WOBURN DISTRICT COURT
HVAC SYSTEM EVALUATION SUMMARY

Visited October 20, 2020. While on site, inspected the air handling units and toured the occupied portions of the building to determine if the spaces generally matched usage oted on the architectural plans. The Woburn District Courthouse is a two-story building with a basement, built-in 1965, with a floor area of approximately 24,000 gross square feet. Ventilation is provided by three constant-volume air handling units (AHUs), located in a penthouse mechanical room.

1.0 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	12	600	50	224	19
Courtroom 116	33	3,500	106	895	27
Courtroom 213	13	910	70	247	19
Courtroom 227	13	860	66	233	18

2.0 Recommendations

Section	Recommendation/Finding	Action
2.1	**Filtration Efficiency**	
RF-1	Replace filters with a MERV-13 filter	Complete
RF-3	Install a differential pressure sensor with a display across the filter bank	In-progress
2.2	**Testing and Balancing**	
RTB-1	Test and rebalance air handling unit supply air and minimum outside air flow rates	In-progress
RTB-4	Test and balance reheat coil flow rates	N/A
RTB-6	Test and balance all air handler chilled and hot water coils	In-progress
2.3	**Equipment Maintenance and Upgrades**	
RE-1	Test existing air handling system dampers and actuators for proper operation	In-progress
RE-2	Clean air handler coils	Complete
RE-4	Inspect reheat coils and control valves	Complete
RE-5	Install freeze stat or confirm the existing freeze stat is working correctly on each air handling unit	In-progress
RE-7	Test the existing air handler control valves and actuators for proper operation	In-progress
2.4	**Control System**	
RC-1	Implement a pre-occupancy flush sequence	In-progress
2.5	**Additional Filtration and Air Cleaning**	
RFC-1	Install portable HEPA filters	In-progress

2.6	Humidity Control	
	No actionable items listed – continuous monitoring for seasonal changes	On-going
2.7	Other Recommendations	
2.7.1	Install a building management system	In-progress
2.7.2	Clean reheat coils	Complete

Woburn District Court
Woburn, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

May 23, 2021

Tighe&Bond

100% Recyclable

Section 1
Existing Conditions and Site Observations

Tighe & Bond visited the Woburn District Court on October 20, 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:
  - Michael Stack
  - Joao Lopes
- Tighe & Bond:
  - Todd Holland, PE, Senior Mechanical Engineer

1.1 Existing Ventilation System Description

The Woburn District Courthouse is a two-story building with a basement, built in 1965, with a floor area of approximately 24,000 gross square feet. Ventilation is provided by three constant-volume air handling units (AHUs), located in a penthouse mechanical room.

TABLE 1
Existing Air Handlers

Unit #	*Design Airflow (CFM)*	*Design Min OA (CFM)*	*Filters*	*Condition*
AC-1	3,575	1,535	2" MERV-8	Good to Fair
AC-2	8,725	2,230	2" MERV-8	Good to Fair
AC-3	6,765	1,835	2" MERV-13	Good to Fair

The air handlers each have a single cooling coil that also acts as a preheat coil in winter. Each unit has a supply air fan, filter section, and mixing box with return air (RA) and outdoor air (OA) dampers. The filter sections have 2" pleated filters in a v-bank arrangement. One unit has been retrofitted with MERV-13 filters and the other units are using MERV-8. Each AHU is paired with a separate return air fan.

During the visit we noted that each of the AHUs had the OA damper fully open and the RA damper fully closed. Facilities personnel explained this was a temporary override to maximize ventilation rates, and this practice would be discontinued with the onset of winter weather.

Photo 1 – Typical Air Handler

Chilled water is supplied by a 100-ton air-cooled Carrier chiller mounted on the penthouse roof. A pair of circulator pumps, run primary/standby, serve the three AHUs. Chilled water is not distributed beyond the penthouse.

The building is heated by a pair of HB Smith oil-fired cast iron boilers rated at 863 MBH each. Hot water is circulated by four pumps, three active and one standby. The three heating hot water circuits are the hot water reheat coils, perimeter radiation, and radiant ceilings in perimeter zones on the first and second floors.

All HVAC equipment was replaced during a 1996 renovation and appears to be in good to fair condition. Ductwork, piping, and reheat coils are original.

Photo 2 – Typical Cooling Coil

Supply air is distributed from each the AHUs in a single zone configuration, each unit serves one of the floors. Each floor has multiple sub-zones each served by a hot water reheat coil for temperature control.

The lockup area is served by AC-1, which provides conditioned air to the corridors. Each of the holding cells is served by exhaust grilles over the combination toilet/lavatory fixture. This exhaust system was operational at the time of the visit.

