

P6220/21/22

WATER FLOW IN PIPES AND FITTINGS EXPERIMENTS



INTRODUCTION

The flow of fluids in closed conduits or pipes is a major topic in the Mechanical Engineering subject of Mechanics of Fluids due to its practical importance in so many fields of study. It is also of significant interest in such diverse fields as Civil and Chemical Engineering, and Biology and Medicine.

Early work in the subject was essentially empirical and despite many advances in mathematical analysis the complexity of the flow of real fluids is such that very few complete solutions of flow situations exist and therefore a large part of the topic of fluid flow in closed conduits remains an empirical science.

In this area, three sets of experiments are considered which are all concerned with the flow of water through circular pipes or tubes, the head loss through pipe fittings, the loss of head at changes in pipe section, the head loss which occurs at entry and exit to pipes, the pressure loss across valves and valve characteristics.

P6220 LAMINAR FLOW APPARATUS

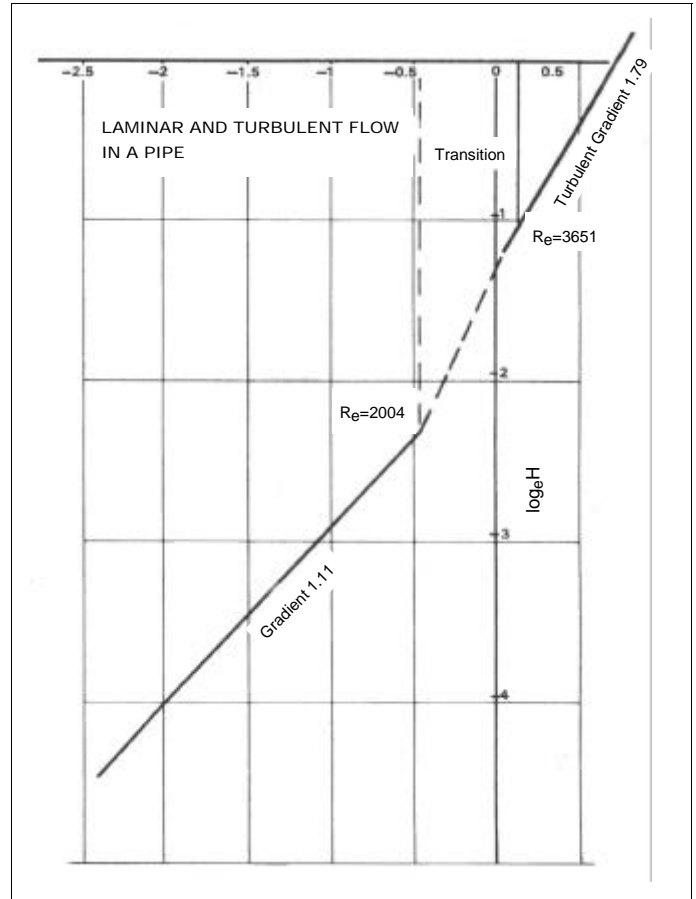
Cussons P6220 Laminar Flow Apparatus consists of a tubular test section of 3 mm internal bore and 508 mm long, including a 13 mm bell nose entry, which is supported inside a protective outer 25 mm tube and is terminated at each end in bushed unions.

Two static pressure tapings are provided, the first tapping being 95 mm from the entry plane with a distance between the two tapping points of 360 mm. It is intended that the test section should be mounted between the P6103 Constant Head Inlet Tank and the P6104 Variable Head Outlet Tank.

The P6106 Manometer Board is used to measure the head loss across the tubular test section. The test section is shown in Fig. 1 below.

EXPERIMENTAL CAPABILITIES

- ◆ Laminar and turbulent flow regions involving Poiseuille's and Darcy-Weisbach equations.
- ◆ Upper and lower critical values of Reynolds number.
- ◆ Friction factors for fluid flow in a pipe.



ACCESSORIES REQUIRED

- P6103 Constant Head Inlet Tank
- P6104 Variable Head Outlet Tank
- P6105 Feed Block (to extend pressure range of experiment) - optional
- Measuring Cylinder (not supplied)
- P6106 Manometer
- P6108 Rotameter (optional)
- P6102 Pump Speed Display (optional)

DIMENSIONS AND WEIGHTS

Nett:- 60 x 60 x 500 mm, 0.3 Kg.

Gross:- 0.003m³, 1.0 Kg.

