Understanding and Using the MC Series

After reading this Product Note, you should be able to:

1) Understand how the MC Series is specified.
2) Determine if the MC Series is right for your application.
3) Test and confirm the actual performance of your unit.

Introduction.

MC Series balances are designed for weighing applications where additional resolution is desired. For specific range of weight classes, they may also be used as mass comparators.

A critical element to successful weighing with the MC is a benign and constant environment. This is more than simply maintaining a constant temperature because air conditioning systems will often blow copious amount of air in order to keep the room temperature at a set point.

The inner environment also needs to be considered-balances should always be given ample time to warm-up, from 24 to 72 hours minimum, depending on conditions.

As a general rule, balances should be plugged-in and kept on at all times so that they are warmed-up and ready for use.

The MC Series spans as many as 10 million divisions, in the case of the MC-1000, comparable with that of microbalances. And, as with microbalances, a stable anti-vibration bench, good environment and a smooth, constistent interaction with the balance are key to successful results.

1. Understanding how the MC Series is specified.

Let's look at the key specifications of the MC-6100:

Specifications	Sample weight range	MC-6100	Units
Capacity		6100	g
Readability		0.0010	g
Repeatability (σ)	‹ 2000 g	0.0015	g
	2000 to 5000 g	0.0040	g
	5000 to 6100 g	*not specified*	
Linearity		± 0.0300	g
Sensitivity Drift		± 2	ppm / °C

Table 1.

These specifications are based on use of the auto-centering pan, pictured below, or when loading and unloading are performed using an automatic (robotic) loading machine under good ambient conditions.

The auto-centering pan eliminates eccentricity and is required to meet the published specifications of the MC Series.

Model	Description
AX-MC1000PAN	Autocentering pan for MC-1000
AX-MC6100PAN	Autocentering pan for MC-6100
AX-MC10K-30KPAN	Autocentering pan for MC-10/30K

In many precision and some analytical balances, the repeatability is equal to the readability (resolution). In contrast, however, the MC Series is specified differently. Looking at the table 1, we could recast the specifications in terms of division equivalents:

Specifications	Sample weight range	σ in (g)	equivalent displayed divisions
Repeatability (σ)	‹ 2000 g	0.0015	1 ½
	2000 to 5000 g	0.0040	4
	5000 to 6100 g	*not specified*	
Linearity		± 0.0300	30

Table 2.

Repeatability is determined through standard deviation, namely the square root of the average of the squared differences from the mean. Take 10 readings (see section 3.) and calculate using the formula below, or the STDEV function in Excel ™.

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

2. Will the MC work for my application?

The primary application of the MC Series is as a precision balance with extended resolution. It may also be suitable for use as a mass comparator under certain conditions.

However, it is important to understand the specifications and performance characteristics discussed above. Conventional corner load testing, for example, is not relevant to the MC Series as the required autocentering pan eliminates corner loading.

3. How to weigh on an MC.

3.1 Plug-in the MC and turn on. Level the balance and allow to warm-up for 24 hours, preferably 48. Assure that room conditions are ideal for weighing: constant temperature with no drafts or air currents. Keep in mind that air microcurrents, including convection flows from, say, a colder floor, and which are undetectable to a person, may still adversely affect weighing.

3.2 For the mass to be compared, say 5 kg, place the mass on the balance for 24 hours. This step allows the balance to become accustomed to the stress of loading. It also improves long term (creep) behavior. Remove after 24 hours.

3.3 Place the reference weight on the pan and remove it. Repeat twice more. This releases internal stress built-up from the previous step above. Wait 5 minutes.

3.4 Weigh. In a careful and consistent manner, place the sample or reference weight on the auto-centering pan. When ○, the stable indicator, lights up, record the value.

3.5 If the sample is left on the pan, the display value will start to change, this is normal. This is due to creep of the zero value. Balances are designed to produce repeatable, consistent span values. Zero drift added to a constant span appears as if the measurement is drifting.
Of course, this effect is avoided by re-zeroing and making measurements crisply so as to avoid this physical phenomenon.

3.6 Repeat the measurement and calculate repeatability.

Appendix

Modern analytical and precision balances primarily use the electro-magnetic equilibrium method, whose main component is commonly known as a force restoration motor.

Increasing demands for technical reference standards led to the development of the MC Series. As it turns out, the ability to achieve a stable display of an extra digit of resolution was confirmed when product development started more than a decade ago.

However, the difficulty of dealing with corner errors and achieving adequate performance over the entire weighing capacity required the development of additional accessories, specifically the Auto Centering pans for the MC Series.

References

MC 1000 / 6100 Instruction Manual and MC 10K / 30 K Instruction Manual, both available at:
http://www.andonline.com/weighing/products/details.php?catname=Balances&product_num=MC_Series

NIST - Calculation of standard deviation
http://www.itl.nist.gov/div898/handbook/mpc/section3/mpc3334.htm

Development of the MC Series of High-resolution Balances (Mass Comparators)
http://www.aandd.jp/support/dev_stories/story9.html

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