KOLEJ YAYASAN PELAJARAN JOHOR
FINAL EXAMINATION

COURSE NAME	:	**FLUID MECHANICS**
COURSE CODE	:	**DKM 2122**
EXAMINATION	:	**APRIL 2018**
DURATION	:	**2 HOURS**

INSTRUCTION TO CANDIDATES

1. This examintaion paper consists **FIVE (5)** questions.
   Answer **FOUR (4)** questions only in Answer Booklet.

2. Candidates are not allowed to bring any material to examination room except with the permission from the invigilator.

3. Please check to make sure that this examination pack consist of:
   i. Question Paper
   ii. Answer Booklet

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This examination paper consists of 16 printed pages including front page

QUESTION 1 / *SOALAN 1*

a) Define the following terms:
Takrifkan istilah berikut:

i. Fluid
Bendalir

(1 marks / *markah*)

ii. Fluid statics
Bendalir statik

(1 marks / markah)

iii. Fluid dynamics
Bendalir dinamik

(1 marks / markah)

(3 marks / *markah*)

b) Explain the difference between the fluid in the liquid, gas and solid condition.
Terangkan perbezaan antara bendalir dalam keadaan cecair, gas dan pepejal.

(3 marks / 3 *markah*)

c) A Bourdon pressure gauge is attached to a boiler which is located at sea level with a reading preassure of 7 bar. If atmospheric pressure is 1.013 bar, calculate the absolute pressure in that boiler (in kN/m^2).

Satu tolok tekanan Bourdon di pasangkan pada sebuah dandang yang terletak di atas aras laut menunjukkan tekanan sebanyak 7 bar. Jika tekanan atmosfera adalah 1.013 bar, kirakan tekanan mutlak dalam dandang tersebut (dalam kN/m^2).

(7 marks / 7 *markah*)

d) Determine the specific weight, ω (in kN/m^3) and specific gravity,s of fluid if the weight of fluid is 10N and the volume is 500 cm^2.
Tentukan nilai berat tertentu, ω (dalam kN/m^3) dan graviti tentu,s cecair jika berat cecair sebanyak 10N dan isipadunya sebanyak 500 cm^2.

(7 marks / 7 *markah*)

[20 marks / *20 markah*]

QUESTION 2 / *SOALAN* 2

a) By using a diagram, briefly describe and sketch the types of flow below.
Dengan bantuan gambarajah, terangkan secara ringkas jenis aliran di bawah.

i. Steady flow
Aliran sekata

(2 marks / *markah*)

ii. Uniform flow
Aliran seragam

(2 marks / *markah*)

iii. Turbulent flow
Aliran gelora

(2 marks / *markah*)

iv. Laminar flow
Aliran laminar

(2 marks / *markah*)

(8 marks / 8 *markah*)

b) The water in a tank is pressurized by air, and the pressure is measured by a multifluid manometer as shown in **Figure 1**. Determine the gage pressure of air in the tank if $h_1 = 0.4$ m, $h_2 = 0.6$ m, and $h_3 = 0.8$ m. Take the densities of water, oil, and mercury to be 1000 kg/m^3, 850 kg/m^3 and 13 600 kg/m^3, respectively.

Air di dalam sebuah tangki di beri tekanan oleh udara. Tekanan di ukur dengan menggunakan multifluid manometer seperti di dalam ***Rajah 1****. Tentukan nilai tolok tekanan jika $h_1 = 0.4$, $h_2 = 0.6$ m, dan $h_3 = 0.8$ m. Di beri nilai ketumpatan bagi air, minyak, dan merkuri adalah 1000 kg/m^3, 850 kg/m^{3}dan 13 600 kg/m^3.*

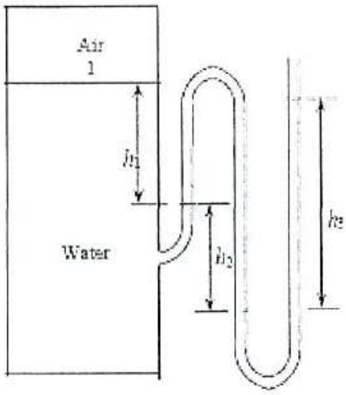


Figure 1 / Rajah 1

(6 marka / 6 *markah*)

c) Given the absolute pressure in water at a depth of 8 m is read to be 175 kPa as in **Figure 2**. Determine:
Diberi tekanan mutlak di dalam air dengan kedalaman 8 m, di baca dengan nilai 175 kPa seperti di dalam ***Rajah 2.*** *Tentukan:*

i. The local atmospheric pressure
Tekanan atmosfera setempat

(3 marks / *markah*)

ii. The absolute pressure at a depth of 8 m in a liquid whose specific gravity is 0.78 at same location.
Tekanan mutlak cecair dalam kedalaman 8 m di mana gravity tentu adalah 0.78 di lokasi yang sama.

