LABORATORY METHODOLOGY

Centrifugation: ×g or rpm?

Why centrifugal force must be expressed in universal units in scientific publications

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The problem: rpm ≠ force

Rotor A

rmax = 10.8 cm

3,000 rpm

= 1,090 ×g

≠

Rotor B

rmax = 8.5 cm

3,000 rpm

= 858 ×g

Same angular velocity → different forces (–21%). A protocol reporting only rpm cannot be reproduced across laboratories.

The formula: rpm → ×g

$$RCF = 1.118 \times 10^{-5} \times r \times N^2$$

RCF
Relative centrifugal force (×g)

r
Rotor radius in cm

N
Rotational speed in rpm

Physical origin

Derived from $F = m\omega^2 r$,
with $\omega = 2\pi \cdot N/60$ and normalization by $g = 9.81\ m/s^2$

How to use it

Enter r in cm (from the rotor manual) and N in rpm. The result is the multiple of gravitational force applied to the sample.

Where to find the rotor radius

1. Rotor manual / datasheet

Technical specification on the manufacturer's website (Beckman, Eppendorf, Thermo). Reports rmin, ravg and rmax for each tube configuration.

2. Centrifuge display

Modern models show the rpm ↔ ×g conversion in real time, automatically recognizing the installed rotor.

3. Engraved on the rotor / nomogram

Many rotors have values printed on their surface. Also check the nomogram attached to the centrifuge.

Which radius to use?

rmax

Cell and bacterial pellets. Ensures complete recovery. **Standard for publications.**

ravg

Density gradients (sucrose, CsCl). Midpoint of the gradient.

rmin

Rarely used: describes the minimum force (top of the tube).

Tip: before every experiment, always note down the rmax of your rotor and keep it with your data.

A classroom calculation

Protocol: 3,000 rpm, rotor with rmax = 10.8 cm

Lab A (your lab)

rmax = 10.8 cm

N = 3,000 rpm

$$RCF = 1.118 \times 10^{-5} \times 10.8 \times 9{,}000{,}000$$

= 1,090 ×g

✓ Complete pellet

Lab B (replication)

rmax = 8.5 cm

N = 3,000 rpm

$$RCF = 1.118 \times 10^{-5} \times 8.5 \times 9{,}000{,}000$$

= 858 ×g

⚠ −21%: incomplete pellet!

THE KEY MESSAGE

rpm describes

the machine

→

not universal

×g describes

the experiment

When you publish, describe **what happens to the sample**,
not how you set the instrument.