Although pigmented coatings generally provide a better barrier to rain penetration and usually have a longer effective life, clear coatings are useful when it is required to maintain the natural appearance of brick, stone and other masonry surfaces. Silicone-based water repellents complying with the requirements of BS 6477 and other clear water repellents (e.g. based on aluminium stearates) applied to porous surfaces in good condition may be effective for up to 10 years. Much of the rain penetration of brickwork occurs at mortar joints, and water repellents will not always seal these fine cracks or the larger ones that may develop; water shed from the treated areas then tends to run into the cracks and aggravates the condition.

Clear solutions of resins, e.g. acrylic, may also be useful for waterproofing and may be more effective than water repellents when there are fine cracks, but they have more effect on the appearance of the surface and restrict evaporation of water from the wall to a greater degree. Their durability is difficult to predict as it is partly dependent on the depth of penetration.

Clear water repellents and coatings should be applied only to dry substrate and after major cracks and other defects have been repaired.

Clear coatings may be required for interior facing brick or stone walls to prevent soiling and facilitate cleaning. Clear water repellents or acrylic solutions may be suitable for this purpose; clear acrylic emulsions are a possible alternative.

30 Plaster

30.1 General

This clause should be read in conjunction with clause **29** which describes the general characteristics of 'wet' materials of construction and the considerations in respect of painting.

30.2 Characteristics

30.2.1 *General*

The plasters in general use for internal work comprise the following:

calcium sulphate (gypsum) types, other than lightweight plasters, complying with the requirements of BS 1191 : Part 1;

calcium sulphate (gypsum) lightweight plasters complying with the requirements of BS 1191 : Part 2;

thin-wall plasters;

cement plasters;

lime plasters.

Their characteristics, in relation to painting, are described in **30.2.2** to **30.2.6**.

30.2.2 *Calcium sulphate (gypsum) plasters*

Used neat and when fully dry and set these plasters can be painted without difficulty with most types of paint. Added lime (or cement in backing coats), in the presence of moisture, may cause alkalinity.

BS 1191 : Part 1 distinguishes four grades of gypsum plasters as follows.

(a) *Grade A. Plaster of Paris.* This is not normally used for plastering but is sometimes used for repairs and may be gauged with lime or lime and sand. For painting purposes, it may be considered with grade B.

(b) *Grade B. Retarded hemi-hydrate plasters.* These have a smooth, hard but moderately porous surface to which paint adhesion is good, but absorption is sometimes variable and may cause patchiness of water-thinned paints. Grade B plasters are generally neutral in reaction and, even if gauged with lime, should not usually affect paint unless there is a source of alkali in the backing. Over-wetting during application may produce a powdery surface. In damp conditions (e.g. from prolonged heavy condensation or moisture penetration from behind), 'sweat out' may occur, resulting in softening of the plaster and consequent paint failure.

(c) *Grade C. Anhydrous plasters.* These are harder and less porous than grade B plasters. Over-trowelling can produce a 'polished' surface to which paint adhesion is poor. Anhydrous plasters are slightly alkaline but, if used neat, should not normally affect paint. However, the addition of lime to improve workability is common and this may react with accelerating salts contained in the plaster, making it more likely to affect paint.

If the drying of anhydrous plasters is accelerated they may fail to hydrate fully, giving a powdery surface ('dry out') with poor paint adhesion; this may not always be obvious at the time of painting. If moisture subsequently gains access to the powdery layer, delayed expansion can cause severe blistering or disintegration of the plaster. Excessive heating, in an attempt to hasten drying and facilitate early painting, can lead to this kind of difficulty.

(d) *Grade D. Keene's cement.* This is similar to grade C plasters and can be trowelled to a smooth, hard surface, especially suitable when gloss finishes are to be used. It is normally slightly acid in reaction but is unlikely to affect paint, unless lime is present, when it may

become strongly alkaline. It should not be gauged with lime, but the latter may be brought forward from backing materials during drying.

Excessive trowelling of Keene's cement can produce a dense, 'polished' surface to which paint may not adhere satisfactorily. To overcome this a traditional practice was to prime 'following the trowel', i.e. as soon as the surface was firm enough to resist disturbance, using a 'sharp' primer containing a high proportion of solvent and very little oil. Timing and the composition of the primer are critical to the success of the method, and it is now rarely employed; if used, it should be only on Keene's cement that shows an acid reaction. It should be noted that proprietary alkali-resisting primers and primer-sealers are not usually suitable for use as 'sharp' primers.

30.2.3 ***Lightweight plasters***

BS 1191 : Part 2 describes lightweight gypsum undercoat and finish plasters based on grade B plasters with lightweight aggregates. Their general characteristics, in relation to painting, are as described in **30.2.2**(b). Premixed lightweight cement plaster undercoats may be used in some circumstances, and these are strongly alkaline.

Lightweight plasters initially hold more water than other types and may take longer to dry out particularly in winter.

30.2.4 ***Thin-wall plasters***

These are based on organic binders and, as they are used in thin layers, dry out rapidly. They normally present no difficulties in painting when used on dry backings but sometimes appear underbound and may be excessively absorbent; in these cases, treatment as described in **30.3.2** may be necessary.

30.2.5 ***Cement plasters***

Cement/sand or cement/sand/lime plasters may be used where strong, hard or moisture-resistant surfaces are required. As noted in **30.2.3**, some lightweight plaster undercoats may be cement-based. All these materials are strongly alkaline and, until they have substantially dried out, are likely to attack oil-based paints.

30.2.6 ***Lime plasters***

Non-hydraulic lime plasters made with high-purity lime and clean sand are free from soluble salts and caustic alkali but may react with salts from backing to form caustic alkalis which attack oil-based paints and some emulsion paints if they are applied before the plaster has substantially dried out. Hydraulic lime plasters are variable in caustic alkali content and may attack paints severely.

Generally, it should be assumed that all lime plasters present a risk of alkaline attack until they have dried out.

30.3 Paint systems for plaster

30.3.1 ***Surface preparation***

30.3.1.1 *Cleaning*

Dirt and loose surface deposits can usually be removed by dry brushing. Plaster nibs and splashes should be scraped off, care being taken to avoid damaging the surface. Efflorescence, if present, should be treated as described in **29.2.2**.

Mould growth may occur on plastered surfaces if drying out has been prolonged, especially in conditions of poor ventilation. The affected areas should be treated as described in **53.8.3**.

30.3.1.2 *Treatment of stains*

See **29.2.5**.

30.3.1.3 *Stopping and filling*

Cracks, holes and surface imperfections should be stopped and filled with plaster, water-mixed filler or, in cement plasters, with masonry cement, before application of first or priming coats. Alternatively, in oil-based paint systems, oil-based stoppers and fillers may be used after priming.

30.3.2 ***Priming***

Recommendations for priming are given in table 15. Priming is required when oil-base paint systems are applied to plaster; it is not usually necessary with emulsion paints but see **29.2**, especially **29.2.4** and **29.2.5**.

When emulsion paints are applied to plaster of high or variable porosity, differential absorption can cause difficulties in application or variations in colour or sheen which may persist through several coats. A well-thinned first coat of emulsion paint, sometimes referred to as a 'sealing' or 'mist' coat, often overcomes the trouble but is likely to have relatively poor opacity and, if it is required, should be regarded or specified as an additional coat in the system. Where this proves inadequate it is usually necessary to apply a coat of alkali-resisting primer (3/1) or primer-sealer (3/3), but this should be done only if the substrate is substantially dry. The primer or primer-sealer may require thinning to ensure that it does not provide a glossy surface to which emulsion paint may not adhere properly.

30.3.3 ***Finishing***

Guidance on the selection of finishes for plaster is given in **29.3.2**, and details of systems are incorporated in table 15.

31 External renderings

31.1 General

This clause should be read in conjunction with clause **29** which describes the general characteristics of 'wet' materials of construction and the considerations in respect of painting.

31.2 Characteristics

31.2.1 *Cement renderings*

The renderings in general use are cement-based and may incorporate lime. They are strongly alkaline and likely to attack oil-based paints until they have substantially dried out. However, they may not require painting when new, although this may eventually be necessary for appearance or if repairs are carried out.

31.2.2 *Stucco*

This term is often applied to the external renderings, usually painted, found in older buildings. Lime/sand renderings were used for the earlier work; later work (from about 1790) may be 'Roman' or Portland cement-based. Examples of oil mastic stucco (1790-1820) may also be found. Where deterioration or removal of the paint coating exposes the original surface, there are unlikely to be any difficulties in repainting, provided the rendering is sound and dry.

31.2.3 *Repairs to renderings*

If repairs to old renderings, including stucco, are necessary, they should be carried out in accordance with the recommendations in BS 5262, using cement-based mixes. The repaired portions should then be treated as for new work in respect of painting.

