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Optimizing Mask Performance

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Facemasks were first introduced into hospitals to protect patients from airborne infectious bacteria and viruses generated by health-care providers (HCP). Early studies in those facilities showed the clinical value of this personal barrier by demonstrating a reduction in patient exposures to microbial-laden droplets released during coughing, sneezing, and even speaking. Of special significance, a decline in the incidence of post-surgical wound infections was also observed when HCP wore masks. The rationale for masks was gradually modified to include protection of HCP from exposure to potential microbial pathogens in aerosols, spatter, and splashes as science-based clinical and research evidence expanded in the areas of infectious diseases and respiratory infection control. Extensive medical and dental investigations conducted since then have proven that, when worn properly, masks can effectively protect HCP mucous membranes from inhalation of potentially infectious aerosolized particles. As a result, use of a facemask remains a standard of practice for both medical and dental surgical procedures and when aerosols and spatter are generated during patient care. In order to ensure that facemasks provide adequate protection, The American Society of Testing and Materials (ASTM) developed testing methods to determine performance specifications of materials in facemasks used in healthcare (Table 1), and these specifications have been accepted as the industry standard.

Consultants' Comments:

"Masks have a good fit, are secure, and comfortable."

"I like the availability of three barrier levels."

"I like the top and bottom strips for better adaptation/comfort."

With specific application to dentistry, droplets and aerosols of saliva, blood, and other biological debris are discharged from a patient's mouth when procedures are performed using air/water sprays, handpieces, and ultrasonic scalers. Masks are now designed and available to meet any encountered condition. Optimal performance requires a dental health-care professional (DHCP) to consider an evaluation of specific features of an "ideal" facemask when selecting these disposable items (Table 2). Filtration of airborne particles is the basic mask function, and is determined by the size of the pores in mask material (in microns) and the filtration efficacy (i.e., percentage of particles filtered out by the mask). These properties are measured and listed on the mask box as bacterial filtration efficiency (BFE) and the particle filtration efficiency (PFE) (Table 1). Additional measurements include Fluid Resistance and Delta P (breathing resistance), where lower breathability is associated with better filtration. We rely on these qualifications to categorize the available mask types. Masks with features performing within ASTM performance levels (ASTM 1, 2, & 3) are recommended for routine use in a dental practice. The N95 respirators have a close facial fit and are very efficient filtration of airborne particles. N95 respirators are certified by the National Institute for Occupational Safety and Health (NIOSH) and perform the best. Unrated masks that don't meet ASTM standards can be used for non-aerosols or non-spatter-generating examinations.

Table 1. ASTM F2100 Medical Facemask Material Requirements by Performance Level.

	ASTM Level 1	ASTM Level 2	ASTM Level 3
FLUID RESISTANCE, mmHg	80	120	160
BFE	≥95%	≥98%	≥98%
PFE, @ 0.1 micron	≥95%	≥98%	≥98%
DELTA P, mm H_2O/cm^2	<4.0	<5.0	<5.0
FLAME SPREAD	Class 1	Class 1	Class 1

FLUID RESISTANCE:
- represents mask's resistance to penetration by synthetic blood under pressure (mmHg)
- measures ability of mask's construction to minimize fluids from traveling through the material and potentially coming into contact with the wearer
- higher the fluid resistance (filtration), the better the protection

BFE (Bacterial Filtration Efficiency):
- represents percentage of bacteria filtered out at pore size of 1 – 5 microns
- the measure of efficiency of the mask filtering bacteria through it

PFE (Particulate Filtration Efficiency):
- represents percentage of particles filtered out at a pore size of 0.1 – 1.0 microns
- the measure of the efficiency of the mask in filtering particles passing through it
- the size of the particles filtered is critical

DELTA P (Differential Pressure):
- represents the pressure drop across the mask or resistance to air flow in mmH_2O/cm^2
- determines breathing resistance
- higher the Delta P, the less breathability, but the better the filtration

FLAME SPREAD:
- measures flame spread of the mask material

Source: The American Society for Testing and Materials. Standard specification for performance of materials used in medical face masks. F2100-11 Standard

As important as measurable criteria are, only the DHCP can determine the proper mask fit for their face. A mask is only as good as the fit it provides. Worn masks should not have any gaps on the sides of the face, around the nose, or under the chin. While all masks have an adjustable metal or plastic nosepiece to provide a seal for that area, many medical and dental professionals use a "one size fits all" approach when wearing face masks. This philosophy is flawed because people come with different size faces and facial contours. These variations can lead to open gaps along the sides of the mask and under the chin (Figure 1). An innovative approach to address this issue was introduced in 2011, with a mask manufactured containing a second bottom aluminum strip (***Secure Fit® Masks***, *Crosstex International,* Patent Pending). When the wearer pinches both strips to create an individual, custom fit, a tight seal is now visibly formed at the top, sides, and bottom of the mask (Figure 2). The resultant seal is similar to that created when using specialized N95 particulate respirators, which provide the wearer with maximum filtration protection. These latter masks are highly effective and indicated when treating patients with airborne diseases, such as influenza and tuberculosis.

With masks of various shapes and features, mask selection should be based on the wearer's personal and protection needs. Besides fit, another area of consideration that is often overlooked is the potential for development of dermatitis reactions to components found within mask material, such as dyes, inks, or chemicals. *Crosstex* addressed this problem with a line of ***Ultra Sensitive Earloop*** with ***Secure Fit Technology*** masks. These masks provide the same custom fit with a lower risk of developing facial irritation problems.

Facemasks are a key component of personal protection from airborne pathogens. It is up to the DHCP to choose which mask is best for them based on filtration, fit, comfort, and sensitivity. So when DHCP from across the nation were asked to clinically evaluate ***Secure Fit Masks***, the findings resulted in a +++++ rating and an Editors' Choice Award from THE DENTAL ADVISOR. These masks have also been voted THE DENTAL ADVISOR's **Top Mask** for four consecutive years (2012, 2013, 2014, and 2015).

Table 2. Selection Criteria for Masks

1	High particle filtration efficiency (PFE)
2	High bacterial filtration efficiency (BFE)
3	High filtration resistance
4	Conforms to fit tightly to face
5	Does not cause fogging of eyewear
6	Fabric does not irritate skin or cause allergic reaction
7	Does not contact nose or lips
8	Easy to put on and remove

Figures 1. One size fits all mask.

Figures 2. Custom fit using *Secure Fit Masks*.