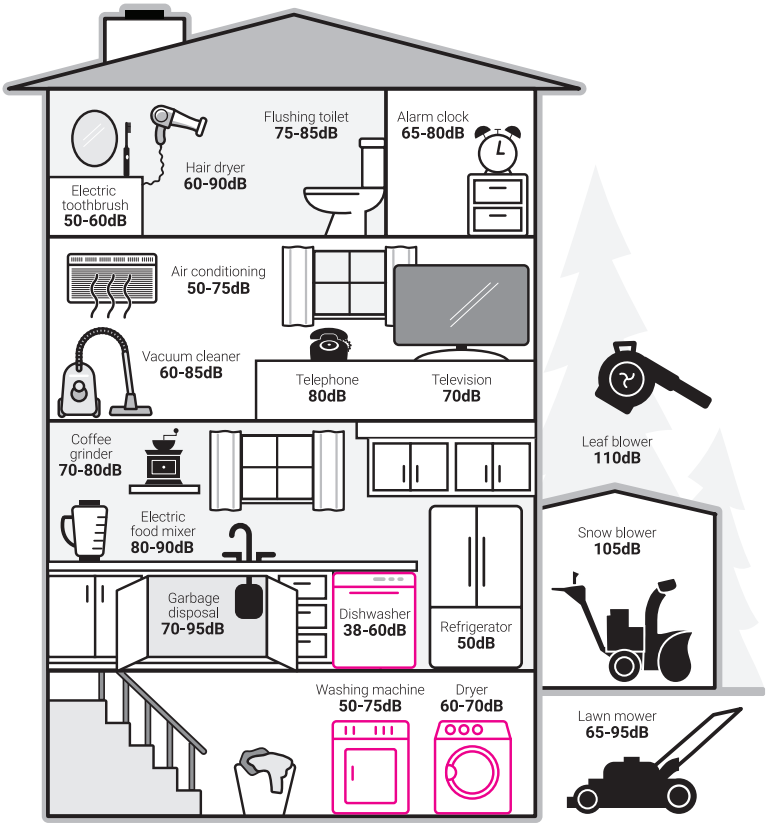
THE IMPORTANCE OF QUIET APPLIANCES

1. NOISE CONCERNS FOR HOME APPLIANCES

Home life has changed over the past 50 years with appliances, small and large, providing automated cycles to aid in storage, cleaning, and cooking. Appliances have proven to do these tasks conveniently with more efficiency than people. The convenience of appliances has changed home life by freeing up time for recreation, relaxation, and home entertainment. Home designs have also changed to adapt to the change in lifestyles. Locating the appliances close to activity or areas where they are needed is a highlight of home designs. In the kitchen, for example, a common design guidance is known as the "kitchen triangle." The triangle describes the orientation of the refrigerator, cooktop/oven, and sink/dishwasher in the kitchen space so there is a flow to the movement between them while cooking and cleaning up. Clothes washers, long relegated to the basement in older homes, have found their way into the main living areas. Many homes have even added a room entitled the "Mud Room" on the main floor near an entrance that contains the washer and dryer. Some have chosen to place a laundry room/suite near the bedrooms in the home to increase the convenience of their use. The price of that convenience is the increase in background sound levels in typically quiet areas of the home.

Appliances with their motors, pumps, and fans emit sound that raises background sound levels in the home. Figure 1 shows many of the typical sound levels emitted within a home.

FIGURE 1 — Noise levels of common household sounds



2. ADVERTISING SOUND RATINGS FOR APPLIANCES

Consider that the sound emitted by a clothes washer in the spin cycle is approximately the same level as a car passing a person standing on the side of the road or traffic noise[1]. Clothes washers emit sounds of water splashing or spraying along with the water extraction by spinning the clothes at a high speed that adds to the background din that is now an all-too-common part of our lives.

