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## Learning outcomes

After reading this 'Guide to Scavenging of Nitrous Oxide' you should:

- Understand why nitrous oxide scavenging is essential
- Be aware of the correct methods of active dental scavenging
- Understand how to use scavenging equipment efficiently to minimise exposure
- Ensure your scavenging arrangements are up to date and comply with Control of Substances Hazardous to Health (COSHH) and other standards



*Child with ClearView breathing system with disposable mask*

## Scavenging of nitrous oxide

# GUIDE TO... Scavenging of Nitrous Oxide

This guide looks at dental nitrous oxide scavenging, why it is required, the rules and regulations governing the process, and how to manage it correctly and safely

## What is scavenging?

'A scavenging system, simply defined, is a means to collect and remove excess gases to prevent them from being vented back into the operating room. Installation of an efficient scavenging system is the most important step in reducing trace gas concentration. It has been demonstrated that ambient concentrations have been lowered by 90% through the use of an efficient system' (National Institute for Occupational Safety and Health, 1996).

## Regulations and recommendations

UK recommendations include the *Standards in Conscious Sedation for Dentistry* (Society for the Advancement of Anaesthesia in Dentistry, 2000). This states: 'There should be adequate scavenging of waste gases where inhalation sedation is used, since inadequate scavenging may result in unacceptable risks to health of the dental team. Adequate scavenging of gases should not rely on window opening or air conditioning alone and it should conform to current COSHH standards.'

The latest *BDA Advice on Conscious Sedation* states: 'Scavenging of waste gases must be active and sufficient to fully conform to COSHH standards. Breathing systems should have a separate inspiratory and expiratory limb to allow proper scavenging. Nasal masks should be close fitting providing a good seal without air entrainment

valves' (British Dental Association, 2012). This latter cites 'Section 9, Equipment for Nitrous Oxide/Oxygen', in *Inhalation Sedation in Conscious Sedation in the Provision of Dental Care* (Department of Health (DH), 2003), which gives the same information and remains the accepted advice to date.

Nitrous oxide scavenging for dental purposes should be active. However, confusion still exists among dental professionals as to what exactly 'active' dental scavenging comprises.

The generally accepted definition in chapter 10 of *Health Technical Memorandum 02-01* (DH, 2006) is: 'Active scavenging for dental installation is an entirely different concept. An active system is one in which there is a flow generated through the patient's nasal mask and this carries away the waste gases exhaled by the patient. This flow is in the order of 45 litres/min and is achieved by connection of the mask (via a suitable flow-limiting adapter) to either a dental vacuum system or directly to

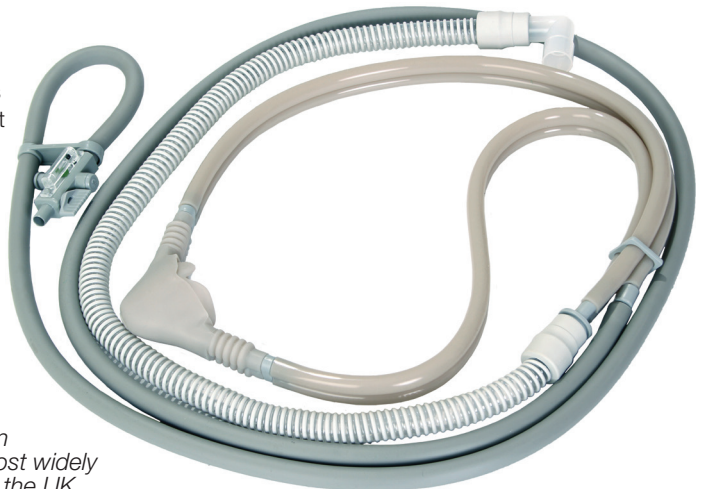


Figure 1. The Porter Brown breathing system is the most widely used scavenger system in the UK

Figure 2. Accutron ClearView: this has a disposable mask to improve infection control



an active scavenging system (BS/EN) wall terminal.'

The origin of the required 45 litres/min flow rate at the nasal mask comes from the US National Institute for Occupational Safety and Health standard, although it has become universally adopted (NIOSH, 1996). This fits neatly with the UK's Control of Substances Hazardous to Health (COSHH) regulations (HM Government, 2002), which require a maximum exposure limit of nitrous oxide of 100 ppm (parts per million) over an eight-hour time weighted average.

## Compliance

The usual methods for complying with the dental standard are:

- Use of an efficient active scavenging breathing system using a vacuum draw of 45 litres/min
- 12–15 room air changes per hour, or another form of ventilation such as a room's natural ventilation with a low-level extractor fan
- Staff rotation.

The current standard is set out in *HTM 02-01* (DH, 2006); a new dental standard is being drawn up for the DH and is due to be published early next year.

## Active scavenging and risks of passive systems

The definition of active scavenging and how to carry it out successfully are where most confusion arises.

Scavenging is usually divided into two main sections—patient delivery circuit and vacuum source. Both elements have to be suitable for dental application to be successful.

A common mistake is using the older (and now considered obsolete) type of passive breathing circuit, connected to an air break

on an anaesthetic gas scavenging wall terminal or a standalone unit such as a Purair 130,

especially as the latter is described as a self-contained scavenging system conforming to BS 6834: 1987.

