Fire Demand of Water: Kuichling, Freeman, NBFU and Buston

Fire-fighting water demand of a town from its population by the Kuichling, Freeman, NBFU and Buston formulas, with the storage for a fire duration.

Method: Classical water supply engineering methods (population forecasting, fire demand formulas)

Input parameters

Unit system: SI

Parameter	Value	Unit
Population (thousands)	100.00	
Fire duration for storage	3.0000	h

Calculated results

Parameter	Value	Unit
Kuichling	31,820	L/min
Freeman	34,095	L/min
National Board of Fire Underwriters	41,733	L/min
Buston	56,630	L/min
Storage for the duration at the highest demand	10,193	m³

Notes for this case

• These empirical formulas give the fire flow in litres per minute with the population P in thousands: Kuichling 3182√P, Freeman 1136.5(P/5 + 10), National Board of Fire Underwriters 4637√P(1 − 0.01√P) and Buston 5663√P. They spread widely, so the adopted value follows local practice and regulations; the yearly volume is small but the rate is high, so it mainly affects pipe and reservoir sizing. Fire services may set their own requirements for buildings.

Formula and method

$$Q_K = 3182\sqrt{P}, \quad Q_F = 1136.5\left(\frac{P}{5}+10\right), \quad Q_N = 4637\sqrt{P}\left(1-0.01\sqrt{P}\right), \quad Q_B = 5663\sqrt{P}$$

Variables

P	Population (thousands)	-
t	Fire duration for storage	s
Q_K	Kuichling	m³/s
Q_F	Freeman	m³/s
Q_N	National Board of Fire Underwriters	m³/s
Q_B	Buston	m³/s
V	Storage for the duration at the highest demand	m³

Method and standards

Fire demand.

Assumptions and limits

- Empirical formulas; P in thousands.

References

Classical water supply engineering methods (population forecasting, fire demand formulas)

Report details

Report reference	FCC-CXHK-R4ZY (the same inputs always give the same reference)
Generated	23 November 2026, 17:50 UTC
Calculator	Fire Demand of Water: Kuichling, Freeman, NBFU and Buston
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/civil/hydraulics/fire-demand-formulas

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.