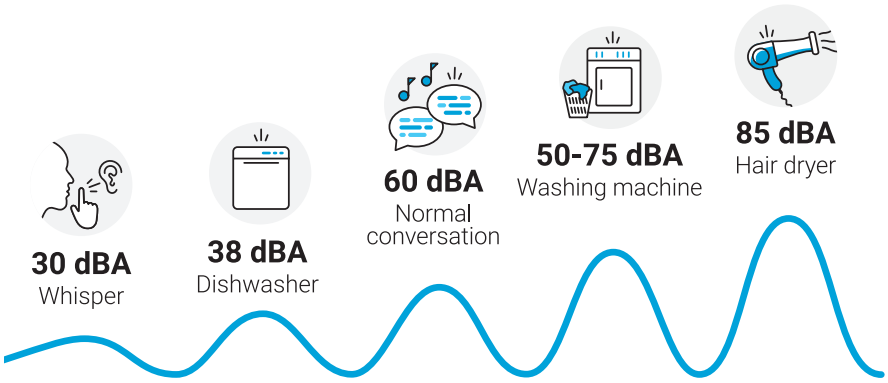
This level of sound can be very disruptive in the home, especially if the appliance is located in the main living space or near the bedrooms. It was not that long ago that dishwashers were similarly considered loud and disruptive. As touted in appliance advertisements of the time, homeowners couldn't talk on their phone while the dishwasher was running. Manufacturer research identified that the sound level of dishwashers was beginning to influence consumer purchasing decisions. Therefore, marketing began to create impressive names for sound packages to improve the likelihood of purchase. Dishwashers were sold with names like "Quiet Wash," "Silent Wash," and "Ultra-Quiet Wash." However, the consumer had no way to compare the various packages and had to hope that the name of the sound package identified how quiet the product actually was. Sales staff at retailers were also unsure of how one unit compared to another, and through the 1990s, the sound levels of most dishwashers changed little. In the early 2000s, a major appliance retailer approached Owens Corning to help develop a standard to provide a sound rating for dishwashers that would provide data for customers to use to compare products. The sound rating standard for the dishwasher is based on the measurement of the average sound power level emitted by the dishwasher during the full wash cycle. The dry cycle would be included if an active drying system was present[2].

3. LABELING SOUND POWER VS. SOUND QUALITY

Sound power is the acoustic energy radiated by the dishwasher during operation as opposed to sound pressure, which is what is sensed by the ear. The advantage of sound power is that it is not influenced by the design of the space where the dishwasher is installed. The final version of the standard incorporates internationally accepted sound power determination standards and North American operational practices. For the dishwasher, this type of measurement works well because the characteristics of the sound, frequency content (think "Pitch" in musical terms), and the amplitude (think "Volume" in musical terms) are nearly equal at most frequencies and stimulate our ears much in the same way as "white noise." White noise, similar to white light, is sound that produces equal energy at all frequencies. The sound measurement is made in decibels. Decibels are a logarithmic scale that compress the amazing range that the human ear can sense, where the loudest sound sensed by the ear is approximately a hundred billion times higher than the quietest. Microphones and analyzers can measure sound levels and provide a filter representing how a human would sense the sound, named Type A weighting. For a dishwasher, the sound level is similar across most of the measurement frequency range. The Type A weighting measure does well to represent how a person would perceive this type of sound.

When the sound contains tones, buzzes, clicks, or hums, the perception of the listener changes based on the frequencies of the sound. For example, a motorcycle with a smaller or higher revving engine will be perceived to "whine," whereas one with a large four cylinders will be perceived to "rumble." Objectively, the sound levels may be the same, but subjectively, people may prefer the "rumble" more than the "whine." The rating of these subjective perceptions is called Sound Quality, which can be applied to more complex sounds. This is the measure used extensively in the automotive industry to develop luxury vehicles. Clothes washers, where the sound shifts between the agitation and the spin with intermittent water fill and drain sounds, would be good candidates for this type of measurement for a rating system.

