12–1 A full journal bearing has a journal diameter of 25 mm, with a unilateral tolerance of −0.03 mm. The bushing bore has a diameter of 25.03 mm and a unilateral tolerance of 0.04 mm. The l/d ratio is 1/2. The load is 1.2 kN and the journal runs at 1100 rev/min. If the average viscosity is 55 mPa·s, find the minimum film thickness, the power loss, and the side flow for the minimum clearance assembly.

Given:

Journal (shaft) diameter d_{max} = 25 mm,

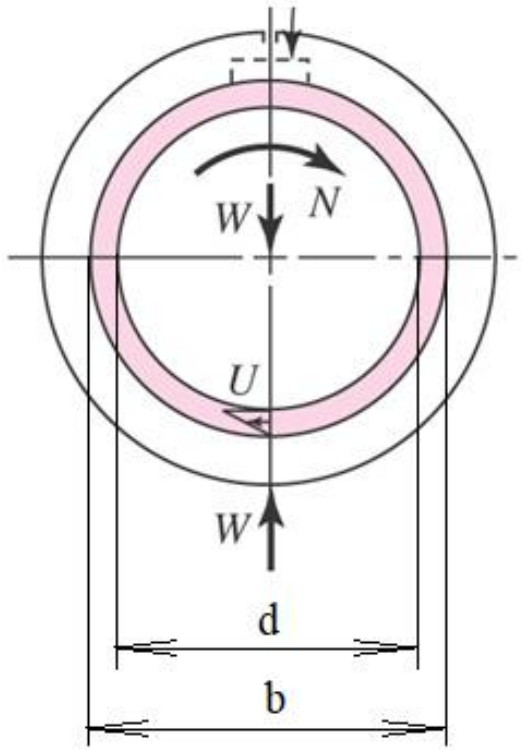
Bearing bore (diameter): b_{min} = 25.03 mm,

l/d = 1/2

W = 1.2 kN

μ = 55 mPa·s

n = 1100 rev/min.



Find: h_0, H_{loss}, Q_s

$$c_{\min} = \frac{b_{\min} - d_{\max}}{2} = \frac{25.03 - 25}{2} = 0.015 \text{ mm}$$

$r = 25/2 = 12.5$ mm

l/d=0.5 → l=12.5 mm

$r/c = 12.5/0.015 = 833.3$

$N = 1100/60 = 18.33$ rev/s

$P = W/(ld) = 1200/\ [12.5(25)] = 3.84$ N/mm^2 = 3.84 MPa

$$S = \left(\frac{r}{c}\right)^2 \frac{\mu N}{P} = 833.3^2 \left[\frac{55\left(10^{-3}\right)18.33}{3.84\left(10^{6}\right)}\right] = 0.182$$

