BRITISH STANDARD

BS 6150 : 1991

Code of practice for

Painting of buildings

Code de bonne pratique pour la peinture des bâtiments

Richtlinie für das Anstreichen von Gebäuden

STANDARDS

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Basic Data and Performance Criteria for Civil Engineering and Building Structures Standards Policy Committee (BDB/-) to Technical Committee BDB/7, upon which the following bodies were represented:

Association of Metropolitan Authorities
British Constructional Steelwork Association Ltd.
British Plastics Federation
British Steel Industry
British Wood Preserving and Damp-proofing Association
Chartered Institution of Building Services Engineers
Convention of Scottish Local Authorities
Department of the Environment (Property Services Agency)
Health and Safety Executive
Incorporated Association of Architects and Surveyors
Institute of Clerks of Works of Great Britain Inc.
Institution of Civil Engineers
Institution of Structural Engineers
London Regional Transport
Royal Institute of British Architects
Royal Institution of Chartered Surveyors
Union of Construction, Allied Trades and Technicians
Zinc Development Association

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

Association of Painting Craft Teachers
British Decorators Association
British Railways Board
Department of Health
Department of the Environment (Building Research Establishment)
National Federation of Painting and Decorating Contractors
Oil and Colour Chemists Association
Paint Research Association
Paintmakers Association of Great Britain Ltd.
Scottish Decorators Federation
Timber Research and Development Association

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Contents

Foreword

This code of practice is a new edition of and supersedes BS 6150 : 1982, which is withdrawn. This edition introduces technical changes by the inclusion of various amendments (particularly to clauses **25**, **28** and **29**) circulated for public comment in November 1989. Other changes have also been introduced as a result of the comments that had been invited regarding all sections, appendices and tables of BS 6150 : 1982. Whilst these changes bring the standard up-to-date, they do not reflect a full review of the standard which will be undertaken in due course.

Coating materials and processes are subject to continuing development and improvement, and the recommendations in this code do not preclude the use of other materials or processes when these can be shown to have equivalent or better performance.

Standards relating to specific coatings are included in the list given on page 131.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Section 1. General

1 Scope

This code provides recommendations for good practice in the initial and maintenance painting of buildings, e.g. dwellings, offices, light industrial buildings, schools, hospitals, hotels and public buildings generally, in which decoration is a significant and often the major factor. The code does, however, take into account the need to protect many building materials against the weather or other forms of attack normally encountered in the types of buildings referred to. For guidance on the protection of steel structures, reference should be made to BS 5493 and DD 24.

The coatings referred to in this code are principally of conventional type, as defined in **21.2**, but limited reference is made to specialist coatings (**21.3**) and factory-applied coatings (**21.4**). In respect of materials generally, the code does not claim to cover in detail the wide and constantly increasing range available. Some materials have been excluded because of their obsolescence, limited or specialized usage or, in the case of newly-developed products, lack of experience of their performance in service.

NOTE 1. Product references (see **21.2**) are indicated in the text by figures in parentheses, e.g. (1/2), and refer to the products listed and described in tables 1 to 8.

NOTE 2. Bibliographic references are listed in appendix C.

The code does not cover:

(a) decorative processes such as graining, marbling, glazing, scumbling, gilding and other work usually carried out by specialists;

(b) the particular requirements of listed or historic buildings;

NOTE 3. Notice to the Department of the Environment of work on buildings scheduled under the Ancient Monuments Acts is required by law.

(c) limewash and distemper coatings;

NOTE 4. These materials are either made up from dry powders or are supplied as ready-mixed formulations. They are significant for reasons of traditional compatibility, permeability, hygiene and economy; especially in relation to some older buildings, and to medical and agricultural applications. Information and advice regarding these materials may be obtained from the Society for the Protection of Ancient Buildings and from the British Lime Association.

(d) preservative treatments for structural timber, for which reference should be made to BS 5268 : Part 5;

(e) coatings for fire protection, for which reference should be made to BS 8202.

The recommendations made in the code are intended to facilitate achievement of standards of finish likely to be acceptable in most cases in the types of buildings referred to above, providing that the work of other trades has been completed to a satisfactory standard. Where especially high standards of finish are required, more elaborate processes and systems than those described in the code may be necessary and should be specified accordingly.

NOTE 5. The titles of the publications referred to in this standard are listed on page 131.

2 Definitions

For the purposes of this British Standard, the definitions given in BS 2015 apply.

3 Use of the code

It should be noted that this code is not intended to be cited in its entirety as a substitute for a detailed specification.

Correct selection of coating systems and clear, precise specifying of methods and processes are essential, and it is a major function of this code to give guidance on these aspects. However, they will not alone ensure that the chosen systems perform satisfactorily, and it is equally important that consideration be given to the factors described in section 2 of the code. Of particular importance in relation to performances are the influence of design and detailing, proper organization and supervision and, in some circumstances, an effective inspection procedure. It is recommended that all users should refer to section 2 as a preliminary to the selection of coating systems.

Clause **9** (in section 2) and appendix A describe some of the particular hazards to health and safety that may be encountered in the painting of buildings, and the precautions that should be taken. They also refer to applicable legislation. These aspects should be considered in terms of a safe system of work. The health and safety of all persons involved in the building during the painting process, including client, occupier, painter, supervisory and inspection staff, should be ensured. The general safety hazards of access for painting are not dealt with as these are covered by other standards to which reference is made : see appendix C of BS 8210 : 1986.

Section 3 provides general information on the functions and components of coating systems and the properties of individual materials. Experienced users may not require such detailed information, but all users should familiarize themselves with tables 1 to 8 which allocate product references to the main types of coatings, these references being used for identification purposes in later sections.

Section 4 gives guidance on the general principles of selection and describes the characteristics, preparation and subsequent treatment of the new or untreated substrates normally encountered in buildings. The tables in this section, in conjunction with tables 1 to 8, provide basic information on systems for the various substrates and include information on life expectancy. The tables may be useful for quick reference, but study of the accompanying text, and especially of clause **24**, is recommended.

Section 5 is concerned with the practical aspects of initial and maintenance painting, including craft practice, application methods and inspection procedures. All users, whether or not they are directly involved with application, should refer to this section since much of the information given is relevant to the preparation of specifications.

Section 6 describes considerations in respect of maintenance treatment not dealt with elsewhere in the code, including the economic aspects, planned maintenance and the treatment of previously painted surfaces.

Section 2. Design, specification and organization

4 Introduction

Section 2 describes aspects of initial or maintenance painting to be considered at an early stage. Where appropriate, reference is made to other sections of the code where more detailed information is given.

5 Design considerations

5.1 General

All parts of a building to which coatings are to be applied should be designed to avoid, as far as possible, the creation of features or conditions that may cause difficulties in application, impair the performance of coatings or promote decay or corrosion of structural materials. Points to which attention should be given are indicated in **5.2** to **5.6**.

5.2 Accessibility

Spaces between adjacent wood or metal members, e.g. in roof trusses, should be sufficiently wide to allow access for painting. Alternatively, hidden or contact surfaces should receive protective treatment before assembly or erection. Pipes and similar components should be fixed sufficiently clear of walls to allow them to be painted completely.

Access for external repainting should be considered at the design stage. Where repainting cannot be carried out from ladders, balconies or the interior of the building, permanent cradle rails should be provided or provision made for the anchoring of cradle supports. Similar arrangements should be made for lofty internal spaces.

5.3 Exclusion of moisture

Penetration of moisture is a common cause of the premature failure of coatings; it may also lead to decay or corrosion of structural materials. Attention should be paid to the design and location of damp-proof courses and membranes, vapour barriers, flashings, weatherings, drip-mouldings and throatings. Measures should be taken to prevent the retention of water on horizontal surfaces, e.g. by bevelling or sloping them or, in the case of structural metalwork, by providing drainage holes. Rainwater run-off or dripping on to coated surfaces should be prevented by appropriate detailing. See also **25.2.1** and **27.3**.

5.4 Condensation

In varying degree, condensation is likely to occur at times in some part of most buildings. Persistent heavy condensation may cause failure of coatings, and measures to prevent or minimize it should be considered at the design stage, especially where processes or activities carried on in the building create conditions of high humidity. See **41.2** and **41.3**.

5.5 Profiles

Coatings have a tendency to recede from sharp edges during application and this may result in the film having inadequate thickness at these points. Timber arrises should be slightly rounded, a radius of 1 mm to 2 mm for timber other than sills and thresholds usually being sufficient: sills and thresholds may need a 3 mm rounding. Sharp edges of metal, e.g. burrs and nibs, should be removed before painting.

5.6 Substrates and coating systems

The properties of substrates and their influence on the selection of coating systems should be considered at the design stage. These factors are discussed in section 4.

Building materials to which coatings are to be applied should be chosen for their inherent properties of durability and resistance to decay or corrosion in the environments in which they are to be used. Over-reliance should not be placed on the ability of coatings to upgrade the performance of inherently unsuitable materials, especially in circumstances where frequent maintenance is likely to be impracticable or uneconomic.

Consideration should be given to alternative or supplementary treatments, e.g. galvanizing or sprayed metal coatings (see **28.2.2**), and to ancillary treatments such as wood preservatives (see **25.3**), to enhance the protection afforded by coatings. Consideration should also be given, when the facility is available, to the factory application, wholly or in part, of coating systems. This is often more satisfactory than site application and may offer a wider choice of systems.

6 Environmental considerations

The general and local environments and the conditions of service are major factors to be taken into account in the selection of coating systems. Reference should be made to clause **24** for general guidance on the principles of selection and to clause **41** for information on special conditions and requirements which may influence selection.

7 Documentation

7.1 General

Specifications and other documents that may be required in respect of initial or maintenance painting should be prepared in sufficient detail to afford proper guidance in the preparation of estimates and the execution of the work.

Where relevant, there should be an exchange of information at an early stage between the painting contractor or subcontractor and those responsible for the constructional work, including other trades whose work may affect or be affected by painting.

A painting project may involve several parties, including client, main contractor and subcontractors, suppliers and inspectors. Copies of all relevant documents should be available to all parties, including site personnel responsible for supervision.

General requirements in respect of painting specifications and associated documents are described in **7.2** to **7.5**.

7.2 Specifications

7.2.1 *General*

The prime functions of a specification for initial or maintenance painting are as follows:

(a) to describe the substrates to be treated and the means by which the required finish is to be achieved. 'Means' includes surface preparation, materials, systems, application methods (where relevant) and the conditions under which the work is to be done;

(b) to provide a basis for accurate pricing and tendering;

(c) to serve as a comprehensive reference document for all parties;

(d) to act as a reference if disputes arise or arbitration is necessary.

Specifications should be clear, concise and unambiguous. It should not be assumed that anyone expected to comply with an instruction or requirement in a specification will correctly infer its intended meaning if an alternative interpretation is possible; nor should it be assumed that an ambiguity will be clarified by its context. Aspects to which special attention should be given in the preparation of painting specifications are described in **7.2.2** to **7.2.6**.

7.2.2 *Surface preparation*

With the possible exception of structural steelwork, there are no standards for preparatory work which have general application to the wide range of substrates and surface conditions likely to be encountered in the painting of buildings. Nevertheless, because of the influence of preparation on costs, appearance and subsequent performance, the nature and extent of preparatory work should be specified as clearly as possible. In particular, imprecise terms such as 'Thoroughly prepare' or 'Burn off where necessary', without further qualification, should be avoided; see also **53.2.1**.

In some circumstances, it may be difficult to describe, with any degree of precision, the standard of preparation to be achieved. An example is the preparation of walls bearing thick residues of old coatings. In such cases, a sample area can be prepared as an indication for tendering purposes of the standard required. If this approach is adopted, it should be ensured that the indicated standard can be achieved on the remainder of the work.

Any particular method of preparation specified should be appropriate and relevant to the result required. For example, a requirement to 'Remove all rust and scale by chipping, scraping and wirebrushing' cannot be achieved (see **27.5.2.5**); the choice lies between specifying a more effective method or accepting a lower standard of preparation.

7.2.3 *Materials*

All the materials in a coating system should, if possible, be obtained from the same manufacturer. Differing makes or brands specified should be compatible; see **20.5**.

The specification should require materials to be applied or used strictly in accordance with the manufacturer's instructions.

7.2.4 *Application methods*

The specification should state if circumstances require or preclude the use of particular methods of application.

7.2.5 *Application conditions*

The specification should indicate any requirements or constraints in respect of the conditions under which work is to be carried out or, if necessary, suspended, e.g. of temperature, humidity, climatic conditions or other factors; see clauses **44** and **52**.

7.2.6 *Inspection procedure*

If the work is to be subject to inspection the intended procedure should be described in the specification. See also clause **14**.

7.3 Bills of quantities

These should be prepared in accordance with the relevant edition of a document such as 'SMM7, Code of Practice for the Method of Measurement of Building Works', or 'The Code for the Measurement of Building Works in Small Dwellings', as appropriate.[1] It is essential that the relevant edition, or any other method of measurement adopted, should be stated.

[1] Both of these documents are published and supplied by the Royal Institution of Chartered Surveyors.

7.4 Schedules

For work of modest size or where relatively few finishes or colours are to be used, information identifying different systems with particular areas can often be incorporated in the painting specification. For large or more complex projects, the preparation of a finishing schedule, detailing location, nature of substrate, coating system and (where relevant) colour, is recommended.

A schedule of finishes should not be regarded as a substitute for the painting specification; site personnel responsible for supervision should have copies of both documents.

7.5 Drawings

These may be required on large projects for tendering purposes or as an aid to the organization and control of work. Drawings are often essential in order to locate the areas referred to in schedules.

8 Organization of work

Where applicable, painting work should be planned in relation to the work of other trades, to ensure that surfaces are in a fit condition to be painted and that completed work is not damaged by subsequent building operations; in particular, ample time should be allowed for drying out of plaster and similar surfaces before they are painted.

In maintenance painting in factories and commercial buildings, it may be necessary for work to proceed without interrupting the normal functions of the building. This will require careful planning to avoid inconvenience to the occupants and minimize loss of productive time by the contractor. In such circumstances, it may be necessary to allow for the erection of temporary partitioning or other means to isolate the areas where painting is in progress.

9 Health and safety

The recommendations of appendix A should be followed, concerning the manner of dealing with typical hazards to health and safety that may be encountered in the painting of buildings. It is beyond the scope of the code to provide complete coverage of all aspects, and attention is drawn to current legislation in relation to health and safety and the relevant statutory requirements.

In particular, attention is drawn to the Control of Lead at Work Regulations 1980, the Control of Substances Hazardous to Health Regulations 1988 and the Noise at Work Regulations 1989.

In cases of doubt on matters relating to health and safety, reference to the Health and Safety Executive Guidance Notes is essential. Information on the properties or constituents of coatings or other painters' materials which may affect health and safety should be obtained from manufacturers or suppliers and the precautions set out in their safety data sheets and container labels should be taken. All preservatives should be handled with care in accordance with the manufacturers' specific instructions. In particular, attention is drawn to the Control of Pesticides Regulations 1986.

Potential hazards include the following:

(a) inhalation, absorption through the skin or ingestion of toxic substances, including fumes, vapours and dusts;

(b) injury to eyes and skin;

(c) fire and explosion;

(d) noise;

(e) lack of personal hygiene.

Hazards may also be created by the use of unsuitable or defective scaffolding. Consideration of this aspect is beyond the scope of the code but guidance is given in BS 5973.

