BNWAT26: Household tapware - an overview

Version 1.0

This Briefing Note and referenced information is a public consultation document and will be used to inform Government decisions. The information and analysis form part of the Evidence Base created by Defra's Market Transformation Programme.

1 Summary

This Briefing Note covers information regarding taps installed in UK domestic properties and explores the issues and problems which arise when considering increasing the water efficiency of taps. The first section looks at the definition of a tap, including various discrete types of tap used with wash hand basins in bathrooms, and sinks installed in kitchens and utility rooms. The mechanisms of tap function are then investigated. Issues surrounding water pressure and flow are briefly addressed before discussion of the water consumption associated with taps and the factors that contribute to tap water efficiency. The tapware market is then considered. Finally some of the barriers and problems which arise with efficient taps are discussed.

2 Definition

This document defines a tap as a 'small diameter manually operated valve from which water is drawn' (BS 6100[1]).

There are three types of tap which are commonly installed in dwellings across the UK:

Pillar taps
Pillar taps, suitable for mounting on a horizontal surface, have a vertical inlet and a nozzle bent to discharge in a downwards direction[2]. Pillar taps are used on basins, sinks and bidets with two-hole installation. They are generally sold in a matching pair, designed to control hot and cold water flow through separate units. They can be low-height taps or high-neck taps (often used for kitchen sinks). Pillar taps are usually operated by one of two mechanisms, spindle or ceramic disc (explained in section 3), and are constructed with ½-inch threaded inlet tails.

Monobloc mixers
Monobloc mixers are a form of combination tap assembly, whereby a hot water tap and a cold water tap are coupled together with a common outlet nozzle which may

[1] BS 6100: Section 3.3: 1992: Glossary of building and civil engineering terms.
[2] BS 1010: Part 2: 1973: Specification for draw-off taps and stopvalves for water services (screw-down pattern).

be either fixed or swivelling, so as to discharge hot, cold or mixed hot and cold water[3]. Monobloc taps are designed to be installed in a single-hole basin or bidet. They have two separate handle operations to independently control hot and cold water flow, or alternatively a single lever operation which controls the flow and the mix of hot and cold water. These can be either single or dual flow taps (explained in section 3).

Two-hole mixers
Two-hole mixers are a form of combination tap assembly, whereby a hot water tap and a cold water tap are coupled together with a common outlet nozzle which may be either fixed or swivelling, so as to discharge hot, cold or mixed hot and cold water[4]. A two-hole mixer tap requires two separate tap holes for the supply inlets. Mixed water is supplied through a central swivel spout. These mixers can be supplied as single or divided flow fittings (explained in section 3).

Note that three-hole mixers are appearing on the market which are essentially the same as the two-hole mixer, except that the two water controls (hot and cold) and the nozzle are separate.

3 Mechanisms of tap operation and flow types

3.1 Divided and single flow taps

Mixer taps can be either divided or single flow type:

Single flow
Single flow taps allow the hot and cold water to be mixed in the body (spout) of the tap, and the water comes out of the spout as mixed warm water.

Divided flow
Divided, or dual, flow taps keep the hot and cold water separate to the point of discharge. There are separate channels all the way to the end of the spout for hot and cold water. Taps that comply with BS 5412[5] are required to deliver a higher flow of hot water than cold water when both taps are fully open and at the same supply pressure. Divided flow taps can therefore be used where the cold water pressure is greater (mains fed) than the hot water pressure (storage fed).

3.2 Mechanisms for controlling water flow

There are two mechanisms by which tap handles operate:

Spindle taps
This traditional design uses a replaceable washer and works by squeezing the washer over a machined hole to control the flow of water. Spindles can be either rising or non-rising. With a rising spindle, when the tap is turned on and off, the spindle on which the head is attached will move up and down. In a non-rising spindle tap, the spindle will not move up and down[6]. Spindle taps produce a high flow rate,

[3] BS 1010: Part 2: 1973: Specification for draw-off taps and stopvalves for water services (screw-down pattern).
[4] BS 1010: Part 2: 1973: Specification for draw-off taps and stopvalves for water services (screw-down pattern).
[5] BS 5412: 1996: Specification for low-resistance single taps and combination tap assemblies (nominal size ½ and ¾) suitable for operation at PN 10 max. and a minimum flow pressure of 0.01MPa (0.1 bar).
[6] www.bristan.com/pages/technical_advice_taps.html accessed 20 December 2007.

suitable for most systems whether they are high (minimum pressure 0.5 bar) or low pressure (minimum pressure 0.1 bar).

