

Sand Filter Design Protocol

1. Select type of sand filter

- Buried single-pass, pressure dosed
- Free access, single-pass, pressure dosed
- Free access, recirculating, pressure dosed

2. Select Maximum filter forward Loading Rate, $MLR = \underline{\hspace{2cm}}$ (GPD/ft²).

• Compute Minimum filter Surface Area; $MSA = DDF/MLR$

where DDF = (Design Daily Flow Rate, Gallons)

$$MSA = DDF/MLR = (\quad) / (\quad) = \underline{\hspace{2cm}} \text{ (ft}^2\text{)}$$

3. Select number of filters, $NF = \underline{\hspace{2cm}}$

4. Select Filters Dimensions: $FL = \underline{\hspace{2cm}}$ (length); $FW = \underline{\hspace{2cm}}$ (width)

• Compute filter Surface Area, $FSA = FL \times FW = (\quad) \times (\quad) = \underline{\hspace{2cm}}$ (sq.ft.)

• Compute total filter Area, $TFA = NF \times FSA = (\quad) \times (\quad) = \underline{\hspace{2cm}}$ (sq. ft.) (TFA must be \geq MSA)

• Compute filter design Loading Rate = $FLR = DDF/TFA =$
 $(\quad) / (\quad) = \underline{\hspace{2cm}}$ (GPD/ft²)

-Make sure $FLR \leq MLR$ (if not, choose bigger filter or more filters)

5. Layout/Design Filter Distribution Network:

Select Number $\underline{\hspace{2cm}}$ and length $\underline{\hspace{2cm}}$ of laterals (in each filter)

Total Filter Lateral Length, $FLL = \underline{\hspace{2cm}}$ (ft, in all filters to be separately dosed)

Filter Lateral Size, $FLS = \underline{\hspace{2cm}}$ (inches)

Lateral Orifice Size, $LOS = \underline{\hspace{2cm}}$ (inches)

Lateral Orifice Spacing, $OSP = \underline{\hspace{2cm}}$ (feet)

• Compute Lateral Volume, $FLV = FLL \times \underline{\hspace{2cm}}$ gals/ft
 $= \underline{\hspace{2cm}} \times \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$ (gallons)

• Compute Number of Orifices, $NO = FLL/OSP$
 $= (\quad) / (\quad) = \underline{\hspace{2cm}}$

• Compute Filter dosing rate, $Q = NO \times \underline{\hspace{2cm}}$ (GPM_{LOS} @DPH)
 where DPH = design pressure head (≥ 4 ft) = $\underline{\hspace{2cm}}$ (feet)
 $Q = NO \times \underline{\hspace{2cm}} = (\quad) \times (\quad) = \underline{\hspace{2cm}}$ (gpm)

6. Select Dose Volume/Day, $DVD = \underline{\hspace{2cm}}$ (gallons)

-for single pass, $DVD = DDF = \underline{\hspace{2cm}}$

-for Recirc Filter, $DVD = \underline{\hspace{2cm}}$ (recirc ratio +1) x DDF
 $= \underline{\hspace{2cm}} \times \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$

7. Select Number of Doses/Day, $DPD = \underline{\hspace{2cm}}$ (recommend choosing 4,6,8,12,24, or 48)

•Compute Volume/Dose = $VD = DVD/DPD$

$$= \frac{(\quad)}{(\quad)} = \text{_____ (gallons)}$$

•Compute Lateral Volume Exchanges/Dose, $LVD = VD/FLV$

$$= \frac{(\quad)}{(\quad)} = \text{_____}$$

If $LVD < 6$, select fewer doses/day or smaller laterals

•Compute Pump Run Time, $PRT = VD/Q$

$$= \frac{(\quad)}{(\quad)} = \text{_____ (minutes)}$$

Recommend pump run time 3-10 minutes, though smaller may be allowable, if other options limiting. Adjust by changing orifice size, number of laterals, orifice spacing and/or number of doses/day.

•Compute Pump Off Time, $POT = [(24/DPD) \times 60] - PRT$

$$= \frac{24}{(\quad)} \times 60 - \text{_____} = \text{_____ (minutes)}$$

8. Summary of Filter Design Parameters selected/computed:

- Type of Filter _____; -Design Daily Flow, DDF _____ (gallons)
- Number of Filters, NF: _____ (filters to be separately dosed)
- Filter Dimensions, FLxFW= (_____ x _____)
- Filter Surface Area, FSA: _____ (sq.ft.); -Total Filter Surface Area, TFA= _____ (sq.ft.)
- Filter Loading Rate, FLR= _____ (GPD/ft²)
- Lateral Network Specifications:
 - Number _____ and length _____ of laterals
 - Total Lateral Length, FLL _____ (feet per separately dosed filter)
 - Lateral Size, FLS: _____ (inches)
 - Orifice Size, LOS: _____ (inches), and spacing _____ (feet)
 - Total Number of Orifices, NO: _____
 - Design Pressure Head, DPH _____ (feet)
 - Filter Dose Rate, Q _____ (GPM)
- Recirc Ratio _____ (where applicable)
- Number of Doses per day; DPD= _____
- Volume per Dose, VD: _____ (gallons)
- Lateral Volume exchanges per Dose, LVD _____
- Pump Run Time, PRT: _____ (minutes)
- Pump Off Time, POT: _____ (minutes)

Glossary of Abbreviations

DDF:	Design Daily Flow (gallons)
DPD:	Number of Doses Per Day
DPH:	Design Pressure Head (feet)
DVD:	Dosing Volume Per Day (gallons)
FSA:	Actual Filter Surface Area (ft ²)
FL:	Filter Length
FLL:	Total Filter Lateral Length (ft)
FLR:	Filter Design Loading Rate (GPD/ft ²)
FLS:	Filter Lateral Size (inches)
FLV:	Lateral Volume (gallons)
FW:	Filter Width
LOS:	Lateral Orifice Size (inches)
LVD:	Lateral Volume Exchanges Per Dose
MLR:	Maximum Filter Forward Loading Rate (GPD/ft ²)
MSA:	Minimum Filter Surface Area (ft ²)
NF:	Number of separately dosed filters
NO:	Number of Orifices
OSP:	Lateral Orifice Spacing (feet)
POT:	Pump Off Time (minutes)
PRT:	Pump Run Time (minutes)
Q:	Filter Design Rate (GPM)
TFA:	Total Filter Surface Area (ft ²)
VD:	Volume Per Dose (gallons)