

# Silent Mice - White paper

By Logitech, August 2016

## Executive summary

Several studies have shown that noise can affect human health and productivity in a negative manner (Banbury & Berry, 1998; Maxwell 2001). To reduce the disturbance induced by computer mice, Logitech has launched new models integrating technology that lowers the noise level.

New click switches, new gliding feet and new internal construction are all part of the solution to make the new mice quieter. As a result, independent tests commissioned by Logitech have shown that the noise emitted by the clicks has decreased by more than 90%. As evidence of this achievement, Logitech is the first mouse company in the world to receive the Quiet Mark certification, an international mark of approval award program from the UK Noise Abatement Society<sup>1</sup> recognizing technology that has been designed to reduce noise.

## Introduction

According to Julian Treasure, renowned sound expert, noise affects us physiologically, psychologically, cognitively and behaviorally (Treasure, J. 2009). Most of the sound around us is unintentional and unpleasant. Although, unfortunately, many people are unaware of the possible negative effects of noise, being unable to get away from it can be extremely damaging for health and productivity .

According to a study published by Banbury and Berry (1998), productivity is reduced by 66% in open-plan offices, a massive decrease that is mainly due to the negative effects of sound.

With a goal of improving health and productivity, Logitech has decided to tackle the irksome sounds of one of the most used computer companions by introducing "***Silent Mice***".

## Problem

Besides affecting the health and productivity of its user (Maxwell, 2001), the sound of a mouse also impacts people in the vicinity. With the prevalence of open-space office layouts and conference calls, the clicking sound can be highly disturbing to a large number of people. In a home environment, using a loud clicking mouse when partners, children or roommates are going to bed can actually prevent them from falling asleep.

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<sup>1</sup> Noise Abatement Society official website: [www.noiseabatementociety.com](http://www.noiseabatementociety.com)

## Solution

In computer mice, the sound comes from three distinct sets of components: 1) the feet, when gliding the mouse on a mousepad or table, 2) the wheel module, when scrolling up and down, and especially 3) the switches, when clicking on the left, right or middle button.



Figure 1: Bottom and side views of Logitech M330

Through technological advancements, Logitech has considerably reduced the sound emitted by these components.

## Technological advancements

### Switches

The switches used in Logitech Silent Mice are made of a rubber actuator that dampens both the vibration and the sound. A red plastic cap covers the rubber actuator to improve the switch's tactile feedback and lengthen its lifespan. The switches used by Logitech have a lifespan of 5 million cycles, on par or often better than most of the non-silent mice found on the market today.

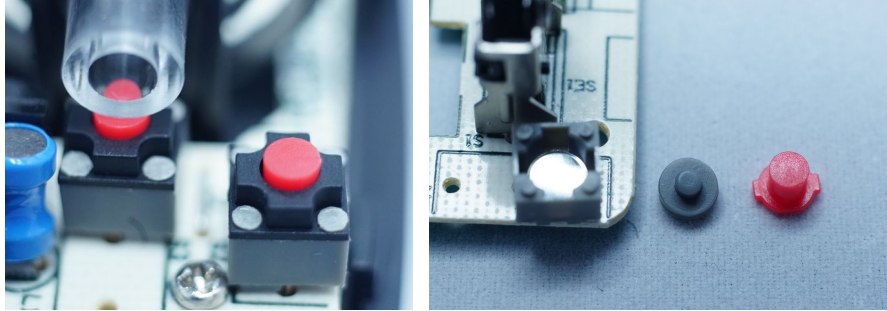


Figure 2: Assembled silent switches - Figure 3: Dismantled silent switches

The new switches significantly reduce the clicking sound while keeping a tactile feedback similar to that found in non-silent models.

## Scrolling

Logitech used a mechanical encoder for its M330 Silent Plus Mouse model. As compared to an optical module, the mechanical encoder has the advantage of considerably reducing the sound level while maintaining a satisfying feeling of ratchets when scrolling the wheel up and down.

## Feet

Logitech normally uses gliding feet made of Unsaturated Polyester (UPE) material for its lower- and middle-range mice, and Polytetrafluoroethylene (PTFE) for its higher-end range. UPE feet provide good performance at a reasonable price, while PTFE feet provide a better gliding performance.

For its Silent Mice, Logitech opted for Plastic Lumber (PL) material, which proves quieter and more durable than other materials such as UPE and PTFE.

## Plastic part design

Most mice have a large empty cavity under the keyplate. While it is often necessary to give the mouse a certain volume to achieve the desired comfort level, this empty chamber also amplifies the noise created by the clicking switches, scrolling wheel and gliding feet. To further reduce the noise level, Logitech added plastic ribs within its Silent Mice. Like a noise barrier on the side of the highway, these inner walls dampen the sound and reduce the echo created within the mouse.