(3 marks / *markah*)

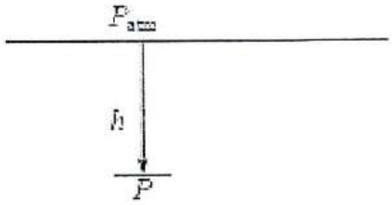


Figure 2 / Rajah 2

(6 marks / 6 *markah*)

[20 marks / 20 markah]

QUESTION 3 / *SOALAN* 3

a) Sketch the velocity distribution diagram in the round pipe system.
Lakarkan gambarajah pengagihan halaju dalam satu sistem paip bulat.

(5 marks / 5 *markah*)

b) In **Figure 3**, two reservoirs have a difference in level of H is 8 m and are connected by a pipe line, which is 40 mm in diameter for the first 12 m and 25 mm for the remaining 5 m. Calculate the discharge of flow in m^3/s if the coefficient of friction, f = 0.001 for both pipes and coefficient of contraction. Cf = 0.66.

***Rajah 3** menunjukkan dua tangki mempunyai perbezaan ketinggian, H ialah 8 m dan di sambungkan oleh satu sistem talian paip, yang mempunyai diameter 40 mm untuk panjang. 12 m pertama dan diameter 25 mm untuk panjang 5 m selebihnya. Kirakan kadar alir dalam m^3/s jika pekali geseran untuk kedua – dua paip adalah, f = 0.001 dan pekali pengecutan, Cf = 0.66.*

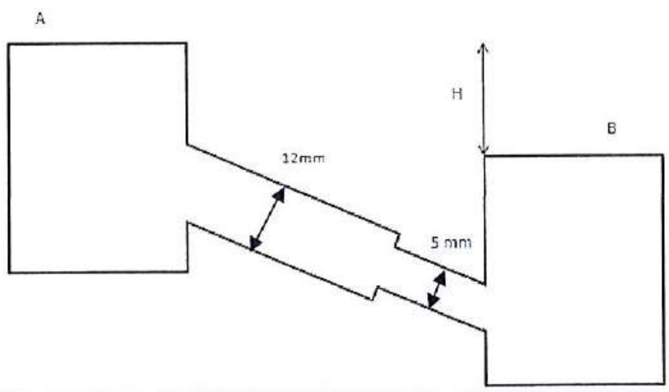


Figure 3 / *Rajah 3*

(15 marks / 15 *markah*)

[20 marks / 20 *markah*]

QUESTION 4 / *SOALAN* 4

a) List **FIVE (5)** types of fluid flow
*Senaraikan **LIMA (5)** jenis aliran bendalir*

(5 marks / 5 *markah*)

b) Explain **flow rate** and **mass flow rate.**
*Terangkan **kadaralir** dan **kadaralir jisim**.*

(3 marks / 3 *markah*)

c) As in **Figure 4**, the raw oil through a pipe with a diameter of 40 mm and entered a pipe with a diameter of 25 mm. The volume flow rate is at 3.75 L/s. Calculate the flow velocity of both pipes and the density of raw oil if the mass flow rate is at 3.23 kg/s.

*Seperti dalam **Rajah 4**, minyak mentah mengalir melalui paip diameter 40 mm dan memasuki paip berdiameter 25 mm. Kadar alir isipadu ialah 3.75 L/s. Kirakan halaju aliran di kedua – dua paip tersebut dan ketumpatan minyak mentah jika kadar aliran jisim adalah 3.23 kg/s.*

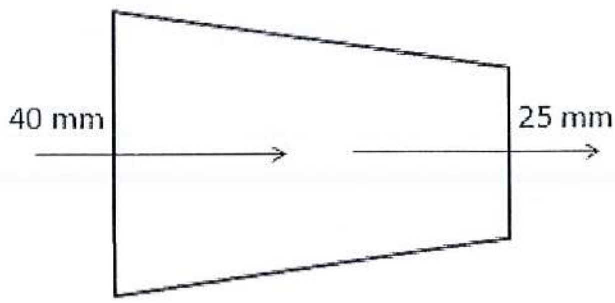


Figure 4 / Rajah 4

(12 marks / 12 *markah*)

[20 marks / 20 markah]

QUESTION 5 / *SOALAN* 5

a) Please stated, how you identify a measurement whether **Langarian** or **Eularian**.
Sila nyatakan, bagaimana anda mengenalpasti sesuatu pengukuran sama ada ia adalah ***Langarian*** *atau* ***Eularian***.

