49 Standards and Certification

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49.1 Introduction

Standards are vital components of UK marketing strategy. Ordering and procurement is increasingly done over the Internet and in order to ensure that the products are suitable for the purpose required, compliance with a nationally and internationally approved standard is of increasing importance to customers. Reflecting the growth of electronic communication, standards authorities such as the British Standards Institution have been making considerable investment in Information Technology in order to exploit the rapid communication possibilities of IT in providing industry with the standards it needs. From the year 2000 this will become the major means of communication in the standards field. Details of information sources are given in subsequent parts of this chapter.

A standard is defined as a technical specification or other document available to the public, drawn up with the co-operation and consensus or general approval of all interests affected by it, based on the consolidated results of science, technology and experience, aimed at the promotion of optimum community benefits and approved by a body recognised on the national, regional, or international level.

The National Standards Body recognised in the United Kingdom is the British Standards Institution (BSI) whose principal function is the preparation and/or publication of national standards and/or the approval of standards produced by other bodies. BSI serves as the national member of the corresponding international and regional standards organisations. The international standards organisation principally concerned with electrical standards is the international Electrotechnical Commission (IEC) and the corresponding regional standards organisation for Europe is the European Committee for Electrotechnical Standardisation (CENELEC). CENELEC is very important to UK manufacturers, because it has the power to issue *Directives* which are binding on all EEC member states and effectively outlaw any product which does not fully comply with the standard requirements contained in that directive. More detail of these and other standardising bodies is given in Section 49.2.

Standards are revised, when necessary, by the issue of amendments, or, in the event of the need for major alterations or additions, by the issue of new and revised editions. Users of standards must ensure that they use the latest amendments or editions. Standardising bodies supply regular information on all such changes (in the United Kingdom, this information is summarised annually by BSI who also issue their catalogue in electronic form. The information is up-dated monthly in *Update-Standards* and general information about standards is published bi-monthly in *Business Standards*. Both publications are available from BSI.)

More immediate access is provided over the Internet on the BSI Website : www.bsi-global.com

49.1.1 The need for standards and the aims of standardisation

The primary need for standardisation is to provide a set of criteria by which a product can be judged to be suitable for the purpose for which it is intended in comparison with like products from a variety of sources. This is of value to both manufacturer and user (see Section 49.1.1.1). Achievement of all the targets of performance set in the standard by samples taken from production at regular intervals is also a measure of the sustained quality of manufacture, the standard again providing the yardstick by which consistency of manufacture can be assessed (see Section 49.1.1.5).

Those preparing standards have common agreed aims (see Section 49.1.1.2) designed to make the standard of optimum applicability and usefulness to meet the needs of the application.

Standardisation is needed also to avoid the pitfalls of proliferation of sizes and performance specifications which in the absence of standardisation would make difficult the replacement of a damaged component by one of different manufacture or even from the same manufacturer if modifications have been subsequently made to the design (see Section 49.1.1.3).

Last but by no means least, safety requirements can be carefully thought through by a standardising committee which has representation of health and safety bodies, to ensure that there are clauses in the standard which spell out clearly the necessary requirements and design criteria which the product must meet in order to ensure that it is safe in normal use (see Section 49.1.1.4).

49.1.1.1 The value of standardisation

Users are increasingly aware of the value of purchasing a product certified to national and international standards. They can rely on its performance to a known set of criteria, and if its quality of manufacture is regularly assessed, they know that the standard of performance is maintained and that the product does not have design faults which are likely to make it fail prematurely in normal service. This can ensure a financial saving not only of the cost of early replacement but also of the cost of the 'down-time'. Furthermore, with the more strict personal liability for health and safety at work applying today, the user is even keener to ensure to the best of his ability that the product he is using is not unsafe in use. If he buys a product which has not been tested to the appropriate safety requirements of the standard the chance of an accident is much higher. He also may consequently be legally liable, whereas if the product had been certified to the appropriate standards and correctly installed and applied, he would have done all that he could do to avoid an accident.

New regulations introduced in 1966 (detailed in 'RIDDOR 95' published by the HSE) put extra responsibilities on employers when accidents occur in the workplace, and legislation is becoming increasingly intolerant of those employers who neglect to provide adequate protection. Compliance with all safety aspects of standards is therefore paramount in producing a satisfactory risk assessment.

The commercial advantage to the manufacturer in having a range of products fully certified to the appropriate standards is therefore very apparent. His customers need to buy his products of demonstrated performance and safety, rather than making false economies by purchasing cheap untested competitive products which are likely to fail or malfunction in service, possibly dangerously. The certification to safety standards gives also a degree of protection against legal action in the event of accident involving the product.

The value to the general public at large of standardisation is the improved reliability of the equipment around them, giving longer uninterrupted service and greater personal safety.

Under the Directives of the EEC, larger users will be compelled to change their installations, replacing components not conforming with harmonised European standards. This is considered further in Section 49.2.3.

Standards are also needed to simplify contractual agreements, because the supplier can ensure that his products comply with all the relevant clauses of the appropriate

standard and such compliance can be written into the contract for any of his customers. Otherwise it would be necessary to prepare a detailed technical performance specification for each product for each customer. Having stated the appropriate standard it remains only to add any special requirements, delivery dates, price agreement etc. and both sides are presented with an unambiguous contract. Savings on stock levels are also facilitated, because it is generally only necessary to stock standardised items for which there is more general demand.

49.1.1.2 Specific aims of standardisation

From considerations of the need for standards similar to those summarised above, five aims of standardisation have been identified in BS 0:1991:

(1) provision of means of communication amongst all interested parties;
(2) promotion of economy in human effort, materials and energy in the production and exchange of goods;
(3) protection of consumer interests through adequate and consistent quality of goods and services;
(4) promotion of the quality of life: safety, health and the protection of the environment; and
(5) promotion of trade by removal of barriers caused by differences in national practices.

In the following sections we can see how well these aims have been achieved by national, regional, and international standardisation. BS 0 has only recently been completely revised, but with the advance of the electronic age it will doubtless soon require further revision.

49.1.1.3 Reduction of proliferation

The issue of a standard promotes the reduction in proliferation of product sizes which do not fit in standard equipment, product ratings which are too restrictive for general application and products which are non-compatible with all the systems of which they are intended to be a component.

Standardisation therefore represents a major economy in the stocks of spares which have to be kept to replace spent or worn-out components, and considerably eases the task of designers of equipment incorporating a range of products, with standard ratings based where possible on the R10 series. This harmonisation means that the standard product can be specified, knowing that it will fit and will have the required technical performance with the specified level of safety.

This principle is increasingly being extended internationally through the work of the IEC (see Section 49.2.2) and in Europe by CENELEC (see Section 49.2.3). After 1992 many CENELEC harmonised documents will have the force of law, and the corresponding products will only be saleable in the UK and Europe if they comply in all respects.

49.1.1.4 Safety

Standards also cover aspects of safety. In this respect they seek to define the acceptably reasonable level of risks of personal harm in the foreseeable use or misuse of a product, process or service.

An example of a standard specifically classifying different levels of acceptable risk is BS 60529 (identical with IEC 60529) 'Classification of Degrees of Protection Provided by Enclosures'. This standard specifies tests for a series of levels of protection and defines an IP (International Protection) code which identifies the degree of protection against direct contact, against ingress of solid objects and/or water, etc. For example an enclosure classified as IP2X has been tested to ensure that an average finger cannot be poked into the enclosure in such a way that it can come into contact with live parts or dangerous moving parts. However, wires can be poked in. If protection is provided against touching by ingress of wires down to 1 mm. diameter, the category is IP4X. Space does not permit further detail here, and readers are referred to the standard, which is applicable to enclosures containing any electrical equipment, providing its rated voltage does not exceed 72.5 kV.

