INSTRUCTIONS

FOR THE USE OF THE

AUDCO PIPE FLOW CALCULATOR

FOR

LIQUIDS and GASES

The calculator is designed to solve quickly and accurately the fundamental equation for the turbulent flow of fluids through pipes, this equation being:—

$$P = \frac{Q^2 f S L}{K d^5}$$

where:—

K = a constant and is 23,100 for liquids, 486,000 for gases.

P = Pressure drop in p.s.i. and is shown on the front inner red scale.

Q = Volume, galls/hr. for liquids, cu. ft/hr. @ S.T.P. for gases and is shown on the front outer black scales.

L = Length of pipe, feet.

d = Dia. of pipe, inches.

f = Friction factor which varies with viscosity, velocity of fluid and pipe surface. Velocity variation is built into the calculator and the variation with viscosity is taken care of by a separate viscosity scale. The answers given by the calculator are correct for commercial steel or wrought iron pipes. For cast iron pipes flows will be 10% less than shown.

S = Specific gravity, relative to water for liquids, and relative to air for gases.

GAS FLOW

The above formula takes no account of compressibility of gases and the calculator is only applicable so far as gases are concerned to flow around atmospheric pressure, and pressure drops below 3 p.s.i. For higher pressures the flow will be larger for the same pressure drop.

VISCOSITY

On the back of the calculator are tabulated, in alphabetical order, the kinematic viscosities in centistokes at various temperatures and also the specific gravities of over 50 liquids. Scales are also given to convert Redwood No. 1 or Saybolt Universal viscosity to centistokes. If viscosities for other fluids are available in absolute units namely centipoises, then these can be converted to centistokes by dividing by the specific gravity.

It should be borne in mind that the viscosities of liquids which are not chemically pure such as fuel oils, crude oil, molasses etc. are liable to vary appreciably from the average figures given according to the source of supply and the exact specification. Whilst a variation of say 50% causes little error if the flow is turbulent, it would make a considerable difference if the flow were streamline.

TURBULENT OR STREAMLINE FLOW

In nearly all practical problems the flow is turbulent, but scales are provided on the back of the calculator to check on doubtful cases. These scales determine the Reynolds Number and turbulent flow should be assumed at all values above 2,000. The calculator does not solve the streamline flow but the appropriate formula is given on the back for reference.

P.T.O.

OPERATION

1. From the back of the calculator confirm whether the flow is turbulent and check viscosity and specific gravity. When the diameter or flow are unknown initially check after these have been determined. If the flow should prove to be streamline as may happen with high viscosity liquids, use the formula given on the back.

2. Set any two pairs of the following variables on the front of the calculator:—

Pipe dia.	to	Pipe length and/or
Pressure Drop	to	Specific Gravity and/or
Flow	to	Viscosity

Read off the unknown quantity against the fifth variable.

Example

To find the flow of 98% sulphuric acid at 50°C through a 3″ dia. pipeline 100ft. long with a pressure drop of 10 p.s.i.

On the reverse side set the large black arrow to 98% sulphuric acid.

Read off:— viscosity at 50°C = 5.82 centistokes
specific gravity = 1.84

Turn to front.

Set 3″ dia. to 100 ft. long.

Set 1.84 specific gravity to 10 p.s.i. pressure drop.

Read off : **FLOW = 9,600** galls./hr. opposite 5.82 viscosity.

Check on the reverse side that the flow is turbulent using the red scales:—

Set 9,600 galls./hr. to 3″ dia.

Note that the Reynolds number for a viscosity of 5.82 is 35,000 and that consequently the flow is turbulent.

ALLOWANCE FOR BENDS AND ELBOWS

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

Pipe Diameter (inches)	Length to Add (feet)	
	Elbows	Long Radius Bend
½	1	.5
1	2	.75
2	4	1.5
4	6	2
8	12	5
12	18	7
20	30	12
40	60	24

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Price 15/- each