

PAINTS AND  
COATINGS  
SKILL COUNCIL



# Participant Handbook

Sector  
**Paints and Coatings**

Sub-Sector  
**Application**

Occupation  
**Decorative Application**

Reference ID: **PCS/Q5006, Version 2.0**  
**NSQF Level 3**



**Assistant Decorative  
Painter**

#### Published by

**PAINTS AND  
COATINGS  
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Prime Minister of India

“ Skilling is building a better India.  
If we have to move India towards  
development then Skill Development  
should be our mission. ”

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We would also like to acknowledge here the long hours spent by our colleagues in editing and improving the drafts to make the final work more reader friendly and compact.

**Paints and Coatings Skill Council**

## About this book

This Participant Handbook is designed to train participants for the job 'Assistant Decorative Painter', a NSQF approved level 3 qualification covered by QP reference no. PCS/Q5006.

The job involves supporting the painter in preparation and application of paints and related materials on various substrates like interior and exterior walls of buildings, metal/ wood frames of doors and windows, metal/ wooden furniture.

This QP consists of 6 NOS, each dealt under a separate unit as follows

1. PCS/N5016 Support preparation and application of paint to masonry surface.
2. PCS /N5017 Support preparation and application paint to metal surface.
3. PCS/N5018 Assist in preparation and painting of paint, varnish and polish on wooden surfaces.
4. PCS/N9901 Coordinate with colleagues and/or Customers.
5. PCS/N9902 Maintain standards of product/service quality.
6. PCS/N9903 Maintain Occupational, Health and Safety standards and follow environmental norms.

## Symbols Used



Key Learning Outcomes

The key learning outcomes are listed at the beginning of each module. These outline the focus areas that the learners will cover in every module.



Tips

Wherever possible, tips are included in every module. They provide additional insight to learners on a particular topic being discussed.



Steps

These provide step-by-step instructions for a specific process.



Notes

Notes at the end of each module is a space for learners to list down their key points related to the topic.



Summarize

These provide the summary or the takeaways of the unit.



Unit Objectives

These are listed at the beginning of each unit under every module. They highlight the focus areas that the learners will cover in every unit.

# Table of Content

S.No	Modules and Units	Page No
<b>1</b>	<b>Introduction</b>	<b>1</b>
	Unit 1.1 - About Paints and Coatings Sector in India	3
	Unit 1.2 - Classification of Paints and the Coatings Industry	5
	Unit 1.3 - Basics of Paint Chemistry and Paint Manufacture	6
	Unit 1.4 - Colour	10
	Unit 1.5 - Colour Standards	14
	Unit 1.6 - Types of Finish	15
	Unit 1.7 - Gloss Measurement	17
	Unit 1.8 - What are Decorative Paints?	18
	Unit 1.9 - Job Role of an Assistant Decorative Painter	21
<b>2</b>	<b>Support Preparation and Application of Paint to Masonry Surface, Metal Surface and Wooden Surface (Applicable NOS – PCS/N5016, PCS/N5017, PCS/N5018)</b>	<b>23</b>
	Unit 2.1 - Assist Supervisor/Painter in Measuring the Painting Area and Estimating the Material Requirement	25
	Unit 2.2 - Cleaning and Sanding the Surface	27
	Unit 2.3 - Types of Primers	37
	Unit 2.4 - Application of Paint	41
<b>3</b>	<b>Coordinate with Colleagues and Customers (Applicable NOS – PCS/N9901)</b>	<b>49</b>
	Unit 3.1 - Interacting with Superior	51
	Unit 3.2 - Communicating with Colleagues	52
	Unit 3.3 - Communicating Effectively with Customers	53
<b>4</b>	<b>Maintain Standards of Product / Service Quality (Applicable NOS – PCS/N9902)</b>	<b>57</b>
	Unit 4.1 - Meeting and Exceeding Customer Expectations	59
	Unit 4.2 - Coating Defects, Tests and Standards	61
	Unit 4.3 - Your Responsibility as an Assistant Decorative Painter	77
	Unit 4.4 - Prevention of Injuries	78



<b>5</b>	<b>Maintain OH&amp;S Standards and Follow Environmental Norms (Applicable NOS – PCS/N9903)</b>	<b>81</b>
	Unit 5.1 - Responsibility Regarding Safety	83
	Unit 5.2 - Waste Disposal	87
	Unit 5.3 - Use Safety Tools and Personal Protective Equipment (PPE)	88
	Unit 5.4 - Handling of Coating Materials and Equipment as per Safety and Environmental Standards	92
	Unit 5.5 - Precautionary Measures	93



## PAINTS AND COATINGS SKILL COUNCIL



# 1. Introduction

- Unit 1.1 - About Paints and Coatings Sector in India
- Unit 1.2 - Classification of Paints and the Coatings Industry
- Unit 1.3 - Basics of Paint Chemistry and Paint Manufacture
- Unit 1.4 - Colour
- Unit 1.5 - Colour Standards
- Unit 1.6 - Types of Finish
- Unit 1.7 - Gloss Measurement
- Unit 1.8 - What are Decorative Paints?
- Unit 1.9 - Job Role of an Assistant Decorative Painter

Scan the QR code for video





## Key Learning Outcomes

At the end of this module, you will be able to:

1. Discuss the paints and coatings sector in India, and its sub-sectors
2. What is paint and how it is made?
3. Name different types of paints and their characteristics.
4. Mix and prepare the paint by mixing the base, hardner (if recommended) and thinner as recommended by the manufacturer.
5. Assist in estimating the time, material and equipment required.
6. Importance of colours and standards for colour.
7. Gain in-depth knowledge about finish and types of finish
8. Describe the role and responsibilities as an Assistant Decorative Painter.
9. Demonstrate how to apply the paint on the prepared surface, using either brush/roller or spray.

## UNIT 1.1 About Paints and Coatings Sector in India

### Unit Objectives



At the end of this unit, you will be able to:

1. Explain what paints and coatings are
2. Describe the purpose behind the use of paints

### 1.1 About Paints and Coatings Sector in India

Paints are present all around us. Wherever we look we see paint in some form – on walls, doors, floors, furniture, fans, cell phones, gas cylinders, cars, computers and laptops, motorcycles and scooters, trains and buses, shop signage and road signs, bridges, electric poles, pipelines—the list goes on. As you see, there are very few articles or items that we see or use in our daily lives that do not carry some coating or the other. You will be surprised to know that even metal cans that are used to pack food and beverages, glass bottles carrying soft drinks and other products, metal tips of shoe laces, door knobs and handles, airport runways and factory rooftops, aeroplanes and ships – all have coatings applied on them for protection, indication or decoration. The paint industry adds so much colour and convenience to our everyday lives that it would be difficult to imagine a world without it! As you look around and see the universal presence of coatings everywhere, you would also realise that the paint and coatings field is quite complex.

What is the purpose behind the use of paints? Decoration is certainly one important reason why paints are used. They lend colour and beauty to objects on which they are applied and greatly increase their visual appeal. An equally important reason for the use of paints is protection. The life of products, especially those made of metal or wood is enhanced if an appropriate coating is applied on them. The universal use of iron and steel on various industrial and household products would be unthinkable in the absence of coatings to protect them. Likewise, Wooden furniture and articles are known to last centuries if they are protected by regular application of coatings on them. Our ancestors understood this, which explains why varnishes and lacquers are as old as civilisation itself.

Coatings are also used for “indication”. All of us are aware that red is a colour used to indicate danger or fire and hence fire tenders, stop signs and caution/danger signals are invariably painted red. Ambulances and hospital furniture are always painted white while school buses are yellow. You will find that paints help to identify and make life convenient for us. White road marking, red post boxes, green park fencing, black and yellow taxis and auto rickshaws – one can think of many such examples.

Paints also help to improve cleanliness and hygiene. Coatings with antifungal properties help to keep walls in homes and buildings free from fungus especially in damp weather. Coatings used in food cans prevent the contents from spoiling and serve as a protective barrier. Coatings can even help retard fire or enhance the protection against fire. Thus, there are many uses for paints and coatings in our everyday life.

While the common person sees it as being colourful with a great deal of variety, to the technical people formulating and making paint and to those who apply it on surfaces, it is a complex world—of different chemistries and technologies, of a range of demanding and often conflicting requirements of many application challenges and steadily increasing customer expectations.



Exterior Wall



Bus



Commercial Vehicle



Road Marking



Wood Polishing



Motorcycle



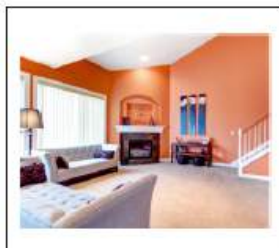
Runway



Aeroplane



Bicycle



Interior Wall



Car



Household Appliances

Fig 1.1: Paints are used everywhere

## Notes



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## UNIT 1.2 Classification of Paints and the Coatings Industry

### Unit Objectives



At the end of this unit, you will be able to:

1. List different types of paints

Broadly, paints are of two types, viz. decorative and industrial.

Decorative paints consist mainly of products that go on interiors and exteriors of buildings as well as on furniture items to make them look aesthetically pleasing. Industrial paints include a wide variety and are further classified under various subgroups, such as Automotive OE, Automotive Refinish, Powder Coatings, General Industrial, Coil Coatings, Protective and Marine Coatings, Packaging Coatings etc.

Decorative	Industrial
Building Exteriors	Automotive OE Finish
Building Interiors	Automotive Refinish
Furniture	Powder Coatings
	General Industrial Paints
	Coil Coatings
	Protective Coatings
	Marine Coatings
	Packaging Coatings

### Notes




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## UNIT 1.3 Basics of Paint Chemistry and Paint Manufacture

### Unit Objectives



At the end of this unit, you will be able to:

1. Talk about the components of paint and their types
2. Explain characteristics of resins/binders used for paints.
3. Explain different paint systems and their features or characteristics

### 1.3.1 Components of Paints and Coatings

The success of any coating depends on its nature, chemical composition, the physical condition of the substrate and application techniques. The compositions vary considerably depending on the end applications, economics and the durability expectations of the coated components. A typical paint product is a homogenous mixture of pigments, extenders, resins or binders, additives and solvents.

**Pigments:** Pigments are powder material insoluble in resin, water, or solvents and impart colour and opacity (hiding power) to the paint. They may be organic or inorganic. Combinations of different coloured pigments give a variety of other colours. In metallic colours, aluminium / other metal pigments and effect pigments (pearl mica) are used to impart sparkling / metallic effect.



Fig 1.3.1 (i): Colour pigments



Fig 1.3.1 (ii): White pigment

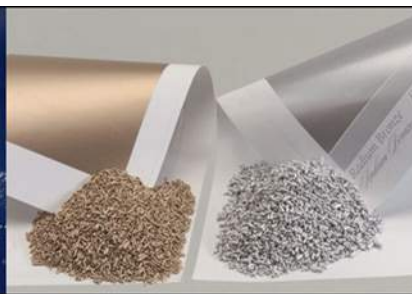


Fig 1.3.1 (iii): Metallic pigments



Fig 1.3.1 (iv): Extender

**Extenders:** Extenders are economical minerals added to increase the pigment content of the paint and contain the cost. They give filling properties, increase bulk volume and add certain desired properties to the paint. Calcium carbonate is a typical extender.

**Resins or Binders:** Resins are prepared by a chemical process called polymerisation. The resin helps to bind the pigment particles together and hence it is also called a binder. It is a major ingredient of any paint and is responsible for the film formation in a paint. The paint performance depends mainly



on the type and quality of resin. Different resins are used in paints depending on the end use. Resins may be solvent based or water based.



Fig 1.3.1 (v): Resins used in coatings

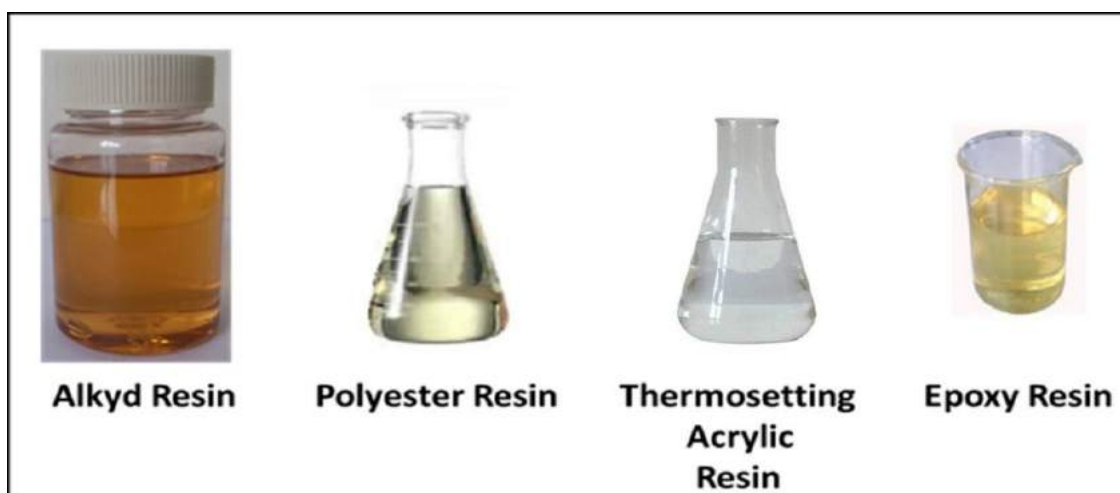


Fig 1.3.1 (vi): Types of resins

**Additives:** Additives are used in small quantities for enhancing certain desired properties like pigment wetting and dispersion, ease of application, flow and levelling, drying, curing, UV resistance, colour stability etc. In general, additives upgrade the performance properties of paint. Examples – anti-settling agent, anti-skinning agent, anti-sag agent, flow modifier, adhesion promoter, de-foamer, wetting agent, driers, matting agents etc.



Fig 1.3.1 (vii): Additives in liquid and powder form

**Solvents:** These are liquids used to reduce the viscosity of paint so that it can be easily applied on the surface. Solvents can be classified as aliphatic (mineral turpentine), aromatic (xylene, toluene), alcohols, ketones and esters. For water-based products, water is the solvent.

A solvent may be a true solvent, co-solvent or a diluent. Different solvents have different ability to dissolve resin. A solvent that dissolves a resin is the true solvent for that resin. Co-solvent dissolves the resin in the presence of the true solvent. A diluent is used only to reduce the viscosity. There are fast evaporating, medium evaporating and slow evaporating solvents. Generally, a combination of different solvents is used to achieve the desired film performance.

Powder coating, which is paint in a dry powder form, does not require any solvent during manufacture or application. As we shall see in the next sections, the manufacturing process for powder coating differs from that of liquid paints. The equipment used for powder manufacture are also different.

### 1.3.2 Characteristics of Different Resins

As we have already seen, resin is a major ingredient in paint and is responsible for making the paint into a film. There are different types of resins that can be used to make paint. It is important to understand the characteristics of each resin type as they determine the properties of the final paint.

TYPE OF RESIN	CHARACTERISTICS
ALKYDS	Alkyds are economical resins, mainly used in architectural paints. Enamel or oil paint is based on this resin. Technically, an alkyd is an oil modified polyester. By adding driers (special additive) these paints are made air-drying type. Paint film formation takes place at room temperature.
POLYESTERS	These resins are superior to alkyd resins in performance. They are mainly used in automotive/general industrial paints and powder coatings.
ACRYLICS	These resins have good durability against ultraviolet rays. They are mainly used in automotive clear coats, base coats and mono coats.
EPOXIES	Epoxies have good corrosion resistance, chemical resistance and water resistance properties. They are used mainly in protective coatings. These paints are supplied as base and hardener packed in separate containers. Such paints are called two pack (2K) paints.
AMINO	These are melamine formaldehyde (MF) or urea formaldehyde (UF) resins used for curing and achieving hardness of the paint film. These resins crosslink with alkyd, polyester, epoxy resins and give excellent toughness. This reaction starts at high temperature (above 120° C). Hence, such paints are supplied as one pack (1K) paint. MF resin is widely used in automotive paints.
ISOCYANATE	This hardener reacts with alkyd, polyesters and acrylic resins to form Polyurethane coatings. The crosslinking reaction between the -OH of the resins and -NCO of the isocyanate hardener starts at room temperature, once the two are mixed. Hence these paints are supplied as 2K (base and hardener) packed in separate containers.

### 1.3.3 Comparison of Paint Systems

We have already seen that there are many different types of resins that can be used in the manufacture of paints. Paint technologists refer to these as different paint chemistries. Thus, a paint chemistry is defined by the binders or resins that are used to make it.

Paints from different chemistries vary in properties such as curing time and temperature, appearance, mechanical properties, durability, chemical resistance, cost etc. Thus, depending on the end use requirements of the painted product / surface, the right chemistry is chosen.

Paints are classified based on the type of resin used such as alkyd-based paints, polyester paints, acrylic paints, epoxy paints, alkyd-amino paints, polyurethane paints etc. Further, paints are classified by:

- The physical state - liquid paint, stiff paint, powder coating
- Mode of thinning: water thinnable / solvent thinnable
- End use: architectural, industrial, protective coatings, automotive coatings etc.
- Mode of drying: air drying, forced drying, baking / stoving, UV cured
- Order of application: Undercoats (primer, primer surfacer) and top coats

In the case of powder coatings, the types of powders based on resin chemistry include epoxy, epoxy-polyester, pure polyester, polyurethane and acrylic powders.

### Notes



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## UNIT 1.4 Colour

### Unit Objectives



At the end of this unit, you will be able to:

1. Explain the concept of colour
2. Talk about different categories of colour
3. Discuss how we perceive colour

### 1.4.1 Colour Concepts

When we speak of paints, the first thought that comes to our mind is that of colour. We always associate paints with colour. We see the colour of an object when light falls on it and gets reflected. In darkness, we see no colour. Similarly, under different light sources such as sunlight, fluorescent light or sodium vapour street lights the same object will appear different in colour. So the colour that we perceive depends on the light source. When we speak of colour, we normally refer to what is seen in day light. The colour of an object that we perceive changes with the light source.

Colours can be classified as follows:

#### Primary colours

- Red, yellow and blue are called primary colours.
- They cannot be obtained by mixing together other colours.

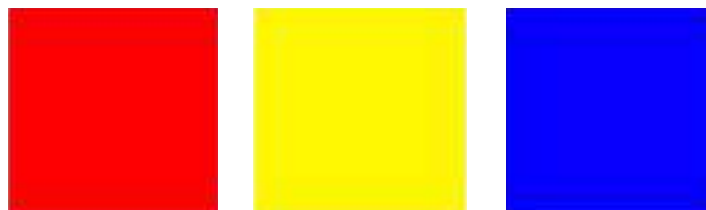


Fig 1.4.1 (i): Primary colours

#### Secondary colours

- Orange, green and violet are called secondary colours.
- They are obtained by mixing in equal amounts two adjoining primaries.