Standardising bodies also publish documents summarising up-to-date knowledge on safety related matters. An example of this is IEC 61479-1 'Effects of Current passing through the Human Body', which provides basic guidance on the effects of shock currents on the human body. This provides a most useful source of reference when establishing electrical safety requirements for products, or when devising regulations for electrical safety with respect to avoidance of death or injury from electric shock. Hazards due to overheating of electrical equipment can lead to oxidation of contact surfaces, deterioration of insulation, burns to personnel, or in an extreme case to ignition and fire. Consideration of these matters becomes complicated when a number of heat producing units are contained in a single enclosure because the temperature rises permitted in switchgear standards result from conventional situations which may differ appreciably from the situation within an enclosure and connected to other heat producing equipment. In this case, guidance can be obtained from IEC 60943 'Guide for the specification of permissible temperature rise for parts of electrical equipment, in particular for terminals'. IEC also publishes a bound volume containing the text of all its electrical safety standards up to the time of publication. This is a very useful compendium, sold at a price significantly less than the total cost of the standards bought separately, and provides a most handy source of reference although it is necessary to check that a particular standard has not been up-dated since the date of publication.

Safety aspects contained within product specifications establish matters such as marking of the product to inform the user of the product ratings and limitations, and where necessary to warn of dangers of misapplication etc.

Safety tests are also included in standards, e.g. by limiting the emission of arc products, restricting temperature rise to prevent injury, decomposition and degradation of insulation or other properties of materials, or ignition leading to fire hazard, etc. Sometimes the level of safety is indicated in the title of the standard e.g. if it states that it is intended for use by authorised persons, which implies that there can be an additional level of hazard in untrained hands.

It is impossible to make any product completely safe. One cannot do without water, but one can drown in it. Safety regulations reduce the risk. In the same way the standard will generally set a defined level of acceptable risk, at a point where most hazards are eliminated as far as is possible without extravagant expenditure on remote chances of danger through misuse. A warning will normally be found in the standard where there could be any hazard that may arise in the use or foreseeable misuse of the products covered by the standard.

49.1.1.5 Quality assurance

The quality of goods and services are provided for in standards by defining features and characteristics which establish their ability to satisfy the stated needs. A quality assurance procedure provides a standard framework for

regular checking to ensure maintenance of quality in production, and continued adherence of the product to the standard to which it is claimed to conform. It would be inappropriate to go into any great detail here, but the reader is referred to the following British Standards: BS 4891 contains a guide to quality assurance, terminology is in BS 4778, and specification of quality systems can be found in BS 5750.

Although not an electrical standard, firms of quality often also seek approval to ISO 9000 to demonstrate quality of management. Year 2000 revisions to the ISO 9000 series of quality management standards are expected to bring a great many new business benefits to companies making the transition to the new standard (details available from BSI head office).

49.2 Organisations preparing electrical standards

One of the problems facing a manufacturer developing a product for export is that the product is required to conform with the appropriate standard which applies to the particular country to which he is exporting. He may already have test certificates to certify complete compliance with the British Standard, as is necessary for sales within the UK, but the other country may have national standards which differ in significant details from the British Standard and local regulations and trade practices which enforce an expensive series of re-testing to slightly different prescriptions in a test station in the other country. This is particularly troublesome in the USA where manufacturers of tried and tested products find that they must spend considerable sums of money and time having their products tested once again at the Underwriters Laboratories (UL) or some similar test company before they are able to market that product in the USA. Now that Canada has joined with USA in a common market activity, it is likely that the same will apply to Canada in future. The organisation of standards in the USA is somewhat chaotic, compared with other developed industrialised countries. There are approximately 35 different bodies producing electrotechnical standards for the USA. These are loosely coordinated by the national body, The American National Standards Institution (ANSI) which does not develop standards, but may approve standards produced by the other bodies as American National Standards. Apart from UL standards and similar product standards, there are two basic standards generally recognised in the USA:

(1) The National Electrical Code, produced by the National Fire Protection Association (NFPA); and
(2) The National Electrical Safety Code, produced under the auspices of the Institute of Electrical and Electronic Engineers (IEEE).

The National Electrical Manufacturers' Association (NEMA), the US equivalent of BEAMA is also active in producing standards. The system is illustrated below for the case of the Underwriters' Laboratories Inc.

A parallel situation existed for many years in Europe, where approvals were needed in each country, especially for electrical equipment sold to the general public, and equipment sold in several countries would be studded with approvals marks for KEMA, VDE, SEMKO, NEMKO or DEMKO, etc. as proof to the purchaser that the local approvals authority had passed it. The European Committee for Electrotechnical Standardisation (CENELEC) since its formation in 1972 has reduced much of the unnecessary duplication of testing activity and has introduced a new approvals mark which should eventually replace all the existing marks within the CENELEC regional group of countries. However, to ensure that all electrical equipment in the EEC is up to a uniform standard of quality and safety, it has become mandatory for all electrical goods to carry the 'CE' mark.

As detailed below, CENELEC is far advanced in actively converting all National Standards within the EEC into European Standards and in the process eliminating national differences in preparation for the removal of trade barriers in 1992. Although this gives many technical and commercial problems, it will undoubtedly simplify European trade when the process has worked through the system. Canada and the USA are going through a similar transition, having formed a similar regional group.

Other international and regional standardising bodies exist as detailed below, but most of the electrotechnical groups tend to follow the standards produced by the International Electrotechnical Commission (IEC).

The IEC was formed in 1906 to harmonise all electrotechnical standards world-wide and to rationalise the test and certification requirements in such a way that all nations can work to one set of electrotechnical standards. Considerable progress has been made this century in that direction, and it is only to be hoped that the strengthening of the regional groups will not delay the progress to World harmonisation by leading to the erection of more formidable regional barriers to trade.

49.2.1 British Standards Institution (BSI)

In the UK, the British Standards Institution is the recognised body for the preparation and promulgation of national standards in all fields. In 1901, it was set up by the professional engineering associations with the title 'Engineering Standards Committee' changed at the end of World War I to the 'British Engineering Standards Association'. A Royal Charter was granted in 1929 supplemented in 1931 when the body was retitled the 'British Standards Institution', an independent body whose Royal Charter was consolidated in 1981 as an independent body with the following objectives:

(a) to co-ordinate the efforts of producers and users for the improvement, standardisation and simplification of engineering and industrial materials so as to simplify production and distribution, and to eliminate the national waste of time and material involved in the production of an unnecessary variety of patterns and sizes of articles for one and the same purpose;
(b) to set up standards of quality and dimensions, and to prepare and promote the general adoption of British Standard Specifications and schedules in connection therewith, and from time to time to revise, alter and amend such specifications and schedules as experience and circumstances may require;
(c) to register, in the name of the Institution, marks of all descriptions, and to approve and affix or license the affixing of such marks or other proof, letter, name, description or device; and
(d) to take such action as may appear desirable or necessary to protect the objects and interests of the Institution.

BSI acts as the national member of the corresponding international and regional standards organisations and as such is responsible for paying the subscriptions to these bodies (more than a million pounds!). As a completely independent body, BSI has to raise income to meet its

expenditure. A large proportion of its income is derived from quality assurance activities, sales of publications, testing and technical help. The remainder of its income was in the main divided between subscriptions from the tens of thousands of members and Government grant-in-aid. Electrotechnical Standardisation represents a significant fraction of BSI activity, due to the high technological level and national importance of the industry, and its rapid rate of advance into new and exciting fields of discovery and development, necessitating the preparation of standards for products which did not exist in any form in earlier generations.

