CONSTRUCTION NOISE AND VIBRATION CONTROL

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Eliminating or minimizing noise and vibration generated by construction activities, and complying with applicable noise regulations, specification requirements, and noise and vibration limits specified within this Section.

B. Use equipment with effective noise-suppression devices and employ other noise control measures such as enclosures and barriers necessary to protect the public. Schedule and conduct operations in a manner that will minimize, to the greatest extent feasible, the disturbance to the public in areas adjacent to the construction activities and to occupants of buildings in the vicinity of the construction activities.

C. If required, submit a Noise Control Plan and a Noise Monitoring Plan, as specified in this Section. Both plans shall be prepared by an Acoustical Engineer meeting the qualifications specified in this Section. Do not operate noise generating construction equipment at the construction site prior to acceptance of the Noise Control and Monitoring Plans. Any Noise Control Plan must be updated every three months.

D. Compliance with the requirements of this Section may require the use of equipment with special exhaust silencers or noise attenuating enclosures, and construction of temporary enclosures or noise barriers around activities. Use haul routes and staging areas, as approved by Metro and the according to the local jurisdiction authorities to minimize noise at residential and other sensitive receptor sites. Do not operate trucks used for removal of excavated material and delivery of construction materials on local residential streets or on streets that pass by schools during school hours, unless specifically accepted by Metro or its designee.

E. Metro or its designee will monitor Contractor's performance of tasks specified, and will inspect necessary records, reports and procedures.

F. Designate staff member as Noise and Vibration Control Representative to be trained by and work with the Acoustical Engineer specified in this Section.

1.02 RELATED SECTIONS

A. Section 01 33 00: Submittal Procedures

B. Section 01 43 20: Project Quality Program Requirements - Design/Bid/Build

C. Section 01 35 23 Worksite Safety Requirements

D. Section 01 35 53 Worksite Security Requirements
1.03 REFERENCES

A. California Code of Regulations (CCR), Title 24

B. California Health and Safety Code (CHSC)

C. City of Los Angeles Building Code, Chapter XI, Los Angeles Noise Ordinance

D. American National Standards Institute (ANSI):
   1. ANSI S1.4 - Specification for Sound Level Meters
   2. ANSI S2.4 - Method for Specifying the Characteristics of Auxiliary Analog Equipment for Shock and Vibration Measurements

E. ASTM International (ASTM):
   1. ASTM C423 - Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
   2. ASTM E90 - Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
   3. ASTM E413 - Classification for Rating Sound Insulation

F. International Electrotechnical Commission (IEC):
   1. IEC 61672 - Electroacoustics Sound Level Meters

G. Occupational Safety and Health Act (OSHA) regulations (CCR Title 8)

H. Society of Automotive Engineers (SAE):
   1. SAE J88 - Sound Measurement Off-Road Work Machines - Exterior
   2. SAE J366 - Exterior Sound Level for Heavy Trucks and Buses
   3. SAE J994 - Alarm- Backup- Electric Laboratory Performance Testing

I. International Organization for Standardization (ISO):

J. U.S. Department of Transportation, Federal Highway Administration (FHWA):


L. U.S. Environmental Protection Agency (EPA):
   1. EPA Report NTID 300.1 – Notice from Construction Equipment and Operations, Building Equipment, and home Appliances. (1972)
1.04 **QUALITY ASSURANCE**

A. Comply with Project Quality Program Requirements (see 1.02 above).

1.05 **SUBMITTALS**

A. Refer to Section 01 33 00 – Submittal Procedures, for submittal requirements and procedures.

B. Qualifications and work experience of the acoustical engineer as specified in this Section. This submittal is required prior to the submittal of the Noise Control and Noise Monitoring Plans.

C. Contractor's Noise Control Plan as specified in this Section.

D. Contractor's Noise Monitoring Plan and the weekly Noise Measurement Reports as specified in this Section.

E. Noise measurement equipment makes and models, and calibration conformance certificates as specified in this Section.

F. Equipment noise certification reports as specified in this Section.

G. Shop and Working Drawings, computations, material data and other criteria, for noise abatement measures, identified in the Noise Control Plan and for moveable noise barriers, noise barrier fences and noise control curtains as specified in this Section. Have drawings and computations stamped by a License Professional Engineer registered in the State of California.

H. Contractors Weekly Vibration Measurement Reports as specified in this Section.

I. Material Safety Data Sheets (MSDS): Manufacturer’s Material Safety Data Sheets for each type of material used in Work.

1.06 **DEFINITIONS**

A. Construction Site: For purpose of noise and vibration control requirements, the Contract limits of construction. This includes Right-of-Way lines, property lines, construction Easement Boundary or property lines and Contractor staging areas outside the defined boundary lines, used expressly for construction.

B. Noise Level Measurements: Unless otherwise indicated, the use of A-weighted and "slow" response settings of instrument complying with Type 2 requirements of latest revision of ANSI S1.4 and IEC 61672.

C. A-Weighted Noise Levels: Decibels (referenced to 20 micro-Pascal) as measured with A-weighting network of standard sound level meter, abbreviated dBA.

D. C-Weighted Noise Level: Decibels (referenced to 20 micro-Pascal) as measured using the C-weighting network on a sound level meter complying with the criteria for a Type 1 (Precision) or Type 2 (General Purpose Sound Level Meter), as defined in the current revision of ANSI S1.4. Use the FAST setting on the sound level meter to measure the C-
weighted sound level.

E. Vibration Measurements: The use of a vibration transducer, amplifier, peak detector, and frequency band filters complying with ANSI S2.4.

F. Vibration: Velocity in microinches per second. Vibration levels are expressed as velocity levels in Decibels referenced to one microinch per second, abbreviated VdB.

G. Daytime: The period from 7:00 AM to 9:00 PM Monday through Friday local time, and Saturdays, and Sundays, 8:00 AM to 6:00 PM, unless defined differently by the local jurisdiction.

