28 September 2012

630.10356 LR001 20120918.docx

DHL Supply Chain
Rhodes Corporate Park
Level 3, Building A
1 Homebush Bay Drive
Rhodes NSW 2138

Attention: David Henderson

Dear David

Building B1, 23-107 Erskine Park Road, Erskine Park (Lot 1 DP1128233)
Dangerous Goods Warehouse and Distribution Development
Noise Compliance Monitoring September 2012

1 Introduction

SLR Consulting Australia Pty Ltd (SLR Consulting) has been engaged by DHL Supply Chain to conducted noise monitoring to assess noise compliance in relation to the requirements of development consent conditions SSD-4953 for the Dangerous Goods Warehouse and Distribution Development located at Building B1, 23-107 Erskine Park Road, Erskine Park.

The noise monitoring report has been prepared with reference to Australian Standard AS 1055:1997 *Description and Measurement of Environmental Noise* Parts 1, 2 and 3 and in accordance with the Environmental Protection Authority (EPA), *NSW Industrial Noise Policy* (INP).

1.1 Hours of Operation

The hours of operation of the Project site are between 6:00 am and 6:00 pm.

1.2 Acoustic Terminology

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

2 Development Consent Noise Criteria

The development consent conditions issued by the EPA for the DHL operation, which relate to noise, are reproduced below:

NOISE

Operational Noise Criteria

*The Applicant shall ensure that the noise generated by the operations on-site does not exceed the limits in **Table 1** at any private residential receiver.*

Table 1 Noise Impact Assessment Criteria dB(A)

Location	*6.00am - I0.00pm*	*6.00am - 7.00am*
	LAeq (15 minute)	*LA1 (1 minute)*
Receiver 1 (517 - 537 Mamre Road, Orchard Hills)	*33*	*38*
Receiver 2 (100 Pine Creek Circuit, St Clair)	*30*	*30*
Receiver 3 (45 Corio Drive, St Clair)	*30*	*34*
Receiver 4 (80 Cowarra Drive, St Clair)	*30*	*32*

Note: Noise generated by the development is to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy.

3 Operational Noise Monitoring

3.1 General Requirements

All acoustic instrumentation used in the survey was compliant with the requirements of AS IEC 61672 (parts 1 and 2) 2004 *Electroacoustics – Sound Level Meters* and carries current NATA or manufacturer calibration certificates. Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dBA.

3.2 Monitoring Location

The nearest affected residential receivers to the site are to the north and west of the development. Noise levels were measured at all nearest potentially affected residential receiver locations identified in **Table 2** and illustrated in **Figure 1**.

Table 2 Noise Compliance Monitoring Locations

Location	Description
Receiver 1 (517 - 537 Mamre Road, Orchard Hills)	Eastern Boundary of Property
Receiver 2 (100 Pine Creek Circuit, St Clair)	Southern Boundary of Property
Receiver 3 (45 Corio Drive, St Clair)	Southern Boundary of Property
Receiver 4 (80 Cowarra Drive, St Clair)	Southern Boundary of Property

