Plumber IP Formulas

$1\ \text{ft.}^2\ \text{EDR} = 240\ \text{Btuh}$

$1\ \text{U.S. gal.} = 8.33\ \text{lb.}$

$12\,000\ \text{BTU of cooling} = 1\ \text{ton}$

$$\text{Boyle's law: } \frac{V_1}{V_2} = \frac{P_2}{P_1}$$

$$\text{Charles' Law: } \frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\text{Expansion} = \text{length} \times \Delta T \times \text{coefficient of expansion}$$

$$\text{Force} = \text{pressure} \times \text{area}$$

$$\text{gpm} = \frac{\text{BTU}}{\text{lb./gal.} \times \Delta T}$$

$$\text{gpm} = \frac{\text{total Btuh}}{\Delta T \times \text{mass} \times \text{minutes} \times \text{specific heat capacity}}$$

$$\text{Grade} = \frac{\text{drop or rise}}{\text{run}}$$

$$\begin{aligned} \text{Grains} = {} & (\#\ \text{of persons} \times \text{gallons per day}) \\ & \times (\text{hardness in grains} + \text{iron concentration} \times \#\ \text{of persons}) \\ & \times \text{days of regeneration} + 20\% \end{aligned}$$

$$\text{Litres} = \text{area} \times \text{rainfall intensity}$$

$$\text{Pressure} = \text{height} \times \text{density}$$

$\text{Pressure head conversion unit} = 0.433\ \text{psi/ft.}$

$\text{Travel offset of a } 45^\circ \text{ elbow} = 1.414$

Plumber IP Formulas continued

Hydronic Thermal Formulas

$$\Delta T = \frac{\text{Btuh}}{500 \times \text{gpm}}$$

$$\text{gpm} = \frac{\text{Btuh}}{500 \times \Delta T \text{ (water)}}$$

$$\text{Btuh} = \text{gpm} \times 500 \times \Delta T$$

Circumference / Perimeter

Circumference of circle $= \pi d$

Perimeter of rectangle $= 2(L + W)$

Perimeter of triangle $= a + b + c$

Area

Area of circle $= \pi r^2$

Area of cylinder (open top) $= \pi r^2 + \pi dH$

Area of cylinder (totally enclosed) $= 2\pi r^2 + \pi dH$

Area of rectangle box (open top) $= (L \times W) + 2(W \times H) + 2(L \times H)$

Area of rectangle box (totally enclosed) $= 2(L \times W) + 2(W \times H) + 2(L \times H)$

Area of rectangle $= L \times W$

Area of sphere $= \pi d^2$ or $4\pi r^2$

Area of triangle $= \dfrac{bH}{2}$

Plumber IP Formulas continued

Volume

Volume of cylinder $= \pi r^2 H$

Volume of rectangle box $= L \times W \times H$

Volume of sphere $= \dfrac{4 \pi r^3}{3}$

Coefficients

Material	Coefficient of linear expansion per 1 °F	Coefficient of linear expansion per 1 °C
ABS	0.0000550	0.0000990
Brass	0.0000105	0.0000189
Cast iron	0.0000059	0.0000108
Copper	0.0000095	0.0000171
PVC	0.0000330	0.0000594
Steel	0.0000067	0.0000120

Conversion factors

To Convert	To	Multiply by
°C	°F	1.8 and add 32
gpg (grains per U.S. gal.)	ppm	17.12
kg	lb.	2.205
kg/m³	lb./ft.³	0.06243
kN	lb.	224.81
kN/m	lbf/ft.	68.52
kN/m³	lbf/ft.³	6.360
kPa	lbf/in.² (psi)	0.1450
kPa	lbf/ft.²	20.88
L	gal. (imp.)	0.2200
L/s	gal./min (gpm)	13.20
m	ft.	3.281
m²	ft.²	10.76
mm	in.	0.03937
m/s²	ft./s²	3.281