HYDRAULIC EQUATIONS

Friction Losses in Pipes (Hazen - Williams)

	Metric Units	U.S. Units
	$J = 1.131 * 10^9 \left(\frac{Q}{C}\right)^{1.852} * D^{-4.87} * L$	$J = 10.45 * \left(\frac{Q}{C}\right)^{1.852} * D^{-4.87} * L$
Head Loss	J [m W.C.]	J [ft W.C.]
Flow Rate	Q [m^3/ h]	Q [U.S. gpm]
H.W. Factor	C steel pipes = 100 - 125 C plastic pipes = 150	C steel pipes = 100 - 125 C plastic pipes = 150
Pipe Diameter	D [mm]	D [inch]
Pipe Length	L [m]	L [ft]

example

Q = 100 m^3/ h	Q = 400 U.S. gpm
C = 135	C = 135
D = 150 mm	D = 6"
L = 200 m	L = 600 ft
$J = 1.131 * 10^9 \left(\frac{100}{135}\right)^{1.852} * D^{-4.87} * 200$	$J = 10.45 * \left(\frac{400}{135}\right)^{1.852} * 6^{-4.87} * 600$
= 3.3 m (= 0.33 bar)	= 7.6 ft (= 1.6 psi)

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Average Velocity in Pipes

	Metric Units	U.S. Units
	$\bar{v} = 353.7 * \frac{Q}{D^2}$	$\bar{v} = 0.4085 * \frac{Q}{D^2}$
Average Flow Velocity	$\bar{v}$ [m / s]	$\bar{v}$ [ft / s]
Flow Rate	Q [m^3/ h]	Q [U.S. gpm]
Internal Pipe Diameter	D [mm]	D [inch]

example

Q = 100 m^3/ h	Q = 400 U.S. gpm
D = 150 mm	D = 6"
$\bar{v} = 353.7 * \frac{100}{150^2} = 1.6$ m / s	$\bar{v} = 0.4085 * \frac{400}{6^2} = 4.5$ ft / s

Head Loss Factor in Valves

	Metric Units	U.S. Units
	$Kv = \frac{Q}{\sqrt{dp}}$	$Cv = \frac{Q}{\sqrt{dp}}$
Factor	Kv	Cv
Flow Rate	Q [m^3/ h]	Q [U.S. gpm]
Head Loss	dp [bar]	dp [psi]

example

Q = 100 m^3/ h	Q = 400 U.S. gpm
dp = 0.2 bar	dp = 3 psi
$Kv = \frac{100}{\sqrt{0.2}} = 224$	$Cv = \frac{400}{\sqrt{3}} = 231$

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Screen Sizes (approximately)

	Metric Units	U.S. Units
	$\text{mesh} = \frac{15000}{d}$	$\text{mesh} = \frac{600}{d}$
Aperture in Screen	d [microns]	d [mils]

example 1

d = 250 microns (= 0.25 mm)	d = 10 mils (= 0.01")
$\text{mesh} = \frac{15000}{250} = 60$	$\text{mesh} = \frac{600}{10} = 60$

example 2

mesh = 60	mesh = 60
$d = \frac{15000}{60} = 250$ microns (= 0.250 mm)	$d = \frac{600}{60} = 10$ mils (= 0.010")

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Flow Velocity in Gravel / Sand Filters

	Metric Units	U.S. Units
	$v = 1.273 * 10^6 * \frac{Q}{D^2}$	$v = 1470 * \frac{Q}{D^2}$
Average Flow Velocity	v [m / h]	[ft / h]
Flow Rate	Q [m^3/ h]	Q [U.S. gpm]
Filter Diameter	D [mm]	D [inch]
		$\left(\text{or } 183.4 * \frac{Q}{D^2} \ \frac{\text{U.S. gpm}}{\text{sq. ft}}\right)$

example

Metric Units	U.S. Units
Q = 50 m^3/ h	Q = 200 U.S. gpm
D = 900 mm	D = 36"
$v = 1.273 * 10^6 * \frac{50}{900^2}$	$v = 1470 * \frac{200}{36^2}$
= 78.6 m / h	= 227 ft / h
	$\left(183.4 * \frac{200}{36^2} = 28.3 \ \frac{\text{U.S. gpm}}{\text{sq. ft}}\right)$

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CONVERSION TABLES

Metric Units

U.S. Units

LENGTH

To Convert	into	Multiply by
millimeter (mm)	inch	0.03937
centimeter (cm)	inch	0.3937
meter (m)	inch	39.37
kilometer (km)	mile	0.6215
meter (m)	feet	3.281