Preparing standards for such innovatory products necessitates the formation of new committees to add to the present total of over 3000 technical and subcommittees, each committee being provided with a secretary by the BSI, with over 25 000 committee members nominated by organisations representing the views of users, manufacturers, health and safety authorities, testing authorities etc. BSI maintains more than 10 000 current British Standards and a similar number of standards projects. Approximately one third of these are electrotechnical in nature.

Membership of BSI is divided into several categories, for example: individuals, professional firms and partnerships, industrial and commercial firms in both the private and public sectors, professional institutions, research associations and similar bodies, local authorities, and other organisations. Members pay subscriptions related to the size of the organisation.

Committee members are mainly nominees of the organisations which they represent and are responsible for standardisation project work, and obtaining the consensus of opinion of interested parties on any matter to be raised at committee meetings, reporting back to their organisations.

Each of the tens of thousands of committee members is therefore reporting back to a large number of other persons and organisations which indicates the vast amount of effort and time devoted to standardisation matters, and the importance attached to it by all concerned.

British Standards may be used to promote standardisation in any of the following stages:

(1) terminology, symbols;
(2) classification;
(3) methods of measuring, testing, analysing, sampling, etc.;
(4) methods of declaring, specifying, etc.;
(5) specification of materials or products;
(6) dimensions, performance, safety, etc.;
(7) specifications for processes, practices, etc.;
(8) recommendations on product or process applications; and
(9) codes of practice.

The most familiar type of British Standard Specification is one that lays down a set of requirements to be satisfied by the material, product, or process standardised and which embraces, often by reference, relevant methods by which compliance may be determined.

More information on the different types of British Standard Specifications and other British Standard publications are given in Section 49.3.1.

British Standards were originally all publicly available documents voluntarily agreed. However, the publication by the BSI does not at present ensure their use. This position is progressively changing, notably where the standard is also a harmonised European standard where compliance becomes mandatory. Otherwise a British Standard only becomes binding if a claim of compliance is made, if it is invoked in a contract, or if it is called up in some other legislation. Regulations made under a number of British Acts of Parliament call up approximately 300 British Standards.

Support for the application of British Standards as agreements produced in the public interest is given by the Restrictive Trade Practices Act 1976. The care exercised in the production of British Standards is relied upon by users who themselves owe a similar duty to the public. The compliance with the requirements of a British Standard does not in itself necessarily imply that a product is safe and suitable for all possible applications. It remains the responsibility of users to ensure that a particular British Standard is appropriate to their needs. Within their scope, British Standards provide evidence of an agreed 'state of the art' and may be taken into account by the Courts in determining whether or not someone was negligent.

In July 1982, the Department of Trade on behalf of HM Government issued a document entitled 'Standards, Quality and International Competition' (Cond 8621) in which the BSI was recognised as the main producer of standards in the UK, and HM Government agreed to maintain the annual grant-in-aid based on the level of contributions from other subscribers and to support BSI's efforts to achieve international harmonisation of standards through ISO, IEC, CEN, CENELEC, etc. in the interests of UK industry and trade, and to encourage fuller participation of public purchasing authorities in the preparation of and compliance with British Standards in their purchasing decisions, quality assurance requirements, and in their operational procedures. The BSI undertook the huge task of reviewing, and where necessary revising existing British Standards to ensure that these, and any new British Standards, will be suitable for reference in Government Regulations as unambiguous statements of technical requirements. With the rapid movement to international harmonisation, in particular within the European Regional harmonisation within CENELEC, BSI is somewhat hindered in fully carrying out this task, since agreement must be obtained with all the international partners before any change whatever can be made in a harmonised standard. However, the Public Procurement Directive enforces mandatory compliance with the corresponding European standard, and thus some apparent ambiguities may be ineradicable.

However, both BSI and CENELEC are agreed that IEC standards are the most suitable for harmonisation, since they have been formulated with the benefit of world-wide expert opinion and agreed by a substantial majority vote of all interested nations. They thus offer the best chance of achieving a common set of standards world-wide. There are two major benefits:

(1) a major international trade barrier is removed if the trading countries have common standards; and
(2) users specifying a common standard are ensured that they have a common and valid base for examining and comparing competing products.

British Standards and new European standards for electrotechnical products etc. are therefore almost exclusively generated by the IEC. In order to have any influence on the content of future British Standards it is therefore vital to have adequate representation on IEC committees and even more important to maintain active participation in all the Working Groups of IEC, since it is in the Working Groups that basic standards are formulated and contentious points are resolved.

49.2.2 International Electrotechnical Commission (IEC)

The International Electrotechnical Commission (IEC) was established in 1906, and now comprises the national

electrotechnical committees of over 50 countries in all continents throughout the world. During the twentieth century the IEC had produced over 3000 standards compiled by over 80 technical committees, and over 120 sub-committees that collectively represented over 80% of the world's population that produced and consumed 95% of the total electrical energy. National committees include representatives from manufacturers, users, testing authorities, trade associations, governments, and professionals and academics from research organisations and colleges.

IEC Standards are widely adopted as the basis of national electrotechnical standards so far as local customs and conditions permit. They are also quoted in manufacturers' specifications and by users when calling for tenders This widespread adoption facilitates international trade in the electrical and electronic engineering sectors.

The International Conference on Large High-Voltage Electric Systems (CIGRE), meeting in Paris when necessary, has a number of working groups which produce papers discussed at the meetings and subsequently form the basis of work to produce standards within the IEC. The IEC works in close cooperation with the International Organisation for Standardisation (ISO) which is mainly concerned with standards in non-electrical fields. However there are overlapping areas, for example the ISO deals with automotive electrics (see Sections 49.2.5), and IEC is responsible for standards for steam and hydraulic turbines, which are almost exclusively employed for generation of electrical power.

In 1982, the IEC began its Quality Assessment System for Electronic Components (IECQ). This was initially introduced for quality assessment of mass-produced components, such as resistors and capacitors, but it has been much extended to embrace components made for special purposes. The major exporting countries of electronic components, more than 20 countries, are members of IECQ.

The British Standards Institute is the UK member body for the International Organisation for Standardisation (ISO) and the European Committee for Standardisation (CEN).

The Electrotechnical Council forms the British Electrotechnical Committee, the UK national committee of the parallel International Electrotechnical Organisation, the International Electrotechnical Commission (IEC) and the parallel regional electrotechnical organisation the European Committee for Electrotechnical Standardisation (CENELEC). BSI also participates as the UK member in producing European Standards (EURONORMS) for the European Coal and Steel Community (ECSC).

Towards the end of the twentieth century BSI was working on over 10 000 standards projects, the major proportion of which were involved in international standardisation. At the same time they held the UK Secretariats of about 200 technical- and sub-committees of international standardising bodies, of which 17% were within IEC and CENELEC, and many more secretariats of working groups. The major importance to the UK of its electrical industry would suggest that Britain should be deeper involved in this activity, but BSI is compelled to keep its activities within the provision of services within the UK, due to the constraints of its limited budget. The sale of standards was anticipated to be enhanced by the pace of international standardisation in which case it could have offered some growth of income for promoting such work. Even this source could be threatened if, for example, a decision were made to sell all European standards from Brussels or some other profit centre outside the UK. With the revolution in Information Technology it has become possible to deliver Standards over the Internet, and BSI has invested large sums in the provision of advanced IT facilities to meet this challenge. Standards are available to subscribers on-line (www.bsi-global.com), and many standards are also available on CD ROM as well as the traditional hard-copy format all available from the BSI bookshop (open to all every weekday from 0900 to 1730). 'Print on demand' has been introduced from images stored on electronic files and enquiries can be transmitted to BSI by e-mail: info@bsi.org.uk

Many new strategies are being developed to support the continuation of BSI's standardisation work, and a substantial range of new services is being made available to customers in addition to the loan facilities available at modest cost from BSI library.

