J. MICHAEL RUANE JUDICIAL CENTER
HVAC SYSTEM EVALUATION SUMMARY

Visited September 16, 2020. Inspected the air handling units and toured the occupied portions of the building to determine if the spaces generally matched usage noted on the architectural plans. The J. Michael Ruane Judicial Center is a six-story building (including the basement), constructed in 2011, with a floor area of approximately 268,000 gross square feet. The HVAC system includes 11 variable air volume (VAV) air handling units. The air handling units are generally in good condition. Filters and coils were generally clean. The dampers and actuators that were observed appeared to be in good condition.

1.0 Airflow Rate per Person (Reduced Occupancy)

	Total	Total Air		Outdoor Air	
Courtroom	***People (Reduced Occupancy)***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outside Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Jury Pool Room	40	3,120	78	1,560	39
Courtroom A	28	4,000	146	1,200	42
Courtroom B	14	1,400	100	370	26
Courtroom C	28	3,350	120	870	31
Courtroom D	32	3,400	106	1,080	34
Courtroom E	23	3,100	135	980	43
Courtroom F	23	2,900	126	920	40
Courtroom G	30	3,400	113	1,000	34
Courtroom H	30	3,200	107	1,010	34
Courtroom I	30	2,700	90	860	29
Courtroom J	30	3,100	104	990	33
Courtroom K	38	4,200	109	1,200	32

2.0 Recommendations

2.1 Filtration Efficiency Recommendations – **completed**

The existing MERV 8 pre-filter / and MERV 13/14 final arrangement provides high levels of filtration for occupied areas. This level of filtration is adequate and is in line with ASHRAE recommendations.

2.2 Testing & Balancing Recommendations
RTB-1: Test and rebalance air handling unit supply, return, and minimum outside air flow rates – **completed**
RTB-3: Increase outside air flow rate beyond minimum under non-peak conditions – **completed**
RTB-5: Consider rebalancing all air inlets and outlets – **deferred until March, 2021**
RTB-6: Test and balance all air handler chilled and hot water coils – **deferred until March, 2021**

2.3 Equipment Maintenance & Upgrades
RE-1: Test existing air handling system dampers and actuators for proper operation – **completed**
RE-4: Inspect VAV Boxes and controllers – **deferred until March, 2021**

2.4 Control System Upgrades
RC-1: Implement a pre and post-occupancy flush sequence – **completed**
RC-3: Install controls required to introduce outside air beyond the minimum requirements in a stepped approach – **deferred until March, 2021**
RC-5: Disable demand control ventilation sequences – **completed**

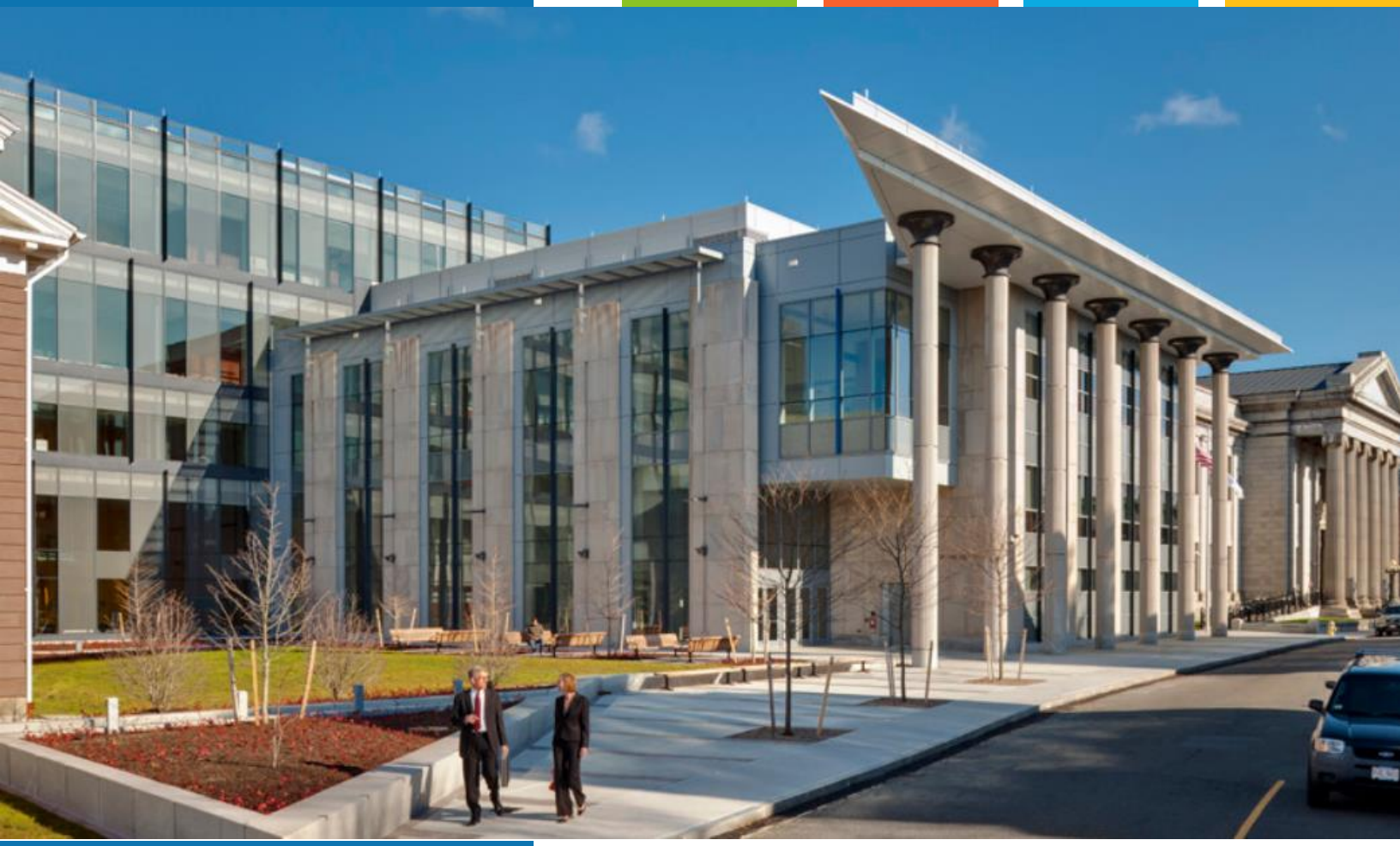
2.5 Additional Filtration and Air Cleaning
RFC-1: Install portable HEPA filters – **On-site and will install prior to start of jury trials**
If the Courthouse is to operate at a high capacity (i.e. 50%-75% occupancy or greater), we recommend installing portable HEPA filters in high traffic areas, such as entrance lobbies or places outside courtrooms where people may congregate.

2.6 Humidity Control – **to be evaluated**
Installing duct mounted or portable humidifiers can help maintain the relative humidity levels recommended by ASHRAE.

2.7 Other Recommendations
2.7.1 Implement strict entry and PPE protocols for the large 2nd floor mechanical room for the duration of the pandemic – **completed**

2.7.2 Increase the VAV minimum airflow from 40% to 50% in Courtrooms – **completed**

2.7.3 Replace CO_2 sensors that are malfunctioning or beyond their expected life – **scheduled for March, 2021**



J. Michael Ruane Judicial Center
Salem, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

December 9, 2020

Tighe&Bond

100% Recyclable

Section 1
Existing Conditions and Site Observations

Tighe & Bond visited the J. Michael Ruane Judicial Center in Salem, MA on September 16, 2020. While on site, we inspected the air handling units and toured the occupied portions of the building to determine if the spaces generally matched usage noted on the architectural plans.

Site Visit Attendees:

- *Office of Court Management:*
  - Marcos (Marc) Olivera, Facilities Supervisor
  - Jim Cawley, Facilities, HVAC Specialist
- *Tighe & Bond:*
  - Sean Pringle, PE, Project Mechanical Engineer
  - Christina Wu, Staff Engineer

1.1 Existing Ventilation System

The J. Michael Ruane Judicial Center is a six-story building (including the basement), constructed in 2011, with a floor area of approximately 268,000 gross square feet. The HVAC system includes 11 variable air volume (VAV) air handling units (AHU), with AHU's 1 through 4 located in the rooftop penthouse, AHU's 5 through 8 and 11 located on the 2nd floor, and AHU's 9 and 10 located on the 4th floor.

All AHU's have a heating hot water coil with freeze pump, a chilled water cooling coil, supply fan, remote return air fan, independent return air (RA), outside air (OA), and exhaust air dampers, and return, supply, and outside airflow stations. AHU's 5&7, and AHU's 6&8 work in parallel with each other and function as a single VAV system. The air handling units are generally in good condition. Filters and coils were generally clean. The dampers and actuators that were observed appeared to be in good condition. The units are original and approximately 10 years old. According to staff, motors, actuators, bearings, and other wear items are replaced when they fail. Most dampers could not be inspected because they were within ductwork, and not part of the AHU. All cooling is provided through the AHU's. In areas with large perimeter loads, finned tube radiation is provided for additional heating.

During the visit, staff informed us that to improve ventilation in response to COVID-19, the AHU's have been set to operate in occupied mode 24/7, including maintaining occupied temperatures.

TABLE 1
Existing Air Handlers

Unit #	*Design Airflow (CFM)*	*Design Min OA (CFM)*	*Filters*	*Condition*
AHU-1	6,000	1,900	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-2	6,000	1,900	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-3	6,000	1,900	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-4	10,800	3,200	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-5	25,000	7,000	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-6	25,000	7,000	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-7	25,000	7,000	2" MERV 8 prefilter 12" MERV 14 final	Good
AHU-8	25,000	7,000	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-9	29,000	6,800	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-10	4,600	1,200	2" MERV 8 prefilter 12" MERV 14 final	Good
AHU-11	15,400	2,300	2" MERV 8 prefilter 12" MERV 14 final	Good

Several AHU issues were identified during the site visit:

- Minor general issues
  - Several motors / fans have bearing noises.
  - Cooling coils have rusty condensate pans and lower frames but are not showing any signs of poor drainage. This is likely due to the proximity to the coast. As these trays fail, they should be replaced with stainless steel trays.
- AHU's 5-8
  - The unfiltered exhaust air from these units is exhausted directly into the mechanical room, before exiting the building through exhaust louvers. Given the current pandemic, this presents a worker safety concern.
- AHU-9
  - The VFD was not working and running in bypass at the time of the visit. Facilities staff mentioned they have repairs scheduled.

  - According to the 2020 BQ2 Associates report, the minimum OA for this unit is 0% in the DCV sequence. This should be increased to be comparable to other units.
  - According to the Siemens September 2020 work report, the OA airflow station was not working at the time of the visit. This should be repaired as soon as possible.
- AHU-11
  - The prefilters were much dirtier than the other units. According to Facilities staff, this AHU receives dirtier air due to the proximity to the roadway. Consider increasing the filter change frequency for this unit.
  - Facilities staff also mentioned that this unit suffers from freeze stat trips in cold weather due to the close proximity of the outside air ductwork to the louver, causing poor mixing with return air and generating cold spots on the heating coil.

Supply air is regulated to each zone by variable air volume (VAV) boxes, with hot water reheat coils at each unit. As the building is less than 10 years old, we assume the VAV boxes (and all equipment) are original and have not been replaced. The working condition of these boxes is unknown but based on the age it is assumed they would be in generally good condition. Each courtroom is served by a dedicated VAV. We understand that the heating system is active during the summer to provide reheat to VAV boxes serving spaces under a demand control ventilation sequence.

The basement lockup area is provided with mixed supply air through VAV's set to a constant airflow from the 2nd floor AHU's, supplied into the corridors and the cells. Air is exhausted from the cells through the toilet exhaust risers. The attorney / client interview rooms, control rooms, corridor and other similar spaces within the secure corridor have supply and return air registers to the AHU's. Each secure area on the upper floors is supplied from a dedicated VAV set to a constant airflow into the corridors and the cells and exhausted through the cells.

Chilled water is provided by a pair of 320 ton water cooled chillers. Hot water is provided from a pair of 3.6 MMBH (output) boilers. Neither the hot nor chilled water systems contain glycol.

Photo 1 – Representative Air Handler

1.2 Existing Control System

The courthouse has a complete Siemens building management control system (BMS). It is tied to the existing boiler, chiller, AHU's, VAV's, auxiliary heating, and exhaust fans. While onsite, Tighe & Bond was able to observe various control system screens and setpoints. We were also provided with the sequence of operation delivered to the building during commissioning from Cosentini Associates.

The system provides air handler demand-controlled ventilation (DCV) sequences. DCV varies the outside air percentage from a minimum to a maximum limit in response to carbon dioxide (CO_2) concentration levels measured in high density spaces throughout the building. While this feature exists, the BQ2 Associates report noted that the DCV minimum OA airflows are set close to the design OA minimum airflows. This limits the functionality if the VAV system as it limits the reduction in outside air under light occupancy. They also noted that AHU-9 has a 0% outdoor minimum. Even during lightly occupied periods, there should be some outdoor air provided. The report also mentioned that many CO_2 sensors are beyond their useful life and malfunctioning.

VAV terminals that serve high density spaces also utilize zone-level DCV controls. When the space CO2 rises above the setpoint, the VAV will increase the supply air flow to the zone, increasing the outdoor air flowrate to the zone.

Section 2
Recommendations

2.1 Filtration Efficiency Recommendations

The existing MERV 8 prefilter / and MERV 13/14 final arrangement provides high levels of filtration for occupied areas. This level of filtration is adequate and is in line with AHRAE recommendations.

According to conversations with staff, the court plans to upgrade the prefilters to MERV 13 and the final filters to MERV 14 across all air handlers. While upgrading the final filters to MERV 14 is a good approach, using MERV 13 prefilters will only increase the AHU pressure drop and may reduce performance. We recommend the continued use of MERV 8 prefilters and upgrading the final filters to MERV 14. Using MERV 14 final filters will not likely have any noticeable impact on the filter change frequency or pressure drop compared to the existing MERV 13 filters.

2.2 Testing and Balancing Recommendations

The basis of design climactic outdoor air conditions state a summer design condition of 91°F/74°F DB/WB and a winter condition of 7°F. In reviewing the originally designed entering mixed air temperatures for the chilled water and hot water coils in the air handling units, it appears that the coils as designed are insufficient to accommodate any additional outside air on a design day. The coils appear to be slightly under-designed to maintain the required cooling and heating supply air setpoints. If the courtroom AHU's are currently not experiencing any heating or cooling issues at the design outside air quantities, then we recommend maintaining the original OA flow rates, but not increasing them.

We recommend the following testing and balancing measures:

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

> The original design outdoor airflow requirements and the outdoor airflows calculated by Tighe & Bond, based on the 2015 International Mechanical Code (IMC) are listed below.

TABLE 2
Recommended Air Handler O.A. Flow Rates

Unit #	*Original Design Airflow (CFM)*	*Original Design Min OA (CFM)*	*Current Code Min. OA Requirements (CFM)*	*Recommended Min OA (CFM)*
AHU-1	6,000	1,900	2,100	1,900
AHU-2	6,000	1,900	2,400	1,900
AHU-3	6,000	1,900	2,200	1,900
AHU-4	10,800	3,200	3,800	3,200
AHU's-5&7	50,000	14,000	10,800	14,000
AHU's-6&8	50,000	14,000	12,300	14,000
AHU-9	29,000	6,800	6,200	6,800
AHU-10	4,600	1,200	1,650	1,200
AHU-11	15,400	2,300	3,700	2,300

The discrepancies in the calculated ventilation rates are likely due to variations in assumptions in the expected occupant concentration ad airflow per person. Where the original design outdoor airflow rates are higher than the values per the current code minimums, we recommend maintaining the outdoor airflows at the original designed values, as these are more conservative and will likely result in improved indoor air quality (IAQ).

We recommend that the outdoor airflows for all units be checked to confirm that they match the recommended minimum OA amounts shown in the table above. Because this system uses airflow stations, it is possible that these changes can be made with control setpoint adjustments instead of hiring a TAB Contractor, however these units may not be reporting accurate values. As noted above, while our calculations show a higher outside air requirement than design, the coils do not have adequate capacity to provide these higher outside air quantities under peak outdoor air conditions.

The airflow rate per person is shown below in Table 3. These values are based on the recommended outdoor airflow, and original design supply airflow rates shown in Table 2 above. The airflow rate per person also 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.

TABLE 3
Average Airflow Rate Per Person

	All spaces	*Courtrooms*	*Non-Courtroom Spaces*
Total Occupancy (People)	1,500	620	850
Total Supply Air (CFM/Person)	120	54	170
Outdoor Air (CFM/Person)	32	16	44

The airflow rate per person for each courtroom is shown below in Table 4. These values are based on full occupancy, the original design supply airflow rate, and the recommended outdoor airflow rate, without taking diversity into account. 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 - Courtrooms

		Total Air		***Outdoor Air***	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outside Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Jury Pool Room	100	3,120	31	1,560	16
Courtroom A	114	4,000	35	1,200	10
Courtroom B	45	1,400	31	370	8
Courtroom C	90	3,350	37	870	10
Courtroom D	100	3,400	34	1,080	11
Courtroom E	100	3,100	31	980	10
Courtroom F	76	2,900	38	920	12
Courtroom G	100	3,400	34	1,000	10
Courtroom H	100	3,200	32	1,010	10
Courtroom I	76	2,700	36	860	11
Courtroom J	100	3,100	31	990	10
Courtroom K	114	4,200	36	1,200	11

Note: Note: Courtroom occupancy is based on seating layouts shown on HVAC drawings provided to Tighe & Bond

The airflow rate per person for each Courtroom and the Jury Pool Room, based on a reduced occupancy scheduled 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)

Courtroom	Total People (Reduced Occupancy)	Total Air		Outdoor Air	
		Supply Airflow (CFM)	Airflow Rate (CFM/Person)	Outside Airflow (CFM)	Airflow Rate (CFM/Person)
Jury Pool Room	40	3,120	78	1,560	39
Courtroom A	28	4,000	146	1,200	42
Courtroom B	14	1,400	100	370	26
Courtroom C	28	3,350	120	870	31
Courtroom D	32	3,400	106	1,080	34
Courtroom E	23	3,100	135	980	43
Courtroom F	23	2,900	126	920	40
Courtroom G	30	3,400	113	1,000	34
Courtroom H	30	3,200	107	1,010	34
Courtroom I	30	2,700	90	860	29
Courtroom J	30	3,100	104	990	33
Courtroom K	38	4,200	109	1,200	32

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

The heating coils and cooling coils generally appear to be in good condition. We recommend increasing the outdoor air flow rate by up to 35% beyond the recommended outdoor air flow rates under nonpeak outdoor air conditions. We do not believe this would cause a threat of a potential coil to freeze given the amount of outside air as a percentage of total supply air, however cold spots on the coil may develop due to poor mixing. This may cause nuisance freeze stat trips via the existing freeze stat.

RTB-5: *Consider rebalancing all air inlets and outlets.*

Lockup Spaces
The lockup ventilation strategy is based on maintaining a slight airflow deficit in the cells relative to the corridors. To minimize the risk of one prisoner infecting others, it is important that the air balance in the cells and corridors is correct. If any vents have been accidently closed or if the supply air flow is too high in the cells, the likelihood of cross contamination increases. Both prisoners and guards are at increased risk in the lockup areas due to the risk profile or prisoners and extended time within these spaces.

Whole building or spaces with airflow/temperature issues
If the Courthouse experiences regular cooling and heating comfort complaints, we recommend exploring rebalancing all air inlets and outlets throughout the building. Prior to rebalancing the building, we recommend verifying the chiller and boiler plants are maintaining the correct supply water temperatures.

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. Considering the coils are only 10 years old, we don't expect there to be a significant issue with the flow rates.

2.3 Equipment Maintenance & Upgrades

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

The typical life expectancy for actuators ranges from 10-15 years. The existing damper actuators are approximately 10 years old and some may be malfunctioning. Replace dampers and actuators that are not functioning.

RE-4: *Inspect VAV Boxes and controllers*.

VAV boxes determine whether individual office areas will receive the required amount of outdoor air. We recommend, at minimum, surveying the VAV's through the BMS by looking for alarms, forcing them to exercise and checking that the airflow and damper position changes as expected. Consider cleaning airflow stations and similar preventative maintenance. Any suspect boxes should be rebalanced.

2.4 Control System

The Salem District Courthouse has a BMS. We recommend the following control system strategies be implemented into the existing control system:

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

It is our understanding based on conversations with staff that the building is currently being operated in an occupied mode 24/7, including using daytime occupied temperature setpoints. This likely results in more air changes and energy cost than necessary. If the current strategy is continued, it is recommended that the nighttime temperature setpoints be used instead of the daytime setpoints to save energy.

RC-3: *Install controls required to introduce outside air beyond the minimum requirement in a stepped approach.*

This approach can most likely be performed with programming changes within the existing BMS.

RC-5: *Disable Demand-Controlled Ventilation Sequences (at the AHU level).*

For the duration of the COVID-19 pandemic, we recommend disabling the AHU-level DCV sequence to provide a higher level of outside air into the building. Note that the VAV-level DCV sequences for densely occupied spaces should be left operational as this maintains adequate airflow in these spaces.

2.5 Additional Filtration and Air Cleaning

Based on conversations with the client, we understand that they would prefer to prioritize improving existing ventilation systems to the extent possible over portable filtration or air cleaning devices such as bipolar ionization or UVGI.

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.

2.7 Other Recommendations

2.7.1 Implement strict entry and PPE protocols for the large 2nd floor mechanical room for the duration of the pandemic.

The exhaust openings from AHU's 5-8 discharge directly into the 2nd floor mechanical room, making the entire room an exhaust plenum carrying air from all parts of the building served by the AHU's. While CDC and WHO guidance varies, there are indications that COVID-19 can be transported through air systems to some degree.

Entering and handling surfaces in this mechanical room should be treated with the same precautions used when entering AHU's and replacing filters. Refer to section 2.1 of the "Overview of Recommendations" Report.

We highly recommend routing this exhaust ductwork directly to the outdoors as soon as possible. Further investigate is required to determine if this is feasible.

2.7.2 Increase the VAV minimum airflow from 40% to 50% in Courtrooms

As VAV boxes open and close from maximum to the minimum position, the total airflow and the outdoor airflow delivered to spaces decreases. The current code requires air handlers to provide enough outdoor air to meet the code requirements while the VAV box is at the minimum position. Based on our outdoor air calculations, it appears this Courthouse was designed when this requirement was not in effect. Since we are not recommending increasing the outdoor air flow rate to current code minimums, an alternative approach to help increase the quantity of outside air into each space is to increase the VAV box minimum airflows from 40% to 50% of maximum airflow. Increasing the minimum airflow setting will result in an increase in outside air being delivered to the space.

Please note that this can increase the risk of overcooling, however VAVs are reheating the supply air during the summer. This will increase the demand of reheating the air and increase energy usage of the boiler system.

2.7.3 Replace CO2 sensors that are malfunctioning or beyond their expected life

CO_2 sensors must be replaced every 5-10 years, depending on the manufacturer. The sensors will become inaccurate over time and can will not control the outdoor air flowrate as designed. The site has reportedly already replaced about half of the building sensors and is planning a project for the other half (approximately 60 in total). Because the CO_2 sensors increase ventilation rates in densely occupied areas in response to occupancy to maintain the required airflow, these should be replaced as soon as possible to ensure that these spaces are properly ventilated.

Section 3
Testing & Balancing Results

On November 13, 2020 Milharmer Associates, Inc. visited the J. Michael Ruane Judicial Center to test the airflow rates of the air handling units and the exhaust fans. The Office of Court Management's Automatic Temperature Controls (ATC) Contractor was also on site to assist in the balancing process. A summary of the tested airflow rates versus the design airflow rates are shown below in Tables 5 and 6. Their full testing and balancing report is attached.