31.3 Paint systems for external renderings

31.3.1 *Surface preparation*

31.3.1.1 *Cleaning*

New surfaces normally require little more than brushing down with stiff (not wire) brushes to remove loose material. Efflorescence should be treated as described in **29.2.2**. Old unpainted surfaces, especially if rough or textured, may require more rigorous treatment, including washing down, to remove accumulated dirt before painting. If washing is necessary, time should be allowed for drying out. Organic growths may be present on old surfaces. These should be treated as described in **53.8**.

31.3.1.2 *Treatment of stains*

See **29.2.5**.

31.3.1.3 *Stopping and filling*

Minor cracks, holes and surface defects should be made good with exterior grade water-mixed filler or masonry cement before application of the primer or first coat of paint. Alternatively, in oil-based paint systems, oil-based stoppers or fillers may be used after priming.

31.3.2 *Priming*

Recommendations for priming are given in table 16. Priming is required when oil-based paint systems are to be applied; it is not usually necessary with emulsion paints but see **29.2.4** and **29.2.5**.

31.3.3 *Finishing*

Guidance on the selection of finishes for external renderings is given in **29.3.3**, and details of systems are incorporated in table 16.

32 Concrete

32.1 General

This clause should be read in conjunction with clause **29** which describes the general characteristics of 'wet' materials of construction and the considerations in respect of painting.

32.2 Characteristics

Concrete does not usually require painting for protection although this may be necessary to prevent long-term deterioration in aggressive atmospheres. Protective painting, using chemical-resistant paints, may also be necessary to prevent further penetration of carbon dioxide, water and salts after repair of deteriorated concrete, or even on new concrete if the thickness and integrity of concrete over reinforcement is insufficient to provide protection. In most circumstances, however, concrete is painted to improve its appearance, especially on large areas.

In relation to painting, the general characteristics of concrete are similar to those of external rendering as described in clause **31**. Because of the greater thicknesses usually involved, it may take concrete much longer to become dry enough to paint without restrictions on the choice of paints.

The surface finish of concrete may vary widely from smooth and dense (e.g. with precast components) to rough and porous with large voids. Specialist advice may be needed as it is difficult in some cases to achieve a good, uniform coating unless a suitable filler or sealer has been used.

Residues of release agents present on the surface of cast and shuttered concrete can seriously impair the adhesion of paints and should be removed. Laitance on trowelled surfaces can also impair adhesion if it is not removed.

32.3 Paint systems for concrete

32.3.1 *Surface preparation*

32.3.1.1 *Cleaning*

On new surfaces, deposits and loose material, including laitance, should be removed by scraping and brushing with stiff (not wire) brushes. If efflorescence is evident, it should be treated as described in **29.2.2**.

Residues of release agents should be removed with detergents or emulsifying agents rather than with solvents, which may simply spread the contaminant.

Old unpainted surfaces may require washing to remove accumulated dirt before painting; if this is necessary, time should be allowed for drying out before painting. Surfaces on which organic growths are present should be treated as described in **53.8**.

32.3.1.2 *Stopping and filling*

Large voids and air-holes may be filled with masonry cement or epoxy resin mortars. Minor surface defects should be made good with interior or exterior grade water-mixed filler or with masonry cement. Alternatively, in oil-based paint systems, oil-based stoppers and fillers may be used after priming. Application of cement paint or 'bagging' with a cement/sand slurry will reduce surface roughness and fill minor imperfections.

32.3.2 *Priming*

Recommendations for priming are given in tables 15 and 16. Priming is required when oil-based systems are applied; it is not usually necessary with emulsion paints but see **29.2.4** and **29.2.5**.

32.3.3 *Finishing*

General guidance on the selection of finishes for concrete is given in **29.3**, and details of systems are incorporated in tables 15 and 16.

Coatings applied to give additional protection have to be of an impervious type, e.g. bituminous or other specialized coatings (5/8, 5/10, tables 7 and 8), to prevent ingress of water, corrosive salts and gases; and should be applied only to dry surfaces. By protecting the integrity of the concrete cover over mild or high-tensile steel reinforcement, the time to initiation of disruptive corrosion can be extended, as well as reducing the rate of further deterioration of repaired existing concrete. Periodic maintenance will be needed.

33 Brick and stone

33.1 General

This clause should be read in conjunction with clause **29** which describes the general characteristics of 'wet' materials of construction and the considerations in respect of painting.

33.2 Characteristics

33.2.1 *General*

Brick and stone are durable materials, generally of attractive natural appearance and, when new, do not usually require painting. Common brickwork, not rendered or plastered, is an exception and may need to be painted for appearance or to facilitate cleaning, especially on interior surfaces.

On older buildings, painting may be necessary to improve appearance, hide repairs and alterations or reduce rain penetration (see **29.4**). On large buildings, painting of external masonry essentially for 'cosmetic' reasons should be undertaken only after consideration of the implications in respect of maintenance expenditure.

Generally, brick (other than concrete bricks) and stone are not, in themselves, alkaline, but the mortars used in construction will usually be strongly alkaline and, until dry, are likely to give rise to the difficulties in painting described in **29.2.4**. Efflorescence (see **29.2.2**) may also occur on brickwork and stonework.

Where external brickwork and stonework are exposed to severe weathering conditions, e.g. in parapet, free-standing and retaining walls and below ground level damp-proof courses, it is difficult to ensure that moisture does not penetrate. If this occurs, paint coatings are likely to be disrupted; also, they may prevent or retard drying out of moisture and thereby increase the risk of the brick or stone being damaged by frost. It is recommended that, in the situations referred to, brickwork and stonework should not be painted.

33.2.2 *Clay bricks*

Clay bricks may be classified in general terms, by type, as common, facing and engineering bricks.

(a) *Common bricks.* These are usually plastered or rendered, but painting may be considered as a low-cost alternative especially for interior walls.

Paints of all types are liable to failure by loss of adhesion when applied to Fletton common bricks externally. Failure occurs initially over 'kiss marks' in the bricks, often within 2 years, and increases progressively; after 4 or 5 years, the paint on the whole of the brick surfaces may be affected. Sand-faced and rustic Flettons are not subject to paint adhesion failures to any great extent.

BRE Information Paper IP 22/79 recommends that external walls built with the intention of painting should be of either sand-faced or rustic clay bricks or of calcium silicate or concrete

bricks. It also gives recommendations for alternative treatments in situations where the extent of paint failure on walls already painted makes it not worth attempting to maintain them in the painted state.

(b) *Facing bricks.* These are made or selected for their appearance, e.g. colour or texture. Adhesion of paint is usually satisfactory.

(c) *Engineering bricks.* These are dense, strong bricks made to defined limits of strength and water absorption. The adhesion of paints of conventional type to the virtually non-porous surface of bricks of this type is generally poor and, if painting is necessary, paints of the types recommended for glazed bricks (see **39.2**) should be used.

Most clay bricks contain soluble salts and these, in combination with water and the alkalis in cement mortars, may promote efflorescence (see **29.2.2**).

33.2.3 *Calcium silicate (sandlime or flintlime) bricks*

BS 187 classifies calcium silicate bricks according to their compressive strength, and the different classes vary in porosity; in general, compared with that of clay bricks, porosity is more uniform between bricks and over the surface of individual bricks. The surface of calcium silicate bricks is usually smoother than that of clay bricks although textured facing bricks are available. Paint adhesion is generally satisfactory.

Calcium silicate bricks are practically free from soluble salts, and efflorescence is much less likely to occur than with clay bricks.

33.2.4 *Concrete bricks*

These are strongly alkaline and oil-based paints are likely to be attacked if they are applied before the brickwork has substantially dried out.

33.2.5 *Stone*

The many varieties of natural stone differ considerably in hardness and porosity, e.g. from virtually non-porous granite or marble to porous limestone or sandstone. There may also be differences in surface texture according to the method by which the stone is dressed or finished. The adhesion of conventional paints to the harder, non-porous stones, especially if the surface is smooth or polished, is likely to be poor and, if painting is essential, paints of the types recommended for glazed bricks (see **39.2**) should be used.

33.3 Paint systems for brick and stone

33.3.1 *Surface preparation*

33.3.1.1 *Cleaning*

New surfaces, e.g. fair-faced brickwork, normally require little more than brushing down with stiff (not wire) brushes to remove loose material. Efflorescence should be treated as described in **29.2.2**. Old unpainted surfaces may require more vigorous treatment, including washing down, to remove accumulated dirt. If washing is necessary, time should be allowed for drying out before painting. Organic growths may be present on old external surfaces and should be treated as described in **53.8**.

33.3.1.2 *Stopping and filling*

On old, unpainted surfaces, repairs and re-pointing should be carried out well in advance of painting to facilitate drying out.

Minor surface defects should be made good with interior or exterior grade water-mixed filler or with masonry cement. Alternatively, in oil-based paint systems, oil-based stoppers or fillers may be used after priming.

33.3.2 *Priming*

Recommendations for priming are given in tables 15 and 16. Priming is necessary with oil-based systems and, because mortar joints are likely to be alkaline, an alkali-resisting primer should be used. Priming is not usually necessary with emulsion paints but see **29.2.4** and **29.2.5**.

