Redlands Boulevard and Hemlock Avenue Gas Station Project

Noise and Vibration Study

prepared for

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1 Project Description and Impact Summary

1.1 Introduction

This study analyzes the potential noise and vibration impacts of the proposed Redlands Boulevard and Hemlock Avenue Gas Station Project (project) in the City of Moreno Valley, Riverside County, California. Rincon Consultants, Inc. (Rincon) prepared this study for A&S Engineering, Inc. (applicant) for use in support of environmental documentation pursuant to the California Environmental Quality Act (CEQA). The purpose of this study is to analyze the project's noise and vibration impacts related to both temporary construction activity and long-term operation of the project. Table 1 provides a summary of project impacts.

Table 1 Summary of Impacts

Impact Statement	Level of Significance	Applicable Recommendations
Would the project result in generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	Less Than Significant Impact	None
Would the project result in generation of excessive groundborne vibration or groundborne noise levels?	Less Than Significant Impact	None
For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	No Impact	None

1.2 Project Summary

Project Location

The 6.9-acre project site is located in the city of Moreno Valley in Riverside County, California. The project site lies south of the intersection of Redlands Boulevard and Hemlock Avenue (Accessor Parcel Number 488-310-012). The project site is currently vacant. Surrounding land uses include residences and commercial uses to the south and vacant land to the west and north. Redlands Boulevard borders the project to the east. In addition, the Redlands and Hemlock Booster Station is adjacent to the project's eastern boundary. State Route (SR) 60 is approximately 560 feet south of the project site. Figure 1 shows the project site's regional location and Figure 2 shows an aerial view of the project site and surrounding area.

Figure 1 Regional Location

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Project Location

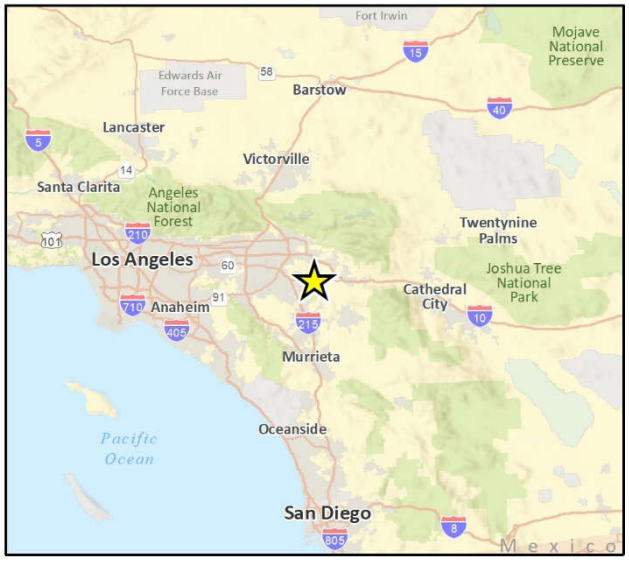
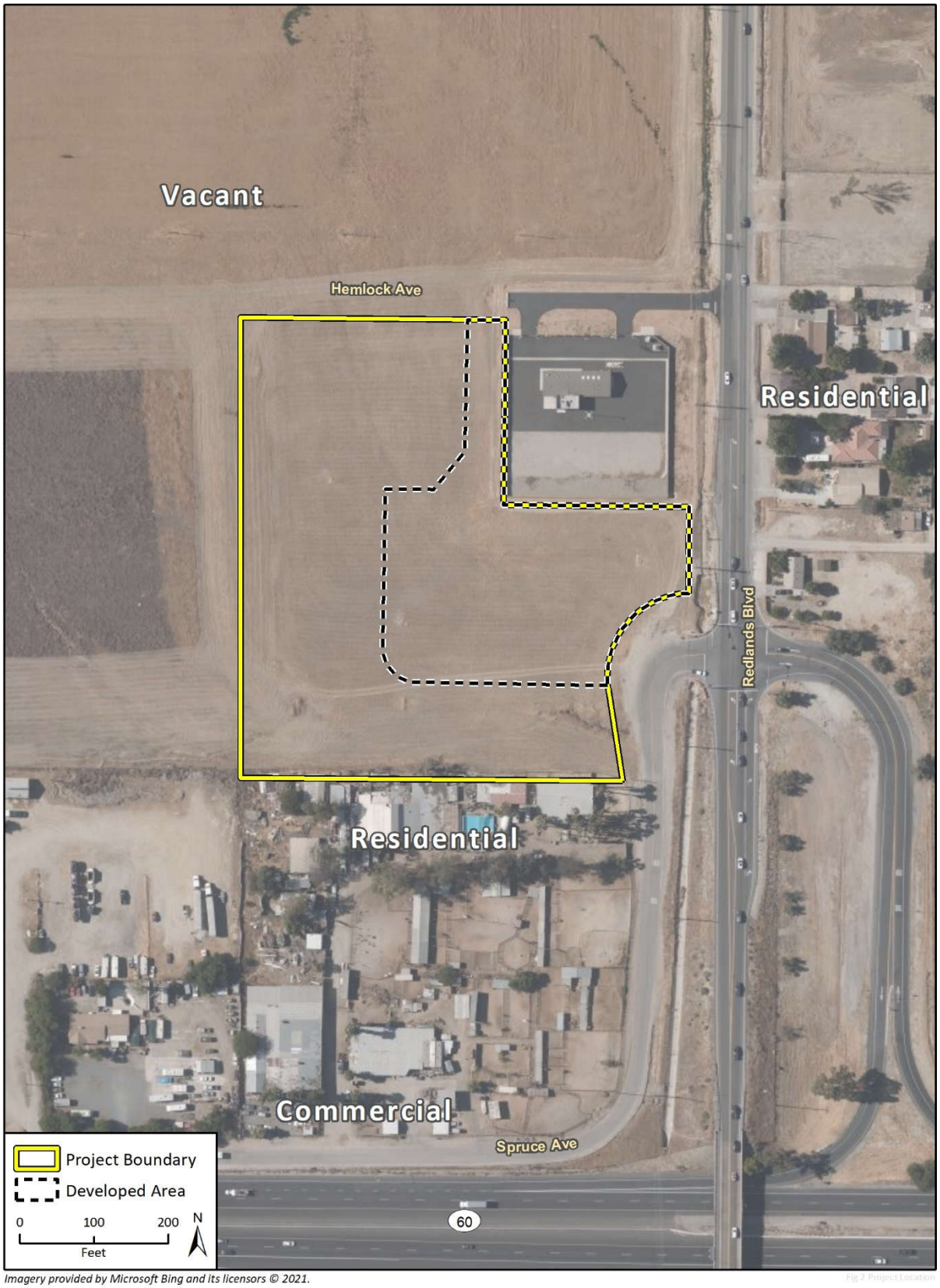


Figure 2 Project Site Location



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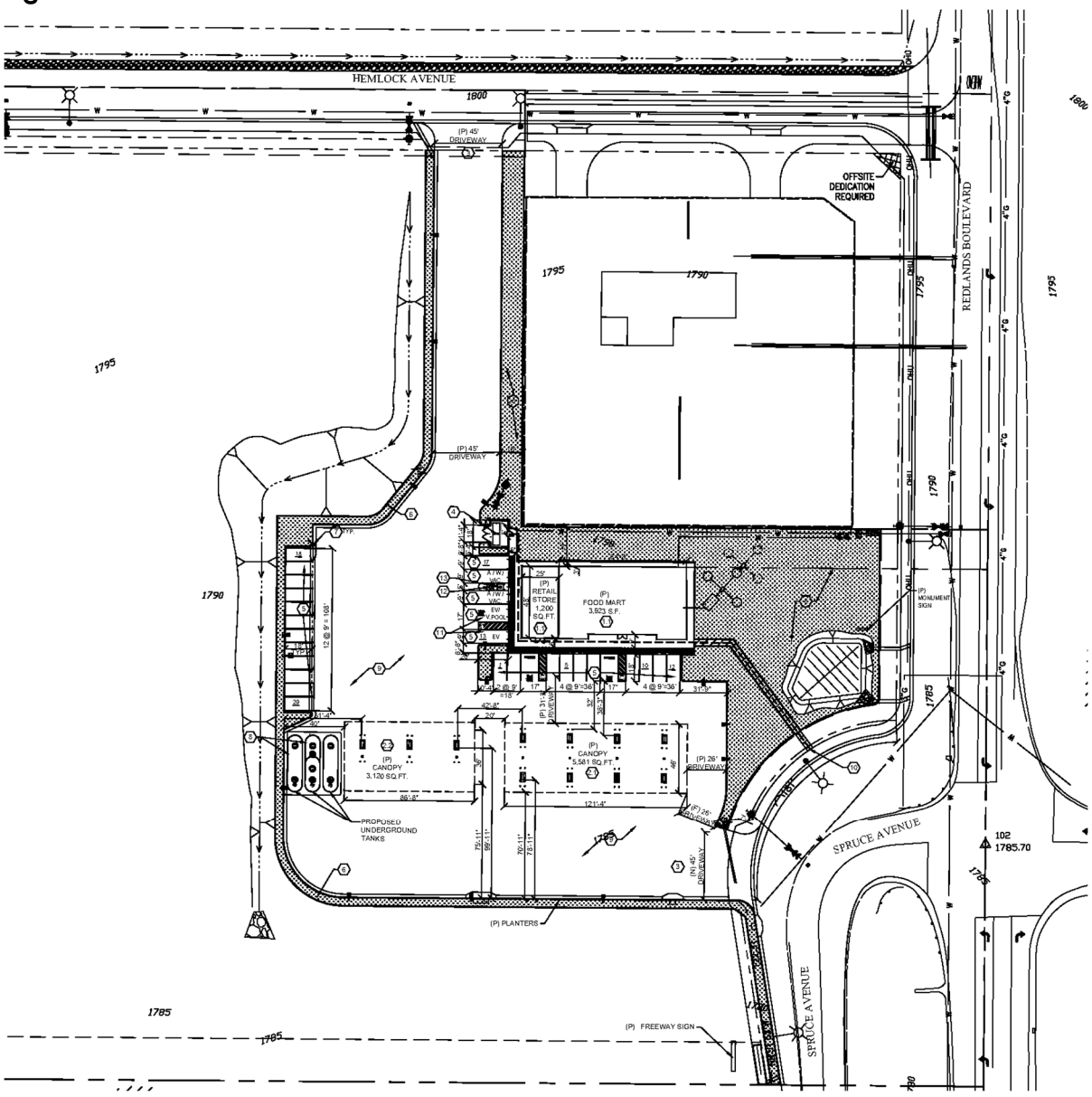
Project Description

The project would include the development of a gas station with 11 fueling stations (16 total dispensers), a 3,923 square foot food mart with 1,200 square feet of office and storage in the mezzanine level, and a 1,200 square foot retail store adjacent to the food mart. Of the 16 dispensers, 14 of the dispensers would be gasoline dispensers and would be underneath a 5,581 square foot canopy. The remaining 2 dispensers would be diesel dispensers underneath a 3,120 square foot canopy. An 18 x 12.5 x 6 foot trash enclosure would also be constructed adjacent to the western boundary of the food mart/retail store. The project would provide a total of 29 parking spaces in a surface lot with two stalls for electric vehicle parking. Additional improvements include curb and sidewalk enhancements and landscaping. Access to the project site would be provided from two driveways with one off Redlands Boulevard and the other driveway off of Hemlock Avenue. Of the 6.9-acre site, only approximately 2.4 acres would be developed; the remaining 4.5 acres would remain undeveloped. An additional 0.63 acres would be improved for off-site modifications (e.g., storm drain improvements) for a total disturbed area of 7.53 acres. Figure 3 shows the project plan layout.

Construction

Construction is expected to begin in January 2022 and estimated to be completed in December 2022 for a total construction period of 12 months. Construction activities would include site preparation, grading, building construction, paving, and architectural coating (e.g., painting). During grading, approximately 300 cubic yards of soil would be exported. All construction would occur within the current conceptual limits of the project.

Figure 3 Site Plan



2 Background

2.1 Overview of Sound Measurement

Sound is a vibratory disturbance created by a moving or vibrating source, which is capable of being detected by the hearing organs. Noise is defined as sound that is loud, unpleasant, unexpected, or undesired and may therefore be classified as a more specific group of sounds. The effects of noise on people can include general annoyance, interference with speech communication, sleep disturbance, and, in the extreme, hearing impairment (California Department of Transportation [Caltrans] 2013).

Noise levels are commonly measured in decibels (dB) using the A-weighted sound pressure level (dBA). The A-weighting scale is an adjustment to the actual sound pressure levels so that they are consistent with the human hearing response, which is most sensitive to frequencies around 4,000 Hertz and less sensitive to frequencies around and below 100 Hertz (Kinsler, et. al. 1999). Decibels are measured on a logarithmic scale that quantifies sound intensity in a manner similar to the Richter scale used to measure earthquake magnitudes. A doubling of the energy of a noise source, such as doubling of traffic volume, would increase the noise level by 3 dBA; reducing the energy in half would result in a 3 dBA decrease (Crocker 2007).

Human perception of noise has no simple correlation with sound energy: the perception of sound is not linear in terms of dBA or in terms of sound energy. Two sources do not "sound twice as loud" as one source. It is widely accepted that the average healthy ear can barely perceive changes of 3 dBA, increase or decrease (i.e., twice the sound energy); that a change of 5 dBA is readily perceptible (8 times the sound energy); and that an increase (or decrease) of 10 dBA sounds twice (half) as loud ([10.5x the sound energy] Crocker 2007).

Sound changes in both level and frequency spectrum as it travels from the source to the receiver. The most obvious change is the decrease in level as the distance from the source increases. The manner in which noise reduces with distance depends on factors such as the type of sources (e.g., point or line, the path the sound will travel, site conditions, and obstructions). Noise levels from a point source typically attenuate, or drop off, at a rate of 6 dBA per doubling of distance (e.g., construction, industrial machinery, ventilation units). Noise from a line source (e.g., roadway, pipeline, railroad) typically attenuates at about 3 dBA per doubling of distance (Caltrans 2013). The propagation of noise is also affected by the intervening ground, known as ground absorption. A hard site, such as a parking lot or smooth body of water, receives no additional ground attenuation and the changes in noise levels with distance (drop-off rate) result from simply the geometric spreading of the source. An additional ground attenuation value of 1.5 dBA per doubling of distance applies to a soft site (e.g., soft dirt, grass, or scattered bushes and trees) (Caltrans 2013). Noise levels may also be reduced by intervening structures. The amount of attenuation provided by this "shielding" depends on the size of the object and the frequencies of the noise levels. Natural terrain features such as hills and dense woods, and man-made features such as buildings and walls, can substantially alter noise levels. Generally, any large structure blocking the line of sight will provide at least a 5-dBA reduction in source noise levels at the receiver (Federal Highway Administration [FHWA] 2011). Structures can substantially reduce exposure to noise as well. The FHWA's guidelines indicate that modern building construction generally provides an exterior-to-interior noise level reduction of 20 to 35 dBA with closed windows.

The impact of noise is not a function of loudness alone. The time of day when noise occurs and the duration of the noise are also important factors of project noise impact. Most noise that lasts for more than a few seconds is variable in its intensity. Consequently, a variety of noise descriptors have been developed. One of the most frequently used noise metrics is the equivalent noise level (L_{eq}); it considers both duration and sound power level. L_{eq} is defined as the single steady A-weighted level equivalent to the same amount of energy as that contained in the actual fluctuating levels over time. Typically, L_{eq} is summed over a one-hour period. L_{max} is the highest root mean squared (RMS) sound pressure level within the sampling period, and L_{min} is the lowest RMS sound pressure level within the measuring period (Crocker 2007).

Noise that occurs at night tends to be more disturbing than that occurring during the day. Community noise is usually measured using Day-Night Average Level (L_{dn}), which is the 24-hour average noise level with a +10 dBA penalty for noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours; it is also measured using Community Noise Equivalent Level (CNEL), which is the 24-hour average noise level with a +5 dBA penalty for noise occurring from 7:00 p.m. to 10:00 p.m. and a +10 dBA penalty for noise occurring from 10:00 p.m. to 7:00 a.m. (Caltrans 2013). Noise levels described by L_{dn} and CNEL usually differ by about 1 dBA or less. The relationship between the peak-hour L_{eq} value and the L_{dn}/CNEL depends on the distribution of traffic during the day, evening, and night. Quiet suburban areas typically have CNEL noise levels in the range of 40 to 50 dBA, while areas near arterial streets are in the 50 to 60-plus CNEL range. Normal conversational levels are in the 60 to 65-dBA L_{eq} range; ambient noise levels greater than 65 dBA L_{eq} can interrupt conversations (Federal Transit Administration [FTA] 2018).

2.2 Vibration

Groundborne vibration of concern in environmental analysis consists of the oscillatory waves that move from a source through the ground to adjacent structures. The number of cycles per second of oscillation makes up the vibration frequency, described in terms of Hz. The frequency of a vibrating object describes how rapidly it oscillates. The normal frequency range of most groundborne vibration that can be felt by the human body starts from a low frequency of less than 1 Hz and goes to a high of about 200 Hz (Crocker 2007).

While people have varying sensitivities to vibrations at different frequencies, in general they are most sensitive to low-frequency vibration. Vibration in buildings, such as from nearby construction activities, may cause windows, items on shelves, and pictures on walls to rattle. Vibration of building components can also take the form of an audible low-frequency rumbling noise, referred to as groundborne noise. Groundborne noise is usually only a problem when the originating vibration spectrum is dominated by frequencies in the upper end of the range (60 to 200 Hz), or when foundations or utilities, such as sewer and water pipes, physically connect the structure and the vibration source (FTA 2018). Although groundborne vibration is sometimes noticeable in outdoor environments, it is almost never annoying to people who are outdoors. The primary concern from vibration is that it can be intrusive and annoying to building occupants and vibration-sensitive land uses.

Vibration energy spreads out as it travels through the ground, causing the vibration level to diminish with distance away from the source. High-frequency vibrations diminish much more rapidly than low frequencies, so low frequencies tend to dominate the spectrum at large distances from the source. Discontinuities in the soil strata can also cause diffractions or channeling effects that affect the propagation of vibration over long distances (Caltrans 2020). When a building is affected by

vibration, a ground-to-foundation coupling loss will usually reduce the overall vibration level. However, under rare circumstances, the ground-to-foundation coupling may actually amplify the vibration level due to structural resonances of the floors and walls.

Vibration amplitudes are usually expressed in peak particle velocity (PPV) or RMS vibration velocity. The PPV and RMS velocity are normally described in inches per second. PPV is defined as the maximum instantaneous positive or negative peak of a vibration signal. PPV is often used in monitoring of blasting vibration because it is related to the stresses that are experienced by buildings (Caltrans 2020).

2.3 Sensitive Receivers

Noise exposure goals for various types of land uses reflect the varying noise sensitivities associated with those uses. Sensitive land uses are generally defined as locations where people reside or where the presence of noise could adversely affect the use of the land. The City of Moreno Valley General Plan list of noise sensitive uses includes residences, motels and hotels, nursing homes, auditoriums, natural areas, parks, and outdoor recreation (City of Moreno Valley 2021). Sensitive receivers in the area include the single-family residences located across Redlands Boulevard to the east of the project site and office zoned single-family residences adjacent to the south of the project site.

Vibration sensitive receivers are similar to noise sensitive receivers, such as residences and institutional uses (e.g., schools, libraries, and religious facilities). The General Plan does not identify vibration sensitive receivers, however concert halls, hospitals, libraries, research operations, residential areas, schools, and offices would also be considered vibration sensitive uses. Vibration sensitive receivers also include buildings where vibrations may interfere with vibration-sensitive equipment, affected by levels that may be well below those associated with human annoyance (FTA 2018; Caltrans 2013).

2.4 Project Noise Setting

The most common source of noise in the project site vicinity is vehicular traffic from Redlands Boulevard, Spruce Avenue, and SR 60. To characterize ambient sound levels at and near the project site, two 15-minute sound level measurements were conducted on March 16, 2021. Noise Measurement (NM) 1 was taken at the central eastern edge of the project site to capture noise levels from Redlands Boulevard across the street from existing single-family residences. NM2 was taken at the central southern edge of the project site to capture ambient noise levels at the adjacent residences due to Spruce Avenue and SR 60 traffic noise. Table 2 summarizes the results of the noise measurement, and Table 3 shows the recorded traffic volumes from the noise measurement.

Table 2 Project Site Vicinity Sound Level Monitoring Results

Measurement Location	Measurement Location	Sample Times	Approximate Distance to Primary Noise Source	L_{eq} (dBA)	Lmin (dBA)	Lmax (dBA)
NM1	Central Eastern Property Boundary, adjacent to Redlands Boulevard	10:00 – 10:15 a.m.	Approximately 100 feet to centerline of Redlands Boulevard	61	52	72
NM2	Central Southern Property Boundary	9:31 – 9:46 a.m.	Approximately 240 feet from Spruce Avenue	54	49	60

Detailed sound level measurement data are included in Appendix A.

Table 3 Sound Level Monitoring Traffic Counts

Measurement	Roadway	Traffic	Autos	Medium Trucks	Heavy Trucks
NM1	Redlands Boulevard	15-minute count	132	7	4
		One-hour Equivalent	528	28	16
Percent			**92%**	5%	**3%**
NM2	Spruce Avenue	15-minute count	6	3	1
		One-hour Equivalent	16	12	4
Percent			**50%**	**38%**	**12%**

Detailed sound level measurement data are included in Appendix A.

2.5 Applicable Regulatory Setting

Federal

FTA Transit and Noise Vibration Impact Assessment Manual

The FTA provides reasonable criteria for assessing construction noise impacts based on the potential for adverse community reaction in their *Transit and Noise Vibration Impact Assessment Manual* (FTA 2018). For residential, commercial, and industrial uses, the daytime noise threshold is 80 dBA L_{eq}, 85 dBA L_{eq}, and 90 dBA L_{eq} for an 8-hour period, respectively.

State

California regulates freeway noise, sets standards for sound transmission, provides occupational noise control criteria, identifies noise standards, and provides guidance for local land use compatibility. State law requires each county and city to adopt a General Plan that includes a Noise Element prepared per guidelines adopted by the Governor's Office of Planning and Research. The purpose of the Noise Element is to limit the exposure of the community to excessive noise levels. CEQA requires all known environmental effects of a project be analyzed, including environmental noise impacts.

California Noise Control Act of 1973

California Health and Safety Code Sections 46000 through 46080, known as the California Noise Control Act, find that excessive noise is a serious hazard to public health and welfare and that exposure to certain levels of noise can result in physiological, psychological, and economic damage.

The act also finds that there is a continuous and increasing bombardment of noise in urban, suburban, and rural areas. The California Noise Control Act declares that the State of California has a responsibility to protect the health and welfare of its citizens by the control, prevention, and abatement of noise. It is the policy of the State to provide an environment for all Californians that is free from noise that jeopardizes their health or welfare.

City of Moreno Valley Noise Standards

The Noise Element of the City of Moreno Valley General Plan provides a description of existing noise levels and sources and incorporates comprehensive goals and policies. The General Plan includes the Community Noise Compatibility Matrix, which establishes acceptable noise, conditionally acceptable, normally unacceptable, and clearly unacceptable noise levels for various land uses. Ambient noise levels up to 70 dBA CNEL are normally acceptable and ambient noise levels up to 77.5 dBA CNEL are conditionally acceptable for commercial development (City of Moreno Valley 2021). The following goals and policies from the Noise Element applicable to the project:

Goal N-1: Design for a pleasant, healthy sound environment conducive to living and working.

