8. Tables of Useful Data

8.1 The International System of Units (SI)

The international metric system (SI) has been adopted by the International Organisation for Standardization (ISO) and recommended by all national standards organisations. Much has been written about SI units in recent years and it is not the present intention to add to that literature. For an account of the background and specified uses of SI units readers are referred to the informative British Standard publications BS 3763 (1976) (The international system of units – SI) and PD 5686 (1978) (The use of SI units).

Quantity	Name of unit	Unit symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

Table 13: The Basic SI units

Note Temperature difference is commonly expressed in degree Celsius instead of Kelvins, but the unit for Celsius and Kelvin scales is the same: 1 degree C = 1 K .

Physical quantity	SI unit	Unit Symbol
Force	newton	$N = kg\ m/s^2$
Work, energy, quantity of heat	joule	J = N/m
Power	watt	W = J/s
Electrical charge	coulomb	C = A s
Electrical potential	volt	V = W/A
Electrical capacitance	farad	F = A s/V
Electric resistance	ohm	Ω = V/A
Frequency	hertz	$Hz = s^{-1}$
Magnetic flux	weber	Wb = V s
Magnetic flux density	tesla	$T = Wb/m^2$
Inductance	henry	H = V s/A

Physical quantity	SI unit	Unit Symbol
Luminous flux	lumen	lm = cd sr*
Illumination	lux	$lx = lm/m^2$

Table 14: some derived SI units having special names.

8.2 How to use SI Units

The SI is a rationalised selection of units in the metric system which individually are not new. There are seven basic units (Table 13) and several derived units having special names (Table 14). these derived units are merely for convenience and they can all be expressed, if desired, in terms of the basic units. A few derived units without special names are given in Table 15. Some SI units are of inconvenient size but the use of multiplying prefixes overcomes this difficulty. A list of the internationally agreed prefixes is given in Table 16.
Great care should be taken in the use of these prefixes. For example, the prefix should always be written immediately adjacent to the unit to be qualified, e.g. mega newton (MN) kilojoule (kJ), microsecond (μs), and so on. The primary units on the other hand, should be spaced apart, e.g. $N\ s/m^2$ or $kg/s\ m^2$. Only one prefix can be applied to a given unit at any one time; thus, one thousand kilograms (the 'tonne') is 1 megagram (Mg) and not 1 kilo-kilogram.
The symbol m stands for the basic unit 'metre' and the prefix 'milli', so to avoid confusion it has to be used very carefully in certain circumstances. For example, mN stands for milli newton while m N denotes the metre-newton. However, convention of spacing the basic unit is probably not sufficient safeguard in this case, so for the sake of clarity it is better to write the metre as the second unit, i.e. Newton-metre (N m).
Another important point to be noted is that when a multiple of a basic unit is raised to a power, the power applies to the whole multiple and not the basic unit alone.
Thus 1 km^2 means 1 $(km)^2 = 10^6\ m^2$ and not 1 $k(m)^2 = 10^3\ m^2$.
Not all the prefixes in Table 16 will come into common usage. Indeed there is much to be said for the suggestion to confine the choice of prefixes to those powers of 10 which are multiples of ±3, e.g. μ, m, k, etc. There is also some support for the use of 'strict SI' units, i.e. m, kg, s, in scientific publications and to write the power of ten in full, e.g. $3 \times 10^{-6}\ m\ s^{-1}$ rather than $3\ \mu m\ s^{-1}$.

Pressure	$N/\ m^2$
Dynamic viscosity	$N\ s/m^2$
kinematic viscosity, diffusivity	m^2/s
Surface energy or surface tension	J/m^2 or N/m
*Enthalpy	J/kg
*Enthropy, heat capacity	J/kg K

Thermal conductivity	W/m K
Heat transfer coefficient	W/m^2 K
Mass transfer coefficient	m/s
Electric conductivity	A/V m
Magnetic permeability	H/m
Electric field strength	V/m
Magnetic field strength	A/m
Permitivity	F/m
Luminance	cd/m^2
Electric flux density	C/m^2

* may also be expressed in terms of the mol or kmol

Table 15: some other derived units

8.3 The Advantages of SI Units

Although the SI is simply a development of the metre-kilogram-second (MKS) system, it is superior to MKS because it is a coherent system of units. By this is meant that the product of quotient of unit quantities in SI yield a unit resultant quantity (e.g. 1 N x 1 m = 1 J or 1 kg x 1 m ÷ 1 s^2 = 1 N). No numerical factors are involved, such as 4π which crops up in electrical technology if irrational definitions of basic units are used, or g which tends to appear unexpectedly in relationships which employ the gravitational unit of force. SI units do not eliminate g, but they do relegate it to its proper place, i.e. to situations where the force of gravity is actually involved. For example, the SI unit of force is the Newton, defined as the force required to impart an acceleration of 1 m/s^2 to a mass of 1 kg. Thus the weight of a mass m kilograms is a force of mg newtons, where g(m/s^2) is the local value of the acceleration due to gravity. As a matter of fact a Newton is just about the weight of an apple.

