STANDARDIZATION TO-DAY AND TO-MORROW

by

COMMANDER (E) J. B. ALDRED, R.N.

First of all the author would like to give his interpretation of three words most commonly used in connection with this subject, viz. harmonization, rationalization and standardization.

Harmonization

Is the agreement on the objectives or, as the Services say, the " Staff Requirement ", which must be decided before detailed consideration can begin, e.g. recently it was desired to produce a standard for milk churns. Before laying

down thicknesses of metal, method of tinning and other details, agreement had to be obtained on whether a heavy milk churn with a long life was required or a light one with a short life, or a compromise ; whether one man should be capable of lifting it and whether it was to travel in a pony trap, or only by lorry and railway van.

Rationalization

In earlier times this was called simplification, and the author prefers the word, but rationalize, which the dictionary defines as " bringing into conformity with reason ", is now in common use. Rationalization generally occurs between harmonization and standardization, because it is not often that a standard is called for until there are a number of varieties of an article in the market. One of its objectives is the reduction of a range of articles to the minimum that will cover the requirement. This number then forms the rationalized list.

Standardization

Refers to the setting up of a standard. The standard may cover :—

A Function—meaning that it refers to tests or other methods of checking fitness for purpose. For instance, children's toy balls must bounce, but not split, be poisonous, or inflammable.

A Dimension—meaning that it lists a range of sizes. Those sizes and weights will normally be toleranced and follow some curve or progression. For instance, B.S.21—Pipe Threads gives basic sizes and tolerances. It is not necessary to specify a functioning test, as experience has proved that threads with these tolerances will screw together satisfactorily. In an existing but antiquated Admiralty specification the phrase " Nuts and bolts to fit together hand tight " was discovered. This is a relic of the days before tolerancing and gauging and is, in fact, a functional standard where a dimensional one is now used.

A Practice—meaning that it lays down a good method that should be followed by all to achieve the benefits of standardization. Drawing practice is an example of this. The Packaging Code is another.

A Terminology—meaning that it lays down the standard terms, probably with definitions, that should be used in technical correspondence, drawings, etc., on that particular subject.

Common misunderstandings about the effects of standardization

The rule of the road is a standard. One surrenders the right to drive absolutely freely in order to progress more rapidly and safely.

Standardization is sometimes regarded as leading to a drab sameness and identified with austerity and utility clothes. Anything can be carried to extremes, whether it is efficiency or the flat earth theory, but the benefits of reasonably applied standardization are so great that in many spheres all would regard the reduction of an infinite choice of sizes and shapes to a logical range as desirable rather than regrettable.

If those who object to standardization paused to think in what fields it is every day serving an essential purpose, many of their fears would be allayed. How many people want their wireless sets full of components so special that only one manufacturer can supply them ? Who would wish to search high and low for a battery to fit their torch ? Yet in the early days of industrialization special parts were frequently deliberately made in order that one firm only could provide them.

EXTRACT FROM A COMMISSION BY CHARLES I ON THE SUBJECT OF ARMS AND ARMOUR

JUNE, 1631

ORDERS IN REGARD TO PATTERNS.

PATENT ROLLS (CHANCERY) T CHARLES I. PART 20 (C66/2579)

TRANSCRIPT

And because we are credibly given to understand that the often and continuall altering and changing of the fashion of armes and armours, some countrys and parts of the Kingdome having armours of one fashion, and some of another, do put many of our subjects to a great and unnecessary charge, and more than need requireth ; for the avoiding whereof, our will and pleasure is, and wee doe hereby appoint and command, that hereafter there shall be but one uniform fashion of armours of the said common and trayned bands throughout our said Kingdome of England and domynion of Wales, when as any of the said armours shall be supplied and new made, and that that form and fashion of armour shall be agreeable to the last and modern fashion lately set downe and appoynted to be used by the lords and others of our Councel of Warre (the patterns whereof are now and shall remayn in the office of our ordinance from tyme to tyme, which is our pleasure likewise concerning gunnes, pikes and bandaliers whereof patterns are and shall remayn from tyme to tyme in our said office).

HISTORY OF STANDARDIZATION TO 1790

One of the earliest standards to be widely accepted was time. A waterclock of 1540 B C. has come down from Karnak, in Egypt. Sundials were in use as early as the third century B.C., and several were discovered at Pompeii. There were even portable models for the use of travellers. Candle-clocks with hourly and half-hourly rings were used in England in pre-Norman times. The hour-glass that used to mark the length of the family chaplain's sermon has survived as the modern egg-timer.