To accommodate variations in surface porosity and facilitate application, primers or first coats may require thinning in accordance with the manufacturer's instructions.

33.3.3 *Finishing*

Guidance on the selection of finishes for brick and stone is given in **29.3**, and details of systems are incorporated in tables 15 and 16.

34 Precast concrete blocks

34.1 General

This clause should be read in conjunction with clause **29** which describes the general characteristics of 'wet' materials of construction and the considerations in respect of painting.

34.2 Characteristics

34.2.1 *General*

Precast concrete blocks are described in BS 6073 : Part 1. Their essential constituents are cement

(usually ordinary or rapid-hardening Portland cement), aggregates and water. A wide variety of aggregates may be used, the broad distinction being between dense aggregates, such as natural gravels, crushed rock and dense slag, and lightweight aggregates, including pulverized fuel ash (PFA), clinker, foamed slag, expanded clay and wood sawdust. The main types of blocks are as follows.

(a) *Aerated concrete blocks* are usually made from mixtures of cement and siliceous materials, such as sand or pulverized fuel ash or a mixture of these, together with an aerating agent.

(b) *Dense and lightweight blocks* are made from cement and dense or lightweight aggregates, moulded and compacted by vibration or pressure.

The aggregates used and the manufacturing process employed will affect the physical properties, surface texture and colour of the blocks. Surfaces may vary from coarse and open to fairly smooth and fine-textured. Colour is derived from the aggregates used, but pigments may be incorporated. Blocks are also available with a factory-applied coloured glaze which is resistant to staining and chemical attack.

Provided that types having the appropriate properties are selected, concrete blocks are durable in most internal and external situations and, when they are painted, it is usually for aesthetic reasons or to facilitate cleaning. However, protection may be required where blockwork is exposed to severe driving rain. The natural appearance of some blocks may be acceptable without further treatment although clear finishes may be useful to prevent staining or soiling.

34.2.2 *Moisture content*

To minimize drying shrinkage, blocks should be kept as dry as possible, particularly during site storage. If this recommendation is met, the moisture content of new blockwork is unlikely to cause serious difficulties in painting. It is, however, necessary to allow time for drying out of the mortar joints.

34.2.3 *Alkalinity*

Because of their cement content, concrete blocks are strongly alkaline but if the blocks are kept reasonably dry, as good practice requires (see **34.2.2**), this is less likely to be a problem than with concrete or cement rendering. The alkalinity of open-textured concrete decreases fairly rapidly if it is exposed.

34.2.4 *Efflorescence*

This may occur with concrete blocks but is rarely serious.

34.2.5 *Porosity*

Concrete blocks vary considerably in porosity and absorption according to their manufacturing process, density and the nature of the aggregate used, but even the densest blocks are usually sufficiently porous to afford a satisfactory 'key' for paint. The more open and porous materials, however, will need a more protective system in exposed situations. On blocks of high or variable porosity, adjustments to primers or first coats may be necessary; see **34.3.2**.

34.2.6 *Texture*

Blockwork is often painted directly to save the cost of rendering or plastering, but it should be appreciated that normal paint systems will not completely mask the texture of the blocks, while attempting to smooth the surface by conventional filling methods is rarely satisfactory. Roller or spray application of heavy-bodied, thick coatings (5/9 or 5/11) can usefully combine both protective and aesthetic functions. When appearance is important, blocks having an acceptable surface texture, e.g. of 'facing' quality, should be used, paint being used to complement the texture rather than mask it.

34.3 Paint systems for precast concrete blocks

34.3.1 *Surface preparation*

34.3.1.1 *Cleaning*

Brushing down with stiff (not wire) brushes to remove loose material is usually all that is required. Efflorescence, if present, should be treated as described in **29.2.2**.

34.3.1.2 *Stopping and filling*

Cracks, holes and damaged areas should be made good with cement mortar, masonry cement, or, in dry interior conditions, with water-mixed fillers.

As indicated in **34.2.6**, overall filling of the surface of blockwork by conventional methods is not recommended. On the finer-surfaced blocks, a cement/sand slurry or cement paint scrubbed into the surface will reduce texture and fill small holes. Thick textured coatings are also useful in this respect (5/9 and 5/11).

34.3.2 *Priming*

Recommendations for priming are given in tables 15 and 16. Priming is necessary with oil-based paint systems, and an alkali-resisting primer should be used. Priming is not usually required when emulsion paints are used but see **29.2.4** and **29.2.5**.

To accommodate variations in surface porosity and assist application, primers or first coats may require thinning in accordance with the manufacturer's instructions.

34.3.3 ***Finishing***

Guidance on the selection of finishes for concrete blockwork is given in **29.3**, and details of systems are incorporated in tables 15 and 16.

35 Cement-based sheets, boards and components

35.1 Characteristics

35.1.1 ***General***

The sheets, boards and components to which this clause refers are manufactured from cementitious materials reinforced with fibres. They comprise:

(a) asbestos-cement goods;

(b) cement-based insulating boards, ceiling tiles and planks;

(c) glass fibre reinforced cement (GRC) cladding.

NOTE. Materials containing asbestos are subject to the legislation that requires precautions to be taken in handling them to ensure that they do not constitute a hazard to health; see **35.2.1.1** and appendix A.

35.1.2 ***Asbestos-cement goods***

These include roofing and cladding materials, lining sheets, decking tiles, rainwater goods and other components. They are manufactured from Portland cement, asbestos fibre and water, compressed to a fairly high density.

Asbestos-cement is a reasonably durable material, resistant to most forms of attack, and does not require painting for protection except in highly acidic atmospheres. In other situations, painting is mainly for appearance or to facilitate cleaning. Most asbestos-cement sheets and components are available with factory-applied finishes having good chemical resistance.

Asbestos-cement is strongly alkaline when new and, if it is damp when painted or becomes so later, paints susceptible to alkaline attack (see **29.2.4**) will be affected.

If impermeable paint systems are applied to one side only of flat sheets or profiled sheets with large flat areas, differential carbonation may cause distortion and cracking of the sheets. To prevent this, back-painting (see **35.2.3**) of the sheets is necessary.

35.1.3 ***Cement-based insulating boards, tiles and planks***

These may be made from Portland cement and asbestos fibre, but increasing use is being made of glass and other fibres as alternatives to asbestos. Calcium silicate may also replace Portland cement in some types.

Cement-based insulating materials are less dense and more porous than asbestos-cement goods and are used principally as internal wall and ceiling linings. In the situations in which they are normally used, painting is essentially for appearance and to facilitate cleaning. Some materials are available with a factory-applied primer or finish.

The materials, especially the types employing calcium silicate as a binder, are usually less alkaline than asbestos-cement goods. Differential carbonation (see **35.1.2**) is not a problem, and back-painting is not therefore necessary.

35.1.4 ***GRC components***

Most GRC consists of Portland cement matrix reinforced with glass fibre. There is a variety of GRC components, a major use being in sheets and composite cladding panels, many with a factory-applied finish. The general requirements for site painting are as for other cement-based products.

35.2 Paint systems for cement-based sheets, boards and components

35.2.1 ***Surface preparation***

35.2.1.1 *Cleaning*

On new surfaces, brushing down with stiff (not wire) brushes to remove loose material is usually all that is required. With materials containing asbestos, precautions to prevent inhalation of dust, including wet brushing, are essential; see appendix A.

Organic growths may be present on old, unpainted external cladding and roofing materials; if so, the surfaces should be treated as described in **53.8**.

35.2.1.2 *Stopping and filling*

The necessity for stopping does not normally arise with external cladding and roofing materials or with internal linings when patent fixing methods are used. When internal linings are fixed by nailing or screwing, a water-mixed filler (see **22.5**) should be used for stopping.

Where a high standard of paint finish is required on flat internal surfaces, smooth-surface boards should be specified but, if necessary, water-mixed fillers may be used.

35.2.2 ***Priming***

Recommendations for priming are given in tables 15 and 16. Alkali-resisting primers may not be strictly necessary in oil-based paint systems for some types of cement-based insulating boards of low alkalinity, but there is no disadvantage in their use.

Alkali-resisting primers of conventional type, as normally used in oil-based paint systems, are not

suitable for use with chlorinated rubber paints (see **35.2.4**) which are normally applied directly to the surface or over a chlorinated rubber-based primer, as recommended by the paint manufacturer.

Asbestos-cement goods vary in porosity, and cement-based insulating boards may be highly porous. Thinning of primers or first coats may be necessary to facilitate uniform application.

35.2.3 *Back-painting*

As indicated in **35.1.2**, back-painting of asbestos-cement sheets may be necessary to prevent differential carbonation. For this purpose, impermeable paints of similar type to those used on the exposed surface may be used; alternatively, a cheaper material, e.g. bituminous paint, may be applied.

35.2.4 *Finishing*

The types of finish described in **29.3** and the systems shown in tables 15 and 16 are suitable for use on cement-based sheets, boards and components. If, however, a glossy or semi-glossy finish is required for asbestos-cement roofing and cladding sheets and components, chlorinated rubber paint (which does not require an alkali-resisting primer) is preferred to the system of alkali-resisting primer, undercoat and finish that is required with gloss finishes of conventional type.