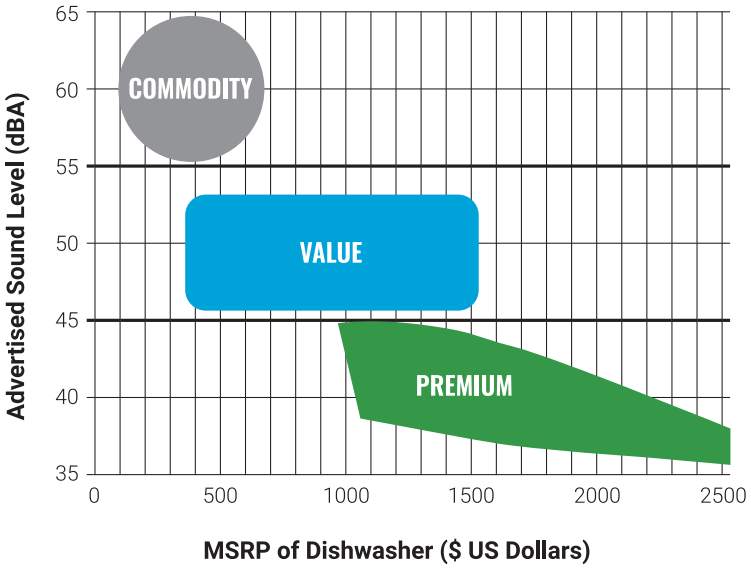
FIGURE 2 — Comparative examples of noise levels



4. SOUND LABELS INFLUENCE CONSUMERS

Having the right standard for the dishwasher allowed quick acceptance in the market. Consumers took advantage of this new tool to buy dishwashers with lower sound ratings. Soon, all manufacturers were utilizing the Owens Corning Acoustic Research Center to provide sound ratings for their dishwashers and advertising the low sound levels, as one example shows in **Figure 2**. By the 2010s, brand segmentation for dishwashers matured and three separate branding levels emerged **(See Figure 3)**. Manufacturers had quickly identified that the premium units provided greater profit and began to migrate their production to quieter dishwashers as demand for them increased. A decade after the standard became active, the sound ratings of the loudest and quietest dishwashers on the market dropped. The quietest units dropped by 10 decibels, which is typically perceived as being half as loud[3]. In fact, many of the premium branded units are so quiet that owners could not tell they were running. The dishwashers had sound emission levels lower than the background sound levels in the homes where they were installed. Manufacturers responded by adding lights to alert customers that the unit is running, or finished, so that the owners know the dishwasher is working correctly.

FIGURE 3 — Segmentation of dishwasher brands offered for sale in the United States during August 2015 (pricing and sound rating from major appliance retailer websites)



In the nearly two decades since the dishwasher sound standard was introduced, consumers have enjoyed the reduction in dishwasher noise levels in their homes. Consumers benefited from competition to produce quieter dishwashers. The same premium unit in 2012 that had a sound rating of 50 sold for nearly $300.00 less in 2015 as manufacturers responded to the market and produced dishwashers with lower sound ratings with little or no sound packages to be sold at lower price points. Manufacturers have seen proliferation of higher profits and created distinct market segments to sell their commodity, value, and premium dishwasher brands. Now that dishwashers are no longer the loudest appliance noise source within the home,

other products should now be identified for creation of a sound rating to provide the consumer with more opportunity to continue to reduce the sound levels within their homes. A good candidate would be the clothes washer with its sound emission levels approximately 1,000 times higher (30 dB) than a quiet dishwasher.

Currently, the purchase decisions for most appliances are now typically based on energy efficiency, capacity, and price only, with the exception of a dishwasher, which now also includes sound level. Sound level is a purchasing decision influencer for dishwashers but should be one for all other appliances as well due to the additional sound emitted that adds to the cacophony of appliance sounds in the home.

5. REFERENCES

1. Cowan, J.P. (1994). *Handbook of environmental acoustics.* John Wiley & Sons.

2. Herreman, K.M. & Mouw, N.A. (2004). *A potential standard for determining dishwasher sound power levels.* Proceedings NOISE-CON 06, 2006 December 3-6, Honolulu, HI, edited by Scott Sommerfeldt and Ichiro Yamada, CD-ROM paper no.nc060641 (Institute of Noise Control Engineering Inc., Ames, IA).

3. Herreman, K.M. *Market effect on sound ratings for dishwashers.* Proceedings NOISE-CON 16, 2016 June 13-15, Providence, RI, edited by Gordon Ebbitt and Courtney Burroughs, paper no.nc16_159 (Institute of Noise Control Engineering Inc., Washington, DC).

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