Fig 1.4.1 (ii): Secondary colours

## Mixing of colours

- Yellow + Blue = Green
- Red + Yellow = Orange
- Blue + Red = Violet

### Mixing Colours

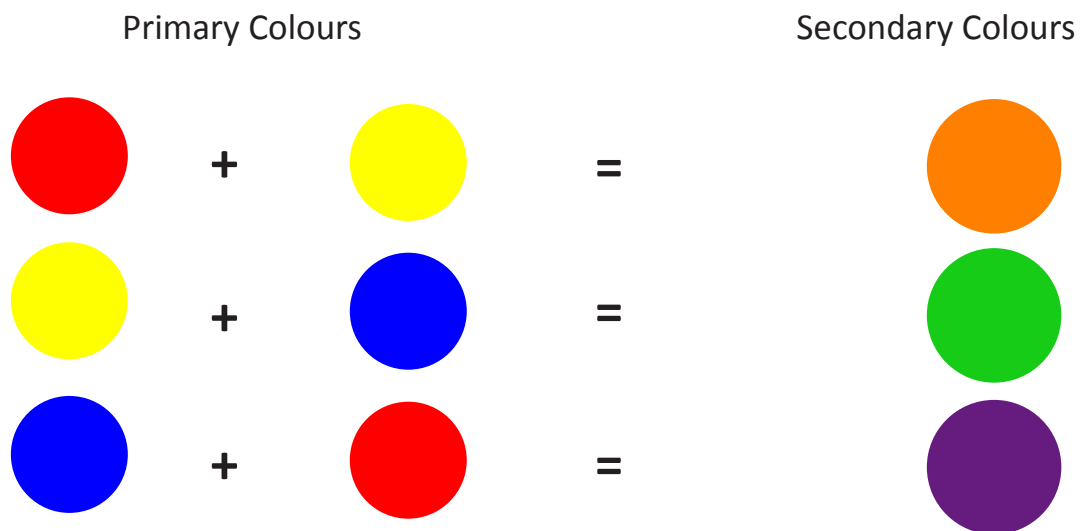


Fig 1.4.1 (iii): Mixing of colours

## Intermediary colours

When the primaries are not mixed in equal amounts, intermediary colours are formed, such as yellow-green (chartreuse), green-yellow (apple green), etc.

- Yellow-Green
- Blue-Green
- Blue-Violet
- Red-Violet
- Red-Orange
- Yellow-Orange

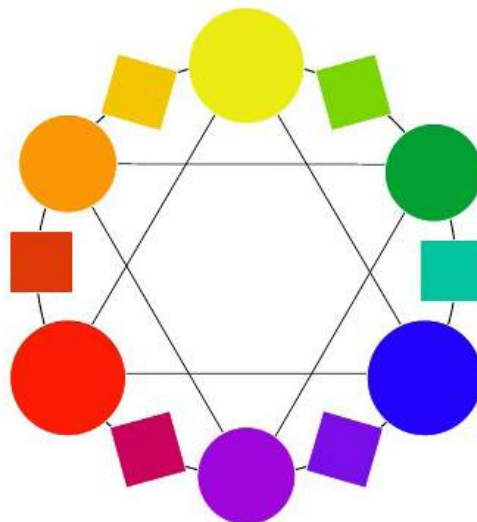


Fig 1.4.1 (iv): Intermediary colours (pinsdaddy.com)

**Tertiary Colours:** Tertiary colours are obtained by mixing two secondary colours, such as orange with green (olive), green with violet (slate) or violet with orange (russet).





Fig 1.4.1 (v): Tertiary colours ([firstascentdesign.com](http://firstascentdesign.com))

**Complimentary Colours:** Colours that appear opposite each other on the colour wheel are called complimentary colours. Complimentary colours include: red and green, yellow and blue etc. A complimentary colour is often used to reduce the chroma (brightness or intensity) of its opposite. When two complimentary colours are mixed in equal parts, although theoretically they should produce black, they produce neutral a greyish dark brown.

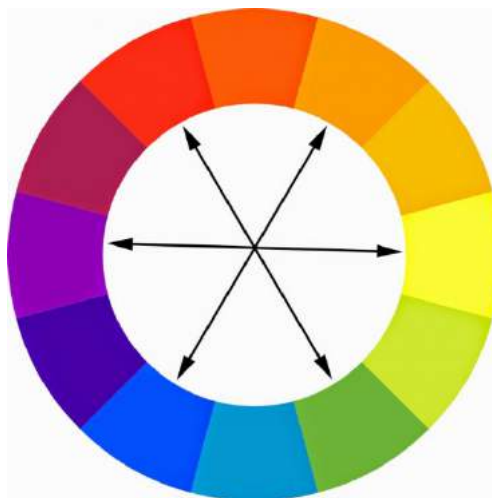


Fig 1.4.1 (vi): Complimentary colours ([copicmarkertutorials.com](http://copicmarkertutorials.com))

	Warm Colours	Cool Colours
HUES	Reds Yellows Oranges Red violets	Blues Blue-greens Blue-violets
NATURE	Vivid, bold	Calming, soothing
USUALLY DEPICT	Sun, fire, heat, warnings	Water/water bodies, cold environs, freshness



Fig 1.4.1 (vii): Warm and cool colours (webflow.com)

## Notes



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## UNIT 1.5 Colour Standards

### Unit Objectives



At the end of this unit, you will be able to:

1. Explain what are colour standards and why they are useful



Fig 1.5: RAL shade card

RAL is used for information defining standard colours for paint and coatings. It is the most popular central European Colour Standard used today. The colours are used in architecture, industry and road safety. The human eye distinguishes about ten million colour shades. How can we tell exactly which colour we mean? With the use of RAL colour charts!

Since 1927, RAL has created a uniform language when it comes to colour. It has standardised, numbered and named the abundance of colours. These standards are easily understandable and applicable - worldwide. Some example colours from the RAL colour chart are mentioned below. The first digit relates to the shade of the colour:

1xxx Yellow RAL 1000	Green Beige - RAL 1034 Pastel Yellow (27)
2xxx Orange RAL 2000	Yellow Orange - RAL 2012 Salmon Orange (12)
3xxx Red RAL 3000	Flame Red - RAL 3031 Orient Red (22)
4xxx Violet RAL 4001	Red Lilac - RAL 4010 Telemagenta (10)
5xxx Blue RAL 5000	Violet Blue - RAL 5024 Pastel Blue (23)
6xxx Green RAL 6000	Patina Green - RAL 6034 Pastel Turquoise (32)
7xxx Grey RAL 7000	Squirrel Grey - RAL 7047 Telegrey 4 (37)
8xxx Brown RAL 8000	Green Brown - RAL 8028 Terra Brown (19)
9xxx White/Black RAL 9001	Cream - RAL 9018 Papyrus White (12)

## UNIT 1.6 Types of Finish

### Unit Objectives

At the end of this unit, you will be able to:

1. Explain finish
2. List different types of finishes commonly used

Besides colour there are two other aspects describing the appearance of a finish that you will come across – ‘Gloss’ and ‘Type of finish’. Gloss refers to the shine in the paint film. A high gloss surface appears mirror like whereas a matt finish is dull or flat. The gloss level is expressed as percentage of the light that is reflected from a surface in a mirror like fashion. Since the extent of reflection also depends on the angle at which the surface is held, gloss level is measured and expressed as a value at a specific angle.

FINISH	GLOSS LEVEL
Dead Matt	0-15%
Matt	15-30%
Egg Shell Matt	30-45%
Satin	45-60%
Semi Glossy	60-75%
Glossy	75-90%
High Gloss	90% +

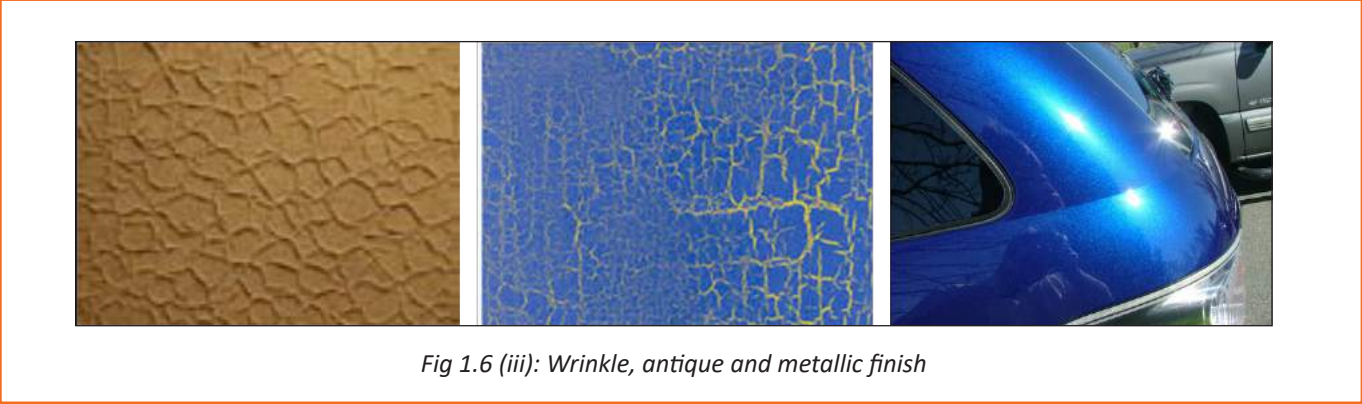
Type of finish refers to the texture or the visual feel of the finish. Examples of common types of finish are illustrated below.



Fig 1.6 (i): Gloss, semi-gloss and matt finish



Fig 1.6 (ii): Hammer tone finish, structure finish and coarse texture



*Fig 1.6 (iii): Wrinkle, antique and metallic finish*

## Notes

[illegible]



## UNIT 1.7 Gloss Measurement

### Unit Objectives



At the end of this unit, you will be able to:

1. Explain gloss and its measurement
2. Describe how gloss value is expressed

- Gloss is measured by a gloss meter at different angles
- Gloss reading depends on the angle at which it is measured. So, gloss is always expressed as a percentage at an angle (e.g.: 60% at 20°)
- An angle of 60° is most common in the coating industry. Usually recommended for medium gloss levels
- An angle of 20° is used to achieve a more differentiated result of high gloss surfaces usually recommended for Automotive class “A” finish using liquid coatings
- An angle of 85° is used to achieve a more differentiated result of low gloss surfaces, not so popular in coating industry

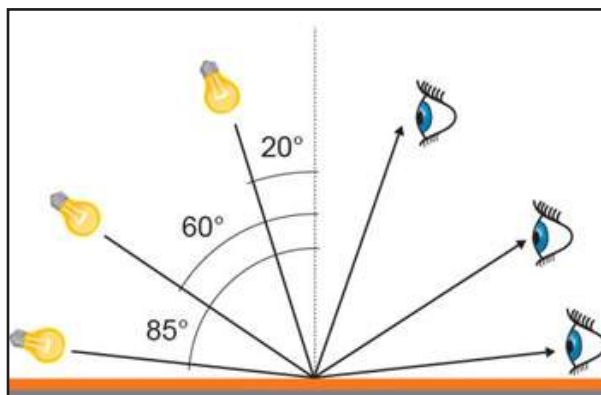


Fig 1.7: Reading gloss at different angles



Fig. 1.7.1: Digital Gloss meter

## UNIT 1.8 What are Decorative Paints?

### Unit Objectives



At the end of this unit, you will be able to:

1. Describe what are decorative paints
2. Discuss different forms of decorative paints
3. Explain the differences between types of decorative paints

Decorative Paints comprises interior wall paint, exterior wall paint, wood finishes, enamels and ancillary products such as primers, putty, etc. In the decorative paints segment, a good part of the demand comes from household painting. One salient feature of this segment is that the demand peaks during festive seasons. Decorative paints account for 75% of the Indian paint market. Application plays a very important part in the quality, appearance and performance of paints. Given that 75% of the paint demand is in the decorative segment and this segment is projected to grow in the years ahead, the opportunities for decorative painters is large and growing. Apart from general painters who do painting of masonry, metal and wooden surfaces, there are specialists in wood finishes who polish and spray paint wooden surfaces, specialists who do textured finishes and so on. There is a great demand for skilled, professional painters and it is growing.

Several established paint companies are now offering painting services to their customers and therefore, opportunities in established companies for painters is growing fast. This will mean professional growth from painters to supervisors and managers of projects.



Fig 1.8: A well painted wall ([associatedpaints.com](http://associatedpaints.com))

### Notes



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### 1.8.1 Forms of Decorative Paints

LIQUID PAINTS	PASTE	POWDER
<ul style="list-style-type: none"> <li>Liquid paints, most common form of paints, may be either solvent thinnable or water thinnable.</li> <li>Examples of solvent thinnable paints are Enamels, Solvent based primers and Varnishes.</li> <li>Examples of water thinnable paints are interior and exterior emulsions and water-based primers.</li> </ul>	<ul style="list-style-type: none"> <li>Some economy paints are supplied in a thick paste like consistency.</li> <li>Example is Distempers. These are diluted to the required consistency prior to painting.</li> <li>Putty is also in paste form and is used to fill cracks or dents in the surface.</li> </ul>	<ul style="list-style-type: none"> <li>In decorative paints, Cement Paints are supplied in powder form.</li> <li>This is mixed with water and converted to a liquid paint and then applied on the surface.</li> </ul>



Fig 1.8.1: Liquid paints and powder paints ([durgambasuppliers.net](http://durgambasuppliers.net), [bakerross.co.uk](http://bakerross.co.uk))

### 1.8.2 Types of Decorative Paints

WATER THINNABLE PAINTS	SOLVENT THINNABLE PAINTS
Emulsions	Enamels
Distempers	Varnishes
Cement paints (These are generally supplied in powder form and mixed with water for application)	

- Emulsions** are water-based paints and can be used for interior or exterior application. Exterior emulsions are specially fortified for protection against UV rays and to withstand direct rainfall on the surface. This is achieved by adding certain additives to the emulsion paints. In interior emulsions there are several types available: (a) matt finish (b) silk (c) lustre or pearlescent finish. The difference in these different types of emulsions is varying levels of gloss and in the case of pearlescent finish additives to give a metallic feel. All this is achieved by adding special additives.

2. **Enamels** are solvent based paints and normally applied on metallic or wooden surfaces. Enamels are also available in varying levels of gloss (glossy, semi glossy, matt) but the most popular one is gloss finish.
3. **Distempers** are supplied in high viscosity – almost in paste form. Distempers are ideally suited for interiors. Distemper paints need to be thinned with water for achieving application viscosity.
4. **Varnishes** are enamel paints without pigments and are clear coatings. Like enamels they are widely used on metal and wooden surfaces.
5. **Cement paints** are normally sold in powder form. These are economically priced exterior paints. Like distemper, cement paints need to be thinned with water for application.

## NOTES

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## UNIT 1.9 Job Role of an Assistant Decorative Painter

### Unit Objectives



At the end of this unit, you will be able to:

1. Clearly state different aspects of an assistant decorative painter's job

An Assistant Decorative painter is a person who supports the painter in surface preparation and application of paints on masonry, wood and metal surfaces. Performance of paints depends on three factors: the quality of the paint in the can; the surface preparation and the paint application. Any shortfall in any one of three will result in a less than good paint performance and hence an unhappy customer. The assistant decorative painter's main role is to effectively assist the painter to manage these three factors to deliver a satisfactory paint performance. For a household customer the key concerns are quality, cost and time. So, a good assistant decorative painter will assist the decorative painter in not only delivering a quality paint job but also within the cost estimate provided to the customer. The Assistant Decorative Painter also needs to understand the time frames to complete the job and assist the painter to complete the whole job as estimated. Completing the job within the agreed time frame enhances the overall experience of the customer is good and favourable for getting future business.

Due to rapid economic growth in India, income levels of people are rising. This is leading to higher spending on home maintenance and decoration. A number of new buildings are also being constructed to meet the needs of employed persons with good income levels. These factors are contributing to a rapid rise in decorative painting jobs. Therefore, the future for a person skilled in this field is very good.



Fig 1.9: Special effects on interior walls ([classic.mouldings.com](http://classic.mouldings.com), [diynetwork.com](http://diynetwork.com), [archiexpo.com](http://archiexpo.com))

## Tips



Decorative Paints account for 75% of the paint market in India. With the growth in demand for new homes under Pradhan Mantri Awas Yojna of the Central Government and growth in re-painting of existing houses, the demand for assistant decorative painters and decorative painters is increasing. The paint industry is predicted to grow at about 12% p.a. thereby increasing the demand for skilled painters.

## Notes



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Scan the QR code for video



**PAINTS AND  
COATINGS  
SKILL COUNCIL**



## 2. Support Preparation and Application of Paint to Masonry Surface, Metal Surface and Wooden Surface

Unit 2.1 - Assist Supervisor/ Painter in Measuring the Painting Area and  
Estimating the Material Requirement

Unit 2.2 - Cleaning and Sanding the Surface

Unit 2.3 - Types of Primers

Unit 2.4 - Application of Paint

Scan the QR code for video



Applicable NOS – PCS/N5016,  
PCS/N5017, PCS/N5018

## Key Learning Outcomes

At the end of this module, you will be able to:

1. List the measurements to be carried out to calculate the area to be painted.
2. Explain the different cleaning and surface preparation steps for interior and exterior masonry surfaces, metal surfaces and wooden surfaces.
3. Identify the different types of primers and topcoats. Define the criteria for selection of the primer and topcoat for a given substrate.
4. Describe the method of application for the selected primer/ topcoat and substrate.
5. List the criteria for selection of an application tool
6. Identify the different application tools, it's maintenance, cleaning and storage.



## UNIT 2.1 Assist Supervisor/Painter in Measuring the Painting Area and Estimating the Material Requirement

### Unit Objectives

At the end of this unit, you will be able to:

1. Explain how to measure the painting area.



Fig 2.1 (i): (saharanpurweb.in)

A careful estimation of time and manpower required to complete the job. It is based on the following:

1. The total area to be painted:
  - Interior walls
  - Ceiling
  - Doors
  - Windows
  - Exterior walls
  - Any other surface to be painted
2. The quality and condition of the surface
3. The painting system being applied – complete system or over coating
4. The number of painters/assistant painters/helpers required to meet the customer's timelines
5. Customer's preferred painting sequence

To estimate the material required, the area to be painted needs to be measured/ estimated.