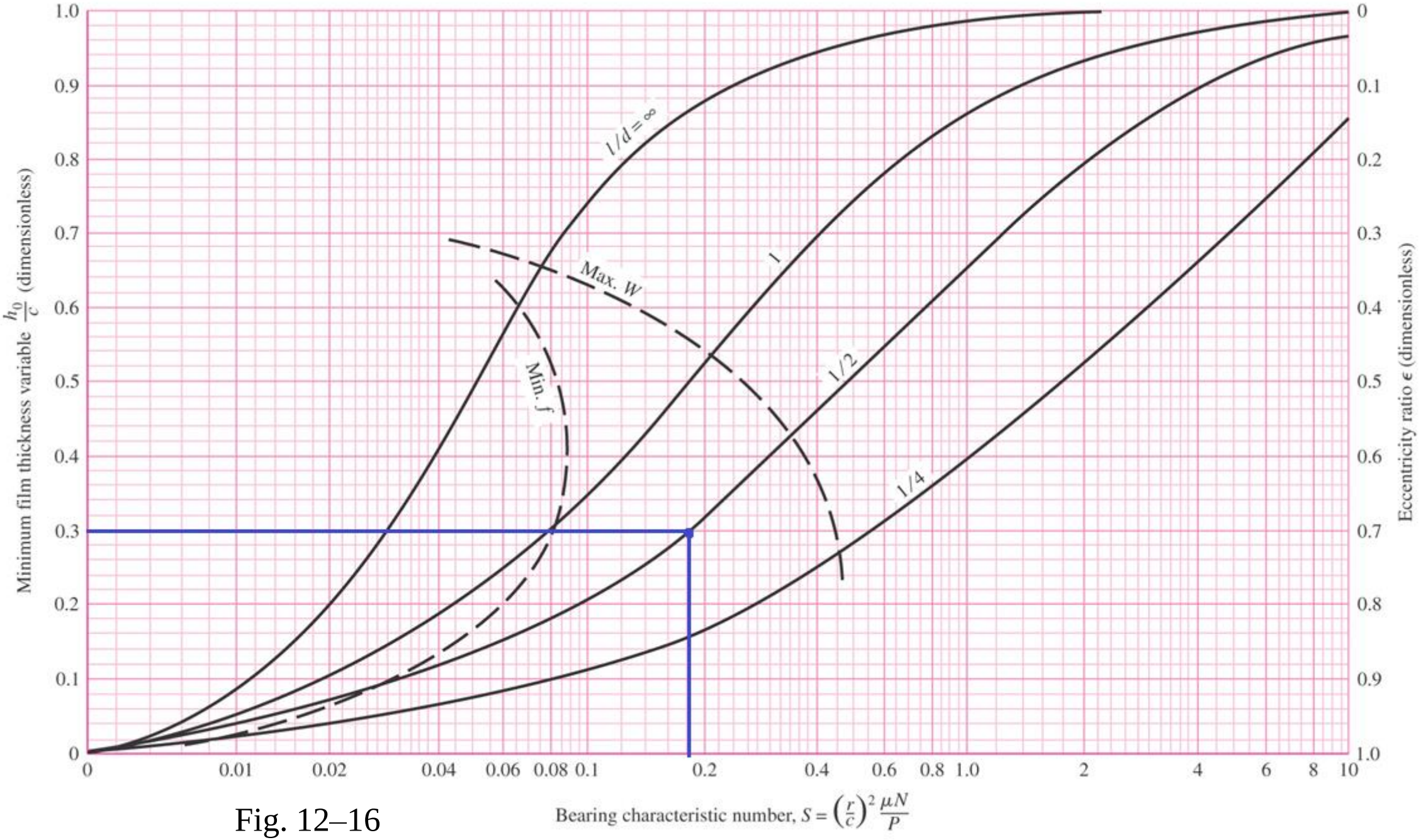

Minimum film thickness variable $\frac{h_0}{c}$ (dimensionless)
Eccentricity ratio ϵ (dimensionless)
Bearing characteristic number, $S = \left(\frac{r}{c}\right)^2 \frac{\mu N}{P}$
1/d = ∞
1
1/2
1/4
Max. W
Min. f
0
0.01
0.02
0.04
0.06
0.08
0.1
0.2
0.4
0.6
0.8
1.0
2
4
6
8
10
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Fig. 12–16

