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# INTRODUCTORY GUIDE TO PAINTING

Revised Edition

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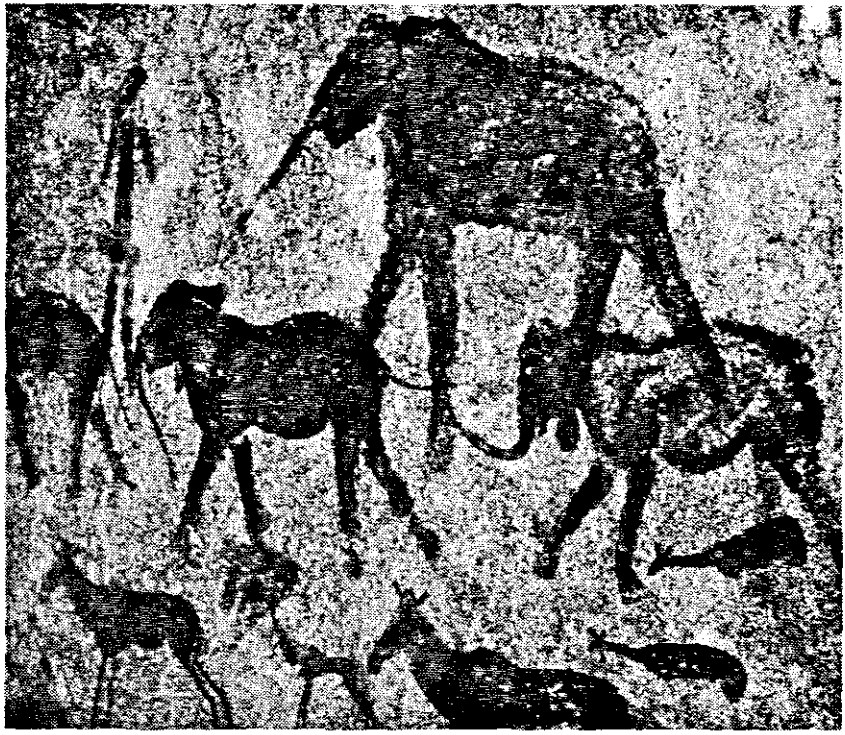


# INTRODUCTION

Painting is as old as mankind. Thousands of years ago primitive man made use of some of the colourful materials that he found around him to stain his body and clothing.

He also decorated the walls of his cave with pictures of hunters and wild animals drawn with these coloured materials and it was not until comparatively recent times that we began to ask any more of a paint than this. There are indeed times when we ask too much of it and the secret of getting good value from paint is to know what it can and cannot do.

The early cave paintings were very easily rubbed away and after a while man found that he got a more permanent finish by trapping the colour in a layer of some adhesive such as fat, egg, or blood. Such adhesives are called 'binders'.

In the very dry climate found in Egypt the artistic side of painting was developed quite extensively with chalk, charcoal, red and yellow ochres and green terra verte being used to provide the colour. For binders the Egyptians used gum arabic, egg, gelatin and beeswax.

By Roman times it had been discovered that if certain minerals were mixed or heated together some colourful residues were produced. However, egg remained a popular binder, with the result that paint had little protective value. In India, shellac was being used while in China the first varnishes were being applied in the form of the sap of what is not surprisingly called the 'varnish tree'.

The first oil paints as we know them today did not appear in Europe until after the Renaissance. At this time varnishes made with linseed oil were described and used by artists.

The key to the success of these oil paints was that the oils were converted by oxidation and polymerisation into a tough skin.

Usually the oil on its own dries very slowly and some ingredient must be added to speed the process. This is called a 'drier' and it was fortunate for the early experimenters that many of the ochres they wished to use for colouring were natural drying agents. Where no colour was needed, as in varnish, the oil was boiled with gum to accelerate the drying.

Once the colour and oil had been combined they often formed stiff putty-like mixtures that were extremely difficult to apply, but by the eighteenth century it had been discovered that these stiff mixtures could be thinned to a workable consistency with oil of turpentine. During this century a few master craftsmen put great effort into the manufacture of these paints which were very expensive. Architectural painting was a luxury reserved for churches, palaces and the homes of the wealthy, and house painting was largely done with lime wash. It was to be another hundred years before paint became cheap enough to be widely used on buildings.

Today the manufacture of paints has been largely automated and in relation to the cost of a building they are comparatively inexpensive. The oil paint that began the paint revolution more than two hundred years ago is now obsolete and has almost completely disappeared from the market.

Paints have now been developed to suit almost every situation. The result is a formidable looking list of products which, in many cases, instead of helping the decorator merely confuses him, and he may easily end up using a paint system that is less than ideal.

There are three golden rules for a good paint job:

1. Select the correct paint for the job you have to do.
2. Prepare the surface correctly.
3. Apply the paint according to the manufacturer's instructions.

Each of these three rules forms a separate theme for this guide. Follow them through and you will get good value for the money you spend on paint.

But one last thought before you begin -- modern paints can be remarkably tough and if your walls look dowdy and dirty it may pay to try cleaning them. This should be done by sponging them down with warm water and detergent. If this is not completely satisfactory the whole wall can be scrubbed with a mildly abrasive household cleaner. You never know, you may find that you don't need a new paint job after all!

# REASONS FOR PAINTING

Paint may be applied either for protection or for decoration.

It is important not to expect too much of it, particularly when it is exposed to the fierce Highveld sun. Deterioration is continuous and if the coating is still good after ten years it has done very well indeed.

**Protection.**

Steel is a good example of a material which needs protection. Left exposed to the elements it soon develops traces of rust and this can spread until the steel is almost completely destroyed. Galvanised wares may show white corrosion which is a poor substrate for paint. Once this process accelerates it is not long before the zinc is breached and red rust puts in an appearance. A good paint system is well fitted to give steel the protection it needs. On the other hand aluminium probably needs little protection and painting it may well be classed as 'decoration'.

Wood forms a component of many houses and, where it is exposed to the elements, requires to be protected from their worst effects. This, too, is a job that paint can do.

Even bricks and mortar may need protection, as in the case of houses at the Cape which may suffer from excessive damp on their windward side, particularly if the wall does not have a cavity. Paint can be used to make it more difficult for rain to gain access, though it would be wrong to try to seal such a wall completely. Before deciding to paint for this reason, householders should read the 'Introductory Guide to Damp in Buildings' in this series, and make certain that the source of the damp is in fact rain on the walls and not, say, leakage beneath a window sill or a breached damp-proof course.

**Decoration.**

While it is still important to do a good job, it is probably not necessary to aim for a ten-year life-span for a purely decorative finish, since tastes and fashion change more rapidly than this.

# COST IMPLICATIONS OF PAINTING

When a painted surface deteriorates there is usually no option but to repaint it. It is usually impractical to remove all traces of a previous finish, and if this is done by, say, sandblasting the texture of the original surface will probably be lost.

From this the conclusion can be drawn that when someone opts for a painted wall he is committing himself to repainting it, at intervals, for the life of the property.

This should be taken into account when planning a building because a more expensive finish such as tiles or facebricks may be cheaper in the long run, particularly when one takes into account the likely increase in the cost of re-painting.

However for interior surfaces, which are painted purely for decorative reasons, and which suffer hardly at all from the elements, a coat of paint will almost certainly last for as long as the housewife will want the colour scheme.

Let us take a look at the economics of painting.

No one will claim that any specific paint is 'just as good as it can possibly be.' It will always be possible to improve it, but with each improvement it will become more expensive. There are 'Rolls Royces' in the paint world, but just as most of us must put up with less exotic transport, so more pedestrian paints fill the decorating needs of the majority.

When one is painting for protection, the amount of money one is prepared to spend will probably be related to the value of the item being painted, and the ease with which the surface can be maintained. The cost of a first class finish may be several times that of a minimum coating. The higher cost may well be justified if the item needs protecting and cannot easily be maintained, because say, it is inaccessible.

