Type ‘AB’ Air Gaps

Practical Examples and Calculations

Ian McCrone BSc. CEng. MIMechE., Chairman ATCM

This article is aimed at clarifying regulation requirements of Type ‘AB’ Air Gaps and the new thinking by the Water Companies in their practical application.

The Regulations are quite specific, a type ‘AB’ Air Gap is, by definition is **unrestricted. i.e. No Screening of the Spill Slot.**

However, as was further explained, due to practical considerations WRAS and the Water Undertakers are now prepared to accept or recommend in certain circumstances, the need to screen a Type ‘AB’ Spill Slot.

In practice, this will mean, most if not all Type ‘AB’ Spill Slots will be accepted when provided with appropriate **screening and cowl outlet.**

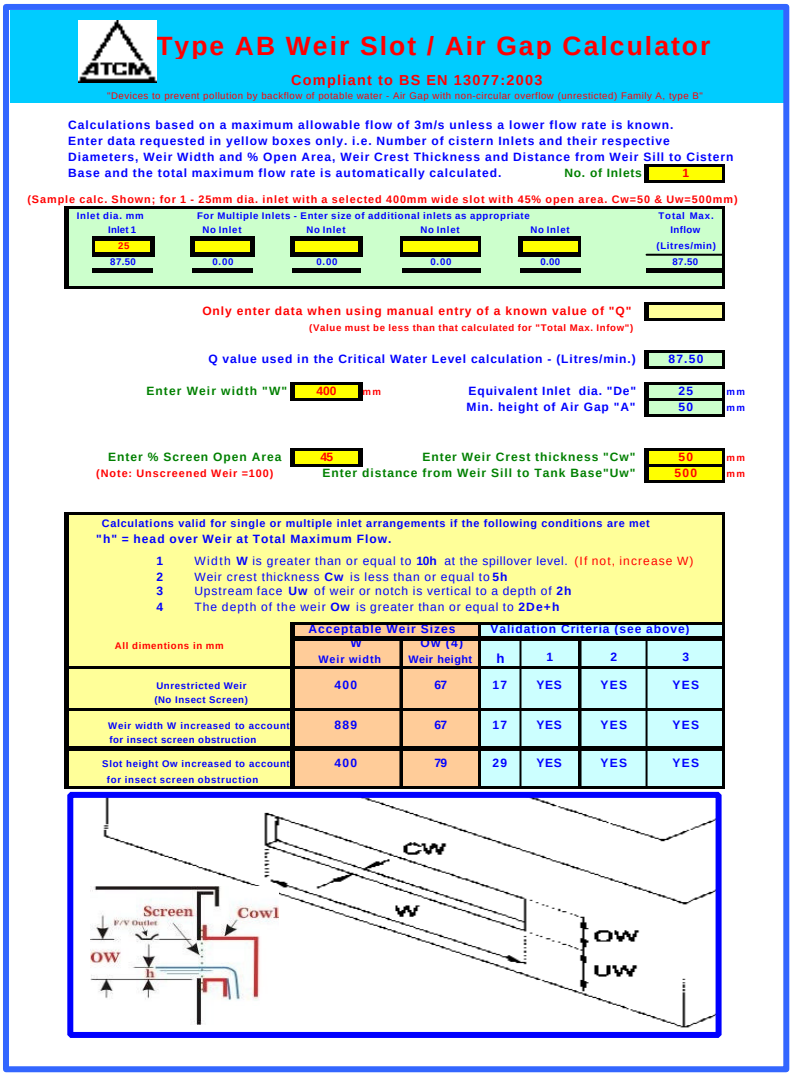
The onus will still be with the **Tank designer,** for any given duty, to ensure the spill slot size and configuration will be compliant with the Regulations.

The Fundamental’s

The determination of a Type ‘AA’ and ‘AB’ Air Gaps and spill slot design still rests, at the present time, with BS 6281:Part1:1992 (BS EN 13077). The Specification for the now superseded Type ‘A’ Air Gap.