Fig. 12-16: $h_0 / c = 0.3$

$\Rightarrow h_0 = 0.3(0.015) = 0.0045$ mm

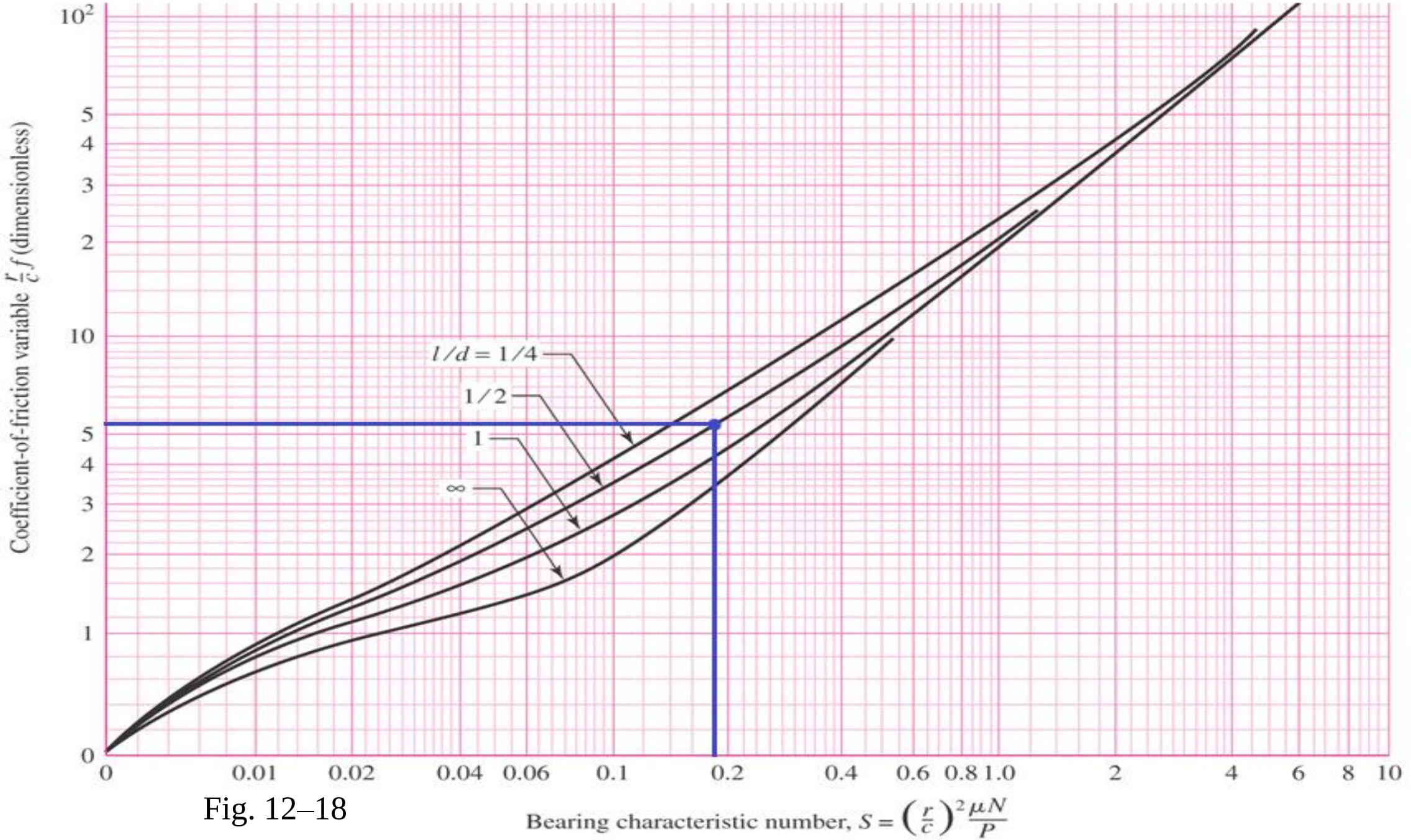

Coefficient-of-friction variable $\frac{r}{c}f$ (dimensionless)
10^2
5
4
3
2
10
5
4
3
2
1
0
$l/d = 1/4$
1/2
1
∞
0
0.01
0.02
0.04
0.06
0.1
0.2
0.4
0.6
0.8
1.0
2
4
6
8
10
Bearing characteristic number, $S = \left(\frac{r}{c}\right)^2 \frac{\mu N}{P}$

