BROCKTON TRIAL COURT
HVAC SYSTEM EVALUATION SUMMARY

Visited August 11, 2020. While on-site, inspected the air handling equipment located in the mechanical rooms and toured the facility to determine if the spaces generally matched usages noted on the architectural plans. The Brockton Trial Courthouse was constructed in 1999 and is approximately 175,000 square feet in size. The building is served by three York air handling units located in the mechanical penthouse. Each unit contains a supply fan, return fan, hot water heating coil, chilled water cooling coil, a steam humidifier, a 2” MERV 8 pre-filter, and a 12” MERV 14 final filter. The units also have exhaust dampers, which allow them to run in economizer mode. AHU-3 serves all of the courtrooms in the building. AHU-1 and AHU-2 supply into a common plenum, which serves the remainder of the building.

1.0 Airflow Rate per Person (Reduced Occupancy)

		Total Air		*Outdoor Air*	
Courtroom	*Total People (Reduced Occupancy)*	*Supply Airflow (CFM)*	*Airflow Rate (CFM/Person)*	*Outside Airflow (CFM)*	*Airflow Rate (CFM/Person)*
Jury Pool Break Room	17	1,400	82	465	27
Housing Courtroom 150	20	2,600	130	1,385	69
District Courtroom 320	14	2,000	143	1,070	76
District Courtroom 330	12	2,000	167	1,100	92
Juvenile Courtroom 4	17	2,000	118	1,100	65
Juvenile Courtroom 5	14	2,000	143	1,100	79
Probate & Family Courtroom 360	10	2,250	225	1,250	115
Probate & Family Courtroom 370	12	1,700	142	1,150	104
District Courtroom 420	16	2,250	141	1,800	113
District Courtroom 430	16	2,000	125	1,600	100
District Courtroom 440	15	2,000	133	1,600	107
District Courtroom 450	15	2,000	133	1,600	107
Probate & Family Courtroom 460	11	2,250	205	1,800	164
Probate & Family Courtroom 470	15	1,750	159	1,400	127

2.0 Recommendations

Section	Recommendation/Finding	Action
2.1	**Filtration Efficiency**	
	No actionable items identified	MERV-14 in use
2.2	**Testing and Balancing**	
RTB-1	Test and rebalance air handling unit supply air and minimum outside air flow rates	In-progress

Brockton Trial Court HVAC System Evaluation Continued		
RTB-3	Increase outside air flow rate beyond minimum under non-peak conditions	Complete
RTB-6	Test and balance hot water and chilled water control valves	Complete
2.3	**Equipment Maintenance and Upgrades**	
RE-1	Test existing air handling system dampers and actuators for proper operation	Complete
RE-2	Clean air handler coils	Complete
RE-7	Test the existing control valves and actuators for proper operation	Complete
2.4	**Control System**	
RC-1	Implement a pre and post-occupancy flush sequence	Complete
RC-3	Install controls required to introduce outside air beyond the minimum requirements in a stepped approach	Complete
RC-4	Confirm the economizer control sequence is operational	Complete
RC-5	Disable demand control ventilation sequences	Complete
RC-6	Monitor space relative humidity	Complete
2.5	**Additional Filtration and Air Cleaning**	
RFC-1	Install portable HEPA filters in high traffic areas – *if courthouse is to operate at a high occupancy (i.e. 50% or greater), install portable HEPA filters in high traffic areas.*	In-progress
2.6	**Humidity Control**	
	No actionable items listed – continuous monitoring for seasonal changes	On-going

Brockton Trial Court
Brockton, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

February 19, 2021

Tighe&Bond

100% Recyclable

Section 1
Existing Conditions & Site Observations

Tighe & Bond visited the Brockton Trial Courthouse on August 11, 2020. While on site we inspected the air handling equipment located in the mechanical rooms and toured the facility to determine if the spaces generally matched usages noted on the architectural plans.

Site Visit Attendees:

- *Office of Court Management:*
  - Ronald De Pesa, Manager of Court Facilities – Region 4
  - Courthouse Facilities Staff
- *Tighe & Bond*
  - Jason Urso, PE, Senior Mechanical Engineer
  - Timothy Bill, Staff Mechanical Engineer

1.1 Existing Ventilation System

The Brockton Trial Courthouse was constructed in 1999 and is approximately 175,000 square feet in size. The building is served by three York air handling units located in the mechanical penthouse. Each unit contains a supply fan, return fan, hot water heating coil, chilled water cooling coil, a steam humidifier, a 2" MERV 8 pre-filter, and a 12" MERV 14 final filter. The units also have exhaust dampers, which allow them to run in economizer mode. AHU-3 serves all of the courtrooms in the building. AHU-1 and AHU-2 supply into a common plenum, which serves the remainder of building.

The three air handling units are in good condition. The outside air, return air, and exhaust air dampers are in good or fair condition. Each damper is operated by two actuators. Some actuators appeared to be new and were in good condition and others were older and in fair condition. The visible areas of the heating and cooling coils appear to be fairly clean. At the time of our visit, we were unaware of whether the steam humidifiers are currently used or whether there are any operational issues with them. Upon further correspondence with the Office of Court Management, we understand the humidifiers were abandoned due to operational issues.

Each air handler is a variable air volume (VAV) unit, where VAV boxes regulate the airflow into zones throughout the building. There are fan powered and non-fan powered boxes throughout the building. According to the 1998 design plans, there are three toilet exhaust fans, EX-2, EX-5, and EX-7. EX-2 is located on the roof and is in good condition. EF-5 and EF-7 are located up high in the penthouse and also appear to be in good condition.

A central 475 ton, water cooled chiller located in the mechanical penthouse provides chilled water to all air handlers. A 10 million BTH/hr gas fired hot water boiler plant provides hot water to all air handling units, terminal units, and a 3 million BTU/hr gas fired steam boiler provides steam to the humidifiers in the air handlers.

