Float Operated Inlet Control Valves

Their Ins and Outs

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

Typical Water Works Float Valve

Most float valves are purchased and installed by a Plumber or Mechanical Contractor but valve selection may be that of a Consultant. Water Regulation Advisory Service (WRAS) approved float valves should be used as part of the selection process for building services applications.

Within the context of water regulation compliance and maximising tank capacity determining the appropriate position of the top water level (TWL) within a tank can be a minefield.

Understanding the general design considerations of each float valve type and how to apply this in practice will assist in deciding on the most appropriate float valve selection.

Float Valve Function and Design Considerations

The Water Industry can require valves sized up to 900mm dia. The normal range being 25 - 300mm dia. On the other hand 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 the tank is full. A simple enough task one would think but Valve Manufacturers have been trying to perfect such a valve for the last 130 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 a valve's internal frictional resistance and shut off loads whilst ensuring the float / lever mechanism is always in control.

Every tank installation and its associated inlet control device are unique. Tank Manufacturers require to be advised of the float valve type selected to ensure it is correctly located to maximise tank capacity, achieve the required regulation air gap if required and to determine the appropriate position and size of warning and overflow pipe 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 their inlet bore for either a 6 or 10 bar rated shut-off pressure. Valves for higher pressures are also available.

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

Float valves are available from many manufacturers, in essence however there are only four basic types.

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

The most common type in use within the UK domestic market is the 15mm BS 1212 type as applied to most domestic W/Cs and loft tanks. BS 1212 Valves are more restrictive on flow and incur a much higher headloss than say those of the Equilibrium type**.** For intermittent use this is satisfactory. However with ever reducing mains pressures, tanks that are in constant demand require the lower head loss and higher capacity benefits of the Equilibrium type.

The Pressure Operated type uses mains pressure to assist valve activation via an internal pilot valve controlled by the leaver and float mechanism. The advantage, a much reduced variance in tank water level between full open and closed. Valve headloss is greater than that of an Equilibrium type but is particularly suited for large tanks or reservoirs with a high pressure supply.


Keraflo K Type

The Keraflo valve type on the other hand brings a refreshing concept to controlling water level within a tank. 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 built in. In it's various formats available in sizes 15mm to 150mm as standard, larger sizes are also available.

Quick Opening and Closing Types

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

The advantage of a valve of this type is that the tank is maintained at or near its full level at all times and where tanks are pump supplied and activated by level and pressure sensors, float valve and pump operation is minimized offering reduced energy and maintenance costs.

Assessment has to be made that the snap closing action of this valve type does not create potentially noisy or damaging pressure surges in the system.

Put in context, for every 1 m/s flow rate brought to rest instantly (one pipe period or less), a pressure rise of 10 bar over the static pressure will occur in the pipe system.

(To minimise water hammer to the acceptable limit of not more than 25 % of the maximum static pressure within a pipe system requires a closing time of not less than 10 pipe periods. A pipe of common bore supplying a float valve of equal diameter would require to be not more than 50 m long to meet this pressure limitation requirement.)

Fortunately, installations within buildings are generally safe from high pressure surges. Inherent damping arises from the many changes in pipe diameter from its main's source to shut off point further supplemented by multiple, on route outlets, which act as pressure relief points.

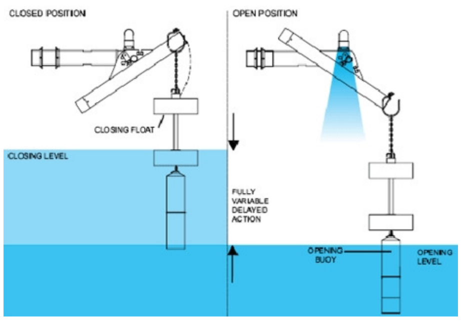
Water Industry tanks and reservoirs, served by much longer, dedicated pipe runs require assessment as to the speed or control offered by a float valve's closing action. Specially ported valves designed to limit flow to the maximum allowable or provide tailored made closing characteristics are available to assist in these instances.