BSI has also established many centres overseas, which are listed in Section 49.5.1.

Every international committee in which the UK participates has an equivalent committee, usually a BSI committee which appoints and briefs the UK delegation. Each delegation has a leader who is the principal UK spokesman at the international meeting, and a Rapporteur to assist the leader in technical interpretation of documents at the meeting and to keep a record of the proceedings from which he produces a brief report of the main decisions of the meeting for BSI. Members chosen as delegates in international standards work are chosen for their special knowledge and powers of advocacy, and they are responsible for presenting the viewpoint of the UK as agreed in the corresponding BSI committee. Five responsible and properly briefed delegates would normally be the maximum number on any committee, ideally comprising the leader, a manufacturer, a user, a testing specialist, and a technical expert with an academic or industrial research background (although the size and composition of the delegation will vary depending on the availability of funding for the attendees, and the nature and importance of the matters to be discussed). If regulatory matters are to be discussed, the delegation should also, if possible, include a representative of the appropriate Government department serving also on the corresponding BSI committee. As stated above, this representative should also actively participate in the work of the working group preparing the voting document if there are any special UK requirements which need to be included. Special European standards which need to be developed where there is no equivalent standard available or under consideration in the IEC.

The IEC is governed by IEC council and its committee of action. It operates also certain special committees referred to by the following acronyms:

ACET	Advisory Committee on Electronics and Telecommunications
ACOS	Advisory Committee on Safety
CISPR	International Special Committee on Radio Interference
ITCG	Information Technology Coordination Group

49.2.3 European Committee for Electrotechnical Standardisation (CENELEC)

In 1959 the standardisation institutions of Western Europe formed the European Committee for Standardisation (CEN) which co-ordinated the drafting of standards within the two regional trading groups: The European Economic Community (EEC) and the European Free Trade Area (EFTA). Electrotechnical standards were then made the responsibility of CENEL (the electrotechnical counterpart of CEN). The CEN certification body was referred to under the acronym CENCER.

However, as the EEC began to be enlarged in 1972, the European Committee for Electrotechnical Standardisation (CENELEC) was set up which creates harmonisation documents (HDs) and European standards (ENs). CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the UK. Once an EN is approved, by the agreed voting procedure, it must be printed or endorsed as a national standard in all the countries within the EEC. Electrotechnical ENs and HDs are preferably derived from, or exact copies of, corresponding IEC standards. However, after 1992, when all trade barriers were removed in the EEC (under Article 100 of the treaty of Rome), it became apparent that there were many national variants in the standards of the various EEC countries which would need to be resolved before a truly free-trade situation could exist. The Vilamoura procedure was rather quickly introduced to provide for such national standards which might be converted into regional standards. In the UK this has given many problems of possibly losing standards that are urgently needed to be maintained and gaining others which are not wanted. This is liable to produce problems unlikely to be resolved until well into the 21st century.

With the advent of CENELEC there has been a considerable change in the method of drafting British Standards in order to avoid conflict with HDs. When CENELEC begins work on a given subject, a 'standstill' or '*status quo*' arrangement comes into effect. Changes to national standards relating to that subject cannot then be made until harmonisation has been agreed, or permission obtained from CENELEC. It is still possible to have a national standard for a particular type of equipment which is of no interest to any other member countries of CENELEC, provided that the type of equipment is not just a local variant of an HD or EN. At the time of writing, individual customers may still obtain equipment to their own specification, sometimes as a 'special' carrying perhaps a delivery and/or a price penalty. However, freedom to obtain such 'specials' has been restricted from 1992 within the EEC especially for companies like the electrical supply industry, which are subject to the Public Procurement Directive whether or not they are privatised.

As the CENELEC standards are based on IEC standards wherever possible, active participation in IEC committee meetings and working groups has become more important than work in the BSI or CENELEC committees alone. Once a European Standard or a EURONORM is called up in an EEC Directive it is binding on Governments of all Member States, and the terms of the Directive will determine its status.

49.2.4 Underwriters Laboratories Inc. (UL)

The Underwriters Laboratories Inc. (UL) is an independent not-for-profit organisation in the USA which was originally set up by the insurance underwriters to carry out testing for public safety, but is now completely independent. It was originally founded in 1894 and is chartered as a not-for-profit organisation without capital stock, under the laws of the State of Delaware, to establish, maintain, and operate laboratories for the examination and testing of devices, systems, and materials. A complete description of the organisation, purposes, and methods of UL can be found in a pamphlet '*Testing for Public Safety*' obtainable from UL. The UL is given here as an example of a major test organisation in the USA, which is also very active in producing national standards in that country, in cooperation with US manufacturers of the products standardised.

UL will grant a 'listing' which 'observes' the requirements of the UL standard. In this respect, a product employing materials or having forms of construction differing from those detailed in the requirements of the standard may be examined according to 'the intent' of the requirements, and if found to be substantially equivalent, may be listed. Listings may be granted in certain circumstances, partly on tests at UL and tests carried out by the manufacturer. Under the UL arrangements a US manufacturer can obtain a listing and get a product on the market much more quickly than with the normal standardisation approval delay elsewhere. However, this is by no means a 'soft option' because UL usually requires 'follow-up' testing to be carried out at regular intervals, and any failure at that stage will result in withdrawal of listing, stopping production until the matter is put right. In this respect compliance with UL standards could be regarded as intermediate between 'type testing' (tested once only) and a service such as the BSI 'kite mark' scheme (of which there is more detail in Section 49.4).

49.2.5 Other bodies (ISO other national and regional committees etc.)

The International Organisation for Standardisation (ISO) was founded in 1947 in the aftermath of World War II, and the national standards bodies of approximately 90 different countries now participate in its work. ISO produces standards which are published on approval by 75% of the member bodies. ISO is governed by the ISO Council, and within the organisation there are in excess of 2000 technical committees, sub committees, and working groups involved in the preparation of International Standards. ISO had published approximately 8000 standards in the 20th century. In principle, ISO does not produce electrical standards, this being the province of its electrical counterpart the IEC. However, in practice, where the electrical standard relates to a product assembled within a larger product, ISO will take over the task of preparing a standard. An example of this is in automotive electrics. Electrical components in a motor vehicle constitute a significant proportion of the product, but such electrical components are not standardised by IEC but by ISO. A specific example is the standardisation of the fuses which would normally be the province of IEC/TC32. However, these are covered by an ISO committee concerned with the vehicles, although IEC/SC32C (Miniature Fuses) is kept informed of their decisions through a liaison system. This is typical of the type of liaison which exists between different standardisation bodies world-wide. Further detail of the ISO/IEC Code of principles on 'reference to standards' can be found in the following: Annex B to BS 0: Part 1: 1991.