Calendars have been in use from the earliest times, such great Empires as the Chinese, the Chaldeans, and the Aztecs having tried to spread their own version. The Julian Calendar, first under the Empire and then the Papacy, has remained substantially unaltered to the present day.

In this connection an early example of delay in standardization and of the resistance to it occurred in the eighteenth century, when the errors which had crept into the Julian Calendar, and which Gregory XIII corrected in 1582, were at long last introduced into England in 1752 and led to rioting, with the slogan " Give us back our eleven days ". No doubt a standardization of British measures would lead to a similar scene with the cry : " Give us back our rod, pole or perch ".

Coinage

Another type of standard with a wide acceptance was coinage, especially gold. All the early civilizations had their systems of minting. The widest circulation was probably the Roman gold *aureus*, which superseded the copper *libra*, of which numerous examples, with every Emperor's stamp, are found in England.

The British pound, which diplomats, soldiers and " English milords " spread through Europe, and traders throughout the world, was the next really widely accepted standard since the *aureus*.

Roads

Another type of standard was the Roman road, with the same approximate construction, width and principle all over the Empire. The *routes nationales* of the French Empire fall into the same category at a later date.

Measures

Various measures achieved a degree of standardization at an early date. These include the Roman *mille passus*, the English cloth yard (both for material and the arrowshaft), the barrel and the pint.

Heraldry

The standard metals, colours and devices of heraldry were common throughout the mediaeval world. This led to a celebrated example of standardization being carried too far, when it was discovered just before the battle of Poitiers that Lord Clermont on the French side and Sir John Chandos on the English were bearing the same devices. Sir John settled both the difficulty and Lord Clermont with a stroke of the sword. Heraldry's poor relation, inn and shop signs—the bush, the black and white checks, the pestle and mortar, the barber's pole, the pawnbroker's three balls were to be found in all parts of Europe.

Hallmarks

The hallmarking of silver and gold, which started in this country in 1300, was one of the earliest standards to have Governmental support.

Thus, although broadly speaking industrial standardization did not exist because it was not required, our ancestors had standards for what they considered necessary. One failure to standardize, which must have been most annoying, must be remarked on—that of candles and candlesticks. This was not settled till the 1830s.

THE INDUSTRIAL REVOLUTION—1790 to 1890

The history of standards is closely connected with that of the Industrial Revolution. The period from 1692 to 1890 was one of slowly increasing mechanization. How slow, one can judge from the writings of the period. Early ones, such as Defoe's *Moll Flanders* (1722), etc., do not mention mechanization at all, while Bronte's *Shirley* (1817) revolves about the introduction of machinery and the workers' blind resistance to it, and *John Halifax Gentleman* (1857) contains the episode where the machinations of the wicked nobleman in cutting off the water power are defeated by the introduction of an engine, despite the attacks of the machine breakers (or Luddites).

During the period being discussed, the beginning took place of the production of machinery and machine tools in various centres, Lancashire, Glasgow, Cornwall, each with its own set of standards. It can readily be seen, therefore, that, when a degree of interchangeability was required such as between a nut

and bolt, formidable difficulties arose and an immense amount of special manufacture and fitting was required. To take an example, suppose a thread stripped on some Cornish tin mine pumping engine, no one within fifty miles would be able to cut a thread, let alone one to match the mating part. The damaged component would have to be removed and sent by cart to the maker, who would produce a new part, cut a new thread and fit by hand till satisfactory.

Such a state of affairs with each widely separate manufacturer working to his own rough and ready standards continued till about 1841, when Sir Joseph Whitworth, F.R.S., wrote a series of papers and proposed certain standards for plane surfaces, screw threads, wire and sheet thickness (as well as mentioning candlesticks and holders). These were accepted by the Board of Trade and most of them are still in use. Despite his logical and understandable system there still are in this country :—

Standard Wire Gauge.
Birmingham Wire Gauge.
Whitworth Decimal Wire and Plate Gauge.
Birmingham Plate Gauge.
Lancashire Gauge.
Sheet and Hoop Iron Standard.
Various tinplate Gauges.

Some 10 years after Whitworth had produced his standard thread in Britain, Sellars put forward a different one in the U.S. His was a 60 degree thread, while Whitworth's was 55 degree. The difficulties caused by this have probably been experienced by all engineers and the author is glad to have had a very small share in the recent agreement which will gradually overcome this.