10 Records

Much painting and decorating work is carried out at regular intervals as a maintenance operation, and a planned approach is essential. Planning, in turn, is dependent on availability of information, and it is recommended that, where expenditure on maintenance painting is significant, accurate records should be maintained. The essential information to be recorded should include dimensions, details of initial and maintenance coating systems (including preparation) and costs. Other relevant information may include the conditions (e.g. of weather, atmosphere or environment) under which the work was done, methods of application employed, size of labour force and any special difficulties or problems encountered. When work is subject to independent inspection during application (see clause **14**), inspection reports should be retained as a permanent record. Similarly, where a system of regular inspection of paintwork is in operation, as recommended in clause **49**, the observations made should be recorded. Apart from its contribution to ease and economy of maintenance, a system of recording as described can assist in the investigation of failures and the settlement of disputes.

11 Off-site work

Factory application of coating systems, wholly or in part, to a variety of components is now well established. Typical examples of components partially treated by the manufacturer or supplier include primed joinery, blast-cleaned and primed steelwork, pretreated non-ferrous metal components and primed or sealed building boards. Other components may be finished completely in the factory, often with stoving or cold-curing coatings.

Where components are to be supplied partially-finished, e.g. primed, the treatment or coating should have properties appropriate to the environment or conditions of service to which it will be exposed. Also, the primer (or other treatment) and the coatings to be applied on site should be compatible. Measures to minimize damage to the treatment during transit should be taken by the supplier; recommendations for repairing any damage that may occur should be incorporated in the painting specification for the site work.

Special care should be taken with components that are supplied fully finished, to prevent damage during transit and on site, as it may not be possible to effect repairs to a standard equal to that of the original finish. The manufacturer's or supplier's recommendations for repairing damage and for subsequent maintenance treatment should be obtained.

12 Protection of components on site

Measures should be taken to prevent damage or deterioration of components and factory-applied treatments on site, i.e. during off-loading, handling, storage and erection. If mechanical lifting equipment is used in handling large or heavy components, slings should be well padded at contact points. Wrapping or other means of protection provided by manufacturers should not be removed before it is essential to do so. Factory-finished articles and components should be stored away from 'traffic' areas and be protected against damage and soiling.

Joinery, whether primed or unprimed, should not be stored out of doors, especially when it is to be installed in a centrally-heated building. If external storage cannot be avoided, the components should be protected against moisture and weather. Components, whether stored indoors or outdoors, should not be in direct contact with the ground. If stacking is necessary, spacers should be provided between the components to permit air circulation and, in the case of primed joinery, to prevent sticking at contact surfaces.

Metal components prepared and painted with part or the whole of the coating system before delivery to site should, if their size permits, be stored indoors; if stored outside they should be protected and, if necessary, stacked as described for joinery.

Primed structural steel members, if stored in the open, should be stacked in such a manner that they do not retain water even if no cover is provided. The bottom layer in the stack should be laid on timber packings to raise it above the ground and the rainwater splash zone. Spacers should be placed between subsequent layers to permit air circulation and prevent sticking.

Consideration should be given to applying additional coats, e.g. of primer, when there is a possibility of long delay between initial and final painting after erection.

13 Workforce and supervision

The number of operatives employed should be appropriate to the size of the contract, its planned duration and the nature and availability of the work involved. Preparation is generally more labour intensive than application, and the size and deployment of the workforce should allow for this. With tiring or tedious operations, such as the preparation of steelwork by manual cleaning (see **27.5.2.5**), adequate manning assists in the maintenance of satisfactory standards and also facilitates priming of prepared surfaces without undue delay. On extensive ceiling and wall areas, the number of operatives deployed should be sufficient to enable working edges to be kept 'alive' (see **46.2.3**) and should take into account working conditions and the characteristics of the coatings to be applied.

Operatives should be skilled and experienced in the types of work involved and with the materials, methods and equipment to be used. With novel materials, methods or equipment, special training may be required.

Adequate supervision should be provided, having regard to the nature of the work and the size and deployment of the workforce. Supervisors should be experienced in all aspects of the work for which they are responsible. They should be provided with copies of all working documents, e.g. specifications, finishing schedules and product information necessary for effective supervision and control of the work. They should also be provided with, or have ready access to, test equipment, e.g. moisture meters, film-thickness gauges and flow cups, when the nature of the work requires it.

14 Inspection requirements

For large contracts, each stage of the work may be subject to inspection and approval by a nominated

person or specialist inspection organization.
The essential purpose of such an arrangement is to ensure compliance with the specification; it is not of itself a guarantee of good performance if the specification is unsound or inadequate.

Where a scheme of inspection is to operate, the intended procedure should be stated in the specification so that contractors are aware of the implications at the tendering stage. It should be appreciated that inspection does not remove or diminish the contractor's responsibility for proper supervision of the work.

Inspection procedures are described in clause **47**.

15 Materials sampling and testing

This clause describes the general considerations in relation to sampling and testing of materials. Procedures are described in clause **47**.

Routine sampling and testing is usually carried out for one or both of the following reasons:

(a) to ensure compliance by suppliers with specifications or stated requirements for materials;

(b) as a safeguard against overthinning, adulteration or similar undesirable practices during application.

In either case, site action is usually confined to taking or setting aside samples for examination in the specifying authority's own laboratory or with an independent testing organization.

Where sampling and testing is carried out for the reason indicated in (a), samples should be in the original unopened containers.

It is usually the responsibility of the specifying authority to arrange for testing, but if the specification requires the contractor to provide such samples then the frequency of sampling and the quantity of material to be provided should be clearly stated.

In respect of (b), the procedure will usually require samples to be taken during application, e.g. from painters' kettles or spray-equipment containers. Subsequent testing is generally the responsibility of the specifying authority, but the specification should define the contractor's responsibility for providing samples and describe the tests that will be carried out, e.g. by reference to BS 3900.

Sampling and testing procedures can be time-consuming and expensive and will be effective only if they are properly implemented.

Section 3. Materials

16 Introduction

Materials used in the painting of buildings fall into three main categories:

(a) pigmented coatings, i.e. paints and wood stains;

(b) clear coatings, e.g. varnishes and lacquers;

(c) ancillary materials, e.g. fillers, stoppers and materials similarly used in the preparation of surfaces or in coating systems.

Clauses **17** to **21** and tables 1 to 8 provide information on the types of coatings in general use in the painting of buildings as an aid to selection, specification and use. Ancillary materials are described in clause **22**.

17 Functions of coatings

17.1 General

The possible functions of coatings in relation to building surfaces are many, but those described in **17.2** to **17.6** are typical. In some situations the requirements may be so specialized as to need individual consideration by a consultant or paint manufacturer with experience in the particular field.

17.2 Protection

Essentially, this depends upon the ability of the coating to prevent moisture, atmospheric pollutants, aggressive chemicals or other destructive elements coming into direct contact with the surface. In this respect, the effectiveness of the coating will depend upon its composition and especially its thickness and also upon the severity of attack. Whenever possible and particularly in severe conditions, consideration should be given to reducing dependence on the protective properties of coatings, e.g. by using less vulnerable building materials, by modifying the design of components or by environmental changes such as improved ventilation; see clause **6**.

17.3 Decoration

Even where the main emphasis is on protection or other function, coatings are usually expected to contribute to the overall appearance and decorative effect of buildings; in many instances, paint will be the main decorative medium, providing the required colours and degree of gloss or texture.

Careful choice of paint colours and their coordination with those of other elements in the decorative scheme, such as furnishing fabrics, floor coverings, laminated and ceramic goods, is important. BS 4800 provides a range of paint colours derived from the 'parent' BS 5252 and, in conjunction with other 'satellite' ranges, affords the facility for fully coordinated schemes to be designed.

The aesthetic aspects of colour are not within the scope of this code, but practical considerations relating to paint colours are described in appendix B.

17.4 Hygiene

The ability to withstand regular cleaning is often a requirement in a coating; where high standards of hygiene or sterile conditions have to be maintained, this may be the most important function.
The coating should be of a type which will be resistant not only to the soiling agent but also to the cleaning agent and method used.

In situations favourable to the development of mould growths, coatings having fungicidal properties may be helpful, although too much reliance should not be placed on the ability of coatings alone to prevent mould growth and, where possible, they should be supplemented by other measures as described in **41.4**.

17.5 Identification

A useful function of paint is as a means of identifying the nature of piped services and the location of safety appliances by means of colour codes. BS 1710 and BS 5378 give details of this application.

'House' colours are used by many large organizations to give corporate identity to buildings, equipment, vehicles, etc. Many standard colours of this nature used by official bodies are embodied in BS 381C.

17.6 Special functions

In some circumstances there may be specialized requirements, e.g. of resistance to high humidity or direct chemical attack, reduction of surface spread of flame and inhibition of mould growth. These and other special requirements are referred to in clause **41**.

18 Constituents of coatings

18.1 General

Most coatings consist of binder, solvent or thinner and, in paints and stains, pigment. The binder is the non-volatile film-forming constituent of the coating. The solvent or thinner imparts the required degree of fluidity to the binder during application; the combination of binder and solvent forms the 'vehicle' or 'medium' of the coating.

Pigment provides colour and opacity and may have other functions in some types of coatings. Other constituents may be present to ensure the stability of the coating or to prevent deterioration in storage.

18.2 Binders

18.2.1 ***General***

The nature and proportion of binder present in a coating largely determines its characteristics, e.g. method of drying, compatibility with other coatings, application properties, degree of gloss, durability and resistance to attack. A characteristic of many binders is that they are dispersions or solutions of synthetic or natural resins or polymers. Individual resins and other film-forming materials differ widely in properties and provide the basis for a great variety of coatings. The types of binder in general use are described in **18.2.2** to **18.2.7**.

18.2.2 ***Drying-oil binders***

Many vegetable oils, notably linseed, soya and tung oils, dry slowly to form tough, elastic films when exposed to air; some primers employ binders of this type. More usually, drying oils are combined with resins to produce an oil-modified alkyd, usually referred to simply as alkyds. These alkyds can be further modified by the inclusion of other resins, e.g. polyurethane or silicone, to impart specific properties such as hardness, gloss retention or flexibility. Alkyds are used to produce clear coatings (varnishes) or, when pigmented, paints.

Coatings based on drying-oil type binders are characterized by being relatively slow in drying and hardening compared with emulsion-based types. The actual rate depends upon their composition and the conditions of application, but typically they are dry to touch in 4 h to 8 h and recoatable overnight. Initial drying and hardening is slower or may cease altogether in cold or damp conditions or in atmospheres where the supply of oxygen is restricted. Drying and hardening may also be retarded by the presence of grease or dirt on the surface to which the coating is applied.

Drying-oil type coatings are invariably organic solvent-thinned, usually with white spirit, although manufacturers' recommendations in this respect should be observed; see **18.3**.

18.2.3 ***Emulsion binders***

These are aqueous dispersions of particles of synthetic polymers, e.g. vinyl or acrylic, alone or in combination, and contain no drying oils. Drying and hardening proceed by evaporation of the water followed by coalescence of the particles. In favourable circumstances, they are dry to touch or even recoatable in an hour or two, and full washability is attained within a day or so of application. Damp atmospheres retard evaporation and cause delay in drying whilst very low tempratures may prevent coalescence and produce an unsatisfactory film.

Emulsion paints are used mainly as coatings for walls and ceilings, but many primers, undercoats and finishes, traditionally formulated with drying-oil type binders, now have emulsion-based equivalents. Bituminous emulsions are also available, see **18.2.7**.

Emulsion-based coatings usually have less odour than those containing drying oils and/or organic solvents. Also, water, rather than expensive thinners, can be used for thinning and for cleaning tools and equipment after use.

18.2.4 ***Chemically-curing binders***

Coatings employing binders of this type are supplied as two-pack materials, one container holding the 'base' and the other the appropriate quantity of 'curing agent', 'hardener' or 'activator'. The two components are combined shortly before use to induce a chemical reaction which converts the applied film from liquid to a solid state.

Typical examples utilize epoxy or polyurethane resins and are available as clear or pigmented coatings. These have excellent resistance to chemical attack and abrasion but require high standards of surface preparation. 'Curing' of the film is temperature-dependent and is slowed or may be inhibited completely at low temperatures. These factors tend to limit the use of coatings of this type on building surfaces.

Epoxy and polyurethane resins may be combined with other resins, notably alkyds, in drying-oil type binders to produce 'one-pack' materials, but these are not 'chemically-curing' and do not have the degree of chemical and abrasion resistance characteristic of the 'two-pack' types.

18.2.5 ***Solution binders***

In these, film-forming material is in solution, and conversion to the dry film is accomplished essentially by evaporation of the solvent. Examples include solutions of shellac (knotting) treated rubber (mainly chlorinated and isomerized), vinyl-type resins, nitrocellulose and bitumen.

Although the properties of solution binders vary considerably, a general characteristic is that they tend to remain more or less soluble in the original solvent, and this may create difficulties in applying several coats of the same material, especially by brush. Another characteristic is their rapid drying which, again, may make them difficult or impossible to apply by brush to large areas. Modification with other materials can improve application properties; for example, chlorinated rubber may be combined with alkyd/drying oil although at the expense of some reduction in its chemical resistance.

18.2.6 ***Inorganic (cement and silicate) binders***

White Portland cement forms the binding agent in cement paints for use on concrete, brickwork and similar surfaces. This type of coating is usually supplied in powder form and mixed with water immediately before use.

In continental Europe masonry paints based on water soluble silicate (e.g. potassium silicate) have been used for a considerable time. The coatings form inert, non-flammable films of considerable durability. The liquid paint is highly alkaline, hence pigmentation is normally by stable metal oxides resulting in a high order of colour stability.

Some specialist coatings for the protection of iron and steel (see BS 5493) are based on silicates.

18.2.7 ***Bituminous binders***

Bitumens and tars in solution or as emulsions are used in low-cost coatings, mainly for waterproofing.

Suitable coal tar fractions are combined with epoxy resins in some specialist coatings; see table 8.

Coatings based on bituminous materials are usually black although, with some types, a limited range of dark colours is available. They may also 'bleed' into and discolour other types of coatings applied over them; see clause **40**.

18.3 Solvents and thinners

18.3.1 ***General***

Solvent imparts the appropriate degree of fluidity, i.e. viscosity, to a paint to facilitate application. During the drying process solvent evaporates and so determines the initial speed of drying. Solvent vapours in the atmosphere may give rise to toxicity or flammability hazards (see appendix A).

Coatings other than emulsion paints are generally supplied ready for use, although further additions of the recommended thinner by the user may be permissible, e.g. to assist the penetration of priming coats on absorbent surfaces or for application of coatings by spray. Emulsion paints may be formulated for use as supplied or may require thinning with water.

Over-thinning can seriously impair the opacity and other properties of coatings, but painting specifications should not preclude thinning; as indicated in the previous paragraph, this may be necessary in some circumstances. The specifications should state, however, that thinning is to be carried out under competent supervision and strictly in accordance with manufacturers' recommendations as to type and proportion of thinner.

18.3.2 ***Hydrocarbon solvents***

These are generally of the white spirit type, although aromatic hydrocarbons such as xylene or naphtha may be encountered occasionally. Conventional white spirit contains about 20 % of aromatic hydrocarbons, but low aromatic solvents such as de-aromatized white spirit or isoparaffins are increasingly used. As well as having low odour, these solvents are considered to be less harmful.

18.3.3 ***Oxygenated solvents***

These are derived from organic chemicals and small quantities may be included for specific purposes, e.g. emulsion paints. They are a major constituent of cellulose-based paints and knotting solutions, and are also used in two-pack epoxy and polyurethane paints.

18.3.4 ***Water***

Emulsion paints and bituminous emulsions are thinned using water. However, many emulsion paints contain some oxygenated solvent to give good low temperature film formation.

18.4 Pigments

18.4.1 ***General***

The major function of the pigment is to provide colour and opacity; most pigments contribute to this to a greater or lesser degree. Additionally, and according to the nature of the pigments used, they may increase the thickness of the dry film, reinforce it physically, absorb or reflect harmful ultraviolet radiation, inhibit corrosion on metal surfaces or otherwise contribute to the durability or stability of the coating.