36 Fibre building board, wood chipboard and plasterboard

36.1 Characteristics

36.1.1 *General*

The boards referred to in this clause are widely used for internal linings; some types of fibre building board are used as external cladding materials. Many boards are available with a factory-applied finish, e.g. a surface coating or laminate; this clause is concerned with those that are painted on site.

Painting of such boards usually has a mainly decorative function, but it may be necessary for protection in some circumstances, e.g. with boards used externally or in conditions of prolonged high humidity. In such cases manufacturers' recommendations should be followed in respect of board types and design details.

Many fibre building boards and wood chipboards can be supplied with a factory-applied primer, sealer or surfacer on one or both faces. These treatments may enable a reduction in the number of site-applied coats to be made, or enable a higher standard of finish to be achieved.

36.1.2 *Fibre building board*

This is made from the fibres of wood or woody plants, utilizing the adhesive properties inherent in the fibres; bonding agents may also be incorporated.

BS 1142 describes four main types of fibre building board, i.e. hardboard, mediumboard, medium density fibreboard (MDF) and softboard. Their characteristics in respect of painting are as follows.

(a) *Hardboard.* This is of a high density and presents a smooth, slightly absorbent surface upon which a satisfactory standard of finish can be obtained with most types of paint including gloss finishes.

Hardboard is available in 'standard' and 'tempered' grades. Tempered hardboard is impregnated with oils or resins and heat-treated during manufacture to improve its water resistance. Some impregnation treatments may slightly retard the drying of oil-based paints, but this is rarely serious.

(b) *Mediumboard.* This is less dense and usually slightly more absorbent than hardboard but has a similarly smooth surface upon which a satisfactory finish can be obtained with most paints including gloss finishes.

(c) *Medium density fibreboard (MDF).* This is manufactured by a dry process in which the primary bond is derived from a bonding agent. A smooth, slightly absorbent surface is presented upon which a satisfactory finish can be obtained with most types of paint, including gloss finishes. Edges tend to be more absorbent and where exposed (e.g. by machining) and requiring a decorative finish, an additional coat of primer or sealer may be required (see table 17).

(d) *Softboard.* This is of low density and unless specially treated, e.g. surfaced or laminated, has a rough, highly absorptive surface upon which it is difficult to achieve a high standard of finish, especially with gloss finishes.

Bitumen-impregnated softboard has greater resistance to moisture than the normal type. It is used mainly for sarking and similar purposes where it does not require painting; if painting is necessary and oil-based paints are to be applied, an aluminium primer (1/2) is necessary to prevent discoloration.

In addition to factory-applied decorative treatments, including coatings and laminates, there are other treatments for fibre building boards which may affect painting. Typical treatments, and the types of boards to which they apply, are described below.

(e) *Pulp or ivory surface.* A surface layer of finely-ground wood fibre is incorporated during manufacture and gives a uniform, light-coloured surface of low porosity. This facilitates direct application, without priming or sealing, of emulsion paints. The treatment is available on medium board and insulating board.

(f) *Sealed.* A treatment which reduces absorption and may obviate the need to apply a primer or sealer on site. The treatment is available with 'standard' hardboard.

(g) *Primed.* The board is supplied primed with a pigmented primer ready for site finishing. The treatment is available with 'standard' hardboard and insulating board.

(h) *Flame retardant treatment.* Chemical impregnation can render most boards flame retardant according to class 1 of BS 476 : Part 7 : 1987. Boards are also available with a flame retardant coating on one or both sides. Some impregnation treatments can affect the appearance or behaviour of paint systems; see **36.2.2.** The treatment is available with hardboard, mediumboard and insulating board.

(i) *Perforated.* Boards may be perforated during manufacture to increase sound absorption as in acoustic tiles, or for other reasons, e.g. for decorative effect or to provide ventilation. When perforated boards or tiles are used for their acoustic properties, it is important that the holes do not become blocked with paint; to prevent this, spray or roller application of thin coats is recommended. Perforated hardboard, mediumboard and insulating board are available.

36.1.3 *Wood chipboard*

This is composed of chips or particles of wood, mainly softwood, in a synthetic resin binder. It is sometimes described as 'particle' board. Fungicidal, insecticidal and fire-retardant chemicals may be incorporated. Small amounts of paraffin wax may be added to give limited protection against moisture absorption and consequent swelling of the wood chips.

Like timber, chipboard can be attacked by wet-rot fungus if its moisture content is above the critical level (see **25.2.3**) for lengthy periods; the physical properties of the board can also be affected. Moisture-resistant grades are available for use in highly humid conditions and should be installed in accordance with manufacturers' recommendations regarding design detailing and fixing methods. Preservative treatment, as recommended for wood in **25.3**, is not usually suitable for wood chipboard.

The natural surface of chipboard varies according to the method of spreading the chips during manufacture; there are four main methods as follows.

(a) *Single layer.* The chips used are of the same size or mixture of sizes throughout the thickness of the board. This produces a relatively coarse or 'open' surface which requires filling to obtain a satisfactory paint finish.

(b) *Three layer.* The board is of sandwich construction, usually with high-density outer surfaces, composed of fine chips or thin flakes, and a core of larger chips. This method may be used to produce a surface of finer texture requiring little or no filling before painting.

(c) *Multi-layer.* This is similar to (b) and may also be used to produce a surface of finer texture.

(d) *Graded.* The chips are evenly graded in size throughout the thickness of the board, giving smooth, high-density surfaces and a low-density core.

Other factory-applied treatments, in addition to decorative finishes such as surface coatings, laminates and veneers, include the following.

(e) *Primed/filled.* A paste filler/primer, off-white or grey in colour, is applied to one or both sides of the board. It provides a smooth, hard surface, receptive to most types of paint. Boards treated in this way and flame retardant according to class 1 of BS 476 : Part 7 : 1987 are available.

(f) *Primed.* A semi-transparent or opaque primer is applied to one or both sides of the board and obviates the need for site priming.

(g) *Sealed.* A clear sealer, usually polyurethane-based, is applied to one or both sides of the board. This gives protection against moisture penetration and also serves as a base for site-applied clear and pigmented coating systems.

(h) *Paper-faced.* Special resin-impregnated papers are applied to one or both sides of the board and provide a satisfactory base for painting.

36.1.4 *Plasterboard*

This consists of a core of gypsum plaster with a thick paper liner on each side. Plasterboard may be skimmed with plaster after fixing, the surface then being painted as described for plaster in clause **30.** It is also widely used in dry-lining systems in which paint or wallcoverings are applied directly to the board surface after fixing. Dry-lining systems usually involve special treatment of the joints between the boards; see **36.2.1.2.**

36.2 Paint systems for fibre building board, wood chipboard and plasterboard

36.2.1 *Surface preparation*

36.2.1.1 *Sanding*

Except with the more open-surface grades of wood chipboard (see **36.1.3**), building boards do not usually need sanding before being painted. If sanding is considered necessary to improve adhesion to glossy-surfaced hardboards, a fine grade of abrasive paper should be used and care should be taken to avoid scoring the surface, as this may result in localized swelling along the score marks when paint is applied.

Wood wool surfaces should be cleaned with a stiff, but not wire, brush. Loose dust may be removed with a soft fibre brush or vacuum cleaner, if preferred (the dust may be strongly alkaline).

36.2.1.2 *Joint treatment*

Other than in plasterboard dry-lining systems, it is not possible to hide joints satisfactorily with conventional paint systems of normal thickness, and it is usually recommended that they should be 'featured', e.g. by using bevel-edged boards or cover strips.

Plasterboard dry-lining systems employ tapered-edge boards, enabling a smooth, seamless surface to be obtained by taping and filling the shallow trough formed by abutting edges. The process can be carried out manually or mechanically.

Recommendations for internal plastering are given in BS 5492. Recommendations for dry lining and partitioning using gypsum plasterboard are given in BS 8212.

36.2.1.3 *Stopping and filling*

The materials used for stopping and filling are described in **22.5** and the techniques in **45.4**. For stopping-up nail and screw holes and repairing minor damage to the surface, either water-mixed or oil-based stoppers or fillers may be used. Water-mixed stoppers and fillers may be used on either primed or unprimed surfaces. On the latter and on factory-primed or sealed boards, exposed heads of nails and screws, unless they are rust-resistant, should be touched-in with quick-drying oil-based primer to prevent rust-staining. If a water-mixed material is used for stopping-up after priming or on factory-primed or sealed boards, it may be necessary to 'touch-in' the stopping with primer to ensure a surface of uniform absorption. Oil-based stoppers and fillers should be used only on primed or sealed surfaces.

Overall filling of smooth surfaced boards is rarely necessary. It may be desirable if a high standard of finish on some types of wood chipboard is to be achieved (see **36.1.3**); water-mixed or oil-based fillers may be used, but the surface should first be primed. Direct application of water-mixed fillers will cause swelling of the wood chips; with oil-based fillers, the binder will be absorbed.