A Government Standard

The middle of the nineteenth century saw a notable example of Government action to set up a standard. This was a Government Commission to decide the gauge to be used on the various independent railways springing up all over the country. The width chosen became universal in England and Europe, (except Russia), but while this was a great convenience it has been said that the wider gauge would have allowed greater speeds to-day.

HISTORY FROM 1890 TO PRESENT DAY

In 1895 Mr. Skelton, a well-known iron merchant, wrote to *The Times* pointing out the wastefulness of each architect specifying different cross-sections of iron beams. This led in 1901 to the setting up of an Engineering Standards Committee whose investigation into the varieties of beams led to their reduction from 175 to 113 types. Wheels for colliery tubs were next rationalized from 3,000 to 17 and in 1918 the Engineering Standards Committee became the British Engineering Standards Association.

A Royal Charter was issued in 1929 and in 1931 this title was changed to British Standards Institution and a small Government grant was made. Throughout the years, however, the Institution has been primarily supported by the subscriptions of industry and the scale of its publications, as well as the devoted but unpaid work of a large number of experts on its many committees.

Events in the U.S.A.

In the U.S.A. the course of events has been slightly different. In 1918 the American Society of Mechanical Engineers (A.S.M.E.) and the Society of Automotive Engineers (S.A.E.), which had grown up out of their respective

fields, combined to sponsor the American Engineering Standards Committee, now the American Standards Association (A.S.A.). This, while comparable in many ways to the B.S.I., has no official Government backing and is naturally dependent on its patrons and the industries they represent.

The Governmental body is the Federal Bureau of Standards, whose function is similar to that which in Great Britain would be performed by a combination of the National Physical Laboratory and the British Services' Engineering Standards Co-ordinating Committee.

There are also many powerful bodies with their own standards, such as the American Society for Testing Materials (A.S.T.M.) and the American Petroleum Institute (A.P.I.).

International Exchanges on Standardization

In recent years a large number of countries have realized the value of a standards organization and there are now some twenty-five national associations in correspondence with the B.S.I., whose library contains 30,000 overseas standards.

International Standards Association

These national bodies formed the International Standards Association, which published a number of standards prior to 1939, such as the I.S.A. Limits and Fits.

International Organization for Standardization

The 1939-45 war led to the setting up of a United Nations Standards Co-ordinating Committee in 1943. Then in October, 1946 the International Organization for Standardization (I.S.O.) replaced the I.S.A. The various subjects to which the I.S.O. has given priority are made the responsibility of different countries, the secretaryship of each subject being given to an interested nation. Screw threads are the responsibility of Sweden and an eminent Swedish engineer has therefore put forward a proposal to bridge the gap between " threads per inch " and metric pitches by means of a number system, as in the B.A. and U.S. small sizes, rather than specifically by diameter and thread per inch.

STANDARDIZATION TO-DAY—THE B.S.I. ORGANIZATION

Standardization in England centres round the B.S.I. so that a description of its organization and working is the best introduction to the present position.

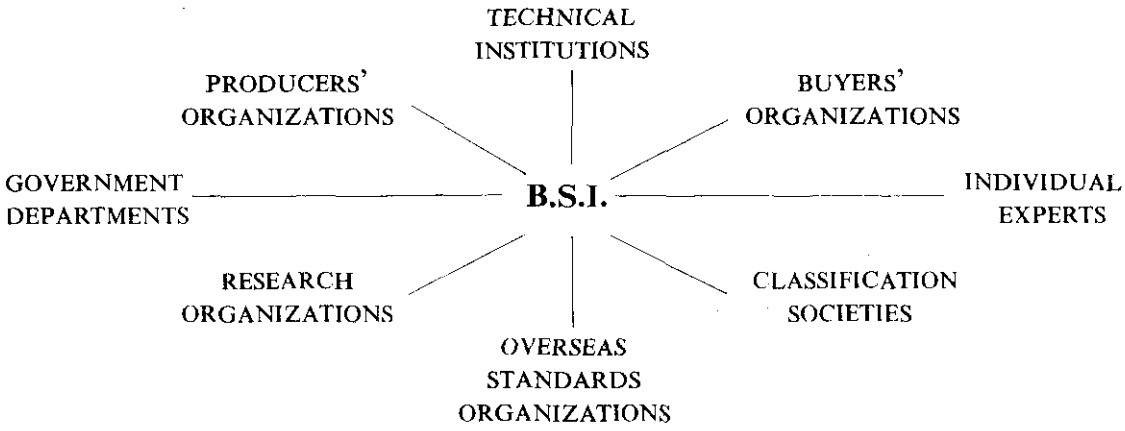
The organization of the B.S.I. to-day is based on its Council, sub-committees and panels of which there are more than 1,400 covering the major industries. In most cases all the work except the secretarial is done voluntarily by representatives from industry. The staff of the B.S.I. has no executive power and is purely co-ordinating.