H. Nighttime: Periods other than daytime.

I. Noise Sensitive Locations: Residential areas, institutions, hospitals, parks, and other locations so named herein.

J. \( L_{\text{max}} \): The maximum measured sound level.

K. One-hour \( L_{eq} \): A weighted Equivalent Sound Level: The continuous sound level that represents the same sound energy as the varying sound levels over one hour.

L. Sound Transmission Class (STC): A single number rating calculated in accordance with ASTM E413, using values of sound transmission loss. It provides an estimate of the performance of a partition in certain common sound insulation problems.

M. Stationary/Continuous Noise: Daytime noise from stationary sources, and parked mobile sources that produce repetitive or long-term noise lasting more than two hours.

N. Mobile/Intermittent Noise: Daytime noise from non-stationary mobile equipment operated by a driver, or from source of intermittent, non-recurring on long-term basis, non-scheduled, non-repetitive, short-term noises (not lasting more than two hours).

1.07 RESPONSIBILITIES OF CONTRACTOR

A. Perform Work within the permissible noise levels, work schedule limitations, and procedures provided for in this Section and applicable Federal, state, county and municipal codes, regulations, and standards.

B. Other than those provided herein, be responsible for obtaining, at Contractor's own expense, permits, variances, equipment certifications, and other documents required by this Section and by applicable Federal, state, county and municipal codes, regulations and standards.

C. With regard to noise monitoring, include the following:
   1. Furnish instrumentation for noise monitoring that complies with the standards specified in this Section and that is capable of measuring the sound levels defined in this Section.
   2. Collect and report noise monitoring data, report whether the noise monitoring data indicates compliance under specialized in this Section, and submit a Noise Measurement Report to Metro or its designee on a weekly basis.
   3. Provide access to Metro or its designee to review measured data and coordinate the Contractor's schedule for noise monitoring.
4. Implement noise abatement measures as required by this Section, based on the Contractor's noise monitoring data and nuisance conditions reported by Metro or its designee.

PART 2 – PRODUCTS

2.01 NOISE CONTROL MATERIALS

A. Noise control materials may be new or used. Used materials shall be sound and free of damage and defects and shall be of a quality and condition to perform their designed function.

2.02 NOISE BARRIER FENCES

B. Use material that will last for the duration of construction of this Contract. Construct using two layers of 3/4 inch Medium Density Overlay (MDO) plywood sheeting or acceptable equal. Line the construction site side with glass fiber or mineral wool type noise-absorbing material at least two inches thick. Protect this material using wire mesh or perforated sheets that are corrosion resistant and that have at least 30 percent open area and provision for water drainage. Or Provide a wall assembly with a STC-25 or greater, based on certified sound transmission loss data taken according to ASTM E90 and a Noise Reduction Coefficient (NRC) rating of NRC-0.70 or greater, based on certified sound absorption coefficient data taken according to ASTM C423. Construct gates and doors in the fence either hinged or rolling of the same or equally effective material as the noise barrier fence. Construct gates and doors in the fence to ensure that the edges overlap the fence to eliminate gaps. During nighttime hours maintain gates and doors in a closed position except for brief periods of time to allow access to the Construction Site.

C. Attach lagging to support posts designed so that the fence will withstand 80 mph wind loads plus a 30 percent gust factor.

D. Provide flush mating surfaces of wall sides when walls are joined together or at corners. Close gaps between wall sections and between bottom edge of walls and grade with material that will completely close the gaps and be dense enough to attenuate noise.

E. Be responsible for the design, detailing and adequacy of the framework and supports, posts, attachment methods and other appurtenances required for the proper erection of the noisebarriers.

F. Prepare the design details for the noise control wall footing, steel posts, supports and framework, signed and sealed by a Professional Engineer licensed in the State of California. Submit the design and detailed engineering to Metro or its designee.

G. Height of barriers: As required to meet noise control plans

2.03 MOVEABLE NOISE BARRIERS

A. Construct moveable barriers of one inch thick Medium Density Overlay (MDO) plywood sheeting, or other acceptable material with a STC25 rating or greater.
B. Line barriers on construction site side with glass fiber or mineral wool type sound absorbing material at least two inches thick. Protect this material by wire mesh or perforated sheets that are corrosion resistant and that have at least 30 percent open area, with provision for water drainage.

C. Provide materials and details of construction sufficiently weather resistant to last through the duration of construction of this Contract.

D. Construction Details:
   1. Attach barrier panels to support frames constructed in sections to provide a moveable barrier utilizing the standard temporary precast concrete median barrier or other supports.
   2. When barrier units are joined together, overlap the mating surfaces of the barrier sides or make flush with each other. Close gaps between barrier units, and between the bottom edge of the barrier panels and the ground, with material that will completely close the gaps and be dense enough to attenuate noise.
   3. Height of barriers: As required to meet noise control plans.

2.04 NOISE CONTROL CURTAINS

A. Noise Control Curtains: Durable, flexible composite material featuring a noise barrier layer bonded to a sound-absorptive material on one side.
   1. STC rating of STC-25 or greater based on certified sound transmission loss data taken according to ASTM E90.
   2. NRC rating of NRC 0.70 or greater based on certified sound absorption coefficient data taken according to ASTM C423.

B. Noise Barrier Layer: A rugged, impervious material with a surface weight of at least one pound per square foot. Height of barriers: As required to meet noise control plans

C. Sound Absorptive Material: Include a protective facing, and securely attached to one side of the noise barrier layer over its entire surface.
   1. Mildew resistant, vermin proof and non-hygroscopic.

D. The noise control curtain materials: Abuse resistant, exhibiting superior hanging and tear strength during construction. The curtain barrier material shall have a minimum breaking strength of 120 lb/in. and a minimum tear strength of 30 lb/in. Based on the same test procedures, the curtain absorbive material facing shall have a minimum breaking strength of 100 lb/in. and a minimum tear strength of seven 7lb/in.
   1. Corrosion resistant to most acids, mild alkalis, road salts, oils and grease.
   2. Fire retardant, and approved by the City of Los Angeles Fire Department prior to procurement.

