

Applications

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Technical Report

Eppendorf Safe-Lock Tubes – Outstanding performance for centrifugation and incubation of samples in the laboratory

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Abstract

Important and frequently performed processing steps in the laboratory include the centrifugation and incubation of samples. Microliter tubes that are used for this purpose should be able to endure high g-forces and be safely and tightly sealed. The experiments shown here confirm that the Eppendorf 1.5 ml Safe-Lock Tubes exhibit a higher centrifugation stability (30 min at 30,000 x g) and a better lid closure than five other competing products. Thus, they are perfectly designed for safety and performance in demanding applications.

Introduction



Eppendorf micro test tubes were developed more than 40 years ago for the analysis of small samples. Today, the Eppendorf microliter system is based on them, consisting of pipettes, tips, centrifuges and thermomixers. The daily routine in the laboratory consists not only of heating,

cooling and storing samples of varying chemical composition in the tubes, but also frequently spinning them at high g-forces. This places great demands on the mechanical and thermal stability of the material as well as on the design of the tubes.

Eppendorf tubes are made of highly pure polypropylene, a material that is mechanically stable and can be used in a broad temperature range while also being very resistant to chemicals [1]. The tube and lid geometry of the Safe-Lock Tubes is designed to minimize sample loss through evaporation and to prevent the opening of the lid at high temperatures.

This technical report describes three experiments designed to evaluate the properties of Eppendorf 1.5 ml Safe-Lock Tubes and 5 products of other manufacturers in typical laboratory applications. We examined the centrifugation stability at 30,000 x g, the closure of the lid at 100 °C as well as the seal tightness of the tubes in an evaporation test.

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Materials and Methods

24 Eppendorf Safe-Lock Tubes 1.5 ml and corresponding tubes of 5 other manufacturers (S, V, T, A, G) each were used in the experiments. Table 1 lists the maximum centrifugation stability of the tubes as indicated in the technical data of each manufacturer.

Table 1 Maximum centrifugation stability according to manufacturer data

1.5 ml tube	Eppendorf Safe-Lock	Competitor S	Competitor V	Competitor T	Competitor A	Competitor G
Max. g-force	30,000 x g	20,000 x g	40,000 x g	38,000 x g	20,000 x g	18,000 x g

Centrifugation stability

The tubes were filled with 1 ml aqueous saline solution and centrifuged at 30,000 x g in the Eppendorf Centrifuge 5430 (Rotor FA-45-24-11-HS) for 5, 10, 20 and 30 min at room temperature. Afterwards, the tubes were examined for possible damage such as breakage or deformations of the tubes.

Seal safety

Tubes filled with 1 ml aqueous solution were incubated for 30 min at 100 °C in a water bath. Then, the number of opened lids were determined for each tube type.

Vapor tightness

After filling the tubes with 1 ml of a water-ethanol mixture, they were incubated for 1 h at 70 °C. Weighing out before and after incubation determined the quantity of evaporated liquid. For each tube type, the mean values as well as the standard deviations were calculated.

Results

Centrifugation stability

As shown in Table 2 and Figure 1, only Eppendorf Safe-Lock Tubes could be centrifuged for 30 min at 30,000 x g without any damage or deformation. Three other products were stable for shorter centrifugation times at 30,000 x g

(V: 10 min, T: 5 min, A: 20 min). Tubes of manufacturers S and G already exhibited damage after 5 min of centrifugation time. Figure 2 shows pictures of examples of damaged tubes.

Table 2 Number of damaged tubes after centrifugation

Duration	Safe-Lock	S	V	T	A	G
5 min	0	1	0	0	0	21
10 min	0	23	0	3	0	n.d.*
20 min	0	n.d.*	0 (deformation)	24	0	n.d.*
30 min	0	n.d.*	2 (deformation)	n.d.*	7	n.d.*