Policies:

> N.1-2: Guide the location and design of transportation facilities, industrial uses, and other potential noise generators to minimize the effects of noise on adjacent land uses.
>
> N.1-3: Apply the community noise compatibility standards (Table N-1) to all new development and major redevelopment projects outside the noise and safety compatibility zones established in the March Air Reserve Base/ Inland Port Airport Land Use Compatibility (ALUC) Plan in order to protect against the adverse effects of noise exposure. Projects within the noise and safety compatibility zones are subject to the standards contained in the ALUC Plan.
>
> N.1-4: Require a noise study and/or mitigation measures if applicable for all projects that would expose people to noise levels greater than the “normally acceptable” standard and for any other projects that are likely to generate noise in excess of these standards.
>
> N.1-5: Noise impacts should be controlled at the noise source where feasible, as opposed to at receptor end with measures to buffer, dampen, or actively cancel noise sources. Site design, building orientation, building design, hours of operation, and other techniques, for new developments deemed to be noise generators shall be used to control noise sources.
>
> N.1-6: Require noise buffering, dampening, or active cancellation, on rooftop or other outdoor mechanical equipment located near residences, parks, and other noise sensitive land uses.

Goal N-2: Ensure that noise does not have a substantial, adverse effect on the quality of life in the community.

Policies:

> N.2-1: Use the development review process to proactively identify and address potential noise compatibility issues.
>
> N.2-2: Continue to work with community members and business owners to address noise complaints and ensure voluntary resolution of issues through the enforcement of Municipal Code provisions.

N.2-3: Limit the potential noise impacts of construction activities on surrounding land uses through noise regulations in the Municipal Code that address allowed days and hours of construction, types of work, construction equipment, and sound attenuation devices.

The Noise Ordinance included in Chapter 11.80 of the Moreno Valley Municipal Code provides performance standards and noise control guidelines for operational activities and for construction activities, as described below.

Operational Noise Standards

Moreno Valley Municipal Code Section 11.80.030.C, Nonimpulsive Sound Decibel Limits, provides the following restriction:

> No person shall maintain, create, operate or cause to be operated on private property any source of sound in such a manner as to create any nonimpulsive sound which exceeds the limits set forth for the source land use category (as defined in Section 11.80.020) in Table 11.80.030-2 (Table 5 of this report) when measured at a distance of two hundred (200) feet or more from the real property line of the source of the sound, if the sound occurs on privately owned property, or from the source of the sound, if the sound occurs on public right-of-way, public space or other publicly owned property. Any source of sound in violation of this subsection shall be deemed prima facie to be a noise disturbance. (Moreno Valley n.d. Section 11.80.030.C)

For industrial and commercial land uses, based on the commercial land use standard of Moreno Valley Municipal Code Table 11.80.030-2 (Table 5 of this report), the operational noise level limits are 65 dBA L_{eq} during the daytime hours (8:00 a.m. to 10:00 p.m.) and 60 dBA L_{eq} during the nighttime hours (10:00 p.m. to 8:00 a.m.). Therefore, at a distance of 200 feet from the property line, operational noise from commercial and industrial buildings is not permitted to exceed 65 dBA L_{eq} during the day and 60 dBA L_{eq} during the night.

A. **General Prohibition.** It is unlawful and a violation of this chapter to maintain, make, cause, or allow the making of any sound that causes a noise disturbance, as defined in Section 11.80.020.

B. **Sound Causing Permanent Hearing Loss**

   1. **Sound level limits.** Based on statistics from the Center for Disease Control and Prevention and the National Institute for Occupational Safety and Health, Table 1 (Table 4 of this report) specifies sound level limits which, if exceeded, will have a high probability of producing permanent hearing loss in anyone in the area where the sound levels are being exceeded. No sound shall be permitted within the city which exceeds the parameters set forth in Table 11.80.030-1 (Table 4 of this report), of this chapter:

Table 4 City of Moreno Valley Maximum Continuous Sound Levels[1]

Duration per Day Continuous Hours	Sound level [dbA]
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25	115

[1] When the daily sound exposure is composed of two or more periods of sound exposure at different levels, the combined effect of all such periods shall constitute a violation of this section if the sum of the percent of allowed period of sound exposure at each level exceeds 100 percent.

Source: Moreno Valley Municipal Code, Title 11 Peace, Morals and Safety, Table 11.80.030-1.

C. **Non-impulsive Sound Decibel Limits.** No person shall maintain, create, operate or cause to be operated on private property any source of sound in such a manner as to create any non-impulsive sound which exceeds the limits set forth for the source land use category (as defined in Section 11.80.020) in Table 11.80.030-2 (Table 5 of this report), when measured at a distance of two hundred (200) feet or more from the real property line of the source of the sound, if the sound occurs on privately owned property, or from the source of the sound, if the sound occurs on public right-of-way, public space or other publicly owned property. Any source of sound in violation of this subsection shall be deemed prima facie to be a noise disturbance.

Table 5 City of Moreno Valley Maximum Sound Levels (in dBA) for Source Land Uses

Residential		Commercial	
Daytime	Nighttime	Daytime	Nighttime
60	55	65	60

Source: Moreno Valley Municipal Code, Title 11 Peace, Morals and Safety, Table 11.80.030-2.

D. **Specific Prohibitions.** In addition to the general prohibitions set out in subsection A of this section, and unless otherwise exempted by this chapter, the following specific acts, or the causing or permitting thereof, are regulated as follows:

7 **Construction and Demolition.** No person shall operate or cause the operation of any tools or equipment used in construction, drilling, repair, alteration or demolition work between the hours of 8:00 p.m. and 7:00 a.m. the following day such that the sound there from creates a noise disturbance, except for emergency work by public service utilities or for other work approved by the city manager or designee. This section shall not apply to the use of power tools as provided in subsection (D)(9) of this section.

9 **Power Tools.** No person shall operate or permit the operation of any mechanically, electrically or gasoline motor driven tool during nighttime hours so as to cause a noise disturbance across a residential real property boundary.

3 Methodology

3.1 Construction Noise

Construction noise was estimated using the FHWA Roadway Construction Noise Model (RCNM) (FHWA 2006). RCNM predicts construction noise levels for a variety of construction operations based on empirical data and the application of acoustical propagation formulas. Using RCNM, construction noise levels were estimated at noise sensitive receivers near the project site. RCNM provides reference noise levels for standard construction equipment, with an attenuation rate of 6 dBA per doubling of distance for stationary equipment.

Variation in power imposes additional complexity in characterizing the noise source level from construction equipment. Power variation is accounted for by describing the noise at a reference distance from the equipment operating at full power and adjusting it based on the duty cycle of the activity to determine the L_{eq} of the operation (FHWA 2006). Each phase of construction has a specific equipment mix, depending on the work to be accomplished during that phase. Each phase also has its own noise characteristics; some will have higher continuous noise levels than others, and some have high-impact noise levels.

Construction activity would result in temporary noise in the project site vicinity, exposing surrounding nearby receivers to increased noise levels. Construction noise would typically be higher during the heavier periods of initial construction (i.e., site preparation and grading) and would be lower during the later construction phases (i.e., building construction and paving). Typical heavy construction equipment during project grading could include dozers, loaders, graders, and dump trucks. It is assumed that diesel engines would power all construction equipment. Construction equipment would not all operate at the same time or location. In addition, construction equipment would not be in constant use during the 8-hour operating day.

Project construction would occur nearest to the office-zoned single-family residences to the south of the project site. Over the course of a typical construction day, construction equipment would be located as close as 50 feet to the properties but would typically be located at an average distance farther away due to the nature of construction and the lot size of the project. For example, during a typical construction day, the equipment may operate across the horizontal distance of the site (150 to 350 feet) from a nearby noise receiver to the south of the project site. Single family residential uses are located across Redlands Boulevard to the east of the project site. Construction equipment would be located as close as 100 feet to these properties but would typically operate at an average distance of 200 feet. Therefore, it is assumed that over the course of a typical construction day the construction equipment would operate at an average distance of 150 feet from the office-zoned single-family residences to the south and 200 feet from single family residences to the east of the project site.

Construction noise is typically loudest during activities that involve excavation and move soil, such as site preparation and grading. A potential high-intensity construction scenario includes a grader, loader, dozer, and dump truck working during grading to excavate and move soil. At a distance of 100 feet, a grader, a front-end loader, a dozer, and a dump truck would generate a noise level of 78 dBA L_{eq} (RCNM calculations are included in Appendix B).

3.2 Groundborne Vibration

The project does not include any substantial vibration sources associated with operation. Thus, construction activities have the greatest potential to generate groundborne vibration affecting nearby receivers, especially during grading and excavation of the project site. The greatest vibratory source during construction within the project vicinity would be a vibratory roller. Neither blasting nor pile driving would be required for construction of the project. Construction vibration estimates are based on vibration levels reported by Caltrans and the FTA (Caltrans 2020, FTA 2018). Table 6 shows typical vibration levels for various pieces of construction equipment used in the assessment of construction vibration (FTA 2018).

Table 6 Vibration Levels Measured during Construction Activities

Equipment	PPV at 25 ft. (in/sec)
Large Bulldozer	0.089
Loaded Trucks	0.076
Small Bulldozer	0.003

Source: FTA 2018

Although groundborne vibration is sometimes noticeable in outdoor environments, it is almost never annoying to people who are outdoors; therefore, the vibration level threshold is assessed at occupied structures (FTA 2018). Therefore, all vibration impacts are assessed at the structure of an affected property.

3.3 Operational Noise Sources

On-site noise source would include general conversations, landscape maintenance, waste hauling, and the heating, ventilation, and air conditioning (HVAC) equipment. There are no large gathering areas on the project site and these sources would be transient in nature as people transit from vehicles to the store or fuel pumps. Therefore, general conversations would not represent a substantial noise source. Landscape maintenance and waste hauling typically occur during the less noise sensitive daytime hours and would be active for short periods of time. Thus, the primary noise source of concern would be associated with mechanical equipment.

Retail Store and Food Mart Mechanical Equipment

Noise-generating mechanical equipment on the retail store and food mart rooftops include HVAC units and an exhaust fan (food mart only). The equipment was assumed to be placed on the approximate center of the rooftop; noise levels for the equipment are described below. This analysis conservatively assumes the equipment would operate continuously for a full hour (100 percent for 60 minutes) during the daytime and nighttime. For a conservative assessment, it has been assumed that the equipment would not include any type of screening.

Heating, Ventilation, and Air Conditioning Units

Based upon one ton of HVAC per 600 sf of building space and the square footage of each proposed building shown on the site plan, one 3-ton Carrier 38HDR036 Performance Series Air Conditioner unit is estimated to be required for the retail store and one 10-ton Carrier 38AUD14 HVAC unit is

estimated to be required for the food mart (see Appendix C for manufacturer's specifications). The units for the retail store and food mart would generate an approximate sound power level of 72 dBA and 79 dBA; respectively, see Table 7 for noise spectrum data.

Table 7 HVAC Noise Levels

	Noise Levels in dB[1] Measured at Octave Frequencies							Overall Noise Level in A-weighted Scale (dBA)[1]
HVAC Unit	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	
3-ton	56.5	63.0	65.0	66.0	64.0	62.5	57.0	72
10-ton	78.6	78.1	75.1	75.2	71.4	67.9	65. 1	79

[1] Noise Levels for 3-ton Carrier HDR38 Performance Series and 10-ton Carrier 38AUD14 rooftop HVAC units (see Appendix C for specification sheets).

Hz = Hertz; KHz = kilohertz

Roof Exhaust Fan

The food mart would also potentially include a roof exhaust fan on the rooftop of the building. It has been assumed that a Greencheck G-090-VG Direct Drive Centrifugal Roof Exhaust Fan would be used for the project (see Appendix D for manufacturer's specifications). This unit would generate an approximate sound power level of 66 dBA; see Table 8 for noise spectrum data.

Table 8 Roof Exhaust Fan Noise Levels

Noise Levels in dB[1] Measured at Octave Frequencies								Overall Noise Level in A-weighted Scale (dBA)[1]
63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	
77	74	69	63	58	55	51	44	55

[1] Noise Levels for a Greencheck G-090-VG Direct Drive Centrifugal Roof Exhaust Fan (see Appendix D for specification sheets).

Hz = Hertz; KHz = kilohertz

3.4 Traffic Noise

Noise affecting the project site is primarily from traffic on Redlands Boulevard. Traffic noise was modeled with the FHWA RD-77-108 Traffic Noise Prediction Model. The Traffic Impact Analysis (Ganddini 2019) traffic volumes were input into the model as shown in Table 9.

Table 9 Traffic Volumes

Roadway	Segment	Existing ADT	Existing with Project ADT	Opening Year 2024 ADT	Opening Year 2024 with Project ADT	General Plan Buildout Year 2040 ADT	General Plan Buildout Year 2040 with Project ADT
Redlands Boulevard	Ironwood Ave to Hemlock Avenue	15,070	15,680	19,300	19,900	23,500	24,100
	Hemlock Ave to SR 60 WB Ramps	14,470	15,010	18,600	19,100	23,600	22,400
	SR 60 WB Ramps to Eucalyptus Avenue	11,760	12,520	19,400	20,200	27,200	28,100
Ironwood Avenue	West of Redlands Boulevard to Redlands Boulevard	4,420	4,570	5,100	5,200	9,000	9,200
	Redlands Boulevard to east of Redlands Boulevard	730	880	2,600	2,700	6,200	6,400
Hemlock Avenue	West of Redlands Boulevard to Redlands Boulevard	–	530	–	500	4,100	5,900
Eucalyptus Avenue	West of Redlands Boulevard to Redlands Boulevard	670	970	9,200	9,500	11,200	11,500
	Redlands Boulevard to east of Redlands Boulevard	330	630	2,200	2,500	9,200	9,500

See Appendix E for traffic volumes.

Source: Ganddini 2019

The posted speed limits on Redlands Boulevard, Ironwood Avenue, Hemlock Avenue, and Eucalyptus Avenue are 50 miles per hour (mph), 55 mph, 25 mph, and 35 mph, respectively. To determine the vehicle classification mix for modeling, the observed mix from the site measurement was used, which observed 92 percent automobiles, 5 percent medium trucks, and 3 percent heavy trucks.

3.5 Significance Thresholds

The following thresholds are based on City of Moreno Valley noise standards and Appendix G of the CEQA Guidelines. Noise impacts would be considered significant if:

- **Item 1.** The project would result in the generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
  - Based on the Moreno Valley Municipal Code Chapters 11.80, construction noise would be significant if:
    - Noise levels exceed the FTA daytime criteria of 80 dBA L_{eq}, 85 dBA L_{eq}, and 90 dBA L_{eq} for an 8-hour period for residential, commercial, and industrial land uses, respectively.
    - Construction and demolition work are conducted between the hours of 8:00 p.m. and 7:00 a.m.

- Based on Moreno Valley Municipal Code Table 11.80.030-2, operational noise would be significant if:
  - Noise levels exceed 60 dBA from 8:00 a.m. to 10:00 p.m. or 55 dBA from 10:00 p.m. to 8:00 a.m.
- Traffic-related noise impacts would be considered significant if project-generated traffic would result in exposure of sensitive receivers to an unacceptable increase in noise levels.
  - For purposes of this analysis, a significant impact would occur if project-related traffic increases the ambient noise environment of noise-sensitive land uses by 3 dBA or more if the locations are subject to noise levels in excess of conditionally compatible levels, or by 5 dBA or more if the locations are not subject to noise levels in excess of the conditionally compatible levels identified in the City of Moreno Valley General Plan.

- **Item 2.** The project would result in the generation of excessive groundborne vibration or groundborne noise levels.
  - Vibration levels equal to or below 0.4 in./sec. PPV at residential structures would prevent structural damage for most residential building and vibration levels equal to or less than 1.0 in./sec. PPV would prevent damage to more substantial construction, such as high-rise, commercial, and industrial buildings. For human annoyance, the vibration level threshold at which transient, or temporary, vibration sources are considered to be distinctly perceptible is 0.24 in./sec. PPV.

- **Item 3.** For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, if the project exposes people residing or working in the project area to excessive noise levels.

4 Impact Analysis

4.1 Item 1 – Temporary and Permanent Noise Increase

Item:	Would the project result in generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies? *(Less Than Significant Impact)*

Construction

As described in Section 3.1, at a distance of 100 feet, a grader, front-end loader, a dozer, and a dump truck would generate a noise level of 78 dBA L_{eq}. For the office-zoned single-family properties to the south and single-family properties to the east of the site, project construction noise levels would be 74 dBA L_{eq} and 72 dBA L_{eq}, respectively (see Appendix B for construction noise modeling results). The FTA's daytime construction noise limit is 80 dBA for residential uses; therefore, project construction noise levels would not exceed construction noise thresholds. In addition, construction activities would be restricted to daytime hours per the Moreno Valley Municipal Code Chapters 11.80 allowed hours of 7:00 a.m. and 7:00 p.m. Therefore, impacts from construction noise would be less than significant.

Operation

The project would introduce sources of operational noise to the site, including mechanical equipment (HVAC units and exhaust fan). Assumptions for these sources are discussed in Section 3.3. Noise levels at the nearest properties from each noise source and their combined noise levels are shown in Table 10.

Table 10 Operational Noise Levels at Off-site Land Uses

		Noise Level (dBA L_{eq})				
Receiver	**Description**	**3-ton HVAC**	**10-ton HVAC**	**Exhaust Fan**	**Combined**	**Exceed Thresholds?[4]**
Residential	South of site[1,2]	37	44	20	45	No
Residential	East of site[3]	36	44	20	45	No

[1] South of site residential receivers are located on properties that are zoned office use.

[2] Assumes 280 feet to residence south of the site

[3] Assumes 285 feet to residence east of the site

[4] Thresholds would be exceeded if exterior noise levels exceed 60 dBA from 7:00 a.m. to 10:00 p.m. or 55 dBA from 10:00 p.m. to 7:00 a.m.

See Figure 4 for receiver locations.

As shown in Table 10, combined operational activities on the project site would generate noise levels up to 45 dBA L_{eq} at nearby office- and residential-zoned properties. The combined operational noise from the retail store and food mart mechanical equipment would not exceed Moreno Valley's daytime and nighttime noise standards of 60 dBA and 55 dBA L_{eq}, respectively.

Off-site Traffic Noise

The project would generate new vehicle trips that would increase noise levels on nearby roadways, which would occur primarily on Redlands Boulevard. The increase in roadway noise with the addition of project traffic is shown in Table 11. Traffic data was obtained from the project's Traffic Impact Analysis (Ganddini 2019). Due to the relatively small increase in overall ADT volumes from project-generated traffic, the noise level increases would range between 0.1 dBA L_{dn} to be 2.8 dBA L_{dn}. One project area roadway segment, Eucalyptus Avenue from Redlands Boulevard to east of Redlands Boulevard would experience the largest traffic noise level increase, 2.8 dBA L_{dn}, when comparing existing to existing plus project traffic scenario. It should be noted that there are no noise sensitive receivers along this roadway segment. Furthermore, the project's traffic noise increase would not exceed 3 dBA or more, and impacts would be less than significant.

4.2 Item 2 – Vibration

Item:	Would the project result in generation of excessive groundborne vibration or groundborne noise levels? *(Less Than Significant Impact)*

Construction activities known to generate excessive groundborne vibration, such as pile driving, would not be conducted by the project. The greatest anticipated source of vibration during general project construction activities would be from a dozer, which may be used within 50 feet of the nearest off-site structure. A dozer creates approximately 0.089 in./sec. PPV at a distance of 25 feet (Caltrans 2020). This would equal a vibration level of 0.0315 in./sec. PPV at 50 feet. This vibration level is lower than the threshold of 0.24 in./sec. PPV. Therefore, temporary impacts associated with construction would be less than significant.

The project does not include any substantial vibration sources associated with operation. Therefore, operational vibration impacts would be less than significant.

4.3 Item 3 – Airport Noise

Item:	For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels? *(No Impact)*

The March Air Reserve Base/Inland Port Airport is the nearest airport, located approximately 6.7 miles to the southwest of the project site. According to the noise compatibility contours figure for the March Air Reserve Base/Inland Port Airport Land Use Compatibility Plan (Riverside County Airport Land Use Commission 2014), the project site is located outside the airport's 60 dBA CNEL noise contour. Therefore, no substantial noise exposure from airport noise would occur to construction workers, users, or employees of the project, and no impacts would occur.

Table 11 Traffic Noise Levels (dBA L_{dn} at 50 Feet)

Roadway	Segment	Existing	Existing with Project Traffic	Increase with Project Traffic	Opening Year 2024	Opening Year 2024 with Project Traffic	Increase with Project Traffic	General Plan Buildout Year 2040	General Plan Buildout Year 2040 with Project Traffic	Increase with Project Traffic
Redlands Boulevard	Ironwood Ave to Hemlock Avenue	68.4	68.6	0.2	69.5	69.6	0.1	70.3	70.4	0.1
	Hemlock Ave to SR 60 WB Ramps	68.2	68.4	0.2	69.3	69.4	0.1	70.3	70.1	-0.2
	SR 60 WB Ramps to Eucalyptus Avenue	67.3	67.6	0.3	69.5	69.7	0.2	71.0	71.1	0.1
Ironwood Avenue	West of Redlands Boulevard to Redlands Boulevard	63.9	64.0	0.1	64.5	64.6	0.1	67.0	67.1	0.1
	Redlands Boulevard to east of Redlands Boulevard	56.1	56.9	0.8	61.6	61.8	0.2	65.4	65.5	0.1
Hemlock Avenue	West of Redlands Boulevard to Redlands Boulevard	–	52.0	–	–	51.8	–	60.9	62.5	1.6
Eucalyptus Avenue	West of Redlands Boulevard to Redlands Boulevard	53.0	54.6	1.6	64.4	64.6	0.1	65.3	65.4	0.1
	Redlands Boulevard to east of Redlands Boulevard	50.0	52.8	2.8	58.2	58.8	0.6	64.4	64.6	0.1

See Appendix E for model inputs and results.

Source: Ganddini 2019

5 Conclusions

The project would generate both temporary construction-related noise and long-term noise associated with operation of the project. Construction noise would not exceed Moreno Valley Municipal Code noise standards at the nearby land uses and impacts from construction noise would be less than significant.

Combined operational activities on the project site would generate noise levels up to 45 dBA L_{eq} at nearby residential office-zoned and residential-zoned properties, to the south and east of the site, respectively. The combined operational noise from the mechanical equipment would comply with Moreno Valley's daytime and nighttime noise standards, and the project would be consistent with the Moreno Valley noise standards.

Project-generated traffic would generate an increase of up to 2.8 dBA on analyzed roadways. The roadway segment of Eucalyptus Avenue from Redlands Boulevard to east of Redlands Boulevard would experience the largest traffic noise level increase, 2.8 dBA L_{dn}, when comparing existing to existing plus project traffic scenario only, however, there are no noise sensitive receivers along this roadway segment to be impacted. Traffic noise increases due to the project is below the threshold of 3 dBA; therefore, the off-site traffic noise increase would be less than significant.

The project would generate groundborne vibration during construction. Groundborne vibration would not exceed the applicable vibration threshold at the nearest structures, and construction-related vibration impacts would be less than significant.

The project site is outside the noise contours for the March Air Reserve Base/Inland Port Airport. Therefore, no substantial noise exposure would occur to construction workers, employees, or users of the project from aircraft noise.

Given the aforementioned, the project as designed would result in less than significant impacts and no mitigation is necessary.