The ISO Council organise their activities through a number of committees referred to under the following acronyms:

CERTICO	Committee on certification
COPOLCO	Committee on consumer policy
DEVCO	Development Committee (aimed at the needs of developing countries)
EXCO	Executive Committee (which is also responsible for finance)
INFCO	Information Committee
PLACO	Planning Committee
REMCO	Reference Materials Committee
STACO	Standardisation Principles Committee

The International Commission for Conformity Certification of Electrical Equipment (CEE) was set up immediately after World War II to harmonise electrical equipment standards. It comprised the national electrotechnical committees of 23 European countries together with observers from Australia, Canada, Hong Kong, Iceland, India, Japan, South Africa and the USA. A Certification Body (CB) was set up which could validate certificates of testing valid in all European member countries for electrical equipment tested in two of them at recognised testing authorities. This was known as the 'CB Scheme'. CEE also established the 'E' mark for marking a product to signify approval. This should be superseded by the 'CE' mark which should become mandatory throughout the EEC. CEE became later IECEE when it was taken over by IEC in 1985.

Most of the testing to this system is therefore now incorporated in the *IEC System for Conformity Testing to Standards for Safety of Electrical Equipment* (IECEE). IECEE's objective is the reciprocal recognition of test results among all participating countries, and offers the only world-wide recognition scheme for the safety of electrical equipment tested against IEC Standards. About half of the member organisations of the IEC are also members of IECEE. Addresses of most of these can be found in Section 49.5.1. The scheme is intended for electrical equipment used in homes, offices, workshops and similar locations and covers safety-related standards for the following categories of equipment:

(1) electronic entertainment equipment;
(2) measuring instruments;
(3) cables and cords;
(4) lighting equipment;
(5) household and similar electrical appliances;
(6) portable power tools;
(7) accessories, including certain components;
(8) switches for appliances and automatic controls;
(9) protective equipment for installation, including fuses and fuse-holders;
(10) low-voltage switchgear and controlgear;
(11) transformers;
(12) office machines and IT equipment; and
(13) electromedical equipment.

Under this scheme a manufacturer can contact the national certification body in his own country (BSI in the UK) and have his equipment tested in conformity to standards for safety at the designated testing laboratory. The equipment is then included in the '*List of CB Test Certificates*', where new certificates are published each year. Importers can procure conforming equipment by having it tested fully to the same scheme, but it only needs to be tested once to cover all countries for testing standards included in the scheme.

Importers can confirm which recently successfully type-tested equipment is and where, by consulting the regularly published *CB Bulletin* available from the IECEE Secretariat at the IEC Central Office.

There are many other international and regional groups concerned with aspects of electrical standardisation, but in the main they tend to apply IEC standards or North American variations. An international body is IFAN, the International Federation for the Application of Standards, which comprises the official standards-user bodies recognised by their national standards organisations. Regional bodies include ARSO, the African Region Organisation for Standardisation, which was founded in 1977 by the United Nations Economic Commission for Africa (ECA) and comprises the national standards bodies of the African countries who are members of ECA and the Organisation of African Unity (OAU), ASMO, the Arab Organisation for Standardisation and Metrology which was set up for the League of Arab States in 1965 as a specialised technical body in the field of standardisation, metrology and quality control, the Council for Mutual Economic Assistance (CMEA) which since 1949 acted to harmonise the national standards of USSR and Eastern Europe, and also later Cuba, Mongolia, and Vietnam, the Pan American Standards Commission (COPANT) comprising the standards bodies of the United States of America and 11 Latin American countries who since 1961 have been working to co-ordinate their policy of implementing IEC standards and recommendations within the Pan American region, the Pacific Area Standards Congress (PASC) which was founded in 1973 to assist countries in the Pacific area in international standards activities and promote closer cooperation between its members (active members Australia, Canada, China, Hong Kong, Indonesia, Japan, Republic of Korea, Malasia, New Zealand, Philippines, South Africa, Thailand and the USA), and the Nordic Electrotechnical Standards Cooperation Committee (NOREK) comprising Denmark, Finland, Norway and Sweden, which reviews the work of national organisations and formulates regional policy for presentation to IEC and CENELEC and ensures that standards prepared by IEC can be implemented in the Nordic countries with as few modifications or deviations as possible.

Although all major developed countries and regions belong to the IEC and are committed to eventual harmonisation of electrotechnical standards, there are still significant differences in details and special requirements and necessity for verification in a local test station which can so add to costs that a product from outside the region can be priced out of the market. It appears also that those countries which are most vociferous in wanting their own products admitted to other world markets with as low tariffs as possible and without testing other than to their own local requirements in their own country tend to be those with the most standards barriers to reciprocal trade. However, progress in the last quarter of the 20th century tends to indicate, with occasional minor setbacks, a trend towards a world-wide set of harmonised electrotechnical standards with common wording and interpretation in the early 21st century. It is also remotely possible that in that century, test certificates and approvals to an IEC standard from an internationally recognised test authority in any region might be recognised as good and sufficient proof of compliance with the appropriate electrotechnical standards in any other region in the world without further local testing.

49.2.6 Communication with organisations concerned with standards

It is clear from the above that anyone wishing to export products has first to penetrate the minefield of local standards regulations imposed either by government or by local traders in the target region. Also any contractor wishing to undertake a construction project, large or small, must apprise himself of all the standards mandatory in the region where his project is to be completed, since such compliance will be implicit in the contract, even if not specifically elaborated.

Appropriate addresses for enqiries in the various lands or international organisations are to be found in Section 49.5.1 (addresses of organisations concerned with standards).

However, the best source of information in the UK on standards matters is the British Standards Institution which runs a service of Technical Help to Exporters which was a popular free enquiry service, originally supported by DTI for the BOTB. However, in response to requests from users of the service and others to make it more comprehensive, the service has been considerably extended in its scope. This greatly expanded service, however can no longer be provided free of charge because of the possible incalculable very large cost of an open-ended service, and the considerably improved service is now self financing. With the advance of IT systems at the beginning of the 21st century, the internet is developing as the best and quickest route to information on standards. How this source is developing is detailed in Section 49.2.6.1.

49.2.6.1 The impact of the Internet on the distribution of standards

Any reader interested in standards who is not connected with the Internet should install the facility as soon as possible, with the fastest means of access available. Year 2000 saw the commencement of a big change in the distribution of standards and related material. At the beginning of the millennium more than 10 000 users had registered with the new service WEBSITE: bsonline.techindex.co.uk, email: bsonline@techindex.co.uk

This service, known as 'British Standards On-line' provides subscribers anywhere in the world with new and existing standards from its database. This method ensures that all documents transmitted are updated with the latest up-to-the-minute revisions, which previously might appear much later due to the delay in typesetting and printing. In addition, the user of the standard gets immediate access to the standards information he requires without any postal distribution delays. It is still necessary to pay for standards, because the work of standards publication is largely supported by sale of the standards. In previous years, free distribution of international standards might have led to vastly escalating publishing costs. In future years, however, if printing ceased to be used altogether, and some reliable system of financing standardisation work could be agreed, it might be possible to make all standards free on-line. At the time of writing this chapter there is no remote possibility of such a move, and the sale of standards is essential to support the continuation of the service.

In addition, most standardising bodies have installed websites where the latest freely distributed information is displayed, and from some of which standards can be purchased over the Internet. The two most important sites for UK users are the British Standards Website http://www.bsi-global.com and the IEC Website http://www.iec.ch which are good sources of general information on the standardisation of electrical products. Throughout the text of this chapter readers may find many other websites and e-mail addresses which may be used to gather further information concerning individual aspects of standardisation, and within the major websites more detailed addresses can be specially useful. For example, the IEC created within their website a possibility of viewing a slide presentation of seminars using Microsoft Powerpoint.

The leader of the project team on IEC 80416 promoted the use of 'virtual meetings' over the world-wide web. An interesting idea, though troublesome for those experts sitting in on a meeting when it is the middle of the night in their location!

