

## Practical formulae, graphs and conversion tables

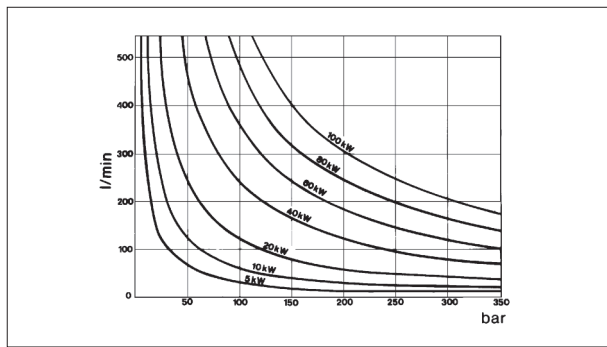
**1 UNIT OF MEASUREMENT CONVERSION TABLE**

QUANTITY	S.I. UNIT	SYMBOL	OTHER UNITS	SYMBOL	EQUIVALENCE
<b>MASS</b>	kilogram	[kg]	Pound	[lb]	1 [lb] = 0,4536 [kg]
			Ounce	[oz]	1 [oz] = 0,02335 [kg]
<b>LENGTH</b>	millimeter [ $10^{-3}$ m]	[mm]	Inch	[in] or ["]	1 [in] = 25,40 [mm]
			Foot	[foot]	1 [foot] = 304,8 [mm]
<b>AREA</b>	square centimeter [ $10^{-4}$ m <sup>2</sup> ]	[cm <sup>2</sup> ]	Square inch	[sq in]	1 [sq in] = 6,4516 [cm <sup>2</sup> ]
			Square foot	[sq ft]	1 [sq ft] = 929,034 [cm <sup>2</sup> ]
<b>CAPACITY</b>	cubic centimeter [ $10^{-6}$ m <sup>3</sup> ]	[cm <sup>3</sup> ]	Liter	[l]	1 [l] = 1000 [cm <sup>3</sup> ]
			Cubic inch	[cu in]	1 [cu in] = 16,3870 [cm <sup>3</sup> ]
			Cubic foot	[cu ft]	1 [cu ft] = 28317 [cm <sup>3</sup> ]
			UK gallon	[Imp gal]	1 [Imp gal] = 4546 [cm <sup>3</sup> ]
			US gallon	[US gal]	1 [US gal] = 3785 [cm <sup>3</sup> ]
<b>FLOW RATE</b>	liter per minute	[l/min]	Cubic foot per minute	[cu ft/min]	1 [cu ft/min] = 28,32 [l/min]
			Gallon (UK) per minute	[Imp gal/min]	1 [Imp gal/min] = 4,5456 [l/min]
			Gallon (US) per minute	[US gal/min]	[US gal/min] = 3,7848 [l/min]
<b>FORCE</b>	Newton [kgm/s <sup>2</sup> ]	[N]	Kilogram force	[kg <sub>f</sub> ]	1 [kg <sub>f</sub> ] = 9,806 [N]
			Pound force	[lb <sub>f</sub> ]	1 [lb <sub>f</sub> ] = 4,448 [N]
<b>PRESSURE</b>	bar [ $10^5$ N/m <sup>2</sup> ]	[bar]	Pascal [1 N/m <sup>2</sup> ]	[Pa]	1 [Pa] = $10^{-5}$ [bar]
			Atmosphere	[atm]	1 [atm] = 1,0132 [bar]
			Kilogram force/cm <sup>2</sup>	[kg <sub>f</sub> /cm <sup>2</sup> ]	1 [kg <sub>f</sub> /cm <sup>2</sup> ] = 0,9806 [bar]
			Pound force/in <sup>2</sup>	[lb <sub>f</sub> /in <sup>2</sup> ] or [psi]	1 [psi] = $6,8948 \cdot 10^{-2}$ [bar]
<b>ANGULAR SPEED</b>	revolution per minute	[rpm]	Radian per second	[rad/sec]	1 [rpm] = 9,55 [rad/sec]
<b>POWER</b>	kilowatt [1000 Nm/s]	[kW]	Kilogram per meter second	[kg <sub>f</sub> •m/s]	1 [kg <sub>f</sub> •m/s] = $9,803 \cdot 10^{-3}$ [kW]
			Metric horse power	[CV]	1 [CV] = 0,7355 [kW]
			Horse power	[HP]	1 [HP] = 0,7457 [kW]
<b>KINEMATIC VISCOSITY</b>	centistoke [ $10^{-6}$ m <sup>2</sup> /s]	[Cst]	Square meter per second	[m <sup>2</sup> /s]	1 [m <sup>2</sup> /s] = $10^6$ [cSt]
			Engler degree	[°E]	1 [°E] = 7,598 [cSt]
<b>TEMPERATURE</b>	Celsius degree	[°C]	Kelvin degree	[K]	1 [K] = 1 [°C] + 273,15
			Fahrenheit	[°F]	1 [°F] = 1,8 [°C] + 32
<b>MOMENTUM (TORQUE)</b>	Newton per meter	[Nm]	Kilogram f per meter	[Kg f m]	1 [Kg f m] = 0,102 Nm
			Pound force per inch	[lbf in]	1 [lbf in] = 0,113 Nm