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Appendix A

Noise Measurement Data

Rincon Consultants, Inc.
Environmental Scientists Planners Engineers
www.rinconconsultants.com

Ambient Noise Survey Data Sheet

Instructions: Document noise measurement locations with a photo of the site, including the noise meter. ~~Additionally, take notes on general and secondary noise sources, including the instantaneous noise level if~~ possible. As a reminder, A/C weighting should be set to "A", and response time should typically be set to "slow." ~~For additional information, please review the Noise Measurement Protocols in the case or on live.~~

Project Name: Rdlnds & Hmlock AV Gas **Job Number:** 21-10878

Date: 3/16/2021 **Operator Name:** Destiny Timms

Measurement #1

Location: NM 1 **Begin time:** 10:00 **Finish time:** 10:15

Measurement No.: 002 **Wind (mph):** 5 **Direction:** SSE

Cloud Cover Class: Overcast (>80%) Light (20-80%) Sunny (<20%)

Calibration (dB): Start: 94.6 End: 94.9

Primary Noise Sources: Redlands Blvd **Distance:** 100 Ft from Centerline

Secondary Noise Sources: 60 Freeway

Notes: Dogs barking from adj residential from east
Stopped @ 7 MINS

Traffic Count: Passenger Cars: 132

Redlands Blvd Medium Trucks (2 axles, 6 tires): |||||| (7) Heavy Trucks (3+ axles): |||| (4)

Instantaneous Noise Sources/Levels (e.g., airplane, bus airbrake, etc.):

L_{eq}:	61.2	SEL:	90.7	L_{max}:	72.3	L_{min}:	51.7	PK:	86.1
L(05):	64.6	L(10):	63.6	L(50):	60.3	L(90):	55.7	L(95):	54.7

Response: Slow Fast Peak Impulse

Measurement #2

Location: NM 2 **Begin time:** 9:31 **Finish time:** 9:46

Measurement No.: 001 **Wind (mph):** 5 **Direction:** SE

Cloud Cover Class: Overcast (>80%) Light (20-80%) Sunny (<20%)

Calibration (dB): Start: 95.5 End: 94.7

Primary Noise Sources: Spruce **Distance:** 238 ft from centerline

Secondary Noise Sources: 60 Freeway

Notes: Rooster crowing from adj land use,
BIRDS in trees from Moreno Ranch Supply

Traffic Count: Passenger Cars: |||| (6)

ON SPRUCE Medium Trucks (2 axles, 6 tires): ||| (3) Heavy Trucks (3+ axles): | (1)

Instantaneous Noise Sources/Levels (e.g., airplane, bus airbrake, etc.):

L_{eq}:	53.8	SEL:	83.3	L_{max}:	59.7	L_{min}:	49.4	PK:	78.3
L(05):	56.4	L(10):	55.6	L(50):	53.1	L(90):	51.3	L(95):	50.7

Response: Slow Fast Peak Impulse

Appendix B

Roadway Construction Noise Model (RCNM) Results

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 03/17/2021

Case Description: Redlands/Hemlock Construction./Demolition.

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
100 foot Reference	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dozer	No	40		81.7	100.0	0.0
Front End Loader	No	40		79.1	100.0	0.0
Grader	No	40	85.0		100.0	0.0
Dump Truck	No	40		76.5	100.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Leq	Noise Limits (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Dozer	75.6	71.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	73.1	69.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	79.0	75.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	70.4	66.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	79.0	77.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #2 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
Single Family to the South	Residential	55.0	50.0	45.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dozer	No	40		81.7	150.0	0.0
Front End Loader	No	40		79.1	150.0	0.0
Grader	No	40	85.0		150.0	0.0
Dump Truck	No	40		76.5	150.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Leq	Noise Limits (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Dozer	72.1	68.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	69.6	65.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	75.5	71.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	66.9	62.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	75.5	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #3 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
Single Ramily to the East	Residential	65.0	60.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dozer	No	40		81.7	200.0	0.0
Front End Loader	No	40		79.1	200.0	0.0
Grader	No	40	85.0		200.0	0.0
Dump Truck	No	40		76.5	200.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Dozer	69.6	65.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	67.1	63.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	73.0	69.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dump Truck	64.4	60.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	73.0	71.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Appendix C

HVAC Unit Specifications

38HDR
Performance™ Series Air Conditioner with Puron® Refrigerant
1–1/2 to 5 Nominal Tons

Carrier®
Turn to the Experts.℠

Product Data

Puron™ the environmentally sound refrigerant

Performance™ SERIES

Carrier's Air Conditioners with Puron® refrigerant provide a collection of features unmatched by any other family of equipment. The 38HDR has been designed utilizing Carrier's Puron refrigerant. The environmentally sound refrigerant allows you to make a responsible decision in the protection of the earth's ozone layer.

As an Energy Star® Partner, Carrier Corporation has determined that this product meets the Energy Star® guidelines for energy efficiency. Refer to the combination ratings in the Product Data for system combinations that meet Energy Star® guidelines.

NOTE: Ratings contained in this document are subject to change at any time. Always refer to the AHRI directory (www.ahridirectory.org) for the most up-to-date ratings information.

INDUSTRY LEADING FEATURES / BENEFITS

Energy Efficiency

- 13 - 15 SEER/10.9 - 12.5 EER

Sound

- Levels as low as 68 dBA

Design Features

- New aesthetics
- Small footprint, same as old model and "stackable"
- WeatherArmor™ cabinet
  - — All steel cabinet construction
  - — Baked on powder paint
  - — Mesh coil guard

Reliability, Quality and Toughness

- Scroll compressor
- Crankcase Heater standard on sizes 030-060
- Factory-supplied filter drier
- High pressure switch
- Low pressure switch
- Line lengths up to 250' (76.2 m)
- Low ambient operation (down to -20°F/-28.9°C) with low ambient accessories.

MODEL NUMBER NOMENCLATURE

1	2	3	4	5	6	7	8	9	10	11	12	13
N	N	A	A	A/N	N	N	N	A/N	A/N	A/N	N	N
3	8	H	D	R	0	1	8	A	0	0	3	0
Product Series	HDR = Horizontal Discharge Condensing Unit			Cooling Capacity				Variations	Open	Open	Voltage	Minor Series
38=AC/HP	Major Model			1,000 Btuh Nominal				A=Standard	0=Not Defined	0=Not Defined	3=208/230–1 5=208/230–3 6=460/3	0, 1, 2...

Puron™ the environmentally sound refrigerant

ARI PERFORMANCE CERTIFIED™ ARI Standard 210/240 Unitary Air Conditioners

ISO 9001:2000 QMI REGISTERED

c UL® us

ENERGY STAR PARTNER

This product has been designed and manufactured to meet Energy Star® criteria for energy efficiency when matched with appropriate coil components. However, proper refrigerant charge and proper air flow are critical to achieve rated capacity and efficiency. Installation of this product should follow all manufacturing refrigerant charging and air flow instructions. **Failure to confirm proper charge and air flow may reduce energy efficiency and shorten equipment life.**

PHYSICAL DATA

UNIT 38HDR	018	024	030	036	048	060
NOMINAL CAPACITY (Tons)	1.5	2.0	2.50	3.0	4.0	5.0
OPERATING WEIGHT lb (kg)	155 (70.3)	180 (81.6)	200 (90.7)	218 (98.9)	284 (128.8)	294 (133.4)
REFRIGERANT TYPE	R–410A					
METERING DEVICE	TXV					
CHARGE lb (kg)	6.3 (2.86)	6.0 (2.73)	8.7 (3.95)	8.7 (3.95)	11.5 (5.23)	12.0 (5.45)
COMPRESSOR						
Type	Scroll					
Oil Charge (POE –oz)	25.0	25.0	25.0	25.0	42.0	42.0
Crankcase Heater (watts)	—	—	40	40	40	40
OUTDOOR FAN						
Rpm/Cfm	840/1720	840/1720	850/3900	850/3900	850/3900	850/3900
Diameter in. (mm)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)
No. Blades	3	3	3	3	3	3
Motor hp (w)	1/8 (93)	1/8 (93)	1/4 (187)	1/4 (187)	1/4 (187)	1/4 (187)
OUTDOOR COIL						
Face Area (sq ft)	5.8	7.3	12.1	12.1	14.1	14.1
No. Rows	2	2	2	2	2	2
FPI	20	20	20	20	20	20
HIGH PRESSURE SWITCH						
Cut–In (psig) Cutout (psig)	420 ± 25 650 ± 10	420 ± 25 650 ± 10	420 ± 25 650 ± 10	420 ± 25 650 ± 10	420 ± 25 650 ± 10	420 ± 25 650 ± 10
LOW PRESSURE SWITCH						
Cut–In (psig) Cutout (psig)	45 ± 25 20 ± 5	45 ± 25 20 ± 5	45 ± 25 20 ± 5	45 ± 25 20 ± 5	45 ± 25 20 ± 5	45 ± 25 20 ± 5
REFRIGERANT LINES						
Connection Type	Sweat					
Max. Liquid Line* (in.) OD	3/8	3/8	3/8	3/8	3/8	3/8
Rated Vapor Line† (in.) OD	5/8	5/8	3/4	3/4	7/8	1–1/8**
CONTROLS						
Control Voltage‡	24 vac					
System Voltage	208/230 v	208/230 v	208/230 v	208/230 v, Single and 3 Phase, 460 v, 3 Phase		
FINISH	Gray					

* See *Liquid Line Sizing For Cooling Only Systems with Puron Refrigerant* tables.

† Units are rated with 25 ft (7.6 m) of lineset length. See *Vapor Line Sizing and Cooling Capacity Loss* table when using other sizes and lengths of lineset.

‡ 24 v and a minimum of 40 va is provided in the fan coil unit.

** Vapor connection size is 7/8 inch.

FPI – Fins Per Inch

POE – Polyol Ester

REFRIGERANT PIPING LENGTH LIMITATIONS

Liquid Line Sizing and Maximum Total Equivalent Lengths† for Cooling Only Systems with Puron® Refrigerant:

The maximum allowable length of a residential split system depends on the liquid line diameter and vertical separation between indoor and outdoor units.

See Table below for liquid line sizing and maximum lengths :

Maximum Total Equivalent Length
Outdoor Unit BELOW Indoor Unit

Size	Liquid Line Connection	Liquid Line Diam. w/ TXV	AC with Puron Refrigerant Maximum Total Equivalent Length†: Outdoor unit BELOW Indoor Vertical Separation ft (m)								
			0–5 (0–1.5)	6–10 (1.8–3.0)	11–20 (3.4–6.1)	21–30 (6.4–9.1)	31–40 (9.4–12.2)	41–50 (12.5–15.2)	51–60 (15.5–18.3)	61–70 (18.6–21.3)	71–80 (21.6–24.4)
018 AC with Puron	3/8	1/4	150	150	125	100	100	75	– –	– –	– –
		5/16	250*	250*	250*	250*	250*	250*	250*	225*	150
		3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
024 AC with Puron	3/8	1/4	75	75	75	50	50	– –	– –	– –	– –
		5/16	250*	250*	250*	250*	250*	225*	175	125	100
		3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
030 AC with Puron	3/8	1/4	30	– –	– –	– –	– –	– –	– –	– –	– –
		5/16	175	225*	200	175	125	100	75	– –	– –
		3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
036 AC with Puron	3/8	5/16	175	150	150	100	100	100	75	– –	– –
		3//8	250*	250*	250*	250*	250*	250*	250*	250*	250*
048 AC with Puron	3/8	3/8	250*	250*	250*	250*	250*	250*	230	160	– –
060 AC with Puron	3/8	3/8	250*	250*	250*	225*	190	150	110	– –	– –

*** Maximum actual length not to exceed 200 ft (61 m)**

† Total equivalent length accounts for losses due to elbows or fitting. See the Long Line Guideline for details.

– – = outside acceptable range

Maximum Total Equivalent Length
Outdoor Unit ABOVE Indoor Unit

Size	Liquid Line Connection	Liquid Line Diam. w/ TXV	AC with Puron Refrigerant Maximum Total Equivalent Length†: Outdoor unit ABOVE Indoor Vertical Separation ft (m)							
			25 (7.6)	26–50 (7.9–15.2)	51–75 (15.5–22.9)	76–100 (23.2–30.5)	101–125 (30.8–38.1)	126–150 (38.4–45.7)	151–175 (46.0–53.3)	176–200 (53.6–61.0)
018 AC with Puron	3/8	1/4	175	250*	250*	250*	250*	250*	250*	250*
		5/16	250*	250*	250*	250*	250*	250*	250*	250*
		3/8	250*	250*	250*	250*	250*	250*	250*	250*
024 AC with Puron	3/8	1/4	100	125	175	200	225*	250*	250*	250*
		5/16	250*	250*	250*	250*	250*	250*	250*	250*
		3/8	250*	250*	250*	250*	250*	250*	250*	250*
030 AC with Puron	3/8	1/4	30	– –	– –	– –	– –	– –	– –	– –
		5/16	250*	250*	250*	250*	250*	250*	250*	250*
		3/8	250*	250*	250*	250*	250*	250*	250*	250*
036 AC with Puron	3/8	5/16	225*	250*	250*	250*	250*	250*	250*	250*
		3/8	250*	250*	250*	250*	250*	250*	250*	250*
048 AC with Puron	3/8	3/8	250*	250*	250*	250*	250*	250*	250*	250*
060 AC with Puron	3/8	3/8	250*	250*	250*	250*	250*	250*	250*	250*

*** Maximum actual length not to exceed 200 ft (61 m)**

† Total equivalent length accounts for losses due to elbows or fitting. See the Long Line Guideline for details.

– – = outside acceptable range

REFRIGERANT CHARGE ADJUSTMENTS

Liquid Line Size	Puron Charge oz/ft (g/m)
3/8	0.60 (17.74) (Factory charge for lineset = 9 oz / 266.16 g)
5/16	0.40 (11.83)
1/4	0.27 (7.98)

Units are factory charged for 15 ft (4.6 m) of 3/8" liquid line. The factory charge for 3/8" lineset 9 oz (266.16 g). When using other length or diameter liquid lines, charge adjustments are required per the chart above.

Charging Formula:

[(Lineset oz/ft x total length) – (factory charge for lineset)] = charge adjustment

Example 1: System has 15 ft of line set using existing 1/4" liquid line. What charge adjustment is required?

Formula: (.27 oz/ft x 15ft) – (9 oz) = (-4.95) oz.

Net result is to remove 4.95 oz of refrigerant from the system

Example 2: System has 45 ft of existing 5/16" liquid line. What is the charge adjustment?

Formula: (.40 oz/ft. x 45ft) – (9 oz.) = 9 oz.

Net result is to add 9 oz of refrigerant to the system

LONG LINE APPLICATIONS

An application is considered Long Line, when the refrigerant level in the system requires the use of accessories to maintain acceptable refrigerant management for systems reliability. See Accessory Usage Guideline table for required accessories. Defining a system as long line depends on the liquid line diameter, actual length of the tubing, and vertical separation between the indoor and outdoor units.

For Air Conditioner systems, the chart below shows when an application is considered Long Line.

AC WITH PURON® REFRIGERANT LONG LINE DESCRIPTION ft (m)
Beyond these lengths, long line accessories are required

Liquid Line Size	Units On Same Level	Outdoor Below Indoor	Outdoor Above Indoor
1/4	No accessories needed within allowed lengths	No accessories needed within allowed lengths	175 (53.3)
5/16	120 (36.6)	50 (15.2) vertical or 120 (36.6) total	120 (36.6)
3/8	80 (24.4)	35 (10.7) vertical or 80 24.4) total	80 (24.4)

Note: See Long Line Guideline for details

VAPOR LINE SIZING AND COOLING CAPACITY LOSS

Acceptable vapor line diameters provide adequate oil return to the compressor while avoiding excessive capacity loss. The suction line diameters shown in the chart below are acceptable for AC systems with Puron refrigerant:

Vapor Line Sizing and Cooling Capacity Losses — Puron® Refrigerant 1-Stage Air Conditioner Applications

Unit Nominal Size (Btuh)	Maximum Liquid Line Diameters (In. OD)	Vapor Line Diameters (In. OD)	Cooling Capacity Loss (%) Total Equivalent Line Length ft. (m)								
			26–50 (7.9–15.2)	51–80 (15.5–24.4)	81–100 (24.7–30.5)	101–125 (30.8–38.1)	126–150 (38.4–45.7)	151–175 (46.0–53.3)	176–200 (53.6–61.0)	201–225 (61.3–68.6)	226–250 (68.9–76.2)
018 1 Stage AC with Puron	3/8	1/2	1	2	3	5	6	7	8	9	11
		5/8	0	1	1	1	2	2	2	3	3
		3/4	0	0	0	0	1	1	1	1	1
024 1 Stage AC with Puron	3/8	5/8	0	1	2	2	3	3	4	5	5
		3/4	0	0	1	1	1	1	1	2	2
		7/8	0	0	0	0	0	1	1	1	1
030 1 Stage AC with Puron	3/8	5/8	1	2	3	3	4	5	6	7	8
		3/4	0	0	1	1	1	2	2	2	3
		7/8	0	0	0	0	1	1	1	1	1
036 1 Stage AC with Puron	3/8	5/8	1	2	4	5	6	8	9	10	12
		3/4	0	1	1	2	2	3	3	4	4
		7/8	0	0	0	1	1	1	1	2	2
048 1 Stage AC with Puron	3/8	3/4	0	1	2	3	4	5	5	6	7
		7/8	0	0	1	1	2	2	2	3	3
		1 1/8	0	0	0	0	0	0	0	1	1
060 1 Stage AC with Puron	3/8	3/4	1	2	4	5	6	7	9	10	11
		7/8	0	1	2	2	3	4	4	5	5
		1 1/8	0	0	0	1	1	1	1	1	1

Applications in this area may be long line and may have height restrictions. See the *Residential Piping and Long Line Guideline*.

ACCESSORY THERMOSTATS

THERMOSTAT / SUBBASE PKG.	DESCRIPTION
TP–PRH01–A	Programmable Thermidistat
TP–NRH01–A	Non–programmable Thermidistat
TP–PAC01	Performance Series Programmable AC Stat
TP–NAC01	Performance Series Non–programmable AC Stat
TSTATCCSEN01–B	Outdoor Air Temperature Sensor
TSTATXXBBP01	Backplate for Builder's Thermostat
TSTATXXNBP01	Backplate for Non–Programmable Thermostat
TSTATXXPBP01	Backplate for Programmable Thermostat
TSTATXXCNV10	Thermostat Conversion Kit (4 to 5 wires) – 10 Pack

ACCESSORIES

KIT NUMBER	KIT NAME	018	024	030	036	048	060
KAACH1401AAA	Crankcase Heater	X	X				
Standard	Crankcase Heater			S	S	S	S
KAAFT0101AAA	Evaporator Freeze Stat	X	X	X	X	X	X
KAATD0101TDR	Time Delay Relay	X	X	X	X	X	X
KAAWS0101AAA	Winter Start Kit (for low ambient)	X	X	X	X	X	X
53DS–900–––086	Low Ambient Control (Puron)	X	X	X	X	X	X
53DS–900–––070	Wind Baffle	X					
53DS–900–––087	Wind Baffle		X				
53DS–900–––071	Wind Baffle			X	X		
53DS–900–––088	Wind Baffle					X	X
53DS–900–––075	Stacking Kit	X	X				
53DS–900–––076	Stacking Kit			X	X	X	X
53DS–900–––077	Wall Mounting Kit	X	X				
53DS–900–––078	Wall Mounting Kit			X	X	X	X

X = Accessory, S = Standard

ACCESSORY USAGE GUIDELINE

ACCESSORY	REQUIRED FOR LOW–AMBIENT COOLING APPLICATIONS (Below 55°F/12.8°C)	REQUIRED FOR LONG LINE APPLICATIONS* (Over 80 ft. / 24.4 m)	REQUIRED FOR SEA COAST APPLICATIONS (Within 2 miles / 3.2 km)
Compressor Start Assist Capacitor and Relay	Yes	Yes	No
Crankcase Heater	Yes	Yes	No
Evaporator Freeze Thermostat	Yes	No	No
Hard Shutoff TXV	Yes	Yes	Yes
Liquid Line Solenoid Valve	No	See Longline Application Guideline	No
Low–ambient Control	Yes	No	No
Winter Start Control	Yes	No	No

* For tubing line sets between 80 and 200 ft. (24.38 and 60.96 m) and/or 35 ft. (10.7 m) vertical differential, refer to Residential Piping and Longline Guideline.

Accessory Description and Usage (Listed Alphabetically)

1. Crankcase Heater

An electric resistance heater which mounts to the base of the compressor to keep the lubricant warm during off cycles. Improves compressor lubrication on restart and minimizes the chance of liquid slugging.

Usage Guideline:

Required in low ambient cooling applications.

Required in long line applications.

Suggested in all commercial applications.

2. Evaporator Freeze Thermostat

An SPST temperature-actuated switch that stops unit operation when evaporator reaches freeze-up conditions.

Usage Guideline:

Required when low ambient kit has been added.

3. Low-Ambient Control

A fan-speed control device activated by a temperature sensor, designed to control condenser fan motor speed in response to the saturated, condensing temperature during operation in cooling mode only. For outdoor temperatures down to -20°F (-28.9°C), it maintains condensing temperature at 100°F ±10°F (37.8°C ± 5.5°C).

Usage Guideline:

A Low Ambient Controller must be used when cooling operation is used at outdoor temperatures below 55°F (12.8°C).

Suggested for all commercial applications.

4. Outdoor Air Temperature Sensor

Designed for use with Carrier Thermostats listed in this publication. This device enables the thermostat to display the outdoor temperature. This device also

is required to enable special thermostat features such as auxiliary heat lock out.

Usage Guideline:

Suggested for all Carrier thermostats listed in this publication.

5. Thermostatic Expansion Valve (TXV)

A modulating flow-control valve which meters refrigerant liquid flow rate into the evaporator in response to the superheat of the refrigerant gas leaving the evaporator.

Kit includes valve, adapter tubes, and external equalizer tube. Hard shut off types are available.

NOTE: When using a hard shut off TXV with single phase reciprocating compressors, a Compressor Start Assist Capacitor and Relay is required.

Usage Guideline:

Accessory required to meet ARI rating and system reliability, where indoor not equipped.

Hard shut off TXV or LLS required in air conditioner long line applications.

Required for use on all zoning systems.

6. Time-Delay Relay

An SPST delay relay which briefly continues operation of indoor blower motor to provide additional cooling after the compressor cycles off.

NOTE: Most indoor unit controls include this feature. For those that do not, use the guideline below.

Usage Guideline:

Accessory required to meet ARI rating, where indoor not equipped.

7. Winter Start Control

This control is designed to alleviate nuisance opening of the low-pressure switch by bypassing it for the first 3 minutes of operation.

ELECTRICAL DATA

38HDR UNIT SIZE	V–PH–Hz	VOLTAGE RANGE*		COMPRESSOR		OUTDOOR FAN MOTOR			MIN CKT AMPS	FUSE/CKT BKR AMPS
		Min	Max	RLA	LRA	FLA	NEC Hp	kW Out		
018–31	208/230–1–60	187	253	9.0	48.0	0.8	0.125	0.09	12.1	20
024–32	208/230–1–60	187	253	13.5	58.3	0.8	0.125	0.09	17.7	25
030–31	208/230–1–60	187	253	14.1	73.0	1.5	0.250	0.19	19.1	30
036–31	208/230–1–60	187	253	14.1	77.0	1.5	0.250	0.19	19.1	30
	208/230–3–60	187	253	9.2	71.0	1.5	0.250	0.19	13.0	20
	460–3–60	414	506	5.6	38.0	0.8	0.250	0.19	7.9	10
048–32	208/230–1–60	187	253	19.9	109.0	1.5	0.250	0.19	26.4	40
	208/230–3–60	187	253	13.1	83.1	1.5	0.250	0.19	17.9	25
	460–3–60	414	506	6.1	41.0	0.8	0.250	0.19	8.4	15
060–32	208/230–1–60	187	253	26.4	134.0	1.5	0.250	0.19	34.5	60
	208/230–3–60	187	253	16.0	110.0	1.5	0.250	0.19	21.5	30
	460–3–60	414	506	7.8	52.0	0.8	0.250	0.19	10.6	15

* Permissible limits of the voltage range at which the unit will operate satisfactorily

FLA – Full Load Amps

HACR – Heating, Air Conditioning, Refrigeration

LRA – Locked Rotor Amps

NEC – National Electrical Code

RLA – Rated Load Amps (compressor)

NOTE: Control circuit is 24–V on all units and requires external power source. Copper wire must be used from service disconnect to unit. All motors/compressors contain internal overload protection.