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

TABLE 1
Existing Air Handling Units

Unit	Original Design Airflow (CFM)	Original Design Min. O.A. (CFM)	Pre/Final Filters	Condition
AHU-1	50,000	16,500	2" MERV 8/ MERV 14	Good
AHU-2	50,000	16,500	2" MERV 8/ MERV 14	Good
AHU-3	27,000	21,600	2" MERV 8/ MERV 14	Good

Photo 1 - Representative Air Handler

1.2 Existing Control System

The Brockton Trial Courthouse appears to have a full Automated Logic (ALC) building management system (BMS) that controls all HVAC equipment throughout the Courthouse. The control system monitors return air relative humidity (RH) levels and modulates the humidifiers to maintain a setpoint of 50% RH in the return air. The Courtrooms monitor carbon dioxide (CO_2) levels and the outdoor air flow rate is modulated for AHU-3, based on CO_2 levels. According to staff, the control system equipment was upgraded approximately four years ago.

Section 2 Recommendations

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

2.1 Filtration Efficiency Recommendations

We do not recommend any filtration upgrades to the air handling units. The units contain MERV 14 filters, which ASHRAE is recommending be installed during the COVID-19 pandemic.

2.2 Testing & Balancing Recommendations

Air Solutions & Balancing LLC performed air testing and balancing in 2015. It appears the air handlers, VAV boxes, and all air inlets and outlets throughout the Courthouse were tested. According to this report, both AHU-1 and AHU-2 are providing 15,785 CFM of outside air (a deficit of 715 CFM) and AHU-3 is providing 9,152 CFM of outside air (a deficit of 12,448 CFM).

It is unclear why AHU-3 was designed to accommodate 21,600 CFM of outside air. According to our calculations, 9,600 CFM of outside air is required for AHU-3. Two potential reasons why the 2015 TAB report is reporting 9,152 CFM of outside air include:

1. Control of AHU-3 includes a DCV sequence which will reduce the quantity of outside air based on the level of CO2 concentrations in the spaces it serves. A deficit of 12,448 CFM may reflect that the spaces were not fully occupied at the time of the airflow testing by the TAB Contractor, however a TAB Contractor typically balances the outside air to the full quantity stated on the design documents.

2. Assuming the Courthouse was fully occupied at the time of the testing and balancing, the outdoor air damper may have been positioned to allow the required outdoor air to maintain the proper CO2 levels within the spaces. If this is the case, this would suggest the specified 21,600 CFM of outside air is excessive to the code requirements and the code required airflow of 9,600 CFM that we calculated is more appropriate.

Table 2 describes the reported airflow rates from the TAB report for the toilet exhaust fans. Further analysis is required to evaluate and understand the cause for the significant difference in the design versus tested airflow rates for EX-5 and EX-7.

TABLE 2
Exhaust Fan Tested Airflow Rates

Unit	Original Design Airflow (CFM)	TAB Reported Airflow (CFM)
EX-2	5,900	6,152
EX-5	5,100	3,570
EX-7	7,700	10,994

We did not review the airflow reports for the VAV boxes and for the room air inlets and outlets. We presume the airflows are in general conformance with the original design documents and any significant issues or discrepancies between design and measured flor rates were corrected.

We recommend the following testing and balancing measures be implemented:

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

We recommend testing and balancing the outdoor air flow rate for AHU-1, AHU-2, and AHU-3 to the recommended minimum O.A. rates listed in Table 3.

TABLE 3
Recommended Air Handler O.A. Flow Rates

Unit	*Original Design Airflow (CFM)*	*Original Design Min. O.A. (CFM)*	*Current Code Min. O.A. Requirements (CFM)*	**Recommended Minimum O.A. (CFM)**
AHU-1	50,000	16,500	10,600	16,500
AHU-2	50,000	16,500	8,200	16,500
AHU-3	27,000	21,600	10,600	21,600

The 2015 TAB report indicated that AHU-1 and AHU-2 were providing the identical outdoor air flow rate of 15,785 CFM. The likelihood of both units providing identical flowrates is suspect. We would expect the flow rate to vary to some degree between two different air handling units. For this reason, we believe it would be beneficial to double check the outdoor air flow rates for these two units.

According to the 2015 TAB report, AHU-3 was providing approximately 450 CFM below the current code minimum outdoor air flow rate and is providing a deficit of over 12,000 CFM less than the original design airflow rate. We are unaware why this unit was designed to provide 21,600 CFM of outdoor air, but it appears to be excessive and would expend more energy to run at this outdoor air flow rate. Further analysis of the building and this unit is required to attempt to understand the reasoning for the excessive quantity of outdoor air. For the time being, we recommend this unit be tested and balanced to the original design outdoor airflow rate of 21,600 CFM, and to disable the demand control ventilation (DCV) sequences

The average airflow rate per person is shown below in Table 4. These values are based on the original design supply airflow rate and the recommended outdoor airflow rates as shown in Table 3 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 4
Average Airflow Rate per Person

	All spaces	***Courtrooms***	***Non-Courtroom Spaces***
Total Occupancy (People)	1,691	905	786
Total Supply Air (CFM/Person)	75	30	127
Outdoor Air (CFM/Person)	32	24	42

The airflow rate per person for each courtroom is shown below in Table 5. These values are based on the original design supply airflow rate and the code required outdoor airflow rate, without taking diversity into account.