Figure 1 Noise Compliance Monitoring Locations

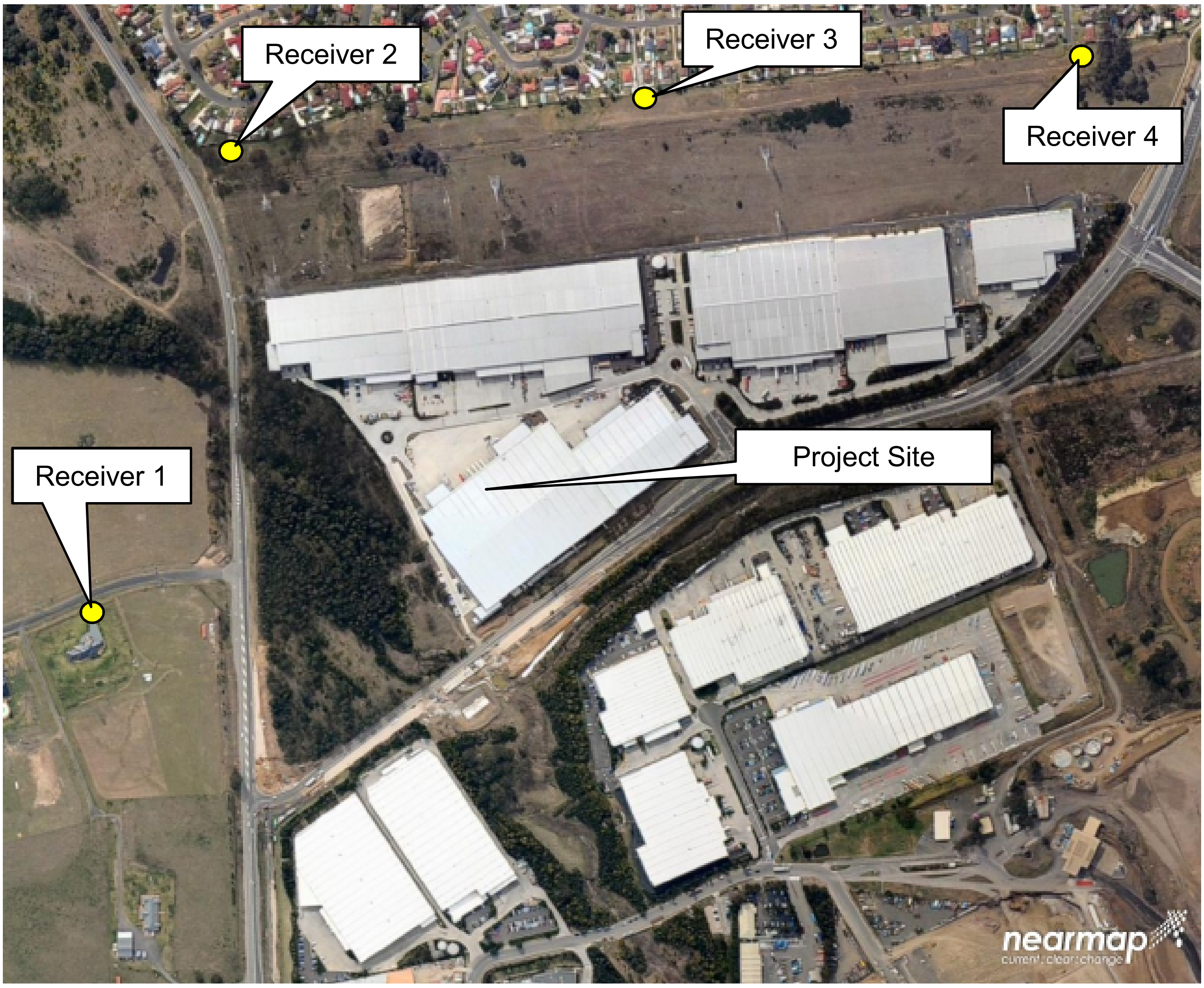


Image Source: Nearmaps

3.3 Operator Attended Noise Monitoring

Operator attended noise measurements were conducted during the day and morning shoulder periods on Wednesday 12 September 2012, Friday 14 September 2012 and Monday 17 September 2012 at the noise monitoring locations identified in **Table 2**. The objective of the operator attended noise monitoring was to measure $L_{Aeq(15minute)}$, L_{Amax} and $L_{A1(1minute)}$ noise levels at the nearest potentially affected receivers to determine the noise contribution of activities associated with Project Site, and to assist in defining noise sources and the character of noise in the area. Operator attended noise measurements were conducted using an integrating B&K 2270 sound level meter (S/N 2679354).

Operated attended noise survey results are summarised in **Table 3**. Ambient noise levels given in the tables include all noise sources such as traffic, insects, birds and quarry operations. The table provides the following information:

- Monitoring location.
- Date, start time, Wind velocity (m/s) and Temperature (Temp ºC) at the measurement location.
- Typical maximum (L_{Amax}) and contributed noise levels.

It is relevant to note that operator attended compliance monitoring was conducted during peak period times and represent a worst-case scenario.

Table 3 Summary of Operated Attended Noise Measurements

Period	Date/Start Time/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emissions and Typical Maximum Noise Levels (dBA)
		L_{Amax}	L_{A1}	L_{A10}	L_{A90}	L_{Aeq}	
		Receiver 1					
Day	14/09/2012 02:30 pm Wind SW 2.5 m/s Temp 20ºC	80	64	51	43	55	Birds 52 - 61 Road traffic Mamre Road 51 - 57 Insects 32 Local traffic 79 – 80 Dog Barking 60 **DHL Operations Not Audible**
		Estimated contribution DHL Operations Not Audible					
Morning Shoulder Period	12/09/2012 06:19 am Calm Temp 5ºC	76	62	59	55	58	Birds 61 - 63 Road traffic Mamre Road 58 - 60 Distant road traffic 55 -58 Local traffic 68 – 76 **DHL Operations Not Audible**
		Estimated contribution DHL Operations Not Audible					
		Receiver 2					
Day	14/09/2012 02:09 pm Calm Temp 20ºC	72	64	59	47	56	Birds 63 Insects 40 Road traffic Mamre Road 61 - 67 Plane flyover 45 Dog Barking 72 **DHL Operations Not Audible**
		Estimated contribution DHL Operations Not Audible					
Morning Shoulder Period	12/09/2012 06:41 am Calm Temp 5ºC	73	67	63	52	60	Birds 51 - 57 Road traffic Mamre Road 62 - 72 Dog Barking 63 - 73 **DHL Operations Not Audible**
		Estimated contribution DHL Operations Not Audible					
		Receiver 3					
Day	12/09/2012 07:09 am Calm Temp 13ºC	73	60	49	44	49	Birds 45 - 73 Road traffic Mamre Road 44 Plane flyover 48-51 Distant traffic 40 Industrial Noise 51 **DHL Operations Audible 38 at times**
		Estimated DHL $L_{Aeq(15minute)}$ contribution <30 dBA L1 (1 minute) contribution 34 dBA					