A wide variety of pigments, differing in origin, colour and properties, is available. The principal categories are described in **18.4.2** to **18.4.6**.

18.4.2 ***White pigments***

Because of the preponderant use of white and light-coloured finishes, white pigments are of considerable importance in the manufacture of paint. Titanium dioxide is the most widely-used white pigment; it is non-toxic, has excellent colour and opacity and is resistant to discoloration. White lead, formerly the main white pigment, is now rarely used because of its toxicity, poor colour and opacity and tendency to discolour in polluted atmospheres.

18.4.3 ***Tinting pigments***

This category comprises pigments that are used primarily for their colour when used alone or as 'tinters' in combination with white, although some may have other properties. The main pigments in this category are natural or synthetic metal oxides, organic pigment dyestuffs and carbon black.

Coloured pigments vary considerably in properties and, in particular, in opacity. Some dyestuff pigments are relatively low in opacity and, with strongly-coloured coatings based on pigments of this type, additional coats may be required; see appendix B.

18.4.4 ***Extenders***

These are inert materials, usually of mineral origin. Although generally classed as pigments, they may contribute little to the opacity of coatings but have other useful functions. According to the type of extender used, these functions may include reinforcing the mechanical strength of the dry film; assisting application; imparting bulk or 'structure' to the liquid paint and helping to prevent settlement of the solid ingredients during storage; improving intercoat adhesion; imparting roughness or texture to the coating when this is required.

18.4.5 ***Corrosion-inhibitive pigments***

These have the property of inhibiting or retarding corrosion of ferrous and non-ferrous metals and are used in primers for these surfaces. They include metallic zinc and lead and derivatives of these metals, such as red lead (lead oxide), zinc chromate and zinc phosphate. Red iron oxide (red oxide), although having no inhibitive properties, is often used in conjunction with inhibitive pigments as an 'extender'. Due to their toxicity, lead and chromate pigments are now less frequently used.

The properties of an inhibitive pigment may be influenced by the nature of the medium in which it is used. Red lead, for example, gives best results when combined with drying-oil media. Similarly, metallic zinc is generally used in conjunction with oil-free binders of the solution or chemically-curing type, e.g. those based on chlorinated rubber or epoxy resin.

18.4.6 ***Laminar pigments***

These pigments have a flaky structure and, within the paint film, the individual flakes lie parallel to the surface and overlap, forming a moisture barrier and improving tensile strength. Widely-used pigments of this type include micaceous iron oxide, aluminium and graphite. The two latter pigments, in addition to their general use in protective coatings, are also used in heat-resisting paints.

19 General properties of coatings

19.1 General

Properties common to several types of coatings can influence their application, appearance or performance in service. They include film thickness, viscosity, thixotropy and flow, properties that are in some degree interrelated.

19.2 Film thickness

This is determined essentially by the proportion of non-volatile solids (e.g. pigment or resin) present in the coating. The method of application may also affect film thickness; see clause **46**. The protective properties of a coating are generally in direct proportion to its film thickness which may also influence the filling and levelling properties.

Film thickness may be expressed as 'wet', i.e. the thickness immediately after application, or 'dry' when the volatile constituents have evaporated. Dry film thickness is the significant factor in relation to protection and filling properties.

Most coatings have a film thickness or 'build' determined by the application and other characteristics. For most general purpose building paints, this is of the order 20 μm to 35 μm per coat dry film thickness. Some special purpose coatings, such as low-build wood stains or two-pack pretreatment primers, have dry film thicknesses of 10 μm or less. In addition, depending on type, 'high-build' coatings may yield films in the range 60 μm to 3 mm (e.g. textured masonry paints), although 100 μm to 250 μm are more typical.

BS 3900 : Part C5 describes methods of determining the film thickness of applied coatings.

19.3 Viscosity

In relation to most coatings, viscosity may be regarded as the resistance offered by the material to shearing forces, e.g. brushing or rolling, and, in consequence, directly affects the ease with which the material can be applied. Indirectly, it may influence film thickness because, if the viscosity is low, the coating may be spread out too far, yielding an excessively thin film. If it is too high, it may be difficult to apply the coating in a film of uniform thickness, especially by brush.

Application properties cannot always be assessed either from the apparent consistency of the material in the container or by stirring or pouring, because of the effect of thixotropy; see **19.4**.

19.4 Thixotropy

Thixotropy is the property of changing reversibly from a gel or semi-liquid state when at rest to a more liquid consistency when shearing forces (e.g. brushing or stirring) are applied. It is inherent in some types of paint (e.g. emulsion paints) and is imparted to others (e.g. alkyd gloss finishes) by the addition of gelling agents. The level of thixotropy may vary from being barely perceptible, for ease of brushing, to being very pronounced to reduce drips and/or enable thick films to be obtained without the occurrence of running or sagging.

19.5 Flow

Flow is the extent to which a coating is able to flow out to a film of uniform thickness free from brush marks and similar irregularities produced by the method of application.

Flow properties are determined by the rheology of the liquid constituents of the coating and, to some extent, by the volume and nature of the pigment used. Simple oil-based paints generally have relatively poor flow, as do most emulsion paints. Most gloss finishes, including varnishes, have good flow. Thixotropic coatings usually have poorer flow than their 'liquid' counterparts. Quick-drying coatings may exhibit apparent poor flow if the film sets before flow-out is complete.

Although good flow is a desirable attribute in a finish, excessive flow may make the material difficult to control in application and cause running and sagging. Coatings with good flow also tend to recede from external angles and sharp edges, reducing the thickness and protective value of the film at these points. For this reason, primers and undercoats are usually formulated to flow less freely than finishing coats.

20 Components of coating systems

20.1 General

Depending upon the type of surface and the nature and function of the coating, most systems will comprise at least two coats; more may be required, especially with coating systems having a protective function. Again depending upon the surface and the type of coating, systems may consist of several coats of the same material or a sequence of coats of differing type. In the latter case, a typical system may comprise a 'primer', one or more 'undercoats' and one or more coats of 'finish'; sometimes the undercoats are omitted, the finish being applied directly over the primer. The functions of the individual coats in multi-coat systems of this kind are described in **20.2** to **20.5**.

20.2 Primers and sealers

An essential function of a primer is to secure good adhesion to the surface to which it is applied and, in turn, to provide a base to which the succeeding coats will adhere satisfactorily; other functions may include:

(a) on absorbent surfaces, such as wood, lightweight blocks, plaster and many building boards, the prevention of undue absorption of 'binder' from the subsequent coats, leaving them underbound or lacking in gloss;

(b) on metal, especially iron and steel, the inhibition of corrosion;

(c) on surfaces of an alkaline nature, such as concrete, cement rendering, asbestos-cement and some types of plaster, a reduction of the risk of attack on subsequent coats;

(d) on new wood, metal and other materials exposed to attack by moisture or other adverse elements, the provision of protection in the interval between erection or fixing and application of the complete coating system.

'Sealer' is a term often loosely applied to coatings which may combine some of the functions of primers described in (a) to (d) with other functions, or which may be used for purposes other than priming. Examples include:

(e) aluminium-pigmented primers that may be used as wood primers and also as 'sealers' for bituminous surfaces other than wood; see clause **40**;

(f) primer-sealers for powdery or friable surfaces (see **53.5**) or for plaster and similar surfaces of high or variable porosity (see **30.3.2**);

(g) protective coatings, usually unpigmented; e.g. clear sealers for metal-sprayed steel (see **27.4**) and some multi-coloured finishes (see table 5).

Well-thinned first coats of emulsion paint may be needed on plaster of high or variable porosity; see **30.3.2**. These are sometimes referred to as 'sealing' or 'mist' coats.

20.3 Undercoats

These are relatively highly pigmented matt or mid-sheen materials, applied to primed or previously painted surfaces before the application of finishing coats. Their essential function is to provide a uniformly opaque base of a colour appropriate to that of the finish, but they also contribute to the thickness, filling properties and cohesion of the paint system.

Manufacturers' recommendations regarding the use of undercoats should be observed. In some circumstances, undercoats may not be needed, or can be replaced in part by additional coats of finish. Many oil-based matt or mid-sheen finishes, for example, are applied direct without undercoats to primed or previously painted surfaces. Oil-based gloss finishes are usually applied over undercoats but, in three-coat systems on primed or previously painted surfaces and with manufacturers' approval, a system of one undercoat and two coats of gloss finish can be used in preference to two undercoats and one coat of finish, for greater durability externally or in severe internal environments.

20.4 Finishes

The final coat in the system provides the required colour, degree of gloss, texture or other attributes, including resistance to weather, chemical attack and mechanical damage. In this respect, the finish may be considered to be the most important coat in the system to the extent that its appearance and performance in service are frequently the criteria by which the system as a whole is judged. However, the finish cannot compensate for deficiencies in preceding coats in the system, whether these relate to quality, suitability or application.

20.5 Compatibility of coatings

It is essential that the individual coats in the system are mutually compatible. Compatibility is influenced mainly by the composition and physical properties of each of the coatings in the system and, to some degree, by their juxtaposition. Thus, a coating based on a 'solution' binder (see **18.2.5**) may be unsuitable for use over a drying-oil type coating, because its solvents may soften or disrupt the latter, although no problem may arise if the sequence of coats is reversed. Similarly, application of a hard coating over a softer one may result in cracking of the composite film whilst application of the softer coating over the harder one may be satisfactory. Incompatibility may be a cause of poor adhesion between coats in a system.

Compatibility problems are less likely to arise with systems comprising coatings of similar composition and properties but, even with these, slight variations between different brands of the same types of coatings may adversely affect the performance of the system. It is advisable, therefore, to ensure that all the coatings in a system are of the same brand and are used in accordance with the manufacturer's recommendations regarding the sequence and number of coats.

21 Types of coatings

21.1 General

For the purposes of this code, paints and similar coatings are grouped in three categories as follows:

(a) conventional coatings;

(b) specialist coatings;

(c) factory-applied coatings.

Metallic coatings are referred to in clause **28**.

21.2 Conventional coatings

These represent the greater proportion of the coatings in general use in the painting of buildings and are based mainly on drying-oil or emulsion binders. They are listed and described in tables 1 to 7, generally according to their functions within the coating system, as follows:

Table 1. Primers for wood

Table 2. Primers for metal

Table 3. Miscellaneous primers

Table 4. Undercoats

Table 5. General pigmented finishes

Table 6. Finishes for wood

Table 7. Bituminous and tar-based coatings.

Conventional coatings based on binders of the types referred to above may be modified to impart specific properties, e.g. of mould-resistance or flame-retardance; see clause **41**.

To facilitate use of the code, products are numbered within the relevant table, the combined table/product numbers providing a 'product reference'; e.g. the reference '2/2A' denotes the second of the products listed in table 2, a red lead metal primer complying with type A of BS 2523. It is emphasized that product references are intended solely as a means of identification within the code and especially in using tables 11 to 17 which describe coating systems for various substrates; they have no status in relation to specifying or ordering materials nor should they be confused with or regarded as alternatives to the product references given in BS 5493.

21.3 Specialist coatings

This category comprises coatings having properties, e.g. of chemical resistance, hardness or other characteristics, not possessed by materials of conventional type as defined in **21.2** above. They may require special techniques or conditions of application or necessitate high standards of surface preparation and may not be readily available from normal sources of supply. Often, the complete system is of specialist type and may not be suitable for use over primers or existing coatings of conventional type. For these reasons specialist coatings have limited usage in the painting of buildings.

Accordingly, the code does not refer to them in detail, but table 8 summarizes the characteristics of the principal types. Within the generic categories, there may be considerable variation in the formulation and, in consequence, the characteristics of individual materials.

Reference to manufacturers is advised when there appears to be a requirement for the use of specialist coatings. BS 5493 and DD 24 give detailed recommendations regarding specialist coatings for the protection of iron and steel structures.

The comments in **21.2** relating to product references in tables 1 to 7 apply also to table 8.

21.4 Factory-applied coatings

These range from stoving or air drying paints, applied to wood and metal components by spraying or dipping, to 'coil coatings' mechanically applied to coiled flat sheet for subsequent forming and fabrication. Coatings of types unsuitable for site application may be employed; correctly chosen and applied, they can be tougher, harder and more durable than most site-applied finishes. With the possible exception of plasticized PVC coatings (see **38.4**) they do not present serious difficulties in maintenance repainting.

For light gauge steel, guidance in choice of coatings is given by DD 24, although there have been improvements in and additions to the types there described. Organic finishes for aluminium extrusions (e.g. windows) are defined in BS 4842, and the expected performance of a variety of coatings on metal and other claddings is tabulated in BS 5427. No such guidance is available for complete factory-applied systems on timber, but they can give better durability than the conventional site-applied coatings at no greater cost.

It should be noted that components for interior use are sometimes finished by processes suitable for the dry conditions of a completed building, but inadequate for exposure to weather or condensation during erection. To avoid premature failure, a higher grade coating may have to be specified. Likewise, the life indicated for various categories in DD 24 could be extended by additional coats or increased thickness.

22 Ancillary materials

22.1 General

Materials other than coatings used in the painting of buildings include cleaning agents, sterilizing washes, knotting, stoppers and fillers, mastics, paint removers and waterproofing treatments.

22.2 Cleaning agents

Surface cleanliness is essential to the satisfactory performance of coating systems. Soap or detergent solutions or proprietary powder cleaners are usually adequate for normally soiled surfaces. For removal of oil or grease, proprietary solvent-emulsion cleaners may be required. See also **53.3**.

22.3 Sterilizing washes

Surfaces contaminated with mould or algal growths should be treated before coatings are applied. Household bleach solutions are often effective in killing the growths but, in severe cases, proprietary mould-inhibitive washes will provide a measure of protection against their reappearance.
See also **53.8**.

22.4 Knotting (see BS 1336)

A quick-drying solution (e.g. of shellac in industrial methylated spirit) should be applied to knots or resinous areas in wood before priming to retard discoloration of light-coloured opaque finishes.

It should be noted that knotting is likely to be ineffective in cases of resin exudation.

See **25.5.2.4.**

22.5 Stoppers and fillers

22.5.1 *General*

The traditional distinction between 'stoppers' and 'fillers' is that the former are stiff pastes used for stopping up holes, wide cracks, open joints and similar imperfections, while fillers are of more fluid consistency and are used for filling and levelling shallow depressions, open grain, surface roughnesses, fine cracks and the like.

The distinction between stoppers and fillers has become less clear-cut with the widespread use of proprietary materials, many of which, although described as 'fillers', are used for both purposes. More meaningfully, the materials may be categorized as stoppers, general purpose stoppers/fillers and surface fillers, and these are described in **22.5.2** to **22.5.4**. Methods of stopping and filling are described in **45.4**.

22.5.2 *Stoppers*

Oil-based stoppers have been traditionally used on woodwork and some other surfaces. However, some types of ready-mixed water-borne polymer fillers may give satisfactory performance. Materials based on lead pigments should not be used due to the toxic hazards they present. See **A.1.2**.

The use of linseed oil putty as a stopper is inadvisable.

For stopping deep holes in woodwork proprietary materials based on two-pack polyester or epoxy resins can give good performance but it is essential to use a grade supplied specifically for use on wood and not a material supplied for use on car-body repairs.

22.5.3 *General purpose stoppers/fillers*

The types in general use are usually water-mixed and comprise the following.

(a) *Powder fillers.* These are supplied in powder form for mixing with water and are usually based on water-soluble cellulose and gypsum or white Portland cement.

Those containing gypsum are suitable for general use as stoppers and fillers in dry interior situations. They are not usually suitable for use for external work, especially on wood, but the manufacturer's recommendations in this respect should be observed.

Portland cement types are suitable for external use on masonry surfaces. They should not be used on woodwork.