These sub-committees, which form the base of the tree shown on page 413, are grouped under fifty industry committees, while they in turn are placed under divisional councils, of which there are five, building, chemical, engineering, textile and special.

The General Council, consisting of elected and nominated representatives of the professional institutions, industrial and trade associations and government departments, supervises the whole work. It will be noted that, as with financial support, the Government's share is a small one, and that the B.S.I. is truly representative of industry. This is shown diagrammatically on page 413.

GENERAL COUNCIL

Divisional Councils	Building	Chemical	Engineering	Textile	Special
Industry committees ...	9	18	18	5	
Technical committees, sub-committees and panels	183	193	938	5	330

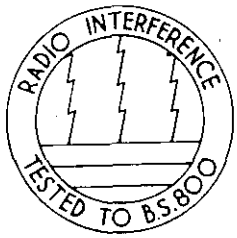


British Standards Institution Contacts

The B.S.I. also has many foreign connections, and, in its Monthly Information Sheets, the B.S.I. lists all the major standards received from overseas, which are then placed in the library, where they are available to all subscribers.

To attempt listing all B.S.I. standards here is impractical, as the 1947 Year Book shows some 1,400 ranging from measurement to nomenclature, and wireless components to womens' underclothes.

The procedure for preparing and issuing a standard is briefly as follows. Some manufacturer, user, technical institution, or Government body, proposes to the B.S.I. that a standard is desirable. If the B.S.I., by suitable enquiry, is satisfied that a need exists, a sub-committee representative of all affected parties is set up to investigate the possibility of preparing a standard, and, if agreement is reached, proceeds to prepare a draft. The draft is circulated throughout industry, Government bodies, etc. and comments are received. If they are generally favourable, their points of criticism are considered by the sub-committee, and a standard produced, which is then considered in turn by the Technical Committee and the Divisional Council, before issue as a British Standard.



British Standards Institution Marks

These marks can be seen on items as varied as galvanized pipe T-pieces and motor car safety glass.

They serve as a visual guarantee to the buyer, because they mean that an independent body has confirmed that the manufacturer operates a satisfactory system of control of production. The B.S.I. also has the right to check samples at the place of manufacture or in the open market.

The right to mark items in alliance with a firm's own trade mark, is an individual arrangement between the firm and the B.S.I.

Standards in Industrial Concerns

Large industrial concerns employ considerable staffs solely on standardization. These staffs maintain Standards Books which contain details of all permissible standardized items, e.g. one sheet will list all allowed angle iron sections ; another sheet will include all the sizes of washers which designers are authorized to include in a plant. All these standards items are maintained in store or are readily available, and in this way stocks are kept to a minimum number of varieties, and accounting simplified.

A standard list is made mandatory only after circulating a draft to all departments and obtaining their views, and the final standard is approved by a committee composed of representatives of all divisions.

In such concerns, every item that the firm uses is covered by a standard, from gloves to grommets, and a procedure is laid down for the H.Q. standards section to be consulted when it is desired to add a new item or create a special.

The fact that big firms spend money in this way is a fair indication that they find it is a paying proposition and the moral should be drawn by the nation as a whole.

Standards in the Services

The supply sides of all three Services have their Standards Organizations, one extending back four or five years, the others being more recent. These organizations are building up their books of standards, based on B.S.I. publications where possible. These latter are frequently suitable as Service Departments often take part in the work of B.S.I. sub-committees preparing standards.

Where, owing to their specialized requirements, B.S.I. Standards are not suitable or do not exist, three linked inter-Service Standardization Committees produce their own standards for Service use. These committees have B.S.I. representatives.

Where a requirement is peculiar to one Service, or that Service is a major user, it will develop its own standard.

Much of the work of the Service Standards Organizations is rationalizing their existing multiplicity of items, but it is rarely possible to make decisions retrospective, so that reductions will only be effected gradually as new designs come out. To illustrate this, the rationalization of grease nipples has been effected in all Services, but it is impracticable to replace nipples in existing equipment, and so only when present equipments are superseded will it be possible for the Stores Departments to clear their shelves of types outside the rationalized lists, although the demands for the obsolete types should decrease steadily through the years.