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)**
AHU-1	6,000	1,900	4,100	6,055	2,152	3,303
AHU-2	6,000	1,900	4,100	6,025	2,409	3,616
AHU-3	6,000	1,900	4,100	4,365	2,214	2,151
AHU-4	10,800	3,200	7,600	11,616	4,336	7,280
AHU-5	50,000	14,000	36,000	15,887	7,080	8,807
AHU-6	50,000	14,000	36,000	20,175	7,110	13,065
AHU-7	50,000	14,000	36,000	17,962	7,215	10,747
AHU-8	50,000	14,000	36,000	19,412	7,170	12,242
AHU-9	29,000	6,800	22,200	22,225	6,795	15,433
AHU-10	4,600	1,200	3,400	4,488	1,651	2,837
AHU-11	15,400	2,300	13,100	11,450	N/T	N/T

N/T: Not Tested.

TABLE 6
Return & Exhaust Fan Testing & Balancing Results

Unit	Serving	Design Fan Airflow	Actual Fan Airflow
F-14	AHU-1 Return	5,850	5,853
F-15	AHU-2 Return	4,680	4,872
F-16	AHU-3 Return	4,850	4,850
F-17	AHU-4 Return	9,800	9,912
F-20	AHU-5 Return	20,000	13,825
F-21	AHU-6 Return	20,000	15,776
F-22	AHU-7 Return	20,000	19,250
F-23	AHU-8 Return	20,000	17,999
F-18	AHU-9 Return	26,000	18,919
F-19	AHU-10 Return	4,200	4,634
F-27	AHU-11 Return	13,600	N/T
F-24	Toilet Exhaust	7,150	6,070
F-25	Toilet Exhaust	5,025	4,894
F-26	Toilet Exhaust	1,475	1,756
F-28	Toilet Exhaust	225	239
F-29	Toilet Exhaust	1,325	1,740

N/T: Not Tested.

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

1. AHU-1, AHU-2, AHU-4, and AHU-10 are performing within acceptable airflow range of design for both fans.
2. AHU-3 total supply airflow is approximately 75% of the design airflow rate, although the outdoor airflow above the design airflow. This AHU serves courtrooms F and J. We recommend further investigation to determine why the supply airflow isn't meeting the designed air flow rate.
3. AHU-5, AHU-6, AHU-7, and AHU-8 supply and return airflow rates are approximately 75% of the design airflow rates. The outdoor airflow is within the acceptable range. We recommend further investigation to determine why the supply airflow isn't meeting the designed air flow rate. Note that the AHU's 5/6 and 7/8 are designed to operate in parallel and are fully redundant.

4. The report suggested that the outdoor air flow stations for AHU-5 thru AHU-8 should be relocated to allow for more uniform readings.
5. AHU-9 supply airflow is significantly less than design airflow rate and the outside airflow station could not be calibrated. This should be investigated further by the ATC contractor with support from the airflow station manufacturer.
6. Most toilet exhaust fan flow rates are within acceptable range of design. F-24 is 15% below design. We recommend that this issue be investigated and corrected.
7. According to the report, all air handling units appear to have sufficient capacity to increase the filter efficiency to MERV 13 or 14.

Disclaimer

Tighe and Bond cannot in any way 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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TEST AND BALANCE REPORT

Project: **J. Michael Ruane Judicial Center**
58 Federal St., Salem, MA

Project No.: **20-548** **Project Date:** **11/13/2020**

MECHANICAL CONTRACTOR
Tighe & Bond

3384

A N.E.B.B. Certified Company

Project:	J. Michael Ruane Judicial Center		
Address:	58 Federal St., Salem, MA		
Date:	11/13/2020	**Project No.**	20-548

CERTIFICATION

Submitted & Certified by:

Milharmer Associates, Inc.

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

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

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

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

Certification

THIS IS TO CERTIFY THAT

Milharmer Associates, Inc.

HAS MET ALL REQUIREMENTS FOR NEBB CERTIFICATION IN THE FOLLOWING DISCIPLINE

Testing, Adjusting and Balancing of Environmental Systems

FOR THE NEBB BOARD OF DIRECTORS

March 31, 2021

Expiration Date

NEBB President

3384

NEBB Certification Number

NEBB President-Elect

NEBB Certification Board

NEBB Certified Professional

Scott F. Miller

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

Testing, Adjusting and Balancing of Environmental Systems

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

March 31, 2021

Expiration Date

23541

NEBB Certificant Number

Richard Farr

NEBB Certification Board Chairman

Cynthia Heath

NEBB Certification Director

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

Project:	J. Michael Ruane Judicial Center		
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SECTION 2 **TAB Building Systems**

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

INSTRUMENT SHEET

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

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

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

Technician:

SYMBOL SHEET

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

SYMBOL SHEET CONTINUED

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

Project:	J. Michael Ruane Judicial Center		
Address:	58 Federal St., Salem, MA		
Date:	11/13/2020	**Project No.**	20-548

REPORT SUMMARY

The following is the report for J. Michael Ruane Judicial Center. A survey was performed on AHU-1 thru AHU-11 and the toilet exhaust fans. In addition to the testing, we worked with the ATC contractor to calibrate the air flow stations and we have listed deficiencies below that were found during the testing. Testing on the Air Handling Units was performed with the VAV Boxes overridden to the full cooling positions and the Outside Air Damper set to it minimum position with the DCV system overridden.

1. AHU-1 thru 4 were all tested and found to be within design parameters and all airflow measuring stations were tested and calibrated with the ATC contractor.

2. AHU-5 thru AHU-8 were tested with the VAV boxes set to the full cooling position and all 4 units tested well below design for supply and return airflow. Additionally, the outside air flow stations are in a bad location and should be re-located to allow for more uniform readings. Both supply and return airflow stations calibrated fine.

3. AHU-9 was tested with the VAV boxes set to the full cooling position and the unit is well below design airflow. The outside air flow station also will not calibrate and should be investigated further by the ATC contractor or AFMS manufacturer.

4. AHU-10 was tested and found to be within design parameters and all airflow measuring stations were tested and calibrated with the ATC contractor.

5. AHU-11 was tested and found to be below design airflow but the return fan was under performing due to bad fan belts which need to be replaced prior to re-testing the unit.

Overall, the HVAC equipment appears to be running at design or capable of achieving design airflow throughout the facility. The units that are low on design airflow need to be investigated further to determine if there is some blockage in the duct work or if there are control issues preventing the units from reaching design airflow. Based on present readings, all Air Handling Units appear to have sufficient capacity to increase the filter efficiency to MERV 13/14.

Project:	J. Michael Ruane Judicial Center		
Address:	58 Federal St., Salem, MA		
Date:	11/13/2020	**Project No.**	20-548

REPORT SUMMARY

AIR HANDLING UNITS

UNIT	SUPPLY	RETURN	OUTSIDE AIR
AHU-1	6,055 CFM	3,303 CFM	2,152 CFM
AHU-2	6,025 CFM	3,616 CFM	2,409 CFM
AHU-3	4,365 CFM	2,151 CFM	2,214 CFM
AHU-4	11,616 CFM	7,280 CFM	4,336 CFM
AHU-5	15,887 CFM	8,807 CFM	7,080 CFM
AHU-6	20,175 CFM	13,065 CFM	7,110 CFM
AHU-7	17,962 CFM	10,747 CFM	7,215 CFM
AHU-8	19,412 CFM	12,242 CFM	7,170 CFM
AHU-9	22,225 CFM	15,433 CFM	6,795 CFM
AHU-10	4,488 CFM	2,837 CFM	1,651 CFM
AHU-11	11,450 CFM	NA	NA

FANS

UNIT	EXHAUST
F-14	5,853 CFM
F-15	4,872 CFM
F-16	4,850 CFM
F-17	9,912 CFM
F-20	13,825 CFM
F-21	15,776 CFM
F-22	19,250 CFM
F-23	17,999 CFM
F-18	18,919 CFM
F-19	4,634 CFM
F-27	NA
F-24	6,070 CFM
F-25	4,894 CFM
F-26	1,756 CFM
F-28	239 CFM
F-29	1,740 CFM

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

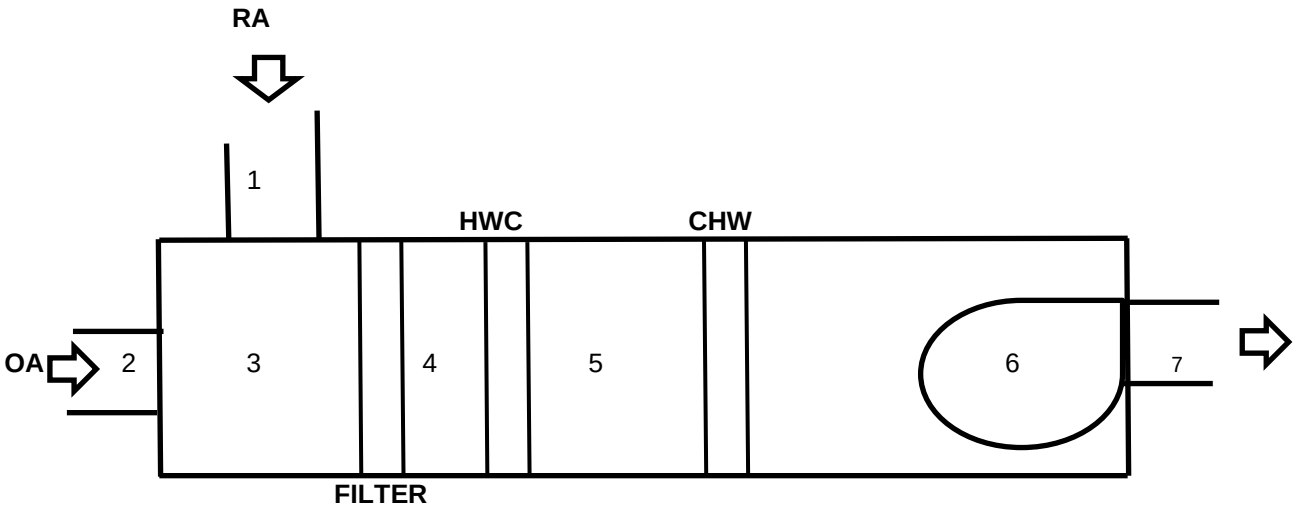
	FAN NO. AHU-1		FAN NO. F-14	
Serves / Location:	Courtrooms	Mech. 6400	Return for AHU-1	Mech 6400
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN14C011KF311XGS		QEI-20-1-50	
Size:	14		NL	
Serial Number:	4309U23149		11887851	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	215T	NL	184T
Horsepower:	10	10	5	5
Brake Horsepower:	7.2	NA	2.2	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	12.2	9.9	6.6	4.9
Motor RPM:	1760	1800	1750	1800
Speeds:	VFD	60 Hz	VFD	60 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:	6000	6055 *1		
Return Air CFM:	3900	3903	5850	5853 *2
Exhaust Air CFM:			1950	1950
Outside Air CFM:	2100	2152		
Suction Pressure:	NL	-2.07	NL	-1.35
Discharge Pressure:	NL	1.67	NL	0.58
Fan Static Pressure:	5.0"	NA	NL	NA
External Pressure:	NL	3.74	1.5"	1.93
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	NA	NL	INLINE
Motor Drive:	NL	BK35	NL	4.25" OD
Motor Size/Bore:	NL	1 3/8	NL	QT 1 1/8
Fan Drive:	NL	BK77	NL	INLINE
Fan Size/Bore:	NL	1 7/16	NL	INLINE
Belt Size / Number:	NL	BX77x1	NL	AP58x2
Shafts C-C:	NL	27.6	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 At 55.2 Hz**

***2 At 60 Hz.**

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-1 STATIC PROFILE



LOCATION	STATIC
1	-.41"
2	-.32"
3	-0.99
4	-1.29"
5	-1.69"
6	-2.07"
7	+1.67"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 22 " WIDTH x 14 " DEPTH Sq Ft = 2.14

AIR DENSITY DATA

STATIC PRESS @ CL:	NA	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	3395
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**3396**

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

TEST HOLE	1	2	3	4	5	6	7
A	1593	1703	1714	1533	1593	1674	
B	1462	1643	1830	1724	1759	1518	
C	936	1127	1732	1702	1712	1597	
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 18 AVERAGE FPM = 1586

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T2
Supply @ 60 Hz TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 22 " WIDTH x 14 " DEPTH Sq Ft = 2.14

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = NL
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 3186
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **3188**

AIR DENSITY RATIO CORRECTION = 1.00 T1 + T2 = Total CFM
SCFM CORRECTION FACTOR 1.00 Total CFM = 6581
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	566	752	1428	1727	1967	2113	
B	618	1094	1409	1761	1956	2045	
C	869	1371	1637	1690	1840	1954	
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 18 AVERAGE FPM = 1489

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 34 " WIDTH x 20 " DEPTH Sq Ft = 4.72

AIR DENSITY DATA
STATIC PRESS @ CL: -0.48 InWg. DESIGN CFM = 3900
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 3903
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **3901**

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

TEST HOLE	1	2	3	4	5	6	7
A	500	761	572	543	326	511	297
B	1068	1227	955	679	776	826	710
C	1085	1196	1280	1028	1249	1391	1017
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 27 AVERAGE FPM = 827

J	309	202					
K	748	671					
L	1358	1044					
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
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VELGRID TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T1
Outside Air TRAVERSE LOCATION: Mech 6400

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:	NA	InWg.	DESIGN CFM =	2100
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	2152
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**2153**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = 0.851
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	564	531	496	518			
B	373	355	368	418			
C	86	51	37	77			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 323

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-14 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	34	" WIDTH x	20	" DEPTH	Sq Ft =	4.72

AIR DENSITY DATA

STATIC PRESS @ CL:	0.91	InWg.	DESIGN CFM =	5850
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	5853
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**5870**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = 0.984
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	465	448	1141	857	825	489	767
B	1121	1065	1840	1442	1025	1164	1227
C	1996	1525	1794	1907	1564	1873	2098
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 27 AVERAGE FPM = 1240

J	303	1628					
K	1007	1601					
L	1558	753					
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

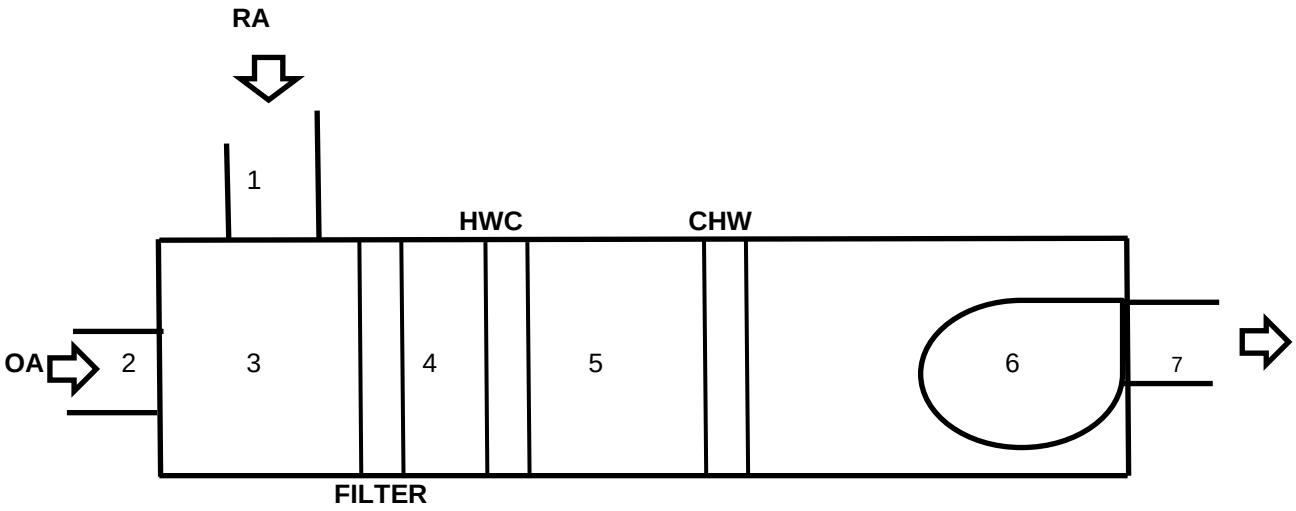
FAN DATA SHEET

	FAN NO. AHU-2		FAN NO. F-15	
Serves / Location:	Courtrooms	Mech. 6400	Return for AHU-2	Mech 6400
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN14C011KF311XGS		QEI-18-1-50	
Size:	14		NL	
Serial Number:	4309U23150		11887852	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	215T	NL	184T
Horsepower:	10	10	5	5
Brake Horsepower:	7.2	NA	2.2	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	12.2	6.9	6.6	4.1
Motor RPM:	1760	1355	1750	1447
Speeds:	VFD	45.2 Hz	VFD	48.2 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:	6000	6025		
Return Air CFM:	3600	3616	4680	4872
Exhaust Air CFM:			1080	1256
Outside Air CFM:	2400	2409		
Suction Pressure:	NL	-1.08	NL	-0.44
Discharge Pressure:	NL	1.12	NL	0.36
Fan Static Pressure:	5.0"	NA	NL	NA
External Pressure:	NL	2.2	1.5"	0.8
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1939	1460	NL	INLINE
Motor Drive:	NL	BK35	NL	4.25" OD
Motor Size/Bore:	NL	1 3/8	NL	QT 1 1/8"
Fan Drive:	NL	BK77	NL	INLINE
Fan Size/Bore:	NL	1 7/16	NL	INLINE
Belt Size / Number:	NL	B77x1	NL	AP56x2
Shafts C-C:	NL	27.6	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments:

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-2 STATIC PROFILE



LOCATION	STATIC
1	-.11"
2	-.12"
3	-.31"
4	-.62"
5	-.80"
6	-1.08"
7	+1.12"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T1
Supply Branch 1 TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND) 16 " DIAMETER Sq Ft = 1.40
DUCT SIZE (RECT.) " WIDTH x " DEPTH Sq Ft = 0.00

AIR DENSITY DATA

STATIC PRESS @ CL:	1.12	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	2895
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**2905**

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

TEST HOLE	1	2	3	4	5	6	7
A	2355	2050	2336	2035			
B	2159	2027	2281	1935			
C	2027	1940	2170	1984			
D	1986	1830	2098	1873			
E							
F							
G							
H							
I							

NO. OF READINGS = 16 AVERAGE FPM = 2068

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T2
Supply Branch 2 TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 20 " WIDTH x 16 " DEPTH Sq Ft = 2.22

AIR DENSITY DATA

STATIC PRESS @ CL:	1.44	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	3130
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**3143**

AIR DENSITY RATIO CORRECTION = 1.00 T1 + T2 = Total CFM
SCFM CORRECTION FACTOR 1.00 Total CFM = 6025
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	1470	1369	1268	1547	1719		
B	1376	1208	1179	1539	1699		
C	1496	1274	1177	1391	1435		
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 15 AVERAGE FPM = 1410

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	36	" WIDTH x	16	" DEPTH	Sq Ft =	4.00

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.11	InWg.	DESIGN CFM =	3600
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	3616
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**3617**

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

TEST HOLE	1	2	3	4	5	6	7
A	674	977	1017	1178			
B	392	936	1039	1115			
C	456	946	1022	1099			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 904

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T1
Outside Air TRAVERSE LOCATION: Mech 6400

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:	-0.027	InWg.	DESIGN CFM =	2400
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	2408
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**2410**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.203
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	383	394	414	387			
B	355	344	362	347			
C	278	301	389	379			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 361

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-15 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	36	" WIDTH x	16	" DEPTH	Sq Ft =	4.00

AIR DENSITY DATA

STATIC PRESS @ CL:	NA	InWg.	DESIGN CFM =	4650
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	4872
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4875**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = 1.295
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	1474	1510	1545	1282	1541	1417	
B	1171	1170	1084	1142	1260	1329	
C	911	867	1006	875	1129	1213	
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 18 AVERAGE FPM = 1218

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

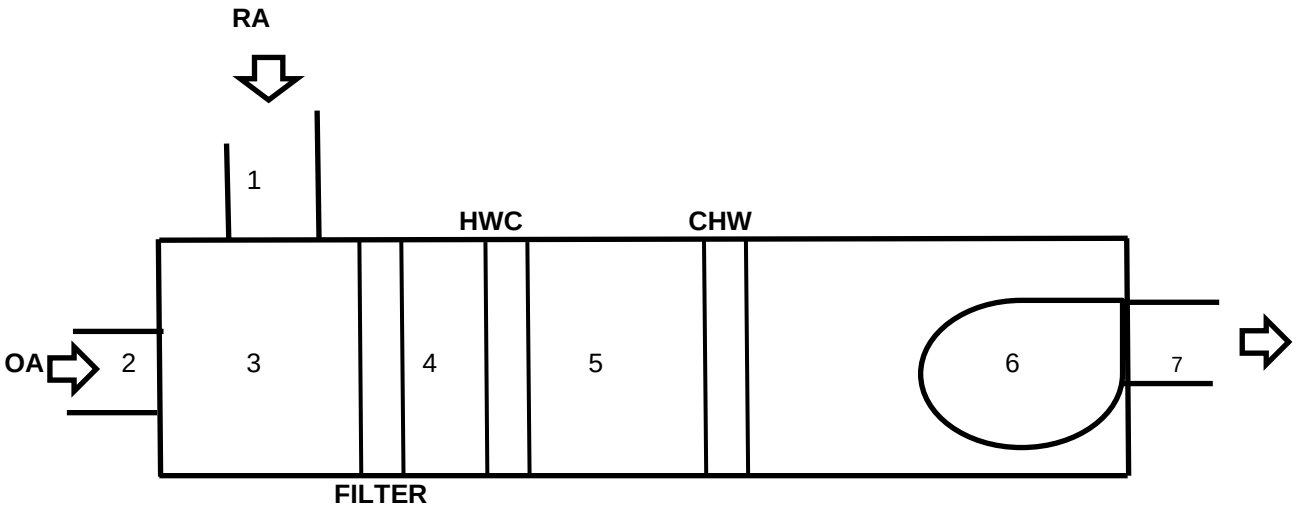
FAN DATA SHEET

	FAN NO. AHU-3		FAN NO. F-16	
Serves / Location:	Courtrooms	Mech. 6100	Return for AHU-3	Mech 6100
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN14CD11KF411XGS		QEI-18-1-60	
Size:	14		NL	
Serial Number:	4309U23151		11887853	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	215T	NL	184T
Horsepower:	10	10	5	5
Brake Horsepower:	7.2	NA	2.2	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	12.2	7	6.6	4.2
Motor RPM:	1760	1800	1750	1536
Speeds:	VFD	60 Hz	VFD	51.2 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:	6000	4365		
Return Air CFM:	3800	2151	4850	4853
Exhaust Air CFM:				
Outside Air CFM:	2200	2214		
Suction Pressure:	NL	-1.24	NL	-0.59
Discharge Pressure:	NL	1.14	NL	0.07
Fan Static Pressure:	5.0"	NA	NL	NA
External Pressure:	NL	2.38	1.5"	0.66
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1932	1932	NL	INLINE
Motor Drive:	NL	BK77	NL	4.5" OD
Motor Size/Bore:	NL	1 3/8	NL	QT 1 1/8"
Fan Drive:	NL	BK70H	NL	INLINE
Fan Size/Bore:	NL	H1 7/16	NL	INLINE
Belt Size / Number:	NL	BX74x1	NL	AP56x2
Shafts C-C:	NL	27.3	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments:

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-3 STATIC PROFILE



LOCATION	STATIC
1	-.11"
2	-.10"
3	-.38"
4	-.60"
5	-.77"
6	-1.24"
7	+1.14"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-3 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 6100

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = _____
DUCT SIZE (RECT.) 30 " WIDTH x 16 " DEPTH Sq Ft = 3.33

AIR DENSITY DATA

STATIC PRESS @ CL:	1.14	InWg.	DESIGN CFM =	6000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	4365
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4380**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .875
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	1462	1363	1254	1338	1052	1300	1510
B	1582	1291	1310	1293	1238	1225	1335
C	1616	1212	1171	1074	1111	1198	1245
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 1311

J	1468						
K	1530						
L	1276						
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-3 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Mech 6100

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 38 " WIDTH x 16 " DEPTH Sq Ft = 4.22

AIR DENSITY DATA
STATIC PRESS @ CL: -0.09 InWg. DESIGN CFM = 3800
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 2152
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **2153**

