**UK WATER INDUSTRY RESEARCH LIMITED**

**REPORT REF NO 14/DW/04/14**

# BRASS FITTINGS – A SOURCE OF LEAD IN DRINKING WATER?

## Executive Summary

## Objectives

The project objectives are as follows:

1. To assess the contribution of brass fittings to concentrations of lead in drinking water.

2. If lead levels are considered elevated by brass fittings, to inform how this might affect the development of national and local strategies to reduce lead levels in drinking water.

3. To provide evidence/information to inform a discussion about the suitability of the present UK norms for the lead content of brass fittings.

## Conclusions

- The brass fittings typically found in plumbing systems between the water main and the kitchen tap comprise on the public side (communication pipe) ferrule, meter, stoptap and compression joints and on the private side (supply pipe) compression joints, stoptap and kitchen tap. The literature review, stagnation tests and field trials indicate that all brass fittings, including those manufactured with low lead grades, can be expected to leach lead throughout their lifetimes.

- The literature review and testimony from manufacturers shows that the highest concentration of lead leaches from new (unused) fittings immediately after installation and that the concentration falls off with length of time in service levelling off over a period of a few weeks to a few months. This was confirmed by the results of field trials at hard and soft water sites. The age of an installation is therefore a key issue affecting observed leaching. The literature review indicates this levelled-off value is around one third of the concentration observed in the new product; but the field trials indicated that even lower levelled-off concentrations can be found.

- The literature review indicates that there is a strong effect caused by the characteristics of the water in supply, in particular hardness; lead leaching tends to be higher in soft waters. The field trial results found that leaching was higher from most fittings in non-phosphate dosed soft water than hard water.

- Lead concentrations increase with increasing stagnation time but the most substantial increase generally occurs during the first few hours.

- The stagnations tests show that some models of unused ferrules, meters, stopcocks and taps can, following stagnation of 16 hours, individually yield lead concentrations of >10 µg/l and even >25 µg/l in a one litre sample (as used for Random Daytime Samples - RDS[1]) in the absence of any other lead leaching pipework or fittings. This was confirmed by field tests where, after four months, water meters in soft non-phosphate dosed water could still exceeded >10 µg/l after overnight stagnation and that certain combinations of other fittings could approach this concentration.

- The amount of lead leached from the high lead fittings and some low lead fittings in both soft and hard water fell rapidly from the start of the field trials, within the first two weeks, and generally reached a stable rate of release after 20 to 30 days. However, in non-phosphate dosed soft water leaching from water meters and a stoptap were found to increase following this initial reduction before levelling/falling slowly.

- Phosphate dosing exerts a strong, rapid effect on lead leaching from fittings, reducing both the time taken to reach a stable leaching concentration and reducing this concentration compared with non-phosphate dosed water.

- The laboratory and field trials confirmed that low-lead brass fittings give substantially lower leaching of lead compared to conventional brass fittings.

- The literature search and stagnation tests show large differences in the concentration of lead that leaches from different models of the same type of fitting and smaller differences between samples of the same model (the latter also verified by the long term testing). The leaching characteristics of brass fittings are influenced by the characteristics of the individual fitting and water quality.

- Predicting the contribution of any fitting without undertaking some form of testing on the finished product is very difficult since information on the grades of alloy, surface areas in contact with water, manufacturing technique and so on are very hard to obtain. With the substantial range of fittings/models that are available and the fact that information on leaching characteristics is limited to very few individual models that have been studied it is not possible to predict the leaching characteristics of any particular installation within a building, save that the concentrations will be highest immediately following installation and will reduce over time.

- As regulatory sampling uses 1 litre samples, taps, isolation valves and other fittings in contact with that 1 litre of water are likely to have the greatest influence on lead concentrations. However, overall any fitting containing lead can cause elevated lead concentrations – for example a meter could be the biggest contributor to lead levels at the tap.

[1] RDS are samples taken without any prior flushing, as used for statutory monitoring for lead and several other determinands.

- The field trials indicate that in a worst case scenario (where the RDS were taken from a non-phosphate dosed supply after an overnight stagnation, where the fittings had been installed for four month and the kitchen tap was located close to the road, so the draw would include the contents of brass fittings between the supply pipe and the tap) then 10 µg/l could be exceeded, but not 25 µg/l Pb.

- At the national level the UK has to take into consideration international developments relating to the regulation of the lead content of brass. Specifically: low- lead brass requirements in the USA, implementation of the 4MS scheme within Europe which may also influence the international fittings supply market and the UK designated grades of brass, bronze and gunmetal with different compositions for different uses in fittings.

- Advising customers to replace brass taps/fittings with other brass taps/fittings following a PCV exceedance is no guarantee of reducing observed lead concentrations.

- Guidance on flushing could be used as part of an exposure reduction strategy. Suitable advice might be to flush frequently when brass fittings are new and to flush after prolonged stagnation when fittings are older.

- There is no regime for routine inspection or approval of the brass alloys used in fittings installed in the UK so there is no guarantee that the current norms are adhered to across the supply chain.

## Recommendations

- That the extent to which water companies will be replacing their traditional brass fittings with plastic fittings in future for new connections, water meter installations and water meter replacements should be further investigated since this may have a measurable impact on overall exposure to leached lead. However the plastic fittings may contain brass and installing new fittings could cause an increase in lead concentrations in the short term. This links with a new project that WRc plc is undertaking with assistance from NSF-WRc on behalf of DWI/Defra to examine the impact of water meter installation onto lead supply pipes – this is primarily focussed on disturbance of lead pipe resulting in increased lead levels but the installation of new brass fittings could also cause increased lead levels.

- At the national level the UK should take into consideration international developments relating to the regulation of the lead content of brass, including American legislation and the development of the 4MS scheme.

- Water companies should consider their risk based strategies for phosphate dosing to reduce lead concentrations from brass fittings as well as lead pipework. However it could be difficult to justify the use of phosphate dosing solely to reduce lead leaching from water fittings containing brass

## Benefits

Understanding the potential contribution of brass fittings to lead concentrations at customers' taps will:

- increase our understanding of how brass fittings might be contributing to lead concentrations and exposure and identify ways of reducing both;
- avoid the cost of installing and then replacing fittings that are contributing to elevated lead levels;
- ensure that expenditure to replace lead pipework is properly justified and effective;
- eliminate anomalous lead results with potential benefits in terms of reducing orthophosphate dosing at treatment works;
- assess the likely impact that brass fittings may have if plumbosolvency treatment is removed;
- inform future assessment of the potential risks to compliance from brass fittings; and
- inform and improve the investigations carried out by water companies when they investigate failures of lead standards or carry out other risk assessments related to lead levels in drinking water.