Complies with 2007 requirements of ASHRAE Standards 90.1

A-WEIGHTED SOUND POWER (dBA)

Unit Size	Standard Rating (dBA)	Typical Octave Band Spectrum (dBA) (without tone adjustment)						
		125	250	500	1000	2000	4000	8000
018–31	68	52.0	57.5	60.5	63.5	60.5	57.5	46.5
024–32	69	57.5	61.5	63.0	61.0	60.0	56.0	45.0
030–31	72	56.5	63.0	65.0	66.0	64.0	62.5	57.0
036–31	72	65.0	61.5	63.5	65.0	64.5	61.0	54.5
048–32	72	58.5	61.0	64.0	67.5	66.0	64.0	57.0
060–32	72	63.0	61.5	64.0	66.5	66.0	64.5	55.5

NOTE: Tested in accordance with ARI Standard 270–08 (not listed in AHRI).

CHARGING SUBCOOLING (TXV-TYPE EXPANSION DEVICE)

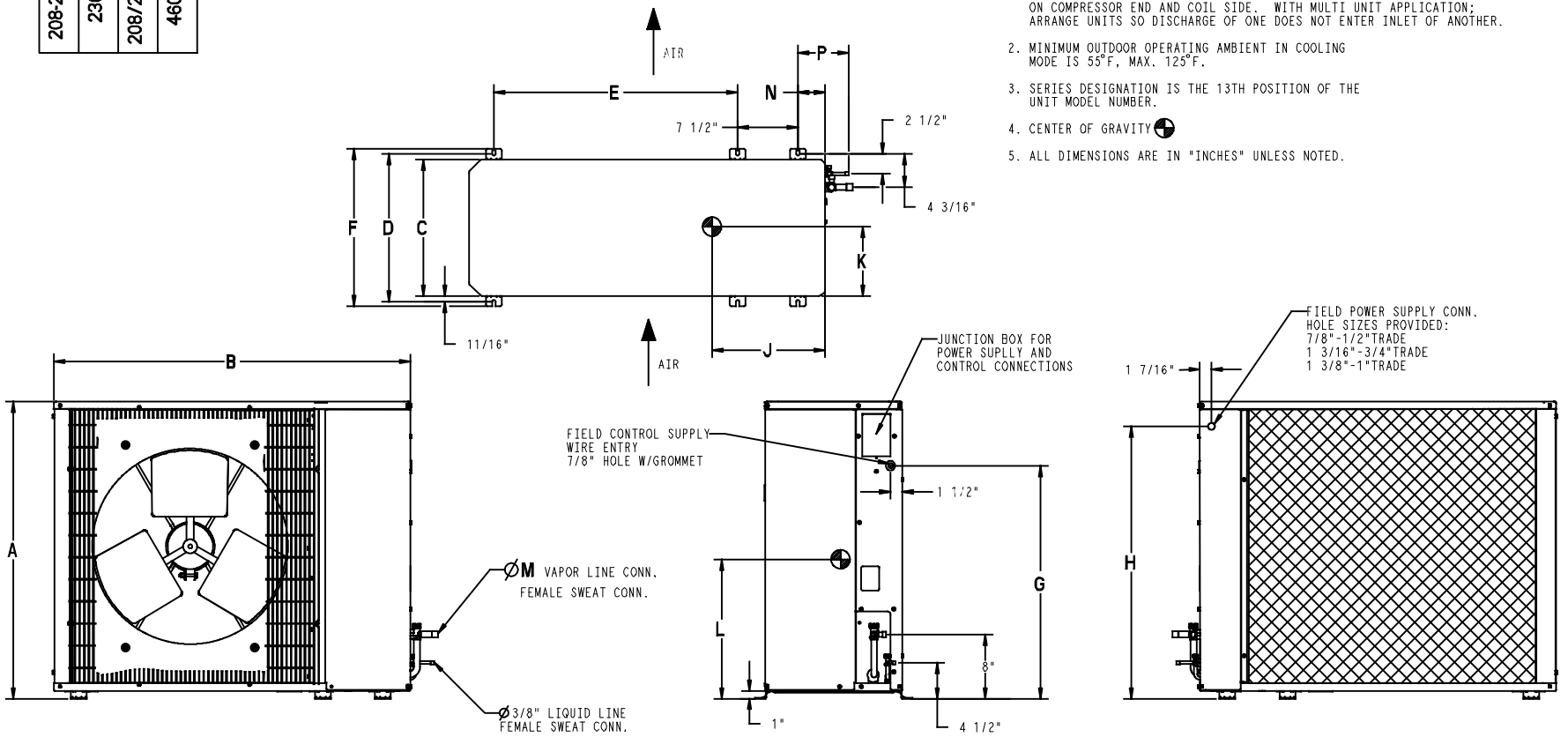
UNIT SIZE–VOLTAGE, SERIES	REQUIRED SUBCOOLING °F (°C)
018–31	12 (6.7)
024–32	12 (6.7)
030–31	12 (6.7)
036–31	12 (6.7)
048–32	12 (6.7)
060–32	12 (6.7)

DIMENSIONS - ENGLISH

UNIT	SERIES	ELECTRICAL CHARACTERISTICS				A	B	C	D	E	F	G	H	J	K	L	M	N	P	OPERATING WEIGHT(lbs)	SHIPPING WEIGHT(lbs)	SHIPPING DIMENSIONS (L x W x H)
38HDR018	1	X	O	O	O	25 1/8"	36 15/16"	14 9/16"	16"	23 7/16"	17 3/16"	17 1/8"	22"	13"	6 5/8"	11 1/4"	5/8"	2 15/16"	6"	155	171	42 9/10" X 18" X 28 1/10"
38HDR024	1,2	X	O	O	O	31 1/8"	36 15/16"	14 9/16"	16"	23 7/16"	17 3/16"	23 1/8"	28"	14"	6 3/4"	11 5/8"	5/8"	2 15/16"	6"	180	198	42 9/10" X 18" X 34 1/10"
38HDR030	1	X	O	O	O	37 3/16"	44 9/16"	17 1/16"	18 7/16"	30 1/2"	19 5/8"	29 3/16"	34 1/16"	13 11/16"	8 1/8"	15 7/8"	3/4"	3 7/16"	6 1/2"	200	223	50 1/2" X 20 1/2" X 40 2/10"
38HDR036	1	X	O	X	X	37 3/16"	44 9/16"	17 1/16"	18 7/16"	30 1/2"	19 5/8"	29 3/16"	34 1/16"	13 11/16"	8 1/8"	15 7/8"	3/4"	3 7/16"	6 1/2"	218	240	50 1/2" X 20 1/2" X 40 2/10"
38HDR048	1,2	X	O	X	X	43 3/16"	44 9/16"	17 1/16"	18 7/16"	30 1/2"	19 5/8"	35 3/16"	40 1/16"	14 1/2"	8 1/2"	18 7/8"	7/8"	3 7/16"	6 1/2"	284	309	50 1/2" X 20 1/2" X 46 2/10"
38HDR060	1,2	X	O	X	X	43 3/16"	44 9/16"	17 1/16"	18 7/16"	30 1/2"	19 5/8"	35 3/16"	40 1/16"	14 1/2"	8 1/2"	18 7/8"	7/8"	3 7/16"	6 1/2"	294	319	50 1/2" X 20 1/2" X 46 2/10"
		208-230-1-60	230-1-60	208/230-3-60	460-3-60																	

X = YES
O = NO

1. REQUIRED CLEARANCES: WITH COIL FACING WALL; ALLOW 6" MIN CLEARANCE ON COIL SIDE AND COIL END AND 36" MIN CLEARANCE ON COMPRESSOR END AND FAN SIDE. WITH FAN FACING WALL; ALLOW 8" MIN CLEARANCE ON FAN SIDE AND COIL END AND 36" MIN CLEARANCE ON COMPRESSOR END AND COIL SIDE. WITH MULTI UNIT APPLICATION; ARRANGE UNITS SO DISCHARGE OF ONE DOES NOT ENTER INLET OF ANOTHER.
2. MINIMUM OUTDOOR OPERATING AMBIENT IN COOLING MODE IS 55°F, MAX. 125°F.
3. SERIES DESIGNATION IS THE 13TH POSITION OF THE UNIT MODEL NUMBER.
4. CENTER OF GRAVITY
5. ALL DIMENSIONS ARE IN "INCHES" UNLESS NOTED.



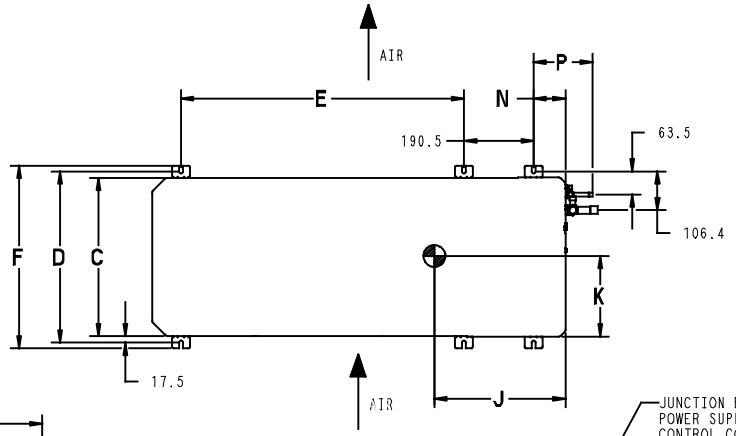
UNIT SIZE	MINIMUM MOUNTING PAD DIMENSIONS
18,24	23" X 42"
30,36,48,60	24" X 50"

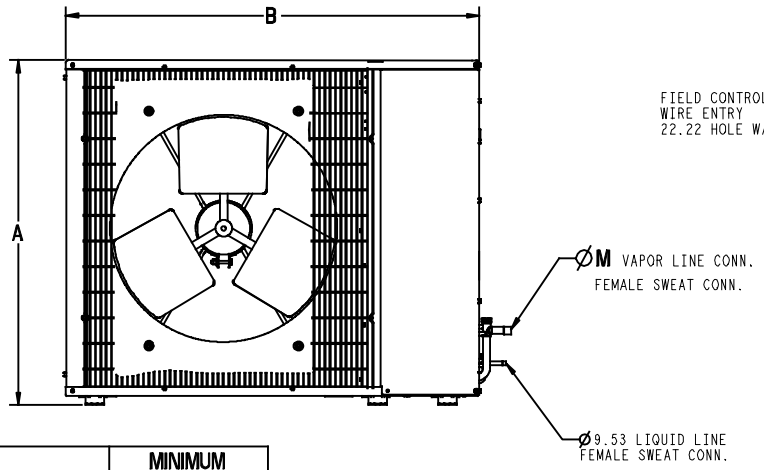
DIMENSIONS - SI

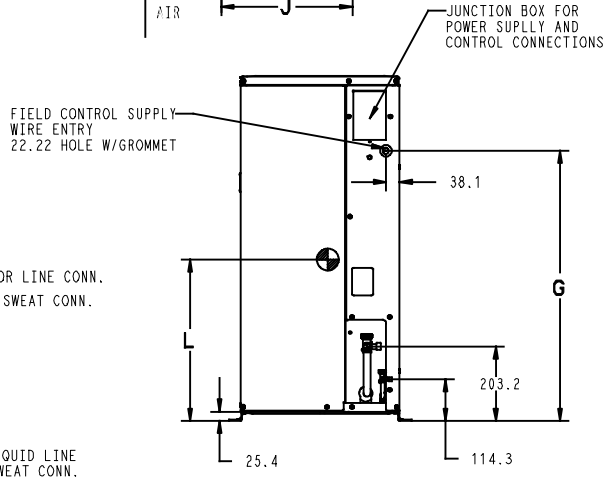
UNIT	SERIES	ELECTRICAL CHARACTERISTICS				A	B	C	D	E	F	G	H	J	K	L	M	N	P	OPERATING WEIGHT(KG)	SHIPPING WEIGHT(KG)	SHIPPING DIMENSIONS (L x W x H)
38HDR018	1	X	O	O	O	638.2	938.2	369.9	406.4	595.3	436.6	435.0	558.8	330.2	168.3	285.8	15.9	74.6	152.4	70.4	77.7	1090.2 X 457.7 X 714.3
38HDR024	1,2	X	O	O	O	790.6	938.2	369.9	406.4	595.3	436.6	587.4	711.2	355.6	171.5	295.3	15.9	74.6	152.4	81.8	90.0	1090.2 X 457.7 X 866.7
38HDR030	1	X	O	O	O	944.6	1131.9	433.4	468.3	774.7	498.5	741.4	865.2	347.7	206.4	403.2	19.0	87.3	165.1	90.9	101.4	1282.7 X 520.7 X 1020.7
38HDR036	1	X	O	X	X	944.6	1131.9	433.4	468.3	774.7	498.5	741.4	865.2	347.7	206.4	403.2	19.0	87.3	165.1	99.0	109.0	1282.7 X 520.7 X 1020.7
38HDR048	1,2	X	O	X	X	1097.0	1131.9	433.4	468.3	774.7	498.5	893.8	1017.6	368.3	215.9	479.4	22.2	87.3	165.1	129.0	140.4	1282.7 X 520.7 X 1173.1
38HDR060	1,2	X	O	X	X	1097.0	1131.9	433.4	468.3	774.7	498.5	893.8	1017.6	368.3	215.9	479.4	22.2	87.3	165.1	133.6	145.0	1282.7 X 520.7 X 1173.1
		208-230-1-60	230-1-60	208/230-3-60	460-3-60																	

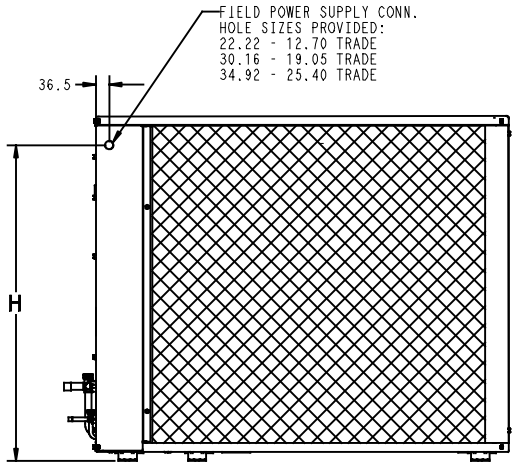
X = YES
O = NO

1. REQUIRED CLEARANCES: WITH COIL FACING WALL; ALLOW 152.4 MIN CLEARANCE ON COIL SIDE AND COIL END AND 914.4 MIN CLEARANCE ON COMPRESSOR END AND FAN SIDE. WITH FAN FACING WALL; ALLOW 203.2 MIN CLEARANCE ON FAN SIDE AND COIL END AND 914.4 MIN CLEARANCE ON COMPRESSOR END AND COIL SIDE. WITH MULTI UNIT APPLICATION; ARRANGE UNITS SO DISCHARGE OF ONE DOES NOT ENTER INLET OF ANOTHER.
2. MINIMUM OUTDOOR OPERATING AMBIENT IN COOLING MODE IS 12.8°C, MAX. 51.7°C.
3. SERIES DESIGNATION IS THE 13TH POSITION OF THE UNIT MODEL NUMBER.
4. CENTER OF GRAVITY
5. ALL DIMENSIONS ARE IN "MM" UNLESS NOTED.









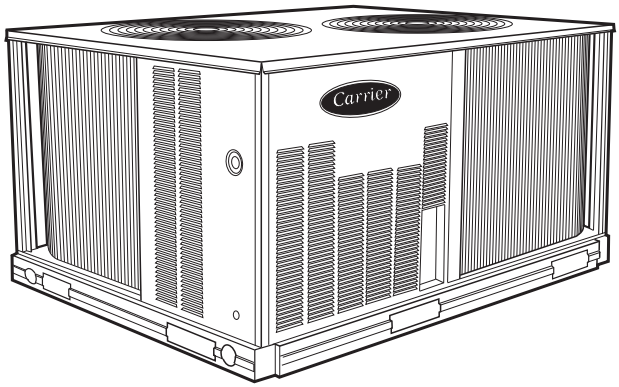
UNIT SIZE	MINIMUM MOUNTING PAD DIMENSIONS
18,24	584.2 X 1066.8
30,36,48,60	609.6 X 1270.0

38AUZ/D 50 Hz
Commercial Split Systems
Air Conditioning Condensing Units
18.3 kW to 59.2 kW

Carrier
turn to the experts

Product Data

Gemini



C09227

38AUZ07-08 shown

Certified to ISO 9001

Carrier's air-cooled air conditioning split systems:

- provide a logical solution for commercial needs
- have a rugged, dependable construction
- are available in single and circuit scroll compressor capacity control
- have cooling capability up to 52°C (125°F) ambient and down to 2°C (35°F) ambient standard

FEATURES/BENEFITS

These dependable outdoor air cooled condensing units match Carrier's indoor-air handlers to meet a wide selection of cooling solutions.

Constructed for long life

The 38AUZ single circuit and 38AUD dual circuit, scroll compressor models are designed and built to last. The high efficient designed outdoor coil construction allows for a more efficient design in a smaller cabinet size that utilizes an overall reduction in refrigerant charge. Where conditions require, special coil coating coil protection option is available. Cabinets are constructed of prepainted galvanized steel, delivering unparalleled protection from the environment. Inside and outside surfaces are protected to ensure long life, good looks, and reliable operation. Safety controls are used for enhanced system protection and reliability.

Each unit utilizes the Comfort Alert diagnostic and troubleshoot control system. This protects the units operation and provides valuable diagnostic information when required.

Factory-installed options (FIOPs)

Certified and pre-engineered factory-installed options (FIOPs) allow units to be installed in less time, thereby reducing installed cost. FIOPs include:

- low ambient controls which provide cooling operation down to -29°C (-20°F) ambient temperatures
- non-fused disconnect
- special coil coating coil protection
- louvered hail guard

FEATURES AND BENEFITS (cont.)

Efficient operation

These air cooled condensing units will provide EER's up to 12.6 (tested in accordance with ASHRAE 90.1 standards).

This high efficiency will help reduce overall operating cost and energy consumption.

Controls for performance dependability

The 38AU condensing units offer operating controls and components designed for performance dependability. The high efficiency hermetic scroll compressor is engineered for long life and durability. The compressors include vibration isolation for quiet operation. The high-pressure switch protects the entire refrigeration system from abnormally high operating pressures. A low-pressure switch protects the system from loss of charge. These units also include anti-short-cycling protection, which helps to protect the units against compressor failure.

All units include a crankcase heater to eliminate liquid slugging at start-up. Each unit comes standard with the Comfort Alert™ control system. This provides:

- System Go LED indicator
- Fault LED indicator
- Compressor fault LED indicator
- Phase loss protection
- Phase reversal protection
- Safety pressure indicator
- Anti-short cycle protection

Innovative Carrier 40RU packaged air handlers are custom matched to 38AUZ/D condensing units

Information on matching 40RU DX packaged air handler follows for convenience. See separate product data for more details. The 40RU Series has excellent fan performance, efficient direct-expansion (DX) coils, a unique combination of indoor-air quality features, and is easy to install. Its versatility and state-of-the-art features help to ensure economical performance of the split system both now and in the future.

Indoor-air quality (IAQ) features

The unique combination of IAQ features in the 40RU Series air handlers help to ensure that only clean, fresh, conditioned air is delivered to the occupied space.

Direct-expansion (DX) 4 row cooling coils prevent the build-up of humidity in the room, even during part-load conditions.

Standard 2-in. (51mm) disposable filters remove dust and airborne particles from the occupied space for cleaner air.

The pitched, non-corroding drain pan can be adjusted for a right-hand or left-hand connection to suit many applications and provide positive drainage and prevent standing condensate.

The accessory economizer can provide ventilation air to improve indoor-air quality by using demand control ventilation. When used in conjunction with Carrier Comfort System and CO_2 sensors, the economizer admits fresh outdoor air to replace stale, recirculated indoor air.

Economy

The 40RU Series packaged air handlers provide reduced installation expense and energy-efficient performance.

Quick installation is ensured by the multipoise design. Units can be installed in either the horizontal or vertical configuration without modifications. Fan motors and contactors are pre-wired and thermostatic expansion valves (TXVs) are factory-installed on all 40RU models.

High efficiency, precision-balanced fans minimize air turbulence, surging, and unbalanced operation, cutting operation expenses.

The economizer accessory precisely controls the blend of outdoor air and room air to achieve comfort levels. When the outside air enthalpy is suitable, outside air dampers can fully open to provide "free" cooling without energizing mechanical cooling.

Rugged dependability

The 40RU series units are made to last. The die-formed galvanized steel panels ensure structural integrity under all operating conditions. Galvanized steel fan housings are securely mounted to a die-formed galvanized steel fan deck.

Rugged pillow-block bearings (40RU14) are securely fastened to the solid steel fan shaft with split collets and clamp locking devices. Smaller unit sizes have spider-type bearings.

Coil flexibility

Model 40RU direct- expansion coils have galvanized steel casings; inlet and outlet connections are on the same end. The coils are designed for use with Puron (R-410A) refrigerant and have $^3/_8$-in. diameter copper tubes mechanically bonded to aluminum sine-wave fins. The coils include matched, factory-installed thermostatic expansion valves (TXVs) with matching distributor nozzles and offers a removable power element and extended connections.

Easier installation and service

The multipoise design and component layout ensures quick unit installation and operation. Units can be converted from horizontal to vertical operation by simply repositioning the unit. Drain pan connections are duplicated on both sides of the unit. The filters, motor, drive, TXVs, and coil connections are all easily accessed by removing a single side panel.

MODEL NUMBER NOMENCLATURE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
3	8	A	U	Z	A	0	7	A	0	A	9	–	0	A	0	A	0

Model Type
Commercial Air Cooled Cond. Unit
Puron® R–410A Refrigerant

Type of Coil
D = Dual Circuit
Z = Single Circuit

Refrigerant Options
A = Standard
B = Low Ambient Controls

Nominal Tonnage
07 = 18.3 kW (5.2 Tons)
08 = 23.2 kW (6.6 Tons)
12 = 29.1 kW (8.3 Tons)
14 = 35.2 kW (10.0 Tons)
16 = 45.8 kW (13.0 Tons)
25 = 59.2 kW (16.8 Tons)

Factory Assigned
A = Default

Factory Assigned
0 = Default

Coil Options (Condenser)
With Round Tube/Plate Fin Design
All models except 14 size (12.5 Ton)
A = Al/Cu Standard
B = Pre Coat Al/Cu
C = E–Coat Al/Cu
E = Cu/Cu
M = Al/Cu Standard with louvered hail guard
N = Pre Coat Al/Cu with louvered hail guard
P = E–Coat Al/Cu with louvered hail guard
R = Cu/Cu – Louvered hail guard
Coil Options (Condenser)
With All Aluminum – NOVATION Design (07–16 sizes)
G = Al/Al Standard
K = E–Coat Al/Al
T = Al/Al with louvered hail guard
W = E–Coat Al/Al with louvered hail guard

Voltage
9 = 400–3–50

Design Rev
– = Factory Assigned

Base Unit Controls
0 = Standard Electro–Mechanical Controls

Factory Assigned
A = Default

Service Options
0 = None

Electrical Options
A = None
C = Non–Fused Disconnect

Brand / Packaging
0 = Standard
1 = LTL

AHRI CAPACITY RATINGS

UNIT	COOLING STAGES	NOM. CAPACITY (TONS)	NET COOLING CAPACITY (MBH)	TOTAL POWER (kW)	EER
38AUZ07/40RU07	1	5	62.7	5.1	12.2
38AUZ08/40RU08	1	6.3	79.3	6.9	11.5
38AUD12/40RU12	2	8.3	103.0	8.2	12.6
38AUD14/40RU14	2	10.4	125.0	10.9	11.5
38AUD16/40RU16	2	12.5	162.0	13.5	12.0
38AUD25/40RU25	2	16.7	202.2	16.6	12.2

LEGEND

AHRI – Air Conditioning, Heating and Refrigeration Institute
ASHRAE – American Society of Heating, Refrigerating and Air Conditioning, Inc.
EER – Energy Efficiency Ratio
IEER – Integrated Energy Efficiency Ratio

NOTES

1. Rated in accordance with AHRI Standard 340/360, as appropriate.
2. Ratings are based on:
   Cooling Standard: 27°C (80°F) db, 19°C (67°F) wb indoor air temp and 35°C (95°F) db outdoor air temp.
3. All units comply with ASHRAE 90.1 Energy Standard for minimum EER and IEER requirements.