Figure 4: Red parts show noise-dampening ribs inside M330 Silent Plus top case

## Methodology and results

Acoustic measurements of Logitech Silent and Non-Silent models were conducted by an independent lab, Foxconn CMC, located in Suzhou, China. The sound equipment was placed 1 meter from the center of the mouse and measurements were taken at four different angles around the mouse.



Figure 5: Testing setup at Foxconn CMC anechoic chamber with < 6 dBA background noise

Sound pressure level (SPL) or acoustic pressure level is a logarithmic measure of the effective pressure of a sound relative to a reference value. It is measured in dB. Below is the Noise Abatement Society's description of what a difference in dBA represents for the average human ear:

- 1 dB difference – imperceptible
- 2 dB difference – you can just about convince yourself there's a difference
- 3 dB difference – yes, I can definitely tell there's a slight difference
- 4 dB difference – the difference is clearly noticeable
- 5 dB difference – quite a big difference there
- 6 dB difference – wow it's getting towards twice as loud!
- 7 dB difference – yes, I think almost twice as loud
- 8 dB difference – around twice as loud
- 9 dB difference – more than twice as loud!
- 10 dB difference – massive difference between these levels!

A-weighted sound measurements (dBA) are filtered to reduce the effect of very low and very high frequencies, better representing human hearing. With A-weighting, sound monitoring equipment approximates the human ear's sensitivity to the different frequencies of sound.

The results for the left click as measured by the independent lab show a maximum Sound Pressure Level (SPL) of 25 dBA for Logitech M330 Silent Plus and 26.4 dBA for Logitech M220 Silent, while the minimum measurement for the Logitech M170 was 36.1 dBA, which represents a difference of more than 11 dBA in the case of the M330.

The following formula puts in relation the measured SPL level to a source radiating a certain acoustic power level ( $L_w$ ), assuming a directivity factor  $Q=2$  (half spherical, for a device laid on a table):

$$L_w = L_p + 10 \cdot \log \left( \frac{Q}{4\pi \cdot r^2} \right)$$

where  $L_w$  is the Sound Power Level of the source,  $L_p$  is the measured Sound Pressure Level and  $r = 1$  m, the distance to the sound source.

The noise reduction is then computed with the following relationship:

$$\text{Noise reduction} = [1 - 10^{-(\Delta_{\text{SWL}}/10)}] \cdot 100$$

where  $\Delta_{\text{SWL}}$  is the difference between the Logitech M330 Silent Mouse's maximum SWL and the Logitech M170's minimum SWL. The measured noise reduction was thus of **93.3%**.