1.2 Existing Control System

The Courthouse HVAC equipment is controlled by the original Honeywell pneumatic control system. It is an old, obsolete system, and appears to be original although in fair condition with no major leaks noted. The air compressor and dryer were replaced very recently and are in excellent condition.

We did not see any evidence or components of a Building Management System (BMS) during our site visit. We are not aware of any demand control ventilation sequences in use at this courthouse.

Section 2
Recommendations

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

2.1 Filtration Efficiency Recommendations

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

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

The TAB Contractor and/or Engineer shall verify that the air handlers can accommodate a MERV-13 filter per Appendix A in the overview of recommendations report.

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

2.2 Testing & Balancing Recommendations

The AHUs are approximately 24 years old and it is unknown to Tighe & Bond when the last time the units were tested and balanced. Also, the code required outside air flow rates that were used to design the system in 1972 are different than the 2015 International Mechanical Code (IMC) and ASHRAE Standard 62.1.

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 OA flow rates for the AHUs to the recommended minimum OA rates listed in Table 2.

TABLE 2
Recommended Air Handler O.A. Flow Rates

Unit	Original Supply Airflow (CFM)	Original Design Min. O.A. (CFM)	Current Code Min. O.A. Requirements (CFM)	Recommended Minimum O.A. (CFM)
AC-1	3,575	1,535	879	1,535
AC-2	8,725	2,230	1,390	2,230
AC-3	6,765	1,835	1,428	1,835

The average airflow rate per person is shown below in Table 3. These values are based on the original design supply airflow rate and the recommended outdoor air flow rates shown in Table 2. The airflow rate per person assumes a diversity factor

of 70%, meaning the maximum number of occupants assumed to be in all zones at all times equates to 70% of the code default occupancy.

TABLE 3
Average Airflow Rate per Person

	All spaces	***Courtrooms***	***Non-Courtroom Spaces***
Total Occupancy (People)	278	167	111
Total Supply Air (CFM/Person)	69	32	124
Outdoor Air (CFM/Person)	19	8	36

The airflow rate per person for each Courtroom and the Jury Pool Room is shown below in Table 4. These values are based on full occupancy without taking diversity into account, the original design supply airflow rate, and the recommended outdoor airflow rate. The airflow rate per person assumes the full supply airflow is being delivered to the room. At times when the supply airflow is reduced due to the space temperature being satisfied, the airflow rate per person will also be reduced.

TABLE 4
Airflow Rate per Person – (Full Occupancy)

		Total Air		***Outdoor Air***	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outside Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Jury Pool Room	33	600	18	224	7
Courtroom 116	131	3,500	27	895	7
Courtroom 213	54	910	17	247	5
Courtroom 227	53	860	16	233	4

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

The airflow rate per person for each Courtroom and the Jury Pool Room, based on a reduced occupancy schedule determined by the Office of Court Management, is shown below in Table 4a. The airflow rate per person assumes the full supply airflow is being delivered to the room. At times when the supply airflow is reduced due to the space temperature being satisfied, the airflow rate per person will also be reduced.

TABLE 4a
Airflow Rate per Person – (Reduced Occupancy)

		Total Air		Outdoor Air	
Courtroom	*Total People*	*Supply Airflow (CFM)*	*Airflow Rate (CFM/Person)*	*Outside Airflow (CFM)*	*Airflow Rate (CFM/Person)*
Jury Pool Room	12	600	50	224	19
Courtroom 116	33	3,500	106	895	27
Courtroom 213	13	910	70	247	19
Courtroom 227	13	860	66	233	18

RTB-4: *Test and balance reheat coil flow rates.*

We recommend testing and balancing the reheat coils to ensure each space is being supplied the proper quantity of air, and that each coil is receiving the proper quantity of hot water.

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

Testing and balancing the coils in the air handlers will help ensure the coils are receiving the proper chilled and hot water flow rates. Due to the age of the coils, the coils may not perform as required to properly temper the supply air. Coils become fouled over time, which degrades the performance.

2.3 Equipment Maintenance & Upgrades

We recommend performing the following equipment maintenance and upgrades:

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

The dampers and actuators in the AHUs appeared to be operational because they were fully open. We were unable to inspect the dampers on the return fans' discharge because of their physical location. We did not see whether the open dampers would fully close and vice versa. We recommend testing the dampers and actuators to ensure they are functioning properly, opening and closing fully, and accurately assuming their minimum OA positions.

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

Cooling coils and drain pans for the AHUs were noted to be generally clean, but one unit has a visible buildup of dust (see Photo 2). We recommend inspecting these and cleaning them as necessary.

