Comparison Measurements Fixed Accelerometer to Different BKS Configurations

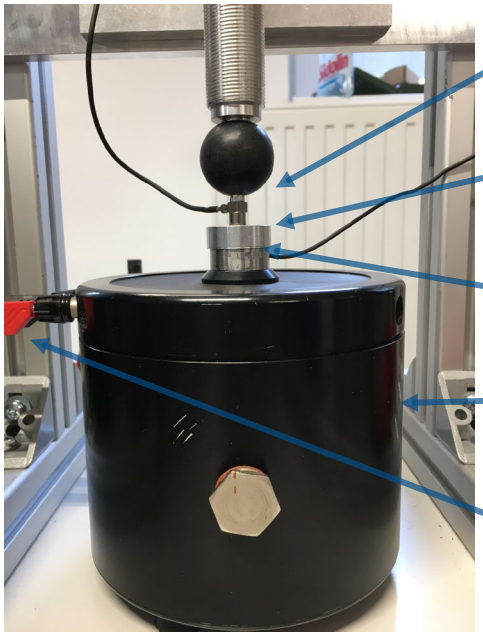
Discom GmbH, 2022

Test Setup

A KS91D accelerometer was mounted inside a stainless-steel box onto a shaker The box can be equipped with different caps, to test for example rounded or rough surfaces. Box and cap had a fixed, stiff connection to the shaker. Different configurations of BKS sensors were pressed from above onto the box cap. Using a function generator, the shaker was run through a **sweep from 70 Hz to 20 kHz**, duration 180 seconds. The signals of both accelerometers (in the box and part of the BKS) were recorded and for each configuration the spectral difference (deviation) was calculated.

For each configuration (e.g., for a certain press-on force), at least 4 repetitions were recorded, and the results of the measurements were averaged.

Taking into account the require-ments in production testing, a **deviation** between fixed sensor and BKS sensor **≤ 2 dB** can be considered as linearity.

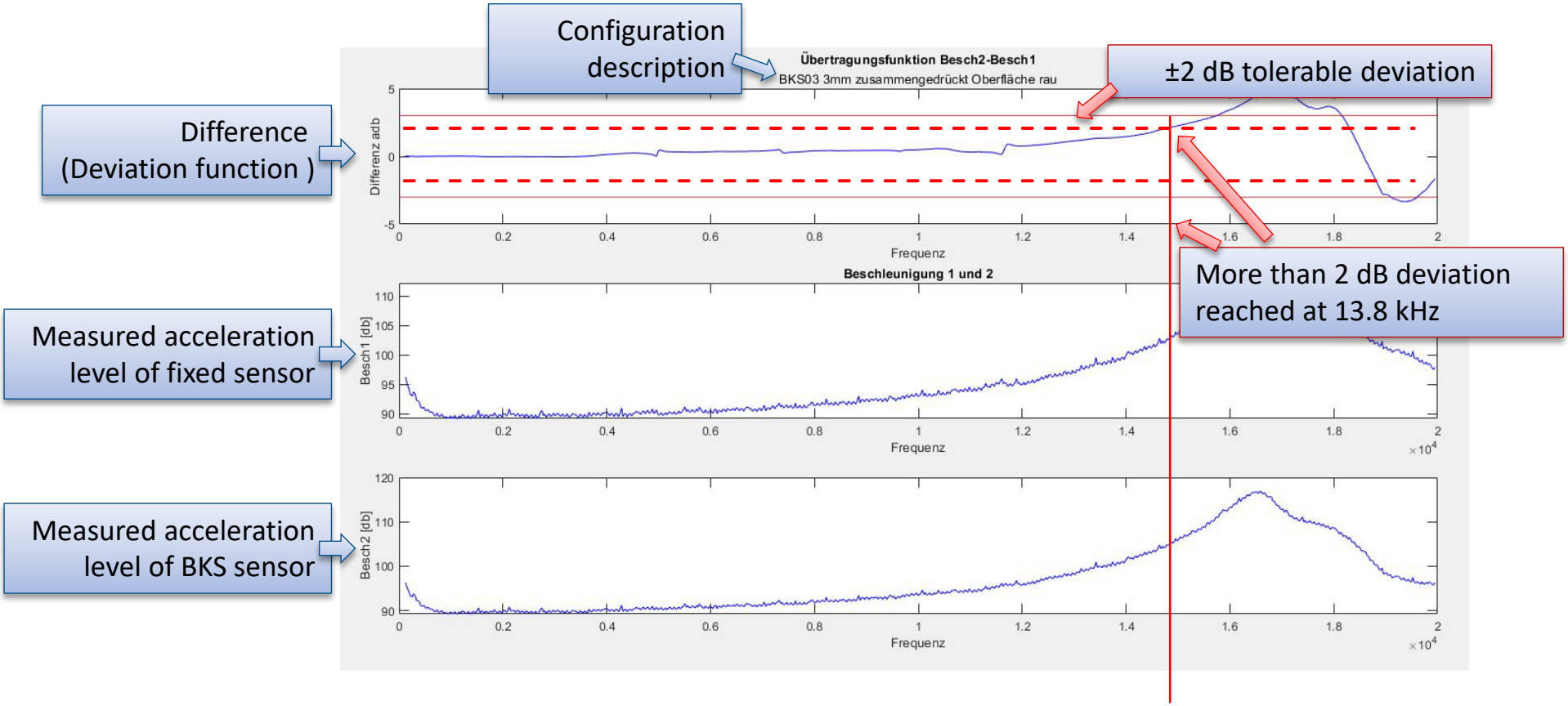


Remark: the results shown in this presentation are a subset of the overall test collection and focus on the most important conclusions.

