METRIC MEASURES

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JOURNAL OF WEIGHTS AND MEASURES

40 NAYE PAISE

CONVERSION TABLES OF PRICES FOR WEIGHTS

TABLE A

(Factor used : 1 kg.—1·0717 seers)

Rupees per seer to Rupees per kg

Rs./Seer	0	1	2	3	4	5	6	7	8	9
	Rs/kg	Rs/kg	Rs/kg	Rs/kg	Rs/kg	Rs/kg	Rs/kg	Rs/kg	Rs/kg	Rs/kg
0	0	1·07	2·14	3·22	4·29	5·36	6·43	7·50	8·57	9·65
10	10·72	11·79	12·86	13·93	15·00	16·08	17·15	18·22	19·29	20·36
20	21·43	22·51	23·58	24·65	25·72	26·79	27·86	28·94	30·01	31·08
30	32·15	33·22	34·29	35·37	36·44	37·51	38·58	39·65	40·72	41·80
40	42·87	43·94	45·01	46·08	47·15	48·23	49·30	50·37	51·44	52·51
50	53·58	..	..	..	..	..	..	..	..	..

metric measures

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metric
measures

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My Experiences in Enforcement of Weights & Measures

H. L. MEHANDRU
Controller of Weights and Measures,
Delhi

EXPERIENCE is a word that usually receives mixed reception: the agreeable part is recalled and cherished with delight, the bitter part remembered with distaste. The emphasis put on the cheerful often throws into the background the unpalatable, jeopardizing thereby a balanced view. This is one of the dangers lurking in the recital of one's experiences. Even then it is worth the trouble because the future takes shape out of the past and the present.

We may then consider the experiences right from the creation of the Weights and Measures Organization in Delhi, through its evolution, growth and development to its present size.

Early Conditions

Fraudulent practices, dishonest dealings, clever tricks and subterfuges and subtle manoeuvrings with weights and measures and weighing and measuring instruments were very common in Delhi prior to 1952 or so. As in other States of India the multiplicity and complexity of the systems of weights and measures made confusion worse confounded and profitable to the dishonest traders. To mention only a few instances of malpractices, it has since been found by the Weights and Measures Organization that certain bullion tola weights bearing the denomination of 20 tolas actually weighed 25 tolas. It is evident that such weights were kept by the traders for making purchases from the rustics and ignorant villagers.

Petrol dealers tampered with the adjusting mechanism of the pumps to effect short deliveries to the extent of 4 to 6 oz of petrol per gallon. Wooden beams having unequal arms or having pans of unequal weights were palmed off on the public. There had been instances when magnet pieces were placed beneath the iron goods pans of the beam scales to effect short weight. The cutting of the wooden beams at one corner, cording of the beams horizontally on one side and vertically on the other, hollowing the wooden beam on one side and filling it with lead on the other were other glaring but constantly practiced devices. Grooves in the bearings of large size beam scales were also detected. Removeable parts of platform weighing machines and also their loose weights were used by the traders to their own advantage. And the indifferent readings of weights recorded by the none-too-dependable person weighing machines made many a man fly to his physician. In fact, those were the days of a son receiving a lecture from

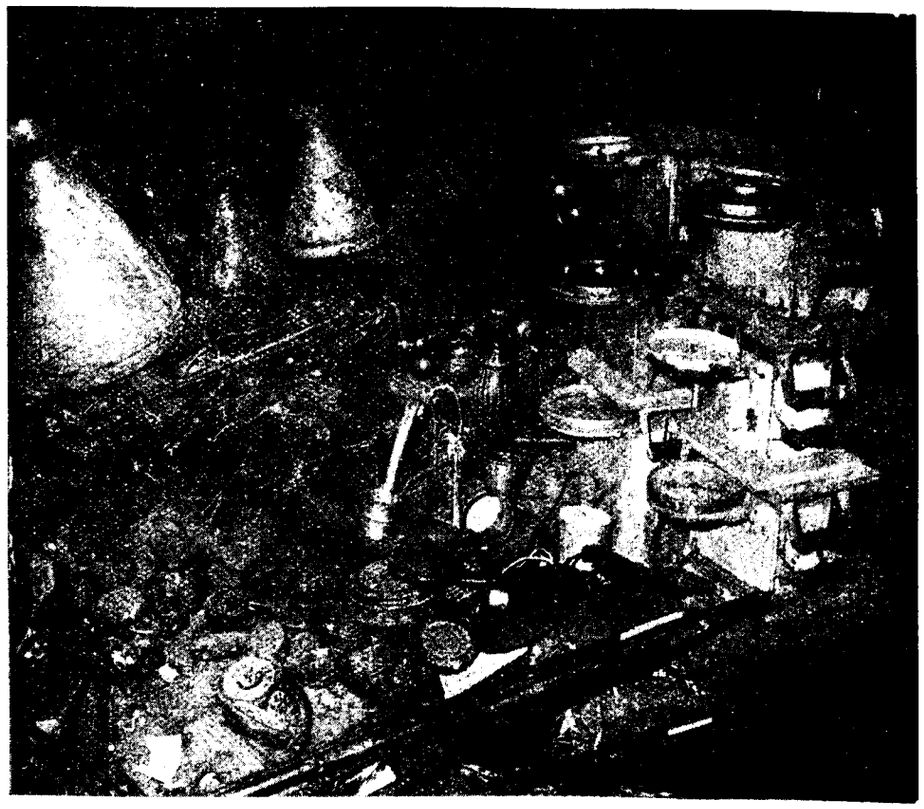

Fig. 1—A Collection of Seized Weights and Measures. These were used for Deceiving the Public by Giving Short Weight or Measures.

his father; a husband submitting to the admonition of his wife for having failed to 'forearm' himself against deceits of the traders, though 'forewarned' by the clever wife.

It may be interesting to examine the extent to which short and fraudulent weights and scales were found in the markets and the malpractices on the part of the traders detected. The following statement shows the shortages in certain cases:

Sl. No.	Type of Weight or Measure	Deficiency	Percentage of Shortage
	Cast Iron Weights		
(1)	5 seers	14 oz	8·75
(2)	2½ seers	8 oz	10
(3)	20 seers (stone weight)	2 seers	10
(4)	½ seer	1/2 oz	3
(5)	¼ seer	½ oz & ½ dram	7
	Bullion Tola Weights		
(6)	5 tolas	15 grains	1·6
(7)	4 tolas	10 grains	1·4
(8)	3 tolas	7 1/2 grains	1·4
(9)	40 tolas	78 grains	1·0
	Milk measures		
(10)	⅛ seer	1 oz & ½ dram	25

Fig. 2—A Beam Scale which is Balanced with 2 Seers Weight in One Pan and 1 1/2 Seers in the Other. Another Instance of Giving Short Weight.

Creation of Weights and Measures Organization

The situation, evidently, was riddled with plenty of abuses and their remedy lay only in the creation of a Government Weights and Measures Organization. This actually came into existence in 1952, although the Orissa Weights and Measures Act, 1943, with modifications, was extended to Delhi in 1949.

The underlying principles of the Act were:

(1) To ensure transactions in trade in terms of uniform weights and measures and to inculcate and foster the use of standard weights and scales.

(2) To eradicate the unscrupulous use of short and fraudulent weights, measures, scales etc. and to ensure the public a fair deal when purchasing or selling by weight or measure.

(3) To provide control over all weighing and measuring equipment in use for trade so as to ensure that these conform to the standards and are kept in an accurate condition, besides guaranteeing that their nature and construction do not provide an opportunity for fraud by the user.

In short, the ultimate objective was to evolve order out of chaos.

Steps for Enforcement

For the enforcement of the Act in Delhi, it was necessary to have properly trained staff. I was deputed late in 1949 for training to Bombay where the Bombay Weights and Measures Act had been in force since 1935 and considerable experience of enforcement gathered. Soon after my return the necessary Rules were framed under the Orissa Weights and Measures Act, 1943, and promulgated by the Delhi Administration in September 1952. These Rules had been drafted in such a way that they were easy to understand, easy to apply and commensurate with the 'climate' of Delhi. The necessary laboratory equipment was subsequently set up and stamping work was undertaken from 15 April 1953 with the help of one Inspector and two Sub-Inspectors and a few hands in the Office.

The Organization had under its purview 22,000 shops covering the following areas :

(1) Areas within the jurisdiction of Delhi Municipal Committee, Delhi.

(2) Areas within the jurisdiction of New Delhi Municipal Committee, New Delhi.

(3) Areas within the jurisdiction of Notified Area Committee, Fort, Delhi.

(4) Areas within the jurisdiction of Delhi Municipal Committee, Civil Lines, Delhi.

The completion of the census work in respect of these 22,000 shops, as also factories under the Factories Act 1948, Railways within the meaning of Indian Railways Act, 1890, Municipal Posts and petrol companies using weights and measures and weighing and measuring instruments for trade purposes was an arduous task and required considerable persuasion, patience, pains and perseverence on the part of the staff, particularly

when we keep in mind the suspicion lurking in the minds of the people. The work, however, made the traders conscious that the time had come for them to wean themselves away from old ways of thinking and action.

In order to cultivate and give an impetus to industries in Delhi and to create self sufficiency, it was considered desirable to register only local manufacturers, repairers and dealers in weights and measures. After scrutiny of cases, as many as 117 dealers, 30 manufacturers, and 17 repairers in weights and measures were registered.

Difficulties and Solutions

To start with, the staff employed for verification and stamping of weights and measures was inadequate and the stamping work suffered. This provided an opportunity to the manufacturers to exploit the public by raising the prices of stamped weights and measures. Due to the abnormal rise of prices, the Organization experienced heavy weather as the public was reluctant to purchase weights and measures at the higher prices. As there was no statutory provision in the Act for the fixation of prices, the only course left was to open negotiations with the manufacturers and dealers. Through a series of meetings with the manufacturers and dealers, and after working out the break-up of cost of production, the prices were brought down to a reasonable level, allowing 6·25 percent profit to the manufacturers and the same percentage to the dealers.

Another difficulty was that the manufacturers of yard measures, finding no scope in the manufacture of these measures, curtailed the production. They were subsequently assisted by granting quotas of iron squares for the manufacture of yard measures with a view to compensate them against the rising price of iron and steel in the market.

Persistent but sympathetic and dispassionate espousal of the cause disarmed the people of their prejudices and predilections. The inevitable result was that the work in the laboratory became too heavy and the inadequacy of resources in man and material was evident and subsequently two sub-offices were opened to meet the growing demands of the local trade.

Modifications and Improvements

It may be useful to record the modifications and improvements introduced. While the Delhi Weights and Measures Rules, 1952, were being framed for the implementation of the Orissa Weights and Measures Act, 1943, the people were informed about the various ways and means used by traders to dupe the public by giving short weighment. The provisions made in the Rules to eliminate these practices were fully explained to the public. For instance, to facilitate differentiation between weights of smaller denomination, weights under 1/4 lb and 1/8 seer were required to be made of brass while weights above these were to be made of cast iron. All weights in the seer-series were to be circular in shape and all weights in the pound series were to be square. As flat, circular and knobbed rati weights could not be manufactured according to specifications, flat and square rati weights were permitted to be manufactured. For the convenience of cloth dealers who complained of inconvenience experienced in the use of yard measures graduated in inches—accustomed as they were to use the yard measures graduated in girahs—the manufacturers of yard measures were asked to provide cross-marks on the 9th, 18th and 27th inch which corresponded with the existing 4th, 8th and 12th girahs. This satisfied the traders in the beginning and with the passage of time they got familiar with the use of yard measures with inches.

Another modification was the introduction of milk measures with long horizontal handles affixed to their walls for measuring out hot and boiling milk. Further, to facilitate quicker and larger delivery of milk by the milkmen to the 'halwais' and milk depots, milk measures of standard specification and larger capacities ranging from 5 seers to 20 seers were introduced.