(b) *Emulsion-based fillers.* These are usually based on vinyl or acrylic resin emulsions and are supplied in paste form, ready for use.

Materials of this type vary considerably in characteristics and usage. The manufacturer's recommendations, especially regarding suitability for exterior use, should be observed. It should be noted that some exterior grades contain coarse particles, making the attainment of a fine finish difficult.

22.5.4 ***Surface fillers***

These are formulated specifically for use as fillers in the traditional sense, as defined in **22.5.1**, and are preferred to the 'general purpose' types when a high standard of finish is required, especially with oil-based paint systems. They are supplied ready for use as smooth, finely-ground, creamy pastes, usually applied with a wide filling knife or spatula. The types in general use are emulsion-based, but oil-based formulations are available.

22.6 Mastics and sealants

The use by painters of mastics and sealants is mainly for the repair or replacement of external pointing between window or door frames and adjacent masonry. Generally, and provided that the mastic is to be over-painted, proprietary one-pack, non-elastomeric types are suitable.

22.7 Paint removers

Information on paint removers, including the types available and the precautions to be taken in their use, is given in **53.2.3**.

22.8 Water repellents

External application of water-repellent solutions may be considered when rain penetration of walls has caused internal dampness. Materials and the factors relating to their use are described in **29.4**.

Section 4. Substrates and coating systems

23 Introduction

In this code, 'coating system' refers to the totality of the preparatory work and the type, number and sequence of coats necessary to obtain the required finish on a specified substrate. This section describes the general principles involved in the selection of coating systems, the characteristics and treatment of the substrates encountered in buildings and the types of coatings in general use. Although it is concerned essentially with new work, surfaces which may not have been painted initially, such as external masonry or non-ferrous metal, come within the scope of the section. Maintenance treatment is described in section 6, but much of the information given here is relevant.

The coatings referred to in this section are generally those of conventional type, as defined in **21.2** and described in tables 1 to 7, but clause **41** describes some functions and situations for which specialist coatings (see **21.3** and table 8) or modified conventional coatings may be required.

Information on coating systems is tabulated (tables 11 to 16) for substrates or groups of substrates having similar characteristics, and the tables may be referred to directly although preliminary reference to clause **24** is recommended.

Similarly, reference to clause **29**, dealing with the problems encountered in the painting of new 'wet' materials of construction, should precede reference to the clauses relating to individual substrates such as plaster, cement rendering and brickwork.

Information is given in the relevant tables on the expected life to first maintenance, in specified environments, of the coating systems referred to. The environment categories employed are described in table 10.

24 Selection of coating systems

24.1 General

The selection of coating systems requires consideration of a number of factors and subsequent judgement, often on a qualitative basis, of their relative importance in relation to particular circumstances. Often more than one type of system will meet the requirements, and selection might be made on the basis of relative cost, availability or individual preference, but care should be taken to ensure that other factors are in fact comparable; lower initial costs may well be more than outweighed by shorter life and consequent higher maintenance expenditure. In other circumstances, a single factor may exert so strong an influence that selection is limited to a single type of system.

The factors that have to be considered will usually include the following:

(a) the functional requirements;

(b) the substrates to be treated;

(c) the nature of the environment;

(d) constraints on selection;

(e) the availability of suitable coatings and systems;

(f) costs and maintenance considerations.

These considerations are listed in table 9, with an indication of reference sources within this code or elsewhere. Not every question will be relevant to all circumstances, and the importance of each may vary. There is a considerable degree of interaction between factors involved, and they should not be considered in isolation. Accordingly, answers to some questions will require reference to others, and the list should be studied as a whole before the questions are considered in detail.

24.2 Environment

In relation to the selection of coating systems, 'environment' refers to the general atmosphere and conditions of use or service to which a system may be exposed. A broad distinction may be made between external and internal environments but, in either, there may be considerable variation in the severity of attack or rigours of service, even within a single building. Externally, the main variables are location, proximity to the coast and level and nature of atmospheric pollution but elevation, aspect and the direction of prevailing winds may also have a significant effect. Internally, high humidity and the presence of process chemicals and dusts may create severe conditions although, in most of the types of buildings with which this code is concerned, the main factor will be the degree of wear or soiling likely to occur.

Table 10 indicates the broad categories of external and internal environments that may be encountered and the types of coatings likely to be suitable. It is intended to provide general guidance; it is not possible to take into account the many local variables which may influence the nature of the environment and the selection of coating systems in specific circumstances.

The ratings in respect of severity of exposure in the first column of table 10 are also used in the substrate clauses and coating systems tables in this section.

25 Wood

25.1 Characteristics

25.1.1 *Structure*

Wood is a cellular material in which most of the cells are aligned vertically in the tree, giving wood its characteristic 'grain'. Other cells lie in horizontal bands (rays) running outwards in the tree.

In softwoods (coniferous trees), the vertical cells (fibres) are about 3 mm long and contain an air space, the cell cavity. Liquid movement is by way of the cavities and through openings (pits) in the walls of adjacent cells.

In hardwoods (broad-leaved trees), the cells or fibres are only about 1 mm to 2 mm long and surround much larger cells (pores or vessels). The pores are responsible for liquid movement, and their size and distribution, together with the relative thickness of the fibres, determine the texture of hardwood.

Cell walls formed later in the growing season are thicker than those formed earlier, and the alternating bands of soft and hard tissue (early and late wood) form the annual or growth rings. Quarter sawing (radial cut) produces a surface with closely alternating bands of early and late growth; with flat sawing (tangential cut) the bands are wider.

25.1.2 *Moisture content*

'Green' timber contains both free water in the cell cavities and water absorbed by the cell walls. Reducing the moisture content to about 25 % to 30 % of the oven-dry mass removes free water from the cell cavities, but the fibres remain saturated and the wood is fully swollen; it shrinks progressively as more moisture is removed. Shrinkage is greatest across the grain and is reversible, so that changes in weather or humidity cause alternate swelling and shrinkage. Wood should, therefore, be painted or varnished when its moisture content is near to that at which it will stabilize in service, generally about 18 % but somewhat lower in buildings which are centrally heated continuously. Excessively dry timber will swell as it takes up moisture, imposing stresses on the coating; damp timber will shrink during drying, causing joints to open, creating further points for water to enter. Also, blistering or flaking of the surface coating is likely to occur on damp timber.

25.1.3 *Permeability and penetration of liquids*

The permeable nature of wood affects not only moisture movement but also the ease of impregnation by preservatives and the behaviour of paint.

In general, penetration is deeper and more rapid through end grain than through lateral surfaces, and is also deeper and more rapid through sapwood than through heartwood. There are also differences in permeability between early and late growth areas causing differential swelling which imposes stresses on surface coatings.

Deep penetration is not necessary for paints to adhere satisfactorily and may be both wasteful of material and detrimental to performance as binder may be absorbed, leaving the coating underbound or weak.

The large pores in hardwoods may be bridged by paint coatings, leaving an air space beneath the film and forming a weak point which may cause breakdown. To prevent this, filling (see **25.5.4**) is usually required when hardwoods are painted.

Ease of penetration is important when considering preservative treatment. The ease with which a timber can be penetrated with preservatives is explained and classified in BRE Digest 296.

25.1.4 *Extractives*

Many softwoods and some hardwoods (e.g. gurjun, keruing and agba) contain resins which may exude and impair surface coatings. Kiln drying reduces the activity of resin in potentially troublesome timber but, when the resin content is high, exudation may continue for long periods, especially on external woodwork exposed to the sun.

Other woods, such as teak and some cedars, contain oil which may impair the drying, hardening or adhesion of coatings. These woods may be washed down with white spirit immediately before priming or varnishing. However, they can usually be painted satisfactorily if an aluminium primer (1/2) is used. Water soluble tannins, present in oak and chestnut, may also interfere with the drying and hardening of oil-based priming paints and may discolour water-thinned paints.

25.2 External influences

25.2.1 *Moisture*

Multi-coat, oil-based paint systems are reasonably effective barriers to the movement of moisture in liquid and vapour form provided the coating is continuous and remains intact.

Moisture may however gain entry through open joints, defective putties and sealants, and the paint film may then serve not to keep the water out but to hold it in. In jointed components the principal route for moisture entry is through end grain concealed within the joints. The sealing of end grain during component manufacture markedly reduces the risk of wetting and substantially improves coating performance.

Where joinery is to be in contact with brickwork, concrete and similar materials, vertical and horizontal damp-proof courses should be so placed that moisture penetration at contact surfaces is prevented; painting or similar treatment, although advisable, should not alone be relied upon to achieve this. Where external joints between frames and walls are pointed with mastic or sealants to prevent ingress of water, provision should be made for drainage of joints, e.g. by stopping short the sealant at a suitable point.

As a result of increased attention to heat conservation, internal condensation has assumed considerable importance as a source of moisture. The absence of flues, blocking of unused flues and airbricks, draught-proofing and similar measures have greatly reduced internal ventilation rates, especially in domestic buildings. In consequence, the water vapour produced by normal domestic activities is unable to escape readily and may migrate to colder rooms and condense on single-glazed windows, eventually penetrating open joints, defective putties and other discontinuities in the paint film. This is a frequent cause of timber decay and paint failure on wooden window frames and sills. Wet rot in timber cladding or failure of the external paint may also be caused by condensation within the wall cavity.

25.2.2 ***Sunlight***

Exposure of unprotected timber successively to sunlight and rain causes degradation of the surface, impairing its ability to hold coating systems, and causing change or loss of colour, although very durable timbers, such as teak, are affected mainly in colour. Paint is an effective protection against the effects of sunlight; clear finishes are usually less durable because they may not filter out the damaging wavelengths in sunlight which attack the underlying wood surface. Solar heat gain causes shrinkage of wood and consequent cracking and opening of joints; it may also increase resin exudation, resulting in discoloration and disruption of coatings. This will be exacerbated by the use of dark finishes: see **25.5.2.4**.

25.2.3 ***Fungal attack***

Wood is susceptible to fungal attack if its moisture content exceeds about 22 % for lengthy periods. In painted woodwork, the principal agents of decay are the wet-rot fungi. Surface moulds and blue-stain fungi have little effect on the durability of timber although they are unsightly and may disfigure paintwork.

Timber species vary in their resistance to fungal attack; BRE Digest 296 classifies timber species according to the natural resistance of the heartwood to decay when in ground contact and this is used in making recommendations for preservative treatment. Four categories are included: perishable, non-durable, moderately durable, and very durable. The sapwood of most species is perishable (a few are non-durable) and, on economic grounds, it may not be possible to exclude it completely. Nor, for the reasons indicated in **25.2.1**, can it be assumed that paint or similar treatment will prevent moisture penetration in all circumstances. Consequently, most external woodwork is at risk and preservative treatment, in addition to painting or similar treatment, is advisable and may be mandatory in some cases.

25.3 Preservative treatments

Reference should be made to BS 5589 for recommendations for the preservative treatment of timber according to species, end use and desired service life. Items (a) and (b) indicate treatments likely to be suitable for components subsequently to be painted or given similar surface treatment. (Reference should be made to BS 5268 : Part 5 for recommendations concerning preservative treatments for structural timber).

(a) Treatments for window joinery and other external building timbers not in ground contact:

(1) *Copper / chrome / arsenic* (CCA) *water-borne preservatives* by vacuum pressure process in accordance with BS 4072 : Part 1, applied by a vacuum pressure process as specified in BS 4072 : Part 2. Some distortion may occur during drying, hence this method is not generally employed for the treatment of completed joinery. After drying, the preservatives are insoluble and, provided that loose salts are removed, do not usually affect applied coatings.

(2) *Organic solvent preservatives,* e.g. complying with BS 5707 : Part 1. Water-repellent types, containing waxes or resins, suitable for painting, can be used with advantage. Organic solvent preservatives can be applied by immersion or the double vacuum process as specified in BS 5707 : Part 3. Application by brushing or spraying is not recommended except for site treatment of cut ends etc., or in remedial work. These preservatives are generally suitable for over-painting provided a minimum of 48 h in conditions of good ventilation is allowed for evaporation of solvent, but users should satisfy themselves as to the compatibility of the particular treatment with the finish to be applied.

(3) *Diffusion treatment with disodium octoborate* (see the British Wood Preserving Association Manual 1986 for details). This treatment has to be carried out on freshly

felled timber and cannot be applied to seasoned timber. The salts remain water-soluble and may affect coatings if the timber becomes wet although, in practice, few difficulties appear to arise.

(b) Treatments for fencing and gates in or out of ground contact:

BS 5589 lists timber species which are sufficiently durable to be used for fencing and gates without preservative treatment provided there is not an excess of sapwood present. If there is, or less durable species are used, treatment is advisable. The recommended treatment, if a paint or similar finish is required, is with CCA as in (a)(1). Alternative treatment with creosote (pressure or open tank processes) is not suitable for over-painting. However, in view of the cost of painting extensive areas of fencing and the frequent maintenance treatment that may be required, consideration should be given to initial treatment with creosote by the processes referred to and subsequent maintenance by brush application of this material.

NOTE. BS 5589 recommends certain double vacuum schedules with organic solvent preservatives for the treatment of certain fencing components that will remain out of ground contact.

25.4 Flame retardant treatments

25.4.1 *General*

Materials, either surface or impregnation treated, that are to receive a decorative coating system should be kiln dried to a maximum moisture content of 12 %.

It is important that the surface of the treated material is clean and dust free. Chemical or other surface deposits should be removed by light sanding.

Treated materials can be painted with clear, pigmented and opaque products, using conventional methods of application, following manufacturer's recommendations. However, it is essential to establish that any finishes to be applied will not adversely affect the spread of flame characteristics or the treated materials.

Highly flammable finishes such as nitro-cellulose based lacquers, that may contribute to the risk of flame spread, should not be used.

Advice on painting over flame retardant treated materials should be sought from the manufacturer.

25.4.2 *Inorganic flame retardants*

Inorganic flame retardant treated materials should be protected at all times from the elements, both at the treatment plant and on site.

The flame retardant treated material should receive at least the first coat of the finishing system as soon as possible and before installation.

Providing these recommendations are followed, the presence of the flame retardant chemicals in the wood should not affect the performance of the paint film in a dry environment.

25.4.3 *Resin based flame retardants*

An integral part of a resin based flame retardant treatment process is kiln drying after treatment, to cure the chemical within the timber.

Resin based flame retardants can be used externally or can be subjected to high humidities and under these conditions there is no loss of flame retardance or paint film integrity.

25.5 Surface preparation, priming, stopping and filling

25.5.1 *General*

For the reasons given in **25.1.2**, the moisture content at the time of painting should not exceed about 18 %. Moisture content may usually be measured with sufficient accuracy for painting purposes with an electrical moisture meter of the conductive type. An instrument preferably having long probes should be used so that readings can be taken at a depth not so readily affected by surface drying.

NOTE. Electrical moisture meters may give a falsely high reading if soluble salts are present, e.g. from preservative treatment with disodium octoborate – see **29.2.1.2(c)**.

If there is a delay between delivery to site and fixing or erecting of joinery, it should be protected against ingress of moisture; see clause **12**.

If timber has received preservative treatment, time should be allowed for drying out or evaporation of solvent before priming; see **25.3**.

25.5.2 *Surface preparation*

25.5.2.1 *General*

Preparatory treatment of wood before priming will include cleaning, sanding and treatment of knots. Thorough preparation is especially important on wood that has been exposed to weather without protection.

25.5.2.2 *Cleaning*

A clean surface is essential to the satisfactory adhesion and appearance of the paint system. Dirt and surface deposits, exuded resin and soluble salts arising from preservative treatment should be removed. Solvent cleaning (see **53.3**) will be necessary if the surface is contaminated with oil or grease.

