



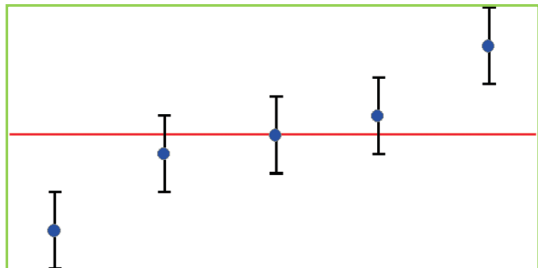
what is measurement uncertainty?

The measurement uncertainty of analytical results is made up of the random error (standard deviation) and the unknown systematic errors caused by the measuring instruments and reference substances used. Such unknown systematic errors are e.g. deviations in the actual volumes of volumetric flasks and pipettes from the designated volumes, the purity of reference substances, deviations in weight from the values indicated by laboratory balances etc.

The measurement uncertainty is thus always greater than the standard deviation. However, determination of the measurement uncertainty of analytical processes is a somewhat time consuming procedure.

why is measurement uncertainty so important?

Analytical results can be evaluated more precisely if the measurement uncertainty is known, e.g. by indicating error ranges. In such case it becomes quite clear whether a particular result is above or below the specified limit.



The UncertaintyManager®

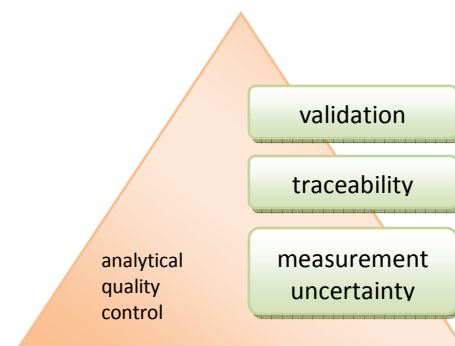
The UncertaintyManager® software determines the measurement uncertainty of the following analytical procedures quickly and reliably:

- Volume, mass and concentration
- HPLC (in this case, also photometry)
- Titration
- ICP-OES (in this case, also AAS)
- Organic and inorganic sample preparation

You can now determine the Measurement Uncertainty of your analytical results rapidly and reliably with the

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Uncertainty Manager® Software



UncertaintyManager®

The software that saves time and money when calculating the measurement uncertainty of analytical results



example:

Preparation of a standard solution of caffeine with a concentration of approx. 1 g/L.

● procedure 1:

Approximately 20 mg of caffeine (standard analytical balance) are placed in a 20 mL volumetric flask, dissolved, and made up to the mark with water. The instruments used and the purity of the standard (in this case 99 – 100%, uncertainty 1%) as well as their measurement uncertainties are then selected from the database of the UncertaintyManager®. The overall measurement uncertainty of the procedure is then calculated.

● result:

Concentration	Absolute measurement uncertainty	Relative measurement uncertainty																								
c = 0,9403 g/l	u(c) = 0,0125 g/l	u(c;rel)= 1,33 %																								
<table border="1"> <thead> <tr> <th>Influences</th> <th>Value</th> <th>Unit</th> <th>Contribution</th> </tr> </thead> <tbody> <tr> <td>c</td> <td>0,0125</td> <td>g/l</td> <td></td> </tr> <tr> <td>Rep</td> <td>-0,000626</td> <td>g/l</td> <td></td> </tr> <tr> <td>Purity</td> <td>0,30122</td> <td>g/l</td> <td></td> </tr> <tr> <td>V</td> <td>-0,0000252</td> <td>g/l</td> <td></td> </tr> <tr> <td>m</td> <td>0,30679</td> <td>g/l</td> <td></td> </tr> </tbody> </table>			Influences	Value	Unit	Contribution	c	0,0125	g/l		Rep	-0,000626	g/l		Purity	0,30122	g/l		V	-0,0000252	g/l		m	0,30679	g/l	
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Contributions to measurement uncertainty:

- Rep: Repeatability (standard deviation)
- Purity: Purity of the standard
- V: Volumetric flask
- m: Laboratory balance

The measurement uncertainty of the standard solution is high at $\pm 1.3\%$. The principal reason is the high measurement uncertainty of the balance. Conclusion: 20 mg is too low an amount for this particular balance.

● procedure 2:

Approximately 100 mg of caffeine are placed in a 100 mL volumetric flask, dissolved, and made up to the mark.

● result:

Concentration	Absolute measurement uncertainty	Relative measurement uncertainty																								
c = 0,97014 g/l	u(c) = 0,00629 g/l	u(c;rel)= 0,648 %																								
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The measurement uncertainty of procedure 2 is now (approx. $\pm 0.6\%$) only half of that of procedure 1. The principal contribution to uncertainty is no longer the balance but the purity of the standard. The procedure could thus be further optimized by using a standard of higher purity.

The UncertaintyManager® can thus not only be used for the calculation of the uncertainty of existing procedures; it can be used to simulate and optimize new procedures.

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