K-Brake™ Ultracompact Suppressor Brake

Engineering the Balance: Achieving Full-Size Performance in an Ultrashort Design

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Executive Summary

The **K-Brake™ Ultracompact Suppressor Brake** was developed to achieve what no suppressor-mounted brake had before: **meaningful recoil reduction with true hearing-safe sound performance**, all in a form adding only **0.165"** to suppressor length. Through a data-driven, iterative development process combining precision recoil measurement and advanced acoustic analysis, we refined a unique **Convergent-Divergent-Convergent (CDC)** geometry that delivers the efficiency of a full-size multi-baffle brake in an ultrashort design. Testing confirmed up to a **67% increase in overall recoil reduction** and an **RSI of 2.8–4.1**, representing one of the most efficient recoil-to-sound trade-offs recorded. The K-Brake suppressor brake sets a new benchmark for suppressor-mounted performance — compact, effective, and uncompromising.

Development and Testing Process

The **K-Brake™ suppressor brake** was developed through an extensive and data-driven iterative testing process, all in pursuit of one clear objective: to deliver the recoil-reducing performance of a full-size multi-baffle brake while adding minimal length and weight to the suppressor — all without significantly degrading sound performance.

To achieve this goal, we used a combination of **state-of-the-art acoustic measurement systems** and a **high-precision ballistic pendulum** to collect accurate, repeatable data on both recoil and sound. Alongside our own prototypes, we also tested competitor benchmark brakes to establish meaningful performance baselines. Dozens of prototype configurations were then evaluated through iterative live-fire testing, allowing us to refine geometry step by step toward an optimal balance of recoil reduction and acoustic efficiency.

Preliminary testing showed a consistent pattern across all suppressor brakes: compared with a traditional front cap, sound pressure level (SPL) increased most at the shooter's ear, while microphones positioned 1 meter lateral to the muzzle typically recorded only minimal change. Because brakes are frequently used in hunting and other practical field applications — where the sound perceived by the shooter is most relevant — the shooter's-ear data served as the foundation for our acoustic performance analysis.

Early testing revealed the fundamental challenge. Designs that achieved substantial recoil reduction often produced unacceptable increases in peak sound pressure levels, while

configurations that preserved excellent sound performance delivered only marginal recoil improvement. We observed these same trade-offs across all competitor benchmark brakes as well, confirming that the optimal solution would not come from simply adding ports or volume, but from **precise geometric refinement**.

To guide development, we established two proprietary performance metrics that quantify both total performance and efficiency:

- **Overall Performance Index (OPI):** measures the relative improvement in recoil reduction compared to a traditional suppressor front cap. Our target OPI was **60%** — meaning that for a suppressor achieving 25% recoil reduction, a 60% OPI would increase that value to 1.6 × 25% = 40%.
- **Recoil-Sound Index (RSI):** describes how efficiently a design converts added sound energy into recoil reduction. RSI is calculated by dividing the *increase in recoil reduction (%)* by the *increase in peak sound pressure level (dB)*. **Higher RSI values indicate a more favorable tradeoff between sound and recoil reduction.**

Through extensive experimentation, we found that traditional multi-port geometries could not meet both targets within the compact form factor we required. The breakthrough came with the development of a unique **Convergent-Divergent-Convergent (CDC)** bore geometry — a carefully tuned internal profile that shapes gas expansion and flow dynamics within an ultrashort volume. After more than a dozen CDC profile iterations, we refined the geometry to maximize both RSI and OPI. The result is a compact unit—only **0.165"** longer than a standard front cap—that delivers near full-size multi-baffle brake performance.

In final testing, the **K-Brake™ suppressor brake** consistently delivered an approximately **63-67%** increase in overall recoil reduction compared to a traditional front cap and achieved an **RSI of 2.8–4.1** depending on caliber — meaning the shooter gains roughly **2.8–4.1%** additional recoil reduction for every **1 dB** increase in peak sound. Among all test configurations, these were the **highest RSI values achieved**.

Performance Data

Testing was conducted under controlled live-fire conditions to evaluate both absolute and comparative performance. Recoil reduction was measured using a high-precision ballistic pendulum, and sound data were recorded at the shooter's ear. Each value shown represents the average of five shots per configuration.

