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Herbert Hoover Elementary School

Palo Alto Unified School District

School Reopening Report
Evaluation Date: November 3, 2020
Report Date: December 10, 2020

Prepared By:

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1.0 Executive Summary

1.1 Overview

Ecology Action performed functional testing of the HVAC units at Palo Verde Elementary School on 11/3/2020 to focus on whether sufficient outside air ventilation was being supplied to occupied spaces. The evaluation was to determine if the occupied spaces were meeting the minimum indoor air quality (IAQ) guidelines set by PAUSD, referencing CDC, ASHRAE, and Title 24 code.

The following people were involved in the process:

1. Mike Diep, PE
Sr. Mechanical Engineer
2. Aaron Worthy
Project Manager
3. Randy Arenas
PAUSD HVAC Technician

1.2 Process

The following steps were taken to evaluate the occupied spaces at school.

Specifications

1. Room dimensions were measured using laser distance measurements to calculate room area (sq. ft.) as well as volume (cu. ft.)
2. Make and model of HVAC equipment noted
3. Visual verification of filter and filter size

Measurements

1. All windows and doors were closed during testing
2. Outside air (OA) dampers were commanded to minimum position
3. Airflow measurements were taken with flow hood anemometers as well as hot wire anemometer if required. Flows were measured in the occupied space and were as follows:
 - a. Supply air
 - b. Return air
 - c. Outside air
 - i. Calculated based on difference between supply, return, and exhaust
 - ii. Directly measured at HVAC unit when required due to access issue at return air

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1.3 Inspection

1. Outside air dampers were inspected for functionality and position
2. Each outside air damper was commanded to open 100% through the BMS, then returned to its minimum position. If there were issues, they were noted and often repaired on site by districts HVAC technician

2.0 Qualifications

There are 3 main qualifications to determine whether the system is sufficient for reopening.

1. Air filter
 - a. Min. MERV 13 per CASH Covid-19 recommendation
2. Ventilation
 - a. Requires minimum 30 cfm/person per PAUSD agreement to double Title 24 requirements of 15 cfm/person
 - b. Total outside air cfm is based on district determined occupancy in the space.
 - i. Example: If the space is limited to 15 people, then the total outside air cfm required is 450 cfm (30 cfm/person x 15 people)
3. Mechanical Functionality
 - a. The functionality of the mechanical system is important to remotely control the OA dampers if needed. Although, the minimum position is evaluated to determine if sufficient OA is delivered whenever the unit is operating.

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3.0 Results

Results are presented in a table outlining the measurement and evaluation of each room.

To better help understand the table, here are a few items to note:

- i. 3-color ranking – Rows for each room will be highlighted in the following colors to determine performance
 - a. GREEN – No attention required. IAQ and mechanical is sufficient
 - b. YELLOW – Minor attention required. IAQ may still be sufficient
 - c. RED – Major attention required. May not be suitable for occupancy based on IAQ without further filtration or reduction in occupancy
- ii. Actual Room Capacity – This is based on 15 occupants per 1,000 sq. feet of floor space.
 - a. Space dimensions and occupancy quantities that should be noted are highlighted in red text. This may be to show that the area was smaller or larger than the typical room. Also, the room capacity may be modified for the Administration building.
- iii. Sufficient columns – These columns will be highlighted in green if sufficient and red if not.
 - a. MERV Rating
 - i. Based on actual air filters installed
 - b. Ventilation
 - i. Based on Ventilation Required (CFM) column which calculates the minimum cfm based on the Actual Room Capacity.
 1. A “N” will be shown if the measured OA cfm is below the ventilation required cfm.
 - c. Mechanical
 - i. This is to evaluate the operation of the HVAC unit
 1. If the OA damper was functioning based on BMS command and it was set to the appropriate minimum OA damper position, a “Y” will be noted.
 2. A “N” is provided if there is an issue with the mechanical operation. However, the OA damper position can be locked into a minimum position and therefore still pass the OA cfm requirements.
- iv. Air Changes
 - a. Fresh Air Changes per Hour
 - i. Number of air changes per hour of fresh air
 - b. Total Air Changes per Hour
 - i. Number of air changes per hour of total air through

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School	Hoover Elementary School
Evaluation Date	11/3/2020
Report Date	12/10/2020

Color Legend

GREEN	No attention required. IAQ and mechanical is sufficient.
YELLOW	Minor attention required. IAQ may still be sufficient.
Portable	Major attention required. May not be suitable for occupancy based on IAQ without further filtration or reduction in occupancy