RE-4: *Inspect reheat coils and control valves.*

Reheat coils regulate the temperature of supply air delivered to each space. At a minimum, we recommend cycling the control valve to verify proper operation. Any valves not fully opening or closing should be repaired or replaced.

RE-5: *Install freeze stat or confirm the existing freeze stat is working correctly on each air handling unit.*

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

2.4 Control System

The Woburn District Courthouse has a pneumatic control system with limited functionality. We recommend the following short-term control system strategies be implemented into the existing control system:

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

2.5 Additional Filtration and Air Cleaning

We recommend the installation of the following air cleaning devices:

RFC-1: *Install portable HEPA filters.*

These are recommended for office and library areas served by unit ventilators, which cannot have their filters upgraded to MERV-13. 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 Install a Building Management System

Within 3-5 years, we recommend replacing the Honeywell pneumatic control system with a BMS to control and monitor equipment. Pneumatic air systems are antiquated and do not offer the same benefits as a BMS.

2.7.2 Clean Reheat Coils

Although we were unable to inspect the reheat coils, they are original to the 1965 construction and do not have individual filters. We recommend inspecting these and cleaning them as necessary.

Section 3
Testing & Balancing Results

Milharmer Associates, Inc. visited the Woburn District Courthouse on January 26, 2021 to test the airflow rates of the air handling units and exhaust fans. A summary of the tested airflow rates versus the design airflow rates are shown below in Tables 5 and 6. The full testing and balancing report is attached.

TABLE 5
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)
AC-1	3,575	1,535	2,040	4,544	1,413	3,253
AC-2	8,725	2,230	6,495	7,194	2,017	7,107
AC-3	6,765	1,835	4,930	5,252	1,725	5,056

TABLE 6
Exhaust Fan Testing & Balancing Results

Unit	Serving	Design Return/Exhaust Airflow (CFM)	Actual Return/Exhaust Airflow (CFM)
EF-4	Toilets	2,875	1,628

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

1. AC-1 is supplying more than 25% more airflow than designed. A new fan sheave is required to reduce the supply airflow to the design value. This is more of a concern for noise than ventilation.
2. The AC-2 return fan is performing within the acceptable range, however the supply fan is providing about 18% less than design. The outdoor airflow is within the acceptable range. Tighe & Bond recommends increasing the supply airflow, and a new fan sheave will be required.
3. The AC-3 return fan is performing very close to the design value, however the supply fan is providing about 22% less than design. A new fan sheave will be required to increase the supply airflow to the design level. The outdoor airflow is within the acceptable range.

4. Toilet exhaust fan EF-4 is not performing within acceptable range, more than 40% below design. We recommend repairing or replacing this fan and/or its damper as required to achieve design airflow and provide proper ventilation for the toilet rooms.

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.

\\Tighebond.com\data\Data\Projects\M\M1671 Comm. of MA Court System\011 - COVID-19 Courthouse Evaluations\Report_Evaluation\Draft Reports\Woburn\Woburn District Court Report.docx

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: **Woburn District Court**
30 Pleasant St., Woburn, MA

Project No.: **21-018** **Project Date:** **1/26/2021**

MECHANICAL CONTRACTOR
Tighe & Bond

3384

A N.E.B.B. Certified Company

Project:	Woburn District Court		
Address:	30 Pleasant St., Woburn, MA		
Date:	1/26/2021	**Project No.**	21-018

CERTIFICATION

Submitted & Certified by:

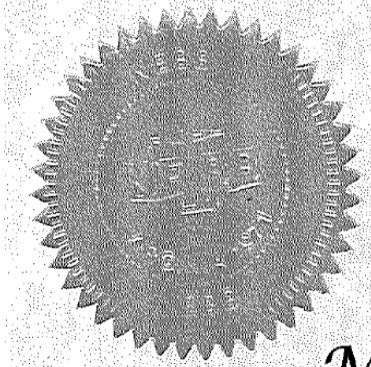
Milharmer Associates, Inc.

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 Fant

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:	Woburn District Court		
Address:	30 Pleasant St., Woburn, MA		
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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
N.S.	Not Specified

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

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REPORT SUMMARY

The following is the report for the Woburn District Court. A survey was performed on AC-1, AC-2 & AC-3 with the following comments:

1. AC-1 was tested at 4,544 CFM and is designed for 3,575 CFM. A motor sheave change would be required in order to decrease the airflow to design. The new motor sheave would need to be a 1VP50 x 1 1/8" with an B65 Belt.

2. AC-2 was tested at 7,195 CFM and is designed for 8,725 CFM. A fan sheave change would be required in order to increase the airflow to design. The new fan sheave would need to be a BK120 x 1 7/16" with an B53 Belt.

