

# HEADSPACE GUIDE



TESTING HEADSPACE  
IN MODIFIED ATMOSPHERE  
PACKAGING



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# WHAT ARE HEADSPACE AND MODIFIED ATMOSPHERE PACKAGING?

When products are sold in sealed packaging, the package typically contains a certain amount of 'empty' space – i.e., the space that is not occupied by the product. This is referred to as the headspace. Modified atmosphere packaging (MAP) is the process of inserting a specified mixture of oxygen (O<sub>2</sub>), carbon dioxide (CO<sub>2</sub>) and nitrogen (N<sub>2</sub>) into the headspace to help preserve the product.

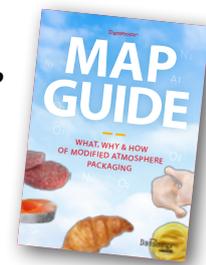
During the packaging process, products are 'flushed' with the appropriate gas mixture to preserve them most effectively. Once the product has been placed in its packaging, the specified gas mixture is blown

into the package to replace the regular air. The package is then hermetically sealed.

MAP is used for foods such as dairy products, fruit and vegetables, fresh and cured meats, seafood, bread, cake, fresh pasta, coffee and snacks. It is also used for healthcare products, such as surgical implants and pharmaceutical blister packs.

**You can learn more about MAP in our MAP Guide.**

[DOWNLOAD HERE](#)



***In sealed packaging, the "empty" space that is not occupied by the product is referred to as the headspace.***

# THE BENEFITS OF USING MAP

## EXTEND SHELF LIFE

By using only atmospheric gases, MAP is the most natural way to preserve food, and it creates significant benefits for both consumers and producers. By enabling natural and unprocessed packaged food to remain fresh for a longer time, MAP extends the shelf life of the product and reduces food waste. The shelf life of cured meat, for example, can be extended from three to 21 days, cheese from seven to 180 days, and fresh pasta from three to 60 days. This extended shelf life is achieved without the need to add artificial preservatives – a fact that appeals to today's consumers.

## IMPROVE TASTE APPEAL

The MAP process also preserves the visual appearance of the product and helps to ensure a

consistently good taste experience. This enhances the reputation of the product and its producers, and helps to create and maintain consumer loyalty.

## LOGISTICAL AND COST ADVANTAGES

For manufacturers, the use of MAP provides significant benefits to their supply chain. Food products can be stored for a longer time and transported over greater distances, while remaining fresh. MAP also helps manufacturers to reduce costs, as it is less expensive for them to chill products than freeze them. Supermarkets also benefit from the availability of products with extended shelf lives that only require a cooler rather than a freezer.



*The shelf life of cured meat can be extended from three to 21 days, without the need to add artificial preservatives – a fact that appeals to today's consumers.*

# ENSURING THE RIGHT GAS MIX FOR DIFFERENT FOOD CATEGORIES

For various reasons, the ratio of O<sub>2</sub>, CO<sub>2</sub> and N<sub>2</sub> required in MAP headspace will vary depending upon the type of product being packaged.

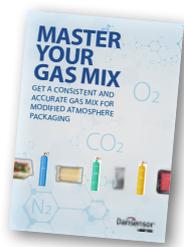
For example, N<sub>2</sub> is an inert gas that is used either to replace and exclude O<sub>2</sub> from the package, or to be a filler gas – in other words, to 'top up' a gas mixture. Unlike N<sub>2</sub>, CO<sub>2</sub> is soluble and its primary function is to inhibit the growth of aerobic bacteria. CO<sub>2</sub> is both water- and fat-soluble and therefore can cause packages of certain products to collapse from a reduction in internal pressure as the gas dissolves. The gas can cause a slight tainting of the product's sensory experience.

## THE ART OF (MOSTLY) EXCLUDING OXYGEN

O<sub>2</sub> is mostly excluded from MAP packaging because it causes oxidative deterioration of foods. However, there are reasons to include O<sub>2</sub> in controlled quantities. It can inhibit anaerobic organism growth; it maintains freshness and natural coloring in red meats (where the target gas composition would be 80% O<sub>2</sub> and 20% CO<sub>2</sub>); and it allows respiration to occur, which is important for fresh fruit and vegetables, where the O<sub>2</sub> concentration can vary from 3% to 18%, depending on the product.

