

STANDARDS TO FACILITATE METRIC CHANGEOVER IN THE ENGINEERING INDUSTRY IN SRI LANKA-Part I

Rasa Rajeswaran

1.00 The Metric System of Weights and Measures is simple, has many inherent advantages, and is used by many countries with which Sri Lanka has trade relations. In view of these advantages and the overall benefit to the country, the Government of Sri Lanka decided on the adoption of the 'Metric System' in 1970. A detailed programme for the conversion and implementation of the 'Metric System' was prepared in 1972 by the 'National Metrication Board' which was set up for this purpose. To ensure the success of metric conversion in the different sectors and to co-ordinate and execute the national metrication programme through close collaboration with Industry and trade, it became necessary for the Government, to set up the "National Metric Conversion Authority" by an Act of Parliament invested with the requisite statutory powers. The legal enforcement of the Weights and Measures Ordinance in Sri Lanka is however, with the "Weights and Measures Division" of the Department of Commerce. Hence this Division plays the major role in the implementation of the metrication programme of Sri Lanka.

The Bureau of Ceylon Standards works very closely with the metrication programme of Sri Lanka and has been entrusted with the responsibility to facilitate the changeover to Metric, by furnishing Industry and Commerce with all the necessary Metric Standards in accordance with the planned programme of changeover. The International System of Units (SI) which is accepted as the Simplified Metric System is a refinement of the traditional metric system. This system which is accepted in Sri Lanka as the Metric System has six basic and two supplementary units and a large number of derived units for use in all fields of science, technology and commerce. This system is simply the rationalized metre-kilogram-second-ampere system, expanded by the addition of kelvin and the candela as basic units, to include units used in heat and photometry.

2.00 The planning of the changeover to this system is a difficult task as it is very necessary to see that the changeover does not affect adversely the national economy. The metric changeover in the engineering industry however is very complex because it involves a complete changeover in design, production and organizational practices. In formulating the necessary Sri Lanka Standards for such a changeover and while metricating the existing national standards, it became necessary to study a whole range of interlinked and interwoven problems. The pattern of the existing overseas trade, the availability of metric components, tools, wearing out of existing components and tools, market strategy, the life cycle of the present production range are some of the important parameters, which needed consideration.

2.10 It also became necessary to rationalize and standardise, based on internationally accepted practice. Advantage was also taken while metricating to effect through international standardisation, a reduction on the

number of product sizes, conservation of materials and an improvement of product quality, by incorporating modern concepts of science and technology. Importance was attached to aligning the National Standards with the standards formulated by the International Standards Organisation and International Electro-Technical Commission. As any non-standard and unco-ordinated approach can lead to confusion, disharmony and considerable national loss, the following basic standards were issued by the Bureau, as a guide to facilitate rationalization and smooth switchover.

- (a) CS 83 - 1969 "Rules for the Use of Units of the International System of Units, and Selection of the Decimal Multiples and Sub-Multiples of the S.I. Units."
- (b) CS 99 - 1970 "Conversion Factors and Tables".
- (c) CS 102 - 1971 "Presentation of Numerical Values".
- (d) CS 116 - 1971 "Principles of Conversion".
- (e) CS 103 - 1971 "Preferred Numbers".
- (f) "Guide to the Use of the International System of Units".

In accordance with the above Sri Lanka Standards in specifying metric values, the following steps of conversion need recognition.

- (i) interchangeable conversion from non-metric to metric values.
- (ii) rounding off values converted from non-metric to metric values.
- (iii) adoption of rationalised metric values.

The rationalized value, thus selected should also satisfy one or more of the following conditions, which satisfy its rationality.

- (a) Whether the value is one of the preferred values, in accordance with CS 103 - 1971 "Preferred Numbers" and conforms to internationally accepted standards.
- (b) Whether it is dimensionally co-related with its components sub-assemblies with which it should fit and be interchangeable.

The following basic requirements should also be kept in mind and the above standards could be used to decide on the appropriate steps to be taken up depending on a particular case in question. Eg.—

- (i) interchangeability.
- (ii) limits and fits in case of assembly components eg. fasteners, lampholds, plugs and sockets, fittings, etc.
- (iii) implications of re-design on production.
- (iv) consideration of related and interdependent industries.

2.20 The other basic standards issued by the Bureau to facilitate the metric changeover with regards to basic units and quantities are as given below:—

- (a) CS 84-1971 "Ceylon Standard on Basic Quantities and Units of S.I."
- Part 1 "Basic Quantities and Units of the S.I. and Quantities and Units of Space and Time".
- Part 2 "Quantities and Units of Periodic and Related Phenomena".
- Part 3 "Quantities and Units of Machines".
- Part 4 "Quantities and Units of Heat".
- Part 5 "Quantities and Units of Electricity and Magnetism".
- Part 6 "Quantities and Units of Acoustics".

