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Drinking Water
Engineering and Science
Discussions

# *Interactive comment on* "Effects of network pressure on water meter under-registration: an experimental analysis" *by* C. M. Fontanazza et al.

**C. M. Fontanazza et al.**

chiara.fontanazza@gmail.com

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Responses to the Referee 1

The authors are grateful to the Referee 1 for the detailed comments and useful recommendations. Generally the Authors have accepted Referee's comments changing the manuscript accordingly. Detailed responses to the Referee have been reported in the following paragraphs.

The authors regret doing not agree with Referee 1 which states that the authors have not proved the effect of pressure on meter under-registration. This effect, along with that of meter age on meter starting flow, is widely proved by means of both laboratory and numerical analysis. The parameter k and Per (equation 2) are shape parameters



and not much vary with pressure; however, the most important parameter, Qstart, is greatly influenced by the pressure, as Figures 6-8 clearly showed. Figure 7 showed the starting flow begins to increase proportionally more than age with meter ageing, demonstrating the increasing impact of wear and tear. The effect of pressure on the average starting flow gradually becomes less evident as the meter ages. Figure 8 confirms that increasing pressure reduces the starting flow. The effect of pressure on the starting flow is essentially linear and the newer the meter is, the greater the influence of pressure. The linear dependency of the average starting flow on pressure is checked for by means of t test, the results of that is showed in Table 3. Finally the assumptions of normality, homoscedasticity and linearity are tested by analysing the standardized residuals (Figures 9 and 10).

All the water meters were tested for pressure ranging from 0.5 to 4 bar. In the first version of the paper, the authors only showed the results for pressure ranging from 0.5 to 2 bar because these values are typical for intermittent network, where pressure surplus very rarely occurs. In this reviewed version, the analysis has been extended for pressure values equal to 3 and 4 bar as suggested by the Referee.

The manuscript title has been changed to make only reference to single and multi-jet water meters as suggested by the Referee.

In the zip file, the Referee will find the new version of the manuscrit, the track change copy, figures and tables.

Please also note the supplement to this comment:
http://www.drink-water-eng-sci-discuss.net/6/C62/2013/dwesd-6-C62-2013-supplement.zip

Interactive comment on Drink. Water Eng. Sci. Discuss., 6, 119, 2013.

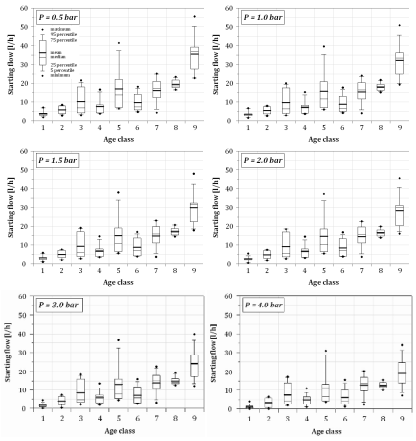


Figure 6. Box plots summarising the laboratory results



**Fig. 1.** Figure 6. Box plots summarising the laboratory results



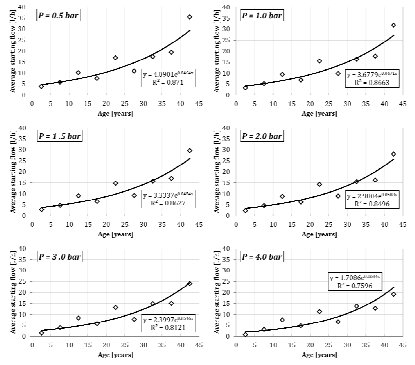


Figure 7. Relationship between average starting flow and meter age for the six different test pressures.



**Fig. 2.** Figure 7. Relationship between average starting flow and meter age for the six different test pressures.

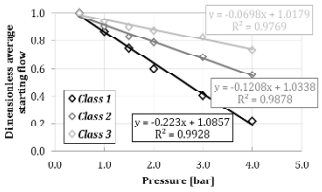


Figure 8. Relationship between average starting flow and test pressure for the different meter age classes.

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**Fig. 3.** Figure 8. Relationship between average starting flow and test pressure for the different meter age classes.



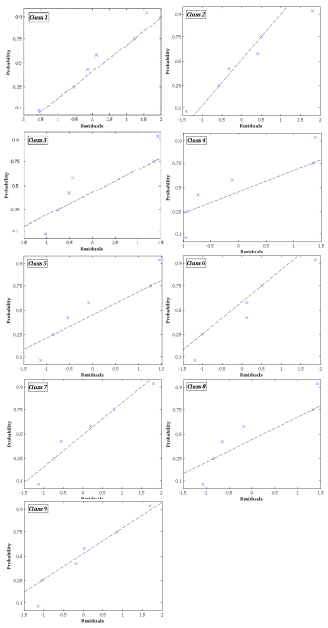


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**Fig. 4.** Figure 9. Normal probability plot of standardized residuals

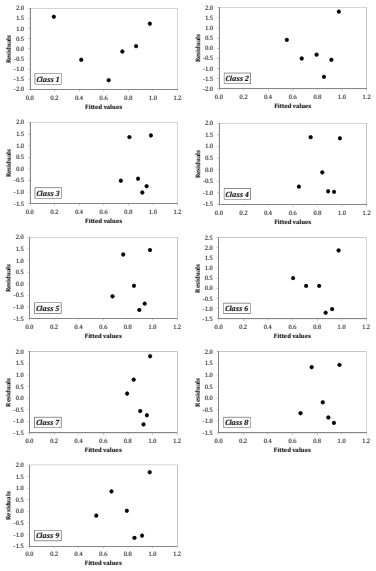


Figure 10. Residual plot for the mean starting flow data

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**Fig. 5.** Figure 10. Residual plot for the mean starting flow data



1 Table 3. Results of the *t* test.

| Age class | $t$ | $\alpha$ | $t_{\alpha/2}$ |
|---|---|---|---|
| 1 | -23.453 | 0.01 | 5.597 |
| 2 | -12.705 | | |
| 3 | -7.341 | | |
| 4 | -10.012 | | |
| 5 | -9.171 | | |
| 6 | -11.117 | | |
| 7 | -5.627 | | |
| 8 | -9.528 | | |
| 9 | -13.062 | | |

2

3

4

5

3

**Fig. 6.** Table 3. Results of the t test