25.5.2.3 *Sanding*

The main purpose in sanding is to smooth the surface, but it also helps to reduce paint penetration by closing the wood vessels, thus producing a thicker, more uniform film than on unsanded wood. Sanding may also be necessary to remove the degraded outer layer of wood that has been exposed to weather.

Wood may be sanded mechanically or manually; the latter, using abrasive paper is more common for site work. It is essential to use a grade of abrasive paper appropriate to the surface; excessively coarse grades will damage the wood fibres, impairing the appearance and possibly the performance of the paint system. The surface should be sanded in the direction of, and not across, the grain without using excessive pressure, which may damage the wood fibres. Care should also be taken not to damage moulding and arris edges.

25.5.2.4 *Knot treatment*

Discoloration of paint, especially noticeable with light colours, may occur over knots and resinous areas especially if the wood has been treated with preservative containing certain organic solvents (see **25.3**). It is normally prevented by the application of 'knotting' (see **22.4**); two coats are more effective than one, but heavy applications and the use of knotting which has thickened through evaporation of solvent should be avoided, otherwise paint adhesion may be impaired. It may not be necessary to use knotting if woodwork is to be primed with an aluminium primer (1/2).

Knotting or aluminium primer is rarely effective in preventing physical disruption of paint films by heavy exudation of resin. This is more likely to occur externally over knots in surfaces exposed to strong sunlight, which liquefies the resin and makes it more active. The use of light-coloured paints reduces solar heat gain and may therefore reduce resin exudation although it is unlikely to prevent it completely; also, the resin will be more obvious on a light-coloured surface. An alternative is the use of an exterior wood stain; see **25.7.3.3**.

25.5.3 *Priming*

Primers for wood are listed and described in table 1, and typical applications are indicated in table 10.

A good primer, applied to dry sound substrates, is the foundation of a durable paint system. Priming in the factory or works is recommended; if site priming is necessary, it should be carried out immediately after delivery of the joinery, provided that its moisture content is at a satisfactory level. Although single coats of primer retard surface degradation by sunlight (see **25.2.2**), they provide only limited protection against moisture, especially if the wood has not been treated with a water-repellent preservative. The full system should therefore be applied as soon as possible. Primed joinery, if not fixed or erected immediately, should be properly stored; see clause **12**.

If primed woodwork has been exposed for a lengthy period, the condition of the primer should be checked before continuing application of the paint system. It is important that areas of defective or poorly-adhering primer be removed and the exposed areas reprimed. If the primer is firmly adhering but is chalking or powdery, it should be rubbed down and a further coat applied.

25.5.4 *Stopping and filling*

Materials used for stopping and filling are described in **22.5** and the techniques are described in **45.4**. Oil-based stoppers and fillers should be used only on primed surfaces, otherwise oil will be absorbed leaving the material underbound.

25.6 Conventional systems for wood
(see table 11)

25.6.1 *Alkyd finishing systems*

Alkyd finishing systems are widely employed, with appropriate primers on wood, metal, plaster, etc. and hence may not be specifically formulated for the requirements of wood. They are available in gloss, semi-gloss and matt finishes with the gloss version being used externally and internally and the semi-gloss and matt mainly on internal surfaces. The finishes tend to lose flexibility with age and in exterior and severe interior situations show decreasing tolerance to wood movement and tend to fail by cracking. They are usually of low water vapour permeability and hence inhibit escape of water which has entered woodwork through construction defects or breaks in the paint coating.

Traditionally a four coat gloss system (including primer) has been recommended for exterior or severe interior use. However there has been controversy as to the composition of the system of two undercoats and one gloss, or one undercoat and two gloss coats. It should be appreciated that the normal undercoat is formulated for opacity and hence is highly pigmented and may lack flexibility. Not all gloss finishes are suitable for applications as consecutive coats, and manufacturers' recommendations should be followed.

With the advent of joinery pretreated with approved preservative treatments, three coat systems have become accepted for external work. They are also suitable for most internal situations.

Semi-gloss and matt finish systems do not usually incorporate undercoats, successive coats of finish being applied over the primer. In the internal environment in which these types of finish are generally used, three-coat systems, including primers are usually satisfactory, the main criterion usually being opacity.

25.6.2 *Varnishes*

The depth and clarity of finish provided by full-gloss varnish is difficult to equal by any other treatment, but varnishing is expensive and, for exterior work, is likely to require more frequent maintenance than paint. On full exterior exposure, most varnishes tend to embrittle fairly rapidly so that they can no longer resist the stresses imposed by timber movement. Also, ultraviolet light can pass through the film and degrade the underlying wood surface, resulting in detachment of the surface layer and the varnish film. Polyurethane varnishes of the two-pack or moisture-curing types are especially prone to develop stresses within the film sufficient to detach a degraded surface layer; unless there is a specific requirement for toughness and abrasion resistance, the use of varnishes of this type for exterior woodwork is best avoided.

The performance of varnish on internal woodwork is usually satisfactory and generally equates with that of paints of equivalent levels of gloss or sheen.

Varnish performs best on close-grained woods with a smooth surface; it should not be used on species that are prone to resin exudation.

If the wood is to be coloured by a decorative wood stain (6/5) before varnishing, it is advisable to undertake a trial on a similar piece of wood to ensure compatibility of the stain and the varnish.

25.7 Special systems for wood

NOTE. All coating systems have numerous properties which have to be optimized if they are to perform well. These include drying and recoat times, storage and application properties. With wood coatings, permeability, extensibility and fungicidal properties are of especial importance.

25.7.1 *General*

With the recognition of the drawbacks of the conventional alkyd gloss paints on external woodwork, a variety of special systems has been developed covering the exterior wood stains through to specially formulated paint systems.

The majority of the special systems will maintain a greater level of flexibility than conventional alkyd gloss systems, hence will accommodate movement of the wood; and can offer considerable improvement in the life of the coating system, particularly when formulated to give optimum permeability.

25.7.2 *Permeability*

A proportion of these special systems are described by their manufacturers as 'microporous', 'breathing', 'ventilating', etc. These terms imply that the coating is more permeable to water vapour than the conventional alkyd gloss systems.

However, the optimum level of permeability will vary according to circumstances. A more permeable coating may be beneficial in permitting surface drying of the wood but the movement of water through a coating of high permeability may result in excessive movement and cracking or splitting of the wood.

NOTE. No coating system can overcome the problems of excessive moisture ingress caused by design or constructional defects.

25.7.3 *Transparent/semi-transparent/opaque finishes* *(see also table 6).*

NOTE. See table 12 for natural finishes to wood.

25.7.3.1 *General*

Transparent, semi-transparent and opaque finishes (excluding conventional alkyd gloss and varnishes) do not completely obscure the grain of the wood although they may modify its colour in varying degree. They comprise a wide variety of finishes, many of them of a specialized nature. This subclause deals with finishes used on general building wood surfaces, and forming part of normal paintwork. It does not include french polishing and the use of cellulose or similar specialized wood finishes nor the treatment of wood floors.

On external exposure to sun and rain, unprotected wood loses its original colour and the surface degrades until it consists of a thin layer of loosely matted fibres, usually dirt-stained and darkened by fungal and iron stains. After periodic wetting and drying, the growth rings may become prominent and splitting and distortion may occur. If it is desired to preserve the natural appearance of external woodwork, protective surface treatment is, therefore, necessary.

Blue-stain fungi often contribute to the darkening of weathered wood. Once blue-stain has developed extensively under these finishes, the colour of the wood cannot be restored. It is therefore recommended that exterior woodwork which is to be so finished should first be treated with a preservative effective against blue-stain. With adequate maintenance, the fungicide in exterior wood stains will usually inhibit the development of blue-stain.

Internal exposure is unlikely to result in similar degradation of the surface, and the main functions of natural finishes on interior woodwork are to enhance its appearance, prevent soiling, staining and abrasion damage and facilitate cleaning.

Like paints, transparent, semi-transparent and opaque finishes may not prevent the entry of moisture. Accordingly, their use, even of those types described as having preservative or water-repellent properties, does not obviate the need for preservative treatment of non-durable timber as described in **25.3**.

On exterior exposure, these finishes are usually less durable than paints and therefore require more frequent maintenance to preserve appearance. This may make their use uneconomic on high-rise buildings where the cost of scaffolding is a significant proportion of the total cost of the work. On the other hand, some exterior wood stain treatments require fewer coats and less extensive preparation than paint systems so that an overall saving in maintenance costs can be made.

Standard softwood joinery often has blemishes such as knots, splits, shakes and discoloration with blue-stain fungi. Natural finishes will not obscure these blemishes, with the possible exception of blue-stain. If this is not acceptable, a higher quality of timber has to be specified. Similarly, a standard of joinery which might be appropriate for painting may be unacceptable for natural finishes because fixings, gaps and wide glue lines will not be concealed. Hardwood joinery is usually of an acceptable standard and, as the timber is relatively impermeable and dimensionally stable, natural finishes are used essentially for appearance.

With most natural finishes, putty glazing is not suitable, and new work should be designed for glazing using preformed plastics gaskets with or without glazing beads. See also BS 6262.

Exposed nails, fixings, hinges and similar components should be of hot-dip galvanized, sherardized or stainless steel or non-ferrous metal to prevent rust-staining of adjacent woodwork.

25.7.3.2 *Surface preparation*

Where a high standard of finish is required, e.g. on varnished woodwork, the surface should be machined or sanded smooth, taking care to avoid tearing or scoring the grain.

Transparent, semi-transparent and opaque finish systems do not include the use of primers of conventional type but, if there is likely to be delay in completing the work, one or more coats of the intended system should be applied to provide some protection against soiling and ingress of moisture. Surfaces of window and door frames in contact with wet plaster, brickwork, masonry and similar sources of moisture should be coated before fixing. An oil-based or aluminium wood primer (1/1, 1/2) may be used if care is taken to avoid its spreading on to the visible surfaces; alternatively, two coats of exterior grade oil varnish (6/1) or the natural finish primer recommended by the manufacturer may be applied.

If stopping-up of nail holes is necessary on exterior work, the stopper should be used after application of the first coat of finish, the stopper being tinted to match the colour of the treated wood. For interior work, water-soluble fillers, similarly tinted, may be used before application of the first coat of finish.

Proprietary tinted stoppers and fillers are also available.

25.7.3.3 *Exterior wood stains*

These are described in table 6. Classification is somewhat arbitrary, and there are often no clear-cut distinctions between the various types (for greater detail on classification refer to BS 6952 : Part 1).

These materials combine some of the characteristics of a paint or varnish with those of water-repellent preservative. On exposure, they weather by eroding rather than by flaking or peeling, so reducing the amount of preparatory work required in maintenance treatment. By making the surface of the wood water-repellent, they help to regulate penetration of water.

Most stains contain pigment, which gives protection against degradation of the surface layer by ultraviolet light and imparts colour to the surface without completely obscuring the grain of the wood. Colours range from light straw to black although not all types are available in full range. Unpigmented 'stains' afford no protection against ultraviolet light, and the wood eventually assumes a grey appearance.

Most exterior wood stains contain fungicides, and these inhibit the development of blue-stain fungi which are often the cause of surface discoloration. The extent to which wood stains penetrate timber is not sufficient to provide significant protection against wet-rot fungi, hence the need for full preservative treatment of susceptible species.

Exterior wood stains are reasonably tolerant of surface imperfections, e.g. splits, shakes and knots, and most can be used on rough timber. They are probably the most suitable type of treatment for resinous woods, as resin exudation can occur without disrupting the coating. Many stains, especially the low-solids type (6/7), are suitable for use on plywood; checks that develop in the face veneer (see **26.1**) do not affect adhesion of the stain.

For initial treatment of new external wood a minimum of two and preferably three coats of exterior wood stain should be applied. Darker colours are more durable because they are more effective in absorbing ultraviolet light; on the other hand, they increase solar heat gain so that the moisture content of the wood decreases more rapidly and there may be a greater tendency to surface checking, especially with softwoods. The nature of the surface may also affect durability;

rough timber absorbs more stain, and thus the life of the treatment may be increased.

Some exterior wood stains are suitable for interior woodwork, either as finishes in themselves or beneath varnish. The fungicides in some types may preclude this use, and reference should be made to the manufacturer in case of doubt.

It is convenient to refer here to the application of linseed oil, sometimes suggested as a finishing treatment for hardwoods, especially oak, externally. This finish holds dirt, provides nutrient for blue-stain fungi and cannot be recommended. Even when they incorporate fungicides, stains containing linseed oil are more likely to support fungal growth than those that do not.

25.7.3.4 *Interior wood stains*

These stains (6/5) have no protective or preservative properties and serve essentially to impart colour to wood prior to the application of varnish or other clear finish.

25.7.4 ***Multi-coat paints formulated for improved performance***

Multi-coat paints formulated for improved performance on wood can be of water-borne or solvent borne types or even mixed systems. Frequently the first coat is referred to as the base coat (rather than the primer) and may be unpigmented and contain a fungicide.

Whilst the full benefit would be obtained only by the use of the full system, a partial system may be used in maintenance work over existing sound paintwork. However it is essential that the manufacturer's recommendations be sought on their use.

26 Plywood

26.1 Characteristics

Plywood has many of the general characteristics of solid timber, including susceptibility to the effects of moisture although the method of construction gives it greater dimensional stability with changes in moisture content. Plywood for external use is manufactured with weatherproof adhesive but not necessarily with durable species of timber throughout; if non-durable species are incorporated, preservative treatment is required for satisfactory service; see **25.3**.

The outer layers of plywood exposed to weather are prone to develop fine surface cracks ('checks') running parallel to the grain, even when painted. Checking varies in severity according to the species of timber used for the outer veneer. It is less severe, for example, with African mahogany and gaboon, whilst Douglas fir (Columbian pine) and Finnish birch are prone to severe cracking. It may be assumed, however, that the species in general use are all liable to check when used outside. Checking affects only the surface layer of the outer veneer but, if the surface is painted, the cracks are communicated to the coating, allowing entry of moisture and failure of the paint film. Plywood is available with a resin-impregnated paper overlay which prevents checking and provides a satisfactory base for painting; the use of this type of material is recommended for external plywood cladding and similar applications when a paint finish is required, especially with species prone to severe checking. Exterior wood stains (**25.7.3.3**), especially those of the low-solids type, are less likely to give trouble and are more suitable than paint or varnish for use externally on plywood without a paper overlay. However, because of the low resistance of low-solids wood stains to water vapour, fluctuations in moisture content may result in water-soluble salts, present in the adhesive, being brought to the surface. These are normally removed by rain but, if the surface is sheltered from direct rainfall, a white deposit may build up and mar the appearance. The salts can be washed off but will reappear until they have all been removed.

26.2 Paint systems for plywood

26.2.1 ***Surface preparation***

This follows the recommendations for solid timber in **25.5.2**. Knots are rarely a problem on good-quality plywood, but any present should be treated with knotting before painting.

26.2.2 ***Priming***

Primers for plywood which is to be painted are as described for wood in table 1. Typical applications are shown in table 11. Varnish and wood stains are usually applied direct, but thinning of first coats may be necessary. In this respect, reference should be made to manufacturers' recommendations.

26.2.3 ***Stopping and filling***

See **25.5.4** and **25.7.3.2**. If checking has occurred on external plywood and it is to be painted, filling will be required after priming.

26.2.4 ***Finishes for plywood***

Paint and natural finish systems suitable for use on plywood are shown in tables 11 and 12 respectively.

27 Iron and steel

27.1 Introduction

This clause deals with the painting of the ferrous metal surfaces normally encountered in buildings, in 'moderate' external and internal environments (see table 10) using paints of conventional type. For a comprehensive treatment of the subject reference should be made to BS 5493 and to DD 24, especially in situations where attack is 'severe', the areas are extensive or 'long-life' painting systems are required.