*n.d. Not determined

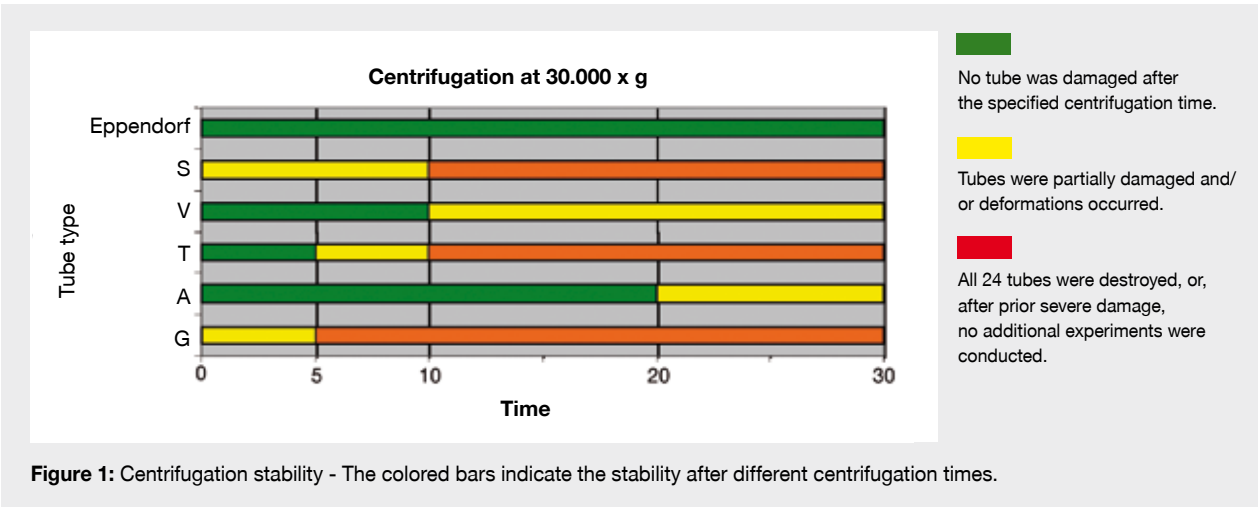


Figure 1: Centrifugation stability - The colored bars indicate the stability after different centrifugation times.

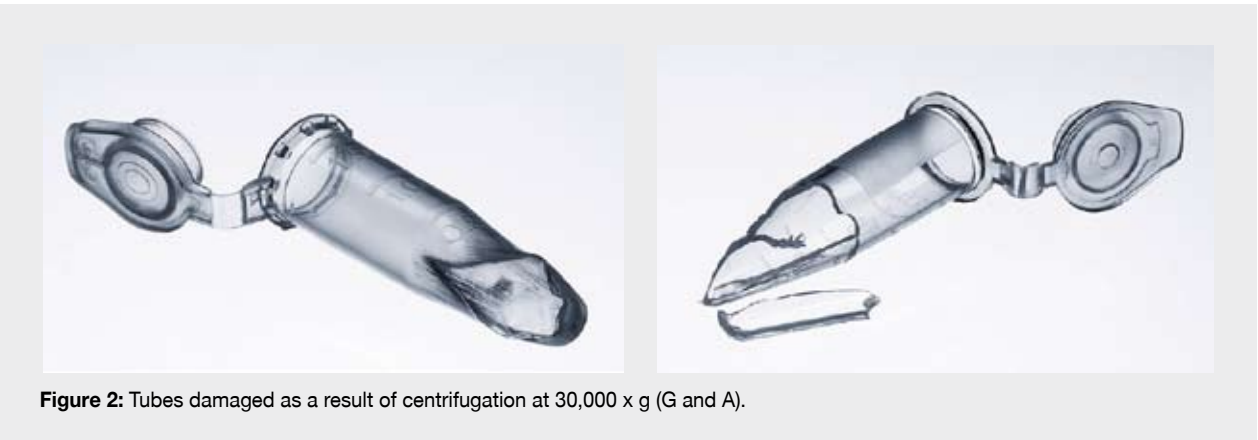


Figure 2: Tubes damaged as a result of centrifugation at 30,000 x g (G and A).

Seal safety

During incubation in a boiling water bath, only the Eppendorf Safe-Lock Tubes remained safely closed. 10 % to 20 % opened lids were found for the tubes of manufacturers S and A, while T and G exhibited more than one-third and V nearly 80% opened lids (Fig. 3).

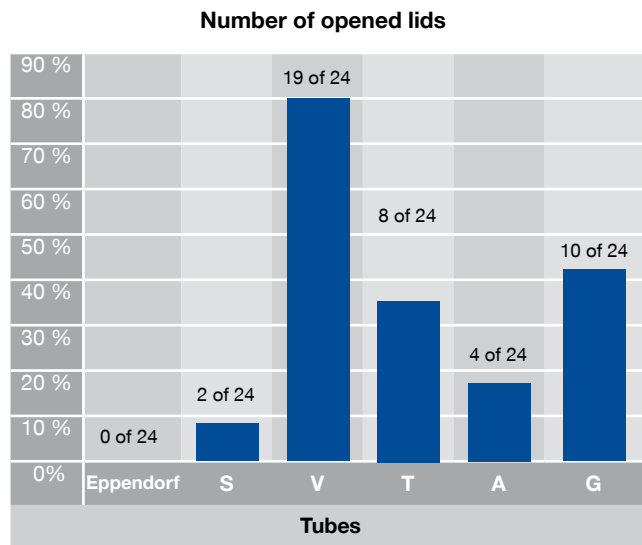


Figure 3: Seal safety - Shown is the percentage of tubes that have opened during incubation in the water bath at 100 °C.

Vapor tightness

This test was used to evaluate the tightness of the tubes. As shown in Figure 4, three manufacturers (Eppendorf, S, A) exhibited both a low evaporation rate (mean value < 1‰) and a low standard deviation. Tube types T and G exhibited far greater evaporation rates and the individual values differed more widely. It was impossible to evaluate the results with tubes made by manufacturer V, since several tube lids had opened during incubation.