Delayed Action Float Valves

Keraflo KB Type

Similar in concept as the Quick Opening and Closing Valves but providing a much greater adjustable delay in its opening and closing actions thus furthering the benefits of reduced maintenance and energy use.

Special float mechanisms are employed as part of valve assemblies allowing tanks to empty to a set lower water level prior to initiating valve reopening and a re-commencement of the filling cycle. The Keraflo KB type offers this facility.



Common Problems Associated with Float Valves

The following highlights common difficulties and problems that can arise with float valves in operation particularly if they have been incorrectly selected, installed or badly maintained.

1) Valve will not close off drop tight.

The main problems associated with this type of failure are,

a) Dirt on valve seat.
b) Valve face is worn.
c) The float / lever mechanism has insufficient operating force to close against the shut off pressure.

The necessary corrective actions for a) and b) are fairly obvious (clean and replace) however for c) it can be more complicated if an under rated valve was selected.

Equil. Float Valve with cranked Drop Rod

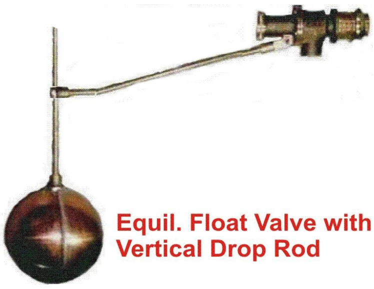
Determine the maximum mains pressure at the tank location and select and fit an appropriately rated float valve. If practical, fitting a lever extension or a larger ball float to the existing float valve could well overcome the problem.

Further considerations are the float may be damaged and unable to provide the necessary upthrust. A ball float should be no more than half submerged when the valve closes against its fully rated pressure. Delayed action float valves such as Keraflo, are unaffected by this.

2) Valve will not close at desired TWL.

The float arm requires adjustment. Special valves which provide such adjustment are available, the Keraflo 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. However this adjustment is not included in the WRAS approval a valve may have. In most cases valve operation is not compromised, as the closing force is still sufficient to meet the actual shut off pressure conditions.

Equil. Float Valve with 20 deg. "Set Down"



Equil. Float Valve with Vertical Drop Rod

Where it is obvious this 'setting down' would be excessive, it is necessary to consider alternatives.

a) Fit a larger diameter float increasing the effective lever length and buoyancy.
b) Fit a 'drop rod' lever arm extension, which extends the lever and is adjustable to achieve the desired TWL. This modification however has no WRAS approval and no WRAS approved valves incorporating 'drop rod' extension arms are available in the market.

3) Valve chatter or drumming noise.

Valve chatter occurs when the float / lever assembly is not in positive control of the valve internal due to ever changing hydraulic forces during the final closing action. The frequency of the drumming being of the order 10 to 20 c/s. Not a possibility in the Keraflo range.

This problem is most noticeable when small draw offs are taken from the tank. If left unchecked 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;

a) Install a float valve of a higher pressure rating.
b) For BS1212 valves, fit the valve with a smaller orifice. Most manufacturers have such conversion kits available.
c) 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 if flow rates are excessive. Ideally 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 noise level increases, as does the ware and tare in the internal controlling equipment. Float valves operating at over 3m/s not only create high, troublesome noise levels but will require regular / frequent maintenance. Reduced orifice or specially ported float valves should be employed when conditions such as these are likely to arise.

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 is likely to 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 creates the problem and it is necessary to disrupt this natural resonant frequency between the valve and wave action. This is very much a matter of trial and error. Possible cures;

a) Introduce a baffle between the discharging water and valve float to reduce surface turbulence around the float.
b) Install a float stilling chamber 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.

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.

Further assistance on tanks and appropriate float valve selection is available from ATCM Members via the ATCM Members page at - www.atcmtanks.org.uk
or E-mail imcc@atcmtanks.org.uk

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