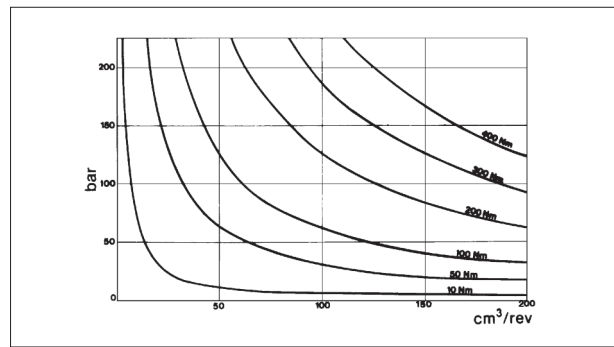
\* See diagrams of section 4

**2 PRACTICAL FORMULAE AND DIAGRAMS FOR PUMPS AND MOTORS**

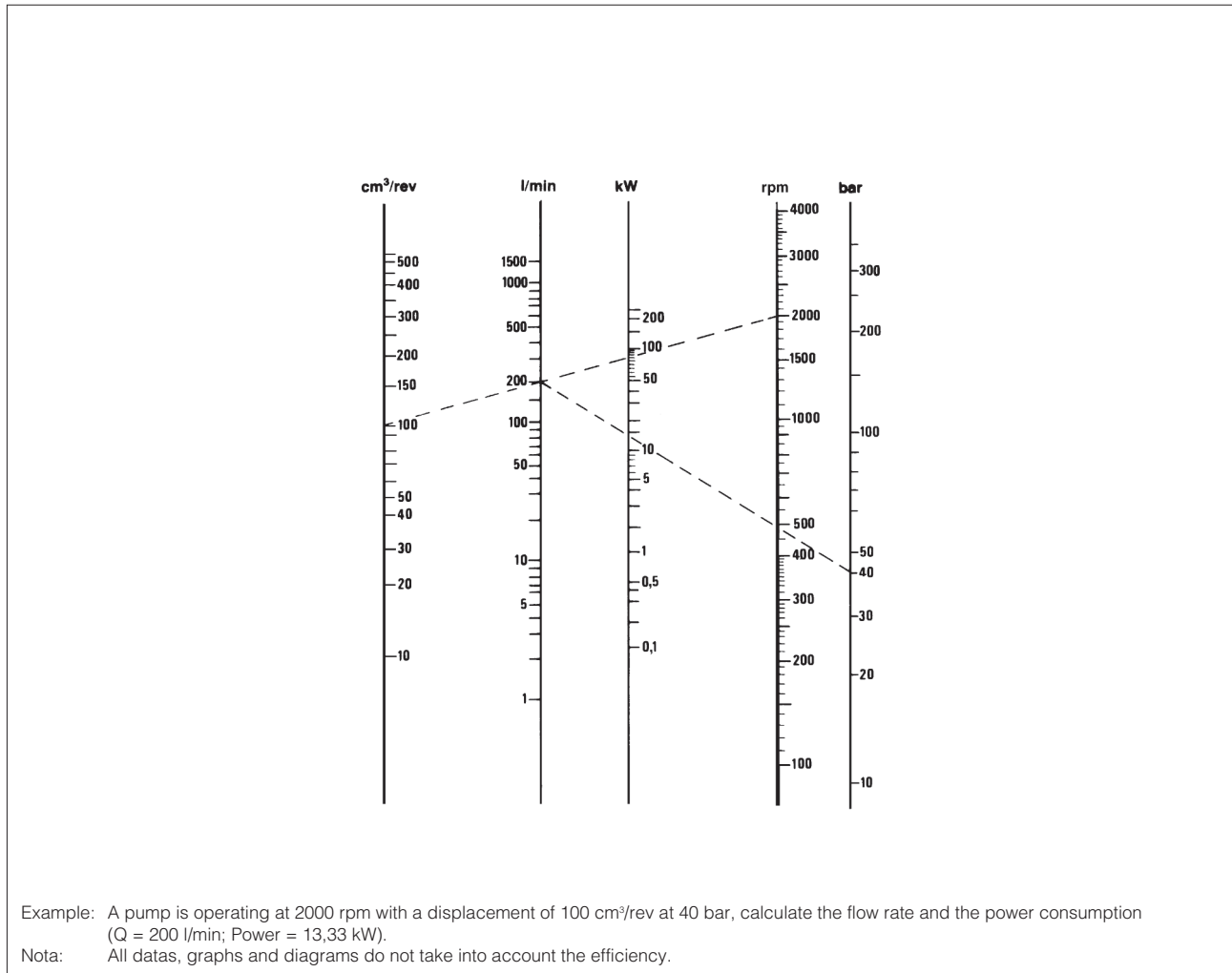
**2.1 Power**



**2.2 Torque**



**2.3 Graphs used in calculations with pumps**



**2.4 Main formulae**

**Pumps:**

– power consumption [kW]:  $\frac{Q P}{612 \eta}$

– required shaft torque [Nm]:  $\frac{v P}{20 \pi \eta} \cong \frac{v P}{62,8 \eta}$

**Motors:**

– power delivered [kW]:  $\frac{Q P}{612} \eta$

– shaft torque produced [Nm]:  $\frac{v P \eta}{20 \pi} \cong \frac{v P \eta}{62,8}$

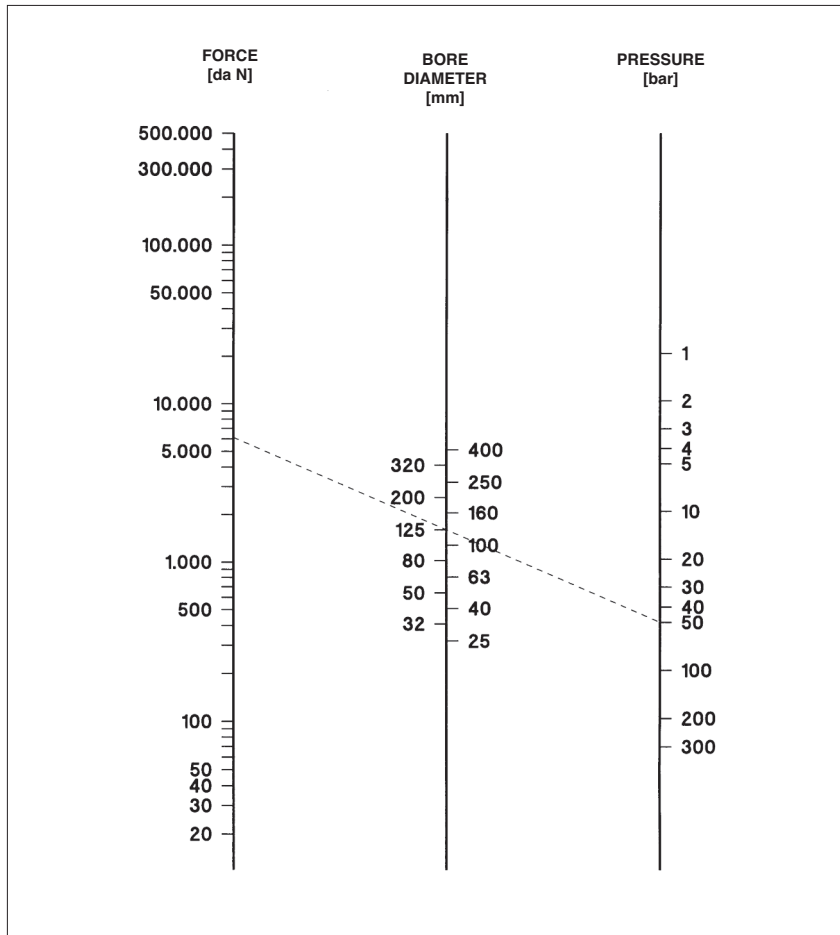
– power supplied [kW]:  $\frac{n [Nm]}{9545}$