SOUND POWER LEVELS, dB

UNIT	COOLING STAGES	OUTDOOR SOUND (dB)								
		A–WEIGHTED	63	125	250	500	1000	2000	4000	8000
NOVATION – All Aluminum Coil Design										
38AUZ07	1	82	78.7	91.2	84.4	79.7	76.9	73.5	71.9	67.5
38AUZ08	1	81	81.7	89.7	82.6	77.6	74.4	70.3	68.0	64.2
38AUD12	2	78	79.2	81.1	78.4	75.0	72.9	68.2	66.4	68.2
38AUD14	2	79	76.2	78.6	78.1	75.1	75.2	71.4	67.9	65.1
38AUD16	2	80	90.3	81.8	78.0	76.7	75.2	70.5	66.4	61.9
RTPF – Round Tube/Plate Fin Coil Design										
38AUZ07	1	83	81.7	88.2	84.0	79.7	78.1	74.0	71.4	68.0
38AUZ08	1	83	81.7	88.2	84.0	79.7	78.1	74.0	71.4	68.0
38AUD12	2	80	76.0	79.9	79.8	77.4	75.6	69.8	67.8	66.4
38AUD16	2	83	86.7	81.2	78.9	80.4	78.0	74.2	70.2	65.0
38AUD25	2	85	91.0	85.0	80.0	86.0	79.0	73.0	68.0	63.0

NOTE: Outdoor sound data is measure in accordance with AHRI standard 270–2008.
LEGEND:
dB = Decibel

PHYSICAL DATA

SINGLE CIRCUIT MODELS with RTPF – Round Tube/Plate Fin Coil Design		
	38AUZ07	**38AUZ08**
Refrigeration System		
# Circuits / # Comp. / Type	1 / 1 / Scroll	1 / 1 / Scroll
R–410a shipping charge A/B (lbs, 50 Hz)	11	13
System charge w/ fan coil* (50 Hz)	14	17
Metering device	TXV	TXV
High–press. Trip / Reset (psig)	630 / 505	630 / 505
Low–press. Trip / Reset (psig)	54 / 117	54 / 117
Cond. Coil		
Material	Al/Cu	Al/Cu
Coil type	RTPF	RTPF
Rows / FPI	2 / 17	2 / 17
Total face area (ft2)	17.5	17.5
Cond. fan / motor		
Qty / Motor drive type	2 / direct	2 / direct
Motor HP / RPM	1/4 / 1100	1/4 / 1100
Fan diameter (in)	22	22
Nominal Airflow (cfm)	6000	6000
Watts (total)	610	610
Piping Connections		
Qty / Suction (in. ODS)	1 / 1 1/8	1 / 1 1/8
Qty / Liquid (in. ODS)	1 / 3/8	1 / 1/2

SINGLE CIRCUIT MODELS with NOVATION – All Aluminum coil Design		
	38AUZ07	**38AUZ08**
Refrigeration System		
# Circuits / # Comp. / Type	1 / 1 / Scroll	1 / 1 / Scroll
R–410a shipping charge A/B (lbs)	4.4	4.9
System charge w/ fan coil	8.4	10.2
System charge w/ fan coil (50hz)	9.0	12.3
Metering device	TXV	TXV
High–press. Trip / Reset (psig)	630 / 505	630 / 505
Low–press. Trip / Reset (psig)	54 / 117	54 / 117
Cond. Coil		
Material	Al	Al
Coil type	microchannel	microchannel
Rows / FPI	1 / 17	1 / 17
total face area (ft2)	17.5	20.5
Cond. fan / motor		
Qty / Motor drive type	2 / direct	2 / direct
Motor HP / RPM	1/4 / 1100	1/4 / 1100
Fan diameter (in)	22	22
Nominal Airflow (cfm)	6,000	6,000
Watts (total)	610	610

RTPF – Round tube /plate fin design

* Approximate system charge with about 25 ft piping of sizes indicated with matched 40RU.

PHYSICAL DATA (CONT)

DUAL CIRCUIT MODELS with RTPF – Round Tube/Plate Fin Coil Design			
	38AUD12	**38AUD16**	**38AUD25**
Refrigeration System			
# Circuits / # Comp. / Type	2 / 2 / Scroll	2 / 2 / Scroll	2 / 2 / Scroll
R–410a shipping charge A/B (lbs, 50 Hz)	8.0 / 8.0	16.0 / 16.0	14.0 / 14.0
System charge w/ fan coil* (50 Hz)	11.0 / 10.0	22.0 / 22.0	19.0 / 19.0
Metering device	TXV	TXV	TXV
High–press. Trip / Reset (psig)	630 / 505	630 / 505	630 / 505
Low–press. Trip / Reset (psig)	54 / 117	54 / 117	54 / 117
Compressor			
Model	ZP51 (2)	ZP83 (2)	ZP103 (2)
Oil Charge A/B (oz)	42 / 42	60 / 60	110 / 110
Speed rpm 50 Hz	2900	2900	2900
Cond. Coil			
Material	Al/Cu	Al/Cu	Al/Cu
Coil type	RTPF	RTPF	RTPF
Rows / FPI	2 / 17	2 / 17	2 / 17
Total face area (ft2)	25.1	23.5 x 2	25.0 x 2
Cond. fan / motor			
Qty / Motor drive type	2 / direct	3 / direct	4 / direct
Motor HP / RPM	1/4 / 1100	1/4 / 1100	1/4 / 1100
Fan diameter (in)	22	22	22
Nominal Airflow (cfm)	6000	9000	12000
Watts (total)	610	970	1150
Piping Connections			
Qty / Suction (in. ODS)	2 / 1 1/8	2 / 1 3/8	2 / 1 3/8
Qty / Liquid (in. ODS)	2 / 3/8	2 / 1/2	2 / 1/2

DUAL CIRCUIT MODELS with NOVATION – All Aluminum coil Design			
	38AUD12	**38AUD14**	**38AUD16**
Refrigeration System			
# Circuits / # Comp. / Type	2/2/Scroll	2/2/Scroll	2/2/Scroll
R–410a shipping charge A/B (lbs)	3.0 /3.1	3.7/3.9	6.1/6.1
System charge w/ fan coil	7.4 / 7.4	10.8 / 10.8	12.0/12.0
System charge w/ fan coil (50hz)	7.5 / 7.5	11.2 / 11.2	14.0 /14.0
Metering device	TXV	TXV	TXV
High–press. Trip / Reset (psig)	630 / 505	630 / 505	630 / 505
Low–press. Trip / Reset (psig)	54 / 117	54 / 117	54 / 117
Cond. Coil			
Material	Al	Al	Al
Coil type	microchannel	microchannel	microchannel
Rows / FPI	1 / 17	1 / 17	1 / 17
total face area (ft2)	25.0	31.8	25.0 x 2
Cond. fan / motor			
Qty / Motor drive type	2 / direct	2 / direct	3 / direct
Motor HP / RPM	1/4 / 1100	1/4 / 1100	1/4 / 1100
Fan diameter (in)	22	22	22
Nominal Airflow (cfm)	6,000	6,000	10,000
Watts (total)	610	610	970

RTPF – Round tube /plate fin design

* Approximate system charge with about 25 ft piping of sizes indicated with matched 40RU.

DIMENSIONS

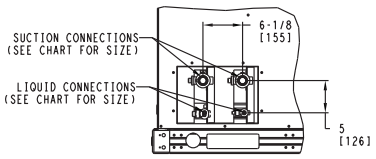
UNIT	STD. UNIT WT.		CORNER A		CORNER B		CORNER C		CORNER D		CENTER OF GRAVITY			UNIT HEIGHT
	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	X	Y	Z	H
38AUZ-07 (MCHX)	149	328	58	128	31	68	28	62	32	70	21 [533.4]	19 [482.6]	13 [330.2]	42-3/8 [1076.0]
38AUZ-08 (MCHX)	160	353	63	138	33	72	29	65	35	78	19 [482.6]	23 [584.2]	13 [330.2]	42-3/8 [1076.0]
38AUD-12 (MCHX)	226	499	88	193	50	111	38	72	56	123	20 [508.0]	23 [584.2]	15 [381.0]	50-3/8 [1279.2]
38AUD-14 (MCHX)	229	505	86	190	40	88	34	76	68	151	20 [508.0]	24 [609.6]	15 [381.0]	50-3/8 [1279.2]
38AUZ-07 (RTPF)	176	389	64	141	44	96	28	62	41	91	18 [457.2]	24 [609.6]	21 [533.4]	42-3/8 [1076.0]
38AUZ-08 (RTPF)	177	391	64	142	44	96	28	62	41	91	18 [457.2]	24 [609.6]	21 [533.4]	42-3/8 [1076.0]
38AUD-12 (RTPF)	234	516	84	185	53	117	38	83	59	131	19 [482.6]	23 [584.2]	24 [609.6]	50-3/8 [1279.2]

CG CENTER OF GRAVITY

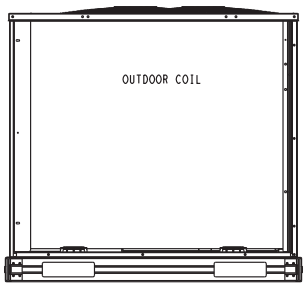
DIRECTION OF AIR FLOW

DIMENSIONS IN [ ] ARE IN MM

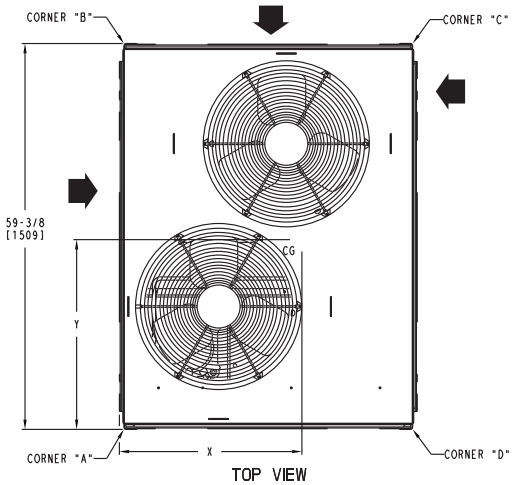
SERVICE VALVE CONNECTIONS		
UNIT	SUCTION	LIQUID
38AUZ07	1-1/8 [28.6]	3/8 [9.5]
38AUZ08	1-1/8 [28.6]	1/2 [12.7]
38AUD12	1-1/8 [28.6]	3/8 [9.5]
38AUD14	1-3/8 [34.9]	1/2 [12.7]



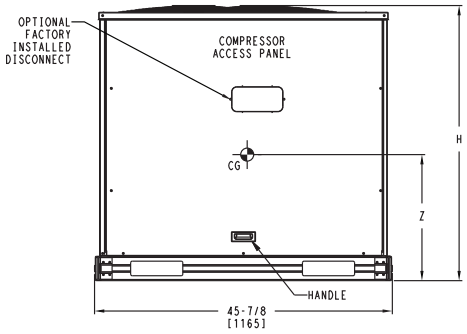
RIGHT SIDE VIEW
(FOR 38AUD SYSTEMS)



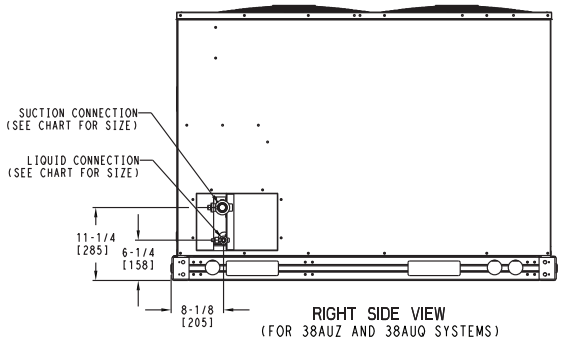
PLAN VIEW



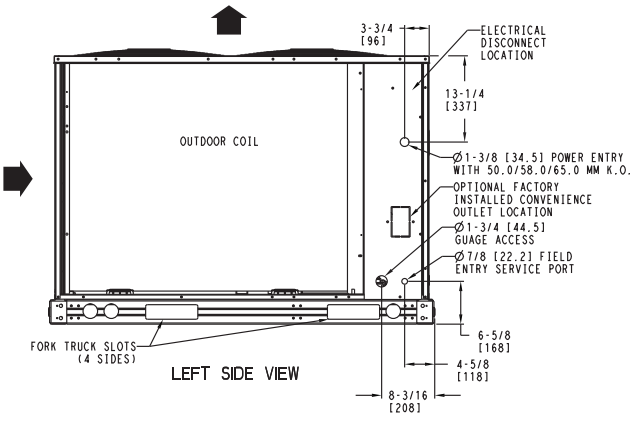
TOP VIEW



FRONT VIEW



RIGHT SIDE VIEW
(FOR 38AUZ AND 38AUQ SYSTEMS)



LEFT SIDE VIEW

NOTES:

1. MINIMUM CLEARANCE (LOCAL CODES OR JURISDICTION MAY PREVAIL):
   A. BOTTOM TO COMBUSTIBLE SURFACES: 0 INCHES.
   B. OUTDOOR COIL, FOR PROPER AIR FLOW: 36 INCHES ONE SIDE, 12 INCHES THE OTHER. THE SIDE GETTING THE GREATER CLEARANCE IS OPTIONAL.
   C. OVERHEAD: 60 INCHES, TO ASSURE PROPER OUTDOOR FAN OPERATION.
   D. BETWEEN UNITS: CONTROL BOX SIDE, 42 INCHES PER NEC.
   E. BETWEEN UNIT AND UNGROUNDED SURFACES: CONTROL BOX SIDE, 36 INCHES PER NEC.
   F. BETWEEN UNIT AND BLOCK OR CONCRETE WALLS AND OTHER GROUNDED SURFACES: CONTROL BOX SIDE, 42 INCHES PER NEC.
2. WITH EXCEPTION OF THE CLEARANCE FOR THE OUTDOOR COIL AS STATED IN NOTE 1B, A REMOVABLE FENCE OR BARRICADE REQUIRES NO CLEARANCE.
3. UNITS MAY BE INSTALLED ON COMBUSTIBLE FLOORS MADE FROM WOOD OR CLASS A, B OR C ROOF COVERING MATERIAL.

C10590

DIMENSIONS (cont.)

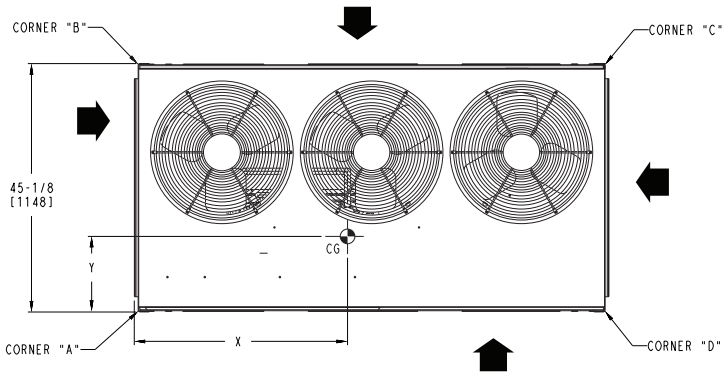
UNIT	STD. UNIT WT.		CORNER A		CORNER B		CORNER C		CORNER D		CENTER OF GRAVITY			UNIT HEIGHT
	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	X	Y	Z	H
38AUD16 (MCHX)	288	633	100	220	61	134	61.5	135	65.5	144	38 [965.2]	19 [482.6]	15 [381]	50-3/8 [1279.2]
38AUD16 (RTPF)	332	731	107	237	78	172	61	135	84	186	38 [965.2]	19 [482.6]	17 [431.8]	50-3/8 [1279.2]

CG CENTER OF GRAVITY

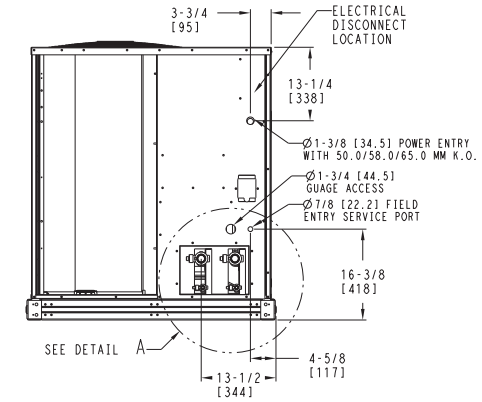
DIRECTION OF AIR FLOW

DIMENSIONS IN [ ] ARE IN MM

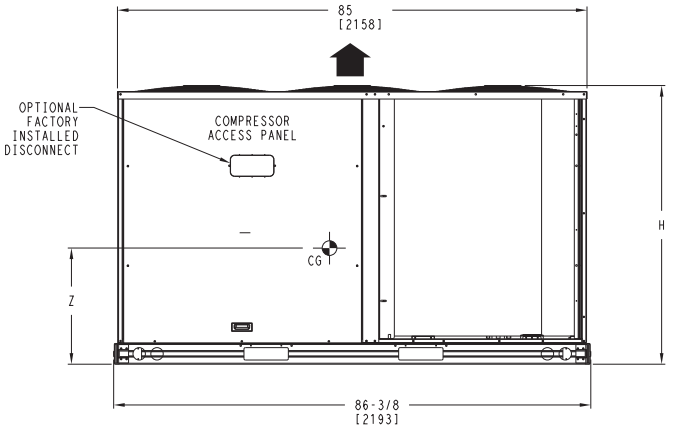
SERVICE VALVE CONNECTIONS			QTY
UNIT	SUCTION	LIQUID	
38AUD16	1-3/8 [34.9]	1/2 [12.7]	2 EA



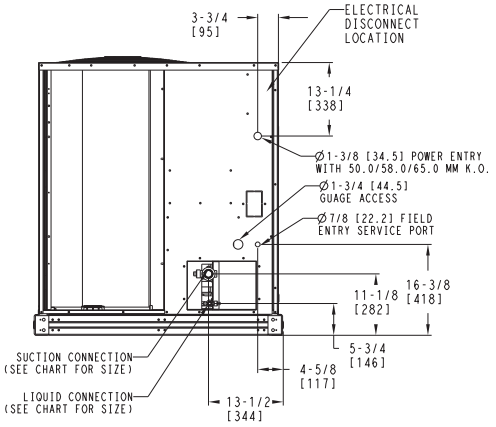
TOP VIEW



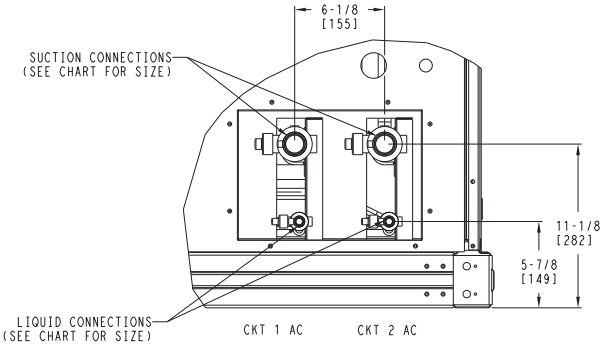
LEFT SIDE VIEW FOR 38AUD SYSTEMS



FRONT VIEW



LEFT SIDE VIEW



DETAIL A
(NOTE POSITION OF CKT 1)

NOTES:
1. MINIMUM CLEARANCE (LOCAL CODES OR JURISDICTION MAY PREVAIL):
   A. BOTTOM TO COMBUSTIBLE SURFACES: 0 INCHES.
   B. OUTDOOR COIL, FOR PROPER AIR FLOW: 36 INCHES ONE SIDE, 12 INCHES THE OTHER. THE SIDE GETTING THE GREATER CLEARANCE IS OPTIONAL.
   C. OVERHEAD: 60 INCHES, TO ASSURE PROPER OUTDOOR FAN OPERATION.
   D. BETWEEN UNITS: CONTROL BOX SIDE, 42 INCHES PER NEC.
   E. BETWEEN UNIT AND UNGROUNDED SURFACES: CONTROL BOX SIDE, 36 INCHES PER NEC.
   F. BETWEEN UNIT AND BLOCK OR CONCRETE WALLS AND OTHER GROUNDED SURFACES: CONTROL BOX SIDE, 42 INCHES PER NEC.
2. WITH EXCEPTION OF THE CLEARANCE FOR THE OUTDOOR COIL AS STATED IN NOTE 1B, A REMOVABLE FENCE OR BARRICADE REQUIRES NO CLEARANCE.
3. UNITS MAY BE INSTALLED ON COMBUSTIBLE FLOORS MADE FROM WOOD OR CLASS A, B OR C ROOF COVERING MATERIAL.

C10591

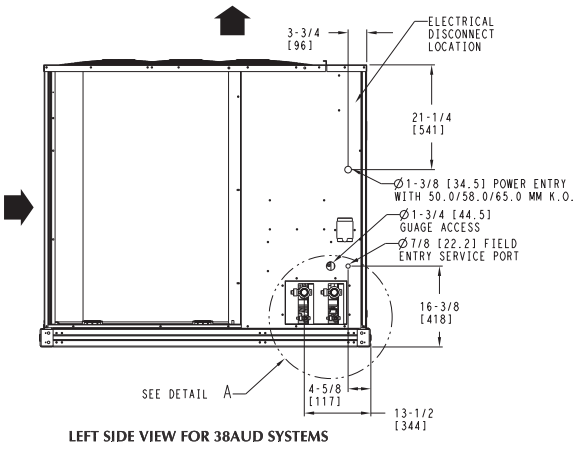
DIMENSIONS (cont.)

