Sheet E1 · Experimental validation

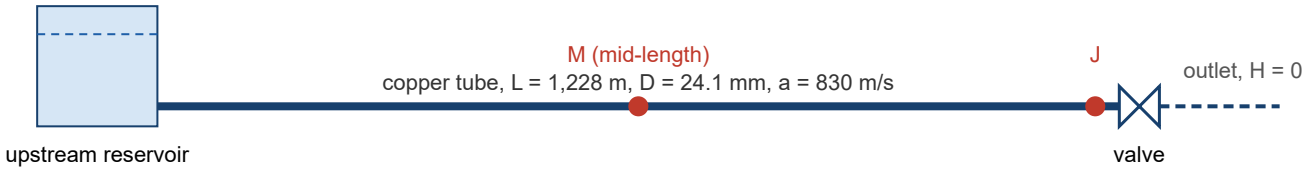
Programmed valve closure: Propson's tests (single pipe)

Source : E. B. Wylie, V. L. Streeter, Fluid Transients, McGraw-Hill, 1978, § 9-4, fig. 9-20 (Propson's tests, University of Michigan)

1. The question

A valve closure programmed to limit the pressure rise, measured on a long copper tube: does CBELIER reproduce the head measured at the valve and at mid-length, and above all its maximum?

2. The case

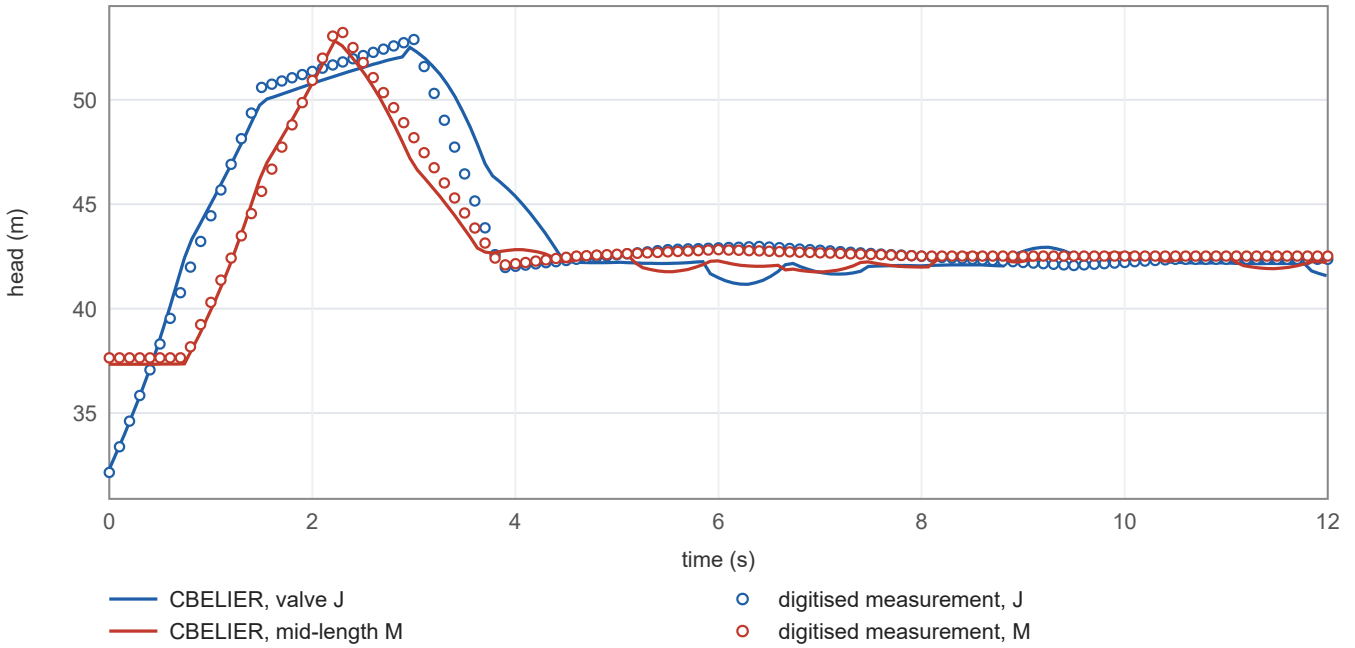


A constant-head reservoir feeds a 1,228 m copper tube. At the downstream end, a servo valve reduces the velocity from 0.34 to 0.03 m/s within three wave round trips (4.44 s), following an opening law designed to keep the pressure rise low. Head is measured at the valve and at mid-length. In CBELIER the tube is split into two reaches at measuring point M; the opening law is imposed by a scenario.

3. Data and status

Data	Value	Status
Tube length (4,030 ft)	1,228 m	PUBLISHED
Inside diameter (0.95 in)	24.1 mm	PUBLISHED
Initial and final velocity (1.1 → 0.1 ft/s)	0.34 → 0.03 m/s	PUBLISHED
Manoeuvre duration (3L/a)	4.44 s	PUBLISHED
Upstream reservoir head (139 ft, ± 1 ft)	42.37 m	READ FROM FIGURE
Initial head at the valve (106 ft, ± 1 ft)	32.31 m	READ FROM FIGURE
Valve opening law τ(t) (± 0.03)	7 points	READ FROM FIGURE
Wave speed 3L/Tf (consistent with 2,709 ft/s in fig. 9-22)	830 m/s	DERIVED
Friction: roughness derived from the 139 – 106 ft drop	0.025 mm	DERIVED
Zero-head outlet, 10 m dummy downstream pipe	—	ASSUMED

4. Results



Head at the valve and at mid-length: CBELIER computation (lines) and experimental curves digitised from figure 9-20 (circles). No parameter is fitted.

5. Differences

Indicator	CBELIER	Reference	Difference
Maximum head at the valve	52.51 m	52.88 m	−0.7 %
Initial head at the valve	32.32 m	32.31 m	0.01 m
Maximum difference to the curve, valve	3.87 m	—	—
Maximum difference to the curve, mid-length	1.28 m	—	—

The maximum at the valve, the design quantity, is reproduced within 1 %. The largest differences lie in the steep fall around t = 4 s, where a shift of a few hundredths of a second is enough, and both the opening law and the curves are read from a figure.

6. Limitations and assumptions

- The experimental curves and the opening law are read from a published figure: this is a comparison of shape and order of magnitude, not a fine quantitative validation.
- Wave speed and friction are derived, not measured; the zero-head outlet is an assumption.
- Small scale (24 mm tube, low velocities): the case validates wave propagation and the manoeuvre, not a real water-supply network.