(2 marks / 2 *markah*)

b) A reversing elbow as shown in **Figure 5** makes the fluid a 180° U-turn before it is discharged water at flow rate of 14 kg/s into the atmosphere. The cross-sectional area of the elbow is113 cm^2 at the inlet and 7 cm^2 at the outlet. The elevation difference between the centers of the outlet and the inlet is 30 cm. The weight of the elbow and the water in it is considered to be neglected. Determine:

Satu elbow jenis undur seperti dalam ***Rajah 5*** *menyebabkan bendalir berputar 180o sebelum mengeluarkan air dengan kadar alir 14 kg/s ke atmosfera. Luas keratin rentas bagi elbow adalah 113 cm2 di masukkan dan 7 cm2 pada keluaran. Perbezaan ketinggian pusat antara masukkan dan keluaran adalah 30 cm. Berat air di dalam elbow di abaikan. Tentukan:*

i. The gauge pressure at the center of the inlet and
Tolok tekanan pada pusat masukkan

(5 marks / *markah*)

ii. The anchoring force needed to hold the elbow in place.
Tekanan berlabuh yang di perlukan untuk memegang elbow dalam keadaan setempat.

(4 marks / *markah*)

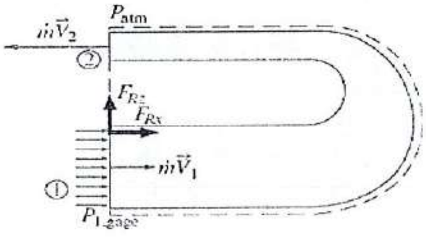


Figure 5 / Rajah 5

(8 marks / 8 *markah*)

c) Water flows through the horizontal elbow in **Figure 6** and exits to atmosphere. The pipe diameter d_1 = 10 cm while d_2 = 3 cm. At flow rate of 0.0153 m^3/s the pressure at section 1 is 2.33 bar. If the weight of water and elbow is 30 kg, determine the magnitude and direction of force to hold the pipe in place.

Air mengalir melalui elbow dalam keadaan membaring seperti mana ***Rajah 6*** *dan keluar terus ke atmosfera. Diameter paip* d_1 *= 10 cm manakala* d_2 *= 3 cm. Pada kadar alir 0.0153* m^3/s *tekanan pada seksyen 1 adalah 2.33 bar. Jika berat air dan elbow adalah 30 kg. Tentukan magnitude dan arah tekanan untuk memegang paip tersebut dalam 1 kawasan.*

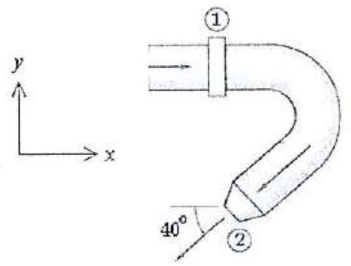


Figure 6 / Rajah 6

(10 marks / 10 *markah*)

[20 marks / 20 *markah*]

QUESTION END

FORMULA

Density :

$\rho = m/v$

Pressure :

$P = F / A$

$P = \rho gh$

$P = P_0 - \rho gh$

$P_{gage} = P_{abs} - P_{atm}$

$P_{vac} = P_{atm} - P_{abs}$

$P_{abs} = P_{gage} - P_{atm}$

Specific Gravity : $\gamma_{substance} / \gamma_{water}$

Specific Weight,W : ρg

Heat, Q : $C_p m\, dT$

Langarian and Eularian :

$$\bar{a} = \frac{d\vec{V}}{dt} = \frac{\partial\vec{V}}{\partial t}\frac{dt}{dt} + \frac{\partial\vec{V}}{\partial x}\frac{dx}{dt} + \frac{\partial\vec{V}}{\partial y}\frac{dy}{dt} + \frac{\partial\vec{V}}{\partial z}\frac{dz}{dt}$$

$$= \frac{\partial\vec{V}}{\partial t}(1) + \frac{\partial\vec{V}}{\partial x}(u) + \frac{\partial\vec{V}}{\partial y}(v) + \frac{\partial\vec{V}}{\partial z}(w)$$

$$= \frac{\partial\vec{V}}{\partial t} + u\frac{\partial\vec{V}}{\partial x} + v\frac{\partial\vec{V}}{\partial y} + w\frac{\partial\vec{V}}{\partial z}$$