For estimating masonry paint requirement, the following thumb rule may be used:

$$\text{Total wall area} = (\text{length} + \text{breadth} \times 2) \times \text{Height} - \text{total area of windows and doors}$$

**Example:**

Let us take a room of 12ft × 15ft and height from floor to ceiling is 8ft. The room has two windows 4ft × 3ft each and a door 6ft × 3ft.

$$\text{Wall painting} = (12\text{ft} + 15\text{ft}) \times 2 = 54\text{ft.}$$

$$54 \times 8 \text{ (Height)} = 432 \text{ ft.}$$

$$\text{Less door and windows} : 432 - 42 = 390 \text{ sq. ft.}$$

$$\text{Ceiling area to be painted} = 12 \times 15 = 180 \text{ sq. ft.}$$

$$\text{Windows} = 4 \times 3 = 12.$$

$$\text{Two windows} \quad 12 \times 2 = 24 \text{ ft.}$$

$$\text{Door} = 6 \times 3 = 18 \text{ ft.}$$

$$\text{Total doors and windows} = 42 \text{ sq. ft.}$$



Fig 2.1 (ii): clipart-library.com

The material requirement is worked out based on these surface area measurements.

For example: If the emulsion paint for walls covers 100 sq ft / litre per coat you will need approximately 8 litres for a two-coat job. Similarly, based on the covering capacity of the product, as given by the manufacturer in their product data sheets, the experience of the supervisor/ painter and the condition of the surface, an estimate of the total material requirement – putty, primer, brushes, rollers, putty blades, thinners for enamels, sand papers, emery paper, cleaning cloth, masking tape and so on, for all types of substrate to be painted, is arrived at.

### Practical Activity

To estimate the material required, the area to be painted needs to be measured practically/estimated. Measure the area of the wall using a measuring tape.

## UNIT 2.2 Cleaning and Sanding the Surface

### Applicable NOS – PCS/N5017

#### Unit Objectives



At the end of this unit, you will be able to:

1. Examine the condition of the surface and estimate the cleaning requirements.
2. Identify the appropriate cleaning method, available cleaning machines and its use.
3. Distinguish between different grades and quality of sand paper and its use.
4. Discuss the use of sanding machines and its advantages.
5. Explain the different methods of surface preparation based on the substrate
6. Carry out masking

Surfaces must be prepared before paint is applied. The objective of surface preparation is to ensure adhesion of the paint coats to the surface. Adhesion becomes an even more critical condition when paint is applied over metal substrates in corrosive area. Modern day paints require a clean and roughened surface to achieve long term durability. Inspection for surface cleanliness is a continuous process and should take place at least 3 times during the painting process.

- Before any surface preparation activity
- After surface preparation, before coating begins
- Between each application of coating in a multi-coat system

Surface preparation is the essential first stage treatment of a surface before the application of any paint. It is generally accepted as being the most important factor affecting the total success of a paint system. The performance of paint is significantly influenced by its ability to adhere properly to the surface. It includes assessment and inspection of surface condition, including surface defects and removing

- Dirt, dust and loose particles
- Fungus, mildew, algae growth
- Residues of oil, grease and soil
- Residues of (nonvisible) soluble salts, which can induce blistering, flaking and corrosion under the coating
- Rust on the surface, which interferes with the coating bonding
- Loose or broken mill scale resulting in early coating failure and tight mill scale resulting in later failure
- Anchor pattern (formed by surface preparation actions) – sharp ridges, burrs, edges, or cuts from Mechanical cleaning equipment, which prevent adequate thickness of coatings over the irregularities
- Surface condensation which, if painted over, may result in blistering and delamination failure
- Old paint that may have poor adhesion or may be too deteriorated for recoating

Adequate cleaning of masonry and concrete, mild steel, aluminium and wood surfaces is essential to achieve proper performance of the selected paint system. The nature and condition of the surface to be prepared and painted affects the degree of surface preparation required. A severe service environment - marine or chemical - normally requires a higher degree of cleanliness to ensure good performance of the paint system. A milder service environment—with less pollution—will allow better performance of the same paint system or the same performance when applied to a lesser degree of surface preparation.

There is a large variety of cleaning machines available in the market. From simple household vacuum cleaners to heavy duty steam cleaners to clean masonry surfaces.



*Fig 2.2 (i): Wall steam cleaning machine and pressure washing a brick wall*

For thorough and simple cleaning there are cleaning machines with scrubbers (thick brushes) mounted on a rotary wheel. These scrubbers thoroughly clean the wall and suck in the dust into a dust bag. Thus, the working space remains dust free and workers do not suffer the discomfort of dust inhalation. At the other end, there are high pressure water washers mainly used for exterior surfaces. These high-pressure washers have a motor, water pump, pressure hose and a trigger switch. These washers mostly operate with gas or compressed air as power source. Use of electric motors is not practical while cleaning exterior surfaces. The high-pressure water washers are hazardous equipment and need to be used with extreme care. They can cause serious injury if directed on a person and can damage the surface if the nozzle is closer than the specified distance.

Techniques available for surface preparation include:

- Sanding – for all substrates
- Solvent cleaning – mainly for metal substrates
- Hand tool cleaning – mainly for metal substrates
- Power tool cleaning – for metal and wooden substrates
- Flame cleaning – for metal and plastic substrates
- Acid pickling – for metal substrates

- Blast cleaning, using shot or grit – for metal and exterior masonry walls
- Water jetting, using water only – for masonry and metal substrates
- Wet abrasive blasting, using water with injected abrasives – for metal substrates
- Chemical pre-treatment – for metal substrates

**Sanding:** For sanding the most commonly used abrasive material is sand paper. Sanding can be done either manually or with electrically operated equipment.

DIFFERENT TYPES OF SAND PAPER	
Aluminium Oxide	Used mainly for wood and metals and is a hard-synthetic abrasive
Silicon Carbide	Used for masonry surfaces and between coats of paints
Emery	Natural abrasive with fine grains and used on metals
Garnet	Natural abrasive used for bare wood

Sandpaper is available as paper sheets, backed by cloth and disks. It is graded on the coarseness; the lower grade is coarse and as the number goes higher the coarseness reduces and the grains get finer. So, it is important to choose the right sanding paper to achieve best results in surface preparation.



Fig 2.2 (ii): Metal, wood and wall sanding

**Metal surface sanding:** Use emery paper (No.150) to thoroughly sand the surface. After thorough sanding of the surface use mineral turpentine to clean the surface of dust and loose particles. NOTE: Wait for the surface to completely dry.

**Wooden surface sanding:** While sanding wooden surfaces care must be taken to sand along the grains and not across. Wooden surfaces must be sanded in phases – changing the coarseness of the sand paper from coarse to medium. (60/80/100/120)

**Wall sanding:** Masonry surfaces and previously painted wall surfaces must be sanded using a coarse silicon carbide sandpaper (No.80) and finally must be sanded using a fine grade of sand paper like 180, 220 etc.

*Note: At regular intervals, dust the surface and fold the sand paper for a newer sanding side; replace the sandpaper when the grains have worn off.*

Traditionally sanding the surface, whether masonry, wood or metal, has been a tedious manual process. It is a time-consuming process and especially difficult in large expanse of surface. Technology has come up with a solution in the form of the electric or pneumatic sander which is efficient, fast and ensures uniformity.

Electric sanders have an important added benefit of dust extraction as part of the sanding system. Sanders are basically power tools with abrasives attached and are powered either by electricity or compressed air. There are several types of electric sanders to suit different surface requirements.



Fig 2.2 (iii): Wall sanding with electric sander (doityourself.com)

The key components of an electric sander are:

1. **Sanding disc:** Sanding discs are abrasives on a paper / cloth or other synthetic material and come in different sizes (diameters) and also in different sizes of grit (grains sizes). Sanding discs come with velcro to be fixed to the rotating wheel. The discs have holes in them to collect the dust produced by the sanding process.
2. **Electric motor:** The electric sander has a 1.2 KV electric motor to power the disc and the dust collector.
3. **Dust collector:** Like a vacuum cleaner, the electric sander sucks all the dust generated by the sanding through the holes in the disc into a dust bag.
4. **Handle:** Handles come in different shapes to suit customer preferences. The most common are the palm grip and long handle. Electric sanders also come with D handles.
5. **Trigger switch:** The trigger switch is to switch on or off the rotating disc. Some sanders also have speed control radials to change the speed of the sanding.

### 2.2.1 Types of Electric Sanders

There are several types of electric sanders to suit every requirement. However, the three most popular types are:

- Belt sander
- Orbital sander
- Random orbit sander





Fig 2.2.1 (i): Orbital sander, belt sander and random orbit sander

An orbital sander is a sanding device most commonly used for sanding wood. An orbital sander comprises a motor that powers a rotating wheel. Sanding discs are attached to the sanding wheel. The orbital sander can be used freely on wood without worrying about the grain direction. Some orbital sanders also come with a dust collector to collect the fine wooden dust.

A belt sander is most commonly used on wooden surface. Belt sander is very effective and suited for flat surface. A flat belt, in a continuous loop, runs on two roller drums. The belt is made of abrasive cloth material. While using a belt sander care must be taken not to apply too much pressure as this will choke the sander with the dust.

A random orbit sander is a superior version of the orbital sander. The discs rotate and also move in an elliptical fashion. This eliminates swirl marks.

Apart from these there are several other sanders for different surfaces and applications. For example, there are table top drum sanders, detail sanders, floor sanders, stroke sanders and so on.

Because of the high- speed action and rugged discs, loose particles and dust tend to fly fast and can cause injuries to the eyes. Therefore, protective gear especially protective eye wear is a must while machine sanding. Similarly, it is important to be familiar with the sanding machine operation especially how the abrasives are fixed to the wheel before using the sanding machine.

**Solvent Cleaning:** For simple oil or grease stains in walls, cleaning with vinegar or soap solution is sufficient. For stronger and stubborn stains, especially on metal surfaces, chemicals are available to clean the surface.



Fig 2.2.1 (ii): Solvent cleaning with a soft swab



Fig 2.2.1 (iii): Use of alkaline cleaners

**Chemical paint stripping:** Solvents such as kerosene, turpentine, naphtha, mineral spirits, xylol, etc., clean the metal by dissolving and diluting the oil and grease contamination on the surface. Inorganic materials such as chlorides, sulphates, weld flux, and mill scale are not removed by organic solvents. The last wash or rinse should be made using a clean solvent to remove the slight film of oil or grease that may be left on the surface. This film, if left in place, may interfere with the adhesion of the coating to the surface.



Fig 2.2.1 (iv): Hand cleaning

**Hand and power tool cleaning:** Hand tool cleaning is a method to prepare surfaces using non-powered hand tools. Hand tool cleaning removes all loose mill scale, rust, paint, and other detrimental foreign matter. Adherent mill scale, rust, and paint are not generally intended to be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.





Fig 2.2.1 (v): Tools used in hand cleaning

**Power tool cleaning:** Power tool cleaning is a method of surface preparation using power assisted mechanical cleaning tools. These tools are essentially like the tools used for hand tool cleaning, but a power source, such as electricity or compressed air, is used. Power tools are ideal when the area of the surface to be prepared is very large. Power tool cleaning is frequently used in maintenance operations to remove loose mill scale, rust, and paint. Modern power tooling has been developed not only to achieve a good standard of surface cleanliness and profile but also to provide near total containment of all dust and debris generated. New equipment is now available to use percussive reciprocating needles, rotary abrasive coated flaps and right-angle grinders, all within a vacuum shroud to enable on-site surface preparation to be environmentally acceptable.



Fig 2.2.1 (vi): Rotary Wire Brush

Fig 2.2.1 (vii): Rotary Grinder

Fig 2.2.1 (viii): Needle Gun

**Flame Cleaning:** This method uses an oxy/gas flame that is passed over the steel surface. The sudden heating causes rust scales to flake off as a result of differential expansion between the scales and the steel surface. All loose rust can then be removed by scraping and wire brushing followed by dust

removal. Flame cleaning is not an economical method and may damage coatings on the reverse side of the surface being treated. Also, the technique is not very effective in removing all rust from steel, so it is rarely used.

**Blast Cleaning:** Sandblasting of concrete surface is resorted when the texture of the wall needs change or thorough removal of the previous paint system is required on a large area. Sandblasting is usually done on exterior walls. Blast cleaning is more often used for protective coatings and industrial applications.



*Fig 2.2.1 (ix): Sand blasting interior wall (billtonnesen.com)*

Normally high-pressure washers are preferred to sand blasting for households because there is every possibility that sandblasting can damage some intricate part of the house. However, it can be used for exterior walls when the area to be prepared is large.

Care must be taken that while sand blasting, proper protective equipment is worn to protect the eyes and to protect from inhaling the dust. So, eyewear and masks are mandatory.

Some of the methods of blast cleaning are:

- Centrifugal blasting
- Sand-injected water blast
- Slurry blast
- Wet abrasive blast
- Dry abrasive blast
- Dry grit blast cleaning

### Practical Activity

Sanding – Sand the job using a sand paper.



Fig 2.2.1 (x): Manual abrasive blasting

The most generally established method of surface preparation for the application of coatings is by dry *grit blasting* as defined below. A highly-concentrated stream of small abrasive particles projected at a surface removing rust, mill scale, or other contaminants and creating a rough surface good for adhesion. The surface is abraded through the high-velocity impact of abrasive particles. In preparing surfaces for painting by blast cleaning, rust, mill scale, and old paint are removed along with some of the base surface.

**Chemical Pretreatment:** For previously unpainted metal surfaces, an alternative to mechanical surface preparation is chemical pretreatment. It prepares the surface and enhances the adhesion of the coating to the surface thus improving its resistance to corrosion. Pretreatment involves passing the job through multiple baths containing various chemicals for cleaning and treating the component. A phosphate coating is deposited on the metal to enhance corrosion protection and improve adhesion of the subsequent coating.

#### Other pretreatment methods

A three-in-one chemical combining degreasing and phosphating in a single chemical, is also being used. The performance in this case is not as good as a multi stage system. It is mainly used for repainting structures and components which cannot be pre-treated through a multi stage system.

**Masking:** It is done when only a specific area of the surface must be exposed to a process. Masking tapes, sheets are used to mask areas such as switch boards, metal work, borders, handles, etc. Old newspapers with masking tape attached at the edges is a cost-effective masking process for large areas. Parts of surfaces which are not to be coated are masked.

Masking is generally carried out for tubular components to prevent water/ chemical solution entering the component. The masking in this case is generally done using metal/ rubber/ plastic plugs.

#### Notes




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Fig 2.2.1 (xi): Masking with tape ([vancouver.sun.com](http://vancouver.sun.com) and [listinspired.com](http://listinspired.com))



Fig 2.2.1 (xii): Masking with sheets ([house-painting-info.com](http://house-painting-info.com) and [prettyhandygirl.com](http://prettyhandygirl.com))

**Primer Application:** For a good performance of the paint system, it is important to have a smooth and even surface. The surface should not have pores that will absorb paint. And the surface should provide good adhesion to the paint. All this is done by the primer. A good primer fills all surface imperfections and provides adhesion to the surface and to the finish coat. Application of paint without a primer coat can lead to performance problems such as cracking, peeling, flaking, etc.

## Notes



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## UNIT 2.3 Types of Primers

### Applicable NOS – PCS/N5018

#### Unit Objectives



At the end of this unit, you will be able to:

1. Differentiate between different primers available, it's characteristics and use.
2. Define "putty" and its application.
3. Prepare paint for application by mixing with appropriate thinners.

**Solvent based primer:** are the most commonly used primers for metal and wooden surfaces. For ferrous metal surfaces, red oxide primer is commonly used. Red oxide primer protects the surface from rust and corrosion. For Aluminium substrate, Zinc Chromate primers are used for adhesion and protection.

For wooden surfaces, specially formulated wood primers are available. Wood primers seal the pores in the wood and prevent resinous material from oozing out of the wood.

Wood Primers are available in two colours – White and Pink. Wood Primers are also thinned with mineral turpentine (MTO).

Solvent based primers are used for new masonry surfaces and have excellent alkali resistant properties. They effectively seal all the pores and provide good adhesion to the top coat. Care must be taken that the primer coat is fully dried before applying the finish coat. Solvent thinnable masonry primer is thinned with mineral turpentine (MTO).

There are higher grades of primers for metals depending on service atmospheric conditions such as red oxide zinc chrome primer, zinc rich primer, etc.

**Water based primer:** is thinned with water and extensively used for masonry surfaces, both interior and exterior. The primers are quick drying and offer the advantages of sealing pores, filling cracks and imperfections and providing adhesion. This coat is also used as an undercoat to achieve better opacity when the existing colour is dark and is being changed. Tinting the primer to the topcoat colour tone is also done to improve the opacity and colour of the topcoat. While painting on existing pre-painted surface which is clean, free of loose particles or flaking paint, primer coat application may not be necessary. However, it is still recommended to apply a primer coat to improve performance and durability of paint system.

The use of low VOC primers and/ or water-based primers for metal and wood is slowly increasing due to environmental protection awareness.

**Primer application:** The primer is normally applied using a brush. Spray application, using a spray gun, is sometimes followed for exterior wall painting, metal and wood primers. The Product/ Technical Data Sheet of the manufacturer generally mentions the thinning ratio and the recommended re-coating interval. Follow the instructions of the supervisor/ painter for thinning the primer and application. After each coat of primer application and drying, the surface needs to be sanded to achieve smoothness and an even surface. The sanded surface must be cleaned thoroughly and completely, with a moist cloth. Seek the supervisor's/ painter's approval before application of the next coat.



*Fig 2.3 (i): Putty application*

**Putty application:** Putty is an elastic material in a paste like consistency and is used as a filler to smoothen and level the surface. Ideally, putty is applied on a primed surface. The surface must be free of dirt, dust, loose particles and any kind of contamination.

The masonry surface may be lightly wetted prior to putty application for ease of application.

Putty is applied with a spatula, putty blade or trowel. Care must be taken not to apply very thick coat of putty as this will lead to several paint defects like cracking at a later stage.

Thin, even coat of putty is applied and left to dry for at least 12 hours (over-night). Putty must be applied in a bottom to top direction in even strokes. This method is to avoid material wastage and spillage. After the surface is levelled with putty, and the putty has completely dried, the surface must be sanded. All loose particles, dust, etc must be cleaned thoroughly, preferably with a moist cloth.

**Mixing paint:** After the surface is thoroughly cleaned, sanded, levelled with putty and primed with an appropriate primer, it is ready for application of the finish coat.



*Fig 2.3 (ii): Stirrer*

The paint in the can must be stirred well to ensure that it is a homogeneous mixture without any settling or lumps in it. Air drying solvent-based paints have a tendency of skin formation, if the container is not kept air-tight. This must be removed before mixing the paint. This stirring is a difficult and a long process manually. Mixing and stirring can be done efficiently and in lesser time with mixers

and stirrers which are electrically/ pneumatically powered. There is a vast array of stirrers and mixers to suit different volumes and consistency. There are specialised stirrers / mixers for putty. Stirrers are available as hand held devices and on a stand. The stirrers comprise an electric motor, a rotating rod and flat blades / spatulas attached to the rod. There are stirrers with varying speed.



Fig 2.3 (iii): Stirrer

While using stirring / mixing machine care must be taken to have the container covered or else the paint is likely to splash and spill. The normal practice is to make a hole through a piece of cardboard and have the rod go through it. The cardboard needs to cover the lid of the container and must be held in place.