The use of one system for the circulation of documents has great advantages because there are incompatibilities between different word-processing products. IEC have operated for several years with document circulation using Microsoft 'Word' for this purpose which can also readily be circulated by e-mail among working group and committee members. This was a step in the right direction but which gave many problems when some committee members invested in a later version of the product, distributed early in the USA, which could not be read on earlier versions and produced hundreds of pages of obscure symbols instead of the document. This matter needs to be standardised. Even at the Houston meeting the IEC provided a battery of PCs all programmed to read Word 6 which were all found to be unable to read documents on disk for the meeting brought by a convenor who had just bought a later version.

BSI committee members, commencing in year 2000 are to have all their committee documents distributed via the Internet. Eventually no paper copies of documents will be distributed to committee members (except of course to those who agree personally to meet the additional cost of providing such a service). The file format adopted by BSI at the time of writing is that of the Acrobat PDF file system which has been found very satisfactory by most users except for users with certain makes of printer which show difficulty in printing graphics in the latest version of Acrobat. PDF files are quite secure, however, and cannot be edited. This is a disadvantage for a committee member wishing to prepare a new draft, but the difficulty may be overcome by copying text into a Word document and then making the desired changes to that.

Committee members can read these files, and only need to print out those in which they have a particular interest or need for a forthcoming meeting.

IEC also distribute documents in PDF format. However they also use FTP sites, for which you have to be an FTP client. Some files are compressed and need to be un-zipped, for example with Winzip.

A further problem at the moment is the long period of time on the Internet sometimes required for downloading. However, contact with the Internet by faster means than the enhanced modem should undoubtedly overcome this difficulty in the future.

49.3 The structure and application of standards

The drafting and presentation of British Standards is itself the subject of a British Standard i.e. BS 0: Part 3: 1991 'A Standard for Standards: Part 3. Guide to Drafting and Presentation of British Standards'. In this part of BS 0, strong emphasis is placed on the need for precision in drafting, particularly in relation to titles, scopes, requirements, and test methods appropriate to specifications, and the advice in this standard is still of great value in preparing draft clauses for standards. However, this guidance can now only apply at the drafting stage, because most British (and CENELEC) standards are now to be IEC standards often with identical text. Any wording has therefore to be agreed by all International partners in the agreement, and the final version made into an identically worded British Standard even when it is not in 'good English' as spoken in England. The 1991 revision required alterations to the earlier editions of BS 0: Part 3, in order to accommodate the changes required by the IEC/ISO directives—Part 3; 1989 *Drafting and presentation of International standards* and the CEN/CENELEC Internal Regulations—Part 3: 1990 *Rules for the drafting and presentation of European standards*.

The example given below of structure of British Standards therefore reflects typical IEC structure, which sometimes conflicts with the aspirations of BS 0.

49.3.1 Different types of British Standard documents

British Standards are used to promote standardisation of a wide range of technical matters, terminology and symbols, marking and classification, methods of measuring, testing, analysing , sampling, etc.; methods of declaring, specifying, etc.; specifications for materials or products, specified dimensions, performance, safety requirements, etc.; specification of processes and practices etc.; recommendations on applications of products and processes, and desirable safe procedures.

The type of British Standard document for each of these purposes must obviously vary since the purpose of the document is different, varying from a set of instructions to a code of advice on good practice. There are thus British Standard Specifications, Drafts for Development (where a new technology is rapidly being introduced), Published Documents of information and guidance, British Standard Codes of Practice, Guides, Handbooks, Glossaries, etc. Standards may also be referred to in Regulations to avoid inclusion of detailed technical provisions and criteria in the body of the law.

In the following parts of this section some more detail is given of these different forms of documents produced by the BSI.

49.3.1.1 British Standard Specifications

A British Standard Specification is the most well known and understood type of BSI standards publication. It lays down a set of requirements to be satisfied by the product, material, or process in question, and embraces, often by reference, the relevant methods by which compliance may be determined.

The general series of British Standards uses the prefix BS and is numbered sequentially. This is followed by a colon and the part or section number (if any) and then another colon and year of issue (or year of revision when the standard is revised). At one time this nomenclature was mainly restricted to British Standard Specifications, but now is also used for codes of practice (see Section 49.3.1.4). The number has no special significance, although many British Standard committees keep one number for a product (e.g. BS88: Part 4: 1988 has been retained for low-voltage fuses for the protection of semiconductor devices) and only the date is changed when the standard undergoes revision. At the time of writing it is possible that the parts of IEC 20269 corresponding to BS 88 may become Harmonised Documents (prefix HD), but it is unlikely that they will become ENs. This is because the harmonisation document permits a country to choose only those parts of the document which are to be used in that country. If the document becomes a full EN, all parts become the British Standard. Although the performance standards are practically the same for all fuses in IEC 60269, the dimensions are very different. If all the parts of the IEC standard were to be included in the EN, fuses would be supplied which would not fit into any existing UK installation, and users would not want to rip out their installations just in order to replace them with fuses of exactly the same performance but of new dimensions.

The automobile series are indicated by the letters BS AU plus a sequential number with a suffix letter which advances with every amendment (e.g. BS AU 242a: 1998).

The prefix BS ISO indicates the British version of an ISO standard, and BS CISPR similarly a CISPR document.

The prefix PAS implies a product assessment specification issued as an interim measure, and QC in the prefix relates to quality control.

The marine series are indicated by the prefix BS MA and is numbered sequentially.

The aerospace series uses a still different nomenclature, being numbered sequentially within classes, each class being indicated by a letter, e.g. 'F' for fabrics, 'S' for steels, etc. Editions other than the first bear a prefix number to show the edition. e.g. BS 3M 60:1998 is the third edition whereas in the case of BS Z 15:1998 no current standard is superseded.

Amendments became numbered sequentially under the prefix AMD, although earlier amendments were numbered as published documents (e.g. in BS 3036 Amendment No. 3 was classified as PD 5141, whereas Amendment No. 4 is AMD 2463).

Every British Standard used to be also classified according to the Universal Decimal Classification (UDC) (details in BS 1000). The UDC number was assigned at the manuscript stage and for older British Standards it can be found in small print beneath the BS number on the front cover. Every BSI publication for sale (except amendments) carries also an International Standard Book Number (ISBN) on the outside back cover. This appears usually near the top left-hand side of the back cover (e.g. on the rear cover of BS 88: Section 2.2:1988 you will find 'ISBN 0 580 16846 8).

Other general information, outside the main body of the standard, tends also to be printed on the inside and outside of the front and back cover. A group number may also be included which indicates the purchase price of the standard.

In the case of a dual numbered standard where there is identical text, the international or regional document number is printed beneath the British Standard number on the top right-hand corner of the front cover: The following example is a European Standard (EN) which is now a part of BS88:

BS EN 60269-3:1995
BS 88 Section 3.1:1995
IEC 269-3 :1987

In this example, in the numbering of the EN it can also be detected that the standard is derived from IEC 269-3. The general series of British Standards have white covers, which identifies them from other types of British Standard publication. This will have decreasing relevance as distribution goes electronic.

49.3.1.2 Drafts for development

Drafts for Development (DDs) can be regarded as equivalent to the 'provisional' or 'tentative' standards that are issued in certain countries outside the UK. They are published when guidance is urgently needed, for example in a new and rapidly developing technology, but where such guidance, though theoretically sound, has not yet been subjected to enough practical application to justify the publication of a British Standard. DDs are particularly advantageous for setting a framework for new test methods where extensive use of the tests is needed to establish satisfactory repeatability and reproducibility. The IEC equivalent to a DD is the Technical Trend Document (TTD). An example is the dual numbered document:

DD 183:1989
IEC 127-4 TTD

Drafts for Development may be converted into British Standards of any type or withdrawn when sufficient experience has been obtained and considered by the appropriate committee.

