

EXTERNAL OR INTERNAL?

By Henrik, January 2019, Rev.3

For people suffering from “the Hum” the most important thing is to determine whether what they hear or perceive is an actual environmental (acoustic) sound or noise, or whether what they perceive is an internally generated hum, or possibly a mix of both.

It is very useful to start by determining the frequency of the perceived hum. This can give important clues as to whether the hum is likely to be environmental or internal. See some hints below.

If it can be determined that what you hear is an environmental sound, it can be traced with the right instrumentation, and the source can possibly be remedied, unless it comes from a local factory, power plant or military base, etc.

However, suffering from an internally generated hum does not make anyone deaf! It is therefore very possible that in one location you hear an environmental noise that is within the normal hearing range, maybe a power substation or a refrigerator compressor, while in a totally quiet location you may only hear your internal hum. Anything internally generated will vary in intensity, just like headaches come and go. I believe many of the confusing observations reported about hearing the/a hum in several but not all locations and worse in certain seasons, etc. stem from the fact that people may hear both environmental noises and an internally generated sounds in a random mix in different situations.

The definitive test is this: **If it can be determined with reasonable certitude that no environmental noise above the hearing threshold can be measured or recorded when you hear “the Hum”, then, at that moment, the source is internal.** This is what we call “the real Hum”. Additionally, you may hear environmental noises at other times and in other places. There is no single “World Hum”, which would have the exactly same frequency for everybody.

Thanks to the extensive assistance of one of our blog participants, who would prefer to remain anonymous, we have managed to establish two low-cost methods to execute this “definitive test”, one using a regular smartphone and one using a low-cost audio recorder.

The descriptions are collected in a separate paper under the name “**DETECTING ENVIRONMENTAL NOISE WITH BASIC TOOLS**” on the home page.

Determine the frequency of your Hum

The frequency can be found by comparing the hum to a known audio signal. For some people it is easier to use a generator, which has a keyboard with musical notes (which can also be fine tuned to near-by frequencies). For other people it is easier to use a continuously adjustable signal generator. Both generators are available on-line, so you do not need to buy any hardware, except possibly a pair of headphones, which fully cover the ears and have a good bass response.

One online tone generator using musical keys is: <http://www.szynalski.com/tone-generator/> .

Get hold of regular (NOT noise-canceling!) headphones, which have good bass response and cover the ears completely. If the Hum disappears when you put on the headphones, this indicates an external source. In that case, move one of the ear capsules off one ear while letting the other cover the other ear. Open the site on a PC, notebook or tablet. Position the “Play” button to the upper edge of your screen, and click the little button with a musical note sign beside it to show the musical note “keypad”. Click any tone button and the “Play”. Select sine wave. Adjust the volume with the slider.

For hearing the lowest tones, you may have to turn up the volume of your computer to max, since both the ear’s sensitivity and the headphones’ response curve fall dramatically as the frequency falls, especially below 100 Hz.

Adjust the level to be the same as the Hum you hear, and click one tone at a time to find one, which is close to the Hum. You will have to reduce the volume as you move up in frequency, since the sensitivity of

the ear increases a lot at higher frequencies. When you are somewhere close, you can step the frequency one Hz at a time using the mouse. Do not let the tone generator become stronger than your Hum tone, preferably a bit weaker. Then just compare and find the best match. If you know how to identify the “beat” between two nearby tones, please use that for exact frequency reading, otherwise just note down which frequency (in Hz) you think is the best match.

After determining the frequency, close the tone generator app, switch on the Spectroid app (see instruction on the home page), and check whether the same frequency shows up on the screen. If it does, what you hear is an external sound, and you can start tracking it with the Spectroid on your smartphone. If not, you hear an internally generated hum, or got the frequency wrong.

If you know how to hear the “beat” between two close frequencies, you can alternatively try to use the continuous sine wave generator at <http://www.onlinetonegenerator.com>. Same headphones and same level (volume) adjustments as above.

I quote this instruction by Bernie Hutchins: “As for pitch matching to the Hum or to a hum seems in fact to be MUCH more difficult than one might suppose. Two hints: First, it may be useful to first match your own vocal humming (sing along) to any Hum/hum and THEN match the combination to the online generator. Secondly, (a bit more about beating) when you feel you are close, cut back the level of the online generator and slowly scan, listening for a “shimmering” (second-order beating) or even amplitude fluctuations (first-order beating). As you get close, the beat rate slows, and stops (zero-beat) when you have it rather exactly. If you do not understand beating well enough, start up two copies of an online tone generator and experiment in a mid-range of pitch (say 440 Hz and 442 Hz) etc.”

Clues to be drawn from the Hum frequency

Assuming that you have been able to determine your Hum frequency, we can draw the following initial conclusions.

1. If the frequency is exactly 100 Hz (US: 120Hz) or its multiples, the source is almost certainly external and coming from an electromagnetic non-rotating device with a winding, like a transformer or contactor.
2. If the frequency is exactly 90Hz or 120Hz, you may hear a computer hard disk spinning at 5400 or 7200 rpm respectively.
3. If you live in a country with 50Hz grid, any stable frequency in the range 23-25Hz, 46-50Hz, 92-100Hz, 138-150Hz and 184-200Hz could quite likely be external and come from rotating electric motors. If you live in a 60Hz-country the corresponding ranges are 27.6-30Hz, 55.2-60Hz, 110.4-120Hz and 165.5-180Hz. Small motors like fans and refrigerator compressors are closer to the lower end of the brackets, while big motors are closer to the upper end of the brackets. This is because of the slip effect (see Wikipedia).
4. For all other Hum frequencies below 200Hz, we cannot make an educated guess for whether it is external or internal just based on the frequency. Combustion engines may create almost random frequencies depending on the number of cylinders, two-stroke vs. four-stroke, rpm, etc. For all these observations it becomes most important to take note of possible variations in the frequency or volume, periodic patterns, etc. which could give clues to the origin.