Putty, primer and finish paint must be mixed with recommended thinners to achieve the right application consistency.

1. After stirring thoroughly, if necessary, the paint must also be sieved, using appropriate sieves/ cloth mesh, to ensure that it is free from any foreign particles or lumps.
2. Ensure that dust from the top of the can is wiped/ blown off before opening the can. The spatula or stirrer to be used for mixing should be clean to prevent contamination.
3. Small quantity of the paint is usually transferred from the supply can into another can for application. Ensure that the can used for application is clean. This smaller quantity is adjusted for application viscosity/ consistency, by mixing the recommended thinner – water for water-based paints and MTO (Mineral Turpentine)/ recommended thinner for solvent based paints, as recommended in the Product Data Sheet by the manufacturer.

**Adjust the application viscosity/ consistency:** The paint supplied by the manufacturer is usually at a higher viscosity/ consistency, not suitable for application. Therefore, the consistency of the paint needs to be adjusted to suit the application method. The application consistency depends on the method of application and the manufacturer's Product Data Sheet gives the recommended thinner and it's mixing ratio, for application by brush, roller and spray.

In case of water-based paints using water as a thinner, care should be taken to ensure that "hard" water is not used or the "hard" water is suitably softened before use. Most reputed, large paint companies' products are formulated to be compatible with "hard" water and no additional 'softeners' are required.

After mixing the paint for achieving application consistency, apply on a small trial area to check if the desired consistency has been achieved for application. If not, fine tune the consistency by adding more water / solvents, as the case may be.

**Mixing of two pack paint systems:** A two-pack system – a base and hardener – is one where two separately packed components are mixed just before painting. The base and hardener ratio must be maintained very strictly and as specified in the Product Data Sheet. In mixing a two-pack system there are two critical factors:

- **Mixing ratio** is the ratio of base to hardener and usually product packs come in the recommended ratios. Both pack of the component should be mixed in a can and stirred well.
- **Pot life** is the time within which the paint must be consumed, after mixing of the base and hardener. Else the mixed paint will increase in viscosity, and harden in extreme cases in the container, rendering itself un-usable.

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## UNIT 2.4 Application of Paint

### Unit Objectives



At the end of this unit, you will be able to:

1. Identify and use the different tools for paint application
2. Explain the basis for selection of an application tool
3. Explain the different types of spray application, its characteristics and use
4. Describe a two-component paint system and its critical factors to be considered

Brush and roller is the most commonly used application tool for decorative painting on masonry, metal and wooden surface. Spray application is the most widely used method for industrial and protective coatings. Use of spray for masonry surfaces, decorative metal surfaces and wood is slowly increasing. One or more of the following may influence the choice of the method used.

Size and type of job	Bigger jobs are more likely to use more sophisticated equipment. The type of job (defined by the specification) will determine what application method is required or most suitable.
Accessibility of the areas to be coated	Some areas (e.g. ornamental arches, elevated water tanks, radio/TV masts) will place restrictions on the type of application equipment used for practical reasons.
Configuration of areas to be coated	Complex areas may be difficult to coat adequately with spray equipment. Large flat areas are mostly suited for spray application. The use of brushes and rollers rather than spray equipment is preferred if there are areas or surrounding environment that could be damaged by overspray.
Type of coating	Many modern coatings, particularly high-solids and high-build coatings, are designed for spray application. Brush or roller application is not recommended and should only be used when spray application is not possible or when small areas, such as repair areas, are to be coated.  Application method depends on the type of coating being used. Some specialised coatings may be restricted to a specific application method. Coatings that are 100%-solids, for example, can only be applied using special equipment such as heated airless spray pumps or by mechanical methods, such as by trowel or by hand.

**Conventional liquid paints:** Applied by brush, roller, or spray - should generally be applied in multiple passes, thin enough to allow proper evaporation of the solvents as the paint dries and cures. Paints used on porous surfaces should be able to penetrate and fill the surface voids in the substrate and should be thinned if necessary to ensure penetration.

**Brush application:** Brush application is the oldest painting method in common use today. The advantage of brush application is the paint's good penetration in the surface pores. Brush application is a slow process and a relatively expensive one. On large surfaces, brush application does not produce a sufficiently uniform and good-quality film.

**Roller application** is often preferred to brush application because of the speed of the method - the paint is rolled onto the surface. The paint roller is primarily a paint application tool for the application of top coats on large and smooth surfaces and is not recommended for use with a primer. These days it is common to see paint rollers with designs on them as illustrated in the picture below.



Fig 2.4 (i): Variety of paint brushes and paint application with brush ([homedepot.com](http://homedepot.com), [diynetwork.com](http://diynetwork.com))



Fig 2.4 (ii): Roller application and anatomy of a roller



Fig 2.4 (iii): Variety of rollers for texture painting



Fig 2.4 (iv): Rollers with patterns (1.bp.blogspot.com &img.etsystatic.com)

**Spraying:** Spraying is the most commonly used painting method for large surfaces today. Different types of sprayers have been developed for various paint applications. In spray application, a liquid paint is transformed into a fine droplet spray. This is called atomisation, wherein droplets with high energy come out. It is a physical mechanical process. These atomised droplets are seen as a spray cloud. Atomisation Energy (AE) and Coating Flow (CF) are important components of spray.

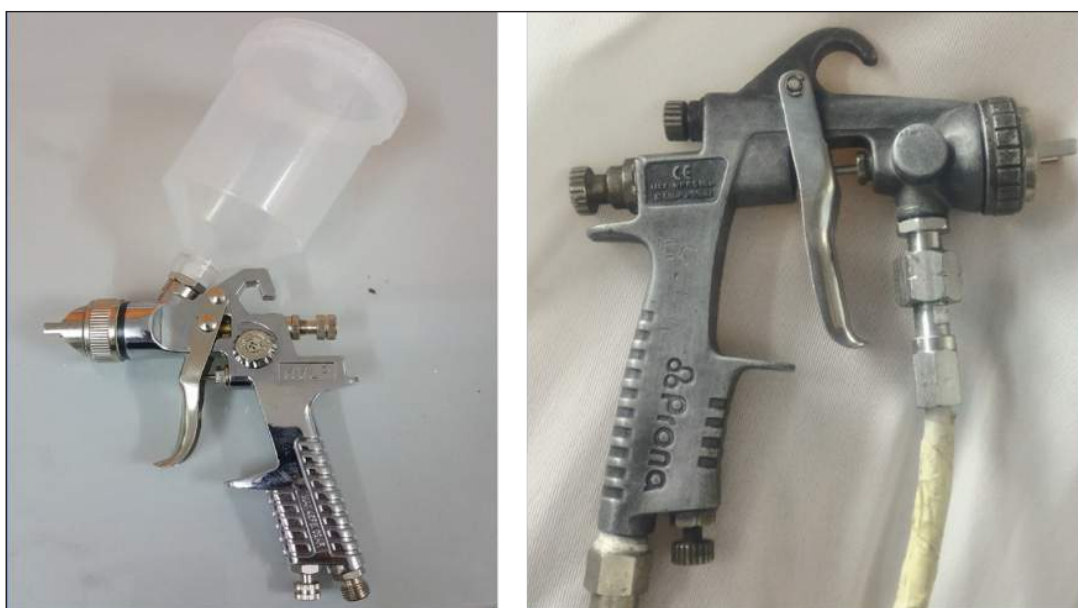


Fig 2.4 (v): Spray guns

- Plural component spray guns have two or more suction hoses for the base and hardener respectively, which are then mixed at the tip of the spray nozzle, this eliminates the problem of using up the two component paints within the pot life.
- Coating Flow means volume of paint coming out from spray equipment. It is expressed in ml /minute.
- The air pressure, fan width and paint flow rate are important application parameters to be controlled for consistent quality of deposition of the coating, in spray application.





Fig 2.4 (vi): Roof being spray-painted (oldprocessroofing.com)

**Low pressure (conventional) air spray:** Air atomising sprayer, is the oldest of the sprayer types. It is still in extensive use for example, for painting homes, cars etc. In low pressure air spraying, the liquid is injected, either under hydrostatic pressure or slight overpressure, into the middle of the sprayer gun nozzle. The liquid from the nozzle is then atomised into fine mist by air jets directed at different angles to the paint material being ejected. The volume of the liquid flow to the nozzle can be adjusted using the needle valve or by adjusting the nozzle orifice size. The spray pattern is determined by the angle and volume of the air jets. The method requires the availability of pneumatic air and thinning of the paint material. The quality of the finish is uniform and smooth. The method is not suitable for forming thick coats, since thinning is used to regulate the coating finish. Conventional spraying is not recommended for coating complex structures. Atomising prevents paint material from entering tight corners and the surface pores. Air atomising spraying is also called low-pressure spraying because of the low operating pressure used.



Fig 2.4 (vii): Gravity feed gun, suction feed gun and pressure pot

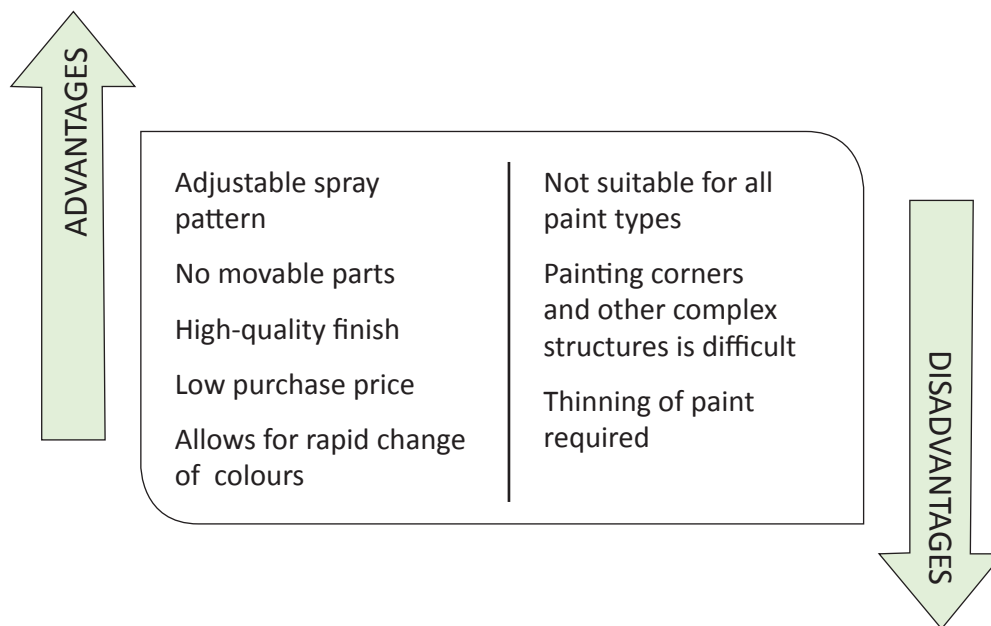


Fig 2.4 (viii): Advantages and disadvantages of using spray guns

### Airless – High Pressure Spraying

Airless spraying is the most commonly used painting method for thicker coating thickness and exterior masonry surfaces. The atomisation of liquid paint in airless spraying is based on the great pressure difference induced by conveying the liquid under high pressure through a small nozzle orifice. The resulting paint mist is fine in quality and the droplets hit the surface at a high velocity. Because there is no “air lock” to overcome, the paint enters freely into corners and to the bottom of the surface pores. The pressure required for airless spraying is supplied by a high-pressure pump, which increases the pressure by tens of times, depending on the surface area ratio between the air-side pistons and the liquid-side pistons.



Fig 2.4 (ix): Nozzle sizes

For spraying paint without thinning, a nozzle pressure of 120 – 250 bar is usually required. Using too high a spraying pressure should be avoided, since this will increase the volume of spray dust and, thus, the visual texture of the finish. As low a pressure as possible should be applied to achieve a cost-effective outcome. The operating pressure can also be significantly reduced by using an appropriate paint heater as an auxiliary device.

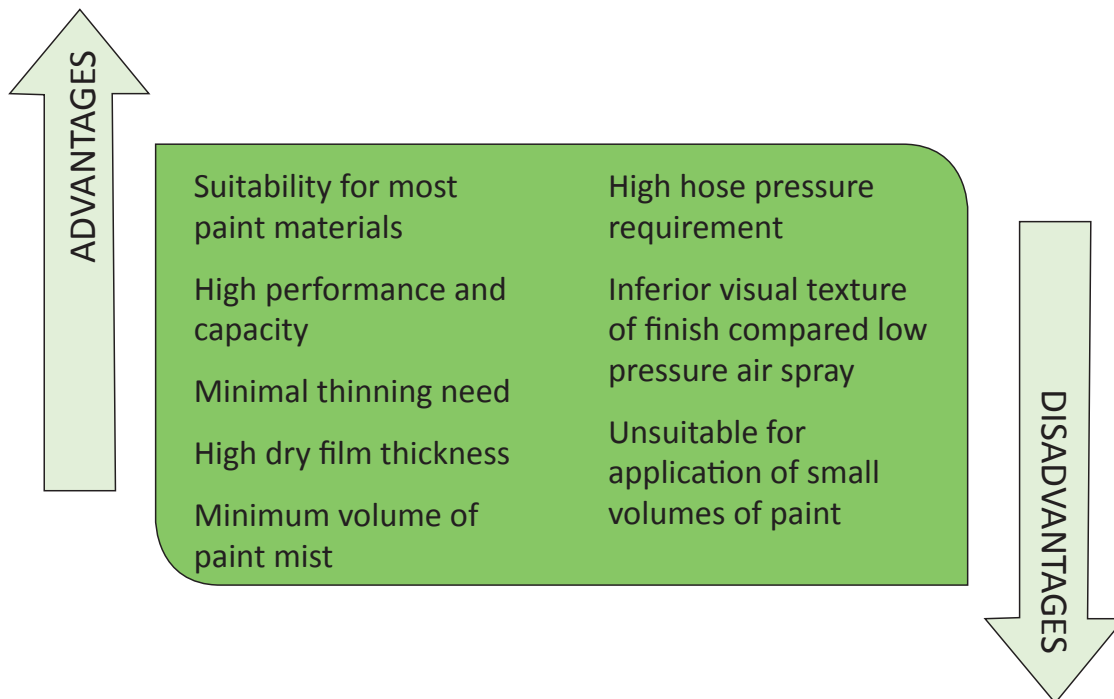


Fig 2.4 (x): Advantages and disadvantages of airless spraying

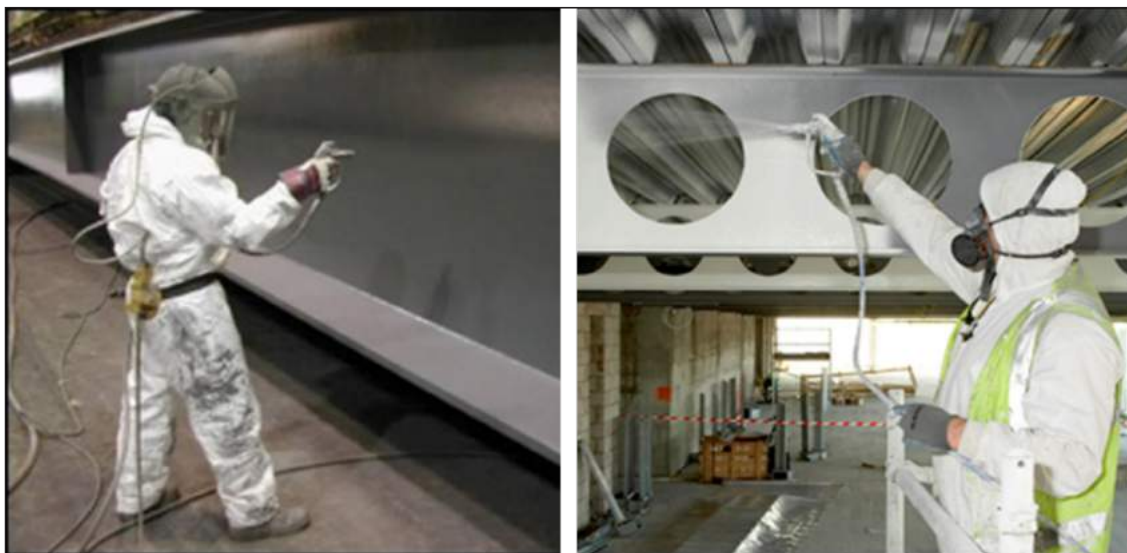


Fig 2.4 (xi): Airless spray technique

### Two-pack spraying

In certain two-pack coatings, the curing reaction time is so short that dedicated two-pack spray applicators have been developed. The applicators pump the curing agent and the base component from separate containers and mix the components to the correct proportion before the liquid reaches the spray gun.

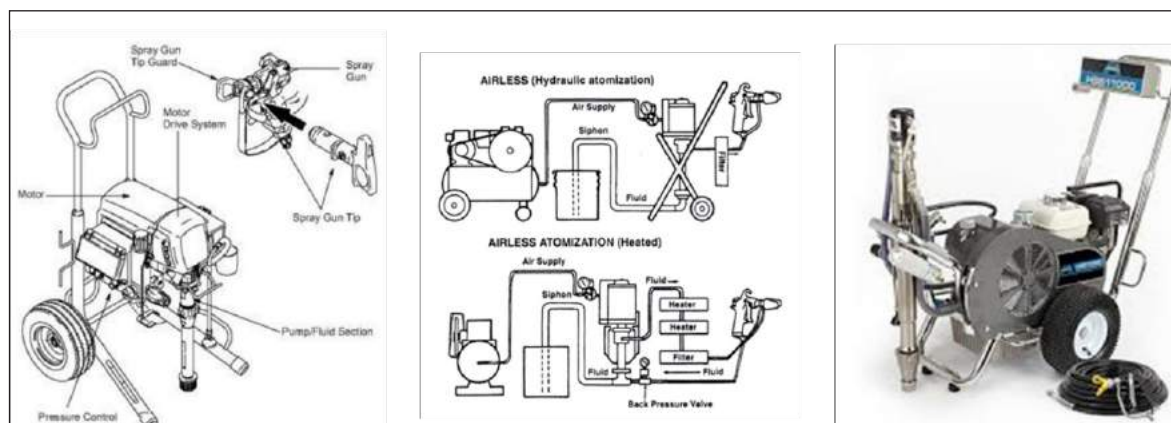


Fig 2.4 (xii): Plural component system

BRUSH APPLICATION	ROLLER APPLICATION	SPRAY GUN APPLICATION
<ul style="list-style-type: none"> <li>• The paint must be thinned as recommended by the manufacturer and strained through a clean cloth.</li> <li>• For large, flat wall areas a 4 or 6-inch brush must be used.</li> <li>• Brush must be dipped in paint to cover up to half the height of the bristles, but care must be taken not to carry excessive paint, for it will cause dripping.</li> <li>• Tap the brush on the rim of the paint can to shed the excess paint.</li> <li>• Paint must be applied in even strokes vertically first and horizontally next. It must be finished with vertical strokes.</li> <li>• Overbrushing on the same area must be avoided to avoid brush marks.</li> <li>• The first coat must be allowed to dry for 4 to 6 hours or as recommended by the manufacturer before applying the second coat.</li> <li>• In case a pastel colour is chosen, a third coat may be necessary to get the opacity and the required colour.</li> <li>• When painting involves two colours, for e.g. white for the ceiling and a slightly darker colour for the walls, paint the lighter colour first. It is easier to cover the lighter colour with the darker colour in the edges when painting the darker colour.</li> <li>• The surface to be painted must be clean and dry and free from dust. The area to be painted must be clean and well ventilated.</li> <li>• Door / window trims must be first 'cut in' meaning narrow strips and edges must be first painted with a narrower paint brush, eg. 1" brush and then the rest of the larger flat surface with a 3" or 4" brush.</li> </ul>	<ul style="list-style-type: none"> <li>• Roller is ideal for painting large, flat surfaces. However, even when using a roller, the edges of the walls must be brush applied first.</li> <li>• Pour the paint in a flat tray or vessel for full access of the roller.</li> <li>• Dip the roller in paint to ensure that the roller has picked up sufficient paint.</li> <li>• Roll up and down in sweeping long motion with a slight overlap.</li> <li>• Apply the paint with a slight pressure.</li> <li>• Without reloading on the paint, go over painted surface lightly to smoothen the paint.</li> </ul>	<ul style="list-style-type: none"> <li>• Make sure the paint is thinned as per the manufacturer's recommendation and strained to avoid clogging.</li> <li>• Apply the paint from a distance of a foot.</li> <li>• Hold the gun straight, perpendicular to the surface.</li> <li>• First spray a sample on a panel or on a sampling surface before actual painting.</li> <li>• Start moving the gun before actually releasing the paint.</li> <li>• While applying paint avoid lighter areas by overlapping. Generally, a 50% overlap is recommended.</li> <li>• The tip of the spray gun nozzle may get clogged so clean the tip with a cloth at regular intervals.</li> </ul>



Finish coat or top coat is the final coat of paint that completes the painting system for protection and adds beauty to the surface. Finish coat application is very important as this determines the aesthetic appeal of the asset.

