

Chris Harkins Asks...

Why Do Old GM Brake Boosters Mount at an Upward Angle?

 Marlan Davis

Q: I've always wondered why the power-brake servos on many older GM rear-drive cars are angled up. Do you know?

A: The primary reason is for correct brake-pedal geometry. Back in the day, most GM vehicles were offered with both standard manual brakes as well as optionally with power-assisted brakes. The optimum manual-brake, pedal-to-master cylinder pushrod ratio (aka "pedal advantage") is around 6:1, compared to about 4:1 for power-assisted brakes that don't need as much pedal advantage because they "boost" the force generated by the average human leg. GM used a common brake pedal with two pushrod holes located about 1 to 1½ inches apart; the upper hole was for the 6:1 manual brakes and the bottom hole yielded the power-brake 4:1 ratio. When the brake pushrod was installed in the lower hole for use with power brakes, achieving the proper pushrod arc of travel, center of force, and proper alignment with the brake booster/master-cylinder assembly piston centerline required a firewall mounting bracket that positions the assembly at a fairly sharp "up-angle."

Over many years, this resulted in substantial savings for GM in parts and manufacturing costs, cutting the required number of brake pedals for any given model in half (from four to two: one for automatics, another for stick-shift transmissions). Drilling two pushrod holes in the pedal also allows a common firewall master-cylinder/vacuum-booster mounting pattern and a single, large center hole with any brake option. An additional benefit is increased fender and/or valve-cover clearance, critical with old-school big-block engines. (Even so, on many installations including Vettes and Camaros, the rear of the big-block driver-side valve covers was cut off at an angle for power-brake booster clearance.)

Generally the up-angle on a power booster/master-cylinder installation was at least 17 degrees, but if you look closely at an old stock manual brake setup, it often had a slight upward angle, too—about 6 degrees, which paralleled a typical GM engine installation's slight upward angle. Reasons for angling the engine slightly up include firewall clearance, ease of engine/trans assembly drop-in at the assembly plant, and/or achieving desirable driveshaft angles.



[This Classic Performance Products (CPP) power booster, dual master cylinder, and proportioning valve combo is representative of the OE power-brake system used on most classic 1967-and-later GM vehicles. The rear bracket bolts to the vertical firewall and angles the unit up about 17 degrees. CPP offers many variations, including retrofit kits for earlier vehicles.

 TEN Archives / Mark Hamminger


[This is the OE power-brake vacuum booster and dual master cylinder as installed on a 1968 Firebird. The primary reason for its steep upward angle was to achieve the proper pedal geometry when the pushrod was correctly mounted to the stock brake pedal's lower hole.

 Mark Rollings


[This 1966 GTO is still equipped with only a single-pot master cylinder with optional power booster; it also has the up-angle needed to connect properly to the pedal's lower hole. Dual masters were Federally mandated beginning in 1967, and are a great safety enhancement for earlier cars.

 John Wheeler

Judging from comments on various online performance forums, the power-booster's severe up-angle seems to offend some hot rodders' aesthetic sensibilities. They consider it to be to be uncool or ugly. But function must supersede form: You can't just move the pushrod to the top hole willy-nilly!

The end goal must be correct system brake pressure and function, as established by the pedal ratio, the pedal travel, the pushrod length, the master-cylinder piston stroke, the master-cylinder piston-bore diameter, any downstream secondary (slave) cylinders if drum brakes, and the sizes

of the brakes. (For reference, the old-school power-assist master cylinders generally had a $7/8$ -inch bore size, compared with about 1 inch for a manual master cylinder.) A change to any one of these components almost certainly mandates re-engineering at a minimum the power-booster/master-cylinder combination. Obviously, you'd also need a nonangled power-booster firewall mounting bracket. In some cases, depending on the car model, "straight," aesthetically pleasing solutions are now available from various aftermarket brake specialists.



[On a classic GM pedal with two pushrod holes, the top hole is for manual brakes; the bottom is for power (which needs less ratio). The booster/master-cylinder mounts at a steep up-angle to properly align with the pushrod. Pedal advantage is determined by dividing A (the pedal pivot to the pedal-pad center push point) by B (the distance from the pivot to the pushrod hole).

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In any event, don't compromise safety. If the pedal/pushrod stroke ends up too short to allow the master cylinder's full piston travel, full system pressure cannot be achieved. Conversely, if the stroke is too long, the brakes could go into bind and lock up. In no circumstances should you permit the brake pedal to go over center.

Of interest is that even today—when power antilock brakes are standard across the board—some GM rear-drive cars continue to use a slight upward mounting angle (although much less than on the old classic cars). We aren't sure why this practice continues, but most logically, it would be to achieve optimum pedal arc and stroke within the constraints of both engine-compartment clearance and under-dash clearances. (We'd love to hear from a current brake-systems engineer on this one!)

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