Float Valves

Their Ins and Outs

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How often are you confronted with problems associated with Float Operated, Level Control Valves? Many cistern or tank operational difficulties arise as a result of the inappropriate selection, sizing and installation of the most appropriate float valve for the respective duty.

Most float valves are purchased and installed by the Plumber or Mechanical Contractor. Selection may be down to the Consultant, but what does he know.

Within the context of compliance with the new water regulations (air gaps and all that), determining the appropriate position of the TWL (float valve shut off level) within a cistern is a minefield.

Understanding the general design considerations of each float valve type and how to apply this in practice will assist in formulating your positive and constructive response.

Float Valve Function and Design Considerations

The Plumbing, Heating and Ventilating Industry generally utilise float valves in the size range, 15 - 100mm dia.

The function of any float valve is simplicity itself, allow a reasonable discharge into a cistern and be capable of closing off against maximum pipeline pressure when TWL is obtained. A simple enough task one would think but Valve Manufacturers have been trying to perfect such a valve for the last 120 years.

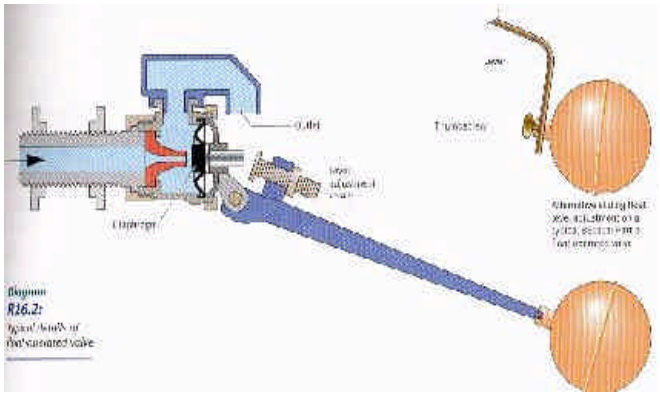
Design considerations include providing high flow rates at low head loss (low running pressure at valve inlet), designing the valve seat to minimise cavitation and noise, minimise frictional resistance and shut off loads and ensuring the float / lever mechanism is always in control of the valve internal.

Valves are designed pilot operated or standard, with small and large orifices, long levers / small floats or short levers / large floats, levers under slung or fitted over the valve body, etc. This detail is required to be known to the Cistern Manufacturer to ensure the valve can be correctly located and fitted in relationship to warning and overflow provisions.
To obtain reasonable valve life and minimise noise emission a float valve should not be over rated in terms of flow or pressure. Generally float valves are sized on 2 to 3 m/s flow rates based on nominal inlet bore and for either 6 or 10 bar rated shut-off pressure.

Valves installed in applications outside of their design limits will give rise to such problems as non shut-off, premature seat wear, high noise, water hammer or seat chatter which will seriously affect valve life whilst making the building virtually uninhabitable.

Float valves are available from many manufacturers; however in essence there are only three basic types.

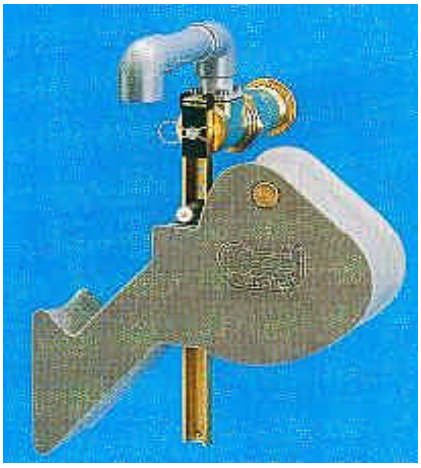
a) BS 1212 Parts 1 to 4.
b) Equilibrium.
c) Keraflo



The most common type in use within the UK is the 15mm BS 1212 type as applied to most W/Cs and domestic loft cisterns. The Part 1 type is not suited to use in W/Cs due to its inability to prevent backflow unless fitted with an upstream check valve. A BS 1212 Part 2 float valve is shown to the right.

Without going into the many complex hydraulic design principles the **BS 1212 Valves are much more restrictive on flow and absorb a much higher headloss than say those of the Equilibrium type.** For intermittent use this is satisfactory. However with ever reducing mains pressures, cisterns, which are in constant demand, require the lower head loss and higher capacity benefits of the Equilibrium.