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

TEST HOLE	1	2	3	4	5	6	7
A	778	812	785	693			
B	868	831	857	814			
C	533	527	518	512			
D	529	564	558	534			
E	109	278	259	117			
F	116	229	279	133			
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 510

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-3 TRAVERSE NUMBER : T1
Outside Air TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 48 " WIDTH x 18 " DEPTH Sq Ft = 6.00

AIR DENSITY DATA
STATIC PRESS @ CL: -0.07 InWg. DESIGN CFM = 2200
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 2214
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **2215**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .715
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	312	352	460	498	526	520	404
B	289	438	357	346	496	320	501
C	343	342	409	261	275	394	495
D	492	283	294	241	246	311	251
E							
F							
G							
H							
I							

NO. OF READINGS = 32 AVERAGE FPM = 369

J	227						
K	400						
L	397						
M	263						
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-16 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Exhaust Duct

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	38	" WIDTH x	16	" DEPTH	Sq Ft =	4.22

AIR DENSITY DATA

STATIC PRESS @ CL:	0.003	InWg.	DESIGN CFM =	4850
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	4853
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4856**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.129
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	260	0	147	627	878	1321	1627
B	192	165	492	690	937	1121	1559
C	209	381	626	1029	1268	1641	1825
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 30 AVERAGE FPM = 1150

J	1889	2099	1824				
K	1752	1935	2098				
L	1859	1999	2056				
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

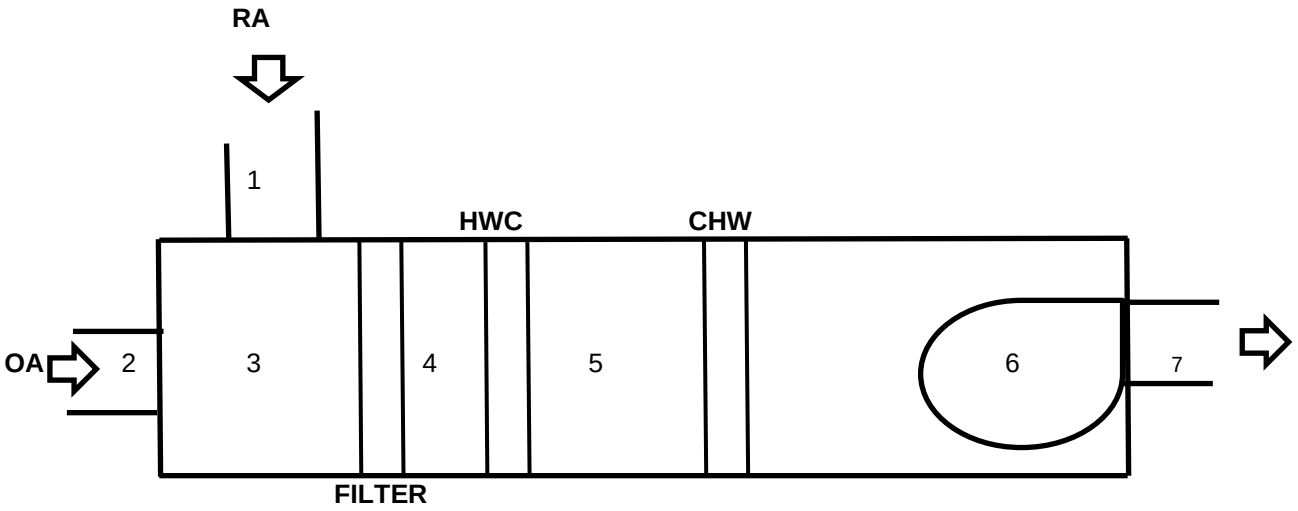
FAN DATA SHEET

	FAN NO. AHU-4		FAN NO. F-17	
Serves / Location:	Courtrooms	Mech. 6100	Return for AHU-4	Mech 6100
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN25C011KF511XGS		QEI-24-1-75	
Size:	25		NL	
Serial Number:	4309U23152		1187854	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	256T	NL	213T
Horsepower:	20	20	7.5	7.5
Brake Horsepower:	13.3	NA	4.6	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	23.7	17.1	9.6	6.4
Motor RPM:	1760	1800	1770	1770
Speeds:	VFD	60 Hz	VFD	59 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:	10800	11616		
Return Air CFM:	7000	7280	9800	9912
Exhaust Air CFM:			2800	2630
Outside Air CFM:	3800	4336		
Suction Pressure:	NL	-2.51	NL	-0.77
Discharge Pressure:	NL	1.1	NL	0.84
Fan Static Pressure:	5.2"	NA	NL	NA
External Pressure:	NL	3.61	2.0"	1.61
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1387	1387	NL	INLINE
Motor Drive:	NL	2B5V66	NL	4" OD
Motor Size/Bore:	NL	B1 5/8	NL	Q1 1 3/8
Fan Drive:	NL	2BK90	NL	INLINE
Fan Size/Bore:	NL	1 7/16	NL	INLINE
Belt Size / Number:	NL	BX90x2	NL	BX654x2
Shafts C-C:	NL	34.1	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments:

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-4 STATIC PROFILE



LOCATION	STATIC
1	-.52"
2	-.49"
3	-1.48"
4	-1.72"
5	-.2.14"
6	-2.51"
7	+1.10"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-4 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 6100

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 54 " WIDTH x 16 " DEPTH Sq Ft = 6.00

AIR DENSITY DATA
STATIC PRESS @ CL: 1.1 InWg. DESIGN CFM = 10800
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 11616
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **11654**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = 1.096
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	2599	2672	2394	2379	1818	2425	2420
B	2041	2145	2230	2155	1390	2236	1932
C	1642	1695	1696	1399	1310	1340	1550
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 27 AVERAGE FPM = 1936

J	2540	2420					
K	1698	1606					
L	1355	1169					
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-4 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Mech 6100

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 36 " WIDTH x 30 " DEPTH Sq Ft = 7.50

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.85	InWg.	DESIGN CFM =	7000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	7282
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**7271**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = NA
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	366	0	224	0	0	0	0
B	1155	0	0	0	0	0	0
C	2144	544	410	393	774	1223	1047
D	1796	1572	1347	1400	1390	1274	1498
E	1920	2280	2340	2518	1894	1887	1961
F							
G							
H							
I							

NO. OF READINGS = 45 AVERAGE FPM = 971

J	0	0					
K	0	0					
L	230	1632					
M	1556	1760					
N	1925	2193					
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-4 TRAVERSE NUMBER : T1
OSA TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 48 " WIDTH x 30 " DEPTH Sq Ft = 10.00

AIR DENSITY DATA
STATIC PRESS @ CL: -0.37 InWg. DESIGN CFM = 3800
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 4336
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **4335**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = 1.271
SCFM CORRECTION FACTOR 1.00 **AFMS fluctuating, unable
ACTUAL DENSITY 0.075 to calibrate properly.

TEST HOLE	1	2	3	4	5	6	7
A	474	438	427	388			
B	470	454	429	406			
C	467	455	442	485			
D	371	366	383	483			
E							
F							
G							
H							
I							

NO. OF READINGS = 16 AVERAGE FPM = 434

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-17 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 6100

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 48 " WIDTH x 24 " DEPTH Sq Ft = 8.00

AIR DENSITY DATA

STATIC PRESS @ CL:	-1.21	InWg.	DESIGN CFM =	9800
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	9912
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**9888**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = 0.911
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	939	1014	1036	1023	1439	1229	1271
B	896	924	994	1061	1427	1234	1236
C	884	938	996	1162	1414	1271	1268
D	837	919	1001	1039	1377	1256	1265
E							
F							
G							
H							
I							

NO. OF READINGS = 48 AVERAGE FPM = 1239

J	1242	1265	1438	1426	1968		
K	1231	1269	1516	1389	1956		
L	1256	1271	1537	1379	1727		
M	1259	1251	1517	1382	842		
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

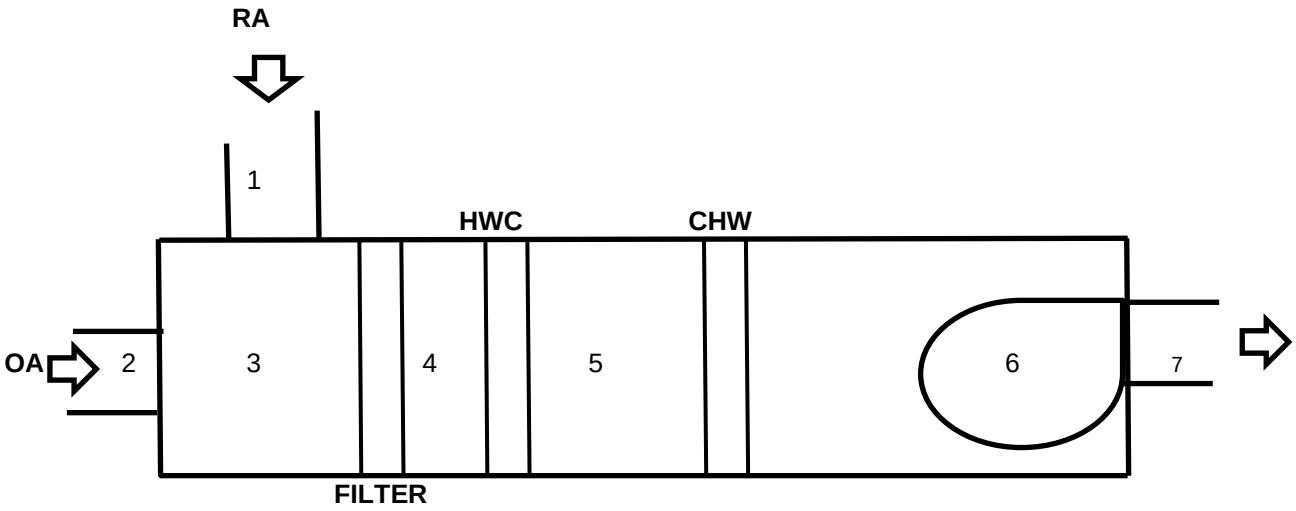
	FAN NO. AHU-5		FAN NO. F-20	
Serves / Location:	Admin Areas	Mech 2250	AHU-5 Return	Mech 2250
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN50C011KF622XGS		QEI-36-1-150	
Size:	50		NL	
Serial Number:	4309U23190		1187857	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	*1	NL	AO Smith
Frame Number:	NL	*1	NL	S254T
Horsepower:	40	*1	15	15
Brake Horsepower:	31.3	*1	7.1	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	52	36.7	18.9	12
Motor RPM:	*1	1722	1770	1800
Speeds:	VFD	57.4 Hz	VFD	60 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:	25000	15887		
Return Air CFM:	18000	8807	20000	13825
Exhaust Air CFM:				
Outside Air CFM:	7000	7080 *2		
Suction Pressure:	NL	-1.1	NL	-1.15
Discharge Pressure:	NL	3.19	NL	0.04
Fan Static Pressure:	5.5"	NA	NL	NA
External Pressure:	NL	4.29	1.5"	1.19
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1162	1134	NL	INLINE
Motor Drive:	NL	2B5V90	NL	5.7" OD
Motor Size/Bore:	NL	B2 1/8	NL	1 5/8
Fan Drive:	NL	2B5V136	NL	INLINE
Fan Size/Bore:	NL	B1 15/16	NL	INLINE
Belt Size / Number:	NL	5VX1320 x2	NL	BP98x3
Shafts C-C:	NL	48"	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 No motor nameplate tag.**

***2 AFMS not calibrating.**

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-5 STATIC PROFILE



LOCATION	STATIC
1	-.24"
2	-.32"
3	-.43"
4	-.65"
5	-.79"
6	-1.11"
7	+3.19"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-5 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 2250

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:	3.79	InWg.	DESIGN CFM =	25000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	15887
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**16044**

AIR DENSITY RATIO CORRECTION = 1.01 AFMS Cal = 1.023
SCFM CORRECTION FACTOR 1.01
ACTUAL DENSITY 0.076

TEST HOLE	1	2	3	4	5	6	7
A	2022	1646	1629	1102	951	648	601
B	2086	1990	1836	1258	867	964	1435
C	1884	1773	1687	1266	881	819	905
D	1582	1274	1385	1165	773	909	1012
E	1140	1059	1182	1096	952	1058	987
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1275

J	573	930	1241				
K	1188	1051	1491				
L	1269	1708	1710				
M	1226	1542	1707				
N	1323	1580	1404				
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-5 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Return Intake

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:	NA	InWg.	DESIGN CFM =	18000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	8812
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**8817**

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

TEST HOLE	1	2	3	4	5	6	7
A	706	716	734	1083			
B	1117	1063	631	644			
C	188	379	586	608			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 705

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-5 TRAVERSE NUMBER : T1
Outside Air TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 60 " WIDTH x 36 " DEPTH Sq Ft = 15.00

AIR DENSITY DATA

STATIC PRESS @ CL:	NA	InWg.	DESIGN CFM =	7000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	7080
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**7084**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 0.761
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	312	535	706	753	306		
B	677	275	797	609	519		
C	488	-96	781	216	664		
D	691	-87	806	-172	652		
E							
F							
G							
H							
I							

NO. OF READINGS = 20 AVERAGE FPM = 472

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: F-20 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 2250 Exhaust

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:	NA	InWg.	DESIGN CFM =	20000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	5013
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**5015**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .864
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	476	689	575	586			
B	406	387	404	559			
C	174	153	129	276			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 401

J							
K							
L							
M							
N							
O							
P							
Q							
R							

AHU-5 Return + F-20 Exhaust = Total CFM
8812 + 5013 = 13825 cfm.

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

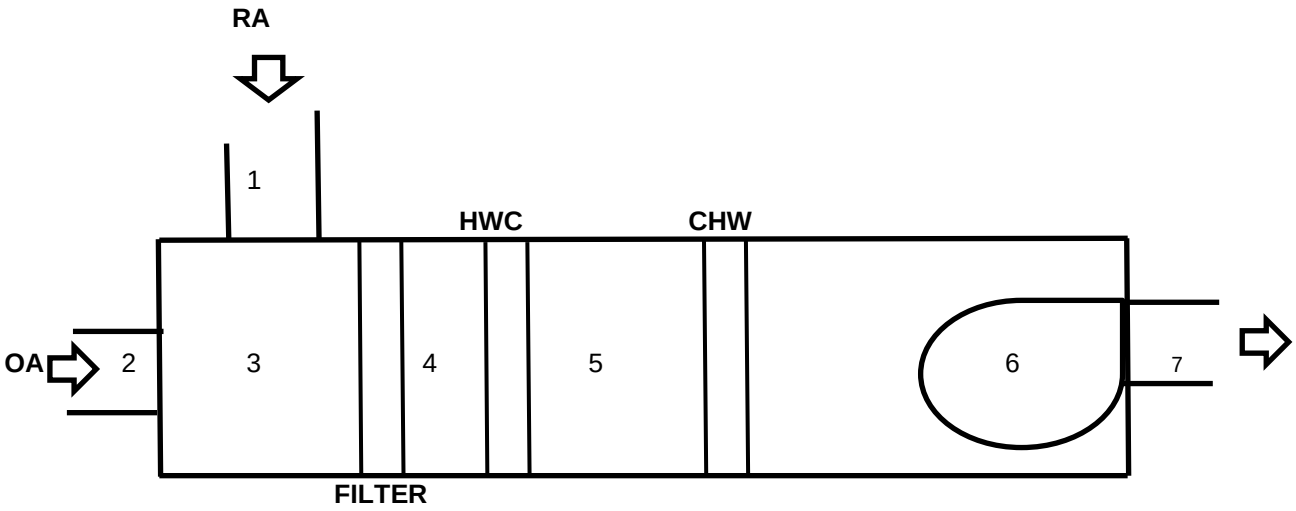
	FAN NO. AHU-6		FAN NO. F-21	
Serves / Location:	Admin Areas	Mech 2250	AHU-6 Return	Mech 2250
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN50C011F722XGS		QEI-36-1-150	
Size:	50		NL	
Serial Number:	4309U23195		11887858	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	*1	NL	BALDOR
Frame Number:	NL	*1	NL	254T
Horsepower:	40	*1	15	15
Brake Horsepower:	31.3	*1	7.1	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	52	38.9	17.7	11.2
Motor RPM:	*1	1699	1765	1800
Speeds:	VFD	56.6 Hz	VFD	60 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:	25000	20175		
Return Air CFM:	18000	13065	20000	15776
Exhaust Air CFM:				
Outside Air CFM:	7000	7110 *2		
Suction Pressure:	NL	-1.86	NL	-1.54
Discharge Pressure:	NL	3.99	NL	0.37
Fan Static Pressure:	5.5"	NA	NL	NA
External Pressure:	NL	5.85	1.5"	1.91
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	1119	NL	INLINE
Motor Drive:	NL	2B5V90	NL	5.7" OD
Motor Size/Bore:	NL	B2 1/8	NL	1 5/8
Fan Drive:	NL	2B5V136	NL	INLINE
Fan Size/Bore:	NL	B1 15/16	NL	INLINE
Belt Size / Number:	NL	5VX1320 x2	NL	BP98x3
Shafts C-C:	NL	48"	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 No motor nameplate tag.**

***2 AFMS not calibrating.**

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-6 STATIC PROFILE



LOCATION	STATIC
1	-.52"
2	-.48"
3	-.90"
4	-1.17"
5	-1.41"
6	-1.86"
7	+3.99"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-6 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 2250

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:	NA	InWg.	DESIGN CFM =	25000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	20175
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**20186**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.059
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	2068	2116	1999	2113	1464	2014	2274
B	1881	1883	1839	1558	1937	1984	2373
C	1680	1677	1457	865	1137	832	1956
D	1273	1484	1268	792	544	858	1217
E	1102	1355	966	1012	620	907	1190
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1614

J	2559	2568	2609				
K	2352	2435	2331				
L	1848	1730	1847				
M	1232	1608	1760				
N	1315	1417	1384				
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-6 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Return Intake

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:	NA	InWg.	DESIGN CFM =	18000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	13063
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**13070**

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

TEST HOLE	1	2	3	4	5	6	7
A	1041	1037	1090	416			
B	1374	1387	1281	535			
C	1316	1336	863	867			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 1045

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-6 TRAVERSE NUMBER : T1
OSA TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 60 " WIDTH x 36 " DEPTH Sq Ft = 15.00

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 7000
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 7110
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **7114**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .167
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	718	763	753	906	1014		
B	363	655	831	803	1010		
C	341	318	427	435	509		
D	131	325	-307	-233	541		
E							
F							
G							
H							
I							

NO. OF READINGS = 20 AVERAGE FPM = 474

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: F-21 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 2250

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:	NA	InWg.	DESIGN CFM =	20000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	2713
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**2714**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.081
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	521	467	508	615			
B	361	439	237	245			
C	-231	-174	-206	-179			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 217

J							
K							
L							
M							
N							
O							
P							
Q							
R							

AHU-6 Return + F-21 Exhaust = Total CFM
TECHNICIAN: David Burns 13063 + 2713 = 15776 CFM

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

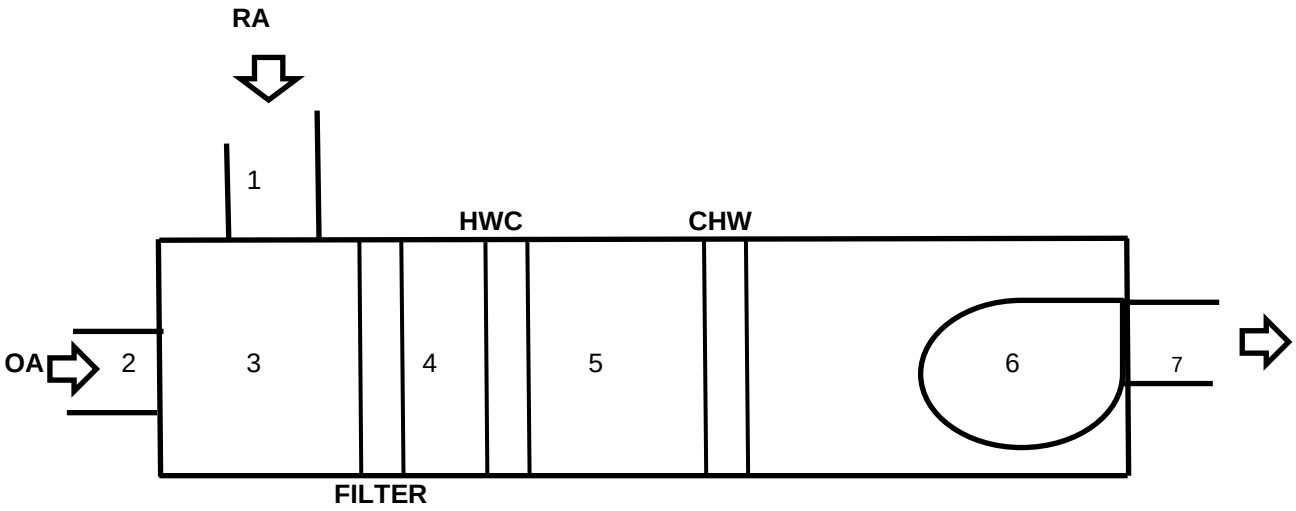
	FAN NO. AHU-7		FAN NO. F-22	
Serves / Location:	Admin Areas	Mech 2250	AHU-7 Return	Mech 2250
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN50C011F722XGS		QEI-36-1-150	
Size:	50		NL	
Serial Number:	4309U23194		11887859	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	*1	NL	BALDOR
Frame Number:	NL	*1	NL	254T
Horsepower:	40	*1	15	15
Brake Horsepower:	31.3	*1	7.1	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	52	36	17.7	10.9
Motor RPM:	*1	1662	1765	1798
Speeds:	VFD	55.4 Hz	VFD	60 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:	25000	17962		
Return Air CFM:	18000	10747	20000	19250
Exhaust Air CFM:				
Outside Air CFM:	7000	7215 *2		
Suction Pressure:	NL	-1.56	NL	-1.28
Discharge Pressure:	NL	4.32	NL	0.5
Fan Static Pressure:	5.5"	NA	NL	NA
External Pressure:	NL	5.88	1.5"	1.78
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	1119	NL	INLINE
Motor Drive:	NL	2B5V90	NL	5.7" OD
Motor Size/Bore:	NL	B2 1/8	NL	1 5/8
Fan Drive:	NL	2B5V136	NL	INLINE
Fan Size/Bore:	NL	B1 15/16	NL	INLINE
Belt Size / Number:	NL	5VX1320 x2	NL	BP98x3
Shafts C-C:	NL	48"	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 No motor nameplate tag.**

***2 AFMS not calibrating.**

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-7 STATIC PROFILE



LOCATION	STATIC
1	-.38"
2	-.41"
3	-..52"
4	-.79"
5	-1.06"
6	-1.56"
7	+4.32"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-7 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 2250

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:	3.19	InWg.	DESIGN CFM =	25000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	17962
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**18113**

AIR DENSITY RATIO CORRECTION = 1.01 AFMS = 1.112
SCFM CORRECTION FACTOR 1.01
ACTUAL DENSITY 0.076

TEST HOLE	1	2	3	4	5	6	7
A	1691	1788	1603	1669	1737	1479	1981
B	1819	1701	1683	1789	1546	1622	1838
C	933	1045	1447	1246	1304	1342	1690
D	1296	821	345	422	1179	1152	1439
E	796	482	381	156	679	808	1275
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1437

J	2003	1863	2100				
K	2170	2289	2354				
L	1909	1684	2066				
M	1543	1666	1769				
N	1281	1424	1524				
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-7 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Return Intake

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:	NA	InWg.	DESIGN CFM =	18000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	10750
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**10756**

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

TEST HOLE	1	2	3	4	5	6	7
A	1128	1218	1174	1053			
B	858	961	843	927			
C	474	502	511	668			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 860

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-7 TRAVERSE NUMBER : T1
OSA TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 60 " WIDTH x 36 " DEPTH Sq Ft = 15.00

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 7000
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 7215
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **7219**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .417
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	272	461	438	874	883		
B	655	384	518	936	855		
C	478	383	622	1001	672		
D	580	-107	-164	-90	-36		
E							
F							
G							
H							
I							

NO. OF READINGS = 20 AVERAGE FPM = 481

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: F-22 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 2250