The finish coat completes the painting system and is the visible skin of the décor. The entire beauty of a home or an object rests on the quality and application of the finish coat. The beauty of the finish coat will depend on:

1. The quality of the paint system
2. The quality of surface preparation
3. The skill of the painter

Prior to application, the painter must ensure that the place is clean and well ventilated. The surface to be painted must be completely dry.

### Tips



A clean and well-prepared surface will enhance the adhesion of the paint to the substrate and help improve its performance and durability.

### Practical Activity

Apply a paint on a metal surface by brush, roller, spraying.

### Notes



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## PAINTS AND COATINGS SKILL COUNCIL



# 3. Coordinate with Colleagues and Customers

Unit 3.1 - Interacting with Superior

Unit 3.2 - Communicating with Colleagues

Unit 3.3 - Communicating Effectively with Customers

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Applicable NOS – PCS/N9901

## Key Learning Outcomes

At the end of this module, you will be able to:

1. Learn behavioural skills to interact with your colleagues and co-workers effectively
2. Describe steps to achieve customer satisfaction
3. List quality and service orientation markers

## UNIT 3.1 Interacting with Superior

### Unit Objectives



At the end of this unit, you will be able to:

1. Describe best ways of interaction with your superiors at work

An organisation is a group of people working collectively towards a common goal linked to an external audience/environment. Simply put, all the employees in an organisation act as tiny parts of a large machinery which help seamless and efficient functioning.

Every organisation must have a structure. The organisation structure enables clarity of purpose and role of every individual ensuring there are no overlap in functions. It also clearly defines a hierarchy which determine who takes what decision and thus how those decisions shape the organisation. These decisions provide the direction needed in the organisation.

Interpersonal relations / communication between employees across hierarchies are thus very important. A code of conduct / protocol ensures expectation management and reducing the gap between superior and subordinates by increasing the levels of trust and support ultimately achieving organisational and personal goals.

Openness and comfort in communication plays a very important role in achieving job satisfaction. Reporting problems and asking for possible solutions after your own unsuccessful attempts, taking feedback etc. all come under interactions with your superior.

### Notes



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## UNIT 3.2 Communicating with Colleagues

### Unit Objectives



At the end of this unit, you will be able to:

1. Describe best ways of communication with colleagues

Building trust with colleagues and co-workers is as important as doing your work efficiently and effectively. Here are a few actions you can take to build a relationship of trust and respect with your colleagues and co-workers:

- Greet everyone in the workplace with a smile and positive body language.
- Offer help to a new colleague to settle down in the job.
- Show courtesy and respect to colleagues.
- Do not disturb others when they are working.
- Keep your workstation clean.
- Leave washroom and other common facilities clean after use, for others.
- Do not waste your time and others' time by holding long conversations which are not related to work.
- Do not use cell phones at work.
- Do not mope. Keep a smiling face.

Following right communication rules is very important to keep a healthy relationship with colleagues and co-workers. In modern day workplace, people generally work in teams. It is important to build healthy relationship with the team members. Following are some important communication rules to follow:

- Speak in a polite and respectful tone. A voice tone suggesting impatience, sarcasm or taunt is not acceptable in the workplace.
- Use positive words and body language. Avoid words and topics which may offend anyone at workplace.
- If there is any conflict with a co-worker, resolve the issue amicably without raising your voice or getting angry.
- Greet your colleagues and co-workers in the morning or at the beginning of the shift.
- Use positive words and body language.

The quality of relationship you build with your colleagues and co-workers will depend on the behaviour you demonstrate while interacting with them. A relationship built on trust, good and clear communication, polite language and appropriate behaviour at all times helps you to be successful at work.

## UNIT 3.3 Communicating Effectively with Customers

### Unit Objectives



At the end of this unit, you will be able to:

1. Describe best way of communicating with customers
2. List quality and service satisfaction markers

A customer in your context is anyone – internal or external who might legitimately have a work-related expectation from you. Both their opinions are critical to the success of your company and sale of your products.

**Internal customers** are persons within the organisation who use products or services delivered by you as inputs in their work. For example, production staff in a factory are internal customers of maintenance technicians. The feedback provided internal customers is valuable. It must be implemented and taken seriously.

**External customers** are the end consumers and/or companies who buy your products. They do not belong to your organisation. These individuals are essential to the success of your company, as they purchase your product. Satisfied external customers make repeat purchases. They also refer the experience to others.



*digitalbusinessblog.files.wordpress.com*

- Understanding customer expectations and implementing the same helps achieve customer satisfaction. Delivering more than expected adds to the overall experience of a good sale. It brings repeat customers.
- Managing customer relations requires dedicated and committed effort. It involves understanding the customer's need correctly and fulfilling it every time. With a business customer, it involves understanding their business and in what ways our product / service can help grow and improve their business.

General tips for interactions with customer are as follows:

- Greet and welcome the customer in a friendly manner
- Make an earnest effort to understand customer needs. Ask specific pertinent questions.
- Be attentive, listen carefully and make notes. Suggest upgradation and add-ons if they give value to the customer.
- Find out customer's likes and dislikes by soliciting their opinion and comments on the demonstrated samples
- Never promise more than you can deliver. Always deliver more than you promise, never fall short
- Agree on all terms and conditions

When the customer is another organisation (such as an OE company, a cooperative society or a club), many persons from the customer organisation get involved. Each may have different needs and expectations. In such situations,

- Identify all the stakeholders (internal and external) and opinion makers right at the outset and understand their needs
- Understand the organisation's strategy and its priorities. This is critical to understanding which needs rank high.
- Be aware that there will be internal dynamics at work in any organisation, and one needs to steer clear of getting caught up in any interpersonal conflicts.
- Document what will be delivered (quantities, specifications and timelines) with a formal sign-off from the customer's side. This can avoid misunderstanding and disappointment later. Such document should also list key expectations from the customer that are critical for timely and quality delivery.
- With a long-term customer, explore ways of bringing about continuous improvements that can help the customer's business. This is critical to keep getting continuing business.
- Be available to deal with the customer's queries and concerns promptly and at all times.

### Notes



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*canvasquality.com*

**Quality** is the sum total of all the elements connected with the product and service that impact the customer's perception positively. Examples are the product's functional performance, aesthetic appeal, reliability, durability, quality of the material used, meeting the design specifications of the end user, customer service during and after the delivery etc. The test of quality is when the customer is totally satisfied with the product in every respect.

**Service orientation** is the ability and desire to anticipate, recognise and meet customers' needs. It is a personality characteristic which makes people focus on providing satisfaction and making themselves available to others. Excellent customer service is unthinkable without customer service orientation.



fenero.com

Customer satisfaction means the customer is satisfied and happy with the work we have done. A satisfied customer is ready to give us repeat business or recommend us to friends and acquaintances.

Customer satisfaction is important because in today's competitive market place every business competes for customers. Your business is constantly under threat from competition trying to take it away; consistently maintaining high customer satisfaction is crucial to retain customers for the long term. Customer satisfaction is the best indicator that the customer is likely to be a repeat customer. It is always cheaper to retain an existing customer than to acquire a new one.

### Tips



Always remember customer is King! Think of the many ways in which you can contribute to increased customer satisfaction.

### Notes



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**PAINTS AND  
COATINGS  
SKILL COUNCIL**



## 4. Maintain Standards of Product / Service Quality

- Unit 4.1 - Meeting and Exceeding Customer Expectations
- Unit 4.2 - Coating Defects, Tests and Standards
- Unit 4.3 - Your Responsibility as an Assistant Decorative Painter
- Unit 4.4 - Prevention of Injuries

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**Applicable NOS – PCS/N9902**

## Key Learning Outcomes

At the end of this module, you will be able to:

1. Explain product / service quality requirements for wood polishing
2. Follow company's policy and work instructions on quality standards to achieve customer satisfaction.
3. List out various defects and tests to check the quality of the wood polishing

## UNIT 4.1 Meeting and Exceeding Customer Expectations

### Unit Objectives

At the end of this unit, you will be able to:

1. Describe the target customer and the quality standards defined by the company.
2. Implement the improvement suggested by supervisor and the customer.

A thorough understanding of the total polishing system is necessary to begin the discussion with the customer.

#### 1. Understand customer requirements:

You should be able to obtain clear instructions and specifications from the customer about the desired finish, look, durability expectation and corrosion protection specifications. Some customers may not have a clear idea about their requirements. In such cases they will need to be guided. Prepare a few samples and get the customer to choose finish, gloss, and shade, which are some basic visual requirements for a coated film.

Established industries generally have well defined specifications stating their requirement. However, even here it is necessary to engage with the customer to ensure common understanding on tolerances, subjective parameters, working limitations and skill levels at customer factory as well as other unstated terms. For example

- When the customer asks for exact match to a standard colour panel, what is the level of tolerance permitted? Will the customer go by visual judgement or by an instrument match?
- What are the testing methods and standards that the customer would use?
- What is the process for maintaining and updating standard panels?
- What are the application equipment, parameters and conditions at the customer end?
- Are there any work restrictions at the customer's premises, for example on working hours, holidays, use of elevators, etc.? It is important to be clear on these while committing to aggressive completion targets.
- Can we describe what performance would be seen as exceeding the customer's expectations?
- Does the customer have internal targets for continuous improvements over time? What are the expectations from the coating supplier/ contractor in this regard?

#### 2. Understand the total coating application system/process, nature of the facility and limitations:

Delivering good and consistent quality in the design, production or application of paints and coatings requires understanding application conditions in detail. This includes obtaining insights and information on all relevant factors such as:

- Type and quality of the substrate and variations that may be encountered
- Surface preparation needed
- The type of coatings to be applied
- The application equipment available/ needed

- Applicable/expected quality standards
- Ambient conditions and site conditions
- Maximum size of components which can be fitted
- Overall magnitude of the job
- Maximum weight the conveyor can take (known as point load)
- Bake conditions, oven design, baking window
- Support facility limitations (e.g. conveyor speed, maximum loading etc.)

### 3. Fool-proof the process and have the right equipment

Analyse and find areas which need to be corrected to gain control of the overall process. This will reduce variations/ surprises and facilitate meeting quality expectations in a consistent and timely manner.

- Inspect the material(s) to be coated before starting the process to ensure good quality and good finish
- Check materials and consumables to be used. Make sure that they conform to specifications
- If the input jobs do not meet the requirements, discuss with the customer and quality in-charge and take appropriate actions
- Follow the right processes and use correct equipment for the job
- Ensure that applicable SOPs are adhered to

### 4. Get feedback from the customer and incorporate suggestions for improvement:

- After delivering the product/ output, proactively find out specific customer feedback
- Make a note of the feedback and improvements the customer is looking for
- Tell the customer what improvements you will incorporate in the next job

## 4.1.1 Quality Standards of the Company

When coating is carried out under proprietary or customer specifications usually the following criteria are considered to check the quality of the finished job.

- On visual inspection, the coating should show the desired finish and correct curing without defects or blemishes.
- Mechanical strength checks are performed to ascertain that the DFT (Dry Film Thickness), hardness and flexibility criteria are met
- The film is tested for corrosion resistance. This may include salt spray resistance test, humidity resistance test etc.
- Outdoor durability tests include ultraviolet resistance test and actual outdoor resistance test





## UNIT 4.2 Coating Defects, Tests and Standards

### Unit Objectives

At the end of this unit, you will be able to:

1. Explain the process of maintaining and enhancing quality standards.
2. Describe various tests and their pass/fail criteria and acceptable tolerance level.
3. List the equipment used for quality tests.
4. Describe the ways to improve company's customer satisfaction rating.

A company's policy defines and helps ensure adherence to quality standards.

- What kind of durability must the finished product meet?
- What are the criteria laid out for the quality assurance program?
- What are the customer specifications?

Based on these a 'Standard Operating Procedure' or 'SOP' is generated with specific work instructions. An **SOP** is a procedure specific to the operation that describes the activities necessary to complete tasks in accordance with industry regulations, legal requirements and quality standards

Why is it important to follow an SOP?

- Saves time and eliminates mistakes
- Ensures that consistent standards are followed throughout the process
- Reduces training costs
- Supports quality goals

### 4.2.1 Tests and Standards to Check Quality

- Dry Film Thickness (DFT) measurement
- Gloss
- Colour
- Flexibility / bend test
- Pencil hardness test
- Adhesion test

#### 4.2.1.1 Dry Film Thickness (DFT) Measurement

This test is devised to check the correct coating thickness on the components as per the specifications.

- Dry film thickness (DFT) is the thickness of the coating

- DFT is measured for cured coatings. Proper thickness range is recommended in specifications
- There are various types of DFT gauges available in the market, from simple magnetic gauges to digital gauges
- The gauge should be calibrated periodically by using a bare metal plate (zero setting) and standard thickness plastic foils (shims) which are supplied with the gauge
- Different gauges are available for ferrous and non-ferrous substrates (F and NF)
- Destructive method or ultrasonic method of DFT measurement is used for non-metallic substrates like wood, plastic, etc.



Fig 4.2.1.1 (i): Magnetic Gauge



Fig 4.2.1.1 (ii): Digital Gauge

#### 4.2.1.2 Gloss Check



Fig 4.2.1.2: Gloss meter

- Gloss is measured with Gloss Meter of different designs. The reflection is measured, and the angle of reflection is specified at 20°, 45°, 60° and 85°
- An angle of 60° is most common in the coating industry
- An angle of 20° is used for a more differentiated result of high gloss surfaces; usually recommended for Automotive class "A" finish
- An angle of 85° is used for a more differentiated result of matt surfaces, not so popular in coating industry

#### 4.2.1.3 Colour Check

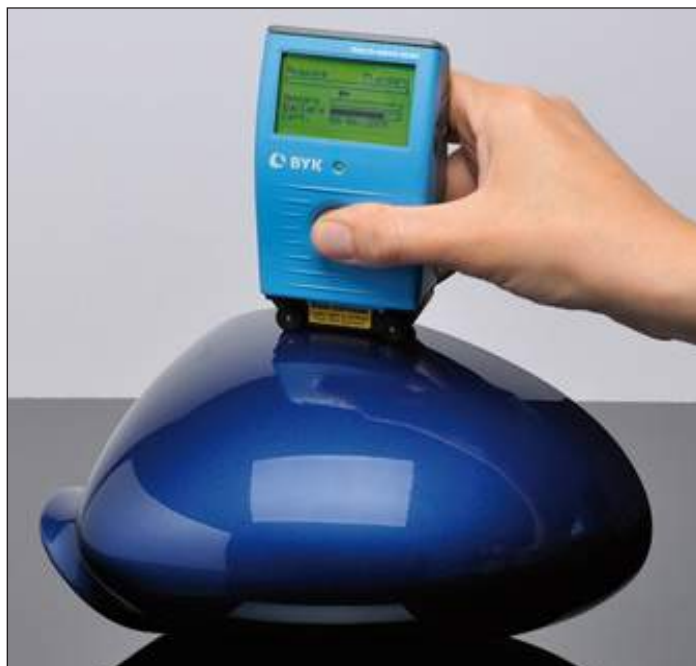


Fig 4.2.1.3: Spectrophotometer

Colour may be checked visually or using a computer aided spectrophotometer. If measured by a spectrophotometer, the colour difference is reported as  $\Delta E$  (Delta E). The  $\Delta E$  should fall within the demarked tolerance zone.