The Keraflo valve type on the other hand brings a refreshing concept to controlling water level within a cistern. The main features are a 10 bar shut off, an adjustable TWL, long seat life, minimal operating forces and positive, quick opening and closing action with a minor delayed action facility. In it's various formats available in sizes up to 80mm.



Keraflo 'K' series shown

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The down side is they are more restrictive in their positioning within a cistern due the size and action of the special float and having higher headloss / lower flow rate characteristics, comparable with the BS1212 range. Further, their flow characteristics are variable across the size range. Hence selecting the most appropriate valve size for a given flow requirement necessitates an accurate knowledge of the running pressure at valve inlet.

Quick Opening and Closing Types

The principal feature of this float valve type is its capability of closing very rapidly from full open to shut when top water level is reached and also to open rapidly to full bore on a minor drop in TWL.

2) Valve will not close at desired TWL.

The float arm requires adjustment. Special valves which provide such adjustment are available, the Aylesbury range for example, however for the more conventional BS1212 and Equilibrium types the setting down of the float arm is allowable but with care. Such action must not compromise valve function. A reduction in the designed lever ratio occurs when a lever is bent downward and hence a comparable reduction in valve closing force. In most cases the valve operation is not compromised, as the closing force is still sufficient to meet the actual shut off pressure conditions.

Where it is obvious that this 'setting down' is excessive, say, valve fully open and float is directly impinged on by the discharging water (> 25 deg.) it is necessary to consider alternatives.

i) fit a larger diameter float, thus increasing the lever ratio and reducing the amount of 'set down'.
ii) fit a 'drop rod' lever arm extension, which extends the lever and is adjustable to achieve the desired TWL.

3) Valve chatter or drumming noise.

Valve chatter (not possible in the Aylesbury range) occurs when the float / lever assembly is not positively in control of the valve internal which is being subjected to ever changing hydraulic forces during the final closing action. The frequency of the drumming being of the order 5 to 15 c/s.

This problem is most noticeable when small draw offs are taken from the tank and the valve responds by just cracking open. If left unchecked (this is doubtful as the building occupants are unlikely to put up with a 'Concorde' in their midst) the valve seating will rapidly deteriorate, as would the lever linkage. Damage to pipeline joints is also a distinct possibility as high frequency water hammer shock waves are generated. Almost certainly, the installed float valve will be found to be underrated for the closing off pressure.

The solution;

i) fit a float valve of a higher rating.
ii) for BS1212 valves, fit the valve with a smaller orifice. Most manufacturers have such conversion kits available.
iii) fit an oversized float or increase the lever length to increase the positive closing forces.

4) High noise level when discharging

Float valves and their surrounding pipework can emanate troublesome nose levels within a building if flow rates are excessive. Generally feed pipes and float valves should be sized on the basis of a flow rate not greater than 2 m/s. As flow velocity increases general noise level increases, as does the ware

and tare in the controlling equipment. Float valves operating at over 3m/s not only create high, troublesome noise levels but will require regular / frequent maintenance.

5) Valve Surging.

This troublesome and potentially damaging phenomenon occurs when the action of the valve is in synchronous frequency with wave action within the tank. The cyclic frequency is much slower than that discussed in the previous paragraph, probably in the order of 1 to 2 c/s but with much greater internal valve movement. This in turn produces large and rapid change in pipeline velocity giving rise to serious pressure surges.

If left unchecked premature pipe failure will occur. Remember, for every 1 m/s instantaneous change in flow velocity an additional 10 bar pressure surge is generated on top of the normal static pressure within the pipe system.

Surface wave action within the tank creates the problem. The solution is to disrupt the natural resonant frequency between the valve and wave action. This is very much a matter of trial and error.

Possible cures;

i) introduce a baffle between the discharging water and valve float to reduce surface turbulence around the float.
ii) install a baffle across the tank to prevent reflected return wave action affecting float action.

Care requires to be exercised in the selection of appropriate materials for baffle construction when storing wholesome water to ensure compliance with BS 6920 and the water regulations.

The use of an unventilated drop pipe from valve outlet to below the water level is not allowable, as this would contravene the water regulations related to backflow.

Summary

It is hoped this appraisal of float valve types, their characteristics and potential problems provides useful practical guidance and the confidence to select the most appropriate float valve for optimum performance for any given installation.

Note: The information provided is advisory only.

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