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:	NA	InWg.	DESIGN CFM =	20000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	8500
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**8505**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.081
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	257	1274	1922	1578			
B	512	674	693	724			
C	184	115	109	116			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 680

J							
K							
L							
M							
N							
O							
P							
Q							
R							

AHU-7 Return + F-22 Exhaust = Total CFM
TECHNICIAN: David Burns 10750 + 8500 = 19250 CFM

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

	FAN NO. AHU-8		FAN NO. F-23	
Serves / Location:	Admin	Mech 2250	AHU-8 Return	Mech 2250
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN50C011F622XGS		QEI-36-1-150	
Size:	50		NL	
Serial Number:	4309U23191		11887860	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	*1	NL	BALDOR
Frame Number:	NL	*1	NL	254T
Horsepower:	40	*1	15	15
Brake Horsepower:	31.3	*1	7.1	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	52	36.7	17.7	11.4
Motor RPM:	*1	1722	1765	1800
Speeds:	VFD	57.4 Hz	VFD	60 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:	25000	19412		
Return Air CFM:	18000	12242	20000	17999
Exhaust Air CFM:				
Outside Air CFM:	7000	7170 *2		
Suction Pressure:	NL	-0.99	NL	-1.21
Discharge Pressure:	NL	4.94	NL	0.31
Fan Static Pressure:	5.5"	NA	NL	NA
External Pressure:	NL	5.88	1.5"	1.52
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	1162	NL	INLINE
Motor Drive:	NL	2B5V136	NL	5.7" OD
Motor Size/Bore:	NL	B2 1/8	NL	1 5/8
Fan Drive:	NL	2B5V136	NL	INLINE
Fan Size/Bore:	NL	B1 15/16	NL	INLINE
Belt Size / Number:	NL	5VX1320 x2	NL	BP98x3
Shafts C-C:	NL	48"	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 No motor nameplate tag.**

***2 AFMS not calibrating.**

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-8 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 2250

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:	2.8	InWg.	DESIGN CFM =	25000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	19412
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**19557**

AIR DENSITY RATIO CORRECTION = 1.01 AFMS = 1.013
SCFM CORRECTION FACTOR 1.01
ACTUAL DENSITY 0.076

TEST HOLE	1	2	3	4	5	6	7
A	3949	3573	4008	1569	0	4028	4015
B	2920	3521	3043	3335	3417	3336	3563
C	384	1590	1148	1712	1507	1212	1454
D	0	1036	0	584	646	747	0
E	0	0	0	0	0	482	414
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1553

J	4002	3980	3897				
K	3075	2016	2103				
L	897	0	0				
M	462	0	0				
N	0	0	0				
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-8 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Return Intake

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:	NA	InWg.	DESIGN CFM =	18000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	12238
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**12245**

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

TEST HOLE	1	2	3	4	5	6	7
A	1867	1952	1558	1483			
B	166	257	316	1492			
C	876	622	479	684			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 979

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-8 TRAVERSE NUMBER : T1
OSA TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 60 " WIDTH x 36 " DEPTH Sq Ft = 15.00

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 7000
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 7170
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **7174**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .175
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	687	713	864	923	778		
B	896	1034	314	328	626		
C	686	969	577	549	603		
D	-334	-236	-249	-194	26		
E							
F							
G							
H							
I							

NO. OF READINGS = 20 AVERAGE FPM = 478

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: F-23 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 2250

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:	NA	InWg.	DESIGN CFM =	20000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	5762
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**5765**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.259
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	892	953	959	1009			
B	584	638	696	723			
C	-211	-309	-174	-225			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 461

J							
K							
L							
M							
N							
O							
P							
Q							
R							

AHU-8 Return + F-23 Exhaust = Total CFM
TECHNICIAN: David Burns 12237 + 5762 = 17999 CFM

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

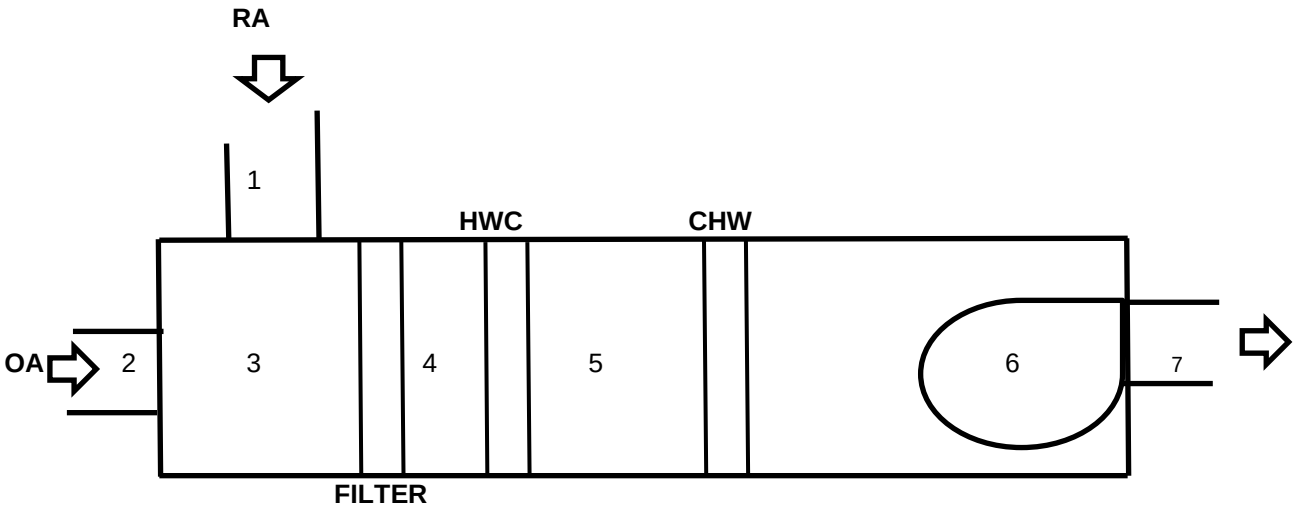
FAN DATA SHEET

	FAN NO. AHU-9		FAN NO. F-18	
Serves / Location:	Admin	Mech 4600	AHU-9 Return	Mech 4600
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN61C011F833XGS			
Size:	50		NL	
Serial Number:	4309U23198			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	326T	NL	256T
Horsepower:	50	50	20	20
Brake Horsepower:	34.8	NA	12	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	57.9	36.8	23.5	15.4
Motor RPM:	1760	1798	1765	1800
Speeds:	VFD	60 Hz	VFD	60 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:	29000	22225		
Return Air CFM:	22200	15433	26000	18919
Exhaust Air CFM:				
Outside Air CFM:	6800	6795		
Suction Pressure:	NL	-3.12	NL	-1.26
Discharge Pressure:	NL	2.67	NL	1.05
Fan Static Pressure:	5.2"	NA	NL	NA
External Pressure:	NL	5.79	1.5"	2.31
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	989	993	NL	INLINE
Motor Drive:	NL	2B5V90	NL	6" OD
Motor Size/Bore:	NL	B2 1/8	NL	1 5/8
Fan Drive:	NL	2B5V160	NL	INLINE
Fan Size/Bore:	NL	B2 3/16	NL	INLINE
Belt Size / Number:	NL	5VX1400x2	NL	BX106x3
Shafts C-C:	NL	50"	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 AFMS not reading airflow properly or tracking changes in flow.**

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-7 STATIC PROFILE



LOCATION	STATIC
1	-.38"
2	-.41"
3	-..52"
4	-.79"
5	-1.06"
6	-1.56"
7	+4.32"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-9 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Supply Duct

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:	2.67	InWg.	DESIGN CFM =	29000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	22225
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**22384**

AIR DENSITY RATIO CORRECTION = 1.01
SCFM CORRECTION FACTOR 1.01
ACTUAL DENSITY 0.076

TEST HOLE	1	2	3	4	5	6	7
A	1063	1642	1778	1825	1927	1919	2013
B	1094	1681	1794	1791	1852	1927	1979
C	916	1655	1815	1655	1901	1944	1984
D	884	1637	1823	1688	1871	1951	1986
E	787	1008	1476	1443	1823	1777	1871
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1778

J	2101	2263	2476				
K	1868	2186	2389				
L	1873	2138	2065				
M	2024	2124	1841				
N	2021	2135	1204				
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-9 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Return Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 48 " WIDTH x 44 " DEPTH Sq Ft = 14.67

AIR DENSITY DATA

STATIC PRESS @ CL:	NA	InWg.	DESIGN CFM =	22200
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	15433
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**15442**

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

TEST HOLE	1	2	3	4	5	6	7
A	996	1031	1074	1281	1245	1064	
B	884	1024	1111	1224	1256	981	
C	868	969	1115	1178	1253	859	
D	885	906	1038	1137	1197	667	
E							
F							
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 1052

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-9 TRAVERSE NUMBER : T1
OSA TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 108 " WIDTH x 30 " DEPTH Sq Ft = 22.50

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 6800
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 6795
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **6799**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .071
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	296	317	302	307	314	333	
B	254	306	319	328	325	341	
C	202	287	300	345	292	367	
D	196	243	303	336	289	352	
E							
F							
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 302

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: F-18 TRAVERSE NUMBER : T1
TRAVERSE LOCATION:

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 72 " WIDTH x 30 " DEPTH Sq Ft = 15.00

AIR DENSITY DATA

STATIC PRESS @ CL:	NA	InWg.	DESIGN CFM =	26000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	18919
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**18929**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.259
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	1341	1671	1613	1673	1481	2202	1830
B	1777	1797	1737	1552	1361	2052	1661
C	1745	1867	1682	1589	1362	1937	1437
D	1705	1729	1716	1665	1593	2025	1539
E	1673	1631	1658	1688	1344	2203	1670
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1261

J	540	1149	0				
K	80	520	0				
L	161	0	0				
M	178	0	0				
N	462	481	285				
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

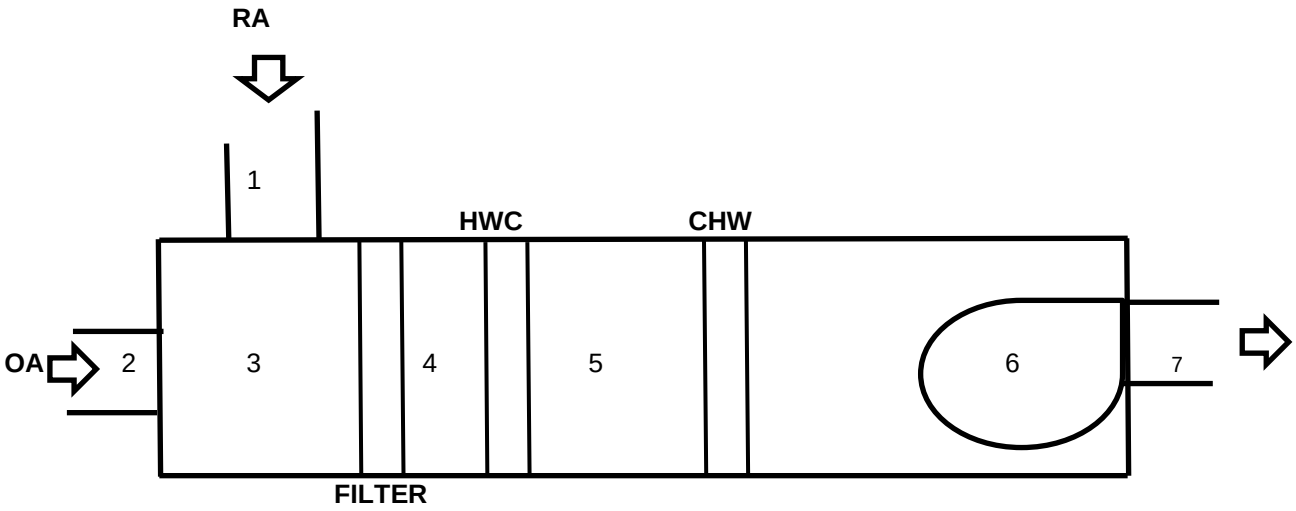
FAN DATA SHEET

	FAN NO. AHU-10		FAN NO. F-19	
Serves / Location:			AHU-10 Return	
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN1C011KF911XGS		QEI-18-1-30	
Size:	50		NL	
Serial Number:	4309023153		11887856	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	215T	NL	182T
Horsepower:	10	10	3	3
Brake Horsepower:	6	NA	1.6	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	12.2	7.9	4	2.6
Motor RPM:	1760	1800	1755	1556
Speeds:	VFD	60 Hz	VFD	51.9 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:	4600	4488		
Return Air CFM:	2950	2837	4200	4634
Exhaust Air CFM:				
Outside Air CFM:	1650	1651		
Suction Pressure:	NL	-1.63	NL	-0.78
Discharge Pressure:	NL	1.1	NL	0.05
Fan Static Pressure:	5.0"	NA	NL	NA
External Pressure:	NL	NA	1.5"	0.83
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	2455	2455	NL	INLINE
Motor Drive:	NL	BK90	NL	3.5" OD
Motor Size/Bore:	NL	1 3/8	NL	QTX 1 1/8
Fan Drive:	NL	BK65H	NL	INLINE
Fan Size/Bore:	NL	H1 3/16	NL	INLINE
Belt Size / Number:	NL	BX70x1	NL	A55x2
Shafts C-C:	NL	24.6	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments:

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-10 STATIC PROFILE



LOCATION	STATIC
1	-.26"
2	-.33"
3	-..52"
4	-.88"
5	-1.12"
6	-1.63"
7	+1.10"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-10 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Supply Duct

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 24 " WIDTH x 16 " DEPTH Sq Ft = 2.67

AIR DENSITY DATA

STATIC PRESS @ CL:	1.1	InWg.	DESIGN CFM =	4600
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	4488
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4503**

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

TEST HOLE	1	2	3	4	5	6	7
A	1004	1134	1324	1728	2009	2068	
B	1067	1386	1560	1690	1894	2131	
C	1501	1483	1821	1839	2033	2168	
D	1167	1517	1800	2047	1827	2154	
E							
F							
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 1681

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-10 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Return Intake

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

AIR DENSITY DATA
STATIC PRESS @ CL: -0.3 InWg. DESIGN CFM = 2950
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 2846
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **2846**

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

TEST HOLE	1	2	3	4	5	6	7
A	618	1534	1495	1563	1572	1387	595
B	1513	1311	1393	1295	1438	1512	328
C	855	1003	832	612	444	626	788
D	259	142	233	0	130	203	309
E							
F							
G							
H							
I							

NO. OF READINGS = 36 AVERAGE FPM = 754

J	518	619					
K	541	480					
L	213	131					
M	373	278					
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-10 TRAVERSE NUMBER : T1
OSA TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 30 " WIDTH x 20 " DEPTH Sq Ft = 4.17
Damper @ 2.5V

AIR DENSITY DATA
STATIC PRESS @ CL: 0.06 InWg. DESIGN CFM = 1650
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 1651
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **1652**

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

TEST HOLE	1	2	3	4	5	6	7
A	1938	1239	1186	1449	1480	1416	1096
B	0	683	0	526	0	333	0
C	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0
E							
F							
G							
H							
I							

NO. OF READINGS = 32 AVERAGE FPM = 396

J	884						
K	431						
L	0						
M	0						
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-19 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: F-19 Intake

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

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.66	InWg.	DESIGN CFM =	4200
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	4634
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4629**

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

TEST HOLE	1	2	3	4	5	6	7
A	1781	1769	1781	1146	1637	1782	1760
B	831	1642	1804	950	1013	1216	1685
C	892	1508	1575	1158	869	1061	1433
D	915	1280	1612	1126	885	1171	1124
E							
F							
G							
H							
I							

NO. OF READINGS = 36 AVERAGE FPM = 1226

J	1308	972					
K	1135	749					
L	565	742					
M	674	599					
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

	FAN NO. AHU-11		FAN NO. F-27	
Serves / Location:	Law Library	Mech 6400	AHU-11 Return	Mech 6400
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN1CD11KFB22XGS		QEI-30-1-75	
Size:	NL		NL	
Serial Number:	4390U23200		11887861 0910	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	284T	NL	213T
Horsepower:	40	25	NL	7.5
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:	29.8	24.2	9.7	8.8
Motor RPM:	1775	1800	1770	1800
Speeds:	VFD	60 Hz	VFD	60 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:	15400	11450		
Return Air CFM:	11700		13600	*1
Exhaust Air CFM:				
Outside Air CFM:	3700	*2	1900	
Suction Pressure:				
Discharge Pressure:				
Fan Static Pressure:				
External Pressure:				
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	NA	NL	INLINE
Motor Drive:	NL	2TB80	NL	5" OD
Motor Size/Bore:	NL	Q1 1 7/8	NL	Q1 1 3/8 - 5/16
Fan Drive:	NL	2B5V124	NL	INLINE
Fan Size/Bore:	NL	B1 11/16	NL	INLINE
Belt Size / Number:	NL	B116x2	NL	*1
Shafts C-C:	NL	43"	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 Needs new belt.**

***2 AFMS not working properly. Shield inside unit is directing return air into the OSA monitoring station.**

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-11 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 2904

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	34	" WIDTH x	34	" DEPTH	Sq Ft =	8.03

AIR DENSITY DATA

STATIC PRESS @ CL:	2.68	InWg.	DESIGN CFM =	15400
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	11450
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**11532**

AIR DENSITY RATIO CORRECTION = 1.01 AFMS = 1.097
SCFM CORRECTION FACTOR 1.01
ACTUAL DENSITY 0.076

TEST HOLE	1	2	3	4	5	6	7
A	2502	2530	2398	2029	1857	1480	1498
B	1856	1603	1374	1548	1332	1592	1388
C	1741	1348	1078	782	823	1143	1442
D	1890	1337	1137	875	690	1022	1357
E	1522	1265	1324	1065	920	1123	1142
F	1585	1316	1542	1137	1460	1305	1549
G							
H							
I							

NO. OF READINGS = 42 AVERAGE FPM = 1426

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

	FAN NO. F-24		FAN NO. F-25	
Serves / Location:	Toilet exh.	Roof	Toilet Exh.	Roof
Manufacturer:	GREENHECK		GREENHECK	
Model Number:	24-AFSW-21-10-1		22-AFSW-21-10-1	
Size:	NL		NL	
Serial Number:	11887138		11887137	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	DAYTON	NL	DAYTON
Frame Number:	NL	182/4T	NL	182/4T
Horsepower:	5	5	5	5
Brake Horsepower:	3.5	NA	1.9	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	6.33	5.75	6.33	5.3
Motor RPM:	1760	1768	1760	1768
Speeds:	NL	1	NL	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:	7150	6070	5025	4894
Outside Air CFM:				
Suction Pressure:	NL	-0.71	NL	-1.07
Discharge Pressure:	NL	0.27	NL	0.52
Fan Static Pressure:	NL	NA	NL	NA
External Pressure:	2"	0.98	1.5"	1.59
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	NA	NL	NA
Motor Drive:	NL	4.5" OD	NL	4" od
Motor Size/Bore:	NL	SHx1 1/8	NL	QTx 1 1/8
Fan Drive:	NL	2AK74	NL	2AK84
Fan Size/Bore:	NL	QT 1 7/16	NL	Q1 7/16
Belt Size / Number:	NL	AP54x2	NL	A55x2
Shafts C-C:	NL	20"	NL	20.5"
Turns Open:	NL	FIXED	NL	FIXED

Comments:

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-24 TRAVERSE NUMBER : T1
TRAVERSE LOCATION:

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	30	" WIDTH x	24	" DEPTH	Sq Ft =	5.00

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.71	InWg.	DESIGN CFM =	7150
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	6070
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**6063**

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

TEST HOLE	1	2	3	4	5	6	7
A	1297	1455	1517	1548	1568	1567	1664
B	1165	981	1231	1177	1272	1559	1650
C	1246	677	683	851	1219	1512	1542
D	782	793	783	976	1416	1490	1602
E	973	987	925	1248	1501	1498	1356
F							
G							
H							
I							

NO. OF READINGS = 40 AVERAGE FPM = 1214

J	939						
K	1020						
L	1299						
M	890						
N	700						
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-25 TRAVERSE NUMBER : T1
TRAVERSE LOCATION:

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	24	" WIDTH x	24 " DEPTH	Sq Ft =	4.00

AIR DENSITY DATA

STATIC PRESS @ CL:	-1.07	InWg.	DESIGN CFM =	5025
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	4894
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4884**

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

TEST HOLE	1	2	3	4	5	6	7
A	546	1517	1816	1765	1395	1222	
B	0	1332	1726	1446	1090	1010	
C	0	1517	1777	1720	880	699	
D	0	1506	1793	1764	945	1266	
E	722	1597	1718	1571	1067	1298	
F							
G							
H							
I							

NO. OF READINGS = 30 AVERAGE FPM = 1224

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

	FAN NO. F-26		FAN NO. F-28	
Serves / Location:	Toilet exh.	Roof	Toilet Exh.	Roof
Manufacturer:	GREENHECK		GREENHECK	
Model Number:	BSQ-160HP-7		BSC-80-4	
Size:	NL		NL	
Serial Number:	11887614		11887615	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	WEG	NL	MARATHON
Frame Number:	NL	B56	NL	48Y
Horsepower:	3/4	3/4	1/4	1/4
Brake Horsepower:	0.45	NA	0.15	NA
Safety Factor:	NL	1.35	NL	1.35
Volts/Phase:	460/3	460/3	115/1	115/1
Motor Amperage:	1.2	1.1	5	3.6
Motor RPM:	1740	1748	1725	1731
Speeds:	NL	1	NL	1
Heater Size:	NL	NA	NL	CB
Heater Amps.:	NL	NA	NL	CB
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	1475	1756	225	239
Outside Air CFM:				
Suction Pressure:	NL	-0.72	NL	-0.31
Discharge Pressure:	NL	0.14	NL	0.04
Fan Static Pressure:	NL	NA	NL	NA
External Pressure:	1"	0.86	1"	0.35
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	INLINE	NL	INLINE
Motor Drive:	NL	VP34	NL	VP34
Motor Size/Bore:	NL	5/8	NL	1/2
Fan Drive:	NL	INLINE	NL	INLINE
Fan Size/Bore:	NL	INLINE	NL	INLINE
Belt Size / Number:	NL	A48	NL	*1
Shafts C-C:	NL	INLINE	NL	INLINE
Turns Open:	NL	1	NL	4

Comments: ***1 Has unibelt, needs new belt.**

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-26 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 6100

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	22	" WIDTH x	10	" DEPTH	Sq Ft =	1.53

AIR DENSITY DATA

STATIC PRESS @ CL:	0.14	InWg.	DESIGN CFM =	1475
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	1756
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**1758**

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

TEST HOLE	1	2	3	4	5	6	7
A	962	1250	1332	1400	1398	1492	
B	988	985	979	983	1069	1353	
C	1170	955	895	940	1188	1349	
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 18 AVERAGE FPM = 1149

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-28 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 2904

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	12	" WIDTH x	6	" DEPTH	Sq Ft =	0.50

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.31	InWg.	DESIGN CFM =	225
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	239
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**239**

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

TEST HOLE	1	2	3	4	5	6	7
A	483	378	539				
B	421	515	534				
C							
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 6 AVERAGE FPM = 478

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project:	J. Michael Ruane Judicial Center		
Address:	58 Federal St., Salem, MA		
Date:	11/13/2020	**Project No.**	20-548

FAN DATA SHEET

	FAN NO.	**F-29**	**FAN NO.**	
Serves / Location:	Toilet exh.	Roof		
Manufacturer:	GREENHECK			
Model Number:	BSQ-130-7			
Size:	NL			
Serial Number:	11887616			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	WEG		
Frame Number:	NL	B56		
Horsepower:	1.5	3/4		
Brake Horsepower:	0.55	NA		
Safety Factor:	NL	1.25		
Volts/Phase:	460/3	460/3		
Motor Amperage:	1.2	1.2		
Motor RPM:	1740	1744		
Speeds:	NL	1		
Heater Size:	NL	NA		
Heater Amps.:	NL	NA		
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	2475	1740		
Outside Air CFM:				
Suction Pressure:	NL	-0.3		
Discharge Pressure:	NL	0.13		
Fan Static Pressure:	NL	NA		
External Pressure:	1.25"	0.43		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	INLINE		
Motor Drive:	NL	1VP34		
Motor Size/Bore:	NL	5/8		
Fan Drive:	NL	INLINE		
Fan Size/Bore:	NL	INLINE		
Belt Size / Number:	NL	A41-1		
Shafts C-C:	NL	INLINE		
Turns Open:	NL	3		