30	Cfm/person
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Room ID	Equipment Tag	Type	Manufacturer	Model Number	Filter		Ventilation			Room Specifications				Sufficient?	
					Size (inches)	Currently Installed Rating	Supply (CFM)	Return (CFM)	Outside Air (CFM) ⁵	Floor Area (ft2)	Room Volume (ft3)	Actual Room Capacity (Occupant qty)	Ventilation Required (CFM)	MERV Rating ¹	Ventilation ²
1	Hv-1	Furnace	International comfort	Comfortmaker	16x25x2	MERV-13	1,537	-490	1,047	1,050	13,650	15	450	Y	Y
2	Hv-2	Furnace	International comfort	Comfortmaker	16x25x2	MERV-13	1,767	-495	1,272	1,080	14,040	15	450	Y	Y
3	Hv-3	Furnace	International comfort	Comfortmaker	16x25x2	MERV-13	1,426	-393	1,033	960	12,480	15	450	Y	Y
4	Hv-4	Furnace	International comfort	Comfortmaker	16x25x2	MERV-13	1,613	-480	1,133	960	12,480	15	450	Y	Y
5	Hv-5	Furnace	International comfort	Comfortmaker	16x25x2	MERV 13	1,500	-451	1,049	960	12,480	15	450	Y	Y
6	Hv-6	Furnace	International comfort	Comfortmaker	16x25x2	MERV 13	1,589	-454	1,135	960	12,480	15	450	Y	Y
7	Hv-7	Furnace	International comfort	Comfortmaker	16x25x2	MERV 13	1,497	-461	1,036	960	12,480	15	450	Y	Y
8	Hv-8	Furnace	International comfort	Comfortmaker	16x25x2	MERV 13	1,431	-435	996	960	12,480	15	450	Y	Y
9	Hv-9	Furnace	International comfort	Comfortmaker	16x25x2	MERV 13	1,494	-470	1,024	960	12,480	15	450	Y	Y
10	Hv-10	Furnace	International comfort	Comfortmaker	16x25x2	MERV 13	1,407	-448	959	960	12,480	15	450	Y	Y
11	Hv-11	Furnace	International comfort	Comfortmaker	16x25x2	MERV 13	1,626	-517	1,109	960	12,480	15	450	Y	Y
12	Hv-12	Furnace	International comfort	Comfortmaker	16x25x2	MERV 13	1,524	-456	1,068	960	12,480	15	450	Y	Y
13	Hv-13	Furnace	International comfort	Comfortmaker	16x25x2	MERV 13	1,402	-446	956	960	12,480	15	450	Y	Y
14	Hv-14	Furnace	International comfort	Comfortmaker	16x25x2	MERV 13	1,159	-475	684	960	12,480	15	450	Y	Y
Portable 15	Php-15	Heatpump	Bard	Qtec	16x35x2	MERV 13	930	-847	83	1,365	12,285	15	450	Y	N
Portable 16	Php-16	Heatpump	Bard	Qtec	16x35x2	MERV 13	1,004	-904	100	1,365	0	15	450	Y	N
Portable 17	Php-17	Heatpump	Bard	Qtec	16x35x2	MERV 13	1,022	-912	110	1,365	12,285	15	450	Y	N
Portable 18	Php-18	Heatpump	Bard	Qtec	16x35x2	MERV 13	998	-780	218	1,365	12,285	15	450	Y	N
Portable 19	Php-19	Heatpump	Bard	Qtec	16x35x2	MERV 13	995	-905	90	1,365	12,285	15	450	Y	N
Portable 1	Php-1	Heatpump	Bard				0		0	0	0	15	450	na	na
Portable 2	Php-2	Heatpump	Bard				0		0	0	0	15	450	na	na
Portable 27	Local Control	Heatpump	Bard		16x35x2	MERV-13	1,148	-925	223	897	7,625	15	450	Y	N
Portable 28	Local Control	Heatpump	Bard		16x35x2	MERV-13	1,256	-1,028	228	897	8,073	15	450	Y	N
Portable 29	Local Control	Heatpump	Bard		16x35x2	MERV-13	1,324	-1,089	235	897	8,073	15	450	Y	N
Portable 30	Local Control	Heatpump	Bard		16x35x2	MERV-13	1,417	-1,380	37	903	7,583	15	450	Y	N
Portable 30	Local Control	Heatpump	Bard		16x35x2	MERV-13	1,376	-1,370	6	897	7,176	15	450	Y	N
Portable 31	Local Control	Heatpump	Bard		16x35x2	MERV-13	1,193	-860	333	897	7,176	15	450	Y	N
Portable 32	Local Control	Heatpump	Bard		16x35x2	MERV-13	1,199	-1,040	159	897	7,176	15	450	Y	N
Portable 32	Local Control	Heatpump	Bard		16x35x2	MERV-13	1,209	-850	359	897	7,176	15	450	Y	N
Portable 32	Local Control	Heatpump	Bard		16x35x2	MERV-13	1,272	-1,060	212	897	7,176	15	450	Y	N
Teachers lounge	F-17	Furnace	International comfort	Comfortmaker	16x25x2	MERV-13	927	-467	460	788	7,250	15	450	Y	Y
Office	F-16	Furnace	International comfort	Comfortmaker	16x25x2	MERV-13	833	-375	458	624	5,741	15	450	Y	Y
Principal	F-15	Furnace	International comfort	Comfortmaker	16x25x2	MERV-13	1,195	-740	455	440	4,048	15	450	Y	Y
Library	F-18	Furnace	Reznor		30x16x1	MERV-13	1,639	-414	1,225	2,000	23,400	15	450	Y	Y

1 MERV 13 minimum rating per CASH Covid-19 recommendations.

2 Values based on 2019 Title 24 120.1(c)3 Equation 120.1-G