Explanation about the Result Graphs

For each measurement configuration (for example, BKS03 pressed in by 3mm), the averaged result from all repeated measurements is presented. The two lower curves show the measured acceleration levels of both sensors, the topmost curve the difference from those.

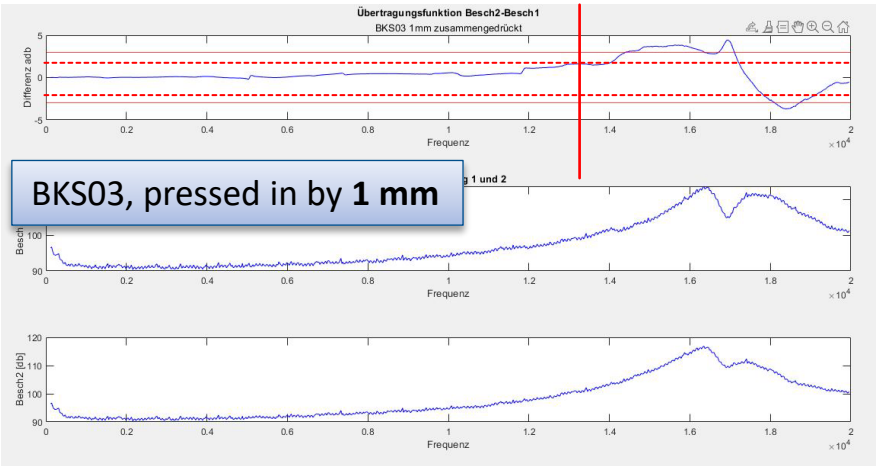
Main focus is on the shaker frequency up to which the difference is below 2 dB.



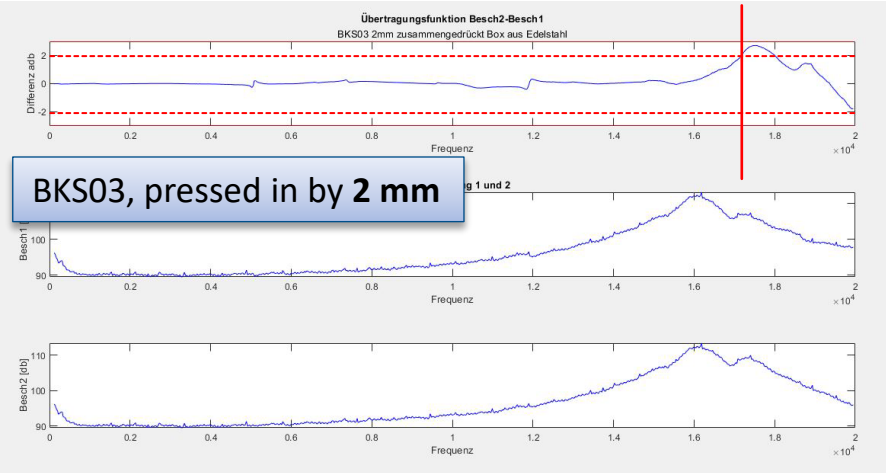
BKS03, vertically pressed on

Result: using a **press-on depth of 3 mm, up to 19 kHz** the deviation between fixed sensor is **less than 2 dB**, and **less than 3 dB up to and beyond 20 kHz**.

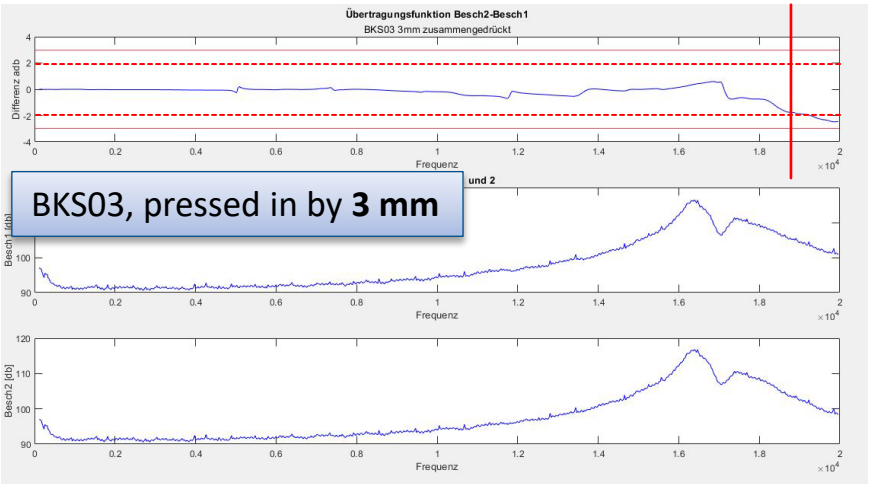
A press-on depth of more than 4 mm is not recommended because of material wear-off.