**LEGENDA:**

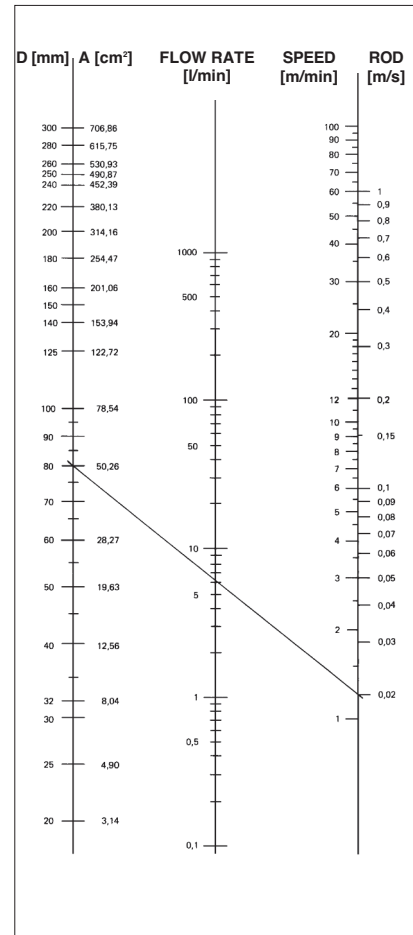
Quantity	Unit	Symbols	Quantity	Unit	Symbols
Displacement	$cm^3$	V	Flow rate	l/min	Q
Angular speed	rpm	n	Efficiency	-	$\eta$
Pressure	bar	P			

