Design, Specification, Installation & Maintenance for Multiple Coanda Screen Installations
(Types A, AB, C, F and K)

1 INTRODUCTION

Aquashear Coanda intake screens are designed to provide an extremely low maintenance screening solution for water intakes without the need for any moving parts. This self-cleaning ability together with a high abstracted flow capacity is a function of the shape of the screen and the arrangement of the wedge wires that make up the screen material.

The screens are usually installed on the downstream side of a weir. The river water flows over the top of the screen, clean water and fine silt particles (<1mm) pass through the screens, whilst larger silt and debris is excluded and deposited downstream. During times of low river flow the screen capacity may be greater than the available water. Under these conditions debris can build up on the lower parts of the screen. This will be washed off the next time the river flow rises above the screen capacity.

Laboratory testing on 1mm screens have shown that 100% of material >1mm in diameter is excluded by the screen, and up to 95% of material >0.5mm can be excluded.

2 TYPES OF SCREEN

This design guide covers larger installations (generally 200 l/s and above), which are suitable for multiple screen units. There is a choice of four types of screen, and multiple units can be installed to give the required flow rate:

- Type A – “full height” with removable screen material
- Type AB – “full height” fully welded
- Type C – “half height” fully welded
- Type F – “quarter height” fully welded
- Type K – an extended-height fully welded screen for larger installations

The Type A screens were developed by Aquadyne in the USA more than 20 years ago, and are the original “AquaShear” Coanda screen. The screen material is removable from the frame, to allow replacement due to wear or damage, and they are therefore particularly suitable to sites with high abrasive bed load. They are similar in size and capacity to Type AB screens, which have the screen material welded into the frame for extra strength – Type AB screens should be considered in situations where high flood levels are unavoidable.

Types A and AB have a similar cross section, and give a total headloss of 1270mm. For sites where this is an issue (such as medium head hydro schemes, or where excavation down into bedrock would be problematic) the Type C screens will be more appropriate. These are one-piece screens with half the amount of screen material of the Type A/AB, and thus have a headloss of only 700mm.

For low head applications, Dulas have developed a Type F “quarter height” screen with 400mm headloss.

Type K screens have been developed to meet the requirement for larger screens than the Type A and AB screen. With a head loss of 1.9m, and a rated capacity of 250 l/s per metre
weir crest, the Type K screens are designed for larger high-head schemes, with abstraction rates typically higher than 3m$^3$/s.

3 SPECIFICATION & CAPACITY

All screens and frames are made from 304 stainless steel as standard, and are acid cleaned before shipping. Grade 316 is available on request, suitable for marine applications.

The standard wire aperture is 1.0mm. Finer screens have been supplied in a few cases, but these have not always proved to be successful. If screening of less than 1mm is preferred, we would recommend the supply of Type A screens to allow easy replacement of the screen material if required at a later date.

Laboratory and on-site tests have indicated that the screens can have up to 50% higher capacity than the rated values. The rated capacities are guaranteed when first installed, and the extra capacity allows for reduction in performance due to abrasion over time (see below).

The screens are usually supplied with EPDM or Nitrile rubber gaskets. These fill the gaps between the screens, allowing for unevenness in the concrete or screen alignment. Concrete fixings are not supplied (see below). Stainless nuts, bolts & washers for bolting frames together side to side are supplied on request, but these are simply stainless steel M10x30 set screws with washers and lock nuts, which can be easily sourced.

