TECHNICAL NOTE

50 – Pool Filter Specification

July 2020

The purpose of this technical note is to highlight factors that need to be considered when specifying or selecting a sand filter. There are many manufacturers and an extensive catalogue of components and ancillaries. This note provides guidance on what is required from a pool filter in terms of operation, life cycle, maintenance and safety.

All information is based on best industry practice. It is most usefully read in conjunction with the PWTAG book, *Swimming Pool Water: treatment and quality standards for pools and spas***.**

Filtration rate

The quicker the pool water passes through the filter media, the less efficient it will be in capturing particulate matter – including, crucially, the chlorine resistant cysts of *Cryptosporidium*. For public swimming pools, with high bathing loads, medium-rate filtration is recommended.

Medium-rate filters generally operate up to $25m^3/m^2/h$ (usually expressed as 30m/h). High-rate filters operate between 25m and $50m^3/m^2/h$. High-rate filters can be acceptable in pools with very low bathing loads, such as domestic pools.

PWTAG also recommends the use of effective coagulants to facilitate the precipitation of organic material (and microorganisms) out of solution and to improve the efficiency of fine particle removal. This contributes positively to bather safety and chloramine control in swimming pools. This is dealt with in detail in *Swimming Pool Water*.

A flowmeter should be incorporated between the pumps and the filters to monitor the circulation rate and backwash flow rate. Filter connections should be sized appropriately to accept both.

Filter vessel construction

The diameter of the body of the filter vessel will be calculated to achieve the necessary filtration rate. The height of a filter needs to be sufficient to accommodate bed expansion, without losing media. For a 1,200mm bed depth, the body height typically ranges from 1,500 to 1,700mm.

There are two common types of sand filter construction – mild steel lined and glass fibre-reinforced polyester resin(GRP).

Steel – The carbon steel filter shell comprises the body, top and bottom dished ends and support legs (see illustration). The body should be a minimum of 8mm thick and the dishes 10mm. Various ancillaries can be incorporated into the shell, such as inlet/outlet connection plates, pressure gauge boards, air release boss and top and side access manways. All the components are welded together.

GRP – The body and dishes of the filter are produced from a mould, with support skirt added and polyester flanged connections for ancillaries. Ancillaries can be incorporated into the shell or added in a similar way to steel filters. But they should be reinforced against any penetration that might otherwise compromise the structural integrity of the GRP shell.

Filter lining

Carbon steel filters need to be protected against chlorinated pool water. The internal face of the filter and all flanged connections are therefore lined. The most common form of lining is a two-part epoxy process. The internal faces are blasted to provide a key in the surface. The paint is then sprayed or roller applied. Following application, whether in the factory or in situ, an ultrasonic test should be done to ensure a minimum 500micron lining is applied in all areas.

GRP filter material has a natural chemical barrier and does not require any additional lining process after construction.

If pool water is exposed to ozone this should always be specified as it may affect the specification of both steel and GRP filters.

Filter collection system

At the bottom of the filter, there needs to be a collection system, referred to as underdrains. The most common design in medium-rate sand filters is a series of nozzles, with fine openings (typically 0.2– 0.35mm) that retain the media in the vessel. The nozzles should be positioned to provide even collection across the full diameter of the filter, and also provide even air distribution if air scouring is being used.

In a steel filter, the nozzles are inserted into lateral uPVC pipes and the bottom dish of the filter is filled with concrete up to the underside of the laterals, acting as a support.

In a GRP filter, the nozzles are inserted into a nozzle plate, which is manufactured in GRP, often with localised integral steel reinforcement. The nozzle plate is structurally integrated within the vessel bottom dish.

The alternative to nozzles, in both steel and GRP filters, is simple lateral pipes with small holes/slots. These laterals are considered to be less effective in retaining the fine filter media and are not considered to be as robust as the nozzle collection system. If laterals are used, a sulphate-resistant cement bed should be installed in the bottom dish to support the laterals and minimise microbiological growth.

Filter media

The two most common types of filter media are sand and glass. The sand specification is commonly 16/30 dried silica sand, to the requirements of BSEN 12904. Glass media is available from a number of manufacturers, with varying grades. There is a separate PWTAG technical note on glass media.

The media in a filter is typically multi-layered, with a larger diameter (typically 6-10mm) support material at the bottom and the finer grade material above. On single-grade media beds, the finer grade media bed depth ranges between 1and 1.2m and the support layer is 15-20% of the bed depth. On multi-grade beds, the media is typically graded in 5 or 6 layers between 10mm gravel and finer sand/glass as described above.