The formula for determining the head of water ‘h’ discharging over the weir the spill slot is advised as are the other critical parameters related to the slot design.

The ATCM web site www.atcmtanks.org.uk, on its Technical / News page, provides the ATCM “Type AB Air Gap and Spill Slot Calculator” (as shown right) in the form of an Excel Spreadsheet. Inputting tank inlet diameter/s and slot length the Calculator automatically provides the value ‘h’ for an unscreened slot and minimum slot height.



Type AB Weir Slot / Air Gap Calculator

Compliant to BS EN 13077:2003

"Devices to prevent pollution by backflow of potable water - Air Gap with non-circular overflow (unrestricted) Family A, type B"

Calculations based on a maximum allowable flow of 3m/s unless a lower flow rate is known. Enter data requested in yellow boxes only. i.e. Number of cistern Inlets and their respective Diameters, Weir Width and % Open Area, Weir Crest Thickness and Distance from Weir Sill to Cistern Base and the total maximum flow rate is automatically calculated. No. of Inlets: 1

(Sample calc. Shown; for 1 - 25mm dia. inlet with a selected 400mm wide slot with 45% open area. Cw=50 & Uw=500mm)

Inlet dia. mm	For Multiple Inlets - Enter size of additional inlets as appropriate				Total Max. Inflow
Inlet 1	No Inlet	No Inlet	No Inlet	No Inlet	(Litres/min)
25					
87.50	0.00	0.00	0.00	0.00	87.50

Only enter data when using manual entry of a known value of "Q" (Value must be less than that calculated for "Total Max. Inflow")

Q value used in the Critical Water Level calculation - (Litres/min.) 87.50

Enter Weir width "W" 400 mm — Equivalent Inlet dia. "De" 25 mm; Min. height of Air Gap "A" 50 mm

Enter % Screen Open Area 45 (Note: Unscreened Weir =100) — Enter Weir Crest thickness "Cw" 50 mm; Enter distance from Weir Sill to Tank Base"Uw" 500 mm

Calculations valid for single or multiple inlet arrangements if the following conditions are met
"h" = head over Weir at Total Maximum Flow.

1 Width **W** is greater than or equal to **10h** at the spillover level. (If not, increase W)
2 Weir crest thickness **Cw** is less than or equal to **5h**
3 Upstream face **Uw** of weir or notch is vertical to a depth of **2h**
4 The depth of the weir **Ow** is greater than or equal to **2De+h**

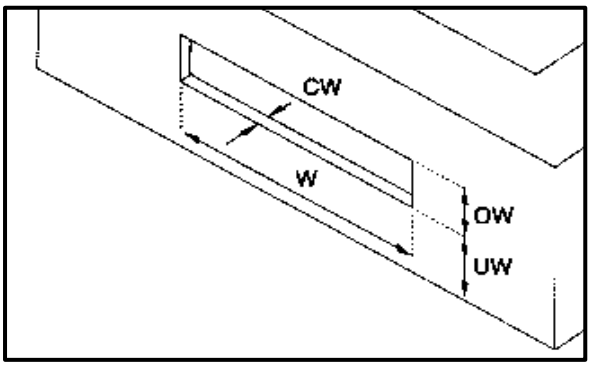
All dimentions in mm	Acceptable Weir Sizes		Validation Criteria (see above)			
	W Weir width	Ow (4) Weir height	h	1	2	3
Unrestricted Weir (No Insect Screen)	400	67	17	YES	YES	YES
Weir width W increased to account for insect screen obstruction	889	67	17	YES	YES	YES
Slot height Ow increased to account for insect screen obstruction	400	79	29	YES	YES	YES

Additionally it advises **i)** for the same value of 'h' the required increased slot length for a screen with a particular % free area or **ii)** for the same slot length the increase required in 'h'.

The calculated results are only valid if the Validation's 1 to 4 are met.