10^{-18}	atto	a	10^{1}	deca	da
10^{-15}	femto	f	10^{2}	hecto	h
10^{-12}	pico	p	10^{3}	kilo	k
10^{-9}	nano	n	10^{6}	mega	M
10^{-6}	micro	μ	10^{9}	giga	G
10^{-3}	milli	m	10^{12}	tera	T
10^{-2}	centi	c	10^{15}	peta	P
10^{-1}	deci	d	10^{18}	exa	E

Table 16: Prefixes for Unit Multiples and Sub-multiples

9. Terminology of Test Sieving

Test sieving, using woven wire or perforated plate sieves, has its own special terminology which has been agreed internationally (ISO 2395 'Test sieves and test sieving-vocabulary').

9.1 Material to be sieved

Agglomerate	Several particles adhering together.
Apparent size	The mass of the charge divided by volume at the moment when it is placed on the sieving medium.
Charge	A test sample, or part of a test sample, placed on a test sieve or a nest of sieves.
Particle	A discrete element of the material regardless of its size.

9.2 Test Sieves

Aperture size	Dimension defining an opening.
Bridge width (bar)	Distance between the nearest edges of two adjacent holes in a perforated plate
Certified test sieve	A test sieve that has been examined and certified, by an authority accredited for the purpose, as complying with an agreed specification.
Frame	A rigid framework which supports the sieving medium and limits the spread of the material being sieved.
Full set of test sieves	All the test sieves of a given sieving medium contained in a standard specification.
Irregular set of test sieves	A number of sieves taken in irregular order from a full set of test sieves, for a particle size analysis.
Lid (cover)	A cover which fits snugly over a sieve to prevent escape of the material being sieved.
Margin	Distance between the outside edges of the outside rows of holes and the edges of a perforated plate.
Matched test sieve	A test sieve that reproduces the results of another test sieve within defined limits for a given material.
Nest of test sieves	A set (regular or irregular) of test sieves assembled together with a lid (cover) and receiver (pan).
Percentage	Ratio of the area of the apertures to sieving area the total area of sieving medium, as a percentage.

Perforated plate	A sieving medium consisting of a plate with uniform holes in symmetrical arrangement.
Pitch (centres)	Distance between corresponding points of two adjacent holes in a perforated plate.
Plain weave	Weave in which every warp wire crosses alternately above and below every weft wire and vice versa. (see Figure 8)
Plate thickness	Thickness of the plate after perforation.
Punch side	The surface of a perforated plate which the punch entered during the perforating operation.
Receiver (pan)	A pan which fits snugly beneath a sieve to receive the whole of the passing fraction.
Regular set of test sieves	A number of sieves taken in regular order from a full set of test sieves, for a particle size analysis.
Sieve	An apparatus for the purpose of sieving, consisting of a sieving medium mounted in a frame.
Sieving medium	A surface containing regularly arranged apertures of uniform shape and size.
Test sieve	A sieve, intended for the particle size analysis of the material to be sieved, which conforms to a test sieve standard specification.
Twilled weave	Weave in which every warp wire crosses alternately above and below every second weft wire and vice versa. (see Figure 9)
Type of weave	The way in which warp and weft wires cross each other.
Warp	All wires running lengthwise of the cloth as woven.
Weft (shoot)	All wires running crosswise of the cloth.
Wire diameter	Diameter of the wire in the woven cloth.
Woven wire	A sieving medium of wires which cross cloth each other to form the apertures

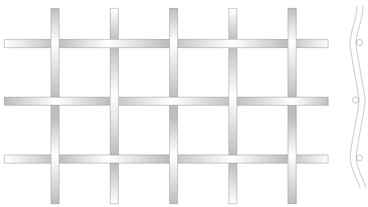

Figure 8: Plain weave

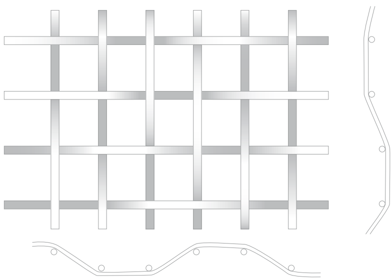

Figure 9: Twilled weave

9.3 Test Sieving

Blinding	Obstruction of the apertures of a sieving medium by particles of material being sieved.
Dry sieving	Sieving in the absence of a liquid.
End Point	The point in time after which further sieving fails to pass an amount sufficient to change the result significantly. The end point should be specified in particular standards for each product in terms of the sieving rate, clarity of liquid in wet sieving, or other measurable criterion.
Near-size particle	Particle of size approximately equal to the sieve aperture.
Oversize (residue)	That portion of the charge which has not passed through the apertures of a stated sieve.
Sieving	The process of separating a mixture of particles according to their size by means of one or more sieves.
Sieving rate	Quantity of material, expressed either in units of mass or as a percentage of the charge, passing through a sieve in a given interval of time.
Test sieving	Sieving with one or more test sieves.
Undersize (fines)	That portion of the charge which has passed through the apertures of a stated sieve.
Wet sieving	Sieving in the presence of a liquid.