Comments:

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-29 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 4600

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 18 " WIDTH x 14 " DEPTH Sq Ft = 1.75

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.3	InWg.	DESIGN CFM =	2475
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	1740
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**1740**

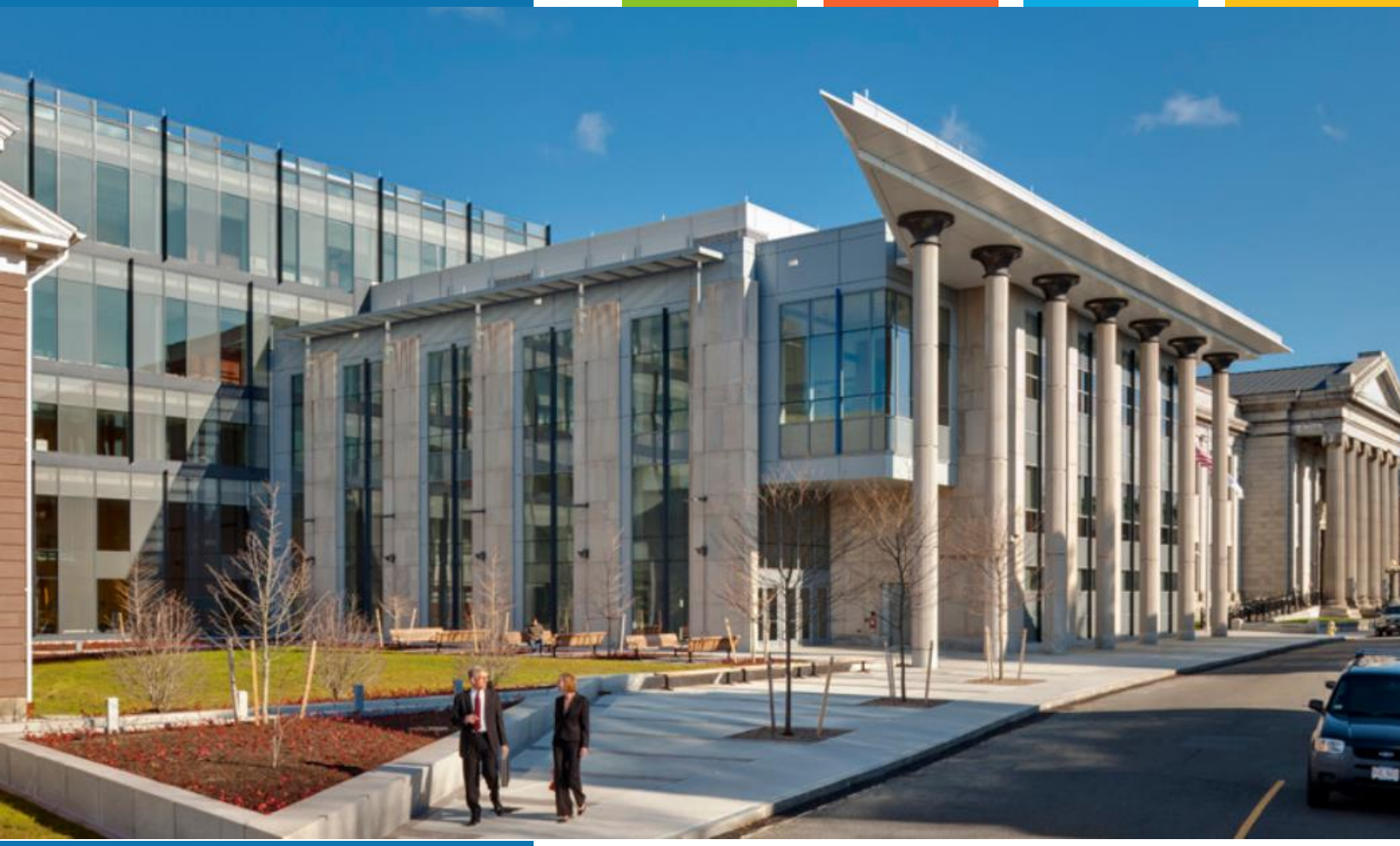
AIR DENSITY RATIO CORRECTION = 1.00
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	1147	1153	858	1215	1081		
B	783	1443	1441	1548	1352		
C	562	681	1125	1173	770		
D	403	631	961	945	615		
E							
F							
G							
H							
I							

NO. OF READINGS = 20 AVERAGE FPM = 994

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns



J. Michael Ruane Judicial Center
Salem, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

December 9, 2020

Tighe&Bond

100% Recyclable

Section 1
Existing Conditions and Site Observations

Tighe & Bond visited the J. Michael Ruane Judicial Center in Salem, MA on September 16, 2020. While on site, we inspected the air handling units and toured the occupied portions of the building to determine if the spaces generally matched usage noted on the architectural plans.

Site Visit Attendees:

- *Office of Court Management:*
  - Marcos (Marc) Olivera, Facilities Supervisor
  - Jim Cawley, Facilities, HVAC Specialist
- *Tighe & Bond:*
  - Sean Pringle, PE, Project Mechanical Engineer
  - Christina Wu, Staff Engineer

1.1 Existing Ventilation System

The J. Michael Ruane Judicial Center is a six-story building (including the basement), constructed in 2011, with a floor area of approximately 268,000 gross square feet. The HVAC system includes 11 variable air volume (VAV) air handling units (AHU), with AHU's 1 through 4 located in the rooftop penthouse, AHU's 5 through 8 and 11 located on the 2nd floor, and AHU's 9 and 10 located on the 4th floor.

All AHU's have a heating hot water coil with freeze pump, a chilled water cooling coil, supply fan, remote return air fan, independent return air (RA), outside air (OA), and exhaust air dampers, and return, supply, and outside airflow stations. AHU's 5&7, and AHU's 6&8 work in parallel with each other and function as a single VAV system. The air handling units are generally in good condition. Filters and coils were generally clean. The dampers and actuators that were observed appeared to be in good condition. The units are original and approximately 10 years old. According to staff, motors, actuators, bearings, and other wear items are replaced when they fail. Most dampers could not be inspected because they were within ductwork, and not part of the AHU. All cooling is provided through the AHU's. In areas with large perimeter loads, finned tube radiation is provided for additional heating.

During the visit, staff informed us that to improve ventilation in response to COVID-19, the AHU's have been set to operate in occupied mode 24/7, including maintaining occupied temperatures.

TABLE 1
Existing Air Handlers

Unit #	*Design Airflow (CFM)*	*Design Min OA (CFM)*	*Filters*	*Condition*
AHU-1	6,000	1,900	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-2	6,000	1,900	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-3	6,000	1,900	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-4	10,800	3,200	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-5	25,000	7,000	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-6	25,000	7,000	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-7	25,000	7,000	2" MERV 8 prefilter 12" MERV 14 final	Good
AHU-8	25,000	7,000	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-9	29,000	6,800	2" MERV 8 prefilter 12" MERV 13 final	Good
AHU-10	4,600	1,200	2" MERV 8 prefilter 12" MERV 14 final	Good
AHU-11	15,400	2,300	2" MERV 8 prefilter 12" MERV 14 final	Good

Several AHU issues were identified during the site visit:

- Minor general issues
  - Several motors / fans have bearing noises.
  - Cooling coils have rusty condensate pans and lower frames but are not showing any signs of poor drainage. This is likely due to the proximity to the coast. As these trays fail, they should be replaced with stainless steel trays.
- AHU's 5-8
  - The unfiltered exhaust air from these units is exhausted directly into the mechanical room, before exiting the building through exhaust louvers. Given the current pandemic, this presents a worker safety concern.
- AHU-9
  - The VFD was not working and running in bypass at the time of the visit. Facilities staff mentioned they have repairs scheduled.

  - According to the 2020 BQ2 Associates report, the minimum OA for this unit is 0% in the DCV sequence. This should be increased to be comparable to other units.
  - According to the Siemens September 2020 work report, the OA airflow station was not working at the time of the visit. This should be repaired as soon as possible.
- AHU-11
  - The prefilters were much dirtier than the other units. According to Facilities staff, this AHU receives dirtier air due to the proximity to the roadway. Consider increasing the filter change frequency for this unit.
  - Facilities staff also mentioned that this unit suffers from freeze stat trips in cold weather due to the close proximity of the outside air ductwork to the louver, causing poor mixing with return air and generating cold spots on the heating coil.

Supply air is regulated to each zone by variable air volume (VAV) boxes, with hot water reheat coils at each unit. As the building is less than 10 years old, we assume the VAV boxes (and all equipment) are original and have not been replaced. The working condition of these boxes is unknown but based on the age it is assumed they would be in generally good condition. Each courtroom is served by a dedicated VAV. We understand that the heating system is active during the summer to provide reheat to VAV boxes serving spaces under a demand control ventilation sequence.

The basement lockup area is provided with mixed supply air through VAV's set to a constant airflow from the 2nd floor AHU's, supplied into the corridors and the cells. Air is exhausted from the cells through the toilet exhaust risers. The attorney / client interview rooms, control rooms, corridor and other similar spaces within the secure corridor have supply and return air registers to the AHU's. Each secure area on the upper floors is supplied from a dedicated VAV set to a constant airflow into the corridors and the cells and exhausted through the cells.

Chilled water is provided by a pair of 320 ton water cooled chillers. Hot water is provided from a pair of 3.6 MMBH (output) boilers. Neither the hot nor chilled water systems contain glycol.

Photo 1 – Representative Air Handler

1.2 Existing Control System

The courthouse has a complete Siemens building management control system (BMS). It is tied to the existing boiler, chiller, AHU's, VAV's, auxiliary heating, and exhaust fans. While onsite, Tighe & Bond was able to observe various control system screens and setpoints. We were also provided with the sequence of operation delivered to the building during commissioning from Cosentini Associates.

The system provides air handler demand-controlled ventilation (DCV) sequences. DCV varies the outside air percentage from a minimum to a maximum limit in response to carbon dioxide (CO_2) concentration levels measured in high density spaces throughout the building. While this feature exists, the BQ2 Associates report noted that the DCV minimum OA airflows are set close to the design OA minimum airflows. This limits the functionality if the VAV system as it limits the reduction in outside air under light occupancy. They also noted that AHU-9 has a 0% outdoor minimum. Even during lightly occupied periods, there should be some outdoor air provided. The report also mentioned that many CO_2 sensors are beyond their useful life and malfunctioning.

VAV terminals that serve high density spaces also utilize zone-level DCV controls. When the space CO2 rises above the setpoint, the VAV will increase the supply air flow to the zone, increasing the outdoor air flowrate to the zone.

Section 2
Recommendations

2.1 Filtration Efficiency Recommendations

The existing MERV 8 prefilter / and MERV 13/14 final arrangement provides high levels of filtration for occupied areas. This level of filtration is adequate and is in line with AHRAE recommendations.

According to conversations with staff, the court plans to upgrade the prefilters to MERV 13 and the final filters to MERV 14 across all air handlers. While upgrading the final filters to MERV 14 is a good approach, using MERV 13 prefilters will only increase the AHU pressure drop and may reduce performance. We recommend the continued use of MERV 8 prefilters and upgrading the final filters to MERV 14. Using MERV 14 final filters will not likely have any noticeable impact on the filter change frequency or pressure drop compared to the existing MERV 13 filters.

2.2 Testing and Balancing Recommendations

The basis of design climactic outdoor air conditions state a summer design condition of 91°F/74°F DB/WB and a winter condition of 7°F. In reviewing the originally designed entering mixed air temperatures for the chilled water and hot water coils in the air handling units, it appears that the coils as designed are insufficient to accommodate any additional outside air on a design day. The coils appear to be slightly under-designed to maintain the required cooling and heating supply air setpoints. If the courtroom AHU's are currently not experiencing any heating or cooling issues at the design outside air quantities, then we recommend maintaining the original OA flow rates, but not increasing them.

We recommend the following testing and balancing measures:

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

> The original design outdoor airflow requirements and the outdoor airflows calculated by Tighe & Bond, based on the 2015 International Mechanical Code (IMC) are listed below.

TABLE 2
Recommended Air Handler O.A. Flow Rates

Unit #	*Original Design Airflow (CFM)*	*Original Design Min OA (CFM)*	*Current Code Min. OA Requirements (CFM)*	*Recommended Min OA (CFM)*
AHU-1	6,000	1,900	2,100	1,900
AHU-2	6,000	1,900	2,400	1,900
AHU-3	6,000	1,900	2,200	1,900
AHU-4	10,800	3,200	3,800	3,200
AHU's-5&7	50,000	14,000	10,800	14,000
AHU's-6&8	50,000	14,000	12,300	14,000
AHU-9	29,000	6,800	6,200	6,800
AHU-10	4,600	1,200	1,650	1,200
AHU-11	15,400	2,300	3,700	2,300

The discrepancies in the calculated ventilation rates are likely due to variations in assumptions in the expected occupant concentration ad airflow per person. Where the original design outdoor airflow rates are higher than the values per the current code minimums, we recommend maintaining the outdoor airflows at the original designed values, as these are more conservative and will likely result in improved indoor air quality (IAQ).

We recommend that the outdoor airflows for all units be checked to confirm that they match the recommended minimum OA amounts shown in the table above. Because this system uses airflow stations, it is possible that these changes can be made with control setpoint adjustments instead of hiring a TAB Contractor, however these units may not be reporting accurate values. As noted above, while our calculations show a higher outside air requirement than design, the coils do not have adequate capacity to provide these higher outside air quantities under peak outdoor air conditions.

The airflow rate per person is shown below in Table 3. These values are based on the recommended outdoor airflow, and original design supply airflow rates shown in Table 2 above. The airflow rate per person also 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.

TABLE 3
Average Airflow Rate Per Person

	All spaces	*Courtrooms*	*Non-Courtroom Spaces*
Total Occupancy (People)	1,500	620	850
Total Supply Air (CFM/Person)	120	54	170
Outdoor Air (CFM/Person)	32	16	44

The airflow rate per person for each courtroom is shown below in Table 4. These values are based on full occupancy, the original design supply airflow rate, and the recommended outdoor airflow rate, without taking diversity into account. 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 - Courtrooms

		Total Air		***Outdoor Air***	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outside Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Jury Pool Room	100	3,120	31	1,560	16
Courtroom A	114	4,000	35	1,200	10
Courtroom B	45	1,400	31	370	8
Courtroom C	90	3,350	37	870	10
Courtroom D	100	3,400	34	1,080	11
Courtroom E	100	3,100	31	980	10
Courtroom F	76	2,900	38	920	12
Courtroom G	100	3,400	34	1,000	10
Courtroom H	100	3,200	32	1,010	10
Courtroom I	76	2,700	36	860	11
Courtroom J	100	3,100	31	990	10
Courtroom K	114	4,200	36	1,200	11

Note: Note: Courtroom occupancy is based on seating layouts shown on HVAC drawings provided to Tighe & Bond

The airflow rate per person for each Courtroom and the Jury Pool Room, based on a reduced occupancy scheduled 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)

Courtroom	Total People (Reduced Occupancy)	Total Air		Outdoor Air	
		Supply Airflow (CFM)	Airflow Rate (CFM/Person)	Outside Airflow (CFM)	Airflow Rate (CFM/Person)
Jury Pool Room	40	3,120	78	1,560	39
Courtroom A	28	4,000	146	1,200	42
Courtroom B	14	1,400	100	370	26
Courtroom C	28	3,350	120	870	31
Courtroom D	32	3,400	106	1,080	34
Courtroom E	23	3,100	135	980	43
Courtroom F	23	2,900	126	920	40
Courtroom G	30	3,400	113	1,000	34
Courtroom H	30	3,200	107	1,010	34
Courtroom I	30	2,700	90	860	29
Courtroom J	30	3,100	104	990	33
Courtroom K	38	4,200	109	1,200	32

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

The heating coils and cooling coils generally appear to be in good condition. We recommend increasing the outdoor air flow rate by up to 35% beyond the recommended outdoor air flow rates under nonpeak outdoor air conditions. We do not believe this would cause a threat of a potential coil to freeze given the amount of outside air as a percentage of total supply air, however cold spots on the coil may develop due to poor mixing. This may cause nuisance freeze stat trips via the existing freeze stat.

RTB-5: *Consider rebalancing all air inlets and outlets.*

Lockup Spaces
The lockup ventilation strategy is based on maintaining a slight airflow deficit in the cells relative to the corridors. To minimize the risk of one prisoner infecting others, it is important that the air balance in the cells and corridors is correct. If any vents have been accidently closed or if the supply air flow is too high in the cells, the likelihood of cross contamination increases. Both prisoners and guards are at increased risk in the lockup areas due to the risk profile or prisoners and extended time within these spaces.

Whole building or spaces with airflow/temperature issues
If the Courthouse experiences regular cooling and heating comfort complaints, we recommend exploring rebalancing all air inlets and outlets throughout the building. Prior to rebalancing the building, we recommend verifying the chiller and boiler plants are maintaining the correct supply water temperatures.

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. Considering the coils are only 10 years old, we don't expect there to be a significant issue with the flow rates.

2.3 Equipment Maintenance & Upgrades

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

The typical life expectancy for actuators ranges from 10-15 years. The existing damper actuators are approximately 10 years old and some may be malfunctioning. Replace dampers and actuators that are not functioning.

RE-4: *Inspect VAV Boxes and controllers*.

VAV boxes determine whether individual office areas will receive the required amount of outdoor air. We recommend, at minimum, surveying the VAV's through the BMS by looking for alarms, forcing them to exercise and checking that the airflow and damper position changes as expected. Consider cleaning airflow stations and similar preventative maintenance. Any suspect boxes should be rebalanced.

2.4 Control System

The Salem District Courthouse has a BMS. We recommend the following control system strategies be implemented into the existing control system:

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

It is our understanding based on conversations with staff that the building is currently being operated in an occupied mode 24/7, including using daytime occupied temperature setpoints. This likely results in more air changes and energy cost than necessary. If the current strategy is continued, it is recommended that the nighttime temperature setpoints be used instead of the daytime setpoints to save energy.

RC-3: *Install controls required to introduce outside air beyond the minimum requirement in a stepped approach.*

This approach can most likely be performed with programming changes within the existing BMS.

RC-5: *Disable Demand-Controlled Ventilation Sequences (at the AHU level).*

For the duration of the COVID-19 pandemic, we recommend disabling the AHU-level DCV sequence to provide a higher level of outside air into the building. Note that the VAV-level DCV sequences for densely occupied spaces should be left operational as this maintains adequate airflow in these spaces.

2.5 Additional Filtration and Air Cleaning

Based on conversations with the client, we understand that they would prefer to prioritize improving existing ventilation systems to the extent possible over portable filtration or air cleaning devices such as bipolar ionization or UVGI.

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.

2.7 Other Recommendations

2.7.1 Implement strict entry and PPE protocols for the large 2nd floor mechanical room for the duration of the pandemic.

The exhaust openings from AHU's 5-8 discharge directly into the 2nd floor mechanical room, making the entire room an exhaust plenum carrying air from all parts of the building served by the AHU's. While CDC and WHO guidance varies, there are indications that COVID-19 can be transported through air systems to some degree.

Entering and handling surfaces in this mechanical room should be treated with the same precautions used when entering AHU's and replacing filters. Refer to section 2.1 of the "Overview of Recommendations" Report.

We highly recommend routing this exhaust ductwork directly to the outdoors as soon as possible. Further investigate is required to determine if this is feasible.

2.7.2 Increase the VAV minimum airflow from 40% to 50% in Courtrooms

As VAV boxes open and close from maximum to the minimum position, the total airflow and the outdoor airflow delivered to spaces decreases. The current code requires air handlers to provide enough outdoor air to meet the code requirements while the VAV box is at the minimum position. Based on our outdoor air calculations, it appears this Courthouse was designed when this requirement was not in effect. Since we are not recommending increasing the outdoor air flow rate to current code minimums, an alternative approach to help increase the quantity of outside air into each space is to increase the VAV box minimum airflows from 40% to 50% of maximum airflow. Increasing the minimum airflow setting will result in an increase in outside air being delivered to the space.

Please note that this can increase the risk of overcooling, however VAVs are reheating the supply air during the summer. This will increase the demand of reheating the air and increase energy usage of the boiler system.

2.7.3 Replace CO2 sensors that are malfunctioning or beyond their expected life

CO_2 sensors must be replaced every 5-10 years, depending on the manufacturer. The sensors will become inaccurate over time and can will not control the outdoor air flowrate as designed. The site has reportedly already replaced about half of the building sensors and is planning a project for the other half (approximately 60 in total). Because the CO_2 sensors increase ventilation rates in densely occupied areas in response to occupancy to maintain the required airflow, these should be replaced as soon as possible to ensure that these spaces are properly ventilated.

Section 3
Testing & Balancing Results

On November 13, 2020 Milharmer Associates, Inc. visited the J. Michael Ruane Judicial Center to test the airflow rates of the air handling units and the exhaust fans. The Office of Court Management's Automatic Temperature Controls (ATC) Contractor was also on site to assist in the balancing process. A summary of the tested airflow rates versus the design airflow rates are shown below in Tables 5 and 6. Their full testing and balancing report is attached.

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)**
AHU-1	6,000	1,900	4,100	6,055	2,152	3,303
AHU-2	6,000	1,900	4,100	6,025	2,409	3,616
AHU-3	6,000	1,900	4,100	4,365	2,214	2,151
AHU-4	10,800	3,200	7,600	11,616	4,336	7,280
AHU-5	50,000	14,000	36,000	15,887	7,080	8,807
AHU-6	50,000	14,000	36,000	20,175	7,110	13,065
AHU-7	50,000	14,000	36,000	17,962	7,215	10,747
AHU-8	50,000	14,000	36,000	19,412	7,170	12,242
AHU-9	29,000	6,800	22,200	22,225	6,795	15,433
AHU-10	4,600	1,200	3,400	4,488	1,651	2,837
AHU-11	15,400	2,300	13,100	11,450	N/T	N/T

N/T: Not Tested.

TABLE 6
Return & Exhaust Fan Testing & Balancing Results

Unit	Serving	Design Fan Airflow	Actual Fan Airflow
F-14	AHU-1 Return	5,850	5,853
F-15	AHU-2 Return	4,680	4,872
F-16	AHU-3 Return	4,850	4,850
F-17	AHU-4 Return	9,800	9,912
F-20	AHU-5 Return	20,000	13,825
F-21	AHU-6 Return	20,000	15,776
F-22	AHU-7 Return	20,000	19,250
F-23	AHU-8 Return	20,000	17,999
F-18	AHU-9 Return	26,000	18,919
F-19	AHU-10 Return	4,200	4,634
F-27	AHU-11 Return	13,600	N/T
F-24	Toilet Exhaust	7,150	6,070
F-25	Toilet Exhaust	5,025	4,894
F-26	Toilet Exhaust	1,475	1,756
F-28	Toilet Exhaust	225	239
F-29	Toilet Exhaust	1,325	1,740

N/T: Not Tested.

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

1. AHU-1, AHU-2, AHU-4, and AHU-10 are performing within acceptable airflow range of design for both fans.
2. AHU-3 total supply airflow is approximately 75% of the design airflow rate, although the outdoor airflow above the design airflow. This AHU serves courtrooms F and J. We recommend further investigation to determine why the supply airflow isn't meeting the designed air flow rate.
3. AHU-5, AHU-6, AHU-7, and AHU-8 supply and return airflow rates are approximately 75% of the design airflow rates. The outdoor airflow is within the acceptable range. We recommend further investigation to determine why the supply airflow isn't meeting the designed air flow rate. Note that the AHU's 5/6 and 7/8 are designed to operate in parallel and are fully redundant.

