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January to November 1963

metric measures

JOURNAL OF WEIGHTS AND MEASURES

THE PUBLICATIONS DIVISION

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THE PUBLICATIONS DIVISION

ABBREVIATIONS FOR METRIC UNITS

(1) DECIMAL MULTIPLES AND SUBMULTIPLES

Prefix		Value in Terms of Unit	Abbreviation
kilo	..	1 000	k
centi	..	0·01 (10^{-2})	c
milli	..	0·001(10^{-3})	m
micro	..	0·000 001(10^{-6})	μ

(2) WEIGHTS

Denomination		Value	Abbreviation
tonne	..	1 000 kg	t
quintal	..	100 kg	q
kilogram	..	1 kg	kg
gram	..	1 g	g
milligram	..	1 mg	mg
carat	..	200 mg	c

(3) CAPACITY

kilolitre	..	1 000 l	kl
litre	..	1 l	l
millilitre	..	1 ml	ml

(4) VOLUME

cubic metre	..	m^3	m^3 or cu m*
cubic centimetre		cm^3	cm^3 or cu cm*
cubic millimetre		mm^3	mm^3 or cu mm*

(5) LENGTH

kilometre	..	1 000 m	km
metre	..	1 m	m
centimetre	..	1 cm	cm
millimetre	..	1 mm	mm
micron	..	1/1 000 mm or 10^{-3} mm	μm

(6) AREA

square kilometre		1 000 000 m^2	km^2 or sq km*
square metre	..	1 m^2	m^2 or sq m*
square centimetre		1 cm^2	cm^2 or sq cm*
square millimetre		1 mm^2	mm^2 or sq mm*

(7) LAND MEASURE

are	..	100 m^2	a
hectare	..	100 a	ha
centiare	..	m^2	ca

*Both these abbreviations are current, but the first set should preferably be used. The former abbreviation is used internationally.

Rules for Abbreviations

(1) Do not make any change, such as addition of 's' to indicate plurality *e.g.*, write 1 kg, 10 kg, 20 g, 5g, 10 t, 20 ml, 27 l, 165 km, 2 mm, 100 cm^3, 66 km^2;

(2) Do not capitalize the abbreviations. For example, do not write 1 Kg, 2 Kg, 20 MM, 50 MM; the right way is to write 1 kg, 2 kg, 20 mm, 50 mm, etc.

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P797

metric measures

(JOURNAL OF WEIGHTS AND MEASURES)
STANDING METRIC COMMITTEE
MINISTRY OF COMMERCE AND INDUSTRY

Vol. 6 JANUARY 1963 (PAUSA 1884) No. 1

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1819-1820 Hans Christian Oersted's experiments on electro-magnetism.

1829 Laplace formulated the law regarding forces between current carrying conductors (popularly known as Biot and Savart's law).

1831-1832 Wilhelm Weber and Karl Friedrich Gauss, Professors at University of Gottingen, develop electrostatic and electromagnetic units.

1850 Weber co-ordinates the different methods utilised in electricity into a system, 'the absolute CGS electromagnetic system'. The millimetre-milligramme-second (m-m-s) system of units proposed by Gauss and Weber.
Michael Faraday and James Clerk Maxwell develop the concept of electromagnetic fields.
The British Association for the Advancement of Science (BAAS) in England introduced the foot-grain-second (FGS) system followed by the introduction of the 'metre-gramme-second' (MGS) system.

1856 Experimental correlation between the electrostatic and electromagnetic systems obtained by Weber and Kohlrausch. Both these systems found extensive use in physics from this period onward.

1872 Committee of the BAAS appointed for 'Reporting on the Nomenclature of Dynamical and Electrical Units'. The Committee advocated the use of CGS system of units.

1881 The first Electrical Congress adopts the CGS system. Five 'practical units'—the volt, ampere, ohm, coulomb and farad—were introduced which were made exact multiples of corresponding CGS units.

1882-1890 Von Helmholtz (1882) and Hertz (1890) attempted to avoid the disadvantages of the double system of units in the same field. A new combined system of units known as Gaussian system was evolved

1889 'Joule' and 'Watt' were introduced.

1891 Prof. Perry of England suggested that the value of μ_o (permeability of free space) be set equal to $4\pi \times 10^{-9}$; that the unit of magnetomotive force be termed 'ampere-turn'; and the unit of magnetic field intensity be termed 'ampere turn per cm'. This revolutionary idea of assigning a number other than unity to the permeability was not well received.

1892 'Henry' was introduced.

1901 In Rome, Prof. Giorgi described the MKS system of units. It was pointed out that an absolute electromagnetic system of units could be devised having the already-determined 'practical units' as 'absolute units' without any change. The electromagnetic field was described in terms of the volt and ampere. Metre and kilogram were reintroduced because, by their use the mechanical unit of energy and the electrical unit of energy became equal.

1904 David Robertson of Bristol, England, developed MKS system independently. The International Electrical Congress at its meeting in St. Louis, U.S.A., reviewed Prof. Giorgi's paper on MKS system of units. At the same Congress, Prof. Ascoli of Italy showed that the Giorgi system is only one of many such possible systems which could be devised on the basis of the existing 'practical units'. (One such system was evolved by Maxwell as early as 1881 which involved the unit of length of 10,000 km—an unsuitable figure for any practical use.

1927 Without having recourse to 'mechanical forces' and by basing arguments exclusively on 'electrical phenomena', R. W. Pohl of Gottingen, Germany, developed the electromagnetic theory, with voltage and current as starting points.

1935 At the meeting of the International Electrotechnical Commission (I.E.C.) held at Scheveningen, Brussels, it was resolved to adopt the proposals of Giorgi. The name 'Giorgi system' was recommended.

1938 The I.E.C. resolution of 1935 was confirmed by the Advisory Committee at its meeting held at Torquay. The Committee approved the suggestion of the Chairman thus : 'That the question of rationalisation should be left over for the time being as it did not appear to him sufficiently ripe yet for the adoption of final conclusion'.

1950 *The Revue Generale de L' Electricite* of Paris published a letter from Prof. Giorgi clarifying a few points that were misunderstood. On 19 August 1950, just prior to the world-wide acceptance of his system, Prof. Giorgi died.

The British Standards Institution published a document: 1637: 1950: entitled: 'Memorandum on the MKS System of Electrical and Magnetic Units—Decision taken by the I.E.C.' L. H. A. Carr summarized the decisions arrived at the Commission's meeting regarding the Giorgi system.

History of Rationalised MKS System

In 1893 Oliver Heaviside very strongly stated that the system of CGS electrical units existing then was an 'absurdly irrational one'. J. C. Maxwell had earlier (in the 1880's) pointed out this irrationality of electrical units. Thus, towards the end of the nineteenth century, the need for a rationalised system of units was acutely felt. Though Giorgi proposed his system of rationalised units as early as 1901, it was only in July 1950—one month before his death—that the I.E.C., at its meeting held at Paris, decided in favour of the 'rationalised' form with 'Ampere' as the fourth basic unit. International recognition to the 'Rationalised MKS' system came in 1951 through a resolution adopted by the I.E.C. In 1954, further supplementary recommendations followed dealing in the main with :

(*i*) the value of μ_o;
(*ii*) the preference of rationalized form; and
(*iii*) the approved alternate name, MKSA system.
(Metre - kilogram - second - Ampere system).

The Giorgi or the rationalised MKSA system came to be accepted internationally in fields of electricity and magnetism.

TABLE 1

Sl. No.	Name of Unit	Named after	Life Period	Country
(1)	Volt	Alessandro Volta	1745—1827	Italy
(2)	Ampere	Andre Marie Ampere	1775—1836	France
(3)	Ohm	George Simon Ohm	1789—1854	Germany
(4)	Coulomb	Charles Augustine De Coulomb	1736—1806	France
(5)	Farad	Michael Faraday	1791—1867	England
(6)	Henry	Joseph Henry	1797—1878	America
(7)	Joule	James Prescott Joule	1818—1889	England
(8)	Watt	James Watt	1736—1819	Scotland
(9)	Newton	Sir Issac Newton	1642—1727	England
(10)	Gilbert	William Gilbert	1544—1603	England
(11)	Oersted	Hans Christian Oersted	1777—1851	Denmark
(12)	Maxwell	James Clerk Maxwell	1831—1879	England
(13)	Gauss	Karl Friedrich Gauss	1777—1855	Germany
(14)	Weber	Wilhelm Weber	1804—1890	Germany

SURVEY OF TEN SYSTEMS

(1) CGS Absolute Units

In 1863 a Committee sponsored by the BAAS under the chairmanship of Maxwell recommended the adoption of the CGS system. The additional basic quantity used was μ_o, the permeability of free space, which was assigned the value of unity. The units under this system were called, 'Absolute Units'. The BAAS Commitee stated thus :

> The word 'absolute' .... does not mean that the measurements or units are absolutely correct, but only that the measurement, instead of being a simple comparison with an arbitrary quantity of the same kind as that measured, is made by reference to certain fundamental units of another kind treated as postulates.

One great disadvantage of this CGS system was that the magnitudes of the units were not convenient for practical use. Further, this system was not convenient for use with electrostatic equations.

(2) The CGS Absolute Electrostatic System

This is the most convenient system of units for dealing with purely electrostatic problems. It is based on Coulomb's law in electrostatics.

$$F \underset{\text{(in dynes)}}{=} \frac{q_1 q_2}{k_o d^2}$$

The unit of charge is defined as being such that two unit positive charges 1 cm apart in vacuum repel one another with a force of 1 dyne. This means that k_o, the dielectric constant or the permittivity of vacuum, is unity.

(3) The CGS Absolute Electromagnetic System

Since it is now held that all magnetic effects are produced by moving charges and that free, magnetic point-poles do not exist, this system is less commonly used now than before. The basic law of this system is :

$$F \underset{\text{(in dynes)}}{=} \frac{m_1 \; m_2}{\mu_o \; d^2}$$

From this equation it follows that two unit north poles placed 1 cm apart in vacuum repel one another with a force of 1 dyne. This means that μ_o, the magnetic space constant or permeability of empty or free space, is unity.

(4) The Practical System

Practical units are related to the CGS units by multiples or sub-multiples of 10. They are designated and named after distinguished scientists and are adapted to the needs of the practical engineer. By defining $\mu_o = 10^{-7}$, the fundamental units of the MKS system become identical with the corresponding practical units. Thus, the ampere, volt, ohm, farad and henry were absorbed directly into the MKS system without any change in their magnitudes.

(5) The International System

The international units were defined by the International Electrical Congress at Chicago in 1893 and slightly modified by the London Electrical Conference in 1908. The International Committee of Weights and Measures decided to abandon these units in 1948 in favour of the MKS system, with length, mass, time and permeability (μ_o) as the fundamental quantities.

The values of the absolute units were first defined in terms of the CGS units, thus:

1 ohm $= 10^9$ abohms
1 ampere $= 1/10$ abampere
1 volt $= 10^8$ abvolts
1 watt $= 10^7$ ergs/sec.

The MKS system is an 'absolute-practical system'. The international units are based on specifications of standards such as :

(*i*) the international ohm;
(*ii*) the international ampere.
(*iii*) the value of the emf of the Weston standard cell, in terms of the 'international volt'.

As on 1-1-1948 equivalents of international units and the practical-absolute units or the MKS units, are given in Table 2.

TABLE 2

International Units	MKS (or practical-absolute) Units
1 ampere	0.999835 ampere
1 coulomb	0.999835 coulomb
1 ohm	1.000495 ohm
1 volt	1.00033 volt
1 henry	1.000495 henry
1 farad	0.999505 farad
1 joule	1.000165 joule
1 watt	1.000165 watt

(6) The Gaussian System (or the 'Symmetric' CGS System)

This system is really a combination of two CGS systems—electrostatic and electromagnetic. Electrostatic definitions are used for all electrical quantities and electromagnetic definitions for all magnetic quantities. Both μ_o and k_o are taken as unity and dimensionless. This leads to the factor :

c, $\frac{1}{c}$, c^2 or $\frac{1}{c^2}$ into many of the terms—'c'

being the velocity of electromagnetic radiation. The Gaussian system is the most convenient system for use in certain branches of theoretical physics. Consider the equation for the force of an electric charge :

$$\bar{F} = q\bar{E} + (q)\,(\bar{v} \times \bar{B})$$

where, $\bar{F}$ is the force on a charge moving with a velocity $\bar{v}$ in electric and magnetic fields of intensity $\bar{E}$ and $\bar{B}$ respectively.

Here, the first term, representing an electrostatic force, is written in esu system; and the second term, representing an electromagnetic force, is written in emu system.

The Gaussian system gets over this difficulty by writing thus :

$$\bar{F} = q\bar{E} + (q/c)(\bar{v} \times \bar{B}),$$

where, q is in esu throughout the equation, even though $\bar{B}$ is in emu.

Equations relating to electrical and magnetic quantities then involve the velocity of light, *e.g.*,

$$\text{curl } \bar{E} = -\frac{1}{c}\frac{\delta \bar{B}}{\delta t}$$

The average practical engineer seldom, if ever, uses this 'mixed' system of units.

(7) The Heaviside-Lorentz System

The system is used in advanced physics and not in electrical engineering. It is a rationalised form of the Gaussian system. In this system, $\mu_o = 4\pi/10^9$; $k_o = 1/(36\pi \times 10^{11})$. The relationship between Heaviside-Lorentz and MKS units is given in the following table :

TABLE 3

Sl. No.	Quantity	Symbol	No. of H-L Units in One MKS Unit
(1)	Charge	Q	$3 \times \sqrt{4\pi} \times 10^9$
(2)	Displacement or electric flux density	D	$3 \times \sqrt{4\pi} \times 10$
(3)	Electricity Intensity	E	$3 \times \sqrt{4\pi} \times 10^{-1}$
(4)	Magnetic Flux Density	B	$10^4 \div \sqrt{4\pi}$
(5)	mmf gradient or magnetic field intensity	H	$\sqrt{4\pi} \div 1000$

(8) The MKS (Unrationalised System)

In 1946, the International Committee of Weights and Measures passed a resolution that from 1 January 1948, the system of electrical units should be the absolute system, based on the MKS mechanical units, and defined permeability of free space as 10^{-7} units. This absolute system is known as the MKS system of units.

Objects of the MKS System

(1) To consolidate the three systems of electrical units in present use, so that only one system is necessary for all electrical calculations. (This is done by modifications of the CGS electromagnetic system, and the CGS electrostatic system, causing those two

systems of units to coalesce with the present system of practical units—the volt, the ampere and other units derived from them).

(2) To introduce deliberately a distinction between relative and absolute permeability and between relative and absolute permittivity, respectively.

(3) To supply the missing practical unit of flux, called the weber (=volt × second).

(4) To distinguish between B and H; and D and E, respectively (see Table 3); and to force a discrimination between them at all stages in electrical calculations.

(5) To provide any new mechanical units needed, consequential on the changes in the units of mass and length, *e.g.*, the newton, the newton-metre, etc.

Table 4 gives the common mechanical and electrical units in the MKS system of units.

TABLE 4

Sl. No.	Unit of	Name of Unit	Abbreviation
(1)	length	metre	m
(2)	mass	kilogram	kg
(3)	time	second	s
(4)	electric current	ampere	A
(5)	force	newton	N
(6)	work	joule	J
(7)	power	watt	W
(8)	electrical pressure ..	volt	V
(9)	charge	coulomb	C
(10)	magnetic flux	weber	Wb
(11)	resistance	ohm	Ω
(12)	inductance	henry	H
(13)	capacitance	farad	F

(9) RMKS or Giorgi System

In this system, the fourth basic quantity is the ampere which is defined in terms of the MKS unit of force : the newton (= 10^5 dynes). The ampere is defined as the strength of that constant current which, flowing through two parallel, straight and infinitely long conductors of negligible cross-section, and placed in vacuo at a distance of 1 metre from each other, produces between these conductors a force of 2×10^{-7} newtons per metre of their length. This value was chosen so that the ampere as defined in this manner would have the same magnitudes as with the earlier definition in terms of the electrolytic deposition of silver. (Actually, there is a small discrepancy). The new definition is equivalent to giving a value of $4\pi\times10^{-7}$ newton/amp^2 to μ_o, the permeability of empty space. It can be shown that $\sqrt{\mu_o k_o}=\frac{1}{c}$ in any consistent system of units. Using this relation, the value of permittivity k_o can be evaluated in the RMKSA system. Table 5 summarises the value of μ_o and k_o for the two CGS systems and the MKS and RMKS systems.

TABLE 5

Constant	CGS System		MKS Systems	
	esu	emu	MKS	RMKS
μ_o	$\frac{1}{c^2}=\frac{1}{9\times10^{20}}$ s^2/cm^2	1 (unity)	10^{-7}	$4\pi\times10^{-7}=1\cdot257\times10^{-6}$ H/m
k_o	1 (unity)	$\frac{1/c^2}{1}=\frac{1}{9\times10^{20}}$ s^2/cm^2	$\frac{10^{-9}}{9}$	$\frac{10^{-9}}{36\pi}=8\cdot854\times10^{-12}$ F/m

The RMKSA system will be considered exhaustively later on.

(10) MIE System

This was proposed in Germany but never became popular. In this system,

Unit of mass = 10,000 kg

Unit of force = 10^7 dynes = 100 newtons = 1 sthen

$\mu_o=4\pi\times10^{-9}$

$k_o=(36\pi\times10^{11})^{-1}$

RATIONALISATION AND ITS IMPLICATIONS

The MKS system adopted by the I.E.C. is the rationalised form because of several overwhelming advantages it offers in spite of a few minor defects.

(1) What is "Rationalisation of Units"?

Rationalisation means the transferring of the ubiquitous factor : π, 2π, 4π from some of the basic equations of electrostatics and electromagnetism from one place to another for some valid reasons. Rationalisation is not actually essential or peculiar to the MKS system alone but this principle can be applied to any unrationalised system of units, such as, the CGS system of units.

A traditional equation of the CGS system can be rationalised by substitution as follows: '$4\pi\ \mu_r\ \mu_o$' for 'μ' and '$4\pi\ k_r\ k_o$' for 'k'. The significance of these equations is :

$\frac{B}{H}=\mu=\mu_r\mu_o$, where

μ = absolute permeability

μ_o = permeability of free space = $4\pi/10^7$ = 1.257×10^{-6} H/m

μ_r = relative permeability of the medium, dimensionless.

$=\frac{\text{Flux density produced in the medium}}{\text{Flux density produced in free space}}$

Similarly, $k=k_o k_r$, where

k = absolute permittivity

k_o = permittivity of free space = $\frac{10^{-9}}{9\times4\pi}=\frac{10^{-9}}{36\pi}=8.854\times10^{-12}$ F/m

k_r = Relative permittivity of a medium, dimensionless

$=\frac{\text{Permittivity of a medium}}{\text{Permittivity of free space}}$

Note : μ_r and k_r are each unity for vacuum or air. Some of the important traditional equations in the CGS system and the same restated in the RMKSA system are given in Table 6.

TABLE 6

Sl. No.	Equation Describing	In CGS Units	Units in Rationalised MKSA
(1)	M.M.F. of a coil of N turns.	$\frac{4\pi\ NI}{10}$ Ampere-turns	NI Ampere-Turns
(2)	Inductance of a solenoid.	$4\pi\frac{N^2A}{l}\frac{dB}{dH}\times10^{-9}$ Henrys	$\frac{N^2A}{2}\frac{dB}{dH}$ Henrys
(3)	Capacity of parallel plates.	$\frac{kA}{4\pi d}\times10^9$ Farads	$\frac{kA}{d}$ Farads
(4)	Capacity of concentric cylinders.	$\frac{Kl}{\log\frac{R}{r}}\times10^9$ Farads	$2\pi\frac{kl}{\log\frac{R}{r}}$ Farads
(5)	Capacity of isolated sphere.	$kr\times10^9$ Farads	$4\pi\ kr$ Farads

It is evident from the above table that π's occur in the formulae expressed in CGS units in the cases of linear symmetry but they are absent in the cases which have circular, cylindrical or spherical symmetry. Any school-going child who is taught geometry and mensuration knows that π's occur in every formula connected with a circle, cylinder or sphere. For example, we have :

(1) Circumference of a circle $= 2\pi r$
(2) Area of a circle $= \pi r^2$
(3) Surface area of a sphere $= 4\pi r^2$
(4) Volume of a sphere $= 4/3\pi r^3$

The cause for the irrationality in the appearance of π's in the wrong places and their non-appearance in the right places in the traditional CGS system electrical formulae, was beautifully impressed upon by Oliver Heaviside as long ago as 1893—nearly 70 years ago :

'Heaviside devoted a number of his papers to tilting at the mathematical expression 4π which forms a part of many of the officially recognised electrical units. Heaviside, of course, found difficulty in moving the higher electrical and scientific authorities in his country and referred to the commonsense attitude of the chemists in revising the chemical nomenclature for water, H_2O. Fitzgerald in reply said : 'You won't be able to move physicists as the H_2O question moved chemists. Besides H_2O had very little money at its back but that wretched 4π is a millionaire, and you might as well try to get a patent against Rothschilds as to break its vested interests.'

He further explained them :

'Imagine a situation where, after having fixed the centimetre as the unit of length we fix the unit of area as the area of a circle having one centimetre as its diameter and call it a 'circular centimetre.' This unit of area will then become $\pi/4$ square centimetres. Conversely, the area of a square with its side equal to one centimetre, will be $4/\pi$ 'circular centimetres.' Similarly, if we define the unit of volume as that of a sphere with its diameter as one centimetre, its volume will be one 'cubical centimetre' or $4/3\ \pi(\frac{1}{2})^3 = \pi/6$ cubic centimetres'. On this basis the volume of a cube with its side as one centimetre will be $6/\pi$ 'cubical centimetres.'

Heaviside wrote thus :

'No one would deny that such a system was an absurdly irrational one. I maintain that the system in present use for electricity is founded on similar irrationality, which pervades it from top to bottom'.

Such an irrationality existed in the system of electrical units for over a century—from the 1850's to 1950's.

(2) Major Consequences of Rationalisation

(i) The restatement of the two laws of Coulomb deliberately introducing 4π into the denominator thus :

In electrostatic:

$$F \text{ (In newtons)} = \frac{q_1 q_2}{4\pi k r^2} = \frac{q_1 q_2}{4\pi k_o k_r r^2} \quad \ldots (1)$$

In electromagnetism :

$$F \text{ (In Newtons)} = \frac{m_1 m_2}{4\pi\mu r^2} = \frac{m_1 m_2}{4\pi\mu_o\mu_r r^2} \quad \ldots (2)$$

The restatement of these two laws removes the incongruity and we get π's in the right places. Another possibility is to define the permeability and permittivity of free space as 4π times their normal unrationalised values. It is the latter method which is used in the RMKS system of units.

(ii) The π's came in the wrong place because we have defined a unit magnetic pole as one which has one magnetic line of force per cm^2 of its surface of one unit radius. On this assumption, 4π magnetic lines of force have to emanate from a unit pole ! If we had taken 'uniform fields' instead of isolated, point magnetic poles, this difficulty would not have arisen. It may be pointed out that this is not peculiar to the CGS system alone, but is inherent in any system which attempts to build up a system of units based on 'point charges or poles' instead of 'uniform electric or magnetic fields'. Point magnetic poles is now an obsolete conception.

* * *

Unit Weight of Building Materials

J. K. VARSHNEYA
Deputy Director (Metric),
National Buildings Organisation,
New Delhi

(*Metric Measures* has been publishing a series of articles by Shri J. K. Varshneya, Deputy Director, (Metric), National Buildings Organisation, New Delhi, on the adoption of the metric system in the building industry. As Shri Varshneya has almost completed the compilation of a comprehensive metric *Handbook for Building Engineers* there is no doubt that he is best qualified to summarise information for the building engineer.

This article is the sixth in the series being published in *Metric Measures*. Previous articles have appeared in the following issues of *Metric Measures*.

May 1961 — November 1961
July 1961 — July 1962.
September 1961

It is hoped that when the series is completed, the building engineer would have a readymade guide for his use.

—*Editor*)

Aluminium sheet per mm thickness	2·8	kg/m²
Asbestos, felt	150	kg/m³
Ashes	640	,,
Asphalt flooring	2200	,,
Ballast, stone	1600 to 1920	,,
Bamboo	370	,,
Bees wax	960	,,
Bell metal	8730	,,
Bitumen	1040	,,
Brass, rolled	8550	,,
Bricks :		
Common burnt clay	1600 to 1920	,,
Sand cement	1840	,,
Sand lime	2080	,,
Brick ballast	1200	,,
Brick dust (surkhi)	1010	,,
Brick masonry	1920	,,
Cement :		
Ordinary and aluminous	1440	kg/m³
Rapid hardening	1280	,,
Cement concrete, plain :		
Aerated	260	,,
Brick aggregate	1840	,,
Clinker	1440	,,
Stone ballast	2240	,,
Cement concrete, reinforced :		
with 1 percent steel	2370	,,
with 2 percent steel	2420	,,
with 5 percent steel	2580	,,
Cinder or clinker	700 to 880	,,
Clay :		
Dry lumps	1040	,,
Dry compact	1440	,,
Damp compact	1760	,,
Wet compact	2080	,,
Compressed cork flooring	400	,,

Concrete with brick aggregate and lime mortar	1920	kg/m³
Copper sheet per mm thickness	8·69	kg/m²
Cork	240	kg/m³
Creosote	1070	,,
Earth:		
Dry, loose	1280	,,
Dry, compact	1550	,,
Moist, loose	1440	,,
	to 1600	
Moist, compact	1760	,,
	to 1840	
Foam slag, foundry pumice	700	,,
Glass:		
Crown	2510	,,
Common	2530	,,
Flint	3060	,,
Plate glass	2750	,,
Gravel	1600	,,
	to 2000	
Gunmetal	8780	,,
Gypsum powder	1600	,,
Iron :		
Pig	7200	,,
Grey, cast	7030	,,
	to 7130	
White, cast	7580	,,
	to 7720	
Wrought	7700	,,
Lead sheet per mm thickness	11	kg/m²
Lime :		
Limestone, crushed	1280	kg/m³
	to 1440	
Lime, freshly burnt	960	,,
Lime, slaked	640	,,
Mortar :		
Cement	2080	,,
Gypsum	1200	,,
Lime	1760	,,
Oils :		
Castor	960	,,
Diesel	960	,,
Linseed	930	kg/m³
Naptha	850	,,
Olive	910	,,
Turpentine	865	,,
Petrol	690	,,
Pitch	1120	,,
Plastics	1100	,,
	to 1600	
Plywood per mm thickness	0·7	kg/m²
Pudlo	670	kg/m³
Rubber	960	,,
Sand :		
Dry clean	1600	,,
River	1840	,,
Wet	1760	,,
	to 2000	
Slag	1520	,,
Slagwool	270	,,
Steel :		
Cast	7850	,,
Wrought mild	7830	,,
Stones :		
Basalt	2850	,,
	to 2960	
Cast	2240	,,
Gneiss	2400	,,
	to 2690	
Granite	2640	,,
	to 2800	
Kankar	1360	,,
	to 1470	
Laterite	2080	,,
	to 2400	
Limestone	2400	,,
	to 2640	
Marble	2720	,,
Quartz rock	2640	,,
Sand stone	2240	,,
	to 2400	
Slate	2800	,,
Stone masonry :		
Cast stone	2300	,,
Dry rubble	2080	,,
Granite, ashlar	2640	,,

Granite, rubble	2400	kg/m³
Limestone, ashlar	2560	,,
Marble, dressed	2700	,,
Sand stone, dressed	2240	,,
Tar	1010	,,
Terra-cotta (solid)	2080	,,
Timber		
Hardwood	640	,,
	to 960	
Lightwood	400	kg/m³
	to 480	
Medium wood	480	,,
	to 640	
Tin	7300	,,
Varnish	960	,,
Wood-wool slabs	600	,,
Zinc sheet per mm thickness	7·1	kg/m²

News & Views

Recent Notifications

(1) *Description of Textile Materials*

Ministry of Commerce and Industry
Notification
(Trade and Merchandise Marks)

New Delhi, the 20th September 1962.

S.O. 2937—In exercise of the powers conferred by section 95 of the Trade and Merchandise Marks Act, 1958 (43 of 1958), and in supersession of the notification of the Government of India in the late Home Department (Judicial) No. 1474 dated the 13th November, 1891, and all other notifications issued on the subject, the Central Government hereby issues the following instructions for the limits of variation in respect of trade descriptions of number, quantity, measure, gauge or weight, which are to be recognized by criminal courts as permissible in the case of the goods specified hereunder, namely :

I. A trade description of length stamped on grey, bleached mercerised, or coloured cotton piecegoods—

(*i*) in pieces stamped as of length 9 metres, and below, the stamped length shall not exceed the actual length by more than 1 per cent of the piece length or 7·5 cm whichever is less, and

(*ii*) in pieces stamped as of length above 9 metres the stamped length shall not exceed the actual length by more than 0·6 per cent of the piece length or 7·5 cm. whichever is higher :

Provided that the average length of the pieces in question shall not be less than the stamped length.

II. A trade description of width stamped on grey, bleached mercerised or coloured cotton piecegoods—

(*i*) in pieces stamped as of width 102 cm or below, the stamped width shall not exceed the actual width at any point by more than 1·3 cm;

(*ii*) in pieces stamped as of width over 102 cm upto 152 cm the stamped width shall not exceed the actual width at any point by more than 1·25 per cent of the stamped width of the piece :

(*iii*) in pieces stamped as of width 152 cm and above, the stamped width shall not exceed the actual width at any point by more than 1·25 per cent of the stamped width of the piece or 2·5 cm whichever is less :

Provided that the average width of the piece in question shall not be less than the stamped width.

III. A trade description of count or number, length or weight, applied to grey yarn or bleached yarn or bleached and mercerised yarn or grey mercerised yarn, single or two-fold cotton yarn, other than that made wholly of waste—

(*i*) the described count or number shall not be greater or less than the actual count or number by more than 5 per cent, provided the actual count or number is equivalent to the average count or number of the yarn in one bundle ;

(*ii*) in a bundle of grey yarn, or of bleached and mercerised yarn, or grey mercerised yarn, the length of any individual hank shall not be less than the actual length by more than 1·2 per cent ;

(*iii*) in the case of a bundle of yarn, the described or stamped weight shall not be more than the actual weight by more than 1 per cent.

IV. A trade description of count or number applied to a bundle of cotton yarn made wholly of waste, or dyed yarn, or folded yarn other than two-fold grey or bleached and mercerised yarn, shall be accepted as indicating length only, the hank being taken to measure 840 yards (768 metres) in the British Count System, or 1000 metres in the Metric System, and the length of any hank in a bundle shall not be less by more than 3·7 per cent.

V. A trade description of length or weight for cotton threads—

(*i*) in units of 91·4 metre (100 yards) or less—

(*a*) the actual length or weight of any individual unit shall not be over 5 per cent below the declared length or weight of the units in the smallest packet or box, and

(*b*) the total actual length or weight of the units in the smallest packet or box shall not be over 2 per cent below the declared total length or weight ;

(*ii*) in units of more than 91·4 metre (100 yards)—

(*a*) the length of any individual unit shall not be over 1·25 per cent below the declared length or weight of the unit in the smallest packet, or box, and

(*b*) the total actual length or weight of the units in the smallest packet or box shall not be over 1 per cent below the declared total length or weight.

Note 1 : Two-fold sewing or darning thread other than such thread in the shape of skeins and balls or on cords, reels and paper tubes shall be considered as yarn.

Note 2 : The dimensions of goods on which their length or width are stamped shall be determined by measurement in the *Standard Yards* or Standard Metres and the Weight of the goods shall be determined in standard pound or standard kilogram.

[No. 7(3)-TMP/59.]

K.V. VENKATACHALAM,
Joint Secretary

2) *Mines and Minerals*

Government of India
Ministry of Mines and Fuel
New Delhi,
the 31st October 1962
9th Kartika 1884

MII-152 (26)/62—In exercise of the powers conferred by sub-section (3) of section 9 of the Mines and Minerals (Regulation and Development) Act, 1957 (67 of 1957), the Central Government hereby makes the following amendments to the second Schedule to the said Act, namely :

In the said Schedule—

(*i*) for items 2, 4, 7, 8, 9 and 13 the following items shall respectively be substituted, namely : —

2. Mica—		
(*a*) Crude Mica	..	Rs. 4·00 per 100 kg.
(*b*) Trimmed mica of heavy-stained, dense-stained, or spotted second quality	.. ..	Rs. 5·00 per 100 kg.
(*c*) Trimmed mica of qualities other than (b)	.. ..	Rs. 10·00 per 100 kg.
(*d*) Waste and scrap mica	.. ..	Re. 0·50 per 100 kg.
(*e*) Waste rounds	..	Rs. 2·50 per 100 kg.
4 Iron—		
(*i*) Ore—		
(*a*) containing more than 62% of Fe.		Rs. 1·50 per tonne.
(*b*) containing upto 62% of Fe.	..	Rs. 1·00 per tonne.
(*ii*) Ore fines in sizes less than 1·25 centimetres, produced incidental to mining and sizing of ore	..	Re. 0·25 per tonne.
(*iii*) Red oxide	..	Rs. 2·00 per tonne.
7. Chromite—		
(*a*) containing 45% Cr_2O_3 and above	.. ..	Rs. 7·00 per tonne.
(*b*) containing less than 45% Cr_2O_3.		Rs. 4.00 per tonne.
8. Limestone	.. ..	Rs. 0·75 per tonne, but subject to a rebate of Rs. 0·38 per tonne to be given on limestone beneficiated by froth flotation method.
9. Dolomite	.. ..	Re. 1·00 per tonne.

13. Gypsum—

(*a*) containing 85% and above $CaSO_4$ .. .. Rs. 1·25 per tonne.

(*b*) containing less than 85% $CaSO_4$ .. .. Re. 0·75 per tonne;

(*ii*) after item 13 as so substituted, the following items shall be inserted, namely :

'14. Limeshell .. .. Re. 0·75 per tonne.

15. Fire Clay .. .. Re. 1·00 per tonne.

16. Ilmenite .. .. Five per cent of the sale price at the pit's mouth.'

(*iii*) the existing item 14, shall be *renumbered* as item 17.

(Sd. S.K. MUKERJEE)
Deputy Secretary to the Govt. of India.

* * *

No. MII-152 (26)/62 dated 6th November 1962.

In exercise of the powers conferred by sub-section (3) of section 9 of the Mines and Minerals (Regulation and Development) Act, 1957 (67 of 1957), the Central Government hereby makes the following amendments to the Second Schedule to the said Act, namely :

In the said Schedule, for item 6, the following item shall be substituted, namely :

6. Manganese—

(*a*) Manganese dioxide Fifteen rupees per tonne.

(*b*) Manganese ore—

(*i*) High grade— (Forty-five per cent Mn. and over). Six rupees per tonne.

(*ii*) Low Grade—

(Thirty-five per cent Mn. and above, and below forty-five per cent Mn.) Three rupees per tonne.

(Below thirty-five per cent Mn.) Two rupees per tonne.

(*Sd*/.) S. K. MUKHERJEE
Deputy Secretary to the Govt. of India

Seventh Conference of Controllers Postponed

The proposed seventh Conference of Controllers of Weights and Measures which was scheduled to be held during the third week of January 1963, at Bhopal, has been postponed on account of the national emergency.

French Count Number for Cotton Textiles

A meeting of representatives of Government, textile industry, research institutions, cotton yarn trade and handloom and powerloom interests was held on 18 October 1962, in the Textile Commissioner's Office, Bombay to consider the adoption of the metric system for the measurement of fineness of cotton yarn. Shri Doraiswamy presided over the meeting. The following decisions were taken at this meeting :

(1) The French count system must be adopted by the cotton textile industry and trade.

(The French count system is an indirect system in which the yarn is expressed as the number of hanks, each 1,000 metres long in 500 grams of the yarn. This unit is approximately equal to 0·85 of the cotton count at present in use. —*Editor*).

(2) The French count should be stamped in the main and the English count will be shown only in brackets.

(3) From 1-10-63, the industry should manufacture yarn, for all purposes, exclusively in hanks of 1000 metres, and in bundles of 2·5 kg or 5 kg for the coarser varieties.

(4) Textile products for export, whether yarn or cloth, will continue to be manufactured according to the overseas customers' specifications, and packed and invoiced in the manner they may desire.

(5) The recognised associations of the industry and trade will bring these decisions immediately to the notice of their members and advise them to act on them promptly. They will also conduct publicity to make their members and the public familiar with the changes proposed.

The All India Handloom Board should also be primarily responsible for publicity work in regard to educating the handloom weavers in the new system.

(6) A committee with representatives of the industry and the Textile Commissioner will be set up to keep under continuous review the progress in adopting the new system. The committee will advise the industry and the Textile Commissioner on the various problems which may arise in carrying out the programme.

Special Capacity Measures for Liquor

A meeting of a committee consisting of Excise Commissioners and Controllers of Weights and Measures and representatives of the Indian Standards Institution and the Ministry of Commerce and Industry was held in Udyog Bhavan on 31 October 1962. Shri A. Bose, Excise Commissioner, West Bengal, presided over the meeting. The Committee made the following recommendations:

(1) *Glass Measure*

A special glass beaker of 300 ml capacity graduated at 100, 120, 150, 180, 200, 250 and 300 ml would be allowed for use in the liquor trade. The limits of error would be as follows :

100—120	±2 ml
150—300	±3 ml

(2) *Peg Measure*

Peg measures would be of two capacities 60 ml and 30 ml, the errors allowed on them being ± 2 ml and ± 1 ml respectively.

(3) *Error in Sealed Bottles*

The volume of liquor varies with temperature. Unless a definite temperature is specified, the verification of volume of liquor in a bottle would not be possible. It is not practicable to mark this temperature on the bottles. Liquors other than country spirits, would therefore, be verified only at the places where they were bottled.

A permissible error of —2 percent for beer and —2 percent subject to a maximum of —7·5 ml for spirits and liquors would be allowed. Liquors other than country spirits would be verified only at the place of bottling. Country spirits were seldom sold or consumed far from the place where they are produced.

Manual for Inspectors

(It will be recollected that the sixth Conference of Controllers of Weights and Measures recommended that an Inspectors' Manual should be prepared by the Ministry of Commerce and Industry (See Recommendation 23, *Metric Measures*, November 1962, p. 13). Already a start has been made and the Ministry of Commerce and Industry has suggested an outline or synopsis of the Manual for consideration by Controllers of Weights and Measures in the States and Union Territories. The synopsis is reproduced here.

Readers of *Metric Measures* are requested to send their suggestions about the Manual to the Editor).

OUTLINE OF THE MANUAL

(1) Constitutional Provisions Relating to Weights and Measures, Their Interpretation and Significance.

(2) Legislation by Parliament

(*a*) Texts of :

(*i*) Standards of Weights and Measures Act, 1956.

(*ii*) Standards of Weights and Measures Rules, 1958.

(*iii*) Notifications issued under various sections of the Act.

(*b*) Explanations and commentaries on important sections of the Act and rules.

3) Legislation by States

(*a*) Texts of :

(*i*) Model Weights and Measures (Enforcement) Bill.

(*ii*) Model Weights and Measures (Enforcement) Rules.

(*iii*) Notifications issued by State Governments under various sections of the Weights and Measures (Enforcement) Acts.

(*iv*) Significant departures from the Model Bill and rules in the Acts and rules of the various States.

(*b*) Explanations and commentaries on important sections of the State Acts and rules.

(4) Standards, Instruments, Test Weights and Measures, Tools, and Other Equipment Maintained by Weights and Measures Departments.

(*a*) Complete list of standards, instruments, test weights and measures, tools etc., with broad particulars of the design, material etc.

(*b*) procedure for the periodical verification of :

(*i*) Working and secondary standard weights, measures of length, and measures of capacity.

(*ii*) Inspector's balances, secondary standard balances, and precision balances.

(5) Procedure for Verification of Weights, Measures and Instruments.

(*a*) Commercial weights, including cast iron and brass weights, bullion weights, carat weights and sheet metal weights.

(*b*) Commercial capacity measures, including dispensing measures, peg measures, beaker measures etc.

(*c*) Commercial length measures, including woven metallic tapes, steel tapes, survey chains etc.

(*d*) Commercial weighing machines :

(*i*) Beam scales

(*ii*) Platform weighing machines

(*iii*) Steelyards

(*iv*) Counter machines

(*v*) Spring balances

(*vi*) Weighbridges

(*vii*) Crane weighing machines

(*viii*) Automatic weighing machines

(*ix*) Person weighing machines, including baby weighing machines.

(*x*) Self-indicating and semi-self-indicating machines.

(*e*) Commercial measuring instruments :

(*i*) Petrol dispensing pumps

(*ii*) Vehicle tanks for petroleum products.

(*iii*) Taxi meters

(*iv*) Water meters

(6) Procedure for Verification of Sealed Packages

(7) Duties and Powers of Inspectors :

(*a*) Limits and extent of powers, statutory or otherwise, of Inspectors, Assistant Controllers etc.

(*b*) Inspector's functions and responsibilities.

(*c*) Returns to be submitted and registers maintained by Inspectors.

Training of Inspectors—Questionnaire

(The Sixth Conference of Controllers had recommended, while reviewing the report submitted by the French Experts, M. Francis Viaud and M. Louis Krach, that the standard of training of Inspectors must be improved and a committee should be set up to devise a course of training for Inspectors of Weights and Measures. The Committee has recently been set up to consider the subject under the Chairmanship of Shri Triguna Sen, Rector, Jadavpur University, Calcutta. A questionnaire has been issued to all the Controllers of Weights and Measures in the States and Union Territories, the Mints at Bombay and Calcutta, the National Physical Laboratory and the Indian Standards Institution. The following questions have been set down for assessing the requirements of the type of training etc., before the matter is considered in a full meeting of the Committee

—*Editor*)

(I) Existing Arrangements for Training of Inspectors

(1) Are there facilities for training Inspectors in your Department?

(2) If the reply to (i) is in the affirmative, give the following particulars :

(*a*) Duration of the training

(*b*) Subjects taught (under broad heads)

(*c*) Arrangements for practical training, in the laboratory as well as in the field.

(*d*) What, if any, special staff is employed for training.

(*e*) Number of persons trained so far :

(*i*) for your own Department

(*ii*) for Weights and Measures Departments of other States.

(II) Proposed All India Training Centre for Inspectors

(1) Financing and Control :

Whether the Centre should be under the control of the Central Government

or one of the State Governments, which have facilities for training Inspectors.

(2) Location of the Centre :
Where the Centre should be located.

(3) Number of persons to be admitted to the Course.

(4) Particulars of the Training

	For fresh Recruits	*For those who have received some training at Bombay, Patna or elsewhere and are working as Inspectors.*
(*a*) Duration of the training.		
(*b*) Subjects to be taught (under broad heads).		
(*c*) Kind of practical training to be given:		
(*i*) In the laboratory.		
(*ii*) In the field.		

(5) Organisation :
(*a*) Personnel
(*i*) Director or Principal : Qualifications, Experience, Status.
(*ii*) Teaching Staff : Categories of staff needed(*e.g.*, Lecturers, Demonstrators, etc.) Their qualifications, experience and status.
(*b*) Building and Equipment :
(*i*) Building
(*ii*) Equipment :
Give particulars under broad heads.

(III) Refresher Course for Senior Personnel of Weights and Measures Departments (e.g., Assistant Controllers, Deputy Controllers etc.)

(1) Should the Institute offer a Refresher Course for Senior Personnel.

(2) The nature of the training to be given whether by lectures, seminars, conducted study tours, etc.

(3) Duration of the course.

(IV) Any Other Suggestions

Book Review

KHADI MEN NAYA NAAP-TOL (Hindi)—Dwarkanath Lele; Khadi and Gramodyog Commission, Irla Road, Vile Parle (West), Bombay-56; pp. 49; March 1962; second printing; price (not indicated).

Here is a well thought out and scientifically oriented study of the change-over in an industry like khadi which goes to the grass-roots of the nation. Such clear studies are rare and, therefore, refreshing.

After tracing the history of weights and measures in India, the author introduces the metric system and its units. He then briefly relates the origin of the British count system for cotton yarn.

The development of khadi began in India in the twenties of this century. A condition for the membership of the Akhil Bharat Charkha Sangh (ABCS) was the contribution of 1,000 yards of yarn as subscription. To assess the yarn, the ABCS laid down that the round be taken as 4 ft. the lea 90 rounds, and the hank 7 leas (840 yards). However, after a few years, this formula was changed in favour of one which had a relation with the quarter and decimal systems prevalent in India. With the introduction of the metric system, however, it was necessary to revise ideas and to evolve new concepts reflecting the metric spirit.

The author has very ably done this. He proposes that the round should be 1 metre and the hank 1,000 metres. He then proposes the following formula:

1 metre	=	1 round
10 rounds	=	1 pati
100 rounds	=	1 lea
500 rounds	=	½ hank or half kilometre
1,000 rounds	=	1 hank or 1 kilometre.

The half hank is provided to facilitate working with hanks of different fineness of yarn.

He also proposes a metric system of numbering the fineness of yarn, called *naya ank* (new number system), in which 1,000 metres of yarn weighing 1 kilogram give the unit value. Its relationship with the old is that old number 3 is equal to new number 5 and so on. It is possible to get *new numbers* directly by weighing 100 metres of yarn against decimal coins.

He has then indicated methods for determining the texture of cloth of various types. In the case of length and width, he has suggested that the width should be rounded off preferably to the nearest 10 centimetres. The perfect understanding of the metric system by the author is evident from the fact that he has specifically avoided the use of fractions like the quarter and three quarters.

The author has gone into every aspect of spinning and weaving of khadi and shown the simplification achieved by the adoption of the metric system. His proposals may be summarised as follows:

(1) The hank of yarn should be 1,000 metres.

(2) If the weight of hank of 1,000 metres is 1 kilogram, then the *naya ank* is one.

(3) The comb should be calculated in 100's only.

(4) The length of the cloth should be in metres.

(5) The width of the cloth should be in centimetres.

(6) Ten percent allowance should be made for shrinking and defects.

(7) The texture should be calculated on basis of decimetres of yarn.

The book has 10 appendices which deal with the *naya ank* and its relation with the old, weight of hank according to the *naya ank*, then the usual conversion tables, the rates to be paid for spinning and weaving, the length of the round, the relationship of the *naya ank* with tex and denier, etc.

The author has made a thorough study of his subject before making his proposals. He has shown a rare insight into the practical working of the metric system. His reasoning is, therefore, scientific and his proposals for the change-over in the khadi industry appear feasible and logical. What is more his proposals would be readily understood even by illiterate workers.

It would be a pity if his study is not processed and put into effect as early as possible. Millions of illiterate people are working in the khadi industry and there is no doubt that the implementation of the author's proposals would simplify the 'arithmetic of khadi' for them.

'A COMPREHENSIVE CALCULATOR OF METRIC WEIGHTS AND MEASURES AND THE PRICE CONVERSION TABLES'—compiled and published by B. S. Jain & Co., 71, Abupura, Muzaffarnagar (U.P.); third revised edition, July 1962; pp. 30+55; price Rs. 3.25.

A change-over of weights and measures of the magnitude that India has undertaken, would demand the publication of a large number of conversion tables which may be required for various trades and explain the significance of the change-over to the common man. This is one of them. The compiler has expressed the hope that his publication would facilitate the public in general and would be useful to Government and semi-Government offices and industrial concerns in their day-to-day work.

The book contains the text of the Standards of Weights and Measures Act, 1956 and gives a brief summary of the work that has been done and information about weights and measures, the new units to be used in trade and hints on the use of the metric system.

The tables cover the conversion of metric units to the foot-pound and seer units as also of the latter to metric units.

The book gives simplified price conversion tables as also conversion tables for prices from various units like the pound, seer, maund, cwt, tolas etc. to metric units. A small chapter on metric system in timber trade is a novelty. Examples indicating the application of the metric system are also included.

DIAGRAM CHARTS FOR CLOTHING TRADE (English, Hindi, Gujarati and Marathi)—M. U. Choudhari, Director, Adarsh Tailoring Corporation, Hanuman Road, Vile Parle (East), Bombay-57; Price Rs. 1·50 per chart.

The author has prepared diagram charts which indicate at a glance information about dimensions required in cutting and stitching of various garments like shirts, coats, baby frocks, blouses etc. The charts would be of great use to tailors, tailoring classes and such housewives as cut and stitch clothes at home. They not only give technical diagrams but explain fully the various aspects of cutting and provide the desired information at a glance. What is important, all the dimensions are given only in rational metric units.

Adarsh Tailoring Corporation is doing pioneering work in familiarising the tailoring trade with the metric sytem. The use of metric length measures has now become compulsory and it is but right that the tailoring trade should adjust itself to the new units and their use in everyday work. It is even necessary that tailoring schools and colleges should immediately start teaching students in metric units only as the inch units have become illegal. In the light of this urgent necessity, it is gratifying to see a knowledgeable, courageous and well-trained person like Shri M. U. Choudhari come forward with such useful and instructive charts which can be directly used by the students of tailoring. The author, therefore, deserves to be complimented for his work.

It is understood that Shri Choudhari intends to bring out soon a book for the tailoring trade in which only the metric system will be used. There is little doubt that the book would help in the introduction of the metric system in the tailoring trade, if it keeps up the promise shown in these charts and avoids the pitfall of mere conversions of old inch units.

Readers' Forum

Land Area Conversions Made Easy

Dear Sir,

For a smooth change-over to the metric system of measurement in respect of land area, conversion tables have been prepared and published by the Indian Standards Institution as well as by the Survey of India Department and other private agencies. However, a table showing the conversion from links (Gunter's) to links (metric) does not find a place in the published tables. It is, therefore, considered that a formula should be evolved to help surveyors or persons who desire to convert Gunter's link measurement to metric link measurement.

Since 100 links of Gunter's chain are equal to 100.584 links of a 20 metre metric chain, it will be found that if a distance is measured separately by Guntur's chain and by a 20 metre chain, the following relationship exists:

Measurement by 20 m chain = Measurement by Gunter's chain + 0·584 × number of Gunter's chains measured.

or

= Measurement by Gunter's chain. + 0·6 × number of Gunter's chains measured.

For example, to arrive at the metric chain value of Gunter's chain measurement of say

1036 links, we have $1036+0\cdot6\times10=1042$ links by metric chain. Even using Tables A(1) and A(2) of *The Metric Conversion Tables for Length and Area* (Survey of India Publication) we get the same value. Hence the formulae (1) M = G + 0·6 N (2) G = M — 0·6 N, where G = value in Gunter's chain, M = value in metric chain and N = Number of full chains measured. Thus with very little effort values from one system can be converted into those of the other.

In the case of lengths up to 25 chains (Gunter's) there would not be any difference between the values obtained by conversion with exact equivalents and that by the simplified formula given above. In the case of a length of 100 chains (Gunter's) one link will have to be deducted from the value obtained by the simplified formula to get the correct metric equivalent. As such, this simplified formula can be used in all cases with more accuracy than is normally required.

Again, the conversion of existing acres and cents into metric measures is rendered easy by the fact that acres and cents are also in decimal multiples of basic units. Though '*Indian Standard Conversion Factors and Conversion Tables* (I.S. 786—1956 issued in March 1957) and *Metric Conversion Tables for Length and Area* (Survey of India Publication) contain tables for converting acres to hectares, a rough and ready formula is given below which can be easily used for converting acres and cents to hectares.

Taking 1 acre = 0·405 hectare or 2 acres = 0·81 hectare, instead of the correct value 0·404686 hectare to an acre as given in *Indian Standard Conversion Factors and Conversion Tables* (I.S. 786—1956, page 29), we get the following formulae

$$\frac{0\cdot81A}{2}+\frac{0\cdot81C}{200}=H$$

Where A represents the area in acres, C represents the area in cents and H represents the area in hectares.

For example, to convert 11 acres and 85 cents to hectares:

$$\frac{11\times0\cdot81}{2}+\frac{85\times0\cdot81}{200}=4\cdot79925 \text{ hectares}$$

or

4·80 (correct to 2 decimals)

By using approved conversion tables, we get the metric equivalents for 11·85 acres as 4·7955 hectares (or 4·80 correct to 2 decimals) thus showing a difference of 0·00375 hectares or 0·009267 acres only. As this difference continues to be negligible upto 1000 acres, the above formula may be useful for all practical purposes and for quick estimates without reference to conversion tables.

G. VENKATESWARAN
Assistant Director,
Weights and Measures,
Ministry of Commerce and Industry,
Madras.

Standards News

(Indian Standards which have a particular bearing on the change-over to the metric system are indicated here. Copies would be available from the Indian Standards Institution, Manak Bhavan, 9 Mathura Road, New Delhi or their Branch Offices at Bombay, Calcutta, Madras and Kanpur)

Indian Standard for Commercial Metric Capacity Measures (IS: 1058—1962)

The Indian Standards Institution has published a revision of the Indian Standard Specification for Commercial Metric Capacity Measures (IS:1058—1962), which prescribes the requirements for metric capacity measures of cylindrical and conical shapes, intended for use in normal commercial transactions. These measures are intended for measuring liquids only.

This standard was first published in 1957 and during the few years of its currency, the need has been felt to revise it. This standard covers metric capacity measures of denominations from 20 ml up to and including 20 litres. For measures of higher capacities which are required by petroleum companies and wholesale traders, a separate standard is under preparation.

Two types of cylindrical measures, namely, the dipping and the pouring type, and one type of conical measures, have been recognized in this standard. Cylindrical measures are generally used in the sale of commodities like milk, while conical measures are generally used in the sale of mineral oils.

The standard gives the minimum constructional details and dimensions; manufacturers are expected to ensure that finished measures will have adequate robustness for durability.

This standard is one of the series of Indian Standards for commercial metric weights and measures being prepared by the Indian Standards Institution at the instance of the Standing Metric Committee of the Government of India.

Price Rs. 2·00

ISI Handbook for Structural Engineers-2: Steel Beams and Plate Girders

Steel forms a very important basic raw material for industrialization and, therefore, has been receiving special attention in all our development plans. On the recommendation of the Planning Commission a special Steel Economy Project was set up in ISI in 1956, which later developed into a fulfledged Structural and Metals Division. Continuous study in India and abroad and the deliberations at a number of sittings of committees, panels and study groups of this Division of the Indian Standards Institution have resulted in the publication of about 20 Indian Standards in the field of steel production, designs and use and a number of other standards on the subject are in different stages of formulation.

In order to reduce the work involved in designing computations and to facilitate the use of the various Indian Standard Codes of Practice, ISI undertook the preparation of a number of design handbooks. The Handbook on Steel Beams and Plate Girders is the second in the series. The first one

relating to Structural Steel Sections was published in March 1959. The third handbook which will cover steel columns and struts is under print. A few more handbooks covering design of different types of structures are proposed to be published by the Institution in the series in due course.

The values in the Handbook, which covers 190 pages, have been specified in the metric system in view of the country's change-over to that system. The matter in the book is arranged from the point of view of maximum convenience in using it and has been divided into the following nine sections :

(*a*) Section I	General— containing Design Procedure and Code of Practice.
(*b*) Section II	Design of Rolled Beams.
(*c*) Section III	Design of Plate Girders.
(*d*) Section IV	Numerical Analysis of Bending Moments and Deflections in Beams.
(*e*) Section V	Special Problems in Beam and Girder.
(*f*) Section VI	Perforated and Open Web Beams.
(*g*) Section VII	Tapered Beams
(*h*) Section VIII	Composite Beam Construction.
(*j*) Section IX	Continuous Beam Design.

Special effort has been made in the handbook to introduce only modern and practical methods of analysis and design that will result in economy in utilization of steel. In accordance with the main objectives, those types of beams and girder designs that lead to the greatest weight saving in steel have been emphasized as far as possible.

Price Rs. 10·00

Draft Indian Standard Guide for Selection of Fits [Doc:EDC 43 (550)]

The Indian Standards Institution has prepared a draft Indian Standard Guide for Selection of Fits [Doc: EDC 43(550)]. Indian Standard Recommendations for Limits and Fits for General Engineering Purposes (IS: 919-1959) has already been published; the users of this standard felt that another standard giving the combination of holes and shafts used in fits for various purposes of general engineering should also be prepared. This draft standard indicates the more common types of shafts and holes used for fits.

The draft standard will be circulated shortly to all interests concerned for their critical comments and suggestions for improvements.

Draft Indian Standard for Dimensions of Gauges for ISO Metric Screw Threads (1·6 to 39 mm) [Doc: EDC 27 (703)]

The Indian Standards Institution has prepared draft Indian Standard Dimensions of Gauges for ISO Metric Screw Threads (1·6 to 39 mm) [Doc: EDC 27 (703.)] This draft standard gives dimensions of gauges for ISO metric screw threads within the range 1·6 to 39 mm with coarse and fine pitches. These gauges are valid for normal and coarse class tolerances.

Draft Indian Standard Tolerances for ISO Metric Screw Threads (Dia. Range 1·6 to 300 mm), [Doc: EDC 27(652)] has been finalized; and, based on this, draft revision of IS: 1362-1962 Dimensions of Screw Threads for General Purposes (Diameter Range 1·6 to 39 mm) is under finalization. In addition draft Indian Standard Gauging Practice for Metric Screw Threads (1·6 to 300 mm) is under preparation.

This draft standard has been prepared to assist the manufacture and testing of gauges for screw threads mentioned in IS: 1362-1962 (*Revised*). With the preparation of this standard, the more important work in connection with the adoption of metric screw threads with ISO profile will have been completed.

This draft standard will shortly be put into wide circulation to all interests concerned for eliciting technical comments.

Licensed Manufacturers, Dealers and Repairers of Weights and Measures (23)

Metric Measures has been publishing a series of lists of manufacturers, dealers and repairers of weights and measures, weighing and measuring instruments licensed by the Governments in the various States and Union Territories under the Weights and Measures (Enforcement) Acts in their respective jurisdiction. This is the twenty-third list. The necessity to economise on paper due to the national emergency has made it necessary to publish lists of only manufacturers and repairers.

The number in brackets against the name of the State or Union Territory indicates the particular instalment number of the State or Union Territory.

An analysis of the licensees, including the present list, shows that the total number of licensees in 14 States and 5 Union Territories is 1,120 manufacturers, 5,531 dealers, and 1,205 repairers. The details of published information are as follows:

Sl. No.	State/Union Territory	Licensees		
		Manufacturers	Dealers	Repairers
(1)	Andhra Pradesh	101	194	54
(2)	Assam	16	97	28
(3)	Bihar	20	69	34
(4)	*Delhi*	28	93	20
(5)	Gujarat	117	669	147
(6)	*Himachal Pradesh* ..	1	28	1
(7)	Kerala	52	480	123
(8)	Madhya Pradesh ..	115	496	9
(9)	Madras	7	828	126
(10)	Maharashtra ..	101	905	352
(11)	*Manipur*	14	85	5
(12)	Mysore	104	471	165
(13)	Orissa	87	17	3
(14)	*Pondicherry*	2	12	2
(15)	Punjab	39	157	29
(16)	Rajasthan	43	206	44
(17)	*Tripura*	1	9	0
(18)	Uttar Pradesh ..	207	515	8
(19)	West Bengal ..	65	200	55
		1,120	5,531	1,205

MAHARASHTRA (5)

BOMBAY REGION

Repairers

(1) Adamali Abdulhusain, Dhurojiwala, 243, Sipra Cottage, Dutta Mandir, Thana.

(2) T. S. Ahiroo Gadhave Mansion, Ground Fl. Bhandakali Mandir, Nasik.

(3) Alexander Mahit Engineering Corp., Kaling—Mavipada, Bombay-29.

(4) Asgarath Akabarally Kartawala Hakim, 448, Madhevrao Rokde Road, Bombay-9.

(5) Asha Iron Beam Scales Repairing Workshop, H. No. 13/3550, Sakria Road, Dhulia.

(6) Ashok Kumar and Shanker Co. H. No. 2337/C Lane No. 7 at, Dhulia.

(7) Asia Engineering Corp., No. 4, Gustad Chamber, Jail Road, Opp. J. J. Hospital Gate No. 6, Bombay-9.

(8) Avery Co. of India P. Ltd., 16, Dugal Road, Ballard Estate, Bombay.

(9) Bansilal & Co., Main Road, Nasik City.

(10) B. A. Brothers, 176—Kazi Sayed St., Dhobie Buildings, Mandir Kohiwada, Bombay-3.

(11) B. R. and Mohatta (India) Private Ltd., 'Brabhoj' Mansion, Masjid Dana Bunder, Bombay.

(12) M. C. Brothers, 11, 2nd Bhoiwada Lane, Bhalishwar, Bombay-2.

(13) Bombay Scale Repairing Works, Shop No. 156—160, Repon Road, 1st Bhulabhai St., Bombay-8.

(14) V. G. Chavan Behind Vasant Tea House, Navi Peth, Jalgaon.

(15) Crown Engineering Corp., 51, Kholsa Mohalla Godown, No. 7, Bombay-3.

(16) Damodar Bhikaji Kautawala, 4-A, Masjid Siding Road, Dana Bunder opp.—Sator's Home, Bombay-9.

(17) S. G. Dhodpakar, H. No. 2042, Nehru Chauk, Nasik City, Nasik.

(18) Ebrahim Gulamhusain, 254, Ripon Road, Sujan Building, Bombay-9.

(19) Fidaali Gulamali, 163, Janjikar St., Bombay-3.

(20) Gold Star Engineering Co., Shorir Bang, B. Block, Shop No. 10, Babul Tank Road, Opp. J. J. Hospital Gate No. 5, Bombay-9.

(21) Hindustan Scale Co., 249, Nagdevi St., Bombay-3.

(22) Honesty Scale Repairing Works, Sunavbhayya Compound, Dharavi Road, Near Bus Stand, Dharavi.

(23) Jathar & Co., Gaum Devi Road, Sultana Building, Near Telephone Exchange, Naupada Thana.

(24) E. G. Kantawala, 85, Sarang St., Bombay-3.

(25) S. Kantawala, 175, Dintinkar Road, Shop No. D-2, Bombay-8.

(26) A. A. Kantawalla, Dhobigalli, Momudi House, Bombay-3.

(27) S. H. Kadri & Sons, 36, New Kazi St., 1st Floor, Bombay-3.

(28) Haiderli Kasaurji, Chawal, 179/81, Janjikar Road, Bombay-3.

(29) N. J. Mehta & Co., 10, Kavasji Naik Road, Laxmi Niwas, Bombay-9.

(30) Misrilal Motilal, 71, Sarang St., Bombay-3.

(31) Mohan Brothers, Repairing Shop, Khed Mirjol Taluka, Chiplun, Dist. Ratnagiri.

(32) Mulji Laxmidhar & Co., 360, Samuel St., Bombay-3.

(33) Mysore Chemical Soap Works, Compound Road, No. 2, Scheme No. 1, Sion, Bombay.

(34) National Scale Co., Gokul Pasta Road, Dadar, Bombay-14.

(35) Noble Scale Works & Co., Farida Manzil, Shop No. 7, 26, Byculla St. Road, Bombay-11.

(36) Z. H. Prabhatam, Gokuldas Pasta Road, Dadar, Bombay-14.

(37) J. M. Prabhatani, 3, Gokuldas Pasta Road, Dadar Bombay-14.

(38) Prakash Scale Repairing Works, Near Post Office, Dabhod, Taluka, Malegaon, Dist. Nasik.

(39) Ram & Co., 88—90 Yatin Manzil Dadasaheb, Phalki Road, Dadar, Bombay-14.

(40) Ramesh, Bajaj Work Shop, 492, Ulhasnagar Kalyan, Dist. Thana.

(41) Ramkrishna Vishram Sonar, H. No. 221, Bhusawal, Dist. Jalgaon.

(42) V. D. Rajani, 142, Upper Dunkan Road, Bombay-8.

(43) Ravaji Ram Chandra & Co., Shop No. 56, Surat St., Dana Bunder, Bombay-9.

(44) V. R. Rawool Husainbhai Davji, Chawal, Navali Road, Palghar, Dist. Thana.

(45) Ripon Road Iron Foundry, Lamington Road, Opp. Agripada Police St., Bombay-11.

(46) Saple's Scale Manufacture Co., 180-B, Gaiwadi, Girgaum, Bombay-4.

(47) G. S. Sawant Atlost Damri, Fouda Ghat, Dist. Ratnagiri.

(48) SFGT Oliya, Kantawala, 12, Khetwadi.

(49) Shankar Bala Dusana, Premises of Pophle Ginning and Pressing Factory, Mosum Bridge, Malegaon, Dist. Nasik.

(50) Shrikrishan Workshop, Jamner, Badri Plot, Jamner Road, Bhusaval.

(51) Suchal Trading Corporation, 49, Khoka Bazar, Bombay-3.

(52) G. S. Sutar Repairs of Weights and Measures, Station Road, Punjab National Bank, Jalgaon, Dist. Jalgaon.

(53) Tahira Industries (I) P. Ltd., 19/21 Mandhardas St., Bombay-1.

(54) Union Metal Works, 28/30, Dhaku Prabhu Wadi Chorpdeo, Bombay-10.

(55) D. L. Vaid, 202, 215-A, Ripon Road, Bombay.

(56) Vijaya Repairing Works, Bhatwadi Kolawb, Taluka Malvan, Dist. Ratnagiri.

(57) Wadkar, Workshop, Near Ganpat Revdi Wala, Manmad.

(58) Yeshwant Daulat Bandre, Shop No. 4, Bldg. No. 7, Lane No. 7, Kamathipura, Bombay.

POONA REGION—C

(59) N. M. Alwekar At & P, Ichalkaranji, Dist. Kolhapur.

(60) Ananda Krishna Londhe At & P., Haregaon, Dist. Ahmednagar.

(61) Baboo Hanif Sgaikh Sanglikar, H. No. 443, Power House Road, Sangli.

(62) B. A. Brothers, 176, Kazi Sayed Street, Mandvi, Koliwada, Bombay.

(63) D. H. Bagnikar, Karnal Chowki, Namdeo Mandir, Sangli.

(64) Baraskar Stationery Mart, H. No. 914, Theatre Road, Sangli.

(65) G. L. Bhakare, 187, Mangalwar Peth, Karad.

(66) Bharat Home Industries, C. No. 1408, Laxmipuri, Kolhapur.

(67) Bhimrao Shamrao Patil, Burud Galli, Tapker Chal H. No. 418, Sangli.

(68) T. N. Chakke, 23/24 Rawiwar Peth, Karad.

(69) Engineering Scales Repairing Works, Poona, H. No. 74, Rasta Peth, Poona-2.

(70) Galaj Motiram Chatre, H. No. 1646, Maliwad, Dist. Ahmednagar.

(71) B. T. Ghotge, 437-B, Mangalwar Peth, Kolhapur.

(72) Gold Star Engineering Co., 53, end Floor, 3rd Marine Street, Bombay-2.

(73) Gurudatta Workshop, 79, Sidheshwar Peth, Sholapur.

(74) Jai Bharat Stores, 38, Raviwar Peth, Karad.

(75) M. G. Kotekar Somwar Peth, Hatimalal Road, Kolhapur.

(76) Maharashtra Scale Co., 24, Ghorpade Peth, Poona-2.

(77) A. M. Maner, 1636, Maner Galli, Islampur.

(78) G. R. Mestri, At & P, Godhinglaj, Dist. Kolhapur.

(79) Mohammad Ibrahim Fakersheb Chowdhari, 79, Sidheshwar Peth, Sholapur.

(80) Monohar Co., 736, Shukrawar Peth, Poona-2.

(81) V. S. Nikam Shukrawar Peth, 166, D, Ward, Dist. Kolhapur.

(82) Ostwal Brothers, 134, Vakhar, Bhag Sangli.

(83) Pandwany Workshop, H. No. 4260, Telilane, Pandharpur.

(84) S. M. Phatak, 262, Chati Galli, Sholapur.

(85) B. W. Potdar, New Extension, Gadhinglaj, Dist. Kolhapur.

(86) Prakash Co., 65, Vetal Peth, Poona-2.

(87) Prakash Scale Repairing Works, Near Power House, P.O. Shrirampur, Dist. Ahmednagar.

(88) N. A. Ponawala & Co., 2419/A, Saifi Street, Poona.

(89) Shivaji Bhikaji Kharat, Marwad Peth, Beramati, Dist. Poona.

(90) S. F. & Co., 1481, Shukrawar Peth, Poona-2.

(91) Shankar Rambhan, Shaide, At & P., Shrirampur, Dist. Ahmednagar.

(92) B. G. Shinde & Co., 76, Shukrawar Peth, Poona-2.

(93) Shrikrishna Co., 738 m Shukrawar Peth, Poona.

(94) Sumit Datta Workshop, 3891, Lakshmi Road, Barshi.

(95) A. S. Sutar (Mistry) New Extension, Gadhinglaj.

(96) Vishwas Co., 757, Shukrawar Peth, Poona-2.

VIDARBHA REGION

NAGPUR

(97) Abdul Jabbar Abdul Sattar, Akola.

(98) Asia Engineering Corporation, No. 4, Ghustad Chambers, Jail Road, Bombay-9.

(99) Asha Iron & Scale Repairing Workshop, Wardha.

(100) Avery Co. of India Ltd., Kingsway, Nagpur.

(101) Baboo Manilal Workshop, Yeotmal.

(102) Baboo Tukaram Lohar, Umarkhed.

(103) Bhai Parmeshwardin Baldeo Prasad Gupta, Hansapuri, Nagpur.

(104) Bihari Mechanical Workshop, Wardha.

(105) C. P. Foundry Works, Nagpur-4.

(106) Chawra Engineering Works, Gondia.

(107) Dayabhai Khimji Popat, Khamgaon.

(108) Deccan Scale Repairing Works, Chalisgaon, Distt. Jalgaon.

(109) Ebrahim Mulla Abdul Taiyeb, 69, Sarang Street, Bombay.

(110) Gold Ornament Artist & Jewellers, Bhandara.

(111) Gurjar Scale Co., Dharaska Road, Nagpur.

(112) Honesty Paper Mart, Anji Road, Wardha.

(113) Hassonbeg Haji Mohd. Beg, Itwari Bazaar, Amravati.

(114) B. R. Herman Mohatta India (P) Ltd., People's Building, P. M. Road, Bombay-1.

(115) Indo Aryan Traders, 71-Pipe Road, Kurla, Bombay-70.

(116) Jadhao & Sons, Buldhana.

(117) Jai Hind Welding Works, Khamgaon.

(118) Janata Workshop, Sudam Nagri, Akola.

(119) Jamnadas Ratilal Soni, Itwari, Nagpur-2.

(120) A. A. Kantewala, Amravati.

(121) Laxmanprasad Gangaprasad Sisodiaya, Itwari Bazar, Amravati.

(122) G. B. Lohar, Shani Mandir Road, Yeotmal.

(123) Madhoji Purshottam Adatiya, Gupta Market, Amravati.

(124) Madhaorao Ramji Wankhede, Blacksmith Shop, Khamgaon.

(125) Madhoprasad Ramcharan Gupta, Umrer.

(126) Mannalal Babulal Bagadia, Itwari, Nagpur.

(127) Mohamadali & Brothers, W. No. 25, Nagpur.

(128) Namdeo Tukaram Dhanokar, W. No. 3, Shegaon.

(129) Papat Repairing Workshop, Chikhli.

(130) Popatlal Manilal Shah, Itwari, Nagpur-2.

(131) Piraja Workshop, Pusad.

(132) Prabhakar Workshop, Digras.

(133) Ramchand Gurudinlal Jaiswal, Anjangaon, Surji.

(134) Rajen Scale Traders, Amravati.

(135) Ramji Devji Katewala, Malipura, Akola.

(136) Sandalbeg Gulzarbeg Ansariward, Bhandara.

(137) Swastik Iron Works, Nagpur (Ghat Road).

(138) Saran & Co., Liberty Building, Nagpur.

(139) Saikhpapa Hidayatulla, Amravati.

(140) Vidarbha Stores, Khamgaon.

(141) Vidarbha Engineering Industries, 31, Nag Road, Nagpur.

(142) Wevel & Co., Central Avenue Road, Nagpur.

(143) Vijay Weighing and Repairing Workshop, Medical College, Chowk, Nagpur.

AURANGABAD REGION

(144) Abdul Shikoor, Dealer and Repairer in Weights & Measures, Udgir, Dist. Osmanabad.

(145) Ashok Kata Workshop, Sadar Bazar, Jingar Galli, Hingoli, Dist. Parbhani.

(146) Allauddin Mohammed Ali, Prop. Bombay Scale Works, Basir Ganj, Parbhani.

(147) Asia Engineering Corporation, 13—8 Bruce Street, Fort, Bombay-1.

(148) Bhujanganath Rao, Repairer of Weights & Measures, Chowk, Nanded, Dist. Nanded.

(149) D. M. Chaudhari, Repairer of Weights & Measures, Sarapepura, Kaularchal, Ahmednagar, Dist. Ahmednagar.

(150) Deccan Repairing Works, Prop: M. P. Rikame, Dhulia Road, Chalisgaon, Dist. Jalgaon (EK).

(151) Deccan Industrial Corporation, Station Road, Parbhani.

(152) Ebrahim Mulla Abdultayab, 63, Sarang Street, Bombay.

(153) Md. Fassiuddin, Dealer & Repairer of Weights & Measures, Degloor, Dist. Nanded.

(154) Fulchand Mundada & Bros., Ganeshpar, (Ganesh Temple) Parli—Vaijneth, Dist. Bhir.

(155) Gulam Ahmed, Dealer & Repairer of Weights & Measures, Bhir.

(156) B. R. Hermen & Mohotta (India) Private Ltd., Peoples Bldgs., Sir P. M. Road, Fort, Bombay.

(157) Jalna Industries Private Ltd., Station Road, Jalna, Dist. Aurangabad.

(158) Maharashtra Repairing Works, Prop: Abdul Hamid Dawood Bhai Kachi, Station Road, Parli, Dist. Bhir.

(159) Misrilal Motilal, Chowk, Aurangabad.

(160) Manoor Workshop C/o Shri Gous Mohidan Hussein Chein Wadi, Near Civil Hospital, Osmanabad.

(161) V. D. Pathak, Latur, C/o Pathak Bros., Oil Mill, Nanded Road, Latur, Dist. Osmanabad.

(162) M. Rahmetullaha M. Nazir Ali, Chowk, Aurangagad.

(163) Radhakrishan Agarwal, Prop. Subhaschandra Scale Merchant, Mama Chowk, Jalna, Dist. A'bad.

(164) Scales Adjusting Services, Begum Bazar, Hyderabad Dn.

(165) Shantilal Jainendrakumar, Chelipura, Aurangabad.

(166) Vijay Repairing Works, Loha Bazar, Pandit Nehru Road, Jalna, Dist. Aurangabad.

(167) Vishwanath Maroti, Repairer of Weights & Measures, Shop No. 2-3-29, Shivaji Road, Udgir, Dist. Osmanabad.

GUJARAT (6)

The following is the list of manufacturers and repairers licensed from 1 April to 30 September 1962 by the Government of Gujarat, under the Bombay Weights & Measures (Enforcement) Act, 1958

Manufacturers

Sl. No.	Name and Address of Manufacturer	Details of Articles Manufactured
(1)	Ishwarlal Narottamdas, Opp. Parsi Wad, Vyara	Steelyard.
(2)	Ranjhans Scale Co., Manibhai Road, Makwana Bela, Savarkundla.	Non-flexible Measures.

Repairers

Sl. No.	Name and Address of Repairer	Details of the Articles Repaired
(1)	Ambica Vijaya, Scale Repairing Works, Behind Sitaram's Mandir, Station Road, Patan, Dist. Mehsana.	Weights, Measures, Weighing and Measuring Instruments.
(2)	T. G. Bharmal, Mulla Medi Road, Jamnagar .. .	Weights and Measuring Instruments.
(3)	Chunilal Gopalji, Near Panchnath Temple, Jivan Vasta Delha, Rajkot.	Weights, and Weighing Instruments.
(4)	Harsora Brothers, Relief Road, Opp. Padshah's Pole, Ahmedabad.	Weights, Measures, Weighing and Measuring Instruments.
(5)	Mahagujarat Scale Repairing Works, Opp. Padshah's Pole, Relief Road, Ahmedabad.	Weights, Measures, Weighing and Measuring Instruments.

Repairers *(Concld.)*

(6)	Ramraja Scale Repairing Works, Mamakotha Road, Bhavnagar.	Weights and Weighing Instruments.
(7)	Sayed Ahmedalli Sayad, Tulsi Falia, Near Moti Talkies, Begampura, Surat.	Weights, Measures, Weighing and Measuring Instruments.
(8)	Shakti Repairing Works, Buhari, Via-Madhi, Tal Barodli, Dist. Surat.	Weights, Measures, Weighing and Measuring Instruments.

TYPICAL METRIC PRICING UNITS FOR WHOLESALE TRANSACTIONS

Serial No.	Commodity	Metric Unit
		10 grams (g)
(1)	**Gold**	1 kilogram (kg)
(2)	**Grocery and Confectionery** Biscuits, sweetmeats, cardamoms.	
	Textiles and Textile Fibres Cotton yarn, damaged and seconds cloth, raw silk, rayon, silk yarn, raw wool, wool manufactures (when sold by weight).	
	Paints and Chemicals Paint (if sold by weight), indigo, liquid chlorine.	
	Hides, Skins & Leather Raw hides, leather (hides and skins).	
	Metals Silver, aluminium sheets, strips and circles, copper and brass wires and utensils.	
	Miscellaneous Tea, meat, camphor tablets, mica.	
(3)	**Grains and Pulses** Rice, wheat, jowar, arhar, moong, masur, gram.	1 quintal (q) (100 kilograms)
	Spices Black pepper, mustard, chillies, dhania, dalchini, turmeric, betelnuts.	
	Plantation Products Rubber, cashewnuts, cashew kernels, tobacco (raw and manufactured).	
	Forest Products Lac and lac products, gums, myrobalans, galnuts, soapnuts.	
	Textiles & Textile Fibres Raw jute, raw hemp, coir yarn.	
	Oils, Oilseeds & Oilcakes Vegetable oils, oilseeds, oilcakes.	
	Non-Ferrous Metals *Aluminium* : ingots, bars, blocks, slabs, billets. *Lead* : ingots, sheets and strips. *Copper* : ingots, blooms, slabs, cakes, tiles, bricks, billets, blisterbars and wirebars, rods, sections and pipes, plates, sheets and strips, circles. *Brass* : ingots, rods, sections, pipes, sheets, strips, circles. *Zinc* : ingots, sheets, strips. *Tin* : blocks.	
	Chemicals Caustic soda, bleaching powder, glycerine, soaps, paper salt.	
	Others Sugar, gur, ice, fish, sugarcane, vegetables, tamarind.	
(4)	**Minerals** Iron ore, manganese ore, bauxite, coal.	one metric tonne (t) (1,000 kilograms)
	Iron & Steel Pig iron, iron and steel manufactures, semis (billets for rerolling etc.)	
(5)	Cloth (mill, handloom, silk, rayon and woollen cloth).	1 metre (m)
(6)	Jute carpets, coir mats and mattings, sheet glass.	one square metre (m^2)
(7)	Timber.	one cubic metre (m^3)
(8)	Paints (when sold by measure), spirits.	one litre (l)

Weights

(1) In place of the present units of seer, pound, rattal, viss etc., use the kilogram.

(2) In place of the tola, use the gram or 10 grams.

(3) In place of maund or corresponding unit, use the quintal *i.e.*, 100 kg.

Capacity Measures

In place of seer or gallon or any other measure use the litre.

Length Measures

(1) Use the metre in place of yard or foot and the centimetre in place of inch.

Square Measures

(1) Use the square metre in place of square yard or square foot, and square centimetre in place of square inch.

Cubic Measures

(1) Use the cubic metre in place of cubic yard or cubic foot and cubic centimetre in place of cubic inch.

Packaging

It is advantageous if sizes of packages correspond to series of commercial weights and measures prescribed.

These are: 50 kg, 20 kg, 10 kg, 5 kg, 2 kg, 1 kg, 500 g, 200 g, 100 g, 50 g, 20 g, 5 g, 2 g, 1 g, and so on.

TYPICAL PRICING UNITS FOR RETAIL TRADE

Serial No.	Commodity	Metric Unit for Use
(1)	Foodgrains, cereals, pulses, spices, ghee, bread, vegetables, meat, fish, sweetmeats, tea, coffee, sugar, salt.	1 kg
(2)	Oil for cooking	1 kg or 1 litre depending upon prevalent practice.
(3)	Fruits	1 kg or number depending upon prevalent practice.
(4)	Milk	1 litre
(5)	Cloth and related materials	1 metre
(6)	Prepackaged materials	Preferably sizes corresponding to series of commercial weights and measures.

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metric measures

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metric measures

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metric measures

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Systems of Electric & Magnetic Units : Part 2

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MAIN UNITS IN MKS & RMKS SYSTEMS

(1) Mechanical Units

METRE is the unit of length. The latest definition, as adopted at the 11th General Conference of Weights and Measures in Paris on 14 October 1960 is as follows:

The metre is equal in length to 1,650 763·73 wavelengths of the radiation in vacuum corresponding to the transition between the levels 2 p10 and 5 d5 of the krypton 86 atom.

Kilogram is the unit of mass, being the mass of a certain lump of platinum in the standard kilogram.

Second is the unit of time and $= \frac{1}{86400}$ of the mean solar day. The absolute standard is the mean period of the rotation of the earth (1 day $= 24 \times 60 \times 60 = 86400$ second). The standard second is obtained from uniformly running clocks which are checked against the earth's rotation.

In 1960 the Conference mentioned above ratified the definition of the second adopted in 1956 as follows:—

The second is the fraction $\frac{1}{31\ 556\ 925{\cdot}9747}$ of the tropical year for 0 January 1900 at 12 hours ephemeris time.

Newton is the unit of force. One newton of force is required to accelerate a mass of one kilogram with an acceleration of 1 metre per second.

Joule is the unit of work or energy. One joule of work is done when the point of application of a force of one newton is moved one metre in the direction of the force ($1\ J = 10^7$ ergs).

Watt is the unit of power. One watt is the power or rate of doing work when one joule is expended in one second ($1\ W = 10^7$ ergs/s).

One Newton metre is the unit of torque. One newton-metre is the torque produced by a force of one newton acting at a radius of one metre. 1 newton metre $= 10^7$ dyne.cm.

Torque in newton metres can be converted into kg metres by dividing by 9.81, the value of 'g' in MKS system.

(2) Electrical Units

Ampere is the unit of current—the fourth fundamental unit. It has already been defined earlier in this article. Its standard is a current-balance.

Coulomb is the unit of electric charge.

Volt is the unit of emf and potential difference. It is defined thus :

The potential difference between two points in a circuit is one volt if one joule of work is involved in the passage of one coulomb between them.

Ohm is the unit of resistance and is defined thus:

The passage of one ampere through a resistance of one ohm produces heat at the rate of one watt (or produces a potential difference of one volt).

Farad is the capacitance of a capacitor between the plates of which there appears a potential of one volt, when it is charged by one coulomb of electricity.

Henry is the inductance of a closed circuit in which an emf of 1 volt is produced when the electric current in the circuit varies uniformly at a rate of 1 amp/s.

Weber is the unit of magnetic flux and defined thus :

An emf of one volt is generated when a conductor cuts flux at the rate of one weber/second or when the flux linked with one turn alters at the rate of one weber/second. The weber is also the unit of pole strength. 1 weber = 10^8 maxwells. (A weber is also a volts).

Weber per sq. metre is the unit of flux density. 1 $wb/m^2 = 10^4$ gauss $= 10^8$ maxwells/m^2
$= 10^4$ maxwells /cm^2

Ampere-turn is the unit of magnetic motive force (mmf) and of magnetic potential difference.

Ampere-turn/metre is the unit of magnetic intensity or field strength and is defined as follows:

One ampere per metre is the magnetic field strength produced by a mmf of one ampere-turn acting uniformly along a path of one metre length.

Important Points

The following points may be noted :

(1) 'Weber' takes the place of 'maxwell' in the CGS system.

(2) Wb/m^2 takes the place of 'gauss' in the CGS system.

(3) A/m takes the place of 'oersted' in the CGS system.

(4) The absolute volt and ampere are now fixed by 2 conventions :

(*i*) the unit of electrical energy shall equal unit of mechanical energy.
1 V. A.s = 1 N.m

(*ii*) μ_0 shall have a certain fixed value
$= \frac{4\pi}{10^7}$ $\frac{V.s}{A.m}$ or H/m

By these two conventions, the product and the ratio of the volt and ampere are fixed.

(5) 1 coulomb = 1 C = 1 A.s
1 farad = 1 F = 1 $\frac{A.s.}{V}$

1 ohm = 1 Ω = 1 V/A
1 henry = 1 H = 1 V.s/A
1 weber = 1 Wb = 1 V.s.

(6) There is a controversy of analogy between E and H and D and B, which is not dealt with here in detail but is summarised as follows:

(*i*) *In Gaussian system*

for vacuum D = E, B = H } D and E have the dimensions at the same point in vacuum D = E

(*ii*) *In esu system :*
D = E (for vacuum)
$B = \frac{H}{c^2}$

(*iii*) *In emu system*
$D = E/c^2$
B = H (for vacuum)

(*iv*) *In the 'Giorgi' system*
D = kE and B = μ H

D has a value and dimension different from E not only in matter but also in vacuum.
Same applied to B and H.

(7) The following fields may be noted:

(*i*) for the current field in a conductor, apply Ohm's law :
I = G × V.

(*ii*) for the electrostatic field in a condenser, apply capacity law, ψ = C × V (where ψ represents electric flux).

(*iii*) for the magnetic field in a coil, apply induction law :
φ = L × I (where φ represents magnetic flux).

THE 'NEWTON' AND ITS IMPLICATIONS

The unit of mechanical force in the MKS and RMKS systems of units is the 'newton'. Prof. David Robertson in a letter to the *Electrician*, London, in April, 1904, suggested the name 'newton' for the unit of force in the system of units advocated by him, which is identical with the MKS system. The 'newton' as the unit of force was finally accepted in July 1950. The accepted symbol for 'newton' is 'N'.

By definition, the newton is the force which produces an acceleration of 1 m/s^2 when acting on a 1 kg mass.
∴ 1 N = 1 kg. $m/s^2 = 10^5$ dynes

The feature of the newton is that for conversion of 'mechanical' to 'electrical' or 'magnetic' or 'thermal' energy, the following simple equations can be applied :

1 N.m.	= 1 V.A.s	= 1 W.s	= 1 J
1 newton-metre (Mechanical)	= 1 Volt-Ampere-second (Electrical)	= 1 Watt. second (*Magnetic*)	= 1 Joule (*Thermal*)

It is no matter of chance that these relationships hold exactly; the volt and ampere are defined in such a manner that these relations exist. It is, however, best to use 'N.m.' for *Mechanical Work;* 'W. s' for *Electrical energy;* and 'J' for *Heat energy*.

It is strongly recommended that the gravitational unit of force in the MKS system, *viz.*, the kilogram weight and the CGS absolute unit of force, *viz.*, the dyne, should no more be used.

Given below are the relations between some units of work or (energy) and power.

1 erg. = 1 dyne. cm = 10^{-7} N. m

1 kilowatt-hour (kWh) = $3 \cdot 6 \times 10^6$ W.s.

1 gram-calorie (g. cal.) = 4·2 J. or 1 J = 0·24 calorie

1 metric horse power (a gravitational unit) = 75 kgf.m/s. = 75 × 9.81 N.m/s.

1 B.t.u. = $1 \cdot 056 \times 10^3$ joule

∴ 1 J = $0 \cdot 947 \times 10^{-3}$ B.t.u.

UNITS USED BY ENGINEERS

The range of units used by any electrical engineer (power or telecommunications) and a physicist in electrical or radio experiments are summarised in Table 7 :

TABLE 7

Sl. No.	Potential Difference	Current	Resistance	Power	Energy
(1)	μV	μA	—	μW	—
(2)	mV	mA	—	mW	—
(3)	V	A	Ω	W	Whr
(4)	kV	—	KΩ	kW	kWh
(5)	MV	—	MΩ	MW	MWh

UNITS USED IN TEACHING

Of special interest to teachers of electrical engineering and of electricity and magnetism in physics is the *Report of the Sub-Committee of the Science Masters' Association*, published under the title : *The Teaching of Electricity, with special reference to the use of the MKS Units* published in 1954. This recommends the rationalised MKSA as the best system and this has been adopted in England not only in colleges but in the sixth form teaching and even in Grammar schools. Both the Institution of Electrical Engineers, London, and the Institution of Radio Engineers, New York, long ago favoured the RMKSA system. The Committee on Electric and Magnetic Units appointed by the American Association of Physics Teachers reported as long ago as 1938 in favour of this system. The Second World

War delayed the spread of this system to the schools in the UK and USA but certainly accelerated it among radio engineers, electronics specialists and radar physicists, who were quick to appreciate its unifying simplicity from their study of wave guides and microwave phenomena.

TEXTBOOKS IN RMKSA UNITS

Prof. Eric Bradshaw, Professor of Electrical Engineering, University of Manchester, himself the author of a monograph : *Electrical Units with special reference to the MKS system* (Chapman & Hall, 1952) while reviewing the English translation of the book : *Electrical Theory on the Giorgi System—RMKSA* by P. Cornelius of Philips Research Laboratories, Eindhoven, Holland (Cleaver-Hume Press Ltd., London, 1961), in the J.I.E.E., London, Vol. 7, No. 77, May 1961, on page 314 has stated thus :

> Those who have seen the almost complete adoption of the MKS* system of units in electrical engineering during the last decade or so may wonder *whether a book on electrical theory not based on the Giorgi System (RMKSA) would be acceptable to engineers today.*
>
> *Means RMKSA

He further states:

> The volume is particularly recommended for the teacher and the practising engineer, to some extent the student today who is already using MKS units may feel some surprise at pleas on behalf of a system which is already accepted by him.

The following is a brief list of excellent textbooks on electrical engineering and physics (electricity and magnetism) written in RMKSA system of units.

British

(1) *Electromagnetism*:—An introductory textbook based on the RMKS system of units, by J. Goodier & G. Ghey (John Murray, London, 1952, 1955).

(2) *An Introduction to Electricel Engineering* by Prof. E.W. Merchant (Methuen & Co., Ltd., London, 1947).

(3) *The MKS System of Units*—A Guide for Electrical Engineers, by McGreevey, T. (Pitman's, London, 1953).

(4) *The Electrical Units with special reference to the MKS (and RMKS) Units* by Eric Bradshaw (Chapman and Hall, London, 1952).

(5) *Electrical Technology* in RMKS Units, by H. Cotton (7th Edition) (Pitman's, London, 1960).

(6) *The Principles of Electricity* (in RMKS units) by Arthur Moolly & Edward Hughes —(Longman's, London, 9th impression 1960).

(7) *Applied Electricity* by E. Hughes (Longman's, London).

(8) *Applied Electricity* by H. Cotton (Cleaver Hume Press).

(9) *Fundamentals of Electrical Engineering* by E. Hughes (Longman's, London).

(10) *Admiralty Examples in Electrical Calculations* (H. M. Stationery Office, London, 1960).

(11) *Electrical Technology* by E. Hughes (in RMKS Units) (Longman's London, 1960).

(12) *Electricity & Magnetism* by A.W. Hirst (Blackie, 3rd Edition, 1959).

(13) *Solution of Problems in Electrical Technology* by H. Cotton and J.V. Parry (Pitman's, London, 1958).

(14) *Services' textbook of Radio :* Vols. 1 to 7. H. M. Stationery Office, London.

(15) *Electrical Engineering Problems with Solutions* by F. A. Benson (E. & F. N. Spon, London, 1954).

(16) *Electrical Measurements and Measuring Instruments* by E. W. Golding—Chapter II, 4th Edition (Pitman's, London, 1955).

(17) *Electricity and Magnetism* by S .G. Brown (Longman's London).

(18) *Electricity and Magnetism* by Sears & Zemansky.

(19) *A Textbook of Electricity* (MKS edition) by H. G. Mitchell, 1961— (Asia Publishing House, Bombay).

(20) *National Certificate Elec., Engineering* by R. Bowne (Macdonald & Evans Ltd., London, 1957).

American

(1) *College Physics* by Weber, While & Manning (McGraw Hill, 1959).

(2) *Physics* by Sears & Zemansky, Vol. II.

(3) *Electromagnetic Engineering*. I (Fundamentals) by R. W. P. King (McGraw Hill, 1945).

(4) *Electromagnetic Theory* by J. A. Stratton (McGraw Hill, 1945).

(5) *The 14-Systems of Units* by Wm. R. Varner, (3rd Edition, revised) (O. S. C. Co-op. Assn., Corvallis, Oregon, 1961).

(6) *Electromagnetic Waves* by S. A. Schelkunoff. (D. Van Nostrand, New York).

(7) *Principles of D.C. Machines* by A. S. Langsdorf (McGraw Hill).

(8) *Principles of A.C. Machines* by A. S. Langsdorf (McGraw Hill).

GREEK ALPHABET LETTERS USED AS SYMBOLS FOR ELECTRICAL UNITS

While talking of units used in teaching electricity and magnetism, it is pertinent to survey the different Greek letters used as symbols in treating electricity with 'Giorgi' system. Hence, this brief survey is made.

Table 8

α(alpha) for attenuation-coefficient; angles.

β(beta) for phase-coefficient; resistance-temperature co-efficient; angles.

γ (gamma) for propagation co-efficient; conductivity; specific conductance.

ζ (zeta) for the numerical value of velocity of light in vacuo $= 3 \times 10^{10}$ cm/sec.

ϵ (epsilon) for dielectric constant or permitivity.

η (eta) for efficiency.

θ (Theta) for temperature.

k (kappa) for dielectric constant or permitivity.

k (kappa) for relative permitivity.

λ (lambda) for wave-length.

μ (mu) for permeability; amplification factor, also for 'micro'.

μ_o (mu naught) for permeability of free space.

μ_r (mur) relative permeability.

υ (nu) for frequency.

π (pi) $= 3.1416$ comes in several equations (rationalisation) mainly deals with (*i*) doing away with π in some equations and (*ii*) putting them in right ones of circular or spherical symmetry).

ρ (rho) for specific resistance (resistivity), density, volume density of charge, volume resistivity in Ω /cm^3.

σ (sigma) for conductivity; surface density of charge; leakage coefficient.

τ (tau) for time.

ϕ (phi) for magnetic flux; phase angle.

ψ (psi) for electric flux.

ω (omega) for angular velocity $= 2\pi f$

Ω (omega) for 'ohms'

$\mho$ (mho) for conductance.

δ (delta) for loss angle; log decrement; dissipation factor for dielectrics, nearly same as power factor.

CONCLUSION

Students of physics and electrical engineering will recall that the CGS systems are

rather awkward to adopt because quantities like voltages and current are expressed in 'abvolts' and 'statvolts', 'abamperes' and 'statamperes', respectively rather than in practical volts and amperes. Small wonder, therefore, that the RMKSA system of electrical units has become more popular, because in this system all the units of importance to the engineer have practical magnitudes. Prof. J. A. Stratton in the preface to his book '*Electromagnetic Theory*' (McGraw Hill, 1941) said thus :

> There is still the feeling among physicists that this system is being forced upon them by a subversive group of engineers. Perhaps, it is, although it was Maxwell himself who first had the idea.

However, no better recommendation for the standardisation of this system can be made than that given by Prof. S. A. Schelkunoff in his famous article on the 'Battle of Units', under the title: *The End is in Sight* (*Proc. I. R. E.* New York, 36 (7) : 827, July 1948). The following quotation is from that source :

> Although the RMKS system of units was first suggested in the middle of the last century, it remained almost unknown until about 15 years ago. In the last 15 years, however, it has made astonishingly rapid conquests. The reasons for this are many. In the MKS system the electrical units are those already in common use in laboratory measurements; the volt, the ampere, the ohm, etc. If the system is of the rationalized variety, Maxwell's equations assume a form which is merely a generalisation of the one-dimensional transmission-line equations. In recent years, the gap between circuit and transmission-line theories on the one hand and field theory on the other hand has been closed by wave guides and microwave circuits in general.
>
> This made it essential that there be no clash between the ideas, terminology, and units employed in these theories. Since the rationalized MKS system fulfils this requirement, it is only natural that it should enjoy rapidly increasing popularity. An added factor in this popularity is that the rationalized MKS system is equally well adapted to electromechanical theories. It has begun to appeal to many physicists as well as to engineers which is particularly fortunate, since the engineer of today must be somewhat of a physicist, and the physicist somewhat of an engineer.

In 1950, the I.E.C. adopted the RMKS system of units and in 1954 the Science Masters' Association of the UK in its report on 'The Teaching of Electricity' recommended the adoption of this system in schools. Early this year (April 1962) a conference was held at the West Ham College of Technology, London, on the use of the RMKS system of units in the teaching of GCE advanced level physics.

Electrical engineers readily accepted even from 1950's the I.E.C. recommendations and they were soon followed by the Physics Departments of Universities such as the world-famous Cavendish Laboratory, Cambridge, where the RMKS system is now used.

The adoption of the RMKS system of units in schools is clearly advantageous to those proceeding to more advanced courses. As a Professor, I am confident that all those who work through a scheme of teaching based on this system will soon be convinced that the advantages far outweigh the disadvantages associated with such a change-over. This system removes at once the necessity of working with a minimum of 3 sets of electrical units : (*i*) CGS electrostatic (*ii*) CGS electromagnetic (*iii*) practical. It also enables us to develop a readily comprehensible and co-ordinated theory of all electric and magnetic phenomena.

However, the main difficulties now retarding the progress of this system in schools and colleges (science, engineering and technology) are said to be :

(1) lack of suitable textbooks;
(2) lack of teachers experienced and well-versed in this system; and
(3) the appearance in examination papers of questions based on the CGS system.

Regarding (1), the situation is becoming better and better as is seen by the appearance of a large number of textbooks in the English language in physics (electricity and magnetism), electrical technology, electrical engineering, electronics and radio engineering —(These have been listed earlier).

Regarding (2), the staff of each college or school should be given a brief orientation course during each summer at several selected centres.

As regards (3), according to the circular issued by the Ministry of Scientific Research and Cultural Affairs, the following phased programme has been laid down for the adoption of the metric system in technical education in India.

(a) The metric system should be adopted in teaching the 1st and 2nd year classes of engineering and technological institutions commencing from the academic session: 1962-63. In the following year, *i.e.* 1963-64, it should be introduced in the 3rd and 4th year classes and in the 5th year class in 1964-65.

(b) For the All-India Engineering Services examinations and similar examinations, both the FPS and the metric system should be used from 1965—70 and for the examinations conducted from 1970 onwards, the metric system alone should be adopted.

The Institution of Engineers (India), has decided to follow the MKS system for its examinations to be held from May 1965 onwards.

The Giorgi or the RMKSA system of units is increasingly gaining international recognition. It is now officially backed by both the American and British Institutions of Electrical Engineers, Radio Engineers, etc. (Professional Institutions).

Therefore, any engineer, technologist or physicist working in any branch of electricity and magnetism should henceforth use only the rationalised MKS system.

APPENDIX I

MECHANICAL UNITS

Quantity	CGS Unit	No. of CGS Units in one MKS Unit	MKS Unit
Length	centimetre (cm)	10^2	metre (m)
Mass	gram (g)	10^3	kilogram (kg)
Time	second (s)	1	second (s)
Force	dyne	10^5	newton
Energy	erg	10^7	joule=1 metre-newton
Power	erg/s	10^7	watt

APPENDIX II

ELECTRICAL UNITS

Quantity	Esu	esu in 1 emu	emu	emu in 1MKS Unit	MKS Unit
(1) Charge	Statcoulomb	c	Abcoulomb	10^{-1}	coulomb
(2) current	Statampere	c	abampere	10^{-}	ampere
(3) elec-dipole moment ..	Statcoulomb cm (=esu)	c	abcoulomb cm	10	coulomb metre

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ELECTRICAL UNITS—*contd.*

Quantity	Esu	esu in 1 emu	emu	emu in 1 MKS Unit		MKS Unit
(4) Polarisation (P) Elec. displacement (D)		Statcoulomb/ cm^2	c	abcoulomb/cm^2	10^{-5}	coulomb/m^2
(5) Elec. field intensity (E)		dyne/statcoulomb or statvolt/cm	c^{-1}	dyne/abcoulomb or abvolt/cm	10^6	volt/m (=10^{-2} volt/cm)
(6) Potential (V) emf	..	statvolt	c^{-1}	abvolt	10^8	volt
(7) Capacity (C)	.. ..	cm	c^2	abfarad	10^{-9}	farad=10^6
(8) Resistance (R)	..	s/cm	c^{-2}	abohm	10^9	ohm
		c=Velocity of electromagnetic wave $=3\times10^{10}$ cm/s				

APPENDIX III

MAGNETIC AND ELECTROMAGNETIC UNITS IN THE MKSA AND RMKSA SYSTEMS

Quantity	emu	emu in 1MKS Unit	MKS Unit
(1) magnetic flux	maxwell	10^8	weber
(2) magnetic induction B	gauss	10^4	weber/m^2
(3) inductance L	abhenry or cm	10^9	henry
		Rationalised MKS	unit
(4) magnetic pole m	m.u.pole	$1/4\pi\times10^8$	(weber)
(5) magnetic moment M	m.u.moment	$1/4\pi\times10^{10}$	(weber m)
(6) magnetisation I	m.u.magnetisation	$1/4\pi\times10^4$	(weber/m^2)
(7) Mag. field intensity H	oersted (often called gauss)	$4\pi\times10^{-3}$	(amp turn/m)
(8) magnetic potential mmf	oersted-cm, or abampere	$4\pi\times10^{-1}$	(ampere-turn)
(9) reluctance R	cm^{-1}	$4\pi\times10^{-9}$	(ampere-turn/weber)

OBITUARY

Metric Measures announces with deep sorrow the premature death of Shri R. S. Bawal, Controller of Weights & Measures, Madhya Pradesh, Bhopal, at Gwalior on the 27 December 1962.

Using Rational Units

FROM 1 April 1963 the use of the metric units of weight, length, capacity, volume and area would have become compulsory all over India. One of the exceptions is that a transition period of 3 years from October 1962 will be allowed for the use of both the old and new units 'in the case of transactions relating to and involving the area of land'.

The use of weights became compulsory in April 1962. The number of weights in use in trade far exceeds the total number of length, capacity or any other measures. So the compulsion had a considerable influence in familiarizing traders and consumers with the metric system. Ordinary across-the-counter-transactions had to be carried out in terms of metric weights. Commodities which are sold by weight in packages, such as vanaspati, ghee and others had also to be packed in terms of the gram and the kilogram units.

Similarly, the legal binding to use only the metric length measures became effective from October 1962. From that date cloth traders had to employ the metre. Traders dealing in pipes, bars, rods, wires or similar other commodities, including steel products, which are sold by length had to use metric units.

The adoption of commercial capacity measures was carried out in three phases, each phase making the compulsion effective over larger and larger regions. From April 1963, the compulsion to use capacity and volume units would be country-wide. As a result liquid commodities like milk, paints, petroleum products would have to be sold by the litre. Even collection of water taxes for water metered out would have to be done in litres or kilolitres. In the case of volume units, the compulsion would be applicable to trades like the timber or sand trade which use the cubic metre and related units. In the case of area, the exception is transactions relating to land as indicated above. So traders who sell plywood, sheet-glass etc., would have to use the square metre.

Future Tasks

Commercial transactions would thus have to be carried out in terms of metric units from April 1963. This, however, does not mean that the introduction of the metric system is now complete. A large field remains to be covered. For example, people in certain areas and trades have yet to get accustomed to the proper use of the new units. Education in schools, technical and medical colleges, workshops, etc. has to be oriented to the full use of the metric system. Industries, particularly the engineering industries, have to alter their designs to use the new metric dimensioned raw materials. The building and other engineers have to work with metric designs and constructional materials. Generally speaking, the sectors where some work and thought have to be put in relate to training the mind of certain sections of the public to the proper use of the metric system and to the education and training of the practising and future engineers in terms of the metric system. We consider the first aspect.

What is meant by the proper or correct use of metric units in trade ? It means that not only prices should be quoted in metric units but purchases also be made in terms of rational units—both in the wholesale and retail trades.

Wholesale and Retail Trade

It will be recalled that the Ministry of Commerce and Industry had recommended about two years ago certain units for use in wholesale and retail trades. By and large, these units have been adopted by the trade and the people. Certain isolated sections of trade in parts of the country have adopted the traditional way of converting the old units into the new system. Thus, instead of replacing the maund by the quintal (100 kg), some wholesale trades have adopted odd units like 37 kg, 40 kg, 50 kg. One could appreciate the argument for adopting the units at a time when two sets of units were used side by side—the metric units in places where their use had become compulsory according to the phased programme and seer-lb units where this was not so. Facility of trade sometimes required that a unit almost equivalent to the prevailing unit be used. Now that the use of metric weights has become compulsory all over the country, the force in this argument has vanished. It would be in the interest of the trade itself if the units recommended by this Ministry are now adopted for wholesale transactions by every trader in the country, irrespective of past requirements and traditions.

In retail trade, the position is largely satisfactory. The prices are being quoted by the kilogram, litre and metre in most parts of the country. There are, however areas where people have not yet got accustomed to the new units. Almost all traders in these areas have now purchased metric weights and most of them are using them in their day-to-day transactions. A minority, however, still carry on their transactions with old seer weights in spite of their seizure by Inspectors of Weights and Measures. To replace the seized set, the trader acquires another set of old weights and starts using it. It is to be hoped that such traders would give up this habit quickly in their own interest. After all, if a trader goes on replacing seized weights in this manner, he only adds to his expenses. It is cheaper to buy metric weights and start using them. If this truth is brought home to these traders, we may expect a 100 percent use of new weights in the markets in the near future.

Use Decimal Reckoning

Just purchase of metric weights by traders is not enough. The traders must use them as they are meant to be used. Commodities previously sold by the seer, pound and other units, should now be sold and purchased by the kilogram. When dealing with quantities less than 1 kilogram the decimal principle should be followed. Thus if a commodity is priced at Rs. 1.20 per kilogram, its decimal unit, namely, 100 grams would cost 12 nP. Purchase and sale in terms of 100 gram units for quantities less than 1 kg, would obviously simplify transactions both for the trader as well as the consumer.

In most of the trades this principle is now being used with good results. But there are trades in which old practices have been adapted. The most prominent among the defaulters is the vegetable trade. In this trade, the sale is effected using metric weights, but in terms of a unit of 930 grams (1 seer of 80 tolas) or with another strange unit, *viz.* the pound (454 grams) rounded off to 400 grams and so on. These practices could be understood in the conditions prevailing two years ago; now things are different.

One of the complaints of the traders who do not use metric units is that the consumers ask for their requirements in terms of old units. The consumer should also be cautioned

that if he insists upon transactions in terms of the old system, he can be easily cheated by unscrupulous traders. The customer is not aware of the conversion factors and the unscrupulous trader is always in a hurry to close the transaction. It is, therefore, absolutely essential that in order to protect himself the customer should get accustomed to the new metric way of purchasing indicated above.

What has been said about weights also applies to some extent to capacity and length measures. With the metric capacity measures it is not possible to sell 1 seer of milk (930 or 940 ml) because it requires the use of a large number of measures. It is, however, possible that some vendors may cheat the unwary customer by palming off the 200 ml measure as quarter litre (250 ml). It is doubly necessary that while buying commodities like milk the transaction is carried out in terms of the litre or 100 ml units. There is no capacity measure of 250 ml even as there is no weight of 250 grams.

In the case of area and volume also it is necessary to adopt the metric system fully instead of trying to devise units nearer the old units. Such units will neither be metric nor traditional nor even national. The 'naya acre' or 'naya cubic metre' would be incongruous. India is adopting the metric system to unify the weights and measures in the country and be in line with international practices. Any attempt to tamper with the simplicity and order of the metric system would land us into difficulties in the future.

Some Suggestions

How can we make those people who do not use the proper units take to them? The reluctance to use metric units for transactions arises from a suspicion of anything new or it may be due to local reasons and influences. It is necessary to locate these and remedy them. The problem could be effectively tackled through organisations of traders such as Chambers of Commerce or Trade Associations and the State Organisation of Weights and Measures.

Most of the wholesale trade in the country is now organised. The organisations of trade should prevail upon their individual members to use rational metric units like the kilogram, quintal or the tonne in place of the seer, viss, pound, hundredweight, maund, candy and the like. They should make it clear that they want to do away with other units like 37 kg, 40 kg, 50 kg, 250 kg. and so on. They should point out that it is undesirable to use varying metric units for the same commodity in different areas. That is defeating the very purpose of the adoption of the metric system, *viz.* unification of weights and measures and consequently related trading practices in the country. If these realities can be convincingly passed on to their erring members by trade bodies the problem will be on the way to solution. If the traders have any genuine difficulties these can always be considered either in consultation with the local Inspector of Weights and Measures, or the Controller of the State or even the Central Ministry of Commerce and Industry. It may be mentioned that trades which have already adopted rational metric units have not complained of any difficulties. The problem is mainly psychological and can be solved if we show the will to get over it.

The various Chambers of Commerce and Trade have been devoting their attention to steps to be devised for holding the price line. They should also make it a part of their work to ensure the use of recommended metric units in quotation of prices to unify the wholesale trade of the country so far as its weights and measures aspect is concerned.

Retail Trade

The retail trade is widely dispersed and is not easily approachable with the usual

centralised channels of communication. It is also possible that in some cases local conditions would have to be studied before devising effective steps to ensure use of rational metric practices. The Inspector of Weights and Measures is best fitted to undertake the task of persuading the retail trade to use metric units where it has not done so. In the course of his official duties he has occasion to contact every trader in his area. This fact was utilised earlier to prevail upon retail traders to purchase new metric weights and has proved very successful. Rarely was the law required to be invoked to achieve the aim. He is also conversant with metric usage. He can appreciate genuine difficulties of traders and try to remedy them. The Inspector, therefore, would now have to impress upon the traders (and the customers by implication) the necessity of using the metric method of transactions.

He has to concentrate on the trader because he cannot approach every customer. The Inspector has to look after some 2,500 to 3,500 traders. Even if we assume that each trader may cater to the needs of an average of 100 people, every Inspector would have to train some 300,000 people. This is obviously rather difficult. If the trader is prevailed upon to use metric practice, he can pass on the knowledge to the customers by carrying out his transactions only in terms of metric units. This process has already paid rich dividends in many States where metric usage is now commonly prevalent.

Conclusion

In conclusion, it may be stated that although the correct use of the metric units now prevails in most parts of the country, effective steps have to be taken to achieve 100 percent success. To ensure this it is necessary that organisations of trade and Departments of Weights and Measures should campaign vigorously for a unification of trading units in wholesale and retail trade all over the country.

Compulsion from April 1963

(The use of metric weights has become compulsory from 1 April 1962. Metric length measures are the only legal measures from October 1962. Use of other than metric capacity, volume and area measures (except for land area) will be illegal in commercial transaction from April 1963.

Metric Measures has earlier published conversion tables for weights and length measures. Now conversion tables for area, volume and capacity measures and for prices are being published.

—*Editor.*)

Sq. Ft. to Square Metres (m^2)

(1 to 100 sq. ft.)

Conversion Factor : 1 sq. ft. = 0·092903 square metre (m^2)

sq. ft.	m^2	sq. ft.	m^2	sq. ft.	m^2	sq. ft.	m^2
1	0·09	26	2·42	51	4·74	76	7·06
2	0·19	27	2·51	52	4·83	77	7·15
3	0·28	28	2·60	53	4·92	78	7·25
4	0·37	29	2·69	54	5·02	79	7·34
5	0·46	30	2·79	55	5·11	80	7·43
6	0·56			56	5·20		
7	0·65	31	2·88	57	5·30	81	7·53
8	0·74	32	2·97	58	5·39	82	7·62
9	0·84	33	3·07	59	5·48	83	7·71
10	0·93	34	3·16	60	5·57	84	7·80
		35	3·25			85	7·90
11	1·02	36	3·34	61	5·67	86	7·99
12	1·11	37	3·44	62	5·76	87	8·08
13	1·21	38	3·53	63	5·85	88	8·18
14	1·30	39	3·62	64	5·95	89	8·27
15	1·39	40	3·72	65	6·04	90	8·36
16	1·49			66	6·13		
17	1·58	41	3·81	67	6·22	91	8·45
18	1·67	42	3·90	68	6·32	92	8·55
19	1·77	43	3·99	69	6·41	93	8·64
20	1·86	44	4·09	70	6·50	94	8·73
		45	4·18			95	8·83
21	1·95	46	4·27	71	6·60	96	8·92
22	2·04	47	4·37	72	6·69	97	9·01
23	2·14	48	4·46	73	6·78	98	9·10
24	2·23	49	4·55	74	6·87	99	9·20
25	2·32	50	4·65	75	6·97	100	9·29

Acres to Hectares

(0·1 to 1000 acres)

(Conversion Factor : 1 acre=0·404686 hectare)

Acres	Hectares	Acres	Hectares	Acres	Hectares	Acres	Hectares
0·1	·040	1	0·40	20	8·09	200	80·94
0·2	·081	2	0·81	30	12·14	300	121·41
0·3	·121	3	1·21	40	16·19	400	161·87
0·4	·162	4	1·62	50	20·23	500	202·34
0·5	·202	5	2·02	60	24·28	600	242·81
0·6	·243	6	2·43	70	28·33	700	283·28
0·7	·283	7	2·83	80	32·37	800	323·75
0·8	·324	8	3·24	90	36·42	900	364·22
0·9	·364	9	3·64	100	40·47	1000	404·69
		10	4·05				

Cu. Ft. to Cubic Metres (m^3)

(1 to 100 cu. ft.)

Conversion Factor : 1 cu. ft.=0·0283168 cubic metre (m^3)

cu. ft.	m^3	cu. ft.	m^3	cu. ft.	m^3	cu. ft.	m^3
1	0·03	26	0·74	51	1·44	76	2·15
2	0·06	27	0·76	52	1·47	77	2·18
3	0·08	28	0·79	53	1·50	78	2·21
4	0·11	29	0·82	54	1·53	79	2·24
5	0·14	30	0·85	55	1·56	80	2·27
6	0·17			56	1·59		
7	0·20	31	0·88	57	1·61	81	2·29
8	0·23	32	0·91	58	1·64	82	2·32
9	0·25	33	0·93	59	1·67	83	2·35
10	0·28	34	0·96	60	1·70	84	2·38
		35	0·99			85	2·41
11	0·31	36	1·02	61	1·73	86	2·44
12	0·34	37	1·05	62	1·76	87	2·46
13	0·37	38	1·08	63	1·78	88	2·49
14	0·40	39	1·10	64	1·81	89	2·52
15	0·42	40	1·13	65	1·84	90	2·55
16	0·45			66	1·87		
17	0·48	41	1·16	67	1·90	91	2·58
18	0·51	42	1·19	68	1·93	92	2·61
19	0·54	43	1·22	69	1·95	93	2·63
20	0·57	44	1·25	70	1·98	94	2·66
		45	1·27			95	2·69
21	0·59	46	1·30	71	2·01	96	2·72
22	0·62	47	1·33	72	2·04	97	2·75
23	0·65	48	1·36	73	2·07	98	2·78
24	0·68	49	1·39	74	2·10	99	2·80
25	0·71	50	1·42	75	2·12	100	2·83

Liquid Seer to Litre

Conversion factor used : —1 L. Seer= ·937 litres

L. Seer	Litres	Millilitres (to nearest ml)
1/64	—	15
1/32	—	29
1/16	—	59
1/8	—	117
1/4	—	234
1/2	—	469
		(to nearest (10 ml)
1	—	940
2	1	870
3	2	810
4	3	750
5	4	690
6	5	620
7	6	560
8	7	500
9	8	430
10	9	370
20	18	740
30	28	110
40	37	480
	(to nearest litre)	
50	47	
60	56	
70	66	
80	75	
90	84	
100	94	

Millilitres	L. Seer	Tolas (to nearest tola)
200	—	17
300	—	26
400	—	34
500	—	43
600	—	51
700	—	60
800	—	68
900	—	77
1000	1	5

Litres	L. Seer	Tolas (to nearest 5 tolas)
1	1	5
2	2	10
3	3	15
4	4	20
5	5	25
6	6	30
7	7	40
8	8	45
9	9	50
10	10	55

Conversion Table : Litre to Liquid Seer

Conversion factor : 1 litre=1·067 liquid seer

Millilitres	L. Seer	Tolas (to nearest tola)
10		1
20		2
30	—	3
40	—	3
50	—	4
60	—	5
70	—	6
80	—	7
90	—	8
100	—	9

Litres	L. Seer	Tolas (to nearest 5 tolas)
20	21	30
30	32	—
40	42	50
50	53	30
60	64	—
70	74	60
80	85	30
90	96	—
100	106	60

CONVERSION TABLE FOR PRICES

Square Foot to Square Metre

Conversion Factor : 1 sq. metre (m^2) = 10·7639 sq. feet

nP/sq. ft.	Rs/m^2	nP/sq. ft.	Rs/m^2
1	0·11	49	5·27
2	0·22	50	5·38
3	0·32	51	5·49
4	0·43	52	5·60
5	0·54	53	5·70
6	0·65	54	5·81
7	0·75	55	5·92
8	0·86	56	6·03
9	0·97	57	6·14
10	1·08	58	6·24
11	1·18	59	6·35
12	1·29	60	6·46
13	1·40	61	6·57
14	1·51	62	6·67
15	1·61	63	6·78
16	1·72	64	6·89
17	1·83	65	7·00
18	1·94	66	7·10
19	2·05	67	7·21
20	2·15	68	7·32
21	2·26	69	7·43
22	2·37	70	7·53
23	2·48	71	7·64
24	2·58	72	7·75
25	2·69	73	7·86
26	2·80	74	7·97
27	2·91	75	8·07
28	3·01	76	8·18
29	3·12	77	8·29
30	3·23	78	8·40
31	3·34	79	8·50
32	3·44	80	8·61
33	3·55	81	8·72
34	3·66	82	8·83
35	3·77	83	8·93
36	3·88	84	9·04
37	3·98	85	9·15
38	4·09	86	9·26
39	4·20	87	9·36
40	4·31	88	9·47
41	4·41	89	9·58
42	4·52	90	9·69
43	4·63	91	9·80
44	4·74	92	9·90
45	4·84	93	10·01
46	4·95	94	10·12
47	5·06	95	10·23
48	5·17	96	10·33

Conversion Table for Prices—*contd.*

nP/sq. ft.	Rs/m^2
97	10·44
98	10·55
99	10·66
100	10·76

Rs/sq. ft.	Rs/m^2
1	10·76
2	21·53
3	32·29
4	43·06
5	53·82
6	64·58
7	75·35
8	86·11
9	96·88
10	107·64
11	118·40
12	129·17
13	139·93
14	150·69
15	161·46
16	172·22
17	182·99
18	193·75
19	204·51
20	215·28
21	226·04
22	236·81
23	247·57
24	258·33
25	269·10

CONVERSION TABLE FOR PRICES

Cubic Foot to Cubic Metre (m^3)

Conversion Factor used : 1m^3 = 35·3147 cu. ft.

nP/cu. ft.	Rs/m^3
1	0·35
2	0·71
3	1·06
4	1·41
5	1·77
6	2·12
7	2·47
8	2·83
9	3·18
10	3·53
11	3·88
12	4·24
13	4·59
14	4·94
15	5·30
16	5·65
17	6·00
18	6·36
19	6·71
20	7·06
21	7·42
22	7·77
23	8·12
24	8·48
25	8·83
26	9·18
27	9·53
28	9·89
29	10·24
30	10·59
31	10·95
32	11·30
33	11·65
34	12·01
35	12·36
36	12·71
37	13·07
38	13·42
39	13·77
40	14·13
41	14·48
42	14·83
43	15·19
44	15·54
45	15·89
46	16·24
47	16·60
48	16·95
49	17·30
50	17·66
51	18·01
52	18·36
53	18·72
54	19·07
55	19·42
56	19·78
57	20·13
58	20·48
59	20·84
60	21·19
61	21·54

Conversion Table for Prices—*contd.*

nP/ cu. ft.	Rs/m³	Rs./cu. ft.	Rs./m³
62	21·90	3	105·94
63	22·25	4	141·26
64	22·60	5	176·57
65	22·95	6	211·89
66	23·31	7	247·20
67	23·66	8	282·52
68	24·01	9	317·83
69	24·37	10	353·15
70	24·72	11	388·46
71	25·07	12	423·78
72	25·43	13	459·09
73	25·78	14	494·41
74	26·13	15	529·72
75	26·49	16	565·03
76	26·84	17	600·35
77	27·19	18	635·66
78	27·55	19	670·98
79	27·90	20	706·29
80	28·25	21	741·61
81	28·60	22	776·92
82	28·96	23	812·24
83	29·31	24	847·55
84	29·66	25	882·87
85	30·02	26	918·18
86	30·37	27	953·50
87	30·72	28	988·81
88	31·08	29	1024·13
89	31·43	30	1059·44
90	31·78	31	1094·75
91	32·14	32	1130·07
92	32·49	33	1165·39
93	32·84	34	1200·70
94	33·20	35	1236·01
95	33·55	36	1271·33
96	33·90	37	1306·64
97	34·26	38	1341·96
98	34·61	39	1377·27
99	34·96	40	1412·59
100	35·31	41	1447·90
		42	1483·22
		43	1518·53
		44	1553·85
		45	1589·16
		46	1624·48
		47	1659·79
		48	1695·11
		49	1730·42
		50	1765·74

Cubic Foot to Cubic Metre

1 cubic metre (m³) = 35·3147 cubic ft.

Rs./cu. ft.	Rs/m³
1	35·31
2	70·62

CONVERSION TABLE FOR PRICES

Liquid Seer to Litre

(Conversion Factor used : 1 kiquid Seer = ·937 Litre)

nP/L Sr	nP/1	nP/LSr	nP/1	nP/LSr	nP/1	nP/LSr	nP/1	nP/L Sr	nP/1
1	1	21	22	41	44	61	65	81	86
2	2	22	23	42	45	62	66	82	87
3	3	23	25	43	46	63	67	83	89
4	4	24	26	44	47	64	68	84	90
5	5	25	27	45	48	65	69	85	91
6	6	26	28	46	49	66	70	86	92
7	7	27	29	47	50	67	71	87	93
8	9	28	30	48	51	68	73	88	94
9	10	29	31	49	52	69	74	89	95
10	11	30	32	50	53	70	75	90	96
11	12	31	33	51	54	71	76	91	97
12	13	32	34	52	55	72	77	92	98
13	14	33	35	53	57	73	78	93	99
14	15	34	36	54	58	74	79	94	100
15	16	35	37	55	59	75	80	95	101
16	17	36	38	56	60	76	81	96	102
17	18	37	39	57	61	77	82	97	103
18	19	38	41	58	62	78	83	98	105
19	20	39	42	59	63	79	84	99	106
20	21	40	43	60	64	80	85	100	107

Rs/L Sr	Rs/1	Rs/L Sr	Rs/1	Rs/L Sr	Rs/1	Rs/L Sr	Rs/1	Rs/L Sr	Rs/1
1	1·07	11	11·74	21	22·41	31	33·08	41	43·75
2	2·13	12	12·80	22	23·47	32	34·14	42	44·81
3	3·20	13	13·87	23	24·54	33	35·21	43	45·88
4	4·27	14	14·94	24	25·61	34	36·28	44	46·95
5	5·34	15	16·01	25	26·68	35	37·35	45	48·02
6	6·40	16	17·07	26	27·74	36	38·41	46	49·08
7	7·47	17	18·14	27	28·81	37	39·48	47	50·15
8	8·54	18	19·21	28	29·88	38	40·55	48	51·22
9	9·60	19	20·27	29	30·94	39	41·61	49	52·28
10	10·67	20	21·34	30	32·01	40	42·68	50	53·35

Produce More Goods

Reduce Your Needs

Do You Know?

The rates of conversion and basis of calculation of travelling allowances and joining time admissible to Government servants have been revised. For convenience charts showing the rates in metric units now applicable are published here for reference and use. The dates with effect from which the orders came into effect are indicated at the bottom of each chart.

TABLE 1—CONVERSION TABLE

Sl. No.	Item in brief	Reference to rule or order affected [A.G.P. & T. Compilation of FR & SRs Third edition (Reprint)]	Grade under S.R.17	Previous provisions	Revised provisions
1	2	3	4	5	6
(1)	Road mileage for journeys other than by public conveyance.	S.R. 46	I	6 as per mile	24 nP per km.
			II	4 as per mile	16 nP per km.
			III	2 as per mile	8 nP per km.
			IV	1 as per mile	4 nP per km.
(2)	Increased rates of road mileage for journeys other than by public conveyance.	Govt. of India's Decision (3) below S.R. 46	I	8 as per mile	32 nP per km.
			II	6 as per mile	24 nP per km.
			III	2½ as per mile	10 nP per km.
			IV	1½ as per mile	6 nP per km.
(3)	Road mileage for journeys by public conveyance on single seat basis.	Govt. of India's Order (1) below S.R. 46.	I	2½ as per mile	10 nP per km.
			II	2 as per mile	8 nP per km.
			III	1½ as per mile	6 nP per km.
			IV	1 as per mile	4 nP per km.
(4)	Railway and Telegraph servants travelling on unopened line of Railway.	S.R. 84(*a*)	I	1½ as per mile	6 nP per km.
			II	9 pies per mile	3 nP per km.
			III	3 pies per mile	1 nP per km.
			IV		
(5)	Radial jurisdiction of headquarters for admissibility of travelling allowances.	S.R. 71 & other Rules.		5 miles	8 kilometres.
				10 miles	16 kilometres
(6)	Minimum distance for exchange of daily allowance for road mileage.	S.R. 76 (*a*) (*ii*) & other rules.		20 miles	32 kilometres
(7)	Quantum of personal effects for transportation at Govt. cost (*a*) not possessing family.	S.R. 116 (*a*) I (*iii*)	I	40 maunds	1500 kilograms
			II	20 maunds	750 kilograms
			III	12 maunds	450 kilograms
			IV	3 maunds	115 kilograms

TABLE 1—*contd.*

1	2	3	4	5	6
	(*b*) possessing family.		I	60 maunds	2240 kilograms
			II	30 maunds	1120 kilograms
			III	15 maunds	560 kilograms
			IV	5 maunds	190 kilograms
(8)	Conveyance of car/motor cycle on transfer.	S.R. 116		80 miles	150 kilometres
				2 as per mile	8 nP per km.
				1 as per mile	4 nP per km.
(9)	Concession to Survey of India subordinates.	S.R. 140		250 miles	500 kilometres
(10)	Compulsory recall from leave	S.R. 143		200 miles	350 kilometres
(11)	Joining time.	S.Rs. 294 & 294-A		250 miles	500 kilometres
				200 miles	350 kilometres
				80 miles	150 kilometres
				15 miles	25 kilometres
				8 miles	15 kilometres
				5 miles	8 kilometres

The revised rates etc. came into force with effect from 1 September 1962.

TABLE 2—REVISED RATES OF DAILY ALLOWANCE AND OF INCIDENTAL EXPENSES FOR RAIL JOURNEY ON TOUR AND TRANSFER

Grade of the Government servant (see explanation in Chart 3)	Daily Allowance			Incidental expenses for tour and transfer journeys by rail
	Ordinary places	Delhi, Simla, Madras and the whole of Jammu & Kashmir	Bombay/ Calcutta/ Darjeeling District (except Siliguri Sub-division) and Darjeeling town/NEFA areas beyond Inner Line Naga hills, Tuensange Area beyond Inner Line Spiti and Lahaul areas of Punjab/Chini Tehsil/ Parganas of Dassau/ Antharabis and Pandarabis of Rampur Tehsil/Dodra Kawar of Rohru Tehsil in the District of Mahasu, Pangi sub-Tehsil of Chamba Distt.	
1	2	3	4	5
1. (*a*) Pay up to Rs. 1000.	Rs. 9·40	Rs. 13·10	Rs. 16·25	*Tour Journeys*
(*b*) Pay exceeding Rs. 1000.	Rs. 9·40 nP. for the first Rs. 1000 *plus* Rs. 1·50 for every additional Rs. 500 or fraction thereof subject to a maximum of Rs. 15·70.	Rs. 13·10 nP. for the first Rs. 1000 *plus* 60 nP. for every additional Rs. 250 or fraction thereof subject to a maximum of Rs. 15·70.	Rs. 16·25 nP. for the first Rs. 1000 *plus* 60 nP. for every additional Rs. 250 or fraction thereof subject to a maximum of Rs. 18·75.	35 nP. per every 10 km or part thereof exceeding 5 km.

TABLE 2—*contd.*

1	2	3	4	5
II.	25 nP. for every Rs. 12·50 of pay or fraction thereof subject to a maximum of Rs. 8·00.	33 nP. for every Rs. 12·50 of pay or fraction thereof subject to a minimum of Rs. 5·30 and a maximum of Rs. 10·70.	50 nP. for every Rs. 12·50 of pay or fraction thereof subject to a minimum of Rs. 8·00 and a maximum of Rs. 13·30.	24 nP. per every 10 km or part thereof exceeding 5 km.
III.	25 nP. for every Rs. 12·50 of pay or fraction thereof subject to a minimum of Rs. 2·00.	33 nP. for every Rs. 12·50 of pay or fraction thereof subject to a minimum of Rs. 2·70.	50 nP. for every Rs. 12·50 of pay or fraction thereof subject to a minimum of Rs. 3·30.	13 nP. per every 10 km or part thereof exceeding 5 km.
IV.	Rs. 2·00	Rs. 2·70	Rs. 3·30	½ Third Class fare by passenger train. *Transfer journey* (*a*) Lumpsum at the rate of half month's pay subject to a maximum of Rs. 150, *plus* (*b*) Two times the rate indicated as for tour journeys.

The above entitlements came into force with effect from September 15, 1962.

TABLE 3—TRAVEL FACILITIES ADMISSIBLE TO THE VARIOUS GRADES OF GOVERNMENT SERVANTS

Grade of officer	Pay group	Entitlement in respect of journey by air and rail
1	2	3
I.	(1) Government servants drawing pay of Rs. 2,250 or above per month.	By air or by *air conditioned class at their discretion.
	(2) Government servants drawing pay of Rs. 1,600 or above but less than Rs. 2,250 per month.	(*i*) by air; or (*ii*) in case of rail journey: (*a*) by first class or (*b*) by **air conditioned class on payment of 1 nP. per km. by them.
	(3) Government servants drawing a pay of Rs. 800 or more but less than Rs. 1,600 per month.	First Class by rail.
II.	Government servants drawing pay of Rs. 220 or more but not exceeding Rs. 799 p.m.	First Class by rail.

TABLE 3—*contd.*

(1)	(2)	(3)
III.	Government servants whose maximum of pay sacle exceeds Rs. 110 and whose actual pay is less than Rs. 110 per mensem.	Second class by rail.
IV.	Government servants whose maximum of pay scale does not exceed Rs. 110 per mensem.	Third class by rail.

*Travel by air conditioned class is not allowed in respect of journeys on transfer.

**The gradation of Government servants indicated in column 2 above came into force with effect from January 15, 1963.

News & Views

Recent Notifications

(1) *Coir Industry (Registration & Licensing) Amendment Rules*, 1963.

New Delhi, the 1 February, 1963.

G.S.R. 255.—In exercise of the powers conferred by section 26 of the Coir Industry Act, 1953 (45 of 1953) and in supersession of the notification of the Government of India in the Ministry of Commerce and Industry No. G.S.R. 1243 dated the 10th October, 1961, the Central Government hereby makes the following rules further to amend the Coir Industry (Registration and Licensing) Rules, 1958 with effect from 10th October, 1961, the same having been previously published as required by sub-section (1) of that section, namely:—

Rules

1. These rules may be called the Coir Industry (Registration and Licensing) Amendment Rules, 1963.

2. In the Coir Industry (Registration and Licensing) Rules, 1958 (hereinafter referred to as the said rules) for the word 'tons' wherever it occurs, the words 'tonne(s)' shall be substituted.

3. In rule 23 of the said rules—

(*i*) for the figure, words and abbreviation '5 naye Paise per Cwt' the following figures and words shall be substituted, namely:—

'5 naye Paise per 50 kilograms'

(*ii*) for clause (*ii*) of the explanation, the following clause shall be substituted namely:—

'(*ii*) In calculating the fee for a licence under this rule, any weight below 50 kilograms shall be taken as 50 kilograms.'

4. In Form II of the said Rules, for the abbreviation 'cwt' wherever it occurs the word 'kilogram' shall be substituted.

5. In Form XI, XII and XIII of the said Rules, for the abbreviation 'Cwts' wherever it occurs the word 'Kilograms' shall be substituted.

(2) *Secondary Units of Length, Area, Volume, Mass and Capacity*

No. S.O. dated December 1962.

In pursuance of section 12 of the Standards

of Weights and Measures Act, 1956 (89 of 1956), and in supersession of the notification of the Government of India in the Ministry of Commerce and Industry No. S.O. 290, dated the 30th January 1959, the Central Government hereby declares in relation to the primary units of length, area, volume, mass and capacity, the following units to be their secondary units, namely:—

(1) *Secondary units in relation to metre*

Micron	$= 10^{-6}$	metre
Millimetre	$= 10^{-3}$	metre
Centimetre	$= 10^{-2}$	metre
Decimetre	$= 10^{-1}$	metre
Decametre	$= 10$	metres
Hectometre	$= 10^{2}$	metres
Kilometre	$= 10^{3}$	metres
Megametre	$= 10^{6}$	metres

(2) *Secondary units in relation to square metre*

Square millimetre	$= 10^{-6}$	square metre
Square centimetre	$= 10^{-4}$	square metre
Square decimetre	$= 10^{-2}$	square metre
Square decametre (are)	$= 10^{2}$	square metres
Square hectometre (hectare)	$= 10^{4}$	square metres
Square kilometre	$= 10^{6}$	square metres
Square megametre	$= 10^{12}$	square metres

(3) *Secondary units in relation to cubic metre*

Cubic millimetre	$= 10^{-9}$	cubic metre
Cubic centimetre	$= 10^{-6}$	cubic metre
Cubic decimetre	$= 10^{-3}$	cubic metre
Cubic decametre	$= 10^{3}$	cubic metres
Cubic hectometre	$= 10^{6}$	cubic metres
Cubic kilometre	$= 10^{9}$	cubic metres
Cubic megametre	$= 10^{18}$	cubic metres

(4) *Secondary units in relation to the kilogram*

Microgram	$= 10^{-9}$	kilogram
Milligram	$= 10^{-6}$	kilogram
Centigram	$= 10^{-5}$	kilogram
Decigram	$= 10^{-4}$	kilogram
Gram	$= 10^{-3}$	kilogram
Decagram	$= 10^{-2}$	kilogram
Hectogram	$= 10^{-1}$	kilogram
Quintal	$= 10^{2}$	kilograms
Megagram (tonne)	$= 10^{3}$	kilograms

(5) *Secondary units in relation to the litre*

Millilitre	$= 10^{-3}$	litre
Centilitre	$= 10^{-2}$	litre
Decilitre	$= 10^{-1}$	litre
Decalitre	$= 10$	litres
Hectolitre	$= 10^{2}$	litres
Kilolitre	$= 10^{3}$	litres
Megalitre	$= 10^{6}$	litres

Metric system in Medical Education

The metric system is being adopted fully in engineering education from the session beginning in 1962-63 according to a phased programme.

It is now the turn of the medical colleges and allied institutions. All medical colleges and other post-graduate medical institutes, State Medical Officers and Directors of Public Health Services and all the offices working under the Director General of Health Services (DGHS) have been informed by the DGHS to adopt the metric system in accordance with a phased programme which is on the following lines :

(*i*) *Medical Colleges*
- 1963-64 .. I and II year classes
- 1964-65 .. III and IV year classes
- 1965-66 .. V year class

(*ii*) *Nurses Training*
- 1963-64 .. I year class
- 1964-65 .. II year class
- 1965-66 .. III year class

(*iii*) *Pharmacists (Two Years' Training)*
- 1963-64 .. I year
- 1964-65 .. II year.

The heads of medical colleges and hospitals have been directed to take preliminary steps to implement the programme. Further, instruments etc. wherever necessary and feasible would be adjusted or replaced by those designed in the metric system. All the new instruments to be purchased in future should be in metric system.

Litre and the Cubic Decimetre

It will be recollected that the Eleventh General Conference of Weights and Measures had recommended a system of units called the *Systeme International* (SI) which should be used in all scientific and technical work.* The Conference had further recommended that the International Committee on Weights and Measures (CIPM) should study the problem of eliminating the confusion between the cubic decimetre and the litre.† The CIPM met recently, and recommended that the results of precise measurement of volumes should be expressed in units of the *Systeme International* and not in litres.

However, before this recommendation becomes effective it has to be approved by the General Conference on Weights and Measures. The next General Conference will be held in 1966.

'Metric Deepika' (in Malayalam)

The first issue of the Anglo-Malayalam Quarterly 'Metric Deepika' which is to be published by the Department of Weights and Measures, Kerala, was released by Shri P. T. Chacko, Minister for Home Affairs, Kerala, on 29 January 1963, in Trivandrum.

It is very gratifying that another State Government has begun publication of a new magazine dealing exclusively with the metric system of weights and measures. West Bengal Government has been bringing out 'Metric Paddhati' (in Bengali) for the last few years. It may be hoped that, when circumstances permit, other States also will follow the lead given by West Bengal and Kerala.

New Sizes of Invitation Cards

It is understood that the Government of India have now standardised the sizes of invitation cards for Government use. The cards will be in the sizes of A. 5 (210 mm × 148 mm trimmed) and A.6 (148 mm × 105 mm trimmed).

*See *Metric Measures*, September 1961, pp. 23-24.
†See *Metric Measures*, January 1962, p. 20.

Readers' Forum

Gold Carat and Diamond Carat

Sir,

In the bullion and precious stones trade the use of metric weights has been made compulsory to the exclusion of other weights throughout the country since April 1962. The variety of weights in use in the bullion trade has thus been eliminated. The trade is now using the 10 gram pricing unit all over India. Thus the metric system is being effectively used in transactions relating to gold and gold ornaments.

In the precious stones and real pearl trade another metric unit called the carat (equal to 200 mg) is being used. Weights of various denominations of carat are used in this trade.

With the promulgation of the Gold Control Rules from 10 January 1963, the Central Government has brought under control transactions in gold and the manufacture of gold ornaments etc. Under these rules the manufacture of gold ornaments of purity more than 14 carats is illegal.

The rules have thus fundamentally altered the general frame-work of the bullion trade.

• It must be made clear here that the word carat used in conjunction with gold may create the impression that it is related to the carat used in the diamond trade. This is not so. The word carat when applied to gold defines the purity of gold. Thus 100 percent pure gold is called 24 carat. As the purity of gold decreases the number of carats also decreases.

Thus 14 carat gold is an alloy of gold, copper, silver etc. the ratio being 14 parts of pure gold and 10 parts alloying metals *i.e.* 14 : 10 or 7:5. This means that out of 12 grams of 14 carat gold only 7 grams is pure gold and 5 grams is admixture. Similarly in 12 carat gold 6 gram is pure gold and 6 gram is copper.

How can we calculate the quantity of pure gold in an ornament of 14 carat gold ? An easy way is:

The weight of pure gold is equal to the weight of ornament multiplied by 0.5833. This is 7/12.

An illustration of arithmetical calculation is given below:

Calculate the cost of a 14 carat gold ring weighing 7.200 gram @ Rs. 107.00 per 10 grams of gold.

(Since 14 carat gold is composed of 7 : 5)
Therefore, the weight of pure gold

$$= \frac{7}{12} \times 7.200$$

$$= 0.5833 \times 7.200$$

$$= 4.200$$

Therefore, cost of gold $= 10.70 \times 4.200$

$$= \text{Rs. } 44.94$$

The price of the actual waste in polish can be added to the cost as manufacturing charges.

It is to be hoped that the bullion trade will switch over to the use of metric units in their manufacturing process calculations with the new changes that have been brought about due to the Gold Control Rules.

Joginder Singh Bakshi
Inspector of Weights & Measures,
Yamuna Nagar, Punjab.

Dozens and Tens

Sir,

It seems that old names and systems of dozen containing 12 and gross containing 12 dozens *i.e.* 144 have not been changed into metric system, which is most necessary in these days with a view to facilitate work.

When we keep all accounts in metric system, it is necessary to count and make entries of packages of 10 and 10 such separate packages making altogether 100, instead of the present running calculation of dozen of 12 and gross of 12 dozens *i.e.* 144.

We cannot understand why it is not modified. Further in the same connection it is also necessary to fix the modern names of a bundle of 10 and a bundle of 100 instead of dozen and gross.

R. N. Jain
Proprietor

M/s. Jain Products,
Adoni,
Andhra Pradesh.

(In view of the adoption of decimal coinage and the metric system of weights and measures in India, it is undoubtedly advantageous to change our packages to 10's and 100's in place of dozens and gross. The decimal relation between such packages, the money value and the weights and measures should be obvious. One would have thought that such an extremely obvious step would not have needed any legislation or even directives from the Government for its adoption by the trade. It would be desirable, therefore, to leave it to the trade to realise the necessity of the adoption of the decimal method of packing goods in place of the confusing dozens and gross. It is heartening that many trades have already adopted decimal packages. Others should follow the lead.

So far as the names of packages of 10's and 100's are concerned, these may vary from language to language. However, we would invite suggestions from our readers on this subject.

—*Editor.*)

Book Review

METRIC WEIGHTS AND MEASURES (A Guide for Textbook Writers): (English), R. C. Saxena, Central Bureau of Textbook Research, Central Institute of Education, 33, Chhatra Marg, Delhi-6, published by the Central Institute of Education, 1962, pp. 102.

An extremely important and far reaching aspect of the change-over to the metric system, is the change in the teaching of arithmetic and allied subjects. Arithmetic is the very foundation of calculations and enters the sphere of commercial transactions a man has to carry out right from childhood to old age. It is, therefore, but right that arithmetic should now be re-oriented to the metric system to the almost exclusion of other systems.

Till now the metric system was just an additional system of weights and measures to be taught for familiarity. The bulk of the teaching relied heavily on Indian and British systems. With the change-over to the metric system in commercial transactions, it is necessary that this change in transactions should be reflected in education. The curricula as also textbooks used for teaching arithmetic would need drastic revisions. Mere playing about with the examples while leaving the basic structure of arithmetic undisturbed, is not likely to prove effective in the long range. As the Director of Central Bureau of Textbook Research (CBTR) in his foreword says:

'It does not only mean giving information about new units but implies a complete change in the basic approach to the learning of various processes and principles in arithmetic.'

To direct such a fundamental change-over, it is necessary that guidance should be given by authoritative bodies. The book under review which is brought out by the Central Bureau of Textbook Research, an authoritative organization in the field of textbooks, deserves to be commended to all teachers and textbooks writers, for deriving practical guidance in their work.

The Guide has been designed to aid the textbook writer in visualising some of the problems that crop up due to the change in the nature of our weights and measures and coinage. It is divided into eleven chapters. The first chapter deals with the concept of measurement and its basic philosophy. It then introduces the metric system in its various aspects and shows clearly how one should develop a correct approach to the metric system. It then describes with examples the use of the units of length, weight, area, volume and capacity. One chapter is devoted to the various applications of the metric system, another to practical exercises and solutions of problems, one more to grade placement of content and the last chapter gives simple lessons. The Guide covers the requirements of the primary classes.

The Guide duly emphasizes the teaching of decimals. Fractions have been 'put in their place'. It is, therefore, perfectly metric oriented and is sure to be extremely useful not only to textbooks writers but also immediately to teachers.

The subject has been presented in a very simple language and numerous illustrations,

line drawings and half-tone blocks add to the practical value of this Guide. It is neatly printed.

It is understood that the second part of the Guide dealing with the requirements of higher classes is under preparation,

METRIC GUIDE AND CONVERSION TABLES FOR TRADE AND COMMERCE (English) by J. K. Varshneya, Deputy Director (Metric), National Buildings Organisation, Ministry of Works, Housing and Supply, New Delhi, 1963; published by Allied Publishers Private Ltd., 13/14, Asaf Ali Road, New Delhi-1; pp. 115, price Rs. 3·00.

The author, who has been engaged in the compilation of a *Handbook for Building Engineers in the Metric System*, has presented in this book in 13 chapters some 110 useful tables. As Shri K. V. Venkatachalam, Joint Secretary, Ministry of Commerce and Industry, says in the Foreword to this book:

'Tables for easy conversion have a valuable part to play in the smooth transition to the new system.'

In spite of many tables which have been published by the Government and other organisations, there is always a demand for conversion tables to suit particular requirements of various trades and interests. This is because the scope of every table and the trade to which it is applicable, varies according to the trade practice. In this context the publication of these tables is welcome.

In the first chapter the author introduces the metric system and the various denominations of weights and measures which have been standardised. He then proceeds to indicate the units of the metric and the seer-pound systems as also the abbreviations for metric units and their correct usage. After dealing with accurate conversion factors, equivalent metric units are described and then conversion factors and metric units for wholesable and retail trade. Then come many conversion tables for length, area, volume, capacity and weights. Price conversion tables for various units are also prominent in this book. Among miscellaneous tables are those which deal with conversion of horse power to kilowatts, miles per gallon to kilometres per litre, properties of round steel bars, wire and sheet metal gauges in millimetres and metric paper sizes.

This set of tables is of 'great help not only to the ordinary trade but also to those working in offices, whether of Government or business houses, engineers or technologists'.

The book has been published in a handy size (11 cm × 16.5 cm). The subject-matter is neatly and clearly printed. There is no necessity to refer to and fro for locating values. We expect that the tables will prove useful to the general public.

Licensed Manufacturers and Repairers

[*Metric Measures* had been publishing in the past a series of lists of licensed manufacturers, dealers and repairers of weights and measures, weighing and measuring instruments licensed by the Governments in the various States and Union Territories under the Weights and Measures (Enforcement) Acts. To economise on paper, it is possible only to publish lists of licensed manufacturers and repairers.

A new feature of statistics of verification and licences issued is also being published in *Metric Measures*.

—*Editor.*]

STATISTICS OF VERIFICATION OF WEIGHTS ETC., AND LICENCEES

Sl. No.	State/Union Territory	Period	Weights	Capacity measures	Length measures	Weighing instruments	Measuring instruments	Total Licences issued: Manufacturers	Dealers	Repairers
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	Assam ..	1 April to 30 Nov.	2,83,601	8,969	1,338	343	36	4	54	11
(2)	Andhra Pradesh	—	—	—	—	—	—	—	—	—
(3)	Bihar ..	—	—	—	—	—	—	—	—	—
(4)	Gujarat ..	1 April to 31 July	4,55,890	38,144	7,987	31,205	128	3	35	5
(5)	Kerala ..	—	—	—	—	—	—	—	—	—
(6)	Madras ..	—	—	—	—	—	—	—	—	—
(7)	Madhya Pradesh	—	—	—	—	—	—	—	—	—
(8)	Maharashtra	—	—	—	—	—	—	—	—	—
(9)	Mysore ..	1 April to 30 Nov.	4,81,354	1,05,253	1,037	59,674	8,420	126	493	92
(10)	Orissa ..	1 April to 30 Nov.	—	—	—	—	—	11	75	4
(11)	Punjab ..	1 April to 30 Nov.	6,73,338	26,755	14,474	57,421	375	4	21	19
(12)	Rajasthan ..	—	—	—	—	—	—	—	—	—
(13)	Uttar Pradesh	1 April to 31 May	5,34,506	7,951	4,702	907	113	3	99	18
(14)	West Bengal	—	—	—	—	—	—	—	—	—
(15)	Jammu & Kashmir	1 April to 30 Nov.	120	395	—	3	—	1	—	—
(16)	A. & N. Islands	—	—	—	—	—	—	—	—	—
(17)	Delhi	1 April to 30 Nov.	1,59,929	12,799	7,093	14,576	304	26	72	18
(18)	Himachal Pradesh	1 April to 31 May	16,167	1,211	593	0	2,958	—	1	1

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(19)	L.M.A. Islands	—	—	—	—	—	—	—	—	—
(20)	Manipur ..	1 April to 30 Nov.	6,080	1,510	81	114	—	—	—	—
(21)	Pondicherry..	1 April to 30 Sept.	18,923	5,549	567	857	7	4	13	3
(22)	Tripura ..	1 April to 30 Nov.	5,326	1,545	—	—	8	2	49	1

ASSAM

List of Manufacturers and repairers licensed in Assam State during 1 April to 30 November 1962.

MANUFACTURERS

(1) Annapurna Rice & Oil Mills, Ulubari, Gauhati.
(2) Ashok Industries, Udyognagar, Tinsukia.
(3) Burode Engineering Works, Tinsukia.
(4) Jayshree Assam Engg. Works, Dhubri.

REPAIRERS

(1) Alilur Rahman, C/o B.O.C. (I.T.) Ltd., Digboi.
(2) Annapurna Rice & Oil Mills, Ulubari, Gauhati.
(3) Asia Engineering Corpn., Marjorie, Yvoun, Dhaud, Sole Proprietor, Scheherzade, Near Strand Cinema, Colaba, Bombay-5.
(4) J. C. Bhattacharjee, C/o B.O.C. (I.T.) Ltd., Digboi.
(5) D. C. Choudhuri, C/o B.O.C. (I.T.) Ltd., Digboi.
(6) C. E. Demello, C/o B.O.C., (I.T.) Ltd., Digboi.
(7) B. S. Gill & Co., Namrup, Lakhimpur.
(8) J. C. Gogoi, C/o B.O.C. (I.T.) Ltd., Digboi.
(9) Jain Engineering Supply Company, Dhubri.
(10) Standard Vacuum Oil Company, Station Road, Gauhati.
(11) Udit Chandra Sarma, P.O. Tinsukia.

GUJARAT

List of manufacturers and repairers licensed in Gujarat during the period 1 April 1962 to 31 December 1962.

MANUFACTURERS

Sl. No.	Name and Address of Manufacturers	Details of Articles Manufactured
(1)	Hasanali Amiji & Bros., Gujari Bazar, Rajkot	Conical Capacity Measures.
(2)	Pravin & Co., Jamadar Pada, Savarkundla	Beam Scales Class C&D.
(3)	Punjab Steel Rolling Mills, Baroda	Metric Weights.
(4)	Standard Mechanical & Iron Works, Pratapanagar Road, Satyadev Chemical Compound, Baroda.	Metric Weights and Conical Litre Measures.

REPAIRERS

(1) Alanker Scale Repairing Works, 1482, Near Parabadi, Raikhad, Nava Vas, Ahmedabad-1.
(2) Burma Scale Co., Tarn Taran.
(3) Charanji Lal and Sons, Patiala.
(4) Chaman Lal, Cycle Mistri, Ambala Cantt.
(5) Gujarat Scale Repairing Works, Ganipura, Near United Industries, Dholka.
(6) Jaswant Singh-Charan Singh, Nawanshahar.
(7) Janta Trading Co., Radaur Road, Yamuna Nagar.
(8) Kunj Lal Prop. M/s. Vish Karma Workshop, Dharmasala.
(9) Kartar Singh Mistri, Outside Zira Gate, Ferozepur City.
(10) Luhar Kanji Jivanbhai, Sanghavi Sheri, Gondal.
(11) Malook Chand, 69, Lower Bazar, Simla.
(12) Mittal Industrial Corpn., Kesar Gunj Road, Ludhiana.
(13) Ramraja Scale Repairing Works, Bhavnagar.
(14) Razak Repairing Works, Prop. Abdulrajak Badulsadar, Shah Pol, Near Talal's Bukhari Dargah, Nilkant No. 1919, Surat.
(15) Shiv Ram Mistri, Markanda, Ludhiana.
(16) Swaran Singh, M/s. B. S. Electric Servite, Bhatinda.

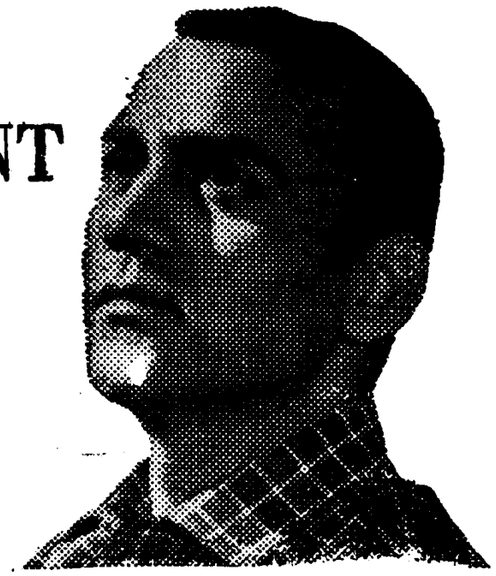
M203DPD/62—5,750—(Sec. I)—14-3-63—GIPF.

Now is the time to re-affirm our resolve

To-day let us re-affirm our resolve to resist the aggressor. Do not slacken vigilance and determination—for **this is your war.** Take action **now**. Volunteer to serve in the National Service Organisations. • Wage war on waste and cut all unnecessary expenditure • Food and clothing are valuable. Do not waste them • Time is precious too. Measure it not in terms of hours spent, but by what you accomplish • Shoulder your responsibilities. Act with discipline in all things, at all times.

BE VIGILANT

take part in national preparedness



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metric measures

THE PUBLICATIONS DIVISION

ABBREVIATIONS FOR METRIC UNITS

(1) DECIMAL MULTIPLES AND SUBMULTIPLES

Prefix		Value in Terms of Unit	Abbreviation
kilo	..	1,000	k
centi	..	0·01 (10^{-2})	c
milli	..	0·001(10^{-3})	m
micro	..	0·000 001(10^{-6})	μ

(2) WEIGHTS

Denomination		Value	Abbreviation
tonne	..	1 000 kg	t
quintal	..	100 kg	q
kilogram	..	1 kg	kg
gram	..	1 g	g
milligram	..	1 mg	mg
carat	..	200 mg	c

(3) CAPACITY

kilolitre	..	1 000 l	kl
litre	..	1 l	l
millilitre	..	1 ml	ml

(4) VOLUME

cubic metre	..	m^3	m^3 or cu m^3
cubic centimetre		cm^3	cm^3 or cu cm^3
cubic millimetre		mm^3	mm^3 or cu mm^3

(5) LENGTH

kilometre	..	1 000 m	km
metre	..	1 m	m
centimetre	..	1 cm	cm
millimetre	..	1 mm	mm
micron	..	1/1 000 mm or 10^{-3} mm	μm

(6) AREA

square kilometre		1 000 000 m^2	km^2 or sq km^2
square metre	..	1 m^2	m^2 or sq m^2
square centimetre		1 cm^2	cm^2 or sq cm^2
square millimetre		1 mm^2	mm^2 or sq mm^2

(7) LAND MEASURE

are	..	100 m^2	a
hectare	..	100 a^2	ha
centiare	..	m^2	ca

*Both these abbreviations are current, but the first set should preferably be used. The former abbreviation is used internationally.

Rules for Abbreviations :

(1) Do not make any change, such as addition of 's' to indicate plurality *e.g.*, write 1 kg, 10 kg, 20g, 5 g, 10 t, 20 ml, 27 l, 165 km, 2 mm, 100 cm^3, 66 km^2;

(2) Do not capitalize the abbreviations. For example, do not write 1 Kg, 2 Kg, 20 MM, 50 MM, the right way is to write 1 kg, 2 kg, 20 mm, 50 mm, etc.

(3) Do not use any other abbreviations except those given above.

metric measures

(JOURNAL OF WEIGHTS AND MEASURES)

MINISTRY OF COMMERCE AND INDUSTRY

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CONTENTS

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metric measures

METRIC MEASURES is published every two months.

METRIC MEASURES provides information to the general public on the administrative, commercial, educational, industrial, historical and other aspects of weights and measures, with particular reference to the introduction of the metric system in India.

Contributions for publication should be sent to the Editor, METRIC MEASURES, Ministry of Commerce & Industry, Udyog Bhavan, New Delhi.

Enquiries regarding subscriptions and supply of copies should be addressed to the Business Manager, Publications Division, Ministry of Information and Broadcasting, Old Secretariat, Delhi-6.

Introduction of Metric System in TISCO

A. V. SUKHATME
Office of Chief Statistician, The Tata Iron and Steel Company, Ltd.,
Jamshedpur.

WHEN the Government of India decided to adopt the metric system of weights and measures in India in place of the FPS system, the Tata Iron and Steel Co., made up its mind to gear up its efforts to make the change-over as smooth as possible. The preliminary work in this respect was, therefore, started as early as in August 1957 when a High Power Committee, called the Metric Committee, was formed. This Committee was headed by the General Superintendent of the Works and included the Chief Statistician as the Secretary, together with seven other members carefully selected from various fields of activity *viz.*, Engineering and Plant Operations, Accounts and Sales, Metallurgy and Inspection, etc. The functions of this Committee were to plan and co-ordinate all activities in the smooth and systematic change-over to the new system.

The task of the complete change-over from FPS to the metric system in every sphere of activity of this huge organisation embracing multifarious functions and responsibilities was by no means an easy one. However, by active planning, foresight and fortitude of workers in various fields of operations, working as a team for this common goal, it was made possible to complete the task and finally 30 September 1960 was fixed as the final date for the complete implementation. In the following paragraphs a brief resume is given of the various problems tackled during this period of three years of preparation.

It was envisaged from the very beginning that to achieve a smooth change-over to a completely new system *i.e.* the metric system, a properly phased programme had to be drawn up and followed stage by stage. These stages could be made to overlap each other to some extent, but the objective to be achieved must be clearly defined for each phase. A three-stage programme was, therefore, drawn up : (1) introduction of the concept to the workers, (2) the preparation of equipment and methods to suit the metric system and (3) full adoption of the metric system.

Stage 1 : Introduction of Concept

During this stage the primary aim was to imbibe in everybody concerned the proper concept of the metric system and its advantages. Arrangements for training and propaganda were, therefore, the main features of the drive at this stage. For purpose of training, separate arrangements were made both for incoming fresh apprentice recruits as well as for a large number of old and experienced personnel selected from different fields of operations at the plants and offices. For new apprentices, the problem

was easily solved by including lessons in metric system in the regular syllabus for training. But for old hands, familiar with the FPS system ever since their employment, and not always possessing adequate academic qualifications, the problem was different. For them a simple but comprehensive course in metric system was carefully drawn. About 700 employees received training in batches of 20 per week. The training included both theoretical and practical classes and covered 2½ hours per day for the duration of one week.

Simultaneously with the above, a booklet was prepared containing various useful tables to serve as ready reckoners from the FPS to the metric system and *vice versa*. Care was taken to make all these tables to suit the exact requirements of ranges and types of conversions required for field use on daily routine basis. In addition, various wall charts were prepared and distributed for exhibition on shop floor depicting essential features of metric measurements. Popular lectures were arranged whenever possible and articles on the metric system with pictorial presentations were published from time to time in the house journals both in Hindi and English. All these activities helped to create an atmosphere in which the minds of the workers got prepared to accept easily the impending change-over to the new system.

Stage 2 : Preparation of Equipment and Methods

Having prepared the ground for the change-over, the next objective was to take stock of everything—what we had and what we wanted. This stage was, therefore, really a stage for preparation of equipment and development methods. The activities at this stage were mostly concerned with supervisory staff and higher management, in fixing policies and laying down of procedures and manufacturing codes. The important points tackled during this stage are briefly noted below :

(i) Conversion of Weighing Machines

A complete census was taken of all weighing machines installed in the Works. The range varied from small Salter's spring balances to big 200 tonne weighbridges. Every detail of these approximately 500 weighing machines, such as (1) make, (2) year of installation, (3) type of scale, (4) materials weighed etc. was studied, which made it possible to draw up priority lists for conversion of these machines to suit the metric system. It was decided that machines directly used for weighment of materials for outside shipments would be tackled first. The task of conversions of weighing machines, however, presented many serious problems for want of appropriate spares, and in many cases, the maker's representatives not being available in India to undertake the job. Some of the machines were even converted through our departmental personnel connected with repairs and upkeep of such machines.

(ii) Other Measuring Instruments

Apart from weighing machines, there were various other measuring instruments in large numbers, viz. (a) pressure gauges (b) micrometers (c) verniers and callipers (d) foot rules and measuring tapes etc. which were also to be adequately taken care of before launching the new metric system in the production line. Detailed statistics were collected for all these instruments in stocks and in field use. A programme was drawn for replacements of such instruments to suit the metric system when the existing ones fully played out their lives. In certain cases fixing up dual calibration devices to read off directly equivalent values in metric measurements were tried with success.

(iii) Procurement of Materials

At this stage the general market was not ready to adopt the new system on a large scale. Negotiations of purchase contracts for the thousands of store items in general use for the Works could not, therefore, be carried out in metric units at the early stage. However, to create confidence in the market that we were ready to purchase material in metric units, a clause was inserted in all our purchasing enquiries that the suppliers were free to quote for the materials in metric units whenever possible. For procurement of raw materials (e.g. ore, stone, coal etc.), however, which came mostly from internal sources, metric system was fully introduced from a very early stage.

(iv) Changes in Engineering Drawings

There were a very large number of engineering drawings which needed modifications to make them suitable for the metric system. The Engineering Division was entrusted with the task of checking up all these drawings with a view to make whatever changes were necessary in them. It was also decided that all future drawings would be issued in the metric system.

(v) Reporting of Figures in Metric System

An important decision taken at this stage was to start reporting of all figures of monthly performances on a dual system, *i.e.* the figures were to be reported both in the FPS (current system) and metric (new system) units side by side. In the initial stages, this could only be done through extensive use of conversion charts, copies of which were made readily available. The greatest advantage drawn through this double reporting system was that the monthly cost sheets could then be easily moulded to follow the same pattern. This automatically helped in adopting the new system in the discussions of problems on costs and performances without losing any bearings on past performances recorded in the FPS system. This double reporting system was continued for enough time, and when the concerned personnel were acquainted thoroughly with metric figures, the corresponding FPS figures were dropped out.

Stage 3 : Full Adoption

Rolling of Metric Sections of Materials in the Mills

Implementation of the metric system could not be taken as complete unless goods were actually manufactured and sold in terms of metric standards. For the new rolling mills under the TMP expansion of TISCO, it was decided that all their products would be rolled in metric sections from the very beginning. There was also no difficulty in switching over to rolling of metric sections in the Sheet Mills and Plate Mills where any new flat products conforming to metric sizes could be easily taken care of, as and when necessary. But the real difficulty was with the Rail and Structural Mill and old Merchant Mill where there were already large outstanding tonnages on order in B.S. section and a large stock of rolls to suit B.S. sections. These costly rolls were procured through considerable expenditure of foreign exchange and, therefore, these could not be discarded before they actually played out their full lives, without incurring heavy losses. Detailed statistics were, therefore, collected for each B.S. section with outstanding tonnage on order and when these quantities were set against expected roll life of existing stock of rolls, it was possible to draw a programme indicating when these mills could be made ready to take up the metric sections.

At the same time the specifications of metric sizes of materials to be rolled were drawn up in consultation with the Sales

Division and the Government Authorities. A booklet was also published by the Sales Office indicating proposed metric sections to be rolled in each mill and booking of orders for metric sections started accordingly. The customers were also informed about the alternative sizes in metric sections that could be supplied in lieu of outstanding quantities in B.S. sections and in many cases these offers were readily accepted. At present all products excepting a few typical cases like rails, angles, beams of certain dimensions, tees etc. are being rolled and supplied only in metric dimensions. For all quantitative measurements, however, the metric system is now invariably followed right through booking of orders, plant production, scheduling and sales of all materials.

The above synopsis gives a broad outline of how the problem of switching over to the metric system was tackled by the organisation within the short stipulated time. Various other incidental points such as the effect of change-over to metric system in the preparation and sales of canteen products, dairy farm goods, changes in stock accounting systems of thousands of different materials (solids, liquids and gases), disposal of bye-products, etc. also arose. To tackle these at short notice, the office of the Secretary, Metric Committee was always kept alert. The success achieved in effecting the smooth change-over to the metric system within such a short time can mainly be attributed to the determination of the Management and the personnel concerned to make it work.

* * *

Produce More Goods
Reduce Your Needs

Your Discipline is
India's Strength

Maps and Metric System

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IN the article published in the *Metric Measures*, May 1958, the procedure connected with the switch-over to the metric system had been discussed. Since then, the Survey of India has made steady progress which is listed below. The progress would have been considerable but for the fact that the major potential had to be diverted to project and other development surveys.

Topographical Maps

(1) *1 : 50,000 Series with Contours at 20 metres Interval*

The total number of maps in this series is about 5,200 which cover the whole of India. Fresh surveys are necessary to produce this map cover as the contour interval is substantially different and the scale larger than that of the existing map cover, which is also very much out of date. The number of maps published so far and those surveyed and under drawing on this scale is about 500. Concurrently, a larger number of maps are also under survey in metric terms.

(2) *1 : 100,000 Series with Contour Interval of 50 metres*

This series is compiled from 1:50,000 survey maps. It is at present in abeyance as its maintenance is not absolutely essential while the time and labour involved would be more gainfully applied to the production of other smaller scale series.

(3) *1: 250,000 Series with Contours at 100 metres Interval*

The total number of maps comprising this series is about 400. Each of the maps is normally based on the larger scale component maps of the area, such as 1:50,000 and 1 : 100,000 where they exist. The progress on this series is primarily dependent upon the progress of 1 : 50,000 map series mentioned in (1) above. The number of maps published so far or under drawing on 1:250,000 scale is about 60.

Geographical and General Maps of India

(1) *1 : 1,000,000 Carte Internationale due Monde Series*

This map series covering India consists of 30 maps as part of the I/M (International Map) of the World. Steady progress on this series has been maintained and to date 3 sheets have been published and 25 are in hand. Some minor changes in the specifications were introduced at the 1962 Boon Conference and these will be incorporated in future editions.

(2) *1: 1,000,000 Charts for the International Civil Aviation Organisation (I.C.A.O.)*

This is a comparatively recent commitment for the Survey of India, flowing from the decisions reached at the International Civil Aviation Organisation (I.C.A.O.) Conference held at Brussels in April 1948, in which India was represented. India has

to produce 23 charts of the World Aeronautical Series on the I/M scale covering her territory. Of these 11 charts have been published and 12 are in hand or under publication. The main task now will be to keep these charts up-to-date.

(3) 1 : 2,000,000 Southern Asia Series

The series consists of 24 maps. The scale of the maps is metric but contours and heights are in feet except for a few sheets which have contours in metres. Conversion to metric as well as a general revision of the series have been taken up. Bringing them up-to-date will take some years.

(4) 40-Mile Map of India

The metric scale adopted for this map is 1:2,500,000. Owing to certain considerations, it has been decided to recompile this map on an improved and more suitable projection. The recompilation work will be taken up shortly.

(5) 40-Mile Road Map of India

The new edition of this map on metric scales (1:2,500,000) was published in 1961. Its second edition is in hand.

(6) 67-Mile Railway Map of India

The metric scale adopted for this map is 1:3,500,000. The new edition of the map has already been fair drawn and will be published shortly.

(7) 70-Mile Political Map of India

The proposed metric scale for this map is 1:4,000,000. Owing to considerable changes in the States and other administrative boundaries, it is intended to recompile this map afresh. As an interim measure, first edition of this map in metric system will be published on 1/4,500,000 scale.

(8) 70-Mile Physical Map of India

The metric scale and the present state of the map are the same as for the 70-Mile Political Map of India mentioned in item (7) above.

(9) 128-Mile Map of India

The new edition of this map is being compiled on scale 1:8,000,000 and it will be published shortly.

(10) 192-Mile Map of India

The compilation of this map on metric scale 1:12,000,000 is in hand. Its publication may take another year.

(11) 250-Mile Map of India

New edition of this map in metric terms on scale 1:16,000,000 was published in 1961.

(12) 1 : 1,000,000 State Maps

The adoption of metric system does not affect the specifications of State Maps to any degree since their scale, etc. is already in metric terms. A number of State maps are at various stages of maping and printing.

(13) School Atlas

A School Atlas in metric terms has already been published.* Its second edition is under preparation.

Guide Maps

Delhi Guide Map

The new edition of the map in metric terms on scale 1:20,000 was published in 1961. A few other maps of this category are also being progressed but it may not be possible to convert all these maps to the metric system in the near future. Most of these maps will require to be surveyed *de novo*.

Conversion of Departmental Books and Pamphlets etc. to Metric Terms

The trigonometrical and levelling, etc. data which form the framework and basis of survey and map-making have been hitherto

*A review of the *School Atlas* appeared in *Metric Measures*, Vol. 5, July 1962, p. 23.

in the FP system, and so were the ancillary departmental books of instructions, mathematical tables and computational forms for working out the data. Since the introduction of the metric system, substantial progress has been made for converting them to metric terms. Pending complete finalisation, however, conversion factors to render the existing values to metric values have been worked out for day-to-day use. The new editions of books and pamphlets, etc., with data in metric terms, either already published or in the course of being published are given below :

(i) The Departmental book of instructions on cartography (Topo Hand-Book Chapter VI) revised to metric terms, is under printing.

(ii) Auxiliary Tables, Part II, containing logarithmic tables, etc. have been printed off. Other tables are nearing completion.

(iii) Survey of India Metric Conversion Tables for Lengths and Areas have been printed.

(iv) Conversion of levelling pamphlets, showing heights of bench-marks, is in progress.

(v) The Indian Tide Tables and Tide Tables relating to Kandla, Bombay and Rangoon for 1963 in metric terms have been printed.

(vi) The Tide Gauge Diagrams in metric terms have been printed and brought into use with effect from 1-1-1962.

(vii) Grid Pamphlets containing co-ordinates and heights in metric terms are being steadily progressed.

(viii) Re-casting of computational forms in metric terms is also in progress.

Procurement of Instruments etc. in Metric Terms

Replacement of instruments by those in the metric system involves difficulties both financial and technical. Draft specifications for various instruments are under preparation which will be processed by the Indian Standards Institution. Comments on various other instruments which are in the offing have already been furnished to them. 'Geodetic Levels' have been procured for use with level staves which are in metric terms.

Project Maps

The working group on Co-ordinated Study of Surveys, set up by the Technical Committee on Land, Natural Resources of the Planning Commission, has recommended that the scales to be adopted for these maps should be 1/2,000, 1/5,000, 1/10,000 or 1/25,000 as in the case of cadastral and forest maps so that the same map may serve a variety of needs and extra cost and labour involved in preparing different maps for different needs is reduced to the minimum. In rare cases where maps on 1/15,000 or 1/20,000 are required for planning or development, procedure decided for forest maps may be adopted *i.e.* the photographic enlargements of specified areas could be made from 1/25,000 surveys. The accuracy in that case would be limited to that of 1/25,000 scale but more space on paper would be available for work. Contour intervals may be 1, 2.5, 5 or 10 metres according to the nature of the country, scale adopted or purpose of the project.

The metric system will be introduced in all future project surveys unless any indentor specifically asks for surveys in the FP system.

From the foregoing it will be seen that in the course of the next few years we would be well on the way to accomplishing a major portion of the task of conversion of maps, departmental books and instruments to the metric terms.

Definitions of Certain Metric Units

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THE Eleventh General Conference of Weights and Measures, held at Paris in October 1960, has ratified the adoption of International System of Units (abbreviated as SI) for international use. This system of units consists of 6 basic units, 2 supplementary units and 28 derived units. The highlights of the SI are that the unit of thermodynamic temperature is degree Kelvin (K°), that of force is newton (N) and of work, energy and quantity of heat the joule (J).

In the metric system of weights and measures there are three other units of force namely, dyne (dyn), sthene (sn), and kilogram-force (kgf). In practical civil engineering, however, the following units for temperature, force and quantity of heat are most commonly used :

Temperature—degree Centigrade (°C.)
Force —kilogram-force (kfg.)
Quantity of heat—calorie (cal)

This article gives the latest definitions of 13 of the most commonly used units as accepted by various international organisations. These units are commonly used in civil engineering and the architectural professions.

(1) Length

The fundamental unit of length in the metric system is the metre. The Eleventh General Conference of Weights and Measures has defined metre as the length equal to 1 650 763.73 wave lengths in vacuum of the radiation corresponding to the transition between the levels $2\ p_{10}$ and $5\ d_5$ of the atom of krypton 86.

1 nautical mile (international) = 1852 metres
1 micron = 10^{-6} metre

(2) Area

1 Are = 100 square metres

(3) Capacity

The fundamental unit of capacity in the metric system is the litre. This is defined as the volume occupied by the mass of one kilogram of pure air-free water at the temperature of its maximum density (4° Centigrade) and under normal atmospheric pressure. (*See* also *Metric Measures*, March 1963, pp 3-10.)

(4) Mass

The fundamental unit of mass in the metric system is the kilogram. This is defined in terms of the platinum-iridium international prototype kilogram kept at the International Bureau of Weights and Measures.

1 carat = 200 milligrams
1 quintal = 100 kilograms
1 tonne = 1,100 kilograms

(5) Time

The fundamental unit of time in the metric system is the second. The Eleventh General Conference of Weights and Measures has ratified the following definition of second :

> **The second is the fraction 1/31 556 925.974 7 of the tropical year for 1900 January 0 at 12 hours ephemeris time.**

(6) Acceleration

The standard acceleration of free fall (g_n), usually called 'standard gravity' is 980.665 cm/s² (exactly). The standard value is now recognised as a conventional numerical value and should not be associated with any geographical location.

(7) Force

(a) The dyne, newton and sthene are the units of force in the metric system. These units are defined as follows :

(i) *Dyne* (*dyn*)—The dyne is that force, which when applied to a body having a mass of one gram, gives it an acceleration of one centimetre per second per second.

(ii) *Newton* (*N*)—The newton is that force which, when applied to a body having a mass of one kilogram, gives it an acceleration of one metre per second per second.

(iii) *Sthene* (*sn*)—The sthene is that force which, when applied to a body having a mass of one tonne, gives it an acceleration of one metre per second per second.

(b) The technical unit of force in the metric system is kilogram-force which is defined as follows :

Kilogram Force (*kgf*)—The kilogram force is that force which, when applied to a body having a mass of one kilogram, gives it an acceleration of 9.806 65 metres per second per second.

The principal conversion factors are :

1 newton = 10^5 dynes (exactly)
1 sthene = 10^8 dynes (exactly)
1 kilogram-force = 980 665 dynes (exactly)

(8) Work and Energy

The units of work and energy in the metric system are erg and joule. They are defined as follows :

(a) *Erg*—The erg is the work done when the point of application of a force of one dyne is displaced through a distance of one centimetre in the direction of the force.
(1 erg = 1 dyn cm = 10^{-7} Joule)

(b) *Joule* (*J*)—The joule is the work done when the point of application of a force of one newton is displaced through a distance of one metre in the direction of the force.

(9) Quantity of Heat

The fundamental unit of quantity of heat in the metric system is the calorie. The calorie is the quantity of heat required to raise the temperature of one gram of air-free water through one degree Centigrade at a constant pressure of 1 normal atmosphere.

(10) Luminous Flux

The unit of measurement of luminous flux in the metric system is the lumen, and is defined as the luminous flux emitted within unit solid angle (one steradian) by a point source having a uniform intensity of one candela.

Definition adopted by the 9th General Conference on Weights and Measures (1948).

(11) Illumination

The units of measurement of illumination in metric system are :

lux =one lumen per square metre
phot =one lumen per square centimetre
1 phot $=10^4$ lux

(12) Intensity of a Source

The intensity of a source in any given direction is measured by the luminous flux emitted per unit solid angle in that direction.

The unit of measurement of intensity in the metric system is the candela. The magnitude of candela is such that the luminance of a full radiator at the temperature of solidification of platinum is 60 candelas per square centimetre. Definition adopted by the 9th General Conference on Weights and Measures (1948).

(13) Brightness

The brightness of a surface is defined as the luminous intensity of unit area. The international unit of brightness is the stilb, a stilb being defined as a luminance of one candela per cm^2. The other unit is Lambert which is defined as the brightness of a perfectly diffusing surface giving out one lumen per square centimetre.

1 stilb=3.141 6 lambert
1 lambert=0.318 3 stilb

Training and Education of Engineers

THE Seventh Indian Standards Convention was held in Calcutta from 23 January to 2 February 1963.

One of the sessions was devoted to 'Training and Education of Engineers in Metric System'. It was presided over by Dr. T. Sen, Rector, Jadavpur University. In all 16 papers were presented and the discussion was spread over the whole of 31 January 1963.

The following sixteen papers came up for discussion :

Doc: No.	Title	Author
S—9/1	Some Suggestions in Speeding Up Adoption of Metric System in Engineering Institutions.	K. N. Sundaram Ministry of Scientific Research and Cultural Affairs, New Delhi
S—9/2	Textbooks in Metric System—Some Suggestions	N. H. Mohile The Concrete Association of India, Bombay
S—9/3	MKSA System of Electrical Units	R. K. Tandan National Physical Laboratory, New Delhi
S—9/4	Standardization in the Adoption of Metric System in Technical Education	Prof. V. V. L. Rao Department of Technical Education, Andhra Pradesh

Doc: No.	Title	Author
S—9/5	Training in Metric System with special Reference to Electricity and Magnetism	Prof. P. Venkatramaiah Engineering College, Anantapur
S—9/6	Introduction of Metric System in Engineering Institutions	B. Dash Sharma Delhi Polytechnic, Delhi
S—9/7	Introduction of Metric System in Engineering Drawing Classes	Prof. Indu Bhushan Banaras Hindu University, Varanasi
S—9/8	Training and Education of Civil Engineers in Metric System	J. K. Varshneya National Buildings Organisation, New Delhi
S—9/9	Young Engineers' Training in Metric System for Modern Industry	N. V. Meswani The Premier Automobiles Limited, Bombay
S—9/10	Interconversion of Inch and Metric Sizes	N. Subrahmanyam Cooper Engineering Ltd., Satara Road, Maharashtra
S—9/11	Application of Alignment Charts to Conversion Problems	V. S. Tulpule Laxminarayan Institute of Technology, Nagpur
S—9/12	Running an Industry in Metric Terms—Conclusions from Eight Years of Practical Experience	K. H. Martin Motor Industries Co. Ltd., Bangalore
S—9/13	Switching Over to Metric System in Design Offices and Research Laboratories	J. Walter Public Works Department, Madras
S—9/14	Metric System and the Structural Engineer	N. M. Thadani Sahu Cement Service, New Delhi
S—9/15	Problems of Conversion to Metric System Related to Vehicles	Lt. Col. A. Y. Moghe Technical Development Establishment (Vehicles), Ahmednagar
S—9/16	Conversion of FPS Drawings to Metric System on Railways	K. S. Krishnan Research, Designs and Standards Organisation, Simla

For convenience of discussion the papers were divided into 4 groups as follows :

Group 1—Papers 1 and 2.
Group 2—Papers 3, 4, 5 and 6.
Group 3—Papers 7, 8, 9, 10, 11 and 16.
Group 4—Papers 12, 13, 14 and 15.

Group 1 Papers

Shri Sundaram, while presenting his paper, pointed out that a 3 year programme of change-over in engineering colleges had already been laid down and was being followed up. The recalibration of instruments in colleges was proceeding apace with suitable financial help from the Central Government. Staff of technical colleges is being encouraged either to write original textbooks in the metric system to suit Indian needs or to translate better known textbooks from French, German or Russian into English for use in India. Textbook writers were being provided with stenographic and other necessary help. Arrangements were also being made to publish the approved textbooks, if necessary, through Government agencies.

Shri Mohile said that textbooks on building and engineering materials were now being written by Indian authors. Their conversion to metric units would not present difficulties. Textbooks on structural designs were, however, mostly written by English or American authors. In their case, translations would have to be undertaken. Such translations should preferably be done by engineers.

In the discussion that followed it was pointed out that the difficulty of getting accustomed to metric units after having used FPS units for some time was exaggerated. Students trained fully in the FPS system were able to adjust themselves to work with the metric system easily if they used it constantly. This had been proved in the case of students who had gone for training in engineering subjects to countries using the metric system. Similarly personnel employed in factories working on the metric system also adapted themselves quickly to the change. It was a matter of environment and necessity.

Students who came as freshers into colleges were new to the subject and could adjust themselves to any system of units. Their training, therefore, would be simplified very much if they could be provided with textbooks written fully in terms of the metric system. Teachers would have to rewrite their lecture notes. It is the teachers that might feel some difficulty.

It was also desirable that technological organizations should write Handbooks dealing with their fields in the metric system for use by practising engineers. An instance was the preparation of the 'Handbook for Building Engineers in the Metric System' by the National Buildings Organization.

Group 2 Papers

Prof. V. V. L. Rao presented all the papers in the absence of authors. He made a strong plea for the adoption of the Rationalized MKSA units in place of the large number of systems which were used in teaching engineering subjects. So far as electrical engineering was concerned, he pointed out that many textbooks in English using RMKSA system were now available. There should, therefore, be no difficulty in teaching, particularly as the units used in electrical technology were already metric. On an enquiry, it was pointed out that the ISI was now using only absolute units for all purposes in preference to gravitational units. It was felt that the use of absolute units in teaching would also be beneficial.

(It may be noted that the 11th General Conference of Weights and Measures adopted in October 1960 the 'System International' (SI) which defines over 20 units which are recommended for all scientific and technical work. See *Metric Measures*, Vol. 4, No. 5, 1961, pp. 23-24 for the text of the resolution.—*Editor*)

Group 3 Papers

Prof. Indu Bhushan in his paper pointed out that a special metric scale with $\frac{1}{2}$, $\frac{1}{4}$ and $\frac{1}{8}$ metric scale on one side and inch on the other side was being used for making reduced drawings. Preferred dimensions evolved by him were also used.

Shri J. K. Varshneya gave information which a civil engineer would require in changing over to the metric system. The appropriate use of abbreviations, metric building products, unit weight of building materials, floor loads on buildings, surveying, drawing, hydraulic formulae, codes, handbooks, as also curricula, textbooks, lecture notes were all dealt with by the author. He suggested refresher courses for practising engineers.

Shri N. V. Meswani in his paper indicated that the basic idea behind training should be to make the trainee think in the metric system. Continuous thinking and

working in the metric system was the best way to achieve lasting results and overcome problems.

Shri N. Subrahmanyam discussed certain problems of inch-millimetre conversions involving interchangeability.

Shri V. S. Tulpule in his paper dealt with the use of an alignment chart he had devised for conversion of a large number of FPS units to metric units. A card with a moving curser could be devised for use in laboratories.

Shri K. S. Krishnan explained the tremendous amount of work done by the Railways in converting some 60,000 drawings. The precautions taken to ensure that the inch and metric drawings did not get mixed up were outlined. The procedure followed for conversion of drawings was discussed fully. All part drawings for new items or modified part drawings, whenever made, were now done in the metric system only.

During the discussion it was stressed that both the systems of units need not be taught side by side. Scales in metric system alone should be used. The Survey of India and the ISI had recommended scales to be used for various purposes. In the field of fasteners, some firms had already started production of metric bolts and nuts and these should be available shortly.

Group 4 Papers

Shri K. H. Martin in his paper pointed out that as his firm was already working in metric system problems of conversion were rare. There were problems of purchasing as metric dimensioned materials were not yet freely available. Skilled personnel had to be trained to work in metric system. After training, however, the workers found that it was easier to use the metric system.

Shri J. Walter presented tables of data required by the civil engineer. Tables included typical design dimensions adopted in various projects in Madras State, and conversion tables for soil, concrete and hydraulic laboratories.

Shri N. M. Thadani suggested that in structural design what is needed is not exact conversion but rationalization of the values into suitable whole numbers. He made a strong appeal to engineers to get used to the 'feel' of the new metric units.

Lt. Col. A. Y. Moghe discussed in his paper the problems of conversion likely to be experienced by the automobile industry. He pointed out that co-ordinated action should be taken to solve the problems. ISI had to play an important role in this work.

From the discussion it was clear that there was a demand from practising engineers for metric handbooks. For example, it was pointed out that the Central Water and Power Commission as also the Transport Department should bring out their own Handbooks written fully in the metric system and rational units.

The point that was repeatedly stressed throughout the discussions was that it was essential that engineers should think in terms of metric units. Unless they visualized their work in metric units, they would always be faced with difficulties. Constant practice and availability of reference books in metric units would go a long way towards the practising engineer getting the 'feel' of metric units. The future generation of engineers should be fully conversant only with the metric usage and not burdened with conversion problems in their college careers.

Summing up the discussion, Dr. Sen said that thinking in metric terms was essential for all. The tools, books, instruments should all be metric. Teachers have to get to know the metric usage and orient themselves to the new units.

The session concluded at 5.30 p.m. with a vote of thanks to the Chair.

Conversion of Yarn Count to Metric System

(In the January 1963 issue of *Metric Measures*, page 16, a note was published on the adoption in India of the French Count number for cotton textiles. In implementation of the recommendations, the Textile Commissioner has written to all the textile mills in the country bringing to their notice the recommendations made by the Conference. With the letter was also circulated a note explaining the various points arising out of the adoption of the French count in the cotton mill industry. The text of the note is published below.

—*Editor*)

AS mills are aware, the fineness of cotton yarn is now being expressed in the English (FPS) system. Under this system, the fineness of yarn is expressed in terms of the English cotton count. The count of a particular yarn is said to be 'X' if 'X' hanks (each of 840 yards) of that yarn together weigh 1 lb. To illustrate, 1 lb. of yarn of 40s count will measure 40×840 yards. The system is thus an indirect one since the count measures the length per unit weight. Thus, finer the yarn higher is the count number and coarser the yarn, lower is the count number.

As regards sales of yarn and cloth, manner of marking and the form of package practised at present are as under :

Yarn is generally sold in bales of hank yarn or in cases of cone yarn except for sales in loose packages of beams and pirns. A bale of yarn generally contains 40 bundles making a bale weight of 400 lb for counts lower than 60s and 200 lb for counts 60s and finer.

The bundle weight is maintained at 10 lb for counts less than 60s and 5 lb for counts 60s and finer. The method of bundling for counts lower than 60s is that, 10 hanks each of 840 yards are packed together and made into a 'knot' and bundle is made of as many knots as is the count of that yarn. As regards counts 60s and finer, the bundle will be made by packing as many knots as is equivalent to half that count number. There is thus a direct relationship between the count of yarn and the number of knots in the bundle. The Trade and the Weavers are fully aware of this relationship and make use of the same while making their purchase. Mills are also stamping on every bundle, the count and the bundle weight along with the other markings like name of mill. As regards cone yarn, each case contains nearly 100 cones weighing together about 200 lb. Each cone is wrapped in paper and the count is stamped along with other details on the wrapper. The case also bears these markings.

In regard to the description of cloth, mills are now specifying the warp and the weft counts, reed and pick per inch and the dimensional and other descriptive particulars. Dimensional particulars *viz.* the length and width are being expressed in terms of metres and centimetres, since 1 April 1961.

The question of implementation of the metric system for expressing the fineness of cotton yarn has been engaging the attention of the concerned interests for sometime now and it has been decided that the same may be expressed in terms of the 'French Count'. Under this system, the count number of particular quality of yarn will be 'X' if 'X' hanks (each of 1 000 metres) together weigh 0.5 kg. The correspondence between the English Count and the French Count thus works out to :

English Count×0.847=French Count.

A table is attached herewith showing the French Count corresponding to various English Counts ranging from ls to 140s. It will be seen therefrom that there is a close direct relationship between the English Count and the French Count, the French Count, of a particular yarn being however always less than its corresponding English Count. The aspect of the count number increasing with the fineness of yarn is thus maintained under the French Count system also.

It has also been decided that, with effect from 1 April 1963, mills should stamp yarn bundles in terms of French Count expressed to the first decimal place as indicated in column (3) of the table referred to above. Mills should also stamp the corresponding English Count within brackets. The weight of the yarn bundle namely 10 lb or 5 lb, as the case may be, will be stamped only in terms of the corresponding equivalent weight in the metric system *viz.* 4.54 kg or 2.27 kg. Stamping relating to count and weight will with effect from 1 April 1963 be as under :

For example, Count : 33.9 F.C. (40s) : 50.8 F.C. (60s)

Weight : 4.54 kg : 2.27 kg.

From 1 October 1963, mills will have to reel yarn exclusively in hanks of 1 000 metres and make 'knots' of 10 hanks each of 1 000 metres. The weight of the bundle will then exactly be 5 kg or 2.5 kg depending on whether the French Count is lower than 50.8 or whether the French Count is 50.8 and over.

As regards constructional and dimensional particulars of cloth, dimensional particulars are already being expressed in the metric system. In regard to particulars of warp and weft counts only, it is necessary for mills to specify from 1 April 1963 these counts in the French Count system in addition to specifying the corresponding English Counts in brackets.

All the records in the several departments of the mills, as also the returns submitted to this Office (Textile Commissioner's Office) and other Government agencies should be maintained in the metric system from 1-4-1963 and the counts of yarn should be recorded in the French Count system, the corresponding English Counts being also shown in brackets.

TABLE OF CONVERSION OF FRENCH COUNT

English Cotton Count	Equivalent French Count	Rounded French Count
(1)	(2)	(3)
1	0·85	0·8
1½	1·27	1·3
2	1·69	1·7
4	3·39	3·4
5	4·23	4·2

TABLE OF CONVERSION OF FRENCH COUNT

English Cotton Count	Equivalent French Count	Rounded French Count
(1)	(2)	(3)
6	5·08	5·1
8	6·77	6·8
10	8·47	8·5
12	10·16	10·2
14	11·85	11·8
16	13·55	13·5
18	15·24	15·2
20	16·93	16·9
22	18·63	18·6
24	20·32	20·3
26	22·01	22·0
28	23·71	23·7
30	25·40	25·4
32	27·09	27·1
34	28·79	28·8
36	30·48	30·5
40	33·87	33·9
44	37·25	37·2
50	42·33	42·3
60	50·80	50·8
64	54·19	54·2
70	59·27	59·3
72	60·96	61·0
80	67·74	67·7
84	71·12	71·1
100	84·67	84·7
110	93·14	93·1
120	101·60	101·6
140	118·54	118·5

Note : French Count = English Count × 0·8467

News & Views

Recent Notifications

Secondary Units of Length, Area, Volume, Mass and Capacity

The text of this notification was published on page 25 of the March 1963 issue of *Metric Measures*. The number and date of the notification could not be included.

These are No. S.O. 543 dated 15th February 1963.

International Organisation of Legal Metrology (O.I.M.L.)

Inspector-General M. Maurice Jacob has retired from the office of Chief of the Belgian Metrological Service on reaching the age limit. He has also retired from the Presidentship of the International Committee of Legal Metrology, which he held from the inception of the International Organisation for Legal Metrology in 1956. Recently the Government of Belgium conferred on M. Jacob the title of Commander of the Order of Leopold I.

Dr. Josef Stulla-Gotz, Privy Councillor, Director of the Austrian Metrology Service, is now the new President of the International Committee of Legal Metrology.

The Bulletin of the International Organisation for Legal Metrology would now be available to institutions, enterprises and persons interested in problems of legal metrology. The annual subscription is 40 new Francs (French) payable by bank cheque to the following address :

The International Bureau of Legal Metrology,
9, Avenue Franco-Russe,
Paris-VII,
France

The membership of the O.I.M.L. is now 34. The members are :

Australia	Japan
Austria	Lebanon
Belgium	Monaco
Bulgaria	Morocco
Cuba	Netherlands
Czechoslovakia	Norway
Denmark	Poland
Dominican Republic	Rumania
Finland	Sweden
France & Overseas Countries	Switzerland
	Tunisia
Germany	Spain
Guiana	United Arab Republic
Hungary	United Kingdom
India	U.S.S.R.
Indonesia	Venezuela
Iran	Yugoslavia
Italy	

Third International Measurement Conference

The Third International Measurement Conference (IMEKO 1964) will be held in Stockholm during April 1964 jointly with the Sixth Instruments and Measurements Conference. The main purpose of the conference will be to discuss scientific achievements in the fields of measurement and instrumentation. In addition to a plenary session there will be five scientific sessions devoted to the following general subjects : Fundamental problems of metrology; Theory and practice of instrument design; Technology and organization in instrument manufacture; General electronics as applied to measurements and instruments; and border questions of measurement and automation. Discussions at six specialized sections will be on instruments and methods relating to measurement of geometrical and mechanical quantities, including geodetic measurements; thermal quantities; physico-chemical measurements; measurement of electrical and magnetic quantities, measurements in radio engineering; and measurement of radioactive reduction. Abstracts (150—250 words) of papers intended for presentation at the conference should reach the IMEKO Secretariat, Budapest 5, P.O. Box 3, accompanied by an application form for lecturers obtainable from the Secretariat by 31 January 1963.

(*Journal of Scientific & Industrial Research* Vol. 22, 1963, p. 4.)

Volume of Timber Logs

There were a number of enquiries regarding the publication of the Indian Standard for the measurement of the volume of timber.

The Indian Standards Institution has now published Indian Standard for Tables for Volume of Round Timber Logs (IS:2184—1962). A short note on the subject appears under *Standards News* in this issue.

Book Review

TRAINING IN METRIC SYSTEM FOR ENGINEERING INDUSTRY : Ministry of Commerce and Industry, available from the Manager of Publications, Ministry of Works, Housing and Rehabilitation, Old Secretariat, Delhi-6; price : Rs. 1·45 nP.; pp. 86; 1963.

The introduction of metric system in engineering industries is an arduous task and has to be planned carefully and systematically. One of the first requisites is the availability of metric standards for the various raw materials and practices. The Indian Standards Institution has made considerable progress in meeting the demand for these. The Industry then has to adopt these standards and use them in their design so as to produce commodities which are entirely in the metric system. In preparing new designs the engineer will need much technical information and data for his work.

The present pamphlet, as described in the Foreword, 'presents some material which may be found helpful in planning a co-ordinated change-over in the engineering industry.' It includes papers which reflect the thinking of the Engineering Sub-committee of the Standing Metric Committee and the Indian Standards Institution, which devoted a special session to this subject at the ISI Convention held in Kanpur in December 1961.

The pamphlet is divided into 7 sections. The first section is the Foreword. The second consists of extracts from the speech delivered by Shri K. V. Venkatachalam, Chairman of the session *Introduction of Metric System in Engineering Industries* at the ISI Convention. The third section deals with the important steps in planning the change-over to metric system in design and manufacture in engineering industries. The fourth and the largest section pertains to *Notes for Training in Metric System for Engineering Industries.* The *Notes* are intended to serve as a source of information for personnel engaged in engineering drawings and design offices and toolrooms. As such this section is very comprehensive and further subdivided into 7 chapters relating the basic units, conversion of standard features, rules for rounding off numerical values, methods for precise conversion of dimensions to ensure interchangeability, limits and fits, screw threads and modules and diametral pitches of cylindrical gears for general engineering. This section contains 23 extremely useful tables and deals with fundamental information which will undoubtedly be useful for reference. Sections 6 and 7 consist of the texts of the articles *Utilisation of Present and Future Machine Tools for Production in Metric and Inch Terms* by M. W. Lalchandani, (Jyoti Limited, Baroda), and *Introduction of Metric System in Indian Telephone Industries Ltd.* by D. A. Chelliah (Indian Telephone Industries Ltd., Bangalore), which illustrate the experiences of the two engineering concerns in their change-over to the metric system.

The pamphlet is a *must* for all engineering personnel, and particularly to those who are working in mechanical engineering industries.

METRIC DEEPIKA: (Anglo-Malayalam Quarterly) published by the Department of Weights and Measures, Kerala, price : single copy—50 nP. (Annual Rs. 2)

We had an occasion to refer to the publication of the English-Malayalam quarterly *Metric Deepika* in the March 1963 issue of *Metric Measures.*

The first issue of this magazine which runs into 64 pages is extremely informative. The issue contains messages from Shri V. V. Giri, Governor of Kerala; Shri Manubhai Shah, Minister of International Trade; Shri R. Sankar, Chief Minister of Kerala; Shri P. T. Chacko, Minister for Home Affairs, Kerala; Shri K. Chandrasekharan, B.A., B.L., Member, Legislative Assembly, Kerala.

The opening article by Shri K. V. Venkatachalam, Joint Secretary, Ministry of Commerce and Industry, New Delhi, indicates what is effective enforcement. The second by Shri K. S. Menon, the former Controller of Weights and Measures, Kerala, indicates the progress of enforcement in all fields in that State. Shri T. P. Krishnan Nayar has contributed an interesting piece on how *satyam* and *dharmam* can be maintained through weights and measures. Shri G. Venkateswaran, Assistant Director, Ministry of Commerce and Industry, has shown how the public can co-operate in the change-over to the metric system. Shri T. Ravindran Thampi has reviewed the reform of weights and measures. The picture feature explaining the new weights and measures and useful conversion tables form an important part of the first issue. There is also a section on the directions to be observed by importers of weights and measures from other States. Requirements of cloth for various types of apparel are prominently tabulated. Other features provide information on the various aspects of the reform and the help being rendered to the manufacturers of weights and measures. The issue is rounded off with a list of manufacturers.

The first issue, therefore, is particularly interesting. We are sure that the magazine will contribute to a better understanding of the metric reform which so fundamentally touches the life of every man, woman and child in the country. We wish it success.

(1) NEW STEAM TABLES (IN METRIC UNITS) WITH LOGARITHMIC AND TRIGONOMETRIC TABLES (2) ENTHALPY-ENTROPY CHART FOR STEAM UP TO 700°C and 300 ATA: (1) A. S. Dighe, Lecturer, Mechanical Engineering Department, Victoria Jubilee Technical Institute, Bombay; published by the Educational Publishing Co., 17, Benham Hall Lane, Girgaon, Bombay-4; price 75 nP.; 1962; pp., 28.

(2) Edited by A. S. Dighe, published by the Educational Publishing Co., price : Rs. 1.25; chart 60×40 cm.

Steam tables and charts are essential reference works for an engineer. Till now these had been based on the British system. With the metric change-over, we have now to use tables and charts based on the metric system.

So far as is known, this is the first attempt made to fulfil the need for these tables and charts in the metric system. Shri Dighe has rendered useful service in the field of engineering education and practice.

The tables under review are based on the data of Prof. M. P. Wukalowitsch. These tables give the properties of 1 kg of dry and saturated steam at different temperatures and pressures.

The steam tables are based on the technical atmosphere, called *ata*, which is defined as 1 kg/cm^2. The physical atmosphere which is equal to 1.033 kilograms per square centimetre is referred to in the tables. This basic departure should be noted while using the tables. Also for the units of

power and energy the unit called Watt is now being preferred to either the metric or the British Horse Power.

Besides the steam tables, the booklet also contains tables for logarithms, antilogarithms, natural sines, natural tangents, logarithmic sines, logarithmic tangents, squares, square roots and reciprocals. The utility of the booklet is enhanced by these tables. A table for cubes and cube roots should also have been introduced, as volume calculations are also useful.

Enthalpy Entropy Chart which is based on the values given by Prof. Wukalowitsch, is a large chart (60 × 40 cm) and easy to read. The tables and charts together fulfil a long-felt need of the engineering students and the practising engineer.

Standards News

(Indian Standards which have a particular bearing on the change-over to the metric system are indcated here. Copies would be available from the Indian Standards Institution, Manak Bhavan, 9, Mathura Road, New Delhi or their Branch offices at Bombay, Calcutta, Madras and Kanpur.)

Indian Standard for Dimensions for Screw Threads for General Purposes (Diameter Range 1.6 to 39 mm) (IS : 1362—1962)

The Indian Standards Institution has published the first revision of the Indian Standard Dimensions for Screw Threads for General Purposes (Diameter Range 1.6 to 39 mm) IS : 1362—1962). This standard deals with basic and design profiles as well as dimensions, allowances, tolerances and designations for screw threads for screws, bolts and nuts of nominal diameter range 1.6 to 39 mm, intended for general purposes. The pitch diameter combinations, that is coarse and fine, covered in this standard are those specified in IS : 1330—1958 General Plan for Metric Screw Threads with ISO Profile (Diameter Range 0.25 to 300 mm). This standard specifies tolerances only for the three standard tolerance classes, 7hn, 8dN for bolt threads and 7HN, 8HN and 9HN for the nut threads.

This Indian Standard was originally issued in 1959 specifying dimensions and tolerances for screw threads for general engineering purposes in the diameter range 0.25 to 39 mm. Subsequently, the International Organization for Standardization issued a new proposal. Accordingly, IS : 1362—1959 has been revised, and some of the main modifications in this revised standard are as follows:

(a) An allowance has been provided on the bolt threads for classes 8 and 9 [normal (medium) and coarse];

(b) Tolerances have been modified ; and

(c) Tolerances for screw threads of diameter below 1.6 mm have not been included as it has been felt that these

require further investigations and also there is no urgent need for their specification.

Price : Rs. 5·00.

Indian Standard for Dimensions for Steel Plate, Sheet and Strip for Structural and General Engineering Purposes (IS : 1730—1961)

The Indian Standards Institution has published Indian Standard Dimensions for Steel Plate, Sheet and Strip for Structural and General Engineering Purposes (IS: 1730—1961). This standard specifies nominal dimensions for steel plate, sheet and strip for structural and general engineering purposes; and also includes structural properties of the sections as calculated on the nominal dimensions.

In the standardization of dimensions, the following aspects have been kept in view :

(a) Taking maximum possible advantage of the inherent system.

(b) Keeping the range and gradation of sizes sufficient to meet consumer requirements efficiently and economically.

(c) Making the change-over of Indian industry to the metric system as easy as possible.

(d) Ensuring that the standards do not impose difficulties on the producers by prescribing too many standardized sizes.

Metric system has been adopted in India and all quantities and dimensions in this standard have been given in this system.

Price : Rs. 6·00.

Indian Standard for Rivets for General Purposes (Below 12 mm Diameter) (IS : 2155—1962)

The Indian Standards Institution has published an Indian Standard Specification for Rivets for General Purposes (Below 12 mm Diameter) (IS : 2155—1962), which prescribes the requirements for mild steel and high tensile steel rivets, below 12 mm in diameter for general purposes.

This Standard, which is one of a series of Indian Standards being prepared by the Institution on metric screw threads and fasteners, deals with mild steel and high tensile steel rivets of smaller sizes for general purposes. Rivets of diameter range 12 to 48 mm have been covered in IS : 1929—1962 Specifications for Rivets for General Purposes (12 to 48 mm Diameter).

Price : Rs. 2·00.

Indian Standard for Method for Calculation of Bulk Quantities of Petroleum and Liquid Petroleum Products (IS : 2164—1961)

The Indian Standards Institution has published an Indian Standard Method for Calculation of Bulk Quantities of Petroleum and Liquid Petroleum Products (IS : 2164—1961). This Standard prescribes methods of calculations, normal and special, of bulk quantities of petroleum and liquid petroleum products.

The Indian Standards on tank calibration, gauging, sampling, temperature measurement, determination of density have laid down procedures which, when followed, allowed the volume, temperature and density of a bulk quantity of oil to be determined with considerable precision.

The methods of calculation given in this Standard have, therefore, been drawn up to give the maximum possible accuracy in the final calculated quantities compatible with the precision of the physical measurements.

For large quantities, namely, supplies made by tanker, pipeline, transfer from a shore tank into a ship, barges, etc. It is essential that the methods specified in this Standard should be used for accurate assessment. However, for small quantities, namely, supplies made in barrels, tank lorries and rail tank wagons of which a very large number of despatches are made

daily, a short method has been given in appendix to the Standard.

Price : Rs. 6·00.

Indian Standard for Heavy-Duty Burnt Clay Building Bricks (IS : 2180—1962)

The Indian Standards Institution has published an Indian Standard Specification for Heavy-Duty Burnt Clay Building Bricks (IS : 2180—1962), which specifies dimensions, quality and strength of heavy duty burnt clay building bricks.

Heavy-duty bricks (also known as 'engineering-bricks') are required for masonry in heavy engineering works, such as bridge structure, industrial foundations, multi-storeyed buildings, etc. In view of the large number of such works being undertaken in the Third Five Year Plan and also subsequently, a need for manufacture of heavy duty bricks on larger scale has been felt.

Investigation conducted in the Central Building Research Institute also reveals the possibility of making heavy-duty bricks from alluvial soils, thus reducing the problem of procurement of the raw material. In referring to 'clay' in these Standards the term is deemed to include all alluvial or similar type of soils.

Metric system has been adopted in India and all quantities and dimensions in this Standard have been given in this system.

Price : Rs. 1·50.

Indian Standard for Tables for Volume of Round Timber Logs (IS : 2184—1962)

The Indian Standards Institution has published Indian Standard Tables for Volume of Round Timber Logs (IS : 2184—1962). This Standard furnishes tables for cubic contents of round timber logs of midgirths from 10 cm to 260 cm in steps of 2 cm. The following lengths of logs have been covered:

Midgirth	Length Covered	Table No.
cm	cm	
10 to 20	30 to 1 200 in steps of 15 cm ..	1
22 to 36	30 to 1 200 in steps of 10 cm ..	2
38 to 260	30 to 1 225 in steps of 5 cm	3 to 114

The tables given in this Standard relate to the cubic contents of round timber logs and are based on the quarter girth formula for volume used in current trade practices in this country. These tables are not meant to serve as a standard code of practice for measuring the true volume in logs. The volumes obtained from these tables generally fall short of the true volume and, therefore, it is proposed to formulate a separate Indian Standard for true volume of timbers in due course.

Metric system has been adopted in India and all quantities and dimensions in this Standard have been given in this system. This Standard has been brought out primarily to facilitate the adoption of metric units in due time by the timber trade and industry in the country.

Price : 10·00.

Indian Standard for Burnt-Clay Perforated Building Bricks (IS : 2222—1962)

The Indian Standards Institution has published an Indian Standard Specification for Burnt-Clay Perforated Building Bricks (IS : 2222—1962) which specifies dimensions, quality and strength, and methods of sampling and tests for vertically perforated burnt-clay building bricks for use in walls and partitions.

As a result of the extensive programme of building construction undertaken in this country, the need for increased supply of bricks is keenly felt by the building trade, and while the brick industry steps up its

production to meet this growing demand, it is but appropriate that improved and special types of bricks are also introduced for use by builders in addition to the common bricks. This Standard lays down the essential requirements regarding dimensions, strength, percentage of water absorption, etc. of perforated brick and is intended to serve as a guide for control of its quality in manufacture and use.

Metric system has been adopted in India and all quantities and dimensions in this Standard have been given in this system.

Price : Rs. 2·00.

Indian Standard for Straightedges for Drawing Office Use (IS : 2233—1962)

The Indian Standards Institution has published an Indian Standard Specification for Straightedges for Drawing Office Use (IS: 2233—1962), which covers the requirements of straightedges in five sizes of 2 000, 1 500, 1 000, 750 and 500 mm.

Straightedge is a drawing instrument used by draughtsmen, cartographers, surveyors and engineers to draw straight lines with a high degree of accuracy on plans, drawing and maps.

Price: Re. 1·00

Controllers in States & Union Territories

In the November 1961 issue of *Metric Measures* a list of Controllers in the States and Union Territories was published for the guidance of the general public. Since then, many changes have taken place in the list published and an up-to-date list is, therefore, published below.

(1) ANDHRA PRADESH
Shri B. L. Oates,
Controller of Weights and Measures,
Chirag Ali Lane,
Hyderabad (Deccan).

(2) ASSAM
Shri Giridhor Sharma,
Controller of Weights and Measures,
Government of Assam,
Gauhati.

(3) BIHAR
Shri V. N. Singh,
Controller of Weights and Measures,
Government of Bihar,
Patna.

(4) GUJARAT
Dr. C. B. Patel,
Director of Industries,
Government of Gujarat,
New Civil Hospital, Block No. B-4,
Asarva, Ahmedabad.

(5) JAMMU & KASHMIR
Dr. Nasir Ali Agha,
Controller of Weights & Measures,
Government of Jammu & Kashmir,
Jammu/Srinagar.

(6) KERALA
Shri Rama Varma Thampuran,
Controller of Weights & Measures,
T.C. No. 478/479, Opposite Women's and Children's Hospital,
Thycaud, Trivandrum-14,

(7) MADHYA PRADESH
Shri S. N. Sihno,
Controller of Weights and Measures,
Government of Madhya Pradesh,
Deria Sadan, Malaviya Nagar,
Bhopal.

(8) MADRAS
Shri A. Krishnaswamy,
Controller of Weights and Measures,
No. 37, Spur Tank Road, Chetput,
Madras-31.

(9) MAHARASHTRA
Shri V. M. Pednekar,
Deputy Director of Industries (Metric) and Deputy Controller of Weights and Measures, Maharashtra State, Old Customs House Yard, Fort, Bombay-1.

(10) MYSORE
Shri R. Bharaniah,
Chief Marketing Officer and Controller of Weights & Measures, P.B. No. 30, Ali Askar Road, Bangalore.

(11) ORISSA
Shri R. N. Dwivedi,
Joint Director of Marketing and Ex-Officio Controller of Weights and Measures, Govt. of Orissa,
Bhubaneshwar.

(12) PUNJAB
Shri Kanwar Jit Singh,
Controller of Weights and Measures,
Government of Punjab,
Ambala Cantt.

(13) RAJASTHAN
Shri K. N. Mathur,
Controller of Weights and Measures,
Government of Rajasthan,
Industries & Supplies Department,
Jaipur.

(14) UTTAR PRADESH
Shri G. P. Mital,
Controller of Weights & Measures,
Government of Uttar Pradesh,
Issue Office Building,
7, Walaqadar Road, (Chaulakhi),
Lucknow.

(15) WEST BENGAL
Shri Sukhamoy Banerjee,
Controller of Weights and Measures,
Government of West Bengal,
45, Ganesh Chandra Avenue,
3rd Floor, Calcutta-13.

(16) ANDAMAN AND NICOBAR ISLANDS
Shri R. Ramakrishnan,
Supply Officer and Controller of Weights and Measures,
Andaman & Nicobar Islands Administration,
Port Blair.

(17) DELHI
Shri H. L. Mehandru,
Controller of Weights and Measures,
Bhagirath Palace,
Chandni Chowk,
Delhi.

(18) HIMACHAL PRADESH
Shri N. C. Kaushal,
Superintendent of Weights and Measures,
Industries Department,
Himachal Pradesh Administration,
Simla-4.

(19) LACCADIVE, MINICOY AND AMINDIVI ISLANDS
Shri U. Radhakrishna Panicker,
Controller of Weights and Measures, and Secretary to the Administrator, Laccadive, Minicoy & Amindivi Islands,
Kozhikode (Calicut).

(20) MANIPUR
Shri Ch. Pratap Singh,
Controller of Weights and Measures,
Manipur Administration,
Imphal.

(21) PONDICHERRY
Shri J. Arlanda,
Controller of Weights and Measures,
Government of Pondicherry,
Weights and Measures Department,
Pondicherry.

(22) TRIPURA
Shri P. R. Purohit,
Superintendent of Weights and Measures,
Tripura Administration,
Agartala.

Licensed Manufacturers and Repairers

[*Metric Measures* had been publishing in the past a series of lists of licensed manufacturers, dealers and repairers of weights and measures, weighing and measuring instruments licensed by the Governments in the various States and Union Territories under the Weights and Measures (Enforcement) Acts. To economise on paper, it is possible only to publish lists of licensed manufacturers and repairers.

A new feature of statistics of verification and licences issued is also being published in *Metric Measures*.

—*Editor*]

STATISTICS OF VERIFICATION OF WEIGHTS ETC. AND LICENSEES

Sl. No.	States/Union Territories	Period	Weights	Capacity measures	Length measures	Weighing Instruments	Measuring Instruments	Total number of		
								Manufacturers [As on last day of column (2)]	Dealers	Repairers
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	Andhra Pradesh	Apr-May '62	2,78,450	40,851	5,054	2,912	117	64	109	21
(2)	Assam ..	April '62 to 31 Jan. '63	3,80,087	19,410	3,617	444	52	13	156	13
(3)	Bihar ..	—	—	—	—	—	—	—	—	—
(4)	Gujarat ..	1 April to 30 Nov.	5,59,708	54,133	12,724	80,743	513	108	581	141
(5)	Kerala ..	1 April to 31 July '62	—	—	—	—	—	73	459	162
(6)	Jammu & Kashmir	1 April to 30 Nov. '62	120	395	—	3	—	1	—	—
(7)	Madhya Pradesh	—	—	—	—	—	—	—	—	—
(8)	Madras ..	—	—	—	—	—	—	—	—	—
(9)	Mysore ..	1 April to 30 Nov. '62	4,81,354	1,05,253	1,037	59,674	8,420	126	493	92
(10)	Maharashtra	—	—	—	—	—	—	—	—	—
(11)	Orissa ..	1 April to 30 Nov. '62	—	—	—	—	—	11	75	4
(12)	Punjab ..	1 April to Nov. '62	6,73,338	26,755	14,474	57,421	375	4	21	19
(13)	Rajasthan ..	—	—	—	—	—	—	—	—	—
(14)	Uttar Pradesh	1 April to 31 May '62	5,34,506	7,951	4,702	907	113	3	99	18
(15)	West Bengal ..	April '62 to Jan. '63	20,03,339	12,762	2,061	88,041	—	116	684	80
(16)	Andaman & Nicobar Island	—	—	—	—	—	—	—	—	—

Sl. No.	States/Union Territories	Period	Weights	Capacity measures	Length measures	Weighing Instruments	Measuring Instruments	Total Number of Manufacturers [As on last day of column (2)]	Dealers	Repairers
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(17)	Delhi ..	1 April to 31 Jan. '63	1,81,952	14,668	7,641	16,562	359	26	72	18
(18)	Himachal Pradesh	1 April to 30 Nov. '62	42,103	3,793	1,832	7,169	—	1	24	11
(19)	L.M.A. Island	—	—	—	—	—	—	—	—	—
(20)	Manipur ..	1 April to 31 Mar. '63	9,035	2,029	81	213	—	—	—	—
(21)	Pondicherry ..	1 April to 31 Jan. '63	23,815	13,712	667	1,377	11	5	29	3
(22)	Tripura ..	April '62 to Jan. '63	5,326	1,545	—	—	8	2	49	1

ASSAM

List of manufacturers and repairers licensed from 1 December 1962 to 31 January 1963

Dass Metal Crafts,
P.O. Dhubri.

ORISSA

List of manufacturers and repairers licensed in Orissa state during 1 April 62 to 31 November 1962.

MANUFACTURERS

(1) Agarwal Tin Manufacturing Co. and Engineering Works, Sultanganj, Agra.
(2) Associated Industrial Corporation, 81, North Vijainagar, Agra.
(3) Balanga Iron Works Limited, Balasore.
(4) Bharati Scales and Engineering Co., 4/1, Haldaspara Lane, Khurat, Howrah, West Bengal.
(5) New Orissa Engineering Works, Khetrajpur, Sambalpur.
(6) Oriental Metal Pressing Works Private Ltd., Post Box No. 6556, 131, Worli, Bombay-18.
(7) Raiz and Brothers, Sadar Bazar, New Delhi.
(8) Rourkela Machine Tools Ltd., Rourkela-4.
(9) Satish Chandra Das and Co., 113, Khaengrapatti, Street, Calcutta.
(10) Standard Steel and Iron Foundry, Laxmi Mills, Jeoni Mandi, Agra.
(11) D. L. Vaid, 215-A, Ripon Road, Bombay-2.

REPAIRERS

(1) Avery Company of India (P) Ltd., Calcutta-3.
(2) Hadusubudhi and Brothers, Bigbazar, Berhampur.
(3) Orissa Agricultural Industries, Firm Road, Sambalpur.
(4) Raghunath Rath, Proprietor, Engineering Stores, Station Road, Berhampur.

PONDICHERRY

List of manufacturers and repairers licensed in Pondicherry during 1 April 1962 to 31 January 1963.

Sl. No.	Name and Address of the Manufacturer	Details of Articles Manufactured
(1)	Honesty Engineers & Contractors, 3, Bis, Rue Surcouf, Pondicherry.	All Kinds of weights, weighing and measuring instruments.
(2)	Kannan M., 9/63, Vazhakulam, Pondicherry.	All types of capacity measures.
(3)	Latchumnan V., North Boulvard, Pondicherry.	All types of capacity measures.
(4)	Raja Engineering Enterprises, West Boulvard, Pondicherry.	All types of weights and measures.
(5)	V. P. Raju Achari, 81 B, Bharathi Street, Pondicherry.	Bullion weights only.
(6)	Swamy Foundry, 232 Bis, West Boulvard, Pondicherry.	All types of weights and measures.
(7)	Tamilarasan Industry, North Boulvard, Pondicherry.	All types of capacity measures.

REPAIRERS

(1) Avery & Co., of India (P) Ltd., Madras-1.
(2) Everest Scales Services 2, Jubillee Market, Tiruvarur.
(3) Honesty Engineers & Contractors, 3 bis Rue Sourcouf, Pondicherry.
(4) Thiyagaraja Engineering Works, Market, Karaikal.

TRIPURA

List of the manufacturers and repairers licensed in Tripura from 1 April to 31 May 1962.

MANUFACTURERS

(1) National Mechanical Works, Kasaripatti, Agartala, Tripura.
(2) Rajdeep Trading Co., 7 Colonal Bari Road, Agartala, Tripura.

REPAIRER

(1) Was Dev, National Mechanical Works, Kasaripatti, Agartala, Tripura.

CONVERSION TABLE FOR PRICES

Square Foot to Square Metre
Conversion Factor : 1 sq. metre (m^2) = 10·7639 sq. feet

nP/sq. ft.	Rs/m^2	nP/sq. ft.	Rs./m^2
1	0·11	49	5·27
2	0·22	50	5·38
3	0·32	51	5·49
4	0·43	52	5·60
5	0·54	53	5·70
6	0·65	54	5·81
7	0·75	55	5·92
8	0·86	56	6·03
9	0·97	57	6·14
10	1·08	58	6·24
11	1·18	59	6·35
12	1·29	60	6·46
13	1·40	61	6·57
14	1·51	62	6·67
15	1·61	63	6·78
16	1·72	64	6·89
17	1·83	65	7·00
18	1·94	66	7·10
19	2·05	67	7·21
20	2·15	68	7·32
21	2·26	69	7·43
22	2·37	70	7·53
23	2·48	71	7·64
24	2·58	72	7·75
25	2·69	73	7·86
26	2·80	74	7·97
27	2·91	75	8·07
28	3·01	76	8·18
29	3·12	77	8·29
30	3·23	78	8·40
31	3·34	79	8·50
32	3·44	80	8·61
33	3·55	81	8·72
34	3·66	82	8·83
35	3·77	83	8·93
36	3·88	84	9·04
37	3·98	85	9·15
38	4·09	86	9·26
39	4·20	87	9·36
40	4·31	88	9·47
41	4·41	89	9·58
42	4·52	90	9·69
43	4·63	91	9·80
44	4·74	92	9·90
45	4·84	93	10·01
46	4·95	94	10·12
47	5·06	95	10·23
48	5·17	96	10·33

Conversion Table for Prices—*contd.*

nP/sq. ft.	Rs/m^2	Rs./sq ft.	Rs./m^3
97	10·44	10	107·64
98	10·55	11	118·40
99	10·66	12	129·17
100	10·76	13	139·93
		14	150·69
Rs/sq. ft.	Rs./m^2	15	161·46
		16	172·22
1	10·76	17	182·99
2	21·53	18	193·75
3	32·29	19	204·51
4	43·06	20	215·28
5	53·82	21	226·04
6	64·58	22	236·81
7	75·35	23	247·57
8	86·11	24	258·33
9	96·88	25	269·10

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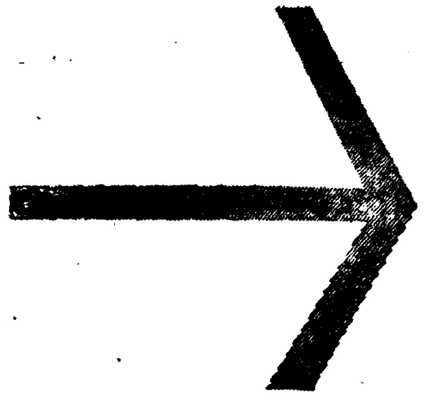

now THE LITRE

Metric capacity measures are now compulsory in trade throughout the country. • The kilogram and the metre became compulsory last year; thus the metric system of weights and measures is now the only legal system in India. • The simplicity of the metric system will be obvious if you use the units (litre, metre and kilo) as they are, for their intrinsic value. • Do not equate metric measures to old units like seer, viss or ollock.

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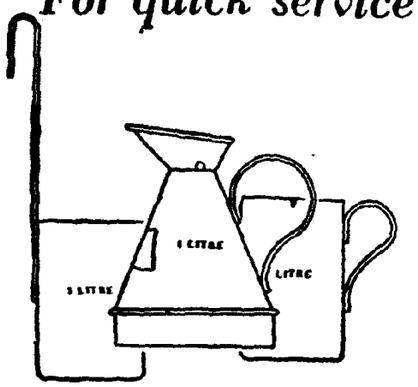

METRIC UNITS

in Round Figures

DA 62/819

TYPICAL METRIC PRICING UNITS FOR WHOLESALE TRANSACTIONS

Serial No.	Commodity	Metric Unit
		10 grams (g)
(1)	Gold	1 kilogram (kg)
(2)	Grocery and Confectionery Biscuits, sweetmeats, cardamoms. Textiles and Textile Fibres Cotton yarn, damaged and seconds cloth, raw silk, rayon, silk yarn, raw wool, wool manufacturers (when sold by weight). Paints & Chemicals Paint (if sold by weight), indigo, liquid chlorine. Hides, Skins & Leather Raw hides, leather (hides and skins). Metals Silver, aluminium sheets, strips and circles, copper and brass wires and utensils.	
	Miscellaneous Tea, meat, camphor tablets, mica. (3) Grains and Pulses Rice, wheat, jowar, arhar, moong, masur, gram. Spices Black pepper, mustard, chillies, dhania, dalchini, turmeric, betelnuts. Plantation Products Rubber, cashewnuts, cashew kernels, tobacco (raw and manufactured). Forest Products Lac and lac products, gums, myrobalans, galnuts, soapnuts. Textiles & Textile Fibres Raw jute, raw hemp, coir yarn. Oils, Oilseeds & Oilcakes Vegetable oils, oilseeds, oilcakes. Non-Ferrous Metals *Aluminium* : ingots, bars, blocks, slabs, billets. *Lead* : ingots, sheets and strips. *Copper* : ingots, blooms, slabs, cakes, tiles, bricks, billets, blisterbars and wirebars, rods, sections and pipes, plates, sheets and strips, circles. *Brass* : ingots, rods, sections, pipes, sheets, strips, circles. *Zinc* : ingots, sheets, strips. *Tin* : blocks. Chemicals Caustic soda, bleaching powder, glycerine, soaps, paper salt. Others Sugar, gur, ice, fish, sugarcane, vegetables, tamarind.	1 quintal (q) (100 kilograms)
(4)	Minerals Iron ore, manganese ore, bauxite, coal. Iron & Steel Pig iron, iron and steel manufactures, semis (billets for rerolling etc.)	one metric tonne (t) (1,000 kilograms)
(5)	Cloth (mill, handloom, silk, rayon and woollen cloth).	1 metre (m)
(6)	Jute carpets, coir mats and mattings, sheet glass.	one square metre (m^2)
(7)	Timber.	one cubic metre (m^3)
(8)	Paints (when sold by measure), spirits.	one litre (l)

Weights

(1) In place of the present units of seer, pound, rattal, vist etc., use the kilogram.

(2) In place of the tola, use the gram or 10 grams.

(3) In place of maund or corresponding unit, use the quintal *i.e.*, 100 kg.

Capacity Measures

In place of seer or gallon or any other measure use the litre.

Length Measures

(1) Use the metre in place of yard or foot and the centimetre in place of inch.

Square Measures

(1) Use the square metre in place of square yard or square foot, and square centimetre in place of square inch.

Cubic Measures

(1) Use the cubic metre in place of cubic yard or cubic foot and cubic centimetre in place of cubic inch.

Packaging

It is advantageous if sizes of packages correspond to series of commercial weights and measures prescribed.

These are: 50 kg, 20 kg, 10 kg, 5 kg, 2 kg, 1 kg, 500 g, 200 g, 100 g, 50 g, 20 g, 5 g, 2 g, 1 g, and so on.

TYPICAL PRICING UNITS FOR RETAIL TRADE

Serial No.	Commodity	Metric Unit for Use
(1)	Foodgrains, cereals, pulses, spices, ghee, bread, vegetables, meat, fish, sweetmeats, tea, coffee, sugar, salt.	1 kg
(2)	Oil for cooking	1 kg or 1 litre depending upon prevalent practice.
(3)	Fruits	1 kg or number depending upon prevalent practice.
(4)	Milk	1 litre
(5)	Cloth and related materials	1 metre
(6)	Prepackaged materials	Preferably sizes corresponding to series of commercial weights and measures.

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metric measures

THE PUBLICATIONS DIVISION

ABBREVIATIONS FOR METRIC UNITS

(1) DECIMAL MULTIPLES AND SUBMULTIPLES

Prefix		Value in Terms of Unit	Abbreviation
kilo	..	1,000	k
centi	..	0·01 (10^{-2})	c
milli	..	0·001(10^{-3})	m
micro	..	0·000 001(10^{-6})	μ

(2) WEIGHTS

Denomination		Value	Abbreviation
tonne	..	1 000 kg	t
quintal	..	100 kg	q
kilogram	..	1 kg	kg
gram	..	1 g	g
milligram	..	1 *mg*	*mg*
carat	..	200 mg	c

(3) CAPACITY

kilolitre	..	1 000 l	kl
litre	..	1 l	l
millilitre	..	1 ml	ml

(4) VOLUME

cubic metre	..	m^3	m^3 or cu m*
cubic centimetre		cm^3	cm^3 or cu cm*
cubic millimetre		mm^3	mm^3 or cu mm*

(5) LENGTH

kilometre	..	1 000 m	km
metre	..	1 m	m
centimetre	..	1 cm	cm
millimetre	..	1 mm	mm
micron	..	1/1 000 mm or 10^{-3} mm	μm

(6) AREA

square kilometre		1 000 000 m^2	km^2 or sq km*
square metre	..	1 m^2	m^2 or sq m*
square centimetre		1 cm^2	cm^2 or sq cm*
square millimetre		1 mm^2	mm^2 or sq mm*

(7) LAND MEASURE

are	..	100 m^2	a
hectare	..	100 a	ha
centiare	..	m^2	ca

*Both these abbreviations are current, but the first set should preferably be used. The former abbreviation is used internationally.

Rules for Abbreviations :

(1) Do not make any change, such as addition of 's' to indicate plurality *e.g.*, write 1 kg, 10 kg, 20g, 5 g, 10 t, 20 ml, 27 l, 165 km, 2 mm, 100 cm^3, 66 km^2;

(2) Do not capitalize the abbreviations. For example, do not write 1 Kg, 2 Kg, 20 MM, 50 MM, the right way is to write 1 kg, 2 kg, 20 mm, 50 mm, etc.

(3) Do not use any other abbreviations except those given above.

metric measures

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DIRECTORATE OF WEIGHTS & MEASURES
MINISTRY OF COMMERCE AND INDUSTRY

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CONTENTS

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metric measures

METRIC MEASURES is published every two months.

METRIC MEASURES provides information to the general public on the administrative, commercial, educational, industrial, historical and other aspects of weights and measures, with particular reference to the introduction of the metric system in India.

Contributions for publication should be sent to the Editor, METRIC MEASURES, Ministry of Commerce & Industry, Udyog Bhavan, New Delhi.

Enquiries regarding subscriptions and supply of copies should be addressed to the Business Manager, Publications Division, Ministry of Information and Broadcasting, Old Secretariat, Delhi-6.

819 P.

Development of Capacity Measures in South India—Part 1

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Ministry of Commerce and Industry,
New Delhi

IN an earlier series of articles[1] we had occasion to trace very briefly the development of and causes leading to the variety in certain units of weights in the Madras area. Madras area was then taken to mean the old Madras province as also the nearby States like Travancore, Cochin, Mysore, Hyderabad, Coorg etc. The area, therefore, would include the present States of Andhra Pradesh, Kerala, Madras and Mysore. It is now intended to explore the development of capacity measures in this area of South India.

Dry and Liquid Measures

Capacity measures are generally used for measuring out specified volumes of liquid substances like milk, edible oils or solid substances like foodgrains. When they are used for liquid commodities the measures are called liquid capacity measures. When used for 'dry' commodities, like foodgrains the appellation dry measures is given to them.

There are two methods of using dry measures—as level or struck measures, and heaped measures. When used as struck measures, the commodity to be measured is poured to overflowing into the measures and a circular or flat straight-edge is used to strike off the excess commodity so that the measure is full only up to the brim or level. For use as a heaped measure, the commodity is poured into the measure until it is full and the heap or cone formed over the brim of the measure remains constant. The heap is considered to be a part of the measure. Obviously the heaps on top of the measure will have different heights depending on the fineness or coarseness of the commodity.

In some cases, dry measures are made so as to contain a specified weight of a specified grain. In these cases, if the grain measured out is not the same as the standard grain the weight of the delivered grain is different from the standard weight, though the volume may remain unchanged.

Whatever the mode of use, the capacity measures, liquid and dry, have to be standardized before they can be used for commercial purposes. There are two methods of verifying their correctness. The first is to calibrate the measure against water, irrespective of whether the measure is to be used as a dry or liquid measure. If it is used as a dry measure, the struck measure is commonly prescribed. In these cases the measures are calibrated to deliver a specified volume of the commodity. This method is most commonly used.

The second method applies to dry measures only. In this case the capacity is sometimes determined by filling the standard measure,

either heaped or struck, with a certain weight or volume of a suitable grain and then filling the measure under test with the grain so measured out and noting the error.

The standardization of measures by these two methods, depending on suitability of each, is an ancient practice. We shall have occasions later on to refer to them.

Legally Recognised Measures

Even as in the rest of India, there were many types of measures used in South India prior to the introduction of metric capacity measures.

Before analysing the variety, it is desirable to indicate the various Indian capacity units and measures prescribed under the old laws in the area. It is intended here to describe only those capacity units which were used for local purposes only. The following summary briefly shows the recognised units :

MADRAS

Madras Weights and Measures Act, 1948, defines the primary units in the Schedule, in Part III as follows :

The Madras measure, being equivalent to 108 cubic inches (62½ fluid ounces).

The type seer, being equivalent to 72 cubic inches (41⅔ fluid ounces).

NOTE—Three type seers are equivalent to two Madras measures.

(The measures are verified against water.)

ANDHRA PRADESH

Andhra Weights and Measures Rules, 1955, prescribe the capacity measures defined in the Madras Weights and Measures Act, 1948.

COCHIN

The Cochin Weights and Measures Act, LXIII of 1112 (*i.e.* 1937), in its Section 3 prescribes :

The primary standard for measures of capacity shall be called an 'Edangali' and shall be a measure of metal certified to be capable of holding 44 ounces of water.

TRAVANCORE

The Travancore Weights and Measures Act, 1084 (*i.e.* 1910), in Section 2 lays down :

The primary standard for measures of capacity shall be called an 'Edangali' and shall be a measure of metal certified to be capable of holding 80 cubic inches of water.

COORG

Coorg Weights and Measures Act, 1954, defines measures of capacity in Part III of the Schedule as follows :

(a) The Coorg seer, being capable to hold 100 standard tolas of water.

MYSORE

Rules under Mysore Weights and Measures Act III of 1902, promulgated from October 1929, contain the following definition of capacity measures :

Rule 3

The standard of measure of capacity shall be the 'Mysore seer' measure which is a hollow bronze cylinder in the possession of Government and which, when filled to the brim, holds exactly 108 tolas' weight (each tola being 180 grains troy) of distilled water, at its maximum density and under the normal atmospheric pressure.

HYDERABAD

Weights and Measures Act, 1356 Fasli (Hyderabad) in its Schedule, Part A defines the seer in the following manner :

Explanation 1 : The seer is that measure of capacity in which one seer air-free distilled water when weighed must be contained.

(Seer is 80 tolas of 180 grains each.)

PONDICHERRY

Regulation on Tax for Verification of Weights and Measures, 1916 in its Annexure, prescribes rate charges to be collected for the verification of weights and measures and weighing and measuring instruments. Some of its provisions are indicated below :

Dry and liquid measures both for grain and dry substance, and for liquids,

Per parah of 70 litres and above	*Fee*
Per parah of less than 70 litres	

We may now tabulate the capacity of the measures in terms of litres and millilitres, assuming that cubic centimetres and millilitres are equal. This procedure does not introduce any practical error because 1 ml = 1.000 028 cubic centimetres. It should also be noted that throughout this article the ml and cm^3 are treated as equal.

(1) Madras measure	108 cubic inches	= 1·770 l
(2) Type seer	72 cubic inches	= 1·180 l
(3) Edangali (Cochin)	44 fluid ounces	= 1·250 l
(4) Edangali (Travancore)	80 cubic inches	= 1·311 l
(5) Coorg seer	100 tola	= 1·171 l
(6) Mysore seer	108 tola	= 1·266 l
(7) Seer (Hyderabad)	80 tola	= 0·937 l

Usual Tables

After examining the principal legal units, we may now consider the usual tables of subunits and multiples based on these and used in transactions in the various areas :

Madras

ollock		= 221 ml
8 ollock	= 1 padi = 1 Madras measure	= 1·770 l
8 padi	= 1 marakkal	= 14·160 l
5 marakkal	= 1 para	= 70·800 l
80 para	= 1 garce	= 5 664 l

Cochin

azhakku		= 39 ml
2 azhakku	= 1 uzhakku	= 78 ml
2 uzhakku	= 1 uri	= 156 ml
2 uri	= 1 nazhi or uri-thavi	= 312 ml
4 nazhi	= 1 edangali	= 1·250 l
10 edangali	= 1 para	= 12·50 l
	= 1 kudam	= 12·50 l
10 para	= 1 chaku	= 125 l

Travancore

thudam		= 82 ml
4 thudam	= 1 nazhi	= 328 ml
4 nazhi	= 1 edangali	= 1·310 l
10 edangali	= 1 para	= 13·10 l

Coorg

seer		= 1·171 l
2 seer	= 1 hani	= 2·342 l
10 seer	= 1 Coorg pare	= 11·713 l
8 pare	= 1 batti	= 93·700 l
15 batti	= 1 cart load	= 1 405·5 l

Mysore

seer		= 1·266 litres
chataku	= 1/16 seer	= 79 ml
adapavu	= 1/8 seer	= 158 ml
pavu	= 1/4 seer	= 316 ml
acheru	= 1/2 seer	= 633 ml
balla	= 4 seers	= 5·064 l
kolaga	= 8 seers	= 10·128 l
palla	= 100 seers	= 126·6 l
khandi	= 160 seers (20 kolagas)	= 202·6 l

Hyderabad

seer		= 0·937 l
chatak	= 1/16 seer	= 59 ml
2 seer	= 1 adholi	= 1·874 l
4 seer	= 1 pyali	= 3·748 l
40 seer	= 1 maund	= 37·48 l
120 seer	= 1 palla	= 112·44 l

Besides the measures expressed above in terms of official capacities, there are any number of variations of measures. For example, the marakkal (also called marakal, maracal, mercal, markal, murcal etc.) which is shown to be equal to 8 padi in the above equation, is 4 padi in Madras city (*see* Fig. 1), 8 padi in Musiri and Perambulur, 6 padi in Karur and so on.[2]

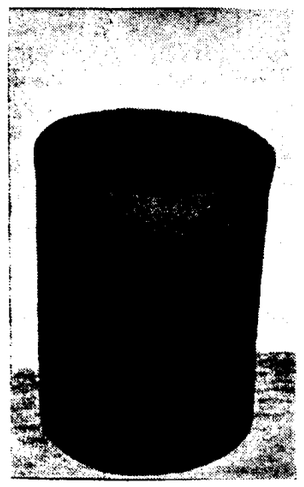

Fig. 1—Madras marakkal of 4 padi (7·080 litres).

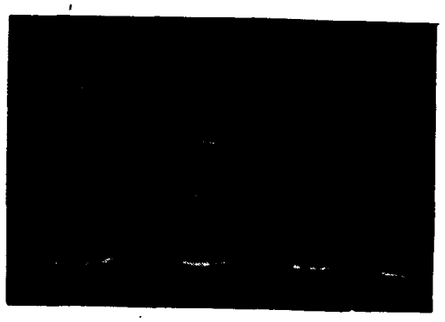

Fig. 2—Madras measures. From left to right : Madras measure or padi (1·770 l), ½ padi, ¼ padi and ⅛ padi or ollock.

Similarly there are many variations of other units. There are also plenty of additional units in many areas. The kalam is one such unit whose capacity varies from 24 to 96 padi or Madras measures. We shall have occasion to refer to such variations of capacities later on.

Length Units Important

How did all these units come into use? Was there originally any definite system behind them from which all these variations arose? What were the reasons that led to the variations observed from unit to unit from one region to another ? To find answers to these questions we have to go back to ancient times. In the absence of physical samples of measures throughout the history of India except for the last two or three centuries the evaluation of the capacities of the measures has to be undertaken mainly through calculation and interpretation of data available in ancient literature.

We can trace the roots of some of the capacity measures to Vedic times. It must, however, be remembered that this Vedic link may sometimes be only restricted to the name but not to the content.

In ancient literature capacity measures are often defined either as the volume occupied by a certain weight of a commodity or as the volume of a geometrical figure whose dimensions in length units are given. So far as weights are concerned we have already examined some data.[1] We have now to examine the length units which we may require in our analysis later on. Of the length units the two most important for our immediate purpose are the angula (finger breadth) and the hasta (cubit). Other length units like mushti, vitasti, dhanurgrah etc. are required only as multiples or submultiples of the above two units.

In view of the confusion in later Sanskrit literature regarding the magnitudes of these units, we may trace their origins and take the earliest reliable value for our use. Even for this limited objective, we have to trace the evolution of these two units from the Vedic times.

Vedic Length Measures

References to angula are common in the oldest Vedic book, the *Rigveda*. The most famous of these occurs in the well-known Purusha Sukta :

सहस्रशीर्षा पुरुषः सहस्राक्षः सहस्रपात् ।
स भूमिं विश्वतो वृत्वात्यतिष्ठद्दशाङ्गुलम ॥
ऋग्वेद 10.7.90.1]

[Purusha, who has a thousand heads, a thousand eyes, a thousand feet, investing the earth in all directions, exceeds (it by a space) measuring ten fingers][3]

Angula, the 'lowest measure', is mentioned in the *Shatapatha Brahmana*[4] also.

References to aratni, (ell or cubit), which is used as a measure of length, occur in the *Taittiriya Samhita*[5] (5.2.5.1.; 6.3.3.5.) and the *Atharvaveda*[6] (19.57.6.).

In this early literature, however, neither the ratio of these two units to each other is prescribed nor is any information available which would guide us in assigning them values in terms of modern units.

Arthashastra Tables

It is only when we travel through history and centuries of years and come to the *Arthashastra*[7] that we find the first and the earliest *systematic* attempt to lay down tables of weights and measures. We shall try to evaluate the units mentioned in this oldest systematic effort and take the values so obtained as standard for our purposes. Later references are often vitiated by many contradictory influences.

The *Arthashastra* written by Kautilya is assigned to about the 4th century B.C. The time interval between the *Rigveda* and the *Arthashastra* may be of the order of about 3 500 years, if we take the oldest acceptable age of the *Rigveda* as 4 000 B.C. Through the millennia the system of weights and measures may have undergone developments, making it difficult to correlate the units mentioned in the two books. The units of angula and hasta are, however, related to the limbs of man. We may assume that their values could not have undergone extensive changes, as happened, for instance, in the case of the unit of yojana. The following extract from the table prescribed in Chapter 20, in the second book of *Arthashastra* has an important place in ancient metrology :

8 yava (barley of middle size)	= 1 angula (or the middlemost joint of the middle finger of a man of medium size may be taken to be equal to an angula)
4 angula	= 1 dhanurgraha
12 angula	= 1 vitasti or 1 chhayapaurusha
2 vitasti	= 1 aratni or 1 Prajapatya hasta
2 vitasti+1 dhanurgraha	= 1 hasta (used in measuring balances and cubic measures and pasture lands)

[अष्टौ यवमध्या अङ्गुलम् ।6। मध्यमस्य पुरुषस्य मध्यमाया अङ्गुल्या मध्यप्रकर्षो वाऽङ्गुलम् ।7। चतुरङ्गुलो धनुर्ग्रहः ।8। द्वादशाङ्गुला वितस्तिः, छायापौरुषं च ।10।

द्विवितस्तिररत्निः प्राजापत्यो हस्तः ।12। सधनुर्ग्रहः पौतवविवीतमानम् ।13। (अर्थशास्त्र 2·20)]

An analysis of this table shows that the Prajapatya hasta consists of 24 angula while the commercial hasta, *i.e.* the one measuring 2 vitasti+1 dhanurgraha, is of 28 angula. The Prajapatya hasta, as its very name implies, must have been used for religious purposes, particularly in the operations of measurement connected with the sacrifice (यज्ञ). We are, therefore, left with the 28 angula hasta which obviously was used for commercial purposes.

Angula and Hasta

We may, now select the following three units for further analysis :

8 yava	= 1 angula
24 angula	= 1 Prajapatya hasta
28 angula	= 1 Commercial hasta

The yava is the basic unit mentioned here. It is obvious that the angula cannot be the length obtained by placing 8 yava seeds lengthwise end to end in a row. For that would give a length of over 6.5 cm for the angula which is obviously too large. The yava seeds, therefore, must have been placed in a row breathwise. There is no estimate available of the standard maximum diameter of the medium sized yava.

It is, therefore, necessary to use other sources for the definition of angula. The digit or finger has been used as a unit of length in all parts of the world from very ancient times. So a large number of values have accumulated for the length of this unit. For example, the British practice is to take it as ¾ inch or say 19 mm. This definition is, however, derived from many old systems and fitted into the present FPS units to arrive at a round figure. The value of the finger or digit in the British Isles was known to vary in medieval

times from $\frac{3}{4}$ inch to $1\frac{1}{4}$ inch or so[8]. The Greek and Roman digits have values of 0.73", 0.76", and so on. It would, therefore, be rather difficult to accept a definite value for the Indian digit from non-indigenous sources. The Indian hasta as a result also poses similar problems, and cannot be accepted as accurate when it is equated with the cubit of 18 inches.

The situation, however, is not hopeless. In India hasta measures based on the old concepts had been in use for a long time before the English yard replaced it in the 19th century. Admirable studies relating to the actual lengths of many such old hasta or cubits have been carried out during the last century or two.

Recent Studies in Hasta

A study of Indian commercial weights and measures by Gover[9], published in 1865, shows that the hasta which was used in trade all over India did not measure about 18 inches as had been taken for granted by many learned scholars in those days. He found that although the hath or hasta as used all over India varied from 15 to 30 inches in 19 out of 20 cases it was between 18.5 to 21 inches. Of the 41 hasta measures for which he has given values, 34 lie between 19 and 19.8 inches. Gover, on analysing the data, ultimately arrives at the mean Indian cubit or hasta of length of 19.65 inches. This works out to 49.91 centimetres.

Browne[10], in his book, *The Merchants' Handbook*, published in 1899, mentions 19.66 inches or 49.94 centimetres as the value of the Bengal hath (hasta) and 19.65 inches or 49.91 centimetres as that of the Madras hath.

Prinsep[11] has also listed many haths of over 19 inches used in cities in India.

Jervis[12] had calculated that the hasta used for defining volumes had a length of 19.5639 inches or 49.69 centimetres. There are references in Alberuni[13] as well as Abul Fazal's *Ain-i-Akbari*[14] to support the view that a hath of about 50 cm was in use in India in their days.

General Cunningham remarks in Thomas' *Chronicles of the Pathan Kings of Delhi*[15] that the Indian finger breadth is less than $\frac{3}{4}$". On the basis of measurement of 42 copper coins of Sikandar Lodi, which were known to be adjusted to finger breadth, he has worked out a value of 0.72289". The mean is 0.72632" which is approximately 18.4 mm.

An actual measurement of the span (vitasti *i.e.* 12 angula) of some 20 males belonging to different States of India and of the age group 25 to 50 by the authors gave an arithmetical mean value of 21.35 cm. This gives a commercial hasta (28 angula) as 49.8 cm. The value is in very close agreement with the estimates we have made from physical samples.

It is obvious that the estimate of 3/4 inch (19.05 mm) as the length of the angula made by many British scholars is on the high side.

We may, therefore, now take that the hasta of 28 angulas defined in the *Arthashastra* may have measured about 49.9 centimetres. This value, which is only a rough estimate, is so near the half-metre that if a rounded value of 50 cm (19.685 inches) is taken for the commercial hasta we would not be introducing any practical error in the cubic measures we shall examine. The Prajapatya hasta would then be 42.86 cm or 16.87 inches, a value much lower than 18" which would be obtained by taking the angula as $\frac{3}{4}$ inch. On this basis the angula works out at 17.86 millimetres.

We may now record our findings about the *Arthashastra* length measures as follows :

Angula	= 17·86 mm
Prajapatya hasta	= 42·86 cm
Commercial hasta	= 50 cm

The use of two different hasta has led to many confusing cubic measures in later times. In fact this confusion has been responsible for the mix up about the actual length of the hasta—17 inches or 19.5 inches, the value for angula also consequently varying from 0.80" (20.3 mm) to 0.70" (17.8 mm). We shall have occasions to note this in Part 2 of this article in which we shall take up the analysis of a few important ancient cubic measures.

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(14) Blochmann, H.—*Ain-i-Akbari*, (Royal Asiatic Society of Bengal, Calcutta), 1927.

(15) Thomas Edward—*The Chronicles of Pathan Kings of Delhi*, (Trubner & Co., London), 1871.

Working Standard Balances: Part 3—Beam Design

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THE first two Parts* of this series of articles dealt with the guiding factors in the design of working standard balances used by Inspectors of Weights and Measures and the considerations which influenced the general specifications. In this Part it is intended to discuss the various aspects of the design of beams.

Working standard balances are precision weighing instruments. The weighing instrument is one of the few machines in which the manufacturer aims at attaining the same efficiency as the standard derived from theoretical considerations. When he speaks about the knife-edge, he means nothing but an extremely fine edge around which moments of the load can be accurately determined. When he talks of the rigidity of the beam, he intends to develop a beam which will not deflect under a load equal to the capacity of the balance. When he declares that the edges are parallel and coplaner, he has used every device available to him to ensure that the edges *are* coplaner at different loads and are parallel. Unlike the manufacturer of a steam or internal combustion engine or even an elctrical motor, the manufacturer of precision balances cannot offer a weighing instrument which has about 60 or 70 percent efficiency.

In fact, every single component of even a simple precision balance has to be made and fitted with great care and caution, so as to obtain the highest efficiency in the final product. What is more, these components besides being made to precise dimensions and finish, have to be durable. The specified initial performance of a working standard balance is expected to be maintained after a few years of use. It has to reproduce that performance even if it is not carefully maintained or is somewhat negligently used. In short, the manufacturer has to develop a balance which must be robust and accurate although it is intended to be used by trained personnel.

There are two types of working standard balances, outdoor (portable) and indoor (stationary). The outdoor or portable balances are in greater use. They are moved from place to place throughout the period in which the Inspector of Weights and Measures completes a round of his jurisdiction on verification duty. The fitting of the parts of outdoor balances has to be so rigid that even the severe jolts received in a bullock cart do not displace them. It is, therefore, axiomatic that the simpler the construction

*(1) Working Standard Balances: Part 1—Guiding Factors in Design—*Metric Measures*, Vol. 4, No. 3, pp. 3—6, 1961.

(2) Working Standard Balances: Part 2—General Specifications—*Metric Measures*, Vol. 5, No. 5, pp. 3—8, 1962.

of the balance the less are the chances of its getting damaged.

A working standard balance consists of the following essential components:

(1) Beam
(2) Knife-edges
(3) Bearings
(4) Beam hangers
(5) Pan suspension
(6) Pans
(7) Parts which are used in assembling these components.

Theoretical Considerations

We shall consider the importance and design of each of the important components in this series of articles. In the present article, we shall consider the design of a suitable beam, particularly for the portable working standard balance.

In Part 1 it was shown that in the design of the beam its length and section were dependent on the capacity of the balance. It was stated that in the case of outdoor balances in particular, the length was also influenced by the necessity of the beam being easily portable. The weight of the beam is also a dominant factor as is shown by the following equation for the sensitivity of the beam:

$$S = \frac{\theta}{m} = \frac{L}{Md - 2Wh}$$

where,

S = Sensitivity of the beam
θ = Deflection of the beam due to excess load in one pan
m = Excess load in one pan
2L = Length of the beam
M = Weight of the beam
d = Depth of the centre of gravity below the central knife-edge
W = Load in each pan
h = Height of the edges above the central edge.

A good designer would conclude from the above equation that the ideal beam should have the following features:

(1) *Length*—Longest possible without affecting portability or occupying too much space in the laboratory.
(2) *Weight*—Lightest possible beam.
(3) *Depth*—As deep as possible at the centre.
(4) *Section*—Minimum section at the centre but sufficient to withstand the maximum shear at the centre.

The only possible beam which satisfies these conditions is a thin triangular open pattern frame with a long base as shown in Fig. 1.

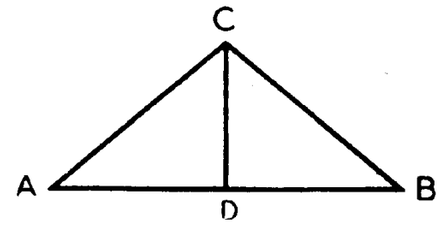

Fig. 1—The Ideal Beam

In Fig. 1,

AB is the length which satisfies condition (1)
CD is the depth at the centre to fulfil condition (3)
ACB is the frame which fulfils condition (2)
The section at CD satisfies condition (4)

This is just the shape used for the beams of most of the good indoor balances. A triangular frame is the most satisfactory and has enough rigidity to prevent deflection under load. One manufacturer has gone to the extent of making a beam from thin wires for the members AC and CB and flat strip for AB as it carries the fittings of knife-edges.

Beams for Outdoor Balances

An open pattern frame is, however, likely to collect dust unless it is housed in a suitable glass case. When it is not possible to provide a glass case, as in the case of outdoor balances of heavy capacity, the beam has necessarily to be made of solid pattern. This immediately leads to an increase in the weight of the beam. To compensate for these loss factors, the depth at the centre has to be considerably reduced. A shape similar to that given in Fig. 2 or Fig. 3 would automatically come up for consideration.

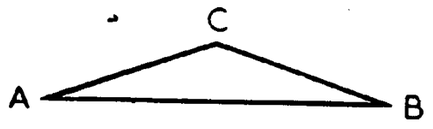

Fig. 2—Possible Shape for Solid Beam

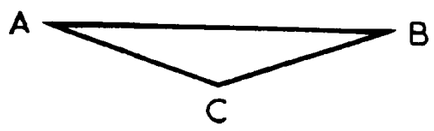

Fig. 3—Possible Shape for Solid Beam

It should be mentioned here that the plane passing through the knife-edges is usually slightly above the centre of gravity of the beam. This can be visualized from the formula for the sensitivity of the beam given above. The value of 'd' *i.e.* distance from the fulcrum to the centre of gravity of the beam should be as small as possible. Designers, therefore, prefer a beam-shape which is identical above and below the plane passing through the knife-edges. The practical shape of the beam for outdoor balances of heavy capacity, therefore, works out to be a long diamond as shown in Fig. 4.

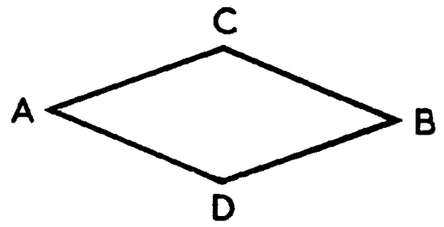

Fig. 4—Practical Shape of Outdoor Beam

This is the shape adopted. The accumulation of dust is very much reduced by rounding off the edges of the beam and avoiding deep crevices. Beams of 50 kg and 5 kg balances are designed on this principle.

All working standard balances are equal armed weighing instruments. An equal armed lever is easier to assemble and adjust. It simplifies comparison of equal masses against each other and eliminates calculations of buoyancy of air if masses of the same material are compared. The designer, therefore, maintains a similarity of shapes on both sides of the fulcrum. Slight differences in the equality of weights on both the sides of the fulcrum are compensated by adjusting devices. Besides, the inequality in weight of the arms does not affect the comparison of masses whose moments are transferred through the side knife-edges.

The last statement will be clear on examining the following facts.

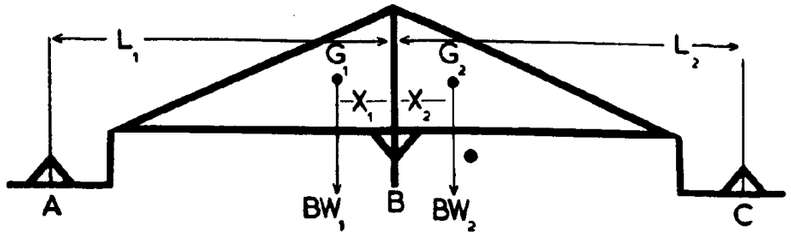

Fig. 5—Inequality of Mass

Consider the beam A B C with three knife-edges A B and C, A and C being the side-edges and B being the fulcrum edge. Consider that it is not loaded even with the pan suspensions. $AB=L_1=BC=L_2$ *i.e.* the arms of the beam are equal.

The left arm of the beam has its weight BW_1 acting through G_1 at distance X_1 from the fulcrum and the right arm of the beam has its weight BW_2 acting through G_2 at a distance X_2. The moments $BW_1 \times X_1$ and $BW_2 \times X_2$ keep the beam in equilibrium. The position of the beam will be horizontal if the moments are equal.

Consider that the equilibrium position is not horizontal. To bring it to the horizontal position unequal external forces can be applied at the knife-edges A and C. These may be two pans with the suspensions being of unequal weight. Let the weights of the left and right hand pans be PW_1 and PW_2. The beam with empty pans is now in horizontal position under the influence of the moments on the left and right side of fulcrum;

$PW_1 \times L_1 + BW_1 \times X_1 = PW_2 \times L_2 + BW_2 \times X_2$.

Let the sum of the moments on left side be called Q_1 and the sum of the moments on the right hand side be called Q_2. Then $Q_1 = Q_2$. These Q_1 and Q_2 are constants of any beam scale with empty pans. Any addition of mass M_1 in the left pan will have moment round the fulcrum $C = M_1 \times L_1$ and tilt the beam to left side. To bring the beam to the original horizontal position the moment round the fulcrum on the right hand side will have to be applied by placing mass M_2 on the right hand side. The beam will be under the influence of the following moments :

$Q_1 + M_1 \times L_1 = Q_2 + M_2 \times L_2$

But $L_1 = L_2$

$\therefore\ M_1 = M_2$.

This shows that Q_1 and Q_2 have nothing to do with the comparison of masses M_1 and M_2.

It may, therefore, be concluded that the ideal shape of a beam for outdoor working standard balances is symmetrical around the horizontal and vertical planes passing through the fulcrum.

Material of Beam

Having worked out the shape, the choice of a suitable material for the beam comes next. The material should :

(1) be light, with low density
(2) have high tensile strength
(3) be sufficiently strong to resist shear
(4) be rigid
(5) be able to withstand atmospheric action
(6) not be brittle

The choice of aluminium or gunmetal is common. Small capacity beams are generally made of aluminium and heavier capacity of gunmetal. It is desirable to use rolled material as it has better tensile strength. It would, therefore, be uneconomical to use rolled material for beams of 5 kg and 50 kg capacity balances. Good castings, thoroughly checked and aged, are used in these balances. Rolled strips and sheets suitable for smaller capacity beams *i.e.* 200 g and 2g are readily available. To impart them even thickness and rigidity some manufacturers cold roll them.

Having discussed beam design, we may turn our attention to knife-edges, which are in contact with the beam. A full discussion of the subject will be taken up in Part 4 of this series

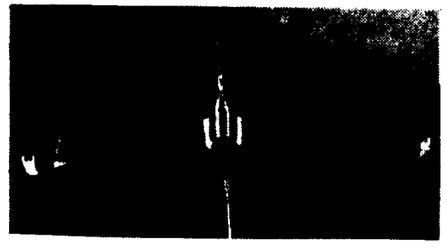

Fig. 6—Beam of 50 kg Working Standard Balance

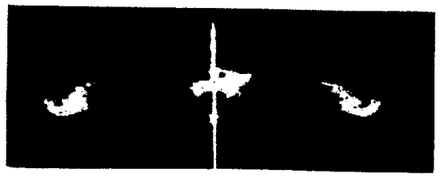

Fig. 7—Beam of 5 kg Working Standard Balance

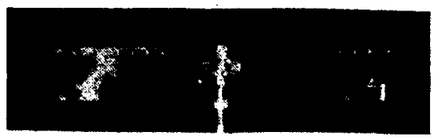

Fig. 8—Beam of 200 g Working Standard Balance

Fig. 9—Beam of 2g Working Standard Balance

(*Continued from page* 31)

Repairers

(1) A. Abdul Khadir, Kuttikadu Purayidom, Andamukkom South, Quilon.
(2) Pandiparambil Bavakutty, Chana Road, Ponnani, Palghat.
(3) Everest Scale Services, QMC No. 4—6, Padmabhavan Compound, Kottamukku, Quilon.
(4) C. M. Hamed Bava Rowther, Tinsmith, Kavala, Changanesserry.
(5) Kaliyath Hardwares, Main Road, Tirur.
(6) K. B. Mammoo, Oriental Metal Industries, Koothuparambu.

Metric Building Standards

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THE Standards of Weights and Measures Act, 1956, lays down a period of 10 years for the complete implementation of the metric system in all spheres of activities. So far the Indian Standards Institution (ISI) have formulated a large number of standards for basic building products and components and have laid down a number of codes for design and construction purposes.

A programme of change-over in the buildings, architectural and allied fields was agreed upon at a Conference held in September 1959. This programme is now being implemented by the Central and State Governments. One of the essential pre-requisites for such a thorough-going change as is involved in the building industry requires the establishment of a number of standard specifications and codes in rational metric units. The ISI has been doing its best to meet this need.

There has, however, been no systematic effort made so far to list all the important available Indian Standard specifications and codes in the metric system for easy reference. It is hoped that the classified list provided in this paper would prove of use to engineers and others concerned.

(1) METRIC INDIAN STANDARDS FOR BUILDING MATERIALS AND COMPONENTS (PUBLISHED UP TO MARCH 1963)

A—Cement, Lime, Sand, Pozzolana and Aggregates

(1) IS: 269—1958	Ordinary, Rapid Hardening and Low Heat Portland Cement (Revised).
(2) IS: 455—1962	Portland Blastfurnace Slag Cement (Revised).
(3) IS: 515—1959	Aggregates for Use in Mass Concrete.
(4) IS: 712—1956	Building Lime.
(5) IS: 1344—1959	Surkhi for Use in Mortar and Concrete.
(6) IS: 1489—1962	Portland—Pozzolana Cement.
(7) IS: 1542—1960	Sand for Plaster.

B—Bricks and Blocks

(8) IS: 1077—1957	Common Burnt Clay Building Bricks.
(9) IS: 1725—1960	Soil Cement Blocks.
(10) IS: 2180—1962	Heavy Duty Burnt Clay Buiid-ing Bricks.
(11) IS: 2185—1962	Load Bearing Hollow Concrete Blocks.
(12) IS: 2222—1962	Burnt Clay Perforated Building Bricks.

C—Stones

(13) IS: 1127—1957	Dimensions and Workmanship of Natural Building Stones.
(14) IS: 1128—1957	Limestone Slabs.

D—Timber

(15) IS: 303—1960	Plywood for General Purposes (Revised).
(16) IS: 1328—1958	Veneered Decorative Plywood.
(17) IS: 1331—1958	Cut Sizes of Timber.

(18) IS: 1629—1960 Rules for Grading of Cut Sizes of Timber.
(19) IS: 1658—1960 Fibre Hardboards.
(20) IS: 1659—1960 Blockboards.

E—Tar and Bitumen

(21) IS: 73—1961 Paving Bitumen (Revised).
(22) IS: 212—1961 Crude Coal Tar for General Purposes (Revised).
(23) IS: 215—1961 Road Tar (Revised).
(24) IS: 216—1961 Coal Tar Pitch (Revised).
(25) IS: 217—1961 Cutback Bitumen (Revised).
(26) IS: 218—1961 Creosote and Anthracene Oil for Use as Wood Preservative (Revised).
(27) IS: 454—1961 Digboi Type Cutback Bitumen (Revised).
(28) IS: 702—1961 Industrial Bitumen (Revised)
(29) IS: 1580—1960 Bitumen (Plastic) for Water-proofing Purposes.
(30) IS: 1834—1961 Hot Applied Sealing Compound for Joints in Concrete.
(31) IS: 1838—1961 Performed Fillers for Expansion Joint in Concrete Non-extruding and Resilient Type (Bitumen Impregnated Fibre).

F—Structural Steel Sections

(32) IS: 226—1962 Structural Steel (Standard Quality) (III Revision).
(33) IS: 808—1957 Rolled Steel Beams, Channels, and Angles.
(34) IS: 811—1961 Cold Formed, Light Gauge Structural Steel Sections.
(35) IS: 961—1962 Structural Steel, High Tensile (Revised).
(36) IS: 1030—1962 Steel Castings for General Engineering Purposes.
(37) IS: 1173—1957 Rolled Steel Tee Bars.
(38) IS: 1252—1958 Rolled Steel Bulb Angles.
(39) IS: 1730—1961 Steel Plate, Sheet and Strip for Structural and General Engineering Purposes.
(40) IS: 1731—1961 Steel Flats for Structural and General Engineering Purposes.
(41) IS: 1732—1961 Round and Square Steel Bars for Structural and General Engineering Purposes.
(42) IS: 1863—1961 Rolled Steel Bulb Plates.
(43) IS: 1977—1962 Structural Steel (Ordinary Quality).
(44) IS: 2004—1962 Carbon Steel Forgings for General Engineering Purposes.
(45) IS: 2062—1962 Structural Steel (Fusion Welding Quality).

G—Reinforcement

(46) IS: 432—1960 Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for Concrete Reinforcement.
(47) IS: 1139—1959 Hot Rolled Steel and Medium Tensile Steel Deformed Bars for Concrete Reinforcement.
(48) IS:1566—1960 Hard Drawn Steel Wire Fabric for Concrete Reinforcement.
(49) IS: 1785—1961 Plain Hard Drawn Steel Wire for Prestressed Concrete.
(50) IS: 1786—1961 Cold Twisted Steel Bars for Concrete Reinforcement.
(51) IS: 2090—1962 High Tensile Steel Bars Used in Prestressed Concrete.

H—Floor Coverings

(52) IS: 653—1962 Sheet Linoleum (Revised).
(53) IS: 657—1962 Materials for Use in the Manufacture of Magnesium Oxy-Chloride Flooring Composition (Revised).
(54) IS: 777—1961 Glazed Earthenware Tiles.
(55) IS: 809—1957 Rubber Flooring Materials for General Purposes.
(56) IS: 1195—1958 Mastic Asphalt for Flooring.
(57) IS: 1237—1959 Cement Concrete Flooring Tiles.
(58) IS: 1478—1959 Clay Flooring Tiles.

J—Roof Coverings

(59) IS: 277—1963 Galvanized Steel Sheets (Plain and Corrugated) (Revised).
(60) IS: 459—1962 Unreinforced Corrugated Asbestos Cement Sheets (Revised).
(61) IS: 654—1962 Clay Roofing Tiles, Mangalore Pattern (Revised).
(62) IS: 1254—1958 Corrugated Aluminium Sheet.
(63) IS: 1322—1959 Bitumen Felts for Water-proofing and Damp-proofing.
(64) IS: 1464—1959 Ridge and Ceiling Tiles.

K—Pipes and Tubes

(65) IS: 404—1962 Lead Pipes (Revised).
(66) IS: 407—1961 Brass Tubes for General Purposes (Revised).
(67) IS: 458—1961 Concrete Pipes (With and Without Reinforcement) (Revised).
(68) IS: 651—1962 Salt-Glazed Stoneware Pipes and Fittings (Revised).
(69) IS: 784—1959 Prestressed Concrete Pipes.
(70) IS: 1161—1958 Steel Tubes for Structural Purposes.

(71) IS: 1230—1957 Cast Iron Rainwater Pipes and Fittings.
(72) IS: 1239—1958 Mild Steel Tubes and Tubulars.
(73) IS: 1536—1960 Centrifugally Cast (Spun) Iron Pressure Pipes for Water, Gas and Sewage.
(74) IS: 1537—1960 Vertically Cast Iron Pressure Pipes for Water, Gas and Sewage.
(75) IS: 1538—1960 Cast Iron Fittings for Pressure Pipes for Water, Gas and Sewage.
(76) IS: 1592—1960 Asbestos Cement Pressure Pipes.
(77) IS: 1626—1961 Asbestos Cement Building Pipes, Fittings and Gutters (Spigot and Socket Type).
(78) IS: 1728—1960 Sheet Metal Rainwater Pipes for General Purposes.
(79) IS: 1879—1961 Malleable Cast Iron Pipe Fittings.

L—Doors and Windows

(80) IS: 1003—1957 Timber Panelled and Glazed Doors and Windows.
(81) IS: 1038—1957 Steel Windows, Ventilators and Doors.
(82) IS: 1361—1959 Steel Windows for Industrial Buildings.
(83) IS: 1948—1961 Aluminium Doors, Windows and Ventilators.
(84) IS: 1949—1961 Aluminium Windows for Industrial Buildings.
(85) IS: 2191—1962 Wooden Flush Door Shutters (Cellular and Hollow Core Type).
(86) IS: 2202—1962 Wooden Flush Door Shutters (Solid Core Type).

M—Builder's Hardware

(87) IS: 204—1961 Tower Bolts (Revised).
(88) IS: 205—1962 Non-ferrous Metal Butt Hinges (Revised).
(89) IS: 206—1962 Tee and Strap Hinges (Revised).
(90) IS: 275—1961 Padlocks (Second Revision).
(91) IS: 362—1962 Parliament Hinges (Revised).
(92) IS: 363—1961 Hasps and Staples (Revised).
(93) IS: 364—1962 Fanlight Catch (Revised).
(94) IS: 412—1962 Expanded Metal Steel Sheets for General Purposes (Revised).
(95) IS: 451—1961 Wood Screws (Revised).
(96) IS: 723—1961 Copper Wire Nails (Revised).
(97) IS: 725—1961 Copper Wire Nails (Revised).
(98) IS: 1018—1961 M Type Brass Padlocks (Revised).
(99) IS: 1019—1957 Rim Latches.
(100) IS: 1341—1962 Steel Butt Hinges (Revised).
(101) IS: 1363—1960 Black Hexagonal Bolts (6 to 39 mm) with Nuts and Black Hexagonal Screws (6 to 24 mm).
(102) IS: 1364—1960 Precision Hexagonal Bolts (6 to 39 mm) with Nuts and Precision Hexagonal Screws (6 to 39 mm).
(103) IS: 1386—1961 Dimensions of Ends of Bolts and Screws.
(104) IS: 1568—1960 Wire Gauze for General Purposes.
(105) IS: 1821—1961 Dimensions for Clearance Holes for Metric Bolts.
(106) IS: 1823—1961 Floor Door Stoppers.
(107) IS: 1837—1961 Fanlight Pivots.
(108) IS: 1929—1961 Rivets for General Purposes (12 to 48 mm diameter).
(109) IS: 2014—1962 T-Bolts.
(110) IS: 2016—1962 Plain Washers.
(111) IS: 2155—1962 Rivets for General Purposes (Below 12 mm diameter).
(112) IS: 2209—1962 Mortice Locks (Vertical Type).

N—Water Supply and Sanitary Equipment

(113) IS: 771—1958 White Glazed Earthenware Sanitary Appliances.
(114) IS: 772—1962 General Requirements of Enamelled Cast Iron Sanitary Appliances (Revised).
(115) IS: 774—1960 Flushing Cisterns for Water.
(116) IS: 775—1962 Brackets and Supports for Wash Basins and Sinks (Revised).
(117) IS: 776—1962 Wooden Water Closet Seats and Covers.
(118) IS: 779—1961 Watermeters (Domestic Type) (Revised).
(119) IS: 781—1959 Sand-Cast Brass Screw Down Bib Taps and Stop Taps for Water Services.
(120) IS: 782—1962 Kaulking Lead (Revised).
(121) IS: 804—1959 Rectangular Pressed Steel Tanks.
(122) IS: 1520—1960 Horizontal Centrifugal Pumps for Clear, Cold, Fresh Water.
(123) IS: 1700—1960 Drinking Fountains.
(124) IS: 1701—1960 Mixing Valves for Ablutionary and Domestic Purposes.
(125) IS: 1703—1962 Ball Valves (Horizontal Plunger Type) including Floats for Water Supply Purposes.
(126) IS: 1710—1960 Vertical Turbine Pumps for Clear, Cold, Fresh Water.

(127) IS: 1711—1960 Self Closing-taps.
(128) IS: 1726—1960 Cast Iron Manhole Covers and Frames intended for use in Drainage Works.
(129) IS: 1795—1961 Pillar Taps.
(130) IS: 2104—1962 Water Meter Boxes (Domestic Type).

P—Electrical Accessories

(131) IS: 374—1960 Electric Ceiling Fans (Revised).
(132) IS: 418—1957 Tungsten Filament General Services Electric Lamps (Revised).
(133) IS: 555—1960 Table Type Electric Fans (Revised).
(134) IS: 1169—1957 Pedestal Type Electric Fans.
(135) IS: 1391—1960 Room Air Conditioners.
(136) IS: 1594—1960 Metric Sizes of Copper Wires and Conductors for Electrical Purposes.
(137) IS: 1596—1962 Polythene Insulated and PVC Sheathed Cables for Electrical Power and Lighting.
(138) IS: 1653—1960 Steel Conduits and Fittings for Electrical Wiring.
(139) IS: 1777—1961 Industrial Lighting Fittings with Metal Reflectors.

Q—Miscellaneous

(140) IS: 278—1962 Galvanized Steel Barbed Wire for Fencing (Revised).
(141) IS: 405—1961 Lead Sheets for General Purposes.
(142) IS: 1137—1959 Thicknesses of Sheet and Diameters of Wire.
(143) IS: 1550—1960 Copper Sheet and Strip for the Manufacture of Utensils and for General Purposes.
(144) IS: 1761—1961 Transparent Sheet Glass for Glazing and Framing Purposes.
(145) IS: 1826—1961 Venetian Blinds for Windows.
(146) IS: 1883—1961 Steel Shelving Racks (Adjustable Type).
(147) IS: 2140—1962 Standard Galvanized Steel Wire for Fencing.

(To be Continued)

Produce More Goods
Reduce Your Needs

Conversion of Cubic Feet

G. VENKATESWARAN,
Assistant Director (Weights & Measures),
Ministry of Commerce and Industry,
Madras.

WITH the compulsory enforcement of metric system in respect of volume units in timber trade from 1 April 1963, traders dealing in timber as well as contractors and officers of the Forest and Public Works Departments feel the need for tables giving conversions for cubic feet and its subdivisions in terms of cubic metres. Table No. 55 in the Indian Standard Conversion Factors and Conversion Tables (IS: 786—1956) published by the Indian Standards Institution gives conversion for cubic feet to cubic metres. In order to use this table the volume has to be calculated in cubic feet and its decimal parts. But the common practice is to express the volume in terms of cubic feet and its fractions, *viz.*, inches and parts. The normal table followed by the majority of timber merchants in India for fractions of the cubic foot is as follows:

12 parts = 1 inch
12 inches = 1 cubic foot.

This 'inch' should not be construed as the inch used in length measurement *i.e.*, 12 inches make one foot. For example, the cubic content of a scantling 7½" breadth, 6" thickness and 15' long, is written as 4·69 cu ft or cu ft 4-8-3. The latter figure is calculated by multiplying 7½, 6, and 15 together and dividing the product thus obtained by 12 successively twice *i.e.*, $7\frac{1}{2} \times 6 \times 15 = 675$ and this product when divided by 12 successively twice gives 4-8-3. The metric equivalent of 4·69 cu ft can be easily obtained by referring to Table No. 55 in IS: 786—1956. But to use the same table for converting cu ft 4-8-3 to cubic metres one has first to convert the volume into cubic feet and its decimal parts. In order to avoid this and to be directly useful the following table giving conversion of volumes expressed in terms of cubic feet and its fractions to cubic metres is prepared.

How to Use Table

The cubical content of a scantling 5½ breadth, 1½" thickness and 12 feet length is cu ft 0-7-6. To get its value in metric units see against cu ft 0-7-6 in the Table. The value obtained is 0·017698 or 0·0177 cubic metres correct to 4 decimal places.

The cubical content of a scantling 7½" breadth, 6" thickness and 15' length is cu ft 4-8-3. To get its value in metric units the values against cu ft 4-0-0 (*viz.*, 0·113267) and cu ft 0-8-3 (*viz.* 0·019468) may be added together to get 0·132735 cubic metres, or 0·1327 cubic metres correct to 4 decimal places.

CONVERSION OF CUBIC FEET TO CUBIC METRES

Cu ft	m^3
0-0-1/8	0·000025
0-0-1/4	0·000049
0-0-3/8	0·000074
0-0-1/2	0·000098
0-0-5/8	0·000123

Conversion of Cubic Feet to Cubic Metres—*contd.*

Cu ft	m^3	Cu ft	m^3
0-0-3/4	0·000147	0-4-2	0·009832
0-0-7/8	0·000172	0-4-3	0·010029
0-0-1	0·000197	0-4-4	0·010226
0-0-2	0·000393	0-4-5	0·010422
0-0-3	0·000590	0-4-6	0·010619
0-0-4	0·000787	0-4-7	0·010815
0-0-5	0·000983	0-4-8	0·011012
0-0-6	0·001180	0-4-9	0·011209
0-0-7	0·001377	0-4-10	0·011405
0-0-8	0·001573	0-4-11	0·011602
0-0-9	0·001770	0-5-0	0·011799
0-0-10	0·001966	0-5-1	0·011995
0-0-11	0·002163	0-5-2	0·012192
0-1-0	0·002360	0-5-3	0·012389
0-1-1	0·002556	0-5-4	0·012585
0-1-2	0·002753	0-5-5	0·012782
0-1-3	0·002950	0-5-6	0·012979
0-1-4	0·003146	0-5-7	0·013175
0-1-5	0·003343	0-5-8	0·013372
0-1-6	0·003540	0-5-9	0·013568
0-1-7	0·003736	0-5-10	0·013765
0-1-8	0·003933	0-5-11	0·013962
0-1-9	0·004130	0-6-0	0·014158
0-1-10	0·004326	0-6-1	0·014355
0-1-11	0·004523	0-6-2	0·014552
0-2-0	0·004719	0-6-3	0·014748
0-2-1	0·004916	0-6-4	0·014945
0-2-2	0·005113	0-6-5	0·015142
0-2-3	0·005309	0-6-6	0·015338
0-2-4	0·005506	0-6-7	0·015535
0-2-5	0·005703	0-6-8	0·015732
0-2-6	0·005899	0-6-9	0·015928
0-2-7	0·006096	0-6-10	0·016125
0-2-8	0·006293	0-6-11	0·016322
0-2-9	0·006489	0-7-0	0·016518
0-2-10	0·006686	0-7-1	0·016715
0-2-11	0·006883	0-7-2	0·016911
0-3-0	0·007079	0-7-3	0·017108
0-3-1	0·007276	0-7-4	0·017305
0-3-2	0·007473	0-7-5	0·017501
0-3-3	0·007669	0-7-6	0·017698
0-3-4	0·007866	0-7-7	0·017895
0-3-5	0·008062	0-7-8	0·018091
0-3-6	0·008259	0-7-9	0·018288
0-3-7	0·008456	0-7-10	0·018485
0-3-8	0·008652	0-7-11	0·018681
0-3-9	0·008849	0-8-0	0·018878
0-3-10	0·009046	0-8-1	0·019075
0-3-11	0·009242	0-8-2	0·019271
0-4-0	0·009439	0-8-3	0·019468
0-4-1	0·009636	0-8-4	0·019664

Conversion of Cubic Feet to Cubic Metres—*concld.*

Cu ft	m^3	Cu ft	m^3
0-8-5	0·019861	0-10-8	0·025171
0-8-6	0·020058	0-10-9	0·025367
0-8-7	0·020254	0-10-10	0·025564
0-8-8	0·020451	0-10-11	0·025760
0-8-9	0·020648	0-11-0	0·025957
0-8-10	0·020844	0-11-1	0·026154
0-8-11	0·021041	0-11-2	0·026350
0-9-0	0·021238	0-11-3	0·026547
0-9-1	0·021434	0-11-4	0·026744
0-9-2	0·021631	0-11-5	0·026940
0-9-3	0·021828	0-11-6	0·027137
0-9-4	0·022024	0-11-7	0·027334
0-9-5	0·022221	0-11-8	0·027530
0-9-6	0·022418	0-11-9	0·027727
0-9-7	0·022614	0-11-10	0·027924
0-9-8	0·022811	0-11-11	0·028120
0-9-9	0·023007	1-0-0	0·028317
0-9-10	0·023204	2-0-0	0·056634
0-9-11	0·023401	3-0-0	0·084951
0-10-0	0·023597	4-0-0	0·113267
0-10-1	0·023794	5-0-0	0·141584
0-10-2	0·023991	6-0-0	0·169901
0-10-3	0·024187	7-0-0	0·198218
0-10-4	0·024384	8-0-0	0·226535
0-10-5	0·024581	9-0-0	0·254852
0-10-6	0·024777	10-0-0	0·283168
0-10-7	0·024974		

News & Views

Eighth Indian Standards Convention

The Indian Standards Institution has decided to hold the Eighth Indian Standards Convention at Ahmedabad from 22 to 28 December 1963. Shri K. C. Reddy, Union Minister for Commerce and Industry and President of the Institution, will preside over the Inaugural Function on Sunday, 22 December 1963.

The convention will discuss among other subjects :

Progress of Change-over to Metric System in Industrial Production.

Foodgrains and Jute Bags

It is understood that the Department of Food, Ministry of Food and Agriculture, Government of India have recently ordered that as and when the Heavy Cees Plain and Heavy Cees Green bags are utilized for packing of foodgrains, the following standard weights should be filled in the bags at the time of standardization:

Type of Gunny	Size of Gunny	Standard Net Weight	
		Wheat	Rice
Heavy Cees Plain	40″ × 28″	95 kg	95 kg,
Heavy Cees Green	43″ × 29″	100 kg	100 kg

Necessary instructions have been issued for the implementation of this decision to all concerned both at docks and depots.

Decimal Currency in Australia and New Zealand

It is understood that Australia would get a system of decimal currency by February 1966, if the National Mint at Canberra is completed on schedule late in 1964. This would allow full production of the new coins for at least one year before the target date. The existing Mints at Perth and Melbourne would supplement the production of the new Mint. But they would have to produce the present coins also up to 1967.

The new system would be based on the principal unit of ten shillings. This unit would be divided into 100 parts, so that the minor unit would be equal to 1·2 pence of the existing coinage. These decisions follow the recommendations of the Decimal Currency Committee, which submitted its report to the Australian Government in August 1960.

The announcement was made in Canberra on 7 April 63 by Mr. Harold Holt, Chancellor of the Exchequer. It is likely that the names dollar and cent may be adopted for the coins. Mr. Holt, however, preferred an Australian name such as the 'Austral'.

Legislation to set up a statutory authority to plan and administer the change-over and to provide for the denominations would be introduced in the Parliament later this year. A Cabinet Committee has been set up to consider all the aspects of this reform. The most pressing at the moment are the establishment of the statutory body, names of new coinage and denominations of the new bank notes and coins.

It has been estimated that the reform would cost Australia £(A)30 million.

Following the announcement of Mr. Holt, the New Zealand Finance Minister, Mr. Harry Lake, also stated that New Zealand

would switch over to decimal currency in 1967 *i.e.* one year after Australia has done so.

It will be recalled that recently South Africa and Pakistan changed over to decimal currency. Thus in a few years, UK alone among the advanced countries may be using a non-decimal system of coinage.

Progress of International Work

Two new prefixes for the formation of submultiples of units of measures were adopted in October 1962 by the International Committee of Weights and Measures (CIPM). These are :

femto (symbol : f) = 10^{-15}

atto (symbol : a) = 10^{-18}

These two prefixes had already been adopted in September 1960 by the International Union of Pure and Applied Physics. They supplement the prefixes approved by the 11th General Conference of Weights and Measures in October 1960 (see *Metric Measures*, Vol. 4, September 1961, p. 23).

The October 1962 meeting of the Consultative Committee for the Definition of the Metre recommended to the CIPM 12 secondary wavelength standards of length. These are :—

(A) *Wavelengths of Krypton* 86

6 458·072 0 × 10^{-10}m
6 422·800 6 × 10^{-10}m
5 651·128 6 × 10^{-10}m
4 503·616 2 × 10^{-10}m

(B) *Wavelengths of Mercury* 198

5 792·268 3 × 10^{-10}m
5 771·198 3 × 10^{-10}m
5 462·270 5 × 10^{-10}m
4 359·562 4 × 10^{-10}m

(C) *Wavelengths of Cadmium* 114

6 440·248 0 × 10^{-10}m
5 087·237 9 × 10^{-10}m
4 801·252 1 × 10^{-10}m
4 679·458 1 × 10^{-10}m

The value on the basis of the 1960 definition (see *Metric Measures*, Vol. 4, September 1961, p. 22) works out to be 6 057·802 1.... × 10^{-10}m. The above values have not yet been accepted as international secondary standards of length.

The Advisory Committee on Thermometry of the CIPM has made 6 proposals to modify the International Practical Temperature Scale.

(1) Incorporate the T_{58} (He^4) and T_{62} (He^3) scales. This will give a basis for measurements in the range 0·25 to 5°K.

(2) Define the equiliterium boiling point of hydrogen to be about 20·267°K and the boiling point of oxygen to be about 90·17°K. The term *about* indicates that these values may change on new experiments by 1966, when the 12th General Conference is due to be held.

(3) Incorporate a platinum resistance thermometer scale in the region between the hydrogen and oxygen points.

(4) Eliminate the sulphur point and replace it with the zinc point.

(5) Change the values of the zinc (419·505°C), silver (960·8°C) and the gold (1063°C) points by about + 0·07, + 1·1 and + 1·5°C respectively.

(6) Replace the standard thermocouple with the platinum resistance thermometer.

(NBS Technical News Bulletin, Feb. 63, pp. 28–30)

Ultrasonic Thermometer for Low-Temperature Determinations

The ultrasonic thermometer has been refined at the National Bureau of Standards, USA, to the point where temperature measurements in the range 2 to 20°K can be made with great accuracy and precision. Based on the determination of the speed of sound in helium gas, the ultrasonic thermometer is expected to establish an absolute temperature scale in the region 4 to 14°K,

and to provide the basis for the calibration of germanium resistance thermometers. This thermometer eliminates the troublesome corrections required with gas thermometry, and the need for precise volume and pressure determinations.

(*National Bureau of Standards, Technical News Bulletin, Jan*, 1963, *pp.* 4-5.)

Metric Guide for Engineers and Architects

Sri Mandir Karyalaya, Publishers, 15, Daryagang, Delhi-6 announce the publication of *Metric Guide for Engineers and Architects* by Shri J. K. Varshneya, B.E. (CIVIL), C.E.S.(I), Deputy Director (Metric), National Buildings Organisation, New Delhi.

Shri Varshneya is the author of *Metric Guide and Conversion Tables for Trade and Commerce* which has been published by Allied Publishers, New Delhi.

The contents of the book will be as follows :

(1) The Origin, Evolution and Impact of Metric System.
(2) Definitions of Metric Units.
(3) Abbreviations for Metric Engineering Units and Their Correct Usage.
(4) Equivalent Metric Units and Conversion Factors.
(5) Metric Building Products.
(6) Unit Weight of Building Materials.
(7) Floor Loads on Buildings.
(8) Metric System in Surveying.
(9) Metric Drawing Equipment and Accessories.
(10) Constants for R.C.C. Design.
(11) Soil Classification and Safe Bearing Capacity.
(12) Metric Hydraulic Formulae.
(13) Metric Construction Equipment.
(14) Modular Coordination in Building Industry.
(15) Metric System in Technical Education.
(16) Metric Standardization in Indian Building Industry.

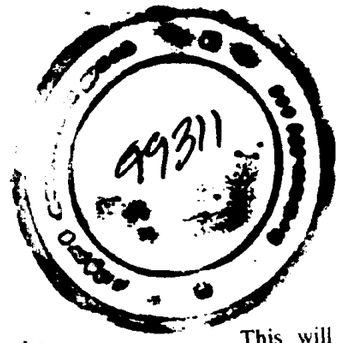
Appendix I—Metric Indian Standards.
Appendix II—Handbook for Building Engineers in Metric System.
Appendix III—Wire and Sheet Metal Gauges.
Appendix IV—Test Sieves.
Appendix V—Metric Paper Sizes.
Appendix VI—Metric and British Units.
Appendix VII—Principal Conversion Factors.

The book will be available early in August 1963. The price is Rs. 5·50 nP. per copy. Engineers, architects, builders and engineering students will find the book extremely useful. Those interested should contact the publishers directly.

A Black Business

In a hearing before Oxford magistrates recently four men pleaded guilty to charges concerning theft or receiving anthracite and boiler fuel. The solicitors appearing were Messrs. Cole and Cole, a defendant was named Grimes and the prosecutor was a Mr. Dust.

(*The Monthly Review—March* 1963)



Readers' Forum

Easy Method of Weight Conversions

Sir,

Although the metric system of weights and measures has become compulsory throughout the country, conversions have to be resorted to in some cases. Many hawkers and small vendors still quote rates in the old system. Customers, not fully conversant with the conversions of one system of units into another are confused. It is not easy to use conversion factors like:

(1) 1 kilogram = 1·0717 seers
(2) 1 seer = 0·9331 kg

The use of such factors involves tedious calculations for which the common man has neither the aptitude nor the time. Simple, easy to remember formulae are suggested below:

Converting Kilograms to Seers

(1) Multiply the number of kg by 15/14. This would give the number of seers up to 40 kg.

Add 0·01 kg after the first 40 kg for every unit of 40 kg, thereafter i.e. from 41 to 80 add 0·01, from 81 to 120 add 0·02, from 121 to 160, add 0·03 and so on. This will give results correct to two places of decimal.

Converting Seers to Kilograms

(2) Multiply number of seers by 14/15. Subtract 0·01 after the first 40 seers for every unit of 40 seers thereafter *i.e.* subtract.

0·01 from 41 to 80
0·02 from 81 to 120
0·03 from 121 to 160
0·04 from 161 to 200 and so on.

This will give results to two places of decimal.

Examples

Convert 48 kg, 82 kg and 124 kg to seers and 48 seers, 82 seers and 124 seers to kg to two places of decimal.

Answer

(1) 48 kg = 48×15/14+0·01 = 360/7+0·01 = 51·43+0·01 = 51·44 seers.
(2) 82 kg = 82×15/14+0·02 = 615/7+0·02 = 87·86+0·02 = 87·88 seers.
(3) 124 kg = 124×15/14+0·03 = 930/7+0·03 = 132·86+0·03 = 132·89 seers
(4) 48 seers = 48×14/15—0·01 = 224/5—0·01 = 44·80—0·01 = 44·79 kg
(5) 82 seers = 82×14/15—0·02 = 1148/15—0·02 = 76·53—0·02 = 76·51 kg
(6) 124 seers = 124×14/15—0·03 = 1736/15—0·03 = 115·73—0·03 = 115·70 kg

The above formulae also hold good when prices of articles are given in rupees *i.e.* Re. 1 per kg or 1 seer.

Note

In the above examples, if the price of 1 seer is Re. 1 then the cost of 48 kg, 82 kg and 124 kg would be Rs. 51·44, Rs. 87·88 and Rs. 132·89 respectively.

If the price of 1 kg is Re. 1 the cost of 48 seers, 82 seers and 124 seers would be Rs. 44·79, Rs. 76·51 and Rs. 115·70 respectively.

Ministry of Commerce & Industry,
New Delhi

M. L. KALSI

History Repeats Itself

Sir,

The metric system has now been introduced in the country. We have changed over to the metre, kilogram and the litre. The Railways are now using the kilometre for indicating distances. On the roads also the mile is being replaced by the kilometre.

In the circumstances it may appear somewhat bold if I state that the kilometre is not something new to us. It has been with us from ancient times as a double measure of distance called kos i.e. the kilometre is equal to half a kos.

According to ancient measurement:

4 cubits = 1 Danda
10 Danda = 1 Rajju
100 Danda = 1 Nalwa
1000 Danda = 1 kos

As one cubit used to be equal to 50·3 cm (19·8 in), danda used to be equal to 2·01 metres (79·2 in or 6·6 ft) and kos used to be equal to 2·1 km (5 furlongs). In other words kilometre is another name for half a kos. While the ancients used danda of four cubits as the unit of measurement we shall now use the metre, equal to 2 cubits, as the unit of measurement.

When we are introducing the metric system, we must tell the layman that it is nothing new. It is what our forefathers made use of.

I would also point out that what used to be called 'rajju' was equal to a chain and 'nalwa', equal to a furlong. Even the word mile is a misnomer these days as it is now 8 furlongs. In ancient times it used to be 10 furlongs *i.e.* one kos. Its very name suggests that it used to be equal to one thousand danda. Let us summarise:

10 dandas = Rajju = chain	= 22 yard	= 20 metres
100 dandas = nalwa = furlong	= 220 yards	= 20 metres
1000 dandas = kos	= mile	= 2200 yards = 2·01 kms
1000 metres = km	= ½ kos	= 5 furlongs

13/5, West Patel Nagar, New Delhi-12 — BAL BHADRA

CORRECTION

On page 25 of March 1963 issue of *Metric Measures* make the following correction in Table 3 :

III	"Government servants whose maximum of pay scale exceeds Rs. 110 but whose actual pay is less than Rs. 220 per mensem.	Second Class by Rail"

Book Review

STEAM TABLES IN METRIC UNITS—compiled by S. A. Urry; Sir Isaac Pitman & Sons Ltd., London; 1963; 17 pp, Price not indicated.

In the May 1963 issue of *Metric Measures*, steam tables compiled by Shri Dighe were reviewed. In the wake of Shri Dighe's tables come the tables compiled by S. A. Urry on the basis of the values obtained by Vukalovitch.

In the preface the author says: 'the increasing use of the metric system in English-speaking countries has prompted the preparation of these tables.'

They extend to 1000° C and a pressure of 1000 kgf/cm². There are in all 6 tables.

I Saturated Water and Steam (Pressure Tables).
II Saturated Water and Steam (Temperature Tables).
III Volume of Superheated Steam and Compressed Water.
IV Internal Energy of Superheated Steam and Compressed Water.
V Enthalpy (Total Heat) of Superheated Steam and Compressed Water.
VI Energy of Superheated Steam and Compressed Water.

The importance of steam tables and charts for engineers cannot be over-emphasized. To that extent the present booklet partially serves a real need. There are, however, certain items which could have been adequately treated. For example, the range of temperature in Table II could usefully have been extended from 100° C to 374° C or that the specific volume in Table I could have been given up to 7 places of decimals instead of 6 places.

It is necessary that Indian engineers should have for reference comprehensive steam tables which could cover a much wider range of values than are given in the booklet.

The Indian Standards Institution, realizing this need, has set up an *Ad hoc* Expert Committee on Properties of Steam. This Committee has taken in hand the preparation of authentic and comprehensive steam tables. It is understood that this work may be completed in 6 to 8 months' time.

Till such time as the ISI tables are published, Steam tables compiled by Urry and Dighe should serve a useful purpose by meeting the immediate requirements of engineers.

The booklet is well printed and the tables are well arranged so as to facilitate their reading. ●●●

Conversion Table from Yards to Metres

The following is a table for use in measuring cloth, electric wires, ribbons etc.

Yards	Metres	Suggested Metric Length for Cloth Purchases	Yards	Metre	Suggested Metric Length for Cloth Purchases
1	2	3	1	2	3
1/8	0·11	0·10	5 1/8	4·69	4·70
1/4	0 23	0·25	5 1/4	4·80	4·80
3/8	0·34	0·35	5 3/8	4·91	4·90
1/2	0·46	0·45	5 1/2	5·03	5·05
5/8	0·57	0·55	5 5/8	5·14	5·15
3/4	0·69	0·70	5 3/4	5·26	5·25
7/8	0·80	0·80	5 7/8	5·37	5·35
1	0·91	0·90	6	5·49	5·50
1 1/8	1·03	1·05	6 1/8	5·60	5·60
1 1/4	1·14	1·15	6 1/4	5·72	5·70
1 3/8	1·26	1·25	6 3/8	5·83	5·85
1 1/2	1·37	1·35	6 1/2	5·94	5·95
1 5/8	1·49	1·50	6 5/8	6·06	6·05
1 3/4	1·60	1·60	6 3/4	6·17	6·15
1 7/8	1·71	1·70	6 7/8	6·29	6·30
2	1·83	1·85	7	6·40	6·40
2 1/8	1·94	1·95	7 1/8	6·52	6·50
2 1/4	2·06	2·05	7 1/4	6·63	6·65
2 3/8	2·17	2·15	7 3/8	6·74	6·75
2 1/2	2·29	2·30	7 1/2	6·86	6·85
2 5/8	2·40	2·40	7 5/8	6·97	6·95
2 3/4	2·51	2·50	7 3/4	7·09	7·10
2 7/8	2·63	2·65	7 7/8	7·20	7·20
3	2·74	2·75	8	7·32	7·30
3 1/8	2·86	2·85	8 1/8	7·43	7·45
3 1/4	2·97	2·95	8 1/4	7·54	7·55
3 3/8	3·09	3·10	8 3/8	7·66	7·65
3 1/2	3·20	3·20	8 1/2	7·77	7·75
3 5/8	3·31	3·30	8 5/8	7·89	7·90
3 3/4	3·43	3·45	8 3/4	8·00	8·00
3 7/8	3·54	3·55	8 7/8	8·12	8·10
4	3·66	3·65	9	8·23	8·25
4 1/8	3·77	3·75	9 1/8	8·34	8·35
4 1/4	3·89	3·90	9 1/4	8·46	8·45
4 3/8	4·00	4·00	9 3/8	8·57	8·55
4 1/2	4·11	4·10	9 1/2	8·69	8·70
4 5/8	4·23	4·25	9 5/8	8·80	8·80
4 3/4	4·34	4·35	9 3/4	8·92	8·90
4 7/8	4·46	4·45	9 7/8	9·03	9·05
5	4·57	4·55	10	9·14	9·15

Licensed Manufacturers and Repairers

(*Metric Measures* had been publishing in the past a series of lists of licensed manufacturers, dealers and repairers of weights and measures, weighing and measuring instruments licensed by the Governments in the various States and Union Territories under their Weights and Measures (Enforcement) Acts. To economise on paper, it is possible only to publish lists of licensed manufacturers and repairers.

A new feature of statistics of verification and licences issued is also being published in *Metric Measures*. ——*Editor*)

STATISTICS OF VERIFICATION OF WEIGHTS ETC., AND LICENCEES

Sl. No.	States/Union Territories	Period	Weights	Capacity Measures	Length Measures	Weighing Instruments	Measuring Instruments	Total number of Mfrs. (As on last day of March 1963)	Dealers	Repairers
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	Andhra Pradesh ..	1 Apr to 31 Jul 62	4,56,255	74,480	6,323	8,025	314	62	121	36
(2)	Assam ..	1 Apr 62 to 31 Mar 63.	4,72,461	34,286	4,239	572	92	17	767	13
(3)	Bihar ..	——	—	—	—	—	—	—	—	—
(4)	Gujarat ..	1 Apr to 30 Nov 62	5,59,708	54,133	12,724	80,743	513	108	581	141
(5)	Kerala ..	1 Apr 62 to 31 Jul 62	—	—	—	—	—	73	459	162
(6)	Jammu & Kashmir ..	1 Apr to 30 Nov 62.	120	395	—	3	—	1	—	—
(7)	Madhya Pradesh.. ..	——	—	—	—	—	—	—	—	—
(8)	Madras ..	——	—	—	—	—	—	—	—	—
(9)	Mysore ..	1 Apr to 30 Nov 62.	4,81,354	1,05,253	1,037	59,674	8,420	126	493	92
(10)	Maharashtra	——	—	—	—	—	—	—	—	—
(11)	Orissa ..	1 Apr 62 to 31 Mar 63.	4,23,597	86,060	3,089	1,596	2	8	103	6
(12)	Punjab ..	1 Apr to 30 Nov 62.	6,73,338	26,755	14,474	57,421	375	4	21	19
(13)	Rajasthan ..	——	—	—	—	—	—	—	—	—
(14)	Uttar Pradesh	1 Apr to 31 May 62.	5,34,506	7,951	4,702	907	113	3	99	18
(15)	West Bengal	1 Apr 62 to 31 Jan 63.	20,03,339	12,762	2,061	88,041	—	116	684	80
(16)	A. & N. Island	——	—	—	—	—	—	—	—	—

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(17)	Delhi ..	1 Apr to 31 Jan 63.	1,81,952	14,668	7,641	16,562	359	26	72	18
(18)	Himachal Pradesh ..	1 Apr to 30 Nov 62.	42,103	3,793	1,832	7,169	—	1	24	11
(19)	L.M.A. Island	1 Apr 62 to 31 Mar 63.	—	—	—	—	—	—	—	—
(20)	Manipur ..	1 Apr 62 to 31 Mar 63.	9,035	2,029	81	213	—	—	—	—
(21)	Pondicherry..	1 Apr to 31 Mar 63.	24,531	15,985 + 200 (peg measures)	711	1,470	48	13	58	6
(22)	Tripura ..	1 Apr 62 to 31 Jan 63.	5,326	1,545	—	—	8	2	49	1

ANDHRA PRADESH

List of manufacturers and repairers licensed during the period from 1 June to 30 September 1962.

Manufacturers

Sl. No.	Name and Address of the Manufacturer	Details of Articles Manufactured
(1)	Bhagavannarayana Iron Balance Works, Dowlaishwaram, East Godavari Dist.	Weights, Measures, Weighing and Measuring Instruments.
(2)	Pappu Yerakayya & Sons, Dowlaishwaram, East Godavari Dist.	Weights, Measures, Weighing and Measuring Instruments.

Repairers

(1) Abdul Karim Maniyar, D. No. 99, Ward No. 29, Narasaraopet, Adoni.
(2) Anjaneya Weights and Measures Depot, Vinayak Street, Tenali.
(3) Central Metal Works, Feel Khana, Hyderabad.
(4) Chunduri Sambaiah, Cloth Bazaar, Guntur Dist.
(5) Haris Scientific Co., Durgapuram, Vijayawada.
(6) Hyderabad Standard Service, Gandhi Road, Sadasivpet.
(7) Hyderabad Cresent Scale Centre, Market Road, Mahaboobnagar.
(8) Janata Dealers, Sadasivpet.
(9) J. Joseph, Mandi Bazaar, Warrangal.
(10) Khaja Maslehuddin, Old Beat Bazaar, Warrangal.
(11) Kukkadapu Krishna Murthy, Old Beat Bazaar, Warrangal.
(12) K. Malakondaiah, Kondameedi Kondem Village, Nellore Dist.
(13) Marella Venkata Ramaiah & Sons, B. K. M. Street, Cuddapah.
(14) Satyanarayana Iron Steel Works, Trunk Road, Kavali, Nellore Dist.
(15) Repairing and Adjusting Centre, Jammalamadugu, Cuddapah Dt.
(16) Scale Adjusting Services, Osmangunj, Hyderabad, A.P.
(17) Sekhar & Co., Main Bazaar, Eluru.
(18) Syed Hussain Scale Centre, Market Road, Mahboobnagar.
(19) Syed Ibrahim, Kothaguda, Suryapet, Nalgonda Dt.
(20) Telengana Scale Adjusting Services, Sardar Road, Sadasivpet.
(21) Vetcha Gangaraju & Sons, 18/245, Main Road, Rajahmundry.
(22) Waheed Scale Adjusting Centre, Bus Stand Road, Nirmal.

ASSAM

List of manufacturers and repairers licensed from 1 February to 31 March 1963.

Manufacturers

(1) Annapurna Rice & Oil Mills, Ulubari, Gauhati.
(2) El-Dorado Furnishers, Udyognagar, Tinsukia.
(3) Jayshree Assam Engg. Works, Dhubri.
(4) Sharma & Co., Trunk Road, Tinsukia.
(5) Steel Worth Ltd., Commercial Building, Tezpur.

Repairers

(1) Alilur Rahman, C/o B. O. C. (I. T.) Ltd., Digboi.
(2) Annapurna Rice & Oil Mills, Ulubari, Gauhati.
(3) J. C. Bhattacharjee, C/o B. O. C. (I. T.) Ltd., Digboi.
(4) Bindeswar Koch, C/o B. O. C. (I. T.) Ltd., Digboi.
(5) Chamanlal David, C/o Caltex (India) Ltd., Pandu, Assam.
(6) D. C. Choudhari, C/o B. O. C. (I. T.) Ltd., Digboi.
(7) C. E. Demello, C/o B. O. C. (I. T.) Ltd., Digboi.
(8) J. C. Gogoi, C/o B.O. C. (I. T.) Ltd., Digboi.
(9) Maniruddin, C/o B. O. C. (I. T.) Ltd., Digboi.
(10) Standard Vacuum Oil Company, Station Road, Gauhati.
(11) Tinsukia Steel & Wire Manufacturing Co., Udyognagar, Tinsukia.
(12) Wazid Ali, C/o B. O. C. (I. T.) Ltd., Digboi.

GUJARAT

List of manufacturers and repairers licensed from 1 February to 31 March 1963.

Manufacturers

Sl. No.	Name and Address of the Manufacturers	Details of Articles Manufactured
(1)	Delichand Raichand Doshi, Jamadar Pada, Savarkundla.	Beam Scales
(2)	Luhar Shamji Valhi, Gandhi Chowk, Savarkundla	Beam Scales
(3)	Parmur Scale Co., Devla Gate, Bar Sheri, Savarkundla	Beam Scales

Repairers

(1) Amery Scale Co., Tower Road, Surendranagar.
(2) Gandhi Anantrai Hirachand, Bazar, Damagar.
(3) Kansara Ramjibhai, Motibhai, J/2—1749, Kansara Street, Ahmedabad.

KERALA

The following is a list of licencees of manufacturers and repairers licensed during the period from 1 January to 31 January 1963.

Manufacturers

Sl. No.	Name and Address of the Manufacturers	Details of Articles Manufactured
(1)	N. B. Kanju Mohammed, Lila Industries, K. K. Road, Kanjirappally.	Dry Measures
(2)	C. P. Lonappar & Sons, Trichur	Wooden Length Measures
(3)	K. Nadarajan Asari, Theepachamkala puthen veedu, Vazhattoor, Neyyattinkara.	Dry Measures
(4)	R. Radhakrishnan, Ravi Metal Works, 24/208, Melemuri, Palghat-6.	Dipping & Pouring type Measures
(5)	Southern Scale Services, 23/360, Melemuri, Palghat ..	Beam Scales C & D classes.
(6)	Tellicherry Small Scale Industries, Kayath Road, Tellicherry.	Dry Measures
(7)	Zuhra Metal Industries, Francis Road, Calicut-1 ..	Conical Measures

(*Continued on page* 14)

DON'T EQUATE !

Most of us resent being compared to our neighbours. So it is with Metric Weights.

To obtain the maximum benefit out of the metric system, use metric weights as they are, for their intrinsic value.

DO NOT USE A NUMBER OF METRIC PIECES TO MAKE UP A SEER OR A VISS.

You will waste your time and often lose in the transaction.

FOR QUICK SERVICE AND FAIR DEALING

USE METRIC UNITS *IN ROUND FIGURES*

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TYPICAL METRIC PRICING UNITS FOR WHOLESALE TRANSACTIONS

Serial No.	Commodity	Metric Unit
		10 grams (g)
(1)	**Gold**	1 kilogram (kg)
(2)	**Grocery and Confectionery** Biscuits, sweetmeats, cardamoms.	
	Textiles and Textile Fibres Cotton yarn, damaged and seconds cloth, raw silk, rayon, silk yarn, raw wool, wool manufacturers (when sold by weight).	
	Paints & Chemicals Paint (if sold by weight), indigo, liquid chlorine.	
	Hides, Skins & Leather Raw hides, leather (hides and skins).	
	Metals Silver, aluminium sheets, strips and circles, copper and brass wires and utensils.	
	Miscellaneous Tea, meat, camphor tablets, mica.	1 quintal (q) (100 kilograms)
(3)	**Grains and Pulses** Rice, wheat, jowar, arhar, moong, masur, gram.	
	Spices Black pepper, mustard, chillies, dhania, dalchini, turmeric, betelnuts.	
	Plantation Products Rubber, cashewnuts, cashew kernels, tobacco (raw and manufactured).	
	Forest Products Lac and lac products, gums, myrobalans, galnuts, soapnuts.	
	Textiles & Textile Fibres Raw jute, raw hemp, coir yarn.	
	Oils, Oilseeds & Oilcakes Vegetable oils, oilseeds, oilcakes.	
	Non-Ferrous Metals *Aluminium* : ingots, bars, blocks, slabs, billets. *Lead* : ingots, sheets and strips. *Copper* : ingots, blooms, slabs, cakes, tiles, bricks, billets, blisterbars and wirebars, rods, sections and pipes, plates, sheets and strips, circles. *Brass* : ingots, rods, sections, pipes, sheets, strips, circles. *Zinc* : ingots, sheets, strips. *Tin* : blocks.	
	Chemicals Caustic soda, bleaching powder, glycerine, soaps, paper salt.	
	Others Sugar, gur, ice, fish, sugarcane, vegetables, tamarind.	
(4)	**Minerals** Iron ore, manganese ore, bauxite, coal.	one metric tonne (t) (1,000 kilograms)
	Iron & Steel Pig iron, iron and steel manufactures, semis (billets for rerolling etc.)	
(5)	Cloth (mill, handloom, silk, rayon and woollen cloth).	1 metre (m)
(6)	Jute carpets, coir mats and mattings, sheet glass.	one square metre (m^2)
(7)	Timber.	one cubic metre (m^3)
(8)	Paints (when sold by measure), spirits.	one litre (l)

Weights

(1) In place of the present units of seer, pound, rattal, viss etc., use the kilogram.

(2) In place of the tola, use the gram or 10 grams.

(3) In place of maund or corresponding unit, use the quintal *i.e.*, 100 kg.

Capacity Measures

In place of seer or gallon or any other measure use the litre.

Length Measures

(1) Use the metre in place of yard or foot and the centimetre in place of inch.

Square Measures

(1) Use the square metre in place of square yard or square foot, and square centimetre in place of square inch.

Cubic Measures

(1) Use the cubic metre in place of cubic yard or cubic foot and cubic centimetre in place of cubic inch.

Packaging

It is advantageous if sizes of packages correspond to series of commercial weights and measures prescribed.

These are: 50 kg, 20 kg, 10 kg, 5 kg, 2 kg, 1 kg, 500 g, 200 g, 100 g, 50 g, 20 g, 5 g, 2 g, 1 g, and so on.

TYPICAL PRICING UNITS FOR RETAIL TRADE

Serial No.	Commodity	Metric Unit for Use
(1)	Foodgrains, cereals, pulses, spices, ghee, bread, vegetables, meat, fish, sweetmeats, tea, coffee, sugar, salt.	1 kg
(2)	Oil for cooking	1 kg or 1 litre depending upon prevalent practice.
(3)	Fruits	1 kg or number depending upon prevalent practice.
(4)	Milk	1 litre
(5)	Cloth and related materials	1 metre
(6)	Prepackaged materials	Preferably sizes corresponding to series of commercial weights and measures.

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metric measures

THE PUBLICATIONS DIVISION

ABBREVIATIONS FOR METRIC UNITS

(1) DECIMAL MULTIPLES AND SUBMULTIPLES

Prefix		Value in Terms of Unit	Abbreviation
kilo	..	1,000	k
centi	..	0·01 (10^{-2})	c
milli	..	0·001(10^{-3})	m
micro	..	0·000 001(10^{-6})	μ

(2) WEIGHTS

Denomination		Value	Abbreviation
tonne	..	1 000 kg	t
quintal	..	100 kg	q
kilogram	..	1 kg	kg
gram	..	1 g	g
milligram	..	1 mg	mg
carat	..	200 mg	c

(3) CAPACITY

kilolitre	..	1 000 l	kl
litre	..	1 l	l
millilitre	..	1 ml	ml

(4) VOLUME

cubic metre	..	m^3	m^3 or cu m*
cubic centimetre		cm^3	cm^3 or cu cm*
cubic millimetre		mm^3	mm^3 or cu mm*

(5) LENGTH

kilometre	..	1 000 m	km
metre	.	1 m	m
centimetre	..	1 cm	cm
millimetre	..	1 mm	mm
micron	..	1/1 000 mm or 10^{-3} mm	μm

(6) AREA

square kilometre		1 000 000 m^2	km^2 or sq km*
square metre	..	1 m^2	m^2 or sq m*
square centimetre		1 cm^2	cm^2 or sq cm*
square millimetre		1 mm^2	mm^2 or sq mm*

(7) LAND MEASURE

are	..	100 m^2	a
hectare	..	100 a	ha
centiare	..	m^2	ca

*Both these abbreviations are current, but the first set should preferably be used. The former abbreviation is used more commonly internationally than the latter.

Rules for Abbreviations :

(1) Do not make any change, such as addition of 's' to indicate plurality *e.g.*, write 1 kg, 10 kg, 20g, 5 g, 10 t, 20 ml, 27 l, 165 km, 2 mm, 100 cm^3, 66 km^2;

(2) Do not capitalize the abbreviations. For example, do not write 1 Kg, 2 Kg, 20 MM, 50 MM, the right way is to write 1 kg, 2 kg, 20 mm, 50 mm, etc.;

(3) Do not use any other abbreviations except those given above.

metric measures

JOURNAL OF WEIGHTS AND MEASURES
DIRECTORATE OF WEIGHTS & MEASURES
MINISTRY OF INTERNATIONAL TRADE

Vol. 6 SEPTEMBER 1963 (BHADRA 1885) No. 5

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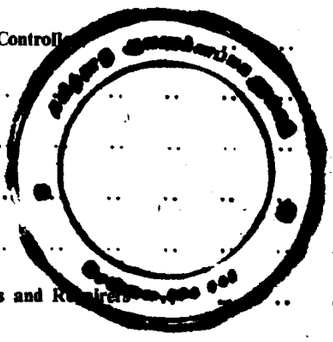

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metric measures

METRIC MEASURES is published every two months.

METRIC MEASURES provides information to the general public on the administrative, commercial, educational, industrial, historical and other aspects of weights and measures, with particular reference to the introduction of the metric system in India.

Contributions for publication should be sent to the Editor, METRIC MEASURES, Ministry of International Trade, Udyog Bhavan, New Delhi.

Enquiries regarding subscriptions and supply of copies should be addressed to the Business Manager, Publications Division, Ministry of Information and Broadcasting, Old Secretariat, Delhi-6.

Development of Capacity Measures in South India—Part 2

L. RAJU & V. B. MAINKAR

Ministry of International Trade,
New Delhi

IN Part 1 of this series of articles, we discussed the variety of capacity measures used in South India. It was found that in order to understand the variety, legal and otherwise, it was necessary to go back to Vedic times and study the development of capacity measures from that time onwards. As capacity measures are often based on the volume of vessels of specified dimensions, we found it necessary to define two length units—angula and hasta. Two types of hasta were shown to be in use. On studying the earliest systematic data on the hasta, the following dimensions were established for these length units:

Angula	=17·86 mm
Prajapatya hasta	=42·86 cm
Commercial hasta	=50 cm

Vedic Capacity Measures

As there is very little information available on the capacity measures used in the Indus Valley civilization, our study has necessarily to begin with the oldest of the Sanskrit books —the *Rigveda*. In the *Rigveda*, the drona (द्रोण), kumbh (कुंभ), khari (खारी) and dronakalash (द्रोणकलश), which may or may not be the same as the drona, are mentioned. The other *Vedas* also have many references to these capacity measures. The khari and drona are sometimes equated (*Rigveda* 4.3.11.17). There is, however, little information about their contents. The *Vedic Index*[4] remarks:

'The drona is a wooden trough and more specifically it designates in the plural vessels used for holding Soma.' It further adds: 'The great wooden reservoir for Soma is called a dronakalash.' In the section on Soma it is mentioned that the drona may also be the vessel from which the priests drank the Soma. It would thus appear that the drona was an indefinite measure.

Vedanga Jyotisha Table

It is when we come to the *Vedanga Jyotisha*[16] that we get some estimate of the capacities of some measures. Here units like prastha (verse 7), pala, adhaka, drona (verse 24) are mentioned. For example, verse 24 is as follows:

पलानि पञ्चाशदपां धृतानि तदाढकंद्रोणमतः प्रमेयम ।
त्रिभिर्विहीनं कुडवैस्तु कार्यं तन्नाडिकायास्तु भवेत्प्रमाणम्।।
।।7।।

(A vessel in which 50 palas of water can be kept is called an adhaka; from adhaka the measure of drona should be inferred, as already pointed out; if from a drona, three kudavas are deducted, it will be the measure of a nadika).

The table given by commentators is as follows:

1 kudava =3¼ pala
4 kudava =prastha =12½ pala
4 prastha =1 adhaka =50 pala
4 adhaka =1 drona =200 pala.

The determination of time in the days of *Vedanga Jyotisha* was apparently carried out by means of a metal cup which could hold a prastha of water *i.e.* 12½ palas. This pot had a small hole at the bottom and was placed in another larger vessel filled with water. The time taken by the vessel to fill and sink was the unit of time.

The above table is useful insofar as it establishes a table of relations of units. But it does not help us in calculating volumes which could be converted to modern units, because it does not define the pala.

Arthashastra Table

For this purpose, we again have to refer to the *Arthashastra*[7] which was written a few centuries after the *Vedanga Jyotisha*. It should be remembered that we are assuming that the traditions remained almost unchanged during this period. The table of capacity measures given in chapter 19, Book 2, of *Arthashastra* is on the following lines:

200 pala in the grains of masha =1 drona, which is an ayamana, a measure of royal income.
187½ pala in the grains of masha =1 public drona.
175 pala in the grains of masha =1 bhajaniya, servants' measure.
162½ pala in the grains of masha =1 antahpurabhajaniya, harem measure.

Adhaka, prastha and kudumba are each one-fourth of the one previously mentioned.

16 drona =1 vari or khari
20 drona =1 kumbha
10 kumbha=1 vaha.

It is further laid down that cubic measure shall be so made of dry and strong wood that, when filled with grains, the conically heaped-up portion of the grains standing on the mouth of the measure is equal to one-fourth of the quantity of the grains (so measured); or the measure may also be so made that a quantity equal to the heaped-up portion can be contained within (the measure) (or level to the mouth). (Measures can be so made that grains can be measured level to the mouth).

But liquids shall be measured level to the mouth of the measure.

Evaluating Arthashastra Units

While analysing this table we have to assume that the contents of the measures quoted above are for struck measures. Secondly, we shall have to evaluate the contents in terms of water so as to obtain comparable values. This is particularly necessary as we have no information about the weight-volume ratio of the masha grains. Moreover, if the capacity measure is taken to mean the space occupied by that much weight of the grain, it would only mean that many different measures would have to be maintained by the Superintendent of Weights and Measures. That these measures were used as dry as well as liquid measures would be apparent from the fact that they were employed for measuring time (Ch. 20, book 2), gauging rain (Ch. 24, book 2) and wines (Ch. 25, book 2), and liquid commodities as well as grains.

The basic unit is the pala. In the *Arthashastra* two palas are mentioned—pala and dharanapala. The latter is supposed to be greater by one karsha from the ordinary pala, *i.e.* it consists of 5 karshas. We are concerned with the ordinary pala which is equal to 320 gunja seeds according to the *Arthashastra*[7]. We have already seen in the *Vedanga Jyotisha* that the adhaka and prastha were standardized with water for measurement of time. We may evaluate the *Arthashastra* measures also in terms of water for simplicity and comparison. We find that the pala weighs 39·680 grams, if we assume the average weight of the gunja is 124 mg. We had taken this weight as standard in the series of articles on Madras weights[1]. We may use it in the absence of a better value. Taking the specific gravity of water to be unity, the pala would measure 39·68 ml. The table would then work out as follows:

TABLE I—ARTHASHASTRA MEASURES EVALUATED

Relation to Drona	Unit	Drona Unit 200 pala		Drona Unit 187·5 pala		Drona Unit 175 pala		Drona Unit 162·5 pala	
1/64	Kudumba	124	ml	116	ml	108	ml	101	ml
1/16	Prastha	496	ml	465	ml	434	ml	403	ml
¼	Adhaka	1·984	l	1·860	l	1·736	l	1·612	l
1	Drona	7·936	l	7·440	l	6·944	l	6·448	l
16	Khari	126·976	l	119·040	l	111·104	l	103·168	l
20	Kumbha	158·72	l	148·8	l	138·88	l	128·96	l
200	Vaha	1587	l	1488	l	1389	l	1290	l

The *Vedanga Jyotisha* table is the same as the *Arthashastra* table and hence we may assume that the same values would be valid for the *Vedanga Jyotisha* units.

We may note one point. Each drona is 12½ pala larger or smaller than the preceding or succeeding one. We know that 12½ pala make a prastha which is the capacity of the standard vessel used in the determination of time.

An interesting observation from this table is that the kudumba is 124 ml. As the above values are obtained with water, 124 ml are equal to 124 grams. We have taken the weight of the gunja (or raktika) as 124 mg. So the kuduva represents 1,000 gunjas *i.e.* 3⅛ pala of 320 gunja each. In the *Taittiriya Samhita*[5] (2.3.2.) there is mention of a shataraktika being the weight of a certain quantity of gold. The kudumba then represents 10 shataraktika. It is possible that 10 pieces of shataraktika or shatamana, as it is later called in the *Taittiriya Samhita*, may have served to standardize and calibrate the kudumba vessel.

We have now established the volumes of the oldest capacity measures in terms of the metric system. We have seen that during the period of a few centuries between the compilation of the *Vedanga Jyotisha* and the *Arthashastra*, there had been very little change in the capacities of measures used. It is mainly in the literature produced after the 4th century B.C. that the variety is noticeable for many reasons. We shall take the *Arthashastra* tables as the basic table for further analysis later on.

Other Later Measures

We may make a very rapid survey of the later measures mentioned in a few prominent Sanskrit works as also the tables of capacity measures which historians believe were in use in the kingdoms of certain South Indian Kings. It must be stressed that this can only be a rapid review as the material which can be examined is immense. Only the salient points from a few prominent sources can be touched upon in this article.

The important post—*Arthashastra* section of Sanskrit literature which we may examine is the *Puranas*. The following tables are quoted by Colebrooke.[17]

Varaha Purana

1 mushti or handful =1 pala =39·68 ml
2 pala =1 prasriti =79·36 ml
8 mushti =1 kunchi =317·44 ml
8 kunchi =1 pushkala =2·540 litres
8 pushkala =1 adhaka =10·158 litres
4 adhaka =1 drona =40·632 litres
=(1,020 palas).

Skanda Purana

		Pala @ 39·68 *ml*		*Pala* @ 31 ml.	
2 pala	=1 prasriti	= 79·36 ml		62	ml
2 prasriti	=1 kudava	=158·72 ml		124	ml
4 kudava	=1 prastha	=634·88 ml		496	ml
4 prastha	=1 adhaka	= 2·540	l	1·984	l
4 adhaka	=1 drona (256 pala)	= 10·158	l	7·936	l
2 drona	=1 kumbha (1)	= 20·316	l	15·872	l
20 drona	=1 kumbha (2)	=203·16	l	158·72	

The *Bhavishya Purana* and the *Padma Purana* also give tables similar to the *Skanda Purana*, wherein the drona contains 256 pala. The larger units are as follows:

Bhavishya Purana

2 drona =1 kumbha or surpa
16 drona =1 khari or shari

Padma Purana

2 drona =1 kumbha (according to some)
20 drona =1 kumbha (according to others)

It is well-known that the traditions recorded in the *Puranas* are sometimes misleading. The above two tables illustrate this belief. The tables from two *Puranas* show a ratio of 1:4 in the volume of the drona. Hari Prasad Shastri in his English translation of *Valmiki Ramayana*[18] has stated that the drona is a measure of about 92 pounds. Taking 10 lb to the gallon, this would work out to 41·823 litres, which is very nearly the drona of the *Varaha Purana*.

The *Skanda Purana* table can be explained if we presume that the drona remains unchanged in value at 7·936 litres as given by *Arthashastra*. This means that 200 pala of *Arthashastra* are equal to 256 pala of *Skanda Purana*. If this is done, the value of the pala works out to be 31 ml. There is some sanction to make this assumption. Colebrooke[17] has stated that the *Gopatha-Brahmana* describes the prastha of Magadha as follows:

4 krishnala	=1 masha	= 0·496 ml
64 masha	=1 pala	=31·744 ml
32 pala	=1 prastha as used in Magadha	=1·016 litres.

This pala is very nearly equal to the 31 ml pala derived above.

Another way of looking at this table is that for a struck measure the weight-volume ratio of rice is about 1:1.25. We know that there was in some areas a tradition to take rice as the standard commodity for evaluating dry measures. So to fill a pala (struck) measure of about 40 ml, the weight of rice required would be about 30 to 31 grams. If this base is used, the 256 pala drona, based on volume of rice, would be about 200 pala weight of rice, or alternatively 200 pala of water.

It is on the basis of a pala of 31 ml that the second set of values is calculated.

We may now examine the data supplied by Varahamihira, the well-known astronomer of the 6th century A.D., in his *Brihatsamhita*.[19] While prescribing the construction and operation of a raingauge he states (Ch. 23, verse 2) that the gauge should have the dimension of one hasta and when it accumulates 50 pala of water, it will be equal to one adhaka. This adhaka is equal to the *Vedanga Jyotisha* and *Arthashastra* adhaka and we may take it that the drona would also correspond to 200 pala.

South Indian Measures

The literature on weights and measures current in South India from the earliest times is rather meagre. There is, however, often a correspondence between the units recorded in Sanskrit literature and those prevalent in South India. The names of the units may or may not differ.

A comprehensive table of measures current in South India from the 4th to 10th century, devised from South Indian inscriptions[20] is on the following lines:

5 sevidu	=1 alakku
2 alakku	=1 ulakku
2 ulakku	=1 uri
2 uri	=1 nali
8 nali	=1 kuruni
2 kuruni	=1 padakku
2 padakku	=1 tuni
3 tuni	=1 kalam.

This table has a strong resemblance to the table now in use in Madras, particularly if we remember that the padi and the nali have been used as the names for the same measure.

The table as shortened would then be:

5 sevidu	=1 alakku
8 alakku	=1 nali (padi)
8 nali	=1 kuruni (marakkal)
12 kuruni	=1 kalam.

There has been a tradition in South India that the nali or padi should be the volume occupied by a certain weight, usually viss, of a specified grain, usually rice, or a mixture of grains. The grains have often varied giving rise to differing values of nali. To obviate this confusion, we shall work out the basic values in terms of water.

There are 40 palam in a viss and the nali or padi is the volume occupied by one viss weight of rice. The palam of ancient days consisted of 320 gunjas as against 288 gunjas (3 tolas) in recent times. The ancient nali would, therefore, have a capacity of 40×39·68 =1·5872 litres of water. Then the kuruni is 12·6976 litres and the kalam is 152·37 litres. It will be noticed that the kuruni or marakkal is 1/10 of the ayamana khari of *Arthashastra*. The other values would work out to be specified proportions of this unit. The sevidu works out to be equivalent to a palam. This is not very surprising. Thus we see that the epigraphic values have a continuous link with the *Arthashastra* values and have continued over in the contemporary period though in forms highly mutilated for a variety of reasons.

The literature on weights and measures in later times in South India is too scattered to enable us to work out any tables. No physical samples of the measures used during the period or even much later are available. Hence an analysis of further historical data is not possible.

Bhaskaracharya's Lilavati

So far we have examined the capacity measures on the basis of volume occupied by a certain weight of commodities, which we reduced to water basis for comparison. We may now examine the measures based on the volume of geometrical figures whose dimensions are given in length units. Earlier we referred to the construction of a raingauge as prescribed by Varahamihira. *Arthashastra*[7] also describes a similar vessel. But he had not defined all the units specifically, although certain inferences could be drawn. Other measures also have been variously described. For example, a kudava is defined as a vessel four fingers wide and as many deep, and also as a cube of 3½ fingers each side.[17] The most important source of information is, however, the *Lilavati* of Bhaskaracharya,[21] the great mathematician and astronomer of the twelfth century. As the *Lilavati* is an authoritative book on arithmetic we may assume that the data on weights and measures given in it would be substantially reliable, as arithmetic has to be related to the existing weights, measures and trade practices. His table on capacity measures works out as follows:

4 kudava	=1 prastha
4 prastha	=1 adhaka
4 adhaka	=1 drona
16 drona	=1 kharika

The kharika, which is also called Magadha Kharika, is defined as a cube each side of which measures one hasta *i.e.* ghanahasta.

(हस्तोन्मितैः विस्तृतिदैर्घ्यपिंडैः यैर्द्वादशास्त्रं घनहस्तसंज्ञं ।
धान्यादिके यद्घनहस्तमानं शास्त्रोदिता मागधखारिका सा ॥ 6 ॥
द्रोणस्तु खार्याः खलु षोडशांशः स्यादाढको द्रोणचतुर्थभागः ।
प्रस्थश्चतुर्थांश इहाढकस्य प्रस्थाद्रिराद्यैः कुडवः प्रदिष्टः ॥ 7 ॥

लीलावती, परिभाषाप्रकरण 6-7)

He has defined hasta as 24 angula and the angula as 8 yava. We have, however, seen earlier that traditionally the commercial hasta consisted of 28 angulas. Assuming that Vedic and later traditions had got mixed-up by the time of Bhaskaracharya, we shall work out a table of values for various units using the hasta of 24 and 28 angula as defined in Part 1.

$(\text{hasta})^3 = (42 \cdot 86 \text{ cm})^3 = 78 \cdot 73$ litres

$(\text{hasta})^3 = (50 \text{ cm})^3 = 125$ litres

The following table is prepared on the basis of the above two values of the hasta.

TABLE 2—EVALUATION OF *Lilavati* MEASURES

Relation to Drona	Unit	24 Angula	28 Angula
1/64	kudava	77 ml	122 ml
1/16	prastha	307 ml	488 ml
¼	adhaka	1·230 l	1·953 l
1	drona	4·920 l	7·813 l
16	khari (ghanahasta)	78·73 litres	125
20	kumbha	98·4 litres	156·3
200	vaha	984	1563

The results given in Table 2 are astonishing. It will be noted that the value of khari, also called ghanahasta, obtained by mathematically cubing the hasta of 28 angula which became equal to 24 angula in the times of Bhaskaracharya, the value of angula having changed, is in very close agreement with the value obtained on the basis of the volume occupied by 200 pala weight of water from the data given in *Arthashastra*. The other measures of khari based on 187·5, 175 and 162·5 pala became obsolete in the course of time. If the medium is other than water the bulk density of the medium would change the volume proportionately.

The correspondence of values obtained by using two entirely different approaches clearly indicates that in ancient times, the weight, capacity and volume units were all related as they are in the metric system of today. This statement is valid only if the medium of evaluation is water. The hasta should also be taken as 28 angula and not 24 as given in later literature. In any case, it is necessary to equate the 28 angula commercial hasta with the later 24 angul hasta. It is also likely that only the ayamana measures of *Arthashastra* remained predominently in use in later times as shown by the *Lilavati* values.

Confusion About Hasta

The confusion between the 24 angula hasta and 28 angula hasta becomes all the more marked as we go through later literature. Sometimes, the 24 angula hasta has the same length as the 28 angula hasta, but the length of the angula is increased. The 24 angula Prajapatya hasta then should shrink further. This is exactly what has happened to the two hasta of 24 and 21 angula mentioned in the *Aditya Purana*[22]. $\frac{(24 \times 24}{28} = 20 \cdot 6$ angula or 21 to the nearest angula). In trade or commerce such a mix-up about the very basic unit of the hasta would lead to tremendous confusion. Add to that the trade practice which required that the capacity measure should be the volume occupied by a certain weight of grain. The grain could differ from place to place. Even if the same grain was used the specific quality has to be prescribed if standardization is to be achieved. To top it all, the mode of use of the dry measure, whether heaped or struck, would also make its own contribution towards confusion. A conflict of all these interests could only lead to one result—utter confusion.

In the absence of reliable data and literature, we now have to skip over a period of some 600 years of ever increasing confusion and take up our thread after the arrival of the British in India.

Some admirable studies of the contents of the measures existing in 18th and 19th century made by British scholars are available.

On the basis of their data, we shall discuss certain variations of units of capacity in the concluding Part 3 of this series of articles.

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(*continued from Part 1*)

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Metric Building Standards

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[In the July 1963 issue of *Metric Measures* a list of 147 standards bearing on the various products and practices of the building industry was published on pages 15 to 18.

In this issue the concluding portion of the list of 259 Indian Standards is published.

—*Editor*]

(2) METRIC DESIGN CODES

(148)	IS: 287—1960	Recommendations for Maximum Permissible Moisture Content of Timber Used for Different Purposes in Different Climatic Zones (Revised).
(149)	IS: 456—1957	Codes of Practice for Plain and Reinforced Concrete.
(150)	IS: 732—1963	Code of Practice for Electrical Wiring Installations (Revised).
(151)	IS: 800—1962	Code of Practice for Use of Structural Steel in General Building Construction (Revised).
(152)	IS: 801—1956	Code of Practice for Use of Cold Formed Light Gauge Structural Steel Members in General Building Construction.
(153)	IS: 806—1957	Code of Practice for Use of Steel Tubes in General Building Construction.
(154)	IS: 883—1961	Code of Practice for Use of Structural Timber in Buildings (Material, Grading and Design).
(155)	IS: 1080—1962	Code of Practice for Design and Construction of Spread Foundations.
(156)	IS: 1172—1957	Basic Requirements for Water Supply Drainage and Sanitation.
(157)	IS: 1233—1958	Recommendations for Modular Coordination of Dimensions in the Building Industry.
(158)	IS: 1343—1960	Code of Practice for Prestressed Concrete.
(159)	IS: 1414—1962	Code of Practice for Fixing Wall Coverings.
(160)	IS: 1553—1960	Primary Elements in the Design of Library Buildings.
(161)	IS: 1634—1960	Code of Practice for Design and Construction of Wood Stairs.
(162)	IS: 1649—1962	Code of Practice for Design and Construction of Flues and Chimneys for Domestic Heating Purposes.
(163)	IS: 1742—1960	Code of Practice for Building Drainage.
(164)	IS: 1860—1961	Code of Practice for Installation Operation and Maintenance of Electric Passenger and Goods Lifts.
(165)	IS: 1888—1962	Method of Load Tests on Soils.
(166)	IS: 1892—1962	Code of Practice for Site Investigations for Foundations.

(167)	IS: 1893—1962	Recommendations for Earthquake Resistant Design of Structures.
(168)	IS: 1904—1961	Code of Practice for Structural Safety of Buildings—Foundations.
(169)	IS: 1905—1961	Code of Practice for Structural Safety of Buildings—Masonry Walls.
(170)	IS: 1911—1961	Schedule of Unit Weights of Building Materials.
(171)	IS: 1915—1961	Code of Practice for Steel Bridges.
(172)	IS: 1950—1962	Code of Practice for Sound Insulation of Non-Industrial Buildings.
(173)	IS: 2189—1962	Code of Practice for Automatic Fire Alarm Systems.
(174)	IS: 2212—1962	Code of Practice for Brickwork.
(175)	ISI Handbook for Structural Engineers: No. 2	Steel Beams and Plate Girders.
(176)	ISI Handbook for Structural Engineers No. 3	Steel Columns and Struts.

(3) METRIC CONSTRUCTION CODES

(177)	IS: 658—1962	Code of Practice for Magnesium Oxychloride Composition Floors (Revised).
(178)	IS: 783—1959	Code of Practice for Laying of Concrete Pipes.
(179)	IS: 1081—1960	Code of Practice for Fixing and Glazing of Steel Doors, Windows and Ventilators.
(180)	IS: 1196—1958	Code of Practice for Laying of Mastic Asphalt Flooring.
(181)	IS: 1197—1958	Code of Practice for Laying Rubber Floors.
(182)	IS: 1198—1958	Code of Practice for Laying and Maintenance of Linoleum Floors.
(183)	IS: 1346—1959	Code of Practice for Waterproofing of Roofs Using Bitumen Felts.
(184)	IS: 1443—1959	Code of Practice for Laying and Finishing of Cement Concrete Flooring Tiles.
(185)	IS: 1447—Pt. I —1959	Finishing of Iron and Steel in Buildings—Painting and Allied Finishes : Part I Operations and Workmanship.
(186)	IS: 1498—1959	Classification and Identification of Soils for General Engineering Purposes.
(187)	IS: 1609—1960	Code of Practice for Laying Damp-proof Course Using Bitumen Felts.
(188)	IS: 1625—1962	Code of Practice for Preparation and Use of Lime Mortar in Buildings.
(189)	IS: 1661—1960	Cement and Cement Lime Plaster—Finishes on Walls and Ceilings.
(190)	IS: 1946—1961	Code of Practice for Use of Fixing Devices in Walls and Floors of Solid Construction.
(191)	IS: 2064—1962	Code of Practice for Selection, Installation and Maintenance of Sanitary Appliances.
(192)	IS: 2110—1962	Code of Practice for *in situ* Construction of Walls in Buildings with Soil Cement.
(193)	IS: 2114—1962	Code of Practice for Laying *in situ* Terrazzo Floors.
(194)	IS: 2115—1962	Code of Practice for Flat Roof Finish: Mud Pushka.
(195)	IS: 2118—1962	Code of Practice for Construction of Jack Arch Type of Built-up Floor or Roof.
(196)	IS: 2119—1962	Code of Practice for Construction of Brick-*cum*-Concrete Composite (Madras Terrace) Floor or Roof.
(197)	IS: 2204—1962	Code of Practice for Construction of Reinforced Concrete Shell Roof.

(4) METRIC TREATMENT CODES

(198)	IS: 401—1961	Preservation of Timber (Revised).
(199)	IS: 1129—1959	Dressing of Natural Building Stones.
(200)	IS: 1141—1958	Seasoning of Timber.
(201)	IS: 1635—1960	Field Slaking of Lime and Preparation of Putty.
(202)	IS: 1861—1961	Code of Practice for Manufacture of Lime in Vertical Mixed-Feed Type Kilns.
(203)	IS: 1902—1961	Preservation of Bamboos and Cane for Non-Structural Purposes.

(5) WELDING ACCESSORIES

(204)	IS: 814—1957	Covered Electrodes for Metal Arc Welding of Mild Steel.
(205)	IS: 1278—1958	Filler Rods and Wires for Gas Welding.

(206) IS: 1395—1959 1/2 Per cent Molybdenum Steel Covered Electrodes for Metal Arc Welding.

(207) IS: 1442—1959 Covered Electrodes for Metal Arc Welding of High Tensile Structural Steel.

(6) WELDING CODES

(208) IS: 816—1956 Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel.

(209) IS: 819—1957 Code of Practice for Resistance Spot Welding for Light Assemblies in Mild Steel.

(210) IS: 1261—1959 Code of Practice for Seam Welding in Mild Steel.

(211) IS: 1323—1959 Code of Practice for Oxy-Acetylene Welding for Structural Work in Mild Steel.

(7) METRIC BUILDING CONSTRUCTION EQUIPMENT

(212) IS: 1630—1960 Mason's Tools for Plaster Work and Jointing Work.

(213) IS: 1791—1961 Batch Type Concrete Mixers.

(214) IS: 2093—1962 Distributors for Hot Tar and Bitumen.

(215) IS: 2094—1962 Heaters for Tar and Bitumen.

(8) METRIC DRAWING INSTRUMENTS AND CODES

(216) IS: 962—1960 Code of Practice for Architectural and Building Drawings.

(217) IS: 1360—1959 Engineer's Pattern Tee Square.

(218) IS: 1444—1959 Engineer's Pattern Drawing Boards.

(219) IS: 1480—1960 Metric Scales for General Purposes.

(220) IS: 1481—1961 Metric Steel Scales for Engineers.

(221) IS: 1482—1960 Metric Scales for Use With Drafting Machines.

(222) IS: 1491—1959 Metric Scales for Architectural Purposes.

(223) IS: 1561—1962 Set Squares for Use of Drawing Offices.

(224) IS: 1562—1962 Metric Diagonal Scales.

(225) IS: 1563—1962 Protractors for Use of Drawing Offices.

(226) IS: 2103—1962 Engineer's Square.

(227) IS: 2233—1962 Straight Edge for Drawing Office Use.

(9) METRIC SURVEYING INSTRUMENTS

(228) IS: 1269—1958 Metric Woven Metallic Tape Measures.

(229) IS: 1270—1959 Metric Steel Tape Measures (Winding Type).

(230) IS: 1492—1959 Metric Surveying Chains.

(231) IS: 1632—1960 Bubbles.

(232) IS: 1764—1961 Trough Compass.

(233) IS: 1779—1961 4-Metre Levelling Staff, Folding Type.

(234) IS: 1842—1961 Surveying Chain Pins.

(235) IS: 1955—1961 Prismatic Compass, Liquid.

(236) IS: 1957—1961 Prismatic Compass, Non-Liquid.

(10) FIRE EXTINGUISHERS

(237) IS: 933—1959 Portable Chemical Fire Extinguisher Foam Type.

(238) IS: 934—1960 Portable Chemical Fire Extinguisher, Soda Acid Type.

(239) IS: 935—1959 Portable Chemical Fire Extinguisher, Carbon Tetrachloride Type.

(240) IS: 940—1961 Portable Chemical Fire Extinguisher, (Gas Pressure).

(241) IS: 1924—1961 Portable Fire Extinguisher, Water Type (Bucket Pump).

(242) IS: 1933—1961 Portable Chemical Fire Extinguisher, Chlorobromomethane Type.

(243) IS: 2171—1962 Portable Fire Extinguisher, Dry Powder Type.

(11) SOIL CLASSIFICATION

(244) IS: 1498—1959 Classification and Identification of Soils for General Engineering Purposes.

(12) EQUIVALENT METRIC UNITS AND MEASUREMENT OF BUILDING WORKS

(245) IS: 965—1958 Equivalent Metric Units for Dimensions, Scales and Quantities in General Construction Work.

(246) IS: 1200—1958 Method of Measurement of Building Works.

(13) BUILDING BYE-LAWS

(247) IS: 1256—1958 Building Bye-Laws.

(14) FIRE SAFETY OF BUILDINGS

(248) IS: 1641—1960 Fire Safety of Buildings (General) : General Principles and Fire Grading.

(249) IS: 1642—1960 Fire Safety of Buildings (General) : Materials and Details of Construction.

(250) IS: 1643—1960 Fire Safety of Buildings (General) : Exposure Hazard.

(251) IS: 1644—1960 Fire Safety of Buildings (General) : Personal Hazard.

(252) IS: 1645—1960 Fire Safety of Buildings (General) : Chimneys, Flues, Flue Pipes and Hearths.

(253) IS: 1646—1961 Fire Safety of Buildings (General) : Electrical Installations.

(254) IS: 1647—1960 Fire Safety of Buildings (General) : Non-Electric Lighting Equipment, Oil and Gas Heaters and Burners of Small Capacity.

(255) IS: 1648—1961 Fire Safety of Buildings (General): Fire Fighting Equipment and Its Maintenance Including Construction and Installation of Fire-Proof Doors.

(256) IS: 1649—1962 Design and Construction of Flues and Chimneys for Domestic Heating Appliances.

(257) IS: 2189—1962 Automatic Fire Alarm Systems.

(258) IS: 2190—1962 Selection, Installation and Maintenance of Portable First Air Fire Appliances.

(15) MODULAR COORDINATION IN BUILDING INDUSTRY

(259) IS: 1233—1958 Recommendations for Modular Coordination of Dimensions in the Building Industry.

Conversion of Length Units

M. L. KALSI

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IN the July 1963 issue of *Metric Measures* (p. 25) was published an easy method for conversion of weights (seers and kilograms) and related prices. It is now intended to work out easy methods for conversion of (*i*) the metre and yard (*ii*) the kilometre and mile (*iii*) the furlong and kilometre and (*iv*) the inches and metres.

The conversion factors are:

(1) 1 yard = 0·9144 metre
(2) 1 mile = 1·609344 km
(3) 1 inch = 0·0254 metre

The use of such factors involves tedious calculations. Simple formulae are suggested below:

I—YARDS AND METRES

A. Conversion of Metres to Yards

Multiply the number of metres by 12/11. Add 0·01 for every (3¾) metres or part thereof. For larger numbers add 0·04 for every 15 metres. This will give results correct to two places of decimals.

Examples

Convert 52, 105 and 225 metres into yards:

(*i*) 52 metres $= 52 \times 12/11 + 3 \times 0.04 + 0.02$
($\because 52 = 15 \times 3 + 7$)
$= 624/11 + 0 \cdot 12 + 0 \cdot 02$
$= 56 \cdot 73 + 0 \cdot 14$
$= 56 \cdot 87$ yards.

(*ii*) 105 metres $= 105 \times 12/11 + 7 \times 0 \cdot 04$
$= 1260/11 + 0 \cdot 28$
$= 114 \cdot 55 + 0 \cdot 28$
$= 114 \cdot 83$ yards.

(*iii*) 225 metres $= 225 \times 12/11 + 15 \times 0 \cdot 04$
$= 2700/11 + 0 \cdot 60$
$= 245 \cdot 46 + 0 \cdot 60$
$= 246 \cdot 06$ yards

B. Conversion of Yards to Metres

Multiply the number of yards by 11/12 and subtract 0·01 for every 4 yards. But when the number is above 40 yards subtract 0·09 for every 40 yards.

This will give results correct to two places of decimals.

Examples

Convert 52, 105 and 225 yards into metres.

(*i*) 52 yards $= 52 \times 11/12 - 0 \cdot 09 \times 52/40$
$= 143/3 - 1 \cdot 17/10$
$= 47 \cdot 67 - 0 \cdot 12$
$= 47 \cdot 55$ metres.

(*ii*) 105 yards $= 105 \times 11/12 - 0 \cdot 09 \times 105/40$
$= 1155/12 - 1 \cdot 89/8$
$= 96 \cdot 25 - 0 \cdot 24$
$= 96 \cdot 01$ metres.

(*iii*) 225 yards $= 225 \times 11/12 - 0 \cdot 09 \times 225/40$
$= 2475/12 - 0 \cdot 09 \times 45/8$
$= 206 \cdot 25 - 4 \cdot 05/8$
$= 206 \cdot 25 - 0 \cdot 51$
$= 205 \cdot 74$ metres.

(The above formulae also apply to prices of articles).

Note—In the above examples, if the price of 1 yard is Re. 1, the cost of 52 metres, 105 m and 225 m would be Rs. 56·87 nP, Rs. 114·83 and Rs. 246·06 nP respectively.

If the price of 1 metre is Re. 1, the cost of 52 yards, 105 yards and 225 yards would be Rs. 47·55 nP, Rs. 96·01 nP and Rs. 205·74 nP.

II—MILES AND KILOMETRES

A. Conversion of Kilometres to Miles

Multiply the number of kilometres by 5/8 and subtract 0·02 for every 5 kilometres. But when the number is above 20 kilometres but below 250 km subtract 0·09 for every 25 kilometres. After 250 km subtract 0·91 for every 250 kilometres.

This will give results correct to two places of decimals.

Examples

Convert 18, 205 and 948 kilometres into miles:

(*i*) 18 kilometres $= 18 \times 5/8 - 0 \cdot 02 \times 18/5$
$= 45/4 - 0 \cdot 36/5$
$= 11 \cdot 25 - 0 \cdot 07$
$= 11 \cdot 18$ miles.

(*ii*) 205 kilometres $= 205 \times 5/8 - 0 \cdot 09 \times 205/25$
$= 1025/8 - 3 \cdot 69/5$
$= 128 \cdot 12 - 0 \cdot 74$
$= 127 \cdot 38$ miles.

(*iii*) 948 kilometres $= 948 \times 5/8 - 0 \cdot 91 \times 948/250$
$= 237 \times 5/2 - 0 \cdot 91 \times 948/250$
$= 1185/2 - 3450 \cdot 72/1000$
$= 592 \cdot 50 - 3 \cdot 45$
$= 589 \cdot 05$ miles.

B. Conversion of Miles to Kilometres

Multiply by 8/5 and add one less than the number of miles divided by 100. When the number of miles is above 25, add one less for every 15 divided by 100. That is for 30 miles add 0.28, for 45 and 0·42 and so on.

Examples

Convert 21, 500, 840 miles into kilometres

(*i*) 21 miles $= 21 \times 8/5 + 20/100$
$= 168/5 + 0 \cdot 20$
$= 33 \cdot 60 + 0 \cdot 20 = 33 \cdot 80$ km.

(*ii*) 500 miles $= 500 \times 8/5 + 14 \times 500/15 \times 100$
($\because$ for 15 we have to take 14
$\therefore$ for 500 we have to take $\frac{44 \times 500}{15}$)
$= 800 + 14/3$
$= 800 + 4 \cdot 67$
$= 804 \cdot 67$ km.

(*iii*) 840 miles $= 840 \times 8/5 + 14 \times 840/15 \times 100$
$= 168 \times 8 + 1176/150$
$= 1344 + 7 \cdot 84$
$= 1351 \cdot 84$ km.

Note—To convert furlongs into kilometres, multiply the number of furlongs by 0·2.

III—INCHES TO CENTIMETRES

A. Conversion of Inches to Centimetres

Multiply the number of inches by 5/2 and add the number of inches multiplied by 4 and divided by 100.

Examples

Convert 5″ and 36″ into centimetres

5 inches $= 5 \times 5/2 + \frac{5 \times 4}{100}$
$= \frac{25}{2} + \frac{1}{5}$
$= 12 \cdot 50 + 0 \cdot 20$
$= 12 \cdot 70$ cm.

36 inches $= \frac{36 \times 5}{2} + \frac{36 \times 4}{100}$
$= 90 \cdot 00 + \frac{144}{100}$
$= 90 \cdot 00 + 1 \cdot 44$
$= 91 \cdot 44$ cm.

B. Conversion of Centimetres to Inches

Multiply the number of metres by 2/5 and subtract 0·02 for every 3 centimetres.

Examples

Convert 8 cm and 35 cm into inches.

8 cm $= 8 \times \frac{2}{5} - \frac{0{\cdot}02}{3} \times 8$

$= \frac{16}{5} - \frac{0{\cdot}16}{3}$

$= 3{\cdot}20 - {\cdot}05$

$= 3{\cdot}15$ inches.

35 cm $= 35 \times \frac{2}{5} - \frac{0{\cdot}02}{3} \times 35$

$= 14 - \frac{0{\cdot}70}{3}$

$= 14 - 0{\cdot}23$

$= 13{\cdot}77$ inches.

Seventh Conference of Controllers

The Seventh Conference of Controllers was held in 'Udyog Bhavan' at New Delhi on 6 and 7 August 1963. Details of the proceedings of the Conference will be published in the November 1963 issue of *Metric Measures*.

Following are some of the items which came up for discussion.

(1) Amendments to the States Weights and Measures (Enforcement) Acts and Rules have to be made to make them more effective. Among the important amendments to the (Enforcement) Act the following was considered;

(*i*) Make it an offence to quote commodity prices, or express quantities in non-standard weights and measures in transactions of any kind and prescribe penalties for such offences.

(2) Among the amendments to the Weights and Measures (Enforcement) Rules the following are among the more important:

(*i*) Denominations, name or trade mark of the manufacturers, etc. should be marked in Devanagri script and in either the Roman script or a script of one of the regional languages recognised by the Constitution.

(*ii*) Permissible errors for sealed packages such as for biscuits and cloth.

(*iii*) Recognition of stroke measures used in the sale of petroleum products.

Among other points to be considered were :

(3) The training of Inspectors and Senior officials.

(4) Preliminary steps to be taken for the preparation of a *Manual for Inspectors*.

(5) Setting up of a central laboratory for testing prototypes.

(6) Standardization of the forms and registers used in the enforcement of the Weights and Measures (Enforcement) Act by the various States and Union Territories.

News & Views

Demonetisation of Anna and Pice

With effect from 1 January 1964, the Union Government will call in the following denominations of the anna-pie series:

(1) Cupro-nickel one anna coin,
(2) Copper double pice coin,
(3) Copper and bronze single pice coin.

From that date, these coins will cease to be legal tender. They will, however, be accepted from the public till 30 June 1964, at all offices of the Reserve Bank of India, at all agency banks of the Reserve Bank of India conducting Government business and at all Government treasuries and sub-treasuries in payment of dues as well as for exchange. During the same period, *i.e.*, from 1 January 1964 to 30 June 1964, they will also be accepted at all railway offices and post and telegraph offices but only in payment of dues such as in payment for railway tickets, booking of goods by railways, postage stamps and other postal stationery, radio licence fees, etc.

Moreover, until further notice, these coins will continue to be accepted even after 30 June 1964 at the offices of the Issue Department of the Reserve Bank of India at Bombay, Calcutta, Madras, Kanpur, New Delhi, Bangalore and Nagpur only.

During the period from 1 July 1963 to 31 December 1963, the public are adivsed to tender, as far as possible, 1 anna, double pice and single pice coins in their possession, whenever they make payments of Government dues like income-tax, sales tax and entertainment tax etc., and all the deposits of fees, money into the treasuries, sub-treasuries and Reserve Bank of India and agency banks conducting Government business. They may also tender these coins as far as possible for the purchase of postal stationery, railway tickets etc., at the Posts and Telegraphs and railway offices. Even after 31 December 1963, there will still be facilities for exchange of these coins but only at the particular offices and in the particular manner indicated above.

The demonetisation of these coins is the fourth step which the Union Government has taken in the withdrawal of old coins after the introduction of the decimal coinage. The rupee, half rupee and the quarter rupee coins will continue to be legal tender as before and they are not being demonetised.

Eighth Indian Standards Convention

As reported earlier, (See *Metric Measures*, July 1963, p 22) the Eighth Indian Standards Convention will be held at Ahmedabad from 22 to 28 December 1963.

An entire session (S-5) has been devoted to discuss the 'Progress of Change-over to Metric System in Industrial Production'. The scope of the Session is as follows:

Technical and administrative problems of adopting the metric system in production; ways and means of co-ordinating the demand and supply of materials, tools, components and instruments; general review of the progress in individual industries and individual firms.

Following topics illustrate the scope of the session:

(*i*) Problems of conversion of designs and drawings and their possible solutions.

(*ii*) Survey of the difficulties involved in introducing metric system in actual production.

(*iii*) Availability of metric raw materials, tools, instruments and gauges.

(*iv*) Review of standards in metric system presently available and indication of those still required to be prepared.

(*v*) Review of the progress of change-over in a given plant or in a given industry, etc.

Sale of Kerosene by Non-Standard Measure (Bottle)

In Himachal Pradesh the metric system is being introduced more by persuasion than by force. Some people, however, insist on using unlawful practices.

A trader from Dhali, a locality near Simla, was instructed by the Inspector of Weights and Measures, twice or thrice not to use the bottle measure for the sale of kerosene oil, but he paid no heed to it. The trader was caught red handed by the Inspector one day while using the bottle measure for delivering kerosene oil to the customer. There was no other alternative but to file the prosecution case in the court of law.

There is a general belief that a kerosene oil tin of 18·5 l contains 24 bottles, the standard capacity of such a bottle being undefined. In this case also the trader had fixed the price of a bottle of kerosene oil at 44 nP. which he was going to charge from the customer at that time. The retail rate of a tin prevalent at that time was Rs. 10·56.

The bottle used by the trader was of 23 oz which when converted into metric units comes to 650 ml. The 18·5 l tin, therefore, contains 28½ bottles of kerosene oil. The rate per bottle of kerosene oil measuring 650 ml (23 oz) on the basis of Rs. 10·56 per tin of 18·5 l works out to 37nP whereas the trader charged 44 nP. He thus earned by unfair means 7 nP per bottle *i.e.* Rs. 1·98 per tin.

In this case the trader committed two offences at the same time. First, the use of non-standard measure in contravention of sub-section (1) of section 7 of the Rajasthan Weights and Measures (Enforcement) Act, 1958 as extended to the Union Territory of Himachal Pradesh and, secondly, giving short measure to the customer.

On trial under sub-section (1) of section 7 of the Act, the trader was fined Rs. 200·00 or in lieu thereof one month's imprisonment by the court of law. The offender paid the fine.

Readers' Forum

Thoughts on 14 Carat Gold

Sir,

I have seen the article on *Thoughts on 14 Carat Gold* in the March issue of *Metric Maptol*. With regard to finding price per gram of 14 carat gold, I suggest a simpler method *viz* 6 percent of the quoted price of pure gold reduced by 3 percent.

Thus in the example quoted the price per gram of 14 carat gold will be 6 percent of 107 less 3 percent *i.e.* 6·42—0·19=6·23. Accordingly, the price of the ring weighing 7·2 grams will be 7·2×6·23=Rs. 44·86.

While the slight difference of 8 nP in a commodity costing about Rs. 44·94 is negligible this method will enable anybody to assess the price very quickly and that to a very close approximation.

S. L. Saha

Surveyor of Works (VI),
Zone I, Central P.W.D.,
New Delhi

Simple method for Conversion of Acres to Hectares

Sir,

I have gone through the *Readers' Forum* on *Land Area Conversions Made Easy* on pages 23 and 24 of the January 1963 issue of your Magazine entitled *Metric Measures* and suggest a simpler method for the conversion of area in acres to hectares. The easiest formula would be to multiply the area in acres by 4/10 and then increase the product by 1-1/6% to get the area in hectares.

Thus the area of 11·85 acres cited in the example on page 24 would by this method work out to:

11·85×4+1-1/6% = 4·74+·0474+·0079 =4·7935 hectares, which is so close to the figure 4·7955 hectares mentioned in the conversion tables.

S. L. Saha

Surveyor of Works (VI),
Zone I, Central P.W.D.,
New Delhi

Book Review

METRIC GUIDE FOR CIVIL ENGINEERS AND ARCHITECTS (English)——by J. K. Varshneya, Deputy Director (Metric), National Buildings Organisation, New Delhi; published by the Sri Mandir Karyalaya, 15, Daryaganj, Delhi-6; price Rs. 5·50; 1963; pp. 126.

Shri Varshneya, who is engaged in the compilation of a very comprehensive *Handbook for Building Engineers in Metric System*, has brought out a *Metric Guide for Civil Engineers and Architects*. This book is a collection of the papers written by the author on various aspects of the metric system as applied to the building industry, which were published in technical journals in India, including *Metric Measures*.

The author emphasises that metricisation does not mean mere arithmetical conversion but involves three steps, namely arithmetical conversion, rationalization and standardization in accordance with international practice.

In the foreword, Dr. Lal C. Verman, Director of the Indian Standards Institution, rightly stresses that 'To think in terms of metric units instead of converting existing weights and measures into corresponding metric values is of utmost importance'.

The book is divided into 16 chapters and 7 appendices. The book sets out with the history of the metric system, and then proceeds to discuss definitions and abbreviations of units and equivalent metric units and conversion factors. The chapters which are of immediate use to building engineers deal with unit weight of building materials, floor loads on buildings, metric system in surveying, metric drawing equipment and accessories constants for R.C.C. design, soil classification and safe bearing capacity, metric hydraulic formulae, metric construction equipment and modular co-ordination in building industry. A chapter each has also been included on metric system in technical education and metric standardisation in Indian building industry. The first appendix lists out various Indian Standards of use to the building engineer. The second gives information about the *Handbook for Building Engineers in Metric System*. The other appendices deal with wire and sheet metal gauges, test sieves, paper sizes, metric and British units and certain conversion factors.

The book collects in a handy form a good deal of information which the building engineer or architect would require for constant reference.

The change-over in the building industry would demand from the engineers that they should get accustomed to the new units and scales as early as possible. There has been up-to-now a dearth of books which brought together the information which is spread over in a large number of publications. This book for the first time presents substantial basic information required by the building engineer. He is likely to benefit from a perusal of this book. It is, therefore, recommended as the first step or introduction to the metric idea in the building industry.

METRIC SYSTEM IN PRINTING INDUSTRY (English)—A brief note prepared and published by Shri R. P. Barooah, Superintendent, Assam Government Press, Shillong; 1963; pp. 12.

This is a 'brief note prepared and published by Shri Barooah for the benefit of persons

engaged in the printing industry in Assam.' The brief note has been printed in the A-5 size of paper.

As the author rightly remarks 'Amongst all the industries, printing is lagging behind in adopting metric system and persons employed in this industry are found to have very vague ideas about the system and the effects after its introduction. The note has been written for the benefit of those printers who are still not aware of the metric sizes of paper and the problems faced by them in implementing the metric system'.

The author begins by indicating the basis of the A-series of paper sizes, namely, that the aspect ratio is 1: $\sqrt{2}$, and the area of the main size is 1 sq metre. On the basis of this size, the smaller and larger sizes are worked out simply by halving and doubling. The sizes of trimmed paper and of raw stock are listed. The substance of paper is now indicated in grams per square metre(gsm). This system of expressing substance has many advantages, as it avoids long calculations, is not dependent on the sizes and is applicable to all types of paper.

The author then discusses the changes necessary in the various departments of the printing press. For example, changes would have to be made in cutting machines, chases, formes. So far as printing machines are concerned, the full printing capacity (in respect of the maximum size of a machine) can rarely be utilized. More often than not, much smaller formes have to be printed on bigger machines. The author then tabulates 14 types of machines commonly used in India which can take up printing on A-1 size of paper. In another list are given some of the letter-press printing machines with maximum sheet sizes which they can accommodate and the nearest metric sizes which could be used now. On the rotaries, A-4, A-5 and A-6 publications could be printed with little wastage by carefully arranging the forme with as many ups as possible. The B and C series are then touched upon. The conclusion reached is that the problems confronted in the processes of change-over are not complicated and the adoption of the metric system is not a costly affair. The author, however, wants the printers that while purchasing new machinery and printers' equipment, they should keep in view that they would have to work with new metric sizes in the future. An Appendix lists out the various paper sizes of A-series recommended for different uses.

Though the booklet is small, it is informative and would be of interest to those connected with the paper and printing industry.

CORRECTION

On page 10 of May 1963 issue of *Metric Measures* please make the following corrections

(1) Column 1, *for* (kfg), *read* (kgf)

(2) Column 2, *for* 1100 kilograms, *read* 1000 kilograms.

Standards News

(Indian Standards which have a particular bearing on the change-over to the metric system are indicated here. Copies would be available from the Indian Standards Institution, Manak Bhavan, 9, Mathura Road, New Delhi or their Branch Offices at Bombay, Calcutta, Madras and Kanpur.)

Indian Standard Specification for Galvanized Steel Sheets (Plain and Corrugated) (IS: 227—1962)

The Indian Standards Institution has published a revision of Indian Standard Specification for Galvanized Steel Sheets (Plain and Corrugated) (IS: 227—1962). This standard covers the requirements for the following four classes of plain and corrugated galvanized steel sheets, produced by hot dip galvanized process :

Class 1—Extra heavy coating of zinc, nominal 750 g/m²

Class 2—Heavy coating of zinc, nominal 600 g/m²

Class 3—Medium coating of zinc, nominal 450 g/m²

Class 4—Light coating of zinc, nominal 375 g/m²

This standard was first issued in 1951. The main modifications made in this revision relate to the inclusion of another class of galvanized steel sheets having a light coating of zinc and inclusion of rationalized metric values in the standard.

Price : Rs. 2·00

Indian Standard Specification for Mild Steel Wire for General Engineering Purposes (IS: 280—1962)

The Indian Standards Institution has published the first revision of Indian Standard Specification for Mild Steel Wire for General Engineering Purposes (IS: 280—1962), which covers requirements for mild steel wire of sizes 0·125 mm to 12·5 mm diameter for general engineering purposes.

This standard was first issued in 1951. Based on the experience gained in the use of this standard during the last 12 years, the technical committee concerned has issued this revision. The important modifications in the standard pertain to the inclusion of mild steel wire of sizes 0·125 mm to 12·5 mm diameter for general engineering purposes.

Price : Rs. 2·00

Revised Indian Standard Specification for High Tensile Brass Rods and Sections (IS: 320—1962)

The Indian Standards Institution has published revision of Indian Standard Specification for High Tensile Brass Rods and Sections (IS: 320—1962), which covers three grades of high strength brass where superior mechanical properties are desired.

This standard has been prepared for material largely used for dropforging, stamping and, to a certain extent, in the manufacture of valve stems, gears and lever arms, where strength and toughness are required.

This standard was first issued in 1951 as a tentative standard, and has now been revised and published as a firm standard. The main modifications made in this revision and some of the additional information now included are with regard to the following :

(*a*) General requirements for the supply of material,

(*b*) Chemical composition table is modified and three grades of alloys are included,

(*c*) Freedom from defect,

(*d*) Information to be given by the purchaser,

(*e*) Sampling and criteria for conformity based on statistical principles,

(*f*) Details of tensile tests,

(*g*) Mercurous nitrate test, and

(*h*) Recommended sizes and tolerances of rods and sections.

Price Rs. : 3·00

Indian Standard Specification for Steel Cylinder Reinforced Concrete Pipes (IS: 1916—1963)

The Indian Standards Institution has published Indian Standard Specification for Steel Cylinder Reinforced Concrete Pipes (IS: 1916—1963), which lays down requirements and methods of tests for steel cylinder reinforced concrete pipes having nominal internal diameter from 200 mm to 1 800 mm for use in water mains, sewers, irrigation works and similar situations. The specification covers pipes having (*a*) spigot and socket ends and (*b*) plain or slip-in type ends suitable for field welding.

Steel cylinder reinforced concrete pipes are used in water mains and, to a limited extent, in the pressure sewer lines and irrigation works. Ordinary reinforced concrete pipes being unsuitable for use in situations where relatively high water pressures are met with, other types of pipes such as prestressed concrete pipes, steel pipes, cast iron pipes and asbestos cement pressure pipes, are often used in such situations.

Steel cylinder reinforced concrete pipes are one of such type pipes and these have the advantage that they provide the required rigidity even when very thin shells are used to form the steel cylinder.

The Institution has published a series of Indian Standards on concrete pipes. Other standards published so far in the series are: Specification for Concrete Pipes (With and Without Reinforcement (Revised), Code of Practice for Laying of Concrete Pipes, and Specification for Prestressed Concrete Pipes.

Price Rs. : 2·50

Indian Standard Recommendations for Limits and Fits for Sizes above 500 mm up to 3 150 mm (IS: 2101—1962)

The Indian Standards Institution has published Indian Standard Recommendations for Limits and Fits for Sizes above 500 mm up to 3 150 mm (IS: 2101—1962).

Components in very large sizes are being made to universally or locally interchangeable fits or to matched fits. However, there are many practical difficulties in achieving interchangeable manufacture in large diameters, due mainly to difficulties of measurement. This standard, should, therefore, be regarded as tentative and for trial.

Price Rs. : 4·50

Indian Standard Specification for Code of Practice for Manufacture of Hand-Made Common Burnt-Clay Building Bricks (IS: 2117—1963)

The Indian Standards Institution has published Indian Standard Code of Practice for Manufacture of Hand-Made Common Burnt-Clay Building Bricks (IS: 2117-1963), which covers the selection of raw material, moulding and burning of hand-made common burnt-clay building bricks. Manufacture of machine-made bricks is excluded from the scope of this standard.

The manufacture of building brick, being a village industry, has been following traditional methods which have not been much developed or refined ever since the time these methods were introduced. With the limited resources at his disposal, the brick-maker in this country usually utilizes whatever soil is locally available and makes only the minimum modifications in its composition which are absolutely essential for moulding. More so, different practices for the

manufacture of brick are adopted in different regions of the country. Investigations made at the Central Building Research Institute have, however, indicated certain broad limits, within which the mechanical grading of the soil should lie in order to obtain the required strength, low water absorption and other essential requirements for the burnt brick. The existing knowledge and experience can be advantageously utilised for specifying the minimum requirements for various manufacturing operations. There is also much scope for improvement in the design and construction of the mould for brick.

Among the types of brick kilns used for burning building brick in the country, continuous kilns have been found to be the most efficient, and are recommended for general adoption. The design of a kiln is no doubt a complicated aspect requiring detailed investigations; it is, however, possible to give some general guidance on the setting density, the rate of fire travel, fuel to be used, and such other aspects with a view to ensuring the optimum degree of burning, which enables the brick to serve as a strong and durable building material. An attempt has, therefore, been made in this standard to furnish general guidance for the manufacture of building bricks; particular attention has been given to those cases where the manufacturer, due to limited resources, depends upon hand-moulding methods.

Price : Rs. 4·00

Indian Standard Specification for Dimensions for Gauge Limits for ISO Metric Screw Threads (1·6 to 39 mm) (IS: 2306—1963)

The Indian Standards Institution has published Indian Standard Dimensions for Gauge Limits for ISO Metric Screw Threads (1·6 to 39 mm) (IS: 2306—1963).

This standard specifies dimensions for gauge limits for gauging ISO metric screw threads in the diameter range 1·6 to 39 mm. These gauge limits are valid only for the normal (8dN and 8HN) and Coarse (9dN and 9HN) classes of tolerances covered in IS: 1362—1962 Dimensions for Screw Threads for General Purposes (Revised). This Standard does not specify the dimensions of the body, handle, etc. of the gauges.

Price : Rs. 5·00

Indian Standard Specification for Recommendation for Modular Co-ordination Applied to RCC Framed Structures (IS: 2375—1963)

The Indian Standards Institution has published Indian Standard Recommendation for Modular Co-ordination Applied to RCC Framed Structural (IS : 2375—1963), which lays down recommendations for preferred dimensions of reinforced concrete structural members like beams, columns, braces, and their relative disposition with a view to achieving a modular co-ordination.

This standard which is in continuation of IS : 1233—1958 Recommendations for Modular Co-ordination of Dimensions in the Building Industry, provides more detailed, recommendations applying special types of structures.

Price : Re. 1·00

Indian Standard Specification for Code of Practice for Calibration of Vehicle Tanks for Petroleum Products and other Liquids (IS: 2383—1963)

Indian Standards Institution has published Indian Standard Code of Practice for Calibration of Vehicle Tanks for Petroleum Products and other Liquids (IS: 2383—1963), which covers recommendations for the calibration of vehicle tanks which are used for transport of petroleum products and other liquids.

The object of this standard is to have uniformity in calibrating the vehicle tanks for petroleum products and other liquids.

Price : Rs. 2·00

Indian Standard Specification for Equivalent Metric Units for Scales Dimensions and Quantities in General Construction Work [Doc: SWCB (673) (Revision of IS: 965—1958)]

The Indian Standards Institution has prepared a draft Indian Standard Equivalent Metric Units for Scales, Dimensions and Quantities in General Construction Work, [Doc: SWCB (673), (Revision of IS: 965—1958)]. This draft standard lays down the equivalent metric units which should be used for scales, dimensions, quantities and physical properties of materials, generally met with in the building field The proposed equivalent metric units in place of the existing fps units take note of the practices at present being followed in the metric countries and the units which have become familiar and conversant over a period of their use.

This standard was first issued in 1958. Based on the experience gained during the course of its use, the standard has been revised.

The draft standard will be circulated shortly to all interests concerned for eliciting technical comments.

Draft Indian Standard for B-Twill Jute Bags for Packing Foodgrains (Doc : TDC 39/666)

The Indian Standards Institution has prepared a draft Indian Standard Specification for B-Twill Jute Bags for Packing Foodgrains, Doc: TDC 39(666). This standard prescribes the constructional details and other particulars of B-Twill jute bags used for packing foodgrains.

During normal course of transit and storage, jute bags filled with foodgrains undergo rough handling. It is, therefore, a matter of great importance to lay down the requirements of jute bags which would satisfactorily withstand such normal hazards. It is expected that jute bags conforming to this specification would form a satisfactory packing material for foodgrains.

The Study Group on Quality Control and Pre-shipment Inspection of Jute Goods for Export, set up by the Government of India for the purpose of introduction of quality control of jute products for export, recommended, among other things, the formulation of Indian Standard specification for important export items of jute products, including B-Twill bags of construction covered in this specification. As the Committee responsible for the preparation of this specification took cognizance, of this recommendation of the Study Group, this specification is also intended to serve the purpose of quality control and pre-shipment inspection of B-Twill jute bags for packing foodgrains.

The draft standard will be circulated shortly to interested consumers and technologists for eliciting technical comments.

Indian Standard Specification for Hexagonal Head Bolts, Screws, Nuts and Lock Nuts (M1.6 to M5)

The Indian Standards Institution has published Indian Standard Specification for Hexagonal Head Bolts, Screws, Nuts and Lock Nuts (M1·6 to M5), which covers the requirements for hexagonal head bolts, screws, nuts and lock nuts for sizes M 1·6 to M5.

Hexagonal bolts, screws, nuts and lock nuts of sizes M6 to M39 used for general engineering purposes, have already been covered by IS: 1363—1960 Specification for Black Hexagonal Bolts (6 to 39 mm) with Nuts and Black Hexagonal Screws (6 to 24 mm), and IS: 1364—1960 Specification for Precision and Turned Hexagonal Bolts (6 to 39 mm) with Nuts and Hexagonal Screws (6 to 39 mm). This standard deals with hexagonal bolts, screws, nuts and lock nuts of sizes M1·6 to M5 used in light engineering applications.

Price: Rs. 2·00

Draft Indian Standard Specification for Beam Scales

The Indian Standards Institution has prepared a draft revision of IS : 1433-1960 [Specification for Beam Scales, [Doc: EDC 41(661)], which prescribes the requirements for beam scales of four classes meant for commercial purposes.

The Institution had, in 1960, published IS: 1433 in which dimensions of some of the sizes were not specified as sufficient data was not available. This revision specifies all those dimensions.

The draft standard is being circulated shortly to the manufacturers, consumers, technologists and other interests for eliciting technical comments.

Licensed Manufacturers and Repairers

[*Metric Measures* had been publishing in the past a series of lists of licensed manufacturers, dealers and repairers of weights and measures, weighing and measuring instruments licensed by the Governments in the various States and Union Territories under their Weights and Measures (Enforcement) Acts. To economise on paper, it is possible only to publish lists of licensed manufacturers and repairers.

A feature on statistics of verification and licences issued is also being published in *Metric Measures*.]

—Editor

STATISTICS OF VERIFICATION OF WEIGHTS ETC. AND LICENCEES

States/Union Territories	Period	Weights	Capacity Measures	Length Measures	Weighing Instruments	Measuring Instruments	Total number of Mfrs.	Dealers	Repairers
							As on first day of June 63		
1	2	3	4	5	6	7	8	9	10
(1) Andhra Pradesh	1 Apr to 31 July 62	4,56,255	74,480	6,323	8,025	314	62	121	36
(2) Assam	1 Apr 62 to 31 May 63	5,54,606	39,293	6,240	641	125	4	59	11
(3) Bihar	..	..	..	..	..	..	..	..	..
(4) Gujarat	1 Apr 62 to 31 Jan 63	8,64,698	42,049	15,272	1,08,604	663	111	584	142

States/Union Territories	Period	Weights	Capacity Measures	Length Measures	Weighing Instruments	Measuring Instruments	Total number of Manufacturers	Dealers	Repairers
							As on first day of June 63		
1	2	3	4	5	6	7	8	9	10
(5) Kerala	1 Apr to 31 Jul 62	..	..		..	..	73	459	142
(6) Jammu & Kashmir	1 Apr to 30 Nov 62	120	395	..	3	..	1	..	..
(7) Madhya Pradesh	..	..	..	..	..	..	..	..	..
(8) Madras	..	..	..	..	..	..	..	..	..
(9) Mysore	1 Apr to 30 Nov 62	4,81,354	1,05,253	1,037	59,674	8,420	126	493	92
(10) Maharashtra	..	..	..	..	..	..	..	..	..
(11) Orissa	1 Apr 62 to 31 Mar 63	4,23,597	86,060	3,089	1,596	2	8	103	6
(12) Punjab	1 Apr 62 to 31 Mar 63	11,28,594	58,400	34,099	1,57,736	172	4	21	10
(13) Rajasthan	..	..	..	..	..	..	..	..	..
(14) Uttar Pradesh	1 Apr to 31 May 62	5,34,506	7,951	4,702	907	113	3	99	18
(15) West Bengal	1 Apr 62 to 31 Jan 63	20,03,339	12,762	2,061	88,041	..	116	684	80
(16) A. & N. Islands	..	..	..	..	..	..	..	..	..
(17) Delhi	1 Apr 62 to 31 May 63	2,66,759	23,925	10,380	32,762	470	6	72	18
(18) Himachal Pradesh	1 Apr 62 to 31 May 63	52,550	4,532	2,174	8,649	..	1	24	11
(19) L.M.A. Islands	1 Apr 62 to 31 Mar 63	..	..	..	..	..	..	..	..
(20) Manipur	1 Apr 62 to 31 May 63	11,613	2,129	152	259	..	Nil	5	1
(21) Pondicherry	1 Apr 62 to 31 Mar 63	24,531	15,985 +200 (peg measures)	711	1,470	18	13	58	6
(22) Tripura	1 Apr 62 to 31 Jan 63	5,326	1,545	—	—	8	2	49	1

GUJARAT

The following are the manufacturers and repairers licensed during December 1962 to June 1963.

Manufacturers

Sl. No.	Name and Address of Manufacturer	Details of Articles Manufactured
(1)	Dalichand Raichand Doshi, Jamadarpada, Savarkundla	Beam Scale Class C & D
(2)	Dhiraj Metal Works, Street No. 6, Mill Para, Rajkot	Dipping Type Cylindrical measures.
(3)	Luhar Shamji Valji, Gandhi Chowk, Savarkundla	Beam Scale Class C
(4)	Pravin & Co., Jamadarpada, Savarkundla	Beam Scale Class C & D

Repairers

(1) Luhar Chimanbhai Odhavji Gohel Zaveri Bazar, Veraval
(2) Luhar Manji Dava & Bros, Mota Bhamodra (Via Kundla), Mota-Bhamodra.
(3) Nutan Scale Works, Near Police Station, At & P. O. Idar, Dist. Sabar-kantha.
(4) Razak Repairing Works, Shahpor, Near Jalal's Bukhari, Dargah Millant No. 1919, Surat.

KERALA

Manufacturers and Repairers licensed during the period 1-8-1962 to 30-11-1962.

Manufacturers

Sl. No.	Name and Address of Manufacturers	Details of Articles Manufactured
(1)	M. Abdul Rahiman, Swaraj Industrial Society, T. B. Road, Kottayam.	Dry and Conical Measures
(2)	E. M. Chackkoru, Peoples Hardware Mart, Parayil, Kunnamkulam ..	Beam Scales C & D Classes only.
(3)	Cheruvathil Raman, Blacksmith, Thavam, Via, Cherukunnam, Cannanore.	Beam Scales C & D Classes only.
(4)	S. K. Francis, Siby Metal Works, Changanassery, Kottayam ..	Dry Measures
(5)	T. A. Haneefa, Gibs Industries, Industrial Eastate, Ettumannoor, Kottayam.	Dry Measures
(6)	Hindustan Tin Works, Palayam Road, Calicut-1	Liquid and Dry Measures
(7)	G. Kabir Hussain, Azad Industries, Nedumkayam, Punalur, Quilon	Dry and Conical Measures and Metallic Length measures.
(8)	A. Kassim Pillai, Razac Metal Industries, Thamarakulam, Quilon ..	Dry and Conical Measures.
(9)	P. C. Kelappan & Sons, Tharan, Payangadi, Cannanore	Beam Scales, C & D Class Wooden Length Measures and Dry Measures (1 1 & below)
(10)	P. Kochukunjan, Industrial & Agricultural tools Worker, Parassala, Trivandrum.	Dry Measures and Beam Scales C & D Classes only.
(11)	R. Kuttan pillai, Minerva Metal Industries, Valthungal P.O. Quilon.	Conical & Dry Measures I 1 and below.
(12)	C. V. Mathan & Co., Mulanthuruthy.	Beam Scales C & D Classes only.
(13)	Metric Scale Industries, Irinjalakuda, Trichur	Platform machines only.

Sl. No.	Name and Address of the Manufacturers	Details of Articles Manufactured
(14)	K. V. Narayanan, Blacksmith, Pundackad, Viyoor, Trichur	Dry Measures and Wooden Length Measures.
(15)	Narayana Engineering Industries Ltd., Kulappully, Palghat	Beam Scales C & D Classes only.
(16)	Radha Metal and Steel Industries, Alwaye	Dry Measures and Length Measures wooden & metallic.
(17)	Rajendra Small Scales Industries, Kannanor palghat	Beam Scales C & D Classes only
(18)	Sailaja Carpentry Corporation, Fort Road, Cannanore	Wooden Length Measures.
(19)	A. V. Thoma & Sons, Iron Merchants, High Road, Trichur-1	
(20)	K. Usman Koya, Kerala Tin Works, Robinson Road, Calicut	Dry Measures and Conical Measures.
(21)	P. V. Varghese, Mill View Estate, Medumkayam, Punalur, Quilon.	Dry Measures and Metallic Metre rods.

Repairers

(1) P. Abdulla, Puthiya Valappil house, Chaliyattu Theruvu, Hosdurg, Cannanore.
(2) V. Janardhanan, Varuvil Veedu, Pannivizha, Addor.
(3) T. O. John, Paigalil Veedu, Kunnathoor, Thurithikkara P. O. Quilon.
(4) A. Ramaswamy, Government Contractor, T.C. 31/463 Chalai, Trivandrum.
(5) St. George Mechanical Works, Near Seematti Talkies, Alleppey.

WEST BENGAL

Repairers licensed from April '62 to January '63.

Repairers

(1) All Weights Scales & Eng. Works, 16/1 Beliaghata Main Road, Calcutta-10.
(2) Aum Sum Engineering Works, 104, Chinstophor Road, Calcutta-46.
(3) Avery Co. of India P. Ltd., 28/2 Waterloo Street, Calcutta.
(4) Asiatic Machinery Corpns., Private Ltd., 10/1 Kailash Chandra Lane, Satragachi, Howrah.
(5) K. B. Aloky & Co., 87/1 Talpakur Road, Calcutta-10.
(6) Bengal Chemical & Pharmaceutical Works Ltd., 164, Maniktala Main Road, Calcutta-11.
(7) Bharat Weighing Scales & Engineering Syndicate, 75/1 Kala Chand Mandi Lane, Howrah.
(8) Bharate Scale & Engineering Co., 4/1 Halderpara Lane, Howrah.
(9) Banku Behari Haha, P. O. Rajiganj, Dt. Burdwan.
(10) Calcutta Machine Mfg. Co., 26, Baroaritolla Road, Calcutta-10
(11) Chinsura Scale Repairing House, Chowk Bazar Road, Hoogly.
(12) Calcutta Licenced Measures, 3, Satya Doctors Road, Calcutta-23.
(13) R. K. Dhar & Sons, P. Ltd, 7 Fakir Chakraborty Lane, Calcutta-6.
(14) Dey's Weighing Scales & Engineering Works, 233, Belilious Road, Howrah.
(15) N. C. Das & Brothers, 10/13 Brindaban Mullick Lane, Howrah.
(16) Dinesh Chandra Karmakar, 74/4 Charakdanga Road, Calcutta-10
(17) H. P. Dass & Co., 22, Shree Gopal Mullick Road, Ariadah Barrackpur, 24 Parganas.
(18) Eastern Weighing Machine, Co. 192, Mahendra Bhattacharjee Road. Howrah.
(19) B. D. Engineering Works, 76/1 Beneras Road, Howrah.
(20) St. Engineering Syndicate, 37, Choulpatty Road, Calcutta-10.

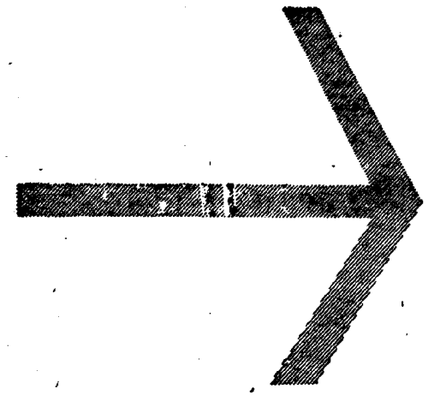
Repairers—*contd.*

(21) Electro Gas Welding Co., P. O. Panihati, B. T. Road, 24-parganas.
(22) Free India Scales Corporation, 76/1 Beneras Road, Howrah.
(23) Far Eastern Scales, 9 Dharamtalla Street, Calcutta-13.
(24) S. P. Gochait & Sons P. Ltd., 2, Madhusudan Paul Choudhury Lane, Howrah.
(25) Gopal Chandra Das, 98/A/B, Charak Danga Road, Calcutta.
(26) Gopal Chandra Karmakar & Sons, 16/2 Tarak Bose Lane, Calcutta-2.
(27) Gopal Chandra Karmakar, 16/c Tarak Basu Lane, Calcutta-2.
(28) Girish Chandra Ghosh, 37, B. T. Road, Calcutta.
(29) Hindustan Weighbridge & Engineering Co., 48, N. K. Guin Lane, Serampur, Hooghly.
(30) Hindustan Weighing Machine and Co., 14/1 Sri Gopal Mallick Lane, Calcutta-12.
(31) House of Commerce Private Ltd., 7, Hari Street, Calcutta.
(32) India Scales Company, 74, Diamond Harbour Road, Calcutta-8.
(33) India Weights & Scales, Company, 27/B Chowlpatty Road, Calcutta-10
(34) India Machinery Co. Ltd., Dassnagar, Howrah.
(35) India Weigh Bridge Workshop 34, K. M. Saha Street, Serampur, Hooghly.
(36) James Scales Engineerng Co. 54/1/1 Kashundia Road, P.O. Serhagobue, Howrah.
(37) Jeetendra Nath Ghosh, 37, B. T. Road, Calcutta-2
(38) Jugal Krishore Banerjee, Nemai Tirtha Ghat, P.O., Baidyabati, Serampur, Hooghly.
(39) T. K. Karmakar, 119/3 Narasingh Dutta Road, Howrah.
(40) Karmakar & Co., 64, Howrah Road, P. O. Salkia, Howrah.
(41) Koley Engineering Works, Jehapur, Dasnagar, Howrah.
(42) Kulada Prasad Karmakar & Sons, Vill & P. O. Gulsi, Dist, Burdwan.
(43) R. K. Karmakar & Sons, P.O. Mohala, Dt. Murshidabad.
(44) Karmakar Brothers, New Market, P.O. Balurghat, Dt. West Dinajpur.
(45) Karmakar & Co., 76, Diamond Harbour Road, Calcutta-5.
(46) M. C. Kenna, Bryon & Co., 90, Pepon Street, Calcutta-16.
(47) Laxmi Scale Works, 4, Chandi Charan Banerjee Lane, Calcutta-35.
(48) Maliany Karmakar, Samuboya Samity Ltd., Vill. Moliary P. O. Dhutar, Dt. 24-Parganas.
(49) W. B. Lowson & Co., 116, Ripon Street, Calcutta-16.
(50) Mahajati Weighing Scales 216, Netaji Subhas Road, Satragachi, Howrah.
(51) Maity & Co., 64, Howrah Road, P. O. Salkia, Howrah.
(52) Mondal Show & Co., 49, Kalachand Nandi Lane, Howrah.
(53) Madhu Hardware Stores, 8 B, Sree Rampur Road, Malanchapara, Nabadwip, Dt. Nadia.
(54) Nagendra Nath Karamkar, 16/17 Narikeldanga Main Road, Calcutta-11.
*Prop. Sarbasree Gourcharan Gopinath & Abani Karmakar.
(55) Nagendra Nath Karmakar, Prop. Makhan Lal Karmakar & others 16/17 Narikeldanga Main Road, Calcutta-11.
(56) Nilkanta Roy, 13/1 Radha Madhab Dutta, Garden Lane, Calcutta-10.
(57) New Bengal Scale Co., 48 Fakir Chand Ghosh Lane, P. O. Satragachi, Howrah.
(58) S. K. Nath, 8, Ratan Baboo Road, Calcutta-2.
(59) Pran Krishna Dhar, Krishnapada Das, 18, Lakshmandas Lane, Howrah.
(60) Precision Scale Works, Subhaspalli, P. O. Barmpur, Dt. Burdwan.
(61) Rajendra Nath Poriya, Kalaghat, Midnapur.
(62) Ram Kumar Agarwalla, 88A, Madan Mohan Barman, Calcutta-7.
(63) Ram Krishna Scale Manufacturing Co., 78F, Cossipur Road, Calcutta.
(64) Raman Industries, 216, Netaji Subhas Road, Howrah.
(65) K. C. Roy Private Ltd., 32, Latafat Hussain Lane, Calcutta-10.
(66) Sankar Juti, 31, Amulya Kumar Roy Lane, Howrah.
(67) K.C. Samanta, 19 Atual Krishna Bose Lane, Barrackpur, Calcutta-36.
(68) Scientia Industries, India (Ltd.) 34 Banerjee Bagan Lane, Salkia, Howrah.
(69) Syamsundar & Co., 16/1 Beliaghata Main Road, Howrah.
(70) Shree Fanindra Nath Karmakar, Howbazar Road, Nabadwip, P. O. & Dt. Nadia.
(71) Tulsi Charan Karmakar, 92, Diamond Harbour Road, Calcutta-18.
(72) Wooma Charan Karmakar, 23B Narikeldanga Main Road, Calcutta-11.

Repairers—*concld.*

(73) Weighing Scales & Engineering Co. P. Ltd., 233, Bellilious Road, Howrah.
(74) Wooma Charan Karmakar, Prop. Sri Barendra Lal Karmakar, 23A & 22D Narikeldanga Main Road, Calcutta.
(75) Wooma Charan Karmakar, Prop. Tarak Nath Karmakar, 23A & 22D, Narikeldanga Main Road, Calcutta-11.
(76) Wormald, 74, Theater Road, Calcutta-12.
(77) Wooma Charan Gupta No. 1 Bhadreswar, G.T. Road, Hoogly Gate, Chandernagar.
(78) Wooma Charan Karmakar, Prop. Jogendra Nath Karmakar, 23/c Narikeldanga Main Road, Calcutta-11.
(79) Wooma Charan Karmakar, 22D & 23A Narikeldanga Main Road, Calcutta-11.

M64DPD/63—G1PF.



now THE LITRE

Metric capacity measures are now compulsory in trade throughout the country. • The kilogram and the metre became compulsory last year; thus the metric system of weights and measures is now the only legal system in India. • The simplicity of the metric system will be obvious if you use the units (litre, metre and kilo) as they are, for their intrinsic value. • Do not equate metric measures to old units like seer, viss or ollock.

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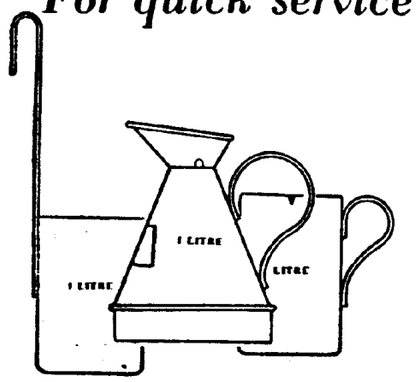

METRIC UNITS

in Round Figures

DA/63-152

TYPICAL METRIC PRICING UNITS FOR WHOLESALE TRANSACTIONS

Serial No.	Commodity	Metric Unit
		10 grams (g)
(1)	Gold	
(2)	Grocery and Confectionery Biscuits, sweetmeats, cardamoms.	
	Textiles and Textile Fibres Cotton yarn, damaged and seconds cloth, raw silk, rayon, silk yarn, raw wool, wool manufacturers (when sold by weight).	
	Paints & Chemicals Paint (if sold by weight), indigo, liquid chlorine.	1 kilogram (kg)
	Hides, Skins & Leather Raw hides, leather (hides and skins).	
	Metals Silver, aluminium sheets, strips and circles, copper and brass wires and utensils.	
	Miscellaneous Tea, meat, camphor tablets, mica.	
(3)	Grains and Pulses Rice, wheat, jowar, arhar, moong, masur, gram.	
	Spices Black pepper, mustard, chillies, dhania, dalchini, turmeric, betelnuts.	
	Plantation Products Rubber, cashewnuts, cashew kernels, tobacco (raw and manufactured).	
	Forest Products Lac and lac products, gums, myrobalans, galnuts, soapnuts.	
	Textiles & Textile Fibres Raw jute, raw hemp, coir yarn.	
	Oils, Oilseeds & Oilcakes Vegetable oils, oilseeds, oilcakes.	1 quintal (q) (100 kilograms)
	Non-Ferrous Metals *Aluminium* : ingots, bars, blocks, slabs, billets. *Lead* : ingots, sheets and strips. *Copper* : ingots, blooms, slabs, cakes, tiles, bricks, billets, blisterbars and wirebars, rods, sections and pipes, plates, sheets and strips, circles. *Brass* : ingots, rods, sections, pipes, sheets, strips, circles. *Zinc* : ingots, sheets, strips. *Tin* : blocks.	
	Chemicals Caustic soda, bleaching powder, glycerine, soaps, paper salt.	
	Others Sugar, gur, ice, fish, sugarcane, vegetables, tamarind.	
(4)	Minerals Iron ore, manganese ore, bauxite, coal.	one metric tonne (t) (1,000 kilograms)
	Iron & Steel Pig iron, iron and steel manufactures, semis (billets for rerolling etc.)	
(5)	Cloth (mill, handloom, silk, rayon and woollen cloth).	1 metre (m)
(6)	Jute carpets, coir mats and mattings, sheet glass.	one square metre (m^2)
(7)	Timber.	one cubic metre (m^3)
(8)	Paints (when sold by measure), spirits.	one litre (l)

Weights

(1) In place of the present units of seer, pound, rattal, viss etc., use the kilogram.

(2) In place of the tola, use the gram or 10 grams.

(3) In place of maund or corresponding unit, use the quintal *i.e.*, 100 kg.

Capacity Measures

In place of seer or gallon or any other measure use the litre.

Length Measures

(1) Use the metre in place of yard or foot and the centimetre in place of inch.

Square Measures

(1) Use the square metre in place of square yard or square foot, and square centimetre in place of square inch.

Cubic Measures

(1) Use the cubic metre in place of cubic yard or cubic foot and cubic centimetre in place of cubic inch.

Packaging

It is advantageous if sizes of packages correspond to series of commercial weights and measures prescribed.

These are: 50 kg, 20 kg, 10 kg, 5 kg, 2 kg, 1 kg, 500 g, 200 g, 100 g, 50 g, 20 g, 10 g, 5 g, 2 g, 1 g, and so on.

TYPICAL PRICING UNITS FOR RETAIL TRADE

Serial No.	Commodity	Metric Unit for Use
(1)	Foodgrains, cereals, pulses, spices, ghee, bread, vegetables, meat, fish, sweetmeats, tea, coffee, sugar, salt.	1 kg
(2)	Oil for cooking	1 kg or 1 litre depending upon prevalent practice.
(3)	Fruits	1 kg or number depending upon prevalent practice.
(4)	Milk	1 litre
(5)	Cloth and related materials	1 metre
(6)	Prepackaged materials	Preferably sizes corresponding to series of commercial weights and measures.

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metric measures

THE PUBLICATIONS DIVISION

ABBREVIATIONS FOR METRIC UNITS

(1) DECIMAL MULTIPLES AND SUBMULTIPLES

Prefix		Value in Terms of Unit	Abbreviation
kilo	..	1,000	k
centi	..	0·01 (10^{-2})	c
milli	..	0·001(10^{-3})	m
micro	..	0·000 001(10^{-6})	μ

(2) WEIGHTS

Denomination		Value	Abbreviation
tonne	..	1 000 kg	t
quintal	..	100 kg	q
kilogram	..	1 kg	kg
gram	..	1 g	g
milligram	..	1 mg	mg
carat	..	200 mg	c

(3) CAPACITY

kilolitre	..	1 000 l	kl
litre	..	1 l	l
millilitre	..	1 ml	ml

(4) VOLUME

cubic metre ..	m^3	m^3 or cu m*
cubic centimetre	cm^3	cm^3 or cu cm*
cubic millimetre	mm^3	mm^3 or cu mm*

(5) LENGTH

kilometre	..	1 000 m	km
metre	..	1 m	m
centimetre	..	1 cm	cm
millimetre	..	1 mm	mm
micron	..	1/1 000 mm or 10^{-3} mm	μm

(6) AREA

square kilometre	1 000 000 m^2	km^2 or sq km*
square metre ..	1 m^2	m^2 or sq m*
square centimetre	1 cm^2	cm^2 or sq cm*
square millimetre	1 mm^2	mm^2 or sq mm*

(7) LAND MEASURE

arc	..	100 m^2	a
hectare	..	100 a	ha
centiare	..	m^2	ca

*Both these abbreviations are current, but the first set should preferably be used. The former abbreviation is used more commonly internationally than the latter.

Rules for Abbreviations :

(1) Do not make any change, such as addition of 's' to indicate plurality *e.g.*, write 1 kg, 10 kg, 20g, 5 g. 10 t, 20 ml, 27 l, 165 km, 2 mm, 100 cm^3, 66 km^2;

(2) Do not capitalize the abbreviations. For example, do not write 1 Kg, 2 Kg, 20 MM, 50 MM, the right way is to write 1 kg, 2 kg, 20 mm, 50 mm, etc.;

(3) Do not use any other abbreviations except those given above.

metric measures

JOURNAL OF WEIGHTS AND MEASURES

MINISTRY OF INTERNATIONAL TRADE

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CONTENTS

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metric measures

METRIC MEASURES is published every two months.

METRIC MEASURES provides information to the general public on the administrative, commercial, educational, industrial, historical and other aspects of weights and measures, with particular reference to the introduction of the metric system in India.

Contributions for publication should be sent to the Editor, METRIC MEASURES, Directorate of Weights & Measures, Ministry of International Trade, Udyog Bhavan, New Delhi.

Enquiries regarding subscriptions and supply of copies should be addressed to the Business Manager, Publications Division, Ministry of Information and Broadcasting, Old Secretariat, Delhi-6.

Development of Capacity Measures in South India—Part 3

L. RAJU & V. B. MAINKAR
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IN Parts 1 and 2, we examined certain units of capacity measures used in South India. In order to trace the development of these units, it was necessary to go back to Vedic times. As some of these units happened to be based on length measures, we had to define the angula and hasta, the two units most often used in old literature for defining capacity measures. Having defined these, we worked out the capacities of many units mentioned in old Sanskrit literature. We found that there was a certain unity that knit together the capacity measures of ancient times. The capacities obtained by converting weight of water to volume and also calculating from given dimensions of measure gave astonishingly corroborating results. In the course of time this unity suffered an eclipse because of numerous causes. In this concluding Part, the diversity that resulted from this confusion is partially analysed in the light of the data presented in Parts 1 and 2.

British Studies of Madras Measures

There is very little recorded evidence which would enable us to build up tables of weights and measures used in South India from century to century. We have, therefore, necessarily to skip a few centuries and take up our thread in the British period in India.

During the latter half of the eighteenth century and throughout the nineteenth we come across some interesting British studies of Indian weights and measures used in trade. An analysis of the information recorded in these studies shows that the attempts of British rulers to standardize the then existing weights and measures resulted in introducing a new element into the already chaotic situation in this field. That they should try to achieve uniformity in this field was natural because they had to safeguard their immensely important trading interests. The cause for further confusion lay in their attempts to correlate the Indian weights and measures with the British system.

Colebrooke, Jones, Jervis, Prinsep, Gover, Thomas, Strachey, Warren have all made important contributions to the study of weights and measures in India. Some of them like Gover and Strachey were bold enough to suggest that the only way out of the utter confusion that went under the name of the Indian system of weights and measures was to scrap the old system in its entirety and replace it by the metric system.

Official British efforts to evolve a system of weights and measures in South India and particularly in the Madras region which was directly under their charge and was an

extremely important centre of trade for them, seem to have commenced from 1801. The then Government of Madras accepted the proposal of Mr. Ellis, a Subsecretary of the Board of Revenue, who drew up a plan for remodelling the measures of capacity so that when heaped they should correspond with the old 'struck' measure[2]. The plan did not materialise because a large number of measures would have been required for replacement.

Jervis[12] has pointed out that the standardization of Madras capacity measures was often vitiated by a desire to correlate them with the British units. Thus Major de Havilland had proposed a marakkal of 860·168 cubic inches, so that 2½ marakkal of this capacity would be exactly equal to the Winchester bushel of 2150·42 cubic inches.

The attempts went on through the years with little real success. In 1839, the Madras Government set up a Committee 'to correlate the Madras and Imperial systems of weights and measures.' After a round of consultations, the Committee made certain recommendations. The 1846 proclamation based on these recommendations fixed the following values for capacity measures:

1 olluck =12·5 cubic inches (205 ml)
8 ollucks =1 measure=100 cubic inches (1·638 l)
8 measures =1 mercal=800 cubic inches (13·110 l).

The proclamation was never implemented.

Jervis made a systematic study of the Madras capacity measures prior to 1835. According to him the 'parrah' is half of the ghanahasta. Taking the hasta at 19·5639 inches i.e. 49·69 cm he derives a value of 61·212 l for the para and 12·242 litres for the marakkal. The padi would then work out to 1·530 litres. He then proceeds to analyse other measures on the basis of the ghanahasta i.e. kharika. His method was later taken up by Gover[9] and applied to further units with the following results:

Madras garce=40 kharika (4,897 litres)
Pooteé or burnum=2 kharika (244·85 litres)
Marakkal, toomi, nawty=1/10 kharika (12·242 litres)
Toom=1/40 kharika (3·061 litres)
Padakku=1/5 kharika (24·485 litres)

Prinsep[11] has quoted the following tables :

1 walak (vulgarly olluck)=11·719 cubic inches=192 ml
8 walaks=1 padi=93·752 cubic inches=1·536 l
8 padis=1 markal=750 cubic inches=12·290 l
5 markals=1 parra=3,750 cubic inches=61·45 l
80 paras=1 garce=300,000 cubic inches=4,916 l

Woolhouse[23] records a table of capacity measures as follows:

olluck=192 ml
8 ollucks=1 measure or puddy=0·338 gallons=1·537 l
8 measures=1 marcal=2·704 gallons=12·292 l
5 marcals=1 para or chunam=13·52 gallons=61·461 l
80 paras=1 garce, weighing 8,400 lb.=135 bushels or 16·9 quarters=4,917 l.

The four values for garce do not agree among themselves :

8,400 lbs	=3,819 litres
135 bushels	=5,110 litres
16·9 quarters	=4,918 litres

Browne[10] lays down the following table and also furnishes the metric values :

1 olluck	=205 ml
8 ollucks=1 puddee or measure	=1.640 l
8 puddies=1 mercal	=13·116 l
5 mercals=1 para or chunam	=65·581 l
80 para=1 garce	=5,246 l

There is also a mention in the *Gazetteer*[24] that the marakkal and the smaller measures were ordered to be made of wood, were to be round and rimmed with iron or brass. The marakkal was 9·3 inches deep, 10·3 inches diameter and contained 27 lb, 20 oz 2 drams avoirdupois of fresh well water. The parah was to measure 2 feet square and 6·5 inches deep[24]. This gives a marakkal of 12·71 litres if calculated from the dimensions and 12·37 litres from the pound values. The parah is 61·189 litres, being 5 times from the

pound value. The padi is 1·589 litres, if marakkal is 12·71 litres.

The padi as defined in the recent past was the measure which held 132 tola by weight of second sort of rice when fully heaped, 120 tola struck or 62·5 ounces of water and the type seer held 80 tola by weight of rice struck, 88 tola of rice heaped or 41·7 ounces of water[2].

Taking the estimates of the capacity of the padi, measured physically in the 19th century or legalized from time to time, we get the following values :

(1) Jervis	(1·530 l)=93·385	cubic inches
(2) 1846 Proclamation	(1·638 l)=100	cubic inches
(3) Prinsep	(1·536 l)=93·752	cubic inches
(4) Gover	(1·530 l)=93·385	cubic inches
(5) Woolhouse	(1·537 l)=93·768	cubic inches
(6) Browne	(1·640 l)=100·5	cubic inches
(7) 1948 Act	(1·770 l)=108	cubic inches
(8) Gazetteer	(1·589 l)=96·75	cubic inches

An interesting fact emerges from this tabulation. The padi is either 100 cubic inches (values 2 and 6), a round value in terms of cubic inches, or it is ⅛ of a marakkal of 750 cubic inches (3, 5), another round unit. Jervis and Gover have calculated their values on the basis of the ghanahasta in which the hasta is about 50 cm. The 1948 Act value of 108 cubic inches is, however, larger than any of the above. The cause for it is discussed below.

Probable Origins

We may also refer to the values of padi and marakkal derived in Part 2 on the basis of old Sanskrit literature. The marakkal or nali as it was then called, was found to be equal to 12·698 litres, i.e. equal to 1/10 of khari, and consisted of 320 pala, the khari being 3,200 pala according to the *Arthashastra*. The phara would then be 63·488 litres or ¼ khari, and the garce 5,079·04 litres or 40 khari or 640 drona. The padi would be 1·587 litres in terms of water.

We may now examine the padi, marakkal etc. from another point of view. The padi traditionally is the volume occupied by 40 palam weight of rice i.e. 40×39·68=1.587 kg, the palam being 39·68 g. It was normally used as a heaped measure before the advent of the British. By experiment, it can be shown that the heaped measure would be about 10-12 percent higher in volume than the weight if the measure has a ratio of diameter to height of 1:1·5. Assuming it to be 10 percent, the capacity of the padi measure would work out to be 1·746 litres (1·587+0·1587=1.746).

Corruption of Padi

In recent times, however, the viss was made equal to 120 tola i.e. 40 palam of 3 tola. The viss is then 1·40 kg. The padi is used as a heaped measure. So the capacity of the measure would be 1.540 litres, an increase of about 10 percent, as indicated above. This is about 94 cubic inches. This is the padi evaluated by Prinsep and others. But the British wanted it to be used as a struck measure[2]. So a larger measure was necessary to contain the heap. By experiment it can be shown that the weight-volume ratio of water to rice is approximately 1:1·25. So the struck volume would be 1·40+0·35=1·75 litres (or 106·5 cubic inches). This is so close to the value of heaped measure we calculated above on the basis of old literature that the legal use of a struck measure of this capacity was almost a foregone conclusion. This was rounded off to 108 cubic inches or 62·5 fluid ounces (1·770 l) in the 1948 Act. There was, however, reluctance on the part of people to use struck measures. So this very measure of 1·770 litres was allowed to be used as a heaped measure. The result is that the present padi of Madras is larger by about 10 percent than standardized i.e. it is now 1·95 litres. Such a step was perhaps taken to avoid the purchase of new measures by the traders. This expediency has led to

the astonishing spectacle of the original padi of 1·540 litres capacity (or 120 tola rice) having risen to 1·95 litres, simply by the process of being used as a heaped measure and a struck measure alternately.

The litre measures of today are being used as struck measures in some South Indian States. If the history of the padi is any indication, we may expect that there would be a demand to use these as heaped measures. The best way out of this vicious circle of struck and heaped measures would be their replacement by weights.

Andhra Pradesh

In Andhra Pradesh the so-called type seer of 72 cubic inches (41⅔ fl. ounces or 1.180 l) is commonly used. The basis of its use follows closely the tradition of the Madras padi. In the immediate past, it was taken as equal to 2/3 of a padi. This was because the Madras padi was based on the 120 tola viss and the Andhra type seer on the 80 tola seer. There are, however, some interesting relations of the type seer with the other units used in Andhra Pradesh.

On the basis of the data in the *Gazetteers*[24] we can work out the following two tables:

5 tola weight of rice	=1 gidda	=62 ml
4 gidda	=1 sola	=248 ml
2 sola	=1 tavva	=496 ml
2 tavva	=1 manika or seer	=992 ml
	(holds 80 tola weight of rice)	
2 manika	=1 adda	=1·984 l
2 adda	=1 kuncham (320 tola weight of rice)	=3·968 l

After this stage there are two varieties of tables :

First Variant

20 kuncham	=1 yedumu or kavadi	= 79·36 l
2 yedumu	=1 pandumu	=158·72 l
2 pandumu	=1 palle-putti	=317·44 l
7½ palle-putti	=1 garce (garrisa) of 600 kuncham or 192 000 tola weight of rice	=2 380·8 l

Second Variant

10 kuncham	=1 tamu	= 39·68 l
4 tamu	=1 gonedu	=158·72 l
5 gonedu	=1 putti	=793·6 l
3 putti	=1 garce of 600 kuncham or 192 000 tola weight of water	=2 380·8 l

The second table would be as follows:

10 tola weight of rice	=1 gidda	=124 ml
4 gidda	=1 sola	=496 ml
2 sola	=1 tavva or seer	=992 ml
	(holding 80 tolas weight of rice)	
2 tavva	=1 manika	=1·984 l
5 manika	=1 kuncham	=9·920 l
	(800 tola weight of rice)	
2 kuncham	=1 irusa	= 19·840 l
2 irusa	=1 tamudu	= 39·68 l
5 tamudu	=1 yedumu	=198·40 l
2 yedumu	=1 pandumu	=396·80 l
2 pandumu	=1 putti	=793·60 l
	(of 80 kuncham or 640 000 tola weight of rice).	

For the purposes of comparison, the capacity of the units have been reduced to the water medium. The seer, whether called manika or tavva, then becomes 80 tolas of water or 0·937 litre. But the tola is a comparatively modern unit. To evaluate the above units, we may reduce 937 ml to palams of 39·68 ml each, as we did in the case of the padi earlier. This gives 23·61 palam in 937 ml of water. Let us assume that the type seer originally consisted of 25 palam, and the later process of correlating it with the Madras padi and so on caused the present value. We should note that 25 palam is also equal to ½ of adhaka or 2 prastha. Now 25 palam=992 ml (39·68×25). We calculated the values in the above tables on this basis. It will be noticed that although the values of the units bear a ratio of 1:2 in the above two tables, the putti in both the cases works out to 793·6 litres which is equal to 100 drona or 5 kumbha, as the kumbha is 158·72 litres. The *Arthashastra* also lays down that the kumbha may be further divided into ½, ¼ and ⅛ fractions. These values are 79·361, 39·681

and 19·841 which are recurring in the above tables but under different names.

On the basis of the volume occupied by the specified weight of rice, the capacities would increase by 10 percent for heaped measure and 25 percent for struck measure. But we have assumed that by certain processes of trade expediencies and the need felt by the rulers to correlate it with another more favoured unit i.e. the tola, the type seer got whittled down to 80 tolas. The volume occupied by this type seer would then be 1·040 litres heaped (about 64 cubic inches) and 1·172 litres struck (or about 70·5 cubic inches). The actual value as defined in the 1948 Act is 1·180 litres struck measure (or 72 cubic inches).

We have now seen that the capacity measures in Madras and Andhra Pradesh had a direct relation with the ancient capacity measures based on the ghanahasta or khari, calculated on the basis of the water medium. We have also noted that the hasta, equal to 50 cm, as used in trade, was the basic unit for the calculation of the capacities of measures. The attempt to evaluate the padi or type seer based on this ancient system in terms of English units and the vagaries of trade usage led to their standardization at different values at different times.

We may now briefly discuss the variety of the higher and lower multiples of the padi.

Olluck

Olluck, ¼ of a padi, is entirely dependent on the variety of padi used.

Padi or Madras Measure

We have already examined the queer history of the padi. No single unit of measure in any country could have been so misused as the padi. That the original padi was about 1·56 litres or 1/80 part of the khari or 1/5 of a drona is now clear. What started out as a simple device to measure out quickly a specified weight of rice has turned out to be a perfect muddle in the field of standardization of weights and measures.

The padi is dependent for its cubical content on three factors : (1) the viss used as the fundamental unit, (2) the mode of use of the measure i.e. as struck or heaped, and (3) the grain used for standardization.

Visses of 100, 125, 126, 130, 135 tola are known to have been in use[2]. Add to this fact, the possibility that the type seer of 80 tola may also have been used under the name of padi. Such seers of 66, 75, 80, 82, 86 tola etc. were used in the old Madras Presidency[2]. All these measures could be used either as heaped or as struck measures for one reason or another. And to top it all, not only rice but other commodities have been known to be used for the standardization of measures. A naudhanya or a mixture of 9 types of grains, paddy and even salt are used for this purpose[25]. If all these factors are added up the variety that would result is immense.

Marakkal

The marakkal is an important unit of this series. Originally it was equal to 1/10 of a khari or ghanahasta i.e. 12·698 litres. According to the 1948 Act it is 14·160 litres.

Marakkals of 2, 3, 3-5/8, 4 Madras measures were in use in some districts, and of 8 type seers in others. A marakkal of 5 padi, called godu, was known to have been used. This marakkal equals the theoretical drona. A traditional marakkal of 104·25 cu. in (1·708 litres) is also mentioned[25].

Numerous other marakkals are known. These are all different multiples of the various padi measures.

Phara

Phara is equal to 5 times the marakkal, which makes it half of ghanahasta or khari.

Garce

Here again we find quite a few varieties, the Madras variety being about twice the

Andhra variety. But they are again related to the smaller principal units.

There are other units in use in certain areas. For example, a vallam of 134·8 fl. oz (3·828 litres) equal to about 2 adhaka, was used in Avanashi taluk in Madras State but the vallam in Dharapuram was 150·8 fl. oz (4·283 l). It is difficult to explain. A unit in use in the Kollegal taluk was the seer of 66 fl. oz (1·874 litres) which is one adhaka, the manam being ¼ of it i.e. equal to prastha.

Fig. 2—Cochin Dry Measures. From left to right : para (12·5 l), edangali (1·25 l), nazhi (312 ml), uri (156 ml) and azhakku (78 ml).

Cochin Measures

We may now examine the capacity units in other areas. In Part 1, we have pointed out that the Cochin edangali is 1·250 litres. This is just 1/100 of the ghanahasta of 125 litres. In Cochin 10 such edangalis make a para of 12·50 litres. The chaku is 10 para i.e. 125 litres or exactly a ghanahasta or khari. From the edangali, the submultiples are then derived on the basis of the binary system, until we reach azhakku which is 39 ml i.e. equal to the palam of ancient literature. Thus the edangali would be 32 ancient palam, the value being derived on the ghanahasta basis. The Cochin measures are an instance of the purity of old measures having been retained unharmed through centuries.

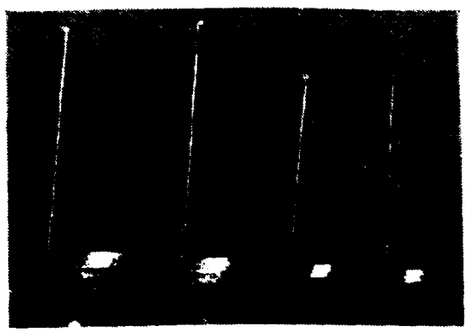

Fig. 1—Cochin Liquid Measures. From left to right : nazhi thavi (312 ml), uri (156 ml), uzhakku (78 ml) and azhakku (39 ml).

Travancore Measures

The Travancore edangali is 1·310 litres. This is not exactly 1/100th of the ghanahasta. If the hasta is taken as 50·5 cm, the ghanahasta would be about 129 litres. We shall, therefore, not be wrong in assuming that the Travancore edangali is also 1/100th of the khari or ghanahasta within practical limits. Another possibility is that while defining the edangali at 80 cubic inches, a process of rounding off to British units may have been introduced. The Cochin edangali at 44 fluid ounces is 76·29 cubic inches (1·250 litres). This in practice may have been conveniently rounded off to 80 cubic inches.

Just as there are many types of padis in use, there are also many types of nazhis. In the Kerala area, nazhi is taken as ¼ of the edangali. The nazhi in certain areas is 12 fluid ounces. The Cochin Act, however, gives a nazhi of 11 fluid ounces, as the edangali is 44 fluid ounces, while the Travancore Act would give a nazhi of 20 cubic inches i.e. 11·535 fl. oz. The nazhi, therefore, automatically becomes 12 fluid ounces for trade use. The unit of 12 fluid ounces is extremely convenient for trade as it is divisible by 2, 3, 4 and 6. The nazhi, therefore, became 12 fluid ounces for trade purposes. Once the

nazhi becomes 12 fluid ounces the other related units follow suit.

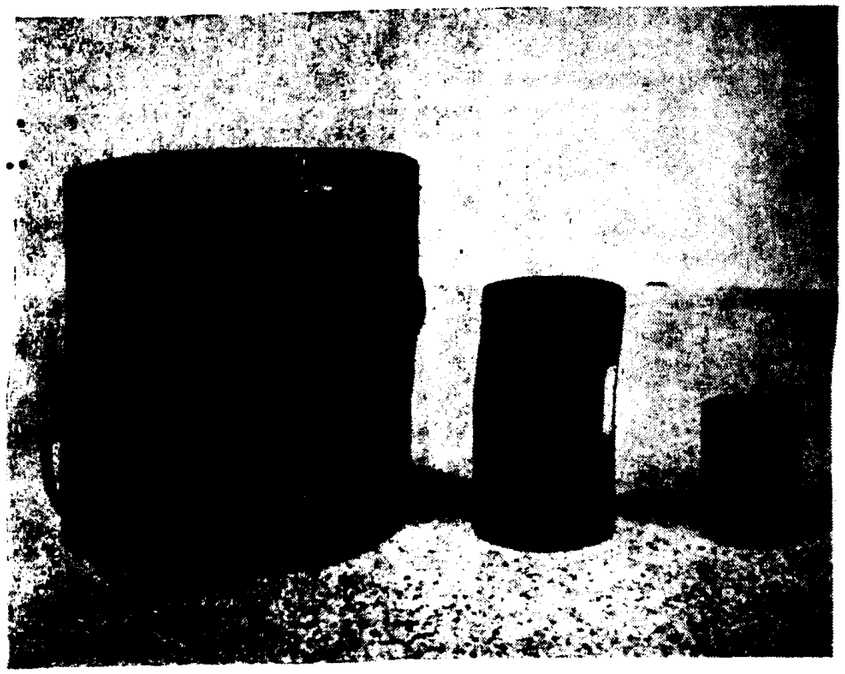

Fig. 3—Travancore Measures. From left to right : para (13·10 l), edangali (1·31 l), nazhi (328 ml).

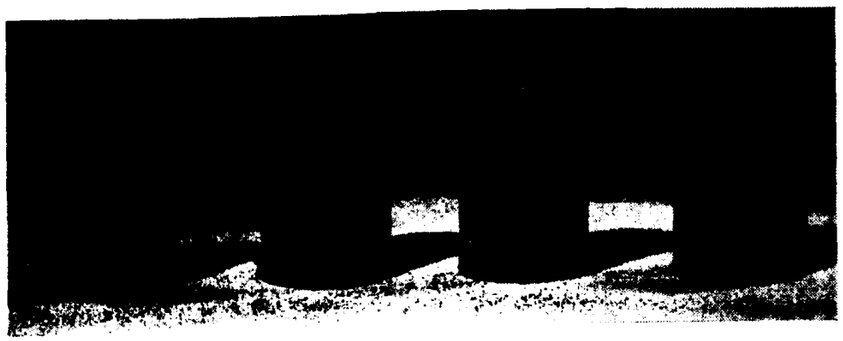

Fig. 4—Travancore Measures, showing nazhi of different shapes

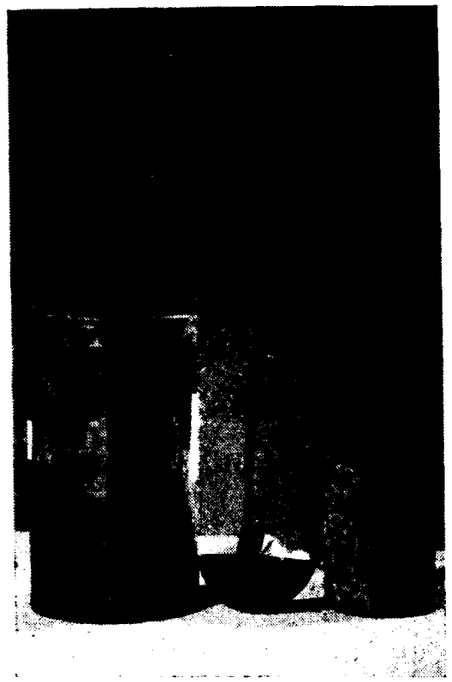

Fig. 5—Travancore Measures. From left to right : edangali (1·310 l), thudam (83 ml), nazhi (328 ml).

cubic inches. This may mean that the kalzige is perhaps related with the cubic inch and not with any other measure. Among liquid measures a maund of 10 kuthi of 448 fluid ounces i.e. 12·72 litres was used. This maund is 1/10 and the kuthi 1/100 ghanahasta or khari. The kuthi in turn was equal to 4⅜ seers, the seer being 24 tolas of weight unit. The mix-up of units here has produced very peculiar results.

Mysore Measures

The Mysore capacity units also show a definite and interesting relation with the ghanahasta. The palla, which is a very popular unit for wholesale trade, is 126·6 litres. This is practically equal to the ghanahasta or khari. What is more it consists of 100 seers and so the seer unit, defined at 108 tolas, is also 1/100th of khari. Moreover, sub-units like chataku, adapavu are multiples of the ancient palam of 39·68 ml. The balla, kolaga and khandi are units which were perhaps required for trade with adjoining areas. Variations of these units can be explained as due to exigencies of trade.

Coorg Measures

The Coorg seer is approximately equal to the Madras type seer. This is because it is the capacity of 100 tola of water, and we know that 80 tola of rice by weight would occupy about 100 tola struck capacity. The batti would then be about 10 drona or half a kumbha of *Arthashastra*. The Coorg para of 11·7 litres, the Cochin para of 12·5 l and Travancore para of 13·10 litres, contrast with the 71 litre phara of Madras.

In South Kanara a dry measure called kalzige of 14 seer was in use. The seer at 41·7 fl. oz or 1·180 litres gave the kalzige a value of 16·52 litres which is equal to 1008

Hyderabad

The Hyderabad measures are related to the 80 tola seer based on the water medium. These units have been subjected to intense Muslim and British influences and so may not yield values to correspond with the older units. Even then we may note that the palla may have been the original khari or ghanahasta and the adholi the adhaka of *Arthashastra*.

Summary of Units

We may now summarize the principal legal units used in the immediate past in the Madras area and their relation to the ancient units discussed in Part 2.

TABLE 1—RELATION OF LEGAL CAPACITY MEASURES TO ANCIENT CAPACITY MEASURES

Name of Unit (1)	Present Value (2)	Original Value (3)	Ratio to Ancient Units (4)
Madras measure	1·770 l	1·587 l	1/80 khari or 1/5 drona
Marakkal	14·160 l	12·698 l	1/10 khari
Phara	70·800 l	63·488 l	1/2 khari
Type-seer	1·180 l	992 ml	1/2 adhaka
Putti	—	793·6 l	5 kumbha
Cochin edangali	1·250 l	1·250 l	1/100 khari
Cochin para	12·50 l	12·50 l	1/10 khari
Chaku	125 l	125 l	1 khari
Travancore edangali	1·310 l	1·250 l	1/100 khari
Coorg seer	1·170 l	992 ml	1/2 adhaka
Batti	93·700 l	79·36 l	10 drona
Mysore seer	1·266 l	1·25 l	1/100 khari
Mysore palla	126·6 l	125 l	1 khari
Hyderabad adholi	1·874 l	1·953 l	1 adhaka
Hyderabad palla	112·44 l	125 l	1 khari

Conclusion

A study of the capacity measures in the four Southern States of India leads us to believe that there was perhaps a common origin for all of them. The zeal to mould the original units to suit the ever-changing requirements of trade and the isolated efforts of rulers to standardize and unify the weights and measures only in their own areas led to a bewildering variety. The British rulers added to the confusion by trying to correlate the then existing variety with their own system of measures. This only served to create utter chaos out of confusion. As a result vestiges of the origin of the measures are today discernible only very dimly.

There was no way out of this situation but to reject the corrupted practices outright and adopt in their place something more rational, orderly and scientific—the metric system.

The lesson that we must learn from past experience is that we should not try to mould old units to suit new needs under any circumstances nor try to adapt new units to fit into the old system. That is the surest way to create confusion. If we do so we shall only be sowing the seeds of a future variety. The best course is to forget the old system and use the metric system as it ought to be used without making any attempt at all to correlate the old with the new.

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Enforcement of Metric System among Adibasis

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ORISSA has the highest percentage of tribal population in India, being 24·06 percent of the total population. The extent of tribal areas is more than 1/3 of the total area of the State and comprises the entire districts of Koraput, Mayurbhanj, Sundergarh and Ganjam agencies. Besides, there are also patches like the Bhuyan Pirh and Juang Pirh areas of Kevnjhar district and Kasipur area of Kalahandi district which are mostly populated by *adibasis*.

Classification of Adibasis

Next to Assam, Orissa has the greatest variety of tribal population. There are as many as 62 Scheduled Tribes which can be divided into 4 distinct categories based on their relative socio-economic development. These are Real Primitives, the Tribes in Transition, Assimilated Tribes and Aristocratic Tribes.

Real Primitives are found in the inaccessible interior areas. The dull thud of pestles which can be heard long before sunrise is one of the important characteristics of the primitive communities. Geographical barriers have protected them from contact with outside agencies. Shifting cultivation constitutes their principal means of subsistence. In short, Real Primitives are a group of contented people living almost in complete isolation.

The second group, namely, the Tribes in Transition are a people who live in the foothills and depend primarily on shifting cultivation. They also practise wet cultivation to some extent. They have not completely lost their social contacts with the Real Primitives but are gradually making new alliances in the socio-economic spheres with the people living in plains. They show significant signs of change in many small and subtle ways. The younger people do not appear to be so much loyal to tribal tradition. They regularly visit the weekly hats and sandies and imbibe new ideas.

The third category of Assimilated Tribes live in villages where other tribes and castes also live. Agriculture forms their primary means of livelihood, in addition to certain subsidiary occupations such as daily labour, trade and services. In certain areas adjoining the factories, mines and quarries the adibasis mainly work as labourers. Shifting cultivation is not common with these people who have taken up regular wet cultivation. Economically this group is somewhat better off and are adopting the ways of living of the plains people and gradually losing their primitive tribal traits.

The last class of tribals are the descendants of the old tribal aristocracy. They are

special priests of the aboriginal gods. Originally they formed the militia of the tribal people.

Method of Approach

Attempts have been made to introduce and enforce the metric system among the last two categories of adibasis, viz. Assimilated Tribes and Aristocratic Tribes. As explained earlier, the first two categories have no trade contacts with outside agencies. It would, therefore, take some time to prepare them to accept metric weights and measures. The method of approach so far has been to introduce the metric system:

(1) In the colonies of adibasi settlement;
(2) Through the Ashram and Sevashram schools established by Government;
(3) Through Government fair price shops.

Approach Through Colonies and Shops

The Government has sponsored a scheme for settling the adibasis in colonies in the plains in order to wean them from the pernicious practice of *Poddu* (Shifting) cultivation. About 100 colonies have been set up so far in districts with the largest concentration of adibasi population and a fairly large number of tribal families have been rehabilitated. Government fair price shops have also been set up in some of the selected colonies. There are at present 38 fair price shops. Most of these shops possess metric weights. The Inspectors of Weights and Measures were instructed to visit these shops regularly and to enforce the metric system. But systematic visits have not been possible so far owing to difficulties of communication and the shops being scattered over large areas.

Through Ashram Schools

For education of tribal boys and girls the Government has opened a special type of institution called Ashram Schools which are residential institutions of M.E. standard. Besides, there are also Sevashram schools of primary standard. A few sets of metric weights have been given to the Ashram schools for demonstration purposes. In addition to these measures, the adibasis are being gradually made conscious of the metric system during their visits to the weekly hats, sandies and other trading centres. Some of the village merchants who function in the heart of the adibasi areas have also adopted metric weights. Demonstration of metric weights in some of the important village hats has been arranged through the Public Relations Department. It is common knowledge that adibasi men and women are regular visitors to weekly hats and happenings in the hats have a very good impact on them, particularly on the younger sections of the people. Experience shows that some of the adibasis have shown interest and inquisitiveness about metric weights.

It has not been possible so far to correctly assess the reactions of the adibasis regarding the metric system. This is mainly because reactions, either favourable or unfavourable, to any new system in the adibasi area is always voiced by the adibasis through the village headmen rather than directly. It must be admitted that village headmen still exercise considerable influence in the adibasi area and any measure of improvement to be effective has to be routed through them. In certain areas in the initial stages the village headmen showed some amount of reluctance to adopt the new system because of their traditional habits.

Future Work

For systematic enforcement of the metric system in the adibasi area the following measures are expected to prove useful.

(1) Rigid enforcement of sale of salt by weight.
(2) Appointment of part-time workers from among the adibasis for

demonstration of metric weights in selected trading centres and adopting other persuasive measures.

(3) Enforcement through official organisations and institutions like Ashram schools, fair price shops, Grain golla, M.P.C.S. and Forest Marketing Society.

(4) Persuasion through active support of the non-official agencies.

(5) Organisation of a special propaganda and publicity unit for the adibasis.

The average adibasi may not have many things to buy but he must purchase salt and for this purpose he regularly comes in contact with a trader. Experience has shown that the traders dealing in salt have more access to the adibasi area than other traders. In view of this it would be very convenient to introduce and enforce the metric system in adibasi areas through transactions in salt. The State Government have already issued notifications directing that in salt trade no transaction, dealing or contract shall be made or had except by weight only. This is to be pursued vigorously.

The adibasi people have a general tendency not to accept any change except on the advice of the leaders of their own community. Continuous exploitation by outside traders has been responsible for this inherent suspicion and mistrust. It is, therefore, necessary to select adibasi local leaders as part-time workers on an honorary basis. These workers should be provided with sets of weights and measures and some of the common weighing instruments. They will carry out concentrated work in selected pockets having trade importance. In their transactions the adibasis depend on the purchaser to do the weighment or measurement for them. These workers will come to the rescue of the adibasis and would be able to convince them of the utility of adopting metric weights.

Enforcement through official agencies and Semi-Government institutions has been initiated to some extent. But as the adibasi area is very extensive and communication facilities extremely poor and inadequate, there is need for providing sets of metric weights to all the grain gollas, fair price shops, co-operatives as well as Ashram schools. Suitable instructions would be given to these institutions in consultation with the Tribal Welfare Department for concentrating on the use of metric weights.

There are several non-official organisations like the Akhil Bharatiya Sarba Seva Sangh, Servants of India Society etc. which are engaged in development work in adibasi areas. Some of them get grants from the Government of India. These organisations should be advised to persuade people to adopt the metric system of weights and measures. This they can easily do along with their normal activities of socio-economic upliftment.

Some of the publicity measures like distribution of folders, posters, leaflets, conversion tables are not quite suitable for the adibasi area. Publicity in the adibasi area has to be organised to suit the tastes and habits of the adibasi population. One of the effective ways would be through songs and dialogues specially composed for the purpose in adibasi dialects. Special demonstration and publicity should also be arranged on different festive occasions like Pahuri Puja, Bhuyan Durbar, Jeth Jatra when large congregations of adibasis gather at one place. A special publicity unit with the necessary publicity equipments should be provided for this purpose. This will be in close touch with the adibasis and should also study and devise methods for effective publicity.

Records and Returns For Weights & Measures Organisation

KANWAR JIT SINGH
Controller of Weights & Measures,
Punjab

THE Indian States and Union Territories are constitutionally responsible for the enforcement of weights, measures, weighing and measuring apparatus in use for trade and commerce. They have enacted almost identical Weights and Measures (Enforcement) Acts to ensure effective enforcement within their territorial jurisdictions. The enforcement machinery in every State or administrative unit comprises a well-knit organisation of Inspectors as well as supervisory and controlling staff. Although the Controller, as also Deputy and Assistant Controllers have been vested with powers to supervise and control the work of the Inspectors, to all intents and purposes the Inspector constitutes the backbone of the Organization.

Need for Forms & Registers

To achieve the dual object of maintaining a steady flow of revenue according to a well planned roster of work, and at the same time afford a clear picture of the activities of the Inspectorate staff, it is essential that they should maintain an effective record of their work and submit informative and comprehensive periodical reports. An effective record not only simplifies the work of the Inspectors but also helps in controlling their work conveniently and expeditiously.

To achieve uniformity in this field all over the country, a standard set of forms and registers for different types of record is required to be maintained at all levels. To that end the seventh Conference of Controllers has taken the right step by formulating a set of forms and registers to be maintained by the Weights and Measures Organisations in the States and for the submission of reports and returns by the Inspectors.

The records to be maintained may be classified under two categories. The first category comprises records to be kept by the Inspectors which also covers the submission of diaries and returns on the prescribed forms. The second category deals with records to be maintained by the Controller.

Inspector's Record

Of the multifarious duties assigned to the Inspector, the following call for the maintenance of a cumulative record of official acts and submission of prescribed diaries and returns. These in turn when summarised in periodical reports go a long way to indicate the progress of work according to the norms fixed in general or for a particular area:

(1) Verification and inspection of weights, measures etc. and collection of fees and other charges.

(2) Safe and proper custody of secondary and working standards entrusted

to his charge and articles seized and detained in the course of his duty.

(3) Submission of prescribed reports and returns and maintenance of such books and records as required by the Controller.

The ledger or census register forms the nucleus of the individual trader's dealings with the Department. It should be detailed and comprehensive. It should identify the individual trader, give a summary of each item of weight, measure, weighing or measuring apparatus held by him, information regarding verification and realization of fees, routine or surprise checks by Inspector, and defects or violations of law detected, if any. This record needs to be grouped area-wise with a view to ensure continuity of work which generally facilitates the phased programme of reverification.

To locate information regarding a particular trader, an alphabetical index may be appended with advantage to the census register, even if it relates to a small area. For convenience in dealing with special apparatus *viz.* weighbridges, automatic weighing machines, factories' apparatus, bullion weights etc., small eyelets or other types of flags of specified colours may be stitched to the relevant pages.

The seizure and prosecution registers record important entries relating to the impounding of unauthorized apparatus and consequential prosecutions of the defaulters on the basis thereof. They should be precise and free from lacuna so as to stand the judicial test in the courts of original as well as appellate jurisdiction. Columns should be provided for the follow-up of every complaint till its final decision. In case of acquittal the reasons should be indicated so as to serve as a future guide to plug the lacuna.

Of the diaries and reports required to be submitted by the Inspector, special mention should be made of the daily inspection and verification summaries supported by copies of cash receipts issued during the day, duly summarised in the weekly deposit report with a copy of the treasury deposit receipt and seizure of apparatus and prosecution reports. These reports are further consolidated in monthly returns with a view to check the normal flow of work in respect of any one centre.

The periodical verification of the standards as also the balances used with them has to be duly certified to authenticate their prescribed precision. Records and returns in this respect need rigid scrutiny and keen vigil to obviate the exigency of these standards transgressing the prescribed tolerances which renders them illegal.

Though every effort has been made to eliminate overlapping in prescribing forms for these reports, they need not be brief to a fault, whereby their informative purpose is lost.

Controllers' Record

The important registers etc., at the Controller's end include:

(1) Standards verification register for the reference, secondary and working standards and the balances appertaining thereto.
The prescribed periodical verification of these standards should be duly recorded to ensure their continued conformity to the legal requirements.

(2) Cash collection register indicating the centrewise revenue receipts—anticipated and actually realized.

(3) Prosecution and seizure registers indicating the exact position in respect of every complaint, sanction accorded, final disposal of the case and the seized apparatus,

(4) Licensees' registers bearing details of registration of manufacturers, repairers and dealers with the renewal dates of their licenses. With a view to safeguard against possible leakage of revenue or otherwise stimulating trade of unauthorised apparatus with forged Inspector's stamp, the licensed manufacturers, repairers and dealers are compulsorily required to maintain on the prescribed form a record of their day-to-day dealings in the line.

(5) Stamps-impression register containing facsimiles of the impressions of the various stamps held by the Inspector for verification purposes.

The record with the Deputy or Assistant Controller comprises such books, forms etc., as may be prescribed by the Controller and does not call for a separate or detailed examination.

* * *

Enforcement of Metric System in Gujerat

H. N. DESAI
Deputy Controller of Weights & Measures,
Gujerat

HUMAN nature requires time to adjust itself to any change, even a good one, in the normal routine of life. The general tendency is to follow the adage 'old is gold'.

No wonder, therefore, that the change of weights and measures which meant a change in mental habits required time to take root. It was, however, achieved through constant efforts, frequent contacts with traders, both wholesale and retail, their associations and above all, the co-operation of the common purchasers.

Early Steps

Gujerat was formed on 1 May 1960. Before that it was included in the State of Bombay. The Bombay Weights and Measures Act, 1932 was, therefore, in force in the State since 1935. This Act was enforced fully in the then British part of the State. Baroda State, Saurashtra and Kutch had different Acts of their own, more or less on the lines of Bombay Act, but the administration there was not so vigorous as in other regions of the State. The enforcement of the Bombay Weights and Measures (Enforcement) Act, 1958 which prescribes the adoption of the metric system had, therefore, to be taken up in such a manner that all the regions could be covered adequately.

The (Enforcement) Act was initially enforced from October 1958 in respect of weights in the municipal towns of Baroda, Ahmedabad and Rajkot and the market areas of Dhansura, Patan, Unjha, Kapadvanj, Savarkundla and Una notified under the different Agricultural Produce Market Acts. The transitional period was two years. Compulsion became effective in these areas from 1 October 1960. It was found that right up to the end of the transition period, no effective steps had been taken by traders to purchase new weights in spite of the fact that there were one or two manufacturers licensed in the State. Propaganda was carried out among Associations and leading merchants in these areas prevailing upon them to switch over to the new weights. As a result, some Associations did purchase weights but did not use them in transactions. Thus the transition period of two years had not the desired effect.

On 1 October 1960, for fear of legal action, a large number of traders rushed to buy weights. This created a scarcity of weights and prices did go up for about 15 days in the beginning. This scarcity, however, did not last long as between June 1960 and October 1960, a large number of manufacturers were licensed in Gujerat and selling agencies were sanctioned liberally to manufacturers from other States.

Second Phase

In the second phase beginning from 1 October 1961 district headquarters towns like Surat, Broach, Godhra, Anand, Mehsana, Himatnagar, Palanpur, Surendranagar, Junagadh, Jamnagar, Bhavnagar,

Amreli and Bhuj were covered. As a measure of persuasion this time, traders were exempted from stamping of old weights if they purchased new weights and they were told that they would be able to use old weights along with the new till 30-9-1961. This had the desired effect. The traders saved stamping and repairing fees of old weights. The Government revenue did not suffer as there was stamping of new weights. The conversion of capacities of scales also could be taken up in these areas. As a result of the enforcement of weights in the specified areas was complete on 1-10-1961 without any rush for new weights or rise in prices.

This system was so effective that on 1-4-1962, the enforcement of weights was almost complete in the State as also the conversion of scales to new capacities. Here I may add that we also took steps to remove old 'D' class round beams which were largely used by the traders in retail sale.

The enforcement of linear measures and capacity measures was also completed on schedule.

Role of Inspectors

One of the tasks for the Inspectors after 1-4-1962 was to take up re-verification and stamping of weights and paying frequent surprise visits to traders' premises. This was often necessary as old weights had a tendency to come into use surreptitiously. The Inspectors used persuasion. But sometimes seizure of old weights had to be carried out. In fact, the State Government realised about Rs. 14,000 from auction of unauthorized weights etc. during the last two years. The Inspectors persuaded traders to remove old weights; only where necessary they seized them. The Inspectors now pay frequent visits throughout their jurisdiction as it is the only way to achieve effective and smooth enforcement. As a result the revenues have gone up as follows: Rs. 3·75 lakhs in 1960-61, Rs. 5·44 lakhs in 1961–62 and Rs. 6·12 lakhs in 1962-63.

The difficulty felt by some traders in the State is that some customers still persist in demanding rates and quantities on the basis of old denominations, although the old weights are not used in the shop. Unscrupulous traders are sometimes tempted to use old weights which they usually hide suitably when not in use. Propaganda is still necessary to stop this and unless every housewife learns the metric concept, this type of irregularity is bound to persist for some time to come. We are handicapped in our State in this respect as our Inspectors are not only Inspectors of Weights and Measures but are Industries Inspectors. They have also to devote their time to other investigational work of the Department.

Pricing Units

So far as prices are concerned, they are usually quoted in terms of the kilogram in retail trade and 10 or 20 kg in wholesale trade. Exceptions are that in some areas of Saurashtra, particularly in the retail vegetable trade, the unit of 400 grams is also used. The unit of 18 kilos is in force in the tobacco trade only. Otherwise if the customers ask for the price of seer of a commodity, (the Gujerat seer is of 40 tolas) the traders quote the rate for 500 grams and the weight of 500 grams is taken as the new seer and deliveries made accordingly.

The use of a unit of 400 grams in retail trade in some places exists probably because this unit can be divided into fractions of $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$. To avoid misunderstanding a board is exhibited in the market prominently saying that the rates in the market are for a unit of 400 g. The unit of 18 kg in tobacco trade was adopted as the equivalent of the katcha maund of 20 seers in this trade. I am sure that this idea of quoting prices in terms

of the old maund will disappear with time and the unit of one or 10 kg adopted.

As for linear measures, a large number of traders have adopted the metre and the use of the yard is not much prevalent now. Even the remnants are bound to disappear with time and the vigilant watch of the Inspectors.

In short, the enforcement of the Metric Act in Gujerat is now complete except in a few scattered cases of hawkers. Even in this case remarkable results have been achieved where Inspectors have devoted their time to this objective.

Seventh Conference of Controllers

THE Seventh Conference of Controllers of Weights and Measures was held in New Delhi on 6 and 7 August 1963. Shri K. V. Venkatachalam, Joint Secretary, Ministry of Industry, presided.

Controllers of Weights and Measures of the States and Union Territories and representatives of the National Physical Laboratory (NPL), Indian Standards Institution (ISI) and Ministries of International Trade, Economic & Defence Co-ordination, Finance, Information and Broadcasting and Law attended the Conference.

President's Opening Remarks

Reviewing the progress of the reform during the last seven years, the Chairman congratulated the representatives of the States Weights and Measures Departments and others concerned on the commendable achievement. Reports showed that progress in enforcing weights and measures had been remarkable. Metric weights and measures had come into extensive use in trade in most parts of the country. In certain States, the new weights were accepted even more readily in the rural areas than in towns and cities. Instances were certain remote areas in Himachal Pradesh and Jammu and Kashmir. There should, however, be no complacency. Continuous efforts should be made to preserve the gains achieved, and to make further progress. Relaxation of vigilance would endanger the gains achieved at much cost and effort.

There was an impression in certain States that the metric system having been successfully introduced, the strength of the Enforcement Organisations might well be reduced. Any such action would have most undesirable consequences. It would jeopardize the gains of the last seven years. Where the strength of the Organisation was adequate, it should be maintained intact. Elsewhere it should be strengthened. Inspectors of Weights and Measures and others concerned with enforcement should be free to devote their time and energy exclusively to this work. In the major States, Supervisory Officers, including the Controllers must also be officers with no responsibility unconnected with weights and measures. It would be false economy to weaken the Weights and Measures Departments or to merge them with other

Departments. An efficient and well-organised Weights and Measures Department would be able to maintain itself from the revenue it earns. In many of the States, Weights and Measures Departments were already in this happy situation.

The metric system, he continued, had gained general acceptance in the country. It had been successfully introduced in trade all over the country. There have been very few occasions for resorting to penal action under the law. The habit of quoting prices in the old units, however, persisted, particularly among certain traders. One of the major remaining tasks was to induce them to use metric units in expressing prices and to make the general public think in metric terms. This could be achieved only through wide and continuous publicity and education.

The main objective of the reform was to bring about uniformity in weights and measures, as also in the manner in which they were being enforced. Diversity of enforcement procedure would cause difficulty and harassment to trade and industry. The purpose of the periodical Conferences of Controllers of Weights and Measures was to draw up a procedure for enforcement which would be accepted and adopted in all the States. There would be no justification for holding these Conferences, if their recommendations were not adopted by the States. A convention should be established that the Conference's recommendations would be accepted and acted upon by the Weights and Measures Departments of all the States.

The main conclusions and recommendations of the Conference are summarised below:

(1) Enforcement of Metric Weights and Measures

Enforcement has, in general, been satisfactory throughout the country. Weights and Measures Organisations should be strengthened in States where they are not sufficiently strong for their responsibilities. Inspectors of Weights and Measures, Assistant Controllers, and Deputy Controllers, should, in general, be wholetime officers with no responsibilities unconnected with weights and measures. In the major States, Controllers should also be wholetime officers.

(2) Amendments to the States Weights and Measures (Enforcement) Acts

(*a*) *Quoting prices or expressing quantities in non-standard weights and measures to be made an offence*

The Acts should be amended by the addition of a clause on the following lines:

No person shall quote prices or express the quantities or rates, in any transactions for trade or commerce, except in terms of standard weights or measures. Whoever quotes prices or expresses quantities or rates, in any transaction for trade or commerce, otherwise than in terms of a standard weight or measure shall be punishable with a fine which may extend to rupees two thousand.

(*b*) *Penalty for demanding, receiving or giving more or less than the quantity purported to be transacted*

The Act should be amended adding a clause providing for a penalty for this offence. A fine not exceeding Rs. 500 would be an adequate penalty.

(*c*) *Definition of the term 'sealed package'*

The term 'sealed package' to which reference is made in Section 14 of the Model Weights and Measures (Enforcement) Act should be defined in the Act. The following definition is recommended:

'Sealed package' means a closed packet, bottle, casket, tin, barrel, case, receptacle, bag, sack, wrapper, or any other container which is intended to be sold with its contents, without any weighment or measurement of such contents at the time of sale.

(*d*) *Exemption of small food packages*

Food packages having net weights below 60 g should be exempted from the provisions of the Act regarding marking and verification of sealed packages. In the case of

biscuits, confectionery and sweets, however, the limit should be 120 g. The term 'food' will have the meaning given to it in the Prevention of Food Adulteration Act, 1954.

(*e*) *Penalty for giving short weight or measure*

The maximum penalty for this offence should be raised to a fine of Rs. 500.

(*f*) *Permissible errors in selling articles by weight or measure*

The Acts authorise the State Governments to prescribe the limits of errors which may be tolerated in selling articles by weight or measure generally or as regards any trade or class of trades. A penalty has been prescribed for delivering to a purchaser less than what is purported to be sold, if the deficiency exceeds the prescribed limit of error. It is difficult to prescribe reasonable limits of errors to be allowed, where the commodity is sold loose, and not in sealed packages. The words 'if the deficiency exceeds the prescribed limits' may, therefore, be deleted. Permissible errors, will, however, be prescribed for sealed packages in regard to major commodities. In other cases whether the quantity delivered was reasonably correct or not would be left to the discretion of the courts.

(3) Amendments to States Weights and Measures (Enforcement) Rules

(*a*) *Reverification, at concessional rates, of stamped weights held in stock unsold by manufacturers or dealers for long periods*

As a rule, no concession can be granted in the case of weights or measures held in stock with manufacturers or dealers. In special cases, however, where stocks were held on the suggestion of the Government and could not be sold till the expiry of the period for which the verification stamps were valid, the weights or measures may be reverified at a concessional fee at 25 percent of the prescribed rates.

(*b*) *Rules to govern appeals against decisions of Inspectors*

Rules should be made to govern appeals from aggrieved parties against decisions of Inspectors.

(*c*) *Enhancement of rates of fees for verifying length measures*

The rates of fees for stamping length measures may be raised to the following :

Length of Measure	*Fee for Verification*
0·5m	25 nP.
1m	50 nP.
above 1m	Re. 1

(*d*) *Marking of denominations, trade mark of manufacture, etc., on weights and measures*

The denominations and the name or trade mark of the manufacturer should be marked on all commercial weights and measures in two scripts. One of the two must be Devnagri. The other may be either the Roman script or the script of any of the regional languages mentioned in the Constitution. The numerals to be used should always be Indo-Arabic numerals (*i.e.* 1, 2, 3, 4, 5, *etc.*)

(*e*) *Permissible errors in the net weights of commodities sold in sealed packages*

The following limits of errors may be permitted in the net weights of biscuits and piece-goods sold in sealed packages :

Biscuits

Net weight of package	*Limits of permissible error*
Below 500 g	±7 percent
500 g and above but below 1 kg	±6 percent
1 kg and above but below 2 kg	±5 percent
2 kg and above	±2·5 percent

Piece-goods

An error not exceeding 7 percent

The limits of permissible errors for other important commodities sold in sealed packages

should be determined in consultation with the interests concerned, and notified in the Rules. The commodities suggested were pulses, flour, hydrogenated oil, milk, sweetmeats, confectionery, chemicals, cashewnuts, dry fruits, fruit products and preserves, butter; ghee, coffee, salt, sugar, edible oils and hair oils.

(*f*) *Stroke measures used in the sale of petroleum products*

The oil companies may be permitted to continue using stroke measures. The quantity delivered per stroke must be marked on every measure in millilitres. The measures should be verified and stamped by Inspectors. The Weights and Measures (Enforcement) Rules should be amended to recognise the use of these measures, and provide for their verification and stamping. The ISI would standardise stroke measures. When the standard is ready, appropriate specifications would be laid down in the Rules.

(*g*) *Fees for verifying tank vehicles on the request of the user*

Tank vehicles are sometimes reverified, before reverification becomes due under the Act, on the request of the user. In such cases, the user should be required to pay verification fees at full rates.

(*h*) *Period of licensing of manufacturers and dealers*

The period covered by a licence should be the calender year.

(4) Training of Personnel

(*i*) *Inspectors*

Every person recruited for a wholetime post of Inspector of Weights and Measures should receive six months' training in the Bihar Institute of Weights and Measures. A shorter course of two months' duration would also be provided for the benefit of those who are working as Inspectors but have not received formal training in a recognised Institution. Such persons should be sent to the Bihar Institute for training according to the covenience of the Departments. A Committee may be appointed to work out details of the training including curricula for theoretical and laboratory instruction, as well as field training.

(*ii*) *Senior Personnel*

The Maharashtra Department of Weights and Measures will provide a fortnight's refresher course for senior personnel including Controllers, Deputy Controllers and Assistant Controllers. Officers will be deputed for training according to the convenience of the Departments.

(5) Licensing of Manufacturers

The Conference re-affirmed the recommendation of previous Conferences that :

(*i*) every manufacturer of weights, measures and instruments must take out a licence from the Government of the State in which his establishment is situated;

(*ii*) with such a licence he has the right to manufacture weights, measures, etc., for sale in any part of the country. He must not be asked to obtain a manufacturer's licence from any authority outside the State in which he functions.

A licensed manufacturer of one State must not, under any circumstance, be asked to take out a licence from the Government of any other State, as a condition for selling his products in that State.

(6) Standardization of Forms and Registers

The Conference adopted standard forms of return and standard forms of registers to be used in Weights and Measures Department.

(7) Manual for Inspectors

The synopsis for the Manual drafted by the Directorate of Weights and Measures was

approved. A chapter would be added on the genesis of the metric system and the work of the International Bureau of Weights and Measures and the International Organisation of Legal Metrology. A Committee was set up to advise the Directorateon the compilation of the Manual. The revised synopsis is given in the Appendix.

(8) Central Laboratory for Testing Prototypes of Weighing Machines

The Conference accepted in principle the suggestion of the ISI that a Central Laboratory should be set up for testing prototypes of weighing machines. The function of the laboratory would be to ensure that weighing machines manufactured in the country were so designed as to conform in all respects, to the requirements of the Rules. A Committee was set up to study the subject and make recommendations.

(9) Calibration of Tank Lorries

(i) Permissible error

The permissible error prescribed for a vehicle tank was a margin allowed for unavoidable errors. It was not something to be added to the marked capacity. The maximum permissible error prescribed in the Rules is 0.05 percent. A vehicle tank would qualify for approval if its capacity was between the capacity marked on the tank and the marked capacity plus 0.05 percent.

(ii) Verification of tank lorries flying in more than one State.

The Conference reaffirmed the recommendation of the 6th Conference that a tank lorry plying in a number of States should be stamped by Inspectors of all the States. It was unnecessary and wasteful to have it verified independently by Inspectors in all these States. It should be sufficient if it was physically verified in one State. The Inspectors in the other States should accept the correctness of this verification and stamp it without further verification. Fees at the scheduled rates would, however, be payable to all the States.

(10) Weighing Instruments Used in Industrial Concerns

Weighing machines are used in factories and other industrial establishments for commercial as well as non-commercial purposes. The weights, measures and instruments used for commercial purposes are subject to regulation by Weights and Measures authorities. It is, therefore, necessary to determine which of these weights, measures and instruments are used for commercial purposes and which are not. The uses to which weights, measures and instruments are put in various departments in each industry should be examined for this purpose in consultation with persons having intimate knowledge of the industries. The task may be referred to small Study Groups consisting of representatives of the Industry, the Controllers of Weights and Measures, and the Directorate of Weights and Measures.

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APPENDIX

MANUAL FOR INSPECTORS OF WEIGHTS & MEASURES

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(1) Constitutional provisions relating to weights and measures—Their interpretation and significance.

(2) Legislation by Parliament.
- (a) Texts of :
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- (b) Explanations and commentaries on important sections of the Act and Rules.

(3) Legislation By States
- (a) Texts of :
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- (b) Explanations and commentaries on important sections of the State Acts and rules.

(4) Genesis of the metric system and the work of the International Bureau of Weights & Measures and the International Organization of Legal Metrology.

(5) Standards, instruments, test weights and measures, tools and other equipment maintained by Weights and Measures Departments :
- (a) Complete list of standards, instruments, test weights and measures (including proving measures), tools, etc., with broad particulars of the design, materials, etc.; figures showing designs of verification stamps in various States.
- (b) Procedure for the periodical verification of :
  - (i) Working and secondary standard weights and measures of length, and measures of capacity.
  - (ii) Inspector's balances, secondary standard balances and reference standard balances.

(6) Procedure for verification of weights, measures and instruments :
- (a) Commercial weights, including cast iron and brass weights, bullion weights, carat weights, and sheet metal weights.
- (b) Commercial capacity measures, including dispensing measures, peg measures, beaker measures, vehicle tanks for petroleum products etc.
- (c) Commercial length measures, including woven metallic tapes, steel tapes, survey chains etc.
- (d) Commercial weighing machines :
  - (i) Beam scales
  - (ii) Platform weighing machines
  - (iii) Steelyards
  - (iv) Counter machines
  - (v) Spring balances
  - (vi) Weighbridges
  - (vii) Crane weighing machine
  - (viii) Automatic weighing machines
  - (ix) Person weighing machines, including baby weighing machines
  - (x) Self-indicating and semi-self-indicating machines.
- (e) Commercial measuring instruments :
  - (i) Instruments for measuring volumes, *e.g.*, petrol dispensing pumps, barrel fillers, flow meters, water meters.
  - (ii) Instruments for measuring area *e.g.*, planimeter.
  - (iii) Instruments for measuring length.
  - (iv) Special instruments like taximeters.

  For convenience of reference, summary tables of tolerances will be given under each sub-head.

(7) Procedure for verification of sealed packages.

(8) Duties and powers of Inspectors and other Enforcement Authorities :
- (a) Limits and extent of powers, statutory or otherwise, of Inspectors, Assistant Controllers etc.
- (b) Procedure for seizure and disposal of unauthorised weights, investigating cases, and conducting prosecutions and appeals.
- (c) Returns to be submitted and registers, cash books, etc. maintained by Inspector.

(9) Statutory functions and responsibilities of licensed manufacturers, repairers and dealers.

News & Views

Recent Notifications

(1) *Rates of Royalty on Major Minerals Revised*

New Delhi, the 27th August, 1963
5th Bhadra, 1885.

No. MII-152(26)/62—In exercise of the powers conferred by sub-section (3) of Section 9 of the Mines and Minerals (Regulation and Development) Act, 1957, the Central Government hereby makes the following amendments in the Second Schedule to the said Act, namely :—

In the said Schedule—

(*i*) for items 3, 11 and 12 and the entries relating thereto, the following items and entries shall respectively be substituted, namely :—

'3. Gold, Silver, platinum and other precious metals and their ores.	Seven percent of the sale price at the pit's mouth.';
'11. China clay	
(a) Crude	One rupee per tonne.
(b) Washed	Five rupees per tonne.';
'12. Kyanite	Sixteen rupees per tonne.';

(*ii*) in item 7, after entry (*b*), the following entry shall be inserted, namely :—

'(c) Chromite concentrates in fines prepared through crushing and panning (irrespective of percentage content of Cr_2O_3)	Two rupees per tonne.';

(*iii*) after item 16, the following items and entries shall be inserted, namely :—

17. Copper ore	Seven percent of the sale price at the pit's mouth.'
18. Lead concentrates	Seven percent of the sale price at the pit's mouth.
19. Zinc concentrates	Seven percent of the sale price at the pit's mouth.
20. Garnet (Abrasive)	Five rupees per tonne.
21. Sillimanite	Eighteen rupees per tonne.
22. Barytes	
(a) White	Five rupees per tonne:
(b) Buff	Three rupees per tonne.
23. Quartz	Fifty *naye paise* per tonne.
24. Glass-sand	Seventy-five *naye paise* per tonne.
25. Corundum	Thirty-five rupees per tonne.
26. Bauxite	
(a) Chemical grade	Two rupees per tonne.
(b) Metal grade	One rupee per tonne.
27. Ochre	Two rupees per tonne.
28. Steatite	Three rupees per tonne

(*iv*) item 17 shall be renumbered as item 29 and for the entries in item 29 as so renumbered, the following entries shall be substituted, namely :—

'29. All other minerals not hereinbefore specified	Seven percent of sale price at the pit's mouth.'

Unit for Timber Trade

The Conference of Conservators of Forests held in New Delhi, on 19 December 1961, had recommended that the cubic metre should be used as the unit for timber transactions. (See *Metric Measures*, March 1962, pp. 18 and 19.) Certain timber and other interests had represented that as the cubic metre was about 30 times larger than the cubic foot and the cubic decimetre equally smaller, a unit approximately corresponding to a cubic foot should be recommended. The suggestion generally made was that the unit should be 1/10 or 1/100 of the cubic metre.

The question whether or not to recognise a unit like 1/10 or 1/100 cubic metre for timber trade was referred to the Indian Standards Institution. The Timber Conversion and Grading Sub-Committee (BDC 9:10) considered this question in detail and concluded that it was not desirable to introduce such odd units as 1/10 or 1/100 of a cubic metre. The only unit recognised by the International Organisation for Standardisation (ISO) and in the European countries like France, Germany and Russia is the cubic metre.

In view of these considerations, the ISI has now finally recommended that the cubic metre alone should be used as the pricing unit in timber trade.

French Count System in Cotton Textiles

The Textile Commissioner has written to all the textile mills producing staple fibre yarn, that from 1 October 1963 the packing of staple fibre yarn of all kinds may be in bundles of 2·5 kg. It will, however, be in order if mills pack the staple fibre yarn up to NF 50 in bundles of 5 kg also. The mills have also been informed that with effect from 1 October 1963, they should adopt the metric system, namely, the French count system, to denote the length of the staple fibre yarn.

UK Weights and Measures Act Passed

The UK Weights and Measures Act, 1963 was passed on 31 July 1963.

This Act repeals all earlier legislation relating to weights and measures in England, Scotland and Wales.

It is divided into six parts and has ten Schedules. The first three Parts deal respectively with the basic units of measurement and the physical standards which represent them, the units of measurement and the weighing and measuring equipment which may be used for trade, and the provision of public weighing and measuring equipment. Part IV regulates transactions in a wide range of goods. Part V provides for the administration and enforcement of the Act and of the subordinate legislation made under it, while Part VI deals with miscellaneous and general matters.

Part I of the Act legalises units for both imperial and metric systems and defines the yard and the pound as equivalent to 0.9144 metre exactly and 0.453 592 37 kilogram exactly respectively. The metre and kilogram have thus become for the first time in British history the fundamental units of weights and measures, from which all other units of weight and measure including those of the imperial system are derived. Although it does not provide for the abandonment of the imperial system, it does not militate against the change in future.

It provides for a permanent expert Commission on Units and Standards of Measures to be set up to advise the Board of Trade on the need for statutory definitions of further

units of measurement and on a number of other matters. This Commission will act as a common reservoir of advice and experience for all Government Departments concerned with the use of authoritative measuring equipment.

Section 21 of the Act gives the Board of Trade extensive powers to make orders and regulations in respect of goods. Any statement of the weight, measure or number of goods sold is required to be accurate at the time of sale to the ultimate consumer. Thus a trader who is pre-packing an article which is required by the Act to be marked with its weight is not permitted to mark the article with the 'weight when packed' but he must make allowances for any expected loss of weight during distribution and storage, so that the statement of weight is correct when the article is purchased by the consumer. The Act, however, provides safeguards and defences for the packer in case of losses of weight due to unexpected and unavoidable causes.

No tolerances are prescribed in the Act in respect of the weight or measure of prepacked articles. This is left in the first place to the judgement of the Inspector and finally to the Courts who are required, where the proceedings are in respect of a number of articles tested on the same occasion, to have regard to the average quantity in all the articles tested and generally to all the circumstances of the case. Where the proceedings are in respect of a single article, the Courts are required to disregard any inconsiderable deficiency besides having regard generally to all the circumstances of the case.

There are 10 schedules in the Act of which Schedule 4 relating to foods, is further subdivided into XII parts and Schedule 7 for 'Miscellaneous Goods Other than Foods' is divided into XIII parts. The items covered under these two Schedules include such items as meat and food containing meat, fish, poultry and sausage-meat, cheese, bread, milk, intoxicating liquor, fresh fruits and vegetables, various types of prepacked goods, liquid fuel and lubricants, and cement and other items of pre-packed materials.

The Act and the Schedules together cover 119 pages. The Act is available from Her Majesty's Stationery Office, London, at 7 shillings net.

Weights and Measures Enforcement in Israel

The Annual Report of the Weights and Measures Service for the period 1-4-1962 to 31-3-1963 makes interesting reading. It shows that the Service has been doing excellent work in its field.

The instruments verified and reverified during the year were : measure of length 1,511, measures of capacity 3,113, measuring pumps 892, weights 91, 536, weighing machines 21,277, giving a total of 118,329.

The revenue has also been on the increase and it was 50,622 Israel Pounds for the year under review. The average revenue per instrument worked out at 42·8 Agorot. During last year more than 17,000 inspections were carried out. In over 15,000 of these the instruments' capacities were found to comply with the requirements. 1,653 traders received notices.

During the year there were 151 prosecutions resulting in 150 convictions and only one acquittal. The main offence was, as in previous years, possession for use in trade of self-indicating weighing machines which were not properly balanced and indicated weight to the prejudice of the buyer.

During the year, there were published in the Official Gazette, under the authority of the Weights and Measures Ordinance, 1947 :

(1) Weights and Measures (Instruments for Use in Trade) Order, 1963;

(2) Weights and Measures Rules, 1963;

(3) Notification of the Controller of Weights and Measures in respect of Authentication of Secondary Standards.

Mr. P. Wolff, Chief of the Weights and Measures Section, represented the Ministry of Trade and Industry at the Second International Conference of Legal Metrology.

Readers' Forum

(The following is a free translation of a letter sent by M. H. Moreau on behalf of the Director, International Bureau of Weights and Measures, Sevres, France. As it reflects the views of the highest international authority on units of weights and measures, it deserves the attention of those who are concerned with scientific terminology and its use in education and books.

Editor.)

Dear Sir,

On reading the article by J. K. Varshneya, 'Definitions of Certain Metric Units' published in 'Metric Measures' May 1963, p. 10, some remarks occurred to us which we send you.

The terms 'degree centigrade', 'degree centesimal' have been changed by the 9th General Conference on Weights and Measures in 1948 which has adopted the term degree Celsius (°C).

The use of the kilogram-force and units derived from it is not recommended in the plan for the adoption of the International System of Units (SI); these units would disappear progressively from metrological terminology. As regards the 'sthene' (the MTS units of force) it is no more legal in France since the issue of the decree of Weights and Measures of 3 May 1961.

The calorie—the quantity of heat required to raise by one degree C the temperature of a gram of air-free water at 15° C under normal atmospheric pressure (101 325 N/m^2)—is not the fundamental unit of quantity of heat; it is the *joule*. The calorie may still be frequently used, but the French Law classifies it as a unit of a different system.

The term 'brightness' should be replaced by *luminance*. The SI unit of luminance is the candela per square metre (cd/m^2); the stilb is the only CGS unit 1 stilb = 1 cd/cm^2 = 10^4 cd/m^2. (It should be noted that the unit 'lambert' is particularly used only in anglo-saxon publications.)

On page 10, there is a typing error, which should read 1 tonne = 1000 kilograms.

H. Moreau

International Bureau of
Weights and Measures, Pavillon De Breteuil,
Sevres (S. & O.), France.

Licensed Manufacturers and Repairers

[*Metric Measures* had been publishing in the past a series of lists of licensed manufacturers, dealers and repairers of weights and measures, weighing and measuring instruments licensed by the Governments in the various States and Union Territories under their Weights and Measures (Enforcement) Acts. To economise on paper, it is possible only to publish lists of licensed manufacturers and repairers.

A feature on statistics of verification and licences issued is also being published in *Metric Measures*.] —*Editor*

STATISTICS OF VERIFICATION OF WEIGHTS ETC. AND LICENCEES

States/Union Territories	Period	Weights	Capacity Measures	Length Measures	Weighing Instruments	Measuring Instruments	Total number of Mfrs. (As on 31st July, 1963)	Dealers	Repairers
1	2	3	4	5	6	7	8	9	10
(1) Andhra Pradesh	1 Apr to 31 July 62	4,56,255	74,480	6,323	8,025	314	62	121	36
(2) Assam	1 Apr 62 to 31st July 63	6,42,529	73,935	7,731	1,068	150	4	69	11
(3) Bihar	1 Apr 62 to 31 Jan 63	1,28,211	..	..	19,309	56	30	203	43
(4) Gujarat	1 Apr 62 to 31 Jan 63	8,64,698	42,049	15,272	1,08,604	663	111	584	142
(5) Kerala	1 Apr 62 to 31 Jul 62	..	..	..	..	..	73	459	142
(6) Jammu & Kashmir	1 Apr 62 to 31 May 63	1,45,550	48	1,274	577	..	1	49	..
(7) Madhya Pradesh	..	..	..	..	..	..	..	..	..
(8) Madras	..	..	..	..	..	..	..	..	..
(9) Mysore	1 Apr to 31 Nov 62	4,81,354	1,05,253	1,037	59,674	8,420	126	493	92
(10) Maharashtra	1 Apr 62 to 31 Mar 63	18,74,286	5,37,135	33,988	..	..	..	..	..
(11) Orissa	1 Apr 62 to 31 Mar 63	4,23,597	86,060	9,089	1,596	2	8	103	6
(12) Punjab	1 Apr 62 to 31 Jul 63	14,09,892	73,744	38,673	1,91,006	339	9	31	16
(13) Rajasthan	N.A.	..	..	..	..	..	..	..	..
(14) Uttar Pradesh	1 Apr to 31 May 62	5,34,506	7,951	4,702	907	113	3	99	18
(15) West Bengal	1 Apr 62 to 31 Jan 63	20,03,339	12,762	2,061	88,041	..	116	684	80
(16) A. & N. Islands	N.A.	..	..	..	..	..	..	..	..
(17) Delhi	1 Apr 62 to 31 May 63	2,66,759	23,925	10,380	32,762	470	6	72	18
(18) Himachal Pradesh	1 Apr 62 to 31 May 63	52,550	4,532	2,174	8,649	..	1	24	11
(19) L.M.A. Islands	N.A.	..	..	..	..	..	..	..	..
(20) Manipur	1 Apr 62 to 31 July 63	13,389	3,696	214	295	2	..	5	1
(21) Pondicherry	1 Apr 62 to 31 Mar 63	24,531	15,985 +200 (peg measures)	711	1,479	18	13	58	6
(22) Tripura	1 Apr 62 to 31 May 63	61,084	7,379	720	6	8	4	74	2

N.A.—Statistics not available as yet.

LICENSED MANUFACTURERS AND REPAIRERS

PUNJAB

Manufactures and Repairers licensed during 1st April 1963 to 31st July 1963.

MANUFACTURERS

(1) Doaba Body Builders, Jullundur City.
(2) Hardeep Industries, Sonepat.
(3) J. L. Jain and Sons, Jagadhari.
(4) Multan Engineering Works, Sonepat.
(5) Murari Lal Tara Chand, Bhiwani.

REPAIRERS

(1) Doaba Body Builders, Jullundur City.
(2) Harichand Mistri, Narnaul.
(3) Jagan Nath, Chaura Bazar, Karnal.
(4) Lakshmi Narain, C/o M/s. Mela Mal Sulekha Mal, Amritsar.
(5) Raja Ram Mistri, Hansi.
(6) Singla Engineering Works, Gurgaon.

TRIPURA

Manufacturers and Repairers licensed during 1st April 1963 to 31st May 1963.

MANUFACTURERS

(1) National Mechanical Works and Foundry, Kasari Patti (near Municipality Office), P.O. Agartala, Tripura.
(2) Tirthamayee Aluminium Products, Arundhutinagar, P.O. Agartala, Tripura.

REPAIRERS

(1) National Mechanical Works, Kasari Patti (near Municipality Office), P.O. Agartala, Tripura.

M96DPD/63—GIPF.

TYPICAL METRIC PRICING UNITS FOR WHOLESALE TRANSACTIONS

Serial No.	Commodity	Metric Unit
		10 grams (g)
(1)	**Gold**	1 kilogram (kg)
(2)	**Grocery and Confectionery** — Biscuits, sweetmeats, cardamoms.	
	Textiles and Textile Fibres — Cotton yarn, damaged and seconds cloth, raw silk, rayon, silk yarn, raw wool, wool manufacturers (when sold by weight).	
	Paints & Chemicals — Paint (if sold by weight), indigo, liquid chlorine.	
	Hides, Skins & Leather — Raw hides, leather (hides and skins).	
	Metals — Silver, aluminium sheets, strips and circles, copper and brass wires and utensils.	
	Miscellaneous — Tea, meat, camphor tablets, mica.	1 quintal (q) (100 kilograms)
(3)	**Grains and Pulses** — Rice, wheat, jowar, arhar, moong, masur, gram.	
	Spices — Black pepper, mustard, chillies, dhania, dalchini, turmeric, betelnuts.	
	Plantation Products — Rubber, cashewnuts, cashew kernels, tobacco (raw and manufactured).	
	Forest Products — Lac and lac products, gums, myrobalans, galnuts, soapnuts.	
	Textiles & Textile Fibres — Raw jute, raw hemp, coir yarn.	
	Oils, Oilseeds & Oilcakes — *Vegetable oils, oilseeds, oilcakes.*	
	Non-Ferrous Metals — *Aluminium* : ingots, bars, blocks, slabs, billets. *Lead* : ingots, sheets and strips. *Copper* : ingots, blooms, slabs, cakes, tiles, bricks, billets, blisterbars and wirebars, rods, sections and pipes, plates, sheets and strips, circles. *Brass* : ingots, rods, sections, pipes, sheets, strips, circles. *Zinc* : ingots, sheets, strips. *Tin* : blocks.	
	Chemicals — Caustic soda, bleaching powder, glycerine, soaps, paper salt.	
	Others — Sugar, gur, ice, fish, sugarcane, vegetables, tamarind.	
(4)	**Minerals** — Iron ore, manganese ore, bauxite, coal.	one metric tonne (t) (1,000 kilograms)
	Iron & Steel — *Pig iron, iron and steel manufactures,* semis (billets for rerolling etc.)	
5)	Cloth (mill, handloom, silk, rayon and woollen cloth).	1 metre (m)
6)	Jute carpets, coir mats and mattings, sheet glass.	one square metre (m^2)
7)	Timber.	one cubic metre (m^3)
8)	Paints (when sold by measure), spirits.	one litre (l)

Weights

(1) In place of the present units of seer, pound, rattal, viss etc., use the kilogram.

(2) In place of [illegible], use the gram or 10 grams.

(3) In place [illegible]d or corresponding unit, use the quinta[illegible]

Capacity Measures

In place of seer or gallon or any other measure use the litre.

Length Measures

(1) Use the metre in place of yard or foot and the centimetre in place of inch.

Square Measures

(1) Use the square metre in place of square yard or square foot, and square centimetre in place of square inch.

Cubic Measures

(1) Use the cubic metre in place of cubic yard or cubic foot and cubic centimetre in place of cubic inch.

Packaging

It is advantageous if sizes of packages correspond to series of commercial weights and measures prescribed.

These are: 50 kg, 20 kg, 10 kg, 5 kg, 2 kg, 1 kg, 500 g, 200 g, 100 g, 50 g, 20 g, 10 g, 5 g, 2 g, 1 g, and so on.

TYPICAL PRICING UNITS FOR RETAIL TRADE

Serial No.	Commodity	Metric Unit for Use
(1)	Foodgrains, cereals, pulses, spices, ghee, bread, vegetables, meat, fish, sweetmeats, tea, coffee, sugar, salt.	1 kg
(2)	Oil for cooking	1 kg or 1 litre depending upon prevalent practice.
(3)	Fruits	1 kg or number depending upon prevalent practice.
(4)	Milk	1 litre
(5)	Cloth and related materials	1 metre
(6)	Prepackaged materials	Preferably sizes corresponding to series of commercial weights and measures.

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