Paints and other organic coatings are available for factory-application (see **21.4**) to components and cladding and will usually compare favourably in performance, including cost in use, with site-applied systems, but their consideration is outside the scope of this code.

Non-ferrous metals, notably zinc and aluminium, are frequently used as protective coatings on iron and steel, either alone or in conjunction with paints. Painting systems for metallic coatings are described in clause **28**.

27.2 Characteristics

27.2.1 *General*

Most forms of iron and steel, if not protected, tend to revert to their oxides by gradual combination with oxygen and moisture to form rust. Most corrosion is an electrochemical process. For example, atmospheric corrosion is due typically to the existence within metal or upon its surface of areas of differing electrical potential (anodic and cathodic areas). In the presence of an electrolyte, e.g. water and dissolved salts, these form cells, and the resulting flow of current causes wastage of the metal at the anodic areas. In clean atmospheres, significant corrosion is unlikely unless the relative humidity exceeds about 70 % but, if there are sulphur compounds or soluble salts (e.g. sea salt) in the atmosphere or on the surface, severe corrosion can occur at lower levels of relative humidity. Thus, corrosion is likely to be more severe in humid industrial areas and near the coast than in rural or urban environments. The rate of corrosion of unprotected mild steel freely exposed externally in the United Kingdom is about 25 μm per year in rural areas and 125 μm per year in industrial areas.

The effect of the general environment may, however, be modified by the 'micro-climate' immediately surrounding the structure or component. Such factors as orientation, degree of exposure and the flow of air over the surfaces may increase or reduce the rate of corrosion. The frequency and extent to which condensation occurs, as a result of the difference in temperature between the metal and the air, may also be relevant; in this respect, the thickness of the metal can be a significant factor.

27.2.2 *Mild steel*

Hot-rolled mild steel bears a layer of millscale. Initially, this is tightly-adhering, but eventually it loosens and falls away. It may take several months or even years for this to occur, depending upon the conditions of exposure and whether or not the steel has been painted. If shedding of millscale occurs at an early stage, before the steel has been painted, differences in electrical potential between the exposed surface and the surrounding adherent scale may create corrosion cells and result in severe attack on the bare steel. If the scale becomes detached after painting is completed, costly preparation and repainting will be necessary. It is desirable, therefore, that millscale should be removed before the steel is painted; it is essential that this should be done if high-durability or specialist coatings are to be applied. Methods of removing millscale are described in **27.5.2**.

27.2.3 *Cast iron*

The casting scale formed on cast iron is more adherent than the millscale on mild steel and has some protective value. If the scale is removed, cast iron corrodes at about the same rate as mild steel. This may not be evident because the corrosion process leaves behind a non-metallic residue which largely retains the appearance of the original metal although its mechanical strength is negligible.

27.2.4 *Wrought iron*

In respect of painting, this is similar in characteristics to mild steel although its corrosion rate may differ slightly according to its composition.

27.2.5 *Stainless steel*

Stainless steel surfaces rarely need painting. If necessary, say for aesthetic reasons, surfaces should be abraded and degreased before application of a pretreatment primer. Proprietary systems are available for application to stainless steel. See also table 14.

27.3 Design considerations

The effectiveness of paints in protecting iron and steel can be increased, and the risks of corrosion diminished, by good design. BS 5493 gives detailed guidance on designing for the prevention of corrosion, but the following aspects have general application.

(a) All surfaces of exposed metal that will need regular maintenance painting should be fully accessible. Surfaces such as back-to-back angle-iron trusses should be spaced far enough apart to permit painting or be treated with mastic or anti-corrosive paste before being butted together. Sealing gaps with gun or trowel grade sealants is an accepted method of protecting surfaces inaccessible for painting.

Pipework, especially when sited externally, should be spaced from walls far enough to admit a paintbrush or paint glove.

(b) Drainage of trough sections should be arranged, e.g. by drilling holes, to prevent retention of water. This is especially important in salt-laden atmospheres. Water traps should be avoided where steel stanchions enter the ground or are embedded in a concrete base.

Measures should be taken to prevent discharge of waste steam and liquids on to steelwork.

(c) Sharp, internal angles, crevices and cavities should be avoided or, if unavoidable, should be filled with weld metal or mastic.

(d) Electrochemical corrosion can occur at contact surfaces between dissimilar metals in the presence of an electrolyte, e.g. rainwater. If possible, direct contact should be prevented by measures such as placing plastic sheet between the contact surfaces or applying thick bituminous coatings to them. Alternatively, electrolyte should be excluded by making joints watertight and applying an impermeable coating.

Rainwater run-off from copper to steel can also cause corrosion.

27.4 Metallic coatings

Non-ferrous metals, notably zinc and aluminium, are generally less corrodible than iron and steel and are often used as protective coatings either alone or in conjunction with paint, especially in conditions of severe exposure or where frequent maintenance is not possible. Paint systems for metallic coatings are described in clause **28**.

27.5 Paint systems for iron and steel

27.5.1 *General*

The effectiveness of painting systems in protecting iron and steel is dependent upon the following factors.

(a) The nature and thoroughness of the preparatory method and especially the extent to which millscale and rust are removed. Preparatory methods are described in **27.5.2**.

(b) The type of primer used. Generally, primers for iron and steel should contain corrosion-inhibitive pigments (see **18.4.5**). The choice of primer will be influenced by the type of preparatory method employed; see **27.5.3**.

(c) The extent to which the system is able to exclude air and moisture. This is determined mainly by the total thickness of the paint film and the conditions of exposure. The minimum film thickness for satisfactory protection in 'moderate' external environments is about 125 μm but films of 250 μm or more may be required in 'severe' environments.

Whenever possible, steelwork should be prepared and primed off-site; this usually compares favourably in cost and effectiveness with site treatment. When practicable it may be advantageous to apply one or more of the subsequent coats off-site, although this may result in divided responsibility for the work.

27.5.2 *Surface preparation*

27.5.2.1 *General*

The effectiveness with which millscale and rust are removed depends upon the method employed; the methods in general use are described in **27.5.2.2** to **27.5.2.5**. Removal of oil, grease and dirt is also important. Particular care in cleaning is necessary if iron and steel have been exposed in marine and industrial environments where surface contaminants may stimulate corrosion.

27.5.2.2 *Blast-cleaning*

This normally involves directing a stream of metal shot, grit or other abrasive particles at high velocity against the surface of the steel. The abrasive may be propelled by compressed air or high-pressure water or thrown by centrifugal force from an impeller wheel. For some purposes, high-pressure water without abrasive may be used. Properly done, blast-cleaning is the most effective method of preparing steelwork for painting and is essential when specialist coatings are to be used, e.g. in 'severe' and 'moderate' environments. In respect of cost and effectiveness, blast-cleaning is best carried out under factory conditions although the method is also suitable for the preparation of erected steelwork in some circumstances. BS 7079 describes standards for blast-cleaning. Further information on blast-cleaning, including guidance on its specification and quality control, is given in BS 5493.

In addition to its effectiveness in removing rust and millscale blast-cleaning provides a roughened surface which affords a good 'key' for paint. Excessive roughening may produce 'peaks' which protrude through the paint film and form focal points for corrosion.

Blast-cleaned surfaces are extremely vulnerable to corrosion and should be primed as soon as possible and in any case within 4 h of cleaning; see **27.5.3**.

27.5.2.3 *Acid-pickling*

This is a factory process involving immersion of iron and steel in hot acid solutions to remove millscale and rust. The 'Duplex' or 'Footner' process incorporates a final treatment in hot 2 % phosphoric acid solution which leaves a thin, rust-inhibitive phosphate coating on the surface. The method is not now generally used for structural steelwork, but large plates for storage tanks have been prepared by pickling. It may not provide a satisfactory base for some specialist coatings.

Proprietary washes and pastes, usually based on phosphoric acid, are available for site treatment of steelwork. They will not remove heavy rust or tightly-adhering scale but may assist manual cleaning (see **27.5.2.5**). Many types require washing-off; if this is not done properly, the performance of the paint may be affected and, if drying is slow, the steel will rust again. Washing-off water should not be allowed to run over adjacent brickwork or stonework. Some solutions are said not to require washing-off; such claims should be confirmed by the manufacturer.

27.5.2.4 *Flame-cleaning*

In flame-cleaning, a high temperature oxy-acetylene flame is passed over the surface, causing detachment of rust and scale by differential expansion and the evolution of steam from moisture in the rust. The method is more suitable for use in maintenance painting than in the initial treatment of new steel. It will not remove all rust and scale and is in no way a substitute for blast-cleaning. It is not suitable for use on thin sheets or on sections less than about 0.5 mm in thickness because of the risk of distortion, or on steel which has been coated with non-ferrous metals such as zinc and cadmium. Flame-cleaning may not provide a satisfactory base for some specialist coatings.

Flame-cleaned steel should be primed whilst it is still dry and warm but not hot.

27.5.2.5 *Manual cleaning*

This includes the preparation of iron and steel using hand or powered tools such as wire brushes, chipping hammers, chisels, scrapers and vibratory-needle guns. It is the least satisfactory method of preparation especially for steelwork exposed to 'severe' or 'moderate' conditions although the size of the areas or other circumstances may preclude the use of more effective methods. It does not provide a satisfactory base for specialist coatings.

Manual preparation, whether with hand or power tools, is laborious and it is difficult to maintain a uniform standard for any length of time. Power tools usually give best results, but care is necessary to avoid surface damage such as indentation, burring and scoring as this may produce 'peaks' which protrude through the paint film and become focal points of corrosion. Over-vigorous brushing with hand or power tools should be avoided as it can produce excessively burnished areas to which paint adhesion is poor.

Reliance is often placed on 'weathering' (i.e. exposure to the elements) to loosen millscale sufficiently to permit its removal by manual cleaning. However, weathering to the point where all the millscale has loosened may take many months, and it is rarely practicable to allow time for this. It is unlikely, either, that all the surfaces will weather at the same rate, thus making it impossible to prepare the surface to a uniform standard. Also, in chemically-polluted and marine atmospheres, lengthy exposure will result in contamination of the surface and increased risk of corrosion. The method should not be employed as an alternative to more effective methods, such as blast-cleaning, in situations where complete removal of rust and scale is essential.

27.5.2.6 *Removal of oil, grease and surface deposits*

In factory processes, oil and grease may be removed with solvents, solvent emulsions or hot alkali solutions, followed by thorough rinsing with water, or by steam cleaning or high-pressure water jets. It may be possible to use some of these methods on site, but often all that can be done is to wipe the surface with white spirit and a succession of clean swabs, taking care to avoid spreading the oil or grease over the surface.

Surfaces which are contaminated following exposure in marine or chemically charged atmospheres should be washed with clean water, rinsed and allowed to dry before priming. Rust that develops as a result of washing should be removed.

27.5.3 ***Priming***

Table 2 lists and describes the primers for iron and steel in general use in conjunction with undercoats and finishing paints of conventional use. Typical applications are shown in table 13. Zinc-rich epoxy primers (2/8C) may be overcoated with most types of finishes, including most specialist coatings. Advice should be sought when alkyd or oil-based coatings are to be used over zinc-rich primers.

Selection of primers for iron and steel will be determined mainly by the type and standard of surface preparation and the conditions of exposure, including the time that is likely to elapse between priming and completion of painting.

Blast-cleaning provides a satisfactory base for all types of primers, but when steelwork is blast-cleaned in the factory it is usual to combine this treatment with application of a prefabrication primer, e.g. a zinc-rich epoxy type (2/8C). When less effective methods are employed, notably manual cleaning, more 'tolerant' primers, e.g. 2/2A/B, 2/3, 2/4, or 2/7 (some types), should be used.

It is essential that priming follows preparation as quickly as possible and certainly on the same day, otherwise further corrosion may develop. The interval between preparation and priming is especially critical with blast-cleaned surfaces, and priming should follow preferably within 1 h and certainly within 4 h; if it is likely to be delayed beyond this, a temporary protective or 'holding' primer, e.g. 2/1A/B, should be applied.

Primed surfaces should be overcoated as soon as possible. If there is likely to be a delay in applying further coats, the primer should be resistant to weathering and has to afford some protection to the surface. Most prefabrication primers and the 'tolerant' types referred to above may be left uncoated for a maximum of about 9 months depending upon the conditions of exposure and the effectiveness of the preparatory work. Other types of primers may be equally satisfactory, but the manufacturer should be consulted on this aspect.

Primed steelwork, especially if it has been exposed for a lengthy period, should be examined carefully before further coats of paint are applied. If the primer has deteriorated, e.g. is perished, eroded or poorly adhering, or has been damaged, so allowing corrosion to develop, the affected areas should be re-prepared and primed. If there is evidence of widespread corrosion beneath the primer, it should be removed and the surface again prepared and primed.

Oil, grease and surface deposits should be removed from primed surfaces as described in **27.5.2.6**. Removal of salt deposits by washing from surfaces primed with zinc-rich primers is especially important as the corrosion products formed by reaction between the salts and the zinc can affect the performance of subsequent coats.

With a single coat of primer, it is difficult to obtain films of uniform thickness and free from pinholes, the points at which corrosion starts. In all but 'mild' interior environments, application of two coats of primer is desirable. If application of two coats cannot extend to the whole of the surface, a second coat should be applied to vulnerable points, e.g. along external angles and to bolts and rivet heads. When a factory-applied prefabrication primer has been used and a paint system of conventional type is to be applied, the second coat can be a drying-oil chromate (2/5) or zinc phosphate (2/4) type.

27.5.4 *Finishing*

27.5.4.1 *General surfaces*

The number and type of coats applied after priming will be determined by the requirements in respect of protection and appearance as well as by the properties of the individual coatings. Generally, the combined thickness of priming and finishing coats should be a minimum of about 125 μm for good protection in 'moderate' exterior environments; any significant increase or decrease will affect the protective properties and life expectancy of the coating proportionately.

Alkyd finish systems of adequate thickness afford good protection in mild environments and offer a wide choice of colour. Gloss finishes should be used externally, but mid-sheen finishes may be used internally in average and light wear environments.

Aluminium paints, although giving rather thin films, have good protective properties and provide an economical finish for steel. They are also suitable for use on heated surfaces; see **27.5.4.2**.

Micaceous iron oxide (MIO) paints (5/7) give good protection and are widely used in situations where the limited range of colours in which they are available is not a disadvantage although, with the manufacturer's approval, they can be overcoated with alkyd gloss finishes. MIO paints of normal type provide films of substantial thickness, and there are also 'high-build' types, usually applied by airless spray, giving films of even greater thickness.

Bituminous and tar paints (table 7), if applied in thick films, provide good protection against fresh and salt water and some chemicals in situations where colour is not a requirement. When exposed to direct sunlight, they craze and chalk and should be overcoated with bituminous aluminium paint. Generally, bituminous and tar paints should be applied over an inhibitive primer; the solvents in some types may cause softening and lifting of the primer unless several weeks are allowed for it to harden or a specially formulated primer is used.

Table 13 indicates some typical paint systems for iron and steel in 'moderate' exterior and interior environments. Specialist coatings, often in conjunction with metallic coatings, will usually be necessary for 'severe' conditions or where life expectancies in excess of those shown in table 13 are required; in these circumstances, reference should be made to BS 5493.

27.5.4.2 *Heated surfaces*

In addition to providing protection, paint systems applied to flues, chimneys, radiators, heating panels and other heated surfaces may have to be heat-resistant. Resistance to heat is influenced mainly by the maximum temperature reached in service and the nature of the heating cycle, i.e. where sustained or intermittent. The behaviour of the coating will also be influenced by the extent to which the surface remains dry when cold.

The following is a general guide to the types of paint systems likely to be satisfactory at temperatures up to about 200 °C.