4. The report suggested that the outdoor air flow stations for AHU-5 thru AHU-8 should be relocated to allow for more uniform readings.
5. AHU-9 supply airflow is significantly less than design airflow rate and the outside airflow station could not be calibrated. This should be investigated further by the ATC contractor with support from the airflow station manufacturer.
6. Most toilet exhaust fan flow rates are within acceptable range of design. F-24 is 15% below design. We recommend that this issue be investigated and corrected.
7. According to the report, all air handling units appear to have sufficient capacity to increase the filter efficiency to MERV 13 or 14.

Disclaimer

Tighe and Bond cannot in any way 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.

J:\M\M1671 Comm. of MA Court System\011 - COVID-19 Courthouse Evaluations\Report_Evaluation\Draft Reports\Ruane Judicial Center\Ruane Judicial Center Report.docx

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

TEST AND BALANCE REPORT

Project: **J. Michael Ruane Judicial Center**
58 Federal St., Salem, MA

Project No.: **20-548** **Project Date:** **11/13/2020**

MECHANICAL CONTRACTOR
Tighe & Bond

3384

A N.E.B.B. Certified Company

Project:	J. Michael Ruane Judicial Center		
Address:	58 Federal St., Salem, MA		
Date:	11/13/2020	**Project No.**	20-548

CERTIFICATION

Submitted & Certified by:

Milharmer Associates, Inc.

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

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

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

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

Certification

THIS IS TO CERTIFY THAT

Milharmer Associates, Inc.

HAS MET ALL REQUIREMENTS FOR NEBB CERTIFICATION IN THE FOLLOWING DISCIPLINE

Testing, Adjusting and Balancing of Environmental Systems

FOR THE NEBB BOARD OF DIRECTORS

March 31, 2021

Expiration Date

NEBB President

3384

NEBB Certification Number

NEBB President-Elect

NEBB Certification Board

NEBB Certified Professional

Scott F. Miller

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

Testing, Adjusting and Balancing of Environmental Systems

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

March 31, 2021

Expiration Date

23541

NEBB Certificant Number

Richard Farr

NEBB Certification Board Chairman

Cynthia Heath

NEBB Certification Director

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

Project:	J. Michael Ruane Judicial Center		
Address:	58 Federal St., Salem, MA		
Date:	11/13/2020	**Project No.**	20-548

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D. Instrument Sheet
E. Symbol Sheet

SECTION 2 **TAB Building Systems**

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

INSTRUMENT SHEET

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

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

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

Technician:

SYMBOL SHEET

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

SYMBOL SHEET CONTINUED

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

Project:	J. Michael Ruane Judicial Center		
Address:	58 Federal St., Salem, MA		
Date:	11/13/2020	**Project No.**	20-548

REPORT SUMMARY

The following is the report for J. Michael Ruane Judicial Center. A survey was performed on AHU-1 thru AHU-11 and the toilet exhaust fans. In addition to the testing, we worked with the ATC contractor to calibrate the air flow stations and we have listed deficiencies below that were found during the testing. Testing on the Air Handling Units was performed with the VAV Boxes overridden to the full cooling positions and the Outside Air Damper set to it minimum position with the DCV system overridden.

1. AHU-1 thru 4 were all tested and found to be within design parameters and all airflow measuring stations were tested and calibrated with the ATC contractor.

2. AHU-5 thru AHU-8 were tested with the VAV boxes set to the full cooling position and all 4 units tested well below design for supply and return airflow. Additionally, the outside air flow stations are in a bad location and should be re-located to allow for more uniform readings. Both supply and return airflow stations calibrated fine.

3. AHU-9 was tested with the VAV boxes set to the full cooling position and the unit is well below design airflow. The outside air flow station also will not calibrate and should be investigated further by the ATC contractor or AFMS manufacturer.

4. AHU-10 was tested and found to be within design parameters and all airflow measuring stations were tested and calibrated with the ATC contractor.

5. AHU-11 was tested and found to be below design airflow but the return fan was under performing due to bad fan belts which need to be replaced prior to re-testing the unit.

Overall, the HVAC equipment appears to be running at design or capable of achieving design airflow throughout the facility. The units that are low on design airflow need to be investigated further to determine if there is some blockage in the duct work or if there are control issues preventing the units from reaching design airflow. Based on present readings, all Air Handling Units appear to have sufficient capacity to increase the filter efficiency to MERV 13/14.

Project:	J. Michael Ruane Judicial Center		
Address:	58 Federal St., Salem, MA		
Date:	11/13/2020	**Project No.**	20-548

REPORT SUMMARY

AIR HANDLING UNITS

UNIT	SUPPLY	RETURN	OUTSIDE AIR
AHU-1	6,055 CFM	3,303 CFM	2,152 CFM
AHU-2	6,025 CFM	3,616 CFM	2,409 CFM
AHU-3	4,365 CFM	2,151 CFM	2,214 CFM
AHU-4	11,616 CFM	7,280 CFM	4,336 CFM
AHU-5	15,887 CFM	8,807 CFM	7,080 CFM
AHU-6	20,175 CFM	13,065 CFM	7,110 CFM
AHU-7	17,962 CFM	10,747 CFM	7,215 CFM
AHU-8	19,412 CFM	12,242 CFM	7,170 CFM
AHU-9	22,225 CFM	15,433 CFM	6,795 CFM
AHU-10	4,488 CFM	2,837 CFM	1,651 CFM
AHU-11	11,450 CFM	NA	NA

FANS

UNIT	EXHAUST
F-14	5,853 CFM
F-15	4,872 CFM
F-16	4,850 CFM
F-17	9,912 CFM
F-20	13,825 CFM
F-21	15,776 CFM
F-22	19,250 CFM
F-23	17,999 CFM
F-18	18,919 CFM
F-19	4,634 CFM
F-27	NA
F-24	6,070 CFM
F-25	4,894 CFM
F-26	1,756 CFM
F-28	239 CFM
F-29	1,740 CFM

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

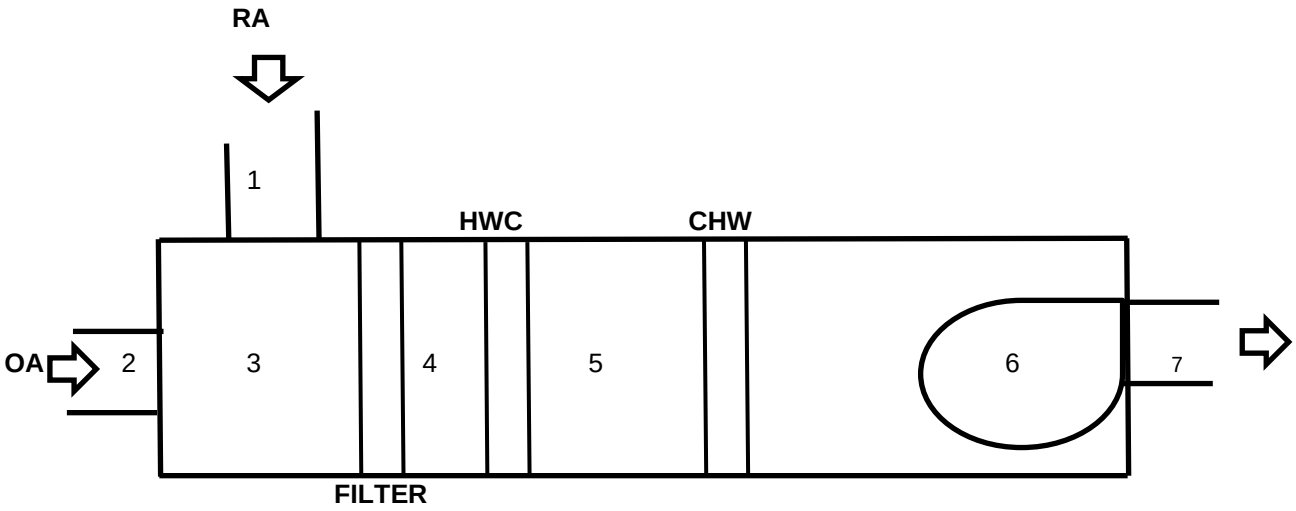
	FAN NO. AHU-1		FAN NO. F-14	
Serves / Location:	Courtrooms	Mech. 6400	Return for AHU-1	Mech 6400
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN14C011KF311XGS		QEI-20-1-50	
Size:	14		NL	
Serial Number:	4309U23149		11887851	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	215T	NL	184T
Horsepower:	10	10	5	5
Brake Horsepower:	7.2	NA	2.2	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	12.2	9.9	6.6	4.9
Motor RPM:	1760	1800	1750	1800
Speeds:	VFD	60 Hz	VFD	60 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:	6000	6055 *1		
Return Air CFM:	3900	3903	5850	5853 *2
Exhaust Air CFM:			1950	1950
Outside Air CFM:	2100	2152		
Suction Pressure:	NL	-2.07	NL	-1.35
Discharge Pressure:	NL	1.67	NL	0.58
Fan Static Pressure:	5.0"	NA	NL	NA
External Pressure:	NL	3.74	1.5"	1.93
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	NA	NL	INLINE
Motor Drive:	NL	BK35	NL	4.25" OD
Motor Size/Bore:	NL	1 3/8	NL	QT 1 1/8
Fan Drive:	NL	BK77	NL	INLINE
Fan Size/Bore:	NL	1 7/16	NL	INLINE
Belt Size / Number:	NL	BX77x1	NL	AP58x2
Shafts C-C:	NL	27.6	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 At 55.2 Hz**

***2 At 60 Hz.**

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-1 STATIC PROFILE



LOCATION	STATIC
1	-.41"
2	-.32"
3	-0.99
4	-1.29"
5	-1.69"
6	-2.07"
7	+1.67"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 22 " WIDTH x 14 " DEPTH Sq Ft = 2.14

AIR DENSITY DATA

STATIC PRESS @ CL:	NA	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	3395
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**3396**

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

TEST HOLE	1	2	3	4	5	6	7
A	1593	1703	1714	1533	1593	1674	
B	1462	1643	1830	1724	1759	1518	
C	936	1127	1732	1702	1712	1597	
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 18 AVERAGE FPM = 1586

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T2
Supply @ 60 Hz TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 22 " WIDTH x 14 " DEPTH Sq Ft = 2.14

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = NL
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 3186
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **3188**

AIR DENSITY RATIO CORRECTION = 1.00 T1 + T2 = Total CFM
SCFM CORRECTION FACTOR 1.00 Total CFM = 6581
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	566	752	1428	1727	1967	2113	
B	618	1094	1409	1761	1956	2045	
C	869	1371	1637	1690	1840	1954	
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 18 AVERAGE FPM = 1489

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 34 " WIDTH x 20 " DEPTH Sq Ft = 4.72

AIR DENSITY DATA
STATIC PRESS @ CL: -0.48 InWg. DESIGN CFM = 3900
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 3903
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **3901**

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

TEST HOLE	1	2	3	4	5	6	7
A	500	761	572	543	326	511	297
B	1068	1227	955	679	776	826	710
C	1085	1196	1280	1028	1249	1391	1017
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 27 AVERAGE FPM = 827

J	309	202					
K	748	671					
L	1358	1044					
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T1
Outside Air TRAVERSE LOCATION: Mech 6400

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:	NA	InWg.	DESIGN CFM =	2100
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	2152
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**2153**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = 0.851
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	564	531	496	518			
B	373	355	368	418			
C	86	51	37	77			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 323

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-14 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	34	" WIDTH x	20	" DEPTH	Sq Ft =	4.72

AIR DENSITY DATA

STATIC PRESS @ CL:	0.91	InWg.	DESIGN CFM =	5850
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	5853
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**5870**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = 0.984
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	465	448	1141	857	825	489	767
B	1121	1065	1840	1442	1025	1164	1227
C	1996	1525	1794	1907	1564	1873	2098
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 27 AVERAGE FPM = 1240

J	303	1628					
K	1007	1601					
L	1558	753					
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

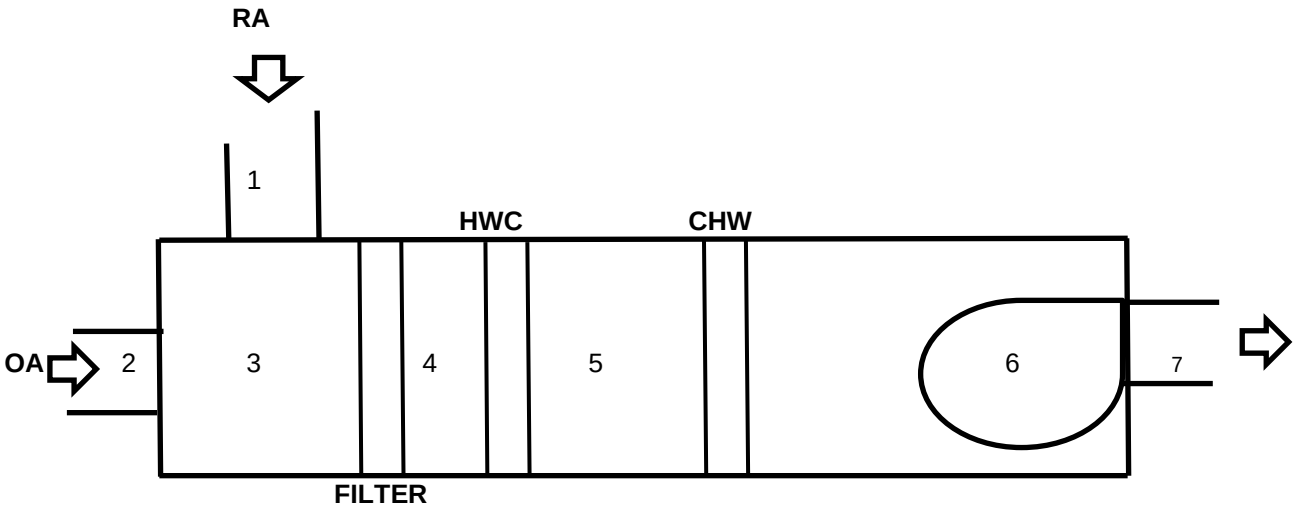
FAN DATA SHEET

	FAN NO. AHU-2		FAN NO. F-15	
Serves / Location:	Courtrooms	Mech. 6400	Return for AHU-2	Mech 6400
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN14C011KF311XGS		QEI-18-1-50	
Size:	14		NL	
Serial Number:	4309U23150		11887852	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	215T	NL	184T
Horsepower:	10	10	5	5
Brake Horsepower:	7.2	NA	2.2	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	12.2	6.9	6.6	4.1
Motor RPM:	1760	1355	1750	1447
Speeds:	VFD	45.2 Hz	VFD	48.2 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:	6000	6025		
Return Air CFM:	3600	3616	4680	4872
Exhaust Air CFM:			1080	1256
Outside Air CFM:	2400	2409		
Suction Pressure:	NL	-1.08	NL	-0.44
Discharge Pressure:	NL	1.12	NL	0.36
Fan Static Pressure:	5.0"	NA	NL	NA
External Pressure:	NL	2.2	1.5"	0.8
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1939	1460	NL	INLINE
Motor Drive:	NL	BK35	NL	4.25" OD
Motor Size/Bore:	NL	1 3/8	NL	QT 1 1/8"
Fan Drive:	NL	BK77	NL	INLINE
Fan Size/Bore:	NL	1 7/16	NL	INLINE
Belt Size / Number:	NL	B77x1	NL	AP56x2
Shafts C-C:	NL	27.6	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments:

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-2 STATIC PROFILE



LOCATION	STATIC
1	-.11"
2	-.12"
3	-.31"
4	-.62"
5	-.80"
6	-1.08"
7	+1.12"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T1
Supply Branch 1 TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND) 16 " DIAMETER Sq Ft = 1.40
DUCT SIZE (RECT.) " WIDTH x " DEPTH Sq Ft = 0.00

AIR DENSITY DATA

STATIC PRESS @ CL:	1.12	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	2895
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**2905**

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

TEST HOLE	1	2	3	4	5	6	7
A	2355	2050	2336	2035			
B	2159	2027	2281	1935			
C	2027	1940	2170	1984			
D	1986	1830	2098	1873			
E							
F							
G							
H							
I							

NO. OF READINGS = 16 AVERAGE FPM = 2068

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T2
Supply Branch 2 TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 20 " WIDTH x 16 " DEPTH Sq Ft = 2.22

AIR DENSITY DATA

STATIC PRESS @ CL:	1.44	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	3130
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**3143**

AIR DENSITY RATIO CORRECTION = 1.00 T1 + T2 = Total CFM
SCFM CORRECTION FACTOR 1.00 Total CFM = 6025
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	1470	1369	1268	1547	1719		
B	1376	1208	1179	1539	1699		
C	1496	1274	1177	1391	1435		
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 15 AVERAGE FPM = 1410

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	36	" WIDTH x	16	" DEPTH	Sq Ft =	4.00

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.11	InWg.	DESIGN CFM =	3600
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	3616
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**3617**

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

TEST HOLE	1	2	3	4	5	6	7
A	674	977	1017	1178			
B	392	936	1039	1115			
C	456	946	1022	1099			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 904

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T1
Outside Air TRAVERSE LOCATION: Mech 6400

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:	-0.027	InWg.	DESIGN CFM =	2400
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	2408
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**2410**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.203
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	383	394	414	387			
B	355	344	362	347			
C	278	301	389	379			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 361

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-15 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 6400

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	36	" WIDTH x	16	" DEPTH	Sq Ft =	4.00

AIR DENSITY DATA

STATIC PRESS @ CL:	NA	InWg.	DESIGN CFM =	4650
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	4872
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4875**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = 1.295
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	1474	1510	1545	1282	1541	1417	
B	1171	1170	1084	1142	1260	1329	
C	911	867	1006	875	1129	1213	
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 18 AVERAGE FPM = 1218

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

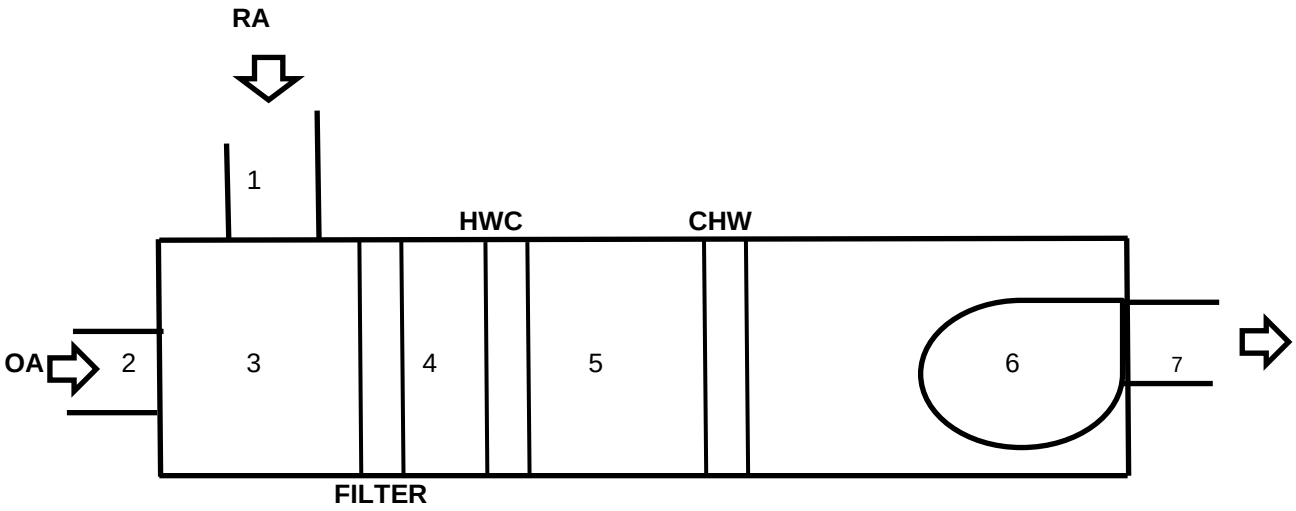
FAN DATA SHEET

	FAN NO. AHU-3		FAN NO. F-16	
Serves / Location:	Courtrooms	Mech. 6100	Return for AHU-3	Mech 6100
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN14CD11KF411XGS		QEI-18-1-60	
Size:	14		NL	
Serial Number:	4309U23151		11887853	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	215T	NL	184T
Horsepower:	10	10	5	5
Brake Horsepower:	7.2	NA	2.2	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	12.2	7	6.6	4.2
Motor RPM:	1760	1800	1750	1536
Speeds:	VFD	60 Hz	VFD	51.2 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:	6000	4365		
Return Air CFM:	3800	2151	4850	4853
Exhaust Air CFM:				
Outside Air CFM:	2200	2214		
Suction Pressure:	NL	-1.24	NL	-0.59
Discharge Pressure:	NL	1.14	NL	0.07
Fan Static Pressure:	5.0"	NA	NL	NA
External Pressure:	NL	2.38	1.5"	0.66
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1932	1932	NL	INLINE
Motor Drive:	NL	BK77	NL	4.5" OD
Motor Size/Bore:	NL	1 3/8	NL	QT 1 1/8"
Fan Drive:	NL	BK70H	NL	INLINE
Fan Size/Bore:	NL	H1 7/16	NL	INLINE
Belt Size / Number:	NL	BX74x1	NL	AP56x2
Shafts C-C:	NL	27.3	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments:

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-3 STATIC PROFILE



LOCATION	STATIC
1	-.11"
2	-.10"
3	-.38"
4	-.60"
5	-.77"
6	-1.24"
7	+1.14"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-3 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 6100

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = _____
DUCT SIZE (RECT.) 30 " WIDTH x 16 " DEPTH Sq Ft = 3.33

AIR DENSITY DATA

STATIC PRESS @ CL:	1.14	InWg.	DESIGN CFM =	6000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	4365
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4380**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .875
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	1462	1363	1254	1338	1052	1300	1510
B	1582	1291	1310	1293	1238	1225	1335
C	1616	1212	1171	1074	1111	1198	1245
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 1311

J	1468						
K	1530						
L	1276						
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-3 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Mech 6100

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 38 " WIDTH x 16 " DEPTH Sq Ft = 4.22

AIR DENSITY DATA
STATIC PRESS @ CL: -0.09 InWg. DESIGN CFM = 3800
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 2152
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **2153**

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

TEST HOLE	1	2	3	4	5	6	7
A	778	812	785	693			
B	868	831	857	814			
C	533	527	518	512			
D	529	564	558	534			
E	109	278	259	117			
F	116	229	279	133			
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 510

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-3 TRAVERSE NUMBER : T1
Outside Air TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 48 " WIDTH x 18 " DEPTH Sq Ft = 6.00

AIR DENSITY DATA
STATIC PRESS @ CL: -0.07 InWg. DESIGN CFM = 2200
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 2214
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **2215**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .715
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	312	352	460	498	526	520	404
B	289	438	357	346	496	320	501
C	343	342	409	261	275	394	495
D	492	283	294	241	246	311	251
E							
F							
G							
H							
I							

NO. OF READINGS = 32 AVERAGE FPM = 369

J	227						
K	400						
L	397						
M	263						
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-16 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Exhaust Duct

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	38	" WIDTH x	16	" DEPTH	Sq Ft =	4.22

AIR DENSITY DATA

STATIC PRESS @ CL:	0.003	InWg.	DESIGN CFM =	4850
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	4853
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4856**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.129
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	260	0	147	627	878	1321	1627
B	192	165	492	690	937	1121	1559
C	209	381	626	1029	1268	1641	1825
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 30 AVERAGE FPM = 1150

J	1889	2099	1824				
K	1752	1935	2098				
L	1859	1999	2056				
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