E. Construct gates and doors of a material with a STC 25 or greater rating.

F. Construction Details:
1. Install the noise control curtains in vertical segments extending the full curtain height, and have seams and joints with a minimum overlap of two inches and be sealed using hook fasteners or double grommets. Use construction details according to the manufacturer’s recommendations.

2. Secure the curtain at ground level and/or at intermediate points by framework and supports.

3. Be responsible for the design, detailing and adequacy of framework, supports, ties, attachment methods and other appurtenances required for the proper installation of the curtain.

4. Prepare and seal the design and details necessary for the noise control curtain framework and supports using a Professional Engineer licensed in the State of California. Submit the design and detailed engineering to Metro or its designee for review prior to procurement.

PART 3 – EXECUTION

3.01 NOISE LEVEL LIMITS

A. Stationary/Continuous Noise: Prevent noise intrusion from stationary sources, and parked mobile sources which produce repetitive or long-term noise lasting more than two hours from exceeding limits shown on Table 1.

B. Mobile/Intermittent Noise: Prevent noise from non-stationary mobile equipment operated by a driver, or from sources of intermittent, non-recurring on a long term basis, non-repetitive, short term noises (not lasting more than two hours), from exceeding the limits shown on Table 2.

C. Nighttime operations noise limits are established by local jurisdiction, generally by variance. For reference, the LAPD Noise and Vibration Criteria is shown on Tables 1 and 2. The LAPD limits are based on pre-construction ambient $L_{eq}$ measurements plus five dBA. The LAPD limits apply for the hours of 9:00 PM to 7:00 AM Monday through Friday, 9:00 PM Friday to 8:00 AM Saturday, 6:00 PM Saturday to 8:00AM Sunday and 6:00PM Sunday to 7:00AM Monday. Enforcement will be based on a 15 minute average measurement.

D. At the surface of the construction site during night time hours use only equipment that, operating under full load, meets the noise limits specified in Table 3 when measured according to the test procedures used for equipment noise certification as specified in this Section, or as specified by a variance.

E. Contractor is prohibited from operating equipment at night that does not meet nighttime noise emission limits in Table 3 below. If the Contractor’s existing equipment on-site does not meet nighttime noise emission limits for surface construction activities specified in Table 3 or falls out of compliance, remove the non-compliant equipment promptly from nighttime service by immediately parking and turning off equipment when it is safe to do so.

F. Trucks operating off-site between the hours of 12:00 midnight and 5:00 AM have lower
emission limits (80 dBA at 50 feet emission limit) than normally required by the California Vehicle Code. All trucks used for these nighttime hours must be certified in accordance with these specifications. Take necessary steps to comply with this limit, which may include fitting this equipment with high grade engine exhaust silencers and engine casing sound insulation.

3.02 NOISE CONTROL PLAN

A. Requirements:

1. Within 180 days, prior to requesting a noise variance from the local jurisdiction, submit to Metro or its designee the name, address, and qualifications of the Acoustical Engineer responsible for preparing and overseeing the implementation of the Noise Control Plan.

2. The minimum requirements for the Acoustical Engineer: Bachelor of Science Degree or higher degree, from a qualified program in engineering, physics, or architecture offered by an accredited university or college, and five years experience in noise control engineering and construction noise analysis, or current enrollment as a full Member or Board-certified Member in the Institute of Noise Control Engineering.

3. In addition to the basic requirements shown above, the Acoustical Engineer must demonstrate substantial and responsible experience in preparing and implementing construction noise control and monitoring plans on construction projects conducted in an urban setting, calculating construction noise levels, and designing and overseeing the implementation of construction noise abatement measures.

4. Within 100 days prior to requesting a noise variance from the local jurisdiction, submit the Noise Control Plan to Metro or its designee.

5. Noise Control Plan: Include the following for nighttime construction activities that may occur at the surface of the construction site:

a. Site Drawing: Prepare a scaled drawing of the construction site indicating the following:

   1) Contract name and number
   2) Contractor's name
   3) Date
   4) Scale
   5) Direction of North
   6) Noise sensitive locations near the construction site
   7) Construction equipment locations used during nighttime hours, designated by the code letter used in Column (a) in Part A of the Noise Control Plan Form, Figure 4.
   8) Locations of the noise levels calculated for residential, commercial, and industrial areas as specified in this Section.
   9) Locations and types of noise abatement measures that may be required to meet codes and regulations as indicated by the calculations as specified in this Section.
b. Equipment Inventory: Prepare an inventory of equipment used during nighttime hours by providing the following information in the indicated columns of Noise Control Plan Form, Figure 4.

1) Column (a): Code letter in sketch to indicate position of equipment on site and to identify Certificates of Noise Compliance
2) Column (b): Appropriate equipment category from Table 3
3) Column (c): Equipment manufacturer and model, if known at the time of the Plan's preparation
4) Column (d): Unique identifier (ID), such as registration number, if known at the time of the Plans preparation.
5) Column (e): Equipment horsepower
6) Column (f): Noise emission limit from Table 3.
7) Column (g): Estimated noise level at 50 feet; if greater than the value in Column (f), source noise control device (e.g. mufflers) must be used to comply with limit.
8) Column (h): Estimated date of first use on site
9) Column (i): Estimated date of last use on site.

c. Noise Calculations: Prepare calculations of nighttime \( L_{\text{max}} \) and one-hour \( L_{\text{eq}} \) noise levels expected at the nearest residential, commercial and industrial property line based on the equipment noise levels given in Part A of the Noise Control Plan Form. Determine the nearest property lines from the currently identified noise sensitive locations indicated in Table 4. Calculate preliminary one-hour \( L_{\text{eq}} \) construction noise projections for those sensitive locations and insert with locations into Table 5. Make the calculations for locations where noise emitted by applicable equipment will cause the greatest noise level for each type of land use, for nighttime periods, if necessary. Provide the results on Part B of the Noise Control Plan Form with calculations included below the results, and with the locations for the calculations indicated on the site sketch. The noise calculation procedure shall be as follows:

1) Calculate \( L_{\text{max}} \) according to the method outlined below:

\[
L_{\text{max}}(\text{equipment}) = EL - 20 \log_{10} \left( \frac{D}{50} \right)
\]

where:

\( EL \) = Estimated equipment noise level at 50 feet, in dBA.