On a number of occasions, standards which the Services have produced for their own use have come to be used by large sections of industry and have then been adopted by B.S.I. These include grease nipples and rotary oil seals.

In other cases, the Services have requested the B.S.I. to undertake work on their behalf.

Standardization in the Future

The two great objectives of the future are a common system of measurement and a common thread.

The first step towards the achievement of a common thread have been taken by the recent introduction of a Unified Thread in the U.K. and U.S. As this is a 60 degree thread it opens the way to an amalgamation with the metric thread which is also 60 degree by some system of referring to sizes of thread by numbers.

While no positive steps are in prospect on a common system of measurement, the author feels that the increasing preponderance of industrial production to the inch system, together with the dependence of Europe on that production, will not advance the metric cause. Both systems are, in fact, completely arbitrary and the author would expect the inch and decimals of the inch to win the day. Perhaps an opportunity of settling the matter was lost when nearly all the metric Governments were resident in London during the last war.

A world coinage has moved a step nearer with the various agreements limiting devaluation, and under the influence of the several customs unions.

It is frequently said that British Industry cannot compete with the U.S. on account of our smaller market. This is untrue, because a market of 50 million is big enough to permit economic runs of manufacture of nearly every article, possibly even the more specialized, such as machine tools for special purposes. The gain of economy on runs of manufacture after the first 100,000 items is very small, and there are few cases where a run of 10 million parts can cheapen an article appreciably over a run of one million parts. What is true is that, until economic runs are obtained in as many forms of manufacture as possible by means of standardization, competition is not possible, and it is this false pride and prejudice about individualism which has been so hampering in the age of mass production. It is for this reason that the work of the B.S.I. and its Service and Industrial counterparts is of such importance to the country.

Marine Engineering in the Future

In the shipyard the author would hope to see the very primitive standards of protection, convenience and amenities replaced by the conditions of a modern factory.

All those components which are common to all ships would be standardized.

The buyer of ships would be encouraged to choose his engines from a

standardized range of horsepowers, or units of horsepower, which in turn would allow a further large range of components to be standardized, ranging from internal combustion engine cylinders, turbine rotors and blading etc. through their attendant auxiliaries, to propeller shaft, plummerblocks and propellers. How often is it now seen in the Press that a special aircraft has been chartered to fly a propeller shaft to the end of the earth? Despite the British standard, too many different varieties of shafting are in use and hence the provision of a spare is always a " special ". The gas turbine presents a hopeful field for standardization and it is to be hoped that the relatively few builders of these machines will agree among themselves on such points as a series of bearing sizes, blade and groove sizes, etc.

In order to carry out the programme referred to above, a common drawing practice is required. At present every firm has its own system. The author hopes in the future to see the drawing of every firm interchangeable, and every drawing intelligible and unambiguous. A great deal of work has been done on the subject by the Services, and he would like to draw the attention of those concerned with design to *The Analysis of Engineering Designs* recently published by H.M. Stationery Office. Further works, dealing with those subjects not touched on in the B.S. Drawing Practice (B.S.308), are imminent, and, in fact, the Admiralty has issued a " preview " to their contractors entitled *An Interim Guide to Designers and Draughtsmen.*

Another fundamental requirement is a system of basic linear sizes. By this is meant a series of lists of dimensions, arranged in order of preference, from which the designer will choose. As a very simple example he will be encouraged to take as first preference for a dimension 1 inch rather than 0.95 or 1.05, as second preference 0.95 rather than 0.955 or 0.945. This system automatically tends to reduce the numbers of varieties, simplifies gauges, measurement and drawings, excludes " specials " and has a particular application to Limits and Fits.

A widely accepted system of Limits and Fits is very desirable, to reduce the numbers of gauges and simplify the achievement of interchangeability. A system for locomotives has recently been published and B.S. 164 is under revision.

Conclusion

In the past, although industrial standardization may be said to have started in England, individualism has led us to look down on mass production and simplification and in this way to hamstring ourselves. It has been estimated that effective standardization in an industry can raise its efficiency by as much as 10 per cent. Apply this to trade as a whole and there results more productivity with very little extra effort. It is therefore essential for our future prosperity that standardization is pressed on with in every field.

The main requirements are :—

More ready acceptance of standards by designers and draughtsmen.
Basic linear sizes.
A common drawing practice.
A wider acceptance of existing standards, particularly British Standards.

The author desires to acknowledge the assistance he has received in the preparation of this paper from Mr. S. J. Harley and Mr. H. L. Griffiths while making it clear that the views expressed are his own.