



Rimfire Custom Drag Curve (CDM) - Data Sources & Cost

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A practical guide to the Advanced Drag (RA4 / Multi-BC / CDM) feature in Shooting Solution: the free built-in RA4 option, what the CDM input actually needs, and where to source real Cd(Mach) data for rimfire loads that need it.

What This Feature Is

The Shooting Solution Advanced Drag panel offers three ways to go beyond a single BC value: RA4 (a built-in .22 LR drag curve, free and no data entry), Multi-BC (2-3 velocity-banded BC values you supply), and CDM - Custom Drag Model (a full Cd-vs-Mach curve you supply).

RA4 is the zero-effort option: select it and it just works, using your bullet's real weight and diameter against a fixed, built-in .22 LR drag curve. It only appears as an option for rimfire rifles, and it is calibrated specifically to a 40gr .22 LR solid - see "RA4: Start Here" below.

Multi-BC is the low-effort, self-supplied option: enter a BC that applies above a velocity threshold and another that applies below it. Good enough for most rimfire use out to typical match/hunting distances.

CDM is the high-effort, high-precision option: it bypasses BC entirely and integrates drag directly from your own pasted Cd(Mach) points. This matters most for rimfire because a .22-class round decelerates through the transonic region (around Mach 1) within the first 50-100 m, where a single BC does not hold.

Only one mode is active at a time, set by the Drag method dropdown (BC, CDM, or RA4). Multi-BC only has an effect when Drag method is set to BC; it is ignored while CDM or RA4 is selected.

RA4: Start Here (Free, Built In)

RA4 is a published standard drag function for a 40gr .22 LR solid projectile - identical to the G1 standard below 1400 fps, and diverging above it to track how .22 LR actually decelerates through the transonic region. Source: JBM Ballistics' public RA4 drag table.

Because it is a fixed, built-in table, selecting RA4 needs no BC, no pasted curve, and no testing of any kind - just pick it from the Drag method dropdown on a rimfire rifle.

RA4 is specific to .22 LR-shaped bullets. It is not a valid stand-in for other rimfire calibers - .22 WMR, .17 HMR, .17 HM2, and .17 WSM use meaningfully different (typically pointed, polymer-tipped) bullet shapes, so the app only offers RA4 as an option when the selected rifle is .22 LR.

If your rifle is not .22 LR, or you need more precision than a standard published curve can offer, use Multi-BC or CDM instead - see the options below.

What "Cd" Means In The CDM Box



The pasted numbers are not a BC. The solver uses your bullet's real diameter and weight together with the pasted Cd value to compute drag directly: $\text{acceleration} = -0.5 \times \text{air density} \times \text{Cd} \times \text{frontal area} / \text{mass} \times \text{velocity}^2$.

This is the actual physical drag coefficient of your bullet's shape at a given Mach number, not a BC relative to a standard reference projectile. Pasting a generic standard drag table (G1, G7, etc.) as-is assumes your bullet has the same shape as that reference projectile, which it does not.

Format: one point per line, "mach,c" (e.g. 0.5,0.35). Space-separated also works. Points are sorted by Mach number automatically; malformed or negative lines are ignored.

The solver linearly interpolates between your pasted points at every step of the trajectory, and holds the nearest end value for any Mach number outside your pasted range.

Where To Get Data For Your Own Curve

Everything below is for Multi-BC or CDM - only relevant if RA4 does not apply to your rifle (not .22 LR) or you need more precision than it offers.

Option A: Derive it from a BC you already have

Cost: Free

- The app already has the standard G1 drag table built in. Every BC is really a form factor (i = sectional density / BC) relative to that standard shape.
- Compute sectional density from your bullet's weight and diameter (0.223 in for .22 LR), work out the form factor from your known BC, then multiply that constant across the standard G1 Cd table at several Mach points (e.g. 1.3, 1.1, 1.05, 1.0, 0.95, 0.9, 0.8, 0.7) to get your mach,c pairs.
- This reproduces your existing single-BC behaviour in curve form. It will not fix an inaccurate BC, but it is a zero-cost starting point and needs no extra equipment.

Option B: Back-solve it from a manufacturer's published trajectory table

Cost: Free (if available)

- Some match rimfire makers (Lapua, Eley, RWS, SK) publish actual velocity-at-distance tables for specific loads, not just a single BC.
- Between two known distances, $\text{deceleration} = (v_1^2 - v_2^2) / (2 \times \text{distance})$. Convert that to Cd with: $\text{Cd} = -2 \times \text{deceleration} \times \text{mass} / (\text{air density} \times \text{frontal area} \times \text{velocity}^2)$, using the segment's average velocity for the matching Mach number.
- Each pair of table entries gives one mach,c point. Worth checking your ammo maker's technical documentation before doing any of your own testing.

Option C: Measure it yourself with a chronograph at multiple distances

Cost: Approx. \$100-300 (one-time, if you do not already own a chronograph)

- Same back-solve formula as Option B, but you generate your own velocity-at-distance data: chronograph at the muzzle, then at several downrange stations (e.g. 25 m, 50 m, 75 m, 100 m), using a consistent ammo lot and stable conditions.
- Basic optical chronographs (Caldwell, Competition Electronics ProChrono) run roughly \$100-150. A barrel-mounted MagnetoSpeed is more consistent, around \$200.



- This is the most practical route for a curve tailored to your actual rifle and ammo, rather than a generic published number.

Option D: Doppler radar or published rimfire drag research

Cost: Approx. \$550-650 for a consumer unit; tens of thousands for professional-grade radar

- Consumer doppler chronographs (LabRadar, Garmin Xero C1) capture continuous velocity vs. time/distance in one shot string, giving much denser data than manual station readings. They still require the same back-solve math afterward - they do not output a ready-made Cd(Mach) table.
- True professional doppler radar (the class of equipment Applied Ballistics uses to build their published drag models) is not practical for an individual to own.
- Leaning on published rimfire drag research (e.g. Bryan Litz / Applied Ballistics rimfire testing, roughly \$30-40 for the relevant book, or an AB Analytics/Kestrel subscription) gives access to expert-measured curves for a handful of common loads, but the data is not exportable - values would need to be transcribed by hand from whatever is presented.

Recommended Approach

- On a .22 LR rifle: select RA4 first. It is free, built in, needs no data entry, and already fits .22 LR's subsonic/transonic behaviour better than a flat BC.
- On any other rimfire caliber (.22 WMR, .17 HMR, .17 HM2, .17 WSM), RA4 does not apply - start with Option B below: check whether your specific match ammo already publishes a multi-distance velocity table. If so, this is free and needs no extra equipment.
- If not, Option C (chronograph readings at 2-4 distances) is the best practical method for most shooters - low cost, and it reflects your actual rifle and ammo rather than a generic published number.
- Reserve a full custom CDM curve for extended-range work where even RA4 or Multi-BC are not precise enough. For normal use, the built-in Multi-BC bands feature captures most of the transonic benefit with far less effort: two chronograph readings (near-muzzle and past-transonic) are usually enough to populate two velocity-banded BCs.
- A JBM Ballistics-style external drag-function library was considered for anything beyond RA4 and is not useful: it only offers the same public-domain standard shapes (G1, G2, G5, G6, G7, G8, G1, GL) already available, not measured per-load rimfire data. It would not improve rimfire accuracy over what this app already computes locally.