

# Forensic-Swab

DNA-free Swabs for Forensic Applications



## Introduction:

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In recent years, the requirements to which swabs used for forensic applications must conform have changed substantially. Without exception, swabs marked 'sterile' had been typically used in the past while, today, a forensic swab must meet a multitude of characteristic prerequisites.

## Background:

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Swabs used for forensic purposes are designed for comparative sampling or securing traces at the crime scene, typical traces and comparative specimens being blood, saliva, sperm, epithelial cells, etc. From the samples recovered, DNA is purified and the DNA profile determined, also known as the genetic fingerprint. Comparing this DNA profile with the information compiled in a DNA data base may be useful to manifest the offender's identity or an individual's defence. Consequently, using swabs with DNA contamination can lead to mistakes in police investigations. In the recent past, these circumstances led to confusion in a number of murder cases which pointed to a female production aid working in the manufacture of swabs used for the collection of evidence, the Heilbronn phantom. It finally turned out that the woman's DNA profile had not been established at the crime scenes but already during the production of the swabs. It is, therefore, all the more important that swabs used for the collection of evidence conform to defined requirements:

## Absence of DNA

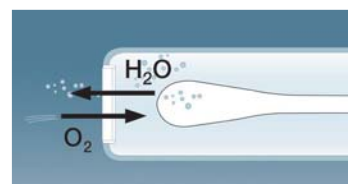
Formerly, swabs typically used in forensic environments were just sterile. Sterile means that the item is free from living micro organisms. Sterilisation is usually performed using irradiation. DNA contamination, if any, is not removed. In the case of the Heilbronn phantom described above, this very fact placed the focus of investigation on the above-mentioned swab production aid as a criminal suspect. During production, several swabs had been unintentionally contaminated with her DNA. For example, a few saliva drops likely to be produced while speaking or epithelial cells coming into contact with the cotton would already be sufficient. The methods applied in modern DNA analytics are sensitive enough to detect even the smallest DNA volumes which might result in wrong leads caused by contamination during production. It is therefore planned to use only DNA-free swabs for forensic applications in the future. To exclude contamination, Sarstedt's Forensic-Swab is therefore produced under the most stringent hygienic purity conditions. The completely assembled swab is then individually wrapped and the final product subjected to a special EtO sterilisation procedure developed for forensic applications. With a test procedure based on a **detection limit of 0.023ng DNA/ $\mu$ l extracted volume**, absence of DNA is now guaranteed. A 73 bp amplicon also enables the detection of partly degraded DNA (target gene: human cytochrom oxidase). Studies reveal that EtO sterilisation can reliably remove DNA contamination [1]. During sterilisation, DNA is degraded into fragments of a size too small to establish a DNA profile.

## Self-drying in the tube

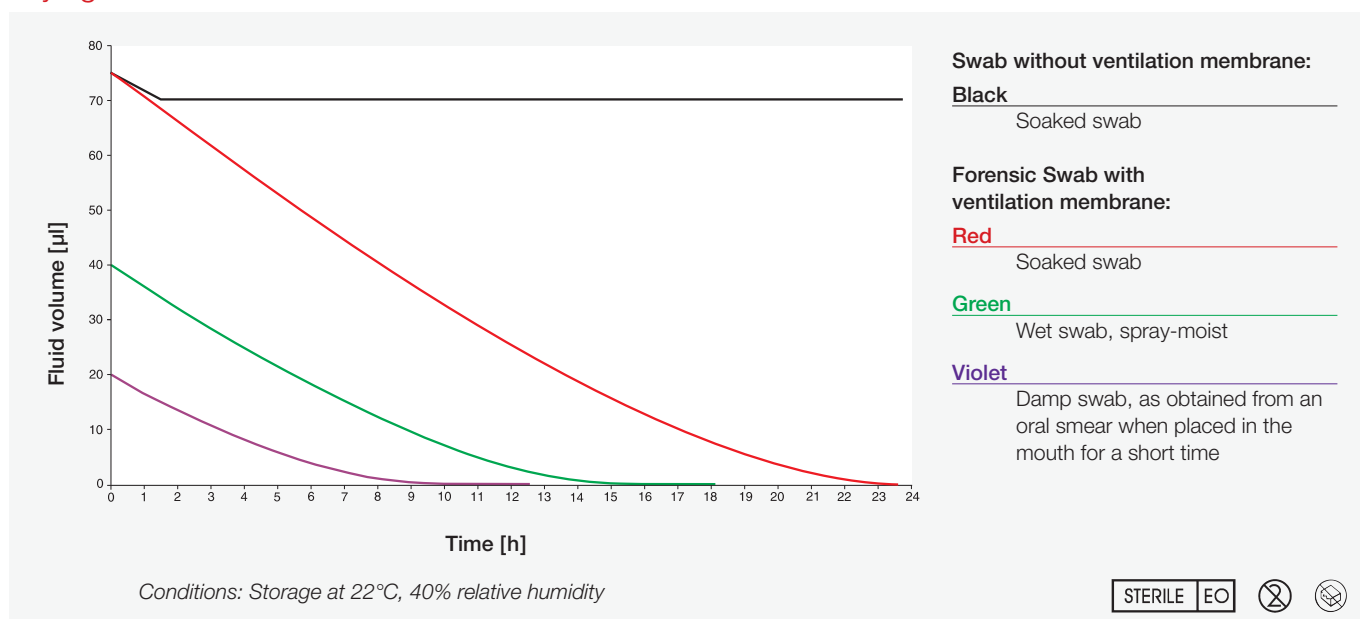
As a rule, the swab is moistened to collect a specimen. Likewise, the swab is wet after collecting a comparative sample (i.e. saliva specimen using an oral smear from a suspect). On a wet swab, bacteria or mildew growth is likely to occur before it reaches the laboratory for analysis (frequently 3 to 4 days) making the swab unsuitable for DNA cleanup. Bacteria may feed on the DNA as a carbon source degrading it accordingly. In such cases, DNA purification and, as a result, allocation to a specific offender or individual is no longer possible. Accordingly, drying the swabs is of fundamental importance.