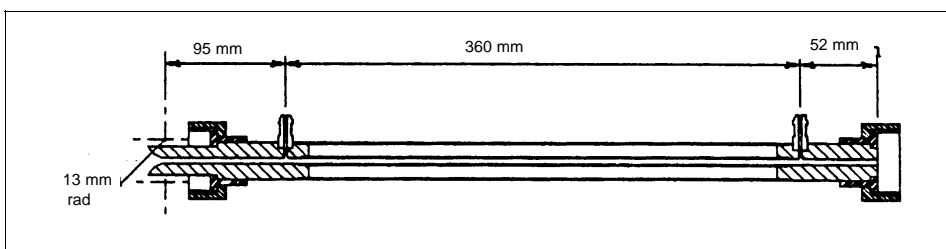


FIG. 1

P6221 LOSSES IN PIPES & FITTINGS

Cussions P6221 Losses In Pipes and Fittings

Apparatus consists of a set of six test sections each 464 mm long. The test sections may be used one at a time by mounting the required test section between the P6103 Constant Head Inlet Tank and the P6104 Variable Head Outlet Tank. The six test sections, which are shown in Fig. 2 are:

- 7 mm nominal bore pipe with two static pressure tappings 360 mm apart.
- 10 mm nominal bore pipe with two static pressure tappings 360 mm apart.
- 10 mm nominal bore pipe incorporating four bends (40 mm bend radius) with two static pressure tappings with a total pipe length of 540 mm between the tappings.
- 10 mm nominal bore pipe incorporating four elbows with two static pressure tappings with a total pipe length of 540 mm between the tappings.
- 10 mm nominal bore pipe incorporating a ball valve, two static pressure tappings are provided 360 mm apart.
- 10 mm nominal bore pipe incorporating an angle seat valve, two static pressure tappings are provided 360 mm apart.

EXPERIMENTAL CAPABILITIES

- ◆ Determination of Pressure Drop across various pipes and fittings at differing flow rates.
- ◆ Estimation of Loss Coefficient (K) for various pipes, pipe fittings and valve settings.
- ◆ Flow rate/diameter relationship determination for fluid flow in pipes.
- ◆ 'Friction Factor' determination for fluid flow in smooth pipes.

ACCESSORIES REQUIRED

P6103 Constant Head Inlet Tank

P6104 Variable Head Outlet Tank

P6105 Feed Block (to extend pressure range of experiment) - optional

P6102 Pump Speed Display (optional)

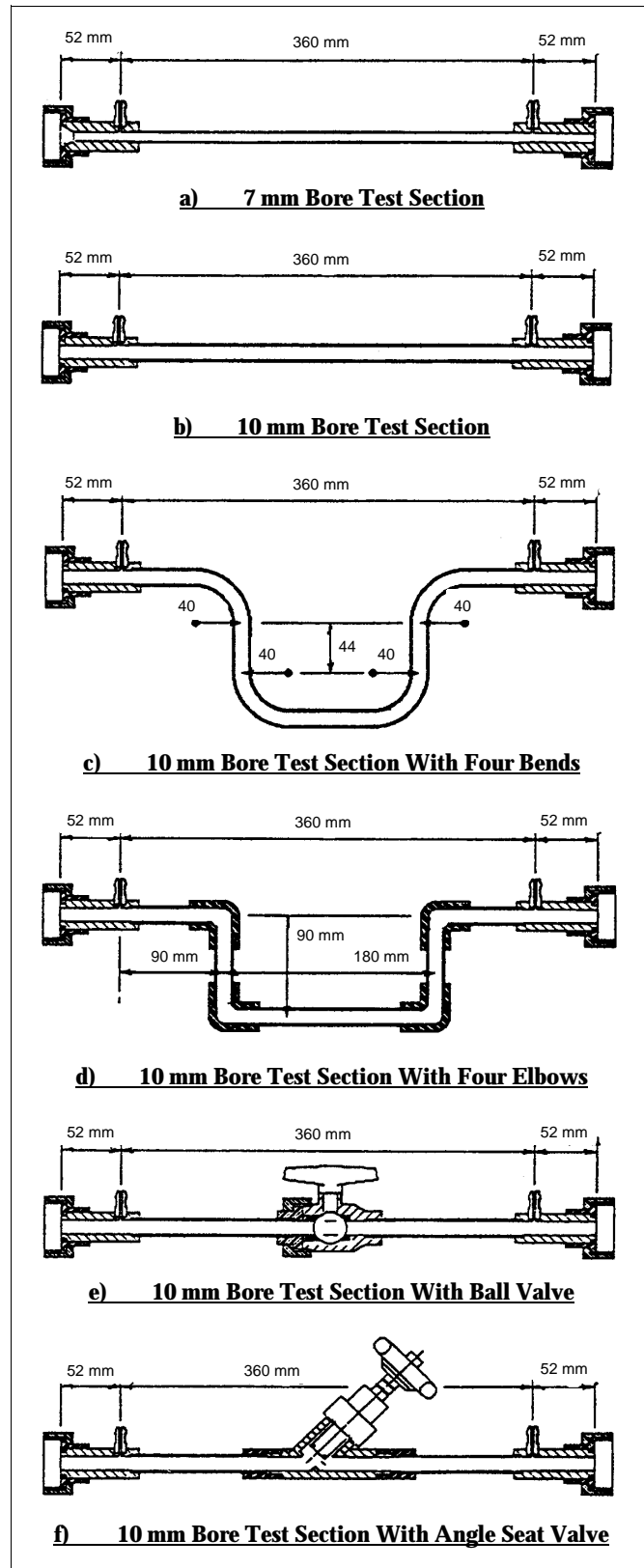


FIG. 2

DIMENSIONS AND WEIGHTS

Nett:- 80 x 130 x 500 mm, 1.5 Kg.

