



Arlington Public Schools Ventilation Assessment – TJ Middle  
March 2021

**Arlington Public Schools**  
**Building Ventilation Assessment – Thomas Jefferson**  
March 2021

Final

## **VENTILATION ASSESSMENT – TJ Middle School**

Arlington Public Schools is in the process of doing additional assessment of ventilation systems in the less ventilated schools to improve conditions as recommended to open schools. The assessment is to review the available ventilation systems and include short term and long-term planning to increase the ventilation in the classrooms to accommodate the hybrid in-person learning (short term) and include ventilation rates to meet expected occupancy of the facilities (long term).

The buildings are conditioned by different types of HVAC systems, even in the same facility. Thus, a “typical” classroom, that was ventilated differently, was reviewed based on system type in the facility. In general, the main at TJ Middle school is a centrally located HVAC system. In rooms where the ventilation rate were below the recommendations, these systems were reviewed to determine methods to increase the ventilation in the classrooms. The continuation of the ventilation study was review schools in which ventilation rates are to be increased to the extent possible. This report addresses the Thomas Jefferson Middle School.

The current American Society for Heating, Refrigerating and Air Conditioning (ASHRAE) code 62.1-2010 requires ventilation to be calculated based both on the classroom size (square foot of the room) and classroom occupancy. The classroom ventilation was designed as necessary to meet the current code level ventilation unit. As part of the guidelines for opening buildings, ventilation rates should be increased to the extent possible as a method to dilute airborne contaminants to the extent possible. ASHRAE recommends diluting the room air utilizing ventilation to the extent possible while not adversely affecting space air conditioning.

Harvard T.H. Chan’s Guidelines for opening schools recommend that facilities verify the outside air ventilation system is operational and provide adequate ventilation. In addition to outside air ventilation, the guidelines also recommend that the building HVAC systems provide adequate air movement in the classrooms by using a combination of outdoor air and recirculating air. The target air movement rate in a classroom is to cycle the air in a room 4 to 6 times per hour [called air change rates per hour (ACH)]. Having a minimum of 5 ACH would mean the air is cycled 5 times in an hour – or every 12 minutes. The recommendation for cycling air in the classroom is to allow the HVAC systems to filter the air.

Both Harvard and ASHRAE recommend increasing filtration efficiencies to the highest allowable by the limits of the HVAC system. This varies by HVAC system, with MERV 13 equivalence being the minimum recommended filtration level due to its ability to remove 85 percent of the particles larger than 1 micron. While the virus is smaller than 1 micron, the general consensus is that the virus transmits in droplet form with the RNA infectious dose most likely in a size range greater than 1 micron. If the HVAC system isn’t capable of utilizing MERV 13 filtration, the recommendation is to supplement the room with a fan/filter unit capable of using very high-efficient filters (HEPA) to allow better filtration and to increase the effective, clean air in the room.

Central HVAC systems: Thomas Jefferson Middle School uses central type HVAC air handling units mainly located in dedicated penthouse mechanical room(s). These units condition several classrooms throughout the facility. The ventilation for these units operates using dampers and controls directly connected to the outdoors via ductwork and louvers drawing in outdoor air through the unit. The unit then heat or cools the ventilation air providing the necessary cooling/heating air to the individual classrooms and spaces. Each classroom includes a terminal unit which provides a constant airflow which is temperature controlled to maintain space temperature while meeting the necessary outside air ventilation rates.

Discussion:

The air handling unit's cooling/heating capacity and associated outside air ductwork/exterior louver were originally designed to deliver the ventilation airflows of around 15-20% of full design airflow. Review of the air handling unit and system operating capacities, based on hybrid space occupancies, demonstrates that operating the school in a hybrid mode is satisfactory. To increase the ventilation rates, above current operating conditions, the controls and dampers will need to be adjusted and calibrated as necessary to increase the ventilation airflows to approximately 33 percent capacity.

The design/installed capacities of the HVAC system have the ability to provide adequate heating and cooling utilizing the hybrid ventilation rates. However, for normal, typical occupancies, the existing handling unit infrastructure will require modifications necessary to increase higher ventilation rates.