It may be worthwhile to mention here a peculiar problem which at length proved to be a storm in the tea cup. Large quantities of milk are supplied from milk dairies to milk depots after weighing on machines calibrated in the units of mass but distributed at the milk depots by volume. As the specifications for capacity measures used for milk and similar liquids were laid down in terms of air-free distilled water as the standard liquid, the previously weighed milk when measured in terms of volume actually came out to be less. To illustrate, 40 seers (by weight) of milk weighed at the dairy actually measured about 39 seers in terms of volume at the retailer's end. A hue and cry was raised that the milk measures prescribed by the Government were bigger in size. This was understandable, for few people knew that this variation arose due to the difference in the specific gravities of milk and water, milk being heavier. Accordingly, on the basis of experiments and analysis, *the weighing machines were calibrated in terms of volume*. The milk dairies had to weigh 41 seers of milk to be distributed as 40 seers of milk in terms of volume, thus avoiding loss to the retailers.

Paint and varnish dealers were advised to take up the use of Imperial standard gallon measure in place of the O.M. gallon. Local packers were asked to see that their packings contained net quantities as indicated on the labels. They were also instructed to write the word 'fluid' in the case of liquid commodities when these were intended to be given by volume so that the distinction between weight and volume would be clear to the intending purchaser.

The use of wooden beam scales was totally prohibited and iron beams having an indicator in the centre were introduced. The beam scales were divided into four different classes, depending upon the use to which they were put. The complaint of the fruit and vegetable wholesale dealers and traders that the pointed indicators of the beam scales pricked their hands was genuine and was promptly attended to by requiring the manufacture of beams with rounded indicators.

The enforcement of the Act created good will in our foreign trade also. As a result of a number of complaints received from Afghan traders that the kirana merchants in Delhi realized 43 to 44 seers of dry-fruits to a maund from them, the Act was amended to provide legal action against a person demanding or causing to be demanded an excess quantity of commodity than purported.

Functions of the 'Eyes and Ears'

Here a short account of the Inspectors' duties in the laboratory and the field may not be out of place. Under the statutory obligations of the Act, all weights, measures, weighing and measuring instruments used by the local traders require verification and stamping at least once in every two years and those used by the factories registered under the Factories Act, 1948, have to be verified and stamped at least once in every twelve months. The period of verification and stamping under the Act helps in making up the losses and defects in weights and measures that may accrue due to wear and tear in the normal course of business.

Fig. 3—The Author Verifying A Commercial Weight Against a Working Standard Weight in the Laboratory.

Fig. 4—The Stamping of Verified Commercial Weights.

In the laboratory, the work is planned on scientific and systematic lines. A specific number of registered manufacturers and repairers are under the charge of an Inspector or Sub-Inspector who is responsible for testing, verification and stamping of the goods brought by the manufacturers and repairers in response to traders' requirements necessitated by the advance notices served on them by the Inspectors. Each repairer or manufacturer gets two turns in a week so as to ensure him a sound and speedy delivery and disposal of his goods, and avoiding undue hardship to him as well as to his customers. Weighing machines, such as weighbridges, platform machines, deadweight machines etc., are verified and stamped *in situ*. Work of testing petrol pumps and oil-filling machines and calibration of oil tanks and lorries is also carried out *in situ* by the Inspector or Sub-Inspector concerned. The returns of the verification and stamping work done by the Inspectors are submitted every week.

The Inspector or Sub-Inspector carries out day-to-day checking in his respective sub-zone (each sub-zone consists of about 3,000 shops) and maintains as much personal contact with and concern about the traders' difficulties, grievances, lapses and omissions as possible. 'Eyes and ears' as they are of this Organization, the Inspectors and Sub-Inspectors maintain a daily diary recording their day-to-day work and observations. The Inspector or Sub-Inspector, whenever he is assigned a sub-zone, is provided with a list of prosecution cases made out in that particular zone during the previous 3 or 4 years. This list acts as a guide for him to mould his approach into moderation towards those who are not habitual offenders and severity towards those who develop a habit of indulging in deceit and dishonesty and wilful omissions.

Frequent raids by a number of Inspectors are organized in different areas to detect infringements of the Act and the Rules. The raids are almost in the nature of miniature blitzkriegs: a particular area is covered

by 4 or 5 Inspectors, each occupying a strategic position and each swooping down upon the offenders at a mutually agreed fixed time. It may be observed here that the continuous use of unstamped and unauthorized weights and scales by hawkers and squatters necessitated all the more the organization of such raids, because by no other means could it be implanted effectively in their minds that to deliver short by weight or measure is a crime and a social evil.

Metric System and Steps Towards its Adoption

The advent of the metric system brought in its wake a general invigoration of the Weights and Measures Organization, besides solving a multitude of problems created by the existence of too many systems of weights and measures. As a logical conclusion the Rajasthan Weights and Measures (Enforcement) Act, 1958, prescribing the metric system, was introduced in the Union Territory of Delhi and the Delhi Weights and Measures Rules, 1959, were framed under this Act.

As many as 9 licences to manufacturers, 17 to repairers and 54 to dealers have been issued under the above Act. Verification and stamping of metric weights and weighing instruments have also been taken in hand and steady progress maintained. Since the enforcement of the Act, the number of metric weights and weighing instruments verified has been on a rapid increase, and the demand for them in the market is also growing day by day.

The United Chamber of Trade Associations, Delhi have been contacted and the representatives of different Trade Associations have been requested to make the best use of the transition period, as a hurried change-over towards the end of the transition period would create confusion and difficulty in day-to-day transactions. The members of the Chamber desired that the adjoining districts of Alwar, Rohtak, Bulandshehr and Karnal should also go metric, so that the traders engaged in the distribution trade may not have any difficulty in carrying out transactions in these places. The Government of India have been accordingly requested to take necessary measures. It is expected that this demand would be met with in April 1960 when it is intended to introduce metric weights all over the country.

In order to prepare the public for the change-over and to educate them in the new reform, a Metric Publicity Week and Seminar were organized in September 1958 by the Metric Publicity Committee. A detailed account of these has already appeared in *Metric Measures* (November 1958).

As a result of the Seminar and group meetings of Trade Associations, the traders have begun to appreciate that the new system is simpler and easier and initial difficulties would be overcome in the course of time through practical experience. In order to maintain the tempo created by the Metric Publicity Week and Seminar, demonstration sets of weights, visual publicity charts and conversion tables have been supplied to various Trade Associations for display at conspicuous sites.

The Individual Approach

What constitutes the best individual psychological approach to the education and publicity for the metric system depends upon the Inspector or Sub-Inspector and the intuitive or acquired understanding of human nature he brings to that approach. A liberal disposition and an amicable temperament, besides the courage and determination to act, are the essence of any approach.

It is a patent fact that traders are usually not interested and are unmoved by noble

talk and so-called academic 'diversions' of the men in charge of publicity and education. To strike a responsive chord, a personal touch is needed—the 'sensitive barometers' should elaborate on what the traders need and want, interspersed with particular instances, rather than giving a general dissertation which may include the history of the metric system. Nor should the talk smack of pedantism. It should rather be in the spirit : 'Man must be taught as if you taught him not, and things unknown proposed as things forgot'. Equally good is the need of methods of commonsense. There is no reason why one should talk of the 50 kilogram weight while addressing bullion merchants or of denominations below 100 grams while instructing wholesale vegetable dealers or coal dealers.

Thus the personality of the individual carries some 'weight' in the successful implementation of any programme. 'How' you implement is as significant as 'what' you implement, *i.e.* how best to make people law-abiding and prevail upon them to accept and assimilate the new concept.

Whatever the situation, a sense of proportion and poise has always to be maintained. Any impulsive action definitely alienates and scares people. A little thought, a sympathetic view, a genuine understanding of the other person's attitudes, problems and difficulties go a long way in soothing tempers. There are some situations that can be easily managed by ready wit and humour, as for example :

To escape prosecution, a trader tried to overwhelm me with hospitality bordering on cheap flattery. Every few minutes he assured me rather artfully that the hospitality was not for the authority I represented but was just a token of the respect of one human being for another. I pointed to a man passing that way and said, good-humouredly, "I admire your spirit. Would you not like to serve a bit of this token to that man ? After all, he is also a human being."

The trader was disarmed of his clever trickery.

To sum up : Firm, but balanced, mature and benevolent and not arrogant, callow and malevolent should be the keynote of every approach; it should be constructive and corrective.

Universal Yarn Numbering System

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THE systems employed at present for expressing fineness of yarn are numerous as can be seen from the list recorded in Appendices A and B. These could be broadly classified into two groups : (1) indirect systems and (2) direct systems. In the former, the unit is expressed as the length of the material per specified weight. For example, the cotton count is the number of hanks, each 840 yards, in one pound of the yarn. In this system the larger number would represent a finer material. On the other hand, in the direct system, the fineness is measured by the weight of the material of a specified length. Hence a larger figure would correspond to a coarser material. An example of this is the 'denier' (weight in g of 9 000 metres) employed for silk and man-made fibres.

The systems falling under the indirect category are given in Appendix A and those under the direct category in Appendix B. It will be noted from the tables given there that for the same material different countries have adopted different units of measurement. Sometimes, even within the same country different units exist for the same commodity. Occasionally both the indirect and direct systems are used for the same purpose. Further, the units employed for yarns are entirely different from those used for fibres. Thus, there exists a great deal of confusion, and comparison becomes extremely difficult, if not impossible.

Necessity of a Universal System

In order to overcome the confusion of having different systems, it is necessary to have a common system which could be employed for all types of fibres and yarns alike. It should be simple and scientific. Taking all these facts into consideration the Textile Technical Committee of the International Organization for Standardization (ISO) agreed to have a universal numbering system for textile materials which should be direct, decimal and based on metric units. Later on, it was resolved to express the fineness (or linear density) of a yarn, regardless of the fibre used, in terms of a new unit (named *tex*) *which is the weight in grams of a kilometre of yarn or other material.* A thousandth part of this unit (*millitex*) could be used for the purpose of denoting the fineness of extremely fine fibres like cotton, silk etc.

Advantages of the New System

The advantages of employing the tex system of numbering textiles are :

(1) The confusion caused by having bewildering system of units to express the fineness of yarn is avoided by having

one system for all types of textiles. This would also enable one to compare easily yarns manufactured from such diverse fibres as jute and cotton.

(2) The fineness of fibres and yarns could also be easily compared, so that the ratio between the two directly gives the number of fibres per cross-section of the yarn.

(3) The use of the same system for drawing slivers, rovings etc., would clearly show the relationships between the interim processes in the manufacture of yarn than when different systems are used.

(4) It also simplifies calculations required for the manufacture of fancy yarns, the weight of yarn needed for weaving a particular type of cloth etc.

(5) The tenacity of yarns or even fabrics is more easily compared with that of the component fibres or yarns.

(6) It would be easier to carry out calculations in the new system than in any other system which makes use of fractions.

(7) The fineness of fibres or yarns could be easily determined by weighing them directly in an ordinary balance.

Inter-relationships Between Present and Proposed Units

It is likely that most of the countries in the world would be changing over to the new universal system within a decade or so. India, as it is well-known by now, has adopted the metric system from 1 October 1958. The change-over from the present to the new system would be by stages during which time the public will gradually assimilate the new units. It is, therefore, essential to know how the measures of fineness employed at present are related to the tex values. Further as a consequence of this change in the system of numbering yarns, there would be changes in the expressions for tenacity and the twist factors of the yarn also; and similar inter-relationships have to be worked out in their cases as well.

To be brief, this article deals with only three characteristics: fineness or linear density, tenacity and twist factor. For the same reason, only the terms used in the case of cotton will be dealt with here. This topic is treated in greater detail in one of the Bulletins (Series B. 67) issued by the Technological Laboratory at Matunga, Bombay.