Normal decoration is expected to be renewed at intervals and will not usually warrant the most expensive coatings.

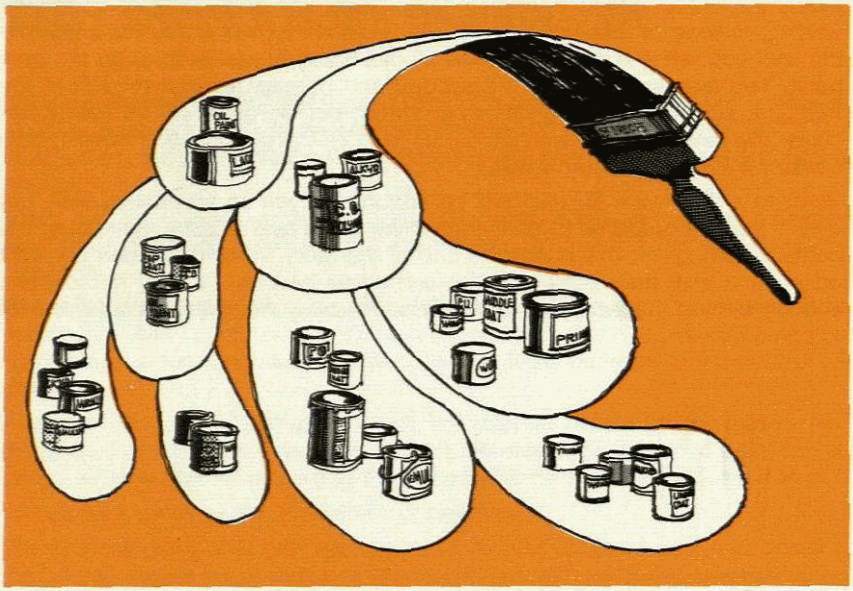
Let us try to establish an acceptable standard. A good quality acrylic paint, properly applied to a well-prepared wall, can be expected to last 10 years out of doors and even longer indoors.

The catch may lie in the term 'well-prepared'. If the wall to be painted is covered with poor quality deteriorated paint the preparation for a long-life finish may well be very arduous. In this case you may feel it is worth buying a 'guaranteed' ten-year lifespan, even though it will probably cost you three times as much as a coat of acrylic. Bear in mind, however, that if the finish is not going to last the full ten years the firm that gives you the guarantee will be subjected to a rash of claims and may not be around long enough to put your problem right.

The opposite situation also bears investigation. You will find that you can buy emulsion paint at about a third of the price of a top quality product. What is the difference? What are the consequences of buying such a paint?

Firstly the cheap paint will contain large quantities of calcium carbonate or whiting, instead of titanium dioxide. This means that when you have painted the wall you will still be able to see all the old dirty marks through the new paint. You may have to give it a second and perhaps even a third coat. By this time your price saving has evaporated, but worse is still to follow because the new paint job will not last as long as the good quality acrylic; particularly if it is on an external wall.

Perhaps a three-year lifespan will be enough for you on an internal wall, but even if you are prepared to do the job three times over to save the cost of the better quality paint, this is not the end of the story. A stain accidentally spilt on such a wall may soak into the paint and because it may not contain enough binder, the paint will probably come away altogether should you try to scrub it clean.



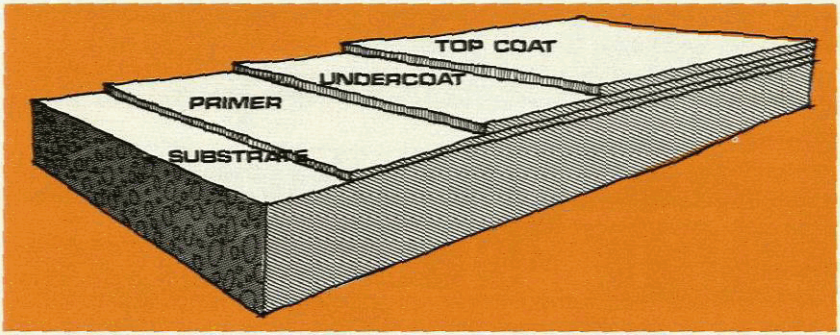
# FUNCTIONS OF PAINT

Few paints can, on their own, perform all the functions required of them, so paint is usually applied in separate layers or coats; together these form what is known as a paint system.

The following list details some of the varied requirements of a paint.

- It must adhere firmly to the surface it covers.
- It must hide existing marks or stains and have the desired colour finish and texture.
- It must resist wear and tear that may result from the elements or from steam, grease and chemical attack.
- It must be hard enough to resist knocks and scrapes, and yet elastic enough to take up the normal movements of the surface it covers.
- The paint coating must be of the correct thickness because its life is partly dependent on this.
- It may need to seal porous material.

By utilising the best features of particular paint formulae a sound paint system may be built up, layer by layer.




**The primer**

Primers have several functions. They adhere to a surface and generally dry with a matt finish that gives a key for the next layer of paint. Some protect metal surfaces from corrosion while others seal porous materials, such as softwood and brick, which might otherwise absorb too much of the binder.

**The undercoat**

This layer of paint has three main functions. It masks any discolouration on the surface to which it is applied. It helps to provide a flat even surface that can be sanded smooth and it generally dries with a matt surface that enables the final coat to get a good grip. Sometimes more than one undercoat may be desirable. The colour of the undercoat should be almost the same colour as the final coat. Slightly different colours make it easier to ensure that each coat has completely covered the previous one.

**The topcoat**

This is the coat that will be seen. It provides colour and texture and the resistance that protects the paint system from damage. Unlike the primer and the undercoat, the surface of the topcoat is not always suitable to take another coat of paint. Attempts to paint over finished work occasionally end in failure (see page 23).

The primer, undercoat and topcoat each contain some or all of the basic ingredients: pigment, binder, drier and solvent. Because different manufacturers of primer, undercoat and finish may use a very wide variety of chemicals they may not all be fully compatible; it is therefore wise to buy a system marketed by a single manufacturer.

Some of the different kinds of finishes and paints that you may come across are given below, but before making a decision about which to use you must weigh up all the consequences. If you use limewash, for instance, you may have to re-apply it every year.

**Limewash**

Limewash is an old material commonly used for coating the walls of houses. It is used throughout the world and is a suspension of calcium hydroxide in

water. Various 'recipes' incorporating such extras as salt to keep the limewash moist and tallow to make it more water resistant, are available. Limewash binds poorly to a wall and often causes paint that has been applied over it to flake off.

**Cement-based paints**

Cement paints are made from white portland cement and pigments. Formulations incorporating materials to absorb moisture, and polymeric resins to act as an early setting binder, are now common.

**Distemper**

This is an interior decorative finish in which the pigment is bound with water-soluble glue or size. It is cheap and is sold in powder form for mixing with water. It cannot be used out of doors and will rub off if washed. Where a paint of a different kind has been applied over it, it leads to the flaking of the new paint.

**Solvent-borne paints**

These paints can be bought with either a gloss, semi-gloss or matt finish and are based on alkyd, silicone, polyurethane, epoxy, rubber, vinyl or acrylic resins. The alkyd materials are those most frequently found on paint shop shelves.

**Aerosol paints**

These paints are commonly made from nitrocellulose binders and harden by evaporation of the solvent. They are useful for small applications requiring rapid drying.

**Sanding sealers**

When freshly sanded wood is painted the solvent is absorbed by the surface fibres which then tend to stand up proud and spoil the new finish. Sanding sealers are intended to seal the grain, to make the wood less absorbent and to leave a layer which can be sanded smooth enough to take the finish. They should be used to seal knots in wood when a clear varnish is to be applied.

**Water emulsion paints**

Sometimes called plastic paints or latex paints (USA), this group includes: PVA, pure acrylics, and various co-polymers.

