Aircraft Noise Terminology/Metrics

To assist in understanding the noise measurements and noise metrics used in evaluating airport noise, this fact sheet provides a brief introduction to noise terminology used in this report. Specifically, the noise metrics discussed are the decibel (dB), the A-weighted sound level, the maximum noise level (Lmax), the sound exposure level (SEL), and the Community Noise Equivalent Level (CNEL).

The decibel or dB is the unit of measure used to represent the change in sound pressure, which is detected by the human ear. Since the range between the slightest and greatest sounds that we hear is extremely large, the decibel uses the logarithmic scale to compress this range to a more meaningful scale with 0 dB representing the slightest sound we can hear. Most sounds we experience in our day-to-day lives vary somewhere between 30 dB and 100 dB. Figure 2 presents typical sound levels of several common transportation sources.

Aircraft sound measurements generally use the metric known as A-weighted sound level. This is the sound level that has been filtered or weighted to reduce the influence of high and low frequency extremes. This closely replicates the sensitivity of the human ear in the frequency range of 500 – 10,000 Hz and correlates well with perceptions of the loudness of sounds. Thus, an aircraft noise event with a higher A-weighted sound level is perceived to be louder than an aircraft noise event with a lower A-weighted sound level. This correlation with human's perception of loudness is the primary reason that A-weighted sound levels are used to evaluate environmental noise sources.

The sound level heard during an arrival or departure of an aircraft varies as a function of the distance from the aircraft to the person hearing the noise (or "receiver"), and as a function of the direction of the aircraft noise source. As the aircraft approaches the receiver, the sound level increases and, as the aircraft moves away from the receiver, the sound level decreases. The effect of noise exposure during such an event can be described in terms of either the maximum sound level (Lmax) or the sound exposure level (SEL) of individual aircraft noise events.

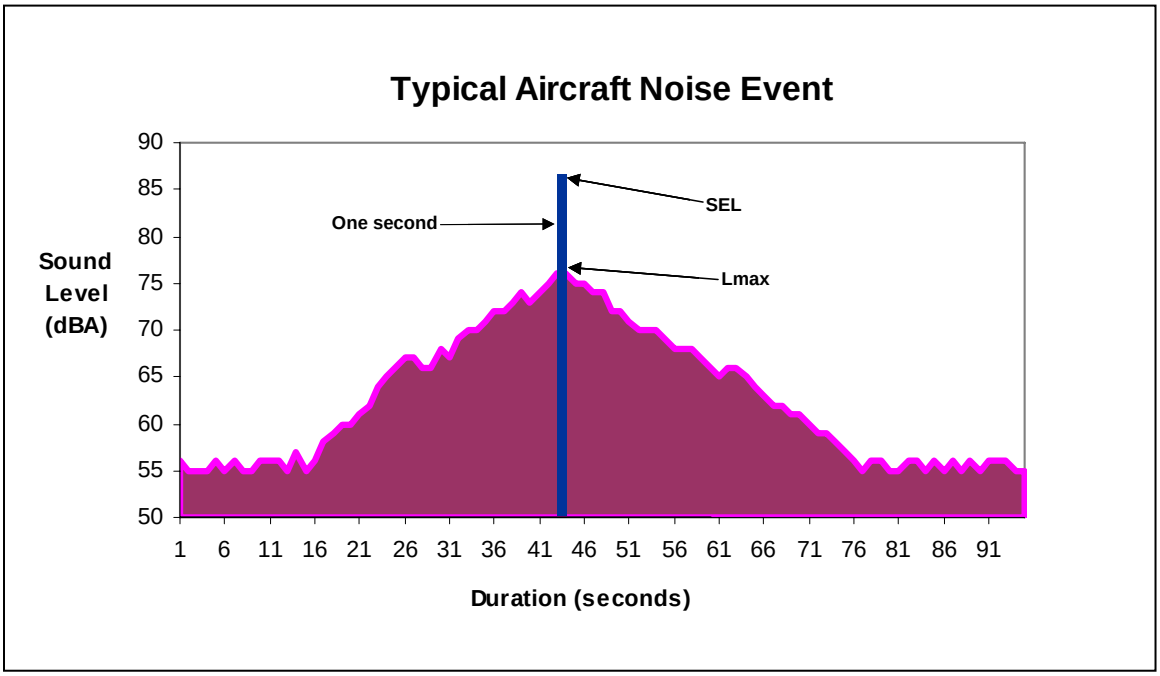
Noise Event Metrics

The **maximum sound level (Lmax)** metric represents the highest instantaneous noise level heard at a receiver site during a single aircraft event (arrival or departure). However, since this metric describes only the instantaneous maximum noise value, it provides no information on the duration of noise exposure. Human response to noise is not only a function of the maximum level, but also of the duration of the event. Therefore, a term or metric is needed that accounts for both intensity and duration and provides a uniform assessment of noise events with differing intensities and durations. This metric is the sound exposure level or SEL.

The **sound exposure level (SEL)** represents the cumulative sound energy detected above an established threshold for a single event considering both intensity and duration of the sound. The SEL represents the acoustical energy of the event once it surpasses a specified noise level, but as though it had occurred within one second. Thus, for example, two events with the same intensity but different durations can be differentiated with the longer duration event having a higher SEL. For locations relatively close to an

airport, the SEL for most aircraft departures will usually be about 10 decibels higher than the corresponding Lmax. For example, an aircraft departure producing a maximum sound level of 70 dB at a particular location would be expected to produce an SEL value of about 80 dB at the same location. Figure 1 is a graphic representation of a typical aircraft noise event. Thus, SEL gives us a common basis for comparing noise events that matches our instinctive impression – the higher the SEL, the more annoying it is likely to be.