A practical approach to industrial problems was kept in mind while formulating Sri Lanka Standards and metrizing the existing standards. The following are worthwhile mentioning; the transitional nature of the problems of the changeover; the limitation of the useful life of manufacturing tools and dies and equipment, the provision for the period of changeover based on obsolescence of the tools and equipment.

3.00 Weights and Measures

The reference standards for weights and measures in Sri Lanka, are maintained at the "Weights and Measures Division" of the Department of Commerce. However, as the Bureau had already established the necessary network for the preparation of national standard specifications to meet the requirements of the industry, the Bureau was also entrusted with the task of formulating standards for commercial weights and measures. The Standard under preparation will conform to the recommendations of the International Organisation for Legal Metrology (OILM), the intergovernmental organisation set up under a convention to evolve international laws and practices in standardisation and enforcement of weights and measures. The OILM convention prescribes that these international standards should be uniformly adopted by the participating countries thus facilitating international trade and unifying weights and measures practices in the country concerned.

3.10 The Bureau Drafting Committee on metric weights

(a) Cast iron and brass (b) for pharmaceutical trade (c) for use in Ayurveda and (d) laboratory weights, is at the final stages of formulating the standard for cast iron weights. While formulating the standard for this item, it became necessary to introduce a new design so that there will not be any confusion with the old ones. It was decided to accept the hexagonal shape for cast-iron weights as there were weights in round, square and other shapes. Many metric countries were also using the hexagonal shape for iron weights. It is intended to make provision for two series: non-bullion weights in the case of brass weights.

In all the above standards, provision is to be made for a loading hole filled with lead, to adjust the weights within the tolerance limits and also to take the stamp of the inspecting authority. This provision will also allow for any readjustment due to wear and tear and re-certifying, if necessary. The possibility of building up, any weight with the denominations in steps of 10 was considered and accepted as the basis for the series. The 1,2,2,5 which is internationally used, was accepted for this purpose.

3.11 The beam scale can be considered to be the most popular and accurate instrument amongst the many weighing machines. The Sri Lanka Standard under preparation is intended to cover 4 classes; class A: for precision weighing; class B: for weighing precious stones, jewels, drugs, perfumes etc; class C: for spices, tea, cereals and allied commodities; while class D: is for weighing relatively cheaper materials like wood, scrap iron etc.

The Sri Lanka standard specification for beam scales, which is under preparation, is also intended to cover in addition to certain basic loading dimensions and design requirements, the sensitivities and the maximum and permissible errors. In the case of instruments like beam scales counter machines, it is possible to use these machines with an indication of capacity in terms of the metric system. Re-calibration could be carried out in the case of platform machines and weighbridges.

The other similar items for which Sri Lanka Standards may become necessary are 'gas', 'water' and 'electric meters', 'spring balances', 'dispensing pumps', 'taximeters', 'clinical thermometers' and 'automatic weighing machines'.

3.12 While considering the linear measuring and land measuring instruments, attention should be drawn to the following Sri Lanka Standards:

- (a) CS 194-1973 "Rulers for General Purposes".
- (b) CS 227-1973 "Standard for Graduation of Levelling Staves".

It will also soon become necessary to formulate standards for 'half metre and one metre measures for retail cloth trade', 'steel tape measures' and 'metric surveying chains', metric scales for general and architectural purposes.

3.13 With a view to rationalising and standardising capacity measures, the Bureau is presently formulating a number of standards for liquid measures eg. the 'conical type', 'dipping type' and the 'pouring type'. These measures are usually meant for dispensing items like kerosene oil, coconut oil, milk etc. Some of the standards which are under preparation in this respect are:

- (a) "volume measures for commercial use".
- (b) "glass medicinal containers".
- (c) "metric measuring cups and spoons and standard measure for domestic use".

Rasa Rajeswaran

Graduated in Mechanical Engineering, University of Ceylon 1962 with 1st Class Honours.

Diploma in Technical Science— } on a Commonwealth
Production Engineering } Scholarship at the University of Manchester (U.M.I.S.T.).

M.Sc. Machine Tool Engineering) 1963 - 1965

Postgraduate practical training in) in the UK on a C.B.I.
Production Engineering) Scholarship 1965 - 1966.

Worked as Design Engineer in the Machine Tool Industry in the U.K. and then as a consultant in Production Engineering before joining the Bureau in February 1971 as the Assistant Director (Standardisation) in charge of all standardisation activities of the Bureau of Ceylon Standards.

3.14 While formulating Sri Lanka Standards for 'bottles and glassware' used for packing by volume, it became necessary to consider the following practical problems which may be encountered in implementation:

- (a) limitations of the machines used in the packaging industry without intensive replacement of parts to accommodate changes in the dimensions of the container.
- (b) the current life of the moulds.

In the case of bottle and glassware the following standards have now been issued by the Bureau.