Fluid dynamics :

$$\frac{P_1}{\omega} + \frac{v_1^2}{2g} + z_1 = \frac{P_2}{\omega} + \frac{v_2^2}{2g} + z_2$$

$$Q_{actual} = C_d \times A_1\sqrt{\frac{2gH}{(m^2 - 1)}}$$

$$Q_{actual} = \frac{C_d \times A_1}{\sqrt{(m^2 - 1)}}\sqrt{2g\left[\frac{P_1 - P_2}{\omega} + (z_1 - z_2)\right]}$$

Energy losses in pipes :

$$h_C = \left[\frac{1}{Cc} \quad 1\right]^2 \times \frac{v_2^2}{2g}$$

$$h_i = 0.5\frac{v_2^2}{2g}$$

$$h_F = \frac{4fl}{d}\frac{v^2}{2g}$$

$$h_L = \frac{(V_1 - V_2)^2}{2g}$$

Nozzle :

$$\frac{P_c}{P_1} = \left(\frac{2}{\gamma+1}\right)^{\frac{\gamma}{\gamma+1}}$$

$$\frac{T_C}{T_1} = \frac{2}{\gamma+1}$$

$$\frac{T_1}{T_2} = \left(\frac{P_1}{P_2}\right)^{\frac{\gamma-1}{\gamma}}$$

$$V_C = \frac{RT_C}{P_C} \quad A_C = \frac{\dot{m}V_C}{C_C}$$

Coefficient of Volume Expansion

Constant : P / p

Specific heat at constant pressure, k : C_p/C_v

Absolute Viscosity : (F/A) / (v/y)

Kinematic Viscosity, V : μ / p

Hydraulic : $F_1 / A_1 = F_2 / A_2$

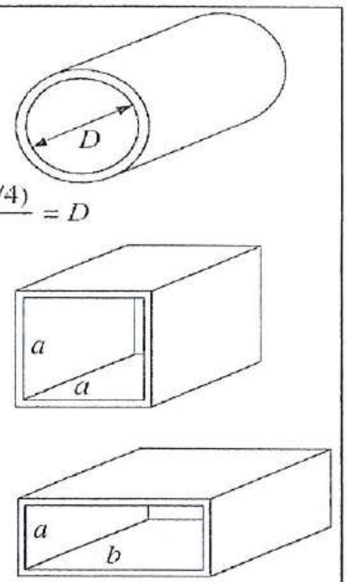
$F_2 / A_2 = A_2 / A_1$

$P_1 = P_2$

Buoyancy : Momen inertia from surface / volume of water displaced

Bernoulli :

$P_1 / p + V_1^2 / 2 + gz_1 = P_2/p + V_2^2 + gz_2$



Circular tube:

$$D_h = \frac{4(\pi D^2/4)}{\pi D} = D$$

Square duct:

$$D_h = \frac{4a^2}{4a} = a$$

Rectangular duct:

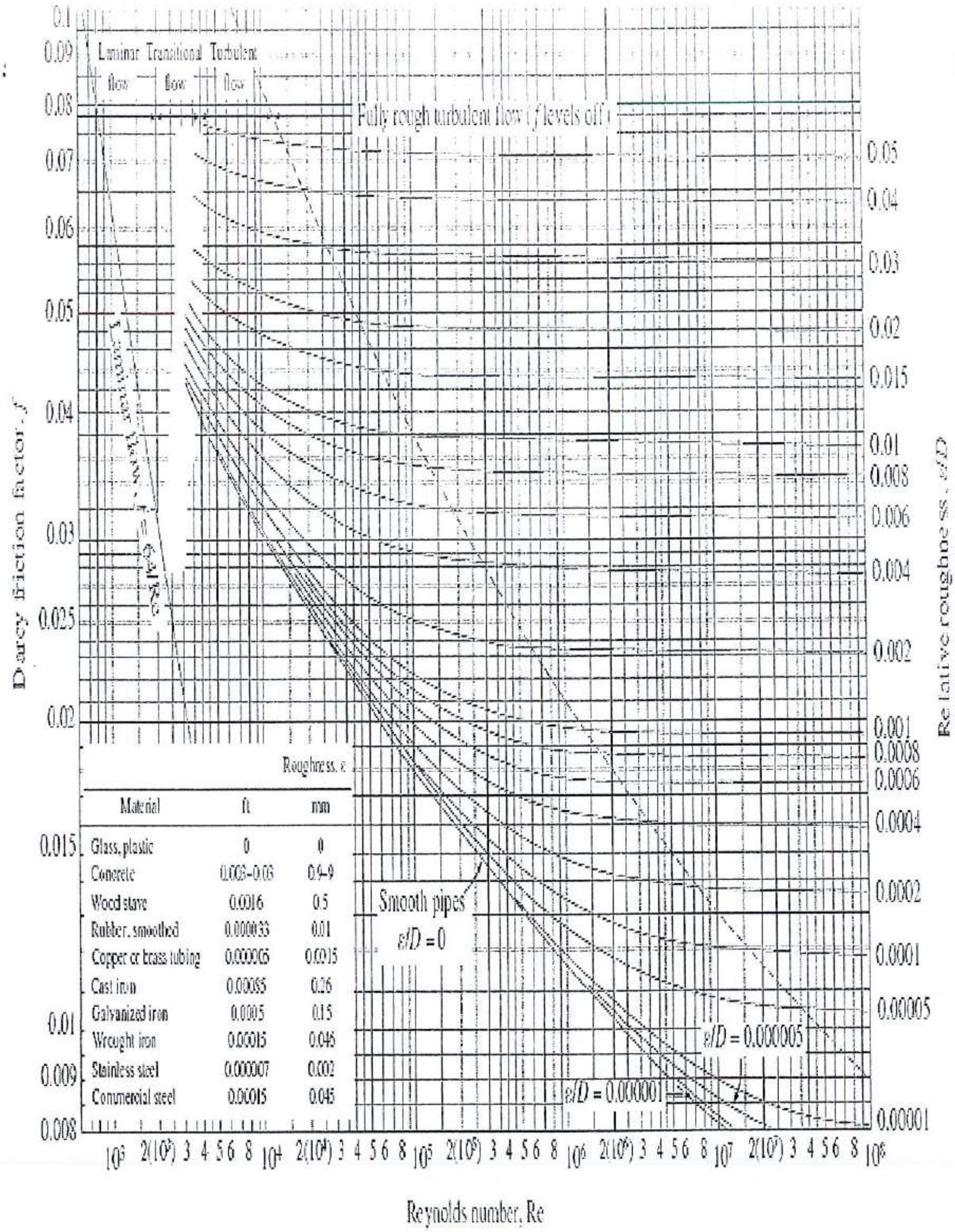
$$D_h = \frac{4ab}{2(a+b)} = \frac{2ab}{a+b}$$

Relative Roughness, ε/D	Friction Factor, f
0.0*	0.0119
0.00001	0.0119
0.0001	0.0134
0.0005	0.0172
0.001	0.0199
0.005	0.0305
0.01	0.0380
0.05	0.0716

* Smooth surface. All values are for Re = 10^6 and are calculated from the Colebrook equation.

Equivalent roughness values for new commercial pipes*

Material	Roughness, ε ft	Roughness, ε mm
Glass, plastic	0 (smooth)	
Concrete	0.003–0.03	0.9–9
Wood stave	0.0016	0.5
Rubber, smoothed	0.000033	0.01
Copper or brass tubing	0.000005	0.0015
Cast iron	0.00085	0.26
Galvanized iron	0.0005	0.15
Wrought iron	0.00015	0.046
Stainless steel	0.000007	0.002
Commercial steel	0.00015	0.045