On initial inspection, connection to either of the two latter items would appear to make the passive breathing circuit 'active'. Unfortunately, this is not the case as the value of the induced flow rate in these circumstances is only 0.5 litres/min instead of the required much higher 45 litres/min. The low vacuum rate of 0.5 litres/min in these cases is relying on the conscious patient's expiratory effort to drive the waste gases; it therefore allows for significant leakage, especially from around the area of the single nasal mask, possibly resulting in fairly high occupational exposure levels, which makes it unacceptable. It is only when the waste gases reach the fan unit within these units that an extraction flow rate operating at 80–130 litres/min can be achieved.

Porter Instruments, the original equipment manufacturer, discontinued making passive circuit systems in January 2009. However, some generic types continue to be produced and used, despite all standards stating that only active breathing circuits should be employed.

## Active breathing circuits

A number of these are available from different manufacturers. Most are designed with autoclavable components but there has been a rise in demand for single patient use components in recent years. It is possible to 'mix and match' elements within all systems.

The most widely used type on the UK marketplace is the Porter Brown breathing system (*Figure 1*), made by Porter Instruments in the US. This, until recently, incorporated the only double mask available and has proved extremely popular over the years. Now, with infection control in mind, another US company—Accutron—has produced the ClearView disposable, scented double nasal mask (see cover picture and *Figure 2*),

which is proving to be equally popular.

The most commonly seen makes of active breathing circuit are Porter Brown, Accutron and Matrix ANS. These are used with a variety of single and double nasal masks, including autoclavable and single patient use masks.

Various studies have proven the efficiency of the Porter Brown double mask, the best known of which is still a study comparing three nitrous oxide scavenging units (Certismo et al, 2002). However, any of the other active systems, correctly used, should allow practices to comply with COSHH.

### Active vacuum sources

Currently, there are only three methods of removing waste gases from the surgery.

#### Connection to a dental vacuum system

This has never been popular in the UK, although it is used widely elsewhere, including in the US and Europe. One issue is that the high-volume port must be used and a secondary consideration is that the suction must be capable of sustaining a 45 litres/min draw throughout the whole of the sedation procedure without fluctuation. A lot of dental systems have only one high-volume and one low-volume port; the low volume port is not usually suitable so this option is generally not considered.

### Centralised scavenging system

Centralised anaesthetic gas scavenging (AGS) systems are widely used in locations such as dental hospitals and larger health centres (Figure 3). These are efficient and easy to use but are expensive to install and maintain.

The AGS terminal is not connected via an air break. Instead, an AGS probe adapter is screwed directly into the terminal, and the vacuum control block (the flow limiter) is connected into this. The flow limiter is adjusted to control the flow of waste gases from the patient delivery circuit into the AGS system at the rate of 45 litres/min; this is usually indicated by a flow bobbin and a coloured band.

#### Miniscav

Where other methods are not available, a Miniscav (Figure 4) can be used. This is a small, boxed standalone scavenger unit designed to work in with an active breathing circuit. It is easily retrofitted, requiring only a 15 mm external vent and 240 V power socket.

### Ventilation sources

There is a publication specifically covering ventilation in these circumstances—*HTM 03-01 Specialised Ventilation for Healthcare Premises* (DH, 2007). However, this document is written for larger premises and difficult to apply to smaller establishments. Part of compliance

Figure 3. Centralised anaesthetic gas scavenging system used in hospitals and large clinics



ensures using any existing natural ventilation, such as by opening windows or doors.

Room air changes are usually only required in larger healthcare establishments. Where applicable, the recommendation is 12–15 changes per hour. In smaller surgeries, with the use of good active scavenging, this is not usually needed. However, a low-level extractor fan may remove stray gases that may have escaped, for whatever reason, from the breathing circuit or vacuum draw. Because nitrous oxide is heavier than air, it is easily removed by using a low-level fan, positioned usually just above skirting board level.

### Monitoring of nitrous oxide

It is recommended that team members' nitrous oxide exposure should be monitored at least once a year; this recommendation will be included in the forthcoming dental standard.

Measurement should be repeated if results show unacceptably high levels after an investigation into causative factors has been carried out and the problems solved.

The most simple and effective method is to use personal monitoring (or diffusion) pens, worn in the breathing zone. An alternative method is to use nitrous oxide monitors such as the Geotech G200. While these are excellent for reading background exposure levels, they are more problematic to wear as a personal monitor. A further drawback to use is the cost, pricing being in the region of £1 600 upwards, whereas personal monitors start at £32 each.

### Checking equipment before use

All sedation and scavenging equipment should be regularly maintained. It is recommended and established practice in the UK that this is carried out once a year to maintain optimum working performance. Manufacturers' recommendations should also be followed. The forthcoming dental standard will cover this in more detail.

On a daily basis, before equipment is used, a pre-use checklist should be worked through. This should include checking the scavenging system, the breathing circuit and the vacuum draw. A checklist should be available from the equipment supplier.



Figure 4. Miniscav: this standalone unit works with an active breathing circuit and is easily retrofitted

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# Scavenging can be child's play

See us at the  
Dental  
Showcase,  
Stand F11



Studies show that use of efficient scavenging can significantly reduce staff exposure to Nitrous Oxide.

A simple combination of a Miniscav and active breathing system can remove all concerns about compliance with standards



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