Thomas Jefferson HVAC system provides the Hybrid occupancy, code level ventilation while providing an average room airflow of 10.32 ACH. This air change rates equates to the air being cycled every 6 minutes, reducing stagnant airflow in the classrooms. The required code level ventilation rates do not adversely affect the HVAC's system ability to heat and cool the classrooms.

However, the effective air change rate depends on filtration levels, with MERV 13 equivalence being recommended. Therefore, the recommendation to add an auxiliary HEPA filtration unit, increases the effective air change rate for the classroom to approximately 4 to 6 ACH, averaging over 6 ACH (or cycled every 10 minutes). A few of the larger than typical classrooms are utilizing two filtration units to increase the effective air change rate.

Issues (Hybrid)

- The existing outside air dampers and controls would need to be adjusted to increase the ventilation rates to approximately 40-45% of the supply air.
- The outside airflow rates would need to be measured and set by balanced.
- Several classrooms will require rebalancing and diffuser adjustments as necessary to provide the adequate supply and ventilation air change rates.

Recommendations (Hybrid):

- Rebalance outside air flows.
- Rebalance approximately 11 classrooms to achieve desired air change rates and ventilation airflows.

Issues (Normal)

- Existing ductwork and louver infrastructure cannot accommodate normal occupancy ventilation rates; therefore, ductwork and louver modifications would be necessary to increase the ventilation airflows.
- The existing air handling unit cooling and heating coils (existing) would need to be increased in capacity (by rebalancing system chilled water and heating water airflows).
- The central heating and cooling plants would need to be reviewed for capacity to accommodate increased cooling and heating loads presented by increased ventilation loads.

Recommendations (Normal):

## Temporary, short term:

- In order to increase ventilation airflow rate, outside air temperature operating conditions needs to be adjusted to allow the air handling unit's existing cooling/heating coils to produce adequate supply air temperatures to meet the classrooms heating and cooling needs.

## Long term corrections.

- Ductwork changes and louvers will need to be replaced to allow additional ventilation airflows.
- Air handling airflows along with cooling and heating coil adjustments will be necessary to increase existing system capacity as necessary to accommodate increase ventilation rates. This effects several air handling units.
- The chiller plant and boiler plant and associated flows would need to be reviewed and engineered to provide increased capacity. It is estimated that an additional 100 to 150 tons of central cooling capacity to serve the handling unit capacity is estimated to be required.

- The existing outside air dampers and controls would need to be adjusted to increase the ventilation rates to approximately 40% of the supply air.
- The outside airflow rates would need to be measured and set by balanced.
- Many classrooms will require rebalancing and diffuser adjustments as necessary to provide the adequate supply and ventilation air change rates. Primarily effects approximately 35 of the 82 classrooms to achieve desired air change rates and ventilation airflows.

**APPENDIX A**

Disclaimers

Air change calculations using HEPA filter units.

## Disclaimers

- The information in this document is provided as general guidance based on the current information available utilizing the strategies developed by ASHRAE and Harvard. HVAC systems play only a small role in infectious disease transmission, the airflow information provided in these documents are not mitigation strategies. Additional non-HVAC mitigation strategies to be used includes:
  - **Building Occupancy Levels Allowed**
  - **Face mask requirements**
  - **Social distancing between desks, students, teachers, etc.**
  - **Directional flow for movement through the building**
  - **Personal hygiene**
  - **Cleaning requirements**
  - **Touchless services.**
- It is important to note that HVAC strategies are means to improve the air quality and reduce risk but will not prevent all possibility of virus transmission, user should acknowledge that there is a no “zero risk” scenario. HVAC improvements are intended to be used as part of an overall risk reduction strategy for reopening schools. Each building and situation are unique and the guidance provided doesn’t not equally apply to all buildings or classrooms.
- The information in this report is based on the very latest recommendations but the COVID-19 crisis remains an ever-evolving situation and this assessment and our recommendations are not intended to override or supersede any current or future guidance from health and government experts. This guidance should be used in conjunction with relevant guidance and research from governmental agencies. This information is not a substitute for guidance as recommended by health care professionals.
- CMTA does not warrant the accuracy or completeness of this guidance, by adopting these recommendations for use, each adopter agrees to accept the full responsibility in connection with their use. CMTA assumes no responsibility for any injury, loss, or damage arising out of or in connection with this guidance.