\( D \) = Distance from the equipment to property-line location, in feet.

Then, combine the individual contributions of each piece of equipment to obtain the overall maximum construction noise level at each location as follows:

\[
L_{\text{max}}(\text{overall}) = 10 \log_{10} \left( \sum 10 \left[ L_{\text{max}}(\text{equipment})/10 \right] \right)
\]

2) Calculate one-hour \( L_{\text{eq}} \) according to the methodology recommended by the US Department of Transportation, Federal Highway Administration Special
Report Highway Construction Noise: Measurement, Prediction and Mitigation, as follows:

First, calculate the construction one-hour $L_{eq}$ at each property-line location for each item of equipment using the following equation:

$$\text{One-hour } L_{eq}\text{(equipment)} = EL - 20 \log_{10}(D/50) + 10 \log_{10}(UF/100)$$

where:

- $EL =$ Estimated equipment noise level at 50 feet, in dBA.
- $D =$ Distance from the equipment to the property-line location, in feet.
- $UF =$ "Usage factor," expressed as the percent of time that the equipment is operated at full power while on site. This factor shall be estimated by the Contractor or the qualified acoustical engineer. Guidelines for the selection of usage factors are provided by the US Environmental Protection Agency (EPA) Report NTID 300.1, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances.

Then, combine the individual contributions of each piece of equipment to obtain the overall construction one-hour $L_{eq}$ at each location as follows:

$$\text{One-hour } L_{eq}\text{(overall)} = 10 \log_{10}(\text{SUM} 10^{[\text{one-hour } L_{eq}\text{(equipment)}/10]})$$

3) Compare the calculated $L_{max}$ and one-hour $L_{eq}$ values with the Contract limits specified in this Section.

5. Update the Noise Control Plan at three month intervals (based on Metro or its designee's initial acceptance date) and re-submit the Plan within 10 days of the start of each quarterly period. Update and re-submit the Noise Control Plan upon any major change in work schedule, construction methods, or equipment operations not included in the most recent Plan.

B. Noise Abatement Measures: If the results of the noise calculations prepared in accordance with this Section or the noise variance obtained from the local jurisdiction indicate that noise level limits will be exceeded, identify proposed noise abatement measures, their anticipated effects (dBA reductions), and a schedule for their implementation. Re-calculate the noise levels at the nearest sensitive receptor location property lines which include the anticipated noise reduction effects and submit the results on Part B of the Noise Control Plan Form. Include, as backup documentation to Part B of the Noise Control Plan, drawings, sketches, and suitable calculations which demonstrate anticipated noise reduction benefits and that proposed structures or facilities comply with applicable building code requirements.

C. Noise Reduction Methods: To the extent required to meet the noise limits specified by this Section or the noise variance obtained by the local jurisdiction, include noise reduction measures listed below, or others of the Contractor's devising to minimize construction noise emission levels. Noise reduction measures include, but are not limited to the following:

1. Scheduling truck loading, unloading, and hauling operations so as to minimize noise impact near noise sensitive locations and surrounding communities.
2. Locating stationary equipment so as to minimize noise impact on the community.
3. Do not leave equipment pieces idling when not in use.
4. Limiting the use of enunciators or public address systems, except for emergency notifications.
5. Maintaining equipment such that parts of vehicles and loads are secure against rattling and banging.
6. Limit the time that steel decking or plates for street decking or covering excavated areas are in use.
8. Grading of surfaced irregularities on construction sites to prevent the generation of impact noise and ground vibrations by passing vehicles.
9. Schedule Work to avoid simultaneous activities that both generate high noise levels.

3.03 NOISE MONITORING PLAN

A. Requirements:

1. When a Noise Monitoring Plan is required, have the Noise Monitoring Plan prepared and administered by the Contractor's Acoustical Engineer.

2. Within 45 days of requesting a noise variance from the local jurisdiction, submit the Noise Monitoring Plan to Metro or its designee, specifying the nighttime and daytime construction activities, monitoring locations, equipment, procedures, schedule of measurements and reporting methods to be used.

3. Furnish noise monitoring data to Metro or its designee on a weekly basis. Include measurements taken during the previous week.

4. In the event that the measured noise levels exceed allowable limits, immediately notify Metro or its designee and immediately implement additional Noise Abatement Measures as specified in the Noise Control Plan.

5. If the measured nighttime levels exceed the noise limits specified in this Section or the noise variance obtained from the local jurisdiction, reduce the noise levels by appropriate abatement measures in order to comply with the noise variance requirements or terminate the nighttime construction activity responsible for the noise limits exceedance until the daytime hours when higher noise levels are permitted.

B. Measurement Locations:

1. Measure the noise-sensitive locations identified in the approved Noise Monitoring Plan in the vicinity of the construction site for noise levels. These locations may change during the Contract and shall be updated as required by Metro.

2. Prepare and submit a scaled plan indicating monitoring locations, including measurements to be taken at construction site boundaries and at nearby residential, commercial and industrial property lines.

C. Measurement Equipment:

1. Perform noise measurements with an instrument that is in compliance with the criteria for a Type 1 (Precision) or Type 2 (General Purpose) Sound Level Meter as defined in the current revision of ANSI S1.4.
2. Provide sound level meters capable of measuring the $L_{\text{max}}$ and one-hour $L_{\text{eq}}$ on both the A-Weighted and C-Weighted scales required by regulatory criteria and Noise Level Limits.

3. Calibrate sound level meters, microphones, and calibrators for certified laboratory conformance at least once a year. Submit a current certificate of conformance to Metro or its designee prior to using the sound level meter and submit updated certificates following subsequent calibrations on a yearly basis for the duration of this Contract or upon the completion of repairs to the instrument.