36.2.2 *Priming*

If not primed or sealed during manufacture, building boards need priming before application of oil-based (e.g. alkyd) paint systems. Table 17 gives general guidance on the selection of primers. Normal practice is to use primers of the types employed for wood or plaster (tables 1 and 3), but any specific recommendations of board or paint manufacturers should be followed.

Except as indicated in table 17 priming is not usually needed when emulsion paints or similar water-thinned coatings are to be applied to building boards. Priming of boards that have received flame retardant treatment (see **36.1.2**(h)) is recommended to prevent efflorescence or discoloration caused by reaction between water-thinned coatings and chemicals used in the treatment. Similarly, priming of single layer wood chipboard (see **36.1.3**(a)) may be necessary to prevent absorption of water and consequent swellings of the chips that will produce a rough surface.

Bitumen-impregnated insulating boards, if they are to be painted with oil-based paints, should be primed with an aluminium primer or sealer to prevent discoloration (bleeding).

Traditional practice, especially with fibre building boards, is to prime or paint (back-prime) unexposed faces of boards to prevent absorption of moisture. In most circumstances, and provided that boards of appropriate types are installed in accordance with manufacturers' recommendations, this is not necessary. Unless the board manufacturer advises otherwise, building boards of the types referred to in this clause should not be back-primed.

36.2.3 *Finishing*

36.2.3.1 *Internal work*

The types of finishes indicated in **29.3.2** as suitable for use on plaster are equally appropriate for use on building boards. Finishing systems and life expectancies are as indicated for systems (a) to (h) in table 15.

36.2.3.2 *External work*

When installed in accordance with the supplier's recommendations, some types of hardboard and mediumboard are suitable for external use. Factory-applied treatments suitable for exterior exposure are available but, when site painting is necessary, the types of finishes (except cement paints) described in **29.3.3** as suitable for external

surfaces may be used. Typical finishing systems for externally sited boards are as indicated for systems (a) to (f) in table 16.

On external cladding, it is recommended that vapour-permeable (breathing) paint finishes should be used; textured coatings (5/9 and 5/11) are particularly suitable. Selection of systems and their performance in service will, however, be influenced by the materials and forms of construction, and reference should be made to board and paint manufacturers' recommendations in specific circumstances.

37 Paper and wallcoverings

37.1 Characteristics

37.1.1 *General*

Papers and other wallcoverings comprise, first, those that are supplied uncoloured and that are intended to be painted and, secondly, existing coloured materials that may be suitable for painting in order that their appearance may be restored or that their colour may be changed. The main types in each category are as follows:

(a) *New and intended to be painted*

(1) lining papers;

(2) woodchip papers;

(3) relief wallcoverings;

(4) natural hessians (painting optional);

(5) blown vinyl wallcoverings.

(b) *Existing coloured materials*

(1) wallpapers;

(2) paper-backed and sheet vinyls;

(3) coloured hessians.

No problems arise with materials in the first category in respect of painting, but problems may be experienced with some of those in the second category, as indicated in **37.1.2** and **37.1.3**.

37.1.2 *Wallpapers*

The metallic inks used in some patterns may react with water-thinned paints and cause discoloration, as may some red inks. With any papers containing 'gold' or red in their pattern, a test area should be painted to see if discoloration occurs; if it does, a 'sealer' will be required (see **37.2.1**) or the paper should be removed.

It should be appreciated that application of paint to wallpaper makes its removal more difficult, should this be necessary at a later date, especially if oil-based paints are used. Wallpaper should be painted only if it is firmly adhering and without blisters, creases or prominent joins.

37.1.3 *Vinyl wallcoverings*

These may be vinyl-faced (e.g. paper-backed) or sheet vinyls. They may be suitable for painting, but migration of plasticizer from the vinyl into the paint coating may cause softening or the development of glossy patches in mid-sheen finishes. It is not possible to assess the likelihood of this by short-term tests and, in cases of doubt, the manufacturer of the wallcovering or paint should be consulted.

37.2 Paint systems for paper and wallcoverings

37.2.1 *Surface preparation*

Newly-hung lining paper and wallcoverings should be allowed to dry out completely before painting. Dry surfaces should be lightly brushed to remove loose material.

With existing wallcoverings, loose material should be refixed with the recommended adhesive; if adhesion is generally suspect, painting will make it worse and the wallcovering should be removed.

Wallcoverings affected by mould growths should be removed and the surface treated as described in **53.8.3**.

If water-thinned paints are to be used and there is a risk of discoloration (see **37.1.2**), a test area should be coated with the paint it is proposed to use and should be inspected after 24 h. If discoloration occurs, it may be prevented by applying a coat of knotting (see **22.4**) or oil-based primer (3/1 or 3/3) overall or to the areas responsible. It may often be more satisfactory to remove the wallcovering.

37.2.2 *Priming*

Paper surfaces should be primed when alkyd or oil-based finishes are to be applied; water-thinned primers (3/2) are suitable and may be less likely to raise the paper fibres than oil-based primers. Vinyl surfaces do not normally need priming, but reference should be made to manufacturer's recommendations. Alkyd or oil-based paints are not usually applied to hessian but, if this is necessary, a water-thinned primer should be used.

Emulsion paints are usually applied direct to paper and other wallcoverings except when there is a risk of discoloration on existing coloured wallpapers (see **37.2.1**), when it may be necessary to apply knotting or oil-based primer.

37.2.3 *Finishing*

Paper and vinyl surfaces are usually finished with emulsion paint or with alkyd gloss, mid-sheen or matt finishes. Emulsion paint is generally used for

hessian. Suitable systems are as references (a), (b), (c) and (d) in the fourth column of table 15.

38 Plastics

38.1 General

Increasing use is being made in buildings of plastics components and factory-applied plastics coatings. Typical examples include: unplasticized polyvinyl chloride (UPVC) cladding, rainwater goods and window frames; glass reinforced polyester (GRP) cladding and mouldings; and a variety of plastics coatings for metal.

These materials generally have good durability, but the effects of weathering, soiling and mechanical damage over a number of years may suggest painting as a means of restoring the original appearance. Occasionally, premature deterioration occurs, and painting may then prove cheaper than replacement or, in the case of plastics coatings, may be necessary to prevent deterioration of the substrate. However, probably the most frequent reason for painting is to change the colour, especially with components, such as UPVC rainwater goods, available in a very limited range of colours. This clause gives general recommendations for painting in such circumstances; for more detailed information, see BRE Information Paper IP 11/79. If painting is considered as a method of restoring defective or deteriorated surfaces, specialist advice should be sought.

Other plastics surfaces that may need painting for decorative purposes are expanded polystyrene and vinyl wallcoverings.

38.2 UPVC components

Painting new UPVC with the types of building paints in general use severely reduces impact resistance. On ageing, UPVC becomes more brittle and, after 7 years to 10 years, the effect of painting on impact resistance can probably be discounted; it may be of little significance on new components not subject to impact.

Abrasion of new UPVC also reduces its impact resistance and should be avoided. Surfaces, new or weathered, should be prepared for painting by washing with warm detergent solution, rinsing with clean water and drying.

If impact resistance is not important, new UPVC, prepared as described above, can be painted with conventional alkyd gloss finishes. Direct application of the finish is sometimes recommended, but better adhesion is obtained if an undercoat is used. Emulsion paints, including masonry types, also have good adhesion. UPVC is thermoplastic and, if exposed to direct sunlight, should not be painted in a colour significantly darker than its original colour otherwise heat absorption will be increased.

Paints of conventional type may perform satisfactorily on UPVC, but subsequent maintenance painting at intervals of 3 years to 5 years may be necessary, thus negating an important advantage of plastics, i.e. a reduction in the frequency of maintenance. This may not be of significance where the areas are small and adjacent surfaces of traditional materials require maintenance painting at relatively short intervals. However, consideration should be given to the use of long-life coatings on large areas such as cladding. Long-life coatings will usually be of specialist type, e.g. two-pack polyurethanes or epoxies, but no general recommendations can be made and specialist advice should be sought.

38.3 GRP components

Conventional alkyd gloss finishes, applied over undercoat, adhere satisfactorily to GRP as do chlorinated rubber paints and emulsion paints, including masonry paints. Surfaces should be prepared by thorough scrubbing with warm detergent solution and a stiff bristle brush or nylon pad (not wire wool, which can cause rust stains) followed by rinsing and drying. For heavy contamination, a proprietary degreasing solution may be needed.

As with UPVC, consideration should be given to the maintenance aspects of painting GRP and the use of long-life coatings in certain circumstances. Although GRP is less sensitive to solar gain than UPVC, the use of light-coloured finishes is recommended.

38.4 Plastics coated metal

A wide variety of organic coatings classifiable as plastics is used on metal cladding and other components. The properties of individual types vary considerably, and no general recommendations regarding painting can be made. With the softer types of coatings, e.g. PVC plastisols and organosols, diffusion of plasticizers may present a problem with overpainting, though this is less significant on weathered surfaces. Specialist coatings are available which are said to overcome the problem and to permit overpainting with conventional paints. Harder stoved coatings, e.g. acrylics and alkyd/melamine types, do not present the problem of plasticizer migration, and painting with conventional or specialist long-life paints may be possible.