Period	Date/Start Time/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emissions and Typical Maximum Noise Levels (dBA)
		L_{Amax}	L_{A1}	L_{A10}	L_{A90}	L_{Aeq}	
Morning Shoulder Period	17/09/2012 06:43 am Calm Temp 8ºC	66	57	53	49	51	Birds 61 Road traffic Mamre Road 51 - 55 Dog Barking 50 Industrial Noise 52-56
		Estimated contribution DHL Operations Not Audible					**DHL Operations Not Audible**
Receiver 4							
Day	12/09/2012 07:40 am Calm Temp 15ºC	65	56	51	45	49	Birds 65 Road traffic Erskine Park Road 55-58 Local Traffic 41 Distant road traffic 45 Industrial Noise 53-57
		Estimated contribution DHL Operations Not Audible					**DHL Operations Not Audible**
Morning Shoulder Period	17/09/2012 06:25 am Calm Temp 8ºC	63	58	54	50	52	Birds 52 - 63 Road traffic Mamre Road 49 - 60 Erskine Park Road 55 - 57 Distant road traffic 49 Local traffic 49 – 59
		Estimated contribution DHL Operations Not Audible					**DHL Operations Not Audible**

Continuous road traffic noise from the sounding road network dominated the ambient noise levels during all attended noise surveys, except during the daytime monitoring at location Receiver 3, making it difficult to distinguish any DHL operational noise sources. L_{A90} noise levels were generally above 43 dBA throughout the day and 49 dBA during the morning shoulder period during all attended surveys.

Several lulls in traffic noise levels were observed during the daytime attended noise survey at Receiver 1 Minimum noise levels (Lmin) in the order of 37dBA were recorded at these times. During these periods DHL operations remained inaudible suggesting that any contribution would be at least 10 dBA below the L_{min} noise level (ie. <30dBA) and likely to be below the consent level at this location.

The measured daytime noise contribution at Receiver 3 represents a worst-case scenario as this receiver location has a direct line of sight to the DHL operations. An interpolation from this result has been made to determine the likely noise contribution at Receiver 2 and Receiver 4. Allowing for distance and barrier corrections noise levels <30dBa would be expected at Receiver 2 and Receiver 4 during the daytime and morning shoulder periods.

Furthermore, since the DHL operations were inaudible during the morning shoulder period at location R3, the measured day time noise levels have been assumed as a worst-case scenario for the likely morning shoulder period noise levels at location R3.

4 Noise Compliance Assessment

The contribution from the Project Site operation has been determined from the operator-attended noise monitoring results presented in **Table 3** and is summarized in **Table 4**.

Table 4 Noise Compliance Assessment

Location	Period	Measured Contribution LAeq(15minute)	Measured Contribution LA1(1minute)	Consent Criteria		Compliance
				LAeq(15minute)	LA1(1minute)	
Receiver 1	Morning Shoulder	<30	<30	33	38	Yes
	Day	<30	N/A		N/A	Yes
	Evening	N/A	N/A		N/A	Yes
	Night	N/A	N/A	N/A	N/A	Yes
Receiver 2	Morning Shoulder	<30	<30	30	30	Yes
	Day	<30	N/A		N/A	Yes
	Evening	N/A	N/A		N/A	Yes
	Night	N/A	N/A	N/A	N/A	Yes
Receiver 3	Morning Shoulder	<30	34	30	34	Yes
	Day	<30	N/A		N/A	Yes
	Evening	N/A	N/A		N/A	Yes
	Night	N/A	N/A	N/A	N/A	Yes
Receiver 4	Morning Shoulder	<30	<30	30	32	Yes
	Day	<30	N/A		N/A	Yes
	Evening	N/A	N/A		N/A	Yes
	Night	N/A	N/A	N/A	N/A	Yes

As can be seen from **Table 4** noise from the operation of the project site complies with the operational and sleep disturbance development consent noise limits for morning shoulder, day, evening and night periods.

5 Conclusion

SLR consulting has conducted a series of noise compliance surveys for the DHL Dangerous Goods Warehouse and Distribution Development located at Building B1, 23-107 Erskine Park Road, Erskine Park.

The results show compliance with the operational and sleep disturbance noise limit specified in the development consent conditions for day, evening and night periods.

