Estimated gear mesh noise as a sizing criteria

dBA air borne sound level estimate, KISSsoft release 03-2017

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1.3 References

[1] KISSsoft 03-2017A
2 Background

2.1 Noise model

Based on the research published in [2], an airborne noise level in dBA is calculated based on the gear properties and load data defined in KISSsoft.

All the limitations associated with the theory mentioned above are of course also applicable to the KISSsoft calculation. Therefore, the user must be aware of these limitations and should read and understand the underlying theory.

It is expected the noise model is valid for industrial gearboxes and geared motors of a typical center distance around 200mm.

The authors report that their model is in line with measurements in a range of approximately 5 dB.

2.2 KISSsoft implementation

The model described in [2] is implemented in KISSsoft release 03-2017 onwards. The sound level is shown at the end of the section as shown below:

![Figure 2.2-1 KISSsoft report, section «Additional data», lowermost line showing sound pressure level.](image)

2.3 Recommended usage

We recommend to use this sound pressure level calculation as follows

- Use mainly for design comparisons, e.g. compare design A to design B and see which one gives lower sound pressure level
- Measurements were done for gear pairs with properties as shown below. The closer the gear design is to this reference, the more reliable the result will be
- The calculated sound pressure level is intended for an assessment of the gear macro geometry, not the gear micro geometry
- Great caution has to be applied if gears are not made of steel
3 Example application

3.1 Basic gear data

Let us consider a gear pair with the below basic parameters (see example “CylGearPair 1(spur gear)” in the KISSsoft installation):

The following load and rating data applies:
We then find the below safety factors:

And the below mesh:

3.2 Resulting sound pressure level

In the rating report (press F6 to generate it), we find the below shown sound pressure level result:
To ensure that all gear designs have a similar strength, define in the module specific settings target values as shown below (they are based on the strength of the basic gear design above):

![Module specific settings](image)

See file “THE-KSS-WW-1707-00-EES-Gear-Mesh-Noise-Step-1.z12”

### 4 Gear macro geometry optimization

#### 4.1 Objective

We now want to design a gear pair that has roughly the same size and properties as the basic design shown above. Of course, the strength of the new design should be in a similar range too. The overall objective however is to reduce the above shown sound pressure level by choosing a suitable gear geometry.

#### 4.2 Set up of fine sizing function, procedure 1

In this first step, we want to find a gear design while keeping the gear reference profile as it is.

Start the fine sizing function by pressing ![coast](image) and define search parameters as follows:
Ensure that all solutions that do not meet the required target safety factors are removed from the set of proposed solutions and then run the calculation:

Figure 4.2-1 Setup of the fine sizing function, part 1.

Figure 4.2-2 Setup of the fine sizing function, part 2.
4.3 Results of fine sizing function, procedure 1

We now find the resulting sound pressure level listed in the tab “Results”. If we sort the list in ascending order, we find the lowest sound pressure level at 80.25 dBA while we had 80.78 dBA before. This is a minimal improvement only.

Figure 4.3-1 Resulting sound pressure.


4.4 Set up of fine sizing function, procedure 2

In a second step, we now introduce a helix angle in the fine sizing function (increase the number of possible solutions to 9999):

Figure 4.4-1 Defining a range for the helix angle in the fine sizing function.
4.5 Results of fine sizing function, procedure 2

Now, we find a higher number of possible gear designs and the one with the lowest sound pressure level now has a reduced level of 78.50 dBA.

Figure 4.5-1 Resulting sound pressure level in second sizing process.


4.6 Set up of fine sizing function, procedure 3

In a third step, we now also include deep tooth form with a transverse contact ratio of $\varepsilon > 2.05$:

Figure 4.6-1 Setup of the fine sizing function such that gear design has a higher contact ratio.

4.7 Results of fine sizing function, procedure 3

Now, we find again a reduction of the lowest sound pressure level to 77.72 dBA:

Figure 4.7-1 Resulting sound pressure level in third sizing process.

4.8 Graphics results display

Note that it is recommended to delete solution “0” from the list to compare the solutions of step 3 in the tab “Graphics”.

In the tab “Graphics” the noise level can be shown as a color scale as a function of two axes. For the two axes, different parameters may be selected. E.g. below we see that the noise level is quite independent of the center distance (horizontal axis) but it is depending on the overlap ratio (vertical axis). This is in line with expectations.

![Figure 4.8-1 Display of sound pressure level results in tab “Graphics”](image)

Figure 4.8-1 Display of sound pressure level results in tab “Graphics”.