Examination of Domestic Cold Water Storage Tanks

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September 2016

AECOM

Domestic cold water storage tanks -

1. Aim
2. Design methodology
3. Water quality standards and regulations
4. Potential causes of cold water tank failure
5. Mitigation measures
6. Summary

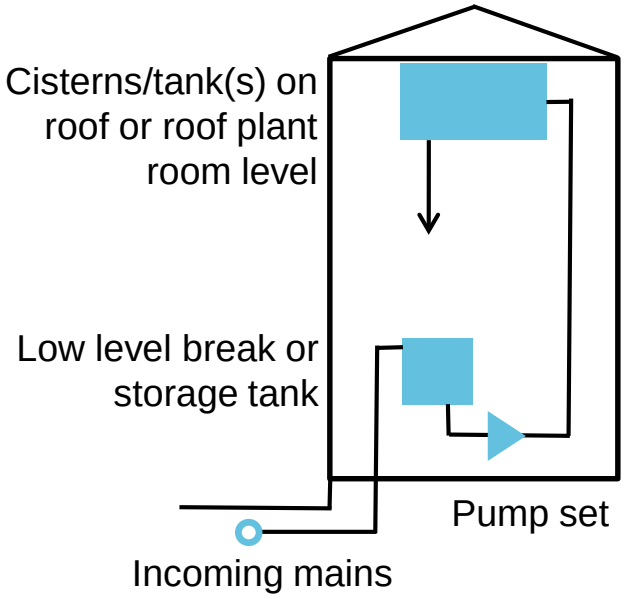
Domestic cold water storage tanks– Aim

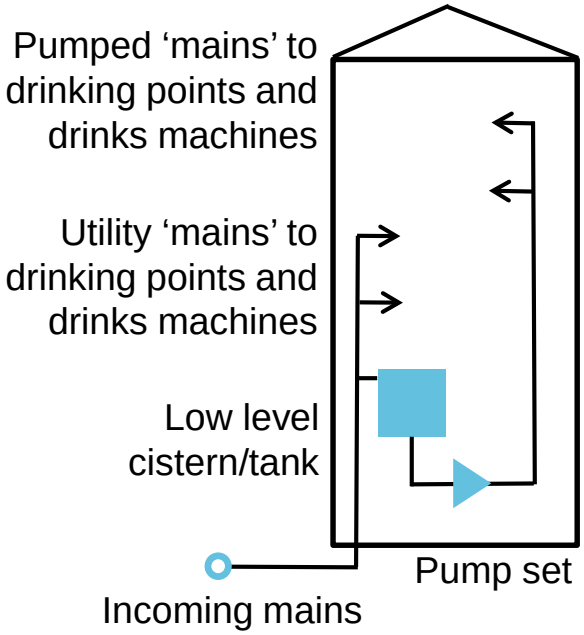
To highlight how various parameters may contribute to the performance of cold water storage tanks.

This examination comprised of three parts:

1. To study the methodology used;
2. Examine potential causes of cold water tank failure;
3. To suggest potential mitigation measures to maintain acceptable cold water system quality.

Domestic cold water storage tanks- Water system types





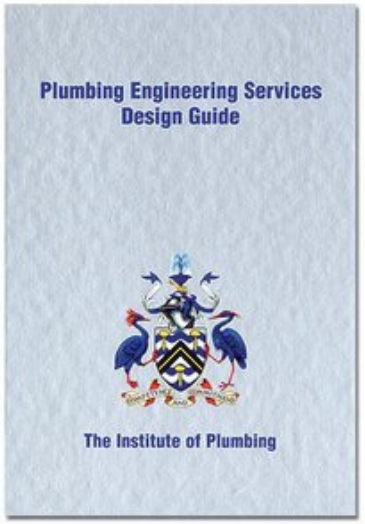
Images from* Plumbing Engineers Design Guide IoP 2002

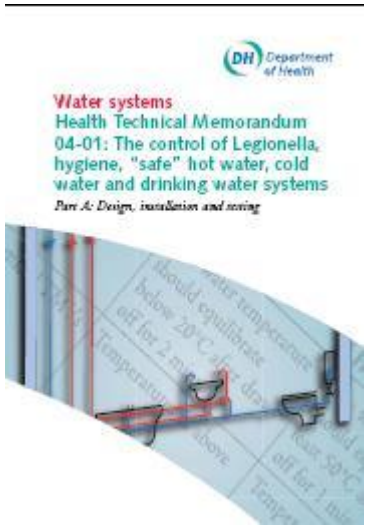
(A) Combined pump and gravity (B) Mains water for drinking