**To learn more about MAP gas mixes and how they affect different foods, please refer to our guide, MASTER YOUR GAS MIX.**

[DOWNLOAD HERE](#)



## EXAMPLES OF FOOD CATEGORIES AND TYPICAL GAS MIXES

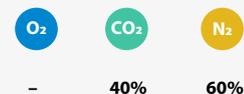
### Raw meat



### Coffee



### Fish and seafood



### Bread and cake



# WHY MAP HEADSPACE GAS ANALYSIS IS CRUCIAL

To provide maximum protection and ensure optimal freshness, it is vital that the headspace contains the correct mix of O<sub>2</sub>, CO<sub>2</sub> and N<sub>2</sub>. An incorrect gas mix could lead to various adverse impacts. These include bacteria growth, which can result in food becoming spoiled, foul-smelling, discolored and inedible. When the ratio of MAP gases is incorrect it can also cause oxidation, whereby a reaction with oxygen results in significant product quality deterioration, including loss of flavor and aroma, discoloration and a change in texture. In addition, an incorrect gas mix can lead to packaging either collapsing or ballooning, either of which can result in consumer rejection. In fact, should any of these impacts occur and an affected

batch reaches a shop shelf, it could have extremely serious consequences in terms of brand reputation and consumer loyalty.

## QUALITY DEPENDS ON TESTING

Gas mixers are used to ensure the correct amount and ratio of gases are inserted into each package. However, deviations can sometimes occur, either because O<sub>2</sub> has not been sufficiently flushed out before the package is sealed, or because of an insufficient flow rate. It is therefore essential to perform headspace gas composition testing, to ensure that the appropriate mix is preserved, and prevent the above adverse impacts from occurring.

***Incorrect gas mix can cause microbial growth - the biggest limiting factor for bakery product shelf life.***



***Bacteria cause discoloration of meat by reducing the O<sub>2</sub> tension at the meat's surface, causing the formation of Metmyoglobin.***



***Incorrect gas mix can affect the aroma and flavor of fresh coffee.***



# ACCURACY AND RELIABILITY ARE THE KEY REQUIREMENTS FOR HEADSPACE ANALYSIS

It is vital that headspace gas analyzers should be as accurate and reliable as possible. They should also be able to ensure repeatability of results, and the data that they generate needs to be traceable.



**Certain food types require an extremely high accuracy in headspace analysis. Even a small amount of O<sub>2</sub> can cause oxidative rancidity in milk powder.**

There are certain food types where highly accurate analysis of the headspace gas composition is particularly important – for example, milk powder, which is at high risk of oxidative rancidity if the package contains more than just a very small amount of O<sub>2</sub>. A headspace gas analysis inaccuracy of even  $\pm 0.1\%$  could severely affect the product's taste and significantly reduce its shelf life. It is therefore crucial to select an analyzer that guarantees accuracy to within a very small percentage.

## **When accuracy and uptime matter**

*Dansensor® CheckMate 4 is a high-precision headspace gas analyzer which ensures unrivaled accuracy in monitoring and analyzing modified atmosphere packaging.*

*With its unique exchangeable sensor module, annual service and calibration are completed in minutes for maximum uptime and flexibility. Revolutionize your quality control with this advanced technology, safeguarding product integrity and extending shelf life effortlessly.*

