

MAPtest Accuracy Checking

Quality Assurance rules often require a "proof of accuracy" of the gas analysers used to check packaging atmospheres. This requirement frequently gets translated as a requirement to calibrate the analysers in question. Although this process is straightforward, it does require a degree of skill and reference to the operating manual and as a result can give rise to irritation and problems.



It is therefore preferable to use the much less problematic and simpler process called 'verification' to satisfy QA requirements. The following explains the difference between verification and calibration and provides other information concerning accuracy and the checking of it. Our new range of AUTO-CALIBRATING analysers, MAPtest 4050, 3050 and 3050G can only be verified and avoid this question altogether.

Accuracy

It is important that the accuracy specification of the analyser and that of the gas mixture used are both taken into account when establishing an acceptable performance. The accuracy for most commercially available 'standard' or 'calibration' gas mixtures is $\pm 2\%$ of the quoted concentration, and the analyser accuracy is quoted in its operation manual. The following example shows how to calculate the results that may be expected from an analyser working to specification. If a gas mixture of 2.0% oxygen and 80.0% carbon dioxide were to be used, the normal accuracy tolerance would mean that the oxygen concentration could range from 1.96% to 2.04% and that of the carbon dioxide from 78.4% to 81.6%. (Note that pure gases, e.g. 100% oxygen or 100% carbon dioxide, are typically much better than this; see recommendations for calibration). If this were used to verify the calibration of a MAPtest 3000 analyser, which has an accuracy of $\pm 2\%$ of reading for the oxygen and $\pm 1\%$ of span for the carbon dioxide,

acceptable readings would be between 1.92% and 2.08% for oxygen and 77.4% and 82.6% for carbon dioxide. In the UK, calibrated gas mixtures can be purchased from the large gas suppliers such as Air Products and BOC as well as several specialist suppliers.

Verification

Verification involves applying gases of known composition (the so called 'standard' or 'calibration' gases) to an analyser in normal measurement mode and checking that it gives results consistent with the gases applied, i.e. it proves its accuracy and takes the well proven approach of "if it works - don't fix it". The gas is introduced into the analyser using the standard syringe injection technique - see next page. Several injections of any one gas can be quickly analysed to give a very thorough check.

As an additional approximate check, gas mixtures can be generated by diluting 100% gases with air using a standard graduated 20ml syringe. Use the table below to select the required concentration and then follow the directions given on the following page. Mixtures generated using CO₂ or O₂ volumes of less than 5ml tend not to be very accurate because of the syringe dead volume. The technique is not reliable if, instead of drawing in air to dilute the first gas, the syringe is filled from a second pressure source. i.e. 100% oxygen + 100% carbon dioxide mixtures cannot be made reliably.

Gas volumes	Resultant mix	Gas volumes	Resultant mix
5ml CO ₂ + 15ml Air	25%CO ₂ : 15.7%O ₂ : 59.3% Bal	5ml O ₂ + 15ml Air	40.7%O ₂ : 59.3% Bal
10ml CO ₂ + 10ml Air	50%CO ₂ : 10.5%O ₂ : 39.5% Bal	10ml O ₂ + 10ml Air	60.5%O ₂ : 39.5% Bal
15ml CO ₂ + 5ml Air	75%CO ₂ : 5.2%O ₂ : 19.8% Bal	15ml O ₂ + 5ml Air	80.2%O ₂ : 19.8% Bal

Mixtures made using the other graduations can be calculated using the following formulæ.

If the starting volume of 100% CO₂ is V then:

$$\%O_2 = 21 - (1.05 \times V) \text{ and } \%CO_2 \text{ is } 5 \times V$$

If the starting volume of 100% O₂ is V then:

$$\%O_2 = 21 + (3.95 \times V)$$

Balance % is 100 - (%CO₂ + %O₂) in both cases.