- Visual inspection, compared to a master. It is very important to use a relevant light source when judging colour
- Computer aided spectrophotometer
- Stationary equipment or portable equipment

#### 4.2.1.4 Flexibility - Bend Test

This test is to determine the elasticity, adhesion and elongation ability of a dry coated film applied on a flat metal support. **This test cannot be performed on rigid substrates like wood, plastic, etc.**

- It is checked using either a conical or cylindrical mandrel with a graduated scale
- The apparatus contains a holder for a mandrel, a bending lever fitted with height adjustable rollers, and sliding tongs for fastening the sample
- It is a laboratory apparatus to bend coated test panels over a conical/cylindrical shaped mandrel in order to assess the elasticity of the coating, in accordance with ISO 6860 and ASTM D522
- The conical shape of the bending area allows the deformation of the test panel and examination of the elasticity range of a coating over any diameter between 3.1 and 38 mm in one single test

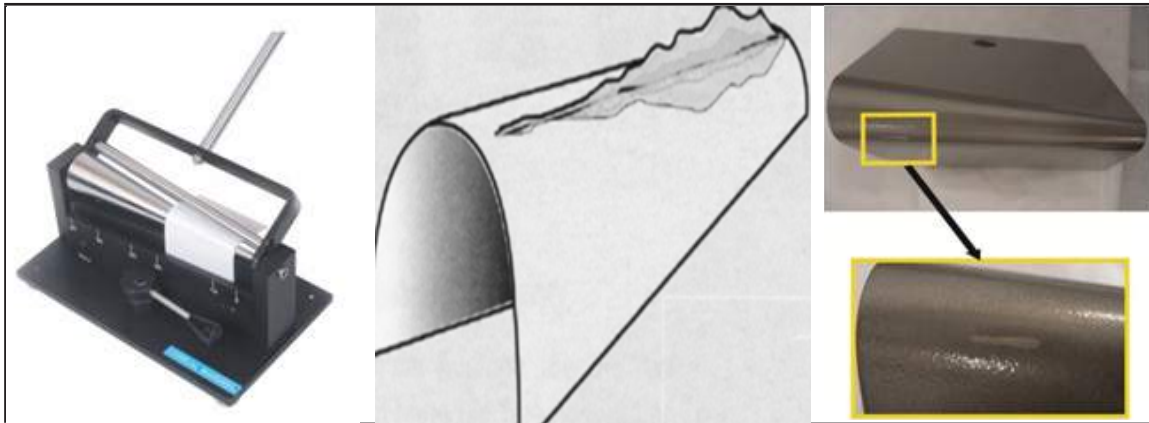


Fig 4.2.1.4: Bend test on a conical mandrel

#### 4.2.1.5 Pencil Hardness Test



Fig 4.2.1.5: Pencil Hardness Test

Pencil hardness test is one of the many tests used to evaluate coatings. It is a simple and dependable test that uses pencils that are graded. The grade of the pencil is determined by the amount of baked graphite and clay in its composition. The test is performed by scratching the coated surface with pencils of known hardness.

Softer Pencils							Harder Pencils						
6B	5B	4B	3B	2B	B	HB	F	H	2H	3H	4H	5H	6H

#### 4.2.1.6 Adhesion Test

Adhesion test is used to determine if the paint or coating will adhere properly to the substrate to which it is applied. There are three different tests to measure the adhesion of the coating to the substrate.

- Cross-cut test
- Scrape adhesion
- Pull-off test

**Cross-cut test:** This test determines the resistance of the coating to separation from the substrate by utilising a tool to cut a right-angle lattice pattern into the coating, penetrating all the way to the substrate. It is a quick test to establish pass/fail test. When testing a multi-coat system, the resistance to separation of different layers from one another can be determined by this test.

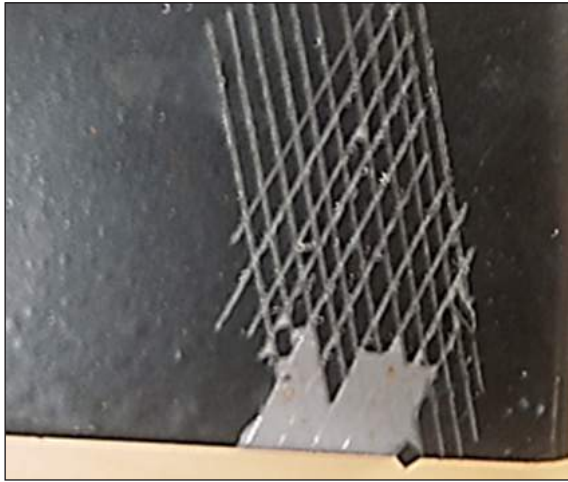


Fig 4.2.1.6 (i): Adhesion test fail

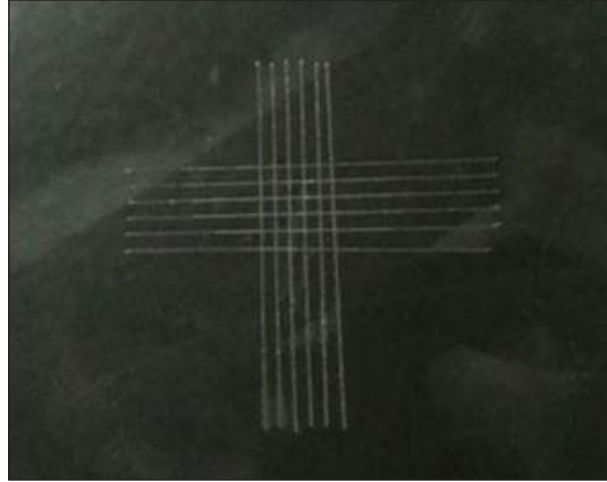


Fig 4.2.1.6 (ii): Adhesion test pass

**Pull off dolly test:** Unlike the other methods, this method maximises the tensile stress, therefore results may not be comparable to the others.

- The test is done by securing loading fixtures (dollies) perpendicular to the surface of a coating with an adhesive. Then the testing apparatus is attached to the loading fixture and is then aligned to apply tension perpendicular to the test surface.
- The force that is applied gradually increases and is monitored until a plug of coating is detached.

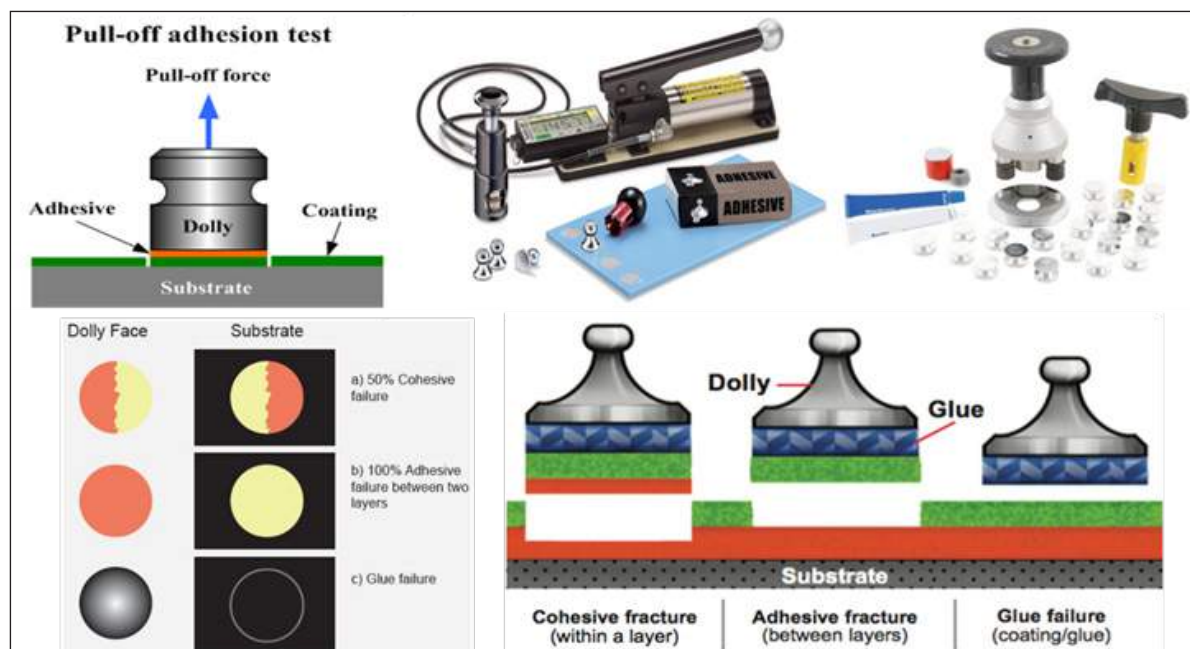


Fig 4.2.1.6 (iii): Pull-off Adhesion Test

#### 4.2.1.7 Impact Test

Impact test is also known as drop weight test. The coated panel is subjected to mechanical impact by dropping a standard weight which can deform the coating and /or the substrate. With this test coating is tested for elasticity, brittleness, and adhesion to the substrate. As per ISO 6272-1:2011 - it is a method for evaluating the resistance of a dry coating film to cracking or peeling from a substrate when it is subjected to a deformation caused by a falling weight, with a 20-mm-diameter spherical indenter, dropped under standard conditions.

- Measures the deformation of a coating film
- Test performed on the front and reverse sides of a panel
- Result expressed as Pass or Fail
- Test is mainly performed on metal substrate.



Fig 4.2.1.7 (i): Impact Tester



Fig 4.2.1.7 (ii): Impact Test

#### 4.2.2 Defects in a Coated Film

Quality checks and maintenance are a mandate every coating applicator must follow. Quality maintenance reflects excellence in your own skills and makes you an expert at your job. The quality parameters to be met and the checks to be performed will depend on the coating and where it is applied. For example, the requirements of a performance or industrial coating are very different from that of a house paint.



No.	DEFECT	CAUSES
1	<b>RUNS AND SAGS</b>	<ul style="list-style-type: none"> <li>• Over thinned paint</li> <li>• Use of very slow evaporating thinner</li> <li>• Applying paint without proper flash time between coats</li> <li>• Very low air pressure during spray application</li> <li>• Improper spray gun set-up or an unbalanced spray pattern</li> <li>• Very cold substrate</li> </ul>
2	<b>CHALKING</b>	<ul style="list-style-type: none"> <li>• Chalking is a surface phenomenon, generally caused by exposure to UV radiation produced by the sun and its action on the organic binder</li> <li>• In the presence of UV light, airborne reactants such as oxygen, humidity, and pollution react with the resins in the binder, causing it to disintegrate and leaving the pigments free on the surface</li> <li>• Typically, amine-cured epoxies and epoxy esters chalk rapidly and acrylics and acrylic-modified resins have good chalk-resistant properties since they are less affected by the sun's radiation</li> <li>• Chalking may not be a serious problem, and typically the coating will continue to provide protection in most cases, even though it may look faded</li> </ul>
3	<b>EROSION</b>	<ul style="list-style-type: none"> <li>• It is a surface defect often associated with chalking and often seen in brush applied coatings where the brush marks are exposed as the coating wears away</li> <li>• It is caused largely by heavy rainfall, high winds, hail or a combination of wind and rain; by sand erosion along beach areas; or by sandstorms in desert areas</li> <li>• Erosion of internal linings can be a significant problem in pipes carrying slurry or cooling water</li> <li>• Resins with some elastomeric quality may be effective, providing resilience to combat the impact of the eroding particles</li> </ul>
4	<b>CHECKING</b>	<ul style="list-style-type: none"> <li>• Checking is a form of cracking and is identified by small breaks in the coating that form as the coating ages and becomes harder and more brittle</li> <li>• It is a surface phenomenon that does not go all the way to the substrate</li> <li>• It can be caused by the mixture of resins, solvents and pigments that are not compatible.</li> <li>• Excessive film thickness, low flash off between coats, inadequately dry or thick undercoat are also some of the causes for checking</li> <li>• To minimise checking, the coating should be formulated with weather resistant resins, non-reactive pigments that do not contribute to checking, long lasting and stable plasticisers, and reinforcing pigments that reduce stress in the coating surface</li> <li>• Apply thinner coats of paint with adequate flash off or drying between coats</li> </ul>

5	<b>ALLIGATORING</b>	<ul style="list-style-type: none"> <li>• It is mostly a formulation-related failure and prevention is a matter of selection</li> <li>• The coating system selected should not specify a soft primer under a harder topcoat. The coating should be applied in thin coats, which should be allowed to cure before application of successive coats</li> <li>• Never apply a hard coating that oxidises or requires polymerisation over a permanently softer or more rubbery primer</li> </ul>
6	<b>CRACKING</b>	<ul style="list-style-type: none"> <li>• This formulation related failure is due to premature aging or weathering and, unlike checking or alligating, the cracks break through the coating, extending to the substrate</li> <li>• Cracking is a much more serious type of failure than checking</li> <li>• Checking results from the stress on the coating surface, while cracking results from stress throughout the film and between the film and the substrate</li> <li>• The use of proper resins, plasticizers, and pigments in coating formulation minimises the tendency of the coating to cracking</li> <li>• Fibrous or acicular (needle shaped) reinforcing pigments can help in reinforcing the coating against cracking</li> </ul>
7	<b>MUDCRACKING</b>	<ul style="list-style-type: none"> <li>• Unlike alligating, mudcracking goes directly to the substrate. It presents an immediate corrosion problem with possible chipping and flaking of coating from the surface</li> <li>• It occurs when highly filled or pigmented coatings, particularly zinc rich coatings are applied too thick</li> <li>• Highly filled water-based coatings sometimes mud crack, with the reaction occurring as soon as the solvent or water carrier begins to dry out of the coating</li> <li>• Mudcracking can be prevented by a combination of coating selection and proper application. If fast drying conditions exist or are expected, the user should avoid highly filled water-based coatings.</li> <li>• The coating should be applied during more moderate drying conditions, in thin coats without runs and sags</li> </ul>
8	<b>WRINKLING</b>	<ul style="list-style-type: none"> <li>• Wrinkling generally occurs when coatings are applied too thick.</li> <li>• It results from the swelling of a coating where the surface of the coating expands more rapidly during the drying period than the body of the coating</li> <li>• Occurs most with oil-based coatings</li> <li>• If a coating contains an excess of surface driers, wrinkling may occur wherever the coating is thicker than normal</li> <li>• Wrinkling is likely to occur in cold weather when the thickened coating is applied so that a heavy film develops or in hot weather when the topcoat dries quickly but the coating underneath remains soft</li> </ul>

9	<b>BLISTERING</b>	<ul style="list-style-type: none"> <li>• Blister develops first in localised spots where the adhesion is weakest</li> <li>• Blisters can be large or small and may exist in isolation or in groups</li> <li>• Blisters may be initiated by several causes. Mostly, they are formed due to the presence of moisture or other vapours, such as air or solvent, within the coating</li> <li>• A blister generally first appears when the vapour within the coating expands at elevated temperatures. It can also arise from soluble pigments in the primer and soluble chemical salts.</li> <li>• Yet another cause could be inadequate solvent release by the coating</li> </ul>
10	<b>INTER-COAT DELAMINATION</b>	<ul style="list-style-type: none"> <li>• Delamination is the loss of adhesion between coats in a multi coat system and is most common where repair or maintenance coatings are applied over cured coatings</li> <li>• New coatings applied over existing coatings may not be compatible with the previous coating, and delamination can occur</li> <li>• Precautions should be taken to minimise the problem by cleaning adequately and by applying coatings as quickly as possible after the cleaning operation</li> <li>• Another cause of delamination is the application of a coating over another coating that has over cured</li> <li>• Some modern coating formulations have been specifically developed with a low cross-link density to reduce this problem</li> </ul>
11	<b>EXCESSIVE ORANGE PEEL</b>	<ul style="list-style-type: none"> <li>• Film thickness out of proper range In case of powder coating, too slow heat-up rate and slow oven ramp-up time is the main cause</li> <li>• The oven temperature should cross 120°C -140°C very quickly</li> <li>• Grounding should be checked</li> <li>• The kV setting of the spray gun to be lowered</li> <li>• In case of liquid paints, a balance of slow and fast evaporating thinner should be maintained to achieve a smooth, orange peel free film without causing runs and sags.</li> <li>• In air assisted spray, the recommended air pressure should be maintained</li> </ul>
12	<b>GLOSS TOO LOW FOR HIGH GLOSS TYPE COATING</b>	<ul style="list-style-type: none"> <li>• Incompatibility between different coats</li> <li>• Micro-pinholing from outgassing</li> <li>• Excessive orange peel due to inadequate DFT</li> <li>• Over-curing of parts</li> </ul>
13	<b>INCONSISTENT FILM THICKNESS</b>	<ul style="list-style-type: none"> <li>• Incorrect positioning of spray guns</li> <li>• Defective spray equipment / nozzle</li> <li>• Reciprocators not matched to line speed</li> <li>• Air flow in booth disturbing spray pattern</li> <li>• Improper manual technique</li> </ul>

14	<b>POOR IMPACT RESISTANCE AND/OR FLEXIBILITY</b>	<ul style="list-style-type: none"> <li>• Over baked film</li> <li>• Poor cleaning</li> <li>• Excessive film thickness</li> </ul>
15	<b>POOR ADHESION</b>	<ul style="list-style-type: none"> <li>• Poor cleaning / pretreatment</li> <li>• The PT line is not properly maintained</li> <li>• Oil removal from the degreasing stages not proper</li> <li>• Under-cured film</li> </ul>
16	<b>PINHOLES</b>	<ul style="list-style-type: none"> <li>• Moisture in coating</li> <li>• Moisture in compressed air</li> <li>• Mixing of two different coating types</li> <li>• Porous component like casting</li> <li>• Heating too fast creating outgassing while curing</li> </ul>
17	<b>CRACKING OR CRATERS</b>	<ul style="list-style-type: none"> <li>• Moisture in coating</li> <li>• Oil in compressed air</li> </ul>
18	<b>CHIPPING</b>	<ul style="list-style-type: none"> <li>• Loss of adhesion of the film to the substrate due to impact from stones or other hard objects</li> <li>• Sand and featheredge damaged areas to remove chips, then refinish.</li> <li>• Use premium two component undercoat and topcoat system.</li> <li>• Use a flex agent in undercoat and/or topcoat system in areas that are prone to chipping.</li> </ul>
19	<b>DUST CONTAMINATION</b>	<ul style="list-style-type: none"> <li>• Inadequate cleaning of the surface</li> <li>• Dirty spray environment</li> <li>• Inadequate air filtration in the booth</li> <li>• Use of poor grade masking paper</li> <li>• Dirty spray gun</li> <li>• Dirty work clothes</li> <li>• Fine dust contamination can be removed by sanding and polishing</li> </ul>
20	<b>FISHEYES</b>	<ul style="list-style-type: none"> <li>• Spraying over surfaces contaminated with oil, wax, silicone, grease etc.</li> <li>• Use of thinner/ reducer in place of a solvent cleaner Spraying over previously repaired areas containing fisheye eliminator additive</li> <li>• Remove wet paint film with solvent cleaner and refinish. Add recommended fisheye eliminator and respray the affected areas.</li> <li>• Do not use fisheye eliminator in undercoat or basecoat colour.</li> <li>• If the paint has dried, sand to a smooth finish below the fisheye cratering and refinish</li> </ul>

