Economic Diameter of a Pumping Main

Economic diameter of a rising main by Lea's formula and by the pumping-hours form D = 1.3λ^¼√Q, with the resulting velocities.

Method: Lea's formula D = k√Q; D = 1.3λ^¼√Q for pumping λ = t/24 of the day (CPHEEO Manual on Water Supply and Treatment, ch. 6)

Input parameters

Unit system: SI

Parameter	Value	Unit
Flow	540.00	m³/h
Lea coefficient (0.97–1.22)	1.1000	
Pumping hours per day	16.000	h

Calculated results

Parameter	Value	Unit
Lea economic diameter	426.03	mm
Velocity at D_Lea on the average flow Q	1.0523	m/s
Diameter for the pumping hours	557.20	mm
Velocity at D_λ (on peak flow 24Q/t)	0.92272	m/s

Notes for this case

- When pumping 16 h a day the pumps deliver 24Q/t, so the velocity in the Lea diameter while running is 1.58 m/s.
- Q is the average daily flow; when pumping t hours a day the pumps deliver 24Q/t. Both formulas give about 1 m/s; a full life-cycle cost comparison of pipe and energy is the proper basis.

Formula and method

$$D = k\sqrt{Q}, \quad D = 1.3\lambda^{1/4}\sqrt{Q_p}, \quad \lambda = \frac{t}{24}$$

Variables

Q	Flow	m³/s
k	Lea coefficient (0.97–1.22)	-
t	Pumping hours per day	s
D_{Lea}	Lea economic diameter	m
v_{Lea}	Velocity at D_Lea on the average flow Q	m/s
D_λ	Diameter for the pumping hours	m
v_λ	Velocity at D_λ (on peak flow 24Q/t)	m/s

Method and standards

Economic diameter rules.

Assumptions and limits

- Rule-of-thumb economics.
- Lea's formula is applied to the average daily flow Q; the velocity shown for it is on Q, and the note gives the higher running velocity on 24Q/t. Which flow Lea's k was fitted to is not stated in the source, so treat D_Lea as indicative.

References

- Lea's formula D = k√Q; D = 1.3λ^¼√Q for pumping λ = t/24 of the day (CPHEEO Manual on Water Supply and Treatment, ch. 6)

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

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Reopens the calculator with the inputs of this report.