Ceramic disc taps
This design uses two ceramic discs that rotate against each other in order to open and close the water flow. The taps are low maintenance and easy to control, as the handle will only have to turn either a half or quarter rotation from fully closed to fully open. However, ceramic disc taps are not always suitable for use on low pressure systems (below 0.5 bar).

Ceramic discs are also used in single lever operation taps, where the mechanics of the valve enable control of the on/off flow and temperature with a single lever.

4 Hot and cold water systems

Within the UK there are two types of domestic water system, low and high pressure. Different tap operating mechanisms require the correct water pressure in order to operate and function satisfactorily.

Low-pressure systems are generally those which have either hot only, or both hot and cold water fed from a storage tank. High-pressure systems are those which have mains-fed cold water and a mains-fed hot water system. For homes with outlets fed from a storage tank, the water pressure (and therefore flow rate) will depend on the height between the storage tank and the water outlet. If this distance is small (less than 5 metres (ie below 0.5 bar pressure head)) then the system will be low pressure unless a pump is installed.

Low-pressure taps generally have compression valves (spindle mechanism), and hence pillar taps with a spindle mechanism are most suitable for low-pressure systems. Single lever mixer taps could be unsuitable for low-pressure systems as these have a ceramic disc mechanism. The cold water pressure in a kitchen should not present a problem as this should be at mains pressure. However, the pressure of the hot water and other cold water feeds must be considered so that taps which provide appropriate flow rates are installed.

5 Water consumption associated with taps

Approximately 25% of domestic water consumption[7], equivalent to approximately 38 litres per person per day[8], is delivered via internal taps.

Both kitchen and basin taps can be used for various purposes (eg washing, cleaning and rinsing or for vessel filling). Consumption associated with taps is highly user-dependent, as opposed to other appliances with limited options for water consumption such as a WC or washing machine. Whilst technology can control the volume of water used in a specified time period, the length of time for which the tap is used cannot be easily controlled[9].

[7] WRc, 2005. *Increasing the value of domestic water use data for demand management*. Summary Report.
[8] Average pcc (per capita consumption) across England and Wales since 1999 has remained at approximately 150 litres per person per day. EA (2007). Water Supply in England and Wales 2000 to 2007. www.environment-agency.gov.uk
[9] Automatic shut-off and electronic sensor taps are available. However, these are not generally used in household bathrooms or kitchens.

There is generally a significant difference between the flow rate that a tap is capable of delivering at a specified pressure ('nominal flow rate') and the flow rate of the tap in use ('actual flow rate'). This is because the water pressure at the point of installation will usually be slightly different and the user rarely turns a tap on to its maximum flow rate. Whilst there are significant differences in the nominal flow rate of taps designed for kitchen and basin uses, evidence suggests[10] there is little, if any, difference in the actual flow rate of the different types in use.

The average volume of water per tap use in homes is 2.3 litres. However, evidence shows that taps delivering flow rates greater than 1.8 litres per minute have an average volume per use of 1.9 litres, whilst those with a flow rate of less than 1.8 litres per minute have an average volume per use of 3.1 litres[11]. Whilst the evidence shows that taps delivering a lower flow rate generally have a greater average volume per use, this is not necessarily a causal relationship, and it follows that since the lower flow rate taps have a greater average volume per use, they are used for longer periods. It is possible that this is at least partially attributable to hot water tap usage. These taps generally deliver a lower flow rate than cold water taps and may be run to waste for a period of time before water of the required temperature reaches the tap[12]. No evidence is currently available to prove or disprove this hypothesis.