3. AC-3 was tested at 5,252 CFM and is designed for 6,765 CFM. A fan sheave change would be required in order to increase the airflow to design. The new motor sheave would need to be a BK100 x 1 7/16"" with an B47 Belt.

Chilled water was not running during the testing period.

Project:	Woburn District Court		
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REPORT SUMMARY

AIR HANDLING UNITS

UNIT	SUPPLY	RETURN	OUTSIDE AIR
AC-1	4,544 CFM	3,253 CFM	1,413 CFM
AC-2	7,194 CFM	7,107 CFM	2,017 CFM
AC-3	5,252 CFM	5,056 CFM	1,725 CFM

Project: Woburn District Court
Address: 30 Pleasant St., Woburn, MA
Date: 1/26/2021 **Project No.** 21-018

FAN DATA SHEET

	FAN NO. AC-1		FAN NO. EF-1	
Serves / Location:	Basement	Mech. Room	Basement	Mech. Room
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39LAZ081AA523I-L		22-BISW-21-3-CW-UB-I	
Size:	NL		NL	
Serial Number:	1896T81060		96F03940	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	CENTURY	NL	MARATHON
Frame Number:	NL	184T	NL	143T-85
Horsepower:	5	5	1	1
Brake Horsepower:	NL	3.84	NL	0.9
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	208/3	210/3	230/3	230/3
Motor Amperage:	14.4	8.3/8.4/8.3	3.1	3
Motor RPM:	NL	1737	1760	1642
Speeds:	SINGLE	SINGLE	SINGLE	SINGLE
Heater Size:	NL	CB Protected	NL	CB Protected
Heater Amps.:	NL	CB Protected	NL	CB Protected
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:	3575	4544		
Return Air CFM:			3275	3253
Exhaust Air CFM:				
Outside Air CFM:	1535	1413		
Suction Pressure:	NL	0.39	NL	NA
Discharge Pressure:	NL	1.05	NL	NA
Fan Static Pressure:	NL	NA	NL	NA
External Pressure:	2.25	1.44	1	NA
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	1503	NL	NA
Motor Drive:	NL	1VP60	NL	NA
Motor Size/Bore:	NL	1 1/8	NL	NA
Fan Drive:	NL	BK67H	NL	NA
Fan Size/Bore:	NL	1 3/16	NL	NA
Belt Size / Number:	NL	BX35	NL	2 x A53
Shafts C-C:	NL	9 1/2	NL	NA
Turns Open:	NL	2.5	NL	NA

Comments:

Project:	Woburn District Court		
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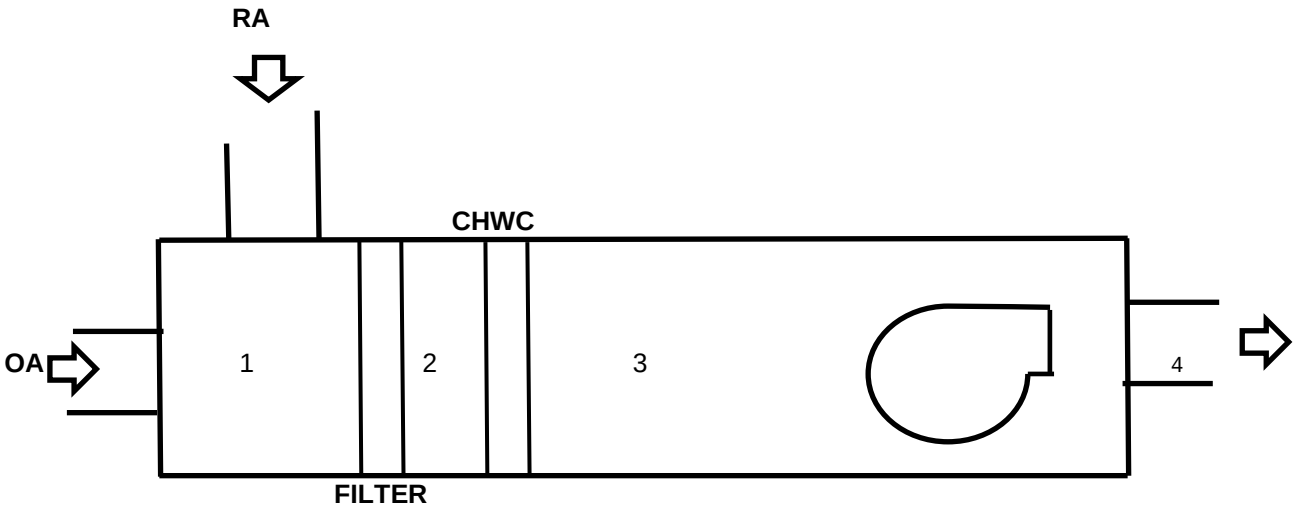
AC-1 STATIC PROFILE



LOCATION	STATIC
1	-0.151"
2	-.391"
3	-.955"
4	+1.05"

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

Project: Woburn District Court
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TRAVERSE DATA

SYSTEM: AC-1 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Supply Main Mech Rm.

