



This is a repository copy of *Experimental quantification of intrusion volumes due to transients in drinking water distribution systems*.

White Rose Research Online URL for this paper:
<http://eprints.whiterose.ac.uk/135683/>

Version: Supplemental Material

Article:

Jones, S.L. orcid.org/0000-0003-1443-2253, Shepherd, W., Collins, R. et al. (1 more author) (2019) Experimental quantification of intrusion volumes due to transients in drinking water distribution systems. *Journal of Pipeline Systems Engineering and Practice*, 10 (1). 04018026. ISSN 1949-1190

[https://doi.org/10.1061/\(ASCE\)PS.1949-1204.0000348](https://doi.org/10.1061/(ASCE)PS.1949-1204.0000348)

This material may be downloaded for personal use only. Any other use requires prior permission of the American Society of Civil Engineers. This material may be found at [https://doi.org/10.1061/\(ASCE\)PS.1949-1204.0000348](https://doi.org/10.1061/(ASCE)PS.1949-1204.0000348)

Reuse

Items deposited in White Rose Research Online are protected by copyright, with all rights reserved unless indicated otherwise. They may be downloaded and/or printed for private study, or other acts as permitted by national copyright laws. The publisher or other rights holders may allow further reproduction and re-use of the full text version. This is indicated by the licence information on the White Rose Research Online record for the item.

Takedown

If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.



eprints@whiterose.ac.uk
<https://eprints.whiterose.ac.uk/>

Figure 1. Schematic of the intrusion system. Dimensions are not to scale.

Figure 2. Meniscus location for a transient generated with initial conditions 2 l/s and 20 m. Intrusion occurs between (a) to (b), (c) to (d), and (e) to (f) – 12.7 ml, 9.4 ml and 8.8 ml, respectively.

Figure 3. Examples of pressure transients generated with four combinations of initial conditions, each sub figure showing five repeats. The sub figures show transients generated for initial conditions of: a) 1 l/s and 20 m, b) 2 l/s and 10 m, c) 2 l/s and 30 m and d) 4 l/s and 20 m.

Figure 4. Comparison of the volume of intrusion for different external media for a range of different transient conditions, a) varying initial head, initial flow of 2 l/s, b) varying initial flow, initial head of 20 m. Intrusion volumes measured with an average accuracy of ± 1.3 ml.

Figure 5. Time integral of the square root of driving head versus experimental volumes of intrusion. Volumes of intrusion have an average accuracy of ± 1.3 ml and the time integral of the driving heads have an accuracy of $\pm 0.40 \text{ m}^{0.5} \text{ s}$.

Figure 6. Comparison of pressure transient data from water and gravel cases, aligned to the initial drop in pressure. Both transients were generated by valve closure from initial conditions of 4 l/s and 20 m.