About Minimum Weight

USP

In the pharmaceutical industry, the United States Pharmacopoeia's (USP) set of standards for managing balances is widely recognized around the world.

According to USP General Chapter <41> "Balances", for substances to be accurately weighed, the balance used must be calibrated over the operating range and meet the following requirements defined for **repeatability** and **accuracy**:

Repeatability requirements

1) Repeatability is assessed by measuring one test weight not fewer than 10 times
2) Repeatability is satisfactory when two times the standard deviation (S.D.) of the weighed values, divided by the nominal value of the weight used, does not exceed 0.10%

These conditions can be expressed as:

(2 × S.D. of not fewer than 10 repeated weighings) / nominal value of the weight used ≤ 0.10%

From this, the lower end of the measurement range is determined, which translates to:

Minimum weight = 2000 × Repeatability (S.D.)

Further,

3) When the S.D. obtained is smaller than 0.41d (d = scale interval), that S.D. is replaced with 0.41d

Minimum weight is the minimum sample quantity required to perform an accurate quantitative analysis with the measurement error of the balance used taken into account. If the sample quantity is too small, the measurement error will take up too large a portion of the measured value, making the result of the analysis unreliable.

Accuracy requirements

1) Using a suitable weight(s), accuracy is satisfactory when the measured value does not deviate by more than 0.10% of the test weight value

2) A suitable test weight has a mass between 5% and 100% of the capacity of the balance
3) The maximum permissible error, or alternatively the calibration uncertainty, of the test weight is not more than 1/3 of the applied test limit of the accuracy test

► Examples of minimum weights (for reference)

Readability	Model	Specifications		Minimum weight (typical)*3
		Capacity	Repeatability (S.D.)	
0.001 mg	BM-20	22 g	2.5 µg*1	3.0 mg
	AD-4212D-33	32 g	2.0 µg*1	3.0 mg
0.01 mg	BM-252	250 g	0.03 mg*2	20 mg
	GH-252	101 g (fine range)	0.03 mg	24 mg
	GH-202	51 g (fine range)	0.02 mg	24 mg
	HR-202i	51 g (fine range)	0.02 mg	24 mg
	GR-202	42 g (fine range)	0.02 mg	30 mg
	AD-4212D-302	320 g	0.02 mg*4	20 mg
0.1 mg	BM-500	520 g	0.2 mg	120 mg
	GH-200	220 g	0.1 mg	120 mg
	GR-200	210 g	0.1 mg	120 mg
	HR-250AZ	252 g	0.1 mg	140 mg
	HR-250A	252 g	0.1 mg	140 mg
0.001 g	GX-203A	220 g	0.001 g	1.4 g
	GF-203A	220 g	0.001 g	1.4 g
	GX-200	210 g	0.001 g	1.4 g
	GF-200	210 g	0.001 g	1.4 g
	FZ-200i	220 g	0.001 g	1.4 g
	FX-200i	220 g	0.001 g	1.4 g
0.01 g	GX-2002A	2200 g	0.01 g	14 g
	GF-2002A	2200 g	0.01 g	14 g
	GX-2000	2100 g	0.01 g	14 g
	GF-2000	2100 g	0.01 g	14 g
	FZ-2000i	2200 g	0.01 g	14 g
	FX-2000i	2200 g	0.01 g	14 g

*1 Specification for a 1 g weight

*2 Specification for a 100 g weight

*3 Based on actual repeatability measured using a weight of 5% of the capacity of the balance, which was properly calibrated (adjusted) and operating in a favorable environment

*4 Specification for a 10 g weight

In order to determine the minimum weight for a balance, repeatability needs to be assessed in the actual environment where the balance is used. For a balance with 0.1 mg or finer resolution, it is important to ensure a good environment as repeatability is influenced by environmental conditions as well as the balance's settings.