Thomas Jefferson - Airflow Calculations															
Room Number	Room Use	Area (Sq Ft)	Ceiling Height (Feet)	Number of Students (Hybrid)	System-Dual Duct	Supply Airflow	Supply Total ACH	Year	Design OA Airflow	Estimated current OA ACH	Blue Air 211+ Airflow	Quant	HEPA ACH	"Clean" ACH	
55	CLASSRM (was workrm)	693	9.0	10.00	AHU-4	480	4.62	2009	103	0.99	350	1	3.37	4.36	
56	CLASSROOM	575	9.0	9.00	AHU-4	165	1.91	2009	35	0.41	350	1	4.06	4.47	
59	CLASSRM (Comp Lab)	762	9.0	14.00	AHU-4	2645	23.14	2009	567	4.96	350	1	3.06	8.02	
61	ART Room	1,320	9.0	8.00	AHU-4	1495	7.55	2009	320	1.62	350	2	3.54	5.15	
63	CLASSROOM	553	9.0	9.00	AHU-4	1170	14.10	2009	251	3.02	350	1	4.22	7.24	
65	CLASSROOM	533	9.0	9.00	AHU-4	735	9.19	2009	158	1.97	350	1	4.38	6.35	
67	CLASSROOM	1,829	9.0	12.00	AHU-4	3055	11.14	2009	655	2.39	350	2	2.55	4.94	
67A	Tech Lab	1,215	9.0	15.00	AHU-4	2025	11.11	2009	434	2.38	350	1	1.92	4.30	
80	CLASSROOM	559	9.0	9.00	AHU-6	650	7.75	2009	130	1.55	350	1	4.17	5.72	
81	CLASSROOM	539	9.0	9.00	AHU-6	650	8.04	2009	130	1.61	350	1	4.33	5.94	
82	CLASSROOM	883	9.0	15.00	AHU-6	1235	9.32	2009	247	1.86	350	1	2.64	4.51	
85	CLASSROOM	608	9.0	10.00	AHU-6	1130	12.39	2009	226	2.48	350	1	3.84	6.32	
86	CLASSROOM	699	9.0	11.00	AHU-6	990	9.44	2009	198	1.89	350	1	3.34	5.23	
87	CLASSROOM (SG)	337	9.0	4.00	AHU-6	460	9.10	2009	92	1.82	350	1	6.92	8.74	
88	CLASSROOM	694	9.0	11.00	AHU-6	1010	9.70	2009	202	1.94	350	1	3.36	5.30	
89	CLASSROOM	609	9.0	11.00	AHU-6	1130	12.37	2009	226	2.47	350	1	3.83	6.31	
104	CLASSROOM	541	9.0	9.00	AHU-8	1120	13.80	2009	210	2.59	350	1	4.31	6.90	
105	CLASSROOM	685	9.0	12.00	AHU-8	1060	10.32	2009	199	1.93	350	1	3.41	5.34	
106	CLASSROOM	689	9.0	11.00	AHU-8	1060	10.26	2009	199	1.92	350	1	3.39	5.31	
108	CLASSROOM	597	9.0	10.00	AHU-8	1480	16.53	2009	493	5.51	350	1	3.91	9.42	
109	CLASSROOM	573	9.0	10.00	AHU-8	1685	19.60	2009	562	6.53	350	1	4.07	10.61	
110	CLASSROOM	580	9.0	10.00	AHU-8	860	9.89	2009	287	3.30	350	1	4.02	7.32	
111	CLASSROOM	736	9.0	12.00	AHU-8	980	8.88	2009	327	2.96	350	1	3.17	6.13	
113	CLASSROOM	450	9.0	5.00	AHU-8	485	7.19	2009	162	2.40	350	1	5.19	7.58	
114	CLASSROOM	631	9.0	10.00	AHU-8	945	9.98	2009	315	3.33	350	1	3.70	7.03	