Table 1 — K-Brake™ vs. Competitor Brakes (.308 Win)

Device	Recoil Reduction Increase from Baseline (%)	Peak SPL Increase from Baseline (Avg of 5 Shots) (dB)	Overall Performance Index (OPI) (%)	Recoil-Sound Index (RSI) (%gain/dB)
K-Brake™ w/ CDC Technology	**15.1%**	**5.4**	**66.7%**	**2.8**
Competitor Benchmark Compact Single-Baffle	8.7%	3.6	38.3%	2.4
Competitor Benchmark Full Size 3-Baffle Brake	20.6%	12.9	90.7%	1.6

Baseline: 22.7% - TiTrex-300 w/ UFC-300 on 20" Barrel, Savage 110 shooting Federal XM80 149gr

Interpretation:

The **K-Brake™ suppressor brake** demonstrated the most balanced performance of all devices tested. The full-size 3-baffle benchmark brake achieved the highest OPI (90.7%), but its **RSI of 1.6** revealed a heavy acoustic cost for those gains. The compact single-baffle brake delivered a respectable RSI (2.4) but an overall performance increase too small to be meaningful in practice. The **K-Brake™ suppressor brake** achieved both—a **strong 66.7% OPI** with a **high RSI of 2.8**—delivering measurable recoil improvement with minimal added sound.

Table 2 — K-Brake™ Performance Across Calibers

Ammunition (Bullet Weight / Barrel Length)	Baseline Recoil Reduction (%)	Recoil Reduction Increase from Baseline (%)	Peak SPL Increase from Baseline (Avg of 5 Shots) (dB)	Overall Performance Index (OPI) (%)	Recoil-Sound Index (RSI) (%gain/dB)
308 Win 149gr/20"	22.7%	15.1%	5.4	**66.7%**	**2.8**
223 Rem 55gr/16"	31.9%	19.9%	4.8	**62.4%**	**4.1**

Interpretation:

Spanning opposite ends of the most common small-arms cartridge spectrum, the **K-Brake™ suppressor brake** maintained high efficiency and consistent performance. The lighter **.223 Rem** platform showed higher RSI scores, indicating even greater efficiency on smaller-caliber rifles. In both cases, results confirm that the **CDC geometry** scales effectively—delivering substantial recoil reduction with minimal added sound.

The Bottom Line:

The **K-Brake™ suppressor brake** is a revolutionary advancement in compact recoil technology. With its **proprietary CDC geometry**, it's the only brake capable of delivering **meaningful recoil reduction while remaining hearing safe**, and it achieves this while adding only minimal length to the suppressor — **just 0.165" more than a standard front cap**. Compact, efficient, and precision-engineered, the K-Brake™ suppressor brake sets a new standard for performance without compromise.

Appendix A — K-Brake™ Development on 308 Win, Full Test Specifications

Baseline Test Parameters

Suppressor:	TiTrex-300
Front Cap:	UFC-300 (Universal Front Cap, 30 Caliber)
Host Firearm:	Savage 110
Barrel Length:	20"
Ammunition:	Federal XM80
Recoil Reduction:	22.7% - (Recoil reduction of suppressor w/UFC compared to bare barrel)

Sound Measurement System

Mic Model:	PCB 378C10
Ear Mic Position:	0.85m Behind and 0.15m Left of Muzzle Exit
Calibrator Model:	LD CAL200 114dB
Sound Meter/DAQ:	NI PXIe-4480
Sample Rate:	1 Million Samples Per Second
System Rise Time:	<15µs
Resolution:	24 Bit
Software:	LabView 2019
Weighting:	Z (linear)

Recoil Measurement System

Device:	Ballistic Recoil Pendulum
Manufacturer:	Precision Armament
Mathematical Principle:	Conservation of Energy
Pendulum Mass:	44.43lbm
Pendulum Length:	59.59"
Pendulum Type:	Ceiling Hung, Dual Suspension Cables
Cable Pivots:	Low Friction Ball Bearings, Both Ends (< 3.0° rotation)
Trigger Pull:	Wireless Remote, Servo-Actuated
Assumed Energy Loss (Mechanical & Viscous Dampening):	<0.20%

Test Results

Device	Recoil Reduction Increase from Baseline (%)	Peak SPL Increase from Baseline (Avg of 5 Shots) (dB)	Overall Performance Index (OPI) (%)	Recoil-Sound Index (RSI) ($\%_{gain}$/dB)
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