So far, this has been done by drying the swab outside the tube. However, this drying procedure may provoke contamination with foreign DNA. Simultaneous drying of several swabs even involves the risk of mix-ups or errors due to incorrect reassembly of the swab and tube after drying.

Sarstedt's new Forensic-Swab is provided with a ventilation membrane in the tube base which enables safe-drying of the swab within the tube so that a soaked swab will dry within 24 h and a damp swab (e.g. from an oral smear) in less than 10 h (The drying behaviour depends on ambient environmental conditions as well as on the volume and type of fluid, e.g. water or secretion.). Due to the fact that the swab is drying within the tube, contamination or mix-up is excluded.



## Drying behaviour



Apart from the self-drying aspect, the membrane in the Forensic-Swab provides a further and decisive advantage comparing to standard swabs. The Forensic-Swab can be sterilised completely assembled and packaged which excludes any further handling stages that would involve new contamination risks. In spite of the high gas permeability, the membrane effectively protects the swab against DNA contamination from the outside. For added safety, the swab is individually wrapped in a paper/plastic packaging that guarantees its tamper-proof quality.



## Conclusion:

Consumables or other materials for forensic applications will have to conform to most stringent demands in the future to extensively exclude contamination of disposables or materials intended for forensic applications [2]. Using DNA-free swabs constitutes an important adoption of the currently applicable detection values of the DNA quantification kits in use. However, swabs are/have always been just one of all the risk potentials involved in the entire process. Apart from the individuals collecting evidence, the disposables used may constitute a source of contamination as well. It is, therefore, important to also use products certified DNA-free (e.g. pipette tips, micro tubes etc.) for subsequent purification and analysis. Ever since Sarstedt established the Biosphere® biological purity standard in 1995, we have set high benchmarks to ensure the absence of DNA in these products. As a matter of principle, products are manufactured under most stringent purity conditions in a germ-free environment excluding human contact. A further validated handling step provides added safety by irreversibly breaking down even the smallest DNA fragments so that we can ensure the absence of DNA in each individual item. In view of this validated procedure, the safety provided by Biosphere® products is not merely statistical. Certified products like, for example, screw cap micro tubes, reagent tubes and pipette tips, are 100% free from DNA.

## References:

- [1] K. Shaw, I. Sesardic, N. Bristol, C. Ames, K.Dagnall, C. Ellis, F. Whittaker, B. Daniel, Comparison of the effects of sterilisation techniques on subsequent DNA profiling, *Int. J. Legal Med*, 122 (2008) 29-33
- [2] P. Gill, et al., Manufacturer contamination of disposable plastic-ware and other reagents – An agreed position statement by ENFSI, SWGDAM and BSAG, *Forensic. Sci. Int. Genet.* (2009), doi:10.1016/j.fsigen.2009.08.009 (in press)