To Convert	into	Multiply by
inch	millimeter (mm)	25.4
inch	centimeter (cm)	2.54
inch	meter (m)	0.0254
mile	kilometer (km)	1.609
feet	meter (m)	0.3048

AREA

To Convert	into	Multiply by
square cm (cm^2)	square inch	0.155
square meter (m^2)	square inch	1550
square meter (m^2)	square feet	10.76
hectare (ha)	square meter	10000
acre	square meter	4047
dunam	square meter	1000
hectare (ha)	dunam	10

To Convert	into	Multiply by
square inch	square cm (cm^2)	6.4516
square inch	square meter (m^2)	0.0006452
square feet	square meter (m^2)	0.0929
square meter	hectare (ha)	0.0001
square meter	acre	0.0002471
square meter	dunam	0.001
dunam	hectare (ha)	0.1

VOLUME

To Convert	into	Multiply by
liter (l)	cubic inch	61.024
liter (l)	cubic feet	0.03531
liter (l)	U.S. gallon	0.2642
liter (l)	U.K. gallon	0.22
cubic cm (cc)	cubic inch	0.06102
cubic m (m^3)	liter (l)	1000
cubic cm (cc)	liter (l)	0.001

To Convert	into	Multiply by
cubic inch	liter (l)	0.01639
cubic feet	liter (l)	28.32
U.S. gallon	liter (l)	3.785
U.K. gallon	liter (l)	4.5455
cubic inch	cubic cm (cc)	16.387
fluid oz.	U.S. gallon	0.0078
U.S. gallon	fluid oz.	128

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Metric Units

U.S. Units

FLOW RATE

To Convert	into	Multiply by
liter / second (l/s)	cubic meter / hr	3.6
liter / second (l/s)	U.S. gpm	15.85
liter / hour (lph)	U.S. gpm	0.0044
cubic meter / hour (m^3/h)	U.S. gpm	4.403

To Convert	into	Multiply by
cubic meter / hr	liter / second (l/s)	0.2778
U.S. gpm	liter / second (l/s)	0.06309
U.S. gpm	liter / hour (lph)	227.1
U.S. gpm	cubic meter / hour (m^3/h)	0.2271

VELOCITY

To Convert	into	Multiply by
meter / second (m/s)	feet / second	3.28
meter / second (m/s)	mile / hour	0.44704
m^3 / h / m^2 (=m/h)	U.S. gpm / sqft	0.409

To Convert	into	Multiply by
feet / second	meter / second (m/s)	0.30488
mile / hour	meter / second (m/s)	2.2369
U.S. gpm / sqft	m^3 / h / m^2 (=m/h)	2.44

ENERGY

To Convert	into	Multiply by
kilowatt	HP - metric	1.36
kilowatt	HP - U.S.	1.34

To Convert	into	Multiply by
HP - metric	kilowatt	0.736
HP - U.S.	kilowatt	0.746

PRESSURE / HEAD

To Convert	into	Multiply by
meter (w.c.)	kPascal (kpa)	9.807
kg / cm^2	meter (w.c.)	10
kg / cm^2	kPascal (kpa)	98.068
kg / cm^2	p.s.i.	14.2
bar	p.s.i.	14.5
bar	millibar	1000
bar	MPascal (Mpa)	0.1

To Convert	into	Multiply by
kPascal (kpa)	meter (w.c.)	0.102
meter (w.c.)	kg / cm^2	0.1
kPascal (kpa)	kg / cm^2	0.0102
p.s.i.	kg / cm^2	0.0703
p.s.i.	bar	0.0689
millibar	bar	0.001
MPascal (Mpa)	bar	10

W.C. = Water Column

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Metric Units

U.S. Units

WEIGHT

To Convert	into	Multiply by
kilogram (kg)	pounds (lb.)	2.20464
gram (gr)	milligram (mg)	1000
gram (gr)	once (oz)	0.03527
kilogram (kg)	long ton (2240 lbs)	0.000984
kilogram (kg)	short ton (2000 lbs)	0.001102

To Convert	into	Multiply by
pounds (lb.)	kilogram (kg)	0.4536
milligram (mg)	gram (gr)	0.001
once (oz)	gram (gr)	28.35
long ton (2240 lbs)	kilogram (kg)	1016
short ton (2000 lbs)	kilogram (kg)	907.2

CONCENTRATION

To Convert	into	Multiply by
percent (%)	p.p.m.	10000
ml / liter	p.p.m.	1000
ml / m^3	p.p.m.	1

