# 3. CALCULATION OF SYSTEM PRESSURE, FLOW OR SIZE

## 3.1. INTRODUCTION

The steps in obtaining an estimate of system head requirements or flow rate or size are the following.

1. Define the geometric parameters of the system and components.
2. Define the flow parameters — velocities and Reynolds numbers.
3. Select appropriate loss coefficients.
4. Calculate individual component losses and correct as necessary for interactions between components.
5. Sum the individual system losses, plus the static lift or the pressure differential across the system, to establish the required pump or fan head.

When geometrical and flow parameters are known, the selection of appropriate loss coefficients is the main task. In situations where the flow or pipe and component size has to be found, the simplest and usually the quickest method is to adopt a trial and approximation procedure, as demonstrated in Examples 2 and 3 in Section 8.6.

## 3.2. EQUATIONS FOR LOSSES

The following equations from Chapter 1 are sufficient to calculate pressure losses for liquids and also for gases flowing at Mach numbers less than 0.2 — equivalent, in the case of air, to a velocity of 70 m/s at normal temperature and pressure.

For individual pipes, passages and components

$$\Delta H = KU^2/2g \tag{3.1a}$$

$$\Delta P = K\rho U^2/2 \tag{3.1b}$$

where $K$ is the loss coefficient, $\Delta H$ is the total head loss (m) and $\Delta P$ is the total pressure loss ($N/m^2$).

Note: For flow in pipes and passages $K$ in equations (3.1) is given by

where

$$f = \frac{\text{Head loss in a one hydraulic diameter of pipe or passage}}{U^2/2g}$$