Formula Sheet for the Class III & IV Exams
Revised 05/02

F057
Flow, gpm =
$$\frac{\text{(Water, hp) x (3960)}}{\text{Head, ft}}$$

F058
Pumping rate, gpm =
$$\frac{\text{(Volume, cf) x (7.48 gal/cf)}}{\text{Time, min}}$$

F059
Motor, hp =
$$\frac{\text{(Flow, gpm) x (TDH, ft)}}{\text{(3960) x (Ep) x (EM)}}$$

F060
Detention time, hrs =
$$\frac{\text{(Tank volume, cu ft) x (24) x 7.5 gal/cu ft}}{\text{Flow rate, gal/day}}$$

F061
Surface loading, gpd/sf =
$$\frac{\text{Flow, gpd}}{\text{Surface area, sq ft}}$$

F062
Solids loading, lbs/day/sf =
$$\frac{\text{(Flow, MGD) x (TSS, mg/L) x (8.34)}}{\text{Surface area, sf}}$$

F063
Sludge age =
$$\frac{\text{TSS in aerator, lbs}}{\text{TSS in primary effluent, lbs/day}}$$

F064
F/M, lbs/day =
$$\frac{\text{lbs BOD/day to aeration tank}}{\text{lbs of MLVSS under aeration}}$$

F065
Waste sludge pumping rate, MGD =
$$\frac{\text{Solids to be wasted, lbs/day}}{\text{(RAS conc, mg/L) x (8.34)}}$$

F066

MCRT, days =

$$\frac{\text{MLSS in aeration tank, lbs}}{\text{(TSS wasted, lbs/day) + (TSS in effluent, lbs/day)}}$$

F067

TSS wasted, lbs/day =

$$\frac{\text{(MLSS in aeration, lbs) - (TSS in effluent, lbs/day)}}{\text{MCRT, days}}$$

F068

MLVSS, mg/L =

$$\frac{\text{BOD loading from primary, lbs/day}}{\text{(F/M ratio) x (aerator volume, mg) x (8.34)}}$$

F069

Return sludge rate, MGD =

$$\frac{\text{Settled solid, ml x (flow, MGD)}}{\text{(1000 ml - settled solids, ml)}}$$

F070

MLSS, lbs =

(Aerator volume, mg) x (MLSS, mg/L) x (8.34)

F071

Hydraulic loading of trickling filter, gpd/sf =

$$\frac{\text{Flow, gpd}}{\text{Surface area, sf}}$$

F072

Organic loading of trickling filter, (lbs BOD/day) / 1000 cf =

$$\frac{\text{BOD applied, lbs/day}}{\text{Volume of media, 1000 cf}}$$

F073

$S0_2$ feed, lbs/day =

(Flow, MGD) x (Residual chlorine, mg/L + SO_2 overdose, mg/L) x (8.34)

F074

Chlorine demand, mg/L =

(Chlorine dose, mg/L) - (Chlorine residual, mg/L)

F075

Chlorine feed rate, lbs/day =

$$\frac{\text{Chlorine required, lbs/day}}{\text{Portion of chlorine in chlorinated lime}}$$

F076

Polymer dose, mg/L =

$$\frac{\text{(Polymer delivery rate, gpm) (polymer, lbs/gal) } (10^6)}{\text{Flow, gpm x 8.34}}$$

F077
Polymer dose, mg/L =

$$\frac{\text{Polymer feed rate, lbs/day x 1,000,000}}{\text{(Flow, gpm) x (1440) x (8.34)}}$$

F078
Volume of seed sludge, gal =
(Volume of digester, gal) x (% seed)

F079
Solid loading, lbs/day =

$$\frac{\text{(Raw sludge volume, gal) x (solid conc, \%) x (volatile fraction, \%) x (8.34)}}{10{,}000}$$

F080
Sludge removal by clarifier, ml =
(Influent settleable solids, ml) - (Effluent settleable solids, ml)

F081
Total settleable solids to be pumped to digester, mgd =
(Sludge removed, ml) x (flow, mgd) x (1000)

F082
% reduction of volatile matter, % =

$$\frac{\text{(In - out) x (100)}}{\text{In - [(in) (out)]}}$$

("in" and "out" in fraction, not in %)

F083
% reduction of volatile matter, % =

$$\frac{\text{[(Initial volatile matter, lbs) - (Final volatile matter, lbs)] x (100)}}{\text{Initial volatile matter, lbs}}$$

F084
Volume of stroke, cf/stroke =

$$\frac{\text{(Cross sectional area of the cylinder, sf) x (distance of stroke, ft/stroke)}}{\text{(Piston pumps)}}$$

F085
Weight of volatile solids, mg =
(Total solids, mg) - (fixed solids, mg)

F086
Volatile solids, % =

$$\frac{\text{(Weight of volatile solids, mg) x (100)}}{\text{Total dry solids, mg}}$$

F087
Seed correction per 1.0 ml of seed =

$$\frac{\text{Initial D.O. – Final D.O.}}{\text{ml of seed in bottle}}$$

BOD_5, mg/L =

$$\frac{[\text{initial D.O., mg/L}) - (\text{final D.O., mg/L}) - (\text{seed correction mg/L})] \times (300\text{ ml})}{\text{ml of sample volume}}$$

F088

Volume diluted, ml =

$$\frac{(\text{Target normality}) \times (\text{target volume})}{\text{Stock acid normality}}$$

F089

Solids loading, lbs/day =

(Raw sludge volume,gal) x (solids conc,%) x (volatile fraction, %) x 8.34

F090

Thickener solids loading, lbs/day/sf =

$$\frac{\text{(Solids applied, lbs/day)}}{\text{Thickener surface area, sf}}$$

F091

Sludge flow, lbs/day/sf =

$$\frac{(\text{Thickener loading}) \times (\text{surface area})}{(8.34)\ (10{,}000) \times (\%\text{ solids})}$$

F092

Desired lbs of solids in aeration tank =

(Daily solids addition, lbs/day) x (sludge age, days)

F093

Initial digestion time, days =

$$\frac{\text{Digester volume, gal}}{\text{Initial sludge flow, gpd}}$$

F094

New digestion time, days =

$$\frac{(\text{Digester volume, gal}) \times (\text{increase in sludge conc, \%})}{(\text{Initial sludge flow, gpd}) \times (\text{initial sludge conc, \%})}$$

F012

Solids loading, lbs/day =

(Flow, MGD) x (influent TSS, mg/L) x 8.34

F022

Chlorine feed rate, lbs/day =

(Flow, MGD) x (dosage, mg/L) x 8.34

F027

Chlorine dose, mg/l = $\frac{\text{Chlorine, lbs}}{(\text{Flow rate, mgd}) \times (8.34)}$

F028
Chlorine demand, mg/L =
Chlorine dosage, mg/L - residual chlorine, mg/L

F039

$$\text{Sludge applied, gal} = \frac{(\text{Area, sf}) \times (\text{depth of application, in}) \times (7.48)}{12 \text{ in / ft}}$$