One reason why emulsion paints are popular is that they don't use 'noxious' solvents and are favoured by ecologists and health authorities. Another is that until they dry, they are water dispersable. This property enables brushes and rollers to be washed under a tap. Some pure acrylics are alkali resistant and thus may be applied to fairly fresh cement based surfaces (see page 13).

**Clear lacquer and varnishes**

Shellac, an excretion of the lac bug was at one time commonly used on interior woodwork and is still used as a 'knotting compound' on timber which is to be painted. Other common varnishes for wood are based on resin-modified alkyds and polyurethane resins.

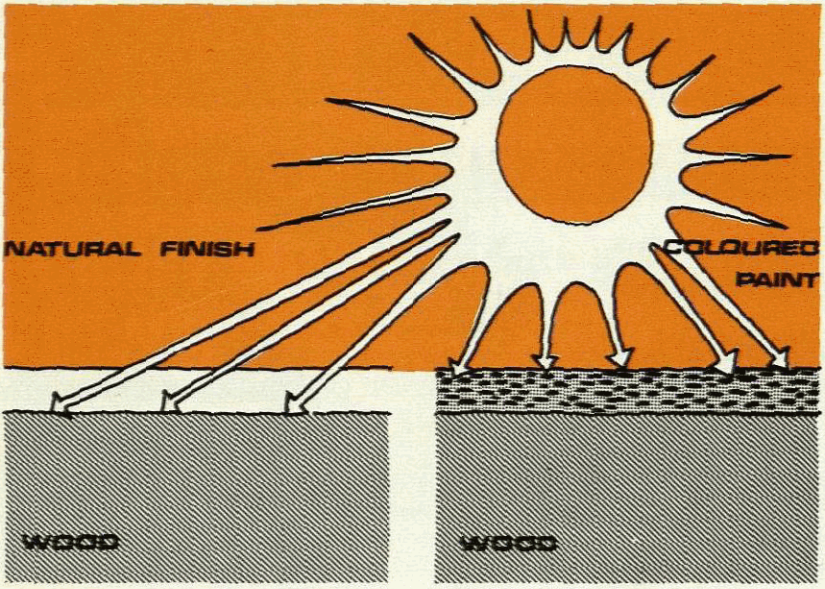
# WHAT PAINT TO USE

When choosing a paint it is as important to think about the nature of the surface to be painted as about the material to apply.

There is a world of difference between a material being painted for the first time and one that is being repainted after the failure of the old coating. For this reason the new surfaces and the old are dealt with separately in this guide.

There are many different painting systems and it often happens that several are equally good. Since the presentation of alternative systems may lead to confusion and error it has been decided to limit mention in this publication to one satisfactory method of painting each surface. There are many first-class paint systems that, for want of space, cannot be mentioned in this booklet. Should you wish to use one of these, and have doubts about it, you are welcome to contact the NBRI for advice.

It is always best when buying a paint system to select the products of a single manufacturer.




*Harmful rays reach the surface of the wood*

*Coloured paint protects the wood*

# PAINTING NEW MATERIALS

**Material: Wood: natural finish**
**Surface: New**
**Climate: Highveld, out of doors**

On the highveld, with its wide temperature and humidity changes and its long hours of sunshine, ultraviolet light will penetrate a transparent coating on exposed timber and destroy the surface of the wood. The very transparency of the varnish is its downfall. Such coatings, long after they have ceased to protect the timber, take a lot of labour to remove. In the long term the most economical wood dressing for exposed timber is two coats of water-repellent stain. This may only last one or two years but it can be re-applied directly over the previous coat and gives an attractive 'oiled wood' appearance.

**Material: Wood: natural finish**
**Surface: New**
**Climate: Indoors**

Modern polyurethane varnish is proof against spills of water, alcohol and most household chemicals. It is tough, easily applied, long lasting and seals

the grain as it dries. Several coats can be used to give a high-gloss finish, provided that they are applied within 24 hours of one another. Best results with this material come from using a two-pack system in which the polymer and hardener are packed separately.

**Material: Wood: pigmented finish**
**Surface: New**
**Climate: Highveld, out of doors**

For best results, exposed wood will need a three-coat system. A good primer to use would be what is known as a 'drying oil-modified alkyd primer' and there are several firms making this in South Africa. It should be followed by a coat of universal undercoat and a compatible topcoat. The use of an undercoat out of doors is recommended because it is loaded with pigment to both hide blemishes and provide a suitable base for a long-life finish.

**Material: Wood: pigmented finish**
**Surface: New**
**Climate: Indoors**

One might think that in the shelter of the home three coats would not be necessary. However, it is suggested that the same system be used as for timber out of doors. (See previous section). The heavily filled undercoat can be sanded to provide a smooth surface leading to an extra-fine finish to the topcoat. The undercoat therefore can be seen as providing either a long life out of doors or a superior finish indoors.

**Metal**

There are two metal surfaces commonly encountered in buildings which need to be painted for protection: steel and galvanised steel. Because different paint systems are required for these at the coast and inland we will recommend a procedure for each area.

It is important for the householder to recognise that there are two kinds of ungalvanised steel that are in use around the house, cold rolled steel and hot rolled steel. The former are the thin sheets that commonly make up surfaces such as garage doors and door frames. The heavier material such as window frames and square section beams are rolled hot and have a dark blueish layer of oxide on their surface (mill-scale) when new.

This latter affords some protection to the surface whereas cold rolled material rusts much more readily.

To coat steel successfully it is essential that all traces of rust and mill-scale be removed.

In a factory or on a building site this is usually done by shot-blasting. For the ordinary homeowner, repainting his windows, such a technique is not available and he must do his best to remove as much rust as possible by scraping, sanding or using a rotary wire brush or an angle grinder. Care will have to be taken to avoid scratching window glass.

The closer one cleans to the bare metal the better the potential result, however the clean metal is highly susceptible to rusting and one is advised to

wipe the new surface with a rag soaked in white spirit (mineral turpentine). The clean surface should not be allowed to stand unpainted overnight, because moisture from rain or condensation will be present on the surface and initiate rusting which will soon destroy the new paintwork. The moisture itself will interfere with the bond between the steel and the primer.

**Material: Steel**
**Surface: Untreated**
**Climate: Inland**

The primer of choice in these non-aggressive conditions is based on zinc chromate (such as SABS 679 type I). Subsequent coats, which should be applied within two or three days, should be an alkyd undercoat, (such as SABS 681 type II) followed by an alkyd topcoat of suitable colour.

**Material: Steel**
**Surface: Untreated**
**Climate: Coastal**

The corrosiveness of the atmosphere at the coast requires that steel should be very well-prepared for painting and that only coating systems that have been proved to provide protection against corrosion be used. The best systems require blast cleaning and factory application. For the odd repair job the householder might use an aluminium pigmented two-part epoxy resin paint (with a pigmented epoxy as a topcoat, if required). At least three coats of 0,05 mm (50 µm) each (150 µm total dry film thickness) must be applied to the well-cleaned steel. Alternatively a high-build, chlorinated rubber system can be used.

These materials are only available at specialist paint shops and those using them should remember that it is absolutely essential to follow the manufacturer's instructions.

**Material: Steel**
**Surface: Galvanised**
**Climate: Inland**

There are two dangers inherent in painting galvanised steel. The first is caused by the reactive nature of the zinc surface which damages alkyd paints and the second by the preservative that is often applied to the surface of sheet material during production. Once the steel has been exposed to the elements for a few years the preservative may disappear but whenever you need to paint new sheet material you should first clean off the preservative using a stiff bristle brush and an abrasive cleaner. Afterwards the abrasive cleaner must be completely removed. The galvanised surface may then be painted with a good quality acrylic roof paint. This coating may be overpainted with an alkyd finish where required for items such as gutters and downpipes.

**Material: Steel**
**Surface: Galvanised**
**Climate: Coastal**

In coastal areas a calcium plumbate primer must be used on galvanised steel. This may be covered with, first, an undercoat and then a gloss topcoat.