I trust the preceding meets your current requirements. If you have any questions or need any further information please do not hesitate to contact me on (02) 4908 4500 or email trobertson@slrconsulting.com.

Yours sincerely

Tristan Robertson

Project Consultant
SLR Consulting Pty Ltd

1 Sound Level or Noise Level

The terms “sound” and “noise” are almost interchangeable, except that in common usage “noise” is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or L_P are commonly used to represent Sound Pressure Level. The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2E-5 Pa.

2 “A” Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an “A-weighting” filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120 110	Heavy rock concert Grinding on steel	Extremely noisy
100 90	Loud car horn at 3 m Construction site with pneumatic hammering	Very noisy
80 70	Kerbside of busy street Loud radio or television	Loud
60 50	Department store General Office	Moderate to quiet
40 30	Inside private office Inside bedroom	Quiet to very quiet
20	Unoccupied recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as “linear”, and the units are expressed as dB(lin) or dB.

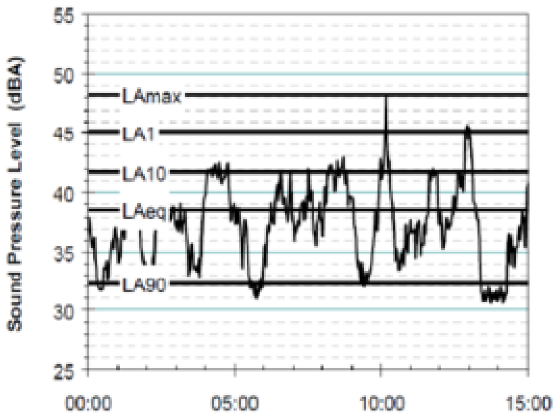
3 Sound Power Level

The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 1E-12 W.
The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

L_{A90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

L_{Aeq} The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the “repeatable minimum” L_{A90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or “average” levels representative of the other descriptors (L_{Aeq}, L_{A10}, etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than “broad band” noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

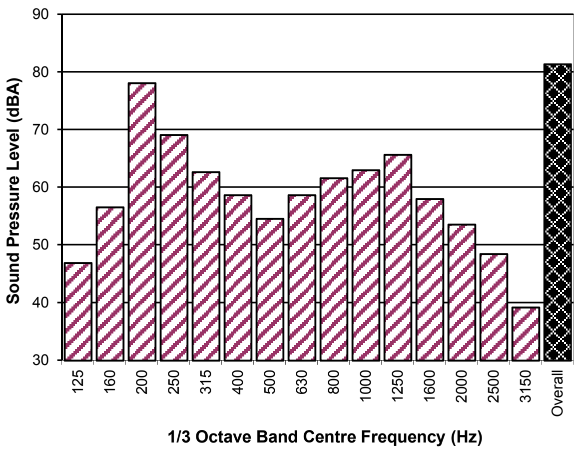
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of “peak” velocity or “rms” velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as “peak particle velocity”, or PPV. The latter incorporates “root mean squared” averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/V_o), where V_o is the reference level (1E-6 mm/s). Care is required in this regard, as other reference levels are used by some organizations.

9 Human Perception of Vibration

People are able to “feel” vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as “normal” in a car, bus or train is considerably higher than what is perceived as “normal” in a shop, office or dwelling.

10 Over-Pressure

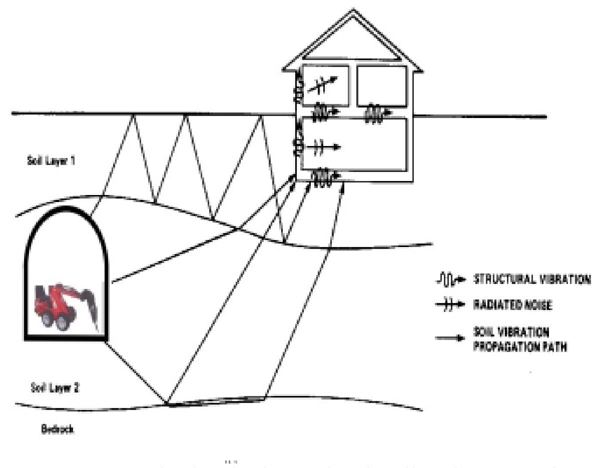
The term “over-pressure” is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed “regenerated noise”, “structure-borne noise”, or sometimes “ground-borne noise”. Regenerated noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of regenerated noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and regenerated noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term “regenerated noise” is also used to describe other types of noise that are emitted from the primary source as a different form of energy. One example would be a fan with a silencer, where the fan is the energy source and primary noise source. The silencer may effectively reduce the fan noise, but some additional noise may be created by the aerodynamic effect of the silencer in the airstream. This “secondary” noise may be referred to as regenerated noise.