

Application Note

Magnet gap vs. Sample space

Different ways of specifying the available gaps in VSMS by different vendors causes confusion, some vendors talk about the sample space where others describe system performance related to the 'magnet air gap'

Figure 1 illustrates the difference between magnet (air) gap and sense coil gap (sample space):

ADE uses coils that are 4.3 mm thick (each) meaning that the sense coil gap is always approximately 9 mm smaller than the magnet gap.

Lakeshore uses coils that are approximately 6.2 mm thick (each) (estimated from their literature), resulting in a difference between the magnet gap that they quote and the sample space of 12.5 mm. (they talk about a magnet air gap of 16 mm and write in a note that this is equivalent to a sensing coil gap of 3.5 mm).

Typically I would advise to have approximately 1 mm on each side of the sample holder. You could get away with a little bit less. So to use a 5 mm sample, you would need a 'sample space' or 'sense coil gap' of 7 mm. Based on this criterion, a sense coil gap of 3.5 mm is useless for most practical applications.

The tables in the remainder of this document refer to the sample space as defined in figure 1. Actual maximum sample size may be ~ 2 mm less.

Table 1 shows some maximum field numbers for different systems

Table 1

Sample Space ↓	ADE EV7	ADE EV9	Lakeshore 7404	Lakeshore 7407
3.5 mm (not very useful)	2.2 T	2.7 T	1.8 T	2.3 T
10.5 mm	2.0 T	2.4 T	1.45 T	2.1 T
Oven gap	1.75 T	2.1 T	0.9 T	1.5 T

The large difference at the oven gap between ADE and Lakeshore systems is caused by the fact that the ADE oven has a smaller Outside diameter (the ADE oven/cryostat has an 8 mm inside diameter, the Lakeshore has a 6.4 mm inside diameter)

The only case a 3.5 mm gap is useful is when a very small sample is mounted on the perpendicular sample holder or at the end of a straight 3 mm rod. (The system comes with a variety of sample holders).

Figure 2 shows graph of the maximum field for different sample spaces for the ADE Model 4 and 886.

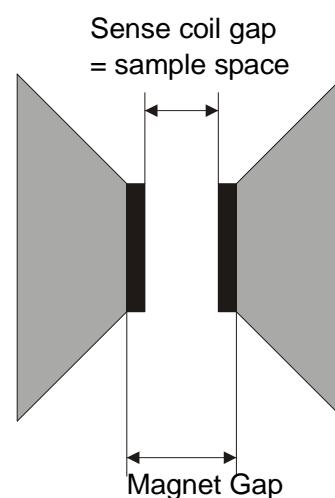


Figure 1, the difference between the magnet gap and the sample space

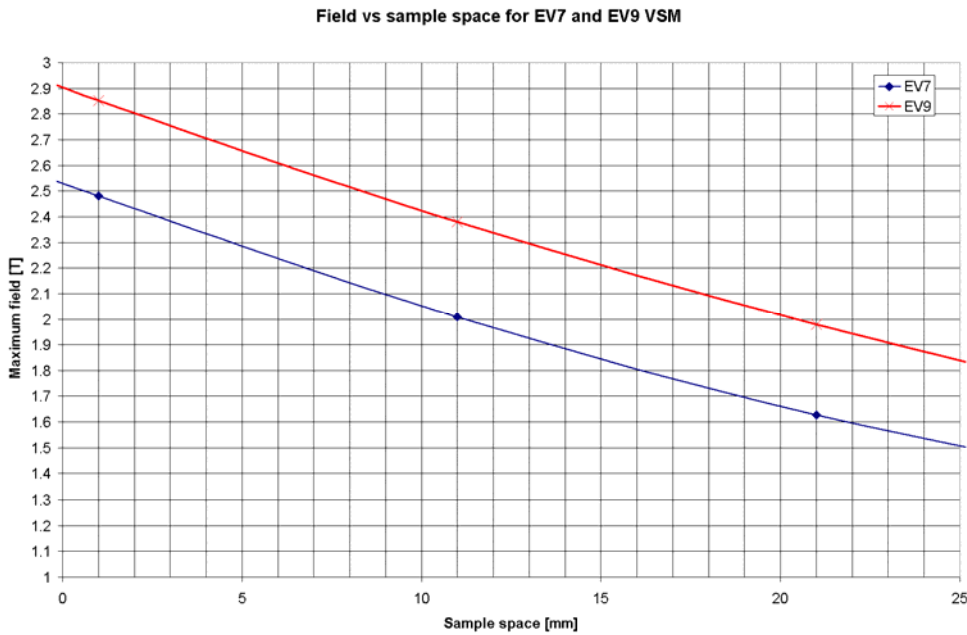


Figure 2, Field vs. Sample space graph for the ADE EV7 and EV9 VSM.

Noise as a function of gap

In publishing noise specifications a similar confusion exists because different vendors use different gaps to specify their performance. Table 2 shows the noise at various gaps, all with 0.1 second per point.

Table 2

Sample Space ↓	ADE Model EV7, EV9 (1)	Lakeshore 7404, 7407 w. EMSC coils (2)
3.5 mm (not very useful)	Not specified (< 1 μemu)	0.75 μemu
10 mm	Not specified (< 1.5 μemu)	1.6 μemu
Oven gap	2.5 μemu	7.5 μemu

The same data is represented in Figure 3.

Notes:

(1) The data in the table and graph for the ADE system was measured on a typical system we shipped. The system is specified and tested at the 18 mm gap needed for the oven.

(2) Lakeshore data taken from www.lakeshore.com and “The performance of the Model 7400 VSM: sensitivity” application note on the Lakeshore website.

Data in table is for the Lakeshore EMSC coils (optimized for small samples)

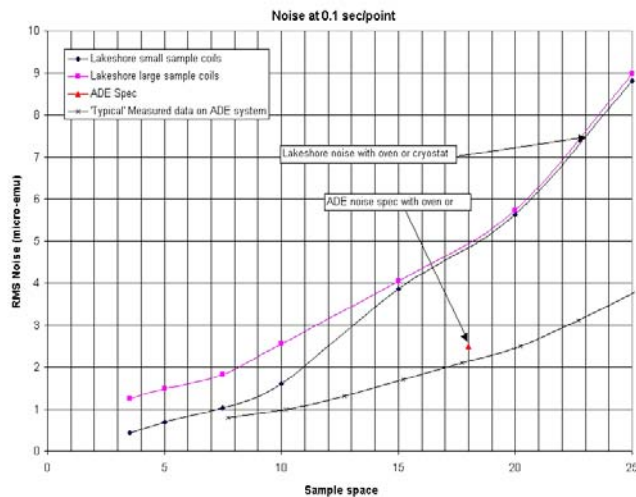


Figure 3, noise vs. sample space for different systems. (2)