TABLE 5
Airflow Rate per Person – (Full Occupancy)

		Total Air		***Outdoor Air***	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outside Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Jury Pool Room	49	1,400	29	465	9
Housing Courtroom 150	118	2,600	22	2,080	18
District Courtroom 320	91	2,000	22	1,600	18
District Courtroom 330	95	2,000	21	1,600	17
Juvenile Courtroom 4	93	2,000	22	1,600	17
Juvenile Courtroom 5	93	2,000	22	1,600	17
Probate & Family Courtroom 360	105	2,250	21	1,800	17
Probate & Family Courtroom 370	98	1,700	17	1,360	14
District Courtroom 420	118	2,250	19	1,800	15
District Courtroom 430	93	2,000	22	1,600	17
District Courtroom 440	93	2,000	22	1,600	17
District Courtroom 450	91	2,000	22	1,600	18
Probate & Family Courtroom 460	109	2,250	21	1,800	17
Probate & Family Courtroom 470	96	1,750	18	1,400	15

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

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

TABLE 5a
Airflow Rate per Person (Reduced Occupancy)

		Total Air		***Outdoor Air***	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outside Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Jury Pool Room	17	1,400	82	465	27
Housing Courtroom 150	20	2,600	130	1,385	69
District Courtroom 320	14	2,000	143	1,070	76
District Courtroom 330	12	2,000	167	1,100	92
Juvenile Courtroom 4	17	2,000	118	1,100	65
Juvenile Courtroom 5	14	2,000	143	1,100	79
Probate & Family Courtroom 360	10	2,250	225	1,250	115
Probate & Family Courtroom 370	12	1,700	142	1,150	104
District Courtroom 420	16	2,250	141	1,800	113
District Courtroom 430	16	2,000	125	1,600	100
District Courtroom 440	15	2,000	133	1,600	107
District Courtroom 450	15	2,000	133	1,600	107
Probate & Family Courtroom 460	11	2,250	205	1,800	164
Probate & Family Courtroom 470	15	1,750	159	1,400	127

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

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

The air handlers were designed to provide more outdoor air that the currently adopted code requires. Regardless, we recommend increasing the outdoor air flow rate beyond the recommended outdoor air flow rates under non-peak conditions. We do not believe this would cause a threat of a potential coil to freeze based on the total percentage of outside air vs. the total amount of outside air, however cold spots on the coil may develop due to poor mixing.

Refer to the Control System upgrades section for the required controls to implement this strategy.

Unless there are unresolved airflow issues from the 2015 balancing exercise, we do not recommend testing and balancing VAV boxes, and air inlets and outlets throughout the Courthouse.

RTB-6: *Test and balance hot water and chilled water control valves.*

We recommend testing and balancing the hot and chilled water control valves serving the air handling units to ensure the coils are getting adequate flow in order to maintain the proper discharge air temperature setpoints. The valves were not tested during the 2015 TAB exercise.

2.3 Equipment Maintenance & Upgrades

We recommend the following equipment maintenance and upgrades:

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

Some dampers and actuators were in good condition, while others were in fair condition. We recommend testing the dampers and actuators to ensure they are functioning properly. Replace dampers and actuators that are not functioning.

RE-2: *Clean air handler coils.*

While the visible portions of the coils appeared to be mostly clean, we were not able to inspect both sides of the coils.

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

The 2015 testing and balancing report does not include any data for the hot and chilled water control valves serving the air handlers. We recommend testing these valves and actuators to ensure they are working properly.

We do not recommend inspecting VAV boxes and controllers. The VAV boxes were tested in 2015. The TAB Contractor identified controllers that were not functioning and they appear to have been fixed by ALC.

2.4 Control System

We recommend the following for the control system:

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

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

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

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

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

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

RC-6: *Monitor space relative humidity.*

Trend return air humidity levels via the existing BMS. Utilize the existing air handler humidifiers if they are working properly and are not causing any indoor air quality, condensation, or mold growth issues.

2.5 Additional Filtration and Air Cleaning

We recommend the installation of the following air cleaning devices:

RFC-1: *Install portable HEPA filters.*

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

2.6 Humidity Control

Due to operational issues with the existing air handler humidifiers identified by the Office of Court Management, we do not recommend using these devices. Further investigation is required to determine the extent of these issues and if they can be corrected.

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

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

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

2.7 Other Recommendations

We do not have any other recommendations at this time.

Section 3
Testing & Balancing Results

Milharmer Associates, Inc. visited the Brockton Trial Courthouse on December 7, 2020 through December 9, 2020 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 6 and 7. The full testing and balancing report is attached.

TABLE 6
Air Handler Testing & Balancing Results

	Design			Actual		
Unit	**Total Supply Fan Airflow (CFM)**	**Recommended Outdoor Airflow (CFM)**	**Return Fan Airflow (CFM)**	**Supply Fan Airflow (CFM)**	**Outdoor Airflow (CFM)**	**Return Fan Airflow (CFM)**
AHU-1	50,000	16,500	33,500	50,375	16,789	33,586
AHU-2	50,000	16,500	33,500	43,661	13,011	30,650
AHU-3	27,000	21,000	6,000	23,996	19,197	4,799

TABLE 7
Exhaust Fan Testing & Balancing Results

Unit	Serving	Design Return/Exhaust Airflow (CFM)	Actual Return/Exhaust Airflow (CFM)
EX-2	Toilet	5,900	7,556
EX-5	Toilet	5,100	3,845
EX-7	Toilet	7,700	10,300

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

1. AHU-1 is performing within an acceptable range and has enough capacity to increase filters to MERV 13.
2. AHU-2 is underperforming compared to the original design airflows. The VFD's are at maximum load while the unit is operating at 87 percent capacity. The low airflow is due to the return, outside air and exhaust air dampers restricting airflow. The actuators need to be fixed or replaced.
3. AHU-3 supply fan is underperforming compared to the original design airflows. The TAB report suggests the motor is running below nameplate amps and can accommodate a MERV 13 filter. We recommend balancing the supply air to the

originally designed airflow rate of 27,000 and then determine if there is adequate capacity to increase the filter efficiency.
4. Exhaust fan EX-2 and EX-7 are operating approximately 30 percent over design airflow.
5. Exhaust fan EX-5 is operating approximately 25 percent under design airflow.

