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Encyclopaedia of Scientific Units, Weights and Measures

Their SI Equivalences and Origins

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Springer

3 Other Systems of Units

Despite the internationalization of SI units, and the fact that other units are actually forbidden by law in France and other countries, there are still some older or parallel systems remaining in use in several areas of science and technology.

Before presenting conversion tables for them, it is important to put these systems into their initial context. A brief review of systems is given ranging from the ancient and obsolete (e.g. Egyptian, Greek, Roman, Old French) to the relatively modern and still in use (e.g. UK imperial, US customary, cgs, FPS), since a general knowledge of these systems can be useful in conversion calculations. Most of the ancient systems are now totally obsolete, and are included for general or historical interest.

3.1 MTS, MKpS, MKSA

3.1.1 The MKpS System

The former system of units referred to by the international abbreviations MKpS, MKfS, or MKS (derived from the French titles mètre-kilogramme-poids-seconde or mètre-kilogramme-force-seconde) was in fact entitled *Système des Mécaniciens* (Mechanical Engineers' System). It was based on three fundamental units, the **metre**, the **second**, and a weight unit, the **kilogram-force**. This had the basic fault of being dependent on the acceleration due to gravity *g*, which varies on different parts of the Earth, so that the unit could not be given a general definition. Furthermore, because of the lack of a unit of mass, it was difficult, if not impossible to draw a distinction between weight, or force, and mass (see also 3.4). In addition, the mechanical units were not self-consistent, as for example the unit of power, the horsepower, which is equal to 75 $kg.m.s^{-1}$. Finally, there were no links with magnetic, electrical, or thermodynamic units.

3.1.2 The MTS System

The French MTS system was based on the **metre**, the metric **tonne**, and the **second**, and was in fact the only legal system used in France between 1919 and 1961, when SI units were formally adopted. Several derived units with special names were based on these three fundamental units, for example the **sthene** (sn) for force or weight, and the **pieze** (pz) for pressure. Like the MKpS system, it had no links with electrical, magnetic, or thermodynamic units.

3.1.3 The MKSA (Giorgi) System

In 1904, the Italian physicist Giovanni L.T. Giorgi proposed a system based on five fundamental units. It was adopted by the IEC during the period 1935–1950. The units of length was to be the **standard metre** maintained at Sèvres, the unit of mass the **standard kilogram**, the unit of time the **second**, plus two new base units, the **ampere** for electric current intensity, and **vacuum magnetic permeability** which was defined as $\mu_0 = 4\pi \times 10^{-7}$ H.m^{-1}. This linkage meant that all units in the system could be used in electromagnetic or electrostatic contexts. The introduction of the factor 4π in the expression for vacuum magnetic permeability meant that all units could be rationalized, i.e. a factor of 2π applied when a system had cylindrical symmetry, and of 4π if it had spherical symmetry.

The advantage – or, for some physicists, the disadvantage – of this system lay in the fact that it made a clear distinction between magnetic field strength H and magnetic flux density B, and similarly between electric field strength E and electric flux density D. This distinction results from the expression for vacuum permittivity and magnetic permeability which is not equal to unity as in the cgs system. The vector equations relating these four quantities are therefore:

$$\mathbf{B} = \mu\mathbf{H} = \mu_0\mu_r\mathbf{H}$$
$$\mathbf{D} = \varepsilon\mathbf{E} = \varepsilon_0\varepsilon_r\mathbf{E}$$

The Giorgi system only became common in electrical engineering from 1948. At that time, the 9th CGPM adopted the modern definition of the ampere. The MKSA system is thus the precursor of the SI, and, perhaps for this reason, there remains some confusion between the two systems among some scientists and engineers.

3.2 Cgs, Gauss, IEUS, a.u.

3.2.1 The cgs System

The cgs (centimetre-gram-second) system has as its three base units the **centimetre**, the **gram**, and the **second**. It was proposed in 1873 by the distinguished British scientists Lord Kelvin and James Clerk Maxwell, and the famous German electrical engineer Ernst Werner von Siemens. As a system, it was outstanding for its consistency and for its clear distinction between force and mass. There are also advantages in the use of equations in four basic dimensions, one of which is electrical, and two fundamental sub-systems came into existence. As a result, the General Assembly of the IUPAP in Copenhagen, 1951, approved via its Resolution 5 the introduction of the following generalized cgs subsystems:

- the *electrostatic cgs system* (centimetre, gram, second, and franklin)
- the *electromagnetic cgs system* (centimetre, gram second, and biot)

The system met with wide acceptance among scientists in many countries and was rapidly extended to every branch of physics. However, many of its units are too small for most scientific and engineering purposes.

Although the use of cgs units is officially discouraged since the introduction of the SI in 1960, practitioners in some fields of physics, such as electricity, magnetism, and optics, have continued to use unofficial derived units (e.g. dyne, erg, poise, stokes, gauss, oersted, maxwell, stilb, phot). The main reason for this is that these units are often of the same order of magnitude as the physical phenomena they define.

The major disadvantage of the cgs system is its inherent subdivision into three subsystems: electromagnetic units (emu or ab units), electrostatic units, (esu or stat units), and the system of practical units for common use. The complications introduced by interconversion of these sub-units were yet another reason for its eventual abandonment in favour of the MKSA system and ultimately the SI.

3.2.1.1 The esu Subsystem

In this cgs subsystem, the electrostatic force **F** between two point charges q_1 and q_2 separated by a distance r in a medium of permittivity ε is given by Coulomb's law, i.e. $\mathbf{F} = \frac{q_1 q_2}{\varepsilon r^2}\mathbf{e}_r$ if F, r, ε, are made equal to unity and $q_1 = q_2 = q$, q_1, and q_2 are unit electric charge. The cgs system of electrostatic units is based on this definition of electric charge. This is the **franklin** (Fr), the cgs unit of electric charge, which is formally defined as follows:

The **franklin** is that charge which exerts on an equal charge at a distance of one centimetre in vacuo a force of one dyne (1941).

All these units are prefixed with the separate acronym **esu** or an international or attached indicator **stat**.

Example: **stat**coulomb or **esu** coulomb (=1 Fr)

3.2.1.2 The emu Subsystem

As with the electrostatic units, the electromagnetic subsystem defines the electromagnetic force **F** between two hypothetical isolated point magnetic poles of strengths m_1 and m_2 separated by a distance r in a medium of magnetic permeability μ by Coulomb's Law for Magnetism, i.e. $\mathbf{F} = \frac{m_1 m_2}{\mu r^2}\mathbf{e}_r$, setting **F**, r, and m equal to unity, and $m_1 = m_2 = m$, m_1 equal to unity, and $m_1 = m_2 = m$, m_1 and m_2 are unit pole strengths. The cgs system of electromagnetic units is based on this definition of pole strength, analogous with the electrostatic system, and has the **biot** (Bi) as the cgs unit of magnetic pole strength, defined as follows:

The **biot** is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed one centimetre apart in vacuo, would produce between these conductors a force equal to two dynes per centimetre of length (1961).

All these units are prefixed with the separate acronym **emu**, or attached indicator **ab**.

Example: **ab**ampere or **emu** ampere (=1 Bi)

Important Notes:

(i) The emu and esu are interconnected by the fundamental equation $\varepsilon\mu c^2 = 1$ where c is the velocity of light in vacuum. Thus the ratio of any pair of emu-esu primary units is equal to c or its reciprocal.

$$\textit{Example:}\quad \frac{\text{abampere}}{\text{statampere}} = \frac{\text{statvolt}}{\text{abvolt}} = c$$

For esu or emu derived units, the ab/stat ratio is obtained by considering each of the primary units involved, thus:

$$\textit{Example:}\quad \frac{\text{abfarad}}{\text{statfarad}} = \frac{\text{abcoulomb}}{\text{abvolt}} = \frac{\text{statvolt}}{\text{statcoulomb}} = c^2$$

(ii) Since electromagnetic and electrostatic units vary so enormously, a third cgs subsystem was used for most practical purposes in electrical engineering. Clearly, however, this added considerable complication to its general structure.

(iii) The use of the cgs system in fields other than mechanics involves exact definition of the subsystem concerned, which again adds to the confusion and is a great source of error in conversion computations.

Exact conversion factors for different systems of units are given in ***Table 3-1*** (opposite).

3.2.2 The Gauss System

Gaussian units are a combination of the emu and esu subsystems. With three base units, it uses em units in magnetism and es units in electrostatics. This involves using the constant c (the velocity of light in vacuum) to interrelate these sets of units, resulting in complex and error-prone conversions.

Table 3-2 below gives the classes of units used for equivalent electromagnetic and electrostatic quantities. The equivalence between SI and cgs electromagnetic quantities is shown in ***Table 3-3***.

Table 3-2 Organization of Gaussian units

Electrostatic units (esu)	**Electromagnetic units (emu)**
electric charge Q (Fr)	magnetic mass m
electric current intensity I (Fr.s^{-1})	magnetic flux Φ ($\Gamma.\text{cm}^2$)
electric field strength **E** (dyne.Fr^{-1})	magnetic field strength **H** (Bi.cm^{-1})
electric displacement **D** (Fr.cm^{-2})	induction field **B** ($\text{dyn.Bi}^{-1}.\text{cm}^{-1}$)
electric potential V (erg.Fr^{-1})	magnetic potential **A**
polarization **P**	magnetization **M**
electric dipole moment **p** (Fr.cm)	magnetic dipole moment **m** ($\text{erg.}\Gamma^{-1}$)
electric susceptibility χ_e	magnetic susceptibility χ_m
polarizability α	magnetizability ξ

Table 3-1 Exact conversion factors between SI and CGS practical, emu and esu electric and magnetic units

Physical quantity and symbol(s)	Equation	Dimension	SI unit	Practical cgs	emu cgs	esu cgs
admittance (Y)	$Y = 1/Z = G + jB$	$M^{-1}L^{-2}T^{3}I^{2}$	1 S	= 1 mho	$= 10^{-9}$ abmho	$= 10^{-5}c^{2}$ statmho
capacitance (C)	$Q = CU$	$M^{-1}L^{-2}T^{4}I^{2}$	1 F	= 1 farad	$= 10^{-9}$ abfarad	$= 10^{-5}c^{2}$ statfarad
conductivity (s, k)	$G = \sigma A/l$	$M^{-1}L^{-3}T^{3}I^{2}$	1 S.m^{-1}	= 10^{-2} mho.cm^{-1}	$= 10^{-11}$ emu	$= 10^{-7}c^{2}$ esu
conductance (G)	$G = \sigma A/l$	$M^{-1}L^{-2}T^{3}I^{2}$	1 S	= 1 mho	$= 10^{-9}$ abmho	$= 10^{-5}c^{2}$ statmho
current density (j)	$dI = j dA$	IL^{-2}	1 A.m^{-2}	= 10^{-4} A.cm^{-2}	= 10^{-5} Bi.cm^{-2}	= $(c/1000)$ esu
current intensity (I, i)	$U = RI$	I	1 A	= 1 ampere	= 10^{-1} biot (Bi)	= $(10c)$ Fr/s
elastance (S)	$S = 1/C$	$ML^{2}T^{-4}I^{-2}$	1 F^{-1}	= 1 daraf	= 10^{9} emu	= $(10^{5}/c^{2})$ esu
electric charge (Q, q)	$Q = It$	IT	1 C	= 1 coulomb	= 10^{-1} Bi.s	= $(10c)$ franklin
electric dipole moment (p)	$p = Q \times r$	ITL	1 C.m	= 100 C.cm	= 10 Bi.cm	= 1000c Fr.cm
electric displacement (D)	$D = \varepsilon_0 \varepsilon_r E$	ITL^{-2}	1 C.m^{-2}	= 10^{-4} C.cm^{-2}	= 10^{-5} Bi.cm^{-2}	= $(c/1000)$ esu
electric field strength (E)	$E = U/d$	$MLT^{-3}I^{-1}$	1 V.m^{-1}	= 10^{-2} V.cm^{-1}	= 10^{6} emu	= $(10^{4}/c)$ esu
electric potential (U, V)	$U = (Q/4\pi\varepsilon_0\varepsilon_r r^{2})$	$ML^{2}T^{-3}I^{-1}$	1 V	= 1 volt	= 10^{8} abvolt	= $(10^{6}/c)$ statvolt
electromotive force ($e.m.f.$, e)	$e.m.f = U_a - U_c$	$ML^{2}T^{-3}I^{-1}$	1 V	= 1 volt	= 10^{8} abvolt	= $(10^{6}/c)$ statvolt
energy (W)	$dW = U dQ$	$ML^{2}T^{-2}$	1 J	= 10^{7} erg	= 10^{7} erg	= 10^{7} erg
force (F)	$F = QE$	MLT^{-2}	1 N	= 10^{5} dyne	= 10^{5} dyne	= 10^{5} dyne
Frequency (f, ν)	$f = 1/T$	T^{-1}	1 Hz	= 1 cycle.s^{-1}	= 1 cycle.s^{-1}	= 1 cycle.s^{-1}
impedance (Z)	$Z = R + j(X_L - X + C)$	$ML^{2}T^{-3}I^{-2}$	1 Ω	= 1 ohm	= 10^{9} abohm	= $10^{5}/c^{2}$ statohm
length (l)	l	L	1 m	= 10^{2} cm	= 10^{2} cm	= 10^{2} cm
magnetic dipole moment (m)	$E_p = -m.B$	IL^{2}	1 A.m^{2}	= 10^{4} A.cm^{2}	= 10^{3} Bi.cm^{2}	= $10^{5}c$ Fr.cm^{2}
magnetic field (H)	$H = B/\mu_0\mu_r$	IL^{-1}	1 A.m^{-1}	= $4\pi 10^{-3}$ oersted	= $4\pi \times 10^{-3}$ Oe	= $4\pi c \times 10^{-1}$ esu
magnetic flux (Φ)	$\Phi = Bn.dA$	$ML^{2}T^{-2}I^{-1}$	1 Wb	= 10^{8} maxwell	= 10^{8} Mx	= $(1/10c)$ esu
magnetic induction (B)	$F = QV \times B$	$MT^{-2}I^{-1}$	1 T	= 10^{4} gauss	= 10^{4} G	= $(100/c)$ esu
magnetic potential vector (A)	$B = \nabla \times A$	$MLT^{-2}I^{-1}$	1 Wb.m^{-1}	= 10^{6} Mx.cm^{-1}	= 10^{6} Mx.cm^{-1}	= $(10^{4}/c)$ esu

(continued overleaf)

Table 3-1 Exact conversion factors between SI and CGS practical, emu and esu electric and magnetic units *(continued from page 23)*

Physical quantity and symbol(s)	Equation	Dimension	SI unit	Practical cgs	emu cgs	esu cgs
magnetic susceptibility (χ_m)	$M = \chi_m \mathrm{H}$	1	1	$= 4\pi$	$= 4\pi$	$= 4\pi$
magnetization (M, J)	$M = \chi_m \mathrm{H}$	IL^{-1}	1 $\mathrm{A.m^{-1}}$	$= 4\pi 10^{-3}$ oersted	$= 4\pi \times 10^{-3}$ Oe	$= 4\pi c \times 10^{-1}$ esu
magnetomotive force (F)	$F = NI$	I	1 A-turn	$= 4\pi 10^{-1}$ gilbert	$= 4\pi \times 10^{-1}$ Gb	$= 4\pi c \times 10^{9}$ esu
mass (m)	m	M	1 kg	$= 10^3$ grams	$= 10^3$ g	$= 10^3$ g
period (T)	$T = 1/f$	T	1 s	= 1 second	= 1 second	= 1 second
permeability (μ)	$B = \mu H = \mu_0 \mu_r H$	$\mathrm{MLT^{-2}I^{-2}}$	1 $\mathrm{H.m^{-1}}$	$= (10^7/4\pi)$ $\mathrm{G.Oe^{-1}}$	$= (10^7/4\pi)$ $\mathrm{G.Oe^{-1}}$	$= (1000/4\pi c^2)$ esu
permeance (P)	$P = \mu_o \mu_r A/l$	$\mathrm{ML^2T^{-2}I^{-2}}$	1 H	= 1 henry	$= 10^9$ abhenry	$= 10^5/c^2$ esu
permittivity (ε)	$C = \varepsilon A/l = \varepsilon_0 \varepsilon_r A/l$	$\mathrm{M^{-1}L^{-3}T^4I^2}$	1 $\mathrm{F.m^{-1}}$	$= 10^{-2}$ $\mathrm{F.cm^{-1}}$	$= 4\pi \times 10^{-11}$ emu	= 1 esu
polarizability (α)	$p = \alpha \varepsilon_0 E$	$\mathrm{L^3}$	1 $\mathrm{m^3}$	$= 10^6$ $\mathrm{cm^3}$	$= 10^6$ $\mathrm{cm^3}$	$= 10^6$ $\mathrm{cm^3}$
polarization (P)	$P = \chi \varepsilon_0 E$	$\mathrm{ITL^{-2}}$	1 $\mathrm{C.m^{-2}}$	$= 10^{-4}$ $\mathrm{C.cm^{-2}}$	$= 10^{-5}$ $\mathrm{Bi.cm^{-2}}$	$= (c/1000)$ esu
pole strength (Q_m)	$Q_m = Fl/NI\mu_0\mu_r$	IL	1 A.m	$= 10^{-2}$ A-turn.cm	$= 4\pi \times 10^{-3}$ Gb	$= 4\pi c \times 10^{7}$ esu
power (P)	$P = W/t = UI\cos\phi$	$\mathrm{ML^2T^{-3}}$	1 W	$= 10^7$ $\mathrm{erg.s^{-1}}$	$= 10^7$ $\mathrm{erg.s^{-1}}$	$= 10^7$ $\mathrm{erg.s^{-1}}$
pulsatance (ω)	$\omega = 2\pi f$	$\mathrm{\alpha T^{-1}}$	1 $\mathrm{rad.s^{-1}}$	= 1 $\mathrm{rad.s^{-1}}$	= 1 $\mathrm{rad.s^{-1}}$	= 1 $\mathrm{rad.s^{-1}}$
reactance (inductive) (X_C)	$X_C = 1/(2\pi fC)$	$\mathrm{ML^2T^{-3}I^{-2}}$	1 Ω	= 1 ohm	$= 10^9$ abohm	$= 10^5/c^2$ statohm
reactance (inductive) (X_L)	$X_L = 2\pi fL$	$\mathrm{ML^2T^{-3}I^{-2}}$	1 Ω	= 1 ohm	$= 10^9$ abohm	$= 10^5/c^2$ statohm
reactive power (P)	$P = UI\sin\phi$	$\mathrm{ML^2T^{-3}}$	1 VA	= 1 VA	$= 10^7$ emu	$= 10^7$ emu
reluctance (R)	$R = l/\mu_0\mu_r A$	$\mathrm{M^{-1}L^{-2}T^2I^2}$	1 $\mathrm{H^{-1}}$	= 1 yrneh	$= 10^{-9}$ emu	$= (c^2/10^5)$ esu
reluctivity (ρ)	$\rho = 1/\mu_0\mu_r$	$\mathrm{M^{-1}L^{-1}T^2I^2}$	1 $\mathrm{H^{-1}.m}$	= 100 yrneh.cm	$= 10^{-7}$ emu	$= (c^2/10^3)$ esu
resistance (R, r)	$R = U/I$	$\mathrm{ML^2T^{-3}I^{-2}}$	1 Ω	= 1 ohm	$= 10^9$ abohm	$= 10^5/c^2$ statohm
resistivity (ρ)	$R = \rho l/A$	$\mathrm{ML^3T^{-3}I^{-2}}$	1 Ω.m	= 100 ohm.cm	$= 10^{11}$ emu	$= 10^7/c^2$ esu
self-inductance (L)	$e = -L\,\mathrm{d}I/\mathrm{d}t$	$\mathrm{ML^2T^{-2}I^{-2}}$	1 H	= 1 henry	$= 10^9$ abhenry	$= 10^5/c^2$ esu
susceptance (B)	$Y = G + \mathrm{j}B$	$\mathrm{M^{-1}L^{-2}T^3I^2}$	1 S	= 1 mho	$= 10^{-9}$ abmho	$= 10^{-5}c^2$ statmho

Notes: $c = 2.997\,924\,58 \times 10^8$ $\mathrm{m.s^{-1}}$ (E).

Table 3-3 Equivalence between SI and CGS electric and magnetic quantities

Physical quantity	SI symbol	cgs (esu and emu) symbol
Electric field strength	E	E
Magnetic induction	B	B/c
Electric displacement	D	$D/4\pi$
Magnetic field strenght	H	$Hc/4\pi$
Dielectric permittivity	ε	$\varepsilon/4\pi$
Magnetic permeability	μ	$4\pi\mu/c^2$
Charge density	ρ	ρ
Current density	j	j
Vector potential	A	A/c
Hertz vector	π	π/c
Capacitance	C	$C/4\pi$
Inductance	L	L/c

$\zeta = 1$ (SI) and $\zeta = 4\pi$ (cgs esu)
$\xi = 1$ (SI) and $\xi = 1/c$ (cgs emu)

3.2.3 International Electrical Units

This separate system of electrical units was used by US electrical engineers, and was adopted internationally until 1947, when it was declared obsolete and replaced first by the MKSA and then by SI, with which it should not be confused. Its base units are defined in concrete terms, as shown by the examples in ***Table 3-4***.

Table 3-4 Basic IEUS units

ampere (int. mean)	One ampere (int. mean) is equal to the unvarying electric current intensity which deposits, in one second, by electrolysis from an aqueous silver nitrate solution, 0.00111800 g of silver metal at the cathode (IEC, 1881)
ohm (int. mean)	One ohm (int. mean) is equal to the electric resistance, measured at the temperature of melting ice (0°C), of a mercury column of 106.300 cm length which has a mass equal to 14.4521 g (IEC, 1908)
volt (int. mean)	One volt (int. mean) is equal to the electromotive force *(e.m.f.)*, measured at 20°C, of a Weston electrochemical cell. It is equal exactly to 1.0183 int. volt (IEC, 1908)

3.2.4 Atomic Units (a.u.)

The system of atomic units with the international acronym **a.u.** was proposed by D.R. Hartree in 1927 with a view to simplifying calculations in problems involving the basic structures of the atom and molecule, as well as in computations in quantum mechanics. The system was based on units of four fundamental quantities, mass, length, time, and electric charge.

The fundamental units of this system were based on five universal constants: the **electron rest mass** (m_0) represented the unit of mass, the **elementary electrostatic charge** (e) was the unit of electric charge, the **first orbit Bohr radius** (a_0) was the unit of length, the first ionizing energy of the hydrogen atom in its ground state, or **rydberg** (Ry) was the unit of energy, and the **rationalized Planck constant** ($\hbar$) was the unit of angular momentum.

In 1959, Shull and Hall proposed a new unit of energy which was approximately equal to two rydbergs, to be called the **hartree** in honour of the inventor of the system.

The importance of this system of units lay in the fact that the numerical results of calculations were expressed as combinations of fundamental atomic constants. The a.u. system is therefore regarded as 'natural units' for calculations involving electronic structure in quantum chemistry. For clarity, they are usually set in *italic* type to distinguish them from other units which should be set in roman type.

It is also usual in specialized litreature (e.g. quantum chemistry, mathematical physics, nuclear and molecular physics) to find the acronym **a.u.** in place of the appropriate unit irrespective of the physical quantity involved. This of course leads to considerable confusion in identification and conversion.

Table 3-5 (opposite) summarizes the main units employed in the system.

3.3 British and American Systems of Units

Despite the increasing importance of SI units, the systems of units developed in the UK and USA are still commonly used or referred to in the British Isles (England, Ireland, Scotland, and Wales), North America (USA and Canada), and in some Commonwealth countries such as Australia and New Zealand. These systems are not only non-metric, but also non-decimal, which increased the complexity of calculations and proved a powerful argument against their continued use, especially in science and technology. However, a counter-argument, that was perhaps more cogent before the age of the electronic calculator, is that their quantities were evenly divisible by a greater number of basic prime factors, and did not so often result in lengthy or recurring decimals.

Preliminary notes for number writing:

- **Cardinal number writing**: in France, Italy and other European countries, the space ( ) or the point (.) is used to separate hundreds from thousands. In Britain and North America, either the comma is used (sometimes omitted in four-figure numbers) or the space (usually omitted in four-figure numbers). The latter is used in this book.

  Example: 1,657 or 1657 instead of 1 657.

- **Decimal number writing**: in France, Italy and other European countries, the comma (,) is used to separate integer from decimal. In Britain and North America the point is used.

  Example: 3.14159 instead of 3,14159.

3.3.1 Imperial Units

The British system of units, known as imperial units, was established by the *Weights and Measures Act* (WMA, 1824) of June 17th, 1824. Its three base units are the **pound avoirdupois**, the **yard**, and the **second**. The yard was defined in 1878 as the distance at 62°F between a pair of lines etched in gold plugs set in a bronze bar. Earlier in 1856, the pound avoirdupois was defined in terms of the mass of a platinum cylinder, known as the Imperial Standard Pound, and both were kept in the Standards Department of the Board of Trade in London. The imperial unit of capacity was the **gallon**, which was defined as the

Table 3-5 Base and derived units of the a.u. system

a.u. quantity	Dimension	SI conversion factor	Equation
angular momentum, action	ML^2T^{-1}	$= 1.054571596\,(82) \times 10^{-34}$ J.s	$\hbar = h/2\pi$
charge density	ITL^{-3}	$= 1.08120228 \times 10^{12}$ C.m^{-3}	$e/{a_0}^3$
electric charge	IT	$= 1.602176462\,(63) \times 10^{-19}$ C	e
electric current intensity	I	$= 6.6236175327 \times 10^{-3}$ A	$eE_h/\hbar$
electric dipole moment	LTI	$= 8.47835267325 \times 10^{-30}$ C.m	ea_0
electric field gradient	$MT^{-3}I^{-1}$	$= 9.71689777437 \times 10^{21}$ V.m^{-2}	$E_h/e{a_0}^2 = e/4\pi\varepsilon_0{a_0}^3$
electric field strength	$MLT^{-3}I^{-1}$	$= 5.14196083758 \times 10^{11}$ V.m^{-1}	$E_h/ea_0 = e/4\pi\varepsilon_0{a_0}^2$
electric potential	$ML^2T^{-3}I^{-1}$	$= 27.2113834433$ V	$E_h/e = e/4\pi\varepsilon_0 a_0$
electric quadripole moment	L^2TI	$= 4.4865509982 \times 10^{-40}$ C.m^2	$e{a_0}^2$
energy (hartree)	ML^2T^{-2}	$= 4.35974381\,(34) \times 10^{-18}$ J	$E_h = \hbar^2/m_0{a_0}^2$
force	MLT^{-2}	$= 8.23872180407 \times 10^{-8}$ N	E_h/a_0
induction magnetic field, magnetic flux density	$MT^{-2}I^{-1}$	$= 2.350517349 \times 10^5$ T	$\hbar/e{a_0}^2$
length (1st Bohr radius)	L	$= 5.291772083(19) \times 10^{-11}$ m	$a_0 = 4\pi\varepsilon_0\hbar^2/m_0e^2$
linear momentum	MLT^{-1}	$= 1.99285150505 \times 10^{-24}$ N.s	$\hbar/a_0$
magnetic dipole moment	L^2I	$= 1.8548017980 \times 10^{-23}$ J.T^{-1} (A.m^2)	$e\hbar/m_0 = 2\mu_B$
magnetizability	$M^{-1}T^2L^2I^2$	$= 7.89103640682 \times 10^{-29}$ Am^{2}T^{-1}	$e^2{a_0}^2/m_0$
mass (electron rest mass)	M	$= 9.10938188\,(72) \times 10^{-31}$ kg	m_0
polarizability	$M^{-1}I^2T^4$	$= 1.6487772491 \times 10^{-41}$ J^{-1}.C^2.m^2	$e^2{a_0}^2/E_h$
time	T	$=2.41888432749 \times 10^{-17}$ s	$\hbar/E_h = m_0{a_0}^2/\hbar$

volume of 10 pounds avoirdupois of distilled water, weighed in air against brass[7] weights at a temperature of 62°F and atmospheric pressure of 30 inches of mercury. These legal measures were then used in all countries of the British Commonwealth. To a close approximation, the metric equivalents of these imperial pound and yard standards are 0.45359243 kg and 0.91443992 m respectively.

However, the WMA of 1963 modified the nature of these standards, and redefined the units in terms of the kilogram and metre standards maintained in Paris (at the Pavillon de Breteuil, Sèvres). These new precise definitions of the pound and yard are respectively 0.45359237 kg and 0.9144 m. The unit of time, the second, has always been the same in both systems and was redefined by the 13th CGPM in 1968.

In 1980, Parliament approved a Statutory Instrument (1980/1070) which began the progressive phasing out of the imperial system by withdrawing authorization of a substantial number of units, such as the **British thermal unit** (Btu), the **cran**, the **furlong**, the **horsepower** (HP), the **hundredweight** (cwt), the **ton** and the **Fahrenheit degree** (°F). In 1985, the **curie**, **rem**, and **rad** were discarded in favour of the **becquerel**, **sievert**, and **gray** respectively, although the legal status of the pound and yard was reaffirmed by the WMA of 1985.

However, from November 1995, the United Kingdom officially adopted metric units for general use and business transactions. As a result, the metre and kilogram are now compulsory in place of the yard and pound avoirdupois.

There have been three major Weights and Measures Acts (WMA) in recent times (1963, 1976 and 1985) all gradually abolishing various units, as well as redefining the standards. All the apothecaries' and troy weights and measures are no longer used in the UK system. Currently legislation has decreed that from October 1st, 1995, for economic, public health, public safety and administrative purposes, only metric units are allowed except for the following, which may be used until December 31st, 1999:

- pounds and ounces for weighing of goods sold in bulk;
- pints and fluid ounces for alcoholic beverages such as beer and cider, waters, lemonades and fruit juices in returnable containers;
- therms for gas supply;
- fathoms and nautical miles for marine navigation.

The following may continue to be used without time limit:

- statute miles, yards, feet and inches for road traffic signs and related measurements of speed and distance;
- pints for dispensing draught beer and cider, and for milk in returnable containers;
- acres for land registration purposes and surveyors' measurements;
- troy ounces for transactions in gold and other precious metals.

3.3.1.1 Imperial Units of Length

The many units of length used at various times in the UK fall into several categories, depending on area of application.

[7] For official comparison between standard organizations through the UK, the density of bras alloy was taken as being equal to 8413 kg m^{-3}.

3.3.1.1.1 UK Linear Measure

Current linear units are the **line**, the **inch**, the **foot**, the **yard**, the **statute mile**[8] (or **land mile**) and the **statute league** (or **land league**). They are employed for measuring distance, length, width, depth, height, and thickness, and are listed fully in ***Table 3-6*** (overleaf).

Other units of length which have been used in the UK are:

1 lea (UK)	= 360 ft
1 skein (UK)	= 360 feet
1 wrap (UK)	= 240 ft
1 bolt (UK)	= 120 feet
1 shackle (UK)	= 90 feet
1 rope (UK)	= 20 feet
1 ell (UK)	= 45 inches
1 pace (UK)	= 30 inches
1 span (UK)	= 9 inches
1 nail (UK)	= 9/4 inches
1 finger (UK)	= 7/8 inch
1 barleycorn (UK)	= 1/3 inch
1 button (UK)	= 1/12 inch
1 iron (UK)	= 1/48 inch
1 calibre (UK)	= 1/100 inch
1 point (UK)	= 1/144 inch
1 mil	= 1/1000 inch
1 mil	= 1 thou

3.3.1.1.2 UK Nautical Measure

The units of length used in navigation are the **fathom**, and the **nautical mile**. The **cable length** and the **nautical league** are now obsolete.

Table 3-7 UK nautical measures of length
[1 mile (UK naut.)=1853.184 m (E)]

UK nautical league (UK, naut. lg)	**UK nautical mile** (UK, naut. mi)	**UK cable length** (UK, naut. cbl)	**UK nautical chain**	**Fathom** (fath)	**Yard** (yd)	**Foot** (ft)	**Inch** (in)
1	**= 3**	= 30	= 1216	= 3040	= 6080	= 18 240	= 218 880
	1	**= 10**	= 1216/3	= 3 040/3	= 6080/3	= 6080	= 72 960
		1	**= 608/15**	= 304/3	= 608/3	= 608	= 7296
			1	**= 5/2**	= 5	= 15	= 180
				1	**= 2**	= 6	= 72
					1	**= 3**	= 36
						1	**= 12**

[8] The mile derived from Roman 'mille passus', 5000 ft, but later it took 5280 ft to accomodate exactly 8 furlongs, the most popular length measure at the time.

Table 3-6 UK linear measures [1 foot=0.3048 m (E)]

UK stat. league (st. lg)	**UK stat. mile** (st. mi)	**Pole** (rd)	**Yard** (yd)	**Pace** (pc)	**Cubit** (cu)	**Foot** (ft,′)	**Span** (sp)	**Hand** (hd)	**Palm** (plm)	**Inch** (in,″)	**UK line** (line)	**Point** (pt)
1	**= 3**	= 960	= 5280	= 6336	= 10 560	= 15 840	= 21 120	= 47 520	= 63 360	= 190 080	= 2 280 960	= 27 371 520
	1	**= 320**	= 1760	= 2112	= 3520	= 5280	= 7040	= 15 840	= 21 120	= 63 360	= 76 0320	= 9 123 840
		1	**= 11/2**	**= 33/5**	= 11	= 16. 5	= 22	= 49.5	= 66	= 198	= 2376	= 28 512
			1	**= 6/5**	**= 2**	= 3	= 4	= 9	= 12	= 36	= 432	= 5184
				1	= 5/3	= 5/2	= 10/3	= 15/2	= 10	= 30	= 360	= 4320
					1	**= 3/2**	= 2	= 9/2	= 6	= 18	= 216	= 2592
						1	**= 4/3**	= 3	= 4	= 12	= 144	= 1728
							1	**= 9/4**	= 3	= 9	= 108	= 1296
								1	**= 4/3**	= 4	= 48	= 576
									1	**= 3**	= 36	= 432
										1	**= 12**	= 144
											1	= 12

1 rod = 1 perch = 1 pole
1 land = 1 statute mile

3.3.1.1.3 UK Surveyors' Measure

Some other units of length were once used by UK land surveyors, the main ones being the **link**, the **chain** (**Gunter's chain**), the **rod**, and the **furlong**. All these units are now obsolete, except for the **furlong (i.e., furrow long)**, which is still commonly used to define distances in a UK horse-race.

Table 3-8 UK surveyors' measures of length
[1 chain (Gunter's) = 20.1168 m (E)]

Statute mile (st. mi)	**Furlong** (fur)	**Gunter's chain** (ch)	**Rod** (rd)	**Yard** (yd)	**Foot** (ft)	**Gunter's link** (lk)
1	= 8	= 80	= 320	= 1760	= 5280	= 8000
	1	= 10	= 40	= 220	= 660	= 1000
		1	= 4	= 22	= 66	= 100
			1	= 5.5	= 16.5	= 25
				1	= 3	= 50/11
					1	= 50/33

1 rod = 1 perch = 1 pole
1 land = 1 statute mile

3.3.1.2 Imperial Units of Area

As with linear measures, units of surface area fall into groups based on their application.

Notes

- It is important to note that in North America and Britain, the prefix *sq.* (an abbreviation of the word *square*) is sometimes used before an area unit instead of raising the unit to the power of two.

  Example: 1666.66 sq. ft = 1666.66 ft^2

- In some technical reports or scientific textbooks written before the 1960s, the term 'square' is represented by a square symbol drawn before the unit (thus $\square''$ should be read as 'square inch').

  Example: 2.56 $\square'$ = 2.56 ft^2 (obsolete)

3.3.1.2.1 UK Measures of Area

The conventional imperial units of surface area are the **square inch**, the **square foot**, the **square yard**, and the **square mile**. They are related as follows:

Table 3-9 UK measures of area
[1 $ft^2 = 9.290304 \times 10^{-2}$ m^2 (E)]

Square mile (sq. mi)	**Square rod** (sq. rd)	**Square yard** (sq. yd)	**Square foot** (sq. ft)	**Square inch** (sq. in)
1	**= 102 400**	= 3 097 600	= 27 878 400	= 4 014 489 600
	1	**= 121/4**	= 1089/4	= 39 204
		1	**= 9**	= 1296
			1	**= 144**

1 square rod = 1 square perch = 1 square pole

3.3.1.2.2 UK Surveyors' Measure

The now obsolete units of area once used by surveyors are listed below. The **square foot** and the **acre** are the only measures to survive into recent times.

Table 3-10 UK surveyors' measure
[1 $ft^2 = 9.290304 \times 10^{-2}$ m^2 (E)]

Section of land (sq. mi)	**Acre** (ac)	**Rood** (ro)	**Square chain** (sq. ch)	**Square rod** (sq. rd)	**Square foot** (sq. ft)	**Square link** (sq. lk)
1	**= 640**	= 2560	= 6400	= 102 400	= 27 878 400	= 64 000 000
	1	**= 4**	= 10	= 160	= 43 560	= 100 000
		1	**= 5/2**	= 40	= 10 890	= 25 000
			1	**= 16**	= 4356	= 10 000
				1	**= 1089/4**	= 625
					1	**= 2500/1089**

1 rod = 1 perch = 1 pole
1 section of land = 1 square statute mile
1 virgate = ¼ hide = 30 acres

3.3.1.2.3 Circular Units

Very rarely, so-called 'circular' units have been used, mainly for wire sizes and then only as the **circular mil** in the USA. In an analogy to square measure, circular units represent the area of a disc of a diameter equal to the equivalent linear unit. A circular mil is the area of a disc one mil (0.001 in) in diameter, and hence equal to $7.85398163398 \times 10^{-7}$ in^2 or 5.067×10^{-10} m^2. Circular units should not be confused with **circular measure**, which refers to the expression of angle in radians.

Table 3-11 Circular units
[1 cin = 5.067074791 × 10^{-4} m^2]

Circular inch (cin)	**Circular millimetre** (cmm)	**Circular mil** (cmil)
1	**= 645.16**	= 1 000 000
	1	**= 1550**

3.3.1.3 Imperial Units of Volume and Capacity

As with the UK units of length and area, units of volume and capacity are often associated with specific trades or fields of application. They do however, in common with many older systems, fall into three categories: geometric measure, expressed in cubic linear units (e.g. **cubic foot**), dry measure, and liquid measure. The latter two categories are known as units of capacity and consist of arbitrary volumes given specific names (e.g. **bushel**, **gallon**), with the same name sometimes being used for measuring solids or liquids.

Note

- It is important to note that in North America and Britain, the prefix *cu.* (an abbreviation of the word *cubic*) is sometimes used before a volume unit instead of raising the unit to the power of three.

Example: 33.75 cu. ft = 33.75 ft^3

3.3.1.3.1 UK Measures of Volume

The volumetric units chiefly used in the UK are the **cubic inch**, **cubic foot**, **cubic yard**, and **cubic statute mile**. They are used for volumes of containers, tanks, boxes, etc. as well as for solids such as stone, concrete, woods, etc. and are summarized in the following table.

Table 3-12 UK geometric measures of volume
[1 ft^3 = 2.831684659 × 10^{-2} m^3 (E)]

Cubic mile (cu. st. mi)	**Rod**	**Register ton**	**Cubic yard** (cu. yd)	**Cubic foot** (cu. ft)	**Cubic inch** (cu. in)
1	**= 147 197 95.2**	= 147 197 952	= 5 451 776 000	= 1.47197952 × 10^{11}	= 2.54358061056 × 10^{14}
	1	**= 10**	= 1000/27	= 1000	= 1 728 000
		1	**= 100/27**	= 100	= 172 800
			1	**= 27**	= 46 656
				1	**= 1728**

1 ocean-ton = 40 ft^3
1 stupping ton = 42 ft^3

3.3.1.3.2 UK Liquid Measure

Practical commercial measurement of liquids meant that vessels of a common size had to be used, with the result that certain standard (if arbitrary) volumes came into use. Of those listed in ***Table 3-13***, the fluid ounce, pint, quart, and gallon are still in common use.

The British imperial gallon was defined in 1824 to be the volume of water which weighed 10 pounds at 62°F and 30 in Hg. In 1963 it was defined by the WMA to be the volume occupied by 10 pounds of distilled water of density 998.859 $kg.m^{-3}$ weighed in air of density 1.217 $kg.m^{-3}$ against brass weights of density 8136 $kg.m^{-3}$. This gives the old value of 4.5459645 dm^3. In 1976, the definition was changed to exactly 4.546092 dm^3 based on the new definition of the litre (i.e., 1 dm^3)

Although the litre is now official in the UK, it is likely that the pint will continue in use for some time because of its popularity as a measure of alcoholic beverages, chiefly beer.

3.3.1.3.3 UK Dry Measure

Over the years, British trades and professions developed standard measures of dry volume for commercial purposes. They were based on liquid measures and are now identically equal to them. The measures in the ***Table 3-14*** are all either obsolete or becoming so, with the exception of the register ton used to specify the size (gross register tonnage) of cargo ships.

Other UK capacity units are as follows:

1 last (UK)	= 640 gallons (UK)
1 butt (UK)	= 108 gallons (UK)
1 puncheon (UK)	= 70 gallons (UK)
1 seam (UK)	= 64 gallons (UK)
1 hogshead (UK)	= 63 gallons (UK)
1 quarter (UK)	= 1 seam (UK)
1 coomb (UK)	= 32 gallons (UK)
1 kilderkin (UK)	= 18 gallons (UK)
1 strike (UK)	= 16 gallons (UK)
1 firkin (UK)	= 9 gallons (UK)
1 chopine (UK)	= 1 pint (UK)
1 demiard (UK)	=1/2 pint (UK)
1 roquille (UK)	= 1 gill (UK)
1 noggin (UK)	= 1 roquille (UK)
1 quartern (UK)	= 1 gill (UK)
1 drop (UK)	= 1 minim (UK)

3.3.1.4 Imperial Units of Weight

3.3.1.4.1 UK Avoirdupois Weight

About AD 1300, London merchants adopted a system of weights known as 'avoirdupois', from the Old French *aver de peis* (goods of weight). This system, used for wholesale weighing, was based on a pound of 7000 grains. The **pound avoirdupois** was established under the WMA of 1856 (see note under yard above) and until 1963 was defined as the mass of the Imperial Standard Pound, a platinum cylinder kept in the Standards Department of the Board of Trade in London. Over that period, it was imposed and used in all countries of the British Commonwealth.

Table 3-13 UK liquid measures of capacity

[1 gallon (UK) = 4.546092×10^{-3} m^3 (E)]

Wey (UK wy)	**Chaldron** (UK chal)	**Bag** (UK bg)	**Bucket** (UK bk)	**Gallon** (UK gal)	**Pottle** (UK pot)	**Quart** (UK qt)	**Pint** (UK pt)	**Gill** (UK gi)	**Fluid ounce** (UK fl. oz)	**Fluid dram** (UK fl. dr)	**Minim** (UK min)
1	**= 10/9**	= 40/3	= 80	= 320	= 640	= 1280	= 2560	= 10 240	= 51 200	= 409 600	= 24 576 000
	1	= 12	= 72	= 288	= 576	= 1152	= 2304	= 9216	= 46 080	= 368 640	= 22 118 400
		1	= 6	= 24	= 48	= 96	= 192	= 768	= 3840	= 30 720	= 1 843 200
			1	= 4	= 8	= 16	= 32	= 128	= 640	= 5120	= 307 200
				1	= 2	= 4	= 8	= 32	= 160	= 1 280	= 76 800
					1	= 2	= 4	= 16	= 80	= 640	= 38 400
						1	= 2	= 8	= 40	= 320	= 19 200
							1	= 4	= 20	= 160	= 9600
								1	**= 5**	= 40	= 2400
									1	**= 8**	= 480
										1	**= 60**

1 ocean ton = 40 ft^3
1 shipping ton = 42 ft^3
1 register ton = 100 ft^3
1 rod = 1000 ft^3
1 chopine = 1 pint
1 demiard = 1/2 pint
1 sack = 1 bag

Table 3-14 UK dry measures

[1 gallon (UK) = 4.546092×10^{-3} m^3 (E)]

Last (UK ls)	**Wey (load)** (UK wy)	**Chaldron** (UK chal)	**Sack** (UK sk)	**Bushel** (UK bu)	**Bucket** (UK bk)	**Peck** (UK pk)	**Gallon** (UK gal)	**Quart** (UK qt)	**Pint** (UK pt)
1	= 2	= 20/9	= 80/3	= 80	= 160	= 320	= 640	= 2560	= 5120
	1	**= 10/9**	= 40/3	= 40	= 80	= 160	= 320	= 1280	= 2560
		1	**= 12**	= 36	= 72	= 144	= 288	= 1152	= 2304
			1	**= 3**	= 6	= 12	= 24	= 96	= 192
				1	= 2	= 4	= 8	= 32	= 64
					1	**= 2**	= 4	= 16	= 32
						1	**= 2**	= 8	= 16
							1	**= 4**	= 8
								1	**= 2**
									1

1 sack = 1 bag
1 seam = 8 bushels
1 coomb = 4 bushels
1 strike = 2 bushels
1 chopine = 1 pint

Table 3-15 UK avoirdupois weight

[1 lb av. (WMA, 1963) = 0.45359237 kg (E)]

Ton (UK ton)	**Wey, Load** (wy av.)	**Hundredweight** (cwt)	**Cental** (CH)	**Quarter** (qr av.)	**Stone** (st av.)	**Clove** (cv av.)	**Pound** (lb av.)	**Ounce** (oz av.)	**Dram** (dm av.)	**Grain** (gr av.)
1	**= 80/9**	= 20	= 112/5	= 80	= 160	= 280	= 2240	= 35 840	= 573 440	= 15 680 000
	1	**= 9/4**	= 63/25	= 9	= 18	= 63/2	= 252	= 4032	= 64 512	= 1 764 000
		1	**= 28/25**	= 4	= 8	= 14	= 112	= 1792	= 28 672	= 784 000
			1	= 25/7	= 50/7	= 25/2	= 100	= 1600	= 25 600	= 700 000
				1	= 2	= 7/2	= 28	= 448	= 7168	= 196 000
					1	= 7/4	= 14	= 224	= 3584	= 98 000
						1	**= 8**	= 128	= 2048	= 56 000
							1	= 16	= 256	= 7000
								1	= 16	= 1750/4
									1	**= 875/32**

1 barrel (salt) = 280 lb
1 barrel (cement) = 376 lb
1 bag (cement) = 94 lb
1 clove = 1 customary stone
1 flask (mercury) = 76 lb

Now, most countries are converting to metric units and the avoirdupois system is being phased out. It was however very widely used and there is still considerable resistance to its replacement. Its base unit is the pound of 16 oz, which under the WMA of 1963 was defined as 0.45359237 kg. A standard New Imperial Pound was created in the form of a platinum cylinder maintained at the Standards Office, Westminster, but, from 1995, Britain officially adopted metric units for all general and business purposes. The avoirdupois units of mass were indicated by the abbreviation avoir., avdp. or av.

Of the units listed in ***Table 3-15***, only the **ounce**, **pound**, **stone**, **hundredweight**, and **ton** have been in anything like regularly use in recent years.

3.3.1.4.2 UK Apothecaries' Weight

The units of weight of the apothecaries' system were formerly used by pharmacists for drugs and medicinal preparations, presumably because their small magnitudes better represented the quantities used in this profession. In this system, the base unit was the **apothecaries' ounce** and was equal to the Troy ounce (see below). The units were indicated by the abbreviation *ap.* or *apth.* These units were legalized by the *Medical Education Acts* of 1858 and 1862, but are now completely obsolete and their use is prohibited by the British and American Pharmacopoeia.

Table 3-16 UK apothecaries' weight
[1 lb apoth. = 0.3732417216 kg]

Pound (lb apoth.)	**Ounce** (oz apoth.)	**Drachm** (dr apoth.)	**Scruple** (scr apoth.)	**Grain** (gr apoth.)
1	= 12	= 96	= 288	= 5760
	1	= 8	= 24	= 480
		1	= 3	= 60
			1	= 20

Note: There was also apothecaries' measure, for liquid quantities, which can be adequately covered by the following brief statement regarding its units. The parallel system of apothecaries' measure was used for liquid quantities. In this system, analogous to imperial capacity measure, 60 minims was equal to one fluid drachm, which was one eighth of a fluid ounce.

3.3.1.4.3 UK Troy Weight

The troy system was formerly the UK legal system for weighing precious metals and gems. The name is derived from the town of Troyes in Northern France, famous in medieval times for its commercial fairs. It is now obsolete except in the USA. Its base unit is the **troy pound** of 5760 grains defined as 0.3732417216 kg, with other units as in the table below. The troy grain is identical to the grain avoirdupois.

Table 3-17 UK troy weight
[1 lb troy = 0.3732417216 kg (E)]

Pound (lb troy)	**Ounce** (oz troy)	**Pennyweight** (dwt)	**Grain** (gr troy)
1	**= 12**	= 240	= 5760
	1	**= 20**	= 480
		1	**= 24**

Note: Another unit still in common use in jewellery for weighing gems is the **carat** the old version of this unit of weight was equal to about 205 mg (about 3.16436 grains). The **metric carat** was standardized at 200 mg (about 3.086471671 grains) in 1932. The **carat** (occasionally **karat**) is also a unit of purity of gold and other precious metal, with 24 carats as 100% wt pure, and other measures in proportion (e.g. 18 carat gold is 75% wt pure).

3.3.2 The American System of Measures (US Customary Units)

This system is substantially the same as the imperial system, the main differences being mentioned below, and the same criticisms of inconsistency and complexity of calculations apply. These units are however still fully legal in the USA and Canada. Where there are differences between them and imperial units, the designation (US) is normally applied.

American weights and measures are based on units used in Britain prior to 1824, when the imperial system was officially established. The US law of 1866 established a relationship with the metric system by defining the metre as equal to 39.37 in, and, in 1883, the yard was also defined in terms of the metre (= 3600/3937 m). Under the *Mendenhall Order* of 1893, the **US yard**, **pound**, and all other derived units were redefined in terms of metric units of length and mass, so that from then on there was no longer a direct relationship with UK units, though the differences were often minute. In 1959, an agreement between English-speaking countries unified metric definitions of units for scientific and technical uses, with the yard defined as 0.9144 m and the pound as 0.45359237 kg. In order to accommodate data from the US geodetic surveys, however, the old standard of 1 ft = 1200/3937 m was retained with the name **US survey foot**. It has the following relationships with other units:

1 rod (perch) = 16.5 ft
1 chain = 66 ft
1 US mile = 5280 ft

3.3.2.1 US Customary Units of Length

As with their British equivalents, the many units of length used at various times in the USA fall into several categories depending on area of application.

3.3.2.1.1 US Linear Measure

Current linear units are the **inch**, the **foot**, the **yard**, and the **statute mile** (or **land mile**). They are employed for measuring distance, length, width, depth, height, and thickness, and are listed fully in the table overleaf.

Table 3-18 US linear measure
[1 ft = 0.3048 m (E)]

Statute league (US st. leag)	**Statute mile** (US st. mi)	**Pole** (rd)	**Yard** (yd)	**Foot** (ft)	**Inch** (in)	**Line** (US line)
1	**= 3**	= 960	= 5280	= 15 840	= 190 080	= 7 603 200
	1	**= 320**	= 1760	= 5280	= 63 360	= 2 534 400
		1	**= 5.5**	= 16.5	= 198	= 7920
			1	**= 3**	= 36	= 1440
				1	**= 12**	= 480
					1	**= 40**

1 rod = 1 perch = 1 pole
1 land = 1 statute mile
1 mil = 1/1000 in
1 bolt = 120 ft
1 hand = 4 in
1 span = 9 in

3.3.2.1.2 US Nautical Measure

US nautical measures are substantially the same as those of the UK, and are summarized in ***Table 3-19***.

Table 3-19 US nautical measure
[1 mile (US naut.) = 1853.184 m (E)]

US nautical league (US naut. leag)	**US nautical mile** (US naut. mi)	**US cable length** (US cbl)	**Fathom** (fath)	**Yard** (yd)	**Foot** (ft)	**Inch** (in)
1	**= 3**	= 76/3	= 3040	= 6080	= 18 240	= 218 880
	1	**= 76/9**	= 3040/3	= 6080/3	= 6080	= 72 960
		1	**= 120**	= 240	= 720	= 8640
			1	**= 2**	= 6	= 72
				1	**= 3**	= 36
					1	**= 12**

1 cannon shot = 3 miles

3.3.2.1.3 US Surveyors' Measure

Units of length in the US Customary system are the **link**, the **chain** (**Ramsden's chain**), the **rod**, and the **furlong**, and are shown in Table 3-20.

3.3.2.2 US Customary Units of Area

As with linear units, US square measure is virtually identical to the British system.

3.3.2.2.1 US Measures of Area

The conventional US units of area are directly related to the linear measures on which they are based, thus the **square inch**, **square foot**, **square yard**, and **square mile**. They are related as in ***Table 3-21***.

Table 3-20 US surveyors' measure
[1 chain (Ramsden's or Engineer's) = 30.48 m (E)]

Statute mile (mi)	**Furlong** (fur)	**Ramsden's chain** (ch)	**Rod** (rd)	**Foot** (ft)	**Ramsden's link** (lk)
1	**= 8**	= 52.8	= 320	= 5280	= 5280
	1	**= 6.6**	= 40	= 660	= 660
		1	= (1000/165) = (200/33)	= 100	= 100
			1	**= 16.5**	= 16.5
				1	**= 1**

1 rod = 1 perch = 1 pole
1 land = 1 statute mile

Table 3-21 US measures of area
[1 $ft^2 = 9.290304 \times 10^{-2}$ m^2 (E)]

Square mile (sq. st. mi)	**Square rod** (sq. rd)	**Square yard** (sq. yd)	**Square foot** (sq. ft)	**Square inch** (sq. in)
1	**= 102 400**	= 3 097 600	= 27 878 400	= 4 014 489 600
	1	**= 121/4**	= 1089/4	= 39 204
		1	**= 9**	= 1296
			1	**= 144**

1 rod = 1 perch = 1 pole
1 section of land = 1 square statute mile

3.3.2.2.2 US Surveyors' Measure

The now obsolete units of area once used by surveyors are listed below in relation to the **square foot** and the **acre**, the only two such measures to survive into relatively recent times.

Table 3-22 US surveyors' measure
[1 $ft^2 = 9.290304 \times 10^{-2}$ m^2 (E)]

Square mile (sq. mi)	**Square chain** (sq. yd) (Ramsden's)	**Square rod, perch, pole** (sq. rd)	**Square foot** (sq. ft)	**Square link** (sq. lk) (Ramsden's)
1	**= 69 696/25**	= 102 400	= 27 878 400	= 27 878 400
	1	**= (100/16.5)^2 = (200/33)^2**	= 10 000	= 10 000
		1	**= 1089/4**	= 1089/4
			1	**1**

1 rood = 3630 ft
1 rod = 1 perch = 1 pole
1 section of land = 1 square statute mile
1 acre = 4840 square yards
1 township = 36 square statute miles
1 homestead = 160 acres and 1 sq. mile = 640 acres

3.3.2.2.3 Circular Units

Very rarely, so-called 'circular' units have been used, mainly for wire sizes and then only as the **circular mil** in the USA (see also ***Table 3-11***). In an analogy to square measure, circular units represent the area of a circle of a diameter equal to the equivalent linear unit. A circular mil is the area of a circle one mil (0.001 in) in diameter, and hence equal to $7.853981634 \times 10^{-7}$ in^2 or $5.067074791 \times 10^{-10}$ m^2. Circular units should not be confused with *circular measure*, which refers to the expression of angle in radians.

3.3.2.3 US Units of Volume and Capacity

As with the UK units of length and area, units of volume and capacity are often associated with specific trades or fields of application. They do however, in common with many older systems, fall into three categories: geometric measure, expressed in cubic linear units (e.g. **cubic foot**), dry measure, and liquid measure. The latter two categories are known as units of capacity and consist of arbitrary volumes given specific names (e.g. **bushel**, **gallon**), with the same name sometimes being used for measuring solids or liquids and thus having different volumes (e.g. the US dry pint $\approx$ 0.550610471 l, while a US liquid pint $\approx$ 0.473176473 l).

3.3.2.3.1 US Measures of Volume

The volumetric units chiefly used in the US are the **cubic inch**, **cubic foot**, **cubic yard**, and **cubic statute mile** identical to imperial units.

Table 3-23 US measures of volume
[1 ft^3 = $2.831684659 \times 10^{-2}$ m^3 (E)]

Cubic mile (cu. mi)	Cubic yard (cu. yd)	Cubic foot (cu. ft)	Cubic inch (cu. in)
1	= 5 451 776 000	= $1.471\,979\,52 \times 10^{11}$	= $2.543\,580\,610\,56 \times 10^{14}$
	1	= 27	= 46 656
		1	**= 1728**

3.3.2.3.2 US Liquid Measure

Liquid measures in the USA are based on the old wine measures in use in Britain before 1824 and differ considerably from their imperial equivalents. The fluid ounce is identical, but there are only 16 to the pint as compared with 20 in the UK system. Thus the US quart, and gallon, both of which are still in common use, are 20% smaller than their British equivalents. The most important multiple is the **barrel** (US, oil) (= 42 US gallons, 35 imperial gallons, 0.158987294928 m^3) which is extensively used in the international oil industry (***Table 3-24*** opposite).

3.3.2.3.3 US Dry Measure

US measures of dry volume are related to liquid measures but differ from them in some respects. They are used for measuring the volume of powdered or granular materials (e.g. flour, sand, grain, powdered ore, etc.). The base unit was the Winchester bushel defined as 268.8025 in^3 exactly 2150.42 in^3 and equal to 8 gallons dry.

Table 3-24 US fluid measure

[1 gallon (US, liquid) = $3.785411784 \times 10^{-3}$ m^3 (E) = 231 in^3 (Def.)]

Tun (US tu)	**Hogshead** (US hhd)	**Barrel (wine)** (US bbl)	**Gallon** (US gal)	**Quart** (US qt)	**Pint** (US pt)	**Gill** (US gi)	**Fluid ounce** (US fl oz)	**Fluid dram** (US fl dr)	**US minim** (US min)
1	**= 4**	= 8	= 252	= 1008	= 2016	= 8064	= 32 256	= 258 048	= 15 482 880
	1	**= 2**	= 63	= 252	= 504	= 2016	= 8064	= 64 512	= 3 870 720
		1	**= 31.5**	= 126	= 252	= 1008	= 4032	= 32 256	= 1 935 360
			1	= 4	= 8	= 32	= 128	= 1024	= 61 440
				1	= 2	= 8	= 32	= 256	= 15 360
					1	= 4	= 16	= 128	= 7680
						1	= 4	= 32	= 1920
							1	= 8	= 480
								1	**= 60**

1 gal (US) = 231 in^3 (E) (def.)
1 bbl (US, oil) = 42 gal (US) (E)

Table 3-25 US dry measure
[1 gallon (US, dry) = 4.40488377086 × 10^{-3} m^3 (E)]

Bushel (US bu)	**Peck** (US pk)	**Gallon** (US gal)	**Dry quart** (US dr. qt)	**Dry pint** (US dr. pt)
1	**= 4**	= 8	= 32	= 64
	1	**= 2**	= 8	= 16
		1	**= 4**	= 8
			1	**= 2**

1 barrel = 26.25 gal
1 firkin = 9 gal
1 chaldron = 36 gal
1 Winchester bushel = 2150.42 in^3
1 chopine = 1 dry pint

3.3.2.3.4 US Apothecaries' Measures of Capacity

The US Customary Units commonly used to measure volumes of medicinal liquids are the **tablespoon** and the **teaspoon.** They are defined as in ***Table 3-26.***

Table 3-26 US apothecaries' measures of capacity
[1 US fl. oz = 29.57352956 × 10^{-6} m^3]

Fluid ounce (US fl. oz)	**Tablespoon**	**Teaspoon**	**Tablespoon** (metric)	**Teaspoon** (metric)	**Cubic centimetre** (cm^3)
1	**= 2**	= 6	**1**	**= 3**	= 15
	1	**= 3**		**1**	**= 5**

3.3.2.4 US Customary Units of Weight

3.3.2.4.1 US Avoirdupois Weight

The US pound avoirdupois was defined by Act of Congress in 1866 as 1/2.2046 kg, but was more accurately related to its metric equivalent in 1895 as 0.45359224277 kg. Today, for engineering purposes, the US and British pounds can be regarded as identical, defined as equal to 0.45359237 kg by the WMA, 1963 in Britain, and in North America by the *US Metric Board* in 1959 (USMB, 1959).

Now, when most countries are converting to metric units and the avoirdupois system is being phased out, there is pressure in the US for alignment with the rest of the world. So far, however, the pressure has been resisted on the grounds of economic and social upheaval.

See *Table* ***3-27*** opposite.

3.3.2.4.2 US Apothecaries' Weight

As with the UK units, these are now completely obsolete and their use is prohibited by the American Pharmacopoeia (USP). See *Table* ***3-28*** opposite.

Table 3-27 US avoirdupois weight
[1 lb av. (USMB, 1959) = 0.45359237 kg (E)]

Long ton (US ton)	**Short ton** (US ton)	**Long hundredweight** (lg cwt)	**Short hundredweight** (sh cwt)	**Pound** (lb av)	**Ounce** (oz av.)	**Dram** (dram av.)	**Grain** (gr av.)
1	= 28/25	= 20	= 112/5	= 2240	= 35 840	= 573 440	= 15 680 000
	1	**= 250/14**	= 20	= 2000	= 32 000	= 512 000	= 14 000 000
		1	**= 28/25**	= 112	= 1792	= 28 672	= 784 000
			1	**= 100**	= 1600	= 25 600	= 700 000
				1	**= 16**	= 256	= 7000
					1	**= 16**	= 875/2
						1	**= 875/32**

1 quintal (US) = 100lb

Table 3-28 US apothecaries' weight
[1 lb apoth. = 0.3732417216 kg]

Pound (lb apoth.)	**Ounce** (oz apoth.)	**Drachm** (dr apoth.)	**Scruple** (scr apoth.)	**Grain** (gr apoth.)
1	**= 12**	= 96	= 288	= 5760
	1	**= 8**	= 24	= 480
		1	**= 3**	= 60
			1	= 20

3.3.2.4.3 US Troy Weight

The troy system was formerly the UK legal system for weighing precious metals and gems. The name is derived from the town of Troyes in Northern France, famous in medieval times for its commercial fairs. It is now obsolete except in the USA. Its base unit is the **troy pound** of 5760 grains defined as 0.3732417216 kg, with other units as in the table below. The troy grain is identical to the grain avoirdupois.

Table 3-29 US troy weight
[1 lb troy = 0.3732417216 kg (E)]

Pound (lb troy)	**Ounce** (oz troy)	**Pennyweight** (dwt)	**Grain** (gr troy)
1	**= 12**	= 240	= 5760
	1	**= 20**	= 480
		1	**= 24**

Note: Another unit still in common use in jewellery for weighing gems is the **carat**; the old version of this unit of weight was equal to about 205 mg (3.164 grains). The **metric carat** was standardized at 200 mg (= 3.086 grains) in 1932. The **carat** (occasionally **karat**) is also a unit of purity of gold and other precious metal, with 24 carats as 100% wt pure, and other measures in proportion (e.g. 18 carat gold is 75% wt pure).

3.3.3 Obsolete Weight and Capacity Measures

In both the UK and the USA, some old measures of weight and capacity survive in a few specialized areas, chiefly with regard to beer, wines, and spirits, and agricultural products, though most are replaced by metric measures. The summary below is given mainly for historical interest.

3.3.3.1 UK Units of Weight for Butter and Cheese

Table 3-30 UK units of weight for butter and cheese
[1 lb (avdp.) = 0.453 592 37 kg (E)]

Wey (Suffolk)	**Whey** (Essex)	**Barrel**	**Dutch cask**	**Tub**	**Firkin**	**Clove**	**Pound** (avdp.)
1	**= 89/59**	= 89/56	= 89/28	= 178/42	= 89/14	= 89/2	= 356
	1	**= 59/56**	= 59/28	= 472/147	= 236/49	= 236/7	= 236
		1	**= 2**	= 64/21	= 32/7	= 32	= 224
			1	**= 32/21**	= 16/7	= 16	= 112
				1	**= 3/2**	= 10.5	= 84
					1	**= 7**	= 56
						1	**= 8**

1 roll = 24 oz

3.3.3.2 UK Units for Beer, Wines, and Spirits

Table 3-31 UK units for alcohols and spirits

Unit (alcohol)	**Approx. volume** (UK gal)	**Approx. volume** (dm^3)
octave (whisky)	16	73
quarter	17–30	77–136
aum (hock)	30–32	136–145
hogshead	44–60	200–273
hogshead (madeira)	45–48	205–218
hogshead (brandy)	56–61	255–277
puncheon	70–120	318–546
pipe	90–120	409–546
butt	108–117	491–532
tonneau, tun	190–200	864–909
stuck (hock)	260–265	1182–1205

Units especially applied to measures of beer are given in ***Table 3-32*** opposite.

Table 3-32 UK units of capacity for beer and ale measures (1803–1824)
[1 gallon (UK, beer) = 4.62115205 $dm^3 \equiv 282$ in^3]

Tun	Butt	Puncheon	Hogshead	Barrel	Firkin	Pin	Gallon
1	**= 2**	= 3	**= 4**	= 6	= 24	= 48	= 216
	1	**= 3/2**	= 2	= 3	= 12	= 24	= 108
		1	**= 4/3**	= 2	= 8	= 16	= 72
			1	**= 3/2**	= 6	= 12	= 54
				1	**= 4**	= 8	= 36
					1	**= 2**	= 9
						1	**= 9/2**

Some bottle sizes, once used for wines in general, are now exclusively reserved for champagne, and then only in general parlance.

Table 3-33 UK units of capacity for wine

French name (English word)	**Reputed quarts** (No. of bottles)	**Volume** (UK gal)	**Volume** (dm^3)
1 salomon (solomon)	**24**	**4**	17.824368
1 nabuchodonosor (nabuchadnezzar)	**20**	**10/3**	15.153640
1 balthazar or balthasar (belshazzar)	**16**	**8/3**	12.122912
1 salmanazar (salmarazd)	**12**	**2**	9.092184
1 mathusalem (methuselah)	**9**	**3/2**	6.819138
1 rèhoboam (rehoboam)	**6**	**1**	4.546092
1 jèroboam (jeroboam)	**4**	**2/3**	3.030728
1 magnum (magnum)	**2**	**1/3**	1.515364
1 bouteille champenoise (reputed quart)	**1**	**1/6**	0.757682

3.3.3.3 UK Units of Weight for Coal

See ***Table 3-34*** overleaf for UK units of weight for coal.

3.3.3.4 UK Units for Clothes

Table 3-35 UK units of length for clothes

Quarter yard	**Nail** (UK)	Inch
1	= 4	= 9
	1	= 9/4

1 inch = 2.54×10^{-2} m (E)

Table 3-34 UK units of weight for coal

[1 pound (avdp.) = 0.45359237 kg (E)]

Ship load	**Keel**	**Room**	**Ton** (long)	**Sack** (large)	**Sack** (sck)	**Hundredweight** (cwt)	**Quarter** (qtr)	**Stone** (st)	**Pound** (lb)
1	**= 20**	= 424/7	= 424	= 4240	= 8480	= 8480	= 33920	= 67840	= 949760
	1	**= 106/35**	= 106/5	= 212	= 424	= 424	= 1696	= 3392	= 47488
		1	**= 7**	= 70	= 140	= 140	= 560	=1120	= 15680
			1	**= 10**	= 20	= 20	= 80	= 160	= 2240
				1	**= 2**	= 2	= 8	= 16	= 224
					1	**= 1**	= 4	= 8	= 112
						1	**= 4**	= 8	= 112
							1	**= 2**	= 28
								1	**= 14**

3.3.3.5 UK and US Hay and Straw Weights

Measures of agricultural fodder formerly used are:

Table 3-36 UK and US hay and straw weights
[1 lb (UK, straw) = 0.453592338 kg]

Load	Truss	Pound (straw)	Pound (old hay)	Pound (new hay)
1	**= 36**	= 1296	= 2016	= 2160
	1	**= 36**	= 56	= 60
		1	**= 14/9**	= 5/3
			1	**= 15/14**

3.3.3.6 UK Weight for Wool

Table 3-37 UK weight for wool
[1 wey (UK, wool) = 114.30527724 kg (E)]

Load	Sack	Wey	Stone	Pound	Ounce
1	**= 108/13**	= 12	= 216	= 3024	= 48 384
	1	**= 13/9**	= 26	= 364	= 5824
		1	**= 18**	= 252	= 4032
			1	**= 14**	= 224
				1	= 16

1 sarpler = 2 sacks
1 tod = 28 lb
1 clove = 8 lb

3.3.3.7 US Units of Capacity Used in Food Recipes

See ***Table 3-38*** overleaf for US units of capacity used in food recipes.

3.3.3.8 US Units of Capacity for Wine

Table 3-39 US units of capacity for wine
[1 gallon (U.S., wine) = 231 in^3 (E) = 3.785411784 × 10^{-3} m^3 (E)]

Tun	Pipe	Puncheon	Hogshead	Tierce	Anker	Gallon
1	**= 2**	= 3	= 4	= 6	= 126/5	= 252
	1	**= 3/2**	= 2	= 3	= 63/5	= 126
		1	**= 4/3**	= 2	= 42/5	= 84
			1	**= 3/2**	= 63/10	= 63
				1	**= 21/5**	= 42
					1	**= 10**

Table 3-38 US units of capacity used in food recipes

[1 fluid ounce (U.S.) = 29.573 529 5625 × 10^{-6} m^3]

Water glassful	Breakfast cup (tumblerful)	Cup	Teacupful (tcf)	Wine glassful	Fluid ounce (fl.oz.)	Coffee measure	Tablespoon (tbsp, tls, Tsp)	Dessertspoon (dst)	Teaspoon (tsp)	Dash	Coffee spoon (csp)	Salt spoon (ssp)	Drop (drp., gtt)
1	**= 8/5**	= 2	= 16/5	= 32/5	= 16	= 16	= 32	= 48	= 96	= 160	= 192	= 384	= 960
	1	**= 5/4**	= 2	= 4	= 10	= 10	= 20	= 30	= 60	= 100	= 120	= 240	= 600
		1	**= 8/5**	= 16/5	= 8	= 8	= 16	= 24	= 48	= 80	= 96	= 192	= 480
			1	**= 2**	= 5	= 5	= 10	= 15	= 30	= 50	= 60	= 120	= 300
				1	**= 5/2**	**= 5/2**	= 5	= 15/2	= 15	= 25	= 30	= 60	= 150
					1	**= 1**	= 2	= 3	= 6	= 10	= 12	= 24	= 60
						1	**= 2**	= 3	= 6	= 10	= 12	= 24	= 60
							1	**= 3/2**	= 3	= 5	= 6	= 12	= 30
								1	**= 2**	= 10/3	= 4	= 8	= 20
									1	**= 5/3**	= 2	= 4	= 10
										1	**= 6/5**	= 12/5	= 6
											1	**= 2**	= 5
												1	**= 5/2**

1 pinch = $\frac{1}{48}$ fluid ounce

3.3.3.9 Modern UK and US Dimensionless Units for Numbers of Paper Sheets

Table 3-40 Modern UK and US dimensionless units for numbers of paper sheets

Bale	Bundle	Ream	Quires	Sheet
1	**= 5**	= 10	= 200	= 5000
	1	**= 2**	= 40	= 1000
		1	**= 20**	= 500
			1	**= 25**

3.3.3.10 Old UK and US Dimensionless Units for Numbers of Paper Sheets

Table 3-41 Old UK and US dimensionless units for numbers of paper sheets

Bale (old)	**Bundle** (old)	**Ream** (old)	**Quires** (old)	**Sheet (old)**
1	**= 5**	= 10	= 200	= 4800
	1	**= 2**	= 40	= 960
		1	**= 20**	= 480
			1	**= 24**

1 perfect ream = 516 sheet

3.3.3.11 Old US Units for Measuring the Volume of Stacked Firewood

US units of volume for stacked firewood are shown in ***Table 3-42*** overleaf.

3.3.3.12 UK and US Dimensionless Counting Units

UK and US dimensionless counting units are shown in ***Table 3-43*** on page 53.

3.4 The Foot-Pound-Second (FPS) System

In parallel with the development of the cgs system (see 3.2.1 above) came what was seen as its imperial equivalent, the foot-pound-second system, proposed by W. Stroud in 1880 and sometimes called the Stroud system in commemoration. It became very widely employed in all branches of engineering, and most technical papers written in Britain, the USA, and other parts of the English-speaking world before about 1960 would have used these units, although scientific papers tended to use cgs units.

Its popularity in engineering was due not only to the use of imperial units as its base, but also because the pound and the foot were felt to be more convenient for engineers than the too-small centimetre and gram, and the too-large metre and kilogram. Although it was, strictly speaking, a non-decimal system, this was technically irrelevant since quantities could be expressed in decimals of feet, pounds, etc., so that the criticism of complexity in calculations usually aimed at the imperial system did not necessarily apply. It must be admitted, however, that, engineers being what they are, measures such as tons-feet and inches per second were not uncommon.

Table 3-42 US units of volume for stacked firewood

[1 cubic foot = 28.316 8465 920 × 10^{-3} m^3]

Standard (St. Petersburg, Pittsburgh)	**Cord** (cd.)	**Stack** (stk.)	**Load** (squared)	**Load** (unhewn)	**Cord-foot (cd-ft)**	**Cubic foot or timber foot (cu.ft, ft^3)**	**Faggot** (fgt)	**Board foot measure (bfm, fbm)**
1	**= 165/128**	= 55/36	= 55/14	= 99/16	= 165/16	= 165	= 55π	= 1980
	1	**= 32/27**	= 64/21	= 24/5	= 8	= 128	= 128π/3	= 1536
		1	**= 54/21**	= 81/20	= 27/4	= 108	= 36π	= 1296
			1	**= 63/40**	= 21/8	= 42	= 14π	= 504
				1	**= 5/3**	= 80/3	= 80π/9	= 320
					1	**= 16**	= 16π/3	= 144
						1	**= π/3**	= 12
							1	**= 36/π**

1 face cord = 1/2 cord (E)
1 house cord = 1/3 cord (E)
1 deal (UK) = 7ft x 6 ft x 5/2 in. (E)
1 deal (US) = 12 ft x 11 in. x 3/2 in. (E)
1 whole deal = 12 ft x 11 in. x 5/8 in. (E)
1 split deal = 12 ft x 8 ft x 16 in. (E)
1 rick = 4 ft x 8 ft x 16 in. (E)

Table 3-43 UK and US dimensionless counting units

Great gross (dozen gross)	Thousand	Gross	Great hundred	Hundred	Shock	Flock	Score	Baker's dozen	Dozen	Decade (dicker)	Hat trick (nest)	Pair (brace, yoke	Point (unity)	Half	Quart	Tithe
1	**= 216/125**	= 12	= 72/5	= 432/25	= 144/5	= 216/5	= 432/5	=1728/13	= 144	= 864/5	= 576	= 864	= 1728	= 3456	= 6912	= 17 280
	1	**= 125/18**	= 25/3	= 10	= 50/3	= 25	= 50	=1000/13	= 250/3	= 100	= 1000/3	= 500	= 1000	= 2000	= 4000	= 10 000
		1	**= 6/5**	=36/25	= 12/5	= 18/5	= 36/5	= 144/13	= 12	=72/5	= 48	= 72	= 144	= 288	= 576	= 1440
			1	**= 6/5**	= 2	= 3	= 6	= 120/13	= 10	= 12	= 40	= 60	= 120	= 240	= 480	= 1200
				1	**= 5/3**	= 5/2	= 5	= 100/13	=25/3	= 10	=100/3	= 50	= 100	= 200	= 400	= 1000
					1	**= 3/2**	= 3	= 60/13	= 5	= 6	= 20	= 30	= 60	= 120	= 240	= 600
						1	**= 2**	= 40/13	=10/3	= 4	= 40/3	= 20	= 40	= 80	= 160	= 400
							1	**= 20/13**	=5/3	= 2	=20/3	= 10	= 20	= 40	= 80	= 200
								1	**= 13/12**	= 13/10	= 13/3	= 13/2	= 13	= 26	= 52	= 260
									1	**= 6/5**	= 4	= 6	= 12	= 24	= 48	= 120
										1	**=10/3**	= 5	= 10	= 20	= 40	= 100
											1	**= 3/2**	= 3	= 6	= 12	= 30
												1	**= 2**	= 4	= 8	= 20
													1	**= 2**	= 4	= 10
														1	**= 2**	= 5
															1	**= 5/2**

Its main problem was that the *pound* had long been in common use as a unit of both *weight* and *mass*. This makes no difference in general and commercial usage, since, because of Earth's gravity, a mass of one pound weighs exactly one pound. For the non-technical reader, the difference may be illustrated by considering the same mass taken to another planet such as the Moon. Because the Moon's gravitational force is about one-sixth that of the Earth, the one-pound mass would weigh only one-sixth of a pound, although the mass itself would not have changed. Weight, therefore, is the *force* with which a mass is attracted by gravity, and, since it is an entirely different quantity, it requires a different unit.

Force was defined by Newton as *mass* × *acceleration*. In a coherent system of units, any derived unit must interrelate one-to-one with the system's base units, so that one force unit equals one mass unit times one acceleration unit. In the FPS system, with the pound as the unit of mass, one force unit is required to impart one acceleration unit (1 $ft.s^{-2}$) to a mass of one pound. The acceleration due to gravity is approximately 32 $ft.s^{-2}$, so that *weight* of one pound *mass* is in fact equal to 32 force units, and the force unit must therefore be 1/32 pounds (to be accurate, since g is 32.1740486 $ft.s^{-2}$, it is 1/32.17 or 0.031081 lbf, = 0.138255 N). This is termed the **poundal**.

However, because in general use the pound had always been appreciated as a unit of weight, there was a tendency among engineers to continue to use it in this way. In a variant of the FPS system, usually termed *technical*, *gravitational* or *engineers' units*, the **pound-force** (lbf) was taken as a base unit, and a unit of mass was derived from it by a reversal of the above considerations. This unit was named the *slug*, and was the mass which when acted upon by one pound-force experienced an acceleration of $1ft.s^{-2}$, so was equal to 32.17 lb. This version of the FPS system was more commonly used in the United States than anywhere else.

The FPS system was never made fully coherent by the incorporation of electrical or molar units. It did however have derived units which were for the most part expressed clearly in terms of their base units and not given separate names as in the SI. It is true that in practice they were often abbreviated (e.g. *psi* for $lbf.in^{-2}$), and that they were often used in a non-standard way, or in a way that confused the two subsystems. The example just quoted shows this quite clearly: the 'p' is intended to mean 'pounds-force', the abbreviation should be written $lbf.in^{-2}$, and the correct FPS pressure unit should have been poundals per square foot ($pdl.ft^{-2}$). In fact, the pound-force and pound-weight were often used quite indiscriminately, with the acceleration due to gravity, '*g*', being used so commonly as a correction factor that it was humorously referred to as the 'engineers' constant'.

Abbreviations of derived units often became acronymic in that engineers spoke of *pee-ess-eye* or *ar-pee-em* rather than pounds force per square inch or revolutions per minute. Among the non-standard abbreviations were sq. ft and cu. ft for square and cubic feet respectively, with sometimes a small square being used with an abbreviation (e.g. □ft) in drawings and calculations. A selection of FPS derived units is given in ***Table 3-44*** opposite.

With its various inconsistencies, inherent and imposed, and with the increasing internationalization of the metric system culminating in the creation of the SI, it was inevitable that the FPS system would become obsolete. Yet, in concluding this brief survey of the FPS system, it is worth noting that there was nothing inherently inconsistent in a system based on the foot and the pound in themselves. Decimalized, with a single set of force and mass units, and integrated with electrical and molar quantities, it could have been just as consistent and international as the metric-based SI. And, as the considerations of the following section on ancient units will show, there is a feeling among human beings that units based on the human body are somehow more comprehensible than those derived from the circumference of the Earth, or referred to the energy level of an atom.

Table 3-44 FPS derived units in common use

Quantity	FPS unit	Abbreviation (other units)	Conversion factor in SI unit
acceleration	foot per square second	$ft.s^{-2}$	1 $ft.s^{-2} = 0.3048$ $m.s^{-2}$ (E)
angular velocity	revolutions per second	$rev.s^{-1}$ (also rps, rev/min, rpm)	1 rps $= 2\pi$ $rad.s^{-1}$ (E)
area	square foot	ft^2, sq. ft	1 $ft^2 = 9.290304 \times 10^{-2}$ m^2
energy, work	foot-poundal	ft.pdl	1ft.pdl $= 4.21401101 \times 10^{-2}$ J
force	poundal	pdl	1 pdl = 0.138254954376 N
frequency	cycles per second	$cycle.s^{-1}$ (cps)	1 cps = 1 Hz
heat	foot-poundal	ft.pdl (also British thermal unit, Btu)	1 ft.pdl $= 4.21401101 \times 10^{-2}$ J 1 Btu = 1055.06 J
power	foot-poundal per second	$ft.pdl.s^{-1}$ (also horsepower, hp)	1 $ft.pdl.s^{-1} = 4.21401101 \times 10^{-2}$ W 1 hp = 745.699871582 W
pressure, stress	poundal per square foot	$pdl.ft^{-2}$ (also pound-force/sq. in, psi)	1 $pdl.ft^{-2} = 1.48816394357$ Pa 1 psi = 6894.75729 Pa
velocity	foot per second	$ft.s^{-1}$ (also miles/hr, mph)	1$ft.s^{-1} = 0.3048$ $m.s^{-1}$ (E)
volume	cubic foot	ft^3, cu. ft	1$ft^3 = 2.83168465920 \times 10^{-2}$ m^{-3}

Note that psi, rpm, mph, Btu, and hp, although in common use in engineering calculations, were not derived FPS units.

3.5 Ancient and Obsolete Systems of Weights and Measures

From the very earliest times, human beings have found it necessary to weigh and measure the world around them, and the most ancient records include references to units of measurement. Most of these ancient units are now entirely obsolete. Our knowledge of them comes from texts and inscriptions which have survived, but the values of many have been quite reliably determined. This presentation of ancient systems of measurement is mainly for historical and general interest. Nevertheless, they illustrate the development of our modern systems, and the associated conversion tables could be of use to engineers and others reconstructing or evaluating ancient machinery, ships, or buildings.

Many early units, with an anthropocentrism which has persisted up to the present day, were based on the human body or its attributes. Units such as the **finger**, **hand**, **palm**, and **foot** are self-explanatory, while the **span** was the maximum width, thumb-tip to small fingertip, of the spread hand. The **inch** was the distance from the tip to the first joint of the thumb, and the surviving French word *pouce* in fact means 'thumb'. As a matter of incidental interest, the English word 'inch' comes from the Old German for 'one-twelfth', and has the same derivation as the word 'ounce'. The **cubit** was the distance from elbow to

fingertips (from the Latin *cubitum*, elbow), and is also sometimes known as the *ell* from the Germanic word for 'forearm' ('elbow' being derived from Old German *elnboga*, arm-bend). Together with the **fathom**, derived from the span of the arms or the height of a man, these ancient units can still be seen in use today when builders, woodworkers, or other tradespeople make rough estimates of quantities.

Units of length greater than the human body itself were usually expressed in terms of walking distances. The yard was about the length of a pace, and one thousand paces was a **mile** (Latin *milia passum*). Other units which expressed distance in terms of human activity were rough periods of time such as an **hour's walking**, or a **day's sailing**.

Measures of area and volume using square or cubic units are relatively recent inventions. Areas were first thought of in terms of reasonable-sized fields, that could be ploughed in a given time, and indeed the word acre is ultimately derived from the Sanskrit for 'field' (*ajra*). Likewise, volumes were thought of in terms of containers such as churns or barrels, or of human-sized portable units such as bundles of wood, bales of hay, sacks of grain, or pails of milk. The parallel between liquids and granular or powered solids was also noted, with the same measures being used for both. Sometimes, however, to equalize the 'feel' of measured quantities, a smaller measure was used for heavier materials, resulting in different sized 'pints', for example, in dry and liquid measures.

Weight units arose from these capacity measures, and there is a unit more or less equal to, and often called, a **pound** (Latin *pondus*, weight), in many ancient and obsolete systems. The relationship remains clear even in modern times. A pint of wine weighs about a pound, and a gallon of water weighs ten pounds. The word **ton** is from the same root as the name of the older unit, tun, a large wine cask of some 250 gallons, which would therefore weigh about 2000 pounds when full.

One of the oldest units of measurement is the **degree of arc**, which is usually supposed to have been invented by the Babylonians over 4000 years ago. It is curious that they should have chosen to divide the circle into 360 degrees: the simplest way would have been to divide it into halves, quarters, and so on, giving 256, or another multiple of 2, degrees in the circle. It has been suggested that the number 360 arose in an early attempt to guess the number of days in the year, but this is unlikely, since accurate astronomical data were known before recorded history began. However, the lunar month of approximately 30 days, the division of the solar year into 12 months, and the solar day into 12 hours, cannot fail to be related to the Babylonian number base of 60 and the division of the circle into 360 degrees.

Finally, of course, it should be remembered that these early units were connected with measuring time and constructing a calendar. In this respect it is interesting to consider that the second, determined by the Babylonians, is still the fundamental unit of time in all current systems of measurement, even the SI itself. It is therefore the unit in longest continuous official use, and, with the degree of arc, one of only two to have been in use throughout recorded history.

3.5.1 Systems from Antiquity

In this section, only the more important and the best known of these ancient systems have been included. It is also important to bear in mind that these systems were not consecutive, but were in a constant state of evolution and overlapped with one another to a large extent. It is therefore impossible to establish a time-scale over which any one system was used.

3.5.1.1 The Chinese System

3.5.1.1.1 Old Chinese Units of Length

These are shown in ***Table 3-45.***

3.5.1.1.2 Old Chinese Units of Area

Table 3-46 Old Chinese units of area
[1 meou = 614.4 m^2 = 6000 square tchi (E)]

Ching	King	Meou	Kish	Fen	Lyi	Kung (sq. pou)	Hao
1	**= 10**	= 100	= 400	= 1000	= 10 000	= 24 000	= 100 000
	1	**= 10**	= 40	= 100	= 1000	= 2400	= 10 000
		1	**= 4**	= 10	= 100	= 240	= 1000
			1	**= 5/2**	= 25	= 60	= 250
				1	**= 10**	= 24	= 100
					1	**= 12/5**	= 10
						1	**= 25/6**

3.5.1.1.3 Old Chinese Units of Weight

Table 3-47 Old Chinese units of weight
[1 jin = 0.596816 kg]

Dan (shih)	Tan	Jun (kwan)	Jin (tchin)	Liang	Zhu	Shu
1	**= 6/5**	= 4	= 120	= 1920	= 46 080	= 4 608 000
	1	**= 10/3**	= 100	= 1600	= 38 400	= 3 840 000
		1	**= 30**	= 480	= 11 520	= 1 152 000
			1	**= 16**	= 384	= 38 400
				1	**= 24**	= 2400
					1	**= 100**

1 jin = 1 catty
1 hao = 1/10000 liang (E)
1 lii = 1/1000 liang (E)
1 fen = 1/100 liang
1 tsouen = 1/10 liang

3.5.1.1.4 Old Chinese Units of Capacity

These are shown in ***Table 3-48*** (p. 59).

Table 3-45 Old Chinese units of length

[1 tchi = 0.32 m]

Tou	Thsan	Poû	Li	Kyo	fen	Yin (Yan)	Zhang	Pou	Tchi	Cun (tsouen)	Fen	Lî	Hao	Su	Hoé
1	**= 25/8**	= 25	= 250	= 1 500	= 3750	= 4500	= 45 000	= 90 000	= 450 000	= 4.5×10^6	= 4.5×10^7	= 4.5×10^8	= 4.5×10^9	= 4.5×10^{10}	= 4.5×10^{11}
	1	**= 8**	= 80	= 480	= 1200	= 1440	= 14 400	= 28 800	= 144 000	= 1.44×10^6	= 1.44×10^7	= 1.44×10^8	= 1.44×10^9	= 1.44×10^{10}	= 1.44×10^{11}
		1	**= 10**	= 60	= 150	= 180	= 1800	= 3600	= 18 000	= 1.8×10^5	= 1.8×10^6	= 1.8×10^7	= 1.8×10^8	= 1.8×10^9	= 1.8×10^{10}
			1	**= 6**	= 15	= 18	= 180	= 360	= 1800	= 1.8×10^4	= 1.8×10^5	= 1.8×10^6	= 1.8×10^7	= 1.8×10^8	= 1.8×10^9
				1	**= 5/2**	= 3	= 30	= 60	= 300	= 3×10^3	= 3×10^4	= 3×10^5	= 3×10^6	= 3×10^7	= 3×10^8
					1	**= 6/5**	= 12	= 24	= 120	= 1.2×10^3	= 1.2×10^4	= 1.2×10^5	= 1.2×10^6	= 1.2×10^7	= 1.2×10^8
						1	**= 10**	= 20	= 100	= 10^3	= 10^4	= 10^5	= 10^6	= 10^7	= 10^8
							1	**= 2**	= 10	= 10^2	= 10^3	= 10^4	= 10^5	= 10^6	= 10^7
								1	**= 5**	= 50	= 5×10^2	= 5×10^3	= 5×10^4	= 5×10^5	= 5×10^6
									1	**= 10**	= 10^2	= 10^3	= 10^4	= 10^5	= 10^6
										1	**= 10**	= 10^2	= 10^3	= 10^4	= 10^5
											1	**= 10**	= 10^2	= 10^3	= 10^4
												1	**= 10**	= 10^2	= 10^3
													1	**= 10**	= 10^2
														1	**= 10**

Table 3-48 Old Chinese units of capacity

[1 cheng = 1.03544 dm^3]

Ping	Chei	Hou	To	Cheng	Yo	Khô	Chao	Ço	Quei
1	**= 5**	= 10	= 50	= 500	= 2500	= 5000	= 50 000	= 500 000	= 5 000 000
	1	**= 2**	= 10	= 100	= 500	= 1000	= 10 000	= 100 000	= 1 000 000
		1	**= 5**	= 50	= 250	= 500	= 5000	= 50 000	= 500 000
			1	**= 10**	= 50	= 100	= 1000	= 10 000	= 100 000
				1	**= 5**	= 10	= 100	= 1000	= 10 000
					1	**= 2**	= 20	= 200	= 2000
						1	**= 10**	= 100	= 1000
							1	= 10	= 100
								1	= 10

Table 3-50 Indian units of weight

[1 pala = 47×10^{-3} kg]

Achita	Bara	Hara	Tuba	Pala	Kharsha	Tola	Kona	Dharana	Tank-sala	Masha	Retti (ratica)	Yava
1	**= 10**	= 100	= 200	= 20 000	= 200 000/3	= 80 000	= 400 000/3	= 200 000	= 3 200 000/9	= 3 200 000/3	= 6 400 000	= 64 000 000
	1	**= 10**	= 20	= 2000	= 20 000/3	= 8000	= 40 000/3	= 20 000	= 320 000/9	= 320 000/3	= 640 000	= 6 400 000
		1	**= 2**	= 200	= 2000/3	= 800	= 4000/3	= 2000	= 32 000/9	= 32 000/3	= 64 000	= 640 000
			1	**= 100**	= 1000/3	= 400	= 2000/3	= 1000	= 16 000/9	= 16 000/3	= 32 000	= 320 000
				1	**= 10/3**	= 4	= 20/3	= 10	= 160/9	= 160/3	= 320	= 3200
					1	**= 6/5**	= 2	= 3	= 16/3	= 16	= 96	= 960
						1	= 5/3	= 5/2	= 40/9	= 40/3	= 80	= 800
							1	**= 3/2**	= 8/3	= 8	= 48	= 480
								1	**= 16/9**	= 16/3	= 32	= 320
									1	**= 3**	= 18	= 180
										1	**= 6**	= 60
											1	**= 10**

3.5.1.2 The Indian System

3.5.1.2.1 Old Indian Units of Length

Table 3-49 Indian units of length
[1 hasta = 0.457 m]

Yodjana	Gavyuti	Crosa	Dhanush (orgyla)	Hasta (cubit)	Vistati (span)	Angula (finger)
1	**= 2**	= 4	= 8000	= 32 000	= 64 000	= 768 000
	1	**= 2**	= 4000	= 16 000	= 32 000	= 384 000
		1	**= 2000**	= 8000	= 16 000	= 192 000
			1	**= 4**	= 8	= 96
				1	**= 2**	= 24
					1	**= 12**

3.5.1.2.2 Indian Units of Weight

See ***Table 3-50*** (overleaf).

3.5.1.2.3 Indian Units of Capacity

See ***Table 3-51*** (p. 62).

3.5.1.3 The Egyptian System

3.5.1.3.1 Egyptian Units of Length

The earliest known unit of length was the **cubit**, which is the distance between the elbow and the tip of the middle finger. It was used by the Sumerians, Babylonians, Israelites, and Egyptians as a base unit. The Egyptian system of linear measure, sometimes called *Pharaonic measurements*, included two kinds of cubit, as shown in ***Table 3-52*** (p. 63).

3.5.1.3.2 Egyptian Units of Area

Table 3-53 Egyptian units of area
[1 pekeis = 27.405 225 m^2 = 100 sq. derah (E)]

Setta	Aurure	Rema (sq. senus)	Ten	Sû	Pekeis	Square derah
1	**= 10**	= 20	= 100	= 160	= 1000	= 100 000
	1	**= 2**	= 10	= 16	= 100	= 10 000
		1	= 5	= 8	= 50	= 5000
			1	**= 8/5**	= 10	= 1000
				1	**= 25/4**	= 625
					1	**= 100**

Table 3-51 Indian units of capacity (measured by weight)
[1 drona = 13.2 kg]

Baha	Cumbha	Shari	Cumbha short	Drona	Adhaka	Prastha	Cudava	Musti (pala)
1	= 10	= 25/2	= 100	= 200	= 800	= 3200	= 6400	= 51 200
	1	= 5/4	= 10	= 20	= 80	= 320	= 640	= 5120
		1	= 8	= 16	= 64	= 256	= 512	= 4096
			1	= 2	= 8	= 32	= 64	= 512
				1	= 4	= 16	= 32	= 256
					1	= 4	= 8	= 64
						1	= 2	= 16
							1	= 8

Table 3-52 Egyptian units of length (System of the Pharaon)

[1 derah (Royal cubit) = 0.5235 m]

Royal atour	**Parasange**	**Shoëme**	**Atour**	**Mille** (mile)	**Stade** (stadium)	**Senus**	**Canne**	**Orgye** (fathom)	**Xilon**	**Long cubit**	**Derah** (Royal cubit)	**Pigon**	**Zereth** (Royal foot)
1	= 3/2	= 5/3	= 2	= 6	= 50	= 200	= 18 000/7	= 5 000	= 20 000/3	= 15 000	= 20 000	= 24 000	= 30 000
	1	= 10/9	= 4/3	= 4	= 100/3	= 400/3	= 12 000/7	= 10 000/3	= 40 000/9	= 10 000	= 40 000/3	= 16 000	= 20 000
		1	= 6/5	= 18/5	= 30	= 120	= 10 800/7	= 3000	= 4000	= 9000	= 12 000	= 14 400	= 18 000
			1	= 3	= 25	= 100	= 9000/7	= 2500	= 10 000/3	= 7500	= 10 000	= 12 000	= 15 000
				1	= 25/3	= 100/3	= 3000/7	= 2500/3	= 10 000/9	= 2500	= 10 000/3	= 4000	= 5000
					1	= 4	= 360/7	= 100	= 400/3	= 300	= 400	= 480	= 600
						1	= 90/7	= 25	= 100/3	= 75	= 100	= 120	= 150
							1	= 35/18	= 70/27	= 35/6	= 70/9	= 28/3	= 35/3
								1	= 4/3	= 3	= 4	= 24/5	= 6
									1	= 9/4	= 3	= 18/5	= 9/2
										1	**= 4/3**	= 8/5	= 2
											1	= 6/5	= 3/2
												1	= 5/4

Table 3-52 Egyptian units of length *(continued)*

[1 derah (Royal cubit) = 0.5235 m]

Orgye (fathom)	**Xilon**	**Long cubit**	**Derah** (Royal cubit)	**Pigon**	**Zereth** (Royal foot)	**Spithame** (span)	**Dichas**	**Choryos** (palm)	**Thebs** (finger)	**Digits**
1	**= 4/3**	= 3	= 4	= 24/5	= 6	= 8	= 12	= 24	= 96	= 192
	1	**= 9/4**	= 3	= 18/5	= 9/2	= 6	= 9	= 18	= 72	= 144
		1	**= 4/3**	= 8/5	= 2	= 8/3	= 4	= 8	= 32	= 64
			1	**= 6/5**	= 3/2	= 2	= 3	= 6	= 24	= 48
				1	**= 5/4**	= 5/3	= 5/2	= 5	= 20	= 40
					1	**= 4/3**	= 2	= 4	= 16	= 32
						1	**= 3/2**	= 3	= 12	= 24
							1	**= 2**	= 8	= 16
								1	**= 4**	= 8
									1	**= 2**

3.5.1.3.3 Egyptian Units of Weight

Table 3-54 Egyptian units of weight
[1 deben = 13.65 × 10^{-3} kg]

Talent (kikkar)	Mine	Kedet	Deben (sicles)	Sep	Grain	Gerah (obol)
1	**50**	= 300	3000	30 000	45 000	= 60 000
	1	= 6	= 60	=600	= 900	= 1200
		1	= 10	= 100	= 150	= 200
			1	= 10	= 15	= 20
				1	= 3/2	= 2
					1	= 4/3

3.5.1.3.4 Egyptian Units of Capacity

Table 3-55 Egyptian units of capacity (measured by weight)
[1 khar = 34 kg]

Letech	Artabe	Metretes of Heron	Khar (keramion)	Apt	Hecte	Maân (mine)	Outen
1	**= 45/16**	= 27/8	= 135/32	= 135/8	= 135/2	= 675/4	= 675
	1	**= 6/5**	= 3/2	= 6	= 24	= 60	= 240
		1	**= 5/4**	= 5	= 20	= 50	= 200
			1	**= 4**	= 16	= 40	= 160
				1	**= 4**	= 10	= 40
					1	**= 5/2**	= 10
						1	**= 4**

3.5.1.4 The Assyrio-Chaldean-Persian System

3.5.1.4.1 Persian Units of Length

These are shown in ***Table 3-56*** (opposite).

3.5.1.4.2 Persian Units of Area

Table 3-57 Persian units of area
[1 gar = 14.7456 m^2 = 1 sq. qasab (E)]

Gur	Gan	Ten	Gar	Square zereth
1	**= 10**	= 100	= 1000	= 144 000
	1	= 10	= 100	= 14 400
		1	**= 10**	= 1440
			1	**= 144**

Table 3-56 Persian units of length

[1 foot (Persian) = 1 zereth (persian) = 0.320 m]

Mansion (stathmos)	**Schoëme**	**Parasang**	**Mille** (mile)	**Ghalva** (stadion)	**Chebel**	**Qasab** (cane)	**Pace**	**Cubit** (long)	**Zereth** (foot)	**Palm**	**Finger**
1	**= 100/27**	= 4	= 400/27	= 1000/9	= 1000	= 20 000/3	= 40 000/3	= 40 000	= 80 000	= 320 000	= 1 280 000
	1	**= 27/25**	= 4	= 30	= 270	= 1800	= 3600	= 10 800	= 21 600	= 86 400	= 345 600
		1	**= 100/27**	= 250/9	= 250	= 5000/3	= 10 000/3	= 10 000	= 20 000	= 80 000	= 320 000
			1	**= 15/2**	= 135/2	= 450	= 900	= 2700	= 5400	= 21 600	= 86 400
				1	**= 9**	= 60	= 120	= 360	= 720	= 2880	= 11 520
					1	**= 20/3**	= 40/3	= 40	= 80	= 320	= 1 280
						1	**= 2**	= 6	= 12	= 48	= 192
							1	**= 3**	= 6	= 24	= 96
								1	**= 2**	= 8	= 32
									1	**= 4**	= 16
										1	= 4

3.5.1.4.3 Persian Units of Weight

Table 3-58 Persian units of weight
[1 talent = 32.6 kg]

Talent	Mine	Drachm
1	100	10 000
	1	100

3.5.1.4.4 Persian Units of Capacity

Table 3-59 Persian units of capacity (measured by weight)
[1 amphora = 32.60 kg]

Gariba	Long amphora	Long artaba	Short artaba	Amphora	Woëbe (modius)	Makuk	Cados
1	**= 8/3**	= 4	= 16/3	= 8	= 16	= 64	= 256
	1	**= 3/2**	= 2	= 3	= 6	= 24	= 96
		1	**= 4/3**	= 2	= 4	= 16	= 64
			1	**= 3/2**	= 3	= 12	= 48
				1	**= 2**	= 8	= 32
					1	**= 4**	= 16
						1	**= 4**

1 subit = 1.5 feet

3.5.1.5 The Hebrew System

3.5.1.5.1 Hebrew Units of Length

Table 3-60 Hebrew units of length
[1 sacred cubit = 0.640 m]
[1 cubit = 0.555 m]

Cubit (long)	Zereth (foot)	Palm	Finger
1	**= 2**	= 6	= 24
	1	**= 3**	= 12
		1	**= 4**

3.5.1.5.2 Hebrew Units of Weight (Sacred System)

Table 3-61 Hebrew units of weight (sacred system)
[1 mina = 0.850 kg]

Talent of Moses	Mina	Shekel	Bekah	Rabah	Gerah (Obol)
1	**= 50**	= 3000	= 6000	= 12 000	= 60 000
	1	**= 60**	= 120	= 240	= 1200
		1	**= 2**	= 4	= 20
			1	**= 2**	= 10
				1	**= 5**

3.5.1.5.3 Hebrew Units of Weight (Talmudic or Rabbinical System)

Table 3-62 Hebrew units of weight (Talmudic or Rabbinical system)
[1 mina = 0.3542 kg]

Talent	Mina	Shekel	Zuzah (Drachm)	Mehah (Obol)	Pondiuscule
1	**= 60**	= 1500	= 6000	= 36 000	= 72 000
	1	**= 25**	= 100	= 600	= 1200
		1	**= 4**	= 24	= 48
			1	**= 6**	= 12
				1	**= 2**

3.5.1.5.4 Hebrew Units of Capacity (Dry)

Table 3-63 Hebrew units of capacity (measured by weight)
(Dry products)
[1 ephah (Old) = 29.376 kg]
[1 ephah (New) = 21.420 kg]

Cor	Ephah	Sath (modius)	Gomor	Cab	Log
1	**= 10**	= 100/3	= 100	= 180	= 720
	1	**= 10/3**	= 10	= 18	= 72
		1	**= 3**	= 27/5	= 108/5
			1	**= 9/5**	= 36/5
				1	**= 4**

3.5.1.5.5 Hebrew Units of Capacity (Liquids)

Table 3-64 Hebrew units of capacity (measured by weight) (Liquids)
[1 bath (Old) = 29.376 kg]
[1 bath (New) = 21.420 kg]

Cor	Bath	Hin	Log
1	**= 10**	= 60	= 720
	1	**= 6**	= 72
		1	**= 12**

3.5.1.6 The Greek System (Attic)

3.5.1.6.1 Greek Units of Length

These are shown in ***Table 3-65*** (opposite).

Table 3-65 Greek (Attic) units of length

[1 pous = 0.30856 m]

Mile	**Stadion**	**Plethron**	**Amma** (cord)	**Akaina**	**Orguia** (fathom)	**Bema** (pace)	**Long cubit**	**Pous** (foot)	**Spithane** (span)	**Dichas**	**Palestra** (palm)	**Condylos**	**Daktylos** (finger)
1	**= 15/2**	= 45	= 75	= 500	= 750	= 1800	= 2250	= 4500	= 6000	= 9000	= 18 000	= 36 000	= 72 000
	1	**= 6**	= 10	= 200/3	= 100	= 240	= 300	= 600	= 800	= 1200	= 2400	= 4800	= 9600
		1	**= 5/3**	= 100/9	= 50/3	= 40	= 50	= 100	= 400/3	= 200	= 400	= 800	= 1600
			1	**= 20/3**	= 10	= 24	= 30	= 60	= 80	= 120	= 240	= 480	= 960
				1	**= 3/2**	= 18/5	= 9/2	= 9	= 12	= 18	= 36	= 72	= 144
					1	**= 12/5**	= 3	= 6	= 8	= 12	= 24	= 48	= 96
						1	**= 5/4**	= 5/2	= 10/3	= 5	= 10	= 20	= 40
							1	**= 2**	= 8/3	= 4	= 8	= 16	= 32
								1	**= 4/3**	= 2	= 4	= 8	= 16
									1	**= 3/2**	= 3	= 6	= 12
										1	**= 2**	= 4	= 8
											1	**= 2**	= 4
												1	**= 2**

1 stathmos = 80 000 pous
1 dolichas = 6 diaulos
1 diaulos = 2 stadia
1 xylon = 4.5 pous
1 pechya = 24 digits
1 pygon = 20 digits
1 cubit = 1.5 pous

3.5.1.6.2 Greek Units of Weight

Table 3-66 Greek (Attic) units of weight
[1 talent = 25.920 kg]

Talent	Mine	Drachma	Diobol	Obol	Chalque
1	**= 60**	= 6000	= 18 000	= 36 000	= 288 000
	1	**= 100**	**= 300**	**= 600**	= 4800
		1	**= 3**	= 6	= 48
			1	**= 2**	= 16
				1	= 8

3.5.1.6.3 Greek Units of Capacity (Dry)

The Greek system of capacity measures, which was divided into two sub-systems, one for dry substances and one other for liquids, was the following:

Table 3-67 Greek (Attic) units of capacity (Dry products)
[1 cotyle = 0.27 dm^3]

Medimnos	Hektos (modius)	Chenica	Sexte	Cotyle	Oxybaphon	Cyanthos
1	**= 6**	= 48	= 96	= 192	= 768	= 1152
	1	**= 8**	= 16	= 32	= 128	= 192
		1	**= 2**	= 4	= 16	= 24
			1	**= 2**	= 8	= 12
				1	**= 4**	= 6
					1	**= 3/2**

3.5.1.6.4 Greek Units of Capacity (Liquids)

Table 3-68 Greek (Attic) units of capacity (Liquids)
[1 cotyle = 0.27 dm^3]

Metretes	Amphora	Maris	Khous (congius)	Cotyle
1	**= 2**	= 6	= 12	= 144
	1	**= 3**	= 6	= 64
		1	**= 2**	= 24
			1	**= 12**

3.5.1.7 The Roman System

The Roman system of weights and measures was among the many customs adopted by the peoples conquered by the Romans throughtout Europe and western Asia.

3.5.1.7.1 Roman Units of Length

These are shown in ***Table 3-69*** (overleaf).

3.5.1.7.2 Roman Units of Area

See ***Table 3-70*** (p. 71).

Table 3-69 Roman units of length

[1 pes (common) = 0.2944 m]
[1 pes (Druisian) = 0.3196 m]
[1 pes (legal, 1st) = 0.2962 m]
[1 pes (legal, 2nd) = 0.2967 m]

Milliarum (mile)	**Actus** (chain)	**Decempeda** (perch)	**Passus** (double pace)	**Gradus** (simple pace)	**Cubitus** (cubit)	**Palmipes**	**Pes** (foot)	**Palmus** (span)	**Uncia** (inch)	**Digitus** (finger)
1	**= 125/3**	= 500	= 1000	= 2000	= 10 000/3	= 4000	= 5000	= 20 000	= 60 000	= 80 000
	1	**= 12**	= 24	= 48	= 80	= 96	= 120	= 480	= 1440	= 1920
		1	**= 2**	= 4	= 20/3	= 8	= 10	= 40	= 120	= 160
			1	**= 2**	= 10/3	= 4	= 5	= 20	= 60	= 80
				1	**= 5/3**	= 2	= 5/2	= 10	= 30	= 40
					1	**= 6/5**	= 3/2	= 6	= 18	= 24
						1	**= 5/4**	= 5	= 15	= 20
							1	**= 4**	= 12	= 16
								1	**= 3**	= 4
									1	**= 4/3**

1 palmipes = 1 pes + 1 palmus (E)
1 cubitus = 1 palmipes + 2 palmus
1 gradus = 2 pes + 2 palmus (E)
1 stadium = 625 pes (E)
1 schoenus = 20 000 pes (E)
1 legua = 7500 pes (E)

Table 3-70 Roman units of area

[1 quadratus pes (legal, 1st) = 8.773444×10^{-2} m^{-2}]

[1 quadratus pes (common à levoil) = 8.667136×10^{-2} m^2]

Saltus	Centurium	Heredium	Jugerum	Actus	Versum	Clima	Short actus	Decempeda quadrata	Quadratus pes
1	**= 4**	= 400	= 800	= 1600	= 2304	= 6400	= 57 600	= 230 400	= 23 040 000
	1	**= 100**	= 200	= 400	= 576	= 1600	= 14 400	= 57 600	= 5 760 000
		1	**= 2**	= 4	= 144/25	= 16	= 144	= 576	= 57 600
			1	**= 2**	= 72/25	= 8	= 72	= 288	= 28 800
				1	**= 36/25**	= 4	= 36	= 144	= 14 400
					1	**= 25/9**	= 25	= 100	= 10 000
						1	= 9	= 36	= 3 600
							1	**= 4**	= 400
								1	**= 100**

3.5.1.7.3 Roman Units of Weight

See ***Table 3-71*** (p. 74).

3.5.1.7.4 Roman Units of Capacity (Dry)

Table 3-72 Roman units of capacity (Dry materials)
[1 modius = 8.788480 dm^3]

Quadrantal	**Modius** (muid)	Semodius	**Sextarius** (setier)	Hemina
1	**= 3**	= 6	= 48	= 96
	1	**= 2**	= 16	= 32
		1	**= 8**	= 16
			1	**= 2**

3.5.1.7.5 Roman Units of Capacity (Liquids)

See ***Table 3-73*** (p. 75).

3.5.1.8 The Arabic System

3.5.1.8.1 Arabic Units of Length

See ***Table 3-74*** (p. 76).

3.5.1.8.2 Arabic Units of Area

See ***Table 3-75*** (p. 77).

3.5.1.8.3 Arabic Units of Weight (System of the Prophet)

See ***Table 3-76*** (p. 77).

3.5.1.8.4 Arabic Units of Capacity

See ***Table 3-77*** (p. 78).

3.5.2 Obsolete National and Regional Systems

3.5.2.1 Western and Southern Europe

3.5.2.1.1 Old French System (Ancien Régime)

In France, under the *Ancien Régime* (i.e., before the French Revolution of 1789), the old measures derived from the system of Charlemagne. However, units varied from one region to another; subdivisions were irregular and also suffered regional variations, which tended to complicate business transactions.

The international metric system has been compulsory since 1794.

Table 3-71 Roman units of weight

[1 uncia = 0. 02725 kg]

Libra (podium)	**Deunx**	**Dextans**	**Dodrans**	**Bes**	**Septunx**	**Semis**	**Quicunx**	**Triens**	**Quadrans**	**Sextans**	**Uncia** (ounce)	**Semuncia**	**Scripulum**
1	= 12/11	= 6/5	= 4/3	= 3/2	= 12/7	= 2	= 12/5	= 3	= 4	= 6	= 12	= 24	= 288
	1	**= 11/10**	= 11/9	= 11/8	= 11/7	= 11/6	= 11/5	= 11/4	= 11/3	= 11/2	= 11	= 22	= 264
		1	**= 10/9**	= 5/4	= 10/7	= 5/3	= 2	= 5/2	= 10/3	= 5	= 10	= 20	= 240
			1	**= 9/8**	= 9/7	= 3/2	= 9/5	= 9/4	= 3	= 9/2	= 9	= 18	= 216
				1	**= 8/7**	= 4/3	= 8/5	= 2	= 8/3	= 4	= 8	= 16	= 192
					1	**= 7/6**	= 7/5	= 7/4	= 7/3	= 7/2	= 7	= 14	= 168
						1	**= 6/5**	= 3/2	= 2	= 3	= 6	= 12	= 144
							1	**= 5/4**	= 5/3	= 5/2	= 5	= 10	= 120
								1	**= 4/3**	= 2	= 4	= 8	= 96
									1	**= 3/2**	= 3	= 6	= 72
										1	**= 2**	= 4	= 48
											1	**= 2**	= 24
												1	**= 12**

1 centum podium = 100 libra
1 mina = 5/3 libra
1 sescuncia = 1/2 uncia

Table 3-71 Roman units of weight *(continued)* [1 uncia = 0.02725 kg]

Libra (podium)	**Uncia** (ounce)	**Semuncia**	**Duella**	**Sicilium**	**Miliaresium**	**Solidus** (sextula)	**Denarius**	**Denier**	**Scripulum**
1	**= 12**	= 24	= 36	= 48	= 60	= 72	= 84	= 96	= 288
	1	**= 2**	= 3	= 4	= 5	= 6	= 7	= 8	= 24
		1	**= 3/2**	= 2	= 5/2	= 3	= 7/2	= 4	= 12
			1	**= 4/3**	= 5/3	= 2	= 7/3	= 8/3	= 8
				1	**= 5/4**	= 3/2	= 7/4	= 2	= 6
					1	**= 6/5**	= 7/5	= 8/5	= 24/5
						1	**= 7/6**	= 4/3	= 4
							1	**= 8/7**	= 24/7
								1	**= 3**

Table 3-73 Roman units of capacity (liquids) [1 sextarius = 0.54928 dm^3]

Culleus (dolium) (hogshead)	**Amphora** (metrete)	**Urna** (urn)	**Congius** (gallon)	**Sextarius** (setier)	**Hemina**	**Quartus**	**Acetabulum**	**Cyathus**
1	**= 20**	**= 40**	= 160	= 960	= 1920	= 3840	= 7680	= 11 520
	1	**= 2**	= 8	= 48	= 96	= 192	= 384	= 576
		1	**= 4**	= 24	= 48	= 96	= 192	= 288
			1	**= 6**	= 12	= 24	= 48	= 72
				1	**= 2**	= 4	= 8	= 12
					1	**= 2**	= 4	= 6
						1	**= 2**	= 3
							1	**= 3/2**

1 cochlearia = 1/48 sextarius (e)

1 chenica = 3/2 sextarius (E)

Table 3-74 Arabic units of length

[1 foot (Arabic) = 0.320 m]

Marhala	**Barid** (veredus)	**Parasang**	**Mille**	**Ghalva**	**Seir** (stadion)	**Qasab**	**Orgye** (pace)	**Cubit** (hachemic)	**Cubit** (new)	**Foot**	**Cabda** (palm)	**Assbaa** (finger)
1	**= 2**	= 8	= 24	= 200	= 240	= 12 000	= 24 000	= 72 000	= 96 000	= 144 000	= 576 000	= 2 304 000
	1	**= 4**	= 12	= 100	= 120	= 6000	= 12 000	= 36 000	= 48 000	= 72 000	= 2 88 000	= 1 152 000
		1	**= 3**	= 25	= 30	= 1500	= 3000	= 9000	= 12 000	= 18 000	= 72 000	= 288 000
			1	**= 225/27**	= 10	= 500	= 1000	= 3000	= 4000	= 6000	= 24 000	= 96 000
				1	**= 6/5**	= 60	= 120	= 360	= 480	= 720	= 2880	= 11 520
					1	**= 50**	= 100	= 300	= 400	= 600	= 2400	= 9600
						1	**= 2**	= 6	= 8	= 12	= 48	= 192
							1	**= 3**	= 4	= 6	= 24	= 96
								1	= 4/3	= 2	= 8	= 32
									1	**= 3/2**	= 6	= 24
										1	**= 4**	= 16
											1	**= 4**

Table 3-75 Arabic units of area

[1 feddan = 5898.24 m^2]

Feddan	**Djarib**	**Daneq**	**Qirat**	**Cafiz**	**Habbah**	**Qamha**	**Qasaba** (Achir)	**Square cubit** (Hachemic)
1	**= 4**	= 6	= 24	= 40	= 72	= 96	= 400	= 14 400
	1	**= 3/2**	= 6	= 10	= 18	= 24	= 100	= 3600
		1	= 4	= 20/3	= 12	= 16	= 200/3	= 2400
			1	**= 5/3**	= 3	= 4	= 50/3	= 600
				1	**= 9/5**	= 12/5	= 10	= 360
					1	**= 4/3**	= 50/9	= 200
						1	**= 25/6**	= 150
							1	**= 36**

Table 3-76 Arabic units of weight (so-called *System of the Prophet*)

[1 rotl = 0.340 kg]

Kikkar	**Quanthar** (talent)	**Ocque** (oka)	**Man** (mine)	**Rotl** (rotolo)	**Oukia**	**Nasch**	**Nevat**	**Dihrem**
1	**= 5/4**	= 125/4	= 125/2	= 125	= 375	= 750	= 3000	= 15 000
	1	**= 25**	= 50	= 100	= 300	= 600	= 2400	= 12 000
		1	**= 2**	= 4	= 12	= 24	= 96	= 480
			1	**= 2**	= 6	= 12	= 48	= 240
				1	**= 3**	= 6	= 24	= 120
					1	**= 2**	= 8	= 40
						1	**= 4**	= 20
							1	**= 5**

Table 3-77 Arabic units of capacity (measured by weight)

[1 cafiz = 32.640 kg]

Gariba (den)	**Artabe** (amphora)	**Modius**	**Cafiz** (talent)	**Khoull** (woëbe)	**Ferk**	**Makuk**	**Sâa**	**Caphite** (kist, kiladja)	**Mudd**
1	**= 4**	= 32/5	= 8	= 16	= 32	= 64	= 96	= 192	= 384
	1	**= 8/5**	= 2	= 4	= 8	= 16	= 24	= 48	= 96
		1	**= 5/4**	= 5/2	= 5	= 10	= 15	= 30	= 60
			1	**= 2**	= 4	= 8	= 12	= 24	= 48
				1	= 2	= 4	= 6	= 12	= 24
					1	= 2	= 3	= 6	= 12
						1	**= 3/2**	= 3	= 6
							1	= 2	= 4
								1	**= 2**

3.5.2.1.1.1 Old French Units of Length

Table 3-78 Old French units of length
[1 pied (de Paris) = 1 pied du Roi (Charlemagne) = 0.3248394167 m]
[1 toise (de Perou) = 1.9490365 m (E)]

Lieue (league)	**Perche** (perch)	**Toise**	**Aune** (ell)	**Pied** (foot)	**Pouce** (inch)	**Ligne** (line)	**Point** (point)
1	**= 380/3**	= 2 280	= 6840	= 13 680	= 161 160	= 1 969 920	= 23 639 040
	1	**= 3**	= 9	= 18	= 216	= 2592	= 31 104
		1	**= 3**	**= 6**	= 72	= 864	= 10 368
			1	**= 2**	= 24	= 288	= 3456
				1	**= 12**	= 144	= 1728
					1	= 12	= 144
						1	= 12

1 lieue (Gauloise) = 2222 m
1 lieue (de Paris) = 1666 toises (1674)
1 lieue (de Paris) = 2000 toises (1674–1737)
1 lieue (de Paris) = 2280 toises (1737–1794)
1 perche (ordinaire) = 20 pieds
1 perche (eaux & forêts) = 22 pieds

Table 3-79 Old French nautical units of length
[1 pied (de Paris) = 0.3248394167 m]
[1 toise (de Perou) = 1.9490365 m (E)]

Lieue marine (nautical league)	**Mille marin** (nautical mile)	**Encablure** (cable length)	**Toise**	**Brasse** (fathom)	**Pied** (foot)
1	= 3	= 30	= 3000	= 3600	= 18 000
	1	= 10	= 1000	= 1200	= 6000
		1	= 100	= 120	= 600
			1	= 6/5	= 6
				1	**= 5**

3.5.2.1.1.2 Old French Units of Area

Table 3-80 Old French units of area
[1 pied carré (de Paris) = 0.105520646642 m^2]

Arpent (Eaux et Forêts)	**Arpent** (de Paris)	**Perche** (Eaux et Forêts)	**Perche** (de Paris)	**Toise carrée**	**Pied carré**
1	**= 121/81**	**= 100**	= 12 100/81	= 12 100/9	= 48 400
	1	**= 8100/121**	= 100	= 900	= 32 400
		1	**= 121/81**	= 121/9	= 484
			1	**= 9**	= 324
				1	**= 36**

1 journal = 40 ares
1 vergé = 1/4 arpent
1 quartier = 25 perches
1 acre = 160 perches

Definition of the journal: surface labourable par un homme en une journée d'été.

Bordeaux	1 journal = 31.9 ares
Saint–Brieuc	1 journal = 40 ares
Mamers	1 journal = 44 ares
Nord de la Mayenne	1 journal = 50 ares
Domfront	1 journal = 50 ares

Table 3-81 Old French units of area (regional variations)

Region	Unit of area	Other Units
Normandie	Acre	1 acre = 160 perches (for land) 1 quartier = 25 perches (for forest)
Bourgogne	Journal	1 journal = 360 perches de 9 pieds et demi (aire que 8 hommes peuvent bécher par une journée d'été) 1 arpent = 440 perches
Dauphiné	Sestérée	1 sestérée = 900 cannes quarrées 1 sestérée = 4 cartelées 1 cartelée = 4 civadiers 1 civadier = 4 picotins
Provence	Saumée	1 saumée = 1500 cannes quarrées 1 saumée = $2\frac{1}{2}$ cartelées 1 cartelée = 4 civadiers 1 civadier = 4 picotins
Languedoc	Saumée	1 saumée = 1600 cannes quarrées 1 canne = 8 pans 1 pan = 8 pouces et 9 lignes
Bretagne	Journal	1 journal = $22\frac{1}{3}$ seillons 1 seillon = 6 raies 1 raie = $2\frac{1}{2}$ gaules 1 gaule = 12 pieds
Tourraine	Arpent	1 arpent = 100 chaines 1 chaine = 25 pieds 1 pied = 12 pouces
Lorraine	Journal	1 journal = 250 toises quarrées 1 toise = 10 pieds 1 pied = 10 pouces
Orléanais	Arpent	1 arpent = 100 perches quarrées 1 perche = 20 pieds 1 pied = 12 pouces

3.5.2.1.1.3 Old French Units of Capacity

Units of capacity for liquids are shown in ***Table 3-82*** (opposite).

Table 3-83 Old French units of capacity (Dry materials)
[1 sétier = 151.68 dm^3]

Muid	Setier	Mine	Minot	Boisseau	Quart	Litron
1	**= 12**	= 24	= 48	= 144	= 576	= 2304
	1	**= 2**	= 4	= 12	= 48	= 192
		1	= 2	= 6	= 24	= 96
			1	**= 3**	= 12	= 48
				1	**= 4**	= 16
					1	**= 4**

1 voie (de Paris) = 1.920 m^3 (for wood)
1 voie (de Paris) = 4 pieds × 4 pieds × 3 pieds 6 pouces
1 corde (Eaux et Forêts) = 8 pieds × 4 pieds × 3 pieds 6 pouces

3.5.2.1.1.4 Old French Units of Weight

These are shown in ***Tables 3-84*** and ***3-85*** (opposite).

Table 3-82 Old French units of capacity (Liquids)

[1 pinte (de Paris) = 0.952146258475 dm^3] = 48 pouches cubes (Def. 1742)

Muid	Feuillette	Quartaut	Velte	Pot (quade, cade)	Pinte (pint)	Chopine (sétier)	Demi-setier	Posson	Demi-posson	Roquille
1	**= 2**	= 4	= 36	= 144	= 288	= 576	= 1152	= 2304	= 4608	= 9216
	1	**= 2**	= 18	= 72	= 144	= 288	= 576	= 1152	= 2304	= 4608
		1	**= 9**	= 36	= 72	= 144	= 288	= 576	= 1152	= 2304
			1	**= 4**	= 8	= 16	= 32	= 64	= 128	= 256
				1	**= 2**	**= 4**	**= 8**	**= 16**	**= 32**	**= 64**
					1	**= 2**	= 4	**= 8**	**= 16**	**= 32**
						1	**= 2**	= 4	**= 8**	**= 16**
							1	**= 2**	= 4	**= 8**
								1	**= 2**	= 4
									1	**= 2**

1 pipe = 1.5 muid
1 tonneau de jauge = 2.83 m^3
1 tonneau de mer = 1.44 m^3
1 muid = 1 tonneau

Table 3-84 Old French units of weight

[1 livre (de Paris) = 0.48950585 kg]

Tonneau de mer	Millier (thousand)	Quintal (quintal)	Livre (pound)	Marc (mark)	Quarteron	Once (ounce)	Lot	Gros (drachm)	Denier (scruple)	Grain (grain)
1	= 2	= 20	= 2000	= 4000	= 8000	= 32 000	= 64 000	= 256 000	= 768 000	= 18 132 000
	1	= 10	= 1000	= 2000	= 4000	= 16 000	= 32 000	= 128 000	= 384 000	= 9 216 000
		1	= 100	= 200	= 400	= 1600	= 3200	= 12 800	= 38 400	= 921 600
			1	= 2	= 4	= 16	= 32	= 128	= 384	= 9216
				1	= 2	= 8	= 16	= 64	= 192	= 4608
					1	= 4	= 8	= 32	= 96	= 2304
						1	= 2	= 8	= 24	= 576
							1	= 4	= 12	= 288
								1	= 3	= 72
									1	= 24

1 marc = 160 esterlin
1 esterlin = 2 oboles (mailles)
1 obole = 2 filins
1 grain = 24 primes

Table 3-85 Old French units of weight (Charlemagne)

[1 livre du Roi (Charlemagne) = 0.367128 kg]

Livre	Sol	Denier	Obole	Grain
1	= 20	= 240	= 480	= 5760
	1	= 12	= 24	= 288
		1	= 2	= 24
			1	= 12

3.5.2.1.2 Old French System (1812–1840)

In 1812, the old weights and measures used before 1789 were restored by the French Emperor Napoleon Bonaparte. These pseudo-metric units were as follows:

3.5.2.1.1.2 Old French Units of Length (Metric)

Table 3-86 Old French units of length (metric)
(period 1812–1840)
[1 pied (metric) = 0.333 m = 1/3 m (E)]

Lieue (metric)	**Mille** (metric)	**Toise** (metric)	**Pied** (metric)	**Pouche** (metric)	**Ligne** (metric)
1	**= 3**	= 2000	= 12 000	= 144 000	= 1 728 000
	1	**= 2000/3**	= 4000	= 48 000	= 576 000
		1	**= 6**	= 72	= 864
			1	**= 12**	= 144
				1	**= 12**

3.5.2.1.1.2 Old French Units of Weight (Metric)

Table 3-87 Old French units of weight (metric)
[1 livre (metric) = 1 kg (E)]

Millier (metric)	**Quintal** (metric)	**Livre** (metric)	**Once** (metric)	**Gros** (metric)	**Denier** (metric)	**Grain** (metric)
1	**= 10**	= 1000	= 1000	= 10 000	= 100 000	= 1 000 000
	1	**= 100**	= 100	= 1000	= 10 000	= 100 000
		1	**= 10**	= 100	= 1000	= 10 000
			1	**= 10**	= 100	= 1000
				1	**= 10**	= 100
					1	**= 10**

However, the Law of July 4th, 1837 reinstated the metric system, making it obligatory in France from January 1st, 1840, and banning the use of other weights and measures from that date.

3.5.2.1.3 Old Belgian System

Metric system adopted in 1816 and compulsory since 1820. Old units derived from both French, and German systems.

3.5.2.1.3.1 Old Belgian Units of Length

Table 3-88 Old Belgian units of length
[1 perche (Belgian) = 6.497 m]

Perche	**Pied**
1	**= 20**

Note: 1 arpent = 100 square perches (E)

3.5.2.1.3.2 Old Belgian Units of Weight

Table 3-89 Old Belgian units of weight
[1 livre (Belgian) = 0.4895 kg]

Charge	Shiffpfund	Balle	Chariot	Quintal	Stein	Livre	Marc	Once	Loth
1	**= 4/3**	= 2	= 80/33	= 4	= 50	= 400	= 800	= 6400	= 12 800
	1	**= 3/2**	= 20/11	= 3	= 75/2	= 300	= 600	= 4800	= 9600
		1	**= 40/33**	= 2	= 25	= 200	= 400	= 3200	= 6400
			1	**= 33/20**	= 165/8	= 165	= 330	**= 2640**	= 5280
				1	**= 25/2**	= 100	= 200	= 1600	= 3200
					1	**= 8**	= 16	= 128	= 256
						1	**= 2**	= 16	= 32
							1	**= 8**	= 16
								1	**= 2**

3.5.2.1.4 Old Swiss System

Metric system adopted in 1868 and compulsory since 1877.

3.5.2.1.4.1 Old Swiss Units of Length

Table 3-90 Old Swiss units of length
[1 fuss (Swiss) = 0.30 m]

Lieue	Perche	Ruthe (toise)	Elle (aune)	Fuss (pied)	Zoll (pouce)	Linie (ligne)
1	**= 1000**	= 8000/3	= 8000	= 16 000	= 192 000	= 2 304 000
	1	**= 8/3**	= 8	= 16	= 192	= 2304
		1	**= 3**	= 6	= 72	= 864
			1	**= 2**	= 24	= 288
				1	**= 12**	= 144
					1	**= 12**

3.5.2.1.4.2 Old Swiss Units of Weight

Table 3-91 Old Swiss units of weight (ordinary)
[1 livre (Swiss) = 0.500 kg]

Livre	Once	Loth
1	**= 16**	= 32
	1	**= 2**

3.5.2.1.4.3 Old Swiss Units of Weight (Apoth.)

Table 3-92 Old Swiss units of weight (Apothecary)
[1 livre (Swiss, Apothecary) = 0.375 kg]

Livre (ordinary)	Livre (apothecary)	Once	Drachme	Scruple	Grain
1	**= 4/3**	= 16	= 128	= 384	= 7680
	1	**= 12**	= 96	= 288	= 5760
		1	**= 8**	= 24	= 480
			1	**= 3**	= 60
				1	**= 20**

3.5.2.1.5 Old Scottish System

Scottish measures in use in Scotland before the adoption of *Imperial Weights and Measures Act* of 1824.

3.5.2.1.5.1 Old Scottish Units of Length

Table 3-93 Old Scottish units of length (before the *Imperial Weights and Measures Act* of 1824)

[1 foot (Scottish) = 0.306446084592 m]

Mile	Furlong	Chain	Fall	Ell	Foot	Inch
1	**= 8**	= 80	= 320	= 1920	= 5920	= 71 040
	1	**= 10**	= 40	= 240	= 740	= 8880
		1	**= 4**	= 24	= 74	= 888
			1	**= 6**	= 37/2	= 74
				1	**= 37/12**	= 37
					1	**=12**

3.5.2.1.5.2 Old Scottish Units of Surface Area

Table 3-94 Old Scottish units of surface area (before the *Imperial Weights and Measures Act* of 1824)

[1 square foot (Scottish) = 0.0939092027605 m]

Nook	Acre	Rod	Square fall	Square foot
1	**= 20**	= 80	= 3200	= 1 095 200
	1	**= 4**	= 160	= 54 760
		1	**= 40**	= 13 690
			1	**= 1369/4**

3.5.2.1.5.3 Old Scottish Units of Capacity

Table 3-95 Old Scottish units of capacity (Liquids) (before the *Imperial Weights and Measures Act* of 1824)

[1 gallon (Scottish, liquid) = 827.232 in^3 = 13.555 903 726 8 dm^3]

Barrel	Gallon	Quart	Pint (jug)	Choppin	Mutchkin	Gill
1	**= 8**	= 32	= 64	= 128	= 256	= 1024
	1	**= 4**	= 8	= 16	= 32	= 128
		1	**= 2**	= 4	= 8	= 32
			1	**= 2**	= 4	= 16
				1	**= 2**	= 8
					1	**= 4**

Table 3-96 Old Scottish units of capacity (Dry) (before the *Imperial Weights and Measures Act* of 1824)

[1 lippy (Scottish, Dry) = 137.333 in^3 (wheat, peas, beans, rice, salt) = 2.25048466031 dm^3]

[1 lippy (Scottish, Dry) = 200.345 in3 (oat, barley, malt) = 3.28306633708 dm3]

Chalder	Boll	Firlot	Peck	Lippy
1	**= 16**	= 64	= 256	= 1024
	1	**= 4**	= 16	= 256
		1	**= 4**	= 64
			1	**= 4**

3.5.2.1.5.4 Old Scottish Units of Weight

Table 3-97 Old Scottish units of weight (before the *Imperial Weights and Measures Act* of 1824)

[1 pound (Scottish) = 9520 grains = 0.616 885 623 200 kg]

Stone	Pound	Ounce	Drop	Grain
1	**= 16**	= 320	= 5120	= 152 320
	1	**= 20**	= 320	= 9520
		1	**= 16**	= 476
			1	**= 119/4**

3.5.2.1.6 Old Irish System

Irish measures in use in Ireland before the adoption of *Imperial Weights and Measures Act* of 1824.

3.5.2.1.6.1 Old Irish Units of Length

Table 3-98 Old Irish units of length (before the *Imperial Weights and Measures Act* of 1824)

[1 foot (Irish) = 0.3048 m]

Mile	Furlong	Chain	Perch, pole	Fathom	Link	Yard	Cubit	Foot	Inch
1	**= 8**	= 80	= 320	= 480	= 800	= 2240	= 4480	= 6720	= 80 640
	1	**= 10**	= 40	= 60	= 100	= 280	= 560	= 840	= 10 080
		1	**= 4**	= 6	= 10	= 28	= 56	= 84	= 1008
			1	**= 3/2**	= 5/2	= 7	= 14	= 21	= 252
				1	**= 5/3**	= 14/3	= 28/3	= 14	= 168
					1	**= 14/5**	= 28/5	= 42/5	= 504/5
						1	**= 2**	= 3	= 36
							1	**= 3/2**	= 18
								1	**= 12**

1 palm (Irish) = 3 inch (Irish) (E)
1 span (Irish) = 3 palm (Irish) (E)
1 pace (Irish) = 5 feet (Irish) (E)

3.5.2.1.6.2 Old Irish Units of Capacity

Table 3-99 Old Irish units of capacity (Liquids) (before the *Imperial Weights and Measures Act* of 1824)
[1 gallon (Irish) = 217.6 in^3 (E) = 3.565 825 126 40 dm^3]

Pipe	Tun	Hogshead (Puncheon)	Tierce	Barrel	Rundlet	Gallon	Pottle	Quart	Pint
1	**= 2**	= 4	= 8	= 32/3	= 56/3	= 504	= 1008	= 2016	= 16 128
	1	**= 2**	= 4	= 16/3	= 28/3	= 252	= 504	= 1008	= 8064
		1	**= 2**	= 8/3	= 14/3	= 126	= 252	= 504	= 4032
			1	**= 4/3**	= 7/3	= 42	= 84	= 168	= 1344
				1	**= 7/4**	= 63/2	= 63	= 126	= 1008
					1	**= 18**	= 36	= 72	= 576
						1	**= 2**	= 4	= 32
							1	**= 2**	= 16
								1	**= 8**

1 noggin (Irish) = 1/4 pint (Irish) (E)

3.5.2.1.7 Old Italian System

These units were in use before the adoption of the metric system. Their definition varies geographically, and some units have changed over the years. The metric system became compulsory in Italy in 1861, but it was adopted in Milan as early as 1803.

3.5.2.1.7.1 Old Italian Units of Length

Table 3-100 Old Italian units of length
[1 piede liprando = 0.51377 m]

Miglio (mile)	**Trabucco**	**Canna**	**Piede** (foot)	**Oncia** (inch)	**Punto** (point)
1	**= 6500/9**	= 3250/3	= 13 000/3	= 52 000	= 624 000
	1	**= 3/2**	= 6	= 72	= 864
		1	**= 4**	= 48	= 576
			1	**= 12**	= 144
				1	**= 12**

3.5.2.1.7.2 Old Italian Units of Weight

Table 3-101 Old Italian units of weight
[1 libbra = 0.307 kg]

Cantaro	**Rubbo**	**Libbra** (pound)	**Oncia** (ounce)	**Ottavo** (drachm)	**Denaro** (scruple)	**Grano** (grain)
1	**= 6**	= 150	= 1800	= 14 400	= 43 200	= 3 110 400
	1	**= 25**	= 300	= 2400	= 7200	= 172 800
		1	**= 12**	= 96	= 288	= 6912
			1	**= 8**	= 24	= 576
				1	**= 3**	= 72
					1	**= 24**

3.5.2.1.7.3 Old Italian Measures (Regional Variations)

Table 3-102 Old Italian measures (regional variations)

City	Measures of weight	Measures of length	Measures of capacity
Venezia (Venice)	1 libbra grossa = 12 once = 0.477 kg 1 libbra sottile = 0.301 kg	1 braccio = 0.683 m 1 piede = 0.348 m	1 moggio = 8 mezzeni = 333.3 l
Milano (Milan)	1 libbra grossa = 28 once = 0.763 kg	1 braccio = 12 once = 0.595 m 1 trabucco = 6 piedi	1 moggio = 8 staia = 146.2 l 1 brenta = 96 boccali = 75.6 l
Torino (Turin)	1 libbra = 12 once = 0.369 kg	1 trabucco = 6 piedi liprandi = 3.096 m 1 raso = 0.6 m 1 piede = 0.293 m	1 sacco = 5 mine = 115.3 l 1 carro = 10 brente = 493.11 l
Bologna	1 libbra mercantile = 12 once = 0.362 kg	1 braccio = 0.64 m 1 piede = 0.38 m	1 corba = 2 staia = 60 boccali = 78.6 l
Firenze (Florence)	1 libbra = 12 once = 0.3395 kg	1 braccio = 2 palmi = 0.583 m	1 moggio = 8 sacca = 584.7 l 1 barile (vino) = 20 fiaschi = 45.6 l 1 barile (olio) = 16 fiaschi = 33.43 l
Genova (Genoa)	1 libbra = 12 once = 0.317 kg	1 palmo = 0.248 m	1 mina = 116.5 l 1 barile = 70 l
Roma (Rome)	1 libbra = 12 once = 0.339 kg	1 canna = 10 palmi = 2.234 m	1 rubblo = 22 scorzi = 294.5 l 1 barile = 32 boccali = 75.5 l
Napoli (Naples)	1 rotolo = 0.861 kg 1 libbra = 12 once = 0.321 kg	1 canna = 10 palmi = 2.646 m	1 botte (vino) = 12 barili = 523.5 l 1 tomolo = 55.54 l
Palermo	1 cantaro = 100 rotoli = 79.34 kg 1 libbra = 12 once = 0.317 kg	1 canna = 10 palmi = 2.065 m	1 salma = 4 bisace = 16 tomoli = 275 l

3.5.2.1.8 Old Spanish System (Castillian)

The metric system has been compulsory since 1860.

3.5.2.1.8.1 Old Spanish Units of Length

These are shown in ***Table 3-103***.

3.5.2.1.8.2 Old Spanish Units of Area

Table 3-104 Old Spanish units of area
[1 square vara = 0.698737169025 m^2]

Yugada	Fanegada	Aranzada	Calemin	Cuartilla	Square vara
1	**= 50**	= 72	= 600	= 18 432	= 460 800
	1	**= 36/25**	= 12	= 9216/25	= 9216
		1	**= 25/3**	= 256	= 6400
			1	= 768/25	= 768
				1	= 25
					1

1 cahizada = 2058.5 m^2

Table 3-103 Old Spanish units of length

[1 vara = 0.835905 m]

Legua (league)	**Milla** (mile)	**Estadal** (perch)	**Estado** (fathom)	**Passo** (pace)	**Vara** (yard)	**Codos** (cubit)	**Pie** (foot)	**Palma** (palm)	**Sesma**	**Pulgada** (inch)	**Diedo** (finger)	**Linea** (line)	**Punto** (point)
1	**= 3**	= 1250	= 2500	= 3000	= 5000	= 10 000	= 15 000	= 20 000	= 30 000	= 180 000	= 240 000	= 2 880 000	= 34 560 000
	1	**= 1250/3**	= 2500/3	= 1000	= 5000/3	= 10 000/3	= 5000	= 20 000/3	= 10 000	= 60 000	= 80 000	= 960 000	= 11 520 000
		1	**= 2**	= 12/5	= 4	= 8	= 12	= 16	= 24	= 144	= 192	= 2 304	= 27 648
			1	**= 6/5**	= 2	= 4	= 6	= 8	= 12	= 72	= 96	= 1 152	= 13 824
				1	= 5/3	= 10/3	= 5	= 20/3	= 10	= 60	= 80	= 960	= 11 520
					1	= 2	= 3	= 4	= 6	= 36	= 48	= 576	= 6912
						1	**= 3/2**	= 2	= 3	= 18	= 24	= 288	= 3546
							1	**= 4/3**	= 2	= 12	= 16	= 192	= 2304
								1	**= 3/2**	= 9	= 12	= 144	= 1728
									1	= 6	= 8	= 96	= 1152
										1	= 4/3	= 16	= 192
											1	**= 12**	= 144
												1	= 12

1 legua (royal) = 24 000 pie

3.5.2.1.8.3 Old Spanish Units of Weight

These are shown in ***Table 3-105*** (opposite).

3.5.2.1.8.4 Old Spanish Units of Capacity (Liquids)

See ***Table 3-106*** (p. 92).

3.5.2.1.8.5 Old Spanish Units of Capacity (Dry)

Table 3-107 Old Spanish units of capacity (Dry materials)
[1 fanega = 55.501 dm^3]

Cahiz	Fanega	Cuartilla	Almude (calemin)	Medio	Cuartillo	Racion	Ochavillo
1	**= 12**	= 48	= 144	= 288	= 576	= 2304	= 9216
	1	**= 4**	= 12	= 24	= 48	= 192	= 768
		1	**= 3**	= 6	= 12	= 48	= 192
			1	**= 2**	= 4	= 16	= 64
				1	**= 2**	= 8	= 32
					1	**= 4**	= 16
						1	**= 4**

3.5.2.1.9 Old Portuguese System

The metric system has been compulsory since 1872.

3.5.2.1.9.1 Old Portuguese Units of Length

These are shown in ***Table 3-108*** (p. 92).

3.5.2.1.9.2 Old Portuguese Units of Area

Table 3-109 Old Portuguese units of area
[1 sq. vara = 1.199025 m^2]

Geira	Ferrado	Sq. vara
1	= 8	= 4840
	1	= 605

Table 3-105 Old Spanish units of weight

[1 libra = 0.460093 kg]

Tonnelada	Quintalmacho	Quintal	Barril	Arroba	Libra (pound)	Marco	Onza (ounce)	Escrupolo (scruple)	Ochava (caracter)	Adarme (drachm)	Dinero	Tomin	Arienzo	Grano (grain)
1	**= 40/3**	= 20	= 40	= 80	= 2000	= 4000	= 32 000	= 128 000	= 256 000	= 512 000	= 768 000	= 1 536 000	= 4 608 000	= 18 432 000
	1	**= 3/2**	= 3	= 6	= 150	= 300	= 2400	= 9600	= 19 200	= 38 400	= 57 600	= 115 200	= 345 600	= 1 382 400
		1	**= 2**	= 4	= 100	= 200	= 1600	= 6400	= 12 800	= 25 600	= 38 400	= 76 800	= 230 400	= 921 600
			1	**= 2**	= 50	= 100	= 800	= 3200	= 6400	= 12 800	= 19 200	= 38 400	= 115 200	= 460 800
				1	**= 25**	= 50	= 400	= 1600	= 3200	= 6400	= 9600	= 19 200	= 57 600	= 230 400
					1	**= 2**	= 16	= 64	= 128	= 256	= 384	= 768	= 2304	= 9216
						1	**= 8**	= 32	= 64	= 128	= 192	= 384	= 1152	= 4608
							1	= 4	= 8	= 16	= 24	= 48	= 144	= 576
								1	= 2	= 4	= 6	= 12	= 36	= 144
									1	= 2	= 3	= 6	= 18	= 72
										1	= 3/2	= 3	= 9	= 36
											1	= 2	= 6	= 24
												1	= 3	= 12
													1	= 4

Table 3-106 Old Spanish units of capacity (Liquids)

[1 arroba (water) = 15.643162 dm^3]
[1 arroba (wine) = 16.133 dm^3]
[1 arroba (oil) = 12.563 dm^3]

Bota	**Pipa**	**Moio**	**Arroba** (cantarra)	**Cuartilla**	**Azumbre**	**Cuartillo** (libra)	**Panilla** (quarterone)	**Copas**
1	**= 10/9**	= 15/8	= 30	= 120	= 240	= 960	= 3000	= 3840 × 10^8
	1	**= 27/16**	= 27	= 108	= 216	= 864	= 2700	= 3456 × 10^8
		1	**= 16**	= 64	= 128	= 512	= 1600	= 2048 × 10^8
			1	**= 4**	= 8	= 32	= 100	= 128
				1	**= 2**	= 8	= 25	= 32
					1	**= 4**	= 25/2	= 16
						1	= 25/8	= 4
							1	**= 32/25**

Table 3-108 Old Portuguese units of length

[1 pe = 0.3285 m]

Legoa (league)	**Milha** (mile)	**Estadio** (stade)	**Vara** (yard)	**Covada**	**Pe** (foot)	**Palmo** (palm)	**Pollegada** (inch)	**Linha** (line)
1	**= 3**	= 24	= 5664	= 9440	= 18 800	= 28 320	= 226 560	= 2 178 720
	1	**= 8**	= 1888	= 9440/3	= 18 800/3	= 9440	= 75 520	= 906 240
		1	**= 236**	= 1180/3	= 2360/3	= 1180	= 9440	= 113 280
			1	**= 5/3**	= 10/3	= 5	= 40	= 480
				1	**= 2**	= 3	= 24	= 288
					1	**= 3/2**	= 12	= 144
						1	**= 8**	= 96
							1	**= 12**

1 legoa (naut.) = 16910 pe

1 milha (naut.) = 5637 pe

3.5.2.1.9.3 Old Portuguese Units of Weight

Table 3-110 Old Portuguese units of weight
[1 libra = 0.459 kg]

Quintal	Arroba	Libra (arratel)	Meio (marco)	Onca (ounce)	Outava (drachm)	Escrupolo (scruple)	Grao (grain)
1	**= 4**	= 128	= 256	= 2048	= 16 384	= 49 152	= 1 179 648
	1	**= 32**	= 64	= 512	= 4096	= 12 288	= 249 912
		1	= 2	= 16	= 128	= 384	= 9216
			1	= 8	= 64	= 192	= 4608
				1	= 8	= 24	= 576
					1	= 3	= 72
						1	= 24

3.5.2.1.9.4 Old Portuguese Units of Capacity (Dry)

Table 3-111 Old Portuguese units of capacity (Dry)
[1 fanga = 54 dm^3]

Moio	Fanga	Alqueira	Meio	Quarto	Outava
1	**= 15**	= 60	= 120	= 240	= 480
	1	**= 4**	= 8	= 16	= 32
		1	**= 2**	= 4	= 8
			1	**= 2**	= 4
				1	**= 2**

3.5.2.1.9.5 Old Portuguese Units of Capacity (Liquids)

Table 3-112 Old Portuguese units of capacity (Liquids)
[1 almude = 16.5 dm^3]

Tonnelada	Bota (pipa)	Almude	Alqueira	Canada	Meio	Quartillo
1	**= 2**	= 52	= 312	= 624	= 1248	= 2496
	1	**= 26**	= 156	= 312	= 624	= 1248
		1	**= 6**	= 12	= 24	= 48
			1	**= 2**	= 4	= 8
				1	**= 2**	= 4
					1	**= 2**

3.5.2.1.10 Old Maltese System

Metric system adopted in 1910 and compulsory since 1921.

3.5.2.1.10.1 Old Maltese Units of Length

Table 3-113 Old Maltese units of length
[1 canna (Maltese) = 2.088 m]

Canna	Palmo
1	**= 8**

3.5.2.1.10.2 Old Maltese Units of Capacity

Table 3-114 Old Maltese units of capacity (Liquids)

1 salma (Maltese) = 290.944 m^3
1 baril (Maltese) = 43.162 m^3
1 caffiso (Maltese) = 20.457 m^3

3.5.2.1.10.3 Old Maltese Units of Weight

Table 3-115 Old Maltese units of weight
[1 rottolo (Maltese) = 0.79379 kg]

Cantaro	Rottolo	Libra	Ounce	Parto
1	**= 100**	= 175	= 2800	= 44 800
	1	**= 7/4**	= 28	= 448
		1	**= 16**	= 256
			1	**= 16**

3.5.2.1.11 Old Balearic Islands System

3.5.2.1.11.1 Old Balearic Units of Length

Table 3-116 Old Balearic units of length
[1 canna (Balearic) = 1.564 m]

Canna	Palmos
1	**= 8**

3.5.2.1.11.2 Old Balearic Units of Capacity (Liquids)

Table 3-117 Old Balearic units of capacity (Liquids)
[1 quartera (Balearic, liq.) = 71.97 dm^3]

Quartera	Barcella	Almude
1	**= 6**	= 36
	1	**= 6**

3.5.2.1.11.3 Old Balearic Units of Capacity (Dry)

Table 3-118 Old Balearic units of capacity (Dry)
[1 quartin (Balearic, dry) = 27.14 dm^3]

Quartin	Quarte	Almude
1	**= 13/2**	= 26
	1	**= 4**

3.5.2.1.11.4 Old Balearic Units of Weight

Table 3-119 Old Balearic units of weight
[1 rottolo (Balearic) = 0.408 kg]

Cargo	Cantaro	Cantaro barbaresco	Misura	Arroba	Quartano (Corta)	Libra mayor	Rottolo
1	**= 27**	= 1404/50	= 78	= 12	= 104/3	= 104	= 312
	1	**= 52/50**	= 26/9	= 4	= 104/9	= 104/3	= 104
		1	**= 100/36**	= 50/13	= 100/9	= 100/3	= 100
			1	**= 36/26**	= 4	= 12	= 36
				1	**= 26/9**	= 26/3	= 26
					1	= 3	= 9
						1	**= 3**

3.5.2.1.12 Old Greek System

Metric system adopted in 1836 and compulsory since 1922.

3.3.2.1.12.1 Old Greek Units of Length

Table 3-120 Old Greek units of length
[1 piki (Greek, short) = 0.648 m]
[1 piki (Greek, long) = 0.669 m]
[1 piki (Greek, mansonry) = 0.750 m]

3.5.2.1.12.2 Old Greek Units of Capacity

Table 3-121 Old Greek units of capacity
[1 oka (Greek, liquid) = 1.333 to 1.340 dm^3]
[1 baril (Greek, liquid) = 74.236 dm^3]

3.5.2.1.12.3 Old Greek Units of Weight

Table 3-122 Old Greek units of weight
[1 oka (Greek) = 1.280 kg]

Talanton	Stater	Mina	Oka	Pound	Dramme
1	**= 3**	= 100	= 120	= 300	= 46 875
	1	**= 100/3**	= 600/15	= 100	= 15 625
		1	**= 6/5**	= 3	= 1875/4
			1	**= 5/2**	= 3125/8
				1	**= 625/4**

3.5.2.1.13 Old Cypriot System

3.5.2.1.13.1 Old Cypriot Units of Length and Area

Table 3-123 Old Cypriot units of length and area

1 pic (Cypriot) = 2 foot (Cypriot) = 0.6096 m
1 scala (Cypriot) = 1 donum (Cyprus) = 1337.803776 m^2

3.5.2.1.13.2 Old Cypriot Units of Capacity

Table 3-124 Old Cypriot units of capacity
[1 oke (Cypriot) = 1.27855 dm^3]

Gomari	Medimno	Kile	Kouza	Kartos	Cass	Oke
1	**= 9/4**	= 9/2	= 63/4	= 63/2	= 1280/37	= 128
	1	**= 2**	= 7	= 14	= 560/37	= 56
		1	**= 7/2**	= 7	= 280/37	= 28
			1	**= 2**	= 80/37	= 8
				1	**= 40/37**	= 4
					1	**= 37/10**

3.5.2.1.13.3 Old Cypriot Units of Weight

Table 3-125 Old Cypriot units of weight
[1 oke (Cypriot) = 1.270058636 kg]

Ton	Aleppo	Kantar	Stone	Mussa	Oke (Uqqa)	Rottolo	Drachme
1	**= 40/9**	= 200/11	= 20	= 160	= 800	= 20 000/11	= 320 000
	1	**= 45/11**	= 9/2	= 36	= 180	= 4500/11	= 72 000
		1	**= 11/10**	= 44/5	= 44	= 100	= 17 600
			1	**= 8**	= 40	= 1000/11	= 16 000
				1	**= 5**	= 125/11	= 2000
					1	**= 25/11**	= 400
						1	**= 176**

3.5.2.1.14 Old Turkish System

Metric system adopted in 1869 and compulsory since 1933.

3.5.2.1.14.1 Old Turkish Units of Length

Table 3-126 Old Turkish units of length
[1 pic (Turkish) = 0.755397246487 m]

Nul	Pic	Urumb	Parmack	Hatt	Nocktat
1	**= 4000/3**	= 32 000/3	= 32 000	= 384 000	= 4 608 000
	1	**= 8**	= 24	= 288	= 3456
		1	**= 3**	= 36	= 432
			1	**= 12**	= 144
				1	**= 12**

3.5.3.1.14.2 Old Turkish Units of Area

Table 3-127 Old Turkish units of area
[1 square pic (Turkish) = 0.570625 m^2]

Djeril	Dunum	Square pic
1	**= 10 000/913**	= 16 000 000/913
	1	**= 1600**

Note: The 'dunum' or 'donum' was the unit of surface area used before 1933 for land measurements and originally imposed by Turkey on the Ottoman Empire including the Middle East and the Balkans. It was defined as the amount a pair of oxen can plough in one day.þ Its value varies with location, and it was later standardized as 1210 square yards, or a quarter of an acre. Sometimes, in Mesopotamia and Arabia, it corresponds to 3600 square yards, and hence was the equivalent of the journal. The Turkish Government stated in 1939 that a dunum was equal to a decare (i.e., one thousand square meters).

3.5.2.1.14.3 Old Turkish Units of Capacity

Table 3-128 Old Turkish units of capacity
[1 cubic zira (Turkish) = 1000 dm^3]

Cubic zira	Fortin	Kile	Chinik
1	**= 5/2**	= 10	= 40
	1	**= 4**	= 16
		1	**= 4**

3.5.2.1.14.4 Old Turkish Units of Weight

See ***Table 3-129*** overleaf.

Table 3-129 Old Turkish units of weight

[1 oka (Turkish) = 1.283 kg]

Tcheki	Kantar	Batman	Oka	Rottel	Yusdrum (cequi)	Miskal	Dirham (drachm)	Denke	Karat
1	**= 4**	= 88/3	= 176	= 400	= 704	= 140 800/3	= 70 400	= 281 600	= 1 126 400
	1	**= 22/3**	= 44	= 100	= 176	= 35 200/3	= 17 600	= 70 400	= 281 600
		1	**= 6**	= 300/22	= 24	= 1600	= 2400	= 9600	= 38 400
			1	**= 25/11**	= 4	= 800/3	= 400	= 1600	= 6400
				1	**= 44/25**	= 352/3	= 176	= 704	= 2816
					1	**= 200/3**	= 100	= 400	= 1600
						1	**= 3/2**	= 6	= 24
							1	**= 4**	= 16
								1	**= 4**

3.5.2.2 Central and Northern Europe

3.5.2.2.1 Old Austrian System

Metric system adopted in 1871 and compulsory since 1876. Older units derived from Prussian and German systems.

3.5.2.2.1.1 Old Austrian Units of Length

Table 3-130 Old Austrian units of length
[1 fuss (Austrian) = 0.316 08 m]
[1 ell (Austrian) = 0.779 2 m]

Meile	Ruthe	Klafter	Fuss	Zoll	Linie	Punkt
1	**= 2000**	= 4000	= 24 000	= 288 000	= 3 456 000	= 41 472 000
	1	**= 2**	= 12	= 144	= 1728	= 20 736
		1	**= 6**	= 72	= 864	= 1068
			1	**= 12**	= 144	= 1728
				1	**= 12**	= 144
					1	**= 12**

3.5.2.2.1.2 Old Austrian Units of Surface Area

Table 3-131 Old Austrian units of surface area
[1 joch (Austrian) = 5754.61822464 m^2]

Joch	Metze	Square klafter
1	**= 3**	= 1600
	1	**= 1600/3**

3.5.2.2.1.3 Old Austrian Units of Capacity (Liquids)

Table 3.132 Old Austrian units of capacity (Liquids)
[1 mass (Austrian, liq.) = 1.4151 dm^3]

Fuder	Dreiling	Fass	Eimer	Viertel	Mass	Halbe	Seidel	Pfiff
1	**= 32/30**	= 16/5	= 320	= 1280	= 1280	= 2560	= 5120	= 10 240
	1	**= 3**	= 30	= 120	= 1200	= 2400	= 4800	= 9600
		1	**= 10**	= 40	= 400	= 800	= 1600	= 3200
			1	**= 4**	= 40	= 80	= 160	= 320
				1	**= 10**	= 20	= 40	= 80
					1	**= 2**	= 4	= 8
						1	**= 2**	= 4
							1	**= 2**

3.5.2.2.1.5 Old Austrian Units of Capacity (Dry)

Table 3-133 Old Austrian units of capacity (Dry)
[1 metzel (Austrian, dry) = 61.489 dm^3]

Muth	Metzel	Viertel	Achtel	Muthmassel	Futtermassel	Becher	Probmetze
1	**= 30**	= 120	= 240	= 480	= 960	= 3840	= 30720
	1	**= 4**	= 8	= 16	= 32	= 128	= 1024
		1	**= 2**	= 4	= 8	= 32	= 256
			1	**= 2**	= 4	= 16	= 128
				1	**= 2**	= 8	= 64
					1	**= 4**	= 32
						1	**= 8**

3.5.2.2.1.5 Old Austrian Units of Weight (Ordinary)

See ***Table 3-134*** opposite.

3.5.2.2.1.6 Old Austrian Units of Weight (Apothecary)

Table 3-135 Old Austrian units of weight (Apothecary)
[1 pfund (Austrian, apothecary) = 0.4200075 kg]

Pfund (ordinary)	Pfund (apothecary)	Unze	Drachme	Scrupel	Gran
1	**= 4/3**	= 16	= 128	= 384	= 7680
	1	**= 12**	= 96	= 288	= 5760
		1	**= 8**	= 24	= 480
			1	**= 3**	= 60
				1	**= 20**

3.5.2.2.2 Old German System (Prussian)

The metric system has been compulsory since 1872.

3.5.2.2.2.1 Old German Units of Length

These Old German units were employed under the Prussian system.

Table 3-136 Old German units of length
[1 fuss (Rheinlandischer) = 0.313857 m]

Meile (mile)	Ruthe (yard)	Elle	Fuss (foot)	Zoll (inch)	Linie (line)
1	**= 2000**	= 192 000/17	= 24 000	= 288 000	= 3 456 000
	1	**= 96/17**	= 12	= 144	= 1728
		1	**= 17/8**	= 51/2	= 306
			1	**= 12**	= 144
				1	**= 12**

1 faden (fathom) = 6 fuss (E)

3.5.2.2.2.2 Old German Units of Weight

These are shown in Table 3.137 (on page 102).

Table 3-134 Old Austrian units of weight (Ordinary)

[1 pfund (Austrian) = 0.56001 kg]

Karch	Saum	Zentner	Stein	Pfund	Mark	Vierding	Unze	Loth	Quentchen	Denat (Pfenig)
1	**= 16/11**	= 16	= 20	= 400	= 800	= 1600	= 6400	= 12 800	= 51 200	= 204 800
	1	**= 11/4**	= 55/4	= 275	= 550	= 1100	= 4400	= 8800	= 35 200	= 140 800
		1	**= 5**	= 100	= 200	= 400	= 1600	= 3200	= 12 800	= 51 200
			1	**= 20**	= 40	= 80	= 320	= 640	= 2560	= 10 240
				1	**= 2**	= 4	= 16	= 32	= 128	= 512
					1	**= 2**	= 8	= 16	= 64	= 256
						1	**= 4**	= 8	= 32	= 128
							1	**= 2**	= 8	= 32
								1	**= 4**	= 16
									1	**= 4**

Table 3-137 Old German units of weight

[1 pfund = 0.467711 kg (E)]

Schiffspfund	Doppelzentner	Zentner (quintal)	Stein (stone)	Pfund (pound)	Loth	Quentchen	Quint	Pfennig	Gran
1	**= 3/2**	= 3	= 15	= 330	= 10 560	= 31 680	= 42 240	= 168 960	= 2 534 400
	1	**= 2**	= 10	= 220	= 7040	= 21 120	= 28 160	= 112 640	= 1 689 600
		1	**= 5**	= 110	= 3520	= 10 560	= 14 080	= 56 320	= 844 800
			1	**= 22**	= 704	= 2112	= 2816	= 11 264	= 168 960
				1	**= 32**	= 96	= 128	= 512	= 7680
					1	**= 3**	= 4	= 16	**= 240**
						1	= 4/3	= 16/3	= 80
							1	= 4	= 60
								1	= 15

1 mark = 1/2 pfund
1 unze = 1/16 pfund

3.5.2.2.2.3 Old German Units of Capacity (Dry)

Table 3-138 Old German units of capacity (Dry)
[1 metzen = 37.0596 dm^3]

Scheffel	Metzen	Mässel	Dreissiger
1	**= 6**	= 48	= 192
	1	**= 8**	= 32
		1	**= 4**

3.5.2.2.2.4 Old German Units of Capacity (Liquids)

Table 3-139 Old German units of capacity (Liquids)
[1 quart = 1.14506909541 dm^3 = 64 cubic zoll (E)]

Fuder	Oxhoft	Ohm	Eimer	Anker	Quart
1	**= 4**	= 6	= 12	= 24	= 720
	1	**= 3/2**	= 3	= 6	= 180
		1	**= 2**	= 4	= 120
			1	**= 2**	= 60
				1	**= 30**

3.5.2.2.3 Old Yugoslavian System

Metric system adopted in 1873 and compulsory since 1883.

3.5.2.2.3.1 Old Yugoslavian Units of Length

Table 3-140 Old Yugoslavian units of length
[1stopa (Yugoslavian) = 0.316 m]

Kvat	Archine	Stopa	Palaz	Linia
1	**= 7/3**	= 6	= 261/5	= 870
	1	**= 9/4**	= 783/40	= 1305/4
		1	**= 87/10**	= 145
			1	**= 50/3**

3.5.2.2.3.2 Old Yugoslavian Units of Surface Area

Table 3-141 Old Yugoslavian units of surface area
[1 square stopa (Yugoslavian) = 0.099856 m^2]

Lanatz	Dan oranja	Raliza	Motyka	Dunum (Donum)	Square kvat	Square stopa
1	**= 5760/3597**	= 288/125	= 36/5	= 288/35	= 1600	= 57 600
	1	**= 3597/2500**	= 3597/800	= 3597/700	= 5995/6	= 35 970
		1	**= 25/8**	= 25/7	= 6250/9	= 25 000
			1	**= 8/7**	= 2000/9	= 8000
				1	**= 1750/9**	= 7000
					1	**= 36**

3.5.2.2.3.3 Old Yugoslavian Units of Weight

Table 3-142 Old Yugoslavian units of weight
[1 oka (Yugoslavian) = 1.280 kg]

Tovar	Akov	Oka	Litra (Satlijk)	Dramm
1	**= 5/2**	= 100	= 400	= 40 000
	1	**= 40**	= 160	= 16 000
		1	**= 4**	= 400
			1	**= 100**

3.5.2.2.4 Old Czechoslovakian System

Metric system adopted in 1871 and compulsory since 1876.

3.5.2.2.4.1 Old Czechoslovakian Units of Length

Table 3-143 Old Czechoslovakian units of length (Bohemia, Silesia, Moravia, and Praha)
[1 stopa (Bohemian) = 0.296 m]
[1 stopa (Praha) = 0.2965 m]
[1 stopa (Moravian) = 0.284 m]
[1 stopa (Silesian) = 0.2895 m]

Mile	Latro	Sah	Loket	Stopa (Strevic)
1	**= 3660**	= 7869/2	= 23 607/2	= 23607
	1	**= 129/120**	= 129/40	= 129/20
		1	**= 3**	= 6
			1	**= 2**

3.5.2.2.4.2 Old Czechoslovakian Units of Surface Area

Table 3-144 Old Czechoslovakian units of surface area
[1 merice = 2000 m^2]

Lan	Jitro	Korec (strych, mira)	Merice
1	**= 30**	= 60	= 4317/50
	1	**= 2**	= 1439/500
		1	**= 1439/1000**

3.5.2.2.4.3 Old Czechoslovakian Units of Capacity

Table 3-145 Old Czechoslovakian units of capacity
[1 merice = 70.6 dm^3]

Korec (Strych)	Merice
1	**= 53/40**

3.5.2.2.5 Old Hungarian System

Metric system adopted in 1874 and compulsory since 1876.

3.5.2.2.5.1 Old Hungarian Units of Length

Table 3-146 Old Hungarian units of length
[1 Faust (Hungarian) = 0.10536 m]

Mertföld (Meile)	Faust (Marok)
1	**= 79 286.25**

3.5.2.2.5.2 Old Hungarian Units of Surface Area

Table 3-147 Old Hungarian units of surface area
[1 square meile (Hungarian) = $6.97826212650 \times 10^6$ m^2]

Square meile	Joch (Hold)
1	**= 16 168.355**

3.5.2.2.5.3 Old Hungarian Units of Capacity

Table 3-148 Old Hungarian units of capacity
[1 eimer (Hungarian) = 54.30 dm^3]

Metzen (Ako)	Eimer	Halbe (Itcze)
1	**= 23/20**	= 368/5
	1	**= 64**

3.5.2.2.6 Old Romanian System

Metric system adopted in 1864 and compulsory since 1884

3.5.2.2.6.1 Old Romanian Units of Length

Table 3-149 Old Romanian units of length
[1 halibiu (Romanian) = 0.701 m]

Stringene	Halibiu	Endere
1	**= 1960/701**	= 1960/662
	1	**= 701/662**

3.5.2.2.6.2 Old Hungarian Units of Capacity

Table 3-150 Old Romanian units of capacity (Liquids)
[1 viacka (Romanian) = 14.15 dm^3]

Viacka	Oke
1	**= 10**

Table 3-151 Old Romanian units of capacity (Dry)
[1 dimerla (Romanian) = 24.6 dm^3]

Kilo	Mirze	Dimerla	Oke
1	**= 2**	= 16	= 256
	1	**= 8**	= 128
		1	**= 16**

3.5.2.2.6.3 Old Romanian Units of Weight

Table 3-152 Old Romanian units of weight
[1 cantar (Romanian) = 56 kg]

Cantar	Oke
1	**= 44**

3.5.2.2.7 Old Dutch System

The metric system has been compulsory since 1820.

3.5.2.2.7.1 Old Dutch Units of Length

Table 3-153 Old Dutch units of length
[1 voeten (Amsterdam) = 0.2830594 m]

Uren	Myl	Roeden	Elle	Voeten	Duime	Lyne
1	**= 5**	= 17 665/13	= 35 330/5	= 17 665	= 211 980	=2 543 760
	1	**= 3533/13**	=7066/5	= 3533	= 42 396	= 508 752
		1	**= 26/5**	= 13	= 156	= 1872
			1	= 5/2	= 30	= 360
				1	**= 12**	= 144
					1	**= 12**

3.5.2.2.7.2 Old Dutch Units of Weight

Table 3-154 Old Dutch units of weight
[1 pond (Amsterdam) = 0.49409032 kg]
[1 pond (ordinary) = 0.49216772 kg]
[1 pond (apothecary) = 3/4 pond (ordinary) = 0.369125790 kg]

Pond (pound)	Mark	Unze (ounce)	Drachme (drachm)	Engel	Vierling	Grein (grain)
1	**= 2**	= 16	= 128	= 320	= 1280	= 7680
	1	**= 8**	= 64	= 160	= 640	= 3840
		1	**= 8**	= 20	= 80	= 480
			1	= 5/2	= 10	= 60
				1	= 4	= 24
					1	**= 6**

3.5.2.2.7.3 Old Dutch Units of Capacity (Dry)

Table 3-155 Old Dutch units of capacity (Dry)
[1 schepel = 27.26 dm^3]

Last	Mud	Zak	Schepel	Vierd	Kop
1	**= 27**	= 36	= 108	= 432	= 3456
	1	**= 4/3**	= 4	= 16	= 128
		1	**= 3**	= 12	= 96
			1	**= 4**	= 32
				1	**= 8**

3.5.2.2.7.4 Old Dutch Units of Capacity (Liquids)

These are shown in ***Table 3-156*** (overleaf).

3.5.2.2.8 Old Danish System

Metric system adopted in 1907 and compulsory since 1912.

3.5.2.2.8.1 Old Danish Units of Length

Table 3-157 Old Danish units of length [1 fod (Danish) = 0.313857 m]

Miil	Ruthe	Favn	Aln	Fod	Tomme	Linie
1	**= 2000**	= 4000	= 12 000	= 24 000	= 288 000	= 3 456 000
	1	**= 2**	= 6	= 12	= 144	= 1728
		1	**= 3**	= 6	= 72	= 864
			1	**= 2**	= 24	= 288
				1	**= 12**	= 144
					1	**= 12**

3.5.2.2.8.2 Old Danish Units of Surface Area

Table 3-158 Old Danish units of surface area
[1 square ruthe (Danish) = 144 square fod (E) = 14.1848951687 m^2]
[1 tondelande (Danish) = 5516.2 m^2]

Pflug	Tonde	Skiepper	Fjerdingar	Album	Penge	Square ruthe
1	**= 32**	= 256	= 1024	= 3072	= 11 136	= 64 000
	1	**= 8**	= 32	= 96	= 348	= 2000
		1	**= 4**	= 12	= 87/2	= 250
			1	= 3	= 87/8	= 125/2
				1	= 29/8	= 125/6
					= 1	= 500/87

Table 3-156 Old Dutch units of capacity (Liquids)
[1 mingelen = 1.200 dm^3]

Vat	Oxhooft	Aam	Anker	Steekan	Stoop	Mingelen	Pint	Mutsje
1	= 4	= 6	= 24	= 48	= 384	= 768	= 1536	= 6144
	1	**= 3/2**	= 6	= 12	= 96	= 192	= 384	= 1536
		1	**= 4**	= 8	= 64	= 128	= 256	= 1024
			1	**= 2**	= 16	= 32	= 64	= 256
				1	**= 8**	= 16	= 32	= 128
					1	**= 2**	= 4	= 16
						1	**= 2**	= 8
							1	**= 4**

3.5.2.2.8.3 Old Danish Units of Capacity

See ***Table 3-159*** overleaf.

Table 3-160 Old Danish units of capacity (Dry)
[1 korntonde (Danish, dry) = 4.5 cubic fod (E) = 139.125895095 dm^3]

Last	Korntonde	Fjerdingkar	Cubic fod	Ottingkar (skieppe)	Viertel	Achtel	Pott
1	**= 22**	= 88	= 99	= 176	= 396	= 792	= 1782
	1	**= 4**	= 9/2	= 8	= 32	= 64	= 144
		1	**= 9/8**	= 2	= 8	= 16	= 36
			1	**= 16/9**	= 64/9	= 128/9	= 32
				1	**= 4**	= 8	= 18
					1	**= 2**	= 9/2
						1	= 9/4

3.5.2.2.8.4 Old Danish Units of Weight

See ***Table 1-161*** (p. 111).

3.5.2.2.9 Old Polish System

Metric system compulsory since 1919.

3.5.2.2.9.1 Old Polish Units of Length

Table 3-162 Old Polish units of length
[1 stopa (Polish, new) = 0.2880 m]
[1 stopa (Polish, Warsaw) = 0.2978 m]
[1 stopa (Polish, Cracow) = 0.23564 m]

Pret	Sazen	Stopa	Lokiec	Cal	Linja
1	**= 15/6**	= 15	= 24	= 144	= 1728
	1	**= 6**	= 12	= 72	= 864
		1	**= 2**	= 12	= 144
			1	**= 6**	= 72
				1	**= 12**

3.5.2.2.9.2 Old Polish Units of Surface Area

Table 3-163 Old Polish units of surface area
[1 square stopa (Polish, new) = 0.082944 m^2]
[1 square stopa (Polish, Warsaw) = 0.08868484 m^2]
[1 square stopa (Polish, Cracow) = 0.0555262096 m^2]

Wloka	Morga	Square pret	Square stopa
1	**= 30**	= 9000	= 2 025 000
	1	**= 300**	= 67 500
		1	**= 225**

Table 3-159 Old Danish units of capacity (Liquids)
[1 pott (Danish, liquid) = 1/32 cubic fod (E) = 0.966152049250 dm^3]

Fuder	Pipe	Oxhoft	Ohm	Anker	Cubic fod	Viertel	Stubchen	Kande	Pott	Paegel
1	**= 2**	= 4	= 6	= 24	= 30	= 120	= 240	= 480	= 960	= 3840
	1	**= 2**	= 3	= 12	= 15	= 60	= 120	= 240	= 480	= 1920
		1	**= 3/2**	= 6	= 15/2	= 30	= 60	= 120	= 240	= 960
			1	**= 4**	= 5	= 20	= 40	= 80	= 160	= 640
				1	**= 5/4**	= 5	= 10	= 20	= 40	= 160
					1	**= 4**	= 8	= 16	= 32	= 128
						1	**= 2**	= 4	= 8	= 32
							1	**= 2**	= 4	= 16
								1	**= 2**	= 8
									1	**= 4**

Table 3-161 Old Danish units of weight

[1 pund (Danish) = 0.500 kg (E)]

Skyplast	Skippund	Centner	Waag	Lispund	Bismerpund	Pund	Mark	Unze	Loth	Quintin	Ort	Es
1	**= 65/4**	= 52	= 1300/9	= 325	= 1300/3	= 5200	= 10 400	= 83 200	= 166 400	= 665 600	= 2 662 400	= 47 590 040
	1	**= 16/5**	= 80/9	= 20	= 80/3	= 320	= 640	= 5120	= 10 240	= 40 960	= 163 840	= 2 928 640
		1	**= 25/9**	= 25/4	= 25/3	= 100	= 200	= 1600	= 3200	= 12 800	= 51 200	= 915 200
			1	**= 9/4**	= 3	= 36	= 72	= 576	= 1152	= 4608	= 18 432	= 329 472
				1	**= 4/3**	= 16	= 32	= 256	= 512	= 2048	= 8192	= 146 432
					1	= 12	= 24	= 192	= 384	= 1536	= 6144	= 109 824
						1	**= 2**	= 16	= 32	= 128	= 512	= 9152
							1	**= 8**	= 16	= 64	= 256	= 4576
								1	**= 2**	= 8	= 32	= 572
									1	**=4**	= 16	= 286
										1	**=4**	= 143/2
											1	**=143/8**

3.5.2.2.9.3 Old Polish Units of Capacity

Table 3-164 Old Polish units of capacity
[1 kwarta (Polish) = 1 dm^3(E)]

Korzec	Cwierc	Garniec	Kwarta	Kwarterka
1	**= 4**	= 32	= 128	= 512
	1	**= 8**	= 32	= 128
		1	**= 4**	= 16
			1	**= 4**

3.5.2.2.9.4 Old Polish Units of Weight

Table 3-165 Old Polish units of weight
[1 funt (Polish) = 0.405504 kg]

Centnar	Kamian	Funt	Uncja	Lut	Drachma	Skrupul	Gran
1	**= 4**	= 100	= 1600	= 3200	= 12 800	= 38 400	= 921 600
	1	**= 25**	= 400	= 800	= 3200	= 9600	= 230 400
		1	**= 16**	= 32	= 128	= 384	= 9216
			1	**= 2**	= 8	= 24	= 576
				1	**= 4**	= 12	= 288
					1	**= 3**	= 72
						1	**= 24**

3.5.2.2.10 Old Swedish System

The metric system has been compulsory since 1889.

3.5.2.2.10.1 Old Swedish Units of Length

See ***Table 3-166*** (opposite).

3.5.2.2.10.2 Old Swedish Units of Area

See ***Table 3-167*** (p. 113).

3.5.2.2.10.3 Old Swedish Units of Weight

See ***Table 3-168*** (p. 114).

3.5.2.2.10.4 Old Swedish Units of Capacity

See ***Table 3-169*** (p. 115).

Table 3-166 Old Swedish units of length (decree of 1665) [1 fot = 0.29690 m]

Mil (mile)	**Fjärdingsväg**	**Ref**	**Alnar** (ell)	**Stang**	**Famn, fanen** (fathom)	**Aln** (Alen)	**Fot** (foot)	**Kvarter**	**Tum** (inch)	**Linje** (line)
1	**= 4**	= 225	= 2000	= 2250	= 6000	= 9000	= 18 000	= 36 000	= 216 000	= 2 592 000
	1	**= 225/4**	= 500	= 1125/2	= 1500	= 4500	= 9000	= 18 000	= 108 000	= 1 296 000
		1	**= 80/9**	= 10	= 80/3	= 80	= 160	= 320	= 1920	= 23 040
			1	**= 9/8**	= 3	= 9	= 18	= 36	= 216	= 2592
				1	**= 8/3**	= 8	= 16	= 32	= 192	= 2304
					1	**= 3**	= 6	= 12	= 72	= 864
						1	**= 2**	= 4	= 24	= 288
							1	**= 2**	= 12	= 144
								1	**= 6**	= 72
									1	**= 12**

1 steg = 1/2 famn

1 tvärhand = 4 tum

1 fingerbredd = 3/4 tum

Table 3-167 Old Swedish units of area (decree of 1665) [1 kvadratfot = $0.088149610 \times 10^{-3}$ m^2]

Pundland	**Spannland**	**Tunnland** (acre)	**Fjârdingsland**	**Kappland**	**Kvardratfot** (sq. foot)	**Kvadrattum** (sq. inch)
1	**= 2**	**= 4**	**= 8**	= 128	= 224 000	= 32 256 000
	1	**= 2**	**= 4**	= 64	= 112 000	= 16 128 000
		1	**= 2**	**= 32**	= 56 000	= 8 064 000
			1	**= 16**	= 28 000	= 4 032 000
				1	**= 1750**	= 252 000
					1	**= 144**

Table 3-168 Old Swedish units of weight (decree of 1665)

[1 skålpund = 0.4250797024 kg]

Nyläst	Skeppsund	Waag	Centner	Sten	Liespund	Skålpund (pound)	Uns	Lod	Ort	Qvintin (kvintin)	Korn	Ass
1	**= 30**	= 800/11	= 120	= 375	= 600	= 12 000	= 192 000	= 384 000	= 1 200 000	= 1 536 000	= 12 000 000	= 106 176 000
	1	**= 80/33**	= 4	= 25/2	= 20	= 400	= 6400	= 12 800	= 40 000	= 51 200	= 400 000	= 3 539 200
		1	**= 33/20**	= 165/32	= 33/4	= 165	= 2640	= 5280	= 16 500	= 21 120	= 165 000	= 1 459 920
			1	**= 25/8**	= 5	= 100	= 1600	= 3200	= 10 000	= 12 800	= 100 000	= 884 800
				1	**= 8/5**	= 32	= 512	= 1024	= 3200	= 4096	= 32 000	= 283 136
					1	**= 20**	= 320	= 640	= 2000	= 2560	= 20 000	= 176 960
						1	**= 16**	= 32	= 100	= 128	= 1000	= 8848
							1	**= 2**	= 25/4	= 8	= 125/2	= 553
								1	**= 25/8**	= 4	= 125/4	= 553/2
									1	**= 32/25**	= 10	= 2212/25
										1	**= 125/16**	= 553/8
											1	**= 1106/125**

Table 3-169 Old Swedish units of capacity (Dry) (decree 1665)
[1 kanna = 2.6171619 209 dm^3 = 1/10 kubikfot (E)]

Kolläst	Koltunna	Tunna	Spanna	Fjerdingar	Kappar	Kanna	Stop	Quarter	Junkfra (ort)
1	**= 12**	= 27/2	= 27	= 108	= 432	= 756	= 1512	= 4536	= 24 192
	1	**= 9/8**	= 9/4	= 9	= 36	= 63	= 126	= 378	= 2016
		1	**= 2**	= 8	= 32	= 56	= 112	= 336	= 1792
			1	**= 4**	= 16	= 28	= 56	= 168	= 896
				1	**= 4**	= 7	= 14	= 42	= 224
					1	**= 7/4**	= 7/2	= 21/2	= 56
						1	**= 2**	= 6	= 32
							1	**= 3**	= 16
								1	**= 16/3**

1 kanna = 1/10 kubikfot (E)
1 halvspanna = 1/2 spanna

Table 3-170 Old Swedish units of capacity (Liquids)
[1 kanna = 2.6171619 209 dm^3 = 1/10 kubikfot (E)]

Fuder	Oxhoft	Am (fat, ohm)	Eimer	Ankar	Kanna	Stop	Kvarter (quarter)	Jungfru (ort)
1	**= 4**	= 6	= 12	= 24	= 360	= 720	= 2880	= 11 520
	1	= 3/2	= 3	= 6	= 90	= 180	= 720	= 2880
		1	**= 2**	= 4	= 60	= 120	= 480	= 1920
			1	**= 2**	= 30	= 60	= 240	= 960
				1	**= 15**	= 30	= 120	= 480
					1	= 2	= 8	= 32
						1	= 4	= 16
							1	= 4

1 pipe = 180 kanna
1 tunna = 48 kanna
1 fjärding = 12 kanna

3.5.2.2.11 Old Norwegian System

Metric system adopted in 1875 and compulsory since 1882.

3.5.2.2.11.1 Miscellaneous Old Norwegian Units

Table 3-171 Miscellaneous old Norwegian units

1 fod (Norwegian) = 0.3137 m
1 mal (Norwegian) = 1000 m^2
1 pot (Norwegian, liquid) = 0.9651 dm^3
1 skjeppe (Norwegian, liquid) = 17.3718 dm^3
1 korntonde (Norwegian, dry) = 138.97 dm^3
1 skaalpund (Norwegian) = 0.4981 kg

3.5.2.2.12 Old Finnish System

Metric system adopted in 1886 and compulsory since 1892.

3.5.2.2.12.1 Old Finnish Units of Capacity

Table 3-172 Old Finnish units of capacity
[1 tunna (Finnish) = 163.49 dm^3]

Tunna	Ottingar	Sextingar	Kannor
1	**= 21/2**	= 21	= 63
	1	**= 2**	= 6
		1	**= 3**

3.5.2.2.13 Old Icelandic System

Metric system adopted and compulsory since 1907, in many points similar to the Danish system.

3.5.2.2.13.1 Old Icelandic Units of Length

Table 3-173 Old Icelandic units of length
[1 fet (Icelandic) = 0.313857 m]

Mila a landi	Faomur	Alin	Fet	Pumlungur	Lina
1	= 4000	= 12 000	= 24 000	= 288 000	= 3 456 000
	1	**= 3**	= 6	= 72	= 864
		1	**= 2**	= 24	= 288
			1	**= 12**	= 144
				1	**= 12**

3.5.2.2.13.2 Old Icelandic Units of Area

See ***Table 3-174*** overleaf.

3.5.2.2.13.3 Old Icelandic Units of Capacity (Dry)

See ***Table 3-175*** overleaf.

3.5.2.2.13.4 Old Icelandic Units of Weight

Table 3-176 Old Icelandic units of weight
[1 pund (Icelandic) = 0.500 kg]

Skippund (Batt)	Tunna smjors	Liespund	Fierding	Fisk	Mark	Pund
1	**= 20/14**	= 5	= 8	= 40	= 160	= 320
	1	**= 7/2**	= 28/5	= 28	= 122	= 224
		1	**= 8/5**	= 8	= 32	= 64
			1	**= 5**	= 20	= 40
				1	**= 4**	= 8
					1	**= 2**

3.5.2.2.14 Old Estonian System

3.5.2.2.14.1 Old Estonian Units of Length

Table 3-177 Old Estonian units of length
[1 arshine (Estonian) = 0.7112 m (E)]

Faden	Arshine	Foute	Elle
1	**= 3**	= 7	= 28/3
	1	**= 7/3**	= 28/9
		1	**= 4/3**

Table 3-174 Old Icelandic units of area

[1 ferfaomur (Icelandic) = 3.54622379216 m^2]

Fermila	Engjateigur	Tundagslatta	Ferfaomur	Feralin	Ferfet	Ferpumlungur
1	**= 10 000**	= 160 000/9	$= 1.6 \times 10^7$	$= 1.44 \times 10^8$	$= 5.76 \times 10^8$	$= 8.2944 \times 10^{10}$
	1	**= 16/9**	= 1600	= 14 400	= 57 600	= 8 294 400
		1	**= 900**	= 8100	= 32 400	= 4 665 600
			1	**= 9**	= 36	= 5184
				1	**= 4**	= 576
					1	**= 144**

Table 3-175 Old Icelandic units of capacity (Dry)

[1 pottar (Icelandic) = 0.966152049250 dm^3]

Korntunna	öltunna	Almen tunna	Anker	Cubic fet	Kornskeppa	Pottar
1	**= 18/17**	= 6/5	= 18/5	= 9/2	= 8	= 144
	1	**= 17/15**	= 17/5	= 17/4	= 68/9	= 136
		1	**= 3**	= 15/4	= 20/3	= 120
			1	**= 5/4**	= 20/9	= 40
				1	**= 16/9**	= 32
					1	= 18

3.5.2.2.14.2 Old Estonian Units of Surface Area

Table 3-178 Old Estonian units of surface area

1 lofstelle (Reval) = 1855 m^2
1 lofstelle (Livonian) = 3710 m^2
1 tonnland (Reval) = 5462.7 m^2
1 tonnland (Livonian) = 5194 m^2

3.5.2.2.14.3 Old Estonian Units of Capacity

Table 3-179 Old Estonian units of capacity
[1 hulmit (Estonian) = 11.48 dm^3]

Tonne	Lof (Livonian)	Lof (Reval)	Hulmit
1	**= 2**	= 4	= 12
	1	**= 2**	= 6
		1	**= 3**

3.5.2.2.14.4 Old Estonian Units of Weight

Table 3-180 Old Estonian units of weight
[1 pfund (Estonian) = 0.460 kg]

Schiffs-pfund	Ton	Centner	Lies-pfund	Pfund	Loth	Quent
1	**= 5/3**	= 10/3	= 20	= 400	= 12 800	= 51 200
	1	**= 2**	= 12	= 240	= 7680	= 30 720
		1	**= 6**	= 120	= 3840	= 15 360
			1	**= 20**	= 640	= 2560
				1	= 32	= 128
					1	**= 4**

3.5.2.2.15 Old Latvian System

3.5.2.2.15.1 Old Latvian Units of Length

Table 3-181 Old Latvian units of length
[1 elle (Latvian) = 0.537 m]

Meile	Verste	Elle	Quartier
1	**= 7**	= 7 467 600/537	= 29 870 400/537
	1	**= 10 668/5370**	= 21 336/2685
		1	**= 4**

3.5.2.2.15.2 Old Latvian Units of Area

Table 3-182 Old Latvian units of area
[1 kapp (Latvian) = 148.64 m^2]

Tonnstelle	Loofstelle (pourvette)	Kapp
1	**= 7/5**	= 35
	1	**= 25**

3.5.2.2.15.3 Old Latvian Units of Capacity

Table 3-183 Old Latvian units of capacity
[1 stoof (Latvian) = 1.2752 dm^3]
[1 faden = 4.077 m3]

Tonne	Loof (poure)	Anker	Kulmet	Kanne	Stoof
1	**= 2**	= 54/15	= 108/9	= 54	= 108
	1	**= 27/15**	= 54/9	= 27	= 54
		1	**= 30/9**	= 15	= 30
			1	**= 9/2**	= 9
				1	**= 2**

3.5.2.2.15.4Old Latvian Units of Weight

Table 3.184 Old Latvian units of weight
[1 pfund (Latvian) = 0.419 kg]

Schiffspfund	Ton	Centner	Liespfund	Pfund	Loth	Quent
1	**= 5/3**	= 10/3	= 20	= 400	= 12 800	= 51 200
	1	**= 2**	= 12	= 240	= 7680	= 30 720
		1	**= 6**	= 120	= 3840	= 15 360
			1	**= 20**	= 640	= 2560
				1	= 32	= 128
					1	**= 4**

3.5.2.16 Old Russian System

All the following units were used before the 1917 Revolution and are now obsolete, although they will be encountered in 19th century Russian literature. The metric system was formally adopted as the national standard of measurement by the Soviet government in 1927.

3.5.2.2.16.1Old Russian Units of Length

These are shown in ***Table 3-185*** (opposite).

Table 3-185 Old Russian units of length

[1 foute = 0.3048 m (E)]

Vyorst (verst)	Saaschen	Arshin	Foute (foot)	Tchevert	Vershok	Duîme	Sotka	Pal′ets	Line	Totchka
1	**= 500**	= 1500	= 3500	= 6000	= 24 000	= 42 000	= 50 000	= 84 000	= 420 000	= 4 200 000
	1	**= 3**	= 7	= 12	= 48	= 84	= 100	= 168	= 840	= 8400
		1	**= 7/3**	= 4	= 16	= 28	= 100/3	= 56	= 280	= 2800
			1	**= 12/7**	= 48/7	= 12	= 100/7	= 24	= 120	= 1200
				1	**= 4**	= 7	= 25/3	= 14	= 70	= 700
					1	**= 7/4**	= 25/12	= 7/2	= 35/2	= 175
						1	**= 25/21**	= 2	= 10	= 100
							1	**= 42/25**	= 42/5	= 84
								1	**= 5**	= 50
									1	**= 10**

3.5.2.2.16.2 Old Russian Units of Weight (Ordinary)

Table 3-186 Old Russian units of weight (Ordinary)
[1 funt = 0.409517179246 kg]

Berkovets	Pood	Funt (pound)	Lana	Once (ounce)	Loth (lot)	Solotnik (denier)	Doli (grain)
1	**= 10**	= 400	= 4 800	= 6400	= 12 800	= 38 400	= 3 686 400
	1	**= 40**	= 480	= 640	= 1280	= 3840	= 368 640
		1	**= 12**	= 16	= 32	= 96	= 9216
			1	**= 4/3**	= 8/3	= 8	= 768
				1	**= 2**	= 6	= 576
					1	**= 3**	= 288
						1	**= 96**

3.5.2.2.16.3 Old Russian Units of Weight (Apothecary)

Table 3-187 Old Russian units of weight (Apothecary)
[1 doli = 44.4349403 mg]

Pound	Once	Drachme	Scrupule	Grain	Doli (grain)
1	= 12	= 96	= 288	= 5760	= 8064
	1	**= 8**	= 24	= 480	= 672
		1	**= 3**	= 60	= 84
			1	**= 20**	= 28
				1	= 7/5

3.5.2.2.16.4 Old Russian Units of Capacity (Dry)

These are shown in ***Table 3-188*** (opposite).

3.5.2.2.16.5 Old Russian Units of Capacity (Liquids)

See ***Table 3-189*** (p. 124).

3.5.2.3 Africa

3.5.2.3.1 Old Moroccan System

Metric system compulsory since 1923.

3.5.2.3.1.1 Old Moroccan Units of Length

Table 3-190 Old Moroccan units of length
[1 pic (Moroccan) = 0.610 m]

Pic	Canna (cubit)	Tonni
1	**= 8/7**	= 8
	1	**= 7**

Table 3-188 Old Russian units of capacity (Dry)
[1 garnetz = 3.279842 dm^3]

Tchevert	Osmini	Lof	Payok	Tcheverik	Vedro	Garnetz	Polou-garnetz	Krushky	Tchast
1	**= 2**	= 120/37	= 4	= 8	= 16	= 64	= 128	= 160	= 1920
	1	**= 60/37**	= 2	= 4	= 8	= 32	= 64	= 80	= 960
		1	**= 37/30**	= 37/15	= 74/15	= 296/15	= 592/15	= 148/3	= 592
			1	**= 2**	= 4	= 16	= 32	= 40	= 480
				1	**= 2**	= 8	= 16	= 20	= 240
					1	**= 4**	= 8	= 10	= 120
						1	= 2	= 5/2	= 30
							1	**= 5/4**	= 15
								1	**= 12**

Table 3-189 Old Russian units of capacity (Liquids)
[1 vedro = 12.29941 dm^3]

Botchka (fass)	**Pipe**	**Anker**	**Stekar**	**Vedro**	**Shtoff**	**Krouchka**	**Bottle** (wine)	**Bottle** (vodka)	**Tcharka**	**Chkalik**
1	**= 10/9**	= 40/3	= 80/3	= 40	= 320	= 400	= 640	= 800	= 4000	= 8000
	1	**= 12**	= 24	= 36	= 288	= 360	= 576	= 720	= 3600	= 7200
		1	**= 2**	= 3	= 24	= 30	= 48	= 60	= 300	= 600
			1	**= 3/2**	= 12	= 15	= 24	= 30	= 150	= 300
				1	**= 8**	= 10	= 16	= 20	= 100	= 200
					1	**= 5/4**	= 2	= 5/2	= 25/2	= 25
						1	**= 8/5**	= 2	= 10	= 20
							1	**= 5/4**	= 25/4	= 25/2
								1	**= 5**	= 10
									1	**= 2**

3.5.2.3.1.2 Old Moroccan Units of Capacity (Liquid and Dry)

Table 3-191 Old Moroccan units of capacity
[1 mud (Moroccan) = 14×10^{-3} m^3]

Saah (Fanega)	Mud (Almude)
1	**= 4**

3.5.2.3.1.3 Old Moroccan Units of Weight

Table 3-192 Old Moroccan units of weight
[1 rotal or artal (Moroccan) = 507.5×10^{-3} kg]

Kantar	Kula	Gerbe	Rotal (artal)
1	**= 50/11**	= 50/3	= 100
	1	**= 11/3**	= 22
		1	**= 6**

3.5.2.3.2 Old Algerian System

Metric system compulsory in Algeria since 1843.

3.5.2.3.2.1 Old Algerian Units of Length

Table 3-193 Old Algerian units of length
[1 pic (dzera a torky) = 0.623 m]
[1 pic (dzera a raby) = 0.467 m]

Pic	Nus	Rebia	Termin
1	**= 2**	= 4	= 8
	1	**= 2**	= 4
		1	**= 2**

3.5.2.3.2.2 Old Algerian Units of Capacity

Table 3-194 Old Algerian units of capacity
[1 khoul (Algerian) = 16.666×10^{-3} m^3]
[1 metalli (Algerian, oil) = 17.90×10^{-3} m^3]

Caffiso (calisse)	Saah (ssah)	Tarri (tarie)	Khoul (kolleh)
1	= 3805/576	= 761/48	= 761/40
	1	**= 12/5**	= 72/25
		1	**= 6/5**

3.5.2.3.2.3 Old Algerian Units of Weight

Table 3-195 Old Algerian units of weight
[1 ukkia (Algerian) = 34.13×10^{-3} kg]

Cantar (kebyr)	Cantar (khaldary)	Cantar (thary)	Rottolo (kebyr)	Rottolo (khaldary)	Rottolo (thary)	Ukkia (ounce)	Metical (metsquat)
1	**= 4/3**	= 3/2	= 100	= 400/3	= 150	= 2400	= 17400
	1	**= 9/8**	= 75/2	= 100	= 225/2	= 1800	= 13050
		1	**= 200/3**	= 800/9	= 100	= 1600	= 11600
			1	**= 4/3**	= 3/2	= 24	= 174
				1	**= 9/8**	= 18	= 261/2
					1	**= 16**	= 116
						1	**= 29/4**

1 gyral = 207 mg

3.5.2.3.3 Old Tunisian System

In Tunisia the metric system is compulsory since 1895.

3.5.2.3.3.1 Old Tunisian Units of Length

Table 3-196 Old Tunisian units of length
[1 pic (Tunisian) = 0.488 m to 0.637 m^2]
[1 pic (Endezian) = 0.673 m]

3.5.2.3.3.2 Old Tunisian Units of Capacity

Table 3-197 Old Tunisian units of capacity
[1 cafisso (Tunisian) = 496×10^{-3} m^3]

Cafisso	Millerole	Whiba	Saah
1	**= 31/4**	= 16	= 129
	1	**= 64/31**	= 516/31
		1	**= 129/16**

3.5.2.3.3.3 Old Tunisian Units of Weight

Table 3-198 Old Tunisian units of weight
[1 uckir (Tunisian) = 31.495×10^{-3} kg]

Cantaro (khaddari)	Cantaro (sucki)	Cantaro (attari)	Rottolo (khaddari)	Rottolo (sucki)	Rottolo (attari)	Uckir (once)
1	**= 10/9**	= 5/4	= 100	= 1000/9	= 250/2	= 2000
	1	**= 9/8**	= 90	= 100	= 225/2	= 1800
		1	**= 80**	= 800/9	= 100	= 1600
			1	**= 10/9**	= 5/4	= 20
				1	**= 9/8**	= 18
					1	**= 16**

3.5.2.3.4 Old Libyan System

Metric system compulsory since 1927.

3.5.2.3.4.1 Old Libyan Units of Length

Table 3-199 Old Libyan units of length
[1 pic (Libyan) = 0.680 m]

Pic	Draa	Palmo
1	**= 3/2**	= 3
	1	**= 2**

3.5.2.3.4.2 Old Libyan Units of Area

Table 3-200 Old Libyan units of area
[1 square pic (Libyan) = 0.4624 m^2]

Jabia	Denum	Square pic
1	**= 9/8**	= 1800
	1	**= 1600**

3.5.2.3.4.3 Old Libyan Units of Capacity (Liquids)

Table 3-201 Old Libyan units of capacity (Liquids)
[1 barile (Libyan) = 62.4975 $\times 10^{-3}$ m^3]

Barile	Giarra	Gorraf	Bozze
1	**= 71/50**	= 5	= 24
	1	**= 250/71**	= 1200/71
		1	**= 24/5**

Note: giarra and gorraf were usually measured by weight, i.e., 1 gorraf = 39/4 oka of water (E).

3.5.2.3.4.4 Old Libyan Units of Capacity (Dry)

Table 3-202 Old Libyan units of capacity (Dry)
[1 orba (Libyan) =7.692 $\times 10^{-3}$ m^3]

Ueba	Temen	Kele	Marta	Orba	Nufsorba
1	**= 4**	= 16/3	= 8	= 16	= 32
	1	**= 4/3**	= 2	= 4	= 8
		1	**= 3/2**	= 3	= 6
			1	**=2**	= 4
				1	**= 2**

Note: kele and marta were usually measured by weight, i.e., 1 marta = 12 oka of water (E).

3.5.2.3.4.5 Old Libyan Units of Weight

Table 3-203 Old Libyan units of weight
[1 rottolo (Libyan) = 0.5128 kg]

Cantar	Mattaro	Oka	Rottolo	Uckin	Termino	Dram	Kharouba
1	**= 50/21**	= 40	= 100	= 1600	= 12 800	= 16 000	= 256 000
	1	**= 84/5**	= 42	= 672	= 5376	= 6720	= 107 520
		1	**= 5/2**	= 40	= 320	= 400	= 6400
			1	**= 16**	= 128	= 160	= 2560
				1	**= 8**	= 10	= 160
					1	**= 5/4**	= 20
						1	**= 16**

3.5.2.3.5 Old Egyptian System

Metric system compulsory since 1891.

3.5.2.3.5.1 Old Egyptian Units of Length

Table 3-204 Old Egyptian units of length
[1 diraa (Egyptian) = 0.58 m]

Farsakh	Mil hachmi	Kassabah	Gasab	Diraa (pic)	Kadam	Abdat	Kirat
1	**= 3**	= 500	= 750	= 3000	= 6000	= 18 000	= 72 000
	1	**= 500/3**	= 250	= 1000	= 2000	= 6000	= 24 000
		1	**=3/2**	= 6	= 12	= 36	= 144
			1	**= 4**	= 8	= 24	= 96
				1	**= 2**	= 6	= 24
					1	**= 3**	= 12
						1	**= 4**

3.5.2.3.5.2 Old Egyptian Units of Area

Table 3-205 Old Egyptian units of area
[1 feddan masri (Egyptian) = 4200.08 m^2]

Feddan masri	Kirat kamel	Sahme
1	**= 24**	= 576
	1	**= 24**

3.5.2.3.5.3 Old Egyptian Units of Capacity

See ***Table 3-206*** opposite.

Table 3-206 Old Egyptian units of capacity

[1 keddah (Egyptian) = 2.0625×10^{-3} m^3]

Daribah	Ardeb	Keila	Rob	Maloua	Keddah	Nisf keddah	Robhah	Toumnah	Khanoubah	Kirat
1	**= 8**	= 96	= 192	= 384	= 768	= 1536	= 3072	= 6144	= 12 288	= 24 576
	1	**= 12**	= 24	= 48	= 96	= 192	= 384	= 768	= 1536	= 3072
		1	**= 2**	= 4	= 8	= 32	= 64	= 128	= 256	= 512
			1	**= 2**	= 4	= 8	= 16	= 32	= 64	= 128
				1	**= 2**	= 4	= 8	= 16	= 32	= 64
					1	**= 2**	= 4	= 8	= 16	= 32
						1	**= 2**	= 4	= 8	= 16
							1	**= 2**	= 4	= 8
								1	**= 2**	= 4
									1	**= 2**

3.5.2.3.5.4 Old Egyptian Units of Weight

Table 3-207 Old Egyptian units of weight
[1 oke (Egyptian) = 1.248 kg]

Helm	Kantar	Oke	Rotoli	Okieh	Miskal	Dirhem	Kirat
1	**= 50/9**	= 200	= 5000/9	= 20 000/27	= 20 000/9	= 80 000/9	= 1 280 000/9
	1	**= 36**	= 100	= 400/3	= 400	= 1600	= 25 600
		1	**= 25/9**	= 100/27	= 100/9	= 400/9	= 6400/9
			1	**= 4/3**	= 4	= 16	= 256
				1	**= 3**	= 12	= 192
					1	**= 4**	= 64
						1	**= 16**

3.5.2.3.6 Old Abyssinian System

3.5.2.3.6.1 Old Abyssinian Units of Length

Table 3-208 Old Abyssinian units of length
[1 pic (Abyssinian) = 0.686 m]

Farsang	Berri	Pic
1	**= 3**	= 7391
	1	= 6/5

3.5.2.3.6.2 Old Abyssinian Units of Capacity

Table 3-209 Old Abyssinian units of capacity
[1 madega (Abyssinian) = 0.44×10^{-3} m^3]

Ardeb (long)	Ardeb (short)	Kuba	Madega
1	**= 12/5**	= 240/23	= 24
	1	**= 100/23**	= 10
		1	**= 23/10**

3.5.2.3.6.3 Old Abyssinian Units of Weight

Table 3-210 Old Abyssinian units of weight
[1 rottolo (Abyssinian) = 0.311 kg]

Rottolo (pound)	**Mocha**	**Wakea** (ounce)	Derime (drachm)
1	**= 10**	= 12	= 120
	1	**= 6/5**	= 12
		1	**= 10**

3.5.2.3.7 Old Eritrean System

3.5.2.3.7.1 Old Eritrean Units of Length

Table 3-211 Old Eritrean units of length
[1 cubi (Eritrean) = 0.32 m]

Emmet (derah)	**Cubi**
1	**= 23/16**

3.5.2.3.7.2 Old Eritrean Units of Capacity

Table 3-212 Old Eritrean units of capacity
[1 messe (Eritrean) = 1.50×10^{-3} m^3]

Entelam	**Ghebeta**	**Tanica**	**Cabaho**	**Messe**
1	**= 8**	= 32/3	= 32	= 128
	1	**= 4/3**	= 4	= 16
		1	**= 3**	= 12
			1	**= 4**

3.5.2.3.7.3 Old Eritrean Units of Weight

Table 3-213 Old Eritrean units of weight
[1 rotolo (Eritean) = 0.448 kg]

Gisla	**Rottolo** (pound)	**Okia** (ounce)
1	**= 364**	= 5824
	1	**= 16**

3.5.2.3.8 Old Ethiopian System

Metric system adopted and compulsory since 1963.

3.5.2.3.8.1 Old Ethiopian Units of Length

Table 3-214 Old Ethiopian units of length
[1 kend (Ethiopian) = 0.490 m]

Kend	**Sinzer**	**Gat**	Tat
1	**= 49/16**	= 49/8	= 98/5
	1	**= 2**	= 32/5
		1	**= 16/5**

3.5.2.3.8.2 Old Ethiopian Units of Weight

See ***Table 3-215*** opposite.

3.5.2.3.9 Old Somalian System

Metric system adopted in 1950 and compulsory since 1972.

3.5.2.3.9.1 Old Somalian Units of Length

Table 3-216 Old Somalian units of length
[1 top (Somalian) = 3.92 m]

Top	Cubito
1	**= 7**

3.5.2.3.9.2 Old Somalian Units of Capacity

Table 3-217 Old Somalian units of capacity
[1 chela (Somalian) = 1.359×10^{-3} m^3]

Gisla	Tabla	Chela	Caba
1	**= 8**	= 120	= 360
	1	**= 15**	= 45
		1	**= 3**

3.5.2.3.9.3 Old Somalian Units of Weight

Table 3-218 Old Somalian units of weight
[1 rotolo (Somalian) = 0.448 kg]

Gisla	Frasla	Rottolo (pound)	Okia (ounce)
1	**= 10**	= 360	= 5760
	1	**= 36**	= 576
		1	**= 16**

3.5.2.3.10 Old Guinean System

Metric system adopted in 1906.

3.5.2.3.10.1 Old Guinean Units of Length

Table 3-219 Old Guinean units of length
[1 pic (Guinean) = 0.578 m]

Jacktan	pic
1	**= 18986/3000**

3.5.2.3.10.2 Old Guinean Units of Weight

See ***Table 3-220*** (p. 134).

Table 3-215 Old Ethiopian units of weight

[1 farasula (Ethiopian, ivory) = 13.4784 kg]

[1 farasula (Ethiopian, coffee) = 16.848 kg]

[1 farasula (Ethiopian, rubber) = 17.9712 kg]

Farasula (rubber)	**Farasula** (coffee)	**Farasula** (ivory)	**Neter**	**Wogiet**	**Alada**	**Mutagalla**	**Kasm**
1	**= 16/15**	= 4/3	= 18 720/35	= 576	= 1152	= 2304	= 4608
	1	**= 5/4**	= 3510/7	= 540	= 1080	= 2160	= 4320
		1	**= 1404/35**	= 432	= 864	= 1728	= 3456
			1	**= 140/13**	= 280/13	= 560/13	= 1120/13
				1	**= 2**	= 4	= 8
					1	**= 2**	= 4
						1	**= 2**

Table 3-220 Old Guinean units of weight

[1 benda (Guinean) = 0.0642 kg]

Kantar	Gammell	Benda	Offa	Seron	Uzan (piso)	Quinto	Aguirage	Mediatabla	Akey
1	**= 5**	= 15 218	= 30 436	= 243488/3	= 121 744	= 486 976/3	= 24 3488	= 486 976	= 973 952
	1	**= 15 218/5**	= 30 436/5	= 243488/15	= 121 744/5	= 486 976/15	= 243 488/5	= 486 976/5	= 973 952/5
		1	**= 2**	= 16/3	= 8	= 32/3	= 16	= 32	= 48
			1	**= 8/3**	= 4	= 16/3	= 8	= 16	= 32
				1	**= 3/2**	= 2	= 3	= 6	= 12
					1	**= 4/3**	= 2	= 4	= 8
						1	**= 3/2**	= 3	= 6
							1	**= 2**	= 4
								1	**= 2**

3.5.2.4 Middle East and Asia

3.5.2.4.1 Old Saudi-Arabian System

Metric system adopted in 1962 and compulsory since 1964.

3.5.2.4.1.1 Old Saudi-Arabian Units of Length

Table 3-221 Old Saudi-Arabian units of length
[1 farsakh (Arabian) = 4830 m]

Marhala	Baryd	Farsakh	Cassaba	Guz	Covid
1	**= 2**	= 8	= 4025/4	= 772 800/127	= 9 660 000/241
	1	**= 4**	= 4025/8	= 386 400/127	= 4 830 000/241
		1	**= 4025/32**	= 96 600/127	= 2 415 000/241
			1	**= 3840/635**	= 1920/241
				1	**= 635/482**

1 busa = 2.54 cm

3.5.2.4.1.2 Old Saudi-Arabian Units of Capacity (Liquids)

Table 3-222 Old Saudi-Arabian units of capacity (Liquids)
[1 nusfiah (Arabian, liq) = 0.95×10^{-3} m^3]

Ardabb (ardebb)	Zudda	Cuddy	Nusfiah	Vakia
1	**= 208**	= 416	= 1664	= 26 624
	1	**= 2**	= 8	= 128
		1	**= 4**	= 64
			1	**= 16**

3.5.2.4.1.3 Old Saudi-Arabian Units of Capacity (Dry)

Table 2-223 Old Saudi-Arabian units of capacity (Dry)
[1 teman (Arabian, dry) = 85×10^{-3} m^3]

Teman	Kella	Mecdema
1	**= 12/5**	= 240/23
	1	**= 100/23**

3.5.2.4.1.4 Old Saudi-Arabian Units of Weight

Table 3-224 Old Saudi-Arabian units of weight
[1 maund (Arabian) = 1.350 kg]

Bokard (bahar)	Kantar (buhar)	Farzil (farcella)	Maund	Ratl	Tukeas (vakias)	Coffilas
1	**= 3**	= 15	= 150	= 450	= 6000	= 60 000
	1	**= 5**	= 50	= 150	= 2000	= 20 000
		1	**= 10**	= 30	= 400	= 4000
			1	**= 3**	= 40	= 400
				1	**= 40/3**	= 400/3
					1	**= 10**

3.5.2.4.2 Old Persian System

Metric system adopted in 1933 and compulsory in Iran since 1949.

3.5.2.4.2.1 Old Persian Units of Length

Table 3-225 Old Persian units of length
[1 farsakh (Persian) = 5486.40 m]

Farsakh (parasang)	Zar	Gez (guerze)	Charak	Urub	Gireh
1	**= 5275**	= 6000	= 24 000	= 48 000	= 96 000
	1	**= 240/211**	= 211/60	= 211/30	= 211/15
		1	= 4	= 8	= 16
			1	**= 2**	= 4
				1	**= 2**

3.5.2.4.2.2 Old Persian Units of Capacity

Table 3-226 Old Persian units of capacity
[1chenica (Persian) = 1.32×10^{-3} m^3]

Artaba	Legana	Colluthun	Sabbitha	Capichas	Chenica	Sextario
1	**= 5/3**	= 8	= 100/11	= 25	= 50	= 200
	1	**= 24/5**	= 60/11	= 15	= 30	= 120
		1	**= 25/22**	= 25/8	= 25/4	= 25
			1	**= 11/4**	= 11/2	= 22
				1	**= 2**	= 8
					1	**= 4**

3.5.2.4.2.3 Old Persian Units of Weight

See ***Table 2-227*** opposite.

Table 3-227 Old Persian units of weight

[1 rottel (Persian) = 0.460 kg]

Karvar	Batman (shirez)	Batman (tauris)	Saddirham	Tcheirek	Rottel	Abbassi	Danar	Pinar	Sir	Dirhem	Miskal	Dartung	Dung	Makhod (carat)
1	**= 100**	= 200	= 400	= 800	= 6400/5	= 1600	= 3200	= 6400	= 8000	= 64 000	= 128 000	= 57 600	= 76 800	= 4 096 000
	1	**= 2**	= 4	= 8	= 64/5	= 16	= 32	= 64	= 80	= 640	= 1280	= 5760	= 7680	= 40 960
		1	**= 2**	= 4	= 32/5	= 8	= 16	= 32	= 40	= 320	= 640	= 2880	= 3840	= 15 360
			1	**= 2**	= 16/5	= 4	= 8	= 16	= 20	= 160	= 320	= 1440	= 1920	= 7680
				1	**= 8/5**	= 2	= 4	= 8	= 10	= 80	= 160	= 720	= 960	= 3840
					1	**= 5/4**	= 5/2	= 5	= 25/4	= 50	= 100	= 450	= 600	= 2400
						1	**= 2**	= 4	= 5	= 40	= 80	= 360	= 480	= 1920
							1	**= 2**	= 5/2	= 20	= 40	= 180	= 240	= 960
								1	**= 5/4**	= 10	= 20	= 90	= 120	= 480
									1	**= 8**	= 16	= 72	= 96	= 384
										1	**= 2**	= 9	= 12	= 48
											1	**= 9/2**	= 6	= 24
												1	**= 4/3**	= 16/3
													1	**= 4**

3.5.2.4.3 Old Syrian System

Metric system adopted in 1931.

3.5.2.4.3.1 Old Syrian Unit of Length

Table 3-228 Old Syrian unit of length

1 pic (Syrian) = 0.582 m

3.5.2.4.3.2 Old Syrian Units of Capacity

Table 3-229 Old Syrian units of capacity
[1 rotl (Syrian) = 3.2×10^{-3} m^3]

Garava	Makuk	Rotl
1	**= 9/5**	= 450
	1	**= 250**

3.5.2.4.3.3 Old Syrian Units of Weight

Table 3-230 Old Syrian units of weight
[1 rottolo (Syrian) = 1.785 kg]

Cantar	Cola	Zurbo	Rottolo	Once	Mitcal (metecali, drachme)	Pesi
1	**= 20/7**	= 40/11	= 100	= 6000	= 40 000	= 60 000
	1	**= 14/11**	= 35	= 2100	= 14 000	= 21 000
		1	**= 55/2**	= 1650	= 11 000	= 16 500
			1	**= 60**	= 400	= 600
				1	**= 20/3**	= 10
					1	**= 3/2**

3.5.2.4.4 Old Turkmenian System

3.5.2.4.4.1 Old Turkmenian Units of Length

Table 3-231 Old Turkmenian units of length

1 hasch (Turkmenian) = 0.7112 m
1 altschin (Turkmenian) = 0.7112 m

3.5.2.4.4.1 Old Turkmenian Units of Weight

Table 3-232 Old Turkmenian units of weight
[1batman (Turkmenian) = 125 to 128 kg]

Batman	Sir	Tscharik	Mimtscha
1	**= 8**	= 64	= 256
	1	**= 8**	= 32
		1	**= 4**

3.5.2.4.5 Old Indian System

Metric system adopted in 1920 and compulsory since 1956.

3.5.2.4.5.1 Old Indian Units of Length

See ***Table 3-233*** overleaf.

3.5.2.4.5.2 Old Indian Units of Area

Table 3-234 Old Indian units of area
[1 square guz (Indian, Bombay) = 0.470321640 m^2]
[1 square guz (Indian, Calcutta) = 0.837225 m^2]

Tenab	Biggah	Cottah	Chattack	Square guz
1	**= 25/16**	= 125/4	= 500	= 2500
	1	**= 20**	= 320	= 1600
		1	**= 16**	= 80
			1	**= 5**

1 ground = 20.3 m^2
1 kani = 307.5 m^2
1 cawnie = 540 m^2
1 chahar = 29620 mm^2

3.5.2.4.5.3 Old Indian Units of Capacity

See ***Table 3-235*** (page 141).

3.5.2.4.5.4 Old Indian Units of Weight

See ***Table 3-236*** (page 142).

3.5.2.4.6 Old Burmese System

3.5.2.4.6.1 Old Burmese Units of Length

Table 3-237 Old Burmese units of length
[1 sandong (Burma) = 0.5588 m]

Dain	Oke thapal	Dha (bamboo)	Lan	Sandong	Taim	Palgat
1	**= 50**	= 1000	= 1750	= 7000	= 77 000/9	= 38 500
	1	**= 20**	= 35	= 140	= 1540/9	= 770
		1	**= 7/4**	= 7	= 77/9	= 77/2
			1	**= 4**	= 44/9	= 22
				1	**= 11/9**	= 11/2
					1	**= 9/2**

Table 3-233 Old Indian units of length

[1 guz (Indian, Bombay) = 0.6858 m]
[1 guz (Indian, Calcutta) = 0.915 m]

Coss	Niranga	Danda	Guz	Covid	Span	Moot	Tassoos	Unglee	Jow (jaob)
1	**= 200**	= 1000	= 2000	= 4000	= 8000	= 24 000	= 48 000	= 96 000	= 288 000
	1	**= 5**	= 10	= 20	= 40	= 120	= 240	= 480	= 1440
		1	**= 2**	= 4	= 8	= 24	= 48	= 96	= 288
			1	**= 2**	= 4	= 12	= 24	= 48	= 144
				1	**= 2**	= 6	= 12	= 24	= 72
					1	**= 3**	= 6	= 12	= 36
						1	**= 2**	= 4	= 12
							1	**= 2**	= 6
								1	**= 3**

Table 3-235 Old Indian units of capacity

[1 parah (Indian) = 0.1101 m^3]

Garce	Khahoon	Candy	Parah (soally)	Adoulie	Pally	Seer	Raik	Tipree	Kunk	Khoonke	Chattack
1	**= 5**	= 10	= 80	= 1280	= 1600	= 5120	= 6400	= 10 240	= 25 600	= 102 400	= 128 000
	1	**= 2**	= 16	= 256	= 320	= 1024	= 1280	= 2048	= 5120	= 20 480	= 25 600
		1	= 8	= 128	= 160	= 512	= 640	= 1024	= 2560	= 10 240	= 12 800
			1	**= 16**	= 20	= 64	= 80	= 128	= 320	= 1280	= 1600
				1	**= 5/4**	= 4	= 5	= 8	= 20	= 80	= 100
					1	**= 16/5**	= 4	= 32/5	= 16	= 64	= 80
						1	**= 5/4**	= 2	= 5	= 40	= 50
							1	**= 8/5**	= 4	= 16	= 20
								1	**= 5/2**	= 10	= 25/2
									1	**= 4**	= 5
										1	**= 5/4**

Table 3-236 Old Indian units of weight

[1 seer (Indian) = 0.93304 kg]

Candy	Maund (bazar)	Dhurra (pally)	Raik	Seer	Powa	Chittak	Parah (pince)	Tank	Tolah (sicca)	Masha	Ruttee
1	**= 20**	= 160	= 640	= 800	= 3200	= 12 800	= 24 000	= 57 600	= 64 000	= 768 000	= 6 144 000
	1	**= 8**	= 32	= 40	= 160	= 640	= 1200	= 2880	= 3200	= 38 400	= 307 200
		1	**= 4**	**= 5**	= 20	= 80	= 150	= 360	= 400	= 4800	= 38 400
			1	**= 5/4**	= 5	= 20	= 75/2	= 90	= 100	= 1200	= 9600
				1	**= 4**	= 16	= 30	= 72	= 80	= 960	= 7680
					1	**= 4**	= 15/2	= 18	= 20	= 240	= 1920
						1	**= 15/8**	= 9/2	= 5	= 60	= 480
							1	**= 12/5**	= 8/3	= 32	= 256
								1	**= 10/9**	= 40/3	= 320/3
									1	**= 12**	= 96
										1	**= 8**

3.5.2.4.6.2 Old Burmese Units of Capacity

Table 3-238 Old Burmese units of capacity
[1 byee (Burma) = 0.505×10^{-3} m^3]

Kwai	Seit	Zayoot	Byee	Zalay	Lamany
1	**= 2**	= 4	= 8	= 32	= 64
	1	**= 2**	= 4	= 16	= 32
		1	**= 2**	= 8	= 16
			1	**= 4**	= 8
				1	**= 2**

3.5.2.4.6.3 Old Burmese Units of Weight

Table 3-239 Old Burmese units of weight
[1 catty (Burma) = 0.544 kg]

Candy	Viss	Catty	Tical	Mat	Moo	Pai	Ruay
1	**= 150**	= 450	= 15 000	= 60 000	= 120 000	= 240 000	= 960 000
	1	**= 3**	= 100	= 400	= 800	= 1600	= 6400
		1	**= 100/3**	= 400/3	= 800/3	= 1600/3	= 6400/3
			1	**= 4**	= 8	= 16	= 64
				1	**= 2**	= 4	= 16
					1	**= 2**	= 8
						1	= 4

3.5.2.4.7 Old Ceylonese and Madrasian System

3.5.2.4.7.1 Old Ceylonese and Madrasian Units of Length

Table 3-240 Old Ceylonese and Madrasian units of length

1 covid (Ceylon) = 0.464 m
1 covid (Madras) = 0.472 m

3.5.2.4.7.2 Old Ceylonese and Madrasian Units of Weight

Table 3-241 Old Ceylonese and Madrasian units of weight
[1 seer (Ceylon and Madras) = 0.283495 kg]

Candy	Maund	Vis	Seer	Powa	Pollam (varahan)	Pagoda	Fanam
1	**= 20**	= 160	= 800	= 3200	= 6400	= 64 000	= 2 304 000
	1	**= 8**	= 40	= 160	= 320	= 3200	= 115 200
		1	**= 5**	= 20	= 40	= 400	= 14 400
			1	**= 4**	= 8	= 80	= 2880
				1	**= 2**	= 20	= 720
					1	= 5	= 180
						1	= 36

3.5.2.4.8 Old Annamese System

3.5.2.4.8.1 Old Annamese Units of Length

Table 3-242 Old Annamese units of length
[1 thuoc moc (Annam) = 0.425 m]
[1 thuoc de ruong (Annam) = 0.470 m]
[1 thuoc vai (Annam) = 0.644 m]

Gon	Mao	That (chai vai)	Sao	Truong	Tam (ngu)	Thuoc	Tat	Phan	Ly
1	**= 2**	= 10	= 20	= 30	= 60	= 300	= 3000	= 30 000	= 300 000
	1	**= 5**	= 10	= 15	= 30	= 150	= 1500	= 15 000	= 150 000
		1	**= 2**	= 3	= 6	= 30	= 300	= 3000	= 30 000
			1	**= 3/2**	= 3	= 15	= 150	= 1500	= 15 000
				1	**= 2**	= 10	= 100	= 1000	= 10 000
					1	**= 5**	= 50	= 500	= 5000
						1	**= 10**	= 100	= 1000
							1	**= 10**	= 100
								1	**= 10**

3.5.2.4.8.2 Old Annamese Units of Area

Table 3-243 Old Annamese units of area
[1 square ngu (Annam) = 5.5225 m^2]

Quo	Mau	Sao	Thuoc	Square ngu
1	**= 2**	= 20	= 300	= 1800
	1	**= 10**	= 150	= 900
		1	**= 15**	= 90
			1	**= 6**

3.5.2.4.8.3 Old Annamese Units of Capacity

Table 3-244 Old Annamese units of capacity
[1 hao (Annam) = 28.26×10^{-3} m^3]

Toa	Hao (Shita)
1	**= 2**

3.5.2.4.8.4 Old Annamese Units of Weight

See ***Table 3-245*** opposite.

3.5.2.4.9 Old Cambodian System

Metric system compulsory since 1914.

Table 3-245 Old Annamese units of weight

[1 dong (Annam) = 3.775×10^{-3} kg]

Kwan	Ta (Picul)	Binh	Yen	Can	Neu	Luong	Dong	Fan	Li	Hao
1	**= 9/8**	= 9/4	= 45/4	= 225/2	= 180	= 1800	= 18 000	= 180 000	= 1 800 000	= 18 000 000
	1	**= 2**	= 10	= 100	= 160	= 1600	= 16 000	= 160 000	= 1 600 000	= 16 000 000
		1	**= 5**	= 50	= 80	= 800	= 8000	= 80 000	= 800 000	= 8 000 000
			1	**= 10**	= 16	= 160	= 1600	= 16 000	= 160 000	= 1 600 000
				1	**= 8/5**	= 16	= 160	= 1600	= 16 000	= 160 000
					1	**= 10**	= 100	= 1000	= 10 000	= 100 000
						1	**= 10**	= 100	= 1000	= 10 000
							1	**= 10**	= 100	= 1000
								1	**= 10**	= 100
									1	**= 10**

3.5.2.4.9.1 Old Cambodian Units of Length

Table 3-246 Old Cambodian units of length
[1 muoi (Cambodian) = 1 m]

Yoch	Sen	Phyeam	mot thuoc (muoi)
1	**= 20**	= 400	= 16 000
	1	**= 20**	= 40
		1	**= 2**

3.5.2.4.9.2 Old Cambodian Units of Capacity

Table 3-247 Old Cambodian units of capacity
[1 sesep (Cambodian) = 40 dm^3]

Sesep (vuong mot gia)	Thang	Tao	Kantang	Muoi (vuong mot bat tay)
1	**= 4/3**	= 8/3	= 16/3	= 40
	1	**= 2**	= 4	= 30
		1	**= 2**	= 15
			1	**= 15/2**

3.5.2.4.9.3 Old Cambodian Units of Weight

See ***Table 3-248*** opposite.

3.5.2.4.10 Old Thai System

Metric system adopted in 1923 and compulsory since 1936.

3.5.2.4.10.1 Old Thai Units of Length

See ***Table 3-249*** (page 148).

3.5.2.4.10.2 Old Thai Units of Area

Table 3-250 Old Thai units of area
[1 square wah (Thai) = 4 m^2]

Rai	Ngan	Square wah
1	**= 4**	= 400
	1	**= 100**

3.5.2.4.10.3 Old Thai Units of Capacity

See ***Table 3-251*** (page 149).

3.5.2.4.10.4 Old Thai Units of Weight

See ***Table 3-252*** (page 150).

Table 3-248 Old Cambodian units of weight

[1 neal (Cambodian) = 0.600 kg]

Hap (picul)	Chong	Pram roi (mot can tay)	Neal	Tael	Chin	Muoi (mot dong can tay)	Hun	Lin
1	**= 2**	= 60	= 100	= 1600	= 16 000	= 60 000	= 160 000	= 1 600 000
	1	**= 30**	= 50	= 800	= 8000	= 30 000	= 80 000	= 800 000
		1	**= 5/3**	= 80/3	= 800/3	= 1000	= 8000/3	= 8000/3
			1	**= 16**	= 160	= 600	= 1600	= 16 000
				1	**= 10**	= 75/2	= 100	= 1000
					1	**= 15/4**	= 5/2	= 25
						1	**= 8/3**	= 80/3
							1	**= 10**

Table 3-249 Old Thai units of length

[1 wah (Thai) = 2 m]

Yote	Roeneng	Sen	Wah	Ken	Sawk	Keup	Niou	Kabiet	Anukabiet
1	**= 4**	= 400	= 8000	= 16 000	= 32 000	= 64 000	= 768 000	= 3 072 000	= 6 144 000
	1	**= 100**	= 2000	= 4000	= 8000	= 16 000	= 192 000	= 768 000	= 1 532 000
		1	**= 20**	= 40	= 80	= 160	= 1920	= 7680	= 15 360
			1	**= 2**	= 4	= 8	= 96	= 384	= 768
				1	**= 2**	= 4	= 48	= 192	= 384
					1	**= 2**	= 24	= 96	= 192
						1	**= 12**	= 48	= 96
							1	**= 4**	= 8
								1	**= 2**

Table 3-251 Old Thai units of capacity

[1 tanan (Thai) = 0.9 to 1.2 dm^3]

Cohi	Koyan (kwien)	Ban	Seste	Tamlaum	Tang	Sat	Tanan (kanahm)	Changawn (laang)	Kam meu	Chai meu	Niou
1	**= 10**	= 20	= 40	= 80	= 800	= 1600	= 32 000	= 64 000	= 256 000	= 1 024 000	= 3 200 000
	1	**= 2**	= 4	= 8	= 80	= 160	= 3200	= 6400	= 25 600	= 102 400	= 320 000
		1	**= 2**	= 4	= 40	= 80	= 1600	= 3200	= 12 800	= 51 200	= 160 000
			1	**= 2**	= 20	= 40	= 800	= 1600	= 6400	= 25 600	= 80 000
				1	**= 10**	= 20	= 400	= 800	= 3200	= 12 800	= 40 000
					1	**= 2**	= 40	= 80	= 320	= 1280	= 4000
						1	= 20	= 40	= 160	= 640	= 2000
							1	**= 2**	= 8	= 32	= 100
								1	**= 4**	= 16	= 50
									1	**= 4**	= 25/2
										1	**= 25/8**

Table 3-252 Old Thai units of weight

[1 tchang (Thai) = 1.2 kg]

Bara	Hap	Doon	Tchang	Tamlung	Baht	Salung	Fuang	Sompay (grani)	Pai	Klam	Klom
1	**= 8**	= 20	= 400	= 8000	= 32 000	= 128 000	= 256 000	= 512 000	= 1 024 000	= 2 048 000	= 4 096 000
	1	**= 5/2**	= 50	= 1000	= 4000	= 16 000	= 32 000	= 64 000	= 128 000	= 256 000	= 512 000
		1	**= 20**	= 400	= 1600	= 6400	= 12 800	= 25 600	= 51 200	= 102 400	= 204 800
			1	**= 20**	= 80	= 320	= 640	= 1280	= 2560	= 5120	= 10 240
				1	**= 4**	= 16	= 32	= 64	= 128	= 256	= 512
					1	**= 4**	= 8	= 16	= 32	= 64	= 128
						1	**= 2**	= 4	= 8	= 16	= 32
							1	**= 2**	= 4	= 8	= 16
								1	**= 2**	= 4	= 8
									1	**= 2**	= 4
										1	**= 2**

3.5.2.4.11 Old Indonesian System

Metric system adopted in 1923 and compulsory since 1938.

3.5.2.4.11.1 Old Indonesian Units of Length

Table 3.253 Old Indonesian units of length
[1 depa (Indonesian) = 1.70 m]

Depa	Hasta	Kilan
1	**= 4**	= 8
	1	**= 2**

3.5.2.4.11.2 Old Indonesian Units of Capacity

Table 3-254 Old Indonesian units of capacity
[1 kan (Indonesian) = 1.5751×10^{-3} m^3]

Kojang	Picul	Takar	Kit	Koelak	Kan
1	**= 30**	= 78	= 663/5	= 2652/5	= 12 597/10
	1	**= 13/5**	= 221/50	= 442/25	= 41 99/100
		1	**= 17/10**	= 34/5	= 323/20
			1	**= 4**	= 19/2
				1	**= 19/8**

3.5.2.4.11.3 Old Indonesian Units of Weight

See ***Table 3-255*** overleaf.

3.5.2.4.12 Old Philippine System

Metric system adopted in 1906 and compulsory since 1975.

3.5.2.4.12.1 Old Philippine Units of Area

Table 3-256 Old Philippine units of area
[1 balita (Philippine) = 2795 m^2]

Quignon	Balita	Loan
1	**= 10**	= 100
	1	**= 10**

3.5.2.4.12.2 Old Philippine Units of Capacity

Table 3-257 Old Philippine units of capacity
[1 kaban (Phillipian) = 99.90×10^{-3} m^3]

Kaban	Ganta	Chupa	Apatan
1	**= 25**	= 25 000	= 100 000
	1	**= 1000**	= 4000
		1	**= 4**

Table 3-255 Old Indonesian units of weight

[1 picul (Indonesian) = 61.7613025 kg]

Kojang (Soera-baya)	**Kojang** (Sema-rang)	**Kojang** (Batavia)	**Timbang**	**Bahar** (long)	**Bahar** (short)	**Amat**	**Picul**	**Catty**	**Tael**	**Real**	**Soekoe**	**Tali**	**Wang**
1	**= 15/14**	= 10/9	= 6	= 20/3	= 10	= 30/2	= 30	= 3000	= 48000	= 96000	= 384 000	= 768 000	= 2 304 000
	1	**= 28/27**	= 28/5	= 56/9	= 28/3	= 14	= 28	= 2800	= 44800	= 89600	= 358 400	= 716 800	= 2 150 400
		1	**= 27/5**	= 6	= 9	= 27/2	= 27	= 2700	= 43200	= 86400	= 345 600	= 691 200	= 2 073 600
			1	**= 10/9**	= 5/3	= 5/2	= 5	= 500	= 8000	= 16000	= 64 000	= 128 000	= 384 000
				1	**= 3/2**	= 9/4	= 9/2	= 450	= 7200	= 14400	= 57 600	= 115 200	= 345 600
					1	**= 3/2**	= 3	= 300	= 4800	= 9600	= 76 800	= 153 600	= 460 800
						1	**= 2**	= 200	= 3200	= 6400	= 25 600	= 51 200	= 153 600
							1	**= 100**	= 1600	= 3200	= 12 800	= 25 600	= 76 800
								1	**= 16**	= 32	= 128	= 256	= 768
									1	**= 2**	= 8	= 16	= 48
										1	**= 4**	= 8	= 24
											1	**= 2**	= 6
												1	**= 3**

For opium trade:
1 tji = 1/100 thail (E)
1 hoen = 1/1000 thail (E)

3.5.2.4.12.3 Old Philippine Units of Weight

Table 3-258 Old Philippine units of weight
[1 catty (Philippine) = 600 × 10^{-3} kg]

Pecul	Caban	Lachsa	Chinanta	Catty	Punto
1	**= 100/97**	= 25/12	= 10	= 100	= 300
	1	**= 97/48**	= 97/10	= 97	= 291
		1	**= 24/5**	= 48	= 144
			1	**= 10**	= 30
				1	**= 3**

3.5.2.4.13 Old Japanese System

3.5.2.4.13.1 Old Japanese Units of Length

These are shown in ***Table 3-259*** (overleaf).

3.5.2.4.13.2 Old Japanese Units of Area

Table 3-260 Old Japanese units of area (land measures)
[1 tsubo = 100/30.25 = 3.30578512 m^2]

Square ri	Chô	Tan	Se	Tsubo	Gô
1	**= 1555.2**	= 15 552	= 1 55 520	= 4 665 600	= 46 656 000
	1	**= 10**	= 100	= 3000	= 30 000
		1	**= 10**	= 300	= 3000
			1	= 30	= 300
				1	**= 10**

3.5.2.4.13.3 Old Japanese Units of Capacity

Table 3-261 Old Japanese units of capacity
[1 sho = (2401/1331) = 1.803906837 dm^3 = 64 827 bu^3]

Koku	To	Sho	Gô	Shaku
1	**= 10**	= 100	= 1000	= 10 000
	1	**= 10**	= 100	= 1000
		1	**= 10**	= 100
			1	**= 10**

3.5.2.4.13.4 Old Japanese Units of Weight

These are shown in ***Table 3-262*** (p. 155).

Table 3-259 Old Japanese units of length

[1 shaku = 10/33 m]

Ri	Chô	Jô	Ken	Hiro	Yabiki	Shaku	Sun	Bu	Rin	Mô	Shi
1	**= 36**	= 1296	= 2160	= 2592	= 5184	= 12 960	= 129 600	= 1 296 000	= 12 960 000	= 120 960 000	= 1 209 600 000
	1	**= 36**	= 60	= 72	= 144	= 360	= 3600	= 36 000	= 360 000	= 3 600 000	= 36 000 000
		1	= 5/3	= 2	= 4	= 10	= 100	= 1000	= 10 000	= 100 000	= 1 000 000
			1	= 6/5	= 12/5	= 6	= 60	= 600	= 6000	= 60 000	= 600 000
				1	= 2	= 5	= 50	= 500	= 5000	= 50 000	= 500 000
					1	**= 5/2**	= 25	= 250	= 2500	= 25 000	= 250 000
						1	**= 10**	= 100	= 1000	= 10 000	= 100 000
							1	**= 10**	= 100	= 1000	= 10 000
								1	**= 10**	= 100	= 1000
									1	**= 10**	= 100
										1	**= 10**

Table 3-262 Old Japanese units of weight

[1 kwan = (15/4) kg = (3.75) kg]

Komma-ichi-da	Karus hiri-ichi-da	Kiyak-kin	Ninsoku-ichi-nin	Kwan	Kin	Hyaku-mé	Niyo	Mommé	Candareen (fun)	Rin	Mô	Shî
1	**= 20/9**	= 5/2	= 40/7	= 40	= 250	= 400	= 10 000	= 40 000	= 400 000	= 4 000 000	= 40 000 000	= 400 000 000
	1	**= 9/8**	= 18/7	= 18	= 225/2	= 180	= 4500	= 18 000	= 180 000	= 1 800 000	= 18 000 000	= 180 000 000
		1	**= 16/7**	= 16	= 100	= 160	= 4000	= 16 000	= 160 000	= 1 600 000	= 16 000 000	= 160 000 000
			1	**= 7**	= 175/4	= 70	= 1750	= 7000	= 70 000	= 700 000	= 7 000 000	= 70 000 000
				1	= 25/4	= 10	= 250	= 1000	= 10 000	= 100 000	= 1 000 000	= 10 000 000
					1	= 8/5	= 40	= 160	= 1600	= 16 000	= 160 000	= 1 600 000
						1	= 25	= 100	= 1000	= 10 000	= 100 000	= 1 000 000
							1	= 4	= 40	= 400	= 4000	= 40 000
								1	**= 10**	= 100	= 1000	= 10 000
									1	**= 10**	= 100	= 1000
										1	**= 10**	= 100
											1	**= 10**

3.5.2.5 Central and South America

3.5.2.5.1 Old Cuban System

Metric system adopted in 1882 and compulsory since 1960.

3.5.2.5.1.1 Old Cuban Units of Area

Table 3-263 Old Cuban units of area
[1 caballera (Cuban) = 134202 m^2]

Caballiera	Fanega	Cordele
1	**= 12**	= 324
	1	**= 27**

3.5.2.5.1.2 Old Cuban Units of Capacity

Table 3-264 Old Cuban units of capacity
[1 bocoy (Cuban) = 136.27 × 10^{-3} m^3]

Bocoy	Barrile
1	**= 6**

3.5.2.5.2 Old Haitian System

Metric system adopted in 1920 and compulsory since 1922. Old units derived from both French and Spanish system.

3.5.2.5.2.1 Old Haitian Units of Length

Table 3-265 Old Haitian units of length
[1 toise (Haitian) = 1.9488 m]

Toise	Aune
1	**= 1624/99**

1 carreau = 1292.3 m^2

3.5.2.5.2.2 Old Haitian Units of Capacity

Table 3-266 Old Haitian units of capacity
[1 baril (Haitian) = 100 × 10^{-3} m^3]

Toise cube	Corde	Baril
1	**= 25/12**	= 80
	1	**= 192/5**

3.5.2.5.3 Old Honduran, Costa-Rican, Nicaraguan, Salvadoran, and Guatemalan System

In these five central American states the metric system was adopted in 1910 and has been compulsory since 1912 by a joint convention. Older units from Spanish Castillian system.

3.5.2.5.3.1 Old Honduran, Costa-Rican, Nicaraguan, Salvadoran, and Guatemalan Units of Length

Table 3-267 Old Honduran, Costa-Rican, Nicaraguan, Salvadoran, and Guatemalan units of length
[1 vara (Costa-Rican) = 0.8393 m]
[1 vara (Guatemalan) = 0.8359 m]
[1 vara (Honduran) = 0.8128 m]

Mecate	Vara	Tercia	Cuarta	Pulgada
1	**= 24**	= 72	= 96	= 864
	1	**= 3**	= 4	= 36
		1	**= 4/3**	= 12
			1	**= 9**

3.5.2.5.3.2 Old Honduran, Costa-Rican, Nicaraguan, Salvadoran, and Guatemalan Units of Area

Table 3-268 Old Honduran, Costa-Rican, Nicaraguan, Salvadoran, and Guatemalan units of area
[1 manzana (Costa-Rican) = 7044.2449 m^2]
[1 manzana (Guatemalan) = 6987.2881 m^2]
[1 manzana (Honduran) = 66064.384 m^2]

Caballiera	Manzana	Square vara
1	**= 64**	= 640 000
	1	**= 10 000**

3.5.2.5.3.3 Old Honduran, Costa-Rican, Nicaraguan, Salvadoran, and Guatemalan Units of Capacity

Table 3-269 Old Honduran, Costa-Rican, Nicaraguan, Salvadoran, and Guatemalan units of capacity
[1 botella = 0.63 to 0.67 $\times 10^{-3}$ m^3]

Cajuella	Botella	Cuartillo
1	**= 25**	= 32
	1	**= 32/25**

3.5.2.5.3.4 Old Honduran, Costa-Rican, Nicaraguan, Salvadoran, and Guatemalan Units of Weight

Table 3-270 Old Honduran, Costa-Rican, Nicaraguan, Salvadoran, and Guatemalan units of weight
[1 fanega = 92 kg]

Carga	Fanega	Caja
1	**= 7/4**	= 161/16
	1	**= 23/4**

3.5.2.5.4 Old Venezuelan System

Metric system adopted in 1857 and compulsory since 1914. Old units derived from Spanish Castillian system.

3.5.2.5.4.1 Old Venezuelan Units of Length

Table 3-271 Old Venezuelan units of length
[1 vara (Venezuelan) = 0.800 m]

Legua	Vara	Pie	Cuarta	Pulgada
1	= 6280	= 6280/3	= 25 120/9	= 25 120
	1	**= 3**	= 4	= 36
		1	**= 4/3**	= 12
			1	**= 9**

3.5.2.5.4.2 Old Venezuelan Units of Weight

Table 3-272 Old Venezuelan units of weight
[1 libra (Venezuelan) = 0.500 kg]

Tonelada	Carga	Saco	Quintal	Arroba	Libbra	Onza
1	**= 8**	= 16	= 20	= 80	= 2000	= 32 000
	1	**= 2**	= 5/2	= 10	= 250	= 4000
		1	**= 5/4**	= 5	= 125	= 2000
			1	**= 4**	= 100	= 1600
				1	**= 25**	= 400
					1	**= 16**

3.5.2.5.5 Old Colombian System

Metric system adopted in 1853 and compulsory since 1854. Older units derived from Spanish Castillian system.

3.5.2.5.5.1 Old Colombian Units of Length

Table 3-273 Old Colombian units of length
[1 vara (Colombian) = 0.800 m]

Legua	Cuadra	Vara	Pie	Cuarta	Pulgada
1	**= 125/2**	= 6250	= 18 750	= 25 000	= 225 000
	1	**= 100**	= 300	= 400	= 3600
		1	**= 3**	= 4	= 36
			1	**= 4/3**	= 12
				1	**= 9**

3.5.2.5.5.2 Old Colombian Units of Weight

Table 3-274 Old Colombian units of weight
[1 libbra (Colombian) = 0.500 kg]

Tonelada	Carga	Saco	Quintal	Arroba	Libbra	Onza
1	**= 8**	= 16	= 20	= 80	= 2000	= 32 000
	1	**= 2**	= 5/2	= 10	= 250	= 4000
		1	**= 5/4**	= 5	= 125	= 2000
			1	**= 4**	= 100	= 1600
				1	**= 25**	= 400
					1	**= 16**

3.5.2.5.6 Old Brazilian System

Metric system adopted in 1862 and compulsory since 1874.

3.5.2.5.6.1 Old Brazilian Units of Length

Table 3-275 Old Brazilian units of length
[1 pe (Brazilian) = 1/3 m (E)= 0.33333 m]

Legoa (league)	**Braca** (fathom)	**Passo geometrico**	**Vara** (yard)	**Pe** (foot)	**Palmo** (palm)	**Pulgado** (inch)
1	= 3000	= 4000	= 6000	= 20 000	= 30 000	= 240 000
	1	**= 4/3**	= 2	= 20/3	= 10	= 80
		1	**= 3/2**	= 5	= 15/2	= 60
			1	**= 10/3**	= 5	= 40
				1	**= 3/2**	**= 12**
					1	**= 8**

3.5.2.5.6.2 Old Brazilian Units of Capacity

Table 3-276 Old Brazilian units of capacity
[1 alquiera (Brazilian) = 5.324×10^{-3} m^3]
[1 alquiera (Brazilian, salt) = 4.076×10^{-3} m^3]
[1 alquiera (Brazilian, common) = 3.626×10^{-3} m^3]
[1 alquiera (Brazilian, Bahia) = 3.524×10^{-3} m^3]

Tonel	Pipa	Moio	Almude	Alquiera	Canada
1	**= 2**	= 3	= 30	= 180	= 360
	1	**= 3/2**	= 15	= 90	= 180
		1	**= 10**	= 60	= 120
			1	**= 6**	= 12
				1	**= 2**

3.5.2.5.6.3 Old Brazilian Units of Weight

Table 2-277 Old Brazilian units of weight
[1 libra (Brazilian) = 0.45905 kg]

Tonelada	Quintal	Arroba	Libra	Marco	Onza
1	**= 27/2**	= 54	= 1728	= 3456	= 27 648
	1	**= 4**	= 128	= 256	= 2048
		1	**= 32**	= 64	= 512
			1	**= 2**	= 16
				1	**= 8**

3.5.2.5.7 Old Paraguayan System

Metric system adopted in 1899.

3.5.2.5.7.1 Old Paraguayan Units of Length

Table 3-278 Old Paraguyan units of length
[1 vara (Paraguayan) = 0.866 m]
[1 vara (Paraguayan, old) = 0.83856 m]

Legua	Cuadra	Cuerda	Vara	Piede	Pulgada	Linea
1	**= 50**	= 180	= 5000	= 1500	= 18 000	= 216 000
	1	**= 18/5**	= 100	= 300	= 3600	= 43 200
		1	**= 250/9**	= 250/3	= 1000	= 12 000
			1	**= 3**	= 36	= 432
				1	**= 12**	= 144
					1	**= 12**

Note: only one unit of surface area 1 lino = 100 square vara (E)

3.5.2.5.7.2 Old Paraguayan Units of Capacity

Table 3-279 Old Paraguayan units of capacity
[1 fanega (Paraguayan) = 288 dm^3]

Pipe	Fanega	Baril	Almude	Frasco	Cuarta
1	**= 2**	= 6	= 24	= 192	= 768
	1	**= 3**	= 12	= 96	= 384
		1	**= 4**	= 32	= 128
			1	**= 8**	= 32
				1	**= 4**

3.5.2.5.7.3 Old Paraguayan Units of Weight

Table 3-280 Old Paraguyan units of weight
[1 libbra (Paraguayan) = 0.459 kg]
[1 libbra (Paraguayan, Old) = 0.46008 kg]

Tonnelada	Quintal	Arrobe	Libbra	Once
1	**= 20**	= 80	= 2000	= 32 000
	1	**= 4**	= 100	= 1600
		1	**= 25**	= 400
			1	**= 16**

3.5.2.5.8 Old Argentinian System

Metric system adopted in 1863 and compulsory since 1887. Older system derived from Spanish Castilian.

3.5.2.5.8.1 Old Argentinian Units of Length

Table 3-281 Old Argentinian units of length
[1 vara (Argentinian) = 0.8666 m]

Legua	Cuadra	Braza	Vara	Pie	Pulgada	Linea
1	**= 40**	= 3000	= 6000	= 18 000	= 2 160 000	= 2 592 000
	1	**= 75**	= 150	= 450	= 5400	= 64 800
		1	**= 2**	= 6	= 72	= 864
			1	**= 3**	= 36	= 432
				1	**= 12**	= 144
					1	**= 12**

3.5.2.5.8.2 Old Argentinian Units of Capacity (Liquids)

Table 2-282 Old Argentinian units of capacity (Liquids)
[1 frasco (Argentinian, liquid) = 2.375×10^{-3} m^3]

Pipa	Cuerta	Baril	Frasco	Cuarta	Octava
1	**= 4**	= 6	= 192	= 768	= 1536
	1	**= 3/2**	= 48	= 192	= 384
		1	**= 32**	= 128	= 256
			1	**= 4**	= 8
				1	**= 2**

3.5.2.5.8.3 Old Argentinian Units of Capacity (Dry)

Table 3-283 Old Argentinian units of capacity (Dry)
[1 fanega (Argentinian, Dry) = 137.1977×10^{-3} m^3]

Lastre	Tonelada	Fanega	Cuartilla
1	**= 30/14**	= 15	= 60
	1	**= 7**	= 28
		1	**= 4**

3.5.2.5.8.4 Old Argentinian Units of Weight

Table 3-284 Old Argentinian units of weight
[1 libra (Argentinian) = 0.4594 kg]

Tonelada	Quintal	Arroba	Libra	Onza	Adarme	Granos
1	**= 20**	= 80	= 2000	= 32 000	= 512 000	= 18 432 000
	1	**= 4**	= 100	= 1600	= 25 600	= 921 600
		1	**= 25**	= 400	= 6400	= 230 400
			1	**= 16**	= 256	= 9216
				1	= 16	= 576
					1	**= 36**

3.5.2.5.9 Old Chilean System

Metric system adopted in 1848 and compulsory since 1865.

3.5.2.5.9.1 Old Chilean Units of Length

Table 3-285 Old Chilean units of length
[1 bara (Chilean) = 0.836 m]

Legua	Cuadra	Bara	Pie	Pulgada	Linea
1	**= 36**	= 5400	= 16 200	= 194 400	= 2 332 800
	1	**= 150**	= 450	= 5400	= 64 800
		1	**= 3**	= 36	= 432
			1	**= 12**	= 144
				1	**= 12**

3.5.2.5.9.2 Old Chilean Units of Capacity

Table 3-286 Old Chilean units of capacity
[1 almude (Chilean)= 8.083×10^{-3} m^3]

Fanega	Arroba	Almude	Cuartillo
1	**= 3**	= 12	= 48
	1	**= 4**	= 32
		1	**= 8**

3.5.2.5.9.3 Old Chilean Units of Weight

Table 3-287 Old Chilean units of weight
[1 libra (Chilean) = 0.460093 kg]

Quintale	Arroba	Libbra	Onza	Castellano	Adarme	Granos
1	**= 4**	= 100	= 1600	= 10 000	= 25 600	= 921 600
	1	**= 25**	= 400	= 2500	= 6400	= 230 400
		1	**= 16**	= 100	= 256	= 9216
			1	**= 25/4**	= 16	= 576
				1	**= 64/25**	= 2304/25
					1	**= 36**

3.5.2.5.10 Old Peruvian System

Metric system adopted in 1862 and compulsory since 1869. Older units derived from Spanish Castillian system.

3.5.2.5.10.1 Old Peruvian Units of Length and Area

Table 3-288 Old Peruvian units of length and area

1 vara (Peruvian) = 0.83598 m
1 pie (Peruvian) = 0.27866 m
1 fanegada (Peruvian) = 4500 square vara (E)
1 topo (Peruvian) = 3872 square vara (E)

3.5.2.5.10.2 Old Peruvian Units of Weight

Table 3-289 Old Peruvian units of weight
[1 libra (Peruvian) = 0.46009 kg]

Fanega	Quintal	Arroba	Libbra
1	**= 7/5**	= 28/5	= 140
	1	**= 4**	= 100
		1	**= 25**

3.5.2.6 North America

3.5.2.6.1 Old Mexican System

The metric system adopted in 1857 and compulsory since 1896.

3.5.2.6.1.1 Old Mexican Units of Length

Table 3-290 Old Mexican units of length
[1 vara (Mexican) = 0.838 m]

Legua	Milla	Vara	Pie	Pulgada	Linea
1	**= 3**	= 5000	= 15 000	= 180 000	= 2 160 000
	1	**= 5000/3**	= 5000	= 60 000	= 720 000
		1	**= 3**	= 36	= 432
			1	**= 12**	= 144
				1	**= 12**

3.5.2.6.1.2 Old Mexican Units of Area

Table 3-291 Old Mexican units of area
[1 fanega (Mexican) = 35662.759296 m^2]

Sitio	Labor	Caballiera	Fanega	Square vara
1	**= 12307/450**	= 12307/300	= 12307/25	= 24 999 947.52
	1	**= 3/2**	= 18	= 914 112
		1	**= 12**	= 609 408
			1	**= 50 784**

3.5.2.6.1.3 Old Mexican Units of Capacity (Liquids)

Table 3-292 Old Mexican units of capacity (Liquids)
[1 cuartillo (Mexican, wine) = 0.456264×10^{-3} m^3]
[1 cuartillo (Mexican, oil) = 0.506162×10^{-3} m^3]

Jarra	Cuartillo
1	**= 18**

3.5.2.6.1.4 Old Mexican Units of Capacity (Dry)

Table 3-293 Old Mexican units of capacity (Dry)
[1 cuartillo (Mexican, Dry) = 1.8918×10^{-3} m^3]

Carga	Fanega	Almude	Cuartillo
1	**= 2**	= 24	= 96
	1	**= 12**	= 48
		1	**= 4**

3.5.2.6.1.5 Old Mexican Units of Weight

Table 3-294 Old Mexican units of weight
[1 libra (Mexican) = 0.46024634 kg]

Tercio	Quintal	Arroba	Libbra	Onza	Ochava	Adarme	Tomin
1	**= 8/5**	= 32/5	= 160	= 2560	= 20 480	= 40 960	= 122 880
	1	**= 4**	= 100	= 1600	= 12 800	= 25 600	= 76 800
		1	**= 25**	= 400	= 3200	= 6400	= 19 200
			1	**= 16**	= 128	= 256	= 768
				1	**= 8**	= 16	= 48
					1	**= 2**	= 6
						1	**= 3**