Drafts for Development are bound in vivid orange covers to distinguish them from other British standard publications. After 1992 IEC ceased publication of TTDs, and only a few DDs were current at the start of the millennium.

49.3.1.3 Published documents

Published Documents (PD) are miscellaneous documents containing supplementary information relating to standardisation. A good example is PD 5688 covering the use of 'SI Units'. This is a useful little booklet which was published by BSI when the metric system was being introduced into British Standards and everyday life in the UK. It gives a brief account of the way the SI system of units has evolved, tabulates the basic units and the principal supplementary and derived units and a few conversion factors relating SI units to the imperial units. (The SI system of units is used in all IEC Standards as well as in British Standards.)

Published Documents were all published in blue covers, except for the Education Section of PDs which had yellow coloured covers.

49.3.1.4 Codes of practice and guides

Codes of Practice have the main function of recommending good accepted practice as followed by competent practitioners. Codes of Practice assemble the results of practical experience and scientific investigation in a form that enables the reader to make immediate use of proven developments in particular branches of industry.

Before 1975, Codes of Practice were numbered in a separate CP series with a red cover. Nowadays, new and revised Codes of Practice are each given a new number in the BS series, retaining the title '*British Standard Code of Practice for . . .*'.

In contrast to British Standard Specifications, British Standard Guides and Codes of Practice are written in the form of guidance only, and are not intended to provide objective criteria by which compliance may be judged. Consequently the word 'must' is never used in a Code of Practice, and 'shall' is replaced by 'should' because none of the requirements are mandatory. Neglect of safety measures prescribed in Codes of Practice and Guides might now however be taken as evidence of liability in the case of an accident.

Care is taken by drafting committees to ensure that Codes of Practice do not become textbooks, the principles behind a particular practice being discussed or explained only when absolutely necessary. Specific recommendations for avoiding certain existing practices are made only where tacit approval of these practices would otherwise be assumed by the reader or if the practices in question may be hazardous. Where appropriate, a code offers a series of options and identifies the implications of accepting them.

49.3.1.5 Glossaries and methods

British Standard Glossaries are documents bringing together agreed sets of terms and definitions for reference. They normally contain a contents list, classified sections giving terms and definitions numbered by section and subsection in a special code which assists retrieval of information, and an alphabetic index referring to the same special code.

British Standard Methods comprise a variety of standards describing formalised ways of performing given tasks. The methods of doing this are clearly stated and explanations given of any calculations etc., necessary to complete each task. British Standard methods can be included in specifications that require them, or alternatively may be published as separate standards with a general BS reference. This is a useful arrangement when the methods are required to be called up in two or more other standards.

49.3.1.6 Handbooks

British Standards Handbooks comprise texts taken from a number of British Standards, complete and/or in part, together with related material previously published elsewhere relating to a particular field. Since a handbook might contain only an extract from a British Standard, problems of interpretation may arise. In any such case, the full text of the British Standard in question should be consulted.

An example of a Handbook was published around the time of 'metrication' mentioned above, the British Standard Handbook No. 18 'Metric Standards for Engineering', which brought together in one volume all the information then currently available on metric standards for general engineering. When first published it was a 580 page book with all available standardised metric information. Comparison of this with the little booklet PD 5686 mentioned above will give some concept of the difference between a Handbook and a Published Document.

49.3.1.7 Regulations

A Regulation is a binding document which contains legislative, regulatory or administrative rules and which is adopted and published by an authority legally vested with the necessary power. References made to standards in regulations may have one of two effects:

(1) *Standards made mandatory*: the standard or the part of the standard which is referred to must be followed, or a specific result in a standard test must be achieved in order to obey the statutory requirement. This means that the text in the standard ceases to be voluntary in the context of the legal requirement.
(2) *Standards deemed to satisfy*: in this case, compliance with the standard is indicated as one way of fulfilling a regulatory requirement. It is possible to choose another route to fulfil the requirement, but those doing so may be required to prove that their alternative complies with the regulation.

Until recently, Regulations might call up British Standards, but are not British Standards. The separation of the regulatory authority and the Standardisation body has needed modification to fit in with the arrangements with CENELEC in co-ordination of Electrical Regulations. Under EEC Directives, European Standards, dual numbered with British Standards cease to be voluntary, and thus effectively become Standard Regulations. This may require changes to the present UK organisation of the regulatory process.

The principal example of this is the case of the *IEE Wiring Regulations—Regulations For Electrical Installations*, popularly known as the 'wiring rules'. These are at present drawn up by the Wiring Regulations Committee of the Institution

of Electrical Engineers. The parallel international work takes place in IEC, which is the international equivalent of the electrical aspects of BSI. The international work on regulations for electrical installations is undertaken by IEC TC64 and the position of the UK regulatory system would fit better into the system if parallel work was carried out by BSI committees issuing standards which take into account CENELEC harmonisation documents. More detail of the problems of co-ordination with International Standards (such as IEC 60364—'Electrical Installations of Buildings') was made in the preface to the 15th edition (amended) of the IEE wiring regulations. Such a reorganisation would not necessarily change the organisations or expertise used in doing the technical work but the Regulations have had to become harmonised standards. These difficulties were resolved in the year 1990/91 by the formation of BSI committee PEL/64 and its subcommittees matching equivalent IEC/TC64 and CENELEC TC64 committees and sub-committees.

In 1997, the 16th edition of the wiring regulations was also published as the second edition of BS 7671.

49.3.2 International equivalents of British Standard documents

As has been noted in Section 49.3.1.1 and Section 49.3.1.2 and elsewhere there are equivalent IEC and European Standards to the more important electrical British Standards. These are indicated by the dual numbering system. As time progresses, however, the distinctions between all such documents tend to decrease, and national deviations diminish. This is particularly the case within Europe, where CENELEC regulations stipulate conditions giving European Standards the status of a national standard without any alteration in the member states.

Many standards current in North America do not have direct equivalents elsewhere. If the USA with its North American bloc could move a little faster in aligning its national standards with IEC, we could see most national deviations vanishing by the year 2050.

49.3.3 Structure of a typical standard

Since most electrotechnical British Standards are directly derived from IEC standards, the structure and wording of the standards originates in IEC decisions rather than independent national decisions. The following is the structure of a typical IEC standard specification:

(a) Foreword (followed by preface and introduction where appropriate), giving the background to the specification and its international development;
(b) Scope;
(c) Object;
(d) Definitions;
(e) Conditions For Operation in Service;
(f) Classification;
(g) Characteristics;
(h) Marking;
(i) Standard Conditions for Construction; and
(j) Tests.

This structure has been criticised in the past in that it sometimes leads to a certain degree of repetition in different clauses. However this disadvantage is offset by the considerable advantage that all the requirements are clearly stated in each clause, and *all* the test requirements are gathered together in the final section rather than being distributed throughout the text. It is thus perfectly clear exactly what has actually been tested and what the product has achieved if it successfully complies with the specification.

49.3.4 Implementation of standards

The implementation of standards is controlled by factors seen above to be changing with the growth of international regulation. British Standards have historically always been *voluntary* in their implementation. However, the changes implied by the EEC Directives are shown above to make them *mandatory* when they become ENs. A similar situation is seen in Section 49.3.1.7 to exist with Regulations.