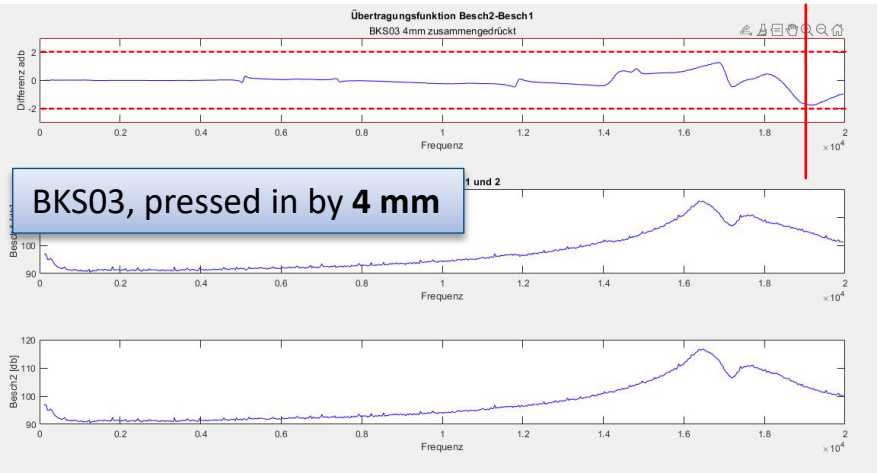
BKS03, pressed in by **1 mm**



BKS03, pressed in by **2 mm**



BKS03, pressed in by **3 mm**

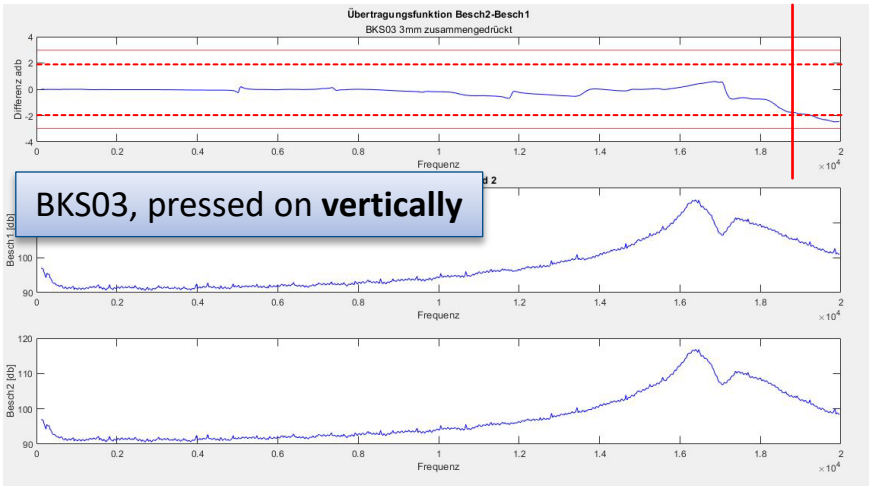


BKS03, pressed in by **4 mm**

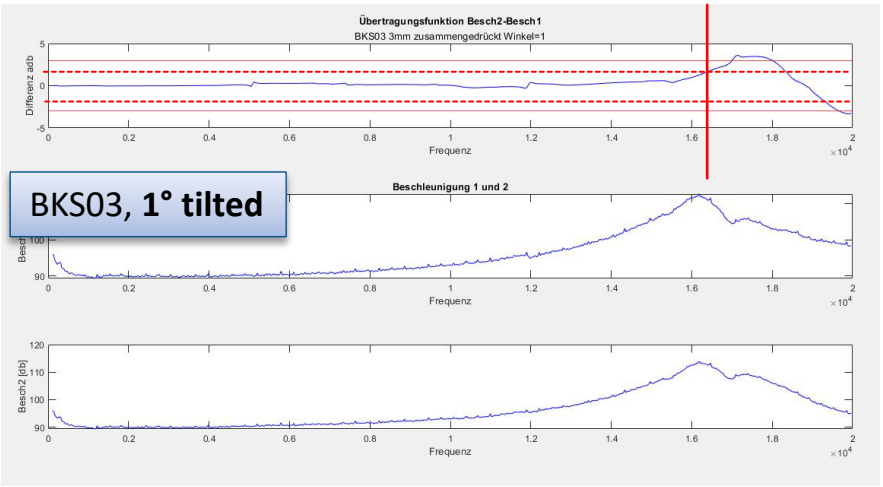
BKS03, Tilted

The BKS03 sensor is not applied vertically but tilted at a small angle.

