EIGHTH EDITION

PIPELINE RULES OF THUMB HANDBOOK

A manual of quick, accurate solutions to everyday pipeline engineering problems

E.W. McAllister, Editor

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A Manual of Quick, Accurate Solutions to Everyday Pipeline Engineering Problems

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As an added bonus to this edition, Elsevier has created online interactive engineering widgets to accompany selected material found in this book. To make the selected table or graph interactive, please scan the code provided next to the table or graph, and you will be sent to an online companion website of widgets. You will need internet access in order to link to the widgets.

1: General Information

Basic Formulas

1. Rate of Return Formulas:

$$S = P(1+i)^n$$

a. Single payment compound amount (SPCA). The $(1+i)^n$ factor is referred to as the compound amount of $1.00.
b. Single payment present worth (SPPW):

$$P = S\left[\frac{1}{(1+i)^n}\right].$$

The factor $[1/(1+i)^n]$ is referred to as the present worth of $1.00.
c. Uniform series compound amount (USCA):

$$S = R\left[\frac{(1+i)^n - 1}{i}\right]$$

$$\text{The factor} = \left[\frac{(1+i)^n - 1}{i}\right]$$

is referred to as the compound amount of $1.00 per period.
d. Sinking fund deposit (SFD):

$$R = S\left[\frac{i}{(1+i)^n - 1}\right].$$

$$\text{The factor} = \left[\frac{i}{(1+i)^n - 1}\right]$$

is referred to as the uniform series, which amounts to $1.00.
e. Capital recovery (CR):

$$R = S\left[\frac{i}{(1+i)^n - 1}\right] = P\left[\frac{i\,(1+i)^n}{(1+i)^n - 1}\right].$$

$$\text{The factor} = \left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$$

is referred to as the uniform series that $1.00 will purchase.
f. Uniform series present worth (USPW):

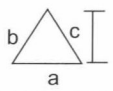
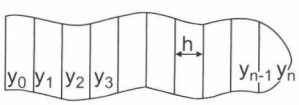
$$P = R\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

The factor $[((1+i)^n - 1)/i(1+i)^n]$ is referred to as the present worth of $1.00 per period.

Where

P = A present sum of money,
S = A sum of money at a specified future date,
R = A uniform series of equal end-of-period payments,
n = The number of interest periods,
i = The interest rate earned at the end of each period.

Mathematics—areas

Form		Method of Finding Area
Triangle		Base x 1/2 perpendicular height $\sqrt{s(s-a)(s-b)(s-c)}$ s = 1/2 sum of the three sides a,b,c
Trapezium		Sum of area of the two triangles
Trapezoid		1/2 sum of parallel sides x perpendicular height
Parallelogram		Base x perpendicular height
Reg. polygon		1/2 sum of sides x inside radius
Circle		πr^2 = 0.78540 x diam^2. = 0.07958 x circumference^2
Sector of a circle		$\frac{\pi r^2 A^\circ}{360}$ = 0.0087266r^2A° = arc x 1/2 radius
Segment of a circle		$r^2\left(\frac{\pi A^\circ}{180} - \sin A^\circ\right)$
Circle of same area as a square		Diameter = side x 1.12838
Square of same area as a circle		Side = diameter x 0.88623
Ellipse		Long diameter x short diameter x 0.78540
Parabola		Base x 2/3 perpendicular height
Irregular plane surface		The larger the value of n, the greater the accuracy of approximation (Simpson's Rule). $A = \frac{h}{3}\left[(y_o + y_n) + 4(y_1 + y_3 + \ldots + y_{n-1}) + 2(y_2 + y_4 + \ldots + y_{n-2})\right]$

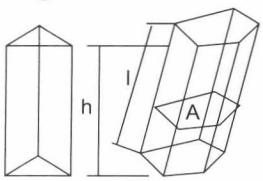
Mathematics—surfaces and volumes

Method of Finding Surfaces and Volumes of Solids
S = lateral or convex surface V = Volume

Parallelopiped

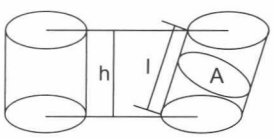
S = perimeter P perp. to sides x lat. length, l
V = area of base x perpendicular height, h
V = area of section A perp. to sides x lat. length, l

Prism-right, oblique, regular or irregular



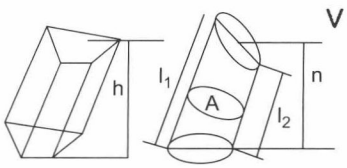
S = perimeter P perp. to sides x lat length l
V = area of base x perp. height, h
V = area of section A perp. to sides x lat. length, l

Cylinder-right, oblique, circular or elliptic, etc.



