/10/2021
AREA SERVED:	**TECH:** BS

FAN DATA

	HV-1		HV-2		HV-3	
FAN NUMBER	HV-1		HV-2		HV-3	
LOCATION	1st Floor South		2nd Floor South		3rd Session	
AREA SERVED	1st Floor South		2nd Floor South		3rd Session	
MANUFACTURER	McQuay		McQuay		McQuay	
MODEL OR SIZE	HD 106AH		HD 106H		HD 209H	
	DESIGN	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**
TOTAL CFM	2600	2659	3000	2899	4600	2334
RETURN AIR	1300	2659	1600	2899	2300	2226
OUTSIDE AIR	1300	0 (1)	1600	0(1)	2300	108 (1)
DISCH. STATIC	---	+0.15"	---	+0.08"	---	+0.08"
SUCTION STATIC	---	-0.47"	---	-0.55"	---	-0.44"
TOTAL STATIC	---	0.62"	---	0.63"	---	0.52"
FAN RPM	---	758	---	922	---	600
PULLEY O.D.	8.0 x 1 3/8		7.0 x 1 7/16		9.5 x 1 3/8	
ESP	0.30		0.37		0.34	
VFD SPEED	No VFD		No VFD		No VFD	
O.A.D.MIN POS	Closed		Closed		Closed	

MOTOR DATA

MANUFACTURER	GE		Marathon		GE	
MODEL OR FR.	56		NA		SC	
HORSEPOWER	314	314	314	314	314	314
MOTOR RPM	1725	1725	1725	1725	1725	1725
VOLTAGE / PH.	208/3	208/3	208/3	208/3	208/3	208/3
AMPS LEG 1	3.6	3.5	4.0	3.5	3.6	2.6
AMPS LEG 2	---	3.5	---	3.5	---	2.6
AMPS LEG 3	---	3.5	---	3.5	---	2.6
SHEAVE O.D.	3.5 x 5/8		3.5 x 5/8		4.25 x 5/8	
BELTS - QTY / SIZE	1/A53		1/A42		1/A53	
SHEAVE POSITION	Fully closed		3/4 Closed		1/2 Closed	

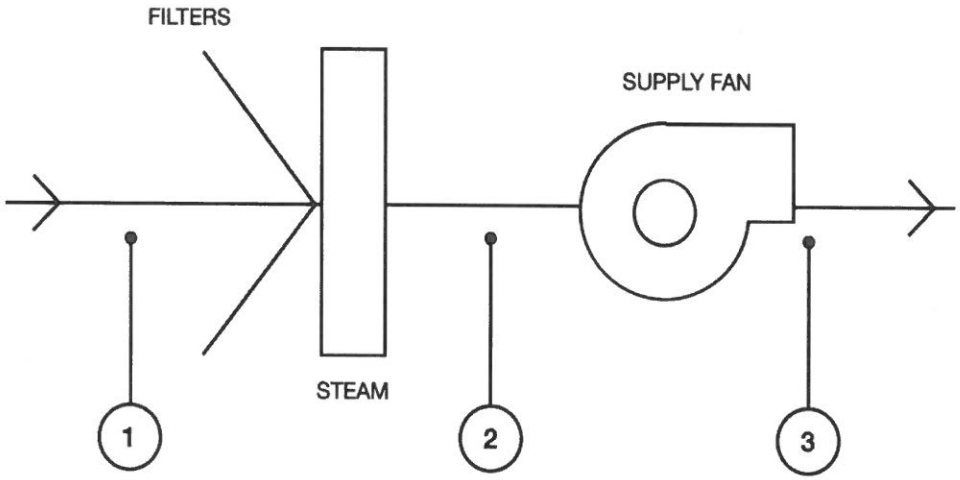
REMARKS

(1) The outside air damper does not open when the unit comes on like it should.

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

SYSTEM STATIC PRESSURE PROFILE

PROJECT: Brockton Superior Court	**DATE:** 9/9/2021
SYSTEM/AREA SERV:	**TECH:** BS



STATIC PRESSURE READINGS "wc

POS. (+) / NEG.(-)	1	2	3	4	5	6	7	NOTES	
HV-1	-0.15"	-0.45"	0.15"						
HV-2	-0.29"	-0.55"	0.08"						
HV-3	-0.26"	-0.44"	0.08"						

REMARKS

EXHAUST FAN REPORT

PROJECT: Brockton Superior Court | **DATE:** 9/9/2021

AREA SERVED: | **TECH:** BS

FAN DATA

FAN NUMBER		EF-8	EF-10	EF-11 (2)	EF-12 (1)	EF-16
LOCATION		Roof	1st Floor Jury	Lock-up	Clerk	2nd Floor Toilet
AREA SERVED		Toilet	Toilet	Toilet	Toilet	Toilet
MANUFACTURER		Greenhack	Greenhack	Cook	Cook	Cook
MODEL OR SIZE		CBE-14-4	SQ-10-10-B	12CVBD	8CU17D	1200
TOTAL CFM	DESIGN	600	600	600	200	600
	ACTUAL	1018	646			650
FAN RPM	DESIGN	ND	DD			NA
	ACTUAL	823	DD			745
PULLEY	O.D.	5.0" x 3/4	DD			5.5" x 3/4
SERVICE						1.35

MOTOR DATA

MANUFACTURER		Dayton	Greenhack			US Motor
MODEL NUMBER		484	NA			482
MOTOR HP	DESIGN	3/8	1/4	1/4	1/4	1/4
	ACTUAL	1/3	1/4			1/4
MOTOR RPM		1725	1725			1728
VOLTAGE/PHASE		115 / 1	115 / 1			115 / 1
MOTOR AMPS	DESIGN	6.6	NA			5.2
	ACT. LEG 1					
	ACT. LEG 2	5.8	6.2			4.4
	ACT. LEG 3					
SHEAVE		2.5" x 1/2	DD			2.5" x 1/2
BELTS-QTY/SIZE		1/Ax24	DD			1/A43
SHEAVE POSITION		Fully closed	DD			Fully closed

REMARKS

(1) Fan does not exist in space. This is only found on the prints.

(2) Fan does not run and is currently being looked at to be fixed.

VELOCITY PRESSURE READINGS

PROJECT: Brockton Superior Court | **DATE:** 9/15/2021

AREA SERVED: | **TECH:** BS

TRAVERSE	DUCT	AREA	DESIGN		CENTERLINE	TEST		
LOCATIONS	SIZE "	SQ.FT.	FPM	CFM	STATIC PRES."	FPM	CFM	NOTES
EF-8 Total	20x20	2.76		600	-0.31"	369	1018	
EF-10 Total	14x10	0.97		600	-0.24"	664	646	
EF-16 Total	36x10	2.5		600	+0.04"	260	650	

REMARKS