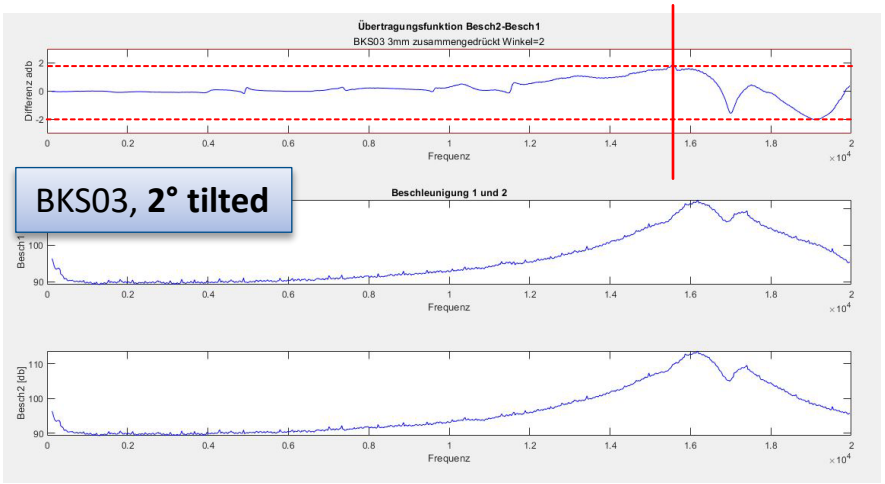
Result: with **3 mm press-on depth**, the deviation from the fixed sensor is even with a **tilting angle of 4° up to 15 kHz less than 2dB**.



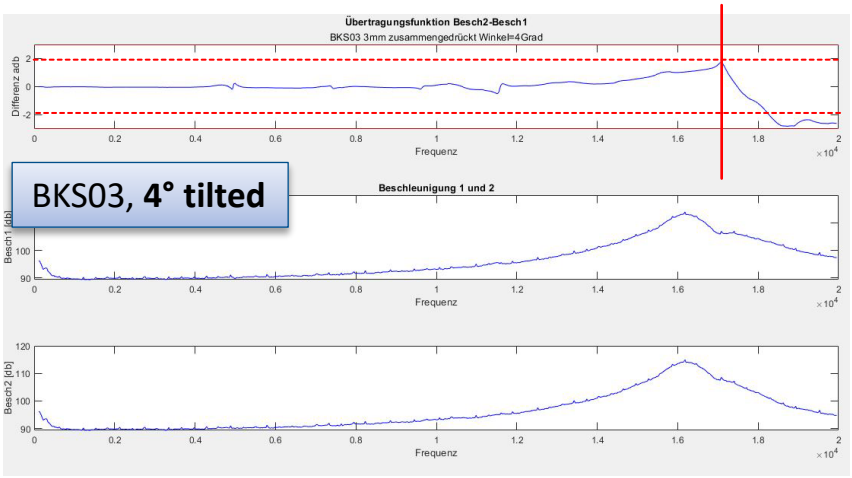
BKS03, pressed on **vertically**



BKS03, **1° tilted**

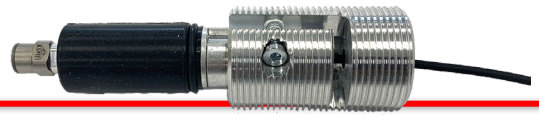


BKS03, **2° tilted**



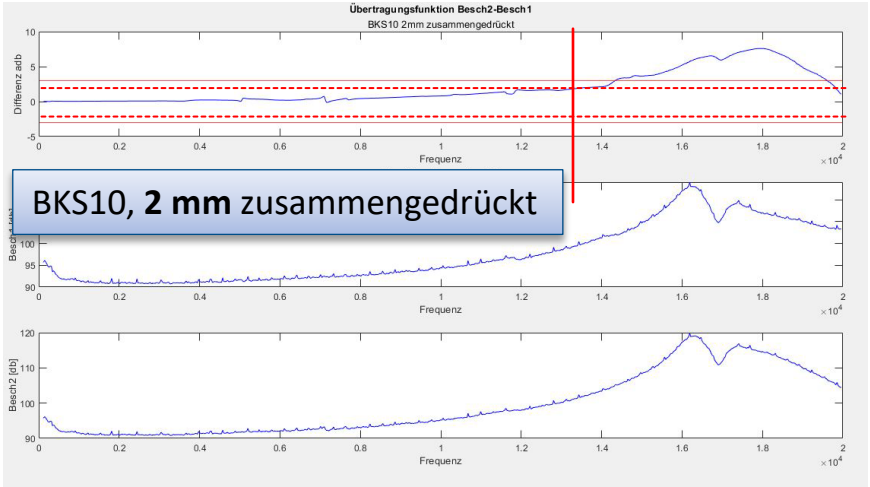
BKS03, **4° tilted**

BKS 10 “black” (soft)