Fig. 1: Time History of a Typical Aircraft Noise Event



The **Community Noise Equivalent Level (CNEL)** is a method of predicting, by a single number rating, cumulative aircraft noise that affects communities in airport environs. As defined in the California Airport Noise Standards, CNEL represents the average daytime noise level during a 24-hour day, adjusted to an equivalent level to account for the lower tolerance of people to noise during evening and nighttime periods relative to the daytime period. CNEL applies a weighting to aircraft events occurring during the evening and nighttime time periods. For evening (7:00 PM – 9:59 PM) and nighttime (10:00 PM – 6:59 AM) aircraft noise events, CNEL logarithmically multiplies each operation by 3 and 10, respectively. This effectively adds 4.8 dB to evening event SELs and 10 dB to nighttime event SELs.

The aircraft CNEL is then derived using the SELs from all aircraft generated events for the period. A total CNEL will include the aircraft generated events as well as other noise events generated in the community during the corresponding time period. Typically, total CNEL in our environment ranges from a low of 40-45 dB in very quiet locations to 80-85 dB immediately adjacent to an active noise source – busy traffic route or active airport. Figure 3 shows representative values of CNEL in typically different environments. Aircraft CNEL is also used to depict noise contours of equal exposure levels around an airport to reflect long-term operations, usually one year.

Fig. 2: Common Transportation Sound Levels in dB

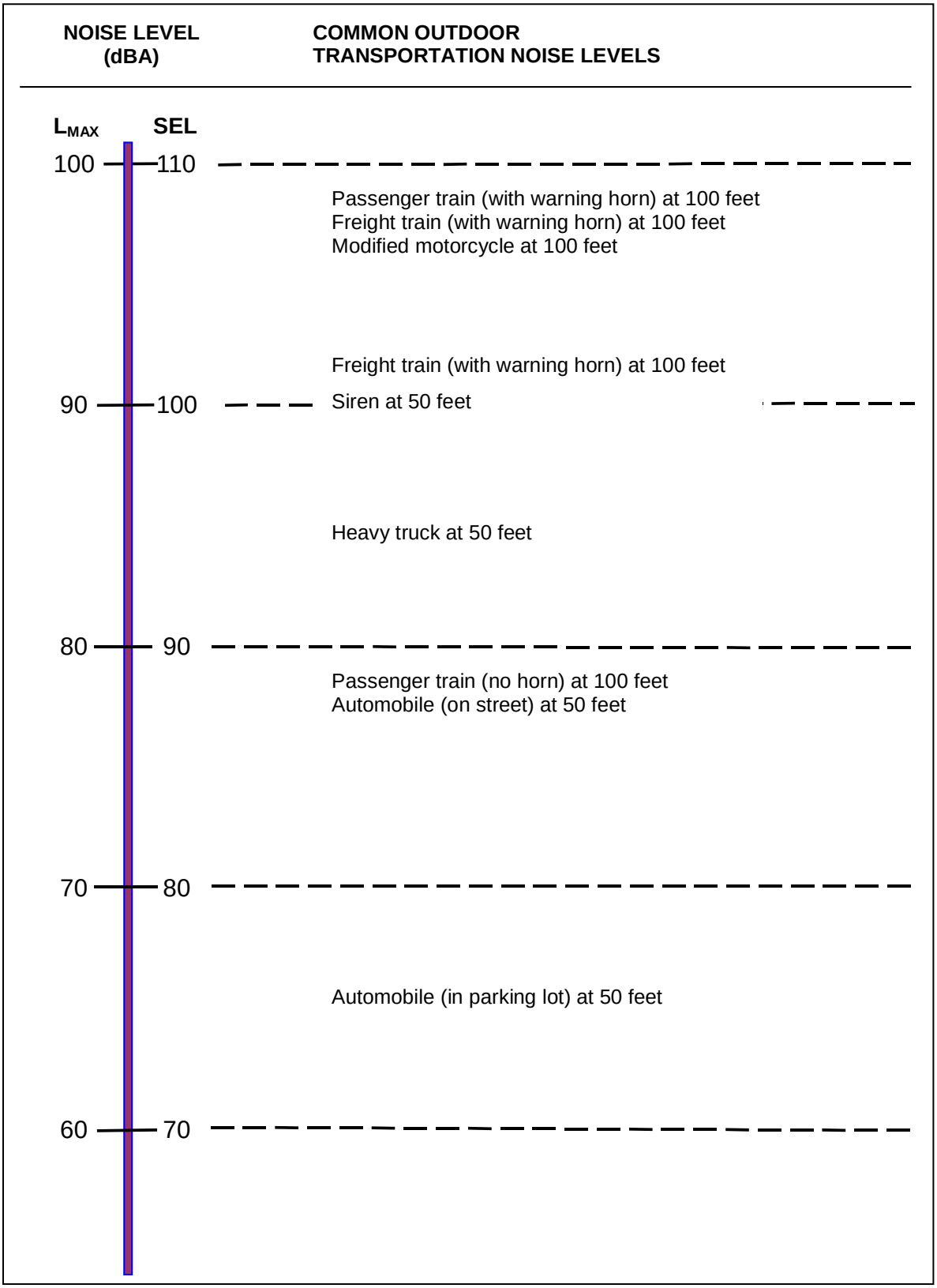


Figure 3: Representative Cumulative Sound Levels