On roofs the suggested topcoat is a roof paint containing micaceous iron oxide.

**Material: Aluminium**
**Surface: Untreated**
**Climate: All areas**

Well-chosen aluminium alloys are among the really long-lasting metals for coastal areas because they develop a highly resistant layer of oxide on the surface. If, however, you have to paint aluminium, it is vital to apply an etch primer and then a compatible topcoat, strictly in accordance with the manufacturer's recommendations. Unpainted aluminium in coastal areas should be washed regularly with clean water to remove salt.

**Concrete or cement rendering**

Those who have lived on a farm will probably remember how surplus fat used to be treated with an alkali to make soap. The same thing can happen at the point where some oil paints come in contact with the wall. The alkali, which is always present in new cement work in the form of calcium hydroxide (lime), turns the oil to soap, destroying the bond between the paint and the wall in the process. The paint cannot be blamed, only the fact that it was used incorrectly.

We say 'new cement' because in time the lime in the cement combines with carbon dioxide in the air to form a less aggressive substance, calcium carbonate. This is, however, only a small part of the story because lime alone cannot saponify the oils and needs water to make it reactive. Water, of course, is almost always present in walls and comes from rain, condensation and the water used during construction, which dries out very slowly. The best solution, and the one usually adopted, is to paint new cement with an emulsion paint which is unaffected by the lime. Many of these paints have the additional advantage of drying to give surfaces which are porous enough to avoid the danger of trapping damp behind the layer of paint.

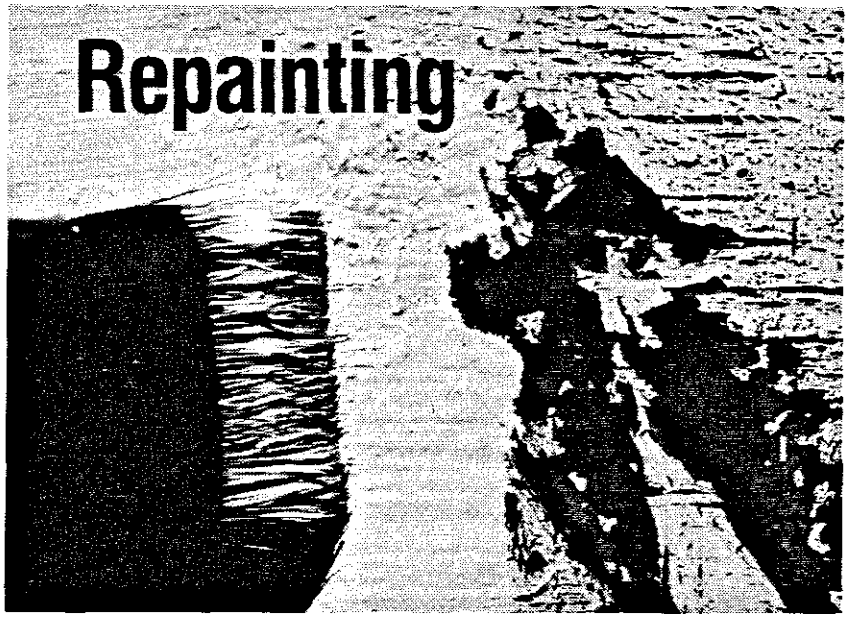
Another method altogether is to use a cement paint. This material can be long lasting but its application requires more care and preparation than other coatings if the best results are to be obtained.

Painting walls with hair cracks is described on page 19.

**Material: Asbestos cement**
**Surface: New**
**Climate: All areas**

The surface of asbestos cement is often covered with a layer of cement dust and this should be thoroughly removed before painting. One must also keep in mind the nails and screws with which it may be fastened. These must be touched up with calcium plumbate or other suitable primer before painting. To the clean, dry, dust free surface apply one coat of vinyl-toluene-based masonry paint. Overcoat it when dry with an emulsion paint. Pure acrylic bound materials are the most durable out of doors.

# Repainting



The success of a repainting job is largely dependent on how well the surface is prepared. Repainting can only be successful if the new paint stays in place. If the old paint to which the new layer is applied, does not adhere to the surface, the whole system will fail.

**Wood**

**Material: Wood with natural finish**

**Surface: Varnished**

**Climate: Outdoors, all areas**

Most varnishes are transparent to ultraviolet rays and allow this radiation to attack wood fibres under the varnish. Since this attack takes place on the surface of the wood it destroys the part of the timber supporting the varnish. In addition, the ingress of moisture to the timber will cause dimensional changes which will rapidly undermine any finish.

Water from say leaking gutters should not be left to damage the timber. Where signs of water damage appear on the timber immediate steps should be taken to repair the leak and the finish. The effects of damp may show up

as a blue stain and sometimes a growth of micro-organisms on the timber while in extreme cases wood rot may be found. No paint finish will stand up for long under these conditions. Where wood is destined to remain damp it should be treated with a wood preservative before varnishing. To get satisfactory results on exposed timber it is necessary to scrape off the old varnish and sand away the damaged wood. After this treatment you are dealing with what amounts to new wood, and a water-repellent stain is the right material with which to protect it. (See page 10).

Varnish which has not been exposed to the direct rays of the sun may become dull and lacklustre without losing much of its adhesion while the wood to which it has been applied remains sound. In this case one can sand the surface of the old varnish lightly, to create a key, and apply another coat of varnish.

If knot marks show through the old varnish it is a sign that they were not properly sealed. In this case it will be necessary to strip off the affected varnish around and over the knots and seal the area with sanding sealer before revarnishing.

**Material: Wood with a natural finish**
**Surface: Varnished**
**Climate: Indoors, all areas**

In a sheltered environment clear varnishes or lacquers are long lasting and usually only need treatment as a result of physical damage such as chipping or staining. Where the damage is confined to the finish it can usually be repaired with a light rub down with sandpaper and another coat of varnish. If the underlying timber is damaged or stained it will need to be exposed by sanding and revarnished as for new wood.

**Material: Wood with a pigmented finish**
**Surface: Old paint**
**Climate: Outdoors, all areas**

The sun's rays and natural movements of the timber are just as much the enemy of pigmented paints as of varnishes, only in this case it is the surface of the paint that receives the full force of the sun and the weather, as a result of which it slowly powders or 'chalks'. The life of a coat of paint out of doors depends largely on its having been properly applied and not subjected to 'sabotage from below'.

Inspect the old paint job for quality. If it is firm, not cracked and not peeling, one need only sand it lightly and then rub it down with a cloth soaked in paint solvent and apply a fresh topcoat. If the surface is greasy it should be cleaned down, using a detergent, before sanding. (If there are any spots where the bare wood is showing, these should be touched up with primer and undercoat before painting). If knots are showing through the paint they should be treated as described in the section on revarnishing above. If the original coat was badly applied it may well be flaking, cracked or blistering. In this case the deteriorated paint will all have to be removed and the procedure for new wood followed. (See page 11).

**Material: Wood with a pigmented finish**
**Surface: Old paint**
**Climate: Indoors, all areas**

As with varnishes, paints can become stained or damaged, though the most common reason for repainting is simply that one has become tired of the colour. Gloss finishes that have stood for a long time become brittle and because they develop a surface to which paint cannot readily bind, a new coat applied directly to them may tend to flake. Gloss finishes must be lightly sanded to provide a rough surface to which the new finish can adhere. If there is to be no change of colour one new topcoat may be enough, otherwise an undercoat should be applied first.

If knot marks show through the old paint it will be necessary to strip off the affected paint around and over the knots and start again with knotting compound, primer, undercoat and topcoat.

**Metal**

The decision to repaint a metal surface may be occasioned by fair wear and tear, as in chalking or erosion of the paint (see page 31), or it may result from some more serious failure, such as rust disrupting the old finish, or the preservative on galvanised sheet causing the previous coat to peel off.

