Arps Decline Curve: Rate and Cumulative Production

Production rate and cumulative production after a time by Arps' exponential, hyperbolic or harmonic decline, from initial rate, decline rate and exponent b.

Method: Ahmed; Reservoir Engineering Handbook; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Initial rate	1,000.0	bbl/d
Initial decline rate (nominal)	0.40000	1/a
Decline exponent (0 exponential, 1 harmonic)	0.50000	
Time	3.0000	a

Calculated results

Parameter	Value	Unit
Rate at time t	390.62	bbl/d
Cumulative production to time t	684,844	bbl
Effective annual decline in the first year	30.556	%

Notes for this case

• D_i is the nominal (instantaneous) decline rate; the effective first-year decline is shown for comparison. Arps' relations hold for boundary-dominated flow at constant bottom-hole pressure.

Formula and method

$$q = \frac{q_i}{(1 + b D_i t)^{1/b}}, \quad N_p = \frac{q_i^b}{(1-b) D_i} \left(q_i^{1-b} - q^{1-b}\right)$$

$$q = q_i e^{-D_i t}, \; N_p = \frac{q_i - q}{D_i} \; (b = 0); \quad N_p = \frac{q_i}{D_i} \ln \frac{q_i}{q} \; (b = 1)$$

Variables

q_i	Initial rate	m³/s
D_i	Initial decline rate (nominal)	1/s
b	Decline exponent (0 exponential, 1 harmonic)	-
t	Time	s
$q(t)$	Rate at time t	m³/s
N_p	Cumulative production to time t	m³
D_e	Effective annual decline in the first year	-

Method and standards

Arps' decline relations.

Assumptions and limits

- Boundary-dominated flow; constant operating conditions.

References

• Ahmed
• Reservoir Engineering Handbook
• 5th ed. (Gulf Professional Publishing, 2019)
• ch. 16 (Arps, 1945)

Report details

Report reference	FCC-710T-7T9A (the same inputs always give the same reference)
Generated	17 November 2026, 19:37 UTC
Calculator	Arps Decline Curve: Rate and Cumulative Production
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 17 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/chemical/oil-gas/arps-decline-curve

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.