UNIT	STD. UNIT WT.		CORNER A		CORNER B		CORNER C		CORNER D		CENTER OF GRAVITY			UNIT HEIGHT
	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	KG.	LBS.	X	Y	Z	H
38AUD25 (RTPF)	444	978	163	360	85	188	67	147	128	283	38 [965.2]	23 [584.2]	17 [431.8]	50-3/8 [1279.2]

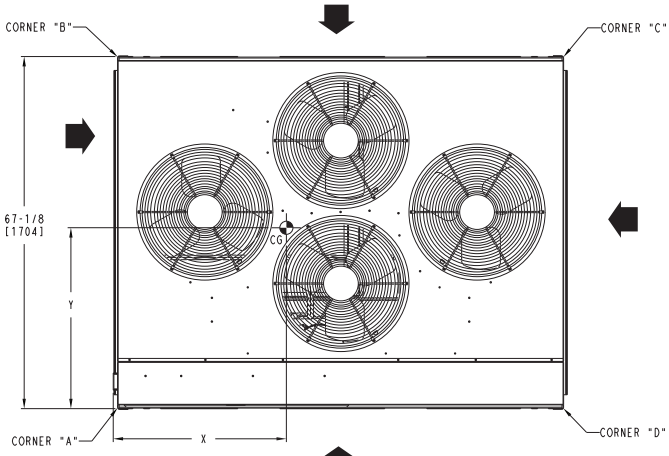
CG CENTER OF GRAVITY

DIRECTION OF AIR FLOW

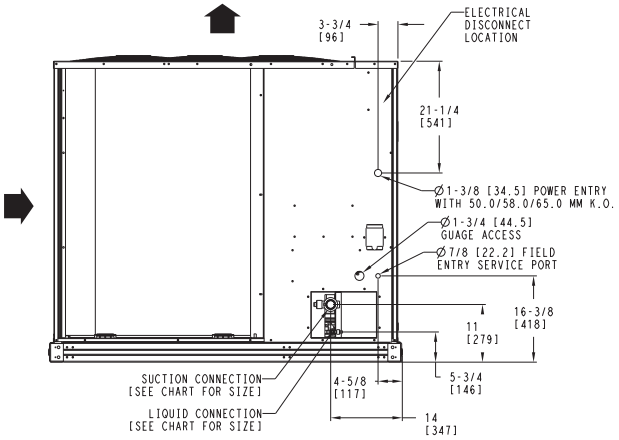
DIMENSIONS IN [ ] ARE IN MM



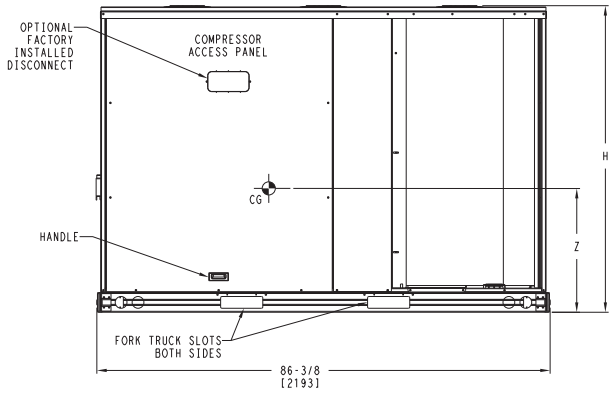
LEFT SIDE VIEW FOR 38AUD SYSTEMS



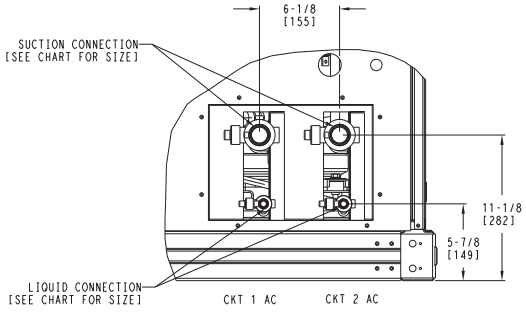
TOP VIEW



LEFT SIDE VIEW



FRONT VIEW



DETAIL A
(NOTE POSITION OF CKT 1)

NOTES:
1. MINIMUM CLEARANCE (LOCAL CODES OR JURISDICTION MAY PREVAIL):
   A. BOTTOM TO COMBUSTIBLE SURFACES: 0 INCHES.
   B. OUTDOOR COIL, FOR PROPER AIR FLOW: 36 INCHES ONE SIDE, 12 INCHES THE OTHER. THE SIDE GETTING THE GREATER CLEARANCE IS OPTIONAL.
   C. OVERHEAD: 60 INCHES, TO ASSURE PROPER OUTDOOR FAN OPERATION.
   D. BETWEEN UNITS: CONTROL BOX SIDE, 42 INCHES PER NEC.
   E. BETWEEN UNIT AND UNGROUNDED SURFACES: CONTROL BOX SIDE, 36 INCHES PER NEC.
   F. BETWEEN UNIT AND BLOCK OR CONCRETE WALLS AND OTHER GROUNDED SURFACES: CONTROL BOX SIDE, 42 INCHES PER NEC.
2. WITH EXCEPTION OF THE CLEARANCE FOR THE OUTDOOR COIL AS STATED IN NOTE 1B, A REMOVABLE FENCE OR BARRICADE REQUIRES NO CLEARANCE.
3. UNITS MAY BE INSTALLED ON COMBUSTIBLE FLOORS MADE FROM WOOD OR CLASS A, B OR C ROOF COVERING MATERIAL.

SERVICE VALVE CONNECTIONS			QTY
UNIT	SUCTION	LIQUID	
38AUD25	1-3/8 [34.9]	1/2 [12.7]	2 EA

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OPTIONS AND ACCESSORIES

38AUZ/D OPTIONS AND ACCESSORIES

ITEM	OPTION*	ACCESSORY†
Disconnect Switch (non-fused)	X	
Special–coated Coil Protection	X	
Low Ambient Temperature MotorMaster I® Control	X	X
Wired Condenser Coil Grille (Novation 07–14 models only)		X
Louvered Hail Guard	X	X
Programmable Thermostats		X

* Factory-installed option.

† Field-installed accessory.

38AUZ/38AUD factory-installed options

E-coated aluminum-fin coils have a flexible and durable epoxy coating uniformly applied to all coil surfaces. Unlike brittle phenolic dip and bake coatings, E-coating provides superior protection with unmatched flexibility, edge coverage, metal adhesion, thermal performance, and most importantly, corrosion resistance.

E-coated coils provide this protection since all coil surfaces are completely encapsulated from environmental contamination. This coating is especially suitable in industrial environments.

Pre-coated coils (RTPF coils only) provide protection in mild coastal environments.

–29°C (–20°F) low-ambient temperature kit option (MotorMaster I®) controls outdoor-fan motor operation to maintain the correct head pressure at low outdoor ambient temperatures.

Louvered hail guard package protects coils against damage from flying debris and hail.

Non-fused disconnect switch is used to remove power locally at the condensing unit. This switch also includes a power lockout capability to protect the service person. This lockout switch saves the service person time and effort because there is no need to access a distant disconnect switch while servicing the unit.

NOTE: Non-fused disconnect switch cannot be used when unit MOCP electrical rating exceeds 80 amps.

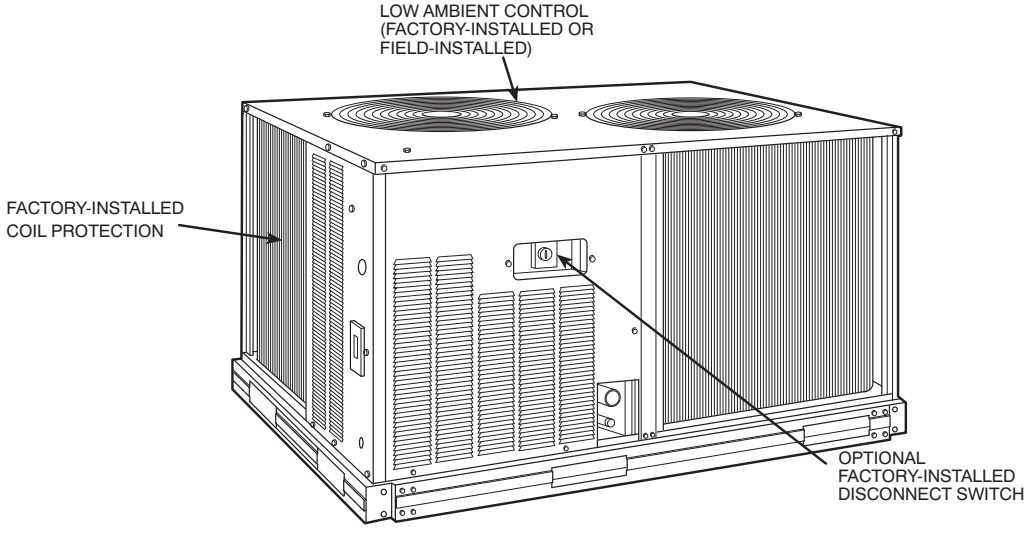
38AUZ/D field-installed accessories

–29°C (–20°F) low-ambient temperature kit accessory (MotorMaster I®) controls outdoor-fan motor operation to maintain the correct head pressure at low outdoor ambient temperatures.

Louvered hail guard package protects coils against damage from flying debris and hail.

Condenser coil grille package protects condensing unit coil from impact by large objects and vandalism.

Carrier's line of thermostats provide both programmable and non-programmable capability with the new **Debonair®** line of commercial programmable thermostats. The **Commercial Electronic** thermostats provide 7-day programmable capability for economical applications.



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OPTIONS AND ACCESSORIES (cont.)

40RU OPTIONS AND ACCESSORIES

ITEM	OPTION*	ACCESSORY†
Alternate Fan Motors	X	
Alternate Drives	X	
CO_2 Sensors		X
Condensate Drain Trap		X
Discharge Plenum		X
Economizer		X
Electric Heat		X
Hot Water Heating Coils		X
Overhead Suspension Package		X
Prepainted Units	X	
Return Air Grille		X
Steam Heating Coil		X
Subbase		X

* Factory-installed option.

† Field-installed accessory.

40RU factory-installed options

Alternate fan motors and drives are available to provide the widest possible range of performance.

Units constructed of prepainted steel are available from the factory for applications that require painted units. Unit color is American Sterling Gray.

40RU field-installed accessories

Two-row hot water coils have $^5/_8$-in. diameter copper tubes mechanically bonded to aluminum plate fins. Coils have non-ferrous headers.

One-row steam coil has 1-in. OD copper tube and aluminum fins. The Inner Distributing Tube (IDT) design provides uniform temperatures across the coil face. The IDT steam coils are especially suited to applications where sub-freezing air enters the unit.

Electric resistance heat coils have an open-wire design and are mounted in a rigid frame. Safety cutouts for high temperature conditions are standard.

Economizer (enthalpy controlled) provides ventilation air and provides "free" cooling if the outside ambient temperature and humidity are suitable. The economizer can also be used in conjunction with Carrier Comfort System thermostats and CO_2 sensors to help meet indoor air quality requirements. The economizer can be used in both vertical and horizontal positions.

Discharge plenum directs the air discharge into the occupied space; integral horizontal and vertical louvers enable redirection of airflow. This accessory is available unpainted or painted.

Return-air grille provides a protective barrier over the return-air opening and gives a finished appearance to units installed in the occupied space. This accessory is available unpainted or painted.

Subbase provides a stable, raised platform and room for condensate drain connection for floor-mounted units. This accessory is available unpainted or painted.

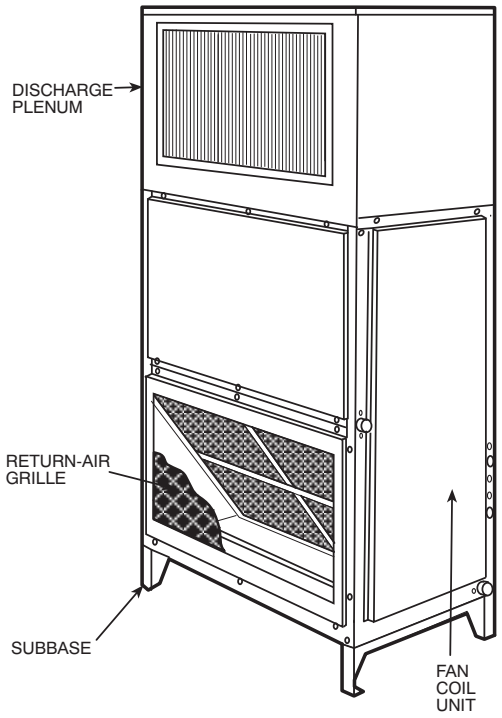
Overhead suspension package includes necessary brackets to support units in horizontal installations.

CO_2 sensors can be used in conjunction with the economizer accessory to help meet indoor air quality requirements. The sensor signals the economizer to open when the CO_2 level in the space exceeds the setpoint. A Carrier Comfort System programmable thermostat can also be used to override the sensor if the outside-air temperature is too high or too low.

Condensate drain trap includes an overflow shutoff switch that can be wired to turn off the unit if the trap becomes plugged. The kit also includes a wire harness that can be connected to an alarm if desired. The transparent trap is designed for easy service and maintenance.

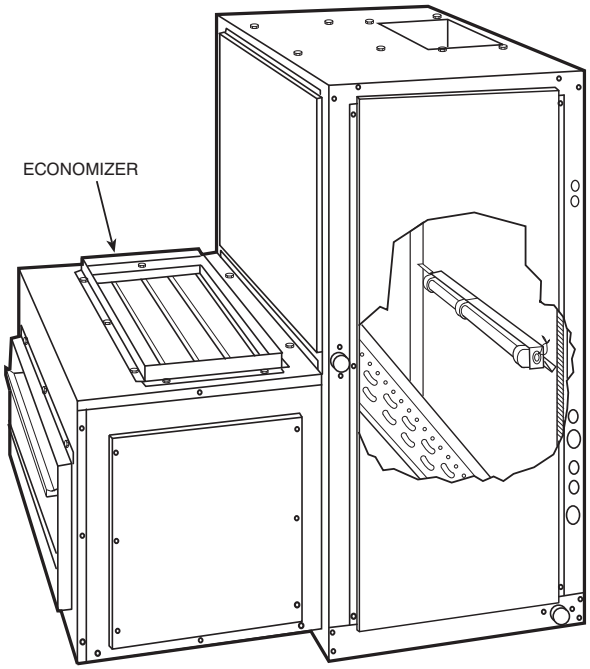
OPTIONS AND ACCESSORIES (cont.)

40RU WITH DISCHARGE PLENUM RETURN-AIR GRILLE AND SUBBASE

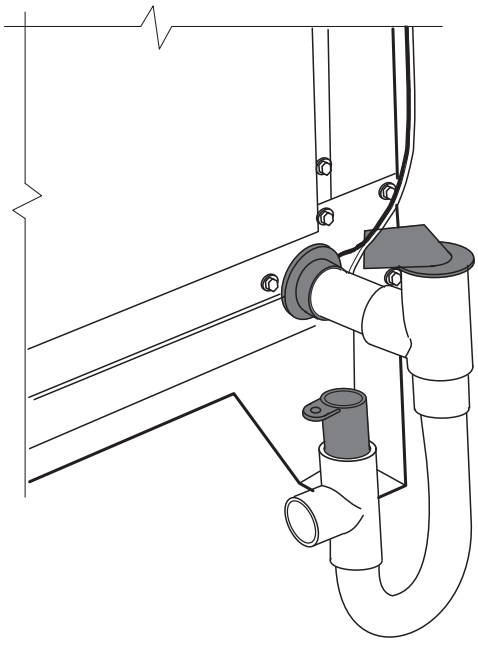


40RU WITH HOT WATER OR STEAM COIL

40RU WITH ECONOMIZER



40RU WITH CONDENSATE TRAP



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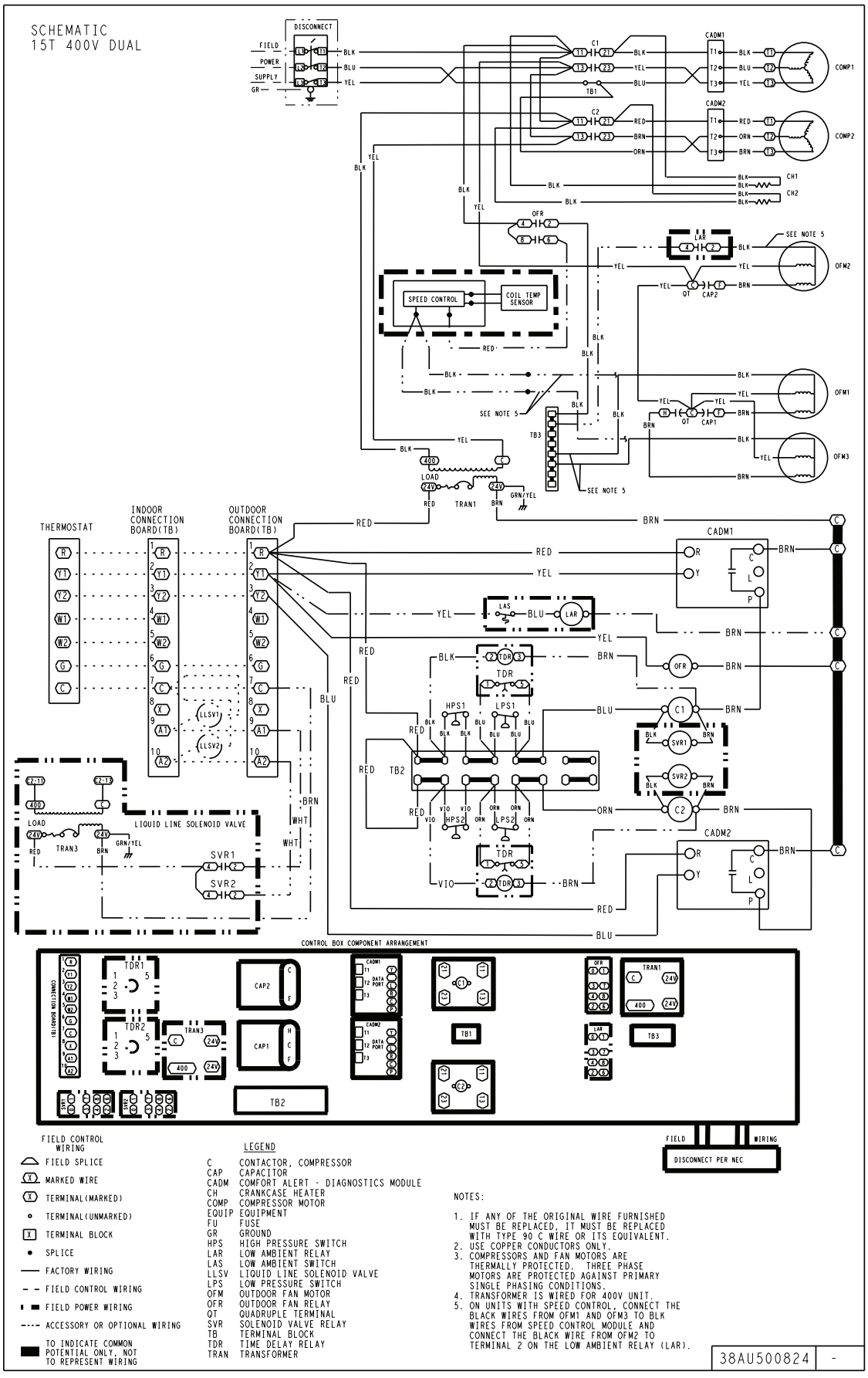
TYPICAL WIRING SCHEMATIC



C10593

Typical 38AUD16 Dual Circuit

ELECTRICAL DATA

38AUZ07 COOLING 50 Hz

38AUZ07							WITHOUT PWRD C.O.		WITH PWRD C.O.	
V–Ph–Hz	VOLTAGE RANGE		COMP 1		OFM (ea)		MCA	Fuse	MCA	Fuse
	MIN	MAX	RLA	LRA	WATTS	FLA				
400–3–50	380	420	9.7	64	270	0.7	13.5	20	15.9	25

38AUZ08 COOLING 50 Hz

38AUZ08							WITHOUT PWRD C.O.		WITH PWRD C.O.	
V–Ph–Hz	VOLTAGE RANGE		COMP 1		OFM (ea)					
	MIN	MAX	RLA	LRA	WATTS	FLA	MCA	Fuse	MCA	Fuse
400–3–50	380	420	12.2	101	270	0.7	16.7	25	19.0	30

38AUD12 COOLING 50 Hz

38AUD12									WITHOUT PWRD C.O.		WITH PWRD C.O.	
V–Ph–Hz	VOLTAGE RANGE		COMP 1		COMP 2		OFM (ea)					
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	MCA	Fuse	MCA	Fuse
400–3–50	380	420	7.8	51.5	7.8	51.5	270	0.7	19.0	25	21.3	30

38AUD14 COOLING 50 Hz

38AUD14									WITHOUT PWRD C.O.		WITH PWRD C.O.	
V–Ph–Hz	VOLTAGE RANGE		COMP 1		COMP 2		OFM (ea)					
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	MCA	Fuse	MCA	Fuse
400–3–50	380	420	10.6	74	10.6	74	270	0.7	25.3	30	27.6	30

38AUD16 COOLING 50 Hz

38AUD16									POWER SUPPLY		DISCONNECT SIZE	
V–Ph–Hz	VOLTAGE RANGE		COMP 1		COMP 2		OFM					
	Min	Max	RLA	LRA	RLA	LRA	Qty	FLA (ea)	MCA	MOCP	FLA	LRA
400–3–50	360	440	12.2	101	12.2	101	3	0.7	29.6	40	30	208

38AUD25 COOLING 50 Hz

38AUD24									POWER SUPPLY		DISCONNECT SIZE	
V–Ph–Hz	VOLTAGE RANGE		COMP 1		COMP 2		OFM					
	Min	Max	RLA	LRA	RLA	LRA	Qty	FLA (ea)	MCA	MOCP	FLA	LRA
400–3–50	360	440	16.7	111	16.7	111	4	0.7	40.4	50	42	230

APPLICATION DATA

Operating limits

Maximum outdoor temperature . . . . . 125°F

Minimum return-air temperature (40RUA) . . . . . 55°F

Maximum return-air temperature (40RUA) . . . . . 95°F

Range of acceptable saturation suction temperature . . . . . 20 to 50°F

Maximum discharge temperature . . . . . 275°F

Minimum discharge superheat . . . . . 60°F

NOTES:

1. Select air handler at no less than 300 cfm/ton (nominal condensing unit capacity).
2. Total combined draw of the field-supplied liquid line solenoid valve and air handler fan contactor must not exceed 22 va. If the specified va must be exceeded, use a remote relay to control the load.

MINIMUM OUTDOOR-AIR OPERATING TEMPERATURE

UNIT 38AU	MINIMUM OUTDOOR TEMP (°F)	
	Std	With MotorMaster I® Control†
Z07	35	–20
Z08	35	
D12	35	
D14	35	
D16	35	
D25	35	

† Wind baffles (field-supplied and field-installed) are recommended for all units with MotorMaster I® control. Refer to Low Ambient Temperature Control Installation Instructions for additional information.

Refrigerant piping

IMPORTANT: Do not bury refrigerant piping underground.

It is recommended that the refrigerant piping for all commercial split systems include a liquid line solenoid valve, a liquid line filter drier and a sight glass.

For refrigerant lines longer than 75 lineal ft, a liquid line solenoid valve installed at the **indoor** unit and a suction accumulator are required. Refer to the Refrigerant Specialties Part Numbers table.

REFRIGERANT SPECIALTIES PART NUMBERS

LIQUID LINE SIZE (in.)	LIQUID LINE SOLENOID VALVE (LLSV)	LLSV COIL	SIGHT GLASS
$^3/_8$	EF680033	EF680037	KM680008
$^1/_2$	EF680035	EF680037	KM680004
$^5/_8$	EF680036	EF680037	KM680005

NOTE: 38AUD units require TWO sets of parts.

38AUZ 07-08 PIPING RECOMMENDATIONS (SINGLE-CIRCUIT UNIT)

R–410A	Equivalent Length									
	meter	0–12		12–23		23–34		34–46		46–57	
	feet	0–38		38–75		75–113		113–150		150–188	
Model	Linear Length										
	meter	0–7.5		7.5–15		15–23		23–30		30–38	
	feet	0–25		25–50		50–75		75–100		100–125	
38AUZ*07	Liquid Line	3/8		3/8	1/2	3/8	1/2	3/8	1/2	3/8	1/2
	Max Lift										
	SI (m)										
	Novation	7.5		15		16	23	9	29	10	34
	RTPF	7.5		15		19	23	12	30	11	38
	EN (ft)										
	Novation	25		50		53	75	34	97	33	112
	RTPF	25		50		63	75	42	100	38	125
	Suction Line	7/8	7/8	7/8		7/8		7/8		1–1/8	
	Charge										
	SI (kg)										
	Novation	3.8		4.4		4.9	5.9	5.4	6.8	6.1	7.9
	RTPF	6.4		7.0		7.4	8.5	7.9	9.3	8.7	10.4
	EN (lbs)										
	Novation	8.4		9.8		10.8	13.1	11.8	14.9	13.5	17.4
	RTPF	14.0		15.4		16.4	18.7	17.4	20.5	19.1	23.0
38AUZ*08	Liquid Line	1/2		1/2	5/8	1/2	5/8	1/2	5/8	1/2	5/8
	Max Lift										
	SI (m)										
	Novation	7.5		9	11	7	10	DNU	10	10	16
	RTPF	7.5		15	NR	23	NR	27	30	18	38
	EN (ft)										
	Novation	25		30	38	24	36	DNU	35	33	53
	RTPF	25		50	NR	75	NR	89	100	62	125
	Suction Line	7/8		7/8		1–1/8		1–1/8		1–1/8	
	Charge										
	SI (kg)										
	Novation	5.5		6.3	7.2	7.4	8.6	DNU	9.9	9.1	11.2
	RTPF	8.6		9.4	NR	10.4	NR	11.3	13.0	12.2	14.3
	EN (lbs)										
	Novation	12.2		13.9	15.8	16.2	19.0	DNU	21.9	20.0	24.8
	RTPF	19.0		20.7	NR	23.0	NR	24.9	28.7	26.8	31.6

Legend:

Equivalent Length – Equivalent tubing length, including effects of refrigeration specialties devices

Linear Length – Linear tubing length, feet

Liquid Line – Tubing size, inches OD.