**Material: Metal of all kinds**
**Surface: Old paint in good condition**
**Climate: Indoors and outdoors, all areas**

Where a paint surface is still sound it can be painted over and it is important to realise that in such a case one is not painting metal - one is painting paint. Because of this the rules are the same, irrespective of the kind of metal you are dealing with.

First remove all traces of fat and grease by washing with hot water and detergent. Then sand the surface lightly to improve the key. Next rub with a soft cloth dipped in paint solvent.

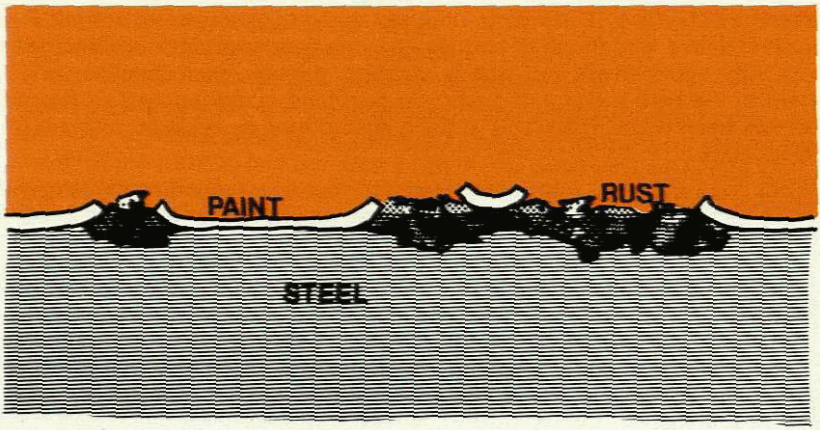
Finally, apply one new topcoat. If the colour is to be changed, using an undercoat first will save you money because an undercoat plus a topcoat will cost less than two topcoats.

**Material: Metal of all kinds**
**Surface: Old paint in poor condition**
**Climate: Indoors and outdoors, all areas**

Where the old paint is unsound we must find out why before proceeding.

The commonest cause of failure is corrosion of the metal, which leads to red rust stains on ungalvanised steel and white corrosion stains on galvanised steel.

Rust is caused by oxygen (from the air) and moisture acting together on the metal. They get to the metal at points where the paint film is damaged or where it has worn thin or where the paint is too porous.




**Material: Steel**
**Surface: Old paint with rust showing through**
**Climate: Outdoors, all areas**

Rust usually appears on a painted surface in the form of blistering or flaking and on steel will be accompanied by unsightly red stains. If more than 10 per cent of the entire surface area is affected by rust marks then one can assume that total failure is inevitable and that a patch-up job will not be worthwhile. The procedure should then be to first strip off the paint. Grit, shot or sand blasting is the best method but where this is not practical a power sanding disc may be used. For small areas paint remover may be useful. It is essential to clean off all traces of the paint remover after it has done its work and for this purpose water or methylated spirit should be used depending on the type of remover. The surface should next be cleaned with a wire brush, followed by steel wool dipped in paint solvent.

Immediately the surface is clean and before any moisture, such as dew, can reach it, it should be treated as for new steel. (See page 12).

**Material: Galvanised steel**
**Surface: Old paint with corrosion showing through**
**Climate: Outdoors, all areas**

The white corrosion (also called white rust or wet storage stain) found on galvanised steel that has been stored under adverse conditions is just as effective at breaking up paint films as the red variety.

Where a galvanised steel roof is in need of repainting it is usual to scrape the old paint away rather than use a paint remover, which will prove expensive and difficult to use over a large area. Paint that has failed usually comes away quite easily. (The use of a blowlamp is not recommended). Red rust stains on a galvanised steel roof mean that the protective zinc layer has been breached at those points and in this case the use of a calcium plumbate primer is essential.

Where the surface is showing only isolated red rust stains it should be brushed with a wire brush to remove all loose paint and zinc corrosion products. Any spots where red rust is showing through must then be sanded down to the bare metal and a calcium plumbate primer applied as soon as this has been done. The whole surface should then be covered with a suitable topcoat.

Where paint is flaking from galvanised iron, but no white corrosion is apparent, it should be suspected that the wrong type of paint has been used or that the preservative was not removed before painting. In either case there is no alternative but to clean off all the previous paint and start again as for new galvanised steel. (See page 12).

If the paint has failed over less than 10 per cent of a metal surface it will often be feasible to do a patch-up job. The affected areas should be cleaned down to the metal, and calcium plumbate primer and undercoat applied. After this, the entire surface should be treated as described (on page 12) for new paint, and given one topcoat.

**Material: Aluminium**
**Surface: Old paint flaking off**
**Climate: Indoors and outdoors, all areas**

If paint is flaking from aluminium it probably indicates that a wash primer was not used. The paint should be stripped off and the metal repainted as described on page 13.

**Cement-based surfaces**

For the sake of economy many painters use cheap paint or dilute their good emulsion paints with powder distemper, limewash or other materials. This will save some money initially.

After the paint has been applied it looks fine, for a while. However, most economies of this sort cause trouble sooner or later and in this case it is the man who is forced to repaint such a surface who pays the bill - with interest.

By the time such a coating fails it is very powdery and comes away when you rub it. A good way to demonstrate the problem of adhesion to such a surface is to press a strip of adhesive tape onto a dusty blackboard. No matter how firmly you apply it it will pull off quite easily and you will see that its adhesive powers have all been spent adhering to chalk particles. Now wipe the board clean with a damp cloth, allow to dry and repeat the tape test.

From this you will have learned that it is no use painting over a powdery surface and that the solution is to remove the old paint (See page 22) before applying the new.

Peeling is another kind of paint failure. If an oil-based paint has been used on an unsealed cement wall it may well be peeling off like damp wallpaper. Once again the root of the problem lies at the junction between paint and wall (see page 30) and the solution is to clean off the failed paint, wash the 'soap' off the wall and repaint with an emulsion paint.

**Material: Concrete and cementwork**
**Surface: Old paint in good condition**
**Climate: Indoors and outdoors, all areas**

When the existing paint is in good condition and adhering firmly to the wall it will act as a sound base for subsequent coats. However you should look carefully at the paint to find out what to do. If it is an alkyd paint (a test spot is stripped by paint remover) then the fact that it is soundly in place indicates that the wall was either fully carbonated (see page 13) or effectively sealed before painting, and you may re-apply a solvent-borne paint after cleaning and keying the surface. If the existing coating is of an emulsion paint, then overpainting with an alkyd paint may cause failure on exterior walls because the alkyd paint will change the way moisture moves in the wall.

The moral therefore is that a wall that was painted with emulsion paint should be repainted with the same material. Failures may also occur if one type of emulsion paint is overcoated with a different type, such as a pure acrylic over a PVA-based material.

**Material: Concrete and cementwork**
**Surface: Old paint disfigured by hair cracks**
**Climate: Indoors and outdoors, all areas**

Hair cracks are a widespread problem on cement rendered walls. The cause usually goes back to the day they were plastered and the best thing to do is to prepare the wall as described in the previous section and then paint with a textured emulsion paint.

A normal finishing coat of emulsion paint applied once the textured surface has dried will help protect the latter and tests at the NBRI have shown that hair cracks treated in this way should stay hidden for several years. If the plaster is very friable a longer lasting finish results if a bonding fluid is applied to the wall before repainting begins, but be sure that it is a solvent borne vinyl toluene or styrenated acrylic bonding fluid both of which are not affected by alkali.

Where hair cracking is more severe a very effective solution is to cover the wall with a glass surface tissue.

This is done by first painting the wall with an acrylic paint and then pressing the tissue into the soft paint with a lambswool roller. Finally a topcoat of acrylic is applied over the glass tissue. This may cost up to three times as much as an ordinary paint job but can be expected to hide hair cracks permanently.

