Vacuum Knowledge

Units and Conversion Tables

Units and Symbols

Dimensions and volume

Parameter	Symbol	Unit in Schmalz catalog
Length	l	mm, m
Width	b	mm, m
Height	h	mm, m
Diameter	d	mm, m
Volume	V	m^3, l

Weight

Parameter	Symbol	Unit in Schmalz catalog
Mass	m	g, kg
Density	ρ	kg/m^3

Force

Parameter	Symbol	Unit in Schmalz catalog
Force	F	N, kg x m/s^2
Theoretical holding force	F_{TH}	N
Acceleration	F_a	N
Tear-off force	F_A	N
Weight	G	N
Friction coefficient	μ	-

Time

Parameter	Symbol	Unit in Schmalz catalog
Duration, evacuation time	t	ms, s, min, h
Speed	v	m/s
Acceleration	a, g	m/s^2, *g*

Temperature

Parameter	Symbol	Unit in Schmalz catalog
Temperature	t	°C

Electrical and magnetic values

Parameter	Symbol	Unit in Schmalz catalog
Voltage	U	V
Strength of current	I	A

Vacuum values

Parameter	Symbol	Unit in Schmalz catalog
Pressure, absolute	p	mbar, bar
Pressure difference	Δp	mbar, bar
Initial pressure	P_a	mbar, bar
Final pressure	P_e	mbar, bar
Negative pressure / vacuum	P_u	mbar, bar
Suction rate	V	l/min, m^3/h
Required suction rate	V_s	l/min, m^3/h
Nominal flow of solenoid valve	V_v	l/min, m^3/h
Present suction rate of vacuum generator	V_{ve}	l/min, m^3/h
Total volume to be evacuated	V_g	m^3, l

Other information

Parameter	Symbol	Unit in Schmalz catalog
Safety factor	S	-
Quantity of suction pads	n	-
Natural logarithm	ln	-
Noise level / sound pressure level	L_p	dB

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Conversion tables

Length

	m	ft	in
1 m	1.000	3.281	39.370
1 ft (foot)	0.305	1.000	12.000
1 in (inch)	0.025	0.083	1.000

Mass

	kg	lb	oz
1 kg	1	2.20	35.27
1 lb (pound)	0.45	1	16
1 oz (ounce)	0.03	0.06	1

Temperature

	K	°C	°F
1 Kelvin	1	-272.15	-457.87
1 °Celsius	274.15	1	33.8
1 °Fahrenheit	255.93	-17.22	1

Suction rate

	m^3/s	l/s	m^3/h	l/min
m^3/s	1	1,000	3,600	60,000
l/s	10^{-3}	1	3.6	60
m^3/h	2.78×10^{-4}	0.278	1	16.67
l/min	1.67×10^{-5}	1.67×10^{-2}	0.06	1

Pressure

	bar	N/cm^2	kPa	mbar
1 bar	1	10	100	10^3
1 N/cm^2	0.1	1	10	100
1 kPa	0.01	0.1	1	10
1 mbar	10^{-3}	0.01	0.1	1

Volume

	m^3	cm^3	l
m^3	1	1×10^6	1,000
cm^3	1×10^{-6}	1	1×10^{-3}
l	1×10^{-3}	1,000	1

Vacuum ranges

	Absolute pressure in mbar	Mean free path of atoms*
Low vacuum	1,000 – 1	68 nm – 0,1 mm
Medium vacuum	$1 – 10^{-3}$	0.1 mm – 100 mm
High vacuum	$10^{-3} – 10^{-7}$	100 mm – 1 km
Ultra high vacuum	$< 10^{-7}$	> 1 km

*The number density of molecules for a temperature of 20 °C

Thread

Thread designation	External diameter in mm	Bead wire diameter	Pitch in mm
Metric ISO thread			
M3	3.00	2.5	0.50
M4	4.00	3.2	0.70
M5	5.00	4.1	0.80
M6	6.00	4.9	1.00
M8	8.00	6.6	1.25
M10	10.00	8.4	1.50
M12	12.00	10.1	1.75
Metric ISO fine thread		12.5	1.50
M14x1.5	14.00	14.9	1.00
M16x1	16.00	18.4	1.50
M20x1.5	20.00	28.4	1.50
M30x1.5	30.00		
Pipe thread			
G⅛	9.73	8.5	0.91
G¼	13.16	11.4	1.34
G⅜	16.66	14.9	1.34
G½	21,00	18.6	1.81
G¾	26.44	24.1	1.81
G1	33.25	30.3	2.31
G1¼	41.91	39.0	2.31
G1½	47.80	44.8	2.31
G2	59.61	56.6	2.31
G2½	75.18	72.2	2.31