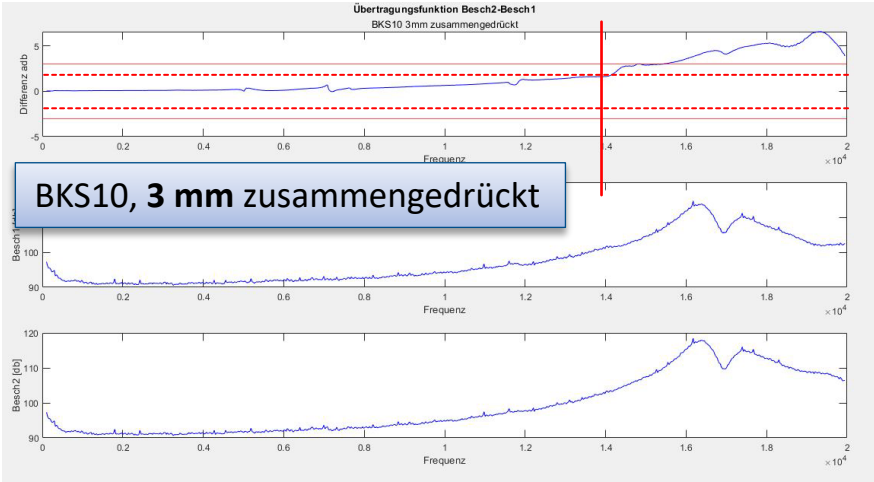


DISCOM

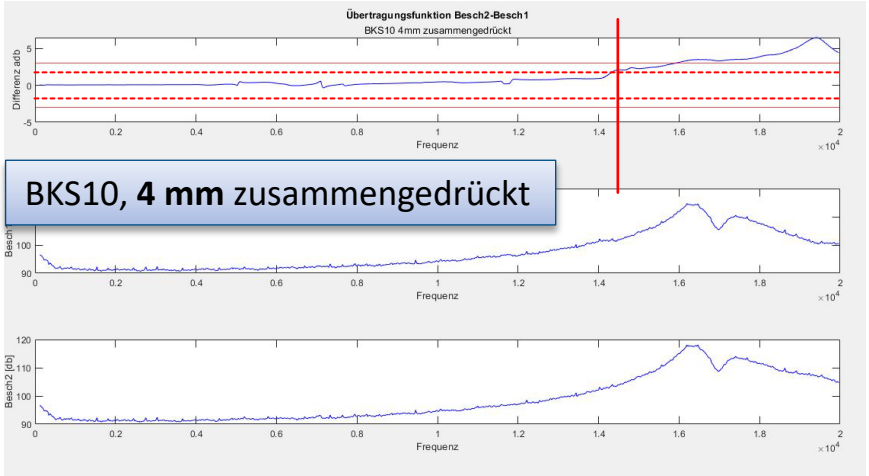
Ergebnis: ab einer Eindrücktiefe von 3 mm ist die Abweichung des BKS10 „schwarz“ vom festen Sensor **bis mindestens 14 kHz kleiner als 2 dB**. Empfohlen wird eine **Eindrücktiefe von 4 mm**.