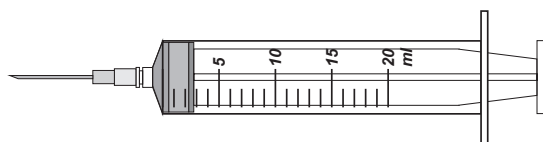
Calibration – refer to the analysers operational manual for full details

The sensors used in Hitech MAPtest 3000 and 4000 analysers are extremely stable only loose their calibration by abuse or normal ageing (typically several years). Other models, (800 and 3000G) that use the 'G' type oxygen sensor, move only slightly with atmospheric pressure changes.

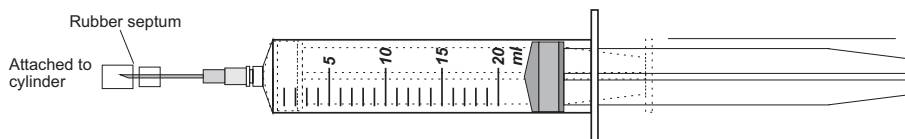
Calibration involves applying gases of known concentration to the analyser when it is set into what is referred to as calibration mode.

In this mode the user is prompted to introduce up to three calibration gases. At each of the three steps the analyser's software adjusts its calibration data information to make the analyser read the correct concentration. Although the process is comparatively straightforward, and the analysers have a degree of error checking, scope exists for things to go wrong. The most common errors are: insufficient purging of the calibration gas system – pressure reducers/gauges, pipework etc.; insufficient purging of the syringe used to apply the sample; use of a used/worn septum in the injection port; incorrect setting-up of the calibration gas data prior to calibration. The best 'all-round' gases to use for calibration are 100% oxygen 100% carbon dioxide and air. This is because they are better than the ±2% accuracy of mixtures, more easily obtained and cheaper. The digital linearisation process for the sensors is built into the software and is very accurate, so calibrating with these gases allows for accurate interpolation of concentrations of less than 100%. Once an instrument is calibrated it should always be verified in normal measurement mode with the gases used for calibration.

Note: The MAPtest 3050 is used for modified atmosphere packaging gas tests.

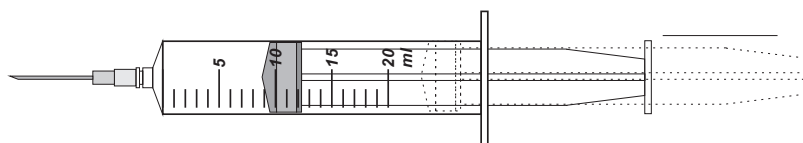


1 Fit a small gauge (20/25G) hypodermic needle to a 20ml syringe and completely discharge it.

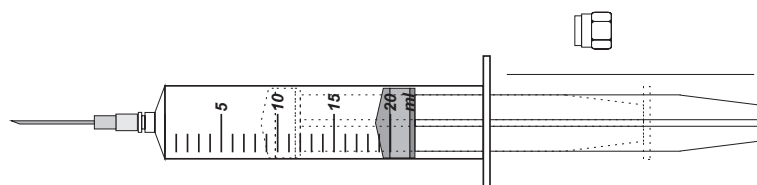


2 Using the cylinder pressure of the oxygen or carbon dioxide, fill the syringe to beyond the 20ml point. This operation is best achieved by having a fitting attached to the cylinder equipped with a septum as illustrated.

Note: Initially, partially fill and empty the syringe several times to ensure that the cylinder fittings and the syringe are thoroughly flushed with the gas.



3 Slowly discharge the syringe until the first sealing flange of the piston is divided by the required calibration mark (refer to table). NOTE: If you over-shoot the calibration mark chose another one to work to or completely discharge the syringe and start again.



4 Slowly draw the piston back until the 20ml mark is lined up with the piston as before. Discharge the mixture into the analyser immediately.

NOTE: If you over-shoot the 20ml calibration mark, completely discharge the syringe and start again.