38.5 Expanded polystyrene

This material is used in tile or sheet form as a ceiling or wall lining to improve thermal insulation. Wall linings are generally employed as a base for wallcoverings, but ceiling tiles often need painting.

Paint solvents will attack expanded polystyrene. Also, paints containing solvents, especially gloss finishes, create a fire hazard when used in conjunction with expanded polystyrene. Painting of expanded polystyrene wall and ceiling linings, other than with emulsion paints, is not recommended.

38.6 Vinyl wallcoverings

Some types are supplied uncoloured for painting after hanging; others may need painting to restore or change their original colour. The considerations in respect of painting are described in clause **37**.

39 Glass and inorganic glazed surfaces

39.1 General

In addition to glass, materials in this category include glazed bricks, terracotta, faience, ceramic tiles and vitreous enamel. They are painted comparatively rarely, but painting may be required in some circumstances, e.g. to obscure clear glass or to renovate glazed surfaces or change their colour.

A general characteristic of the surfaces relative to painting is that they provide little mechanical 'key', and this cannot usually be improved significantly by abrasion. Reliance has therefore to be placed on the inherent adhesive properties of the paint, and this may vary according to type and composition. The painting of extensive or prominent areas should be undertaken only after consultation with manufacturers, especially if the surfaces are exposed to weather or high humidity or are subject to abrasion; if possible, evidence of satisfactory performance in similar conditions should be obtained.

39.2 Paint systems for glass and inorganic glazed surfaces

39.2.1 *Surface preparation*

Surfaces should be perfectly clean and dry at the time of painting. Washing with detergent solution, followed by rinsing with clean water, is a basic recommendation, especially for external surfaces; solvent cleaning may be needed if the surfaces are greasy. On vitreous enamel, abrasion with waterproof adhesive paper, while the surfaces are wet, may help to improve adhesion. Painting should follow cleaning as soon as the surfaces are dry; if there is a delay, wiping with a clean cloth and methylated spirits or cellulose thinner, immediately before painting, is advisable.

39.2.2 *Priming*

Finishes are often applied directly to glass and glazed surfaces, but the paint manufacturer's recommendations in this respect should be followed. Some multi-colour finishes (5/14) are applied over a 'bonding' primer. Priming may also be necessary with vitreous enamel if damage or deterioration has exposed the metal substrate.

39.2.3 *Finishing*

In the interiors of buildings, glazed bricks and ceramic tiling are the surfaces of this type most likely to need painting. Multi-colour finishes have been used fairly widely and give satisfactory results when applied in accordance with the maker's recommendations. Alkyd gloss and mid-sheen finishes and one-pack polyurethane finishes, applied directly to the surface, have also given good results. Chlorinated rubber finishes can be considered, especially for conditions of high humidity or where condensation occurs. Some emulsion paints may be suitable in dry conditions; there is little evidence of their long-term performance on glazed surfaces although they are used to provide temporary 'shading' on glass.

For external surfaces, alkyd gloss or chlorinated rubber finishes may be suitable, but reference should be made to the manufacturers.

None of the conventional types of paints referred to above has the durability and resistance to wear of the original surfaces, and, where these properties are important, consideration should be given to the use of long-life specialist coatings which also have good adhesion, e.g. some two-pack polyurethane and epoxy types. Manufacturers should be consulted regarding the choice of materials and systems.

40 Bituminous surfaces and materials

40.1 General

Surfaces and materials in this category include bituminous paints and coatings, some preservative treatments and asphalt surfaces. A general characteristic is the tendency of these surfaces to discolour oil-based paints applied over them ('bleeding') and sometimes to retard their drying. Cracking of applied paints may also occur with some bituminous substrates.

40.2 Bituminous paints and coatings

Thin, hard coatings, especially when they are aged, can often be overpainted with oil-based paints if aluminium primer (1/2) is first applied. Emulsion paints can usually be applied directly without a primer or sealer; some emulsion-based masonry paint systems include a bituminous emulsion

basecoat as a waterproofing membrane for porous external walls.

Paints applied over thick bituminous coatings may crack and craze, and the cracks may subsequently extend into the underlying material. If removal of the bituminous coating is impracticable, it should be overcoated with material of similar type, e.g. tar paint or bituminous aluminium paint.

40.3 Preservative treatments

Creosote and bituminous preservatives may be used for wood and some types of fibre insulating boards. Creosoted wood can generally be painted satisfactorily if it is allowed to weather for a year or so and is then primed with aluminium primer (1/2). A primer of this type should also be used on fibre insulating board impregnated with bituminous preservative, if it is to be painted with oil-based paint; emulsion paints can usually be applied directly to the board.

40.4 Asphalt and bitumen

There is often a requirement for light-coloured finishes for asphalt and bituminous roofing materials to reduce heat absorption and improve appearance. Particular care in the selection of coatings is essential, as unsuitable types may crack, as described in **40.2**, resulting in serious damage to the roofing material. Because of the 'ponding' effect that may occur on flat roofs, it is also necessary for applied coatings to have good resistance to moisture to prevent loss of adhesion. Sand-rubbing of new asphalt is recommended to assist the adhesion of coatings. Specialist coatings are available for use on asphalt and bituminous roofing materials, and reference should be made to the manufacturers for specific recommendations, based on experience.

Quick-drying road marking paints, resistant to discoloration, are used for marking asphalt roads, parking areas and factory-floors. Light-reflecting solid glass beads are incorporated in some types or may be applied to the surface whilst the paint is wet.

41 Special conditions and requirements

41.1 General

This clause describes some of the conditions and circumstances for which specialist or modified conventional coatings may be required. Because of the diversity of conditions, substrates and coatings, especially in relation to chemical resistance, it is possible to provide only a general indication of the types of coatings that may be suitable. For detailed recommendations in specific circumstances, specialist advice should be sought.

41.2 High humidity

Paints of conventional type are resistant to the levels of humidity normally encountered internally in most domestic and non-industrial environments. Where conditions of moderate or high humidity prevail intermittently, as in kitchens and bathrooms, the less permeable alkyd gloss and mid-sheen finishes should be used in preference to alkyd matt finishes and emulsion paints, although they will tend to make condensation more obvious.

The processes or activities carried out in some buildings may give rise to conditions of constant or frequent high humidity or cause surfaces to be splashed with water. Examples where such conditions may prevail include swimming baths, laundries and factories engaged in the manufacture of food and drink, paper and synthetic and natural fibres. In these conditions, and especially for the protection of steel, wood and other substrates vulnerable to attack by moisture, specifically moisture-resistant coatings may be required.

Chlorinated rubber paints (8/5), especially high-build types, have excellent moisture resistance and are available in a wide range of colours. Where colour is not important, bituminous coatings (table 7), including coal tar epoxies, can be used. There are also thick, semi-drying protective coatings with good moisture resistance and suitable for use on surfaces not subject to handling or abrasion.

A requirement with many moisture-resistant protective coatings is that they are applied in films of substantial thickness, e.g. 100 μm or more, and manufacturer's recommendations in this respect, and regarding preparation and priming, should be followed.

41.3 Condensation

The amount of water vapour that air can hold is limited and, when this limit is reached, the air is said to be saturated. The saturation point varies with temperature, and cool air can hold less water vapour than warm air. The water vapour held by air at a given temperature is expressed as a percentage of the amount that would saturate it at that temperature and is referred to as relative humidity (r.h.).

If moist air is cooled and the amount of water vapour present remains the same, r.h. will rise. When saturation point (100 % r.h.) is reached condensation will occur. The temperature at which condensation occurs in given conditions is the dewpoint; e.g. 15 °C is the dewpoint of air at 20 °C and 80 % r.h.

Most condensation in buildings is caused by warm, moist air coming in contact with cooler surfaces. In domestic and non-industrial buildings, conden-

sation is usually light and intermittent although, in some situations, it may be sufficient to cause water runs and drips, disfigure paintwork or promote mould growth. In dwellings, condensation is most likely to occur in kitchens and bathrooms, but water vapour may diffuse through the house from these rooms and condense on cold surfaces in unheated areas.

Condensation is best prevented or controlled by providing good ventilation to remove moisture-laden air from buildings, preferably from a point near the source of moisture. Adequate levels of heating will increase the capacity of the air to hold moisture but have to be combined with good ventilation, otherwise the problem will be aggravated. Thermal insulation also helps to reduce condensation. For new buildings, guidance on designing to avoid condensation is given in BRE Digest No. 110. See also BS 5250.

Paint treatment alone is not an alternative to the measures described in the preceding paragraph but, where condensation is moderate and occurs only intermittently, anti-condensation paints may be of benefit. They are usually of conventional type but contain aggregates with insulating or absorptive properties. Some coatings have a textured surface which helps to reduce water runs and drips, but these tend to hold dirt and are not easily cleaned. Absorptive types should be used only in situations where it is to be expected that condensation will be followed by conditions favourable to drying out of absorbed moisture.