Disclaimer

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

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

TEST AND BALANCE REPORT

Project: **Brockton District Court**
215 Main St., Brockton, MA

Project No.: **20-552** **Project Date:** **12/9/2020**

MECHANICAL CONTRACTOR

Tighe & Bond

3384

A N.E.B.B. Certified Company

Project:	Brockton District Court		
Address:	215 Main St., Brockton, MA		
Date:	12/9/2020	**Project No.**	20-552

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:_______________________________________

NEBB

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:	Brockton District Court		
Address:	215 Main St., Brockton, MA		
Date:	12/9/2020	**Project No.**	20-552

TABLE OF CONTENTS

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

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

SYMBOL SHEET CONTINUED

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

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

REPORT SUMMARY

AIR HANDLING UNITS

UNIT	SUPPLY	RETURN	OUTSIDE AIR
AHU-1	50,375 CFM	33,586 CFM	16,789 CFM
AHU-2	43,661 CFM	30,650 CFM*	13,011 CFM*
AHU-3	23,996 CFM	4,799 CFM	19,197 CFM

* See comments for AHU-2

FANS

UNIT	EXHAUST
EX-2	7,556 CFM
EX-5	3,845 CFM
EX-7	10,300 CFM

Project:	Brockton District Court		
Address:	215 Main St., Brockton, MA		
Date:	12/9/2020	**Project No.**	20-552

REPORT SUMMARY

The following is the report for the Brockton District Court. A survey was performed on AHU-1 thru AHU-3 and the toilet exhaust fans.

1. AHU-1 and AHU-2 operate in tandem and share common ductwork. Neither unit is equipped with isolation dampers and if one unit needs to be shut down for service, the fans continue to rotate as a result of air blowing from the running unit.

2. AHU-1 was tested with all VAV boxes set to the full cooling position. The unit was tested at design airflow and is running below nameplate amps leaving plenty of room to increase the filter efficiency to MERV 13/14. The unit is not equipped with airflow stations.

3. AHU-2 was tested with all VAV boxes set to the full cooling position. The unit was tested at 87% of design airflow with the VFD at 60Hz. The low airflow is due to the return, outside air and exhaust air dampers not working properly and subsequently restricting the airflow. The actuators for these dampers need to be repaired or replaced. The unit does not have airflow measuring stations.

4. AHU-3 was tested with all VAV boxes set to the full cooling position. The unit was tested at design airflow and is running below nameplate amps leaving plenty of room to increase the filter efficiency to MERV 13/14. The unit is not equipped with airflow stations.

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

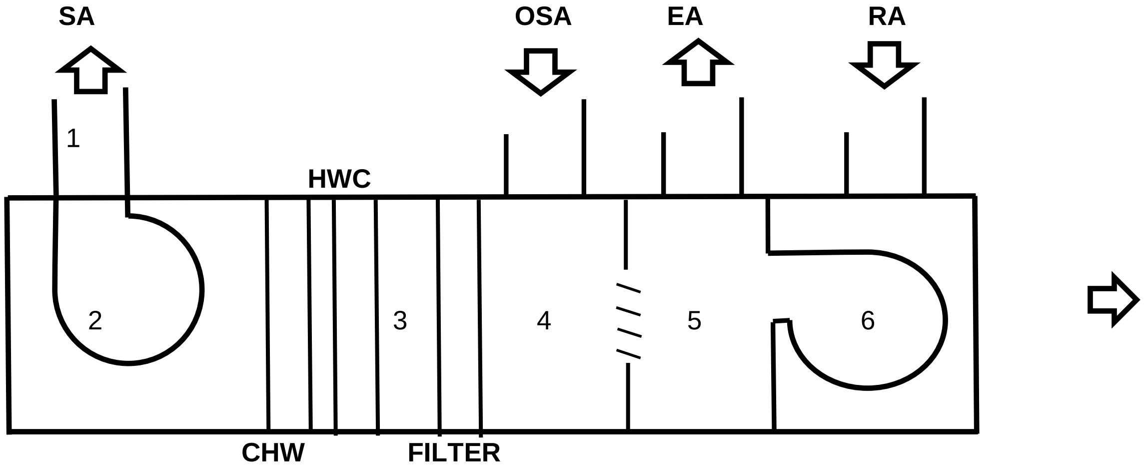
FAN DATA SHEET

	FAN NO. AHU-1		FAN NO. RF-1	
Serves / Location:	VAV Supply	Penthouse	Return / Exhaust	
Manufacturer:	YORK			
Model Number:				
Size:				
Serial Number:	CDGM 00206B			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	MAGNETEK	NL	MAGNETEK
Frame Number:	NL	365T	NL	S326T
Horsepower:	75	75	50	50
Brake Horsepower:	NL	36.11	NL	27.5
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	85.9	35.6	60	27.1
Motor RPM:	1775	1777	1780	1782
Speeds:	VD	60HZ	VFD	60HZ
Heater Size:	NL	VFD Protected	NL	VFD Protected
Heater Amps.:	NL	VFD Protected	NL	VFD Protected
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:	50000	50375 *2		
Return Air CFM:	33500	33586	50000	34537
Exhaust Air CFM:			16500	951
Outside Air CFM:	16500	16789 *2		
Suction Pressure:	NL	*1	NL	*1
Discharge Pressure:	NL	*1	NL	*1
Fan Static Pressure:	NL	*1	NL	*1
External Pressure:	NL	*1	NL	*1
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1260	1260	1263	1263
Motor Drive:	NL	5V8.0 x 3-SF	NL	11.0 x 2B-SK
Motor Size/Bore:	NL	SF x 2 3/8	NL	SK x 2 1/8
Fan Drive:	NL	5V12.5 x 3-E	NL	15.4 x 2B-SF
Fan Size/Bore:	NL	E x 3 3/16	NL	DF x 2 15/16
Belt Size / Number:	NL	5VX1120 x 5	NL	BX116 x 2
Shafts C-C:	NL	40"	NL	59"
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 See unit profile**
***2 Traverse total**