(a) *Up to about* 50 °C. Normal paint systems as described in **27.5.4.1** (except bituminous and tar-based paints) are usually satisfactory. Primers other than the slow-hardening 2/2A/B and 2/6A types are preferred for heated surfaces.

(b) 50 °C *to* 90 °C. Application of two coats of alkyd gloss finish or aluminium paint over primer as in (a) is usually satisfactory; with coloured finishes, some discoloration of light colours may occur at the upper end of the range.

(c) 90 °C *to* 200 °C. Application of two coats of aluminium paint direct to clean bare metal is usually satisfactory although much will depend upon the heating cycle. A coating that has withstood several months exposure to temperatures at the higher end of the range may fail rapidly when the surface cools, especially if condensation occurs.

Further guidance is given in BS 5493. Specialist coatings are likely to be required at temperatures in excess of 200 °C, and reference should be made to coatings manufacturers.

28 Non-ferrous metals and metallic coatings

28.1 Introduction

Clause **28** relates to the site painting of the non-ferrous metals and metallic coatings commonly used in buildings in 'moderate' interior and exterior environments (see table 10) using paints of conventional type. See **27.2.5** for the painting of stainless steel. Paints and other organic coatings for factory application to non-ferrous metals components and cladding materials are available (see **21.4**) and will usually compare favourably in performance, including cost in use, with site applied paint systems, but their consideration is outside the scope of this code.

28.2 Characteristics

28.2.1 *General*

Non-ferrous metals are more resistant to corrosion than iron and steel and, for this reason, are often used as alternatives. Some, notably zinc and aluminium, are used as protective coatings for iron and steel. In most conditions, painting is not necessary except for appearance, but may be needed in some environments, e.g. in acid or marine conditions.

Non-ferrous metals may corrode in contact with alkaline materials such as concrete, cement or lime mortar or with acidic gypsum plasters, e.g. Keene's cement. Water run-off from such materials may also promote corrosion. Aluminium and lead should always be protected against this form of attack; cadmium and tin usually need protection, copper rarely does. Thick bituminous coatings may be used for this purpose; or separation by plastic spacers, tape or membrane.

Corrosion of non-ferrous metals may result from contact with wood, especially Western red cedar, Douglas fir, Oak and Sweet chestnut. Aluminium should not be in contact with wood treated with copper-based wood preservatives. Contact may be prevented with bituminous coatings; or by separation using plastic spacers, tape or membrane.

Electrolytic corrosion may occur if dissimilar metals are in unintentional contact. In particular, contact by copper, nickel and their alloys (e.g. brass and bronze) with aluminium or zinc, and of aluminium or zinc with steel should be avoided. Further information is available in PD 6484. Contact surfaces should be insulated as described in **27.3**(d), or with bituminous coatings.

A characteristic of some non-ferrous metal surfaces is that special preparation or pretreatment, or the use of primers of specific type, is usually necessary to ensure satisfactory adhesion of paint. Preparatory and pretreatment methods are described in **28.3.1** and priming in **28.3.2**.

28.2.2 *Metallic coatings*

Zinc and aluminium are used extensively as protective coatings, both individually and as alloys, for iron and steel structural members, sheets and components and consideration should be given to their use in 'moderate' and 'severe' environments and where long-term protection is required.

BS 5493 gives guidance on the selection and specification of metallic coatings. The different forms of coated product have a thickness or mass of coating, which depending on the product chosen can be selected to suit the expected severity of exposure or service requirements.

Processes in general use for the application of zinc and aluminium coatings to iron and steel are as follows.

(a) *Hot-dip galvanizing* (zinc) for structures and fittings (see BS 729) and claddings (see BS 2989). Clean steel is immersed in molten zinc; an alloying action results in a metallurgically bonded coating.

(b) *Hot-dip aluminizing* is a process similar to (a) for the application of aluminium to steel.

NOTE. Zinc-aluminium and aluminium zinc alloy coatings are also available, for application by a hot-dip process.

(c) *Sherardizing (zinc)* mainly for fittings, fasteners and small items (see BS 4921). The coating is formed by alloying the steel with zinc particles just below their melting point, usually in a rotating barrel.

NOTE. A similar process can be used for the application of aluminium coatings, known as calorizing.

(d) *Electroplating (zinc)* by electrolytic deposition of zinc from zinc salt solutions is sometimes used for small items (see BS 1706 or BS 3382), as well as for sheet components.

(e) *Metal spraying (zinc, aluminium or their alloys)* is the application of a metallic coat by spraying metal in a semi-molten form. It is used mainly for structural steelwork and plates after blast-cleaning; see BS 2569. The process may be undertaken in the factory or, when conditions permit, on site.

The metal coatings in (a) to (e) can provide adequate protection without painting, when correctly specified for the conditions. It may be necessary to paint for appearance or for added protection in some environments. On sprayed metal coatings, clear or pigmented sealers may be used. These are specialist materials normally applied as part of the metal spraying process and are described in BS 5493.

The non-ferrous metal coatings referred to in (a) to (e) need special preparation or pretreatment, or the use of primers of specific type, in order to ensure satisfactory adhesion of paint. See **28.3.1** and **28.3.2**. Appropriate sealer or paint systems usually adhere satisfactorily to sprayed non-ferrous coatings if they are applied soon after the sprayed coatings.

28.3 Paint systems for non-ferrous metals

28.3.1 *Surface preparation*

28.3.1.1 *General*

Preparation of new non-ferrous metal surfaces is concerned essentially with the removal of dirt, grease and corrosion products and, where necessary, treatment to improve paint adhesion, e.g. to galvanized surfaces and to aluminium sheets and extruded sections. Sprayed metal coatings and aluminium castings usually provide a satisfactory key for paint without special treatment, but the surfaces should be clean and free from corrosion products and should be lightly abraded.

Non-ferrous metals are often left unpainted for many years, but painting may eventually be necessary for appearance or to arrest deterioration. If aluminium is left unpainted it may acquire a rough layer of corrosion products which should be removed before painting. Similarly, if erosion of metal coatings (e.g. on galvanized or metal-sprayed steel) has exposed the steel, any rust present should be removed.

28.3.1.2 *Degreasing*

Non-ferrous metals readily retain grease and lubricants used in extrusion and drawing processes and these should be removed. Factory cleaning methods include vapour degreasing or immersion in solvents or detergent solution. On site, after cleaning off any gross contamination with an appropriate cleaning fluid, e.g. white spirit, surfaces may be washed using a detergent solution, rinsed and allowed to dry. Alternatively, surfaces may be wiped over with white spirit and clean swabs; frequent changing of solvent and swabs is necessary to avoid spreading the contaminant over the surface. Proprietary degreasing solutions for site use are also available. In difficult cases more abrasive materials should be used.

28.3.1.3 *Removal of corrosion products*

Unless metal sprayed coatings are sealed (see **28.3.2.4**) corrosion products may develop fairly rapidly, especially in damp or chemically-charged atmospheres. They can be detrimental to the metal coating and will affect paint adhesion. They should be removed before painting. Scrubbing with clean water and stiff bristle or nylon (not wire) brushes, followed by rinsing with clean water, is usually effective.

Removal of the rough layer of corrosion products which may form on aluminium after several years exposure can be difficult and abrasion may be necessary, e.g. with stainless steel wire wool or nylon pads, using water or white spirit as a lubricant. Mild steel, brass, or copper wire should not be used, as broken strands may become embedded in the surface and stimulate corrosion.

If non-ferrous metal coatings on iron and steel are damaged or become eroded on long exposure, rusting of the exposed base metal is likely to occur. Rusted areas should be cleaned to bright metal and should be roughened, by wire brushing or abrasion, care being taken to avoid damage to adjacent sound zinc or aluminium.

28.3.1.4 *Pretreatment (wash or etching) primers*

Although included here with other preparatory treatments, pretreatment primers have some of the properties of a conventional metal primer in addition to their essential function of assisting adhesion of paint systems to non-ferrous metals. They contain pigments which are corrosion-inhibiting and will afford short-term protection although subsequent coats of paint should be applied with as little delay as possible. Pretreatment primers are applied as thin films. The maximum film thickness specified by the manufacturers should not be exceeded. Except in very mild conditions, pretreatment primers are usually followed by a normal primer.

Two-pack pretreatment primers (2/1A) generally give best results but the one-pack types (2/1B) may be more convenient for site application. Some pretreatment primers are sensitive to moisture in the early stages and their suitability for use in conditions where they are likely to be exposed to rain or dew should be checked with the manufacturer. Some types are suitable only for spray application; others may be brushed or sprayed.

28.3.1.5 *Chemical pretreatments*

Zinc, aluminium and some other non-ferrous metals may be pretreated to improve paint adhesion. Such pretreatment is best carried out under controlled, factory conditions. Site-applied treatments with proprietary washes may be less effective and may present difficulties in use, especially if final rinsing is required. A non-proprietary material for the pretreatment of galvanized surfaces is known as 'T wash'[1)] which, when properly applied, blackens zinc surfaces. If this does not occur, the surface should be thoroughly cleaned (see **28.3.1.2**) and the treatment should be repeated. Excessive application of the wash (which, on horizontal surfaces may lead to 'ponding') and excessive thickness of coating, should be avoided.

28.3.1.6 *Weathering*

Exposure to weather of zinc and galvanized surfaces will often improve paint adhesion, but the process is likely to take several months, even in conditions conducive to weathering, and the surface will rarely weather uniformly. Also, they are likely to become soiled or contaminated especially in industrial and marine environments and should be washed (and degreased if necessary) before paint is applied. Weathering is unnecessary if the correct pretreatments and/or primers are used; see **28.3.2**.

28.3.1.7 *Abrasion*

Adhesion of paint to non-ferrous metals may be assisted by abrading the surface with fine emery cloth, or abrasive paper and white spirit; this method may be used for small areas prepared on site. Care should be taken not to abrade through thin films of pure aluminium on composite ('clad') sheets; the use of steel wool or hard abrasives is best avoided on these surfaces.

28.3.1.8 *Anodizing*

This is an electrolytic process used on aluminium in which a corrosion-resistant oxide film is deposited on the surface. Anodizing can provide an excellent surface for painting, but the process is expensive and is rarely used solely to facilitate painting. The advice of the manufacturer should be sought.

28.3.2 ***Priming***

28.3.2.1 *General*

Primers for non-ferrous metals should contain corrosion-inhibiting pigments (**18.4.5**) but some such pigments which may be found in primers for iron and steel, e.g. red lead and graphite, are unsuitable as they can stimulate corrosion.

Film thickness, although it has to be adequate, need not be so critical to the protection of non-ferrous metals as it is with iron and steel. In most conditions, one coat of primer in addition to the possible use of a pretreatment primer will provide a satisfactory base for finishing coats; in some circumstances, a pretreatment primer alone may suffice.

Recommendations in respect of primers for the non-ferrous metals in general use in buildings, assuming subsequent application of paints of conventional type, are described in **28.3.2.2** to **28.3.2.7**. Surfaces, preparatory treatments and primers are correlated in table 14.

28.3.2.2 *Aluminium and its alloys*

Although aluminium and its alloys vary in corrosion resistance, similar primers are used for all of them. Primers containing zinc chromate or other chromates, but not lead or graphite pigments, are suitable. The chromate pigment should constitute about 20 % by mass of the dry paint film, but factory-applied red oxide/chromate primers with about 5 % chromate can be satisfactory if the alloy is resistant to corrosion and the conditions of exposure are not severe. Pretreatment primers, especially the two-pack type (see **28.3.1.4**) are particularly suitable for aluminium and its alloys and assist adhesion on smooth surfaces, e.g. sheets, extruded sections and aluminized steel.

28.3.2.3 *Zinc and zinc-coated (galvanized, sheradized and electroplated) steel*

Zinc reacts with most oil-based paints, forming soluble salts (zinc soaps) beneath the paint film which cause it to become embrittled and lose adhesion. Pretreatment primers (table 2/1A/B) are satisfactory except possibly on galvanized sheet; see following paragraph. Zinc-rich primer (table 2/8A/B/C) can also be used. Calcium plumbate primers (table 2/6A/B) are satisfactory if compatible top coats are used; see **28.3.3**. The toxic nature of calcium plumbate primers is a limitation. Low-lead primers are available as an alternative to calcium plumbate primers. Zinc chromate primers (table 2/5) should normally be applied over a

[1)] Information may be obtained from the Zinc Development Association, 42 Weymouth Street, London W1N 3LQ.

pretreatment primer. Red lead primers should not be used on zinc.

Unless otherwise specified (i.e. oiled or untreated), virtually all galvanized sheet produced in Britain is chromate treated (passivated) to prevent wet storage staining (white rusting) during storage. Such a treatment is likely to prevent pretreatment primers reacting fully with the zinc and it may also be incompatible with phosphate treatments. Galvanized sheet steel and components manufactured from such sheet, may need treatment with proprietary chemicals before pretreatment or painting. Calcium plumbate or low-lead primers formulated for direct application to zinc surfaces are satisfactory subject to the use of compatible top coats. Abrasion may also be used to remove the original chromate treatment but care should be taken to avoid excessive removal of the zinc coating which would reduce the protective value of the system.

28.3.2.4 *Sprayed metal coatings*

If they are to be painted, sprayed zinc, aluminium and zinc aluminium alloy coatings, should receive a coat of pretreatment primer immediately following application of the metallic coating, especially if they are to be exposed to damp or corrosive atmospheres; in order to retard the development of corrosion products which may affect the adhesion or appearance of the paint. If this is not done and corrosion products have developed, they should be removed (see **28.3.1.3**) and the surface allowed to dry before application of the pretreatment primer. Except in very mild conditions, the pretreatment primer should be followed by one coat of zinc chromate primer. Lead-containing primers, including calcium plumbate (formulations designed for galvanized steel), should not be used.

28.3.2.5 *Copper and its alloys (e.g. brass and bronze)*

These are rarely painted except for appearance. Adhesion of paint may be assisted by abrasion with fine abrasive paper and white spirit or application of a pretreatment primer to a bright, clean and grease-free surface. Indoors, direct application of alkyd gloss after abrasion may be satisfactory. Special materials are available if a clear finish is required.

28.3.2.6 *Lead*

Abrasion as described for copper (see **28.3.2.5**), or treatment with phosphating solutions (see **28.3.1.5**) improves adhesion. Pretreatment primers are satisfactory, when applied to clean, grease-free surfaces, as are many conventional metal primers, provided they do not contain graphite. Lead surfaces should not be abraded dry.

28.3.2.7 *Chromium, nickel, tin and cadmium (as coatings)*

New chromium and nickel coatings rarely need painting, but it may be necessary if they become corroded. The surfaces should be lightly abraded to remove corrosion products before application of pretreatment primer.

Tin plate presents few difficulties in painting; most paints will adhere satisfactorily after degreasing and light abrasion of the surface.

Cadmium should not be weathered prior to painting. Phosphate treatment (see **28.3.1.5**) or a pretreatment primer (after light abrasion if necessary) will provide a key for subsequent coats. Cadmium plated surfaces should not be abraded dry.

28.3.3 ***Finishing***

The finishes for iron and steel indicated in **27.5.4.1** are equally suitable for use on non-ferrous metals. In most situations, alkyd finish systems give satisfactory results, but when they are to be applied to primed galvanized surfaces, in particular over calcium plumbate primers, it should be ensured that the primer and succeeding coats are compatible, otherwise adhesion failure may occur, especially in wet conditions. Micaceous iron oxide paints give excellent added protection to galvanized and metal-sprayed steel in 'moderate' and many 'severe' conditions. Bituminous paints can be used for contact surfaces (see **28.2.1**) and where colour and appearance are not critical.

Finishing paints for aluminium should not contain lead or graphite pigments, which stimulate corrosion, as the priming coat may not isolate them from contact with the metal.