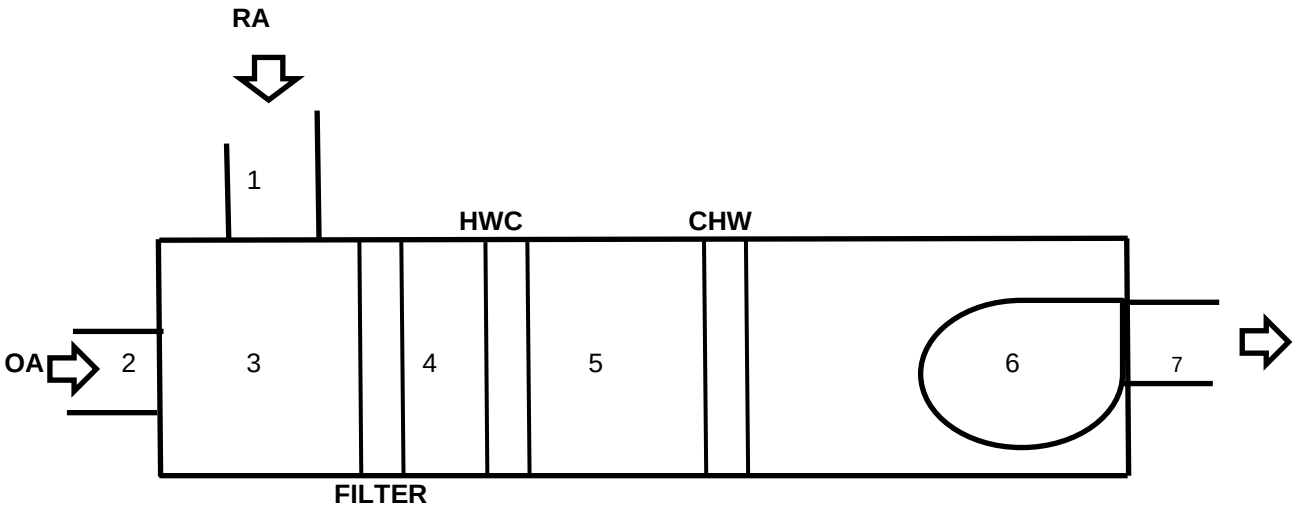
FAN DATA SHEET

	FAN NO. AHU-4		FAN NO. F-17	
Serves / Location:	Courtrooms	Mech. 6100	Return for AHU-4	Mech 6100
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN25C011KF511XGS		QEI-24-1-75	
Size:	25		NL	
Serial Number:	4309U23152		1187854	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	256T	NL	213T
Horsepower:	20	20	7.5	7.5
Brake Horsepower:	13.3	NA	4.6	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	23.7	17.1	9.6	6.4
Motor RPM:	1760	1800	1770	1770
Speeds:	VFD	60 Hz	VFD	59 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:	10800	11616		
Return Air CFM:	7000	7280	9800	9912
Exhaust Air CFM:			2800	2630
Outside Air CFM:	3800	4336		
Suction Pressure:	NL	-2.51	NL	-0.77
Discharge Pressure:	NL	1.1	NL	0.84
Fan Static Pressure:	5.2"	NA	NL	NA
External Pressure:	NL	3.61	2.0"	1.61
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1387	1387	NL	INLINE
Motor Drive:	NL	2B5V66	NL	4" OD
Motor Size/Bore:	NL	B1 5/8	NL	Q1 1 3/8
Fan Drive:	NL	2BK90	NL	INLINE
Fan Size/Bore:	NL	1 7/16	NL	INLINE
Belt Size / Number:	NL	BX90x2	NL	BX654x2
Shafts C-C:	NL	34.1	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments:

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-4 STATIC PROFILE



LOCATION	STATIC
1	-.52"
2	-.49"
3	-1.48"
4	-1.72"
5	-.2.14"
6	-2.51"
7	+1.10"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-4 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 6100

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 54 " WIDTH x 16 " DEPTH Sq Ft = 6.00

AIR DENSITY DATA
STATIC PRESS @ CL: 1.1 InWg. DESIGN CFM = 10800
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 11616
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **11654**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = 1.096
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	2599	2672	2394	2379	1818	2425	2420
B	2041	2145	2230	2155	1390	2236	1932
C	1642	1695	1696	1399	1310	1340	1550
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 27 AVERAGE FPM = 1936

J	2540	2420					
K	1698	1606					
L	1355	1169					
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-4 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Mech 6100

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 36 " WIDTH x 30 " DEPTH Sq Ft = 7.50

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.85	InWg.	DESIGN CFM =	7000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	7282
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**7271**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = NA
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	366	0	224	0	0	0	0
B	1155	0	0	0	0	0	0
C	2144	544	410	393	774	1223	1047
D	1796	1572	1347	1400	1390	1274	1498
E	1920	2280	2340	2518	1894	1887	1961
F							
G							
H							
I							

NO. OF READINGS = 45 AVERAGE FPM = 971

J	0	0					
K	0	0					
L	230	1632					
M	1556	1760					
N	1925	2193					
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-4 TRAVERSE NUMBER : T1
OSA TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 48 " WIDTH x 30 " DEPTH Sq Ft = 10.00

AIR DENSITY DATA
STATIC PRESS @ CL: -0.37 InWg. DESIGN CFM = 3800
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 4336
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **4335**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = 1.271
SCFM CORRECTION FACTOR 1.00 **AFMS fluctuating, unable
ACTUAL DENSITY 0.075 to calibrate properly.

TEST HOLE	1	2	3	4	5	6	7
A	474	438	427	388			
B	470	454	429	406			
C	467	455	442	485			
D	371	366	383	483			
E							
F							
G							
H							
I							

NO. OF READINGS = 16 AVERAGE FPM = 434

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-17 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 6100

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 48 " WIDTH x 24 " DEPTH Sq Ft = 8.00

AIR DENSITY DATA

STATIC PRESS @ CL:	-1.21	InWg.	DESIGN CFM =	9800
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	9912
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**9888**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS Cal = 0.911
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	939	1014	1036	1023	1439	1229	1271
B	896	924	994	1061	1427	1234	1236
C	884	938	996	1162	1414	1271	1268
D	837	919	1001	1039	1377	1256	1265
E							
F							
G							
H							
I							

NO. OF READINGS = 48 AVERAGE FPM = 1239

J	1242	1265	1438	1426	1968		
K	1231	1269	1516	1389	1956		
L	1256	1271	1537	1379	1727		
M	1259	1251	1517	1382	842		
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

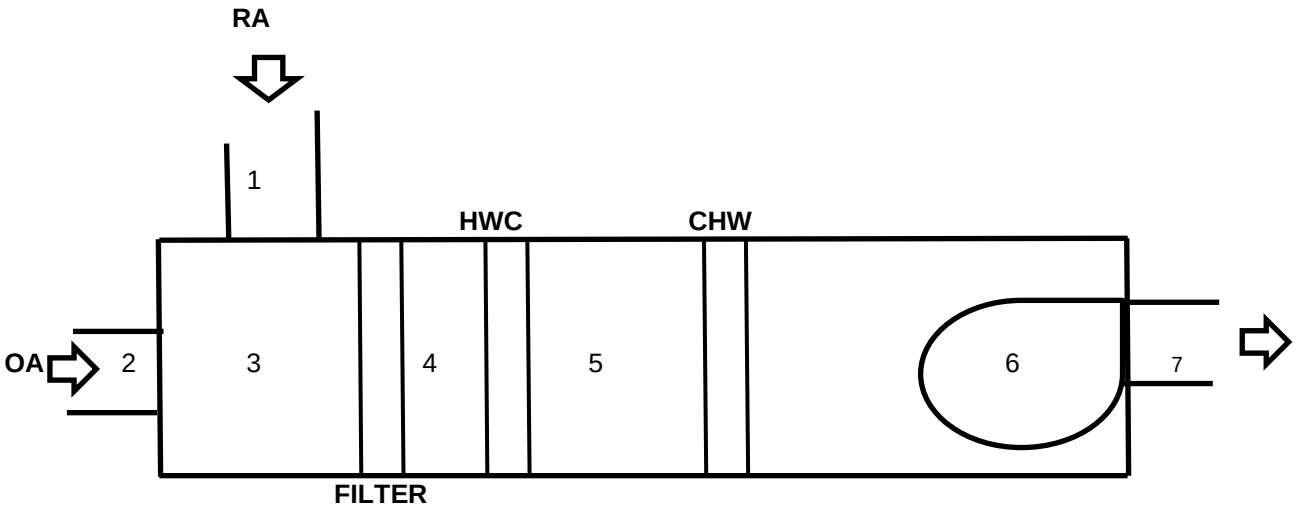
	FAN NO. AHU-5		FAN NO. F-20	
Serves / Location:	Admin Areas	Mech 2250	AHU-5 Return	Mech 2250
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN50C011KF622XGS		QEI-36-1-150	
Size:	50		NL	
Serial Number:	4309U23190		1187857	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	*1	NL	AO Smith
Frame Number:	NL	*1	NL	S254T
Horsepower:	40	*1	15	15
Brake Horsepower:	31.3	*1	7.1	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	52	36.7	18.9	12
Motor RPM:	*1	1722	1770	1800
Speeds:	VFD	57.4 Hz	VFD	60 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:	25000	15887		
Return Air CFM:	18000	8807	20000	13825
Exhaust Air CFM:				
Outside Air CFM:	7000	7080 *2		
Suction Pressure:	NL	-1.1	NL	-1.15
Discharge Pressure:	NL	3.19	NL	0.04
Fan Static Pressure:	5.5"	NA	NL	NA
External Pressure:	NL	4.29	1.5"	1.19
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1162	1134	NL	INLINE
Motor Drive:	NL	2B5V90	NL	5.7" OD
Motor Size/Bore:	NL	B2 1/8	NL	1 5/8
Fan Drive:	NL	2B5V136	NL	INLINE
Fan Size/Bore:	NL	B1 15/16	NL	INLINE
Belt Size / Number:	NL	5VX1320 x2	NL	BP98x3
Shafts C-C:	NL	48"	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 No motor nameplate tag.**

***2 AFMS not calibrating.**

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-5 STATIC PROFILE



LOCATION	STATIC
1	-.24"
2	-.32"
3	-.43"
4	-.65"
5	-.79"
6	-1.11"
7	+3.19"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-5 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 2250

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:	3.79	InWg.	DESIGN CFM =	25000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	15887
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**16044**

AIR DENSITY RATIO CORRECTION = 1.01 AFMS Cal = 1.023
SCFM CORRECTION FACTOR 1.01
ACTUAL DENSITY 0.076

TEST HOLE	1	2	3	4	5	6	7
A	2022	1646	1629	1102	951	648	601
B	2086	1990	1836	1258	867	964	1435
C	1884	1773	1687	1266	881	819	905
D	1582	1274	1385	1165	773	909	1012
E	1140	1059	1182	1096	952	1058	987
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1275

J	573	930	1241				
K	1188	1051	1491				
L	1269	1708	1710				
M	1226	1542	1707				
N	1323	1580	1404				
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-5 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Return Intake

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:	NA	InWg.	DESIGN CFM =	18000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	8812
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**8817**

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

TEST HOLE	1	2	3	4	5	6	7
A	706	716	734	1083			
B	1117	1063	631	644			
C	188	379	586	608			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 705

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-5 TRAVERSE NUMBER : T1
Outside Air TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 60 " WIDTH x 36 " DEPTH Sq Ft = 15.00

AIR DENSITY DATA

STATIC PRESS @ CL:	NA	InWg.	DESIGN CFM =	7000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	7080
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**7084**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 0.761
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	312	535	706	753	306		
B	677	275	797	609	519		
C	488	-96	781	216	664		
D	691	-87	806	-172	652		
E							
F							
G							
H							
I							

NO. OF READINGS = 20 AVERAGE FPM = 472

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: F-20 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 2250 Exhaust

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:	NA	InWg.	DESIGN CFM =	20000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	5013
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**5015**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .864
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	476	689	575	586			
B	406	387	404	559			
C	174	153	129	276			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 401

J							
K							
L							
M							
N							
O							
P							
Q							
R							

AHU-5 Return + F-20 Exhaust = Total CFM
8812 + 5013 = 13825 cfm.

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

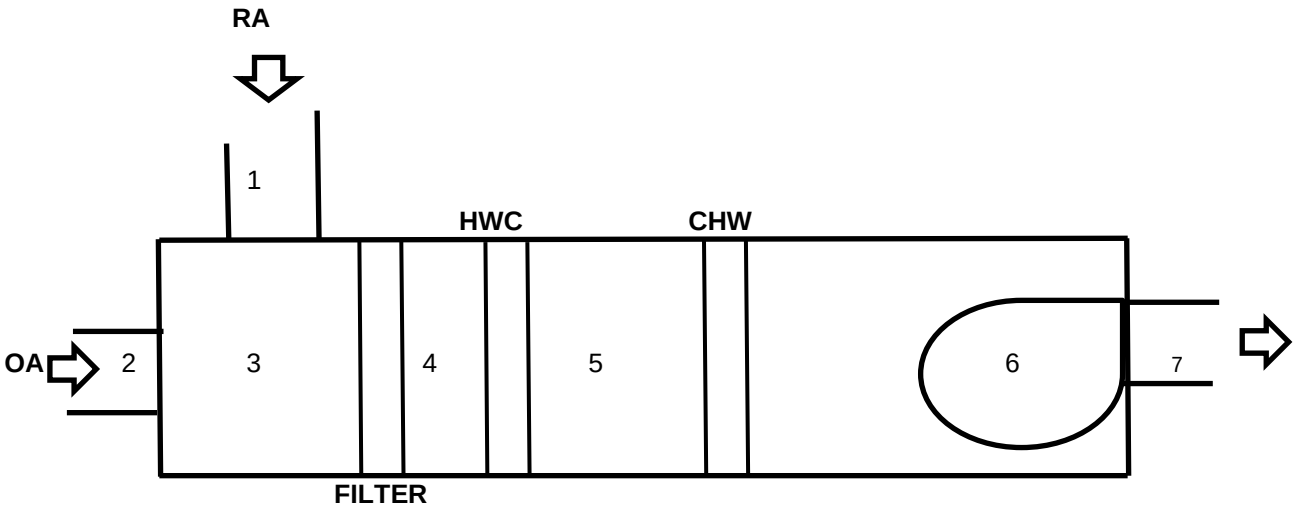
	FAN NO. AHU-6		FAN NO. F-21	
Serves / Location:	Admin Areas	Mech 2250	AHU-6 Return	Mech 2250
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN50C011F722XGS		QEI-36-1-150	
Size:	50		NL	
Serial Number:	4309U23195		11887858	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	*1	NL	BALDOR
Frame Number:	NL	*1	NL	254T
Horsepower:	40	*1	15	15
Brake Horsepower:	31.3	*1	7.1	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	52	38.9	17.7	11.2
Motor RPM:	*1	1699	1765	1800
Speeds:	VFD	56.6 Hz	VFD	60 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:	25000	20175		
Return Air CFM:	18000	13065	20000	15776
Exhaust Air CFM:				
Outside Air CFM:	7000	7110 *2		
Suction Pressure:	NL	-1.86	NL	-1.54
Discharge Pressure:	NL	3.99	NL	0.37
Fan Static Pressure:	5.5"	NA	NL	NA
External Pressure:	NL	5.85	1.5"	1.91
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	1119	NL	INLINE
Motor Drive:	NL	2B5V90	NL	5.7" OD
Motor Size/Bore:	NL	B2 1/8	NL	1 5/8
Fan Drive:	NL	2B5V136	NL	INLINE
Fan Size/Bore:	NL	B1 15/16	NL	INLINE
Belt Size / Number:	NL	5VX1320 x2	NL	BP98x3
Shafts C-C:	NL	48"	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 No motor nameplate tag.**

***2 AFMS not calibrating.**

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-6 STATIC PROFILE



LOCATION	STATIC
1	-.52"
2	-.48"
3	-.90"
4	-1.17"
5	-1.41"
6	-1.86"
7	+3.99"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-6 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 2250

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:	NA	InWg.	DESIGN CFM =	25000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	20175
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**20186**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.059
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	2068	2116	1999	2113	1464	2014	2274
B	1881	1883	1839	1558	1937	1984	2373
C	1680	1677	1457	865	1137	832	1956
D	1273	1484	1268	792	544	858	1217
E	1102	1355	966	1012	620	907	1190
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1614

J	2559	2568	2609				
K	2352	2435	2331				
L	1848	1730	1847				
M	1232	1608	1760				
N	1315	1417	1384				
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-6 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Return Intake

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:	NA	InWg.	DESIGN CFM =	18000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	13063
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**13070**

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

TEST HOLE	1	2	3	4	5	6	7
A	1041	1037	1090	416			
B	1374	1387	1281	535			
C	1316	1336	863	867			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 1045

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-6 TRAVERSE NUMBER : T1
OSA TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 60 " WIDTH x 36 " DEPTH Sq Ft = 15.00

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 7000
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 7110
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **7114**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .167
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	718	763	753	906	1014		
B	363	655	831	803	1010		
C	341	318	427	435	509		
D	131	325	-307	-233	541		
E							
F							
G							
H							
I							

NO. OF READINGS = 20 AVERAGE FPM = 474

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: F-21 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 2250

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:	NA	InWg.	DESIGN CFM =	20000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	2713
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**2714**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.081
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	521	467	508	615			
B	361	439	237	245			
C	-231	-174	-206	-179			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 217

J							
K							
L							
M							
N							
O							
P							
Q							
R							

AHU-6 Return + F-21 Exhaust = Total CFM
TECHNICIAN: David Burns 13063 + 2713 = 15776 CFM

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

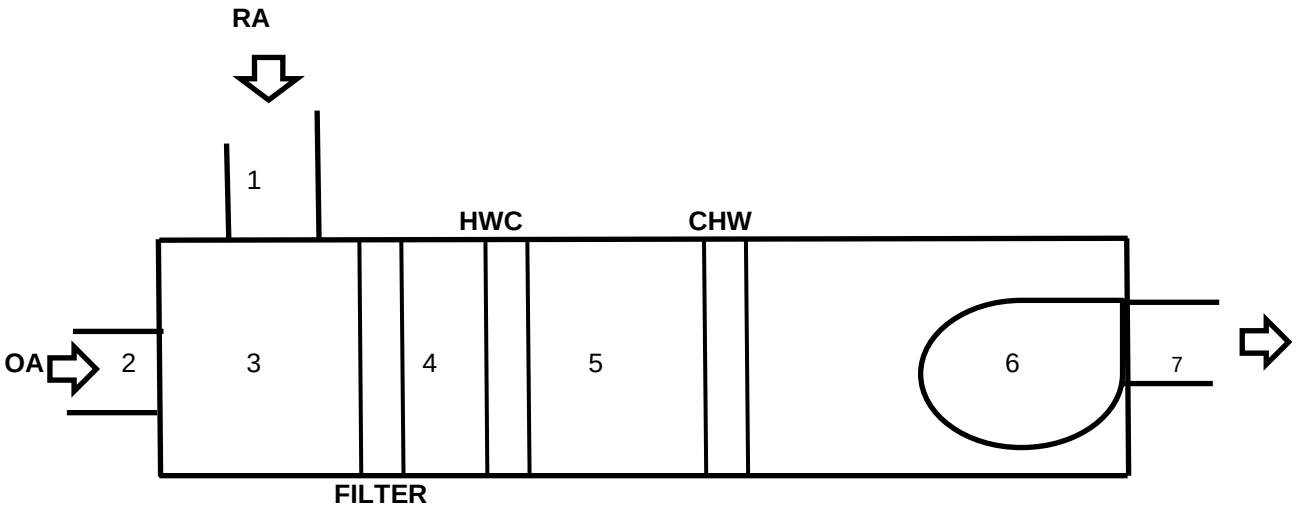
	FAN NO. AHU-7		FAN NO. F-22	
Serves / Location:	Admin Areas	Mech 2250	AHU-7 Return	Mech 2250
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN50C011F722XGS		QEI-36-1-150	
Size:	50		NL	
Serial Number:	4309U23194		11887859	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	*1	NL	BALDOR
Frame Number:	NL	*1	NL	254T
Horsepower:	40	*1	15	15
Brake Horsepower:	31.3	*1	7.1	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	52	36	17.7	10.9
Motor RPM:	*1	1662	1765	1798
Speeds:	VFD	55.4 Hz	VFD	60 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:	25000	17962		
Return Air CFM:	18000	10747	20000	19250
Exhaust Air CFM:				
Outside Air CFM:	7000	7215 *2		
Suction Pressure:	NL	-1.56	NL	-1.28
Discharge Pressure:	NL	4.32	NL	0.5
Fan Static Pressure:	5.5"	NA	NL	NA
External Pressure:	NL	5.88	1.5"	1.78
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	1119	NL	INLINE
Motor Drive:	NL	2B5V90	NL	5.7" OD
Motor Size/Bore:	NL	B2 1/8	NL	1 5/8
Fan Drive:	NL	2B5V136	NL	INLINE
Fan Size/Bore:	NL	B1 15/16	NL	INLINE
Belt Size / Number:	NL	5VX1320 x2	NL	BP98x3
Shafts C-C:	NL	48"	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 No motor nameplate tag.**

***2 AFMS not calibrating.**

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-7 STATIC PROFILE



LOCATION	STATIC
1	-.38"
2	-.41"
3	-..52"
4	-.79"
5	-1.06"
6	-1.56"
7	+4.32"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-7 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 2250

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:	3.19	InWg.	DESIGN CFM =	25000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	17962
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**18113**

AIR DENSITY RATIO CORRECTION = 1.01 AFMS = 1.112
SCFM CORRECTION FACTOR 1.01
ACTUAL DENSITY 0.076

TEST HOLE	1	2	3	4	5	6	7
A	1691	1788	1603	1669	1737	1479	1981
B	1819	1701	1683	1789	1546	1622	1838
C	933	1045	1447	1246	1304	1342	1690
D	1296	821	345	422	1179	1152	1439
E	796	482	381	156	679	808	1275
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1437

J	2003	1863	2100				
K	2170	2289	2354				
L	1909	1684	2066				
M	1543	1666	1769				
N	1281	1424	1524				
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-7 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Return Intake

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:	NA	InWg.	DESIGN CFM =	18000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	10750
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**10756**

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

TEST HOLE	1	2	3	4	5	6	7
A	1128	1218	1174	1053			
B	858	961	843	927			
C	474	502	511	668			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 860

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-7 TRAVERSE NUMBER : T1
OSA TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 60 " WIDTH x 36 " DEPTH Sq Ft = 15.00

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 7000
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 7215
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **7219**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .417
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	272	461	438	874	883		
B	655	384	518	936	855		
C	478	383	622	1001	672		
D	580	-107	-164	-90	-36		
E							
F							
G							
H							
I							

NO. OF READINGS = 20 AVERAGE FPM = 481

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: F-22 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 2250

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:	NA	InWg.	DESIGN CFM =	20000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	8500
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**8505**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.081
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	257	1274	1922	1578			
B	512	674	693	724			
C	184	115	109	116			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 680

J							
K							
L							
M							
N							
O							
P							
Q							
R							

AHU-7 Return + F-22 Exhaust = Total CFM
TECHNICIAN: David Burns 10750 + 8500 = 19250 CFM

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

	FAN NO. AHU-8		FAN NO. F-23	
Serves / Location:	Admin	Mech 2250	AHU-8 Return	Mech 2250
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN50C011F622XGS		QEI-36-1-150	
Size:	50		NL	
Serial Number:	4309U23191		11887860	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	*1	NL	BALDOR
Frame Number:	NL	*1	NL	254T
Horsepower:	40	*1	15	15
Brake Horsepower:	31.3	*1	7.1	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	52	36.7	17.7	11.4
Motor RPM:	*1	1722	1765	1800
Speeds:	VFD	57.4 Hz	VFD	60 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:	25000	19412		
Return Air CFM:	18000	12242	20000	17999
Exhaust Air CFM:				
Outside Air CFM:	7000	7170 *2		
Suction Pressure:	NL	-0.99	NL	-1.21
Discharge Pressure:	NL	4.94	NL	0.31
Fan Static Pressure:	5.5"	NA	NL	NA
External Pressure:	NL	5.88	1.5"	1.52
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	1162	NL	INLINE
Motor Drive:	NL	2B5V136	NL	5.7" OD
Motor Size/Bore:	NL	B2 1/8	NL	1 5/8
Fan Drive:	NL	2B5V136	NL	INLINE
Fan Size/Bore:	NL	B1 15/16	NL	INLINE
Belt Size / Number:	NL	5VX1320 x2	NL	BP98x3
Shafts C-C:	NL	48"	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 No motor nameplate tag.**

***2 AFMS not calibrating.**

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-8 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 2250

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:	2.8	InWg.	DESIGN CFM =	25000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	19412
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**19557**

