DP Flow Square-Root Extraction and Low-Flow Cut-Off

Flow from a differential pressure transmitter by square-root extraction: flow at a reading, the 4–20 mA signal, and the DP at the low-flow cut-off.

Method: Q ∝ √Δp for differential-pressure flowmeters (ISO 5167-1 principle)

Input parameters

Unit system: SI

Parameter	Value	Unit
Flow at full-scale DP In any flow unit; the result is in the same unit.	100.00	
Full-scale DP of the transmitter	250.00	mbar
DP reading	62.500	mbar
Low-flow cut-off (share of full flow)	5.0000	%

Calculated results

Parameter	Value	Unit
Flow at the DP reading	50.000	
Flow as a share of full scale	50.000	%
Signal of a linear-DP transmitter	8.0000	mA
Signal of a square-root (flow) transmitter	12.000	mA
DP at the low-flow cut-off	0.62500	mbar

Notes for this case

- At low flow the square root magnifies noise: 1 % of DP is 10 % of flow, hence the cut-off.

Formula and method

$$Q = Q_{max}\sqrt{\frac{\Delta p}{\Delta p_{max}}},\quad I_{sqrt} = 4 + 16\,\frac{Q}{Q_{max}}\ \text{mA},\quad \Delta p_c = q_c^2\,\Delta p_{max}\quad (Q = 0,\ I_{sqrt} = 4\ \text{mA when}\ Q/Q_{max} < q_c)$$

Variables

Q_{max}	Flow at full-scale DP	-
Δp_{max}	Full-scale DP of the transmitter	Pa
Δp	DP reading	Pa
q_c	Low-flow cut-off (share of full flow)	-
Q	Flow at the DP reading	-
Q/Q_{max}	Flow as a share of full scale	-
I_{lin}	Signal of a linear-DP transmitter	A
I_{sqrt}	Signal of a square-root (flow) transmitter	A
Δp_c	DP at the low-flow cut-off	Pa

Method and standards

Flow through a fixed restriction goes as the square root of DP.

Assumptions and limits

- Constant density and discharge coefficient.
- Below the low-flow cut-off the flow is shown as zero and the square-root signal as 4 mA; Q/Q_max still gives the uncut share.

References

- Q ∝ √Δp for differential-pressure flowmeters (ISO 5167-1 principle)

Report details

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

This calculator online

https://calc.firecad.com/instrumentation/flow/dp-flow-square-root

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.