Finishing systems for non-ferrous metals are similar to those indicated for iron and steel in table 13, except that film thickness tends to be less critical and fewer coats may be used. In many 'moderate' exterior and interior environments, three-coat systems (including primer) having a total thickness of about 85 μm may be adequate; in some interior situations, thinner films may be used. The life expectancy of comparable paint systems on non-ferrous metals tends to be greater than on iron and steel.

For guidance on the selection of paint coatings for galvanized and metal-sprayed iron and steel in 'severe' environments, reference should be made to BS 5493.

29 Plaster, external rendering, concrete (including lightweight and autoclaved aerated blocks), brick and stone: general considerations

29.1 General

The individual characteristics of these substrates are described in succeeding clauses. However, they have a number of characteristics in common and, to avoid repetition, these and general principles applying to the selection of paint for these substrate systems are considered here.

29.2 Characteristics

29.2.1 ***Moisture content***

29.2.1.1 *General*

Water, often in large quantities, is used with all the materials referred to and may also be absorbed as a result of storage of materials in the open without protection.

Excessive moisture affects the adhesion of most types of paints, causes blistering and flaking and encourages the growth of moulds. Additionally, in combination with alkalis and salts contained in many 'wet' materials of construction, it is the cause of other difficulties in relation to painting, including efflorescence, alkaline attack and staining. Until the contained moisture has substantially dried out, therefore, there is some degree of risk in applying most types of coatings. Drying out can take a long time even in favourable conditions, a rough estimate being one week of good drying conditions for each 5 mm thickness of wet construction (typically 4 to 6 weeks).

Internally, ventilation and heat will hasten drying, and dehumidifiers can be used in very bad conditions. Ventilation is particularly important and is often neglected; without it, heating may aggravate the problem by causing condensation on cold surfaces. Solid fuel appliances or other heaters vented to the outside will normally provide good ventilation but, with electric and central heating, windows have to be kept open. Portable oil or gas heaters produce additional moisture and, unless provided with means of exhausting combustion products outside the building, should not be used for drying out. When artificial heating is used to assist drying out, excessive heat should be avoided as it may cause undue shrinkage of wood and cracking of plaster; it may also prevent proper hydration of some types of plaster.

Externally, the atmospheric conditions largely determine the rate of drying. It will be helpful to remove surface water to aid subsequent drying and, if possible, to protect surfaces against further wetting by such means as polyethylene sheets arranged to allow ventilation. Usually, however, there is less pressure to complete the painting of external walls and similar surfaces before they have substantially dried out.

Further information on drying out buildings is given in BRE Digest No. 163.

29.2.1.2 *Measuring moisture content*

Apparent surface dryness is not a reliable indication of the moisture content in depth, especially in good drying conditions when surface moisture evaporates rapidly. It may be possible to judge the suitability of a surface for painting from a knowledge of the method and materials of construction and the conditions prevailing during and after erection. When in doubt, it is advisable to use more accurate methods, which include the following.

(a) *Weighing.* Weighing of the moisture lost during oven drying of samples, e.g. obtained by drilling, is the most accurate method. This may require access to laboratory facilities although a calcium carbide meter can be used with drilled samples for on-site determination of the moisture content of walls and this avoids the need for oven-drying. However, any method of test involving drilling may be impracticable for general use.

(b) *Hygrometer.* The equilibrium humidity produced in an airspace in contact with the substrate can be measured using an accurate hygrometer. The space may be formed by a sealed and insulated box in which the hygrometer is mounted; less reliably, a sheet of polyethylene may be taped to the substrate with the hygrometer inside. In either case, several hours should be allowed for equilibrium to be reached.

(c) *Electrical moisture meters.* Two types in general use are conductivity meters and capacitance meters.

Conductivity meters measure the electrical resistance between two steel probes forced into the substrate; the higher the moisture content, the lower is the resistance to the flow of current. With hard, dense substrates it may be necessary to drill holes in order to obtain readings. Resistance is reduced by the presence of soluble salts so the readings may be higher than is justified by the moisture actually present. Capacitance types have two flat electrodes which are pressed against the surface, thus avoiding damage. These meters register moisture present only in the upper 1 mm to 2 mm of the substrate and are inaccurate on rough surfaces; as with the conductivity types, soluble salts may affect the accuracy of readings.

Electrical moisture meters, although less accurate than the other methods described, are easy and convenient to use and enable a number of readings to be taken quickly. Their use is preferable to reliance on surface appearance or rule-of-thumb methods.

If a wall is believed to be damp but meter readings at a shallow depth indicate low moisture content, the area should be covered with a sheet of polyethylene and rechecked 24 h later. If there is adjacent woodwork, it is useful to check its moisture content; as there is less likelihood of soluble salts being present in wood, readings will be more reliable, especially if they are significantly lower for the wood.

The first column in tables 15 and 16 refers to four stages of drying of walls, i.e. 'dry', 'drying', 'damp', and 'wet', and gives corresponding equilibrium humidity percentages. This is intended as general guidance to the selection of paint systems in relation to the dryness of the substrate and should be supplemented by reference to local conditions and experience.

29.2.2 ***Efflorescence***

This is the appearance on the surface of plaster, rendering, brickwork and similar materials of salts from backing materials taken into solution and brought forward during drying out. It may develop as a bulky, fluffy layer, easily removed, or as a thin, hard film which is impossible to brush or scrape off completely.

The bulky type of efflorescence, usually sodium sulphate, is likely to disrupt impermeable (e.g. oil-based) paints but may come through permeable (e.g. emulsion) paints without much disruption although their adhesion may be impaired. It is undesirable, therefore, to apply even permeable paints until efflorescence has ceased. As it occurs, it should be removed with a dry cloth or brush, followed by wiping with a damp cloth wrung out frequently in clean water avoiding excessive wetting. This treatment should be repeated at intervals of a few days until efflorescence has ceased.

29.2.3 ***Calcium carbonate deposits***

Thin, hard films known as lime bloom cannot be wiped off but can usually be over-painted without much risk of disruption provided the substrate is substantially dry. The glazed surface may impair adhesion and should be lightly abraded to prevent this.

29.2.4 ***Alkalinity***

Materials containing Portland cement or lime are strongly alkaline; gypsum plasters are not usually alkaline in themselves but may become so if they are gauged with lime or it is brought forward from backings during drying. Alkalinity diminishes with ageing, but the process may take several years with cement-based products.

Oil-based paints are likely to be saponified (softened or liquefied) by alkalis in the presence of moisture. Emulsion paints are not attacked in this way but may be weakened or bleached by strong alkalis. Some special purpose paints, notably those based on chlorinated rubber or epoxy resins, are not attacked but require to be applied to dry substrates, and this usually precludes their use on new work. Cement-based paints are also resistant to alkaline attack. Some pigments are attacked by alkalis, causing fading or discoloration, but paints intended for use on substrates that may contain alkalis are usually formulated with resistant pigments.

Alkali-resisting primers (3/1) provide a measure of protection against alkaline attack and should always be used beneath oil-based systems applied to substrates in which alkalis may be present. However, it cannot be too strongly emphasized that the essential function of alkali-resisting primers is to diminish the risk of failure on substrates that are substantially dry, and they do not obviate the need to allow time for this condition to be reached. Alkali-resisting primers may also improve the performance of emulsion paint on cement-based substrates; if so used, they should be applied thinly to avoid producing a glossy surface to which emulsion paint may not adhere satisfactorily.

29.2.5 ***Staining***

Brown stains with no appreciable surface deposit sometimes appear on emulsion paints but do not normally affect oil-based paints. They are usually derived from substrates, notably certain types of brick, hollow clay pot or clinker block, containing soluble salts or colouring materials, or from sands containing organic matter which reacts with alkali. If it is suspected that this type of staining is likely to occur, a coat of alkali-resisting primer will usually prevent it and may also be used over stained emulsion paint to prevent staining of succeeding coats. The substrates should be substantially dry and, for the reason indicated in **29.2.4**, the primer should be applied thinly.

29.3 Paint finishes

29.3.1 ***General***

The choice of paint systems for substrates employing 'wet' materials of construction will be determined mainly by the moisture content at the time of painting. Where time can be allowed for drying out, there are few restrictions and the prime considerations are the conditions of service and the requirements in respect of appearance, i.e. colour, sheen level and texture.

29.3.2 *Internal surfaces*

29.3.2.1 *General*

Mid-sheen or matt finishes are usually preferred for walls and ceilings as they minimize the effect of surface irregularities and reduce reflection of light sources. Their resistance to wear and repeated washing is generally relative to the degree of sheen, and mid-sheen or matt finishes are less suitable than gloss finishes for use in hard-wear environments.

29.3.2.2 *Mid-sheen and matt emulsion paints* (5/4, 5/5)

These are permeable, reasonably resistant to alkaline attack and therefore suitable for use on substrates that are not completely dry, but they should not on this account be misused, e.g. applied to damp surfaces within a few days of plastering. Permeability is generally proportionate to the level of sheen; the matt 'contract' types (5/5) are the most permeable although they are less resistant to wear and frequent washing than the other types. Emulsion paints applied to reasonably dry substrates usually provide a satisfactory base for most of the types of paint that may be required for maintenance painting.

29.3.2.3 *Alkyd and other oil-based mid-sheen and matt finishes* (5/2, 5/3)

These are less permeable and more susceptible to alkaline attack than their emulsion paint counterparts and there is always some degree of risk in applying them to other than completely dry substrates. They should always be applied over an alkali-resisting primer.

29.3.2.4 *Alkyd gloss finishes* (5/1)

These have good resistance to wear and frequent washing but should be applied only to dry substrates primed with an alkali-resisting primer. If the conditions of service warrant the use of a gloss finish and time cannot be allowed for drying out, emulsion paint should be used as a temporary measure and the gloss finish system applied when drying out is complete.

29.3.2.5 *Textured coatings*

These may be used for their decorative effect, to hide surface defects or irregularities and as an alternative to plastering or rendering. Coatings of this type include 'plastic' texture paints (5/15) and emulsion-based, heavy-textured masonry paints (5/9). They are usually relatively permeable and moderately resistant to alkaline attack and may be suitable for direct application to surfaces not completely dry, but reference should be made to manufacturers' recommendations.

29.3.2.6 *Multi-colour finishes* (5/14)

These are very hard-wearing and especially suitable for use on walls in circulating areas, cloakrooms and similar locations. Generally, they should be applied only to substantially dry substrates, usually over special primers or base-coats, but manufacturers' recommendations regarding surface conditions and systems should be followed.

29.3.2.7 *Cement paints* (5/13)

These are permeable, resistant to alkaline attack and suitable for early application to most substrates except gypsum plaster, although their rough surface and limited colour range may preclude their use if ease of cleaning and decorative appearance are important. They may also impose limitations on the choice of maintenance paints. Cement paints are applied directly without priming.

29.3.2.8 *Masonry paints, mineral type* (5/12)

See **29.3.3.6**.

29.3.3 *External surfaces*

29.3.3.1 *General*

These are painted principally to enhance their appearance by imparting colour and texture or, in some cases, to prevent rain penetration; see **29.4**. A range of specialized coatings (8/1 to 8/4) can also be used, following manufacturers' recommendations, in protecting the surface of concrete, etc. from potentially harmful agents, e.g. carbon dioxide, sulphur dioxide and salts. Initial painting and subsequent maintenance can be costly and, in designing new buildings, consideration should always be given to the use of alternative means of achieving the desired objectives, e.g. by using self-coloured renderings or facings which require infrequent maintenance or are resistant to rain penetration.

With older buildings, painting may be the only practicable means of improving the appearance and weather resistance of external walls; painting may also be necessary to provide a uniform appearance when repairs or alterations have been carried out. Although external walls are often not painted until many years after erection, they should still be regarded as 'new'; the considerations in respect of moisture content described in **29.2.1** are equally applicable, especially when rain has penetrated or repairs have been carried out. Additionally, mould and other organic growths may be present, and preparatory treatment to deal with these should be carried out as described in **53.8**.

29.3.3.2 *Gloss finishes*

Gloss finishes are rarely used on external walls except in repainting work on smooth renderings or stucco. If oil-based gloss finishes are used, the substrate should be completely dry and an alkali-resisting primer should be applied. Water-based gloss finishes can be used in suitable conditions of temperature and humidity for satisfactory film formation and drying.

29.3.3.3 *Matt finishes*

Alkyd mid-sheen and matt finishes, as used for internal surfaces, are not suitable for external walls. Most good quality, general purpose matt emulsion paints can be used externally, but emulsion-based masonry paints (5/8) or, on substantially dry substrates, solvent-thinned masonry paints (5/10) are preferred.

29.3.3.4 *Textured finishes*

These cover a wide range from those having a fine sand or stone texture to heavy-texture coatings containing coarse aggregate or deriving their texture from the method of application. Examples of the types available are 5/8 to 5/11.

Although their texture may not appear obvious when seen from more than a short distance, the greater durability of textured finishes compared with that of smooth finishes generally justifies their use. The thicker or more heavily-textured coatings also help to hide surface irregularities, fill fine surface cracks and contribute to the rain resistance of external walls. They are too thin to improve the acoustic or thermal insulation properties of walls, but by reducing rain penetration they may prevent reduction of the original thermal insulation value. Dirt pick-up may be a problem with the heavier textures in polluted atmospheres although the rough texture tends to promote an evenness of soiling that may be less apparent than on a smooth surface.

Some thick, textured sprayed coatings are applied by specialist applicators and may be offered with a warranty as to their durability; this is usually limited to specific aspects of performance but can be of value if the applicator or supplier is of good standing with several years' background of satisfactory applications.

Generally, the cost of materials or application, or both, will be higher with the thicker or more heavily-textured coatings than with the thinner smooth or fine-textured masonry paints. On domestic buildings, the higher initial cost may not be offset by a proportionate increase in durability but may be justified on buildings where application costs are high, e.g. where extensive scaffolding is necessary, or there is a requirement for a high standard of appearance or better resistance to rain penetration. In some circumstances, the use of thick 'organic renderings' (5/9) with good resistance to rain penetration may obviate the need for cement rendering, making their use more economical.

In general, most masonry paints and textured coatings are permeable and alkali-resistant in some degree and are usually suitable for application to substantially dry substrates without priming. However, because of the wide range of types and compositions available, manufacturers' recommendations in these respects should be ascertained.

29.3.3.5 *Cement paints*

See **29.3.2.7**. On external exposure, algal growth is prone to develop on cement paints applied to surfaces which are persistently damp although some paints incorporate a fungicide. They erode rapidly in highly acid atmospheres.

29.3.3.6 *Masonry paints, mineral type*

Mineral paints have been used in continental Europe for a considerable time in grades suitable for external and internal surfaces. They provide inert non flammable films which do not suffer fungal and algal growth and are compatible with all mineral building materials. Compositions of high water vapour permeability are available. External surfaces to be painted should be free from dirt and all previous paint coatings. Application can be by brush, roller or spray. The 'drying' coating can be very susceptible to rain damage.

The liquid paints are highly alkaline and hence precautions should be taken during application.

29.4 Waterproofing treatments

Where rain penetration of masonry walls has been established as the cause of internal dampness, the application of coatings to the external face may be of benefit although, in conditions of extreme exposure or for minimum maintenance, some form of light cladding is preferable. Accurate diagnosis of the cause of dampness is essential. Where it is due to condensation or rising damp rather than rain penetration, the application of coatings externally is likely to aggravate the condition and may induce spalling of the masonry surface. Coatings should be applied only to dry substrates and after cracks and other defects have been repaired.

Paint coatings, particularly the heavier texture coatings referred to in **29.3.3.4**, will reduce rain penetration. Some systems incorporate a waterproof bituminous emulsion coating over which an emulsion-based masonry paint is applied; others include glass or synthetic fibre reinforcing fabric to improve performance at joints and cracks.