It is thought that the frequency of kitchen tap use varies, amongst other factors, according to whether a household owns, and uses, a dishwasher. In homes where a dishwasher is installed it is estimated that kitchen taps are used on average just over 17 times a day per household. In homes where no dishwasher is used, kitchen taps are used on average just over 24 times per day per household[13] [14].

6 Water efficient taps

A water efficient tap is one that performs its required task with the least amount of water being used. Water efficient taps deliver water in a more efficient or controlled manner, which can be achieved by either restricting the flow rate or having an automatic shut-off facility. In domestic properties, automatic shut-off taps are rare[15] and therefore efficiency will usually be achieved by reductions in flow rate.

Water efficient taps can be purchased as a complete unit, or alternatively inserts can be added to existing taps to improve efficiency. Generally, tap inserts will incorporate flow regulators, and often give the illusion of providing more water than is actually flowing.

Aerators

[10] Analysis of WRc's Identiflow® dataset as detailed in Briefing Note BNDW Taps.
[11] Analysis of WRc's Identiflow® dataset as detailed in Briefing Note BNDW Taps.
[12] Note, the taps for hot and cold water do not differ in design; the nominal flow rate is the same. However, differences in pressure of hot and cold water feeds can result in variation in actual (delivered) flow rates.
[13] Analysis from WRc data (2005), *Increasing the value of domestic water use data for demand management*. The ratio of tap uses in homes with and without dishwashers from ecohomes was used as an initial estimate, and then corroborated with the Identiflow® dataset. The number of basin tap uses has been assumed to be 50% of total tap uses in homes with dishwashers and 41% ot total uses in homes without dishwashers. The two ratios, for homes with and without dishwashers combined give a ratio of 45:55 basin to itchen tap uses across all homes. There is currently no further evidence available to support or disprove this assumption.
[14] Ecohomes guidance is available at http://www.breeam.org/filelibrary/EcoHomes_2006_Guidance_v1.2_-_April_2006.pdf The ratio of kitchen tap volume:basin tap volume is calculated from the guidance under 'internal taps'.
[15] A minority of companies are beginning to market infrared sensor taps for domestic properties. This trend will be monitored and the document updated as necessary.

Taps with aerators fitted entrain air in the flow, thus providing an illusion of greater water flow.

Sprays
These deliver a spray pattern rather than a solid stream, acting like a mini shower-head at the outlet. BS 4118[16] and BS 5388[17] define a spray tap as 'a tap supplied with water at a predetermined temperature which it delivers, at a restricted rate of flow, in the form of a spray'.

Water-saving/waterbrake features
Water-saving brakes are used for single-lever mixer taps. As the lever is lifted, resistance is felt once a flow of between 5 and 10 litres per minute is reached. If a higher flow is required, the lever can be pushed past this stop.

Water-saving inserts (flow restrictors)
Small inserts can be fitted to a round tap outlet or standard metric thread of a tap outlet to restrict the flow from the tap. Some devices enable the tap to deliver a spray pattern at low flows, suitable for uses such as washing hands. As the flow increases, the device opens up to allow a full, unrestricted flow for uses such as vessel filling. Other inserts permanently restrict the solid stream of flow but do not deliver a spray pattern.

Currently, there is no evidence available which quantifies the water savings achieved in use by efficient taps over standard taps. Whilst a standard tap is not often used in a fully open position to deliver the maximum possible flow rate, it is assumed that as nominal flow rate decreases, the in-use flow rate tends towards the nominal. For instance, this would mean that the most efficient taps available, with a nominal flow rate of, for example, 1.7 litres per minute, generally also have an in-use flow rate of approximately 1.7 litres per minute.

It is important to consider that the total volume of water consumed by a tap is largely determined by the user. A user can decide to leave any tap, standard or efficient, running for an entire day, which will consume large quantities of water. In addition, the wide variety of functions associated with tap use, from cooking and cleaning to bathing and drinking, makes it difficult to determine the 'necessary' water consumption. Unlike showers, where extensive research has been undertaken into improving performance and making them fit for purpose, taps have no clearly defined single function.