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

AHU-1 STATIC PROFILE



LOCATION	STATIC
1	+1.95"
2	-1.99"
3	-1.12"
4	-0.53"
5	-0.10"
6	-1.69"

** Pressures measured wiith VAV Boxes at full cooling position and fans at 60 Hz.

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T-1
Supply TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) ______ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 3x 38 " WIDTH x 42 " DEPTH Sq Ft = 33.25

AIR DENSITY DATA

STATIC PRESS @ CL:	NA	InWg.	DESIGN CFM =	50000
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	50375
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**50403**

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	746	1575	873	636	2477	2281	
B	806	1577	1971	510	2426	2196	
C	793	1493	1984	553	2408	2055	
D	817	1584	1528	488	2416	2001	
E	855	1570	1815	309	2434	2274	
F							
G							
H							
I							

NO. OF READINGS = 30 AVERAGE FPM = 1515

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T-1
Return TRAVERSE LOCATION: Return Damper

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 3x 38 " WIDTH x 42 " DEPTH Sq Ft = 33.25

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 33500
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 33473
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **33492**

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	1035	1031	963	934	1088	1131	
B	1005	1024	972	951	1073	1125	
C	1017	1022	975	937	1084	1029	
D	1031	1043	955	985	1033	978	
E	994	977	966	973	1047	823	
F							
G							
H							
I							

NO. OF READINGS = 30 AVERAGE FPM = 1007

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: AHU-1 TRAVERSE NUMBER : T-1
Outside Air TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 3x 38 " WIDTH x 42 " DEPTH Sq Ft = 33.25

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 16500
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 16789
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **16799**

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	537	391	333	539	583	516	
B	583	568	463	526	453	484	
C	586	527	478	562	609	400	
D	577	498	474	555	622	363	
E	581	511	469	558	594	208	
F							
G							
H							
I							

NO. OF READINGS = 30 AVERAGE FPM = 505

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: AHU-1 / RF-1 TRAVERSE NUMBER : T-1
Fan Total TRAVERSE LOCATION: Exhaust Discharge

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 3x 38 " WIDTH x 42 " DEPTH Sq Ft = 33.25

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 50000
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 34537
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **34556**

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	1260	1614	490	714	180	2183	
B	1238	1513	442	769	-534	1959	
C	1259	1135	672	643	-303	2013	
D	1157	942	490	1555	727	2157	
E	926	459	501	1044	1928	2028	
F							
G							
H							
I							

NO. OF READINGS = 30 AVERAGE FPM = 1039

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

FAN DATA SHEET

	FAN NO. AHU-2		FAN NO. RF-2	
Serves / Location:	VAV Supply	Penthouse	Return / Exhaust	
Manufacturer:	YORK			
Model Number:				
Size:				
Serial Number:	CDGM 00208B			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	MAGNETEK	NL	MAGNETEK
Frame Number:	NL	365T	NL	S326T
Horsepower:	75	75	NL	50
Brake Horsepower:	NL	38.4	NL	26.5
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	85.9	37.8	60	26.1
Motor RPM:	1775	1778	1780	1785
Speeds:	VD	60HZ	VFD	60HZ
Heater Size:	NL	VFD Protected	NL	VFD Protected
Heater Amps.:	NL	VFD Protected	NL	VFD Protected
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:	50000	43661 *2		
Return Air CFM:	33500	*3	50000	42105 *2
Exhaust Air CFM:			16500	
Outside Air CFM:	16500	*3		
Suction Pressure:	NL	*1	NL	*1
Discharge Pressure:	NL	*1	NL	*1
Fan Static Pressure:	NL	*1	NL	*1
External Pressure:	NL	*1	NL	*1
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1260	1260	1263	1263
Motor Drive:	NL	5V8.0 x 3-SF	NL	11.0 x 2B-SK
Motor Size/Bore:	NL	SF x 2 3/8	NL	SK x 2 1/8
Fan Drive:	NL	5V12.5 x 3-E	NL	15.4 x 2B-SF
Fan Size/Bore:	NL	E x 3 3/16	NL	DF x 2 15/16
Belt Size / Number:	NL	5VX1120 x 5	NL	BX116 x 2
Shafts C-C:	NL	40"	NL	59"
Turns Open:	NL	FIXED	NL	FIXED

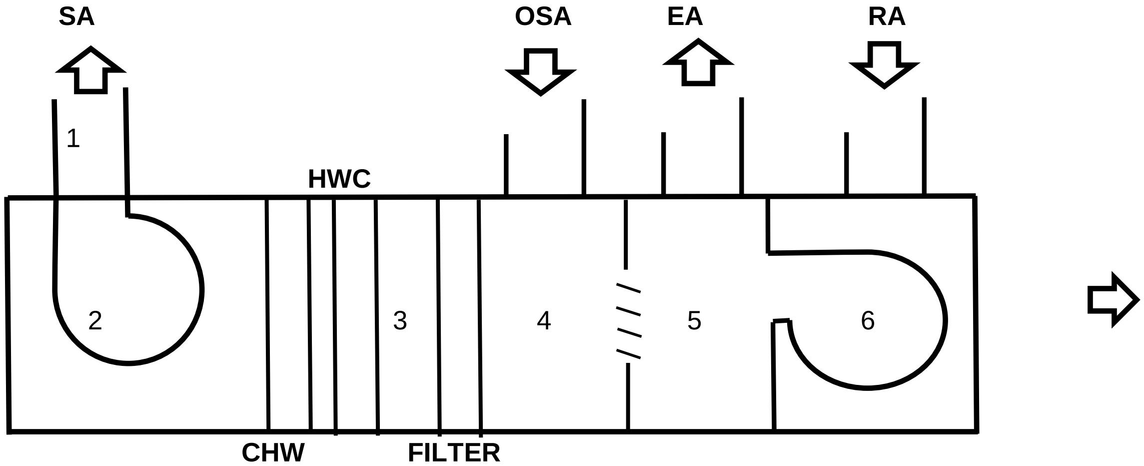
Comments: ***1 See unit profile**

***2 Traverse total**

***3 Damper actuators require repair.**

Project:	Brockton District Court		
Address:	215 Main St., Brockton, MA		
Date:	12/9/2020	**Project No.**	20-552