Practical Guidance

From a design and manufacturing viewpoint limit the options available. Consider adopting only two spill slot lengths suited to a specific tank range. In the examples below 400mm and 800mm have been selected as 'W'. Choose a reasonable maximum value for 'h', say 20mm for inlets up to and including 32mm for the smaller slot and 50mm for the larger inlets and slot size. This approach will provide compact and economical designs.



Example Calculations

1) Determine relative inlet centreline level (c/l) of a 25mm dia. Equilibrium F/V above the weir sill level of a Type 'AB' 400mm long Spill Slot (a - unscreened and b - screened.)

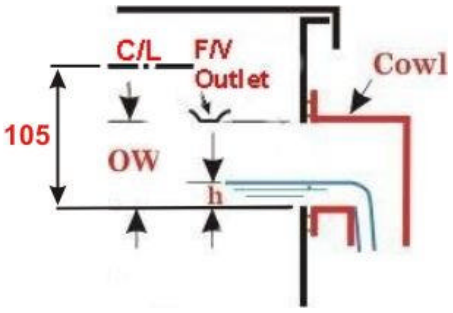
a) Unscreened Slot

'h' = 17mm

'OW' min. slot height = 67mm (2 x F/V dia. + head over weir)

Equilibrium Float Valve inlet centreline is 1.5 x F/V dia. above its discharging outlet = 1.5 x 25 = 38mm.

Therefore, F/V c/l is ('OW' + 38) = 105mm above weir sill level.



b) Screened Slot

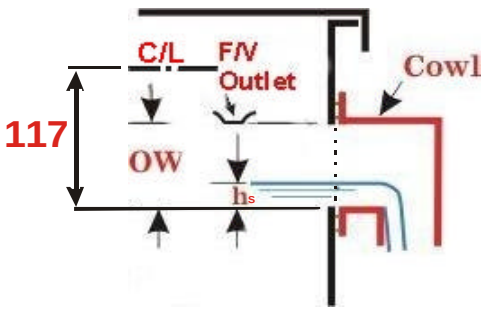
If this 400mm long Spill Slot is fitted with a 45% Free Area Screen the value of 'h' will require to increase.

The Calculator provides the value of 'hs' = 29mm or the following formula advises how this is derived.

$$h_s = h \times (100 / \%\text{Free Area})^{2/3}$$

Therefore 'h' increases until the same flow to passes through the screen. In this instance 'h' requires to increase to -

$$h_s = 17 \times (100 / 45)^{2/3}$$
$$= 29\text{mm}$$



Consequently F/V c/l is required to be positioned 117mm above weir sill level.

Remember, 'OW' (spill slot height) requires to be increased to 79mm and is given by 2 x F/V dia. + head 'hs' over weir.

For other typical inlet and slot size examples the following can be determined,

2) F/V = 50mm dia., Slot length = 800mm

Therefore -

'h' (**unscreened**) = 27mm
'OW' = 127mm.
F/V c/l to weir sill level = 202mm

For Slot with 45% free area screen

'h_s' (**screened**) = 46mm
'OW' = 146mm
F/V c/l to weir sill level = 221mm

3) F/V = 100mm dia. Slot length = 800mm

Therefore -

'h' (**unscreened**) = 68mm
'OW' = 268mm.
F/V c/l to weir sill level = 418mm

For Slot with 45% free area screen

'h_s' (**screened**) = 116mm
'OW' = 316mm
F/V c/l to weir sill level = 466mm

In this latter Screened Slot example the minimum requirement for the slot length of **10 x h_s (1160mm)** is not met by a single 800mm weir slot. It is therefore a non-compliant design. It is recommended 2 x 800mm wide slots be employed.

In example **3)** a further benefit is obtained if **2 x 800mm long Spill Slots** are employed. The values of 'h' and 'hs' would reduce to 43 and 73mm with the effect of **raising the TWL by some 25 and 43mm respectively and if tank surface area is large compared to its depth, considerably increases the volume of water stored**

Note: Information provided is advisory only.