To Convert	into	Multiply by
p.p.m.	percent (%)	0.0001
p.p.m.	ml / liter	0.001
p.p.m.	ml / m^3	1

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GLOSSARY

ENGLISH	SPANISH	FRENCH
Air valve	válvula de aire (ventosa)	Soupape a air (ventouse)
Algae	Algas	Algues
Application rate	Tasa de aplicaión	Débit réel
Array	Batería	Batterie
Backflushing	Retrolavado	Contre lavage
Battery	Pila	Pile
Bleeder	Purgador	Purgeur
Bolt	Tornillo	Boulon
Booster pump	Bomba de elevación	Pompe d`appoint
Brass	Latón	Laiton
Cap	Capuchón	Capuchon
Cast iron	Hierro fundido	Fonte
Cavitation	Cavitación	Cavitation
Check valve	Válvulade retención	Vanne d`arret
Cleaning	Limieza	Nettoyage
Clogging	Obturación	Obturation, colmatage
Coating	Recubrimiento	Revêtement
Collection chamber	Cámara de sedimentación	Chambre collectrice
Concrete floor	Base de hormigón	Base en béton
Configuration	Configuración	Configuration
Connection	Conexión	Connexion, raccord
Depth filtration	Filtración profunda	Filtration en profondeur
Differential pressure	presión diferencial	Pression différentielle
Diffuser	Difusor	Diffuseur
Dirt	Suciedad	Crasse
Downstream	Aguas abajo	Aval
Drain valve	Válvula de drenaje	Vanne de vidange
Dripper	Gotero	Goutteur
Efficiency	Eficiencia	Efficacité
End connection	Conexión final	Connection terminale
Exit	Salida	Sortie
Fertilizer	Fertilizante	Engrais
Fertilizing tank	Tanque fertilizador	Bac d`engrais
Filter	Filter	Filtre
Filter cartridge	Estuche del filtro	Cartouche de filtre
Filter element	Elemento de filtrado	Elément de filtration
Filter grade	Grado de filtración	Degré de filtration
Filter housing	Caja del filtro	Emboîtage de filtre
Filtration	Filtación	Filtration
Flow velocity	Velocidad de flujo	Vitesse d`écoulement
Flushing valve	Válvula de lavado	Vanne de rinçage
Flange	Brida	Bride
Galvanized	Galvanizaso	Galvanisé
Gasket	Empaquetadura, Junta	Joint
Gravel filter	Filtro de grava	Filtre à graviers

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ENGLISH	SPANISH	FRENCH
Headloss	Pérdida de carga	Pert de charge
Hydrocyclone	Hidrociclón	Hydrocyclone
Impurities	Impurezas	Impuretés
Injection	Inyección	Injection
Inlet	Entrada	Entrée
In/out	Dentro/fuera	Entrée/sortie
Iron sludge	Lodo de hierro	Dépôt ferreux
Irrigation	Irrigación	Irrigation
Lid, cover	Tapa	Couvercle
Limiter	Limitador	Limiteur
Manual flushing	Lavado manual	Lavage manuel
Mesh	Malla	Maille
Modular filter head	Capezal modular de filtrado	Tôte de filtration modulaire
Nipple	Niple	Embout
Normally closed	Normalmente cerrado	Normalment fermé
Normally open	Normalmente abierto	Normalment ouvert
Outlet	Salida	Sortie
Particles	Partículas	Particules
Pipe	Tubo, Cano	Tuyau
Pre-filtering	Pre-filtrado	Presiltration
Pressostat	Presostato	Pressostate
Pressure gauge	Manómetro	Manométre
Pressure reducer	Reductor de presión	Réducteur de pression
Pressure sustainer	Sostenedor de presión	Mainteneur de pression
Quick-acting	Accionamiento rápido	Action rapide
Range	Rango	Plage
Rotate	Girar	Tourner
Rubber	Goma, Caucho	Caoutchouc
Sand filter	Filtro de arena	Filter à sable
Screen	Malla	Tamis
Sediments	Sedimientos	Sédiments
Seal	Retén	Joint
Shut-off	Cierre	Arrêt
Silt	Limo	Limon
Steel	Acero	Acier
Stainless steel	Acero inoxidable	Acier inoxydable
Tap	Grifo	Robinet
Three-way	Tres-vías	Trois-voies
Thread	Rosca	Filetage
Upstream	Aguas Arriba	Amont
Water hammer	Golpe de ariete	Coup de bélier
Water network	Red de agua	Réseau de distribution d`eau

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