INSTRUCTIONS

FOR

MEAR'S WATER FLOW CALCULATOR

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CALCULATOR DESIGNERS & MANUFACTURERS
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MEAR'S

WATER FLOW CALCULATOR

Firstly it should be noted that the calculator is a double sided instrument, the two sides being entirely independent.

One side determines the flow of water through pipes and ducts of circular cross section and constructed in a variety of materials i.e. metal pipes, concrete ducts, coated pipes, etc. The other side deals with the flow in large open channels of any cross section, rectangular, round, etc.

DESIGN BASIS - PIPES & DUCTS

This side of the calculator solves the accepted Rational Formula for the flow of fluids in pipes, incorporating coefficients of friction in accordance with the Colebrook-White equations and pipe roughness factors generally as given by Moody. The variable coefficient of friction is built into the calculator and needs no separate determination and a Pipe Material scale makes appropriate allowance for roughness.

The answers have been checked against over 100 well authenticated practical tests on actual pipe lines from small metal tubes to long concrete tunnels up to 18ft. dia. and give an accuracy appreciably better than the usual Hazen-Williams formula. The pressure loss obtained is for pipes in new condition and allowance should be made for deterioration with age due to corrosion or incrustation according to experience with the type of water being handled. This will result in an increased pressure loss or a reduction in the flow.

It will be seen that the flow can be read off against four separate arrows on the quadrant which give it in terms of galls/min., million galls/day, cu.ft./sec. or cu.metres/sec. as desired. These arrows can also be used for straight forward conversion from one of these units to any other. An alternative model is also available calibrated in U.S. gallons. Scales are also provided, coloured green, for determination of velocity.

Flow in Ducts Running Partly Full

The flow through any pipe, duct or open channel running only partly full can be read off directly (in cu.ft./sec. only) against the Proportional Depth scale on the top quadrant. Thus if the depth of water in the pipe is only one quarter of the diameter, the flow is read off immediately opposite .25 on this scale.

It will be seen that paradoxically there is a slight increase in the flow with a pipe only say 95% full, this being due to the appreciable reduction in the length of the wetted perimeter causing a corresponding reduction in the frictional losses as the water leaves the top of the pipe.

With partly full pipes the flow is determined by the slope. Thus if the slope is 1 in 600 it will be appreciated that there is a loss of pressure head of 1ft. in every 600ft. of length. To determine the flow therefore the pressure loss is set at 1ft. and the length at 600ft.

EXAMPLE

Find the flow of water through a smooth concrete pipe 20″ bore, 500ft. long with a pressure loss of 5ft. head.

1. Set 20″ dia. to 500ft. long.
2. Set "Smooth Concrete" to 5ft. Pressure Drop.
3. Read opposite outer arrow:

   Flow = 6,900 imperial galls/min. (or 8,280 U.S. galls/min. on U.S. model)

or opposite second arrow:

Flow = 18.5 cu.ft./sec.

or alternatively if the pipe is only running 30% full read off against .30 on the Proportional Depth scale:

Flow = 3.7 cu.ft./sec.

DESIGN BASIS - OPEN CHANNELS

To deal with open channels of non-circular section the other side of the calculator is arranged to solve the Manning Formula which is:

$$Q = \frac{1.486\, A^{1.66}\, S^{.5}}{n\, P^{.66}}$$

where Q = flow in cu.ft./sec. A = area of channel in sq.ft.
n = Kutters 'n' P = wetted perimeter of channel in ft.
S = slope of channel.

It is necessary to obtain the area of the channel occupied by the water and also the corresponding length of the wetted perimeter and to use these values in the calculation.

The Manning Formula will also deal with the flow in circular channels running partly full but it will give low values for the smaller pipes and steeper slopes and it is preferable to use the other side.

EXAMPLE

Find the flow in a 10ft. square rough concrete channel with a slope of 1 in 1000 running half full.

Area = 10′ × 5′ = 50 sq.ft.
Wetted Perimeter = 5 + 10 + 5 = 20 ft.

1. Set 50 sq.ft. Area to 20ft. Wetted Perimeter.
2. Set "Rough Concrete" arrow to 1000.
3. Read: **Flow = 275 cu.ft./sec.**

ALLOWANCE FOR BENDS AND ELBOWS

If the pipe has number of bends or elbows the following additions to the length should be made for each :—

Pipe Diameter (inches)	Length to Add (feet)			
	Welded Elbow	Long Radius Bend	Globe Valve	Gate Valve
½	1	.5	18	.5
1	2	.75	30	.8
2	3	1.5	54	1.3
4	6	3	107	2.5
8	10	5	214	5
12	15	7		7
20	25	12		12
40	48	22		24

Screwed elbows and bends are double the above figures.

OTHER FLOW CALCULATORS

TURBULENT FLOW CALCULATOR
FOR LIQUIDS AND GASES

Gives the pressure drop in pipe lines of all sizes from ½in. to 40in. diameter when carrying any type of liquid or gas. Includes an extensive chart of kinematic viscosities of various liquids. Invaluable for the Chemical and Process Industries, Plant Manufacturers and Designers, Refineries, etc.

STREAMLINE FLOW CALCULATOR
FOR VISCOUS LIQUIDS

A companion calculator to the above to cover the viscous flow range e.g. heavy fuel oils, syrups, or less viscous liquids in small bore pipes. 5¾in. dia.

GAS FLOW CALCULATOR

Deals with the flow of gases in pipes under both high and low pressure conditions. Specially suitable for Gasworks Distribution Engineers, Gas and Chemical Engineers, Process and Chemical Industries. Covers pipes from ¾in. to 60in. dia., flows up to 10,000,000 c.f.h. and pressures up to 4,000 lbs./sq. in., of our latest improved design with direct reading high pressure scale and made in perspex.

STEAM FLOW CALCULATOR

Gives pressure loss in steam pipes ½in. to 40in. dia. at any vacuum or pressure from 0.2 lbs./sq. in. abs. up to 3,200 lbs./sq. in. abs. Reverse side gives velocities, together with equivalent lengths of bends, valves and fittings, and a section to cover flow at sonic velocities.