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	30	" WIDTH x	18 " DEPTH	Sq Ft =	3.75

AIR DENSITY DATA

STATIC PRESS @ CL:	1.05	InWg.	DESIGN CFM =	N.S.
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	4544
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**4558**

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	389	269	1268	1729	2268		
B	376	463	1159	1745	2091		
C	740	673	1146	2027	1832		
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 15 AVERAGE FPM = 1212

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Jon Bean

Project: Woburn District Court
Address: 30 Pleasant St., Woburn, MA
Date: 1/26/2021 **Project No.** 21-018

TRAVERSE DATA

SYSTEM: AC-1 Return (EF-1)
TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech Rm.

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	30	" WIDTH x	18	" DEPTH	Sq Ft =	3.75

AIR DENSITY DATA

STATIC PRESS @ CL:	0.09	InWg.	DESIGN CFM =	N.S.
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	3253
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**3256**

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	1444	1095	934	992	442		
B	1051	915	656	866	665		
C	1051	851	622	798	631		
D							
E							
F							
G							
H							
I							

NO. OF READINGS = 15 AVERAGE FPM = 868

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Jon Bean

Project: Woburn District Court
Address: 30 Pleasant St., Woburn, MA
Date: 1/26/2021 **Project No.** 21-018

TRAVERSE DATA

SYSTEM: AC-1 TRAVERSE NUMBER : T1
Outside Air TRAVERSE LOCATION: Mech Rm.

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	30	" WIDTH x	18 " DEPTH	Sq Ft =	3.75

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.02	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	1413
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**1414**

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	360	426	487	371	387		
B	331	411	488	314	365		
C	300	472	465	298	234		
D	363	489	435	259	283		
E							
F							
G							
H							
I							

NO. OF READINGS = 20 AVERAGE FPM = 377

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Dan Abbett

Project: Woburn District Court
Address: 30 Pleasant St., Woburn, MA
Date: 1/26/2021 **Project No.** 21-018