	Roughness, ε	
Material	ft	mm
Glass, plastic	0	0
Concrete	0.003–0.03	0.9–9
Wood stave	0.0016	0.5
Rubber, smoothed	0.000033	0.01
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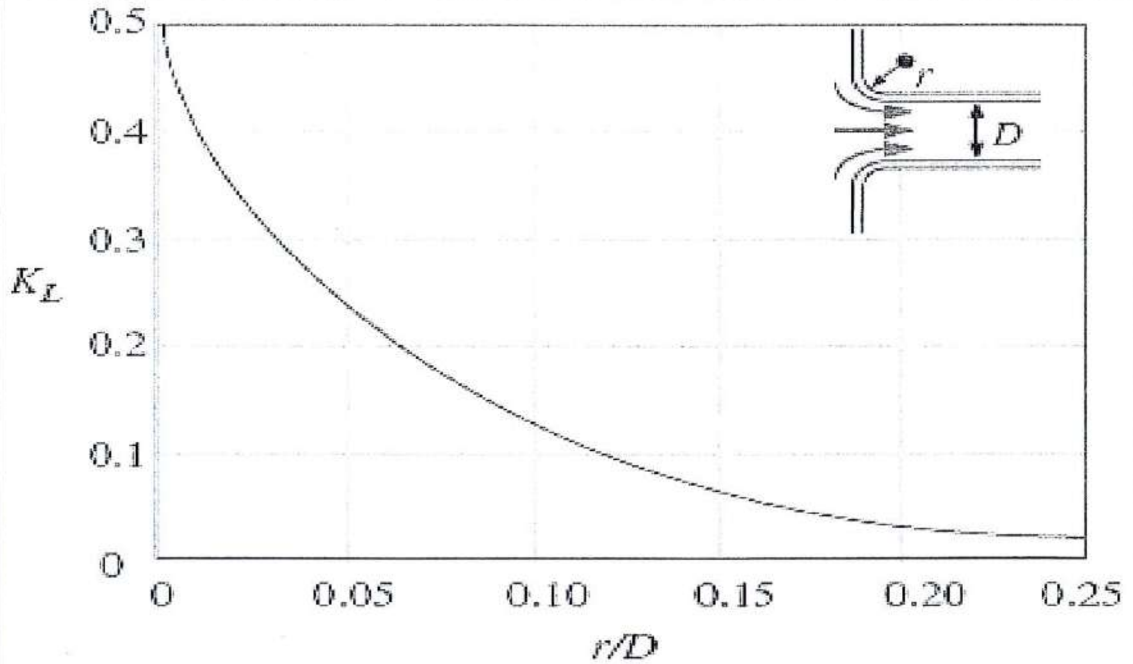
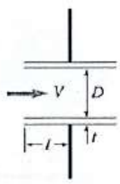


TABLE 14–3

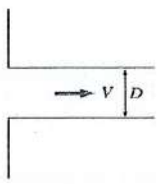
Loss coefficients K_L of various pipe components for turbulent flow (for use in the relation $h_L = K_L V^2/(2g)$, where V is the average velocity in the pipe that contains the component)*

Pipe Inlet

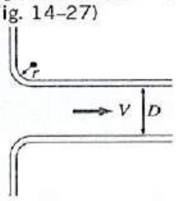
Reentrant: $K_L = 0.80$
($t \ll D$ and $l \approx 0.1D$)



Sharp-edged: $K_L = 0.50$

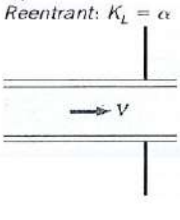


Well-rounded ($r/D > 0.2$): $K_L = 0.03$
Slightly rounded ($r/D = 0.1$): $K_L = 0.12$
(see Fig. 14–27)

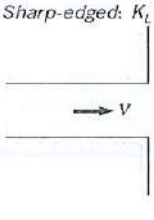


Pipe Exit

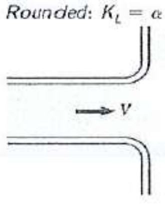
Reentrant: $K_L = \alpha$



Sharp-edged: $K_L = \alpha$



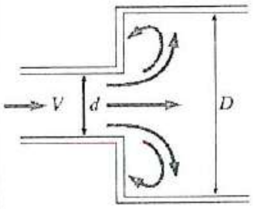
Rounded: $K_L = \alpha$

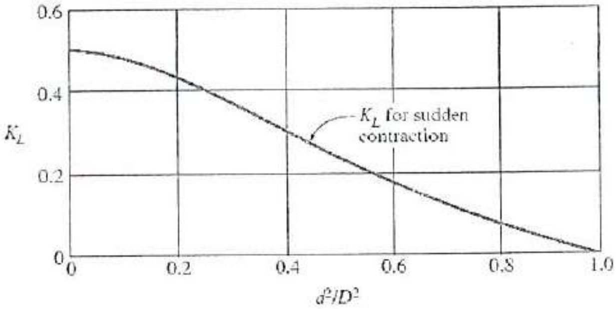


Note: The kinetic energy correction factor is $\alpha = 2$ for fully developed laminar flow, and $\alpha \approx 1.05$ for fully developed turbulent flow.