Where the function of a building gives rise to conditions of constant or frequent high humidity and the measures to prevent or reduce condensation in the preceding paragraphs are impracticable or not fully effective, priority may have to be given to the protection of substrates vulnerable to moisture attack by using specifically moisture-resistant coatings, as described in **41.2**.

41.4 Mould growth

Mould is a form of fungus which sometimes develops on building surfaces especially in damp situations. Typically, it has a black, sooty appearance and may be mistaken for dirt although some moulds are coloured. It is often possible to distinguish mould from dirt and chemical stains by examination with a magnifying glass (×10 or higher) when the filaments or hyphae characteristic of most moulds may be seen.

Mould is propagated by spores which are present in most atmospheres. Moisture and a supply of organic nutrient are essential to its development and growth but, unlike most forms of plant life, it does not require light and will grow at low temperatures. Atmospheres in which relative humidity exceeds 70 % are favourable to the development of mould. Nutrient is available in or upon most building surfaces. Mould growth is especially associated with the conditions of high humidity or frequent condensation referred to in **41.2** and **41.3**. Where there is also an ample supply of nutrient material, as in breweries, bakeries, food preparation areas and similar situations, growth may be rapid and profuse.

Because of its dependence upon a supply of moisture, the growth of mould is most effectively inhibited by reducing humidity and preventing condensation by good ventilation, adequate heating and thermal insulation, as indicated in **41.3**. In domestic and non-industrial environments, these measures and attention to hygiene and cleanliness will usually prevent the growth of mould; where they cannot be applied or are not completely effective, mould-resistant paints may be beneficial. Paints of this type are usually of conventional type but containing mould-inhibitive additives. Some of the more effective mould-inhibitive additives may be toxic and may not be suitable for use in situations where foodstuffs are processed.

In conditions of high humidity, an alternative method of controlling mould growth is to use moisture-resistant paints (see **41.2**) and to sterilize the surface by application of a fungicidal wash at regular intervals. Proprietary washes containing fungicides are available, and some leave an inhibitive residue on the surface; a solution of household bleach will also kill mould but does not have any residual inhibitive properties.

When mould-inhibitive paints or washes are to be used where foodstuffs are prepared or stored, it should be ensured that there is no risk of food products being contaminated with toxic substances or their flavours affected.

The treatment of mould-infected, previously decorated internal surfaces before painting is described in **53.8**. Further information on mould growth and its treatment is given in BRE Digest no. 139.

41.5 Chemical attack

In mildly acidic industrial environments, alkyd gloss and oil-based micaceous iron oxide paints usually perform satisfactorily, provided they are applied to correctly prepared and primed surfaces in systems of adequate thickness. Where there is a need for resistance to heavy fume attack or direct contact with chemicals, chemical-resistant coatings are likely to be required. In this context, the term 'chemicals' embraces the following:

acids and alkalis;
acidic and alkaline substances and solutions;
alcohols;
oils, fats and greases;
solvents;
fresh and salt water.

Chemical-resistant coatings include chlorinated rubber, two-pack epoxy and polyurethane, coal-tar epoxy and bituminous types; see tables 7 and 8. The resistance of any of these coatings is dependent on the specific agent and the form and severity of attack, and no general recommendations on their selection can usefully be made. When there appears to be a requirement for a chemical-resistant coating, specialist advice should be sought unless there is previous experience of the satisfactory performance of a particular type of coating in similar circumstances.

41.6 Resistance to surface spread of flame

Building Regulations require that, in certain types of buildings, the materials of which walls and ceilings are constructed shall comply with specified minimum requirements in relation to the spread of flame across the surfaces when tested as described in the relevant Parts of BS 476. Paint is not regarded as a material of construction and is not subject to the Regulations. Nevertheless, it is desirable that paints should not markedly affect the flame spread rating of the unpainted surfaces; also, in existing buildings, there may be a requirement for the achievement of a specified class of flame spread rating.

Paints of conventional type will meet the requirements in many cases; in others, it may be necessary to use 'flame-retardant' paints. These may be conventional paints containing flame-retardant additives or types which intumesce or swell on heating. They should be applied in the systems recommended by the manufacturer. The flame spread rating of a paint cannot be expressed in isolation but only in relation to its performance on a specified substrate. Manufacturers will supply details of the ratings of their paints when applied to specified substrates, based on test carried out by independent testing authorities.

The flame spread rating of a painted surface may worsen with increasing film thickness or in situations where conventional paints are applied over flame-retardant types. In the latter event, compatibility problems may also arise. To avoid such difficulties, details of systems applied, including dates of application and types or brands of paints used, should be recorded for future reference. It may also be helpful to label surfaces to which flame-retardant paints have been applied.

It should be noted that, where Building Regulations require the materials of which walls or ceilings are constructed to have a specified flame spread rating, flame-retardant paints applied on site cannot be used to upgrade materials that do not meet Building Regulation requirements.

41.7 Resistance to abrasion

Coatings resistant to abrasion may be required for floors, machine surfaces, storage racks and bins, handrails and similar items, especially in factories and commercial buildings. There may also be a requirement for wall and ceiling finishes resistant to frequent vigorous cleaning in such places as dairies, abattoirs and food preparation areas.

Pigmented and clear two-pack epoxy and polyurethane coatings have excellent resistance to abrasion, but their use may be limited by the nature of the substrate or the conditions of application. The modified one-pack types, although lower in abrasion resistance, are subject to fewer restrictions in use and perform reasonably well in many situations; one-pack epoxy ester types, for example, are available as floor and deck paints, often with a non-slip additive. Some modified alkyd paints are reasonably resistant to abrasion and are often used for painting machinery and similar applications. Multi-colour finishes (5/14) are suitable for walls in many interior 'hard wear' environments.

41.8 Anti-graffiti treatments

Several types of treatment are available, selection being determined by the nature of the substrate, the severity of vandalism and the requirements in respect of appearance. Typical coating systems are as follows.

(a) *Textured systems.* These incorporate hard aggregates which discourage marking with felt tip and ball-point pens, lipstick and crayon, whilst the vehicle is of a type which resists staining and facilitates removal of markings with solvents or proprietary graffiti removers. Various degrees of texture are available. Systems of this type, especially those with a heavy texture, are suitable for use on walls in situations where graffiti vandalism is severe.

(b) *Smooth, pigmented systems.* These provide a hard, smooth surface, resistant to staining and permitting removal of markings as with the types described above. The coatings may be plain or multi-coloured, and varying degrees of gloss or sheen are available. They may be preferred to the system described in (a) for interior locations where vandal activity is less severe.

(c) *Smooth, clear systems.* These have similar properties to those described in (b) and may be used where it is desired not to obscure completely the natural appearance of masonry and hardwood surfaces. On external masonry, they tend to impart a 'wet look' in dry weather and a 'dry look' in wet weather, and this may be unacceptable in some situations. Some types tend to yellow on ageing.

Some anti-graffiti treatments require specialist application or may be available only on a supply-and-apply basis. Reference should, in any case, be made to suppliers for guidance on selection, application and maintenance treatment.

Section 5. Application and practice

42 Introduction

Section 5 gives information and recommendations regarding aspects of application and practice relevant to initial and maintenance painting, including conditions of application, craft procedures, application methods and equipment and inspecting, sampling and testing.

NOTE. See also BS 8000 : Part 12.

43 General

43.1 Order of working

When buildings are to be painted internally and externally, it may be convenient to complete the exterior work first, especially when it is necessary to use rooms and windows to gain access to the external surfaces or when painting is carried out from the scaffolding as it is struck. However, the determining factor will often be weather or the time of year at which work is done.

The general order of working is from the upper parts of a building or structure downwards, application of paint following preparation in the same order, but circumstances may require modification of this. If so, care should be taken to ensure that finished work is not spoiled by dust and debris arising from subsequent preparatory work.

43.2 Scaffolding and equipment

Scaffolding should be adequate in quantity and type to permit safe working and avoid delays. Its condition, erection and use have to comply with the relevant statutory requirements. Equipment should be suitable for the type of work being undertaken and in good condition. Mechanical equipment, e.g. for spraying, should be of a capacity or rating appropriate to the work, should operate efficiently and comply with statutory requirements in respect of safety.

Allowance should be made for the provision of temporary heating or drying equipment where necessary (see **29.2.1**).

43.3 Supply of materials

Most conventional decorative materials are available on demand or at short notice from manufacturers or distributors, but this may not apply to all quantities, colours and container sizes or to specialist materials. Manufacture of materials not normally held in stock may take several weeks, and orders should be placed well in advance to avoid delays in starting work.

If non-standard colours are required, manufacturers should be consulted at an early stage regarding the feasibility of producing the colours in particular types of paint and as to any technical limitations, e.g. of opacity or light-fastness, the materials may have.