D. Measurement Procedure:

1. Field calibrate the sound level meter using an acoustic calibrator, according to the manufacturer’s specifications, prior to each measurement.

2. Except as otherwise indicated, perform measurements using the A weighting network and the SLOW response of the sound level meter.

3. Measure impulsive or impact noises using the C-Weighting network and the FAST response of the sound level meter.

4. Fit the measurement microphone with an appropriate windscreen at the location of the sensitive receptor at least four to six feet away from the nearest reflective surface.

5. Take noise measurements at noise sensitive locations within 150 feet of the construction site at least once each week and after a change in construction activity or construction location. Measurement Periods: Minimum of 15 minutes.

6. Construction noise measurements shall coincide with daytime and nighttime periods of maximum noise generating construction activity, and be taken during the construction phase or activity that has the greatest potential to create annoyance or to exceed applicable noise regulations and restrictions.

7. If, in the estimation of the person performing the measurements, outside noise sources contribute significantly to the measured noise level, repeat the measurements (with the same outside source contributions when construction is inactive) to determine the background noise level.

8. Submit noise data to Metro or its designee on a weekly basis using the Noise Measurements Report Form provided in Figure 2. Note the type of measurement (e.g. baseline, on-going construction) on the form.

9. Clearly identify monitoring locations and sketch on the back of the Noise Measurements Report Form, Figure 2, along with the locations of and distances from any noise sensitive location.

10. Identify construction equipment operating during the monitoring period and the locations sketched on the back of the Noise Measurements Report Form, along with the locations and distances to any noise sensitive location.

3.04 EQUIPMENT NOISE CERTIFICATION

A. Requirements for Construction Equipment:

1. Ensure that Contractor and Subcontractor equipment, of the categories listed in Table 3 to be used (during nighttime hours as defined by the local jurisdiction or noise
variance obtained by the Contractor at the surface of the construction site) for a total duration greater than five days, shall be tested for compliance with the stated noise emission limits by the Acoustical Engineer during the first day of use on the construction site or at an alternative site acceptable to Metro or its designee.

2. Retest equipment as described above at six month intervals while in use on-site, and certify new equipment before being placed into service at the site.

3. For each piece of equipment tested, submit a noise report to Metro or its designee by completing the Application for Certificate of Equipment Noise Compliance provided in Figure 3. Ensure that the equipment identification number used for the Certificates is consistent with the identification number used in the Noise Control Plan.

4. Do not use equipment of the categories listed in Table 3, as described above on-site without valid certificates of noise compliance submitted as required.

B. Test Procedures for Construction Equipment:

1. Operate engine powered equipment by the Contractor or Contractor's representative at maximum governed rpm under full load conditions during the tests under the supervision of the Acoustical Engineer.

2. Test portable and mounted impact hammers, such as hoe rams and jackhammers to be used for concrete breaking, by the Acoustical Engineer during the first day of actual operation at the construction site under maximum load conditions as rated by the equipment manufacturer.

3. Noise certification measurements: As specified in Paragraph 3.3 F. of this Section. Use an acoustic calibrator of the type recommended by the sound level meter manufacturer prior to measurements.

4. If possible, make measurements at two locations:
   a. Two feet outside the right side of the equipment casing, at a distance of 50 feet and height of five feet above ground level, and;
   b. Two feet outside the left side of the equipment casing, at a distance of 50 feet and a height of five feet above ground level, with the equipment operating as indicated in items 3.4.B.1, 2, or 3 above for a minimum period of one minute. Reduce measurements made at less than 50 feet, because of space limitations at the test site, by the values given in Table 6 to estimate the 50-foot sound level.

C. Compliance:

1. Submit a noise report to Metro or its designee for each item of equipment used on the surface of the construction site during nighttime hours as defined by the local jurisdiction or as specified in the noise variance obtained by the Contractor of the categories listed in Table 3. Submit the report on the form shown in Figure 3 with certification by the Acoustical Engineer that equipment noise emissions do not exceed those prescribed in Table 3.

2. If the noise levels obtained during the tests exceed those specified in Table 3, remove such equipment from nighttime use until such equipment is modified and retested, or substitute other equipment to meet the noise level requirements.

3. Upon compliance Metro or its designee will mark the noise report indicating Metro or its designee's concurrence, including the certification date and equipment
identification number, for verification by Resident Engineer. Keep the noise reports readily available on file in the construction field office for inspection by Metro or its designee upon request.

4. The Certificate of Noise Compliance will remain valid for a period of six months only. Delays caused by the certification refusal or by time lost in improving the rejected equipment or finding alternate acceptable equipment will not be a basis for monetary or time delay claims, or for avoidance of liquidated damages or withholding of payment.

5. Equipment shall be subject to spot noise level testing by Metro or its designee's discretion to determine that the equipment in use meets the requirements specified in Table 3. If such tests are requested by Metro or its designee, locate and operate the equipment as directed by Metro or its designee at the designated site so as to facilitate the measurements.

a. Provide Metro or its designee with a copy of the results of the measurements. If such tests demonstrate that any equipment does not comply with this part, Metro or its designee will revoke the certificate of Noise Compliance and the Contractor will take the equipment out of use according to requirements of this Section until compliance is achieved. A new Certificate of Noise Compliance will be issued upon proof of compliance.

3.05 VIBRATION LEVEL LIMITS

A. Measures applied to limit noise levels may in some cases limit vibration levels also. Measures specified above for noise levels are applicable.

B. All Areas: Conduct Construction activities so that vibration levels at a distance of 50 feet from construction limits or at nearest affected building (whichever is closer) do not exceed root-mean-square (rms) unweighted vibration velocity levels in vertical direction over a frequency range of 1 to 100 Hz as listed in Table 7.

C. Vibration levels at buildings affected by construction operations refer to vertical direction vibration on ground surface or building floor, or 50 feet from Construction Limits, whichever is closer.

D. Conduct weekly measurements of vibration during peak vibration generating construction activities. If the construction set up changes more often than weekly, conduct vibration measurements as often as the set up changes. Furnish vibration monitoring data to Metro or its designee on a weekly basis. Include measurements taken during the previous week.