(1) Fineness or Linear Density

This property is indicated by the English cotton count (usually abbreviated to count) for cotton which has already been defined. The tex number (t) is related to this measure in the following manner:

$$t = \frac{590{\cdot}5}{C} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Thus the tex number of a yarn is obtained by dividing 590.5 by its count. An approximate value could be readily obtained by dividing 600 by the count. It would also be noted that as the value of the count increases, that of tex decreases and *vice versa*. The usual range of counts (6s to 100s) in the case of cotton yarns is covered by the numbers 100 to 6 in the tex system. It would, of course, take a fairly long time before the workers and the public get accustomed to these new numbers, where the higher values are associated with coarser yarns. In course of time, however, the tex figures would become acceptable and only yarns of certain specified values of tex would be spun. Using the equation (1), Table 1 has been drawn up to give the values of tex corresponding to some values of count.

TABLE 1

VALUES OF TEX CORRESPONDING TO DIFFERENT VALUES OF COUNT

Counts	Tex	Counts	Tex
6	98·4	30	19·7
8	73·8	32	18·5
10	59·1	34	17·4
12	49·2	36	16·4
14	42·2	38	15·5
16	36·9	40	14·8
18	32·8	44	13·4
20	29·5	50	11·8
22	26·8	60	9·8
24	24·6	80	7·4
26	22·7	100	5·9
28	21·1	—	—

(2) Tenacity

The real or intrinsic strength of a material cannot be judged merely on the basis of its breaking strength alone. Some kind of allowance has to be made for its cross-sectional area. It is for this reason that in engineering practice, the strength of a material is always expressed in terms of weight per unit area such as lb/sq. in or kg/mm². As it is very difficult to determine the cross-sectional area of textile fibres or yarns, the linear density or (1/length per unit weight) is used instead. Therefore, the expression for tenacity assumes either of the forms: (strength/weight per unit length) or (strength X length per unit weight). The latter is employed at present in the expression 'Count Strength Product (C.S.P.)' as a measure of tenacity for cotton yarn. It is determined by finding what is called the lea strength of the yarn. This is obtained by breaking a lea of 120 yards of yarn, consisting of continuous loops, each of a girth of 54 in. on a lea tester. The lea strength recorded in pounds multiplied by the count of the yarn gives Count Strength Product (C.S.P.).

It is proposed in the new system that the metric skein strength should be determined by breaking a skein of 100 metres consisting of continuous 100 loops, each a metre in girth. The breaking strength recorded in grams divided by the tex number of the yarn gives the yarn-strength index as defined at the Technological Laboratory. In a recent investigation carried out here comparative tests were made by both these methods stated above and the results have been published in the September 1959 issue of the *Indian Cotton Growing Review*.

The important points are summarized below:

(*i*) A new Yarn-Strength Index (Y.S.I.) has been defined as the breaking strength in grams of a metric skein of yarn consisting of 100 loops, each one metre in length, divided by the tex number of the single yarn. The Yarn-Strength Index divided by 200, gives the tenacity in grams per tex.

(*ii*) The value obtained for the Yarn Strength Index has been found, for all practical purposes, to be numerically equal to the Count Strength Product of the same material, determined by the present procedure.

(*iii*) The coincidence is very helpful for easy change-over from the present system to the metric system. It is, therefore, recommended that the Indian Standards Institution and the International Organization for Standardization may consider this index and advocate it for universal adoption.

(*iv*) Even though the agreement between the Index and Count Strength Product

close, where greater accuracy is needed certain correction factors have to be applied. The values of the Yarn-Strength Index equivalent to some values of Count Strength Product based on this investigation will be found in Table 2 which have been worked out from the regression equation :

(Yarn Strength Index)=0.9352 (Count Strength Product)+137.09.....(II)

TABLE 2

THE VALUES OF YARN STRENGTH INDEX (AND GRAMS PER TEX) EQUIVALENT TO THE VARIOUS VALUES OF COUNT STRENGTH PRODUCT BASED ON THE INVESTIGATION CARRIED OUT AT THE TECHNOLOGICAL LABORATORY

Count-Strength Product (Strength is given in lb.) of the Lea	Yarn-Strength Index of the Metric Skein (Y.S.I.)	Tenacity of the Metric Skein in Terms of g/tex
1000	1072	5·36
1100	1166	5·83
1200	1295	6·30
1300	1353	6·76
1400	1446	7·23
1500	1540	7·70
1600	1633	8·17
1700	1727	8·63
1800	1820	9·10
1900	1914	9·57
2000	2007	10·04
2100	2101	10·51
2200	2195	10·97

) Twist Multiplier (or Twist Factor)

It is well-known that twist has to be inserted in a yarn to give it the required strength. The amount of twist is generally regulated according to the purpose which the yarn is expected to serve. In the case of cotton yarns, generally speaking, the greater the number of twists per unit length, the higher will be the strength up to a certain limit, beyond which the strength diminishes with the increase in twist. At present, the amount of twist is technically assessed by the number of turns per inch (T.P.I.). The required number of turns is determined by employing what is known as the twist multiplier (T.M.), which is equivalent to $\frac{\text{T.P.I.}}{\sqrt{C}}$, *i.e.* $\text{T.P.I.}=\text{T.M.}\sqrt{C}$ where 'C' is the count spun. For the same purpose in the new system, the twist factor (T.F.) is used. This is given by the expression:

$$\text{Turns per mm (T.P.M.)} \times \sqrt{\text{tex}} \quad i.e.\ \text{T.P.M.}=\frac{\text{T.F.}}{\sqrt{\text{tex}}}$$

It could be proved that:

T.F.=0.9567 T.M.....(III)

The values of T.F. corresponding to the usual values of T. M. are given in Table 3.

TABLE 3

THE VALUES OF THE TWIST FACTORS (T.F.) CORRESPONDING TO THE NORMAL VALUES OF THE TWIST MULTIPLIERS (T.M.)

T. M.	T. F.
3¼	3·11
3½	3·35
3¾	3·59
4	3·83
4¼	4·07
4½	4·31
4¾	4·54
5	4·78
5¼	5·02
5½	5·26

Why Introduction of New System should be Smooth

From the foregoing it will be noted that in the new universal yarn numbering system, the Count (C), the Count Strength Product (C.S.P.) and the Twist Multiplier (T.M.) will be replaced by the tex (t), Yarn Strength Index (Y.S.I.) and the Twist Factor (T. F.) respectively. Since

$t=\frac{600}{C}$, C.S.P.=Y.S.I. and T.M.=T.F. approximately, the relationships between the new and the old measures are very simple. Consequently, the introduction of the tex system could be very smooth indeed. Further, it will be rendered even more smooth by the proposal of introducing the new system only by stages, each stage covering an appreciable length of time to make the change introduced familiar to all. The stages might be something like the following :

First Stage

The use of the existing count system should be continued but in all cases of quotation, order, manufacture, delivery etc., the new tex value, inserted in brackets, should be given after the value for the count : *e.g.* 30's counts (19.7 tex).

Second Stage

The manufacture should be changed over to the new numbering system, te.; and the equivalent count value should be given in brackets : *e.g.* 48 tex (12.3 counts).

Third Stage

Only the tex value should be retained and the count shown in brackets should be dropped : *e.g.* 48 tex (12.3 counts) should become 48 tex.

In view of the intrinsic advantages of the new system, already enumerated, and in view of its contemplated introduction in a number of easy stages, it is hoped that the India industry will adopt the new system as earl as possible. There is practically no difficult to make a start with the first stage immediately.

APPENDIX A

Yarn Numbering Systems

LENGTH PER UNIT WEIGHT SYSTEMS (INDIRECT)

Sl. No. (1)	Name of System (2)	Applied to (3)	Unit of Existing Yarn Number: English (4)	Metric (5)	Others (6)	Remar (7)
(1)	English Cotton (British)	Cotton	840 yd/lb			
(2)		Cotton (Bump yarn)	$\frac{\text{yd}}{\text{oz}}\left(\frac{16\ \text{yd}}{\text{lb}}\right)$			
(3)	French No. (Continental)	Cotton		$\frac{\text{km}}{0{\cdot}5\ \text{kg}}$		This unit about 0 cotton co
(4)	Catalonian (Cotton) ..	Cotton			$\frac{500\ \text{canas}}{1\ \text{libra cal}}$	This unit is at 1·04 co (cotton).
(5)	English Linen	Linen (Wet Spun) Hemp Remie Silk Noils	300 yd/lb			

APPENDIX A—(*contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(6)	Silk Count	Silk	1000 yd/lb			For spun silk and spun rayon staple, English cotton system is used.
7)	Silk Ounce	Rew Silk	1000 yd/lb			
(8)	Yorkshire Ounce	Thrown Silk	$\frac{\text{yd}}{\text{oz}}\left(\frac{16\text{ yd}}{\text{lb}}\right)$			For silk noils, English linen system is used.
9)	Alloa	Wool	$\frac{11520\text{ yd}}{24\text{ lbs}}\left(\frac{480\text{ yd}}{\text{lb}}\right)$			
0)	American Cut	Wool	300 yd/lb			
(11)	American Wool Number (American Run)	Wool	$\frac{100\text{ yd}}{\text{oz}}\left(\frac{1600\text{ yd}}{\text{lb}}\right)$			
(12)	Dewsbury	Wool	yd/oz (16 yd/lb)			
(13)	Galashielt	Wool	$\frac{300\text{ yd}}{24\text{ oz}}\left(\frac{200\text{ yd}}{\text{lb}}\right)$			
(14)	Hawick	Wool	$\frac{300\text{ yd}}{26\text{ oz}}\left(\frac{185\text{ yd}}{\text{lb}}\right)$			
(15)	Irish	Wool	$\frac{\text{yd}}{\cdot 25\text{ oz}}\left(\frac{64\text{ yd}}{\text{lb}}\right)$			
(16)	Typp	Wool	1000 yd/lb			
(17)	Western England ..	Wool	320 yd/lb			
(18)	Woollen Yarn Count	Wool	$\frac{\text{yd}}{\cdot 5\text{ oz}}\left(\frac{32\text{ yd}}{\text{lb}}\right)$			
(19)	Yorkshire	Wool	256 yd/lb			
(20)	English Worsted ..	Worsted	560 yd/lb			
(21)	American	Asbestos	100 yd/lb			
(22)	British	Asbestos	50 yd/lb			
(23)	American and British (U.S.A.)	Glass	100 yd/lb			
(24)	Metric	All kinds Except Silk & Man-made Fibres	km/kg			This unit is about 1·7 counts (cotton).
(25)	Numero en Puntos ..				1320 m/ 1 libra de Alcoy	This unit is about 1·65 counts (cotton).

