City College of San Francisco Evans Center

San Francisco, CA

AIRCRAFT MAINTENANCE TECHNOLOGY (AMT) ENGINE EQUIPMENT NOISE STUDY

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INTRODUCTION

This report summarizes our analysis of selected airplane engines and other equipment to be used at the Aircraft Maintenance Technology (AMT) facility proposed for the CCSF Evans Center. The equipment is for students to test and learn about aircraft engines and other components. Currently, this equipment is located at San Francisco International Airport (SFO), but we understand that airport expansion plans have caused CCSF to plan to move the equipment. This report quantifies the noise environment at the project site and evaluation engine noise in comparison to the City noise ordinance Sections 2909(b) and 2909(d).

ACOUSTICAL CRITERIA AND NOISE ENVIRONMENT

San Francisco Noise Ordinance – Section 2090(b)

Section 2909(b) limits Commercial and Industrial property noise to no more than eight dBA[1] above the ambient at any point outside of the property plane. Ambient is defined as the lowest sound level repeating itself during a minimum ten-minute period. We have used the minimum hourly L90[2] as a representation of ambient for our analyses, consistent with City-published noise measurement guidelines. For the purposes of this chapter, in no case shall the ambient be considered or determined to be less than 35 dBA for interior residential noise, and 45 dBA exterior noise.

The Evans Center site is zoned as PDR-2 (Production, Distribution, and Repair), with other PDR-zoned parcels immediately adjacent to it. The closest residential parcels are on Mendell Street three blocks to the south (about 800-feet).

Existing Noise Environment at Evans Center

To quantify the existing noise environment at the Evans Center site, we conducted two long-term measurements and one simultaneous short-term (15-min) measurement between 9 and 11 December 2020. The measured daytime noise levels and a description of the monitor locations are shown below. Daytime noise levels only were evaluated because that is when CCSF AMT's classes that use the engines take place.

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1 A-Weighted Sound Level – The A-weighted sound pressure level, expressed in decibels (dB). Sometimes the unit of sound level is written as dB(A). A weighting is a standard weighting that accounts for the sensitivity of human hearing to the range of audible frequencies. People perceive a 10 dB increase in sound level to be twice as loud.

2 L_n – The sound level exceeded for a stated percentage (n) of a specified measurement period as described in ASTM E1686. L_{10}, L_{50}, and L_{90} are the levels exceeded 10, 50, and 90 percent of the time, respectively.

Table 1: On-site Sound Measurement Data

Monitor	Location	Minimum Daytime Measured Hourly L_{90}
LT-1	Along Mendell Street, 12 feet above grade.	52 dBA
LT-2	Along Evans Street, 12 feet above grade.	55 dBA
ST-1	Near the residences, 12 feet above grade.	50* dBA

*Estimated sound levels based on simultaneous measurements at short and long-term locations.

The allowable sound level at the surrounding PDR property lines/planes would be 8 dBA louder (more) than the measured data given above.

AIRPLANE ENGINE EQUIPMENT NOISE LEVELS

The following planned equipment and their corresponding sound levels are given in Table 2 below. Sound levels were measured at the current Aircraft Maintenance Technology (AMT) Facility at the San Francisco International Airport (SFO) on 8 December 2020. AMT's Pratt & Whitney R-985 Wasp radial engine was not able to be operated during our visit. However, CCSF staff obtained for us a US Department of Transportation (DoT) report[3] summarizing noise levels of a similar Wasp engine in a De Havilland DHC-2 Beaver aircraft for our use in this study. Photos of the equipment are included in the Appendix.

Table 2: AMT Equipment Sound Data

Equipment	Sound Pressure Level (5-feet)	Predicted Sound Pressure Levels at Property Plane	Data Source
Jet Engine	105 dBA	89 dBA	On site at AMT-SFO
Air Compressor	84 dBA	65 dBA	On site at AMT-SFO
Prop Plane Piston Engine	107 dBA	92 dBA	On site at AMT-SFO
Beaver Radial Engine	131 dBA	111 dBA	DoT Report

PROPERTY LINE NOISE ANALYSIS

Section 2909(b)

Given the equipment sound data and the distances to the nearest property lines based on the plans and markups you sent dated 11 December 2020, which show the engines and other equipment outside in a yard adjacent to the Evans Center, with a chain link fence partially around it.