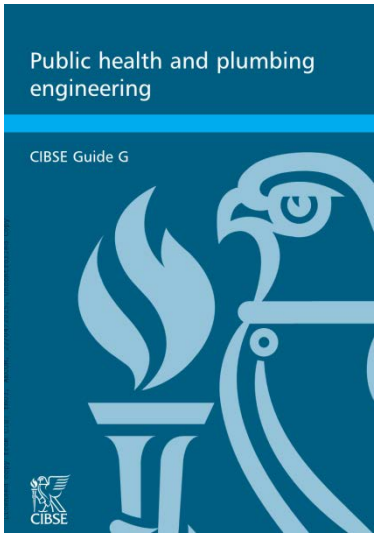
Domestic cold water storage tanks– Sizing methodology

There is evidence to suggest that using industry practice guidelines can result in over sized/failed storage tanks as a number of buildings have had to decommission installed tanks.

Design Guides for water storage quantities: IoP, SHTM-04:01, CIBSE Guide G







Domestic cold water storage tanks– Sizing methodology

The volume of stored water is obtained from:

$$\text{Storage volume} = \begin{pmatrix}\text{number of}\\ \text{persons}\end{pmatrix} \text{x} \begin{pmatrix}\text{litres per}\\ \text{person}\end{pmatrix} \text{x} \begin{pmatrix}\text{number of}\\ \text{days'storage}\\ \text{(or \% of 1 days supply)}\end{pmatrix}$$

Type of building	Demand (litre) CIBSE Guide G	Demand (litre) SHTM04:01	Basis of demand
Hospitals			
District general	600	Acute 299-978	Bed
Surgical ward	250	Specialist 319-531	Bed
Medical ward	220	Long stay 180-306	Bed
Schools			
Nursery	15		Pupil
Primary	15		Pupil
Secondary	20		Pupil
Offices			
With canteen	45		Person
Without canteen	40		Person
Hotels			
Budget	135		Bedroom
Travel Inn	150		Bedroom
Sports Facilities			
Swimming pool	20		Person
Field sports	35		Person

Table 1: Recommendations of water storage quantities.

Domestic cold water storage tanks– Sizing methodology

Type of Building	% of the daily demand
Hospital	50%
Schools	50%
Offices	0-50%
Hotels	50%
Sports Facilities	0-25%

Ref: Institute of Plumbers

Table 2: Recommendations of water percentage stored.

Domestic cold water storage tanks– Legionella / bacteria

The Chartered Institute of Building Services Engineers Technical Memorandum TM13 '*The Control of Legionella*' identifies the following as temperatures for Legionella growth:

1. Dormant; 0°C to 20°C;
2. Will multiply; 20°C to 45°C;
3. Will not multiply and will die in time; 50°C to 70°C;
4. Not active; 70°C to 100°C.

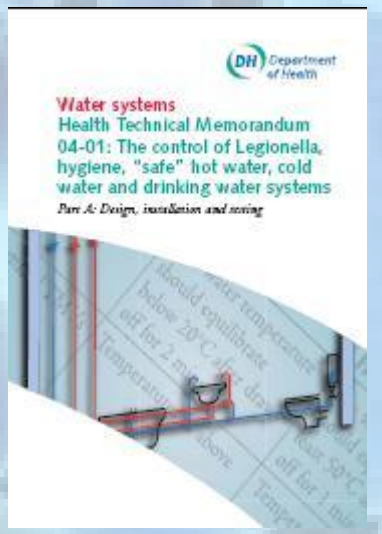
The most favourable temperature, based on empirical data suggests that the ideal microbial growth and proliferation is 36°C.

Domestic cold water storage tanks– Legionella / bacteria

Appliances such as, WHBs, sinks, WC's, drinking fountains, bib taps and urinals are not typically associated with aerosol sprays.

Certain groups of people are known to be more susceptible:

1. men;
2. over 45 year olds;
3. smokers, alcoholics;
4. diabetics;
5. immune compromised and
6. cancer or respiratory or kidney disease.