AHU-2 STATIC PROFILE



LOCATION	STATIC
1	+1.25"
2	-4.47"
3	-3.71"
4	-3.015"
5	+4.71"
6	-0.91"

** Pressures measured wiith VAV Boxes at full cooling position and fans at 60 Hz.

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T-1
Supply TRAVERSE LOCATION: Unit Coil

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 3x 38 " WIDTH x 42 " DEPTH Sq Ft = 33.25

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 50000
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 33752
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **33771**

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	1007	1106	658	1085	1091	989	
B	1009	1053	663	1063	1033	1114	
C	1020	1031	1019	1040	1041	1123	
D	1025	1021	894	1061	884	1071	
E	1023	1018	877	1174	1197	1063	
F							
G							
H							
I							

NO. OF READINGS = 30 AVERAGE FPM = 1015

J							
K							
L							
M							
N							
O							
P							
Q							
R							

33752 + Leakage across Return damper = Total cfm
TECHNICIAN: David Burns Total cfm = 43,661 cfm

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: AHU-2 / RF-2
TRAVERSE NUMBER : T-1
TRAVERSE LOCATION: Return Intake

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 3x 38 " WIDTH x 42 " DEPTH Sq Ft = 33.25

AIR DENSITY DATA

STATIC PRESS @ CL:	NA InWg.	DESIGN CFM =	50000
DUCT AIR TEMP :	70 Deg F	ACTUAL CFM =	32197
BAROMETRIC PRESS :	29.92 In Hg.	SCFM=	**32215**

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	1035	1394	1178	2146	461	1957	
B	603	768	911	1631	621	828	
C	278	983	629	1028	1047	300	
D	-247	753	985	646	1546	202	
E	1339	1520	1604	562	1623	719	
F							
G							
H							
I							

NO. OF READINGS = 30 AVERAGE FPM = 968

J							
K							
L							
M							
N							
O							
P							
Q							
R							

32197 + Leakage across Return damper = total cfm
TECHNICIAN: David Burns
Total cfm = 42105

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: AHU-2 / RF-2 TRAVERSE NUMBER : T-1
Leakage from return damper TRAVERSE LOCATION: Return Intake

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 3x 38 " WIDTH x 42 " DEPTH Sq Ft = 33.25

AIR DENSITY DATA

STATIC PRESS @ CL: NA InWg. DESIGN CFM = 50000
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 9909
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **9914**

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	292	289	287	322	306	266	
B	297	295	298	317	325	271	
C	300	276	301	333	320	252	
D	316	334	307	323	304	258	
E	274	316	280	327	284	270	
F							
G							
H							
I							

NO. OF READINGS = 30 AVERAGE FPM = 298

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T-1
Return TRAVERSE LOCATION: Return Damper

DUCT SIZE (ROUND) ______ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 3x 38 " WIDTH x 42 " DEPTH Sq Ft = 33.25

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 33500
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = #DIV/0!
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **#DIV/0!**

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							
B							
C							
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 0 AVERAGE FPM = #DIV/0!

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: AHU-2 TRAVERSE NUMBER : T-1
Outside Air TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 3x 38 " WIDTH x 42 " DEPTH Sq Ft = 33.25

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 16500
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = #DIV/0!
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **#DIV/0!**

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							
B							
C							
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 0 AVERAGE FPM = #DIV/0!

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

FAN DATA SHEET

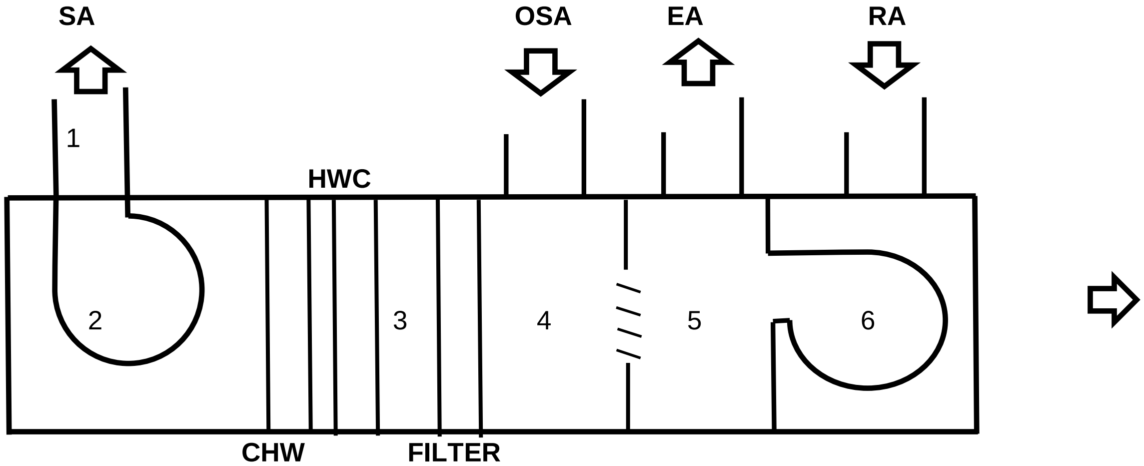
	FAN NO. AHU-3		FAN NO. RF-3	
Serves / Location:	VAV Supply	Penthouse	Return / Exhaust	
Manufacturer:	YORK			
Model Number:				
Size:				
Serial Number:	CDGM 00207B			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	MAGNETEK	NL	MAGNETEK
Frame Number:	NL	S324T	NL	S286T
Horsepower:	40	40	30	30
Brake Horsepower:	NL	34.0	NL	18.9
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	48	33.6	37.5	18.6
Motor RPM:	1780	1786	1780	1784
Speeds:	VD	60HZ	VFD	60HZ
Heater Size:	NL	VFD Protected	NL	VFD Protected
Heater Amps.:	NL	VFD Protected	NL	VFD Protected
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:	27000	23996		
Return Air CFM:	5400	4799 *2	27000	21714 *2
Exhaust Air CFM:			21600	2517
Outside Air CFM:	21600	19197 *2		
Suction Pressure:	NL	*1	NL	*1
Discharge Pressure:	NL	*1	NL	*1
Fan Static Pressure:	NL	*1	NL	*1
External Pressure:	NL	*1	NL	*1
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	1439	1440	1143	1140
Motor Drive:	NL	7.0 x 3B-SK	NL	6.0 x 2B-SDS
Motor Size/Bore:	NL	SK x 2 3/8	NL	SDS x 1 7/8
Fan Drive:	NL	8.6 x 3LB-SF	NL	8.4 x 2B-SK
Fan Size/Bore:	NL	SF x 2 11/16	NL	SK 2 7/16
Belt Size / Number:	NL	BX82 x 3	NL	BX85 x 2
Shafts C-C:	NL	29.7	NL	56"
Turns Open:	NL	FIXED	NL	FIXED