3.1 Type A Screens

These screens have an abstraction capacity of 140 l/s per metre width, and a headloss of 1270mm. Three widths of Type A units are available:

<table>
<thead>
<tr>
<th>Type</th>
<th>Width (mm)</th>
<th>Rated Flow (l/s)</th>
<th>Frame Weight (kg)</th>
<th>Screen Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1534 (Full width)</td>
<td>1534</td>
<td>210</td>
<td>108</td>
<td>47</td>
</tr>
<tr>
<td>A-1010 (Two-third width)</td>
<td>1010</td>
<td>140</td>
<td>72</td>
<td>31</td>
</tr>
<tr>
<td>A-510 (Third width)</td>
<td>510</td>
<td>70</td>
<td>44</td>
<td>16</td>
</tr>
</tbody>
</table>

There are three main parts to each Type A screen assembly, which allows the screen material to be replaced:

- Frame, consisting of the curved acceleration plate, support ribs and foot bracket
- Screen material, with locating hooks
- Clamping plate to hold the screen material in place (supplied with stainless M10 set screws and washers, which fit into captive nuts on the foot bracket)

3.2 Type AB Screens

These screens also have an abstraction capacity of 140 l/s per metre width, and a headloss of 1270mm. Two widths of Type AB screen units are available:

<table>
<thead>
<tr>
<th>Type</th>
<th>Width (mm)</th>
<th>Rated Flow (l/s)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB-1000 (Full width)</td>
<td>1000</td>
<td>140</td>
<td>63</td>
</tr>
<tr>
<td>AB-500 (Half width)</td>
<td>500</td>
<td>70</td>
<td>35 (est)</td>
</tr>
</tbody>
</table>

These are of one-piece fully welded construction.
3.3 **Type C Screens**

These screens also have an abstraction capacity of 65 l/s per metre width, and a headloss of 700mm. Two widths of Type C screen units are available:

<table>
<thead>
<tr>
<th>Type</th>
<th>Width (mm)</th>
<th>Rated Flow (l/s)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1500 (Full width)</td>
<td>1500</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>C-750 (Half width)</td>
<td>750</td>
<td>50</td>
<td>27</td>
</tr>
</tbody>
</table>

These are also of one-piece fully welded construction.

Two types of foot bracket are available – horizontal or vertical (denoted H or V). The older vertical design has been largely superseded by the horizontal version, as the installation is easier. Vertical foot versions are available on request.

3.4 **Type F Screens**

These screens have an abstraction capacity of 35 l/s per metre width, and a headloss of only 400mm. They are available in 1000mm wide one-piece units, weighing approximately 27kgs each.

3.5 **Type K Screens**

These screens have an abstraction capacity of 250 l/s per metre width, and a headloss of 1900mm. They are available in 1000mm wide one-piece units.

3.6 **High-Capacity Screens**

For schemes where there is insufficient room to fit standard (1.0mm) screens, or where the silt removal properties of the Coanda Screen are not as important (i.e. low head schemes), or where alternative silt removal measures are installed, Dulas has developed a ‘high-capacity’ screen. The changed configuration of the screen permits almost twice the volume of water to pass through the screen, but also allows larger silt and sand particles to pass through the screen (<2mm) – but the screen is still very effective at keeping fish and other river fauna, debris and general river detritus out of the system. The screens are not as efficient at self-cleaning as the standard screens, and so may require more regular cleaning.

3.7 **Protection Bars**

All screens, except Type A, are available with protection bars welded over the screen material to prevent flood damage. These are made from laser profiled 5mm stainless steel plate, allowing debris to roll down the front of the screen without damaging the screen material. Depending on the number of bars, the capacity will be reduced by around 3-5%. The bars also make brushing the screens more difficult, so this option should be carefully considered. The suffix “-X100” on a screen type denotes protection bars at 100mm centres.

Another alternative is to have separate “bull bars” fixed to the weir above the screen. These deflect large debris, while allowing the screens to be cleaned as normal. Dulas can give advise on various “pre-screening” options, although locating the screens out of the main flow is usually the preferred option.

4 **DRAWINGS**

Details of the screens and installation requirements are shown on the following drawings:

- AQS-001 “Type A Dimension Details”
5 INTAKE STRUCTURE DESIGN CONSIDERATIONS

Typical installation sections and elevations are shown in the drawings, along with suggestions for concrete arrangements. In addition, the following points should be considered when designing the intake structure. Dulas can advise during the design phase if required.