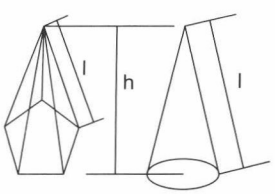
S = perimeter of base x perp. height
V = area of base x perp. height
V = area of section A perp. to sides x lat. length, l

Frustum of any prism or cylinder



V = area of base x perpendicular distance h, from base to center of gravity of opposite face. For cylinder, $1/2A(l_1+l_2)$

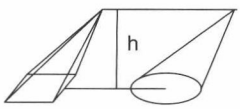
Pyramid or Cone, right or regular



S = perimeter of base x 1/2 slant height, l

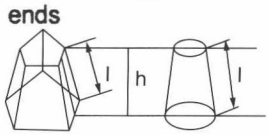
V = area of base x 1/3 perp. height, h

Pyramid or Cone-right, oblique, regular or irregular



V = area of base x 1/3 perp. height, h
V = 1/3 vol. of prism or cylinder of same base and perp height
V = 1/2 vol. of hemisphere of same base and perp. height

Frustum of pyramid or cone, right and regular, parallel ends

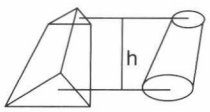


S = (sum of perimeter of base and top) x 1/2 slant height, l

$$V = \frac{h}{3}\left(A_1 + A_2 + \sqrt{A_1 x A_2}\right)$$

Where A_1 and A_2 are the areas of the bases

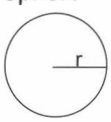
Frustum of any pyramid or cone, parallel ends



$$V = \frac{h}{3}\left(A_1 + A_2 + \sqrt{A_1 x A_2}\right)$$

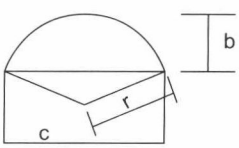
Where A_1 and A_2 are the areas of the bases

Sphere



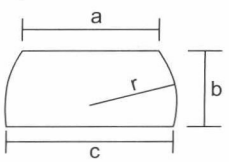
$S = 4\pi r^2$
$V = 4/3\pi r^3$

Spherical Sector



$V = 2/3\pi r^2 b$
$S = 1/2\pi r(4b+c)$

Spherical Zone



$S = 2\pi rb$
$V = 1/24\pi b(3a^2+3c^2+4b^2)$

Rules of exponents

$a^n \times a^m = a^{n+m}$,

$a^n / a^m = a^{n-m}$,

$(a^n)^m = a^{nm}$,

$(ab)^n = a^n b^n$,

$(a/b)^n = a^n / b^n$,

$a^{n/m} = \left(a^{1/m}\right)^n$.

Recommended drill sizes for self-tapping screws

Self-Tapping Screw Size			Major Thread Diameter			Minor Thread Diameter			For Heavy Metals		For Light Metals	
No.	Threads/In	OD	Max	Mean	Min	Max	Mean	Min	Drill Size		Drill Size	
2	32	0.086	0.088	0.0850	0.082	0.064	0.0620	0.0060	49	0.0730	49	0.0730
4	24	0.112	0.114	0.1110	0.108	0.086	0.0840	0.082	41	0.0960	41	0.0960
5	20	0.125	0.130	0.1265	0.123	0.094	0.0920	0.090	36	0.1065	36	0.1065
6	20	0.138	0.139	0.1355	0.132	0.104	0.1015	0.099	32	0.1160	32	0.1160
7	19	0.151	0.154	0.1505	0.147	0.115	0.1120	0.109	30	0.1285	30	0.1285
8	18	0.164	0.166	0.1625	0.159	0.122	0.1190	0.116	28	0.1405	29	0.1360
10	16	0.190	0.189	0.1855	0.182	0.141	0.1380	0.135	20	0.1610	21	0.1590
12	14	0.216	0.215	0.2115	0.208	0.164	0.1605	0.157	13	0.1850	14	0.1820
1/4	14	0.250	0.246	0.2415	0.237	0.192	0.1885	0.185	3	0.2130	4	0.2090
5/16	12	0.313	0.315	0.3105	0.306	0.244	0.2400	0.236	I	0.2720	H	0.2660
3/8	12	0.375	0.380	0.3755	0.371	0.309	0.3040	0.299	R	0.3390	Q	0.3320

Determine pulley speed

Speed of Driven Pulley Required:

Diameter and speed of driving pulley and diameter of driven pulley are known.

D_1 = Diameter of driving pulley 15 in,
RPM_1 = 180 (driving pulley speed),
d_2 = Diameter of driven pulley 9 in,
RPM_2 = Speed of driven pulley,

$$\text{RPM}_2 = \frac{15 \times 180}{9} = 300 \text{ RPM}.$$

Diameter of Driven Pulley Required:

Diameter and speed of driving pulley and speed of driven pulley are known.

D_1 = Diameter of driving pulley 24 in,
RPM_1 = 100 (driving pulley speed),

$$d_2 = \frac{24 \times 100}{600} = 4 \text{ in},$$

RPM_2 = Speed of driven pulley = 600.

Diameter of Driving Pulley Required:

D_1 = in,
d_2 = 36 in,
RPM_2 = 150,
RPM_1 = 600,

$$D_1 = \frac{36 \times 150}{600} = 9 \text{ in}.$$