Usually, placing of orders for materials will be the responsibility of the contractor, but early issue of finishing schedules by specifiers will reduce the risk of delay in supply that could cause work to be delayed.

43.4 Storage of materials

On large projects, facilities should be provided for the storage of materials, having regard to security, avoidance of hazards and maintenance of materials in good condition.

Most coatings, other than water-thinned types, are flammable in the liquid state; precautions to prevent accidental ignition should be taken and emergency fire-fighting equipment provided. If the total quantity of flammable paints, etc. in storage exceeds 50 L at any one time, special provisions are required (see BS 8000 : Part 12). In the case of highly flammable liquids (flash points below 32 °C), which include certain solvents and specialist coatings, there are statutory requirements regarding storage (see appendix A); containers of such materials usually carry a warning label but, in case of doubt, reference should be made to the manufacturer. Further guidance is contained in Department of the Environment Standard Fire Precautions, P.5 and Health and Safety Executive Guidance Note, HS(G)3 'Highly flammable materials on construction sites'.

To maintain coatings in good condition and to prevent rusting of containers and deterioration of 'dry' materials, such as powder fillers, materials should be stored in a dry environment preferably within a temperature range of 5 °C to 30 °C. Coatings containing volatile solvents should not be stored under hot conditions as this may create excessive pressure within containers and increases the risk of fire. Water-thinned coatings should be protected from frost.

On contracts of long duration, when successive batches are delivered at intervals, dates of receipt and batch numbers should be recorded and storage organized so that the materials may be issued in the same order as they were received. If batch numbers are missing or illegible, the containers should be marked with the date of receipt.

44 Conditions of application

44.1 General

The application and performance of coatings is affected by the conditions under which they are applied, e.g. of temperature, humidity and general

environment. The influence of these and other factors is described in **44.2** to **44.7**.

44.2 Temperature and humidity

The initial stage in the drying of most coatings is dependent, in varying degree, on the evaporation of solvent or thinner. Evaporation is slower in conditions of low temperature or high humidity, with a corresponding effect on the drying rate. In very hot conditions, the rate of evaporation may be so rapid as to cause difficulty in maintaining a 'wet edge'; see **46.2.3.**

Oil-based coatings, especially gloss finishes, tend to become thicker and more difficult to apply at low temperatures, and this may result in the application of excessively thick films which through-harden slowly or develop surface defects such as sagging or rivelling (wrinkling). High temperatures cause oil-based coatings to become thinner, and this may result in the application of excessively thin films.

The drying of emulsion paints and other water-thinned coatings depends almost entirely on evaporation of the water content and in highly humid conditions may be very slow, causing the coating to run or sag. With emulsion paints, formation of a homogeneous film, after evaporation of the water, depends upon coalescence of the polymer particles. This can be inhibited at low temperatures, resulting in permanent impairment of film properties, notably washability and film strength.

With two-pack epoxy, polyurethane and similar types of coatings, there is a secondary 'curing' stage in which the full properties of the coating, e.g. of chemical resistance, are developed and this stage is temperature-dependent. There may be a lower temperature limit below which application is not recommended. The pot-life of two-pack coatings, i.e. the period during which they are usable, is also temperature-dependent, becoming shorter as temperature increases. Manufacturers' recommendations in respect of temperature and its relation to curing time and pot life should be strictly observed.

In specifying the conditions under which coatings are to be applied, a general recommendation is that application should not start or should stop if the ambient temperature is below 4 °C to 5 °C or r.h. exceeds 80 %. In addition to the ambient temperature, a critical factor may be that of the surface to which the coating is applied. The temperature of heavy metal sections or plates, as well as plaster, rendering and masonry, for example, can be several degrees lower than the ambient temperature, especially early in the day.

In some circumstances, this general recommendation can be unduly restrictive and cause unnecessary delay or interruption of work. By agreement between the parties concerned, and having regard to the nature of the work and the types of materials involved, some relaxation of the recommendations in respect of temperature and relative humidity may be acceptable. Oil-based coatings, for example, may be less seriously affected than emulsion paints if applied in cold, damp conditions; application of primers and undercoats may be possible in conditions which preclude the application of finishes. Any agreed relaxation of the specified conditions should, however, be subject to the provisos that:

(a) coatings should not be applied to surfaces on which condensation is present;

(b) coatings are of types reasonably tolerant of the prevailing conditions of application;

(c) records are kept of the occasions when relaxation is permitted.

In assessing conditions of application, account should be taken of changes in temperature and relative humidity that are likely to occur within a few hours of application, and especially the effects of overnight frost or high humidity on recently applied coatings; see **44.7.**

44.3 Surface moisture

Adhesion, drying and other properties are likely to be adversely affected if coatings are applied to wet surfaces. Application should not proceed when, as a result of adverse weather, high humidity or other cause, there is a visible film of moisture on the surface.

Condensation is often a problem in unheated buildings during the winter months. Temporary heating equipment may help, but it is important that heating be combined with adequate ventilation otherwise the problem may be aggravated. Portable gas and oil heaters produce water and should be used only if they are provided with means of exhausting combustion products to the outside of the building.

In some circumstances, e.g. when painting heavy metal sections, it may be necessary to delay application when the temperature of the surface is below the dewpoint of the air because of the risk of condensation, even though it has not yet occurred.

When conditions improve, wet surfaces should be dried off, and time should then be allowed for contained or trapped moisture to dry out. This is especially important with absorbent surfaces but it is also applicable to rough metal including metal-sprayed surfaces. Prepared iron and steel surfaces

that have not received a priming coat will require further preparation if rusting has occurred.

44.4 Atmospheric pollution

In industrial environments, fumes may retard the drying or cause discoloration of conventional coatings; in severe cases, it may be necessary to use modified or specialist types, and manufacturers should be consulted.

The adhesion and drying of coatings may be impaired by the deposition of contaminants, including salt in marine environments. Where this occurs, surfaces should be cleaned thoroughly before application of each coat, and intervals between coats should be as short as possible.

The effects of fumes and deposition of contaminants are likely to be most severe in foggy weather and in conditions of high humidity.

44.5 Air movement and wind

Adequate movement of air assists drying and is essential to the removal of solvent vapours which may be unpleasant or potentially toxic or inflammable, especially when work is carried out in confined spaces; manufacturers' recommendations in this respect should be strictly observed.

Wind may carry dust and grit on to wet paint and mar its appearance. Caution is necessary in the use of spray equipment externally in windy weather as paint droplets may be carried for considerable distances, causing damage or annoyance.

44.6 Lighting

Good lighting is essential to efficient working. Where natural daylight is lacking, an adequate level and type of artificial lighting should be provided. Illumination intensity, in lux units, is the number of lumens/m^2 falling on a surface (lux = lm/m^2).

The lighting should simulate, as far as practicable, the final lighting scheme in intensity and direction of lighting.

Information concerning suitable illumination for differing purposes is given in the CIBS Code of Interior Lighting: 1984. For most painting operations 500 lux has been found to be satisfactory. Higher levels, e.g. 750 lux, may be suitable for darker colours and inspection purposes. For colour matching, limited contrast between coats or areas, and fine detail work, 1000 lux may be necessary.

Where the two higher lux levels are necessary and where colour perception in artificial light may be variable, illumination by lamps of colour groups 1A or 1B of the CIBS Code of Interior Lighting, should be used. These include 'North Light' or 'Artificial Daylight' types. Examples of suitable bulbs and tubes are referred to in the CIBS Code of Interior Lighting.

44.7 Seasonal factors

Seasonal variations in temperature, humidity and general weather conditions may impose constraints on the application of coatings, especially on external work. It is generally accepted that the optimum period for external painting in Great Britain is from mid-April to mid-September. However, the climate is sufficiently variable, geographically and from year to year, for there to be frequent exceptions.

Conditions are not always favourable during the period indicated, whilst there are other occasions during the remainder of the year when external painting could proceed without difficulty or detriment to the properties of coatings. Confining external painting strictly to the period traditionally regarded as most suitable may often be unduly restrictive.

If exterior painting is undertaken in conditions when overnight frost or condensation is likely, the application of gloss finishes and water-thinned coatings should be timed to allow a reasonable period for drying before nightfall, otherwise their appearance or film properties may be impaired. Surfaces which are damp as a result of overnight conditions should be dried before coatings are applied; see **44.3**. Additives which are claimed to facilitate application of oil-based paints to damp surfaces without detriment to adhesion or other properties have not been shown to effect any significant improvement in this respect.

45 Craft procedures and practices

45.1 Condition of surfaces

Surfaces should be in a fit condition to allow work to proceed without detriment to the coatings to be applied. In some circumstances additional time will need to be allowed for drying out. Work by other trades that may affect painting should have been completed satisfactorily. If some time has elapsed since preparation of the specification, any change in the nature or condition of the surfaces which may necessitate modification of the specification should be drawn to the attention of the specifying authority.

Factory-primed components should be inspected to ensure that the condition of the primer is satisfactory; if it is not, remedial action should be taken; refer to the relevant substrate clause in section 4.