APPENDIX B

Yarn Numbering Systems

WEIGHT PER UNIT LENGTH SYSTEMS (DIRECT)

Sl. No.	Name of System	Applied to	Unit of Existing Yarn Number: English	Metric	Others	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)	Scottish Titre	Linen (Dry spun) Hemp Jute	$\frac{\text{lb}}{14400\text{ yds}}$			Jute (grist)
(2)	Denier	Silk		$\frac{\cdot 05\text{g}}{450}\left(\frac{\text{g}}{9000\text{m}}\right)$		Applied also to man-made fibres.
(3)	Legal Titre	Silk		$\frac{\text{g}}{1000\text{m}}$		Do.
(4)	—	Silk	$\frac{\text{dr}}{1000\text{ yd}}\left(\frac{\text{lb}}{256000\text{ yd}}\right)$			
(5)	Aberdeen	Wool	1b/14400 yd			
(6)	American Grain ..	Wool	grain /20yd			
(7)	Catalonic Woollen Yarn Titre ..	Wool		$\frac{\text{g}}{504\text{m}}$		
(8)	Halifax (Rural)	Wool	$\frac{\text{dr/80yd}}{}\left(\frac{\text{lb}}{20480\text{ yd}}\right)$			
(9)	Numero en Cuartos de Onza	—			1/4onza/ 500 canas	$\left(\frac{\cdot 0933\text{g}}{\text{km}}\right)$
(10)	Integral (Canada) ..	—	$\frac{\text{grain}}{100\text{ yd}}$			
(11)	American	—	$\frac{\text{grain}}{100\text{ or }120\text{ yd}}$			
(12)	Poumar	—	$\frac{\text{lb}}{1{,}000{,}000\text{ yd}}$			
(13)	Grex	General		$\frac{\text{g}}{10\text{km}}$		
(14)	Tex (gk)	General		$\frac{\text{g}}{\text{km}}$		

Conversion to Metric System in Machine Tool Industry

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IT is pertinent to ask the question : what does the conversion to the metric system in industry mean ? Is it enough to convert inch dimensions into millimetres and pounds into killograms and keep the sizes of raw materials, products and tools the same as they were before ? Legally speaking : 'Yes'. The Government of India's decision relates only to the units of measurement and not to the products to be manufactured, nor to the tools to be used. A product can be of any size as long as its dimensions are expressed in millimetres even if they run into a number of decimal places. But the question is whether it is logical and in consonance with the spirit of the Government's decision to do so. The metric system has been adopted for its scientific basis and simplicity. That purpose will be nullified if millimetre dimensions running into several decimal places obtained by conversion of existing round inch values, are used instead of suitable round numbers in millimetres. Therefore, it will be appropriate to change the sizes of the tools and products to round numbers of standard metric dimensions if we have to derive the full advantage of metric system. As such instead of using the dimension 7.9375 mm which is the conversion of 5/16 in, it will be preferable to change the size to 8 mm which is a round as well as a preferred dimension. Before leaving off the discussion of this basic principle, let us consider the arguments put forward aganist the necessity of changing sizes while changing over to the metric system of measurements :

Interconversion

Argument

Even if sizes are changed to round numbers in millimetres none of their limiting values obtained from allowances and tolerances will be in round number of millimetres. The resolution proposed by the Standing Committee for the Study of Scientific Principles of Standardization (STACO) of the International Organization for Standardization (ISO) and approved by the ISO Council in July 1956 reads as follows :

'Round numbers are of value as a simple means of designing products. In international standardization it is important to adopt such a system of designation that the characteristics of international functional interchangeability are not obscured. In some

cases, however, by making use of round numbers, functionally interchangeable products may be designated by metric values in inch value which are not identical'.

Thus it is possible to express existing round inch dimensions in round mm dimensions by prescribing allowances and tolerances in such a manner that the limiting values remain unchanged *i.e.* there is no change in the size of the product due to conversion to metric system.

Example

$$(1 + 0.016) \text{ inch} = (25 + {}^{+0.8}_{+0.4}) \text{ mm}.$$

One inch diameter shaft having a tolerance of 0.016 in can be called 25 mm diameter shaft having tolerance of $^{+0.8}_{+0.4}$ mm. By doing this the product remains unchanged and the nominal sizes in mm and inch are also in round numbers.

Answer

This principle may be valid for internationally standardized world unitary features but to follow it for all other features will create great confusion. This is because the system of allowances and tolerances will then have to be a special one having a correction factor first, to bring round millimetre dimensions to exact inch equivalent and, secondly, such parts though having nominal metric dimensions will not interchange with parts from metric countries similarly designated. Thereby we shall be having a third standard neither fully agreeing with inch countries nor with other metric countries. Therefore, it will be preferable to change the sizes of the products and tools in conformity with other metric countries while changing over to metric system.

Preferred Numbers

Argument

It is also argued that the present world trend is any way for preferred numbers which are not whole round numbers. (*e.g.* R. 20 Series : 1, 1.12, 1.25, 1.40, 1.60, 1.80, 2, 2.4, 2.5, 2.80, 3.15, 3.55, 4, 4.5, 5, 5.6, 6.3, 7.10, 8, 9, 10). So why insist on round numbers in mm and what is the harm if non-round mm dimensions as obtained by conversion from round inch sizes are adopted ?

Answer

Preferred numbers are more rounded than inch series converted into mm. Secondly, there is also an Ra series which has more rounded values. (*e.g.* Ra 20 series: 1, 1.1, 1.2, 1.4, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.0, 3.5, 4, 4.5, 5.0, 5.5, 6, 7, 8, 9, 10).

Steps for Change-over

We may turn to the steps that should be taken to effect the 'metric' change-over. In order to change over completely to the metric system in conformity with the law and spirit of the Government's decision, the following actions will have to be taken :

(1) Preparation of tables and charts of conversion from inch/lb to the metric system (including formulae) and giving them wide publicity.

(2) Training personnel in the metric system and in the methods to be followed for change-over to it.

(3) To begin with, lay down exact metric equivalents side by side with the in/lb values in the existing specifications.

(4) Start recording measurements in the metric system with the help of conversion tables along with the in/lb measurements as obtained from existing in/lb instruments.

(5) Machine tools designed in the inch system and ready for sale should be fitted

with metric scales and dials in place of inch scales and dials and with a set of change gears to cut metric threads so that results obtained will be metric though machines themselves have been designed in the inch system.

(6) Procure all measuring scales and instruments in metric system as early as possible.

(7) Prepare all intermediate stage designs and drawings (*i.e.* those to be executed after the receipt of metric measuring scales and instruments but before the receipt of raw materials and tools of metric standard) suitable for manufacture with the help of existing raw materials and tools of inch standard. For all other features where it is not essential to maintain inch sizes for the sake of raw materials and tools, only metric standard sizes should be laid down.

For example see Fig 1.

(8) Procure all the raw materials and tools of metric standard (*i.e.* having nominal dimensions in round mm as used in other metric countries) as early as possible.

(9) All new final stage designs and drawings (*i.e.* those to be executed after the receipt of metric measuring scales and instruments and raw material and tools of proper metric standard) should be completely in metric system suitable for manufacture with the help of metric materials and tooling.

For example see Fig 2.

(10) Machine tools already designed in the inch system should be completely redesigned in the metric system if there are repeat orders.

Problems of import, export and maintenance may be solved as follows:

Import

All machinery imported in future either from metric or inch countries should be able to give results in metric system (*i.e.* all scales and dials should give readings in mm) and should be able to cut metric as well as inch threads because inch threads might continue for some time and moreover internationally accepted pipe threads are in threads per inch (TPI). No difficulty will be met here since inch countries can easily fit metric scales and dials and supply gear train for cutting metric threads and similarly metric countries can supply gear train for cutting inch threads.

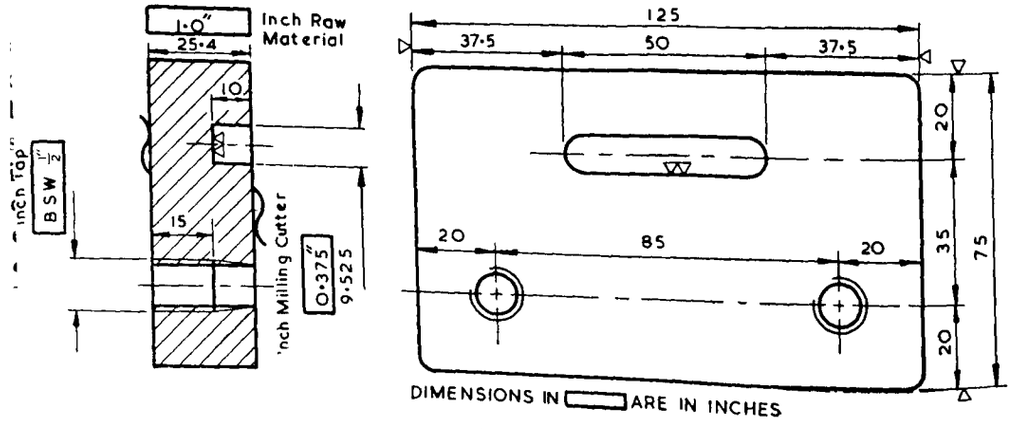

Fig 1

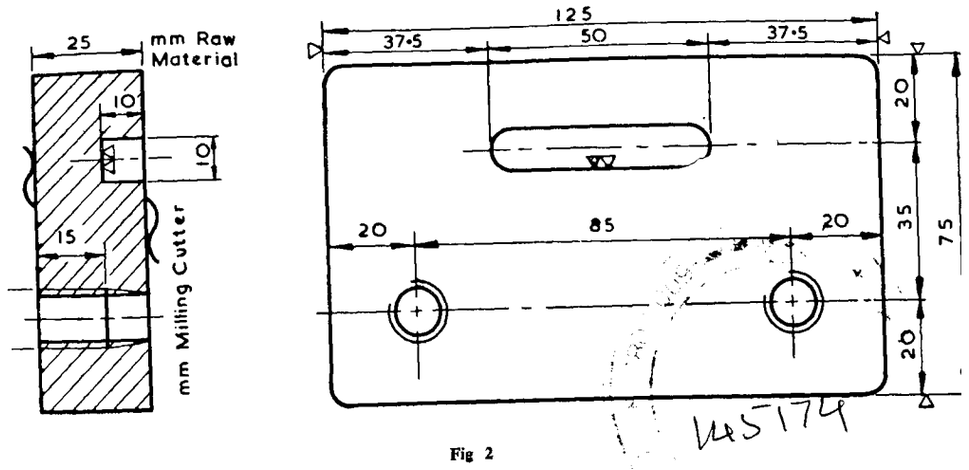

Fig 2

As far as possible in future try to import machinery basically designed in the metric system *i.e.* with metric standard parts, dimensions and threads. Here difficulty may arise while importing machines from inch countries unless they are already doing it for exporting to metric countries. For expanding our industry rapidly, we may be forced to import basically inch designed machines. But that cannot be helped.

The advantage of importing basically metric designed machines is that maintenance will be easier as we are switching over to the metric system and will be the logical change-over to the metric standard.

Export

There will be no difficulty in exporting to metric countries machines which are designed in the metric system and are capable of giving metric results. But difficulty may arise while exporting machine-tools to inch countries which happen to be our neighbouring countries and probable customers.

These customers may be advised to buy basically metric designed machines fitted with inch scales and dials and a set of change gears to cut inch threads as well. This may prove to be foresight as these countries themselves may one day adopt the metric system for its obvious advantages. Even the American Army seems to be thinking of changing over to the metric system.

Of course, if other countries demand that they want machines basically designed in the inch system only and if we are keenly interested in exporting them, then we shall have to produce machines designed in inch system for that purpose.

Maintenance

Manufacture of basically inch designed parts (of course, expressed in exact metric equivalents) will have to continue for some time for the purpose of replacement of parts belonging to existing machinery which is mostly in the inch system and for inch designed machinery which may be imported from inch countries in the near future.

Suggested Action

We may now consider action on the points suggested earlier. There is not mu

difficulty in implementing the first five of the ten items as the cost involved will be very small and not really great effort is required to train the personnel in metric system which is so easy to use.

The main difficulty may have to be faced in implementing 6 and 8 on which depend action on items 7, 9 and 10. To implement items 6 and 8, *i.e.* to procure metric scales and instruments and raw materials and tools to metric standards involves considerable expenditure and may create problems of foreign exchange. Even after overcoming these two hurdles the question of availability of stores and time required to get them still remains.

Therefore, a complete change-over to the metric system in the machine tool industry is essentially a financial proposition involving foreign exchange and has to be solved at the national level.

If due to the present financial and foreign exchange position in India and the large number of huge projects in hand, it is not possible to allot the necessary foreign exchange for the change-over the completion of this essential reform may take considerably longer than was thought possible earlier.