9.4 Expression of Results

Cumulative oversize distribution curve	A curve obtained by plotting the total percentages by mass retained on each of a set of sieves of descending aperture size against the corresponding aperture sizes.
Particle size (sieve size of a particle)	The smallest sieve aperture through which a particle will pass if presented in the most favourable attitude.
Size analysis by sieving	The division of a sample by sieving into size fractions, and the reporting results.
Size distribution curve	A graphical representation of the results of a size analysis.

9.5 Worldwide Applications

Industry	Applications
Construction	Quality control analysis and grading of soils, aggregate, minerals, cement, etc.
General Laboratories	Miscellaneous application of particle analysis and determination of particle size, powder process industries, etc.
Chemical and Pharmaceutical	Oil exploration (analysis of minute fossils) , fuels , explosives, drugs, medical & pharmaceutical applications.
Mining	Quarries (gravel and sand), coal mines (air pollution control), grading and particle size determination, diamond mines, grading of diamonds and industrial diamonds.
Agriculture / Food	Confectionery and food manufacture, miscellaneous applications including kernals, etc.
Education	Schools, universities (training of techniques in particle size analysis and determination of particle size), geological, etc.
Research	Research establishments engaged in original and general research.
Engineering	Steel manufacturing organisations , foundries, iron works, etc. (Determination of particle size of sand moulds, grading of coke, etc.)
Abrasive Grain Industries	Producers of precision materials for abrasive applications, i.e. grinding wheels and sandpaper.

International Comparison Table for Test Sieves							Table 1 – **125-1 mm**			
ISO 565 ISO 3310 Table 1, Sizes in Millimetre			DE	FR	GB	NL	USA		CAN	Tyler®
ISO			DIN	NF	BSI	N	ASTM		CGSB	
Principal sizes	Supplementary sizes		DIN ISO 3310	NF ISO 3310	BS 410 / BS ISO 3310	NEN 2560	ASTM E 11 # ASTM E 323 ■ ●		CAN/ CGSB-8.2 M88 metric	TYLER Screen Scale
R20/3	R 20	R 40/3								
w	w	w	w	w	w	w	w	Inch / No.	w	Mesh
125	125	125	125	125	125	125	125	5 in.	125	
	112		112	112	112	112			112	
		106	106	106	106	106	106	4 1/4 in.		
	100		100	100	100	100	100*	4 in.*	100	
90	90	90	90	90	90	90	90	3 1/2 in.	90	
	80		80	80	80	80			80	
		75	75	75	75	75	75	3 in.		
	71		71	71	71	71			71	
63	63	63	63	63	63	63	63	2 1/2 in.	63	
	56		56	56	56	56			56	
		53	53	53	53	53	53	2 1/8 in.		
	50		50	50	50	50	50*	2 in.*	50	
45	45	45	45	45	45	45	45	1 3/4 in.	45	
	40		40	40	40	40			40	
		37,5	37,5	37,5	37,5	37,5	37,5	1 1/2 in.		
	35,5		35,5	35,5	35,5	35,5			35,5	
31,5	31,5	31,5	31,5	31,5	31,5	31,5	31,5	1 1/4 in.	31,5	
	28		28	28	28	28			28	
		26,5	26,5	26,5	26,5	26,5	26,5	1 1/16 in.		1,05 in.
	25		25	25	25	25	25,0*	1 in.*	25	
22,4	22,4	22,4	22,4	22,4	22,4	22,4	22,4	7/8 in.	22,4	0,883 in.
	20		20	20	20	20			20	
		19	19	19	19	19	19	3/4 in.		0,742 in.
	18		18	18	18	18			18	
16	16	16	16	16	16	16	16	5/8 in.	16	0,624 in.
	14		14	14	14	14			14	
		13,2	13,2	13,2	13,2	13,2	13,2	17/32 in.		0,525 in.
	12,5		12,5	12,5	12,5	12,5	12,5*	1/2 in.*	12,5	
11,2	11,2	11,2	11,2	11,2	11,2	11,2	11,2	7/16 in.	11,2	0,441 in.
	10		10	10	10	10			10	
		9,5	9,5	9,5	9,5	9,5	9,5	3/8 in.		0,371 in.
	9		9	9	9	9			9	
8	8	8	8	8	8	8	8	5/16 in.	8	2 1/2
	7,1		7,1	7,1	7,1	7,1			7,1	
		6,7	6,7	6,7	6,7	6,7	6,7	17/64 in.		3
	6,3		6,3	6,3	6,3	6,3	6,3*	1/4 in.*	6,3	
5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	7/32	5,6	3 1/2
	5		5	5	5	5			5	
		4,75	4,75	4,75	4,75	4,75	4,75	3/16		4
	4,5		4,5	4,5	4,5	4,5			4,5	
4	4	4	4	4	4	4	4	5/32	4	5
	3,55		3,55	3,55	3,55	3,55			3,55	
		3,35	3,35	3,35	3,35	3,35	3,35	1/8		6
	3,15		3,15	3,15	3,15	3,15			3,15	
2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	7/64	2,8	7
	2,5		2,5	2,5	2,5	2,5			2,5	
		2,36	2,36	2,36	2,36	2,36	2,36	3/62		8
	2,24		2,24	2,24	2,24	2,24			2,24	
2	2	2	2	2	2	2	2	0,078	2	9
	1,8		1,8	1,8	1,8	1,8			1,8	
		1,7	1,7	1,7	1,7	1,7	1,7	0,066		10
	1,6		1,6	1,6	1,6	1,6			1,6	
1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	0,055	1,4	12
	1,25		1,25	1,25	1,25	1,25			1,25	
		1,18	1,18	1,18	1,18	1,18	1,18	0,045		14
	1,12		1,12	1,12	1,12	1,12			1,12	
1	1	1	1	1	1	1	1	0,039	1	16
ISO 3310-1	wire-cloth #		125-1	125-1	125-1	125-1	125-1		125-1	26,5-1
ISO 3310-2	round holes ●		125-1	125-1	125-1	125-1	125-1			
	square holes ■		125-4	125-4	125-4	125-4	125-3.35			