3.06 CONSTRUCTION SITE NOISE CONTROL

A. Perimeter Noise Barrier Fence:

1. Maintain existing perimeter noise barrier fences along streets. The noise barrier fences may not provide sufficient noise reduction to meet the daytime or nighttime noise limits specified in this Section. It is the Contractor's responsibility to meet these limits by other methods such as installing additional fixed barrier fences or movable barriers, raising the height of the noise barrier fences, and providing additional noise
control measures specified in this Section.

2. Construct gates and/or doors in the fence either hinged or rolling of the same or equally effective material as the noise barrier fence. Construct gates and doors in the fence to ensure that the edges overlap the fence to eliminate gaps. During nighttime hours maintain gates and doors in a closed position except for brief periods of time to allow access to the Construction Site.

B. During nighttime construction activities shield noise generating equipment to the extent that the line-of-sight is broken between the equipment's engine exhaust stack and/or engine casing and any residential building or structure where sleep activity occurs within 500 feet of that activity.

C. In no case expose public to construction noise levels exceeding 90 dBA (slow) within a 15 minute time limit, or to impulsive noise levels with a peak sound pressure level exceeding 115 dBC maximum transient level as measured on general purpose sound level meter on C-weighting and fast meter response.

3.07 CONSTRUCTION METHODS – EQUIPMENT

A. Minimize the use of impact devices, such as jackhammers, pavement breakers, and hoe rams. Where possible, use concrete crushers or pavement saws rather than hoe rams for tasks such as concrete deck removal and retaining wall demolition.

B. Pneumatic impact tools and equipment used at the construction site shall have intake and exhaust mufflers recommended by the manufacturers thereof, to meet relevant noise ordinance limitations and Metro project criteria shown in this Section.

C. Equip noise producing equipment i.e. jackhammers and pavement breakers with acoustically attenuating shields or shrouds recommended by the manufacturers thereof, to meet relevant noise ordinance limitations.

D. Line or cover hoppers, conveyor transfer points, storage bins, and chutes with sound-deadening material.

E. Provide mufflers or shield paneling for other equipment, including internal combustion engines, recommended by manufacturers thereof.

F. As required to meet the noise limits specified in this Section, use alternative procedures of construction, and select proper combination of techniques that generate least overall noise and vibration. Such alternative procedures include the following:
   1. Use electric welders powered from utility main lines instead of riveting or use of welders powered by on-site electric generators.
   2. Mix concrete off-site instead of on-site.
   3. Employ prefabricated structures instead of assembling on-site.

G. Use construction equipment manufactured or modified to dampen noise and vibration emissions, such as:
   1. Use electric instead of diesel powered equipment.
2. Use hydraulic tools instead of pneumatic impact tools.
3. Use electric instead of air or gasoline driven saws.

3.08 CONSTRUCTION METHODS – OPERATIONS

A. Operate equipment so as to minimize banging, clattering, buzzing, and other annoying types of noises, especially near residential areas during the nighttime hours.

B. To the extent feasible, configure the construction site in a manner that keeps noisier equipment and activities as far as possible from noise sensitive locations and nearby buildings.

C. Install equipment with back-up alarms operated by Contractor, vendors, suppliers, and subcontractors on the construction site, with either audible self-adjusting back-up alarms or manual adjustable alarms. The self-adjusting alarms shall automatically adjust to a minimum of five dBA and a maximum of 10 dBA over the surrounding background noise levels and have an operating range between 77-97 dBA. Set the manual adjustable alarms at the low setting, 87 dBA. Installation and use of alarms shall comply with CCR Title 8, Section 1592, Warning Methods.

D. In no case shall the above restrictions limit the Contractor's responsibility for compliance with applicable Federal, state and local safety ordinances and regulations and other Sections of these construction specifications.

E. Maximize physical separation, as far as practicable, between noise generators and noise receptors. Separation includes following measures:
   1. Provide enclosures for stationary items of equipment and barriers around particularly noisy areas on site.
   2. Locate stationary equipment to minimize noise and vibration impact on community, subject to acceptance of Metro or its designee.

F. Minimize noise-intrusive impacts during most noise sensitive hours.
   1. Plan noisier operations during times of highest ambient noise levels.
   2. Keep noise levels relatively uniform; avoid excessive and impulse noises.
   3. Turn off idling equipment.
   4. Phase in start-up and shut-down of site equipment.

G. Select truck routes for muck disposal so that noise from heavy-duty trucks will have minimal impact on sensitive land uses (e.g., residential).
   1. Conduct truck loading, unloading and hauling operations so noise and vibration are kept to a minimum.
   2. Route construction equipment and vehicles carrying soil, concrete or other materials over streets and routes that will cause least disturbance to residents in vicinity of Work.
   3. Submit haul routes and staging areas to the City of Los Angeles, Bureau of Engineering and LADOT, 30 days before required date.
3.09 CONSTRUCTION METHODS – MOVEABLE NOISE BARRIERS

A. Install moveable noise barriers in accordance with requirements of this Section for Moveable Noise Barriers, as required to comply with the Noise Control Plan and to meet the noise limits specified in this Section, to shield the public from construction noise during the course of the Contract.

B. Provide readily removable noise barriers so that they may be repositioned, as necessary, to provide noise abatement for non-stationary and stationary processes.

C. Installation, Maintenance, and Removal:
   1. Install the barriers such that the sound-absorptive surfaces face the noise source.
   2. Maintain the moveable noise barriers and repair damage that occurs, including, but not limited to, keeping barriers clean and free from graffiti, and maintaining structural integrity. Promptly repair or replace gaps, holes, and weaknesses in the barriers, and openings between, or under the units with new material.

D. The use of moveable noise barriers is a noise control requirement that may not provide sufficient noise reduction to meet the daytime or nighttime noise limits specified in this Section. It is the Contractor’s responsibility to meet these limits by other methods such as installing additional moveable noise barriers, installing noise barrier fences, and providing additional noise control measures specified in this Section as indicated.