We calculated the resulting sound levels from all the equipment running simultaneously and individually during daytime and calculated the resulting sound levels and the property lines. CCSF indicated that several pieces of equipment could be operating simultaneously. Table 3 shows the calculated sound levels at each property line without any mitigation.

Chapman Sound Noise Measurements" DOT-VNTSC-FAA-11-11 Final Report, published January 2012. Aircraft Engine Noise

Table 3: Calculated Aircraft Engine A-weighted Sound Pressure Levels and Ordinance Allowable Levels without Mitigation

Location	Daytime Equipment Sound Levels at Property Plane (Total), dBA	Daytime Allowable Sound Level per Noise Ordinance
West Property Line	112	67
Nearest Residence	66	67

As shown in Table 3, the scheduled mechanical equipment is calculated to exceed the San Francisco Noise Ordinance by 33 dB at the closest property planes without any additional mitigation. Additionally, the expected noise level at the closest residences is shown to be 66 dBA, which while not a noise ordinance requirement, it should still be noted.

MITIGATION RECOMMENDATIONS

The recommended mitigation measures below would help reduce the noise levels to approximately 95 dBA. As calculated, it is likely not feasible to reduce the noise levels to meet the noise ordinance at the west property line with all of the equipment running at the same time. We recommend that the equipment run one at time when it is being utilized and that a conversation with the City for a special permit or noise ordinance variance be explored.

1. We recommend changing the chain link fence to be a CMU wall with the doors moved to the side if possible. Otherwise, we recommend that the doors be sound-gasketed as shown in Figure 1.
2. Additionally, we recommend providing localized sound-reducing barriers that extend at least one foot above the equipment. There are aircraft run-up noise barriers that could be appropriate for this project installed close around the equipment, such as those by IAC Acoustics (https://www.iacacoustics.global/aviation-airport-solutions/airport-products/ground-run-up-enclosures-gres/).
3. The barriers can be prefabricated. Consider the following systems, all of which could incorporate person doors into the assemblies:
    - Silent Screen Panels by Empire (http://www.empireacoustical.com/Acoustical_Panels/Index.htm)
    - Modular Acoustical Metal Panels from IMI Acoustics corporation (http://www.imiac.com/ap.html)
    - Kinetics Noise Control (https://kineticsnoise.com/noiseblock/barrier_walls.html)
    - Noise Barriers LLC QuietSlide (https://www.noisebarriers.com/sliding.html)
4. Alternatively, field-built barriers could be used provided they meet the following criteria:
    - Minimum surface density of 4 psf and having weather-resistant sound-absorbing panels on the inside face with a minimum NRC[4] of 0.80 (e.g., Tedlar-wrapped sound absorbing panels by CMA).

[4] NRC (Noise Reduction Coefficient) – A single-number rating defined in ASTM C423 that quantifies the sound absorbing

performance of a material. NRC is calculated by averaging the material's octave-band sound absorption coefficients in the

Many constructions could meet the surface density requirement. For example, a stud wall with exterior-grade plywood sheathing and a stucco finish (or two layers of 5/8-inch thick plywood) would meet this requirement.

- The barrier should be free of cracks and drainage holes/slots along the bottom of the barrier be kept to a minimum. Where needed, they should be covered by 1 psf mass-loaded vinyl flaps (e.g., Kinetics KNM-100) so water can flow around the vinyl and still drain
- Joints between sheathing layers be offset by 16 inches minimum.