21	<b>LOSS OF GLOSS</b>	<ul style="list-style-type: none"> <li>• Top coat applied in heavy, wet coats</li> <li>• Inadequate flash time between coats</li> <li>• Insufficient film thickness of topcoat colour or clearcoat</li> <li>• Using a poor grade and/or too fast evaporating thinner</li> <li>• Improper cleaning of the substrate</li> <li>• Insufficient air movement during and after application</li> <li>• Spraying over a deteriorated or solvent sensitive substrate finish without proper priming or sealing procedures</li> <li>• Natural weathering of the finish</li> <li>• Allow finish to cure thoroughly, compound or polish to restore gloss.</li> <li>• Sand and refinish</li> </ul>
22	<b>MOTTLING</b>	<ul style="list-style-type: none"> <li>• An uneven distribution of metallic flake</li> <li>• Too much thinner/reducer</li> <li>• Colour overthinned/ reduced</li> <li>• Applying clear coat to a basecoat that has not thoroughly flashed/ dried</li> <li>• Improper application of basecoat</li> </ul> <p>To get a uniform single stage metallic finishes, apply a higher-pressure mist coat, panel by panel, while previous coat is still wet or allow basecoat colour to flash, then apply a low-pressure mist coat. Finishes that have dried must be sanded and refinished. Use recommended spray gun, including fluid tip and air cap for the material being sprayed</p>
23	<b>SANDING MARKS</b>	<ul style="list-style-type: none"> <li>• Scratching or distorting metallic/mica flakes close to the surface of the paint film</li> </ul> <p>Allow finish to dry, sand and refinish. Avoid sanding basecoat finishes before clear coating. If sanding is necessary, apply additional colour following label direction. When sanding single stage, finishes confine the sanding to minor imperfections – nib sanding rather than entire panel</p>
24	<b>SOFT FILM</b>	<ul style="list-style-type: none"> <li>• Applying undercoat and/or topcoat excessively wet</li> <li>• Insufficient dry time between coats</li> <li>• Improper shop ventilation or heating</li> <li>• Adding too much or too little hardener to the paint material.</li> <li>• Using the incorrect thinner/reducer for spray conditions</li> <li>• Omission of drier in enamel/ urethane topcoat</li> </ul> <p>Allow additional dry time, maintaining a shop temperature of 30 degrees centigrade or above or force dry following temperature and time recommendations or remove coating film and refinish. Use recommended spray gun, fluid tip and air cap for the material being sprayed.</p>

25	<b>BLEEDING</b>	<ul style="list-style-type: none"> <li>Solvent in the new topcoat dissolves soluble dyes/pigments in the original finish, allowing them to seep into and discolour the new topcoat.</li> <li>Remedial measures can be to remove original paint film and refinish.</li> <li>Preventive measure can be to isolate the suspected bleeding finish by applying a two-component surface/sealer.</li> <li>Allow to cure and then apply desired topcoat.</li> </ul>
26	<b>TRANSPARENCY</b>	<ul style="list-style-type: none"> <li>Paint not thoroughly stirred</li> <li>Colour over thinned/reduced</li> <li>Substrate not uniform in colour</li> <li>Wrong colour undercoat used</li> <li>Insufficient number of colour coats applied</li> </ul> <p>Apply additional coats of colour until hiding is achieved or sand and apply similar coloured undercoat/ground coat and refinish.</p>



Fig 4.2.2 (i): Sagging of paint coating



Fig 4.2.2 (ii): Chalking



Fig 4.2.2 (iii): Erosion

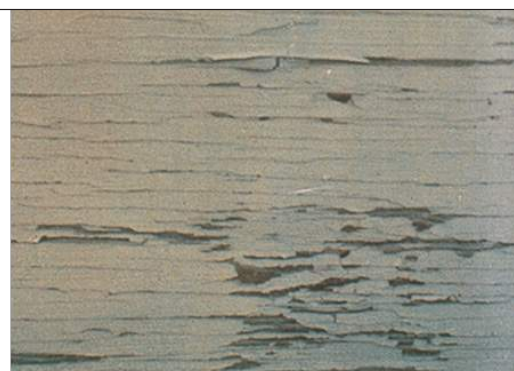
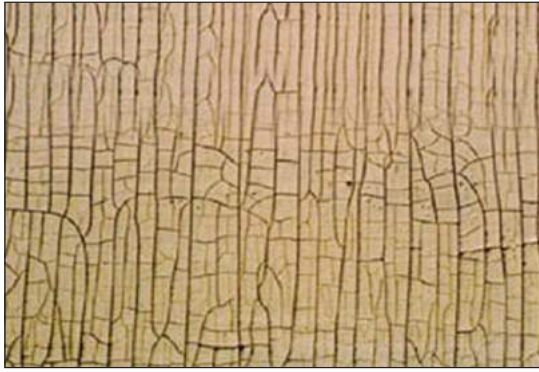


Fig 4.2.2 (iv): Checking





*Fig 4.2.2 (v): Alligatoring*



*Fig 4.2.2 (vi): Cracking*



*Fig 4.2.2 (vii): Mud cracking*



*Fig 4.2.2 (viii): Wrinkling*



*Fig 4.2.2 (ix): Blistering*



*Fig 4.2.2 (x): Inter-coat delamination*



*Fig 4.2.2 (xi): Orange peel*

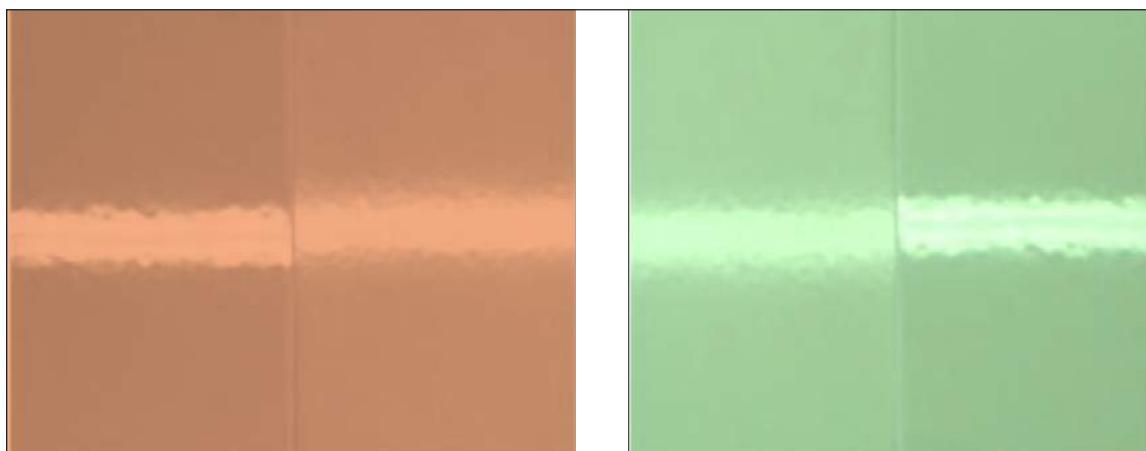


Fig 4.2.2 (xii):  
Standard Gloss      Lower Gloss

Fig 4.2.2 (xiii):  
Standard Gloss      Higher Gloss

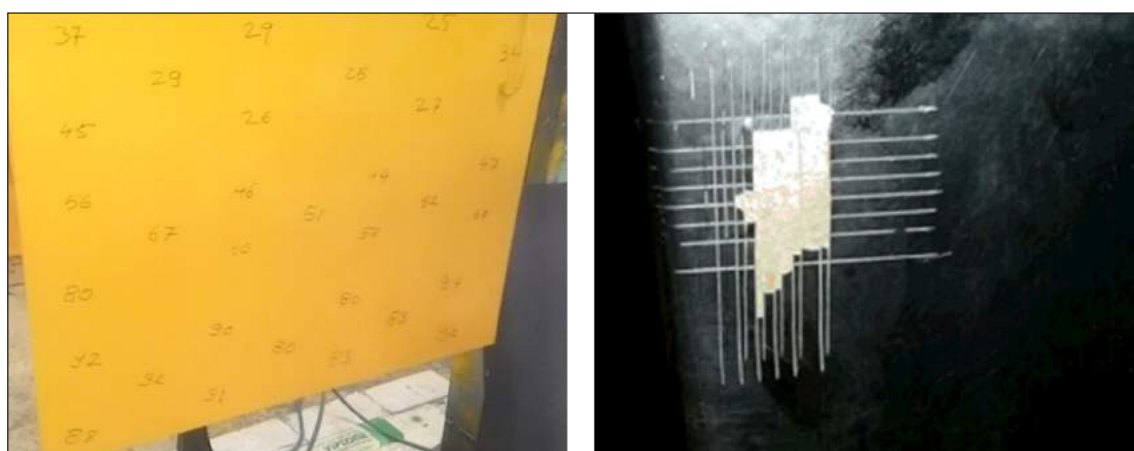


Fig 4.2.2 (xiv): Varied DFTs mentioned on panel

Fig 4.2.2 (xv): Poor pencil adhesion

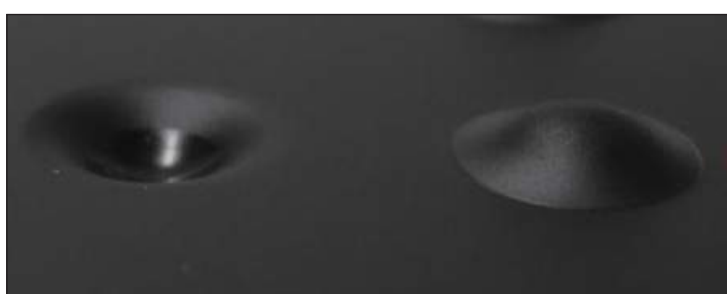


Fig 4.2.2 (xvi): Impact

Reverse Impact



Fig 4.2.2 (xvii): Failed impact test

## Notes



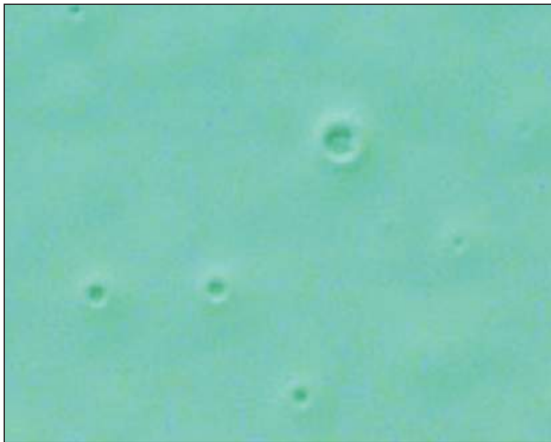

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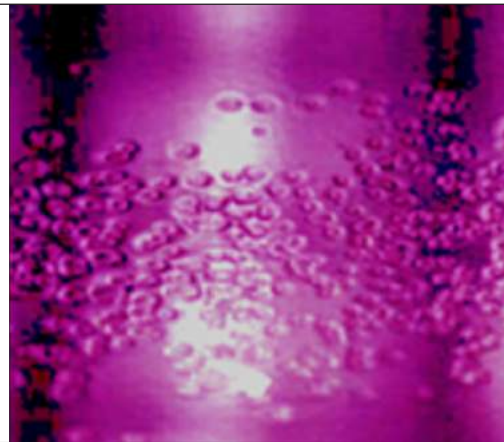
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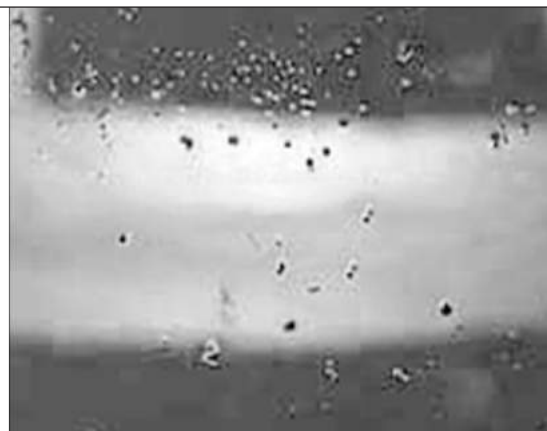
*Fig 4.2.2 (xviii): Pinholes*



*Fig 4.2.2 (xix): Cissing or craters*



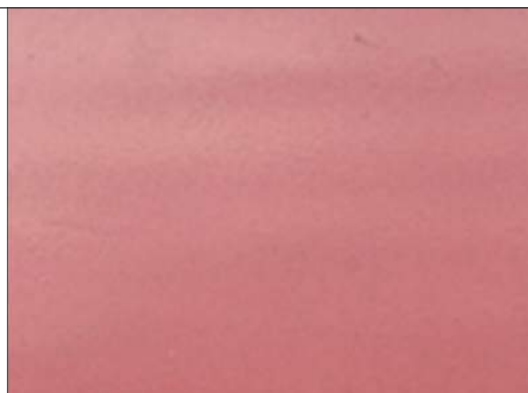
*Fig 4.2.2 (xx): Chipping*



*Fig 4.2.2 (xxi): Dust contamination*



*Fig 4.2.2 (xxii): Fisheyes*



*Fig 4.2.2 (xxiii): Loss of gloss*

## Notes




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*Fig 4.2.2 (xxiv): Mottling*



*Fig 4.2.2 (xxv): Sanding marks*



*Fig 4.2.2 (xxvi): Soft film*



*Fig 4.2.2 (xxvii): Bleeding*



*Fig 4.2.2 (xxviii): Transparency*

### Practical Activity

Carry out the quality tests in the paint laboratory.

## UNIT 4.3 Your Responsibility as an Assistant Decorative Painter

### Unit Objectives



At the end of this unit, you will be able to:

1. Organise paint material and tools for painting as per customer's requirement
2. List down the quantity of paint consumed and consumables used to work out the cost incurred

Your job responsibilities may vary from job to job, but general duties always include:

- Obtain, read, and fully understand the coating specification. Bring up any questions with the appropriate person, and get them resolved
- Fully comply with specification requirements and that work performed matches the required standard of quality
- Determine that all essential raw materials, especially coatings, are stored correctly and used in batches within the manufacturer's recommended shelf life
- Maintain records of all work done, the conditions under which it was done, and any other appropriate report items required by the supervisor
- Ensure that the necessary test instruments and standards required are available at all times and that each instrument is fully functional and properly calibrated

### Notes



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## UNIT 4.4 Prevention of Injuries

### Unit Objectives



At the end of this unit, you will be able to:

1. Apply safe working practices to avoid injuries due to use of high-pressure equipment, moving parts and electric shocks
2. Identify toxic ingredients by reading a MSDS and use recommended PPE

#### Avoiding skin injections:

- Stay clear of high-pressure fluid streams and sprays
- Never remove protective devices, such as spray gun tip guards, during application
- Use proper pressure-relief procedures
- Use proper flushing practices described in instruction manual
- Never try to stop leaks with your hands or body
- Always use the spray gun trigger safety lock when not spraying
- Don't feel for leaks with your hands or a rag

#### Avoiding pressure-related injuries:

- Do not exceed the working pressure ratings (WPR) of components, paying special attention to high-pressure equipment
- Operate the motor within the recommended air or hydraulic pressure
- Do not repair permanently coupled hoses
- Use only genuine service parts as specified by the manufacturer
- Properly align spray tips to prevent back-spray
- Do not use low-pressure fittings on high-pressure equipment
- Do not use damaged or worn out equipment
- Check for proper connections and make sure they are tight before pressurising the system
- Follow procedures for relieving fluid pressure whenever you stop equipment for service or repair

#### Avoiding injury from moving parts:

- Never operate equipment with guards or other protective devices removed
- Check regularly to ensure that safety devices are operating properly
- Properly use bleed type shut-off valves

**Avoiding toxicity:**

- Use recommended personal protection equipment (PPE) to avoid contact with hazardous materials
- Read and follow directions on all coating material labels and material safety data sheets (MSDS)
- Never operate gas engines indoors

**Avoiding electric shocks:**

- Properly ground all objects in the system, including operators
- Follow the procedures in instruction manuals to avoid shocks from electrostatically charged components
- Never operate electric equipment when it is wet or when the surrounding area is wet
- Use only grounded outlets, extension cords and fluid hoses designed for high-pressure spraying that are in good condition
- Do not modify or remove electrical cords

**Tips**

Defects on the painted / coated surface reflects poor skills and workmanship. This may lead to early failure of the coating. Hence a greater emphasis on excelling at your job is important.

**Notes**

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Scan the QR code for video





**PAINTS AND  
COATINGS  
SKILL COUNCIL**



## 5. Maintain OH&S Standards and Follow Environmental Norms

Unit 5.1 - Responsibility Regarding Safety

Unit 5.2 - Waste Disposal

Unit 5.3 - Use Safety Tools and Personal Protective Equipment (PPE)

Unit 5.4 - Handling of Coating Materials and Equipment as per Safety  
and Environmental Standards

Unit 5.5 - Precautionary Measures

Scan the QR code for video



**Applicable NOS – PCS/N9903**

## Key Learning Outcomes

At the end of this module, you will be able to:

1. List the personal protective equipment and its uses to be used at the workplace
2. Explain the precautionary measures for emergencies

## UNIT 5.1 Responsibility Regarding Safety

### Unit Objectives



At the end of this unit, you will be able to:

1. Explain safety
2. Identify various types of hazards in your workplace
3. Describe what an MSDS is and why it is important

Safety is the responsibility of all employees whether at the job site or in a factory. The employer has the prime liability for safety, but every employee should be knowledgeable on safety. They should be able to work in a safe manner without any safety violation.

As a member of the plant team or the site team you are responsible for:

- Your own safety
- Reporting any unsafe conditions or practices to the safety engineer or supervisor
- Following all specific safety requirements as set forth in the specification and by the safety engineer or supervisor
- Adopting safe practices while working with solvents, coatings, spray equipment, scaffolding, abrasive blasting, etc.
- Knowing the location of first aid stations
- Knowing the location of the nearest telephone and emergency telephone numbers like ambulance, fire department, safety engineer etc.

### 5.1.1 Primary Hazards

Fire	Explosion	Reactivity	Health Hazards
<ul style="list-style-type: none"> <li>All solvent based coatings, whether in a container or as a wet film on a surface, are flammable. In most cases, the coating's binder resin is also flammable. Precaution should be taken to prevent a spark or a flame from coming in contact with wet film or liquid paint.</li> </ul>	<ul style="list-style-type: none"> <li>When sufficient solvent vapour is present in the air, a spark or a flame, can cause the entire air volume to react at one time, creating an explosion. Explosion can occur without fire, although they are often combined. Every effort should be made to prevent the solvent-air mixture from reaching 50% of the lower explosive limit.</li> </ul>	<ul style="list-style-type: none"> <li>Reactivity is not ordinarily a major problem from safety standpoint. However, in two pack systems, the mixing of the base and the hardener makes the system reactive and can generate substantial amount of heat. Epoxies, polyurethanes, and similar reactive materials such as polyesters catalysed with acid, develop a substantial amount of heat, whenever they are mixed. Hence the base and the hardener or catalyst should be stored separately.</li> </ul>	<ul style="list-style-type: none"> <li>Most coatings are not so toxic and protective clothing and proper equipment can provide full protection. Any worker sensitive to heights should not work on ladders, scaffolds, or rigs.</li> </ul>

### 5.1.2 Hazards Associated with Coating Materials and Equipment

Most paint materials are hazardous to some degree. All paints, except water-based paints are flammable; many are toxic, and others can irritate the skin. However, most paints are quite safe to use if simple precautions are followed every time.

Among paint raw materials, solvents, resins and solvent based drier solutions are flammable. Some solid materials such as metallic powders carry explosion risk. Products such as fungicides used in certain water-based paints are toxic. Powder raw materials such as pigments and extenders pose risk of inhalation. All these materials need to be handled with appropriate personal protective equipment and, following all safety instructions correctly.