Over a period of time in operation, the media can deteriorate and should be regularly inspected (at least annually) to ensure optimum filtration efficiency.

Filter ancillaries

Air release – At the top of the filter an air release valve should be fitted to avoid a build-up of air in the vessel. Ideally, the air release valve should be automatic, to release when the air reaches a predetermined pressure. There should also be a manual air release valve, to give the operator the opportunity to purge any air from the vessel immediately after a backwash.

Pressure gauges – There should be two gauges mounted on the front of the filter, measuring the pressure differential between filter inlet and the filter outlet. This instrumentation can be used by the operator to determine the condition of the filter media and whether a backwash is required.

Access manways – Larger filters should have two access points, on the side of the filter body and in the top dish. The lower manway is designed for extracting media and for initial installation of the underdrain collection system. The top manway is for initial media filling and also formedia and filter internal inspections. For larger vessels where an operative may have to enter the filter, the manways should be sized to comply with confined space regulations. On steel filters, the manways should be complete with easy lifting handles, due to the weight of the lid.

Viewing port – A clear acrylic viewing port should be specified in all cases. The port should be positioned at the top of the media bed to enable operators to check the condition of the top of the bed and to validate the extent of fluidisation in backwash.

Bellmouths – At the end of the inlet pipe, there should be a bellmouth arrangement: a funnelled fabrication with a diffuser plate, which distributes the flow of water over the surface area of the bed. The bellmouth prevents vortexes, which can result in crowning of the bed. On larger filters with large surface areas, multiple bellmouths should be considered.

Lifting lugs – To assist with installing or replacing filters, lifting lugs are useful. On steel filters, these are welded to the top dish. On GRP filters, a threaded eyebolt is provided through one of the top access manway fixings, or integral GRP lifting lugs are provided.

Access equipment – The internal components of a filter should be inspected regularly (at least annually). With filter frontal pipework and valve arrangements, temporary access equipment can be difficult to position. With steel filters, permanent access ladders are available, welded to the filter shell, with a kneeling plate at the top and lanyard connection point. This access equipment is not available with GRP filters.

Sight glass – On the backwash line from the filter, a clear perspex section of pipe should be incorporated to enable the operator to monitor the clarity of the backwash water prior to discharge into effluent.

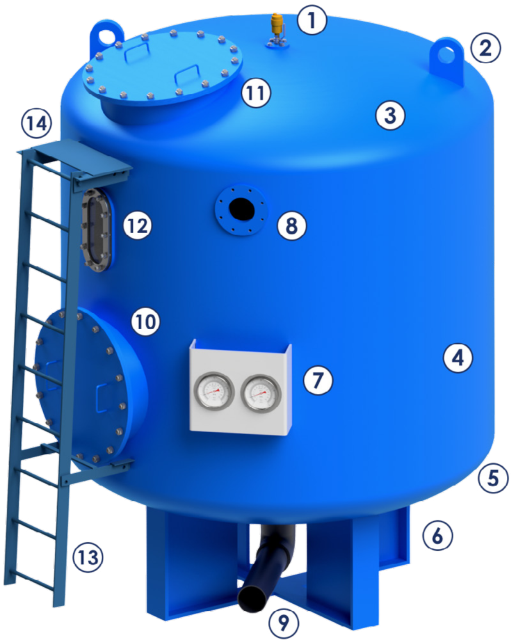
Air scour – On larger filters, it is recommended that an air scour system is used to agitate the media bed prior to backwashing.

Life expectancy

Steel filters have a life expectancy of 30 years – achievable if the filter lining is maintained. The lining would typically be replaced every 10 years at the point when the media is being replaced. Most manufacturers provide a minimum 5-year warranty on the lining.

Good, industrial quality GRP filters are supplied with a manufacturer's warranty of 10 years. However, based on experience and depending on quality, life expectancy may vary between10 and 40 years. So extreme care should be exercised in selecting only the best quality GRP filters for industrial applications. The life expectancy of GRP filters can be reduced if they are operated outside the vessel specification – for example, pressurising beyond the vessel stated operating or test pressures.

Filter Illustration 1



1. Air release connection
2. Lifting lugs
3. Top dished end
4. Filter body
5. Bottom dished end
6. Filter support legs
7. Pressure gauge board
8. Filter inlet
9. Filter outlet
10. Lower access manway
11. Upper access manway
12. Media viewing port
13. Access ladders
14. Kneeling plate

Filter Illustration 2 (section)