**3 CYLINDER'S NOMOGRAPHS**

**3.1 CYLINDER FORCE**

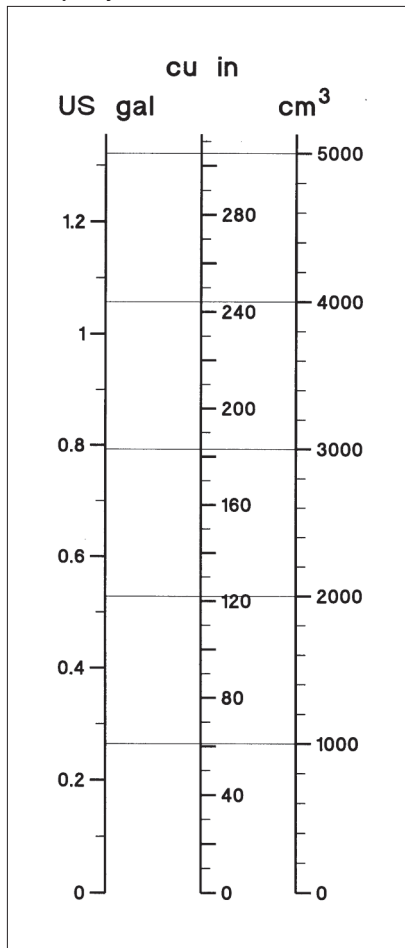


**3.2 CYLINDER SPEED**

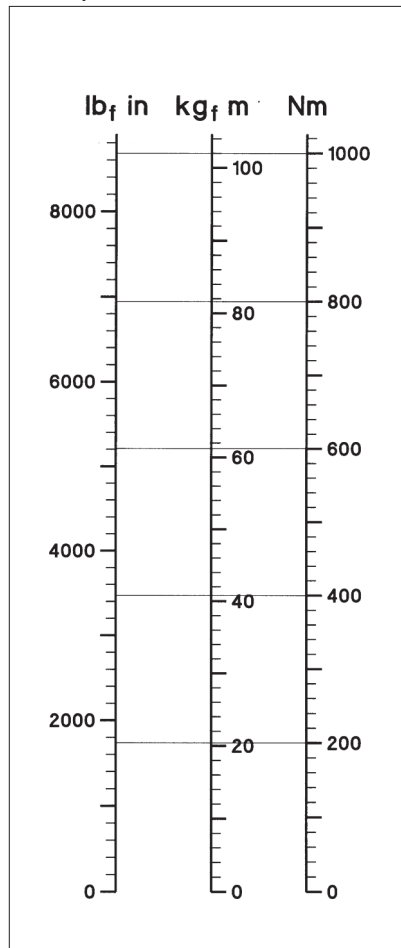


**4 CONVERSION DIAGRAMS**

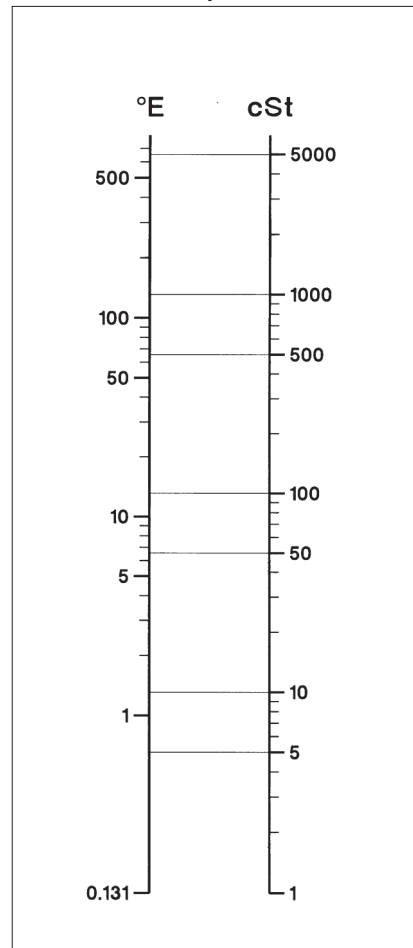
**4.1 Capacity**



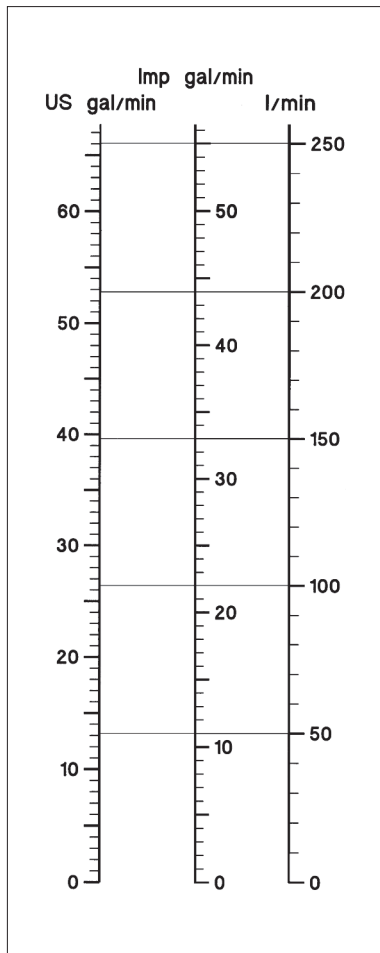