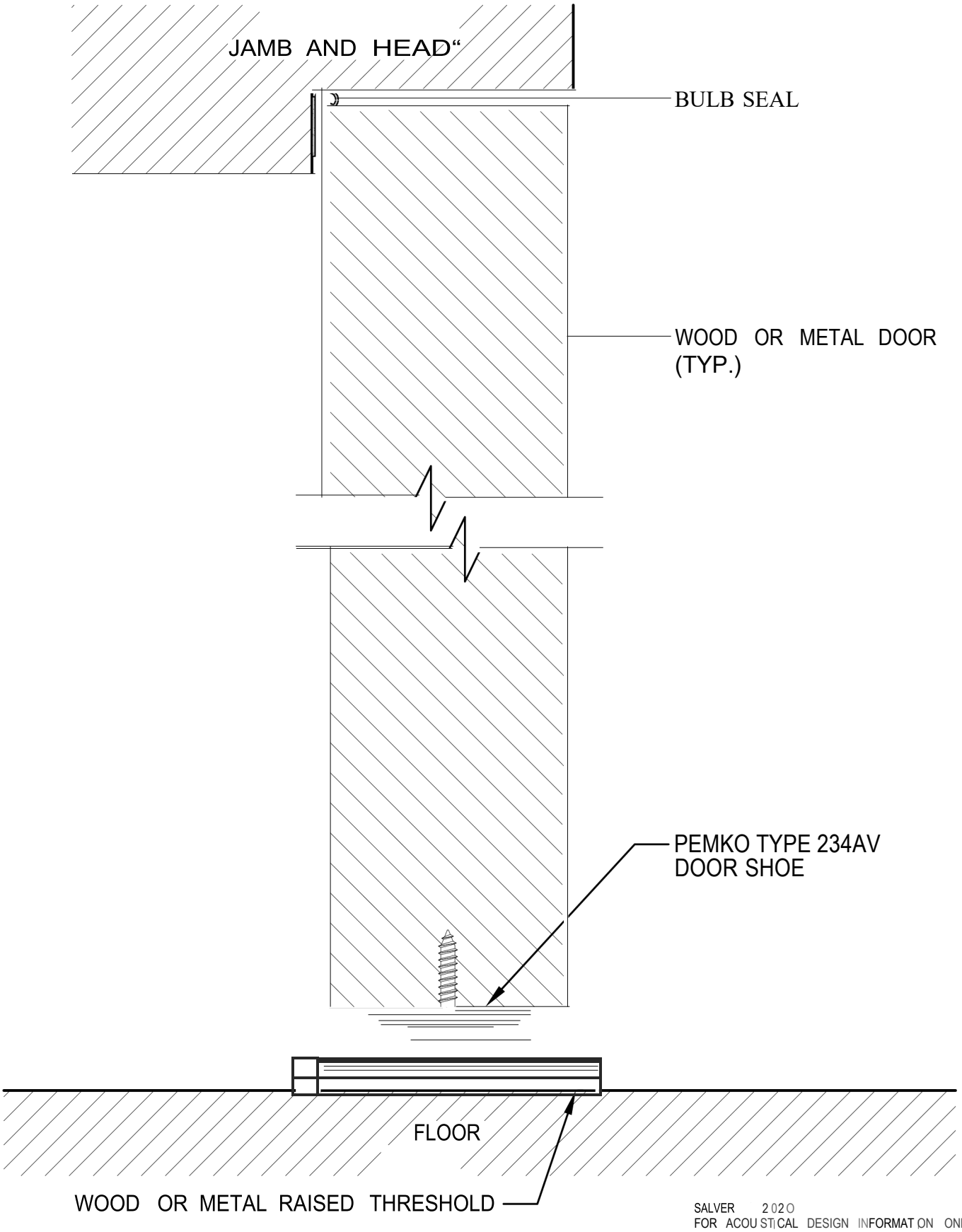
* * *

This concludes our current comments. Once you have had a chance to review, please forward to other relevant parties. Please let us know if you have any questions.

Enclosures as noted

speech frequency range – i.e., at 250, 500, 1000, and 2000 hertz. An NRC of 1.00 represents 100% absorption (no sound reflections). An updated version of the NRC is SAA (sound absorption average).

APPENDIX – SELECTED PHOTOGRAPHS



SALVER 2020
FOR ACOUSTICAL DESIGN INFORMATION ONLY

ACOUSTICALLY — GASKETED DOOR

FIGURE 1

56A
5.1.1, 5.1.2 010714