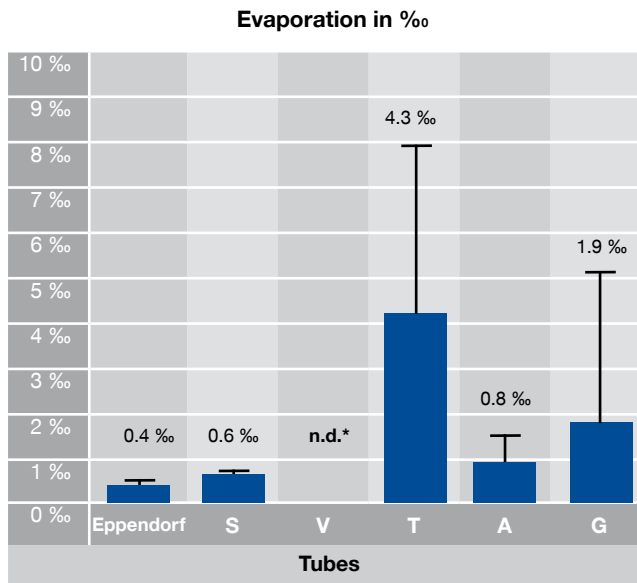


Figure 4: Evaporation test - Shown are the mean values in ‰ (n=24). The error bars indicate the standard deviation.

*n.d.: Not determined since tube lids had opened during incubation.

Conclusion

The results demonstrate that Eppendorf Safe-Lock Tubes can be used for a broad spectrum of methods. They can be centrifuged for at least 30 min at 30,000 x g without a special form-fitting centrifuge rotor. In contrast, the information provided by several other manufacturers concerning the stability of their tubes does not appear to be realistic (see Table 1 and 2). As a point of reference, the centrifugation stability of all Eppendorf tubes is shown in Table 3.

The secure lid sealing that results from the lid lock and the small evaporation rates in the vapor tightness test confirm that Safe-Lock Tubes are optimally suited for incubations at high temperatures. Simultaneously, the homogeneity of the data (low standard deviation) are an indication for the high quality standard of the tubes.

Compared with the competition, Safe-Lock Tubes in all three tests clearly gave the best results. The combination of material, tube geometry and production process results in a product which is designed to be used in demanding laboratory applications and which provides maximum safety when working with valuable samples.

Table 3: Centrifugation stability of Eppendorf tubes*

Tube type	Quality level			
	Standard/PCR clean	Biopur	DNA LoBind	Protein LoBind
Safe-Lock 0.5 ml	30,000 x g	22,000 x g	30,000 x g	18,000 x g
Safe-Lock 1.5 ml	30,000 x g	22,000 x g	30,000 x g	18,000 x g
Safe-Lock 2.0 ml	25,000 x g	22,000 x g	25,000 x g	18,000 x g
3810X 1.5 ml	30,000 x g	—	—	—
3810 1.5 ml	25,000 x g	—	—	—

*The tubes can be centrifuged in a 45 ° fixed-angle rotor at 40 °C für 90 min with aqueous saline solution up to the above-indicated g-numbers (RCF). The centrifugation stability depends on the temperature. Liquids that have a higher density or that attack the stability of the plastic (organic solvents, acids), can reduce the mechanical loading capacity of the tubes.

References

[1] Eppendorf Application Note 56: The best material for original Eppis. (<http://www.eppendorf.com>)

Eppendorf Ordering information

Description	Order no. International	Order no. North America
Safe-Lock Tubes, 0.5 ml	per 500 pcs.	per 500 pcs.
Colorless	0030 121.023	022363611
Amber	0030 121.155	022363638
Blue	0030 121.139	022363646
Green	0030 121.147	022363654
Red	0030 121.120	022363662
Yellow	0030 121.112	022363671
Assorted colors	0030 121.708	022363697
PCR clean		
Colorless	0030 121.301	022363719
Eppendorf Biopur	per 50 pcs.	per 50 pcs.
Individually packaged	0030 121.570	022600001
Safe-Lock Tubes, 1.5 ml	per 1,000 pcs.	per 500 pcs.
Colorless	0030 120.086	022363204
Amber	0030 120.191	022363221
Blue	0030 120.175	022363247
Green	0030 120.183	022363263
Red	0030 120.167	022363280
Yellow	0030 120.159	022363301
Assorted colors	0030 120.694	022363328
PCR clean		
Colorless	0030 123.328	022363212
Eppendorf Biopur	per 100 pcs.	per 100 pcs.
Individually packaged	0030 121.589	022600028
Safe-Lock Tubes, 2.0 ml	per 1,000 pcs.	per 500 pcs.
Colorless	0030 120.094	022363352
Amber	0030 120.248	022363379
Blue	0030 120.221	022363395
Green	0030 120.230	022363417
Red	0030 120.213	022363433
Yellow	0030 120.205	022363450
Assorted colors	0030 120.686	022363476
PCR clean		
Colorless	0030 123.344	022363344
Eppendorf Biopur	per 100 pcs.	per 100 pcs.
Individually packaged	0030 121.597	022600044



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