

# Application News

Nano Particle Size Analyzer: SALD-7101

No. 9

## Volume Dimension and Number Dimension (Dimension of Particle Size Distribution)

The Nano Particle Size Analyzer SALD-7101, in which measurement is based on the laser diffraction method, measures particle size distribution using the volume dimension. However, if necessary, the volume dimension results can be converted into the number dimension particle size distribution for output of the results.

Generally, instruments referred to as “particle size analyzers” are instruments that for the most part measure particle size distribution based on the volume dimension. Instruments known as “counters”, such as microparticle counters, almost always operate on a different principle, performing measurement using the number dimension.

Assuming that the particles are spherical, the number dimension particle distribution can be calculated from the volume dimension particle size distribution. Conversely, the volume dimension particle size distribution can be calculated from the number dimension particle size distribution. Shown below is the calculation formula for converting Differential % (number dimension) from Differential % (volume dimension).

<b>Number of divisions of particle diameter</b>	<b>: <math>m</math></b>	
<b>Particle diameter</b>	<b>: <math>X_j</math></b>	( $j=1,2,\dots,m+1$ )
<b>Average particle diameter per section</b>	<b>: <math>Z_j</math></b>	( $j=1,2,\dots,m$ )
<b>Differential % (volume dimension)</b>	<b>: <math>Q_j</math></b>	( $j=1,2,\dots,m$ )
<b>Difference % (number standard)</b>	<b>: <math>r_j</math></b>	( $j=1,2,\dots,m$ )

$$y_j = \frac{\log_{10} x_j + \log_{10} x_{j+1}}{2}$$

$$z_j = 10^{y_j}$$

$$p_j = \frac{q_j}{(z_j)^3}$$

$$s = \sum_{j=1}^m p_j$$

$$r_j = \frac{p_j}{s} \times 100$$

When considering 1  $\mu\text{m}$  particles and 10  $\mu\text{m}$  particles, even if the ratio is 1:1 using the number dimension, it will be 1:1000 using the volume dimension. Conversely, when the ratio is 1:1 by the volume dimension, it may be 1000:1 using the number dimension. Therefore, depending on whether the volume or number dimension is used, a considerably different impression of the particle size distribution may be obtained even for measurement of the same sample.

If the distribution width is narrow with a mono-peak, there may be cases in which the difference between the results obtained with volume dimension and number dimension is not very large; however, generally there is a very large difference.

For example, the same ribosome measurement results expressed using the volume dimension in Figure 1 will be expressed as shown in Figure 2 when the number dimension is used.

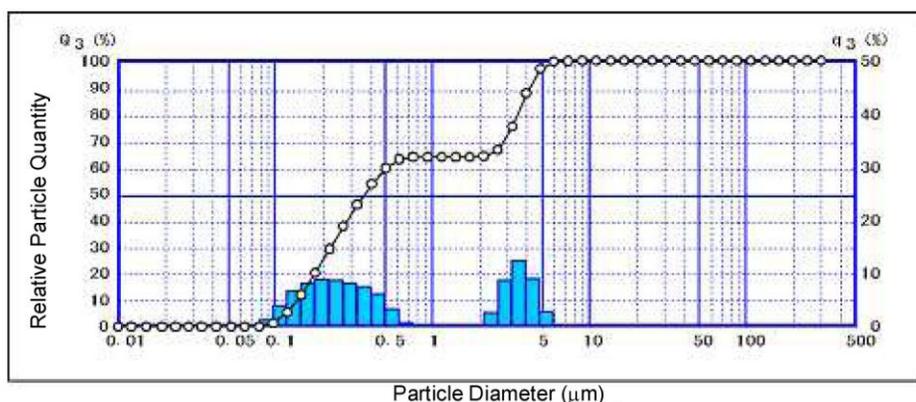


Figure 1: Ribosome Measurement Results Output using Volume Dimension

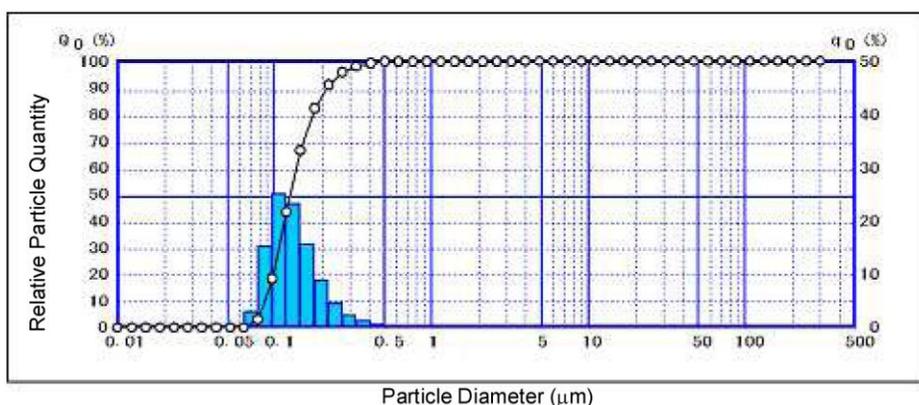


Figure 2: Ribosome Measurement Results Output using Number Dimension

When the output is conducted using the volume dimension as in Figure 1, the existence of a particle-clump included in the sample is clearly evident. However, since this clump greatly affects the volume, while having barely any effect on the number, it completely disappears in the number dimension output shown in Figure 2. Moreover, in the number dimension output, the distribution width is relatively narrow; in other words, it can be assessed that these are ribosomes with complete particle diameters.

In this way, the evaluation result is influenced according to the output format. For example, if a ribosome is used as a DDS (drug delivery system), it must be evaluated using the volume dimension if there is a possibility that particle agglutination might have a harmful effect in the human body.

The results generated using the Nano Particle Size Analyzer SALD-7101 are calculated using the volume dimension. Although output is also possible using the number dimension, since performing evaluation of a sample using only that could pose a risk, it is necessary to select the output format based on the purpose of the measurement.