Max Lift – Maximum liquid lift (indoor unit ABOVE outdoor unit only), at maximum permitted liquid line pressure drop
- Linear Length Less than 30 m (100 ft): Minimum 1.1° C (2.0° F) subcooling entering TXV
- Linear Length Greater than 30 m (100 ft): Minimum 0.3° C (0.5° F) subcooling entering TXV

Suction Line – Tube size, inches OD

Charge – Charge Quantity, lbs. Calculated for both liquid line sizes (where applicable), but only with larger suction line size (where applicable)

DNU – Do Not Use (pressure drop exceeds available subcooling in this model)

NR – Not Recommended (use smaller liquid tube size)

SI – Metric units of measure

EN – English units of measure (I–P)

NOTE: For applications with equivalent length greater than 57 m (188 ft) and/or linear length greater than 38 m (125 ft), contact your local Carrier representative.

38AUD 12-14 PIPING RECOMMENDATIONS (TWO-CIRCUIT UNIT)

NOTE: 38AUD requires TWO sets of refrigeration piping

R–410A	Equivalent Length									
	meter	**0–12**	**12–23**		**23–34**		**34–46**		**46–57**	
	feet	**0–38**	**38–75**		**75–113**		**113–150**		**150–188**	
Model	Linear Length									
	meter	0–7.5	7.5–15		15–23		23–30		30–38	
	feet	0–25	25–50		50–75		75–100		100–125	
38AUD*12	Liquid Line	3/8	3/8		3/8	1/2	3/8	1/2	3/8	1/2
	Max Lift									
	SI (m)									
	Novation	7.5	15		15	23	10	24	13	29
	RTPF	7.5	15		15	23	10	27	11	32
	EN (ft)									
	Novation	25	50		50	75	36	79	44	96
	RTPF	25	50		50	75	36	89	39	106
	Suction Line	7/8	7/8		7/8		7/8		1–1/8	
	Charge									
	SI (kg)									
	Novation	3.3	3.8		4.2	5.3	4.7	6.1	5.1	6.9
	RTPF	4.9	5.4		5.8	6.9	6.3	7.7	6.8	8.6
	EN (lbs)									
	Novation	7.3	8.3		9.3	11.6	10.3	13.4	11.3	15.2
	RTPF	10.9	11.9		12.9	15.2	13.9	17.0	14.9	18.8
38AUD*14	Liquid Line	3/8	1/2	5/8	1/2	5/8	1/2	5/8	1/2	5/8
	Max Lift									
	SI (m)									
	Novation	7.5	13	15	12	14	11	14	17	20
	EN (ft)									
	Novation	25	45	50	42	49	39	48	56	68
	Suction Line	7/8	7/8		7/8		1–1/8		1–1/8	
	Charge									
	SI (kg)									
	Novation	4.6	5.8	6.6	6.6	7.8	7.6	10.7	9.4	12.0
	EN (lbs)									
	Novation	10.1	12.7	14.6	14.5	17.3	16.8	23.5	20.7	26.4

Legend:

Equivalent Length – Equivalent tubing length, including effects of refrigeration specialties devices

Linear Length – Linear tubing length, feet

Liquid Line – Tubing size, inches OD.

Max Lift – Maximum liquid lift (indoor unit ABOVE outdoor unit only), at maximum permitted liquid line pressure drop
- Linear Length Less than 30 m (100 ft): Minimum 1.1° C (2.0° F) subcooling entering TXV
- Linear Length Greater than 30 m (100 ft): Minimum 0.3° C (0.5° F) subcooling entering TXV

Suction Line – Tube size, inches OD

Charge – Charge Quantity, lbs. Calculated for both liquid line sizes (where applicable), but only with larger suction line size (where applicable)

DNU – Do Not Use (pressure drop exceeds available subcooling in this model)

NR – Not Recommended (use smaller liquid tube size)

SI – Metric units of measure

EN – English units of measure (I–P)

NOTE: For applications with equivalent length greater than 57 m (188 ft) and/or linear length greater than 38 m (125 ft), contact your local Carrier representative.

38AUD 16-25 PIPING RECOMMENDATIONS (TWO-CIRCUIT UNIT)

NOTE: 38AUD requires TWO sets of refrigeration piping

R–410A	Equivalent Length									
	meter	**0–12**		**12–23**		**23–34**		**34–46**		**46–57**	
	feet	**0–38**		**38–75**		**75–113**		**113–150**		**150–188**	
Model	Linear Length										
	meter	0–7.5		7.5–15		15–23		23–30		30–38	
	feet	0–25		25–50		50–75		75–100		100–125	
38AUD*16	Liquid Line	3/8	1/2	3/8	1/2	3/8	1/2	3/8	1/2	1/2	
	Max Lift										
	SI (m)										
	Novation	7.5	NR	15	NR	21	23	13	30	38	
	RTPF	DNU	7.5	DNU	15	DNU	23	DNU	30	36	
	EN (ft)										
	Novation	25	NR	50	NR	71	75	43	100	125	
	RTPF	DNU	25	DNU	50	DNU	75	DNU	100	119	
	Suction Line	7/8		1–1/8		1–1/8		1–1/8		1–1/8	
	Charge										
	SI (kg)										
	Novation	5.8	NR	6.3	NR	7.0	8.0	7.5	8.9	9.8	
	RTPF	DNU	9.8	DNU	10.7	DNU	11.6	DNU	12.4	13.3	
	EN (lbs)										
	Novation	12.9	NR	13.9	NR	15.4	17.7	16.5	19.6	21.6	
	RTPF	DNU	21.7	DNU	23.6	DNU	25.5	DNU	27.4	29.3	
38AUD*25	Liquid Line	1/2		1/2		1/2		1/2	5/8	1/2	5/8
	Max Lift										
	SI (m)										
	RTPF	7.5		15		23		20	27	23	32
	EN (ft)										
	RTPF	25		50		75		67	91	76	107
	Suction Line	7/8		1–1/8		1–1/8		1–1/8		1–1/8	
	Charge										
	SI (kg)										
	RTPF	9.4		10.3		11.2		12.1	13.8	13.0	15.1
	EN (lbs)										
	RTPF	20.7		22.8		24.7		26.6	30.4	28.6	33.3

Legend:

Equivalent Length – Equivalent tubing length, including effects of refrigeration specialties devices

Linear Length – Linear tubing length, feet

Liquid Line – Tubing size, inches OD.

Max Lift – Maximum liquid lift (indoor unit ABOVE outdoor unit only), at maximum permitted liquid line pressure drop
- Linear Length Less than 30 m (100 ft): Minimum 1.1° C (2.0° F) subcooling entering TXV
- Linear Length Greater than 30 m (100 ft): Minimum 0.3° C (0.5° F) subcooling entering TXV

Suction Line – Tube size, inches OD

Charge – Charge Quantity, lbs. Calculated for both liquid line sizes (where applicable), but only with larger suction line size (where applicable)

DNU – Do Not Use (pressure drop exceeds available subcooling in this model)

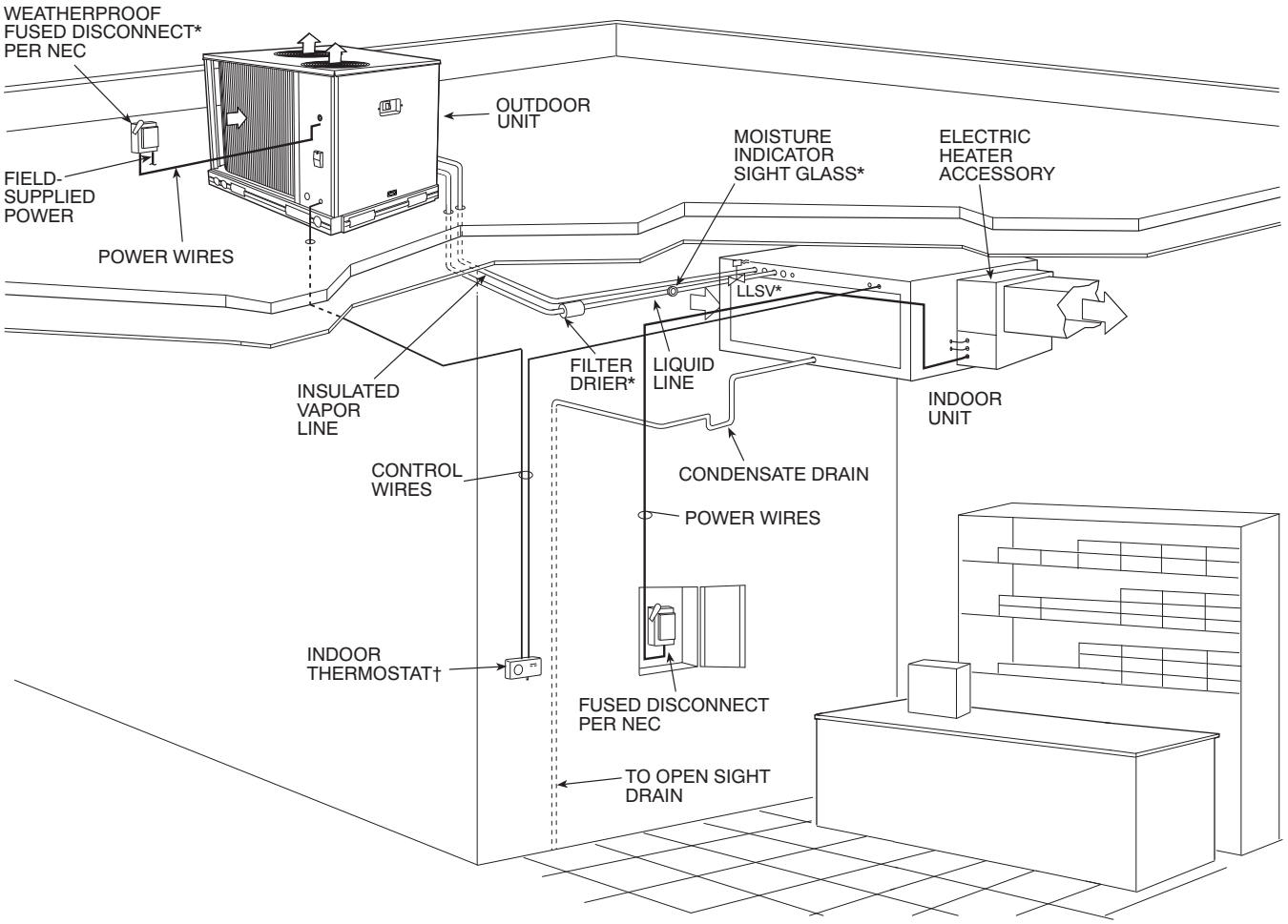
NR – Not Recommended (use smaller liquid tube size)

SI – Metric units of measure

EN – English units of measure (I–P)

NOTE: For applications with equivalent length greater than 57 m (188 ft) and/or linear length greater than 38 m (125 ft), contact your local Carrier representative.

TYPICAL PIPING AND WIRING



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LEGEND:

NEC – National Electrical Code

TXV – Thermostatic Expansion Valve

* Field–supplied

† Double riser may be required. Consult condensing unit product data catalog for details.

NOTES:

1. All piping must follow standard refrigerant piping techniques. Refer to Carrier System Design Manual for details.
2. All wiring must comply with the applicable local and national codes.
3. Wiring and piping shown are general points-of-connection guides only and are not intended for, or to include all details for, a specific installation.
4. Liquid line solenoid valve (solenoid drop control) is recommended to prevent refrigerant migration to the compressor.
5. Internal factory-supplied TXVs not shown.

Appendix D

Greencheck Exhaust Fan Specifications

Job Name: Convenience Store
Tag: EF-1
Quantity: 1
Printed Date: October 14, 2019

Model: G-090-VG

Direct Drive Centrifugal Roof Exhaust Fan

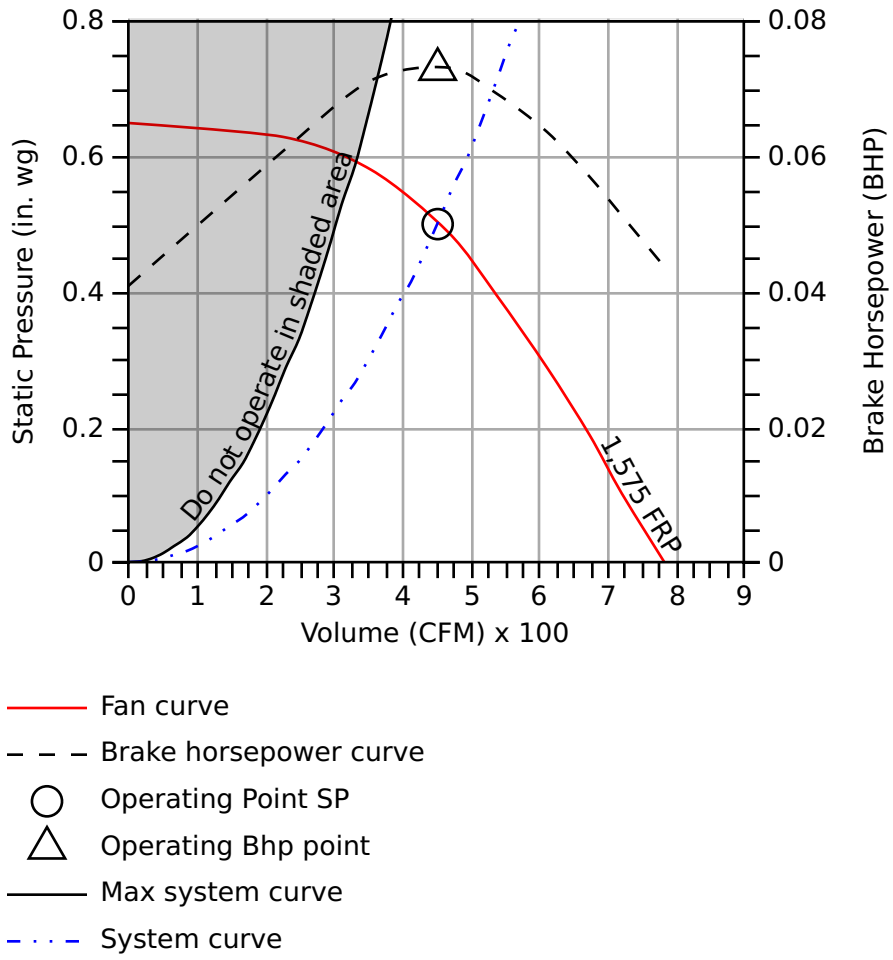
Standard Construction Features: Aluminum housing. Centrifugal backward inclined aluminum wheel. Direct driven motor mounted on vibration isolation.

Fan Configuration	
Drive type	Direct

Performance	
Requested Volume (CFM)	450
Actual Volume (CFM)	450
Total External SP (in. wg)	0.5
Fan RPM	1,575
Operating Power (bhp)	0.07
Startup Power (bhp)	0.07
Air Stream Temp (F)	70
Start-up Temp (F)	70
Air Density (lbs/ft^3)	0.068
Elevation (ft)	2726
Static Efficiency (%)	49
Outlet Velocity (ft/min)	643

Motor	
Enclosure	TENV
Size (hp)	1/10
V/C/P	115/60/1
NEC FLA (Amps)	2.6

FLA - based on tables 150 or 148 of National Electric Code 2002. Actual motor FLA may vary, for sizing thermal overload, consult factory.

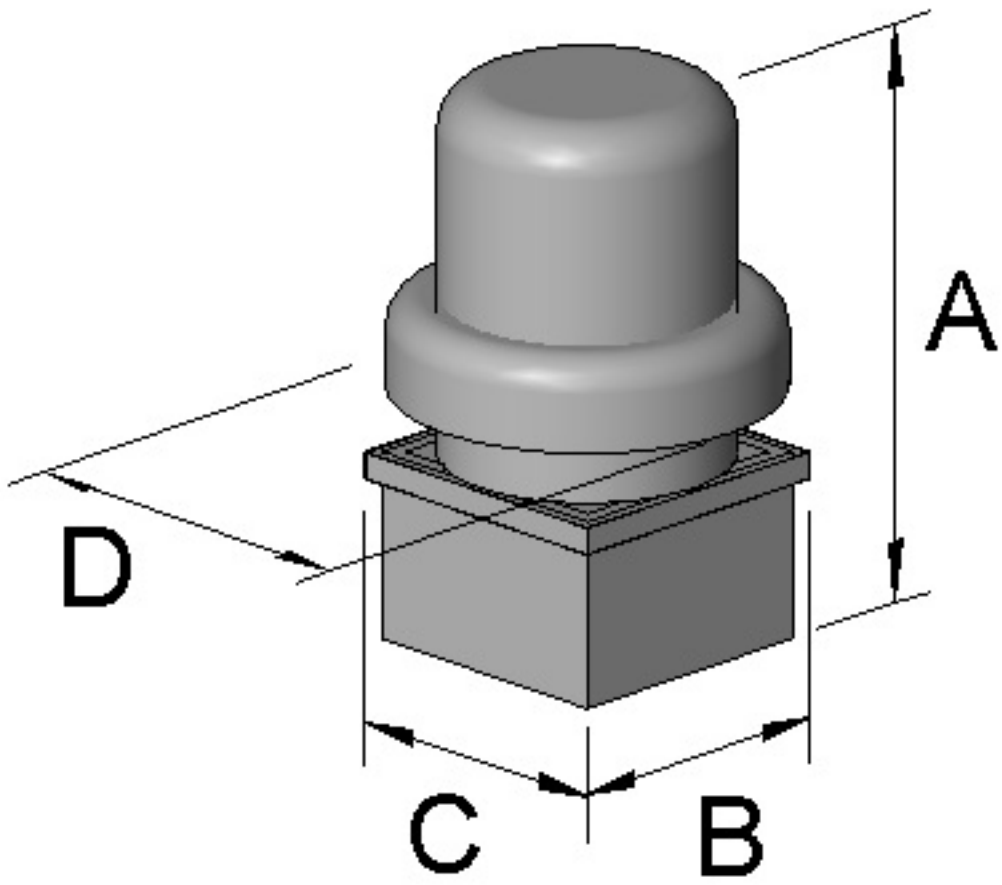


Sound

	Octave Bands (hz)								LwA	dBA	Sones
	62.5	125	250	500	1000	2000	4000	8000			
Inlet	77	74	69	63	58	55	51	44	66	55	7.6

Greenheck Fan Corporation certifies that the model shown herein is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.Performance certified is for installation type A: Free inlet, Free outlet.Power rating (BHP/kW) does not include transmission losses.Performance ratings include the effects of birdscreen.The sound ratings shown are loudness values in fan sones at 5 ft. (1.5 m) in a hemispherical free field calculated per AMCA Standard 301. Values shown are for installation type A: free inlet hemispherical sone levels. dBA levels are not licensed by AMCA International. The AMCA Certified Ratings Seal for Sound applies to inlet sone ratings only.

Dimensions and Weights		
Label	**Value**	**Description**
-	26	Weight w/o accessories (lbs)
A	27	Overall Height (in)
D	22	Overall Width (in)
B	17	Curb Cap Width (in)
C	17	Curb Cap Length (in)
-	10	Duct / Damper Width (in)
-	10	Duct / Damper Length (in)
-	12.5	Roof Opening Width (in)
-	12.5	Roof Opening Length (in)



*All dimensions are in inches.

Model: CSP-A510-VG

Direct Drive Cabinet Fan

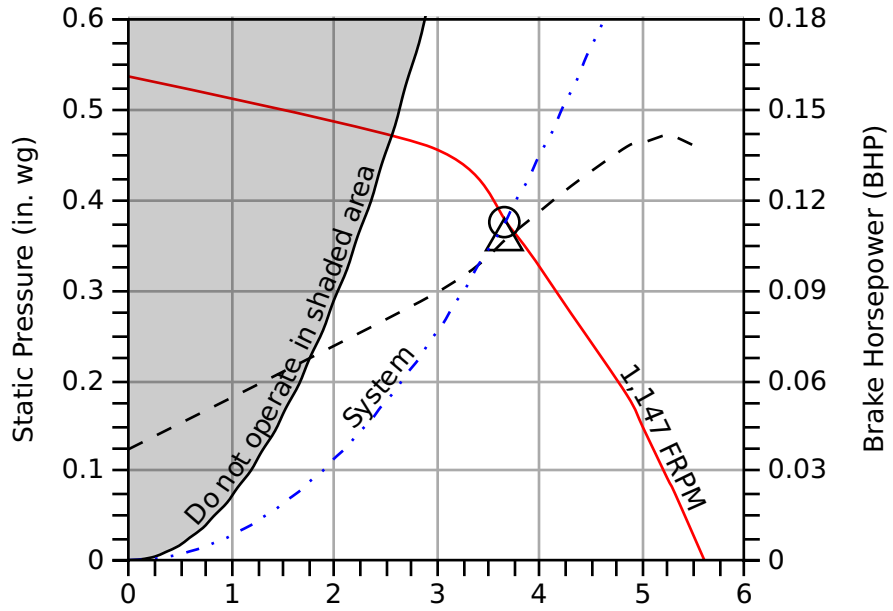
Standard Construction Features: Galvanized steel housing with duct collars. Centrifugal forward curved wheel. Direct driven motor in the air stream.

Fan Configuration	
Drive type	Direct

Performance	
Requested Volume (CFM)	365
Actual Volume (CFM)	365
Total External SP (in. wg)	0.38
Fan RPM	1,147
Operating Power (bhp)	0.11
Startup Power (bhp)	0.11
Air Stream Temp (F)	70
Start-up Temp (F)	70
Air Density (lbs/ft^3)	0.068
Elevation (ft)	2726
Watts (W)	160
Static Efficiency (%)	20
Outlet Velocity (ft/min)	830

Motor	
Enclosure	TENV
Size (hp)	1/6
V/C/P	115/60/1
NEC FLA (Amps)	3.4

Wattage is shown at free air. Wattage is approximate and may vary between motors. Fan shaft input power (bhp) is not certified.FLA - based on tables 150 or 148 of National Electric Code 2002. Actual motor FLA may vary, for sizing thermal overload, consult factory.