FOR MORE INFORMATION

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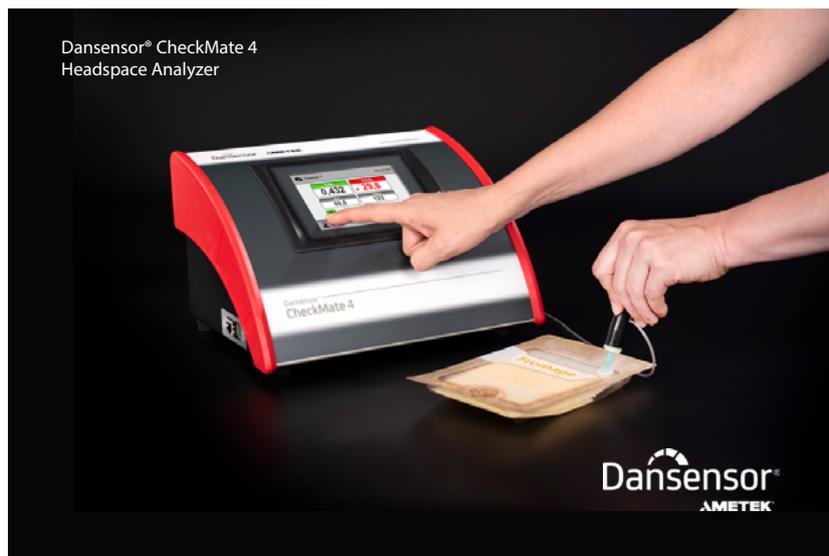
## **THE IMPORTANCE OF RELIABILITY**

Headspace gas analyzers must also provide a very high level of reliability over an extended lifecycle, with low maintenance requirements. Should an analyzer frequently break down, this would impact production throughput and profitability. In addition, analyzers must be able to achieve a high level of repeatability and precision, to ensure consistency of testing. Some devices can degrade relatively quickly, resulting in their accuracy drifting over time, to a point where the analysis is not of value. Selecting analyzers with high repeatability is essential to provide peace of mind and maintain brand reputation.

## **DATA TRACABILITY AND AUDITS**

As a vital safety measure, manufacturers must be able to trace product data when required for audit, verification, and documentation purposes. It is therefore important that headspace gas analyzers can store the results they generate, helping to ensure data traceability.

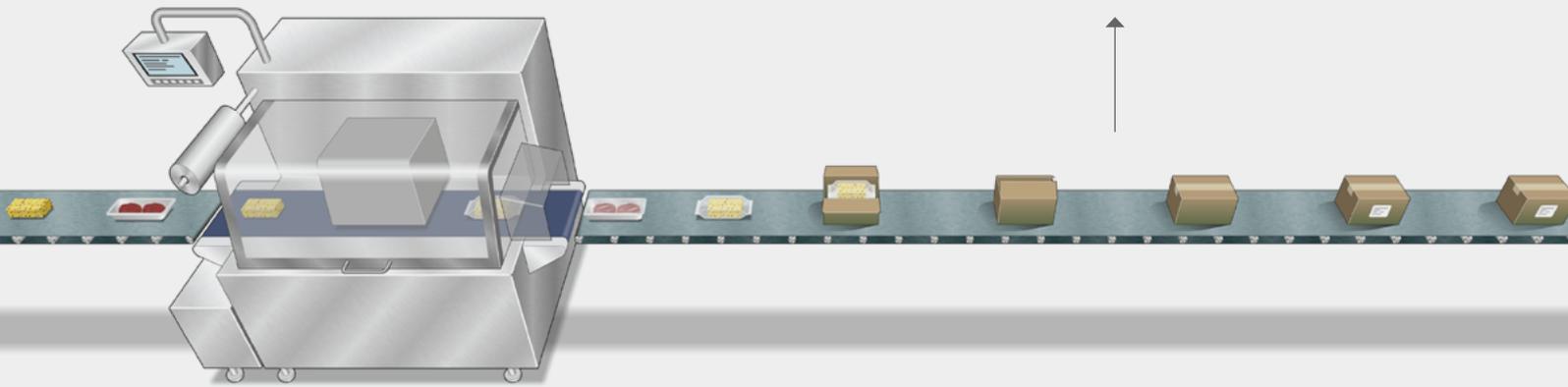
**A headspace gas analysis inaccuracy of even  $\pm 0.1\%$  could severely affect the product's taste and significantly reduce its shelf life.**