1. If the site is subject to extreme flood flows with movement of large rocks (eg Alpine regions) then location of the screens out of the main river flow is recommended in order to prevent physical damage. They can be placed in a separate structure behind a wing wall or at the end of a side channel. If this is not possible then screens with protection bars are also available on request, or Dulas can offer advice about robust pre-screening options.

2. The sump chamber must be deep/wide enough to take the required flow. The floor of the chamber can be sloped towards the exit to increase the cross-sectional area, or the weir walls can be overhung to provide extra width. Note that for all screens except Type A, access is required to this chamber to bolt the frames together from behind.

3. For pressure systems (eg hydro schemes) ensure that the exit pipe is set deep enough in the sump to prevent air entrainment, and install a suitable bell mouth (or similar).

4. The sump chamber under the screens should be vented to atmosphere to prevent air locks and to allow water to flow freely through the screens.

5. A sluice gate or similar should be installed in the weir to enable the water level in the weir pool to be dropped so that the screens can be de-watered for maintenance or inspection.

6. Safe access should be provided to the foot of the screens to allow maintenance (brushing down, or removal/replacement). A 500mm wide concrete ledge set about 500-700mm below the foot of the screens is suitable. Clip-wires or hand rails may also be appropriate in some cases.

7. The reinforcing bars in the weir walls should be designed to avoid the screen fixing bolt locations.

8. Some allowance in the width between the wing walls needs to be made for manufacturing variation and formwork tolerance – see below.

5.1 Concrete Fixings

Suitable concrete fixings include sleeve or wedge anchors, expansion bolts, chemical (resin) anchors or cast-in sockets. Stainless steel should be used wherever possible to prevent corrosion and to avoid galvanic reaction with the frames.

The choice of fixing chosen depends on local conditions and working practices, and the installation method will vary slightly for each situation. Expansion sockets with round-head bolts provide a good finish with little protrusion of metal into the river flow, although they can trap silt and may need flushing to prevent thread damage. Studding has been used at some sites, but this can catch debris such as grass and leaves. The frame holes are 13mm in diameter, suitable for M10 or M12 fixings, although M8 fixings have been used in certain circumstances (eg on uneven concrete, or where alignment is difficult).
The frames are strong enough to cope with the static pressure exerted by most flood flows. However, during high flows the water will tend to suck the screens outwards, rather than to squash them – the fixings need to be sufficiently strong to cope with this force. If the site is subject to extreme flood flows with movement of large boulders then installation of the screens out of the main river flow is recommended.

5.2 Weir Width
The screens are manufactured with a width tolerance of ±2mm, and each gasket will take up 3mm. Some extra width should also be allowed for formwork tolerance – extra gap can be filled, but if the weir is cast too short then it can be difficult to remove concrete to fit the screens. You should allow 5mm per gasket (including manufacturing variation) and 15mm at each end for formwork tolerance.

Examples for calculating the distance between wing walls (screens + gaskets + formwork):

- 10 Type A-1534 screens: 10 x 1534mm + 9 x 5mm + 2 x 15mm = 15,415mm
- 5 Type AB-1000 screens: 5 x 1000mm + 4 x 5mm + 2 x 15mm = 5,050mm

It is advisable to lay out all the frames on the weir before drilling the fixing holes. One or more gaskets can then be omitted if there is found to be insufficient width between the wing walls.