* * *

Teaching of Metric System in Secondary Schools

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THE present curriculum of mathematics in the Higher Secondary Schools is divided into two parts :

(1) Core mathematics : Common to all students.

(2) Additional mathematics: Depending on the individual's choice of the subject.

Core Mathematics

The study of this part is compulsory for all students and it sets the limits of attainment in the subject taking into consideration the social needs of an average boy. The basic knowledge of this branch of mathematics is essential not only to help him to earn his livelihood but also for an intelligent grasp of the life around him. It requires that the child should be properly equipped :

(1) with computational ability which would help him in his calculations of weights, measures and currency;

(2) knowledge of those essentials which help him in integrating his intellectual pursuits in the subject with other branches of studies;

(3) appreciation of the vast mathematical terminology we use in everyday life.

This knowledge is the prerequisite fo all boys whether they leave school immediatel after the secondary stage or continue thei studies further. This is the knowledge whicl must be imparted to all the students, and the curriculum has to be revised to suit this requirement and make possible more learning in the same period at school. There could be many ways of achieving this. One of them is suggested here.

Present Curriculum and Growing Needs

The present curriculum in mathematics is dominated by fractions in almost all topics in some measure, due to the needs of daily transactions. For example, fractions such as $\frac{1}{2}$, $\frac{1}{3}$, 1/5, $\frac{1}{8}$, 1/12, 1/16, and 1/40 are necessary for conversions of older types of weights, measures and currency.

Due to this the emphasis is not only on the teaching of above fractions, but cumbersome fractions also enter into the child's education in the belief that : (1) it might facilitate his learning and develop speed and (2) it would enhance the prestige of the subject in cultivating the desired formal discipline.

This practice, however, precluded to a great extent the possibilities of learning in

tensively as well as extensively certain extremely useful topics like logarithms, approximation by aliquot parts, density, specific gravity, map reading, graphical representations and statistical methods.

Again, the treatment of topics like practice, simple interest and compound interest, profit and loss, percentages is now divided into different compartments with strong barriers of rigid formulae separating each one of them.

It is well-known that considerable time is devoted to fractions right from V standard to the highest form of the high school. Fractions particularly of the large and awkward variety, creep into almost all questions, increase work and often bore the students. Indeed, there has all along been a theoretical treatment of fractional rendering and fractions like 8/17, 9/23, 29/108 have been freely used in textbooks.

It is difficult to imagine how the student reacts to such values. He is also not aware whether at any stage in his life he would be required to use such relations and in what manner.

Even then, considering from a purely theoretical approach, such fractions lend themselves easily to decimal treatment to a fair degree of accuracy.

It is also not very uncommon to see boys of 8-11 years confused with examples like the ones given below:

Arrange in ascending and descending order:

15/16, 18/19, 89/97, and 279/298.

In what conceivable manner the child could quickly find their Least Common Multiple and after having found a common denominator, work out divisions and multiplications into factors in the denominator and numerator and arrange the terms in the given order is difficult to understand. And in many cases the approach being conventional and stereotyped the student is confused.

Again, if rendered in decimals, the working of this example is more clear and brief e.g.

15/16	=	0·9375
18/19	=	0·9474
89/97	=	0·9175
279/298	=	0·9362

and the result follows without much trouble.

Need for Teaching Decimals

The need for an exhaustive treatment of decimals because of their inherent practical use, the clarity they afford in thinking and the greater ease and facility to which they easily lend themselves, as shown above, would thus be clear. The facts also bring out that our present curriculum falls short of these demands, more so because of the latest reforms in currency, weights and measures.

No child can be taught in isolation of its environments and the new currency and weights and measures are already on the horizon of his environments. Moreover, the reform cannot get deeply rooted into the life of a nation if we have different systems of weights and measures, one taught in the school and the other used outside. The child must constantly think in and live with new coins, weights and measures. All the inhibitions caused by the old tables of weight and measures and currency with which the students have gained familiarity through tradition and constant use must go.

It may again be stressed that (1) decimals, (2) dependent topics like approximations and logarithms which facilitate working and increase speed, and (3) auxiliary topics like map reading, practice in decimals etc. the utility of which in the present times has increased and which now do not find a place in the present syllabus should be included in the new syllabus. We may now examine the usefulness of each of the topics.

Decimals

Decimal treatment will help to a great degree in the integration of the syllabus. While elementary knowledge in topics like practice, percentages, profit and loss, simple and compound interest etc. could with profit be imparted at the earlier stages, difficult and inverse sums should be postponed to higher forms.

The examples dealt with here are for boys in higher forms, and show how integration would be possible.

Need for Elimination of Practice (Simple or Compound) From the Syllabus.

Find the cost of 2 tons, 0 Cwt, 61 3/8 lb at £11 8 sh 9 3/4 d per ton.

Here £11 8 sh 9 3/4 d = £11·440625 and 2 tons 0 cwt 61 3/8 lb. = 2·0274 tons.

Working

12 | 9·75
·8125
20 | 8·8125
·440625
14 | 61·375 lb
2 | 4·384
4 | 2·193
20 | ·548
·0274

11·441
×2·027

80 087
228 82
22882 0

23·190907 = £23·191
×20
3·82 sh
×12
9·84 d

Ans: £23 3 sh 10 d.

The question would have been difficult if done with the conventional approach of compound practice rendering 61 3/8 lb into aliquot parts. The example is sufficient proof in itself to show that the *decimal system of money, weights and measures does away with the teaching of 'practice' as a method separate in itself.* This simplicity is seen in the following example :

Find the cost of 49 kg 4 dag 5 g at Rs. 17·3 per kg.

49 kg 4 dag 5 g = 49·045
and Rs. 17·35 = 17·35
49·045
×17·35

245225
147135
343315
49045

850·93075

Rs. 850·93 only.

Need for Teaching Approximation

The population of England and Wales was 29,002,525 in 1891 and 32,577,843 in 1901; that of Scotland was 4,025, 647 in 1891 and 4,472,103 in 1901. Find out which of the populations was increasing at the greater proportional rate during 1891-1901.

Increase in population in England and Wales = 3,575,318

$$\therefore \text{ Percent increase} = \frac{3\,575\,318 \times 100}{29\,002\,525} = \frac{3\,575\,318 \times 100}{29\,002\,500} = \frac{35\,753}{2\,900} = \frac{357\cdot5}{29} = 12\cdot3 \text{ percent}$$

Increase in population in Scotland = 446 456

$$\therefore \text{ Percent increase} = \frac{446\,456 \times 100}{4\,025\,647} = \frac{446\,456}{40\,256} = \frac{446\,400}{40\,200} = \frac{446}{40} = 11\cdot15 \text{ percent}$$

The answer is obviously that of Engla and Wales.

If it had been done in fractions and questions solved with exact promptitu it would have created many difficulties the student.

Treatment of Profit and Loss, Simple Interest

Take another example which we shall solve with decimals without bringing in any fractions.

A sells an article to B at a gain of 10 percent; B sells it to C at a loss of 7 1/2 percent; C disposes of it at a loss of 2 percent. If the prime cost to the manufacturer was Rs. 6·375 find to the nearest nP the price obtained by C.

A buys for Rs. 6·375 and sells it at a gain of 10 percent.

Cost price of B = Rs. 6·375 + 0·6375
= Rs. 7·0125

B sells it at a gain of 7 1/2 % = 7·0125
5% = 0·3506
2 1/2% = 0·1753 } 7 1/2%
Rs. 7·5384

∴ The cost price of C = Rs. 7·5384
C sells it at a loss of 2%
C's selling price = 7·5384

2% = 1/50 = 0·1508 / 7·3876 to four decimal places
= 7·388 to three decimal places
= Rs. 7·39

In fractions in the last step the selling price of C
= 51/8 × 110/100 × 215/200 × 98/100
= (51 × 11 × 43 × 49) / (80 × 40 × 50) (a tedious factor)

From the above example the superiority of the decimal system over fractions would be realized.

Logarithms

Example like:

(1) Amount = Rs. 273·60 x (1·04)^3
(2) Amount = 500 x (1·03)^{18}
(3) 1 metre = 39·370 113 inches.
= 1·093 614 yards.
(4) Render 749·36 metres into yards

lead to a discussion of logarithms and approximation.

Though it must be very strongly advocated that sums involving approximations of incommensurate relations like 1/73=0·013986 (correct to 5 significant figures), 22/7=3·1416 correct to 5 significant figures), 1 metre= 1·093 614 yards (correct to 7 significant figures), should be avoided at the earlier stage, where simple questions involving simple calculations, sums promoting understanding of methods etc. should be set. But in the two highest forms the student should be introduced to such topics as approximations by aliquot parts and logarithms which would help him when he may have to use this knowledge in finding coefficient of expansion or contraction, specific gravity, density etc. up to a fair degree of approximation. Decimal reckoning correct to 5 or 6 significant figures is, in fact, required in scientific instruments demanding a fairly high degree of precision and which are used at an advanced stage of learning.

It is only when topics like specific gravity and density etc. have been introduced in lessons in general science that a sprinkling of these questions in arithmetic will enable the child to understand the close relation between the two subjects and thus make the study more interesting.

If he employs simple methods of multiplication and division such simplifications tend to be exhausting. That is why there is a great need for learning topics that facilitate computation.

A few illustrations may make the point clear.

The retail list price of a bicycle is Rs. 239. The wholesale dealer allows a discount of 6 percent for each and still makes a profit of 14 percent on his outlay. The manufacturers' price to the wholesale dealer is 26 percent higher than the original price at which it was sold to the wholesale dealer.

Find the original cost price of the bicycle.

Approach

Market retail price of the bicycle = Rs. 239
Discount .. .. .. = Rs. 6%
∴ Price after deducting the discount = Rs. 239·00
— 14·34
224·66

∴ Cost price of the wholesale dealer = Rs. 224·66

Cost price of the manufacturer = Rs. 224·66 / 1·14 × 1·26

= log 224·66 − log 1·14 − log 1·26
= 2·3514 − 0·056 9 − 0·100 4 = 2·194 1

Antilog = 156·4 or price is Rs. 156·40 only.

A comparative solution with the help of fractions will establish the superiority of the above approach over the conventional fractional approach.

Market price of the bicycle .. = Rs. 239
discount .. .. = 6%
Actual price of the bicycle .. = 239 × 94 / 100
= Rs. 11 233 / 50

∴ Cost price of the wholesale dealer
= Rs. 11 233/50 × 100/114

∴ Cost price of the manufacturer
= 11 233/50 × 100/114 × 100/126
= 561 650 / 359 1

(not an easy fraction to handle. After a long division it gives the answer as Rs. 156·40).

It is not necessary to give the complete theory of logarithm tables. What is required is that the child should be taught how to use the tables correctly. For the inquisitive boys, the following explanation is extremely useful in making them understand how the tables were built up. This should come after the boys have gained an idea of 'indices and surds.'

$10^0 = 1$ log 1 = 0

$10^{1/2} = 3·162$ log 3·162 = 1/2 = 0·5

$10^{\frac{1}{4}} = (10^{1/2})^{\frac{1}{2}} = \sqrt{3·162}$
= 1·779

log 1·779 = 1/4 = 0·25

$(10)^{3/4} = 10^{1/2+1/4} = 10^{1/2} \times 10^{\frac{1}{4}}$
= (3·162) (1·779)
= 5·625

log 5·625 = 3/4 = 0·75

$(10)^1 = 10$ or log 10 = 1

$(10)^{-1} = 1/10 = 0·1$ or log ·1 = 1

$(10)^{-0·5} = 10^{-1/2} = 1/10^{1/2}$ —

$= \frac{1}{\sqrt{10}} \times \frac{\sqrt{10}}{\sqrt{10}} = \frac{\sqrt{10}}{10}$

$= \frac{3·162}{10} = ·3162$

log ·3162 = −0·5

Thus a table could be constructed as follows :

log ×	0·1	0·3162	1	1·779	3·162	5·625	10
×	−1	−0·5	0	·25	0·50	·75	1

Further the characteristics of a log can always be found by inspection.