**Material: Concrete and cementwork**
***Surface: Old cement paint***
**Climate: Indoors and outdoors, all areas**

Another problem you may have to face is repainting a wall that has cement paint on it. The choices open to you are the same as for a cement rendered wall: emulsion paint, more cement paint or a sealer followed by another system. You will need to examine the cement paint carefully for defects. The surface may be powdery and need brushing down with water, but it may also

show flaking caused either by poor application or by being used on top of some other kind of paint. In such a situation the old paint will need to be brushed or scraped away and a new assessment made when you find out what lies underneath.

**Material: Wood, metal or cementwork**
**Surface: Old bituminous paint**
**Climate: Indoors and outdoors, all areas**

The oils present in bitumen pass through most paint films, softening them and leaving unsightly stains on the surface. Options that are open in this situation include:

- use a black, brown, or aluminium bituminous paint
- use an acrylic emulsion paint.

**Material: Wood, metal or cementwork**
**Surface: Old epoxy paint**
**Climate: Indoors and outdoors, all areas**

These paints fade and chalk rather freely when exposed to sunlight. All chalk must be removed and the surface thoroughly abraded before overcoating. Even after this has been carried out, no guarantee of durability can be given as the bond between new and old epoxy paint is a physical one only. This can result in peeling at a later stage depending on the conditions to which it is exposed.

# PREPARING THE SURFACE

It is a common belief that 'a lot of things can be covered up with a layer of paint'. To some extent this is true, but if one realises that a coat of many of the common paints is only about 0,025 mm (25 μm or 25 microns) thick it becomes clear that it cannot very well hide cracks and irregularities. (There are special paints available which can produce a layer 300 μm thick and these, of course, are very good at hiding small defects).

Add to this the fact that the life of a paint system depends on how well it adheres and it becomes clear that eventual success or failure is determined before the first brushful is applied.

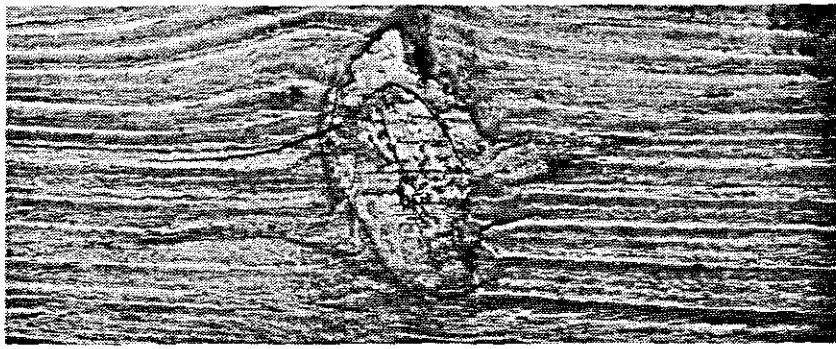
In the previous chapter we have discussed the relationship between the qualities of various materials and the chemical or physical nature of the paints that can be used to cover them. Preparing the surface correctly is an essential step to getting good adhesion and a satisfactory texture.

**Wood**

A suitable paint system adheres well to well-seasoned wood and the only preparation necessary on new wood is to see that it is sanded smooth, that it is free of sawdust and that cracks, splits, nail holes and countersunk screw holes have been filled. A good exterior grade filler should be used or alterna-

tively you can make your own by mixing silica flour with the paint you are using, however, if this is a water based paint you must remember to paint the nails and screws first with a zinc chromate or calcium plumbate primer. The tendency of wood to absorb the binder means that a base coat, such as sanding sealer, which seals the grain should be used before painting.

**Knots.** These tend to exude a sticky resinous substance that undermines the surface of the paint causing unsightly marks. This is not a problem where the wood has been treated with sanding sealer, which is sometimes used for indoor work, but where conventional oil or resin-based finishes are to be used, knots should first be sealed with a knotting compound.



*A knot showing through paintwork*

**Metal**

The aim is to prepare the metal in such a way that the surface is free from grease, dust and, most important, rust and moisture. The technique is to brush it down hard with a stiff wire brush and then to rub the surface with a steel pot scourer dipped in paint solvent. The job must be done in dry weather and the primer must be applied as soon as possible on the same day. Because of the possibility of moisture condensing in the form of dew the surface should not be left unpainted overnight.

**Cement**

A concrete or plastered wall should be scrubbed down thoroughly with water and allowed to dry before painting. If there are traces of a previous finish that has become powdery through exposure to the sun it is best to scrub them off first with a stiff bristle brush.

All surface irregularities, cracks and holes should be filled with exterior grade filler and rubbed down before painting. Do not use calcium sulphate-based fillers (gypsum, plaster of Paris, Keene's cement, 'Glastone') on any surface that will get wet. Again it is a good idea to make your own filler by mixing silica flour with the paint you are using. To get an idea of the final texture, be-

fore you paint, shine a strong light along the surface of the wall. The irregularities will be emphasised by the shadows and these will not be hidden by the paint but rather accentuated by it.

Never start to put the paint on until you are satisfied with the condition of the surface, and remember that applying the paint is the easiest part of the job.

**Old paint**

Since all repainting involves preparing an old paint surface, this kind of preparation accounts for a very large part of the time spent on painting. Where the old paint is in poor condition it will generally need to be removed and the job will thus revert approximately to the status of an original surface. (See page 10).

Where the paint is in good condition it will only be necessary to clean and roughen the surface.

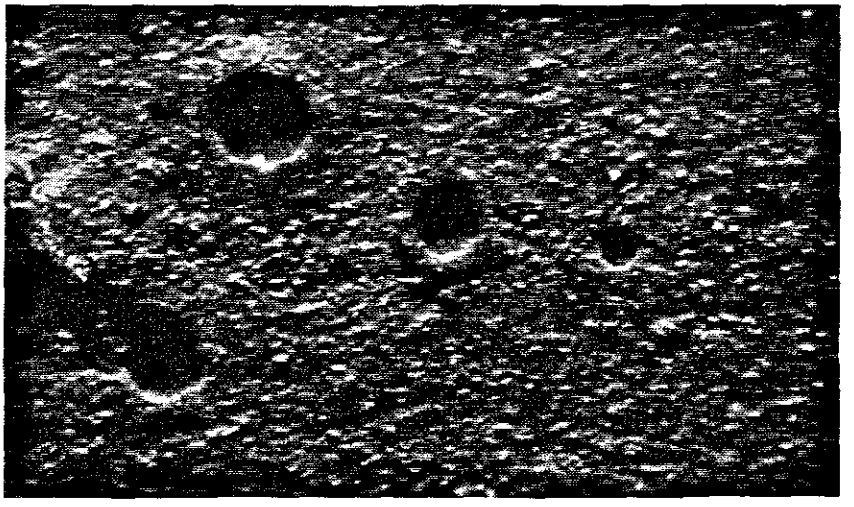
If you are dealing with a gloss paint you should first remove grease stains or wax polish with detergent and then rub the surface down with fine wet emery paper (180-grit) and water, until it has been dulled with scratches. After this, wipe the surface well with a soft cloth dipped in paint solvent. This will remove all loose dust and leave a surface suitable for repainting.

Matt finishes generally need only be rubbed down with paint solvent to give a good surface.

Paints that have been subjected to severe weathering frequently chalk badly and it is suggested that these be washed down with water and detergent before rubbing down with fine wet emery paper.

It is sometimes claimed that using a bonding liquid on surfaces that have chalked obviates the need for thorough preparation. This is not true. The fluid certainly does sink into the chalky surface but unless it reaches the base material beneath the old paint it will not save the new finish. One must always try to remove as much of the chalky material as possible and only if there are traces left that will not come off is a bonding fluid a worthwhile insurance. It is important not to use too much bonding fluid and the surface after it has dried should not be shiny.

Oils, greases, waxes and, above all, silicone polishes prevent paint films from adhering properly. A greasy surface should be washed with detergent and hot water. Some waxes will not be removed by this process and in this case they should be rubbed down with a cloth soaked in a solvent such as white spirit. However, solvents should not be used on porous surfaces because they are likely to carry the greases deeper into the material. In this case sanding the surface is the answer. If silicone polish is present it will probably be necessary to sand the surface, or even to remove the old paint or varnish entirely.