# METHODS OF TESTING

## METHOD A: **RANDOM SAMPLING**

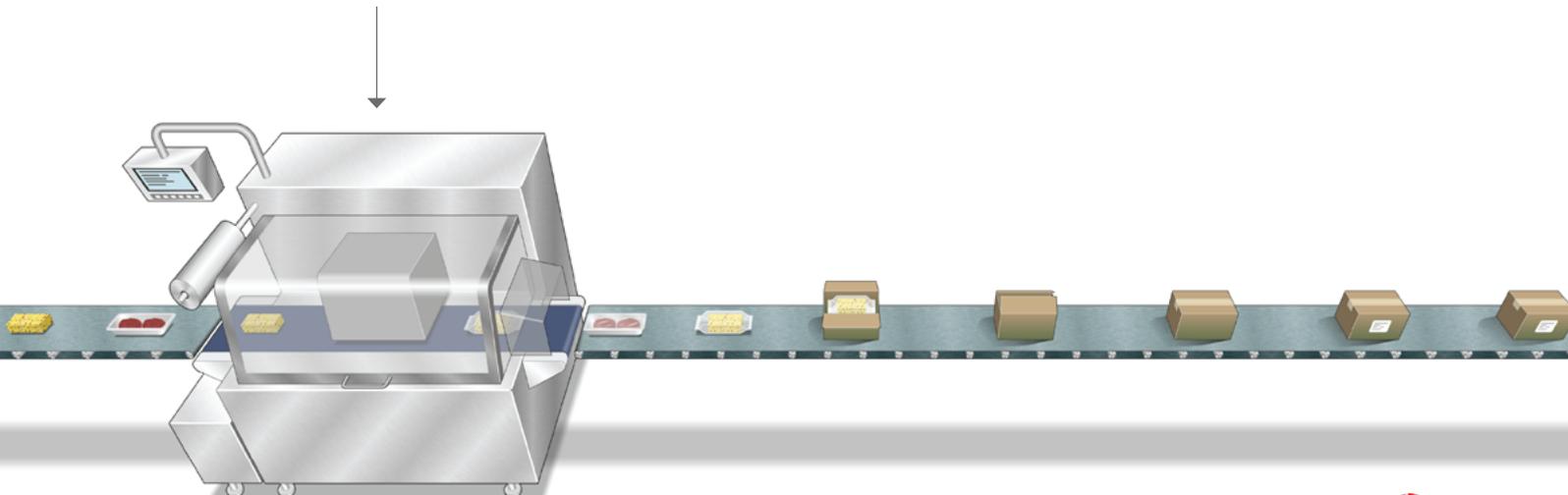
The most straightforward method is to remove random samples from the packaging line at predetermined intervals and analyze each of these samples.



## METHOD B: **CONTINUOUS ON-LINE GAS ANALYSIS**



The alternative method is via continuous on-line gas analysis. Devices integrated into the packaging system, enable analyzing the gas composition in every package.



# RANDOM SAMPLING

## HOW IT WORKS

In this method of analysis, portable or benchtop headspace gas analyzers are used to evaluate the gas mix within the randomly chosen representative samples, with the analysis performed either at the packaging line or in a laboratory. An operator inserts a needle into the package, and the headspace gas composition is measured directly. Because the needle penetrates the package, the packaging used on these samples must subsequently be destroyed, which is why this method is known as destructive testing. The product itself, however, can be repackaged.

### THE IMPORTANCE OF SPEED AND FLEXIBILITY

The percentage of production that is analyzed using this method depends on the speed of the packaging machine and the number of tests performed per hour. To maximize personnel efficiency, it is important to select an analyzer that can perform accurate tests as quickly as possible. Operators will be required to test multiple random samples,

perhaps every 15 or 30 minutes, and time spent waiting for analysis results prevents them performing other important tasks on the packaging line.

This method of testing reduces complexity, as the portable analyzers are easy to use, and a single analyzer should offer the flexibility to serve several packaging lines and cope with different products on the same line. However, a drawback is that this type of testing is labor-intensive, with operators collecting data manually. Also, it does not provide continuous monitoring of every package and because testing is destructive, it results in costly packaging waste.