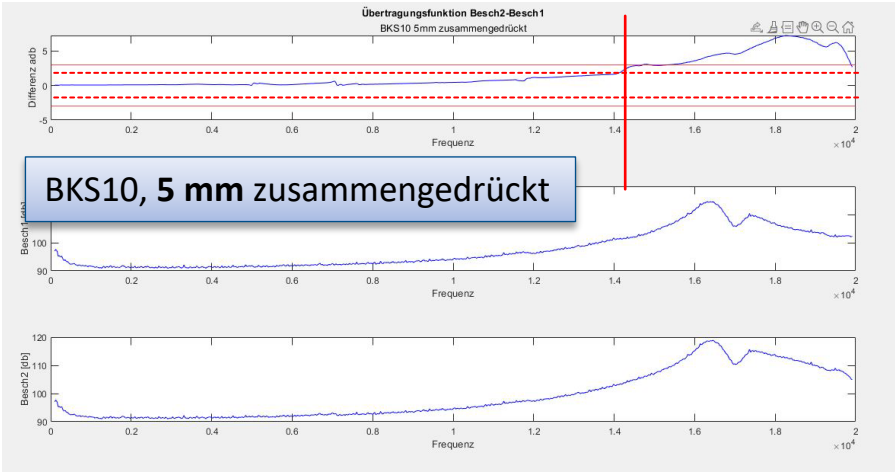
BKS10, **2 mm** zusammengedrückt



BKS10, **3 mm** zusammengedrückt



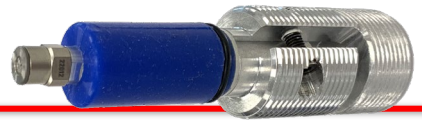
BKS10, **4 mm** zusammengedrückt



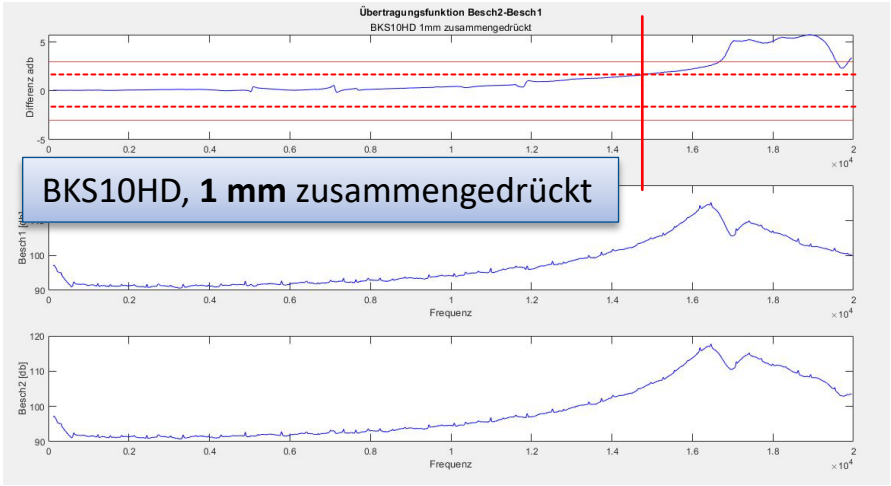
BKS10, **5 mm** zusammengedrückt

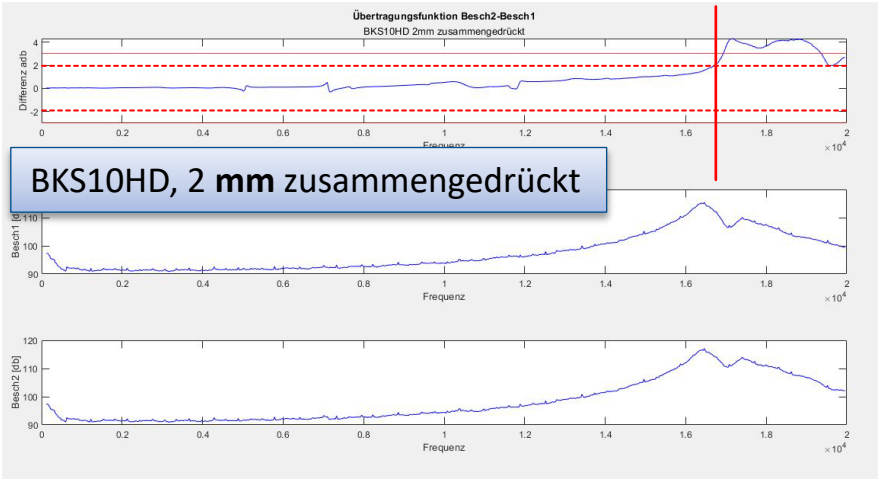
HBK HOTTINGER BRÜEL & KJÆR

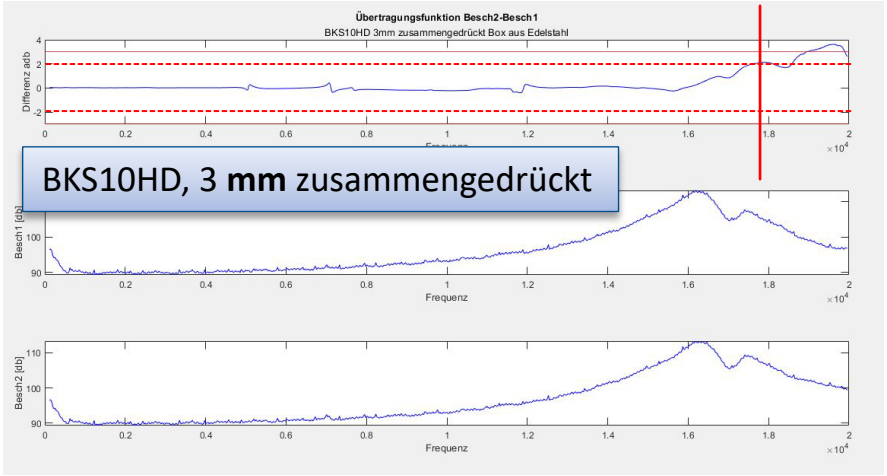
BKS10 HD “blue”

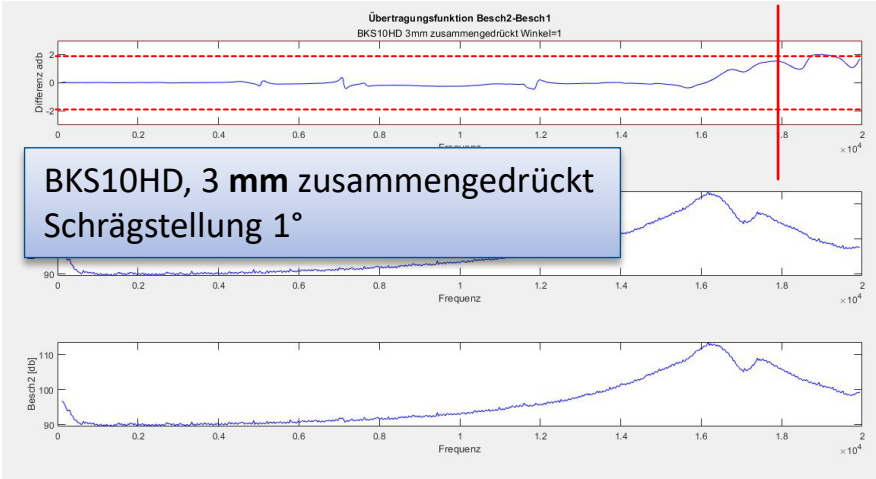


Ergebnis: bei einer **Eindrücktiefe von 3 mm** ist die Abweichung des BKS10HD „blau“ vom festen Sensor **bis mindestens 18 kHz kleiner als 2 dB**. Selbst eine leichte Schrägstellung wird toleriert.