Fig. 12–18

Fig. 12-18: $f\,r/c = 5.4$

$\Rightarrow f = 5.4/833.3 = 0.006\ 48$

$T = f\,Wr = 0.006\ 48(1200)12.5(10^{-3}) = 0.0972$ N·m

$H_{\text{loss}} = 2\pi\,TN = 2\pi(0.0972)18.33 = 11.2$ W

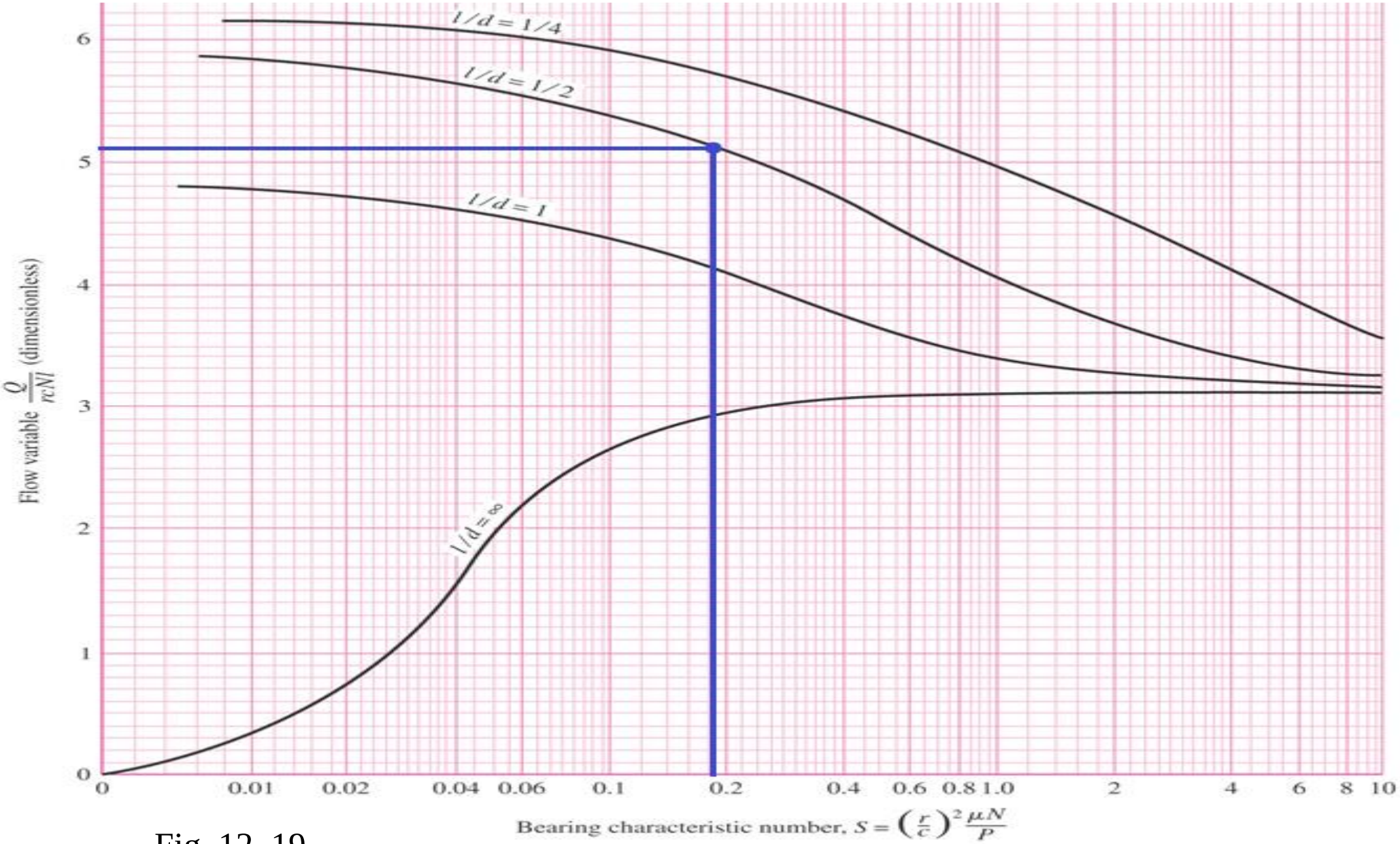

l/d = 1/4
l/d = 1/2
l/d = 1
l/d = ∞
Flow variable $\frac{Q}{rcNl}$ (dimensionless)
0
1
2
3
4
5
6
0
0.01
0.02
0.04
0.06
0.1
0.2
0.4
0.6
0.8
1.0
2
4
6
8
10
Bearing characteristic number, $S = \left(\frac{r}{c}\right)^2 \frac{\mu N}{P}$