- (a) CS 228 - 1973 "Ceylon Standard Specification for Glass Bottles with Crown Finish (650 ml. to 325 ml.)".
- (b) CS 290 - 1974 "Ceylon Standard Specification for Glass Liquor Bottles".
- (c) CS 291 - 1974 "Ceylon Standard Specification for Glass Bottles for Aerated Waters".
- (d) CS 222 - 1973 "Ceylon Standard Specification for Pasteurised Milk and Sterilised Milk".
- (e) CS 193 - 1973 "Round Tins for Paints, Varnishes and Allied Products (Packed by Volume)".

The Standards which are still under preparation are as follows:—

- (a) "Sri Lanka Standard Specification for glass containers for jams (jam jars)".
- (b) "Sri Lanka Standard Specification for cordials and fruit syrups".
- (c) "Sri Lanka Standard Glass containers for agrochemicals".
- (d) "Sri Lanka Standard Specification for tin containers for jams and fruits".

4.00 The Mechanical Engineering Industry

In the mechanical engineering industry there are components, sub-assemblies, including fasteners, bearings and manufactured tolerances which are all unequalled in any industry. The following are just to mention some common items: screw threads, drilled and tapped holes, slots, tapers, key and keyways, splines and serrations, wire gauges, tubes, pipes, sheet metal and bar stock.

Metric production problems could be tackled by proper planning in many ways but the vertical and or horizontal policies stand out depending on the pattern of change suitable in a particular factory. Thus while metricating the existing standards and formulating fresh standards, the opportunity to sort out and rationalize the operations of industries individually and collectively had to be taken into consideration. The following basic Sri Lanka standards in connection with screw threads, tolerances and limits and fits have been issued, based on the relevant I.S.O. recommendations.

- (a) CS 268 - 1974 "The Ceylon Standard Specification for ISO Metric Screw Threads".
Part 1—Basic and Design Profiles.
Part 2—Pitch/Diameters Combinations.
Part 3—Basic Dimensions.
Part 4—Tolerancing System.
Part 5—Tolerances.
Part 6—Limits of Sizes for Commercial Bolts and Nuts.

- (b) CS 279 - 1974 "The Ceylon Standard General Requirements and Technical Supply Conditions for Bolts, Screws and Nuts".
- (c) CS - 1977 "The Ceylon Standard Specification for Machine Screws".
- (d) CS - 1977 "Sri Lanka Specification for Hexagon Bolts, Screws and Nuts (Commercial Grade)".
- (e) CS 238 - 1973 "Ceylon Standard Specification for Metal Washers for General Engineering Purposes".
- (f) CS 239 - 1973 "Ceylon Standard Specification for Steel Spring Washers for General Engineering Purposes".
- (g) CS 15 - 1968 "Ceylon Standard Specification for Mild Steel for General Engineering Purposes".
- (h) CS 110 - 1971 "Ceylon Standard Specification for Thickness of Sheets and Diameters of Wires".
- (i) CS 96 - 1970 "Ceylon Standard Specification for Dimensions of Parallel Coarse Screw Thread of Withworth Form".
- (j) CS 97 - 1970 "Ceylon Standard Specification for Mild Steel Hexagon and Square Black Bolts, Screws and Nuts with Withworth Threads".

Sri Lanka standards for other basic items like 'keys and keyways', 'shaft holes', 'shaftends', 'split cotton pins', 'dowel pins' etc. are also under preparation.

4.10 In the field of design and development, it is estimated that ten percent of savings could be made on design time, due to ease of handling the units and potential savings from variety reduction and alignment to international standards. Care is taken to prepare dual standards during the transition period so that the design drawings could be dual dimensioned and all such measuring devices like inspection gauges, testing instruments etc. dual calibrated.

The following codes of practices for the drawing office have been laid down to facilitate the use of the metric system.

- (a) CS 408² - 1976 "Ceylon Standard Code of Practice for Engineering Drawing".
- (b) CS - "Ceylon Standard Specification for Architectural and Building Drawing".
- (c) CS 157 - 1972 "Ceylon Standard Specification for Drawing Boards".
- (d) CS 158 - 1972 "Ceylon Standard Specification for Tee Squares".
- (e) CS - 1977 "Ceylon Standard Specification for Drawing Sheets".

4.20 The metric values specified in the above standards will provide the necessary information for a smooth transfer to the metric system. It will also soon become necessary to formulate Sri Lanka Standard Specifications for measuring instruments, like 'steel rules', 'vernier calipers', 'micrometers (inside and outside)', 'dial test indicators', 'feeler gauges', 'vernier micrometer depth and height gauges', 'plug and ring gauges of plane and screwed types' and 'radius gauges'. In the case of machine tools the parts which are most likely to require conversion are, those required by the operator to obtain fine adjustment of the position of the cutting tool or workpiece, such as feed screw and dials, vernier scales, optical position indicators or digital read-out for those parts which are used for coarse adjustments and finally those which provide or indicate the rate of movement.

(To be continued)