**4.2 Torque**



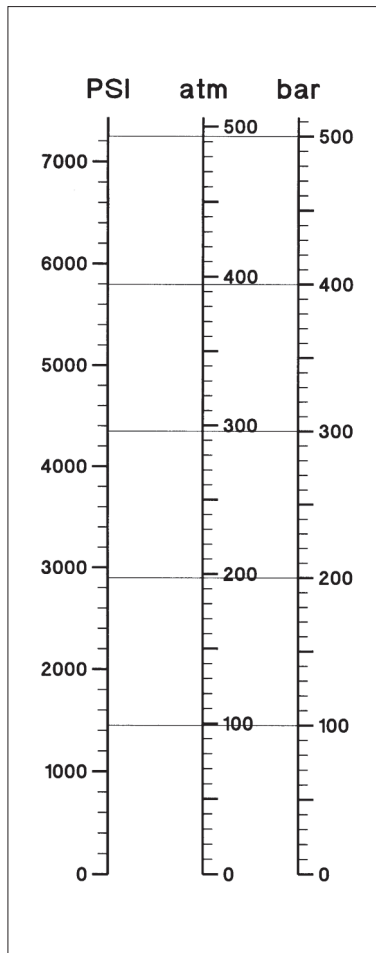
**4.3 Kinematic viscosity**



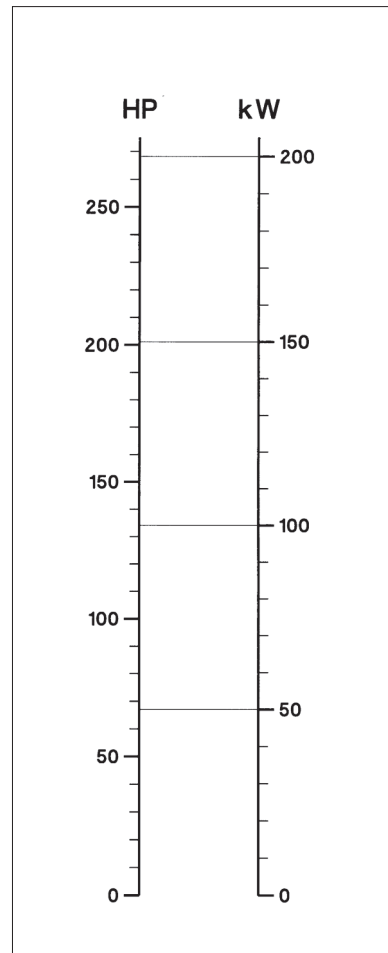
4.4 Flow rate



4.5 Pressure



4.6 Power



5 CHARACTERISTIC CURVES FOR CALIBRATED ORIFICES' SELECTION