3.10 CONSTRUCTION METHODS – NOISE CONTROL CURTAIN

A. Install noise control curtains in accordance with requirements of this Section for Noise Control Curtains, as required to meet the noise limits specified in this Section, to shield public from construction noise during the course of the Contract.

B. The noise control curtains shall be readily moveable so that they may be repositioned, as necessary, to provide noise abatement for non-stationary and stationary processes.

C. Installation, Maintenance and Removal:
   1. The noise control curtains shall be installed without any gaps such that the sound-absorptive side faces the construction activity to be shielded.
   2. Maintain the noise control curtains and promptly repair any damage that may occur. Gaps, holes or weaknesses in the curtain, or openings between the curtain and the ground shall be promptly repaired by the Contractor.
### TABLE 1 – ALLOWABLE SOUND LEVELS OF TOTAL CONSTRUCTION SITE NOISE

<table>
<thead>
<tr>
<th>AFFECTED STRUCTURE OR LAND USE</th>
<th>MAXIMUM ALLOWABLE CONTINUOUS NOISE LEVEL, dBA (Lmax)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DAYTIME</td>
</tr>
<tr>
<td></td>
<td>7:00 AM to 8:00 PM</td>
</tr>
<tr>
<td>Residential</td>
<td>Single family residence not along major arterials</td>
</tr>
<tr>
<td>Land uses along an arterial or in multifamily residential areas, including hospitals</td>
<td>65</td>
</tr>
<tr>
<td>In commercial areas, including hotels</td>
<td>70</td>
</tr>
<tr>
<td>Commercial</td>
<td>In noise sensitive, semi-residential/commercial areas, including schools, libraries, and churches</td>
</tr>
<tr>
<td>In non-noise sensitive commercial areas with no nighttime residency</td>
<td>75</td>
</tr>
<tr>
<td>Industrial</td>
<td>All locations</td>
</tr>
</tbody>
</table>

### TABLE 2 – ALLOWABLE SOUND LEVELS OF SHORT TERM* CONSTRUCTION EQUIPMENT

<table>
<thead>
<tr>
<th>STRUCTURE OR LAND USE</th>
<th>MAXIMUM ALLOWABLE INTERMITTENT NOISE LEVEL, dBA (Lmax)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DAYTIME</td>
</tr>
<tr>
<td></td>
<td>7:00 AM to 8:00 PM</td>
</tr>
<tr>
<td>Residential</td>
<td>Single family residence not along major arterials</td>
</tr>
<tr>
<td>Land uses along an arterial or in multifamily residential areas, including hospitals</td>
<td>80</td>
</tr>
<tr>
<td>In commercial areas, including hotels</td>
<td>80</td>
</tr>
<tr>
<td>Commercial</td>
<td>In noise sensitive, semi-residential/commercial areas, including schools, libraries, and churches</td>
</tr>
<tr>
<td>In non-noise sensitive commercial areas with no nighttime residency</td>
<td>85</td>
</tr>
<tr>
<td>Industrial</td>
<td>All locations</td>
</tr>
</tbody>
</table>

*SHORT-TERM is defined in this Section.
TABLE 3 – NOISE EMISSION LIMITS FOR CONSTRUCTION EQUIPMENT USED DURING NIGHTTIME HOURS; MEASURED AT 50 FEET FROM CONSTRUCTION EQUIPMENT*

<table>
<thead>
<tr>
<th>Equipment Category</th>
<th>L_{max} Level (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backhoe</td>
<td>75</td>
</tr>
<tr>
<td>Bar Bender</td>
<td>75</td>
</tr>
<tr>
<td>Chain Saw</td>
<td>81</td>
</tr>
<tr>
<td>Compactor</td>
<td>75</td>
</tr>
<tr>
<td>Compressor</td>
<td>75**</td>
</tr>
<tr>
<td>Concrete Mixer</td>
<td>71</td>
</tr>
<tr>
<td>Concrete Pump</td>
<td>77</td>
</tr>
<tr>
<td>Crane</td>
<td>81</td>
</tr>
<tr>
<td>Dozer</td>
<td>81</td>
</tr>
<tr>
<td>Front End Loader</td>
<td>75</td>
</tr>
<tr>
<td>Generator***</td>
<td>69</td>
</tr>
<tr>
<td>Gradall</td>
<td>81</td>
</tr>
<tr>
<td>Grader</td>
<td>81</td>
</tr>
<tr>
<td>Paver</td>
<td>81</td>
</tr>
<tr>
<td>Pneumatic Tools</td>
<td>81</td>
</tr>
<tr>
<td>Scraper</td>
<td>81</td>
</tr>
<tr>
<td>Tractor</td>
<td>79</td>
</tr>
</tbody>
</table>

* Noise emission limits apply to equipment used at surface of the construction site during nighttime hours of 9 pm to 7 am.
** Portable Air Compressor that is rated at 75 cfm or greater and that operates at greater than 50 psi
*** Use Quiet Generators from MQ Power, or equivalent to meet the noise limits.

TABLE 4 – NOISE SENSITIVE LOCATIONS – TBD

<table>
<thead>
<tr>
<th>Location No</th>
<th>Address</th>
<th>Land Use</th>
</tr>
</thead>
</table>
TABLE 5 – PRELIMINARY NOISE PROJECTIONS – TBD
(Refer to drawing prepared according to requirements of this Section.)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Construction One-Hour L_{eq} at Each Receiver (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Receiver #1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE 6 – ADJUSTMENTS FOR CLOSE-IN EQUIPMENT NOISE MEASUREMENTS

<table>
<thead>
<tr>
<th>Distance (Feet)</th>
<th>Level to Estimate Sound Level at 50 Feet (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-21</td>
<td>8</td>
</tr>
<tr>
<td>22-23</td>
<td>7</td>
</tr>
<tr>
<td>24-26</td>
<td>6</td>
</tr>
<tr>
<td>27-29</td>
<td>5</td>
</tr>
<tr>
<td>30-33</td>
<td>4</td>
</tr>
<tr>
<td>34-37</td>
<td>3</td>
</tr>
<tr>
<td>38-42</td>
<td>2</td>
</tr>
<tr>
<td>43-47</td>
<td>1</td>
</tr>
<tr>
<td>48-50</td>
<td>0</td>
</tr>
</tbody>
</table>

