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MEDICAL DEVICE TESTING

ISO 18562 BIOCOMPATIBILITY EVALUATION OF BREATHING GAS PATHWAYS IN HEALTHCARE APPLICATIONS

WHITE PAPER

INTRODUCTION

A number of recent high-profile cases concerning the recall of medical devices by the US FDA have highlighted the importance of the evaluation of the biocompatibility of breathing gas pathways in devices such as ventilators, breathing systems, nebulizers and respiratory monitors.

In 2022 the recall of more than 5 million sleep apnoea devices and ventilators is estimated to have cost medical device company Philips at least $1.3 billion. The FDA has received over 105 000 medical device reports linked to potential issues concerning the breakdown of a polymer foam contained within the Philips machines since April 2021. The recall was initiated following concerns that the breakdown products from the foam, which is used to soundproof the devices, may potentially be inhaled by the patient users.

The potential impact on patients of toxic compounds and / or particulate matter deriving from the various components within these types of devices makes the thorough evaluation of biocompatibility a vital stage in the product development process.

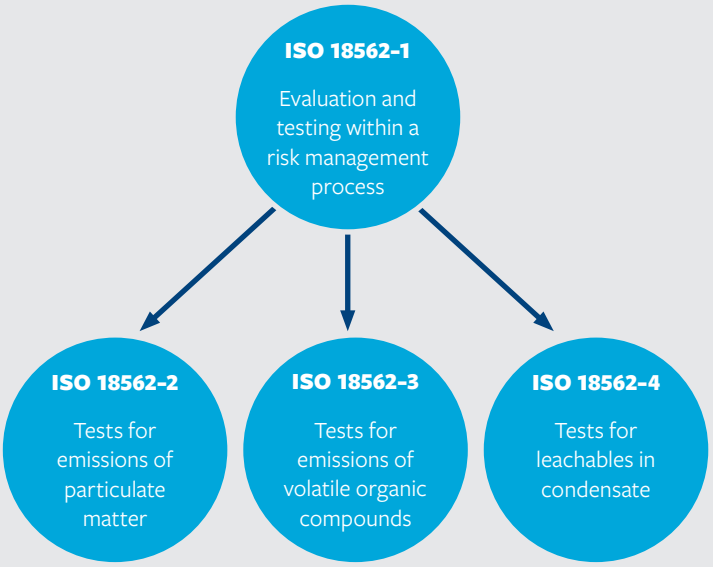
The BS ISO 18562 standard, which was first published in 2017, provides a framework to assess the risks associated with the breathing gas pathway in products used for healthcare applications.

As a critical part of the medical device development process the standard provides an outline of methodologies and associated acceptance criteria for the biological evaluation of gas pathways of medical devices through the implementation of a defined risk management process.

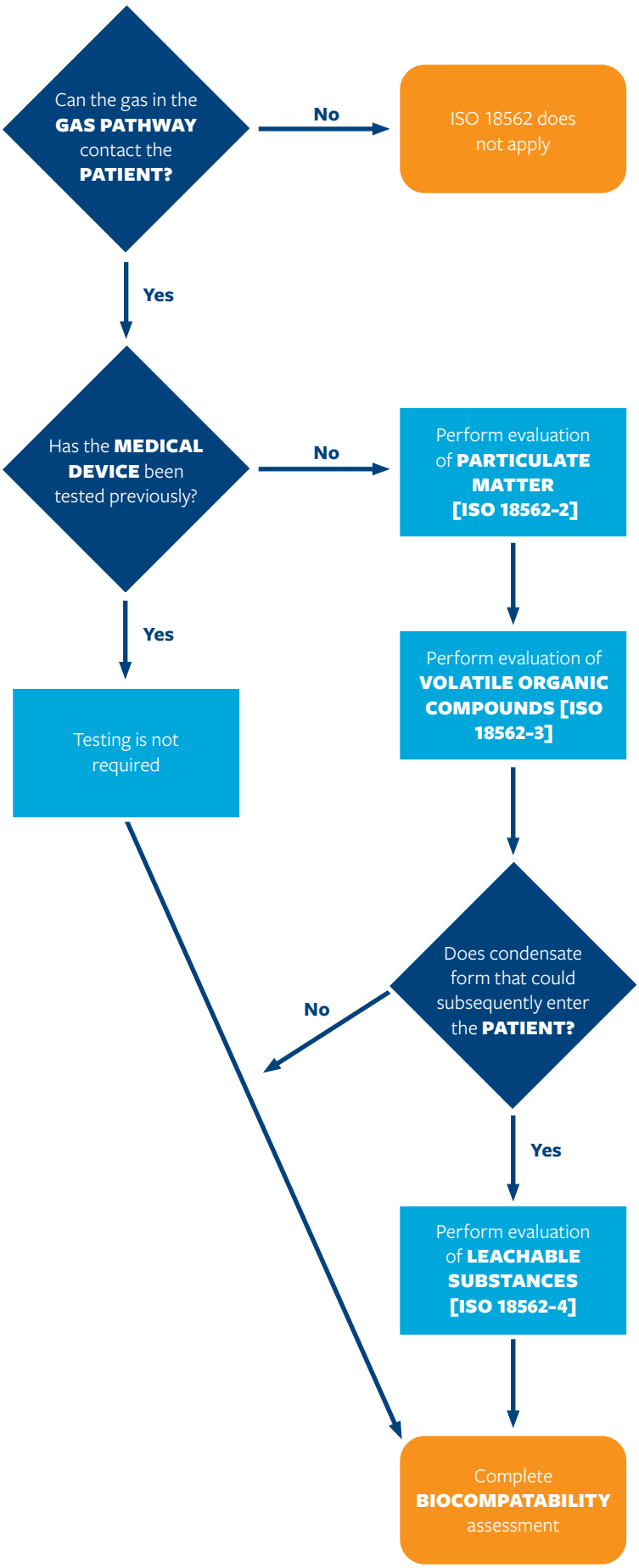
ISO 18562 is focussed on the identification of any potential contamination of the gas stream deriving from a medical device which may ultimately impact on patient safety. The assessment process includes an evaluation of any existing data, the identification of gaps and confirms any requirement for additional data and testing.