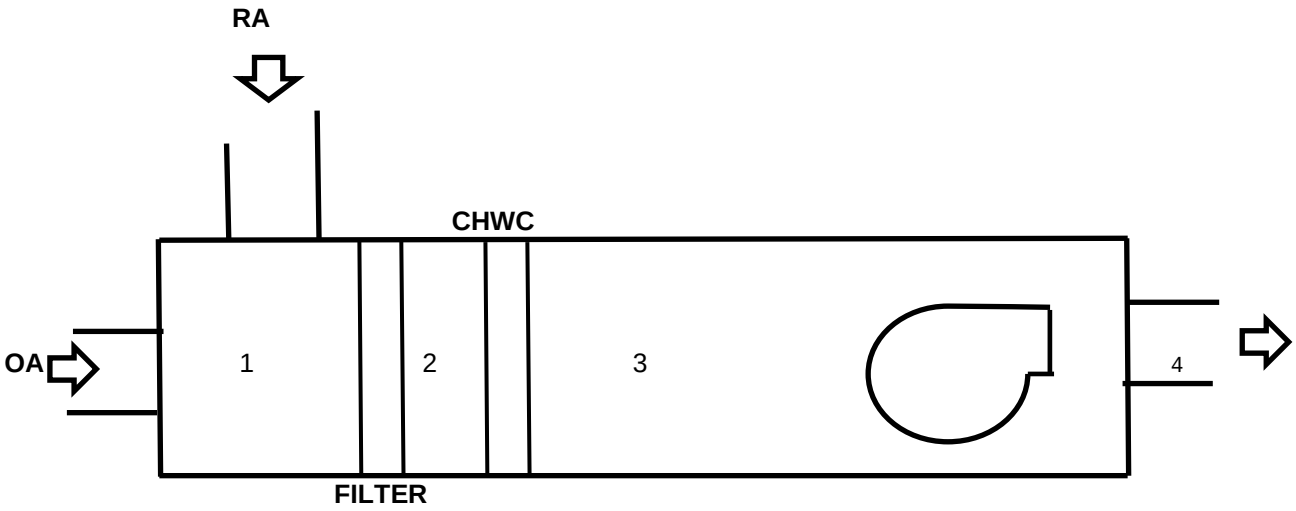
FAN DATA SHEET

	FAN NO. AC-2		FAN NO. EF-2	
Serves / Location:	1st Floor	Mech. Room	1st Floor	Mech. Room
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39LVBA2180809003		22-BISW-21-3-CW-UB-I	
Size:	NL		NL	
Serial Number:	1896T81061		96F04776	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	MAGNETEK	NL	MARATHON
Frame Number:	NL	213T	NL	182T
Horsepower:	NL	7.5	NL	3
Brake Horsepower:	NL	5.73	NL	2.74
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	208/3	208/3	230/3	230/3
Motor Amperage:	21	12.3/12.5/12.3	8.2	7.6
Motor RPM:	1750	1742	1745	1717
Speeds:	SINGLE	SINGLE	SINGLE	SINGLE
Heater Size:	NL	CB Protected	NL	CB Protected
Heater Amps.:	NL	CB Protected	NL	CB Protected
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:	8725	7194		
Return Air CFM:			8060	7107
Exhaust Air CFM:				
Outside Air CFM:	2230	2017		
Suction Pressure:	NL	-0.64		
Discharge Pressure:	NL	1.5		
Fan Static Pressure:	NL	NA		
External Pressure:	2.25	2.14		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	804	NL	NA
Motor Drive:	NL	1VP75	NL	NA
Motor Size/Bore:	NL	1 3/8	NL	NA
Fan Drive:	NL	BK140H	NL	NA
Fan Size/Bore:	NL	H1 7/16	NL	NA
Belt Size / Number:	NL	B56/1	NL	NA
Shafts C-C:	NL	12.7	NL	NA
Turns Open:	NL	2.5	NL	NA

Comments:

Project:	Woburn District Court		
Address:	30 Pleasant St., Woburn, MA		
Date:	1/26/2021	**Project No.**	21-018

AC-2 STATIC PROFILE



LOCATION	STATIC
1	-0.203"
2	-.32"
3	-.64"
4	+1.5"

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

Project: Woburn District Court
Address: 30 Pleasant St., Woburn, MA
Date: 1/26/2021 **Project No.** 21-018

TRAVERSE DATA

SYSTEM: AC-2 TRAVERSE NUMBER : T1
Supply TRAVERSE LOCATION: Supply Main Mech Rm.

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	50	" WIDTH x	18 " DEPTH	Sq Ft =	6.25

AIR DENSITY DATA

STATIC PRESS @ CL:	1.5	InWg.	DESIGN CFM =	8725
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	7194
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**7224**

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	1270	1351	1227	1243	1462	1345	
B	1260	1380	1299	1351	1412	1363	
C	1227	1349	1257	1307	1517	1393	
D	1284	1389	1354	1439	1433	1331	
E	1249	1344	1292	1414	1403	1340	
F							
G							
H							
I							

NO. OF READINGS = 35 AVERAGE FPM = 1151

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

TECHNICIAN: Dan Abbett

Project: Woburn District Court
Address: 30 Pleasant St., Woburn, MA
Date: 1/26/2021 **Project No.** 21-018

TRAVERSE DATA

SYSTEM: AC-2 Return (EF-2)
TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech Rm.

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

AIR DENSITY DATA

STATIC PRESS @ CL:	0.122	InWg.	DESIGN CFM =	8060
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	7107
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**7113**

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	1414	1656	1503	543	0		
B	1436	1625	1582	440	0		
C	1329	1583	1552	437	0		
D	1331	1454	1561	405	0		
E	1195	1375	1517	662	0		
F							
G							
H							
I							

NO. OF READINGS = 25 AVERAGE FPM = 984

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Jon Bean / Dan Abbett

Project: Woburn District Court
Address: 30 Pleasant St., Woburn, MA
Date: 1/26/2021 **Project No.** 21-018

TRAVERSE DATA

SYSTEM: AC-2 TRAVERSE NUMBER : T1
Outside Air TRAVERSE LOCATION:

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

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.01	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	2017
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**2018**

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	319	300	371	232			
B	383	221	324	243			
C	300	244	386	141			
D	372	234	329	166			
E	355	226	308	179			
F	341	352	224	152			
G							
H							
I							

NO. OF READINGS = 24 AVERAGE FPM = 279

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Dan Abbett

Project: Woburn District Court
Address: 30 Pleasant St., Woburn, MA
Date: 1/26/2021 **Project No.** 21-018