A number which has two digits in its integral part such as 32·49 is greater than 10^1 and less than 10^2. Its logarithm lies between 1 & 2 and may be written as

1 + fractional part

Thus

0·03249 = 10^{-2} × 3·249 = $\bar{2}$·5117

0·3249 = 10^{-1} × 3·249 = 1·5117

3·249 = 10^0 × 3·249 = 0·5117

32·49 = 10^1 × 3·249 = 1·5117

324·9 = 10^2 × 3·249 = 2·5117

Approximation by Aliquot Parts

Transform 5 ft. 3 in. into metres.

1 inch / 1 cm = 2·54 cm = (10/4 + 4/100) cm
63 inches = 63(10/4 + 4/100) cm
= 157·5 + 2·52 cm
= 160·02 cm
= 1·6 metres

For converting yards into metres use the multiplie
(1 − 1/10 + 1/70). Change 3 650 yards into metres
Since 1 yard = 0·9144
= 1 − ·1 + ·0144
= 1 − 1/10 + 1/70 correct to 3 decima places.
∴ 3650 yards = 3650 (1 − 1/10 + 1/70) metres

$= 3\ 650 - 365 \div 52 \cdot 143$ metres
$= 333\ 7 \cdot 143$ metres

Similarly

1 metre $= (1 + 1/12 + 1/96)$ yards.

1 kg $= 1 \cdot 0717$ seers

$$= 1 + \frac{7}{100} + \frac{1}{1000} + \frac{7}{10000} \text{ seers}$$

$$= 1 + \frac{1}{1000} + 7\left(\frac{1}{100} + \frac{1}{10000}\right) \text{ seers}$$

1 kg $= 2 \cdot 2046$ lb.

$$= 2 + \frac{2}{10} + \frac{0}{100} + \frac{4}{1000} + \frac{6}{10000} \text{ lb.}$$

$$= 2 + \frac{1}{5} + \frac{0}{100} + \frac{5}{1000} - \frac{1}{10000} \text{ lb.}$$

$$= 2 + \frac{1}{5} + \frac{1}{200} - \frac{1}{2500} \text{ lb.}$$

$$= 2 + \frac{1}{5} + \frac{1}{200}\left(1 - \frac{1}{10}\right) \text{ lb. approx.}$$

Such approximations facilitate simplifications to a fair degree and give results to a sufficient degree of accuracy.

Map Reading

The increased importance of map reading in the present context of studies needs hardly to be stressed and along with map reading, co-ordinate reading of a specific place, finding the representative fraction, finding the area of a certain portion, drawing a certain portion over a graph paper are points which could be systematically introduced from the early stages. The subject is interesting and provides considerable scope for practical and outdoor work.

Often the sketch of a certain area is provided to the student with certain data given on it. The boys are asked to find the distance between two known places, the type of landscape and if the distance is given how to find the scale etc. They enjoy learning a topic which is both informative and instructive.

* * *

Metric System in Buildings, Architecture and Town Planning

A Conference on adoption of metric system in building, architecture and town planning, convened by the Ministry of Works, Housing & Supply was held in New Delhi on the 2 and 3 September 1959. It was inaugurated by Shri K. C. Reddy, Minister for Works, Housing and Supply and was presided over by Shri M. R. Sachdev, Secretary, Ministry of Works, Housing & Supply. It was attended by representatives of State Governments, Central Ministries and other technical organisations. It adopted the following resolutions:

(1) This Conference resolves that all standards for materials should be as per Indian Standard specifications already published. Wherever difficulties are met with in following these specifications, they may be referred to the Indian Standards Institution (ISI) with the necessary experimental or other data to enable the ISI to come to suitable conclusions.

(2) This Conference recommends the adoption of the principle of modular co-ordination of dimensions in the building industry based on a 10 cm module as outlined by the ISI. In this context the Conference notes certain difficulties expressed by some members in regard to brick dimensions specified in the Indian Standard specification and suggests that these difficulties be referred to ISI for consideration with such experimental and other data as may be available.

(3) The Conference recommends that the following measures should be taken by the organizations concerned, for promoting the manufacture of building materials according to metric standards:

(*a*) As far as possible an immediate beginning should be made to place indents for materials in metric sizes.

(*b*) Specific dates should be fixed for the commencement of use of materials according to metric standards.

(4) The Conference notes that there will not be any serious difficulty in procuring the necessary architectural and engineering scales and other measuring instruments, except in the case of steel tapes which will have to be imported until the manufacturing capacity is developed in the country.

In order that all purchases of new scales and equipment by universities and technological institutions are made conforming to metric standards, the Conference recommends that the University Grants Commission may be requested to stipulate suitable conditions while sanctioning grants.

(5) The Conference recommends the adoption of IS:1200—1958 Code of Measurement of Building Works by all construction departments with such minor modifications as may be necessary to suit local conditions.

(6) The Conference recommends the preparation of a comprehensive Handbook for Building Engineers in the Metric System

by the National Buildings Organization so that this would serve as a reference book. Every endeavour should be made to complete this book within a year. Further, the ISI should be requested to expedite publication of its Handbooks on structural steel design.

(7) (*a*) The Conference recommends that from April 1960, the State Governments should encourage the submission of drawings with applications for issue of controlled materials in the metric system.

(*b*) The Conference recommends that the Central Government should request the State Governments to advise the Local Bodies under them to revise their bye-laws introducing the metric system, on the lines of IS: 1256—1957. From April 1962 they should insist on submission of drawings for new buildings in the metric system. Drawings prepared in the metric system from an earlier date should also be accepted.

(8) **Phased Programme for the Conversion :**

This Conference adopts the following phased programme for the introduction of the metric system in the building industry, architecture and town planning.

In drawing up this phased programme the Conference has taken the following factors into consideration:

(*i*) Preparation of drawings and designs of buildings in the metric system should precede construction work.

(*ii*) The programme should stimulate production of building materials to metric standards.

(*iii*) As a complete change-over from a predetermined date is not possible any programme must provide for the co-existence of the two systems during the transitional period ensuring a smooth change-over.

(*iv*) The time and work involved in revising the specifications, analysis, and schedule of rates by various public works departments.

(*v*) Availability of necessary scales, measuring aids, design tables, codes of practice, loading standards and completion of metric standards for all building materials.

(*vi*) The co-operation of private bodies and manufacturers will be forth-coming.

The programme envisages three stages:

The first stage provides for the preparation of surveys and drawings in the metric system and preparation of only the bills of quantities and rates in metric units. The tendering, and payment in respect of these works will also be in metric system. The specifications will, however, remain as at present in the foot-pound system. The only change at this stage will be the use of metric size bricks.

Examples :

Description of the Item	*Quantity*	*Unit*	*Rate*	*Amount*
$1\frac{1}{2}''$ thick cement concrete flooring of 1 : 2 : 4 cement with $\frac{1}{2}''$ ballast finished smooth with neat cement.	X sq metres	sq metre	Rs. 4·00	Rs. 4 X

In the second stage, all materials for which standards exist as on 1 April 1960, will be introduced in the specifications and the analysis of rates for these items will accordingly be modified. The remaining items will continue to exist in the present system. The estimating, tendering, measurement and payment will be done in metric units as in stage 1. At this stage specifications for works, such as R.C.C., structural steel work, timber work, doors & windows will be completely in the metric system.

Example

Description of the Item	*Quantity*	*Unit*	*Rate*	*Amount*
38 mm thick cement concrete flooring of 1 : 2 : 4 cement concrete using 15 mm ballast, finished smooth with neat cement.	X sq metres	Sq metre	Rs. 4·00	Rs. 4.X

In the third stage the remaining items of works will be put in the metric system and the entire specifications, analysis of rates etc., will all be in the metric system.

The Conference recommends the adoption of the following schedule for the introduction of the above three stages:

First stage: Commences 1 *April* 1960

This presupposes that metric scales, measuring tapes, chains, etc., will be available and procured by the concerned department by this date.

(A) All surveys, drawings and designs for new projects and buildings will be prepared in the metric system.

(B) The bills of quantities for the above works will be worked out in metric units, keeping the same nomenclature of items as at present except in regard to bricks. For this purpose schedule and specifications for brickwork items alone will have to be revised and equivalent rates for metric units will be worked out for other items.

Note—It is expected that the drawings will take about three months and estimating and tendering another 3 months and actual procurement of bricks to new sizes will start from the burning season of 1960, *i.e.*, September 1960.

Second Stage : Commences between 1 *April* 1960 & 1 *April* 1962

(A) The nomenclature of such of those items for which standards have been prescribed as on 1 April 1960, will be changed as for metric standards and the rates also worked on the basis of new nomenclature and corresponding analysis. At this stage the following materials are expected to be available in the metric system:

Cement, stone aggregates and sand concrete products, like tiles, etc.

Steel

Timber

Doors and windows

Sheets and wires

Third Stage : Commences 1 *April* 1963

This stage presumes that metric standards for all other materials required by the building industry will be ready and materials to these standards would be procurable.

The entire nomenclature will be brought to the metric standards, analysis of rates revised and schedules completely put in the metric system.

Note—The introduction of third stage on 1 April 1963, provides for a three year period during which any remaining transitional difficulties will be resolved and by 1966 the building industry will be brought entirely into the metric system.

The Conference intends that this time Schedule should apply to all construction agencies in the public sector. The private sector should also follow the same schedule and wherever feasible hasten the introduction of the metric system in their respective fields of operation.

In the case of departments which are considering revision of rates to account for fluctuations in prices, the programme for such revision may be suitably modified to fit in the phased programme for the introduction of the metric system.

Actions to be Taken by Various Agencies

(*i*) Standard specifications for scales and other measuring aids should be issued

the ISI as soon as possible, preferably by the end of 1959 and the Ministry of Commerce and Industry should take all the necessary steps to see that scales are available for the consumers in adequate quantities by the end of 1959. To achieve this, it is necessary that the indenting departments should place indents for their requirements with the manufacturers as early as possible.

(*ii*) For structural design the following aids will be necessary by April 1960. The position regarding these is given below:

(*a*) Structural tables ..	.. Already available.
(*b*) R.C.C. Tables ..	.. Preparation of this should be entrusted to the Concrete Association of India.
(*c*) Conversion tables and codes.	Already available.
(*d*) Strength, properties of materials, in the metric system.	Already available.
(*e*) Basic design standards like loading standards.	Should be made available in the metric system by the ISI.
(*f*) Unit weights of materials	Should be made available in the metric system by the ISI.

(*iii*) Fixing of metric standards for materials not already covered by Indian Standards should be completed by the ISI by 1 April 1962.

(9) The Conference recommends the setting up of a separate cell under an officer not below the rank of Executive Engineer in each of the public works and other departments, to undertake the revision of specifications, schedules of rates for works and for preparation of Handbooks, modifications of type designs and drawings etc.

(10) The Conference notes the progress made by the Central P.W.D. in the revision of the specifications and the schedule of rates in the metric system and resolves to request the Chief Engineer, Central P.W.D., to circulate copies of the revised specifications and schedules to the State P.W.Ds, and other concerned Central Government Departments as and when they become available.

(11) The Conference also notes the useful work done, by the Indian Standards Institution, in laying standards in metric units for building materials and codes of practice for various items of construction and hopes that the remaining work will also be completed expeditiously.

* * *

News & Views

Change in Date for Adoption of Metric System in Collection of Customs Duties

In view of the representations received from the trade and other interests concerned, the Government of India have decided to introduce the metric system in the levy and collection of customs duties and duties of Central Excise from August 1960. It was announced earlier that this change-over would take place on 1 April 1960 (*See Metric Measures, November*, 1959, *p.* 24).