TYPES OF MEDICAL DEVICES INCLUDED IN THE STANDARD

- Ventilators
- Anaesthetic workstations / gas mixers
- Breathing systems
- Oxygen conserving systems and concentrators
- Nebulizers
- Low pressure hose assemblies
- Humidifiers, heat and moisture exchangers
- Respiratory gas / respiration monitors
- Masks and mouth pieces
- Resuscitators
- Breathing tubes, system filters and Y-pieces



ISO 18562-1: THE RISK ASSESSMENT PROCESS



ISO 18562-2: ASSESSMENT OF PARTICULATE MATTER

The standard describes testing methodology and acceptance criteria for the quantitation of particles ranging from 0.2µm to 10µm in diameter. The acceptable levels of particulate matter generated by respiratory medical devices are based on worldwide published health data.

Particulate Diameter	Maximum Particulates
<= 2.5 µm	< 12 µg/m3
<= 10 µm	< 150 µg/m3

The test methods are based on a 'worst case scenario' in terms of patient exposure and utilise a combination of particulate filters to determine the levels of particulate matter based on either a gravimetric assessment or using a particulate counter.

ISO 18562-3: ASSESSMENT OF VOLATILE ORGANIC COMPONENTS (VOCs)

The potential contamination of the gas stream in a respiratory medical device due to the presence of volatile organic compounds (VOCs) presents a significant risk in terms of patient safety. These compounds often cause irritation to the eyes, nose and throat and can have toxic, carcinogenic, mutagenic and / or genotoxic effects on humans.

Medical device gas pathways are tested using continuous flow gas sampling techniques. Simulated use studies are performed to identify and quantify levels of VOCs. These studies typically utilise thermal desorption in conjunction with gas chromatography-mass spectrometry (TD-GC-MS).

The results are then converted to patient exposure levels, for comparison against defined thresholds of toxicological concern (TTC). See table 1

ISO 18562-4: ASSESSMENT OF LEACHABLES IN CONDENSATE

The final part of the standard is only applicable where a medical device has the potential to form a condensate during clinical use.

A simulated use extraction study of the device is performed and any potential inorganic or organic leachables are characterised using a combination of Inductively Coupled Plasma (ICP) and Gas Chromatography-Mass Spectrometry (GC-MS) techniques.

Table 1

Exposure Category	Duration of Patient Exposure	TTC µg/day		
Limited exposure	≤24hr	360	-	-
Prolonged exposure	>24hr and <30 days	360 (for first 24hr)	120 (for subsequent 29 days)	-
Permanent contact	≥30 days	360 (for first 24hr)	120 (for subsequent 29 days)	40 (beyond 30 days)

SUMMARY

The ISO 18562 standard provides a risk based approach to assess the suitability of medical breathing devices using simulated worst-case testing to confirm product safety.

SPECIALISTS IN MEDICAL DEVICE TESTING

Our vast experience helps you:

- Devise the best strategy for your product
- Perform toxicological assessments of data (though a 3rd party partner)
- Tailor testing strategies for complex devices / processes using FMEA risk assessments
- Regulatory support including authoring of appropriate sections and responding to regulatory questions
- Design the most appropriate studies, aligned to the relevant guidelines, using a range of techniques including, but not limited to; GC-MS, LC-DAD-HRMS and ICP-MS
- Bespoke studies designed to support material selection, patient safety, product quality and change / lifecycle management
- Develop and validate test methods
- Structural elucidation of unknowns

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