An Agilent Vial is Not Just a Vial

White Paper

When you think of a vial, you probably consider a small container composed of glass or plastic used to hold your sample. You place your sample in the vial, and the vial into the autosampler. The instrument takes over, and your sample is on its way to being separated and detected.

The vial tends to take a back seat to other components of the analytical workflow. In addition, vials are usually one of the first components to be effected by cost-cutting. Most laboratories are doing all they can to drive down operational costs.

This constant drive to find ways to reduce costs could indirectly cost more in the long term. This unintended consequence is explained in more detail later.

Figure 1 illustrates a complete sample containment solution of the vial, cap, and septum, and their relationship to each other. A needle is shown piercing the cap septum and, as shown in the figure, the septum should be the only component that comes into contact with the needle.

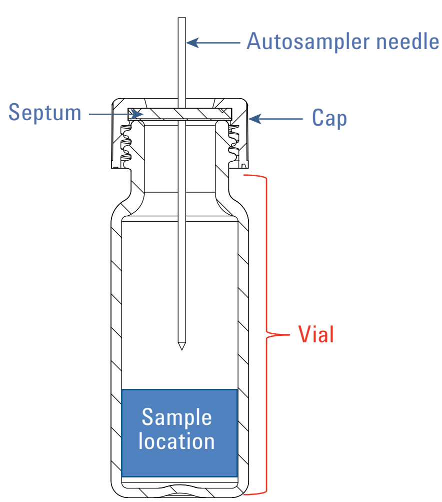

Figure 1. A basic illustration of an Agilent screw vial.

Low Cost Now – Expensive Later

Occasionally, Agilent is contacted by customers who switched to a lower cost vial, leading to a range of issues including:

- Vial breakage
- Leaking sample
- Improper fit
- Leaching extractables
- Sample loss

These issues reduce lab productivity, and more than eliminate any intended cost-savings of the lower cost vial.

Some suppliers offer inferior vials at a low price to win your business, without considering the potential impact this inferior quality can have on lab productivity.

Agilent has a comprehensive quality control process to cover all aspects of the product life cycle, providing the customer a consistent product each time. Consistency in performance is our goal.

Consistency is key

Agilent always maintains high standards, setting a tight specification for the coefficient of expansion (COE) of vial glass. This means that our vials are appropriate for analytical use across a broad range of analytical applications.

Table 1. Glass composition for autosampler vials.

Oxide component	Symbol
Silicon dioxide	SiO_2
Boron oxide	B_2O_3
Aluminum oxide	Al_2O_3
Calcium and magnesium oxide	$CaO + MgO$
Sodium oxide	Na_2O
Potassium oxide	K_2O
Chlorine	Cl^-
Iron oxide (*)	Fe_2O_3
Barium oxide (*)	BaO
Titanium oxide (*)	TiO_2

Coefficient of Expansion - What is it?

What is borosilicate, COE, and Type 1, when it comes to vials? Understanding what is involved in the manufacturing of vial glass will help you to better understand why there are so many different types and qualities.

Boric oxide is common to all silicate glass. Borosilicate glass must contain at least 5 % boric oxide. Boric oxide helps make the glass more tolerant of higher temperatures and corrosion. Next time you order vials, make sure your vials are made from Type 1 borosilicate.

Type I (clear or amber) borosilicate

Type 1 will provide you with the best overall performance inclusive of lower pH shifts, temperatures above 100 °C, and greater resistance to a range of matrices containing water, acids, and most organic substances.

- Type 1 clear borosilicate glass can have a linear coefficient of expansion (COE) of 33 or 51.
- Type 1 amber borosilicate glass has a linear coefficient expansion of 51.
- Some budget vial glass has a linear coefficient expansion of 70+.

What is linear coefficient of expansion (COE)?

The coefficient of thermal expansion describes how the size of an object changes with a change in temperature. Specifically, it measures the fractional change in size per degree change in temperature at a constant pressure. There are many COEs including linear, effects of strain, area, and volume. In the case of vial glass, linear COE is the standard metric. Please refer to Table 3 for the methods followed during the manufacturing of our vial glass.

While 33–51 COE (refer to Tables 1–2 for additional details on metal composition) is acceptable for a majority of analytical conditions, we recommend that our customers stay away from any vial glass manufactured using other COEs including 70+ due to a number of safety concerns including vial breakage, improper fit, and increased leaching of metals into your sample matrices.

Table 2 shows the details of the two COEs we use in the manufacture of our clear and amber vials (32–33 and 48–56).

Table 2. COE Compliance: 0–300 °C, cm/cm × C ×10^{-7} (acceptable expansions for analytical chromatographic purposes).

ASTM E438 Type I, Class A linear COE	ASTM E438 Type I, Class B linear COE
32–33 ± 1.5	48–56 ± 2.0

Some suppliers offer 70–71 COE glass vials. However, these vials are more brittle and prone to breakage. The higher concentration of metals found in 70–71 COE reduces the amount of heat required to form the glass. This occurs because metals have a lower boiling point than silica. This reduces the costs of vial manufacturing substantially, sometimes up to 75 %. Recently, Agilent commissioned an independent study into glass expansion of glass autosampler vials and found that all three are currently being used in the industry.

Another effect of increased metal content

During the heating or annealing processes, the metals migrate to the surface of the vial glass, forming active sites. These active sites can cause various issues for your sample analytes including allyl leaching, adsorption, absorption, and contamination. If your goal is to improve laboratory productivity and operational efficiency, we recommend that you stay away from these vials. Be careful when ordering vials to ensure that 33–51 COE Type 1 borosilicate glass (refer to Table 1) is being used.

Working with lower concentrations

If your analyte of interest is present at a lower concentration in the sample matrix, these stability issues (allyl leaching, adsorption, absorption, and contamination) can be even more problematic.

Our promise to you

At Agilent, we know how valuable your samples are. We only choose materials for our vials that provide your sample with a safe environment before injection or long-term storage.

Low Cost But at What Cost

Be wary of a supplier offering a substantially lower cost vial, especially if they cannot explain which COE is used in their manufacturing process.

Avoid 70–71 COE if you are involved in more sensitive applications or longer term studies, as it can compromise your sample measurement. We also recommend that you avoid 70–71 COE if you are performing any study looking at lower analyte concentrations, for example, validating a new method by determining LODs or LOQs. All Agilent vials are manufactured to comply with the classifications on chemical resistance outlined in Table 3. This compliance ensures that your sample analyte has limited exposure to the vial itself.

You can be assured that Agilent vials will never compromise your results.

Table 3. Chemical resistance classifications.

Resistance glass	Specification
Acid resistance glass	DIN 12116
Alkali resistance glass	ISO 695
ASTM Laboratory class glass	ASTM E438

For More Information

These data represent typical results. For more information on our products and services, visit our Web site at www.agilent.com/chem.

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