Gross:- 0.01m³, 3.0 Kg.

P6222 ENTRY/EXIT & CONTRACTION/ EXPANSION LOSSES

Cussons P6222 Entry/Exit and Contraction/Expansion Losses Apparatus comprises of a set of two test sections each 464 mm long and four adaptor test pieces, as shown in Fig. 3 below.

The two test sections consist of a 10 mm nominal bore pipe at one end and a 20 mm nominal bore pipe at the other end, one of the test sections has a sudden or stepped transition between the two diameters, whilst the other test section has a 30° included angle gradual transition between the two sections.

Each of the two test sections can be used by mounting them either way round between the P6103 Constant Head Inlet Tank and the P6104 Variable Head Outlet Tank. The four adaptor test pieces can be used with the 10 mm section to provide either a sudden inlet contraction, sudden exit enlargement, gradual inlet contraction (30°) or a gradual exit enlargement (30°).

They are designed to be used by inserting them into the experiment attachment boss of the inlet head tank or outlet head tank as appropriate.

Alternatively they can be used in pairs with the 10mm test section of P6221.

EXPERIMENTAL CAPABILITIES

- ◆ Investigation of head loss associated with sharp and smooth enlargements in a pipe.
- ◆ Investigation of head loss associated with sharp and smooth contractions in a pipe.
- ◆ Determination of the loss at entry from a vessel to a pipe for sharp and smooth entry conditions.
- ◆ Determination of the loss at exit from a pipe to a vessel for sharp and smooth exit conditions.

ACCESSORIES REQUIRED

- P6103 Inlet Head Tank
- P6104 Variable Head Outlet Tank
- P6106 Manometer Board
- P6105 Feedblock (optional)
- P6102 Pump Speed Display (optional)

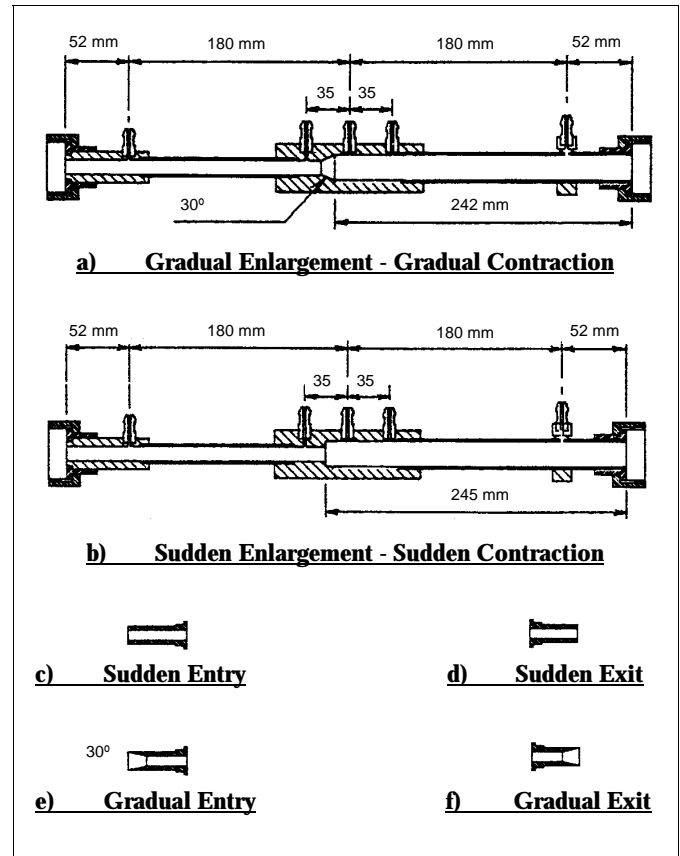


FIG. 3

DIMENSIONS AND WEIGHTS

Nett:- 50 x 50 x 500 mm, 0.5 Kg.

Gross:- 0.003m³, 1.0 Kg.

To provide a greater range of inlet heads and hence a large differential head across the test units the P6105 Feedblock may be used instead of the P6103 Constant Head Inlet Tank. The Variable Speed Pump Control Unit may also be used to control the pump speed and hence the flow rate together with P6102 Pump Speed Display.

At low flow rates it may be convenient to use graduated measuring cylinders (not supplied) of approximately 100cc and 1000cc capacity to measure the flow rate.