AIR DENSITY RATIO CORRECTION = 1.01 AFMS = 1.013
SCFM CORRECTION FACTOR 1.01
ACTUAL DENSITY 0.076

TEST HOLE	1	2	3	4	5	6	7
A	3949	3573	4008	1569	0	4028	4015
B	2920	3521	3043	3335	3417	3336	3563
C	384	1590	1148	1712	1507	1212	1454
D	0	1036	0	584	646	747	0
E	0	0	0	0	0	482	414
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1553

J	4002	3980	3897				
K	3075	2016	2103				
L	897	0	0				
M	462	0	0				
N	0	0	0				
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-8 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Return Intake

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:	NA	InWg.	DESIGN CFM =	18000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	12238
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**12245**

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

TEST HOLE	1	2	3	4	5	6	7
A	1867	1952	1558	1483			
B	166	257	316	1492			
C	876	622	479	684			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 979

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-8 TRAVERSE NUMBER : T1
OSA TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 60 " WIDTH x 36 " DEPTH Sq Ft = 15.00

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 7000
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 7170
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **7174**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .175
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	687	713	864	923	778		
B	896	1034	314	328	626		
C	686	969	577	549	603		
D	-334	-236	-249	-194	26		
E							
F							
G							
H							
I							

NO. OF READINGS = 20 AVERAGE FPM = 478

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: F-23 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 2250

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:	NA	InWg.	DESIGN CFM =	20000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	5762
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**5765**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.259
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	892	953	959	1009			
B	584	638	696	723			
C	-211	-309	-174	-225			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 461

J							
K							
L							
M							
N							
O							
P							
Q							
R							

AHU-8 Return + F-23 Exhaust = Total CFM
TECHNICIAN: David Burns 12237 + 5762 = 17999 CFM

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

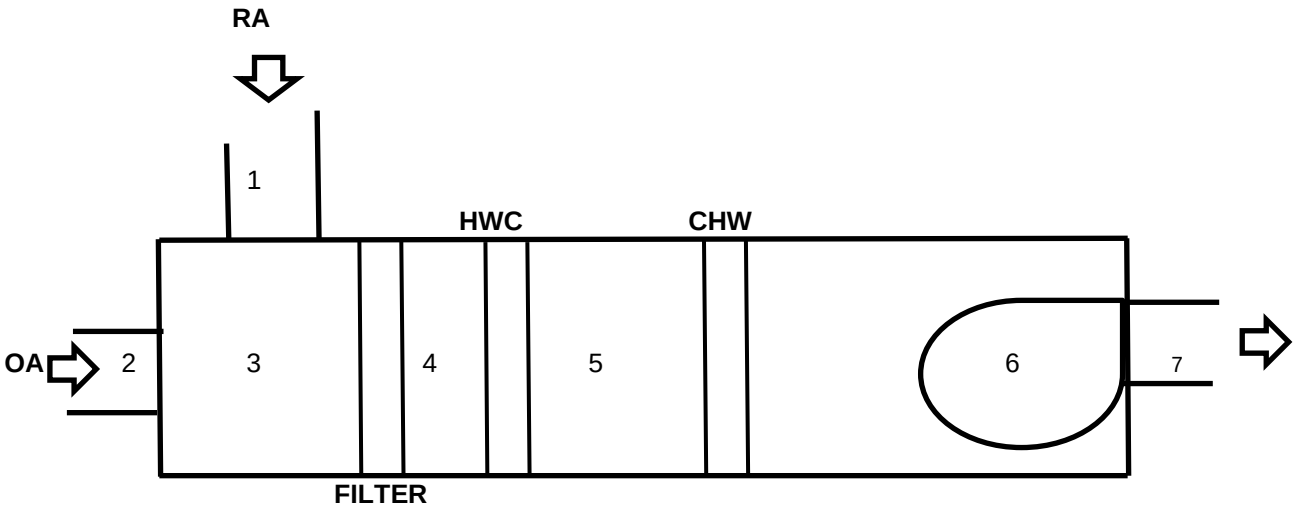
FAN DATA SHEET

	FAN NO. AHU-9		FAN NO. F-18	
Serves / Location:	Admin	Mech 4600	AHU-9 Return	Mech 4600
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN61C011F833XGS			
Size:	50		NL	
Serial Number:	4309U23198			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	326T	NL	256T
Horsepower:	50	50	20	20
Brake Horsepower:	34.8	NA	12	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	57.9	36.8	23.5	15.4
Motor RPM:	1760	1798	1765	1800
Speeds:	VFD	60 Hz	VFD	60 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:	29000	22225		
Return Air CFM:	22200	15433	26000	18919
Exhaust Air CFM:				
Outside Air CFM:	6800	6795		
Suction Pressure:	NL	-3.12	NL	-1.26
Discharge Pressure:	NL	2.67	NL	1.05
Fan Static Pressure:	5.2"	NA	NL	NA
External Pressure:	NL	5.79	1.5"	2.31
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	989	993	NL	INLINE
Motor Drive:	NL	2B5V90	NL	6" OD
Motor Size/Bore:	NL	B2 1/8	NL	1 5/8
Fan Drive:	NL	2B5V160	NL	INLINE
Fan Size/Bore:	NL	B2 3/16	NL	INLINE
Belt Size / Number:	NL	5VX1400x2	NL	BX106x3
Shafts C-C:	NL	50"	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 AFMS not reading airflow properly or tracking changes in flow.**

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-7 STATIC PROFILE



LOCATION	STATIC
1	-.38"
2	-.41"
3	-..52"
4	-.79"
5	-1.06"
6	-1.56"
7	+4.32"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-9 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Supply Duct

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:	2.67	InWg.	DESIGN CFM =	29000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	22225
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**22384**

AIR DENSITY RATIO CORRECTION = 1.01
SCFM CORRECTION FACTOR 1.01
ACTUAL DENSITY 0.076

TEST HOLE	1	2	3	4	5	6	7
A	1063	1642	1778	1825	1927	1919	2013
B	1094	1681	1794	1791	1852	1927	1979
C	916	1655	1815	1655	1901	1944	1984
D	884	1637	1823	1688	1871	1951	1986
E	787	1008	1476	1443	1823	1777	1871
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1778

J	2101	2263	2476				
K	1868	2186	2389				
L	1873	2138	2065				
M	2024	2124	1841				
N	2021	2135	1204				
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-9 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Return Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 48 " WIDTH x 44 " DEPTH Sq Ft = 14.67

AIR DENSITY DATA

STATIC PRESS @ CL:	NA	InWg.	DESIGN CFM =	22200
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	15433
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**15442**

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

TEST HOLE	1	2	3	4	5	6	7
A	996	1031	1074	1281	1245	1064	
B	884	1024	1111	1224	1256	981	
C	868	969	1115	1178	1253	859	
D	885	906	1038	1137	1197	667	
E							
F							
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 1052

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: AHU-9 TRAVERSE NUMBER : T1
OSA TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 108 " WIDTH x 30 " DEPTH Sq Ft = 22.50

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 6800
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 6795
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **6799**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = .071
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	296	317	302	307	314	333	
B	254	306	319	328	325	341	
C	202	287	300	345	292	367	
D	196	243	303	336	289	352	
E							
F							
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 302

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

VELGRID TRAVERSE DATA

SYSTEM: F-18 TRAVERSE NUMBER : T1
TRAVERSE LOCATION:

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 72 " WIDTH x 30 " DEPTH Sq Ft = 15.00

AIR DENSITY DATA

STATIC PRESS @ CL:	NA	InWg.	DESIGN CFM =	26000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	18919
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**18929**

AIR DENSITY RATIO CORRECTION = 1.00 AFMS = 1.259
SCFM CORRECTION FACTOR 1.00
ACTUAL DENSITY 0.075

TEST HOLE	1	2	3	4	5	6	7
A	1341	1671	1613	1673	1481	2202	1830
B	1777	1797	1737	1552	1361	2052	1661
C	1745	1867	1682	1589	1362	1937	1437
D	1705	1729	1716	1665	1593	2025	1539
E	1673	1631	1658	1688	1344	2203	1670
F							
G							
H							
I							

NO. OF READINGS = 50 AVERAGE FPM = 1261

J	540	1149	0				
K	80	520	0				
L	161	0	0				
M	178	0	0				
N	462	481	285				
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

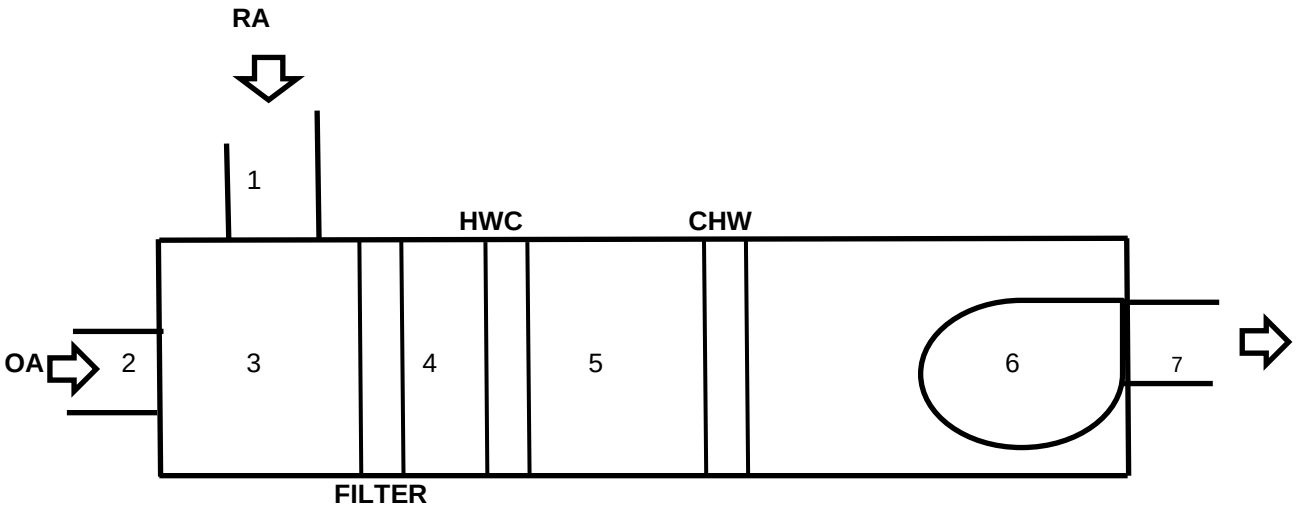
FAN DATA SHEET

	FAN NO. AHU-10		FAN NO. F-19	
Serves / Location:			AHU-10 Return	
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN1C011KF911XGS		QEI-18-1-30	
Size:	50		NL	
Serial Number:	4309023153		11887856	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	215T	NL	182T
Horsepower:	10	10	3	3
Brake Horsepower:	6	NA	1.6	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	12.2	7.9	4	2.6
Motor RPM:	1760	1800	1755	1556
Speeds:	VFD	60 Hz	VFD	51.9 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:	4600	4488		
Return Air CFM:	2950	2837	4200	4634
Exhaust Air CFM:				
Outside Air CFM:	1650	1651		
Suction Pressure:	NL	-1.63	NL	-0.78
Discharge Pressure:	NL	1.1	NL	0.05
Fan Static Pressure:	5.0"	NA	NL	NA
External Pressure:	NL	NA	1.5"	0.83
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	2455	2455	NL	INLINE
Motor Drive:	NL	BK90	NL	3.5" OD
Motor Size/Bore:	NL	1 3/8	NL	QTX 1 1/8
Fan Drive:	NL	BK65H	NL	INLINE
Fan Size/Bore:	NL	H1 3/16	NL	INLINE
Belt Size / Number:	NL	BX70x1	NL	A55x2
Shafts C-C:	NL	24.6	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments:

Project:	Plymouth Trial Court		
Address:	52 Obery St., Plymouth, MA		
Date:	10/30/2020	**Project No.**	20-547

AHU-10 STATIC PROFILE



LOCATION	STATIC
1	-.26"
2	-.33"
3	-..52"
4	-.88"
5	-1.12"
6	-1.63"
7	+1.10"

** Pressures measured wiith VAV Boxes at full cooling position.

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-10 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Supply Duct

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 24 " WIDTH x 16 " DEPTH Sq Ft = 2.67

AIR DENSITY DATA

STATIC PRESS @ CL:	1.1	InWg.	DESIGN CFM =	4600
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	4488
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4503**

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

TEST HOLE	1	2	3	4	5	6	7
A	1004	1134	1324	1728	2009	2068	
B	1067	1386	1560	1690	1894	2131	
C	1501	1483	1821	1839	2033	2168	
D	1167	1517	1800	2047	1827	2154	
E							
F							
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 1681

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-10 TRAVERSE NUMBER : T1
Return TRAVERSE LOCATION: Return Intake

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

AIR DENSITY DATA
STATIC PRESS @ CL: -0.3 InWg. DESIGN CFM = 2950
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 2846
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **2846**

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

TEST HOLE	1	2	3	4	5	6	7
A	618	1534	1495	1563	1572	1387	595
B	1513	1311	1393	1295	1438	1512	328
C	855	1003	832	612	444	626	788
D	259	142	233	0	130	203	309
E							
F							
G							
H							
I							

NO. OF READINGS = 36 AVERAGE FPM = 754

J	518	619					
K	541	480					
L	213	131					
M	373	278					
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-10 TRAVERSE NUMBER : T1
OSA TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 30 " WIDTH x 20 " DEPTH Sq Ft = 4.17
Damper @ 2.5V

AIR DENSITY DATA
STATIC PRESS @ CL: 0.06 InWg. DESIGN CFM = 1650
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 1651
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **1652**

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

TEST HOLE	1	2	3	4	5	6	7
A	1938	1239	1186	1449	1480	1416	1096
B	0	683	0	526	0	333	0
C	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0
E							
F							
G							
H							
I							

NO. OF READINGS = 32 AVERAGE FPM = 396

J	884						
K	431						
L	0						
M	0						
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-19 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: F-19 Intake

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

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.66	InWg.	DESIGN CFM =	4200
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	4634
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4629**

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

TEST HOLE	1	2	3	4	5	6	7
A	1781	1769	1781	1146	1637	1782	1760
B	831	1642	1804	950	1013	1216	1685
C	892	1508	1575	1158	869	1061	1433
D	915	1280	1612	1126	885	1171	1124
E							
F							
G							
H							
I							

NO. OF READINGS = 36 AVERAGE FPM = 1226

J	1308	972					
K	1135	749					
L	565	742					
M	674	599					
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

	FAN NO. AHU-11		FAN NO. F-27	
Serves / Location:	Law Library	Mech 6400	AHU-11 Return	Mech 6400
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39MN1CD11KFB22XGS		QEI-30-1-75	
Size:	NL		NL	
Serial Number:	4390U23200		11887861 0910	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	GE	NL	BALDOR
Frame Number:	NL	284T	NL	213T
Horsepower:	40	25	NL	7.5
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:	29.8	24.2	9.7	8.8
Motor RPM:	1775	1800	1770	1800
Speeds:	VFD	60 Hz	VFD	60 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:	15400	11450		
Return Air CFM:	11700		13600	*1
Exhaust Air CFM:				
Outside Air CFM:	3700	*2	1900	
Suction Pressure:				
Discharge Pressure:				
Fan Static Pressure:				
External Pressure:				
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	NA	NL	INLINE
Motor Drive:	NL	2TB80	NL	5" OD
Motor Size/Bore:	NL	Q1 1 7/8	NL	Q1 1 3/8 - 5/16
Fan Drive:	NL	2B5V124	NL	INLINE
Fan Size/Bore:	NL	B1 11/16	NL	INLINE
Belt Size / Number:	NL	B116x2	NL	*1
Shafts C-C:	NL	43"	NL	INLINE
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 Needs new belt.**

***2 AFMS not working properly. Shield inside unit is directing return air into the OSA monitoring station.**

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: AHU-11 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Mech 2904

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	34	" WIDTH x	34	" DEPTH	Sq Ft =	8.03

AIR DENSITY DATA

STATIC PRESS @ CL:	2.68	InWg.	DESIGN CFM =	15400
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	11450
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**11532**

AIR DENSITY RATIO CORRECTION = 1.01 AFMS = 1.097
SCFM CORRECTION FACTOR 1.01
ACTUAL DENSITY 0.076

TEST HOLE	1	2	3	4	5	6	7
A	2502	2530	2398	2029	1857	1480	1498
B	1856	1603	1374	1548	1332	1592	1388
C	1741	1348	1078	782	823	1143	1442
D	1890	1337	1137	875	690	1022	1357
E	1522	1265	1324	1065	920	1123	1142
F	1585	1316	1542	1137	1460	1305	1549
G							
H							
I							

NO. OF READINGS = 42 AVERAGE FPM = 1426

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

	FAN NO. F-24		FAN NO. F-25	
Serves / Location:	Toilet exh.	Roof	Toilet Exh.	Roof
Manufacturer:	GREENHECK		GREENHECK	
Model Number:	24-AFSW-21-10-1		22-AFSW-21-10-1	
Size:	NL		NL	
Serial Number:	11887138		11887137	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	DAYTON	NL	DAYTON
Frame Number:	NL	182/4T	NL	182/4T
Horsepower:	5	5	5	5
Brake Horsepower:	3.5	NA	1.9	NA
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	6.33	5.75	6.33	5.3
Motor RPM:	1760	1768	1760	1768
Speeds:	NL	1	NL	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:	7150	6070	5025	4894
Outside Air CFM:				
Suction Pressure:	NL	-0.71	NL	-1.07
Discharge Pressure:	NL	0.27	NL	0.52
Fan Static Pressure:	NL	NA	NL	NA
External Pressure:	2"	0.98	1.5"	1.59
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	NA	NL	NA
Motor Drive:	NL	4.5" OD	NL	4" od
Motor Size/Bore:	NL	SHx1 1/8	NL	QTx 1 1/8
Fan Drive:	NL	2AK74	NL	2AK84
Fan Size/Bore:	NL	QT 1 7/16	NL	Q1 7/16
Belt Size / Number:	NL	AP54x2	NL	A55x2
Shafts C-C:	NL	20"	NL	20.5"
Turns Open:	NL	FIXED	NL	FIXED

Comments:

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-24 TRAVERSE NUMBER : T1
TRAVERSE LOCATION:

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	30	" WIDTH x	24	" DEPTH	Sq Ft =	5.00

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.71	InWg.	DESIGN CFM =	7150
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	6070
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**6063**

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

TEST HOLE	1	2	3	4	5	6	7
A	1297	1455	1517	1548	1568	1567	1664
B	1165	981	1231	1177	1272	1559	1650
C	1246	677	683	851	1219	1512	1542
D	782	793	783	976	1416	1490	1602
E	973	987	925	1248	1501	1498	1356
F							
G							
H							
I							

NO. OF READINGS = 40 AVERAGE FPM = 1214

J	939						
K	1020						
L	1299						
M	890						
N	700						
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-25 TRAVERSE NUMBER : T1
TRAVERSE LOCATION:

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	24	" WIDTH x	24 " DEPTH	Sq Ft =	4.00

AIR DENSITY DATA

STATIC PRESS @ CL:	-1.07	InWg.	DESIGN CFM =	5025
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	4894
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4884**

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

TEST HOLE	1	2	3	4	5	6	7
A	546	1517	1816	1765	1395	1222	
B	0	1332	1726	1446	1090	1010	
C	0	1517	1777	1720	880	699	
D	0	1506	1793	1764	945	1266	
E	722	1597	1718	1571	1067	1298	
F							
G							
H							
I							

NO. OF READINGS = 30 AVERAGE FPM = 1224

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

FAN DATA SHEET

	FAN NO. F-26		FAN NO. F-28	
Serves / Location:	Toilet exh.	Roof	Toilet Exh.	Roof
Manufacturer:	GREENHECK		GREENHECK	
Model Number:	BSQ-160HP-7		BSC-80-4	
Size:	NL		NL	
Serial Number:	11887614		11887615	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	WEG	NL	MARATHON
Frame Number:	NL	B56	NL	48Y
Horsepower:	3/4	3/4	1/4	1/4
Brake Horsepower:	0.45	NA	0.15	NA
Safety Factor:	NL	1.35	NL	1.35
Volts/Phase:	460/3	460/3	115/1	115/1
Motor Amperage:	1.2	1.1	5	3.6
Motor RPM:	1740	1748	1725	1731
Speeds:	NL	1	NL	1
Heater Size:	NL	NA	NL	CB
Heater Amps.:	NL	NA	NL	CB
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	1475	1756	225	239
Outside Air CFM:				
Suction Pressure:	NL	-0.72	NL	-0.31
Discharge Pressure:	NL	0.14	NL	0.04
Fan Static Pressure:	NL	NA	NL	NA
External Pressure:	1"	0.86	1"	0.35
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	INLINE	NL	INLINE
Motor Drive:	NL	VP34	NL	VP34
Motor Size/Bore:	NL	5/8	NL	1/2
Fan Drive:	NL	INLINE	NL	INLINE
Fan Size/Bore:	NL	INLINE	NL	INLINE
Belt Size / Number:	NL	A48	NL	*1
Shafts C-C:	NL	INLINE	NL	INLINE
Turns Open:	NL	1	NL	4

Comments: ***1 Has unibelt, needs new belt.**

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-26 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 6100

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	22	" WIDTH x	10	" DEPTH	Sq Ft =	1.53

AIR DENSITY DATA

STATIC PRESS @ CL:	0.14	InWg.	DESIGN CFM =	1475
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	1756
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**1758**

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

TEST HOLE	1	2	3	4	5	6	7
A	962	1250	1332	1400	1398	1492	
B	988	985	979	983	1069	1353	
C	1170	955	895	940	1188	1349	
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 18 AVERAGE FPM = 1149

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-28 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 2904

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	12	" WIDTH x	6	" DEPTH	Sq Ft =	0.50

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.31	InWg.	DESIGN CFM =	225
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	239
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**239**

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

TEST HOLE	1	2	3	4	5	6	7
A	483	378	539				
B	421	515	534				
C							
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 6 AVERAGE FPM = 478

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project:	J. Michael Ruane Judicial Center		
Address:	58 Federal St., Salem, MA		
Date:	11/13/2020	**Project No.**	20-548

FAN DATA SHEET

	FAN NO.	**F-29**	**FAN NO.**	
Serves / Location:	Toilet exh.	Roof		
Manufacturer:	GREENHECK			
Model Number:	BSQ-130-7			
Size:	NL			
Serial Number:	11887616			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	WEG		
Frame Number:	NL	B56		
Horsepower:	1.5	3/4		
Brake Horsepower:	0.55	NA		
Safety Factor:	NL	1.25		
Volts/Phase:	460/3	460/3		
Motor Amperage:	1.2	1.2		
Motor RPM:	1740	1744		
Speeds:	NL	1		
Heater Size:	NL	NA		
Heater Amps.:	NL	NA		
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	2475	1740		
Outside Air CFM:				
Suction Pressure:	NL	-0.3		
Discharge Pressure:	NL	0.13		
Fan Static Pressure:	NL	NA		
External Pressure:	1.25"	0.43		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	INLINE		
Motor Drive:	NL	1VP34		
Motor Size/Bore:	NL	5/8		
Fan Drive:	NL	INLINE		
Fan Size/Bore:	NL	INLINE		
Belt Size / Number:	NL	A41-1		
Shafts C-C:	NL	INLINE		
Turns Open:	NL	3		

Comments:

Project: J. Michael Ruane Judicial Center
Address: 58 Federal St., Salem, MA
Date: 11/13/2020 **Project No.** 20-548

TRAVERSE DATA

SYSTEM: F-29 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech 4600

DUCT SIZE (ROUND) _____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 18 " WIDTH x 14 " DEPTH Sq Ft = 1.75

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.3	InWg.	DESIGN CFM =	2475
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	1740
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**1740**

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

TEST HOLE	1	2	3	4	5	6	7
A	1147	1153	858	1215	1081		
B	783	1443	1441	1548	1352		
C	562	681	1125	1173	770		
D	403	631	961	945	615		
E							
F							
G							
H							
I							

NO. OF READINGS = 20 AVERAGE FPM = 994

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns