metric measures

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Thinking in Metric Units

Shri V. B. MAINKAR,
Ministry of Commerce & Industry
New Delhi

NOW-A-DAYS we are in the midst of the metric system of weights and measures. We know that the units of the metric system such as those for weights, capacity, volume, area etc., are derived from the primary unit of length called 'metre'. We have also learnt that the fundamental concept of the metric system is that, the higher and lower secondary units are obtained from any unit either by multiplying the unit concerned by ten or by taking a tenth of it. To indicate how many times any secondary unit in a series is in comparison with the primary unit *viz.*, gram, metre and litre, we use prefixes like milli, centi, deci, deca, hecto, kilo etc. For example, one kilogram means, 1,000 grams and one centigram means 1/100 of a gram. This is the fundamental feature of the metric system which makes it simple and desirable above all the other systems.

Now suppose we have to use the metric system for our transactions in daily life. We have the kilogram and 1/10 of it, hectogram, *i. e.* 100 grams and the next lower secondary unit, decagram *i. e.* 10 grams and then the gram and so on. Suppose that we use weights which are also of a similar ratio., *viz.*, 1g, 10g, 100g, 1kg etc. Then if we use these weights in practice and we have to weigh, let us say, 7 hectograms or 700 grams, we shall have to pile up 7 weights of one hectogram each in the pan. This would be cumbersome. So there is need for some intermediate weights as also measures. How do we derive these intermediate units of weights and measures ? This is where the second aspect of the metric concept comes in.

Intermediate units can be dervied by taking a definite multiple and submultiple of the various primary and secondary units by using a fixed factor. The question is what should be the factor to be used. It is obvious that the two factors and their reciprocals which can give us convenient integer units are 2 and 1/2, and 5 and 1/5.

Derivation of the Series

By applying both these factors to each of the secondary units of the metric system, we derive the same series. The example of weights is given below in which primary and secondary units are given in italics.

100 *kg= quintal*
50 kg=1/2 quintal *i. e.* 5×myriagram
20 kg=2×myriagram *i. e.* 1/5 quintal
10 *kg=myriagram*
5 kg=1/2 myriagram *i. e.* 5×kilogram
2 kg=2×kilogram *i. e.* 1/5 myriagram
1 *kg=kilogram*
500 g=1/2 kilogram *i. e.* 5×hectogram
200 g=2×hectogram *i. e.* 1/5 kilogram
100 *g=hectogram*

50 g=1/2 hectogram *i. e.* 5 × decagram
20 g=2 × decagram *i. e.* 1/5 hectogram
10 *g=decagram*
5 g=1/2 decagram *i. e.* 5 × gram
2 g=2 × gram *i. e.* 1/5 decagram
1 *g=gram*
500 mg=1/2 gram *i. e.* 5 × decigram
200 mg=2 × decigram *i. e.* 1/5 gram
100 *mg=decigram*
50 mg=1/2 decigram *i. e.* 5 × centigram
20 mg=2 × centigram *i. e.* 1/5 decigram
10 *mg=centigram*
5 mg=1/2 centigram *i. e.* 5 × milligram
2 mg=2 × milligram *i. e.* 1/5 centigram
1 *mg=milligram*

It will be seen that the series of weights descends in the order of 5, 2, 1 or its decimal multiples, namely, 50, 20, 10 and 500, 200 and 100, if we consider only the commonly used units *viz.*, quintal, kilogram, gram and milligram. It will also be evident that for ease of understanding and calculation it is preferable to use the factors 2 and 1/2 instead of 5 and 1/5, although both give the same series. In France and some other countries, the denominations used to be referred to by their actual names, *e. g.*, 2 kg is double kilogram and 500 g is demi-kilogram, 200 g is double hectogram and 50 g is demi-hectogram and so on. It appears, however, that these names are slowly getting out of use there. Similar series can be derived for measures of capacity and length. The new metric weights and measures standardized for India follow this series, known as the metric series, faithfully.

Quarter is Not Convenient

Another point that needs to be emphasized here is that the unit of quarter, for example 1/4 kilogram *i. e.* 250 grams or 250 ml (1/4 litre) or 2.5 kilograms or 25 kilograms, does not fit in with this concept.

Now that India is going over to the metric system we should apply the scientific principles on which the metric system is founded, wherever it is possible, instead of trying to adapt the metric system to our conveniences and ideas derived from the past. There is always an easy temptation to do so and that should be avoided, unless technical reasons demand a departure from the concept. For example, some countries may be using packages or tins or containers of 250 grams or 250 ml. There may have been historical or other reasons for doing so in those countries. Should we, in applying the metric system scientifically, go in for such sizes of packages ? Would it make a tremendous difference if we adopt 200 g or 200 ml packages or tins ?

Let us Avoid Adaptation

Take another case. Our students in schools have been using the foot-rule and 6-inch rules for various kinds of measurements in their work. When we change-over to the metric system the natural temptation is to produce 30 centimetre and 15 centimetre rules, which would least disturb the present practice and would involve no extra labour of thinking and designing because they are almost equivalent to the foot-rule and the 6-inch rule. But then should we prescribe a 15-centimetre rule simply because we have been accustomed to the 6-inch rule and it fits into our pockets or drawing boxes quite snugly ?

Technical Problems

It is obvious that the metric concept as enunciated above cannot be applied to each and every case. It may not be possible to apply it, for instance, to diameters of pipes or to screw threads or many other extremely technical and complicated matters where other considerations have to prevail. In such technical matters the natural tendency is to convert the values by applying a factor and obtaining an equivalent which could be used in place of the original values. Such conversions may not always be rational, practicable and acceptable.

Suppose we are dealing with a liquid cooling device. Assume that when using the British units we used to specify for testing purposes that the temperature of the water feed should be 85° F and the discharge temperature 55° F. By mere conversion of the above values we get the inlet temperature as 29.4° C and the outlet temperature as 12.8° C. Obviously, if we accept the converted units it would only lead to a rather queer set of values derived from an originally rational one. Unless the above temperatures are extremely critical, would it be wrong to prescribe the units as, say 29° C or 30° C and 13° C ?

Take another example. Suppose we are taking a sample of cloth or ribbon for testing and in the olden days we used to take one yard. By mere conversion we get the value of one yard equal to 0.9144 metre which is odd for use and measurement. But suppose, we prescribe a sample of one metre. The difficulty of working with an awkward unit like 0.9144 metre would be overcome. Similar arguments are valid for a very large number of industrial products in India at the moment. Mere conversion would lead us into complexities which are of our own creation.

The main difficulty for many engineers and technical people is that through habit they visualize dimensions in the British system and then convert them into the metric system. We can imagine the pitfalls in this process. The simplest course would be to start thinking in terms of metric units rather than convert old British units to the new metric units. It is only when we have accustomed ourselves to this way of technical thinking that we shall realize all the technological benefits of the metric system.

Daily Transactions

What applies to other fields is also valid for daily transactions. Once we know that 1 kg is a little over a seer and 1 metre is a little longer than a yard and so on, we can imagine how much of any commodity would be required in our house in terms of the units in the metric system. For example, would it not be extremely inconvenient if a buyer asked for 933 grams of rice, because his wife has 'ordered' him to purchase one seer ? The shopkeeper will grumble if he has to weigh out such a quantity with metric weights and the purchaser also will waste time in ascertaining that he has really got 933 grams of the commodity. The simplest way is to purchase 1 kg, although it may mean paying a few naye paise more for a larger amount of the commodity.

Therefore, the simplest and at the same time, to some of us, the most difficult advice to follow, would be : 'think in metric units'.

ADOPTION OF METRIC SYSTEM BY ROYAL MELBOURNE HOSPITAL*

CHARLES B. MACGIBBON
Chief Pharmacist,
Royal Melbourne Hospital,
Victoria, Australia

(In a letter to the Editor, the author says :

The last edition of the British Pharmacopoeia had given metric doses to all the new drugs introduced. The Drug Committee at this hospital decided that some hospital had to pioneer the introduction of the metric system and it was for this reason that the change over from the Imperial system was made. It is almost a year since the change over was made and we are most happy with the way it is functioning.)

IT is about 80 years since the medical profession and scientists suggested the use of the metric system but little impetus to implementing the change was given until after the end of World War 2. The support given to the use of the metric system in medicine has been evident in the post-war publications of the British Pharmacopoeia. In 1953 the British Pharmacopoeia indicated the doses of drugs in the metric system with the Imperial equivalents and this tendency to change has been confirmed in the B. P. 1958. The introduction to the British Pharmacopoeia 1958 states 'Doses are expressed in the metric system only except for those substances and preparations commonly prescribed in the Imperial system. The Commission has expressed the view that arrangements should be made so that the Imperial system of dosage might be abandoned in the next edition of the Pharmacopoeia'.

When, in 1956, the Editorial Committee revised the Royal Melbourne Hospital Manual, which includes the hospital pharmacopoeia, it decided that the metric system would be adopted, as soon as possible, for use in the hospital. All doses of drugs and formulae of preparations were written in the metric system without Imperial equivalents being indicated. It should be noted that this is the first occasion that all doses and formulae in the Imperial system were omitted from the hospital pharmacopoeia. The Pharmacy staff gave their full support to this advance in prescription writing. Though in itself the metre is no better than the yard as a standard, the system based on it is much more convenient than the British system, in that, the multiples and

*Reproduced from *The Australasian Journal of Pharmacy*, 30 October 1958, pp 1131—5.

submultiples being on the decimal system, much time is saved in reduction and quantities are expressed as the decimal of one denomination and not in several. Again the measures of area and volume are simply related to those of length and the gram is so chosen as to be the weight of 1 cubic centimetre of water at the point of maximum density. The pharmacist prefers the metric system for its simplicity in calculations with the decimal point displacing the fraction. Percentage solutions are accurately dispensed because of the direct relationship of the gram and the millilitre and no more does the apprentice become confused over the grain and the minim.

The British Pharmacopoeia 1958 forces the dispensing chemist to use metric measurements if he is to dispense accurately the 125 drugs for which metric doses only are given. Now that we are using milligrams and grams as measurement of weight and millilitres as a measure of volume, we are able to dispose of grains, ounces and pounds as well as minim and fluid ounce measure thereby making the duplication of two systems of weights and measures unnecessary.

It was expected that with the introduction of the metric system to the wards in the hospital that the use, by the Nursing Staff, of minim and fluid ounce measures as well as the domestic household measure of teaspoonful and tablespoonful would cease. The use of millilitres as a volume measurement would mean that the Nursing Staff would have only one system to contend with. It would be of great advantage to the nurse, for all fluid intake and fluid output measurements would be in the same system as the individual dose for the patient. The result of this will mean that the trainee nurse will only be required to learn one system of fluid measurement. Difficulty would have been experienced in using the millilitre as a dosage measurement for Out-Patients so it was decided to retain the domestic measures of teaspoonful and tablespoonful for this section of the hospital.

Another reason that prompted the adoption of the metric system was that the hospital has a responsibility as a teaching institution to instruct the students in the metric system. It was confidently expected that as the medical students were trained in this system that they would become doctors who would universally use the metric system in their prescription writing. Experience had shown that pharmacists were not familiar with the metric system and that most of them use the laborious method of converting metric doses to Imperial doses before dispensing the prescription. It was likewise confidently anticipated that pharmacists after a period at the hospital would gain confidence in using metric weights and measures.

Further support to the adoption of the metric system was given by medical literature and drug manufacturers. All new products being issued have dosage expressed in the metric system so that the relationship between drugs of similar therapeutic action is readily seen. No longer will we have drugs with similar therapeutic action expressed in different systems so that the relation of their doses cannot readily be seen. Powdered Digitalis Leaf has a maintenance dose of 1/2 to 1 1/2 grains (not 30 to 90 milligrams) but Digoxin has a maintenance dose of 0.25 milligrams (not 1/240 grains) once or twice daily. It now becomes the duty of all pharmacists to embrace this system and to end the confusion of the Imperial, the avoirdupois and the apothecaries systems. When the dispensing chemist adopts the metric system entirely it will no longer be necessary to state on the label that the strength of the Morphine Sulphate injection is

1/4 grain in 1 ml. How much more correct will it be to state that the strength is 15 mg in 1 ml.

PRELIMINARY ORGANIZATION

At a conference of medical staff personnel presided over by the Medical Superintendent, the problems which would be created by the introduction of the metric system were discussed. It was soon evident that the greatest danger was that of passive resistance, which might develop as difficulties were encountered. It was resolved to issue a metric conversion table to assist staff to become familiar with the approximate metric equivalents to the Imperial measurements. Positive action was taken by suggesting to the staff conference that everybody should be encouraged to think in the metric system, for as this was done so the necessity to convert from metric to the Imperial system would cease.

The following decisions were endorsed :

(1) All fluid intake and output would be measured and recorded in the metric system.

(2) All body temperatures were to be taken and recorded in degrees Centigrade.

(3) The height of patients was to be measured and recorded in centimetres.

(4) Body weights were to be recorded in kilograms.

(5) A metric conversion table of approximate equivalents was to be prepared. This table would provide a standard for use by the Nursing Staff and would show the equivalent Fahrenheit for a *recorded* Centigrade temperature, the equivalent of stones and pounds to a *recorded* kilogram body weight and the equivalent in feet and inches to a height *recorded* in centimetres,

(6) The Pharmacy was instructed to change all ward labels showing Imperial nomenclature to metric measurements.

Grain to milligram (mg)
Ounce to gram (g)
Minim to millilitre (ml)
fluid ounce to millilitres (ml)
one teaspoonful to 4 millilitres (4 ml).
two teaspoonfuls to 8 millilitres (8 ml).
one tablespoonful to 15 millilitres (15 ml).

(7) The Resident Medical Staff were to be instructed to use the metric system.

(8) The co-operation of the Honorary Medical Staff was to be sought and they were to be asked to change their prescribing to the metric system.

(9) The date for the change-over would be midnight of April 30 so that all hospital records from 1 May 1958 would be in metric system.

Provision of Equipment

(1) *Fluid Intake.*—Clear plastic jugs shaped with a pourer lip and graduated in millilitres were provided.

Fluid Output.—Opaque plastic jugs graduated in millilitres, and of a different shape to those used for fluid intake, were provided.

Stainless Steel Jugs that were in use and graduated in fluid ounces and pints and cubic centimetres were re-marked in millilitres and litres.

All this equipment was delivered prior to 30 April and on 1 May all Imperial measures were withdrawn.

(2) Centigrade thermometers were issued to wards and Fahrenheit thermometers were withdrawn,

(3) The height register graduated in the Imperial system was retained but a brass rod graduated in centimetres was affixed to the present measuring gauge.

(4) It was not possible, except at great cost, to convert the present patient weighing scales to the metric system so the nursing staff were instructed to weigh on the present scale, convert the avoirdupois weight to the metric equivalent and record the weight in the metric system.

(5) Tables showing approximate equivalents were printed on both the front and reverse sides of a folded card. The various tables showed :—

(*a*) the equivalent Fahrenheit temperatures to Centigrade. The range of temperatures were from 35.0° C to 45.0° C.

(*b*) the equivalent kilogram weight for stones and pounds. The range of weights commenced at 31.7 kg (5 stones) and went through to 88.6 kg (14 stones). Any weight greater than this could be calculated from the table.

(*c*) a measurement of length commencing at 91.4 centimetres (3 feet) and ranged to 182.9 centimetres (6 feet).

(*d*) Approximate Equivalents of Fluid Ounces and Millilitres, also Minims and Millilitres.

(*e*) Approximate Equivalents of Ounces/Grains (Avoirdupois) to Grams/Milligrams.

(*f*) A table of Metric Weights and Volumes.

(*g*) Approximate Equivalents for Dispensing Purposes related to the Domestic Measures of teaspoonful and tablespoonful.

(*h*) A percentage dilution table.

A copy of the tables is given in Appendix A at the end of this article.

Re-labelling of Pharmacy Stock

It may be of interest to hospital pharmacists to learn of the method by which pharmacy stock labelled in the Imperial system was changed overnight to the metric system. Much preliminary organization had been done prior to the change-over on 1 May. Labels with doses of ingredients in the Imperial system were withdrawn and new labels showing all doses of ingredients in metric were obtained. As new stock for wards and departments was packed the metric labels were attached. For a short period prior to 1 May 1958, it was necessary to use the domestic measure of one teaspoonful or tablespoonful on the label and the metric dose of 4 millilitres or 15 millilitres was blocked out.

On the evening of the 30 April commencing at 7 p. m. qualified pharmacists assisted by apprentices under the direction of the Chief Pharmacist visited the departments and wards throughout the hospital. The drug cupboards in each department and ward were inspected and any drugs labelled in the Imperial system had the labels changed to the metric system. Uniformity in the equivalent doses was assured by the use of the R. M. H. Metric Conversion Table of approximate equivalents. The task was completed by 9.30 p. m. The hospital was thus assured of correct metric equivalents, no wastage of stock, no interruption in the drug treatment of patients and no inconvenience to the Nursing Staff.

The ease of implementation of the metric system amazed all. The Medical and Nursing Staff co-operated with the Pharmacy Staff and the change-over was effected without disturbance or irritation. In the change-over period from the Imperial to the metric system compromises were permitted

but this period must be limited. All the Imperial system methods and measures must be abolished. The pharmacist must no longer dispense his prescriptions by converting the metric measurements to Imperial equivalents and he will dispose of his Imperial weights and measures. The Royal Melbourne Hospital Metric Conversion Table of Approximate Equivalents will not be reprinted as it was intended only as a means of helping the staff to relate the Imperial and metric systems of measurements.

The Metric system has now been in operation (since May 1958) and is now regarded as the normal measuring system. It is hoped that the metric system will be adopted by other hospitals, doctors and pharmacists generally. It is confidently anticipated that doctors, nurses and pharmacists trained at the Royal Melbourne Hospital will go out into the world and change all prescribing to the metric system. All our efforts will be in vain if the metric system remains unused by the general practitioner and the family chemist. We look hopefully for its universal adoption so that medicine and pharmacy will be able to realize the real advantages of this system.

We, at the Royal Melbourne Hospital, have welcomed the adoption of the metric system and now that we have learnt to think in this system we are realizing its many advantages over the out-moded Imperial system.

Our appeal now is to the dispensing chemist to follow the lead given by this Hospital and in every way endeavour to encourage the use of the metric system in dispensing.

APPENDIX A

The Royal Melbourne Hospital Metric Conversion Table of Approximate Equivalents

COLUMN 1

(FACE OF CARD)

The Royal Melbourne Hospital Metric Conversion Tables

(Approximate Equivalents only)

COLUMN 2

FOR INFORMATION ONLY
TABLE OF METRIC WEIGHTS AND VOLUMES*

1000 micrograms in 1 milligram (mg.)
1000 milligrams in 1 Gramme (G.)
1000 Grammes in 1 Kilogram (kg.)
1 cubic centimetre (c.c.) is equal to 1 millilitre (ml.)
1000 millilitres in 1 litre (L.)

APPROXIMATE EQUIVALENTS FOR DISPENSING PURPOSES.
DOMESTIC MEASURES:

One teaspoonful	4 ml.
Two teaspoonsful	8 ml.
One tablespoonful	15 ml.
Two tablespoonsful	30 ml.

DILUTION TABLE

1% 10ml. diluted to 1,000 ml. (1 in 100)
0.5% 5 ml. diluted to 1,000 ml. (1 in 200)
0.1% 1 ml. diluted to 1,000 ml. (1 in 1,000)
0.05% 0.5 ml. diluted to 1,000 ml. (1 in 2,000).
0.02% 0.2 ml. diluted 1,000 ml. (1 in 5,000)
0.01% 0.1 ml. diluted to 1000 ml. (1 in 10,000)

*The abbreviations adopted for India are mg, g, kg, cm3, ml and l respectively—*Editor.*

COLUMN 3

(FRONT OF CARD)

Approximate Equivalents of Fluid Ounces and Millilitres.

Fluid Ounces	Millilitres.
1/2 fl.oz.	15 ml.
1 fl. oz.	30 „
2 fl. oz.	60 „
3 1/3 fl. oz.	100 „
4 fl. oz.	120 „
5 fl. oz.	150 „
6 2/3 fl. oz	„ 200 „
10 fl. oz	” 300 „
13 1/3 fl. oz	” 400 „
17 1/2 fl. oz	” 500 „
20 fl. oz.	600 „

Record in ml.

Minims	Millilitres.
1 minim	0.06 ml.
1 1/2 minims	0.1 „
3 „	0.2 „
5 „	0.3 „
6 „	0.4 „
8 „	0.5 „
10 „	0.6 „
12 „	0.8 „
15 „	1 „
20 „	1.3
30 „	2 „
45 „	3 „
60 „	4 „
75 „	5 „
90 „	6 „
120 „	8 „
150 „	10 „

Record in ml.

Approximate Equivalents of Ounces/Grains (Avoirdupois) to Grams/Milligrams.

Ounces (Avoirdupois).	Grams
1 oz.	30 G.
4 „	120 „
16 „	450 „
Grains	**Milligrams.**
1/600 gr.	0.1mg.
1/300 „	0.2 „
1/200 „	0.3 „
1/160 „	0.4 „
1/120 „	0.5 „
1/100 „	0.6 „
1/80 „	0.8 „
1/50 „	1.2 „
1/30 „	2 „
1/20 „	3 „
1/10 „	6 „
1/8 „	8 „
1/6 „	10 „
1/4 „	16 „
1/3 „	20 „
1/2 „	30 „
3/4 „	50 „
1 „	60 „
1/4 „	75 „
1 1/2 „	100 „
2 Grains	120 „

Record in mg.

Grains	Grams
3 „	0.2 „
5 „	0.3 „
6 „	0.4 „
8 „	0.5 „
10 „	0.6 „
15 „	1 „
20 „	1.3 „
30 „	2 „
45 „	3 „
60 „	4 „
75 „	5 „
90 „	6 „
120 „	8 „

Record in G.

COLUMN 4

BACK OF CARDS

CONVERSION OF CENTIGRADE TO FAHRENHEIT

35.0°C	95.0°F	40.2°C	104.4°F
35.2°C	95.4°F	40.4°C	104.7°F
35.4°C	95.7°F	40.6°C	105.1°F
35.6°C	96.1°F	40.8°C	105.4°F
35.8°C	96.4°F	41.0°C	105.8°F
36.0°C	96.8°F	41.2°C	106.2°F
36.2°C	97.2°F	41.4°C	106.5°F
36.4°C	97.5°F	41.6°C	106.9°F
36.6°C	97.9°F	41.8°C	107.2°F
36.8°C	98.2°F	42.0°C	107.6°F
37.0°C	98.6°F	42.2°C	108.0°F
37.2°C	99.0°F	42.4°C	108.3°F
37.4°C	99.3°F	42.6°C	108.7°F
37.6°C	99.7°F	42.8°C	109.0°
37.8°C	100.0°F	43.0°C	109.4°F
38.0°C	100.4°F	43.2°C	109.8°F
38.2°C	100.8°F	43.4°C	110.1°F
38.4°C	101.1°F	43.6°C	110.5°F
38.6°C	101.5°F	43.8°C	110.8°F
38.8°C	101.8°F	44.0°C	111.2°F
39.0°C	102.2°F	44.2°C	111.6°F
39.2°C	102.6°F	44.4°C	111.9°F
39.4°C	102.9°F	44.6°C	112.3°F
39.6°C	103.3°F	44.8°C	112.6°F
39.8°C	103.6°F	45.0°C	113.0°F
40.0°C	104.0°F		

Record in C

USUAL INFORMATION

Freezing	0°C	32°F
Cold	7°C	45°F
Cool	19°C	66°F
Temperate	26°C	79°F
Tepid	30°C	86°F
Warm	37°C	99°F
Hot	40°C	104°F
Hot water from tap	68°C	154°F
Boiling water	100°C	212°F

COLUMN 5

(BACK OF CARD)

CONVERSION OF STONES AND POUNDS TO KILOGRAMS (Kg.)

5 st.	0 lbs.	31.7 kg.
5 „	1 „	32.1 „
5 „	2 „	32.6 „
5 „	3 „	33.0 „
5 „	4 „	33.5 „
5 „	5 „	34.0 „
5 „	6 „	34.4 „
5 „	7 „	34.8 „
5 „	8 „	35.3 „
5 „	9 „	35.8 „
5 „	10 „	36.3 „
5 „	11 „	36.7 „
5 „	12 „	37.3 „
5 „	13 „	37.6 „
6 „	0 lbs.	38.1 „
6 „	1 „	38.5 „
6 „	2 „	39.0 „
6 „	3 „	39.4 „
6 „	4 „	39.9 „
6 „	5 „	40.3 „
6 „	6 „	40.8 „
6 „	7 „	41.2 „
6 „	8 „	41.7 „
6 „	9 „	42.2 „
6 „	10 „	42.6 „
6 „	11 „	43.0 „
6 „	12 „	43.5 „
6 „	13 „	44.0 „
7 „	0 lbs.	44.5 „
7 „	1 „	44.9 „
7 „	2 „	45.3 „
7 „	3 „	45.7 „
7 „	4 „	46.2 „
7 „	5 „	46.7 „
7 „	6 „	47.1 „
7 „	7 „	47.6 „
7 „	8 „	48.0 „
7 „	9 „	48.5 „
7 „	10 „	49.0 „
7 „	11 „	49.4 „
7 „	12 „	49.8 „
7 „	13 „	50.3 „

COLUMN 5 (*contd.*

8 st.	0 lbs.	50.8 kg.
8 „	2 „	51.7 „
8 „	4 „	52.6 „
8 „	6 „	53.5 „
8 „	8 „	54.4 „
8 „	10 „	55.3 „
8 „	12 „	56.2 „
9 „	0 „	57.1 „
9 „	2 „	58.0 „
9 „	4 „	58.9 „
9 „	6 „	59.8 „
9 „	8 „	60.7 „
9 „	10 „	61.6 „
9 „	12 „	62.5 „
10 st.	0 lbs.	63.4 „
10 „	2 „	64.3 „
10 „	4 „	65.2 „
10 „	6 „	66.1 „
10 „	8 „	67.0 „
10 „	10 „	67.9 „
10 „	12 „	68.8 „
11 „	0 „	69.7 „
11 „	2 „	70.6 „
11 „	4 „	71.5 „
11 „	6 „	72.4 „
11 „	8 „	73.3 „
11 „	10 „	74.2 „
11 „	12 „	75.1 „
12 „	0 „	76.0 „
12 „	2 „	76 9 „
12 „	4 „	77.8 „
12 „	6 „	78.7 „
12 „	8 „	79.6 „
12 „	10 „	80.5 „
12 „	12 „	81.4 „
13 „	0 „	82.3 „
13 „	2 „	83.2 „
13 „	4 „	84.1 „
13 „	6 „	85.0 „
13 „	8 „	85.9 „
13 „	10 „	86.8 „
13 „	12 „	87.7 „
14 „	0 „	88.6 „

1/4 lb. equals 0.11 kg. 1/2 lb. equals 0.23 kg. 3/4 lb. equals 0.34 kg. 1 lb. equals 0.45 kg.

Record in Kg.

COLUMN 6

(BACK OF CARD)

CONVERSION OF FEET AND INCHES TO CENTIMETRES (cm.)

3 ft.	0 in.	91.4 cm.
3 „	1 „	94.0 „
3 „	2 „	96.5 „
3 „	3 „	99.1 „
3 „	4 „	101.6 „
3 „	5 „	104.1 „
3 „	6 „	106.7 „
3 „	7 „	109.2 „
3 „	8 „	111.8 „
3 „	9 „	114.3 „
3 „	10 „	116.8 „
3 „	11 „	119.4 „
4 „	0 „	121.9 „
4 „	1 „	124.5 „
4 „	2 „	127.0 „
4 „	3 „	129.5 „
4 „	4 „	132.1 „
4 „	5 „	134.6 „
4 „	6 „	137.2 „
4 „	7 in.	139.7 „
4 „	8 „	142.2 „
4 „	9 „	144.8 „
4 „	10 „	147.3 „
4 „	11 „	149.9 „
5 „	0 „	152.4 „
5 „	1 „	154.9 „
5 „	2 „	157.5 „
5 „	3 „	160.0 „
5 „	4 „	162.6 „
5 „	5 „	165.1 „
5 „	6 „	167.6 „
5 „	7 „	170.2 „
5 „	8 „	172.7 „
5 „	9 „	175.3 „
5 „	10 „	177.8 „
5 „	11 „	180.3 „
6 „	0 „	182.9 „

1 inch equals 2,54 centimetres.

Record in cm.

Size of card : 24 centimetres X 14 centimetres which is folded in 3 so that each fold measures 8 centimetres X 14 centimetres.

METRIC UNITS FOR WHOLESALE COMMODITY PRICES

L. RAJU
Ministry of Commerce & Industry,
New Delhi.

MODERN trade and commerce require the constant use of weights and measures. In the fast moving world of today the use of innumerable systems of weights and measures in trading of a single commodity in different markets is unthinkable for a nation like India which wants to develop quickly. Even today a reference to the Indian trade journals would show that the units used in different parts of the country for quotations of wholesale prices of commodities vary considerably.

Present Conditions

Take the quotations for certain commodities in India. Although for cereals the usual unit all over India is a maund of 40 seers, each seer being of 80 tolas (1 tola=180 grains), there are innumerable commodities for which prices are quoted in different units. Take for example, black pepper. The unit for price quotation is the maund in Calcutta market, the hundredweight in Cochin and 25 lb in Madras. Similarly, betelnuts are quoted per hundredweight in Bombay market, per maund in Calcutta and per 24 lb in Bangalore. The price units for raw tobacco are per lb in Guntur, maund in Calcutta and 550 lb in Madras. For gingelly seed, units of hundredweight (Bombay) and maund (Madras, Nagpur) are used. The units used for copra seed are 655.6 lb (Cochin), 655 lb (Alleppy) and maund (Kozhikode) ; for castor oil maund (Calcutta) and candy of 100 lb (Madras); for coconut oil 655.6 lb (Cochin), maund (Calcutta) and 28 lb (Bombay). Cotton yarn (grey Indian) is quoted per lb in the Bombay market, per 5 lb in Calcutta and per 10 lb in Madras. Raw jute is quoted per maund and also per bale of 4 hundredweights in Calcutta. Groundnut oil is priced per maund (Calcutta), per 28 lb (Bombay) and per candy of 500 lb (Madras). Besides, other units like 1 lb of 39 tolas, palla of 240 lb, 1 1/2 cwt are not uncommon.

Variations in the connotations of the words candy and bale are the greatest. A candy, for example, may consist of 784 lb, 392 lb, 100 lb, 500 lb, although the Madras candy is supposed to be about 494 lb. Candies of 680 5/8 lb, 618 lb, 660 lb, 672 lb, 560 lb, 773 lb are also known though rarely used in All-India commodity quotations. While a bale may be 448 lb or 400 lb it can also be 92 1/2 lb, 500 to 600 lb and so on.

There may be historical, commercial or even industrial reasons for the variation of the content of the candy or bale. For example, it is said that the 500 lb candy is the Madras candy of 494 lb rounded off. Similarly, a candy of 784 lb is supposed to be the rounded value for 10 maunds

(820 lb) ! The 560 lb candy may have resulted from the relation that 20 maunds (1 maund= 28 lb) make a candy. Actually, according to Bombay city trade practice, a 'Bombay' maund is taken to weigh 28 lb, although the legal maund in Bombay State is of 40 seers.

This is the condition so far as units in different markets are concerned. There are cases where for the same commodity in the same market different units are used in price quotations. For example, raw jute is sold in Calcutta market by the maund as well as by the bale of 4 cwt; the varieties are, however, different.

Need for All-India Units

There is no doubt that the variety of units makes comparison of prices a difficult task for everyone-expert or the common man. It would be obvious to any impartial observer that such a motley of units cannot be conducive to free flow of trade. It is preferable to have only one unit for a particular commodity for use all over India for price quotations. With the adoption of the metric system we should try to evolve simple units and do away with the old ones, whatever may be the reasons for their continuance and adaptations. The simplicity of the metric system and its decimal basis make it extremely well suited to the requirements of trade in the matter of price quotations.

One point which should be borne in mind while considering the appropriate new units would be that they should be metric units. For example, to fix a price quotation for a unit of 225 kg in place of the candy of 500 lb or 355 kg for the candy of 784 lb would in no way be an improvement. Mere conversion and rounding off of this type will not be advantageous. The bale or package could remain what it is for the time being, only the pricing unit being changed to, say 100 kg. The bale could be rationalized later when the metric system becomes a little more prevalent than it is now.

In metric countries like France and Germany, metric units are already in use for decades and we should make an attempt to adopt units which are similar or comparable to theirs depending upon the volume of trade that is carried out in any commodity in India. A simple principle could be adopted for the the choice of units. In case of weights we should either use 1 kilogram, 1 quintal (100 kilograms) or 1 tonne (1,000 kilograms). For gold, platinum and similar commodities of high value we could use the gram as the unit. For capacities we may use the litre, 100 litres ; for volumes cubic metre (m^3); for length and area, we may use metre and square metre respectively. It will be noticed that the above units are those which are recognised for common use.

Where quotations are given in terms of numbers *e.g.*, bricks, match-boxes and the like we could continue to use the dozen and gross and other units. But the advantage of pricing commodities per piece or 100 pieces or 1,000 pieces cannot be denied especially in view of decimal coinage. The facility in calculation is unmatched and conversion is no problem at all. Although the enforcement of such numerical units for price quotation may not be taken up immediately, it should be kept in view as the ultimate objective.

It is with the intention of giving this problem a start that in the table at the end of this article an attempt has been made by the author to suggest for consideration units for wholesale price quotations for certain common commodities, for many of which more than one unit is now prevalent. In recommending these units, the practices in France and Germany have been kept in view as guides. A few remarks on the principles adopted in suggesting the units for the wholesale price quotation are made here.

(1) The unit of one seer and one pound are frequently used now. Both these may be replaced by the kilogram. No attempt should be made to use the unit of 500 grams.

(2) The units of one maund, one hundredweight, candies of various types, could be replaced by 100 kg or quintal.

(3) The ton unit could be replaced by the metric tonne.

(4) The gallon to be replaced by the litre or 100 litre depending upon the volumes usually measured out.

(5) For dozen and gross, 10 and 100 may be used.

(6) For yard and square yard or foot and square foot, we may use the metre and the square metre and for cubic foot, the cubic metre.

How to make change effective

The question now arises whether all the changes can be made effective immediately. As is now well-known, metric weights have been introduced by law in certain areas and for industries from 1st October, 1958. It is intended to extend the use of metric weights to the whole of India in the next few years. Measures of capacity and length will also be introduced gradually. Moreover, the use of old weights in areas now covered is legal for 2 years more *i.e.*, up to October, 1960, and in the areas to be covered in the future, 2 years from the date of enforcement. In view of these circumstances we cannot change all units immediately. But conversion is possible in all cases and where market quotations are given in old units, additional quotations may be given in metric units now suggested.

The acceptance of the new metric units for price quotations would require a thorough interchange of ideas among the trade and commerce associations all over India. A start could be made right now, so that within the next few months agreement could be reached on a country-wide basis.

UNITS PROPOSED FOR WHOLESALE COMMODITY PRICES IN INDIA

Serial No.	Commodity	Present Units	Proposed Metric Unit
(1)	**Cereals**		
	(*i*) Rice, wheat, jowar, bajra, ragi, etc.	maund	100 kg
(2)	**Pulses**		
	Gram, arhar, moong, masur, urad, etc.	maund	100 kg
(3)	**Spices**		
	(*i*) Pepper, chillies, cloves, turmeric, betelnuts, etc.	cwt, maund, 25 lb, 24 lb etc.	100 kg
	(*ii*) Cardamoms	seer	1 kg
(4)	**Plantations**		
	(*i*) Tea	lb	1 kg
	(*ii*) Coffee	cwt	100 kg*
	(*iii*) Raw Tobacco	1 lb, maund, 550 lb	100 kg
	(*iv*) Rubber	100 lb	100 kg
	(*v*) Cashewnuts	maund, ton	100 kg
	(*vi*) Sugarcane	maund	100 kg
(5)	**Forest Produce**		
	(*i*) Lac	maund	100 kg
	(*ii*) Teakwood, salwood, etc.	cu ft	1 cu metre
	(*iii*) Myrobalans, galnuts, avaram bark, konnam bark etc.	maund, 500 lb	100 kg
(6)	**Cotton : Raw and Manufactures**		
	(*i*) Cotton raw	Candy of 784 lb or 392 lb	100 kg
	(*ii*) Cotton yarn	1 lb, 5 lb, 10 lb	1 kg
	(*iii*) Cotton cloth	yard, lb	1 metre (sale by weight may be abolished).
	(*iv*) Hosiery	dozen	10 pieces

*The Coffee Board has already adopted the unit of 50 kg for wholesale trade.

UNITS PROPOSED FOR WHOLESALE COMMODITY PRICES IN INDIA—(contd.)

Serial No.	Commodity	Present Units	Proposed Metric Unit
(7)	**Jute : Raw Manufactures**		
	(*i*) Raw Jute	maund, bale of 4 cwt	100 kg
	(*ii*) Jute manufactures	100 yards, 100 bags	1 metre (preferably), or 100 metres, 100 bags.
(8)	**Silk & Art Silk : Raw and Manufactures**		
	(*i*) Raw silk and rayon yarn	seer, lb	1 kg
	(*ii*) Silk and rayon manufactures	yard or 50/51 yards	1 metre
(9)	**Wool : Raw & Manufactures**		
	(*i*) Raw wool	maund	100 kg
	(*ii*) Wool manufactures	piece, yard, lb depending upon commodity.	1 piece, 1 metre, 1 kg depending upon commodity.
(10)	**Other Fibres : Raw & Manufactures**		
	(*i*) Raw hemp	maund, 400 lb	100 kg
	(*ii*) Coir yarn	candy of 6 cwts	100 kg
(11)	**Oilseeds & Oils**		
	(*i*) Seeds of groundnut, linseed, castor, gingelly, rapeseed, cotton, copra, etc.	maund, cwt, palla of 240 lb, 655.6 lb, 655 lb etc.	100 kg
	(*ii*) Oils like groundnut, linseed, castor, gingelly, mustard, coconut, etc.	candy of 500 lb, 28 lb, maund, candy of 100 lb.	100 kg
	(*iii*) Vanaspati	tin of 10 lb	1 kg
	(*iv*) Groundnut cake, linseed cake, castor cake, sesamum cake, coconut cake, etc.	maund, 1 1/2 cwt	100 kg
(12)	**Hides & Skins : Raw and Tanned**		
	(*i*) Hides (raw)	20 lb, score etc.	1 kg, 100 pieces
	(*ii*) Skins (raw)	100 pieces	100 pieces
	(*iii*) Leather (hides)	lb, sq ft	1 kg
	(*iv*) Leather (skins)	lb	1 kg
(13)	**Minerals**		
	(*i*) Iron ore, manganese ore, bauxite, etc.	ton	1 tonne
	(*ii*) Coal	ton	1 tonne
	(*iii*) Mica	lb	1 kg
(14)	**Iron & Steel**		
	(*i*) Pig iron	ton	1 tonne
	(*ii*) Manufactures	cwt, ton	1 tonne
	(*iii*) Tin plate	box etc.	box of 100

Serial No.	Commodity	Present Unit	Proposed Metric Unit
(15)	**Non-Ferrous Metals**		
	(*i*) Aluminium (sheets, circles)	lb	100 kg
	(*ii*) Zinc spelter, brass, copper, tin, lead etc.	cwt, 500 lb	100 kg
(16)	**Other Commodities**		
	Onions, sugar, salt, gur, fish	maund, 100 maunds	100 kg
(17)	**Precious Metals**		
	Gold, platinum, silver etc.	tola	1 gram
(18)	**Chemicals & Drugs**		
	(*i*) Sulphuric acid, ammonium sulphate, fertilizers etc.	ton	1 tonne
	(*ii*) Caustic Soda, bleaching powder, glycerine	cwt	100 kg
	(*iii*) Fine chemicals	lb	1 kg
	(*iv*) Paints	cwt, gallon	1 litre
	(*v*) Stone etc	cu ft	cu metre
	(*vi*) Paper	lb	100 kg or 1 kg
	(*vii*) Paper pulp	—	100 kg
	(*viii*) Liquid chlorine, indigo	lb	1 kg
	(*ix*) Glass (sheet)	100 sq ft	1 sq metre
	(*x*) Glass tumblers, bangles	gross	100 pieces
	(*xi*) Soap	Case of 60 bars or 144 cakes gross,	1 case of 100 bars or 100 cakes
	(*xii*) Matches	60 stick box.	100 (60 stick box).
	(*xiii*) Ceramics (cups etc)	each	1 piece
(19)	**Rubber Manufactures**		
	Rubber tyres, tubes, etc.	each	1 piece
(20)	**Leather Manufactures**		
	Shoes	per pair	per pair
(21)	**Power and fuel**		
	(*i*) Electricity	Kwh	1 Kwh
	(*ii*) Kerosene, petrol, diesel oil, etc.	8 Imp gallon, gallon	1 litre
(22)	**Grocery Items**		
	(*i*) Meat	seer, lb	1 kg
	(*ii*) Eggs	dozen	per 10 or 100
	(*iii*) Milk	seer	1 litre

Metric System in Higher Technical Education

K. SRINIVASA RAO
Development Officer (Metric)
Ministry of Commerce and Industry,
New Delhi.

WITH the adoption of the metric system in India, it is necessary to give training in the metric system in the entire educational field, particularly in technical institutions. In the primary and secondary schools, the metric system is being gradually introduced in the teaching of arithmetic, revision of text-books, etc. The entire teaching of arithmetic and other subjects has been, for the past many decades, in the pound-seer systems and the metric system has been taught only as a familiarising measure and has been given secondary importance. This has to be reversed now and much greater emphasis has to be laid on the metric system, the existing pound-seer systems being given a secondary place.

In the teaching of pure sciences like physics and chemistry in science colleges, the metric system is already used and no change may be required in the curricula of these subjects to switch over to the metric system.

In technical institutions, such as poly-technics and engineering colleges, however, the emphasis has all along been on the FPS system. It is important that gradually the metric system should be introduced in the courses of instruction in these institutions. It is realized that there are numerous specialised fields like mechanical engineering, electrical engineering, chemical engineering, telecommunication engineering and others, which may have to follow different methods for introducing the metric system, particularly so, in their application to the everyday needs of the industry. It is, therefore, very difficult to lay down one standard procedure for use, but a few points that are common to all the branches of engineering and in technical education could be discussed. It is, however, necessary that a planned programme for the change-over should be chalked out for all the institutions and a few suggestions are put forward here.

Fundamental

Some lectures may be given on the origin of the metric system and the definitions of the fundamental international units like the metre, kilogram, litre, ampere, second and candela, as accepted by the General Conferences on Weights and Measures from time to time.

Derived units

The derived units which are based on these fundamental units are commonly used *e.g.*, in mechanics, heat, periodic and aperiodic phenomena. All these derived units with corresponding units in the FPS system may be taught so that the students would be able to

appreciate the relationship between the two. A list of the more common derived units, as defined by the International Organisation for Standardization, (ISO), is given below:—

Quantity	FPS	CGS	MKS
Area	square foot	square centimetre	square metre
Volume	cubic foot	cubic centimetre	cubic metre
Density	lb per cubic foot	grams per cubic centimetre	kilogram per cubic metre
Velocity	foot per second	centimetre per second	metre per second
Acceleration	foot per second per second	centimetre per second per second	metre per second per second
Force	poundal	dyne	newton
Work or energy	foot poundal	erg	joule
Pressure	Pounds per square inch	kg per square millimetre or kg per square centimetre	newton per square metre
Power	foot poundal per second	erg per second	watt
Momentum	Poundal second	dyne second	newton second
Surface tension	poundal per foot	dyne per centimetre	newton per metre
Moment of inertia	pound × foot^2	gram × centimetre^2	kilogram × metre^2

Conversion of Dimensions

For some years, instruction should be in both the systems, as all the existing machinery in various industries would continue to be used and the problem of conversion of dimensions and units would exist. For this purpose, instruction should be given in the rules for conversion of dimensions from one system to another and the fineness of rounding as given in the (1) Indian Standard Method of Precise Conversion of Inch and Metric Dimensions to Ensure Interchangeability (IS : 1105 of 1957) and (2) (IS : 2—1949) which deals with the rules for rounding off numerical values.

Fits and Tolerances

The Indian Standards Institution have also finalized standard specifications for fits and tolerances in the metric system to be adopted in the country, and these would be shortly published. It would be useful for technical students to understand the differences between the existing system and in the new system so that for design and other purposes, they could easily adopt the standard tolerances in the metric system.

Screw Threads and Fasteners

In all branches of engineering, the subject of screws and fasteners is common and the new metric standards for screws, bolts, nuts, washers, drills, rivets, gauges of wire and sheets have to be incorporated in the various textbooks. Engineers use some empirical formulae for the length and head dimensions of bolts in terms of diameter in the FPS system, and all such empirical formulae in the metric system have to be incorporated and taught in the technical institutions.

Measuring Instruments

Another common feature for all branches of engineering would be the use of measuring instruments. These are in the FPS system today and new metric measuring instruments like vernier screw gauges, thread gauges, calipers, dial indicators, depth gauges etc., have to be used. The use and construction of these instruments would be necessary adjuncts in the syllabi for all engineering students.

Metric Wires, Pipes etc.

Similarly, it is also desirable to give instruction in the new sizes of wires and sheets, pipes and rods, tubes and the like, in the new

metric dimensions. Indian Standards for these are ready.

Drawing Office Practice

New drawing office practices using metric dimensions are to be taught in the technical institutions. It is understood that an Indian Standard Code of Practice for General Engineering Drawing is likely to be published in the near future.

Machine Tools

At present, most of the machine tools in the country are in the FPS system and the products of these machine tools are also manufactured to inch standards. In future, machine tools have to be used for the manufacture of products in metric dimensions and for this, certain adjustments have to be made in the machine tools. While there are many machine tools and processes which do not require any major change, a few like the lathe and indicating instruments need some adjustments for replacement. It is not the intention to scrap all the existing machines and they have to be made use of for their normal life. The effect of the metric change-over on a few machine tools and small tools is given below:—

(1) *Machine Tools*

(*i*) *Lathes.*—The existing stock of all types of lathes could be easily converted to do the job to millimetre dimensions provided the following parts are changed : lead screws, traverse and longitudinal feed screws together with indicating devices.

(*ii*) *Bench lathes.*—These require change of collets, traverse and feeding screws together with indicating devices.

(*iii*) *Milling machines.*—These require change of feed screws and nuts together with indicating devices.

(*iv*) *Drilling machines.*—Taper shanks and twist drills used with the machines have to be changed over to the metric system; if the taper to be adopted is Morse, many of the machines do not need to be changed at all. If another taper is used, then a change of spindles would become necessary.

(*v*) *Automatic Machines.*—Cams, collets, feeding fingers, tapping and threading holders have to be changed.

(*vi*) *Engraving machines.*—Table screws to be changed.

(*vii*) *Grinding machines.*—Table screws and the indicating devices only are to be changed.

(*viii*) *Heading machines.*—Only the tools of the machine, such as punches, dies, threading dies, slotting screws and other fixtures have to be changed.

(*ix*) *Hobbing machine.*—These machines can be easily adapted for the metric system as only the tooling has to be changed.

(*x*) *Jig boring machine.*—Change effected on feed screw, indicator and dials.

(*xi*) *Shaping and slotting machines.*—Feeding screws and nut require change.

(*xii*) *Tapping machine.*—Complete set of tooling to cater for metric threads including change of gears and fixtures has to be provided.

(2) *Effect on Jigs and Fixtures*

Most of these tools could be used with minor changes such as replacement of pins, bushes, etc.

(3) *Effect on Small Tools*

The change-over to the metric system has greater repercussions on small tools, for example:

(*i*) *Lathe tools.*—No change would be necessary in purely metal removing tools. Threading tools, can be ground to the new sizes in the metric dimensions.

(*ii*) *Drills.*—The existing stock of drills has to be replaced by the metric drills.

(*iii*) *Milling cutters.*—The existing milling cutters could be utilised.

(*iv*) *Machine reamers.*—Existing stock has to be scrapped and fresh reamers have to be stocked. However since the change-over is gradual, the existing stock could be used till worn out. Some of the reamers also may be re-worked.

(*v*) *Screw-drivers, spanners etc.*—These could be used after minor alterations in the sizes so that existing stock need not be scrapped.

(*vi*) *Taps and dies.*—The existing stock of B.S.W., B.S.F., B.A. etc., will have to be replaced by metric thread taps and dies.

(*vii*) *Files, chisels and punches.*—These could be used by altering their nomenclature.

(*viii*) *Hammers, anvils, calipers, bench vices, machine vices, hacksaw blades, etc.*—These are not affected by the conversion and could be used.

(4) *Gauges and Measuring Tools*

(*i*) All plug, profile and miscellaneous gauges at present used for inch measurements could probably be ground to the nearest millimetre sizes and adjustable gap gauges can be readjusted to the millimetre sizes. However, there are certain gauges which cannot be re-worked to metric dimensions and have to be replaced, but these gauges could be used to their full life before replacement.

(*ii*) Thread gauges would have to be scrapped or used to their full life before scrapping.

(*iii*) Vernier calipers and vernier height gauges are, in many cases, calibrated in both the systems. The replacement, therefore, of these may not be necessary, but in the case of micrometers and dial indicators, replacement is essential.

Building and Construction Industries

In the building industry and in structural engineering, the change-over to the metric system involves the new sizes of steel sections in metric dimensions. Calculations of stresses and design in these new dimensions would have to be incorporated in the training programme. In the building industry, instruction is also desirable in the use of modular coordination, rationalization of dimensions etc.

Other Steps

In all technical institutions, examples and problems have to be given in the new units and revision of textbooks, technical books and instruction sheets has to be undertaken. It might be desirable for a period of 3 to 4 years to have examples in both the systems and examination papers also may be set in both the systems. Until revision of textbooks takes place, it may be possible for the tutorial staff to incorporate the new system in their lectures.

This is a brief appreciation of some of the problems involved in technical training and a programme for the introduction of the metric system in higher technical institutions and engineering colleges has to be worked out. Consideration may be given to the teaching of the metric system along with the other systems now in vogue from the next academic year. One hears of proposals to have a 5 year degree course in engineering and it might be desirable to devote the first year for the orientation of the students in the metric system of measurements. This might help the new entrants from the intermediate classes, where, in pure science subjects the metric system is already taught, to adapt themselves to the new system from the beginning of their technical courses. Similarly, it may be desirable for all technical journals to publish article using the new system.

THOUGHTS ON TEACHING ARITHMETIC

PHANINDRA NATH SETH
General Secretary,
Indian Decimal Society,
Calcutta.

THE protagonists of the metric system all over the world claim that it is one of the surest vehicles for liquidation of mass illiteracy, inasmuch as it makes one of the three R's, namely arithmetic, very easy to learn and remember. With the introduction of metric system in India, this aspect of the reform should not be overlooked. We find in many schools that our students are still required to carry on the heavy burden of a heterogenous syllabus of arithmetic. If we cannot relieve this burden and consequent terror at the beginning of the introduction of the new system, the advantage of standardizing on the metric system would be lost. The facility in accounting and calculation was not the only consideration in adopting the metric system. The educationists of the country should give serious thought to the task and evolve a solution at this point of introducing an altogether new system in the teaching of arithmetic.

Preparation of Textbooks

From the primary stage of teaching arithmetic, the old systems should be forthwith abolished. Learning of both systems, old and new, would be a severe strain on the pupils. No more *Subhankari* tables and formulae should be taught. The British system, particularly of coinage, avoirdupois, troy or apothecary weights should not henceforth be taught in schools. Later in life, some few grown-ups may have to pick up some knowledge of the foot-pound system. For them, a short diploma course, lasting say, four months, may be provided after school-final, in some commercial institutions. But the general body of students need not learn any system other than the metric. The transition period should be used mainly to unlearn the old systems. This concession should not be made applicable to new learners.

It should be ensured that after the school-final examination in 1960 no student should be made to learn any other system. So a revised syllabus should be immediately drawn up for school arithmetic, eschewing all references to old systems of coinage, weights and measures, even in citing examples and in exercises. In that case, the entire books on arithmetic would require re-writing. This task of publishing text-books on arithmetic may be taken up by the Education Departments of the State Governments without loss of any more time.

Teaching Programme

In primary teaching, the usual syllabus should be revised. While imparting lessons on the decimal notation, the use of the zero

and the place-value system of digits, attempt should be made to teach initially the multiples of units (tens, hundreds etc.) and then their submultiples (tenths, hundredths etc.). The intricacies of vulgar fractions, and their paraphernalia-numerator, denominator, factor, L.C.M. etc. will be deferred to a later stage of instruction. They will be taught in the secondary stage of schooling. When a pupil is sufficiently adept in understanding and expressing any numerical numbers in this way, and their arrangement in proper order one below the other, he should then tackle simple additions and subtractions. Next come knowledge and use of multiplication tables, to be followed subsequently by simple rules of short multiplication and division. When the student has mastered this much, the tables of decimalized coinage and weights and measures should be introduced, and he should be taught the technique of expressing them properly in writing; then come the rules of addition, subtraction, multiplication and division as applied to these measures. For practical formation of concepts, every school should be required to possess a complete set of weights, a balance, a metre stick with centimetre and millimetre marks, and a litre mug. If possible, a plot of land in the countryard measuring just one 'are' (10×10 metres) should be demarcated for acquiring concept of its area. The last stage should be miscellaneous exercises, solution of simple problems, which are expected to be done by every student in his day-to-day life. Here the primary curriculum of arithmetic should end. With this much knowledge anybody can carry out his daily transactions easily and without any help from other sources.

To make the introduction of the metric system successful, the causes of initial failures in other countries should be studied. In order to break the element of human inertia, a definite point should be fixed where-from there should be a complete break with past traditions. Otherwise old habits will cling on. This could be ensured only through the revised syllabus of arithmetic. In view of the inherent simplicity and scientific basis of the metric system, it has been held by thinkers that only this language of measurement should prevail everywhere. Hence it is urged that no more lessons dealing with older systems should be set for the beginners. If we show any softness here towards the Imperial system or our own seer system it may have a longer lease of life than is really necessary.

No Transitional Difficulties

It may be argued that students who have not learnt the old system in schools may be at a disadvantage during the transition period. This is a wrong idea. If the authorities are earnest, we may expect to wipe out the old system from the common market place within, say, 5 years when such a student will be still too young to enter into worldly affairs. Moreover, do not even street urchins without any proper schooling, pick up from other sources some knowledge of seers and chattaks ? If there be necessity these students might do so even during the transition period. There is no need of schooling.

International Numerals

From the primary stage, only the international form of numerals *i.e.* 1, 2, 3, 4,....10, should be taught and its use encouraged. This form is in use in almost all the countries of the world. Already we see that the international numerals have been fully incorporated in the Tamil, Telegu, Kannada and Malayalam languages.

The suggestions made here are only illustrative, but not exhaustive, nor could it be claimed that these are perfect unless they are given a fair trial. The author personally gave these suggestions a trial on a

(*Continued on page* 31)

CORE OF METRIC SYSTEM

REGINALD LIFBOR

Helsingborg

Sweden

THERE has been observed a tendency among certain writers on the metric system to describe it in a manner which scares the uninitiated instead of arousing their interest. Opponents of the metric system have quoted such articles to support their case against the system. Such attempts have not prevented the spread of the metric system over the greater part of the civilised world. Practically the whole world uses the metric system of weights and measures with the exception of the English speaking countries or countries which were or have been for many years under British influence as protectorates, colonies or vassal states.

Spelling

A number of them have won their independence and there is no reason for their not modernizing their systems of weights and measures and adopt what might also be called the International measurement Units. Of course, it is quite a big task for a country to go from a system of weights and measures to another, but in this respect it should not be forgotten that all European countries, for instance, have gone through such an experience and, what a large number of countries have been able to do, can also be done by any other country. It is only a question of organization and teaching (which can be made easy) as the new system to be introduced is more simple and logical than the old one. Newspapers and many other publications can help much in this respect. Also all State institutions, banks, custom offices, postal administrations, etc., can print on the back of their publications, forms and other papers what must be essentially known about the metric system. This would give every person a ready reference to the system and help businessmen in getting acquainted with the new terms.

Such words as 'Metre, Litre, Gram' may vary slightly in spelling according to countries but they will always be easily recognized. For instance, the United States of America, Germany, the Scandinavian Countries and others use the spelling Meter, Liter, Gram, though England writes 'Metre, Litre, Gramme' and the Spanish speaking countries (Spain, Central and South America, Mexico and Cuba) and the Portuguese (Portugal and Colonies as well as Brazil) prefer a spelling which fits the orthography of their language, namely : 'Metro, Litro, Gramo', and which is for them easier to pronounce.

I would strongly advise any country adopting the metric system of weights and measures to adopt the spelling used in the United States of America and most European countries as it is phonetic and more logical in its spelling.* In this article, however,

*India has chosen 'Metre, Litre, Gram'.—*Editor.*

the spellings that have been adopted in India have been used). Using the metric system helps to a better understanding with the whole world and simplifies calculations in business transactions with other countries. It might be interesting to note that such countries as Mauritius (since May 1878) and Malta (since July 1914), though British, use metric system. A number of countries today do not allow goods to be imported if measurements or weights are not shown according to metric standards. It is to be hoped that such regulations will be enforced everywhere.

Extent of Use

Approximately 80 countries throughout the world have adopted the metric system of weights and measures and it should be further noted that this system, though not adopted, is also legal in the United States of America and Great Britain.

A few examples where the metric system is in use :

1—Afghanistan
2—Albania
3—Algeria
4—Argentina
5—Austria
6—Belgian Congo
7—Belgium
8—Bolivia
9—Brazil
10—Bulgaria
11—Cambodia
12—Chile
13—China
14—Colombia
15—Costa Rica
16—Crete
17—Cuba
18—Czechoslovakia
19—Denmark
20—Dominican Republic
21—Ecuador
22—Egypt (U.A. Rep.)
23—El Salvador
24—Esthonia
25—Ethiopia
26—Finland (suomi)
27—France
28—Germany
29—Greece
30—Guatemela
31—Haiti
32—Holland
33—Honduras
34—Hungary
35—Iceland
36—India
37—Indonesia
38—Iran
39—Iraq
40—Israel
41—Italy
42—Japan
43—Jordan
44—Lebanon
45—Libya
46—Liechtenstein
47—Luxemburg
48—Malta
49—Mauritius
50—Mexico
51—Monaco
52—Morocco
53—Neatherlands Antilles
54—New Guinea
55—Nicaragua
56—Norway
57—Panama
58—Paraguay
59—Peru
60—Philippines
61—Poland
62—Portugal
63—Puerto Rico
64—Rumania
65—St. Pierre & Miquelon
66—San Marino
67—Santo Domingo
68—Seychelles
69—South Korea
70—Spain
71—Sudan
72—Surinam
73—Sweden
74—Switzerland
75—Syria
76—Thailand
77—Tunisia
78—Turkey
79—U.S.S.R
80—Uruguay
81—Venezuela
82—Vietnam (South)
83—Yugoslavia

Monetary Systems

Most countries have also a decimal monetary system. Even countries not using the metric system of weights and measures, for example, the United States of America and Canada have a decimal monetary system. Unit : dollar divided into 100 cents (from : centi=1/100). All other countries in North America, Central America, South America and Europe have a decimal monetary system (except Britain). This system is by far more simple for calculations within the country itself as well as in relations with other countries than the unpractical British system of pounds, shillings and pence which is still more or less to be found in countries where British influence is or was felt.

Terminology

Anyone using the metric system should first get acquainted with the following terms as they are used throughout the system and always have the same meaning and never change their value, whether used with measures of length, area, volume, capacity or weight.

Some of them are not of daily use but the others, which have been given in italics have become part of the language whether you buy eggs by the weight, a bottle of milk or

a length of material. Furthermore be it said, that the difference in length between the metre and the yard is not very big, neither between the litre and the quart so that, in daily use, the changing of the system brings but little difficulty.

Multiples	Abbreviation	Value
Mega	M	1,000,000 times
Hectokilo	HK	100,000 ,,
Myria	ma	10,000 ,,
Kilo	k	1,000 ,,
Hecto	h	100 ,,
Deca	da	10 ,,

Submultiples	Abbreviation	Value
Deci	d	1/10
Centi	c	1/100
Milli	m	1/1,000
Decimilli	dm	1/10,000
Centimilli	cm	1/100,000
Micro	/u	1/1,000,000

The above mentioned terms are placed before the different units of length, area, volume, capacity and weight and give to these terms a value which is 10, 100, 1000 times the unit in question or 1/10, 1/100, 1/1000 part of the unit.

The six different units are as follows :

Length .. .. Metre (m)

Area .. .. .. Square metre (m^2) and the Are (a)

Volume .. .. Cubic metre (m^3)

Capacity .. .. Litre (l)

Weight .. .. Gram (g)

THE ESSENTIAL TABLE OF METRIC SYSTEM OF WEIGHTS AND MEASURES

	Length	Area	Volume	Capacity	Weight
Unit	Metre (m)	Square metre (m^2)	Cubic metre (m^3)	Litre (l)	Gram (g)
10 times	Deca-metre (dam)	Square deca-metre (dam^2)	Cubic deca-metre (dam^3)	Deca-litre (dal)	Deca-gram (dag)
100 ,,	Hecto-metre (hm)	Square hecto-metre (hm^2)	Cubic hecto-metre (hm^3)	Hecto-litre (hl)	Hecto-gram (hg)
1000 ,,	Kilo-metre (km)	Square kilo-metre (km^2)	Cubic kilo-metre (km^3)	Kilo-litre (kl)	Kilo-gram (kg)
1/10 ,,	Deci-metre (dm)	Square deci-metre (dm^2)	Cubic deci-metre (dm^3)	Deci-litre (dl)	Deci-gram (dg)
1/100 ,,	Centi-metre (cm)	Square centi-metre (cm^2)	Cubic centi-metre (cm^3)	Centi-litre (cl)	Centi-gram (cg)
1/1000 ,,	Milli-metre (mm)	Square milli-metre (mm^2)	Cubic milli-metre (mm^3)	Milli-litre (ml)	Milli-gram (mg)
Unit = 100 m^2 100 × Are 1/100 = 1 m^2		Are (a) Hektare (ha) Centiare (ca)			
Unit = 1000 kg					1 metric tonne(t)

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CONVERSION OF WEIGHTS FOR ORDINARY PURPOSES

(4)		(3)		(2)		(1)	(N)	(1A)		(2A)		(3A)		(4A)	
tons	cwt	mds	seers	seers	tolas	tolas	Number	grams	milli grams	kilo grams	grams	quintals	kilo grams	metric tonnes	kilo grams
1	0	2	27	1	6	0·09	1	11	664	—	933	—	37	1	16
1	19	5	14	2	11	0·17	2	23	328	1	866	—	75	2	32
2	19	8	2	3	17	0·26	3	34	991	2	799	1	12	3	48
3	18	10	29	4	23	0·34	4	46	655	3	732	1	49	4	64
4	18	13	16	5	29	0·43	5	58	319	4	666	1	87	5	80
5	18	16	3	6	34	0·51	6	69	983	5	599	2	24	6	96
6	18	18	30	7	40	0·60	7	81	647	6	532	2	61	7	112
7	17	21	17	8	46	0·69	8	93	310	7	465	2	99	8	128
8	17	24	5	9	52	0·77	9	104	974	8	398	3	36	9	144
9	17	26	32	10	57	0·86	10	116	638	9	331	3	73	10	160
19	14	53	23	21	35	1·71	20	233	276	18	662	7	46	20	321
29	11	80	15	32	12	2·57	30	349	914	27	993	11	20	30	481
39	7	107	7	42	69	3·43	40	466	552	37	324	14	93	40	642
49	4	133	38	53	47	4·29	50	583	190	46	655	18	66	50	802
59	1	160	30	64	24	5·14	60	699	828	55	986	22	39	60	963
68	18	187	22	75	1	6·00	70	816	466	65	317	26	13	71	123
78	15	214	14	85	59	6·86	80	933	104	74	648	29	86	81	284
88	12	241	5	96	36	7·72	90	1049	742	83	979	33	59	91	444
98	8	267	37	107	14	8·57	100	1166	380	93	310	37	32	101	605

How to use the Table:

(1) Find the required number from Column(N).

(2) Look up the required value under appropriate column.

(3) Columns(1) and (1A), (2) and (2A), (3) and (3A), (4) and (4A), should be read together. For example, values from (1) and (1A) can be converted but not from (1) and (2A).

Based on IS:1020—1957 Indian Standard Conversion Tables for Ordinary Use

Example: (1) To convert 20 tolas into grams and milligrams, look up 20 under column(N) and find the equivalent under(1A) *viz.*, 233 grams, 276 milligrams. For converting 20 grams look up under column 1. The value is 1·71 tolas.

(2) To convert 50 kilograms into seers, look up 50 under cloumn (N) and find the equivalent under column (2), *viz.*, 53 seers, 47 tolas. To convert 50 seers look up under column 2A. The value is 46 kg and 655 grams.

(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 and Madras)

Indian Standard Code of Practice for the Use of Cold Formed Light Gauge Steel Structural Members in General Building Construction (IS : 801—1958).

A structure carrying light loads on moderate spans often requires elements where use of hotrolled sections are inherently uneconomical if the structural members are selected according to minimum code limitations for hotrolled structural steel. For such cases, it is more economical to use sections of this steel, cold formed from lightgauge strip or sheet.

Coldformed lightgauge sections are increasingly used in building construction, expanded metal lath, aircraft, automobile and various other mobile or stationery constructions where light-weight and strength are desired in USA, UK and other continental countries. In India, these are used to a very limited extent, at the moment in some of the industries like coach building, wagon building and allied industries and in building construction. Apart from lightness and strength, coldformed lightgauge sections have an additional advantage from the fabrication and transportation aspect.

Lightgauge structural members are manufactured by coldforming lightgauge steel sheet and strip. The thickness of sheet and strip used for this purpose varies from 1.2 mm to 4.5 mm. The shapes used in structural work are angles, channels, zees or combination of zees, channels and angles or of any irregular shape desired to meet the requirements of design. The combinations of sections are made by connecting elements of two or more simpler sections by seam welds, bolts, screws, cold driven rivets, or any other suitable device.

The Indian Standards Institution has now issued an Indian Standard Code of Practice for Use of Cold formed Lightguage Steel Structural Members in General Building Construction (IS: 801—1958). This code applies to the design, fabrication and erection of coldformed lightgauge steel structural members. An effort has been made to incorporate the design principles and procedures generally followed in USA, in this Code. The experimental research now going on under the Steel Economy Programme in collaboration with the research organisations of the Government of India and other laboratories will enable to collect more data to improve this code when it is revised in future. The fundamental differences in design procedures incorporated in this Code as compared to the design of structures using hotrolled structurals has been explained in this Code.

The decision of the Government of India regarding the acceptance of metric system of weights and measures has been taken into consideration in the formulation of this Code, and accordingly the dimensional values in this Code are specified in metric units.

Price Rs. 4·00

Indian Standards for Fire-Fighting Equipment

The Indian Standards Institution has issued the following four standards relating to fire-fighting equipment :

(1) **Indian Standard Specification for Couplings, Double Male and Double Female, Instantaneous Pattern, for Fire-Fighting Purposes (IS : 901—1958).** The standard lays down the requirements regarding material, shape and dimensions, construction and test of couplings, double male and double female, instantaneous pattern, used for fire-fighting purposes.

(2) **Indian Standard Specification for Fire Bell (IS : 928—1958).** The standard lays down the requirements regarding materials, shape and dimensions, manufacture, workmanship and finish of 250 mm diameter fire bell which is used on fire appliances and in the appliance rooms of stations for raising alarms at the time of receipt of fire call.

(3) **Indian Standard Specification for Blower and Exhauster for Fire Fighting (IS : 941—1958).** This standard lays down the requirements regarding material, design and performance of blower and exhauster. The purpose of blower and exhauster is to provide a supply of fresh clean air to firemen who may be working in unventilated places, or alternatively, where there is accumulation of foul air, and to exhaust fumes and smoke from storage tanks, ships holds, godowns, living rooms and the like.

(4) **Indian Standard Specification for 275-l min. (or 60-gal/min.) Portable Pump Set for Fire Fighting (IS : 924—1958).** This standard lays down the requirements regarding material and design of 275-l/min. (or 60-gal/min) portable pump set for fire fighting.

It may be recalled that the work on the formulation of Indian Standards for fire fighting equipment and appliances was undertaken by the ISI at the instance of the Ministry of Home Affairs, Government of India, who expressed urgency for standardizing fire-fighting equipment on a nation wide scale so that a national fire-fighting service having similar equipment all over the country could be organized. It is hoped that the formulation of standard specifications for various items of fire-fighting equipment and their implimentation through the Ministry of Home Affairs and the Fire Insurance Association of India will secure for the country an integrated system of fire-fighting units spread all over the country and ready to be mobilised in any emergency without experiencing difficulties on account of non-standard equipment, non-standard appliances, etc.

Price : Re. 1·00 each

Indian Standard Specification for One-mark Pipettes [IS : 1117:1958]

The need for standardization of one-mark pipettes has been keenly felt by manufacturers as well as by scientific workers both in industries and in scientific laboratories. With a view to meet this demand, the Indian Standards Institution has published an Indian Standard Specification for one-mark Pipettes (IS : 1117—1958).

This standard prescribes the requirements and the methods of test for one-mark pipettes, which are used for delivering fixed quantities of liquids.

This standard prescribes two series of tolerances on the capacity of pipettes, namely, Class A and Class B. The Class A has been laid down to meet the requirements of pipettes of reasonably high accuracy, while Class B is designed to have an accuracy suitable for general purposes.

Price : Rs. 2·00

Draft Indian Standard Specification for Round Vanaspati Tins

The Indian Standards Institution had drafted a specification for Round Vanaspati Tins [Doc CDC 28 (1018)], covering the requirements of round containers, manufactured from tinplate, for packing vanaspati in four sizes: 4 kilo, 2 kilo, 1 kilo and 0.5 kilo.

The standard prescribes the nominal and gross capacities of such tins, their capacity, dimensions and tolerances; and thicknesses of tinplate used in the manufacture of such tins.

Copies of the draft standard are being circulated with a view to eliciting the comments of interested persons before finalising it as an Indian Standard.

Draft Indian Standard Specification for Metric Scales

Consequent upon the decision of the Government of India to change over to the metric system of weights and measures ISI has been engaged in the task of formulation of Indian Standards for metric weights and measures. The Institution has now drafted the following four standards relating to metric scales, which are being circulated widely with a view to elicit comments from the interested parties.

(1) Specification for Metric Scales for General Purpose [Doc. : EDC 36 (465)]. This standard covers metric scales made of wood or plastic materials, for general purposes.

(2) Specification for Metric Steel Scales for Engineers [Doc. : EDC 36 (468)]. This standard covers metric scales made of steel for the use of engineers.

(3) Specification for Metric Scales for Architectural Purposes [Doc : EDC 36 (469)]. This standard covers the requirements for metric scales made of varnished cardboard or of plastic material used by architects, engineers and surveyors.

(4) Specification for Metric Scales for Use with Drafting Machines in Design Offices [Doc : EDC 36 (470)]. This standard covers the requirements for four sizes of metric scales of two lengths, namely 50 cm. and 30 cm. for use with drafting machines in design offices.

Draft Indian Standard Specification for Engineer's Files

The Indian Standards Institution has drafted a specification for Engineer's Files [(Doc : EDC 12 (299)], which covers :

(*a*) General requirements and methods of test and (*b*) Specific dimensional and test requirements for

(*i*) files commonly used by engineering and similar industries, and

(*ii*) saw files.

The instrument files, generally used by instrument makers, jewellers, etc., file blocks, die sinker's files and the high alloy content steel files, normally called 'high speed steel files' have not been included. Separate additional parts or separate standards, covering such files, are expected to be issued by the institution later on.

(*Continued from page* 27)

Anyone using the metric system only needs to know the above, that is, the meaning of the prefixes (multiples and submultiples) and the units. In fact 3 multiples, 3 submultiples, 6 units. In all 12 words and no more. (Official abbreviations in parentheses).

Temperature

Countries using the metric system also use a thermometer which is decimal, namely the Celsius or Centigrade scale. The thermometer is divided into 100 degrees (centi= 1/100) with graduations above and below zero.

0°C=Freezing Point (32°F)

100°C=Boiling Point (212 °F)

Human Body Heat : 37°C (98.6°F)

Here also the simplification is obvious.

(*Continued from page* 24)

grand daughter of his (age 6 to 7) with extremely satisfactory results. Let all thoughtful people join hands in drawing up a uniform programme in the method of teaching arithmetic in the metric system.

Licenced Manufacturers, Dealers and Repairers of Weights and Measures

In the March 1959 issue of *Metric Measures* a list of manufacturers and dealers of weights and measures and weighing and measuring instruments licenced under the new Weights and Measures (Enforcement) Act in Bombay, was published.

Similar steps for licencing manufacturers, dealers and repairers are being taken in other States and the list of licensees would be published in *Metric Measures*, as the work of licencing progresses. A list of licensees further to that published in the March 1959 issue of *Metric Measures* is given below :

ANDHRA PRADESH

Manufacturers

Sl. No.	Name and Address of Manufacturer	Details of Articles Manufactured
(1)	Avery Co., of India Private Ltd., Calcutta	Weights, Measures, Weighing & Measuring Instruments.
(2)	Liladhar Jivraj (Star Metal Works), Begumbazar, Hyderabad.	Litre Measures.
(3)	Majestic Metal Works, Mittikasher, Begum Bazar, Hyderabad.	Litre Measures.
(4)	Mohd. Abdul Razzak, Machlikaman, Hyderabad, Deccan.	Brass Weights.
(5)	Pappu Veeranna & Sons, Dowlaishwaram, East Godavari.	Beam Scales.
(6)	Pappu Yerakayya & Sons, Dowlaishwaram, East Godavari Dist.	Beam Scales.
(7)	Ravi Engineering Co., Rajpur Road, Dehradun. ..	Weighing Instruments, Platform Machines, Weighbridges etc.
(8)	S. K. Industries, Mushirabad, Hyderabad, Deccan ..	Cast Iron Weights.
(9)	Saraswati Iron Balance Works, Dowlaishwaram, East Godavari Dist.	Beam Scales.

Dealers

Sl. No.	Name and Address of Dealer	Details of Articles Sold
(1)	Asia Engineering Corporation, Fort, Bombay-1. ..	Weights, Measures, Weighing and Measuring Instruments.
(2)	Avery Co. of India Private Ltd., Post Office Lane, Hyderabad.	Weights, Measures, Weighing and Measuring Instruments.
(3)	Jawanmul Kesrimul, Opposite Osmangunj, Hyderabad, Deccan.	Weights, Measures, Weighing and Measuring Instruments.
(4)	Kesrimal Pratabmal Jain, Begum Bazar, Hyderabad ..	Weights, Measures, Weighing and Measuring Instruments.
(5)	Khaja Maslahuddin, Warangal	Weights, Measures, Weighing and Measuring Instruments.
(6)	Liladhar Jivraj, Begum Bazar, Hyderabad	Weights, Measures, Weighing and Measuring Instruments.
(7)	Misrilal Motilal, Opposite Osmangunj, Hyderabad ..	Weights, Measures, Weighing and Measuring Instruments.
(8)	T. Rajesham, Mandi Bazar, Warangal	Weights, Measures, Weighing and Measuring Instruments.
(9)	United Weights & Measures Co., Begum Bazar, Hyderabad.	Weights, Measures, Weighing and Measuring Instruments.

Repairers

Sl. No.	Name and Address of Repairer	Details of Articles Repaired
(1)	Andhra Scales Centre, Nampalli, Hyderabad, Deccan	Weights, Measures, Weighing and Measuring Instruments.
(2)	Avery Co. of India (Private) Ltd., Post Office Lane, Hyderabad, Deccan.	Weights, Measures, Weighing and Measuring Instruments.
(3)	Jawanmul Kesrimul, Opposite Osmangunj, Hyderabad, Deccan.	Weights, Measures, Weighing and Measuring Instruments.
(4)	J. Joseph, Mandi Bazar, Warangal	Weights, Measures, Weighing and Measuring Instruments.
(5)	Misrilal Motilal, Opposite Osmangunj, Hyderabad, Deccan.	Weights, Measures, Weighing and Measuring Instruments.
(6)	Safe Scale Co., Mir Alam Mandi, Hyderabad, Deccan	Weights, Measures, Weighing and Measuring Instruments.
(7)	Scale Adjusting Services, Mittikasher, Begum Bazar, Hyderabad.	Weights, Measures, Weighing and Measuring Instruments.
(8)	R. Mohan & Bros. Purani Havali, Hyderabad, Deccan	Weights, Measures, Weighing and Measuring Instruments.

BOMBAY

In the March 1959 issue of *Metric Measures* a list of licensed manufacturers, dealers and repairers of weights and measures in Bombay State was published. The following is a list of dealers subsequently licensed by the Government of Bombay under the Bombay Weights and Measurers (Enforcement) Act, 1958.

Dealer

Sl. No.	Name and Address of Dealer	Details of Articles Sold
(1)	Abdulhussain Yusufali Bohori, Patod Darwaja, Yeola, Nasik.	Weights, Measures and Weighing Instruments.
(2)	Alexander Dahil Engineering Corporation, 3rd Floor, Room No. 7, Karim Chamber, Hammam Street, Bombay-1.	Weights and Weighing Instruments.
(3)	Ambadas Latoba Kasar, Itwari Bazar, Municipal No. 18, 1084, Amravati.	Weights, Measures and Weighing Instruments.
(4)	Bhai Parmeshwardin Baldeo Prasad Gupta, Hansapuri, Bhandara Road, Nagpur-2.	Weights, Measures and Weighing Instruments.
(5)	Dawoodbhai Kadarbhai, Tajnapeth, Akola ..	Weights, Measures and Weighing Instruments.
(6)	B. T. Ghatge, Medhe Building, Hattimahal Road, Kolhapur.	Weights, Measures and Weighing Instruments.
(7)	Harilal Bhurabhai, Mandvi Chowk, Rajkot	Weights, Measures and Weighing Instruments.
(8)	A. M. Master & Co., 179/81, Janjikar Street, Bombay-3	Weights, Measures and Weighing Instruments.
(9)	Mohanlal Hargovandas Mistry, Jai Hind, Kanta Bhandar, Station Road, Anand.	Weights, Measures and Weighing Instruments.
(10)	Mulji Lakshmidas Co., 193, Janjikar Street, Cutlery Bazar, Bombay-3.	Weights, Measures and Weighing Instruments.
(11)	Popular Scale Co., 210, Cutlery Bazar, Bombay-3 ..	Weights, Measures and Weighing Instruments.
(12)	Shah Danmal Sawani, Sadar Bazar, Deesa, Dist. Banaskantha.	Weights, Measures and Weighing Instruments.
(13)	Steel Industries of Hindustan Private Ltd., Magazine Street, Darukhana, Bombay-10.	Weights.
(14)	D. L. Vaid, 202, Cutlery Bazar, Bombay-3.	Weights, Measures and Weighing and Measuring Instruments.
(15)	Vishwas Company, 757, Shukrawarpeth, Poona-2 ..	Weights, Measures and Weighing and Measuring Instruments.
(16)	Yusufalli Kadibhai, Iron and Hardware Merchant, Opposite Green Lodge, Rajkot.	Weights, Measures and Weighing and Measuring Instruments.

DELHI

Manufacturers

Sl. No.	Name and Address of Manufacturer	Details of Articles Manufactured
(1)	Bharat National Foundry, Motia Khan, New Delhi ..	Commercial Metric Cast Iron Weights.
(2)	Lakshmi Engineering Works, Hauz Qazi, Delhi-6 ..	Commercial Metric Cast Iron Weights.
(3)	Multan Engineering Works, 1773, Mir Jumla, Lal Kuan, New Delhi.	Commercial Metric Bullion Weights.
(4)	Raj Engineering Works Private Ltd., 8/32, Ajmeri Gate, Delhi.	Commercial Metric Cast Iron Weights.
(5)	Riaz & Brothers, Sadar Bazar, Delhi	Commercial Metric Bullion and Brass Weights.

Dealers

Sl. No.	Name and Address of Dealer	Details of Articles Sold
(1)	Aggarwal Iron Stores, Churi Walan, Chawri Bazar, Delhi.	Weights, Measures, Weighing and Measuring Instruments.
(2)	Shri Ascharj Lal, 31100, Main Road, Shadipur, West Patel Nagar, New Delhi.	Weights, Measures, Weighing and Measuring Instruments.
(3)	Bhondumal Nihal Chand, Bazar Sirkiwalan, Delhi ..	Weights, Measures, Weighing and Measuring Instruments.
(4)	Shri Brij Lal, 10/26, Old Rajinder Nagar, New Delhi	Weights, Measures, Weighing and Measuring Instruments.
(5)	Chiman Paints & Hardware Store, 78, Samman Bazar, Jangpura, Bhogal, New Delhi.	Weights, Measures, Weighing and Measuring Instruments.
(6)	Shri Chuni Lal Chopra, 355, Vill. Tihar, New Delhi	Weights, Measures, Weighing and Measuring Instruments.
(7)	Dewan Chand Kaura Mal, VII/5055, Bazar Sirkiwalan, Delhi.	Weights, Measures, Weighing and Measuring Instruments.
(8)	Gobind Ram Sant Ram, 1565, Pahar Ganj, New Delhi	Weights, Measures, Weighing and Measuring Instruments.
(9)	Jinda Ram Sawan Mall, 2883, Bazar Sirkiwalan, Delhi	Weights, Measures, Weighing and Measuring Instruments.
(10)	Lakshmi Engineering Works, Hauz Qazi, Delhi ..	Commercial Metric Weights.
(11)	Multan Engineering Works, 1773, Mir Jumla, Lal Kuan, Delhi.	Weights, Measures, Weighing and Measuring Instruments.
(12)	Riaz & Brothers, Sadar Bazar, Delhi	Weights, Measures, Weighing and Measuring Instruments.
(13)	Suri Brothers, 44, Meenakshi Garden, Tilak Nagar, New Delhi.	Weights, Measures, Weighing and Measuring Instruments.

Repairers

Sl. No.	Name and Address of the Party	Item for which licensed
(1)	Adarsh Engineering Works, Shop No. 2522, Gali No. 8, Beadon Pura, Karol Bagh, New Delhi.	Beam scales class C & D and commercial metric weights including brass weights.
(2)	Avery Company of India Private, Ltd., 1, Ansari Road, Darya Ganj, Delhi.	Weights and Weighing Instruments.
(3)	Jai Bharat Engineering Co-operative Industries Society Ltd., Tarzon House, Anand Parbat Estate, New Rohtak Road, New Delhi.	Weights and Weighing Instruments.
(4)	Kundan Lal & Company, 12/7, W.E.A. Karol Bagh, New Delhi.	Beam scales class B, C & D Weights including bullion weights and counter machine.
(5)	Nawal Kishore Ram Kishore, 1647, Lal Kuan, Delhi	Beam scales class B, C & D and commercial metric weights (including bullion weights).
(6)	Prabhat Repairing Works, 4486, Gali Jat Wali, Pahari Dhiraj, Delhi.	Beam scales class C & D and commercial metric cast iron weights.
(7)	Riaz & Brothers (Regd.), 134/138, Near Post Office, Sadar Bazar, Delhi.	Weights, beam scales of B, C & D, platform machines and counter scales.
(8)	S. Swinder Singh Batra, Mahaldar Khan, garden, Gur-Ki-Mandi, Delhi.	Beam scales class B, C, D and commercial metric weights including bullion weights.
(9)	Sh. Ved Swarup Berry, 1-U-B, Jawahar Nagar, Delhi.	Weights and Weighing Instruments.

PUNJAB

Manufacturers

Sl. No.	Name and Address of Manufacturer	Details of Articles Manufactured
(1)	Agricultural Industries (Regd.) Batala	*Cast Iron Weights* (*i*) 1 maund to 1/8 seer (*ii*) 56 lb to 4 oz. (*iii*) 50 kg to 100 g *Brass Weights* (*i*) 1/16 and 1/32 seer (*ii*) 2 and 1 oz.
(2)	Eleka Industries, Jullundur	*Brass Weights* (*i*) 1/16 and 1/32 seer (*ii*) 50 g and 20 g *Bullion Weights* 20 to 1/16 tola *Milk Measures* 1 gallon to 1/8 gallon *Iron Beam scales* Class C, capacity 5 kg Class D, capacity 100 kg

Sl. No.	Name and Address of Dealer	Details of Articles Manufactured
(3)	Ichhru Mal Karam Chand, Amritsar	*Brass Weights* (*i*) 1 kg to 1 g (*ii*) 100 B. tola to 1/96 1 seer
(4)	Krishna Foundry Works, Ambala City	*Cast Iron Weights* (*i*) 1 maund to 1/8 seer (*ii*) 50 kg to 100g *Brass Weights* (*i*) 50 g and 20 g (*ii*) 1/16 and 1/32 seer
(5)	Swaraj Foundry & Engineering Works, Batala ..	*Cast Iron Weights* (*i*) 1 maund to 1/8 seer (*ii*) 56 lb to 4 oz (*iii*) 50 kg to 100 g *Brass Weights* 1/16, 1/32 seer 2 and 1 oz *Yard Measures*

Dealers

Sl. No.	Name and Address of Dealer	Details of Articles Sold
(1)	Amar Nath Jain & Sons, Faridkot	Weights, Measures, Weighing and Measuring Instruments.
(2)	Avery Company of India Private Ltd., Amritsar ..	Weights and Weighing Instruments.
(3)	Barnala Iron Store, Patiala	Weights, Measures, Weighing and Measuring Instruments.
(4)	Bhagwan Das Jagan Nath, Ambala City	Measures and Weighing and Measuring Instruments.
(5)	Dhani Ram Amrit Lal, Sarafan Bazar, Ambala City	Weights, Measures, Weighing and Measuring Instruments.
(6)	Jaiswal Metal Mart Ltd., Anaj Mandi, Ambala City	Weights, Measures, Weighing and Measuring Instruments.
(7)	Jawanda Mal Sham Lal, Mandi Phagwara, Dist. Kapurthala.	Weights, Measures, Weighing and Measuring Instruments.
(8)	Kali Ram Baby Ram, Sumana Mandi, Dist. Patiala ..	Weights, Measures, Weighing and Measuring Instruments.
(9)	Kanshi Nath & Sons D. C. Road, Saddar Bazar, Ambala Cantt.	Weights, Measures, Weighing and Measuring Instruments.
(10)	Kartar Singh, Iron Merchant, Raink Bazar, Jullundur	Weights, Measures, Weighing and Measuring Instruments.

	Name and address of Dealer	Details of Articles Sold
(11)	Kishna Hardware Stores, Yamunanagar	Weights Measures, Weighing and Measuring Instruments.
(12)	Kundan Lal Hari Chand, Jagadhri	Weights, Measures, Weighing and Measuring Instruments.
(13)	Muni Lal Gauri Shankar, Jain, Rupar	Weights, Measures, Weighing and Measuring Instruments.
(14)	Pars Ram Dhani Ram, Ambala City	Weights, Measures, Weighing and Measuring Instruments.
(15)	Pyara Singh Amar Singh , Ahmedgarh	Weights, Measures, Weighing and Measuring Instruments.
(16)	Rama Nad Ram Niwas, Narwana Mandi, District Sangrur.	Weights, Measures, Weighing and Measuring Instruments.
(17)	Ram Parshad Kesho Ram, Jagadhri	Weights, Measures, Weighing and Measuring Instruments.
(18)	Santosh Kumar Sudarshan Kumar, Jullundur City ..	Weights, Measures, Weighing and Measuring Instruments.
(19)	Shiboo Mal Budh Ram, Kaseran Bazar, Ambala Cantt.	Weights, Measures, Weighing and Measuring Instruments.
(20)	Sumer Chand Jain & Sons, Ambala Cantt.	Weights, Measures, Weighing and Measuring Instruments.
(21)	Sumer Chand Nem Chand Jain & Sons, Ambala Cantt.	Weights, Measures, Weighing and Measuring Instruments.
(22)	Sunder Lal Sangar Mal Narnaul	Weights, Measures, Weighing and Measuring Instruments.
(23)	Telu Mal Piare Lal, Jagadhri	Weights, Measures, Weighing and Measuring Instruments.
(24)	Thakur Dass Puran Chand, Jullundur City ..	Weights, Measures, Weighing and Measuring Instruments.