Where a tap is likely to have a single function, for instance, in a downstairs cloakroom where the basin will be used only for rinsing hands, it is possible to reduce the user influence on the water use through tap design and technology. For example, it would be possible to install automatic shut-off taps where vessel filling is not a requirement. For more mixed purpose taps, such as in kitchens, designing a tap that minimises water use and yet which performs the range of tasks required, would be more difficult. Waterbrake features go some way towards providing a technology designed for function, by providing alternative flow rates for different types of use.

[16] BS 4118**:** 1981: Glossary of sanitation terms.
[17] BS 5388: 1976: Specification for spray taps.

7 The tapware market

Market & Business Development (MBD) reports that the production of metal taps in the UK has declined in each year between 2002 and 2006, reflecting increased import substitution. Production has been reduced from £41 million in 2002 to an estimated level of £28.6 million in 2006. Imports of metal taps to the UK increased from £110.8 million in 2002 to £174.5 million in 2006, reflecting an overall growth in the market for bathroom fixtures and fittings including taps[18]. The growth of high-pressure systems, in addition to the demand for contemporary continental-style brassware, has resulted in a large proportion of European manufacturers exporting to the UK. This has led to the growth of high-pressure mixer products[19].

8 Issues associated with taps

Backflow

Backflow can occur when the air gap is reduced between the tap discharge outlet and the spillover level of the washbasin. Backflow causes contamination into the pipework if the basin outlet becomes blocked. This issue is covered within The Water Supply (Water Fittings) Regulations 1999[20], and guidance is also issued on the subject by WRAS (Water Regulations Advisory Scheme[21]).

Limescale

In hard-water areas, tap flow restrictors, aerators and spray inserts may need regular descaling to make sure they do not become blocked, particularly in the case of spray taps where outlet holes are small.

Legionella

There are concerns[22] that spray fittings and aerators in taps might introduce a risk of Legionella. The temperature of water is an important factor in the occurrence of Legionella outbreaks. Sufficiently hot water will kill off the Legionella, as the bacteria cannot survive in very high temperatures. Descaling regularly and reducing the pressure of water to taps will minimise the production of aerosol droplets, which is the method by which Legionella usually enters the body.

Installation and maintenance problems

Taps with a spindle mechanism can be relatively high maintenance, as washers require replacing regularly. These taps can also be difficult to operate, particularly by elderly or disabled people, as multiple rotations of the tap head are generally required to achieve the desired flow and to subsequently shut off the flow.

Suitability of taps for high and low pressure systems

Limited information is available at point of sale on the suitability of any tap for high and low pressure systems. An increasing number of houses across the UK have high-pressure hot water systems (mains-fed hot water systems). This can create a number of problems related to the flow rates of water through taps.

[18] Market & Business Development (MBD) (2007). *UK Bathroom Equipment Market Development.*
[19] AMA Research (2006). *Bathroom Market UK 2006.*
[20] http://www.opsi.gov.uk/si/si1999/19991148.htm
[21] http://www.wras.co.uk/
[22] http://www.environment-agency.gov.uk/commondata/acrobat/cwb_ch5_taps_889385.pdf

High water pressure systems should have taps installed that are designed for high-pressure systems (eg ceramic disc). If these are not installed, and the traditional compression valve spindle taps are installed, the users of the taps will receive water at very high flow rates at the outlet, thus leading to increased consumption of water.

If a tap suitable only for a high-pressure system is installed on a low-pressure system, the user will experience a reduced flow rate or no water at all through the tap, and hence poor performance.

Combination boilers and low-flow fittings

There are issues regarding the compatibility of water-saving fittings with combination boilers. The limited flow rate associated with the regulated or restricted output of water-saving devices such as spray taps can lead to possible problems[23].

Most combination boilers use a flow sensor to start the burner. If the water flow is below 2-3 litres per minute, it could be insufficient to activate the burner in the boiler and start the boiler. Modern modulating combination boilers should be compatible with all but the most efficient taps, although larger boilers (which require higher flow rates before they begin heating) may be more problematic. Storage combination boilers solve the low-flow problem but introduce other problems such as a standing heat loss. Lagging hot water pipes can also help, as short flows of hot water can be supplied by the hot water remaining in the pipe.