Fan curve
Brake horsepower curve
Operating Point SP
Operating Bhp point
Max system curve
System curve

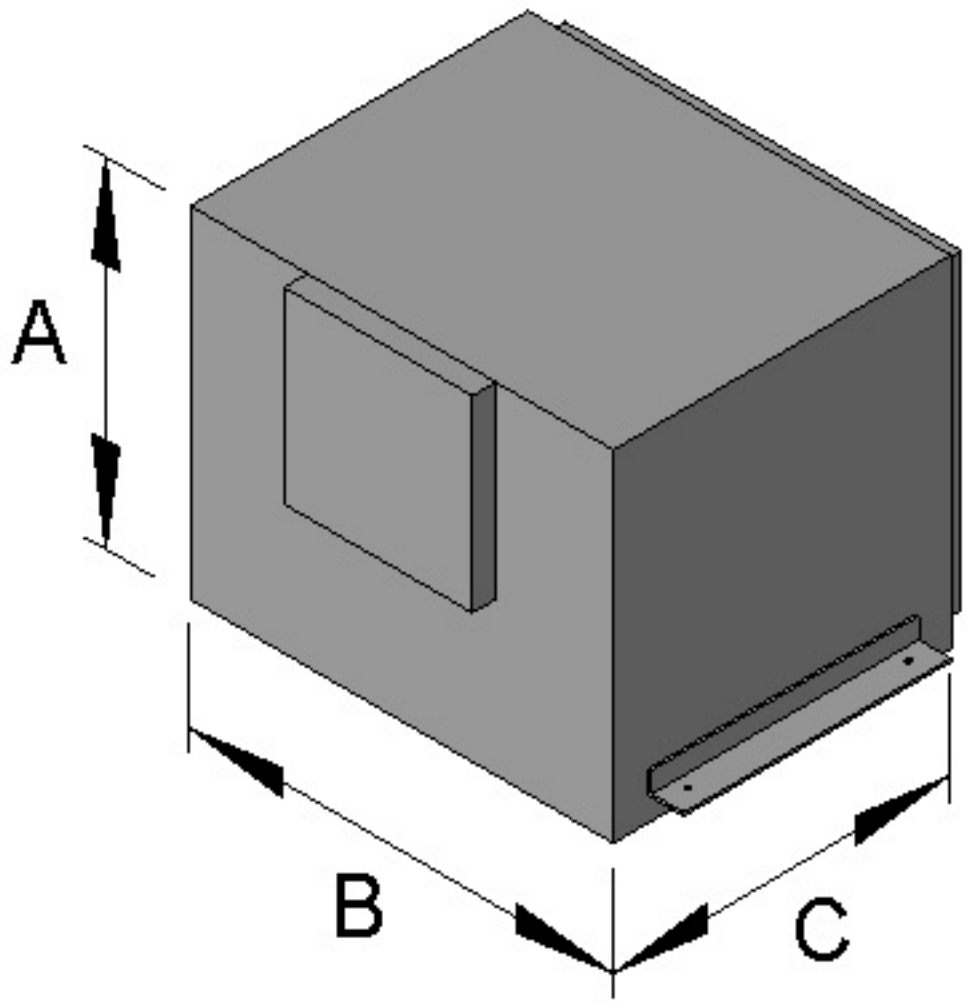
Sound

	Octave Bands (hz)								LwA	dBA	Sones
	62.5	125	250	500	1000	2000	4000	8000			
Inlet	53	59	55	40	35	30	33	27	49	34	1.9

Greenheck Fan Corporation certifies that the model shown herein is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to air performance ratings only.Performance certified is for installation type D: Ducted inlet, Ducted outlet.Power rating (BHP/kW) does not include transmission losses.Performance ratings include the effects of a backdraft damper.Speed (RPM) shown is nominal. Performance is based on actual speed of test. The sound ratings shown are for loudness values in spherical sones at 5 ft. (1.5m) in a spherical free field calculated per Annex B of AMCA 311. Values shown are for installation type D: ducted inlet spherical sone levels. Ratings do not include the effects of duct end correction. Ratings are based on 10 ft. of insulated duct. The AMCA Certified Ratings Seal applies to air performance only.

Job Name: Convenience Store
Tag: EF-2
Quantity: 1
Printed Date: October 14, 2019

Dimensions and Weights		
Label	**Value**	**Description**
-	36	Weight w/o accessories (lbs)
A	15	Overall Height (in)
B	18	Overall Width (in)
C	14	Overall Length (in)
-	16.875	Inlet Width (in)
-	13.25	Inlet Height (in)
-	8	Outlet Width (in)
-	8	Outlet Height (in)



*All dimensions are in inches.

Appendix E

Traffic Noise Modeling Results

Appendix E

Rincon FHWA Traffic Noise Model

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Model Input

Project Name :	Redlands Boulevard and Hemlock Avenue Gas Station Project		
Project Number :	21-10878		
Modeling Condition :	Existing		
Ground Type :	Soft	**Peak ratio to ADT:**	
Metric (L_{eq}, L_{dn}, CNEL) :	Ldn	**Traffic Desc. (Peak or ADT) :**	ADT

Segment Number	Roadway	Segment		Traffic Volume	Speed (mph)	Distance to Centerline	Vehicle Cassification Mix (%)					24-Hour Traffic Distribution (%)			K-Factor
		From	To				Automobiles	Motorcycles	Bus	Medium Trucks	Heavy Trucks	Day	Evening	Night	
1	Redlands Blvd	Ironwood Ave	Hemlock Ave	15,070	50	50	92			5	3	85		15	
2	Redlands Blvd	Hemlock Ave	SR-60 WB Ramps	14,470	50	50	92			5	3	85		15	
3	Redlands Blvd	SR-60 WB Ramps	Eucalyptus Ave	11,760	50	50	92			5	3	85		15	
4	Ironwood Ave	west of Redlands Blvd	Redlands Blvd	4,420	55	50	92			5	3	85		15	
5	Ironwood Ave	Redlands Blvd	east of Redlands Blvd	730	55	50	92			5	3	85		15	
6	Eucalyptus Ave	west of Redlands Blvd	Redlands Blvd	670	35	50	92			5	3	85		15	
7	Eucalyptus Ave	Redlands Blvd	east of Redlands Blvd	330	35	50	92			5	3	85		15	

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Model Results

Project Number :	Redlands Boulevard and Hemlock Avenue Gas Station Project
Modeling Condition :	21-10878
Ground Type :	Existing
Metric (Leq, Ldn, CNEL) :	Ldn

Segment Number	Roadway	Segment		Noise Levels (dB) Ldn					
		From	To	Automobiles	Motorcycles	Bus	Medium Trucks	Heavy Trucks	Total
1	Redlands Blvd	Ironwood Ave	Hemlock Ave	66.3	0.0	0.0	60.0	62.3	68.4
2	Redlands Blvd	Hemlock Ave	SR-60 WB Ramps	66.1	0.0	0.0	59.8	62.1	68.2
3	Redlands Blvd	SR-60 WB Ramps	Eucalyptus Ave	65.2	0.0	0.0	58.9	61.2	67.3
4	Ironwood Ave	west of Redlands Blvd	Redlands Blvd	61.9	0.0	0.0	55.3	57.5	63.9
5	Ironwood Ave	Redlands Blvd	east of Redlands Blvd	54.1	0.0	0.0	47.5	49.7	56.1
6	Eucalyptus Ave	west of Redlands Blvd	Redlands Blvd	50.4	0.0	0.0	44.9	47.8	53.0
7	Eucalyptus Ave	Redlands Blvd	east of Redlands Blvd	47.3	0.0	0.0	41.9	44.7	50.0

Distance to Traffic Noise Contours (feet)				
70 dB	65 dB	60 dB	55 dB	50 dB
39	84	182	391	843
38	82	177	381	820
33	71	154	332	714
20	42	91	196	422
6	13	27	59	127
4	8	17	37	80
2	5	11	23	50

Appendix E

Rincon FHWA Traffic Noise Model

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Model Input

Project Name :	Redlands Boulevard and Hemlock Avenue Gas Station Project		
Project Number :	21-10878		
Modeling Condition :	Existing Plus Project		
Ground Type :	Soft	**Peak ratio to ADT:**	
Metric (L_{eq}, L_{dn}, CNEL) :	Ldn	**Traffic Desc. (Peak or ADT) :**	ADT

Segment Number	Roadway	Segment		Traffic Volume	Speed (mph)	Distance to Centerline	Vehicle Cassification Mix (%)					24-Hour Traffic Distribution (%)			K-Factor
		From	To				Automobiles	Motorcycles	Bus	Medium Trucks	Heavy Trucks	Day	Evening	Night	
1	Redlands Blvd	Ironwood Ave	Hemlock Ave	15,680	50	50	92			5	3	85		15	
2	Redlands Blvd	Hemlock Ave	SR-60 WB Ramps	15,010	50	50	92			5	3	85		15	
3	Redlands Blvd	SR-60 WB Ramps	Eucalyptus Ave	12,520	50	50	92			5	3	85		15	
4	Ironwood Ave	west of Redlands Blvd	Redlands Blvd	4,570	55	50	92			5	3	85		15	
5	Ironwood Ave	Redlands Blvd	east of Redlands Blvd	880	55	50	92			5	3	85		15	
6	Hemlock Ave	west of Redlands Blvd	Redlands Blvd	530	25	50	92			5	3	85		15	
7	Eucalyptus Ave	west of Redlands Blvd	Redlands Blvd	970	35	50	92			5	3	85		15	
8	Eucalyptus Ave	Redlands Blvd	east of Redlands Blvd	630	35	50	92			5	3	85		15	

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Model Results

Project Number :	Redlands Boulevard and Hemlock Avenue Gas Station Project
Modeling Condition :	21-10878
Ground Type :	Existing Plus Project
Metric (Leq, Ldn, CNEL) :	Ldn

Segment Number	Roadway	Segment		Noise Levels (dB) Ldn					
		From	To	Automobiles	Motorcycles	Bus	Medium Trucks	Heavy Trucks	Total
1	Redlands Blvd	Ironwood Ave	Hemlock Ave	66.4	0.0	0.0	60.2	62.4	68.6
2	Redlands Blvd	Hemlock Ave	SR-60 WB Ramps	66.3	0.0	0.0	60.0	62.3	68.4
3	Redlands Blvd	SR-60 WB Ramps	Eucalyptus Ave	65.5	0.0	0.0	59.2	61.5	67.6
4	Ironwood Ave	west of Redlands Blvd	Redlands Blvd	62.0	0.0	0.0	55.5	57.6	64.0
5	Ironwood Ave	Redlands Blvd	east of Redlands Blvd	54.9	0.0	0.0	48.3	50.5	56.9
6	Hemlock Ave	west of Redlands Blvd	Redlands Blvd	49.2	0.0	0.0	43.8	47.2	52.0
7	Eucalyptus Ave	west of Redlands Blvd	Redlands Blvd	52.0	0.0	0.0	46.5	49.4	54.6
8	Eucalyptus Ave	Redlands Blvd	east of Redlands Blvd	50.2	0.0	0.0	44.7	47.5	52.8

Distance to Traffic Noise Contours (feet)				
70 dB	65 dB	60 dB	55 dB	50 dB
40	87	186	402	865
39	84	181	390	841
35	74	160	346	745
20	43	93	200	432
7	14	31	67	144
3	7	15	32	68
5	10	22	47	102
4	8	16	35	76

Appendix E

Rincon FHWA Traffic Noise Model

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Model Input

Project Name :	Redlands Boulevard and Hemlock Avenue Gas Station Project		
Project Number :	21-10878		
Modeling Condition :	Opening Year 2024		
Ground Type :	Soft	**Peak ratio to ADT:**	
Metric (L_{eq}, L_{dn}, CNEL) :	Ldn	**Traffic Desc. (Peak or ADT) :**	ADT

Segment Number	Roadway	Segment		Traffic Volume	Speed (mph)	Distance to Centerline	Vehicle Cassification Mix (%)					24-Hour Traffic Distribution (%)			K-Factor
		From	To				Automobiles	Motorcycles	Bus	Medium Trucks	Heavy Trucks	Day	Evening	Night	
1	Redlands Blvd	Ironwood Ave	Hemlock Ave	19,300	50	50	92			5	3	85		15	
2	Redlands Blvd	Hemlock Ave	SR-60 WB Ramps	18,600	50	50	92			5	3	85		15	
3	Redlands Blvd	SR-60 WB Ramps	Eucalyptus Ave	19,400	50	50	92			5	3	85		15	
4	Ironwood Ave	west of Redlands Blvd	Redlands Blvd	5,100	55	50	92			5	3	85		15	
5	Ironwood Ave	Redlands Blvd	east of Redlands Blvd	2,600	55	50	92			5	3	85		15	
6	Eucalyptus Ave	west of Redlands Blvd	Redlands Blvd	9,200	35	50	92			5	3	85		15	
7	Eucalyptus Ave	Redlands Blvd	east of Redlands Blvd	2,200	35	50	92			5	3	85		15	

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Model Results

Project Number :	Redlands Boulevard and Hemlock Avenue Gas Station Project
Modeling Condition :	21-10878
Ground Type :	Opening Year 2024
Metric (Leq, Ldn, CNEL) :	Ldn

Segment Number	Roadway	Segment		Noise Levels (dB) Ldn					
		From	To	Automobiles	Motorcycles	Bus	Medium Trucks	Heavy Trucks	Total
1	Redlands Blvd	Ironwood Ave	Hemlock Ave	67.3	0.0	0.0	61.1	63.3	69.5
2	Redlands Blvd	Hemlock Ave	SR-60 WB Ramps	67.2	0.0	0.0	60.9	63.2	69.3
3	Redlands Blvd	SR-60 WB Ramps	Eucalyptus Ave	67.4	0.0	0.0	61.1	63.4	69.5
4	Ironwood Ave	west of Redlands Blvd	Redlands Blvd	62.5	0.0	0.0	55.9	58.1	64.5
5	Ironwood Ave	Redlands Blvd	east of Redlands Blvd	59.6	0.0	0.0	53.0	55.2	61.6
6	Eucalyptus Ave	west of Redlands Blvd	Redlands Blvd	61.8	0.0	0.0	56.3	59.1	64.4
7	Eucalyptus Ave	Redlands Blvd	east of Redlands Blvd	55.6	0.0	0.0	50.1	52.9	58.2

Distance to Traffic Noise Contours (feet)				
70 dB	65 dB	60 dB	55 dB	50 dB
46	99	214	461	994
45	97	209	450	970
46	100	215	463	997
22	46	100	215	464
14	30	64	138	296
21	46	98	212	457
8	18	38	82	176

Appendix E

Rincon FHWA Traffic Noise Model

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Model Input

Project Name :	Redlands Boulevard and Hemlock Avenue Gas Station Project		
Project Number :	21-10878		
Modeling Condition :	Opening Year 2024 Plus Project		
Ground Type :	Soft	**Peak ratio to ADT:**	
Metric (L_{eq}, L_{dn}, CNEL) :	Ldn	**Traffic Desc. (Peak or ADT) :**	ADT

Segment Number	Roadway	Segment		Traffic Volume	Speed (mph)	Distance to Centerline	Vehicle Cassification Mix (%)					24-Hour Traffic Distribution (%)			K-Factor
		From	To				Automobiles	Motorcycles	Bus	Medium Trucks	Heavy Trucks	Day	Evening	Night	
1	Redlands Blvd	Ironwood Ave	Hemlock Ave	19,900	50	50	92			5	3	85		15	
2	Redlands Blvd	Hemlock Ave	SR-60 WB Ramps	19,100	50	50	92			5	3	85		15	
3	Redlands Blvd	SR-60 WB Ramps	Eucalyptus Ave	20,200	50	50	92			5	3	85		15	
4	Ironwood Ave	west of Redlands Blvd	Redlands Blvd	5,200	55	50	92			5	3	85		15	
5	Ironwood Ave	Redlands Blvd	east of Redlands Blvd	2,700	55	50	92			5	3	85		15	
6	Hemlock Ave	west of Redlands Blvd	Redlands Blvd	500	25	50	92			5	3	85		15	
7	Eucalyptus Ave	west of Redlands Blvd	Redlands Blvd	9,500	35	50	92			5	3	85		15	
8	Eucalyptus Ave	Redlands Blvd	east of Redlands Blvd	2,500	35	50	92			5	3	85		15	

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Model Results

Project Number :	Redlands Boulevard and Hemlock Avenue Gas Station Project
Modeling Condition :	21-10878
Ground Type :	Opening Year 2024 Plus Project
Metric (Leq, Ldn, CNEL) :	Ldn

Segment Number	Roadway	Segment		Noise Levels (dB) Ldn					
		From	To	Automobiles	Motorcycles	Bus	Medium Trucks	Heavy Trucks	Total
1	Redlands Blvd	Ironwood Ave	Hemlock Ave	67.5	0.0	0.0	61.2	63.5	69.6
2	Redlands Blvd	Hemlock Ave	SR-60 WB Ramps	67.3	0.0	0.0	61.0	63.3	69.4
3	Redlands Blvd	SR-60 WB Ramps	Eucalyptus Ave	67.5	0.0	0.0	61.3	63.5	69.7
4	Ironwood Ave	west of Redlands Blvd	Redlands Blvd	62.6	0.0	0.0	56.0	58.2	64.6
5	Ironwood Ave	Redlands Blvd	east of Redlands Blvd	59.8	0.0	0.0	53.2	55.4	61.8
6	Hemlock Ave	west of Redlands Blvd	Redlands Blvd	49.0	0.0	0.0	43.6	46.9	51.8
7	Eucalyptus Ave	west of Redlands Blvd	Redlands Blvd	61.9	0.0	0.0	56.4	59.3	64.6
8	Eucalyptus Ave	Redlands Blvd	east of Redlands Blvd	56.1	0.0	0.0	50.6	53.5	58.8

Distance to Traffic Noise Contours (feet)				
70 dB	65 dB	60 dB	55 dB	50 dB
47	101	219	471	1,014
46	99	213	458	987
48	102	221	476	1,025
22	47	101	218	470
14	30	65	141	304
3	7	14	30	66
22	47	101	217	467
9	19	41	89	192

Appendix E

Rincon FHWA Traffic Noise Model

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Model Input

Project Name :	Redlands Boulevard and Hemlock Avenue Gas Station Project		
Project Number :	21-10878		
Modeling Condition :	General Plan Buildout Year 2040		
Ground Type :	Soft	**Peak ratio to ADT:**	
Metric (L_{eq}, L_{dn}, CNEL) :	Ldn	**Traffic Desc. (Peak or ADT) :**	ADT

Segment Number	Roadway	Segment		Traffic Volume	Speed (mph)	Distance to Centerline	Vehicle Cassification Mix (%)					24-Hour Traffic Distribution (%)			K-Factor
		From	To				Automobiles	Motorcycles	Bus	Medium Trucks	Heavy Trucks	Day	Evening	Night	
1	Redlands Blvd	Ironwood Ave	Hemlock Ave	23,500	50	50	92			5	3	85		15	
2	Redlands Blvd	Hemlock Ave	SR-60 WB Ramps	23,600	50	50	92			5	3	85		15	
3	Redlands Blvd	SR-60 WB Ramps	Eucalyptus Ave	27,200	50	50	92			5	3	85		15	
4	Ironwood Ave	west of Redlands Blvd	Redlands Blvd	9,000	55	50	92			5	3	85		15	
5	Ironwood Ave	Redlands Blvd	east of Redlands Blvd	6,200	55	50	92			5	3	85		15	
6	Hemlock Ave	west of Redlands Blvd	Redlands Blvd	4,100	25	50	92			5	3	85		15	
7	Eucalyptus Ave	west of Redlands Blvd	Redlands Blvd	11,200	35	50	92			5	3	85		15	
8	Eucalyptus Ave	Redlands Blvd	east of Redlands Blvd	9,200	35	50	92			5	3	85		15	

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Model Results

Project Number :	Redlands Boulevard and Hemlock Avenue Gas Station Project
Modeling Condition :	21-10878
Ground Type :	General Plan Buildout Year 2040
Metric (Leq, Ldn, CNEL) :	Ldn

Segment Number	Roadway	Segment		Noise Levels (dB) Ldn					
		From	To	Automobiles	Motorcycles	Bus	Medium Trucks	Heavy Trucks	Total
1	Redlands Blvd	Ironwood Ave	Hemlock Ave	68.2	0.0	0.0	61.9	64.2	70.3
2	Redlands Blvd	Hemlock Ave	SR-60 WB Ramps	68.2	0.0	0.0	61.9	64.2	70.3
3	Redlands Blvd	SR-60 WB Ramps	Eucalyptus Ave	68.8	0.0	0.0	62.6	64.8	71.0
4	Ironwood Ave	west of Redlands Blvd	Redlands Blvd	65.0	0.0	0.0	58.4	60.6	67.0
5	Ironwood Ave	Redlands Blvd	east of Redlands Blvd	63.4	0.0	0.0	56.8	59.0	65.4
6	Hemlock Ave	west of Redlands Blvd	Redlands Blvd	58.1	0.0	0.0	52.7	56.1	60.9
7	Eucalyptus Ave	west of Redlands Blvd	Redlands Blvd	62.7	0.0	0.0	57.2	60.0	65.3
8	Eucalyptus Ave	Redlands Blvd	east of Redlands Blvd	61.8	0.0	0.0	56.3	59.1	64.4

Distance to Traffic Noise Contours (feet)				
70 dB	65 dB	60 dB	55 dB	50 dB
53	113	244	526	1,133
53	114	245	528	1,137
58	125	269	580	1,249
31	68	146	315	678
25	53	114	245	529
12	27	58	124	267
24	52	112	242	521
21	46	98	212	457

Appendix E

Rincon FHWA Traffic Noise Model

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Model Input

Project Name :	Redlands Boulevard and Hemlock Avenue Gas Station Project		
Project Number :	21-10878		
Modeling Condition :	General Plan Buildout Year 2040 Plus Project		
Ground Type :	Soft	**Peak ratio to ADT:**	
Metric (L_{eq}, L_{dn}, CNEL) :	Ldn	**Traffic Desc. (Peak or ADT) :**	ADT

Segment Number	Roadway	Segment		Traffic Volume	Speed (mph)	Distance to Centerline	Vehicle Cassification Mix (%)					24-Hour Traffic Distribution (%)			K-Factor
		From	To				Automobiles	Motorcycles	Bus	Medium Trucks	Heavy Trucks	Day	Evening	Night	
1	Redlands Blvd	Ironwood Ave	Hemlock Ave	24,100	50	50	92			5	3	85		15	
2	Redlands Blvd	Hemlock Ave	SR-60 WB Ramps	22,400	50	50	92			5	3	85		15	
3	Redlands Blvd	SR-60 WB Ramps	Eucalyptus Ave	28,100	50	50	92			5	3	85		15	
4	Ironwood Ave	west of Redlands Blvd	Redlands Blvd	9,200	55	50	92			5	3	85		15	
5	Ironwood Ave	Redlands Blvd	east of Redlands Blvd	6,400	55	50	92			5	3	85		15	
6	Hemlock Ave	west of Redlands Blvd	Redlands Blvd	5,900	25	50	92			5	3	85		15	
7	Eucalyptus Ave	west of Redlands Blvd	Redlands Blvd	11,500	35	50	92			5	3	85		15	
8	Eucalyptus Ave	Redlands Blvd	east of Redlands Blvd	9,500	35	50	92			5	3	85		15	

rincon

Model Results

Project Number :	Redlands Boulevard and Hemlock Avenue Gas Station Project
Modeling Condition :	21-10878
Ground Type :	General Plan Buildout Year 2040 Plus Project
Metric (Leq, Ldn, CNEL) :	Ldn

Segment Number	Roadway	Segment		Noise Levels (dB) Ldn					
		From	To	Automobiles	Motorcycles	Bus	Medium Trucks	Heavy Trucks	Total
1	Redlands Blvd	Ironwood Ave	Hemlock Ave	68.3	0.0	0.0	62.0	64.3	70.4
2	Redlands Blvd	Hemlock Ave	SR-60 WB Ramps	68.0	0.0	0.0	61.7	64.0	70.1
3	Redlands Blvd	SR-60 WB Ramps	Eucalyptus Ave	69.0	0.0	0.0	62.7	65.0	71.1
4	Ironwood Ave	west of Redlands Blvd	Redlands Blvd	65.1	0.0	0.0	58.5	60.7	67.1
5	Ironwood Ave	Redlands Blvd	east of Redlands Blvd	63.5	0.0	0.0	56.9	59.1	65.5
6	Hemlock Ave	west of Redlands Blvd	Redlands Blvd	59.7	0.0	0.0	54.3	57.6	62.5
7	Eucalyptus Ave	west of Redlands Blvd	Redlands Blvd	62.8	0.0	0.0	57.3	60.1	65.4
8	Eucalyptus Ave	Redlands Blvd	east of Redlands Blvd	61.9	0.0	0.0	56.4	59.3	64.6

Distance to Traffic Noise Contours (feet)				
70 dB	65 dB	60 dB	55 dB	50 dB
54	115	248	535	1,153
51	110	237	510	1,098
59	128	275	593	1,277
32	69	148	319	688
25	54	116	251	540
16	34	73	158	340
25	53	114	246	530
22	47	101	217	467