Fig. 12–19

Fig. 12-19: $Q/(rcNl) = 5.1$

$\Rightarrow\ Q = 5.1(12.5)0.015(18.33)12.5 = 219\ \text{mm}^3/\text{s}$

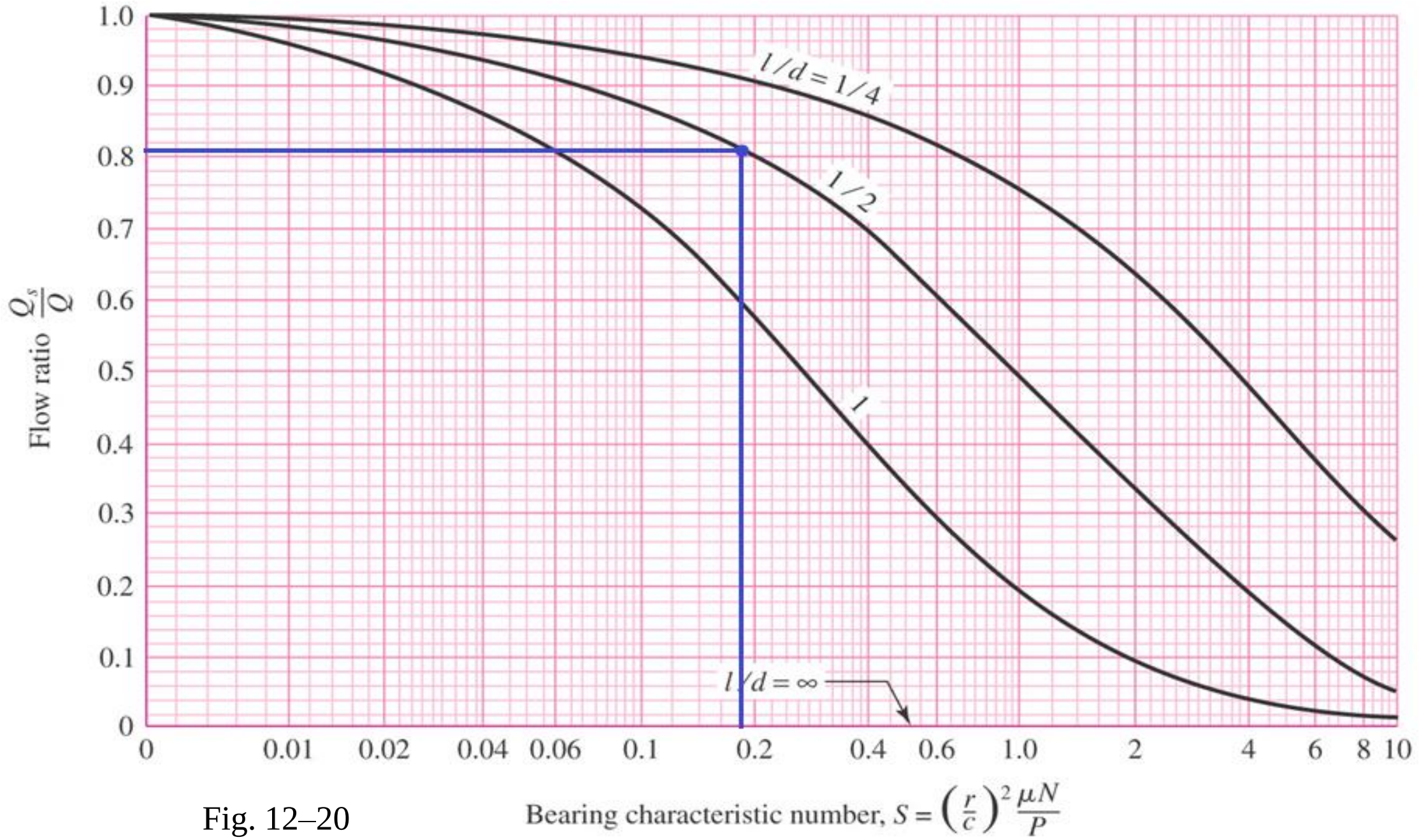

1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Flow ratio $\frac{Q_s}{Q}$
l/d = 1/4
l/2
1
l/d = ∞
0
0.01
0.02
0.04
0.06
0.1
0.2
0.4
0.6
1.0
2
4
6
8
10
Bearing characteristic number, $S = \left(\frac{r}{c}\right)^2 \frac{\mu N}{P}$

Fig. 12–20

Fig. 12-20: $Q_s/Q = 0.81$

$\Rightarrow \quad Q_s = 0.81(219) = 177 \text{ mm}^3/\text{s}$