TABLE 7 – CONSTRUCTION VIBRATION LIMITS

VIBRATION TYPE AND PERMISSIBLE LIMIT:
AGGREGATE DURATION:                     LIMIT:
Sustained (>1 hr/day)                      0.01 in/sec (80 VdB re 10^{-6} in/sec)
Transient (>= 10 min to 1 hr/day)         0.03 in/sec (90 VdB re 10^{-6} in/sec)
Transient (<10 min/day)                   0.10 in/sec (100 VdB re 10^{-6} in/sec)
FIGURE 1

QUARTERLY NOISE CONTROL PLAN FORM - PART B

QUARTERLY NOISE CONTROL PLAN (DUPLICATE AS NEEDED)

Contract No.: ___________________________  Contract Name: ___________________________

Contractor: ___________________________  Site: ___________________________

Date: ___________________________  Land Use: ___________________________

Resubmit every 3 months.

PART B: RESIDENTIAL, COMMERCIAL AND INDUSTRIAL PROPERTY NOISE LEVELS

<table>
<thead>
<tr>
<th></th>
<th>Calculated Noise Levels (dBA)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calculated one hourLeq</td>
</tr>
<tr>
<td></td>
<td>(dBA)</td>
</tr>
<tr>
<td></td>
<td>Calculated Lmax</td>
</tr>
<tr>
<td></td>
<td>(dBA)</td>
</tr>
<tr>
<td>Nighttime</td>
<td></td>
</tr>
</tbody>
</table>

NOISE ABATEMENT MEASURES  ANTICIPATED EFFECTS

CALCULATIONS: Attach additional sheet(s) as needed.

Contract No(s): ___________________________
FIGURE 2. NOISE MEASUREMENTS REPORT FORM

Date: _____________________
Time: _____________________

NOISE MEASUREMENTS REPORT FORM

Measured By: _____________________________ Of: ________________________________ (Company)

Monitoring Address: ________________________________ (Provide Sketch on Back)

Location No: _________ Wind Speed: _________ Km/Hr Direction: ____________

(MPH x 1.6)

Location of Sound Level Meter: (No closer than 15 meters from equipment and 3 meters from building)

Monitoring was Conducted: _________ Meters from Equipment ( _________)

(Type(s): Leave Blank for Baseline)

Land Use:
- Residential/Institutional
- Business/Recreational
- Industrial

Sound Level Meter: Make and Model: __________________

A - Weighted Sound Level (Slow)
C - Weighted Sound Level (Fast)

Duration of Measurement: __________________________

(15 minutes to 1 hour)

<table>
<thead>
<tr>
<th>Calibration</th>
<th>one-hour L&lt;sub&gt;eq&lt;/sub&gt;</th>
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</thead>
<tbody>
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</table>

Field Notes (example: 2200-2205 H, Airplane 90 dB)

<table>
<thead>
<tr>
<th>Calibration</th>
<th>L&lt;sub&gt;50&lt;/sub&gt;</th>
<th>L&lt;sub&gt;10&lt;/sub&gt;</th>
<th>L&lt;sub&gt;1.0&lt;/sub&gt;</th>
<th>MAX&lt;sub&gt;L&lt;/sub&gt;</th>
<th>Allowable Noise Limit</th>
</tr>
</thead>
<tbody>
<tr>
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Check one of the following:

- Ongoing Construction
- Post-Construction: ____________ (Contract)
- Baseline Conditions

(Complete all that apply below)

Active Contract(s): ________________________________

(List all contracts that contribute to measured noise)

Complaint Response: ________________________________

(Describe: Include Log-In Number)

Abatement Follow-up: ________________________________

(Describe)
FIGURE 3

EQUIPMENT SOUND LEVEL DATA REPORTING FORM

APPLICATION FOR CERTIFICATE OF EQUIPMENT NOISE COMPLIANCE

Contractor Name: ____________________________________________________________
Contract Name & Number: ______________________________________________________

Equipment Type: ____________________________________________________________
Manufacturer & Model Number: _________________________________________________
Identification Number: _________________________________________________________
Rated Power & Capacity: _______________________________________________________
Operating Condition During Test: _______________________________________________

Measured Sound Levels at 20 to 50 feet:

Measured Values and Distance:
    Right Side: _____________ dBA (SLOW), at ______________ feet
    Left Side: ______________ dBA (SLOW), at ____________ feet

Estimated Values at 50-Foot Distance:
    Right Side: ______________ dBA (SLOW).
    Left Side: ______________ dBA (SLOW).

Maximum Values Allowed for this Equipment: ______________ dBA (SLOW)
at 50 feet.

If equipment sound level exceeds maximum value allowed, indicate action taken to achieve compliance:
__________________________________________________________________________
__________________________________________________________________________

Name, Address & Phone No. of Acoustical Engineer
__________________________________________________________________________

Authorized Signature: ___________________________ Date: __________
CONTRACTOR'S APPROVAL:
Authorized Signature: ___________________________ Date: __________
ENGINEER'S CONCURRENCE:
Authorized Signature: ___________________________ Date: __________
Contract No.: __________________________ Contract Name: ___________________________ Contractor: ____________________________

Site: __________________________ Date: __________________________ Resubmit every three months

(ATTACH SITE SKETCH)

### PART A: EQUIPMENT INVENTORY

<table>
<thead>
<tr>
<th>Code letter (a)</th>
<th>Equipment</th>
<th>Noise Limit (f)*</th>
<th>Estimated Noise at 50&quot; (g)</th>
<th>Date Begin (h)</th>
<th>Date End (i)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category (b)</td>
<td>Model (c)</td>
<td>ID# (d)</td>
<td>HP (e)</td>
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END OF SECTION 01 56 19