Fire Hydrant Flow Test: Flow Available at a Residual Pressure

Flow from a hydrant outlet by pitot reading and the flow available at a required residual pressure, from the static and test residual pressures.

Method: Hydrant flow test extrapolation with exponent 0.54 (Hazen–Williams); as in NFPA 291 (method only)

Input parameters

Unit system: SI

Parameter	Value	Unit
Static pressure (gauge)	6.0000	bar
Residual pressure during the test	4.5000	bar
Pitot pressure at the outlet	1.4000	bar
Outlet diameter	63.500	mm
Outlet discharge coefficient	0.90000	
Residual pressure required	1.4000	bar

Calculated results

Parameter	Value	Unit
Test flow	2,864.5	L/min
Flow available at the required residual pressure	5,246.2	L/min
Same, in US gpm	1,385.9	US gal/min

Notes for this case

• The pitot pressure in the free stream is its velocity pressure, so the outlet flow is c A √(2p/ρ) (the familiar 29.83 c d² √p in US units). The main pressure drop with flow follows the Hazen–Williams law, Δp ∝ Q^1.85, so the flow at another residual pressure scales as [(S − R_r)/(S − R_t)]^0.54. A test should drop the residual pressure by at least about 10 % of the static for a reliable extrapolation.

Formula and method

$$Q_F = c\frac{\pi d^2}{4}\sqrt{\frac{2p_p}{\rho}}, \quad Q_R = Q_F\left(\frac{S - R_r}{S - R_t}\right)^{0.54}$$

Variables

S	Static pressure (gauge)	Pa
R_t	Residual pressure during the test	Pa
p_p	Pitot pressure at the outlet	Pa
d	Outlet diameter	m
c	Outlet discharge coefficient	-
R_r	Residual pressure required	Pa
Q_F	Test flow	m³/s
Q_R	Flow available at the required residual pressure	m³/s
$Q_{R,gpm}$	Same, in US gpm	m³/s

Method and standards

Hydrant flow test.

Assumptions and limits

- Water at about 20 °C; Hazen–Williams behaviour of the mains.

References

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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/mechanical/piping/fire-hydrant-flow-test

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Reopens the calculator with the inputs of this report.