Standards for low-flow rates

The current UK and European requirements for flow rates in taps are based around minimum flow rates rather than maximum flow rates. Specifying minimum flow rates ensures that tap performance is not impaired under different pressure scenarios. Specifying maximum flow rates in addition to the minimum would better support water efficiency policies[24].

The minimum flow rate tested by the European Standard (BS EN 200: 1992[25]) is 12.0 litres per minute at 3 bar dynamic pressure, measured upstream of the tap assembly for a high-pressure system.

The minimum flow rate requirements for low-flow pressure systems from BS 5412: 1996[26] are set out below. As can be seen from Table 1, the minimum flow rate requirements vary across different tap designs. Nominal size for sink, basin and bidets is ½ inch (½").

Figure 1 Minimum flow requirements for taps on low-pressure systems

Fitting	Flow rate at a test pressure of 0.1 bar
Single taps ½"	7.5 litres per minute
Combination tap assemblies. Divided outlet spouts (mains fed on cold inlet)	

[23] *Combination boilers and low flow fittings*. Elemental Solutions for the Environment Agency (2007). Available at www.elementalsolutions.co.uk

[24] To avoid confusion, it is worth noting that a minimum flow rate is the least amount of water the tap is permitted to supply when fully open.

[25] BS EN 200: 1992: Sanitary tapware. General technical specifications for single taps and mixer taps (nominal size ½) PN 10: Minimum flow pressure of 0.05 MPa (0.5 bar).

[26] BS 5412: 1996: Specification for low-resistance single taps and combination tap assemblies (nominal size ½ and ¾) suitable for operation at PN 10 max. and a minimum flow pressure of 0.01MPa (0.1 bar).

– dual flow ½" : hot waterway ½" : cold waterway	 7.5 litres per minute 4.2 litres per minute
Combination tap assemblies. Divided tap outlet (each side tested separately) ½"	 7.5 litres per minute
Combination tap assemblies. Single outlet mixer a) Each side tested separately ½" b) Both taps fully open ½"	 7.5 litres per minute 10.8 litres per minute

9 Internal tap use across the UK

The evidence presented in this Briefing Note will be used in conjunction with information about stock and sales levels of internal taps to build scenarios of water consumption across the UK, and to investigate how Policy intervention could support more efficient design and use of internal taps, and reduce water consumption. MTP Briefing Note BNDWTaps discusses the modelling work in more detail, whilst the Policy Brief for internal taps details relevant UK and international policy which could influence future water consumption by internal tapware.

10 Improving tap efficiency in the UK

Currently, there are two schemes in the UK which aim to improve the efficiency of taps installed in the UK:

The Enhanced Capital Allowance scheme[27]
Although this scheme is aimed only at commercial customers, it provides a criterion for tap efficiency of 6 litres per minute at 5 bar pressure.

The Bathroom Manufacturers Association labelling scheme[28]
The criterion for labelling a tap, or combination tap assembly, as efficient under this scheme is for the tap to provide no more than 6 litres per minute at 5 bar pressure.

The Code for Sustainable Homes[29] and the Government commitment to include a standard for the whole of house water efficiency in the Building Regulations[30] will mean that the performance of household tapware will need to be considered, along with other fittings, in the future when new homes are built.

[27] http://www.eca-water.gov.uk/
[28] http://water-efficiencylabel.org.uk
[29] http://www.planningportal.gov.uk/england/professionals/en/1115314116927.html
[30] http://www.communities.gov.uk/publications/planningandbuilding/water-efficiency

Related MTP information

BNDWTaps: Briefing Note relating to projections of internal tap water consumption

Policy Brief for Internal Taps: Improving the water efficiency of internal taps

Consultation and further information

Stakeholders are encouraged to review this document and provide suggestions that may improve the quality of information provided, email **info@mtprog.com** quoting the document reference, or call the MTP enquiry line on +44 (0) 845 600 8951.

For further information on related issues visit **www.mtprog.com**