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El Carmelo 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 10/30/2020 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. Richard Ma, PE
Engineering Director
2. Mike Diep, PE
Sr. Mechanical Engineer
3. Aaron Worthy
Project Manager
4. 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

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- 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

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 filter

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School	El Carmelo Elementary School
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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

Room ID	Equipment Tag	Manufacturer	Model Number	Filter		Ventilation			Room Specifications					Sufficient?	
				Size (inches)	Currently Installed Rating	Supply (CFM)	Return (CFM)	Outside Air (CFM)	Room Height (ft)	Floor Area (ft ²)	Room Volume (ft ³)	Actual Room Capacity (Occupant qty)	Ventilation Required (CFM)	MERV Rating ¹	Ventilation ²
1	HF-1	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	n/a	n/a	530	13	1,371	16,048	15	450	Y	Y
2	HF-2	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	n/a	n/a	652	13	960	12,864	15	450	Y	Y
3	HF-3	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,167	-480	687	13	960	12,864	15	450	Y	Y
4	HF-4	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,256	-360	896	13	960	12,864	15	450	Y	Y
5	HF-5	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,353	-650	703	13	960	12,864	15	450	Y	Y
6	HF-6	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,344	-550	794	13	960	12,864	15	450	Y	Y
7	HF-7	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,118	-444	674	13	960	12,864	15	450	Y	Y
8	HF-8	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,339	-554	785	13	960	12,864	15	450	Y	Y
9	HF-9	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,291	-639	652	13	960	12,864	15	450	Y	Y
10	HF-10	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,403	-632	771	13	960	12,864	15	450	Y	Y
11	BHP-13	Bard	QH422	16x35.5x2	MERV 13	163		35	9	285	2,565	15	450	Y	N
12	BHP-13					211		46	9	288	2,592	15	450	Y	N
13	BHP-13					591		129	9	780	7,020	15	450	Y	N
14	BHP-14	Bard	QH422	16x16x2/16x20x2	MERV 13	994	640	1,634	9	1,365	12,285	15	450	Y	Y
15	BHP-15	Bard	QH422	16x35.5x2	MERV 13	1,001	846	1,847	9	1,365	12,285	15	450	Y	Y
16	HF-13	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,393	-651	742	14	1,248	16,632	15	450	Y	Y
17	HF-14	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,342	-739	603	14	1,248	16,632	15	450	Y	Y
18	HF-15	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,298	-845	453	14	1,248	16,632	15	450	Y	Y
19	HF-16	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,287	-1,015	272	14	1,248	16,632	15	450	Y	N
20	HF-17	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,382	-635	747	14	1,209	16,070	15	450	Y	Y
21	HF-18	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,352	-702	650	14	1,209	16,070	15	450	Y	Y
Admin	HF-19	Modine	HFP100TMR	16x25x2 (4)	MERV 13	2,334	-1,410	924	10	2,300	23,000	15	450	Y	Y
Library	HF-11	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,184	-662	522	14	2,500	35,000	15	450	Y	Y
Library	HF-12	ComfortMaker	GNL100N16C3	20x25x2	MERV 13	1,338	-770	568				15	450	Y	Y
Multi-purpose	Unit Heater	Reznor	n/a	n/a	n/a	n/a	n/a	n/a						N	N

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