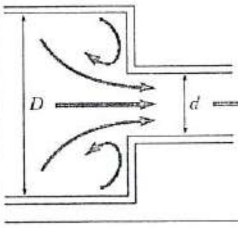
Sudden Expansion and Contraction (based on the velocity in the smaller-diameter pipe)

Sudden expansion: $K_L = \alpha\left(1 - \frac{d^2}{D^2}\right)^2$



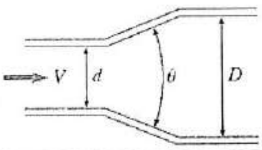


Sudden contraction: See chart.

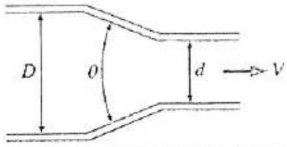


Gradual Expansion and Contraction (based on the velocity in the smaller-diameter pipe)

Expansion (for $\theta = 20°$):
$K_L = 0.30$ for $d/D = 0.2$
$K_L = 0.25$ for $d/D = 0.4$
$K_L = 0.15$ for $d/D = 0.6$
$K_L = 0.10$ for $d/D = 0.8$

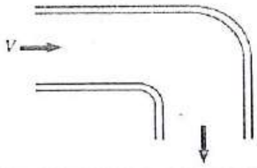


Contraction:
$K_L = 0.02$ for $\theta = 30°$
$K_L = 0.04$ for $\theta = 45°$
$K_L = 0.07$ for $\theta = 60°$

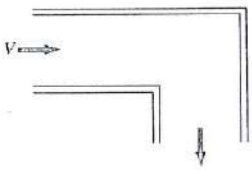


Bends and Branches

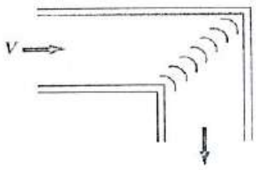
90° smooth bend:
Flanged: $K_L = 0.3$
Threaded: $K_L = 0.9$



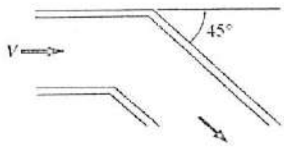
90° miter bend (without vanes): $K_L = 1.1$



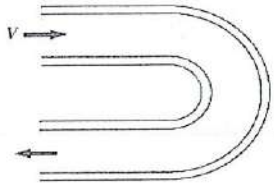
90° miter bend (with vanes): $K_L = 0.2$



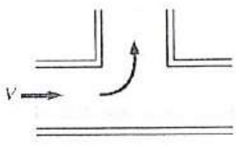
45° threaded elbow:
$K_L = 0.4$



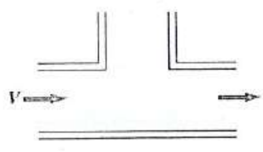
180° return bend:
Flanged: $K_L = 0.2$
Threaded: $K_L = 1.5$



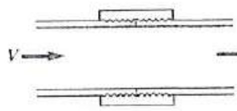
Tee (branch flow):
Flanged: $K_L = 1.0$
Threaded: $K_L = 2.0$



Tee (line flow):
Flanged: $K_L = 0.2$
Threaded: $K_L = 0.9$



Threaded union:
$K_L = 0.08$



Valves

Globe valve, fully open: $K_L = 10$
Angle valve, fully open: $K_L = 5$
Ball valve, fully open: $K_L = 0.05$
Swing check valve: $K_L = 2$

Gate valve, fully open: $K_L = 0.2$
$\frac{1}{4}$ closed: $K_L = 0.3$
$\frac{1}{2}$ closed: $K_L = 2.1$
$\frac{3}{4}$ closed: $K_L = 17$

* These are representative values for loss coefficients. Actual values strongly depend on the design and manufacture of the components and may differ from th given values considerably (especially for valves). Actual manufacturer's data should be used in the final design.