* ASTM Supplementary values

International Comparison Table for Test Sieves							Table 2 – **900-5 µm**			
ISO 565 ISO 3310 Table 2, Sizes in Micrometer			DE	FR	GB	NL	USA		CAN	Tyler®
			DIN	NF	BSI	N			CGSB	
Principal sizes	Supplementary sizes		DIN ISO 3310	NF ISO 3310	BS 410 / BS ISO 3310	NEN 2560	ASTM E 11 # ASTM E 323 ■ ●		CAN/ CGSB-8.2-M88 metric	TYLER Screen Scale
R20/3	R 20	R 40/3								
w	w	w	w	w	w	w	w	Inch / No.	w	Mesh
	900		900	900	900	900			900	
		850	850	850	850	850	850	20		20
	800		800	800	800	800			800	
710	710	710	710	710	710	710	710	25	710	24
	630		630	630	630	630			630	
		600	600	600	600	600	600	30		28
	560		560	560	560	560			560	
500	500	500	500	500	500	500	500	35	500	32
	450		450	450	450	450			450	
		425	425	425	425	425	425	40		35
	400		400	400	400	400			400	
355	355	355	355	355	355	355	355	45	355	42
	315		315	315	315	315			315	
		300	300	300	300	300	300	50		48
	280		280	280	280	280			280	
250	250	250	250	250	250	250	250	60	250	60
	224		224	224	224	224			224	
		212	212	212	212	212	212	70		65
	200		200	200	200	200			200	
180	180	180	180	180	180	180	180	80	180	80
	160		160	160	160	160			160	
		150	150	150	150	150	150	100		100
	140		140	140	140	140			140	
125	125	125	125	125	125	125	125	120	125	115
	112		112	112	112	112			112	
		106	106	106	106	106	106	140		150
	100		100	100	100	100			100	
90	90	90	90	90	90	90	90	170	90	170
	80		80	80	80	80			80	
		75	75	75	75	75	75	200		200
	71		71	71	71	71			71	
63	63	63	63	63	63	63	63	230	63	250
	56		56	56	56	56			56	
		53	53	53	53	53	53	270		270
	50		50	50	50	50			50	
45	45	45	45	45	45	45	45	325	45	325
	40		40	40	40	40			40	
		38	38	38	38	38	38	400		400
R`10	36		36	36	36	36			36	
32			32	32	32	32	32	450	32	450
25			25	25	25	25	25	500		500
20			20	20	20	20	20	635		635
16 (e)			16 (e)	16 (e)		16 (e)	15 (e)			
10 (e)			10 (e)	10 (e)		10 (e)	10 (e)			
5 (e)			5 (e)	5 (e)		5 (e)	5 (e)			
ISO 3310-1	wire-cloth #		900-20	900-20	900-20	900-20	850-20	850-20	900-32	850-20
ISO 3310-3	Electroformed (e)		500-5	500-5		500-5	500-5			