Comments: ***1 See unit profile**

***2 Traverse total**

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

AHU-2 STATIC PROFILE



LOCATION	STATIC
1	+1.75"
2	-3.51"
3	-2.73"
4	-1.99"
5	-0.19"
6	-1.24"

** Pressures measured wiith VAV Boxes at full cooling position and fans at 60 Hz.

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: AHU-3 TRAVERSE NUMBER : T-1
Supply TRAVERSE LOCATION: Unit Coil

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 126 " WIDTH x 72 " DEPTH Sq Ft = 63.00

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 27000
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 24679
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **24692**

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	359	394	337	411	422	395	422
B	354	368	348	424	447	397	418
C	348	379	359	417	433	387	476
D	353	374	352	396	429	396	481
E	349	262	365	399	466	399	473
F	325	252	364	414	396	391	453
G							
H							
I							

NO. OF READINGS = 54 AVERAGE FPM = 392

J	454	387					
K	427	374					
L	381	393					
M	393	376					
N	396	385					
O	410	393					
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: AHU-3 TRAVERSE NUMBER : T-1
Return TRAVERSE LOCATION: Unit Return

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 3x 32 " WIDTH x 32 " DEPTH Sq Ft = 21.33

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 5400
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 4802
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **4805**

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	175	310	178				
B	258	315	184				
C	107	308	213				
D	104	288	227				
E	109	274	204				
F	147	265	213				
G	155	281	289				
H	171	243	293				
I	221	251	295				

NO. OF READINGS = 27 AVERAGE FPM = 225

J							
K							
L							
M							
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O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: AHU-3 TRAVERSE NUMBER : T-1
Outside Air TRAVERSE LOCATION: OSA Intake

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 3x 32 " WIDTH x 32 " DEPTH Sq Ft = 21.33

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 21600
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 19205
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **19216**

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	517	543	566				
B	1254	1227	1121				
C	1313	1261	1257				
D	1115	1119	1210				
E	1233	1271	1202				
F	984	878	795				
G	839	854	807				
H	747	652	667				
I	329	316	229				

NO. OF READINGS = 27 AVERAGE FPM = 900

J							
K							
L							
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O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: RF-3 TRAVERSE NUMBER : T-1
Fan Total TRAVERSE LOCATION: Exhaust Discharge

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 3x 32 " WIDTH x 32 " DEPTH Sq Ft = 21.33

AIR DENSITY DATA
STATIC PRESS @ CL: NA InWg. DESIGN CFM = 27000
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 21728
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **21740**

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	392	1369	1114				
B	837	1979	729				
C	677	1990	781				
D	962	2026	713				
E	921	1869	449				
F	631	1302	573				
G	712	868	464				
H	857	1805	647				
I							

NO. OF READINGS = 27 AVERAGE FPM = 1018

J	889	2134	-191				
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

FAN DATA SHEET

	FAN NO.	EX-2	FAN NO.	EX-5
Serves / Location:	Toilet Exhaust	Roof	Toilet Exhaust	Penthouse
Manufacturer:	COOK		COOK	
Model Number:	27CVH1CB		225 CIC	
Size:	NL		NL	
Serial Number:	NL		NL	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	CENTURY	NL	MAGNETEK
Frame Number:	NL	182T	NL	S184T
Horsepower:	3	3	5	5
Brake Horsepower:	NL	2.9	NL	4
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	460/3	460/3	460/3	460/3
Motor Amperage:	4	4	7	4.1
Motor RPM:	1770	1770	1745	1752
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:	5900	7556	5100	3845
Outside Air CFM:				
Suction Pressure:	NL	-1	NL	-0.61
Discharge Pressure:	NL	0.08	NL	0.1
Fan Static Pressure:	NL	NA	NL	NA
External Pressure:	NL	1.08	NL	0.71
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	NA	1143	INLINE
Motor Drive:	NL	8550	NL	4.75" OD
Motor Size/Bore:	NL	1 1/8	NL	1 1/8
Fan Drive:	NL	AK84	NL	INLINE
Fan Size/Bore:	NL	1"	NL	INLINE
Belt Size / Number:	NL	;4L400R	NL	AX62x2
Shafts C-C:	NL	9.5"	NL	INLINE
Turns Open:	NL	5	NL	Closed 100%

Comments:

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: EX-2 TRAVERSE NUMBER : T-1
Branch 1 TRAVERSE LOCATION: 4th Fl. Womens Toilet