Surface preparation materials like solvents, acid or alkali cleaners can cause skin irritation if not used with care.

Due precautions need to be observed during the use of high pressure abrasive or water blasting methods for surface preparation. Safety gear should be used when using ladders, scaffolds and rigs for working at heights.

Slippery floors and obstacles located on the floor may cause falls.

Electrical /mechanical equipment may produce shocks or other serious injuries if not handled with care. An obvious hazardous location is the interior of a tank at a paint factory or at a customer site. Deviations or taking short cuts and not following proper procedures may produce unsafe working conditions which may result in accidents, loss of life, time and materials.

### 5.1.3 Chemical Hazards

Chemical manufacturers are required to evaluate chemicals produced to determine if they are hazardous. The manufacturer reviews the chemical substance to determine if it is carcinogenic, toxic, irritant or dangerous to human organs, flammable, explosive, or reactive. This information is available in the material safety data sheets (MSDS) that are supplied with materials.

#### What is a Material Safety Data Sheet (MSDS)?

A Material Safety Data Sheet (MSDS) is an information sheet that lists the hazards, safety and emergency measures related to specific products. An MSDS is required for industrial products used in the workplace like chemicals, paint, thinners, pretreatment chemicals and cleaners.

#### Why do I need to use an MSDS?

You may want to know if there are chemicals in the products that can cause adverse health effects such as allergies or asthma during its handling and use. This information may be helpful to prevent exposure to chemicals from new products or in finding out if existing products may be causing symptoms.

### Where can I get an MSDS?

Suppliers provide a MSDS for each product supplied to the customer. This may be available with the safety department of your company. You may also obtain an MSDS from data bank available on internet.

### Why is an MSDS sheet required for a medical emergency?

In an emergency, the doctor can request an MSDS, to understand the nature of the hazard and the anti-dote recommended for treatment.

### Where can I get more Information?

Some product labels include a full list of ingredients. Some suppliers will provide a full list if you request it. You can also ask the supplier's chemist for more information, including a list of additional ingredients.

### Are all ingredients Included in MSDS?

No. Only specific hazardous chemicals are mentioned on a MSDS. Thus, perfume or a chemical odorant that may not be considered hazardous may not show up in the MSDS. Manufacturers do not disclose information they consider proprietary. Such information may relate to the chemical composition.

The MSDS lists each required substance that makes up more than 1 per cent of the product. However, if the chemical causes cancer, respiratory sensitisation, or reproductive effects, then it must be listed even if it makes up more than 0.1 per cent.

### How much of a chemical is a problem?

It is important to consider several factors to determine if you should be concerned. For example, the quantity, toxicity and other effects, and the potential exposures of each chemical are important to think about. It is also important to know that most of the information on an MSDS relates to exposure to one chemical at a time.

### Notes




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 <b>LG Chem</b> Yeosu Complex	Material Safety Data Sheet	Identity No.	GHS - IPA - 001
	<b>ISOPROPYL ALCOHOL</b> <b>CAS No. : 67-63-0</b>	Page	1/10

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### 1. Product and company identification

1) Product name : ISOPROPYL ALCOHOL  
 2) Advisable use and Restriction  
   ◦ Advisable use  
     - Solvent (oils, gums, waxes, resins, alkaloids, cements, primers, varnishes, paints, printing inks)  
     - Medical (antiseptic disinfectant for home, hospital, and industry ; rubbing alcohol)  
   ◦ Restriction of product using : Not available  
 3) Manufacturer/Supplier/Distributor information  
   ◦ Company : LG Chem, LTD. Acrylates plant  
   ◦ Address : 70-1, Hwachi-dong, Yeosu-si, Jeollanam-do  
   ◦ Emergency response number : 061-690-1331  
   ◦ Respondent: 2AA Team

### 2. Hazard identification

1) GHS classification of the substance:  
   - Flammable liquid: Category 2  
   - Eye Damage/Irritation : Category 2A  
   - Specific target organ toxicity (single exposure) : Category 3(respiratory tract irritation, narcotic effect)


2) GHS label elements, including precautionary statements  
   ◦ Pictogram and symbol :  

  
   ◦ Signal word: Danger  
   ◦ Hazard statements  
     H225: Highly flammable liquid and vapour  
     H319: Causes serious eye damage  
     H335: May cause respiratory irritation  
     H336: May cause drowsiness or dizziness  
   ◦ Precautionary statements:  
     - Precaution:  
       P210: Keep away from heat/sparks/open flames/ hot surfaces – No smoking.  
       P233: Keep container tightly closed.  
       P240: Ground/bond container and receiving equipment.  
       P241: Use explosion-proof electrical/ventilating/lighting equipment.

Fig 5.1.3: Material Safety Data Sheet (freeenergystore.com)

**Technical Terms:** Listed below are some definitions of terms you may find on an MSDS.

- Carcinogen: causes cancer
- Hormonal: some chemicals act like hormones
- Reproductive toxin: damages the male or female sex organs, sperm, or eggs
- Sensitisation: a body response which makes you react to a smaller amount than before
- Teratogen: causes developmental abnormalities to the foetus (unborn child)
- Toxin/toxic: poison/poisonous



## UNIT 5.2 Waste Disposal

### Unit Objectives



At the end of this unit, you will be able to:

1. Describe how and why improper waste disposal is hazardous

Impact of dumping waste in the open:

- Water pollution – toxic liquid seeps into surface and groundwater
- Soil pollution – toxins seeps into the soil and surrounding vegetation
- Dump fires – waste decomposition releases inflammable methane which can result into explosion
- Disease – flies, rodents and pets can spread diseases from open dumpsites
- Other impacts – visual ugliness, foul smell, bird menace which can be a hazard to airplane

Waste is treated in an effluent treatment plant, as recommended by the supplier and then disposed of safely, in a specially designed landfill with protective measures to save the environment. Landfills also serve as a backup in case of malfunction in the plant treatment facility.

A good deal of waste is generated even in a simple household painting or polishing job. Such waste includes used sand paper, waste papers, used masking tapes, dust resulting from sanding, waste solvent, waste water after cleaning brushes and containers, empty containers, cotton rags, waste paint etc. It is important to plan, in advance how to minimise such waste and how to safely collect and dispose them off.

Never assume that it is the job of the customer to deal with the waste. Do not throw these sneakily into household waste bins. The waste collection systems in a house or a cooperative housing society may not be designed for such waste.

Discuss the options with the customer before starting the work. At the least most housing waste collectors (such as municipal trucks) would expect the waste to be segregated and handed over. Items that can be recycled (such as used tins and bottles should be sold to scrap dealers who deal in such scrap. Flammables such as solvent soaked cleaning rags should be disposed in a safe manner.

### Notes



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## UNIT 5.3 Use Safety Tools and Personal Protective Equipment (PPE)

### Unit Objectives



At the end of this unit, you will be able to:

1. List the different types of personal protective equipment mandatory while working

Personal Protective Equipment (PPE) and their usage is not an option; it must be practiced always without any deviations. In case of emergency, ensure you safeguard yourself first before helping others.

Personal Safety	Ladders	Scaffolding	Power Tools
<ul style="list-style-type: none"> <li>• Use Personal Protective Equipment (PPE) to limit exposure to the eyes while handling powders or while spraying paint</li> <li>• Use regulated air respirator while spraying</li> <li>• Position yourself upwind of object being sprayed</li> </ul>	<ul style="list-style-type: none"> <li>• Use ladders that are stable</li> <li>• Wear shoes with heels</li> <li>• Inspect for loose, worn, or damaged rungs</li> <li>• Do not carry any tools in hand while climbing</li> <li>• While climbing face ladder, never jump from a ladder</li> <li>• Guard against metal ladder coming in contact with electric power lines</li> </ul>	<ul style="list-style-type: none"> <li>• Inspect for damage or deterioration</li> <li>• Ensure scaffolding is plumb and level</li> <li>• Ensure handrailing is provided on all scaffolding</li> </ul>	<ul style="list-style-type: none"> <li>• Verify safety guards are fitted and operational</li> <li>• Dust collection systems are operational when working with hazardous materials</li> </ul>

### Recommended PPEs

#### 1. Gloves

- a) Nitrile gloves - used against solvent handling / painting
- b) Leather gloves - used against handling hot objects / blasting
- c) Surgical gloves - made up of latex, general purpose
- d) Polyethylene and cotton gloves - in powder coatings / painting

A painter should not use gloves as his hand should connect to the spray gun for grounding of his body. Use of special conductive gloves is recommended.



*Fig 5.3 (i): Latex gloves for painting*



*Fig 5.3 (ii): Gloves for component handling non-skid*

## 2. Masks



*Fig 5.3 (iii): Worker with a paint mask*

- Solvent mask - Dry charcoal network is used as filter in mask used with cartridge or pre-filtered
- Powder mask - It is used while feeding and it is not efficient than solvent mask

### 3. Ear plug/Muff



*Fig 5.3 (iv): Ear plugs*

- Ear plugs are used to protect ears when large sounds are produced
- Ear plus- it can be used for 2 hours
- Non-disposable ear muffs - these can be reused after washing with water

### 4. Eye shield



*Fig 5.3 (v): Eye shield*

- Eye shield must be used while spraying and working with dust and powder.
- Eyewash bottle is also used.
- An eye shield can be used for 8 hours

### 5. Industrial barrier cream

It should be used before work on hand so that any paint can be removed easily.

### 6. Renal hands rub cream

It is used after work to remove paint on hands.

### 7. Head guards and steel toe shoes (safety shoes)

They are used while working on the shop floor.



Fig 5.3 (vi): Safety precaution chart

### Notes



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## UNIT 5.4 Handling of Coating Materials and Equipment as per Safety and Environmental Standards

### Unit Objectives



At the end of this unit, you will be able to:

1. State how one can practice safe handling of materials and equipment used in painting and coating

Coatings Materials	Pretreatment Chemicals	Safety actions for fire risk	High temperature environments
<ul style="list-style-type: none"> <li>• Read the MSDS.</li> <li>• Avoid excessive skin exposure.</li> <li>• Wear proper respiratory equipment.</li> <li>• Wear proper clothing and eyewear.</li> <li>• Always follow the manufacturers written procedures.</li> </ul>	<ul style="list-style-type: none"> <li>• Read the MSDS</li> <li>• Avoid skin contact</li> <li>• Wear recommended safety clothing</li> <li>• Maintain good ventilation</li> <li>• Always stay alert while handling chemicals</li> </ul>	<ul style="list-style-type: none"> <li>• Eliminate sources of ignition</li> <li>• Maintain a safe concentration of powder/ solvent vapour in air- below 50% of the lower explosion (flammability) limits</li> <li>• Maintain a good ground throughout the racks</li> <li>• Maintain a good ground on everything in the electrostatic coating application system</li> </ul>	<ul style="list-style-type: none"> <li>• Allow the temperature to attain the room temperature before carrying out any work</li> <li>• Disconnect power before entering</li> <li>• Use good lighting when entering</li> <li>• Wear a hard hat in areas where it is necessary to stoop</li> <li>• Never open washer or oven during operation</li> <li>• Know the hazards inside the equipment</li> </ul>

Other than the above mentioned, basic elements of combustion such as electrical equipment, matches and cigarettes should be eliminated from site.

### Notes




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## UNIT 5.5 Precautionary Measures

### Unit Objectives



At the end of this unit, you will be able to:

1. Learn about ergonomic lifting, bending and moving equipment
2. List what goes into a first aid kit
3. Learn the actions to take during emergency procedures
4. Identify different kinds of safety signs

### 5.5.1 Ergonomic Lifting, Bending or Moving Equipment and Supplies



Fig 5.5.1 (i): Correct lifting techniques (worldartsme.com)



### 5.5.2 First Aid



A well-stocked first aid kit is a must at the workplace. It is essential to check the kit regularly and have items such as medications, emergency phone numbers, allergy details of employees and medical assistance numbers in the first aid kit. All expired and out-dated medication should be discarded.

As per Red Cross recommendation, following articles must feature in a first aid box

- 2 absorbent compress dressings
- 25 adhesive bandages (assorted sizes)
- 1 adhesive cloth tape
- 5 antibiotic ointment packets
- 5 antiseptic wipe packets
- 2 packets of aspirin
- 1 blanket
- 1 breathing barrier (with one-way valve)
- 1 instant cold compress
- 2 pair of no latex gloves (size: large)
- 2 hydrocortisone ointment packets
- Scissors
- 1 roller bandage (3 inches wide)
- 1 roller bandage (4 inches wide)
- 5 sterile gauze pads
- 5 sterile gauze pads (4 x 4 inches)
- Oral thermometer (non-mercury)
- 2 triangular bandages
- Tweezers

### 5.5.3 Emergency Procedures

On rare occasions, you may experience an emergency while working in a coating plant such as:

- Fire
- Medical emergency
- Armed hold up/robbery
- Bomb threat
- Natural disaster

Find out the emergency procedures and evacuation plan for emergency and obtain information on the evacuation plan of the company. Emergency procedures are reviewed from time to time based on the actual incidents. Remember your safety is of utmost importance in case of any emergency. Please refer to your supervisor/manager for specific information regarding your workplace.

- Evacuation routes and exits are prominently displayed in the building and premises.
- Emergency exits, and evacuation routes must comply with local building codes.

#### You must know

- Preferred method of reporting
- Evacuation policy and procedures
- Emergency escapes procedures and route assignments
- List of emergency contact number inside and outside the facility
- Procedure for employees during shutdown of critical operations

#### You must locate

- Nearest telephone
- Identified restricted areas
- Fire alarm
- Fire extinguisher and fire blankets
- Safety warning tags and signs

## FIRE

- Raise fire alarm
- Use firefighting equipment
- Understand high level of smoke is a hazard
- Increased smoke can decrease visibility and be toxic
- Take a secure escape route
- Notify appropriate personnel immediately

## MEDICAL EMERGENCY

- Person trained in CPR (Cardiopulmonary Resuscitation) must be contacted
- Dial emergency must be contact hospital and ambulance
- Inform supervisor
- Inform family members

### 5.5.4 Display Safety Signs

- Learn to respect safety signs
- Learn to display them at appropriate places
- It is crucial for your safety and safety of other people
- Never take safety sign instructions lightly





### 5.5.5 Safety Checklist

As a paint/powder applicator, for all emergency situations, you must

- Know how to report a safety incident
- Understand the evacuation policy and procedures
- Have access to the list of emergency contact numbers inside and outside the facility
- Understand the procedure for employees during shutdown of critical operations
- Never disconnect hose under pressure
- Not leave pressurised unit unattended
- Never point the spray gun at human body
- Ensure the gun has required trigger guard
- Use electrically conductive hose in airless applications
- Ensure that no ignition source is present when flammable materials are used
- Minimise use of low flash point materials
- Check for adequate ventilation

<b>GENERAL SAFETY</b>	<ul style="list-style-type: none"> <li>• Locate nearest telephone</li> <li>• Identify restricted areas</li> <li>• Locate fire alarm</li> <li>• Locate fire extinguisher and fire blankets</li> <li>• Locate moving objects, cranes, and traffic</li> <li>• Identify and observe safety warning tags and signs</li> <li>• Learn facility alarms, evacuation procedures, and general emergency protocols</li> </ul>
<b>LADDERS</b>	<ul style="list-style-type: none"> <li>• Periodically inspect for loose, worn, or damaged rungs</li> <li>• Never carry any tools in hand while climbing</li> <li>• Always face ladder while climbing</li> <li>• Never jump from a ladder</li> <li>• Guard against danger of metal ladder coming in contact with electric power lines</li> <li>• Secure the ladder</li> </ul>
<b>SCAFFOLDING</b>	<ul style="list-style-type: none"> <li>• Periodically inspect for damage or deterioration</li> <li>• Ensure scaffolding is plumb and level</li> <li>• Ensure handrailing is provided on all scaffolding</li> <li>• Never ride scaffolding on rollers when it is being moved</li> <li>• Verify inspection tags are valid and in place at all times</li> </ul>
<b>POWER TOOLS</b>	<ul style="list-style-type: none"> <li>• Ensure safety guards are fitted and operational</li> <li>• Ensure dust collection systems are operational when working with hazardous materials</li> </ul>
<b>ABRASIVE BLAST</b>	<ul style="list-style-type: none"> <li>• Ensure that the following are installed and in working order: <ul style="list-style-type: none"> <li>◇ Deadman valve</li> <li>◇ Pressure control valves</li> <li>◇ Adequate moisture and oil separators</li> <li>◇ Protective clothing (hoods and gloves)</li> <li>◇ Filtered and regulated air-supplied respirator</li> </ul> </li> <li>• Make certain that: <ul style="list-style-type: none"> <li>◇ Entire system is grounded, including hoses, operator, and work piece</li> <li>◇ Hose couplings are wired shut</li> <li>◇ Abrasive hose is stored in a dry place</li> <li>◇ Abrasive hose is curved around, not bent at 90° angle</li> <li>◇ Nozzle is never pointed at human body or breakable object</li> <li>◇ Abrasive hose is inspected for damage and wear</li> </ul> </li> </ul>

<b>SPRAY APPLICATION</b>	<ul style="list-style-type: none"> <li>• Ensure no ignition sources are present</li> <li>• Minimise use of low flash point materials</li> <li>• Adequate ventilation must always be provided</li> <li>• Ensure spray booth is clear of exhaust fumes from previous spraying</li> <li>• Ensure no rags become soaked with flammable liquid in spray area</li> </ul>
<b>PERSONAL PROTECTION</b>	<ul style="list-style-type: none"> <li>• Goggles and safety glasses must be worn at all times</li> <li>• Regulated air respirator must be used always</li> <li>• Operator must always be positioned upwind of object being sprayed</li> </ul>
<b>HOSE AND GUN</b>	<ul style="list-style-type: none"> <li>• Hoses must be inspected periodically for weak and worn spots</li> <li>• Hose connections must be correct and tightened</li> <li>• Hose must never be disconnected or recoupled while under pressure</li> <li>• Pressurised unit must never be left unattended</li> <li>• Gun must be grounded through hose connections</li> <li>• Operator uses electrically conductive hose in airless applications.</li> </ul>
<b>TEST EQUIPMENT</b>	<ul style="list-style-type: none"> <li>• Holiday detectors must always be grounded</li> <li>• No volatile substances must be present when high voltage detectors are in use</li> <li>• Equipment must be suitable for the environment in which it is being used, e.g., intrinsically safe in hazardous confined spaces</li> </ul>

## Tips



- Working in a safe, environmentally clean manner without adversely impacting your health and that of your co-workers is not an option, but a mandatory requirement in any job.
- Be conscious of the health hazards posed by various chemicals and substances you use and learn and practice ways of mitigating them.
- Always learn to respect safety signs.
- Make safe working a habit.
- Never take safety sign instructions lightly.



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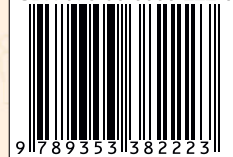
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