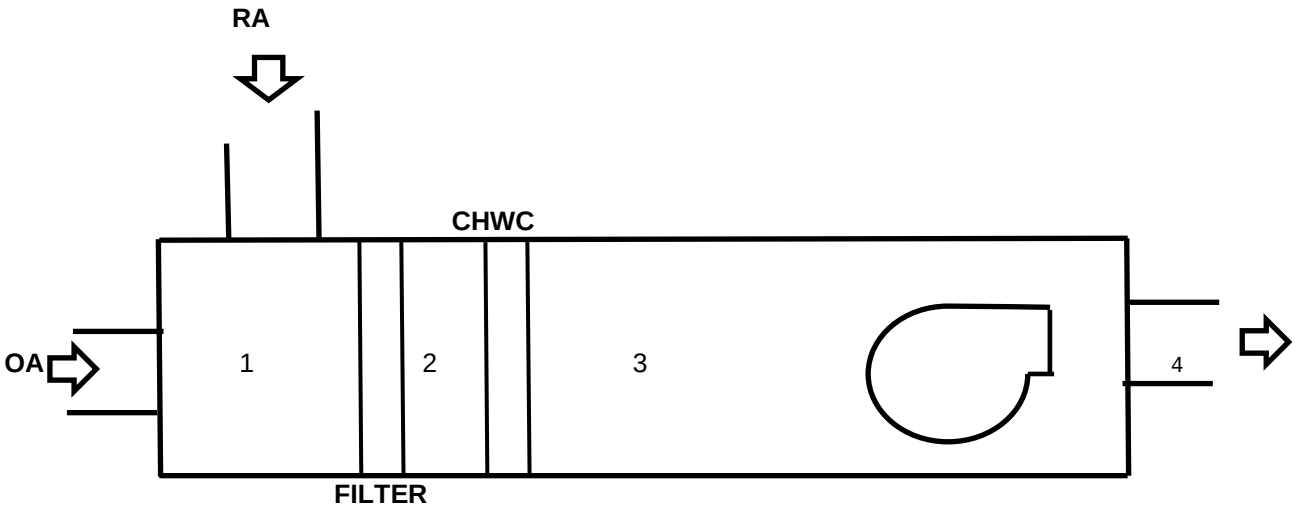
FAN DATA SHEET

	FAN NO. AC-3		FAN NO. EF-3	
Serves / Location:	2nd Floor	Mech. Room	2nd Floor	Mech. Room
Manufacturer:	CARRIER		GREENHECK	
Model Number:	39LA2151AA5231-R		22-BISW-21-3-CW-UB	
Size:	NL		NL	
Serial Number:	1896T81062		96F04769	
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	MAGNETEK	NL	MARATHON
Frame Number:	NL	213T	NL	145T-90
Horsepower:	NL	7.5	NL	2
Brake Horsepower:	NL	6.99	NL	1.76
Safety Factor:	NL	1.15	NL	1.15
Volts/Phase:	200/3	210/3	230/3	230/3
Motor Amperage:	23	15/15.1/15.3	5.8	4.9
Motor RPM:	1765	1744	1735	1729
Speeds:	SINGLE	SINGLE	SINGLE	SINGLE
Heater Size:	NL	CB Protected	NL	CB Protected
Heater Amps.:	NL	CB Protected	NL	CB Protected
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:	6765	5252		
Return Air CFM:			6180	5056
Exhaust Air CFM:				
Outside Air CFM:	1835	1725		
Suction Pressure:	NL	0.196		
Discharge Pressure:	NL	1.61		
Fan Static Pressure:	NL	NA		
External Pressure:	2.25	1.806		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	1000	NL	NA
Motor Drive:	NL	1VP71X	NL	NA
Motor Size/Bore:	NL	1 3/8	NL	NA
Fan Drive:	NL	BK115X	NL	NA
Fan Size/Bore:	NL	1 7/16	NL	NA
Belt Size / Number:	NL	BX48	NL	NA
Shafts C-C:	NL	11.3	NL	NA
Turns Open:	NL	3.5	NL	NA

Comments:

Project:	Woburn District Court		
Address:	30 Pleasant St., Woburn, MA		
Date:	1/26/2021	**Project No.**	21-018

AC-3 STATIC PROFILE



LOCATION	STATIC
1	-0.068"
2	-.196"
3	-.604"
4	+1.61"

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

Project: Woburn District Court
Address: 30 Pleasant St., Woburn, MA
Date: 1/26/2021 **Project No.** 21-018

TRAVERSE DATA

SYSTEM: AC-3 Supply
TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Supply Main Mech Rm.