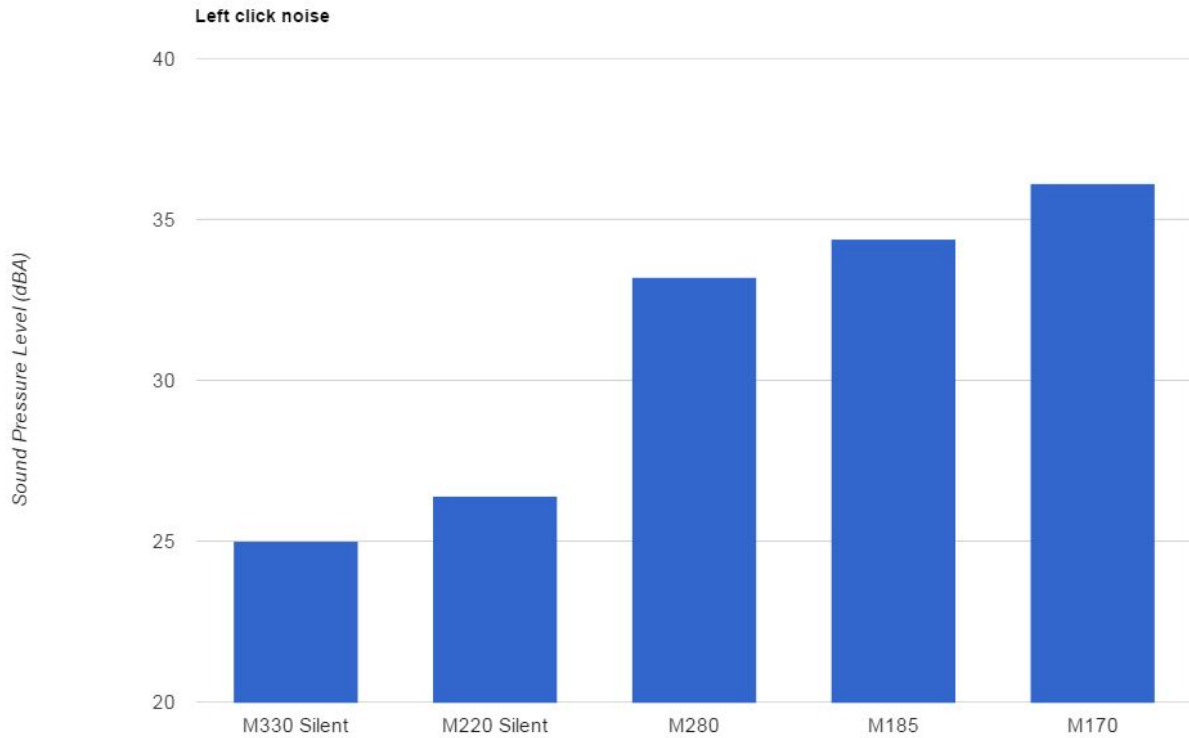


Figure 6 - Results of the acoustic test for the left click

The sound pressure level from the feet was measured by gliding one model of mouse with different foot material 200 mm horizontally and vertically on a melamine board. The results showed an improvement of 1.7 to 2.9 dBA when using Plastic Lumber, the material selected for the silent mice.

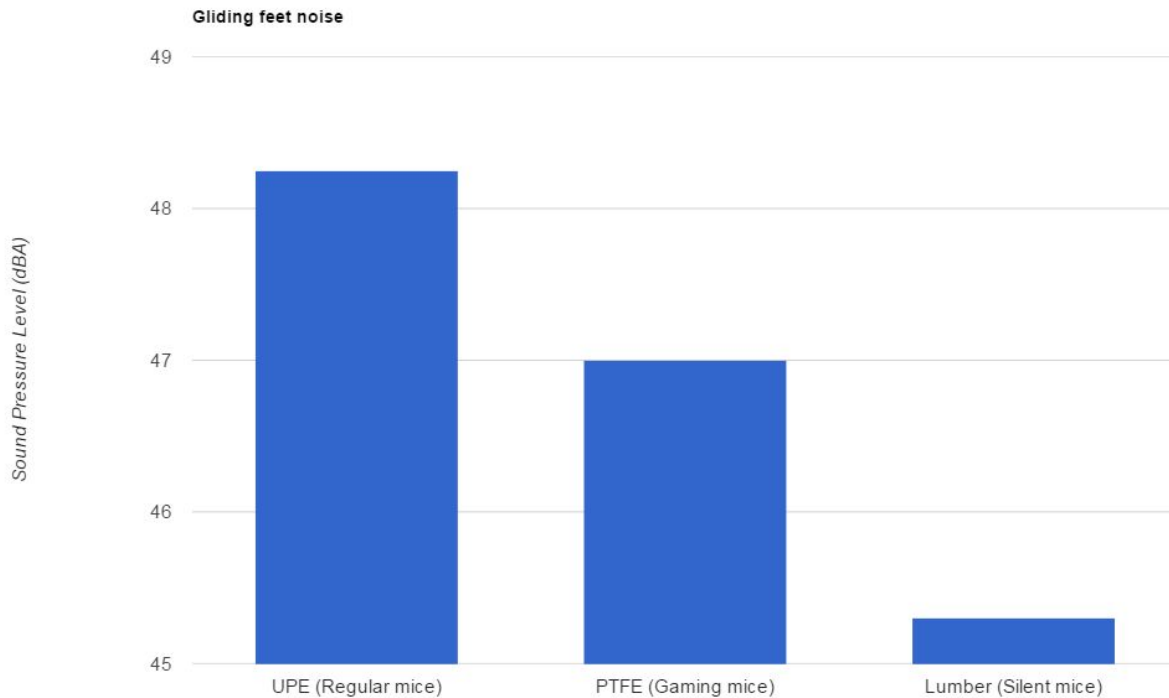


Figure 7 - Results of the acoustic test for different foot material

## Conclusion

By studying the sources and nature of the noise made by a computer mouse, Logitech was able to single out the components that needed changing to tune down their level of decibels. With new gliding feet material, new types of clicking switches, and a new plastic case construction, Logitech is able to produce much quieter mice.

As an evidence of this achievement, Logitech is the first mouse company in the world to receive the Quiet Mark certification. This international mark of approval award program from the UK Noise Abatement Society recognizes technology designed to reduce noise.

Logitech is resolved to reduce unpleasant sounds around us and be part of the solution to improve health and productivity at home and the office.

## Reference

- Banbury, S. and Berry, D.C. (1998), The disruption of speech and office-related tasks by speed and office noise. *British Journal of Psychology*, 89, 499-517
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- Treasure, J. (2009), The 4 ways sound affects us, *TEDGlobal 2009*