*Photomicrograph of defects in the surface of paintwork caused by painting on a hot surface*

# APPLYING THE PAINT

**Safety precautions**

Dry paint is a safe finish to have around the house and painting can hardly be called a dangerous occupation, especially if one undertakes it only occasionally. However there are some precautions that the sensible homeowner should take.

**Fire risk.** Many paints contain flammable solvents and great care should be taken to keep them clear of naked flame, not only when they are being used but when the part-used cans are stored away.

Where birds can enter the roof space to build their nests they create a particularly dangerous fire hazard for anyone using a blowlamp or electric heater to strip paint. Stray flames passing through the entrance to the nest can start a fire in the roof which can become serious before anyone can get into the roof to put it out.

**Risk to health.** The days are now past when white lead was used as a pigment. However there may be some old woodwork or imported goods around that can still present a danger, either to a child putting a painted object into its mouth or eating dislodged flakes of paint or to an unwary renovator who may attempt to burn off such paint. Because lead is still used in primers for steel, burning off of such paintwork should be avoided.

Some of the solvents used in paint are toxic and one should always work in a well ventilated room. When spray painting there will be excess solvent in the air and one should take the added precaution of wearing a suitable mask. Remember that cheap masks designed to keep coarse dust from being inhaled are of no value against solvents. A suitable cartridge type of respirator is needed.

There is a special danger for smokers in that some harmless solvents become dangerous when heated. An innocuous vapour inhaled through a burning cigarette can be converted into something much more harmful. One must make it a rule not to smoke while painting.

A hidden danger accompanies the repainting of asbestos cement because this usually requires the surface to be brushed or sanded. Such a process can liberate fine asbestos fibres, which can be carcinogenic if inhaled. Be sure to use a wet cleaning system or to wear a well-fitting breathing mask while doing a job of this kind. Wash any accumulations of powdered asbestos cement away to prevent them from being disturbed by wind and traffic and redispersed in the air.

Some solvents can cause severe dermatitis while others are toxic and can pass into the body through the skin. For this reason you should never put your hands in liquid paint or solvent. Always wash your hands well after painting and use an appropriate proprietary hand cream if the skin has become defatted by contact with solvents.

**Putting on the paint**

Choosing the right paint and preparing the surface correctly almost guarantees a good job - almost, but not quite, because there are a few things that can happen during the application to ruin an otherwise perfect coating.

**Temperature**

When the weather is very cold - below 5°C - the minute particles in an emulsion paint can fail to coalesce and the paint may crack soon after it has dried. Two-pack materials will not cure below 10°C and conventional air-drying coatings remain sticky for days, picking up much dust and dirt in the process.

When paint is applied to a surface that is too hot the solvent can evaporate too rapidly. The film hardens too quickly, fails to cover and penetrate properly and bubbles of solvent bursting at the surface cause pinholes. The finish has a poor appearance and will not last.

**Wind**

Wind causes rapid evaporation and raises dust which settles on the wet paint spoiling the finish. Always paint on a calm day or out of the wind.

**Damp**

Moisture trapped beneath a film of paint soon causes blisters to form when the sun warms the new finish. For this reason it is unwise to begin painting before the sun has had a chance to dry off all the surfaces. Dull, drizzly days

are not really suitable for painting out of doors, and since really good painting days are very frequent in South Africa it is better not to risk wasting the money you have spent on the paint. Defer the job until the weather improves. There are some paints which can be applied in light rain - in fact it has been claimed that you could paint a swimming pool without emptying the water - but these are more expensive than normal paints and who wants to stand painting in the rain anyway?

**Porous surfaces**

As explained earlier (see page 7), the solvent sometimes soaks away into a porous material leaving a very weakly bound paint on the surface. When faced with the need to paint a porous surface, one should use a penetrating sealer, thin enough to soak right into the material. When this sets it will provide a surface suitable for painting.

**Thinning**

Paint is usually ready to apply as it comes from the tin. However, because of changes that may take place during storage, it may sometimes be necessary to thin a paint to make it easier to apply and to ensure a good bond. It is important to use the correct kind of thinner or solvent and to avoid overthinning. Read the instructions you will find on the tin.

An exception to this rule is that the first coat of sanding sealer should be thinned with at least 10 per cent of thinners to allow it to penetrate deeply into the wood. Subsequent coats, which have the aim of filling grain and small defects, can be applied undiluted.

**Time between coats**

Most manufacturers specify a minimum time between coats and if this is not adhered to, the solvents in the upper coat will interfere with the drying of the undercoat and both can be spoiled.

What is not generally realised is that there is also a maximum time between coats. Up to about two days after the application, particularly of a topcoat, the solvents in the new coat etch their way into the coat below to provide a key. If so much time has passed that the first coating has dried too hard then a subsequent coat will dry before the solvents have had a chance to penetrate the now-hard surface. The eventual result will be peeling paint, particularly where it is exposed to the sun.

Epoxy paints are particularly bad in this respect and should always be overcoated within the specified time. Once they have set hard it is extremely difficult to get good adhesion.

If you are unable to apply consecutive coats on consecutive days it will be wise not to use epoxy paint and to go over the old surface with emery paper before painting.

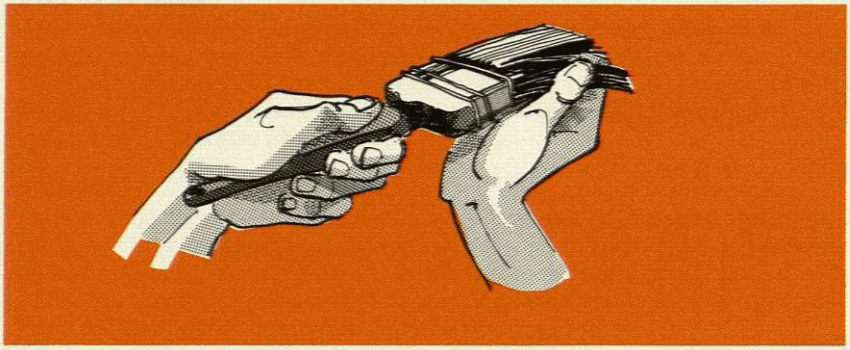
**Condensation**

When a paint surface remains moist for long periods micro-organisms may grow on it. These should be eliminated by washing twice, at half-hour inter-

vals, with household hypochlorite bleach at a strength of at least one bottle of bleach to three bottles of water, and then rinsing with clean fresh water. However if the cause of the moist condition is not eliminated the micro-organisms will return. The use of fungicidal paints is not a permanent solution. The National Building Research Institute has a publication, in this series, on damp in buildings and to obtain a copy you should write to the Chief Director, NBRI, P O Box 395, Pretoria 0001. (Price on application).

# CLEANING BRUSHES AND ROLLERS

A lot of people seem to have an unreasonable aversion to cleaning paint brushes and often seem to leave them to go hard and then buy new ones. If you buy an expensive brush and learn the easy way to clean it you will find that it becomes an old friend and will go on giving service for years.



