Brake Fluid Volume and Pedal Travel

Brake fluid volume displaced by the caliper pistons and system compliance, the master cylinder stroke it needs and the resulting pedal travel.

Method: Hydraulic brake volume balance

Input parameters

Unit system: SI

Parameter	Value	Unit
Caliper piston diameter	54.000	mm
Number of caliper pistons (all wheels)	4.0000	
Piston travel per piston (clearance + pad compression)	0.40000	mm
Hose, line and caliper compliance volume	2.0000	cm³
Master cylinder bore	22.200	mm
Pedal ratio	3.6000	
Pedal free play	5.0000	mm

Calculated results

Parameter	Value	Unit
Fluid volume displaced	5.6644	cm³
Master cylinder stroke	14.634	mm
Pedal travel	57.681	mm
Hydraulic area ratio (one piston to master)	5.9167	

Notes for this case

• Each caliper piston must move through its running clearance and the pad's compression, displacing A_c·x of fluid; hoses swell, calipers deflect and the fluid compresses, adding a compliance volume. The master cylinder supplies this with a stroke s_m = V/A_m, and the pedal moves i_p times as far plus free play. A large hydraulic ratio gives high line pressure per pedal force but long travel; tandem master cylinders must supply both circuits.

Formula and method

$$V = n_p \frac{\pi d_c^2}{4} x + V_c, \quad s_m = \frac{V}{\pi d_m^2/4}, \quad s_p = s_0 + i_p s_m$$

Variables

d_c	Caliper piston diameter	m
n_p	Number of caliper pistons (all wheels)	-
x	Piston travel per piston (clearance + pad compression)	m
V_c	Hose, line and caliper compliance volume	m³
d_m	Master cylinder bore	m
i_p	Pedal ratio	-
s_0	Pedal free play	m
V	Fluid volume displaced	m³
s_m	Master cylinder stroke	m
s_p	Pedal travel	m
A_c/A_m	Hydraulic area ratio (one piston to master)	-

Method and standards

Pedal travel.

Assumptions and limits

- Incompressible fluid except the lumped compliance; rigid pedal.

References

Hydraulic brake volume balance

Report details

Report reference	FCC-EZCX-6KXD (the same inputs always give the same reference)
Generated	23 November 2026, 18:01 UTC
Calculator	Brake Fluid Volume and Pedal Travel
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/automotive/vehicle-dynamics/brake-pedal-travel-fluid-volume

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.