A British Standard Specification forms part of the trade description of a product when quoted by a BS number or when compliance with it is claimed. Marking with a BS number constitutes a unilateral claim that the product complies with *all* the requirements of the BS quoted. The person making such a claim is responsible for its accuracy under the Trade Descriptions Act 1968. To support their claims, manufacturers may have their products certified (see Section 49.4) as complying with the requirements of the appropriate British Standard Specification.

The existence of a British Standard Specification facilitates the preparation of contracts, and any British Standard Specification invoked in a contract becomes legally binding on the contracting parties. However, the compliance with the British Standard does not of itself confer immunity from legal obligations. The user is only guaranteed that the product supplied complies with all the requirements of the standard, and must satisfy himself that these are sufficient to fulfil the tasks for which he is purchasing the product. Many British Standard Specifications contain options and other matters which need to be clarified in any contract to ensure that the correct variant of the British Standard is being specified.

As explained above, British Standard Codes of Practice, Guides and similar recommendations are written in the form of guidance only, and are not intended to provide objective criteria by which compliance may be judged. Such publications are not appropriate for simple reference in contracts.

There are three methods of reference to British Standards used in Regulations and elsewhere:

(1) *Reference to standards by exact identification (strict reference)*: one or more specific British Standard(s) are designated in such a way that later revisions of any such British Standard will not be applied unless the reference is modified. The British Standard is usually indicated by its number and date. This is the method of reference normally used in the UK.
(2) *Reference to standards by undated specification (undated reference)*: one or more specific British Standard(s) are designated in such a way that later revisions of any such British Standard will be applied without the reference needing to be changed. In this case the British Standard is usually designated by its number only.
(3) *General reference to standards*: reference is made in a general way to present and future standards, which means that the relevant reference includes a general clause so that all the present and future standards in a specific field are regarded as meeting the aims of the document containing the reference (e.g. the document could be a regulation).

49.4 Testing, certification and approval to standard recommendations

To confirm compliance with British Standards it is necessary to test and to mark the appropriate products to identify compliance with the appropriate British Standard and/or that the manufacture is maintained at an acceptable level of quality. BSI operates four certification marking systems:

(1) The '*kitemark*', the BSI's certification mark indicates not only compliance with the appropriate standard, but also compliance with a rigorous program of surveillance, inspection and follow-up testing at regular intervals.
(2) The '*safety mark*', which was introduced in 1974 to provide manufacturers with a means of demonstrating compliance with a British Standard specifically related to safety.
(3) The '*registered firm symbol*', operated for manufacturers who produce goods which are not at present covered by a British Standard.
(4) The '*BS 9000 mark*' for electronic components certified under the BS 9000 system.

In its certification activities, BSI does not have, or seek, a monopoly position, but responds to UK needs and aims to provide a service which can be used by industry. Through the Quality Assurance Council the BSI cooperates with other organisations concerned with certification of compliance with standards. The more important of these are:

(1) British Electrotechnical Approvals Board (BEAB);
(2) British Approvals Service for Electric Cables (BASEC);
(3) Association of Short-Circuit Testing Authorities (ASTA);
(4) British Approvals Service for Electrical Equipment for Flammable Atmospheres (BASEEFA).

The BSI has compiled a register of test houses of assessed capability indicating their fields of testing.

The BSI Certification and Assessment Department is responsible not only for the certification of products but also for the assessment of the capabilities of the firms in manufacturing and service industries. The growing realisation of the importance of quality and reliability in goods and services has caused rapid growth in the percentage of firms seeking registration in schemes such as BS 5750. Registration and maintenance to such a quality standard has a dual advantage. Compliance is not only an attraction to customers, it is also a benefit to the efficient business of the registered firm improving its competitiveness and ensuring the maintenance of that quality by independent assessment to the British Standard.

The BSI Test House centred at Hemel Hempstead provides a wide range of testing facilities which are generally available to clients world-wide and embraces tests which are electrical, electronic, mechanical, chemical, photometric, automotive, etc. (www.inspectorate.com)

BSI also carry out import/export inspections, arranging for inspection before shipment at the place of manufacture. The BSI inspectorate is accredited by the following organisations in the UK:

(1) BSI,
(2) BASEC,
(3) Department of the Environment (Property services agency)
(4) Department of Transport,

and it also has accreditation from the following overseas organisations:

(1) Canadian Standards Association (CSA),
(2) Centre Technique du Bois (*France*),
(3) Institute for Industrial Research and Standards (IIRS) (*Eire*),
(4) Instituto del Marchio di Qualita (IMQ) (*Italy*),
(5) Staatliches Materialpruefungsamt (MPA) (*Germany*),
(6) Standards Association of Australia (SAA),
(7) Standards Association of New Zealand (SANZ),
(8) Statens Planverk (*Sweden*),
(9) Technishe Uberwachungs Verein (TUV),
(10) Underwriters Laboratories Inc. (UL),
(11) Underwriters Laboratories of Canada (ULC)
(12) Verband Deutscher Electrotechniker (VDE) (*Germany*).

BEAB certifies household appliances and all home laundry equipment, heating and cooking appliances, refrigerators and freezers, home sound and vision equipment, etc. for compliance with relevant British Standards, for example the many parts of BS 3456. These are mostly already in agreement with CENELEC HDs and the ENs which are superseding parts of BS 3456.

Many retailers in the UK large and small will only stock BEAB-approved appliances.

BASEC provides a certification scheme for manufacturers of electric cables and flexible cords, and ensures that ongoing quality control procedures are adequate to ensure consistently high standards. BSI provides the assessment and inspection facilities (but not the operations management service which it provided in earlier years).

ASTA operates a certification and product marking scheme for circuit-breakers, fuses, fuse-links, fuse-boards, switches, isolators, starters, transformers, reactors and electrical wiring accessories. It offers a number of classes of test certificate, including a certificate of complete compliance with the requirements of a relevant standard.

BASEEFA certifies electrical equipment using any of the recognised forms of explosion protection, and certifies equipment intended for zone II areas. Certification is against recognised standards, where these are available, and otherwise to standards prepared by BASEEFA.

International Standards are prepared with great care, and every attempt is made to avoid ambiguity in specifying tests. However, where any possible ambiguity becomes apparent in the practical performance of the tests, the above bodies assess the most appropriate interpretation of the test. Such interpretations are today often agreed internationally by groups representing test authorities so that tests are of equal severity wherever carried out.

49.5 Sources of standards information

Many libraries throughout the UK have stocks of British Standards and some also stock foreign standards. The most comprehensive source of information, however, is the BSI which has established an extensive standards information service.

BSI library and enquiry service The BSI Library contains a full set of all current and superseded British Standards, a collection of International Standards and complete sets of standards from 80 foreign standardisation bodies. This is one of the world's largest collections of standards, comprising over half a million documents. Documents are available

on loan to members of BSI at a small charge.Tel: 0208 996 7004 fax: 0208 996 7005

BSI PLUS (private list updating service) Available to BSI subscribing members. PLUS monitors and updates subscribers' standards library automatically.

BSI enquiry service This deals with direct enquiries concerning British Standards, international regional and foreign standards. e-mail: info@bsi.org.uk or look in at the website http://www.bsi-global.com

BSI catalogue This publication, up-dated annually, lists all published British Standards and other special series, together with short abstracts.

BSI update STANDARDS These are issued monthly cumulatively up-dating the latest catalogue and gives details of all new and revised British Standards, amendments, withdrawals, renewals, drafts issued and new work started, as well as details of IEC and CENELEC documents.

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