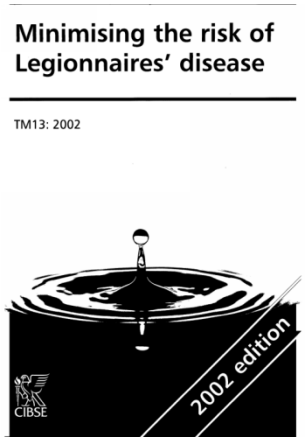


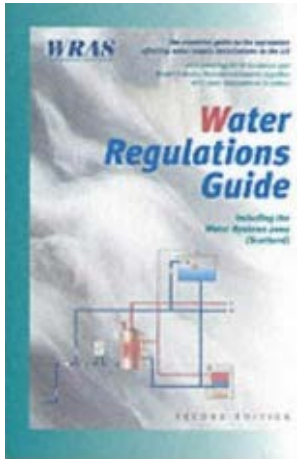
Obvious building where infection would prove catastrophic and potentially fatal is a hospital. The Department of Health have the Technical Memorandum HTM 04-01

BS 8580:2010 provides details of how to conduct a Legionella risk assessment.

Domestic cold water storage tanks– Water quality standards and regulations

1. CIBSE TM13 – ***'Minimzing the risk of Legionnaires disease'*** and BS8580:2010 - ***'Water quality- risk assessments for Legionella control'*** requires CWS to be below 20^{o}C after turned on 120s;
2. WRAS requires temperature below 25^{o}C;
3. UK Health and Safety Executives L8 requires temperature between 20^{o}C and 45^{o}C to be avoided.





Domestic cold water storage tanks– Potential causes of failure

1. The possibility of over sizing the cold water storage tank;

2. A lack of temperature monitoring in the cold water tank, incoming mains and at the extremities of cold water pipe distribution;

3. Reduced periods of occupancy and demand such as at weekends and holidays. Seasonal variations in the occupancy of the building can result in longer standing times of water in the cold water storage tanks;

4. If the plant room where the cold water storage tanks is located and unventilated there may be the potential for cold water storage temperatures to increase when there are periods of low usage;

5. Insufficient separation between the heat generating plant and equipment e.g. boilers, hot water storage cylinders and the cold water storage tank room and a lack of appropriate ventilation in the plantroom housing heat generating plant and equipment;

6. If the occupancy levels in the building after handover is less than envisaged at design stage a lack of domestic water draw-off due to unoccupied spaces and infrequently used outlets may cause elevated temperatures;

7. Ease of access for maintenance;

8. Poor maintenance associated with periodic system flushing;

9. The use of flexible connections which can harbour biofilm;

10. Insufficient consideration of system dead legs;

11. The end user not implementing risk assessments and procedures to control the risk of Legionella.

Domestic cold water storage tanks– Potential mitigation measures

1. Isolate and drain down one cold water storage tank section if it is a sectional tank as in hospitals. This will improve water turnover-to-demand;

2. The addition of chlorine dioxide CL02 dosing system to the domestic water services systems;

3. Provide a delayed action adjustable height ball valve in the water storage tanks to allow stored volumes to be adjusted if tanks are found to be too large;

4. Ensure appropriate controls and sensors are provided for monitoring domestic cold water consumption and cold water temperatures throughout the system;

5. Consider reducing cold water storage levels in buildings appropriate to the building type and anticipate demand (reduce from 24hr to 12hr storage);

6. Incorporate a ‘soft landings’ approach to help building users and operators adjust to their new facility and help them understand the building and associated systems design intent and operation;

7. Include seasonal commissioning in the contract to allow the systems to be adapted to seasonal variations and changes in user need;

8. Encourage clients to learn, for post occupancy evaluation, how the system and building are performing.

9. Industry review of current standards in relation to the design and sizing of cold water tanks, drawing on the experience of industry professionals and available live data across a wide range of building types and sectors;

10. Industry and academic research should investigate the variability of peak consumption over an extended period of time to allow for reassessment of current design codes;

11. Data/Knowledge sharing from live in use buildings.

Domestic cold water storage tanks– Summary

We have reviewed here:

1. History of domestic services;
2. Current water standards and regulations;
3. Potential causes of tank failure and mitigation measures;
4. Suggestions for maintaining a healthier water supply to our clients;
5. Suggestion for promoting a culture of collaboration and knowledge sharing with the goal of benefitting the building services industry and our clients.

Thank you.

September 2016