DUCT SIZE (ROUND) ______ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 18 " WIDTH x 20 " DEPTH Sq Ft = 2.50

AIR DENSITY DATA
STATIC PRESS @ CL: -0.42 InWg. DESIGN CFM = NL
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 2996
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **2995**

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	1428	1370	1535	992	1018		
B	1121	1521	1302	1034	1074		
C	1163	1487	1033	998	926		
D	1165	1461	1442	1418	1017		
E	777	1455	1513	1198	513		
F							
G							
H							
I							

NO. OF READINGS = 25 AVERAGE FPM = 1198

J							
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R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: EX-2 TRAVERSE NUMBER : T-2
Branch 2 TRAVERSE LOCATION: 4th Fl. Mens Toilet

DUCT SIZE (ROUND) ____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 24 " WIDTH x 18 " DEPTH Sq Ft = 3.00

AIR DENSITY DATA
STATIC PRESS @ CL: -0.58 InWg. DESIGN CFM = NL
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 4560
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **4556**

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	1581	1480	1366	1426	1310		
B	1734	1727	1546	1329	1513		
C	1801	1711	1550	1405	1606		
D	1700	1730	1713	963	1658		
E	1783	1434	935	1558	1442		
F							
G							
H							
I							

NO. OF READINGS = 25 AVERAGE FPM = 1520

J							
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O							
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R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: EX-5 TRAVERSE NUMBER : T-1
Branch 1 TRAVERSE LOCATION: Penthouse

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 14 " WIDTH x 16 " DEPTH Sq Ft = 1.56

AIR DENSITY DATA
STATIC PRESS @ CL: -0.33 InWg. DESIGN CFM = NL
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 1116
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **1116**

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	524	671	674	683			
B	656	739	751	789			
C	691	731	797	803			
D	659	775	797	738			
E							
F							
G							
H							
I							

NO. OF READINGS = 16 AVERAGE FPM = 717

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: EX-5 TRAVERSE NUMBER : T-2
Branch 2 TRAVERSE LOCATION: Penthouse

DUCT SIZE (ROUND) ______ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 22 " WIDTH x 16 " DEPTH Sq Ft = 2.44

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.5	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	2729
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**2727**

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	1040	1135	1099	778			
B	1054	1170	1313	1236			
C	1074	1270	1397	1137			
D	784	1053	1240	1084			
E							
F							
G							
H							
I							

NO. OF READINGS = 16 AVERAGE FPM = 1117

J							
K							
L							
M							
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O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

FAN DATA SHEET

	FAN NO.	EX-7	FAN NO.	
Serves / Location:	Toilet Exhaust	Penthouse		
Manufacturer:	COOK			
Model Number:	270 CIC			
Size:	NL			
Serial Number:	NL			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	DAYTON		
Frame Number:	NL	182/4T		
Horsepower:	5	5		
Brake Horsepower:	NL	4.3		
Safety Factor:	NL	1.15		
Volts/Phase:	460/3	460/3		
Motor Amperage:	6.33	5.6		
Motor RPM:	1760	1765		
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:	7700	10300		
Outside Air CFM:				
Suction Pressure:	NL	-0.77		
Discharge Pressure:	NL	0.03		
Fan Static Pressure:	NL	NA		
External Pressure:	NL	0.8		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	INLINE		
Motor Drive:	NL	4" OD		
Motor Size/Bore:	NL	1 1/8		
Fan Drive:	NL	INLINE		
Fan Size/Bore:	NL	INLINE		
Belt Size / Number:	NL	AX70 x 2		
Shafts C-C:	NL	INLINE		
Turns Open:	NL	CLOSED 100%		

Comments:

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: EX-7 TRAVERSE NUMBER : T-1
Branch 1 TRAVERSE LOCATION: Penthouse

DUCT SIZE (ROUND) ____ " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 14 " WIDTH x 16 " DEPTH Sq Ft = 1.56

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.23	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	796
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**796**

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	402	485	492	442			
B	517	551	498	543			
C	485	607	578	541			
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 12 AVERAGE FPM = 512

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: EX-7 TRAVERSE NUMBER : T-2
Branch 2 TRAVERSE LOCATION: Penthouse

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 26 " WIDTH x 26 " DEPTH Sq Ft = 4.69

AIR DENSITY DATA
STATIC PRESS @ CL: -0.19 InWg. DESIGN CFM = NL
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 5149
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **5149**

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	990	1168	1133	1054	829	1055	964
B	942	1091	1221	1204	1128	1241	911
C	929	1248	1246	1192	1197	1155	967
D	896	1263	1289	1237	1084	1214	985
E	881	1202	1292	1106	1163	975	936
F							
G							
H							
I							

NO. OF READINGS = 35 AVERAGE FPM = 1097

J							
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M							
N							
O							
P							
Q							
R							

TECHNICIAN: David Burns

Project: Brockton District Court
Address: 215 Main St., Brockton, MA
Date: 12/9/2020 **Project No.** 20-552

VELGRID TRAVERSE DATA

SYSTEM: EX-7 TRAVERSE NUMBER : T-3
Branch 3 TRAVERSE LOCATION: Penthouse

DUCT SIZE (ROUND) " DIAMETER Sq Ft = 0.00
DUCT SIZE (RECT.) 40 " WIDTH x 16 " DEPTH Sq Ft = 4.44

AIR DENSITY DATA
STATIC PRESS @ CL: -0.29 InWg. DESIGN CFM = NL
DUCT AIR TEMP : 70 Deg F ACTUAL CFM = 4355
BAROMETRIC PRESS : 29.92 In Hg. SCFM= **4354**

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	818	1022	932	855			
B	1087	1023	1023	786			
C	778	820	1114	793			
D	1036	1015	1104	861			
E	1036	1123	1279	1005			
F	958	1123	1211	715			
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 980

J							
K							
L							
M							
N							
O							
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Q							
R							

TECHNICIAN: David Burns