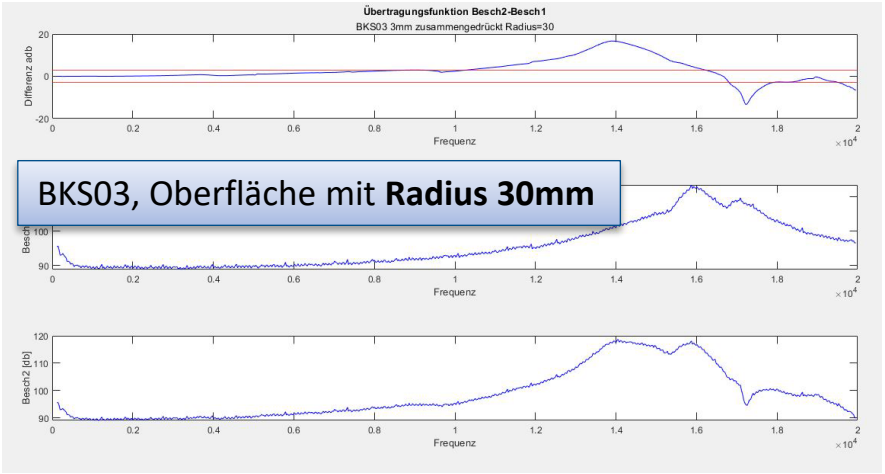


Rounded and Rough Surfaces

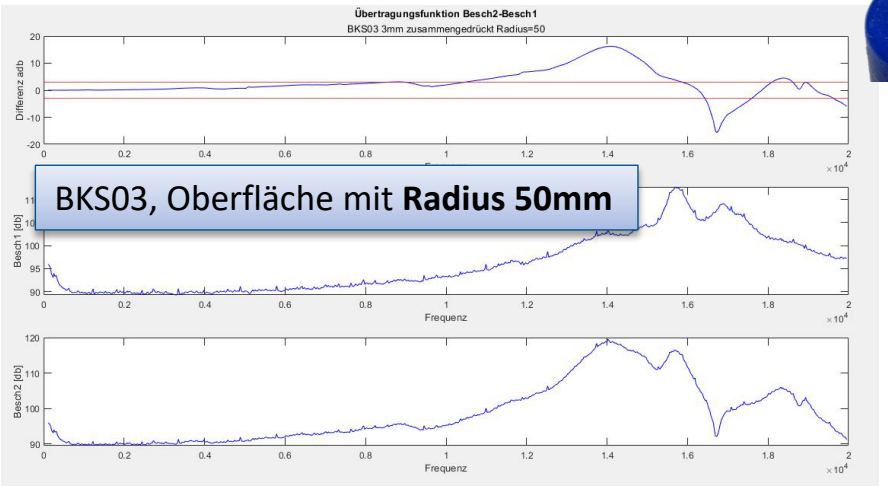
DISCOM

Ergebnis: Das Aufdrücken auf **gerundete Oberflächen reduziert** den nutzbaren Frequenzbereich **erheblich**. Für diese Anwendung ist eine speziell angepasste Sensorspitze zu empfehlen.

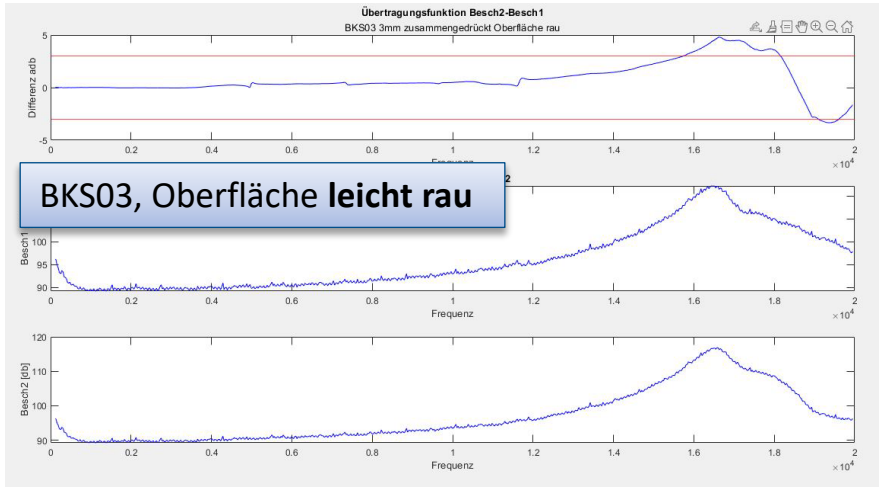
Leicht raue Oberflächen sind tolerabel, mit höherer Rauigkeit sinkt der nutzbare Frequenzbereich.