Random sampling, performed with a portable analyzer, is a suitable method of headspace gas analysis for producers who are not yet ready to invest in continuous online gas analyzers but still want to improve their MAP process and product quality control.



### Embrace portability and ease of use with the Dansensor® CheckPoint® 4

*This compact headspace gas analyzer offers unmatched convenience in monitoring and analyzing modified atmosphere packaging. Elevate your quality control while ensuring product freshness and longevity. Experience the ultimate in portable quality control solutions.*

FOR MORE INFORMATION

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# CONTINUOUS HEADSPACE ANALYSIS

## HOW IT WORKS

In the continuous analysis method, evaluation of the gas mix is performed at the point of package closure and if the values are found to be outside the specified limits, the dosing can be adjusted. If the values are outside the upper limits, the analyzer will notify an operator and stop the production line to prevent potential waste and repackaging.

### CONTINUOUS ANALYSIS IS IDEAL FOR HIGH SPEED PACKAGING LINES

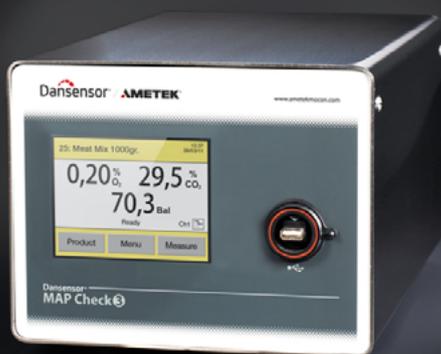
This method of analysis is performed without having to penetrate and destroy packages, and is therefore known as non-destructive testing. The tests must be performed quickly enough to cope with high packaging speeds on both vertical and horizontal flow packaging machines. Thousands of packages per minute could potentially be travelling along the line, so it is vital to ensure that the gas analysis is fast enough to prevent a production bottleneck. Continuous analysis can be performed with only a small amount of gas, which makes it a suitable method for testing packages with minimal headspace.

### EASY DATA HANDLING IS A MUST

Continuous on-line gas analyzers automatically measure and record in a seamless process that provides uniform, traceable data reports. Analysis results are displayed on a screen, stored in a computer database and can be simultaneously sent to a printer, if a paper record is desired. There may be occasions when a quick change between several pre-configured product profiles is required during operation, and the analyzer must be able to handle this.

Continuous on-line analysis is a suitable method for producers who want to take complete control of their MAP process and are ready to make a long-term investment in production quality assurance.

Dansensor® MAP Check 3  
Continuous Gas Analyzer



### **Monitor the gas mixture in EVERY package without destructive testing.**

*The Dansensor MAP Check 3 is an advanced on-line gas analysis system which provides precise, real-time analysis and data logging of gas composition within modified atmosphere packaging. It monitors and adjusts gas levels continuously to achieve significant gas savings, with less labor and waste, for complete quality assurance.*

FOR MORE INFORMATION

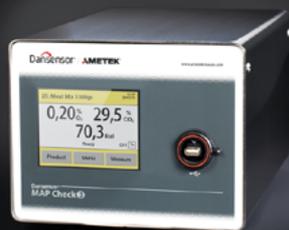
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# WHY CHOOSE DANSENSOR HEADSPACE ANALYZERS?

MOCON Europe is part of AMETEK, Inc., a leading global manufacturer of electronic instruments and electromechanical devices. We are pioneers with more than 40 years of experience in developing, and integrating high-precision instruments for measuring and controlling gas applications. Our specialty is quality control of MAP and our Dansensor MAP monitoring and control instruments have been the global industry standard for headspace MAP gas testing for decades. The instruments are used in thousands of food companies around the world. In addition,

we collaborate with several of the world's leading package machine manufacturers, to provide a measurable difference in performance.

Dansensor products are scalable from basic off-line quality control to fully automated on-line quality assurance, to address your changing needs. So, whether you need end-of-line quality control checks of headspace MAP gas composition in your package, or more advanced, on-line MAP gas analysis, Dansensor products can address your MAP requirements.



Talk to a MAP expert  
**CLICK HERE!**