The exact date on which the new system is to be introduced is to be announced later.

New Zealand Committee Votes for Decimal Coinage

It is understood that a decimal coinage Committee set up in 1957 to investigate the problems of decimal currency has made a favourable report to the New Zealand Government.

In the report tabled in the House of Representatives on 14 October 1959, the committee says the only significant disadvantage of the decimal scheme is that it has less divisibility than the present one.

It says that if decimal coinage is adopted in New Zealand, an immediate inquiry should then be held on the advisability of switching to decimal weights and measures.

The committee makes no recommendation regarding names for new units to replace existing pounds, shilling and pence but recommends that notes and coins under the new system be issued initially as follows:

Notes : 100 units equivalent to £50; 20 units (£10); ten units (£5); two units (£1) and one unit (10/).

Silver Coins : 25 units (2/6); 20 units (2/), ten units (1/); five units (6d); 2½ units (3d).

Bronze Coins : one unit (1·2d); ½ unit (0·6d).

The Committee recommends the date for the change-over should be 3½ years after the adoption of the report by the Government. To prepare for the transition, there should be a two-year preparatory period followed by 18 months for completion of machine conversions.

The Committee says costs of the change-over for machines would be about £NZ 3,500,000, if a partial conversion was adopted and £NZ 4,500,000 for a full conversion.

The Committee suggests a completely new upper unit name should be adopted distinctively associated with New Zealand.

Suggestions received by the committee were NZ dollar, zeal, kiwi, tui and fern.

Suggestions for the lower unit were penny, cent, new penny, and decimal penny, which could later be abridged to decipen.

Recalibration of Spring Balances

The following two firms:

(1) Misrilal Motilal,
71, Sarang Street,
Bombay-3.

(2) Multan Engineering Works,
1773, Mir Jumla, Lal Kuan,
Delhi.

have informed us that they would be able to recalibrate dials of spring balances in the metric system. Those interested may direct their enquiries to these two firms.

Licensed Manufacturers, Dealers and Repairers of Weights and Measures (5)

Metric Measures has been publishing lists of manufacturers, dealers and repairers of weights and measures and weighing and measuring instruments licensed by the various States and Union Territories under their respective Weights and Measures (Enforcement) Acts. This is the fifth list in the series. The first list appeared in the issue of March 1959.

Steps are being taken for licensing manufacturers, dealers and repairers in all States and further lists of licensees would be published in *Metric Measures* as this work progresses.

The number in brackets against the name of the State or Union Territory indicates the instalment number of the list for that State or Union Territory. The issues of *Metric Measures* in which previous lists appear are also indicated suitably.

ANDHRA PRADESH (2)

The first list appeared in the July 1959 issue of *Metric Measures*.

Manufacturers

Sl. No.	Name and Address of Manufacturer	Details of Articles Manufactured
(1)	Asiatic Machinery Corporation (P) Ltd., 10/1, Kailash Ch. Chandra Lane, P.O. Santragachi, Howrah, West Bengal.	Weighing Machines, Platform Machines & Weigh-bridges.
(2)	Bharat National Foundry, Motia Khan, New Delhi	Cast Iron Weights.
(3)	Central Metal Works, Manufacturers of Measures, Feelkhana Camp, Hyderabad Dn.	Measures.
(4)	Deccan Porcelain & Enamel Works Ltd., Manufacturers of Weights, Mushirabad, Hyderabad Dn.	Cast Iron Weights.
(5)	Hercules Engineering Works, Udhyognagar, Sion, Bombay-22.	Counter Scale, Spring Balances, Dry and Liquid Measures.
(6)	Jivan Nagji & Sons, Manufacturers of Scales, Savarkondla (Saurashtra).	Beam Scales.
(7)	Luhar Jiva Gopal, Manufacturers of Scales, Savarkondla (Saurashtra).	Scales.
(8)	Luhar Kanji Ranchod Sidhupura, Manufacturers of Scales, Savarkondla (Saurashtra).	Beam Scales.
(9)	Luhar Karsan Ramji & Sons, Manufacturers of Scales, Savarkondla (Saurashtra).	Beam Scales.

Manufacturers (*contd.*)

Sl. No.	Name and Address of Manufacturer	Details of Articles manufactured
(10)	Luhar Kohdanatha, Manufacturers of Scales, Savarkondla (Saurashtra).	Beam Scales.
(11)	Luharmulji Narayan, Manufacturers of Scales, Savarkondla, (Saurashtra).	Beam Scales.
(12)	Misrilal Motilal, Topkhana Road, Osman Gunj, Hyderabad	Brass Weights, Linear Measures and Weighing Instruments.
(13)	K. Narayana & Sons, Manufacturers of Scales, Dowlaishwaram	Beam Scales.
(14)	Oriental Metal Pressing Works, Private Ltd., Worli, Bombay-18	Weighing and Measuring Instruments.
(15)	Standard Mechanical & Iron Works, Ethna Street, Patel Compound, Lamington Road, Bombay-8.	Weights, Measures and Scales.
(16)	Swamy Engineering Works, Manufacturers of Scales, Dowlaishwaram.	Beam Scales.

Dealers

Sl. No.	Name and Address of Dealer	Details of Articles Sold
(1)	Central Metal Works, 15-1-457, Feelkhana Camp, Hyderabad Deccan.	Weights, Measures and Weighing and Measuring Instruments.
(2)	S. Chenniah, Gunj Bhongir	Weights, Measures and Weighing and Measuring Instruments.
(3)	Deccan Porcelain and Enamel Works, Mushirabad, Hyderabad Deccan.	Weights, Measures and Weighing and Measuring Instruments.
(4)	I.A.E.C. Hyderabad Ltd., Gunfoundry, Hyderabad	Weights, Measures and Weighing and Measuring Instruments.
(5)	K. B. Jaggiah, General Merchant, Karimnagar	Weights, Measurers and Weighing and Measuring Instruments.
(6)	J. Joseph, Mandi Bazar, Warangal	Weights, Measures and Weighing an Measuring Instruments.
(7)	K. Krishnamurthy, General Merchant, Beet Bazar, Warangal	Weights, Measures and Weighing an Measuring Instruments.
(8)	M. Mahboob Ali, Sardar Road, Sadasivepet	Weights, Measurers and Weighing an Measuring Instruments.
(9)	Majestic Metal Works, Mittikasher Begum Bazar, Hyderabad	Weights, Measures and Weighing an Measuring Instruments.
(10)	Md. Taqi Hussain, Peddapalli & Siddipet	Weights, Measures and Weighing an Measuring Instruments.
(11)	Mohammed Yousuf & Bros., Mandi Bazar, Warangal ..	Weights, Measures and Weighing ar Measuring Instruments.
(12)	Paramount Scale Centre, 22-8-430, Purani Haveli, Hyderabad	Weights, Measures and Weighing ar Measuring Instruments.

Dealers (*contd.*)

Sl. No.	Name and Address of Dealer	Details of Articles Sold
(13)	Safe Scale Co., Miralam Mandi, Hyderabad	Weights, Measures and Weighing and Measuring Instruments.
(14)	M. A. Sattar Tarkari Bazar, Taluq Tandur, District Hyderabad	Weights, Measures and Weighing and Measuring Instruments.
(15)	Scales Adjusting Services, Topkhana Road, Opp. Osmangunj, Hyderabad.	Weights, Measures and Weighing and Measuring Instruments.
(16)	T. Suryanarayan Rao, Main Bazar, Mangalgiri, District Guntur.	Weights, Measures and Weighing and Measuring Instruments.

Repairers

Sl. No.	Name and Address of Repairer	Details of Articles Repaired
(1)	Bharat Scale Repairing Shop, Mandi Bazar, Warangal ..	Weights, Measures and Weighing and Measuring Instruments.
(2)	Burmah Shell, Co., Sarojini Devi Road, Secunderabad ..	Weights, Measures and Weighing and Measuring Instruments.
(3)	Deccan Scale Centre, Barkatpura, Hyderabad	Weights, Measures and Weighing and Measuring Instruments.
(4)	K. Krishnamurthy, General Merchant, Warangal	Weights, Measures and Weighing and Measuring Instruments.
(5)	M. Mahboob Ali, Sardar Road, Sadasivepet	Weights, Measures and Weighing and Measuring Instruments.
(6)	Majestic Metal Works, Gandhi Chowk, Nizamabad	Weights, Measures and Weighing and Measuring Instruments.
(7)	Pershad Scale Co., 15-5-393, Akbarja Bazar, Hyderabad Deccan.	Weights, Measures and Weighing and Measuring Instruments.
(8)	M. A. Sattar, Tarkari Bazar, Tandur, District Hyderabad	Weights, Measures and Weighing and Measuring Instruments.

BOMBAY (4)

In the March, July and September 1959 issues of *Metric Measures* lists of licensed manufacturers, dealers and repairers of weights and measures in Bombay State were published. The following is a list of manufacturers, dealers and repairers subsequently licensed by the Government of Bombay under the Bombay Weights and Measures (Enforcement) Act, 1958. Including this list, 22 manufacturers, 160 dealers and 52 repairers have been licensed in Bombay State.

Manufacturers

Sl. No.	Name and Address of Manufacturer	Details of Articles Manufactured
(1)	Asiatic Machinery Corporation, Pvt. Ltd., 10/1, Kailash Chandra Lane, Howrah.	Weighing Instruments.
(2)	Bharat National Foundry, Motia Khan, New Delhi	Weights.
(3)	Shri Krishna Company, 733, Shukrawar Peth, Poona 2 ..	
(4)	Luhar Mulji Naran, Manibhai Road, Savarkundla (Saurashtra).	Weighing Instruments.
(5)	Noble Scale Repairing Works, Gheekanta Road, Bhutni Ambli, Ahmedabad.	Weights.
(6)	Ravi Engineering Company, 81/1, Rajpur Road, Dehra Dun ..	Weighing Instruments.

Dealers

Sl. No.	Name and Address of Dealer	Details of Articles Sold
(1)	Abdulkadar Abdulhusen Rangwala, 1166, Bangudi Bazar, Pankornaka, Ahmedabad.	Weights.
(2)	Akbarali Abdulali Vadgumwala, Near Vohra Musafirkhana, Library Deesa, Dist. Sabarkantha.	Weights.
(3)	Akbarali Mohammedali, Gujri Bazar, Rajkot	Weights, Measures and Weighing Instruments.
(4)	Ambalal Shamaldas Shah, Pattaya Bazar, Kapadwanj, Dist. Kaira.	Weights, Measures and Weighing Instruments.
(5)	Anantrai Hirachand Doshi, Savarkundla	Weights, Measures and Weighing Instruments.
(6)	Associated Scales Industries, Station Road, Savarkundla ..	Weights, Measures and Weighing and Measuring Instruments.
(7)	Bansilal & Co., Main Road, Nasik City	Weights, Measures and Weighing Instruments.
(8)	B.A. Brothers, 176, Kazi Syed Street, Dhoble Building, Mandvi Koliwada.	Weights, Measures and Weighing Instruments.
(9)	Chandrakant Dada Lodage, Block No. 181, Jaysingpur, Gandhi Road, Jaysinghpur, Tal : Shirol, Dist. Kolhapur.	Weights, Measures and Weighing Instruments.
(10)	Chaturbhai N. Patel, Kandvav, Kapadwanj, Dist. Kaira ..	Weights, Measures and Weighing Instruments.
(11)	C & G Chokshi Haveli Street, Rajkot	Weights, Measures and Weighing and Measuring Instruments.
(12)	Continental Impex Co., 421, Himalaya House, 4th Floor, Palton Road, Bombay-1.	Weights, Measures and Weighing Instruments.
(13)	Damjibhai Narayanbhai Luhar, Manilal Chanilal's Madh, Kothariwala, Idar, District Sabarkantha.	Weights and Weighing Instruments.
(14)	Dinanath Rao, Dealer, Weights and Measures, Chowk Bazar, Nanded, Central Railway (Dist. Nanded).	Weights.
(15)	Gokuldas & Co., Shrirampur, Dist. Ahmednagar, At & Post Shrirampur.	Weights, Measures and Weighing Instruments.
(16)	Gold Star Engineering Co., Noble Chamber, 3rd Floor, 21-B, Parai Bazar Street, Fort, Bombay-1.	Weights, Measures and Weighing Instruments.
(17)	Haji Bane Khan Dawoodkhan, 2532, Mahatma Gandhi Road, Ahmedabad.	Weights, Measures and Weighing Instruments.
(18)	Ibrahim Abdul Kayum, Lokhand Bazar, Bhavnagar ..	Weights, Measures and Weighing Instruments.
(19)	Ishwarlal Gopalji Bhujwala, Panchnath Road, Rajkot ..	Weights, Measures and Weighing and Measuring Instruments.
(20)	Jaihind Iron Works, Bazar, Dehgam, Dist. Ahmedabad ..	Weights.
(21)	F. Jamaludeen & Bros., Vadgumwala, Bazar, New Dessa, Dist. Banaskantha.	Weights.

