Supplement to the Operating Instruction AE240 for the METTLER TOLEDO Analytical Balance AE101 Semimicro Balance

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The entire information package for the AE101 semimicro-balance is consisted of:

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Important notice:

The AE101 Semimicro Balance was designed for scientific functions.

The resolution of the weight is very high. The readability of the balance is up to 0.01 mg. In order to get reliable results, a number of precautions have to be taken which are described in the enclosed brochure “Weighing The Right Way”. Two of the described sources of errors (air buoyancy, water adsorption on surface of tare and sample) will be handled more detailed below as these errors occur in almost all weighings.

IN ORDER TO OBTAIN THE BEST POSSIBLE WEIGHING ACCURACY, WE RECOMMEND THAT THE AE101 SEMI-MICRO BALANCE IS BEING INSTALLED BY A METTLER TOLEDO SERVICE TECHNICIAN.

Weighing Error:

Air buoyancy

When making precision weighings in air, the weighing error due to air buoyancy can be accuratly compensated when knowing the air pressure p, the temperature t (°C) and the relative humidity h (%). First one must calculate the air density (in kg/m³ or g/l).

If p is expressed in <u>torr</u> then the air density (Da) is equal to:

$$Da = \frac{0.464554 * p - h\,(0.00252 * t - 0.02058)}{273{,}15 + t}$$

If p is expressed in <u>mbars</u> or <u>hpa</u> the air density (Da) is equal to:

$$Da = \frac{0.348444 * p - h\,(0.00252 * t - 0.02058)}{273{,}15 + t}$$

Be sure to use the real barometric pressure and not the barometric pressure as calculated from sea level.

In many cases it will be enough to use a mean air density, in which case you can use the standard ICAO (<u>I</u>nternational <u>C</u>ivil <u>A</u>viation<u>O</u>rganization) atmosphere.

This amounts to Da = 1.2250 kg/m³ at sea level
or Da = 1.1673 kg/m³ at 500 meters above sea level

The mass of the sample is calculated as follows:

$$m = nw * \frac{1 - Da / Dg}{1 - Da / Dx}$$

where m = mass of sample
nw = weight value (indicated result on display)
Da = air density in kg/m^3
Dx = density of sample in kg/m^3
Dg = density of ca. weight in kg/m^3

Example: **determine the real mass of glass container**

air pressure	p = 715 torr
temperature	t = 20 °C
relative humidity	h = 70%
density of sample	Dx = 2500 kg/m^3
weight value	nw = 90,00000 g
density of cal. weight	Dg = 8000 kg / m^3

$$Da = \frac{0.464554 * 715 - 70 (0.00252 * 20 - 0.02058)}{273,15 + 20}$$

Da = 1,126 kg/m^3

$$m = 90,00000 * \frac{1 - 1.126 / 8000}{1 - 1.126 / 2500}$$

m = 90,02788 g
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If the glass sample happens to be a tare container, the difference between the weight value (nw) and the mass (m) of the container is of no importance because it is tared out. However, if the environmental conditions (barometric pressure, temperature, relative humidity) change during the weighing process, the weighing error of the tare is fully transmitted to the sample.

If the barometric pressure changes 1% to p = 722 Torr, the weight value (nw) of above example would change from 90.00000 g to 89,99973 g. If the temperatur would change 1°C, nw would change to 90,00011 g. A change in relative humidity of 10% can be neglected.

The above example shows how important it is to have constant environmental conditions if highly accurate results are required. At the same time, the example demonstrates that one should always try to use small tare containers.

Weighing Error:

Water adsorption on surface of tare and sample

Already under normal environmental conditions surfaces are coated with a thin water film. When the temperature changes the water film increases or decreases, resulting in a drifting of the weight value. Equilitrium is only reached after about 15 minutes.

A temperature change of 1°C can result in a difference of up to 1 mg when using a large tare. The difference can be even greater for containers with rough and porous surfaces.

To avoid this weighing error the tare and the sample should be acclimatisized in the weighing chamber. Or, for comparative weighings, the same weighing procedure should be used.

In order to get accurate weighing results one should again try to have constant environmental conditions use small tares.

Specifications AE101 Semimicro Balance

Readability	0,01 mg
Weighing range	100 g
Tara range (subtractive)	100 g
Reproducibility (standard deviation)	0,025 mg
Linearity	+/- 0,1 mg
Linearity to 5 g	+/- 0,02 mg
Stabilization time (typically)	8 sec
Integration time (adjustable)	3/6/12 sec
Display sequence - METTLER DeltaDisplay off	0,4 sec
- METTLER DeltaDisplay on	0,2/0,4 sec
Stability detector	
- Sensitivity selectable in three steps	1/2/off
Sensitivity drift (10...30 °C)	± 2 x 10^{-6} /°C

- Example:
  Temp.change + 1 °C, 10 g weight on balance
  Sensitivity drift = (Temp.change in °C) * (weight in g) * 2 * 10^{-6}
  = 1 * 10 * 2 * 10^{-6} g = 0,02 mg

Calibration weight (built-in), adjusted to an apparant mass of 8.0 g/cm^3 in an air density of 1200mg/l	100g, adjusted to ± 0.1 mg
Dimensions: - Weighing pan (stainless steel)	80 mm dia.
- Open space above weighing pan	215 mm
- Balance housing (W x D x H)	205 x 410 x 290 mm
- Net weight	10,3 kg

Power supply:	**- Voltage adjustable**	**115 V / 220 V**
	- Admissible voltage range	**92...132 V, 184...265 V**
	- Frequency	**50...60 Hz**
	- Power consumption	**10 VA**

Admissible ambient conditions during operation:

Temperature	**15...30 °C**
Relative humidity (non-condensing)	**25...85%**

For operating instructions see those of AE240 Dual Range Balance.