5.3 Design Health & Safety
Points to consider for the design risk assessment process (in addition to those for the general weir construction) include:

1. Screen handling and access to the weir during installation – the units will needed to be carried to the weir, or lifted into position with a digger or similar. Type A frames can be stropped, but there are no lifting points on Type A screen material. Shackles can be attached to the fixing holes on the one-piece units if required. Component weights are given above.
2. Sharp edges – the frames and screen material can have sharp edges, so suitable gloves should be worn when handling.
3. Drilling into the concrete for fixing the frames to the weir – standard site H&S precautions should be followed (ear & eye protection, etc). Note that drilling into the main (upper) weir wall may involve working at height if scaffolding is not in place.
4. Confined spaces – for Type A screens all the installation and fixing can be done from the outside. However, all other types require access under the screens to fix the frames together – this will almost certainly be classed as a confined space and suitable precautions should be taken.
5. Access for future maintenance – a flat standing area should be provided at the bottom of the screens to allow inspection, cleaning or maintenance. Suitable access to this area should also be provided (this may involve fixed ladders, step irons, etc). It should be possible to de-water this area by using a sluice gate or similar. Clip-wires or handrails may also be required in certain circumstances.
6. Working near water – general site rules will apply.
7. The only COSHH requirement will be for any anti-seize grease or sealing compounds that are used. The screens themselves are made from stainless steel.

For more details, please refer to:
- The Personal Protective Equipment (PPE) at Work Regulations 1992
- The Manual Handling Operations (MHO) Regulations 1992
- The Noise at Work Regulations 1989
6 INSTALLATION

See the separate site installation instruction sheets which should be printed out and given to contractors on site, along with a site-specific risk assessment.

- AQS-DOC020 “Type A Installation Instructions”
- AQS-DOC021 “Type AB Installation Instructions”
- AQS-DOC022 “Type C Installation Instructions”
- AQS-DOC023 “Type F Installation Instructions”

7 MAINTENANCE

The screens are designed to minimise the maintenance requirements for a water intake. Depending upon the particular water conditions at the site, occasional maintenance may be required.

In order to establish the maintenance regime required for a particular installation the screen should be monitored relatively frequently during the first year of operation. A suitable interval would be monthly visits in most cases. In some cases it can be established that no regular maintenance is required and the intake should be visited for observation only at monthly intervals. In other extreme cases where there is prolific slime or algal growth, or particular types of debris, maintenance or cleaning visits may be required more often – note that this is most likely to be seasonal. In the UK, simply brushing down the screens every month or two is typical.

In some water conditions there can be problems with green slime or algae sticking on the screen material, particularly during hot weather. This can be removed with a stiff brush – a standard yard broom with stiff bristles is suitable. Generally the vast majority of debris can be removed by brushing from the outside. In one case it has been found necessary to clean the underside of the screen at 6-12 monthly intervals to remove peat fibres, which coagulate on the water surface in the sump. The underside of the screen material should therefore be inspected after 3-6 months operation to determine whether regular cleaning will be required at the site.

The vast majority of vegetative debris (leaves and twigs) will be washed off the screens during periods of higher river flow. It may be found that a few pieces of items like pine needles or leaf stems will get stuck between the wedge wires over time. Again, these can be removed using a stiff bristle brush.

Physical damage is a possibility if large boulders or trees are carried down the river during flood conditions. If this is a possibility at the site (e.g. forestry upstream of the intake) then the intake should be visited to check for physical damage after large flood events. In high bed-load situations (such as Alpine regions) the screens should be situated out of the river or have protection bars installed above them.

7.1 Repairs and Replacements

Should there be any physical damage to the screen material it will need to be replaced. At sites where there is a high silt load of abrasive material (e.g. quartz) the capacity of the screens will gradually be reduced as the sharp edges of the wedge wire are rounded off. This will reduce the capacity of the screen and eventually the screen material will need to be
replaced. Experience has shown that in general it will take more than ten years for the flow capacity to drop below the rated capacity. However, in some extreme cases where the silt has a high abrasive content this period can be reduced to five years or less.

For Type A screens, sheets of replacement screen material can be supplied. For one-piece units the whole unit will need to be replaced. Type A screens are therefore recommended in areas with abrasive bed loads.

8 QUALITY

Dulas Hydro have recently been accredited under the ISO 9001:2000 quality management system through SGS. The screens are manufactured in the UK, and the factory is also accredited under ISO 9001:2000 by NQA. Full details are available on request.