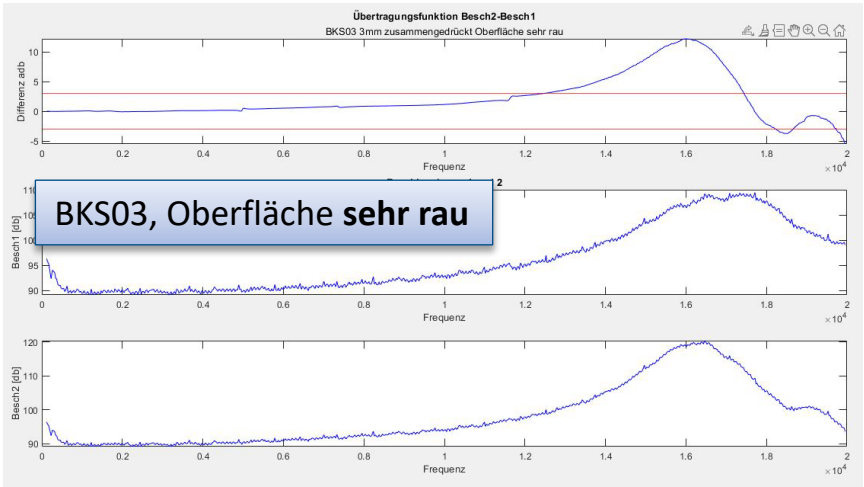
BKS03, Oberfläche mit **Radius 30mm**



BKS03, Oberfläche mit **Radius 50mm**



BKS03, Oberfläche **leicht rau**



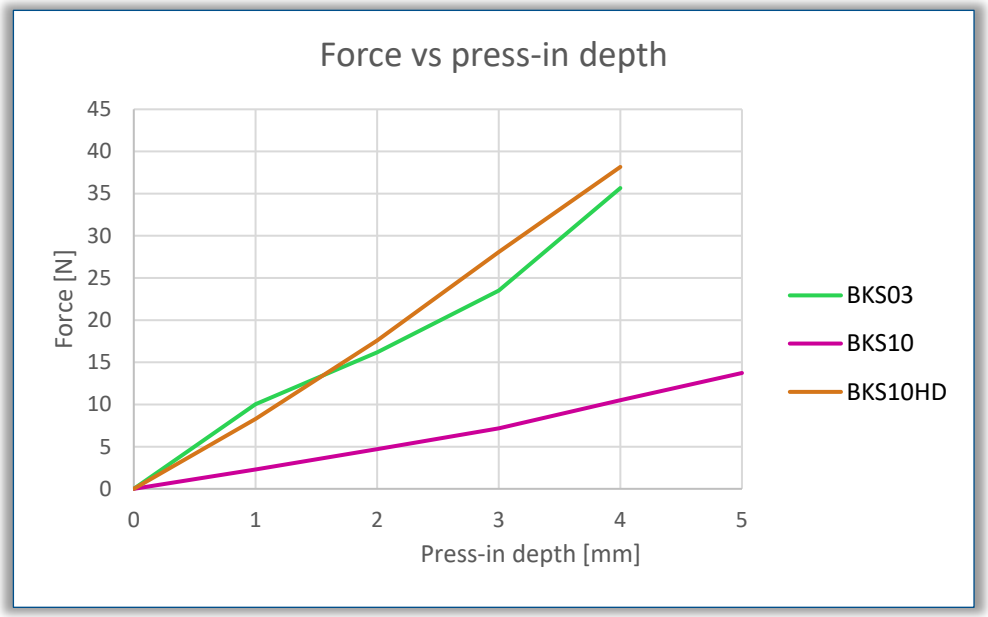
BKS03, Oberfläche **sehr rau**

HBK HOTTINGER BRÜEL & KJÆR

Spring Constants of Elastic Elements

The table and graph below document the spring constants of different elastic elements, i.e. the relation between press-on depth and force.

Press-in depth [mm]	weight [kg]	force [N]		factor
BKS03				
0	0	0		
1	1,024	10,04544		
2	1,649	16,17669		
3	2,396	23,50476		
4	3,635	35,65935		8,54 N/mm
BKS10				
0	0	0		
1	0,235	2,30535		
2	0,480	4,70880		
3	0,732	7,18092		
4	1,071	10,50651		
5	1,400	13,7340		3,61 N/mm
BKS10HD				
0	0	0		
1	0,845	8,28945		
2	1,792	17,57952		
3	2,861	28,06641		
4	3,890	38,16090		9,21 N/mm



Conclusions

This table summarizes the results. Please note:

- The table shows the frequencies up to which the deviation from a fixed mounted sensor is less than 2 dB. The **actual measurement range of the BKS sensors is much larger** (verified up to 80 kHz).
- **Human hearing range** for adults reaches at best **about 16 kHz**.

	Recommended press-on depth and force	Deviation from fixed sensor < 2dB up to	Tolerable tilting angle
BKS03 	3,5 mm / 30 N	19 kHz	4°
BKS10 “black” 	4 mm / 10 N	14 kHz	0°
BKS10HD 	3 mm / 28 N	18 kHz	1°