114A	CLASSROOM (SGI)	400	9.0	5.00	AHU-8	660	11.00	2009	220	3.67	350	1	5.83	9.50	
115	CLASSROOM	597	9.0	10.00	AHU-8	945	10.55	2009	315	3.52	350	1	3.91	7.43	
117	Consumer Sci.	1,725	9.0	12.00	AHU-8	1840	7.11	2009	613	2.37	350	1	1.35	3.72	
120	Drama	981	9.0	12.00	AHU-26	1120	7.61	2009	392	2.66	350	1	2.38	5.04	
125	Band	1,400	9.0	12.00	AHU-26	1785	8.50	2009	625	2.98	350	1	1.67	4.64	
122A	Flex Classroom	230	9.0	4.00	AHU-25	450	13.04	2009	158	4.57	350	1	10.14	14.71	
122	Dance/Vocal	440	9.0	5.00	AHU-25	375	5.68	2009	131	1.99	350	1	5.30	7.29	
126	Orchestra	1,400	9.0	12.00	AHU-25	1785	8.50	2009	625	2.98	350	1	1.67	4.64	
201	Interlude	537	9.0	4.00	AHU-2	745	9.25	2009	140	1.73	350	1	4.35	6.08	
205	Life Skills	1,151	9.0	19.00	AHU-2	1870	10.83	2009	351	2.03	350	1	2.03	4.06	
206	CLASSROOM	576	9.0	9.00	AHU-2	875	10.13	2009	164	1.90	350	1	4.05	5.95	
215	CLASSROOM	673	9.0	12.00	AHU-2	940	9.31	2009	176	1.75	350	1	3.47	5.21	
216	CLASSROOM	731	9.0	12.00	AHU-2	995	9.07	2009	187	1.70	350	1	3.19	4.89	
218	Science	845	9.0	13.00	AHU-2	1270	10.02	2009	238	1.88	350	1	2.76	4.64	
219	Science	1,064	9.0	17.00	AHU-2	1075	6.74	2009	202	1.26	350	2	4.39	5.65	
224	Science	304	9.0	3.00	AHU-2	160	3.51	2009	30	0.66	350	1	7.68	8.33	
225	Science	856	9.0	11.00	AHU-2	770	6.00	2009	144	1.12	350	2	5.45	6.58	
226	Science Lab	1,070	9.0	15.00	AHU-2	1100	6.85	2009	206	1.29	350	2	4.36	5.65	
233	CLASSROOM	621	9.0	12.00	AHU-2	795	8.53	2009	149	1.60	350	1	3.76	5.36	
234	CLASSROOM	591	9.0	10.00	AHU-2	1250	14.10	2009	234	2.64	350	1	3.95	6.59	
238	CLASSROOM	611	9.0	12.00	AHU-3	905	9.87	2009	136	1.48	350	1	3.82	5.30	
239	CLASSROOM	600	9.0	12.00	AHU-3	905	10.06	2009	136	1.51	350	1	3.89	5.40	
241	CLASSROOM	714	9.0	12.00	AHU-3	870	8.12	2009	131	1.22	350	1	3.27	4.49	
244	Speech	340	9.0	5.00	AHU-3	420	8.24	2009	63	1.24	350	1	6.86	8.10	
245	CLASSROOM	608	9.0	10.00	AHU-3	900	9.87	2009	135	1.48	350	1	3.84	5.32	
246	CLASSROOM	597	9.0	10.00	AHU-3	900	10.05	2009	135	1.51	350	1	3.91	5.42	
251	CLASSROOM	654	9.0	11.00	AHU-3	905	9.23	2009	136	1.38	350	1	3.57	4.95	
252	CLASSROOM	667	9.0	11.00	AHU-3	915	9.15	2009	137	1.37	350	1	3.50	4.87	
253	CLASSROOM	665	9.0	11.00	AHU-3	1125	11.28	2009	169	1.69	350	1	3.51	5.20	