Dealers—*(contd.)*

o.	Name and Address of Dealer	Details of Articles Sold
2)	Jashbhai Chaturbhai Patel, Manordasni Khadki, Nadiad..	Weights and Weighing Instruments.
3)	Kamlesh Iron and Steel Works, Bharat Khand Cotton Mills, Compound, Naorda Road, Block No. 35/2, Ahmedabad-11.	Weights.
4)	Kantilal Bhogilal & Co., Near Kandvav, Kapadwanj ..	Weights, Measures and Weighing Instruments.
5)	Kurban Husain Lehari, 153, Bhavani Peth, Jalgaon, District East Khandesh.	Weights, Measures and Weighing Instruments.
6)	Laxmanbhai Purushottamdas & Co., Lal Darwaja, Visnagar..	C.I. Weights and Weighing Instruments.
7)	D. S. Luhar & Bros. Co., Opp. Padsha Pole, Relief Road, Ahmedabad.	Weights and Weighing Instruments.
8)	Madha Manji & Co., Savarkundla	Weights and Measures and Weighing and Measuring Instruments.
9)	Maganlal Amtharam Patel, 1177, Pankornaka, Ahmedabad-1	Weights.
30)	V. K. Makwana & Co., BH 207, Nava Bazar, Baroda.. ..	Weights, Measures and Weighing Instruments.
31)	H. S. Maner, 1642, C. Shivajee Road, Kolhapur	Weights, Measures and Weighing Instruments.
32)	Mechanical Supplying Syndicate, Panchal Blocks, Gheekanta Road, Ahmedabad.	Weights.
(33)	Mistri Jivraj Karsanji and Bros., Hathibhai Street, Savarkundla.	Weighing Instruments.
(34)	Motabhai Alibhai & Co., Lokhand Bazar, Viramgam, District Ahmedabad.	Weights.
(35)	Muzfer Stores, Hardware Merchants, District S. Satara ..	Weights, Measures and Weighing Instruments.
(36)	Nandlal Damodardas Mistry, Near River Bank Parma, Botad	Weights, Measures and Weighing Instruments.
(37)	Narandas Ranchhoddas Patel, Pankornaka, Ahmedabad-1.	Weights.
(38)	National Metal and Measures Stores, 2760, Pankornaka, Ahmedabad-1.	Weights.
(39)	Natvarlal L. Kanthawala, Prop: Bhagodaya Scale, Repairing Works, K—3, 1093/66, Piramshah Roja, Near Regal Cinema, Ahmedabad-1	Weights.
(40)	Pandurang Workshop, 1309, Tanga Stand, Pandharpur	Weights, Measures, Weighing Instruments.
(41)	I. G. Patel, 1147/1, Pankernaka, Ahmedabad-1	Weights.
(42)	M. K. Patel & Co., 1169/1, Pankornaka, Ahmedabad-1 ..	Weights.
(43)	Patel Kachrabhai Mohanlal, 1169/1, Pankornaka, Ahmedabad	Weights.
(44)	Popatlal Laxmichand Doshi, Vadali, A.P. Railway, District Sabarkantha.	Weights.

Dealers—*(contd.)*

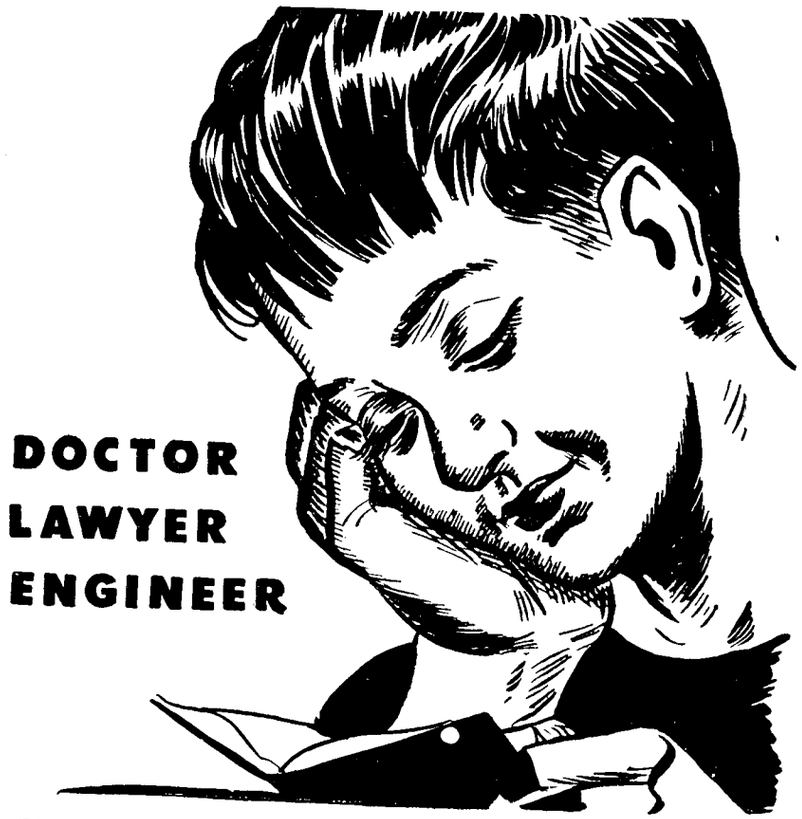
Sl. No.	Name and Address of Dealer	Details of Articles Sold
(45)	Pratapmal Sampatlal, Loha Bazar, Pandit Nehru Road, Jalna	Weights, Measures, and Weighing Instruments.
(46)	Ramanlal Keshavlal Shah, Juna Bazar, Idar, Dist. Sabarkantha	Weights.
(47)	Safuddin Rajabali, Bazar, Dehgam, (A.P. Railway)	Weights and Weighing Instruments.
(48)	H. G. Sakriwala & Sons, Bazar Peth, Sakri, Dist. West Khandesh.	Weights, Measures and Weighing Instruments.
(49)	Salebhai Abdulhusen Lokhandwala, 3749, Pankornaka, Ahmedabad-1	Weights.
(50)	A. Salehbhai & Co., Outside Golwadi Gate, Viramgam, Dist. Ahmedabad.	Weights.
(51)	Shah Bhogilal Pevchand, New Vasant Market, Manak Chowk, Ahmedabad-1	Weights and Weighing Instruments.
(52)	Shah Moulding Works, Sir Chinubhai Baronate Compound, Shahpur, Ahmedabad.	Weights.
(53)	Shankerlal Shivlal Thakkar, Near Office of the Jr. I.I. Talod Dn. Talod.	Weights.
(54)	Sheth Haji Usmanbhai Ahmedbhai, Juna Bazar, Himatnagar	Weights.
(55)	Shirde Stores, Kopergaon, Shivaji Road, At & Post Kopergaon, Dist. Ahmednagar.	Weights, Measures and Weighing Instruments.
(56)	Tarmohamad Ibrahim Memon, Kansara Bazar, Petlad	Weights, Measures and Weighing Instruments.
(57)	Umedram Ranchhoddas Patel, 1167, Pankurenaka, Ahmedabad	Weights.
(58)	Usmanbhai & Jamalbhai Vadnagri, Azad Chowk, Juna Bazar, Himatnagar, Dist. Sabarkantha.	Weights.
(59)	Vishwanath G. Sable & Co., No. 21, Somwar Peth, Malegaon, Dist. Nasik.	Weights, Measures and Weighing Instruments.
(60)	Vithaldas Venichand Panchal, At-Post-Dehgam, Station Road Dist. Ahmedabad.	Weights & Weighing Instruments.

Repairers

Sl. No.	Name and Address of Repairers	Details of Articles repaired
(1)	D. H. Baganikar, Karal Chowki, Namdeo Mandir, Sangli	Weights, Measures & Weighing Instruments.
(2)	Bansilal & Co., Main Road, Nasik	Weights, Measures and Weighing Instruments.
(3)	Bharat Scale Repairing Works, Khargate, Bhavnagar	Weights, Measures and Weighing Instruments.

Repairers *(contd.)*

Sl. No.	Name and Address of Repairers	Details of Articles repaired
(4)	Chaturbhai N. Patel, Kandvav, Kapadwanj, Dist. Kaira	Weights, Measures and Weighing Instruments.
(5)	Durlabhji Devshi & Bros., Gujri Bazar, Rajkot	Weights, Measures and Weighing Instruments.
(6)	B. T Ghatge, Hattimahal Road, Medhe Bldg., Kolhapur	Weights, Measures and Weighing Instruments.
(7)	Gold Star Engineering Co., Sherir Baug, 'L' Block, Shop No. 10, Babula Tank Road, Opp. J.J. Hospital, Gate No. 5, Bombay-9	Weights, Measures and Weighing Instruments.
(8)	Hassanali Amiji & Bros., Gujri Bazar, Rajkot	Weights, Measures and Weighing Instruments.
(9)	Ishwerlal Gopalji Bhujwala, Panchnath Road, Rajkot	Weights, Measures and Weighing Instruments.
(10)	M. G. Kotekar, Somwar Peth, Hattimahal Road, 'C' Ward, Kolhapur.	Weights, Measures and Weighing Instruments.
(11)	D. S. Luhar & Bros. & Co., Opp. Padsha Pole, Relief Road, Allahabad.	Weights.
(12)	V. K. Makwana & Co., Nava Bazar, Baroda	Weights, Measures and Weighing Instruments.
(13)	Moolji Lakshmidas & Co., 350, Samuel Street, Bombay-3	Weights, Measures and Weighing Instruments.
(14)	National Scale Co., Gokuldas Pasta Road, Dadar, Bombay-14	Weights, Measures and Weighing Instruments.
(15)	Natverlal L. Kantawala, K-3, 1093/Piramshah Roja, Near Royal Cinema, Ahmedabad-1.	Weights.
(16)	Ostwal Brothers, 134, Vakhar Bhag, Sangli	Weights, Measures and Weighing Instruments.
(17)	Pandurang Workshop, 1309, Tanga Stand, Pandharpur	Weights, Measures and Weighing Instruments.
(18)	J. M. Parbatani Kantawalla, 3, Gokuldas Pasta Road, Dadar, Bombay-14.	Weights, Measures and Weighing Instruments.
(19)	H. Z. Parbatani, Kantawalla, Gokuldas Pasta Road, Dadar, Bombay-14.	Weights, Measures and Weighing Instruments.
(20)	G. H. Samel & Co., 162, Hill Road, Bandra, Bombay-20 ..	Weights, Measures and Weighing Instruments.
(21)	Shankerlal Shivlal Thakkar, Near the Office of the Jr. Inds. Insp. Talod Dn., Talod.	Weights.



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