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	46	" WIDTH x	16 " DEPTH	Sq Ft =	5.11

AIR DENSITY DATA

STATIC PRESS @ CL:	1.61	InWg.	DESIGN CFM =	6765
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	5252
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**5276**

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	1043	1461	1395	1066	585	349	210
B	1322	1724	1928	1349	878	317	380
C	1598	1628	1658	1360	973	862	444
D	1301	1872	1783	1581	1093	631	543
E							
F							
G							
H							
I							

NO. OF READINGS = 32 AVERAGE FPM = 1028

J	446						
K	432						
L	355						
M	316						
N							
O							
P							
Q							
R							

TECHNICIAN: Dan Abbett

Project: Woburn District Court
Address: 30 Pleasant St., Woburn, MA
Date: 1/26/2021 **Project No.** 21-018

TRAVERSE DATA

SYSTEM: AC-3 Return (EF-3)
TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech Rm.

DUCT SIZE (ROUND)		" DIAMETER			Sq Ft =	0.00
DUCT SIZE (RECT.)	42	" WIDTH x	20	" DEPTH	Sq Ft =	5.83

AIR DENSITY DATA

STATIC PRESS @ CL:	0.229	InWg.	DESIGN CFM =	8060
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	5056
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**5062**

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	1021	752	835	613	615	602
B	1137	917	873	956	680	684	676
C	1172	1007	963	1052	879	565	519
D	1199	1061	1025	1055	932	790	561
E							
F							
G							
H							
I							

NO. OF READINGS = 28 AVERAGE FPM = 867

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Jon Bean

Project: Woburn District Court
Address: 30 Pleasant St., Woburn, MA
Date: 1/26/2021 **Project No.** 21-018

TRAVERSE DATA

SYSTEM: AC-3 TRAVERSE NUMBER : T1
Outside Air TRAVERSE LOCATION:

DUCT SIZE (ROUND)		" DIAMETER		Sq Ft =	0.00
DUCT SIZE (RECT.)	44	" WIDTH x	20 " DEPTH	Sq Ft =	6.11

AIR DENSITY DATA

STATIC PRESS @ CL:	-0.01	InWg.	DESIGN CFM =	NL
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	1725
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**1726**

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	276	278	242	303	302	278	266
B	220	340	296	313	289	252	249
C	284	310	275	388	274	271	256
D	244	306	250	346	283	277	237
E							
F							
G							
H							
I							

NO. OF READINGS = 28 AVERAGE FPM = 282

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Dan Abbett

Project: Woburn District Court
Address: 30 Pleasant St., Woburn, MA
Date: 1/26/2021 **Project No.** 21-018

FAN DATA SHEET

	FAN NO.	EF-4	FAN NO.	
Serves / Location:	Toilets	Mech. Room		
Manufacturer:	TRANE			
Model Number:	31			
Size:	20			
Serial Number:	K88050			
MOTOR	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Manufacturer:	NL	DELCO		
Frame Number:	NL	182		
Horsepower:	NL	1		
Brake Horsepower:	NL	0.88		
Safety Factor:	NL	1		
Volts/Phase:	208/3	208/3		
Motor Amperage:	3.4	3.1		
Motor RPM:	1750	1742		
Speeds:	SINGLE	SINGLE		
Heater Size:	NL	CB Protected		
Heater Amps.:	NL	CB Protected		
FAN	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Supply Air CFM:				
Return Air CFM:				
Exhaust Air CFM:	2875	1628		
Outside Air CFM:				
Suction Pressure:	NL	NA		
Discharge Pressure:	NL	NA		
Fan Static Pressure:	NL	NA		
External Pressure:	NL	NA		
RPM	**DESIGN**	**TESTED**	**DESIGN**	**TESTED**
Fan RPM:	NL	NA		
Motor Drive:	NL	NA		
Motor Size/Bore:	NL	NA		
Fan Drive:	NL	NA		
Fan Size/Bore:	NL	NA		
Belt Size / Number:	NL	A46		
Shafts C-C:	NL	NA		
Turns Open:	NL	NA		

Comments:

Project: Woburn District Court
Address: 30 Pleasant St., Woburn, MA
Date: 1/26/2021 **Project No.** 21-018

TRAVERSE DATA

SYSTEM: EF-4 TRAVERSE NUMBER : T1
TRAVERSE LOCATION: Mech Rm.

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

AIR DENSITY DATA

STATIC PRESS @ CL:	0.04	InWg.	DESIGN CFM =	2875
DUCT AIR TEMP :	70	Deg F	ACTUAL CFM =	1628
BAROMETRIC PRESS :	29.92	In Hg.	SCFM=	**1629**

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	823	686	575	570			
B	745	549	582	631			
C	663	577	600	785			
D	661	608	693	864			
E	618	603	701	782			
F							
G							
H							
I							

NO. OF READINGS = 20 AVERAGE FPM = 666

J							
K							
L							
M							
N							
O							
P							
Q							
R							

TECHNICIAN: Jon Bean