254	CLASSROOM	644	9.0	10.00	AHU-3	1015	10.51	2009	152	1.58	350	1	3.62	5.20	
255	CLASSROOM	653	9.0	11.00	AHU-3	1015	10.36	2009	152	1.55	350	1	3.57	5.13	
256	CLASSROOM	643	9.0	10.00	AHU-3	1130	11.72	2009	170	1.76	350	1	3.63	5.39	
257	CLASSROOM	591	9.0	12.00	AHU-3	900	10.15	2009	135	1.52	350	1	3.95	5.47	
258	CLASSROOM	586	9.0	9.00	AHU-3	875	9.95	2009	131	1.49	350	1	3.98	5.47	
260	CLASSROOM (SGI)	625	9.0	5.00	AHU-5	615	6.56	2009	109	1.16	350	1	3.73	4.89	
261	CLASSROOM	625	9.0	10.00	AHU-5	1255	13.39	2009	221	2.36	350	1	3.73	6.10	
262	CLASSROOM	602	9.0	10.00	AHU-5	1245	13.79	2009	220	2.43	350	1	3.88	6.31	
263	CLASSROOM	660	9.0	11.00	AHU-5	1560	15.76	2009	275	2.78	350	1	3.54	6.32	
264	CLASSROOM	643	9.0	10.00	AHU-5	1385	14.36	2009	244	2.53	350	1	3.63	6.16	
265	CLASSROOM	649	9.0	11.00	AHU-5	1385	14.23	2009	244	2.51	350	1	3.60	6.11	
266	CLASSROOM	643	9.0	10.00	AHU-5	1560	16.17	2009	275	2.85	350	1	3.63	6.48	
267	CLASSROOM	650	9.0	12.00	AHU-5	1265	12.97	2009	223	2.29	350	1	3.59	5.88	
268	CLASSROOM	668	9.0	11.00	AHU-5	1265	12.62	2009	223	2.23	350	1	3.49	5.72	
271	CLASSROOM	663	9.0	11.00	AHU-7	1025	10.31	2009	186	1.87	350	1	3.52	5.39	
272	CLASSROOM	655	9.0	11.00	AHU-7	1030	10.48	2009	187	1.91	350	1	3.56	5.47	
273	CLASSROOM	649	9.0	11.00	AHU-7	1375	14.12	2009	250	2.57	350	1	3.60	6.16	
274	CLASSROOM	672	9.0	11.00	AHU-7	1225	12.15	2009	223	2.21	350	1	3.47	5.68	
275	CLASSROOM	654	9.0	11.00	AHU-7	1185	12.08	2009	215	2.20	350	1	3.57	5.76	
276	CLASSROOM	532	9.0	9.00	AHU-7	600	7.52	2009	109	1.37	350	1	4.39	5.75	
277	CLASSROOM (SGI)	478	9.0	4.00	AHU-7	945	13.18	2009	172	2.40	350	1	4.88	7.28	
277B	CLASSROOM (GJT)	425	9.0	6.00	AHU-7	700	10.98	2009	127	2.00	350	1	5.49	7.49	
278	SPED	704	9.0	11.00	AHU-7	1025	9.71	2009	186	1.76	350	1	3.31	5.08	
280	SPED	621	9.0	11.00	AHU-3	910	9.77	2009	137	1.47	350	1	3.76	5.22	
281	CLASSROOM	442	9.0	7.00	AHU-3	430	6.49	2009	65	0.97	350	1	5.28	6.25	
282	CLASSROOM	638	9.0	12.00	AHU-3	910	9.51	2009	137	1.43	350	1	3.66	5.08	
283	SPED	656	9.0	11.00	AHU-3	915	9.30	2009	137	1.39	350	1	3.56	4.95	
284	CLASSROOM	697	9.0	11.00	AHU-3	930	8.90	2009	140	1.33	350	1	3.35	4.68	
Averages		694				1061	10.32			2.13			3.90	6.03	