This is the way:

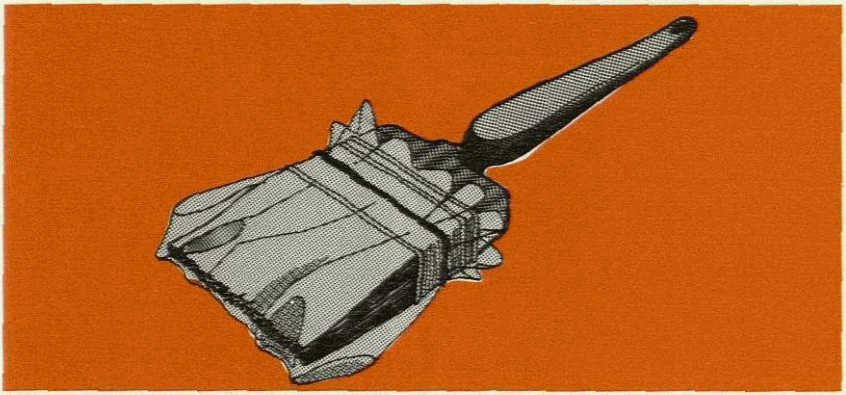
1. work the bristles in a little solvent and press and squeeze them between your fingers until the solvent has penetrated deep into the heel of the brush. If you do not have any plastic or rubber gloves you should work the bristles against the side of the solvent container;
2. pour a little liquid detergent into the bristles or work in a little hand cleaner and again press and squeeze the brush between your fingers;
3. rinse off under the tap;
4. rub the brush on a bar of soap till it works up a lather like a shaving brush and again work it between your fingers;

   You may see that the lather takes on the colour of the paint. If after rinsing and soaping again the colour is still strong work the bristles again in solvent and repeat from Stage 2;
5. Rinse the brush and allow it to dry before storing away for the next time.

You can use the same technique to clean rollers but because of their size you will need to find a container that will hold the roller with a minimum of solvent. An empty plastic container such as is used for household scouring powder will do perfectly if you cut off the top.

Once the roller is clean and the surplus water shaken off you should spin it hard with a brisk stroke of the hand. This will throw the water out of the fibres and make them all stand out. In this condition the roller will dry soft and ready to be used again.

There are a number of commercial brush cleaners on the market which may make the job a bit easier.



*Wrap the brush in plastic or aluminium cooking foil and secure it with a rubber band when prolonged storage is anticipated*

Many modern paint formulations cannot be thinned with water or mineral turpentine, and require special thinners both for thinning and cleaning the brushes. The following list may help identify these paints.

| **Kind of paint** | **Thin with** | **Clean brush with** |
|---|---|---|
| distemper | water | water |
| emulsion | water | water |
| alkyd | mineral turpentine | mineral turpentine or paraffin |
| polyurethane | special thinners | special thinners |
| copal varnish | special thinners | special thinners |
| epoxy | special thinners | special thinners |
| nitrocellulose | lacquer thinners | lacquer thinners |
| sanding sealer | lacquer thinners | lacquer thinners |
| shellac | methylated spirits | methylated spirits |
| *cementitious* | *water* | *water* |

There are some proprietary products that can be used to soften brushes that have gone hard with alkyd paint. Brushes that are hard with laquers and sanding sealers can be revived by soaking them in thinners. Once paints such as epoxy resins and polyurethanes have hardened there is nothing that will soften them and stiff brushes and rollers can be thrown away.


There are two possible places where failures can originate - at the junction between the paint and whatever has been painted, and in the paint itself.

To illustrate these, imagine painting a very porous surface. No sooner is the paint in place than the solvent or water in an emulsion paint are drawn away - as by a piece of blotting paper - leaving on the surface a layer of poorly bonded material which turns to powder and comes away when rubbed. There was nothing wrong with the paint - it just needed to be used correctly.

Again, consider a newly cement-rendered wall painted with normal alkyd paint. The cement will be full of lime which dissolves in the moisture present to form an alkaline solution. As explained earlier, the alkali reacts with the paint to make soap which destroys the bond between the paint and the wall. Once again, the paint was not to blame but only the fact that it was used incorrectly.

Most cases of peeling paint, where it appears to have failed at the junction between the paint and the surface being painted, are caused by a failure to adhere properly from the beginning.

There are many reasons why the paint itself might fail - it may have been thinned too much; it may have had kerosene or some other adulterant added; or it may have been affected by frost or micro-organisms.

Staining may be due to dyes or chemicals soaking through from below the paint film.

*Blistering*

*Alligatoring*

Here are some of the commoner paint failures you may come across and the reasons for them.

**Alligatoring**

This disfiguring cracking of the surface of a paint job is frequently caused by incompatibility between various coats of paint, too rapid surface drying, or too thick a coating.

**Blistering**

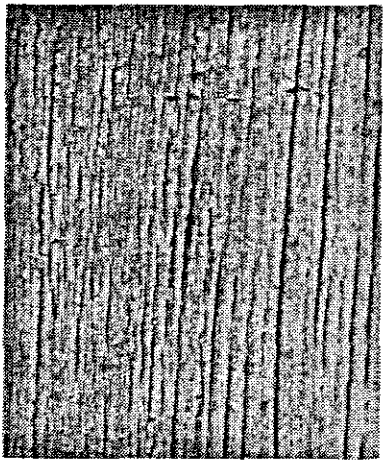
Sometimes in painting, moisture or grease becomes trapped below the coat of paint and when the surface is later subjected to heat, as from the sun, these substances may form blisters. (See sections on Preparing a surface for painting, page 21, and Painting, page 24).

**Chalking**

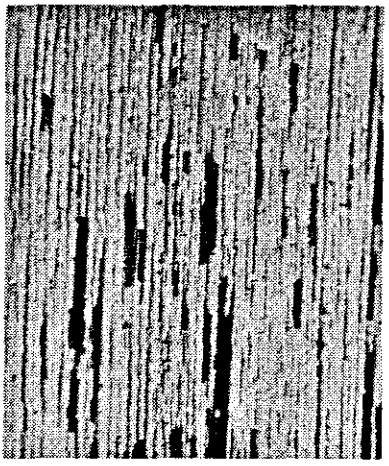
This is the result of natural elements destroying the binder so that the pigment comes away as a powder. All paints are degraded in this way and it is generally regarded as a fault only when it takes place too quickly. If an entire coat of paint deteriorates so that a previous layer or the base material shows through, the fault is known as erosion.

**Cracking**

This is normally the result of using a hard setting paint on top of a slightly flexible substrate. Wood is a good example and it is normal to choose a paint system which remains slightly flexible on drying in order to accommodate



*Cracking*



*Flaking*

movements caused by temperature, moisture and impact. If such a surface is later repainted with a hard-drying paint, enamel or varnish then slight movements will tend to make the new surface crack.

**Discolouration**

Unless you take precautions, paint applied over tar or bitumen will develop brown stains because the relatively volatile components of the tar or bitumen will permeate and migrate through the paint. (See Painting on bitumen, page 20). Certain dyes and organic pigments also tend to migrate into subsequently applied coatings.

Pigments and dyes used in some paint formulations are not colour-fast and are intended for interior use only. If these are used outside they fade in the sunlight. The alkali and moisture in newly plastered walls or new concrete can react with some paint pigments and cause colour changes.

**Failure to dry properly**

When this is associated with two-part paints, the cause is often incorrect mixing, or application when the temperature was below 10°C. If paint is applied over surfaces contaminated with wax, grease or oil, the paint may exhibit wrinkles or non-uniform gloss and may remain tacky almost indefinitely. Alkaline, cement-based surfaces can also cause some paints to remain soft.

**Flaking**

The cause is usually that the paint did not cling well to the surface. The more coats of paint that are piled on top of one another, the greater the risk of flaking. (See sections on Preparing a Gloss Surface, page 23, and Painting on metal, page 11).

*Chalking*

Obviously the bond between the surface and the paint can be no stronger than the surface itself. If this is crumbling or powdery then painting over the top of it will change nothing: crumbling will continue, only this time it will bring the new paint away too. The most important part of a paint job is preparing the surface before painting and you will find much of what you ought to know on pages 21 to 23 of this guide.

# SOME FINAL THOUGHTS ON PAINTING

We have come to expect that bricks and mortar and wood and steel last a very long time.

A paint film, on the other hand, is an organic material (that is, a carbon compound), and is usually thinner than a page of newsprint. Just because we paint it on to, say, a brick does not mean that we endow it with the same permanence as the brick.

People sometimes get quite cross when their swimming pools crack and almost seem to imply that the pool paint is letting them down by not holding the pool together! If we see a coat of paint for what it is, and relate its cost to that of the building, we will be much happier with the results we get.

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